2015
Traffic Safety Report

City of Fort Collins
Traffic Operations

April 2016

Cover photo credits

City staff (bike)
Coloradoan (autos and Max bus)
Muller Engineering (pedestrians)

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Executive Summary

Traffic Safety Matters

Traffic safety is an important component of a community's health and safety. Traffic crashes in 2015 within the City of Fort Collins included 236 significant injury crashes, and four resulted in a fatality. The societal cost of these crashes was in excess of $130 million dollars.

Overall Crash Trends

- Overall traffic crashes are up 15.8% in the past five years. However, the rate of increase in 2015 (4.3%) is less than 2014 (5.8%), and significantly less than 2013 (12.2%).
- Serious crashes (significant injury or fatal) are down, both across five years (0.8%) and from 2014 to 2015 (8.4%).
- When comparing the fatality crash rate per population, Fort Collins ranks relatively favorably when compared to other Colorado Cities, and is second best among 13 peer cities across the nation.

Crash Locations

- More than 70% of all crashes occur at intersections and/or driveways.
- Almost ½ of all crashes (48%) occur at signalized intersections.

Crash Types

- Rear-end crashes make up nearly half (45%) of all crashes, but many of them (97%) are minor crashes.
- DUI crashes represent 4% of all crashes, more than 10% of serious crashes, and about 20% of incapacitating or fatal crashes. 44% of all serious fixed object crashes involve alcohol.
- For serious crashes (those involving non-incapacitating injury, incapacitating injury or fatality), 86% are the result of one of six types of crashes :
    - Bicycle (24%)
    - Rear-End (15%)
    - Right Angle (15%)
    - Approach Turn (14%)
    - Fixed Object (10%)
    - Pedestrian (8%)

Bicycle Crashes

- Bicycle crashes had generally been trending upwards, but have seen a significant decline in the past two years. The number of bike crashes is down 24% since 2012.
- 82% of bike crashes occur at intersections or driveways
- 27% of all bike crashes involve wrong way riding by the cyclist.

Rear End Crashes

- Less than 3% of all rear end crashes result in a serious injury or fatality
- 66% of rear end crashes occur at signalized intersections

Right Angle and Approach Turn Crashes

- Almost 2/3 (63%) of right angle crashes involve a failure to yield after stopping.
- 70% of approach turn crashes occur at signalized intersections.

Fixed Object

- 17% of all fixed object crashes involve alcohol.
- This number increases to 44% of all serious fixed object crashes involve alcohol.

Pedestrian Crashes

- Pedestrian crashes are trending upward, and reported pedestrian crashes tend to be serious crashes with 87% involving some level of injury or fatality.
- For the serious pedestrian crashes, motorists failing to yield account for 35% of crashes.

High Crash Locations

Staff is using the approach detailed in the national Highway Safety Manual (HSM) to identify locations that have higher than expected crash frequency. The table listed on page 31 shows intersections in Fort Collins with the largest value of excess crash costs. These intersections are reviewed to look for specific types or trends in crashes and identify potential countermeasures.

Implementing Safety Measures

A number of low cost improvement options are utilized that can provide a high benefit to cost ratio. In addition to low cost projects, the crash information in this report is integrated into various planning, engineering, neighborhood, school and other projects.

Education and Enforcement

This report will continue to inform both education and enforcement components of traffic safety. This includes cooperative work with Safe Routes to School, education efforts by FCMoves and Police Services.

Looking Forward

Traffic operations staff has utilized the information in this report to identify a few areas of focus for coming years. These include a targeted effort to address certain **types** of crashes in addition to high crash **locations**. Of special interest are approach turn crashes as well as bike and pedestrian crashes.

Section 1 - Introduction

The City of Fort Collins is a vibrant city of 150,000 people nestled against the foothills of the Rocky Mountains about an hour's drive north of Denver. This outdoor oriented community is home to Colorado State University and its 30,000 students. The area is known for its high tech companies, innovation, entrepreneurialism, and beer and bike culture. The Old Town area in the city is a unique, lively downtown with residential areas, historic buildings; retail shops, museums, theatres and restaurants.

Traffic Safety Matters
In 2015, there were 240 crashes involving a serious injury or fatality in Fort Collins

In the past year, there were more than 4,400 traffic crashes in Fort Collins. On average, that is more than 12 crashes per day. Over 800 of the crashes involved some level of injury (minor injury or more serious injury), and four involved a fatality. In 2015 alone, the annual societal costs of these crashes was in excess of $130 million dollars .

This Traffic Safety Report is a compilation of traffic crash and safety information related to crashes on public streets within Fort Collins. It summarizes basic crash information and analyzes specific types of crashes in more detail. It also identifies high crash locations and provides an overview of on-going safety efforts.

This document is intended to be used as an informational and education piece as well as a benchmarking tool to track progress on efforts to reduce the number and severity of crashes . Finally, the document is intended to serve as a tool to help determine strategies and countermeasures to achieve crash reduction goals.

Explanation of Data

The source for crash information is the City of Fort Collins Traffic Operations Department traffic crash database. The department works cooperatively with Fort Collins Police Services to obtain electronic copies of reports for all crashes on public streets. This includes all crashes investigated and reported by Fort Collins Police Services plus those crash reports submitted after the fact to Police Services by involved parties.

Traffic Operations staff reviews each crash report for accuracy prior to input into the database to ensure that data is as complete, accurate and consistent as possible. Crashes that go unreported (or crashes on private property) are not represented in this analysis.

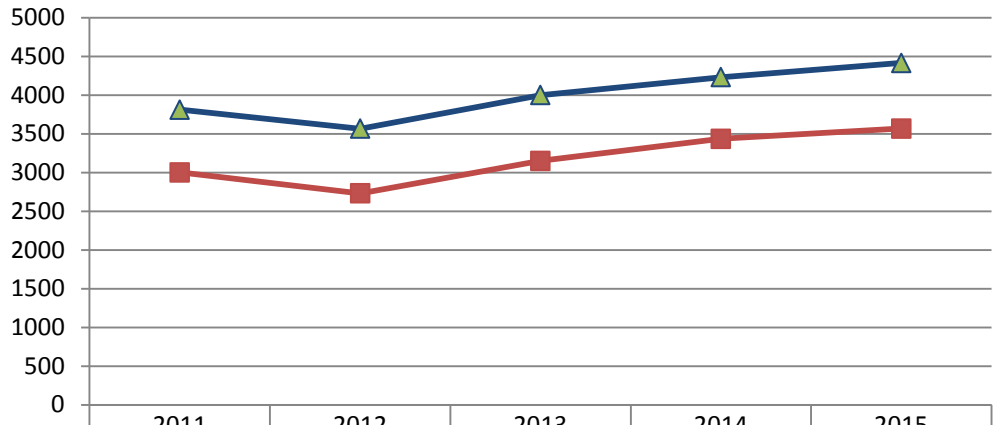
The City Planning Department provids demographic data used in this report. The Colorado Department of Revenue provided data showing the number of licensed drivers by age in Fort Collins. Most of the analysis represents five years of data, from 2011 – 2015.

Section 2 – General Crash Information

The total number of crashes per year for the past five years is shown below. There has been a 15.8% increase in total crashes between 2011 and 2015. Serious injury crashes have been decreasing for the past three years and the overall change in serious injury crashes over 5-years is lower by 0.8%.

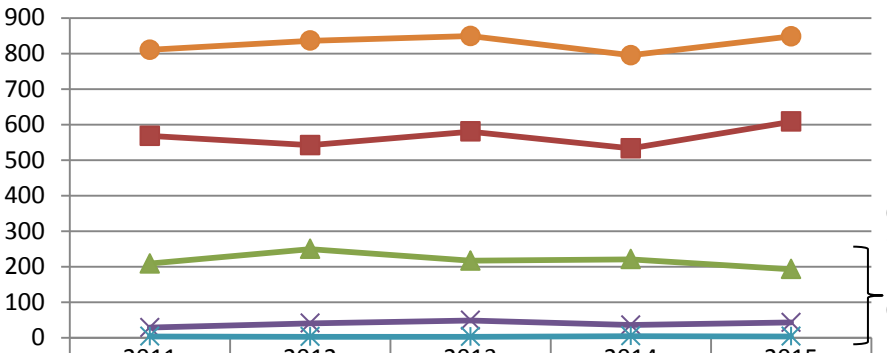
Increase in traffic crashes 2011-2015: **15.8%**

Total Number of Crashes



	2011	2012	2013	2014	2015
Property Damage Crashes	3001	2730	3150	3436	3567
Number of Crashes	3811	3566	4000	4231	4414
% change in total crashes from previous year	7.1%	-6.4%	12.2%	5.8.%	4.3%

Number of Crashes With Some Level of Injury

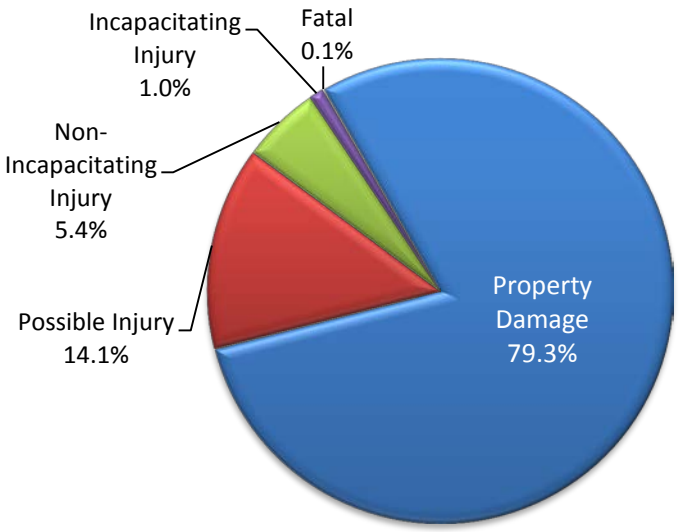


	2011	2012	2013	2014	2015
Possible Injury Crashes	568	542	580	533	608
Non-Incapacitating Injury Crashes	209	250	217	221	193
Incapacitating Injury Crashes	29	41	49	36	43
Fatal Crashes	4	3	3	5	4
Total	810	836	849	795	848
% change in serious injury crashes from previous year	-10.7%	21.5%	-8.5%	-2.6%	-8.4%

2015 Crash Severity

The chart below shows the overall severity for crashes in 2015. The percent of all injury crashes is 19.2% and is below 20% for the second straight year.

Decrease in serious crashes 2011-2015: **0.8%**



2015 Economic Impact of Crashes

Using figures determined by the Federal Highway Administration and published in the *Highway Safety Manual ,* an estimation of economic costs associated with crashes in Fort Collins can be made. The crash costs shown are adjusted to reflect 2015 values. Crash costs include monetary losses associated with medical care, emergency services, property damage, and lost productivity. They also include costs related to the reduction in the quality of life related to injuries.

Societal cost of crashes in 2014: **$ 130 million**

The National Highway Traffic Safety Administration (NHTSA) completed a study on the costs of crashes. The NHTSA study not only concentrated on the costs of crashes, but also who pays the costs. The study found that society at large pays for about 75% of all costs incurred for traffic crashes. Those costs are passed on to the general public through insurance premiums, taxes, direct out of pocket payments for goods/services, and increased medical costs.

Crash Severity	Number of Crashes	Cost Per Crash	Societal Cost
Property Damage Crashes	3,568	$ 10,000	$ 35,680,000
Possible Injury Crashes	608	$ 61,900	$ 37,635,200
Non-Incapacitating Injury Crashes	193	$ 109,700	$ 21,172,100
Incapacitating Injury Crashes	43	$ 300,300	$ 12,912,900
Fatal Crashes	4	$ 5,660,828	$ 22,643,200
Total	**4,416**		**$ 130,043,400**

Comparison with Other Cities

The most consistent way to compare the City's crash frequency with that of other entities is to compare the fatal crash rate (crashes per 100,000 population). The charts below are sorted by fatal crash rate and compare Fort Collins to other cities in Colorado with similar population (between 85,000 and 200,000) and also compare to other peer cities nationwide. The nationwide peer cities are participants in an annual benchmarking survey in which Fort Collins Police Services participates.

Colorado Cities

City	Population	Fatal Crashes, 2011 - 2015						Fatal Crash Rate *(Crashes/100,000*
		2011	2012	2013	2014	2015	Avg.	Population)
Lakewood	149,643	10	9	6	13	15	10.6	**7.1**
Pueblo	108,423	9	11	6	8	4	7.6	**7.0**
Greeley	98,596	3	7	5	8	5	5.6	**5.7**
Arvada	113,574	3	3	4	4	6	4	**3.5**
Longmont	90,237	2	2	2	4	5	3	**3.3**
Thornton	130,307	3	5	4	4	3	3.8	**2.9**
Fort Collins	**158,300**	**4**	**3**	**3**	**5**	**4**	3.8	**2.4**
Boulder	105,112	4	3	0	0	1	1.6	**1.5**
Total Colo Cities	954,192	38	43	30	46	43	40	**4.2**

Peer Cities

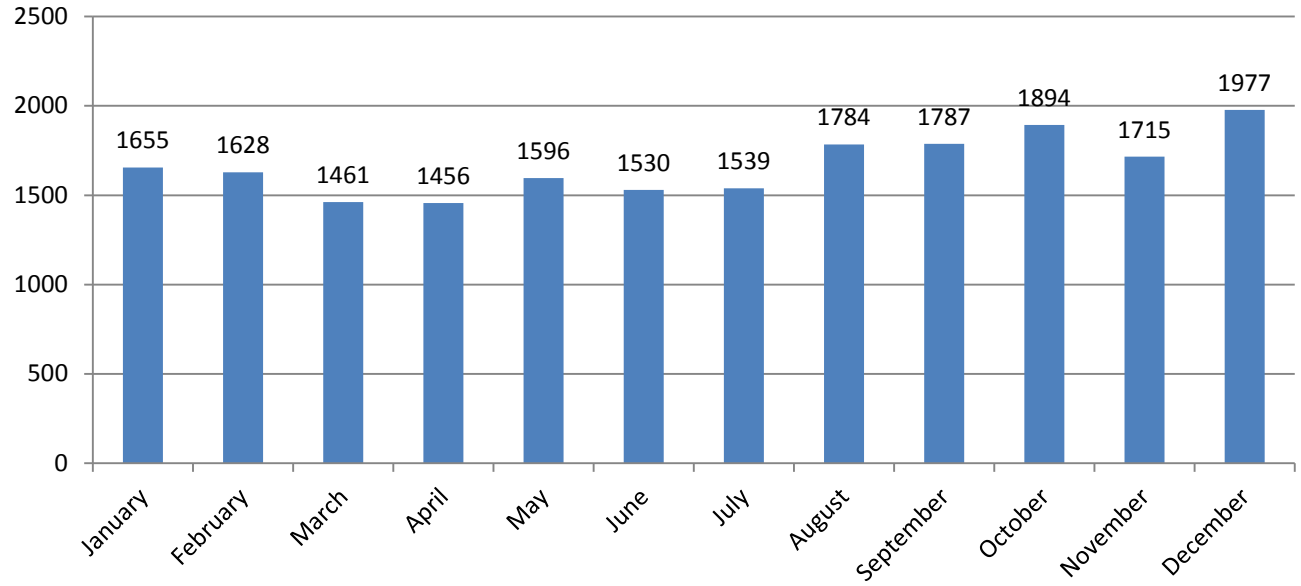
City	Population	Fatal Crashes, 2011 - 2015						Fatal Crash Rate *(Crashes/100,000*
		2011	2012	2013	2014	2015	Avg.	Population)
Boca Raton, FL	91,332	3	12	12	10	na	9.3	**10.1**
Springfield, MO	165,378	10	19	13	14	na	14.0	**8.5**
Broken Arrow, OK	104,726	9	11	7	3	na	7.5	**7.2**
Norman, OK	118,040	5	8	8	7	na	7.0	**5.9**
Coral Springs, FL	127,952	5	5	10	7	na	6.8	**5.3**
San Angelo, TX	98,975	3	4	6	7	na	5.0	**5.1**
Richardson, TX	108,617	2	5	3	7	na	4.3	**3.9**
Cedar Rapids, IA	129,195	2	7	2	5	na	4.0	**3.1**
Bellevue, WA	136,426	4	5	4	3	na	4.0	**2.9**
Overland Park, KS	184,525	6	8	4	3	na	5.3	**2.8**
Olathe, KS	133,062	1	4	8	2	na	3.8	**2.8**
Fort Collins	**158,300**	**4**	**3**	**3**	**5**	na	3.8	**2.4**
Naperville, IL	146,128	1	2	1	3	na	1.8	**1.2**
Total Peer Cities	1,702,656	55	93	81	76	na	76.3	**4.5**

na: data not available

Crash data for other communities (peer cities) was obtained from the National Highway Traffic Safety Administration's Fatal Accident Reporting System which contains data through 2014. Population estimates are for 2015 and are from the U.S. Census.

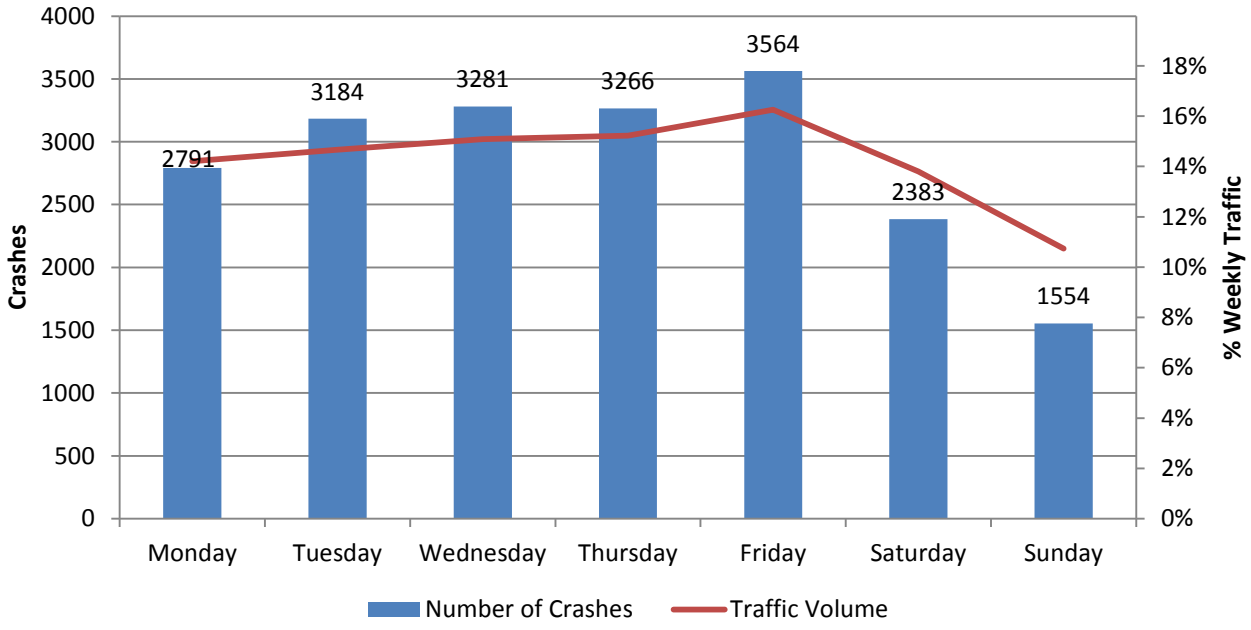
Crashes by Month 2011 - 2015

The variation of crashes by month is shown below. The number of crashes varies by as much as 35% with more crashes occurring in the fall/winter than in the spring/summer. Inclement weather and a higher student population at those times likely contribute to the increase seen during the colder months.



Crashes by Day of Week 2011 - 2015

The chart below shows that more crashes occur on Fridays than on other days of the week. Daily variation in crashes tracks closely with daily variation in traffic volumes (red line).

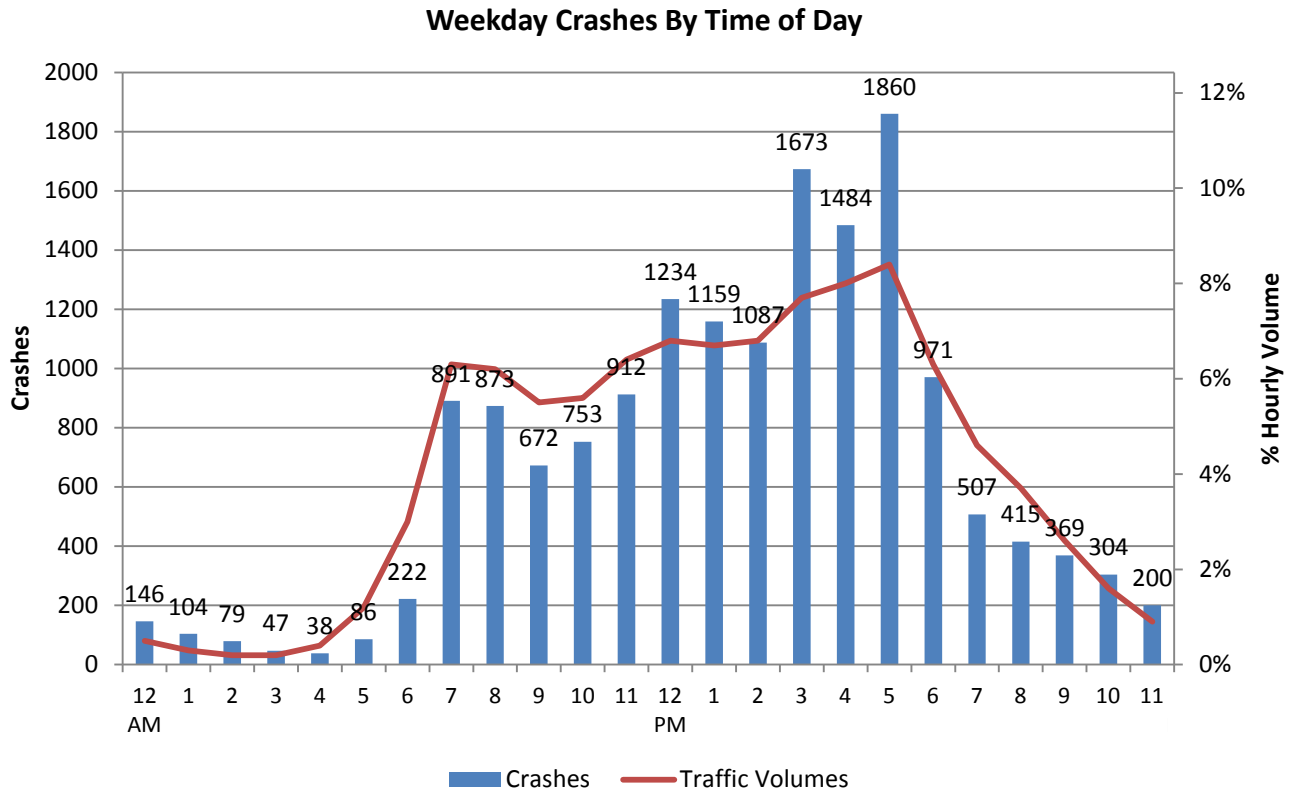


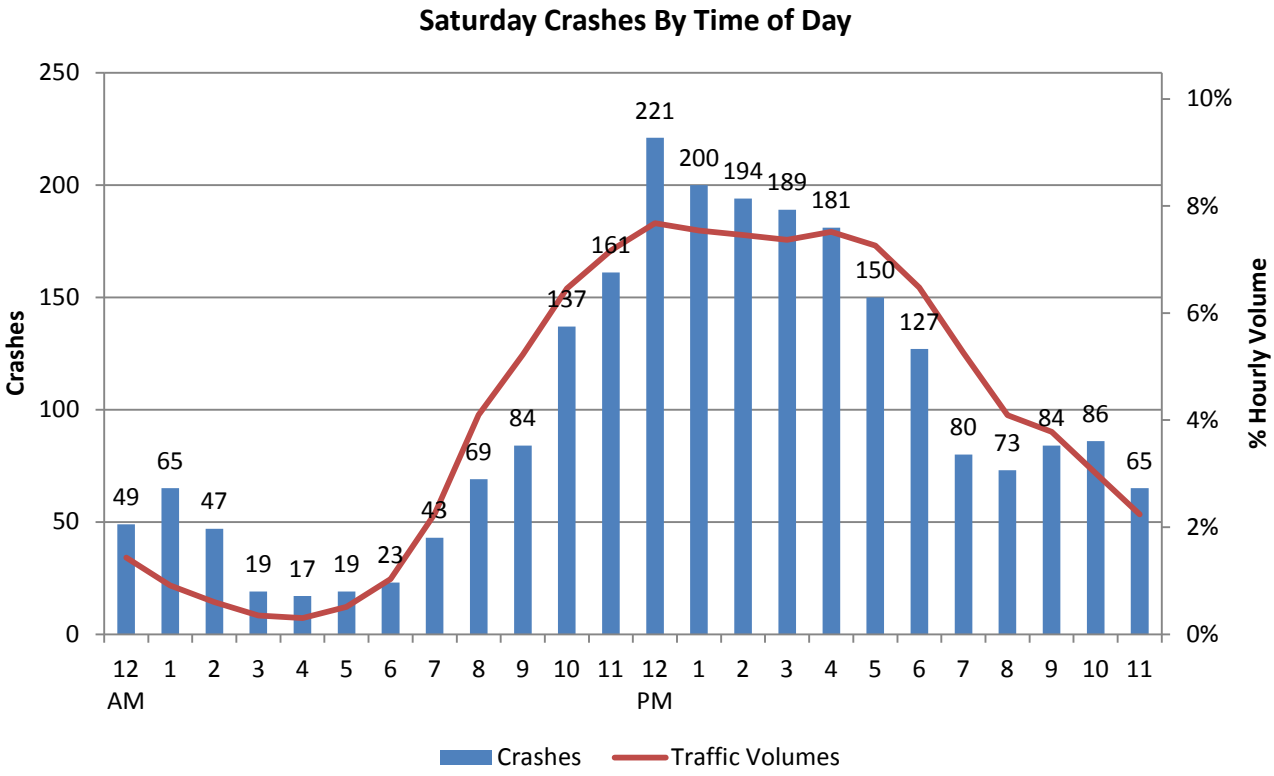
Crashes by Time of Day 2011 - 2015

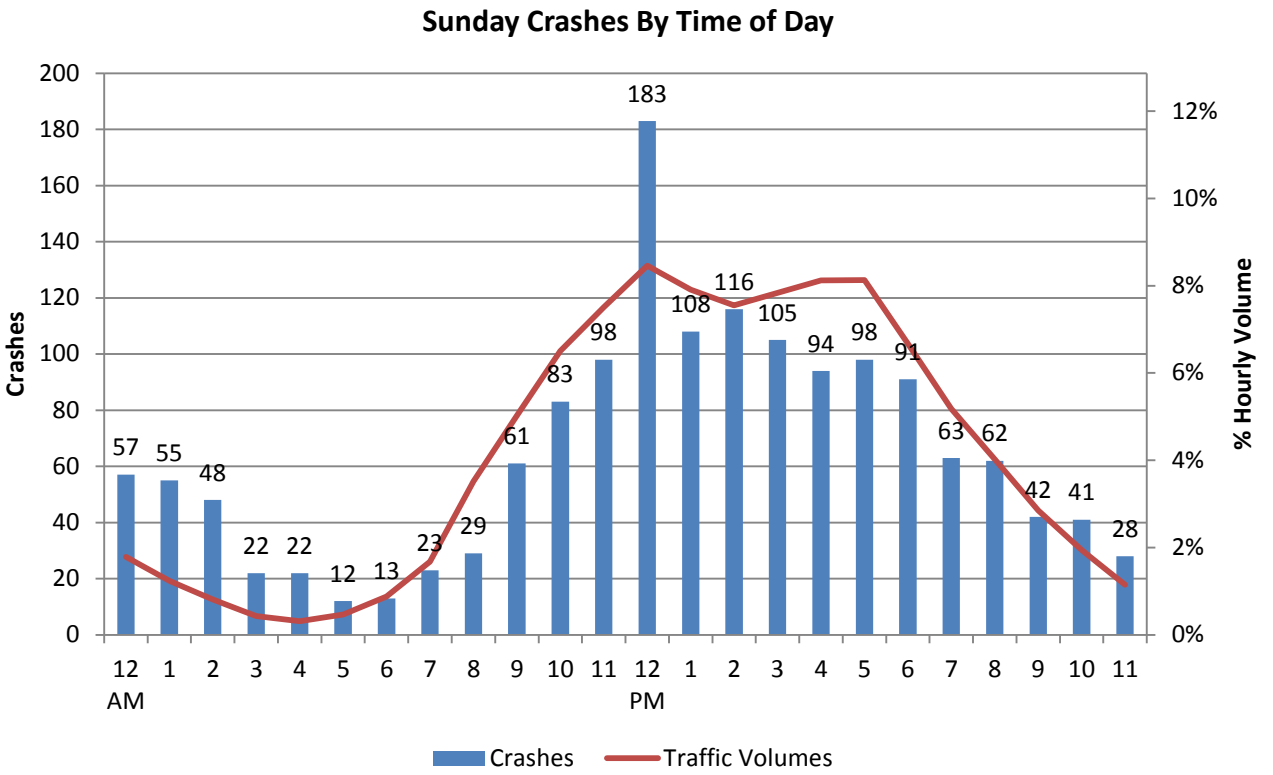
The graph below and on the following page show crashes by time of day for weekdays, Saturdays and Sundays respectively. The charts also show the percentage of daily traffic by hour (red line).

On weekdays (Monday-Friday), crashes are overrepresented during the afternoon hours, particularly the 3 p.m. and 5 p.m. hours. That is, there are more crashes than expected given the amount of traffic on the streets at those times.

On weekends, early morning hours on Saturdays and Sundays are significantly overrepresented. Around 1 a.m. to 2 a.m. on Saturdays and Sundays, there are two to three times as many crashes as would be expected given the traffic volumes at those times. This data suggests that evening activities and alcohol use on weekends may contribute to a high number of crashes. (See page 11 for more data on alcohol related crashes.) Interestingly, the noon hour on Sundays is significantly overrepresented.




Saturday Crashes By Time of Day
Crashes
% Hourly Volume
250
200
150
100
50
0
10%
8%
6%
4%
2%
0%
49 65 47 19 17 19 23 43 69 84 137 161 221 200 194 189 181 150 127 80 73 84 86 65
12 AM 1 2 3 4 5 6 7 8 9 10 11 12 PM 1 2 3 4 5 6 7 8 9 10 11
Crashes
Traffic Volumes

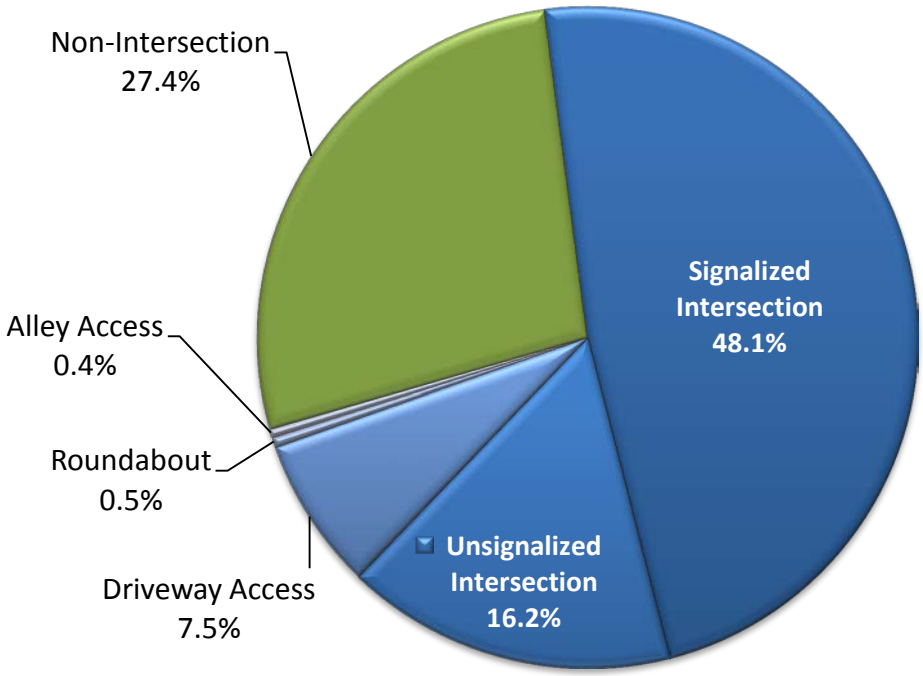

Sunday Crashes By Time of Day
Crashes
% Hourly Volume
200
180
160
140
120
100
80
60
40
20
0
12%
10%
8%
6%
4%
2%
0%
57 55 48 22 22 12 13 23 29 61 83 98 183 108 116 105 94 98 91 63 62 42 41 28
12 AM 1 2 3 4 5 6 7 8 9 10 11 12 PM 1 2 3 4 5 6 7 8 9 10 11
Crashes
Traffic Volumes

Locations of Crashes 2011 - 2015

The chart below shows the location of crashes in Fort Collins. Crashes at intersections or driveways account for 72% of all crashes.

This illustrates the importance of reducing the number of driveways (when possible), minimizing accesses and focusing the traffic safety program at intersections.

More than **70%** of all crashes occur at an intersection or driveway



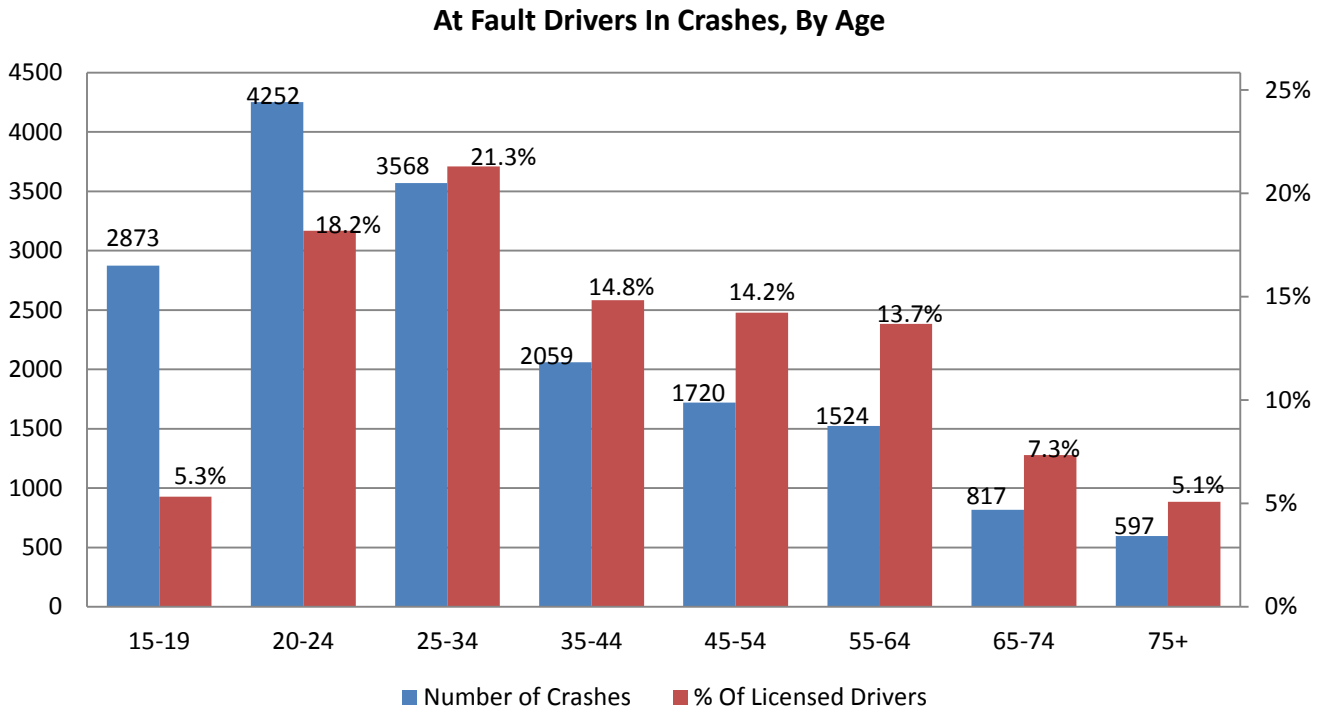
At Fault Drivers by Age 2011 - 2015

The chart below compares the number of crashes by age of an at-fault driver with the percent of licensed drivers in that age category.

Drivers aged 15–19 are three times as likely to be involved in a crash as would be expected given the number of licensed drivers in that age group. Twenty to 24 year-old drivers are also overrepresented in crashes. All other age groups are underrepresented in crashes.

While these statistics are not unique to Fort Collins, they do indicate that driver inexperience is likely a key factor in crashes and countermeasures to deal with this problem would be appropriate at the local level.

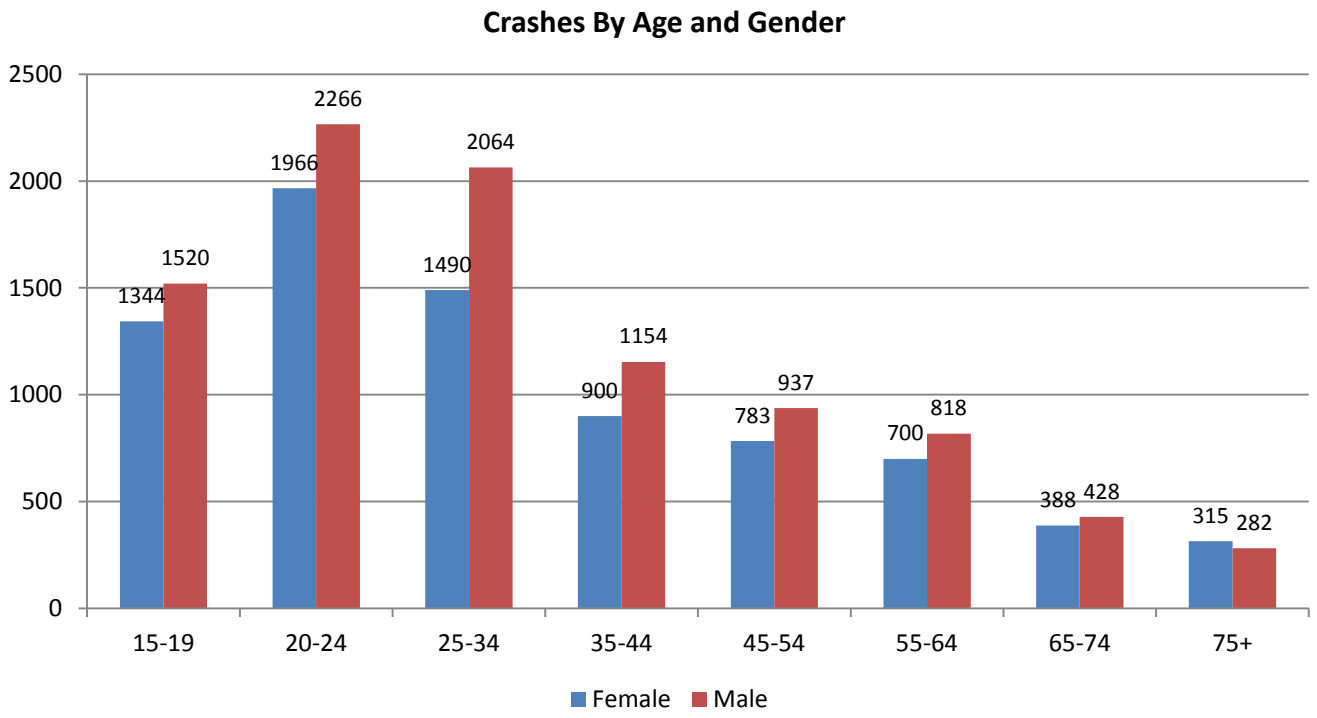
Teenagers represent **5.3%** of all drivers but are responsible for **16.5%** of all crashes.



Crashes by Age and Gender 2011 - 2015

The graph below shows crashes by age and gender (some crashes aren't included if gender information wasn't provided in the report).

Overall, male drivers are involved in more crashes than female drivers. Younger male drivers (20 – 34) in particular are more likely to be involved in crashes than their female counterparts. It should be noted that male drivers tend to drive more vehicle-miles per year.

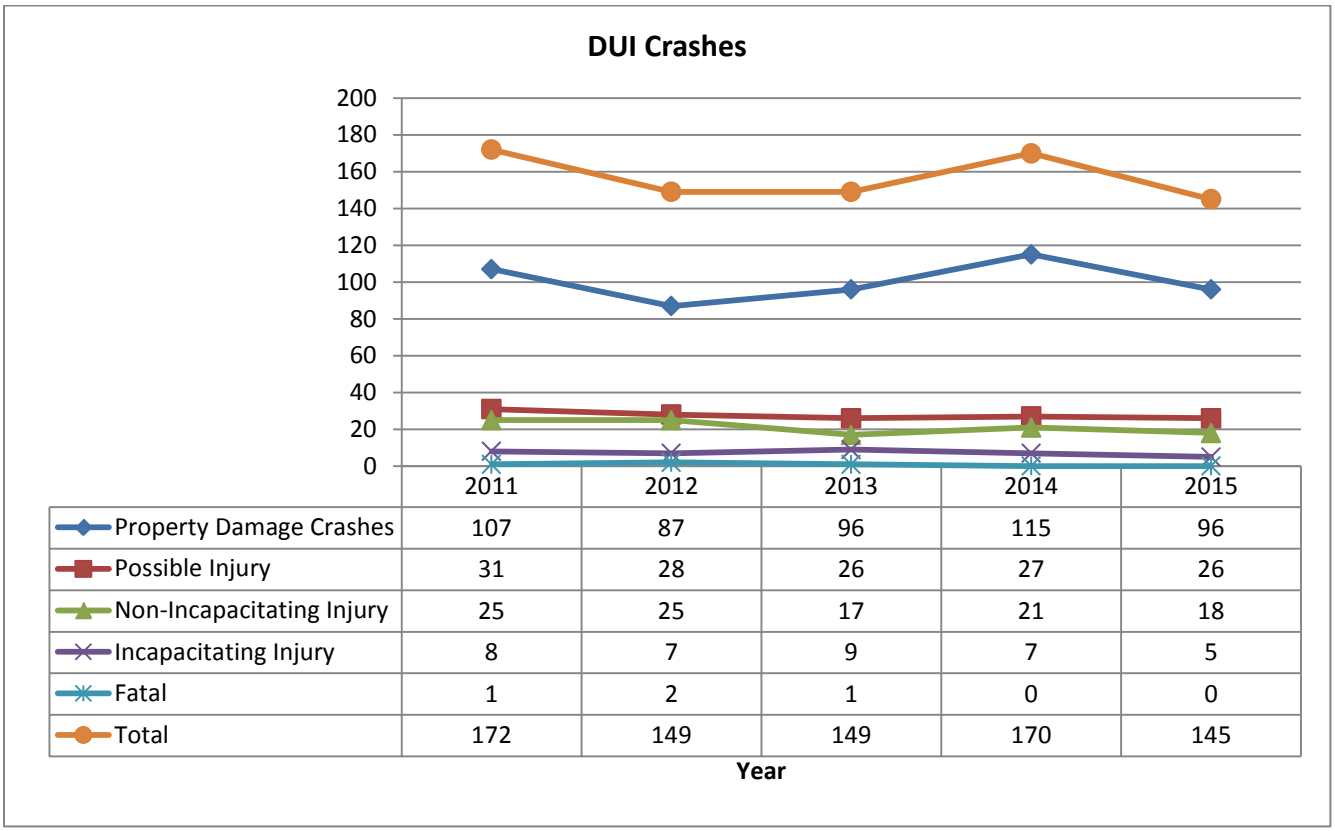


Driver's Under the Influence (DUI Crashes) 2011 - 2015

The graph below shows the number of DUI (driving under the influence) crashes over the past five years. The DUI crashes represent about 4% of all crashes. However, they account for more than 10% of serious crashes, and about 20% of incapacitating or fatal crashes. This suggests that alcohol related crashes are more likely to result in serious injuries.

Trends for DUI crashes have varied. After a spike in crashes in 2014, the number of DUI crashes decreased in 2015 by 15%, and are at their lowest level in more than five years.

Crashes involving DUI represent
4%
of all crashes but
11%
of serious crashes.



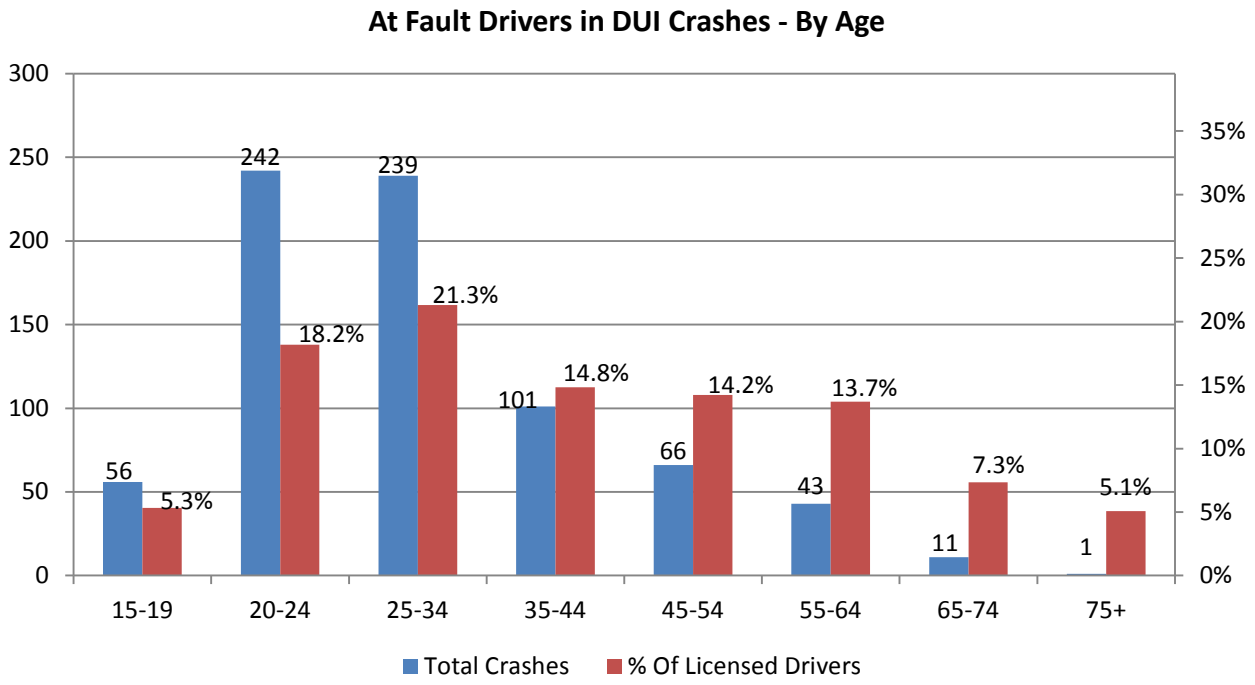
	2011	2012	2013	2014	2015
Property Damage Crashes	107	87	96	115	96
Possible Injury	31	28	26	27	26
Non-Incapacitating Injury	25	25	17	21	18
Incapacitating Injury	8	7	9	7	5
Fatal	1	2	1	0	0
Total	172	149	149	170	145

DUI Crashes By Age 2011 - 2015

Crashes in the past five years that involve Driving Under the Influence (DUI) are shown below by age of at fault drivers.

Drivers 20-24 years old are almost twice as likely as expected to be at fault in alcohol related crashes given the number of licensed drivers in that age group. Also surprising is that drivers 15 – 19 years old are overrepresented despite the fact that they have not reached legal drinking age.

Drivers under the age of 25 represent **23%** of licensed drivers but cause **40%** of DUI crashes.



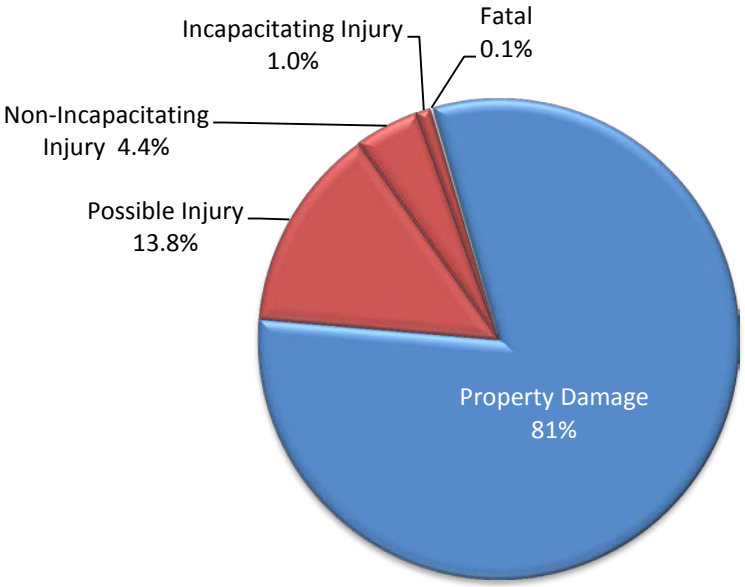
Motorcycle Crashes 2011 - 2015

From 2010 - 2014 there were a total of 336 reported motorcycle crashes. While motorcycle crashes generally follow the same patterns as other crashes they tend to be more severe as shown in the charts below.

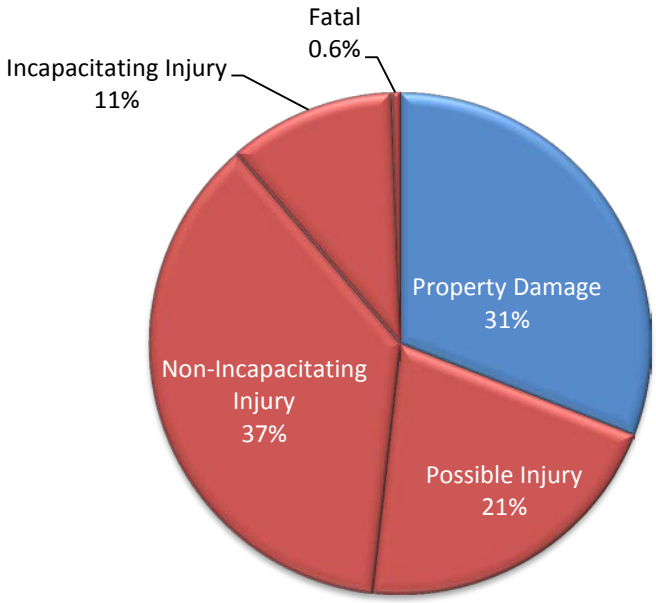
Overall, only 21% of crashes result in in some type of injury while 70% of motorcycle crashes result in injury.

In a crash, motorcyclists are more than **three** times as likely to be injured or killed than motorists in vehicles.

Crash Severity All Crashes



Crash Severity - Motorcyles

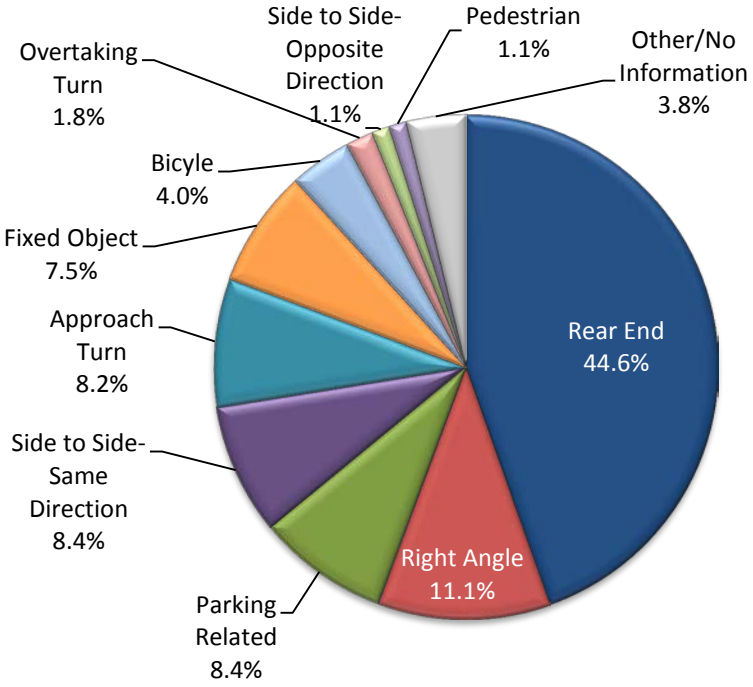


Section 3 – Detailed Review of Specific Types of Crashes

Crashes are categorized into a variety of types. The charts below show the number and percentage of crashes by type for all crashes, and again for severe crashes. Descriptions of crash types are on the following page.

Crashes By Type 2011 - 2015 All Crashes

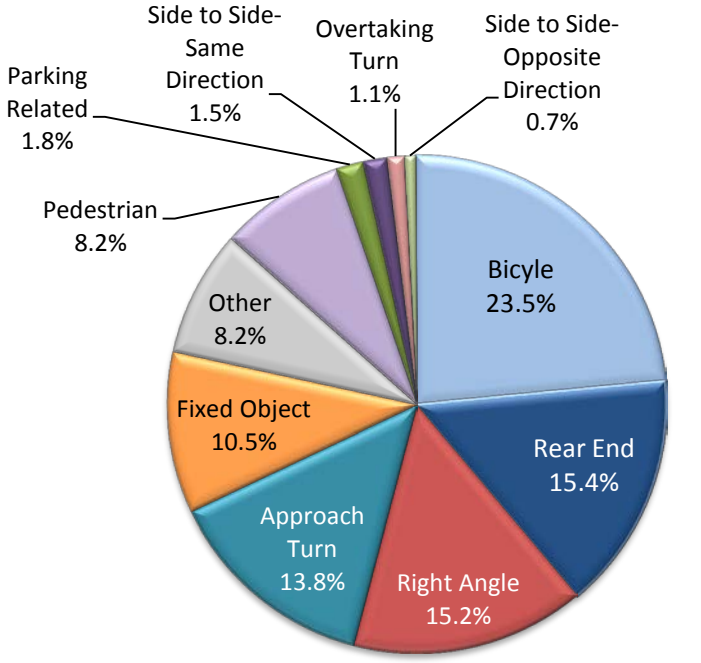
Rear end crashes make up nearly half of all crashes. Right angle, parking related, side to side, approach turn and fixed object crashes are the next most common types of crashes in Fort Collins



Crashes By Type 2011 - 2015 Severe Crashes (Serious Injury / fatal)

While all traffic crashes are of concern, severe crashes (those involving non-incapacitating injuries, incapacitating injuries or fatalities) are of special concern. Bicycle, Rear End, Right Angle, Approach Turn, Fixed Object, and Pedestrian crashes account for more than 85% of the severe crashes in Fort Collins.

Note that while bicycle and pedestrian accidents make up only about 5% of total crashes they make up almost 32% of severe crashes.



Description and Explanation of Crash Type

Each of various crash types is listed below with an explanation and/or description.

Approach Turn – Two vehicles traveling in opposite directions, one turns left (or attempts a U-turn) in front of the oncoming vehicle and is struck.

Bicycle – Any crash that involves a bicyclist.

Fixed Object – A single vehicle crash where a fixed object other than a parked vehicle is struck.

Overtaking Turn – Two vehicles traveling in the same direction, the front vehicle turns right or left and is hit as the following vehicle tries to pass on the right or left.

Parking Related – Any crash involving a parked vehicle or a vehicle entering/leaving a parking space.

Pedestrian – Any crash that involves a pedestrian.

Rear End – Two vehicles traveling in the same direction, leading vehicle struck by following vehicle.

Right Angle – Two vehicles traveling on perpendicular streets one fails to yield or passes a traffic control device and strikes the other.

Sideswipe Opposite Direction (also side to side opposite) – Two vehicles traveling in opposite directions, one veers into the wrong lane and strikes the side of the other car. This often occurs where a vehicle waiting at a STOP sign or traffic signal is struck by a vehicle turning right from a perpendicular road onto the road of the stopped car.

Sideswipe Same Direction (also side to side same) – Two vehicles traveling the same direction, one vehicle veers into the other striking it in the side (usually due to improper lane changes).

Other – Other crashes that do not fit into any other category.

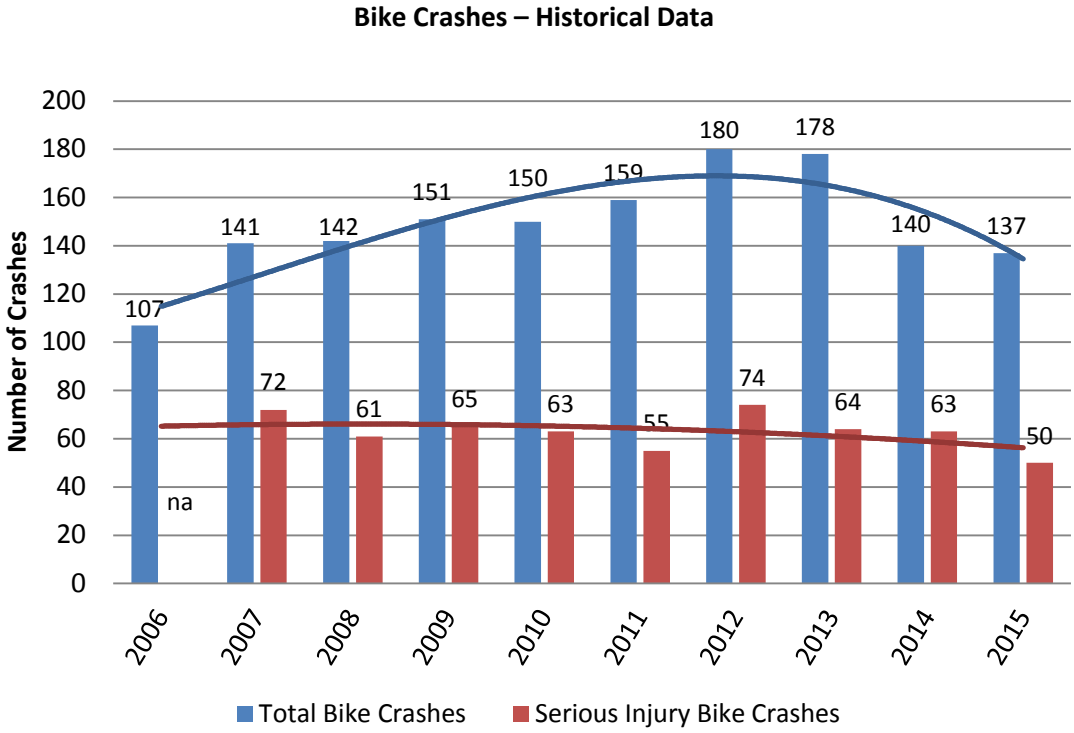
Bicycle Crashes

Number of bike crashes is down **24%** since 2012.

The City of Fort Collins is well known for its bike culture, and there is a strong focus on encouraging increased riding. Bike safety is an important component of supporting these efforts.

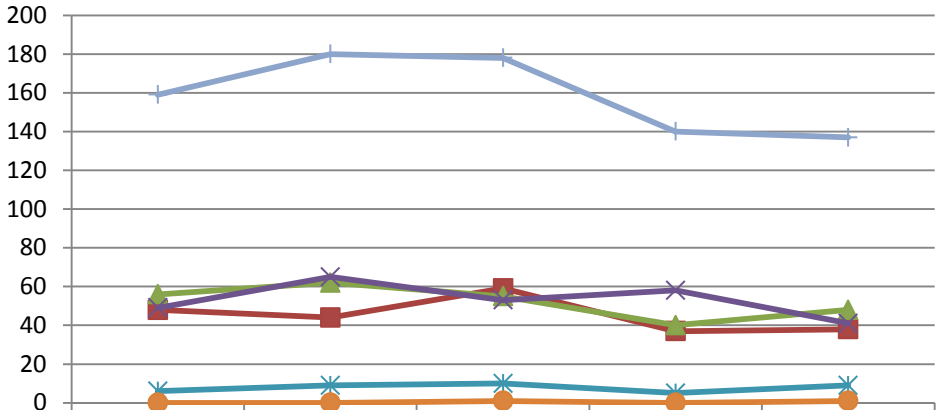
The chart below shows the historical trend of number of bicycle crashes in Fort Collins. While the general trend for bike crashes was upwards for a number of years, the last two years have seen significant decreases. Overall crashes are down 24% and serious injury crashes are down 32% since 2012.

Overall bike crashes account for about 4% of all crashes in the City of Fort Collins.



The chart below provides additional details on the number of bike crashes in the last five years by severity.

Number of Bike Crashes

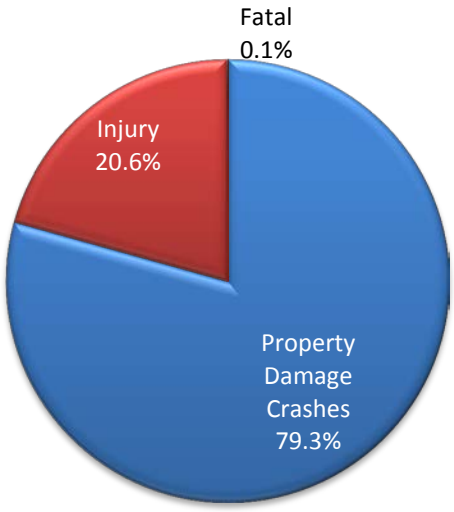


	2011	2012	2013	2014	2015
Property Damage	48	44	59	37	38
Possible Injury	56	62	55	40	48
Non-Incapacitating Injury	49	65	53	58	41
Incapacitating Injury	6	9	10	5	9
Fatal	0	0	1	0	1
Total	159	180	178	140	137
% change in total crashes from previous year	6.0%	13.2%	-1.1%	-21.3%	-2.1%
% change in serious crashes (non-incapacitating injury, incapacitating injury or fatal) from previous year	-12.7%	34.5%	-13.5%	-1.6%	-20.6%

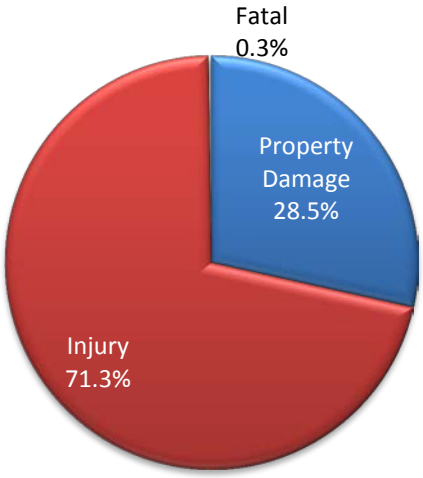
Bicycle Crash Severity

As noted on the previous pages, bike crashes account for about 4% of total crashes. However, they account for about 14% of combined injury and fatal crashes, and almost 24% of the most severe crashes (non-incapacitating injury, incapacitating injury and fatal crashes). This illustrates that bike crashes, when they do occur tend to be more serious than motor vehicle crashes.

Crash Severity All Crashes (2011-2015)

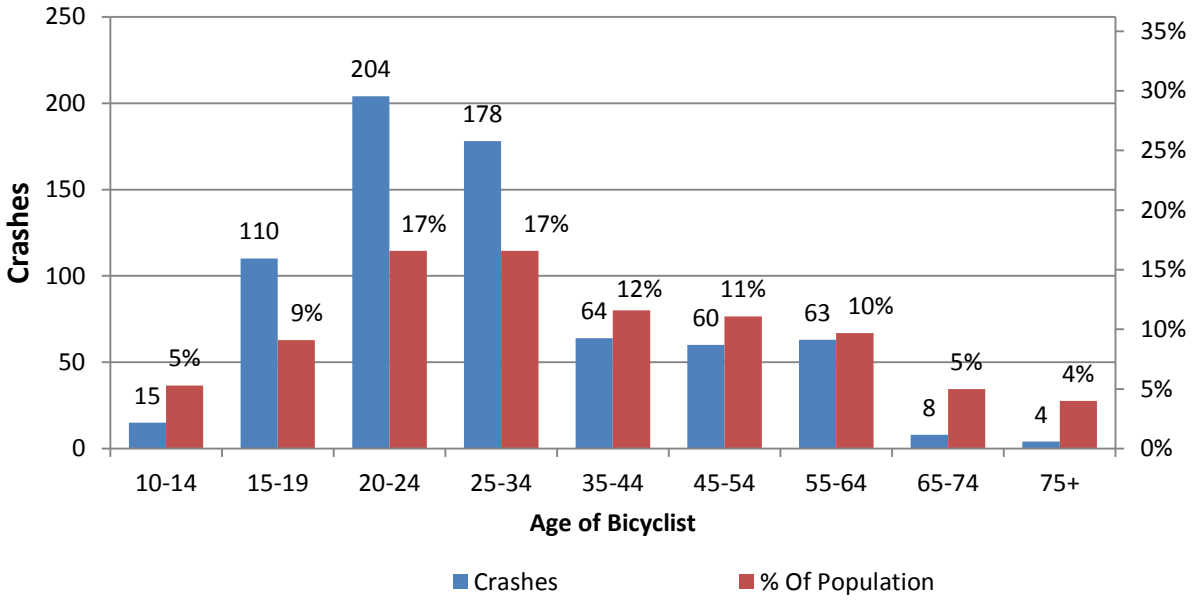


Crash Severity Bike Crashes (2011-2015)



Bicycle Crash By Age

The chart below shows the age of bicyclists involved in crashes in Fort Collins as well as the percentage of population by age. Bicyclists aged 15 - 34 years old are all overrepresented in crashes. Bicyclists aged 15-24 are about 75% more likely to be involved in a crash when compared to population.



Bicycle Crashes – Types and Locations

Bicycle crashes can be further classified by type of collision. The chart below and the table on the following page detail the type of crashes in the past five years.

Crashes at intersections , alleys or driveways account for more than 80% of all bike crashes.

Right angle crashes are by far the most common type of bike crash. And represent more than ½ of all bike crashes.

Significant contributing circumstances in bike crashes include wrong way riding on the sidewalk or street (this inlcudes more than ¼ of all crashes).

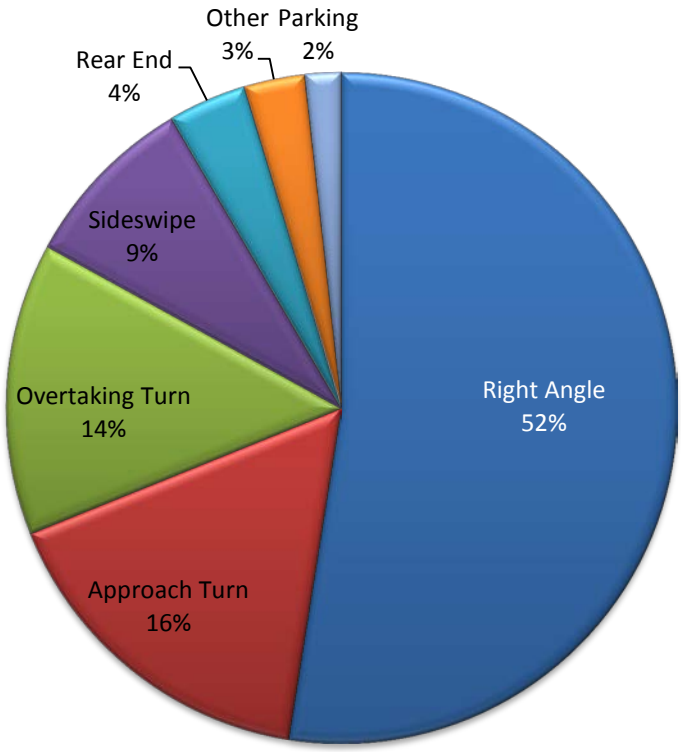
Only 13% of all bike crashes involve a sideswipe or rear-end.

Parking related crashes (i.e. “door zone” crashes) account for less than 2% of all bike crashes. In the past five years, there have been six serious injury crashes.

82%
of all bike crashes occur at intersections or driveways.

27%
of all bike crashes involve wrong way riding

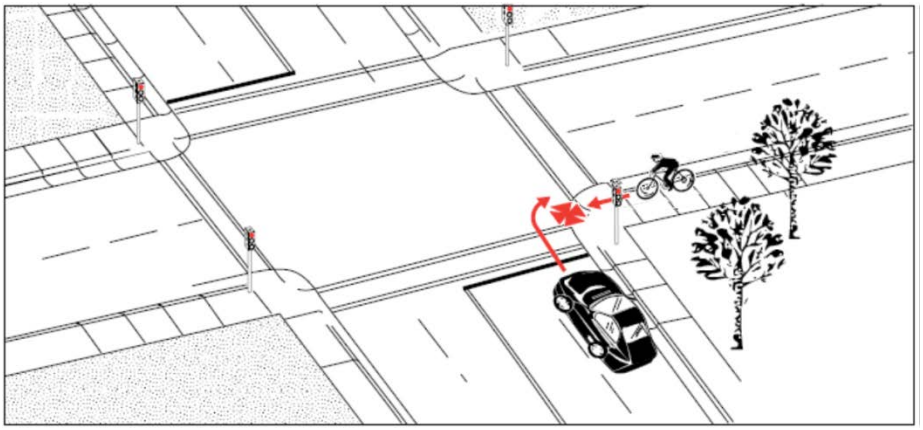
Bike Crashes by Type 2011-2015



Graphical Depiction of Typical Bicycle Crashes

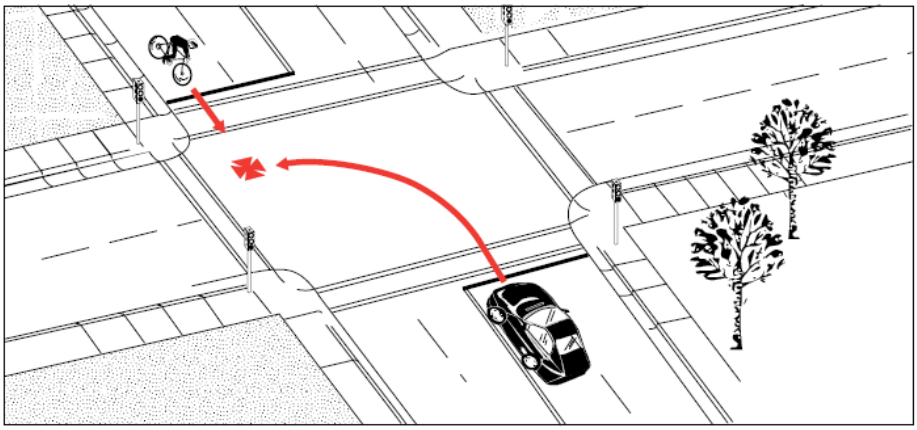
Right Angle Crash

Right angle crashes are by far the most common type of bike crash., representing more than ½ of all bike crashes. 46% of right angle crashes involve a bike riding against traffic on the sidewalk or street.



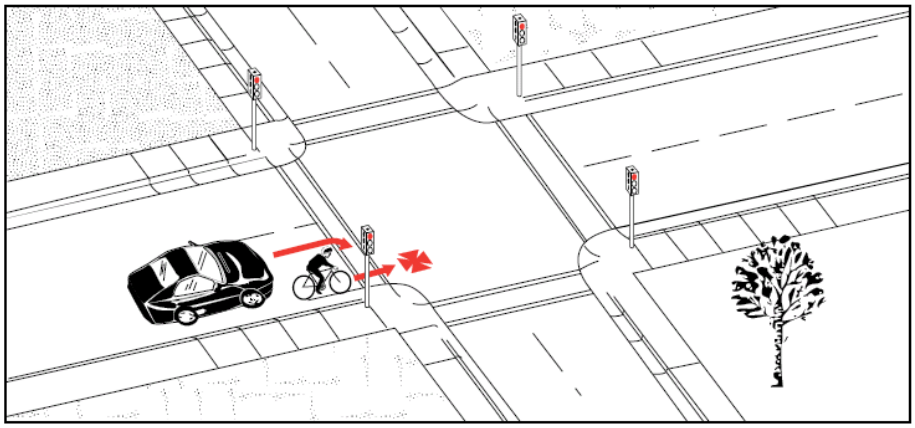
Approach Trun Crash

This type of crash represents about 16% of all crashes. Almost ½ of approach turn crashes result in a serious injury.



Overtaking Turn Crash

Also known as the ***"right hook"*** crash. This represents 14% of all bike crashes.



Detailed Bicycle Crash Tabulation by Type (2011-2015)

Type of Crash	Total Crashes	Serious Injury/Fatal
1 Right Angle		
Bike riding with traffic on street	125	56
Bike riding against traffic on street	41	16
Bike riding with traffic on sidewalk/crosswalk	47	18
Bike riding against traffic on sidewalk/crosswalk	152	49
Bike crossing the street mid-block	11	4
Unknown Location	41	8
1 Right Angle Total	417	151
2 Overtaking Turn		
Bike riding with traffic on street	82	23
Bike riding against traffic on street	4	1
Bike riding with traffic on sidewalk/crosswalk	14	6
Bike riding against traffic on sidewalk/crosswalk	7	4
Bike crossing the street mid-block	1	1
Unknown Location	4	0
2 Overtaking Turn Total	112	35
3 Approach Turn		
Bike riding with traffic on street	96	47
Bike riding against traffic on street	1	1
Bike riding with traffic on sidewalk/crosswalk	26	11
Bike riding against traffic on sidewalk/crosswalk	7	4
3 Approach Turn Total	130	63
4 Sideswipe		
Bike riding with traffic on street	54	26
Bike riding against traffic on street	4	2
Bike riding with traffic on sidewalk/crosswalk	2	1
Bike crossing the street mid-block	3	1
Unknown Location	5	1
4 Sideswipe Total	68	31
5 Parking Related		
Bike riding with traffic on street	12	5
Bike riding against traffic on street	1	1
Unknown Location	1	0
5 Parking Related Total	14	6
6 Rear End		
Bike riding with traffic on street	29	11
Unknown Location	1	0
6 Rear End Total	30	11
7 Head-On		
Bike riding with traffic on street	1	1
Bike riding against traffic on street	1	1
7 Head-On Total	2	2
8 Fixed Object Total	2	1
9 Other, Non Collision or No Information	19	7
Grand Total	794	307

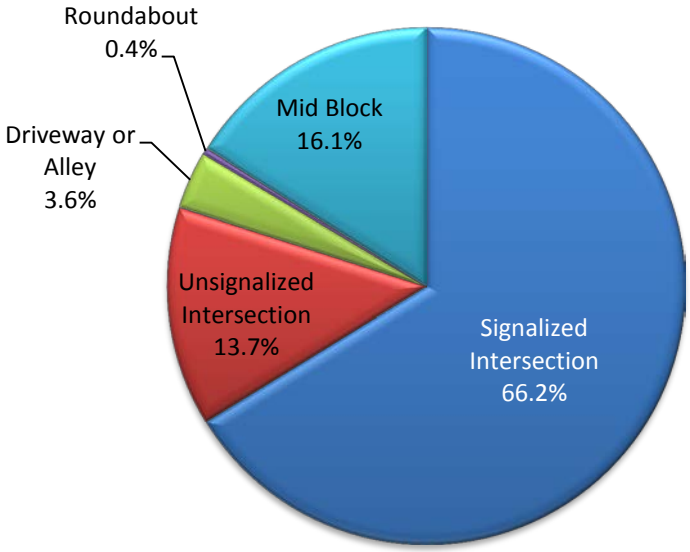
Rear End Crashes

Only 2.3% of all rear end crashes result in a serious injury or fatality in Fort Collins. However, because of the sheer number of these types of crashes, they are an important element to consider in safety reviews.

<3%
of all rear end crashes result in a serious injury or fatality.
66%
occur at signalized intersections

Rear end crashes are typically the result of motorist inattention often combined with unexpected stops in the traffic stream. The graph below shows the number of rear end crashes by location. As can be seen, the majority (66%) of rear end crashes occur at signalized intersections. Inattention along with the onset of a yellow light combined with heavy traffic and/or high speeds can result in increased rear end accident potential.

Rear End Crashes by Location (2011-2015)



Care must be taken to avoid increasing rear end crash potential by implementation of countermeasures intended to reduce other types of crashes.

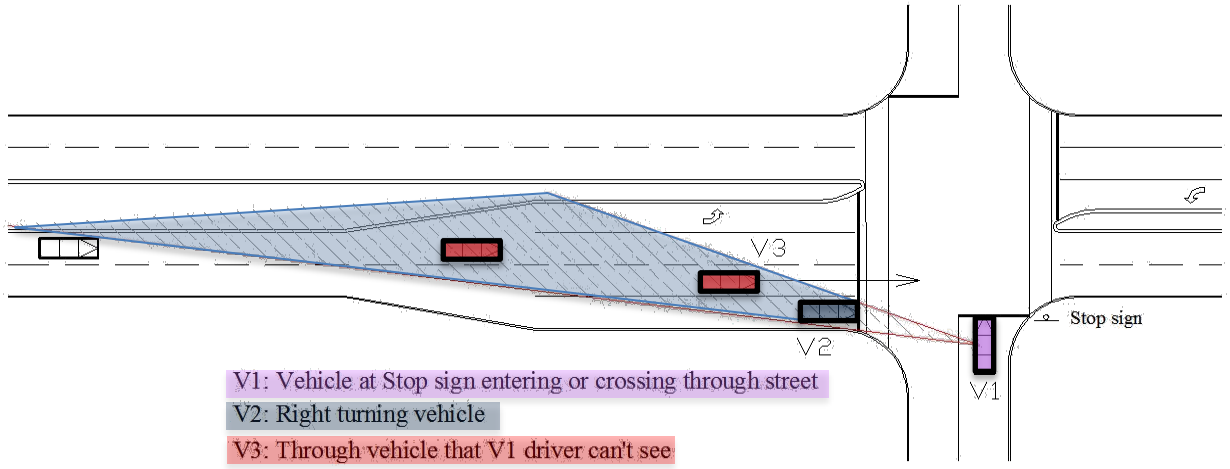
For example, installation of traffic signals, addition of protected only left turn signal phasing at traffic signals, and red light camera enforcement are all countermeasures that may be used to reduce right angle or left turn crashes. However, they also tend to increase the potential for rear end crashes.

Since right angle and left turn crashes tend to be more severe it might make sense to implement these countermeasures at locations with a history of these types of crashes. It may not be appropriate to use these countermeasures at locations where there is not a history of these sorts of crashes because of the increased risk of rear end crashes.

Right Angle Crashes

Right angle crashes occur at intersections when vehicles arrive on perpendicular roads and collide. There are two main types of right angle crashes:

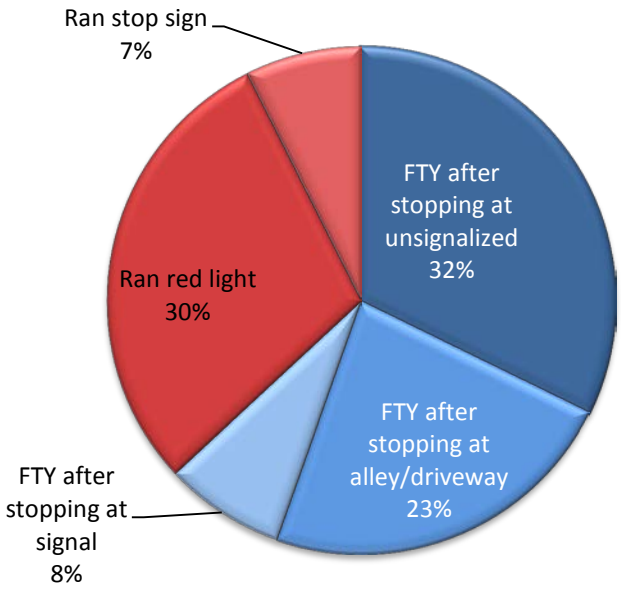
1) Failure to yield after stopping –Typical contributing factors to these crashes include sight obstructions such as fences, trees, shrubs, parked cars, or approaching vehicles that prevent the stopped driver from seeing conflicting traffic. The illustration below shows an example where right turning traffic on the main street limits visibility for motorists stopped at a STOP sign or signal on the side street, effectively hiding approaching traffic in the through lanes.



2) Passing a signal/STOP sign without stopping - Typical contributing factors to these crashes include inattention, wide streets (that make STOP signs less visible), "busy" areas where numerous distractions tend to make traffic control devices blend in or become less obvious, and icy roads.

Right Angle Crashes by Type and Location (2011 – 2015)

As shown, almost 2/3 (63%) of right angle crashes occur where someone stops but then proceeds into oncoming traffic (shades of blue in the chart). The remaining crashes (37%) are the result of a motorist running a red light or stop sign (shades of red).

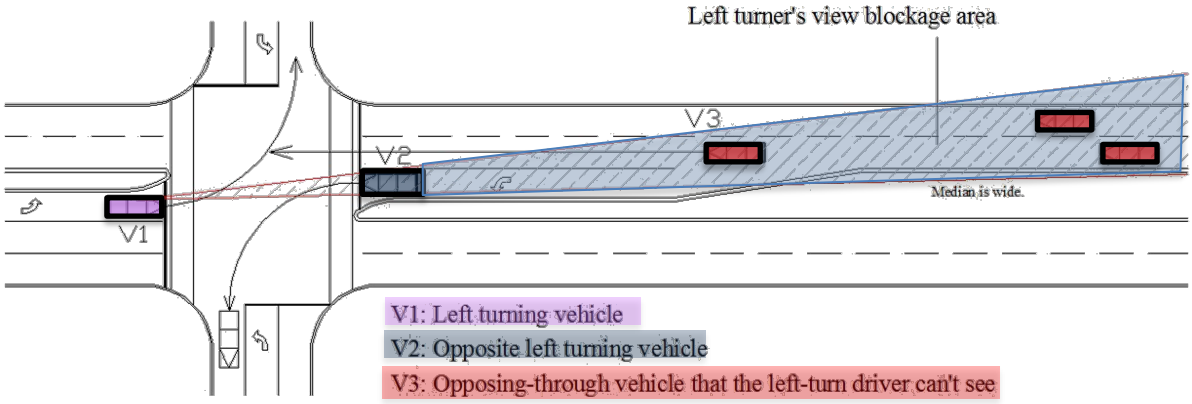


FTY = Failure to Yield

Approach Turn Crashes

Approach turn crashes occur when someone turns left in front of oncoming traffic without yielding the right of way. There are two main causes of approach turn crashes:

1) Poor estimation of distance and/or speed of approaching through traffic -- These accidents occur at both signalized and unsignalized intersections. Poor visibility can contribute to these accidents. Offset left turn lanes can result in vision obstructions as shown in the illustration below. Note that this offset created between opposing left turn lanes is a disadvantage of raised medians at intersections.

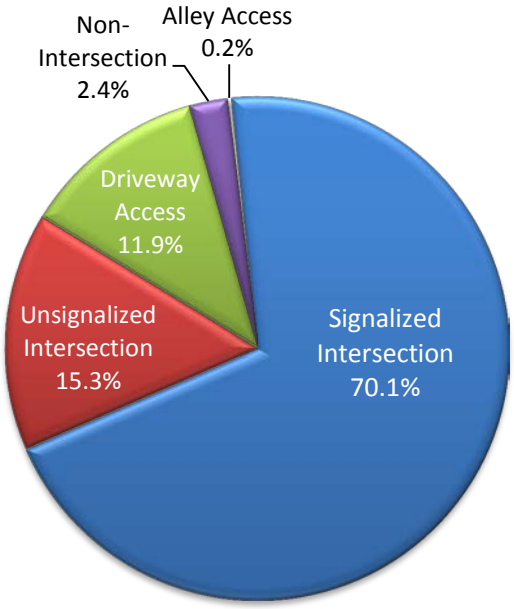


2) Inappropriate response to the onset of the yellow or red signal display – This situation can occur at signalized intersections where permissive left turns are allowed. A driver waiting to turn left on a green ball at a signalized intersection is required to yield the right- of-way to opposing through traffic. When the traffic signal turns yellow and/or red, some left turning drivers assume that oncoming traffic will stop. This causes them to turn in front of oncoming traffic that may not be able (or willing) to stop.

Approach Turn Crashes By Location (2011 – 2015)

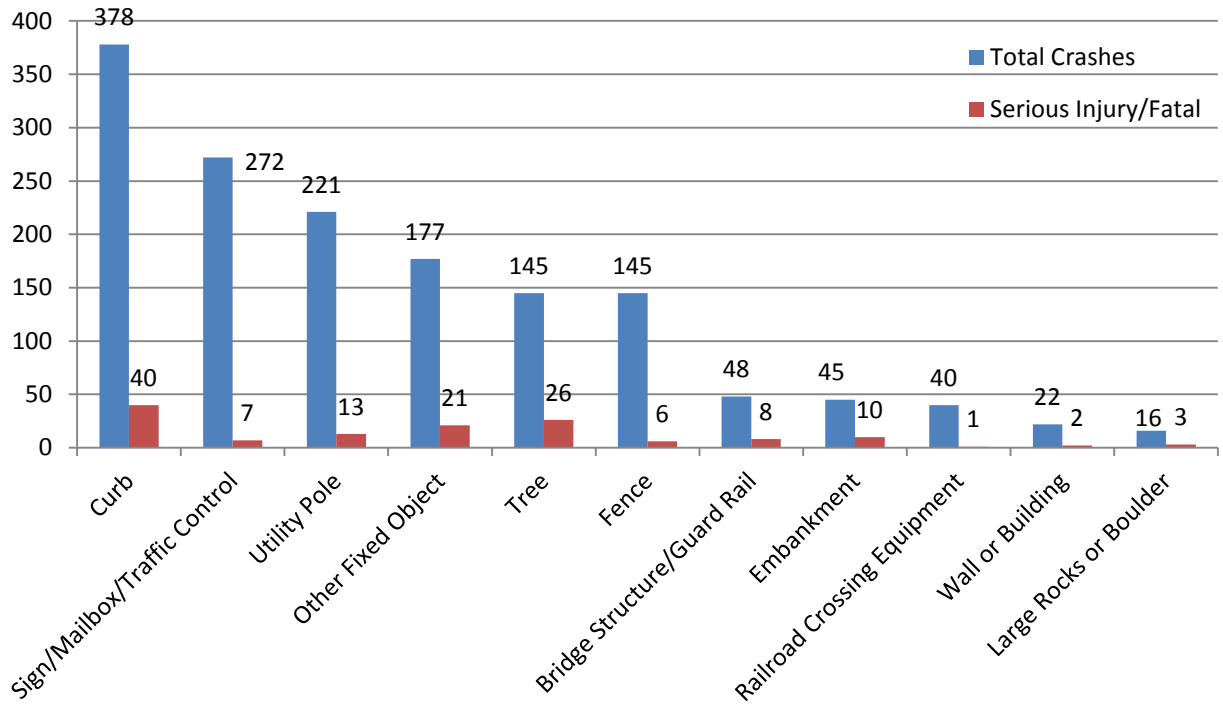
The chart at right shows both the number and percentage of approach turn crashes by location and type of intersection for the past five years.

The majority of approach turn crashes (more than 70%) happen at signalized intersections. The combination of increased complexity and higher turning volumes along with the issue of turning on the yellow/red explain this trend.



Fixed Object Crashes 2011-2015

Fixed object crashes are single vehicle crashes where a driver collides with a fixed roadway feature such as a curb or a median or runs off the road and hits a roadside feature such as a tree or utility pole. The chart below shows fixed object crashes by type of object struck.



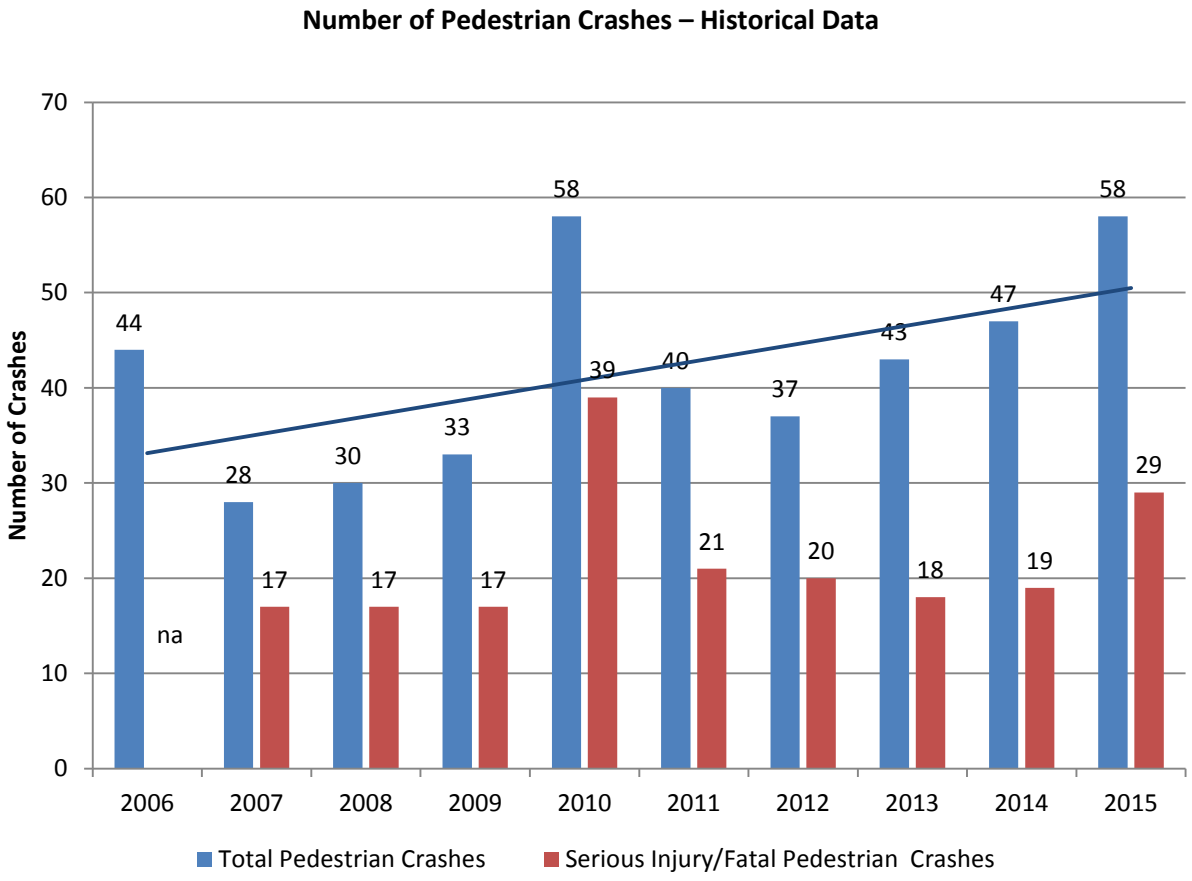
Alcohol is a major contributing factor in fixed object crashes. Seventeen percent (17%) of all fixed object crashes involve alcohol. For serious crashes (involving severe injury or fatal) the percentage related to alcohol goes up to almost 44%.

17%
of all fixed object crashes involve alcohol.
44%
of all serious fixed object crashes involve alcohol

Pedestrian Crashes

Pedestrian crashes account for only about 1% of all crashes, but more than 8% of serious crashes. The chart below shows the historical trend of number of pedestrian crashes in Fort Collins. Although there is significant variation from year to year, generally the trend has been upward.

Pedestrian crashes are trending upward.

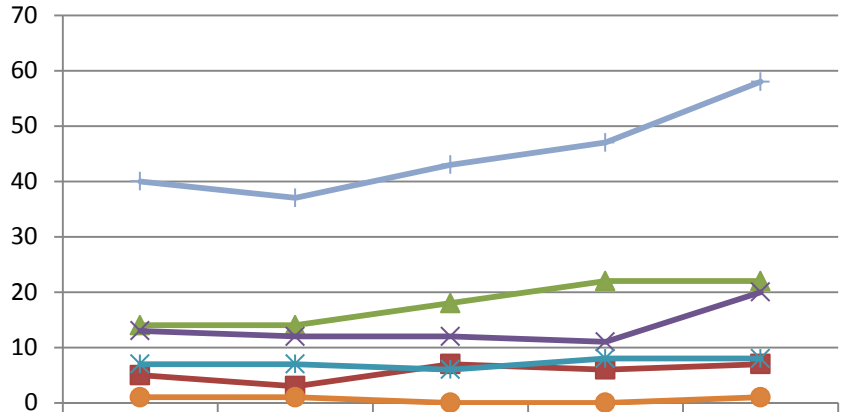


The chart below shows the number of pedestrian crashes in Fort Collins over the last five years by severity.

Pedestrian crashes tend to be serious crashes with 87% involving some level of injury and 48% reported as serious indury or fatal. It is likely that some non-injury pedestrian crashes may not be reported.

87% of all reported pedestrian crashes involve some level of injury or fatality.

Number of Pedestrian Crashes



	2011	2012	2013	2014	2015
Property Damage	5	3	7	6	7
Possible Injury	14	14	18	22	22
Non-Incapacitating Injury	13	12	12	11	20
Incapacitating Injury	7	7	6	8	8
Fatal	1	1	0	0	1
Total	40	37	43	47	58
% change in total crashes from previous year	-31.0%	-7.5%	16.2%	9.3%	23.4%
% change in serious crashes (non-incapacitating injury, incapacitating injury or fatal) from previous year	-46.2%	-4.8%	-10.0%	5.6%	52.6%

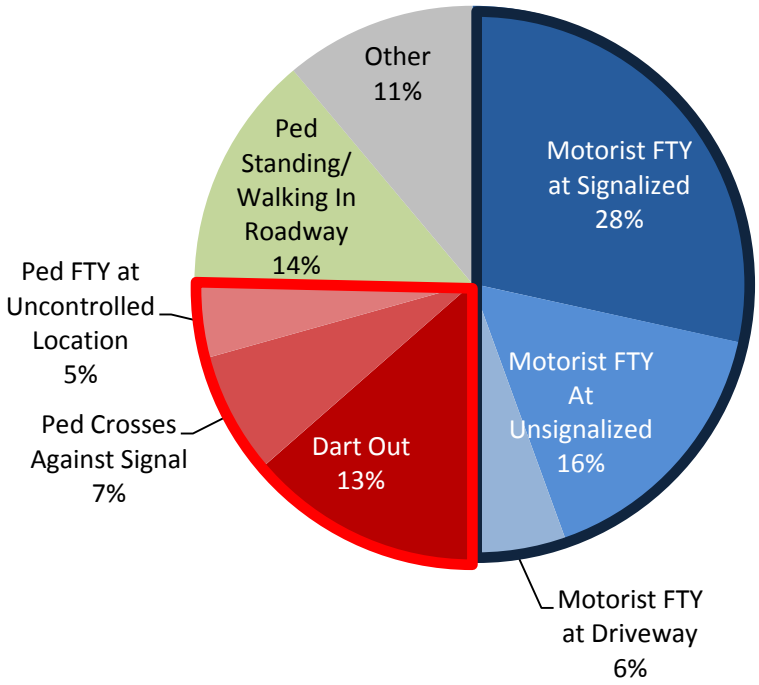
Pedestrian Crashes (2011-2015)

Categorizing pedestrian crashes by type helps to understand contributing factors. A detailed explanation of crash type is shown on the following pages and the chart below shows the percentage of crashes by type for pedestrians in the past five years.

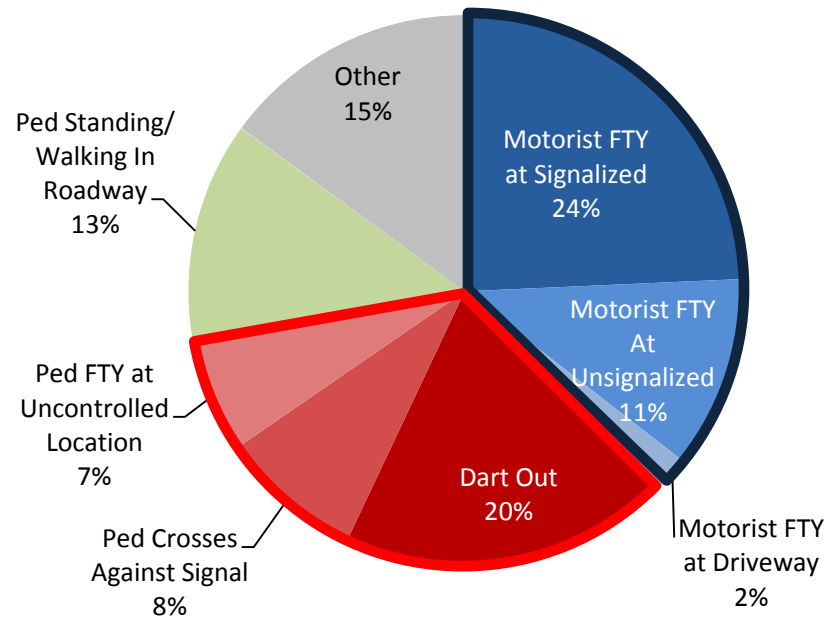
In general, about half of all pedestrian crashes are the result of a motorist failing to yield (shades of blue in the chart). In serious crashes, this percentage is about 35%.

The pedestrian is determined to be at fault (shades of red) in about 25% of all pedestrian crashes, but 35% of serious crashes.

Pedestrian Crash Types – All Crashes

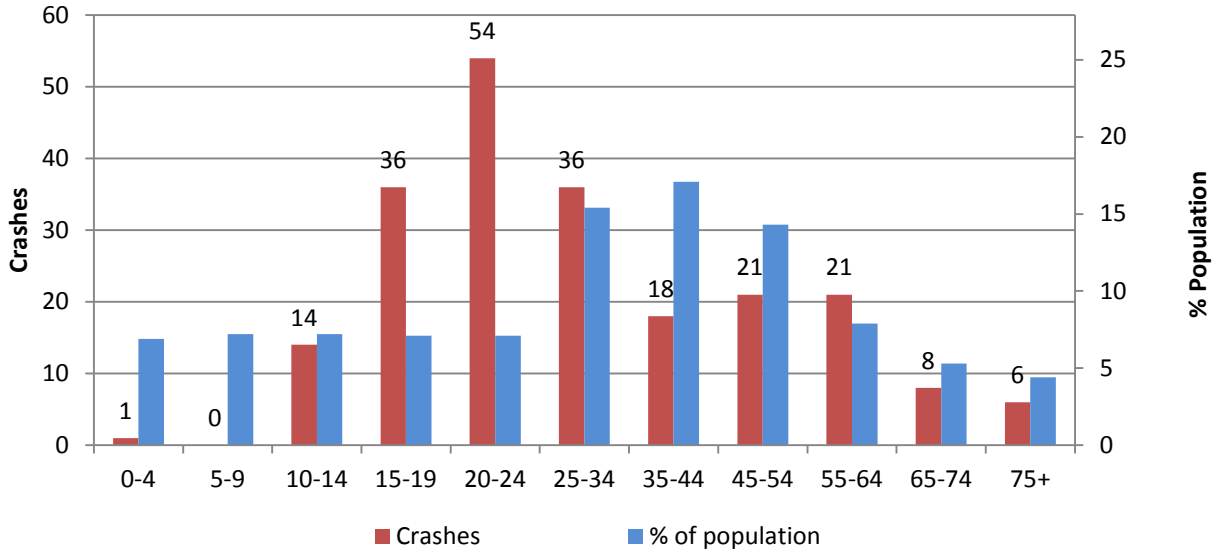


Pedestrian Crash Types – Serious Crashes



Pedestrian Crashes By Age (2011-2015)

The chart below shows the age of pedestrians involved in crashes. Pedestrian that are age 15-34 years old are significantly overrepresented in crashes; and 20 – 24 year old pedestrians in particular were more than three times as likely as expected to be in a crash considering the population in this age range.



** Note: 10 crashes are not listed due to lack of age data in report*

Type of Pedestrian Crashes

Some common types of pedestrian crashes are described below:

Motorist Fails to Yield at Signalized Intersection – Crashes at signalized intersections where a pedestrian legally crossing the street is hit by a motorist. These crashes typically involve a turning driver whose attention is diverted.

Motorist Fails to Yield at Unsignalized Intersection – Crashes where a pedestrian legally in the street is hit by a driver who does not yield the right of way. These crashes typically involve a turning driver whose attention is diverted.

Motorist Fails to Yield while Exiting a Driveway – Crashes that involve motorists crossing a sidewalk in the process of exiting a driveway to a public street and striking a pedestrian on the sidewalk crossing the driveway.

Dart Out - Crashes where a pedestrian enters the street in front of an approaching driver who is too close to avoid a collision. An example of this type of crash is a child chasing a ball into the street running out in front of a car.

Pedestrian Crosses Against Signal – Crashes at signalized intersections resulting from a pedestrian crossing against the signal indication.

Pedestrian Fails to Yield at Uncontrolled Locations - At non-crosswalk locations pedestrians must yield to motorists prior to crossing. These crashes involve pedestrians who attempted to cross without waiting for a safe break in traffic. Most of these crashes occur at night when pedestrians are less visible to motorists.

Pedestrian Standing/Walking in Road – Pedestrian walking on the road but not attempting to cross is struck by a motorist.

Crashes shown as "Other" include many different types of crashes including pedestrians hanging onto the outside of vehicles, pedestrians eluding the police, suicide attempts, pedestrians exiting parked vehicles and pedestrians who fell off the sidewalk into the street.

Detailed Pedestrian Crash Tabulation by Type (2011-2015)

Type of Accident	Total	Injury/Fatal
Motorist Fail to Yield at Signalized Intersection		
Motorist Turning Left on Green	30	12
Motorist Turning Right on Green	8	3
Motorist Turning Right on Red	17	6
Motorist Going Straight	9	5
Total Motorist Fail to Yield at Signalized Intersection	**64**	**26**
Motorist Fail to Yield at Unsignalized Intersection	**36**	**12**
Dart Out	**30**	**21**
Pedestrian Fail to Yield at Uncontrolled Location	**10**	**7**
Pedestrian Crosses Against Signal	**16**	**9**
Pedestrian Standing/Walking in Road	**31**	**14**
Motorist Fail to Yield Exiting Driveway	**13**	**2**
Other	**25**	**16**
Total	**225**	**107**

Section 4 – High Crash Locations

The majority of this report is a summary of the numbers, types, and patterns of crashes. That information can be used to identify overall mitigation and safety efforts throughout the City. Another important element is to use the crash data to identify specific locations for potential improvements through implementation of specific countermeasures.

Crash density maps are included at the end of the report and help identify the locations where the most crashes occur. While helpful information, because volumes and other elements at specific locations vary widely, its difficult to draw relevant conclusions just from the maps.

In addition to crash density information, Traffic Operations staff conducts detailed analysis to identify intersections where there are more crashes than expected taking into account traffic volumes, roadway geometry, type of traffic control etc.

Traffic crashes are at least partially deterministic (i.e. factors affecting crash potential can be controlled). At the same time crashes are, to some extent, random events. This random nature of crashes makes it difficult to determine if a location is truly a problem versus a location where normal variations lead to a high crash frequency during the observation period. In order to identify locations that truly warrant further investigation it is helpful to use a methodology that accounts for the somewhat random nature of crashes.

In 2010 the Transportation Research Board (TRB) and the American Association of State Highway and Transportation Officials (AASHTO) published the *Highway Safety Manual* (HSM). The HSM includes a statistical approach used to account for regression to the mean bias in order to identify locations that have a higher than expected crash frequency even after accounting for random variation. That approach is applied to intersections in Fort Collins.

The method utilizes a calibrated model to predict the number of crashes at a location given the traffic volumes, the roadway geometry, and the type of intersection control. This prediction is then compared to the actual number of crashes at the location (adjusted to account for regression to the mean). The more the actual adjusted number of crashes exceeds the number of crashes predicted by the model the more likely it is that a location has an unusually high number of crashes.

The table on the following page shows the results of the statistical evaluation of intersections in Fort Collins using data for the years 2013 - 2015. The table is ranked by excess crash costs, and intersections with greater than $70,000 in excess crash costs are shown (28 locations). Since injury crashes tend to have higher crash costs associated with them, the ranking method gives more weight to locations with more injury crashes compared to locations with only “fender benders”.

Each of these intersections is reviewed in more detail to look for specific types and trends of crashes. Staff works to identify potential countermeasures to address recurring patterns if present. Note that when considering possible safety projects the cost of specific improvements needs to be considered in order to determine if the benefit will outweigh the cost.

The results of that effort is used in the implementation of safety measures.

Intersection Excess Crash Costs (2013-2015)

Intersection		Model Predicted Crashes/ Yr	Model Predicted FI Crashes/ Yr*	Adjusted Actual Crashes/ Yr	Adjusted Actual FI Crashes/ Yr*	Excess PDO Crashes /Yr **	Excess FI Crashes /Yr*	Excess Crash Costs/ Yr
College	Trilby	23.4	4.8	31.2	8.9	3.7	4.1	$492,813
College	Horsetooth	46.9	8.9	54.2	12.3	3.8	3.5	$426,635
Lemay	Harmony	32.4	6.3	41.6	8.3	7.2	2.0	$298,309
Boardwalk	Harmony	27.4	5.5	32.8	6.7	4.2	1.3	$182,720
Lemay	Riverside	22.5	4.6	26.2	5.9	2.5	1.3	$167,372
College	Monroe	12.0	2.7	25.9	3.8	12.9	1.0	$244,413
Lemay	Horsetooth(W)	21.1	4.0	23.9	6.1	0.7	2.1	$239,779
College	Swallow	19.2	4.1	28.5	5.2	8.1	1.2	$209,618
Mason	Harmony	17.3	3.7	29.9	4.5	11.8	0.8	$207,709
College	Foothills	11.2	2.5	22.2	3.0	10.6	0.4	$154,915
Timberline	Drake	32.0	6.4	27.4	8.2	-6.4	1.8	$134,504
Taft Hill	Harmony	10.9	2.3	13.4	3.3	1.5	1.0	$127,758
Taft Hill	Horsetooth	14.4	3.1	16.6	4.0	1.3	0.9	$114,176
College	Triangle	2.6	0.5	3.8	1.4	0.3	0.9	$106,253
College	Troutman	17.9	3.9	20.6	4.7	1.8	0.8	$106,012
Timberline	Prospect	29.9	6.0	36.1	6.5	5.8	0.4	$104,805
College	Kensington	11.4	2.7	15.7	3.2	3.8	0.5	$95,813
College	Laurel	19.2	4.2	25.3	4.6	5.8	0.3	$92,775
Timberline	Mtn Vista	1.9	0.5	3.8	1.2	1.2	0.7	$91,801
Timberline	Bighorn	4.1	0.9	6.1	1.6	1.4	0.6	$84,095
JFK	Harmony	18.3	3.8	22.1	4.3	3.4	0.4	$83,703
Raintree	Drake	3.6	0.9	4.9	1.6	0.6	0.7	$82,446
Ziegler	Horsetooth	9.4	0.3	12.5	0.5	3.1	0.1	$81,339
Lemay	Prospect	32.1	6.5	34.8	7.0	2.2	0.5	$78,387
Shields	Prospect	31.3	6.3	31.6	7.0	-0.4	0.7	$76,225
Manhattan	Horsetooth	11.7	2.6	12.2	3.2	-0.2	0.7	$73,856
City Park	Mulberry	2.5	0.5	5.9	0.8	3.0	0.4	$70,913
College	Drake	48.2	9.1	55.5	9.1	7.4	0.0	$70,382

* FI = Fatal / Injury Crashes

** PDO = Propoerty Damage Only Crashes

Section 5 – Implementing Safety Measures

The implementation of safety measures is a vital component to the work of not just the Traffic Operations Department, but a number of departments across the City. The data in this report is used to determine opportunities for low cost and longer term improvements, as well as to identify target areas for education and enforcement options.

Low Cost Improvements

Sometimes there are minor, inexpensive solutions that can be funded with maintenance budgets and provide a high benefit to cost ratio. Following are a few tools that are often used to make low cost improveents:

- Tree trimming for better visibility of oncoming traffic and/or signal heads
- Implementatin of flashing yellow arrow displays and protected only (green arrow) left turn movements during peak hours.
- Convert striping to create center turn lanes
- Traffic signal timing adjustments that change the arrival pattern of vehicle platoons to reduce the amount of traffic arriving when the signal changes fro green to red.
- Convert old 8” signal displays to current 12” displays

Integrating Safety into Various City Projects and Programs

In addition to low cost improvements implemented on a case-by-case basis, safety enhancements are also incorporated through engineering efforts in other programs and/or City Departments.

Capital Projects

The Capital Improvement Projects list uses crash history as one criterion for prioritization. In addition, the Engineering Department’s Arterial Intersection Prioritization Study weighs crash history heavily in their identification of potential projects. Subsequently, projects that move forward use detailed crash analysis to develop improvements targeted at specific crash types and patterns. The crash data is also used to apply for Federal Hazard Elimination and Safety (HES) funding. Current construction projects include:

- Shields/Drake and Shields/Davidson: addition of turn lanes and access control improvements (funded partially through HES)
- Timberline / Prospect: Construction of additional auxiliary turn lanes and an eastbound to southbound ‘free right’.
- College/Horsetooth: addition of dual left turn lanes on College

Neighborhood Traffic Mitigation Program

Traffic in neighborhoods can affect the quality of life of residents and the traveling public. With the goal of safer, calmer streets, the program uses a variety of data, including crash data to identify potential calming options. Program accomplishments in 2015 included 95 work orders, five neighborhoods with permanent Radar Speed Displays and three neighborhoodds with speed humps.

School Safety

The department works closely with Poudre School District on all elements of transportation in the vicinity of about 40 schools.

Multi-Modal and Planning Projects

The FCMoves department utilizes crash data in developing a variety of planning documents (area plans and bike, pedestrian plans) and specific efforts such as bike pilot projects are supported through crash analysis.

Education and Enforcement

Education is an important component to a safer transportation system. This includes efforts related to Safe Routes to School, and neighborhood traffic educations programs. The FCMoves department has utilized bike and pedestrian crash data to create specific education campaigns. For instance, the Bicycle Friendly Driver program is targeted to reduce bike/car crashes.

Police Services is the lead entity for enforcement, and can utilize crash data to identify specific types or locations of crashes to target for enhanced presence and/or enforcement.

Ongoing Monitoring

Finally, a key for the traffic safety program is to complete ongoing monitoring of both the overall transportation system, as well as locations where specific projects have been completed. This effort helps to determine the effect of the safety projects, and identify the types of projects that are most beneficial.

Section 6 – Looking Forward

The analysis in this report as well as the extensive data that supports the review can be used to identify areas for focused attention in coming years.

- As discussed on page 33, low cost improvements are an important component to traffic safety. The Traffic Operations department will continue to look for these opportunities.
- Targeting high crash locations and integrating safety into various projects have been and will continue to be a priority.

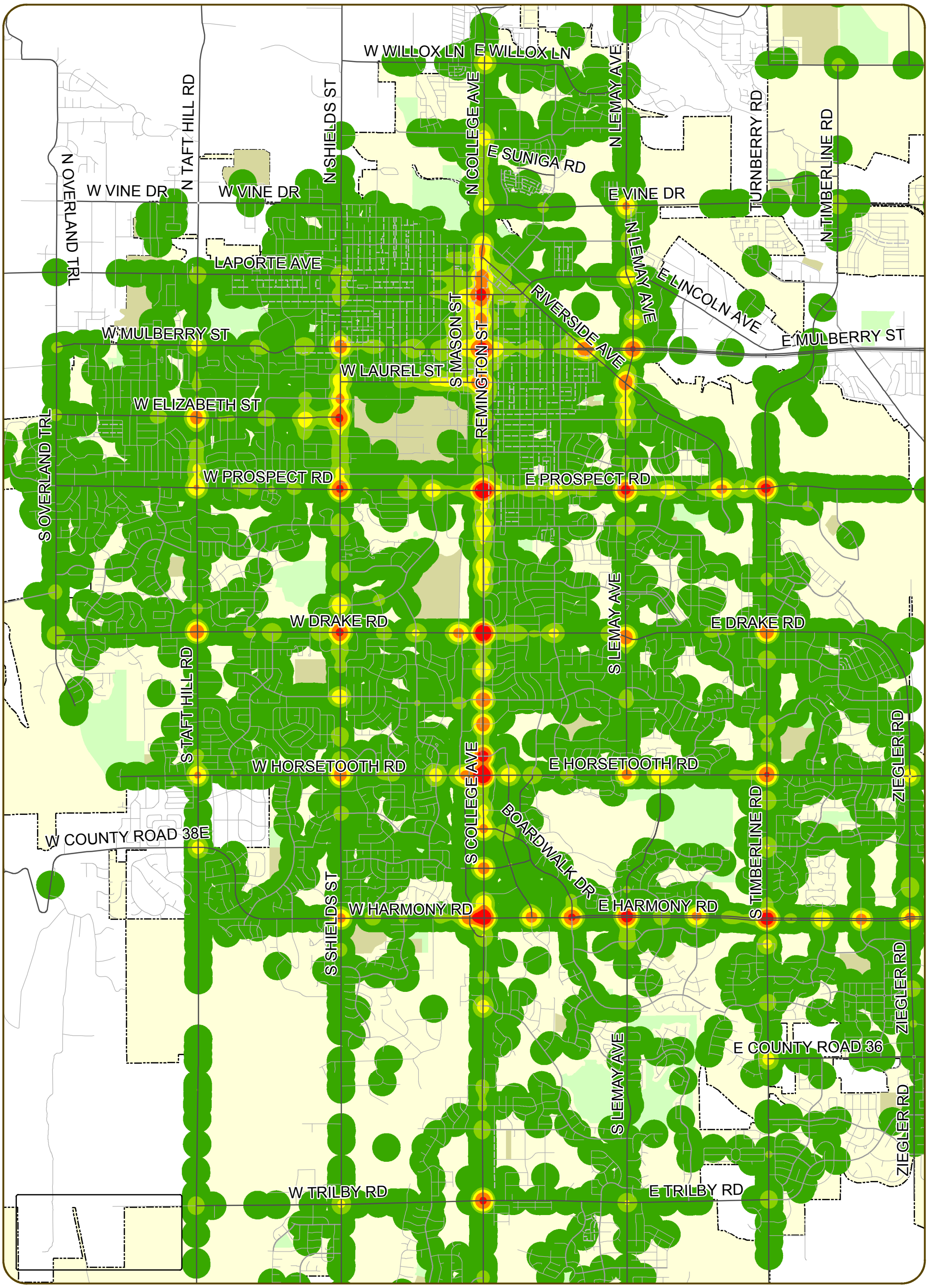
In addition to the efforts above, there are two areas that are identified as special focus areas for the coming years:

- A targeted effort in addressing certain **types** of crashes, not just certain **locations**. For instance, approach turn crashes may be addressed with the continued implementation of the Flashing Yellow Arrow and utilizing time of day protected turn phases. Another example is the education effort related to reducing bike/car crashes.

The ongoing efforts as well as the special focus areas will be used to continue to implement safety improvements for our transportation system. The analysis and review provided in this annual report provide the opportunity to monitor and evaluate the results, and guide the refinement of the program.

All Crash Types

1/1/2011-12/31/2015



Scale 1:41,016

0 0.125 0.25 0.5 0.75 1 Miles

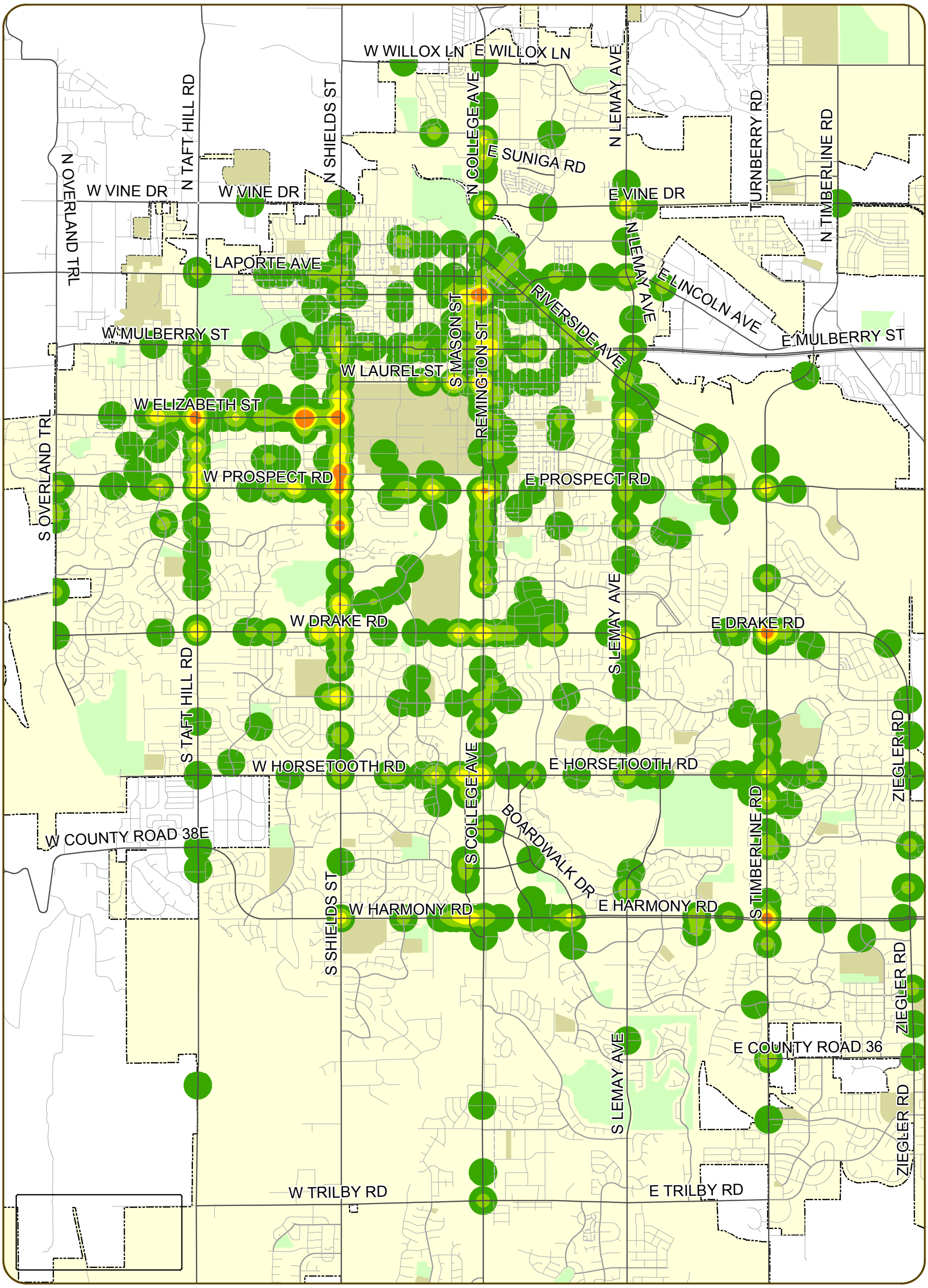
1-10 | 11-38 | 39-91 | 92-175 | 176+

N W E S

Printed: 10/5/2016

Bicycle Crashes

1/1/2011-12/31/2015



Scale 1:41,016

0 0.125 0.25 0.5 0.75 1 Miles

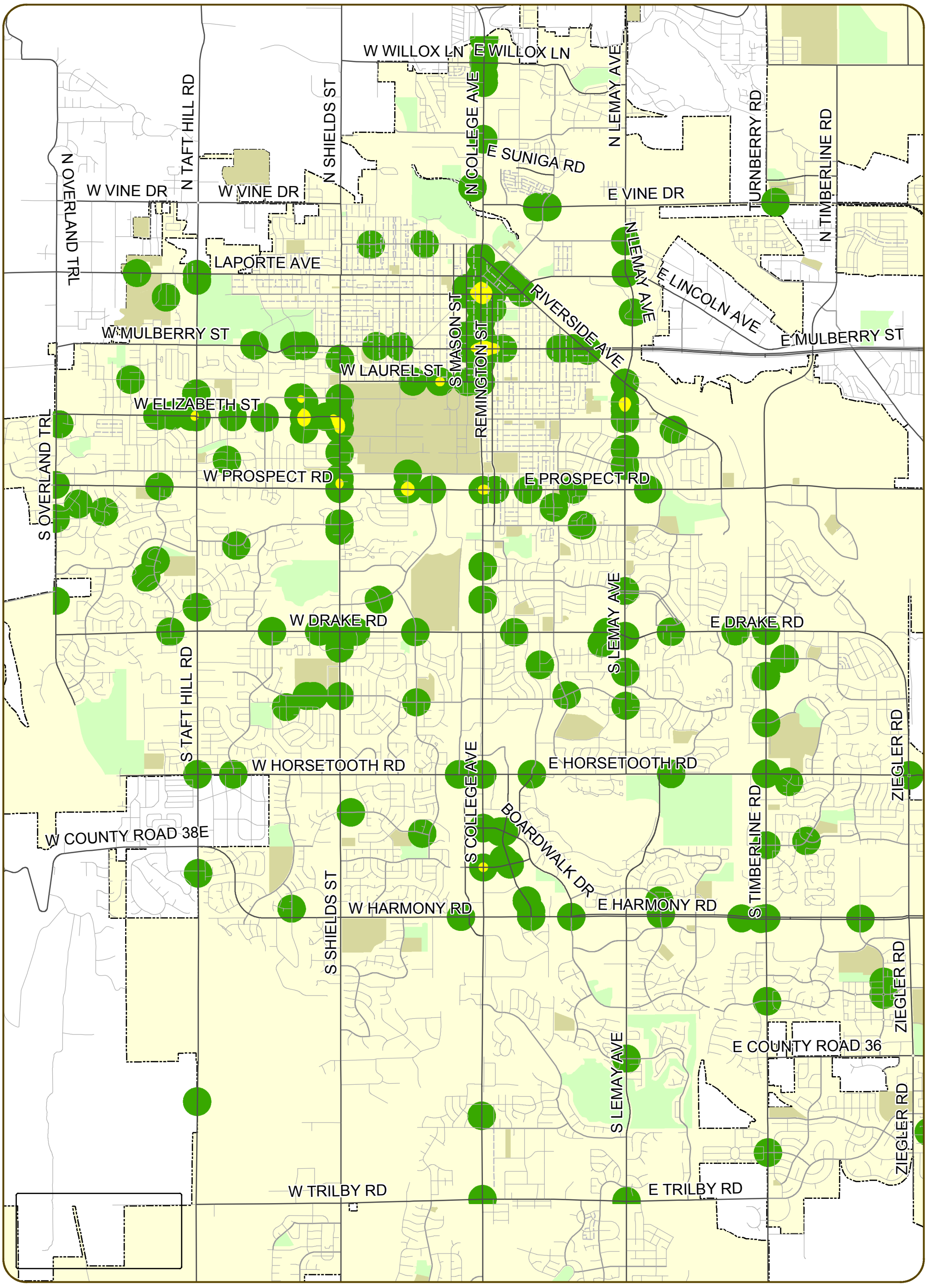
1 2-3 4-6 7-9 10+

N W E S

Printed: 10/5/2016

Pedestrian Crashes

1/1/2011-12/31/2015



Scale 1:41,016

0 0.125 0.25 0.5 0.75 1 Miles

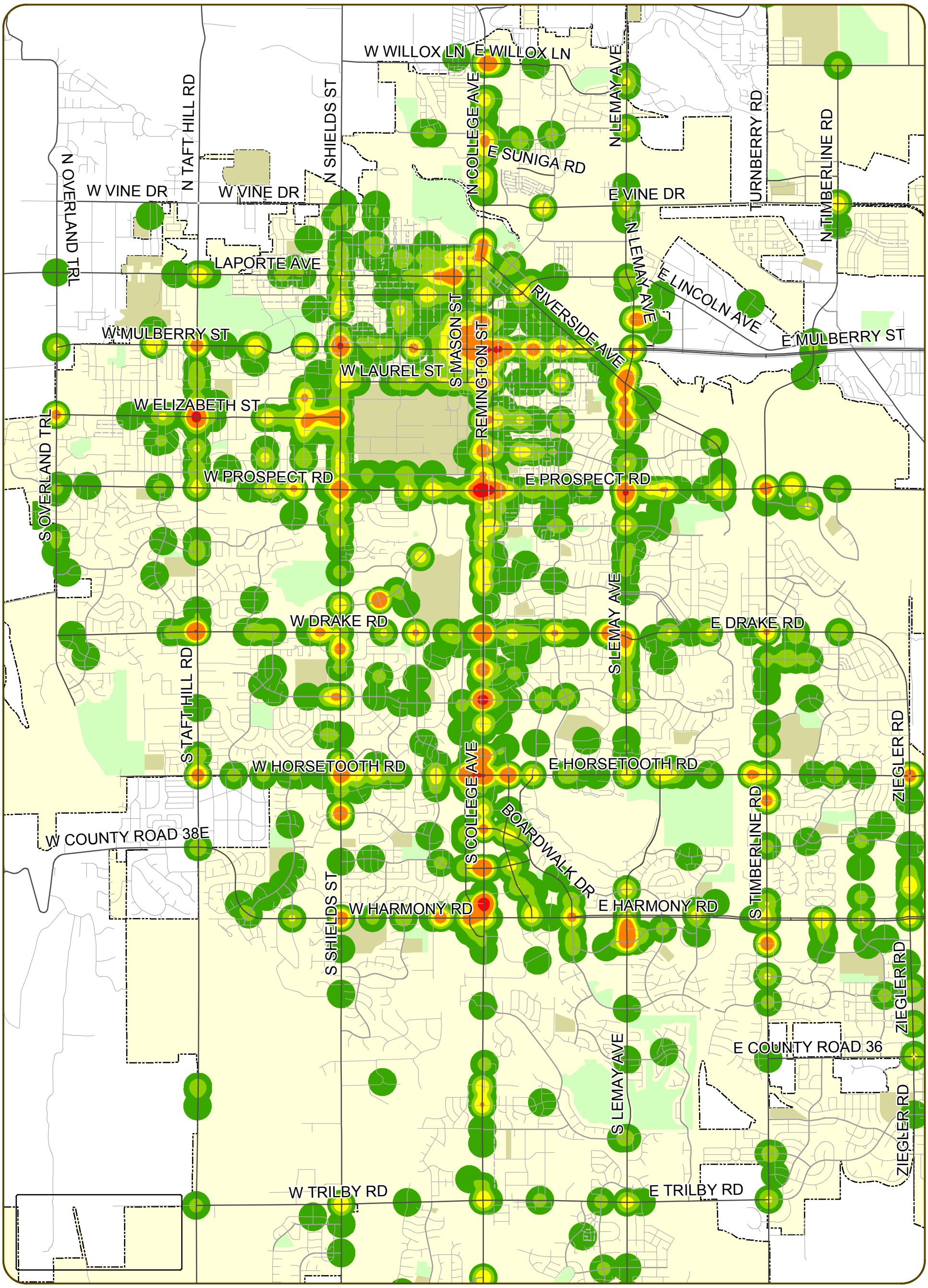
1 2 3

N W E S

Printed: 10/5/2016

Right Angle Crashes

1/1/2011-12/31/2015



Scale 1:41,016

0 0.125 0.25 0.5 0.75 1 Miles

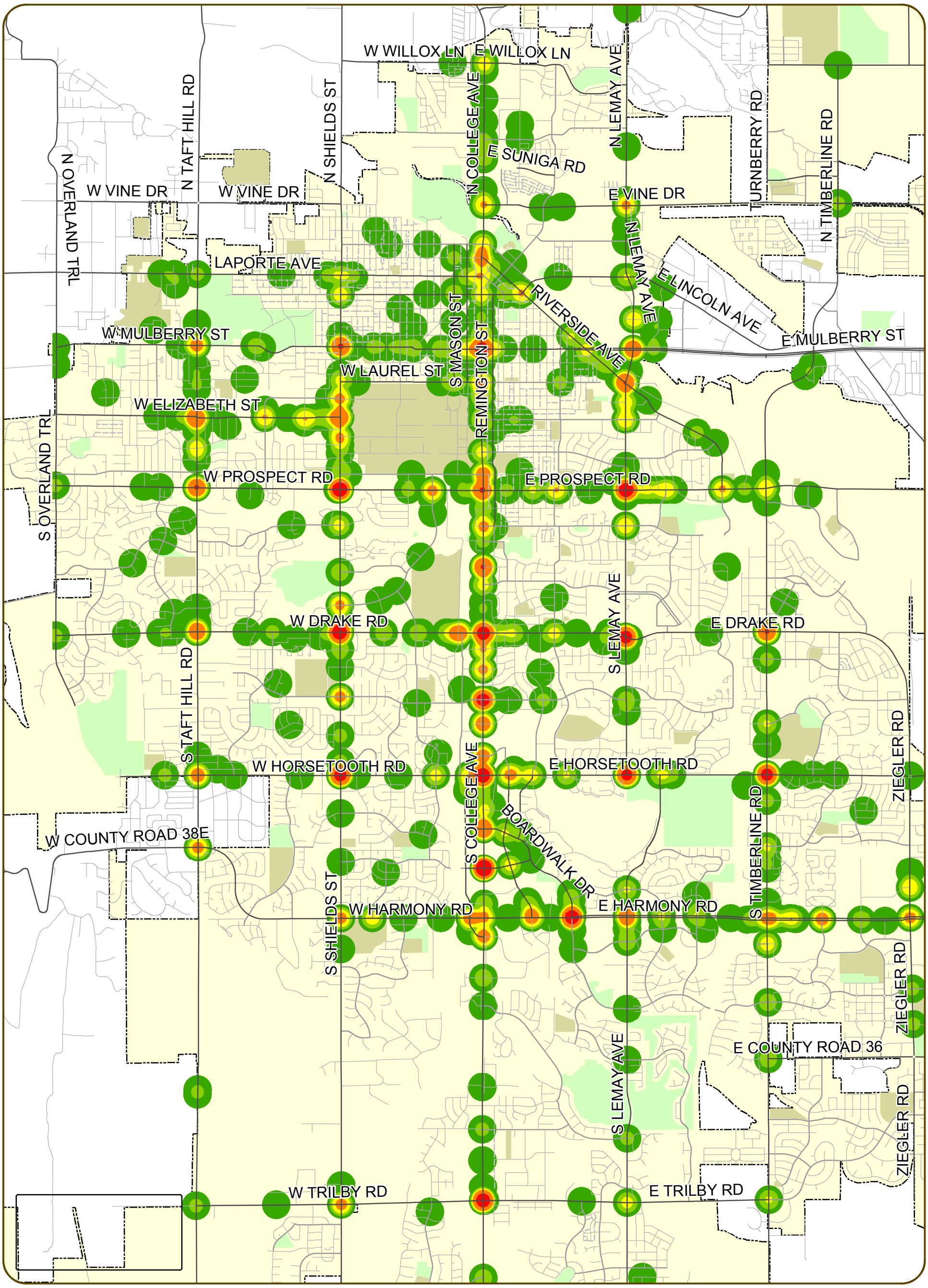
1-2 3-5 6-10 11-16 17+

N W E S

Printed: 10/5/2016

Approach Turn Crashes

1/1/2011-12/31/2015



Scale 1:41,016

0 0.125 0.25 0.5 0.75 1 Miles

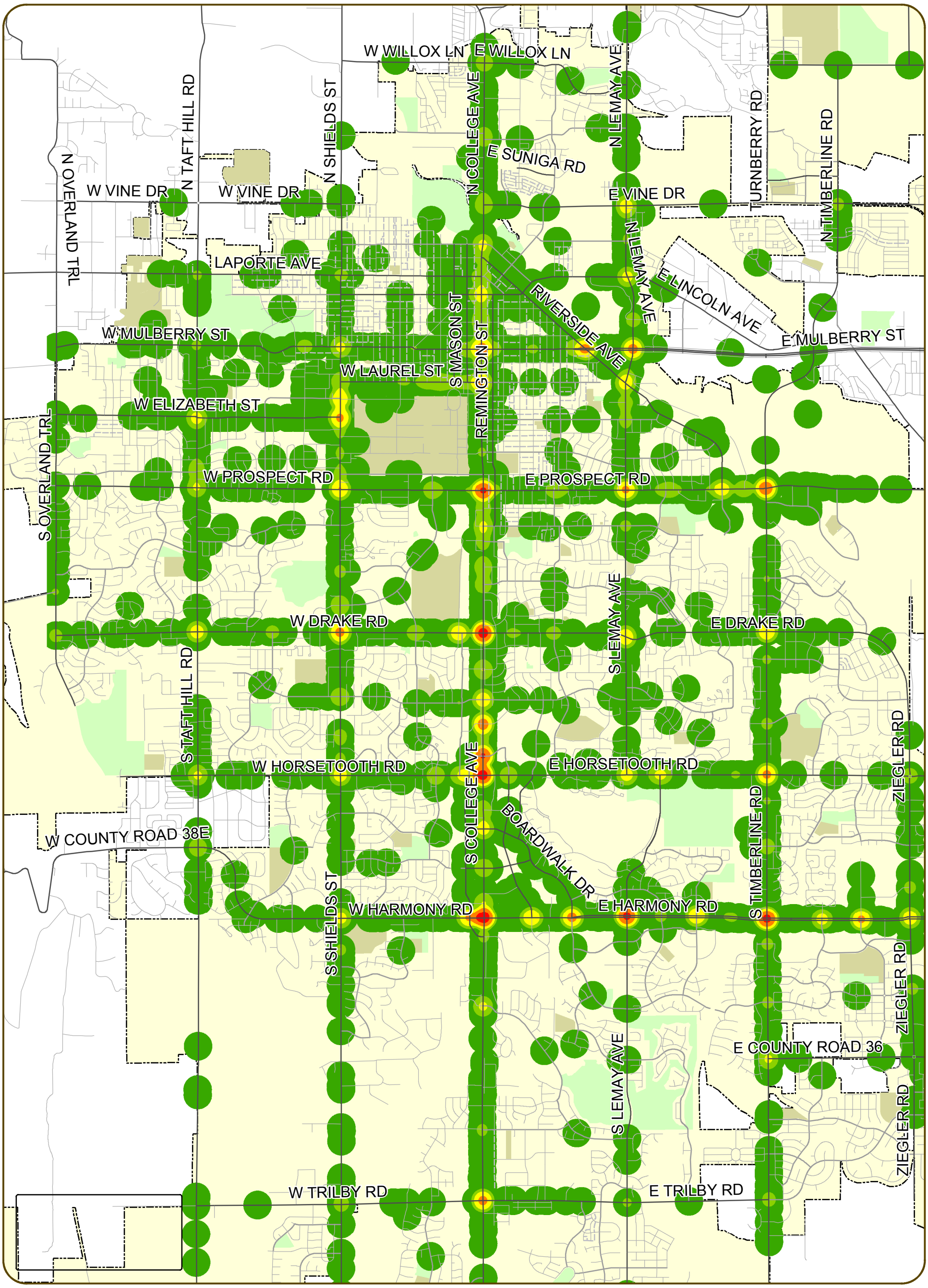
1-3 4-7 8-13 14-20 21+

N W E S

Printed: 10/5/2016

Rear-End Crashes

1/1/2011-12/31/2015



Scale 1:41,016

0 0.125 0.25 0.5 0.75 1 Miles

1-8 9-29 30-64 65-98 99+

N W E S

Printed: 10/5/2016