Pedestrian Crash Analysis In Tippecanoe County

A study of Crashes Involving Pedestrians for 2007 through 2012

12/10/2014
Prepared by the Area Plan Commission of Tippecanoe County

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Contents

List of Figures 2
List of Tables 3
Glossary 4
Key Findings 5
Introduction 6
Chapter 1: General Information on Pedestrian Crashes 7
Chapter 2: Date and Time of Pedestrian Crashes 13
Chapter 3: Pedestrian Crashes by Location 17
Chapter 4: Pedestrian Crashes by Primary Factor 25
Chapter 5: Pedestrian Crashes by Age 28
Chapter 6: Pedestrian Crashes by Gender 36
Chapter 7: Pedestrian Crashes by Fault 40
Chapter 8: Pedestrian Fatality Crashes 43
Conclusions 51
Recommendations 52
Appendix A: Purdue University Schedule 53
Appendix B: Regression Analysis 54

List of Figures

Figure 1: Pedestrian Crashes by Year 7
Figure 2: Location of Pedestrian Crashes in Tippecanoe County....9
Figure 3: Location of Pedestrian Crashes in Lafayette and West Lafayette 10
Figure 4: Location of Pedestrian Crashes in Purdue University Area 11
Figure 5: Location of Pedestrian Crashes in Downtown Lafayette....12
Figure 6: Number of Pedestrian Crashes by Month and Year 13
Figure 7: Pedestrian Crashes by Day of the Week....14
Figure 8: Pedestrian Crashes by Time of Day 16
Figure 9: Pedestrian Crashes by Location Category....17
Figure 10: Pedestrian Crashes by Time of Day 19
Figure 11: Pedestrian Crashes in Tippecanoe County (by Location Category) 20
Figure 12: Pedestrian Crashes in Lafayette (by Location Category) 21
Figure 13: Pedestrian Crashes in West Lafayette (by Location Category) 22
Figure 14: Pedestrian Crashes in Purdue University Area (by Location Category) 23
Figure 15: Pedestrian Crashes in Downtown Areas (by Location Category)....24
Figure 16: Frequency of Primary Factors in Pedestrian Crashes 26
Figure 17: Top Three Primary Factors in Pedestrian Crashes by Time of Day 27
Figure 18: Pedestrian Crashes by Age....28
Figure 19: Peak Period Pedestrian Crashes by Age 30
Figure 20: Pedestrian Crashes by Location and Age....31
Figure 21: Crashes Involving Pedestrians Under 16 Years of Age....32
Figure 22: Crashes Involving Pedestrians From 16-24 Years of Age 33
Figure 23: Crashes Involving Pedestrians Over 65 Years of Age 34
Figure 24: Pedestrian Crashes for 18-24 Year Olds When Purdue University is in Session 35
Figure 25: Pedestrian Crashes for 18-24 Year Olds When Purdue University is not in Session....35
Figure 26: Pedestrian Crashes by Gender and Day of the Week 36
Figure 27: Pedestrian Crashes by Time of Day (For Males Vs Females) 37
Figure 28: Location of Pedestrian Crashes by Gender....38
Figure 29: Male Pedestrian Crashes by Location and Age....38
Figure 30: Female Pedestrian Crashes by Location and Age 39
Figure 31: Crash Fault by Crash Location....40
Figure 32: Crash Fault by Age of Pedestrian....41
Figure 33: Crash Fault for Children Less Than 16 Years of Age....41
Figure 34: Comparison of Male and Female Pedestrians with Crash Fault 42
Figure 35: Pedestrian Fatalities by Year 43
Figure 36: Pedestrian Fatalities by Month....44
Figure 37: Pedestrian Fatalities by Day of the Week....45
Figure 38: Pedestrian Fatalities by Time of Day 46
Figure 39: Location of Pedestrian Fatality Crashes....47
Figure 40: Fatal Pedestrian Crashes within a One Mile Radius of Purdue University....48
Figure 41: Fault in Fatal Pedestrian Crashes....49
Figure 42: Fault in Fatal Pedestrian Crashes for Different Locations....50
Figure 43: Pedestrian Age versus Time of Day 54
Figure 44: Driver Age versus Time of Day....55

List of Tables

Table 1: Pedestrian Crash Data in Tippecanoe County 8
Table 2: Highest Pedestrian Crash Corridors 8
Table 3: Top Ten Pedestrian Crash Intersections 8
Table 4: Number of Pedestrian Crashes by Month and Year 13
Table 5: Pedestrian Crashes by Time of Day and Year 15
Table 6: Pedestrian Crashes by Time of Day and Location Category 18
Table 7: Pedestrian Crashes by Primary Factor 25
Table 8: Pedestrian Crashes by Age and Day of the Week 28
Table 9: Pedestrian Crashes by Time of Day and Age 29
Table 10: Peak Period Pedestrian Crashes by Age 30
Table 11: Pedestrian Crashes by Location and Age 31
Table 12: Pedestrian Crashes by Gender and Day of the Week 36
Table 13: Pedestrian Crashes by Age and Gender 39
Table 14: Purdue University Spring and Fall Semesters (2007-2012) 53

Glossary

Analysis Period- The calendar years for which data was queried, studied, and analyzed while this report was being produced. For this report, the analysis period is 2007 through and including 2012.

ARIES – Automated Reporting Information Exchange System developed and maintained by the Indiana State Police. ARIES provides officers an electronic way to complete and submit the Indiana Officer's Standard Crash Report form. The system also allows authorized individuals access to the Indiana State Police crash records database. ARIES was formerly known as the Vehicle Crash Record System (VCRS).

Fatal Injury Crash: A crash that results in death for one or more of the vehicle(s) occupants or non-motorists. Other occupants or non-motorists may be injured in additional to the fatality.

Motorist – A person in control of a motor vehicle.

Pedestrian: Any person afoot. This includes persons walking bicycles, riding skateboards, rollerblading, using wheelchairs or other power-driven mobility devices, and using other forms of non-motorized/non-pedaled forms of transportation.

Personal Injury Crash: A crash where at least one of the vehicle occupants or non-motorists were injured, but not fatally. Non-Fatal Injuries are classified as Incapacitating, Non-Incapacitating, or Probable. In a few instances, crashes are classified as an injury crash if the individual(s) refused treatment at the scene.

Property Damage Only Crash (PDO)- A crash in which a vehicle or property is damaged and the occupant or non-motorist is not injured. A crash is required by law to be reported if the amount of the damage was $750 or more.

Roadway – That portion of a highway improved, designed, or ordinarily used for vehicular travel. The roadway does not include unpaved areas, paved sidewalks, or shared use paths.

Street, Road or Highway – The entire width between the right-of-way lines of every way or place open to the use of the public for purposes of vehicular traffic. These terms include the sidewalk.

Vehicle – Is any vehicle, whether an automobile, truck, motorcycle, moped, scooter, or bicycle.

Key Findings

When do pedestrian crashes occur?

- An average of 56 pedestrian crashes occurred annually in Tippecanoe County.
- Pedestrian crashes were most likely to occur in October.
- Pedestrian crashes were most likely to occur on a Tuesday.
- Pedestrian crashes were most likely to occur between the hours of 6 p.m. and 7 p.m.
- 8 out of every 10 pedestrian crashes occurred during Purdue University's spring or fall session.
    - Pedestrians between the ages of 18 and 24 were 1.5 times as likely to be in a pedestrian crash during Purdue University's spring or fall session.

Where do pedestrian crashes occur?

- 130 crashes (43%) occurred when a pedestrian was at an intersection or designated crosswalk, and 160 crashes (52%) occurred at another location on the road.
- Only 15 crashes (5%) occurred when a pedestrian was on the sidewalk.

Who is involved in pedestrian crashes?

- Pedestrians between the ages of 16 and 34 were involved in more than half (57%) of the pedestrian crashes in Tippecanoe County.
- Male pedestrians were involved in crashes more often than female pedestrians (57% and 43%, respectively.)

Who is responsible for pedestrian crashes?

- Vehicles were at fault more often (59% of the time) than pedestrians.
- When the vehicle was at fault, the most common cause of crashes was failure to yield the right of way (47%).
- When the pedestrian was at fault, the most common cause of crashes was failure to follow traffic laws (85%).

How often do injuries and fatalities occur?

- On average, there is approximately one pedestrian crash every week and 1 fatal crash every 6 months.
- Pedestrians were injured in approximately 9 out of every 10 crashes.

Introduction

Traveling as a pedestrian is becoming a more attractive option for many people. With fluctuations in the price of fuel, increased awareness of the dangers of emissions from motorized vehicles, and the desire for more physically activity; more people are walking. For those who choose to travel as pedestrians, it is important that it be done safely. Pedestrians and vehicles often share the same space, and sharing the roadway can lead to crashes. One way to evaluate and thus be better able to improve the safety of walking in Tippecanoe County is to examine pedestrian crashes.

This report contains a detailed analysis of pedestrian crashes in Tippecanoe County for calendar years 2007-2012. This report contains information compiled from police reports of all the pedestrian crashes that occurred in all jurisdictions within Tippecanoe County during that time period. This information can be used to learn about the causes of pedestrian crashes, provide a demographic profile of those involved, and help develop plans to improve pedestrian safety in the community.

The data contained in this report came from the Indiana State Police (ISP) Automated Reporting Information Exchange System (ARIES) database. This database contains crash reports submitted by all law enforcement agencies in Tippecanoe County and the Indiana State Police for each crash that occurred in Tippecanoe County between 2007 and 2012. Every individual crash report was reviewed for this analysis. Those crashes that did not occur on the road or road right-of-way were excluded from this report, such as parking lots, yards, driveways, or loading docks.

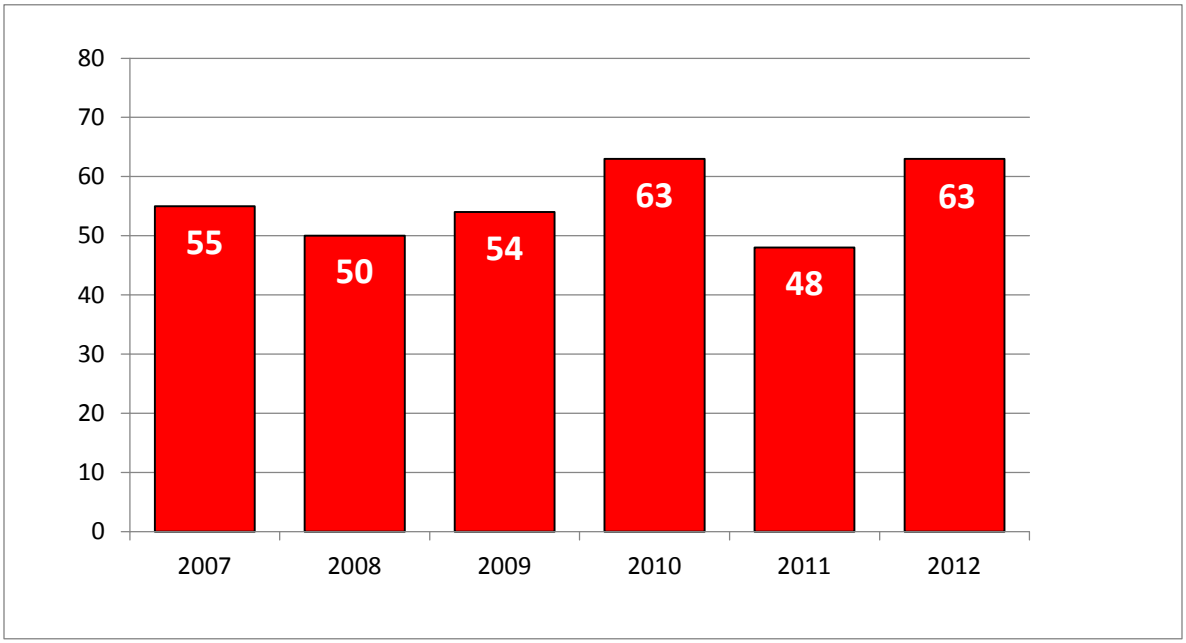
When the pedestrian crash records were queried from ARIES, some of the records had different road names or aliases for the same road. Those had to be reconciled to get an accurate count of the roads that actually had the most pedestrian crashes. (For example, the road listed as “State Road 26” was also known as “State Street,” “Columbia Street,” “South Street,” “SR 26,” and other similar variations.)

Pedestrian-vehicle crashes are the only type of crashes that are recorded in the ARIES system. There is no available data about pedestrian-bicycle crashes. Data and analysis about bicycle-vehicle crashes is available in a companion report (*Bicycle Crash Analysis For Tippecanoe County and the Greater Lafayette Area: A Study of Bicyclist and Motorist Crashes 2007 through 2012*). This report can be found online at http://www.tippecanoe.in.gov/egov/documents/1396985526_20151.pdf.

Chapter 1: General Information on Pedestrian Crashes

To understand when, where, why, and how pedestrian crashes occur it is important to first look at the "big picture," or macro-level look, before delving into more specific analysis.

Figure 1: Pedestrian Crashes by Year



There was an average of 56 pedestrian crashes each year. The highest number (63) occurred in both 2010 and 2012 (Figure 1). The lowest number of pedestrian crashes (48) occurred in 2011. There were slightly more pedestrian crashes in the second half of the analysis period (2010-2012) than in the first half (2007-2009). This may be due to more people walking, but without better data, we cannot accurately determine if a higher percentage of pedestrians are involved in pedestrian crashes or not.

Between 2007 and 2012, there were a total of 333 pedestrian crashes in Tippecanoe County (Table 1). As expected, because pedestrians are so vulnerable, many crashes involved injuries (86%) or fatalities (13%). The highest percentage of injury crashes was in 2011 with 95.8%, and the highest percentage of fatality crashes was in 2007 with 9.1% (Table 1).A fatality crash is a crash that involves at least one fatality (although there could be multiple fatalities in one fatality crash).

Injury crashes vary in severity, and severe injuries are often under-reported because of challenges in obtaining hospital records and other limitations on available data. This puts in-depth injury analysis outside of the scope of this report.

Table 1: Pedestrian Crash Data in Tippecanoe County

Year	Number	Property Damage Only	% of Crashes	Injury Crashes	% of Crashes	Fatality Crashes	% of Crashes
2007	55	4	7.3%	46	83.6%	5	9.1%
2008	50	4	8.0%	45	90.0%	1	2.0%
2009	54	7	13.0%	46	85.2%	1	1.9%
2010	63	9	14.3%	50	79.4%	4	6.3%
2011	48	1	2.1%	46	95.8%	1	2.1%
2012	63	9	14.3%	53	84.1%	1	1.6%
Total	**333**	**34**		**286**		**13**	

Most of the crashes in Tippecanoe County occur within the Lafayette and West Lafayette city limits (Figure 2).This is expected because there are more people, destinations, and traffic inside the city limits. There are several corridors and areas that have a high concentration of pedestrian crashes (Tables 2 and 3). The highest by far is State Street with 43, followed by Northwestern Avenue with 19. Areas of higher pedestrian crashes include the Purdue University academic campus and the nearby residential and commercial areas as well as downtown Lafayette (Figures 3, 4, and 5).

Table 2: Highest Pedestrian Crash Corridors

Rank	Road Name	Pedestrian Crashes
1	State Street	43
2	Northwestern Avenue	19
3	9th Street	13
4	18th Street	8
5	Stadium Avenue	7

Table 3: Top Ten Pedestrian Crash Intersections

Rank	Intersection		Crashes
1	Northwestern Avenue	State Street	5
T2	Grant Street	Northwestern Avenue	4
T2	Marsteller Street	State Street	4
T2	Russell Street	Stadium Avenue	4
T5	3rd Street	Ferry Street	3
T5	4th Street	Columbia Street	3
T5	9th Street	South Street	3
T5	Columbia Street	Northwestern Avenue	3
T5	Grant Street	State Street	3
T5	Jischke Drive	Stadium Avenue	3

Figure 2: Location of Pedestrian Crashes in Tippecanoe County

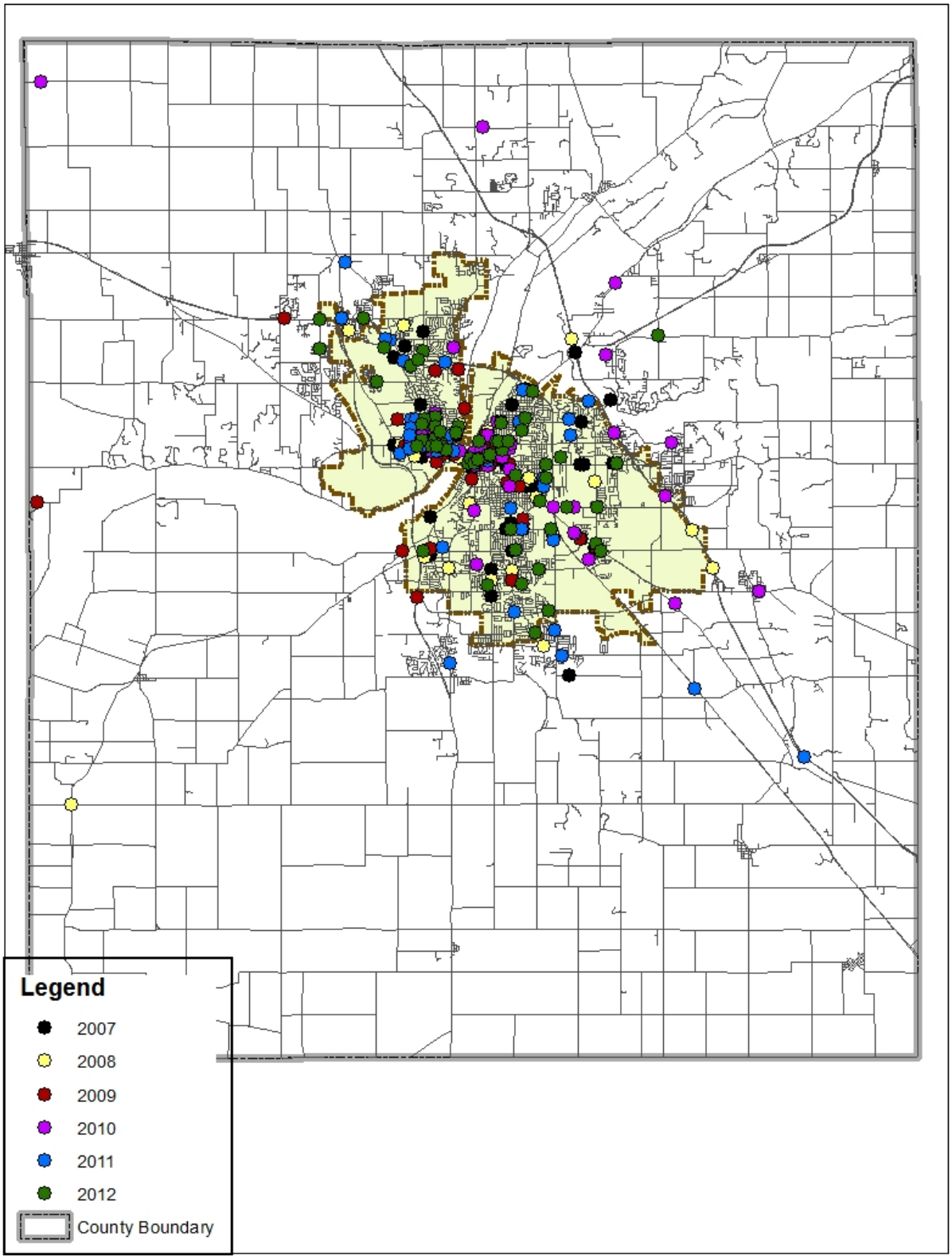


Figure 3: Location of Pedestrian Crashes in Lafayette and West Lafayette

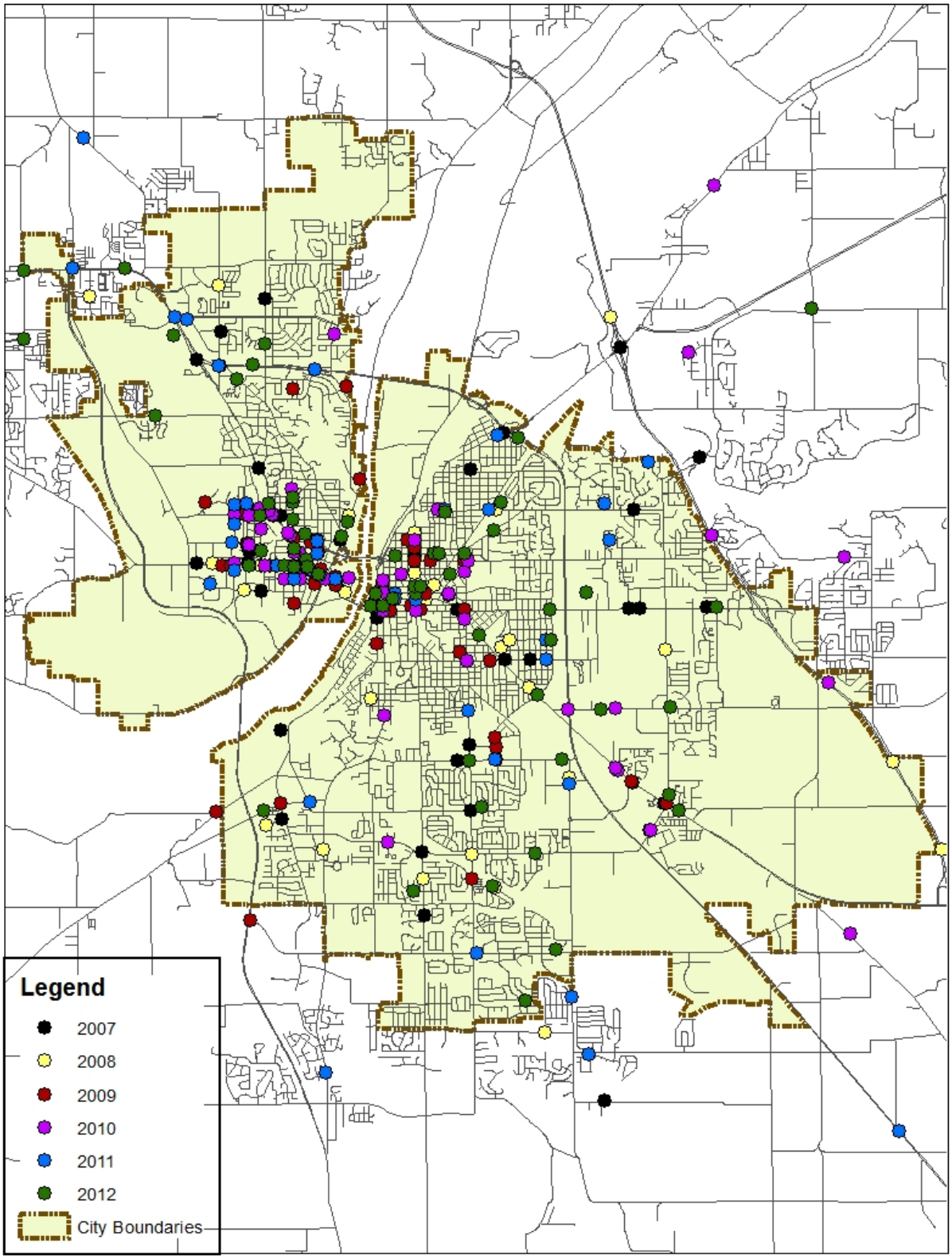


Figure 4: Location of Pedestrian Crashes in Purdue University Area

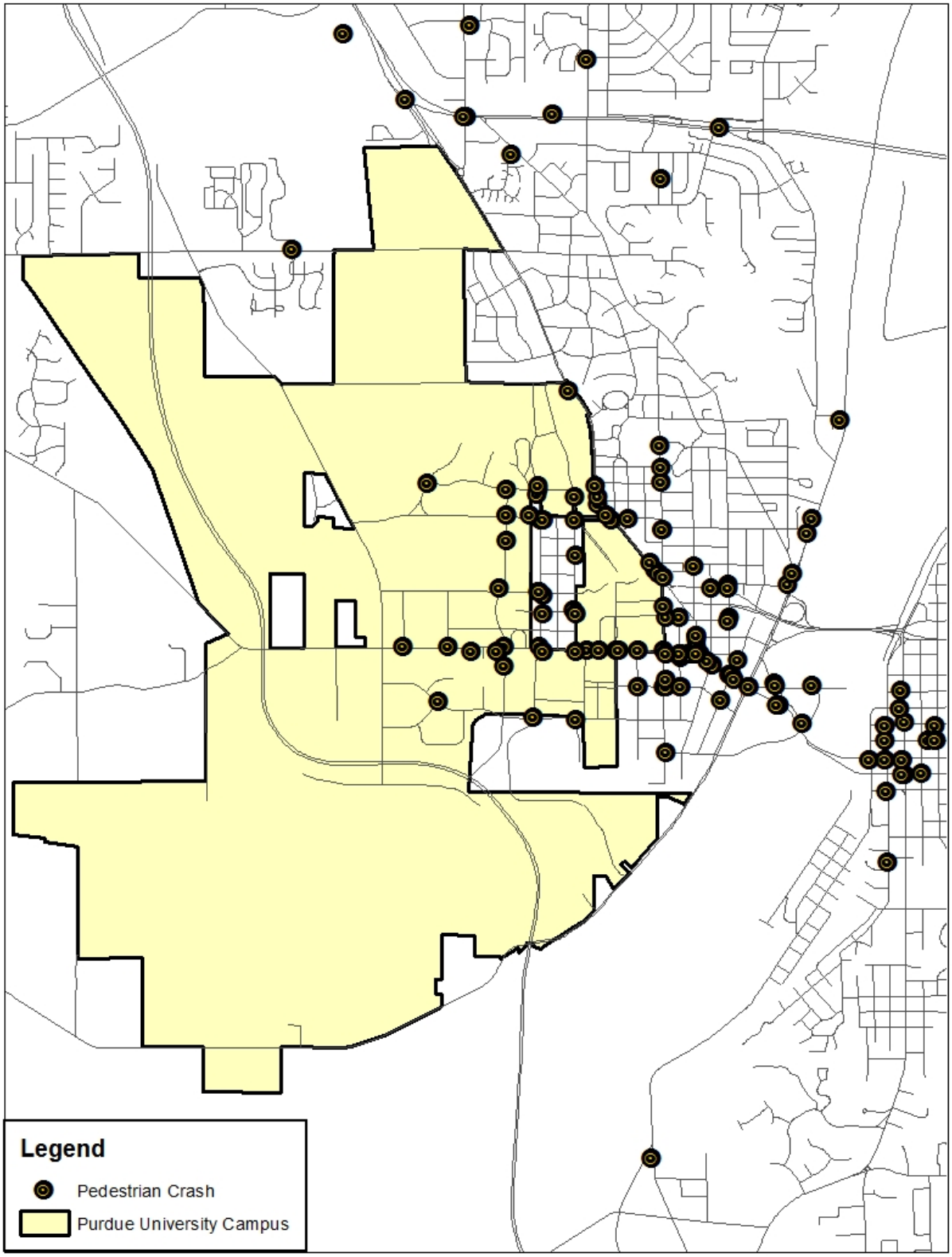
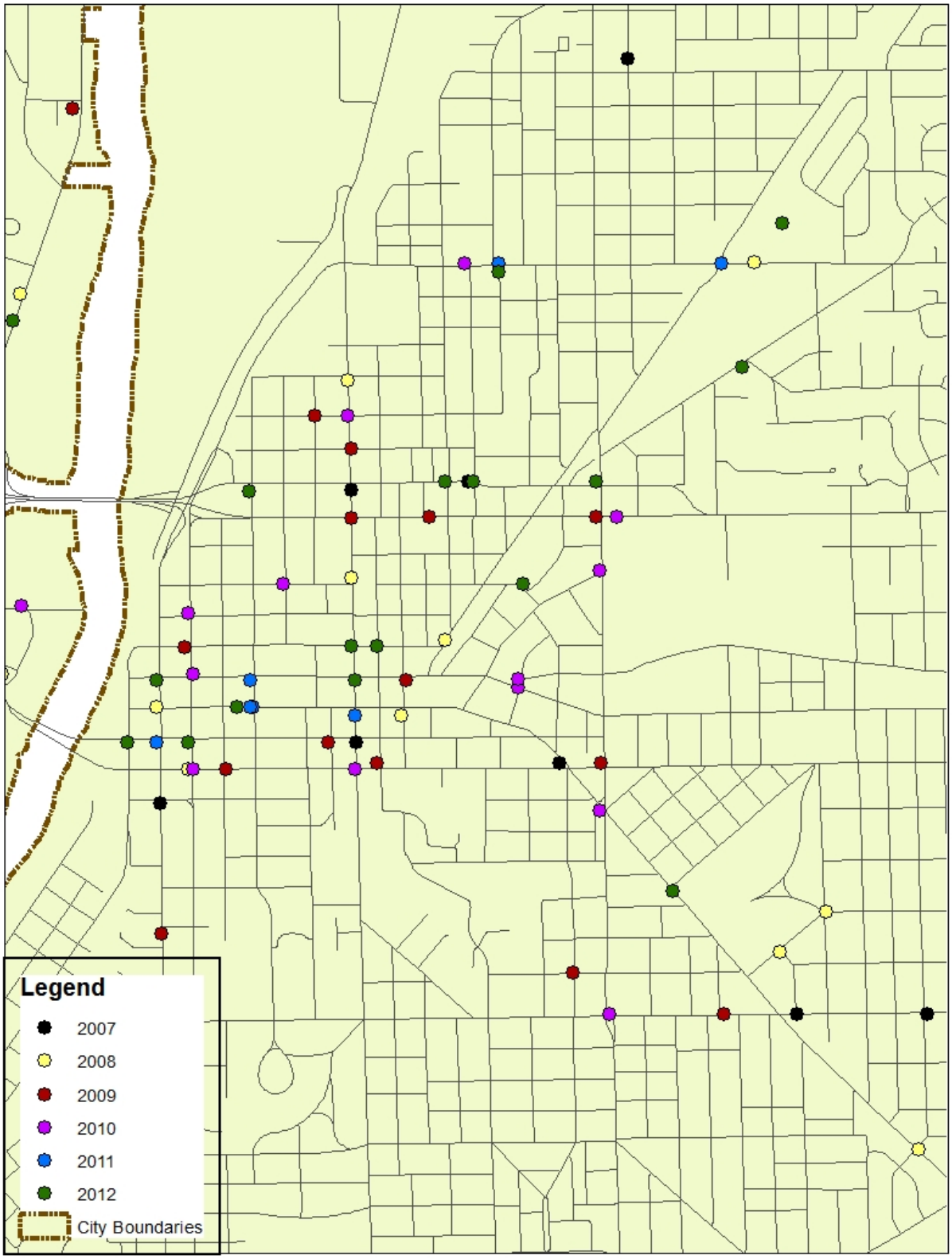


Figure 5: Location of Pedestrian Crashes in Downtown Lafayette



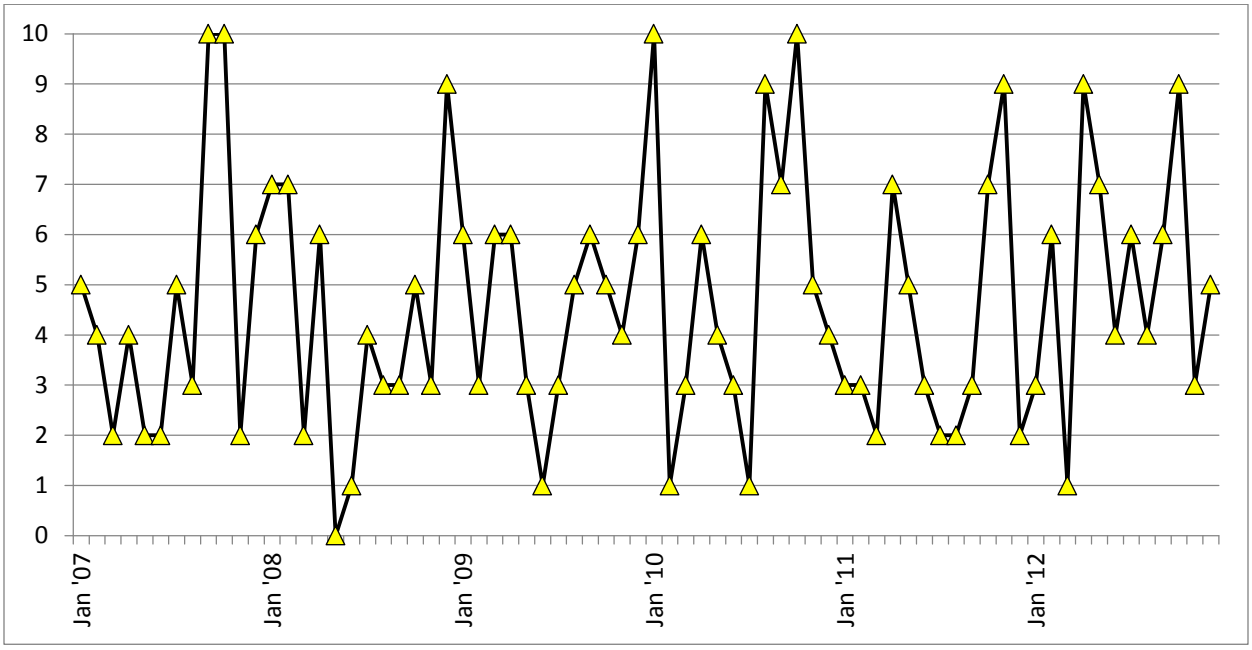
Chapter 2: Date and Time of Pedestrian Crashes

The highest number of crashes occurred in October (46, or 13.8% of all crashes) and the lowest was in March (16, or 4.8%). May 2008 is the only month without a pedestrian crash (Table 4, Figure 6).

Table 4: Number of Pedestrian Crashes by Month and Year

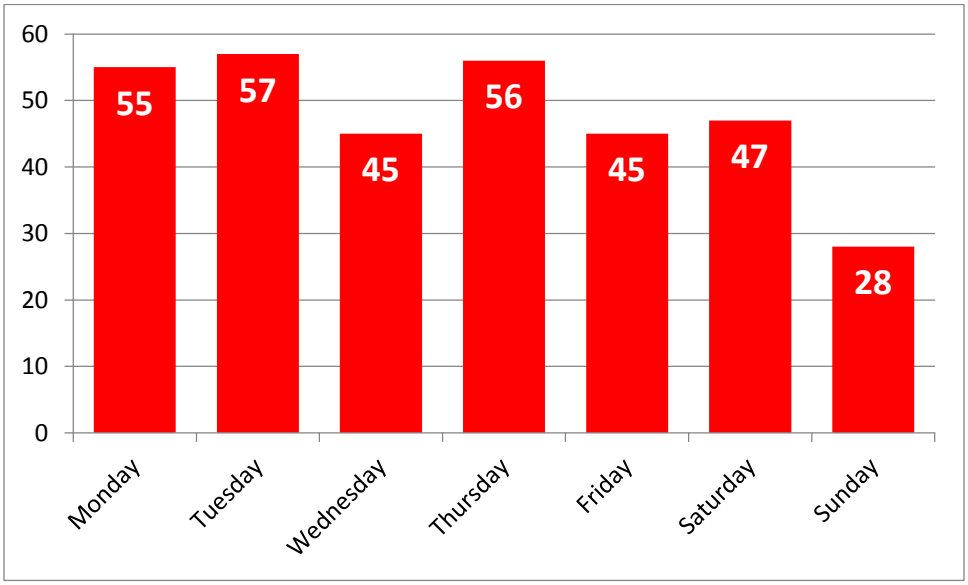
	2007	2008	2009	2010	2011	2012	Total	Percentage	Average Monthly
January	5	7	6	10	3	3	34	10.2%	5.67
February	4	7	3	1	3	6	24	7.2%	4.00
March	2	2	6	3	2	1	16	4.8%	2.67
April	4	6	6	6	7	9	38	11.4%	6.33
May	2	0	3	4	5	7	21	6.3%	3.50
June	2	1	1	3	3	4	14	4.2%	2.33
July	5	4	3	1	2	6	21	6.3%	3.50
August	3	3	5	9	2	4	26	7.8%	4.33
September	10	3	6	7	3	6	35	10.5%	5.83
October	10	5	5	10	7	9	46	13.8%	7.67
November	2	3	4	5	9	3	26	7.8%	4.33
December	6	9	6	4	2	5	32	9.6%	5.33
Total	**55**	**50**	**54**	**63**	**48**	**63**	**333**	100.0%	-

Figure 6: Number of Pedestrian Crashes by Month and Year



Tuesday had the highest number of pedestrian crashes (57), followed closely by Thursday (56) and Monday (55), with the fewest on Sunday (28). It is expected that Sundays have the fewest crashes, because traffic and pedestrian volumes are lower (Figure 7).

Figure 7: Pedestrian Crashes by Day of the Week

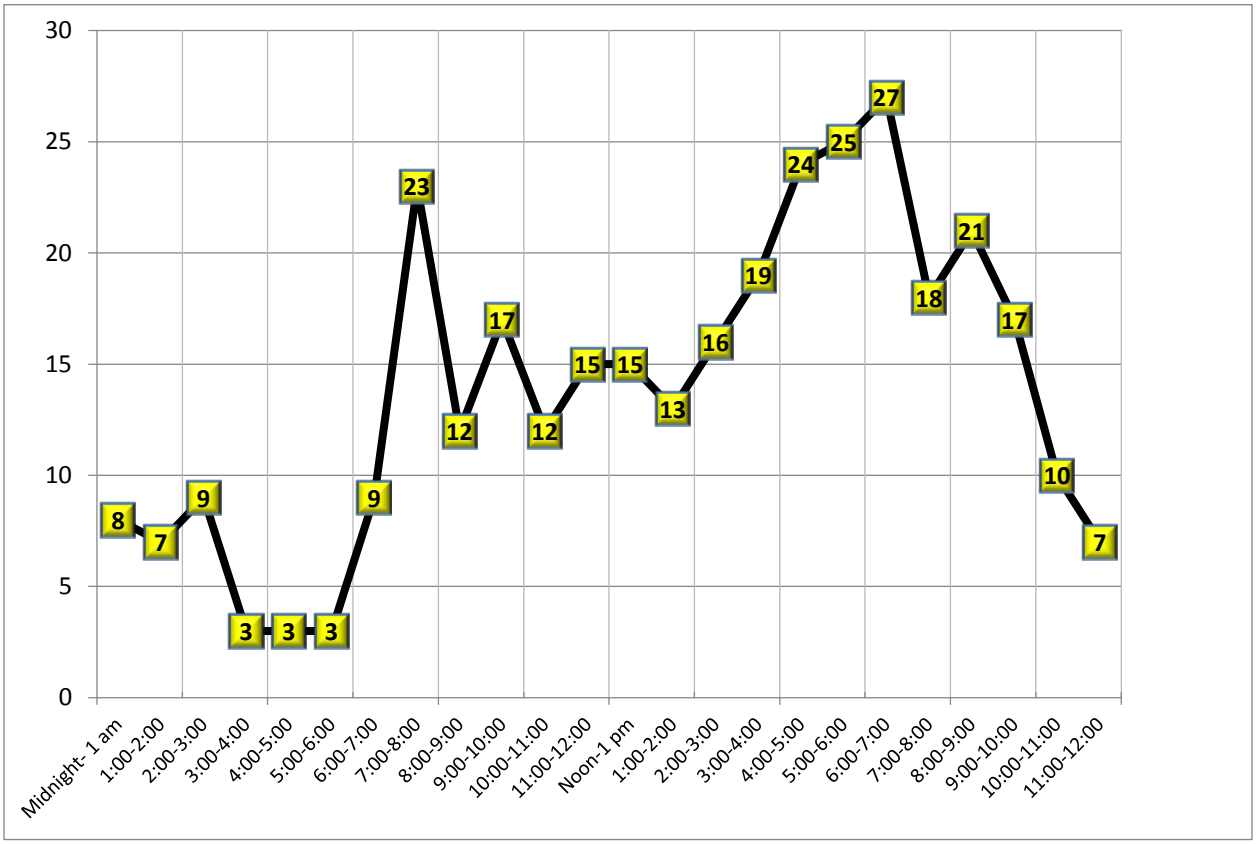


There are distinct morning and evening peak crash periods. The hour of the day with the highest number of crashes was 6 p.m. to 7 p.m. (27) with the two prior hours also being high (Table 5, Figure 8). There was also a distinct morning peak between 7 a.m. and 8 a.m. with 23 crashes and a slight evening rise between 8 p.m. and 9 p.m. with 21 crashes. In between the morning and evening peaks, the crashes vary from 12 to 19.

Table 5: Pedestrian Crashes by Time of Day and Year

	2007	2008	2009	2010	2011	2012	Total	% of Crashes
Midnight- 1 am	2	2	1	0	3	0	8	2.4%
1:00-2:00	1	0	2	1	2	1	7	2.1%
2:00-3:00	0	2	3	0	2	2	9	2.7%
3:00-4:00	0	0	0	1	1	1	3	0.9%
4:00-5:00	0	1	1	0	0	1	3	0.9%
5:00-6:00	1	0	0	1	0	1	3	0.9%
6:00-7:00	2	1	2	2	0	2	9	2.7%
7:00-8:00	4	5	5	2	2	5	23	6.9%
8:00-9:00	1	3	2	2	3	1	12	3.6%
9:00-10:00	4	2	2	4	1	4	17	5.1%
10:00-11:00	2	2	1	3	1	3	12	3.6%
11:00-12:00	3	1	3	3	3	2	15	4.5%
Noon-1 pm	5	3	2	2	0	3	15	4.5%
1:00-2:00	4	2	2	1	2	2	13	3.9%
2:00-3:00	4	3	0	5	0	4	16	4.8%
3:00-4:00	3	2	4	4	4	2	19	5.7%
4:00-5:00	3	4	4	4	5	4	24	7.2%
5:00-6:00	3	1	4	8	1	8	25	7.5%
6:00-7:00	2	6	6	5	3	5	27	8.1%
7:00-8:00	3	1	2	6	0	6	18	5.4%
8:00-9:00	4	3	4	5	5	0	21	6.3%
9:00-10:00	2	4	1	3	4	3	17	5.1%
10:00-11:00	2	1	1	0	4	2	10	3.0%
11:00-12:00	0	1	2	1	2	1	7	2.1%
Total	55	50	54	63	48	63	333	100.0%

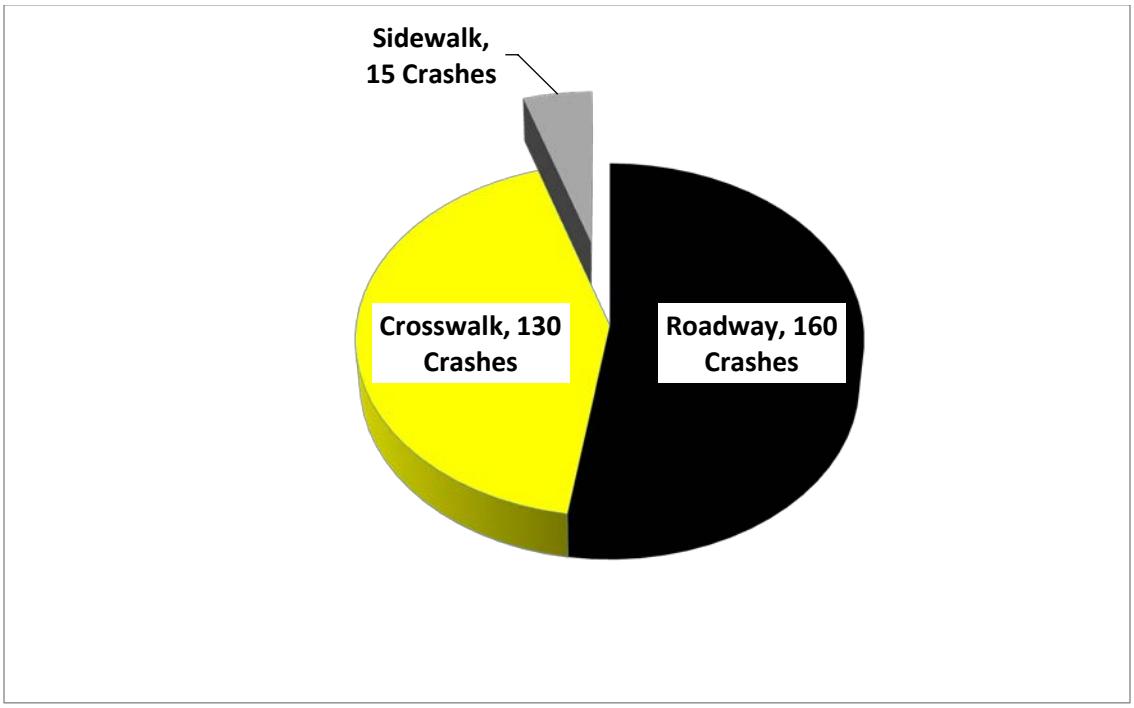
Figure 8: Pedestrian Crashes by Time of Day



Chapter 3: Pedestrian Crashes by Location

Each pedestrian crash was assigned to one of the following three location categories depending on where the crash occurred: “roadway,” “crosswalk,” or “sidewalk.” It should be noted that the term “crosswalk” does not always refer to a painted crosswalk. In ARIES, officers may mark “crosswalk” for a crash occurring at or near an intersection, so that convention is used in this report. The vast majority of pedestrian crashes occur either on a roadway or at a crosswalk (87%, Figure 9). 160 (48%) pedestrian crashes occurred in the roadway and 130 (39%) crashes occurred in a crosswalk. Only 15 (5%) pedestrian crashes occurred while a pedestrian was on a sidewalk. One reason for the high number of pedestrian crashes in the roadway is that drivers expect pedestrians in crosswalk areas and not elsewhere.

Figure 9: Pedestrian Crashes by Location Category



Pedestrians are most likely to get hit in the roadway in the late afternoon and evening (3 p.m. to 11 p.m.) with the peak hour between 6 p.m. and 7 p.m. (Table 6, Figure 10). Pedestrians are most likely to get hit in a crosswalk between 4 p.m. and 7 p.m. and on a sidewalk between 7 a.m. and 9 a.m.

Roadway and crosswalk crashes were not confined to just within the city limits, but also occurred in rural areas. Sidewalk crashes happen mostly inside the city limits (Figures 11-15). The area around Purdue had the greatest concentration of crosswalk crashes (Figure 14).

Table 6: Pedestrian Crashes by Time of Day and Location Category

	roadway	crosswalk	sidewalk	Total
Midnight- 1 am	2	6	0	**8**
1:00-2:00	3	4	0	**7**
2:00-3:00	7	0	0	**7**
3:00-4:00	2	0	0	**2**
4:00-5:00	2	0	0	**2**
5:00-6:00	2	0	0	**2**
6:00-7:00	5	3	0	**8**
7:00-8:00	8	12	3	**23**
8:00-9:00	3	7	2	**12**
9:00-10:00	11	4	0	**15**
10:00-11:00	5	5	1	**11**
11:00-12:00	8	5	1	**14**
Noon-1 pm	5	7	0	**12**
1:00-2:00	5	7	0	**12**
2:00-3:00	7	5	1	**13**
3:00-4:00	10	7	1	**18**
4:00-5:00	9	13	2	**24**
5:00-6:00	10	10	2	**22**
6:00-7:00	13	11	1	**25**
7:00-8:00	9	6	0	**15**
8:00-9:00	10	10	1	**21**
9:00-10:00	9	6	0	**15**
10:00-11:00	9	1	0	**10**
11:00-12:00	6	1	0	**7**
Total	**160**	**130**	**15**	**305**

Figure 10: Pedestrian Crashes by Time of Day

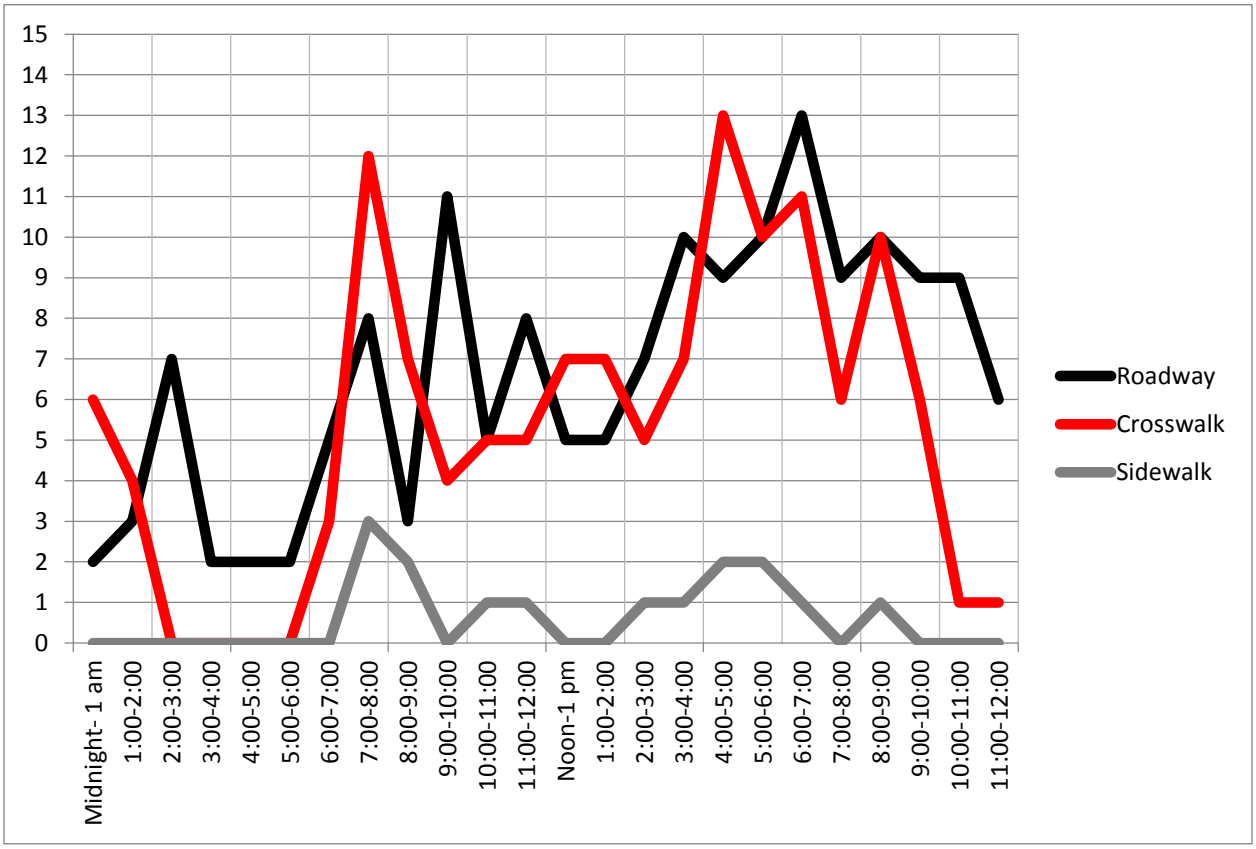


Figure 11: Pedestrian Crashes in Tippecanoe County (by Location Category)

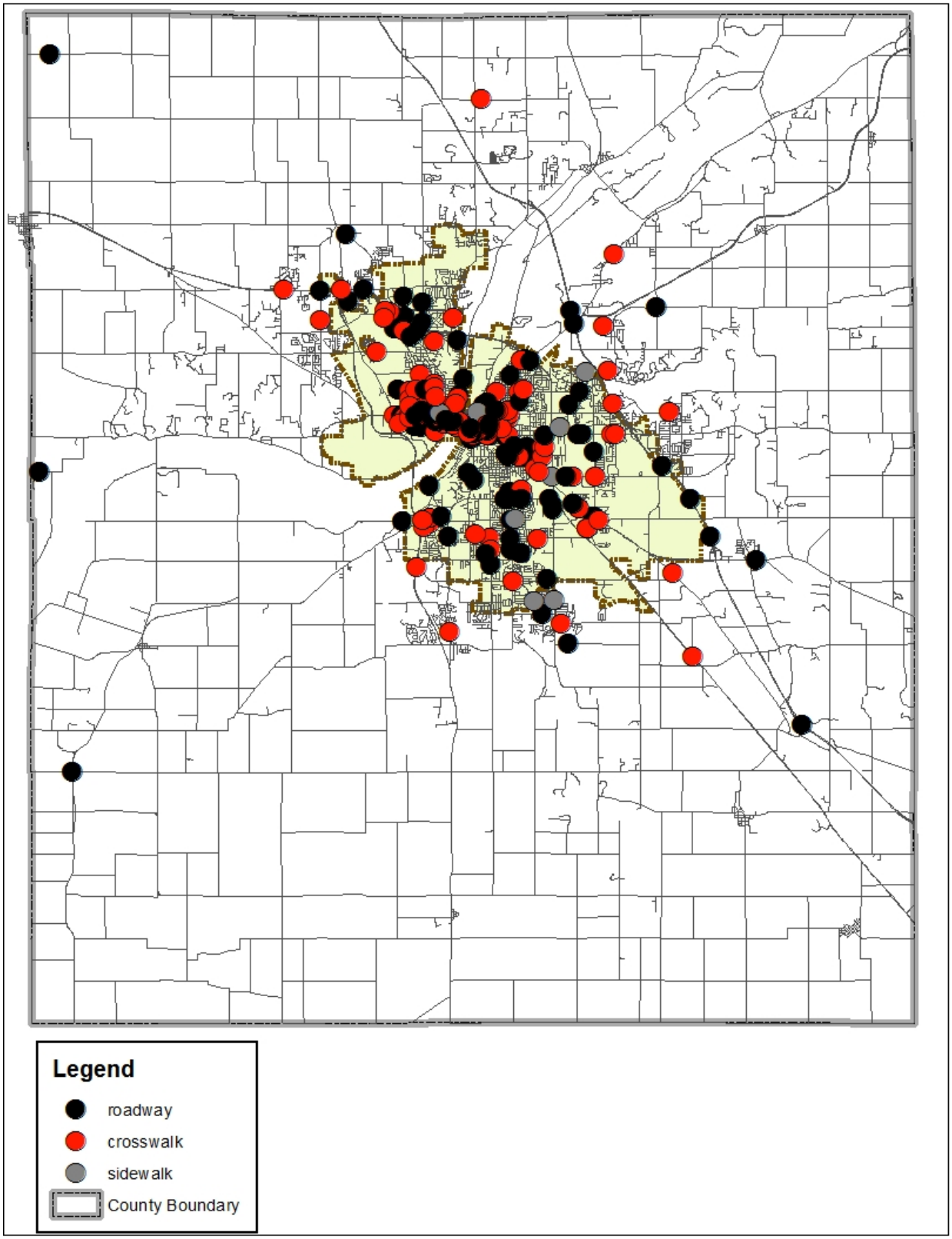


Figure 12: Pedestrian Crashes in Lafayette (by Location Category)

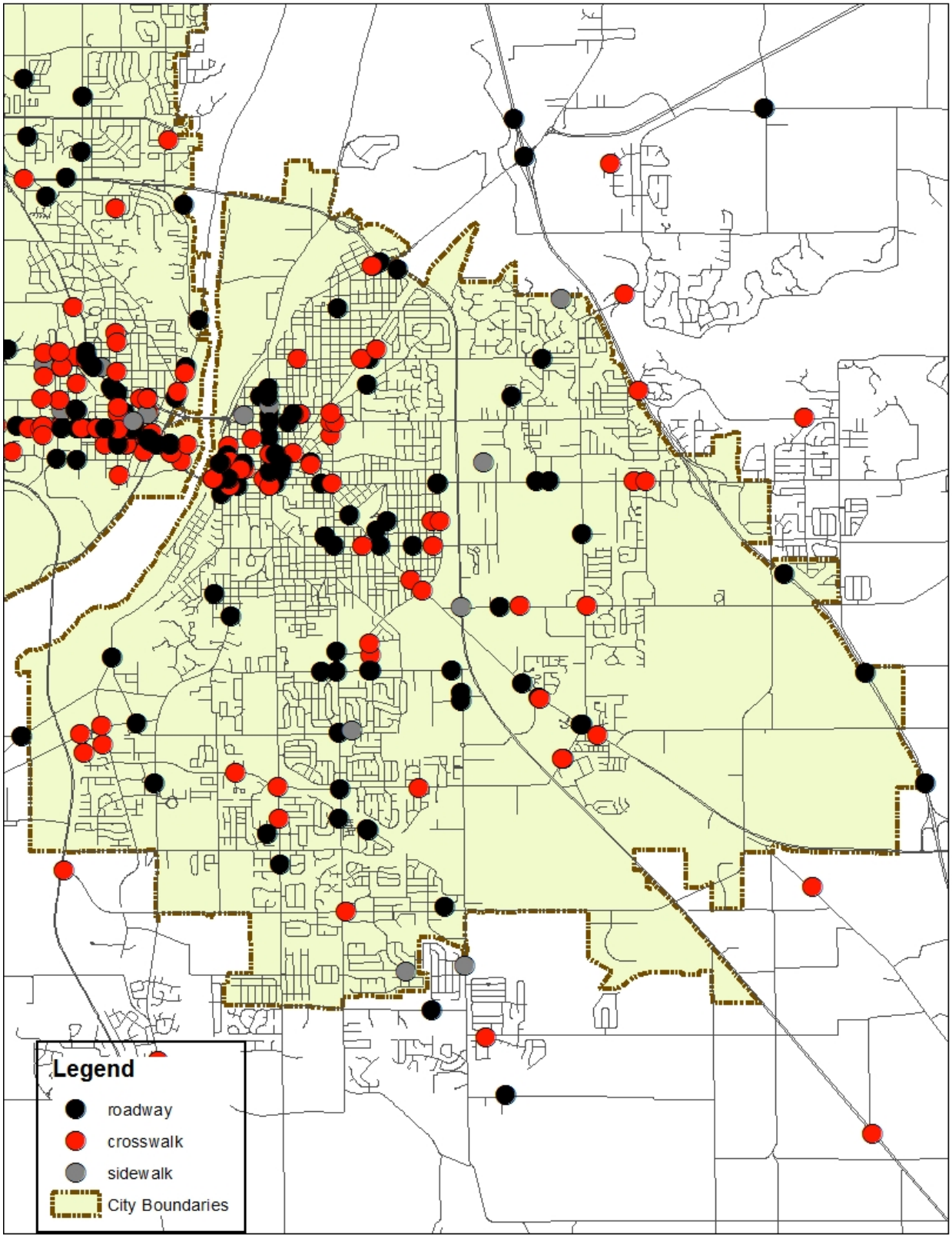


Figure 13: Pedestrian Crashes in West Lafayette (by Location Category)

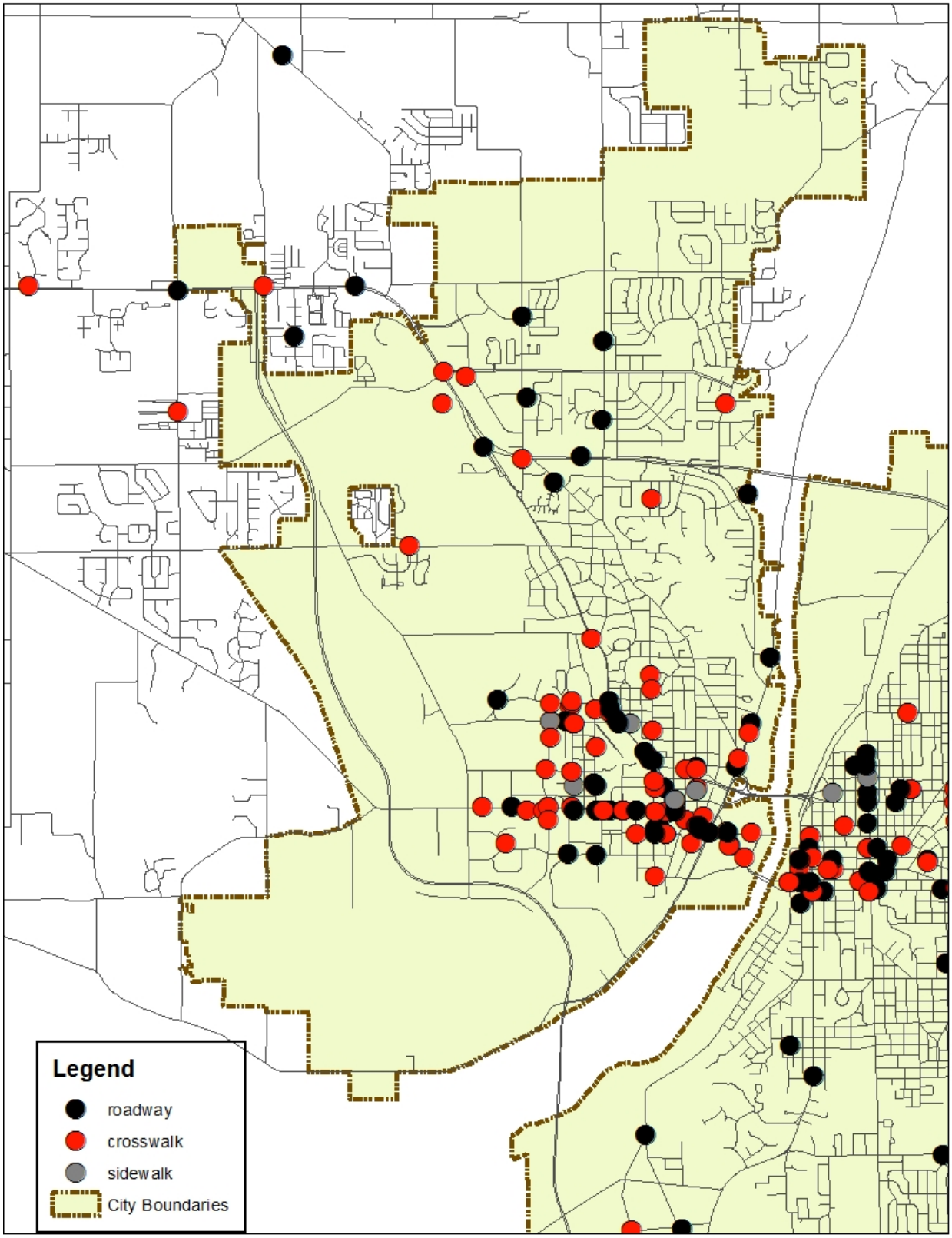


Figure 14: Pedestrian Crashes in Purdue University Area (by Location Category)

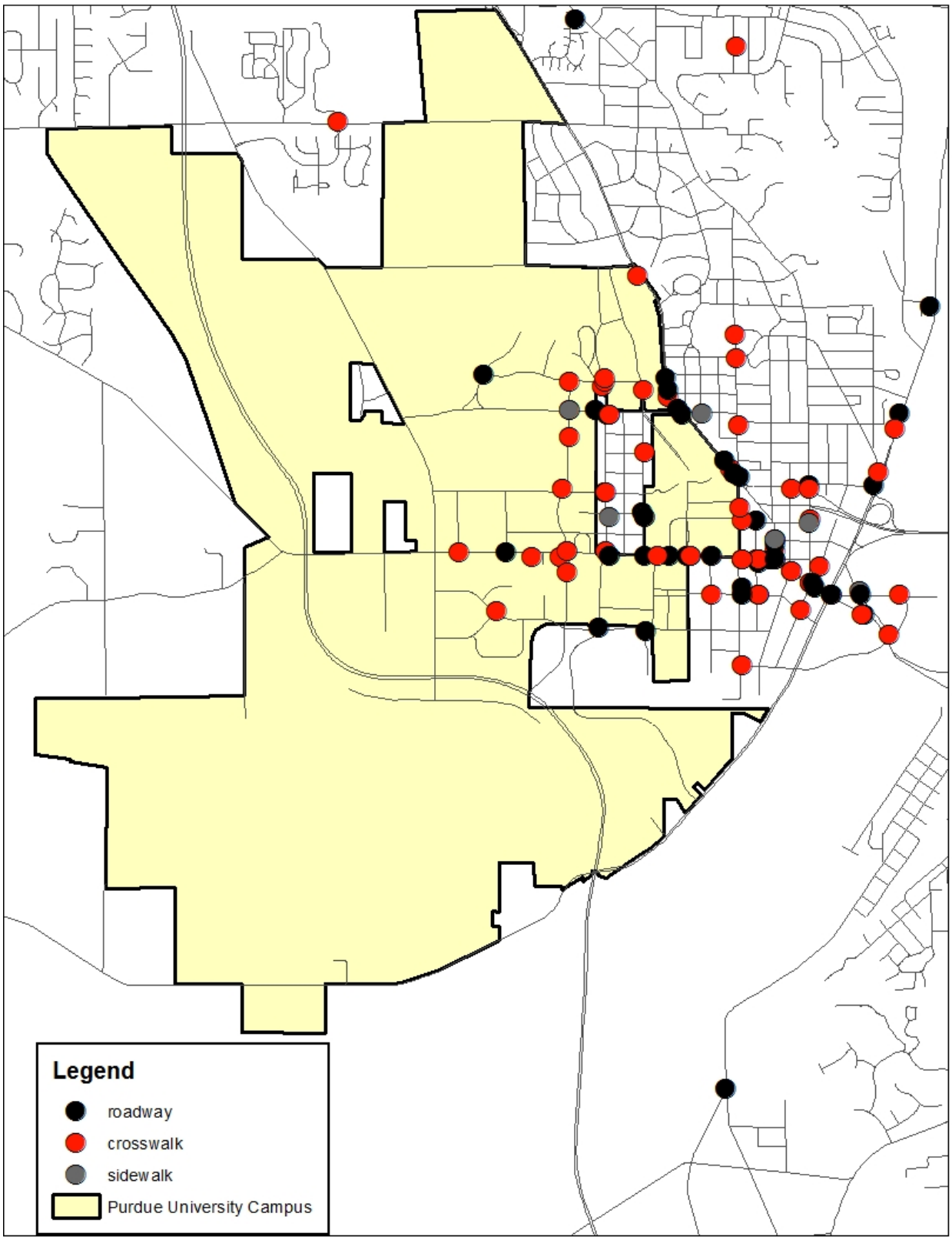
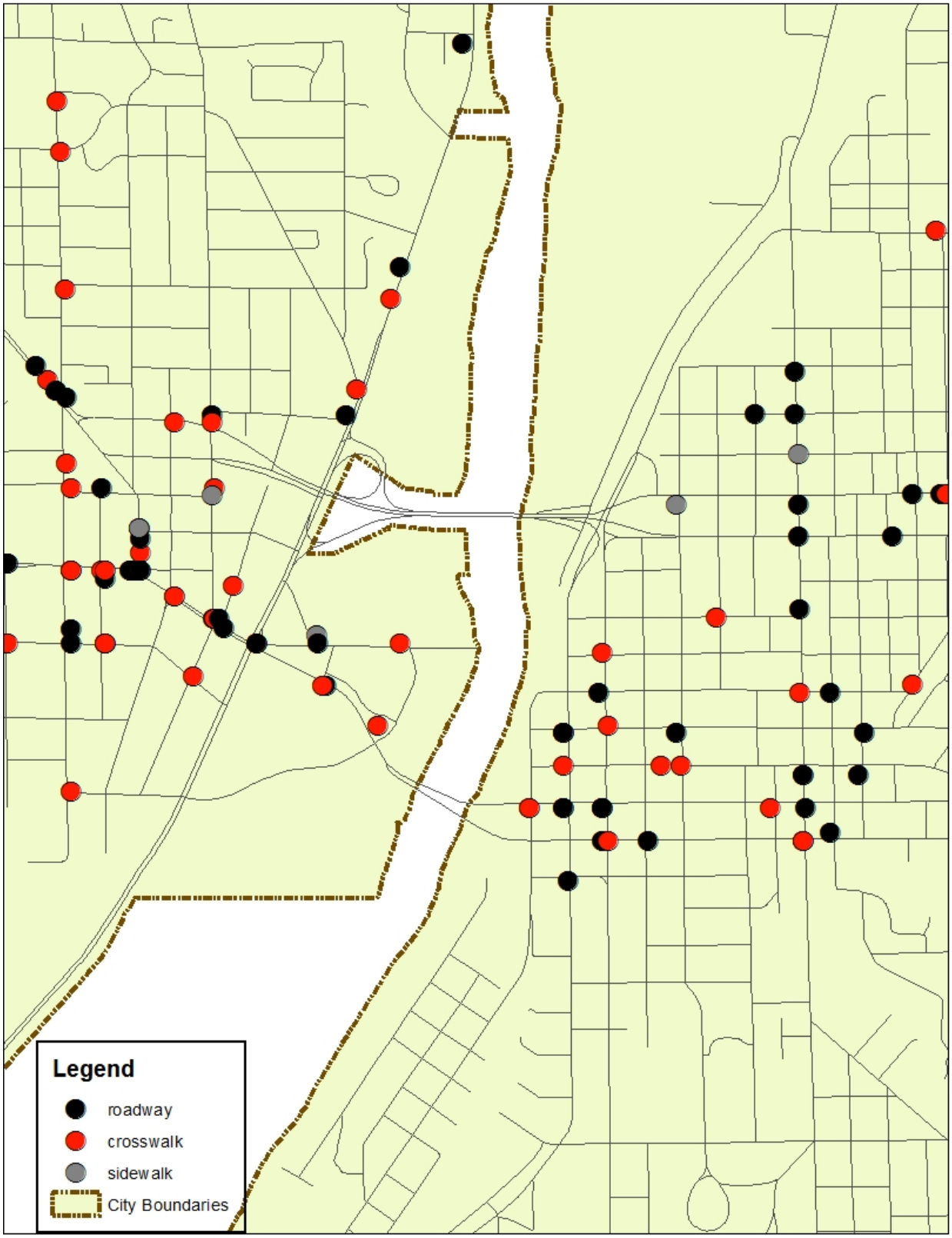


Figure 15: Pedestrian Crashes in Downtown Areas (by Location Category)



Chapter 4: Pedestrian Crashes by Primary Factor

There are many circumstances that contribute to a crash. For each crash report, the investigating police officers are allowed to list up to four contributing circumstances. For each of the vehicles in the crash, one of the four possible contributing circumstances must be listed as the Primary Factor for the crash.

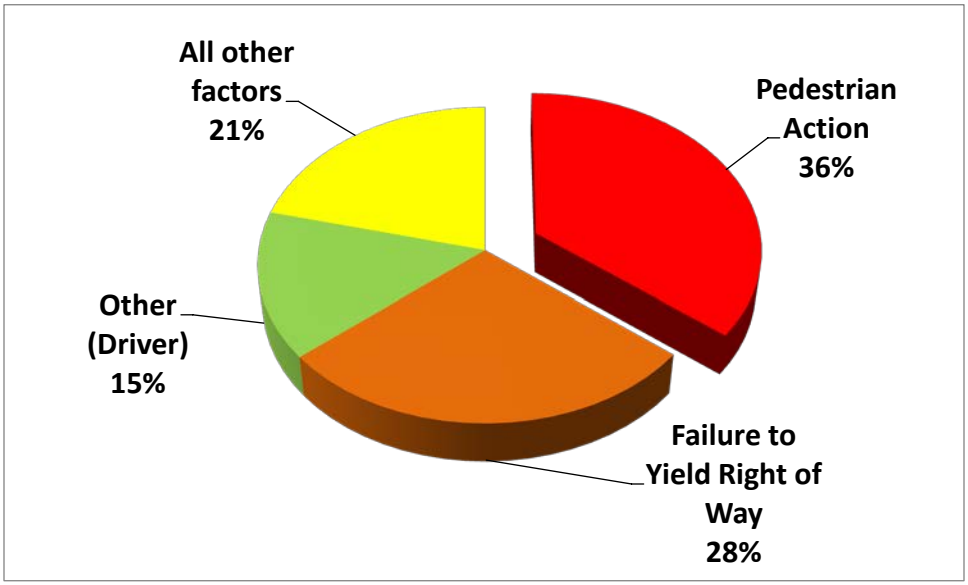
The top three primary factors caused the majority (79%) of pedestrian crashes: "Pedestrian action," "Failure to yield Right of Way," and "Other (Driver)." Because most of the primary factors involved a human error of some kind (instead of an equipment failure or environmental conditions), most pedestrian crashes were preventable (Table 7, Figure 16).

In almost every case, the pedestrian was at fault when "Pedestrian Action" was listed as the primary factor. Similarly, the driver was almost always at fault when "Failure to Yield Right of Way" or "Other (Driver)" was listed. Further discussion of crash fault is in Chapter 7.

Table 7: Pedestrian Crashes by Primary Factor

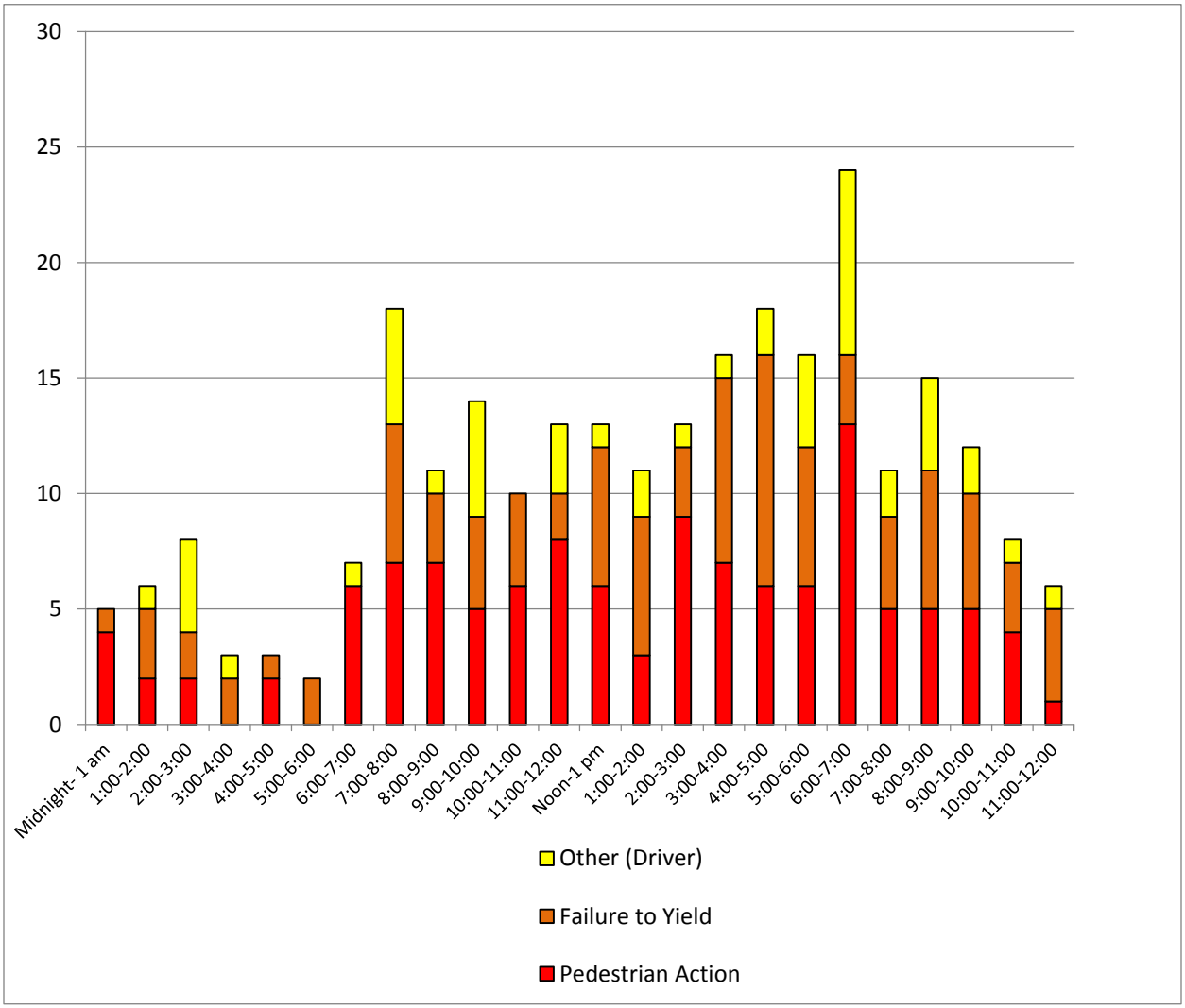
Primary Factor	Number of Crashes
PEDESTRIAN ACTION	119
FAILURE TO YIELD RIGHT OF WAY	94
OTHER (DRIVER)	50
UNSAFE BACKING	14
IMPROPER LANE USAGE	8
IMPROPER TURNING	7
OTHER (ENVIRONMENTAL)	6
UNSAFE SPEED	6
DISREGARD SIGNAL/REG SIGN	4
RAN OFF ROAD RIGHT	4
ALCOHOLIC BEVERAGES	3
FOLLOWING TOO CLOSELY	3
SPEED TOO FAST FOR WEATHER CONDITIONS	3
DRIVER DISTRACTED	3
OTHER (VEHICLE)	3
LEFT OF CENTER	2
ROADWAY SURFACE CONDITION	1
IMPROPER PASSING	1
DRIVER ILLNESS	1
VIEW OBSTRUCTED	1
TOTAL	**333**

Figure 16: Frequency of Primary Factors in Pedestrian Crashes



The top three primary factors also vary by time of the day (Figure 17). The "Pedestrian Action" primary factor contributes to a high percentage of the morning crashes between 6 a.m. and 12 p.m. The "Failure to Yield" primary factor contributes a high percentage of the afternoon crashes between 12 p.m. and 5 p.m. The "Other (Driver)" primary factor has its most significant contribution to crashes between 7 a.m. and 8 a.m. and between 6 p.m. and 7 p.m.

Figure 17: Top Three Primary Factors in Pedestrian Crashes by Time of Day



Chapter 5: Pedestrian Crashes by Age

Pedestrian behavior can vary dramatically depending on the age of the pedestrian. Young pedestrians often make impulsive decisions, teenagers are often distracted by electronics, and the elderly have slower reaction times and more physical limitations. Of the 333 pedestrian crashes, 9 had no pedestrian age reported.

Pedestrians between the ages of 16 and 24 are involved in over 40% of all crashes (Figure 18, Table 8).

Figure 18: Pedestrian Crashes by Age

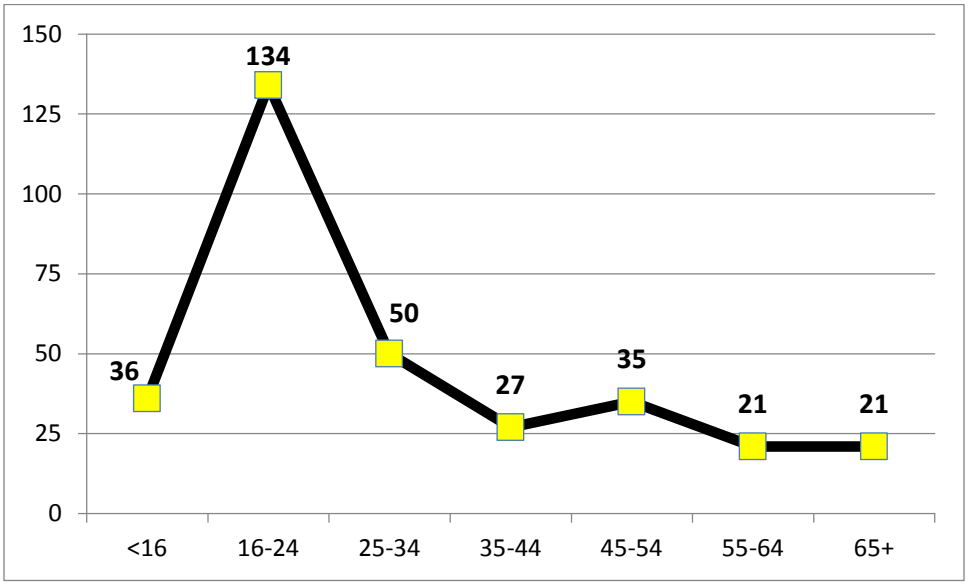


Table 8: Pedestrian Crashes by Age and Day of the Week

	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Total
<16	1	5	4	7	8	7	4	**36**
16-24	13	25	16	19	24	19	18	**134**
25-34	10	6	11	4	5	6	8	**50**
35-44	1	4	6	4	5	2	5	**27**
45-54	2	5	9	5	6	4	4	**35**
55-64	1	6	7	3	3	0	1	**21**
65+	0	4	3	3	3	5	3	**21**
Total	**28**	**55**	**56**	**45**	**54**	**43**	**43**	**324**

In Table 8, the age group with the highest number of crashes is highlighted.

The highest individual hour for any age group was between 4 p.m. and 5 p.m. for 16 to 24 year-olds, which is shown in Table 9, where the hour of the day with the highest number of pedestrian crashes for each age group is highlighted.

Table 9: Pedestrian Crashes by Time of Day and Age

	<16	16-24	25-34	35-44	45-54	55-64	65+	Total
Midnight- 1 am	1	1	1	3	2	0	0	**8**
1:00-2:00	2	3	1	1	0	0	0	**7**
2:00-3:00	0	1	1	0	2	4	1	**9**
3:00-4:00	0	0	0	0	0	2	1	**3**
4:00-5:00	0	0	2	1	0	0	0	**3**
5:00-6:00	0	2	0	0	1	0	0	**3**
6:00-7:00	0	6	2	0	1	0	0	**9**
7:00-8:00	0	11	4	3	0	0	3	**21**
8:00-9:00	1	1	2	1	5	1	0	**11**
9:00-10:00	0	10	4	1	0	1	1	**17**
10:00-11:00	3	2	4	1	0	0	2	**12**
11:00-12:00	5	3	3	0	2	1	1	**15**
Noon-1 pm	0	8	2	1	2	0	0	**13**
1:00-2:00	1	9	2	1	0	0	0	**13**
2:00-3:00	3	7	1	1	1	0	1	**14**
3:00-4:00	3	5	3	2	1	3	1	**18**
4:00-5:00	1	14	2	3	1	0	3	**24**
5:00-6:00	2	13	2	1	5	1	1	**25**
6:00-7:00	5	9	5	2	3	2	0	**26**
7:00-8:00	3	9	2	0	2	0	2	**18**
8:00-9:00	3	4	2	4	4	2	2	**21**
9:00-10:00	2	8	3	1	1	2	0	**17**
10:00-11:00	1	5	1	0	1	1	1	**10**
11:00-12:00	0	3	1	0	1	1	1	**7**
Total	**36**	**134**	**50**	**27**	**35**	**21**	**21**	**324**

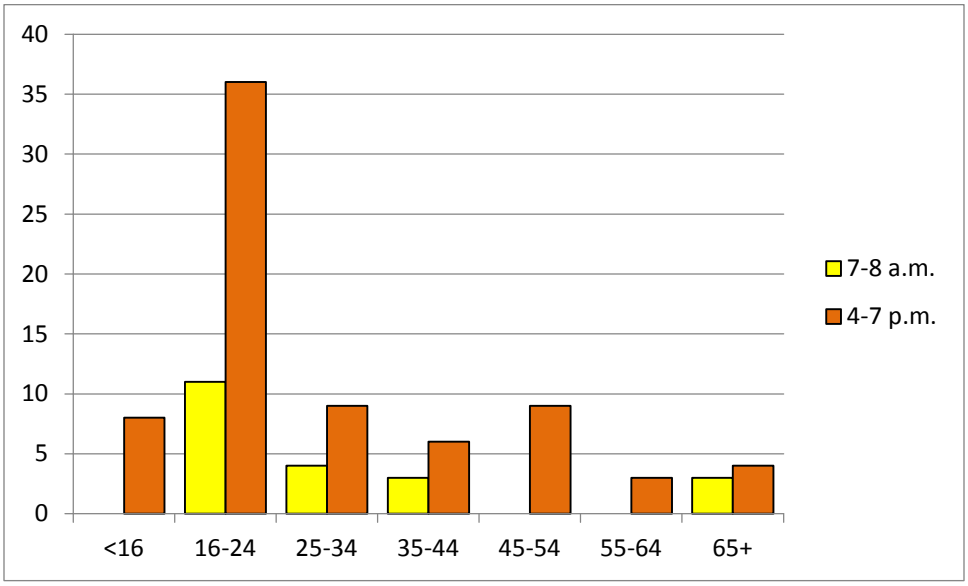
A critical time for pedestrian crashes is during peak traffic periods. The morning peak is typically defined as 7 a.m. to 8 a.m., and the evening peak as 4 p.m. to 6 p.m. However, the hour with the highest number of pedestrian crashes is 6 p.m. to 7 p.m. (Figure 19, Table 10)

For both typical peak periods, 16 to 24 year-olds were involved in almost half of all crashes. During the morning peak period, there were 2 pedestrian crashes where the pedestrian's age was not identified.

Table 10: Peak Period Pedestrian Crashes by Age

Age	7-8 a.m.	4-7 p.m.
<16	0	8
16-24	11	36
25-34	4	9
35-44	3	6
45-54	0	9
55-64	0	3
65+	3	4
Unknown	2	1
Total	**23**	**76**

Figure 19: Peak Period Pedestrian Crashes by Age



The age of a pedestrian can affect his or her behavior and choices on where to cross the road (Figure 20, table 11). Pedestrians below the age of 16, 25 to 44, and over 65 are most likely to be involved in a roadway crash. Pedestrians 16 to 24 and 45 to 64 years old are most likely to be involved in a crash in a crosswalk.

Figure 20: Pedestrian Crashes by Location and Age

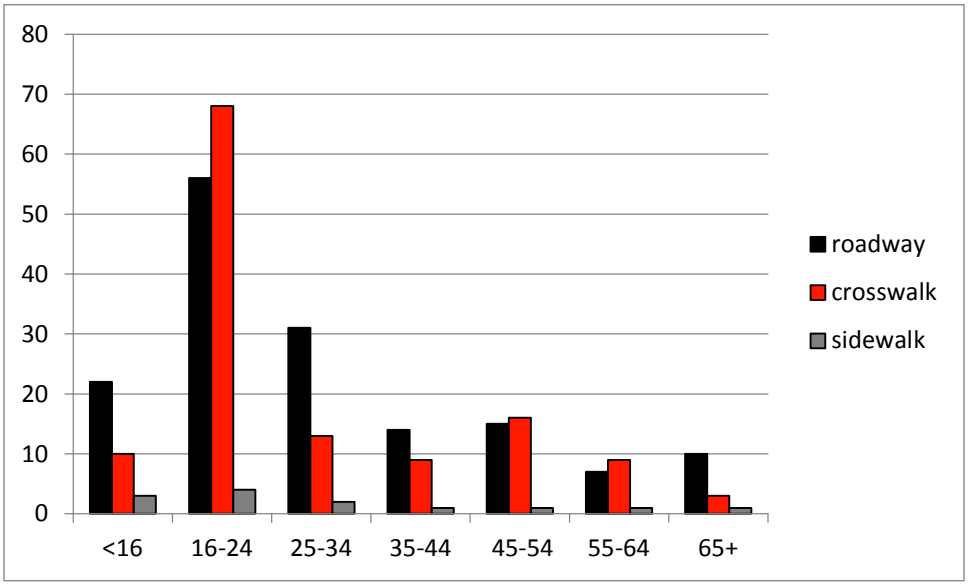


Table 11: Pedestrian Crashes by Location and Age

	<16	16-24	25-34	35-44	45-54	55-64	65+	total	% of crashes
roadway	22	56	31	14	15	7	10	**155**	52.4%
crosswalk	10	68	13	9	16	9	3	**128**	43.2%
sidewalk	3	4	2	1	1	1	1	**13**	4.4%
total	**35**	**128**	**46**	**24**	**32**	**17**	**14**	**296**	100.0%

Pedestrians under 16, between 16 and 24, and over 65 were chosen for further analysis. Pedestrians under 16 or over 65 were chosen because they may behave differently from other pedestrians. Pedestrians between 16-24 were chosen because of the high number of crashes. Figures 21-23 show the locations of pedestrian crashes for those age groups.

Figure 21: Crashes Involving Pedestrians Under 16 Years of Age

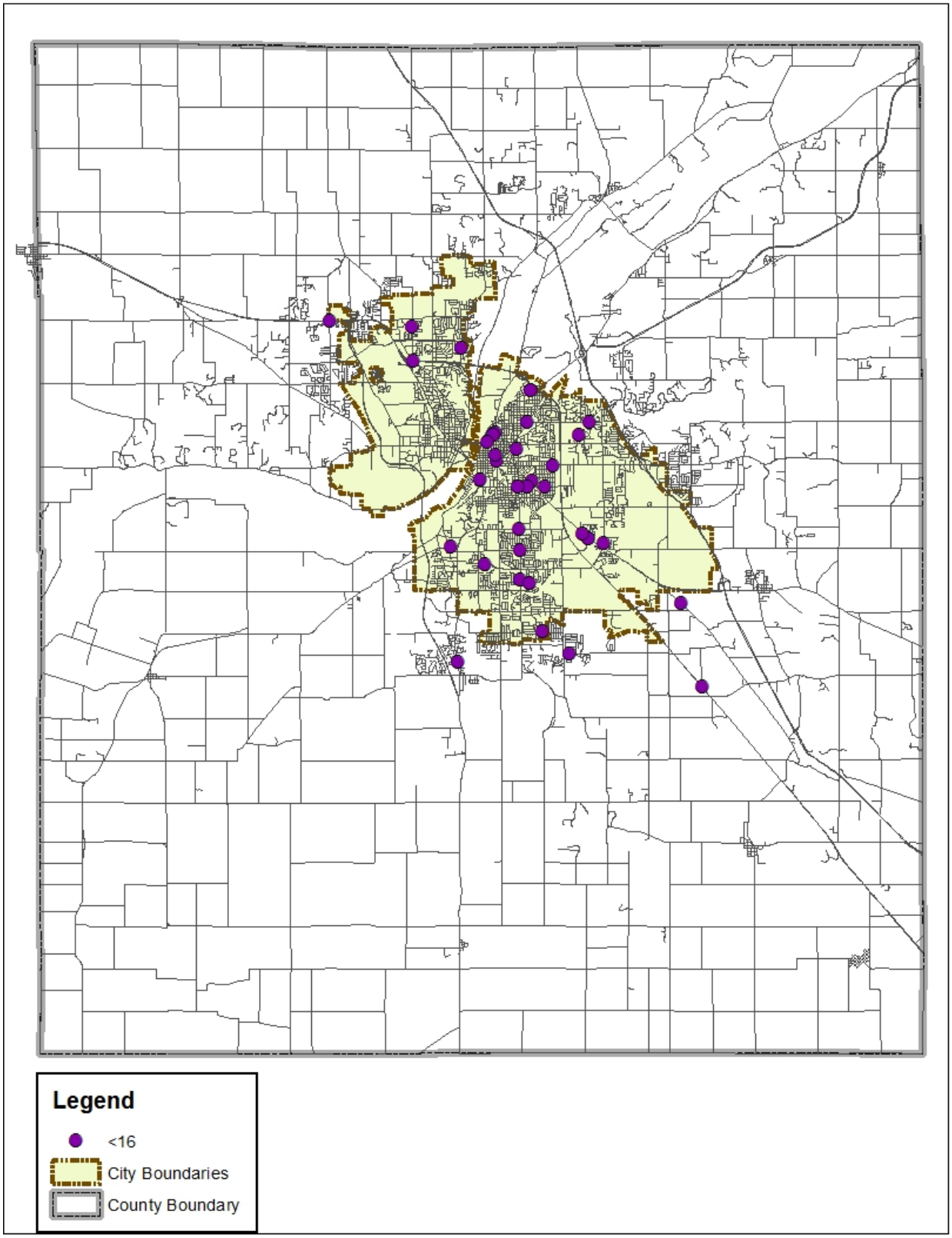


Figure 22: Crashes Involving Pedestrians From 16-24 Years of Age

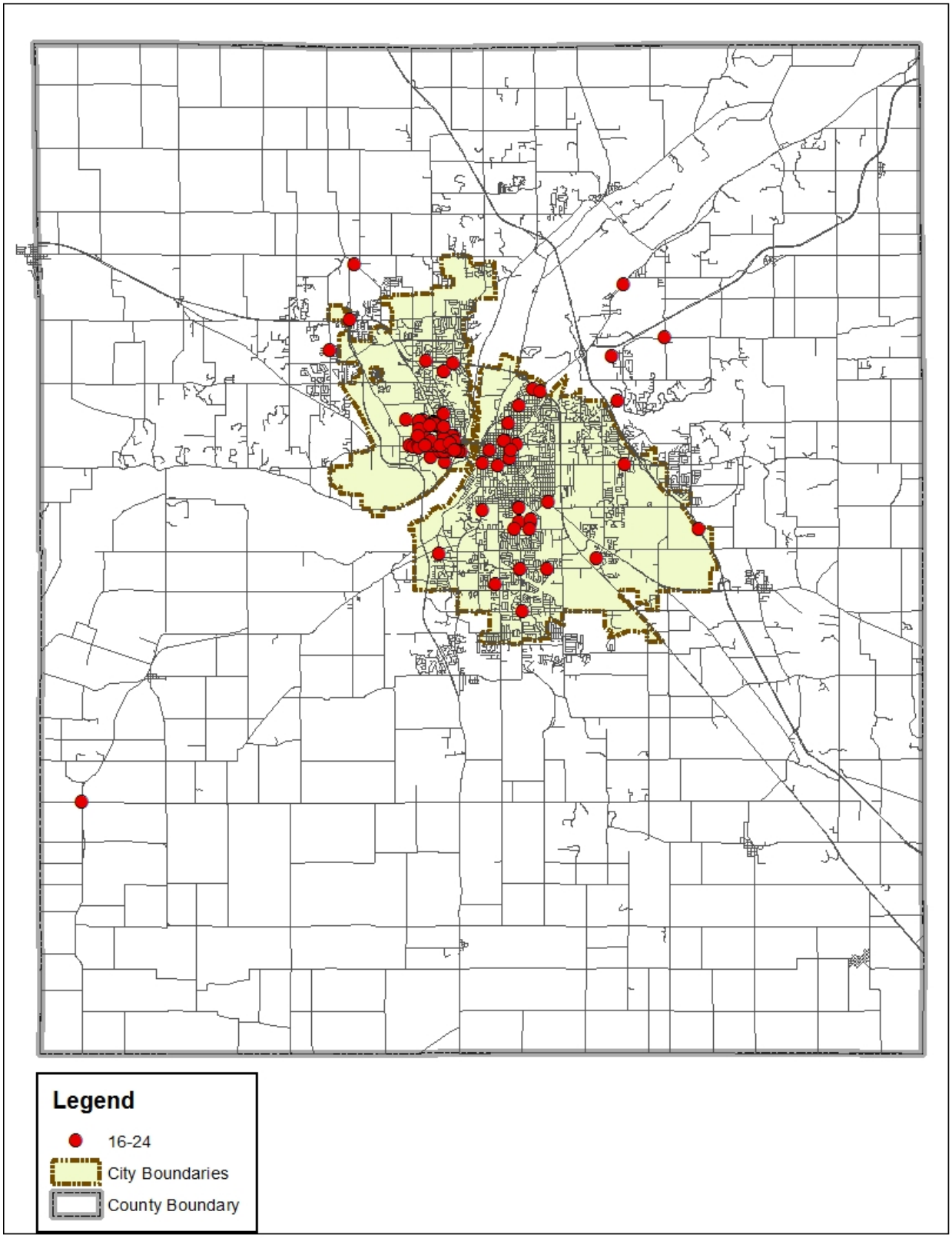
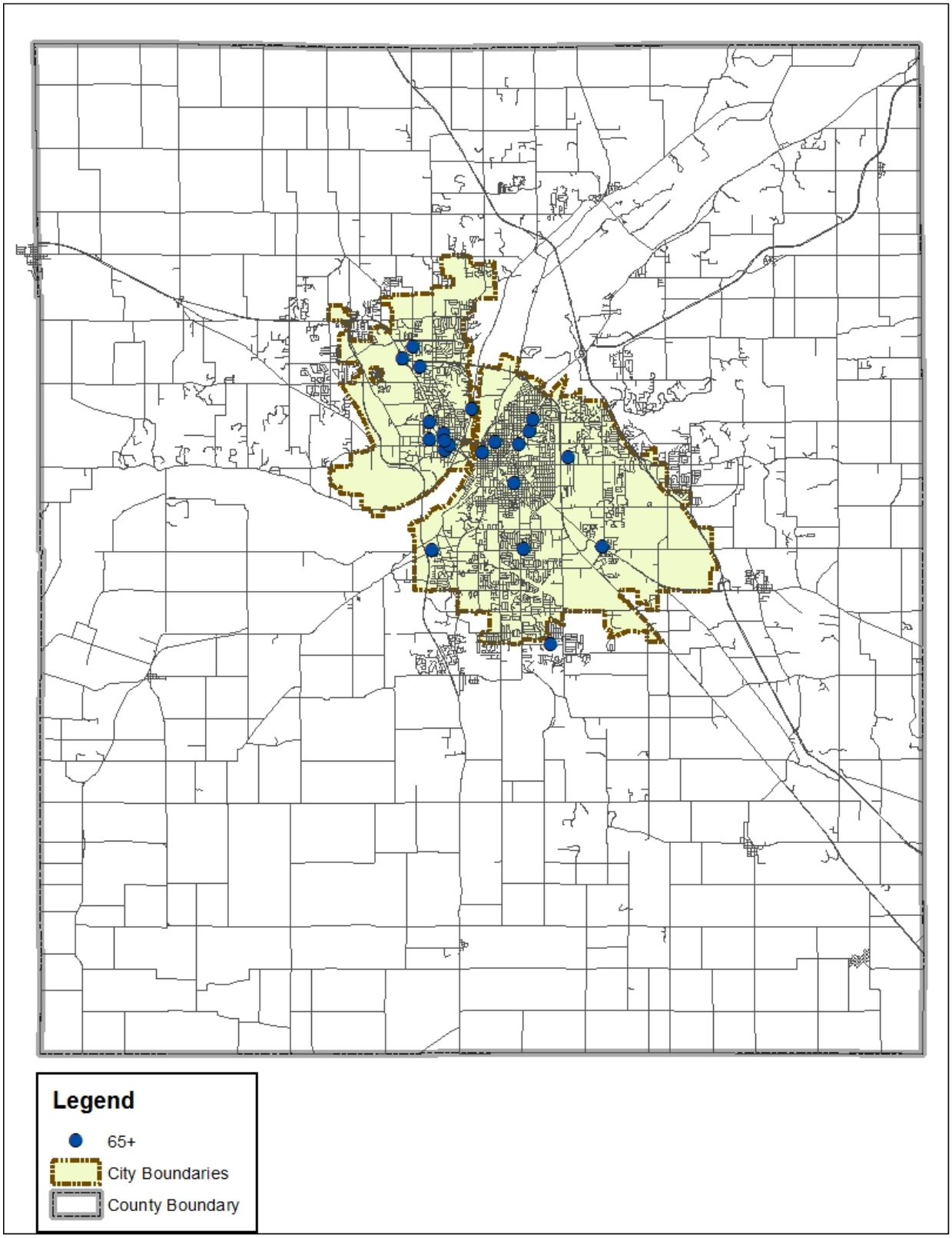


Figure 23: Crashes Involving Pedestrians Over 65 Years of Age



Most of the analysis in this report uses 16-24 year-olds as a group representing young pedestrians. However, that age group does not accurately represent college students. So, for analysis about Purdue University students, 18-24 year-olds were chosen as the best approximation.

When Purdue University is in session, pedestrians in the 18-24 age group are more likely to be involved in a pedestrian crash (Figures 24 and 25). It is reasonable to assume that Purdue University being in session is the primary reason for the large increase in the percentage of crashes that occur for this age group. When Purdue University is in session, 40% of the crashes involve 18-24 year-olds, when it is not, only 26% of the crashes involve that age group.

Figure 24: Pedestrian Crashes for 18-24 Year Olds When Purdue University is in Session

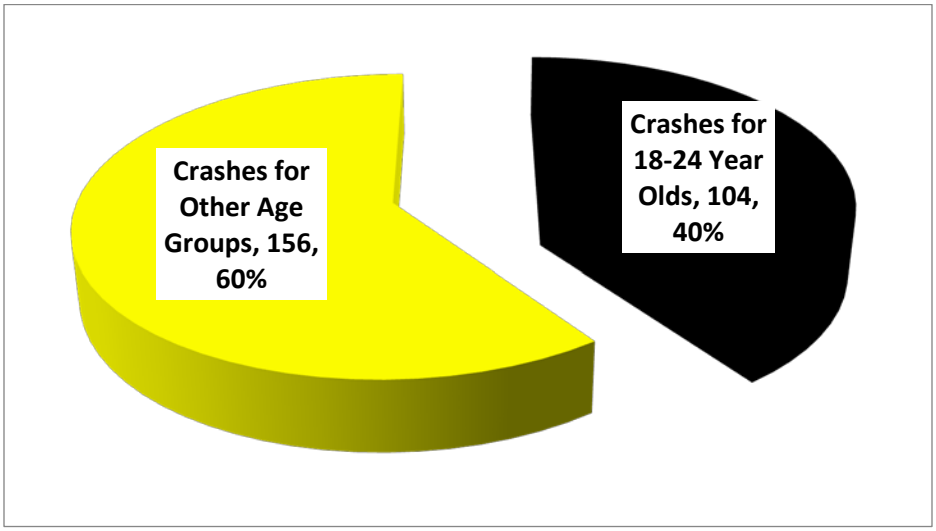
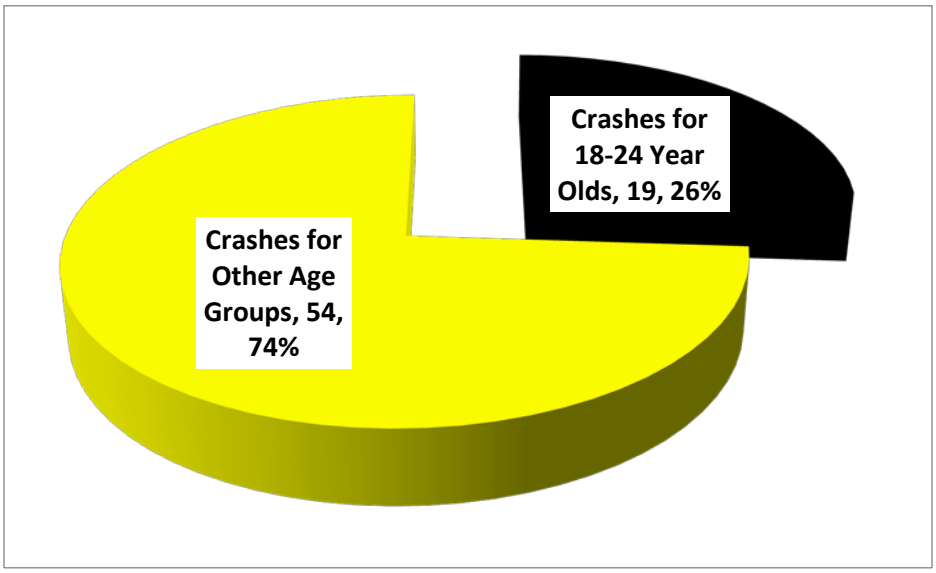


Figure 25: Pedestrian Crashes for 18-24 Year Olds When Purdue University is not in Session



Chapter 6: Pedestrian Crashes by Gender

While there can be differences between male and female behavior, there is not a large gender difference in the crash data. (Figure 26, Table 12).

Figure 26: Pedestrian Crashes by Gender and Day of the Week

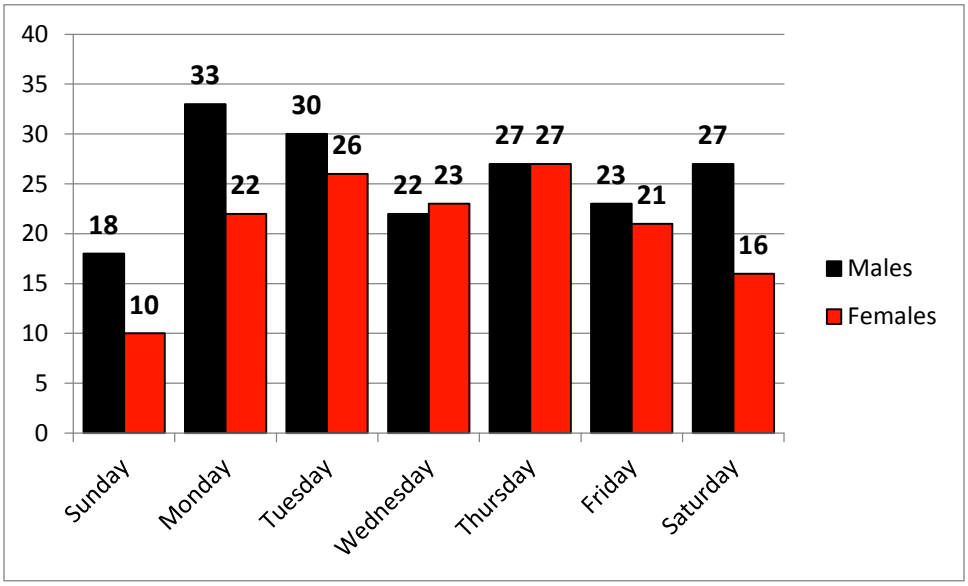


Table 12: Pedestrian Crashes by Gender and Day of the Week

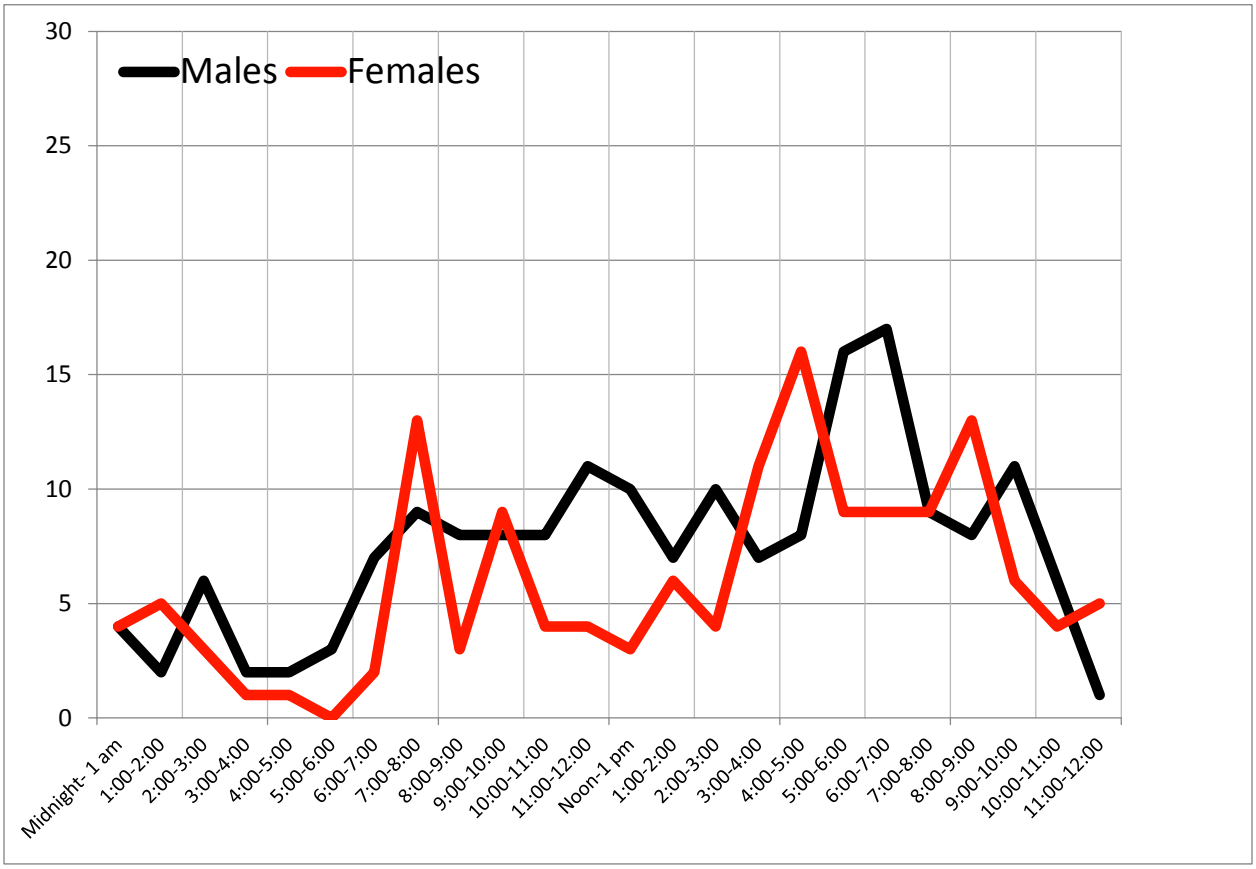
	Sun	Mon	Tues	Wed	Thu	Fri	Sat	Total	% of crashes
Male	18	33	30	22	27	23	27	180	55.4%
Female	10	22	26	23	27	21	16	145	44.6%
Total	**28**	**55**	**56**	**45**	**54**	**44**	**43**	**325**	**100.0%**

Male pedestrians were involved in a higher number of crashes for every day of the week except Wednesday and Thursday. On Wednesdays, females were involved in one more crash than males, and on Thursday, males and females were involved in the same number of pedestrian crashes. There are 8 records where the gender of the pedestrian was not recorded.

Males are more likely to get involved in pedestrian crashes early in the morning (between 3 a.m. and 6 a.m.), in the middle of the day (between 10 a.m. and 2 p.m.), and late afternoon and early in the evening (between 5 p.m. and 7 p.m.) (Figure 27).

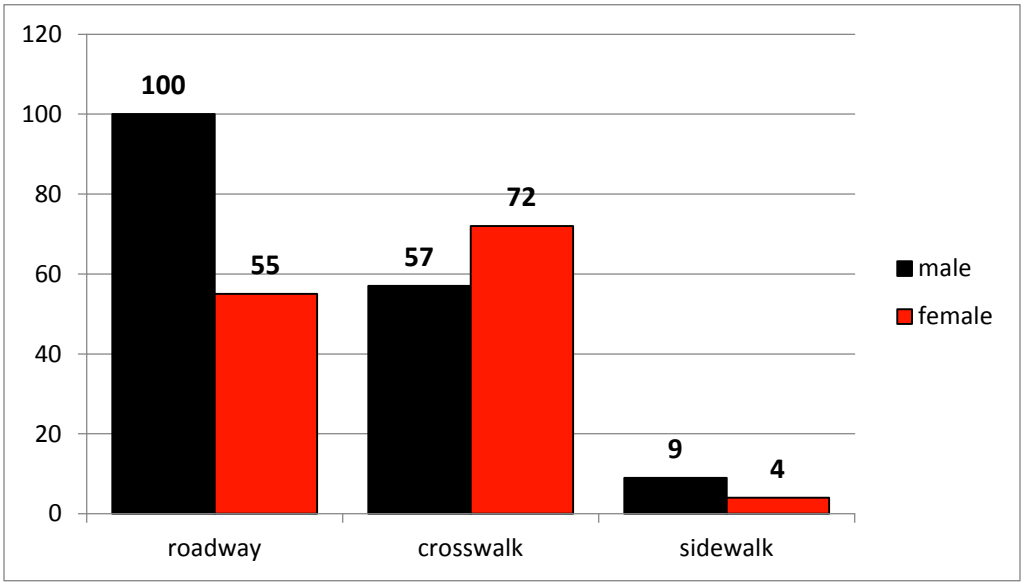
Although females are less likely to be involved in crashes for most times of the day, there are several times where they are more likely to be involved in crashes. The most distinct times are during the morning between 7 a.m. and 8 a.m. and during the late afternoon between 3 p.m. and 5 p.m.

Figure 27: Pedestrian Crashes by Time of Day (For Males Vs Females)



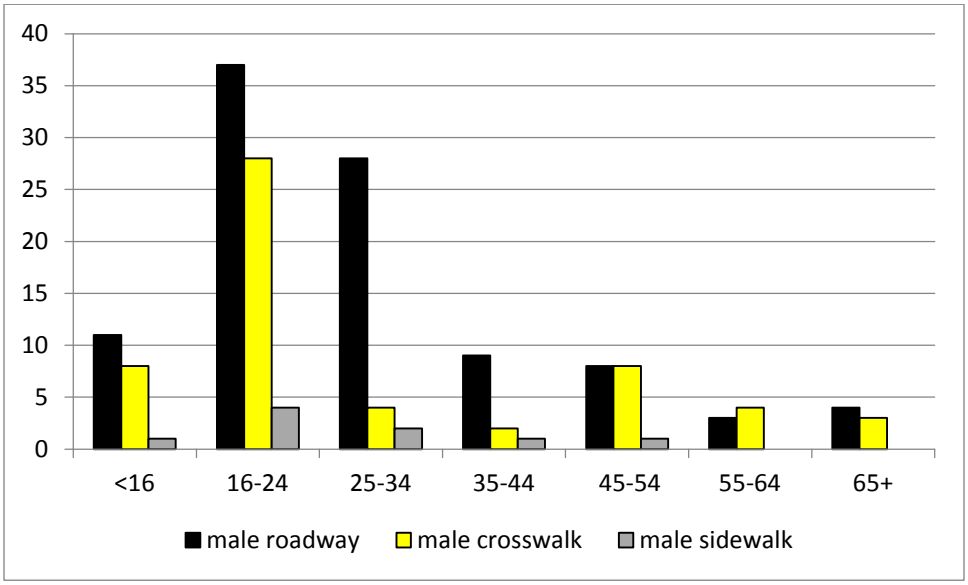
Males are more likely to get hit in the roadway, and females are more likely to get hit in crosswalks (Figure 28).

Figure 28: Location of Pedestrian Crashes by Gender



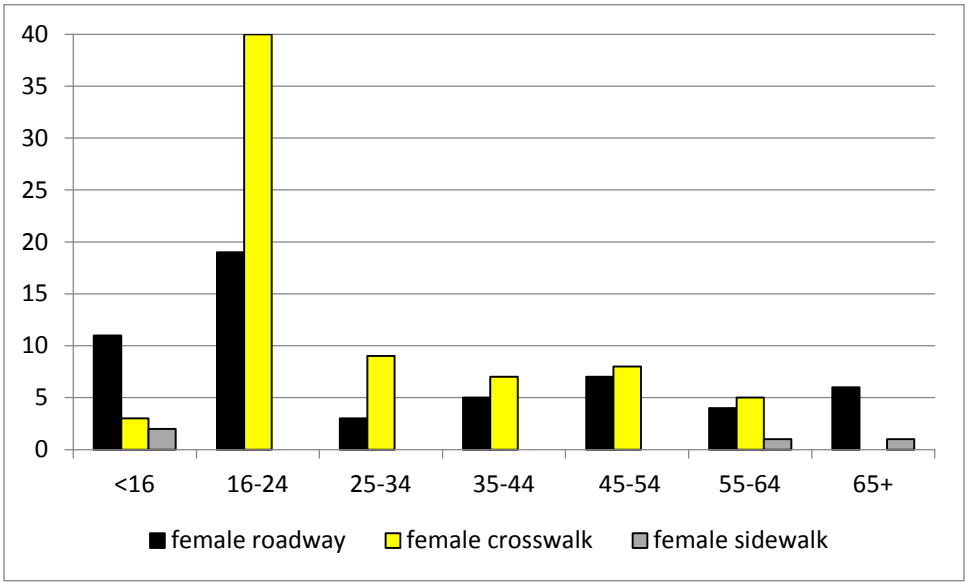
Males under the age of 45 and over 65 are most likely to be in the roadway during a crash. (Figure 29) 45-54 year-old males have an equal number of crashes on the roadway and in crosswalks and 55-64 year-old males have more crosswalk crashes than roadway crashes.

Figure 29: Male Pedestrian Crashes by Location and Age



Females are most likely to be in a crosswalk during a crash (Figure 30). However, females under 16 years of age and over 65 years of age have more roadway crashes then crosswalk crashes.

Figure 30: Female Pedestrian Crashes by Location and Age



For those under the age of 45, male pedestrians are more likely to be involved in pedestrian crashes. For those over the age of 45, females are more likely to be involved in pedestrian crashes (Table 13).

Table 13: Pedestrian Crashes by Age and Gender

	<16	16-24	25-34	35-44	45-54	55-64	65+	Total
Male	21	75	36	14	17	9	8	**180**
Female	16	59	14	13	18	12	13	**145**
Total	**37**	**134**	**50**	**27**	**35**	**21**	**21**	**325**

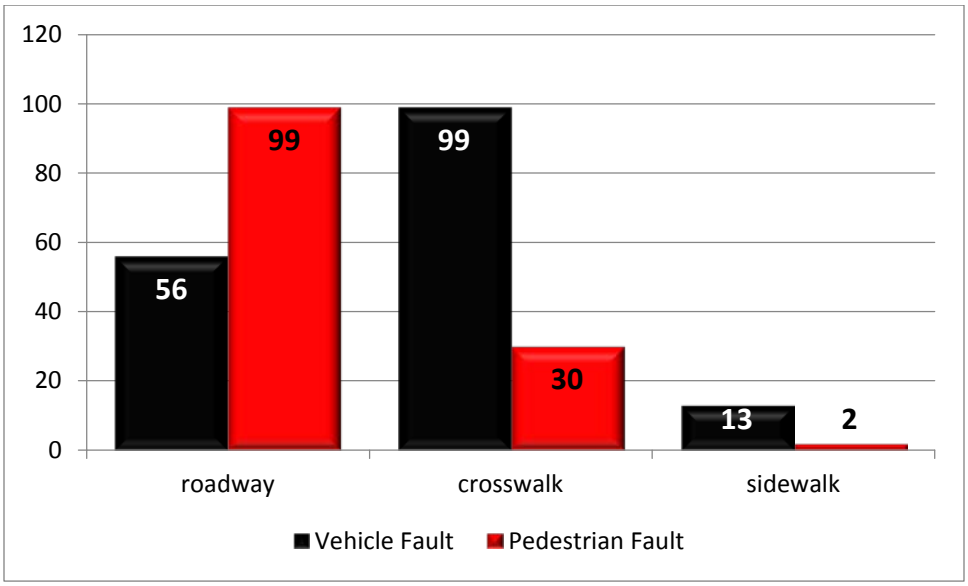
Chapter 7: Pedestrian Crashes by Fault

In this report, the term "fault" refers to the party who had the legal responsibility for causing a crash. Determining fault can be difficult because there are often complex circumstances that affect pedestrian and vehicle behavior. This data is also not usually available from a vehicle owner's private insurance provider, so it was approximated for this report. To approximate who was at fault, every pedestrian crash report in ARIES from 2007 to 2012 was reviewed. Based on the officer's narrative, crash diagram, and other crash data items; fault for each crash was assigned to either a vehicle or pedestrian. This was done for the purposes of analyzing crash trends in this report, and does not necessarily reflect legal fault assessed by any private insurance providers.

Overall, vehicles were at fault 53% of the time, pedestrians 43%, and fault was unable to be determined 4% of the time.

Vehicles were at fault more often than pedestrians for crashes that occurred on crosswalks and sidewalks. Pedestrians were at fault more often when the crash occurred in the roadway (Figure 31). There were 7 crashes where fault was unable to be determined.

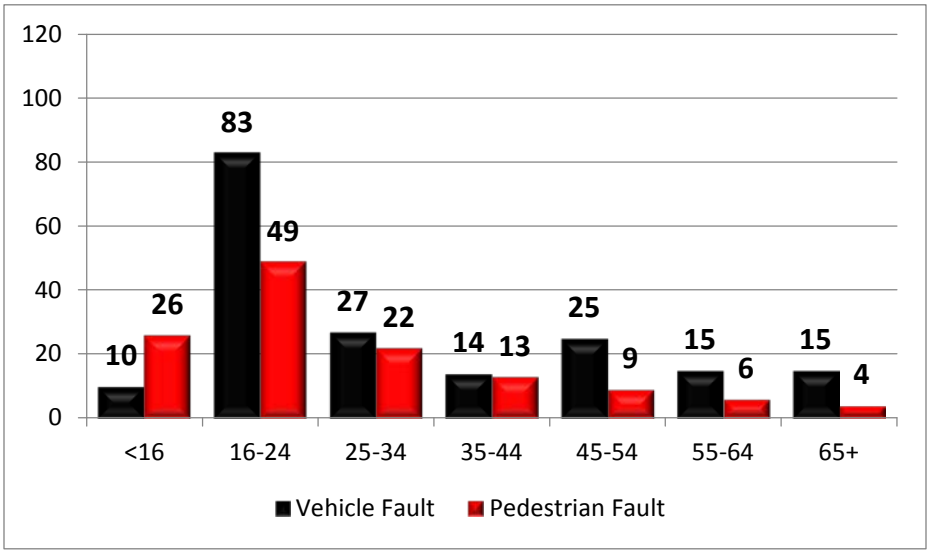
Figure 31: Crash Fault by Crash Location



Pedestrians at different ages behave differently, and are more or less likely to be at fault in pedestrian crashes based on age (Figure 32). Young children, under 16 years old, are much more likely to be at fault than older pedestrians. Vehicles were more likely to be at fault for crashes that involved pedestrians 16 and older.

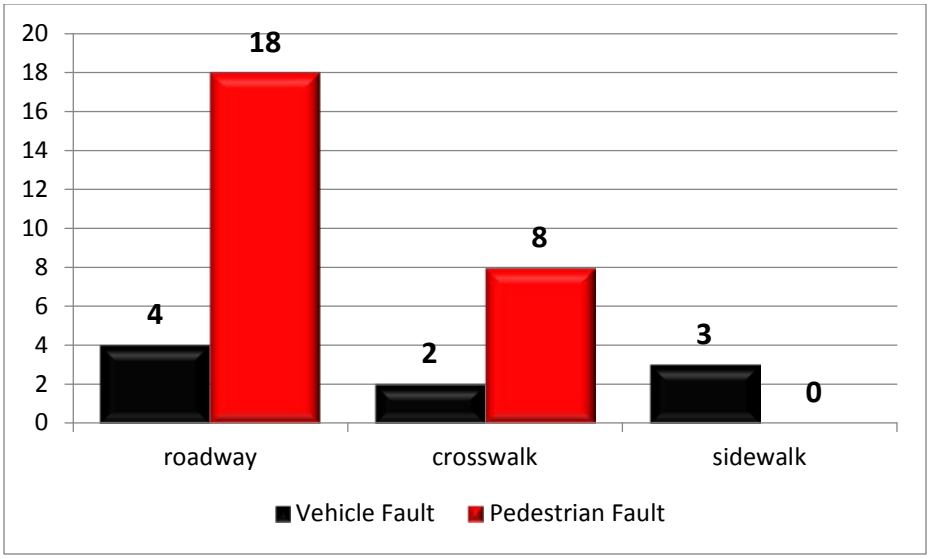
One cause that is hard to quantify is distracted drivers and pedestrians. With electronic devices rising in popularity, distraction is a larger issue. Unfortunately, the data available on distraction is incomplete. As noted in Table 6, distracted driving accounts for only 3 crashes. Data for distracted pedestrians is not available and someone involved in a crash may try to conceal that information from the reporting officer. This makes analysis on distraction beyond the scope of this report.

Figure 32: Crash Fault by Age of Pedestrian



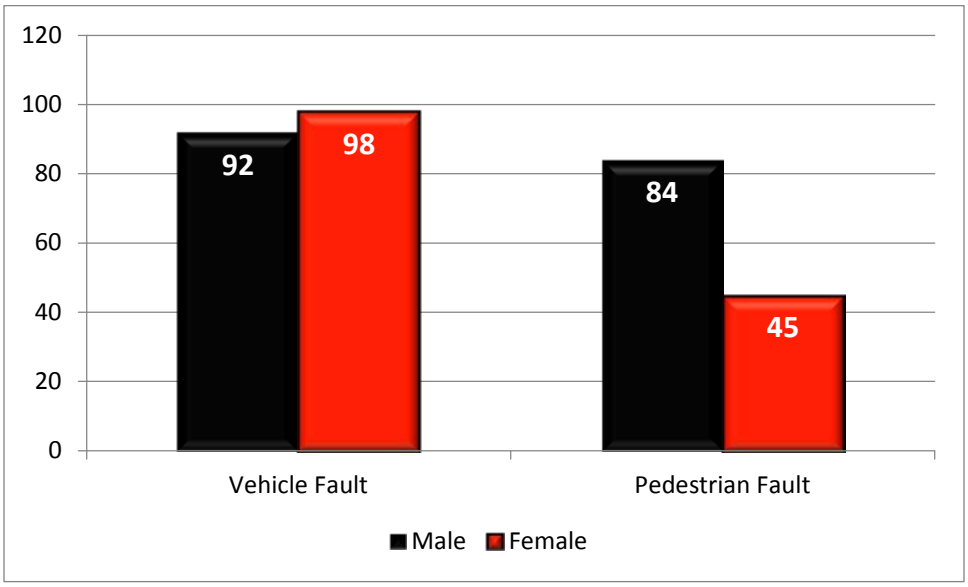
Young children are much more likely to be at fault in crashes that occurred in the roadway and in crosswalks (Figure 33).There were no instances of pedestrians under 16 years of age being at fault for crashes on the sidewalk. Male and female pedestrians were almost equally likely to be involved in a crash where the vehicle was at fault (Figure 34).

Figure 33: Crash Fault for Children Less Than 16 Years of Age



However, male pedestrians were almost twice as likely to be involved in a crash where the pedestrian was at fault. This again shows the propensity of male pedestrians to take more risks and demonstrate unsafe behavior. There were 14 crashes where the gender of the pedestrian, the fault of the crash, or both of those factors was not reported.

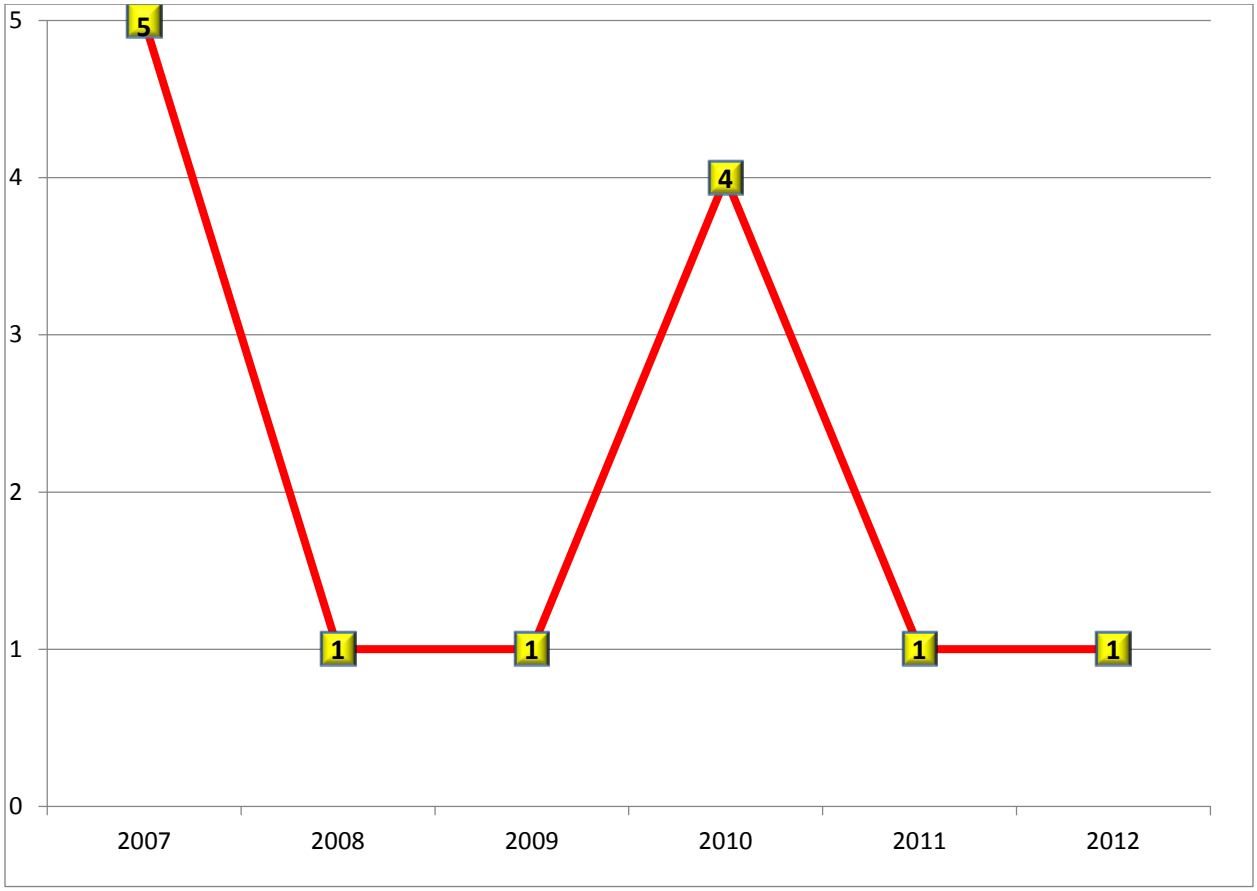
Figure 34: Comparison of Male and Female Pedestrians with Crash Fault



Chapter 8: Pedestrian Fatality Crashes

There is not enough data to draw meaningful conclusions about pedestrian fatalities. They are relatively rare events (13 in six years) that occur randomly. This makes it very difficult to analyze fatalities. There may be long periods of time where no or few fatalities occur, followed by multiple fatalities. Figures 35-38 display the random nature of the data.

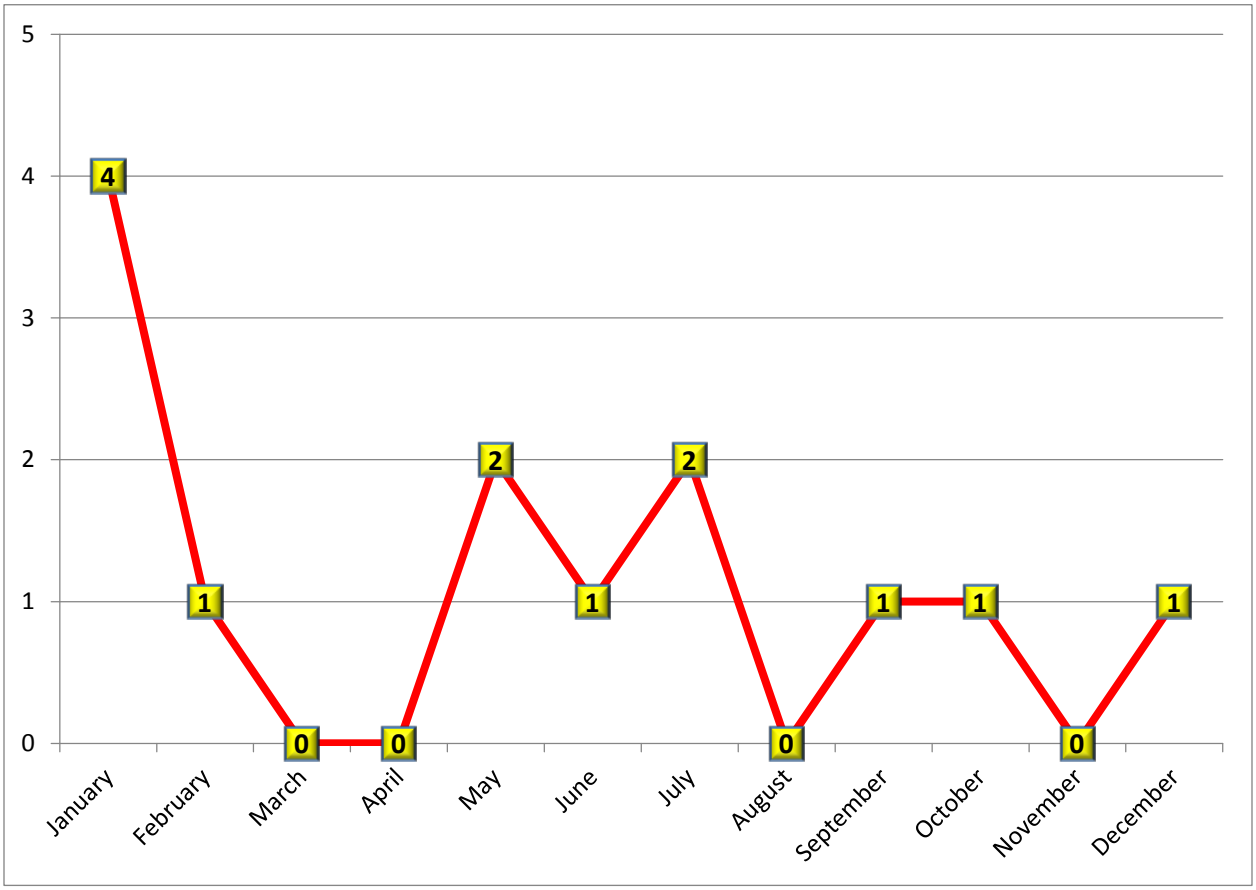
Figure 35: Pedestrian Fatalities by Year



In 2007, there were 5 fatalities, and in 2010, there were 4 fatalities. For every other year, there was only 1 fatality. There is no readily apparent reason why some years have more fatalities than other years.

January had the most pedestrian fatalities (4), followed by May and July (2 each) (Figure 36). No pedestrian fatalities occurred in March, April, August, or November. Of the 4 fatalities that occurred in January, 2 occurred in January 2010. Both of these crashes occurred when there was snow on the roadway. Snowy roadway conditions are also expected in February and December, however, both of those months only had 1 pedestrian fatality. It can be assumed that the 4 pedestrian fatality crashes in January are a statistical outlier, because we examined the crash reports and found no direct explanation for the high number of crashes in January.

Figure 36: Pedestrian Fatalities by Month



There was at least one pedestrian fatality each day of the week (Figure 37). Tuesday had the most fatalities (5) of any day of the week, followed by Wednesday and Friday (2 each).

The highest number of fatalities occurred between midnight and 1 a.m. and between 4 p.m. and 5 p.m. While the 4 to 5 p.m. crash peak coincides with the general evening peak period, the 12 to 1 a.m. crash peak cannot be as easily explained (Figure 38). All 3 fatalities that occurred between midnight and 1 a.m. were in 2007.

All of the pedestrian fatality crashes occurred within the urbanized area of Tippecanoe County (Figure 39). This is expected because that is where most of the pedestrian travel occurs. Four of the thirteen fatal crashes occurred within a one mile radius of the campus of Purdue University (Figure 40). There were also two fatalities on Interstate 65.

Figure 37: Pedestrian Fatalities by Day of the Week

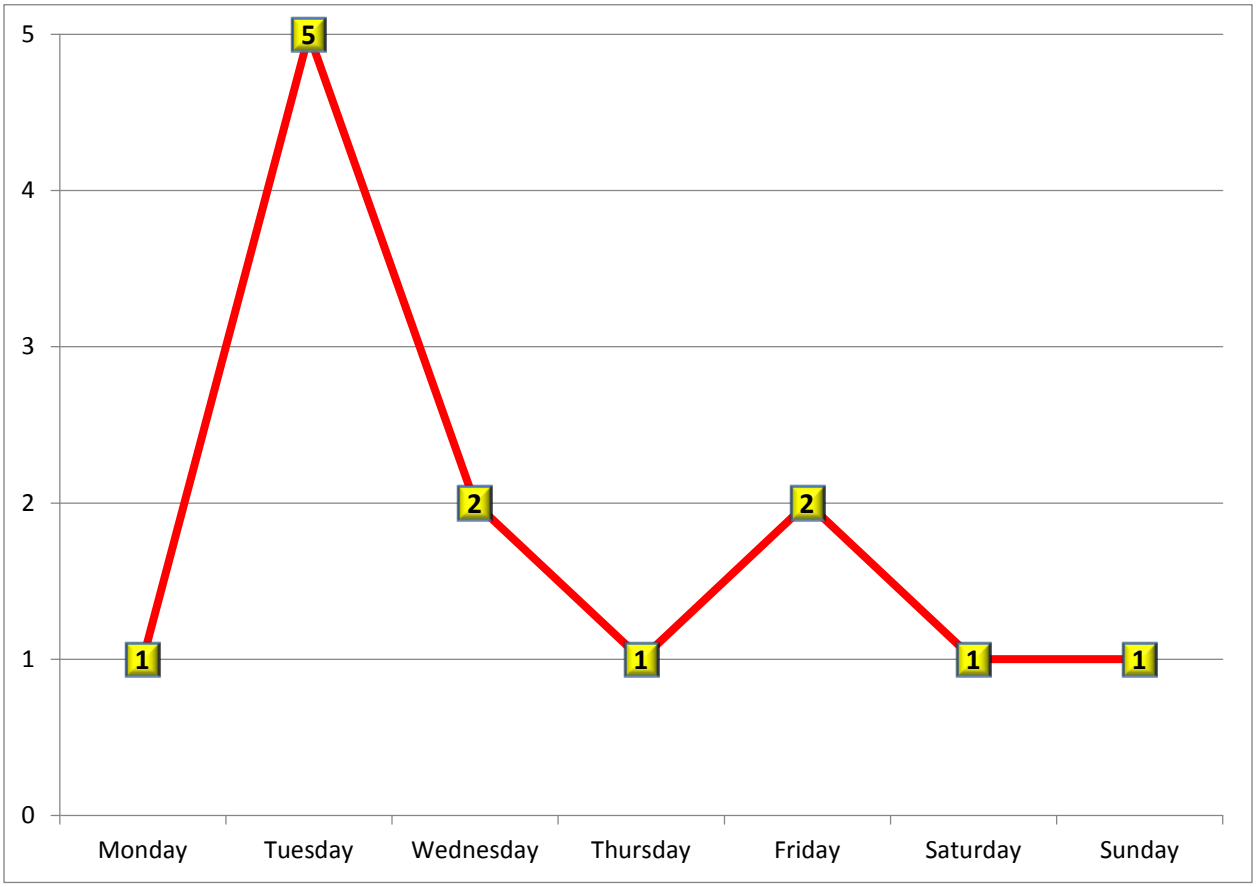


Figure 38: Pedestrian Fatalities by Time of Day

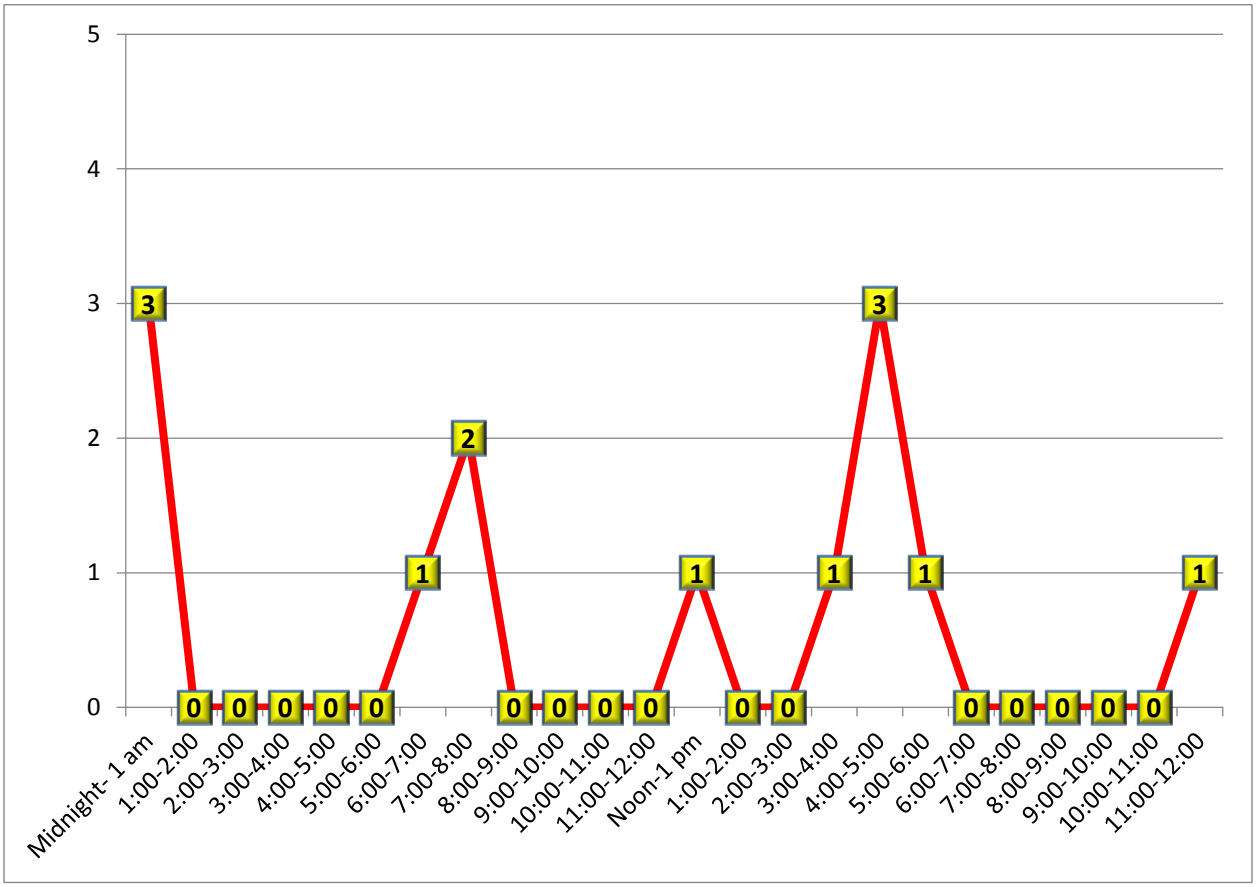


Figure 39: Location of Pedestrian Fatality Crashes

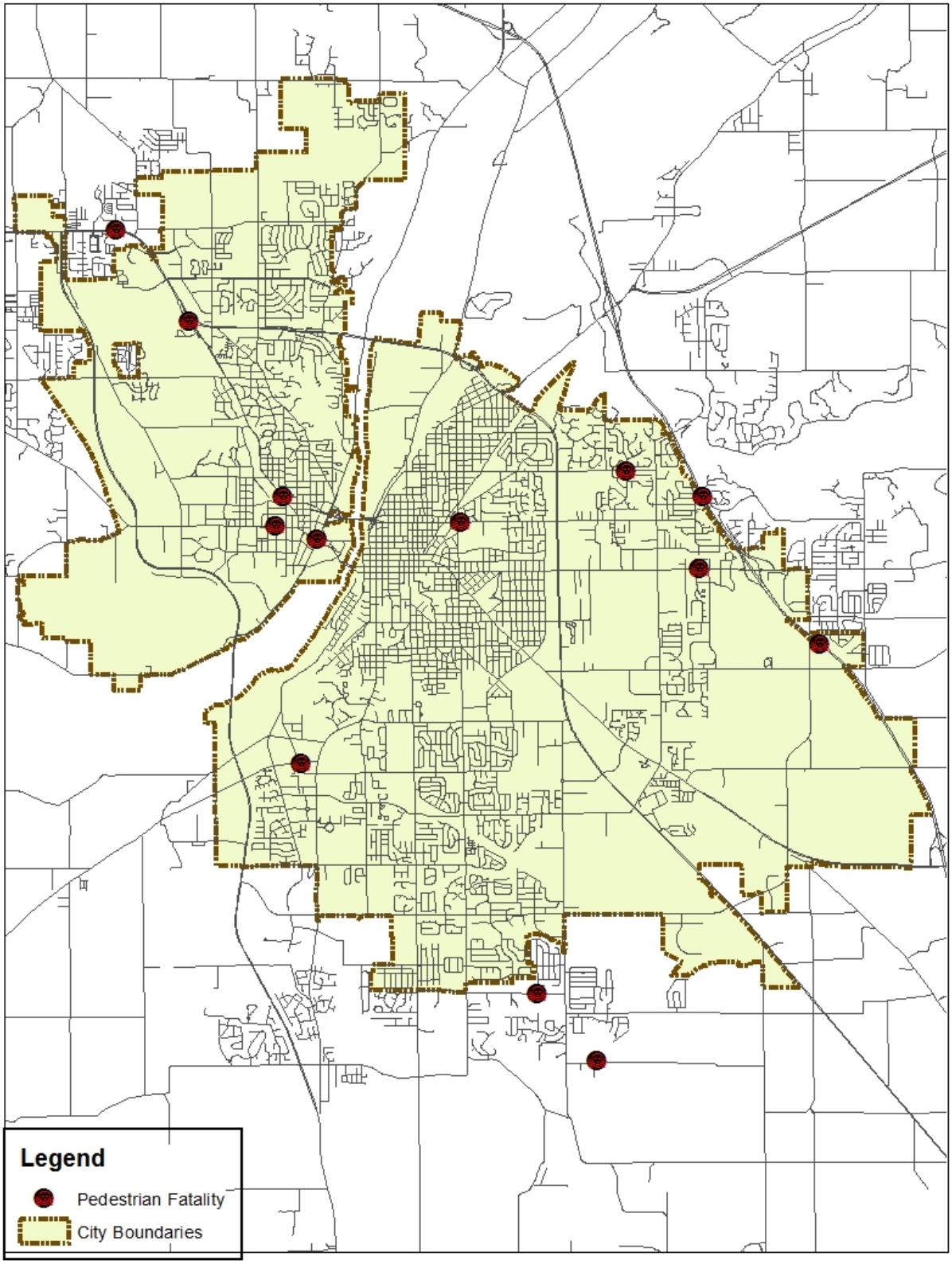
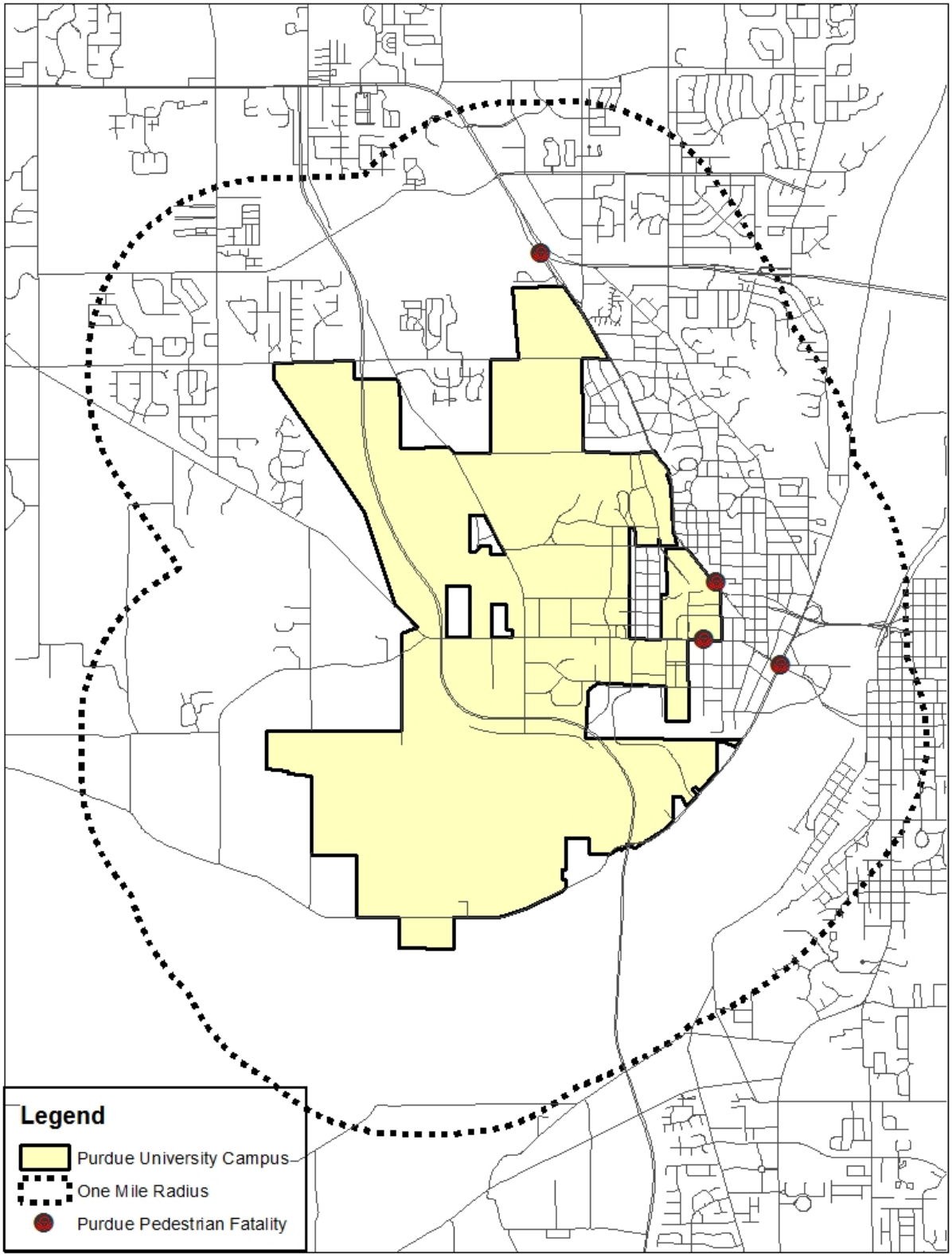


Figure 40: Fatal Pedestrian Crashes within a One Mile Radius of Purdue University



Pedestrians were at fault in fatality crashes more often than vehicles, 46% and 39%, respectively (Figure 41). Vehicles appear to be less at fault in fatality crashes than for all pedestrian crashes, 39% and 59%, respectively (Figures 31 and 41).

As with all pedestrian crashes, pedestrians were more likely to be at fault in roadway crashes (Figure 42).

Pedestrians and vehicles were equally likely to be at fault in crashes that occurred in the crosswalk (although only 2 fatal crashes occurred there). There were two crashes where fault could not be determined, and both of those crashes occurred in the roadway.

Figure 41: Fault in Fatal Pedestrian Crashes

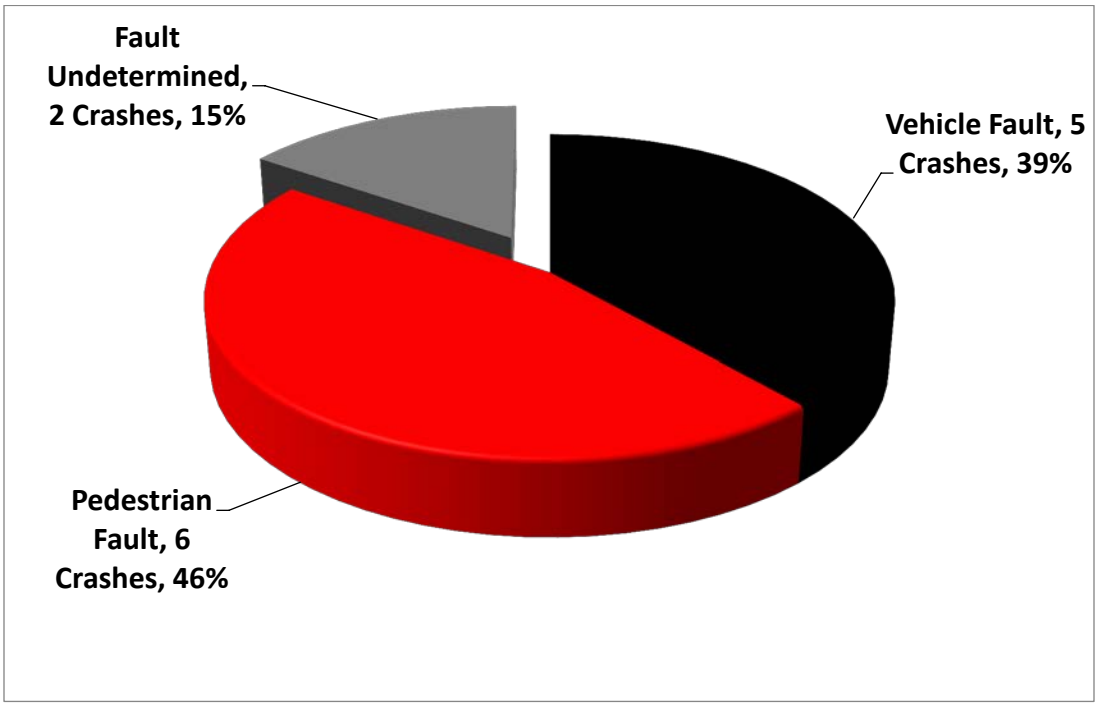
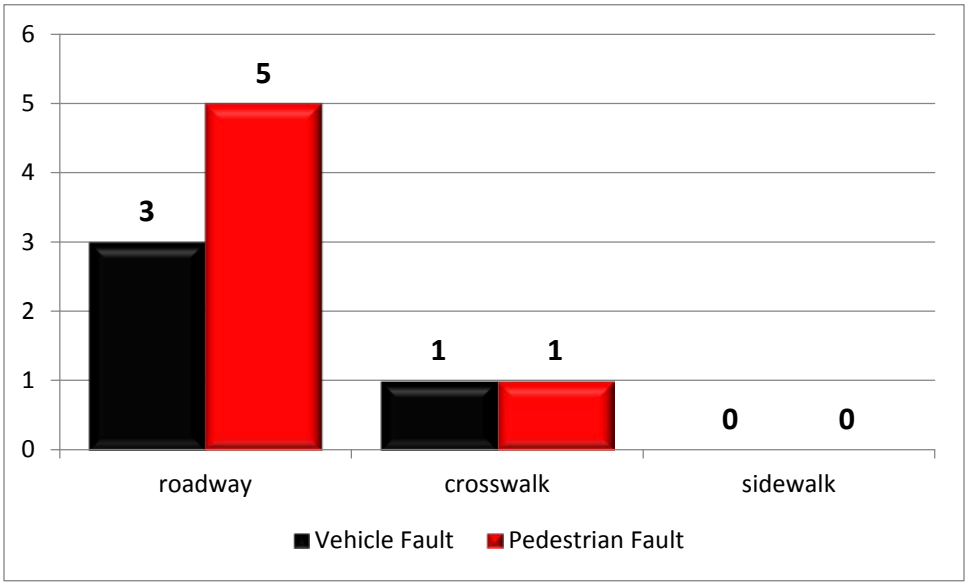


Figure 42: Fault in Fatal Pedestrian Crashes for Different Locations



Conclusions

As people continue to choose walking as a mode of transportation, it is essential to make the road network more pedestrian-friendly and better educate both motorists and pedestrians. This will lead to safer roads and reduced pedestrian crashes.

This report has analyzed many different components of pedestrian crashes. Because crashes are often complex events, there is no way to eliminate them. However, with proper countermeasures, pedestrian crashes can be reduced. Countermeasures range from better roadway design, enforcement, and education for pedestrians and motorists. By selecting appropriate countermeasures, pedestrian safety can be improved in a cost-effective manner.

The analysis presented in this report is very broad. It is intended to be used by the community to identify and improve our roadways and educational programs. It is also intended to inspire additional, more detailed, analysis of the data and help guide road design and safety education countermeasures.

Recommendations

1. Review findings with local Technical Transportation Committee and Local Public Agencies to develop safety improvement projects that qualify for HSIP funding.

2. Meet with local police officers to evaluate and improve crash reporting protocol. Data items to evaluate include: information about pedestrians walking with or against traffic, finalized drug and alcohol test results, classification of injury severity, uniformity in defining where crashes occur on the road right of way, and information included in crash narratives.

3. Identify locations where constructing sidewalks and/or trails may improve connectivity and give pedestrians a more continuous route to safely travel on.

4. Evaluate signage and pavement markings in high pedestrian crash locations.

5. Because of the high number of fatalities near the Purdue University campus (see Figure 40), additional safety education targeted at Purdue students would be beneficial.

6. Perform further study that includes characteristics of vehicle drivers (age and gender) involved in pedestrian crashes.

7. Produce an annual fatality and serious injury report to supplement information in this report. A report on fatal crashes for 2008 to 2012 (*Summary of Fatality Crashes within Tippecanoe County 2008 through 2012*) is available online at http://www.tippecanoe.in.gov/egov/documents/1379098119_00964.pdf

8. Create a stakeholder group for joggers, runners, and users of pedestrian infrastructure for exercise purposes.

9. The Area Plan Commission of Tippecanoe County will entertain all requests from jurisdictions and transportation partners for additional analysis.

Appendix A: Purdue University Schedule

Table 14: Purdue University Spring and Fall Semesters (2007-2012)

Year	Spring Semester	Fall Semester
2007	01/08/2007 - 05/05/2007	08/20/2007 - 12/15/2007
2008	01/07/2008-05/03/2008	08/25/2008 - 12/20/2008
2009	01/12/2009 - 05/09/2009	08/24/2009-12/19/2009
2010	01/11/2010 - 05/08/2010	08/23/2010 - 12/18/2010
2011	01/10/2011 - 05/07/2011	08/22/2011 - 12/17/2011
2012	01/09/2012 - 05/05/2012	08/20/2012 - 12/15/2012

Source: http://www.purdue.edu/registrar/Calendars/10YR_05-16.pdf
retrieved 10/28/13

Appendix B: Regression Analysis

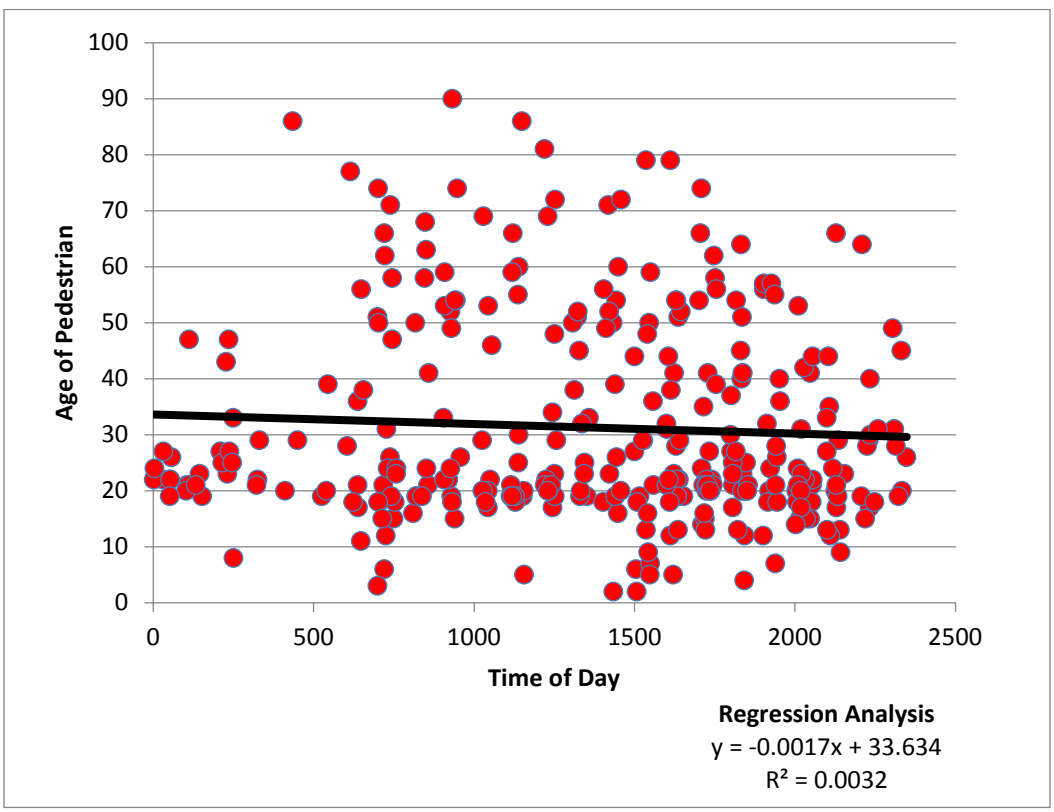
Another way of looking at pedestrian crash data is through regression analysis. Regression analysis compares two different variables and looks for the relationship between them. This relationship is then modeled into an equation.

In this appendix, an example of a regression equation is y=-0.0017x +33.634, which is the relationship between the age of the pedestrian in the crash and the time of day when the crash occurred. This equation can be used in predictive analysis. For example, if the time of day is known, then the equation can be used to predict the age of the pedestrian involved. So, if a crash occurs at 1200 hours, the age of the pedestrian would be -0.0017*1200 + 33.634 = 31.594. So this equation would predict that the age of the pedestrian is approximately 32 years old.

Regression analysis must be used very carefully. One way to check the accuracy of a regression equation is by using a statistical check called the R^2 value. R^2 values are always between 0 and 1. The closer that an R^2 value is to 1, the more accurate the regression equation is in predicting a value. The closer that an R^2 value is to 0, the less accurate the regression equation is in predicting a value.

Regression analysis shows that there is no correlation between the age of the pedestrian and the time of day when pedestrian crashes occurred (Figures 43 and 44).

Figure 43: Pedestrian Age versus Time of Day



It should be noted that military time was used for this graph (0000-2400 hours). There is also no correlation between the age of the driver and the time of day when pedestrian crashes occurred.

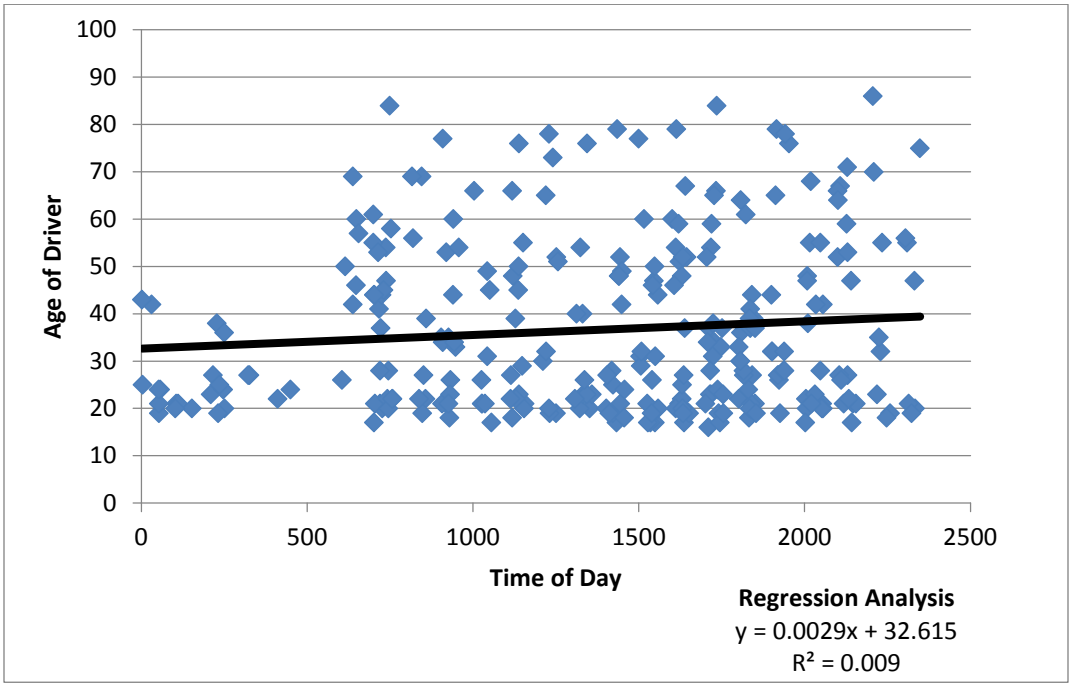



Figure 44: Driver Age versus Time of Day