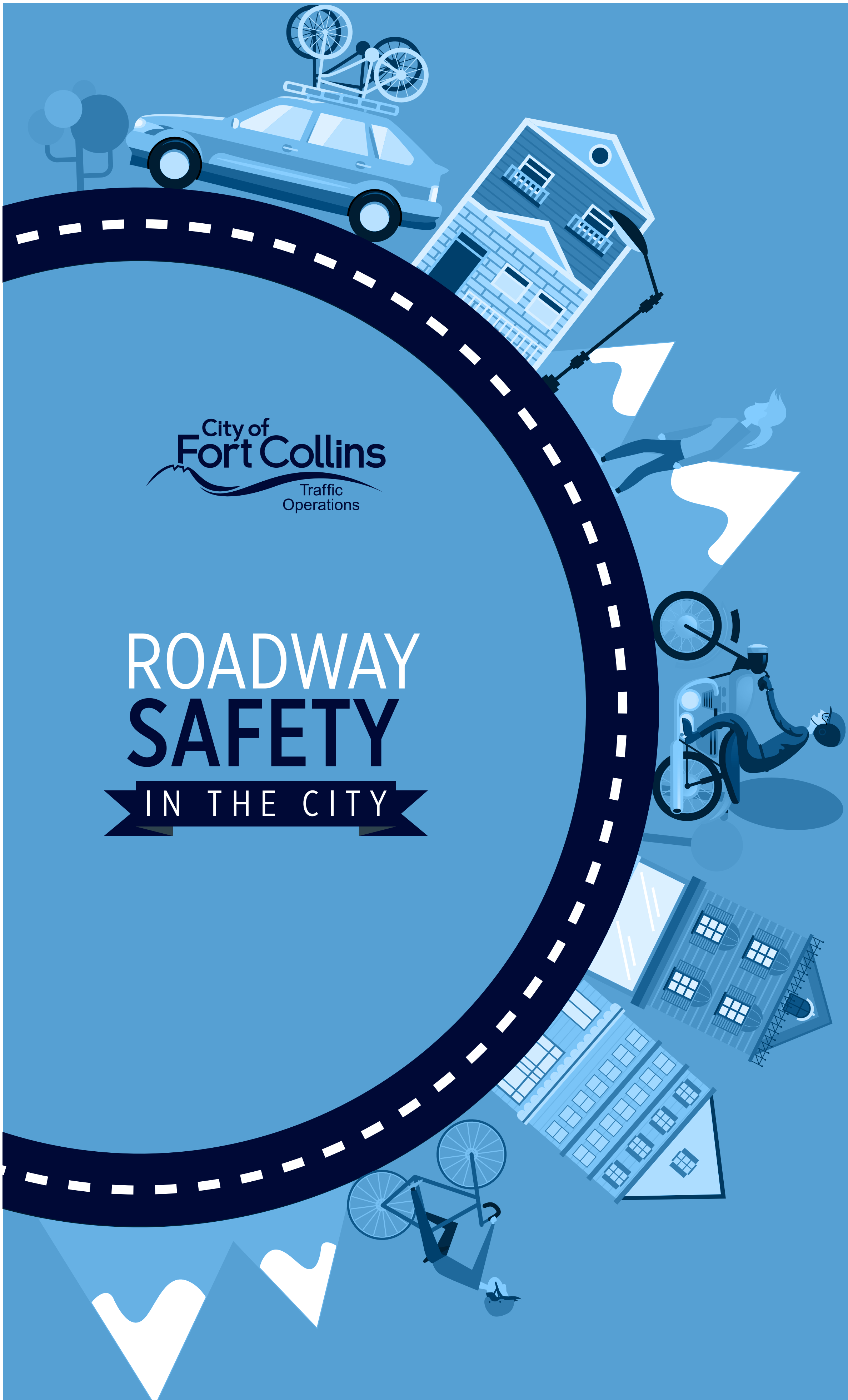

City of Fort Collins
Traffic Operations

ROADWAY SAFETY IN THE CITY

Annual Report
March 2018

18-19272

…ON THE ROAD TO REDUCING FATAL AND INJURY CRASHES AND IMPROVING SAFETY FOR ALL MODES OF TRAVEL.

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Table of Contents

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Executive Summary
Roadway Safety Matters

The City of Fort Collins strives to provide a safe and efficient transportation system for people using all modes of travel. Safety for roadway users is a top priority and in 2016 the City became the first public local entity to join the Colorado Department of Transportation (CDOT) Moving Towards Zero Deaths initiative.

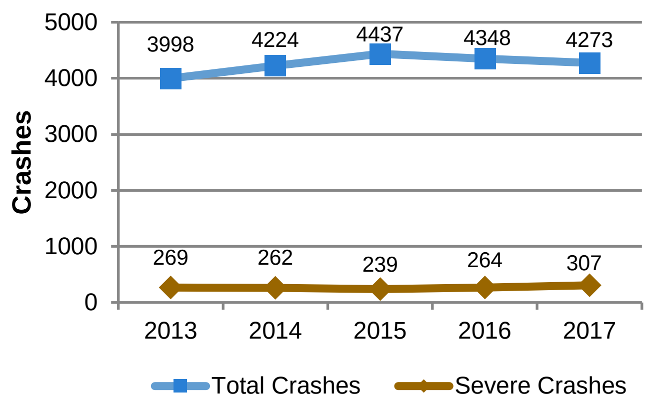
Making progress towards Zero Deaths requires a comprehensive and focused effort by multiple departments within the City, the community and individuals to be dedicated to and responsible for roadway safety.

This report is a detailed review of the City's roadway safety. It includes overall data, crash type analysis, specific location evaluation and trends, and discusses strategies, programs, projects and initiatives for improving safety.

The data presented in this report shows that the City's fatal collision rate remains among the lowest of both similar Colorado cities, as well as peer cities nationwide. Regardless, during 2017 there were still 294 crashes involving a non-incapacitating or incapacitating injury, and 13 individuals lost their lives as a result of a traffic crash. The number of fatal crashes is an all-time high for the City. The societal cost of these crashes was more than $190 million dollars.

Overall Crash Trends

There were 4,273 reported traffic crashes in 2017. This is 1.7% lower than 2016, and continues a downward trend over two years. Almost 80% of all crashes do not result in any injuries (property damage only). Severe crashes (non-incapacitating injury, incapacitating injury or fatal) are trending upwards.



Crash Locations

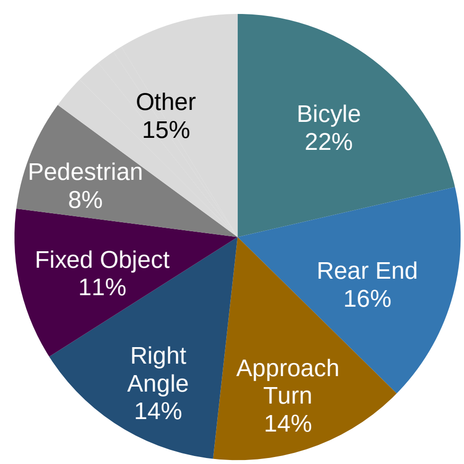
More than 70% of all crashes occur at intersections and/or driveways. Almost half of all crashes (49%) occur at signalized intersections.

Crash Types

Rear end crashes make up nearly half (44%) of all crashes, but most are minor crashes (only 2.4% of all rear end crashes are severe crashes).

Driving Under the Influence (DUI) crashes represent 4% of all crashes, more than 10% of severe crashes, and 18% of incapacitating or fatal crashes. Forty-eight percent of all severe fixed object crashes involve alcohol. Drivers below the age of 35 are significantly over-represented in alcohol related crashes.

For severe crashes, 86% are the result of one of six types of crashes as shown at right. Each crash type is reviewed in more detail in the report.



Severe crashes by type

Crash Trends

Bike and Pedestrian Crashes
Bicycle and pedestrian crashes account for only 4.2% of all crashes, but 24% of severe crashes, indicating the vulnerability of these road users. Both bike and pedestrian crashes are showing encouraging trends.

Total bike crashes are down **21%** and pedestrian crashes down **18%** since 2013 (5 years).

Total bike crashes are down 21% and severe bike crashes down almost 8% since 2013 (5 years). Eighty-nine percent of bike crashes occur at intersections or driveways. Twenty-five percent of all bike crashes involve wrong way riding by the cyclist. These statistics allow for targeted strategies with significant potential benefits.

Pedestrian crashes are also down, with total crashes down 18% and severe pedestrian crashes down 35% since 2013 (5 years).

Approach Turn Crashes
Approach turn crashes are indicating a concerning trend, with total approach turn crashes up 31% in five years. Staff is working on a targeted effort including the installation of flashing yellow arrows by time of day at specific locations to address this concern.

Intersection Evaluations

Traffic Operations staff is using the approach detailed in the national Highway Safety Manual (HSM) to evaluate more than 250 intersections to identify locations that have higher than expected crash frequency, and those with identified crash types and/or trends. This year's report includes a section on intersections with the greater increasing or decreasing crash frequency.

Improving Roadway Safety

Improving roadway safety involves both big and small initiatives and involves road users, vehicles, infrastructure, technology and emergency response.

Engineering efforts include low cost improvements, capital projects, and longer term multi-modal planning. A number of these projects have resulted in significant crash reductions.

28% reduction in annual crashes at Shields / Elizabeth after completion of the intersection improvement project.

Education and encouragement efforts include a broad range of programs, classes, outreach and information for people of all ages.

Enforcement involves the City's Police Services Department which undertakes everything from DUI campaigns to Bike Safety Week. Police Services partners with Fort Collins Municipal Court in the Bicycle Traffic Citation Course.

Evaluation is the keystone to continuing to refine the program in a manner that is data driven and focused on proven crash reduction strategies.

Next Steps

Traffic Operations and other City staff will continue to utilize the information in this report to identify areas of focus for coming years. Further refinements and analysis can identify the most proven strategies and provide targeted information for various initiatives.

The next step in Towards Vision Zero is to develop an Action Plan. The plan, to be created in the next year, will be comprehensive, multi-departmental and include community based set of actions that reflects the understanding that all of us have a role in decreasing serious injury and fatal crashes.

Section 1
Introduction

The City of Fort Collins is a vibrant city of 167,500 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.

Roadway Safety

Transportation safety is always a priority for the City. In the past year, there were more than 4,200 traffic crashes in Fort Collins. On average, that is more than 11 crashes per day. Almost 950 of the crashes involved some level of injury (minor injury or more serious injury), and thirteen involved a fatality (an all time high). In 2017 alone, the annual societal costs of these crashes were more than $190 million dollars.

Safety Matters

In 2017, there were 307 crashes involving a serious injury or fatality in Fort Collins

This Roadway 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, analyzes specific types of crashes in more detail, and evaluates locations for higher than expected crashes, trends, and specific patterns that can lead to mitigation strategies. It also discusses and evaluates efforts to continuously improve safety for all modes of travel.

Moving Towards Vision Zero

In late 2016, the City of Fort Collins became the first public local entity to join the Colorado Department of Transportation's (CDOT) Moving Towards Zero Deaths initiative. The proclamation reflects the City's commitment to the vision of zero traffic-related deaths.

Making progress towards Vision Zero requires a multifaceted, focused effort. The following elements detailed in this report serve as a starting point and an on-going roadmap:

- Understand crash trends to inform mitigation strategies as well as policies, standards, design, and projects
- Analyze intersections to identify high crash locations and their types and trends
- Focus on specific crash types and behaviors more likely to result in serious injuries and fatalities

The analysis is then applied to the various "E"s of roadway safety:

- Engineering: Physical changes such as signs, striping, signal timing, and geometric changes
- Education/Encouragement: Programs and outreach efforts for all road users to teach and support safer behaviors.
- Enforcement: Collaboration with police services and justice system to conduct targeted education and enforcement and provide alternative sentencing that is focused on changing behavior.

- Evaluation: Continue monitoring and evaluating all aspects of roadway safety in order to inform upcoming work and next year's report.

Using the Document

This document is intended to be used as an informational and educational piece as well as a benchmarking tool to track progress on efforts to reduce the number and severity of crashes. The document serves as a tool to 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 provides 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 analyses represent five years of data, from 2013 to 2017.

Section 2

General Safety Information

The total number of crashes per year for the past five years is shown below. Total crashes are down for the second year in a row, although up 6.9% when compared to 2013. Severe (serious injury and fatal) crashes have increased 14% over the span of five years. (For comparison, population has increases by 9%.)

Increase in traffic crashes 2013-2017:

7%

Total Number of Crashes

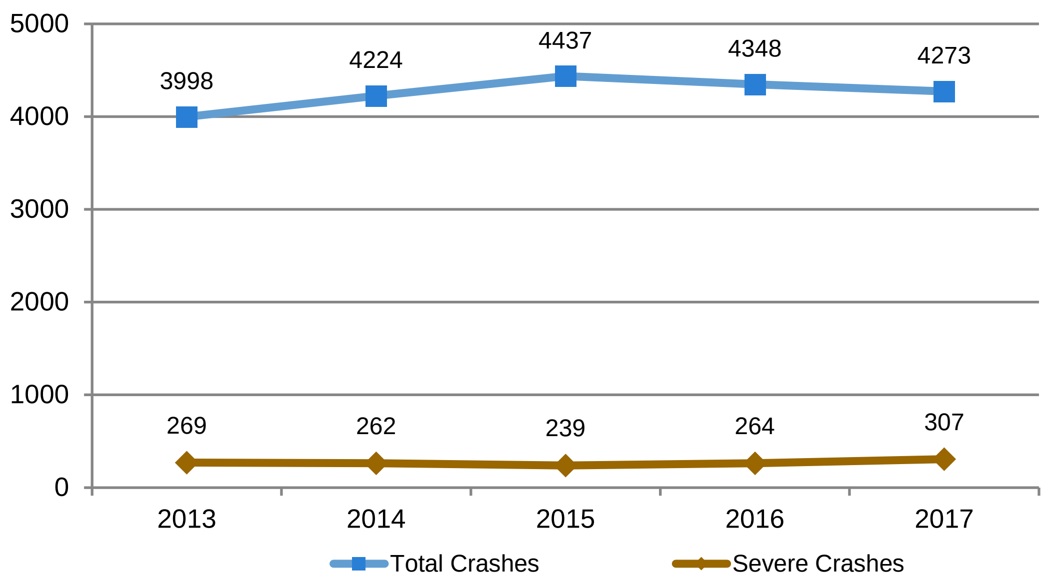


Figure 1

Total number of crashes 2013 to 2017

Number of Total Crashes with Injuries

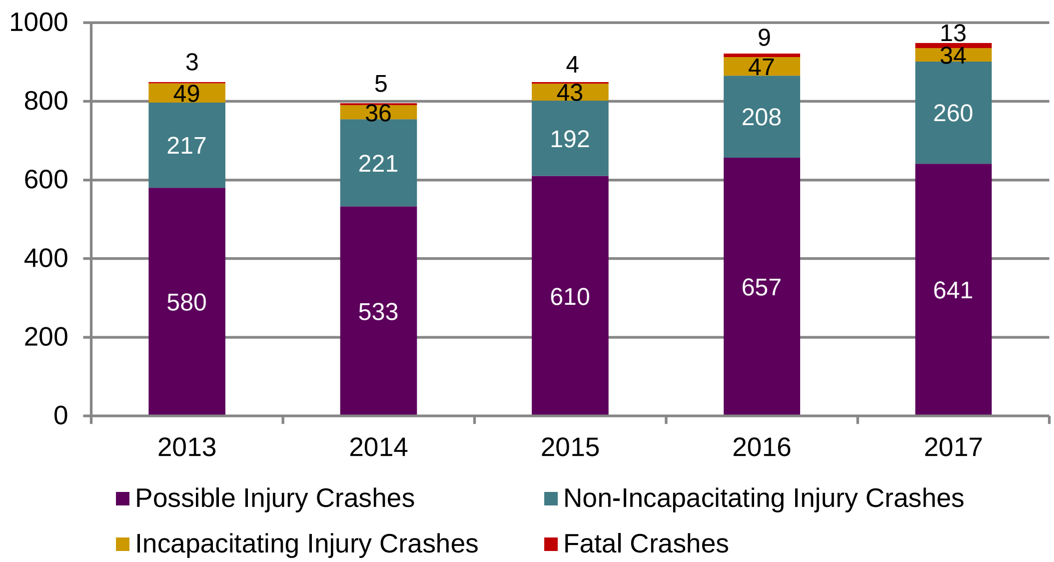


Figure 2

Shows crashes with possible injuries, non-incapacitating injuries, incapacitating injuries, fatal crashes

A severe crash is one that involves non-incapacitating, incapacitating, or fatal injuries

Vulnerable Road User Crashes (Bicycle, Motorcycle,and Pedestrian)

The total number of crashes for vulnerable road users is shown below. More detail is provided in later sections of the report for each group of road users.

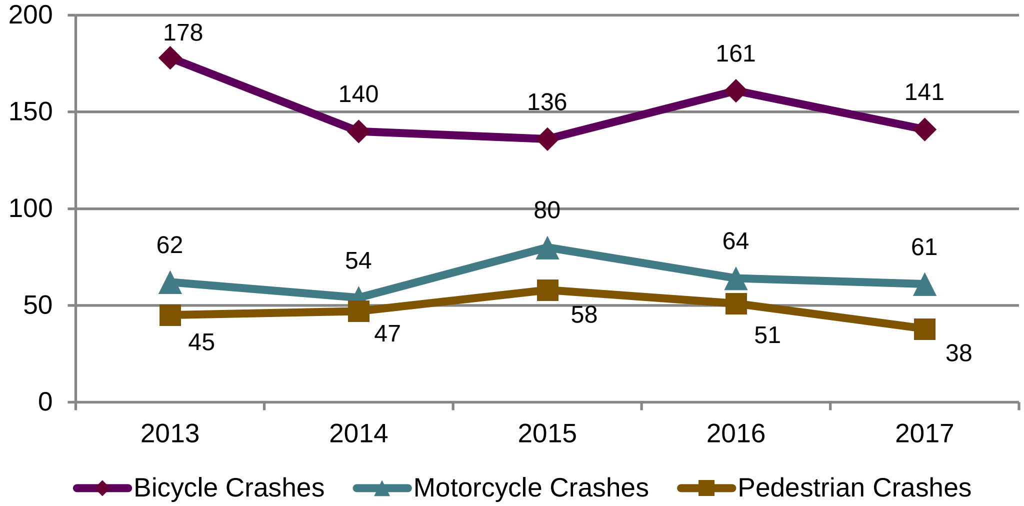
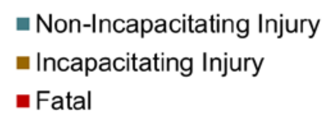


Figure 3

Total reported crashes involving bicycles, motorcycles, and pedestrians (2013 – 2017)

Severe Injury and Fatal Crashes for Vulnerable Road Users (Bicycles, Motorcycles and Pedestrians)



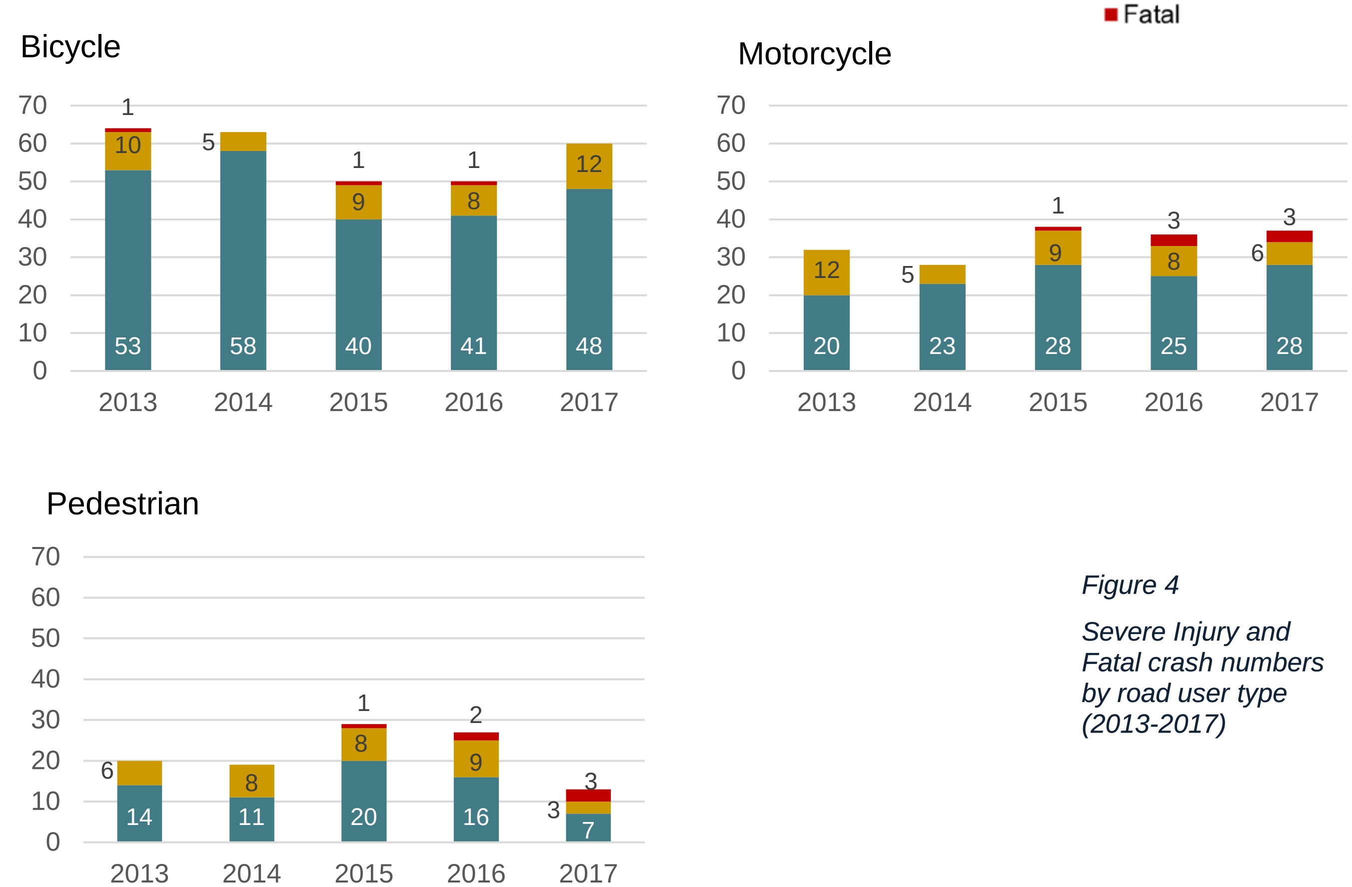
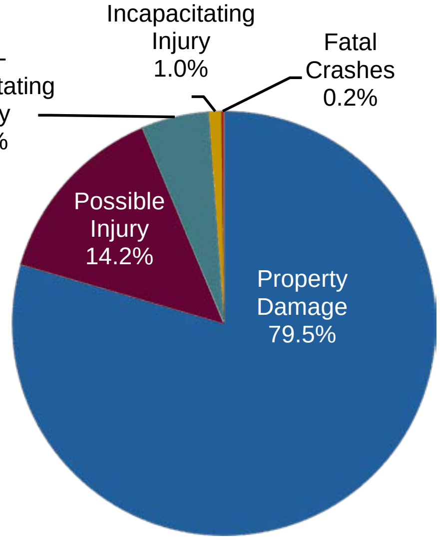


Figure 4

Severe Injury and Fatal crash numbers by road user type (2013-2017)

Crash Severity

The chart at right shows the overall severity for crashes (2013-2017). 80% of all reported crashes do not result in an injury.



Only **6.4%** of all crashes are severe.

Figure 5

Crash severity (2013-2017)

Severe crashes (those involving non-incapacitating, incapacitating or fatal injuries) can be divided by type of road users and are shown below (totals for the past five years).

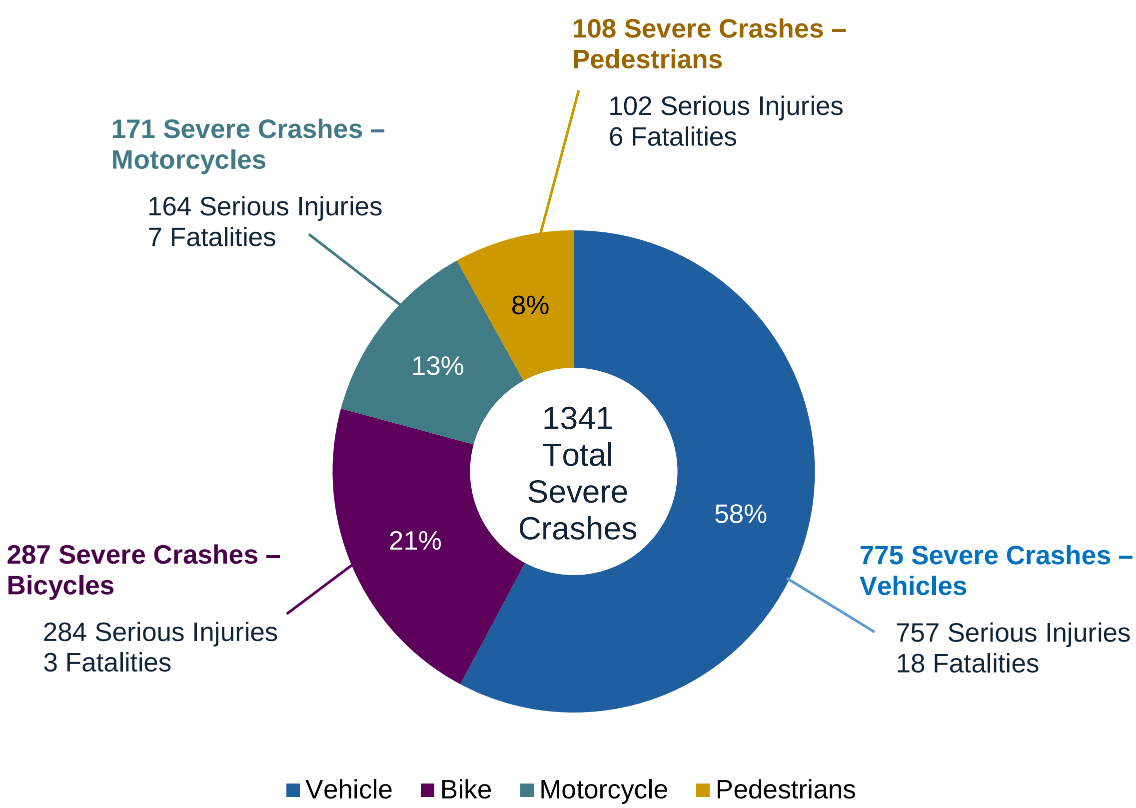


Figure 6

Severe crash data by road user (2013-2017)

2017 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 2017 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 2017:

$ 192 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	3325	$ 10,400	$ 34,580,000
Possible Injury Crashes	641	$ 64,200	$ 41,152,200
Non-Incapacitating Injury Crashes	260	$ 114,000	$ 29,640,000
Incapacitating Injury Crashes	34	$ 312,000	$ 10,608,000
Fatal Crashes	13	$ 5,894,500	$ 76,628,500
Total	**4,273**		**$ 192,608,700**

Table 1

Economic impact of traffic crashes in Fort Collins in 2017

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 tables below are sorted by fatal crash rate and compare Fort Collins to other cities in Colorado with similar population and also compare to other peer cities nationwide with similar population (between 85,000 and 225,000).

Table 2

Fatal crash rate comparison to other Colorado Cities

Colorado Cities								
City	**Population**	**Fatal Crashes, 2013 - 2017**						**Fatal Crash Rate** (Crashes per 100,000 Population)
		2013	**2014**	**2015**	**2016**	**2017**	**Avg.**	
Lakewood	154,393	6	13	15	13	8	11.0	7.1
Pueblo	110,291	6	8	4	5	16	7.8	7.1
Greeley	103,990	5	8	5	7	11	7.2	6.9
Arvada	117,453	4	4	6	10	4	5.6	4.8
Thornton	136,703	4	4	3	11	9	5.4	4.5
Longmont	92,858	2	4	5	2	6	3.8	4.1
Fort Collins	167,500	3	5	4	8	13	6.6	3.9
Boulder	108,090	0	0	1	6	0	1.4	1.3
Total CO Cities	991,278	30	46	43	56	67	48.4	4.9

Colorado crash data is from CDOT. Population estimates are for 2017 and are from the U.S. Census

Table 3

Fatal crash rate comparison to similar peer cities nationwide

Peer Cities								
City	**Population**	**Fatal Crashes, 2012 - 2016**						**Fatal Crash Rate** (Crashes per 100,000 Population)
		2012	**2013**	**2014**	**2015**	**2016**	**Avg.**	
Boca Raton, FL	96,114	12	12	10	12	18	12.8	13.3
Springfield, MO	167,319	19	13	14	21	19	17.2	10.3
Coral Springs, FL	130,059	5	10	7	8	13	8.6	6.6
Norman, OK	122,180	8	8	7	9	6	7.6	6.2
Broken Arrow, OK	107,403	11	7	3	8	4	6.6	6.1
Richardson, TX	113,347	5	3	7	8	10	6.6	5.8
San Angelo, TX	100,702	4	6	7	8	3	5.6	5.6
Olathe, KS	135,473	4	8	2	5	7	5.2	3.8
Cedar Rapids, IA	131,127	7	2	5	1	8	4.6	3.5
Overland Park, KS	188,966	8	4	3	7	7	5.8	3.1
Bellevue, WA	141,400	5	4	3	6	3	4.2	3.0
Fort Collins, CO	161,000	3	3	5	4	8	4.6	2.9
Naperville, IL	147,122	2	1	3	0	4	2.0	1.4
Total Peer Cities	1,742,212	93	81	76	97	110	91.4	5.2

Note: 2016 is most current national data available

Crash data for other communities outside Colorado (peer cities) was obtained from the National Highway Traffic Safety Administration's Fatal Accident Reporting System which contains data through 2016. Population estimates are for 2016 and are from the U.S. Census.

Additional Crash Statistics

Crashes by Month 2013-2017

The variation of crashes by month is shown below. The number of crashes varies by more than 30% from month to month with more crashes occurring in the fall and winter than in the spring and summer. Inclement weather and a higher student population at those times likely contribute to the increase seen during the colder months.

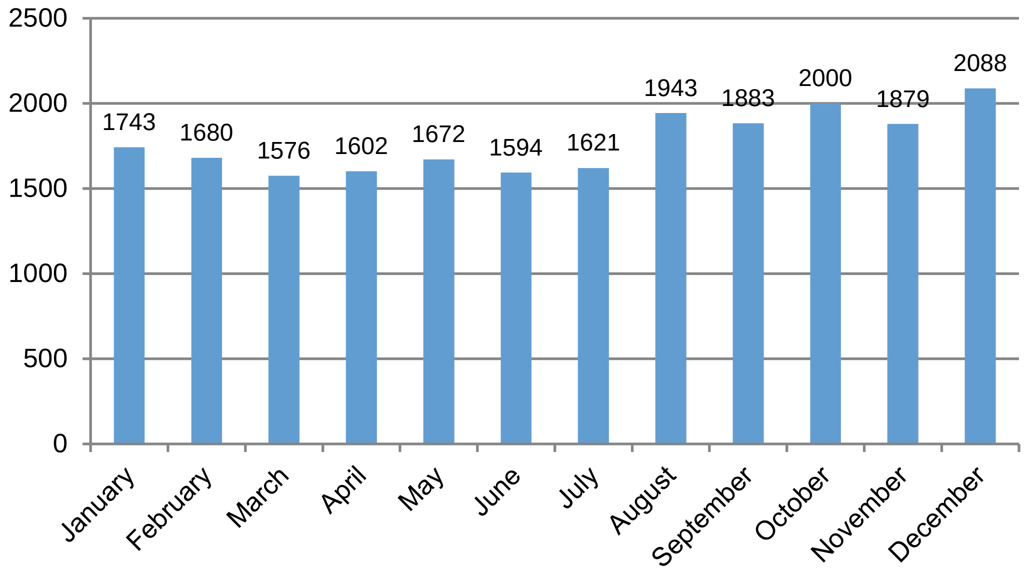


Figure 7

Crash variation by month (2013-2017)

Crashes by Day of Week 2013-2017

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 (brown line).

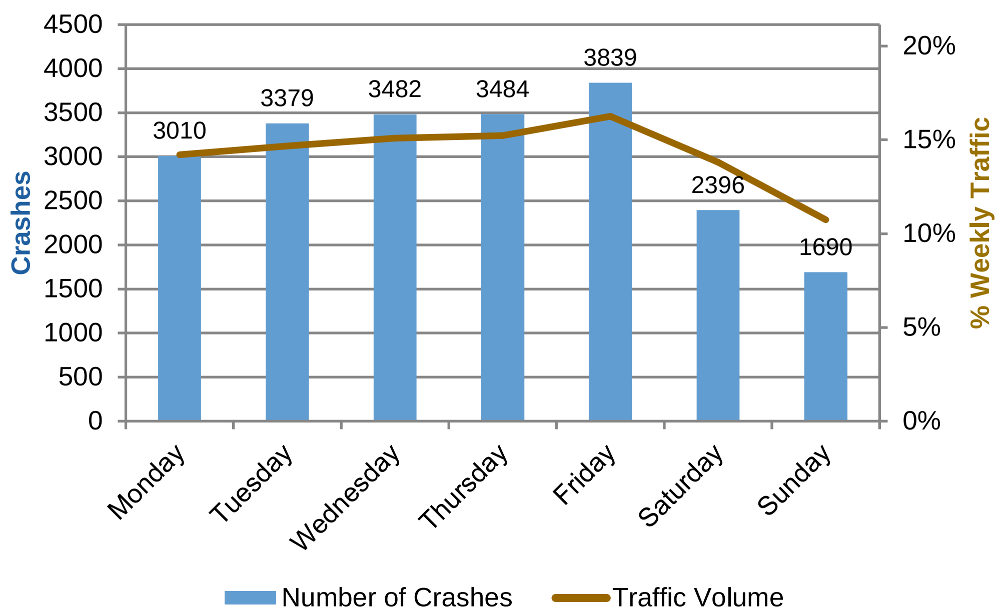


Figure 8

Crashes by day of week (2013-2017)

Crashes by Time of Day 2013 – 2017

The graphs below show crashes by time of day for weekdays, Saturdays and Sundays respectively. The charts also show the percentage of daily traffic by hour (brown line).

On weekdays (Monday-Friday), crashes are overrepresented during the afternoon peak hours from 3 p.m. to 5 p.m.. 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 Saturdays and Sundays is overrepresented.

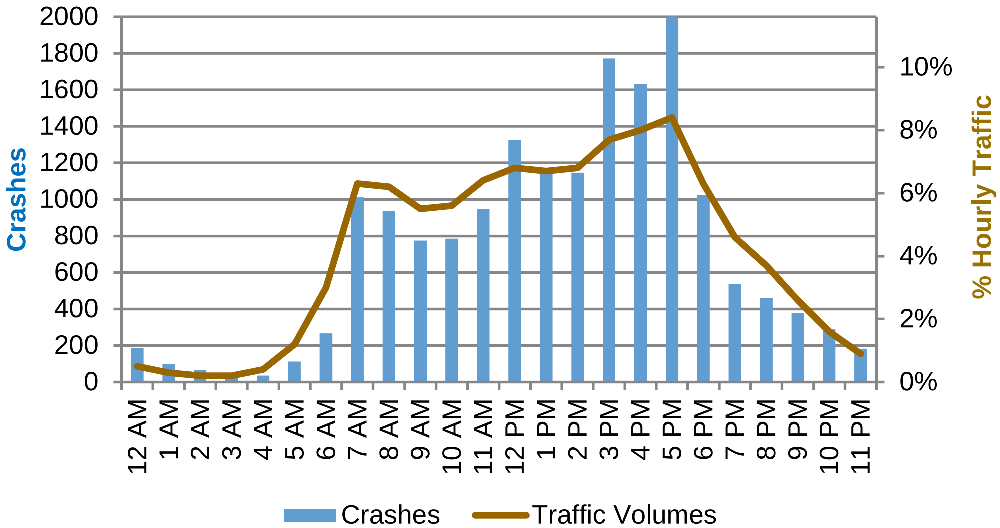
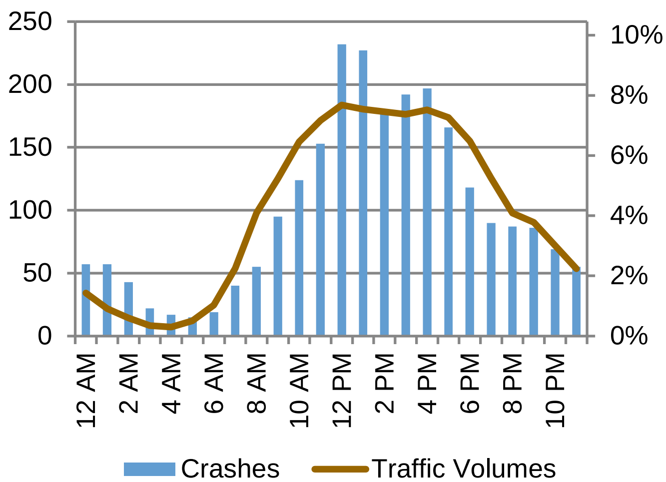


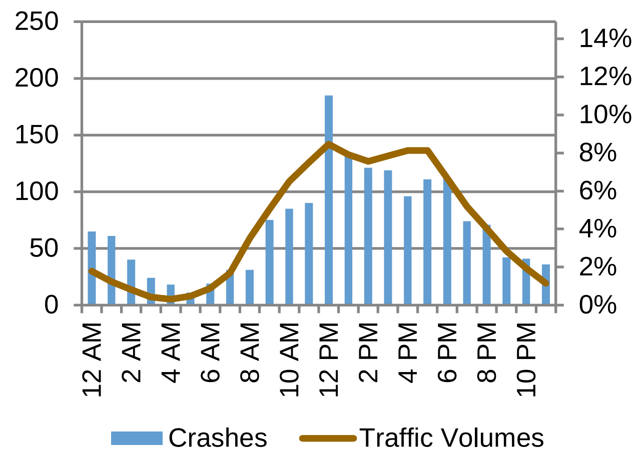
Figure 9

Weekday crashes by time of day (2013-2017)

Saturday Crashes and Volumes



Sunday Crashes and Volumes

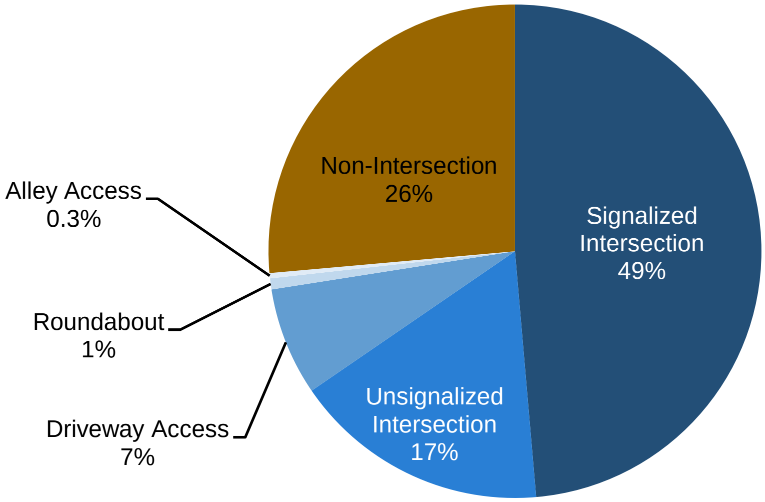


Figures 10,11

Saturday and Sunday crashes by time of day (2013-2017)

Locations of Crashes 2013-2017

The chart below shows the location of crashes in Fort Collins. Crashes at intersections or driveways account for 74% 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

Figure 12

Crash location (2013 – 2017)

At Fault Drivers by Age 2013-2017

The chart below compares the number of crashes, by age, of at-fault drivers 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 address this challenge are appropriate at all levels (local as well as statewide and national).

Teenagers represent **5.3%** of all drivers but are responsible for **15.5%** of all crashes

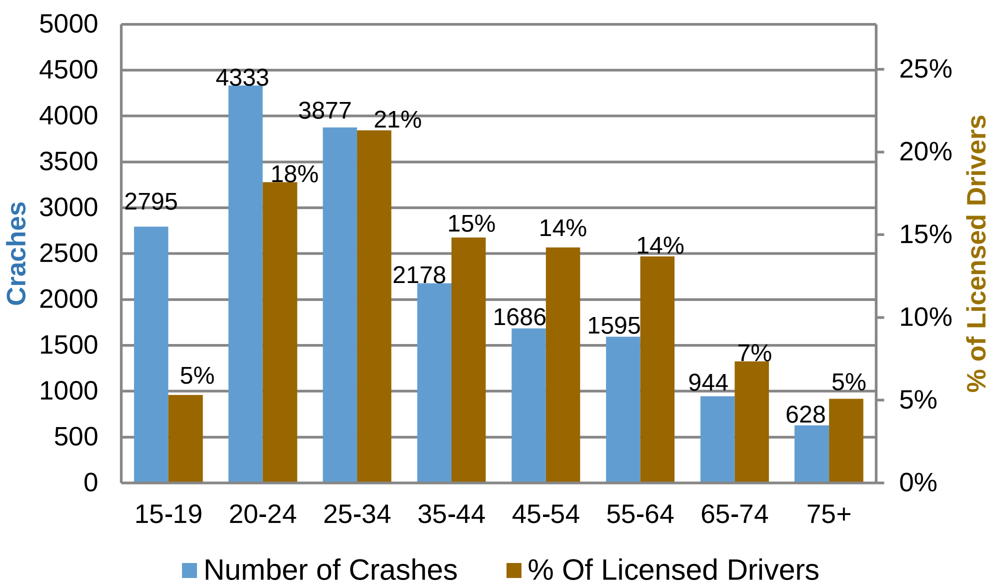


Figure 13

Crashes by age of at fault drivers (2013 – 2017)

Crashes by Age and Gender 2013-2017

The graph below shows crashes by age and gender (some crashes are not included if gender information was not 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.

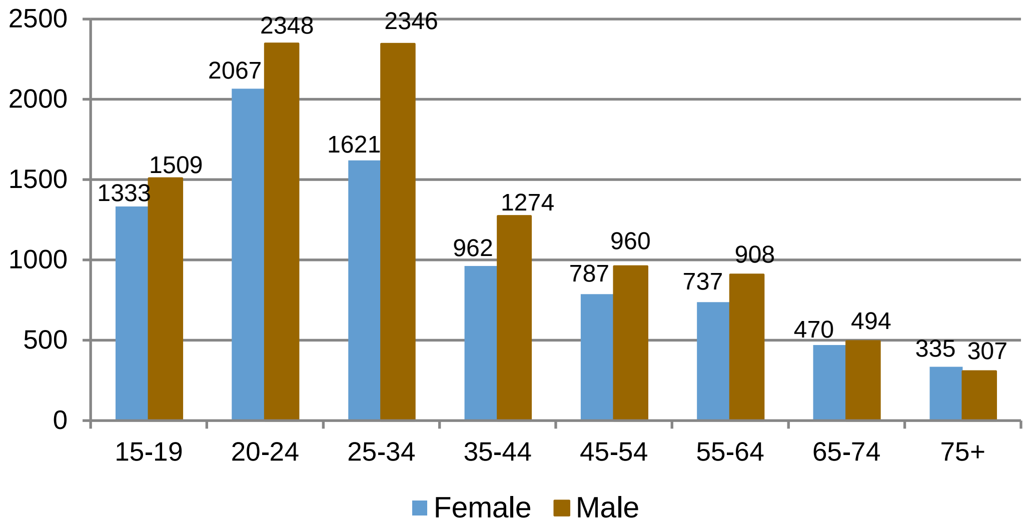


Figure 14

Crashes by age and gender of at fault drivers (2013 – 2017)

Drivers Under the Influence (DUI Crashes) 2013-2017

Crashes involving DUI represent **4%** of all crashes **11%** of severe crashes and **18%** of fatal crashes

The graph below shows the number of DUI crashes over the past five years. The DUI crashes represent about 4% of all crashes. However, they account for 11% of severe crashes, and almost 18% of fatal crashes. This suggests that alcohol related crashes are more likely to result in serious injuries.

Although total DUI crashes are down 20% since 2016 and down 4% in five years, severe crashes involving DUI continue to trend upward. There's been a 48% increase in severe DUI crashes in the last five years.

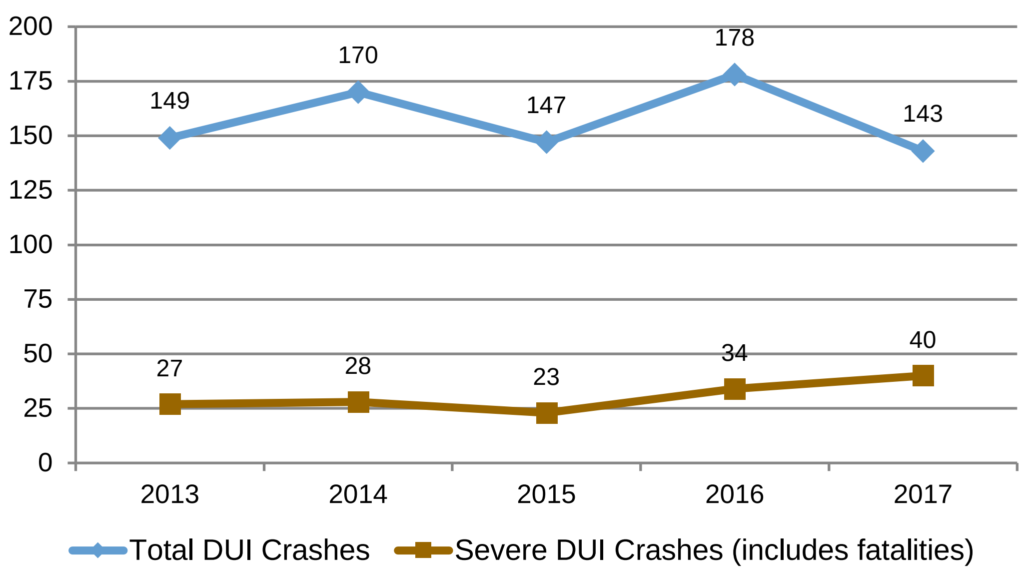


Figure 15

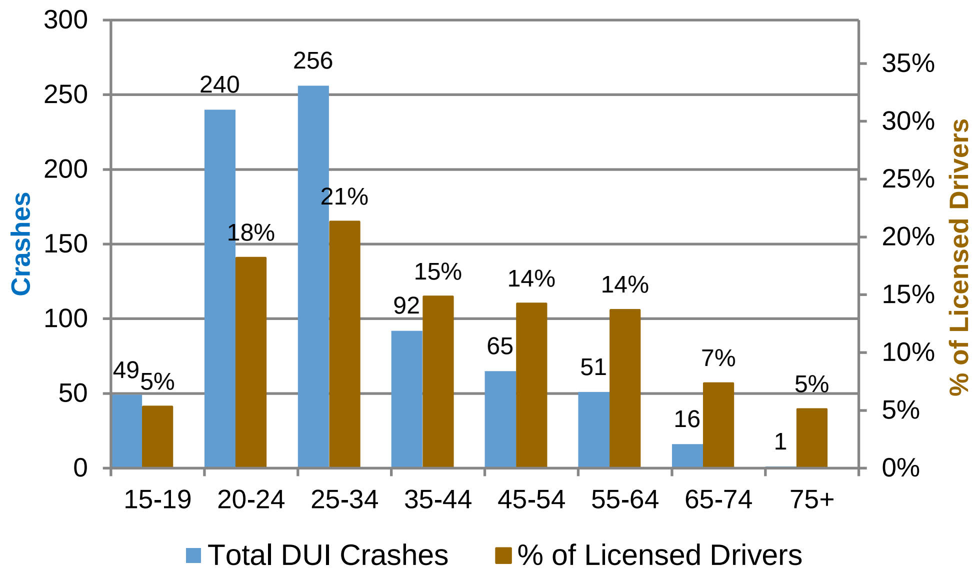
DUI crash trends (2013 – 2017)

48% increase in severe DUI crashes since 2013

DUI Crashes by Age 2013 – 2017

Crashes in the past five years that involve DUI are shown below by age of at fault drivers.

Drivers below the age of 35 are significantly over-represented in alcohol related crashes given the number of licensed drivers in those age groups. 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

24%

of licensed drivers but cause

38%

of DUI crashes

Figure 16

DUI crashes by age of at fault drivers (2013 – 2017)

Motorcycle Crashes 2013 – 2017

From 2013 - 2017 there were a total of 321 reported motorcycle crashes, including seven fatalities (three in 2017). Total crashes are trending downward in the last two years, and are similar to five years ago.

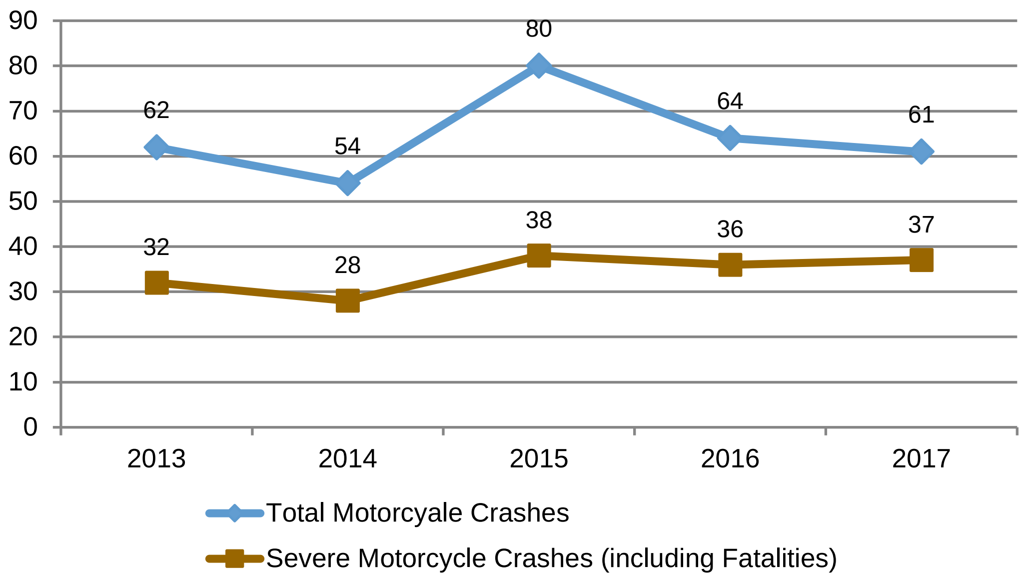


Figure 17

Motorcycle crashes (2013 – 2017)

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 20% of crashes result in some type of injury while 72% of motorcycle crashes result in injury.

In a crash, motorcyclists are more than **three** times as likely to be injured and **11** times as likely to be killed than people in vehicles

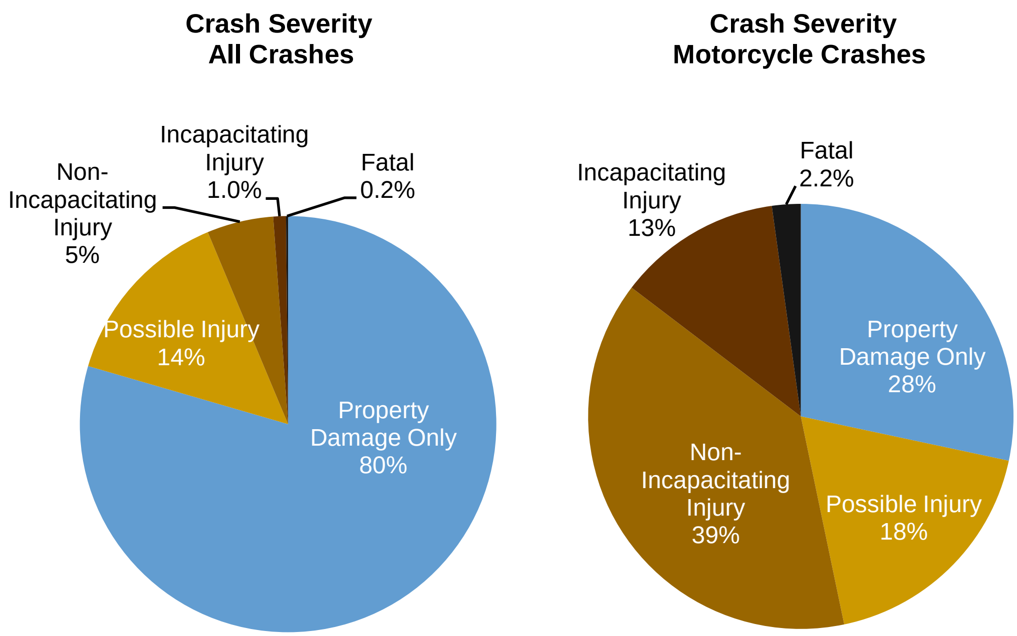


Figure 18

Comparison of crash severity between all crashes and motorcycle crashes

Section 3

Detailed Review of Most Frequent Severe Crash Types

Crashes are categorized into a variety of types. The definitions and explanations are detailed below:

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 cyclist.

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.

Crash Types by Severity

All Crashes by Type 2013 – 2017

Rear end crashes make up nearly half of all crashes. Right angle, side to side, approach turn, parking related, and fixed object crashes are the next most common types of crashes in the CIty. All together, they account for about 88% of all reported crashes in Fort Collins.

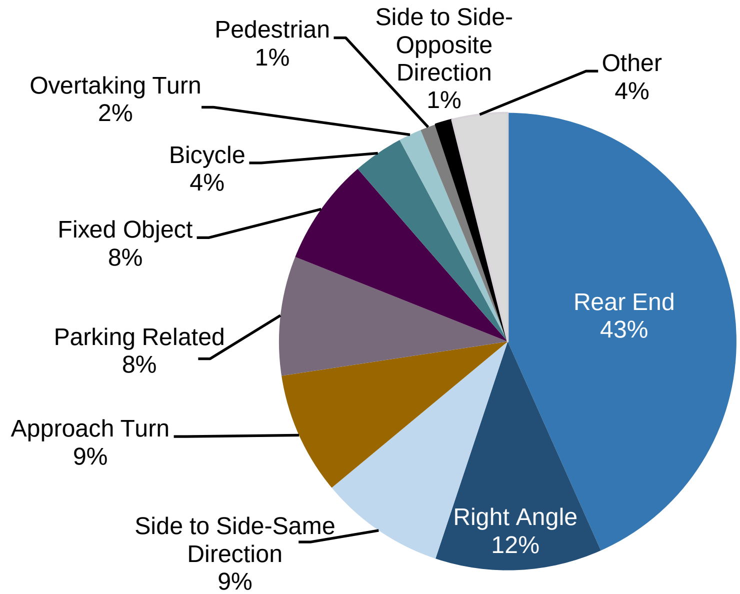


Figure 19

All Crashes by Type (2013– 2017)

Severe Crashes by Type 2013 – 2017

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. These six crash types are discussed in more detail in subsequent pages.

Note that while bicycle and pedestrian crashes make up only about 5% of total crashes they make up 30% of severe crashes.

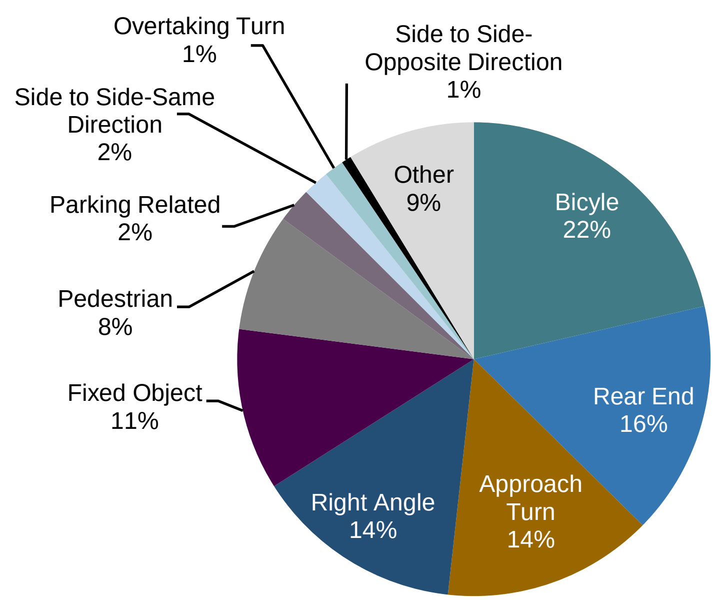


Figure 20

Severe Crashes by Type (2013 – 2017)

Bicycle Crashes

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 bike crashes in Fort Collins. The general trend for bike crashes was upwards for a number of years, then a significant decrease began in 2014. Both total and severe bicycle crashes are similar in number as ten years ago.

Total bike crashes are down **21%** and severe bike crashes down **8%** since 2013 (5 years).

Number of Bike Crashes

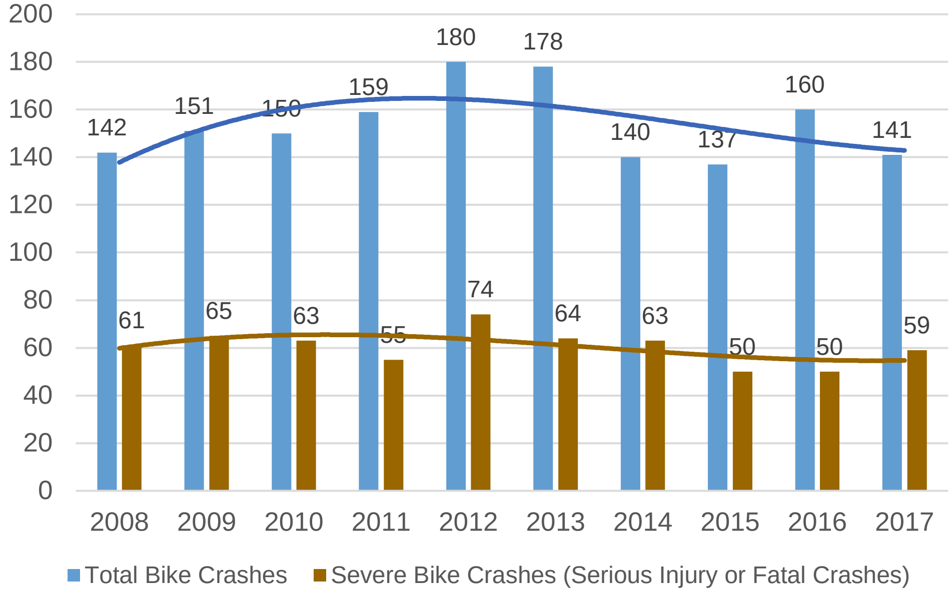


Figure 21

Historical bike crash data (10 years)

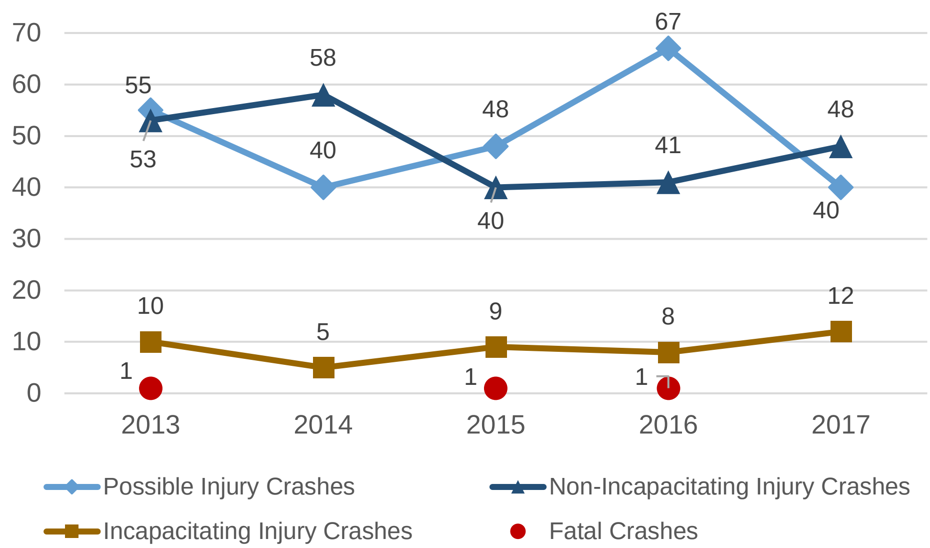
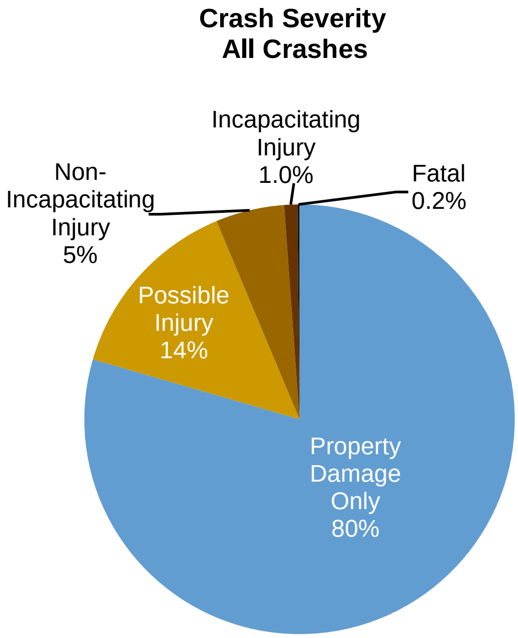


Figure 22

Bike crashes involving some level of injury (2013-2017)

Bike Crash Severity

Overall bike crashes account for about 2.5% of all crashes in the City of Fort Collins. However, they account for 23% of serious injury (non-incapacitating injury and incapacitating injury) and 9% of fatal crashes. This illustrates that bike crashes, when they do occur tend to be more serious than motor vehicle crashes.



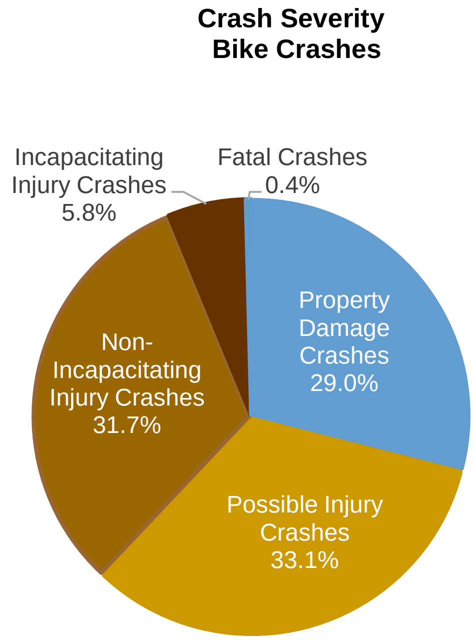


Figure 23

Comparison of crash severity between all crashes and bike crashes

Bike Crashes by Age and Gender

The chart below shows the age of cyclists involved in crashes in Fort Collins as well as the percentage of population by age. Cyclists aged 15 - 34 years old are all significantly overrepresented in crashes. Male cyclists are involved in 71% of all bike crashes.

71%
of all reported bike crashes involve a male cyclist

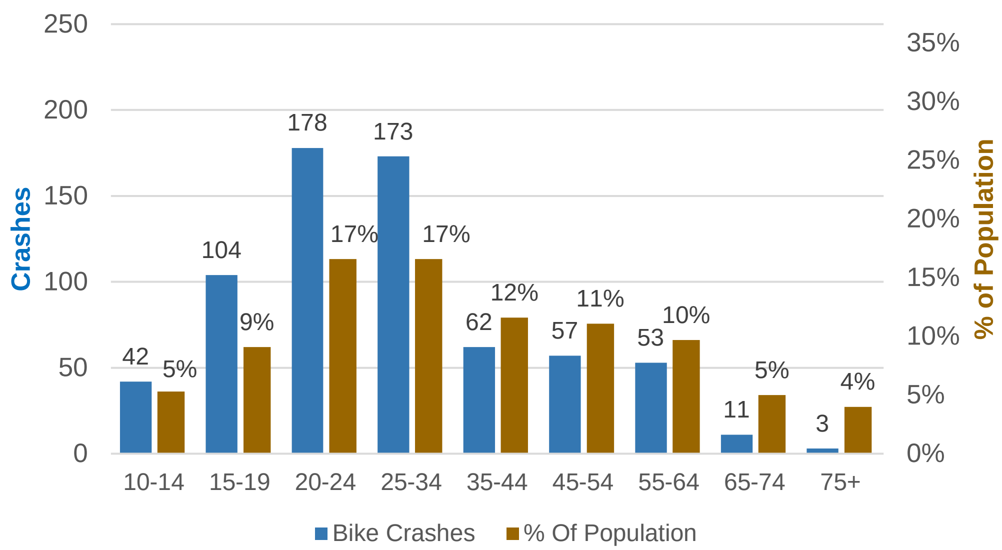


Figure 24

Bike crashes by age and percentage of population (2013-2017)

Bike Crash Location and Types (2013-2017)

Bike crashes can be further classified by location and type of collision. The following information details bike crashes in the past five years (averaged 2013-2017).

89%
of all bike crashes occur at intersections or driveways

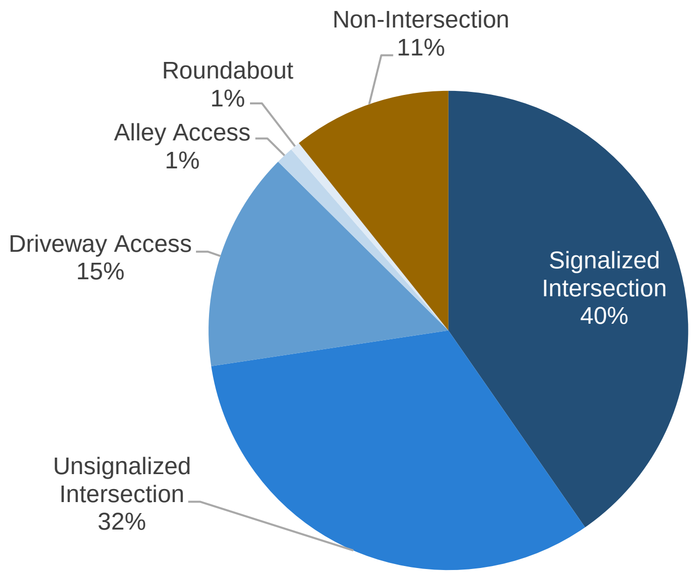


Figure 25

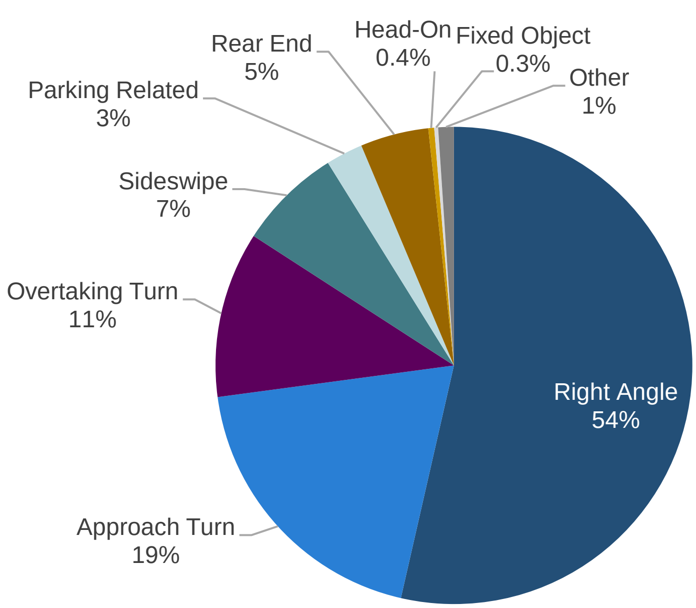
Bike crashes by location (2013-2017)

Crashes at intersections, alleys or driveways account for almost 90% of all bike crashes. It is critical to note that intersections are the locations of greatest risk for bicycle riders. While corridor projects such as buffered or protected bike lanes support greater comfort and perceived safety, an emphasis on intersection safety is needed.

The figure below shows the type of bike crash in the past five years.

Figure 26

Bike crashes by type (2013-2017)



25%
of all bike crashes involve wrong way riding

Right angle crashes are the most common type of bike crash, and represent more than half of all bike crashes. Significant contributing circumstances in bike crashes include wrong way riding on the sidewalk or street (this includes more than one quarter of all crashes, and 40% of right angle crashes.

Along roadways bike crashes include 3% parking related (i.e. “door zone” crashes) and 12% rear-end or sideswipe.

Graphical Depiction of Typical Bike Crashes

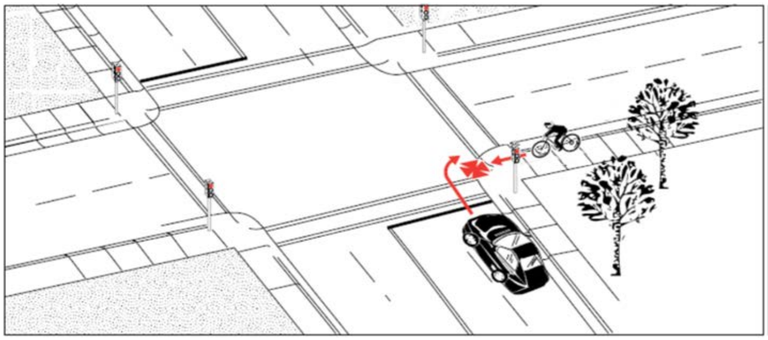


Figure 27

Right angle crash

Right angle crashes are by far the most common type of bike crash representing more than half of all bike crashes. Forty percent (40%) of right angle crashes involve a bike riding against traffic on the sidewalk or street. (2013-2017)

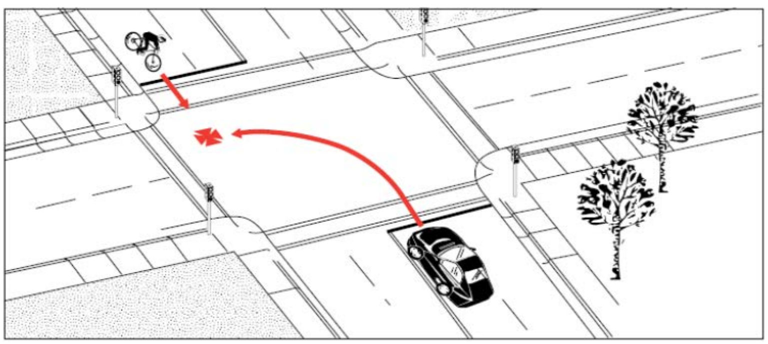


Figure 28

Approach turn crash

This type of crash represents 19% of all crashes. Forty-three percent (43%) of approach turn crashes result in a severe crash (serious injury of fatal). (2013-2017)

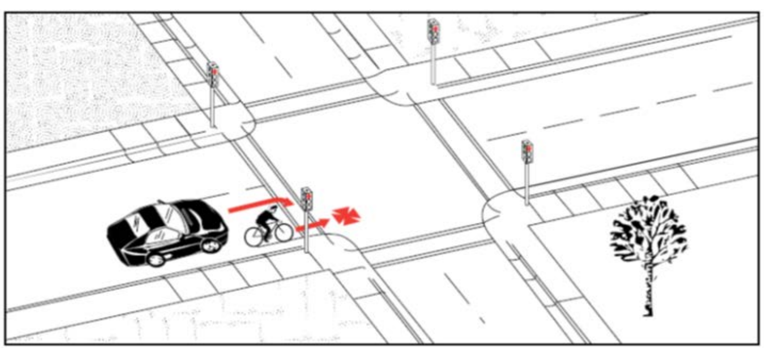


Figure 29

Overtaking turn crash

Also known as the “right hook” crash. This represents 11% of all bike crashes. (2013-2017)

Trends for Bike Crashes By Type (2013-2017)

The figure below shows the general trend of bike crash types for the past five years (as a percentage of total bike crashes). This depicts that right angle crashes remain the most prevalent crash type. The percent of sideswipe crashes increased in the last year.

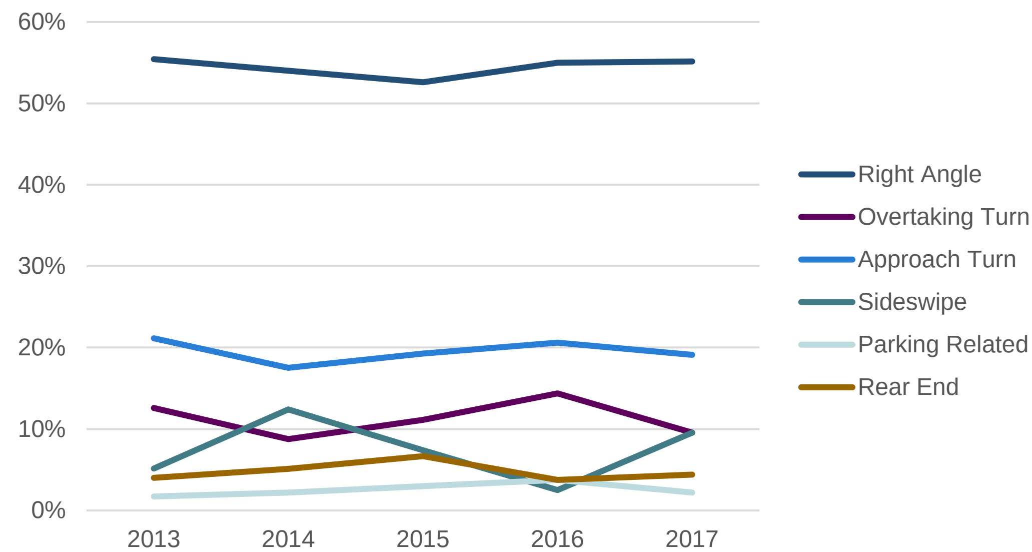


Figure 30

Trends for bike crashes by type

Bike Crashes By Month (2013-2017)

The figure below compares bike crashes by month with aggregated bike volumes from a series of continuous bike counters in Fort Collins. The strong similarity of the trends would indicate that as bike volume increase, bike crashes also increase. The pronounced peak in September is likely related to the start of the university school year.

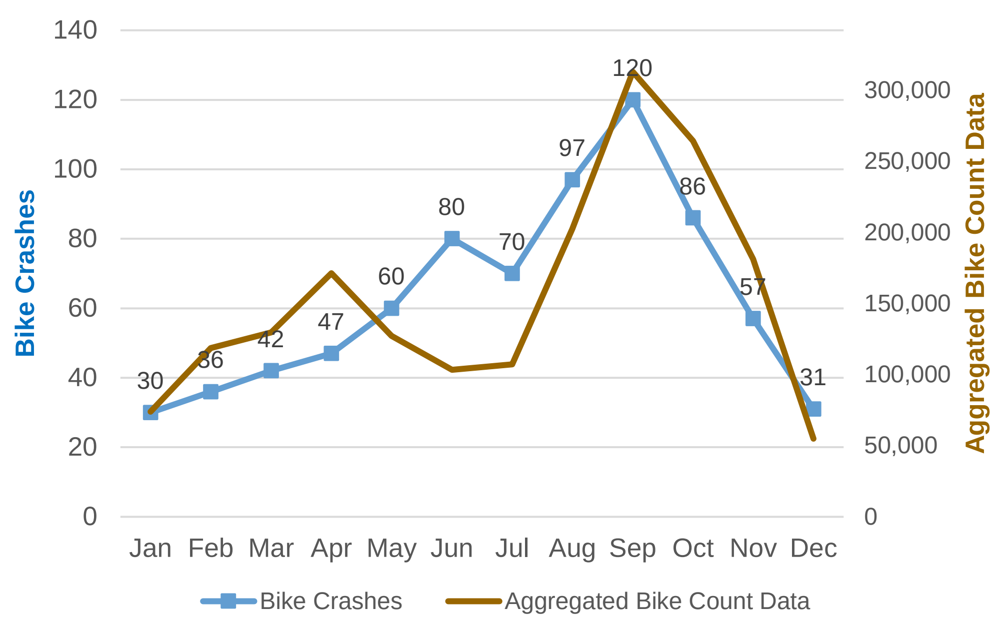


Figure 31

Bike crashes by month (2013-2017) compared with bike volumes

Detailed Bike Crash Tabulation (2013 – 2017)

Table 4

Detailed bike crash tabulation (2013-2017)

Type of Crash	Total Crashes	Severe Crashes
Right Angle		
Bike riding with traffic on street	120	57
Bike riding against traffic on street	34	12
Bike riding with traffic on sidewalk/crosswalk	67	26
Bike riding against traffic on sidewalk/crosswalk	129	42
Bike crossing street mid-block	8	6
Unknown Location	47	9
Right Angle Total	**405**	**152**
Overtaking Turn		
Bike riding with traffic on street	55	15
Bike riding against traffic on street	4	1
Bike riding with traffic on sidewalk/crosswalk	10	2
Bike riding against traffic on sidewalk/crosswalk	8	2
Bike crossing street mid-block	1	1
Unknown Location	7	
Overtaking Turn Total	**85**	**21**
Approach Turn		
Bike riding with traffic on street	105	46
Bike riding against traffic on street	1	1
Bike riding with traffic on sidewalk/crosswalk	27	12
Bike riding against traffic on sidewalk/crosswalk	6	2
Unknown Location	7	2
Approach Turn Total	**146**	**63**
Sideswipe		
Bike riding with traffic on street	42	18
Bike riding against traffic on street	4	
Bike riding with traffic on sidewalk/crosswalk	2	1
Bike crossing street mid-block	2	1
Unknown Location	3	1
Sideswipe Total	**53**	**24**
Parking Related		
Bike riding with traffic on street	18	9
Unknown Location	1	
Parking Related Total	**19**	**9**
Rear End		
Bike riding with traffic on street	34	
Unknown Location	1	
Rear End Total	**35**	**11**
Head-On		
Bike riding with traffic on street	1	1
Bike riding against traffic on street	2	2
Head-On Total	**3**	**3**
Fixed Object	**2**	**2**
Other	**8**	**2**
Total Crashes	**756**	**287**

Rear End Crashes

Rear end crashes are the most prevalent crash type in Fort Collins, accounting for 43% of total crashes. In 2017, there were 1,790 reported rear end crashes.

Number of Rear End Crashes

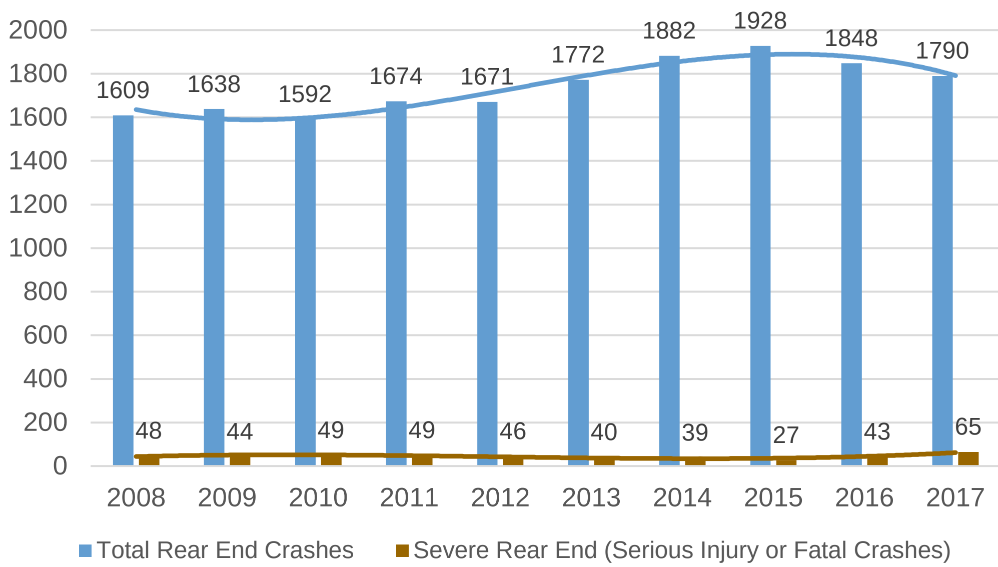


Figure 32

Historical Rear End crash data (10 years)

43%
of all reported crashes are rear-end crashes

Only 3.6% of all rear end crashes in 2017 were severe (resulting in non-incapacitating, incapacitating, or fatal injuries). However, because of the sheer number of these types of crashes, they are an important element to consider in safety reviews.

Rear end crashes are typically the result of motorist inattention often combined with unexpected stops in the traffic stream. The graph below shows the percentage of rear end crashes by location. The majority (68%) 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.

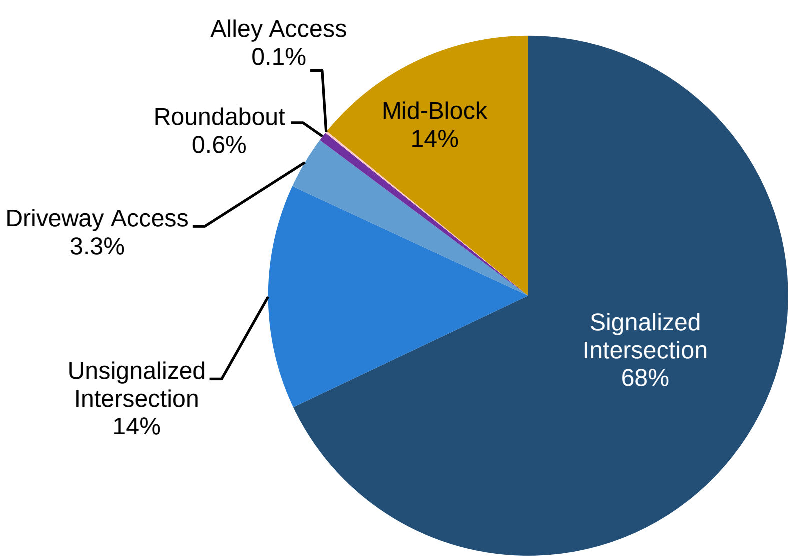


Figure 33

Rear end crashes by location (2013-2017)

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 may be reasonable 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 more serious crashes because of the increased risk of rear end crashes.

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:

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.

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 or flashing yellow arrow 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.

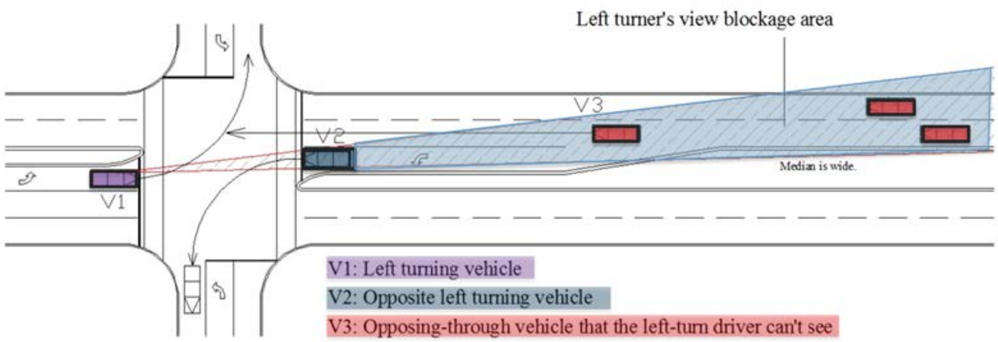


Figure 34

Depiction of typical approach turn crash

Number of Approach Turn Crashes

The chart below shows the historical trend of approach turn crashes in Fort Collins. There is a significant upward trend in approach turn crashes (up 31% in five years). Severe approach turn crashes were also higher than typical in 2017.

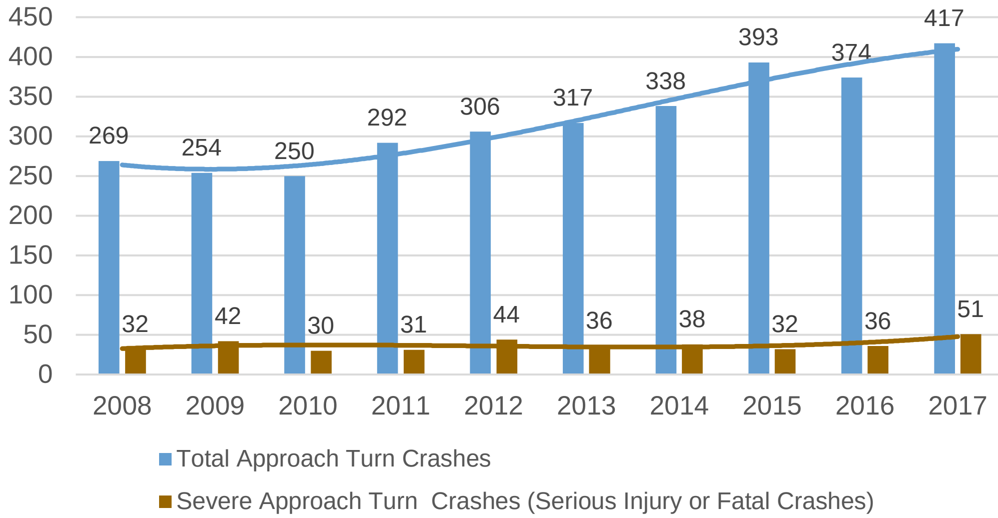


Figure 35

Historical Approach Turn crash data (10 years)

Approach Turn Crashes by Location (2013 – 2017)

The figure below 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 (70%) happen at signalized intersections. The combination of increased complexity and higher turning volumes along with the issue of turning on the yellow/red are likely causes to this trend.

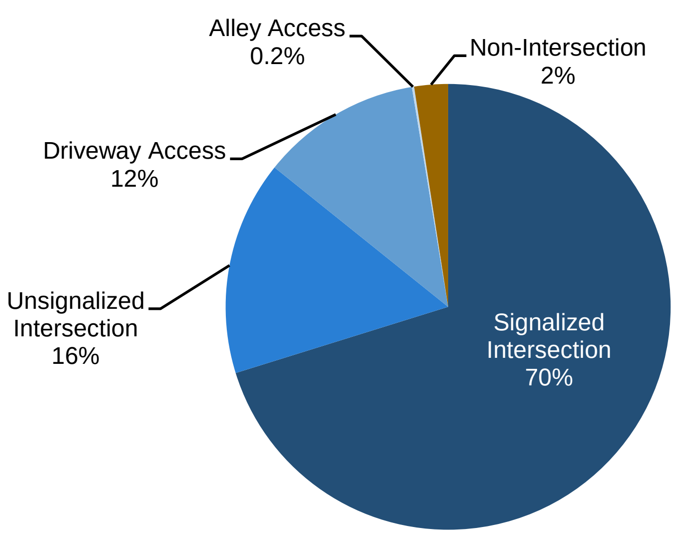


Figure 36

Location of approach turn crashes. (2013-2017)

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 – one where entering traffic has stopped, and one where entering traffic disregards a stop or signal.

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.

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.

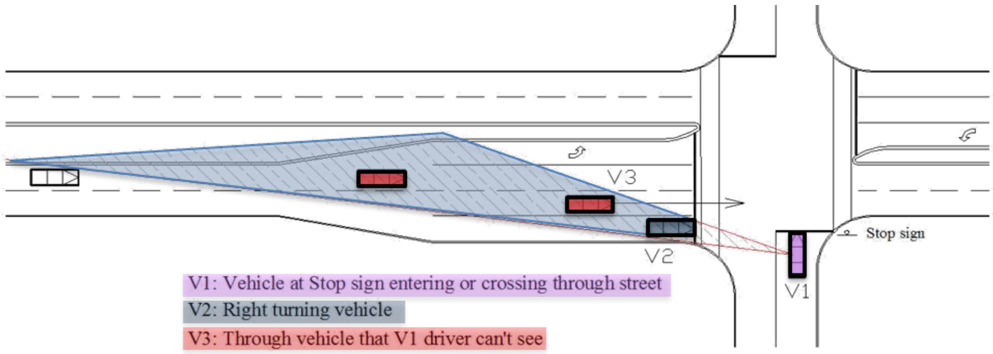


Figure 37

Depiction of typical right angle crash

Number of Right Angle Crashes

The chart below shows the historical trend of right angle crashes in Fort Collins. The general trend was increasing since 2012, but down in 2017. The number of severe right angle crashes have been very consistent over 10 years.

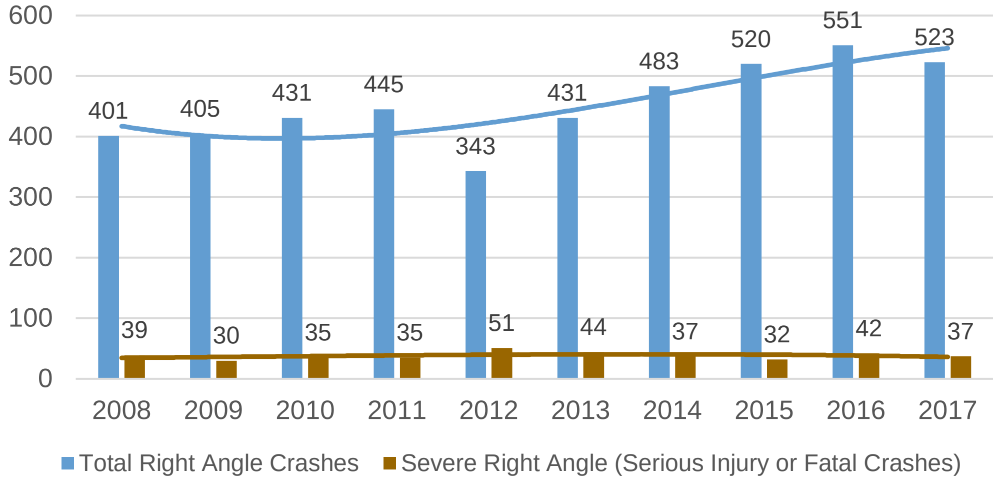


Figure 38

Historical Right Angle crash data (10 years)

Right Angle Crashes by Type and Location (2013 – 2017)

As shown, almost two-thirds (64%) of right angle crashes occur where someone stops but then proceeds into oncoming traffic (shades of blue in the chart). Most of the remaining crashes (34%) are the result of a motorist running a red light or stop sign (shades of brown).

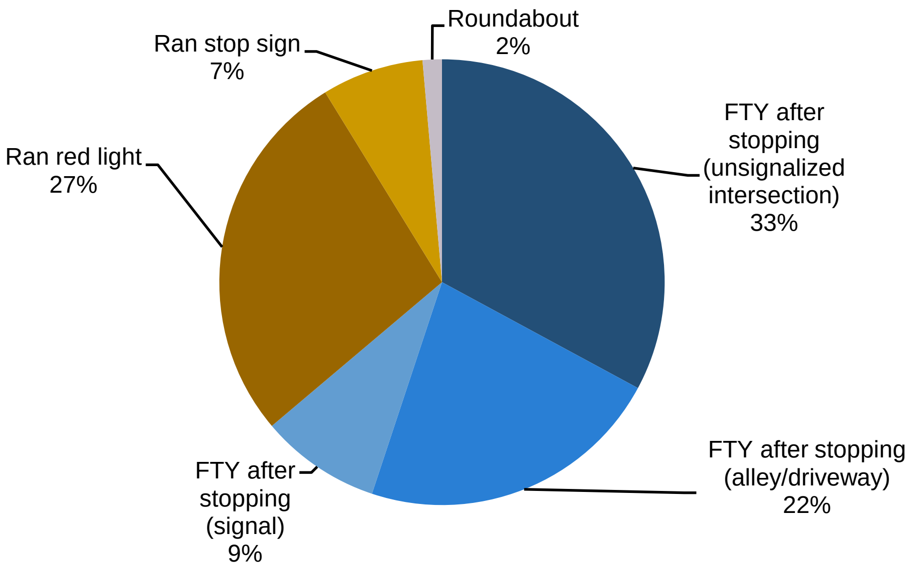


Figure 39

Right angle crashes by type (2013-2017)

FTY = Failure to Yield

Fixed Object Crashes

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.

Minor fixed object crashes often occur in inclement weather. The other main contributor to these types of crashes is alcohol. Seventeen percent (17%) of all fixed object crashes involve alcohol. For severe crashes the percentage related to alcohol goes up to almost 43%.

17%
of all fixed object crashes involve alcohol.

43%
of all severe fixed object crashes involve alcohol

Number of Fixed Object Crashes

The chart below shows the historical trend of fixed object crashes in Fort Collins. These crashes have been tracking relatively consistent in the past five years.

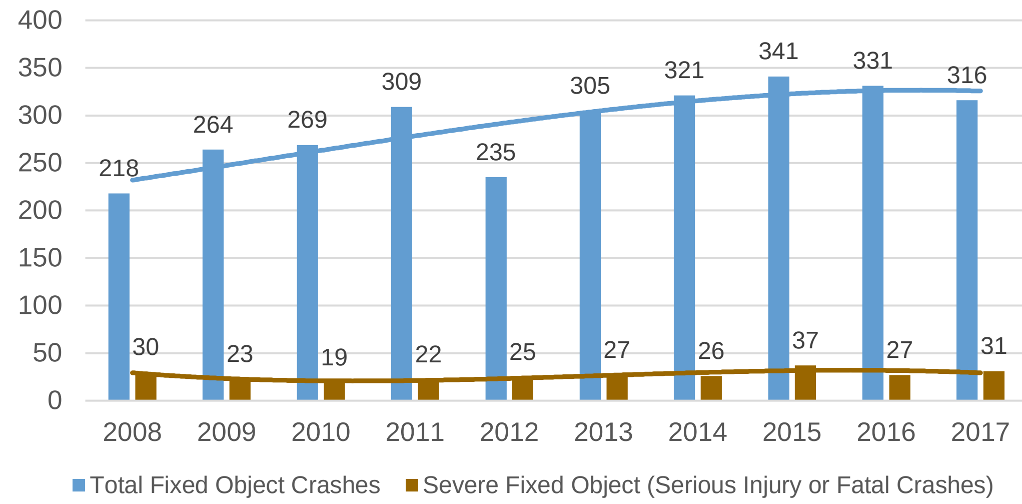


Figure 40

Historical Fixed Object crash data (10 years)

Fixed Object Crashes by Type (2013 – 2017)

The figure below shows fixed object crashes by the type of object stuck.

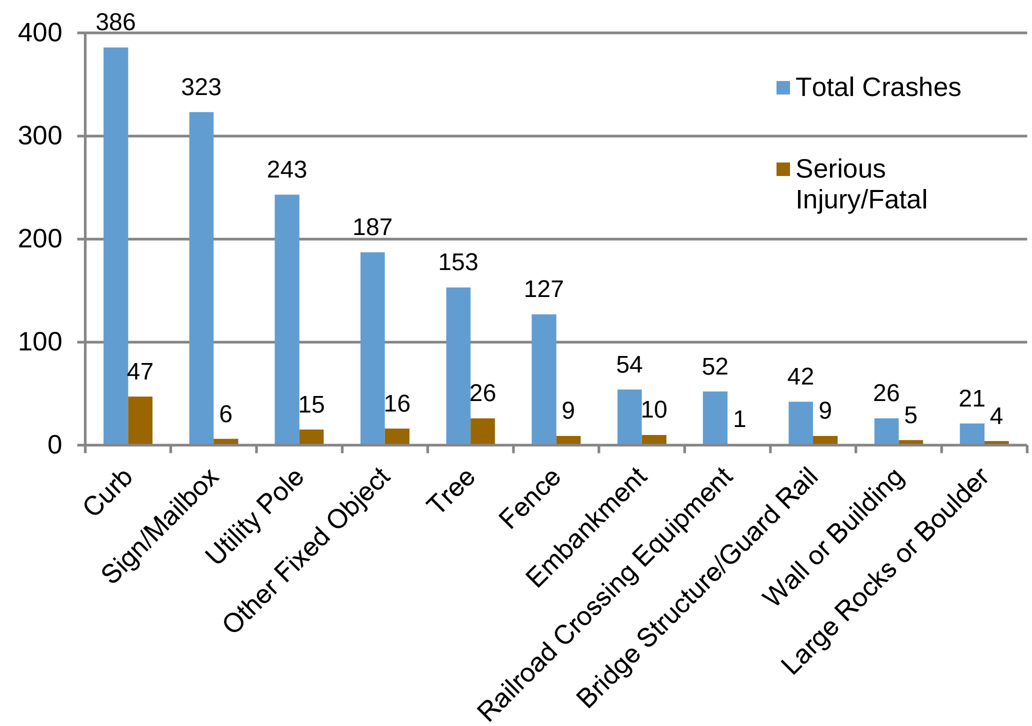


Figure 41

Type and severity of Fixed Object Crashes (2013-2017)

Pedestrian Crashes

Pedestrian crashes account for only about 1% of all crashes, but more than 8% of severe crashes. The charts below show the historical trends of pedestrian crashes in Fort Collins.

Pedestrian crashes tend to be serious crashes. Eighty-seven percent (85%) involve some level of injury and about half (45%) are severe crashes (non-incapacitating, incapacitating or fatal crashes).

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

Number of Pedestrian Crashes

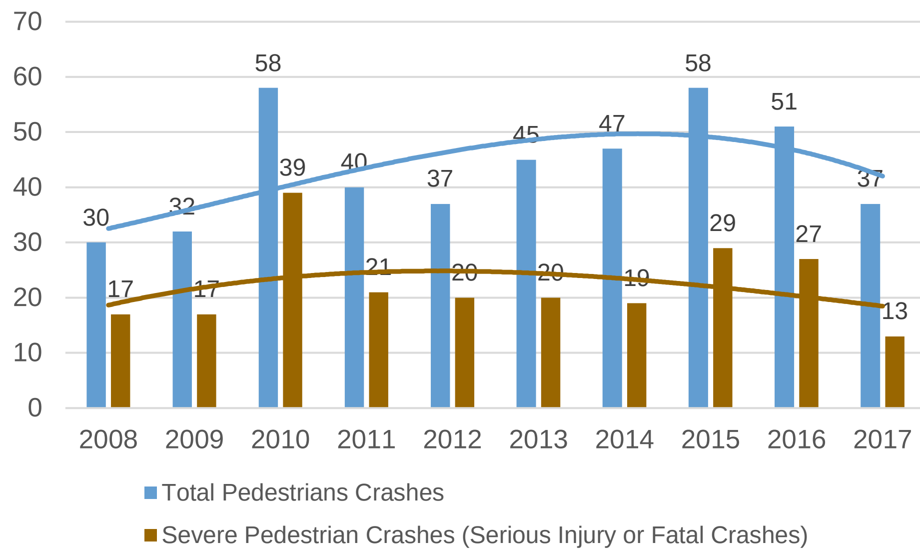


Figure 42

Historical pedestrian crash data (10 years)

Total pedestrian crashes are down **18%** and severe pedestrian crashes down **35%** since 2013 (5 years).

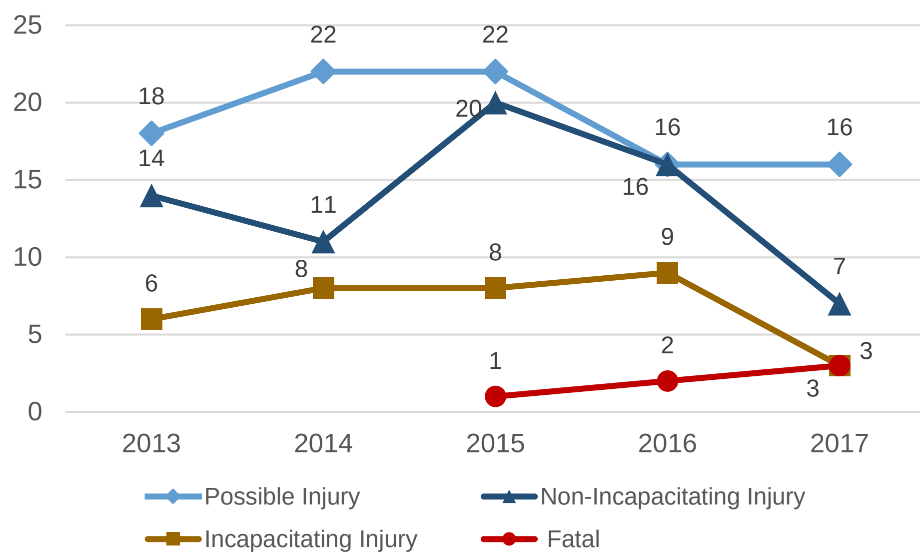


Figure 43

Pedestrian crashes involving some level of injury (2012-2016)

Pedestrian Crashes by Age and Gender (2013 – 2017)

The figure below shows the age of pedestrians involved in crashes. Pedestrian who are age 15-24 years old are significantly overrepresented in crashes; they account for 43% of pedestrian crashes but represent only 26% of the population. Crashes that involve a male pedestrian account for 63% of all pedestrian crashes.

63%
of all reported pedestrian crashes involve a male pedestrian

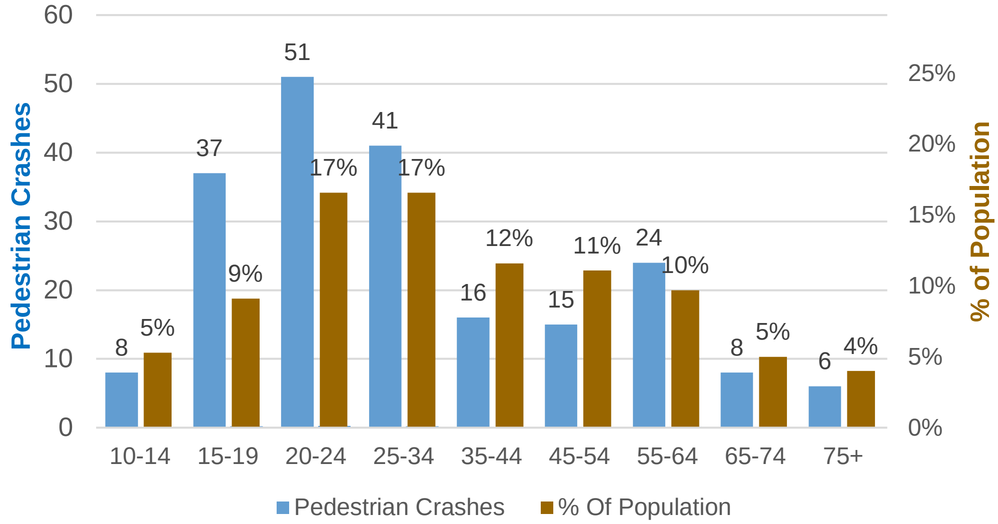


Figure 44

Pedestrian crashes by age and percentage of population (2013-2017)

Note: 34 crashes are not listed due to lack of age data in report

Pedestrian Crash Location and Types (2013-2017)

Categorizing pedestrian crashes by location and type helps to understand contributing factors. The figures below show the percentage of crashes in these categories in the past five years. Explanation of crash types is included on the following page. In general, about half of all pedestrian crashes are the result of a motorist failing to yield (shades of blue in the second figure).

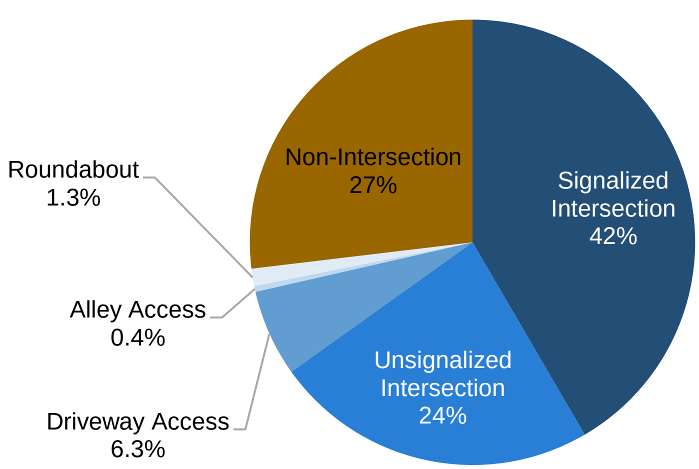


Figure 45

Pedestrian crashes by location (2013-2017)

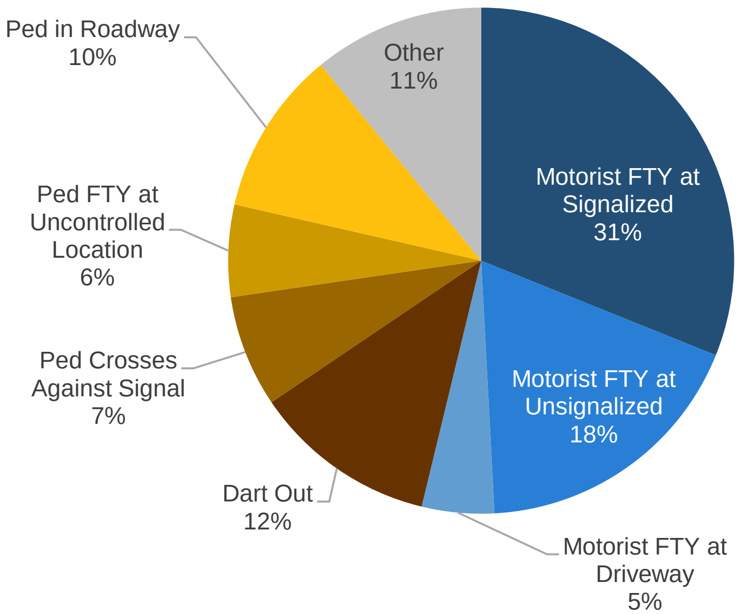


Figure 46

Pedestrian crashes by type (2013-2017)

FTY = Failure to Yield

Types of Pedestrian Crashes

Crashes are categorized into a variety of types. The definitions and explanation of 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 often 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 often 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 (2013 – 2017)

Table 5

Detailed pedestrian crash tabulation (2013-2017)

Type of Crash	Total Crashes	Severe Crashes
Motorist Fail to Yield at Signalized Intersection		
Motorist Turning Left on Green	34	13
Motorist Turning Right on Green	8	4
Motorist Turning Right on Red	22	10
Motorist Going Straight	10	6
Total Motorist Fail to Yield at Signalized Intersection	**74**	**33**
Motorist Fail to Yield at Unsignalized Intersection	43	12
Motorist Fail to Yield Exiting Driveway	11	1
Pedestrian Fail to Yield at Uncontrolled Location	14	7
Pedestrian Crosses Against Signal	17	10
Dart Out	28	18
Pedestrian Standing/Walking in Road	25	13
Other	26	14
Total Pedestrian Crashes (2013-2017)	**238**	**108**

Note: two crashes involving toy vehicles are not included

Section 4
Intersection Evaluation

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.

Total crash numbers at any location (either in a chart or through crash density maps) identify the locations where the most crashes occur. While helpful information, because volumes and other elements at specific locations vary widely, it's difficult to draw relevant conclusions from this data.

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 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.

City staff does an annual statistical evaluation of intersections in Fort Collins using three years of data (in this report: 2015 – 2017). Over 250 intersections were evaluated with 43% having an excess crash cost (versus 57% with a negative crash cost (indicating less crashes than predicted)). The table on the following page shows the 50 intersections (ranked by excess crash costs) with the greatest excess crash costs. (The top 10 are shaded darker, and the next 15 are shaded lighter.) Since injury crashes have higher crash costs associated with them, the ranking method gives more weight to locations with more injury crashes compared to locations with primarily "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.

Intersection Excess Crash Costs (2015 – 2017)

Table 6

Intersection excess cost (2015-2017)

Intersection		Input Data					(3 years of data)		Excess Crash Cost		
STREET1 (north/south)	STREET2 (east/west)	Major Street Volume	Minor Street Volume	Total AADT	Model Predicted Crashes/ Year	Model Predicted FI Crashes/ Year	Adjusted Actual Crashes/ Year	Adjusted Actual FI Crashes/ Year	Excess PDO Crashes/ Year	Excess FI Crashes/ Year	Excess Expected Crash Value ($)
College Ave	Horsetooth	42874	23531	66405	40.4	8.1	57.7	14.0	11.50	5.87	$960,903
College Ave	Trilby Rd	34218	13839	48057	25.2	5.3	32.6	9.4	3.34	4.10	$622,108
Shields St	Prospect Rd	30950	21407	52357	29.0	6.1	37.6	9.9	4.74	3.82	$596,809
Mason St	Harmony Rd	33717	7680	41397	18.6	4.0	34.5	6.5	13.49	2.48	$495,162
Lemay	Harmony Rd	48940	15750	64690	34.7	7.0	43.4	9.4	6.35	2.35	$403,283
Timberline	Carpenter	14993	9723	24716	9.4	2.0	17.8	4.1	6.29	2.09	$364,458
College Ave	Drake Rd	45364	28220	73584	47.0	9.2	55.1	11.2	6.18	1.96	$344,483
Lemay	Drake Rd	27592	25109	52701	28.6	6.0	34.8	7.9	4.28	1.91	$318,917
Shields St	Drake Rd	32008	24438	56446	31.8	6.6	38.8	8.4	5.14	1.82	$314,834
Shields St	Mulberry St	19083	17287	36370	16.5	3.5	22.2	5.3	3.84	1.80	$297,326
College Ave	Monroe	44100	4858	48958	15.7	3.6	28.4	4.7	11.60	1.13	$283,260
Lemay	Horsetooth (W)	29858	24833	54691	21.4	4.2	26.2	5.9	3.07	1.71	$276,713
College Ave	Swallow	43122	7950	51072	20.9	4.6	26.0	6.2	3.57	1.60	$266,498
College Ave	Laurel	34964	8363	43327	18.6	4.3	27.5	5.4	7.75	1.16	$246,984
Raintree	Drake	22433	2006	24439	3.4	0.9	5.4	2.5	0.37	1.57	$228,162
Timberline	Kechter	19422	4135	23557	8.3	1.9	14.0	2.9	4.71	0.99	$190,611
Remington	Mulberry St	23792	4294	28086	10.3	2.4	13.3	3.4	1.95	0.99	$162,570
Lemay	Vine	14989	7046	22035	8.0	1.7	18.2	2.2	9.76	0.41	$160,456
Mason St	Horsetooth Rd	26632	5739	32371	13.3	3.0	16.4	3.9	2.24	0.89	$150,871
Boardwalk	Harmony Rd	47830	11350	59180	27.2	5.4	35.6	5.8	7.94	0.40	$140,301
Snow Mesa	Harmony Rd	51074	6262	57336	20.3	4.4	20.9	5.3	-0.42	0.97	$135,359
College Ave	Smokey	37262	500	37762	2.0	0.4	3.1	1.3	0.15	0.91	$132,604
Ziegler	Horsetooth	19515	6206	25721	10.1	0.4	16.8	0.4	6.69	-0.01	$122,780
City Park	Elizabeth St	16733	4722	21455	7.5	1.7	9.9	2.4	1.67	0.73	$122,164
Shields St	Plum	31964	3612	35576	12.3	2.8	19.0	3.1	6.38	0.33	$114,075
Lemay	Lincoln	16376	8154	24530	9.6	2.1	13.1	2.7	2.96	0.56	$111,716
Lemay	Magnolia	19754	4215	23969	6.0	1.3	9.2	1.8	2.69	0.56	$108,788
Mathews	Mulberry St	24152	1000	25152	2.7	0.7	5.0	1.3	1.74	0.58	$101,559
Shields St	Trilby Rd	15718	7249	22967	8.6	1.9	13.6	2.2	4.60	0.37	$100,332
Linden	Vine	6418	2872	9290	1.5	0.5	4.7	1.0	2.64	0.48	$95,756
College Ave	Kensington	36679	3385	40064	11.0	2.7	15.1	3.1	3.66	0.38	$92,675
College Ave	Troutman	38392	6832	45224	17.5	4.0	19.7	4.5	1.66	0.50	$89,209
McClelland	Drake	29357	3103	32460	6.8	1.5	10.0	1.9	2.71	0.42	$88,583
Manhattan	Horsetooth Rd	27744	4121	31865	11.7	2.7	12.2	3.3	-0.06	0.61	$86,206
Timberline	Trilby Rd	14498	5952	20450	7.1	1.6	7.8	2.1	0.12	0.57	$82,331
Overland	Elizabeth St	11137	2275	13412	0.8	0.1	3.1	0.6	1.89	0.43	$81,727
College Ave	Vine	30748	6443	37191	10.5	2.2	11.3	2.7	0.22	0.54	$80,045
College Ave	Foothills	48062	2664	50726	11.5	2.7	16.4	2.9	4.71	0.20	$77,905
Automation	Horsetooth Rd	26469	2421	28890	2.4	0.5	3.2	1.0	0.27	0.51	$76,060
Shields St	Casa Grande	32157	1197	33354	4.4	1.0	7.1	1.3	2.45	0.34	$73,673
Timberline	Mountain Vista	6709	5910	12619	1.8	0.5	3.7	0.9	1.52	0.39	$72,211
Shields St	Westward	37315	882	38197	2.4	0.5	4.0	0.9	1.22	0.39	$68,789
Timberline	Bighorn	29053	1850	30903	4.0	1.0	5.0	1.5	0.62	0.42	$66,324
McClelland	Horsetooth Rd	28645	2369	31014	5.8	1.3	9.8	1.4	3.80	0.18	$65,991
Overland	Drake	10983	5832	16815	2.6	0.7	8.3	0.8	5.74	0.04	$65,603
Lemay	Riverside	26186	15335	41521	21.4	4.6	27.0	4.6	5.61	0.05	$65,143
Giddings	Richards Lake	3608	800	4408	0.4	0.1	1.0	0.6	0.17	0.44	$64,667
Mason	Laurel	13590	2539	16129	2.6	0.8	6.6	1.0	3.83	0.16	$62,561
Mason	Mulberry St	25983	3978	29961	10.8	2.5	13.9	2.7	2.90	0.23	$62,446
Shields St	Davidson	33537	1502	35039	4.1	1.0	4.5	1.5	0.04	0.42	$61,083

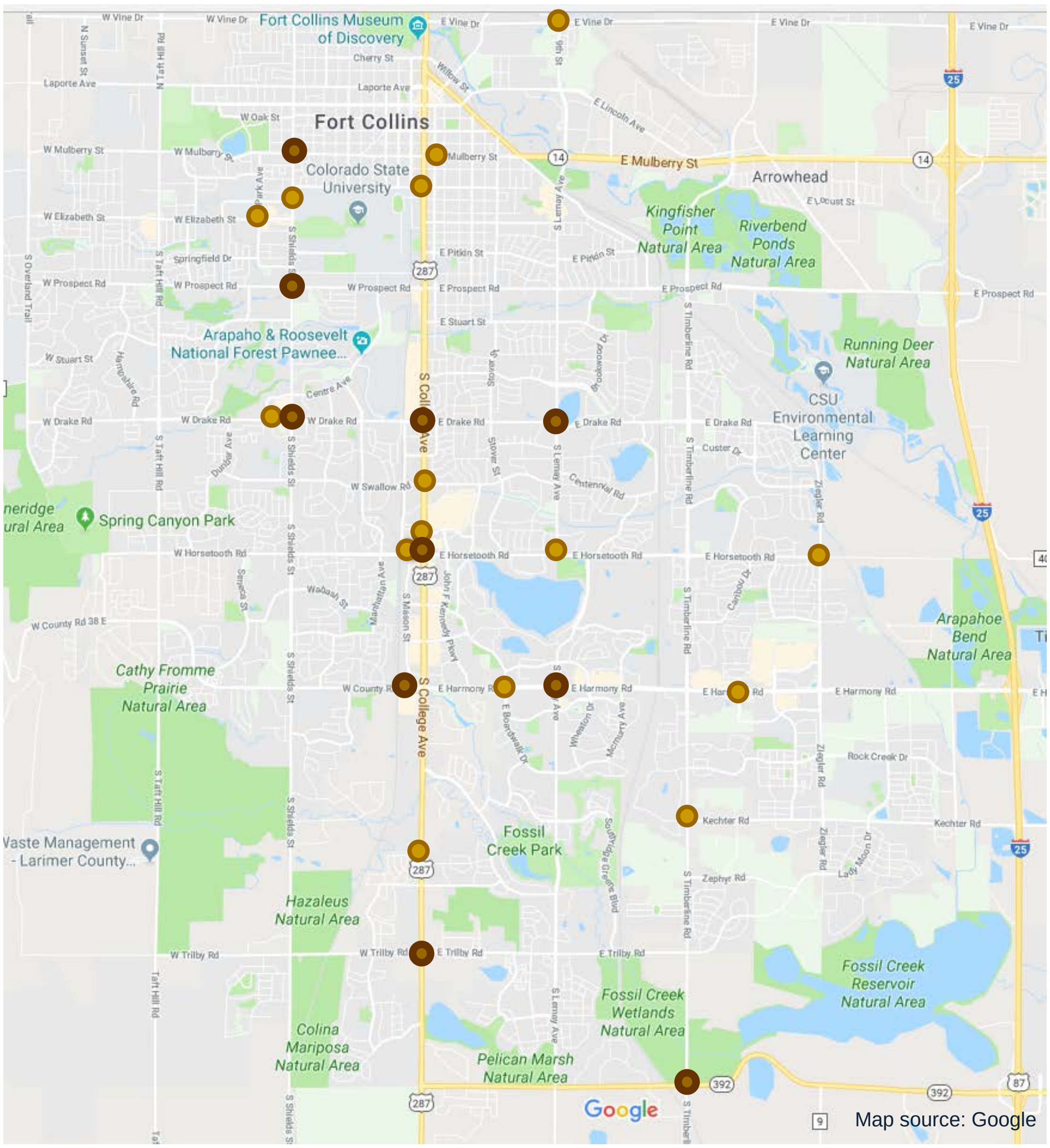
AADT = Annualized Average Daily Traffic
FI = Fatal / Injury Crashes
PDO = Property Damage Only Crashes

XXX = top 10 intersections
XXX = next 15 intersections

Intersection Location Map with Most Excess Crash Costs (2015 – 2017)

Figure 47

Map of intersections with most excess crashes (2015-2017)



Top 10 Intersections with most excess crash costs

Next 15 Intersections with most excess crash costs

Maps, Trends and Patterns

In addition to identifying intersections with higher than expected crash numbers and severity, a review of maps, trends and patterns is helpful.

GIS Based Data

Crash information is geo-coded and can be evaluated through mapping efforts. This allows for a visual depiction of crash numbers at specific locations or along corridors. Maps can be created for specific crash types such as bicycle or pedestrian crashes.

Care should be taken to understand that 'hot spots' on the maps are simple number based, and neither correlated to volumes, nor necessarily indicative of statistically based higher than expected crash locations. The maps may be best used to target enforcement areas.

The heat maps of overall crashes as well as a few of the most prevalent severe crash types (bicycle, right angle, approach turn, and pedestrian) are posted to the City's Traffic Operations safety page at fcgov.com/traffic. Other maps can be created on request.

Example of Map. Visit fcgov.com/traffic for maps

Changes in Excess Crash Costs

Intersection screening in the City has been done since 2009. Reviewing the trends of excess crash costs can identify changing conditions and safety at specific locations. The tables below indicate the intersections with significant changes in excess crash costs, both positively and negatively. The comparison was made using the last six years of data (2012-2017). Excess crash cost for three years of data (2012-2014) and again (2015-2017) were compared. All crash costs are adjusted to reflect 2017 dollars.

Table 7

Intersections with largest decreasing crash costs (i.e. less crashes) 2012/2014 and 2015/2017

Intersections with improving safety trends

Intersection		2015-2017 Excess Crashes & Cost			2012-2014 Excess Crashes & Cost			Change in Excess Crashes & Cost			Notes / Comments Changes Implemented
STREET1 (N/S)	STREET2 (E/W)	PDOs / Year	FIs / Year	Excess Expected Crash Value ($)	PDOs / Year	FIs / Year	Excess Expected Crash Value ($)	in PDO	in F/I	Change in Excess Cost	
Timberline	Prospect	6.16	-1.51	-$151,886	3.39	2.40	$378,648	2.77	-3.90	**-$530,533**	Intersection Rebuilt in 2016
Timberline	Harmony	-9.84	-3.09	-$545,579	-7.32	-0.16	-$99,149	-2.52	-2.93	**-$446,430**	
Lemay	Prospect	-1.64	-1.06	-$168,866	2.38	1.03	$172,471	-4.02	-2.09	**-$341,338**	
Shields	Horsetooth	3.06	-0.89	-$95,661	0.26	1.29	$187,348	2.80	-2.18	**-$283,008**	
Timberline	Horsetooth	-2.61	-0.64	-$118,628	9.06	0.44	$157,291	-11.68	-1.08	**-$275,919**	Intersection Rebuilt in 2015
Boardwalk	Harmony	7.94	0.40	$140,301	1.05	2.74	$403,236	6.89	-2.34	**-$262,935**	
Taft Hill	Horsetooth	1.42	-0.45	-$49,951	2.89	1.27	$212,628	-1.47	-1.73	**-$262,579**	
Timberline	Timberwood	-4.72	-1.44	-$255,809	-2.07	0.19	$5,328	-2.64	-1.63	**-$261,137**	
JFK	Harmony	-4.36	-0.62	-$134,362	2.68	0.59	$112,862	-7.05	-1.21	**-$247,225**	
Ziegler	CouncilTree	-4.93	-1.02	-$197,226	-0.81	0.29	$32,730	-4.12	-1.31	**-$229,956**	
Timberline	Drake	-3.54	-0.23	-$69,102	-2.74	1.27	$152,931	-0.80	-1.49	**-$222,034**	
Lemay	Mulberry	1.40	-1.37	-$181,640	1.48	0.16	$38,332	-0.08	-1.53	**-$219,972**	Construction project completed
Lemay	Horsetooth (East)	-1.26	-0.73	-$117,777	1.28	0.56	$93,916	-2.54	-1.29	**-$211,693**	
College	FossilCreek	-1.89	-0.28	-$60,279	1.38	0.83	$132,827	-3.28	-1.11	**-$193,106**	
JFK	Horsetooth	-4.42	-1.18	-$214,377	-0.79	-0.10	-$21,895	-3.62	-1.08	**-$192,482**	
Whitcomb/ Canyon	Mulberry	-4.84	-1.55	-$271,861	-2.27	-0.41	-$82,995	-2.57	-1.13	**-$188,866**	
Shields	Stuart	-0.43	-0.52	-$78,719	0.15	0.68	$98,370	-0.59	-1.19	**-$177,089**	
Lemay	Vine	9.76	0.41	$160,456	5.53	1.92	$332,093	4.23	-1.50	**-$171,637**	
College	Triangle	0.09	-0.24	-$33,125	-0.15	0.93	$131,554	0.24	-1.17	**-$164,679**	
College	Elizabeth	-2.44	-0.46	-$91,886	0.65	0.44	$70,217	-3.09	-0.91	**-$162,103**	
College	Boardwalk	-3.07	-0.64	-$124,333	0.48	0.17	$28,926	-3.56	-0.81	**-$153,260**	
College Ave	Foothills	4.71	0.20	$77,905	10.61	0.84	$230,229	-5.90	-0.63	**-$152,324**	

FI = Fatal / Injury Crashes
PDO = Property Damage Only Crashes

Intersections with increasing crash trends

Intersection		2015-2017 Excess Crashes & Cost			2012-2014 Excess Crashes & Cost			Change in Crashes and Cost			Notes / Comments Changes Implemented
STREET1 (N/S)	STREET2 (E/W)	PDOs / Year	FIs / Year	Excess Expected Crash Value ($)	PDOs / Year	FIs / Year	Excess Expected Crash Value ($)	in PDO	in F/I	Change in Excess Cost	
Shields	Prospect	4.74	3.82	$596,809	-2.93	-0.01	-$32,361	7.68	3.83	**$629,170**	Accident Trend down in 2017
Lemay	Drake	4.28	1.91	$318,917	-0.86	-1.86	-$276,072	5.14	3.78	**$594,990**	
College	Horsetooth	11.50	5.87	$960,903	8.32	2.47	$440,691	3.18	3.40	**$520,211**	To be re-constructed in 2018
Timberline	Carpenter	6.29	2.09	$364,458	-1.60	0.02	-$13,318	7.90	2.06	**$377,776**	
Mason St	Harmony	13.49	2.48	$495,162	9.78	0.12	$119,224	3.71	2.35	**$375,938**	MAX signals
Shields St	Drake	5.14	1.82	$314,834	4.36	-0.67	-$51,061	0.78	2.50	**$365,895**	
Shields St	Mulberry	3.84	1.80	$297,326	2.92	-0.51	-$42,299	0.92	2.30	**$339,625**	
College	Laurel	7.75	1.16	$246,984	3.31	-0.37	-$19,170	4.44	1.53	**$266,155**	
Mason St	Horsetooth	2.24	0.89	$150,871	1.47	-0.89	-$112,226	0.77	1.78	**$263,097**	MAX signals
College	Trilby Rd	3.34	4.10	$622,108	3.47	2.29	$364,571	-0.13	1.81	**$257,536**	Federal safety grant secured
Raintree	Drake	0.37	1.57	$228,162	-0.42	-0.07	-$14,735	0.78	1.64	**$242,898**	
College	Harmony	7.11	-0.99	-$67,868	6.46	-2.40	-$277,303	0.65	1.41	**$209,435**	
Timberline	Vermont	-1.72	0.44	$45,593	-5.09	-0.68	-$150,692	3.36	1.13	**$196,284**	
Lemay	Harmony	6.35	2.35	$403,283	5.79	1.08	$214,779	0.56	1.27	**$188,504**	
Mason	Mulberry	2.90	0.23	$62,446	0.53	-0.76	-$103,232	2.38	0.98	**$165,677**	
Shields	Swallow	-2.70	0.18	-$2,833	-0.39	-1.12	-$164,542	-2.32	1.30	**$161,710**	
SnowMesa	Harmony	-0.42	0.97	$135,359	-3.13	0.05	-$24,917	2.71	0.92	**$160,276**	Flashing yellow arrows recently added
Welch	Prospect	-1.03	0.11	$5,041	-1.22	-0.95	-$149,432	0.19	1.06	**$154,473**	
Research	Drake	-1.52	0.31	$28,005	-2.92	-0.67	-$126,123	1.40	0.97	**$154,128**	

FI = Fatal / Injury Crashes
PDO = Property Damage Only Crashes

Table 8

Intersections with largest increasing crash costs (i.e. more crashes) 2012/2014 and 2015/2017

Comments are noted in cases where a significant change was made to the intersection during the evaluation period. These notes may not necessarily be the causal factor for the change in excess cost. In locations with few crashes, a single severe crash (especially a fatality) can create a pronounced swing in excess crash costs. However, each location should be reviewed in more detail to try to determine contributing factors to either improved safety or concern.

Interesting finds include:

- Intersections rebuilt with capital projects tend to see a safety improvement (Timberline/Prospect, and Timberline/Horsetooth)
- Arterial intersections along the MAX line and Mason Trail that required added complexity to already congested areas tended to see an increase in crashes since MAX opened in 2014.

Recognizing Patterns in Crash Types

The table below identifies intersections where a pattern of crash types are identifiable. The analysis is a statistical analysis developed by the Colorado Department of Transportation. Some intersections may be listed in more than one category. For instance, Remington and Prospect is listed under both Bicycle crashes and Red Light Running crashes, the causes of which may be related. This more detailed information about patterns of crashes can aid in pin-pointing mitigation measures.

Table 9

Intersection with higher than expected particular crash types (2015-2017)

Approach Turn Crashes	
College	Plum
Shields	Bennett
Cook	Mulberry
College	Mason/Palmer
College	Lake
Lemay	Haxton
College	Troutman
Shields	Horsetooth
Taft Hill	Prospect
Snow Mesa	Harmony
College	Swallow
Right Angle	
Overland	Elizabeth
Larkbunting	Harmony
Meldrum	Laporte
Mason	Magnolia
Mathews	Mulberry
Shields	Wabash
Giddings	Richards Lake
Howes	Maple
Sherwood	Laporte
College	Kensington
Shields	Vine
Remington	Elizabeth
Stanford	Horsetooth
Lemay	Oakridge
Remington	Prospect
Rear End	
College	Harmony
College	Monroe
Lemay	Harmony
Timberline	Kechter
Timberline	Harmony
Boardwalk	Harmony
Timberline	Prospect
Shields	Plum
Riverside	Mulberry
Timberline	Horsetooth
Tulane	Drake
Taft Hill	Lake
Timberline	Vine
Overland	Drake
Sherwood	Laurel
Overland	CR 42 C
Pedestrian	
City Park	Elizabeth
Linden	Jefferson
Remington	Mulberry
Bicycle	
Shields	Pitkin
Edinburgh	Drake
Shields	University
Timberline	Milestone
Shields	Bennett
College	Lake
Lemay	Haxton
College	Mason/Palmer
Shields	Richmond
Mason	Laurel
Cowan	Mulberry
Lemay	Whalers/Wheaton
College	Thunderbird
Remington	Stuart
City Park	Elizabeth
Remington	Prospect
Whedbee	Mulberry
Timberline	Custer
Single Vehicle	
Timberline	Custer
Timberline	Harmony
Shields	Davidson
Century	Horsetooth
Snow and Ice	
Taft Hill	Drake
Alcohol	
College	Mountain
Red Light Running	
College	Kensington
Whedbee	Mulberry
Remington	Prospect
Stanford	Horsetooth

Note that just because an intersection is listed above doesn't automatically indicate a concern. Some of these locations may have very low crash volumes, and a single crash could create a 'trend'. Each location should be evaluated further for determination of safety concerns.

Section 5
Improving Roadway Safety

A successful improvement of a roadway safety requires collaborative efforts from the City, the community, and individuals. It involves road users, vehicles, infrastructure, technology and emergency response. Roadway safety is complex, and both big and small initiatives are important.

The data in this report is used across a broad spectrum of efforts within the City that include engineering, education, encouragement, enforcement, and evaluation. Some of the strategies are site specific and/or are identified to mitigate particular trends. Others, especially education-related efforts, are applicable across the City and address more behavioral issues.

Engineering

Low Cost Improvements

Sometimes there are minor, inexpensive solutions that can be funded with maintenance budgets that provide a high benefit to cost ratio. This can include tree trimming for visibility, implementation of flashing yellow arrows, changes to striping to create center turn lanes, signal timing adjustments, etc.

In the past year, staff has focused on the implementation of two types of low cost improvements:

- Flashing Yellow Arrow (FYA) that run protected-only by time of day, and
- Leading Pedestrian Intervals (LPIs).

Flashing Yellow Arrows involve a four-section signal head that can allow a permissive left turn, as well as protected-only left turn. These can be varied by time of day. At some intersections, the left turns are allowed to run permissive most of the day, but restricted to protected-only during the peak hours when end-of-phase left turn crashes tend to occur. An example of a location recently implemented is Snow Mesa and Harmony. The intersection will be monitored in the coming year to determine whether safety improvements have been realized.

Leading Pedestrian Intervals involve the walk light for pedestrians coming on a few seconds before the adjacent green light for vehicles. This allows the pedestrian a ‘head start’ in crossing the road which improves their visibility to motorists. The intersection of College and Conifer is an example.

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. Recently completed and upcoming projects include:

- Timberline / Prospect: Construction of additional auxiliary turn lanes and an eastbound to southbound ‘free right’.

- Shields / Vine: replacement of the signal with a single lane roundabout
- College / Prospect: intersection re-built to add double left turns and pedestrian 'pork chop' islands
- Shields / Elizabeth: intersection re-built to add pedestrian/bike underpass, double left turns.
- College / Horsetooth: intersection to be re-built in 2018 to add double left turns and pedestrian 'pork chop' islands.

These projects will be monitored in coming years for their safety impact.

Shields and Elizabeth:

This capital project was completed in 2017 and added a grade seperated underpass for bikes and pedestrians, an additional approach lane eastbound, lengthened left turn auxiliary lane northbound and signal timing adjustments. There has been a distinct benefit in terms of operations, efficiency and emissions, but there has also been a safety benefit.

Shields / Elizabeth
Before: 35.3 crashes/year
After: 25.3 crashes/year
Result: **28% reduction in crashes**

Safety Grants

The City's Traffic Operations Department collaborated with the Engineering Department to apply for Federal Highway Safety Improvement Program (HSIP) funding. Utilizing crash data and a proposal for improvements, funds were granted for improvements to the following intersections:

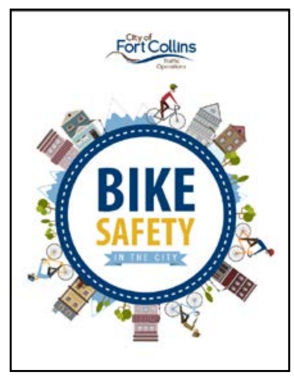
- College Avenue and Horsetooth Road intersection improvements: $1,000,000. This project will be built in 2018.
- College Avenue and Trilby intersection improvements: $2,250,000. Design has begun on this project and is expected to be built in the next few years.

$ 3.25 million
Federal safety funding received for two Fort Collins intersection improvements projects

Multi-Modal and Planning Projects

The FC Moves 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. An example is the Multberry Protected Bike Lane project to be built in 2018.

The update of the Transportation Master Plan In 2017 and 2018 will also include safety elements.



Education and Encouragement

Education is an important component to a safer transportation system. This includes a broad range of efforts from staff in several departments, and data is used to inform specific education campaigns.

Neighborhood Traffic Mitigation Program

Traffic in neighborhoods can affect the quality of life of residents and the traveling public. With the goal of calmer streets, the program uses a variety of data, including crash data to identify potential changes. In 2017, the program received 234 total requests and over 100 work orders were generated. This included 101 deployments of temporary radar speed signs, one neighborhood with new permanent radar speed displays, and seven neighborhoods with new installations of speed humps.

101 locations where temporary radar speed signs were deployed.

7 neighborhoods received speed humps.

School Transportation (Including Safe Routes to School)

The department works closely with Poudre School District on all elements of transportation in the vicinity of about 50 schools. This includes crash data review and identification of potential changes, especially at congested high school locations.

The City also has a comprehensive Safe Routes to School (SRTS) Program that reaches more than 10,000 students each year at about two dozen schools. SRTS staff also pursues grants for construction of bike and pedestrian projects.

Bike and Pedestrian Safety Town

The FC Moves Department received funding and worked with numerous partners to construct a “miniature city” complete with streets, bike lanes, and traffic signs. Constructed in a church parking lot, families, adults, children, and safety classes use the town to practice safe cycling and walking skills.

Bike Classes (including Bike Friendly Driver Program)

FC Moves oversees a number of cycling classes, providing more than 100 total classes each year.   The Bicycle Friendly Driver program is a 90 minute interactive class, taught by Bicycle Ambassadors aimed at educating all drivers on the best and safest ways to share the road with people on bicycles. The program was developed by FC Bikes in collaboration with Bike Fort Collins. The curriculum is based heavily on bike crash data and has reached more than 3,500 participants since its launch in 2015.

Tours and Presentations

Staff is available to provide safety presentations to interested groups throughout the year. This includes tours that occur every other month, service club presentations (several per year), and other specialized safety presentations (such as work zone efforts).

Enforcement

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.

DUI Enforcement

Fort Collins Police Services undertakes targeted DUI campaigns and sobriety checkpoints to support roadway safety. Often done in partnership with other agencies, these are efforts to reduce incidents of intoxicated and impaired motorists being involved in collisions. They also provide an opportunity at increasing community awareness of consequences of driving impaired.

Bicycle Traffic Citation Course

In partnership with the City of Fort Collins Municipal Court, the FC Bikes Bicycle Ambassador Program offers a Bicycle Traffic Citation Course for individuals who have received citations related to cycling. This alternative sentencing option teaches cycling laws and offers tips for safe cycling.

Community Impact Days

Fort Collins Police Services has recently begun Community Impact Days to focus on traffic enforcement and reduce dangerous driving behaviors. Police Services works with Traffic Operations to identify locations for targeted enforcement based on crash data.

Bike Safety Week

Bike safety week is a collaborative effort between FC Bikes and Fort Collins Police Services to make roads safer for everyone. Typically held in the spring and again in the fall when school starts, cyclists and motorists are encouraged to Ride Smart and Drive Smart through targeted education and enforcement by both Police Officers and Bicycle Ambassadors.

Evaluation - Ongoing Monitoring

Finally, a key for the roadway safety program is to continue ongoing monitoring of the overall transportation system, trends, patterns as well as specific locations. Efforts to ensure data quality and completeness, robust analysis, and systematic use of the information in all aspects of roadway safety strategies will continue. The result of evaluation helps to determine the effect of the various safety projects, and identify the types of projects that are most beneficial.

Section 6
Next Steps

Safety is the city's top priority. Improving the safety of all roadway users requires everyone – the City, community and individuals – to share the effort and responsibility of improving and ultimately ensuring safety. The analysis in this report as well as the extensive data that supports the review is a critical step in the complex and multi-faceted challenge of roadway safety. It informs all elements of safety strategies from engineering through enforcement and evaluation.

Towards Vision Zero Action Plan

The City made a commitment to Vision Zero in 2016. Fort Collins was the first public local entity to join the Colorado Department of Transportation (CDOT) Moving Towards Zero Deaths initiative. Data collection, analysis, safety evaluation, and application of the various "E"s of roadway safety have been a mainstay of the City's safety program.

The next step in Towards Vision Zero is to develop an Action Plan. The plan will be a comprehensive, multi-departmental, and community based set of actions that reflects the understanding that all of us have a role in decreasing serious injury and fatal crashes. It is expected to be complete within the next year.

Looking Towards the Future

In coming years, there are number of potential initiatives that can dramatically impact roadway safety.

Near-term changes include Collision Avoidance Systems that are becoming more standard on new vehicles. With almost half of all crashes being rear-end crashes, this has the potential of profound improvements.

In the longer term, connected and autonomous vehicles have the potential to increase capacity and improve safety on the roadway system.

Within the analysis realm, the use of big data including video analytics of near crash events could be one way to pro-actively detect systematic safety concerns before crash patterns in crash reports identify the issue.

All these initiatives and others that are not yet even identified can support the goal of Moving Towards Vision Zero.

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