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Analysis of Bicycle and Pedestrian Crash Causes and Interventions

CELESTE CHAVIS, Ph.D.

YOUNG-JAE LEE, Ph.D.

SEYEDEHSAN DADVAR

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16. Abstract

Pedestrian and bicycle crashes have been over-represented in comparison with their share in commute and all trips share because they are vulnerable road users and usually exposed and unprotected to the traffic. The fatality rates of pedestrians and bicyclists have been significantly higher than national average rates in Washington, DC. Improving the safety features of pedestrians and bicyclists in the nation's capital is a high priority. The previously conducted studies of pedestrian and bicycle crashes did not include in-detail analysis.

In this study, three years of pedestrian and bicycle crashes (2012-14) were digitized, classified, and analyzed. The classification was based on NHTSA PBCAT and recently proposed LMCM crash typologies. Majority of crashes happened at intersections (68%) and drivers were at fault or violation. The main pedestrian crash type was vehicle left turns (parallel paths) and of bicycles was the case of open door to traffic. The NHTSA crash groups were also identified and top three groups were examined in details and applicable PEDSAFE and BIKESAFE countermeasures were also listed. Due to few cases for some original NHTSA crash groups, new pedestrian and bicycle crash groups were proposed to categorize crashes better in Washington, DC area. Decision trees were developed using CHAID method to investigate contributing factors in fatal and severe injury (disabling) crashes. Traffic control type, crash time, alcohol, speeding, light condition, road type, city quadrant, and fault were contributing factors in more severe pedestrian crashes. Bicycle-only crashes and crashes at construction zones were the identified factors attributing in more severe bicycle crashes. The shortcomings of police crash report forms that were used were also discussed.

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INTRODUCTION

The District Department of Transportation (DDOT) recognizes the need for safe, comprehensive active transportation modes. The vision is for Washington, DC to "be a city where any trip can be taken on foot safely and comfortably, and where roadways equally serve pedestrians, bicyclists, transit users and motorists" (District Department of Transportation (DDOT) 2009). Despite the many health and congestion mitigation benefits of active transportation, there are safety concerns. Bicyclists and pedestrians are the most vulnerable roadway users. On average there are approximately 600 pedestrian and 265 bicycle crashes reported per year in the District. Beginning in 2006, DDOT has rapidly increased the number of bike lanes which has contributed to a steady rise in the number of bike commuters and bike crashes (District Department of Transportation (DDOT) 2012) despite the careful street design guidelines outlined in "*Bicycle Facility Design Guide*" (District Department of Transportation (DDOT) 2005).

DDOT maintains a database of several years of crash data; however, it is difficult to link causes of crashes to design as the crash reporting process is primarily based on the assignment of fault. In many instances, better street design may reduce crashes (even those in which the driver is at fault such as in the case of speeding). American Association of State Highway and Transportation Officials (AASHTO) and the Institute of Transportation Engineers (ITE) present clear guidelines for best practices in pedestrian (American Association of State Highway and Transportation Officials (AASHTO) 2004, Institute of Transportation Engineers (ITE) 2010) and bicyclist (AASHTO Executive Committee 1999, National Association of City Transportation Officials (NACTO) 2011) street design.

Using GIS (Geographic Information System) and detailed crash report narratives, municipalities can better summarize types of crashes, causes of crashes and determine countermeasure (Pollack, et al. 2013). In a recent study in Denver, it was found that bicycle design measures such as neighborhood bikeways, bike lanes, tightened corner radii, and colored pavement in conflict zones could mitigate some crashes (Denver Public Works 2016). One tool that facilitates analyzing pedestrian-bicycle crashes is Pedestrian and Bicycle Crash Analysis Tool (PBCAT), a software application designed to assist State and local pedestrian and bicycle coordinators, planners, and engineers in addressing pedestrian and bicyclist crash problems by creating a crash typing database using (Harkey, et al. 2000, 2006).

Identification of causes and contributing factors in pedestrians and bicyclists crashes plays an essential role in choosing appropriate countermeasures to reduce crashes and eventually, fatalities and severe injuries. In this study, three years of pedestrian and bicycle crashes (2012-14) in Washington, DC area were digitized, classified, and analyzed. The following chapters present: a comprehensive literature review, data preparation efforts, methodology, analysis, discussion, and conclusion.

Whether you live in a city or a small town, and whether you drive a car, take the bus or ride a train, at some point in the day, everyone is a pedestrian.

Anthony Foxx, Former US Secretary of Transportation, in a statement (2013)

The bicycle is the most civilized conveyance known to man. Other forms of transport grow daily more nightmarish. Only the bicycle remains pure in heart.

Iris Murdoch, Anglo-Irish novelist and philosopher, in "*The Red and the Green*" (1965)

LITERATURE REVIEW

Walking and cycling are essential parts of urban mobility. They do not use fossil fuels and promote healthy habits and are important in refining the livability of urban areas (International Transport Forum (ITF) 2012). Nevertheless, pedestrians and bicyclists are vulnerable road users (VRUs)[1] and while traffic safety has generally improved greatly over the past decades, the progress in the safe mobility of pedestrians and bicyclists has not been as consistent (Shinar 2012). VRUs account for nearly half (46%) of the traffic fatalities in the world, and in most low-income and middle-income countries – who contribute to more than 90% of road traffic deaths – the most at-risk road users are pedestrians, cyclists, motorcyclists and passengers on unsafe public transport (World Health Organization (WHO) 2009).

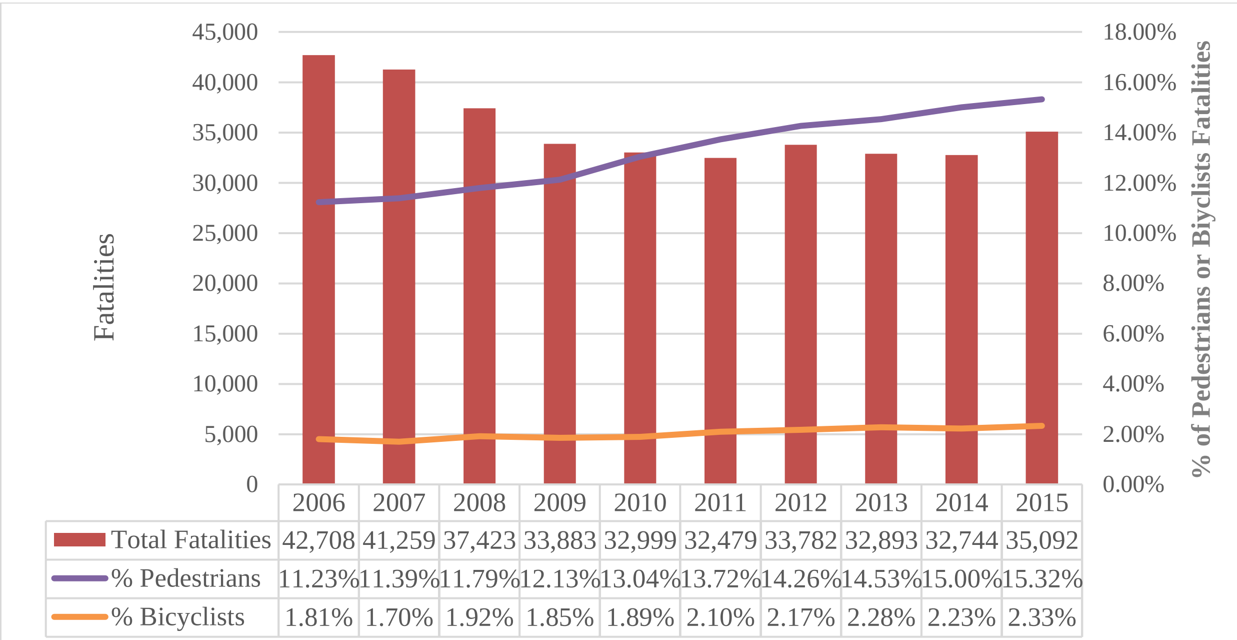
Identification of causes and contributing factors in pedestrians and bicyclists crashes plays an essential role in choosing appropriate countermeasures to reduce VRUs crashes and eventually, fatalities and severe injuries. This section summarizes literature on pedestrians' and bicyclists' safety facts, crash types, studies, and approaches to identify main causes and contributing factors, and possible linkages to countermeasures.

National Studies

In the last four decades (1975 – 2015), 240,419 pedestrians and 32,815 bicyclists died nationwide; equivalent to populations of many large cities such as Lincoln, NE, Toledo, OH, and

[1] List of used acronyms and abbreviations and their expansions and explanations is provided in "Appendix A - List of Acronyms and Abbreviations".

Orlando, FL (Retting 2017, Insurance Institute for Highway Safety (IIHS) and Highway Loss Data Inistitute (HLDI) 2016). Both pedestrian and bicycle fatal crashes increased in terms of frequency (12.12% increase for pedestrians from 4,796 in 2006 to 5,376 in 2015 and 5.96% increase for bicyclists from 772 in 2006 to 818 in 2015) and total fatal crashes share (especially for pedestrians) as shown in Figure 1. It should be noted that pedestrian and bicyclist crashes have been over-represented in comparison with their share in commute and all trips share (Figure 2).



	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Total Fatalities	42,708	41,259	37,423	33,883	32,999	32,479	33,782	32,893	32,744	35,092
% Pedestrians	11.23%	11.39%	11.79%	12.13%	13.04%	13.72%	14.26%	14.53%	15.00%	15.32%
% Bicyclists	1.81%	1.70%	1.92%	1.85%	1.89%	2.10%	2.17%	2.28%	2.23%	2.33%

Figure 1. Total Fatalities and Pedestrians and Bicyclists Fatalities in Traffic Crashes: 2006 – 2015 (National Center for Statistics and Analysis (NCSA) 2017)

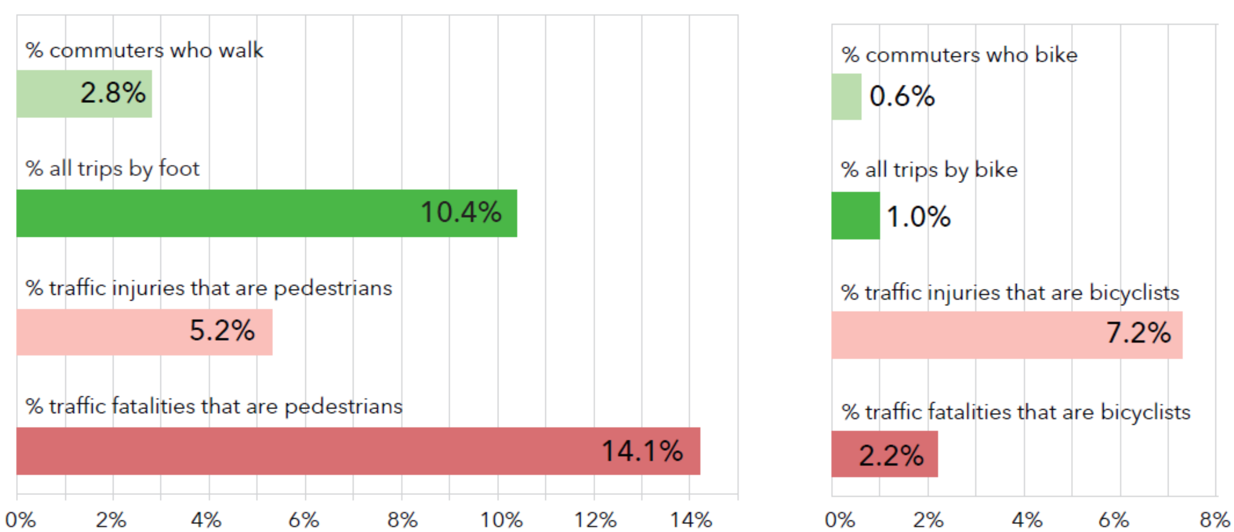


Figure 2. Overview of Walking/Biking and Pedestrians/Bicyclists Safety in the US: 2011 – 2013 (Milne and Melin 2016)

Systematic analysis and understanding of pedestrian and bicycle crash causes and their countermeasures dates back to early 1970s. Prior to the 1970s, the efforts were more general and towards entire crashes or major demographic subsets of them such as those involving school-aged children. However, two National Highway Traffic Safety Administration (NHTSA) studies by Snyder and Knoblauch (1971) on pedestrian crashes and Cross and Fisher (1977) on bicycle crashes changed the paradigm. These studies tried to disaggregate pedestrian and bicycle crashes into specific types with similar behavior causes. There have been many studies focusing on crash types (Cleven and Blomberg 2007). Figure 3 depicts the behavioral model that Snyder and Knoblauch (1971) developed in their study to generalize associated functions (behaviors) and events of pedestrian, driver and vehicle that contribute in a pedestrian crash. A similar model was also used by Cross and Fisher (1977) for analyzing bicycle crashes. The successful completion of the sequence by either party avoids the crash; however, both parties must fail to cause the crash.

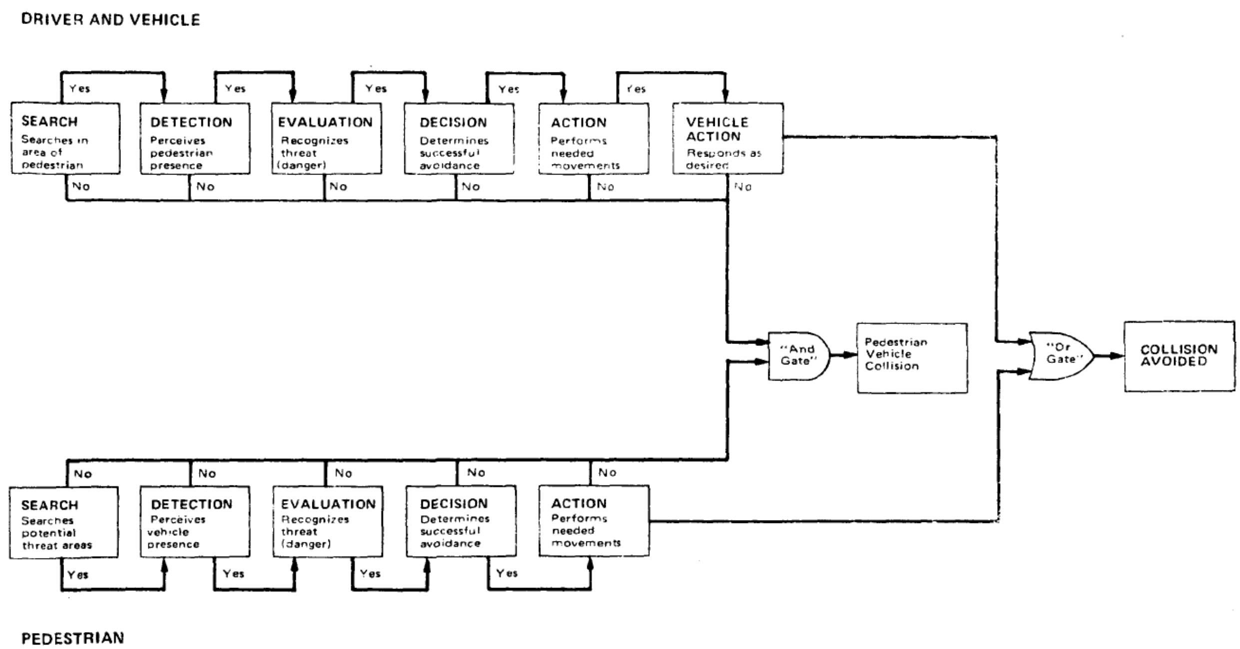


Figure 3. Generalized Function/Event Sequence of a Pedestrian Crash (Adapted from (Snyder and Knoblauch 1971))

The key components of the model are (Cleven and Blomberg 2007):

- *Search*: Both driver and pedestrian scan their environment for potential hazards.
- *Detection*: Each sees the other.
- *Evaluation*: Each recognizes the threat of a collision and the need for action to avoid it.
- *Decision*: Each determines what action to take to avoid a collision.
- *Action*: Either pedestrian or driver or both successfully perform(s) the appropriate action.
- *Vehicle response*: A factor for a motor vehicle is the response of the vehicle to the action taken.

Snyder and Knoblauch (1971) applied their model on 2,000 pedestrian crashes in 13 large cities across the country. Thirty different crash types were identified; however, following top five crash types accounted for more than 50% of the total sampled crashes:

- Dart-out (first half of the roadway)
- Dart-out (second half of the roadway)
- Intersection dash
- Multiple threat
- Vehicle turn/merge

Other crash types that were sufficiently significant to call for initial countermeasure efforts comprised:

- Commercial-bus-related
- Vendor/ice cream truck
- Backing vehicle

As it was mentioned earlier, Cross and Fisher (1977) conceptualized their model for bicycle crash study based on the model developed by Snyder and Knoblauch (1971). The contributing factors were categorized in vehicle factors, operator factors, and environmental factors that are identical to those have been identified generally as causes of roadway crashes in the U.S. (Rumar 1985). Figure 4 shows process of bicycle crash generation.

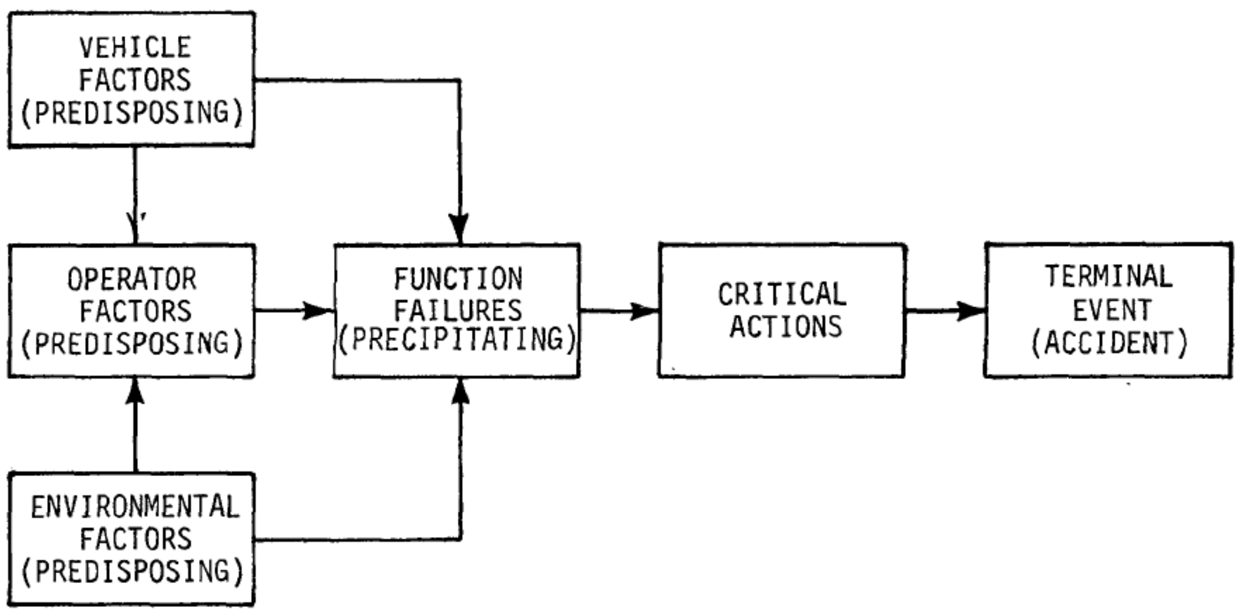


Figure 4. Conceptual Model of the Bicycle Crash Generation Process (Adapted from (Cross and Fisher 1977))

The other components of the model are (Cleven and Blomberg 2007):

- *Critical actions*: They refer to the vehicles' (motor vehicle and bicycle) actions and movement patterns that led directly to the crash.
- *Function failures*: Events that are causally related to the critical actions are characterized as operational failures of the traffic system.
- *Terminal event*: This event is a crash involving a bicycle and any type of vehicle.

Cross and Fisher (1977) applied their model on 919 bicycle crashes in four states (California, Colorado, Michigan, and Florida). Thirty-six different crash types were identified; however, following types were the seven major bicycle crash types:

- Bicyclist ride-out from a residential driveway
- Bicyclist ride-out from a controlled intersection
- Motorist turn/drive-out in front of bicyclist midblock
- Motorist turn/drive-out in front of bicyclist from controlled intersection
- Motorist overtaking/failure to detect bicyclist
- Bicyclist unexpected left turn/swerve in front of traffic
- Motorist unexpected left turn in front of cyclist approaching from straight ahead

These two studies (Snyder and Knoblauch 1971, Cross and Fisher 1977) formed the basis for many countermeasure development efforts in following years until present including but not limited to traffic engineering, behavior measurement, traffic safety regulations, enforcements, and training (Cleven and Blomberg 2007).

Hunter et al. (1996) examined the applicability of original crash types that were developed in 1970s (Snyder and Knoblauch 1971, Cross and Fisher 1977) on new crash data from six states. Besides some minor changes in the percentages of some crash types, the majority of pedestrian and bicycle crash types were applicable to new data thus no changes and updates were applied to crash types so developed countermeasures continued to be effective.

The common types of pedestrian crashes included (Hunter, et al. 1996):

- Intersection-related crashes
  - Vehicle turning at an intersection (10%)
  - Intersection dash (pedestrian entering the roadway suddenly) (7%)
  - Driver violation at an intersection (5%)
  - Other intersection crash type (e.g., multiple-threat, standing in roadway) (10%)
- Midblock-related crashes
  - Midblock dart or dash (pedestrian entering the roadway suddenly) (13%)
  - Other midblock (e.g., multiple-threat, walking in roadway) (13%)

The common types of bicycle crashes included (Hunter, et al. 1996):

- Bicyclist and motorist on crossing (perpendicular) paths
  - Motorist failed to yield (21%)
  - Bicyclist failed to yield at intersection (17%)
  - Bicyclist failed to yield at midblock location (12%)
- Bicyclist and motorist on parallel paths
  - Motorist merged or turned into path of bicyclist (12%)
  - Motorist overtaking bicyclist (9%)
  - Bicyclist merged into path of motorist (7%)

Results of Hunter et al. (1996) led to the development of the Pedestrian and Bicycle Crash Analysis Tool (PBCAT) to assist crash typing. The Federal Highway Administration (FHWA), in cooperation with National Highway Traffic Safety Administration (NHTSA), funded the Highway Safety Research Center (HSRC) to develop a Pedestrian and Bicyclist Crash Analysis Tool (PBCAT). The tool (Figure 5) is a software product intended to assist pedestrian and bicycle planners and engineers through the development and analysis of a database containing details associated with pedestrian-involved and bicycle-involved crashes. The main feature of PBCAT is its ability to allow the user to quickly determine crash type through a series of on-screen questions about the crash (Harkey, et al. 2000). PBCAT was revised in 2006 (Harkey, et al. 2006) to address some improvements such as enhanced navigation in a more familiar user interface and reduced number of crash types (Cleven and Blomberg 2007)[1].

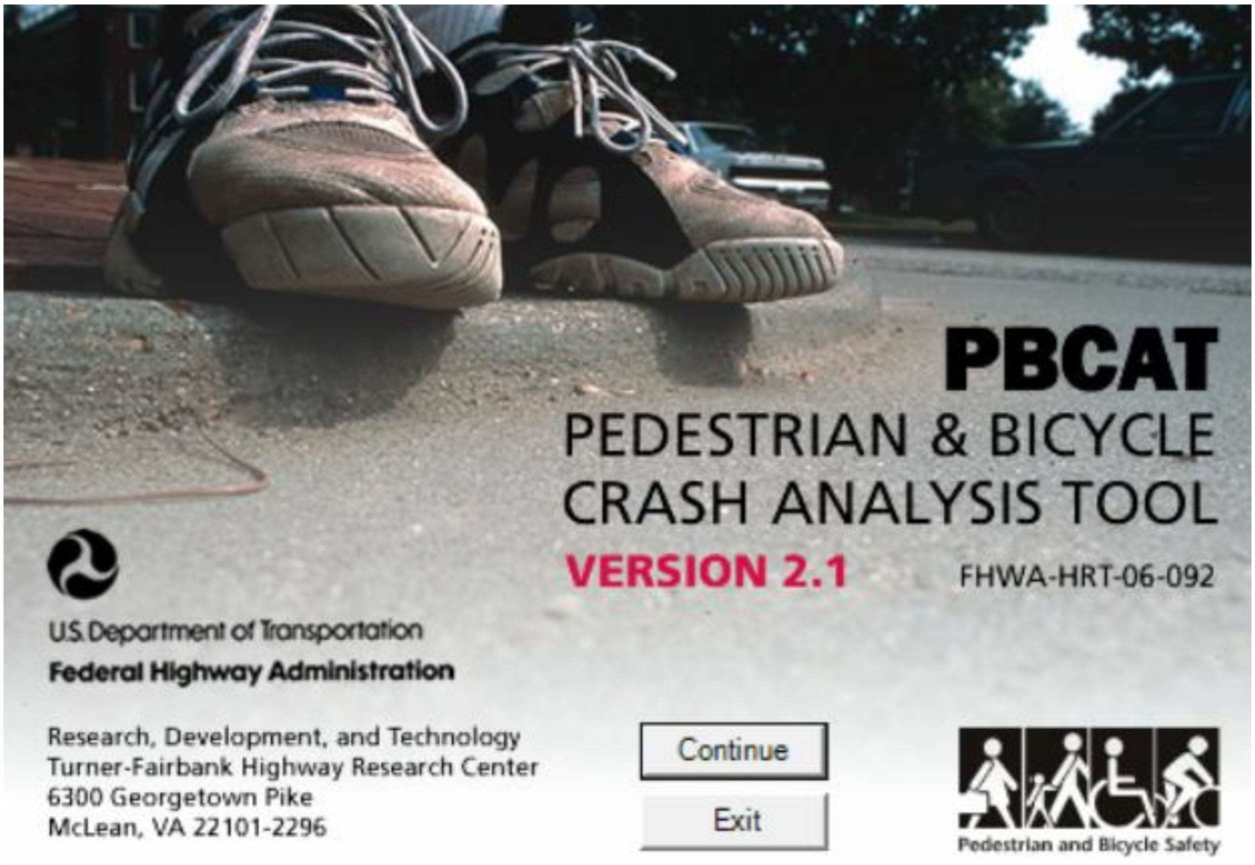


Figure 5. Pedestrian and Bicycle Crash Analysis Tool (PBCAT) (Federal Highway Administration (FHWA) 2006)

[1] As it is indicated on PBCAT download webpage on Pedestrian and Bicycle Information (PBIC) website, PBCAT is not be fully compatible with newer operating systems such as Windows 7 & 10. Since its functionality was very limited and almost ineffective, research team contacted the software support team. The support confirmed that the tool is in dire need of updates to be compatible with current operating systems, yet the sponsor of the tool has not been able to fund an update. There is a hope that the tool will be updated in future.

PBCAT covers 16 pedestrian crash groups that include 56 individual crash types and 21 bicycle crash groups that include 79 individual crash types (Harkey, et al. 2006). Table 1 and Table 2 display PBCAT crash groups for pedestrian and bicycle crashes, respectively.

Table 1. PBCAT Pedestrian Crash Groups (Harkey, et al. 2006)

#	Pedestrian Crash Group Code	Pedestrian Crash Group
1	100	Unusual Circumstances
2	200	Backing Vehicle
3	310	Working or Playing in Roadway
4	340	Bus-Related
5	350	Unique Midblock
6	400	Walking Along Roadway
7	460	Crossing Driveway or Alley
8	500	Waiting to Cross
9	600	Pedestrian in Roadway—Circumstances Unknown
10	720	Multiple Threat/Trapped
11	740	Dash/Dart-Out
12	750	Crossing Roadway—Vehicle Not Turning
13	790	Crossing Roadway—Vehicle Turning
14	800	Off Roadway
15	910	Crossing Expressway
16	990	Other/Unknown—Insufficient Details

Table 2. PBCAT Bicycle Crash Groups (Harkey, et al. 2006)

#	Bicycle Crash Group Code	Bicycle Crash Group
1	110	Loss of Control/Turning Error
2	140	Motorist Failed to Yield—Sign-Controlled Intersection
3	145	Bicyclist Failed to Yield—Sign-Controlled Intersection
4	150	Motorist Failed to Yield—Signalized Intersection
5	158	Bicyclist Failed to Yield—Signalized Intersection
6	190	Crossing Paths—Other Circumstances
7	210	Motorist Left Turn/Merge
8	215	Motorist Right Turn/Merge
9	219	Parking/Bus-Related
10	220	Bicyclist Left Turn/Merge
11	225	Bicyclist Right Turn/Merge
12	230	Motorist Overtaking Bicyclist
13	240	Bicyclist Overtaking Motorist
14	258	Head-On
15	290	Parallel Paths—Other Circumstances
16	310	Bicyclist Failed to Yield—Midblock
17	320	Motorist Failed to Yield—Midblock
18	600	Backing Vehicle
19	850	Other/Unusual Circumstances
20	910	Non-roadway
21	990	Other/Unknown—Insufficient Details

PBCAT includes some schematic images for crash types, Figure 6 and Figure 7 show examples of crash type images for pedestrian and bicycle crashes. All crash types and crash type images are included in the "Appendix B - PBCAT Crash Types" and "Appendix C - PBCAT Crash Type Images".

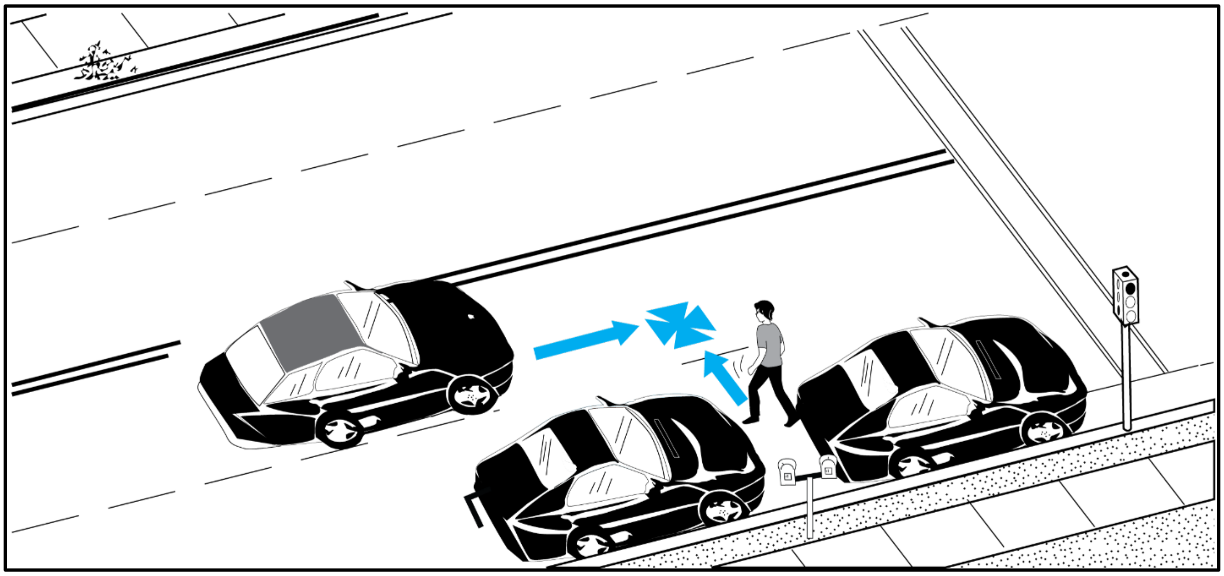


Figure 6. Pedestrian Crash Type 742 - Dart-Out (Federal Highway Administration (FHWA) 2006)

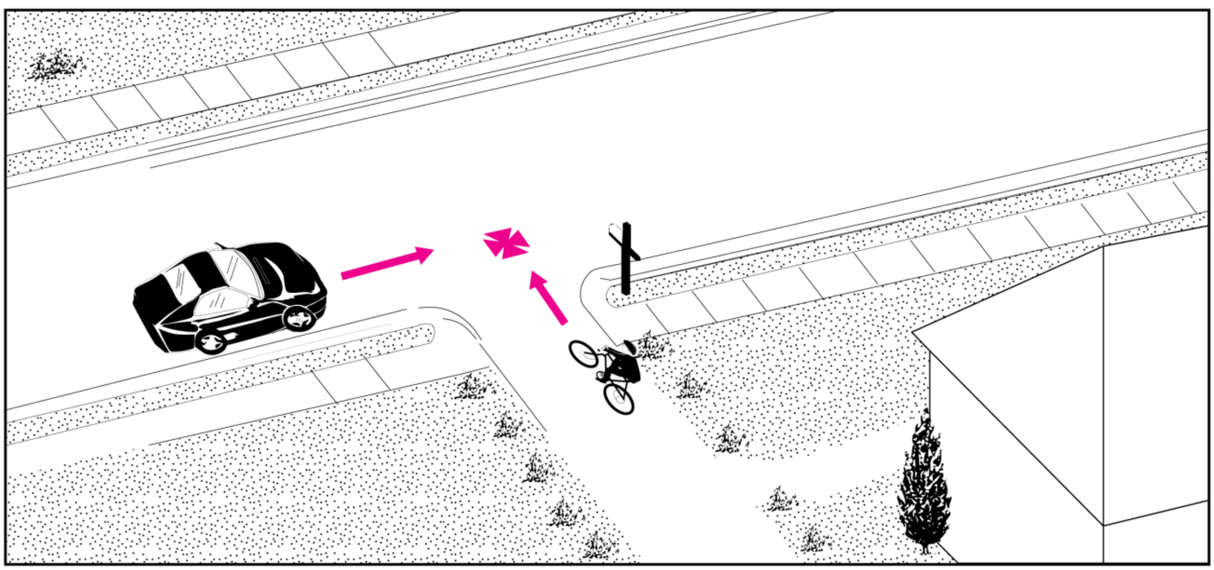


Figure 7. Bicycle Crash Type 311 - Bicyclist Ride Out - Residential Driveway (Federal Highway Administration (FHWA) 2006)

PBCAT has been developed to help users with selecting appropriate countermeasures that cover pedestrian and bicycle crash types to improve safety. The software includes links to two sections of an FHWA website[1] that include countermeasures that may be used accordingly (Figure 8); pedestrian countermeasures are located in PEDSAFE[2] section of the website and bicycle countermeasures are located in BIKESAFE[3] section of the website (Figure 9). This website offers the latest information available for safety and mobility improvement of pedestrians and bicyclists through interactive tools that provide information on preventive countermeasures, cost estimates, decision process to select the most applicable countermeasures for specific locations, and access to case studies, implementation guidance, and reference materials (Harkey, et al. 2006). The PEDBIKE is based on a study by Zegeer et al. (2013) and the BIKESAFE is based on a study by Sundstrom et al. (2014).

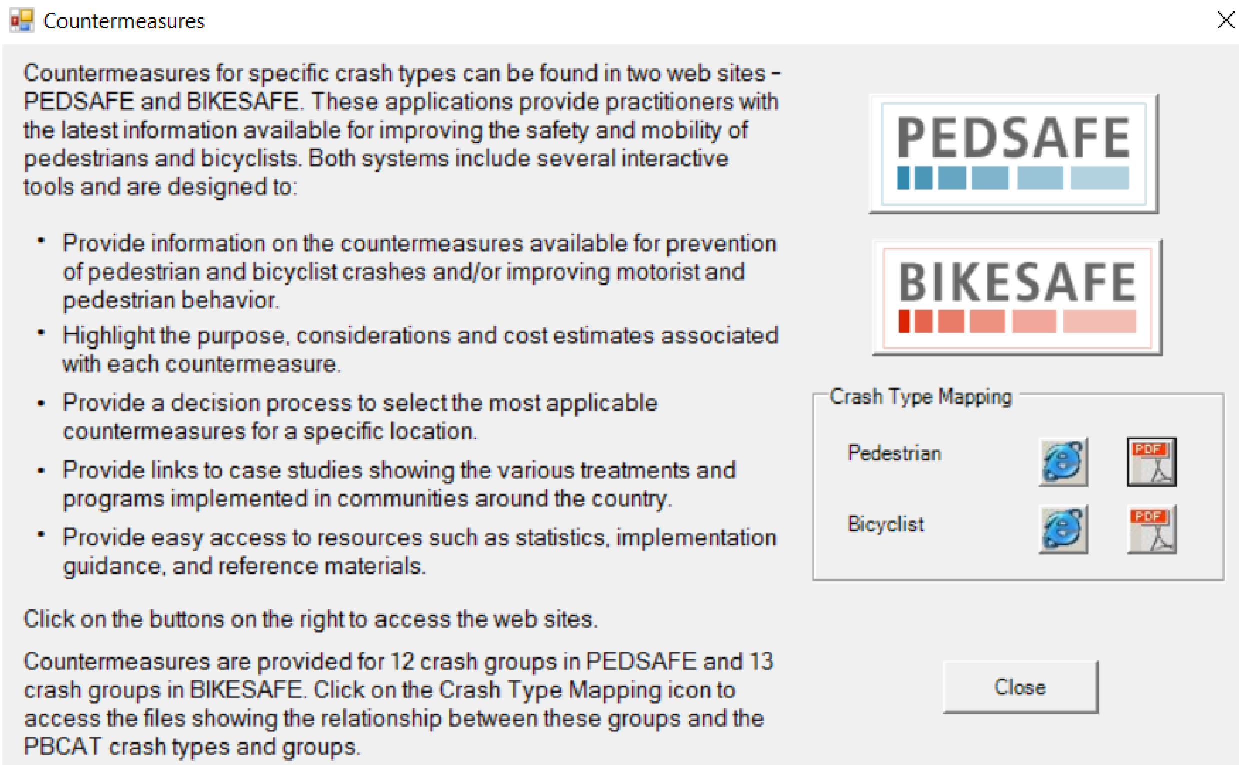


Figure 8. Access to PEDSAFE and BIKESAFE in PBCAT (Federal Highway Administration (FHWA) 2006)

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[1] www.pedbikesafe.org

[2] http://www.pedbikesafe.org/PEDSAFE/index.cfm

[3] http://www.pedbikesafe.org/BIKESAFE/index.cfm

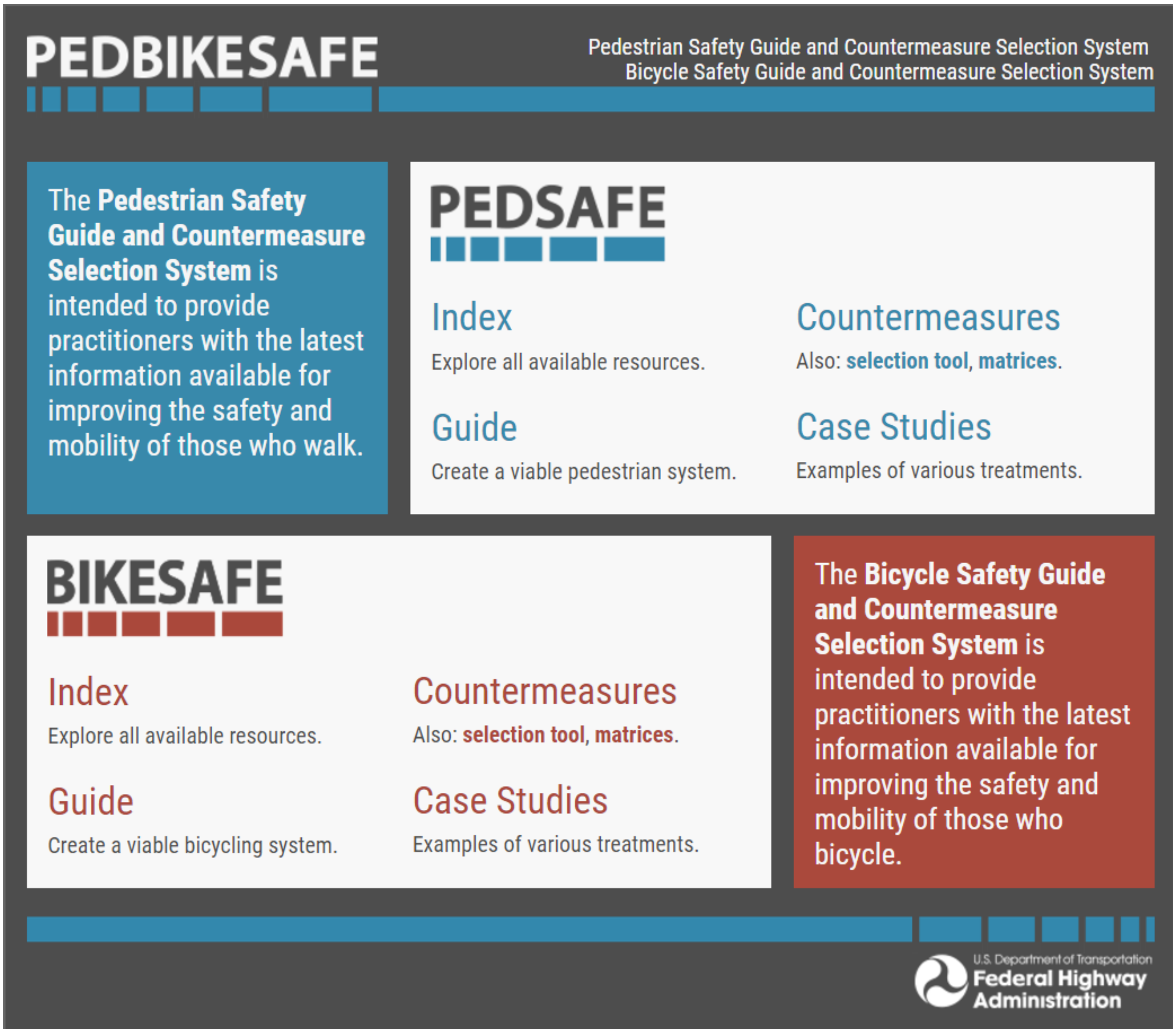

Figure 9. PEDBIKESAFE Website (Federal Highway Administration (FHWA) n.d.)

There are two types of matrices on PEDBIKESAFE that summarize countermeasures: "Crash Type Matrix" and "Performance Objective Matrix". There are countermeasures for 12 crash groups in PEDSAFE (Table 3) and 13 crash groups in BIKESAFE (Table 4) (Federal Highway Administration (FHWA) n.d.).

There are 67 countermeasures for pedestrians grouped into nine categories (Federal Highway Administration (FHWA) n.d.):

1. Along roadway
2. Crossing locations
3. Transit
4. Roadway design
5. Intersection design
6. Traffic calming

7. Traffic management
8. Signals/ signs
9. Other

There are eight performance objectives for pedestrian crashes (Federal Highway Administration (FHWA) n.d.):

1. Reduce speed of motor vehicles
2. Improve sight distance and visibility for motor vehicles and pedestrians
3. Reduce volume of motor vehicles
4. Reduce exposure for pedestrians
5. Improve pedestrian access and mobility
6. Encourage walking by improving aesthetics
7. Improve compliance with traffic laws
8. Eliminate behaviors that lead to crashes

There are 46 countermeasures for bicyclists grouped into eight categories (Federal Highway Administration (FHWA) n.d.):

1. Shared roadway
2. On-road bike facilities
3. Intersection treatments
4. Maintenance
5. Traffic calming
6. Trails/ shared-use paths
7. Markings, signs and signals
8. Other measures

There are seven performance objectives for bicycle crashes (Federal Highway Administration (FHWA) n.d.):

1. Provide safe on-street facilities/space for bicyclists
2. Provide off-road paths or trails for bicyclists
3. Provide and maintain quality surfaces for bicyclists
4. Provide safe intersections for bicyclists
5. Improve motorist behavior/ compliance with traffic laws
6. Improve bicyclist behavior/ compliance with traffic laws
7. Encourage and promote bicycling

Table 3. Pedestrian Crash Type Matrix on BIKESAFE (Federal Highway Administration (FHWA) n.d.)

Pedestrian Crash Type	**Along Roadway**	**Crossing Locations**	**Transit**	**Roadway Design**	**Intersection Design**	**Traffic Calming**	**Traffic Management**	**Signals/ Signs**	**Other**
Dart/Dash	✓	✓	✓	✓		✓	✓	✓	
Multiple Threat/Trapped		✓	✓	✓	✓	✓		✓	✓
Unique Midblock		✓		✓		✓		✓	✓
Through Vehicle at Un-signalized Location		✓	✓	✓	✓	✓		✓	✓
Bus-Related	✓	✓	✓	✓				✓	✓
Turning Vehicle		✓	✓	✓	✓	✓	✓	✓	✓
Through Vehicle at Signalized Location		✓	✓	✓	✓	✓	✓	✓	✓
Walking Along Roadway	✓	✓	✓	✓				✓	✓
Working or Playing in Roadway	✓	✓		✓		✓	✓	✓	✓
Non-Roadway	✓	✓		✓	✓	✓		✓	✓
Backing Vehicle	✓	✓		✓		✓			✓
Crossing an Expressway		✓						✓	✓

"✓" denotes an available countermeasure.

Table 4. Bicycle Crash Type Matrix on BIKESAFE (Federal Highway Administration (FHWA) n.d.)

Bicycle Crash Type	**Shared Roadway**	**On-Road Bike Facilities**	**Intersection Treatments**	**Maintenance**	**Traffic Calming**	**Trails/ Shared-Use Paths**	**Markings, Signs & Signals**	**Other Measures**
Motorist failed to yield - signalized intersection	✓		✓		✓	✓	✓	✓
Motorist failed to yield - non-signalized intersection	✓		✓		✓	✓	✓	✓
Bicyclist failed to yield - signalized intersection	✓		✓		✓	✓	✓	✓
Bicyclist failed to yield - non-signalized intersection	✓		✓		✓	✓	✓	✓
Motorist drove out - midblock	✓					✓	✓	✓
Bicyclist rode out - midblock	✓	✓			✓	✓	✓	✓
Motorist turned or merged left into path of bicyclist	✓	✓	✓		✓	✓	✓	✓
Motorist turned or merged right into path of bicyclist	✓	✓	✓		✓	✓	✓	✓
Bicyclist turned or merged left into path of motorist	✓	✓	✓	✓	✓	✓	✓	✓
Bicyclist turned or merged right into path of motorist	✓	✓	✓	✓	✓	✓	✓	✓
Motorist overtaking bicyclist	✓	✓		✓	✓	✓	✓	✓
Bicyclist overtaking motorist	✓	✓		✓		✓	✓	✓
Non-motor vehicle crashes	✓			✓		✓	✓	✓

"✓" denotes an available countermeasure.

Since the crash groups on PEDBIKESAFE are different from of PBCAT, "Crash Type Mapping" tables are available in the PBCAT User's Manual that show the linkage between PBCAT crash groups and types and PEDBIKESAFE crash groups. These tables are included in "Appendix D - PBCAT - PEDBIKESAFE Crash Type Mapping".

There are many resources on the countermeasures such as "*Countermeasures That Work*" (Goodwin, et al. 2015). Two chapters were dedicated to pedestrians (categorized into pre-school aged children, school-age children, impaired pedestrians, and all pedestrians) and bicycles (categorized into children, adults, all bicyclists, and drivers and bicyclists). Moreover, with the emergence of Connected Vehicles (CV), Autonomous Vehicles (AV), and features such as V2V[1], V2I[2], and V2X[3], there are currently some discussions and speculations about the potential impacts of CVs and AVs on pedestrian and bicycle safety (Sandt and Owens 2017).

Washington, D.C. Studies

Improving the safety features of pedestrians and bicyclists in the nation's capital is a high priority as "*The goal of Vision Zero is straight-forward: zero fatalities and serious injuries in our transportation system, because no loss of life is acceptable* (Vision Zero; Safe Streets for Washington, DC 2015)." As shown in Figure 10, Washington, D.C. has had a relatively good status regarding pedestrians and bicyclists safety in comparison with other US metropolitan regions and its bicyclists' fatality rate was significantly lower in 1999 - 2003 (Schneider, Vargo and Sanatizadeh 2017).

Despite D.C.'s relatively good position, pedestrians and bicyclists make up a significant proportion of fatal crashes every year and despite a decline in bicyclist fatal crashes over past years, pedestrians' fatal share has increased (Figure 11 and Figure 12).

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[1] Vehicle-to-Vehicle

[2] Vehicle-to-Infrastructure

[3] Vehicle-to-Everything

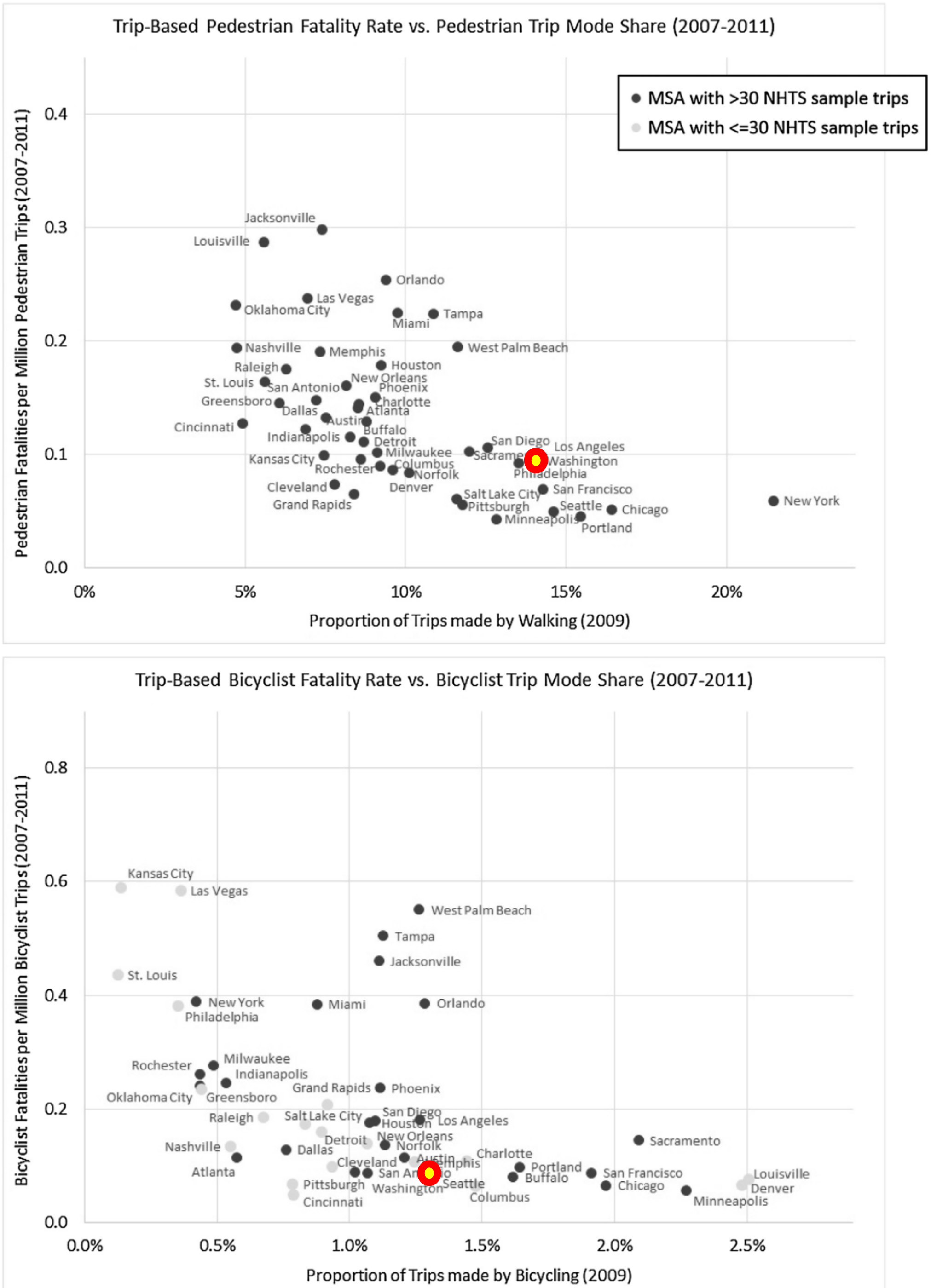


Figure 10. Metropolitan Region Pedestrian and Bicyclist Fatality Rates and Mode Shares (Schneider, Vargo and Sanatizadeh 2017)

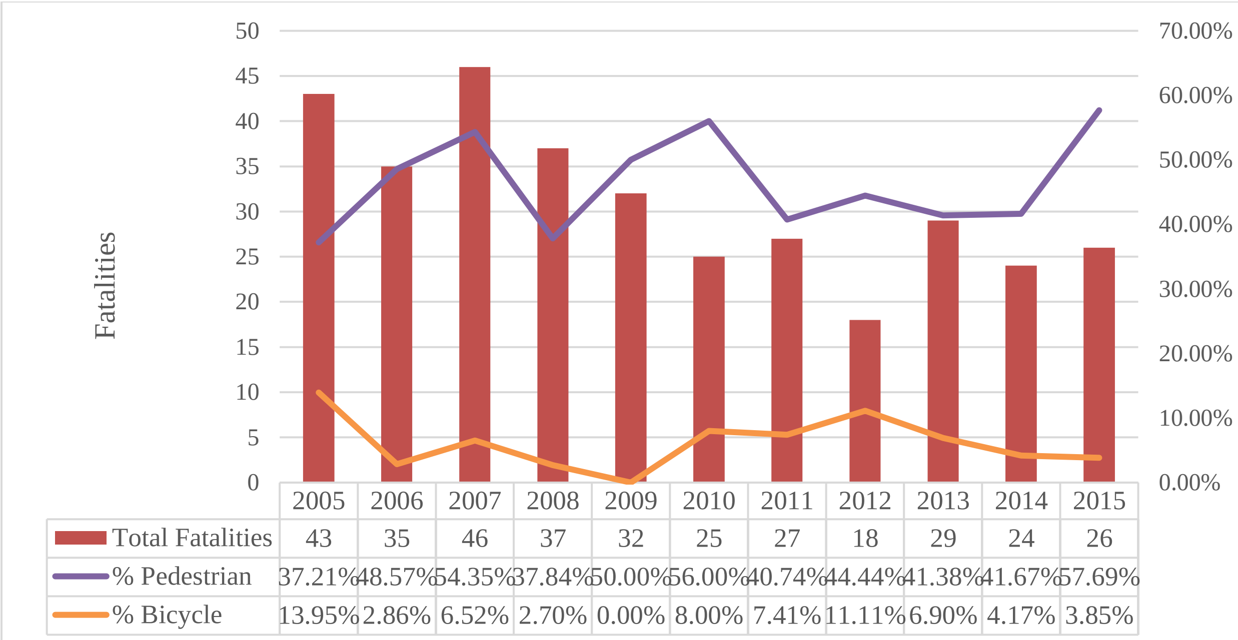


Figure 11. Total Fatalities and Pedestrian and Bicycle Fatalities in Traffic Crashes: 2005 – 2015 (Traffic Safety Statistics Report 2005 - 2015)

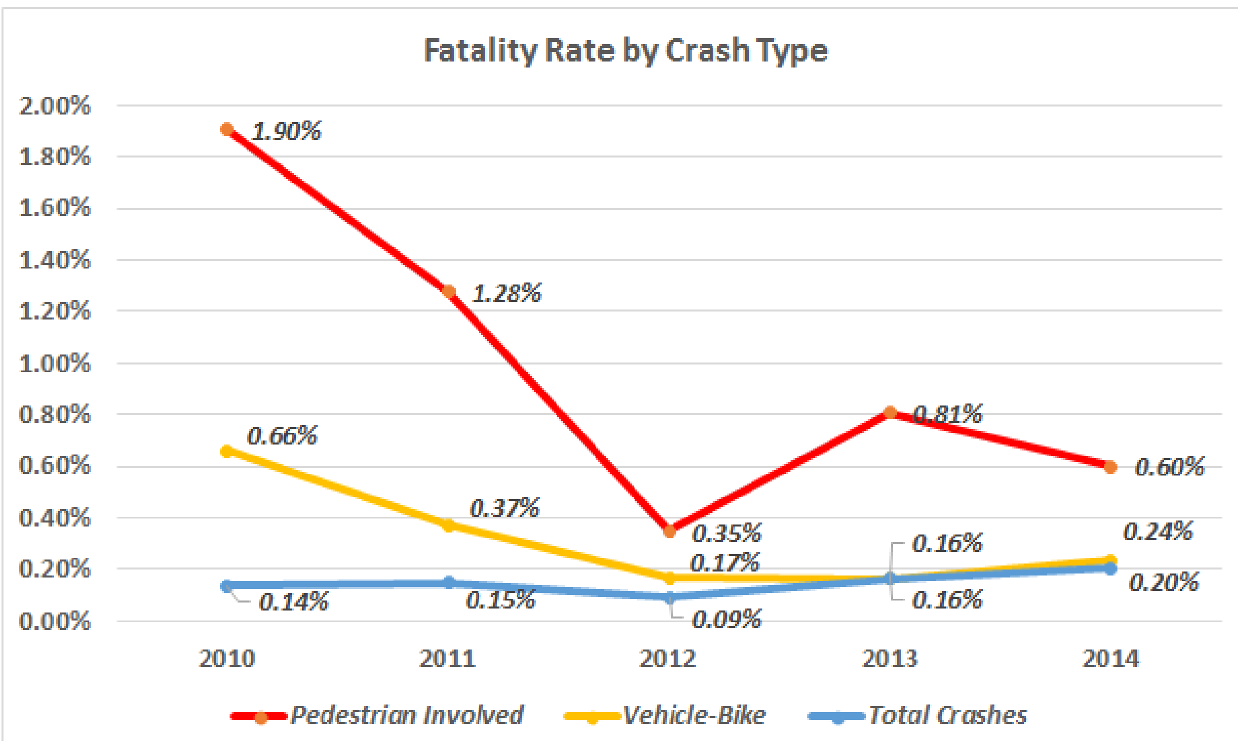


Figure 12. Fatality Rate by Crash Type (Washington D.C., 2010-2014)

District Department of Transportation (DDOT) publishes a "*Traffic Safety Report Statistics*" report yearly; first one in 2005 (Michael Baker Jr., Inc. 2005), from 2008 to 2010 ((Li, et al. 2008, Wang, See and Houh, et al. 2009, Wang, See and Chen, et al. 2010), and since 2013 (Arhin, Noel and Cheeks 2013, Arhin, Noel and Cheeks 2014, Arhin, Noel and Cheeks 2015, Arhin 2016, Arhin 2016). These reports cover three-year periods and comprise general descriptive statistics and trends of traffic crashes in Washington, D.C., some GIS maps, and high crash location analyses; however, the analysis of pedestrian and bicycle crashes does not include in-detail and causual analysis. However, there was a 2002 study regarding pedestrian crash types in Washington, D.C. and Baltimore (Preusser and JoAnn K. Wells 2002).

Pedestrian crashes in Washington, DC and Baltimore (Preusser and JoAnn K. Wells 2002)

- *Objective*: Analyzed pedestrian-involved crashes in Washington, DC and Baltimore, MD based on police reports and compared the results with 1970s studies, determined current (early 2000s) crash patterns and identified countermeasures.
- *Method*: Reviewed police reports and coded crashes into crash types based on the typology used in 1970s (early stages of development of NHTSA crash types). Some GIS analyses on per capita income levels were also performed. Crash types of original 18 crash types were combined to assure sufficient frequencies and made up to seven crash type categories for the analysis.
- *Data*: All police reported pedestrian-involved crashes in 1998; 852 crashes in Washington, DC and 1234 crashes in Baltimore.
- *Results*: The main change for Washington, DC in crash patterns was a substantial decrease in "Midblock dart–dash" crashes by 22% and increase in "Turning vehicle" crashes by 16% (Table 5). However, these changes are somewhat consistent with changes in traffic controls in Washington, DC, whereas, there was 17% increase in traffic signals and 17% decrease in "No control" (e.g., midblock).

Table 5. NHTSA Crash Types by City and Time (Preusser and JoAnn K. Wells 2002)

Crash Type	**NHTSA (1973-1975)**		**Washington (1976)**		**Washington (1998)**		**Baltimore (1998)**	
	Count	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**
Midblock dart–dash	2080	*35%*	491	*37%*	130	*15%*	227	*18%*
Intersection dash	976	*17%*	96	*7%*	79	*9%*	137	*11%*
Turning vehicle	550	*9%*	115	*9%*	212	*25%*	159	*13%*
Vehicle backing	141	*2%*	58	*4%*	62	*7%*	91	*7%*
Pedestrian not in road	247	*4%*	75	*6%*	50	*6%*	76	*6%*
Other crash types	-	-	259	*20%*	169	*20%*	266	*22%*
Not classifiable	-	-	222	*17%*	150	*18%*	278	*23%*
All	**5913**	***100%***	**1316**	***100%***	**852**	***100%***	**1234**	***100%***

Review of Online Information

There is much useful information stored on "*Open Data DC*" portal such as (District of Columbia Government 2017):

- Roadway geometry (e.g., roads, streets centerline, intersection points)
- Bicycle and pedestrian facilities (e.g., bicycle lanes, bike trails, sidewalks, traffic push buttons)
- Vehicular traffic volumes (somewhat old though; 2006 & 2007)
- Vehicular crash data[1] (including pedestrian-involved and bicycle-involved crashes)
- Transit (e.g., metro stations, metro lines, and bus stops)

Figure 13 shows the "Crashes in DC" (2008 - 2017).

[1] A new dataset with new format and fields replaced the retired dataset in June 19, 2017. The new dataset seems incomplete because fatal crashes seem to be excluded from the dataset.

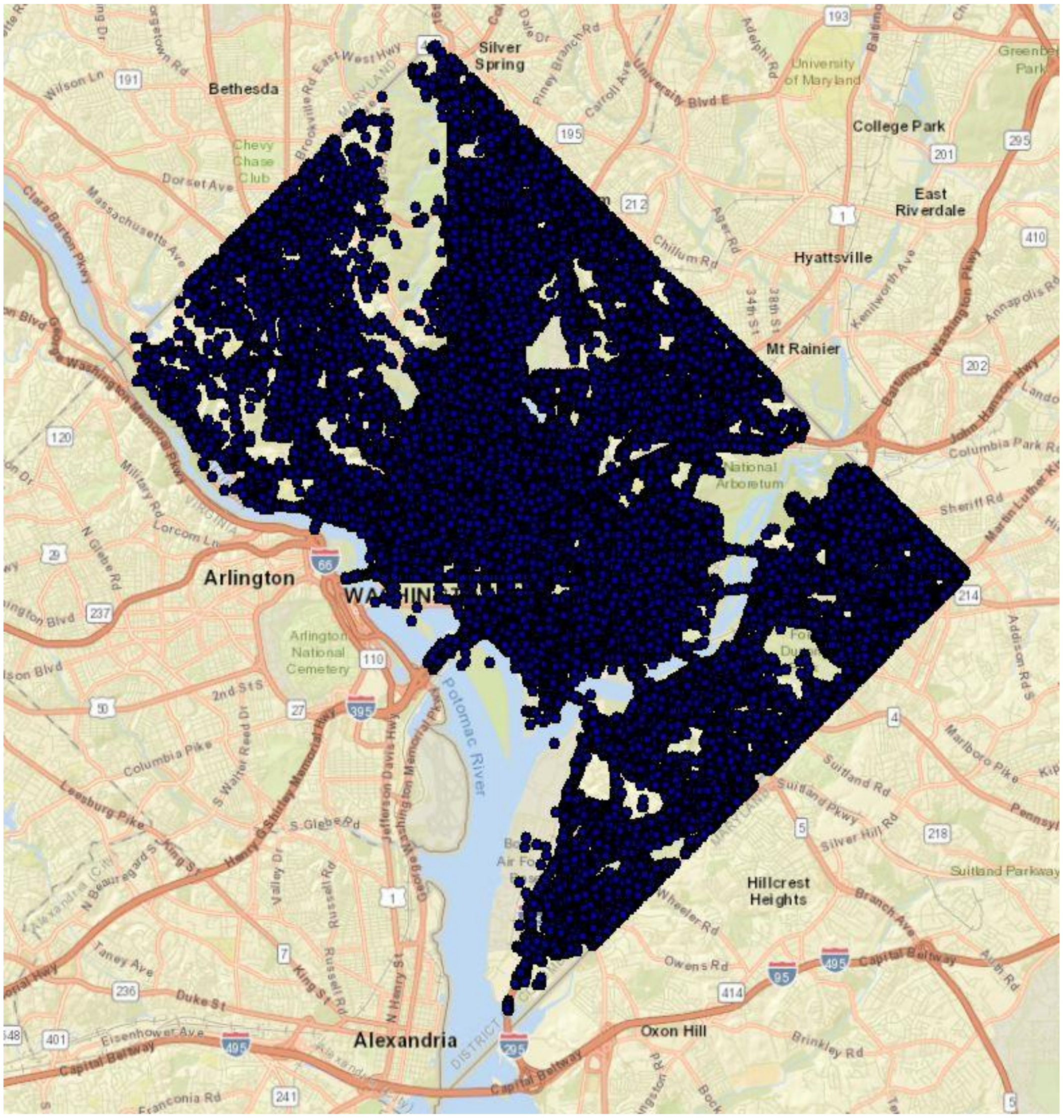


Figure 13. "Crashes in DC" 2008 – 2017 (District of Columbia Government 2017)

Pedestrian crashes (2009 - 2015) were analyzed and geocoded to find the most dangerous intersections in Washington, D.C. (frequency approach) as shown in Figure 14. Locations of bicycle fatalities (1987 - 2014) are also available online as shown in Figure 15.

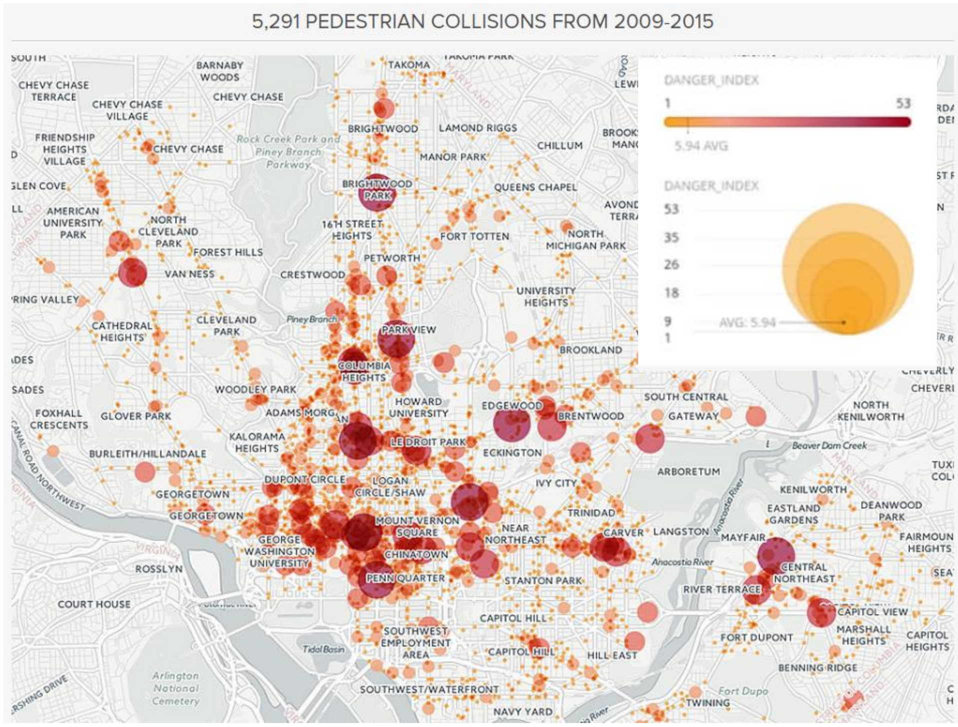


Figure 14. The Most Dangerous Intersections for Pedestrians in Washington, DC (Trombly & Singer PLLC n.d.)

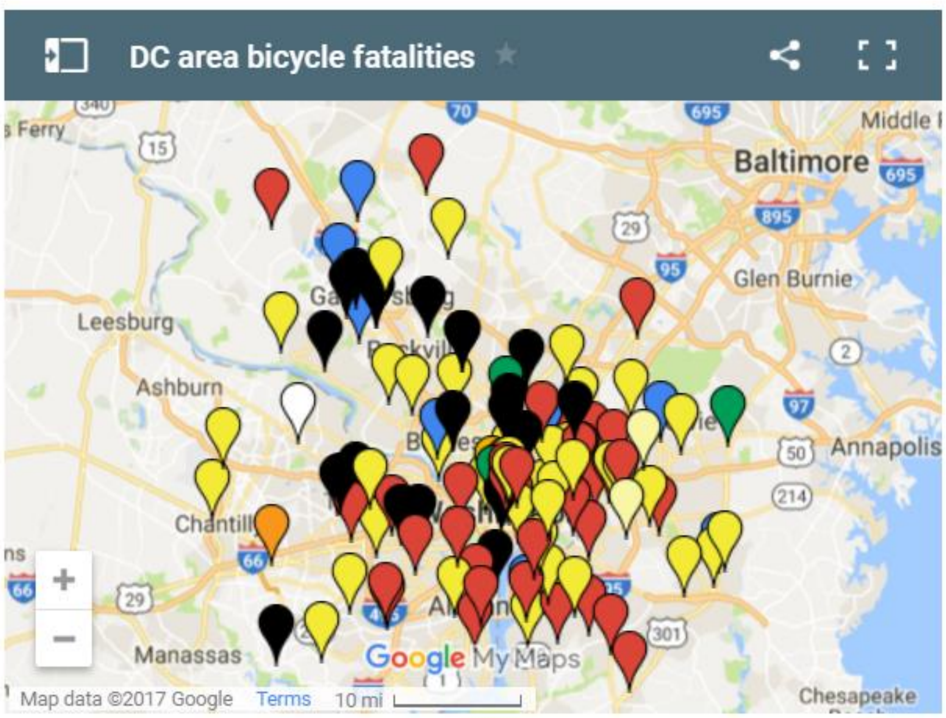


Figure 15. Locations of Bicycle Fatalities in Washington, DC (1987-2014) (Greater Washington 2014)

Structure of Crash Data in DDOT

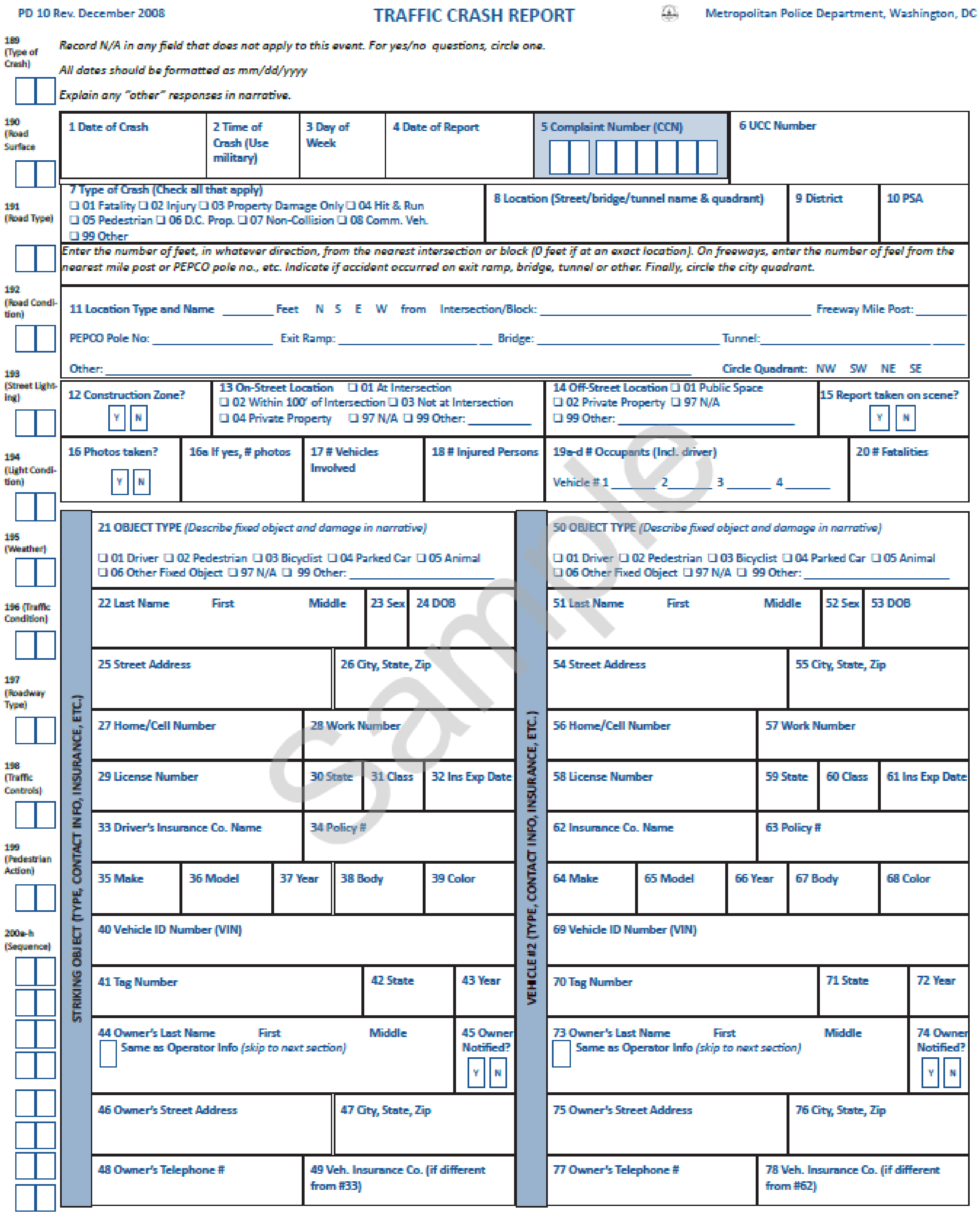
In Washington, D.C., the DC Metropolitan Police Department (MPD) records the crash data onsite in a paper form using a Traffic Accident Report (PD-10 form, Figure 16). Then the filled forms are stored electronically in Traffic Accident Reporting and Analysis System (TARAS). Crash data can be queried by some fields and selected crashes can be exported in PDF. Table 6 summarizes the research team's review of obtained PD-10 forms (2013 – 2016) from DDOT.

Table 6. Review of PD-10 Forms (2013 – 2016)

#	# of Pages	# Bicycle Crashes	# Pedestrian Crashes	K	A	B	C	O	Total
2013_BIKE	1830	610	NA	2	40	231	179	123	610
2013_PEDS	2973	NA	991	12	81	254	428	168	991
2013 (Bicycle & Pedestrian)	4803	610	991	14	121	485	607	291	1601
2014_BIKE	2487	829	NA	1	56	296	244	196	829
2014_PEDS	3510	NA	1170	10	79	306	462	293	1170
2014 (Bicycle & Pedestrian)	5997	829	1170	11	135	602	706	489	1999
2015_BIKE*	1488	496	NA	0	38	201	129	132	496
2015_PEDS	3447	NA	1149	15	64	321	458	258	1149
2015 (Bicycle & Pedestrian)	4935	496	1149	15	102	522	587	390	1645
2016_BIKE*	1095	365	NA	0	13	154	78	95	365
2016_PEDS*	1824	NA	608	2	50	198	185	131	608
2016 (Bicycle & Pedestrian)	2919	365	608	2	63	352	263	226	973
Bicycle (Subtotal)	*6900*	*2300*	*NA*	*3*	*147*	*882*	*630*	*546*	*2300*
Pedestrian (Subtotal)	*11754*	*NA*	*3918*	*39*	*274*	*1079*	*1533*	*850*	*3918*
Total	**18654**	**2300**	**3918**	**42**	**421**	**1961**	**2163**	**1396**	**6218**

Notes:

- *2015_BIKE, 2016_BIKE, and 2016_PEDS are incomplete due to change in data schema*
- *K (fatal), A (disabling), B (non-disabling), C (complaint but not visible), and O (no injury or property damage only) are number of crashes regarding to KABCO scale.*


PD 10 Rev. December 2008 — TRAFFIC CRASH REPORT — Metropolitan Police Department, Washington, DC

Record N/A in any field that does not apply to this event. For yes/no questions, circle one.

All dates should be formatted as mm/dd/yyyy

Explain any "other" responses in narrative.

189 (Type of Crash) | 190 (Road Surface) | 191 (Road Type) | 192 (Road Condition) | 193 (Street Lighting) | 194 (Light Condition) | 195 (Weather) | 196 (Traffic Condition) | 197 (Roadway Type) | 198 (Traffic Controls) | 199 (Pedestrian Action) | 200a-h (Sequence)

1 Date of Crash | 2 Time of Crash (Use military) | 3 Day of Week | 4 Date of Report | 5 Complaint Number (CCN) | 6 UCC Number

7 Type of Crash (Check all that apply) ❑ 01 Fatality ❑ 02 Injury ❑ 03 Property Damage Only ❑ 04 Hit & Run ❑ 05 Pedestrian ❑ 06 D.C. Prop. ❑ 07 Non-Collision ❑ 08 Comm. Veh. ❑ 99 Other | 8 Location (Street/bridge/tunnel name & quadrant) | 9 District | 10 PSA

Enter the number of feet, in whatever direction, from the nearest intersection or block (0 feet if at an exact location). On freeways, enter the number of feet from the nearest mile post or PEPCO pole no., etc. Indicate if accident occurred on exit ramp, bridge, tunnel or other. Finally, circle the city quadrant.

11 Location Type and Name ______ Feet N S E W from Intersection/Block: ______ Freeway Mile Post: ______

PEPCO Pole No: ______ Exit Ramp: ______ Bridge: ______ Tunnel: ______

Other: ______ Circle Quadrant: NW SW NE SE

12 Construction Zone? Y N | 13 On-Street Location ❑ 01 At Intersection ❑ 02 Within 100' of Intersection ❑ 03 Not at Intersection ❑ 04 Private Property ❑ 97 N/A ❑ 99 Other: ______ | 14 Off-Street Location ❑ 01 Public Space ❑ 02 Private Property ❑ 97 N/A ❑ 99 Other: ______ | 15 Report taken on scene? Y N

16 Photos taken? Y N | 16a If yes, # photos | 17 # Vehicles Involved | 18 # Injured Persons | 19a-d # Occupants (Incl. driver) Vehicle # 1 ____ 2 ____ 3 ____ 4 ____ | 20 # Fatalities

STRIKING OBJECT (TYPE, CONTACT INFO, INSURANCE, ETC.)

21 OBJECT TYPE (Describe fixed object and damage in narrative)
❑ 01 Driver ❑ 02 Pedestrian ❑ 03 Bicyclist ❑ 04 Parked Car ❑ 05 Animal ❑ 06 Other Fixed Object ❑ 97 N/A ❑ 99 Other: ______

22 Last Name First Middle | 23 Sex | 24 DOB

25 Street Address | 26 City, State, Zip

27 Home/Cell Number | 28 Work Number

29 License Number | 30 State | 31 Class | 32 Ins Exp Date

33 Driver's Insurance Co. Name | 34 Policy #

35 Make | 36 Model | 37 Year | 38 Body | 39 Color

40 Vehicle ID Number (VIN)

41 Tag Number | 42 State | 43 Year

44 Owner's Last Name First Middle ❑ Same as Operator Info (skip to next section) | 45 Owner Notified? Y N

46 Owner's Street Address | 47 City, State, Zip

48 Owner's Telephone # | 49 Veh. Insurance Co. (if different from #33)

VEHICLE #2 (TYPE, CONTACT INFO, INSURANCE, ETC.)

50 OBJECT TYPE (Describe fixed object and damage in narrative)
❑ 01 Driver ❑ 02 Pedestrian ❑ 03 Bicyclist ❑ 04 Parked Car ❑ 05 Animal ❑ 06 Other Fixed Object ❑ 97 N/A ❑ 99 Other: ______

51 Last Name First Middle | 52 Sex | 53 DOB

54 Street Address | 55 City, State, Zip

56 Home/Cell Number | 57 Work Number

58 License Number | 59 State | 60 Class | 61 Ins Exp Date

62 Insurance Co. Name | 63 Policy #

64 Make | 65 Model | 66 Year | 67 Body | 68 Color

69 Vehicle ID Number (VIN)

70 Tag Number | 71 State | 72 Year

73 Owner's Last Name First Middle ❑ Same as Operator Info (skip to next section) | 74 Owner Notified? Y N

75 Owner's Street Address | 76 City, State, Zip

77 Owner's Telephone # | 78 Veh. Insurance Co. (if different from #62)

Sample

Figure 16. PD-10 Form

The PD-10 form is somewhat outdated and there have been some discussions to update it. "The Washington Area Bicyclist Association (WABA) argued in a July policy paper that *"MPD's PD-10 crash intake form has several deficiencies that make it difficult for police officers to capture accurately the important details of a crash involving a pedestrian or bicyclist."* Other information that can and should be captured, according to WABA, includes *"the location of a non-motorist with respect to the roadway at the time of the crash," "the action of a bicyclist immediately prior to the crash," and "whether the bicyclist was using lights." Executive Director Greg Billing says they haven't received a formal response from DDOT on the recommendations, which they asked to be included in the two-year action plan* (Hughes 2015)."

Other States and Local Studies

Studies from Arizona, Colorado, Florida, Massachusetts, North Carolina, and Wisconsin are summarized in this section.

Arizona

Pedestrian Safety Action Plan (Kimley-Horn and Associates, Inc. 2009)

- *Objective*:
    - Identification and prioritization of high-crash segment locations
    - Development of conceptual countermeasures and their estimated costs
    - Recommendations for new or revisions to existing policies for consideration by Arizona Department of Transportation (ADOT)
- *Method*: Used PBCAT crash typology and PEDSAFE countermeasures
- *Data*: Study scope was limited to pedestrian crashes on state highways from 2002 – 2006 (771 crashes) and among them locations with high pedestrian crashes were selected; 283 roadway segments and 37 interchange crashes.
- *Results*:
    - The most common pedestrian crash types on roadway segments were (Kimley-Horn and Associates, Inc. 2009):
        - Pedestrian failed to yield (44%)
        - Motorist left turn - parallel paths (11%)
        - Motorist right turn - perpendicular paths (10%)
        - Through vehicle at signalized location (10%)
    - The most common pedestrian crash types at interchanges were (Kimley-Horn and Associates, Inc. 2009):
        - Pedestrian failed to yield (36%)
        - Motorist right turn - perpendicular paths (17%)
        - Through vehicle at un-signalized location (17%)
        - Motorist right turn - parallel paths: (13%)

One data limitation was crash data on tribal lands that was not available in state crash databases and if available, it was often incomplete.

Bicycle Safety Action Plan (Kimley-Horn and Associates, Inc. 2012)

- *Objective*: Investigation of bicycle safety in Arizona, identification of common crash types, associated countermeasures, and recommendations to improve safety
- *Method*: Used PBCAT crash typology
- *Data*: Study scope was limited to bicycle crashes on state highways from 2004 – 2008 (1,089 crashes) and among them locations with high bicycle crashes were selected; 480 roadway segments and 266 intersection/interchange crashes

- *Result*: During the study period majority (90%) of bicycle crashes occurred on local city and county roadways that are outside the jurisdiction of ADOT.

  The most common bicycle crash types were (Kimley-Horn and Associates, Inc. 2012):

  - Bicyclist ride through - signalized intersection (13.8%)
  - Motorist drive out - sign-controlled intersection (11.1%)
  - Motorist drive out - right-turn-on-red (10.1%)
  - Motorist drive out - commercial driveway / alley (9.51%)
  - Motorist drive out - signalized intersection (8.17%)

Colorado

Safe Streets Boulder, Striving to Make Boulder Streets Even Safer, A study of motor vehicle collisions involving bicyclists and pedestrians (GO Boulder 2012)

- *Objective*: Identified the most common types of crashes, discussed the causes and found hot-spots.
- *Method*:
  - The research team developed a tool to import the data from the Accident Report forms into a GIS-based spatial and relational database. Maps showing high-collision locations could were generated from this database.
  - Reviewed the narrative of each individual accident report to fill PBCAT fields.
- *Data*: All police reported pedestrian-involved and bicycle-involved crashes in 2008 – 2011; 151 pedestrian, 14 skateboarders and 516 bicycle crashes. Non-motor vehicle crashes were excluded.
- *Results*: Observed pedestrian-involved and bicycle-involved crashes are less than expected values given the high number of pedestrian and bicycle trips in Boulder.

  The most common pedestrian crash types were (GO Boulder 2012):

  - Motorist left turn – parallel pedestrian travel (18.9%)
  - Pedestrian dash out (jaywalking or against the light) (14%)
  - Motorist failed to yield (11.6%)
  - Parking lots (often backing vehicles) (10.4%)
  - Unusual circumstances (7.9%)

  The most common bicycle crash types were (GO Boulder 2012):

  - Motorist right turn – bicycle travelling in the same direction (13.6%)
  - Motorist left turn – bicycle travelling in the opposite direction (13.4%)
  - Motorist drive out – sign-controlled intersection (10.5%)
  - Motorist drive out – right turn on red (9.5%)
  - Motorist drive out at driveway or alley (9.2%)

Bicycle Crash Analysis Understanding and Reducing Bicycle & Motor Vehicle Crashes (Denver Public Works 2016)

- *Objective*: Safety assessment of bicycling in Denver.
- *Method*:

    - Public works staff reviewed the narratives of each crash report to provide additional data to each and also sort the crashes into initial typologies:
        - Broadside
        - Motorist approaching turn
        - Motorist overtaking turn
        - Bicycling approaching turn
        - Bicyclist overtaking turn
        - Rear end
        - Sideswipe
        - Dooring
        - Unknown
    - A multi-modal safety research was conducted by Toole Design Group (TDG)
    - Fault assigned for each crash
    - Additional information were collected from crash narratives (pre-crash location and riding direction of each bicyclist)
    - Mapped crashes by type
    - Developed a set of engineering crash reduction strategies
- *Data*: All bicycle-involved crashes in 2008 – 2012.
- *Results*: Top crash types were:
    - Broadside with on-street bicyclist
    - Same direction crashes with on-street bicyclist
    - Left hook with on-street bicyclist
    - Right hook with bicyclist riding on the sidewalk against traffic
    - Broadside into bicyclist riding on the sidewalk against traffic

Florida

Many studies have been done in Florida regarding improving safety of pedestrians and bicyclists. For example, Figure 17 depicts common vehicle-bicycle crash types in Orlando, Florida. All of these crashes could be avoided by defensive driving (Metropolitan Orlando 2014).

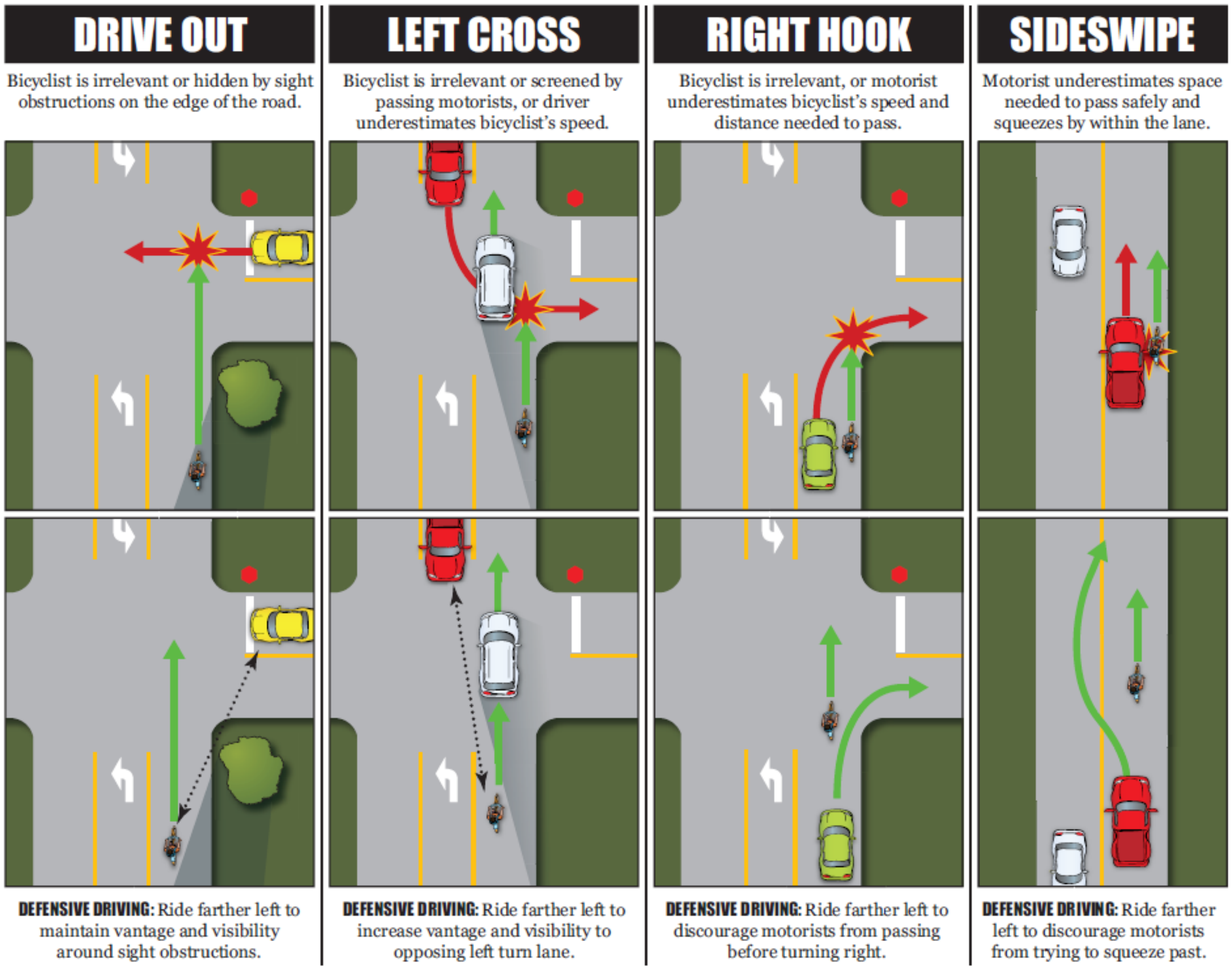


Figure 17. Common Vehicle-Bicycle Crashes (Metropolitan Orlando 2014)

Causative Factors and Trends in Florida Pedestrian Crashes (Spainhour, et al. 2006)

- *Objective*: Going beyond descriptive analyses of the state coded data by crash typing to describe the sequence of events precipitating a crash.
- *Method*: Reviewed state records, traffic crash reports, traffic homicide investigative report narratives, diagrams, and photographs and site visits for selected crashes. Due to somewhat limited sample size, a grouping of NHTSA crash types was needed. Research team assigned a primary contributing factor to each crash. If applicable secondary and tertiary factors were added as well. Factors were selected from human factors (e.g., age, alcohol, decision, inattention, perception, and speed), vehicle factors (e.g., defect, disabled, and tires), environmental factors (e.g., dark, heavy rain, wet-slippery, and wind), roadway factors (e.g., construction, lighting, and obstruction), and other/unknown.
- *Data*: 353 fatal pedestrian crashes mostly occurring in the year 2000 including fatal crashes involving pedestrians and heavy trucks in the years 1999 (13 cases) and 1998 (20 cases).
- *Results*: The most significant causes of pedestrian crashes were pedestrian behavior, alcohol use by both parties, poor pedestrian visibility at night coupled with violation of driver expectation, and lack of compliance with state laws.

Common fatal pedestrian crash types were (Spainhour, et al. 2006):

- Crossing not in a crosswalk (second half) (33%)
- Crossing not in a crosswalk (first half) (20%)
- Exit vehicle (13%)
- Crossing at intersection (10%)
- In road (8%)

Orlando Area Bicyclist Crash Study: A Role-Based Approach to Crash Countermeasures (Wilson n.d.)

- *Objective*: Investigated an alternative role-based countermeasure assignment based on bicyclists, motorists, traffic engineers, planners, and law enforcement officers.
- *Method*: Long-form crash reports were collected and reviewed by the staff using PBCAT. GIS analyses were also performed.
- *Data*: 885 crashes between bicyclists and motorists in Orange, Seminole and Osceola Counties in 2003 - 2004.
- *Results*: Based on the nature of bicycle crashes, countermeasures were recommended for child bicyclists, adult bicyclists, motorists, transportation planners and traffic engineers, and law enforcement officers.

Hillsborough Countywide Bicycle Safety Action Plan (Florida Department of Transportation (FDOT) 2011)

- *Objective*: Reduce bicycle crashes and their severity, and encourage bicycle usage by improving transportation system infrastructure through strategic countermeasures and construction of new bicycle facilities.
- *Method*: Reviewed each individual crash report diagram, narrative and PBCAT crash typology.
- *Data*: 2,430 bicycle crashes in 2005 - 2009
- *Results*: Drivers were at fault for 55-57% of crashes.

Common bicycle crash types were (Florida Department of Transportation (FDOT) 2011):

- Motorist failed to yield at un-signalized intersection (24%)
- Bicyclist rode out - midblock (15%)
- Motorist overtaking cyclist (10%)

Bicycle/Pedestrian Safety Plan Update (Kimley-Horn and Associates, Inc. 2014)

- *Objective*: Reduce bicyclist and pedestrian fatalities in Miami-Dade County, Florida:
    - An analysis of bicycle and pedestrian traffic crashes.
    - An analysis of bicycle and pedestrian level of service (BLOS and PLOS).
- *Method*: Used PBCAT typology.
- *Data*: Used 2006 - 2011 crash data for descriptive purposes and 2010 - 2011 crash data for crash typing.
- *Results*: Crash types were identified and visualized on GIS maps.

Statewide Analysis of Bicycle Crashes (Alluri, et al. 2017)

- *Objective*:

  - Identify specific contributing causes and patterns of bicycle crashes
  - Identify and analyze bicycle hot spots for crash causes and potential countermeasures
  - Develop Florida-specific Crash Modification Factors (CMFs) to assess the safety effects of common engineering treatments on bicycle safety.
- *Method*:
  - Descriptive trend analysis based on temporal, environmental, bicyclist-related, crash location-related and vehicle-related factors.
  - The effect of roadway geometric features on the frequency and severity of bicycle crashes was also studied.
  - Police reports reviewed.
  - Macroscopic spatial analysis to model the relation between demographic, socio-economic, roadway, traffic, and bicycle activity data at the census block group level and bicycle crash frequencies in Florida.
  - A cross-sectional analysis was performed to develop Florida-specific CMFs for bicycle crashes.
- *Data*: 26,036 bicycle crashes that occurred during 2011-2014.
- *Results*:

  Four major bicycle crash types (Alluri, et al. 2017):

  - Motorist turns right while bicyclist is crossing the street
  - Motorist turns left facing bicyclist
  - Bicyclist rides out at intersection
  - Motorist drives out at stop sign

  Common bicycle crash contributing factors (Alluri, et al. 2017):

  - Inadequate street lighting
  - Unconventional intersection geometry
  - Traffic violations by motorists and bicyclists
  - Bicyclists sideswipe vehicles
  - Driveways near intersections
  - U-turn maneuvers by bicyclists and motorists
  - Bicyclists hit the door of parked vehicle
  - Bicyclists ride opposite to the traffic

Massachusetts

Bicycle Crash Fact Sheet City of Cambridge, MA (Parenti 2014)

- *Objective*: Detailed evaluation of crashes on Cambridge Streets.
- *Method*: Cambridge Road Safety Analysis Tool (CamRA) categorized each bicycle crash by type.
- *Data*: Bicycle crashes in 2004 - 2012.
- *Results*: The most common bicycle crash types are shown in Figure 18. Angle crashes (32%) were on top followed by door-related crashes (20%) and left hook (19%).

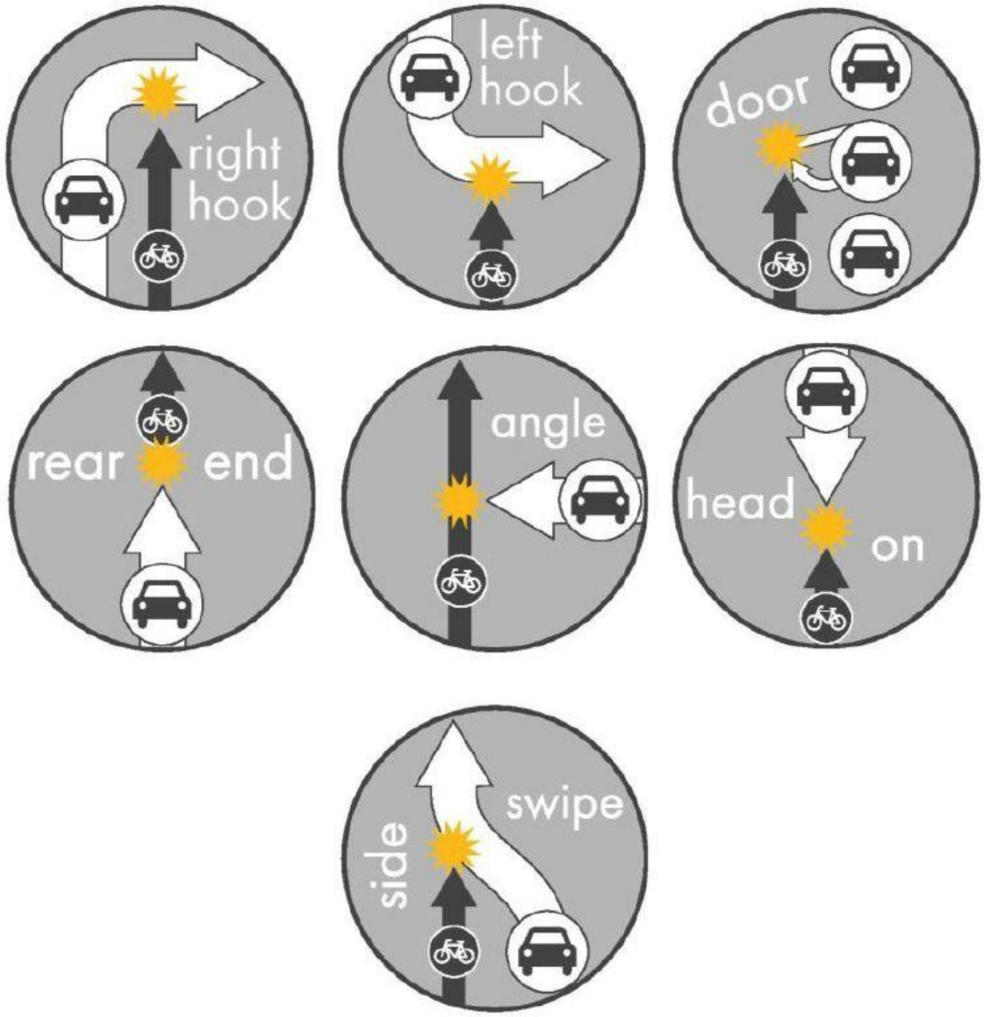


Figure 18. Bicycle Crash Types in Cambridge, MA 2004 – 2012 (Parenti 2014)

North Carolina

As it was stated earlier, the Highway Safety Research Center (HSRC) at the University of North Carolina was funded by FHWA to develop the PBCAT (Cleven and Blomberg 2007).

Bicycle – Motor Vehicle Crashes in Chapel Hill; A Typology and Analysis of Police-Reported Crashes Spanning A Four-Year Period (Pein 2000)

- *Objective*: Typology and Analysis of Police-Reported Crashes.
- *Method*: Slightly modified NHTSA crash types.
- *Data*: 86 bicycle crashes 1996 – 1999.
- *Result*: The main crash types were:
    - Drive Out (20 cases)
    - Ride Out (16 cases)
    - Left Cross (12 cases)
    - Right Hook (10 cases)

North Carolina Pedestrian Crash Types 2008 - 2012 (Thomas, Levitt and Farley, North Carolina Pedestrian Crash Types 2008 - 2012 2014)

- *Objective*: Identify pedestrian crash types in North Carolina.
- *Method*: Reviewed diagrams, narratives, and other details on copies of all crash report forms submitted to NCDOT, and used PBCAT software to code crash type, pedestrian position, and crash location variables for each crash. These data elements were combined with the crash data elements already available in the State's crash database.
- *Data*: 13,186 pedestrian crashes in 2008 - 2012.
- *Results*: Common pedestrian crash types were:
    - Pedestrian failed to yield (14.8%)
    - Off roadway - parking lot (9.4%)
    - Backing vehicle - parking lot (7.4%)
    - Walking along roadway with traffic - from behind (6.8%)
    - Dash (5.6%)

North Carolina Bicycle Crash Types 2008 - 2012 (Thomas and Levitt 2014)

- *Objective*: Identify bicycle crash types in North Carolina.
- *Method*: Reviewed diagrams, narratives, and other details on copies of all crash report forms submitted to NCDOT, and used PBCAT software to code crash type, pedestrian position, and crash location variables for each crash. These data elements were combined with the crash data elements already available in the State's crash database.
- *Data*: 4,889 bicycle crashes in 2008 - 2012.
- *Results*: Common bicycle crash types were:
    - Motorist drive out - sign-controlled intersection (9.8%)
    - Motorist overtaking - other / unknown (9%)
    - Motorist left turn - opposite direction (7.4%)
    - Motorist drive out - commercial driveway / alley (5%)
    - Motorist overtaking - misjudged space (4.8%)

Wisconsin

Bicycle Crash Analysis for Wisconsin using a Crash Typing Tool (PBCAT) and Geographic Information System (GIS) (Amsden and Huber 2006)

- *Objective*: Identify bike-motor vehicle crash types for 2003. Analysis of crashes in more depth to identify commonalities between these crashes and crash characteristics, specifically related to traffic conditions, roadway attributes, and the users involved in the crashes.
- *Method*: Pedestrian and Bicycle Crash Analysis Tool (PBCAT) and GIS.
- *Data*: All bicycle-involved crashes in 2003 (addition of 2002 and 2004 data for rural area). In total 1,165 crashes.
- *Result*: Majority of crashes were in urban areas (94%) and happened at intersections (66%), the fatal crash rate based on bicycle miles in rural areas was almost twice as in urban areas. Four out of the top five crash types indicated that the motorist made the critical error.

  Top five crash types were (Amsden and Huber 2006):

1. Motorist drive-out - sign control (14.3%)
2. Bicyclist ride-through - sign control (7.1%)
3. Motorist left turn - opposite direction (6.12%)
4. Motorist drive-out - right turn on red (5.4%)
5. Motorist ride-out - commercial driveway/alley (5.04%)

Wisconsin Pedestrian and Bicycle Crash Analysis: 2011-2013 (Schneider and Stefanich 2015)

- *Objective*: Analyze pedestrian and bicycle crashes and introduce and compare a new classification method called Location–Movement Classification Method (LMCM).
- *Method*: NHTSA crash typing and LMCM (Table 7). Police reports of sampled crashes were reviewed (especially narrative parts) and information captured along with other characteristics of each crash site with aerial and street-level imagery.
- *Data*: A subset of all police reported pedestrian-involved and bicycle-involved crashes in 2011 – 2013; 296 out of 4,857 pedestrian crashes and 229 out of 3,365 bicycle crashes. Fatal and severe injury crashes were intentionally oversampled.
- *Result*: LMCM provides useful information that is not captured by a NHTSA crash typology and it can complement it.

Table 7. LMCM Crash Coding Scheme (Schneider and Stefanich 2016)

Main Crash Category	First Part of Code	Second Part of Code	Third Part of Code	Fourth Part of Code
Roadway intersection	General location I = roadway intersection	Side of intersection NS = nearside, or where motorist enters intersection FS = farside, or where the motorist exits intersection	Motorist movement ST = straight LT = left turn RT = right turn	Pedestrian or bicyclist movement relative to motorist's preturn direction R = approaching from motorist's right L = approaching from motorist's left S = same direction as motorist O = opposite direction as motorist X = no or unknown direction
Roadway nonintersection	General location N = roadway nonintersection	Location on the roadway RRD = right-side roadway lane LRD = left-side roadway lane RSH = right-side shoulder or bike lane LSH = left-side shoulder or bike lane RSW = right-side sidewalk LSW = left-side sidewalk	Pedestrian or bicyclist movement[a] R = approaching from motorist's right L = approaching from motorist's left S = same direction as motorist O = opposite direction as motorist X = no or unknown direction	None
Parking lot or private property	General location P = parking lot and D = driveway	Motorist movement F = forward B = backward	None	None
Other[b]	All crashes have single code: OTH	None	None	None

[a]R and L movements are not used for shoulder or sidewalk crashes.
[b]Other crashes include situations that do not fit into the categories, including driverless vehicle crashes or multiunit crashes where a pedestrian or bicyclist was struck by a vehicle that had already been struck by another vehicle.

The most common pedestrian crashes by LMCM were (Schneider and Stefanich 2016):

- N_RRD_X: Non-intersection: straight-traveling motorist strikes pedestrian in roadway, pedestrian not approaching from left or right.
- I_FS_ST_L: Intersection: straight-traveling motorist strikes pedestrian approaching from left on farside of intersection.

- N_RRD_R: Non-intersection: straight-traveling motorist strikes pedestrian approaching from right.
- N_RRD_L: Non-intersection: straight-traveling motorist strikes pedestrian approaching from left.
- I_NS_ST_L: Intersection: straight-traveling motorist strikes pedestrian approaching from left on nearside of intersection.

The most common bicycle crashes by LMCM were (Schneider and Stefanich 2016):

- N_RRD_S: Non-intersection: straight-traveling motorist strikes bicyclist on right side of roadway (in travel lane but not bicycle lane or shoulder), bicyclist traveling in same direction (includes door-related).
- I_NS_ST_L: Intersection: straight-traveling motorist strikes bicyclist approaching from left on nearside of intersection.
- I_FS_ST_R: Intersection: straight-traveling motorist strikes bicyclist approaching from right on farside of intersection.
- N_RSH_S: Non-intersection: straight-traveling motorist strikes bicyclist on right roadway shoulder or bicycle lane, bicyclist traveling in same direction.
- N_LRD_O: Non-intersection: straight-traveling motorist strikes bicyclist on left side of roadway (in travel lane), bicyclist traveling in opposite direction.

The NHTSA crash types were also identified as follows:

- Pedestrian crashes: 741 (Dash), 770 (Motorist Failed to Yield), 760 (Pedestrian Failed to Yield), 742 (Dart-Out), and 781 (Motorist Left Turn—Parallel Paths).
- Bicycle crashes: 141 (Motorist Drive-out—Sign-Controlled Intersection), 144 (Bicyclist Ride Through—Sign-Controlled Intersection), 212 (Motorist Left Turn—Opposite Direction), 155 (Bicyclist Ride Through—Signalized Intersection), 231 (Motorist Overtaking—Undetected Bicyclist).

International Studies

Some studies from the Europe and other regions of the world are reviewed in this section.

Europe

Fatal Pedestrian Accidents in France: A Typological Analysis (Fontaine and Gourlet 1997)

- *Objective*: Examine fatal pedestrian crashes and identify main types
- *Method*: Multiple characteristics, actions, and locations were considered in the proposed crash typology based on correspondence analysis and classification.
- *Data*: 1,289 fatal pedestrian crashes in France between March 1990 and February 1991.
- *Results*: Four groups were identified (Figure 19):
    - Elderly pedestrians who were crossing a road in an urban area
    - Children involved in daytime accidents in urban areas whilst playing or running
    - Intoxicated pedestrians involved in night-time accidents in the country whilst walking on the carriageway
    - Pedestrians involved in secondary accidents and changes of transport mode

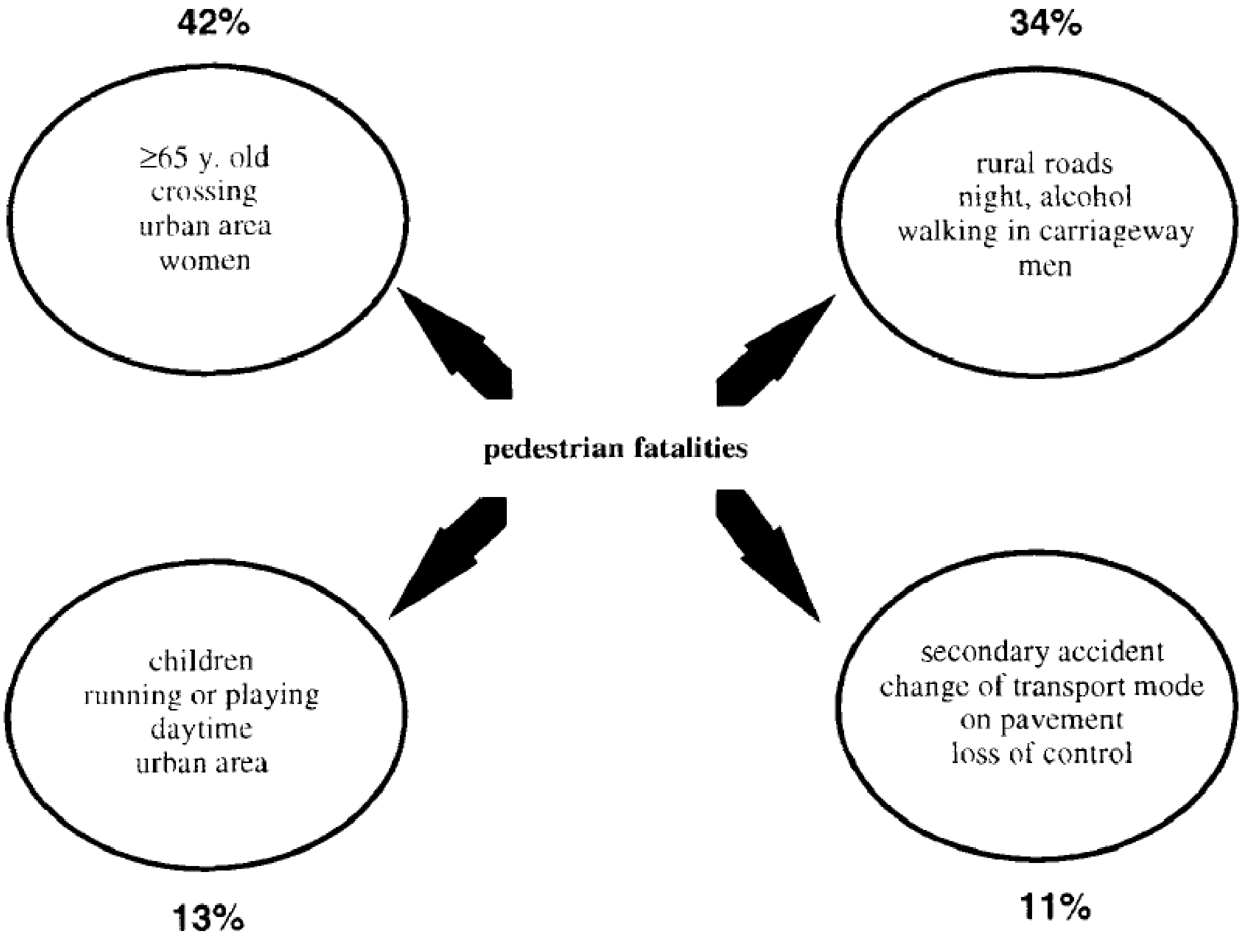


Figure 19. Fatal Pedestrian Crash Types in France 1990 – 1991 (Fontaine and Gourlet 1997)

Pedestrians & Cyclists (SafetyNet 2009)

In addition to general factors such as the speed, design, and weight of vehicles, and the lack of protection of pedestrians and bicyclists, factors that have also been identified as causes of pedestrian and cyclist crashes are visibility, vehicle control, and alcohol consumption (SafetyNet 2009).

Mapping Patterns of Pedestrian Fatal Accidents in Israel (Prato, Gitelman and Bekhor 2012)

- *Objective*: Examine fatal pedestrian crashes and identify main types
- *Method*: A research methodology somewhat similar to Fontaine and Gourlet (1997) and using Kohonene neural networks on a database of four-year pedestrian fatal crashes.
- *Data*: 603 fatal pedestrian crashes in Israel in 2003 – 2006.
- *Results*: Five groups were identified
    - Elderly pedestrians crossing on crosswalks mostly far from intersections in metropolitan areas
    - Pedestrians crossing suddenly or from hidden places and colliding with two-wheel vehicles on urban road sections
    - Male pedestrians crossing at night and being hit by four-wheel vehicles on rural road sections

- Young male pedestrians crossing at night wide road sections in both urban and rural areas
- Children and teenagers crossing road sections in small rural communities.

Single-bicycle Crash Types and Characteristics (Schepers and Wolt 2012)

- *Objective*: While most research on bicycle safety is focused on bicycle motor vehicle crashes, only a few studies addressed single-bicycle crashes. This study developed a categorization of single-bicycle crash types.
- *Method*: A draft categorization was developed and tested using a questionnaire of bicycle crash victims treated at an Emergency Care Department. The crash types were considered based on direct causes (against latent causes) as follows:
    - Infrastructure related crashes
    - Bicyclist related crashes; loss of control
    - Bicycle malfunction
    - Other, or no recall of the crash by the victim
- *Data*: Between February and June 2008, 2,975 questionnaires were sent, 1,156 (39%) were returned and 1,142 could be used for analyses.
- *Result*: The main crash causes were:
    - The bicyclist rode off the road
    - The bicyclist collided with an obstacle
    - The bicycle skidded due to a slippery road surface
    - The rider was unable to stabilize the bicycle or stay on the bike because of an uneven road surface
    - Loss of control at low speed
    - Forces on the front wheel
    - Poor or risky riding behavior
    - Bicycle defects

Other Locales

In this section, some studies are reviewed from Australia, Canada, Ivory Coast, and South Africa.

An Analysis of Fatal Bicycle Accidents in Victoria (Australia) With a Special Reference to Nighttime Accidents (Hoque 1990)

- *Objective*: Examine fatal bicycle crashes with particular emphasis on nighttime crashes.
- *Method*: Crash reports were reviewed and relevant information extracted and coded.
- *Data*: 122 fatal pedestrian crashes in 1981 - 1984.
- *Results*: Common crash types were:
    - Motorist overtaking (20%)
    - Bike swerve out (12.5%)
    - Bike, entering sign (controlled) (11.7%)
    - Bike, driveway, ride-out (9.2%)
    - Bike, entering from curb (8.3%)

City of Toronto Bicycle/Motor-Vehicle Collision Study (Transportation Services Division 2003)

- *Objective*: Study of crash statistics in detail in order to understand and address bicyclists' safety issues.
- *Method*: Adapted from NHTSA crash typology with some changes. Descriptive and GIS analysis of crash points by type.
- *Data*: Police reports of 2,572 vehicle-bicycle crashes within the city between January 1, 1997 and December 31, 1998.
- *Results*: The majority of crashes occurred at intersections and most of those involved motor vehicle turning. For non-intersection cases, crashes most often involved motorists overtaking bicyclists, or opening car doors in the paths of cyclists.

The most common crash types were:

- Drive out at controlled intersection (12.2%)
- Motorist overtaking (11.9%)
- Motorist opens vehicle door (11.9%)
- Motorist left turn - facing cyclist (10.7%)
- Motorist right turn (not at red light) (9.6%)

The most common contributing factors were:

- Bicyclist riding on sidewalk or crosswalk
- Darkness/poor visibility
- Child bicyclist (inexperience)
- Sight lines obstructed
- Motorist improper/unsafe lane change

City of Toronto Pedestrian Collision Study (Transportation Services Division 2007)

- *Objective*: Determine the patterns and the trends to identify the most common types of crashes.
- *Method*: Adapted from NHTSA crash typology with some changes. Descriptive and GIS analysis of crash points by type.
- *Data*: Police reports of 2,572 vehicle-bicycle crashes within the city between January 1, 1997 and December 31, 1998.
- *Result*: The most common crash types were:
    - Pedestrian hit at midblock location (22%)
    - Vehicle is going straight through intersection while pedestrian crosses without right-of-way (14%)
    - Vehicle turns left while pedestrian crosses with right-of-way at intersection (13%)
    - Pedestrian hit in parking lot (11%)
    - Vehicle turns right while pedestrian crosses with right-of-way at intersection (9%)

Pedestrian and Cyclist Safety in Toronto (Bassil, et al. 2015)

- *Objective*: Identify the environmental and individual-level risk factors of pedestrian or bicycle crashes (especially those of severe injuries and fatalities).
- *Method*: Descriptive, statistical tests, review of crash reports, and GIS analysis.
- *Data*: Police reports of pedestrian-involved and bicycle-involved crashes in Toronto in 2008 - 2012, number of trips made with walking or cycling as the primary mode of travel

based on Transportation Tomorrow Survey, 2001, 2006 and 2011, and bikeway network from City of Toronto Transportation Services.

- *Results*:
    - Aggregate analysis of crash rates per 1 million trips indicated a decline in crashes over time.
    - The common pedestrian crash types were:
        - Vehicle turns left in intersection (26%)
        - Pedestrian hit at midblock (16%)
        - Pedestrian hit in parking lot or driveway (15%)
        - Vehicle travelling straight through intersection (15%)
        - Vehicle turns right in intersection (13%)

There are some online resources for City of Montreal to map pedestrian and bicycle crashes and review some descriptive tables and diagrams such as trends by time, age of driver, and ranking of sites with most accidents and danger index (Figure 20). One tool visualizes 3,742 bicycle crashes in 2006 - 2010 (denoted by “A” in Figure 20) and the other one visualizes various crashes (such as pedestrians (depicts in Figure 20 by “B”), bicyclists, and cars only) (Montreal Gazette n.d., Montreal Gazette 2013).

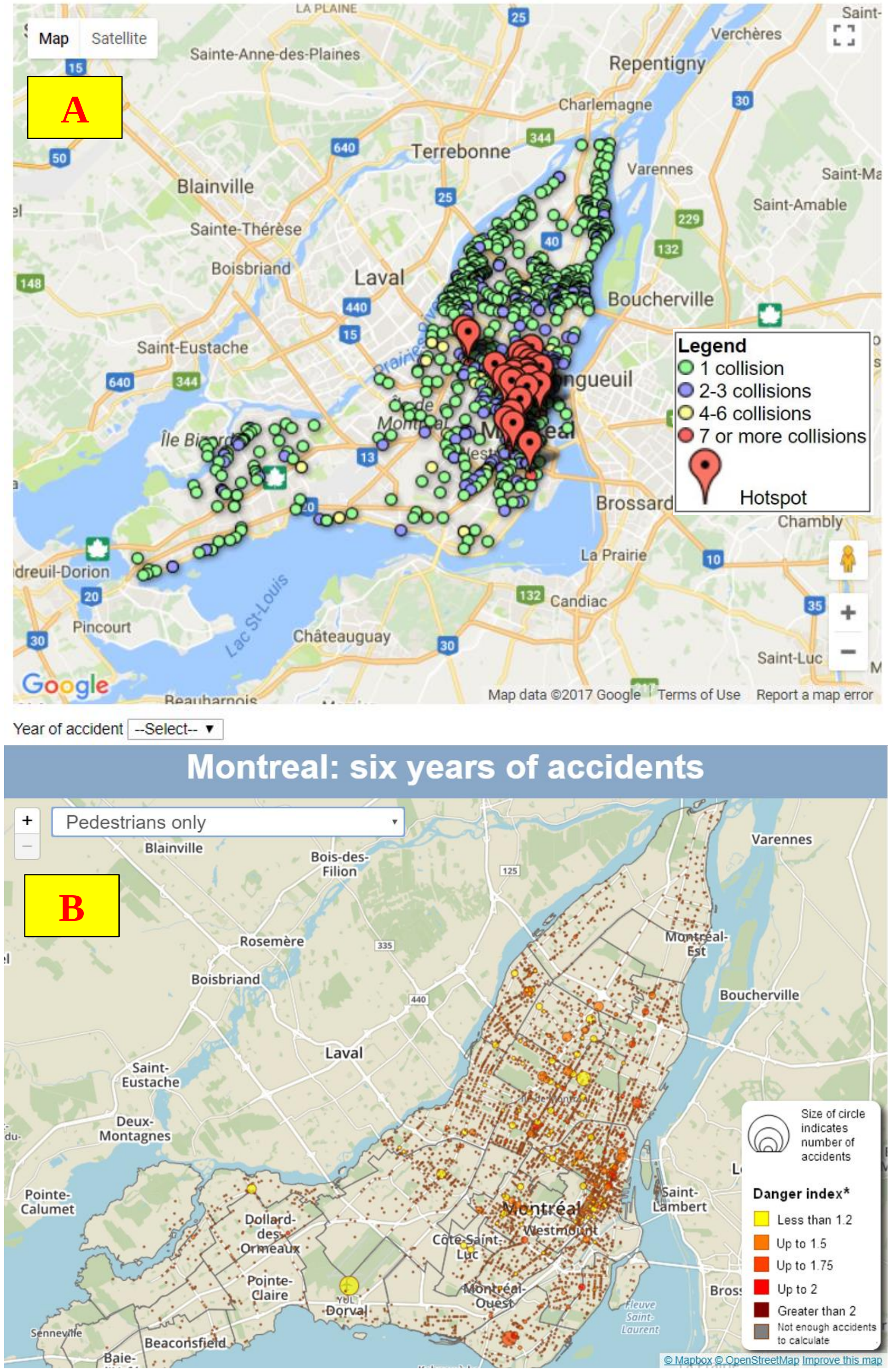


Figure 20. Montreal Crash Mapping Tools (Montreal Gazette n.d., Montreal Gazette 2013)

Study of the Causes of Pedestrian Accidents by Severity (Kouabenan and Guyot 2004)

- *Objective*: Compare three different methods of analyzing pedestrian crash records.
- *Method*: Three different methods to analyze pedestrian crash data: quantitative analysis (comparing the ratios of fatal and nonfatal crashes by some factors), causality-tree analysis, and an analysis of the spontaneous causal explanations given by the involved persons (fault as described as internal or external).
- *Data*: 55 randomly selected police records of pedestrian crashes in the Ivory Coast: 28 fatal and 27 nonfatal crashes.
- *Results*: Each method could capture different aspects of crashes. The quantitative analysis showed that fatal crashes most often occurred when vehicles were speeding or on roads outside the city. The causality-tree analysis showed that the circumstances in which fatal crashes occur were somewhat different from those of accidents involving injury only. The analysis of the spontaneous causal explanations made it clear that pedestrians and drivers explain accidents in a defensive way by stressing factors that tend to incriminate the other party.

Magnitude and Categories of Pedestrian Fatalities in South Africa (Mabunda, Swart and Seedat 2008)

- *Objective*: Describe the magnitude, demographic, and temporal factors associated with pedestrian fatalities and presenting a typological analysis to identify particular groups of at risk pedestrians.
- *Method*: Descriptive and a multiple correspondence analysis (MCA).
- *Data*: 7,433 fatal pedestrian accidents in four cities in South Africa in 2001 - 2004.
- *Results*: Three identified fatal pedestrian crash categories were:
    - Male pedestrian fatalities that showed high levels of alcohol concentrations
    - Female and elderly pedestrian deaths that occurred between 6 AM and midday
    - Children, adolescents, and young adult pedestrian fatalities that typically occurred during weekday afternoons and evenings

Predictive Approach

There have been many studies dealing with predicting dependent variables such as number or severity level of bicycle or pedestrian crashes by independent variables such as roadway information, motor vehicle volumes, land use, demographics and in some studies pedestrians' and bicyclists' volumes. Classification trees were used for predicting severity of bicycle (Prati, Pietrantoni and Fraboni 2017) and pedestrian (Iragavarapu, Lord and Fitzpatrick 2015) crashes and also to identify sources of head injury for pedestrian and bicyclists (Badea-Romero and Lenard 2013).

The *Highway Safety Manual* (HSM) was published in 2010 (American Association of State Highway and Transportation Officials 2010). This manual is a summary of predictive methods for different facility types (either roadway segments or intersections) to estimate frequency of crashes based on reliable predictive models. The predictive method consists of three main components (see Equation 1): safety performance functions (SPFs), crash modification factors (CMFs), and local calibration factors (LCFs) (American Association of State Highway and Transportation Officials 2010, 2014).

Equation 1. The HSM Predictive Method

$$N_{Predicted\ (Adjusted)} = N_{SPF} \times (CMF_1 \times CMF_2 \times \ldots \times CMF_n) \times LCF$$

Where:

$N_{Predicted\ (Adjusted)}$ = Adjusted predicted crash frequency;

N_{SPF} = Average crash frequency under base conditions;

$CMF_1, \ldots, CMF_n$ = Crash Modification Factors; and

LCF = Local Calibration Factor.

To predict crash frequency for a given facility type, N_{SPF} is calculated first to estimate the average crash frequency for base conditions. Then a set of CMFs are multiplied to each other to produce a combined CMF ($CMF_{Combined}$). A CMF is a multiplicative factor or function for evaluating changes in crashes of a given countermeasure or existing condition at the study location (Federal Highway Administration 2016). The product of N_{SPF} and $CMF_{Combined}$ becomes uncalibrated predicted crash frequency. The last task is to compute a LCF, a factor to adjust crash frequency estimated from the HSM predictive method to local conditions (e.g., traffic variation, climate, weather, population, and other contributing factors of crashes) at an aggregate level. LCF is the ratio of total observed crashes to total uncalibrated predicted crashes (i.e., NSPF * $CMF_{Combined}$). An issue is that LCF adjusted at an aggregate level may suffer from an average-over effect from aggregating individual locations, resulting in large errors for individual locations when applied to a study site.

The Crash Modification Factors (CMFs) Clearinghouse[1] of the Federal Highway Administration (FHWA) includes thousands countermeasures (Federal Highway Administration (FHWA) 2017). As of July 11 2017, there were 5,805 starred and 1,022 without star ranking countermeasures on the website. In total 241 (about 3.5%) out of all 6,827 CMFs were labelled with either pedestrians or bicyclists (Table 8).

[1] www.cmfclearinghouse.org

Table 8. List of Countermeasures on CMF Clearinghouse (Federal Highway Administration (FHWA) 2017)

Countermeasure Category	**With Star Ranking**		**Without Star Ranking**	
	Count	***%***	***Count***	***%***
Access management	410	*7%*	20	*2%*
Advanced technology and ITS	365	*6%*	1	*0%*
Alignment	108	*2%*	40	*4%*
Bicyclists	173	*3%*	3	*0%*
Delineation	196	*3%*	52	*5%*
Highway lighting	88	*2%*	13	*1%*
Interchange design	95	*2%*	9	*1%*
Intersection geometry	607	*10%*	156	*15%*
Intersection traffic control	637	*11%*	170	*17%*
On-street parking	42	*1%*	7	*1%*
Pedestrians	39	*1%*	26	*3%*
Railroad grade crossings	14	*0%*	-	-
Roadside	396	*7%*	169	*17%*
Roadway	1045	*18%*	256	*25%*
Shoulder treatments	1153	*20%*	55	*5%*
Signs	161	*3%*	36	*4%*
Speed management	167	*3%*	7	*1%*
Transit	27	*0%*	2	*0%*
Work zone	82	*1%*	-	-
Total	**5805**	***100%***	**1022**	***100%***

Note: Table was made based on data retrieved on July 11 2017.

While the SPFs in the HSM were developed directly for motor vehicles and prediction of the pedestrian and bicycle crashes were limited to some coefficients, some researchers have investigated the applicability and expansion of the HSM methodology in prediction of pedestrian and bicycle crashes.

Siddique, Bish and Salyer (2017) used the predictive method presented in the Part C of the HSM to predict vehicle-pedestrian and vehicle-bicycle crashes and used predicted crashes to perform cost-effectiveness analysis. They used $N_{Predicted}$ and then applied associated coefficients to calculate pedestrian and bicycle crashes. Watkins et al. (2016) investigated CMFs (HSM-style) and its data needs, applicability in Georgia and compared it with other methods (e.g., case-control); however, data review revealed that due to insufficient exposure and underreported crashes for pedestrian and bicycle, the HSM approach should be postponed to future.

One of the key components in analysis of pedestrian and bicyclist safety is the flow of pedestrians and bicyclists that will contribute in safety assessments. Having reliable pedestrians and bicyclists volume will assist in calculating crash rates and make for much more meaningful comparisons; however, one of the challenges is identifying the number of people who are at risk of being in a crash (Bassil, et al. 2015). Due to availability of data, bicyclists flow was included in a study in The Netherlands. The flows of motor vehicles and bicyclists are important predictors of bicycle crashes and literature has indicated that effects of other factors in prediction might be minor because traffic flows can explain largely the systematic variation in accident frequency (Schepers, et al. 2011).

Lack of exposure, sometimes forces the researchers to exclude pedestrian or bicycle volume from the modeling process. Hamann et al. (2015) conducted their epidemiology and spatial examination of bicycle-motor vehicle crashes in Iowa based on bicycle crash characteristics, persons, vehicle and environment, zip code information, etc. and Welch, Zhang and Jiao (2017) also performed their analysis of identification of factors explaining pedestrian crash severity without exposure.

However, some researchers have found solutions by considering an exposure for a region (such as census block group or census tract) in their studies. Application of Transportation Tomorrow Survey, 2001, 2006 and 2011 (City level) was used in a Toronto study (Bassil, et al. 2015). Alluri et al. (2017) used bicycle activity data (a category field) for each segment and intersection based on 2014 Strava dataset at census block group level in their study of analysis of bicycle crashes.

Decision Trees

Data mining methods have been also applied in safety classification and analysis and one of the data mining methods to classify systems based on multiple covariates or to predict for a target variable is decision tree. The procedure classifies the population into an inverted tree-like interaction of a root node, internal nodes, and leaf nodes through a non-parametric algorithm. The methodology includes a built-in validation process that optimizes the tree size. The frequently used techniques are Classification and Regression Trees (CART), Chi-square Automatic Interaction Detection (CHAID), and Quick, Unbiased and Efficient Statistical Tree (QUEST) and the popular programs are IBM SPSS, SAS, and R packages. Common applications of decision trees are as follows (Song and Lu 2015):

- Variable selection
- Assessing the relative importance of variables
- Handling of missing values
- Prediction
- Data manipulation

Decisions trees are capable of determining the most “important" (based on explanatory power) variables in a particular dataset and can also help researchers to craft an effective explanatory model. The process is mathematically identical to certain familiar regression techniques (such as GLM[1] and GAM[2]); however, the representation of the data is in a way that can be interpreted by both professional and nonprofessional audience (Morgan 2014). The main components of a decision tree model are nodes and branches and the most important steps in building a model are

[1] Generalized Linear Models

[2] Generalized Additive Models

splitting, stopping, and pruning (Song and Lu 2015). The algorithms are developed by recursively partitioning the data space and fitting a simple prediction model within each partition. Consequently, the partitioning is usually represented graphically as a decision tree (Loh 2011).

Application of decision trees such as CART in road safety dates back to more than two decades ago; Stewart (1996) reviewed the CART procedure and its application as a classifier and as a regression model to highway safety analyses through some application examples. Many other researchers have also used decision trees in their safety studies; CART by (Montella, et al. 2012, Abellán, López and Juan 2013, Chang and Chien 2013) and CHAID by (Badea-Romero and Lenard 2013, Prati, Pietrantoni and Fraboni 2017, Mohamadi Hezaveh, AzadDisfany and Cherry 2018).

Findings

Multiple factors are contributing in pedestrian-involved or bicycle-involved crashes such as behavioral factors (pedestrian, bicyclist, and driver), vehicle factors, environmental factors, and roadway factors (Snyder and Knoblauch 1971, Cross and Fisher 1977, Rumar 1985, Spainhour, et al. 2006, SafetyNet 2009). Considering a single contributing factor is too simplistic and naïve; however, the following issues have limited sophisticated causal analysis of pedestrian and bicycle crashes (Schepers and Wolt 2012, Schneider and Stefanich 2015, Watkins, et al. 2016)

- Unreported crashes (especially for single bicycle crashes)
- Lack of exposure data
- Injury severity levels recorded by law enforcement officers

Due to aforementioned issues and challenges, using NHTSA crash typology or similar approaches have been widely used in analysis of pedestrian and bicycle crashes. Table 9 summarizes the past studies.

While Schneider and Stefanich (2015, 2016) emphasized that their LMCM methodology captures the location and movement of involved parties better than NHTSA crash types, there are such considerations (nearside/far side and vehicle approach) available in “Pedestrian Location Scenarios” for pedestrian crashes occurred at intersections (Harkey, et al. 2006). Moreover, traffic control seems an important attribute in crash types and associated countermeasures that is not included in the LMCM methodology. Clear linkage to appropriate countermeasures is a practical key that LMCM still needs to acquire.

Table 9. Summary of Crash Typology Studies

Document Title/Source	US State / Country	Publication Year	Study Data Period	Population Size	# Pedestrian Crashes	# Bicycle Crashes	Pedestrian Crash Typology	Bicycle Crash Typology
An Analysis of Fatal Bicycle Accidents in Victoria (Australia) With a Special Reference to Nighttime Accidents (Hoque 1990)	Australia	1990	1981 - 1984	All fatal bicycle crashes	-	122 (All)	-	NHTSA (old version)
Fatal Pedestrian Accidents in France: A Typological Analysis (Fontaine and Gourlet 1997)	France	1997	1990 - 1991	1367	1289 (78 unavailable police reports)	-	Multiple characteristics, actions, and locations	-
Bicycle - Motor vehicle Crashes in Chapel Hill A Typology and Analysis of Police-Reported Crashes Spanning A Four-Year Period (Pein 2000)	NC	2000	1996 - 1999	All bicycle crashes	-	86 (All)	-	Slightly modified NHTSA crash types
Pedestrian crashes in Washington, DC and Baltimore (Preusser and JoAnn K. Wells 2002)	DC, MD	2002	1998	All police reports	DC: 852 (All) Baltimore: 1234 (All)	-	NHTSA	-
City of Toronto Bicycle/Motor-Vehicle Collision Study (Transportation Services Division 2003)	Canada	2003	1997 - 1998	All police reports	-	2572 (All)	-	Adapted from NHTSA crash types
Study of the causes of pedestrian accidents by severity (Kouabenan and Guyot 2004)	Ivory Coast	2004	Two consecutive years	Unknown	55 reports of actual pedestrian accidents randomly selected from police records	-	Three different methods to analyze pedestrian crash data: quantitative analysis, causality-tree	-

Document Title/Source	US State / Country	Publication Year	Study Data Period	Population Size	# Pedestrian Crashes	# Bicycle Crashes	Pedestrian Crash Typology	Bicycle Crash Typology
							analysis, and an analysis of the spontaneous causal explanations given by the involved persons.	
Causative Factors and Trends in Florida Pedestrian Crashes (Spainhour, et al. 2006)	FL	2006	1998 - 2000	All fatal pedestrian crashes	353 (All)	-	Modified NHTSA crash types by a grouping of crash types	-
Orlando Area Bicyclist Crash Study: A Role-Based Approach to Crash Countermeasures (Wilson n.d.)	FL	?	2003 - 2004	All bicycle crashes	-	885 (All)	-	PBCAT (NHTSA)
Bicycle Crash Analysis for Wisconsin using a Crash Typing Tool (PBCAT) and Geographic Information System (GIS)	WI	2006	Urban: 2003 Rural: 2002 - 2004	All bicycle crashes	-	1165 (All)	-	PBCAT (NHTSA)
City of Toronto Pedestrian Collision Study (Transportation Services Division 2007)	Canada	2007	2002 - 2003	All police reports	4775 (All)	-	Adapted from NHTSA crash types	-
Magnitude and Categories of Pedestrian Fatalities in South Africa (Mabunda, Swart and Seedat 2008)	South Africa	2008	2001 - 2004	All fatal pedestrian crashes	7433 (All)	-		-
Pedestrian Safety Action Plan (Kimley-Horn and Associates, Inc. 2009)	AZ	2009	2002 - 2006	771 pedestrian crashes on	283 (segment crashes) 37 (interchange	-	PBCAT (NHTSA)	-

Document Title/Source	US State / Country	Publication Year	Study Data Period	Population Size	# Pedestrian Crashes	# Bicycle Crashes	Pedestrian Crash Typology	Bicycle Crash Typology
				state highways (out of 8,033 pedestrian crashes)	crashes) (Locations with high pedestrian crashes only)			
Hillsborough Countywide Bicycle Safety Action Plan (Florida Department of Transportation (FDOT) 2011)	FL	2011	2005 - 2009	All bicycle crashes	-	2430 (All)	-	PBCAT (NHTSA)
Mapping patterns of pedestrian fatal accidents in Israel (Prato, Gitelman and Bekhor 2012)	Israel	2012	2003 - 2006	All fatal pedestrian crashes	603	-	Multiple characteristics, actions, locations, and Kohonen neural networks	-
Bicycle Safety Action Plan (Kimley-Horn and Associates, Inc. 2012)	AZ	2012	2004 – 2008	1089 bicycle crashes on state highways (out of 9,867 bicycle crashes)	-	746 in focus area crashes	-	PBCAT (NHTSA)
Safe Streets Boulder Striving to Make Boulder Streets Even Safer (GO Boulder 2012)	CO	2012	2008 - 2011	All police reports: 727 Final dataset (Non-motor vehicle crashes were	151 14 (skateboarders)	516	PBCAT (NHTSA)	PBCAT (NHTSA)

Document Title/Source	US State / Country	Publication Year	Study Data Period	Population Size	# Pedestrian Crashes	# Bicycle Crashes	Pedestrian Crash Typology	Bicycle Crash Typology
				excluded): 681				
BICYCLE/PEDESTRIAN Safety Plan Update (Kimley-Horn and Associates, Inc. 2014)	FL	2014	2010 - 2011	Unknown	-	A random sample	-	NHTSA
Bicycle Crash Fact Sheet City of Cambridge, MA (Parenti 2014)	MA	2014	2004 - 2012	Unknown	-	Unknown	-	CamRA categorizes each bicycle crash by type; right hook, left hook, door, rear end, angle, head-on, and side swipe.
North Carolina Bicycle Crash Types 2008 - 2012 (Thomas and Levitt 2014)	NC	2014	2008 - 2012	All bicycle crashes	-	4889 (All)	-	PBCAT (NHTSA)
North Carolina Pedestrian Crash Types 2008 - 2012 (Thomas, Levitt and Farley 2014)	NC	2014	2008 - 2012	All pedestrian crashes	13186 (All)	-	PBCAT (NHTSA)	-
Pedestrian and Cyclist Safety in Toronto (Bassil, et al. 2015)	Canada	2015	2008 - 2012	All pedestrian crashes	10,288 (All)	-	Adapted from NHTSA crash types	-
Wisconsin Pedestrian and Bicycle Crash Analysis: 2011-2013 Final Draft (Schneider and Stefanich 2015)	WI	2015	2011 - 2013	Bicycle crashes: 3365 Pedestrian crashes: 4857	296	229	NHTSA Location-Movement Classification Method (LMCM)	NHTSA Location-Movement Classification Method (LMCM)
Bicycle Crash Analysis Understanding and Reducing	CO	2016	2008 - 2012	All bicycle crashes	-	All	-	1- Broadside 2- Motorist

Document Title/Source	US State / Country	Publication Year	Study Data Period	Population Size	# Pedestrian Crashes	# Bicycle Crashes	Pedestrian Crash Typology	Bicycle Crash Typology
Bicycle & Motor Vehicle Crashes (Denver Public Works 2016)								Approaching Turn 3- Motorist Overtaking Turn 4- Bicycling Approaching Turn 5- Bicyclist Overtaking Turn, Rear End 6- Sideswipe 7- Dooring 8- Unknown

DATA

In this chapter, the crash data (PD-10 forms and geocoded data) and roadway and intersection data (mostly in geocoded format) are summarized. The process of digitizing the PDF formats of police reports (PD-10 forms) is explained. Six students reviewed digitized crashes and selected appropriate values for the NHTSA PBCAT crash types, groups, LMCM crash types, and some other information. The final pedestrian and bicycle crashes in the desired period (2012-14) are summarized.

Crash Data

Crash data consists of police reports (PD-10 forms) and geocoded crash data.

PD-10 Forms

As it was stated earlier (in "Structure of Crash Data in DDOT"), police officers record crash data onsite in PD-10 forms that will be stored electronically in TARAS database with PDF outputs (Figure 21). While PDF is good to store and share information but it is not as good as other formats to review and analyze the data so the next section summarizes some tools to extract data or convert PDF to other formats.

At the time of this study, PD-10 forms were available and accessible from 2010 to middle of 2015 (August) and couple of months in the first half of 2016. The discontinuation was due to PD-10 forms schema change. Thus, the study team selected three full years of crash data from 2012 – 2014 to have sufficient data for analysis and account for seasonal changes.

PD10 For DDOT Internal Use Only

TRAFFIC CRASH REPORT

CCN: 13104814

1 Date of Crash	2 Time of Crash	3 Day of Week	4 Date of Report	5 Complaint Number (CCN)	6 UCC Number
7/26/2013	1730	Friday	7/26/2013	13104814	20130377026

7 Type of Crash (Check all that apply)	8 Location	9 District	10 PSA
[ ]01 Fatality [x]02 Injury [ ]03 Prop. Damage [x]04 Hit&Run [x]05 Pedestrian [ ]06 DC Prop [ ]07 Non-Collision [ ]08 Comm. Veh [ ]99 Other	15th St Nw & Columbia Rd Nw	3	302

Enter the number of feet, in whatever direction, from the nearest intersection or block (0 feet if at on exact location). On freeways, enter the number of feet from th nearest mile post or PEPCO pole no., etc. Indicate if accident occured on exit ramp, bridge, tunnel or other. Finally, circle the city quadrant.

11 Location Type and Name ________ Feet ________ from Intersection/Block: ________ Freeway Mile Post: ________

PEPCO Pole No.: ________ Exit Ramp: ________ Bridge: ________ Tunnel: ________

Other: City Quadrant: NW

12 Construction Zone?	13 On-Street Location	14 Off-Street Location	15 Report taken on Scene?
N	[ ]01 At Intersection [ ]02 Within 100' of Intersection [x]03 Not at Intersection [ ]04 Private Property [ ]97 N/A [ ]99 Other	[ ]01 Public Space [ ]02 Private Property [x]97 N/A [ ]99 Other	Y

16 Photos taken?	16a If yes, # photos	17 # Vehicles Involved	18 # Injured Persons	19a-d # Occupants (Including driver)	20 Fatalities
N	0	2	1	Vehicle # 1: 1 2: 3: 4:	0

189 Type of Crash	190 Road Surface	191 Road Type
19	Asphalt	Straight
192 Road Condition	**193 Street Lighting**	**194 Light Condition**
Dry	Street Lights Off	Daylight
195 Weather	**196 Traffic Condition**	**197 Roadway Type**
Clear	Unknown	Unknown
198 Traffic Controls	**199 Pedestrian Action**	
Unknown	Unknown	

STRIKING OBJECT (TYPE, CONTACT INFO, INSURANCE, ETC.)

21 OBJECT TYPE (*Describe fixed object and damage in narrative*)
[ ]01 Driver [ ]02 Pedestrian [x]03 Bicyclist [ ]04 Parked Car [ ]05 Animal [ ]06 Other Fixed Object [ ]97 N/A [ ]99 Other

22 Last Name, First Name, Middle Name	23 Sex	24 DOB
	M	1/9/1993

25 Street Address	26 City, State, Zip
27 Home/Cell Number	**28 Work Number**

29 License Number	30 State	31 Class	32 Ins Exp Date
	UN	0	

33 Driver's Insurance Co. Name	34 Policy #

35 Make	36 Made	37 Year	38 Body	39 Color
UNKNOWN	UNKNOWN		N/A	Black

40 Vehicle ID Number (VIN)

41 Tag number	42 State	43 Year
	UN	

44 Owner's Last Name, First Name, Middle Name	45 Owner Notified?
	Y

46 Owner's Street Address	47 City, State, Zip
48 Owner's Telephone #	**49 Veh. Insurance Company**

STRIKING OBJECT (TYPE, CONTACT INFO, INSURANCE, ETC.)

50 OBJECT TYPE (*Describe fixed object and damage in narrative*)
[ ]01 Driver [ ]02 Pedestrian [ ]03 Bicyclist [ ]04 Parked Car [ ]05 Animal [ ]06 Other Fixed Object [ ]97 N/A [x]99 Other: Car

51 Last Name, First Name, Middle Name	52 Sex	53 DOB

54 Street Address	55 City, State, Zip
56 Home/Cell Number	**57 Work Number**

58 License Number	59 State	60 Class	61 Ins Exp Date
	UN	0	

62 Driver's Insurance Co. Name	63 Policy #

64 Make	65 Made	66 Year	67 Body	68 Color
MAZD	TRI	2003	SUV	Tan

69 Vehicle ID Number (VIN)

70 Tag number	71 State	72 Year
EE1364	DC	

73 Owner's Last Name, First Name, Middle Name	74 Owner Notified?

75 Owner's Street Address	76 City, State, Zip
77 Owner's Telephone #	**78 Veh. Insurance Company**

Generated at 7/18/2017 2:31:02 PM

1 of 3

Figure 21. A Filled PD-10 Form Sample

Review of PDF Extraction Tools

There are a variety of online and offline tools to extract data, text, and tables from PDFs or convert them into other formats such as Word or Excel. Some are free but some are working on the one-time fee basis or periodical intervals (e.g., monthly or yearly). Table 10 summarizes some available tools and their advantages and disadvantages. Some tools are online and data should be uploaded on a website for processing while some tools can be installed on a computer and data processing can be done locally. Some online tools can store data on cloud-based servers and data can be accessed elsewhere. Among the reviewed tools, some require familiarity with certain programming languages such as PHP, Java, and Python (e.g., Apache PDFBox®, Apache Tike, DocSplit, and PDF Parser) to enhance the process with automation. Majority of online tools are paid or have limited functionality for their free or trial versions; however, working with online tools are easier than offline tools. Some tools produce disordered outputs that mainly are just converted PDFs into Word documents or Excel tables which require extensive post-processing efforts to create organized datasets.

Table 10. Comparison of PDF Extraction Tools

					Pros				Cons			
Tool	**Link**	**Function**	**Offline (Installable)**	**Online**	**Free**	**Easy to Use**	**Automation**	**Minor Post-processing**	**Paid**	**Hard to Use**	**Messy Output**	**Major Post-processing**
Able2extract professional	https://www.investintech.com/order_main.htm	PDF to Excel	✓			✓			✓		✓	✓
Apache PDFBox®	https://pdfbox.apache.org/	Multi-function (command-line)	✓		✓		✓	✓		✓		
Apache Tike	https://tika.apache.org/	Content analysis toolkit (command-line)	✓		✓		✓	✓		✓		
DocParser	http://www.docparser.com	Multi-function		✓		✓	✓	✓	✓			
DocSplit	http://documentcloud.github.io/docsplit/	Multi-function (command-line)	✓		✓		✓	✓		✓		
Free Online OCR	http://www.newocr.com/	Optical Character Recognition (OCR) tool		✓	✓	✓					✓	✓
PDF Data Extractor	http://www.traction-software.co.uk/pdfdataextractor/	Multi-function	✓						✓	✓	✓	✓
PDF Parser	https://www.pdfparser.org/	Multi-function (command-line)	✓		✓		✓	✓		✓		
PDF to Excel	https://www.pdftoexcel.com/	PDF to Excel		✓	✓	✓					✓	✓
PDFMiner	http://www.unixuser.org/~euske/python/pdfminer/	Multi-function (command-line)	✓		✓		✓	✓		✓		
PDFTables	https://pdftables.com	Converting PDF to Excel		✓		✓			✓		✓	✓
Tabstract	http://www.tabstract.io	Table extractor		✓		✓			✓		✓	✓
Tabula	http://tabula.technology/	Data/table extraction tool	✓		✓	✓						✓

Application of DocParser to Convert PD-10 Forms into Excel Spreadsheets

DocParser seems the best option because it can convert PDFs into structured and organized datasets automatically and minor coding expertise is needed. There are different templates in the tool to pull out specific data fields (number, text, address, table, date, etc.). It can also capture values that occur multiple times in a document (this feature is helpful in case of PD-10 form that contains many repeating data items) and using Optical Character Recognition (OCR) can handle scanned documents. Parsed data can be sent to other applications (e.g., Google Spreadsheets) or downloaded in Excel, CSV, JSON, or XML formats. Depending on the data structure in PDFs, parsing rules can be customized to extract data and minimize post-processing work on parsed data. Moreover, it can batch the processing of multiple files. Once parsing rules are set up (some examples are shown in Figure 22 and Figure 23), working with PDF documents (i.e., PD-10 forms) and extracting the relevant data is swift. However, some data items have had multiple stages to get ready for parsing; for example, blank lines were removed in the process of "Detailed Narrative" (Figure 24). In the output of the DocParser each row represents once single PD-10 form. Altogether, parsing rules were designed for 89 data fields of PD-10 form (details are provided in "Appendix E - Parsing Rules for PD-10 Form Data Items").

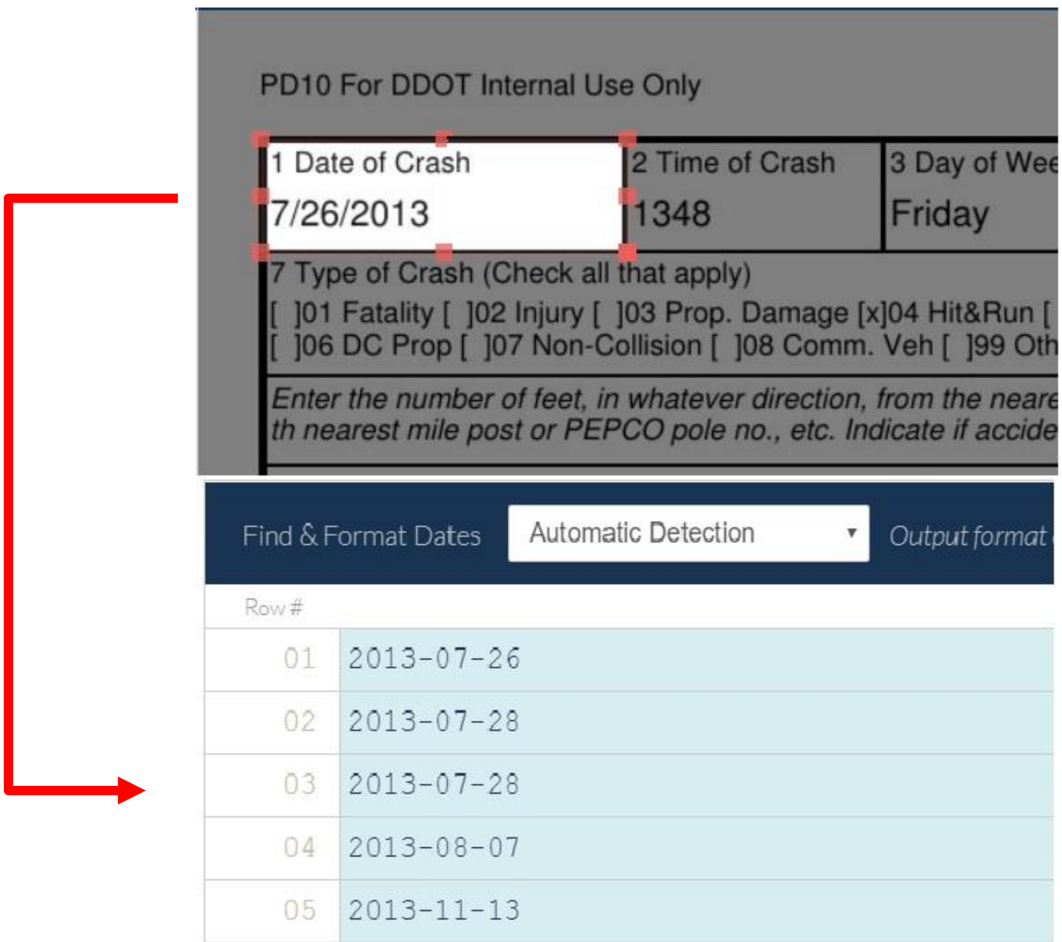


Figure 22. Parsing Rule to Extract "Date of Crash" in DocParser Environment

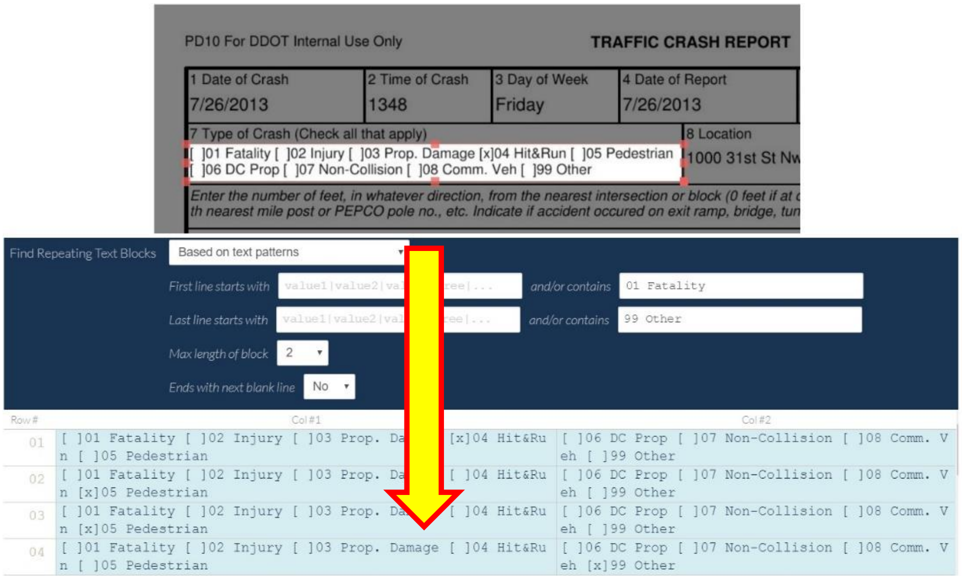


Figure 23. Parsing Rule to Extract "Type of Crash" in DocParser Environment

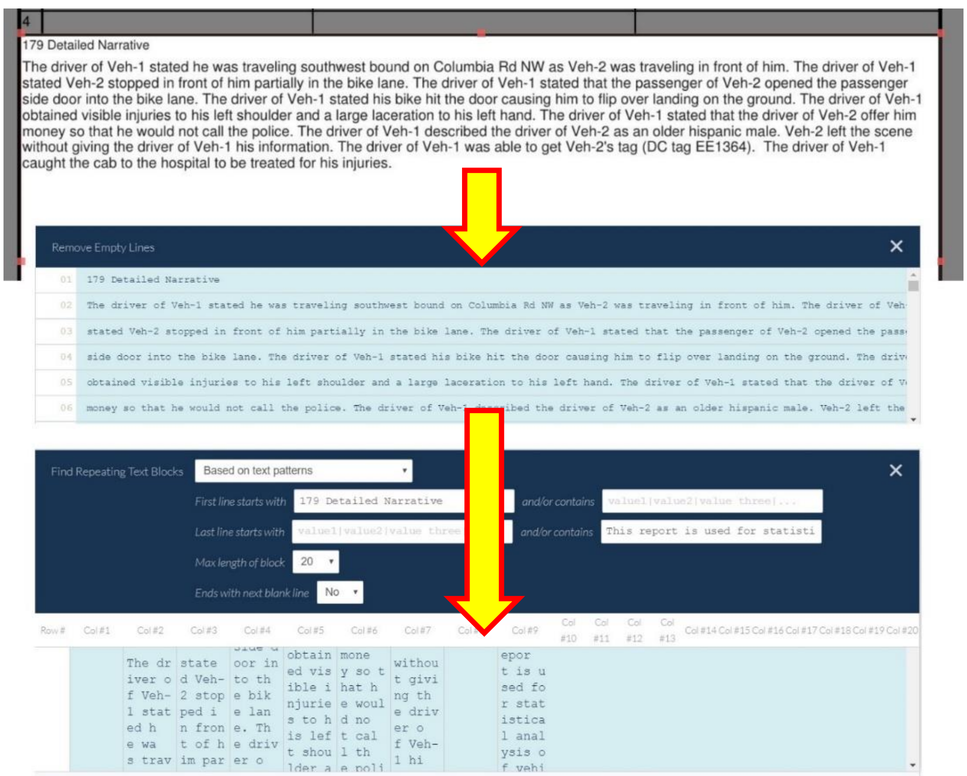


Figure 24. Parsing Rule to Extract "Detailed Narrative" in DocParser Environment

DocParser is an online tool that requires paid subscription for usage (various monthly and yearly options depending on the workload volume). DocParser has a limit on the number of documents can be processed per month (depending on the subscription plan) and each document has limits on page number (maximum 40 pages) and size (maximum 8 MB). Considering all of these limits and desired 2012 – 2014 period, the original PDF files that were received from DDOT were split into multiple smaller files to meet the tool limitations. After splitting crash data PDFs into maximum 39 pages files, they were uploaded on DocParser and then using the previously developed parsing rules, desirable data fields were extracted from PD-10 forms. After parsing crash data, further dataset cleaning and post-processing were needed on the parsed data that are summarized in “Appendix F – DocParser Dataset Cleaning and Post-processing Steps.”

There were 288 pairs of pedestrian and bicycle crashes (based on the files received from Howard University) with identical CCNs (Crash Complaint Number) for all received crash data, this number was 172 for 2012-14. Those crashes were identical crashes but probably due to the queries, showed up in both pedestrian and bicycle crashes. All bicycle crashes with duplicate CCNs were deleted (288 crashes). In the following steps of the study, all crashes will be reviewed for final crash type identification (either pedestrian or bicycle or both in rare cases).

Geocoded Crash Data

Shapefiles of crash data, roadway segments, and intersection points were also downloaded from DC Open Data (DC.GOV 2016) and later the crash data were converted into KML format to be superimposed on Google Earth for reviewing locations of crashes while reviewing the crash reports and narratives (Figure 25). Moreover, buffers were generated with radii of 50 ft. and 100 ft. for each intersection to allow review of crashes that happened “Within 100’ of Intersection” based on the PD-10 crash reports.

Figure 25. Crash Data in ArcGIS & Crash Data and Intersection Buffers in Google Earth

Review of Crash Data

Six students reviewed the original 5,033 pedestrians and bicycles crashes in 2012 – 2014 over a 5 month period (roughly 1,000 crash per month). Students selected appropriate values for the NHTSA PBCAT crash types, groups, LMCM crash types, and some information about the crash scene such as location type (intersection, roadway, and so on), intersection type, traffic control type, fault, distraction, alcohol, and pedestrian or bicyclist positions. At the end of reviews, it revealed that 4,569 crashes can be further analyzed (vehicle-pedestrian (2,599), vehicle-bicycle (1,936), and bicycle-only (34)) based on available NHTSA pedestrian and bicycle crash types; however, separate analysis was done on other pedestrian or bicycle involved crashes (Bicycle-Pedestrian (58), Bicycle-Bicycle (9), and Vehicle-Bicycle&Pedestrian (3)). The 394 crashes with unknown status (blank narrative and other fields of PD-10 form) or those crashes involving neither bicycle nor pedestrian were excluded; less than 8 percent (Figure 26).

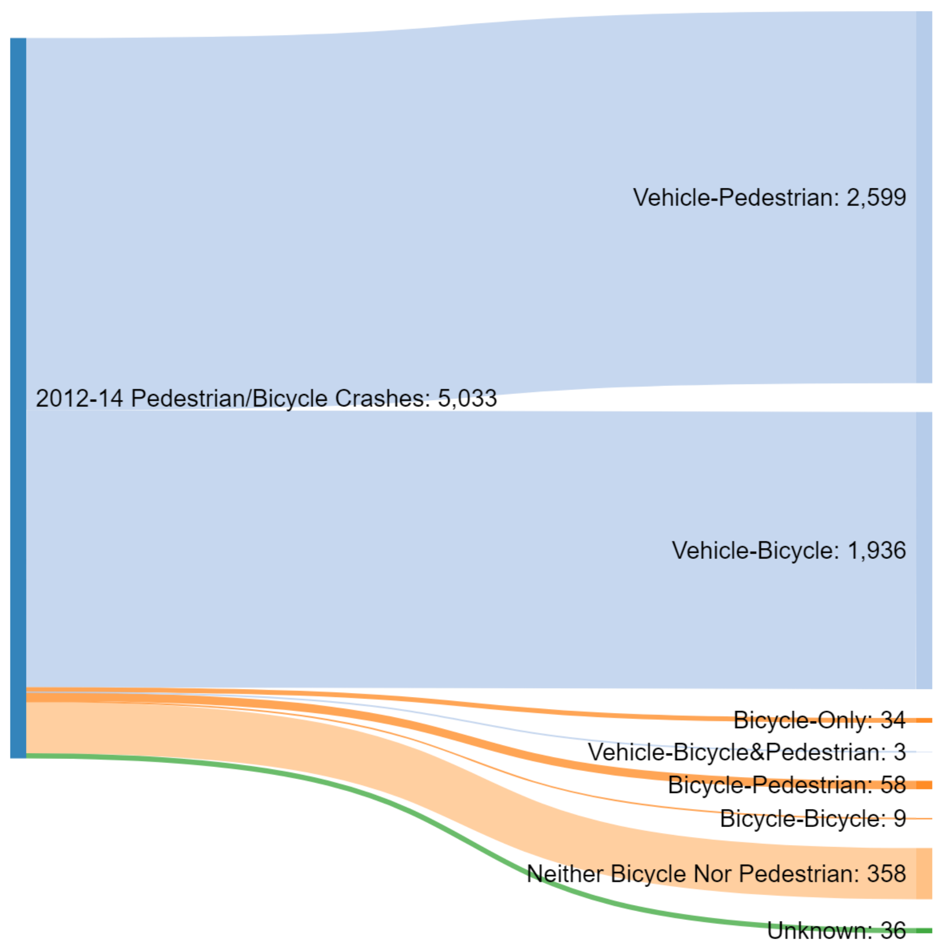


Figure 26. Summary of Original 5,033 Crashes Entitled as Pedestrian or Bicycle Involved Crashes in Washington, DC (2012-14)

After finishing the review of all crashes, the dataset was merged with GIS data and some additional variables were added to each individual crash including associated "INTGISID" for intersections and "STREETSEGID" for roadway segments. The data dictionary for final dataset is presented in "Appendix G – Data Dictionary." Some special crash narratives that included some altercation and other weird interactions between involved parties at crash scenes are listed in “*Appendix H – Some Special Crash Narratives*.”

Crash Data Review Challenges

The main challenges for reviewers for some crashes were as follows:

- Difficulty to determine the location and/or direction of pedestrian or bicyclist or vehicle
- Lack of information about nearside or farside of intersections (especially for pedestrian location scenarios and LMCM intersection crashes)
- Lack of appropriate options for NHTSA or LMCM crash types
- Visualizing some crash scenes because of lack of crash diagrams
- Unclear status of fault
- Unclear status of crash severity

Crash Data Review Notes

After reviewing all crashes, some issues were identified that were summarized in following tables. For 163 crashes (3.24%), the police reports did not have sufficient information about the crash severity. For 368 (7.31%) crashes, the geocoded location did (or seemed) not mactch the crash address stored in the PD-10 form. In about 1.4% of crashes the police officers considered bicyclists as pedestrians.

Table 11. Crash Severity Notes

Crash Severity Notes	Count	%
None	4847	96.30%
Inconsistency between "Crash Narrative" and "205 Injury Code 1-4"	23	0.46%
Insufficient information for crash severity.	163	3.24%
Total	**5033**	**100.00%**

Table 12. Crash Location Notes

Crash Location Notes	Count	%
None	4596	91.32%
Insufficient information for crash location.	48	0.95%
Insufficient information for distance to intersection (50 ft. or 100 ft.).	3	0.06%
Location is incorrect on Google Earth.	239	4.75%
Location seems incorrect on Google Earth.	129	2.56%
The address on "8 [Crash] Location" does not match the location on Google Earth.	18	0.36%
Total	**5033**	**100.00%**

Table 13. Intersection-related Notes

Intersection Type / Control Type Notes	Count	%
None	5021	99.76%
Insufficient information for intersection type and control type.	4	0.08%
Insufficient information for intersection type.	8	0.16%
Total	**5033**	**100.00%**

Table 14. Crash Category Notes

Crash Category Notes	Count	%
None	4961	98.57%
Officer considered bicycle crash as pedestrian crash.	70	1.39%
Officer considered pedestrian crash as bicycle crash.	2	0.04%
Total	**5033**	**100.00%**

Table 15. Summary of Received Files from DDOT

Received Files	Bicycle-Involved		Pedestrian-Involved		Total	
	Count	**%**	**Count**	**%**	**Count**	%
In Bicycle Files	1822	92.49%	2	0.08%	1824	39.92%
In Pedestrian Files	148	7.51%	2597	99.92%	2745	60.08%
Total	**1970**	**100.00%**	**2599**	**100.00%**	**4569**	**100.00%**

METHODOLOGY

In this study, pedestrian and bicycle crashes of Washington, DC were classified using the NHTSA PBCAT crash typology and recently proposed LMCM classification method. Moreover, two decision trees were developed for pedestrian and bicycle crashes separately for crash severity as dependent variable to identify the main contributing factors in fatal and disabling crashes.

However, as it is indicated on PBCAT download webpage on Pedestrian and Bicycle Information (PBIC) website "*The current version of PBCAT may not be fully compatible with newer operating systems such as Windows 7...* (Federal Highway Administration (FHWA) 2018)", PBCAT is not be fully compatible with newer operating systems such as Windows 7 & 10. Since its functionality was very limited and almost ineffective, the research team contacted the software support team. The support confirmed that the tool is in dire need of updates to be compatible with current operating systems, yet the sponsor of the tool has not been able to fund an update. There is a hope that the tool will be updated in future. To address this issue, the research team reorganized the 56 pedestrian crash types (Table 16) and 79 bicycle crash types (Table 17) based on following considerations of attributes of pedestrian or bicyclist, motorist, and other to simplify the process of reviewing crash reports (police officer narratives) and assigning appropriate crash type:

- Location (intersection, intersection-related, non-intersection, non-roadway, and unknown)
- Type (of vehicle)
- Action / behavior (of pedestrian or bicyclist and motorist)
- Unusual circumstances

Table 16. Reorganized NHTSA PBCAT Pedestrian Crash Types

Pedestrian Crashes		Pedestrian		Motorist		Other	
		Crash Type	Crash Group	Crash Type	Crash Group	Crash Type	Crash Group
Location	General	760: Pedestrian Failed to Yield	750: Crossing Roadway - Vehicle Not Turning	770: Motorist Failed to Yield	750: Crossing Roadway - Vehicle Not Turning	690: Intersection - Other/Unknown	990: Other/Unknown - Insufficient Details
Location	Intersection & Intersection-related	510: Waiting to Cross -Vehicle Turning	500: Waiting to Cross	781: Motorist Left Turn - Parallel Paths 782: Motorist Left Turn - Perpendicular Paths 791: Motorist Right Turn - Parallel Paths 792: Motorist Right Turn on Red - Parallel Paths 794: Motorist Right Turn on Red - Perpendicular Paths 795: Motorist Right Turn - Perpendicular Paths 799: Motorist Turn/Merge—Other/Unknown	790: Crossing Roadway - Vehicle Turning		
Location	Non-Intersection	410: Walking Along Roadway With Traffic - From Behind 420: Walking Along Roadway With Traffic - From Front 430: Walking Along Roadway Against Traffic - From Behind 440: Walking Along Roadway Against Traffic - From Front 459: Walking Along Roadway - Direction/Position Unknown	400: Walking Along Roadway	460: Motorist Entering Driveway or Alley 465: Motorist Exiting Driveway or Alley 469: Driveway Crossing - Other/Unknown	460: Crossing Driveway or Alley	680: Nonintersection - Other/Unknown	990: Other/Unknown - Insufficient Details
Location	Non-Intersection	520: Waiting to Cross - Vehicle Not Turning	500: Waiting to Cross				
Location	Non-Intersection	610: Standing in Roadway 620: Walking in Roadway	600: Pedestrian in Roadway - Circumstances Unknown				
Location	Non-Intersection	910: Crossing an Expressway	910: Crossing Expressway				
Location	Non-Roadway					830: Off Roadway - Parking Lot 890: Off Roadway - Other/Unknown	800: Off Roadway
Location	Unknown	590: Waiting to Cross - Vehicle Action Unknown	500: Waiting to Cross			900 Other - Unknown Location	990: Other/Unknown - Insufficient Details
Vehicle Type		250: Play Vehicle-Related	100: Unusual Circumstances	240: Emergency Vehicle-Related	100: Unusual Circumstances		
Vehicle Type				341: Commercial Bus-Related 342: School Bus-Related	340: Bus-Related		
Action / Behavior		130: Pedestrian on Vehicle 160: Pedestrian Loss of Control	100: Unusual Circumstances	110: Assault with Vehicle 150: Motor Vehicle Loss of Control	100: Unusual Circumstances		
Action / Behavior		311: Working in Roadway 312: Playing in Roadway	310: Working or Playing in Roadway	211: Backing Vehicle - Driveway 212: Backing Vehicle - Driveway/Sidewalk Intersection 213: Backing Vehicle - Roadway 214: Backing Vehicle - Parking Lot 219: Backing Vehicle - Other/Unknown	200: Backing Vehicle		
Action / Behavior		313: Lying in Roadway	600: Pedestrian in Roadway - Circumstances Unknown				
Action / Behavior		320: Entering/Exiting Parked Vehicle 330: Mailbox-Related 360: Ice Cream/Vendor Truck-Related	350: Unique Midblock				
Action / Behavior		710: Multiple Threat 730: Trapped	720: Multiple Threat/Trapped				
Action / Behavior		741: Dash 742: Dart-Out	740: Dash/Dart-Out				
Unusual Circumstances				120: Dispute-Related 140: Vehicle-Vehicle/Object 220: Driverless Vehicle 230: Disabled Vehicle-Related	100: Unusual Circumstances	190: Other Unusual Circumstances	100: Unusual Circumstances

Table 17. Reorganized NHTSA PBCAT Bicycle Crash Types

Bicycle Crashes			Bicyclist		Motorist		Other	
			Crash Type	Crash Group	Crash Type	Crash Group	Crash Type	Crash Group
Location	Intersection & Intersection-related	General	114: Bicyclist Turning Error - Left Turn 115: Bicyclist Turning Error - Right Turn 116: Bicyclist Turning Error - Other	110: Loss of Control/Turning Error	111: Motorist Turning Error - Left Turn 112: Motorist Turning Error - Right Turn 113: Motorist Turning Error - Other	110: Loss of Control/Turning Error	160: Crossing Paths - Uncontrolled Intersection 180: Crossing Paths - Intersection - Other/Unknown Control	190: Crossing Paths - Other Circumstances
		Sign-Controlled	142: Bicyclist Ride-out - Sign-Controlled Intersection 144: Bicyclist Ride Through - Sign-Controlled Intersection 147: Multiple Threat - Sign-Controlled Intersection	145: Bicyclist Failed to Yield - Sign-Controlled Intersection	141: Motorist Drive-out - Sign-Controlled Intersection 143: Motorist Drive-through - Sign-Controlled Intersection	140: Motorist Failed to Yield - Sign-Controlled Intersection	148: Sign-Controlled Intersection - Other/Unknown	190: Crossing Paths - Other Circumstances
		Signalized	153: Bicyclist Ride-out - Signalized Intersection 155: Bicyclist Ride Through - Signalized Intersection 156: Bicyclist Failed to Clear - Trapped 157: Bicyclist Failed to Clear - Multiple Threat 159: Bicyclist Failed to Clear - Unknown	158: Bicyclist Failed to Yield - Signalized Intersection	151: Motorist Drive-out - Right Turn on Red 152: Motorist Drive-out - Signalized Intersection 154: Motorist Drive-through - Signalized Intersection	150: Motorist Failed to Yield—Signalized Intersection	158: Signalized Intersection - Other/Unknown	190: Crossing Paths - Other Circumstances
					217: Motorist Right Turn on Red - Same Direction 218: Motorist Right Turn on Red - Opposite Direction	215: Motorist Right Turn/Merge		
	Non-Intersection		225: Bicyclist Ride-out - Parallel Path	290: Parallel Paths - Other Circumstances	215: Motorist Drive-In/Out Parking	219: Parking/Bus-Related	280: Parallel Paths - Other/Unknown	290: Parallel Paths - Other Circumstances
			311: Bicyclist Ride-out - Residential Driveway 312: Bicyclist Ride-out - Commercial Driveway/Alley 318: Bicyclist Ride-out - Other Midblock 319: Bicyclist Ride-out - Midblock—Unknown 357: Multiple Threat - Midblock	310: Bicyclist Failed to Yield - Midblock	321: Motorist Drive-out - Residential Driveway 322: Motorist Drive-out - Commercial Driveway/Alley 328: Motorist Drive-out - Other Midblock 329: Motorist Drive-out - Midblock - Unknown	320: Motorist Failed to Yield - Midblock	380: Crossing Paths - Midblock - Other/Unknown	190: Crossing Paths - Other Circumstances
	Non-Roadway						910: Nonroadway	910: Nonroadway
	Unknown						970: Unknown Approach Paths 980: Unknown Location	990: Other/Unknown - Insufficient Details
Vehicle Type			400: Bicycle Only	850: Other/Unusual Circumstances	216: Bus/Delivery Vehicle Pullover	219: Parking/Bus-Related		
Action / Behavior			121: Bicyclist Lost Control - Mechanical problems 122: Bicyclist Lost Control - Oversteering, Improper Braking, Speed 123: Bicyclist Lost Control - Alcohol/Drug Impairment 124: Bicyclist Lost Control - Surface Conditions 129: Bicyclist Lost Control - Other/Unknown	110: Loss of Control/Turning Error	131: Motorist Lost Control - Mechanical problems 132: Motorist Lost Control - Oversteering, Improper Braking, Speed 133: Motorist Lost Control - Alcohol/Drug Impairment 134: Motorist Lost Control - Surface Conditions 139: Motorist Lost Control - Other/Unknown	110: Loss of Control/Turning Error	259: Head-On - Unknown	258: Head-On
			221: Bicyclist Left Turn - Same Direction 222: Bicyclist Left Turn - Opposite Direction	220: Bicyclist Left Turn/Merge	211: Motorist Left Turn - Same Direction 212: Motorist Left Turn - Opposite Direction	210: Motorist Left Turn/Merge		
			223: Bicyclist Right Turn - Same Direction 224: Bicyclist Right Turn - Opposite Direction	225: Bicyclist Right Turn/Merge	213: Motorist Right Turn - Same Direction 214: Motorist Right Turn - Opposite Direction	215: Motorist Right Turn/Merge		
			241: Bicyclist Overtaking - Passing on Right 242: Bicyclist Overtaking - Passing on Left 243: Bicyclist Overtaking - Parked Vehicle 244: Bicyclist Overtaking - Extended Door 249: Bicyclist Overtaking - Other/Unknown	240: Bicyclist Overtaking Motorist	231: Motorist Overtaking - Undetected Bicyclist 232: Motorist Overtaking - Misjudged Space 235: Motorist Overtaking - Bicyclist Swerved 239: Motorist Overtaking - Other/ Unknown	230: Motorist Overtaking Bicyclist		
			250: Head-On - Bicyclist	258: Head-On	255: Head-On - Motorist	258: Head-On		
			520: Bicyclist Intentionally Caused	850: Other/Unusual Circumstances	219: Motorist Turn/Merge - Other/Unknown	290: Parallel Paths - Other Circumstances		
					510: Motorist Intentionally Caused	850: Other/Unusual Circumstances		
					600: Backing Vehicle	600: Backing Vehicle		
Unusual Circumstances					700: Play Vehicle-Related	850: Other/Unusual Circumstances	800: Unusual Circumstances	850: Other/Unusual Circumstances

In addition, some additional values were added to the LMCM methodology to prevent some crashes to be classified as other (“OTH”):

- Intersection crashes:
    - Using X (as unknown) when there is insufficient information regarding the location of the crash (neither nearside or farside)
    - Using X (as unknown) when the movement of vehicle is backward or unknown
- Non-intersection crashes: in case of insufficient information using RD (roadway), SH (shoulder), and SW (sidewalk) when side of the roadway is unknown or unclear.
- F (forward), B (backward), and X (Unknown)
- Parking lot or private property: in case of insufficient information about the movement of vehicle using X (as unknown)

ANALYSIS

This section includes the in-detail analysis of pedestrian and bicycle crashes in Washington, DC (2012-14). The digitized crashes were examined based on locational and temporal characteristics, and severity level. Characteristics of drivers and pedestrians or bicyclists were also studied at aggregate level. Two special fields of PD-10 forms were also assessed regarding to potential improvements to capture attributes of bicycle crashes.

It should be noted that "**Sig.**" in the following tables demonstrates the result of a Z-test of the difference between two proportions. In majority of tables, the two proportions are proportion of bicycle crashes versus proportion of pedestrian crashes for a particular value of associated variable:

- +++ = proportion of bicycle crashes is significantly higher than proportion of pedestrian crashes at 99% confidence level;
- ++ = proportion of bicycle crashes is significantly higher than proportion of pedestrian crashes at 95% confidence level;
- + = proportion of bicycle crashes is significantly higher than proportion of pedestrian crashes at 90% confidence level;
- --- = proportion of bicycle crashes is significantly lower than proportion of pedestrian crashes at 99% confidence level;
- -- = proportion of bicycle crashes is significantly lower than proportion of pedestrian crashes at 95% confidence level;
- - = proportion of bicycle crashes is significantly lower than proportion of pedestrian crashes at 90% confidence level;
- Blank = proportion of bicycle crashes is not significantly different from proportion of pedestrian crashes.

Example: the value of **Sig.** is "+++" in Table 20 (*Summary of Crashes by Crash Location*) for "Road Crash" so it indicates that the proportion of bicycle-involved crashes on roadway segments (31.98%) was significantly higher than proportion of pedestrian-involved crashes (24.09%) at 99% confidence level.

In some other tables, the two proportions are proportion of fatal and disabling crashes (K & A in KABCO scale) versus proportion of other crash severity levels (B, C, O, and U in KABCO scale) for a particular value of associated variable:

- +++ = proportion of fatal and disabling crashes is significantly higher than proportion of other crashes at 99% confidence level;
- ++ = proportion of fatal and disabling crashes is significantly higher than proportion of other crashes at 95% confidence level;
- + = proportion of fatal and disabling crashes is significantly higher than proportion of other crashes at 90% confidence level;
- --- = proportion of fatal and disabling crashes is significantly lower than proportion of other crashes at 99% confidence level;
- -- = proportion of fatal and disabling crashes is significantly lower than proportion of other crashes at 95% confidence level;

- \- = proportion of fatal and disabling crashes is significantly lower than proportion of other crashes at 90% confidence level;
- Blank = proportion of fatal and disabling crashes is not significantly different from proportion of other crashes.

Example: the value of **Sig.** is "+++" in Table 64 (*Summary of Pedestrian Crashes by Fault / Violation & Severity Level*) for "Pedestrian" so it indicates that when pedestrians were at fault / violation the proportion of fatal and disabling crashes (34.71%) was significantly higher than proportion of other crash severity levels (26.09%) at 99% confidence level.

NHTSA Pedestrian and Bicycle Crashes

Figure 27 demonstrates the geographical distribution of pedestrian and bicycle crashes in Washington, DC (2012-14). Crashes happened more in the NW city quadrant. In this section, the pedestrian (vehicle-pedestrian) and bicycle crashes (vehicle-bicycle and bicycle-only) are examined from following aspects:

- Crash location characteristics
- Crash time characteristics
- Crash severity levels
- Driver and Pedestrian/Bicyclist's Characteristics

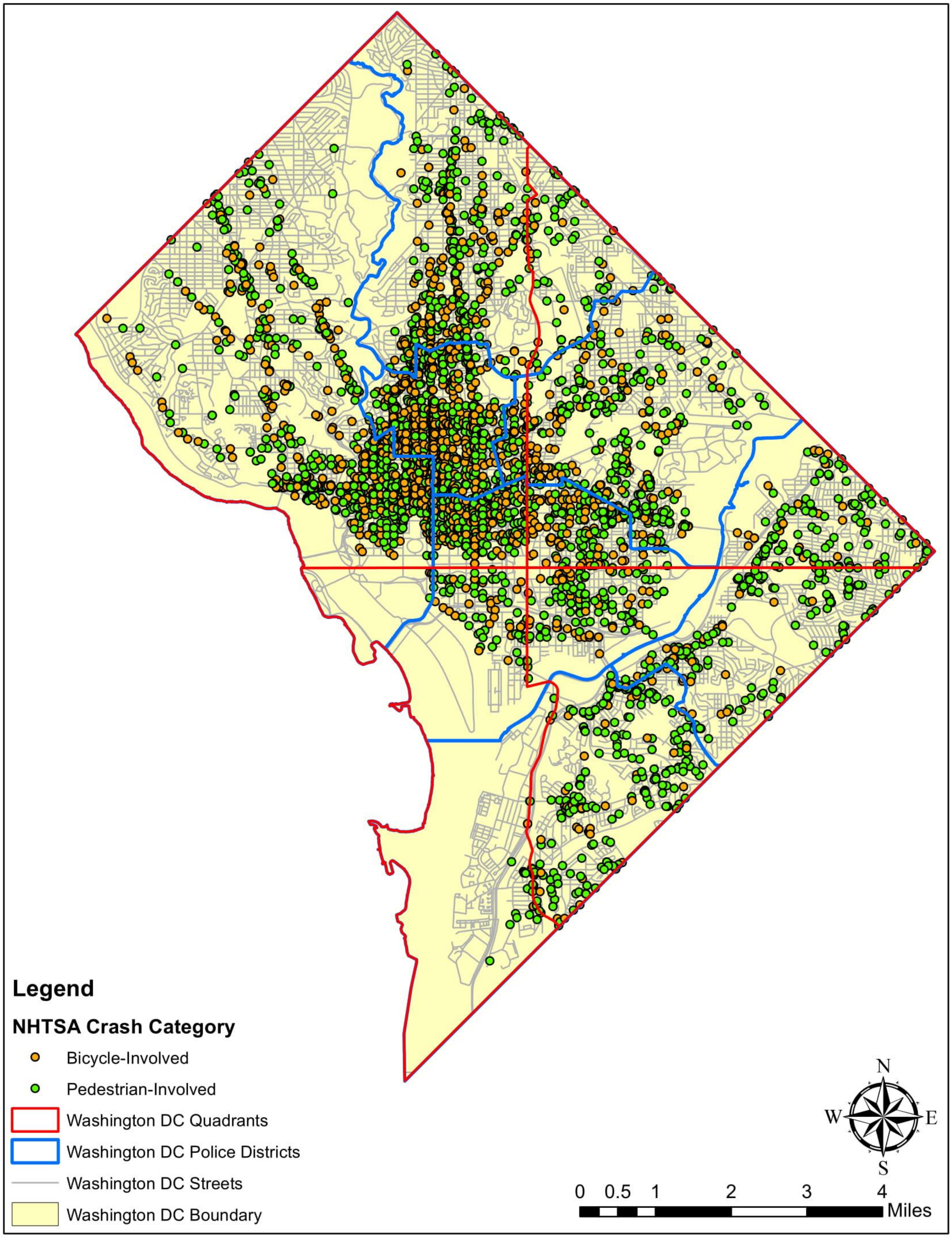


Figure 27. NHTSA Pedestrian and Bicycle Crashes in Washington, DC (2012-14)

Crash Location Characteristics

The first three districts had more than 60% of all pedestrian and bicycle crashes in 2012-14 and rate of bicycle crashes was significantly higher in District 3; 27.4% vs 14.5% (Table 18).

Majority of all pedestrian and bicycle crashes happened in NW city quadrant (65%) followed by NE city quadrant (19.2%); however, the proportion of bicycle crashes was significantly higher in NW city quadrant; 75% vs 57% (Table 19). In other words, three fourth of bicycle crashes occurred in NW city quadrant.

More than 68% of all pedestrian and bicycle crashes happened at intersections or within 100 ft. of an intersection followed by road crashes (27.5%). The proportion of bicycle crashes on roads was significantly higher than pedestrian crashes on roads; 32% vs 24% (Table 20 & Table 21). Fifty percent of intersection crashes happened at 4-leg intersections (Table 22 & Table 23). About 49% of crashes occurred at signalized intersections (Table 24 to Table 26) followed by sign-controlled intersections (12%). While there are about 1,300 signalized intersections in the Washington, DC area versus about 6,300 non-signalized intersections, the normalized rates of pedestrian and bicycle crashes were 1.67 crashes per signalized intersection versus 0.14 crashes per non-signalized intersection (Table 27 & Figure 28).

Table 28 to Table 36 summarize all pedestrian and bicycle crashes by roadway characteristics such as surface type (proportion of bicycle crashes was higher on asphalt than pedestrian crashes), road type, road division (proportion of bicycle crashes was higher on "Two-Way, Divided Unprotected" roads than pedestrian crashes), road condition (proportion of pedestrian crashes was higher on wet roadways than bicycle crashes), traffic condition (the proportion of bicycle crashes was positively correlated with increase in traffic), street lighting, and construction zone.

Table 18. Summary of Crashes by District

District	Bicycle-Involved		Pedestrian-Involved		Total		*Sig.*
	Count	**%**	**Count**	**%**	**Count**	**%**	
1	383	19.60%	489	18.88%	872	19.19%	
2	468	23.95%	557	21.51%	1025	22.56%	+
3	536	27.43%	375	14.48%	911	20.05%	+++
4	235	12.03%	319	12.32%	554	12.19%	
5	199	10.18%	305	11.78%	504	11.09%	-
6	75	3.84%	276	10.66%	351	7.72%	---
7	58	2.97%	269	10.39%	327	7.20%	---
Total	**1954**	**100.00%**	**2590**	**100.00%**	**4544**	**100.00%**	

Table 19. Summary of Crashes by City Quadrant

City Quadrant	Bicycle-Involved		Pedestrian-Involved		Total		Sig.
	Count	%	Count	%	Count	%	
NE	316	16.39%	542	21.41%	858	19.24%	---
NW	1444	74.90%	1436	56.74%	2880	64.59%	+++
SE	130	6.74%	484	19.12%	614	13.77%	---
SW	38	1.97%	69	2.73%	107	2.40%	
Total	**1928**	**100.00%**	**2531**	**100.00%**	**4459**	**100.00%**	

Table 20. Summary of Crashes by Crash Location

Crash Location	Bicycle-Involved		Pedestrian-Involved		Total		Sig.
	Count	%	Count	%	Count	%	
Intersection Crash	1029	52.23%	1516	58.33%	2545	55.70%	---
Private Property, Parking Lot, & Driveway	26	1.32%	165	6.35%	191	4.18%	---
Road Crash	630	31.98%	626	24.09%	1256	27.49%	+++
Within 100 ft. of Intersection	213	10.81%	211	8.12%	424	9.28%	+++
Within 50 ft. of Intersection	72	3.65%	81	3.12%	153	3.35%	
Total	**1970**	**100.00 %**	**2599**	**100.00 %**	**4569**	**100.00 %**	

Table 21. Summary of Crashes by Crash Location (Regrouped)

Crash Location	Bicycle-Involved		Pedestrian-Involved		Total		Sig.
	Count	%	Count	%	Count	%	
Intersection & Within 100 ft.	1314	66.70%	1808	69.57%	3122	68.33%	--
Other	26	1.32%	165	6.35%	191	4.18%	---
Road	630	31.98%	626	24.09%	1256	27.49%	+++
Total	**1970**	**100.00%**	**2599**	**100.00%**	**4569**	**100.00%**	

Table 22. Summary of Crashes by Intersection Type

Intersection Type	Bicycle-Involved		Pedestrian-Involved		Total		
	Count	%	Count	%	Count	%	Sig.
3-leg	246	12.49%	387	14.89%	633	13.85%	--
4-leg	951	48.27%	1286	49.48%	2237	48.96%	
5-leg or more	70	3.55%	99	3.81%	169	3.70%	
N/A	657	33.35%	792	30.47%	1449	31.71%	++
Other	0	0.00%	1	0.04%	1	0.02%	
Roundabout	41	2.08%	27	1.04%	68	1.49%	+++
Unknown	5	0.25%	7	0.27%	12	0.26%	
Total	**1970**	**100.00%**	**2599**	**100.00%**	**4569**	**100.00%**	

Table 23. Summary of Crashes by Intersection Type (Regrouped)

Intersection Type	Bicycle-Involved		Pedestrian-Involved		Total		*Sig.*
	Count	**%**	**Count**	**%**	**Count**	**%**	
3-leg	246	12.49%	387	14.89%	633	13.85%	--
4-leg	951	48.27%	1286	49.48%	2237	48.96%	
Non-Intersection	657	33.35%	792	30.47%	1449	31.71%	++
Other	116	5.89%	134	5.16%	250	5.47%	
Total	**1970**	**100.00%**	**2599**	**100.00%**	**4569**	**100.00%**	

Table 24. Summary of Crashes by Traffic Control Type

Traffic Control Type	Bicycle-Involved		Pedestrian-Involved		Total		*Sig.*
	Count	**%**	**Count**	**%**	**Count**	**%**	
Non-Intersection	657	33.35%	781	30.05%	1438	31.47%	++
Signalized	941	47.77%	1277	49.13%	2218	48.54%	
Sign-Controlled	225	11.42%	317	12.20%	542	11.86%	
Sign-Controlled (Uncontrolled for Driver)	108	5.48%	162	6.23%	270	5.91%	
Uncontrolled	30	1.52%	55	2.12%	85	1.86%	
Unknown	2	0.10%	1	0.04%	3	0.07%	
Yield	5	0.25%	4	0.15%	9	0.20%	
Yield (Uncontrolled for Driver)	2	0.10%	2	0.08%	4	0.09%	
Total	**1970**	**100.00%**	**2599**	**100.00%**	**4569**	**100.00%**	

Table 25. Summary of Crashes by Traffic Control Type (Regrouped)

Traffic Control Type	Bicycle-Involved		Pedestrian-Involved		Total		*Sig.*
	Count	**%**	**Count**	**%**	**Count**	**%**	
Non-Intersection	657	33.35%	781	30.05%	1438	31.47%	++
Other	7	0.36%	5	0.19%	12	0.26%	
Signalized	941	47.77%	1277	49.13%	2218	48.54%	
Sign-Controlled	225	11.42%	317	12.20%	542	11.86%	
Uncontrolled	140	7.11%	219	8.43%	359	7.86%	
Total	**1970**	**100.00%**	**2599**	**100.00%**	**4569**	**100.00%**	

Table 26. Summary of Crashes by Traffic Control Type (Regrouped)

Row Labels	**Bicycle-Involved**		**Pedestrian-Involved**		**Total**		***Sig.***
	Count	**%**	**Count**	**%**	**Count**	**%**	
Non-Intersection	657	33.35%	781	30.05%	1438	31.47%	++
Signalized	941	47.77%	1277	49.13%	2218	48.54%	
Sign-Controlled	225	11.42%	317	12.20%	542	11.86%	
Uncontrolled/Other	147	7.46%	224	8.62%	371	8.12%	
Total	**1970**	**100.00%**	**2599**	**100.00%**	**4569**	**100.00%**	

Table 27. Summary of Crashes by Traffic Control Type (Regrouped & Normalized)

Intersection Control Type	***N***	**%**	**Bicycle-Involved**			**Pedestrian-Involved**			**Total**			***Sig.***
			Count	***%***	***Rate***	***Count***	***%***	***Rate***	***Count***	***%***	***Rate***	
Signalized	1331	17.35%	941	71.67%	0.71	1277	70.24%	0.96	2218	70.84%	1.67	
Non-Signalized	6340	82.65%	372	28.33%	0.06	541	29.76%	0.09	913	29.16%	0.14	
Total	**7671**	**100.00%**	**1313**	**100.00%**	**0.17**	**1818**	**100.00%**	**0.24**	**3131**	**100.00%**	**0.41**	

Notes:

- *Rate = Crash/Intersection*
- *Number of signalized and non-signalized intersections are based on DC Open Data shapefiles.*

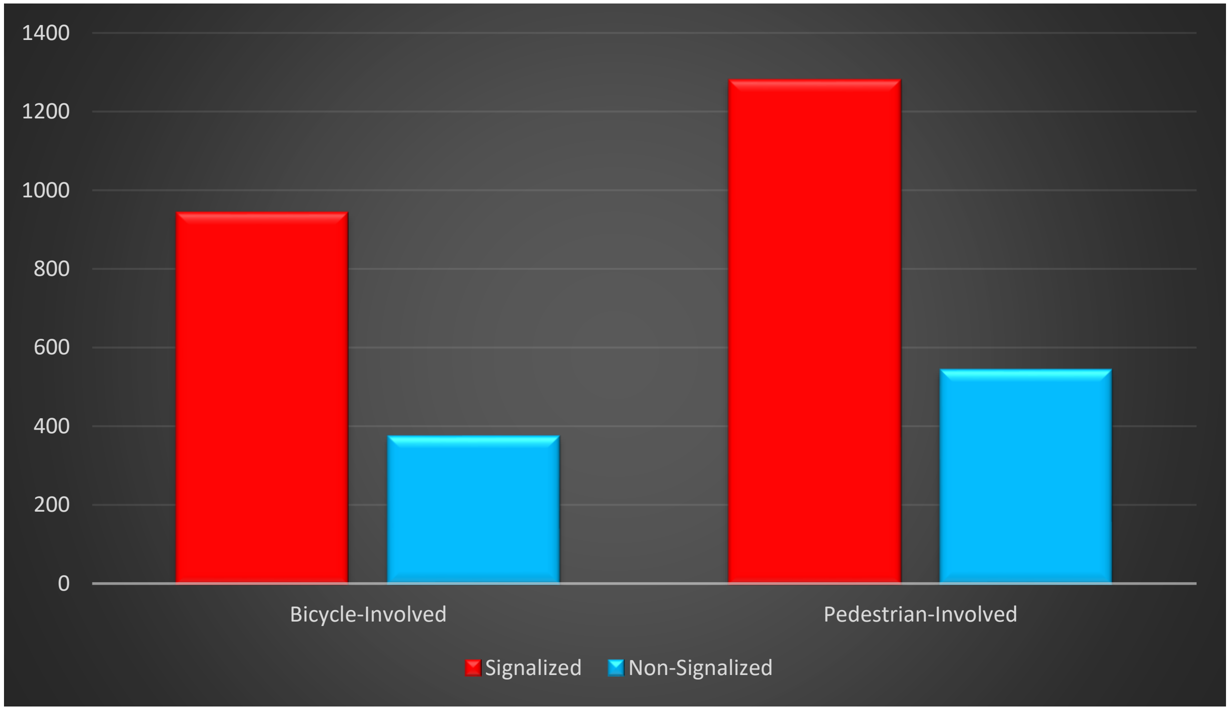


Figure 28. Summary of Crashes by Traffic Control Type (Regrouped & Normalized)

Table 28. Summary of Crashes by Road Surface

Road Surface	Bicycle-Involved		Pedestrian-Involved		Total		Sig.
	Count	%	Count	%	Count	%	
Asphalt	1774	92.49%	2276	90.14%	4050	91.15%	+++
Brick	4	0.21%	9	0.36%	13	0.29%	
Concrete	126	6.57%	215	8.51%	341	7.67%	--
Gravel	1	0.05%	3	0.12%	4	0.09%	
Other	2	0.10%	2	0.08%	4	0.09%	
Unknown	11	0.57%	20	0.79%	31	0.70%	
Total	**1918**	**100.00%**	**2525**	**100.00%**	**4443**	**100.00%**	

Table 29. Summary of Crashes by Road Type

Road Type	Bicycle-Involved		Pedestrian-Involved		Total		Sig.
	Count	%	Count	%	Count	%	
Bridge	1	0.05%	1	0.04%	2	0.04%	
Crest	13	0.67%	4	0.16%	17	0.38%	+++
Curve	64	3.30%	81	3.17%	145	3.22%	
Grade	101	5.20%	117	4.57%	218	4.84%	
Level	89	4.59%	141	5.51%	230	5.11%	
Other	11	0.57%	38	1.48%	49	1.09%	---
Ramp	3	0.15%	5	0.20%	8	0.18%	
Straight	1659	85.47%	2172	84.88%	3831	85.13%	
Total	**1941**	**100.00%**	**2559**	**100.00%**	**4500**	**100.00%**	

Table 30. Summary of Crashes by Road Division

Road Division	Bicycle-Involved		Pedestrian-Involved		Total		Sig.
	Count	%	Count	%	Count	%	
One-Way, Not Divided	299	15.40%	351	13.80%	650	14.49%	
Other	69	3.55%	173	6.80%	242	5.40%	---
Two-Way, Divided Positive	179	9.22%	249	9.79%	428	9.54%	
Two-Way, Divided Unprotected	628	32.35%	714	28.07%	1342	29.92%	+++
Two-Way, Not Divided	750	38.64%	1034	40.64%	1784	39.78%	
Unknown	16	0.82%	23	0.90%	39	0.87%	
Total	**1941**	**100.00%**	**2544**	**100.00%**	**4485**	**100.00%**	

Table 31. Summary of Crashes by Road Condition

Road Condition	Bicycle-Involved		Pedestrian-Involved		Total		Sig.
	Count	%	Count	%	Count	%	
Dry	1730	89.36%	2064	80.69%	3794	84.42%	+++
Ice	0	0.00%	4	0.16%	4	0.09%	-
Other	1	0.05%	3	0.12%	4	0.09%	

Road Condition	Bicycle-Involved		Pedestrian-Involved		Total		Sig.
	Count	%	Count	%	Count	%	
Repairing	7	0.36%	2	0.08%	9	0.20%	++
Sand	0	0.00%	4	0.16%	4	0.09%	-
Slush	1	0.05%	6	0.23%	7	0.16%	
Snow	2	0.10%	11	0.43%	13	0.29%	--
Standing Water	0	0.00%	1	0.04%	1	0.02%	
Unknown	36	1.86%	42	1.64%	78	1.74%	
Wet	159	8.21%	421	16.46%	580	12.91%	---
Total	**1936**	**100.00%**	**2558**	**100.00%**	**4494**	**100.00%**	

Table 32. Summary of Crashes by Traffic Condition

Traffic Condition	Bicycle-Involved		Pedestrian-Involved		Total		Sig.
	Count	%	Count	%	Count	%	
Heavy	353	18.70%	369	14.86%	722	16.51%	+++
Light	569	30.14%	864	34.78%	1433	32.78%	---
Medium	760	40.25%	887	35.71%	1647	37.67%	+++
Other	6	0.32%	42	1.69%	48	1.10%	---
Unknown	200	10.59%	322	12.96%	522	11.94%	--
Total	**1888**	**100.00%**	**2484**	**100.00%**	**4372**	**100.00%**	

Table 33. Summary of Crashes by Street lighting

Street Lighting	Bicycle-Involved		Pedestrian-Involved		Total		Sig.
	Count	%	Count	%	Count	%	
Defective	0	0.00%	3	0.12%	3	0.07%	
None	97	5.06%	174	6.90%	271	6.11%	--
Other	4	0.21%	11	0.44%	15	0.34%	
Street Lights Off	1150	59.99%	1328	52.68%	2478	55.84%	+++
Street Lights On	611	31.87%	940	37.29%	1551	34.95%	---
Unknown	55	2.87%	65	2.58%	120	2.70%	
Total	**1917**	**100.00%**	**2521**	**100.00%**	**4438**	**100.00%**	

Table 34. Summary of Crashes by Light

Light	Bicycle-Involved		Pedestrian-Involved		Total		
	Count	%	Count	%	Count	%	Sig.
Dark (Lighted)	527	27.33%	837	32.99%	1364	30.55%	---
Dark (Not Lighted)	18	0.93%	50	1.97%	68	1.52%	---
Dark (Unknown Lighting)	11	0.57%	14	0.55%	25	0.56%	
Dawn	14	0.73%	27	1.06%	41	0.92%	
Daylight	1298	67.32%	1541	60.74%	2839	63.58%	+++
Dusk	37	1.92%	44	1.73%	81	1.81%	

Light	Bicycle-Involved		Pedestrian-Involved		Total		
	Count	%	Count	%	Count	%	*Sig.*
Other	3	0.16%	2	0.08%	5	0.11%	
Unknown	20	1.04%	22	0.87%	42	0.94%	
Total	**1928**	**100.00%**	**2537**	**100.00%**	**4465**	**100.00%**	

Table 35. Summary of Crashes by Weather

Weather	Bicycle-Involved		Pedestrian-Involved		Total		*Sig.*
	Count	%	Count	%	Count	%	
Blowing Sand	1	0.05%	1	0.04%	2	0.05%	
Clear	1709	89.29%	2033	80.74%	3742	84.43%	+++
Fog/Mist	13	0.68%	28	1.11%	41	0.93%	
Other	25	1.31%	31	1.23%	56	1.26%	
Rain	123	6.43%	346	13.74%	469	10.58%	---
Severe Crosswind	8	0.42%	15	0.60%	23	0.52%	
Sleet/Hail	0	0.00%	4	0.16%	4	0.09%	-
Snow	8	0.42%	25	0.99%	33	0.74%	--
Unknown	27	1.41%	35	1.39%	62	1.40%	
Total	**1914**	**100.00%**	**2518**	**100.00%**	**4432**	**100.00%**	

Table 36. Summary of Crashes by Construction Zone

Construction Zone	Bicycle-Involved		Pedestrian-Involved		Total		*Sig.*
	Count	%	Count	%	Count	%	
Yes	54	2.74%	78	3.00%	132	2.89%	
No	1916	97.26%	2521	97.00%	4437	97.11%	
Total	**1970**	**100.00%**	**2599**	**100.00%**	**4569**	**100.00%**	

Crash Time Characteristics

The proportion of bicycle crashes increased significantly (99% confidence level) more than pedestrian crashes over the years of study (Table 37). The season with the highest number of crashes was fall (about 29% of all pedestrian and bicycle crashes). Fall was also the season with the highest number of pedestrian crashes; however, summer was the season with the highest number of bicycle crashes and the difference in proportions was statistically significant (Table 38). While the number of pedestrian crashes were usually more than bicycle crashes throughout the months of the year, bicycle crashes outnumbered pedestrian crashes in June, July, and August (Table 39) and the differences were significant at 99% confidence level. On the other hand, the proportion of bicycle crashes in January, February, March, November, and December (generally colder months of the year) were significantly lower than pedestrian crashes (Table 39 & Figure 29).

Table 40 and Table 41 summarize crashes by day of week and weekday versus weekend crashes. More than ten percent of all pedestrian and bicycle crashes occurred at 6-7 PM (Table 42) and the proportion of bicycle crashes (12.4%) was significantly higher than of pedestrian crashes (9.7%). Figure 31 to Figure 33 demonstrate percentages of different crash severity levels by time of day for all crashes combined and pedestrian and bicycle crashes separately. The proportions of bicycle and pedestrian crashes at nighttime was not statistically different (Table 43).

Table 37. Summary of Crashes by Year

Year	Bicycle-Involved		Pedestrian-Involved		Total		Sig.
	Count	%	Count	%	Count	%	
2012	582	29.54%	811	31.20%	1393	30.49%	
2013	590	29.95%	860	33.09%	1450	31.74%	--
2014	798	40.51%	928	35.71%	1726	37.78%	+++
Total	**1970**	**100.00%**	**2599**	**100.00%**	**4569**	**100.00%**	

Table 38. Summary of Crashes by Season

Season	Bicycle-Involved		Pedestrian-Involved		Total		Sig.
	Count	%	Count	%	Count	%	
Fall	576	29.24%	736	28.32%	1312	28.72%	
Spring	479	24.31%	656	25.24%	1135	24.84%	
Summer	644	32.69%	534	20.55%	1178	25.78%	+++
Winter	271	13.76%	673	25.89%	944	20.66%	---
Total	**1970**	**100.00%**	**2599**	**100.00%**	**4569**	**100.00%**	

Table 39. Summary of Crashes by Month

Month	Bicycle-Involved		Pedestrian-Involved		Total		Sig.
	Count	%	Count	%	Count	%	
January	95	4.82%	226	8.70%	321	7.03%	---
February	76	3.86%	197	7.58%	273	5.98%	---
March	123	6.24%	213	8.20%	336	7.35%	--
April	169	8.58%	219	8.43%	388	8.49%	
May	187	9.49%	224	8.62%	411	9.00%	
June	211	10.71%	200	7.70%	411	9.00%	+++
July	193	9.80%	163	6.27%	356	7.79%	+++
August	240	12.18%	171	6.58%	411	9.00%	+++
September	230	11.68%	244	9.39%	474	10.37%	++
October	215	10.91%	259	9.97%	474	10.37%	
November	131	6.65%	233	8.96%	364	7.97%	---
December	100	5.08%	250	9.62%	350	7.66%	---
Total	**1970**	**100.00%**	**2599**	**100.00%**	**4569**	**100.00%**	

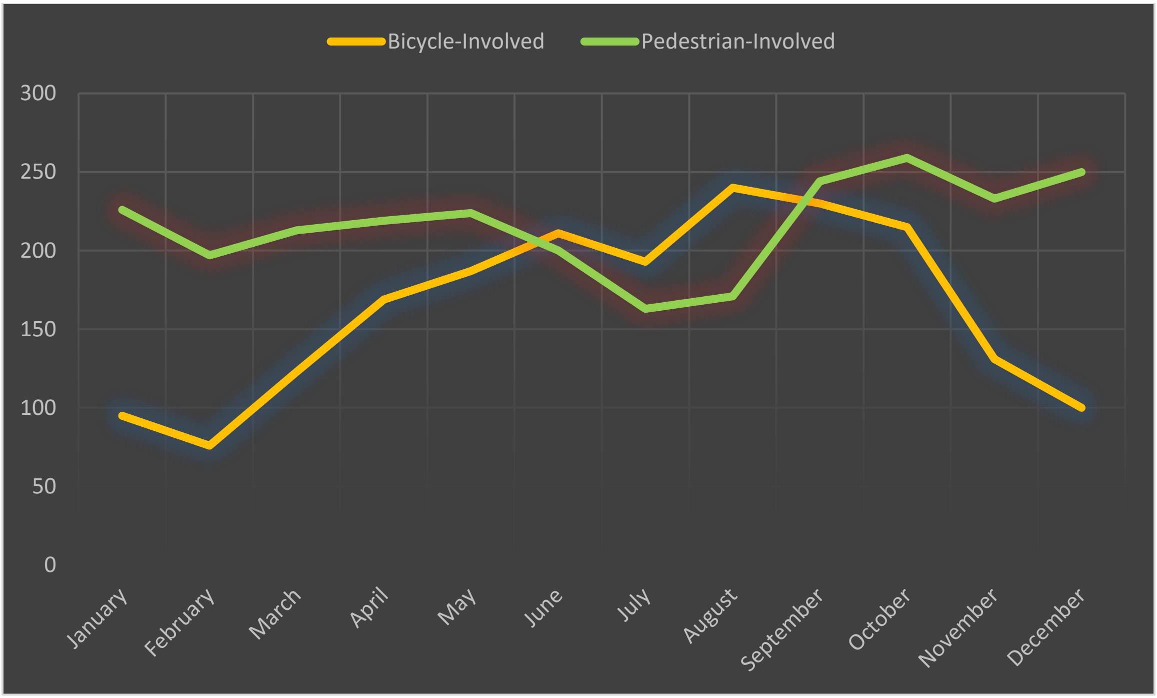


Figure 29. Summary of Crashes by Month

Table 40. Summary of Crashes by Day

Day	Bicycle-Involved		Pedestrian-Involved		Total		*Sig.*
	Count	**%**	**Count**	**%**	**Count**	**%**	
Sunday	176	8.93%	248	9.54%	424	9.28%	
Monday	270	13.71%	352	13.54%	622	13.61%	
Tuesday	309	15.69%	420	16.16%	729	15.96%	
Wednesday	323	16.40%	438	16.85%	761	16.66%	
Thursday	310	15.74%	390	15.01%	700	15.32%	
Friday	347	17.61%	422	16.24%	769	16.83%	
Saturday	235	11.93%	329	12.66%	564	12.34%	
Total	**1970**	**100.00%**	**2599**	**100.00%**	**4569**	**100.00%**	

Table 41. Summary of Crashes by Weekday vs. Weekend

Weekday/Weekend	Bicycle-Involved		Pedestrian-Involved		Total		*Sig.*
	Count	**%**	**Count**	**%**	**Count**	**%**	
Weekday	1524	77.36%	1999	76.91%	3523	77.11%	
Weekend	446	22.64%	600	23.09%	1046	22.89%	
Total	**1970**	**100.00%**	**2599**	**100.00%**	**4569**	**100.00%**	

Table 42. Summary of Crashes by Hour

Hour	Bicycle-Involved		Pedestrian-Involved		Total		
	Count	%	Count	%	Count	%	*Sig.*
0	12	0.61%	16	0.62%	28	0.61%	
1	14	0.71%	35	1.35%	49	1.07%	--
2	18	0.91%	28	1.08%	46	1.01%	
3	22	1.12%	30	1.15%	52	1.14%	
4	2	0.10%	4	0.15%	6	0.13%	
5	3	0.15%	6	0.23%	9	0.20%	
6	8	0.41%	17	0.65%	25	0.55%	
7	13	0.66%	17	0.65%	30	0.66%	
8	24	1.22%	29	1.12%	53	1.16%	
9	23	1.17%	34	1.31%	57	1.25%	
10	109	5.53%	141	5.43%	250	5.47%	
11	104	5.28%	158	6.08%	262	5.73%	
12	130	6.60%	151	5.81%	281	6.15%	
13	122	6.19%	158	6.08%	280	6.13%	
14	86	4.37%	162	6.23%	248	5.43%	---
15	124	6.29%	203	7.81%	327	7.16%	--
16	133	6.75%	197	7.58%	330	7.22%	
17	197	10.00%	227	8.73%	424	9.28%	
18	244	12.39%	253	9.73%	497	10.88%	+++
19	163	8.27%	176	6.77%	339	7.42%	+
20	121	6.14%	177	6.81%	298	6.52%	
21	111	5.63%	132	5.08%	243	5.32%	
22	106	5.38%	132	5.08%	238	5.21%	
23	81	4.11%	116	4.46%	197	4.31%	
Total	**1970**	**100.00%**	**2599**	**100.00%**	**4569**	**100.00%**	

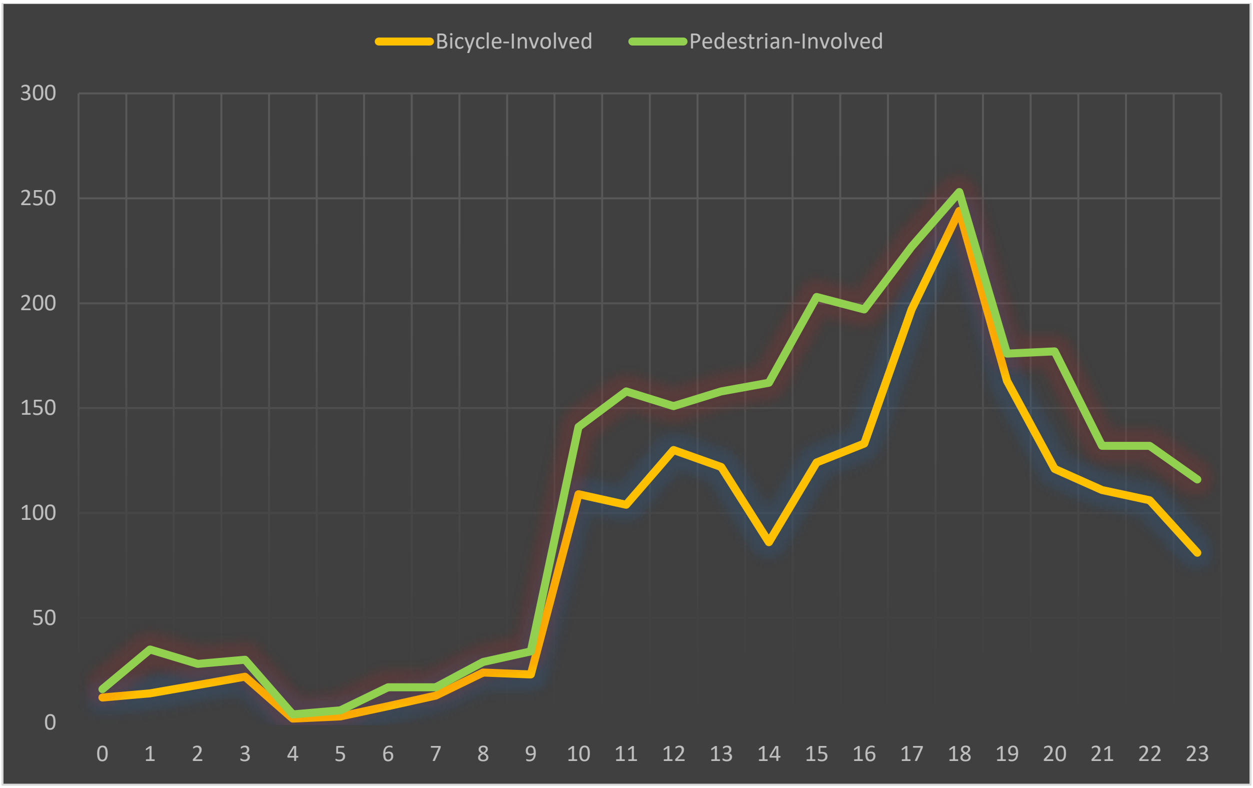


Figure 30. Summary of Crashes by Hour

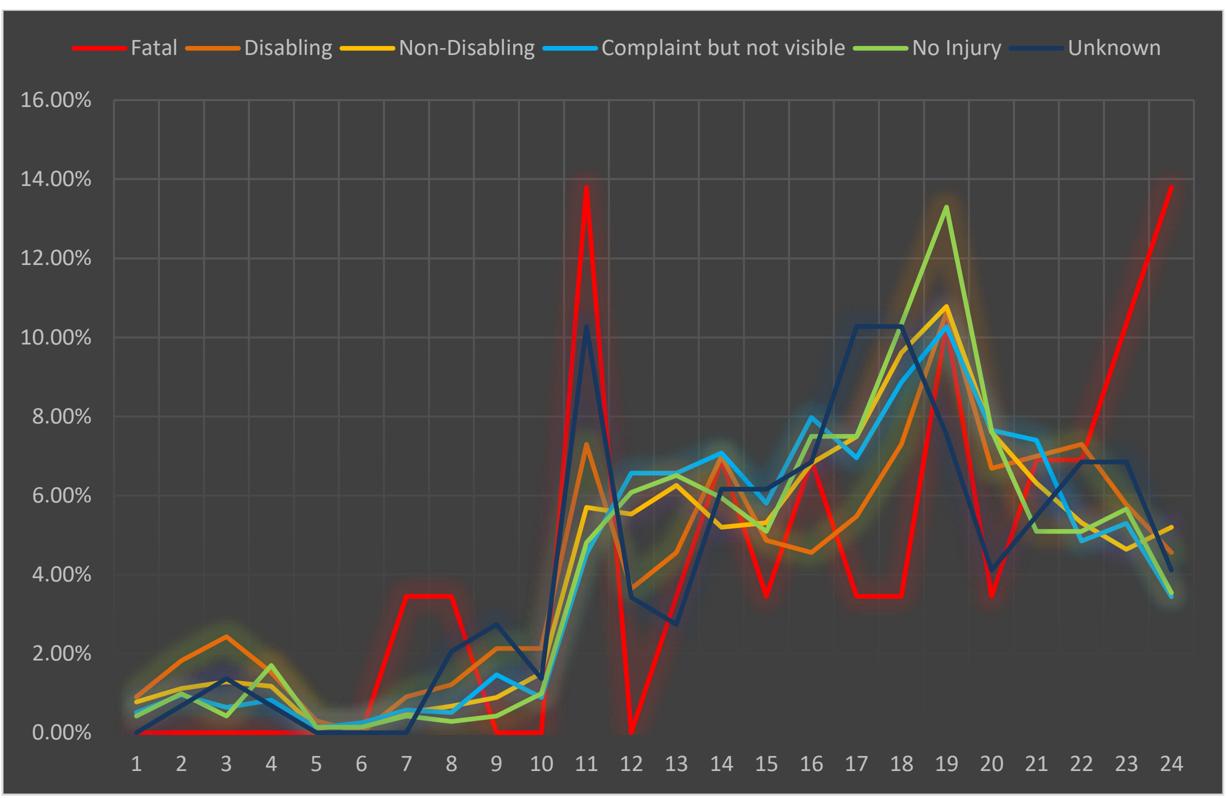


Figure 31. Summary of Crashes by Hour & Crash Severity

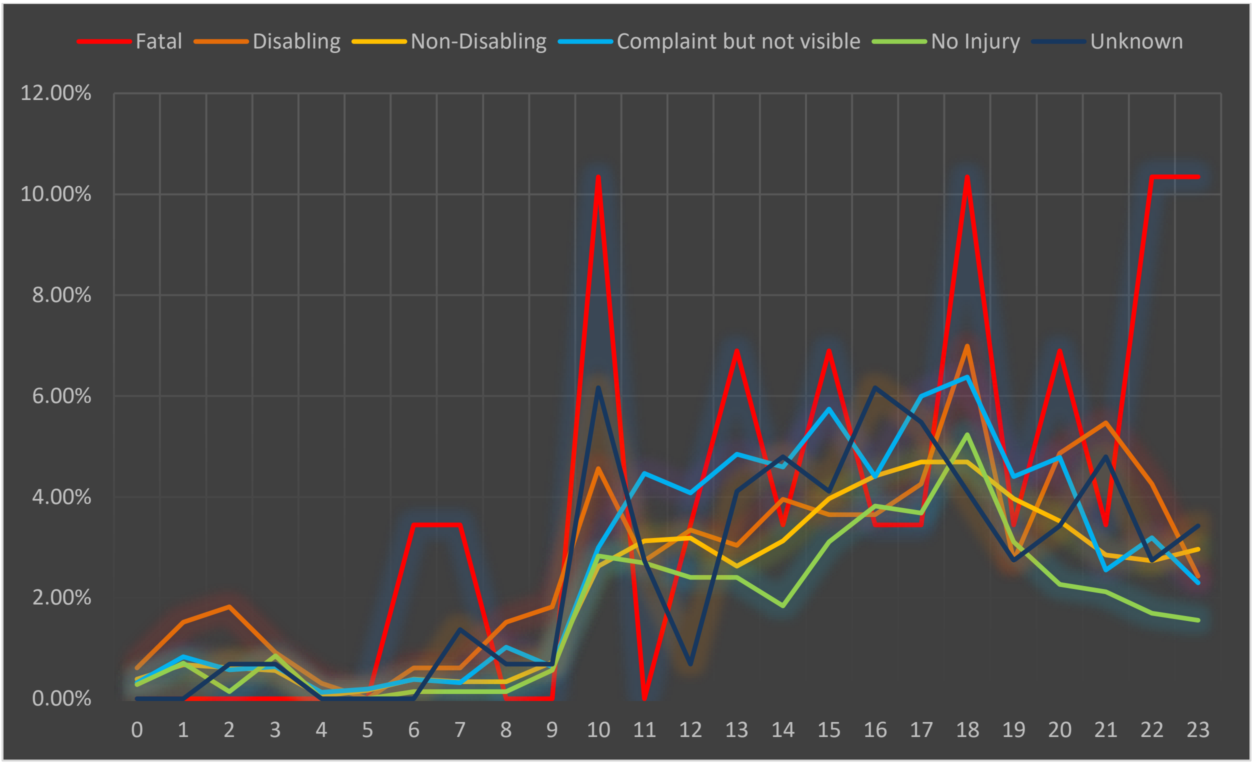


Figure 32. Summary of Pedestrian-Involved Crashes by Hour & Crash Severity

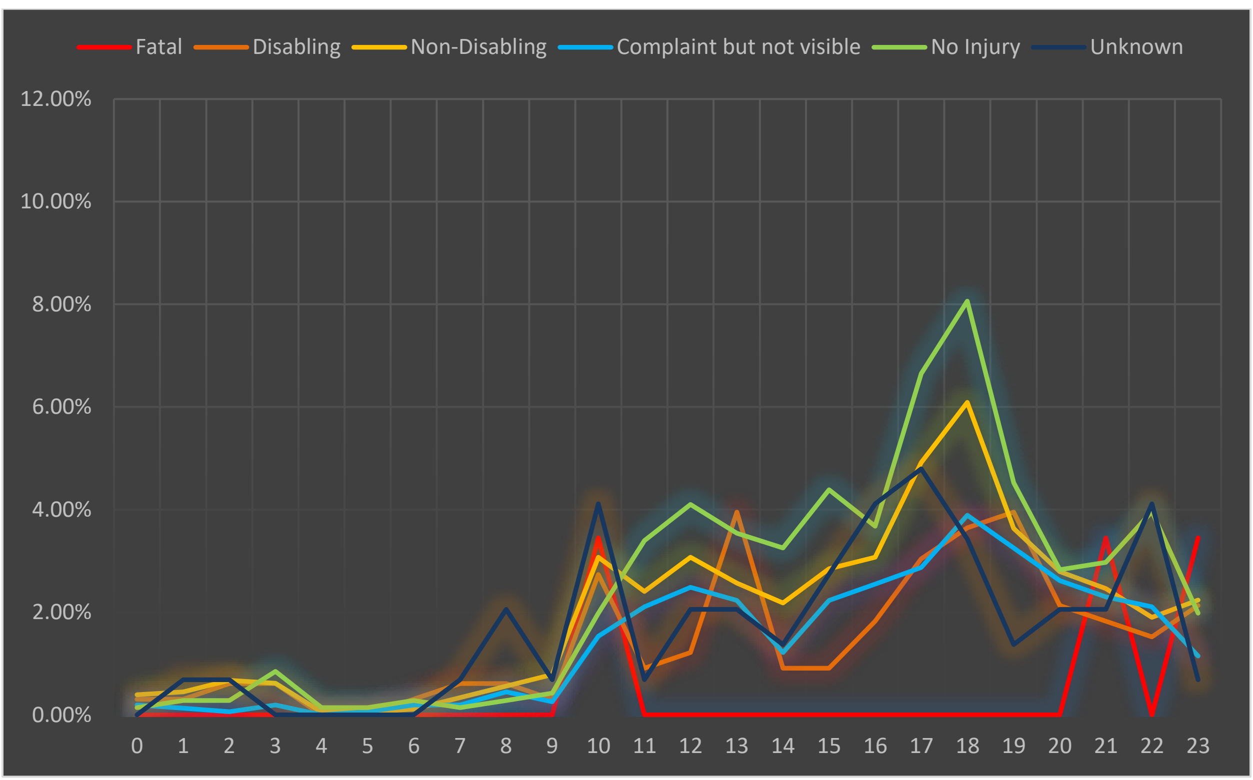


Figure 33. Summary of Bicycle-Involved Crashes by Hour & Crash Severity

Table 43. Summary of Crashes by Day vs. Night

Day/Night	Bicycle-Involved		Pedestrian-Involved		Total		*Sig.*
	Count	%	Count	%	Count	%	
Day (6 AM - 8 PM)	1480	75.13%	1923	73.99%	3403	74.48%	
Night (8 PM - 6 AM)	490	24.87%	676	26.01%	1166	25.52%	
Total	**1970**	**100.00%**	**2599**	**100.00%**	**4569**	**100.00%**	

Crash Severity Levels

Except for "Unknown" crash severity level, all other crash severity levels had significantly different bicycle and pedestrian proportions (Table 44 & Figure 34):

- Pedestrian crash proportions were significantly higher for fatal (1% vs 0.15%), disabling (8.3% vs 5.7%), and complain but not visible (39.7% vs 27.3%)
- Bicycle crash proportions were significantly higher for non-disabling (42.9% vs 36.3%) and no injury (20.9% vs 11.4%)

Using the crash costs[1] (Harmon, Bahar and Gross 2018), all 4,569 pedestrian and bicycle crashes resulted in $1,105,468,100 (2016 dollars); $756,583,800 for pedestrian crashes and $348,884,300 for bicycle crashes. Among the crash severity levels, non-disabling crashes with highest number of crashes (1,790) contributed in $355,315,000 (Table 45).

Table 46 to Table 48 demonstrate different combinations of crash severity levels.

Table 44. Summary of Crashes by Severity Level

Severity	Bicycle-Involved		Pedestrian-Involved		Total		*Sig.*
	Count	%	Count	%	Count	%	
Fatal	3	0.15%	26	1.00%	29	0.63%	---
Disabling	113	5.74%	216	8.31%	329	7.20%	---
Non-Disabling	846	42.94%	944	36.32%	1790	39.18%	+++
Complaint but not visible	537	27.26%	1031	39.67%	1568	34.32%	---
No Injury	412	20.91%	295	11.35%	707	15.47%	+++
Unknown	59	2.99%	87	3.35%	146	3.20%	
Total	**1970**	**100.00%**	**2599**	**100.00%**	**4569**	**100.00%**	

[1] Fatal crash (K) = $11,295,400, disabling crash (A) = $655,000, non-disabling crash (B) = $198,500, complain but not visible crash (C) = $125,600, and no injury crash (O) = $11,900 (Harmon, Bahar and Gross 2018).

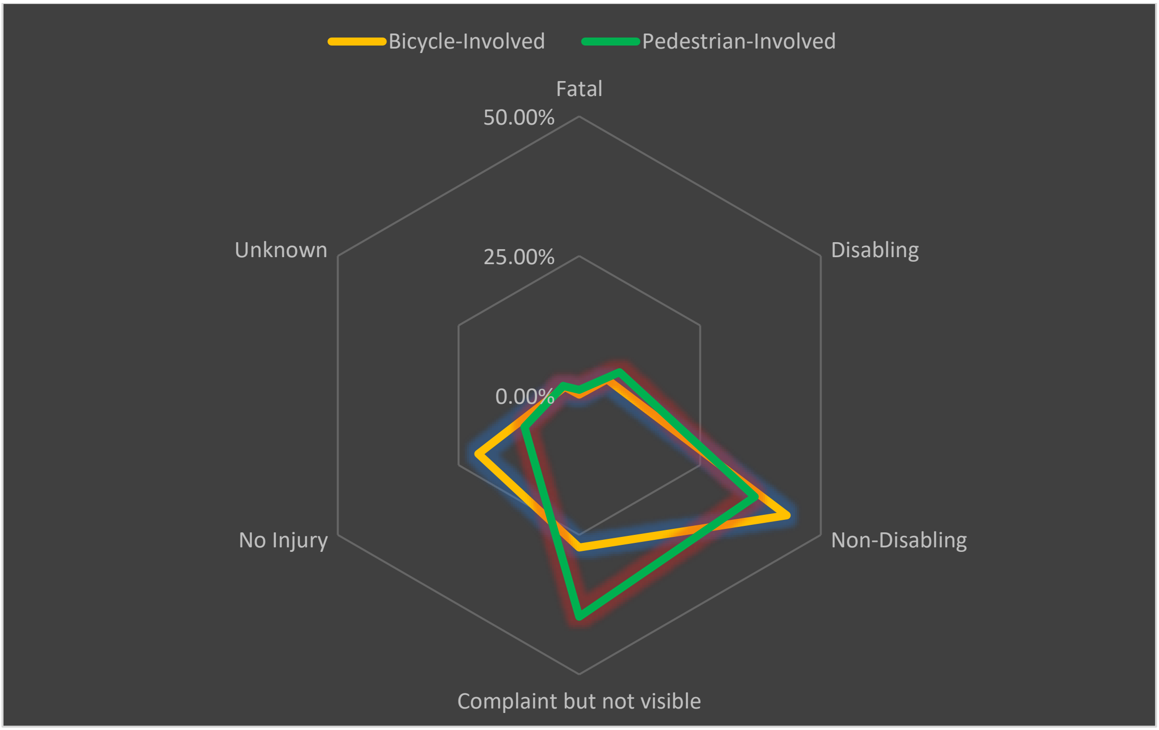


Figure 34. Summary of Crashes by Severity Level

Table 45. Summary of Crashes by Severity Level & Crash Costs

Severity	Bicycle-Involved		Pedestrian-Involved		Total	
	Count	$	Count	$	Count	$
Fatal	3	$33,886,200	26	$293,680,400	29	$327,566,600
Disabling	113	$74,015,000	216	$141,480,000	329	$215,495,000
Non-Disabling	846	$167,931,000	944	$187,384,000	1790	$355,315,000
Complaint but not visible	537	$67,447,200	1031	$129,493,600	1568	$196,940,800
No Injury	412	$4,902,800	295	$3,510,500	707	$8,413,300
Unknown	59	$702,100	87	$1,035,300	146	$1,737,400
Total	**1970**	**$348,884,300**	**2599**	**$756,583,800**	**4569**	**$1,105,468,100**

Note: Crash costs are in 2016 dollars (Harmon, Bahar and Gross 2018).

Table 46. Summary of Crashes by Severity Level: "Fatal & Disabling" vs. "Other"

KA/BCOU	Bicycle-Involved		Pedestrian-Involved		Total		*Sig.*
	Count	%	Count	%	Count	%	
Fatal & Disabling	116	5.89%	242	9.31%	358	7.84%	---
Other	1854	94.11%	2357	90.69%	4211	92.16%	+++
Total	**1970**	**100.00%**	**2599**	**100.00%**	**4569**	**100.00%**	

Table 47. Summary of Crashes by Severity Level: "Fatal & Disabling & Non-Disabling" vs. "Other"

KAB/COU	Bicycle-Involved		Pedestrian-Involved		Total		*Sig.*
	Count	**%**	**Count**	**%**	**Count**	**%**	
Fatal, Disabling, & Non-Disabling	962	48.83%	1186	45.63%	2148	47.01%	++
Other	1008	51.17%	1413	54.37%	2421	52.99%	--
Total	**1970**	**100.00%**	**2599**	**100.00%**	**4569**	**100.00%**	

Table 48. Summary of Crashes by Severity Level: "Fatal & Disabling" vs. "Non-Disabling & Complaint but not visible" vs. "Other"

KA/BC/OU	Bicycle-Involved		Pedestrian-Involved		Total		*Sig.*
	Count	**%**	**Count**	**%**	**Count**	**%**	
Fatal & Disabling	116	5.89%	242	9.31%	358	7.84%	---
Non-Disabling & Complaint but not visible	1383	70.20%	1975	75.99%	3358	73.50%	---
Other	471	23.91%	382	14.70%	853	18.67%	+++
Total	**1970**	**100.00%**	**2599**	**100.00%**	**4569**	**100.00%**	

Driver and Pedestrian/Bicyclist's Characteristics

Vehicle drivers involved in crashes with pedestrian and bicyclists were mainly males (Table 49); however, while pedestrians were almost evenly divided by gender, about three fourth of bicyclists were males (Table 51).

The main age category of vehicle drivers was between 22-34 years of age and accounted for about 28% of all pedestrian and bicycle crashes (Table 50). The dominant age category was also shared with pedestrians and bicyclists; however, while pedestrians had about 27% between the ages of 22-34 more than 50% of bicyclists were between 22-34 years of age (Table 52).

Table 53 and Table 54 summarize crashes by fault or violation. Vehicle drivers were at fault or violation at crash scenes twice higher than pedestrians or bicyclists (55.7% vs 26.9%). Albeit the proportion of vehicle drivers being at fault was significantly higher for pedestrian crashes than bicycle crashes (58.1% vs 52.4%).

About 3.85% of all pedestrian and bicycle crashes were attributed by alcohol (Table 55). Generally, proportions of pedestrian crashes were higher regarding to alcohol and in the crashes that pedestrians or bicyclists were impaired, the overall proportion was twice that of drivers. Summary of crashes by drug, distraction, and speeding (or running for pedestrians) are presented in Table 56 to Table 58.

About twenty percent of crashes were hit & run and proportion of hit and run crashes was higher for pedestrian crashes (Table 59); however, the proportions of severe crashes (fatal and disabling) was higher for bicycle crashes (Table 60).

It should be noted that the proportions presented in this section should be normalized by registered driver's licenses in Washington, DC, Maryland, and Virginia and if data is available with demographics of pedestrians and bicyclists in Washington, DC area.

Table 49. Summary of Crashes by Driver Gender

Driver Gender	Bicycle-Involved		Pedestrian-Involved		Total		Sig.
	Count	%	Count	%	Count	%	
Female	580	29.44%	830	31.94%	1410	30.86%	-
Male	1145	58.12%	1489	57.29%	2634	57.65%	
Not Applicable	34	1.73%	0	0.00%	34	0.74%	+++
Not Available	211	10.71%	280	10.77%	491	10.75%	
Total	**1970**	**100.00%**	**2599**	**100.00%**	**4569**	**100.00%**	

Note: Not Applicable is for the case of "Bicycle-Only" crashes.

Table 50. Summary of Crashes by Driver Age

Driver Age	Bicycle-Involved		Pedestrian-Involved		Total		Sig.
	Count	%	Count	%	Count	%	
21 & under	74	3.76%	148	5.69%	222	4.86%	---
22 - 34	527	26.75%	761	29.28%	1288	28.19%	-
35 - 44	386	19.59%	437	16.81%	823	18.01%	++
45 - 54	378	19.19%	443	17.05%	821	17.97%	+
55 - 64	246	12.49%	392	15.08%	638	13.96%	--
65 & over	177	8.98%	266	10.23%	443	9.70%	
Not Applicable	34	1.73%	0	0.00%	34	0.74%	+++
Not Available	148	7.51%	152	5.85%	300	6.57%	++
Total	**1970**	**100.00%**	**2599**	**100.00%**	**4569**	**100.00%**	

Note: Not Applicable is for the case of "Bicycle-Only" crashes.

Table 51. Summary of Crashes by Pedestrian/Bicyclist Gender

Pedestrian/Bicyclist Gender	Bicycle-Involved		Pedestrian-Involved		Total		
	Count	%	Count	%	Count	%	Sig.
Female	439	22.28%	1173	45.13%	1612	35.28%	---
Male	1460	74.11%	1137	43.75%	2597	56.84%	+++
Not Available	71	3.60%	289	11.12%	360	7.88%	---
Total	**1970**	**100.00%**	**2599**	**100.00%**	**4569**	**100.00%**	

Table 52. Summary of Crashes by Pedestrian/Bicyclist Age

Pedestrian/Bicyclist Age	Bicycle-Involved		Pedestrian-Involved		Total		Sig.
	Count	%	Count	%	Count	%	
21 & under	272	13.81%	328	12.62%	600	13.13%	
22 - 34	1000	50.76%	699	26.89%	1699	37.19%	+++
35 - 44	301	15.28%	337	12.97%	638	13.96%	++
45 - 54	189	9.59%	317	12.20%	506	11.07%	---
55 - 64	105	5.33%	278	10.70%	383	8.38%	---
65 & over	21	1.07%	188	7.23%	209	4.57%	---
Not Available	82	4.16%	452	17.39%	534	11.69%	---
Total	**1970**	**100.00%**	**2599**	**100.00%**	**4569**	**100.00%**	

Table 53. Summary of Crashes by Fault / Violation

Fault / Violation	Bicycle-Involved		Pedestrian-Involved		Total		Sig.
	Count	%	Count	%	Count	%	
Vehicle Driver/Passenger	1033	52.44%	1510	58.10%	2543	55.66%	---
Unknown	340	17.26%	336	12.93%	676	14.80%	+++
Pedestrian/Bicyclist	530	26.90%	699	26.89%	1229	26.90%	
No Fault / Violation	51	2.59%	31	1.19%	82	1.79%	+++
Both	16	0.81%	23	0.88%	39	0.85%	
Total	**1970**	**100.00%**	**2599**	**100.00%**	**4569**	**100.00%**	

Table 54. Summary of Crashes by Fault / Violation (Regrouped)

Fault / Violation	Bicycle-Involved		Pedestrian-Involved		Total		Sig.
	Count	%	Count	%	Count	%	
Other	407	20.66%	390	15.01%	797	17.44%	+++
Pedestrian/Bicyclist	530	26.90%	699	26.89%	1229	26.90%	
Vehicle Driver/Passenger	1033	52.44%	1510	58.10%	2543	55.66%	---
Total	**1970**	**100.00%**	**2599**	**100.00%**	**4569**	**100.00%**	

Table 55. Summary of Crashes by Alcohol

Alcohol	Bicycle-Involved		Pedestrian-Involved		Total		Sig.
	Count	%	Count	%	Count	%	
Both	0	0.00%	1	0.04%	1	0.02%	
None	1492	75.74%	1765	67.91%	3257	71.28%	+++
Pedestrian/Bicyclist	20	1.02%	97	3.73%	117	2.56%	---
Unknown	449	22.79%	687	26.43%	1136	24.86%	---
Vehicle Driver	9	0.46%	49	1.89%	58	1.27%	---
Total	**1970**	**100.00%**	**2599**	**100.00%**	**4569**	**100.00%**	

Table 56. Summary of Crashes by Drug

Drug	Bicycle-Involved		Pedestrian-Involved		Total		*Sig.*
	Count	%	Count	%	Count	%	
None	1540	78.17%	1887	72.60%	3427	75.01%	+++
Pedestrian/Bicyclist	2	0.10%	7	0.27%	9	0.20%	
Unknown	426	21.62%	699	26.89%	1125	24.62%	---
Vehicle Driver	2	0.10%	6	0.23%	8	0.18%	
Total	**1970**	**100.00%**	**2599**	**100.00%**	**4569**	**100.00%**	

Table 57. Summary of Crashes by Distraction

Distraction	Bicycle-Involved		Pedestrian-Involved		Total		*Sig.*
	Count	%	Count	%	Count	%	
Both	0	0.00%	3	0.12%	3	0.07%	
None	894	45.38%	1083	41.67%	1977	43.27%	++
Pedestrian/Bicyclist	45	2.28%	105	4.04%	150	3.28%	---
Unknown	975	49.49%	1318	50.71%	2293	50.19%	
Vehicle Driver	56	2.84%	90	3.46%	146	3.20%	
Total	**1970**	**100.00%**	**2599**	**100.00%**	**4569**	**100.00%**	

Table 58. Summary of Crashes by Speeding / Running

Speeding	Bicycle-Involved		Pedestrian-Involved		Total		
	Count	%	Count	%	Count	%	*Sig.*
Both		0.00%	1	0.04%	1	0.02%	
None	1668	84.67%	2195	84.46%	3863	84.55%	
Pedestrian/Bicyclist	59	2.99%	4	0.15%	63	1.38%	+++
Unknown	228	11.57%	324	12.47%	552	12.08%	
Vehicle Driver	15	0.76%	75	2.89%	90	1.97%	---
Total	**1970**	**100.00%**	**2599**	**100.00%**	**4569**	**100.00%**	

Table 59. Summary of Crashes by Hit & Run

Hit & Run	Bicycle-Involved		Pedestrian-Involved		Total		
	Count	%	Count	%	Count	%	*Sig.*
No	1610	81.73%	2063	79.38%	3673	80.39%	++
Yes	360	18.27%	536	20.62%	896	19.61%	--
Total	**1970**	**100.00%**	**2599**	**100.00%**	**4569**	**100.00%**	

Table 60. Summary of Crashes by Hit & Run and Severity Level

Severity	Hit & Run: No		Hit & Run: Yes		Total		*Sig.*
	Count	%	Count	%	Count	%	
Fatal	22	0.60%	7	0.78%	29	0.63%	
Disabling	272	7.41%	57	6.36%	329	7.20%	
Non-Disabling	1479	40.27%	311	34.71%	1790	39.18%	+++
Complaint but not visible	1298	35.34%	270	30.13%	1568	34.32%	+++
No Injury	507	13.80%	200	22.32%	707	15.47%	---
Unknown	95	2.59%	51	5.69%	146	3.20%	---
Total	**3673**	**100.00%**	**896**	**100.00%**	**4569**	**100.00%**	

PD-10 Form Special Fields

The PD-10 forms that were reviewed in this study had two relatively important and relevant fields; “189 Type of Crash” (Table 61) and “199 Pedestrian Action” (Table 62).

“189 Type of Crash” – there are types four crash types directly referring to pedestrian crashes:

- Backing Hit Ped.
- Left Turn Hit Ped.
- Right Turn Hit Ped.
- Straight Hit Ped.

About 84.8 percent of pedestrian crashes were labeled with one of these four crash types. 41.4% of bicycle crashes were coded as “19” (undefined value in PD-10 form data dictionary that based on data was referring to bicycle crashes) whereas 12.8 percent of bicycle crashes were also labeled with one of the four aforementioned crash types. Similarly, there are also four similar crash types for vehicles (e.g., “Backing Hit Veh.”); a 1.48% of pedestrian crashes were coded with one of the crash types for a hit vehicle and 9.7% of bicycle crashes were coded with one of them.

“199 Pedestrian Action” – this field has mainly information about the location/position of the pedestrian at crash scene such as “With Signal in Crosswalk” (the most prevalent one as more than one fourth of pedestrian crashes were coded with this value) and “From Between Parked Cars”. This field could act as a beginning step to identify the position and eventually NHTSA crash type when the PD-10 forms were reviewed. While the main selected value of this field for bicycle crashes was “N/A” (59.8%) followed by “Other” (10.7%) and “Unknown” (11.6%), police officers selected other values as well (nearly for 18% of bicycle crashes) such as “With Signal in Crosswalk” (6.43%) and “Not In Crosswalk” (4.43%).

Based on these two fields of PD-10 forms and their importance in classification of pedestrian crashes, some changes would contribute in better understanding and classification of bicycle crashes:

- Addition of values explaining the type of bicycle crashes (e.g., “Backing Hit Bicycle” or “Left Turn Hit Bicycle”) for “Type of Crash”

- A new field of "Bicyclist Action" with values similar to those of pedestrians and also "On Bike Lane" or "In Sidewalk" and so on.

Table 61. Summary of "189 Type of Crash" of PD-10 Form

"189 Type of Crash"	Bicycle-Involved		Pedestrian-Involved		Total	
	Count	%	Count	%	Count	%
19	810	41.47%	1	0.04%	811	17.90%
Backing Hit Moving Veh.	10	0.51%	2	0.08%	12	0.26%
Backing Hit Parked Veh.	1	0.05%	8	0.31%	9	0.20%
Backing Hit Ped.	4	0.20%	189	7.33%	193	4.26%
Fixed Object	3	0.15%	13	0.50%	16	0.35%
Head On	64	3.28%	71	2.75%	135	2.98%
Left Turn Hit Ped.	81	4.15%	639	24.79%	720	15.89%
Left Turn Hit Veh.	105	5.38%	18	0.70%	123	2.71%
Non-Collision Accident	17	0.87%	8	0.31%	25	0.55%
Other	80	4.10%	91	3.53%	171	3.77%
Override	1	0.05%	1	0.04%	2	0.04%
Parked Vehicle	43	2.20%	12	0.47%	55	1.21%
Ran Off Roadway	3	0.15%	7	0.27%	10	0.22%
Rear End	88	4.51%	18	0.70%	106	2.34%
Right Angle	170	8.70%	26	1.01%	196	4.33%
Right Turn Hit Ped.	78	3.99%	212	8.22%	290	6.40%
Right Turn Hit Veh.	74	3.79%	10	0.39%	84	1.85%
Side Swiped	228	11.67%	92	3.57%	320	7.06%
Straight Hit Ped.	87	4.45%	1147	44.49%	1234	27.23%
Unknown	6	0.31%	13	0.50%	19	0.42%
Total	**1953**	**100.00%**	**2578**	**100.00%**	**4531**	**100.00%**

Table 62. Summary of "199 Pedestrian Action" of PD-10 Form

"199 Pedestrian Action"	Bicycle-Involved		Pedestrian-Involved		Total	
	Count	%	Count	%	Count	%
Against Signal in Crosswalk	36	1.90%	170	6.64%	206	4.62%
From Between Parked Cars	9	0.47%	163	6.36%	172	3.86%
In Crosswalk - No Signal	78	4.11%	412	16.08%	490	10.99%
In Unmarked Crosswalk	12	0.63%	33	1.29%	45	1.01%
N/A	1133	59.76%	82	3.20%	1215	27.25%
Not In Crosswalk	84	4.43%	539	21.04%	623	13.97%
Other	203	10.71%	382	14.91%	585	13.12%
Unknown	219	11.55%	124	4.84%	343	7.69%
With Signal in Crosswalk	122	6.43%	657	25.64%	779	17.47%
Total	**1896**	**100.00%**	**2562**	**100.00%**	**4458**	**100.00%**

NHTSA Pedestrian Crashes

Figure 35 demonstrates the geographical distribution of pedestrian crashes in Washington, DC (2012-14). Crashes happened more in the NW city quadrant. In this section, the pedestrian crashes (vehicle-pedestrian) were examined and the NHTSA crash types and groups were identified based on crash data in 2012-14. Moreover, the LMCM crash types were also recognized and compared with NHTSA crash types.

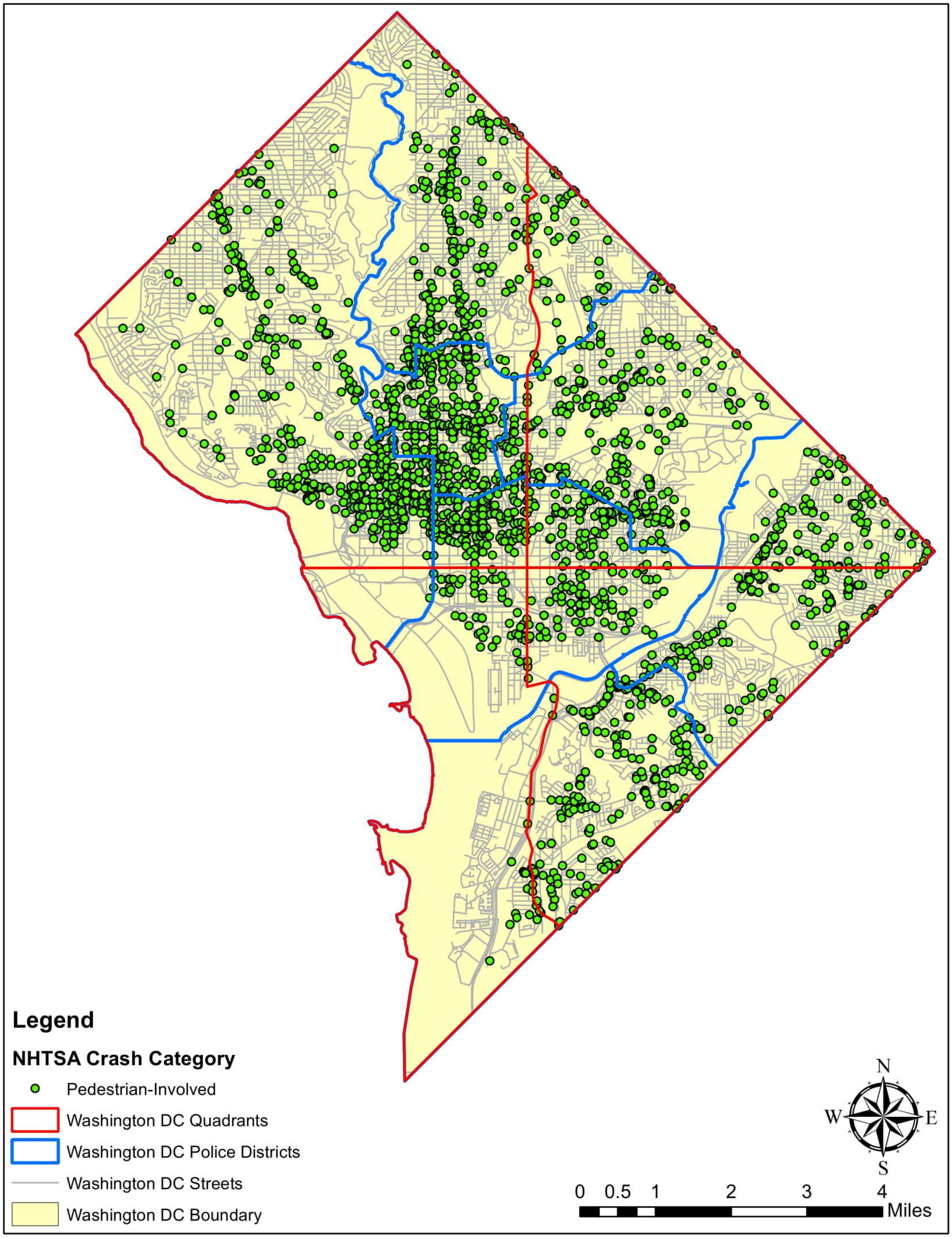


Figure 35. NHTSA Pedestrian Crashes in Washington, DC (2012-14)

Vehicle drivers were at fault twice as pedestrians (58.1% vs 26.9%) but for fatal crashes (26 crashes) pedestrians were at fault more than vehicle drivers (42.3 vs 34.6%) (Table 63) which was also proven to be statistically significant at 99% confidence level (Table 64).

Summary of pedestrian crashes by vehicle driver and pedestrian demographics (gender and age) are demonstrated in Table 65 to Table 70. The notable findings besides general descriptive summaries are as follows; drivers of 45-54 of age were slightly (90% confidence level) lower involved in fatal and disabling crashes compared to other crash severity levels (Table 66). Female pedestrians had experienced slightly (90% confidence level) lower proportion of fatal and disabling crashes (Table 68). Senior pedestrians (65 & over) had significantly (99% confidence level) higher proportion of fatal and disabling crashes compared to other crash severity levels (Table 69).

Summary of pedestrian crashes by construction zone and also hit & run crashes are provided in Table 71 and Table 72. The proportions of fatal, disabling, and non-disabling crashes were not statistically different in these special crash location and type.

Table 63. Summary of Pedestrian Crashes by Fault / Violation & Severity Level

Crash Severity / **Fault / Violation**	**Fatal**	**Disabling**	**Non-Disabling**	**Complaint but not visible**	**No Injury**	**Unknown**	**Total**
Vehicle Driver/Passenger	34.62%	53.70%	57.52%	61.78%	52.88%	56.32%	58.10%
Pedestrian	42.31%	33.80%	30.83%	21.05%	30.51%	19.54%	26.89%
Unknown	19.23%	11.11%	9.32%	15.23%	15.59%	18.39%	12.93%
No Fault / Violation	0.00%	0.46%	1.27%	1.26%	0.34%	4.60%	1.19%
Both	3.85%	0.93%	1.06%	0.68%	0.68%	1.15%	0.88%
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**

Table 64. Summary of Pedestrian Crashes by Fault / Violation & Severity Level

Fault / Violation	**Fatal & Disabling**		**Other**		**Total**		***Sig.***
	Count	**%**	**Count**	**%**	**Count**	**%**	
Vehicle Driver/Passenger	125	51.65%	1385	58.76%	1510	58.10%	--
Pedestrian	84	34.71%	615	26.09%	699	26.89%	+++
Unknown	29	11.98%	307	13.03%	336	12.93%	
No Fault / Violation	1	0.41%	30	1.27%	31	1.19%	
Both	3	1.24%	20	0.85%	23	0.88%	
Total	**242**	**100.00%**	**2357**	**100.00%**	**2599**	**100.00%**	

Table 65. Summary of Pedestrian Crashes by Driver Gender & Severity Level

Driver Gender	Fatal & Disabling		Other		Total		*Sig.*
	Count	%	Count	%	Count	%	
Female	66	27.27%	764	32.41%	830	31.94%	
Male	150	61.98%	1339	56.81%	1489	57.29%	
Not Available	26	10.74%	254	10.78%	280	10.77%	
Total	**242**	**100.00%**	**2357**	**100.00%**	**2599**	**100.00%**	

Table 66. Summary of Pedestrian Crashes by Driver Age & Severity Level

Driver Age	Fatal & Disabling		Other		Total		*Sig.*
	Count	%	Count	%	Count	%	
21 & under	16	6.61%	132	5.60%	148	5.69%	
22 - 34	80	33.06%	681	28.89%	761	29.28%	
35 - 44	46	19.01%	391	16.59%	437	16.81%	
45 - 54	32	13.22%	411	17.44%	443	17.05%	-
55 - 64	32	13.22%	360	15.27%	392	15.08%	
65 & over	26	10.74%	240	10.18%	266	10.23%	
Not Available	10	4.13%	142	6.02%	152	5.85%	
Total	**242**	**100.00%**	**2357**	**100.00%**	**2599**	**100.00%**	

Table 67. Summary of Pedestrian Crashes by Driver Gender, Age & Severity Level

Driver Gender & Age	Fatal & Disabling		Other		Total		*Sig.*
	Count	%	Count	%	Count	%	
21 & under	3	4.55%	46	6.02%	49	5.90%	
22 - 34	26	39.39%	255	33.38%	281	33.86%	
35 - 44	11	16.67%	133	17.41%	144	17.35%	
45 - 54	10	15.15%	120	15.71%	130	15.66%	
55 - 64	4	6.06%	97	12.70%	101	12.17%	
65 & over	10	15.15%	81	10.60%	91	10.96%	
Not Available	2	3.03%	32	4.19%	34	4.10%	
Female	**66**	**100.00%**	**764**	**100.00%**	**830**	**100.00%**	
21 & under	8	5.33%	56	4.18%	64	4.30%	
22 - 34	48	32.00%	346	25.84%	394	26.46%	
35 - 44	32	21.33%	238	17.77%	270	18.13%	
45 - 54	19	12.67%	259	19.34%	278	18.67%	--
55 - 64	25	16.67%	236	17.63%	261	17.53%	
65 & over	14	9.33%	154	11.50%	168	11.28%	
Not Available	4	2.67%	50	3.73%	54	3.63%	
Not Available	**26**	**100.00%**	**254**	**100.00%**	**280**	**100.00%**	
21 & under	5	19.23%	30	11.81%	35	12.50%	
22 - 34	6	23.08%	80	31.50%	86	30.71%	

35 - 44	3	11.54%	20	7.87%	23	8.21%	
45 - 54	3	11.54%	32	12.60%	35	12.50%	
55 - 64	3	11.54%	27	10.63%	30	10.71%	
65 & over	2	7.69%	5	1.97%	7	2.50%	+
Not Available	4	15.38%	60	23.62%	64	22.86%	
Not Available	**26**	**100.00%**	**254**	**100.00%**	**280**	**100.00%**	
Total	**242**	**-**	**2357**	**-**	**2599**	**-**	

Table 68. Summary of Pedestrian Crashes by Pedestrian Gender & Severity Level

Pedestrian Gender	Fatal & Disabling		Other		Total		*Sig.*
	Count	%	Count	%	Count	%	
Female	97	40.08%	1076	45.65%	1173	45.13%	-
Male	117	48.35%	1020	43.28%	1137	43.75%	
Not Available	28	11.57%	261	11.07%	289	11.12%	
Total	**242**	**100.00%**	**2357**	**100.00%**	**2599**	**100.00%**	

Table 69. Summary of Pedestrian Crashes by Pedestrian Age & Severity Level

Pedestrian Age	Fatal & Disabling		Other		Total		*Sig.*
	Count	%	Count	%	Count	%	
21 & under	21	8.68%	307	13.03%	328	12.62%	-
22 - 34	65	26.86%	634	26.90%	699	26.89%	
35 - 44	31	12.81%	306	12.98%	337	12.97%	
45 - 54	25	10.33%	292	12.39%	317	12.20%	
55 - 64	32	13.22%	246	10.44%	278	10.70%	
65 & over	29	11.98%	159	6.75%	188	7.23%	+++
Not Available	39	16.12%	413	17.52%	452	17.39%	
Total	**242**	**100.00%**	**2357**	**100.00%**	**2599**	**100.00%**	

Table 70. Summary of Pedestrian Crashes by Pedestrian Gender, Age & Severity Level

Pedestrian Gender & Age	Fatal & Disabling		Other		Total		*Sig.*
	Count	%	Count	%	Count	%	
21 & under	7	7.22%	165	15.33%	172	14.66%	--
22 - 34	24	24.74%	321	29.83%	345	29.41%	
35 - 44	11	11.34%	145	13.48%	156	13.30%	
45 - 54	12	12.37%	138	12.83%	150	12.79%	
55 - 64	14	14.43%	105	9.76%	119	10.14%	
65 & over	13	13.40%	75	6.97%	88	7.50%	++
Not Available	16	16.49%	127	11.80%	143	12.19%	
Female	**97**	**100.00%**	**1076**	**100.00%**	**1173**	**100.00%**	
21 & under	10	8.55%	117	11.47%	127	11.17%	

Pedestrian Gender & Age	Fatal & Disabling		Other		Total		Sig.
	Count	%	Count	%	Count	%	
22 - 34	38	32.48%	272	26.67%	310	27.26%	
35 - 44	17	14.53%	144	14.12%	161	14.16%	
45 - 54	10	8.55%	133	13.04%	143	12.58%	
55 - 64	14	11.97%	128	12.55%	142	12.49%	
65 & over	13	11.11%	71	6.96%	84	7.39%	
Not Available	15	12.82%	155	15.20%	170	14.95%	
Male	**117**	**100.00%**	**1020**	**100.00%**	**1137**	**100.00%**	
21 & under	4	14.29%	25	9.58%	29	10.03%	
22 - 34	3	10.71%	41	15.71%	44	15.22%	
35 - 44	3	10.71%	17	6.51%	20	6.92%	
45 - 54	3	10.71%	21	8.05%	24	8.30%	
55 - 64	4	14.29%	13	4.98%	17	5.88%	++
65 & over	3	10.71%	13	4.98%	16	5.54%	
Not Available	8	28.57%	131	50.19%	139	48.10%	--
Not Available	**28**	**100.00%**	**261**	**100.00%**	**289**	**100.00%**	
Total	**242**	**-**	**2357**	**-**	**2599**	**-**	

Table 71. Summary of Pedestrian Crashes by Construction Zone & Severity Level

Severity	Construction Zone: Yes		Construction Zone: No		Total		Sig.
	Count	%	Count	%	Count	%	
Fatal	2	2.56%	24	0.95%	26	1.00%	
Disabling	3	3.85%	213	8.45%	216	8.31%	
Non-Disabling	31	39.74%	913	36.22%	944	36.32%	
Complaint but not visible	29	37.18%	1002	39.75%	1031	39.67%	
No Injury	9	11.54%	286	11.34%	295	11.35%	
Unknown	4	5.13%	83	3.29%	87	3.35%	
Total	**78**	**100.00%**	**2521**	**100.00%**	**2599**	**100.00%**	

Table 72. Summary of Pedestrian Crashes by Hit & Run & Severity Level

Severity	Hit & Run: Yes		Hit & Run: No		Total		Sig.
	Count	%	Count	%	Count	%	
Fatal	6	1.12%	20	0.97%	26	1.00%	
Disabling	42	7.84%	174	8.43%	216	8.31%	
Non-Disabling	192	35.82%	752	36.45%	944	36.32%	
Complaint but not visible	191	35.63%	840	40.72%	1031	39.67%	--
No Injury	78	14.55%	217	10.52%	295	11.35%	+++
Unknown	27	5.04%	60	2.91%	87	3.35%	++
Total	**536**	**100.00%**	**2063**	**100.00%**	**2599**	**100.00%**	

The summary of crashes by pedestrian position (NHTSA categories) is demonstrated in Table 73 and Table 74. More than half of pedestrian crashes were labelled as "Crosswalk Area" followed by "Travel Lane" (24%). The proportion of fatal and disabling crashes was significantly (95% confidence level) higher when the pedestrian position was "Travel Lane."

Table 73. Summary of Pedestrian Crashes by Pedestrian Position & Severity Level

Pedestrian Position	**Fatal & Disabling**		**Other**		**Total**		***Sig.***
	Count	**%**	**Count**	**%**	**Count**	**%**	
Crosswalk Area	114	47.11%	1222	51.85%	1336	51.40%	
Travel Lane	73	30.17%	551	23.38%	624	24.01%	++
Paved Shoulder / Bike lane / Parking Lane	12	4.96%	138	5.85%	150	5.77%	
Other / Unknown	12	4.96%	118	5.01%	130	5.00%	
Nonroadway—Parking lot/Other	10	4.13%	105	4.45%	115	4.42%	
Sidewalk / Shared-Use Path / Driveway Crossing	11	4.55%	91	3.86%	102	3.92%	
Intersection	3	1.24%	93	3.95%	96	3.69%	--
Driveway / Alley	7	2.89%	36	1.53%	43	1.65%	
N/A (Bike Crash)	0	0.00%	2	0.08%	2	0.08%	
Unpaved Right-of-Way	0	0.00%	1	0.04%	1	0.04%	
Total	**242**	**100.00%**	**2357**	**100.00%**	**2599**	**100.00%**	

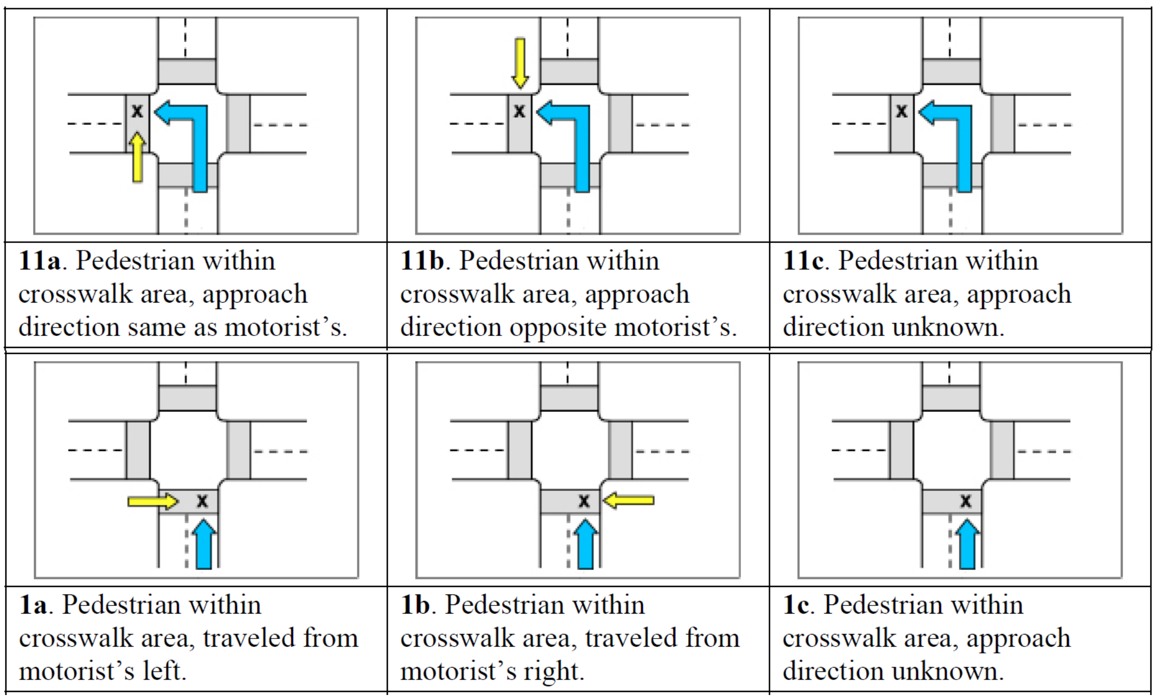
Table 74. Summary of Pedestrian Crashes by Pedestrian Position (regrouped) & Severity Level

Pedestrian Position	**Fatal & Disabling**		**Other**		**Total**		***Sig.***
	Count	**%**	**Count**	**%**	**Count**	**%**	
Crosswalk Area	114	47.11%	1222	51.85%	1336	51.40%	
Travel Lane	73	30.17%	551	23.38%	624	24.01%	++
Other	45	18.60%	477	20.24%	522	20.08%	
Nonroadway—Parking lot/Other	10	4.13%	105	4.45%	115	4.42%	
Not Applicable		0.00%	2	0.08%	2	0.08%	
Total	**242**	**100.00%**	**2357**	**100.00%**	**2599**	**100.00%**	

The pedestrian location scenario (only for intersections) is summarized in Table 75. Left-turn crashes at farside (11b, 11a, and 11c) were the main scenarios accounting for more than 32 percent of intersection crashes followed by straight moving vehicle at nearside crashes (1c, 1 b, and 1a). Figure 36 shows the diagrams of aforementioned six scenarios.

Table 75. Top 10 Pedestrian Location Scenarios & Severity Level

Location Scenario	**Fatal & Disabling**		**Other**		**Total**		***Sig.***
	Count	**%**	**Count**	**%**	**Count**	**%**	
11b	19	13.29%	211	13.96%	230	13.91%	
11a	9	6.29%	145	9.60%	154	9.31%	
11c	6	4.20%	140	9.27%	146	8.83%	--
1c	10	6.99%	132	8.74%	142	8.59%	
1b	12	8.39%	96	6.35%	108	6.53%	
1a	7	4.90%	84	5.56%	91	5.50%	
2c	6	4.20%	57	3.77%	63	3.81%	
3a	7	4.90%	53	3.51%	60	3.63%	
7c	4	2.80%	51	3.38%	55	3.33%	
7a	3	2.10%	51	3.38%	54	3.26%	
Other Scenarios	42	29.37%	353	23.36%	395	23.88%	
Unknown	18	12.59%	138	9.13%	156	9.43%	
Total	**143**	**100.00%**	**1511**	**100.00%**	**1654**	**100.00%**	



11a. Pedestrian within crosswalk area, approach direction same as motorist's.

11b. Pedestrian within crosswalk area, approach direction opposite motorist's.

11c. Pedestrian within crosswalk area, approach direction unknown.

1a. Pedestrian within crosswalk area, traveled from motorist's left.

1b. Pedestrian within crosswalk area, traveled from motorist's right.

1c. Pedestrian within crosswalk area, approach direction unknown.

Figure 36. Main Pedestrian Location Scenarios in Washington, DC (2012-14): Left-Turn Farside & Straight Nearside

Table 77 summarizes the top 10 pedestrian NHTSA crash types. Top three pedestrian crashes (42.8% of all pedestrian crashes) were all intersection-related crashes; crash type 781, which accounts for more than one-fifth of all pedestrian crashes, is defined as "*The motorist was initially traveling on a parallel path with the pedestrian before making a left turn and striking the individual.*" Moreover, in 86% of these crashes vehicle drivers were at fault due to inattention or speeding to not miss the green light. The second prevalent crash type was also due to drivers failing to yield to the pedestrians when "*vehicle not turning*." The third and fourth crash types where the types that pedestrians were at fault; failing to yield at intersections when "*vehicle not turning*" and darting out when the driver's view was blocked until an instant before impact. The top 10 pedestrian crash types account for about 72% of all pedestrian crashes.

Table 76. Top 10 Pedestrian NHTSA Crash Types & Severity Level

NHTSA Crash Type	Fatal & Disabling		Other		Total		*Sig.*
	Count	%	Count	%	Count	%	
781 - Motorist Left Turn—Parallel Paths	37	15.29%	520	22.06%	557	21.43%	--
770 - Motorist Failed to Yield	33	13.64%	294	12.47%	327	12.58%	
760 - Pedestrian Failed to Yield	34	14.05%	195	8.27%	229	8.81%	+++
742 - Dart-Out	14	5.79%	138	5.85%	152	5.85%	
791 - Motorist Right Turn—Parallel Paths	10	4.13%	119	5.05%	129	4.96%	
690 - Intersection—Other/Unknown	15	6.20%	110	4.67%	125	4.81%	
213 - Backing Vehicle—Roadway	6	2.48%	111	4.71%	117	4.50%	
741 - Dash	14	5.79%	91	3.86%	105	4.04%	
190 - Other Unusual Circumstances	9	3.72%	66	2.80%	75	2.89%	
680 - Nonintersection—Other/Unknown	5	2.07%	57	2.42%	62	2.39%	
Other NHTSA Pedestrian Crash Types	65	26.86%	656	27.83%	721	27.74%	
Total	**242**	**100.00%**	**2357**	**100.00%**	**2599**	**100.00%**	

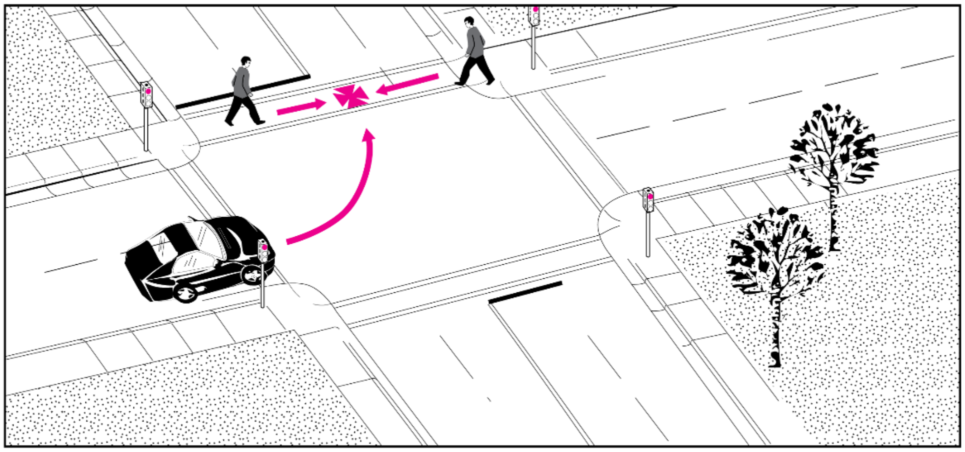
Top three pedestrian crashes had 8 fatal crashes (31% of all fatal crashes) and 96 disabling crashes (44% of all disabling crashes). Some facts about top three pedestrian NHTSA crash types:

- 781 - Motorist Left Turn—Parallel Paths:
  - About 97% at or within 100 ft. of an intersection.
  - About 77% at 4-leg intersection followed by 18.3% at 3-leg intersections.
  - About 79% at signalized intersections followed by 15.1% at sign-controlled intersections. About 5.2% at uncontrolled intersections.
  - Vehicle drivers were at fault in 87% of crashes, pedestrians in 7%, 5.8% unknown. In three crashes (0.54%), both were at fault.
  - The proportion of fatal and disabling crashes was significantly (95% confidence level) lower than other crash severity levels; 15.3% versus 22.1% (Table 76).
- 770 - Motorist Failed to Yield:
  - About 90% at intersections, 5.2% within 100 ft. of an intersection and 4.9% on roads (midblock crossings).
  - About 62.1% at 4-leg intersection followed by 25.7% at 3-leg intersections.

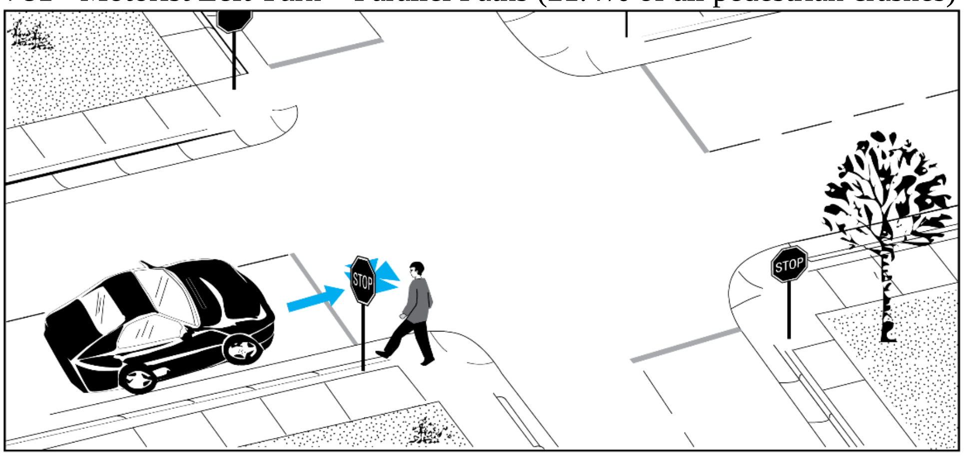
    - About 44.3% at signalized intersections followed by 30% at sign-controlled intersections. About 24.2% at uncontrolled intersections.
    - In two (out of 3) fatal crashes, the vehicle driver was drunk. In one (out of 3) fatal crashes, the vehicle driver was attributed by distraction. In one (out of 3) fatal crashes, the vehicle driver was attributed by speeding.
- 760 - Pedestrian Failed to Yield:
    - About 58% at intersections, 20.5% within 100 ft. of an intersection and 21% on roads.
    - About 54.6% at 4-leg intersection followed by 15.3% at 3-leg intersections. About 22% happened at non-intersections.
    - Sixty nine percent at signalized intersections followed by 21.8% at non-intersections. About 6.6% at uncontrolled intersections.
    - The proportion of fatal and disabling crashes was significantly (99% confidence level) higher than other crash severity levels; 14.1% versus 8.3% (Table 76).

Top three pedestrian NHTSA crash types in Washington, DC (2012 – 14) are presented in Figure 37. Table 77 is also presenting the top 10 pedestrian NHTSA crash types by year. The main crash types were usually similar; however, in the third year, "*742 - Dart-Out*" got the position of the "*760 - Pedestrian Failed to Yield*" as the third common pedestrian NHTSA crash type.

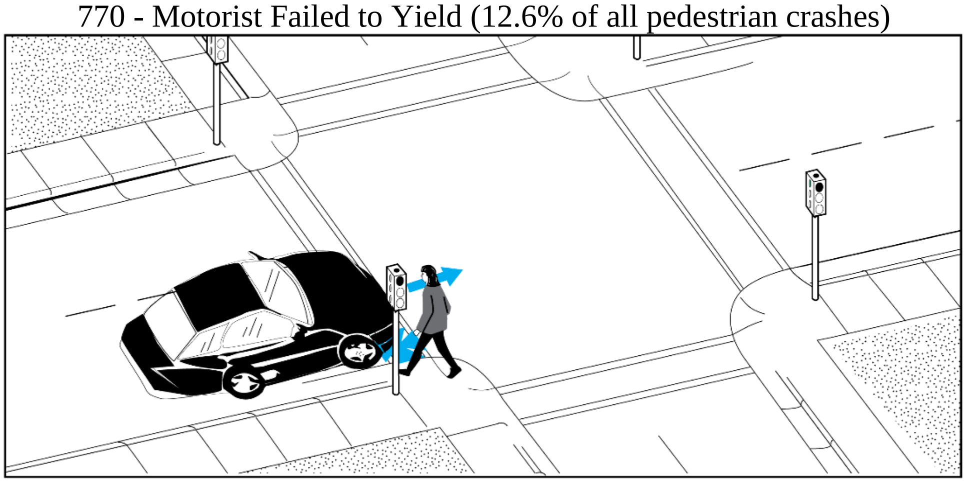
The full list of pedestrian NHTSA crash types including all NHTSA crash types is available in "*Appendix I – Extended Tables*." The appendix also includes the full list of pedestrian NHTSA crash types by year.



781 - Motorist Left Turn—Parallel Paths (21.4% of all pedestrian crashes)



770 - Motorist Failed to Yield (12.6% of all pedestrian crashes)



760 - Pedestrian Failed to Yield (8.8% of all pedestrian crashes)

Figure 37. Top Three NHTSA Pedestrian Crash Types in Washington, DC (2012-14)

Table 77. Top 10 Pedestrian NHTSA Crash Types by Year & Severity Level

NHTSA Crash Type	Fatal & Disabling		Other		Total		*Sig.*
	Count	**%**	**Count**	**%**	**Count**	**%**	
781 - Motorist Left Turn—Parallel Paths	15	18.52%	147	20.14%	162	19.98%	
770 - Motorist Failed to Yield	8	9.88%	95	13.01%	103	12.70%	
760 - Pedestrian Failed to Yield	10	12.35%	68	9.32%	78	9.62%	
742 - Dart-Out	6	7.41%	45	6.16%	51	6.29%	
213 - Backing Vehicle—Roadway	2	2.47%	37	5.07%	39	4.81%	
791 - Motorist Right Turn—Parallel Paths	2	2.47%	37	5.07%	39	4.81%	
190 - Other Unusual Circumstances	6	7.41%	31	4.25%	37	4.56%	
741 - Dash	7	8.64%	26	3.56%	33	4.07%	++
690 - Intersection—Other/Unknown	2	2.47%	23	3.15%	25	3.08%	
680 - Nonintersection—Other/Unknown	2	2.47%	12	1.64%	14	1.73%	
Other NHTSA Pedestrian Crash Types	21	25.93%	209	28.63%	230	28.36%	
2012	**81**	**100.00%**	**730**	**100.00%**	**811**	**100.00%**	
781 - Motorist Left Turn—Parallel Paths	9	10.98%	181	23.26%	190	22.09%	--
770 - Motorist Failed to Yield	10	12.20%	89	11.44%	99	11.51%	
760 - Pedestrian Failed to Yield	18	21.95%	72	9.25%	90	10.47%	+++
690 - Intersection—Other/Unknown	9	10.98%	44	5.66%	53	6.16%	+
791 - Motorist Right Turn—Parallel Paths	4	4.88%	39	5.01%	43	5.00%	
213 - Backing Vehicle—Roadway	2	2.44%	41	5.27%	43	5.00%	
742 - Dart-Out	3	3.66%	34	4.37%	37	4.30%	
741 - Dash	2	2.44%	34	4.37%	36	4.19%	
680 - Nonintersection—Other/Unknown	1	1.22%	29	3.73%	30	3.49%	
190 - Other Unusual Circumstances	1	1.22%	15	1.93%	16	1.86%	
Other NHTSA Pedestrian Crash Types	23	28.05%	200	25.71%	223	25.93%	
2013	**82**	**100.00%**	**778**	**100.00%**	**860**	**100.00%**	
781 - Motorist Left Turn—Parallel Paths	13	16.46%	192	22.61%	205	22.09%	
770 - Motorist Failed to Yield	15	18.99%	110	12.96%	125	13.47%	
742 - Dart-Out	5	6.33%	59	6.95%	64	6.90%	
760 - Pedestrian Failed to Yield	6	7.59%	55	6.48%	61	6.57%	
690 - Intersection—Other/Unknown	4	5.06%	43	5.06%	47	5.06%	
791 - Motorist Right Turn—Parallel Paths	4	5.06%	43	5.06%	47	5.06%	
741 - Dash	5	6.33%	31	3.65%	36	3.88%	
213 - Backing Vehicle—Roadway	2	2.53%	33	3.89%	35	3.77%	
190 - Other Unusual Circumstances	2	2.53%	20	2.36%	22	2.37%	
680 - Nonintersection—Other/Unknown	2	2.53%	16	1.88%	18	1.94%	
Other NHTSA Pedestrian Crash Types	21	26.58%	247	29.09%	268	28.88%	
2014	**79**	**100.00%**	**849**	**100.00%**	**928**	**100.00%**	
Total	**242**	**-**	**2357**	**-**	**2599**	**-**	

Table 78 summarizes the sorted pedestrian NHTSA crash groups. "*790 - Crossing Roadway—Vehicle Turning*" was the main crash group accounting for about 33 percent of all pedestrian crashes followed by "*750 - Crossing Roadway—Vehicle Not Turning*" that accounted for another 21.4% of all pedestrian crashes. After the main two crash groups, "*740 - Dash/Dart-Out*" was the third one. There were some significant differences between the proportions of fatal and disabling crashes versus other crash severity levels; proportions of fatal and disabling crashes were significantly higher for following NHTSA crash groups:

- 750 - Crossing Roadway—Vehicle Not Turning (27.7% vs 20.8%)
- 100 - Unusual Circumstances (13.2% vs 8%)
- 600 - Pedestrian in Roadway—Circumstances Unknown (2.5% vs 1.1%)

The main three NHTSA crash groups accounted for about 64% of all pedestrian crashes. Looking at PEDSAFE online crash type matrix for these three pedestrian crash groups, some applicable countermeasures were identified and listed in Table 79 (the table is showing the matching PEDSAFE crash groups and available countermeasure types, the full list is provided in the "*Appendix J – PEDSAFE Countermeasures for Top Three Pedestrian Crash Groups in Washington, DC*").

Table 78. Pedestrian NHTSA Crash Groups & Severity Level

NHTSA Crash Group	**Fatal & Disabling**		**Other**		**Total**		***Sig.***
	Count	**%**	**Count**	**%**	**Count**	**%**	
790 - Crossing Roadway—Vehicle Turning	56	23.14%	791	33.56%	847	32.59%	---
750 - Crossing Roadway—Vehicle Not Turning	67	27.69%	490	20.79%	557	21.43%	++
740 - Dash/Dart-Out	28	11.57%	229	9.72%	257	9.89%	
100 - Unusual Circumstances	32	13.22%	188	7.98%	220	8.46%	+++
200 - Backing Vehicle	10	4.13%	181	7.68%	191	7.35%	--
990 - Other/Unknown—Insufficient Details	20	8.26%	167	7.09%	187	7.20%	
310 - Working or Playing in Roadway	1	0.41%	69	2.93%	70	2.69%	--
800 - Off Roadway	8	3.31%	49	2.08%	57	2.19%	
350 - Unique Midblock	4	1.65%	52	2.21%	56	2.15%	
460 - Crossing Driveway or Alley	4	1.65%	45	1.91%	49	1.89%	
340 - Bus-Related	3	1.24%	32	1.36%	35	1.35%	
600 - Pedestrian in Roadway—Circumstances Unknown	6	2.48%	25	1.06%	31	1.19%	+
400 - Walking Along Roadway	3	1.24%	25	1.06%	28	1.08%	
720 - Multiple Threat/Trapped	0	0.00%	9	0.38%	9	0.35%	
910 - Crossing Expressway	0	0.00%	3	0.13%	3	0.12%	
500 - Waiting to Cross	0	0.00%	2	0.08%	2	0.08%	
Total	**242**	**100.00%**	**2357**	**100.00%**	**2599**	**100.00%**	

Table 79. Top 3 Pedestrian NHTSA Crash Groups & Matching PEDSAFE Crash Groups

NHTSA Crash Group	PEDSAFE Crash Group	Countermeasure Type
790 - Crossing Roadway—Vehicle Turning	Turning Vehicle	*Crossing Locations*
		Transit
		Roadway Design
		Intersection Design
		Traffic Calming
		Traffic Mgmt.
		Signals/ Signs
		Other
750 - Crossing Roadway—Vehicle Not Turning	Through Vehicle at Signalized Location	*Crossing Locations*
		Transit
		Roadway Design
		Intersection Design
		Traffic Calming
		Traffic Mgmt.
		Signals/ Signs
		Other
	Through Vehicle at Unsignalized Location	*Crossing Locations*
		Transit
		Roadway Design
		Intersection Design
		Traffic Calming
		Signals/ Signs
		Other
740 - Dash/Dart-Out	Dart/Dash	*Along Roadway*
		Crossing Locations
		Transit
		Roadway Design
		Traffic Calming
		Traffic Mgmt.
		Signals/ Signs

Pedestrian NHTSA crash groups are summarized by year in Table 80. The main crash groups were almost similar in all three years except in the second year that "*990 - Other/Unknown—Insufficient Details*" got the position of "*740 - Dash/Dart-Out*" as the third common crash group.

Table 80. Pedestrian NHTSA Crash Groups by Year & Severity Level

NHTSA Crash Group	Fatal & Disabling		Other		Total		*Sig.*
	Count	%	Count	%	Count	%	
790 - Crossing Roadway—Vehicle Turning	21	25.93%	241	33.01%	262	32.31%	
750 - Crossing Roadway—Vehicle Not Turning	18	22.22%	163	22.33%	181	22.32%	

NHTSA Crash Group	Fatal & Disabling		Other		Total		Sig.
	Count	%	Count	%	Count	%	
740 - Dash/Dart-Out	13	16.05%	71	9.73%	84	10.36%	+
100 - Unusual Circumstances	12	14.81%	71	9.73%	83	10.23%	
200 - Backing Vehicle	3	3.70%	61	8.36%	64	7.89%	
990 - Other/Unknown—Insufficient Details	4	4.94%	35	4.79%	39	4.81%	
310 - Working or Playing in Roadway	1	1.23%	22	3.01%	23	2.84%	
800 - Off Roadway	2	2.47%	20	2.74%	22	2.71%	
460 - Crossing Driveway or Alley	2	2.47%	12	1.64%	14	1.73%	
600 - Pedestrian in Roadway—Circumstances Unknown	3	3.70%	9	1.23%	12	1.48%	+
350 - Unique Midblock	1	1.23%	7	0.96%	8	0.99%	
340 - Bus-Related	0	0.00%	8	1.10%	8	0.99%	
400 - Walking Along Roadway	1	1.23%	5	0.68%	6	0.74%	
720 - Multiple Threat/Trapped	0	0.00%	3	0.41%	3	0.37%	
500 - Waiting to Cross	0	0.00%	2	0.27%	2	0.25%	
2012	**81**	**100.00%**	**730**	**100.00%**	**811**	**100.00%**	***Sig.***
790 - Crossing Roadway—Vehicle Turning	16	19.51%	266	34.19%	282	32.79%	---
750 - Crossing Roadway—Vehicle Not Turning	28	34.15%	161	20.69%	189	21.98%	+++
990 - Other/Unknown—Insufficient Details	10	12.20%	73	9.38%	83	9.65%	
740 - Dash/Dart-Out	5	6.10%	68	8.74%	73	8.49%	
100 - Unusual Circumstances	10	12.20%	53	6.81%	63	7.33%	+
200 - Backing Vehicle	3	3.66%	59	7.58%	62	7.21%	
310 - Working or Playing in Roadway	0	0.00%	22	2.83%	22	2.56%	
350 - Unique Midblock	2	2.44%	19	2.44%	21	2.44%	
340 - Bus-Related	2	2.44%	15	1.93%	17	1.98%	
460 - Crossing Driveway or Alley	2	2.44%	13	1.67%	15	1.74%	
800 - Off Roadway	2	2.44%	11	1.41%	13	1.51%	
400 - Walking Along Roadway	0	0.00%	8	1.03%	8	0.93%	
600 - Pedestrian in Roadway—Circumstances Unknown	2	2.44%	6	0.77%	8	0.93%	
910 - Crossing Expressway	0	0.00%	3	0.39%	3	0.35%	
720 - Multiple Threat/Trapped	0	0.00%	1	0.13%	1	0.12%	
2013	**82**	**100.00%**	**778**	**100.00%**	**860**	**100.00%**	***Sig.***
790 - Crossing Roadway—Vehicle Turning	19	24.05%	284	33.45%	303	32.65%	-
750 - Crossing Roadway—Vehicle Not Turning	21	26.58%	166	19.55%	187	20.15%	

NHTSA Crash Group	Fatal & Disabling		Other		Total		*Sig.*
	Count	%	Count	%	Count	%	
740 - Dash/Dart-Out	10	12.66%	90	10.60%	100	10.78%	
100 - Unusual Circumstances	10	12.66%	64	7.54%	74	7.97%	
990 - Other/Unknown—Insufficient Details	6	7.59%	59	6.95%	65	7.00%	
200 - Backing Vehicle	4	5.06%	61	7.18%	65	7.00%	
350 - Unique Midblock	1	1.27%	26	3.06%	27	2.91%	
310 - Working or Playing in Roadway	0	0.00%	25	2.94%	25	2.69%	
800 - Off Roadway	4	5.06%	18	2.12%	22	2.37%	
460 - Crossing Driveway or Alley	0	0.00%	20	2.36%	20	2.16%	
400 - Walking Along Roadway	2	2.53%	12	1.41%	14	1.51%	
600 - Pedestrian in Roadway—Circumstances Unknown	1	1.27%	10	1.18%	11	1.19%	
340 - Bus-Related	1	1.27%	9	1.06%	10	1.08%	
720 - Multiple Threat/Trapped	0	0.00%	5	0.59%	5	0.54%	
2014	**79**	**100.00%**	**849**	**100.00%**	**928**	**100.00%**	
Total	**242**	**100.00%**	**2357**	**100.00%**	**2599**	**100.00%**	

While there are sixteen NHTSA crash groups for pedestrian crashes, some of them had very few cases in three years thus after careful review of crash groups an alternative crash grouping was proposed and presented in Table 81. Crossing roadway crashes were the main crash types and groups so addition of fault would provide more information and might contribute in better countermeasures and preventions. Based on the proposed groups, the sorted pedestrian crash groups would be as follows:

1. Crossing Roadway—Vehicle Left Turn—Motorist Fault (20%)
2. Crossing Roadway—Vehicle Not Turning—Motorist Fault (12.6%)
3. Dash/Dart-Out (9.9%)
4. Crossing Roadway—Vehicle Not Turning—Pedestrian Fault (8.8%)
5. Unusual Circumstances (8.5%)
6. Backing Vehicle (7.3%)
7. Crossing Roadway—Vehicle Right Turn—Motorist Fault (6.4%)
8. Crossing Roadway—Vehicle Left Turn—Pedestrian Fault (2%)
9. Crossing Roadway—Vehicle Right Turn—Pedestrian Fault (0.6%)
10. Other (23.9%)

Table 81. Proposed Pedestrian Crash Groups based on Washington, DC Crashes (2012-14)

NHTSA Pedestrian Crash Group	DDOT (2012-14)%	Proposed Crash Group	DDOT (2012-14)%	Final Ranking
790 - Crossing Roadway—Vehicle Turning	32.6%	Crossing Roadway—Vehicle Left Turn—Motorist Fault	20.0%	**1**
		Crossing Roadway—Vehicle Left Turn—Pedestrian Fault	2.0%	8
		Crossing Roadway—Vehicle Right Turn—Motorist Fault	6.4%	7
		Crossing Roadway—Vehicle Right Turn—Pedestrian Fault	0.6%	9
750 - Crossing Roadway—Vehicle Not Turning	21.4%	Crossing Roadway—Vehicle Not Turning—Motorist Fault	12.6%	**2**
		Crossing Roadway—Vehicle Not Turning—Pedestrian Fault	8.8%	4
740 - Dash/Dart-Out	9.9%	Dash/Dart-Out	9.9%	**3**
200 - Backing Vehicle	7.3%	Backing Vehicle	7.3%	6
100 - Unusual Circumstances	8.5%	Unusual Circumstances	8.5%	5
All other types	20.3%	Other	23.9%	-

Notes:

- *The **green** cells indicate new pedestrian crash groups.*
- *The main nine groups account for 76.1% of all pedestrian crashes in 2012-14.*

The LMCM crash categories for pedestrian crashes are summarized in Table 82 and top ten LMCM crash types are listed in Table 83.

Table 82. Summary of Pedestrian Crashes by LMCM Crash Category & Severity Level

LMCM Crash Category	**Fatal & Disabling**		**Other**		**Total**		***Sig.***
	Count	**%**	**Count**	**%**	**Count**	**%**	
Intersection	156	64.46%	1602	67.97%	1758	67.64%	
Non-Intersection	67	27.69%	572	24.27%	639	24.59%	
Parking lot or private property	13	5.37%	143	6.07%	156	6.00%	
Other	6	2.48%	40	1.70%	46	1.77%	
Total	**242**	**100.00%**	**2357**	**100.00%**	**2599**	**100.00%**	

Table 83. Top 10 Pedestrian LMCM Crash Types & Severity Level

LMCM Crash Type	**Fatal & Disabling**		**Other**		**Total**		***Sig.***
	Count	**%**	**Count**	**%**	**Count**	**%**	
I-NS-ST-X	28	11.57%	218	9.25%	246	9.47%	
N-RRD-X	28	11.57%	214	9.08%	242	9.31%	
I-FS-LT-O	17	7.02%	224	9.50%	241	9.27%	
I-FS-LT-X	9	3.72%	159	6.75%	168	6.46%	-
I-FS-LT-S	11	4.55%	153	6.49%	164	6.31%	
I-NS-ST-R	18	7.44%	127	5.39%	145	5.58%	
I-NS-ST-L	10	4.13%	123	5.22%	133	5.12%	
N-RRD-R	12	4.96%	110	4.67%	122	4.69%	
I-FS-ST-X	10	4.13%	73	3.10%	83	3.19%	
I-FS-ST-R	10	4.13%	65	2.76%	75	2.89%	
Other LMCM Types	89	36.78%	891	37.80%	980	37.71%	
Total	**242**	**100.00%**	**2357**	**100.00%**	**2599**	**100.00%**	

The main LMCM pedestrian crash types were as follows:

- I-NS-ST-X: *Straight-traveling motorist strikes pedestrian in roadway on near side of intersection, no or unknown pedestrian direction*
- N-RRD-X: *Straight-traveling motorist strikes pedestrian on right side of roadway, pedestrian not approaching from left or right or unknown*
- I-FS-LT-O: *Left-turning motorist strikes pedestrian traveling from opposite direction (relative to motorist's direction before turning) in far crosswalk* or *nearby*

Top three pedestrian LMCM crashes had 6 fatal crashes (23% of all fatal crashes) and 67 disabling crashes (31% of all disabling crashes). Some facts about top three pedestrians LMCM crash types:

- I-NS-ST-X:
    - About 62% at 4-leg intersection followed by 27.6% at 3-leg intersections.

- About 61.4% at signalized intersections followed by 18.3% at sign-controlled intersections. About 20.3% at uncontrolled intersections.
  - Vehicle drivers were at fault in 49% of crashes, pedestrians in 41.9%, 7.7% unknown. In two crashes (0.81%), both were at fault.
  - Vehicle driver was at fault for the only fatal crash.
- N-RRD-X:
  - Vehicle drivers were at fault in 40.5% of crashes, pedestrians in 35.1%, 21.5% unknown. In four crashes (1.65%), both were at fault.
  - Pedestrians were at fault in two fatal crashes (50%), vehicle driver in one (25%), and it was unknown for the other fatal crash who was at fault. The driver was drunk in the fatal crash that driver was at fault.
- I-FS-LT-O:
  - About 80% at 4-leg intersection followed by 16.6% at 3-leg intersections.
  - About 74.3% at signalized intersections followed by 21.2% at non-intersections. About 4.6% at uncontrolled intersections.
  - Vehicle drivers were at fault in 88% of crashes, pedestrians in 4.2%, 7.1% unknown. In two crashes (0.83%), both were at fault.
  - Vehicle driver was at fault for the only fatal crash. For about 93.8% of all disabling crashes vehicle driver was at fault.

Table 84 is presenting the top 10 pedestrian LMCM crash types by year. While each year had a different top LMCM crash type, the top three LMCM crashes in 2012-14 showed up at least twice among the top three LMCM crash types in three years.

The full list of LMCM crash types including all NHTSA crash types is available in "*Appendix I – Extended Tables*." The appendix also includes the full list of LMCM crash types by year.

Table 84. Top 10 Pedestrian LMCM Crash Types by Year & Severity Level

LMCM Crash Type	**Fatal & Disabling**		**Other**		**Total**		***Sig.***
	Count	**%**	**Count**	**%**	**Count**	**%**	
I-NS-ST-X	16	19.75%	116	15.89%	132	16.28%	
I-FS-LT-O	6	7.41%	69	9.45%	75	9.25%	
I-FS-LT-X	4	4.94%	56	7.67%	60	7.40%	
N-RRD-X	10	12.35%	50	6.85%	60	7.40%	+
I-NS-ST-R	3	3.70%	34	4.66%	37	4.56%	
I-FS-LT-S	5	6.17%	29	3.97%	34	4.19%	
I-NS-ST-L	2	2.47%	32	4.38%	34	4.19%	
N-RRD-R	3	3.70%	23	3.15%	26	3.21%	
I-FS-ST-X	2	2.47%	16	2.19%	18	2.22%	
I-FS-ST-R	2	2.47%	14	1.92%	16	1.97%	
Other LMCM Types	28	34.57%	291	39.86%	319	39.33%	
2012	**81**	**100.00%**	**730**	**100.00%**	**811**	**100.00%**	
N-RRD-X	8	9.76%	93	11.95%	101	11.74%	
I-FS-LT-O	3	3.66%	79	10.15%	82	9.53%	-
I-FS-LT-S	5	6.10%	61	7.84%	66	7.67%	

LMCM Crash Type	Fatal & Disabling		Other		Total		Sig.
	Count	%	Count	%	Count	%	
N-RRD-R	5	6.10%	58	7.46%	63	7.33%	
I-NS-ST-R	9	10.98%	43	5.53%	52	6.05%	++
I-FS-LT-X	1	1.22%	46	5.91%	47	5.47%	-
I-NS-ST-L	6	7.32%	38	4.88%	44	5.12%	
I-NS-ST-X	2	2.44%	39	5.01%	41	4.77%	
I-FS-ST-R	6	7.32%	24	3.08%	30	3.49%	++
I-FS-ST-X	3	3.66%	27	3.47%	30	3.49%	
Other LMCM Types	34	41.46%	270	34.70%	304	35.35%	
2013	**82**	**100.00%**	**778**	**100.00%**	**860**	**100.00%**	
I-FS-LT-O	8	10.13%	76	8.95%	84	9.05%	
N-RRD-X	10	12.66%	71	8.36%	81	8.73%	
I-NS-ST-X	10	12.66%	63	7.42%	73	7.87%	+
I-FS-LT-S	1	1.27%	63	7.42%	64	6.90%	--
I-FS-LT-X	4	5.06%	57	6.71%	61	6.57%	
I-NS-ST-R	6	7.59%	50	5.89%	56	6.03%	
I-NS-ST-L	2	2.53%	53	6.24%	55	5.93%	
I-FS-ST-X	5	6.33%	30	3.53%	35	3.77%	
N-RRD-R	4	5.06%	29	3.42%	33	3.56%	
I-FS-ST-R	2	2.53%	27	3.18%	29	3.13%	
Other LMCM Types	27	34.18%	330	38.87%	357	38.47%	
2014	**79**	**100.00%**	**849**	**100.00%**	**928**	**100.00%**	
Total	**242**	**-**	**2357**	**-**	**2599**	**-**	

The main intention of developing LMCM crash typology was to complement the NHTSA crash typology by providing location and movement information for crashes (Schneider and Stefanich 2015, Schneider and Stefanich 2016). Table 85 presents the cross-tabulation of top ten NHTSA and LMCM crash types.

Based on the table, for "*781 - Motorist Left Turn—Parallel Paths*" NHTSA crash type, 43% of crashes were "*I-FS-LT-O*", 29% were "*I-FS-LT-S*", and 27% were "*I-FS-LT-X*." In other words, the relative direction of vehicle and pedestrian could be identified for about 72% of this crash type; however, the crash reports did not have sufficient information and only noted that the vehicle and pedestrian were on the parallel paths. For "*770 - Motorist Failed to Yield*" NHTSA crash type, 26% of crashes were "*I-NS-ST-X*", 24% were "*I-NS-ST-R*", 17% were "*I-NS-ST-L*", 8% were "*I-FS-ST-R*", and 6% were "*I-FS-ST-X*." In other words, at least 67% of crashes happened on the nearside of the intersections and in 24% of crashes pedestrian approached the vehicle from right-side and 17% from left-side of vehicle. Similarly for "*760 - Pedestrian Failed to Yield*" NHTSA crash type, 22% of crashes were "*I-NS-ST-X*", 14% were "*I-NS-ST-R*", 14% were "*I-NS-ST-L*", 10% were "*I-FS-ST-R*", 9% were "*I-FS-ST-X*", 7% were "*N-RRD-R*", and 7% were "*N-RRD-X*." A quick review of these figures implies that this NHTSA crash type happened at both intersections (at least 69%) and also midblock crashes (at least 14%). Moreover, the crashes happened more on the nearside of the intersection (at least 50%) versus farside of the intersection (at least 19%) and in the non-intersection crashes pedestrian approached the vehicle from right-side (7%) and unknown approach (7%).

Table 85. Crosstab of Top 10 Pedestrian NHTSA & LMCM Crash Types

NHTSA Pedestrian Crash Type	I-FS-LT-O	I-FS-LT-S	I-FS-LT-X	I-FS-ST-R	I-FS-ST-X	I-NS-ST-L	I-NS-ST-R	I-NS-ST-X	N-RRD-R	N-RRD-X	Other LMCM Types	Total
781 - Motorist Left Turn—Parallel Paths	43%	29%	27%	0%	0%	0%	0%	0%	0%	0%	1%	**557**
770 - Motorist Failed to Yield	0%	0%	0%	8%	6%	17%	24%	26%	2%	2%	15%	**327**
760 - Pedestrian Failed to Yield	0%	0%	0%	10%	9%	14%	14%	22%	7%	7%	18%	**229**
742 - Dart-Out	0%	0%	1%	4%	5%	5%	9%	11%	26%	11%	28%	**152**
791 - Motorist Right Turn—Parallel Paths	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	99%	**129**
690 - Intersection—Other/Unknown	0%	1%	2%	6%	11%	14%	10%	18%	0%	0%	38%	**125**
213 - Backing Vehicle—Roadway	0%	0%	0%	0%	1%	1%	0%	1%	3%	47%	48%	**117**
741 - Dash	1%	0%	0%	3%	9%	6%	5%	18%	17%	15%	27%	**105**
190 - Other Unusual Circumstances	0%	0%	0%	1%	0%	3%	1%	15%	4%	9%	67%	**75**
680 - Nonintersection—Other/Unknown	0%	0%	0%	0%	0%	0%	0%	0%	18%	42%	40%	**62**
Other NHTSA Pedestrian Crash Types	0%	0%	2%	1%	2%	2%	1%	5%	4%	13%	70%	**721**
Total	**9%**	**6%**	**6%**	**3%**	**3%**	**5%**	**6%**	**9%**	**5%**	**9%**	**38%**	**2599**

NHTSA Bicycle Crashes

Figure 38 demonstrates the geographical distribution of bicycle crashes in Washington, DC (2012-14). Crashes happened more in the NW city quadrant. In this section, the bicycle crashes (vehicle-bicycle and bicycle-only) were examined and the NHTSA crash types and groups were identified based on crash data in 2012-14. Moreover, the LMCM crash types were also recognized and compared with NHTSA crash types.

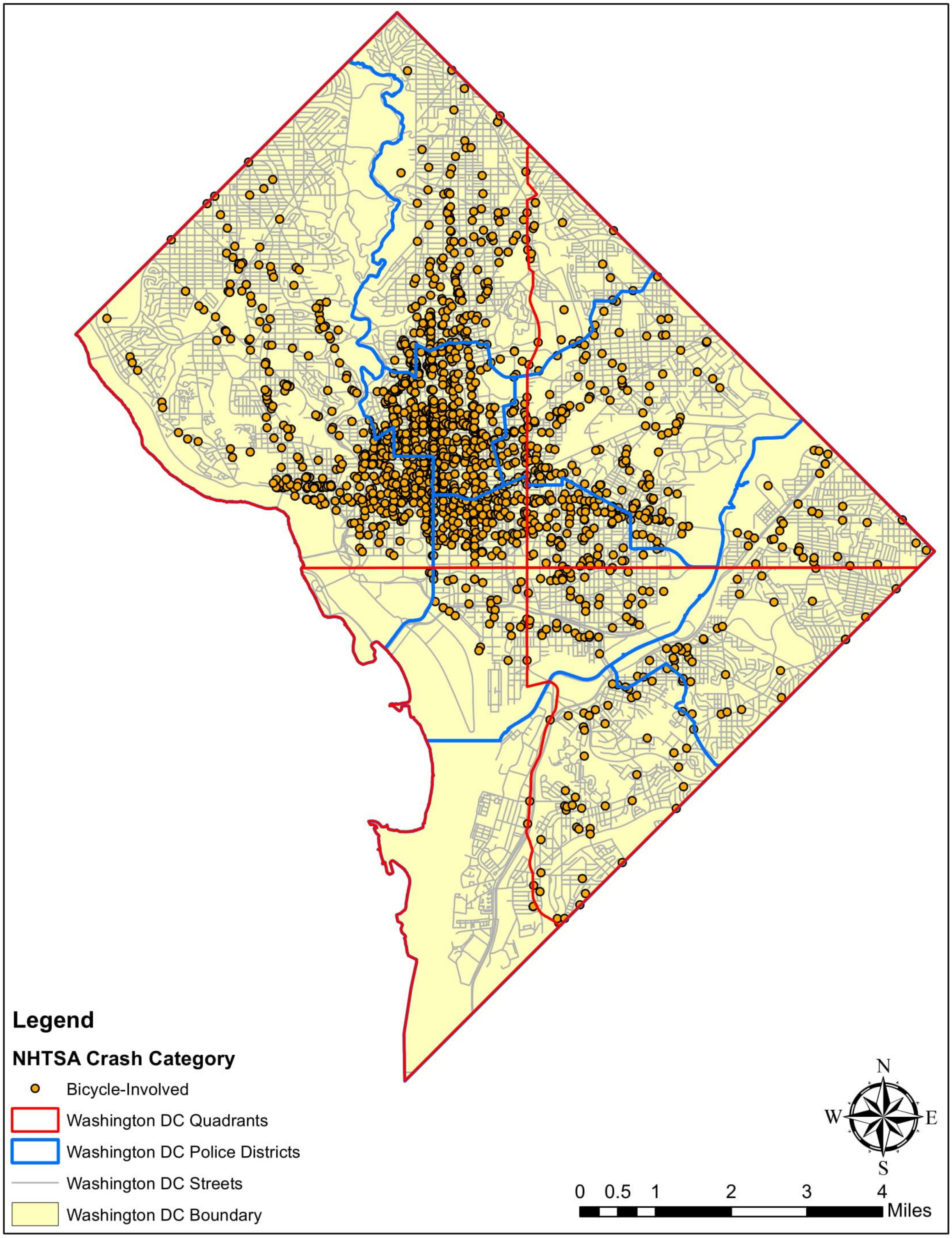


Figure 38. NHTSA Bicycle Crashes in Washington, DC (2012-14)

Vehicle drivers were at fault twice as often as bicyclists (52.4% vs 26.9%). There were only three fatal crashes and in one crash vehicle driver was at fault, in another one the bicyclist was at fault and in the last no fault or violation since it was a bicycle-only crash (bicyclist lost his control while inappropriately carrying a barbecue grill on his bicycle) (Table 86). The proportion of fatal and disabling crashes when bicyclists were at fault was significantly higher than other crash severity levels (34.5% vs 26.4%) (Table 87).

Summary of bicyclist crashes by vehicle driver and bicyclist demographics (gender and age) are demonstrated in Table 88 to Table 93. The majority of bicyclists that had accidents were males (74.1% vs 22.3%). The main age group of bicyclists was 22-34 (about 51% of all bicyclists) and the proportion was higher for females in this age group (70% of female bicyclists vs 46% of male bicyclists). The proportion of fatal and disabling crashes for bicyclists of 22-34 of age was significantly lower than other crash severity levels (40.5% vs 51.4%) but the proportion of fatal and disabling crashes for bicyclists of 35-44 of age was significantly higher than other crash severity levels (21.6% vs 14.9%) (Table 92).

The proportions of fatal and disabling crashes at construction zone were significantly higher (Table 94) but these proportions were not different for the case of hit & run crashes (Table 95). For hit & run crashes, the proportion of no injury crashes were significantly higher.

Table 86. Summary of Bicycle Crashes by Fault / Violation & Severity Level

Crash Severity / **Fault / Violation**	**Fatal**	**Disabling**	**Non-Disabling**	**Complaint but not visible**	**No Injury**	**Unknown**	**Total**
Vehicle Driver/Passenger	33.33%	46.02%	56.15%	57.36%	41.99%	40.68%	52.44%
Bicyclist	33.33%	34.51%	26.36%	21.79%	32.28%	28.81%	26.90%
Unknown	0.00%	15.93%	13.48%	17.88%	23.30%	27.12%	17.26%
No Fault / Violation	33.33%	2.65%	3.19%	2.05%	1.70%	3.39%	2.59%
Both	0.00%	0.88%	0.83%	0.93%	0.73%	0.00%	0.81%
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**

Table 87. Summary of Bicycle Crashes by Fault / Violation & Severity Level

Fault / Violation	**Fatal & Disabling**		**Other**		**Total**		***Sig.***
	Count	**%**	**Count**	**%**	**Count**	**%**	
Vehicle Driver/Passenger	53	45.69%	980	52.86%	1033	52.44%	
Bicyclist	40	34.48%	490	26.43%	530	26.90%	+
Unknown	18	15.52%	322	17.37%	340	17.26%	
No Fault / Violation	4	3.45%	47	2.54%	51	2.59%	
Both	1	0.86%	15	0.81%	16	0.81%	
Total	**116**	**100.00%**	**1854**	**100.00%**	**1970**	**100.00%**	

Table 88. Summary of Bicycle Crashes by Driver Gender & Severity Level

Driver Gender	Fatal & Disabling		Other		Total		Sig.
	Count	%	Count	%	Count	%	
Female	33	28.45%	547	29.50%	580	29.44%	
Male	58	50.00%	1087	58.63%	1145	58.12%	-
Not Applicable	10	8.62%	24	1.29%	34	1.73%	+++
Not Available	15	12.93%	196	10.57%	211	10.71%	
Total	**116**	**100.00%**	**1854**	**100.00%**	**1970**	**100.00%**	

Note: Not Applicable is for the case of "Bicycle-Only" crashes.

Table 89. Summary of Bicycle Crashes by Driver Age & Severity Level

Driver Age	Fatal & Disabling		Other		Total		Sig.
	Count	%	Count	%	Count	%	
21 & under	6	5.17%	68	3.67%	74	3.76%	
22 - 34	26	22.41%	501	27.02%	527	26.75%	
35 - 44	25	21.55%	361	19.47%	386	19.59%	
45 - 54	19	16.38%	359	19.36%	378	19.19%	
55 - 64	11	9.48%	235	12.68%	246	12.49%	
65 & over	9	7.76%	168	9.06%	177	8.98%	
Not Applicable	10	8.62%	24	1.29%	34	1.73%	+++
Not Available	10	8.62%	138	7.44%	148	7.51%	
Total	**116**	**100.00%**	**1854**	**100.00%**	**1970**	**100.00%**	

Note: Not Applicable is for the case of "Bicycle-Only" crashes.

Table 90. Summary of Bicycle Crashes by Driver Gender, Age & Severity Level

Driver Gender & Age	Fatal & Disabling		Other		Total		Sig.
	Count	%	Count	%	Count	%	
21 & under	2	6.06%	22	4.02%	24	4.14%	
22 - 34	12	36.36%	174	31.81%	186	32.07%	
35 - 44	7	21.21%	115	21.02%	122	21.03%	
45 - 54	5	15.15%	100	18.28%	105	18.10%	
55 - 64	3	9.09%	68	12.43%	71	12.24%	
65 & over	4	12.12%	50	9.14%	54	9.31%	
Not Available	0	0.00%	18	3.29%	18	3.10%	
Female	**33**	**100.00%**	**547**	**100.00%**	**580**	**100.00%**	
21 & under	3	5.17%	36	3.31%	39	3.41%	
22 - 34	11	18.97%	268	24.66%	279	24.37%	
35 - 44	14	24.14%	222	20.42%	236	20.61%	
45 - 54	13	22.41%	249	22.91%	262	22.88%	
55 - 64	8	13.79%	159	14.63%	167	14.59%	
65 & over	5	8.62%	116	10.67%	121	10.57%	

Driver Gender & Age	Fatal & Disabling		Other		Total		Sig.
	Count	%	Count	%	Count	%	
Not Available	4	6.90%	37	3.40%	41	3.58%	
Male	**58**	**100.00%**	**1087**	**100.00%**	**1145**	**100.00%**	
Not Applicable	10	100.00%	24	100.00%	34	100.00%	
Not Applicable	**10**	**100.00%**	**24**	**100.00%**	**34**	**100.00%**	
21 & under	1	6.67%	10	5.10%	11	5.21%	
22 - 34	3	20.00%	59	30.10%	62	29.38%	
35 - 44	4	26.67%	24	12.24%	28	13.27%	
45 - 54	1	6.67%	10	5.10%	11	5.21%	
55 - 64	0	0.00%	8	4.08%	8	3.79%	
65 & over	0	0.00%	2	1.02%	2	0.95%	
Not Available	6	40.00%	83	42.35%	89	42.18%	
Not Available	**15**	**100.00%**	**196**	**100.00%**	**211**	**100.00%**	
Total	**116**	**-**	**1854**	**-**	**1970**	**-**	

Note: Not Applicable is for the case of "Bicycle-Only" crashes.

Table 91. Summary of Bicycle Crashes by Bicyclist Gender & Severity Level

Bicyclist Gender	Fatal & Disabling		Other		Total		Sig.
	Count	%	Count	%	Count	%	
Female	22	18.97%	417	22.49%	439	22.28%	
Male	93	80.17%	1367	73.73%	1460	74.11%	
Not Available	1	0.86%	70	3.78%	71	3.60%	
Total	**116**	**100.00%**	**1854**	**100.00%**	**1970**	**100.00%**	

Table 92. Summary of Bicycle Crashes by Bicyclist Age & Severity Level

Bicyclist Age	Fatal & Disabling		Other		Total		Sig.
	Count	%	Count	%	Count	%	
21 & under	15	12.93%	257	13.86%	272	13.81%	
22 - 34	47	40.52%	953	51.40%	1000	50.76%	--
35 - 44	25	21.55%	276	14.89%	301	15.28%	+
45 - 54	13	11.21%	176	9.49%	189	9.59%	
55 - 64	8	6.90%	97	5.23%	105	5.33%	
65 & over	2	1.72%	19	1.02%	21	1.07%	
Not Available	6	5.17%	76	4.10%	82	4.16%	
Total	**116**	**100.00%**	**1854**	**100.00%**	**1970**	**100.00%**	

Table 93. Summary of Bicycle Crashes by Bicyclist Gender, Age & Severity Level

Bicyclist Gender & Age	**Fatal & Disabling**		**Other**		**Total**		***Sig.***
	Count	**%**	**Count**	**%**	**Count**	**%**	
21 & under	1	4.55%	33	7.91%	34	7.74%	
22 - 34	11	50.00%	296	70.98%	307	69.93%	--
35 - 44	6	27.27%	47	11.27%	53	12.07%	++
45 - 54	1	4.55%	20	4.80%	21	4.78%	
55 - 64	2	9.09%	12	2.88%	14	3.19%	
65 & over	1	4.55%	3	0.72%	4	0.91%	+
Not Available	0	0.00%	6	1.44%	6	1.37%	
Female	22	100.00%	417	100.00%	439	100.00%	
21 & under	14	15.05%	216	15.80%	230	15.75%	
22 - 34	36	38.71%	638	46.67%	674	46.16%	
35 - 44	19	20.43%	223	16.31%	242	16.58%	
45 - 54	12	12.90%	152	11.12%	164	11.23%	
55 - 64	6	6.45%	82	6.00%	88	6.03%	
65 & over	1	1.08%	14	1.02%	15	1.03%	
Not Available	5	5.38%	42	3.07%	47	3.22%	
Male	93	100.00%	1367	100.00%	1460	100.00%	
21 & under	0	0.00%	8	11.43%	8	11.27%	
22 - 34	0	0.00%	19	27.14%	19	26.76%	
35 - 44	0	0.00%	6	8.57%	6	8.45%	
45 - 54	0	0.00%	4	5.71%	4	5.63%	
55 - 64	0	0.00%	3	4.29%	3	4.23%	
65 & over	0	0.00%	2	2.86%	2	2.82%	
Not Available	1	100.00%	28	40.00%	29	40.85%	
Not Available	1	100.00%	70	100.00%	71	100.00%	
Total	**116**	**-**	**1854**	**-**	**1970**	**-**	

Table 94. Summary of Bicycle Crashes by Construction Zone & Severity Level

Severity	**Construction Zone: Yes**		**Construction Zone: No**		**Total**		***Sig.***
	Count	**%**	**Count**	**%**	**Count**	**%**	
Fatal	1	1.85%	2	0.10%	3	0.15%	+++
Disabling	7	12.96%	106	5.53%	113	5.74%	++
Non-Disabling	17	31.48%	829	43.27%	846	42.94%	-
Complaint but not visible	14	25.93%	523	27.30%	537	27.26%	
No Injury	12	22.22%	400	20.88%	412	20.91%	
Unknown	3	5.56%	56	2.92%	59	2.99%	
Total	**54**	**100.00%**	**1916**	**100.00%**	**1970**	**100.00%**	

Table 95. Summary of Bicycle Crashes by Hit & Run & Severity Level

Severity	Hit & Run: Yes		Hit & Run: No		Total		*Sig.*
	Count	**%**	**Count**	**%**	**Count**	**%**	
Fatal	1	0.28%	2	0.12%	3	0.15%	
Disabling	15	4.17%	98	6.09%	113	5.74%	
Non-Disabling	119	33.06%	727	45.16%	846	42.94%	---
Complaint but not visible	79	21.94%	458	28.45%	537	27.26%	--
No Injury	122	33.89%	290	18.01%	412	20.91%	+++
Unknown	24	6.67%	35	2.17%	59	2.99%	+++
Total	**360**	**100.00%**	**1610**	**100.00%**	**1970**	**100.00%**	

The summary of crashes by bicycle position (NHTSA categories) is demonstrated in Table 96 and Table 97. About 69 percent of bicycle crashes were labelled as “Travel lane” followed by “Sidewalk / Crosswalk / Driveway Crossing” (15.6%). There were also 226 crashes (11.5%) labelled as “Bike Lane / Paved Shoulder.” The proportions of fatal and disabling crashes were not significantly different from other crash severity levels. The summary of crashes by bicyclist direction is presented in Table 98 and Table 99. In more than eighty percent of crashes, bicyclists were riding with traffic and 8.2% facing traffic.

Table 96. Summary of Bicycle Crashes by Bicyclist Position & Severity Level

Bicyclist Position	Fatal & Disabling		Other		Total		*Sig.*
	Count	**%**	**Count**	**%**	**Count**	**%**	
Bike Lane / Paved Shoulder	15	12.93%	211	11.38%	226	11.47%	
Driveway / Alley	0	0.00%	19	1.02%	19	0.96%	
Nonroadway—Parking lot/Other	0	0.00%	8	0.43%	8	0.41%	
Other	0	0.00%	12	0.65%	12	0.61%	
Sidewalk / Crosswalk / Driveway Crossing	18	15.52%	290	15.64%	308	15.63%	
Travel Lane	81	69.83%	1283	69.20%	1364	69.24%	
Unknown	2	1.72%	31	1.67%	33	1.68%	
Total	**116**	**100.00%**	**1854**	**100.00%**	**1970**	**100.00%**	

Table 97. Summary of Bicycle Crashes by Bicyclist Position (regrouped) & Severity Level

Bicyclist Position	Fatal & Disabling		Other		Total		*Sig.*
	Count	**%**	**Count**	**%**	**Count**	**%**	
Bike Lane / Paved Shoulder	15	12.93%	211	11.38%	226	11.47%	
Other	2	1.72%	70	3.78%	72	3.65%	
Sidewalk / Crosswalk / Driveway Crossing	18	15.52%	290	15.64%	308	15.63%	
Travel Lane	81	69.83%	1283	69.20%	1364	69.24%	

Bicyclist Position	Fatal & Disabling		Other		Total		Sig.
	Count	%	Count	%	Count	%	
Total	**116**	**100.00%**	**1854**	**100.00%**	**1970**	**100.00%**	

Table 98. Summary of Bicycle Crashes by Bicyclist Direction & Severity Level

Bicyclist Direction	Fatal & Disabling		Other		Total		Sig.
	Count	%	Count	%	Count	%	
Facing Traffic	13	11.21%	148	7.98%	161	8.17%	
Not Applicable	12	10.34%	155	8.36%	167	8.48%	
Unknown	4	3.45%	57	3.07%	61	3.10%	
With Traffic	87	75.00%	1494	80.58%	1581	80.25%	
Total	**116**	**100.00%**	**1854**	**100.00%**	**1970**	**100.00%**	

Table 99. Summary of Bicycle Crashes by Bicyclist Direction (regrouped) & Severity Level

Bicyclist Direction	Fatal & Disabling		Other		Total		Sig.
	Count	%	Count	%	Count	%	
Facing Traffic	13	11.21%	148	7.98%	161	8.17%	
Other	16	13.79%	212	11.43%	228	11.57%	
With Traffic	87	75.00%	1494	80.58%	1581	80.25%	
Total	**116**	**100.00%**	**1854**	**100.00%**	**1970**	**100.00%**	

Table 100 summarizes the top 10 bicycle NHTSA crash types. Top three bicycle crashes accounted for more than one quarter of all bicycle crashes. The most common bicycle crash type in Washington, DC is the case of open door to traffic. "*244 - Bicyclist Overtaking—Extended Door*" is defined as: "*The bicyclist struck an extended door on a parked vehicle while passing.*" Crash type "*212 - Motorist Left Turn—Opposite Direction*" was the second prevalent bicycle crashes. While the third crash type, *"213 - Motorist Right Turn—Same Direction,"* is another intersection type (right turn), the fourth common crash type "*155 - Bicyclist Ride Through—Signalized Intersection*" (5.2% of all bicycle crashes) was the only crash type in top 10 that the proportion of fatal and disabling crashes was significantly (90% confidence level) higher than other crash severity levels. The top 10 bicycle crash types account for about 51% of all bicycle crashes.

Table 100. Top 10 Bicycle NHTSA Crash Types & Severity Level

NHTSA Crash Type	Fatal & Disabling		Other		Total		*Sig.*
	Count	**%**	**Count**	**%**	**Count**	**%**	
244 - Bicyclist Overtaking—Extended Door	13	11.21%	205	11.06%	218	11.07%	
212 - Motorist Left Turn—Opposite Direction	10	8.62%	185	9.98%	195	9.90%	
213 - Motorist Right Turn—Same Direction	3	2.59%	110	5.93%	113	5.74%	
155 - Bicyclist Ride Through—Signalized Intersection	10	8.62%	93	5.02%	103	5.23%	+
232 - Motorist Overtaking—Misjudged Space	5	4.31%	84	4.53%	89	4.52%	
158 - Signalized Intersection—Other/Unknown	6	5.17%	57	3.07%	63	3.20%	
211 - Motorist Left Turn—Same Direction	5	4.31%	56	3.02%	61	3.10%	
280 - Parallel Paths—Other/Unknown	1	0.86%	54	2.91%	55	2.79%	
239 - Motorist Overtaking—Other/ Unknown	2	1.72%	53	2.86%	55	2.79%	
231 - Motorist Overtaking—Undetected Bicyclist	1	0.86%	49	2.64%	50	2.54%	
Other NHTSA Bicycle Crash Types	60	51.72%	908	48.98%	968	49.14%	
Total	**116**	**100.00%**	**1854**	**100.00%**	**1970**	**100.00%**	

The top three NHTSA bicycle crash types had zero fatal crashes (there were only three fatal bicycle crashes in 2012-14) and 26 disabling crashes (23% of all disabling crashes); in 23 (out of 26) disabling crashes either driver or vehicle passenger (for some extended door crashes) were at fault. For all three crash types combined, vehicle drivers were at fault for 430 crashes (about 82 percent). Some facts about top three bicycle NHTSA crash types:

- 244 - Bicyclist Overtaking—Extended Door:
    - About 70% road crashes, 23.9% within 100 ft. of an intersection and 13 crashes (5.96%) happened at an intersection.
    - About 20.6% at 4-leg intersection followed by 5.5% at 3-leg intersections.
    - About 22 percent at signalized intersections followed by 5.5% at sign-controlled intersection.
    - Vehicle drivers (or passengers) were at fault for about 89% of crashes followed by 6.4% unknown, bicyclists were at fault only at five crashes (2.3%).
- 212 - Motorist Left Turn—Opposite Direction:
    - About 77% of crashes occurred at an intersection followed by road crashes (about 16%).
    - About 60% at 4-leg intersection followed by 20% at 3-leg intersections.
    - About 62% at signalized intersection. Also 12.8% happened at uncontrolled intersections.

- Vehicle drivers were at fault in about 80.5% of crashes followed by 11.8% unknown and bicyclists were at fault at eleven crashes (5.6%).

- 213 - Motorist Right Turn—Same Direction:
  - About 75% of crashes occurred at an intersection followed by road crashes (about 17.7%).
  - About 62 percent at 4-leg intersection followed by 11.5% at 3-leg intersections.
  - About 65.5% at signalized intersection. Also 12.8% happened at uncontrolled intersections.
  - Vehicle drivers were at fault in about 70% of crashes followed by 21.2% unknown and bicyclists were at fault only at nine crashes (8%).

Top three bicycle NHTSA crash types in Washington, DC (2012 – 14) are presented in Figure 39. Table 101 is also presenting the top 10 bicycle NHTSA crash types by year. The main crash types were usually similar; however, in the first year, "*155 - Bicyclist Ride Through—Signalized Intersection*" got the position of the "*213 - Motorist Right Turn—Same Direction*" as the third common pedestrian NHTSA crash type.

The full list of bicycle NHTSA crash types including all NHTSA crash types is available in "*Appendix I – Extended Tables*." The appendix also includes the full list of bicycle NHTSA crash types by year.

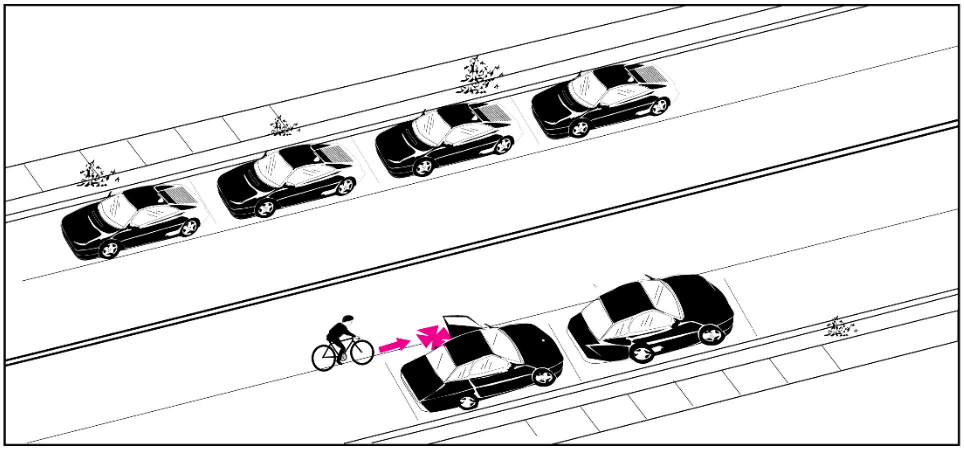
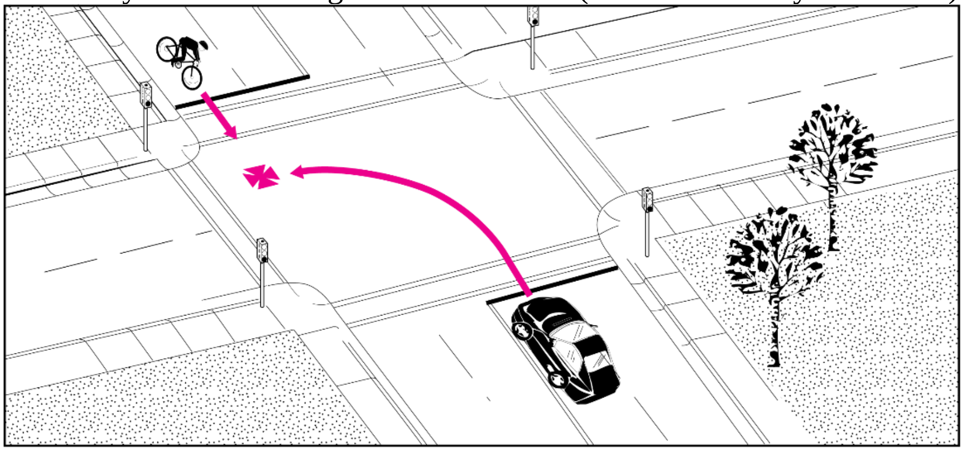
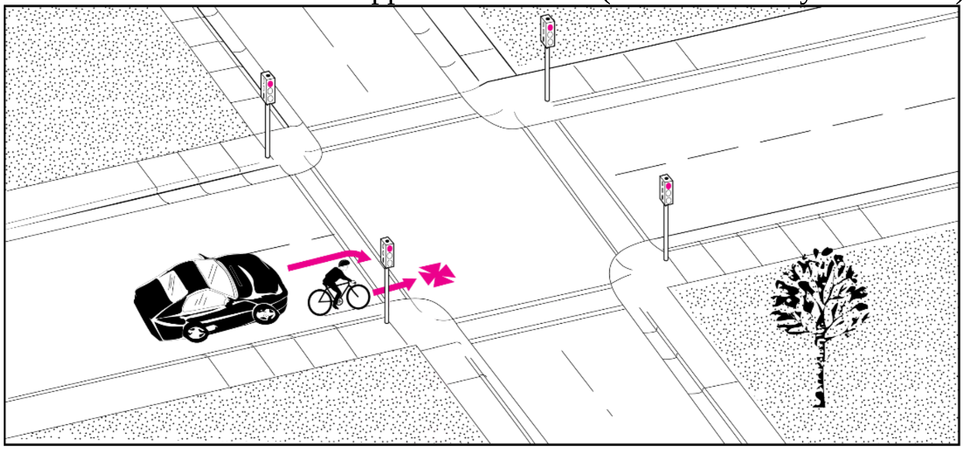

244 - Bicyclist Overtaking—Extended Door (11.1% of all bicycle crashes)

212 - Motorist Left Turn—Opposite Direction (9.9% of all bicycle crashes)

213 - Motorist Right Turn—Same Direction (5.7% of all bicycle crashes)

Figure 39. Top Three NHTSA Bicycle Crash Types in Washington, DC (2012-14)

Table 101. Top 10 Bicycle NHTSA Crash Types by Year & Severity Level

NHTSA Crash Type	Fatal & Disabling		Other		Total		*Sig.*
	Count	%	Count	%	Count	%	
212 - Motorist Left Turn—Opposite Direction	2	5.88%	61	11.13%	63	10.82%	
244 - Bicyclist Overtaking—Extended Door	3	8.82%	50	9.12%	53	9.11%	
155 - Bicyclist Ride Through—Signalized Intersection	4	11.76%	29	5.29%	33	5.67%	
213 - Motorist Right Turn—Same Direction	1	2.94%	24	4.38%	25	4.30%	
158 - Signalized Intersection—Other/Unknown	3	8.82%	20	3.65%	23	3.95%	
211 - Motorist Left Turn—Same Direction	2	5.88%	21	3.83%	23	3.95%	
232 - Motorist Overtaking—Misjudged Space	0	0.00%	18	3.28%	18	3.09%	
280 - Parallel Paths—Other/Unknown	0	0.00%	17	3.10%	17	2.92%	
239 - Motorist Overtaking—Other/ Unknown	0	0.00%	16	2.92%	16	2.75%	
231 - Motorist Overtaking—Undetected Bicyclist	0	0.00%	9	1.64%	9	1.55%	
Other NHTSA Bicycle Crash Types	19	55.88%	283	51.64%	302	51.89%	
2012	**34**	**100.00%**	**548**	**100.00%**	**582**	**100.00%**	
244 - Bicyclist Overtaking—Extended Door	5	15.15%	69	12.39%	74	12.54%	
212 - Motorist Left Turn—Opposite Direction	2	6.06%	55	9.87%	57	9.66%	
213 - Motorist Right Turn—Same Direction	2	6.06%	37	6.64%	39	6.61%	
155 - Bicyclist Ride Through—Signalized Intersection	4	12.12%	22	3.95%	26	4.41%	++
158 - Signalized Intersection—Other/Unknown	1	3.03%	24	4.31%	25	4.24%	
232 - Motorist Overtaking—Misjudged Space	1	3.03%	22	3.95%	23	3.90%	
211 - Motorist Left Turn—Same Direction	3	9.09%	19	3.41%	22	3.73%	+
280 - Parallel Paths—Other/Unknown	0	0.00%	12	2.15%	12	2.03%	
239 - Motorist Overtaking—Other/ Unknown	1	3.03%	9	1.62%	10	1.69%	
231 - Motorist Overtaking—Undetected Bicyclist	0	0.00%	10	1.80%	10	1.69%	
Other NHTSA Bicycle Crash Types	14	42.42%	278	49.91%	292	49.49%	

NHTSA Crash Type	Fatal & Disabling		Other		Total		*Sig.*
	Count	**%**	**Count**	**%**	**Count**	**%**	
2013	**33**	**100.00%**	**557**	**100.00%**	**590**	**100.00%**	
244 - Bicyclist Overtaking—Extended Door	5	10.20%	86	11.48%	91	11.40%	
212 - Motorist Left Turn—Opposite Direction	6	12.24%	69	9.21%	75	9.40%	
213 - Motorist Right Turn—Same Direction	0	0.00%	49	6.54%	49	6.14%	-
232 - Motorist Overtaking—Misjudged Space	4	8.16%	44	5.87%	48	6.02%	
155 - Bicyclist Ride Through—Signalized Intersection	2	4.08%	42	5.61%	44	5.51%	
231 - Motorist Overtaking—Undetected Bicyclist	1	2.04%	30	4.01%	31	3.88%	
239 - Motorist Overtaking—Other/ Unknown	1	2.04%	28	3.74%	29	3.63%	
280 - Parallel Paths—Other/Unknown	1	2.04%	25	3.34%	26	3.26%	
211 - Motorist Left Turn—Same Direction	0	0.00%	16	2.14%	16	2.01%	
158 - Signalized Intersection—Other/Unknown	2	4.08%	13	1.74%	15	1.88%	
Other NHTSA Bicycle Crash Types	27	55.10%	347	46.33%	374	46.87%	
2014	**49**	**100.00%**	**749**	**100.00%**	**798**	**100.00%**	
Total	**116**	**-**	**1854**	**-**	**1970**	**-**	

Table 102 summarizes the sorted bicycle NHTSA crash groups. Due to the case of open door crashes, "*240 - Bicyclist Overtaking Motorist*" was the main crash group as well accounting for 17.4% of all bicycle crashes followed by "*210 - Motorist Left Turn/Merge*" which accounted for another 13 percent of all bicycle crashes. The third crash group was "*230 - Motorist Overtaking Bicyclist*" (10.9%).

There were some significant differences between the proportions of fatal and disabling crashes versus other crash severity levels; proportions of fatal and disabling crashes were significantly higher for following NHTSA crash groups:

- 158 - Bicyclist Failed to Yield—Signalized Intersection (13.8% vs 7.2%)
- 850 - Other/Unusual Circumstances (10.34% vs 2.32%)
- 258 - Head-On (6% vs 2.3%)

However, the proportion of fatal and disabling crashes was significantly lower for "*215 - Motorist Right Turn/Merge*." The main three NHTSA crash groups accounted for about 41% of all bicycle crashes. Looking at BIKESAFE online crash type matrix for these three bicycle crash groups, some applicable countermeasures were identified and listed in

Table 103. The table shows the matching BIKESAFE crash groups and available countermeasure types; the full list is provided in "*Appendix J – BIKESAFE Countermeasures for Top Three Bicycle Crash Groups in Washington, DC*".

Table 102. Bicycle NHTSA Crash Groups & Severity Level

NHTSA Crash Group	**Fatal & Disabling**		**Other**		**Total**		
	Count	**%**	**Count**	**%**	**Count**	**%**	***Sig.***
240 - Bicyclist Overtaking Motorist	17	14.66%	325	17.53%	342	17.36%	
210 - Motorist Left Turn/Merge	15	12.93%	241	13.00%	256	12.99%	
230 - Motorist Overtaking Bicyclist	9	7.76%	206	11.11%	215	10.91%	
190 - Crossing Paths—Other Circumstances	12	10.34%	179	9.65%	191	9.70%	
215 - Motorist Right Turn/Merge	3	2.59%	151	8.14%	154	7.82%	--
158 - Bicyclist Failed to Yield—Signalized Intersection	16	13.79%	134	7.23%	150	7.61%	+++
110 - Loss of Control/Turning Error	9	7.76%	122	6.58%	131	6.65%	
150 - Motorist Failed to Yield—Signalized Intersection	8	6.90%	79	4.26%	87	4.42%	
290 - Parallel Paths—Other Circumstances	2	1.72%	82	4.42%	84	4.26%	
140 - Motorist Failed to Yield—Sign-Controlled Intersection	2	1.72%	60	3.24%	62	3.15%	
850 - Other/Unusual Circumstances	12	10.34%	43	2.32%	55	2.79%	+++
258 - Head-On	7	6.03%	42	2.27%	49	2.49%	++
219 - Parking/Bus-Related	1	0.86%	40	2.16%	41	2.08%	
320 - Motorist Failed to Yield—Midblock	2	1.72%	37	2.00%	39	1.98%	
145 - Bicyclist Failed to Yield—Sign-Controlled Intersection	0	0.00%	33	1.78%	33	1.68%	
220 - Bicyclist Left Turn/Merge	0	0.00%	25	1.35%	25	1.27%	
310 - Bicyclist Failed to Yield—Midblock	1	0.86%	20	1.08%	21	1.07%	
600 - Backing Vehicle	0	0.00%	19	1.02%	19	0.96%	
225 - Bicyclist Right Turn/Merge	0	0.00%	11	0.59%	11	0.56%	
990 - Other/Unknown—Insufficient Details	0	0.00%	3	0.16%	3	0.15%	
910 - Nonroadway	0	0.00%	2	0.11%	2	0.10%	
Total	**116**	**100.00%**	**1854**	**100.00%**	**1970**	**100.00%**	

Table 103. Top 3 Bicycle NHTSA Crash Groups & Matching BIKESAFE Crash Groups

NHTSA Crash Group	BIKESAFE Crash Group	Countermeasure Type
240 - Bicyclist Overtaking Motorist	Bicyclist Overtaking Motorist	*Shared Roadway*
		On-Road Bike Facilities
		Maintenance
		Trails/ Shared-Use Paths
		Markings, Signs & Signals
		Other Measures
210 - Motorist Left Turn/Merge	Motorist Turned or Merged Left into Path of Bicyclist	*Shared Roadway*
		On-Road Bike Facilities
		Intersection Treatments
		Traffic Calming
		Trails/ Shared-Use Paths
		Markings, Signs & Signals
		Other Measures
230 - Motorist Overtaking Bicyclist	Motorist Overtaking Bicyclist	*Shared Roadway*
		On-Road Bike Facilities
		Maintenance
		Traffic Calming
		Trails/ Shared-Use Paths
		Markings, Signs & Signals
		Other Measures

Bicycle NHTSA crash groups are summarized by year in Table 104. The main crash groups were almost similar in all three years except in the second year that "*190 - Crossing Paths—Other Circumstances*" got the position of "*230 - Motorist Overtaking Bicyclist*" as the third common crash group.

Table 104. Bicycle NHTSA Crash Groups by Year & Severity Level

NHTSA Crash Group	Fatal & Disabling		Other		Total		*Sig.*
	Count	%	Count	%	Count	%	
210 - Motorist Left Turn/Merge	4	11.76%	82	14.96%	86	14.78%	
240 - Bicyclist Overtaking Motorist	5	14.71%	81	14.78%	86	14.78%	
230 - Motorist Overtaking Bicyclist	1	2.94%	51	9.31%	52	8.93%	
110 - Loss of Control/Turning Error	1	2.94%	49	8.94%	50	8.59%	
158 - Bicyclist Failed to Yield—Signalized Intersection	4	11.76%	45	8.21%	49	8.42%	
190 - Crossing Paths—Other Circumstances	4	11.76%	42	7.66%	46	7.90%	
215 - Motorist Right Turn/Merge	1	2.94%	44	8.03%	45	7.73%	
150 - Motorist Failed to	5	14.71%	35	6.39%	40	6.87%	+

NHTSA Crash Group	Fatal & Disabling		Other		Total		Sig.
	Count	%	Count	%	Count	%	
Yield—Signalized Intersection							
290 - Parallel Paths—Other Circumstances	0	0.00%	23	4.20%	23	3.95%	
258 - Head-On	5	14.71%	14	2.55%	19	3.26%	+++
140 - Motorist Failed to Yield—Sign-Controlled Intersection	0	0.00%	15	2.74%	15	2.58%	
320 - Motorist Failed to Yield—Midblock	0	0.00%	12	2.19%	12	2.06%	
219 - Parking/Bus-Related	0	0.00%	12	2.19%	12	2.06%	
850 - Other/Unusual Circumstances	3	8.82%	8	1.46%	11	1.89%	+++
145 - Bicyclist Failed to Yield—Sign-Controlled Intersection	0	0.00%	10	1.82%	10	1.72%	
220 - Bicyclist Left Turn/Merge	0	0.00%	9	1.64%	9	1.55%	
310 - Bicyclist Failed to Yield—Midblock	1	2.94%	7	1.28%	8	1.37%	
600 - Backing Vehicle	0	0.00%	4	0.73%	4	0.69%	
910 - Nonroadway	0	0.00%	2	0.36%	2	0.34%	
225 - Bicyclist Right Turn/Merge	0	0.00%	2	0.36%	2	0.34%	
990 - Other/Unknown—Insufficient Details	0	0.00%	1	0.18%	1	0.17%	
2012	**34**	**100.00%**	**548**	**100.00%**	**582**	**100.00%**	
240 - Bicyclist Overtaking Motorist	5	15.15%	105	18.85%	110	18.64%	
210 - Motorist Left Turn/Merge	5	15.15%	74	13.29%	79	13.39%	
190 - Crossing Paths—Other Circumstances	1	3.03%	61	10.95%	62	10.51%	
158 - Bicyclist Failed to Yield—Signalized Intersection	10	30.30%	43	7.72%	53	8.98%	+++
230 - Motorist Overtaking Bicyclist	2	6.06%	47	8.44%	49	8.31%	
215 - Motorist Right Turn/Merge	2	6.06%	47	8.44%	49	8.31%	
110 - Loss of Control/Turning Error	1	3.03%	32	5.75%	33	5.59%	
150 - Motorist Failed to Yield—Signalized Intersection	1	3.03%	26	4.67%	27	4.58%	

NHTSA Crash Group	Fatal & Disabling		Other		Total		Sig.
	Count	%	Count	%	Count	%	
140 - Motorist Failed to Yield—Sign-Controlled Intersection	1	3.03%	23	4.13%	24	4.07%	
850 - Other/Unusual Circumstances	5	15.15%	13	2.33%	18	3.05%	+++
290 - Parallel Paths—Other Circumstances	0	0.00%	18	3.23%	18	3.05%	
258 - Head-On	0	0.00%	13	2.33%	13	2.20%	
219 - Parking/Bus-Related	0	0.00%	10	1.80%	10	1.69%	
145 - Bicyclist Failed to Yield—Sign-Controlled Intersection	0	0.00%	10	1.80%	10	1.69%	
600 - Backing Vehicle	0	0.00%	9	1.62%	9	1.53%	
320 - Motorist Failed to Yield—Midblock	0	0.00%	7	1.26%	7	1.19%	
220 - Bicyclist Left Turn/Merge	0	0.00%	7	1.26%	7	1.19%	
225 - Bicyclist Right Turn/Merge	0	0.00%	6	1.08%	6	1.02%	
310 - Bicyclist Failed to Yield—Midblock	0	0.00%	5	0.90%	5	0.85%	
990 - Other/Unknown—Insufficient Details	0	0.00%	1	0.18%	1	0.17%	
2013	**33**	**100.00%**	**557**	**100.00%**	**590**	**100.00%**	
240 - Bicyclist Overtaking Motorist	7	14.29%	139	18.56%	146	18.30%	
230 - Motorist Overtaking Bicyclist	6	12.24%	108	14.42%	114	14.29%	
210 - Motorist Left Turn/Merge	6	12.24%	85	11.35%	91	11.40%	
190 - Crossing Paths—Other Circumstances	7	14.29%	76	10.15%	83	10.40%	
215 - Motorist Right Turn/Merge	0	0.00%	60	8.01%	60	7.52%	--
158 - Bicyclist Failed to Yield—Signalized Intersection	2	4.08%	46	6.14%	48	6.02%	
110 - Loss of Control/Turning Error	7	14.29%	41	5.47%	48	6.02%	++
290 - Parallel Paths—Other Circumstances	2	4.08%	41	5.47%	43	5.39%	
850 - Other/Unusual Circumstances	4	8.16%	22	2.94%	26	3.26%	++
140 - Motorist Failed to Yield—Sign-	1	2.04%	22	2.94%	23	2.88%	

NHTSA Crash Group	Fatal & Disabling		Other		Total		*Sig.*
	Count	**%**	**Count**	**%**	**Count**	**%**	
Controlled Intersection							
320 - Motorist Failed to Yield—Midblock	2	4.08%	18	2.40%	20	2.51%	
150 - Motorist Failed to Yield—Signalized Intersection	2	4.08%	18	2.40%	20	2.51%	
219 - Parking/Bus-Related	1	2.04%	18	2.40%	19	2.38%	
258 - Head-On	2	4.08%	15	2.00%	17	2.13%	
145 - Bicyclist Failed to Yield—Sign-Controlled Intersection	0	0.00%	13	1.74%	13	1.63%	
220 - Bicyclist Left Turn/Merge	0	0.00%	9	1.20%	9	1.13%	
310 - Bicyclist Failed to Yield—Midblock	0	0.00%	8	1.07%	8	1.00%	
600 - Backing Vehicle	0	0.00%	6	0.80%	6	0.75%	
225 - Bicyclist Right Turn/Merge	0	0.00%	3	0.40%	3	0.38%	
990 - Other/Unknown—Insufficient Details	0	0.00%	1	0.13%	1	0.13%	
2014	**49**	**100.00%**	**749**	**100.00%**	**798**	**100.00%**	
Total	**116**	**-**	**1854**	**-**	**1970**	**-**	

While there are twenty one NHTSA crash groups for bicycle crashes, some of them had very few cases in three years thus after careful review of crash groups an alternative crash grouping was proposed and presented in Table 105. Crash groups that were for either motorist or bicyclist failing to yield at different locations (midblock, signalized and sign-controlled intersections) were combined together to make up crash groups with more matching cases. The NHTSA crash type of "*244 - Bicyclist Overtaking—Extended Door*" was separated from the other crash types under crash group of "*240 - Bicyclist Overtaking Motorist*" to distinguish between the case of extended door crashes and other crash types of this group. Due to significantly different crash severity levels, NHTSA crash type of "*400 - Bicycle Only*" was separated from the other crash types under crash group of "*850 - Other/Unusual Circumstances*" to distinguish between the case of individual bicycle crashes (that may need specific considerations and countermeasures) and other crash types of this group. Based on the proposed groups, the sorted bicyclist crash groups would be as follows:

1. Motorist Left Turn/Merge (13%)
2. Extended Door (11.1%)
3. Motorist Overtaking Bicyclist (10.9%)
4. Bicyclist Failed to Yield (10.4%)
5. Crossing Paths—Other Circumstances (9.7%)
6. Motorist Failed to Yield (9.5%)

7. Motorist Right Turn/Merge (7.8%)
8. Head-On (2.5%)
9. Bicycle Only (1.7%)
10. Other (23.4%)

Table 105. Proposed Bicycle Crash Groups based on Washington, DC Crashes (2012-14)

NHTSA Bicycle Crash Group	**DDOT (2012-14)%**	**Proposed Crash Group**	**DDOT (2012-14)%**	**Final Ranking**
210 - Motorist Left Turn/Merge	13.0%	Motorist Left Turn/Merge	13.0%	**1**
215 - Motorist Right Turn/Merge	7.8%	Motorist Right Turn/Merge	7.8%	7
Crash Type: 244 - Bicyclist Overtaking—Extended Door	11.1%	Extended Door	11.1%	**2**
230 - Motorist Overtaking Bicyclist	10.9%	Motorist Overtaking Bicyclist	10.9%	**3**
190 - Crossing Paths—Other Circumstances	9.7%	Crossing Paths—Other Circumstances	9.7%	5
150 - Motorist Failed to Yield—Signalized Intersection	4.4%	Motorist Failed to Yield	9.5%	6
140 - Motorist Failed to Yield—Sign-Controlled Intersection	3.1%			
320 - Motorist Failed to Yield—Midblock	2.0%			
158 - Bicyclist Failed to Yield—Signalized Intersection	7.6%	Bicyclist Failed to Yield	10.4%	4
145 - Bicyclist Failed to Yield—Sign-Controlled Intersection	1.7%			
310 - Bicyclist Failed to Yield—Midblock	1.1%			
258 - Head-On	2.5%	Head-On	2.5%	8
Crash Type: 400 - Bicycle Only	1.7%	Bicycle Only	1.7%	9
All other types	23.4%	Other	23.4%	-

Notes:

- *The **green** cells indicate proposed bicycle crash groups.*
- *The main nine groups account for 76.6% of all bicycle crashes in 2012-14.*

The LMCM crash categories for bicycle crashes are summarized in Table 106 and top ten LMCM crash types are listed in Table 107.

Table 106. Summary of Bicycle Crashes by LMCM Crash Category & Severity Level

LMCM Crash Category	Fatal & Disabling		Other		Total		
	Count	%	Count	%	Count	%	*Sig.*
Intersection	73	62.93%	1178	63.54%	1251	63.50%	
Non-Intersection	30	25.86%	615	33.17%	645	32.74%	
Parking lot or private property	2	1.72%	33	1.78%	35	1.78%	
Other	11	9.48%	28	1.51%	39	1.98%	+++
Total	**116**	**100.00%**	**1854**	**100.00%**	**1970**	**100.00%**	

Table 107. Top 10 Bicycle LMCM Crash Types & Severity Level

LMCM Crash Type	Fatal & Disabling		Other		Total		*Sig.*
	Count	%	Count	%	Count	%	
N-RRD-S	16	13.79%	290	15.64%	306	15.53%	
I-FS-LT-O	8	6.90%	131	7.07%	139	7.06%	
I-NS-ST-S	2	1.72%	118	6.36%	120	6.09%	--
I-NS-ST-L	5	4.31%	107	5.77%	112	5.69%	
N-RSH-S	2	1.72%	82	4.42%	84	4.26%	
I-NS-RT-S	2	1.72%	74	3.99%	76	3.86%	
I-NS-ST-R	8	6.90%	66	3.56%	74	3.76%	+
I-NS-ST-X	7	6.03%	63	3.40%	70	3.55%	
I-FS-ST-L	6	5.17%	60	3.24%	66	3.35%	
I-FS-ST-S	2	1.72%	57	3.07%	59	2.99%	
Other LMCM Types	58	50.00%	806	43.47%	864	43.86%	
Total	**116**	**100.00%**	**1854**	**100.00%**	**1970**	**100.00%**	

The main LMCM bicycle crash types were as follows:

- N-RRD-S: *Straight-traveling motorist strikes bicyclist on right side of roadway (in a travel lane), bicyclist traveling in same direction (includes door-related crashes)*
- I-FS-LT-O: *Left-turning motorist strikes bicyclist traveling in opposite direction (relative to motorist's direction before turning) on far side of intersection*
- I-NS-ST-S: *Straight-traveling motorist strikes bicyclist traveling in same direction on near side of intersection*

Top three bicycle LMCM crashes had zero fatal crashes (there were only three fatal bicycle crashes in 2012-14) and 26 disabling crashes (23% of all disabling crashes). In 18 (out of 26) disabling crashes either driver or vehicle passenger (for some extended door crashes) were at fault followed by 6 crashes that bicyclists were at fault and one crash that both were at fault. Some facts about top three bicyclists NHTSA crash types:

- N-RRD-S:

- I-NS-ST-X (continued):
    - About 91% road crashes and the rest within 100 ft. of an intersection.
    - In 65.4% of crashes, vehicle drivers/passengers were at fault followed by bicyclists in 17.7% and 14% were unknown.
    - In two disabling crashes, drivers were distracted and in one disabling crash, bicyclist was distracted.
- I-FS-LT-O:
    - About 93% intersection crashes and the rest within 100 ft. of an intersection.
    - About 70% at 4-leg intersections followed by 23% at 3-leg intersections.
    - About 73% at signalized intersection followed by 15.8% at uncontrolled intersections.
    - In 75.5% of crashes, vehicle drivers/passengers were at fault followed by unknown in 11.5% and bicyclists in 9.4%.
- I-NS-ST-S:
    - About 68% intersection crashes and the rest within 100 ft. of an intersection.
    - About 67% at 4-leg intersections followed by 20% at 3-leg intersections.
    - About 79% at signalized intersection followed by 13.3% at uncontrolled intersections.
    - In 46.7% of crashes, vehicle drivers/passengers were at fault followed by bicyclists in 31.7% and 20% were unknown.
    - For this crash type among all top 10 bicycle LMCM crash types, the proportion of fatal and disabling crashes were significantly (95% confidence level) lower than other crash severity levels; 1.7% vs 6.4% (Table 107).

Table 108 presents the top 10 bicycle LMCM crash types by year. Crash type of "*N-RRD-S*" was always on top of the list but the other two crash types of top three LMCM crashes in 2012-14 showed up at least twice among the top three LMCM crash types in three years. The full list of LMCM crash types including all NHTSA crash types is available in "*Appendix I – Extended Tables*." The appendix also includes the full list of LMCM crash types by year.

Table 108. Top 10 Bicycle LMCM Crash Types by Year & Severity Level

LMCM Crash Type	**Fatal & Disabling**		**Other**		**Total**		***Sig.***
	Count	**%**	**Count**	**%**	**Count**	**%**	
N-RRD-S	2	5.88%	70	12.77%	72	12.37%	
I-NS-ST-X	5	14.71%	50	9.12%	55	9.45%	
I-FS-LT-O	2	5.88%	44	8.03%	46	7.90%	
I-NS-ST-R	3	8.82%	32	5.84%	35	6.01%	
I-NS-ST-L	1	2.94%	31	5.66%	32	5.50%	
I-NS-ST-S	0	0.00%	25	4.56%	25	4.30%	
I-NS-RT-S	0	0.00%	17	3.10%	17	2.92%	
N-RSH-S	0	0.00%	15	2.74%	15	2.58%	
I-FS-ST-L	0	0.00%	14	2.55%	14	2.41%	
I-FS-ST-S	1	2.94%	3	0.55%	4	0.69%	
Other LMCM Types	20	58.82%	247	45.07%	267	45.88%	
2012	**34**	**100.00%**	**548**	**100.00%**	**582**	**100.00%**	
N-RRD-S	3	9.09%	131	23.52%	134	22.71%	-

I-FS-LT-O	3	9.09%	58	10.41%	61	10.34%	
I-NS-ST-S	1	3.03%	31	5.57%	32	5.42%	
I-NS-ST-L	1	3.03%	27	4.85%	28	4.75%	
I-FS-ST-L	5	15.15%	21	3.77%	26	4.41%	+++
I-NS-RT-S	1	3.03%	21	3.77%	22	3.73%	
N-RSH-S	1	3.03%	19	3.41%	20	3.39%	
I-FS-ST-S	1	3.03%	17	3.05%	18	3.05%	
I-NS-ST-R	2	6.06%	9	1.62%	11	1.86%	+
I-NS-ST-X	0	0.00%	4	0.72%	4	0.68%	
Other LMCM Types	15	45.45%	219	39.32%	234	39.66%	
2013	**33**	**100.00%**	**557**	**100.00%**	**590**	**100.00%**	
N-RRD-S	11	22.45%	89	11.88%	100	12.53%	++
I-NS-ST-S	1	2.04%	62	8.28%	63	7.89%	
I-NS-ST-L	3	6.12%	49	6.54%	52	6.52%	
N-RSH-S	1	2.04%	48	6.41%	49	6.14%	
I-FS-ST-S	0	0.00%	37	4.94%	37	4.64%	
I-NS-RT-S	1	2.04%	36	4.81%	37	4.64%	
I-FS-LT-O	3	6.12%	29	3.87%	32	4.01%	
I-NS-ST-R	3	6.12%	25	3.34%	28	3.51%	
I-FS-ST-L	1	2.04%	25	3.34%	26	3.26%	
I-NS-ST-X	2	4.08%	9	1.20%	11	1.38%	+
Other LMCM Types	23	46.94%	340	45.39%	363	45.49%	
2014	**49**	**100.00%**	**749**	**100.00%**	**798**	**100.00%**	
Total	**116**	**-**	**1854**	**-**	**1970**	**-**	

Table 109 presents the cross-tabulation of the top ten NHTSA and LMCM crash types. Based on the table, for "*244 - Bicyclist Overtaking—Extended Door*" NHTSA crash type, 46% of crashes were "*N-RRD-S*", 16% were "*N-RSH-S*", 4% were "*I-FS-ST-S,*" and 4% were "*I-NS-ST-S*." In other words, about half of this crash type happened on roadway while about 16% on either bike lane or parking lane when the driver and bicyclist shared same direction.

For "*212 - Motorist Left Turn—Opposite Direction*" NHTSA crash type, 61% of crashes were "*I-FS-LT-O*", 21% were "*I-NS-LT-O*" (not shown in the table because it was among the other LMCM crash types), and 9% were "*N-LRD-O*" (not shown in the table because it was among the other LMCM crash types). A quick review of these figures implies that this NHTSA crash type happened at both intersection areas (at least 61% on the farside and at least 21% on the nearside of the intersection) and also 9% was the case of midblock left-turn crashes which happened on the left-side of the road.

Similarly for "*213 - Motorist Right Turn—Same Direction*" NHTSA crash type, 50% of crashes were "*I-NS-RT-S*", 28% were "*I-FS-RT-R*" (not shown in the table because it was among the other LMCM crash types), 11% were "*N-RRD-S*", and 4% were "*N-RSH-S.*" A quick review of these figures implies that this NHTSA crash type happened at both intersection areas (at least 50% on the nearside and at least 28% on the farside of the intersection) and also midblock crashes (at least 15%).

Table 109. Crosstab of Top 10 Pedestrian NHTSA & LMCM Crash Types

NHTSA Bicycle Crash Type	I-FS-LT-O	I-FS-ST-L	I-FS-ST-S	I-NS-RT-S	I-NS-ST-L	I-NS-ST-R	I-NS-ST-S	I-NS-ST-X	N-RRD-S	N-RSH-S	Other LMCM Types	Total
244 - Bicyclist Overtaking—Extended Door	0%	0%	4%	0%	0%	2%	4%	0%	46%	16%	28%	**218**
212 - Motorist Left Turn—Opposite Direction	61%	0%	0%	0%	0%	0%	0%	0%	0%	0%	39%	**195**
213 - Motorist Right Turn—Same Direction	0%	0%	0%	50%	0%	0%	0%	0%	11%	4%	35%	**113**
155 - Bicyclist Ride Through—Signalized Intersection	2%	20%	1%	1%	24%	10%	0%	8%	0%	0%	34%	**103**
232 - Motorist Overtaking—Misjudged Space	0%	0%	12%	2%	0%	1%	21%	2%	42%	3%	16%	**89**
158 - Signalized Intersection—Other/Unknown	2%	3%	2%	2%	10%	8%	10%	5%	0%	0%	60%	**63**
211 - Motorist Left Turn—Same Direction	0%	0%	0%	0%	0%	0%	0%	0%	21%	7%	72%	**61**
280 - Parallel Paths—Other/Unknown	0%	0%	11%	0%	0%	0%	20%	0%	31%	5%	33%	**55**
239 - Motorist Overtaking—Other/ Unknown	0%	7%	2%	0%	2%	4%	18%	4%	44%	4%	16%	**55**
231 - Motorist Overtaking—Undetected Bicyclist	2%	0%	6%	4%	2%	4%	24%	0%	20%	12%	26%	**50**
Other NHTSA Bicycle Crash Types	2%	4%	3%	1%	8%	5%	6%	6%	10%	3%	53%	**968**
Total	**7%**	**3%**	**3%**	**4%**	**6%**	**4%**	**6%**	**4%**	**16%**	**4%**	**44%**	**1970**

Hot Spots

The hot spots (top twenty intersections, roadway segments, and streets (or corridors)) for all crashes (NHTSA pedestrian and bicycle crashes combined together) based on "Danger Index" (Montreal Gazette 2013, Kunkle 2017)) are demonstrated in Table 110 to Table 112 and Figure 40.

- **Danger Index** = 10 (number of fatal crashes) + 5 (number of disabling crashes) + 3 (number of non-disabling crashes) + 2 (number of complaint but not visible crashes) + 1 (number of no injury / property damage only and unknown severity crashes)

The reason of choosing a weighted approach was because the simple approach of finding hot spots based on only the number of crashes per site would not account for crash severity levels and, on the other hand, using crash costs as weights might skew the results towards the sites with fatal crashes because of massive cost differences. So in order to address the issues of using each aforementioned method, the analysis was done based on "Danger Index" calculation.

Table 110. Top Twenty Intersections with Highest Danger Index for NHTSA Pedestrian and Bicycle Crashes in Washington, DC (2012-14)

Intersection	K	A	B	C	O	U	Sum	Rank (Count)	Danger Index	Rank (Danger Index)	Crash Costs	Rank ($)
BENNING RD NE & BLADENSBURG RD NE	0	1	7	3	1	0	12	**2**	33	**1**	$ 2,433,200	21
18TH ST NW & COLUMBIA RD NW	0	0	6	6	1	0	13	**1**	31	**2**	$ 1,956,500	26
7TH ST NW & H ST NW	0	2	3	5	2	0	12	4	31	**3**	$ 2,557,300	18
7TH ST NW & FLORIDA AVE NW	0	1	5	4	2	0	12	**3**	30	4	$ 2,173,700	23
23RD ST NW & P ST NW	0	2	4	3	1	0	10	7	29	5	$ 2,492,700	20
18TH ST NW & K ST NW	1	1	3	2	0	0	7	34	28	6	$12,797,100	**1**
H ST & NORTH CAPITOL ST	0	1	6	2	0	0	9	12	27	7	$ 2,097,200	24
17TH ST NW & K ST NW	1	1	3	1	1	0	7	42	27	8	$12,683,400	**2**
GEORGIA AVE NW & KENNEDY ST NW	0	2	4	2	0	0	8	23	26	9	$ 2,355,200	22
4TH ST NW & MASSACHUSETTS AVE NW	0	3	1	3	1	0	8	24	25	10	$ 2,552,200	19
14TH ST NW & COLUMBIA RD NW	0	0	4	6	0	0	10	5	24	11	$ 1,547,600	35
11TH ST NW & U ST NW	1	1	2	0	1	1	6	62	23	12	$12,371,200	**3**
GEORGIA AVE NW & HARVARD ST NW	1	0	3	2	0	0	6	68	23	13	$12,142,100	4
14TH ST NW & PARK RD NW	0	0	5	3	1	0	9	10	22	14	$ 1,381,200	47
13TH ST NW & U ST NW	0	1	3	3	1	1	9	13	22	15	$ 1,651,100	29
14TH ST NW & P ST NW	0	0	7	0	1	0	8	16	22	16	$ 1,401,400	46
HOWARD RD SE & MARTIN LUTHER KING JR AVE	0	0	6	2	0	0	8	21	22	17	$ 1,442,200	43
19TH ST NW & L ST NW	0	2	2	2	0	1	7	30	21	18	$ 1,970,100	25
14TH ST NW & U ST NW	0	0	3	4	2	1	10	8	20	19	$ 1,133,600	75
STANTON RD SE & ALABAMA AVE SE	0	0	2	7	0	0	9	15	20	20	$ 1,276,200	59

Notes:

- *K (fatal), A (disabling), B (non-disabling), C (complaint but not visible), and O (no injury or property damage only) are number of crashes regarding to KABCO scale and U stands for "Unknown" crashes.*
- *Danger Index = 10 (K crashes) + 5 (A Crashes) + 3 (B Crashes) + 2 (C Crashes) + 1 (O & U Crashes)*
- *Crash costs are in 2016 dollars* (Harmon, Bahar and Gross 2018).

Table 111. Top Twenty Roadway Segments with Highest Danger Index for NHTSA Pedestrian and Bicycle Crashes in Washington, DC (2012-14)

Roadway Segment	K	A	B	C	O	U	Sum	Rank (Count)	Danger Index	Rank (Danger Index)	Crash Costs	Rank ($)
3100 14TH ST NW	0	0	5	3	0	1	9	**3**	22	**1**	$ 1,381,200	12
2400 18TH ST NW	0	1	2	2	3	1	9	**1**	19	**2**	$ 1,350,800	13
1400 P ST NW	0	0	4	3	1	0	8	4	19	**3**	$ 1,182,700	14
4000 MINNESOTA AVE NE	0	1	2	3	1	0	7	5	18	4	$ 1,440,700	11
2300 GEORGIA AVE NW	0	0	2	4	2	1	9	**2**	17	5	$ 935,100	18
5500 SOUTHERN AVE SE	0	1	2	1	0	0	4	17	13	6	$ 1,177,600	15
1100 MASSACHUSETTS AVE NW	0	0	3	1	1	0	5	7	12	7	$ 733,000	35
15 E ST NW	0	0	3	1	1	0	5	9	12	8	$ 733,000	36
2100 P ST NW	0	0	4	0	0	0	4	15	12	9	$ 794,000	30
765 MORTON ST NW	1	0	0	1	0	0	2	100	12	10	$11,421,000	**1**
3000 14TH ST NW	0	0	2	2	1	0	5	8	11	11	$ 660,100	40
1300 14TH ST NW	0	0	2	2	1	0	5	10	11	12	$ 660,100	41
1000 11TH ST NW	0	0	3	1	0	0	4	11	11	13	$ 721,100	37
1130 17TH ST NW	0	0	3	1	0	0	4	14	11	14	$ 721,100	38
1370 H ST NE	0	1	2	0	0	0	3	18	11	15	$ 1,052,000	16
3100 MONROE ST NE	0	1	1	1	0	0	3	38	10	16	$ 979,100	17
500 EASTERN AVE NE	1	0	0	0	0	0	1	187	10	17	$11,295,400	**2**
1300 NEW YORK AVE NE	1	0	0	0	0	0	1	273	10	18	$11,295,400	**3**
4000 ALABAMA AVE SE	1	0	0	0	0	0	1	333	10	19	$11,295,400	4
1850 ALABAMA AVENUE SE	1	0	0	0	0	0	1	394	10	20	$11,295,400	5

Notes:

- *K (fatal), A (disabling), B (non-disabling), C (complaint but not visible), and O (no injury or property damage only) are number of crashes regarding to KABCO scale and U stands for "Unknown" crashes.*
- *Danger Index = 10 (K crashes) + 5 (A Crashes) + 3 (B Crashes) + 2 (C Crashes) + 1 (O & U Crashes)*
- *Crash costs are in 2016 dollars* (Harmon, Bahar and Gross 2018).

Table 112. Top Twenty Streets (Corridors) with Highest Danger Index for NHTSA Pedestrian and Bicycle Crashes in Washington, DC (2012-14)

Street	K	A	B	C	O	U	Sum	Rank (Count)	Danger Index	Rank (Danger Index)	Crash Costs	Rank ($)
14TH ST	1	13	111	92	51	14	282	**1**	657	**1**	$54,172,600	**1**
GEORGIA AVE	1	4	48	64	28	2	147	**2**	332	**2**	$31,838,800	4
7TH ST	1	7	54	47	19	4	132	**3**	324	**3**	$32,776,300	**3**
16TH ST	0	6	44	46	14	4	114	4	272	4	$18,655,800	17
CONNECTICUT AVE	1	7	47	28	20	1	104	6	263	5	$28,976,600	6
11TH ST	1	7	42	33	19	2	104	7	258	6	$28,612,100	7
18TH ST	0	7	45	30	22	2	106	5	254	7	$17,571,100	20
MASSACHUSETTS AVE	0	9	42	28	11	4	94	9	242	8	$17,927,300	18
13TH ST	1	8	33	37	15	3	97	8	241	9	$27,947,300	8
M ST	1	10	29	23	13	1	77	14	207	10	$26,657,300	9
17TH ST	1	7	32	21	12	1	74	15	196	11	$25,024,700	10
WISCONSIN AVE	0	7	35	22	5	4	73	16	193	12	$14,402,800	24
15TH ST	0	5	34	19	17	5	80	10	187	13	$12,672,200	26
K ST	1	2	32	26	14	4	79	11	186	14	$22,437,200	13
6TH ST	1	8	29	18	11	1	68	19	185	15	$24,695,500	11
1ST ST	1	3	26	31	13	3	77	13	181	16	$22,505,400	12
FLORIDA AVE	0	5	24	33	13	3	78	12	179	17	$12,374,200	27
PENNSYLVANIA AVE	0	6	24	26	14	2	72	17	170	18	$12,150,000	29
BENNING RD	1	3	28	20	11	4	67	20	164	19	$21,508,900	14
RHODE ISLAND AVE	0	6	21	28	14	0	69	18	163	20	$11,781,900	30

Notes:

- *K (fatal), A (disabling), B (non-disabling), C (complaint but not visible), and O (no injury or property damage only) are number of crashes regarding to KABCO scale and U stands for "Unknown" crashes.*
- *Danger Index = 10 (K crashes) + 5 (A Crashes) + 3 (B Crashes) + 2 (C Crashes) + 1 (O & U Crashes)*
- *Crash costs are in 2016 dollars* (Harmon, Bahar and Gross 2018).

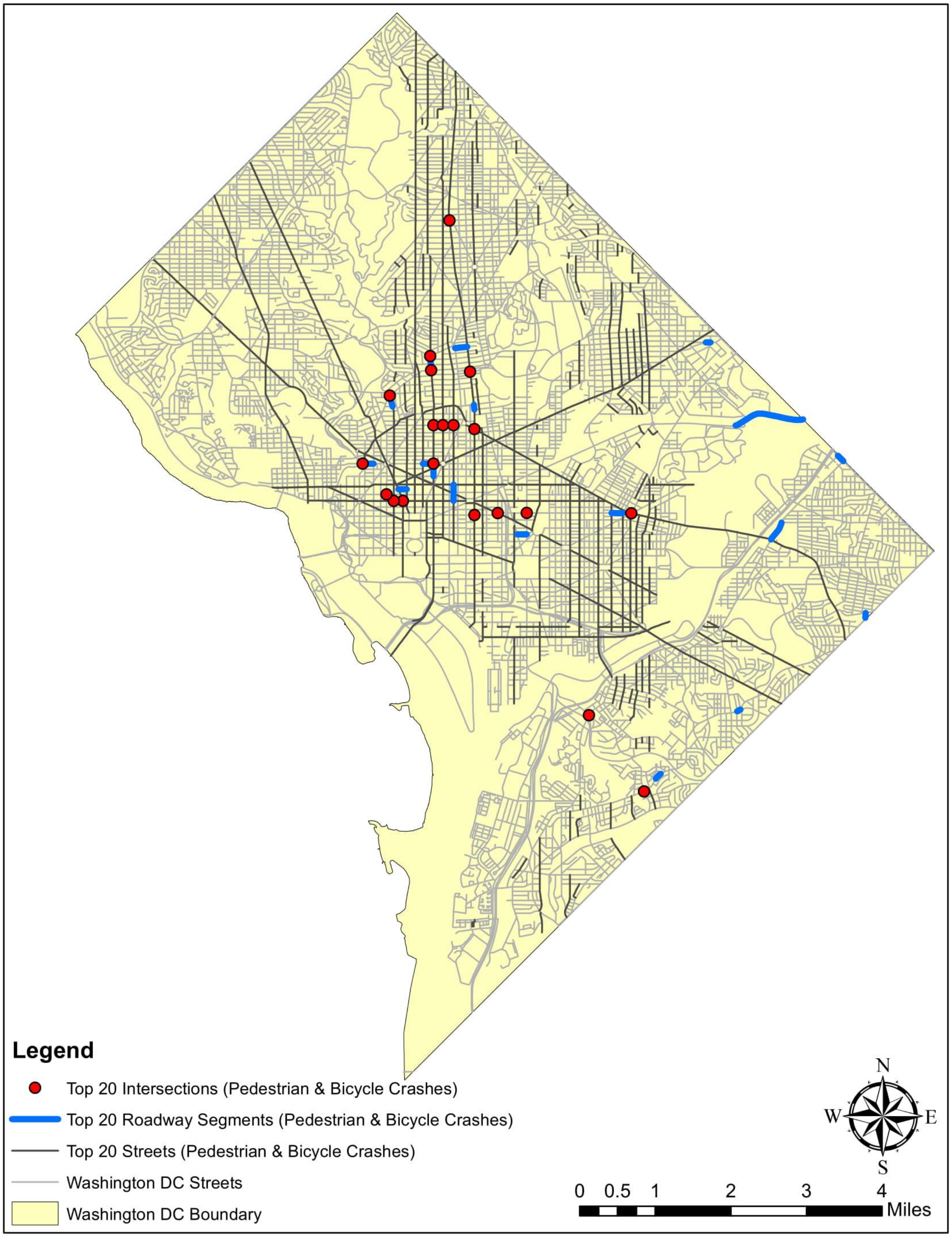


Figure 40. Top Twenty Intersections, Roadway Segments, and Streets (Corridors) with Highest Danger Index for NHTSA Pedestrian and Bicycle Crashes in Washington, DC (2012-14)

Figure 41 to Figure 50 show the top five intersections and roadway segments. The numbers on images are associated "INTGISID" for intersections and "STREETSEGID" for roadway segments.

*#1: Intersection @ "BENNING RD NE & BLADENSBURG RD NE" (*Figure 41*):*

- Signalized intersection
- 5-leg intersection with skew angle.
- Five bicycle and seven pedestrian crashes
- Main bicycle NHTSA crash group: "158 - Bicyclist Failed to Yield—Signalized Intersection" (3 crashes)
- Main pedestrian NHTSA crash groups: "750 - Crossing Roadway—Vehicle Not Turning" and "740 - Dash/Dart-Out" (2 crashes each)
- In 66.7% of crashes, pedestrians or bicyclists were at fault.

Figure 41. The 1st Ranked Intersection with Highest Danger Index for NHTSA Pedestrian and Bicycle Crashes in Washington, DC (2012-14) @ "BENNING RD NE & BLADENSBURG RD NE"

*#2: Intersection @ "18TH ST NW & COLUMBIA RD NW" (*Figure 42*):*

- Signalized intersection
- Intersection is skewed.
- Seven bicycle and six pedestrian crashes
- Main bicycle NHTSA crash groups: "190 - Crossing Paths—Other Circumstances" and "230 - Motorist Overtaking Bicyclist" (2 crashes each)
- Main pedestrian NHTSA crash group: "750 - Crossing Roadway—Vehicle Not Turning" (2 crashes)
- In 46.2% of crashes vehicle drivers were at fault followed by 23.1% pedestrians or bicyclists.

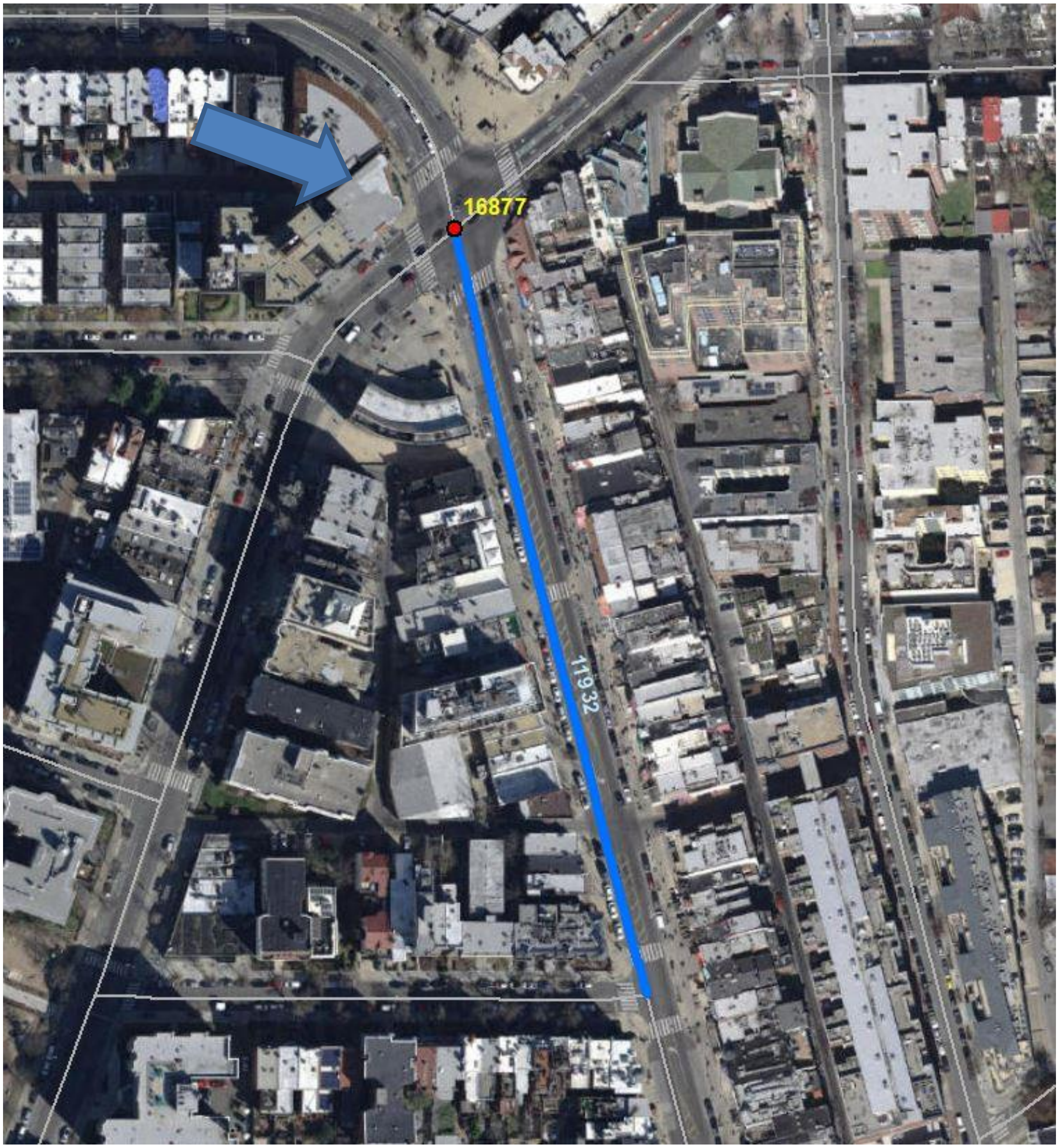


Figure 42. The 2nd Ranked Intersection with Highest Danger Index for NHTSA Pedestrian and Bicycle Crashes in Washington, DC (2012-14) @ "18TH ST NW & COLUMBIA RD NW"

*#3: Intersection @ "7TH ST NW & H ST NW" (*Figure 43*):*

- Signalized intersection
- Three bicycle and nine pedestrian crashes
- Main pedestrian NHTSA crash groups: "750 - Crossing Roadway—Vehicle Not Turning" and "740 - Dash/Dart-Out" (3 crashes each)
- Vehicle drivers and pedestrians or bicyclists were at fault equally (41.7% each). In 16.7% of crashes fault was unknown.

Figure 43. The 3rd Ranked Intersection with Highest Danger Index for NHTSA Pedestrian and Bicycle Crashes in Washington, DC (2012-14) @ "7TH ST NW & H ST NW"

*#4: Intersection @ "7TH ST NW & FLORIDA AVE NW" (*Figure 44*):*

- Signalized intersection
- Intersection is skewed.
- Six bicycle and six pedestrian crashes
- Main bicycle NHTSA crash group: "215 - Motorist Right Turn/Merge" (2 crashes)
- Main pedestrian NHTSA crash group: "790 - Crossing Roadway—Vehicle Turning" (3 crashes)
- In 50% of crashes, vehicle drivers were at fault followed by 33.3% pedestrians or bicyclists. In one crash, both were at fault.

Figure 44. The 4th Ranked Intersection with Highest Danger Index for NHTSA Pedestrian and Bicycle Crashes in Washington, DC (2012-14) @ "7TH ST NW & FLORIDA AVE NW"

*#5: Intersection @ "23RD ST NW & P ST NW" (*Figure 45*):*

- Signalized intersection
- While the intersection is four-legged but there are two ramp exits and a trail close to the intersection and the intersection is slightly skewed.
- Six bicycle and four pedestrian crashes
- Main bicycle NHTSA crash group: "210 - Motorist Left Turn/Merge" (3 crashes)
- Main pedestrian NHTSA crash group: "750 - Crossing Roadway—Vehicle Not Turning" (3 crashes)
- In 60% of crashes, vehicle drivers were at fault followed by 30% pedestrians or bicyclists. In one crash, both were at fault.

Figure 45. The 5th Ranked Intersection with Highest Danger Index for NHTSA Pedestrian and Bicycle Crashes in Washington, DC (2012-14) @ "23RD ST NW & P ST NW"

*#1: Roadway segment @ "3100 14TH ST NW" (*Figure 46*):*

- The segment is linked to another top 20 roadway segment and a top 20 intersection.
- Seven bicycle and two pedestrian crashes
- Main bicycle NHTSA crash group: "240 - Bicyclist Overtaking Motorist" (5 crashes)
- In 77.8% of crashes, vehicle drivers were at fault.

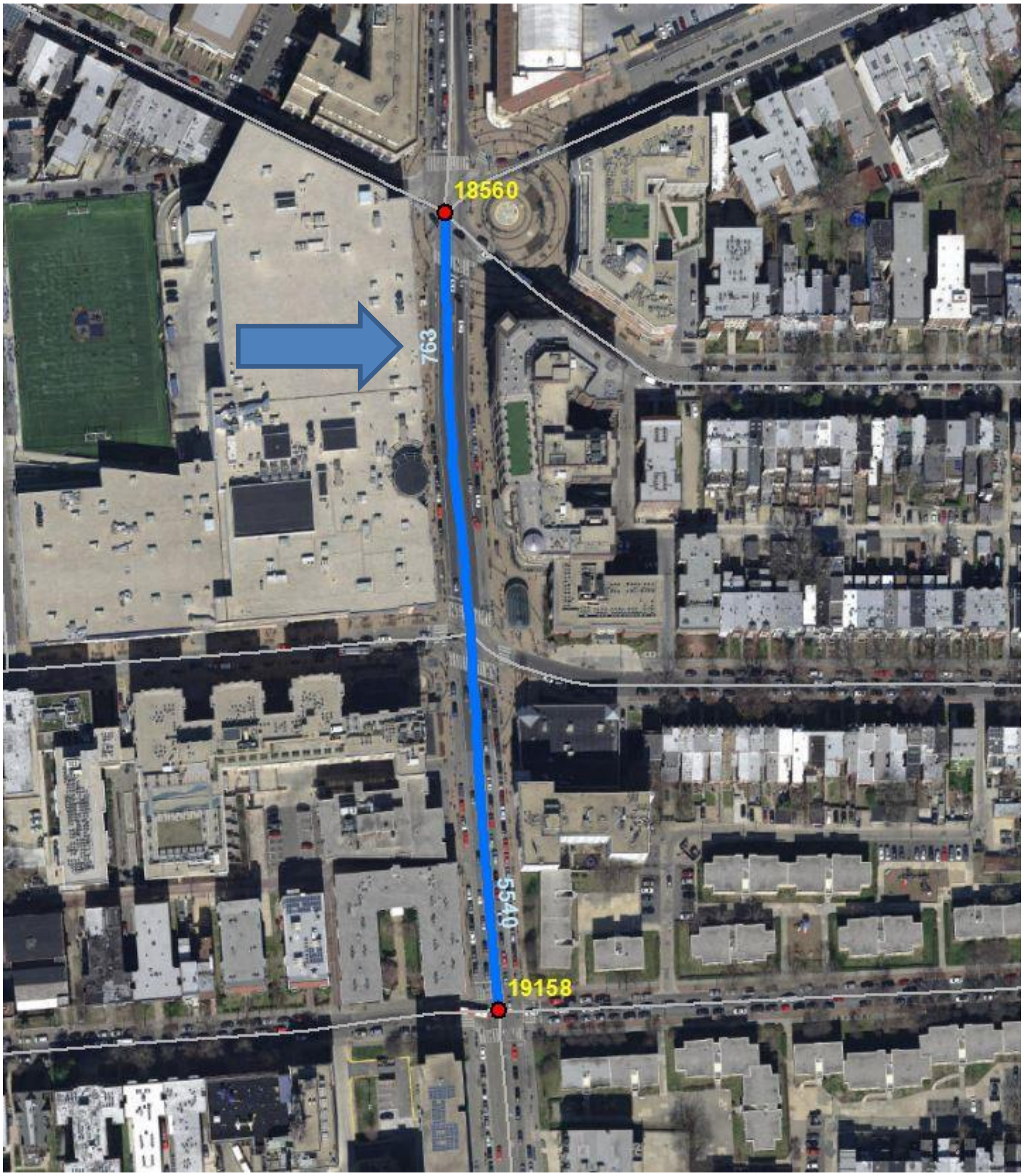


Figure 46. The 1st Ranked Roadway Segment with Highest Danger Index for NHTSA Pedestrian and Bicycle Crashes in Washington, DC (2012-14) @ "3100 14TH ST NW"

*#2: Roadway segment @ "2400 18TH ST NW" (*Figure 47*):*

- The segment is linked to a top 20 intersection.
- The segment has midblock crossing that had multiple pedestrian crossing crashes. Moreover, the segment has parallel parking lane and a center two-way turn lane.
- Three bicycle and six pedestrian crashes
- Main bicycle NHTSA crash group: "240 - Bicyclist Overtaking Motorist" (2 crashes)

- Main pedestrian NHTSA crash group: "750 - Crossing Roadway—Vehicle Not Turning" (5 crashes)
- Vehicle drivers and pedestrians or bicyclists were at fault equally (44.4% each). In one crash fault was unknown.

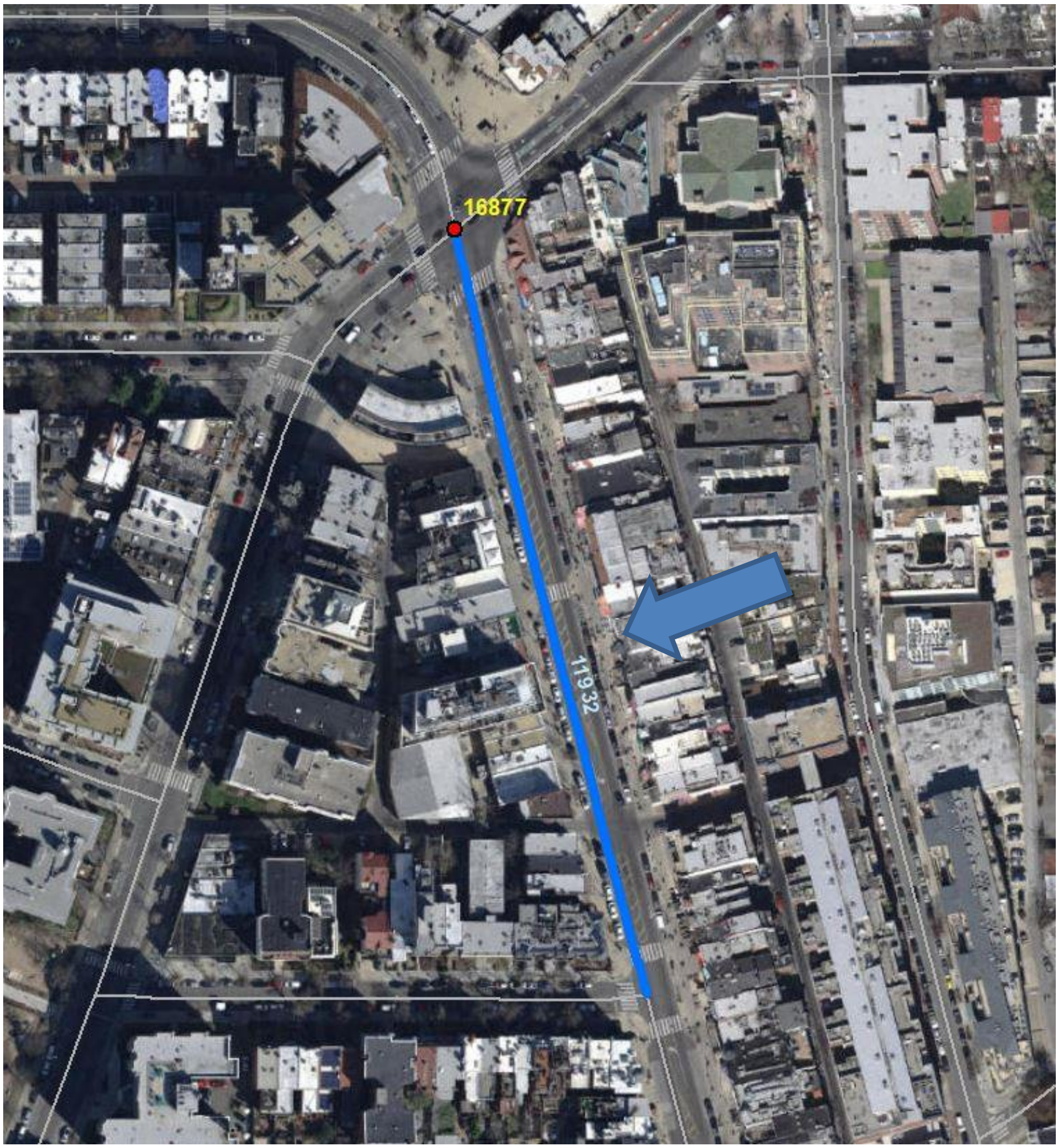


Figure 47. The 2nd Ranked Roadway Segment with Highest Danger Index for NHTSA Pedestrian and Bicycle Crashes in Washington, DC (2012-14) @ "2400 18TH ST NW"

*#3: Roadway segment @ "1400 P ST NW" (*Figure 48*):*

- The segment is linked to a top 20 intersection.
- The segment has midblock crossing.

- Four bicycle and four pedestrian crashes
- Main bicycle NHTSA crash group: "230 - Motorist Overtaking Bicyclist" (2 crashes)
- Main pedestrian NHTSA crash groups: "200 - Backing Vehicle" and "460 - Crossing Driveway or Alley" (2 crashes each)
- In 75% of crashes, vehicle drivers were at fault.

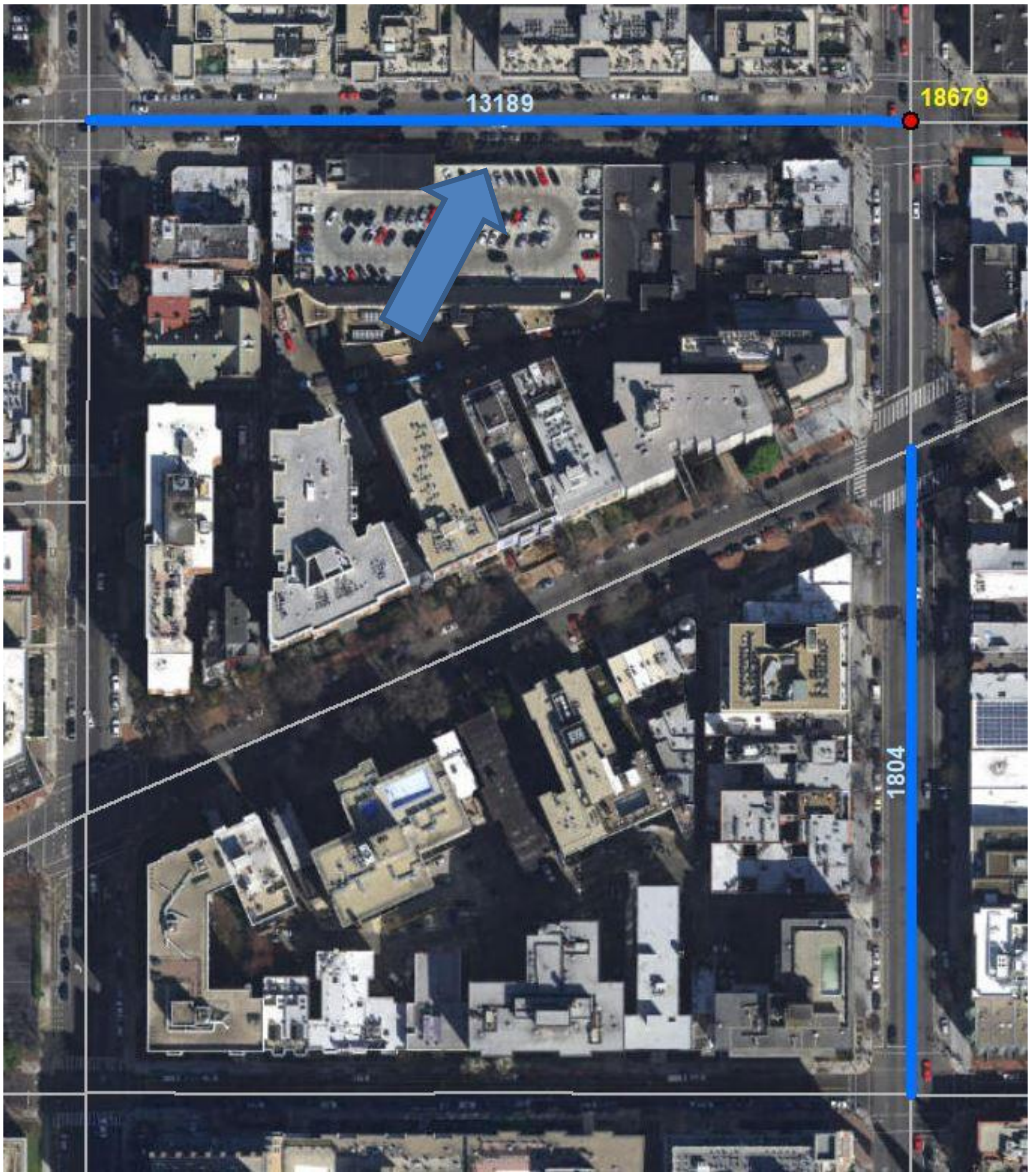


Figure 48. The 3rd Ranked Roadway Segment with Highest Danger Index for NHTSA Pedestrian and Bicycle Crashes in Washington, DC (2012-14) @ "1400 P ST NW"

*#4: Roadway segment @ "4000 MINNESOTA AVE NE" (*Figure 49*):*

- The segment has midblock crossing
- One bicycle and six pedestrian crashes

- Main pedestrian NHTSA crash groups: "750 - Crossing Roadway—Vehicle Not Turning" and "100 - Unusual Circumstances (2 crashes each)
- In 57.1% of crashes, vehicle drivers were at fault followed by 28.6% pedestrians or bicyclists. In one crash, both were at fault.

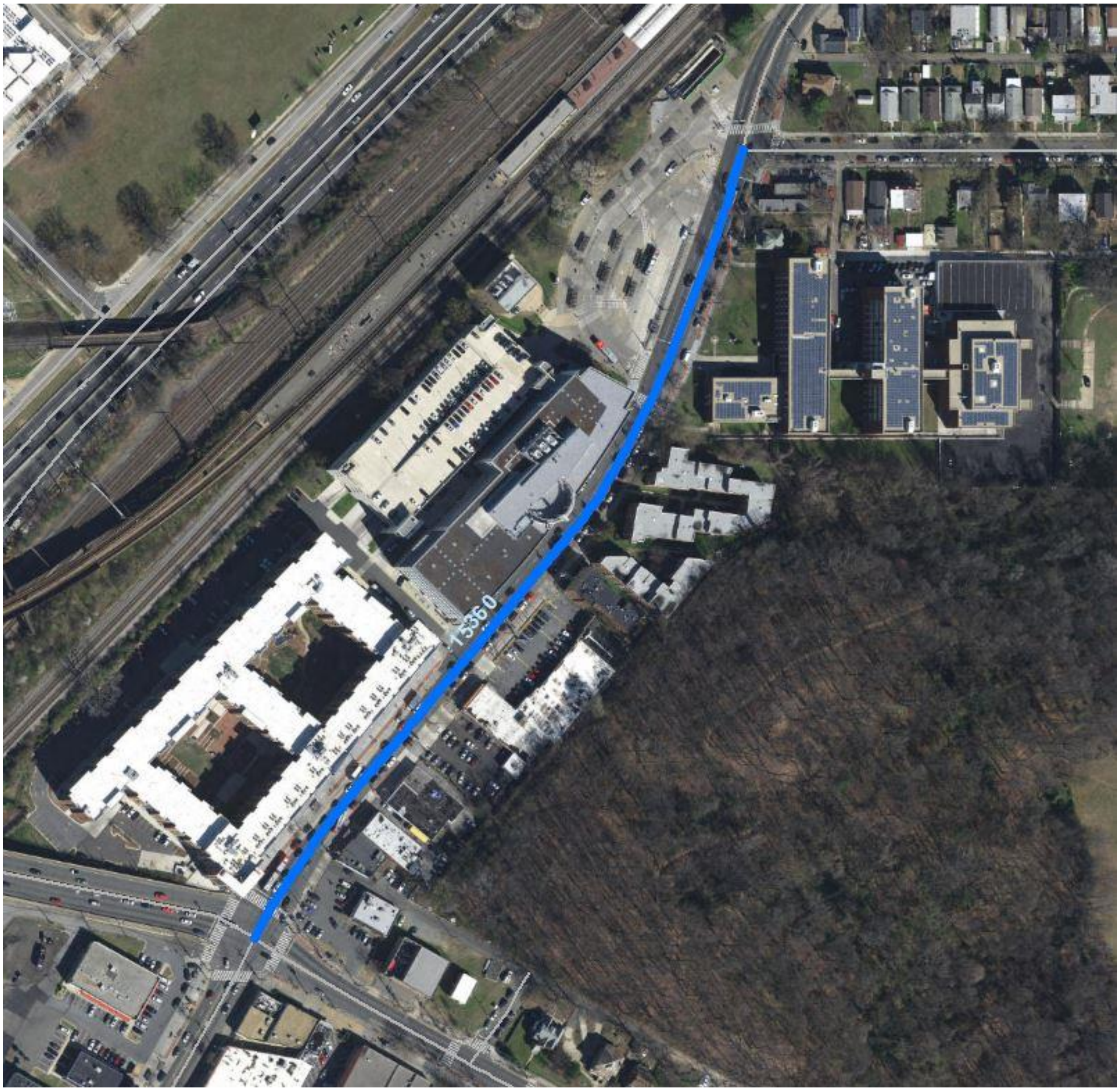


Figure 49. The 4th Ranked Roadway Segment with Highest Danger Index for NHTSA Pedestrian and Bicycle Crashes in Washington, DC (2012-14) @ "4000 MINNESOTA AVE NE"

*#5: Roadway segment @ "2300 GEORGIA AVE NW" (*Figure 50*):*

- The segment ends in two 3-leg intersections.
- The segment has exclusive bus lanes on both directions and multiple restaurants on both sides as well.

- Five bicycle and four pedestrian crashes
- Main bicycle NHTSA crash group: "210 - Motorist Left Turn/Merge" (3 crashes)
- Main pedestrian NHTSA crash group: "350 - Unique Midblock" (2 crashes)
- In 77.8% of crashes, vehicle drivers were at fault.

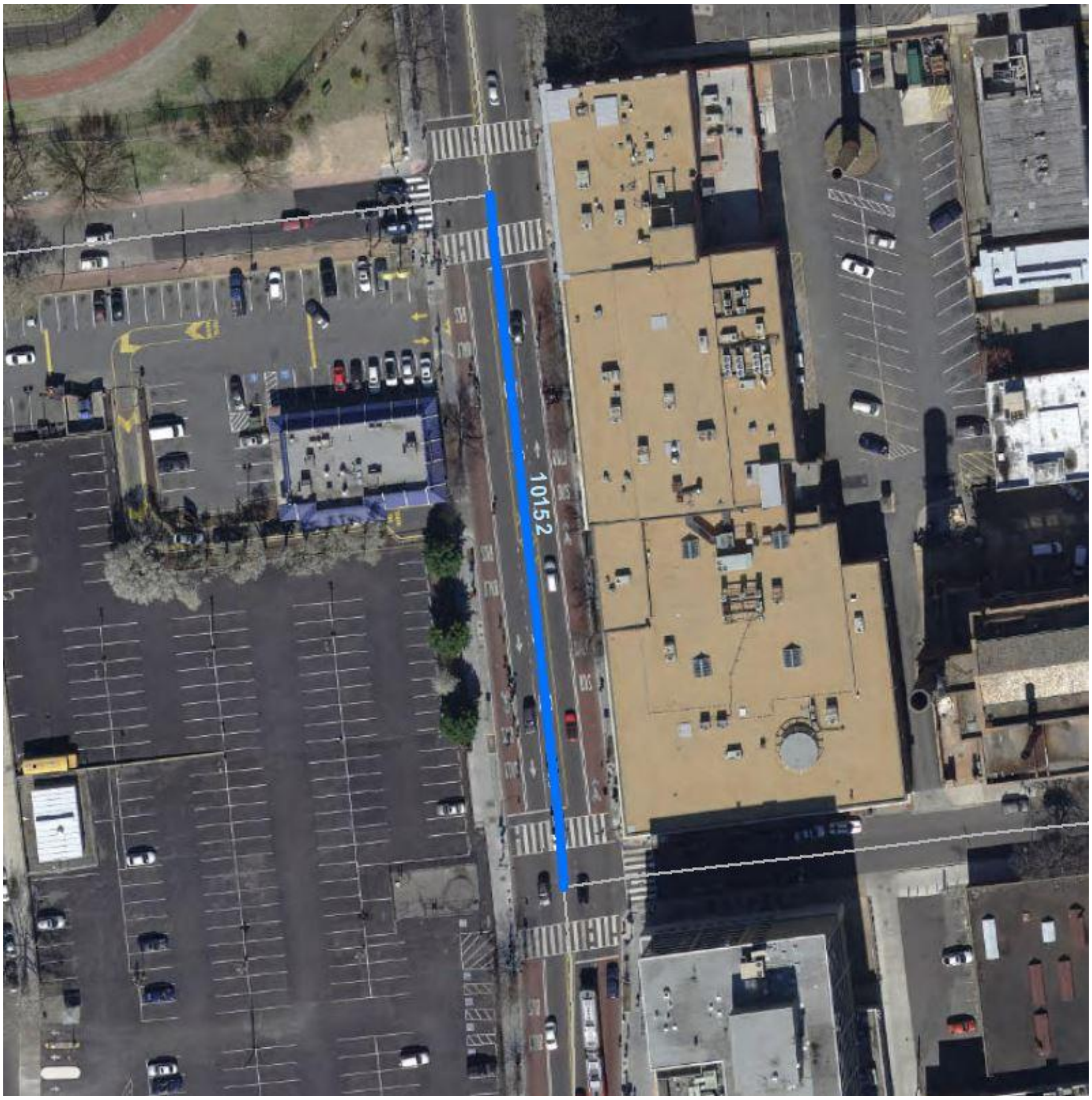


Figure 50. The 5th Ranked Roadway Segment with Highest Danger Index for NHTSA Pedestrian and Bicycle Crashes in Washington, DC (2012-14) @ "2300 GEORGIA AVE NW"

Hot Spots: NHTSA Pedestrian Crashes

The hot spots (top twenty intersections, roadway segments, and streets (or corridors)) for NHTSA pedestrian crashes based on "Danger Index" (cited in (Kunkle 2017)) are demonstrated in Table 113 to Table 115 and Figure 51.

Table 113. Top Twenty Intersections with Highest Danger Index for NHTSA Pedestrian Crashes Combined in Washington, DC (2012-14)

Intersection	K	A	B	C	O	U	Sum	Rank (Count)	Danger Index	Rank (Danger Index)	Crash Costs	Rank ($)
7TH ST NW & H ST NW	0	2	1	5	1	0	9	1	24	1	$ 2,148,400	16
GEORGIA AVE NW & HARVARD ST NW	1	0	3	2	0	0	6	7	23	2	$12,142,100	1
ALABAMA AVE SE & STANTON RD SE	0	0	2	7	0	0	9	2	20	3	$ 1,276,200	34
BENNING RD NE & BLADENSBURG RD NE	0	0	6	1	0	0	7	5	20	4	$ 1,316,600	27
GEORGIA AVE NW & KENNEDY ST NW	0	2	2	2	0	0	6	8	20	5	$ 1,958,200	17
18TH ST NW & K ST NW	1	0	2	2	0	0	5	20	20	6	$11,943,600	3
19TH ST NW & L ST NW	0	2	1	2	0	1	6	9	18	7	$ 1,771,600	18
H ST & NORTH CAPITOL ST	0	1	3	2	0	0	6	10	18	8	$ 1,501,700	23
BENNING RD NE & EAST CAPITOL ST	1	0	2	1	0	0	4	34	18	9	$11,818,000	4
17TH ST NW & K ST NW	1	1	1	0	0	0	3	72	18	10	$12,148,900	2
16TH ST NW & L ST NW	0	0	3	3	2	0	8	3	17	11	$ 996,100	48
SOUTH CAPITOL ST & SOUTHERN AVE SE	0	1	2	3	0	0	6	11	17	12	$ 1,428,800	25
4TH ST NW & MASSACHUSETTS AVE NW	0	2	1	2	0	0	5	21	17	13	$ 1,759,700	19
NEW YORK AVE NW & NORTH CAPITOL ST NW	0	0	2	4	2	0	8	4	16	14	$ 923,200	55
BENNING RD NE & MINNESOTA AVE NE	0	1	2	2	1	0	6	12	16	15	$ 1,315,100	28
9TH ST NW & U ST NW	0	1	2	2	1	0	6	13	16	16	$ 1,315,100	29
19TH ST NW & M ST NW	0	1	3	1	0	0	5	22	16	17	$ 1,376,100	26
23RD ST NW & P ST NW	0	2	2	0	0	0	4	35	16	18	$ 1,707,000	20
7TH ST NW & FLORIDA AVE NW	0	0	3	3	0	0	6	14	15	19	$ 972,300	54
ALABAMA AVE SE & PENNSYLVANIA AVE SE	0	1	2	2	0	0	5	23	15	20	$ 1,303,200	33

Notes:

- *K (fatal), A (disabling), B (non-disabling), C (complaint but not visible), and O (no injury or property damage only) are number of crashes regarding to KABCO scale and U stands for "Unknown" crashes.*
- *Danger Index = 10 (K crashes) + 5 (A Crashes) + 3 (B Crashes) + 2 (C Crashes) + 1 (O & U Crashes)*
- *Crash costs are in 2016 dollars* (Harmon, Bahar and Gross 2018).

Table 114. Top Twenty Roadway Segments with Highest Danger Index for NHTSA Pedestrian Crashes Combined in Washington, DC (2012-14)

Roadway Segment	K	A	B	C	O	U	Sum	Rank (Count)	Danger Index	Rank (Danger Index)	Crash Costs	Rank ($)
4000 MINNESOTA AVE NE	0	1	2	2	1	0	6	**1**	16	**1**	$ 1,315,100	10
2400 18TH ST NW	0	1	1	2	1	1	6	**2**	14	**2**	$ 1,128,500	11
5500 SOUTHERN AVE SE	0	1	2	0	0	0	3	5	11	**3**	$ 1,052,000	12
1400 P ST NW	0	0	2	2	0	0	4	**3**	10	4	$ 648,200	59
2300 GEORGIA AVE NW	0	0	2	2	0	0	4	4	10	5	$ 648,200	60
1300 NEW YORK AVE NE	1	0	0	0	0	0	1	55	10	6	$11,295,400	**1**
4000 ALABAMA AVE SE	1	0	0	0	0	0	1	56	10	7	$11,295,400	**2**
500 EASTERN AVE NE	1	0	0	0	0	0	1	57	10	8	$11,295,400	**3**
1850 ALABAMA AVENUE SE	1	0	0	0	0	0	1	58	10	9	$11,295,400	4
I-695 WESTBOUND SE	1	0	0	0	0	0	1	59	10	10	$11,295,400	5
600 F ST NW	1	0	0	0	0	0	1	60	10	11	$11,295,400	6
SOUSA BRIDGE	1	0	0	0	0	0	1	61	10	12	$11,295,400	7
GEORGIA AVE NW	1	0	0	0	0	0	1	62	10	13	$11,295,400	8
SUITLAND PARKWAY	1	0	0	0	0	0	1	63	10	14	$11,295,400	9
1200 H ST NE	0	0	2	1	0	0	3	6	8	15	$ 522,600	61
1200 WISCONSIN AVE NW	0	1	1	0	0	0	2	13	8	16	$ 853,500	13
1300 H ST NE	0	1	1	0	0	0	2	14	8	17	$ 853,500	14
2700 LANGSTON PL SE	0	1	1	0	0	0	2	15	8	18	$ 853,500	15
1100 HOWARD RD SE	0	0	2	0	1	0	3	7	7	19	$ 408,900	62
1100 11TH ST NW	0	0	2	0	1	0	3	8	7	20	$ 408,900	63

Notes:

- *K (fatal), A (disabling), B (non-disabling), C (complaint but not visible), and O (no injury or property damage only) are number of crashes regarding to KABCO scale and U stands for "Unknown" crashes.*
- *Danger Index = 10 (K crashes) + 5 (A Crashes) + 3 (B Crashes) + 2 (C Crashes) + 1 (O & U Crashes)*
- *Crash costs are in 2016 dollars* (Harmon, Bahar and Gross 2018).

Table 115. Top Twenty Streets (Corridors) with Highest Danger Index for NHTSA Pedestrian Crashes Combined in Washington, DC (2012-14)

Street	K	A	B	C	O	U	Sum	Rank (Count)	Danger Index	Rank (Danger Index)	Crash Costs	Rank ($)
14TH ST	1	5	38	50	15	8	117	**1**	272	**1**	$28,667,100	**3**
GEORGIA AVE	1	4	26	39	11	1	82	**2**	198	**2**	$24,117,600	4
7TH ST	1	3	25	29	4	2	64	**3**	164	**3**	$21,936,700	5
CONNECTICUT AVE	1	5	23	17	10	1	57	5	149	4	$21,402,000	6
16TH ST	0	2	20	30	6	1	59	4	137	5	$ 9,131,300	24
17TH ST	1	4	18	18	3	0	44	11	123	6	$19,784,900	8
MINNESOTA AVE	0	2	22	18	7	3	52	6	122	7	$ 8,056,800	30
13TH ST	1	3	13	25	4	3	49	8	121	8	$19,064,200	9
ALABAMA AVE	2	2	18	17	2	0	41	14	120	9	$29,632,800	**2**
M ST	1	6	13	18	4	1	43	12	120	10	$20,126,200	7
12TH ST	0	4	19	20	2	1	46	10	120	11	$ 8,939,200	27
18TH ST	0	3	21	15	11	1	51	7	120	12	$ 8,160,300	29
BENNING RD	1	1	21	12	9	4	48	9	115	13	$17,780,800	12
WISCONSIN AVE	0	5	17	16	2	2	42	13	112	14	$ 8,706,700	28
6TH ST	1	4	16	13	6	0	40	16	110	15	$18,795,600	10
19TH ST	0	7	15	11	7	1	41	15	110	16	$ 9,039,300	26
MASSACHUSETTS AVE	0	7	12	17	2	0	38	19	107	17	$ 9,126,000	25
NEW YORK AVE	3	2	9	14	1	3	32	27	99	18	$38,788,700	**1**
FLORIDA AVE	0	4	12	15	8	0	39	17	94	19	$ 6,981,200	33
9TH ST	0	3	14	16	4	0	37	20	93	20	$ 6,801,200	34

Notes:

- *K (fatal), A (disabling), B (non-disabling), C (complaint but not visible), and O (no injury or property damage only) are number of crashes regarding to KABCO scale and U stands for "Unknown" crashes.*
- *Danger Index = 10 (K crashes) + 5 (A Crashes) + 3 (B Crashes) + 2 (C Crashes) + 1 (O & U Crashes)*
- *Crash costs are in 2016 dollars* (Harmon, Bahar and Gross 2018).

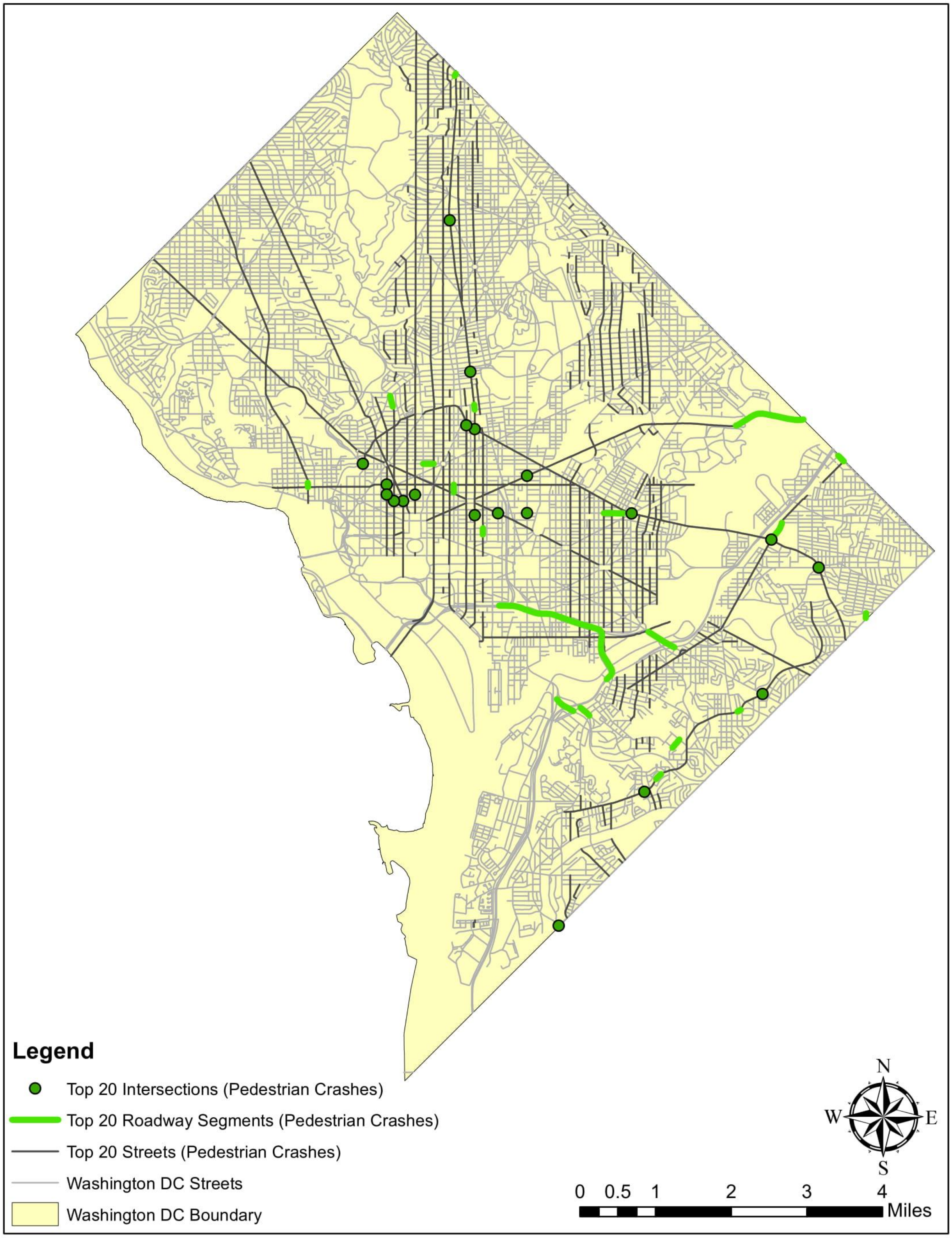


Figure 51. Top Twenty Intersections, Roadway Segments, and Streets (Corridors) with Highest Danger Index for NHTSA Pedestrian Crashes Combined in Washington, DC (2012-14)

Figure 52 to Figure 61 show the top five intersections and roadway segments. The main NHTSA crash groups of these hot spots are almost similar to the top three pedestrian NHTSA crash groups so their associated PEDSAFE countermeasures can be used for these top five intersections and roadway segments as well ("*Appendix J – PEDSAFE Countermeasures for Top Three Pedestrian Crash Groups in Washington, DC*").

The numbers on images are associated "INTGISID" for intersections and "STREETSEGID" for roadway segments.

*#1: Intersection @ "7TH ST NW & H ST NW" (*Figure 52*):*

- Signalized intersection
- Nine pedestrian crashes
- Main pedestrian NHTSA crash groups: "750 - Crossing Roadway—Vehicle Not Turning" and "740 - Dash/Dart-Out" (3 crashes each)
- Vehicle drivers and pedestrians or bicyclists were at fault equally (44.4% each). In one crash fault was unknown.
- Rank (based on combined pedestrian and bicycle crashes): 3^{rd}

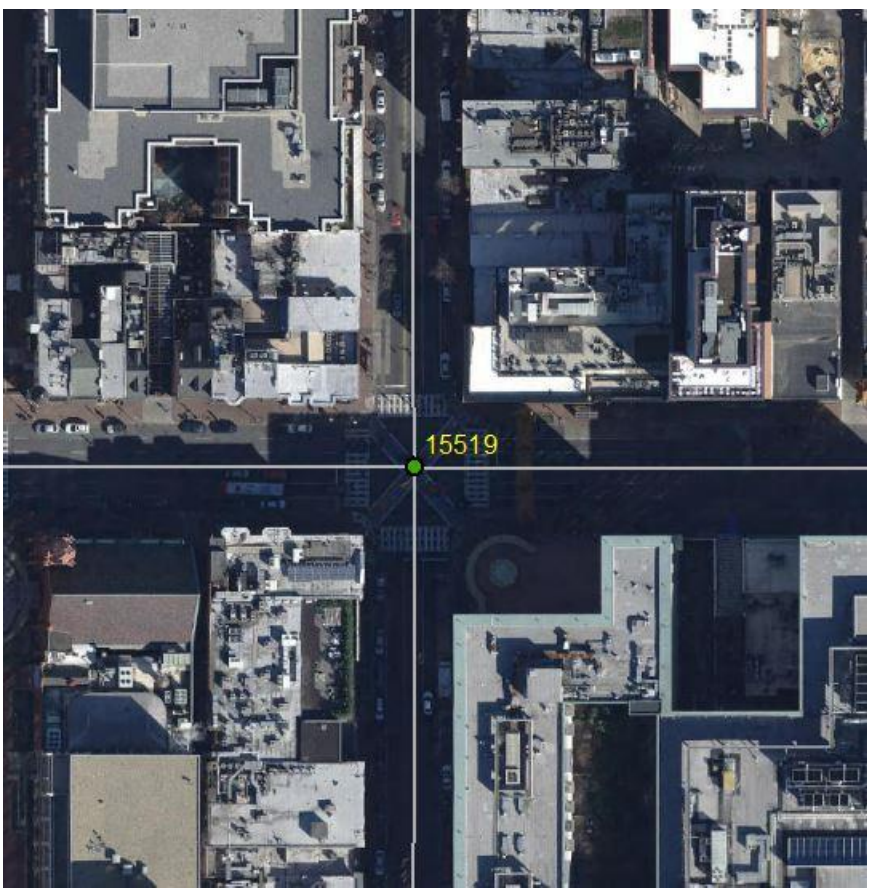


Figure 52. The 1^{st} Ranked Intersection with Highest Danger Index for NHTSA Pedestrian Crashes in Washington, DC (2012-14) @ "7TH ST NW & H ST NW"

*#2: Intersection @ “GEORGIA AVE NW & HARVARD ST NW” (*Figure 53*):*

- Signalized intersection
- Skewed intersection
- Six pedestrian crashes.
- The main pedestrian NHTSA crash group: "790 - Crossing Roadway—Vehicle Turning" (5 crashes)
- Vehicle drivers were at fault in two third of crashes.
- Rank (based on combined pedestrian and bicycle crashes): 13th

Figure 53. The 2nd Ranked Intersection with Highest Danger Index for NHTSA Pedestrian Crashes in Washington, DC (2012-14) @ “GEORGIA AVE NW & HARVARD ST NW”

*#3: Intersection @ “ALABAMA AVE SE & STANTON RD SE” (*Figure 54*):*

- Signalized intersection
- Slightly skewed intersection
- Nine pedestrian crashes.
- The main pedestrian NHTSA crash group: "790 - Crossing Roadway—Vehicle Turning" (nine crashes) Five crashes were left-turns and the rest were right-turns.
- Vehicle drivers were at fault in 77.8% of crashes and the fault was unknown in the rest (2 crashes).
- Rank (based on combined pedestrian and bicycle crashes): 20th

Figure 54. The 3rd Ranked Intersection with Highest Danger Index for NHTSA Pedestrian Crashes in Washington, DC (2012-14) @ "ALABAMA AVE SE & STANTON RD SE"

*#4: Intersection @ "BENNING RD NE & BLADENSBURG RD NE" (*Figure 55*):*

- Signalized intersection
- It is a 5-leg intersection with skew angle.
- Seven pedestrian crashes.
- Multiple NHTSA crash groups each with two crashes.
- Pedestrians were at fault in 71.4% of crashes and the fault was unknown in the rest (2 crashes). Vehicle drivers were not identified to be at fault even in a single crash.
- Rank (based on combined pedestrian and bicycle crashes): 1st

Figure 55. The 4th Ranked Intersection with Highest Danger Index for NHTSA Pedestrian Crashes in Washington, DC (2012-14) @ "BENNING RD NE & BLADENSBURG RD NE"

*#5: Intersection @ "GEORGIA AVE NW & KENNEDY ST NW" (*Figure 56*):*

- Signalized intersection
- The intersection is very close to another top ranked pedestrian crash intersection on the east side.
- Six pedestrian crashes.
- The main pedestrian NHTSA crash group: "790 - Crossing Roadway—Vehicle Turning" (3 crashes)
- Vehicle drivers were at fault in two third of crashes.
- Rank (based on combined pedestrian and bicycle crashes): 9th

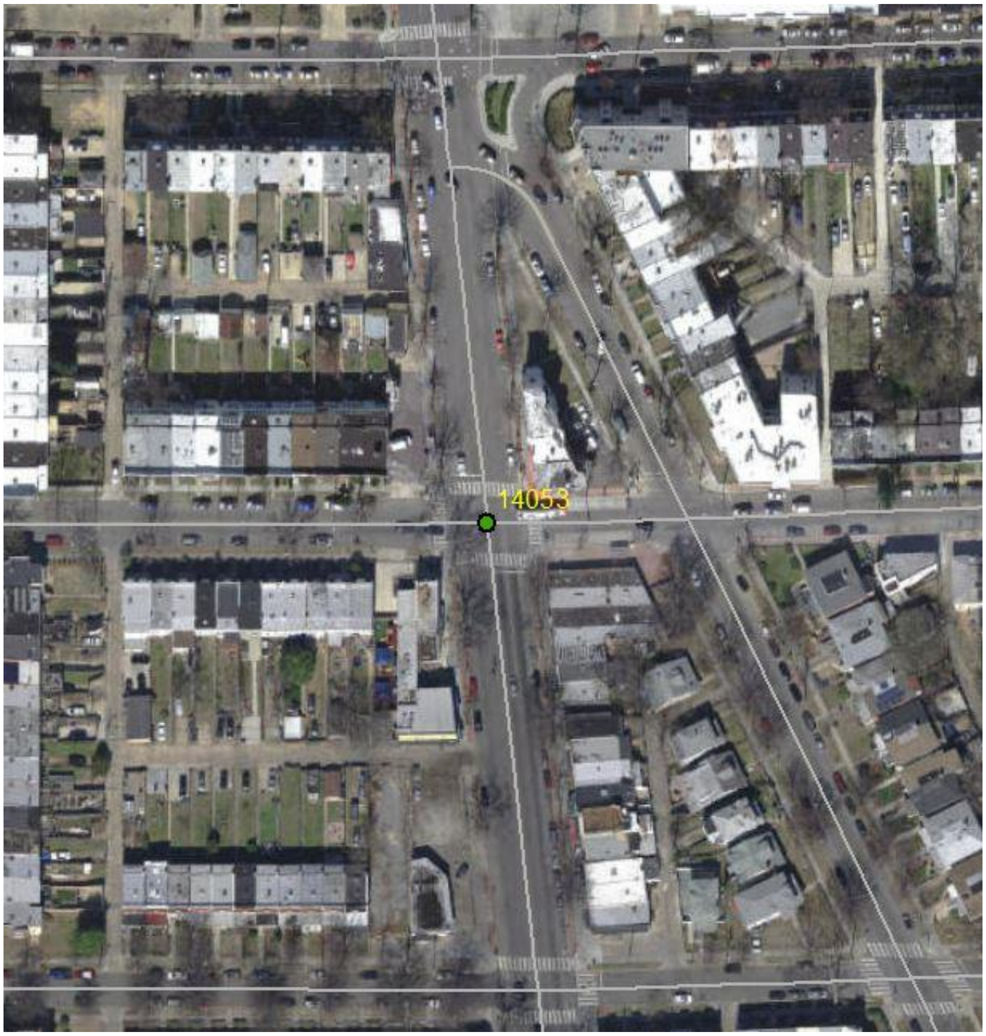


Figure 56. The 5th Ranked Intersection with Highest Danger Index for NHTSA Pedestrian Crashes in Washington, DC (2012-14) @ "GEORGIA AVE NW & KENNEDY ST NW"

*#1: Roadway segment @ "4000 MINNESOTA AVE NE" (*Figure 57*):*

- The segment is linked to a top 20 pedestrian crash intersection.
- The segment has midblock crossing.
- Six pedestrian crashes.
- The main pedestrian NHTSA crash groups: "750 - Crossing Roadway—Vehicle Not Turning" and "100 - Unusual Circumstances" (2 crashes each)
- Vehicle drivers were at fault in 50% of crashes followed by pedestrians in 33.3%. In one crash both were at fault.
- Rank (based on combined pedestrian and bicycle crashes): 4th

Figure 57. The 1st Ranked Roadway Segment with Highest Danger Index for NHTSA Pedestrian Crashes in Washington, DC (2012-14) @ "4000 MINNESOTA AVE NE"

*#2: Roadway segment @ "2400 18TH ST NW" (*Figure 58*):*

- The segment has midblock crossing that had multiple pedestrian crossing crashes. Moreover, the segment has parallel parking lane and a center two-way turn lane.
- Six pedestrian crashes.
- The main pedestrian NHTSA crash group: "790 - Crossing Roadway—Vehicle Turning" (5 crashes)
- Vehicle drivers and pedestrians were at fault equally (50% each).
- Rank (based on combined pedestrian and bicycle crashes): 2nd

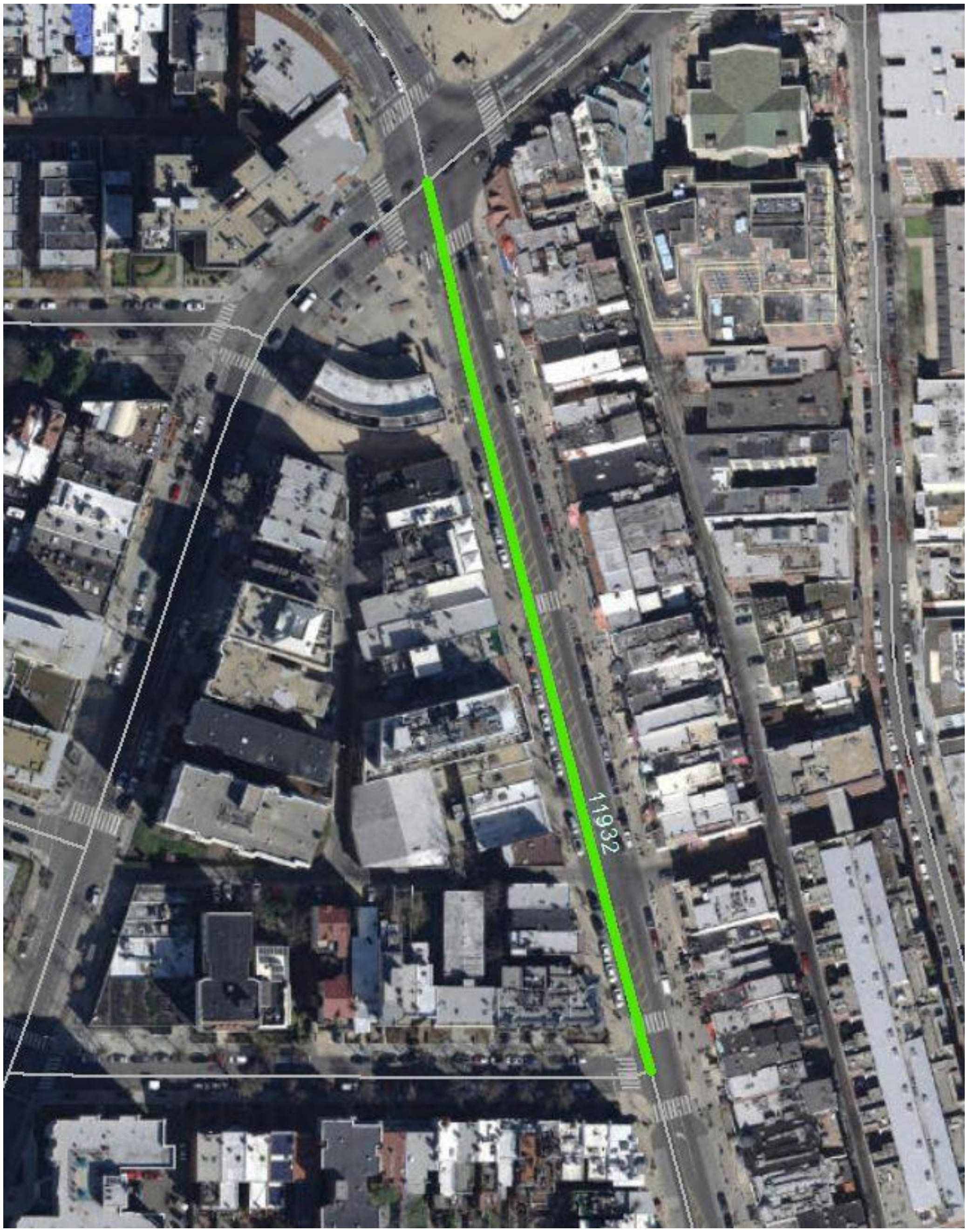


Figure 58. The 2nd Ranked Roadway Segment with Highest Danger Index for NHTSA Pedestrian Crashes in Washington, DC (2012-14) @ "2400 18TH ST NW"

*#3: Roadway segment @ "5500 SOUTHERN AVE SE" (*Figure 59*):*

- Three pedestrian crashes.
- In one crash pedestrian was at fault and two crashes were unknown.
- Rank (based on combined pedestrian and bicycle crashes): 6th

Figure 59. The 3rd Ranked Roadway Segment with Highest Danger Index for NHTSA Pedestrian Crashes in Washington, DC (2012-14) @ "5500 SOUTHERN AVE SE"

*#4: Roadway segment @ "1400 P ST NW" (*Figure 60*):*

- The segment has midblock crossing.
- Four pedestrian crashes.
- The main pedestrian NHTSA crash groups: "460 - Crossing Driveway or Alley" and "200 - Backing Vehicle" (2 crashes each)
- Vehicle drivers were at fault in 50% of crashes followed by pedestrians in 25%. In one crash, the fault could not be determined.
- Rank (based on combined pedestrian and bicycle crashes): 3rd

Figure 60. The 4th Ranked Roadway Segment with Highest Danger Index for NHTSA Pedestrian Crashes in Washington, DC (2012-14) @ "1400 P ST NW"

*#5: Roadway segment @ "2300 GEORGIA AVE NW" (*Figure 61*):*

- The segment ends in two 3-leg intersections.
- The segment has exclusive bus lanes on both directions and multiple restaurants on both sides as well.
- Four pedestrian crashes
- The main pedestrian NHTSA crash group: "350 - Unique Midblock" (2 crashes)
- In all crashes, the vehicle drivers were at fault.
- Rank (based on combined pedestrian and bicycle crashes): 5th

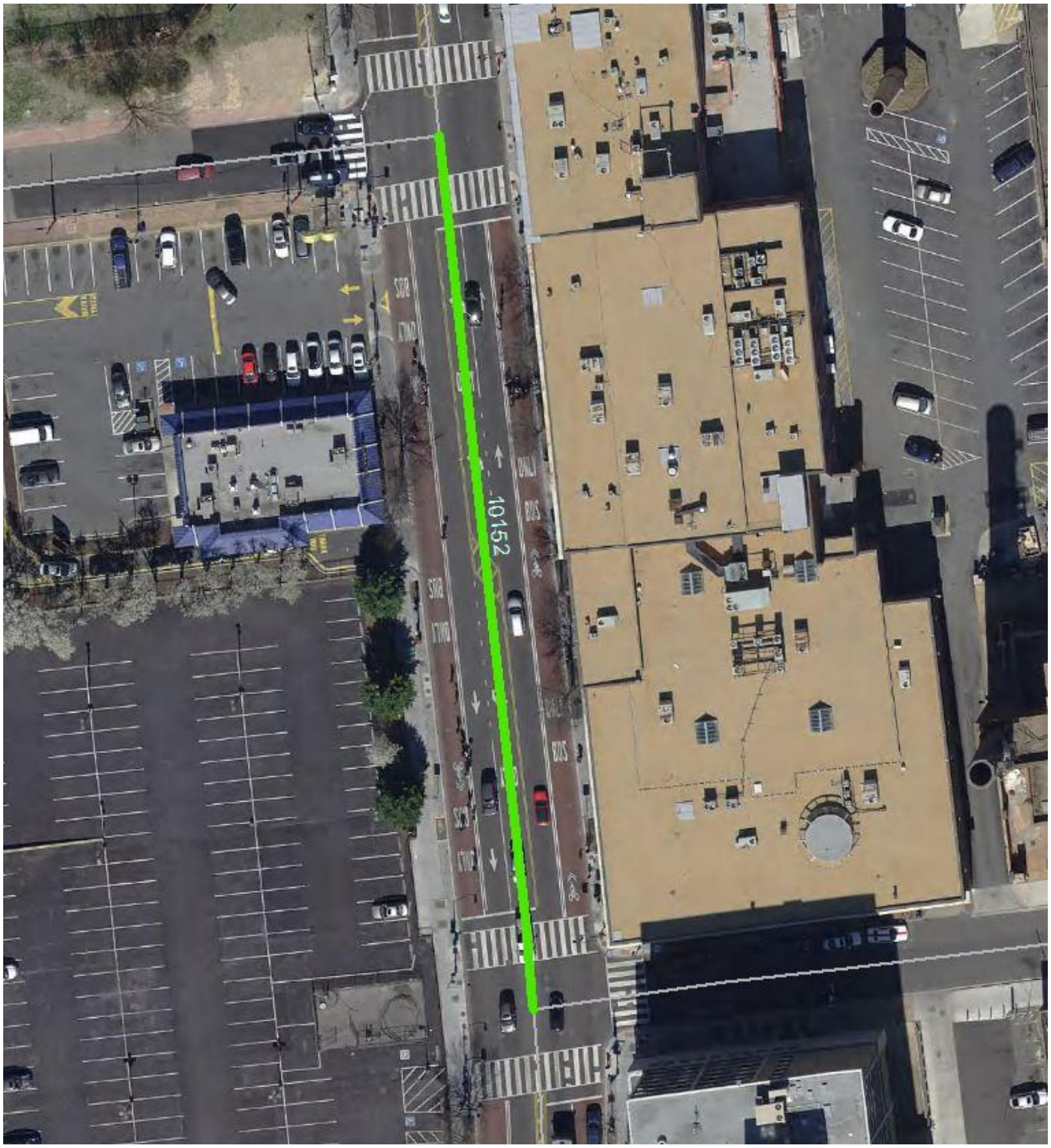


Figure 61. The 5th Ranked Roadway Segment with Highest Danger Index for NHTSA Pedestrian Crashes in Washington, DC (2012-14) @ "2300 GEORGIA AVE NW"

Hot Spots: NHTSA Bicycle Crashes

The hot spots (top twenty intersections, roadway segments, and streets (or corridors)) for NHTSA bicycle crashes based on "Danger Index" (Kunkle 2017) are demonstrated in Table 116 to Table 118 and Figure 62.

Table 116. Top Twenty Intersections with Highest Danger Index for NHTSA Bicycle Crashes in Washington, DC (2012-14)

Intersection	K	A	B	C	O	U	Sum	Rank (Count)	Danger Index	Rank (Danger Index)	Crash Costs	Rank ($)
14TH ST NW & V ST NW	0	0	6	1	0	0	7	**1**	20	**1**	$ 1,316,600	**3**
11TH ST NW & U ST NW	1	1	1	0	0	1	4	16	19	**2**	$12,160,800	**1**
18TH ST NW & COLUMBIA RD NW	0	0	4	3	0	0	7	**2**	18	**3**	$ 1,170,800	8
11TH ST NW & RHODE ISLAND AVE NW	0	1	2	2	0	0	5	8	15	4	$ 1,303,200	4
GEORGIA AVE NW & FLORIDA AVE NW	0	1	2	1	2	0	6	**3**	15	5	$ 1,201,400	7
14TH ST NW & R ST NW	0	1	3	0	0	0	4	17	14	6	$ 1,250,500	5
16TH ST NW & W ST NW	0	1	3	0	0	0	4	18	14	7	$ 1,250,500	6
14TH ST NW & PARK RD NW	0	0	3	2	1	0	6	4	14	8	$ 858,600	21
BENNING RD NE & MARYLAND AVE NE	0	1	1	2	1	0	5	9	13	9	$ 1,116,600	9
14TH ST NW & P ST NW	0	0	4	0	1	0	5	10	13	10	$ 805,900	35
23RD ST NW / P ST NW	0	0	2	3	1	0	6	5	13	11	$ 785,700	38
6TH ST NW & FLORIDA AVE NW	0	1	2	0	1	0	4	19	12	12	$ 1,063,900	10
16TH ST NW & EUCLID ST NW	0	0	4	0	0	0	4	20	12	13	$ 794,000	36
1ST ST NW & IRVING ST NW	0	0	2	3	0	0	5	11	12	14	$ 773,800	47
17TH ST NW & PENNSYLVANIA AVE NW	0	0	2	2	2	0	6	6	12	15	$ 672,000	51
1ST ST NW & NEW YORK AVE NW	0	1	2	0	0	0	3	41	11	16	$ 1,052,000	11
14TH ST NW & W ST NW	0	1	2	0	0	0	3	42	11	17	$ 1,052,000	12
29TH ST NW & M ST NW	0	1	2	0	0	0	3	43	11	18	$ 1,052,000	13
BENNING RD NE & OKLAHOMA AVE NE	0	1	2	0	0	0	3	44	11	19	$ 1,052,000	14
18TH ST NW & FLORIDA AVE NW	0	1	0	3	0	0	4	21	11	20	$ 1,031,800	15

Notes:

- *K (fatal), A (disabling), B (non-disabling), C (complaint but not visible), and O (no injury or property damage only) are number of crashes regarding to KABCO scale and U stands for "Unknown" crashes.*
- *Danger Index = 10 (K crashes) + 5 (A Crashes) + 3 (B Crashes) + 2 (C Crashes) + 1 (O & U Crashes)*
- *Crash costs are in 2016 dollars* (Harmon, Bahar and Gross 2018).

Table 117. Top Twenty Roadway Segments with Highest Danger Index for NHTSA Bicycle Crashes in Washington, DC (2012-14)

Roadway Segment	K	A	B	C	O	U	Sum	Rank (Count)	Danger Index	Rank (Danger Index)	Crash Costs	Rank ($)
3100 14TH ST NW	0	0	4	2	0	1	7	**1**	17	**1**	$ 1,057,100	**2**
2120 P ST NW	0	0	4	0	0	0	4	4	12	**2**	$ 794,000	5
1000 11TH ST NW	0	0	3	1	0	0	4	5	11	**3**	$ 721,100	7
15 E ST NW	0	0	3	1	0	0	4	6	11	4	$ 721,100	8
1300 14TH ST NW	0	0	2	2	1	0	5	**2**	11	5	$ 660,100	9
765 MORTON ST NW	1	0	0	0	0	0	1	72	10	6	$11,295,400	**1**
1200 18TH ST NW	0	0	3	0	0	0	3	8	9	7	$ 595,500	45
1125 CONNECTICUT AVE NW	0	0	3	0	0	0	3	9	9	8	$ 595,500	46
1400 P ST NW	0	0	2	1	1	0	4	7	9	9	$ 534,500	47
4900 NEW HAMPSHIRE AVE NW	0	1	1	0	0	0	2	21	8	10	$ 853,500	**3**
700 RHODE ISLAND AVE NW	0	1	1	0	0	0	2	22	8	11	$ 853,500	4
900 NEW YORK AVE NW	0	0	2	1	0	0	3	10	8	12	$ 522,600	48
1400 COLUMBIA RD NW	0	0	2	1	0	0	3	11	8	13	$ 522,600	49
300 MASSACHUSETTS AVE NE	0	1	0	1	0	0	2	23	7	14	$ 780,600	6
25 K ST NE	0	0	1	2	0	0	3	12	7	15	$ 449,700	50
1408 14TH ST NW	0	0	2	0	1	0	3	13	7	16	$ 408,900	51
3031 14TH ST NW	0	0	2	0	1	0	3	14	7	17	$ 408,900	52
700 7TH ST NW	0	0	2	0	1	0	3	15	7	18	$ 408,900	53
2334 GEORGIA AVE NW	0	0	0	2	2	1	5	**3**	7	19	$ 286,900	68
1515 15TH ST NW	0	0	2	0	0	0	2	24	6	20	$ 397,000	54

Notes:

- *K (fatal), A (disabling), B (non-disabling), C (complaint but not visible), and O (no injury or property damage only) are number of crashes regarding to KABCO scale and U stands for "Unknown" crashes.*
- *Danger Index = 10 (K crashes) + 5 (A Crashes) + 3 (B Crashes) + 2 (C Crashes) + 1 (O & U Crashes)*
- *Crash costs are in 2016 dollars* (Harmon, Bahar and Gross 2018).

Table 118. Top Twenty Streets (Corridors) with Highest Danger Index for NHTSA Bicycle Crashes in Washington, DC (2012-14)

Street	K	A	B	C	O	U	Sum	Rank (Count)	Danger Index	Rank (Danger Index)	Crash Costs	Rank ($)
14TH ST	0	8	73	42	36	6	165	1	385	1	$25,505,500	1
11TH ST	0	6	31	21	13	1	72	2	179	2	$12,887,700	4
7TH ST	0	4	29	18	15	2	68	3	160	3	$10,839,600	6
16TH ST	0	4	24	16	8	3	55	6	135	4	$ 9,524,500	7
MASSACHUSETTS AVE	0	2	30	11	9	4	56	5	135	5	$ 8,801,300	10
18TH ST	0	4	24	15	11	1	55	7	134	6	$ 9,410,800	8
GEORGIA AVE	0	0	22	25	17	1	65	4	134	7	$ 7,721,200	12
13TH ST	0	5	20	12	11	0	48	9	120	8	$ 8,883,100	9
15TH ST	0	3	23	8	15	2	51	8	117	9	$ 7,737,600	11
CONNECTICUT AVE	0	2	24	11	10	0	47	10	114	10	$ 7,574,600	13
K ST	0	1	19	10	11	3	44	11	96	11	$ 5,849,100	17
1ST ST	0	1	15	19	5	1	41	12	94	12	$ 6,090,300	15
M ST	0	4	16	5	9	0	34	15	87	13	$ 6,531,100	14
FLORIDA AVE	0	1	12	18	5	3	39	13	85	14	$ 5,393,000	20
PENNSYLVANIA AVE	0	2	14	11	10	0	37	14	84	15	$ 5,589,600	19
WISCONSIN AVE	0	2	18	6	3	2	31	16	81	16	$ 5,696,100	18
6TH ST	0	4	13	5	5	1	28	19	75	17	$ 5,899,900	16
RHODE ISLAND AVE	0	2	14	9	5	0	30	17	75	18	$ 5,278,900	21
17TH ST	0	3	14	3	9	1	30	18	73	19	$ 5,239,800	22
8TH ST	1	1	11	8	5	1	27	20	70	20	$15,210,100	2

Notes:

- *K (fatal), A (disabling), B (non-disabling), C (complaint but not visible), and O (no injury or property damage only) are number of crashes regarding to KABCO scale and U stands for "Unknown" crashes.*
- *Danger Index = 10 (K crashes) + 5 (A Crashes) + 3 (B Crashes) + 2 (C Crashes) + 1 (O & U Crashes)*
- *Crash costs are in 2016 dollars* (Harmon, Bahar and Gross 2018).

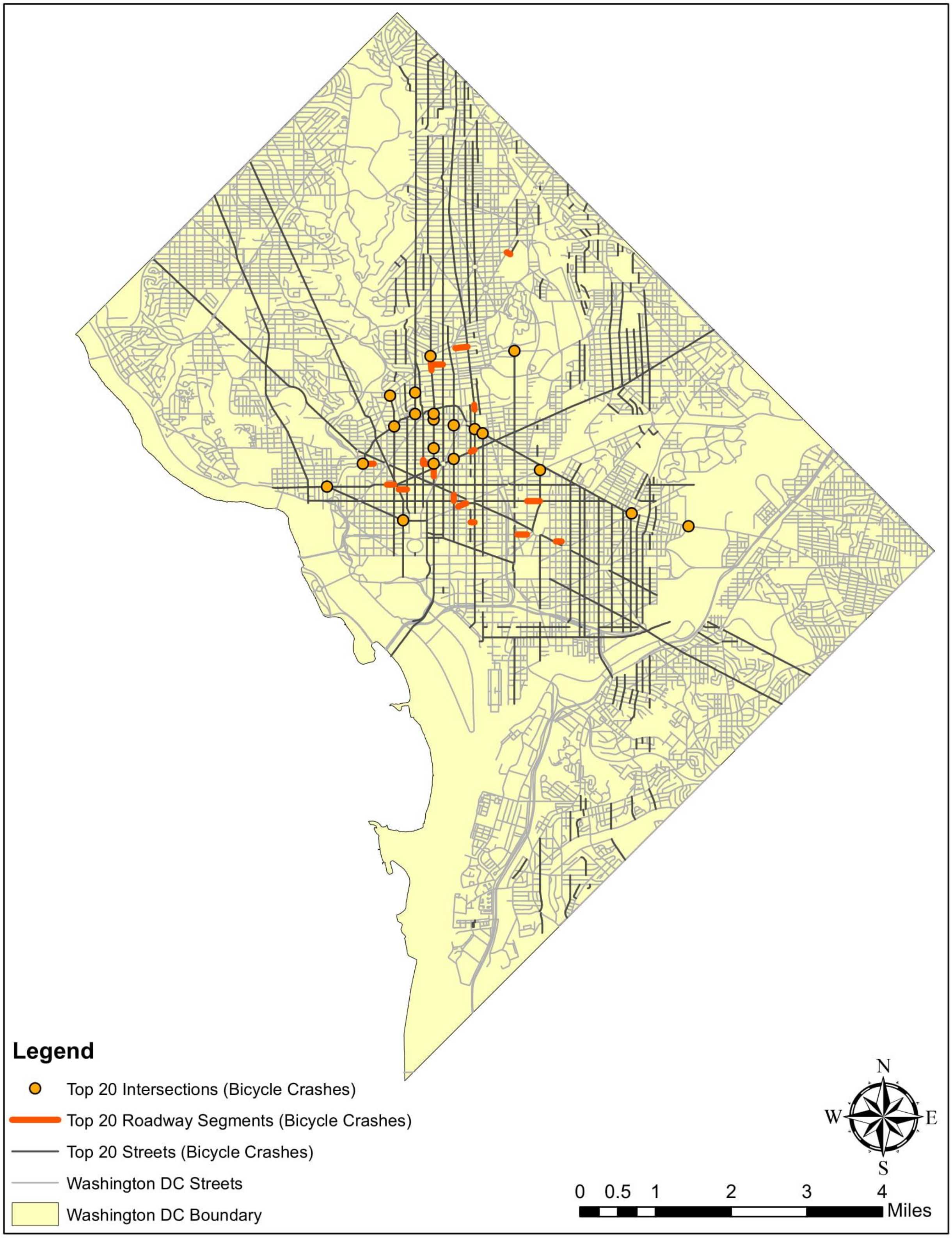


Figure 62. Top Twenty Intersections, Roadway Segments, and Streets (Corridors) with Highest Danger Index for NHTSA Bicycle Crashes in Washington, DC (2012-14)

Figure 63 to Figure 72 show the top five intersections and roadway segments. The main NHTSA crash groups of these hot spots are almost similar to the top three bicycle NHTSA crash groups so their associated BIKESAFE countermeasures can be used for these top five intersections and roadway segments as well ("*Appendix J – PEDSAFE Countermeasures for Top Three Pedestrian Crash Groups in Washington, DC*").

The numbers on images are associated "INTGISID" for intersections and "STREETSEGID" for roadway segments.

*#1: Intersection @ "14TH ST NW & V ST NW" (*Figure 63*):*

- Signalized intersection
- Another top 20 intersection is located north of this intersection
- Seven bicycle crashes.
- The main bicycle NHTSA crash group: "215 - Motorist Right Turn/Merge" (3 crashes)
- Vehicle drivers/passengers were at fault in 71.4% of crashes. In one crash, bicyclist was at fault and one crash was unknown.
- Rank (based on combined pedestrian and bicycle crashes): 25th (This intersection did not show up in the top 20 intersections based on combined pedestrian and bicycle crashes because it did not have any pedestrian crashes.)

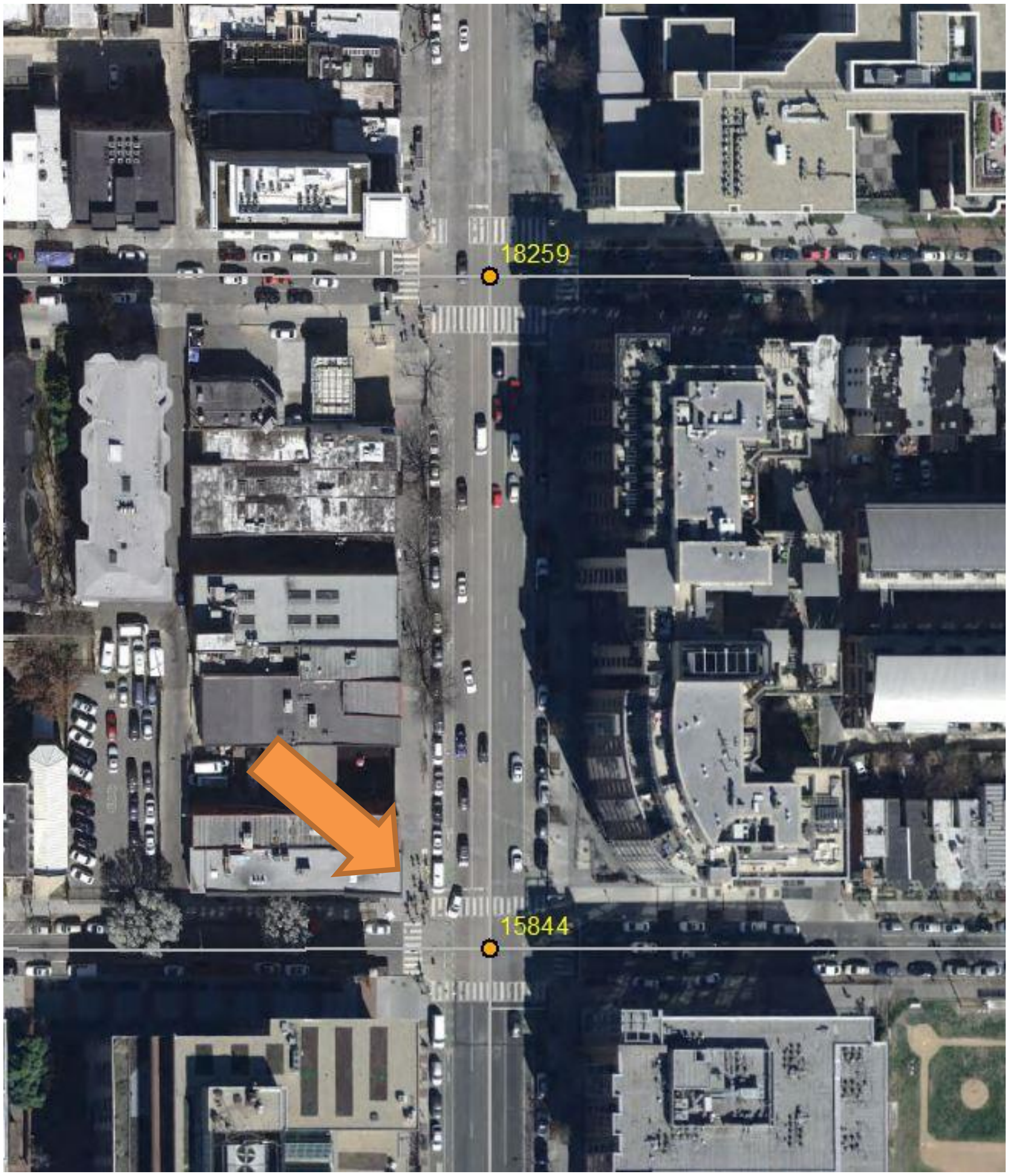


Figure 63. The 1st Ranked Intersection with Highest Danger Index for NHTSA Bicycle Crashes in Washington, DC (2012-14) @ "14TH ST NW & V ST NW"

*#2: Intersection @ "11TH ST NW & U ST NW" (*Figure 64*):*

- Signalized intersection
- Four bicycle crashes.
- In 75% of crashes, bicyclists were at fault.
- Rank (based on combined pedestrian and bicycle crashes): 12th

Figure 64. The 2nd Ranked Intersection with Highest Danger Index for NHTSA Bicycle Crashes in Washington, DC (2012-14) @ "11TH ST NW & U ST NW"

*#3: Intersection @ "18TH ST NW & COLUMBIA RD NW" (*Figure 65*):*

- Signalized intersection
- Intersection is skewed.
- Seven bicycle crashes
- The main bicycle NHTSA crash groups: "190 - Crossing Paths—Other Circumstances" and "230 - Motorist Overtaking Bicyclist" (2 crashes each)
- In about 43% of crashes, vehicle drivers/passengers were at fault and another 43% were unknown. In one crash bicyclist was at fault.
- Rank (based on combined pedestrian and bicycle crashes): 2nd

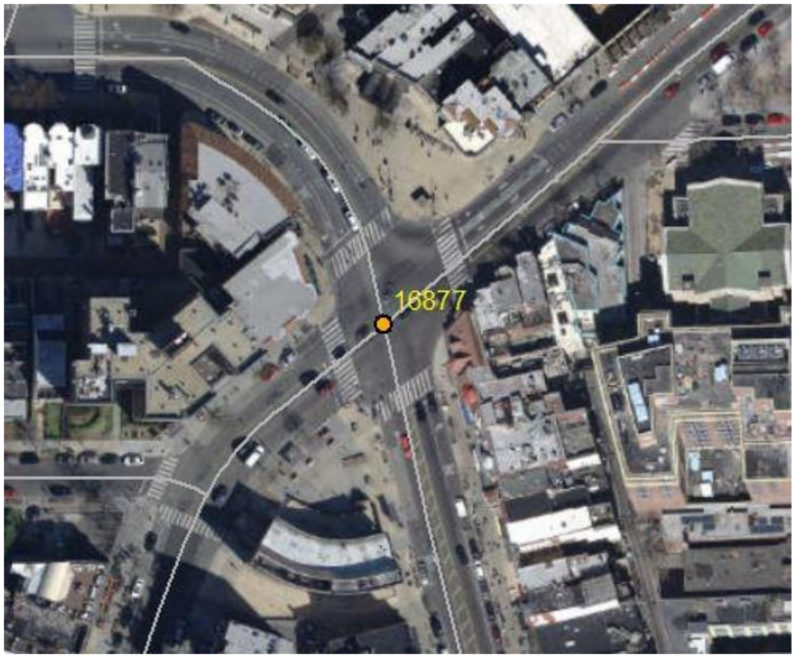


Figure 65. The 3rd Ranked Intersection with Highest Danger Index for NHTSA Bicycle Crashes in Washington, DC (2012-14) @ "18TH ST NW & COLUMBIA RD NW"

*#4: Intersection @ "11TH ST NW & RHODE ISLAND AVE N" (*Figure 66*):*

- Signalized intersection and it is close to two other top ranked intersections
- Five bicycle crashes.
- The main bicycle NHTSA crash group: "210 - Motorist Left Turn/Merge" (3 crashes)
- Rank (based on combined pedestrian and bicycle crashes): 22nd (This intersection did not show up in the top 20 intersections based on combined pedestrian and bicycle crashes because it had only two pedestrian crashes with minor injuries.)

Figure 66. The 4th Ranked Intersection with Highest Danger Index for NHTSA Bicycle Crashes in Washington, DC (2012-14) @ "11TH ST NW & RHODE ISLAND AVE NW"

*#5: Intersection @ "7TH ST NW & FLORIDA AVE NW" (*Figure 67*):*

- Signalized intersection
- Another top 20 intersection is close to this intersection.
- Intersection is skewed.
- Six bicycle crashes.
- The main bicycle NHTSA crash group: "215 - Motorist Right Turn/Merge" (2 crashes)
- In 50% of crashes vehicle drivers/passengers were at fault followed by bicyclists 33.3% and in 1 crash, the fault could not be determined.
- Rank (based on combined pedestrian and bicycle crashes): 4th

Figure 67. The 5th Ranked Intersection with Highest Danger Index for NHTSA Bicycle Crashes in Washington, DC (2012-14) @ "GEORGIA AVE NW & FLORIDA AVE NW"

*#1: Roadway segment @ "3100 14TH ST NW" (*Figure 68*):*

- The segment is intersected with 2 other top 20 roadway segments and a top 20 intersection.
- Seven bicycle crashes.
- The main bicycle NHTSA crash group: "240 - Bicyclist Overtaking Motorist" (5 crashes)
- In 71.4% of crashes, the vehicle drivers/passengers were at fault.
- Rank (based on combined pedestrian and bicycle crashes): 1st

Figure 68. The 1st Ranked Roadway Segment with Highest Danger Index for NHTSA Bicycle Crashes in Washington, DC (2012-14) @ "3100 14TH ST NW"

*#2: Roadway segment @ "2120 P ST NW" (*Figure 69*):*

- Four bicycle crashes.
- The vehicle drivers/passengers and bicyclists were equally at fault (50% each).
- Rank (based on combined pedestrian and bicycle crashes): 9th

Figure 69. The 2nd Ranked Roadway Segment with Highest Danger Index for NHTSA Bicycle Crashes in Washington, DC (2012-14) @ "2120 P ST NW"

*#3: Roadway segment @ "1000 11TH ST NW" (*Figure 70*):*

- Four bicycle crashes.
- The main bicycle NHTSA crash group: "210 - Motorist Left Turn/Merge" (5 crashes)
- Vehicle drivers/passengers were at fault in all crashes.
- Rank (based on combined pedestrian and bicycle crashes): 13th (It did not have any pedestrian crashes.)

Figure 70. The 3rd Ranked Roadway Segment with Highest Danger Index for NHTSA Bicycle Crashes in Washington, DC (2012-14) @ "1000 11TH ST NW"

*#4: Roadway segment @ "15 E ST NW" (*Figure 71*):*

- Four bicycle crashes.
- The main bicycle NHTSA crash groups: "210 - Motorist Left Turn/Merge" and "240 - Bicyclist Overtaking Motorist" (2 crashes each)
- Vehicle drivers/passengers were at fault in all crashes.
- Rank (based on combined pedestrian and bicycle crashes): 8th

Figure 71. The 4th Ranked Roadway Segment with Highest Danger Index for NHTSA Bicycle Crashes in Washington, DC (2012-14) @ "15 E ST NW"

*#5: Roadway segment @ "1300 14TH ST NW" (*Figure 72*):*

- This roadway segment is connected to another top 20 roadway segment.
- Five bicycle crashes.
- The main bicycle NHTSA crash group: "240 - Bicyclist Overtaking Motorist" (2 crashes)
- In 80% of crashes, vehicle drivers/passengers were at fault.
- Rank (based on combined pedestrian and bicycle crashes): 12th (It did not have any pedestrian crashes.)

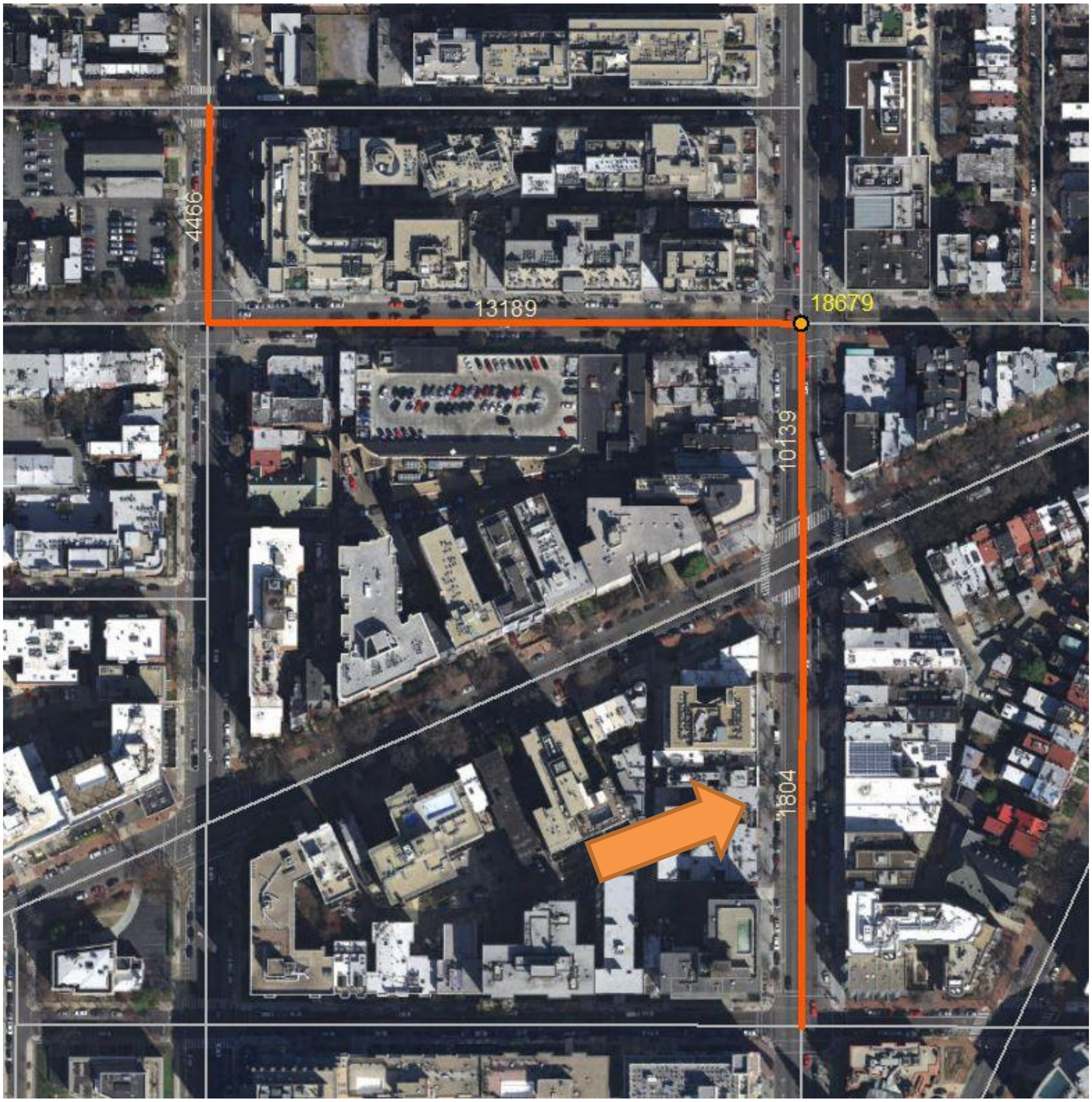


Figure 72. The 5th Ranked Roadway Segment with Highest Danger Index for NHTSA Bicycle Crashes in Washington, DC (2012-14) @ "1300 14TH ST NW"

Hot Spots: Special Cases

Figure 73 and Figure 74 demonstrated the combined hot spots; those of combined pedestrian and bicycle crashes and those of pedestrian crashes and bicycle crashes independently. The purpose of these maps and further review of these locations was to identify clustered locations of hot spots in Washington, DC.

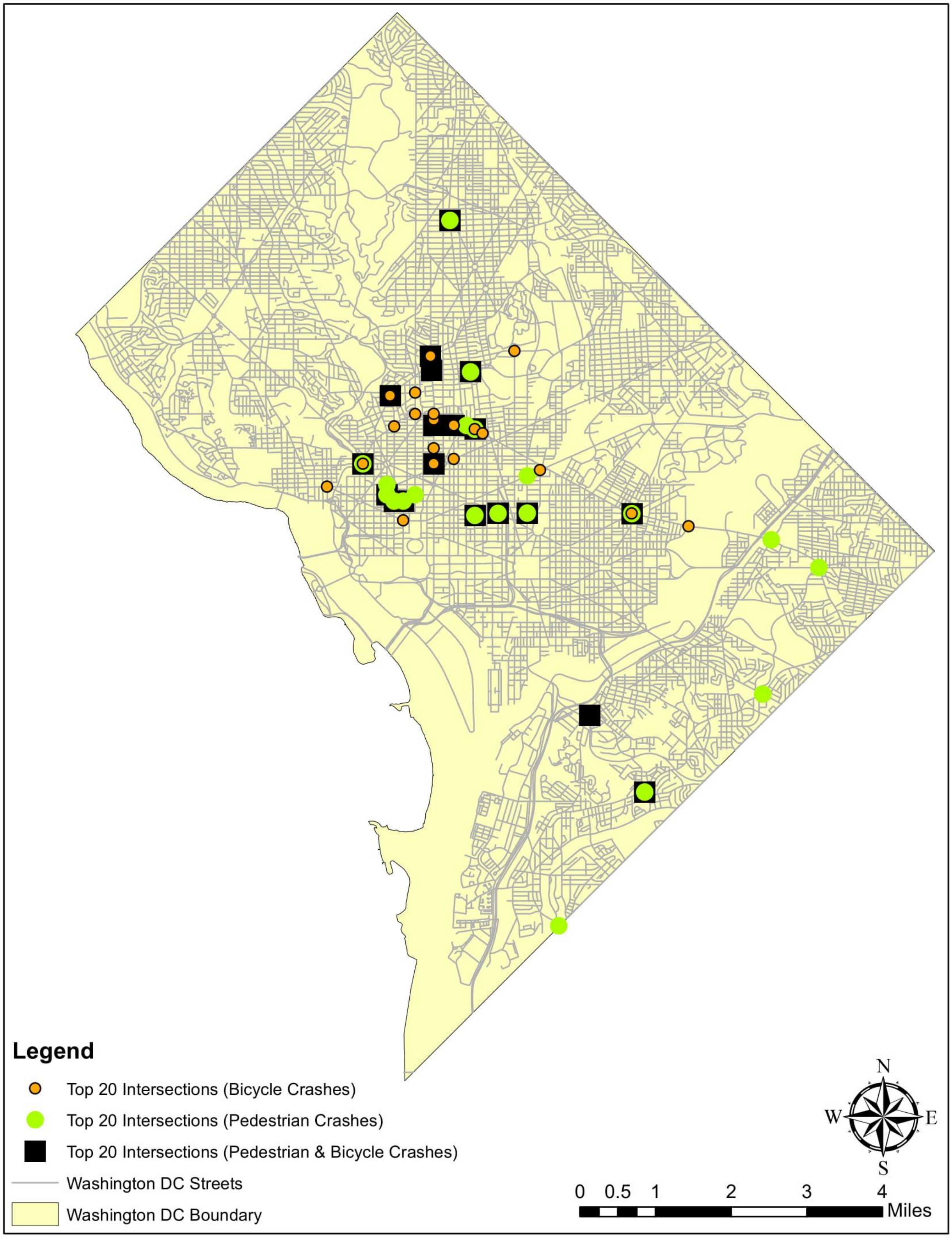


Figure 73. Top Twenty Intersections with Highest Danger Index for NHTSA Pedestrian and Bicycle Crashes (Combined and Separately) in Washington, DC (2012-14)

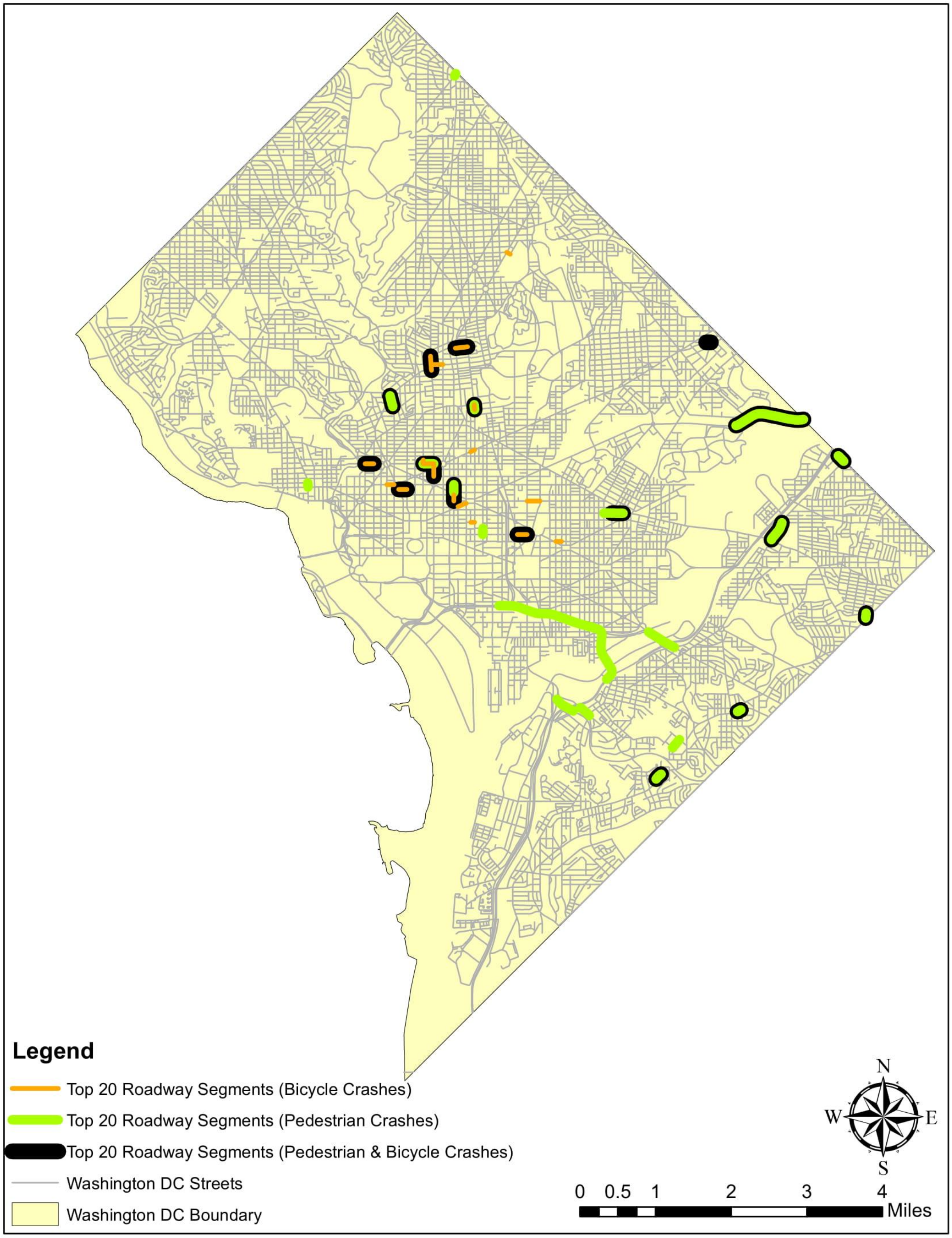


Figure 74. Top Twenty Roadway Segments with Highest Danger Index for NHTSA Pedestrian and Bicycle Crashes (Combined and Separately) in Washington, DC (2012-14)

The signalized intersection at "*BENNING RD NE & BLADENSBURG RD NE*" (Figure 75) was the top intersection when pedestrian and bicycle crashes were combined and ranked as 4th and 9th intersection for pedestrian and bicycle crashes, respectively. It is a 5-leg intersection with skew angle. It is also close to two pedestrian top 20 roadway segments (on H St NE), which one is also combined pedestrian and bicycle crashes.

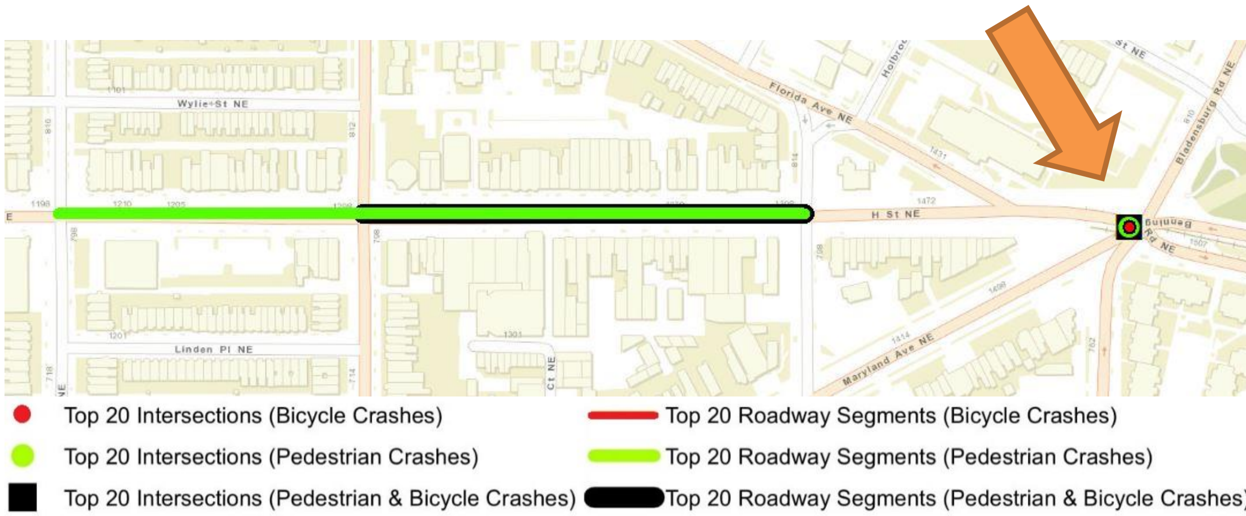


Figure 75. The 1st Ranked Intersection with Highest Danger Index for NHTSA Pedestrian and Bicycle Crashes in Washington, DC (2012-14) @ "BENNING RD NE & BLADENSBURG RD NE"

There were some clustered hot spots near Logan Circle on 14th St, P St, and 15th St and two intersections (for bicycle crashes) on Rhode Island Ave NW and R St NW (Figure 76).

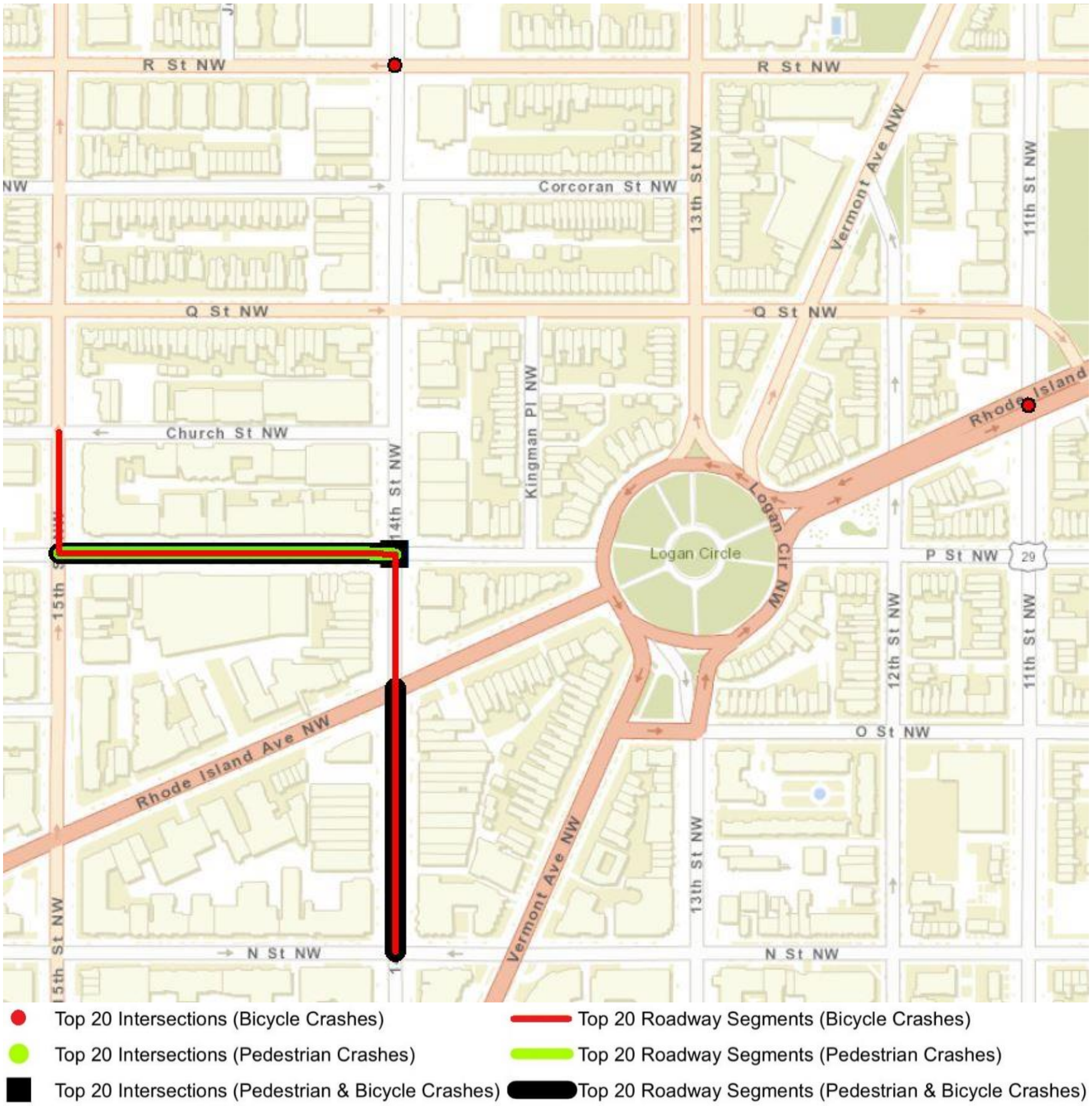


Figure 76. The Clustered Hot Spots Near Logan Circle on 14th St NW & P St NW & 15th St NW and Nearby Intersections

The hot spots on 14th St NW, Georgia Ave NW and nearby area are shown in Figure 77. The signalized intersection at "*HARVARD ST NW & GEORGIA AVE NW*" was also among top 20 pedestrian and combined pedestrian and bicycle crashes intersections.

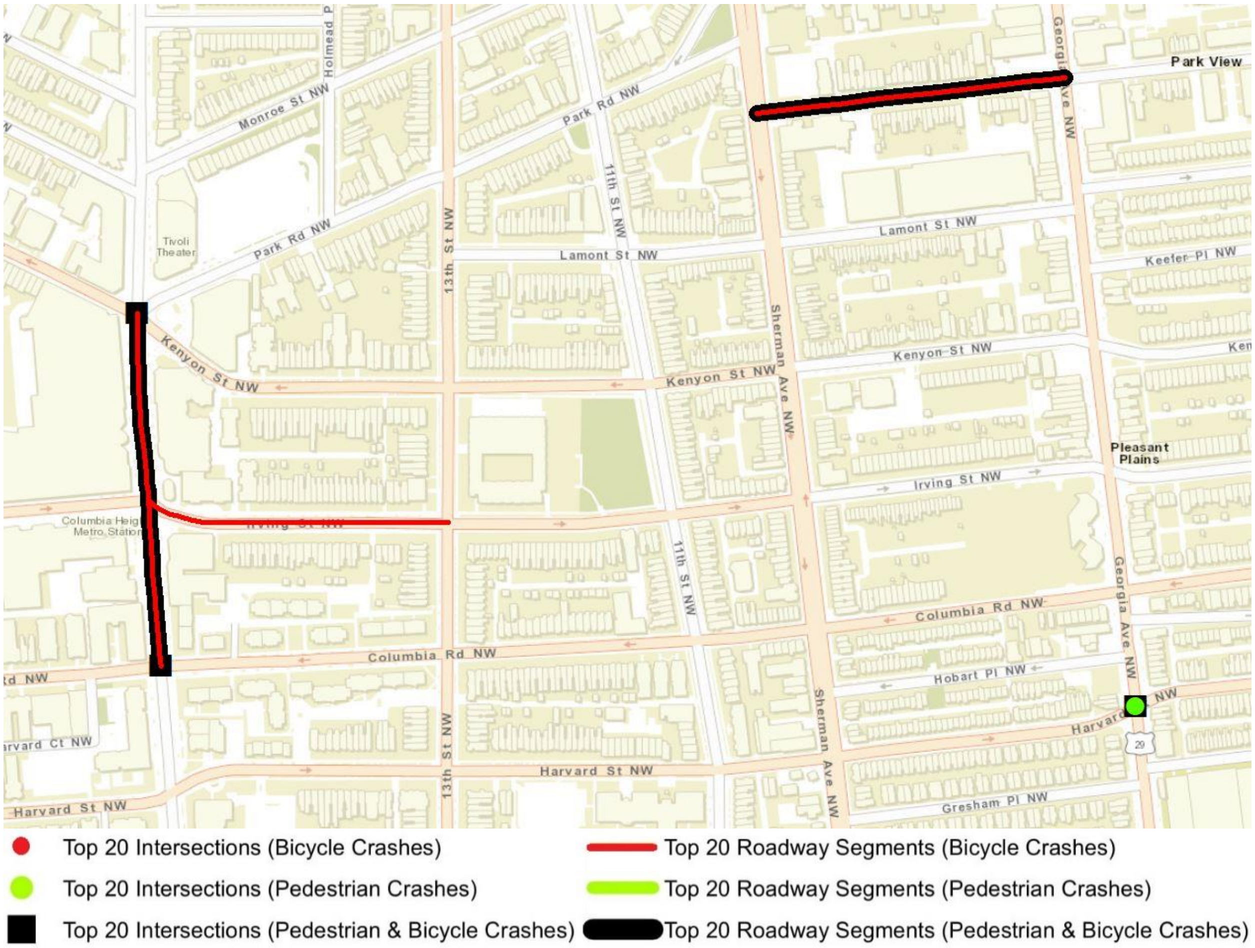


Figure 77. The Hot Spots on 14th St NW & Georgia Ave NW and Nearby Area

Another hot spot area is the six intersections on U St NW and three intersections on 14 St NW (one shared at signalized intersection of "*U ST NW & 14TH ST NW*"). The roadway segment on Georgia Ave NW that was ranked 5th when pedestrian and bicycle crashes were combined and ranked as 5th and 19th roadway segment for pedestrian and bicycle crashes, respectively (Figure 78).

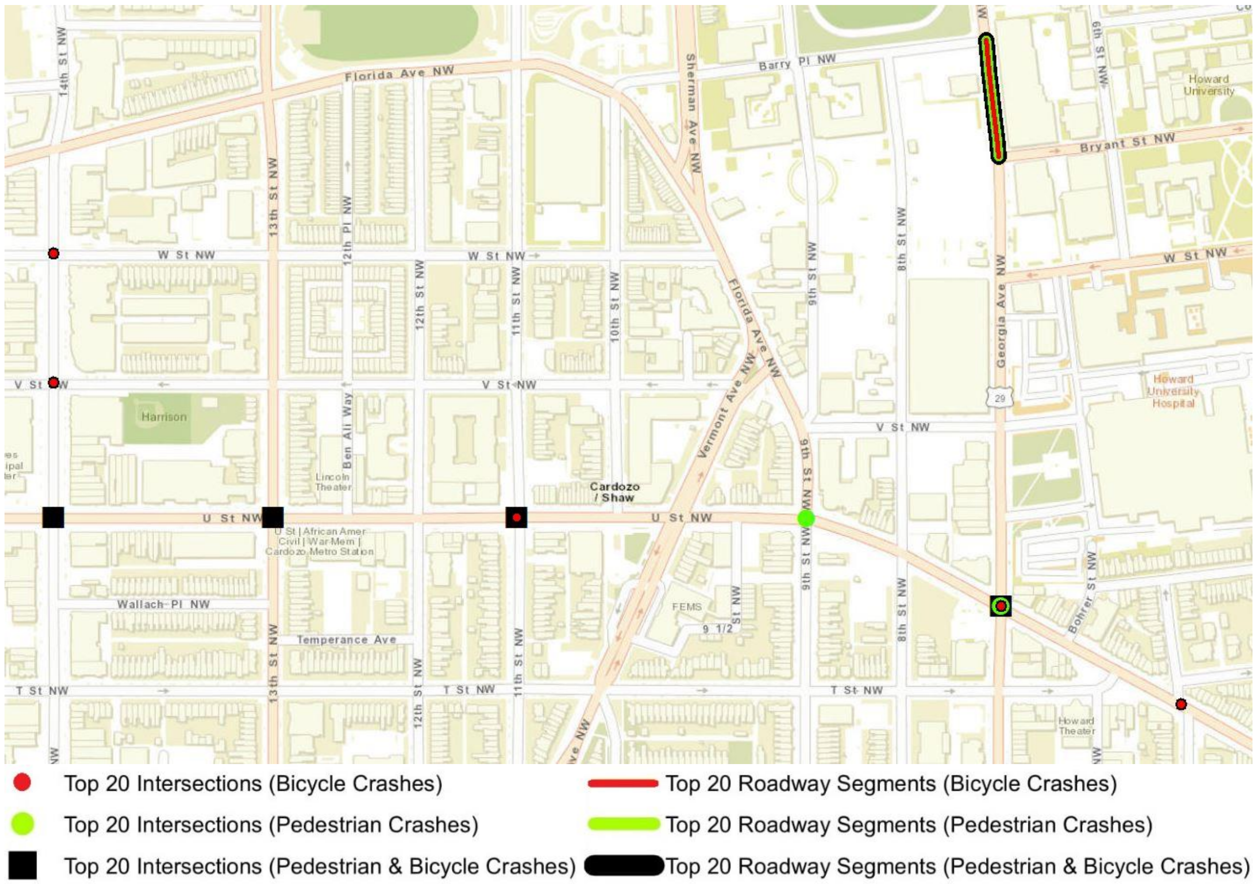


Figure 78. The Hot Spot Intersections on U St NW & 14th St NW and Roadway Segment on Georgina Ave NW

The three intersections of H St NW at North Capitol St, 4th St NW, and 7th St NW, which were among pedestrian top 20 and also combined pedestrian and bicycle intersections, were another hot spot area. There were some top 20 roadway segments nearby such as the one on E St NW, which was among bicycle top 20 and also combined pedestrian and bicycle intersections (Figure 79).

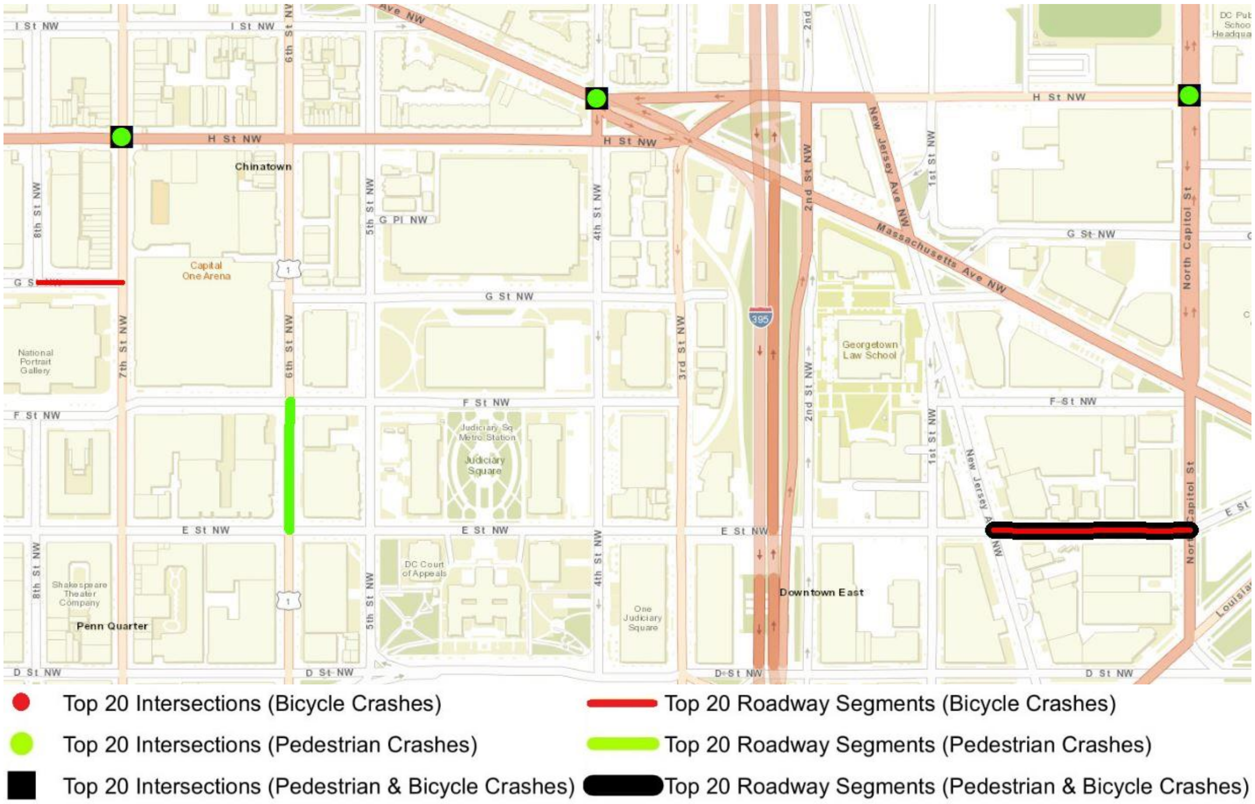


Figure 79. The Hot Spot Intersections on H St and Roadway Segments E St & G St & 6th St

The four intersections on K St NW and 19th St NW, which all were among the top 20 pedestrian intersections (three were among top 20 combined pedestrian and bicycle intersections as well) and two nearby top 20 bicycle roadway segments, which one was also among top 20 combined pedestrian and bicycle intersections are shown in Figure 80.

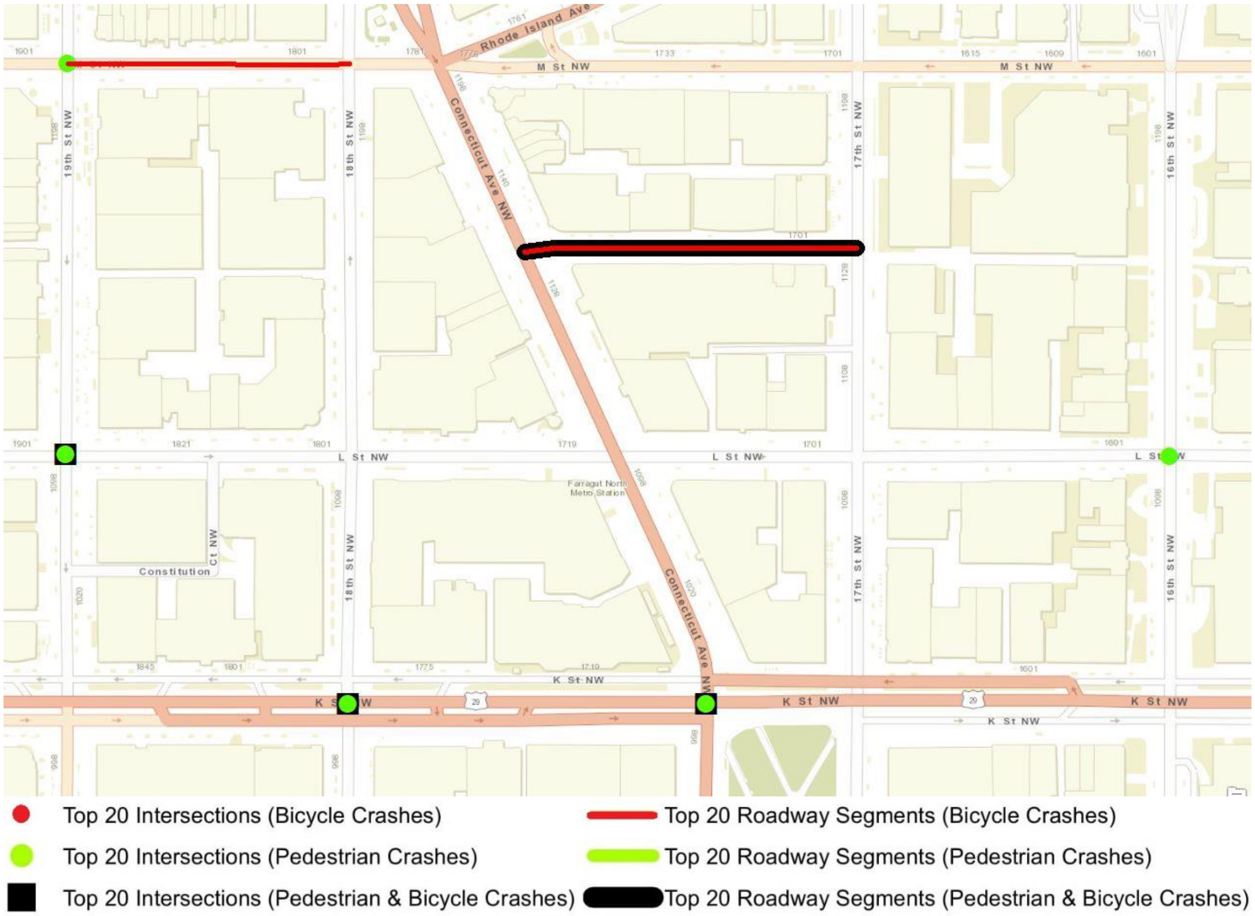


Figure 80. The Hot Spot Intersections on K St NW & 19th St NW and Nearby Roadway Segments

Some roadway segments near Mount Vernon Square on New York Ave NW (only one top 20 bicycle roadway segment) and 11th St NW are shown in Figure 81.

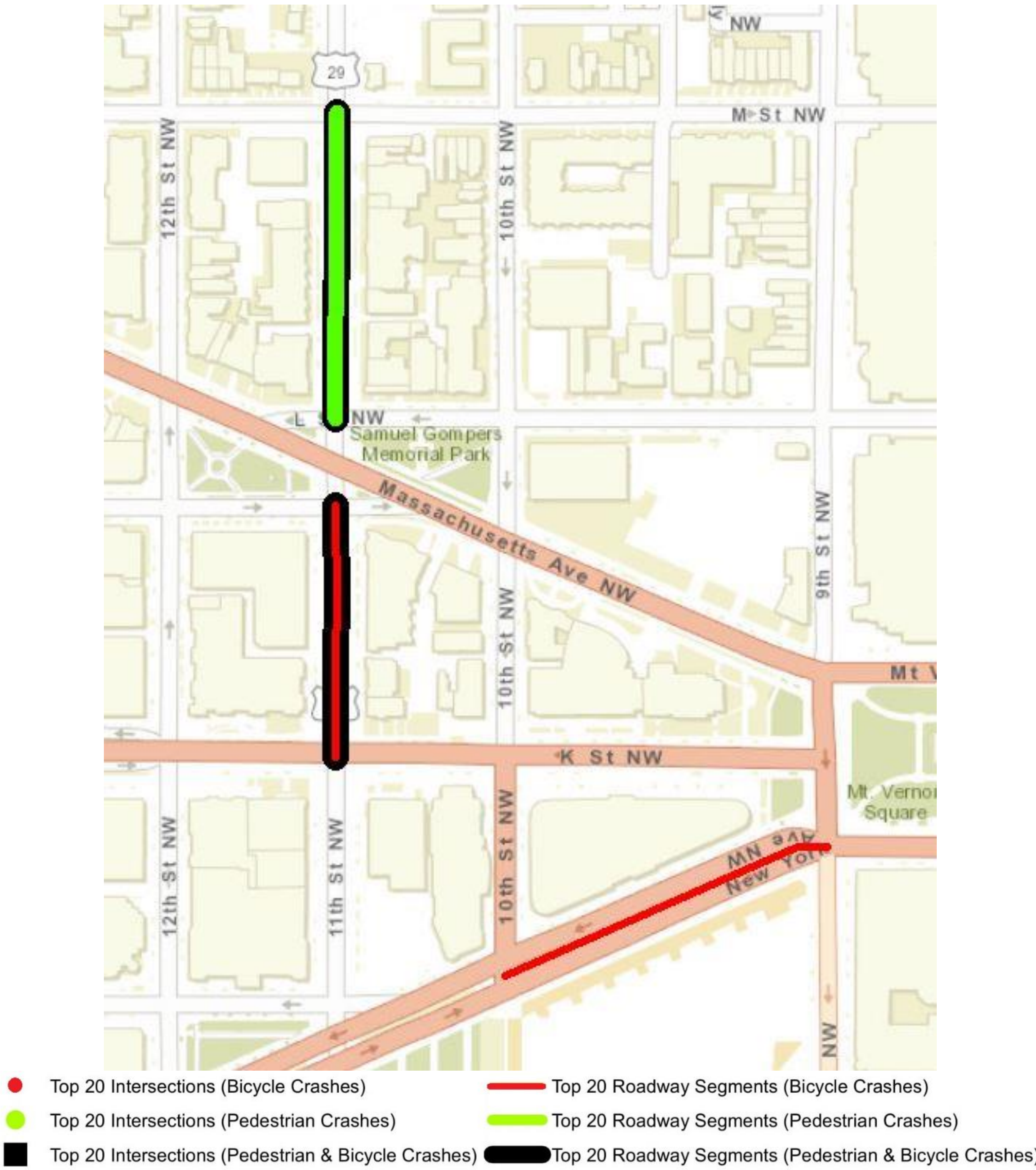


Figure 81. The Hot Spot Roadway Segments on New York Ave NW & 11th St NW

Special Crash Cases

Figure 82 demonstrates the geographical distribution of pedestrian and bicycle crashes that were not included in previous parts of this study. These crashes were as follows:

- Bicycle-Pedestrian (58 crashes)
- Bicycle-Bicycle (9 crashes)
- Vehicle-Bicycle&Pedestrian (3 crashes)
- Bicycle-Only (34 crashes) (while this crash type was examined along with Vehicle-Bicycle crashes, it was included here for further independent analysis.)

These crashes are rare and in total 104 special crashes happened in Washington, DC (2012-14). Crashes happened more in the NW city quadrant. In this section, these crashes are examined from following aspects:

- Crash location characteristics
- Crash time characteristics
- Crash severity levels
- Driver and Pedestrian/Bicyclist's Characteristics

Moreover, the applicable NHTSA pedestrian and bicycle crash fields and also LMCM typology were summarized.

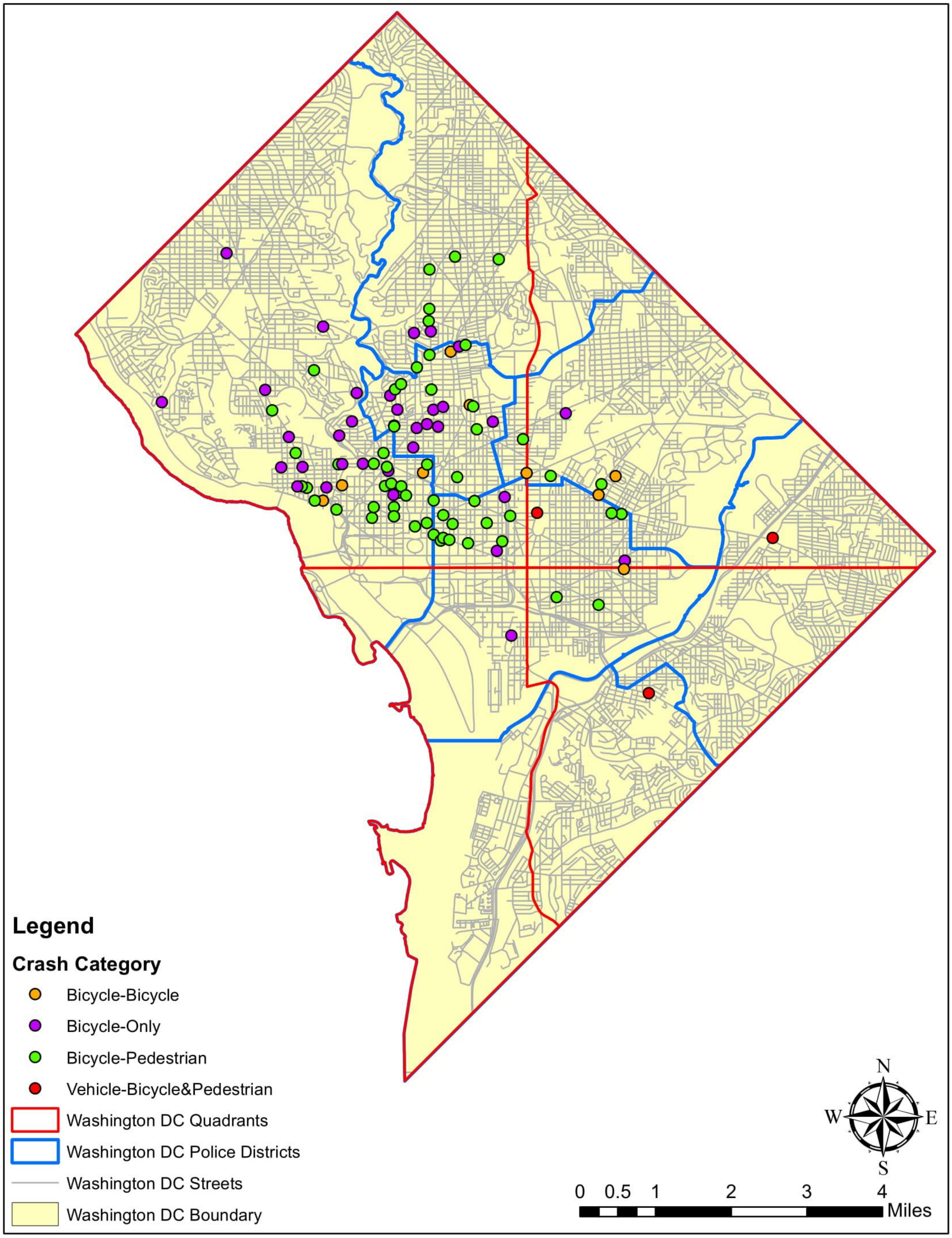


Figure 82. Special Crash Cases in Washington, DC (2012-14)

Crash Location Characteristics

The first three districts accounted for about 85% of special crash types (Table 120). Majority of crashes happened in NW city quadrant (Table 120).

Majority of bicycle-bicycle crashes were at intersections (78%), bicycle-only crashes were on roads, bicycle-pedestrian crashes were slightly more at intersection in comparison with roads; 41.4% vs 36.2% (Table 121). Four-leg intersections and signalized intersections were the common intersection and traffic control types (Table 122 & Table 123).

Summary of crashes by road surface, road type, road division, road condition, traffic condition, street lighting, light, weather, and construction zone are presented in Table 125 to Table 133.

Table 119. Summary of Special Crash Types by District

District	Bicycle-Bicycle		Bicycle-Only		Bicycle-Pedestrian		Vehicle-Bicycle&Pedestrian		Total	
	#	%	#	%	#	%	#	%	#	%
1	1	11.11%	4	11.76%	16	28.07%	1	33.33%	22	21.36%
2	3	33.33%	16	47.06%	25	43.86%	0	0.00%	44	42.72%
3	2	22.22%	11	32.35%	9	15.79%	0	0.00%	22	21.36%
4	0	0.00%	2	5.88%	5	8.77%	0	0.00%	7	6.80%
5	3	33.33%	1	2.94%	2	3.51%	0	0.00%	6	5.83%
6	0	0.00%	0	0.00%	0	0.00%	1	33.33%	1	0.97%
7	0	0.00%	0	0.00%	0	0.00%	1	33.33%	1	0.97%
Total	**9**	**100.00%**	**34**	**100.00%**	**57**	**100.00%**	**3**	**100.00%**	**103**	**100.00%**

Table 120. Summary of Special Crash Types by City Quadrant

City Quadrant	Bicycle-Bicycle		Bicycle-Only		Bicycle-Pedestrian		Vehicle-Bicycle&Pedestrian		Total	
	#	%	#	%	#	%	#	%	#	%
NE	2	22.22%	2	6.25%	4	7.02%	2	66.67%	10	9.90%
NW	6	66.67%	29	90.63%	51	89.47%	0	0.00%	86	85.15%
SE	1	11.11%	0	0.00%	1	1.75%	1	33.33%	3	2.97%
SW	0	0.00%	1	3.13%	1	1.75%	0	0.00%	2	1.98%
Total	**9**	**100.00%**	**32**	**100.00%**	**57**	**100.00%**	**3**	**100.00%**	**101**	**100.00%**

Table 121. Summary of Special Crash Types by Crash Location

Crash Location	Bicycle-Bicycle		Bicycle-Only		Bicycle-Pedestrian		Vehicle-Bicycle&Pedestrian		Total	
	#	%	#	%	#	%	#	%	#	%
Intersection Crash	7	77.78%	3	8.82%	24	41.38%	0	0.00%	34	32.69%
Within 50 ft. of Intersection	0	0.00%	3	8.82%	6	10.34%	0	0.00%	9	8.65%
Within 100 ft. of Intersection	1	11.11%	3	8.82%	7	12.07%	1	33.33%	12	11.54%
Road Crash	1	11.11%	25	73.53%	21	36.21%	1	33.33%	48	46.15%
Private Property, Parking Lot, & Driveway	0	0.00%	0	0.00%	0	0.00%	1	33.33%	1	0.96%
Total	**9**	**100.00%**	**34**	**100.00%**	**58**	**100.00%**	**3**	**100.00%**	**104**	**100.00%**

Table 122. Summary of Special Crash Types by Intersection Type

Intersection Type	Bicycle-Bicycle		Bicycle-Only		Bicycle-Pedestrian		Vehicle-Bicycle&Pedestrian		Total	
	#	%	#	%	#	%	#	%	#	%
3-leg	2	22.22%	1	2.94%	5	8.62%	0	0.00%	8	7.69%
4-leg	6	66.67%	8	23.53%	30	51.72%	1	33.33%	45	43.27%
5-leg or more	0	0.00%	0	0.00%	1	1.72%	0	0.00%	1	0.96%
N/A	1	11.11%	25	73.53%	21	36.21%	2	66.67%	49	47.12%
Unknown	0	0.00%	0	0.00%	1	1.72%	0	0.00%	1	0.96%
Total	**9**	**100.00%**	**34**	**100.00%**	**58**	**100.00%**	**3**	**100.00%**	**104**	**100.00%**

Table 123. Summary of Special Crash Types by Traffic Control Type

Traffic Control Type	Bicycle-Bicycle		Bicycle-Only		Bicycle-Pedestrian		Vehicle-Bicycle&Pedestrian		Total	
	#	%	#	%	#	%	#	%	#	%
Non-Intersection	1	11.11%	25	73.53%	21	36.21%	2	66.67%	49	47.12%
Signalized	4	44.44%	7	20.59%	31	53.45%	1	33.33%	43	41.35%
Sign-Controlled	2	22.22%	0	0.00%	3	5.17%	0	0.00%	5	4.81%
Sign-Controlled (Uncontrolled for Driver)	2	22.22%	1	2.94%	1	1.72%	0	0.00%	4	3.85%
Uncontrolled	0	0.00%	1	2.94%	1	1.72%	0	0.00%	2	1.92%
Unknown	0	0.00%	0	0.00%	1	1.72%	0	0.00%	1	0.96%
Total	**9**	**100.00%**	**34**	**100.00%**	**58**	**100.00%**	**3**	**100.00%**	**104**	**100.00%**

Table 124. Summary of Special Crash Types by Traffic Control Type (regrouped)

Traffic Control Type	Bicycle-Bicycle		Bicycle-Only		Bicycle-Pedestrian		Vehicle-Bicycle&Pedestrian		Total	
	#	%	#	%	#	%	#	%	#	%
Non-Intersection	1	11.11%	25	73.53%	21	36.21%	2	66.67%	49	47.12%
Other	0	0.00%	0	0.00%	1	1.72%	0	0.00%	1	0.96%
Signalized	4	44.44%	7	20.59%	31	53.45%	1	33.33%	43	41.35%
Sign-Controlled	2	22.22%		0.00%	3	5.17%	0	0.00%	5	4.81%
Uncontrolled	2	22.22%	2	5.88%	2	3.45%	0	0.00%	6	5.77%
Total	**9**	**100.00%**	**34**	**100.00%**	**58**	**100.00%**	**3**	**100.00%**	**104**	**100.00%**

Table 125. Summary of Special Crash Types by Road Surface

Road Surface	Bicycle-Bicycle		Bicycle-Only		Bicycle-Pedestrian		Vehicle-Bicycle&Pedestrian		Total	
	#	%	#	%	#	%	#	%	#	%
Asphalt	7	100.00%	29	87.88%	44	77.19%	2	66.67%	82	82.00%
Concrete	0	0.00%	3	9.09%	10	17.54%	1	33.33%	14	14.00%
Other	0	0.00%	1	3.03%	3	5.26%	0	0.00%	4	4.00%
Total	**7**	**100.00%**	**33**	**100.00%**	**57**	**100.00%**	**3**	**100.00%**	**100**	**100.00%**

Table 126. Summary of Special Crash Types by Road Type

Road Type	Bicycle-Bicycle		Bicycle-Only		Bicycle-Pedestrian		Vehicle-Bicycle&Pedestrian		Total	
	#	%	#	%	#	%	#	%	#	%
Straight	8	100.00%	26	78.79%	48	82.76%	2	66.67%	84	82.35%
Other	0	0.00%	7	21.21%	10	17.24%	1	33.33%	18	17.65%
Total	**8**	**100.00%**	**33**	**100.00%**	**58**	**100.00%**	**3**	**100.00%**	**102**	**100.00%**

Table 127. Summary of Special Crash Types by Road Division

Road Division	Bicycle-Bicycle		Bicycle-Only		Bicycle-Pedestrian		Vehicle-Bicycle&Pedestrian		Total	
	#	%	#	%	#	%	#	%	#	%
One-Way	2	25.00%	5	15.15%	8	13.79%	1	33.33%	16	15.69%
Other	0	0.00%	0	0.00%	3	5.17%	0	0.00%	3	2.94%
Two-Way Divided	0	0.00%	1	3.03%	1	1.72%	0	0.00%	2	1.96%
Two-Way Other	6	75.00%	27	81.82%	46	79.31%	2	66.67%	81	79.41%
Total	**8**	**100.00%**	**33**	**100.00%**	**58**	**100.00%**	**3**	**100.00%**	**102**	**100.00%**

Table 128. Summary of Special Crash Types by Road Condition

Road Condition	Bicycle-Bicycle		Bicycle-Only		Bicycle-Pedestrian		Vehicle-Bicycle&Pedestrian		Total	
	#	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**
Dry	8	100.00%	25	75.76%	52	89.66%	3	100.00%	88	86.27%
Other	0	0.00%	3	9.09%	2	3.45%	0	0.00%	5	4.90%
Wet	0	0.00%	5	15.15%	4	6.90%	0	0.00%	9	8.82%
Total	**8**	**100.00%**	**33**	**100.00%**	**58**	**100.00%**	**3**	**100.00%**	**102**	**100.00%**

Table 129. Summary of Special Crash Types by Traffic Condition

Traffic Condition	Bicycle-Bicycle		Bicycle-Only		Bicycle-Pedestrian		Vehicle-Bicycle&Pedestrian		Total	
	#	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**
Heavy	1	14.29%	7	21.21%	9	16.07%	0	0.00%	17	17.17%
Medium	2	28.57%	7	21.21%	23	41.07%	3	100.00%	35	35.35%
Low	4	57.14%	18	54.55%	17	30.36%	0	0.00%	39	39.39%
Other	0	0.00%	1	3.03%	7	12.50%	0	0.00%	8	8.08%
Total	**7**	**100.00%**	**33**	**100.00%**	**56**	**100.00%**	**3**	**100.00%**	**99**	**100.00%**

Table 130. Summary of Special Crash Types by Street Lighting

Street Lighting	Bicycle-Bicycle		Bicycle-Only		Bicycle-Pedestrian		Vehicle-Bicycle&Pedestrian		Total	
	#	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**
Street Lights Off	4	50.00%	21	63.64%	45	78.95%	3	100.00%	73	72.28%
Street Lights On	4	50.00%	11	33.33%	9	15.79%	0	0.00%	24	23.76%
Other	0	0.00%	1	3.03%	3	5.26%	0	0.00%	4	3.96%
Total	**8**	**100.00%**	**33**	**100.00%**	**57**	**100.00%**	**3**	**100.00%**	**101**	**100.00%**

Table 131. Summary of Special Crash Types by Light

Light	Bicycle-Bicycle		Bicycle-Only		Bicycle-Pedestrian		Vehicle-Bicycle&Pedestrian		Total	
	#	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**
Daylight	5	62.50%	22	66.67%	46	79.31%	3	100.00%	76	74.51%
Other	3	37.50%	11	33.33%	12	20.69%	0	0.00%	26	25.49%
Total	**8**	**100.00%**	**33**	**100.00%**	**58**	**100.00%**	**3**	**100.00%**	**102**	**100.00%**

Table 132. Summary of Special Crash Types by Weather

Weather	Bicycle-Bicycle		Bicycle-Only		Bicycle-Pedestrian		Vehicle-Bicycle&Pedestrian		Total	
	#	%	#	%	#	%	#	%	#	%
Clear	8	100.00%	26	78.79%	51	91.07%	3	100.00%	88	88.00%
Rain	0	0.00%	4	12.12%	3	5.36%	0	0.00%	7	7.00%
Other	0	0.00%	3	9.09%	2	3.57%	0	0.00%	5	5.00%
Total	**8**	**100.00%**	**33**	**100.00%**	**56**	**100.00%**	**3**	**100.00%**	**100**	**100.00%**

Table 133. Summary of Special Crash Types by Construction Zone

Construction Zone	Bicycle-Bicycle		Bicycle-Only		Bicycle-Pedestrian		Vehicle-Bicycle&Pedestrian		Total	
	#	%	#	%	#	%	#	%	#	%
Yes	0	0.00%	1	2.94%	4	6.90%	0	0.00%	5	4.81%
No	9	100.00%	33	97.06%	54	93.10%	3	100.00%	99	95.19%
Total	**9**	**100.00%**	**34**	**100.00%**	**58**	**100.00%**	**3**	**100.00%**	**104**	**100.00%**

Crash Time/Date Characteristics

Table 134 through Table 140 summarized crashes by temporal fields such as year, day, and hour. The overall number of crashes per year increased over years of study because of increase in bicycle-only crashes; the rest remained quite constant (Table 134).

Table 134. Summary of Special Crash Types by Year

Year	Bicycle-Bicycle		Bicycle-Only		Bicycle-Pedestrian		Vehicle-Bicycle&Pedestrian		Total	
	#	%	#	%	#	%	#	%	#	%
2012	3	33.33%	4	11.76%	19	32.76%	1	33.33%	27	25.96%
2013	2	22.22%	11	32.35%	18	31.03%	1	33.33%	32	30.77%
2014	4	44.44%	19	55.88%	21	36.21%	1	33.33%	45	43.27%
Total	**9**	**100.00%**	**34**	**100.00%**	**58**	**100.00%**	**3**	**100.00%**	**104**	**100.00%**

Table 135. Summary of Special Crash Types by Season

Season	Bicycle-Bicycle		Bicycle-Only		Bicycle-Pedestrian		Vehicle-Bicycle&Pedestrian		Total	
	#	%	#	%	#	%	#	%	#	%
Spring	2	22.22%	13	38.24%	18	31.03%	0	0.00%	33	31.73%
Summer	3	33.33%	13	38.24%	12	20.69%	1	33.33%	29	27.88%
Fall	2	22.22%	4	11.76%	20	34.48%	2	66.67%	28	26.92%
Winter	2	22.22%	4	11.76%	8	13.79%	0	0.00%	14	13.46%
Total	**9**	**100.00%**	**34**	**100.00%**	**58**	**100.00%**	**3**	**100.00%**	**104**	**100.00%**

Table 136. Summary of Special Crash Types by Month

Month	Bicycle-Bicycle		Bicycle-Only		Bicycle-Pedestrian		Vehicle-Bicycle&Pedestrian		Total	
	#	%	#	%	#	%	#	%	#	%
January	0	0.00%	1	2.94%	3	5.17%	0	0.00%	4	3.85%
February	2	22.22%	1	2.94%	4	6.90%	0	0.00%	7	6.73%
March	0	0.00%	4	11.76%	4	6.90%	0	0.00%	8	7.69%
April	1	11.11%	2	5.88%	6	10.34%	0	0.00%	9	8.65%
May	1	11.11%	7	20.59%	8	13.79%	0	0.00%	16	15.38%
June	0	0.00%	5	14.71%	5	8.62%	0	0.00%	10	9.62%
July	2	22.22%	5	14.71%	4	6.90%	0	0.00%	11	10.58%
August	1	11.11%	3	8.82%	3	5.17%	1	33.33%	8	7.69%
September	1	11.11%	2	5.88%	8	13.79%	1	33.33%	12	11.54%
October	1	11.11%	2	5.88%	6	10.34%	0	0.00%	9	8.65%
November	0	0.00%	0	0.00%	6	10.34%	1	33.33%	7	6.73%
December	0	0.00%	2	5.88%	1	1.72%	0	0.00%	3	2.88%
Total	**9**	**100.00%**	**34**	**100.00%**	**58**	**100.00%**	**3**	**100.00%**	**104**	**100.00%**

Table 137. Summary of Special Crash Types by Day

Day	Bicycle-Bicycle		Bicycle-Only		Bicycle-Pedestrian		Vehicle-Bicycle&Pedestrian		Total	
	#	%	#	%	#	%	#	%	#	%
Sunday	1	11.11%	5	14.71%	6	10.34%	0	0.00%	12	11.54%
Monday	2	22.22%	2	5.88%	4	6.90%	1	33.33%	9	8.65%
Tuesday	0	0.00%	5	14.71%	7	12.07%	2	66.67%	14	13.46%
Wednesday	0	0.00%	4	11.76%	13	22.41%	0	0.00%	17	16.35%
Thursday	4	44.44%	8	23.53%	13	22.41%	0	0.00%	25	24.04%
Friday	1	11.11%	7	20.59%	9	15.52%	0	0.00%	17	16.35%
Saturday	1	11.11%	3	8.82%	6	10.34%	0	0.00%	10	9.62%
Total	**9**	**100.00%**	**34**	**100.00%**	**58**	**100.00%**	**3**	**100.00%**	**104**	**100.00%**

Table 138. Summary of Special Crash Types by Weekday vs. Weekend

Weekday/ Weekend	Bicycle-Bicycle		Bicycle-Only		Bicycle-Pedestrian		Vehicle-Bicycle&Pedestrian		Total	
	#	%	#	%	#	%	#	%	#	%
Weekday	6	66.67%	27	79.41%	48	82.76%	2	66.67%	83	79.81%
Weekend	3	33.33%	7	20.59%	10	17.24%	1	33.33%	21	20.19%
Total	**9**	**100.00%**	**34**	**100.00%**	**58**	**100.00%**	**3**	**100.00%**	**104**	**100.00%**

Table 139. Summary of Special Crash Types by Hour

Hour	Bicycle-Bicycle		Bicycle-Only		Bicycle-Pedestrian		Vehicle-Bicycle&Pedestrian		Total	
	#	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**
0	1	11.11%	0	0.00%	1	1.72%	0	0.00%	2	1.92%
1	0	0.00%	1	2.94%	0	0.00%	1	33.33%	2	1.92%
2	0	0.00%	0	0.00%	1	1.72%	0	0.00%	1	0.96%
3	0	0.00%	0	0.00%	1	1.72%	0	0.00%	1	0.96%
4	0	0.00%	0	0.00%	1	1.72%	0	0.00%	1	0.96%
8	0	0.00%	1	2.94%	0	0.00%	0	0.00%	1	0.96%
10	0	0.00%	3	8.82%	1	1.72%	1	33.33%	5	4.81%
11	0	0.00%	4	11.76%	1	1.72%	0	0.00%	5	4.81%
12	0	0.00%	2	5.88%	5	8.62%	0	0.00%	7	6.73%
13	0	0.00%	4	11.76%	6	10.34%	0	0.00%	10	9.62%
14	2	22.22%	1	2.94%	2	3.45%	0	0.00%	5	4.81%
15	1	11.11%	2	5.88%	3	5.17%	0	0.00%	6	5.77%
16	1	11.11%	1	2.94%	7	12.07%	0	0.00%	9	8.65%
17	0	0.00%	3	8.82%	10	17.24%	1	33.33%	14	13.46%
18	2	22.22%	1	2.94%	8	13.79%	0	0.00%	11	10.58%
19	0	0.00%	2	5.88%	2	3.45%	0	0.00%	4	3.85%
20	0	0.00%	4	11.76%	2	3.45%	0	0.00%	6	5.77%
21	1	11.11%	3	8.82%	1	1.72%	0	0.00%	5	4.81%
22	0	0.00%	1	2.94%	5	8.62%	0	0.00%	6	5.77%
23	1	11.11%	1	2.94%	1	1.72%	0	0.00%	3	2.88%
Total	**9**	**100.00%**	**34**	**100.00%**	**58**	**100.00%**	**3**	**100.00%**	**104**	**100.00%**

Table 140. Summary of Special Crash Types by Day vs. Night

Day/Night	Bicycle-Bicycle		Bicycle-Only		Bicycle-Pedestrian		Vehicle-Bicycle&Pedestrian		Total	
	#	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**
Day (6 AM - 8 PM)	6	66.67%	24	70.59%	45	77.59%	2	66.67%	77	74.04%
Night (8 PM - 6 AM)	3	33.33%	10	29.41%	13	22.41%	1	33.33%	27	25.96%
Total	**9**	**100.00%**	**34**	**100.00%**	**58**	**100.00%**	**3**	**100.00%**	**104**	**100.00%**

Crash Severity Levels

There was one fatal crash in bicycle-only crashes where the bicyclist lost his control, fell, and struck his head to ground which caused severe head injury. The bicyclist was carrying inappropriately a barbeque grill that caused him to lose control of bicycle. Bicycle-only crashes had also the highest proportion of disabling crashes (26.5%), if excluding vehicle-bicycle&pedestrian crashes, one out of three crashes was disabling (33%).

Table 141. Summary of Special Crash Types by Severity Level

Severity	Bicycle-Bicycle		Bicycle-Only		Bicycle-Pedestrian		Vehicle-Bicycle&Pedestrian		Total	
	#	%	#	%	#	%	#	%	#	%
Fatal	0	0.00%	1	2.94%	0	0.00%	0	0.00%	1	0.96%
Disabling	2	22.22%	9	26.47%	6	10.34%	1	33.33%	18	17.31%
Non-Disabling	6	66.67%	20	58.82%	31	53.45%	1	33.33%	58	55.77%
Complaint but not visible	1	11.11%	4	11.76%	16	27.59%	1	33.33%	22	21.15%
No Injury	0	0.00%	0	0.00%	1	1.72%	0	0.00%	1	0.96%
Unknown	0	0.00%	0	0.00%	4	6.90%	0	0.00%	4	3.85%
Total	**9**	**100.00%**	**34**	**100.00%**	**58**	**100.00%**	**3**	**100.00%**	**104**	**100.00%**

Table 142. Summary of Special Crash Types by Severity Level: "Fatal & Disabling" vs. "Other"

KA/BCOU	Bicycle-Bicycle		Bicycle-Only		Bicycle-Pedestrian		Vehicle-Bicycle&Pedestrian		Total	
	#	%	#	%	#	%	#	%	#	%
Fatal & Disabling	2	22.22%	10	29.41%	6	10.34%	1	33.33%	19	18.27%
Other	7	77.78%	24	70.59%	52	89.66%	2	66.67%	85	81.73%
Total	**9**	**100.00%**	**34**	**100.00%**	**58**	**100.00%**	**3**	**100.00%**	**104**	**100.00%**

Table 143. Summary of Special Crash Types by Severity Level: "Fatal & Disabling & Non-Disabling" vs. "Other"

KAB/COU	Bicycle-Bicycle		Bicycle-Only		Bicycle-Pedestrian		Vehicle-Bicycle&Pedestrian		Total	
	#	%	#	%	#	%	#	%	#	%
Fatal, Disabling, & Non-Disabling	8	88.89%	30	88.24%	37	63.79%	2	66.67%	77	74.04%
Other	1	11.11%	4	11.76%	21	36.21%	1	33.33%	27	25.96%
Total	**9**	**100.00%**	**34**	**100.00%**	**58**	**100.00%**	**3**	**100.00%**	**104**	**100.00%**

Table 144. Summary of Special Crash Types by Severity Level: "Fatal & Disabling" vs. "Non-Disabling & Complaint but not visible" vs. "Other"

KA/BC/OU	Bicycle-Bicycle		Bicycle-Only		Bicycle-Pedestrian		Vehicle-Bicycle&Pedestrian		Total	
	#	%	#	%	#	%	#	%	#	%
Fatal & Disabling	2	22.22%	10	29.41%	6	10.34%	1	33.33%	19	18.27%
Non-Disabling & Complaint but not	7	77.78%	24	70.59%	47	81.03%	2	66.67%	80	76.92%

KA/BC/OU	Bicycle-Bicycle		Bicycle-Only		Bicycle-Pedestrian		Vehicle-Bicycle&Pedestrian		Total	
	#	%	#	%	#	%	#	%	#	%
visible										
Other	0	0.00%	0	0.00%	5	8.62%	0	0.00%	5	4.81%
Total	**9**	**100.00%**	**34**	**100.00%**	**58**	**100.00%**	**3**	**100.00%**	**104**	**100.00%**

Driver and Pedestrian/Bicyclist's Characteristics

In five out of nine (55.6%) bicycle-bicycle crashes, one of bicyclists was at fault, three were unknown, and there was no fault / violation in one crash. There was no fault or violation in 19 out of thirty-four (about 56 percent) bicycle-only crashes. Bicyclists and pedestrians were evenly at fault in bicycle-pedestrian crashes (32.8% each); however, there were sixteen crashes with unknown fault or violation status (27.6%) (Table 145). In 2 out of three vehicle-bicycle&pedestrian crashes, pedestrians or bicyclists were at fault (Table 146).

Age and gender had disproportionately large unknown values thus were not summarized.

Table 145. Summary of Special Crash Types by Fault / Violation

Fault / Violation	Bicycle-Bicycle		Bicycle-Only		Bicycle-Pedestrian		Total	
	#	%	#	%	#	%	#	%
Bicyclist	5	55.56%	13	38.24%	19	32.76%	37	36.63%
Pedestrian	0	0.00%	0	0.00%	19	32.76%	19	18.81%
No Fault / Violation	1	11.11%	19	55.88%	4	6.90%	24	23.76%
Unknown	3	33.33%	2	5.88%	16	27.59%	21	20.79%
Total	**9**	**100.00%**	**34**	**100.00%**	**58**	**100.00%**	**101**	**100.00%**

Note: "Vehicle-Bicycle&Pedestrian" was summarized in next table.

Table 146. Summary of Special Crash Types by Fault / Violation (Vehicle-Bicycle&Pedestrian)

Fault / Violation	Vehicle-Bicycle&Pedestrian	
Vehicle Driver/Passenger	1	33.33%
Pedestrian/Bicyclist	2	66.67%
Total	**3**	**100.00%**

Table 147 and Table 148 summarized crashes by fault or violation and crash severity levels. Pedestrians were more at fault for disabling crashes (5 out of six disabling crashes or 83%). Bicyclists were slightly more at fault for non-disabling crashes (29% vs 23%) and pedestrians were more at fault for complain but not visible crashes (44% vs 38%). Two bicycle-pedestrians crashes had drunk pedestrians (Table 149) but no bicyclists were identified drunk in any of these special crashes not limited to bicycle-pedestrian crashes. One bicycle-bicycle and one bicycle-only had distracted bicyclists and one bicycle-pedestrian crash had a distracted pedestrian (Table 151). Five bicycle-only and two bicycle-pedestrian crashes were labelled with speeding bicyclists (Table 152). Ten out of 58 bicycle-pedestrian crashes had bicyclists who left the crash scene (hit & run) that accounted for about 17% of associated crash type (Table 153).

Table 147. Summary of Special Crash types by Fault / Violation & Severity Level

Crash Type \ Severity	Fatal		Disabling		Non-Disabling		Complaint but not visible		No Injury		Unknown		Total	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Bicyclist			1	50%	4	67%		0%					5	56%
No Fault / Violation				0%	1	17%		0%					1	11%
Unknown			1	50%	1	17%	1	100%					3	33%
Bicycle-Bicycle			**2**	**100%**	**6**	**100%**	**1**	**100%**					**9**	**100%**
Bicyclist		0%	5	56%	7	35%	1	25%					13	38%
No Fault / Violation	1	100%	3	33%	13	65%	2	50%					19	56%
Unknown		0%	1	11%		0%	1	25%					2	6%
Bicycle-Only	**1**	**100%**	**9**	**100%**	**20**	**100%**	**4**	**100%**					**34**	**100%**
Bicyclist			1	17%	9	29%	6	38%	1	100%	2	50%	19	33%
Pedestrian			5	83%	7	23%	7	44%		0%		0%	19	33%
No Fault / Violation				0%	3	10%		0%		0%	1	25%	4	7%
Unknown				0%	12	39%	3	19%		0%	1	25%	16	28%
Bicycle-Pedestrian			**6**	**100%**	**31**	**100%**	**16**	**100%**	**1**	**100%**	**4**	**100%**	**58**	**100%**
Vehicle Driver/Passenger				0%	1	100%		0%					1	33%
Pedestrian/Bicyclist			1	100%		0%	1	100%					2	67%
Vehicle-Bicycle&Pedestrian			**1**	**100%**	**1**	**100%**	**1**	**100%**					**3**	**100%**
Total	**1**	**-**	**18**	**-**	**58**	**-**	**22**	**-**	**1**	**-**	**4**	**-**	**104**	**-**

Table 148. Summary of Special Crash types by Fault / Violation & Severity Level (regrouped)

Crash Type \ Severity	Fatal & Disabling		Other		Total		*Sig.*
	#	%	#	%	#	%	
Bicyclist	1	50.00%	4	57.14%	5	55.56%	
No Fault / Violation	0	0.00%	1	14.29%	1	11.11%	
Unknown	1	50.00%	2	28.57%	3	33.33%	
Bicycle-Bicycle	**2**	**100.00%**	**7**	**100.00%**	**9**	**100.00%**	
Bicyclist	5	50.00%	8	33.33%	13	38.24%	
No Fault / Violation	4	40.00%	15	62.50%	19	55.88%	
Unknown	1	10.00%	1	4.17%	2	5.88%	
Bicycle-Only	**10**	**100.00%**	**24**	**100.00%**	**34**	**100.00%**	
Bicyclist	1	16.67%	18	34.62%	19	32.76%	
Pedestrian	5	83.33%	14	26.92%	19	32.76%	+++
No Fault / Violation	0	0.00%	4	7.69%	4	6.90%	
Unknown	0	0.00%	16	30.77%	16	27.59%	
Bicycle-Pedestrian	**6**	**100.00%**	**52**	**100.00%**	**58**	**100.00%**	
Vehicle Driver/Passenger	0	0.00%	1	50.00%	1	33.33%	
Pedestrian/Bicyclist	1	100.00%	1	50.00%	2	66.67%	
Vehicle-Bicycle&Pedestrian	**1**	**100.00%**	**2**	**100.00%**	**3**	**100.00%**	
Total	**19**	**-**	**85**	**-**	**104**	**-**	

Table 149. Summary of Special Crash Types by Alcohol

Alcohol	Bicycle-Bicycle		Bicycle-Only		Bicycle-Pedestrian		Vehicle-Bicycle&Pedestrian		Total	
	#	%	#	%	#	%	#	%	#	%
Pedestrian	0	0.00%	0	0.00%	2	3.45%	0	0.00%	2	1.92%
None	9	100.00%	28	82.35%	47	81.03%	3	100.00%	87	83.65%
Unknown	0	0.00%	6	17.65%	9	15.52%	0	0.00%	15	14.42%
Total	**9**	**100.00%**	**34**	**100.00%**	**58**	**100.00%**	**3**	**100.00%**	**104**	**100.00%**

Table 150. Summary of Special Crash Types by Drug

Drug	Bicycle-Bicycle		Bicycle-Only		Bicycle-Pedestrian		Vehicle-Bicycle&Pedestrian		Total	
	#	%	#	%	#	%	#	%	#	%
None	9	100.00%	30	88.24%	49	84.48%	3	100.00%	91	87.50%
Unknown	0	0.00%	4	11.76%	9	15.52%	0	0.00%	13	12.50%
Total	**9**	**100.00%**	**34**	**100.00%**	**58**	**100.00%**	**3**	**100.00%**	**104**	**100.00%**

Table 151. Summary of Special Crash Types by Distraction

Distraction	Bicycle-Bicycle		Bicycle-Only		Bicycle-Pedestrian		Vehicle-Bicycle&Pedestrian		Total	
	#	%	#	%	#	%	#	%	#	%
Bicyclist	1	11.11%	1	2.94%	0	0.00%	0	0.00%	2	1.92%
Pedestrian	0	0.00%	0	0.00%	1	1.72%	0	0.00%	1	0.96%
None	6	66.67%	27	79.41%	43	74.14%	0	0.00%	76	73.08%
Unknown	2	22.22%	6	17.65%	14	24.14%	3	100.00%	25	24.04%
Total	**9**	**100.00%**	**34**	**100.00%**	**58**	**100.00%**	**3**	**100.00%**	**104**	**100.00%**

Table 152. Summary of Special Crash Types by Speeding / Running

Speeding	Bicycle-Bicycle		Bicycle-Only		Bicycle-Pedestrian		Vehicle-Bicycle&Pedestrian		Total	
	#	%	#	%	#	%	#	%	#	%
Bicyclist	0	0.00%	5	14.71%	2	3.45%	0	0.00%	7	6.73%
None	9	100.00%	26	76.47%	52	89.66%	3	100.00%	90	86.54%
Unknown	0	0.00%	3	8.82%	4	6.90%	0	0.00%	7	6.73%
Total	**9**	**100.00%**	**34**	**100.00%**	**58**	**100.00%**	**3**	**100.00%**	**104**	**100.00%**

Table 153. Summary of Special Crash Types by Hit & Run

Hit & Run	Bicycle-Bicycle		Bicycle-Only		Bicycle-Pedestrian		Vehicle-Bicycle&Pedestrian		Total	
	#	%	#	%	#	%	#	%	#	%
Yes	1	11.11%	0	0.00%	10	17.24%	2	66.67%	13	12.50%
No	8	88.89%	34	100.00%	48	82.76%	1	33.33%	91	87.50%
Total	**9**	**100.00%**	**34**	**100.00%**	**58**	**100.00%**	**3**	**100.00%**	**104**	**100.00%**

Table 154. Summary of Special Crash Types by Hit & Run and Severity Level

Severity / Crash Type	Fatal & Disabling		Other		Total		*Sig.*
	#	%	#	%	#	%	
Yes	0	0.00%	1	14.29%	1	11.11%	
No	2	100.00%	6	85.71%	8	88.89%	
Bicycle-Bicycle	**2**	**100.00%**	**7**	**100.00%**	**9**	**100.00%**	
No	10	100.00%	24	100.00%	34	100.00%	
Bicycle-Only	**10**	**100.00%**	**24**	**100.00%**	**34**	**100.00%**	
Yes	0	0.00%	10	19.23%	10	17.24%	
No	6	100.00%	42	80.77%	48	82.76%	
Bicycle-Pedestrian	**6**	**100.00%**	**52**	**100.00%**	**58**	**100.00%**	
Yes	1	100.00%	1	50.00%	2	66.67%	
No	0	0.00%	1	50.00%	1	33.33%	

Crash Type \ Severity	Fatal & Disabling		Other		Total		*Sig.*
	#	%	#	%	#	%	
Vehicle-Bicycle&Pedestrian	**1**	**100.00%**	**2**	**100.00%**	**3**	**100.00%**	
Total	**19**	**-**	**85**	**-**	**104**	**-**	

Applicable NHTSA & LMCM Fields

In this section, applicable fields of NHTSA and LMCM crash typologies are summarized. Crosswalk area was the main pedestrian position in bicycle-pedestrian crashes (about 40%) followed by "Travel Lane" by 29.3% (Table 155). The main NHTSA pedestrian crash types were "742 - Dart-Out" (pedestrians were darting out in path of bicyclists) and "320 - Entering/Exiting Parked Vehicle" both of them with five cases (Table 156). Bicyclists were in "Travel Lane" in majority of crashes followed by "Bike Lane / Paved Shoulder" (Table 158) and bicyclists were following the traffic in about 79% of crashes (Table 159). "800 - Unusual Circumstances" was the main NHTSA pedestrian crash type which was not surprising due to the special crash types that are being reviewed (Table 160). The prevalent LMCM crash types were "*I-NS-ST-R*" and "*I-NS-ST-L*" (in both of them bicycle assumed the position of a motor vehicle).

Table 155. Summary of Special Crash Types by Pedestrian Position

Pedestrian Position	**Bicycle-Pedestrian**		**Vehicle-Bicycle&Pedestrian**		**Total**	
	#	**%**	**#**	**%**	**#**	**%**
Crosswalk Area	23	39.66%	0	0.00%	23	37.70%
Travel Lane	17	29.31%	1	33.33%	18	29.51%
Sidewalk / Shared-Use Path / Driveway Crossing	10	17.24%	1	33.33%	11	18.03%
Paved Shoulder / Bike lane / Parking Lane	7	12.07%	0	0.00%	7	11.48%
Other / Unknown	1	1.72%	1	33.33%	2	3.28%
Total	**58**	**100.00%**	**3**	**100.00%**	**61**	**100.00%**

Table 156. Summary of Special Crash Types by Pedestrian NHTSA Crash Types

NHTSA Crash Type	**Bicycle-Pedestrian**		**Vehicle-Bicycle&Pedestrian**		**Total**	
	#	**%**	**#**	**%**	**#**	**%**
742 - Dart-Out	5	17.24%	0	0.00%	5	15.63%
320 - Entering/Exiting Parked Vehicle	5	17.24%	0	0.00%	5	15.63%
760 - Pedestrian Failed to Yield	4	13.79%	0	0.00%	4	12.50%
770 - Motorist Failed to Yield	3	10.34%	0	0.00%	3	9.38%
690 - Intersection—Other/Unknown	2	6.90%	0	0.00%	2	6.25%
890 - Off Roadway—Other/Unknown	1	3.45%	0	0.00%	1	3.13%
341 - Commercial Bus-Related	0	0.00%	1	33.33%	1	3.13%
741 - Dash	0	0.00%	1	33.33%	1	3.13%
190 - Other Unusual Circumstances	9	31.03%	1	33.33%	10	31.25%
Total	**29**	**100.00%**	**3**	**100.00%**	**32**	**100.00%**

Table 157. Summary of Special Crash Types by Pedestrian NHTSA Crash Groups

NHTSA Crash Group	Bicycle-Pedestrian		Vehicle-Bicycle&Pedestrian		Total	
	#	%	#	%	#	%
100 - Unusual Circumstances	9	31.03%	1	33.33%	10	31.25%
750 - Crossing Roadway—Vehicle Not Turning	7	24.14%	0	0.00%	7	21.88%
740 - Dash/Dart-Out	5	17.24%	1	33.33%	6	18.75%
350 - Unique Midblock	5	17.24%	0	0.00%	5	15.63%
340 - Bus-Related	0	0.00%	1	33.33%	1	3.13%
800 - Off Roadway	1	3.45%	0	0.00%	1	3.13%
990 - Other/Unknown—Insufficient Details	2	6.90%	0	0.00%	2	6.25%
Total	**29**	**100.00%**	**3**	**100.00%**	**32**	**100.00%**

Table 158. Summary of Special Crash Types by Bicyclist Position

Bicyclist Position	Bicycle-Bicycle		Bicycle-Only		Bicycle-Pedestrian		Vehicle-Bicycle&Pedestrian		Total	
	#	%	#	%	#	%	#	%	#	%
Travel Lane	6	66.67%	29	85.29%	38	65.52%	1	33.33%	74	71.15%
Bike Lane / Paved Shoulder	3	33.33%	2	5.88%	9	15.52%	0	0.00%	14	13.46%
Sidewalk / Crosswalk / Driveway Crossing	0	0.00%	3	8.82%	9	15.52%	1	33.33%	13	12.50%
Multi-use Path	0	0.00%	0	0.00%	1	1.72%	0	0.00%	1	0.96%
Unknown	0	0.00%	0	0.00%	1	1.72%	1	33.33%	2	1.92%
Total	**9**	**100.00%**	**34**	**100.00%**	**58**	**100.00%**	**3**	**100.00%**	**104**	**100.00%**

Table 159. Summary of Special Crash Types by Bicyclist Direction

Bicyclist Direction	Bicycle-Bicycle		Bicycle-Only		Bicycle-Pedestrian		Vehicle-Bicycle&Pedestrian		Total	
	#	%	#	%	#	%	#	%	#	%
With Traffic	8	88.89%	31	91.18%	41	70.69%	2	66.67%	82	78.85%
Facing Traffic	1	11.11%	0	0.00%	3	5.17%	0	0.00%	4	3.85%
Not Applicable	0	0.00%	2	5.88%	12	20.69%	1	33.33%	15	14.42%
Unknown	0	0.00%	1	2.94%	2	3.45%	0	0.00%	3	2.88%
Total	**9**	**100.00%**	**34**	**100.00%**	**58**	**100.00%**	**3**	**100.00%**	**104**	**100.00%**

Table 160. Summary of Special Crash Types by Bicycle NHTSA Crash Types

NHTSA Crash Type	Bicycle-Bicycle	Bicycle-Only	Bicycle-Pedestrian	Vehicle-Bicycle&Pedestrian	Total

	#	%	#	%	#	%	#	%	#	%
800 - Unusual Circumstances	0	0%	0	0%	7	29%	1	33%	8	11%
158 - Signalized Intersection—Other/Unknown	1	11%	0	0%	2	8%	1	33%	4	6%
250 - Head-On—Bicyclist	3	33%	0	0%	0	0%	0	0%	3	4%
129 - Bicyclist Lost Control—Other/Unknown	1	11%	0	0%	2	8%	0	0%	3	4%
122 - Bicyclist Lost Control—Oversteering, Improper Braking, Speed	0	0%	0	0%	1	4%	1	33%	2	3%
380 - Crossing Paths—Midblock—Other/Unknown	0	0%	0	0%	1	4%	0	0%	1	1%
520 - Bicyclist Intentionally Caused	0	0%	0	0%	1	4%	0	0%	1	1%
124 - Bicyclist Lost Control—Surface Conditions	0	0%	0	0%	1	4%	0	0%	1	1%
242 - Bicyclist Overtaking—Passing on Left	1	11%	0	0%	0	0%	0	0%	1	1%
144 - Bicyclist Ride Through—Sign-Controlled Intersection	1	11%	0	0%	0	0%	0	0%	1	1%
155 - Bicyclist Ride Through—Signalized Intersection	0	0%	0	0%	1	4%	0	0%	1	1%
180 - Crossing Paths—Intersection—Other/Unknown Control	0	0%	0	0%	1	4%	0	0%	1	1%
221 - Bicyclist Left Turn—Same Direction	1	11%	0	0%	0	0%	0	0%	1	1%
400 - Bicycle Only	1	11%	34	100%	0	0%	0	0%	35	50%
N/A (Ped Crash)	0	0%	0	0%	7	29%	0	0%	7	10%
Total	**9**	**100%**	**34**	**100%**	**24**	**100%**	**3**	**100%**	**70**	**100%**

Table 161. Summary of Special Crash Types by Bicycle NHTSA Crash Groups

NHTSA Crash Group	Bicycle-Bicycle		Bicycle-Only		Bicycle-Pedestrian		Vehicle-Bicycle&Pedestrian		Total	
	#	%	#	%	#	%	#	%	#	%
850 - Other/Unusual Circumstances	1	11.11%	34	100.00%	8	33.33%	1	33.33%	44	62.86%
110 - Loss of Control/Turning Error	1	11.11%	0	0.00%	4	16.67%	1	33.33%	6	8.57%
190 - Crossing Paths—Other Circumstances	1	11.11%	0	0.00%	4	16.67%	1	33.33%	6	8.57%
258 - Head-On	3	33.33%	0	0.00%	0	0.00%	0	0.00%	3	4.29%
145 - Bicyclist Failed to Yield—Sign-Controlled Intersection	1	11.11%	0	0.00%	0	0.00%	0	0.00%	1	1.43%
158 - Bicyclist Failed to	0	0.00%	0	0.00%	1	4.17%	0	0.00%	1	1.43%

NHTSA Crash Group	Bicycle-Bicycle		Bicycle-Only		Bicycle-Pedestrian		Vehicle-Bicycle&Pedestrian		Total	
	#	%	#	%	#	%	#	%	#	%
Yield—Signalized Intersection										
240 - Bicyclist Overtaking Motorist	1	11.11%	0	0.00%	0	0.00%	0	0.00%	1	1.43%
220 - Bicyclist Left Turn/Merge	1	11.11%	0	0.00%	0	0.00%	0	0.00%	1	1.43%
N/A (Ped Crash)	0	0.00%	0	0.00%	7	29.17%	0	0.00%	7	10.00%
Total	**9**	**100.00%**	**34**	**100.00%**	**24**	**100.00%**	**3**	**100.00%**	**70**	**100.00%**

Table 162. Summary of Special Crash Types by LMCM Crash Category

LMCM Crash Category	Bicycle-Bicycle		Bicycle-Only		Bicycle-Pedestrian		Vehicle-Bicycle&Pedestrian		Total	
	#	%	#	%	#	%	#	%	#	%
Intersection	6	66.67%	0	0.00%	35	60.34%	1	33.33%	42	40.38%
Non-Intersection	2	22.22%	0	0.00%	22	37.93%	1	33.33%	25	24.04%
Other	1	11.11%	34	100.00%	1	1.72%	1	33.33%	37	35.58%
Total	**9**	**100.00%**	**34**	**100.00%**	**58**	**100.00%**	**3**	**100.00%**	**104**	**100.00%**

Table 163. Summary of Special Crash Types by LMCM Crash Types

LMC Crash Type	Bicycle-Bicycle		Bicycle-Only		Bicycle-Pedestrian		Vehicle-Bicycle&Pedestrian		Total	
	#	%	#	%	#	%	#	%	#	%
I-NS-ST-R	1	11.11%	0	0.00%	11	18.97%	0	0.00%	12	11.54%
I-NS-ST-L	0	0.00%	0	0.00%	11	18.97%	0	0.00%	11	10.58%
N-RRD-X	0	0.00%	0	0.00%	6	10.34%	0	0.00%	6	5.77%
I-NS-ST-X	1	11.11%	0	0.00%	4	6.90%	1	33.33%	6	5.77%
N-RRD-R	0	0.00%	0	0.00%	4	6.90%	0	0.00%	4	3.85%
I-FS-ST-R	0	0.00%	0	0.00%	4	6.90%	0	0.00%	4	3.85%
N-RSW-X	0	0.00%	0	0.00%	2	3.45%	0	0.00%	2	1.92%
N-RSW-R	0	0.00%	0	0.00%	2	3.45%	0	0.00%	2	1.92%
I-NS-ST-O	2	22.22%	0	0.00%	0	0.00%	0	0.00%	2	1.92%
N-RSH-R	0	0.00%	0	0.00%	2	3.45%	0	0.00%	2	1.92%
N-LRD-S	1	11.11%	0	0.00%	1	1.72%	0	0.00%	2	1.92%
I-NS-X-L	1	11.11%	0	0.00%	0	0.00%	0	0.00%	1	0.96%
I-X-ST-X	0	0.00%	0	0.00%	1	1.72%	0	0.00%	1	0.96%
I-X-ST-S	0	0.00%	0	0.00%	1	1.72%	0	0.00%	1	0.96%
N-RD-R	0	0.00%	0	0.00%	1	1.72%	0	0.00%	1	0.96%

LMC Crash Type	Bicycle-Bicycle		Bicycle-Only		Bicycle-Pedestrian		Vehicle-Bicycle&Pedestrian		Total	
	#	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**
I-X-X-X	0	0.00%	0	0.00%	1	1.72%	0	0.00%	1	0.96%
N-RRD-L	0	0.00%	0	0.00%	1	1.72%	0	0.00%	1	0.96%
N-RSH-X	0	0.00%	0	0.00%	1	1.72%	0	0.00%	1	0.96%
I-FS-ST-L	0	0.00%	0	0.00%	1	1.72%	0	0.00%	1	0.96%
N-RSW-S	0	0.00%	0	0.00%	1	1.72%	0	0.00%	1	0.96%
N-RRD-S	0	0.00%	0	0.00%	0	0.00%	1	33.33%	1	0.96%
N-X-X	0	0.00%	0	0.00%	1	1.72%	0	0.00%	1	0.96%
I-NS-LT-S	1	11.11%	0	0.00%	0	0.00%	0	0.00%	1	0.96%
I-FS-RT-O	0	0.00%	0	0.00%	1	1.72%	0	0.00%	1	0.96%
N-RSH-O	1	11.11%	0	0.00%	0	0.00%	0	0.00%	1	0.96%
OTH	1	11.11%	34	100.00%	1	1.72%	1	33.33%	37	35.58%
Total	**9**	**100.00%**	**34**	**100.00%**	**58**	**100.00%**	**3**	**100.00%**	**104**	**100.00%**

Decision Trees

In this section, the results of CHAID analysis on pedestrian and bicycle crashes are presented. Analysis was done using IBM SPSS Modeler (version 18) and IBM SPSS (version 24). Only the NHTSA crash types were included in the analysis.

Pedestrian Crashes

The variables that were used in the CHAID analysis are presented in Table 164. Crash severity was selected as the dependent variable. The crash severity level was the most severe harmful event that occurred at the crash scene or within 30 days to the involved pedestrian(s). Due to the distribution of crash severity levels (fatal 1.00%, disabling 8.31%, non-disabling 36.32%, complaint but not visible 39.67%, no injury 11.35%, and unknown 3.35%), the crash severity was recoded as fatal and disabling vs the rest (9.31% vs 90.69%). The same approach was also applied in the literature and can increase the prediction accuracy (Mohamadi Hezaveh, AzadDisfany and Cherry 2018).

Table 164. Variables Used in the CHAID Analysis for Pedestrian Crashes

Variable		Count	%
Crash Severity: KA / BCOU	Fatal (K) & Disabling (A)	242	9.3%
	Other (B, C, O, and U)	2357	90.7%
Crash Time (Day/Night)	Day (6 AM - 8 PM)	1923	74.0%
	Night (8 PM - 6 AM)	676	26.0%
Crash District	1	489	18.9%
	2	557	21.5%
	3	375	14.5%
	4	319	12.3%
	5	305	11.8%
	6	276	10.7%
	7	269	10.4%
Crash City Quadrant	NE	542	21.4%
	NW	1436	56.7%
	SE	484	19.1%
	SW	69	2.7%
Construction Zone	Yes	78	3.0%
	No	2521	97.0%
Hit & Run	Yes	536	20.6%
	No	2063	79.4%
Road Surface	Asphalt	2276	90.1%
	Other	249	9.9%
Road Type	Straight	2172	84.9%
	Other	387	15.1%
Road Condition	Dry	2064	80.7%
	Other	494	19.3%
Street Lighting	Street Lights On	940	37.3%
	Other	1581	62.7%
Light Condition	Daylight	1541	60.7%
	Other	996	39.3%
Weather	Clear	2033	80.7%
	Other	485	19.3%

Variable		Count	%
Traffic Condition	Heavy	369	14.9%
	Medium	887	35.7%
	Low	864	34.8%
	Other	364	14.7%
Roadway Type/Division	One-Way	351	13.8%
	Two-Way Divided	249	9.8%
	Two-Way Other	1921	75.5%
	Other	23	0.9%
Driver Gender	Female	830	31.9%
	Male	1489	57.3%
	Not Applicable/Available	280	10.8%
Driver Age	21 & under	148	5.7%
	22 - 34	761	29.3%
	35 - 44	437	16.8%
	45 - 54	443	17.0%
	55 - 64	392	15.1%
	65 & over	266	10.2%
	Not Available	152	5.8%
Pedestrian Gender	Female	1173	45.1%
	Male	1137	43.7%
	Not Available	289	11.1%
Pedestrian Age	21 & under	328	12.6%
	22 - 34	699	26.9%
	35 - 44	337	13.0%
	45 - 54	317	12.2%
	55 - 64	278	10.7%
	65 & over	188	7.2%
	Not Available	452	17.4%
Crash Location	Intersection & Within 100 ft.	1808	69.6%
	Road	626	24.1%
	Other	165	6.3%
Intersection Type	3-leg	387	14.9%
	4-leg	1286	49.5%
	Non-Intersection	792	30.5%
	Other	134	5.2%
Traffic Control Type	Signalized	1277	49.1%
	Sign-Controlled	317	12.2%
	Uncontrolled	219	8.4%
	Non-Intersection	781	30.1%
	Other	5	0.2%
Fault / Violation	Vehicle Driver/Passenger	1510	58.1%
	Pedestrian	699	26.9%
	Other	390	15.0%
Alcohol	Vehicle Driver/Passenger	49	1.9%
	Pedestrian	97	3.7%
	Other	2453	94.4%
Drug	Vehicle Driver/Passenger	6	0.2%
	Pedestrian	7	0.3%

Variable		Count	%
	Other	2586	99.5%
Distraction	Vehicle Driver/Passenger	90	3.5%
	Pedestrian	105	4.0%
	Other	2404	92.5%
Speeding	Vehicle Driver/Passenger	75	2.9%
	Pedestrian	4	0.2%
	Other	2520	97.0%
Pedestrian Position	Crosswalk Area	1337	51.4%
	Travel Lane	625	24.0%
	Nonroadway—Parking lot/Other	115	4.4%
	Other	522	20.1%

Figure 83 represents the developed tree for pedestrian crashes. The pedestrian tree has 16 nodes and model selected following variables to predict crash severity:

- Traffic Control Type
- Crash Time (Day/Night)
- Alcohol
- Speeding
- Light Condition
- Road Type
- City Quadrant
- Fault / Violation

The first node was "Alcohol" and based on the model, when either pedestrian or driver were drunk the proportion of fatal and disabling crashes (KA) was significantly higher (19.2% vs 8.7%). Then the tree branched under the crashes not being involved either a drunk pedestrian or driver at "Speeding" node; again when either pedestrian or driver were attributed with some kind of speeding; proportion of fatal and disabling crashes (KA) was significantly higher (20.9% vs 8.4%). On the tree branch where either pedestrian or driver were attributed with some kind of speeding, the tree grew at "Traffic Control Type" node and proportion of fatal and disabling crashes (KA) was significantly higher for signalized intersections in comparison to all other control types (40% vs 5.4%). On the other tree branch at "Speeding" node, the tree grew at "Fault / Violation" node and proportion of fatal and disabling crashes (KA) was significantly higher when pedestrian was at fault (11.7% vs 7.2%). When pedestrians were at fault, the tree branched at "City Quadrant" node where proportion of fatal and disabling crashes (KA) was significantly higher in NE and SW vs NW and SE (18% vs 9.4%). Finally, for NE and SW crashes, the proportion of fatal and disabling crashes (KA) was significantly lower in daylight at "Light Condition" node (12.5% vs 29.1%). Other branch (vehicle driver/passenger at fault) under the "Fault / Violation" was at "Crash Time (Day/Night)" node where proportion of fatal and disabling crashes (KA) was significantly higher at nights (9.5% vs 6.4%). The tree grew for daytime crashes under "Road Type" note and straight roadways had a significantly lower proportion (5.6% vs 10.6%). For the nighttime crashes there was a branching at "Traffic Control Type" node where the proportion of fatal and disabling crashes (KA) was significantly higher at uncontrolled or other control types (rather than signalized, sign-controlled or non-intersections) (23.7% vs 8.2%).

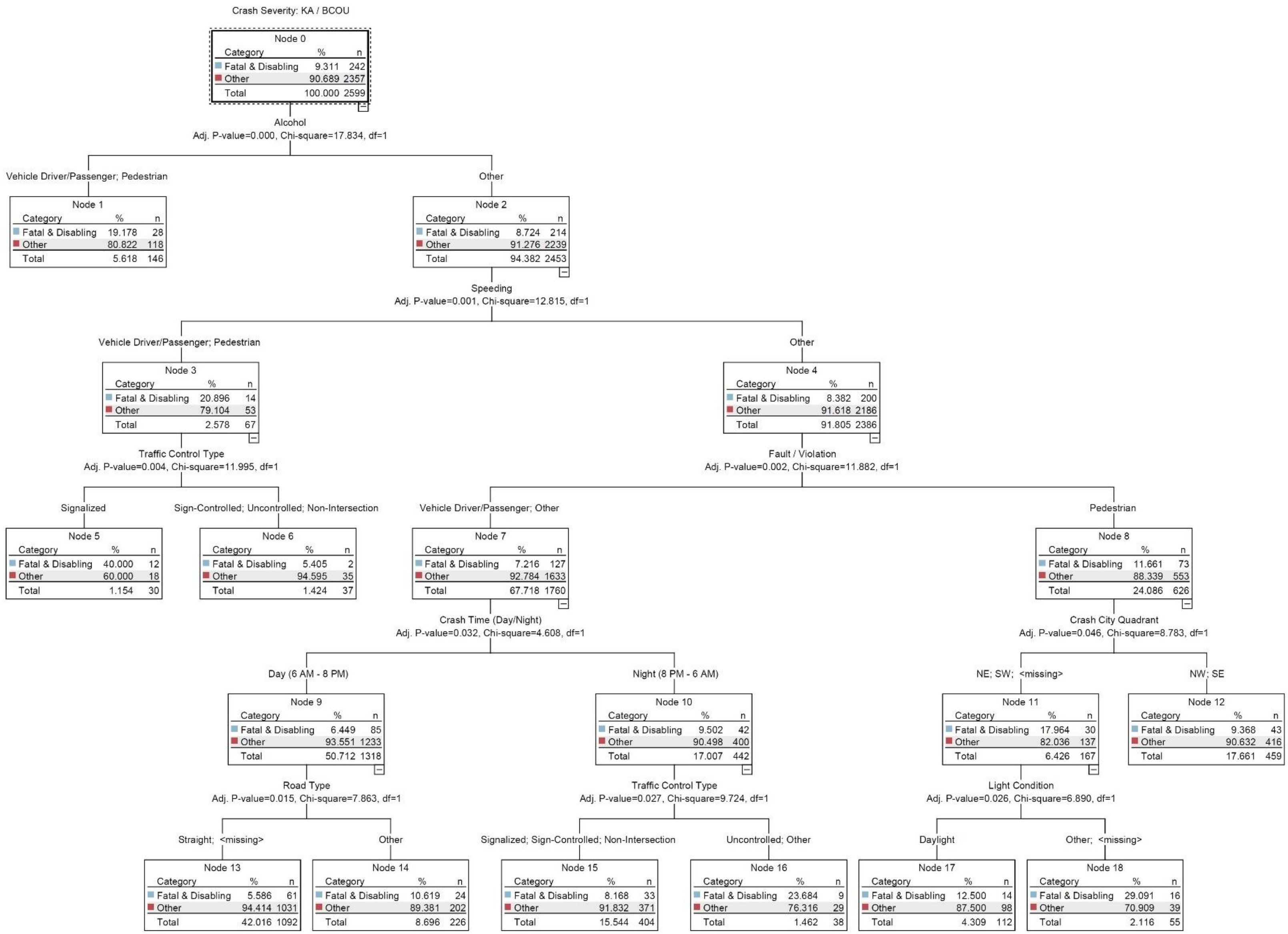


Figure 83. Decision Tree for Pedestrian Crashes

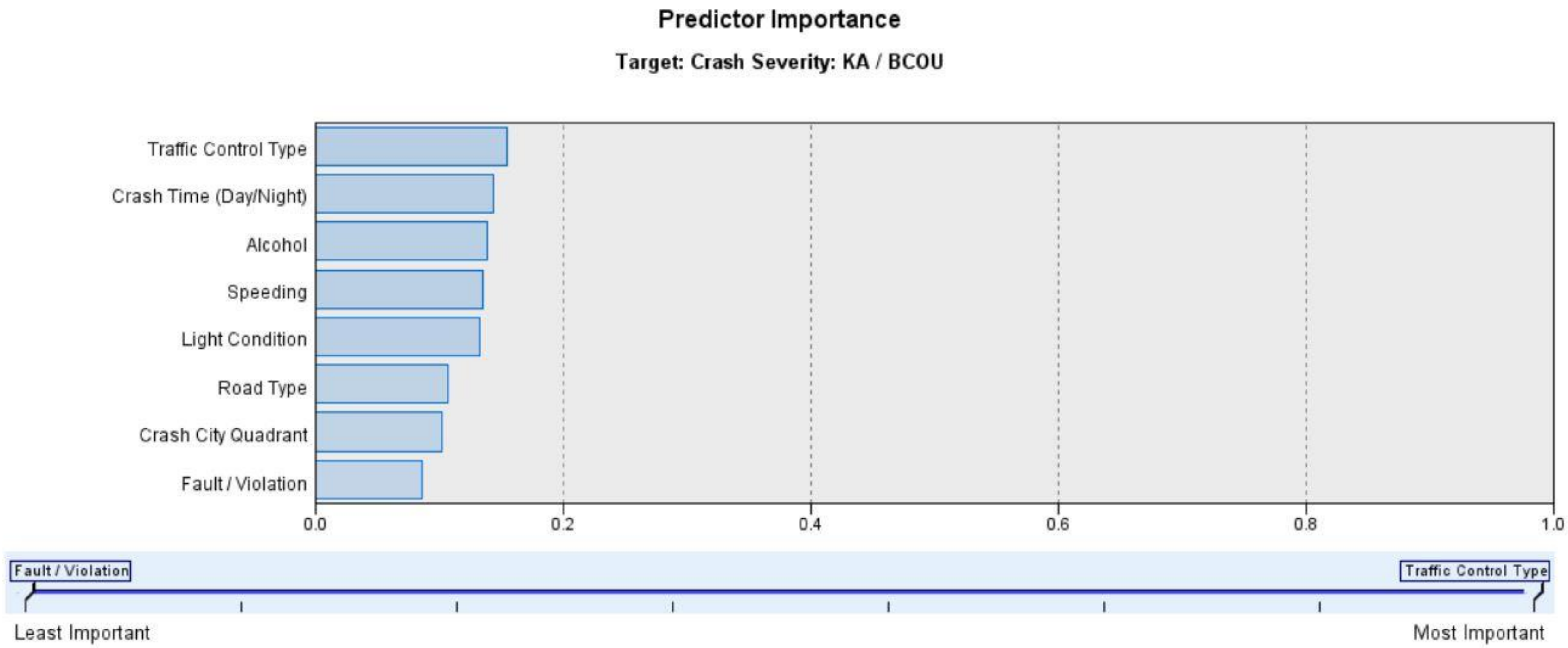


Figure 84. Relative Importance of Variables in the Decision Tree for Pedestrian Crashes

Bicycle Crashes

The variables that were used in the CHAID analysis are presented in Table 165. Crash severity was selected as the dependent variable. The crash severity level was the most severe harmful event that occurred at the crash scene or within 30 days to the involved bicyclist(s).Due to the distribution of crash severity levels (fatal 0.15%, disabling 5.74%, non-disabling 42.94%, complaint but not visible 27.26%, no injury 20.91%, and unknown 2.99%), the crash severity was recoded as fatal and disabling vs the rest (5.89% vs 94.11%).

Table 165. Variables Used in the CHAID Analysis for Bicycle Crashes

Variable		Count	%
Crash Severity: KA / BCOU	Fatal (K) & Disabling (A)	116	5.9%
	Other (B, C, O, and U)	1854	94.1%
Crash Time (Day/Night)	Day (6 AM - 8 PM)	1480	75.1%
	Night (8 PM - 6 AM)	490	24.9%
	(blank)	0	0.0%
Crash District	1	383	19.6%
	2	468	24.0%
	3	536	27.4%
	4	235	12.0%
	5	199	10.2%
	6	75	3.8%
	7	58	3.0%
Crash City Quadrant	NE	316	16.4%
	NW	1444	74.9%
	SE	130	6.7%
	SW	38	2.0%
Construction Zone	Yes	54	2.7%
	No	1916	97.3%
Hit & Run	Yes	360	18.3%
	No	1610	81.7%
Road Surface	Asphalt	1774	92.5%
	Other	144	7.5%
Road Type	Straight	1659	85.5%
	Other	282	14.5%
Road Condition	Dry	1730	89.4%
	Other	206	10.6%
Street Lighting	Street Lights On	611	31.9%
	Other	1306	68.1%
Light Condition	Daylight	1298	67.3%
	Other	630	32.7%
Weather	Clear	1709	89.3%
	Other	205	10.7%
Traffic Condition	Heavy	353	18.7%
	Medium	760	40.3%
	Low	569	30.1%
	Other	206	10.9%
Roadway Type/Division	One-Way	299	15.4%
	Two-Way Divided	179	9.2%

Variable		Count	%
	Two-Way Other	1447	74.5%
	Other	16	0.8%
Driver Gender	Female	580	29.4%
	Male	1145	58.1%
	Not Applicable/Available	245	12.4%
Driver Age	21 & under	74	3.8%
	22 - 34	527	26.8%
	35 - 44	386	19.6%
	45 - 54	378	19.2%
	55 - 64	246	12.5%
	65 & over	177	9.0%
	Not Applicable	34	1.7%
	Not Available	148	7.5%
Bicyclist Gender	Female	439	22.3%
	Male	1460	74.1%
	Not Available	71	3.6%
Bicyclist Age	21 & under	272	13.8%
	22 - 34	1000	50.8%
	35 - 44	301	15.3%
	45 - 54	189	9.6%
	55 - 64	105	5.3%
	65 & over	21	1.1%
	Not Available	82	4.2%
Crash Category	Bicycle-Only	34	1.7%
	Vehicle-Bicycle	1936	98.3%
Crash Location	Intersection & Within 100 ft.	1314	66.7%
	Road	630	32.0%
	Other	26	1.3%
Intersection Type	3-leg	246	12.5%
	4-leg	951	48.3%
	Non-Intersection	657	33.4%
	Other	116	5.9%
Traffic Control Type	Signalized	941	47.8%
	Sign-Controlled	225	11.4%
	Uncontrolled	140	7.1%
	Non-Intersection	657	33.4%
	Other	7	0.4%
Fault / Violation	Vehicle Driver/Passenger	1033	52.4%
	Bicyclist	530	26.9%
	Other	407	20.7%
Alcohol	Vehicle Driver/Passenger	9	0.5%
	Bicyclist	20	1.0%
	Other	1941	98.5%
Drug	Vehicle Driver/Passenger	2	0.1%
	Bicyclist	2	0.1%
	Other	1966	99.8%
Distraction	Vehicle Driver/Passenger	56	2.8%
	Bicyclist	45	2.3%

Variable		Count	%
	Other	1869	94.9%
Speeding	Vehicle Driver/Passenger	15	0.8%
	Bicyclist	59	3.0%
	Other	1896	96.2%
Bicyclist Position	Travel Lane	1364	69.2%
	Sidewalk / Crosswalk / Driveway Crossing	308	15.6%
	Bike Lane / Paved Shoulder	226	11.5%
	Other	72	3.7%
	Not Applicable	0	0.0%
Bicyclist Direction	With Traffic	1581	80.3%
	Facing Traffic	161	8.2%
	Other	228	11.6%
	Not Applicable	0	0.0%

The bicycle tree has only four nodes and model selected following two variables to predict crash severity:

- Crash Category
- Construction Zone

The size of bicycle tree was one fourth of pedestrian tree (four vs sixteen nodes and two vs eight selected variables). The nature of bicycle and pedestrian crashes may differ as does the proportions of fatal and disabling crashes were different in bicycle and pedestrian crashes (5.89% vs 9.31%).

The first node was “Crash Category” and the proportion of fatal and disabling crashes (KA) was significantly higher (29.4% vs 5.5%) for bicycle-only vs vehicle-bicycle crashes. Then there was a node under vehicle-bicycle crashes at “Construction Zone” and the proportion of fatal and disabling crashes (KA) was significantly higher (13.2% vs 5.3%) for crashes that happen in construction zones. These two variables call for special educations for bicyclists and considerations for construction zones.

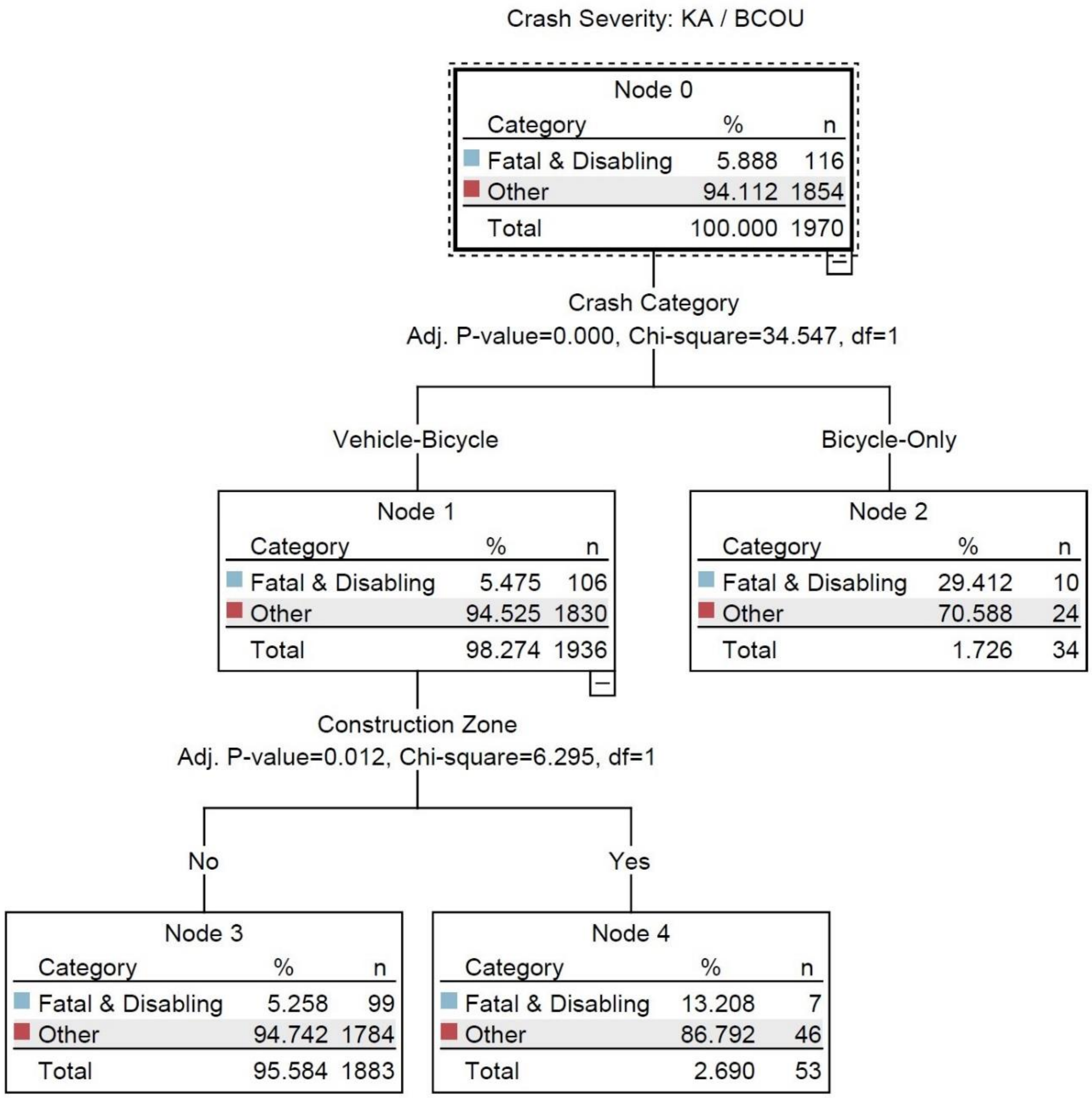


Figure 85. Decision Tree for Pedestrian Crashes

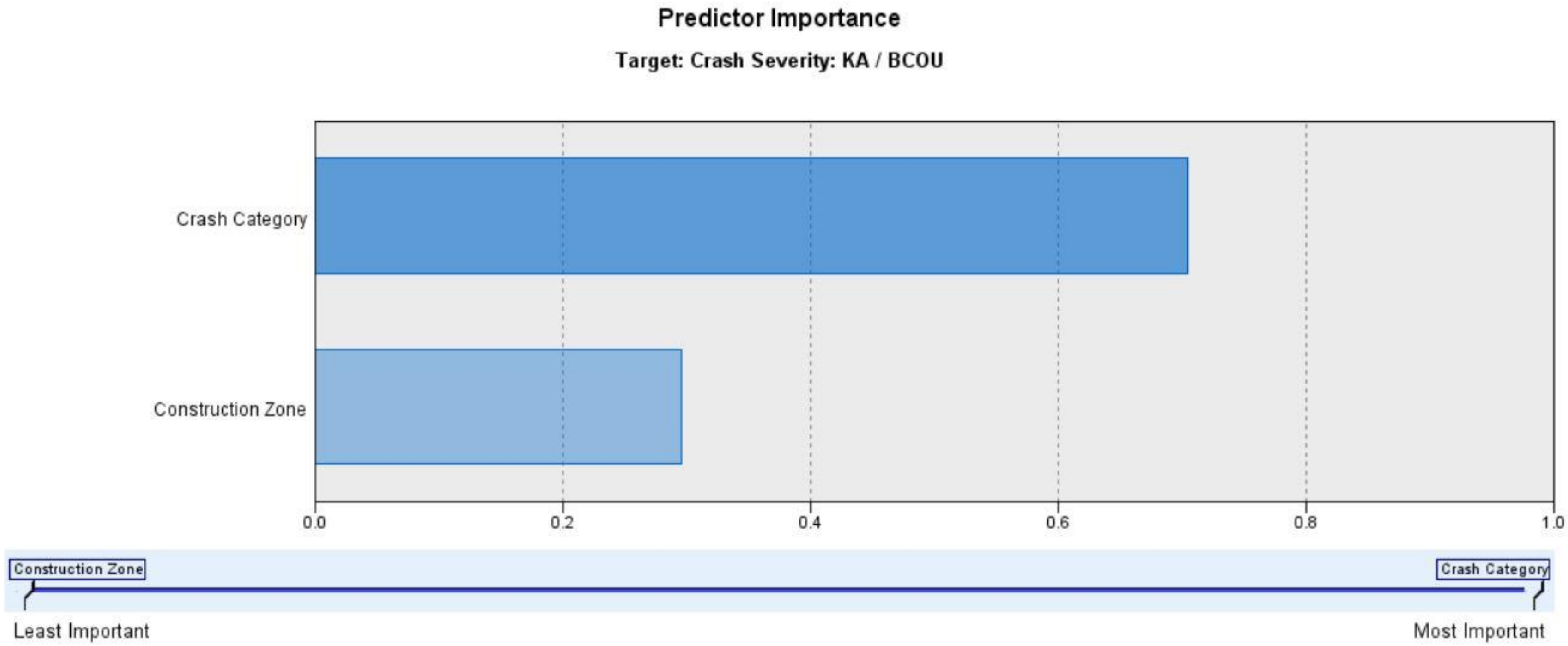


Figure 86. Relative Importance of Variables in the Decision Tree for Pedestrian Crashes

DISCUSSION

Based on the research done in 2002 on pedestrian crashes in Washington, DC (Preusser and JoAnn K. Wells 2002), the main pedestrian crash type was "*Midblock dart–dash*" (37%) in 1976 whereas "*Turning vehicle*" (25%) became the most common crash type in 1998. In this study, "*781 - Motorist Left Turn—Parallel Paths*" accounted for 21.43% of pedestrian crashes as the most common crash type and when all pedestrian crash types involving turning vehicle were combined, resulted in 32.2% of crashes, which is close to 1998 estimates. The same crash type (781) was also the most common crash type in Boulder, CO (18.9%) (GO Boulder 2012) and was the second most common crash type in Arizona (Kimley-Horn and Associates, Inc. 2009) and the fifth most common pedestrian crash type in Wisconsin (Schneider and Stefanich 2015). The main crash type in North Carolina was "*Pedestrian failed to yield*" (14.8%) (Thomas, Levitt and Farley, North Carolina Pedestrian Crash Types 2008 - 2012 2014). The second through fourth pedestrian crash types in this study were "*770 - Motorist Failed to Yield*," "*760 - Pedestrian Failed to Yield*" and "*742 - Dart-Out*," which were exactly the second through fourth crash types in Wisconsin (Schneider and Stefanich 2015).

While in this study the dominant bicycle crash type was "*244 - Bicyclist Overtaking—Extended Door*", it was not among main bicycle crash types in past studies and it calls for further review of these crashes and possibly site-specific analysis of streets with high proportion of this crash type. Besides the case of open door to the traffic, the other common bicycle crash types were "*212 - Motorist Left Turn—Opposite Direction*", "*213 - Motorist Right Turn—Same Direction*", "*155 - Bicyclist Ride Through—Signalized Intersection*", and "*232 - Motorist Overtaking—Misjudged Space*" which were also among the main crash types in Boulder, CO (GO Boulder 2012) and statewide Florida (Alluri, et al. 2017).

In this study vehicle drivers were at fault more than pedestrians (58.1% vs 26.7%) but in Arizona "*Pedestrian failed to yield*" (44%) was the common crash type (Kimley-Horn and Associates, Inc. 2009), which indicated a higher proportion of pedestrians' fault or violation. In Wisconsin, pedestrians were at fault more than this study as well (33% vs 51% of vehicle drivers). In this study vehicle drivers were at fault more than bicyclists (52% vs 27%), but in Wisconsin the proportions were closer (47% vs 38%) (Schneider and Stefanich 2015).

Since the LMCM methodology is relatively new, the results of this study were compared to those examined in Wisconsin (Schneider and Stefanich 2015, Schneider and Stefanich 2016). The top five pedestrian crash types were quite different; the only common type was "*N-RRD-X*" (second in this study and top in the Wisconsin). The remaining four types were all intersection types in this study while they were a mixture of intersections and non-intersections in Wisconsin. Of the bicycle top five crash types, the most common crash type was identical in two studies ("*N-RRD-S*") and other two crash types were common: "*I-NS-ST-L*" (fourth in this study and second in Wisconsin) and "*N-RSH-S*" (fifth in this study and fourth in Wisconsin). The remaining two both were intersection types in this study but in Wisconsin, one of them was non-intersection. One reason could be the high proportion of intersection crashes in this study and another reason might be the fact that in Wisconsin they analyzed a sample of all crashes rather than all crashes; moreover, they did not limit the study to urban area. As the LMCM typology was intended to complement the information captured by NHTSA typology, cross-tabulation of NHTSA and LMCM crash types could add more information about NHTSA crash types.

While there was an emphasis on the LMCM methodology that it captures the location and movement of involved parties better than NHTSA crash types; there are such considerations (nearside or farside and vehicle approach) available in "Pedestrian Location Scenarios" for pedestrian crashes occurred at intersections (Harkey, et al. 2006). Moreover, traffic control seems an important attribute in crash types and associated countermeasures that is not included in the LMCM methodology. Clear linkage to appropriate countermeasures is a practical key that LMCM still needs to acquire.

The majority of identified variables in pedestrian decision tree (traffic control type, time of day, alcohol, speeding/running, light condition, road type, and fault/violation) have been considered as contributing factors in pedestrian crash severity in the literature (Mabunda, Swart and Seedat 2008, Welch, Zhang and Jiao 2017, Mohamadi Hezaveh, AzadDisfany and Cherry 2018). While the bicycle decision tree was limited but still the identified contributing factors were discussed in the literature: crash category (bicycle only vs. vehicle-bicycle) has been an important factor to study bicycle crashes (Schepers and Wolt 2012) and construction zone (Greenfield 2016); however, the proportion of fatalities in construction zone-related crashes was slightly lower than the proportion of fatalities in non-construction zone-related crashes in Florida (Alluri, et al. 2017). Due to relatively small sample size and proportion of fatal and disabling bicycle crashes further investigation is recommended.

The PD-10 form is somewhat outdated and there have been some discussions to update it. "*The Washington Area Bicyclist Association (WABA) argued in a July policy paper that "MPD's PD-10 crash intake form has several deficiencies that make it difficult for police officers to capture accurately the important details of a crash involving a pedestrian or bicyclist.*" Other information that can and should be captured, according to WABA, includes "*the location of a non-motorist with respect to the roadway at the time of the crash," "the action of a bicyclist immediately prior to the crash," and "whether the bicyclist was using lights." Executive Director Greg Billing says they haven't received a formal response from DDOT on the recommendations, which they asked to be included in the two-year action plan* (Hughes 2015)." Following are some recommendations in this regard:

- Addition of values explaining the type of bicycle crashes (e.g., "Backing Hit Bicycle" or "Left Turn Hit Bicycle") for "Type of Crash"
- A new field of "Bicyclist Action" with values similar to those of pedestrians and also "On Bike Lane" or "In Sidewalk" and so on.

Moreover, following are recommendations to police officers for preparing the crash reports:

- Police officers should report the crashes (write the narratives) in a way that clearly implies the positions and directions of all involved parties considering their origin and destination (at crash scene); there have been cases that based on the narratives the movement of pedestrian or bicyclist was not clear especially at intersections.
- Police officers should pay attention to the directions and movements and report them carefully because there were some cases that the narratives did not match the possible movements at crash scenes.
- Police officers should be clear in the narrative about the party who was at fault. The reports sometimes lack the NOI (notice of infraction) or any clear information regarding the violation of either party. However, there were some cases that the reports clearly imply that the decision could not be made due to insufficient or conflicting statements.

- Police officers should use an integrated and consistent way of referring to pedestrian and bicyclists in accidents. There have been some cases that police officers considered a bicyclist as a pedestrian and used one of pedestrian crash types and referred to them as pedestrians in the narrative (P1 or P2 or …) or referred to them as drivers in the narrative (D1, D2, …) or used code 19 to refer to bicycle-involved crashes.

The PBCAT tool and the NHTSA crash typology are also somewhat dated so based on the results of this study and review of three years of pedestrian and bicycle crashes in Washington, DC the following are recommendations in this regards:

- Addition of “Pedestrian Location Scenarios” for bicycle crashes
- Addition of more details for bicycle-only crashes rather than just “Bicycle-Only”
- Addition of crash types for “*Bicycle-Pedestrian*”, “*Bicycle-Bicycle*”, and “*Vehicle-Bicycle&Pedestrian*”: NHTSA PBCAT and LMCM crash typologies both lack types for bicycle-bicycle, bicycle-pedestrian, and vehicle-both pedestrian and bicycle crashes. While these crashes are very few in comparison with main categories, classification and analysis of them will contribute to safer roadways.
- Addition of more NHTSA pedestrian and bicycle crash types such as hit and run.
- Addition of new scenarios to “Pedestrian Location Scenarios” when the vehicle is making backward movement or pedestrian is inside the intersection. The current scenarios only address the cases that pedestrian is either in crosswalk area or crossing the street outside the crosswalk area.

This study had following limitations that may call for future works:

- Unavailable recent data: the usable data for this study was 2012-14; developing and comparing the crash types and groups based on more recent years of data (if data would be available) and also possibly better geocoded data will be a follow-up to this study.
- Lack of crash diagrams: availability of crash diagrams can decrease significantly crash review time and improve the accuracy of identified crash types and groups.
- Normalization of observed and collected data: the proportions presented in this study should be normalized by registered driver's licenses in Washington, DC, Maryland, and Virginia and if data is available with demographics and volume of pedestrians and bicyclists in Washington, DC area. Moreover if data would be available some normalizations should be done on factors such as intersections types (number of legs, roundabout and so on), control types (in this study the normalization of signalized versus non-signalized intersections was done).

CONCLUSION

In this study, 4,569 NHTSA-defined pedestrian- or bicycle-involved crashes (out of original 5,033 crashes) in Washington, DC (2012-14), were classified and analyzed. Moreover, 104 crashes of relatively rare crash cases were examined separately (i.e., bicycle-pedestrian, bicycle-only, bicycle-bicycle, and vehicle-bicycle&pedestrian).

More than 68% of all pedestrian and bicycle crashes happened at intersections or within 100 ft. of an intersection. The proportion of bicycle crashes on roads was significantly higher that pedestrian crashes on roads; 32% vs 24%. While there are about 1,300 signalized intersections in the Washington, DC area versus about 6,300 non-signalized intersections, the normalized rates of pedestrian and bicycle crashes were 1.67 crashes per signalized intersection versus 0.14 crashes per non-signalized intersection.

The season with the highest number of crashes was fall (about 29% of all pedestrian and bicycle crashes). Fall was also the season with the highest number of pedestrian crashes; however, summer was the season with the highest number of bicycle crashes and the difference in proportions was statistically significant. While the number of pedestrian crashes were usually more than bicycle crashes throughout the months of the year, bicycle crashes outnumbered pedestrian crashes in June, July, and August and the differences were significant at 99% confidence level. On the other hand, the proportion of bicycle crashes in January, February, March, November, and December (generally colder months of the year) were significantly lower than pedestrian crashes. More than ten percent of all pedestrian and bicycle crashes occurred at 6-7 PM and the proportion of bicycle crashes (12.4%) was significantly higher than of pedestrian crashes (9.7%).

Pedestrian crash proportions were significantly higher for fatal (1% vs 0.15%), disabling (8.3% vs 5.7%), and complain but not visible crashes (39.7% vs 27.3%); however, bicycle crash proportions were significantly higher for non-disabling (42.9% vs 36.3%) and no injury crashes (20.9% vs 11.4%).

Using the crash costs (Harmon, Bahar and Gross 2018), all 4,569 pedestrian and bicycle crashes resulted in $1,105,468,100 (2016 dollars); $756,583,800 for pedestrian crashes and $348,884,300 for bicycle crashes.

Vehicle drivers involved in crashes with pedestrian and bicyclists were mainly males; however, while pedestrians were almost evenly divided by gender, about three fourth of bicyclists were males. Vehicle drivers were at fault or violation at crash scenes twice higher than pedestrians or bicyclists (55.7% vs 26.9%). Vehicle drivers were at fault twice as pedestrians (58.1% vs 26.9%) but for fatal crashes (26 crashes) pedestrians were at fault more than vehicle drivers (42.3 vs 34.6%), which was also proven to be statistically significant at 99% confidence level. Senior pedestrians (65 & over) had significantly (99% confidence level) higher proportion of fatal and disabling crashes compared to other crash severity level. Left-turn crashes at farside (pedestrian location scenarios: 11b, 11a, and 11c) were the main scenarios accounting for more than 32 percent of pedestrian crashes at intersections followed by straight moving vehicle at nearside crashes (pedestrian location scenarios: 1c, 1 b, and 1a), which accounted for more than 20 percent of intersection crashes. Similarly, vehicle drivers were at fault twice as often as bicyclists (52.4% vs 26.9%). There were only three fatal crashes and in one crash vehicle driver was at fault, in another one the bicyclist was at fault and in the last no fault or violation since it was a bicycle-only crash (bicyclist lost his control while inappropriately carrying a barbecue grill on his bicycle). The proportion of fatal and disabling crashes when bicyclists were at fault was significantly higher than other crash severity levels (34.5% vs 26.4%). The proportions of fatal and disabling bicycle crashes at construction zone were significantly higher but these proportions were not different for the case of hit & run crashes.

The crash classification was based on NHTSA PBCAT crash types/groups and also LMCM typology. The main NHTSA crash types of pedestrian crashes were "*781 - Motorist Left Turn—Parallel Paths*", "*770 - Motorist Failed to Yield*", and "*760 - Pedestrian Failed to Yield*." The main pedestrian LMCM crash types were "*I-NS-ST-X*", "*N-RRD-X*", and "*I-FS-LT-O*." The main NHTSA crash types of bicycle crashes were "*244 - Bicyclist Overtaking—Extended Door*", "*212 - Motorist Left Turn—Opposite Direction*", and "*213 - Motorist Right Turn—Same Direction*." The main bicycle LMCM crash types were "*N-RRD-S*", "*I-NS-ST-S*", and "*I-FS-LT-O*." Top 10 NHTSA crash types are presented in Table 166.

Table 166. Top 10 NHTSA Crash Types in Washington, DC (2012-14)

NHTSA Crash Type		% (2012-14)
Pedestrian Crash Type	781 - Motorist Left Turn—Parallel Paths	21.43%
	770 - Motorist Failed to Yield	12.58%
	760 - Pedestrian Failed to Yield	8.81%
	742 - Dart-Out	5.85%
	791 - Motorist Right Turn—Parallel Paths	4.96%
	690 - Intersection—Other/Unknown	4.81%
	213 - Backing Vehicle—Roadway	4.50%
	741 - Dash	4.04%
	190 - Other Unusual Circumstances	2.89%
	680 - Nonintersection—Other/Unknown	2.39%
	Other NHTSA Pedestrian Crash Types	27.74%
Bicycle Crash Type	244 - Bicyclist Overtaking—Extended Door	11.07%
	212 - Motorist Left Turn—Opposite Direction	9.90%
	213 - Motorist Right Turn—Same Direction	5.74%
	155 - Bicyclist Ride Through—Signalized Intersection	5.23%
	232 - Motorist Overtaking—Misjudged Space	4.52%
	158 - Signalized Intersection—Other/Unknown	3.20%
	211 - Motorist Left Turn—Same Direction	3.10%
	280 - Parallel Paths—Other/Unknown	2.79%
	239 - Motorist Overtaking—Other/ Unknown	2.79%
	231 - Motorist Overtaking—Undetected Bicyclist	2.54%
	Other NHTSA Bicycle Crash Types	49.14%

Notes:

- *The top ten crash types account for 72.3% of all pedestrian crashes in 2012-14.*
- *The top ten crash types account for 50.9% of all bicycle crashes in 2012-14.*

Due to some NHTSA crash groups with very few cases in Washington, DC in three years of study, after careful review of crash groups, alternative crash groupings were proposed. Crossing roadway crashes were the main crash types and groups for pedestrian crashes groups so addition of fault would provide more information and might contribute in better countermeasures and preventions. Multiple cases of either motorist or bicyclist failing to yield crash groups were combined together to make up crash groups with more matching cases. The NHTSA crash type of "*244 - Bicyclist Overtaking—Extended Door*" was separated from the other crash types under crash group of "*240 - Bicyclist Overtaking Motorist*" to distinguish between the case of extended door crashes and other crash types of this group. Due to significantly different crash severity levels, NHTSA crash type of "*400 - Bicycle Only*" was separated from the other crash types under crash group of "*850 - Other/Unusual Circumstances*" to distinguish between the case of individual bicycle crashes (that may need specific considerations and countermeasures) and other crash types of this group. The alternative crash groupings are presented in Table 167.

Table 167. Main NHTSA Crash Groups in Washington, DC (2012-14)

NHTSA Crash Type		% (2012-14)
Pedestrian Crash Group	*Crossing Roadway—Vehicle Left Turn—Motorist Fault*	20.00%
	Crossing Roadway—Vehicle Not Turning—Motorist Fault	12.60%
	Dash/Dart-Out	9.90%
	Crossing Roadway—Vehicle Not Turning—Pedestrian Fault	8.80%
	Unusual Circumstances	8.50%
	Backing Vehicle	7.30%
	Crossing Roadway—Vehicle Right Turn—Motorist Fault	6.40%
	Crossing Roadway—Vehicle Left Turn—Pedestrian Fault	2.00%
	Crossing Roadway—Vehicle Right Turn—Pedestrian Fault	0.60%
	Other	23.90%
Bicycle Crash Group	Motorist Left Turn/Merge	13.00%
	Extended Door	11.10%
	Motorist Overtaking Bicyclist	10.90%
	Bicyclist Failed to Yield	10.40%
	Crossing Paths—Other Circumstances	9.70%
	Motorist Failed to Yield	9.50%
	Motorist Right Turn/Merge	7.80%
	Head-On	2.50%
	Bicycle Only	1.70%
	Other	23.40%

Notes:

- *The **italic** cells indicate proposed crash groups. Please find further information in "*ANALYSIS*" chapter.*
- *The main nine crash groups account for 76.1% of all pedestrian crashes in 2012-14.*
- *The main nine crash groups account for 76.6% of all bicycle crashes in 2012-14.*

Top 5 intersections with highest danger indices (based on combined NHTSA pedestrian and bicycle crashes) were as follows:

1. Intersection @ "BENNING RD NE & BLADENSBURG RD NE"
2. Intersection @ "18TH ST NW & COLUMBIA RD NW"
3. Intersection @ "7TH ST NW & H ST NW"
4. Intersection @ "7TH ST NW & FLORIDA AVE NW"
5. Intersection @ "23RD ST NW & P ST NW"

Top 5 roadway segments with highest danger indices (based on combined NHTSA pedestrian and bicycle crashes) were as follows:

1. Roadway segment @ “3100 14TH ST NW”
2. Roadway segment @ “2400 18TH ST NW”
3. Roadway segment @ “1400 P ST NW”
4. Roadway segment @ “4000 MINNESOTA AVE NE”
5. Roadway segment @ “2300 GEORGIA AVE NW”

The 5-leg signalized intersection at “*BENNING RD NE & BLADENSBURG RD NE*" was a major hot spot for both pedestrian and bicycle crashes. There were some clustered hot spots near Logan Circle on 14th St, P St, and 15th St and two intersections (for bicycle crashes) on Rhode Island Ave NW and R St NW. There were some hot spots on 14th St NW, Georgia Ave NW and nearby area, too. A cluster of hot spots were the six intersections on U St NW and three intersections on 14th St NW (one shared at signalized intersection of “*U ST NW & 14TH ST NW*”). The three intersections of H St NW at North Capitol St, 4th St NW, and 7th St NW were another hot spot area and also the four intersections on K St NW and 19th St NW and some roadway segments near Mount Vernon Square on New York Ave NW.

There were 104 special crash cases (bicycle-pedestrian: 58 crashes, bicycle-bicycle: 9 crashes, vehicle-bicycle&pedestrian: 3 crashes, and bicycle-only: 34 crashes). Majority of bicycle-bicycle crashes were at intersections (78%), bicycle-only crashes were on roads, bicycle-pedestrian crashes were slightly more at intersection in comparison with roads; 41.4% vs 36.2%. In five out of nine (55.6%) bicycle-bicycle crashes, one of bicyclists was at fault, three were unknown, and there was no fault / violation in one crash. There was no fault or violation in 19 out of thirty-four (about 56 percent) bicycle-only crashes. Bicyclists and pedestrians were evenly at fault in bicycle-pedestrian crashes (32.8% each); however, there were sixteen crashes with unknown fault or violation status (27.6%). In 2 out of three vehicle-bicycle&pedestrian crashes, pedestrians or bicyclists were at fault

Decision trees were developed using CHAID method to investigate contributing factors in fatal and severe injury (disabling) crashes. Traffic control type, crash time, alcohol, speeding, light condition, road type, city quadrant, and fault were contributing factors in more severe pedestrian crashes. Bicycle-only crashes and crashes at construction zones were the identified factors attributing in more severe bicycle crashes.

The shortcomings of police crash report forms that were used were also discussed and some recommendations were made to improve the crash reporting procedure. Moreover, some recommendations were made for improving the NHTSA crash typology.

The main contributions of this study were digitizing a relatively large crash reports that besides this study may be used for other studies such as machine learning approach of classification of pedestrian and bicycle crashes. Due to operational issues of PBCAT tool, the research team reorganized NHTSA PBCAT crash types in somewhat fault-based manner, which was helpful to classify crashes and possibly helpful for other studies until an update of the PBCAT. The study team also added some fields to the LMCM crash typology to extend its applicability. The decision trees were also developed and contributing factors in severe crashes were identified. Development and comparison of the crash types and groups based on more recent years of data, are recommended.

Appendix A   List of Acronyms and Abbreviations

Table 168. List of Acronyms and Abbreviations

Acronyms, Abbreviations, and Symbols	Expansion and Explanation
AADT	Annual Average Daily Traffic
AASHTO	American Association of State Highway and Transportation Officials
ADOT	Arizona Department of Transportation
AV	Autonomous Vehicle
BLOS	Bicycle Level of Service
CamRA	Cambridge Road Safety Analysis Tool
CI	Confidence Interval
CL	Confidence Level
CMF	Crash Modification Factor
CV	Connected Vehicle
DDOT	District Department of Transportation
EB	Empirical Bayes
ERSO	European Road Safety Observatory
FHWA	Federal Highway Administration
FI	Fatal and Injury [crashes]
FMCSA	Federal Motor Carrier Safety Administration
GFI	Goodness-of-Fit Index
GIS	Geographic Information System
GLM	Generalized Linear Model
GNM	Generalized Nonlinear Model
GOF	Goodness-of-Fit
GPS	Global Positioning System
HDLI	Highway Loss Data Inistitue
HSM	Highway Safety Manual
HSRC	Highway Safety Research Center
IHSDM	Interactive Highway Safety Design Model
IIHS	Insurance Institute for Highway Safety
ITE	Institute of Transportation Engineers
ITF	International Transport Forum
ITS	Intelligent Transportation Systems
KML	Keyhole Markup Language
LAN	Local Area Network
LCF	Local Calibration Factor
LMCM	Location–Movement Classification Method
LRS	Linear Referencing System
MARS	Multivariate Adaptive Regression Splines
MDOT	Maryland Department of Transportation
MPD	Metropolitan Police Department
MSU	Morgan State University
NCSA	National Center for Statistics and Analysis
NFI	Normed Fit Index
NHTSA	National Highway Traffic Safety Administration

Acronyms, Abbreviations, and Symbols	Expansion and Explanation
NOI	Notice of Infraction
OECD	Organization for Economic Co-operation and Development
PBIC	Pedestrian and Bicycle Information Center
PDO	Property Damage Only [crashes]
PLOS	Pedestrian Level of Service
SHA	Maryland State Highway Administration
SPF	Safety Performance Function
TARAS	Traffic Accident Reporting and Analysis System
TRB	Transportation Research Board
TWLTL	Two-Way Left-Turn Lane
UMTRI	University of Michigan Transportation Research Institute
V2I	Vehicle-to-Infrastructure
V2V	Vehicle-to-Vehicle
V2X	Vehicle-to-Anything
VRU	Vulnerable Road User
WABA	Washington Area Bicyclist Association
WHO	World Health Organization
XML	Extensible Markup Language

Appendix B PBCAT Crash Types/Groups

Pedestrian Crash Types/Groups

Table 169. Pedestrian Crash Types/Groups

#	Crash Type Code	Crash Type	Crash Group Code	Crash Group
1	110	Assault with Vehicle	100	Unusual Circumstances
2	120	Dispute-Related	100	Unusual Circumstances
3	130	Pedestrian on Vehicle	100	Unusual Circumstances
4	140	Vehicle-Vehicle/Object	100	Unusual Circumstances
5	150	Motor Vehicle Loss of Control	100	Unusual Circumstances
6	160	Pedestrian Loss of Control	100	Unusual Circumstances
7	190	Other Unusual Circumstances	100	Unusual Circumstances
8	211	Backing Vehicle—Driveway	200	Backing Vehicle
9	212	Backing Vehicle—Driveway/Sidewalk Intersection	200	Backing Vehicle
10	213	Backing Vehicle—Roadway	200	Backing Vehicle
11	214	Backing Vehicle—Parking Lot	200	Backing Vehicle
12	219	Backing Vehicle—Other/Unknown	200	Backing Vehicle
13	220	Driverless Vehicle	100	Unusual Circumstances
14	230	Disabled Vehicle-Related	100	Unusual Circumstances
15	240	Emergency Vehicle-Related	100	Unusual Circumstances
16	250	Play Vehicle-Related	100	Unusual Circumstances
17	311	Working in Roadway	310	Working or Playing in Roadway
18	312	Playing in Roadway	310	Working or Playing in Roadway
19	313	Lying in Roadway	600	Pedestrian in Roadway—Circumstances Unknown
20	320	Entering/Exiting Parked Vehicle	350	Unique Midblock
21	330	Mailbox-Related	350	Unique Midblock
22	341	Commercial Bus-Related	340	Bus-Related
23	342	School Bus-Related	340	Bus-Related
24	360	Ice Cream/Vendor Truck-Related	350	Unique Midblock
25	410	Walking Along Roadway With Traffic—From Behind	400	Walking Along Roadway
26	420	Walking Along Roadway With Traffic—From Front	400	Walking Along Roadway
27	430	Walking Along Roadway Against Traffic—From Behind	400	Walking Along Roadway
28	440	Walking Along Roadway Against Traffic—From Front	400	Walking Along Roadway
29	459	Walking Along Roadway—Direction/Position Unknown	400	Walking Along Roadway
30	460	Motorist Entering Driveway or Alley	460	Crossing Driveway or Alley
31	465	Motorist Exiting Driveway or Alley	460	Crossing Driveway or Alley
32	469	Driveway Crossing—Other/Unknown	460	Crossing Driveway or Alley
33	510	Waiting to Cross—Vehicle	500	Waiting to Cross

#	Crash Type Code	Crash Type	Crash Group Code	Crash Group
		Turning		
34	520	Waiting to Cross—Vehicle Not Turning	500	Waiting to Cross
35	590	Waiting to Cross—Vehicle Action Unknown	500	Waiting to Cross
36	610	Standing in Roadway	600	Pedestrian in Roadway—Circumstances Unknown
37	620	Walking in Roadway	600	Pedestrian in Roadway—Circumstances Unknown
38	680	Non-intersection—Other/Unknown	990	Other/Unknown—Insufficient Details
39	690	Intersection—Other/Unknown	990	Other/Unknown—Insufficient Details
40	710	Multiple Threat	720	Multiple Threat/Trapped
41	730	Trapped	720	Multiple Threat/Trapped
42	741	Dash	740	Dash/Dart-Out
43	742	Dart-Out	740	Dash/Dart-Out
44	760	Pedestrian Failed to Yield	750	Crossing Roadway—Vehicle Not Turning
45	770	Motorist Failed to Yield	750	Crossing Roadway—Vehicle Not Turning
46	781	Motorist Left Turn—Parallel Paths	790	Crossing Roadway—Vehicle Turning
47	782	Motorist Left Turn—Perpendicular Paths	790	Crossing Roadway—Vehicle Turning
48	791	Motorist Right Turn—Parallel Paths	790	Crossing Roadway—Vehicle Turning
49	792	Motorist Right Turn on Red—Parallel Paths	790	Crossing Roadway—Vehicle Turning
50	794	Motorist Right Turn on Red—Perpendicular Paths	790	Crossing Roadway—Vehicle Turning
51	795	Motorist Right Turn—Perpendicular Paths	790	Crossing Roadway—Vehicle Turning
52	799	Motorist Turn/Merge—Other/Unknown	790	Crossing Roadway—Vehicle Turning
53	830	Off Roadway—Parking Lot	800	Off Roadway
54	890	Off Roadway—Other/Unknown	800	Off Roadway
55	900	Other—Unknown Location	990	Other/Unknown—Insufficient Details
56	910	Crossing an Expressway	990	Other/Unknown—Insufficient Details

Bicycle Crash Types/Groups

Table 170. Bicycle Crash Types/Groups

#	Crash Type Code	Crash Type	Crash Group Code	Crash Group
1	111	Motorist Turning Error—Left Turn	110	Loss of Control/Turning Error
2	112	Motorist Turning Error—Right Turn	110	Loss of Control/Turning Error
3	113	Motorist Turning Error—Other	110	Loss of Control/Turning Error
4	114	Bicyclist Turning Error—Left Turn	110	Loss of Control/Turning Error
5	115	Bicyclist Turning Error—Right Turn	110	Loss of Control/Turning Error
6	116	Bicyclist Turning Error—Other	110	Loss of Control/Turning Error
7	121	Bicyclist Lost Control—Mechanical problems	110	Loss of Control/Turning Error
8	122	Bicyclist Lost Control—Oversteering, Improper Braking, Speed	110	Loss of Control/Turning Error
9	123	Bicyclist Lost Control—Alcohol/Drug Impairment	110	Loss of Control/Turning Error
10	124	Bicyclist Lost Control—Surface Conditions	110	Loss of Control/Turning Error
11	129	Bicyclist Lost Control—Other/Unknown	110	Loss of Control/Turning Error
12	131	Motorist Lost Control—Mechanical problems	110	Loss of Control/Turning Error
13	132	Motorist Lost Control—Oversteering, Improper Braking, Speed	110	Loss of Control/Turning Error
14	133	Motorist Lost Control—Alcohol/Drug Impairment	110	Loss of Control/Turning Error
15	134	Motorist Lost Control—Surface Conditions	110	Loss of Control/Turning Error
16	139	Motorist Lost Control—Other/Unknown	110	Loss of Control/Turning Error
17	141	Motorist Drive-out—Sign-Controlled Intersection	140	Motorist Failed to Yield—Sign-Controlled Intersection
18	142	Bicyclist Ride-out—Sign-Controlled Intersection	145	Bicyclist Failed to Yield—Sign-Controlled Intersection
19	143	Motorist Drive-through—Sign-Controlled Intersection	140	Motorist Failed to Yield—Sign-Controlled Intersection
20	144	Bicyclist Ride Through—Sign-Controlled Intersection	145	Bicyclist Failed to Yield—Sign-Controlled Intersection
21	147	Multiple Threat—Sign-Controlled Intersection	145	Bicyclist Failed to Yield—Sign-Controlled Intersection
22	148	Sign-Controlled Intersection—Other/Unknown	190	Crossing Paths—Other Circumstances
23	151	Motorist Drive-out—Right Turn	150	Motorist Failed to Yield—

#	Crash Type Code	Crash Type	Crash Group Code	Crash Group
		on Red		Signalized Intersection
24	152	Motorist Drive-out—Signalized Intersection	150	Motorist Failed to Yield—Signalized Intersection
25	153	Bicyclist Ride-out—Signalized Intersection	158	Bicyclist Failed to Yield—Signalized Intersection
26	154	Motorist Drive-through—Signalized Intersection	150	Motorist Failed to Yield—Signalized Intersection
27	155	Bicyclist Ride Through—Signalized Intersection	158	Bicyclist Failed to Yield—Signalized Intersection
28	156	Bicyclist Failed to Clear—Trapped	158	Bicyclist Failed to Yield—Signalized Intersection
29	157	Bicyclist Failed to Clear—Multiple Threat	158	Bicyclist Failed to Yield—Signalized Intersection
30	158	Signalized Intersection—Other/Unknown	190	Crossing Paths—Other Circumstances
31	159	Bicyclist Failed to Clear—Unknown	158	Bicyclist Failed to Yield—Signalized Intersection
32	160	Crossing Paths—Uncontrolled Intersection	190	Crossing Paths—Other Circumstances
33	180	Crossing Paths—Intersection—Other/Unknown Control	190	Crossing Paths—Other Circumstances
34	211	Motorist Left Turn—Same Direction	210	Motorist Left Turn/Merge
35	212	Motorist Left Turn—Opposite Direction	210	Motorist Left Turn/Merge
36	213	Motorist Right Turn—Same Direction	215	Motorist Right Turn/Merge
37	214	Motorist Right Turn—Opposite Direction	215	Motorist Right Turn/Merge
38	215	Motorist Drive-In/Out Parking	219	Parking/Bus-Related
39	216	Bus/Delivery Vehicle Pullover	219	Parking/Bus-Related
40	217	Motorist Right Turn on Red—Same Direction	215	Motorist Right Turn/Merge
41	218	Motorist Right Turn on Red—Opposite Direction	215	Motorist Right Turn/Merge
42	219	Motorist Turn/Merge—Other/Unknown	290	Parallel Paths—Other Circumstances
43	221	Bicyclist Left Turn—Same Direction	220	Bicyclist Left Turn/Merge
44	222	Bicyclist Left Turn—Opposite Direction	220	Bicyclist Left Turn/Merge
45	223	Bicyclist Right Turn—Same Direction	225	Bicyclist Right Turn/Merge
46	224	Bicyclist Right Turn—Opposite Direction	225	Bicyclist Right Turn/Merge
47	225	Bicyclist Ride-out—Parallel Path	290	Parallel Paths—Other Circumstances
48	231	Motorist Overtaking—	230	Motorist Overtaking Bicyclist

#	Crash Type Code	Crash Type	Crash Group Code	Crash Group
		Undetected Bicyclist		
49	232	Motorist Overtaking—Misjudged Space	230	Motorist Overtaking Bicyclist
50	235	Motorist Overtaking—Bicyclist Swerved	230	Motorist Overtaking Bicyclist
51	239	Motorist Overtaking—Other/ Unknown	230	Motorist Overtaking Bicyclist
52	241	Bicyclist Overtaking—Passing on Right	240	Bicyclist Overtaking Motorist
53	242	Bicyclist Overtaking—Passing on Left	240	Bicyclist Overtaking Motorist
54	243	Bicyclist Overtaking—Parked Vehicle	240	Bicyclist Overtaking Motorist
55	244	Bicyclist Overtaking—Extended Door	240	Bicyclist Overtaking Motorist
56	249	Bicyclist Overtaking—Other/Unknown	240	Bicyclist Overtaking Motorist
57	250	Head-On—Bicyclist	258	Head-On
58	255	Head-On—Motorist	258	Head-On
59	259	Head-On—Unknown	258	Head-On
60	280	Parallel Paths—Other/Unknown	290	Parallel Paths—Other Circumstances
61	311	Bicyclist Ride-out—Residential Driveway	310	Bicyclist Failed to Yield—Midblock
62	312	Bicyclist Ride-out—Commercial Driveway/Alley	310	Bicyclist Failed to Yield—Midblock
63	318	Bicyclist Ride-out—Other Midblock	310	Bicyclist Failed to Yield—Midblock
64	319	Bicyclist Ride-out—Midblock—Unknown	310	Bicyclist Failed to Yield—Midblock
65	321	Motorist Drive-out—Residential Driveway	320	Motorist Failed to Yield—Midblock
66	322	Motorist Drive-out—Commercial Driveway/Alley	320	Motorist Failed to Yield—Midblock
67	328	Motorist Drive-out—Other Midblock	320	Motorist Failed to Yield—Midblock
68	329	Motorist Drive-out—Midblock—Unknown	320	Motorist Failed to Yield—Midblock
69	357	Multiple Threat— Midblock	310	Bicyclist Failed to Yield—Midblock
70	380	Crossing Paths—Midblock—Other/Unknown	190	Crossing Paths—Other Circumstances
71	400	Bicycle Only	850	Other/Unusual Circumstances
72	510	Motorist Intentionally Caused	850	Other/Unusual Circumstances
73	520	Bicyclist Intentionally Caused	850	Other/Unusual Circumstances
74	600	Backing Vehicle	600	Backing Vehicle
75	700	Play Vehicle-Related	850	Other/Unusual Circumstances
76	800	Unusual Circumstances	850	Other/Unusual Circumstances

#	Crash Type Code	Crash Type	Crash Group Code	Crash Group
77	910	Non-roadway	910	Non-roadway
78	970	Unknown Approach Paths	990	Other/Unknown—Insufficient Details
79	980	Unknown Location	990	Other/Unknown—Insufficient Details

Appendix C PBCAT Crash Type Images

All images were downloaded from following webpages of Federal Highway Administration (FHWA):

- Pedestrian Crashes: http://www.pedbikeinfo.org/pbcat_us/ped_images.cfm
- Bicycle Crashes: http://www.pedbikeinfo.org/pbcat_us/bike_images.cfm

Pedestrian Crash Group 100 - Unusual Circumstances

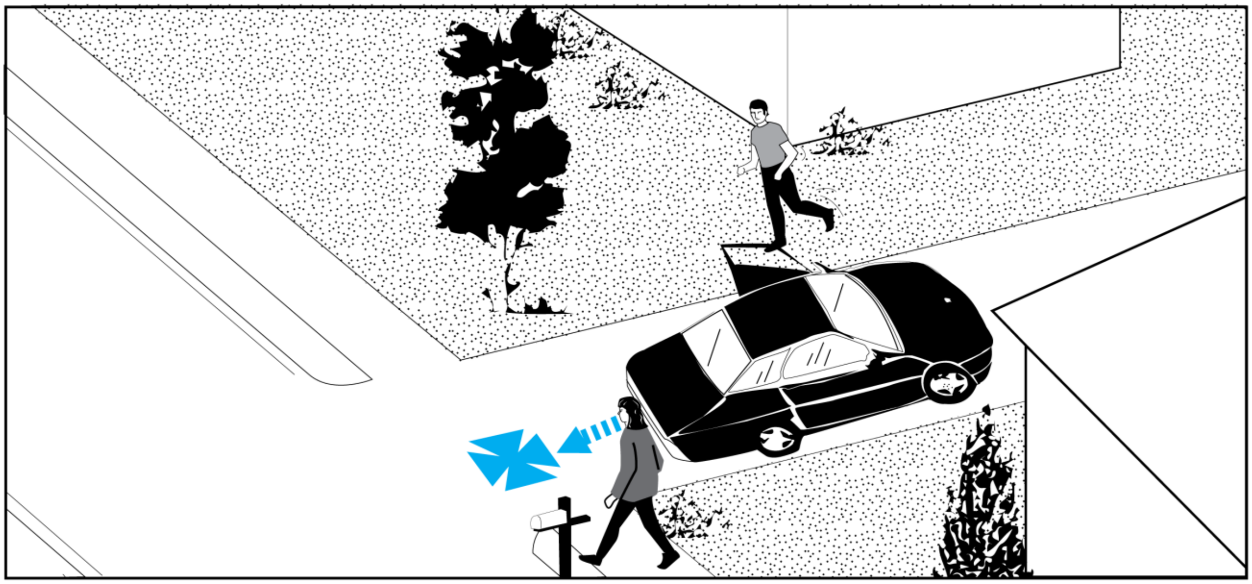


Figure 87. Pedestrian Crash Type 220 - Driverless Vehicle

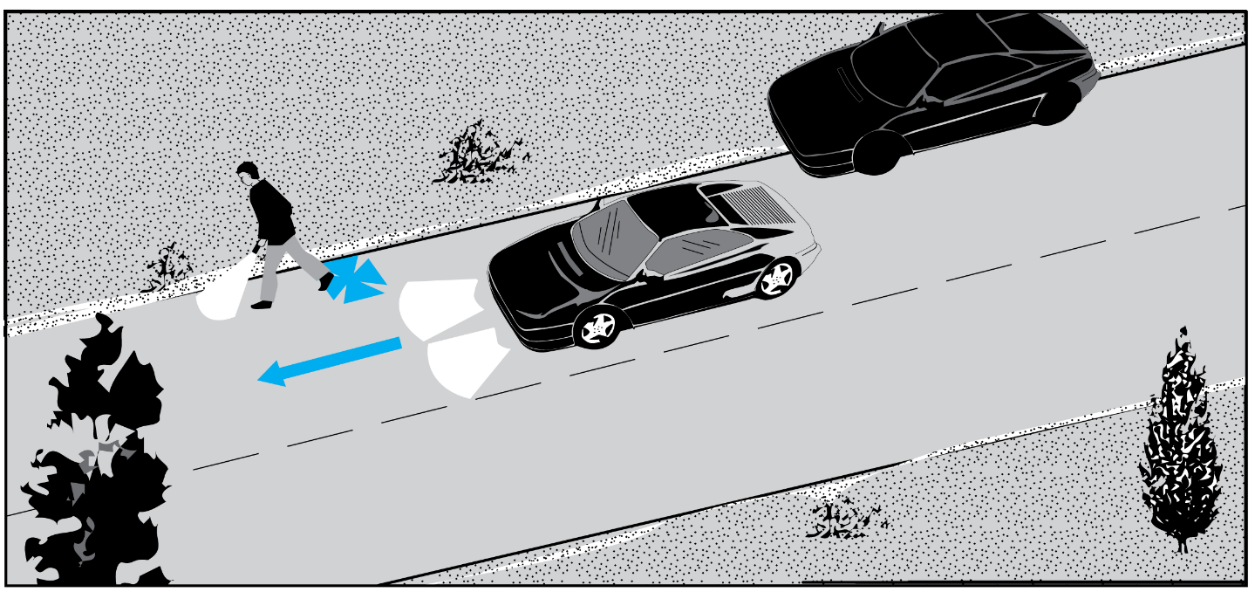


Figure 88. Pedestrian Crash Type 230 - Disabled Vehicle-Related

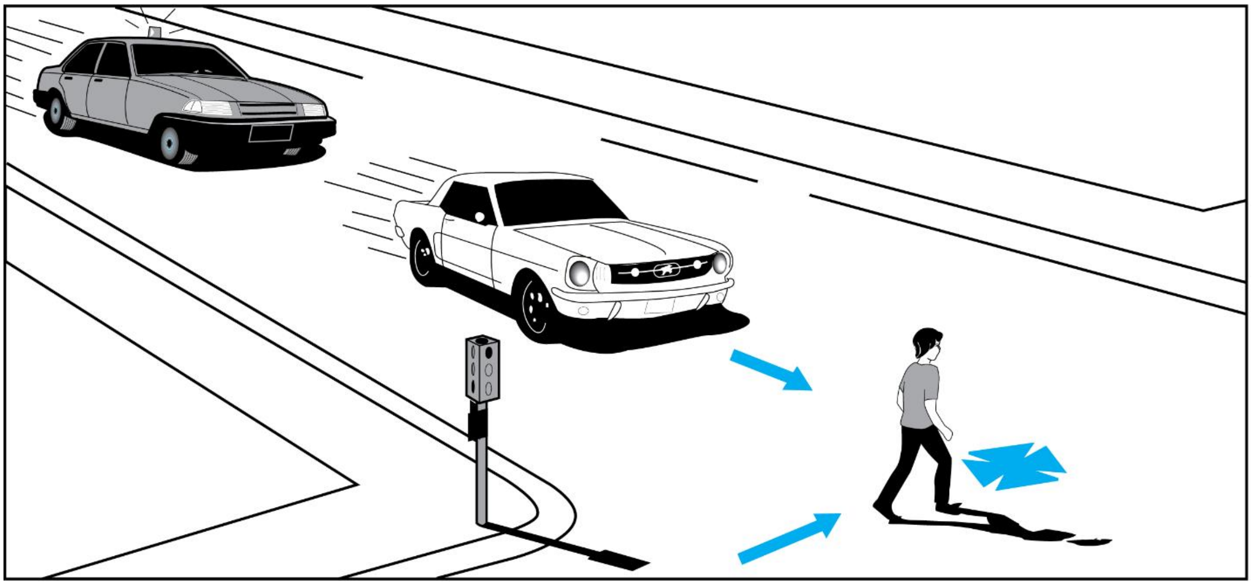


Figure 89. Pedestrian Crash Type 240 - Emergency Vehicle-Related

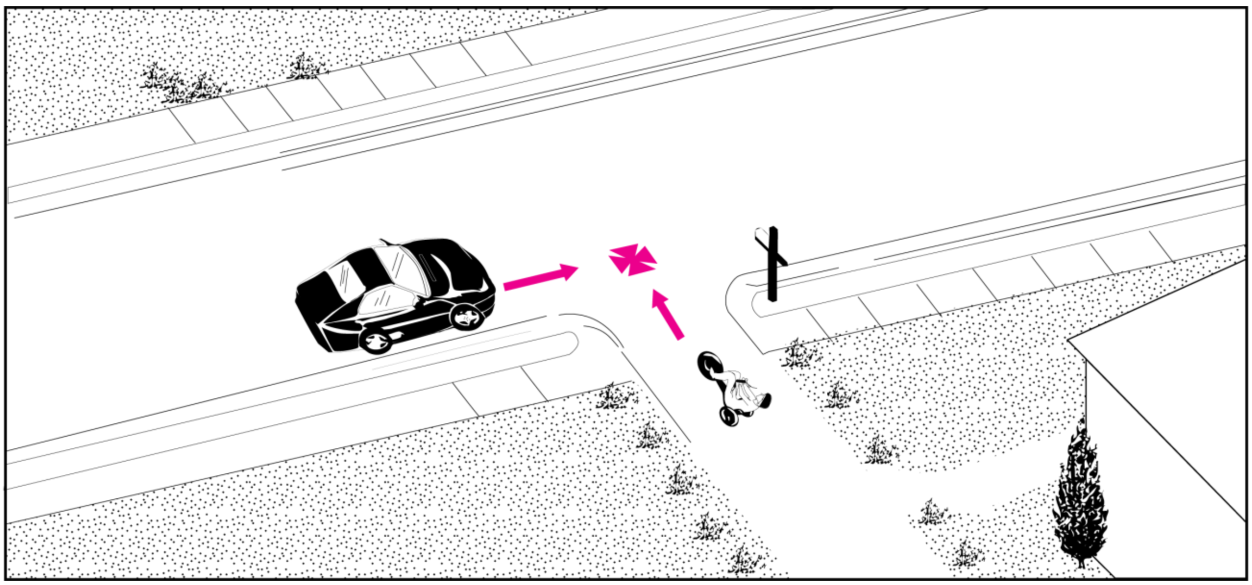


Figure 90. Pedestrian Crash Type 250 - Play Vehicle-Related

Pedestrian Crash Group 200 - Backing Vehicle

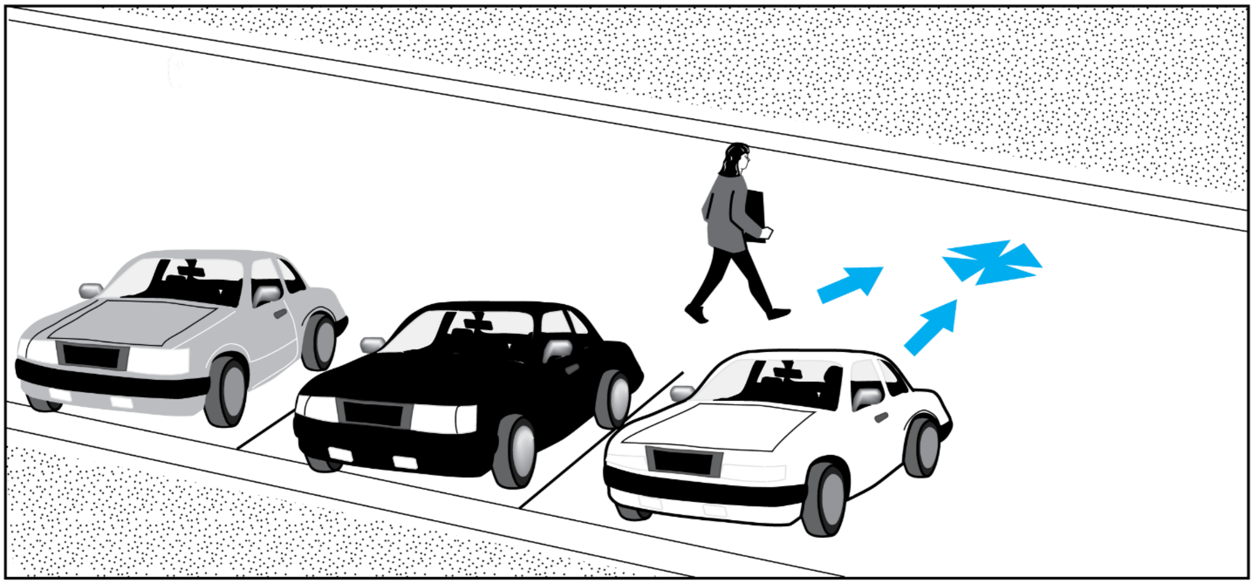


Figure 91. Pedestrian Crash Type 214 - Backing Vehicle - Parking Lot

Pedestrian Crash Group 310 - Working or Playing in Roadway

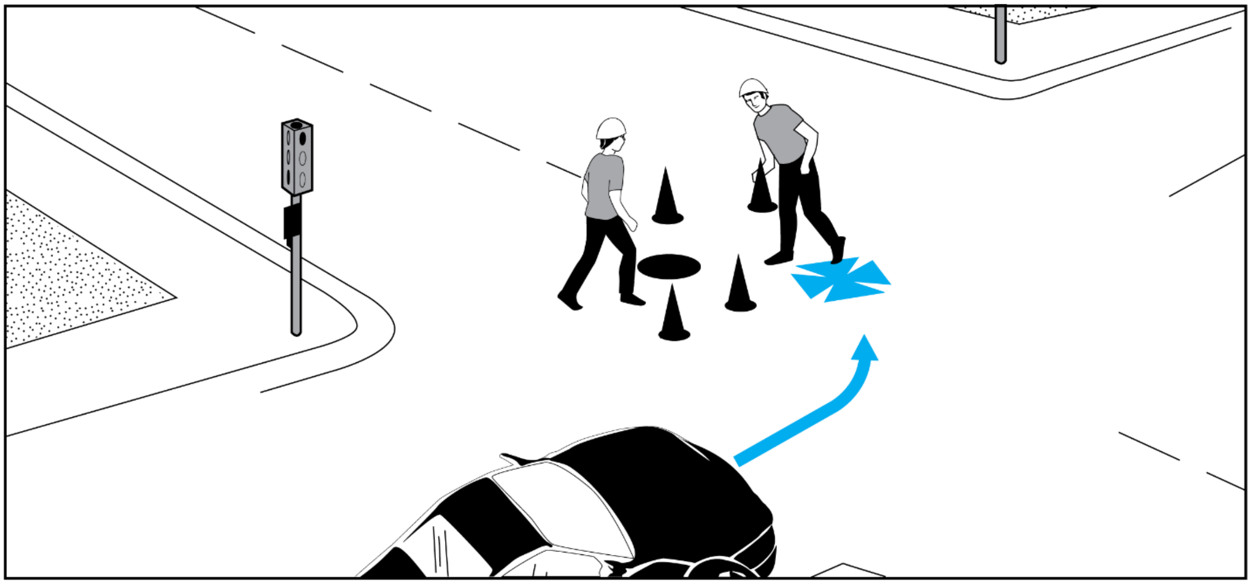


Figure 92. Pedestrian Crash Type 311 - Working in Roadway

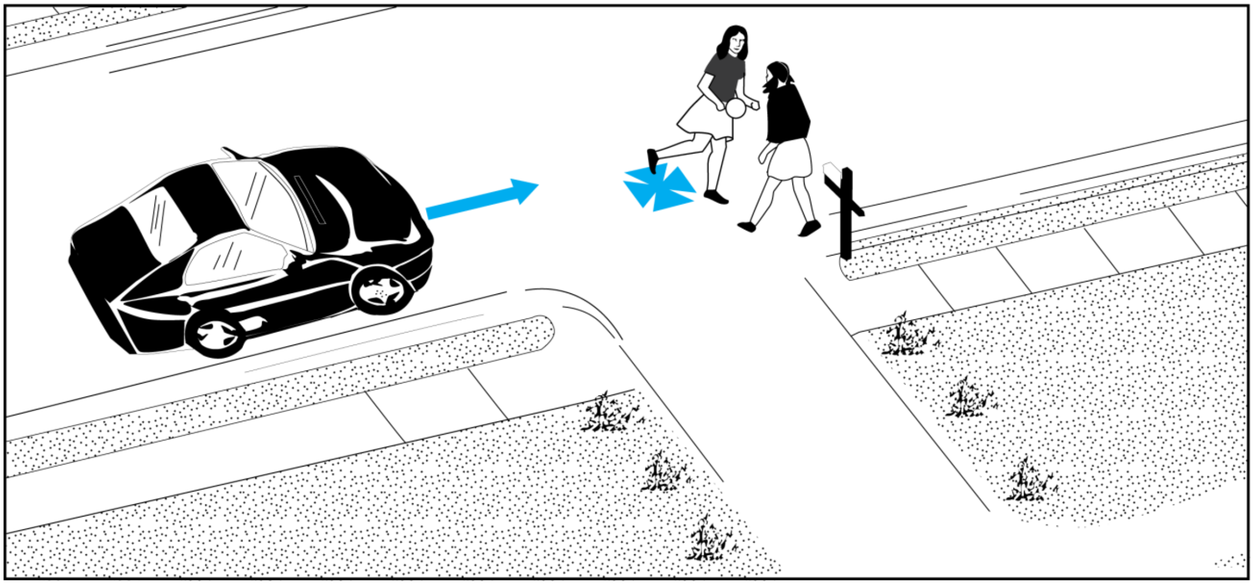


Figure 93. Pedestrian Crash Type 312 - Playing in Roadway

Pedestrian Crash Group 340 - Bus Related

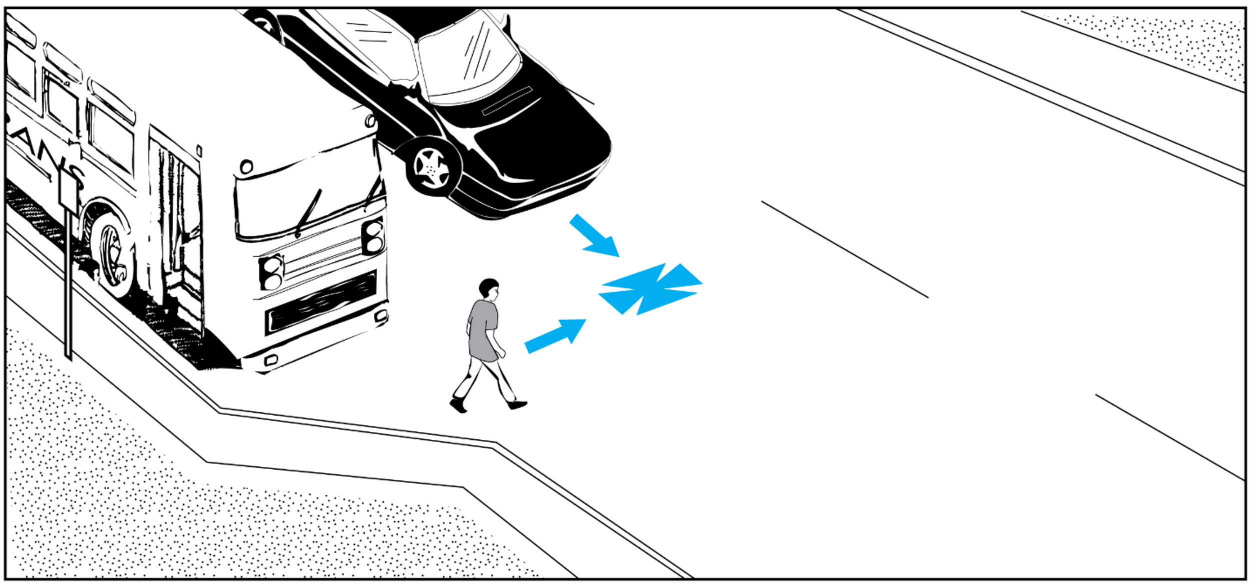


Figure 94. Pedestrian Crash Type 341 - Commercial Bus-Related

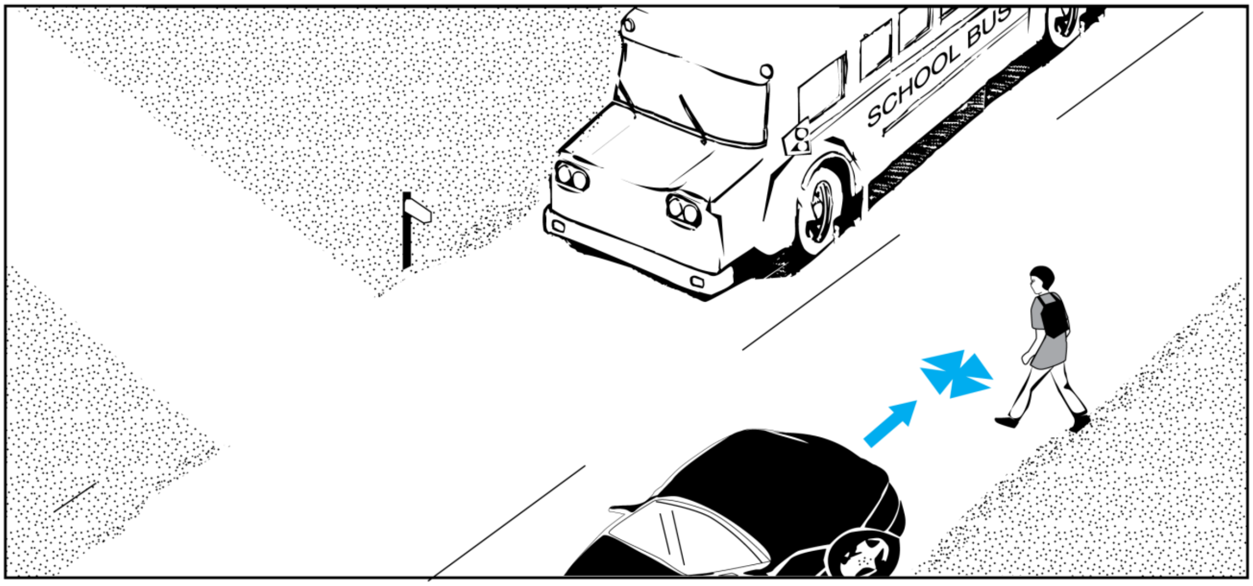


Figure 95. Pedestrian Crash Type 342 - School Bus-Related

Pedestrian Crash Group 350 - Unique Midblock

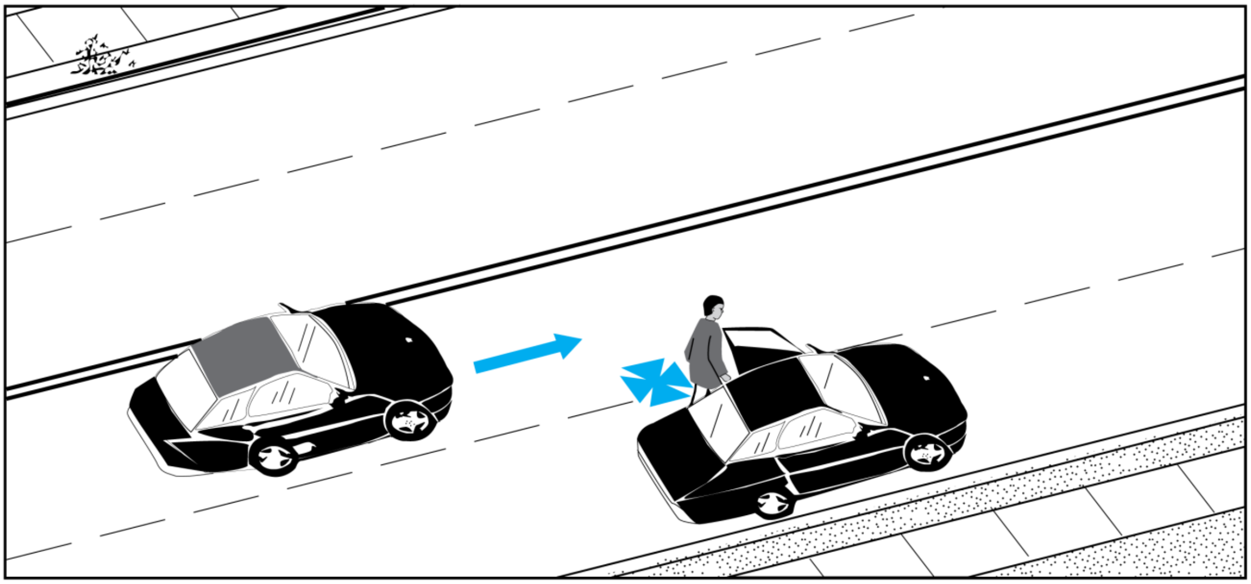


Figure 96. Pedestrian Crash Type 320 - Entering / Exiting Parked Vehicle

Figure 97. Pedestrian Crash Type 330 - Mailbox-Related

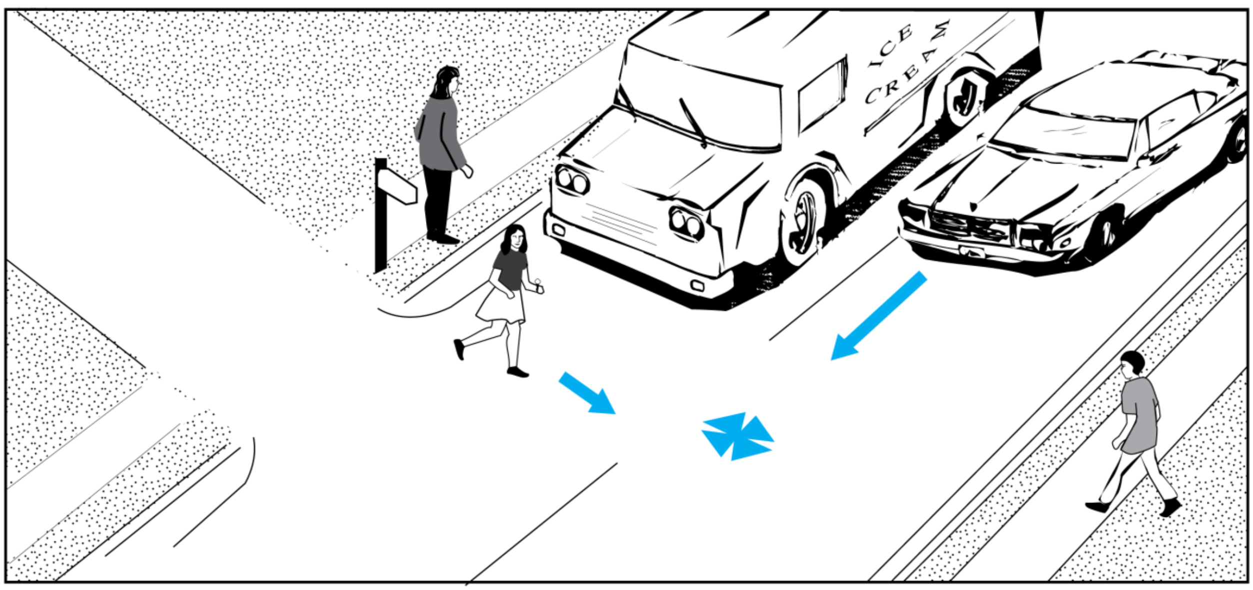


Figure 98. Pedestrian Crash Type 360 - Ice Cream / Vendor Truck-Related

Pedestrian Crash Group 400 - Walking Along Roadway

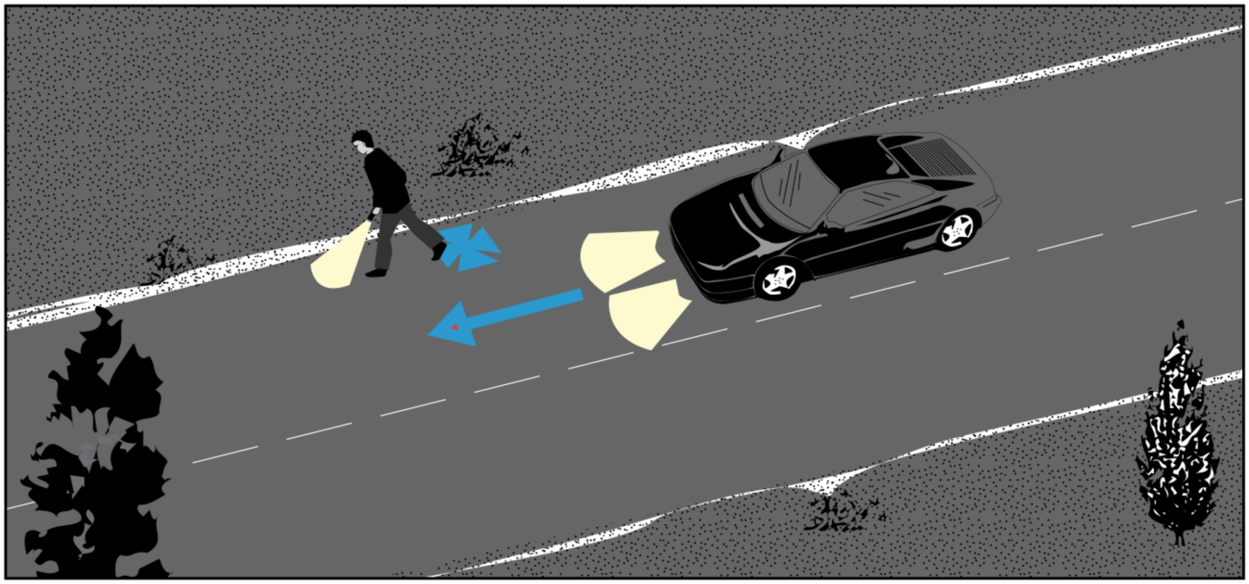


Figure 99. Pedestrian Crash Type 410 - Walking Along Roadway with Traffic - From Behind

Pedestrian Crash Group 460 - Crossing Driveway or Alley

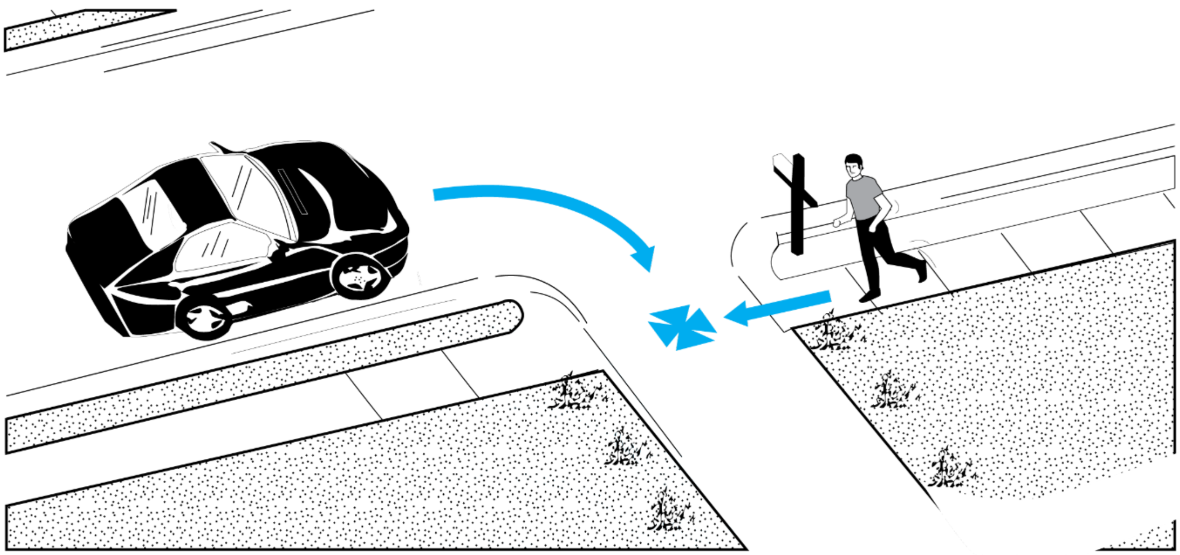


Figure 100. Pedestrian Crash Type 460 - Motorist Entering Driveway or Alley

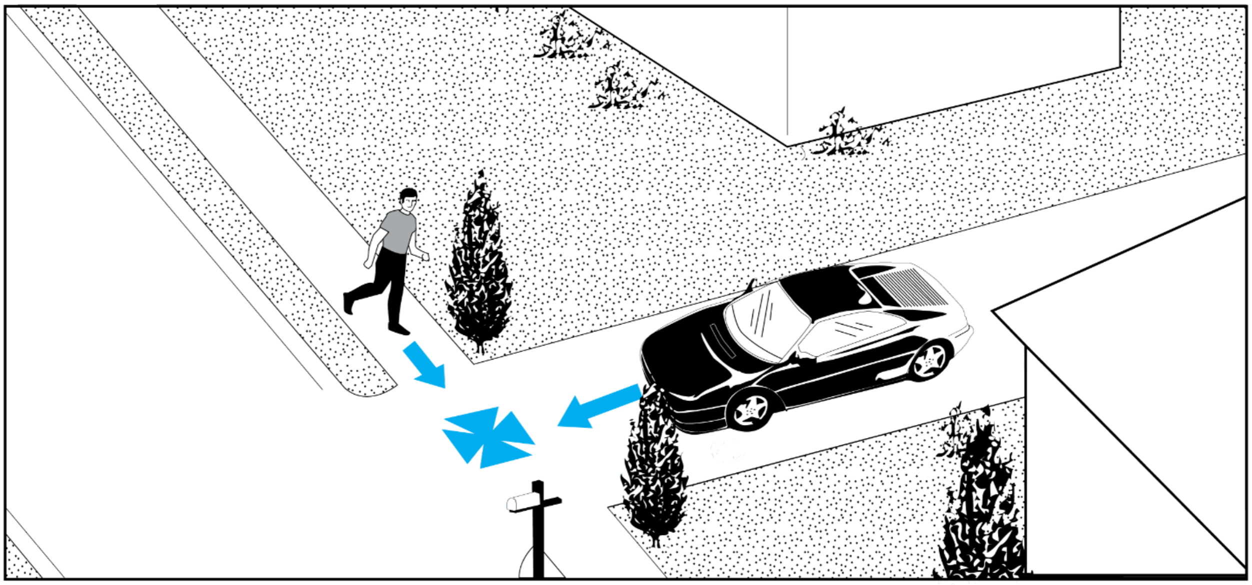


Figure 101. Pedestrian Crash Type 465 - Motorist Exiting Driveway or Alley

Pedestrian Crash Group 500 - Waiting to Cross

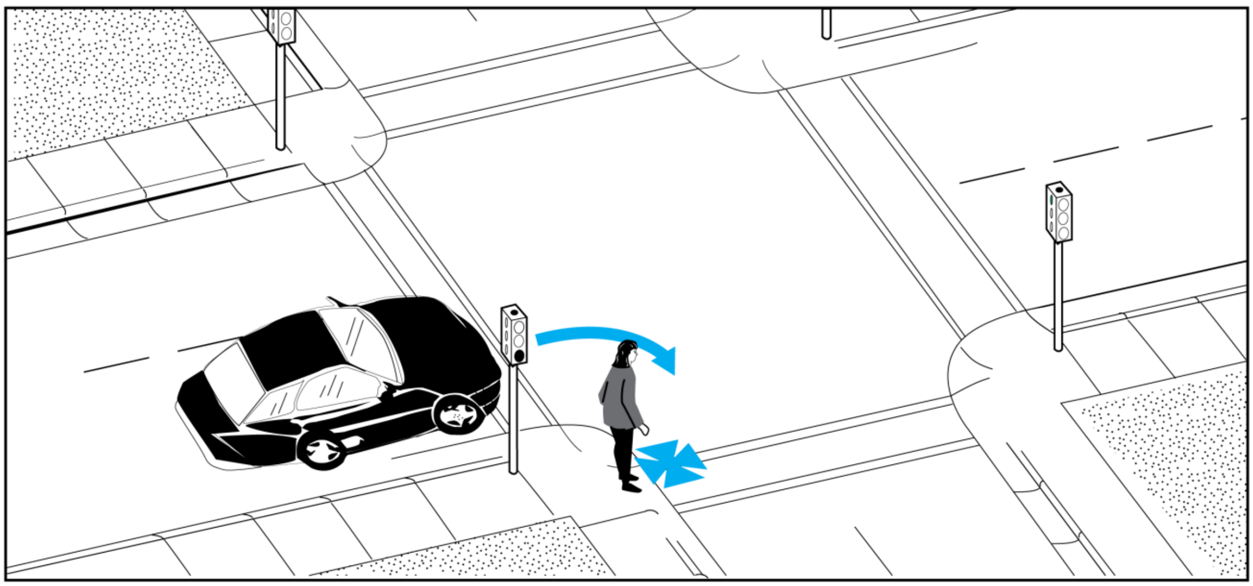


Figure 102. Pedestrian Crash Type 510 - Waiting to Cross - Vehicle Turning

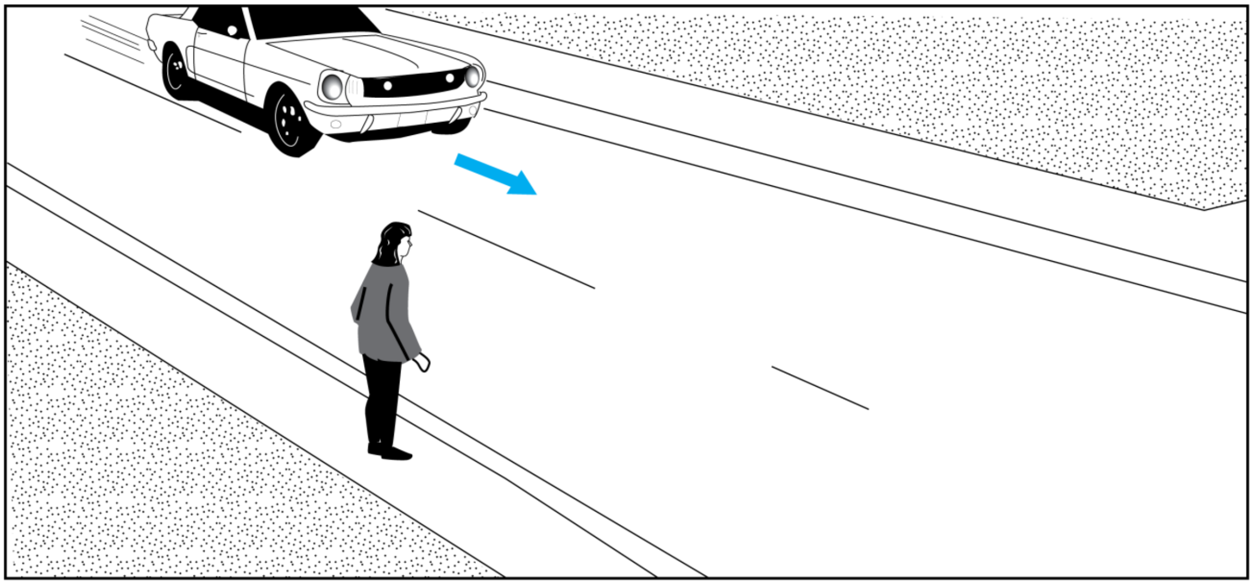


Figure 103. Pedestrian Crash Type 520 - Waiting to Cross - Vehicle Not Turning

Pedestrian Crash Group 600 - Pedestrian in Roadway - Circumstances Unknown

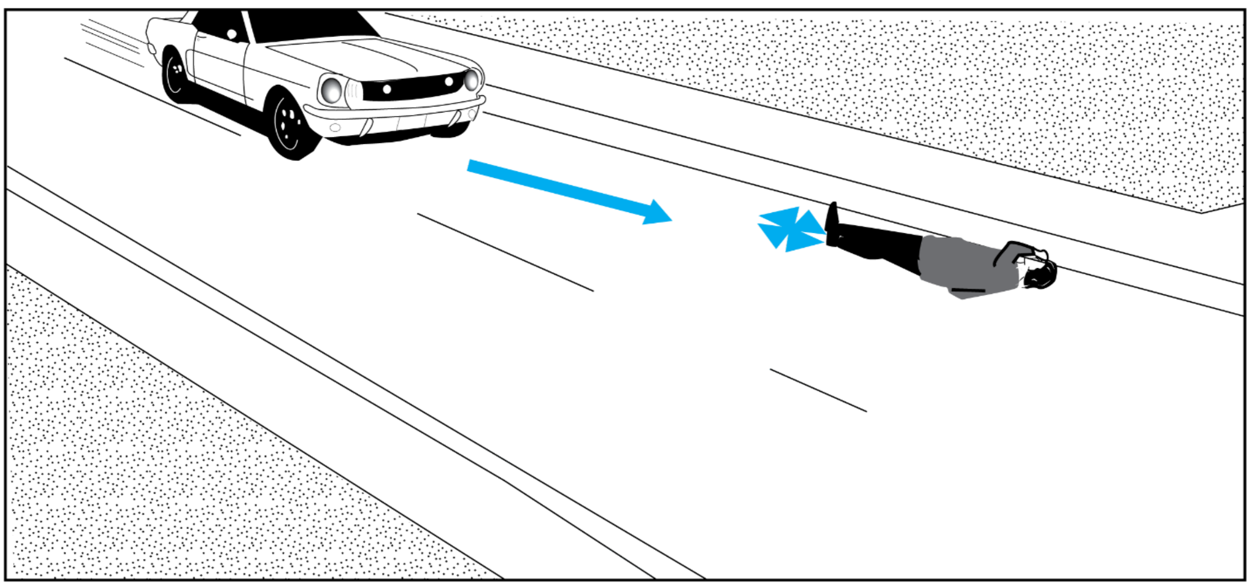


Figure 104. Pedestrian Crash Type 313 - Lying in Roadway

Pedestrian Crash Group 720 - Multiple Threat / Trapped

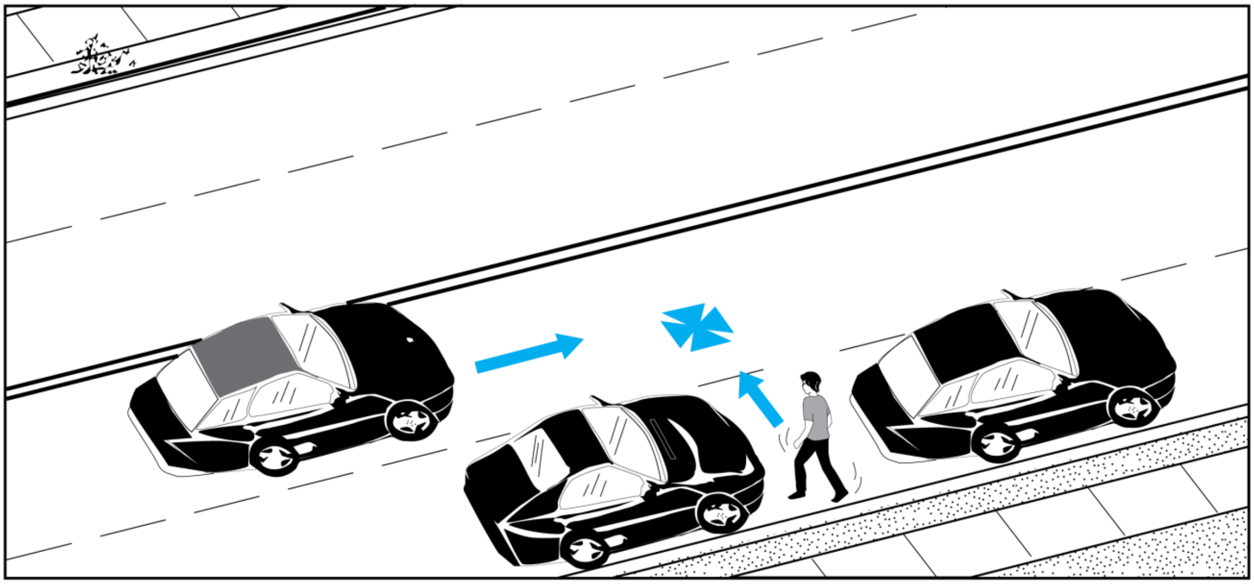


Figure 105. Pedestrian Crash Type 710 - Multiple Threat

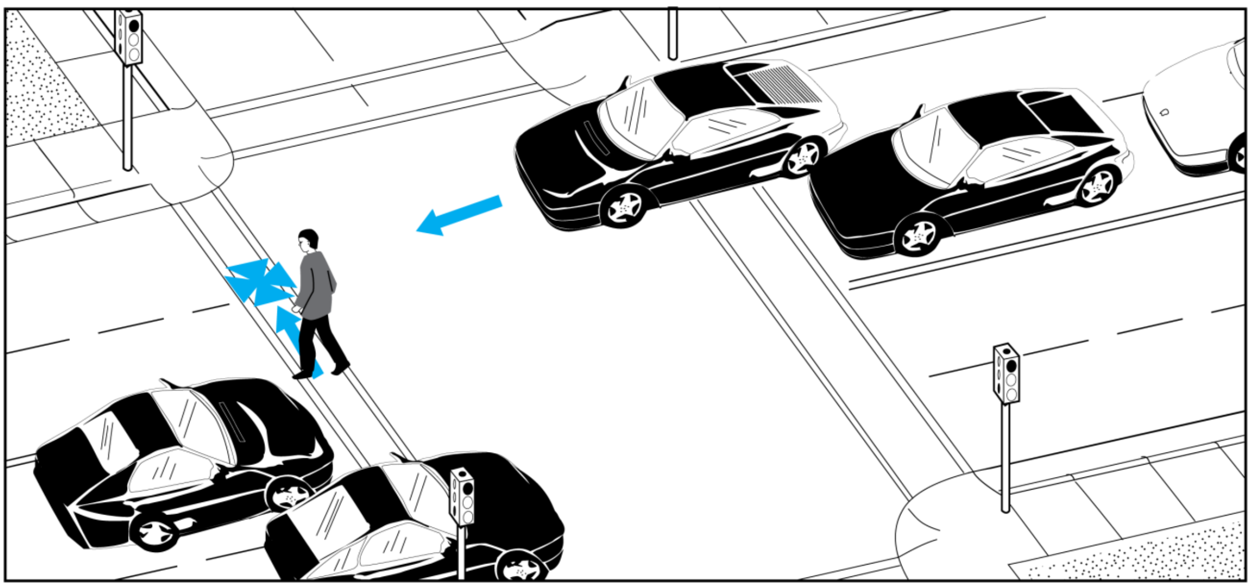


Figure 106. Pedestrian Crash Type 730 - Trapped

Pedestrian Crash Group 740 - Dash / Dart-Out

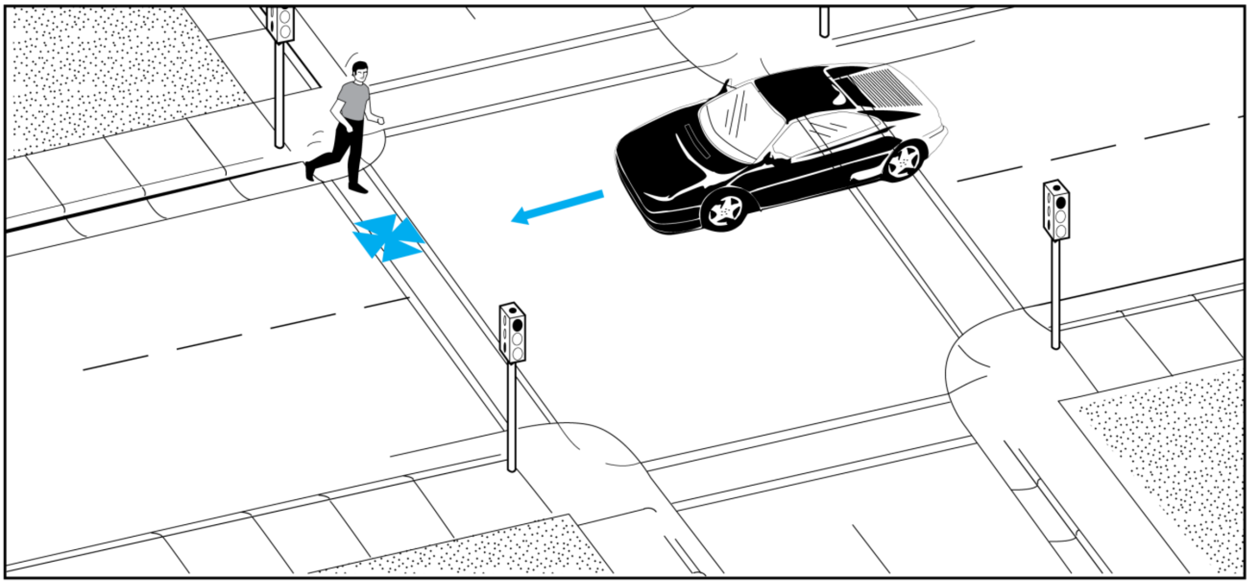


Figure 107. Pedestrian Crash Type 741 - Dash

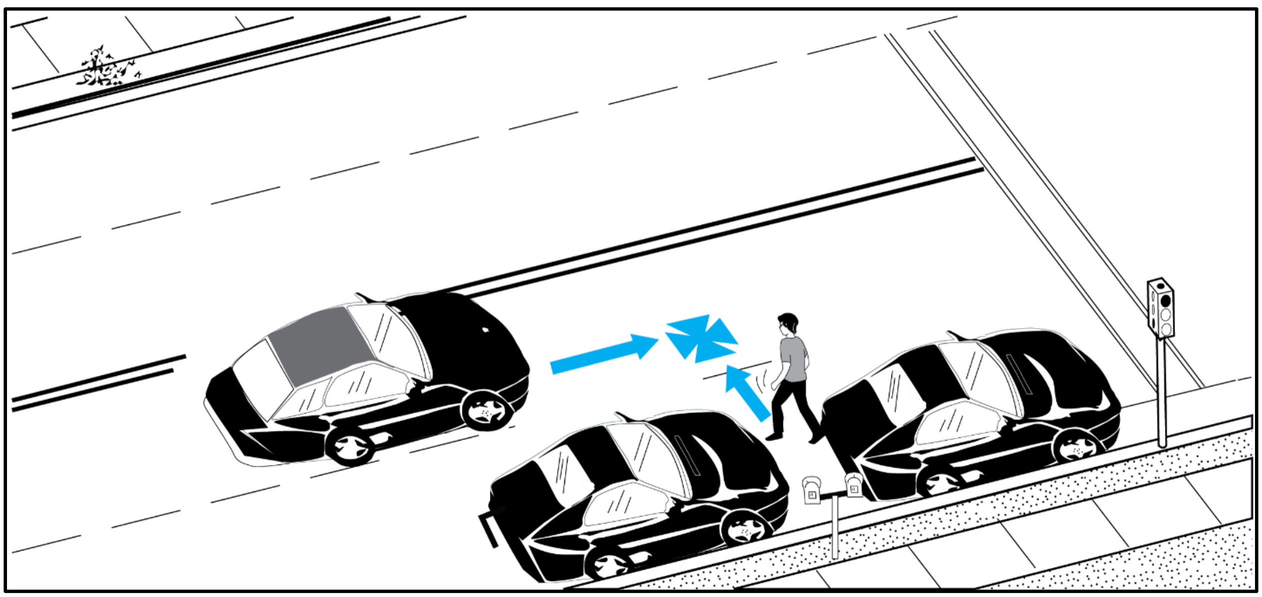


Figure 108. Pedestrian Crash Type 742 - Dart-Out

Pedestrian Crash Group 750 - Crossing Roadway - Vehicle Not Turning

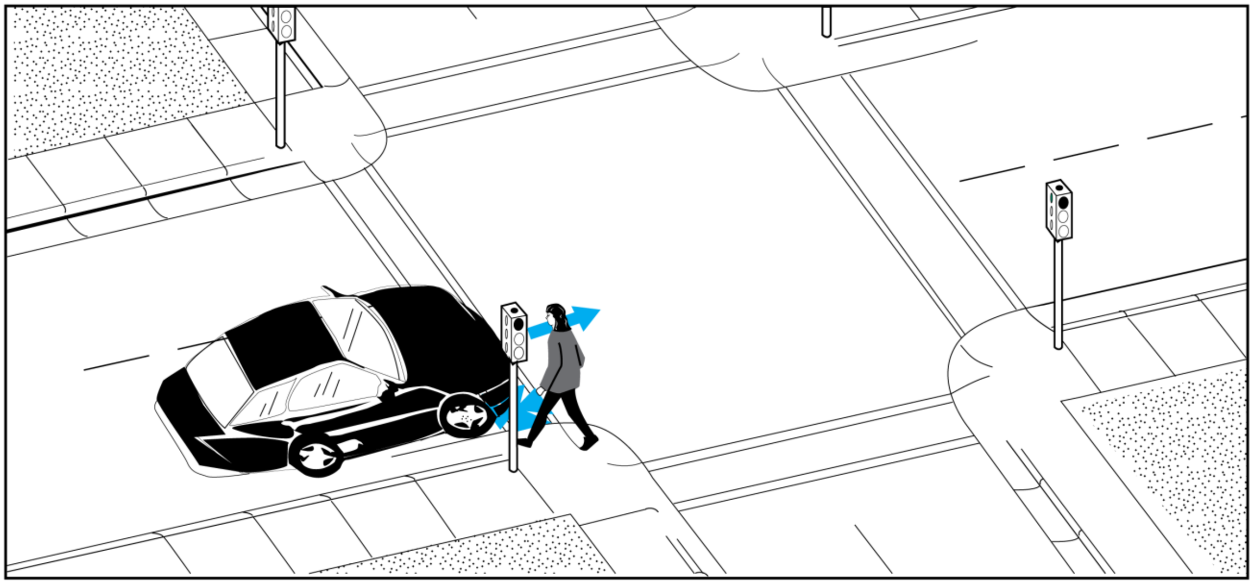


Figure 109. Pedestrian Crash Type 760 - Pedestrian Failed to Yield

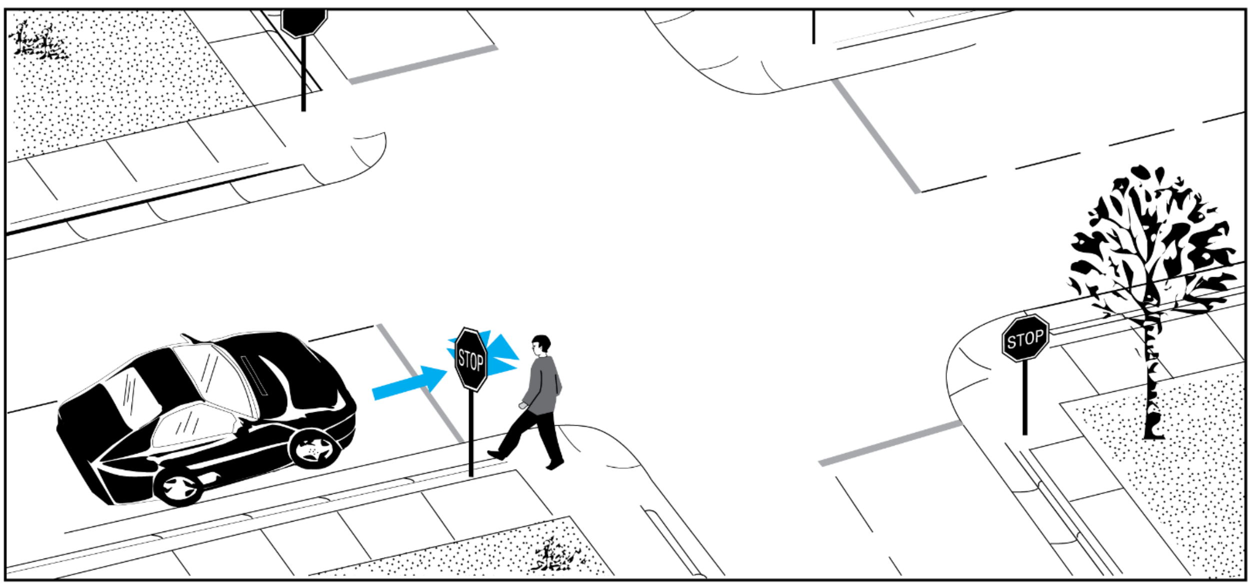


Figure 110. Pedestrian Crash Type 770 - Motorist Failed to Yield

Pedestrian Crash Group 790 - Crossing Roadway - Vehicle Turning

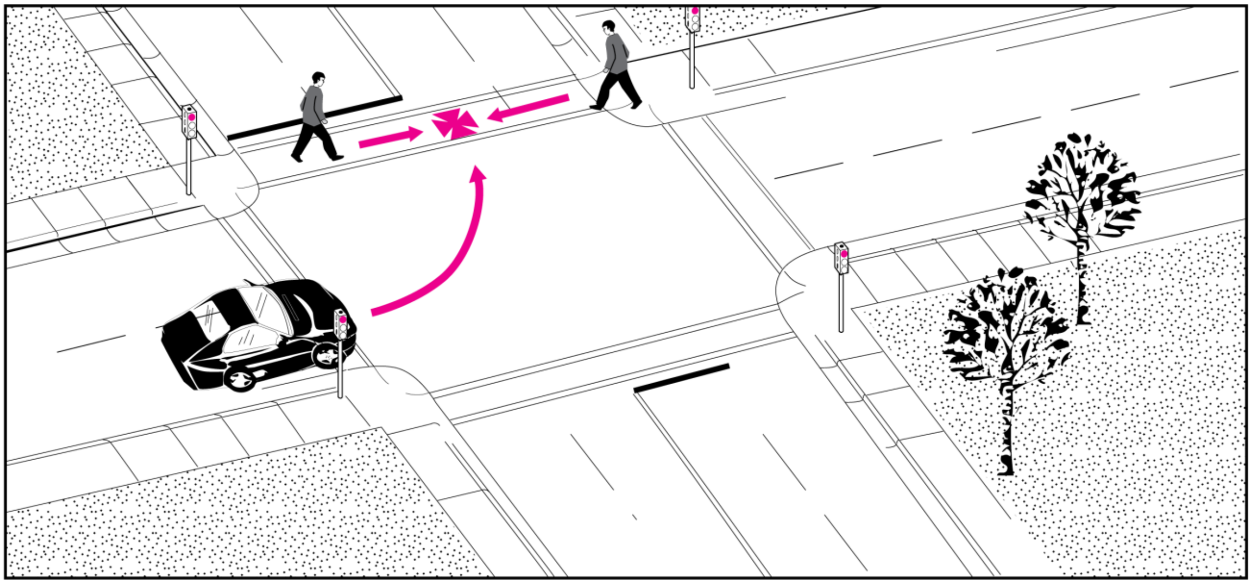


Figure 111. Pedestrian Crash Type 781 - Motorist Left Turn - Parallel Paths

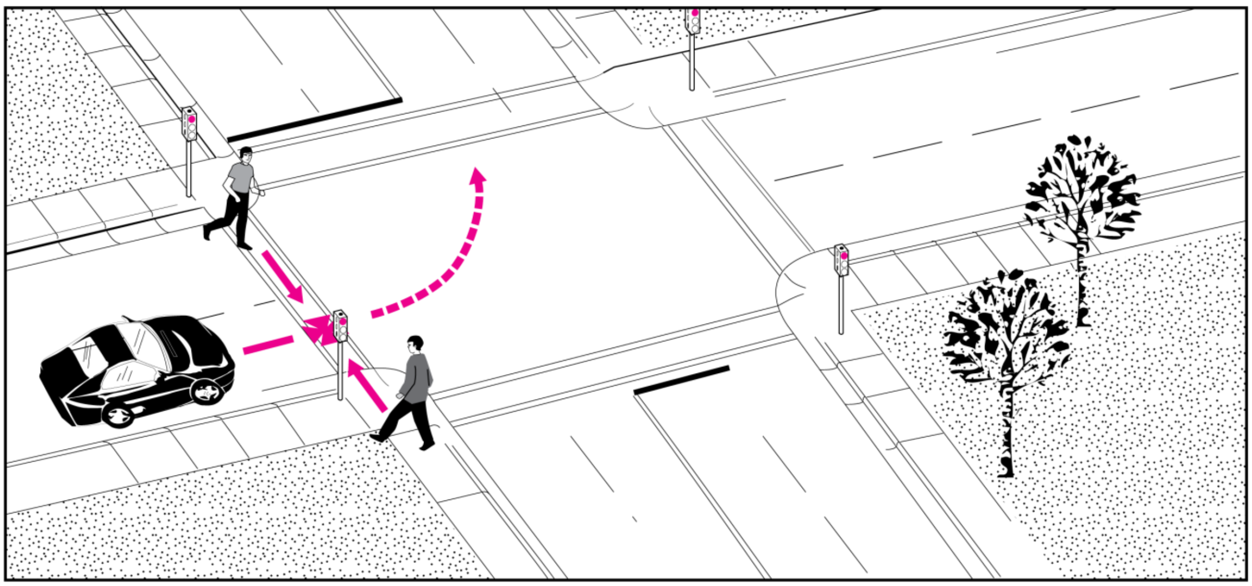


Figure 112. Pedestrian Crash Type 782 - Motorist Left Turn - Perpendicular Paths

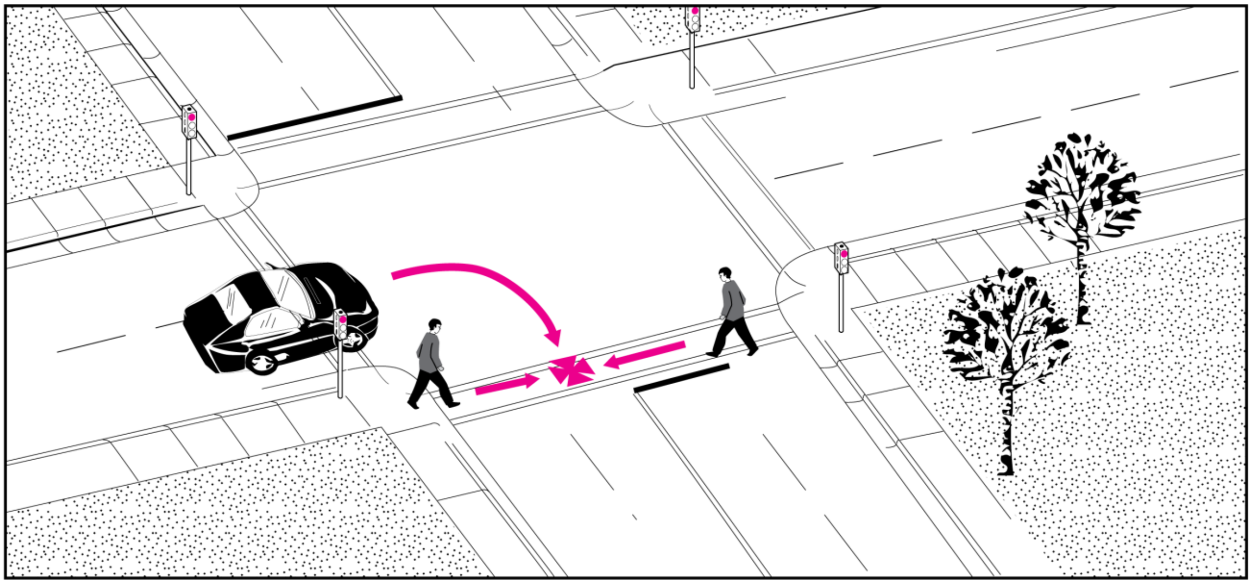


Figure 113. Pedestrian Crash Type 791 - Motorist Right Turn - Parallel Paths

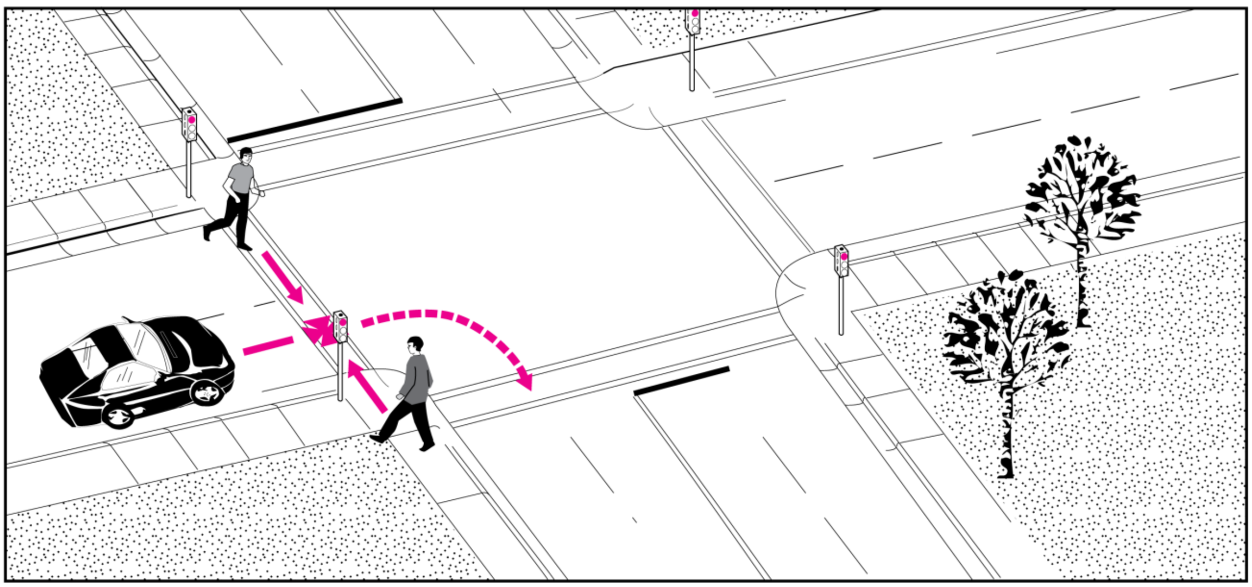


Figure 114. Pedestrian Crash Type 795 - Motorist Right Turn - Perpendicular Paths

Pedestrian Crash Group 800 - Off Roadway

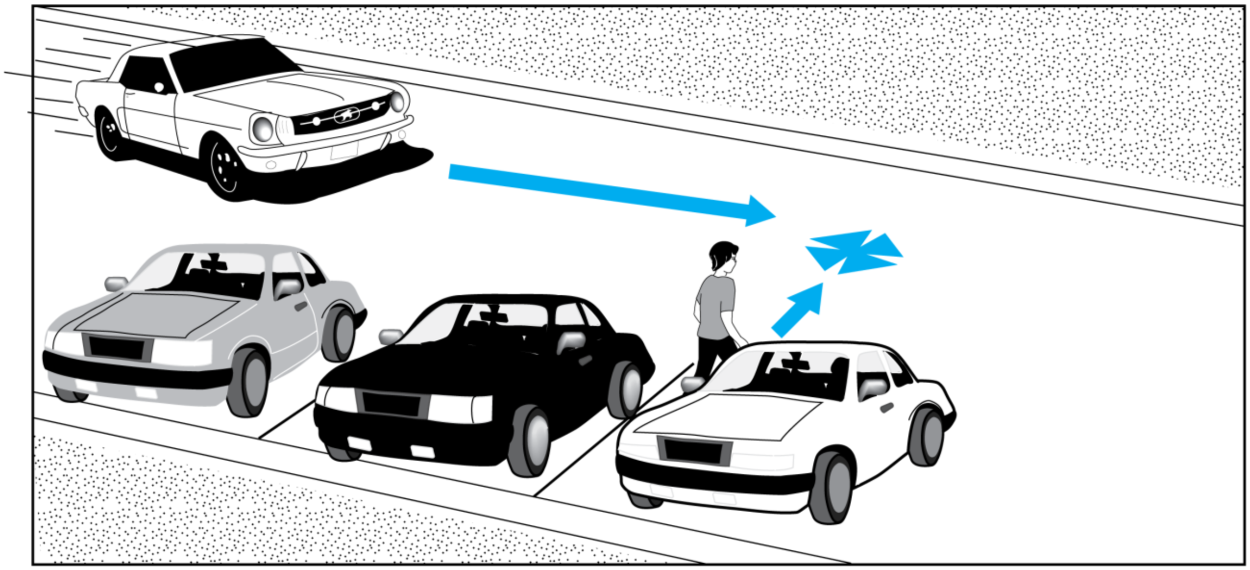


Figure 115. Pedestrian Crash Type 830 - Off Roadway - Parking Lot

Pedestrian Crash Group 910 - Crossing Expressway

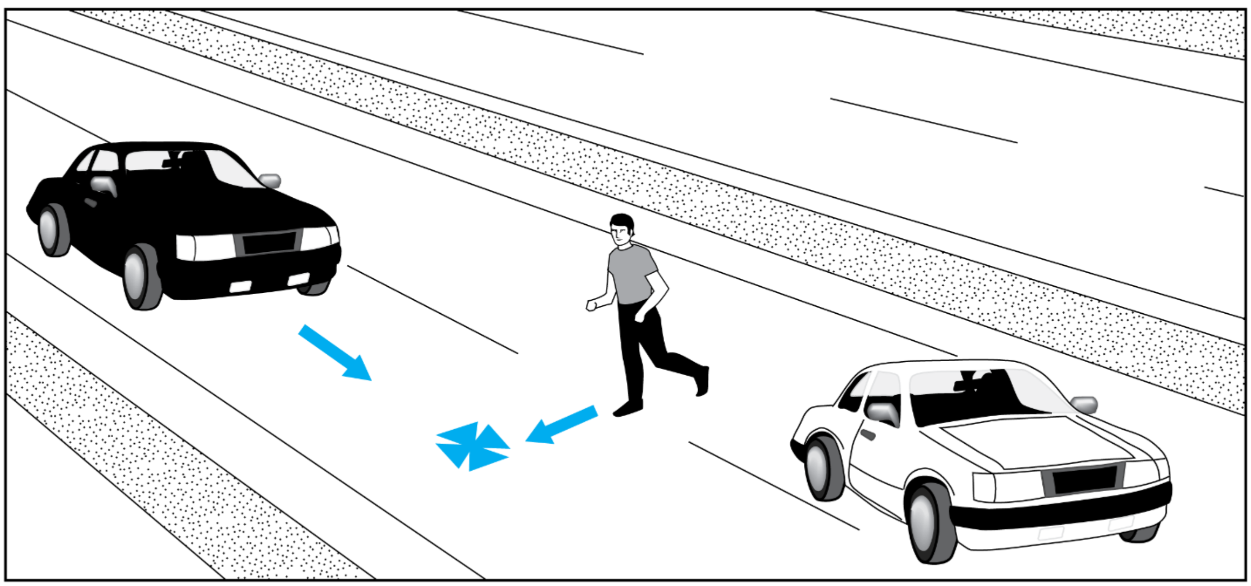


Figure 116. Pedestrian Crash Type 910 - Crossing an Expressway

Bicycle Crash Group 110 - Loss of Control / Turning Error

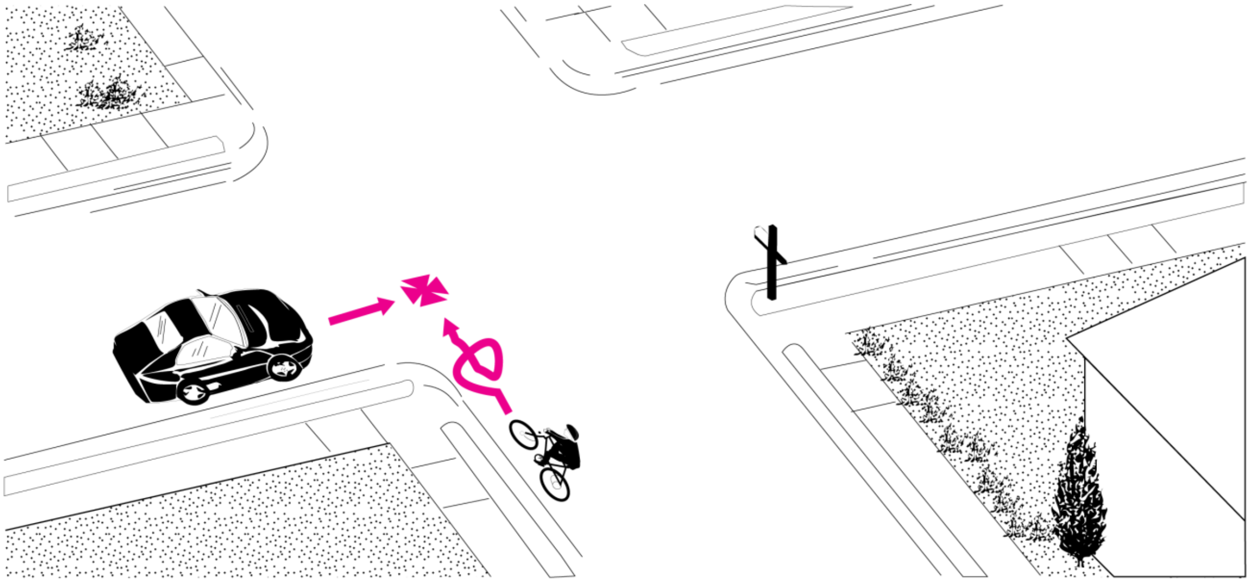


Figure 117. Bicycle Crash Type 120 - Bicyclist Lost Control

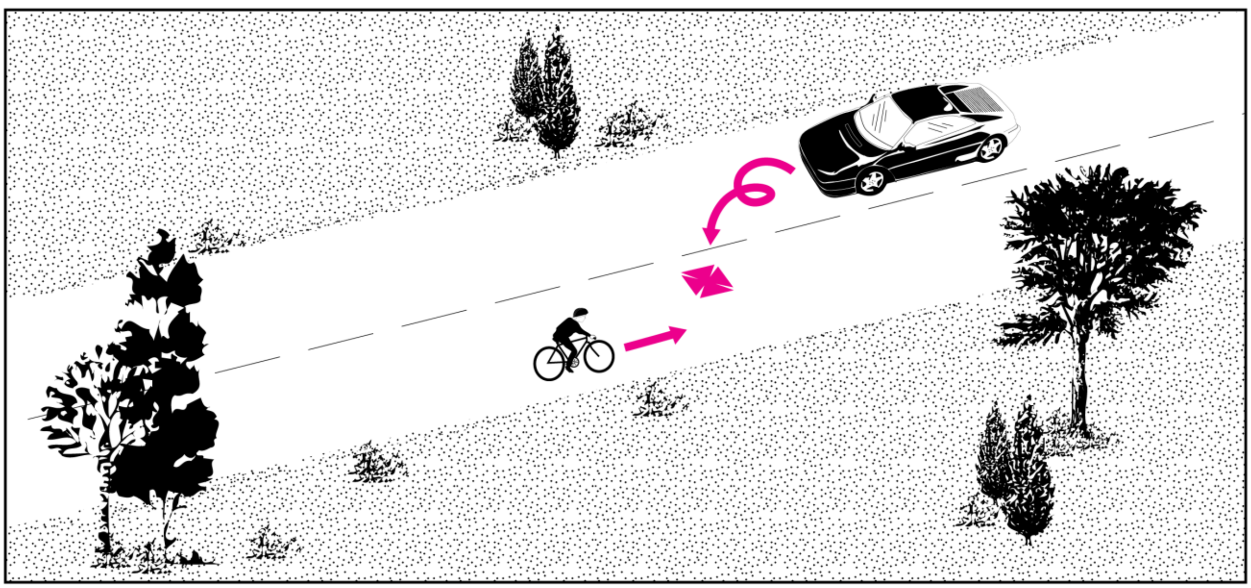


Figure 118. Bicycle Crash Type 130 - Motorist Lost Control

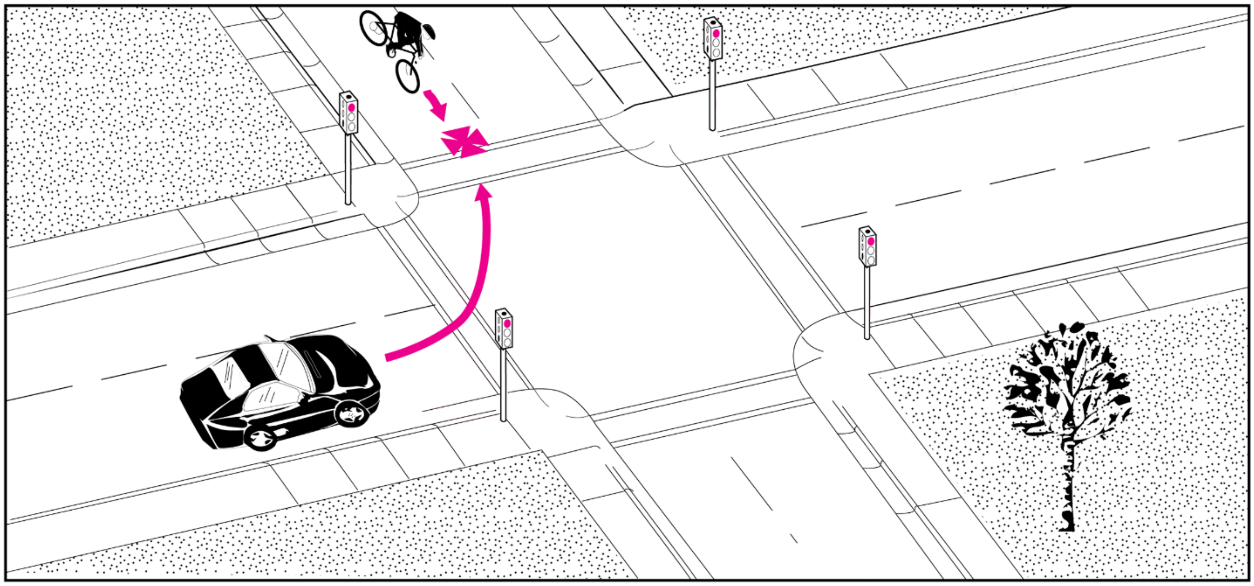


Figure 119. Bicycle Crash Type 111 - Motorist Turning Error - Left Turn

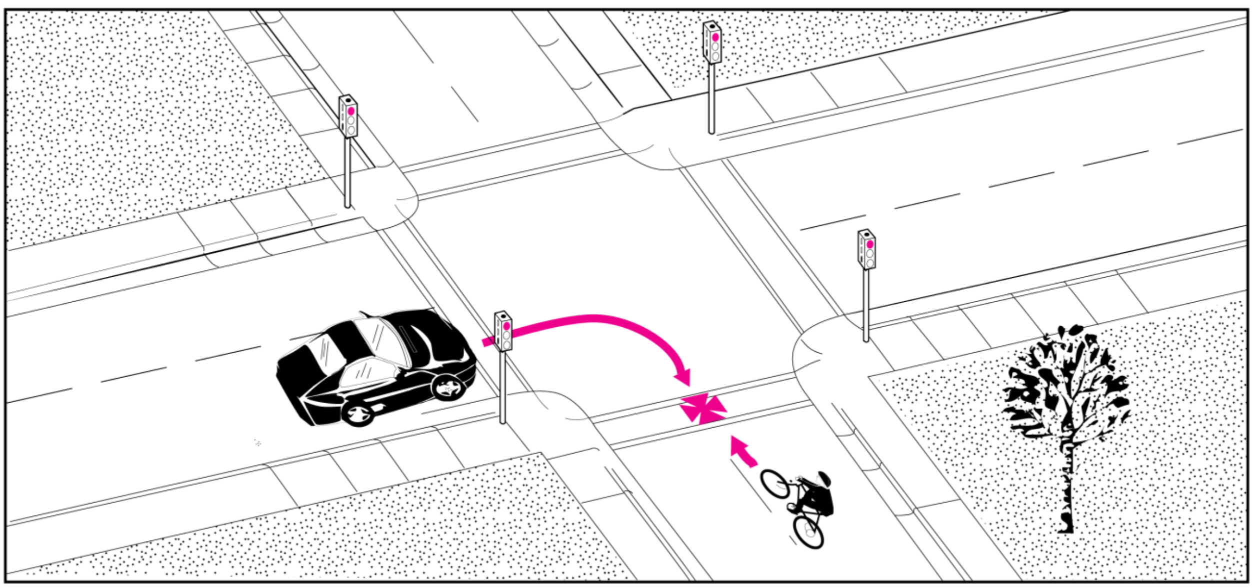


Figure 120. Bicycle Crash Type 112 - Motorist Turning Error - Right Turn

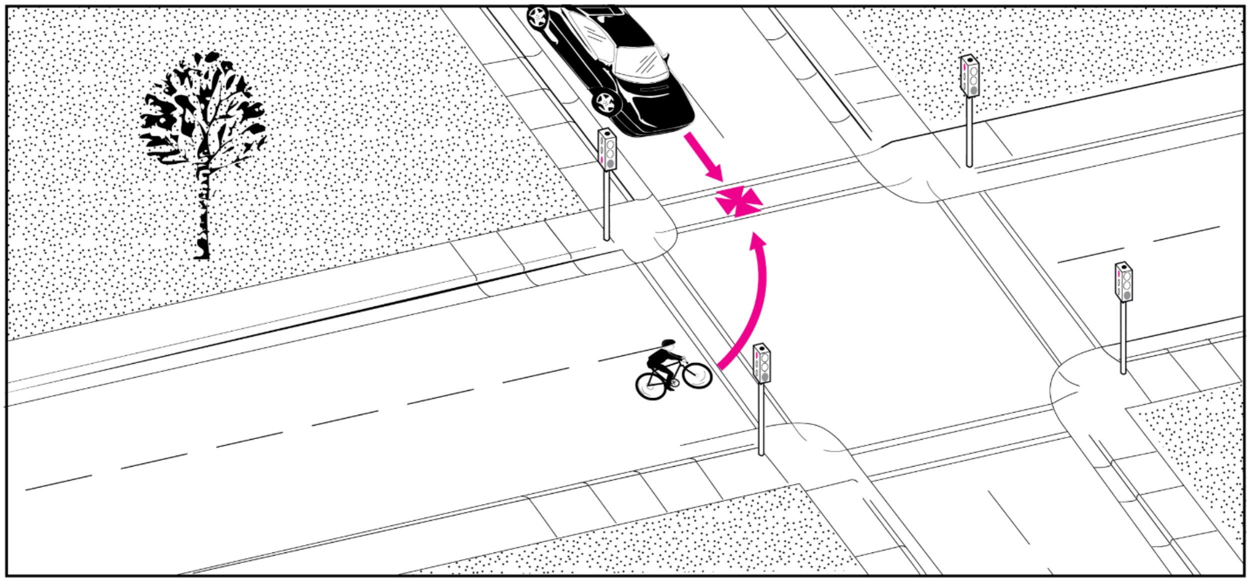


Figure 121. Bicycle Crash Type 114 - Bicyclist Turning Error - Left Turn

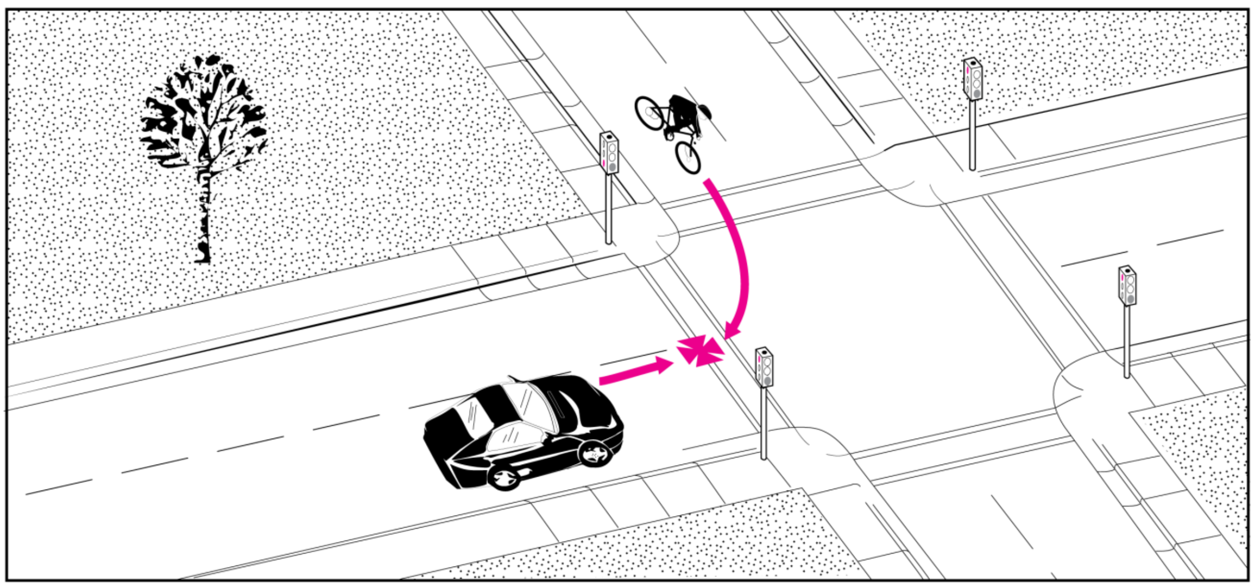


Figure 122. Bicycle Crash Type 115 - Bicyclist Turning Error - Right Turn

Bicycle Crash Group 140 - Motorist Failed to Yield - Sign-Controlled Intersection

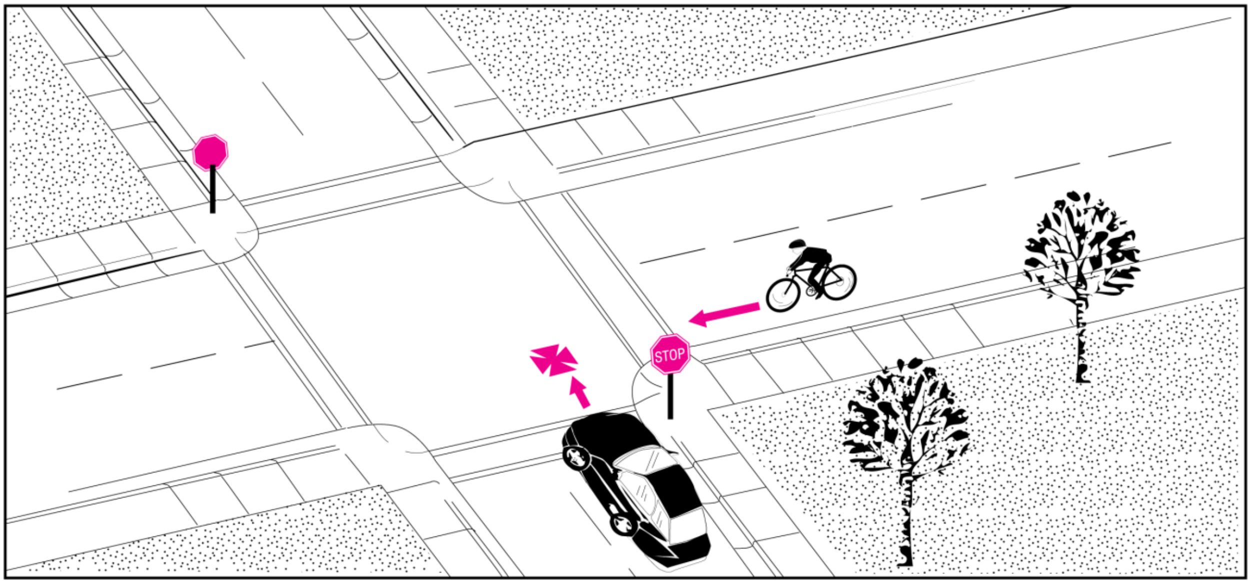


Figure 123. Bicycle Crash Type 141 - Motorist Drive Out - Sign-Controlled Intersection

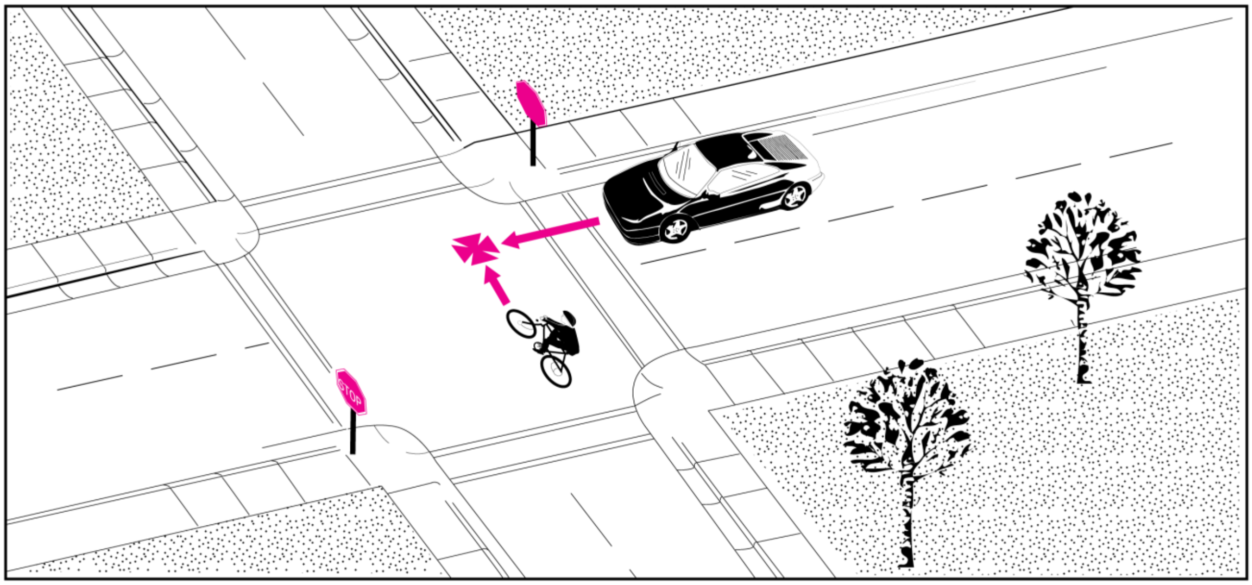


Figure 124. Bicycle Crash Type 143 - Motorist Drive Through - Sign-Controlled Intersection

Bicycle Crash Group 145 - Bicyclist Failed to Yield - Sign-Controlled Intersection

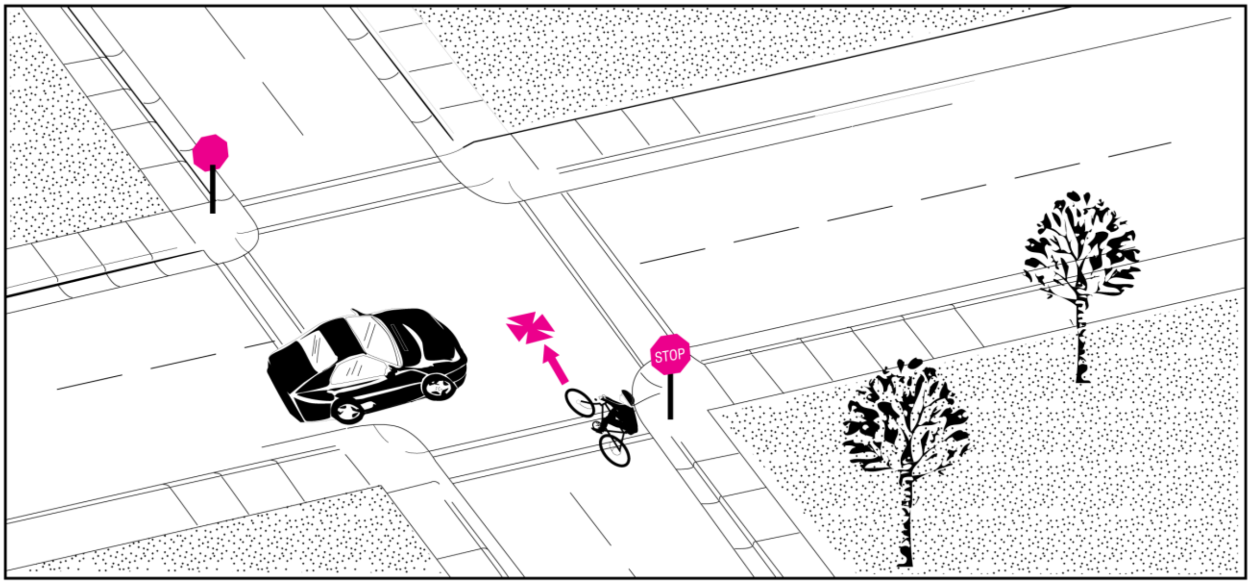


Figure 125. Bicycle Crash Type 142 - Bicyclist Ride Out - Sign-Controlled Intersection

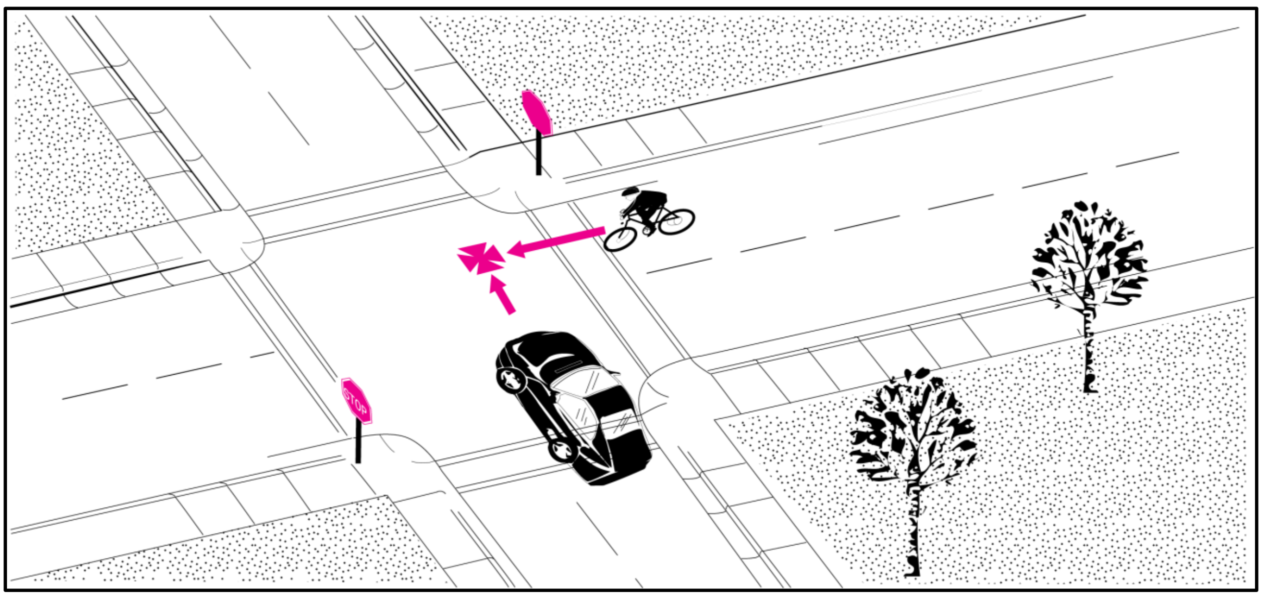


Figure 126. Bicycle Crash Type 144 - Bicyclist Ride Through - Sign-Controlled Intersection

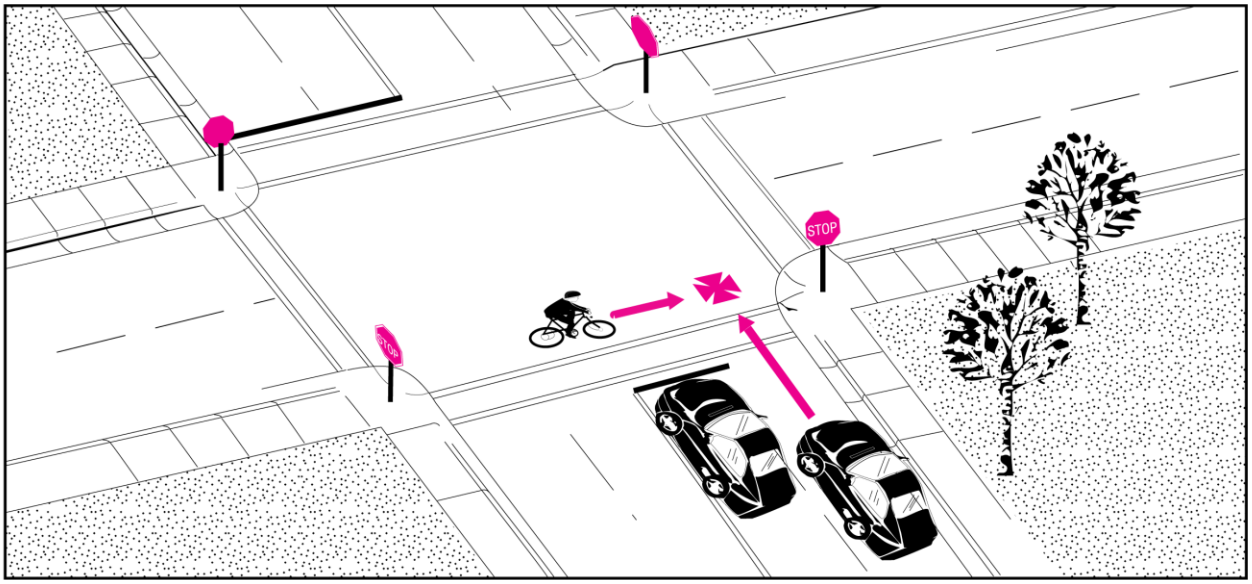


Figure 127. Bicycle Crash Type 147 - Multiple Threat - Sign-Controlled Intersection

Bicycle Crash Group 150 - Motorist Failed to Yield-Signalized Intersection

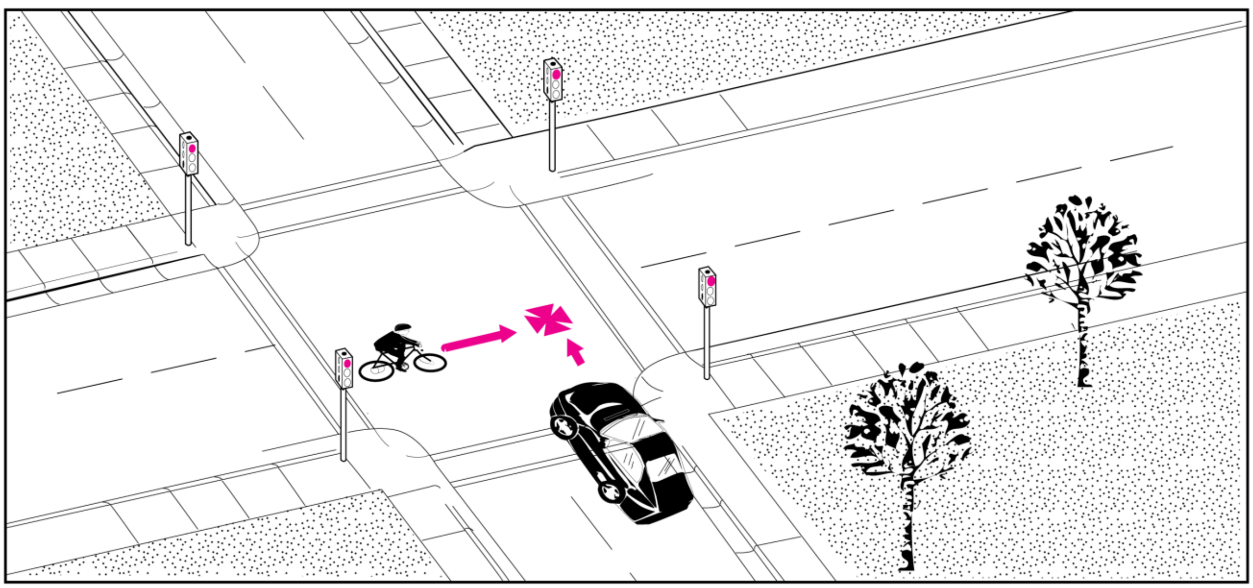


Figure 128. Bicycle Crash Type 152 - Motorist Drive Out-Signalized Intersection

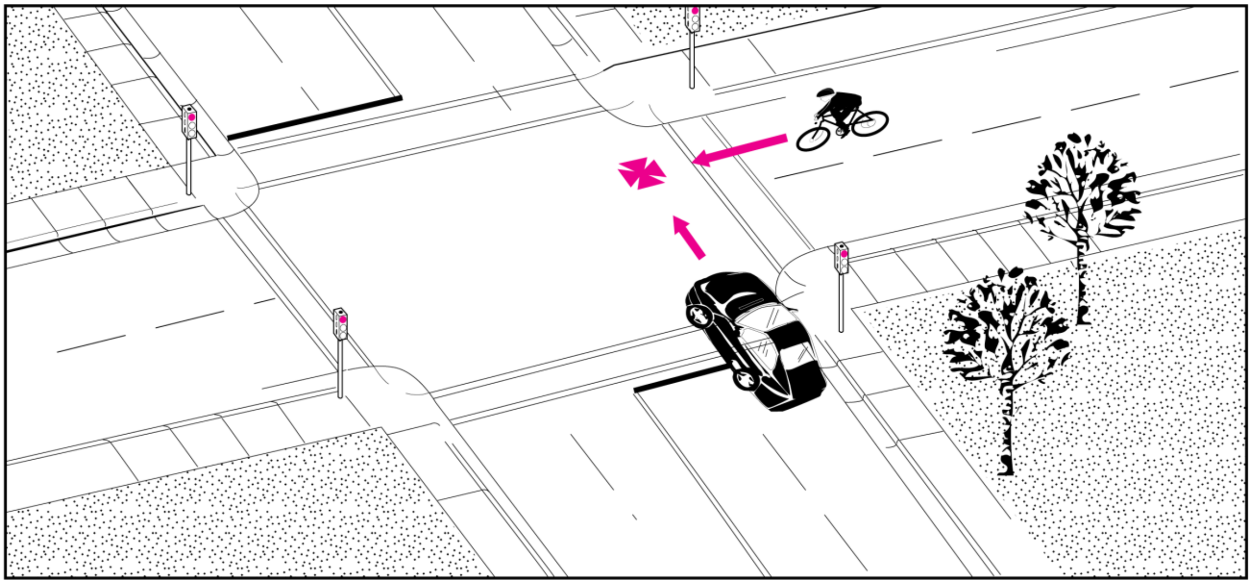


Figure 129. Bicycle Crash Type 154 - Motorist Drive Through-Signalized Intersection

Bicycle Crash Group 158 - Bicyclist Failed to Yield - Signalized Intersection

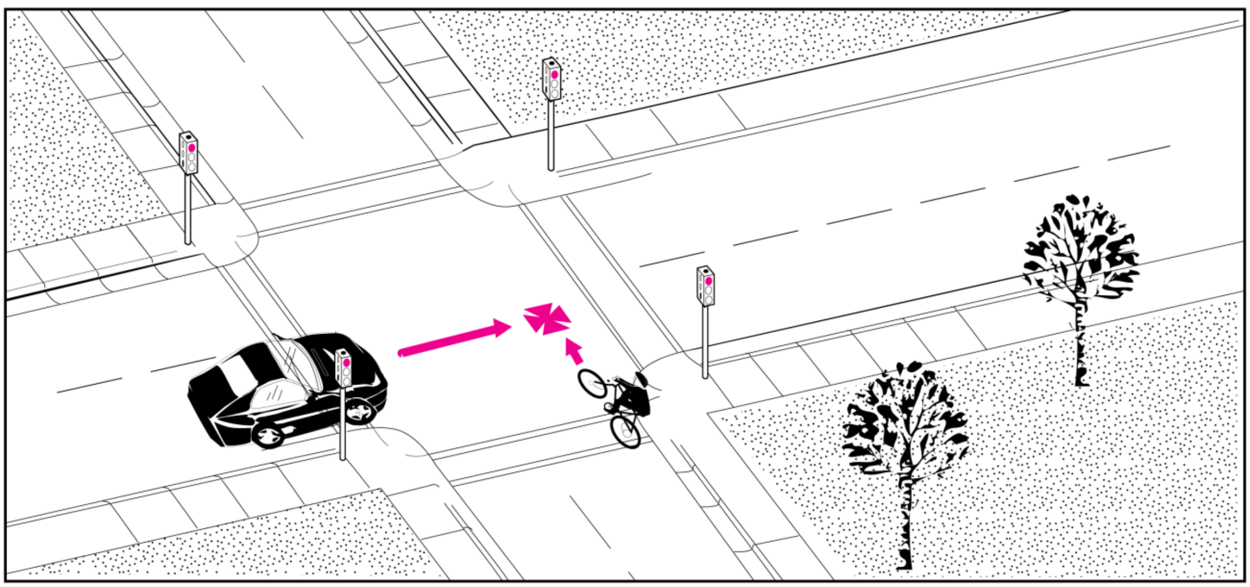


Figure 130. Bicycle Crash Type 153 - Bicyclist Ride Out - Signalized Intersection

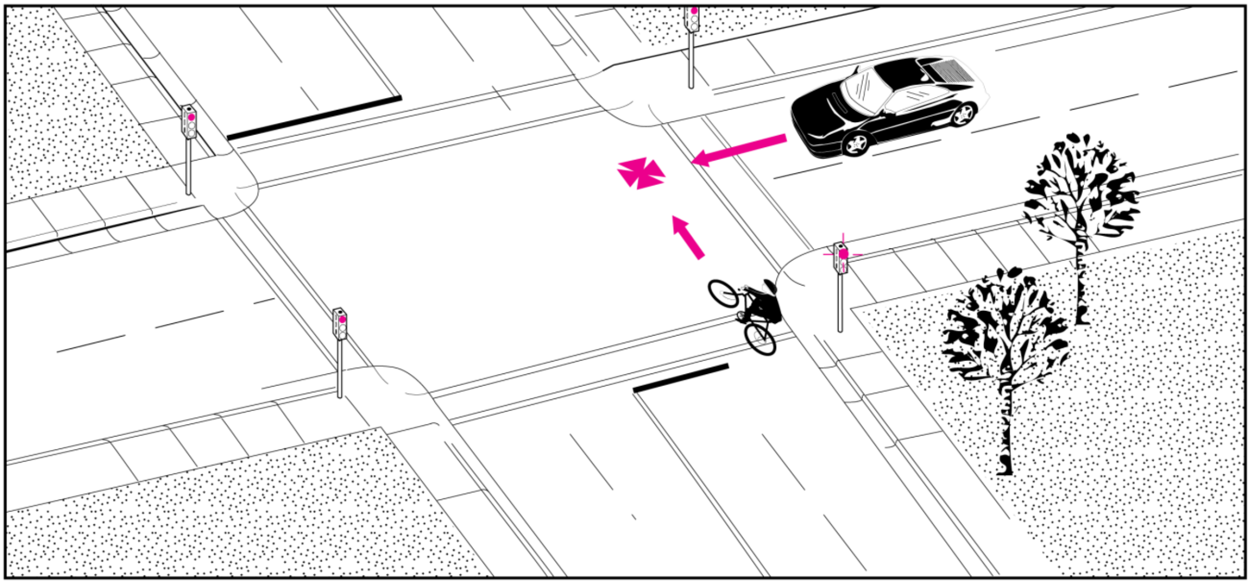


Figure 131. Bicycle Crash Type 155 - Bicyclist Ride Through - Signalized Intersection

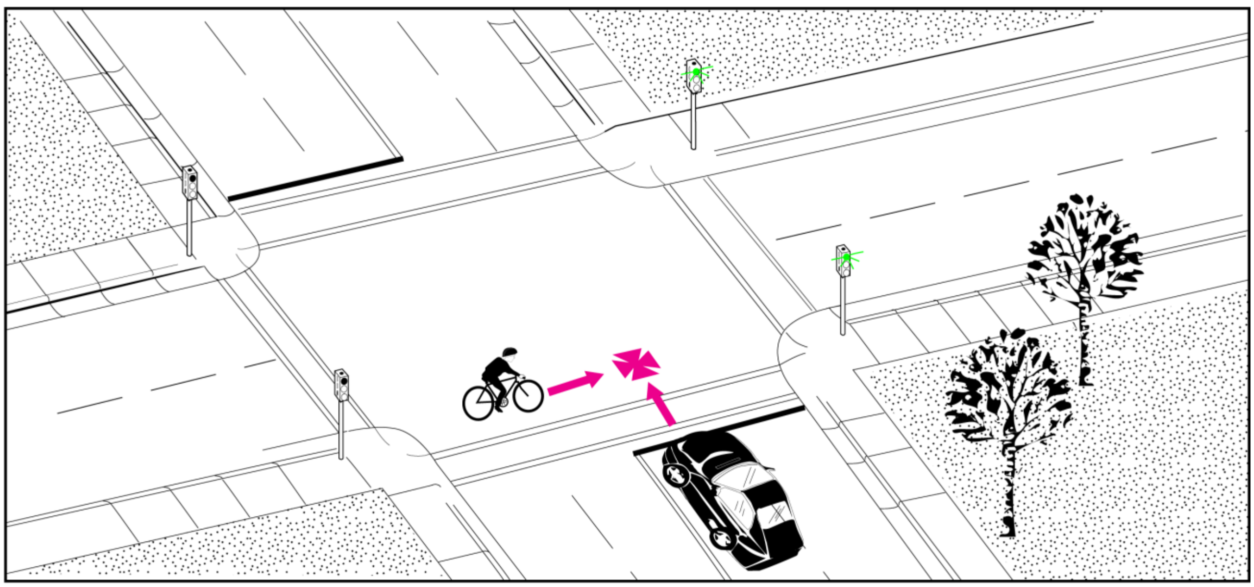


Figure 132. Bicycle Crash Type 156 - Bicyclist Failed to Clear - Trapped

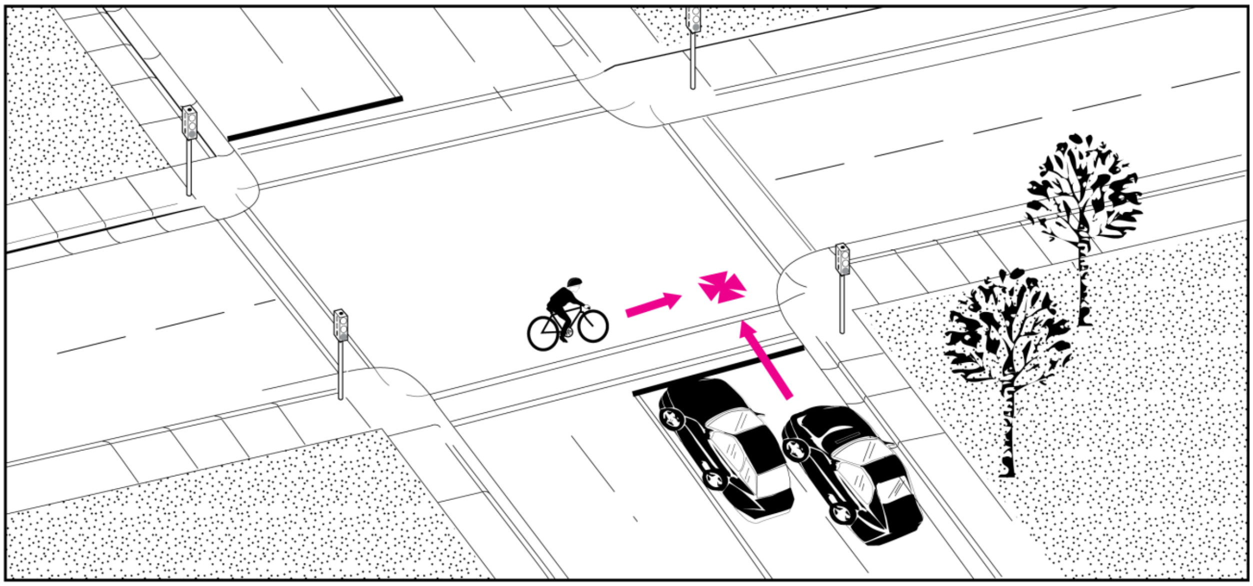


Figure 133. Bicycle Crash Type 157 - Bicyclist Failed to Clear - Multiple Threat

Bicycle Crash Group 210 - Motorist Left Turn / Merge

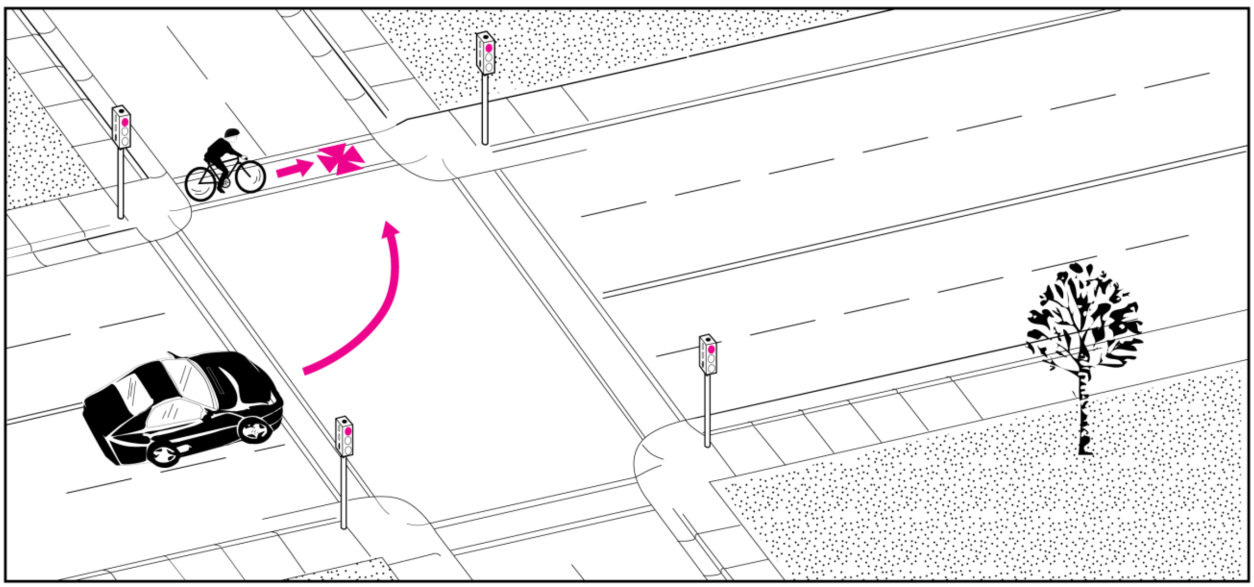


Figure 134. Bicycle Crash Type 211 - Motorist Left Turn - Same Direction

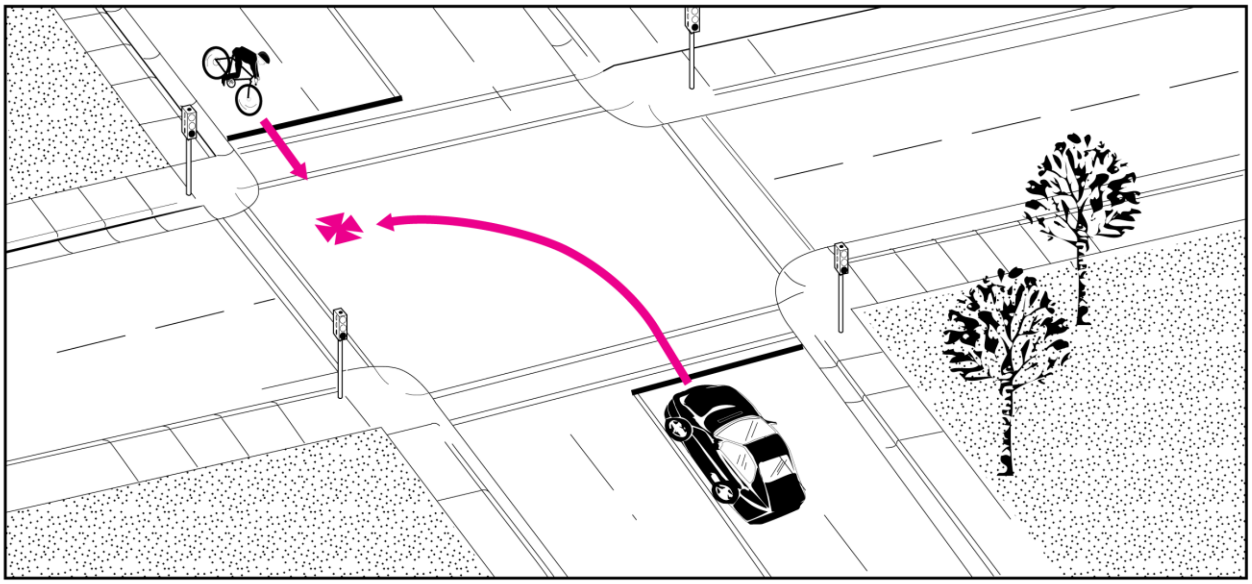


Figure 135. Bicycle Crash Type 212 - Motorist Left Turn - Opposite Direction

Bicycle Crash Group 215 - Motorist Right Turn / Merge

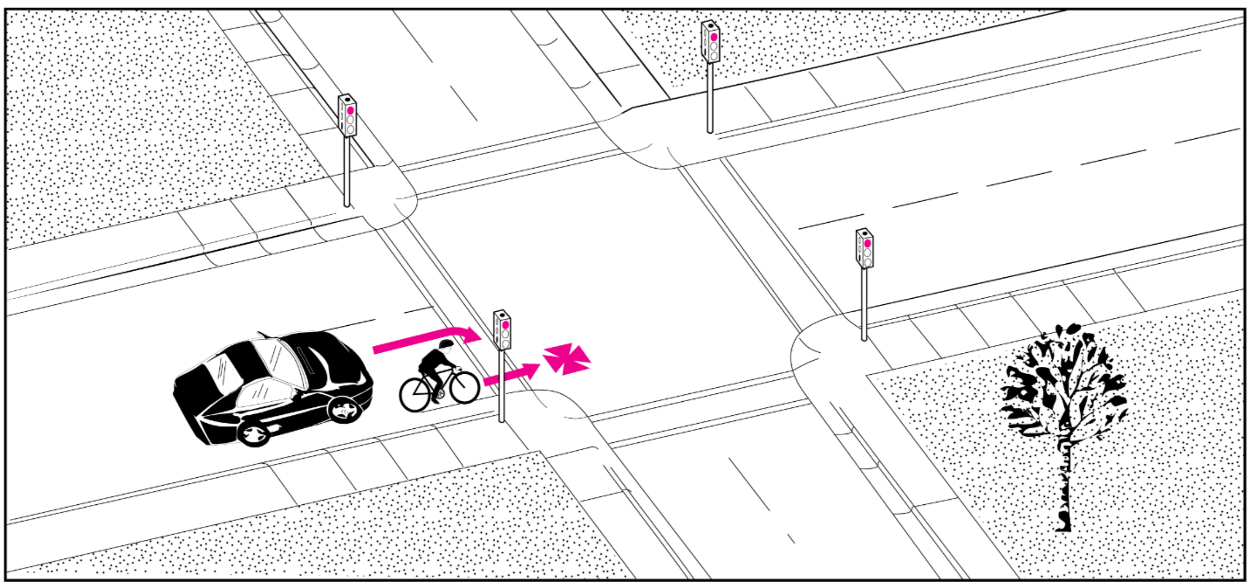


Figure 136. Bicycle Crash Type 213 - Motorist Right Turn - Same Direction

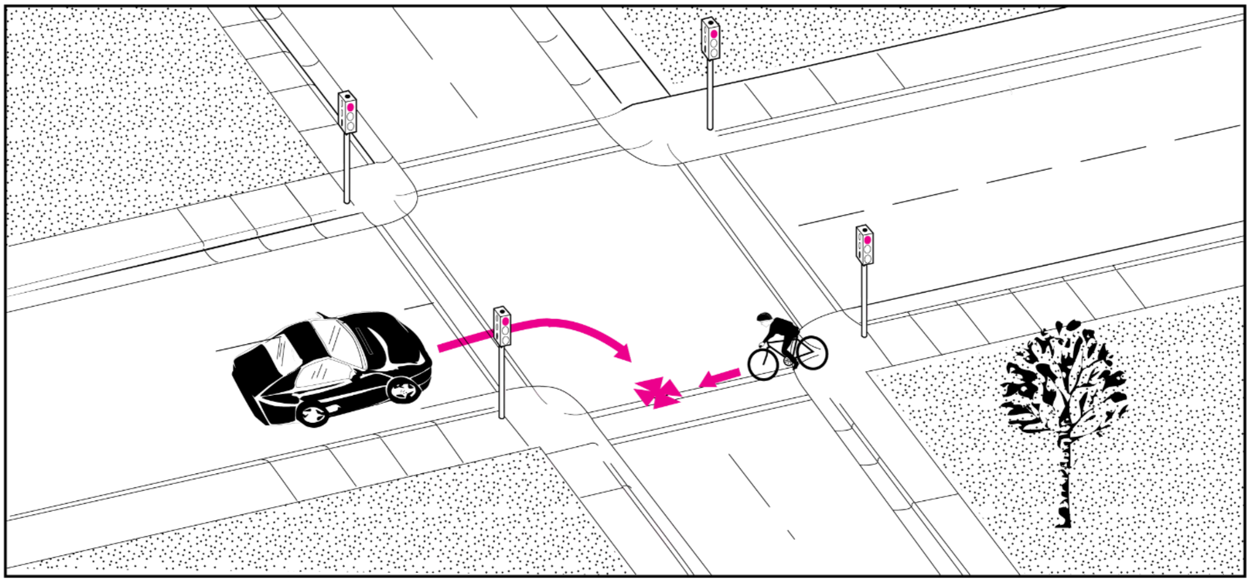


Figure 137. Bicycle Crash Type 214 - Motorist right Turn - Opposite Direction

Bicycle Crash Group 220 - Bicyclist Left Turn / Merge

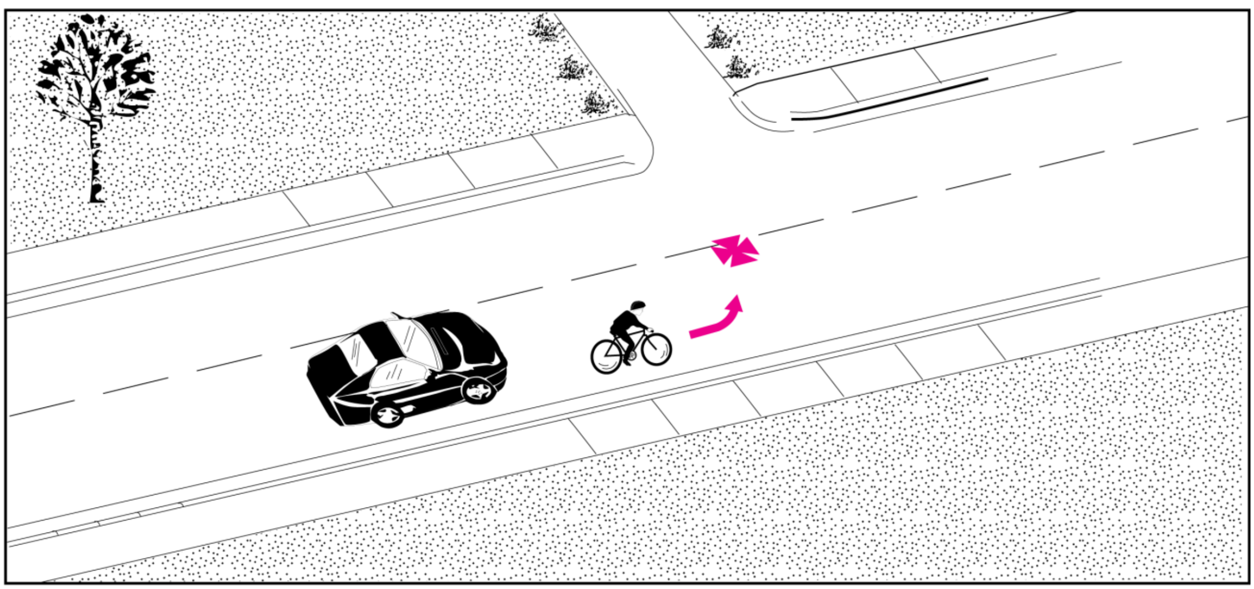


Figure 138. Bicycle Crash Type 221 - Bicyclist Left Turn - Same Direction

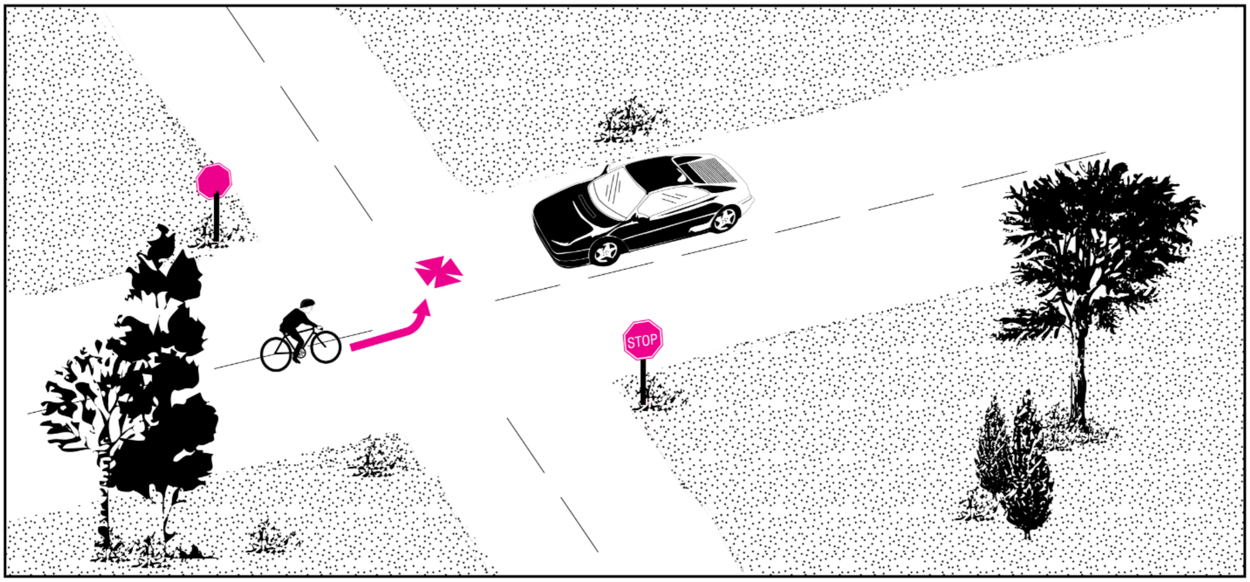


Figure 139. Bicycle Crash Type 222 - Bicyclist Left Turn - Opposite Direction

Bicycle Crash Group 225 - Bicyclist Right Turn - Turn / Merge

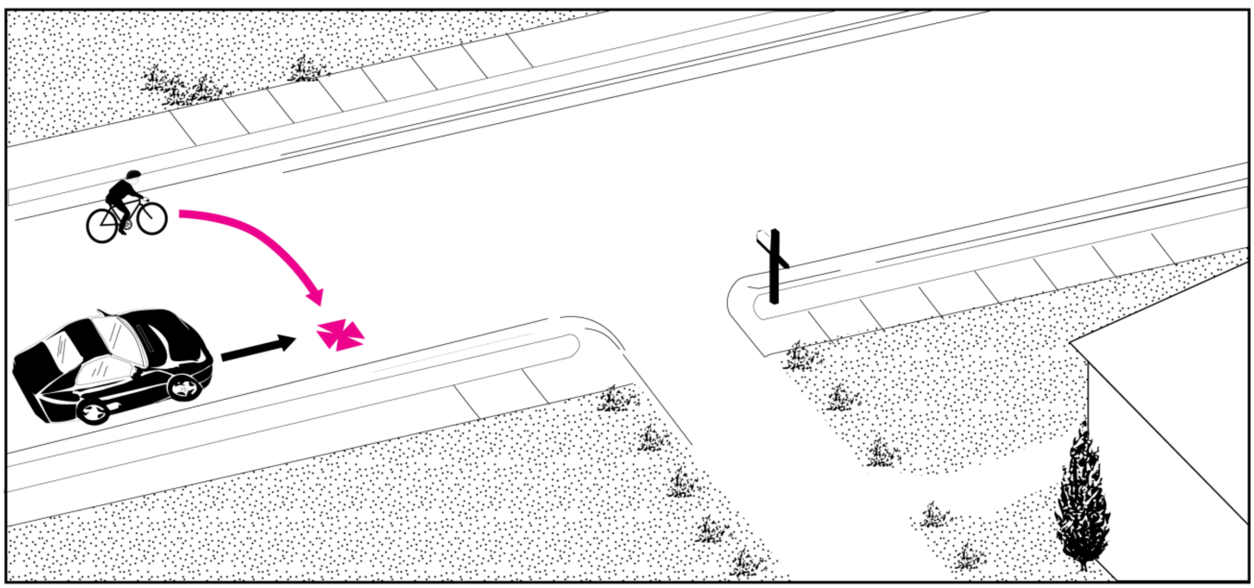


Figure 140. Bicycle Crash Type 223 - Bicyclist Right Turn - Same Direction

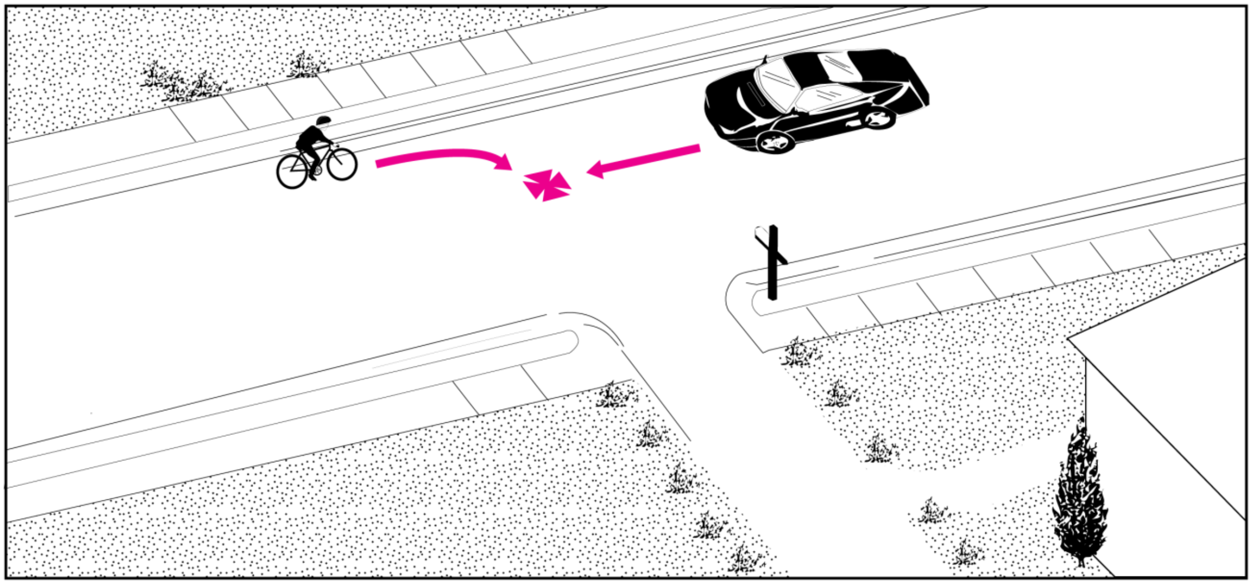


Figure 141. Bicycle Crash Type 224 - Bicyclist Right Turn - Opposite Direction

Bicycle Crash Group 219 - Parking / Bus-Related

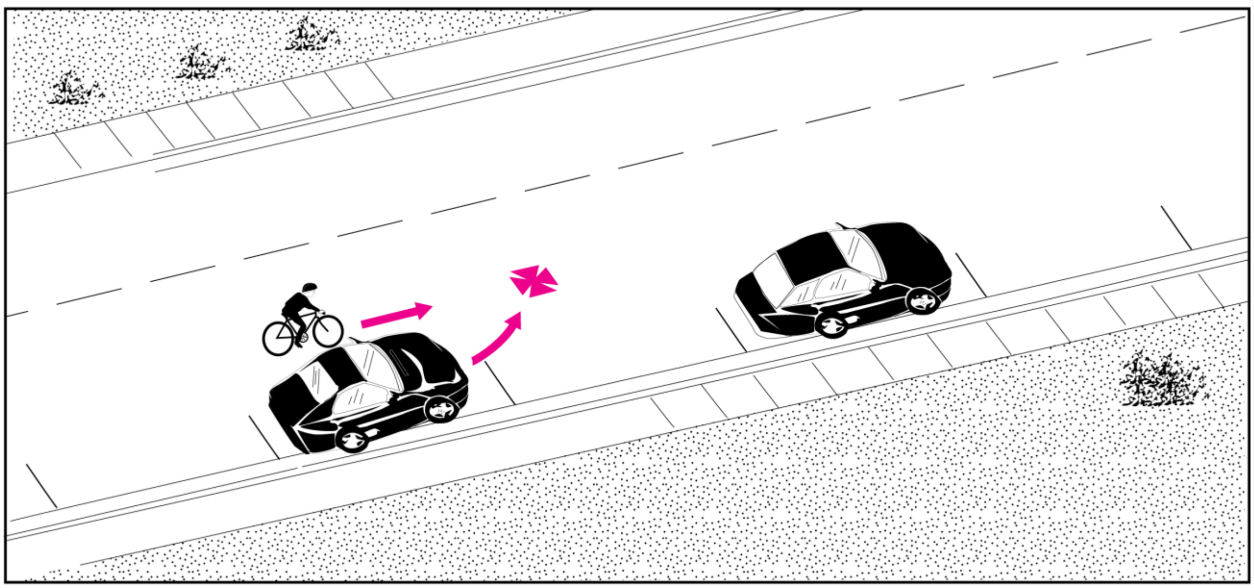


Figure 142. Bicycle Crash Type 215 - Motorist Drive-In / Out Parking

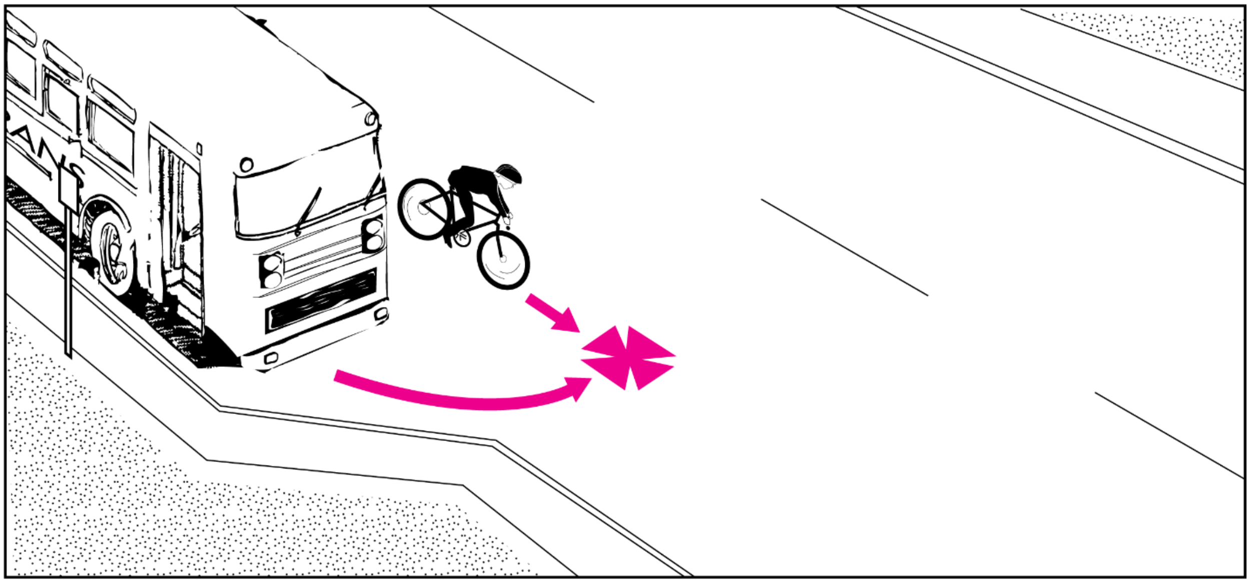


Figure 143. Bicycle Crash Type 216 - Bus / Delivery Vehicle Pullover

Bicycle Crash Group 230 - Motorist Overtaking Bicyclist

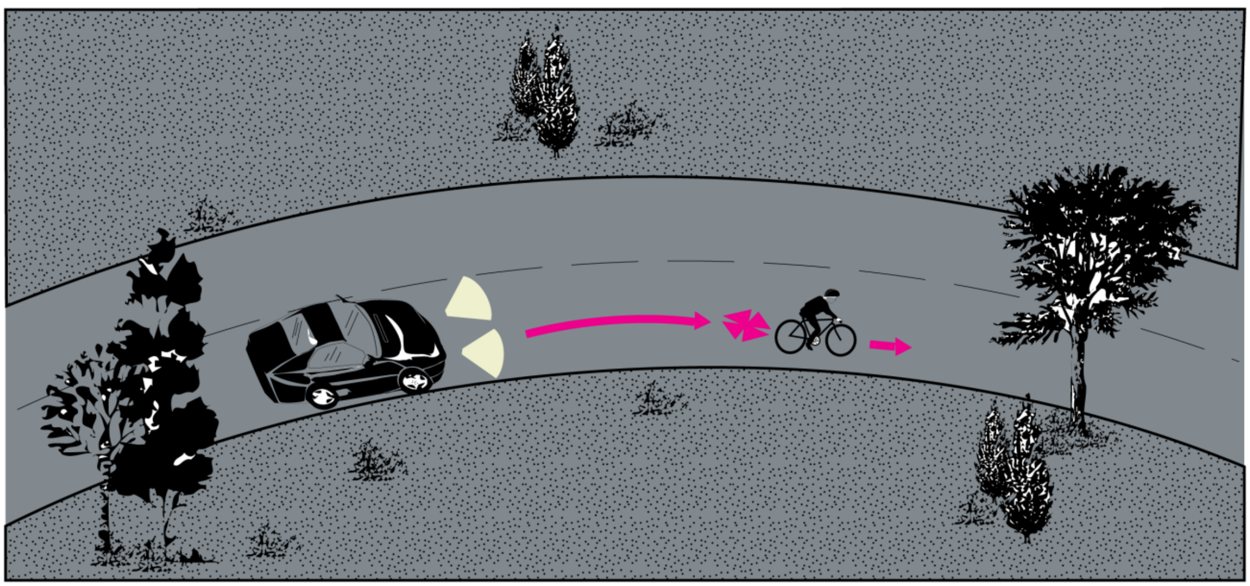


Figure 144. Bicycle Crash Type 231 - Motorist Overtaking - Undetected Bicyclist

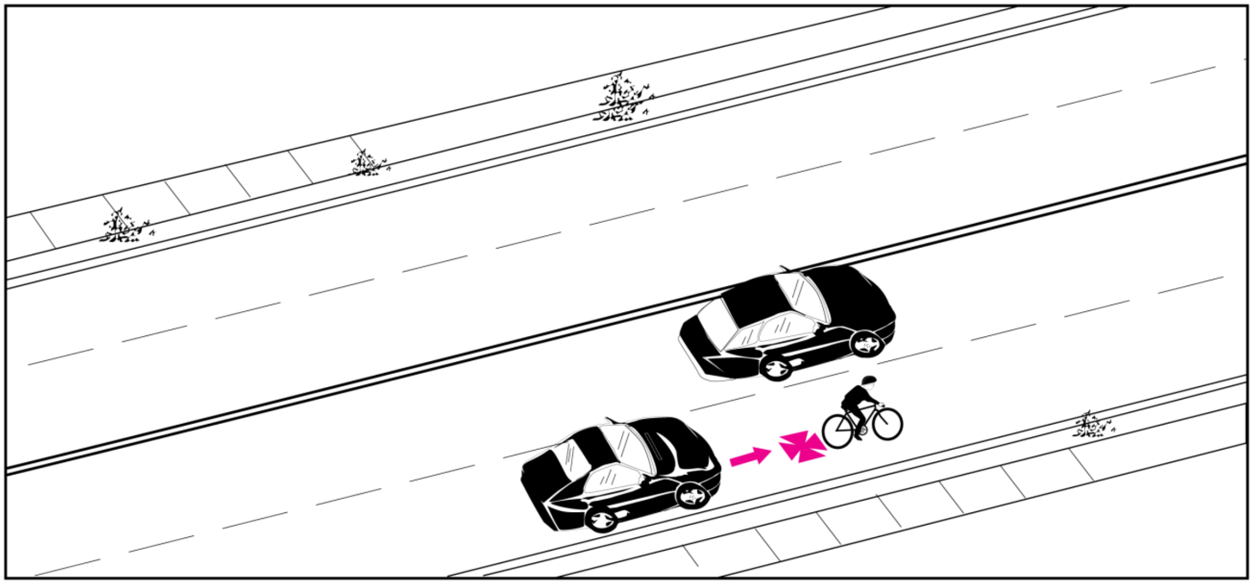


Figure 145. Bicycle Crash Type 232 - Motorist Overtaking - Misjudged Space

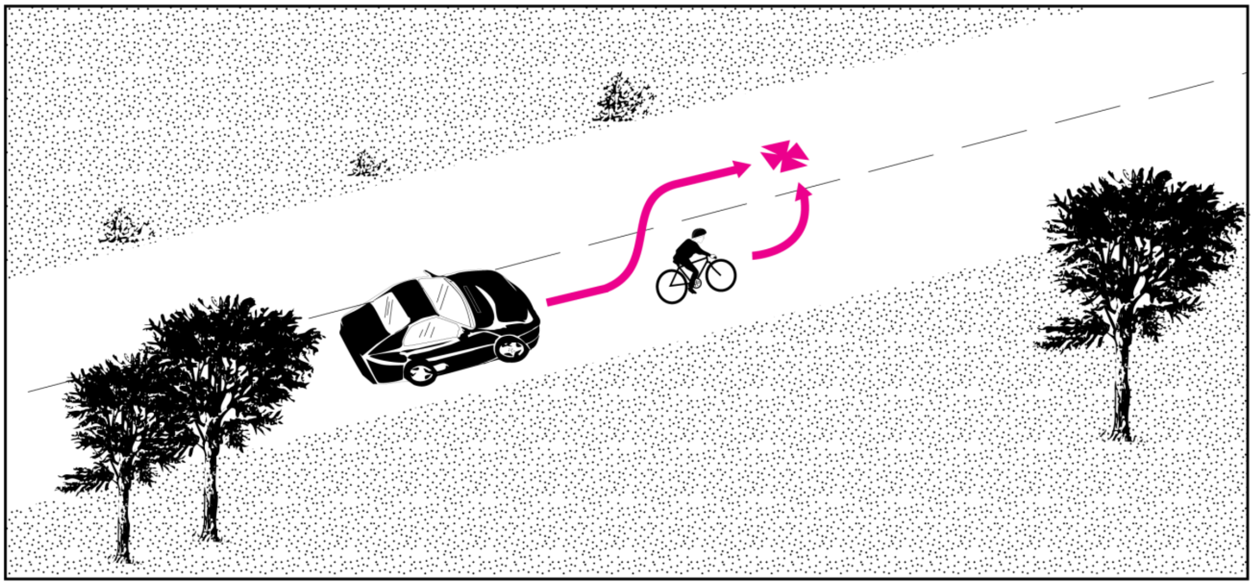


Figure 146. Bicycle Crash Type 235 - Motorist Overtaking - Bicyclist Swerved

Bicycle Crash Group 240 - Bicyclist Overtaking Motorist

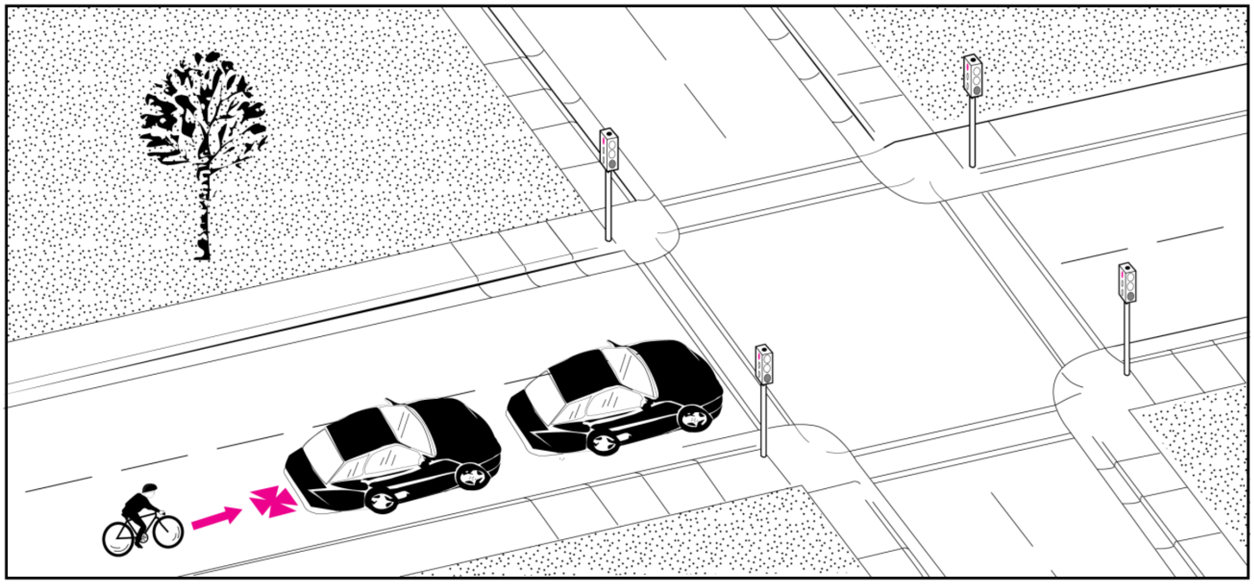


Figure 147. Bicycle Crash Type 241 - Bicyclist Overtaking - Passing on Right

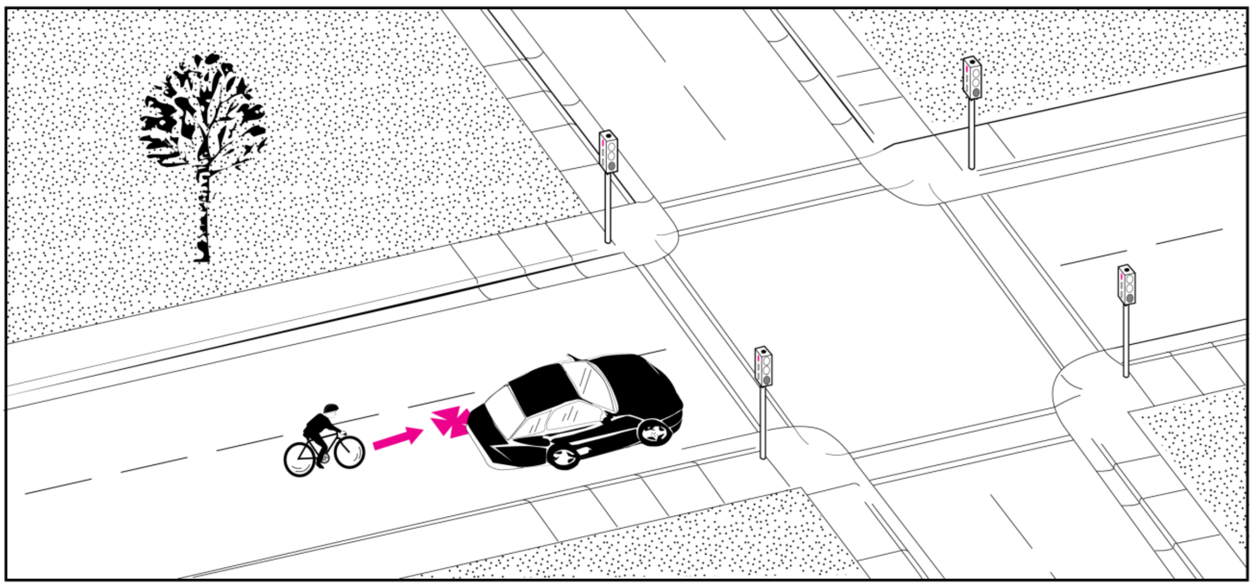


Figure 148. Bicycle Crash Type 242 - Bicyclist Overtaking - Passing on Left

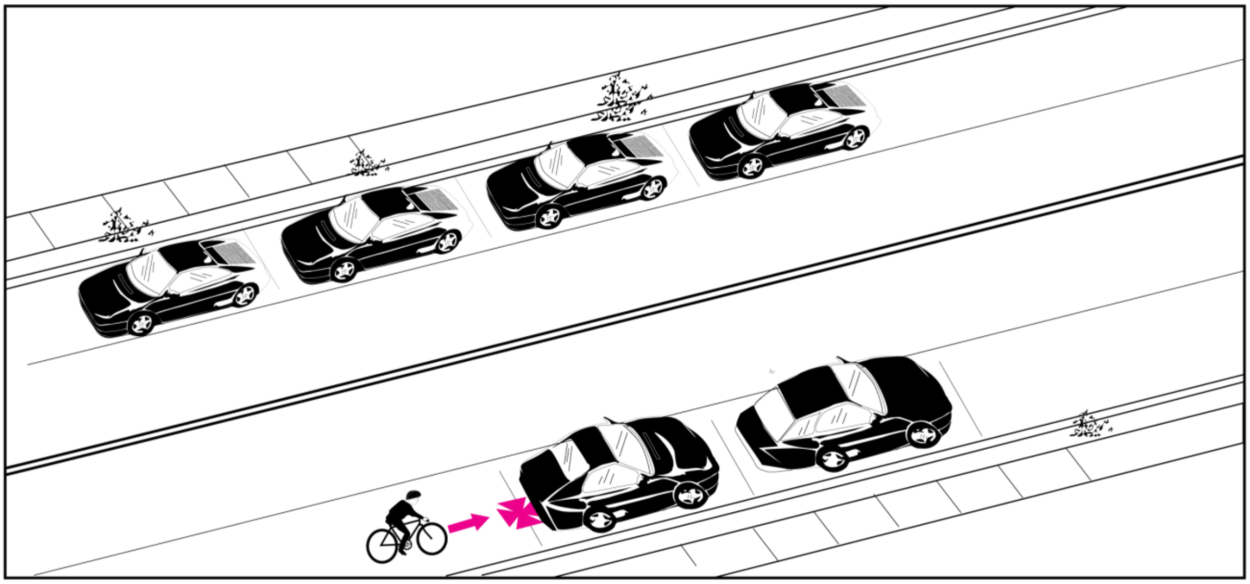


Figure 149. Bicycle Crash Type 243 - Bicyclist Overtaking - Parked Vehicle

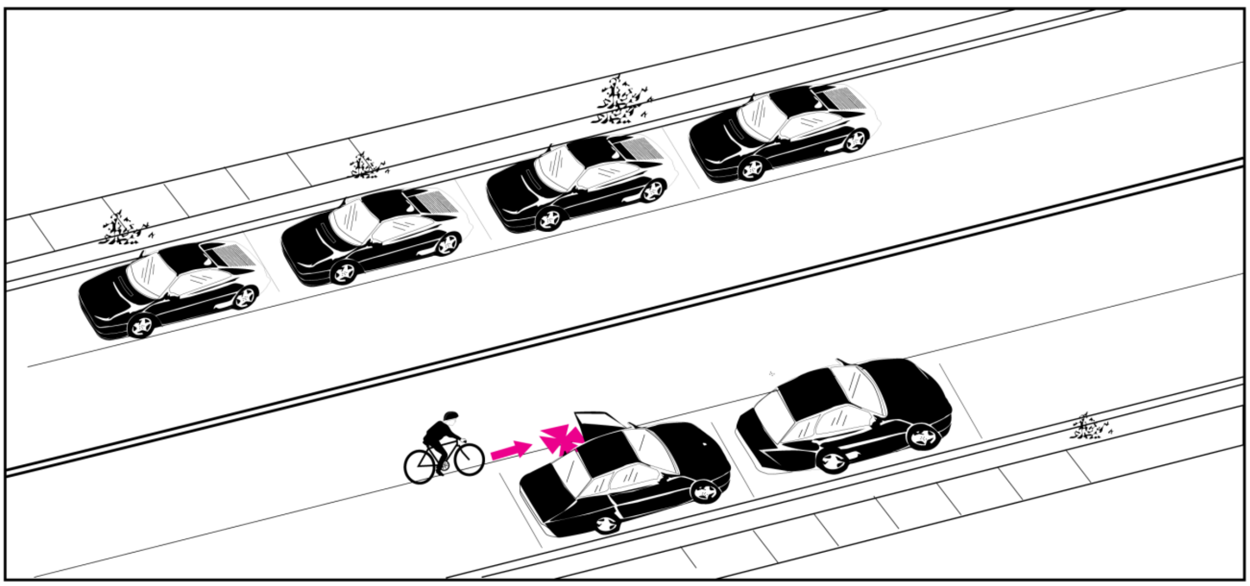


Figure 150. Bicycle Crash Type 244 - Bicyclist Overtaking - Extended Door

Bicycle Crash Group 258 - Head-On

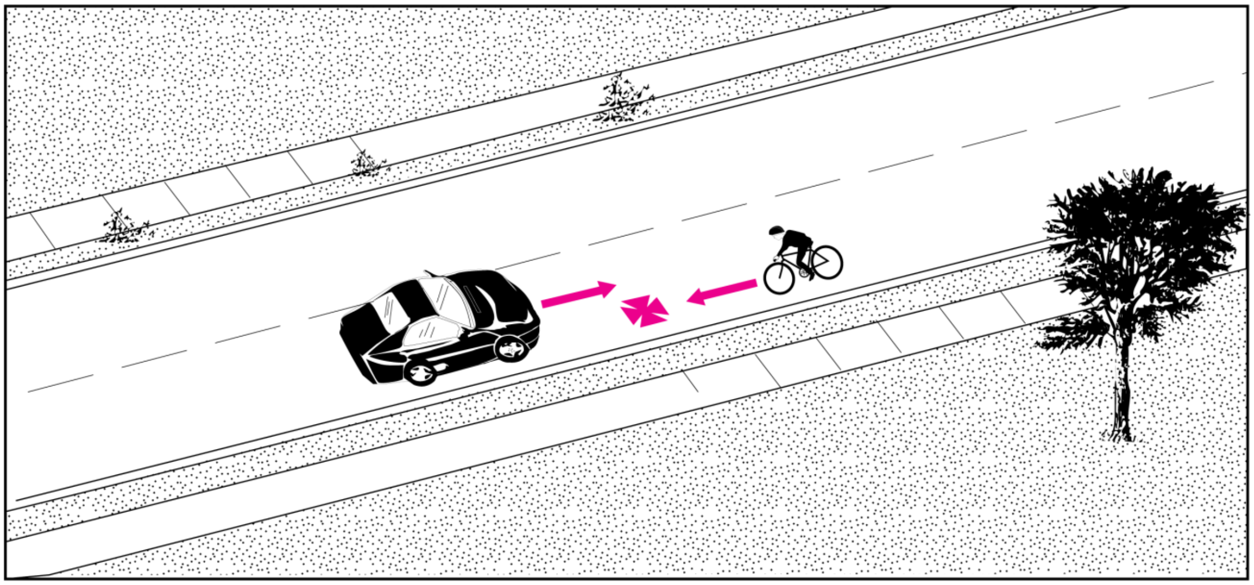


Figure 151. Bicycle Crash Type 250 - Head-on Bicyclist / Motorist / Unknown

Bicycle Crash Group 290 - Parallel Paths - Other Circumstances

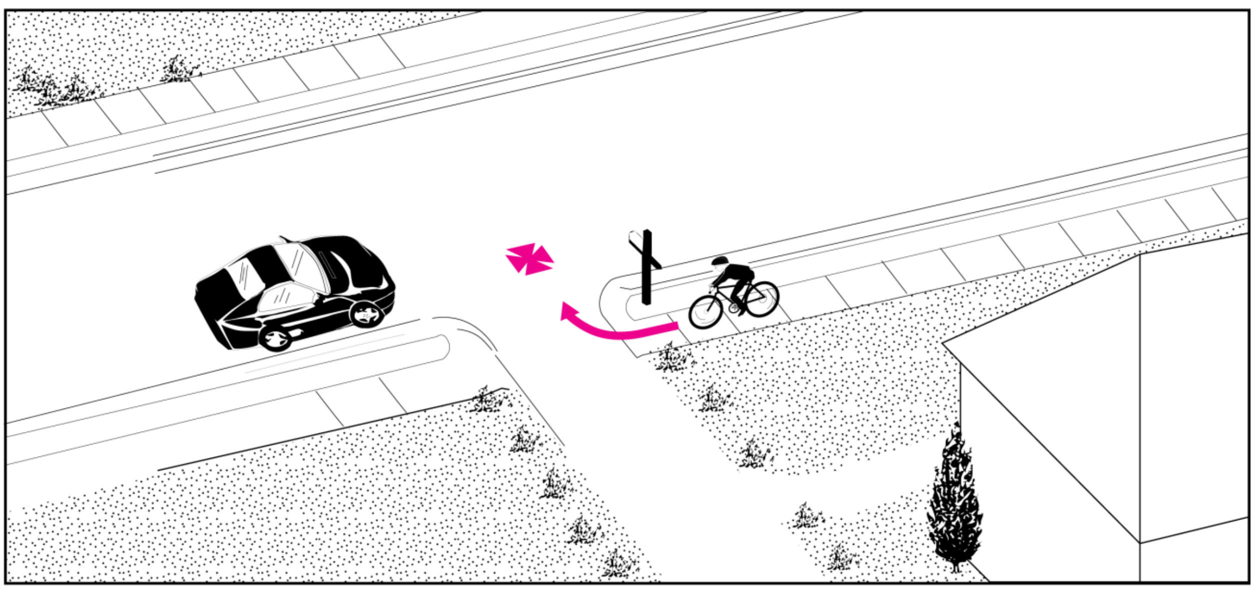


Figure 152. Bicycle Crash Type 225 - Bicyclist Ride Out - Parallel Path

Bicycle Crash Group 310 - Bicyclist Failed to Yield - Midblock

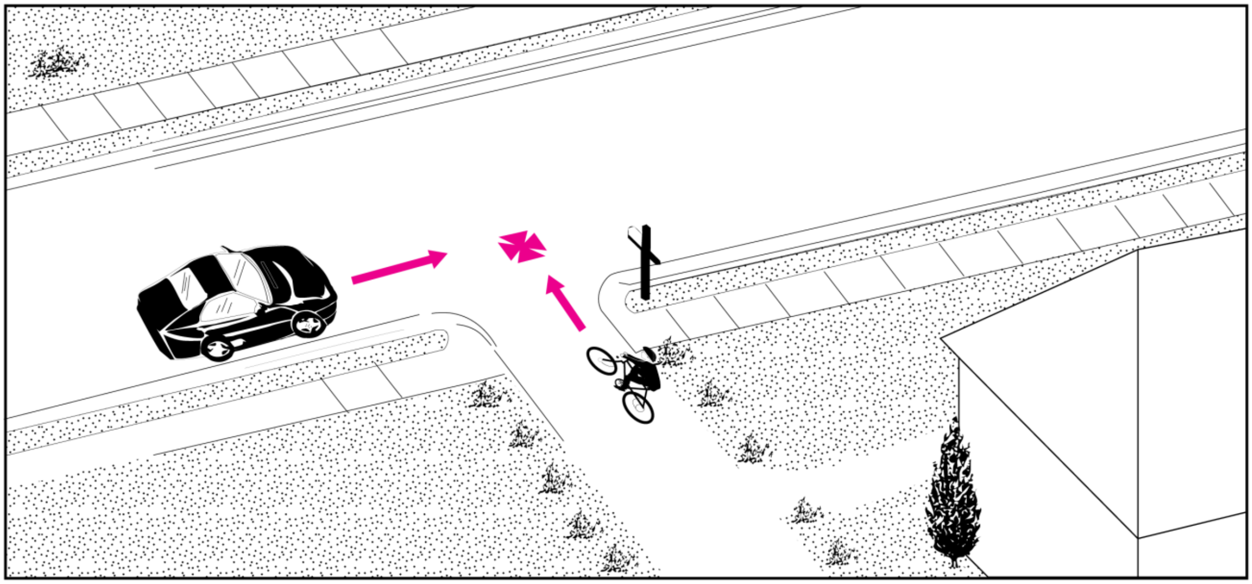


Figure 153. Bicycle Crash Type 311 - Bicyclist Ride Out - Residential Driveway

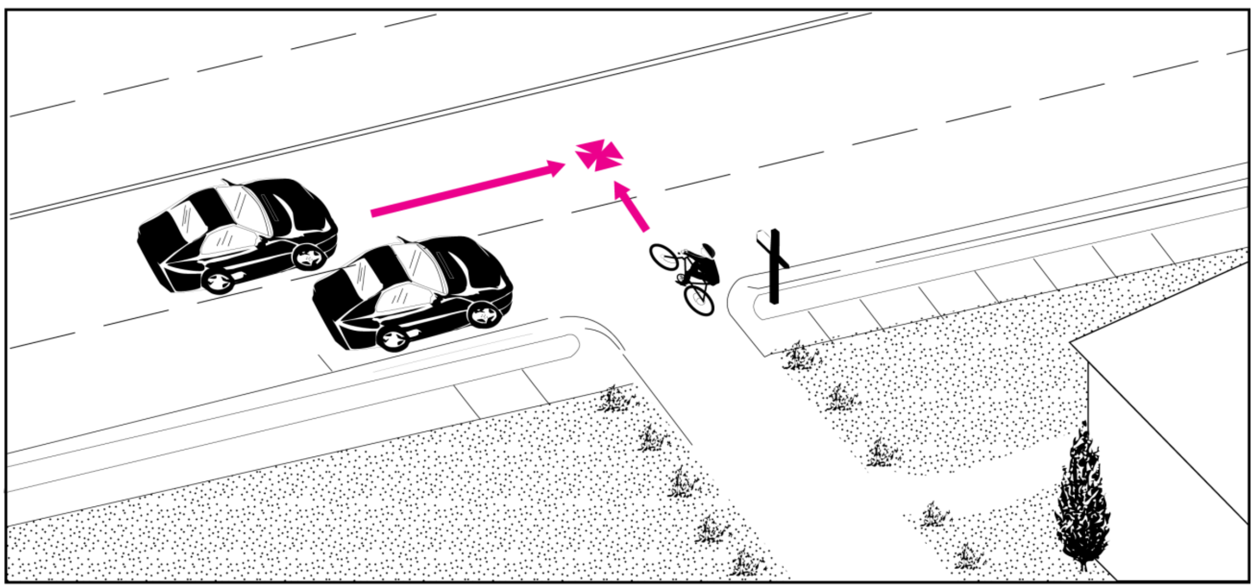


Figure 154. Bicycle Crash Type 357 - Multiple Threat - Midblock

Bicycle Crash Group 320 - Motorist Failed to Yield - Midblock

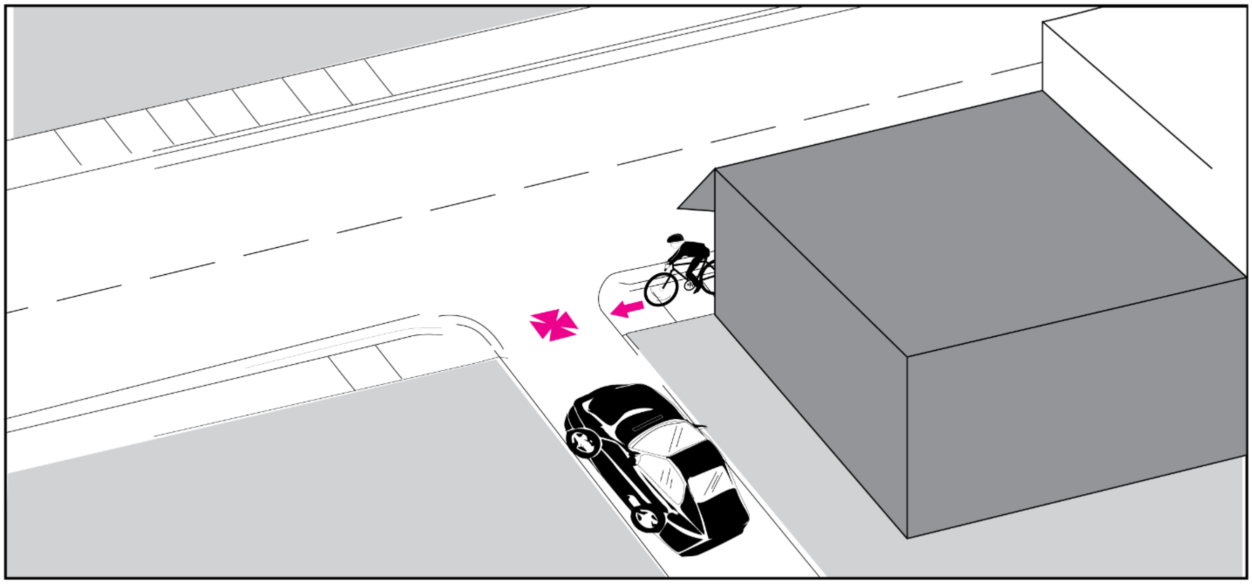


Figure 155. Bicycle Crash Type 321 - Motorist Drive Out - Residential Driveway

Bicycle Crash Group 600 - Backing Vehicle

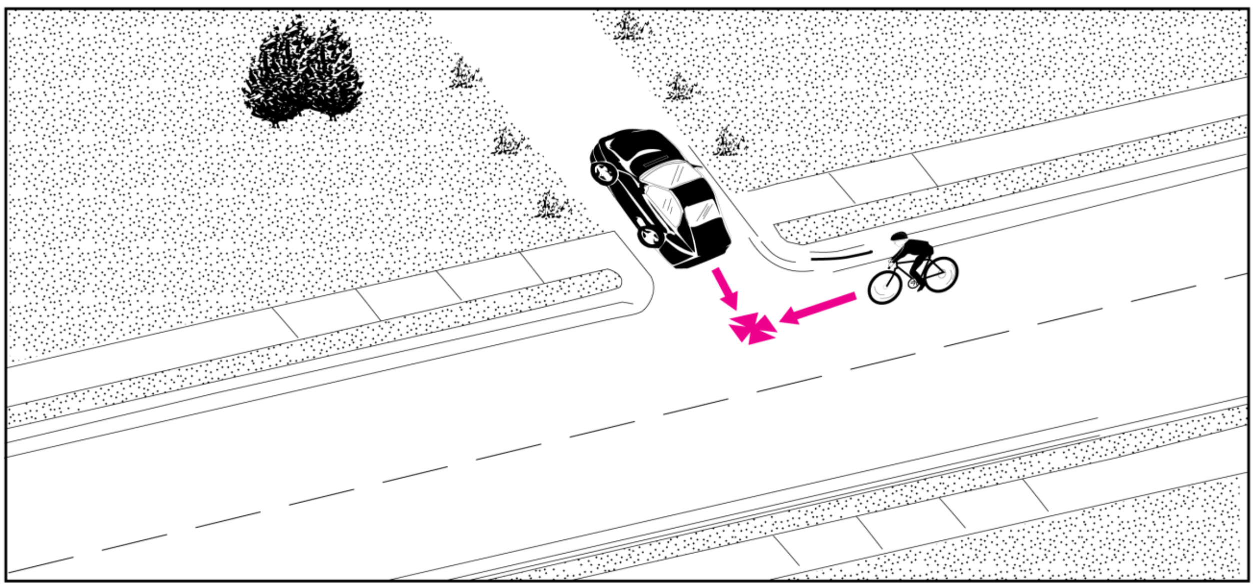


Figure 156. Bicycle Crash Type 600 - Backing Vehicle

Bicycle Crash Group 850 - Other / Unusual Circumstances

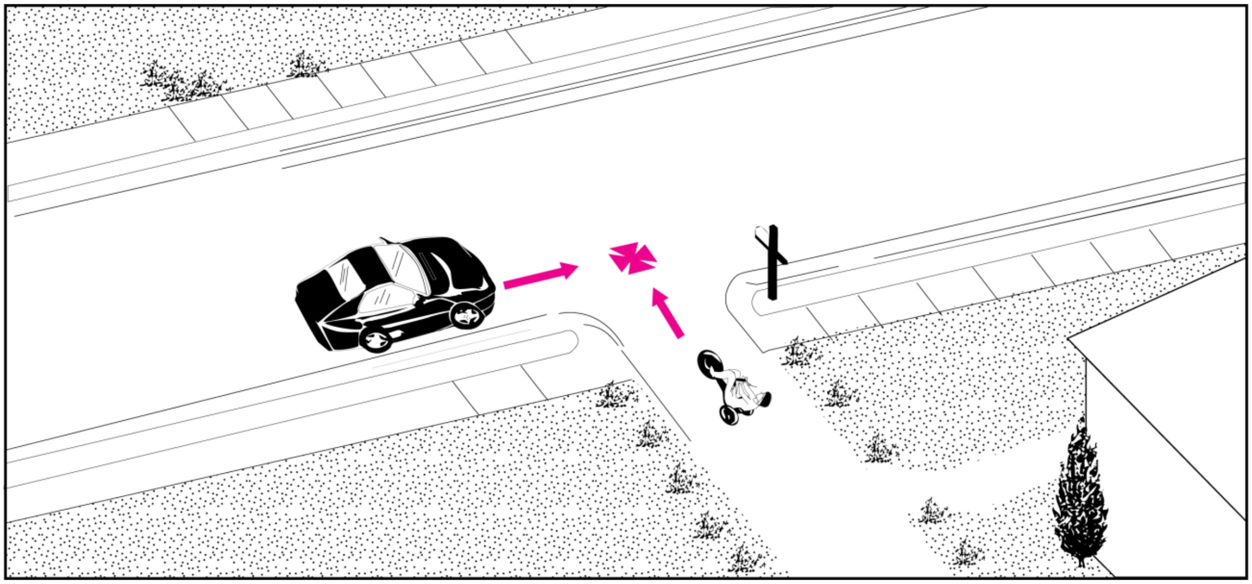


Figure 157. Bicycle Crash Type 700 - Play Vehicle-Related

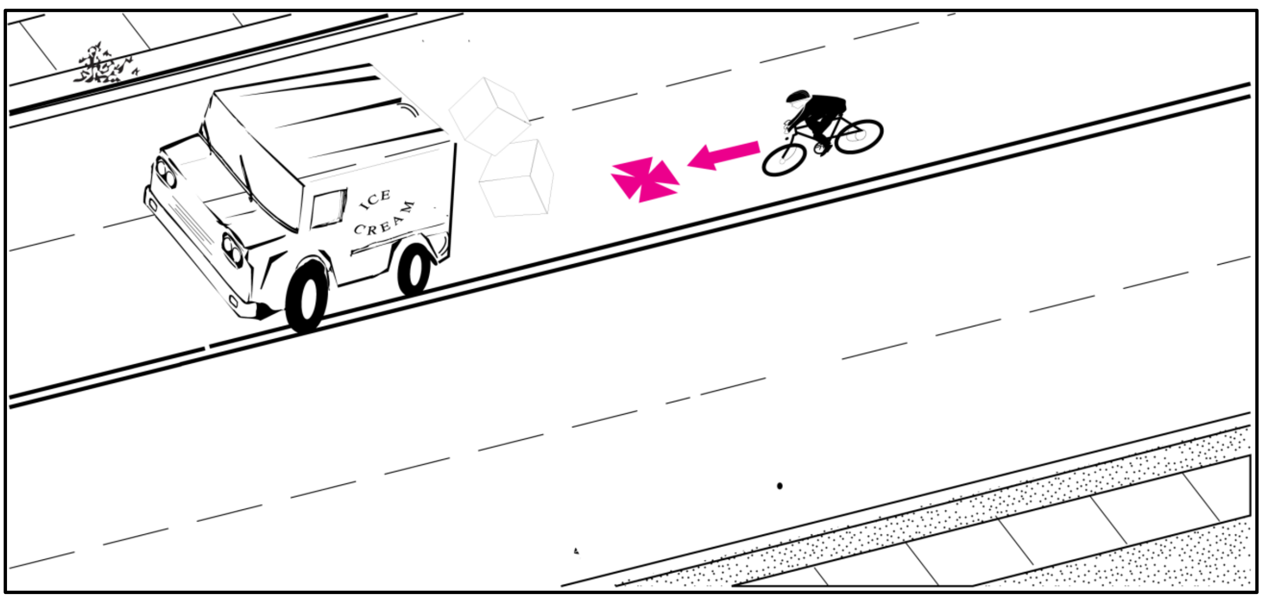


Figure 158. Bicycle Crash Type 800 - Unusual Circumstances

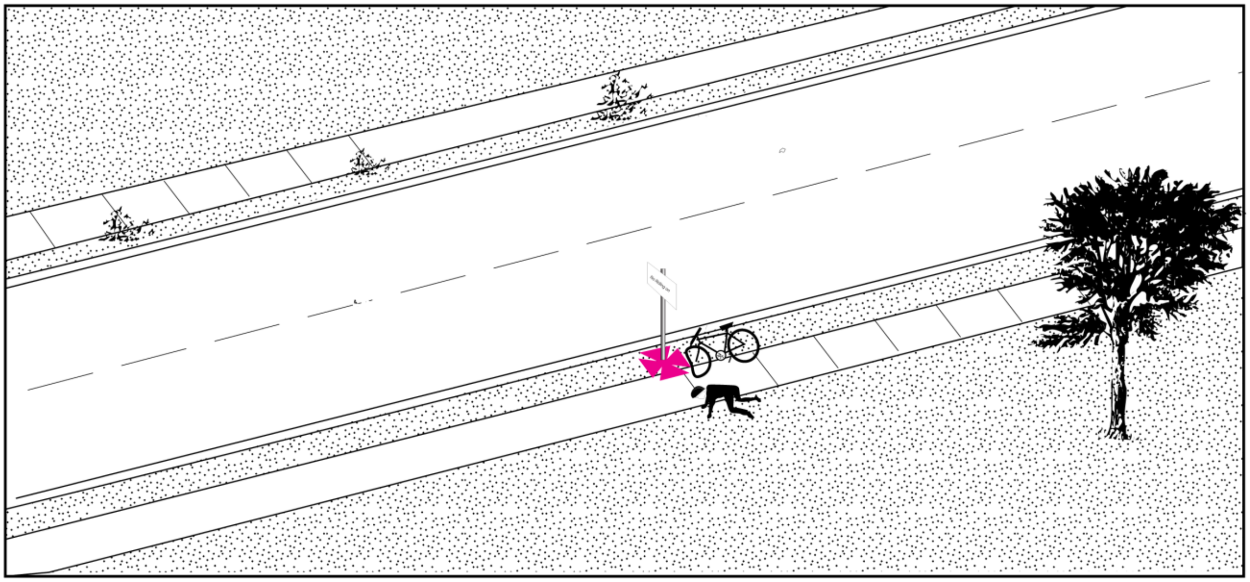


Figure 159. Bicycle Crash Type 400 - Bicycle Only

Bicycle Crash Group 910 - Non-Roadway

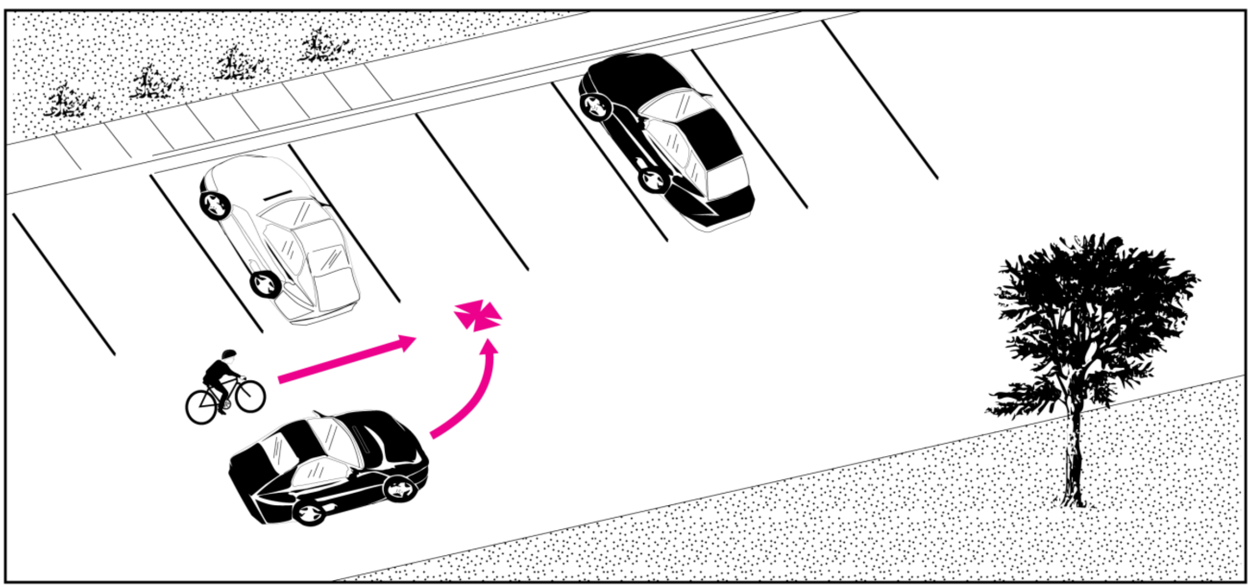


Figure 160. Bicycle Crash Type 910 - Non-Roadway

Appendix D PBCAT - PEDBIKESAFE Crash Type Mapping

Pedestrian Crash Type Mapping

Table 171. Pedestrian Crash Type Mapping (Harkey, et al. 2006)

PEDSAFE Crash Group	PBCAT Crash Group Number	PBCAT Crash Group Name	PBCAT Crash Type Number	PBCAT Crash Type Name
Dart/Dash	740	Dash/Dart-Out	741	Dash
			742	Dart-Out
Multiple Threat/Trapped	720	Multiple Threat/Trapped	710	Multiple Threat
			730	Trapped
Unique Midblock	350	Unique Midblock	320	Entering/Exiting Parked Vehicle
			330	Mailbox-Related
			360	Ice Cream/Vendor Truck-Related
Through Vehicle at Unsignalized Location	750	Crossing Roadway—Vehicle Not Turning	760	Pedestrian Failed to Yield
			770	Motorist Failed to Yield
Bus-Related	340	Bus-Related	341	Commercial Bus-Related
			342	School Bus-Related
Turning Vehicle	790	Crossing Roadway—Vehicle Turning	781	Motorist Left Turn—Parallel Paths
			782	Motorist Left Turn—Perpendicular Paths
			791	Motorist Right Turn—Parallel Paths
			792	Motorist Right Turn on Red—Parallel Paths
			795	Motorist Right Turn—Perpendicular Paths
			794	Motorist Right Turn on Red—Perpendicular Paths
			799	Motorist Turn/Merge—Other/Unknown
	460	Crossing Driveway or Alley	460	Motorist Entering Driveway or Alley
			465	Motorist Exiting Driveway or Alley
			469	Driveway Crossing—Other/Unknown
Through Vehicle at Signalized Location	750	Crossing Roadway—Vehicle Not Turning	760	Pedestrian Failed to Yield
			770	Motorist Failed to Yield
Walking Along Roadway	400	Walking Along Roadway	410	Walking Along Roadway With Traffic—From Behind
			420	Walking Along Roadway With Traffic—From Front
			430	Walking Along Roadway Against Traffic—From Behind
			440	Walking Along Roadway Against Traffic—From Front
			459	Walking Along Roadway—Direction/Position Unknown
Working or Playing in Roadway	310	Working or Playing in Roadway	311	Working in Roadway
			312	Playing in Roadway
Nonroadway	800	Off Roadway	830	Off Roadway—Parking Lot
			890	Off Roadway—Other/Unknown
	460	Crossing Driveway or Alley	460	Motorist Entering Driveway or Alley
			465	Motorist Exiting Driveway or Alley
			469	Driveway Crossing—Other/Unknown

PEDSAFE Crash Group	PBCAT Crash Group Number	PBCAT Crash Group Name	PBCAT Crash Type Number	PBCAT Crash Type Name
Backing Vehicle	200	Backing Vehicle	211	Backing Vehicle—Driveway
			212	Backing Vehicle—Driveway/Sidewalk Intersection
			213	Backing Vehicle—Roadway
			214	Backing Vehicle—Parking Lot
			219	Backing Vehicle—Other/Unknown
Crossing an Expressway	910	Crossing Expressway	910	Crossing an Expressway
Miscellaneous (no specific countermeasures provided in PEDSAFE)	100	Unusual Circumstances	110	Assault with Vehicle
			120	Dispute-Related
			130	Pedestrian on Vehicle
			140	Vehicle-Vehicle/Object
			150	Motor Vehicle Loss of Control
			160	Pedestrian Loss of Control
			190	Other Unusual Circumstances
			220	Driverless Vehicle
			230	Disabled Vehicle-Related
			240	Emergency Vehicle-Related
			250	Play Vehicle-Related
	500	Waiting to Cross	510	Waiting to Cross—Vehicle Turning
			520	Waiting to Cross—Vehicle Not Turning
			590	Waiting to Cross—Vehicle Action Unknown
	600	Pedestrian in Roadway—Circumstances Unknown	620	Walking in Roadway
			610	Standing in Roadway
			313	Lying in Roadway
	990	Other/Unknown—Insufficient Details	900	Other—Unknown Location
			680	Nonintersection—Other/Unknown
			690	Intersection—Other/Unknown

Bicycle Crash Type Mapping

Table 172. Bicycle Crash Type Mapping (Harkey, et al. 2006)

BIKESAFE Crash Group	PBCAT Crash Group Number	PBCAT Crash Group Name	PBCAT Crash Type Number	PBCAT Crash Type Name
Motorist Failed to Yield—Signalized Intersection	150	Motorist Failed to Yield—Signalized Intersection	152	Motorist Drive-out—Signalized Intersection
			151	Motorist Drive-out—Right Turn on Red
			154	Motorist Drive-through—Signalized Intersection
Motorist Failed to Yield—Nonsignalized Intersection	140	Motorist Failed to Yield—Sign-Controlled Intersection	141	Motorist Drive-out—Sign-Controlled Intersection
			143	Motorist Drive-through—Sign-Controlled Intersection
Bicyclist Failed to Yield—Signalized Intersection	158	Bicyclist Failed to Yield—Signalized Intersection	153	Bicyclist Ride-out—Signalized Intersection
			155	Bicyclist Ride Through—Signalized Intersection
			156	Bicyclist Failed to Clear—Trapped
			157	Bicyclist Failed to Clear—Multiple Threat
			159	Bicyclist Failed to Clear—Unknown
Bicyclist Failed to Yield—Nonsignalized Intersection	145	Bicyclist Failed to Yield—Sign-Controlled Intersection	142	Bicyclist Ride-out—Sign-Controlled Intersection
			144	Bicyclist Ride Through—Sign-Controlled Intersection
			147	Multiple Threat—Sign-Controlled Intersection
Motorist Drove-Out—Midblock	320	Motorist Failed to Yield—Midblock	321	Motorist Drive-out—Residential Driveway
			322	Motorist Drive-out—Commercial Driveway/Alley
			328	Motorist Drive-out—Other Midblock
			329	Motorist Drive-out—Midblock—Unknown
Bicyclist Rode Out—Midblock	310	Bicyclist Failed to Yield—Midblock	311	Bicyclist Ride-out—Residential Driveway
			312	Bicyclist Ride-out—Commercial Driveway/Alley
			318	Bicyclist Ride-out—Other Midblock
			319	Bicyclist Ride-out—Midblock—Unknown
			357	Multiple Threat— Midblock
Motorist Turned or Merged Left into Path of Bicyclist	210	Motorist Left Turn/Merge	211	Motorist Left Turn—Same Direction
			212	Motorist Left Turn—Opposite Direction
	219	Parking/Bus-Related	215	Motorist Drive-In/Out Parking
			216	Bus/Delivery Vehicle Pullover
Motorist Turned or Merged Right into Path of Bicyclist	215	Motorist Right Turn/Merge	213	Motorist Right Turn—Same Direction
			217	Motorist Right Turn on Red—Same Direction
			214	Motorist Right Turn—Opposite Direction
			218	Motorist Right Turn on Red—Opposite Direction
	219	Parking/Bus-Related	215	Motorist Drive-In/Out Parking
			216	Bus/Delivery Vehicle Pullover
Bicyclist Turned or Merged Left into Path of Motorist	220	Bicyclist Left Turn/Merge	221	Bicyclist Left Turn—Same Direction
			222	Bicyclist Left Turn—Opposite Direction
			225	Bicyclist Ride-out—Parallel Path
Bicyclist Turned or Merged Right into Path of Motorist	225	Bicyclist Right Turn/Merge	223	Bicyclist Right Turn—Same Direction
			224	Bicyclist Right Turn—Opposite Direction

BIKESAFE Crash Group	PBCAT Crash Group Number	PBCAT Crash Group Name	PBCAT Crash Type Number	PBCAT Crash Type Name
Motorist Overtaking Bicyclist	230	Motorist Overtaking Bicyclist	231	Motorist Overtaking—Undetected Bicyclist
			232	Motorist Overtaking—Misjudged Space
			235	Motorist Overtaking—Bicyclist Swerved
			239	Motorist Overtaking—Other/Unknown
Bicyclist Overtaking Motorist	240	Bicyclist Overtaking Motorist	241	Bicyclist Overtaking—Passing on Right
			242	Bicyclist Overtaking—Passing on Left
			243	Bicyclist Overtaking—Parked Vehicle
			244	Bicyclist Overtaking—Extended Door
			249	Bicyclist Overtaking—Other/Unknown
Nonmotor Vehicle Crashes			400	Bicycle Only
Miscellaneous (no specific countermeasures provided in BIKESAFE)	110	Loss of Control/Turning Error	121	Bicyclist Lost Control—Mechanical problems
			122	Bicyclist Lost Control—Oversteering, Improper Braking, Speed
			123	Bicyclist Lost Control—Alcohol/Drug Impairment
			124	Bicyclist Lost Control—Surface Conditions
			129	Bicyclist Lost Control—Other/Unknown
			131	Motorist Lost Control—Mechanical Problems
			132	Motorist Lost Control—Oversteering, Improper Braking, Speed
			133	Motorist Lost Control—Alcohol/Drug Impairment
			134	Motorist Lost Control—Surface Conditions
			139	Motorist Lost Control—Other/Unknown
			111	Motorist Turning Error—Left Turn
			112	Motorist Turning Error—Right Turn
			113	Motorist Turning Error—Other
			114	Bicyclist Turning Error—Left Turn
			115	Bicyclist Turning Error—Right Turn
			116	Bicyclist Turning Error—Other
	190	Crossing Paths—Other Circumstances	148	Sign-Controlled Intersection—Other/Unknown
			158	Signalized Intersection—Other/Unknown
			180	Crossing Paths—Intersection—Other/Unknown Control
			160	Crossing Paths—Uncontrolled Intersection
			380	Crossing Paths—Midblock—Other/Unknown
	258	Head-On	250	Head-On—Bicyclist
			255	Head-On—Motorist
			259	Head-On—Unknown
	290	Parallel Paths—Other Circumstances	219	Motorist Turn/Merge—Other/Unknown
			280	Parallel Paths—Other/Unknown
			225	Bicyclist Ride-out—Parallel Path
	600	Backing Vehicle	600	Backing Vehicle
	850	Other/Unusual Circumstances	510	Motorist Intentionally Caused
			520	Bicyclist Intentionally Caused
			700	Play Vehicle-Related
			800	Unusual Circumstances
			400	Bicycle Only
	910	Nonroadway	910	Nonroadway
	990	Other/Unknown—Insufficient Details	980	Unknown Location
			970	Unknown Approach Paths

Appendix E Parsing Rules for PD-10 Form Data Items

Table 173. List of Parsing Rules for PD-10 Form Data Items

#	Field Name on PD-10 Form	Parsing Rule Template	Parsing Rule Details	# Columns	Further Actions Needed	Note
1	1 Date of Crash	Date	Crop selection + Use for following pages	1	No	
2	2 Time of Crash	Repeating Text Values	Crop selection + Keyword: "2 Time of Crash" + Move Cursor 1 line + Value ends "End of line"	1	No	
3	3 Day of Week	NA	-	1	Yes	Can be retrieved from "Date of Crash"
4	4 Date of Report	Date	Crop selection + Use for following pages	1	No	
5	5 Complaint Number (CCN)	Repeating Text Values	Crop selection + Keyword: "5 Complaint Number (CCN)" + Move Cursor 1 line + + Value ends "End of line"	1	No	
6	6 UCC Number	Repeating Text Values	Keyword: "6 UCC Number" + Move Cursor 1 line + Value ends after 11 characters	1	Yes	Cases without values must be checked later.
7	7 Type of Crash	Repeating Text Blocks	Crop selection + Based on text patterns: 1st line contains "01 Fatality" + Last line contains "99 Other"	2	Yes	Due to data structure multiple columns (2) will be created.
8	8 [Crash] Location	Repeating Text Values	Crop selection + Keyword: "8 Location" + Move Cursor 1 line + Value ends "End of line"	1	No	
9	9 District	Repeating Text Values	Crop selection + Keyword: "9 District" + Move Cursor 1 line + Value ends "End of line"	1	No	
10	10 PSA	Repeating Text Values	Crop selection + Keyword: "10 PSA" + Move Cursor 1 line + Value ends "End of line"	1	No	
11	11 Distance	Repeating Text Values	Crop selection + Keyword: "Name" + Replace "Name" with " " and then Replace "Feet" with " "	1	Yes	Cases without values must be checked later.
12	11 Direction	Repeating Text Values	Crop selection + Keyword: "Feet" + Replace "Feet" with " " and then Replace "from"	1	Yes	Cases without values must be checked later.

#	Field Name on PD-10 Form	Parsing Rule Template	Parsing Rule Details	# Columns	Further Actions Needed	Note
			with " "			
13	11 Intersection/Block	Repeating Text Values	Crop selection + Keyword: "Block" + Move Cursor 1 line + Value ends "End of line"	1	Yes	Cases without values must be checked later.
14	11 Freeway Mile Post	Repeating Text Values	Crop selection + Keyword: "Post:" + Move Cursor 1 line + Value ends "End of line"	1	Yes	Cases without values must be checked later.
15	11 PEPCO Pole No	Repeating Text Values	Crop selection + Keyword: "Pole No.:" + Move Cursor 1 line + Value ends "End of line"	1	Yes	Cases without values must be checked later.
16	11 Exit Ramp	Repeating Text Values	Crop selection + Keyword: "Ramp:" + Move Cursor 1 line + Value ends "End of line"	1	Yes	Cases without values must be checked later.
17	11 Bridge	Repeating Text Values	Crop selection + Keyword: "Bridge:" + Move Cursor 1 line + Value ends "End of line"	1	Yes	Cases without values must be checked later.
18	11 Tunnel	Repeating Text Values	Crop selection + Keyword: "Tunnel:" + Move Cursor 1 line + Value ends "End of line"	1	Yes	Cases without values must be checked later.
19	11 Other	Repeating Text Values	Crop selection + Keyword: "Other:" + Move Cursor 1 line + Value ends "End of line"	1	Yes	Cases without values must be checked later.
20	11 City Quadrant	Repeating Text Values	Crop selection + Keyword "City Quadrant:" + Move Cursor 17 characters + Value ends "End of line"	1	Yes	This is a part of PD-10 Form item "11 Location Type and Name". Cases without values must be checked later.
21	12 Construction Zone	Repeating Text Values	Crop selection + Keyword: "12 Construction Zone?" + Move Cursor 1 line + Value ends "End of line"	1	No	
22	13 On-Street Location	Repeating Text Blocks	Crop selection + Based on text patterns: 1st line contains "01 At Intersection" + Last line contains "99 Other"	3	Yes	Due to data structure multiple columns (3) will be created.
23	14 Off-Street Location	Repeating Text Blocks	Crop selection + Based on text patterns: 1st line	3	Yes	Due to data structure multiple

#	Field Name on PD-10 Form	Parsing Rule Template	Parsing Rule Details	# Columns	Further Actions Needed	Note
			contains "01 Public Space" + Last line contains "99 Other"			columns (3) will be created.
24	15 Report taken on Scene	Repeating Text Values	Keyword: "Report taken on Scene" + Move Cursor 1 line + Value ends "End of line"	1	No	
25	16 Photos taken	Repeating Text Values	Crop selection + Keyword: "Photos taken" + Move Cursor 1 line + Value ends "End of line"	1	No	
26	16a Number of photos	Repeating Text Values	Crop selection + Keyword: "16a If yes, # photos" + Move Cursor 1 line + Value ends "End of line"	1	Yes	Cases without values must be checked later.
27	17 Number of Vehicles Involved	Repeating Text Values	Crop selection + Keyword: "# Vehicles Involved" + Move Cursor 1 line + Value ends "End of line"	1	No	
28	18 Number of Injured Persons	Repeating Text Values	Crop selection + Keyword: "18 # Injured Persons" + Move Cursor 1 line + Value ends "End of line"	1	No	
29	19 Number of Occupants	Repeating Text Values	Crop selection + Keyword: "Occupants (Including driver)" + Move Cursor 2 lines and 1 character + Value ends "End of line"	1	Yes	Number of Occupants (Including driver) Due to data structure data split will be needed.
30	20 Number of Fatalities	Repeating Text Values	Crop selection + Keyword: "20 Fatalities" + Move Cursor 1 line + Value ends "End of line"	1	No	
31	189 Type of Crash	Repeating Text Values	Crop selection + Keyword: "189 Type of Crash" + Move Cursor 1 line + Value ends "End of line"	1	Yes	Cases without values must be checked later.
32	190 Road Surface	Repeating Text Values	Crop selection + Keyword: "190 Road Surface" + Move Cursor 1 line + Value ends "End of line"	1	Yes	Cases without values must be checked later.
33	191 Road Type	Repeating Text Values	Crop selection + Keyword: "191 Road Type" + Move Cursor 1	1	Yes	Cases without values must be checked later.

#	Field Name on PD-10 Form	Parsing Rule Template	Parsing Rule Details	# Columns	Further Actions Needed	Note
			line + Value ends "End of line"			
34	192 Road Condition	Repeating Text Values	Crop selection + Keyword: "192 Road Condition" + Move Cursor 1 line + Value ends "End of line"	1	Yes	Cases without values must be checked later.
35	193 Street Lighting	Repeating Text Values	Crop selection + Keyword: "193 Street Lighting" + Move Cursor 1 line + Value ends "End of line"	1	Yes	Cases without values must be checked later.
36	194 Light Condition	Repeating Text Values	Crop selection + Keyword: "194 Light Condition" + Move Cursor 1 line + Value ends "End of line"	1	Yes	Cases without values must be checked later.
37	195 Weather	Repeating Text Values	Crop selection + Keyword: "195 Weather" + Move Cursor 1 line + Value ends "End of line"	1	Yes	Cases without values must be checked later.
38	196 Traffic Condition	Repeating Text Values	Crop selection + Keyword: "196 Traffic Condition" + Move Cursor 1 line + Value ends "End of line"	1	Yes	Cases without values must be checked later.
39	197 Roadway Type	Repeating Text Values	Crop selection + Keyword: "197 Roadway Type" + Move Cursor 1 line + Value ends "End of line"	1	Yes	Cases without values must be checked later.
40	198 Traffic Controls	Repeating Text Values	Crop selection + Keyword: "198 Traffic Controls" + Move Cursor 1 line + Value ends "End of line"	1	Yes	Cases without values must be checked later.
41	199 Pedestrian Action	Repeating Text Values	Crop selection + Keyword: "199 Pedestrian Action" + Move Cursor 1 line + Value ends "End of line"	1	Yes	Cases without values must be checked later.
42	21 Object Type [1]	Repeating Text Blocks	Crop selection + Based on text patterns: 1st line contains "01 Driver" + Last line contains "99 Other"	2	Yes	Due to data structure multiple columns (2) will be created.
43	23 Sex [1]	Repeating Text Values	Crop selection + Keyword: "23 Sex" + Move Cursor 1 line +	1	Yes	Cases without values must be checked later.

#	Field Name on PD-10 Form	Parsing Rule Template	Parsing Rule Details	# Columns	Further Actions Needed	Note
			Value ends "End of line"			
44	24 DOB [1]	Repeating Text Values	Crop selection + Keyword: "24 DOB" + Move Cursor 1 line + Value ends "End of line"	1	Yes	Cases without values must be checked later.
45	30 State [1]	Repeating Text Values	Crop selection + Keyword: "30 State" + Move Cursor 1 line + Value ends "End of line"	1	No	
46	31 Class [1]	Repeating Text Values	Crop selection + Keyword: "31 Class" + Move Cursor 1 line + Value ends "End of line"	1	No	
47	35 Make [1]	Repeating Text Values	Crop selection + Keyword: "35 Make" + Move Cursor 1 line + Value ends "End of line"	1	No	
48	36 Made [1]	Repeating Text Values	Crop selection + Keyword: "36 Made" + Move Cursor 1 line + Value ends "End of line"	1	No	
49	37 Year [1]	Repeating Text Values	Crop selection + Keyword: "37 Year" + Move Cursor 1 line + Value ends "End of line"	1	Yes	Cases without values must be checked later.
50	38 Body [1]	Repeating Text Values	Crop selection + Keyword: "38 Body" + Move Cursor 1 line + Value ends "End of line"	1	Yes	Due to the size of PD-10 form cell, some values could not fit the dedicated area.
51	39 Color [1]	Repeating Text Values	Crop selection + Keyword: "39 Color" + Move Cursor 1 line + Value ends "End of line"	1	Yes	Cases without values must be checked later.
52	42 State [1]	Repeating Text Values	Crop selection + Keyword: "42 State" + Move Cursor 1 line + Value ends "End of line"	1	Yes	Cases without values must be checked later.
53	43 Year [1]	Repeating Text Values	Crop selection + Keyword: "43 Year" + Move Cursor 1 line + Value ends "End of line"	1	Yes	Cases without values must be checked later.
54	50 Object Type [2]	Repeating Text Blocks	Crop selection + Based on text patterns: 1st line contains "01 Driver" + Last line contains "99 Other"	2	Yes	Due to data structure multiple columns (2) will be created.

#	Field Name on PD-10 Form	Parsing Rule Template	Parsing Rule Details	# Columns	Further Actions Needed	Note
55	52 Sex [2]	Repeating Text Values	Crop selection + Keyword: "52 Sex" + Move Cursor 1 line + Value ends "End of line"	1	Yes	Cases without values must be checked later.
56	53 DOB [2]	Repeating Text Values	Crop selection + Keyword: "53 DOB" + Move Cursor 1 line + Value ends "End of line"	1	Yes	Cases without values must be checked later.
57	59 State [2]	Repeating Text Values	Crop selection + Keyword: "59 State" + Move Cursor 1 line + Value ends "End of line"	1	Yes	Cases without values must be checked later.
58	60 Class [2]	Repeating Text Values	Crop selection + Keyword: "60 Class" + Move Cursor 1 line + Value ends "End of line"	1	No	
59	64 Make [2]	Repeating Text Values	Crop selection + Keyword: "64 Make" + Move Cursor 1 line + Value ends "End of line"	1	Yes	Cases without values must be checked later. Due to the size of PD-10 form cell, some values could not fit the dedicated area.
60	65 Made [2]	Repeating Text Values	Crop selection + Keyword: "65 Made" + Move Cursor 1 line + Value ends "End of line"	1	No	
61	66 Year [2]	Repeating Text Values	Crop selection + Keyword: "66 Year" + Move Cursor 1 line + Value ends "End of line"	1	Yes	Cases without values must be checked later.
62	67 Body [2]	Repeating Text Values	Crop selection + Keyword: "67 Body" + Move Cursor 1 line + Value ends "End of line"	1	Yes	Due to the size of PD-10 form cell, some values could not fit the dedicated area.
63	68 Color [2]	Repeating Text Values	Crop selection + Keyword: "68 Color" + Move Cursor 1 line + Value ends "End of line"	1	Yes	Cases without values must be checked later.
64	71 State [2]	Repeating Text Values	Crop selection + Keyword: "71 State" + Move Cursor 1 line + Value ends "End of line"	1	Yes	Cases without values must be checked later.
65	72 Year [2]	Repeating Text Values	Crop selection + Keyword: "72 Year" + Move Cursor 1 line + Value ends "End of line"	1	Yes	Cases without values must be checked later.

#	Field Name on PD-10 Form	Parsing Rule Template	Parsing Rule Details	# Columns	Further Actions Needed	Note
66	79 Object Type [3]	Repeating Text Blocks	Crop selection + Based on text patterns: 1st line contains "01 Driver" + Last line contains "99 Other"	2	Yes	Due to data structure multiple columns (2) will be created.
67	81 Sex [3]	Repeating Text Values	Crop selection + Keyword: "81 Sex" + Move Cursor 1 line + Value ends "End of line"	1	Yes	Cases without values must be checked later. Many cases are blank.
68	82 DOB [3]	Repeating Text Values	Crop selection + Keyword: "82 DOB" + Move Cursor 1 line + Value ends "End of line"	1	Yes	Cases without values must be checked later. Many cases are blank.
69	88 State [3]	Repeating Text Values	Crop selection + Keyword: "88 State" + Move Cursor 1 line + Value ends "End of line"	1	Yes	Cases without values must be checked later. Many cases are blank.
70	89 Class [3]	Repeating Text Values	Crop selection + Keyword: "89 Class" + Move Cursor 1 line + Value ends "End of line"	1	Yes	Cases without values must be checked later. Many cases are blank.
71	93 Make [3]	Repeating Text Values	Crop selection + Keyword: "93 Make" + Move Cursor 1 line + Value ends "End of line"	1	Yes	Cases without values must be checked later. Many cases are blank.
72	94 Made [3]	Repeating Text Values	Crop selection + Keyword: "94 Made" + Move Cursor 1 line + Value ends "End of line"	1	Yes	Cases without values must be checked later. Many cases are blank.
73	95 Year [3]	Repeating Text Values	Crop selection + Keyword: "95 Year" + Move Cursor 1 line + Value ends "End of line"	1	Yes	Cases without values must be checked later. Many cases are blank.
74	96 Body [3]	Repeating Text Values	Crop selection + Keyword: "96 Body" + Move Cursor 1 line + Value ends "End of line"	1	Yes	Due to the size of PD-10 form cell, some values could not fit the dedicated area. Many cases are blank.
75	97 Color [3]	Repeating Text Values	Crop selection + Keyword: "97 Color" +	1	Yes	Cases without values must be

#	Field Name on PD-10 Form	Parsing Rule Template	Parsing Rule Details	# Columns	Further Actions Needed	Note
			Move Cursor 1 line + Value ends "End of line"			checked later. Many cases are blank.
76	100 State [3]	Repeating Text Values	Crop selection + Keyword: "100 State" + Move Cursor 1 line + Value ends "End of line"	1	Yes	Cases without values must be checked later. Many cases are blank.
77	101 Year [3]	Repeating Text Values	Crop selection + Keyword: "101 Year" + Move Cursor 1 line + Value ends "End of line"	1	Yes	Cases without values must be checked later. Many cases are blank.
78	108 Object Type [4]	Repeating Text Blocks	Crop selection + Based on text patterns: 1st line contains "01 Driver" + Last line contains "99 Other"	2	Yes	Due to data structure multiple columns (2) will be created.
79	110 Sex [4]	Repeating Text Values	Crop selection + Keyword: "110 Sex" + Move Cursor 1 line + Value ends "End of line"	1	Yes	Cases without values must be checked later. Many cases are blank.
80	111 DOB [4]	Repeating Text Values	Crop selection + Keyword: "111 DOB" + Move Cursor 1 line + Value ends "End of line"	1	Yes	Cases without values must be checked later. Many cases are blank.
81	117 State [4]	Repeating Text Values	Crop selection + Keyword: "117 State" + Move Cursor 1 line + Value ends "End of line"	1	Yes	Cases without values must be checked later. Many cases are blank.
82	118 Class [4]	Repeating Text Values	Crop selection + Keyword: "118 Class" + Move Cursor 1 line + Value ends "End of line"	1	Yes	Cases without values must be checked later. Many cases are blank.
83	122 Make [4]	Repeating Text Values	Crop selection + Keyword: "122 Make" + Move Cursor 1 line + Value ends "End of line"	1	Yes	Cases without values must be checked later. Many cases are blank.
84	123 Made [4]	Repeating Text Values	Crop selection + Keyword: "123 Made" + Move Cursor 1 line + Value ends "End of line"	1	Yes	Cases without values must be checked later. Many cases are blank.

#	Field Name on PD-10 Form	Parsing Rule Template	Parsing Rule Details	# Columns	Further Actions Needed	Note
85	124 Year [4]	Repeating Text Values	Crop selection + Keyword: "124 Year" + Move Cursor 1 line + Value ends "End of line"	1	Yes	Cases without values must be checked later. Many cases are blank.
86	125 Body [4]	Repeating Text Values	Crop selection + Keyword: "125 Body" + Move Cursor 1 line + Value ends "End of line"	1	Yes	Due to the size of PD-10 form cell, some values could not fit the dedicated area. Many cases are blank.
87	126 Color [4]	Repeating Text Values	Crop selection + Keyword: "126 Color" + Move Cursor 1 line + Value ends "End of line"	1	Yes	Cases without values must be checked later. Many cases are blank.
88	129 State [4]	Repeating Text Values	Crop selection + Keyword: "129 State" + Move Cursor 1 line + Value ends "End of line"	1	Yes	Cases without values must be checked later. Many cases are blank.
89	130 Year [4]	Repeating Text Values	Crop selection + Keyword: "130 Year" + Move Cursor 1 line + Value ends "End of line"	1	Yes	Cases without values must be checked later. Many cases are blank.
90	158 STRIKING OBJECT/VEHICLE #1	Repeating Text Blocks	Crop selection + Based on text patterns: 1st line contains "01 N/B" + Last line contains "99 Other"	2	Yes	Due to data structure multiple columns (2) will be created.
91	163 STRIKING OBJECT/VEHICLE #2	Repeating Text Blocks	Crop selection + Based on text patterns: 1st line contains "01 N/B" + Last line contains "99 Other"	2	Yes	Due to data structure multiple columns (2) will be created.
92	168 STRIKING OBJECT/VEHICLE #3	Repeating Text Blocks	Crop selection + Based on text patterns: 1st line contains "01 N/B" + Last line contains "99 Other"	2	Yes	Due to data structure multiple columns (2) will be created. Many cases are blank.
93	173 STRIKING OBJECT/VEHICLE #4	Repeating Text Blocks	Crop selection + Based on text patterns: 1st line contains "01 N/B" + Last line contains "99 Other"	2	Yes	Due to data structure multiple columns (2) will be created. Many cases are blank.
94	137 Assoc. w/Veh #	Repeating Text Blocks	Crop selection + Based on text patterns: 1st line contains "w/Veh #"	5	Yes	Due to data structure multiple columns (5) will be created. Cases

#	Field Name on PD-10 Form	Parsing Rule Template	Parsing Rule Details	# Columns	Further Actions Needed	Note
						without values must be checked later.
95	141 Sex	Repeating Text Blocks	Crop selection + Based on text patterns: 1st line contains "Sex"	5	Yes	Due to data structure multiple columns (5) will be created. Cases without values must be checked later.
96	142 Age	Repeating Text Blocks	Crop selection + Based on text patterns: 1st line contains "Age"	5	Yes	Due to data structure multiple columns (5) will be created. Cases without values must be checked later.
97	144 To Hospital	Repeating Text Blocks	Crop selection + Based on text patterns: 1st line contains "Hosp.?"	5	Yes	Due to data structure multiple columns (5) will be created. Cases without values must be checked later.
98	201 Seat Location Code	Repeating Text Blocks	Crop selection + Based on text patterns: 1st line contains "201 Seat Location Code"	5	Yes	Due to data structure multiple columns (5) will be created. Cases without values must be checked later.
99	202 Seat Belt Code	Repeating Text Blocks	Crop selection + Based on text patterns: 1st line contains "202 Seat BeltCode"	5	Yes	Due to data structure multiple columns (5) will be created. Cases without values must be checked later.
100	203 Air Bag Code	Repeating Text Blocks	Crop selection + Based on text patterns: 1st line contains "203 Air Bag Code"	5	Yes	Due to data structure multiple columns (5) will be created. Cases without values must be checked later.
101	204 Ejection Code	Repeating Text Blocks	Crop selection + Based on text patterns: 1st line contains "204 Ejection Code"	5	Yes	Due to data structure multiple columns (5) will be created. Cases

#	Field Name on PD-10 Form	Parsing Rule Template	Parsing Rule Details	# Columns	Further Actions Needed	Note
						without values must be checked later.
102	205 Injury Code	Repeating Text Blocks	Crop selection + Based on text patterns: 1st line contains "205 Injury Code"	5	Yes	Due to data structure multiple columns (5) will be created. Cases without values must be checked later.
103	206 Driver/Pedestrian Condition	Repeating Text Blocks	Crop selection + Based on text patterns: 1st line contains "206 Driver/Pedestrian Condition"	5	Yes	Due to data structure multiple columns (5) will be created. Cases without values must be checked later.
104	207 Impairment	Repeating Text Blocks	Crop selection + Based on text patterns: 1st line contains "207 Impairment"	5	Yes	Due to data structure multiple columns (5) will be created. Cases without values must be checked later.
105	208 Type of Test Conducted	Repeating Text Blocks	Crop selection + Based on text patterns: 1st line contains "208 Type of Test Conducted"	5	Yes	Due to data structure multiple columns (5) will be created. Cases without values must be checked later.
106	209 BAC	Repeating Text Blocks	Crop selection + Based on text patterns: 1st line contains "209 BAC"	5	Yes	Due to data structure multiple columns (5) will be created. Cases without values must be checked later.
107	210 Electronic Device	Repeating Text Blocks	Crop selection + Based on text patterns: 1st line contains "210 Elec.Device?"	5	Yes	Due to data structure multiple columns (5) will be created. Cases without values must be checked later.
108	211 Driver/Pedestrian Distraction	Repeating Text Blocks	Crop selection + Based on text patterns: 1st line contains "211 Driver/Pedestrian	5	Yes	Due to data structure multiple columns (5) will be created. Cases

#	Field Name on PD-10 Form	Parsing Rule Template	Parsing Rule Details	# Columns	Further Actions Needed	Note
			Distraction"			without values must be checked later.
109	212 Primary Contributing Circumstances	Repeating Text Blocks	Crop selection + Based on text patterns: 1st line contains "212 Primary Contributing Circumstances"	5	Yes	Due to data structure multiple columns (5) will be created. Cases without values must be checked later.
110	213 Driver Action	Repeating Text Blocks	Crop selection + Based on text patterns: 1st line contains "213 Driver Action"	5	Yes	Due to data structure multiple columns (5) will be created. Cases without values must be checked later.
111	214 Vehicle Type: Private	Repeating Text Blocks	Crop selection + Based on text patterns: 1st line contains "214 Vehicle Type: Private"	5	Yes	Due to data structure multiple columns (5) will be created. Cases without values must be checked later.
112	215 Vehicle Type: Government	Repeating Text Blocks	Crop selection + Based on text patterns: 1st line contains "215 Vehicle Type"	5	Yes	Due to data structure multiple columns (5) will be created. Cases without values must be checked later.
113	216 Vehicle Type: Commercial	Repeating Text Blocks	Crop selection + Based on text patterns: 1st line contains "216 Vehicle Type: Commercial"	5	Yes	Due to data structure multiple columns (5) will be created. Cases without values must be checked later.
114	179 Detailed Narrative	Repeating Text Blocks	Crop selection + Based on text patterns: 1st line starts with "179 Detailed Narrative" + Last line contains "This report is used for statistical analysis of vehicular crashes"	Varies	Yes	Due to varying number of narrative lines multiple columns (0-40) will be created. The columns should be concatenated later.
115	Reporter Badge No.	Repeating Text Values	Crop selection + Keyword: "Reporter Badge No." + Move	1	Yes	Cases without values must be checked later.

#	Field Name on PD-10 Form	Parsing Rule Template	Parsing Rule Details	# Columns	Further Actions Needed	Note
			Cursor 1 line + Value ends "End of line"			
116	Official Badge No.	Repeating Text Values	Crop selection + Keyword: "Official Badge No." + Move Cursor 1 line + Value ends "End of line"	1	Yes	Cases without values must be checked later.
117	Approval Level	Repeating Text Values	Crop selection + Keyword: "Approval Level" + Move Cursor 1 line + Value ends after "2" characters	1	Yes	Cases without values must be checked later.
118	Last Update Stamp	Date	Crop selection + Use for following pages	1	No	

Appendix F DocParser Dataset Cleaning and Post-processing Steps

DocParser Dataset Cleaning and Post-processing Steps:

- Deleting blank rows (45 rows from pedestrian dataset and 30 rows from bicycle dataset)
- Reviewing and modifying parsed data fields (especially for following fields):
  - 4 Data Of Report
  - 11 Freeway Mile Post: deleting "Post;"
  - 11 PEPCO Pole No: deleting "Pole No.:"
  - 11 Exit Ramp: deleting "Ramp:"
  - 11 Bridge: deleting "Bridge:"
  - 11 Tunnel: deleting "Tunnel:"
  - 11 City Quadrant: deleting ":"
  - 15 Report Taken On Scene: deleting "A"
  - 42 State [1]: deleting "42 State"
  - 43 Year [1]: deleting "43 Year"
  - 65 Made [2]: deleting "65 Made"
  - 81 Sex [3]: deleting "81 Sex"
  - 82 DOB [3]: deleting "82 DOB"
  - 88 State [3]: deleting "88 State"
  - 89 Class [3]: deleting "89 Class"
  - 93 Make [3]: deleting "93 Make"
  - 94 Made [3]: deleting "94 Made"
  - 95 Year [3]: deleting "95 Year"
  - 96 Body [3]: deleting "96 Body"
  - 97 Color [3]: deleting "97 Color"
  - 100 State [3]: deleting "100 State"
  - 101 Year [3]: deleting "101 Year"
  - 110 Sex [4]: deleting "110 Sex"
  - 111 DOB [4]: deleting "111 DOB"
  - 117 State [4]: deleting "117 State"
  - 118 Class [4]: deleting "118 Cls."
  - 122 Make [4]: deleting "122 Make"
  - 123 Made [4]: deleting "123 Made"
  - 124 Year [4]: deleting "124 Year"
  - 125 Body [4]: deleting "125 Body"
  - 126 Color [4]: deleting "126 Color"
  - 129 State [4]: deleting "129 State"
  - 130 Year [4]: deleting "130 Year"
  - 205 Injury Code 2: deleting "Freeway Mile Post:"
  - 205 Injury Code 3: deleting "e, Freeway Mile Post:", "Freeway Mile Post:". and "T Freeway Mile Post:"
  - 205 Injury Code 4: deleting ". Freeway Mile Post:", "E Freeway Mile Post:", "el:", "el: Third Street Tunnel", "Freeway Mile Post:", "K Freeway Mile Post:", "S Freeway Mile Post:", "T Freeway Mile Post:", "W Freeway Mile Post:", and "y Freeway Mile Post:"
  - 206 Driver/Pedestrian Condition 2: deleting "[ ]02 Within 100' of Inters", "N [ ]02 Within 100' of Inters", "N [x]02 Within 100' of Inters", "Y [ ]02 Within 100' of Inters", and "Y [x]02 Within 100' of Inters"

- 206 Driver/Pedestrian Condition 3: deleting “[ ]04 Private Property [ ]”, “[ ]04 Private Property [x]”, “[x]04 Private Property [ ]”, “N [ ]02 Within 100' of Inters”, “N [x]02 Within 100' of Inters”, “Y [ ]02 Within 100' of Inters”, and “Y [x]02 Within 100' of Inters”
- 206 Driver/Pedestrian Condition 4: deleting “[ ]02 Within 100' of Inters”, “[ ]04 Private Property [ ]”, “[ ]04 Private Property [x]”, “[x]04 Private Property [ ]”, “N [ ]02 Within 100' of Inters”, “N [x]02 Within 100' of Inters”, “Photos taken? 16a If yes, # photos 17 # Vehic”, “Y [ ]02 Within 100' of Inters”, and “Y [x]02 Within 100' of Inters”
- 207 Impairment 2: deleting “section [ ]03 Not at Intersection [ ]02 Private Property”, “section [ ]03 Not at Intersection [x]02 Private Property”, “section [x]03 Not at Intersection [ ]02 Private Property”, and “section [x]03 Not at Intersection [x]02 Private Property”
- 207 Impairment 3: deleting “]97 N/A [ ]99 Other [ ]99 Other”, “]97 N/A [ ]99 Other [x]99 Other”, “]97 N/A [x]99 Other [ ]99 Other”, “97 N/A [ ]99 Other [ ]99 Other”, “section [ ]03 Not at Intersection [ ]02 Private Property”, “section [ ]03 Not at Intersection [x]02 Private Property”, “section [x]03 Not at Intersection [ ]02 Private Property”, and “section [x]03 Not at Intersection [x]02 Private Property”
- 207 Impairment 4: deleting “[ ]01 At Intersection 14 Off-Street Locatio”, “]97 N/A [ ]99 Other [ ]99 Other”, “]97 N/A [ ]99 Other [x]99 Other”, “]97 N/A [x]99 Other [ ]99 Other”, “]97 N/A [x]99 Other [x]99 Other”, “97 N/A [ ]99 Other [ ]99 Other”, “les Involved 18 # Injured Persons 19a-d # Occupants (I”, “section [ ]03 Not at Intersection [ ]02 Private Property”, “section [ ]03 Not at Intersection [x]02 Private Property”, “section [x]03 Not at Intersection [ ]02 Private Property”, and “section [x]03 Not at Intersection [x]02 Private Property”
- 208 Type Of Test Conducted 2: deleting “y [x]97 N/A” and “y [ ]97 N/A”
- 208 Type Of Test Conducted 3: deleting “y [x]97 N/A” and “y [ ]97 N/A”
- 208 Type Of Test Conducted 4: deleting “y [x]97 N/A”, “y [ ]97 N/A”, “n [ ]01 Public Space 15 Repo”, and “Including driver)”
- 209 BAC 2: deleting “20 Fatalities”
- 209 BAC 3: deleting “20 Fatalities” and “1”
- 209 BAC 4: deleting “20 Fatalities”, “ort taken on Scene?”, “0”, and “1”
- 210 Electronic Device 2: deleting “2 Road Condition” and “Device Present”
- 210 Electronic Device 3: deleting “2 Road Condition”, “and..”, “anding Water”, “Device Present”, “e”, “et”, “her”, “nknown”, “now”, “raight Hit Ped.”, and “y”
- 210 Electronic Device 4: deleting “2 Road Condition”, “5 Weather”, “anding Water”, “Device Present”, “e”, “epairing”, “et”, “her”, “nknown”, “now”, “raight Hit Ped.”, “ush”, and “y”
- 211 Driver/Pedestrian Distraction 2: deleting “193 Street Lighting” and “technologies”
- 211 Driver/Pedestrian Distraction 3: deleting “193 Street Lighting”, “Concrete”, “Defective”, “Street Lights Off”, “Street Lights On”, and “technologies”
- 211 Driver/Pedestrian Distraction 4: deleting “193 Street Lighting”, “196 Traffic Condition”, “Asphalt”, “Street Lights Off”, “Street Lights On”, and “Using personal communication”

- 212 Primary Contributing Circumstances 2: deleting “194 Light Condition”
    - 212 Primary Contributing Circumstances 3: deleting “194 Light Condition”, “Bridge”, “Dark (Lighted)”, “Dark (Not Lighted)”, “Dawn”, “Daylight”, and “Dusk”
    - 212 Primary Contributing Circumstances 4: deleting “194 Light Condition”, “197 Roadway Type”, “Dark (Lighted)”, “Dark (Not Lighted)”, “Dark (Unknown Lightin”, “Dawn”, “Daylight”, “Dusk”, and “Straight”
    - 213 Driver Action 2: deleting “protected” and “sitive”
    - 213 Driver Action 3: deleting “129 State 130 Year”, “ng)”, “protected”, and “sitive”
    - 213 Driver Action 4: deleting “129 State 130 Year”, “DC 14”, “ng)”, “protected”, and “sitive”
    - 214 Vehicle Type: Private 2: deleting “8 Traffic Controls 1”
    - 214 Vehicle Type: Private 3: deleting many incorrect parsed data
    - 214 Vehicle Type: Private 4: deleting many incorrect parsed data
    - 215 Vehicle Type: Government 2: deleting “199 Pedestrian Action”
    - 215 Vehicle Type: Government 3: deleting many incorrect parsed data
    - 215 Vehicle Type: Government 4: deleting many incorrect parsed data
    - 216 Vehicle Type: Commercial 2: deleting “escribe fixed object and damage in narrative)”, “icer”, “king P”, and “ng Lea”
    - 216 Vehicle Type: Commercial 3: deleting many incorrect parsed data
    - 216 Vehicle Type: Commercial 4: deleting many incorrect parsed data
    - Reporter Badge No.: deleting “Reporter Badge No.”
    - Official Badge No.: deleting “Official Badge No.”
- Since the following data fields were not used [at least] for pedestrian and bicycle crashes during the desired time period thus they were excluded from final cleaned dataset:
    - 11 Freeway Mile Post
    - 11 PEPCO Pole No
    - 11 Exit Ramp
    - 11 Bridge
    - 11 Tunnel
    - 11 Other

Appendix G Data Dictionary

Table 174. Final Dataset Data Dictionary

Short	Full
ID	ID
CCN	5 CCN
CrDate	1 Date Of Crash Formatted
CrYr	Year
CrMonth	Month
CrDayWk	3 Day of Week
CrTime	2 Time Of Crash Match
CrHr	Hour
CrAddress	8 [Crash] Location
CrSt	ACCIDENTOC
MainSt	MAINSTREET
IntSt	INTERSTREET
INTGISID	INTGISID
STREETSEGID	STREETSEGID
CrDistrict	9 District
CrPSA	10 PSA
CrInt	11 Intersection/Block
CrCityQuad	11 City Quadrant
Constraction	12 Construction Zone
NumVeh	17 Number Of Vehicles Involved
NumInj	18 Number Of Injured Persons
NumFatal	20 Number Of Fatalities
CrTyDDOT	189 Type Of Crash
HitRun	CrashType_Hit&Run
RdSurf	190 Road Surface
RdTy	191 Road Type
RdCond	192 Road Condition
StLight	193 Street Lighting
Light	194 Light Condition
Weather	195 Weather
TrafficCond	196 Traffic Condition
RdDivision	197 Roadway Type
TrafficContDDOT	198 Traffic Controls
PedAct	199 Pedestrian Action
FileTyHU	File Type (HU)
Duplicate	Duplicate
Student	Student
Driver_Gender	Driver_Gender
Driver_Age	Driver_Age
PedBike_Gender	PedBike_Gender
PedBike_Age	PedBike_Age

Short	**Full**
CrCat	Crash Category
CrSev	Crash Severity
CrLoc	Crash Location
IntTy	Intersection Type
TrafficControl	Traffic Control Type
Fault	Fault / Violation
Alcohol	Alcohol
Drug	Drug
Distraction	Distraction
Speeding	Speeding
PedPos	Pedestrian Position
PedLocSc	Pedestrian Location Scenario
NHTSAPedCrTy	NHTSA Pedestrian Crash Type
NHTSAPedCrGr	NHTSA Pedestrian Crash Group
BicPos	Bicyclist Position
BicDir	Bicyclist Direction
NHTSABicCrTy	NHTSA Bicycle Crash Type
NHTSABicCrGr	NHTSA Bicycle Crash Group
LMCMCrCat	LMCM Crash Category
LMCM1	LMCM Part 1
LMCM2	LMCM Part 2
LMCM3	LMCM Part 3
LMCM4	LMCM Part 4
LMCMCrTy	LMCM Crash Type
CrCatNote	Crash Category Notes
CrSevNote	Crash Severity Notes
CrLocNote	Crash Location Notes
IntNote	Intersection Notes
OthNote	Other Notes

Appendix H Some Special Crash Narratives

Table 175. Some Special Crash Narratives

CCN	Date	Note
12044894	4/2/2012	Narrative indicates an NOI for driver but "212 Primary Contributing Circumstances 1" is "Pedestrian Violation".
12083962	6/16/2012	Narrative reads: "V1 was issued a NOI for colliding with a pedestrian." but "212 Primary Contributing Circumstances 1" is "Pedestrian Violation".
12138687	10/1/2012	**Fatal** crash on FARS: https://www-fars.nhtsa.dot.gov/QueryTool/QuerySection/AccidentDisplayForm.aspx?ShowData=accform&CaseNum=11&StateNum=11&CaseYear=2012
12140584	10/4/2012	Narrative reads: "W1 REPORTS THAT HER AND P1 (JAMES SUTTON) WERE WALKING DOWN MARTIN LUTHER KING JR AVE WITH **AN OPEN CONTAINER OF BEER** IN HIS HAND. W1 THEN STATED THAT V1 PUT HIS BEER DOWN AND BEGIN TO PLAY AROUND WITH W1 AT WHICH TIME ME JUMPED OFF THE CURB IN AN UNSAFE MANNER AND WAS STRUCK BY A SMALL 4 DOOR CAR DARK IN COLOR..."
12156626	11/6/2012	Narrative reads: "... P-1 REPORTS HE WAS CROSSING THE INTERSECTION AT THE LISTED LOCATION IN THE CROSSWALK WHEN HIS ELBOW AND LEG WERE STRUCK BY V-1. WHEN P-1 ATTEMPTED TO STOP V-1, THE DRIVER OF V-1 GAVE HIM THE MIDDLE FINGER AND DROVE AWAY..."
12161253	11/16/2012	Narrative reads: "... D2 ADVISED THAT WHEN SHE GOT OUT OF HER VEHICLE TO MAKE SURE THAT D1 WAS OK, D1 TOLD HER THAT SHE WAS LUCKY THAT SHE DIDN'T KNOCK HIM OFF OF HIS BIKE, OR HE WOULD HAVE "***FUCKED HER UP***". D2 ALSO ADVISED THAT D1 **PUNCHED HER TWICE IN THE MOUTH** BEFORE LEAVING THE SCENE ON FOOT IN A N/B DIRECTION. ..."
12163880	11/21/2012	Narrative reads: "P-1 and D-1 had a verbal argument with each other prior to the accident. P-1 reports on the listed date, and time, after the argument, P-1 was walking S/B in the 1200 block of Meigs PL NE, trying to get away from D-1, when the accident occurred. D-1 states, after the argument ended, D-1 drove the wrong way down the 1200 block of Meigs PL NE, and **attempted to run P-1 over**, by drive onto the sidewalk, in the park area, causing P-1 to try and get out of the way of the vehicle. Incidently D-1 did catch up to P-1, and struck P-1 with his vehicle causing the listed damage, and the listed injuries. P-1 complained of pain to his right, knee, leg, and a chipped broken tooth..."
12168537	11/26/2012	Narrative reads: "... P-2 was fleeing on foot from police in the 3600 block of Minnesota Ave." The fleeing pedestrian then had an accident with a vehicle. The pedestrian was holding a firearm as well.
12176922	12/18/2012	Value of "205 Injury Code 4" is "**Fatal**" but narrative reads: "P1 was found at the collision scene conscious and breathing, face down with severe wounds to his head. DCFD Amb 26 arrived on scene and transported him to Medstar WHC for treatment. He was admitted by Dr. Chiflett and is in **stable condition**." However, on the NHTSA FARS dataset the crash is listed so it seems the crash was eventually "fatal". Link to the crash on FARS: https://www-fars.nhtsa.dot.gov/QueryTool/QuerySection/AccidentDisplayForm.aspx?ShowData=accform&CaseNum=13&StateNum=11&CaseYear=2012
13000614	1/2/2013	Pedestrian was crossing **I-295**!

CCN	Date	Note
13004243	1/10/2013	Narrative reads: "... V-1 OPERATED BY D-1, BEGAN BACKING S/B ONTO THE EAST SIDE OF 36TH ST., N.W. P-1 STATES THAT SHE YELLED AT D-1, "***YOU ARE ABOUT TO HIT ME!***", AND THAT D-1 THEN YELLED BACK AT HER, "***GET OUT OF THE WAY!***" P-1 STATES THAT V-1 THEN STRUCK HER RIGHT HIP FROM THE REAR WITH V-1'S RIGHT SIDE MIRROR. P-1 STATES THAT SHE TOLD D-1, "***YOU JUST HIT ME!***" ..."
12005213	1/12/2013	Narrative reads: "D-1 engaged in to a **verbal altercation** with P-1, because he was not walking fast enough across the street. D-1 was a black female drove off over P1's left foot and struck with with the passenger side mirror."
13006057	1/14/2013	Bicyclist drunk alcoholic beverage: "While at the stop sign he stated he observed driver 2 stopped on his bicycle on the sidewalk taking a drink from an **alcoholic beverage**." But the accident was pending investigation. Associated PD-10 Crash fields did not indicate impairment and also BAC test.
13030241	3/8/2013	Narrative reads: "P1 STATES THAT AFTER THE COLLISION, D-1 GOT OUT OF HIS VEHICLE AND STATED "***DONT CALL THE POLICE. I WILL GIVE YOU ONE HUNDRED DOLLARS TO NOT SAY ANYTHING***." P1 STARTED TO WRITE DOWN V-1'S TAG INFORMATION AND CALL THE POLICE WHEN D-1 SNATCHED THE PIECE OF PAPER FROM P1. D-1 ALSO GRABBED P1'S CELL PHONE AND THREW IT ON THE GROUND DESTROYING THE PHONE. D-1 ENTERED BACK IN HIS VEHICLE AND FLED EASTBOUND ON MONROE STREET NE."
13032881	3/13/2013	Narrative reads: "... Driver-1 stated that while stopped at the listed event location P-1 and Driver-1 were engaged in a verbal altercation over P-1 crossing the street. At which time Driver-1 states that P-1 struck Driver-1's listed vehicle with P-1's hand bag. Driver-1 stated that P-1 started to walked away and Driver-1 stated "***what are you doing***" and P-1 stated "***walking across the fucking street***". Driver-1 stated that he apologizes and remained on the scene in good faith with P-1. However P-1 stated "***fuck it***" and continued to walk away. In which Driver-1 drove off, heading towards the 2100 block of Alabama Ave. "
13036815	3/21/2013	Narrative reads: "... THE IMPACT CAUSED PEDESTRIAN#2 TO LAND ON THE GROUND IN FRONT OF VEHICLE#1. VEHICLE#1 CONTINUED EASTBOUND **DRAGGING PEDESTRIAN#1 WITH THE VEHICLE'S UNDERCARRIAGE**. ..."
13045390	4/8/2013	Narartive reads: " V-2, a bicycle, was in the bike lane. V-1 was traveling in the lane next to V-2. D-1 then inadvertently turned and struck V-2 with the left front bumper into the front wheel of V-2. V-1 then left the scene without stopping to make her identity known. V-1 was then stopped at a red light at Massachusetts Ave., SE. D-2 tried to get D-1's attention. When D-1 saw D-2 try to get her attention D-1 then yelled at D-2 and stated, "***Do let me get out of the car or I will fucking shoot you.***" D-1 then drove E/B on Massachusetts Ave., SE. ..."
13074002	6/1/2013	It was a hit & run crash involving a truck and a pedestrian. People could catch the driver and narrative reads: "People in the crowd were yelling out "There she is, there she go, she hit that child and kept going, we got her stopped." OFC Mendryga interviewed Ms Lindsay, who stated that she was driving the burgundy truck, a 1996 Ford Explorer bearing MD registration 3AW1771, and that the **people were trying to beat her up and she was trying to get away**."
13082265	6/16/2013	Narrative indicates a Hit & Run involving a police officer: "... P-1 stated that the driver of the vehicle was a police officer, however, he did not know which agency he was with, nor did the driver stop and make his identity known to P-1....".

CCN	Date	Note
13083183	6/18/2013	The "205 Injury Code 2" is "Fatal" but neither the narrative ("PEDESTRIAN#2 WAS TRANSPORTED TO WASHINGTON HOSPITAL CENTER MED-STAR UNIT AND ADMITTED IN **CRITICAL CONDITION** VIA DR. SHIFLETT.") nor checking the FARS data for June 2013 indicated a fatal accident. The crash assumed "Disabling".
13096427	7/11/2013	Narrative reads: "D-1 REPORTS WHILE TRAVELING **NORTHBOUND** IN THE 1800 BLOCK OF 11TH ST NW SHE ATTEMPTED TO **TURN RIGHT** ONTO VERMONT AVE NW WHEN SHE STRUCK D-2 CAUSING D-2 TO FALL OFF OF HER BICYCLE." Based on reviewing the intersection, it should be either "Southbound" or "Turn left" because turn right while on northbound 11th ST is not possible.
13098951	7/16/2013	Pedestrian was on duty (DDOt Uniform) when had some altercation with a driver that eventually hit her. Narrative reads: "P-1 ALSO REPORTS THAT D-1 TUANTED P-1 BY STATING "***GET OUT OF MY WAY BEFORE I HIT YOUR ASS!***" P-1 STATES THAT D-1 THEN MADE A RIGHT TURN ONTO 18TH ST SE AGAINST P-1'S VERBAL COMMANDS AT WHICH TIME THE VEHICLE OPERATED BY D-1 SIDE SWIPED P-1 KNEES."
13111707	8/8/2013	W-1 ALSO STATED THAT D-1 STATED " ***I DID NOT DO ANYTHING WRONG***". P-1 TOLD D-1 " ***GET OUT OF THE CAR BITCH***". D-1 STATED IN SPANISH : ***I DON'T HAVE TIME FOR YOU NIGGERS***" AND KEPT GOING.
13132838	9/16/2013	Narrative reads: "While speaking to V1's operator a strong odor of what appears to be **alcohol** was omitting from his breath." V1 was a bicyclist but he was not issued an NOI or considered at fault in the accident!
13166284	11/18/2013	Narrative reads: "Driver 1 pulled over and stopped on Rock Creek Church NW road and opened his driver side door put one leg out turned arond and stated "***Damn bikers always getting in my way.***" and then drove off southbound on Rock Creek Church Rd NW."
14059897	4/30/2014	There were two striking vehicles and one went into a bus stop and hit a pedestrian. Narrative reads: "PEDESTRIAN WAS TRANSPORTED TO GEORGE WASHINGTON HOSPITAL BY MEDIC 18. THE PEDESTRIAN WOULD NOT LET DOCTORS AT THE HOSPITAL TREAT HER. THE PEDESTRIAN WAS MAKING STATEMENTS HOW SHE HAD BEEN KIDNAPPED BY PRESIDENT OBAMA AND HELD HOSTAGE AT THE HOSPITAL."
14061390	5/1/2014	Narrative reads: "V-1 STATED THAT SHE WAS OPERATING V-1 WEST IN THE 1100 BLOCK PENNSYLVANIA AVE SE. WHEN THE OPERATOR OF **V-2 SKIRT GOT CAUGHT ONTO HER RIGHT SIDE MIRROR** CAUSING HER TO FALL OFF THE BICYCLE..." ==> Bicyclists should wear appropriate clothing.
14064816	5/8/2014	The "205 Injury Code 2" is "Fatal" but neither the narrative ("P-1 HAD SCRATCHES AND BRUISING TO HER LEFT LEG.") nor checking the FARS data for May 2014 indicated a fatal accident. The crash assumed "Non-Disabling".
14069768	5/17/2014	Another altercation and hit & run. Narrative reads: "... THE DRIVER OF V-1 THEN OPENED HER CAR DOOR AND YELLED "***GET OUT OF THE STREET***". P-2 STATED "***JUST GIVE ME A SECOND***". DRIVER-1 THEN STATED "***GET THE FUCK OUT OF THE STREET YOU CRACKER***". THEN VEHICLE 1 PROCEEDED TO GO STRAIGHT, AT WHICH TIME HER VEHICLE BUMPED PEDESTRIAN-2"S RIGHT LEG..."
14074935	5/26/2014	Pedestrian crossed the street **not in crosswalk** but the driver was issued listed NOI for "Fail to Give Attention" and NOI for "Fail to yield to Pedestrians"

CCN	Date	Note
14074955	5/26/2014	Narrative reads: "D-1 states while traveling at a slow rate of speed (1-2 MPH) behind a slow moving vehicle **P-1 began dancing** near his car in the street no in a cross walk. "
14081054	6/6/2014	The impairment codes are "**Had been drinking and obviously drunk**" and "**Ability Impaired**" and "Primary Contributing Circumstances" is "**Alcohol/Drug Influence**" but the narrative does not imply drunk-driving or drunk pedestrians. So the impairment was considered "Unknown".
14179537	11/18/2014	Narrative reads: "Ped-1, during my interview, restated that she was not injured, but **she wanted to make the streets safer**. I repeatedly asked if she needed medical attention, and she repeatedly declined."
14178780	11/18/2014	Truck driver stated "***I didn't see her, she is so damn short.***"
14179302	11/19/2014	Another hit & run and "The driver of V-1 then gave P-1 the middle finger and then drove away from the scene."
14179258	11/19/2014	**Fatal** crash on FARS (but narrative does not indicate it): https://www-fars.nhtsa.dot.gov/QueryTool/QuerySection/AccidentDisplayForm.aspx?ShowData=accform&CaseNum=22&StateNum=11&CaseYear=2014
14189019	12/8/2014	Narrative reads: "P1 STATED THAT WHILE WORKING AS A FLAGGER HE ATTEMPTED TO STOP D1 AS HE HAD A STOP SIGN VISIBLE IN HIS HAND. D1 DID NOT COMPLY AND CONTNUED DRIVING STRIKING P1 IN THE SHOULDER WITH HIS VEHICLE."

Appendix I Extended Tables

Extended Tables

Table 176. Summary of Crashes by Month by Year

Month	Bicycle-Involved		Pedestrian-Involved		Total		*Sig.*
	Count	%	Count	%	Count	%	
January	34	5.84%	76	9.37%	110	7.90%	--
February	22	3.78%	74	9.12%	96	6.89%	---
March	48	8.25%	74	9.12%	122	8.76%	
April	48	8.25%	65	8.01%	113	8.11%	
May	56	9.62%	75	9.25%	131	9.40%	
June	65	11.17%	53	6.54%	118	8.47%	+++
July	40	6.87%	52	6.41%	92	6.60%	
August	71	12.20%	61	7.52%	132	9.48%	+++
September	72	12.37%	74	9.12%	146	10.48%	+
October	58	9.97%	66	8.14%	124	8.90%	
November	36	6.19%	68	8.38%	104	7.47%	
December	32	5.50%	73	9.00%	105	7.54%	--
2012	***582***	***100.00%***	***811***	***100.00%***	***1393***	***100.00%***	
January	33	5.59%	73	8.49%	106	7.31%	--
February	22	3.73%	62	7.21%	84	5.79%	---
March	38	6.44%	57	6.63%	95	6.55%	
April	60	10.17%	79	9.19%	139	9.59%	
May	57	9.66%	62	7.21%	119	8.21%	+
June	59	10.00%	66	7.67%	125	8.62%	
July	60	10.17%	56	6.51%	116	8.00%	++
August	62	10.51%	55	6.40%	117	8.07%	+++
September	75	12.71%	88	10.23%	163	11.24%	
October	50	8.47%	89	10.35%	139	9.59%	
November	42	7.12%	82	9.53%	124	8.55%	
December	32	5.42%	91	10.58%	123	8.48%	---
2013	***590***	***100.00%***	***860***	***100.00%***	***1450***	***100.00%***	
January	28	3.51%	77	8.30%	105	6.08%	---
February	32	4.01%	61	6.57%	93	5.39%	--
March	37	4.64%	82	8.84%	119	6.89%	---
April	61	7.64%	75	8.08%	136	7.88%	
May	74	9.27%	87	9.38%	161	9.33%	
June	87	10.90%	81	8.73%	168	9.73%	
July	93	11.65%	55	5.93%	148	8.57%	+++
August	107	13.41%	55	5.93%	162	9.39%	+++
September	83	10.40%	82	8.84%	165	9.56%	
October	107	13.41%	104	11.21%	211	12.22%	
November	53	6.64%	83	8.94%	136	7.88%	-
December	36	4.51%	86	9.27%	122	7.07%	---

Month	Bicycle-Involved		Pedestrian-Involved		Total		*Sig.*
	Count	**%**	**Count**	**%**	**Count**	**%**	
2014	***798***	***100.00%***	***928***	***100.00%***	***1726***	***100.00%***	
Total	**1970**	**100.00%**	**2599**	**100.00%**	**4569**	**100.00%**	

Table 177. Summary of Crashes by Crash Severity by Year

Severity	Bicycle-Involved		Pedestrian-Involved		Total		*Sig.*
	Count	**%**	**Count**	**%**	**Count**	**%**	
Fatal	0	0.00%	6	0.74%	6	0.43%	--
Disabling	34	5.84%	75	9.25%	109	7.82%	--
Non-Disabling	258	44.33%	310	38.22%	568	40.78%	++
Complaint but not visible	142	24.40%	299	36.87%	441	31.66%	---
No Injury	137	23.54%	99	12.21%	236	16.94%	+++
Unknown	11	1.89%	22	2.71%	33	2.37%	
2012	***582***	***100.00%***	***811***	***100.00%***	***1393***	***100.00%***	
Fatal	2	0.34%	11	1.28%	13	0.90%	-
Disabling	31	5.25%	71	8.26%	102	7.03%	--
Non-Disabling	247	41.86%	253	29.42%	500	34.48%	+++
Complaint but not visible	170	28.81%	392	45.58%	562	38.76%	---
No Injury	121	20.51%	98	11.40%	219	15.10%	+++
Unknown	19	3.22%	35	4.07%	54	3.72%	
2013	***590***	***100.00%***	***860***	***100.00%***	***1450***	***100.00%***	
Fatal	1	0.13%	9	0.97%	10	0.58%	--
Disabling	48	6.02%	70	7.54%	118	6.84%	
Non-Disabling	341	42.73%	381	41.06%	722	41.83%	
Complaint but not visible	225	28.20%	340	36.64%	565	32.73%	---
No Injury	154	19.30%	98	10.56%	252	14.60%	+++
Unknown	29	3.63%	30	3.23%	59	3.42%	
2014	***798***	***100.00%***	***928***	***100.00%***	***1726***	***100.00%***	
Total	**1970**	**100.00%**	**2599**	**100.00%**	**4569**	**100.00%**	

Table 178. Summary of Pedestrian Crashes by Pedestrian Location Scenarios & Severity Level

Location Scenario	Fatal & Disabling		Other		Total		*Sig.*
	Count	**%**	**Count**	**%**	**Count**	**%**	
11b	19	13.29%	211	13.96%	230	13.91%	
11a	9	6.29%	145	9.60%	154	9.31%	
11c	6	4.20%	140	9.27%	146	8.83%	--
1c	10	6.99%	132	8.74%	142	8.59%	
1b	12	8.39%	96	6.35%	108	6.53%	
1a	7	4.90%	84	5.56%	91	5.50%	
2c	6	4.20%	57	3.77%	63	3.81%	
3a	7	4.90%	53	3.51%	60	3.63%	

Location Scenario	Fatal & Disabling		Other		Total		Sig.
	Count	%	Count	%	Count	%	
7c	4	2.80%	51	3.38%	55	3.33%	
7a	3	2.10%	51	3.38%	54	3.26%	
3b	8	5.59%	39	2.58%	47	2.84%	++
3c	6	4.20%	40	2.65%	46	2.78%	
5b	1	0.70%	32	2.12%	33	2.00%	
2b	4	2.80%	24	1.59%	28	1.69%	
7b	1	0.70%	25	1.65%	26	1.57%	
4c	2	1.40%	21	1.39%	23	1.39%	
12c	4	2.80%	18	1.19%	22	1.33%	
4b	2	1.40%	19	1.26%	21	1.27%	
5c	1	0.70%	20	1.32%	21	1.27%	
9c	1	0.70%	19	1.26%	20	1.21%	
2a	4	2.80%	16	1.06%	20	1.21%	+
9b	3	2.10%	15	0.99%	18	1.09%	
4a	1	0.70%	15	0.99%	16	0.97%	
5a	0	0.00%	14	0.93%	14	0.85%	
9a	0	0.00%	10	0.66%	10	0.60%	
8c	3	2.10%	6	0.40%	9	0.54%	+++
12b	1	0.70%	6	0.40%	7	0.42%	
10c	0	0.00%	4	0.26%	4	0.24%	
12a	0	0.00%	4	0.26%	4	0.24%	
10b	0	0.00%	2	0.13%	2	0.12%	
6c	0	0.00%	2	0.13%	2	0.12%	
8a	0	0.00%	2	0.13%	2	0.12%	
Unknown	18	12.59%	138	9.13%	156	9.43%	
Total	**143**	**100.00%**	**1511**	**100.00%**	**1654**	**100.00%**	

Table 179. Full List of Pedestrian NHTSA Crash Types & Severity Level

NHTSA Crash Type	Fatal & Disabling		Other		Total		Sig.
	Count	%	Count	%	Count	%	
781 - Motorist Left Turn—Parallel Paths	37	15.29%	520	22.06%	557	21.43%	--
770 - Motorist Failed to Yield	33	13.64%	294	12.47%	327	12.58%	
760 - Pedestrian Failed to Yield	34	14.05%	195	8.27%	229	8.81%	+++
742 - Dart-Out	14	5.79%	138	5.85%	152	5.85%	
791 - Motorist Right Turn—Parallel Paths	10	4.13%	119	5.05%	129	4.96%	
690 - Intersection—Other/Unknown	15	6.20%	110	4.67%	125	4.81%	
213 - Backing Vehicle—Roadway	6	2.48%	111	4.71%	117	4.50%	
741 - Dash	14	5.79%	91	3.86%	105	4.04%	
190 - Other Unusual Circumstances	9	3.72%	66	2.80%	75	2.89%	

NHTSA Crash Type	Fatal & Disabling		Other		Total		*Sig.*
	Count	%	Count	%	Count	%	
680 - Nonintersection—Other/Unknown	5	2.07%	57	2.42%	62	2.39%	
795 - Motorist Right Turn—Perpendicular Paths	1	0.41%	55	2.33%	56	2.15%	-
311 - Working in Roadway	1	0.41%	54	2.29%	55	2.12%	-
320 - Entering/Exiting Parked Vehicle	4	1.65%	50	2.12%	54	2.08%	
782 - Motorist Left Turn—Perpendicular Paths	4	1.65%	49	2.08%	53	2.04%	
150 - Motor Vehicle Loss of Control	8	3.31%	37	1.57%	45	1.73%	++
830 - Off Roadway—Parking Lot	4	1.65%	39	1.65%	43	1.65%	
214 - Backing Vehicle—Parking Lot	0	0.00%	39	1.65%	39	1.50%	--
465 - Motorist Exiting Driveway or Alley	1	0.41%	35	1.48%	36	1.39%	
341 - Commercial Bus-Related	3	1.24%	28	1.19%	31	1.19%	
799 - Motorist Turn/Merge—Other/Unknown	3	1.24%	26	1.10%	29	1.12%	
140 - Vehicle-Vehicle/Object	5	2.07%	17	0.72%	22	0.85%	++
410 - Walking Along Roadway With Traffic—From Behind	3	1.24%	17	0.72%	20	0.77%	
120 - Dispute-Related	0	0.00%	19	0.81%	19	0.73%	
610 - Standing in Roadway	2	0.83%	16	0.68%	18	0.69%	
212 - Backing Vehicle—Driveway/Sidewalk Intersection	2	0.83%	15	0.64%	17	0.65%	
160 - Pedestrian Loss of Control	3	1.24%	13	0.55%	16	0.62%	
312 - Playing in Roadway	0	0.00%	15	0.64%	15	0.58%	
890 - Off Roadway—Other/Unknown	4	1.65%	10	0.42%	14	0.54%	++
219 - Backing Vehicle—Other/Unknown	1	0.41%	12	0.51%	13	0.50%	
794 - Motorist Right Turn on Red—Perpendicular Paths	1	0.41%	12	0.51%	13	0.50%	
460 - Motorist Entering Driveway or Alley	3	1.24%	9	0.38%	12	0.46%	+
110 - Assault with Vehicle	3	1.24%	9	0.38%	12	0.46%	+
792 - Motorist Right Turn on Red—Parallel Paths	0	0.00%	11	0.47%	11	0.42%	
220 - Driverless Vehicle	2	0.83%	9	0.38%	11	0.42%	
240 - Emergency Vehicle-Related	1	0.41%	9	0.38%	10	0.38%	
620 - Walking in Roadway	1	0.41%	7	0.30%	8	0.31%	
130 - Pedestrian on Vehicle	1	0.41%	5	0.21%	6	0.23%	
459 - Walking Along Roadway—Direction/Position Unknown	0	0.00%	5	0.21%	5	0.19%	
730 - Trapped	0	0.00%	5	0.21%	5	0.19%	
211 - Backing Vehicle—Driveway	1	0.41%	4	0.17%	5	0.19%	
313 - Lying in Roadway	3	1.24%	2	0.08%	5	0.19%	+++

NHTSA Crash Type	Fatal & Disabling		Other		Total		Sig.
	Count	%	Count	%	Count	%	
710 - Multiple Threat	0	0.00%	4	0.17%	4	0.15%	
342 - School Bus-Related	0	0.00%	4	0.17%	4	0.15%	
910 - Crossing an Expressway	0	0.00%	3	0.13%	3	0.12%	
440 - Walking Along Roadway Against Traffic—From Front	0	0.00%	3	0.13%	3	0.12%	
520 - Waiting to Cross—Vehicle Not Turning	0	0.00%	2	0.08%	2	0.08%	
360 - Ice Cream/Vendor Truck-Related	0	0.00%	2	0.08%	2	0.08%	
230 - Disabled Vehicle-Related	0	0.00%	2	0.08%	2	0.08%	
250 - Play Vehicle-Related	0	0.00%	2	0.08%	2	0.08%	
469 - Driveway Crossing—Other/Unknown	0	0.00%	1	0.04%	1	0.04%	
Total	**242**	**100.00%**	**2357**	**100.00%**	**2599**	**100.00%**	

Table 180. Full List of Pedestrian NHTSA Crash Types & Severity Level by Year

NHTSA Crash Type	Fatal & Disabling		Other		Total		Sig.
	Count	%	Count	%	Count	%	
781 - Motorist Left Turn—Parallel Paths	15	18.52%	147	20.14%	162	19.98%	
770 - Motorist Failed to Yield	8	9.88%	95	13.01%	103	12.70%	
760 - Pedestrian Failed to Yield	10	12.35%	68	9.32%	78	9.62%	
742 - Dart-Out	6	7.41%	45	6.16%	51	6.29%	
791 - Motorist Right Turn—Parallel Paths	2	2.47%	37	5.07%	39	4.81%	
213 - Backing Vehicle—Roadway	2	2.47%	37	5.07%	39	4.81%	
190 - Other Unusual Circumstances	6	7.41%	31	4.25%	37	4.56%	
741 - Dash	7	8.64%	26	3.56%	33	4.07%	++
690 - Intersection—Other/Unknown	2	2.47%	23	3.15%	25	3.08%	
782 - Motorist Left Turn—Perpendicular Paths	2	2.47%	21	2.88%	23	2.84%	
795 - Motorist Right Turn—Perpendicular Paths	1	1.23%	22	3.01%	23	2.84%	
150 - Motor Vehicle Loss of Control	4	4.94%	15	2.05%	19	2.34%	
311 - Working in Roadway	1	1.23%	17	2.33%	18	2.22%	
830 - Off Roadway—Parking Lot	1	1.23%	17	2.33%	18	2.22%	
680 - Nonintersection—Other/Unknown	2	2.47%	12	1.64%	14	1.73%	
465 - Motorist Exiting Driveway or Alley	0	0.00%	10	1.37%	10	1.23%	
214 - Backing Vehicle—Parking Lot	0	0.00%	10	1.37%	10	1.23%	
799 - Motorist Turn/Merge—Other/Unknown	1	1.23%	8	1.10%	9	1.11%	
219 - Backing Vehicle—	0	0.00%	9	1.23%	9	1.11%	

NHTSA Crash Type	Fatal & Disabling		Other		Total		Sig.
	Count	%	Count	%	Count	%	
Other/Unknown							
320 - Entering/Exiting Parked Vehicle	1	1.23%	7	0.96%	8	0.99%	
160 - Pedestrian Loss of Control	0	0.00%	8	1.10%	8	0.99%	
610 - Standing in Roadway	2	2.47%	4	0.55%	6	0.74%	+
341 - Commercial Bus-Related	0	0.00%	6	0.82%	6	0.74%	
620 - Walking in Roadway	0	0.00%	5	0.68%	5	0.62%	
212 - Backing Vehicle—Driveway/Sidewalk Intersection	1	1.23%	4	0.55%	5	0.62%	
312 - Playing in Roadway	0	0.00%	5	0.68%	5	0.62%	
120 - Dispute-Related	0	0.00%	5	0.68%	5	0.62%	
110 - Assault with Vehicle	1	1.23%	4	0.55%	5	0.62%	
410 - Walking Along Roadway With Traffic—From Behind	1	1.23%	4	0.55%	5	0.62%	
890 - Off Roadway—Other/Unknown	1	1.23%	3	0.41%	4	0.49%	
460 - Motorist Entering Driveway or Alley	2	2.47%	2	0.27%	4	0.49%	+++
792 - Motorist Right Turn on Red—Parallel Paths	0	0.00%	3	0.41%	3	0.37%	
794 - Motorist Right Turn on Red—Perpendicular Paths	0	0.00%	3	0.41%	3	0.37%	
140 - Vehicle-Vehicle/Object	1	1.23%	2	0.27%	3	0.37%	
220 - Driverless Vehicle	0	0.00%	2	0.27%	2	0.25%	
730 - Trapped	0	0.00%	2	0.27%	2	0.25%	
342 - School Bus-Related	0	0.00%	2	0.27%	2	0.25%	
240 - Emergency Vehicle-Related	0	0.00%	2	0.27%	2	0.25%	
520 - Waiting to Cross—Vehicle Not Turning	0	0.00%	2	0.27%	2	0.25%	
211 - Backing Vehicle—Driveway	0	0.00%	1	0.14%	1	0.12%	
130 - Pedestrian on Vehicle	0	0.00%	1	0.14%	1	0.12%	
313 - Lying in Roadway	1	1.23%	0	0.00%	1	0.12%	+++
710 - Multiple Threat	0	0.00%	1	0.14%	1	0.12%	
250 - Play Vehicle-Related	0	0.00%	1	0.14%	1	0.12%	
459 - Walking Along Roadway—Direction/Position Unknown	0	0.00%	1	0.14%	1	0.12%	
2012	**81**	**100.00%**	**730**	**100.00%**	**811**	**100.00%**	
781 - Motorist Left Turn—Parallel Paths	9	10.98%	181	23.26%	190	22.09%	--
770 - Motorist Failed to Yield	10	12.20%	89	11.44%	99	11.51%	
760 - Pedestrian Failed to Yield	18	21.95%	72	9.25%	90	10.47%	+++
690 - Intersection—Other/Unknown	9	10.98%	44	5.66%	53	6.16%	+
213 - Backing Vehicle—Roadway	2	2.44%	41	5.27%	43	5.00%	
791 - Motorist Right Turn—Parallel Paths	4	4.88%	39	5.01%	43	5.00%	

NHTSA Crash Type	Fatal & Disabling		Other		Total		*Sig.*
	Count	%	Count	%	Count	%	
742 - Dart-Out	3	3.66%	34	4.37%	37	4.30%	
741 - Dash	2	2.44%	34	4.37%	36	4.19%	
680 - Nonintersection—Other/Unknown	1	1.22%	29	3.73%	30	3.49%	
320 - Entering/Exiting Parked Vehicle	2	2.44%	18	2.31%	20	2.33%	
190 - Other Unusual Circumstances	1	1.22%	15	1.93%	16	1.86%	
341 - Commercial Bus-Related	2	2.44%	13	1.67%	15	1.74%	
795 - Motorist Right Turn—Perpendicular Paths	0	0.00%	15	1.93%	15	1.74%	
214 - Backing Vehicle—Parking Lot	0	0.00%	14	1.80%	14	1.63%	
311 - Working in Roadway	0	0.00%	13	1.67%	13	1.51%	
140 - Vehicle-Vehicle/Object	2	2.44%	11	1.41%	13	1.51%	
782 - Motorist Left Turn—Perpendicular Paths	2	2.44%	11	1.41%	13	1.51%	
799 - Motorist Turn/Merge—Other/Unknown	1	1.22%	11	1.41%	12	1.40%	
150 - Motor Vehicle Loss of Control	3	3.66%	8	1.03%	11	1.28%	++
465 - Motorist Exiting Driveway or Alley	1	1.22%	9	1.16%	10	1.16%	
312 - Playing in Roadway	0	0.00%	9	1.16%	9	1.05%	
830 - Off Roadway—Parking Lot	2	2.44%	7	0.90%	9	1.05%	
120 - Dispute-Related	0	0.00%	5	0.64%	5	0.58%	
610 - Standing in Roadway	0	0.00%	5	0.64%	5	0.58%	
460 - Motorist Entering Driveway or Alley	1	1.22%	4	0.51%	5	0.58%	
794 - Motorist Right Turn on Red—Perpendicular Paths	0	0.00%	5	0.64%	5	0.58%	
410 - Walking Along Roadway With Traffic—From Behind	0	0.00%	5	0.64%	5	0.58%	
220 - Driverless Vehicle	1	1.22%	3	0.39%	4	0.47%	
792 - Motorist Right Turn on Red—Parallel Paths	0	0.00%	4	0.51%	4	0.47%	
890 - Off Roadway—Other/Unknown	0	0.00%	4	0.51%	4	0.47%	
160 - Pedestrian Loss of Control	2	2.44%	2	0.26%	4	0.47%	+++
212 - Backing Vehicle—Driveway/Sidewalk Intersection	0	0.00%	3	0.39%	3	0.35%	
240 - Emergency Vehicle-Related	0	0.00%	3	0.39%	3	0.35%	
910 - Crossing an Expressway	0	0.00%	3	0.39%	3	0.35%	
459 - Walking Along Roadway—Direction/Position Unknown	0	0.00%	3	0.39%	3	0.35%	
110 - Assault with Vehicle	0	0.00%	3	0.39%	3	0.35%	
620 - Walking in Roadway	1	1.22%	1	0.13%	2	0.23%	+
342 - School Bus-Related	0	0.00%	2	0.26%	2	0.23%	
211 - Backing Vehicle—Driveway	1	1.22%	1	0.13%	2	0.23%	+

NHTSA Crash Type	Fatal & Disabling		Other		Total		*Sig.*
	Count	**%**	**Count**	**%**	**Count**	**%**	
130 - Pedestrian on Vehicle	1	1.22%	1	0.13%	2	0.23%	+
230 - Disabled Vehicle-Related	0	0.00%	2	0.26%	2	0.23%	
313 - Lying in Roadway	1	1.22%	0	0.00%	1	0.12%	+++
710 - Multiple Threat	0	0.00%	1	0.13%	1	0.12%	
360 - Ice Cream/Vendor Truck-Related	0	0.00%	1	0.13%	1	0.12%	
2013	**82**	**100.00%**	**778**	**100.00%**	**860**	**100.00%**	
781 - Motorist Left Turn—Parallel Paths	13	16.46%	192	22.61%	205	22.09%	
770 - Motorist Failed to Yield	15	18.99%	110	12.96%	125	13.47%	
742 - Dart-Out	5	6.33%	59	6.95%	64	6.90%	
760 - Pedestrian Failed to Yield	6	7.59%	55	6.48%	61	6.57%	
690 - Intersection—Other/Unknown	4	5.06%	43	5.06%	47	5.06%	
791 - Motorist Right Turn—Parallel Paths	4	5.06%	43	5.06%	47	5.06%	
741 - Dash	5	6.33%	31	3.65%	36	3.88%	
213 - Backing Vehicle—Roadway	2	2.53%	33	3.89%	35	3.77%	
320 - Entering/Exiting Parked Vehicle	1	1.27%	25	2.94%	26	2.80%	
311 - Working in Roadway	0	0.00%	24	2.83%	24	2.59%	
190 - Other Unusual Circumstances	2	2.53%	20	2.36%	22	2.37%	
795 - Motorist Right Turn—Perpendicular Paths	0	0.00%	18	2.12%	18	1.94%	
680 - Nonintersection—Other/Unknown	2	2.53%	16	1.88%	18	1.94%	
782 - Motorist Left Turn—Perpendicular Paths	0	0.00%	17	2.00%	17	1.83%	
830 - Off Roadway—Parking Lot	1	1.27%	15	1.77%	16	1.72%	
465 - Motorist Exiting Driveway or Alley	0	0.00%	16	1.88%	16	1.72%	
214 - Backing Vehicle—Parking Lot	0	0.00%	15	1.77%	15	1.62%	
150 - Motor Vehicle Loss of Control	1	1.27%	14	1.65%	15	1.62%	
341 - Commercial Bus-Related	1	1.27%	9	1.06%	10	1.08%	
410 - Walking Along Roadway With Traffic—From Behind	2	2.53%	8	0.94%	10	1.08%	
120 - Dispute-Related	0	0.00%	9	1.06%	9	0.97%	
212 - Backing Vehicle—Driveway/Sidewalk Intersection	1	1.27%	8	0.94%	9	0.97%	
799 - Motorist Turn/Merge—Other/Unknown	1	1.27%	7	0.82%	8	0.86%	
610 - Standing in Roadway	0	0.00%	7	0.82%	7	0.75%	
140 - Vehicle-Vehicle/Object	2	2.53%	4	0.47%	6	0.65%	++
890 - Off Roadway—Other/Unknown	3	3.80%	3	0.35%	6	0.65%	+++
794 - Motorist Right Turn on Red—Perpendicular Paths	1	1.27%	4	0.47%	5	0.54%	

NHTSA Crash Type	Fatal & Disabling		Other		Total		*Sig.*
	Count	**%**	**Count**	**%**	**Count**	**%**	
240 - Emergency Vehicle-Related	1	1.27%	4	0.47%	5	0.54%	
220 - Driverless Vehicle	1	1.27%	4	0.47%	5	0.54%	
160 - Pedestrian Loss of Control	1	1.27%	3	0.35%	4	0.43%	
219 - Backing Vehicle—Other/Unknown	1	1.27%	3	0.35%	4	0.43%	
792 - Motorist Right Turn on Red—Parallel Paths	0	0.00%	4	0.47%	4	0.43%	
110 - Assault with Vehicle	2	2.53%	2	0.24%	4	0.43%	+++
730 - Trapped	0	0.00%	3	0.35%	3	0.32%	
130 - Pedestrian on Vehicle	0	0.00%	3	0.35%	3	0.32%	
313 - Lying in Roadway	1	1.27%	2	0.24%	3	0.32%	
460 - Motorist Entering Driveway or Alley	0	0.00%	3	0.35%	3	0.32%	
440 - Walking Along Roadway Against Traffic—From Front	0	0.00%	3	0.35%	3	0.32%	
211 - Backing Vehicle—Driveway	0	0.00%	2	0.24%	2	0.22%	
710 - Multiple Threat	0	0.00%	2	0.24%	2	0.22%	
469 - Driveway Crossing—Other/Unknown	0	0.00%	1	0.12%	1	0.11%	
250 - Play Vehicle-Related	0	0.00%	1	0.12%	1	0.11%	
620 - Walking in Roadway	0	0.00%	1	0.12%	1	0.11%	
312 - Playing in Roadway	0	0.00%	1	0.12%	1	0.11%	
459 - Walking Along Roadway—Direction/Position Unknown	0	0.00%	1	0.12%	1	0.11%	
360 - Ice Cream/Vendor Truck-Related	0	0.00%	1	0.12%	1	0.11%	
2014	**79**	**100.00%**	**849**	**100.00%**	**928**	**100.00%**	
Total	**242**	**-**	**2357**	**-**	**2599**	**-**	

Table 181. Full List of Pedestrian LMCM Crash Types & Severity Level

LMCM Crash Type	Fatal & Disabling		Other		Total		*Sig.*
	Count	**%**	**Count**	**%**	**Count**	**%**	
I-NS-ST-X	28	11.57%	218	9.25%	246	9.47%	
N-RRD-X	28	11.57%	214	9.08%	242	9.31%	
I-FS-LT-O	17	7.02%	224	9.50%	241	9.27%	
I-FS-LT-X	9	3.72%	159	6.75%	168	6.46%	-
I-FS-LT-S	11	4.55%	153	6.49%	164	6.31%	
I-NS-ST-R	18	7.44%	127	5.39%	145	5.58%	
I-NS-ST-L	10	4.13%	123	5.22%	133	5.12%	
N-RRD-R	12	4.96%	110	4.67%	122	4.69%	
I-FS-ST-X	10	4.13%	73	3.10%	83	3.19%	
I-FS-ST-R	10	4.13%	65	2.76%	75	2.89%	

LMCM Crash Type	Fatal & Disabling		Other		Total		*Sig.*
	Count	%	Count	%	Count	%	
P-F	10	4.13%	63	2.67%	73	2.81%	
I-FS-ST-L	9	3.72%	62	2.63%	71	2.73%	
I-FS-RT-X	8	3.31%	53	2.25%	61	2.35%	
I-FS-RT-S	3	1.24%	55	2.33%	58	2.23%	
P-B	1	0.41%	55	2.33%	56	2.15%	-
N-RRD-L	4	1.65%	43	1.82%	47	1.81%	
OTH	6	2.48%	40	1.70%	46	1.77%	
N-RD-X	3	1.24%	38	1.61%	41	1.58%	
I-NS-RT-R	1	0.41%	35	1.48%	36	1.39%	
I-NS-X-X	3	1.24%	30	1.27%	33	1.27%	
N-X-X	3	1.24%	29	1.23%	32	1.23%	
I-NS-LT-X	2	0.83%	28	1.19%	30	1.15%	
I-FS-RT-O	1	0.41%	27	1.15%	28	1.08%	
I-X-X-X	2	0.83%	24	1.02%	26	1.00%	
N-RRD-S	7	2.89%	19	0.81%	26	1.00%	+++
I-X-ST-X	3	1.24%	22	0.93%	25	0.96%	
N-RSW-X	2	0.83%	23	0.98%	25	0.96%	
I-NS-RT-X	1	0.41%	22	0.93%	23	0.88%	
I-NS-LT-R	3	1.24%	17	0.72%	20	0.77%	
N-RSH-X	0	0.00%	17	0.72%	17	0.65%	
N-LRD-X	2	0.83%	15	0.64%	17	0.65%	
I-NS-RT-L	0	0.00%	15	0.64%	15	0.58%	
D-F	0	0.00%	14	0.59%	14	0.54%	
I-NS-LT-L	0	0.00%	12	0.51%	12	0.46%	
N-LRD-L	0	0.00%	10	0.42%	10	0.38%	
N-RRD-O	1	0.41%	9	0.38%	10	0.38%	
I-X-LT-X	1	0.41%	8	0.34%	9	0.35%	
I-NS-ST-S	0	0.00%	9	0.38%	9	0.35%	
I-FS-X-X	1	0.41%	6	0.25%	7	0.27%	
D-B	1	0.41%	5	0.21%	6	0.23%	
N-LRD-O	1	0.41%	5	0.21%	6	0.23%	
P-X	0	0.00%	6	0.25%	6	0.23%	
N-LRD-R	0	0.00%	5	0.21%	5	0.19%	
I-FS-ST-O	1	0.41%	4	0.17%	5	0.19%	
I-X-ST-R	1	0.41%	4	0.17%	5	0.19%	
I-FS-ST-S	1	0.41%	4	0.17%	5	0.19%	
I-NS-X-R	0	0.00%	4	0.17%	4	0.15%	
N-RD-R	0	0.00%	4	0.17%	4	0.15%	
N-LSH-X	0	0.00%	4	0.17%	4	0.15%	
I-FS-LT-L	1	0.41%	2	0.08%	3	0.12%	
N-RD-S	0	0.00%	3	0.13%	3	0.12%	

LMCM Crash Type	Fatal & Disabling		Other		Total		*Sig.*
	Count	**%**	**Count**	**%**	**Count**	**%**	
I-X-RT-X	0	0.00%	3	0.13%	3	0.12%	
N-LSW-X	1	0.41%	2	0.08%	3	0.12%	
N-RSW-L	1	0.41%	2	0.08%	3	0.12%	
N-RSW-O	0	0.00%	3	0.13%	3	0.12%	
I-NS-X-L	0	0.00%	3	0.13%	3	0.12%	
I-X-ST-L	1	0.41%	2	0.08%	3	0.12%	
N-RD-L	0	0.00%	2	0.08%	2	0.08%	
N-RSH-S	0	0.00%	2	0.08%	2	0.08%	
I-NS-ST-O	0	0.00%	2	0.08%	2	0.08%	
I-NS-RT-S	0	0.00%	2	0.08%	2	0.08%	
N-RSW-S	0	0.00%	2	0.08%	2	0.08%	
I-NS-LT-S	0	0.00%	2	0.08%	2	0.08%	
N-SW-X	1	0.41%	1	0.04%	2	0.08%	++
N-LSW-O	0	0.00%	2	0.08%	2	0.08%	
N-RSH-R	0	0.00%	2	0.08%	2	0.08%	
N-RSW-R	0	0.00%	2	0.08%	2	0.08%	
I-FS-LT-R	0	0.00%	1	0.04%	1	0.04%	
I-NS-X-S	0	0.00%	1	0.04%	1	0.04%	
N-LSW-R	0	0.00%	1	0.04%	1	0.04%	
N-LSW-S	0	0.00%	1	0.04%	1	0.04%	
N-LRD-S	1	0.41%	0	0.00%	1	0.04%	+++
D-X	1	0.41%	0	0.00%	1	0.04%	+++
I-FS-X-L	0	0.00%	1	0.04%	1	0.04%	
N-X-S	0	0.00%	1	0.04%	1	0.04%	
N-RD-O	0	0.00%	1	0.04%	1	0.04%	
Total	**242**	**100.00%**	**2357**	**100.00%**	**2599**	**100.00%**	

Table 182. Full List of Pedestrian LMCM Crash Types & Severity Level by Year

LMCM Crash Type	Fatal & Disabling		Other		Total		*Sig.*
	Count	**%**	**Count**	**%**	**Count**	**%**	
I-NS-ST-X	16	19.75%	116	15.89%	132	16.28%	
I-FS-LT-O	6	7.41%	69	9.45%	75	9.25%	
I-FS-LT-X	4	4.94%	56	7.67%	60	7.40%	
N-RRD-X	10	12.35%	50	6.85%	60	7.40%	+
I-NS-ST-R	3	3.70%	34	4.66%	37	4.56%	
I-FS-LT-S	5	6.17%	29	3.97%	34	4.19%	
I-NS-ST-L	2	2.47%	32	4.38%	34	4.19%	
P-F	3	3.70%	28	3.84%	31	3.82%	
I-FS-RT-X	2	2.47%	27	3.70%	29	3.58%	
N-RRD-R	3	3.70%	23	3.15%	26	3.21%	

LMCM Crash Type	Fatal & Disabling		Other		Total		*Sig.*
	Count	**%**	**Count**	**%**	**Count**	**%**	
N-RD-X	3	3.70%	22	3.01%	25	3.08%	
P-B	0	0.00%	18	2.47%	18	2.22%	
I-FS-ST-X	2	2.47%	16	2.19%	18	2.22%	
I-FS-ST-R	2	2.47%	14	1.92%	16	1.97%	
I-NS-RT-X	1	1.23%	15	2.05%	16	1.97%	
I-NS-LT-X	1	1.23%	14	1.92%	15	1.85%	
N-X-X	2	2.47%	13	1.78%	15	1.85%	
N-RRD-L	1	1.23%	13	1.78%	14	1.73%	
I-NS-X-X	1	1.23%	13	1.78%	14	1.73%	
I-FS-ST-L	1	1.23%	12	1.64%	13	1.60%	
OTH	1	1.23%	8	1.10%	9	1.11%	
I-FS-RT-S	0	0.00%	9	1.23%	9	1.11%	
N-LRD-X	0	0.00%	9	1.23%	9	1.11%	
I-NS-RT-R	0	0.00%	8	1.10%	8	0.99%	
I-FS-RT-O	0	0.00%	6	0.82%	6	0.74%	
I-NS-LT-R	1	1.23%	5	0.68%	6	0.74%	
N-RRD-S	3	3.70%	3	0.41%	6	0.74%	+++
I-X-ST-X	1	1.23%	4	0.55%	5	0.62%	
I-NS-ST-S	0	0.00%	4	0.55%	4	0.49%	
I-X-LT-X	1	1.23%	3	0.41%	4	0.49%	
I-NS-RT-L	0	0.00%	4	0.55%	4	0.49%	
N-RSW-X	1	1.23%	3	0.41%	4	0.49%	
I-X-X-X	0	0.00%	4	0.55%	4	0.49%	
N-LRD-R	0	0.00%	4	0.55%	4	0.49%	
P-X	0	0.00%	4	0.55%	4	0.49%	
D-F	0	0.00%	3	0.41%	3	0.37%	
I-X-ST-R	1	1.23%	2	0.27%	3	0.37%	
N-LRD-L	0	0.00%	3	0.41%	3	0.37%	
I-FS-ST-O	0	0.00%	3	0.41%	3	0.37%	
I-FS-X-X	1	1.23%	2	0.27%	3	0.37%	
N-RD-S	0	0.00%	3	0.41%	3	0.37%	
I-NS-LT-L	0	0.00%	3	0.41%	3	0.37%	
N-RSW-S	0	0.00%	2	0.27%	2	0.25%	
N-LRD-O	1	1.23%	1	0.14%	2	0.25%	+
D-B	0	0.00%	2	0.27%	2	0.25%	
N-SW-X	1	1.23%	1	0.14%	2	0.25%	+
I-FS-LT-L	1	1.23%	1	0.14%	2	0.25%	+
N-RRD-O	0	0.00%	2	0.27%	2	0.25%	
N-RSH-X	0	0.00%	1	0.14%	1	0.12%	
I-NS-X-S	0	0.00%	1	0.14%	1	0.12%	
N-X-S	0	0.00%	1	0.14%	1	0.12%	

LMCM Crash Type	Fatal & Disabling		Other		Total		*Sig.*
	Count	%	Count	%	Count	%	
I-X-ST-L	0	0.00%	1	0.14%	1	0.12%	
I-FS-LT-R	0	0.00%	1	0.14%	1	0.12%	
I-NS-X-L	0	0.00%	1	0.14%	1	0.12%	
I-X-RT-X	0	0.00%	1	0.14%	1	0.12%	
I-FS-X-L	0	0.00%	1	0.14%	1	0.12%	
N-LSH-X	0	0.00%	1	0.14%	1	0.12%	
N-LSW-X	0	0.00%	1	0.14%	1	0.12%	
2012	**81**	**100.00%**	**730**	**100.00%**	**811**	**100.00%**	***Sig.***
N-RRD-X	8	9.76%	93	11.95%	101	11.74%	
I-FS-LT-O	3	3.66%	79	10.15%	82	9.53%	-
I-FS-LT-S	5	6.10%	61	7.84%	66	7.67%	
N-RRD-R	5	6.10%	58	7.46%	63	7.33%	
I-NS-ST-R	9	10.98%	43	5.53%	52	6.05%	++
I-FS-LT-X	1	1.22%	46	5.91%	47	5.47%	-
I-NS-ST-L	6	7.32%	38	4.88%	44	5.12%	
I-NS-ST-X	2	2.44%	39	5.01%	41	4.77%	
I-FS-ST-L	4	4.88%	30	3.86%	34	3.95%	
I-FS-ST-R	6	7.32%	24	3.08%	30	3.49%	++
I-FS-ST-X	3	3.66%	27	3.47%	30	3.49%	
OTH	3	3.66%	23	2.96%	26	3.02%	
I-FS-RT-S	1	1.22%	23	2.96%	24	2.79%	
N-RRD-L	2	2.44%	15	1.93%	17	1.98%	
P-F	3	3.66%	14	1.80%	17	1.98%	
P-B	0	0.00%	17	2.19%	17	1.98%	
I-FS-RT-X	3	3.66%	14	1.80%	17	1.98%	
I-NS-RT-R	0	0.00%	14	1.80%	14	1.63%	
I-X-ST-X	1	1.22%	12	1.54%	13	1.51%	
N-RSW-X	1	1.22%	10	1.29%	11	1.28%	
I-FS-RT-O	1	1.22%	9	1.16%	10	1.16%	
I-X-X-X	1	1.22%	7	0.90%	8	0.93%	
N-RRD-S	1	1.22%	6	0.77%	7	0.81%	
I-NS-LT-R	2	2.44%	5	0.64%	7	0.81%	+
I-NS-X-X	1	1.22%	5	0.64%	6	0.70%	
N-X-X	1	1.22%	4	0.51%	5	0.58%	
N-RRD-O	1	1.22%	4	0.51%	5	0.58%	
D-F	0	0.00%	5	0.64%	5	0.58%	
I-NS-RT-X	0	0.00%	4	0.51%	4	0.47%	
N-LRD-X	2	2.44%	2	0.26%	4	0.47%	+++
I-NS-LT-X	0	0.00%	4	0.51%	4	0.47%	
I-FS-ST-S	1	1.22%	2	0.26%	3	0.35%	
I-NS-RT-L	0	0.00%	3	0.39%	3	0.35%	

LMCM Crash Type	Fatal & Disabling		Other		Total		*Sig.*
	Count	%	Count	%	Count	%	
I-NS-LT-L	0	0.00%	3	0.39%	3	0.35%	
N-LRD-O	0	0.00%	3	0.39%	3	0.35%	
I-X-LT-X	0	0.00%	3	0.39%	3	0.35%	
I-FS-ST-O	1	1.22%	1	0.13%	2	0.23%	+
N-RSW-O	0	0.00%	2	0.26%	2	0.23%	
N-RD-X	0	0.00%	2	0.26%	2	0.23%	
I-X-ST-L	1	1.22%	1	0.13%	2	0.23%	+
N-LRD-L	0	0.00%	2	0.26%	2	0.23%	
I-X-ST-R	0	0.00%	2	0.26%	2	0.23%	
I-FS-X-X	0	0.00%	2	0.26%	2	0.23%	
I-NS-LT-S	0	0.00%	2	0.26%	2	0.23%	
I-X-RT-X	0	0.00%	2	0.26%	2	0.23%	
I-NS-RT-S	0	0.00%	2	0.26%	2	0.23%	
I-NS-X-R	0	0.00%	2	0.26%	2	0.23%	
N-LSW-S	0	0.00%	1	0.13%	1	0.12%	
I-NS-ST-S	0	0.00%	1	0.13%	1	0.12%	
N-RD-O	0	0.00%	1	0.13%	1	0.12%	
I-NS-X-L	0	0.00%	1	0.13%	1	0.12%	
N-RSW-R	0	0.00%	1	0.13%	1	0.12%	
N-LRD-R	0	0.00%	1	0.13%	1	0.12%	
N-RD-L	0	0.00%	1	0.13%	1	0.12%	
N-LRD-S	1	1.22%		0.00%	1	0.12%	+++
I-FS-LT-L	0	0.00%	1	0.13%	1	0.12%	
N-RSW-L	1	1.22%		0.00%	1	0.12%	+++
I-NS-ST-O	0	0.00%	1	0.13%	1	0.12%	
D-B	1	1.22%		0.00%	1	0.12%	+++
2013	**82**	**100.00%**	**778**	**100.00%**	**860**	**100.00%**	***Sig.***
I-FS-LT-O	8	10.13%	76	8.95%	84	9.05%	
N-RRD-X	10	12.66%	71	8.36%	81	8.73%	
I-NS-ST-X	10	12.66%	63	7.42%	73	7.87%	+
I-FS-LT-S	1	1.27%	63	7.42%	64	6.90%	--
I-FS-LT-X	4	5.06%	57	6.71%	61	6.57%	
I-NS-ST-R	6	7.59%	50	5.89%	56	6.03%	
I-NS-ST-L	2	2.53%	53	6.24%	55	5.93%	
I-FS-ST-X	5	6.33%	30	3.53%	35	3.77%	
N-RRD-R	4	5.06%	29	3.42%	33	3.56%	
I-FS-ST-R	2	2.53%	27	3.18%	29	3.13%	
I-FS-RT-S	2	2.53%	23	2.71%	25	2.69%	
P-F	4	5.06%	21	2.47%	25	2.69%	
I-FS-ST-L	4	5.06%	20	2.36%	24	2.59%	
P-B	1	1.27%	20	2.36%	21	2.26%	

LMCM Crash Type	Fatal & Disabling		Other		Total		*Sig.*
	Count	%	Count	%	Count	%	
N-RRD-L	1	1.27%	15	1.77%	16	1.72%	
N-RSH-X	0	0.00%	16	1.88%	16	1.72%	
I-FS-RT-X	3	3.80%	12	1.41%	15	1.62%	
N-RD-X	0	0.00%	14	1.65%	14	1.51%	
I-NS-RT-R	1	1.27%	13	1.53%	14	1.51%	
I-X-X-X	1	1.27%	13	1.53%	14	1.51%	
N-RRD-S	3	3.80%	10	1.18%	13	1.40%	+
I-NS-X-X	1	1.27%	12	1.41%	13	1.40%	
N-X-X	0	0.00%	12	1.41%	12	1.29%	
I-FS-RT-O	0	0.00%	12	1.41%	12	1.29%	
OTH	2	2.53%	9	1.06%	11	1.19%	
I-NS-LT-X	1	1.27%	10	1.18%	11	1.19%	
N-RSW-X	0	0.00%	10	1.18%	10	1.08%	
I-NS-RT-L	0	0.00%	8	0.94%	8	0.86%	
I-NS-LT-R	0	0.00%	7	0.82%	7	0.75%	
I-X-ST-X	1	1.27%	6	0.71%	7	0.75%	
I-NS-LT-L	0	0.00%	6	0.71%	6	0.65%	
D-F	0	0.00%	6	0.71%	6	0.65%	
N-LRD-L	0	0.00%	5	0.59%	5	0.54%	
N-RD-R	0	0.00%	4	0.47%	4	0.43%	
I-NS-ST-S	0	0.00%	4	0.47%	4	0.43%	
N-LRD-X	0	0.00%	4	0.47%	4	0.43%	
N-LSH-X	0	0.00%	3	0.35%	3	0.32%	
D-B	0	0.00%	3	0.35%	3	0.32%	
N-RRD-O	0	0.00%	3	0.35%	3	0.32%	
I-NS-RT-X	0	0.00%	3	0.35%	3	0.32%	
I-FS-X-X	0	0.00%	2	0.24%	2	0.22%	
P-X	0	0.00%	2	0.24%	2	0.22%	
N-LSW-O	0	0.00%	2	0.24%	2	0.22%	
N-RSH-S	0	0.00%	2	0.24%	2	0.22%	
N-LSW-X	1	1.27%	1	0.12%	2	0.22%	++
I-FS-ST-S	0	0.00%	2	0.24%	2	0.22%	
N-RSW-L	0	0.00%	2	0.24%	2	0.22%	
N-RSH-R	0	0.00%	2	0.24%	2	0.22%	
I-NS-X-R	0	0.00%	2	0.24%	2	0.22%	
I-X-LT-X	0	0.00%	2	0.24%	2	0.22%	
N-LRD-O	0	0.00%	1	0.12%	1	0.11%	
I-NS-X-L	0	0.00%	1	0.12%	1	0.11%	
D-X	1	1.27%		0.00%	1	0.11%	+++
N-RSW-R	0	0.00%	1	0.12%	1	0.11%	
N-LSW-R	0	0.00%	1	0.12%	1	0.11%	

LMCM Crash Type	Fatal & Disabling		Other		Total		Sig.
	Count	%	Count	%	Count	%	
N-RD-L	0	0.00%	1	0.12%	1	0.11%	
N-RSW-O	0	0.00%	1	0.12%	1	0.11%	
I-NS-ST-O	0	0.00%	1	0.12%	1	0.11%	
2014	**79**	**100.00%**	**849**	**100.00%**	**928**	**100.00%**	
Total	**242**	**-**	**2357**	**-**	**2599**	**-**	

Table 183. Full List of Bicycle NHTSA Crash Types & Severity Level

NHTSA Crash Type	Fatal & Disabling		Other		Total		Sig.
	Count	%	Count	%	Count	%	
244 - Bicyclist Overtaking—Extended Door	13	11.21%	205	11.06%	218	11.07%	
212 - Motorist Left Turn—Opposite Direction	10	8.62%	185	9.98%	195	9.90%	
213 - Motorist Right Turn—Same Direction	3	2.59%	110	5.93%	113	5.74%	
155 - Bicyclist Ride Through—Signalized Intersection	10	8.62%	93	5.02%	103	5.23%	+
232 - Motorist Overtaking—Misjudged Space	5	4.31%	84	4.53%	89	4.52%	
158 - Signalized Intersection—Other/Unknown	6	5.17%	57	3.07%	63	3.20%	
211 - Motorist Left Turn—Same Direction	5	4.31%	56	3.02%	61	3.10%	
239 - Motorist Overtaking—Other/Unknown	2	1.72%	53	2.86%	55	2.79%	
280 - Parallel Paths—Other/Unknown	1	0.86%	54	2.91%	55	2.79%	
231 - Motorist Overtaking—Undetected Bicyclist	1	0.86%	49	2.64%	50	2.54%	
122 - Bicyclist Lost Control—Oversteering, Improper Braking, Speed	3	2.59%	43	2.32%	46	2.34%	
154 - Motorist Drive-through—Signalized Intersection	5	4.31%	38	2.05%	43	2.18%	
180 - Crossing Paths—Intersection—Other/Unknown Control	4	3.45%	37	2.00%	41	2.08%	
153 - Bicyclist Ride-out—Signalized Intersection	5	4.31%	36	1.94%	41	2.08%	+
249 - Bicyclist Overtaking—Other/Unknown	0	0.00%	38	2.05%	38	1.93%	
380 - Crossing Paths—Midblock—Other/Unknown	2	1.72%	35	1.89%	37	1.88%	
143 - Motorist Drive-through—Sign-Controlled Intersection	1	0.86%	36	1.94%	37	1.88%	

NHTSA Crash Type	Fatal & Disabling		Other		Total		*Sig.*
	Count	%	Count	%	Count	%	
243 - Bicyclist Overtaking—Parked Vehicle	3	2.59%	34	1.83%	37	1.88%	
214 - Motorist Right Turn—Opposite Direction	0	0.00%	36	1.94%	36	1.83%	
129 - Bicyclist Lost Control—Other/Unknown	2	1.72%	33	1.78%	35	1.78%	
215 - Motorist Drive-In/Out Parking	1	0.86%	34	1.83%	35	1.78%	
148 - Sign-Controlled Intersection—Other/Unknown	0	0.00%	35	1.89%	35	1.78%	
400 - Bicycle Only	10	8.62%	24	1.29%	34	1.73%	+++
241 - Bicyclist Overtaking—Passing on Right	0	0.00%	27	1.46%	27	1.37%	
322 - Motorist Drive-out—Commercial Driveway/Alley	1	0.86%	26	1.40%	27	1.37%	
219 - Motorist Turn/Merge—Other/Unknown	0	0.00%	27	1.46%	27	1.37%	
152 - Motorist Drive-out—Signalized Intersection	3	2.59%	23	1.24%	26	1.32%	
141 - Motorist Drive-out—Sign-Controlled Intersection	1	0.86%	24	1.29%	25	1.27%	
144 - Bicyclist Ride Through—Sign-Controlled Intersection	0	0.00%	24	1.29%	24	1.22%	
242 - Bicyclist Overtaking—Passing on Left	1	0.86%	21	1.13%	22	1.12%	
235 - Motorist Overtaking—Bicyclist Swerved	1	0.86%	20	1.08%	21	1.07%	
250 - Head-On—Bicyclist	2	1.72%	19	1.02%	21	1.07%	
600 - Backing Vehicle	0	0.00%	19	1.02%	19	0.96%	
151 - Motorist Drive-out—Right Turn on Red	0	0.00%	18	0.97%	18	0.91%	
259 - Head-On—Unknown	4	3.45%	13	0.70%	17	0.86%	+++
221 - Bicyclist Left Turn—Same Direction	0	0.00%	17	0.92%	17	0.86%	
160 - Crossing Paths—Uncontrolled Intersection	0	0.00%	15	0.81%	15	0.76%	
121 - Bicyclist Lost Control—Mechanical problems	0	0.00%	14	0.76%	14	0.71%	
312 - Bicyclist Ride-out—Commercial Driveway/Alley	0	0.00%	12	0.65%	12	0.61%	
255 - Head-On—Motorist	1	0.86%	10	0.54%	11	0.56%	
510 - Motorist Intentionally Caused	0	0.00%	10	0.54%	10	0.51%	
800 - Unusual Circumstances	2	1.72%	8	0.43%	10	0.51%	+
223 - Bicyclist Right Turn—Same Direction	0	0.00%	9	0.49%	9	0.46%	
132 - Motorist Lost Control—Oversteering, Improper Braking,	0	0.00%	9	0.49%	9	0.46%	

NHTSA Crash Type	Fatal & Disabling		Other		Total		*Sig.*
	Count	**%**	**Count**	**%**	**Count**	**%**	
Speed							
142 - Bicyclist Ride-out—Sign-Controlled Intersection	0	0.00%	9	0.49%	9	0.46%	
222 - Bicyclist Left Turn—Opposite Direction	0	0.00%	8	0.43%	8	0.41%	
111 - Motorist Turning Error—Left Turn	1	0.86%	6	0.32%	7	0.36%	
216 - Bus/Delivery Vehicle Pullover	0	0.00%	6	0.32%	6	0.30%	
159 - Bicyclist Failed to Clear—Unknown	1	0.86%	5	0.27%	6	0.30%	
124 - Bicyclist Lost Control—Surface Conditions	0	0.00%	6	0.32%	6	0.30%	
321 - Motorist Drive-out—Residential Driveway	0	0.00%	5	0.27%	5	0.25%	
318 - Bicyclist Ride-out—Other Midblock	1	0.86%	3	0.16%	4	0.20%	
328 - Motorist Drive-out—Other Midblock	0	0.00%	4	0.22%	4	0.20%	
218 - Motorist Right Turn on Red—Opposite Direction	0	0.00%	4	0.22%	4	0.20%	
133 - Motorist Lost Control—Alcohol/Drug Impairment	2	1.72%	2	0.11%	4	0.20%	+++
139 - Motorist Lost Control—Other/Unknown	0	0.00%	3	0.16%	3	0.15%	
329 - Motorist Drive-out—Midblock—Unknown	1	0.86%	2	0.11%	3	0.15%	++
970 - Unknown Approach Paths	0	0.00%	3	0.16%	3	0.15%	
319 - Bicyclist Ride-out—Midblock—Unknown	0	0.00%	3	0.16%	3	0.15%	
123 - Bicyclist Lost Control—Alcohol/Drug Impairment	1	0.86%	2	0.11%	3	0.15%	++
910 - Nonroadway	0	0.00%	2	0.11%	2	0.10%	
225 - Bicyclist Ride-out—Parallel Path	1	0.86%	1	0.05%	2	0.10%	+++
311 - Bicyclist Ride-out—Residential Driveway	0	0.00%	2	0.11%	2	0.10%	
224 - Bicyclist Right Turn—Opposite Direction	0	0.00%	2	0.11%	2	0.10%	
114 - Bicyclist Turning Error—Left Turn	0	0.00%	2	0.11%	2	0.10%	
112 - Motorist Turning Error—Right Turn	0	0.00%	1	0.05%	1	0.05%	
700 - Play Vehicle-Related	0	0.00%	1	0.05%	1	0.05%	
217 - Motorist Right Turn on Red—Same Direction	0	0.00%	1	0.05%	1	0.05%	
115 - Bicyclist Turning Error—Right Turn	0	0.00%	1	0.05%	1	0.05%	

NHTSA Crash Type	Fatal & Disabling		Other		Total		*Sig.*
	Count	%	Count	%	Count	%	
Total	**116**	**100.00%**	**1854**	**100.00%**	**1970**	**100.00%**	

Table 184. Full List of Bicycle NHTSA Crash Types & Severity Level by Year

NHTSA Crash Type	Fatal & Disabling		Other		Total		*Sig.*
	Count	%	Count	%	Count	%	
212 - Motorist Left Turn—Opposite Direction	2	5.88%	61	11.13%	63	10.82%	
244 - Bicyclist Overtaking—Extended Door	3	8.82%	50	9.12%	53	9.11%	
155 - Bicyclist Ride Through—Signalized Intersection	4	11.76%	29	5.29%	33	5.67%	
213 - Motorist Right Turn—Same Direction	1	2.94%	24	4.38%	25	4.30%	
211 - Motorist Left Turn—Same Direction	2	5.88%	21	3.83%	23	3.95%	
158 - Signalized Intersection—Other/Unknown	3	8.82%	20	3.65%	23	3.95%	
154 - Motorist Drive-through—Signalized Intersection	2	5.88%	18	3.28%	20	3.44%	
232 - Motorist Overtaking—Misjudged Space	0	0.00%	18	3.28%	18	3.09%	
122 - Bicyclist Lost Control—Oversteering, Improper Braking, Speed	1	2.94%	16	2.92%	17	2.92%	
280 - Parallel Paths—Other/Unknown	0	0.00%	17	3.10%	17	2.92%	
152 - Motorist Drive-out—Signalized Intersection	3	8.82%	13	2.37%	16	2.75%	++
129 - Bicyclist Lost Control—Other/Unknown	0	0.00%	16	2.92%	16	2.75%	
239 - Motorist Overtaking—Other/ Unknown	0	0.00%	16	2.92%	16	2.75%	
214 - Motorist Right Turn—Opposite Direction	0	0.00%	16	2.92%	16	2.75%	
153 - Bicyclist Ride-out—Signalized Intersection	0	0.00%	15	2.74%	15	2.58%	
241 - Bicyclist Overtaking—Passing on Right	0	0.00%	12	2.19%	12	2.06%	
243 - Bicyclist Overtaking—Parked Vehicle	2	5.88%	9	1.64%	11	1.89%	+
143 - Motorist Drive-through—Sign-Controlled Intersection	0	0.00%	10	1.82%	10	1.72%	
380 - Crossing Paths—Midblock—Other/Unknown	0	0.00%	10	1.82%	10	1.72%	
235 - Motorist Overtaking—Bicyclist Swerved	1	2.94%	8	1.46%	9	1.55%	
231 - Motorist Overtaking—Undetected Bicyclist	0	0.00%	9	1.64%	9	1.55%	
215 - Motorist Drive-In/Out Parking	0	0.00%	9	1.64%	9	1.55%	
250 - Head-On—Bicyclist	2	5.88%	6	1.09%	8	1.37%	++
249 - Bicyclist Overtaking—Other/Unknown	0	0.00%	7	1.28%	7	1.20%	
322 - Motorist Drive-out—Commercial Driveway/Alley	0	0.00%	7	1.28%	7	1.20%	
259 - Head-On—Unknown	3	8.82%	3	0.55%	6	1.03%	+++
222 - Bicyclist Left Turn—Opposite Direction	0	0.00%	6	1.09%	6	1.03%	
144 - Bicyclist Ride Through—Sign-Controlled Intersection	0	0.00%	6	1.09%	6	1.03%	

NHTSA Crash Type	Fatal & Disabling		Other		Total		*Sig.*
	Count	%	Count	%	Count	%	
148 - Sign-Controlled Intersection—Other/Unknown	0	0.00%	5	0.91%	5	0.86%	
255 - Head-On—Motorist	0	0.00%	5	0.91%	5	0.86%	
800 - Unusual Circumstances	1	2.94%	4	0.73%	5	0.86%	
141 - Motorist Drive-out—Sign-Controlled Intersection	0	0.00%	5	0.91%	5	0.86%	
219 - Motorist Turn/Merge—Other/Unknown	0	0.00%	5	0.91%	5	0.86%	
180 - Crossing Paths—Intersection—Other/Unknown Control	1	2.94%	3	0.55%	4	0.69%	
400 - Bicycle Only	2	5.88%	2	0.36%	4	0.69%	+++
151 - Motorist Drive-out—Right Turn on Red	0	0.00%	4	0.73%	4	0.69%	
142 - Bicyclist Ride-out—Sign-Controlled Intersection	0	0.00%	4	0.73%	4	0.69%	
600 - Backing Vehicle	0	0.00%	4	0.73%	4	0.69%	
160 - Crossing Paths—Uncontrolled Intersection	0	0.00%	4	0.73%	4	0.69%	
132 - Motorist Lost Control—Oversteering, Improper Braking, Speed	0	0.00%	4	0.73%	4	0.69%	
216 - Bus/Delivery Vehicle Pullover	0	0.00%	3	0.55%	3	0.52%	
139 - Motorist Lost Control—Other/Unknown	0	0.00%	3	0.55%	3	0.52%	
218 - Motorist Right Turn on Red—Opposite Direction	0	0.00%	3	0.55%	3	0.52%	
242 - Bicyclist Overtaking—Passing on Left	0	0.00%	3	0.55%	3	0.52%	
111 - Motorist Turning Error—Left Turn	0	0.00%	3	0.55%	3	0.52%	
221 - Bicyclist Left Turn—Same Direction	0	0.00%	3	0.55%	3	0.52%	
312 - Bicyclist Ride-out—Commercial Driveway/Alley	0	0.00%	3	0.55%	3	0.52%	
910 - Nonroadway	0	0.00%	2	0.36%	2	0.34%	
510 - Motorist Intentionally Caused	0	0.00%	2	0.36%	2	0.34%	
123 - Bicyclist Lost Control—Alcohol/Drug Impairment	0	0.00%	2	0.36%	2	0.34%	
318 - Bicyclist Ride-out—Other Midblock	1	2.94%	1	0.18%	2	0.34%	+++
124 - Bicyclist Lost Control—Surface Conditions	0	0.00%	2	0.36%	2	0.34%	
319 - Bicyclist Ride-out—Midblock—Unknown	0	0.00%	2	0.36%	2	0.34%	
328 - Motorist Drive-out—Other Midblock	0	0.00%	2	0.36%	2	0.34%	
321 - Motorist Drive-out—Residential Driveway	0	0.00%	2	0.36%	2	0.34%	
112 - Motorist Turning Error—Right Turn	0	0.00%	1	0.18%	1	0.17%	
311 - Bicyclist Ride-out—Residential Driveway	0	0.00%	1	0.18%	1	0.17%	
223 - Bicyclist Right Turn—Same Direction	0	0.00%	1	0.18%	1	0.17%	
121 - Bicyclist Lost Control—Mechanical problems	0	0.00%	1	0.18%	1	0.17%	

NHTSA Crash Type	Fatal & Disabling		Other		Total		*Sig.*
	Count	%	Count	%	Count	%	
133 - Motorist Lost Control—Alcohol/Drug Impairment	0	0.00%	1	0.18%	1	0.17%	
159 - Bicyclist Failed to Clear—Unknown	0	0.00%	1	0.18%	1	0.17%	
225 - Bicyclist Ride-out—Parallel Path	0	0.00%	1	0.18%	1	0.17%	
329 - Motorist Drive-out—Midblock—Unknown	0	0.00%	1	0.18%	1	0.17%	
970 - Unknown Approach Paths	0	0.00%	1	0.18%	1	0.17%	
224 - Bicyclist Right Turn—Opposite Direction	0	0.00%	1	0.18%	1	0.17%	
217 - Motorist Right Turn on Red—Same Direction	0	0.00%	1	0.18%	1	0.17%	
2012	**34**	**100.00%**	**548**	**100.00%**	**582**	**100.00%**	***Sig.***
244 - Bicyclist Overtaking—Extended Door	5	15.15%	69	12.39%	74	12.54%	
212 - Motorist Left Turn—Opposite Direction	2	6.06%	55	9.87%	57	9.66%	
213 - Motorist Right Turn—Same Direction	2	6.06%	37	6.64%	39	6.61%	
155 - Bicyclist Ride Through—Signalized Intersection	4	12.12%	22	3.95%	26	4.41%	++
158 - Signalized Intersection—Other/Unknown	1	3.03%	24	4.31%	25	4.24%	
153 - Bicyclist Ride-out—Signalized Intersection	5	15.15%	18	3.23%	23	3.90%	+++
232 - Motorist Overtaking—Misjudged Space	1	3.03%	22	3.95%	23	3.90%	
211 - Motorist Left Turn—Same Direction	3	9.09%	19	3.41%	22	3.73%	+
148 - Sign-Controlled Intersection—Other/Unknown	0	0.00%	19	3.41%	19	3.22%	
154 - Motorist Drive-through—Signalized Intersection	1	3.03%	14	2.51%	15	2.54%	
122 - Bicyclist Lost Control—Oversteering, Improper Braking, Speed	0	0.00%	14	2.51%	14	2.37%	
143 - Motorist Drive-through—Sign-Controlled Intersection	1	3.03%	12	2.15%	13	2.20%	
249 - Bicyclist Overtaking—Other/Unknown	0	0.00%	12	2.15%	12	2.03%	
280 - Parallel Paths—Other/Unknown	0	0.00%	12	2.15%	12	2.03%	
400 - Bicycle Only	5	15.15%	6	1.08%	11	1.86%	+++
380 - Crossing Paths—Midblock—Other/Unknown	0	0.00%	11	1.97%	11	1.86%	
243 - Bicyclist Overtaking—Parked Vehicle	0	0.00%	11	1.97%	11	1.86%	
141 - Motorist Drive-out—Sign-Controlled Intersection	0	0.00%	11	1.97%	11	1.86%	
239 - Motorist Overtaking—Other/ Unknown	1	3.03%	9	1.62%	10	1.69%	
231 - Motorist Overtaking—Undetected Bicyclist	0	0.00%	10	1.80%	10	1.69%	
242 - Bicyclist Overtaking—Passing on Left	0	0.00%	9	1.62%	9	1.53%	
215 - Motorist Drive-In/Out Parking	0	0.00%	9	1.62%	9	1.53%	
600 - Backing Vehicle	0	0.00%	9	1.62%	9	1.53%	
214 - Motorist Right Turn—Opposite Direction	0	0.00%	9	1.62%	9	1.53%	

NHTSA Crash Type	Fatal & Disabling		Other		Total		*Sig.*
	Count	**%**	**Count**	**%**	**Count**	**%**	
129 - Bicyclist Lost Control—Other/Unknown	1	3.03%	7	1.26%	8	1.36%	
151 - Motorist Drive-out—Right Turn on Red	0	0.00%	7	1.26%	7	1.19%	
221 - Bicyclist Left Turn—Same Direction	0	0.00%	7	1.26%	7	1.19%	
121 - Bicyclist Lost Control—Mechanical problems	0	0.00%	6	1.08%	6	1.02%	
250 - Head-On—Bicyclist	0	0.00%	6	1.08%	6	1.02%	
235 - Motorist Overtaking—Bicyclist Swerved	0	0.00%	6	1.08%	6	1.02%	
219 - Motorist Turn/Merge—Other/Unknown	0	0.00%	6	1.08%	6	1.02%	
223 - Bicyclist Right Turn—Same Direction	0	0.00%	6	1.08%	6	1.02%	
259 - Head-On—Unknown	0	0.00%	6	1.08%	6	1.02%	
152 - Motorist Drive-out—Signalized Intersection	0	0.00%	5	0.90%	5	0.85%	
144 - Bicyclist Ride Through—Sign-Controlled Intersection	0	0.00%	5	0.90%	5	0.85%	
142 - Bicyclist Ride-out—Sign-Controlled Intersection	0	0.00%	5	0.90%	5	0.85%	
510 - Motorist Intentionally Caused	0	0.00%	5	0.90%	5	0.85%	
180 - Crossing Paths—Intersection—Other/Unknown Control	0	0.00%	5	0.90%	5	0.85%	
322 - Motorist Drive-out—Commercial Driveway/Alley	0	0.00%	4	0.72%	4	0.68%	
241 - Bicyclist Overtaking—Passing on Right	0	0.00%	4	0.72%	4	0.68%	
159 - Bicyclist Failed to Clear—Unknown	1	3.03%	3	0.54%	4	0.68%	+
160 - Crossing Paths—Uncontrolled Intersection	0	0.00%	2	0.36%	2	0.34%	
318 - Bicyclist Ride-out—Other Midblock	0	0.00%	2	0.36%	2	0.34%	
111 - Motorist Turning Error—Left Turn	0	0.00%	2	0.36%	2	0.34%	
329 - Motorist Drive-out—Midblock—Unknown	0	0.00%	1	0.18%	1	0.17%	
216 - Bus/Delivery Vehicle Pullover	0	0.00%	1	0.18%	1	0.17%	
218 - Motorist Right Turn on Red—Opposite Direction	0	0.00%	1	0.18%	1	0.17%	
970 - Unknown Approach Paths	0	0.00%	1	0.18%	1	0.17%	
800 - Unusual Circumstances	0	0.00%	1	0.18%	1	0.17%	
132 - Motorist Lost Control—Oversteering, Improper Braking, Speed	0	0.00%	1	0.18%	1	0.17%	
115 - Bicyclist Turning Error—Right Turn	0	0.00%	1	0.18%	1	0.17%	
319 - Bicyclist Ride-out—Midblock—Unknown	0	0.00%	1	0.18%	1	0.17%	
133 - Motorist Lost Control—Alcohol/Drug Impairment	0	0.00%	1	0.18%	1	0.17%	
321 - Motorist Drive-out—Residential Driveway	0	0.00%	1	0.18%	1	0.17%	
700 - Play Vehicle-Related	0	0.00%	1	0.18%	1	0.17%	

NHTSA Crash Type	Fatal & Disabling		Other		Total		*Sig.*
	Count	**%**	**Count**	**%**	**Count**	**%**	
255 - Head-On—Motorist	0	0.00%	1	0.18%	1	0.17%	
311 - Bicyclist Ride-out—Residential Driveway	0	0.00%	1	0.18%	1	0.17%	
328 - Motorist Drive-out—Other Midblock	0	0.00%	1	0.18%	1	0.17%	
312 - Bicyclist Ride-out—Commercial Driveway/Alley	0	0.00%	1	0.18%	1	0.17%	
2013	**33**	**100.00%**	**557**	**100.00%**	**590**	**100.00%**	***Sig.***
244 - Bicyclist Overtaking—Extended Door	5	10.20%	86	11.48%	91	11.40%	
212 - Motorist Left Turn—Opposite Direction	6	12.24%	69	9.21%	75	9.40%	
213 - Motorist Right Turn—Same Direction	0	0.00%	49	6.54%	49	6.14%	-
232 - Motorist Overtaking—Misjudged Space	4	8.16%	44	5.87%	48	6.02%	
155 - Bicyclist Ride Through—Signalized Intersection	2	4.08%	42	5.61%	44	5.51%	
180 - Crossing Paths—Intersection—Other/Unknown Control	3	6.12%	29	3.87%	32	4.01%	
231 - Motorist Overtaking—Undetected Bicyclist	1	2.04%	30	4.01%	31	3.88%	
239 - Motorist Overtaking—Other/ Unknown	1	2.04%	28	3.74%	29	3.63%	
280 - Parallel Paths—Other/Unknown	1	2.04%	25	3.34%	26	3.26%	
249 - Bicyclist Overtaking—Other/Unknown	0	0.00%	19	2.54%	19	2.38%	
400 - Bicycle Only	3	6.12%	16	2.14%	19	2.38%	+
215 - Motorist Drive-In/Out Parking	1	2.04%	16	2.14%	17	2.13%	
211 - Motorist Left Turn—Same Direction	0	0.00%	16	2.14%	16	2.01%	
380 - Crossing Paths—Midblock—Other/Unknown	2	4.08%	14	1.87%	16	2.01%	
322 - Motorist Drive-out—Commercial Driveway/Alley	1	2.04%	15	2.00%	16	2.01%	
219 - Motorist Turn/Merge—Other/Unknown	0	0.00%	16	2.14%	16	2.01%	
243 - Bicyclist Overtaking—Parked Vehicle	1	2.04%	14	1.87%	15	1.88%	
122 - Bicyclist Lost Control—Oversteering, Improper Braking, Speed	2	4.08%	13	1.74%	15	1.88%	
158 - Signalized Intersection—Other/Unknown	2	4.08%	13	1.74%	15	1.88%	
143 - Motorist Drive-through—Sign-Controlled Intersection	0	0.00%	14	1.87%	14	1.75%	
144 - Bicyclist Ride Through—Sign-Controlled Intersection	0	0.00%	13	1.74%	13	1.63%	
148 - Sign-Controlled Intersection—Other/Unknown	0	0.00%	11	1.47%	11	1.38%	
241 - Bicyclist Overtaking—Passing on Right	0	0.00%	11	1.47%	11	1.38%	
214 - Motorist Right Turn—Opposite Direction	0	0.00%	11	1.47%	11	1.38%	
129 - Bicyclist Lost Control—Other/Unknown	1	2.04%	10	1.34%	11	1.38%	
242 - Bicyclist Overtaking—Passing on Left	1	2.04%	9	1.20%	10	1.25%	
160 - Crossing Paths—Uncontrolled Intersection	0	0.00%	9	1.20%	9	1.13%	

NHTSA Crash Type	Fatal & Disabling		Other		Total		*Sig.*
	Count	**%**	**Count**	**%**	**Count**	**%**	
141 - Motorist Drive-out—Sign-Controlled Intersection	1	2.04%	8	1.07%	9	1.13%	
312 - Bicyclist Ride-out—Commercial Driveway/Alley	0	0.00%	8	1.07%	8	1.00%	
154 - Motorist Drive-through—Signalized Intersection	2	4.08%	6	0.80%	8	1.00%	++
151 - Motorist Drive-out—Right Turn on Red	0	0.00%	7	0.93%	7	0.88%	
121 - Bicyclist Lost Control—Mechanical problems	0	0.00%	7	0.93%	7	0.88%	
221 - Bicyclist Left Turn—Same Direction	0	0.00%	7	0.93%	7	0.88%	
250 - Head-On—Bicyclist	0	0.00%	7	0.93%	7	0.88%	
600 - Backing Vehicle	0	0.00%	6	0.80%	6	0.75%	
235 - Motorist Overtaking—Bicyclist Swerved	0	0.00%	6	0.80%	6	0.75%	
255 - Head-On—Motorist	1	2.04%	4	0.53%	5	0.63%	
152 - Motorist Drive-out—Signalized Intersection	0	0.00%	5	0.67%	5	0.63%	
259 - Head-On—Unknown	1	2.04%	4	0.53%	5	0.63%	
800 - Unusual Circumstances	1	2.04%	3	0.40%	4	0.50%	
132 - Motorist Lost Control—Oversteering, Improper Braking, Speed	0	0.00%	4	0.53%	4	0.50%	
124 - Bicyclist Lost Control—Surface Conditions	0	0.00%	4	0.53%	4	0.50%	
510 - Motorist Intentionally Caused	0	0.00%	3	0.40%	3	0.38%	
153 - Bicyclist Ride-out—Signalized Intersection	0	0.00%	3	0.40%	3	0.38%	
111 - Motorist Turning Error—Left Turn	1	2.04%	1	0.13%	2	0.25%	+++
222 - Bicyclist Left Turn—Opposite Direction	0	0.00%	2	0.27%	2	0.25%	
223 - Bicyclist Right Turn—Same Direction	0	0.00%	2	0.27%	2	0.25%	
114 - Bicyclist Turning Error—Left Turn	0	0.00%	2	0.27%	2	0.25%	
133 - Motorist Lost Control—Alcohol/Drug Impairment	2	4.08%		0.00%	2	0.25%	+++
321 - Motorist Drive-out—Residential Driveway	0	0.00%	2	0.27%	2	0.25%	
216 - Bus/Delivery Vehicle Pullover	0	0.00%	2	0.27%	2	0.25%	
970 - Unknown Approach Paths	0	0.00%	1	0.13%	1	0.13%	
123 - Bicyclist Lost Control—Alcohol/Drug Impairment	1	2.04%		0.00%	1	0.13%	+++
328 - Motorist Drive-out—Other Midblock	0	0.00%	1	0.13%	1	0.13%	
225 - Bicyclist Ride-out—Parallel Path	1	2.04%		0.00%	1	0.13%	+++
329 - Motorist Drive-out—Midblock—Unknown	1	2.04%		0.00%	1	0.13%	+++
159 - Bicyclist Failed to Clear—Unknown	0	0.00%	1	0.13%	1	0.13%	
224 - Bicyclist Right Turn—Opposite Direction	0	0.00%	1	0.13%	1	0.13%	
2014	**49**	**100.00%**	**749**	**100.00%**	**798**	**100.00%**	

NHTSA Crash Type	Fatal & Disabling		Other		Total		*Sig.*
	Count	**%**	**Count**	**%**	**Count**	**%**	
Total	**116**	**-**	**1854**	**-**	**1970**	**-**	

Table 185. Full List of Bicycle LMCM Crash Types & Severity Level

LMCM Crash Type	Fatal & Disabling		Other		Total		
	Count	**%**	**Count**	**%**	**Count**	**%**	***Sig.***
N-RRD-S	16	13.79%	290	15.64%	306	15.53%	
I-FS-LT-O	8	6.90%	131	7.07%	139	7.06%	
I-NS-ST-S	2	1.72%	118	6.36%	120	6.09%	--
I-NS-ST-L	5	4.31%	107	5.77%	112	5.69%	
N-RSH-S	2	1.72%	82	4.42%	84	4.26%	
I-NS-RT-S	2	1.72%	74	3.99%	76	3.86%	
I-NS-ST-R	8	6.90%	66	3.56%	74	3.76%	+
I-NS-ST-X	7	6.03%	63	3.40%	70	3.55%	
I-FS-ST-L	6	5.17%	60	3.24%	66	3.35%	
I-FS-ST-S	2	1.72%	57	3.07%	59	2.99%	
I-NS-LT-O	5	4.31%	46	2.48%	51	2.59%	
I-FS-ST-R	5	4.31%	40	2.16%	45	2.28%	
I-FS-RT-S	2	1.72%	41	2.21%	43	2.18%	
OTH	11	9.48%	28	1.51%	39	1.98%	+++
N-LRD-S	2	1.72%	35	1.89%	37	1.88%	
I-NS-LT-S	1	0.86%	34	1.83%	35	1.78%	
I-FS-RT-O	0	0.00%	32	1.73%	32	1.62%	
N-RRD-R	1	0.86%	28	1.51%	29	1.47%	
N-LRD-O	1	0.86%	27	1.46%	28	1.42%	
N-RRD-X	2	1.72%	24	1.29%	26	1.32%	
I-NS-RT-R	0	0.00%	26	1.40%	26	1.32%	
I-NS-RT-L	0	0.00%	21	1.13%	21	1.07%	
I-FS-LT-S	3	2.59%	18	0.97%	21	1.07%	
I-NS-X-S	1	0.86%	20	1.08%	21	1.07%	
N-RRD-L	0	0.00%	20	1.08%	20	1.02%	
N-RRD-O	1	0.86%	19	1.02%	20	1.02%	
I-NS-RT-O	0	0.00%	19	1.02%	19	0.96%	
I-FS-ST-O	4	3.45%	15	0.81%	19	0.96%	+++
I-NS-ST-O	0	0.00%	19	1.02%	19	0.96%	
I-NS-X-X	0	0.00%	18	0.97%	18	0.91%	
D-F	2	1.72%	15	0.81%	17	0.86%	
I-NS-RT-X	0	0.00%	14	0.76%	14	0.71%	
N-RD-X	1	0.86%	12	0.65%	13	0.66%	
I-FS-RT-X	0	0.00%	13	0.70%	13	0.66%	
P-F	0	0.00%	13	0.70%	13	0.66%	

LMCM Crash Type	Fatal & Disabling		Other		Total		
	Count	%	Count	%	Count	%	*Sig.*
I-FS-ST-X	2	1.72%	10	0.54%	12	0.61%	
I-X-ST-S	1	0.86%	11	0.59%	12	0.61%	
I-X-X-X	1	0.86%	10	0.54%	11	0.56%	
N-RD-S	0	0.00%	11	0.59%	11	0.56%	
I-FS-X-S	1	0.86%	10	0.54%	11	0.56%	
I-NS-LT-X	0	0.00%	10	0.54%	10	0.51%	
I-NS-LT-L	0	0.00%	9	0.49%	9	0.46%	
I-FS-LT-L	2	1.72%	7	0.38%	9	0.46%	++
I-FS-X-X	1	0.86%	8	0.43%	9	0.46%	
N-LSH-O	0	0.00%	7	0.38%	7	0.36%	
N-LRD-L	1	0.86%	6	0.32%	7	0.36%	
N-LSH-S	0	0.00%	6	0.32%	6	0.30%	
N-RSW-S	1	0.86%	5	0.27%	6	0.30%	
I-FS-LT-X	1	0.86%	5	0.27%	6	0.30%	
I-NS-LT-R	2	1.72%	3	0.16%	5	0.25%	+++
N-LRD-R	0	0.00%	5	0.27%	5	0.25%	
N-RSW-L	0	0.00%	5	0.27%	5	0.25%	
N-RD-O	1	0.86%	4	0.22%	5	0.25%	
I-X-ST-O	0	0.00%	5	0.27%	5	0.25%	
I-X-ST-X	0	0.00%	4	0.22%	4	0.20%	
N-RSW-R	0	0.00%	4	0.22%	4	0.20%	
I-X-RT-X	0	0.00%	4	0.22%	4	0.20%	
I-NS-X-R	0	0.00%	4	0.22%	4	0.20%	
I-FS-LT-R	0	0.00%	4	0.22%	4	0.20%	
N-RSH-O	0	0.00%	4	0.22%	4	0.20%	
I-FS-RT-R	0	0.00%	4	0.22%	4	0.20%	
N-X-X	0	0.00%	3	0.16%	3	0.15%	
I-X-ST-R	0	0.00%	3	0.16%	3	0.15%	
P-B	0	0.00%	3	0.16%	3	0.15%	
I-NS-X-L	0	0.00%	3	0.16%	3	0.15%	
N-LRD-X	0	0.00%	3	0.16%	3	0.15%	
I-X-X-S	0	0.00%	2	0.11%	2	0.10%	
N-RSH-X	0	0.00%	2	0.11%	2	0.10%	
I-X-X-O	0	0.00%	2	0.11%	2	0.10%	
N-RD-L	0	0.00%	2	0.11%	2	0.10%	
N-RD-R	0	0.00%	2	0.11%	2	0.10%	
I-FS-RT-L	1	0.86%	1	0.05%	2	0.10%	+++
I-X-ST-L	0	0.00%	2	0.11%	2	0.10%	
N-RSH-L	0	0.00%	1	0.05%	1	0.05%	
N-X-R	1	0.86%	0	0.00%	1	0.05%	+++
N-SW-L	0	0.00%	1	0.05%	1	0.05%	

LMCM Crash Type	Fatal & Disabling		Other		Total		
	Count	%	Count	%	Count	%	*Sig.*
N-RSH-R	0	0.00%	1	0.05%	1	0.05%	
N-LSW-S	0	0.00%	1	0.05%	1	0.05%	
I-NS-X-O	0	0.00%	1	0.05%	1	0.05%	
I-X-RT-S	0	0.00%	1	0.05%	1	0.05%	
D-X	0	0.00%	1	0.05%	1	0.05%	
N-X-O	0	0.00%	1	0.05%	1	0.05%	
N-LSH-L	0	0.00%	1	0.05%	1	0.05%	
I-FS-X-R	0	0.00%	1	0.05%	1	0.05%	
N-RSW-O	0	0.00%	1	0.05%	1	0.05%	
I-X-LT-X	0	0.00%	1	0.05%	1	0.05%	
I-FS-X-O	0	0.00%	1	0.05%	1	0.05%	
P-X	0	0.00%	1	0.05%	1	0.05%	
N-LSH-R	0	0.00%	1	0.05%	1	0.05%	
N-RSW-X	0	0.00%	1	0.05%	1	0.05%	
Total	**116**	**100.00%**	**1854**	**100.00%**	**1970**	**100.00%**	

Table 186. Full List of Bicycle LMCM Crash Types & Severity Level by Year

LMCM Crash Type	Fatal & Disabling		Other		Total		*Sig.*
	Count	%	Count	%	Count	%	
N-RRD-S	2	5.88%	70	12.77%	72	12.37%	
I-NS-ST-X	5	14.71%	50	9.12%	55	9.45%	
I-FS-LT-O	2	5.88%	44	8.03%	46	7.90%	
I-NS-ST-R	3	8.82%	32	5.84%	35	6.01%	
I-NS-ST-L	1	2.94%	31	5.66%	32	5.50%	
I-NS-ST-S	0	0.00%	25	4.56%	25	4.30%	
I-NS-RT-S	0	0.00%	17	3.10%	17	2.92%	
I-FS-RT-O	0	0.00%	15	2.74%	15	2.58%	
N-RSH-S	0	0.00%	15	2.74%	15	2.58%	
I-FS-ST-L	0	0.00%	14	2.55%	14	2.41%	
I-NS-LT-O	2	5.88%	12	2.19%	14	2.41%	
I-NS-RT-R	0	0.00%	13	2.37%	13	2.23%	
N-RRD-L	0	0.00%	12	2.19%	12	2.06%	
N-RRD-R	0	0.00%	12	2.19%	12	2.06%	
I-FS-ST-R	2	5.88%	9	1.64%	11	1.89%	+
I-FS-LT-S	2	5.88%	9	1.64%	11	1.89%	+
I-NS-LT-S	0	0.00%	11	2.01%	11	1.89%	
I-FS-RT-X	0	0.00%	10	1.82%	10	1.72%	
I-FS-RT-S	1	2.94%	8	1.46%	9	1.55%	
N-LRD-O	1	2.94%	8	1.46%	9	1.55%	
I-NS-RT-L	0	0.00%	9	1.64%	9	1.55%	

LMCM Crash Type	Fatal & Disabling		Other		Total		*Sig.*
	Count	%	Count	%	Count	%	
I-NS-X-S	1	2.94%	8	1.46%	9	1.55%	
N-LRD-S	0	0.00%	8	1.46%	8	1.37%	
N-RRD-X	1	2.94%	6	1.09%	7	1.20%	
N-RD-X	1	2.94%	6	1.09%	7	1.20%	
I-NS-RT-O	0	0.00%	7	1.28%	7	1.20%	
I-NS-X-X	0	0.00%	7	1.28%	7	1.20%	
OTH	3	8.82%	3	0.55%	6	1.03%	+++
I-NS-ST-O	0	0.00%	5	0.91%	5	0.86%	
P-F	0	0.00%	5	0.91%	5	0.86%	
I-NS-LT-X	0	0.00%	4	0.73%	4	0.69%	
I-FS-ST-S	1	2.94%	3	0.55%	4	0.69%	
N-LRD-R	0	0.00%	3	0.55%	3	0.52%	
N-RRD-O	0	0.00%	3	0.55%	3	0.52%	
I-FS-LT-X	1	2.94%	2	0.36%	3	0.52%	++
D-F	0	0.00%	3	0.55%	3	0.52%	
I-NS-X-R	0	0.00%	3	0.55%	3	0.52%	
N-RD-S	0	0.00%	3	0.55%	3	0.52%	
I-FS-ST-O	0	0.00%	3	0.55%	3	0.52%	
I-X-ST-X	0	0.00%	3	0.55%	3	0.52%	
N-LRD-L	0	0.00%	3	0.55%	3	0.52%	
N-LSH-O	0	0.00%	3	0.55%	3	0.52%	
I-X-X-X	0	0.00%	2	0.36%	2	0.34%	
I-FS-X-X	1	2.94%	1	0.18%	2	0.34%	+++
I-FS-ST-X	0	0.00%	2	0.36%	2	0.34%	
I-FS-RT-R	0	0.00%	2	0.36%	2	0.34%	
I-NS-X-L	0	0.00%	2	0.36%	2	0.34%	
I-FS-LT-L	1	2.94%	1	0.18%	2	0.34%	+++
N-RSW-L	0	0.00%	2	0.36%	2	0.34%	
I-NS-RT-X	0	0.00%	2	0.36%	2	0.34%	
N-X-X	0	0.00%	2	0.36%	2	0.34%	
N-LSH-R	0	0.00%	1	0.18%	1	0.17%	
N-RSW-S	0	0.00%	1	0.18%	1	0.17%	
I-X-RT-X	0	0.00%	1	0.18%	1	0.17%	
N-X-R	1	2.94%	0	0.00%	1	0.17%	+++
N-RSH-R	0	0.00%	1	0.18%	1	0.17%	
N-RD-R	0	0.00%	1	0.18%	1	0.17%	
N-RSH-X	0	0.00%	1	0.18%	1	0.17%	
I-NS-LT-L	0	0.00%	1	0.18%	1	0.17%	
N-RSW-R	0	0.00%	1	0.18%	1	0.17%	
N-LRD-X	0	0.00%	1	0.18%	1	0.17%	
I-X-ST-O	0	0.00%	1	0.18%	1	0.17%	

LMCM Crash Type	Fatal & Disabling		Other		Total		*Sig.*
	Count	**%**	**Count**	**%**	**Count**	**%**	
N-RSH-O	0	0.00%	1	0.18%	1	0.17%	
I-NS-LT-R	1	2.94%	0	0.00%	1	0.17%	+++
P-B	0	0.00%	1	0.18%	1	0.17%	
I-FS-RT-L	1	2.94%	0	0.00%	1	0.17%	+++
P-X	0	0.00%	1	0.18%	1	0.17%	
I-FS-X-S	0	0.00%	1	0.18%	1	0.17%	
N-RSH-L	0	0.00%	1	0.18%	1	0.17%	
2012	**34**	**100.00%**	**548**	**100.00%**	**582**	**100.00%**	***Sig.***
N-RRD-S	3	9.09%	131	23.52%	134	22.71%	-
I-FS-LT-O	3	9.09%	58	10.41%	61	10.34%	
I-NS-ST-S	1	3.03%	31	5.57%	32	5.42%	
I-NS-ST-L	1	3.03%	27	4.85%	28	4.75%	
I-FS-ST-L	5	15.15%	21	3.77%	26	4.41%	+++
I-NS-RT-S	1	3.03%	21	3.77%	22	3.73%	
I-FS-ST-R	2	6.06%	20	3.59%	22	3.73%	
N-RSH-S	1	3.03%	19	3.41%	20	3.39%	
I-FS-RT-S	1	3.03%	17	3.05%	18	3.05%	
I-FS-ST-S	1	3.03%	17	3.05%	18	3.05%	
OTH	5	15.15%	8	1.44%	13	2.20%	+++
N-RRD-X	1	3.03%	11	1.97%	12	2.03%	
I-FS-RT-O	0	0.00%	12	2.15%	12	2.03%	
I-NS-ST-R	2	6.06%	9	1.62%	11	1.86%	+
N-LRD-S	1	3.03%	10	1.80%	11	1.86%	
I-NS-LT-S	1	3.03%	9	1.62%	10	1.69%	
N-RRD-R	0	0.00%	10	1.80%	10	1.69%	
N-RRD-O	0	0.00%	8	1.44%	8	1.36%	
N-LRD-O	0	0.00%	8	1.44%	8	1.36%	
I-FS-LT-S	1	3.03%	6	1.08%	7	1.19%	
I-NS-RT-R	0	0.00%	7	1.26%	7	1.19%	
I-FS-ST-X	0	0.00%	6	1.08%	6	1.02%	
I-FS-ST-O	1	3.03%	5	0.90%	6	1.02%	
I-NS-X-S	0	0.00%	6	1.08%	6	1.02%	
I-NS-RT-O	0	0.00%	4	0.72%	4	0.68%	
I-NS-RT-L	0	0.00%	4	0.72%	4	0.68%	
I-FS-LT-L	0	0.00%	4	0.72%	4	0.68%	
N-RSW-S	1	3.03%	3	0.54%	4	0.68%	+
N-RRD-L	0	0.00%	4	0.72%	4	0.68%	
I-NS-RT-X	0	0.00%	4	0.72%	4	0.68%	
I-FS-LT-R	0	0.00%	4	0.72%	4	0.68%	
I-NS-ST-X	0	0.00%	4	0.72%	4	0.68%	
N-LSH-O	0	0.00%	3	0.54%	3	0.51%	

LMCM Crash Type	Fatal & Disabling		Other		Total		*Sig.*
	Count	**%**	**Count**	**%**	**Count**	**%**	
I-FS-X-S	0	0.00%	3	0.54%	3	0.51%	
P-F	0	0.00%	3	0.54%	3	0.51%	
I-NS-X-X	0	0.00%	3	0.54%	3	0.51%	
I-X-X-X	0	0.00%	3	0.54%	3	0.51%	
N-LSH-S	0	0.00%	3	0.54%	3	0.51%	
I-NS-LT-L	0	0.00%	2	0.36%	2	0.34%	
I-NS-LT-R	1	3.03%	1	0.18%	2	0.34%	+++
I-NS-ST-O	0	0.00%	2	0.36%	2	0.34%	
I-FS-RT-R	0	0.00%	2	0.36%	2	0.34%	
I-FS-LT-X	0	0.00%	2	0.36%	2	0.34%	
N-RSW-R	0	0.00%	2	0.36%	2	0.34%	
I-FS-X-X	0	0.00%	1	0.18%	1	0.17%	
I-X-LT-X	0	0.00%	1	0.18%	1	0.17%	
I-X-ST-S	0	0.00%	1	0.18%	1	0.17%	
N-X-X	0	0.00%	1	0.18%	1	0.17%	
I-X-ST-L	0	0.00%	1	0.18%	1	0.17%	
N-RSW-L	0	0.00%	1	0.18%	1	0.17%	
I-NS-LT-X	0	0.00%	1	0.18%	1	0.17%	
I-FS-RT-X	0	0.00%	1	0.18%	1	0.17%	
I-X-ST-X	0	0.00%	1	0.18%	1	0.17%	
N-X-O	0	0.00%	1	0.18%	1	0.17%	
I-FS-X-R	0	0.00%	1	0.18%	1	0.17%	
D-F	0	0.00%	1	0.18%	1	0.17%	
N-RSW-X	0	0.00%	1	0.18%	1	0.17%	
I-X-RT-X	0	0.00%	1	0.18%	1	0.17%	
I-X-ST-R	0	0.00%	1	0.18%	1	0.17%	
N-RD-S	0	0.00%	1	0.18%	1	0.17%	
P-B	0	0.00%	1	0.18%	1	0.17%	
N-LSW-S	0	0.00%	1	0.18%	1	0.17%	
I-NS-X-L	0	0.00%	1	0.18%	1	0.17%	
N-RD-O	0	0.00%	1	0.18%	1	0.17%	
2013	**33**	**100.00%**	**557**	**100.00%**	**590**	**100.00%**	***Sig.***
N-RRD-S	11	22.45%	89	11.88%	100	12.53%	++
I-NS-ST-S	1	2.04%	62	8.28%	63	7.89%	
I-NS-ST-L	3	6.12%	49	6.54%	52	6.52%	
N-RSH-S	1	2.04%	48	6.41%	49	6.14%	
I-FS-ST-S	0	0.00%	37	4.94%	37	4.64%	
I-NS-LT-O	3	6.12%	34	4.54%	37	4.64%	
I-NS-RT-S	1	2.04%	36	4.81%	37	4.64%	
I-FS-LT-O	3	6.12%	29	3.87%	32	4.01%	
I-NS-ST-R	3	6.12%	25	3.34%	28	3.51%	

LMCM Crash Type	Fatal & Disabling		Other		Total		*Sig.*
	Count	%	Count	%	Count	%	
I-FS-ST-L	1	2.04%	25	3.34%	26	3.26%	
OTH	3	6.12%	17	2.27%	20	2.51%	+
N-LRD-S	1	2.04%	17	2.27%	18	2.26%	
I-FS-RT-S	0	0.00%	16	2.14%	16	2.01%	
I-NS-LT-S	0	0.00%	14	1.87%	14	1.75%	
D-F	2	4.08%	11	1.47%	13	1.63%	
I-NS-ST-O	0	0.00%	12	1.60%	12	1.50%	
I-FS-ST-R	1	2.04%	11	1.47%	12	1.50%	
I-X-ST-S	1	2.04%	10	1.34%	11	1.38%	
I-NS-ST-X	2	4.08%	9	1.20%	11	1.38%	+
N-LRD-O	0	0.00%	11	1.47%	11	1.38%	
I-FS-ST-O	3	6.12%	7	0.93%	10	1.25%	+++
N-RRD-O	1	2.04%	8	1.07%	9	1.13%	
I-NS-RT-L	0	0.00%	8	1.07%	8	1.00%	
I-NS-RT-O	0	0.00%	8	1.07%	8	1.00%	
I-NS-RT-X	0	0.00%	8	1.07%	8	1.00%	
I-NS-X-X	0	0.00%	8	1.07%	8	1.00%	
N-RD-S	0	0.00%	7	0.93%	7	0.88%	
N-RRD-X	0	0.00%	7	0.93%	7	0.88%	
I-FS-X-S	1	2.04%	6	0.80%	7	0.88%	
N-RRD-R	1	2.04%	6	0.80%	7	0.88%	
I-NS-RT-R	0	0.00%	6	0.80%	6	0.75%	
N-RD-X	0	0.00%	6	0.80%	6	0.75%	
I-NS-X-S	0	0.00%	6	0.80%	6	0.75%	
I-FS-X-X	0	0.00%	6	0.80%	6	0.75%	
I-X-X-X	1	2.04%	5	0.67%	6	0.75%	
I-NS-LT-L	0	0.00%	6	0.80%	6	0.75%	
I-NS-LT-X	0	0.00%	5	0.67%	5	0.63%	
P-F	0	0.00%	5	0.67%	5	0.63%	
I-FS-RT-O	0	0.00%	5	0.67%	5	0.63%	
I-X-ST-O	0	0.00%	4	0.53%	4	0.50%	
N-RD-O	1	2.04%	3	0.40%	4	0.50%	
I-FS-ST-X	2	4.08%	2	0.27%	4	0.50%	+++
N-RRD-L	0	0.00%	4	0.53%	4	0.50%	
N-LRD-L	1	2.04%	3	0.40%	4	0.50%	
N-LSH-S	0	0.00%	3	0.40%	3	0.38%	
N-RSH-O	0	0.00%	3	0.40%	3	0.38%	
I-FS-LT-S	0	0.00%	3	0.40%	3	0.38%	
I-FS-LT-L	1	2.04%	2	0.27%	3	0.38%	++
I-FS-RT-X	0	0.00%	2	0.27%	2	0.25%	
N-LRD-R	0	0.00%	2	0.27%	2	0.25%	

LMCM Crash Type	Fatal & Disabling		Other		Total		*Sig.*
	Count	%	Count	%	Count	%	
I-NS-LT-R	0	0.00%	2	0.27%	2	0.25%	
N-LRD-X	0	0.00%	2	0.27%	2	0.25%	
I-X-X-S	0	0.00%	2	0.27%	2	0.25%	
I-X-RT-X	0	0.00%	2	0.27%	2	0.25%	
N-RSW-L	0	0.00%	2	0.27%	2	0.25%	
N-RD-L	0	0.00%	2	0.27%	2	0.25%	
I-X-ST-R	0	0.00%	2	0.27%	2	0.25%	
I-X-X-O	0	0.00%	2	0.27%	2	0.25%	
P-B	0	0.00%	1	0.13%	1	0.13%	
N-RSW-R	0	0.00%	1	0.13%	1	0.13%	
N-RD-R	0	0.00%	1	0.13%	1	0.13%	
I-NS-X-R	0	0.00%	1	0.13%	1	0.13%	
N-SW-L	0	0.00%	1	0.13%	1	0.13%	
I-FS-LT-X	0	0.00%	1	0.13%	1	0.13%	
N-RSH-X	0	0.00%	1	0.13%	1	0.13%	
N-LSH-L	0	0.00%	1	0.13%	1	0.13%	
N-RSW-O	0	0.00%	1	0.13%	1	0.13%	
I-X-ST-L	0	0.00%	1	0.13%	1	0.13%	
N-RSW-S	0	0.00%	1	0.13%	1	0.13%	
I-FS-X-O	0	0.00%	1	0.13%	1	0.13%	
I-NS-X-O	0	0.00%	1	0.13%	1	0.13%	
I-FS-RT-L	0	0.00%	1	0.13%	1	0.13%	
N-LSH-O	0	0.00%	1	0.13%	1	0.13%	
D-X	0	0.00%	1	0.13%	1	0.13%	
I-X-RT-S	0	0.00%	1	0.13%	1	0.13%	
2014	**49**	**100.00%**	**749**	**100.00%**	**798**	**100.00%**	
Total	**116**	**-**	**1854**	**-**	**1970**	**-**	

Appendix J PEDSAFE Countermeasures for Top Three Pedestrian Crash Groups in Washington, DC

Table 187. PEDSAFE Countermeasures for Top Three Pedestrian Crash Groups in Washington, DC

NHTSA Crash Group	PEDSAFE Crash Group	Countermeasure Type	Applicable Countermeasures
790 - Crossing Roadway—Vehicle Turning	Turning Vehicle	*Crossing Locations*	Curb Ramp Crosswalk Enhancement Curb Extension Pedestrian Crossing Island Raised Pedestrian Crossing Roadway Lighting Overpass/Underpass
		Transit	Transit Stop Treatments
		Roadway Design	Raised Median One-Way Street Right Turn Slip Lane
		Intersection Design	Modern Roundabout Modified T-Intersection Intersection Median Barrier Smaller Curb Radius Modify Skewed Intersections Pedestrian Accommodations at Complex Interchanges
		Traffic Calming	Mini-Circle Paving Treatments
		Traffic Mgmt.	Diverter Full Street Closure Partial Street Closure Left Turn Prohibitions
		Signals/ Signs	Automated Pedestrian Detection Leading Pedestrian Interval Traffic Signal Pedestrian Signal Pedestrian Signal Timing Signal Enhancement Right Turn on Red (RTOR) Restriction Advanced Stop Lines Left Turn Phasing Push Buttons & Signal Timing Pedestrian Hybrid Beacon (HAWK) Rectangular Rapid Flashing Beacon (RRFB) Sign Improvement

NHTSA Crash Group	PEDSAFE Crash Group	Countermeasure Type	Applicable Countermeasures
		Other	School Zone Improvement Parking Enhancement Ped/Driver Education Police Enforcement Automated Enforcement Systems
750 - Crossing Roadway—Vehicle Not Turning	Through Vehicle at Signalized Location	*Crossing Locations*	Curb Ramp Crosswalk Enhancement Curb Extension Pedestrian Crossing Island Raised Pedestrian Crossing Roadway Lighting Parking Restrictions Overpass/Underpass
		Transit	Transit Stop Treatments
		Roadway Design	Raised Median One-Way Street Right Turn Slip Lane
		Intersection Design	Modern Roundabout Intersection Median Barrier Modify Skewed Intersections Pedestrian Accommodations at Complex Interchanges
		Traffic Calming	Mini-Circle Paving Treatments
		Traffic Mgmt.	Diverter Full Street Closure Partial Street Closure
		Signals/ Signs	Traffic Signal Pedestrian Signal Pedestrian Signal Timing Signal Enhancement Right Turn on Red (RTOR) Restriction Advanced Stop Lines Push Buttons & Signal Timing Puffin Crossing Sign Improvement
		Other	School Zone Improvement Speed Monitoring Trailer Parking Enhancement Ped/Driver Education Police Enforcement Automated Enforcement Systems

NHTSA Crash Group	PEDSAFE Crash Group	Countermeasure Type	Applicable Countermeasures
	Through Vehicle at Unsignalized Location	*Crossing Locations*	Curb Ramp Crosswalk Enhancement Curb Extension Pedestrian Crossing Island Raised Pedestrian Crossing Roadway Lighting Parking Restrictions Overpass/Underpass
		Transit	Transit Stop Treatments Access to Transit
		Roadway Design	Bike Lane/Shoulder Road/Lane Narrowing Fewer Lanes Raised Median
		Intersection Design	Intersection Median Barrier Smaller Curb Radius Modify Skewed Intersections Pedestrian Accommodations at Complex Interchanges
		Traffic Calming	Temporary Installations for Traffic Calming Choker Chicane Mini-Circle Speed Humps Speed Table (midblock) Gateway Landscape Options Paving Treatments Driveway Link/Serpentine
		Signals/ Signs	Traffic Signal Pedestrian Signal Advanced Stop Lines Sign Improvement
		Other	School Zone Improvement Identify Neighborhood Speed Monitoring Trailer Parking Enhancement Ped/Driver Education Police Enforcement Pedestrian Street
740 - Dash/Dart-Out	Dart/Dash	*Along Roadway*	Street Furniture

NHTSA Crash Group	PEDSAFE Crash Group	Countermeasure Type	Applicable Countermeasures
		Crossing Locations	Crosswalk Enhancement Curb Extension Pedestrian Crossing Island Raised Pedestrian Crossing Roadway Lighting Parking Restrictions Overpass/Underpass
		Transit	Transit Stop Treatments
		Roadway Design	Bike Lane/Shoulder Road/Lane Narrowing Raised Median
		Traffic Calming	Temporary Installations for Traffic Calming Choker Chicane Speed Humps Speed Table (midblock) Gateway Driveway Link/Serpentine
		Traffic Mgmt.	Diverter Full Street Closure Partial Street Closure
		Signals/ Signs	Traffic Signal Pedestrian Signal Signal Enhancement Sign Improvement

Appendix K BIKESAFE Countermeasures for Top Three Bicycle Crash Groups in Washington, DC

Table 188. BIKESAFE Countermeasures for Top Three Bicycle Crash Groups in Washington, DC

NHTSA Crash Group	BIKESAFE Crash Group	Countermeasure Type	Applicable Countermeasures
240 - Bicyclist Overtaking Motorist	Bicyclist Overtaking Motorist	*Shared Roadway*	Parking Treatments
		On-Road Bike Facilities	Bike Lanes Wide Curb Lanes Combination Lanes Paved Shoulders Cycle tracks
		Maintenance	Hazard Identification Program Repetitive/Short-Term Maintenance Major Maintenance
		Trails/ Shared-Use Paths	Separate Shared-Use Path
		Markings, Signs & Signals	Pavement Marking Improvements School Zone Improvements Rectangular Rapid Flash Beacons (RRFB) Pedestrian Hybrid Beacon
		Other Measures	Bicyclist/motorist education
210 - Motorist Left Turn/Merge	Motorist Turned or Merged Left into Path of Bicyclist	*Shared Roadway*	Reduce Lane Number Lighting Improvements Median/Crossing Island Parking Treatments Driveway Improvements
		On-Road Bike Facilities	Bike Lanes Combination Lanes Paved Shoulders
		Intersection Treatments	Intersection Markings Turning Restrictions Curb Radii Revisions Merge and Weave Area Redesign Sight Distance Improvements Roundabouts
		Traffic Calming	Traffic Diversion Mini Traffic Circles
		Trails/ Shared-Use Paths	Path Intersection Treatments
		Markings, Signs & Signals	Pavement Marking Improvements Sign Improvements Bicycle signal heads Install Signal/Optimize Timing
		Other Measures	Bicyclist/motorist education

NHTSA Crash Group	BIKESAFE Crash Group	Countermeasure Type	Applicable Countermeasures
230 - Motorist Overtaking Bicyclist	Motorist Overtaking Bicyclist	*Shared Roadway*	Lighting Improvements Reduce Lane Width Bridge and Overpass Access Roadway Surface Improvements Tunnel and Underpass Access Parking Treatments
		On-Road Bike Facilities	Bike Lanes Wide Curb Lanes Combination Lanes Paved Shoulders Cycle tracks
		Maintenance	Hazard Identification Program Repetitive/Short-Term Maintenance Major Maintenance
		Traffic Calming	Speed Tables/Humps/Cushions Traffic Diversion Chicanes Visual Narrowing
		Trails/ Shared-Use Paths	Separate Shared-Use Path
		Markings, Signs & Signals	Pavement Marking Improvements Sign Improvements
		Other Measures	Bicyclist/motorist education

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