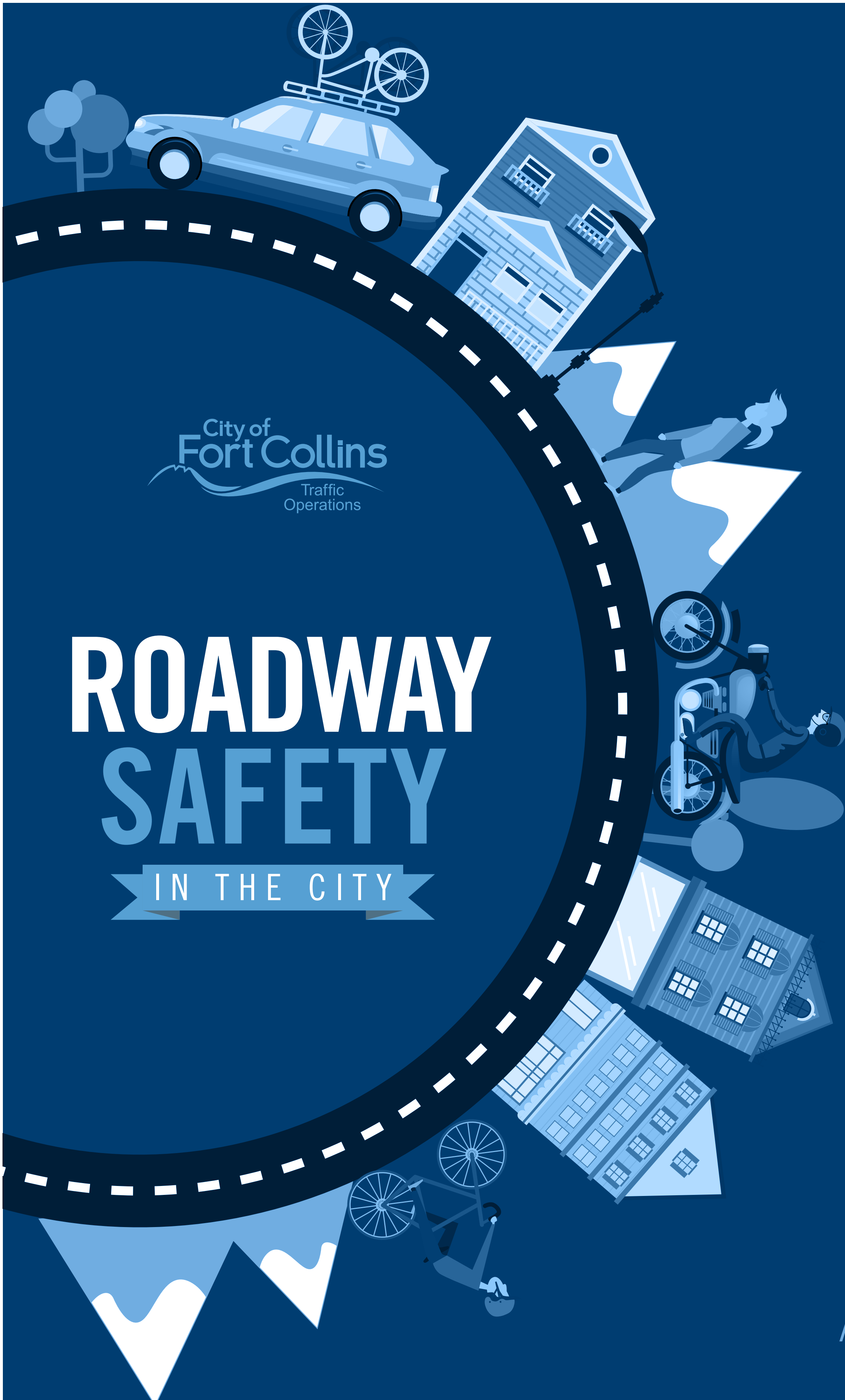

City of Fort Collins
Traffic Operations

ROADWAY SAFETY

IN THE CITY

Annual Report
February 2017

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

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Executive Summary

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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 is among the lowest of both similar Colorado cities, as well as peer cities nationwide. Regardless, during 2016 there were still 256 crashes involving a non-incapacitating or incapacitating injury, and eight individuals lost their lives as a result of a traffic crash. The societal cost of these crashes was almost $160 million dollars.

Key findings from the report include:

Overall Crash Trends

There were 4,348 reported traffic crashes in 2016. This is 2% lower than 2015, but overall an increase of 22% in the past five years. Almost 80% of all crashes do not result in any injuries (property damage only). Severe crashes (non-incapacitating injury, incapacitating injury or fatal) have been decreasing for the past three years, and are now 10% lower than five years ago (264 versus 294).

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 and 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 22% of incapacitating or fatal crashes. Forty-four percent (44%) 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 (those involving non-incapacitating injury, incapacitating injury or fatality), 86% of severe crashes are the result of one of six types of crashes listed below. Each crash type is reviewed in more detail in the report.

- Bicycle (23%)
- Right Angle (15%)

- Rear-End (15%)
- Approach Turn (14%)
- Fixed Object (11%)
- Pedestrian (9%)

Bicycle and Pedestrian Crashes

Bicycle and pedestrian crashes account for only 4.8% of all crashes, but 32% of severe crashes, indicating the vulnerability of these road users.

Total bike crashes had generally been trending upwards then saw a significant decline in 2014 and 2015 before trending upwards again 2016. Severe crashes are down 32% since 2012. Eighty-nine percent (89%) of bike crashes occur at intersections or driveways. Twenty-six percent (26%) of all bike crashes involve wrong way riding by the cyclist. These statistics allow for targeted strategies with significant potential benefits.

Pedestrian crashes are trending upward, and reported pedestrian crashes tend to be severe crashes with 87% involving some level of injury or fatality.

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.

Improving Roadway Safety

The goal of Moving Towards Vision Zero requires a comprehensive and multi-faceted effort. It 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 crash reductions at those locations of more than 50%.

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. More recently, they have partnered with Fort Collins Municipal Court in the creation of 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 a few areas of focus for coming years. Further refinements and analysis can identify the most proven strategies and provide targeted information for various initiatives

Finally, improvements in vehicle safety, connected and autonomous vehicles, and the potential of using big data for proactive analysis are up and coming safety strategies that in future years can further support the goal of Moving Towards Vision Zero.

Section 1
Introduction

The City of Fort Collins is a vibrant city of 160,000 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.

Roadway Safety

Transportation safety is always a priority for the City. In the past year, there were more than 4,300 traffic crashes in Fort Collins. On average, that is more than 12 crashes per day. Over 900 of the crashes involved some level of injury (minor injury or more serious injury), and eight involved a fatality. In 2016 alone, the annual societal costs of these crashes were almost $160 million dollars.

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.

Safety Matters

In 2016, there were 264 crashes involving a serious injury or fatality in Fort Collins

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 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 2012 to 2016.

Section 2

General Safety Information

The total number of crashes per year for the past five years is shown below. There has been a 21.9% increase in total crashes between 2012 and 2016. Serious injury crashes have been decreasing for the past three years and the overall change in serious injury crashes is 10% lower over the span of five years.

Increase in traffic crashes 2012-2016:

22%

Total Number of Crashes

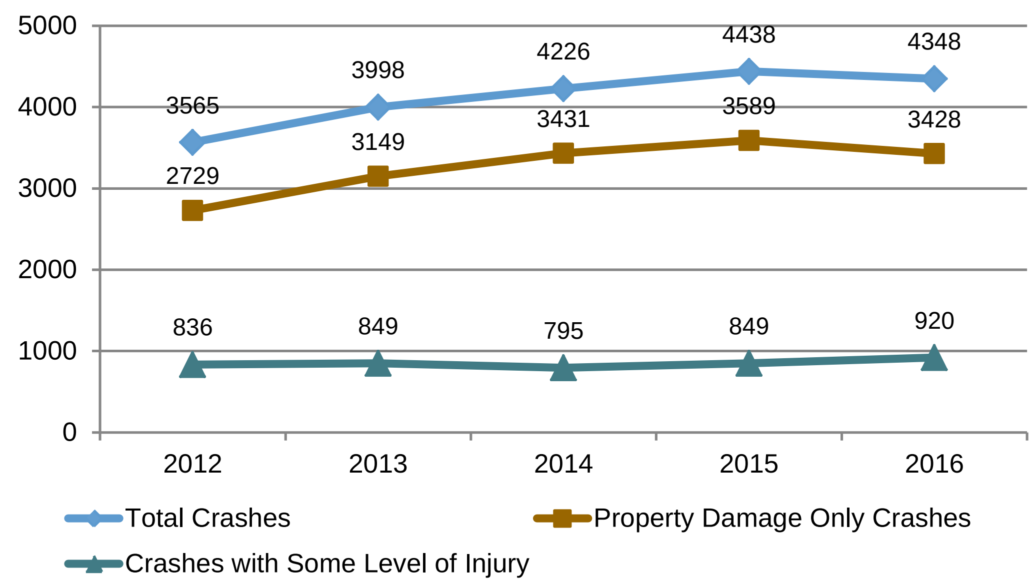


Figure 1

Total number of crashes 2012 to 2016

Number of Total Crashes with Injuries

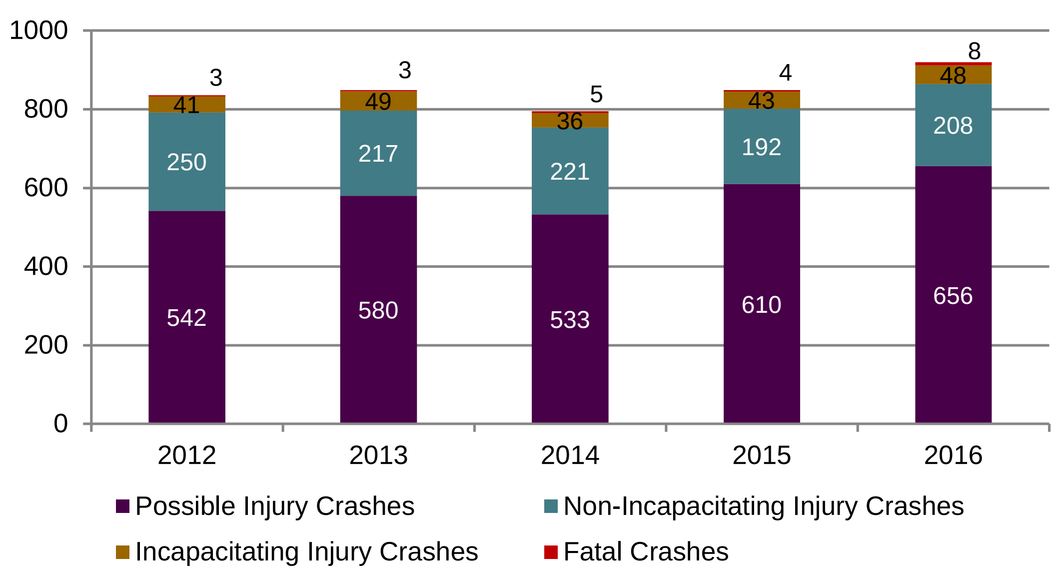


Figure 2

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.

Bicycle, Motorcycle and Pedestrian Crashes

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

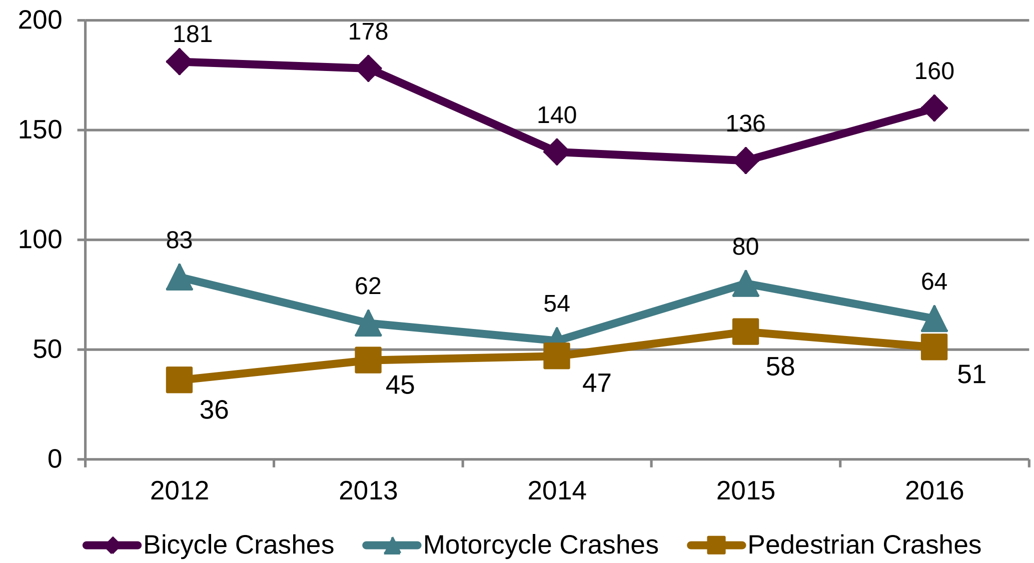
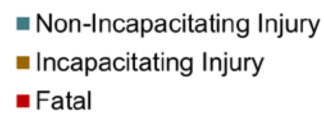


Figure 3

Total reported crashes involving bicycles, motorcycles, and pedestrians (2012 – 2016)

Severe Injury and Fatal Crashes for Bicycles, Motorcycles and Pedestrians



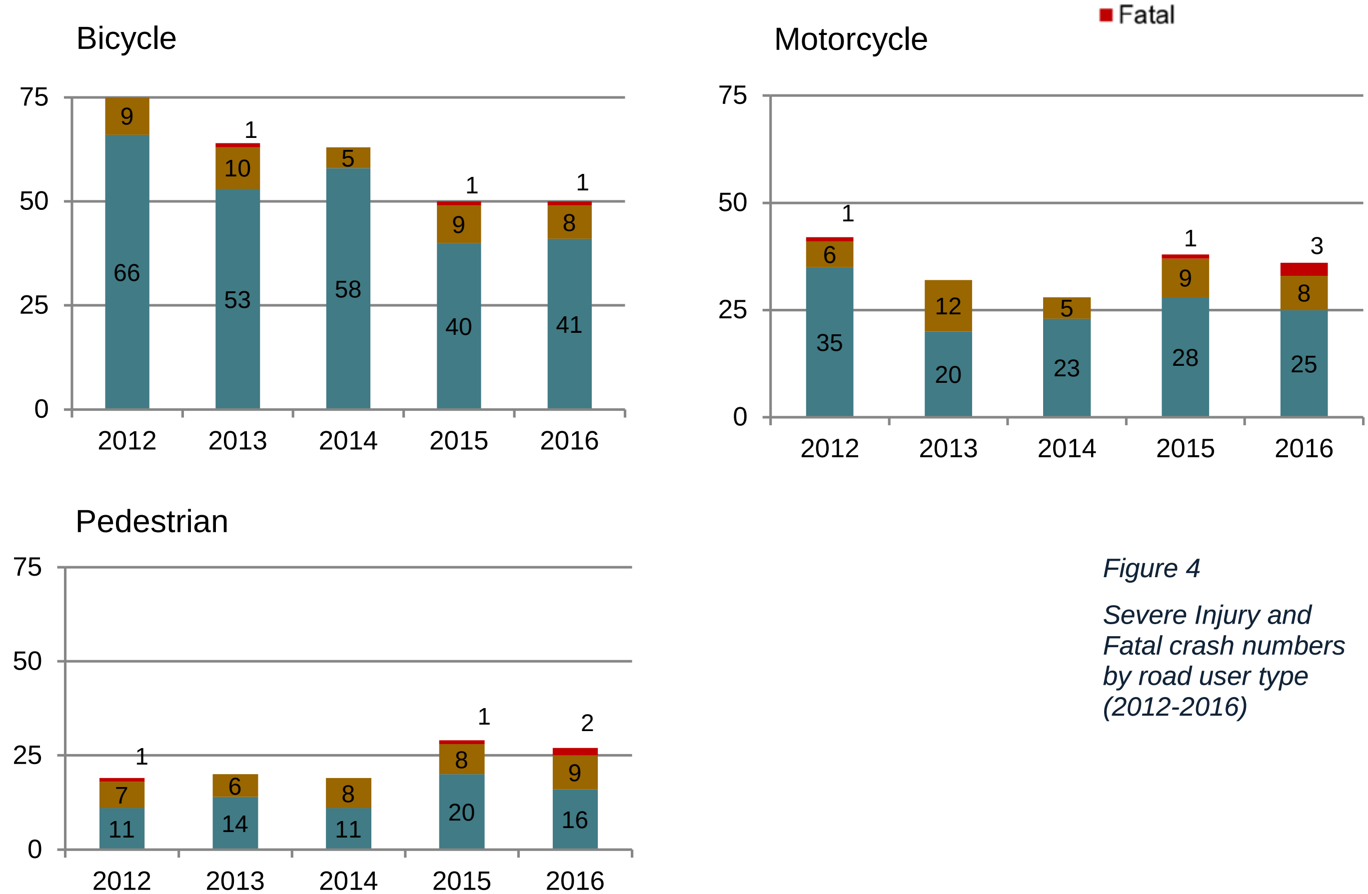
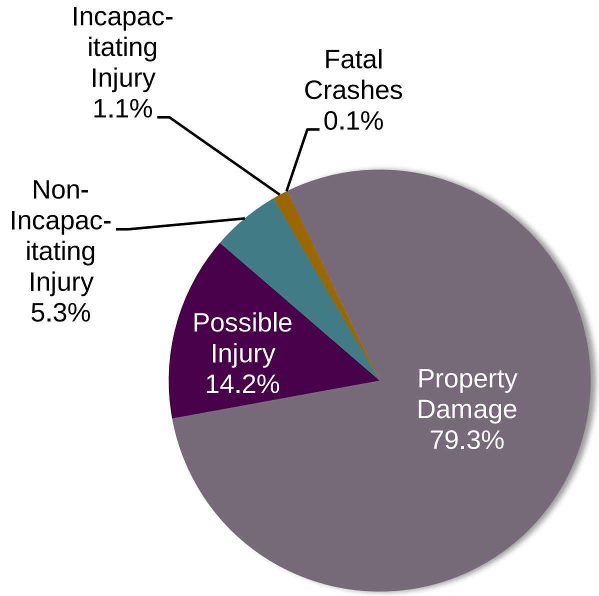


Figure 4

Severe Injury and Fatal crash numbers by road user type (2012-2016)

2016 Crash Severity

The chart at right shows the overall severity for crashes (2012-2016). 80% of all reported crashes do not result in an injury.



Decrease in severe traffic crashes 2012-2016:

10%

Figure 5

Crash severity (2012-2016)

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).

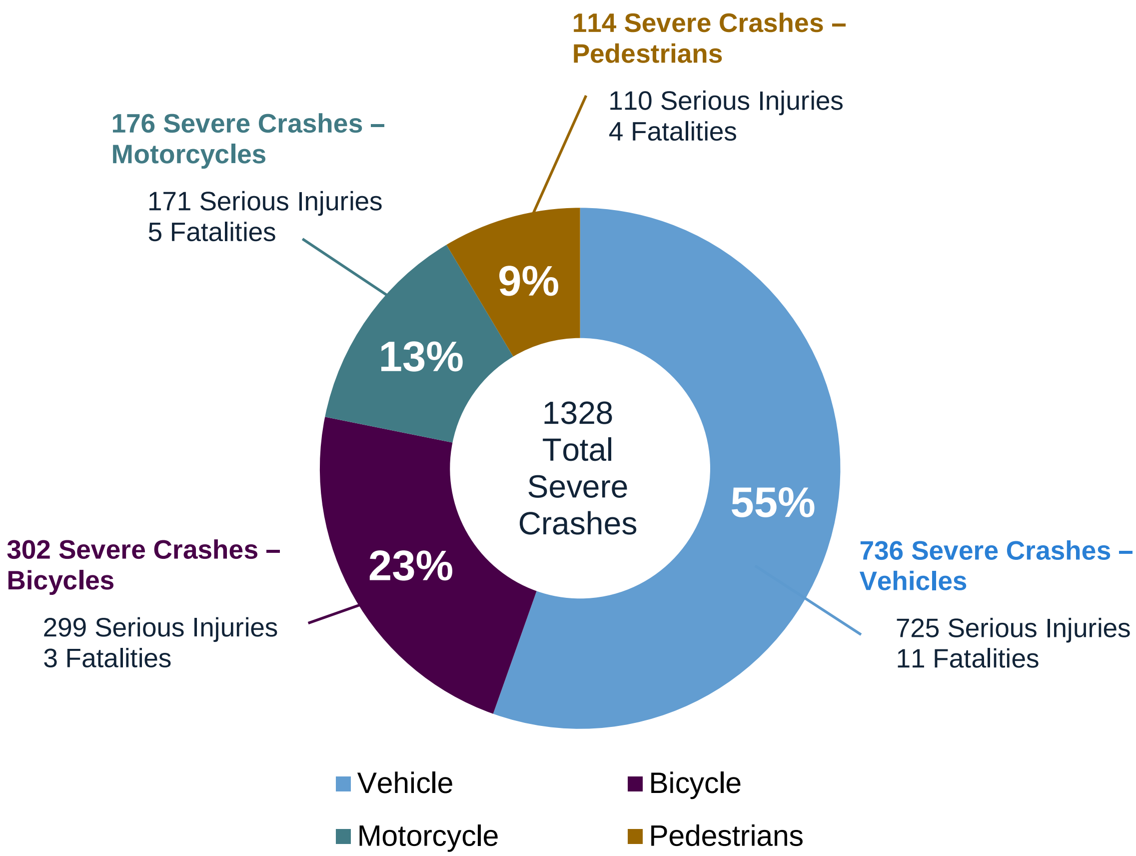


Figure 6

Severe crash data by road user (2012-2016)

2016 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 2016 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 2016:

$ 159 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	3427	$ 10,100	$ 34,612,700
Possible Injury Crashes	656	$ 62,900	$ 41,262,400
Non-Incapacitating Injury Crashes	208	$ 111,600	$ 23,212,800
Incapacitating Injury Crashes	48	$ 305,400	$ 14,659,200
Fatal Crashes	8	$ 5,768,700	$ 46,149,600
Total	**4,347**		**$ 159,896,700**

Table 1

Economic impact of traffic crashes in Fort Collins in 2016

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 (between 85,000 and 200,000) and also compare to other peer cities nationwide with similar population. The nationwide peer cities are participants in an annual benchmarking survey in which Fort Collins Police Services participates.

Table 2

Fatal crash rate comparison to other Colorado Cities

Colorado Cities								
City	**Population**	**Fatal Crashes, 2012 - 2016**						**Fatal Crash Rate** (Crashes per 100,000 Population)
		2012	**2013**	**2014**	**2015**	**2016**	**Avg.**	
Lakewood	149,643	9	6	13	15	13	11.2	7.5
Greeley	98,596	7	5	8	5	7	6.4	6.5
Pueblo	108,423	11	6	8	4	5	6.8	6.3
Arvada	113,574	3	4	4	6	10	5.4	4.8
Thornton	130,307	5	4	4	3	11	5.4	4.1
Longmont	90,237	2	2	4	5	2	3.0	3.3
Fort Collins	158,300	3	3	5	4	8	4.6	2.9
Boulder	105,112	3	0	0	1	6	2.0	1.9
Total Colo Cities	954,192	43	30	46	43	56	43.6	4.6

Table 3

Fatal crash rate comparison to similar peer cities nationwide

Peer Cities								
City	**Population**	**Fatal Crashes, 2011 - 2015**						**Fatal Crash Rate** (Crashes per 100,000 Population)
		2011	**2012**	**2013**	**2014**	**2015**	**Avg.**	
Boca Raton, FL	91,332	3	12	12	10	12	9.8	10.7
Springfield, MO	165,378	10	19	13	14	21	15.4	9.4
Broken Arrow, OK	104,726	9	11	7	3	8	7.6	7.3
Norman, OK	118,040	5	8	8	7	9	7.4	6.3
San Angelo, TX	98,975	3	4	6	7	8	5.6	5.7
Coral Springs, FL	127,952	5	5	10	7	8	7.0	5.5
Richardson, TX	108,617	2	5	3	7	8	5.0	4.6
Bellevue, WA	136,426	4	5	4	3	6	4.4	3.2
Overland Park, KS	184,525	6	8	4	3	7	5.6	3.0
Olathe, KS	133,062	1	4	8	2	5	4.0	3.0
Cedar Rapids, IA	129,195	2	7	2	5	1	3.4	2.6
Fort Collins	158,300	4	3	3	5	4	3.8	2.4
Naperville, IL	146,128	1	2	1	3	0	1.4	1.0
Total Peer Cities	1,702,656	55	93	81	76	97	80.4	4.7

Note: 2015 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 2015. Colorado crash data is from CDOT. Population estimates are for 2016 and are from the U.S. Census

Additional Crash Statistics

Crashes by Month 2012-2016

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.

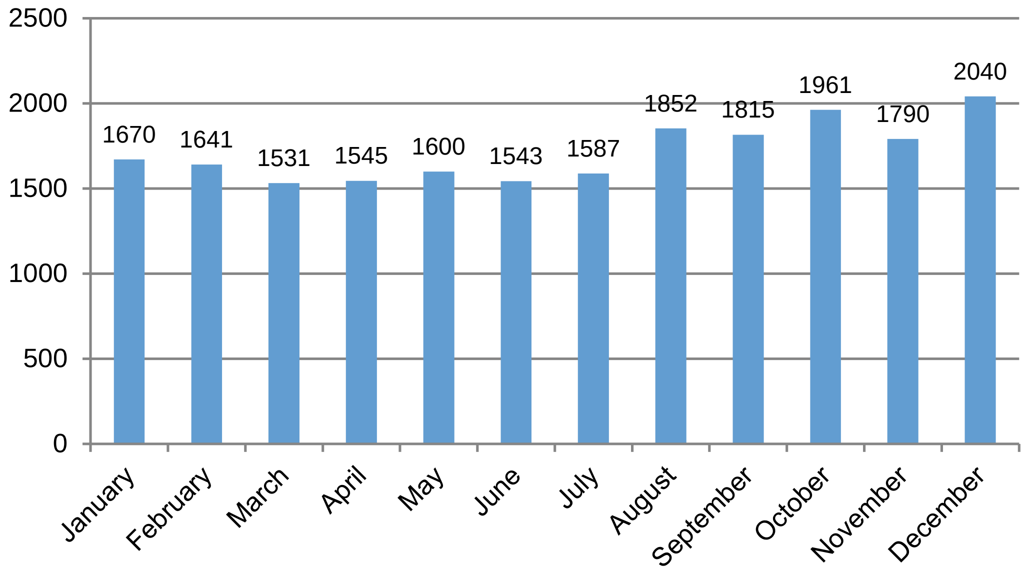


Figure 7

Crash variation by month (2012-2016)

Crashes by Day of Week 2012-2016

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).

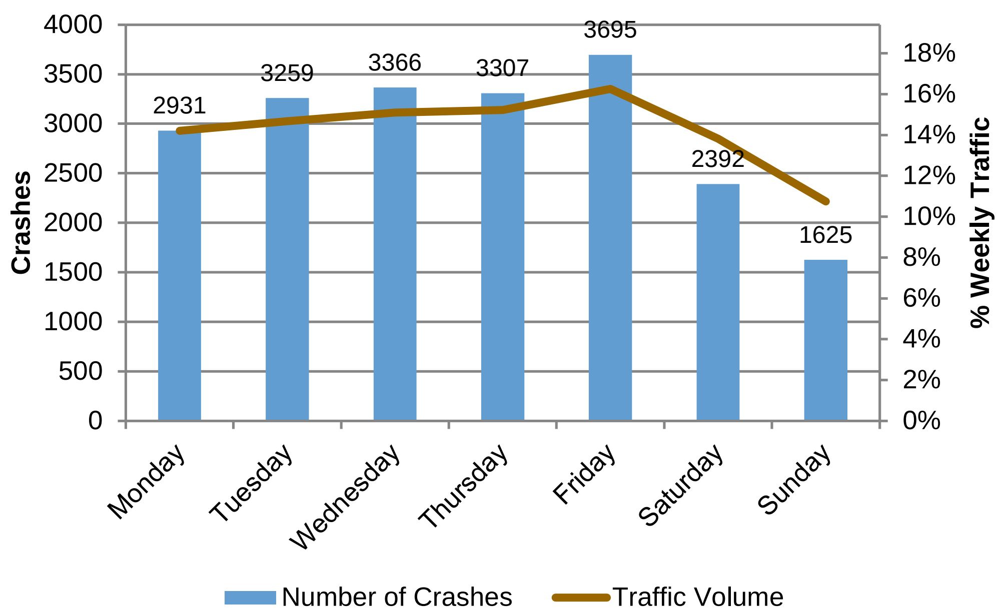


Figure 8

Crashes by day of week (2012-2016)

Crashes by Time of Day 2012 – 2016

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.

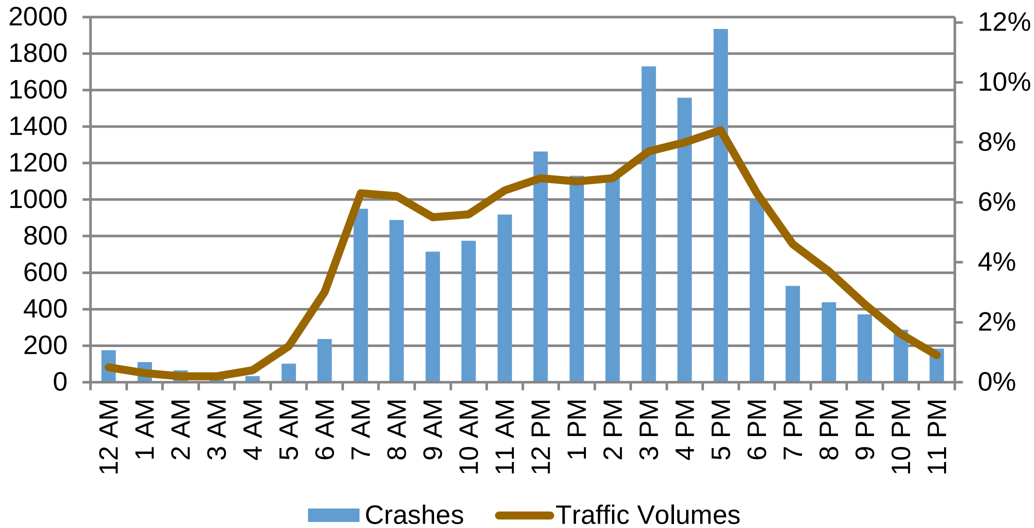
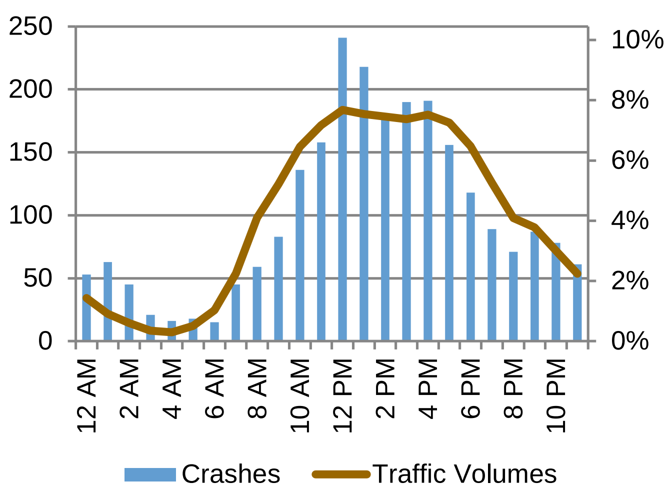


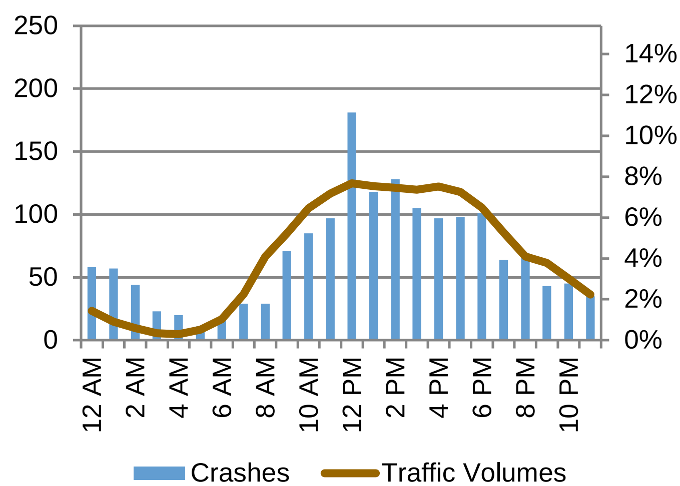
Figure 9

Weekday crashes by time of day (2012-2016)

Saturday Crashes and Volumes



Sunday Crashes and Volumes

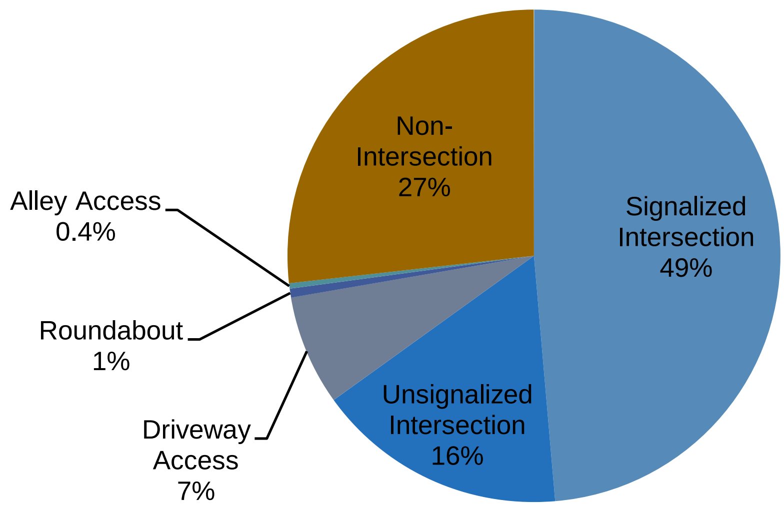


Figures 10,11

Saturday and Sunday crashes by time of day (2012-2016)

Locations of Crashes 2012-2016

The chart below shows the location of crashes in Fort Collins. Crashes at intersections or driveways account for 73% 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 (2012 – 2016)

At Fault Drivers by Age 2012-2016

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 **16%** of all crashes.

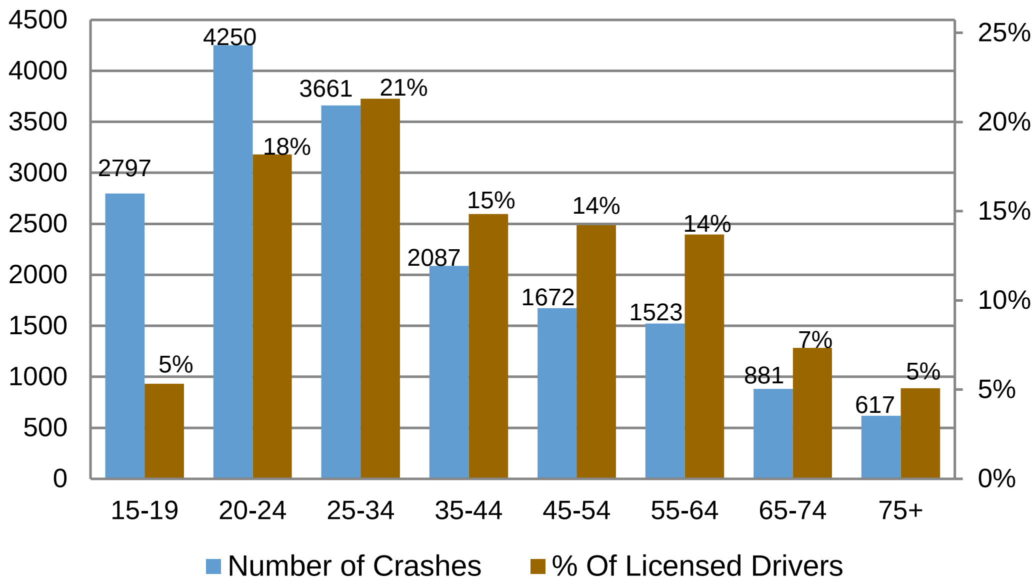


Figure 13

Crashes by age of at fault drivers (2012 – 2016)

Crashes by Age and Gender 2012-2016

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.

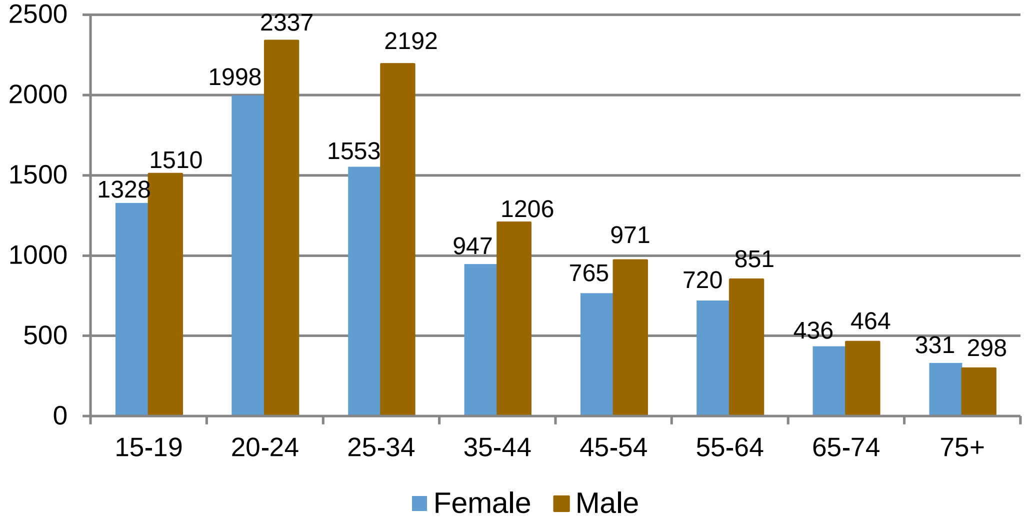


Figure 14

Crashes by age and gender of at fault drivers (2012 – 2016)

Drivers Under the Influence (DUI Crashes) 2012-2016

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 22% of fatal crashes. This suggests that alcohol related crashes are more likely to result in serious injuries.

2016 saw the highest number of DUI crashes in five years. There's been a 20% increase in DUI crashes since 2012, and a 48% increase in severe crashes (including 2 fatalities) in the past year.

Crashes involving DUI represent **4%** of all crashes **11%** of severe crashes and **22%** of fatal crashes.

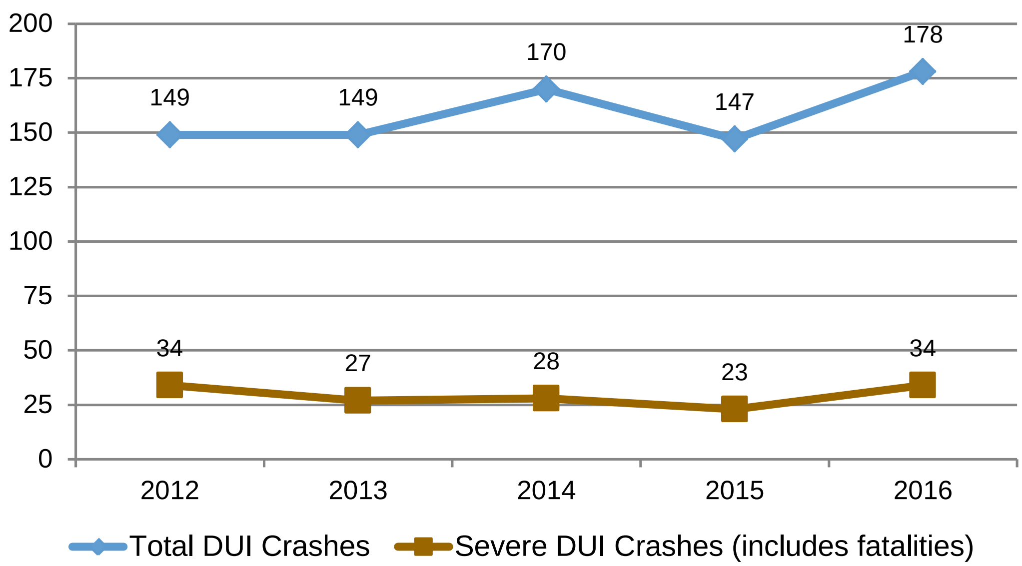


Figure 15

DUI crash trends (2012 – 2016)

20% increase in DUI crashes since 2012

DUI Crashes by Age 2012 – 2016

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

23%

of licensed drivers but cause

37%

of DUI crashes.

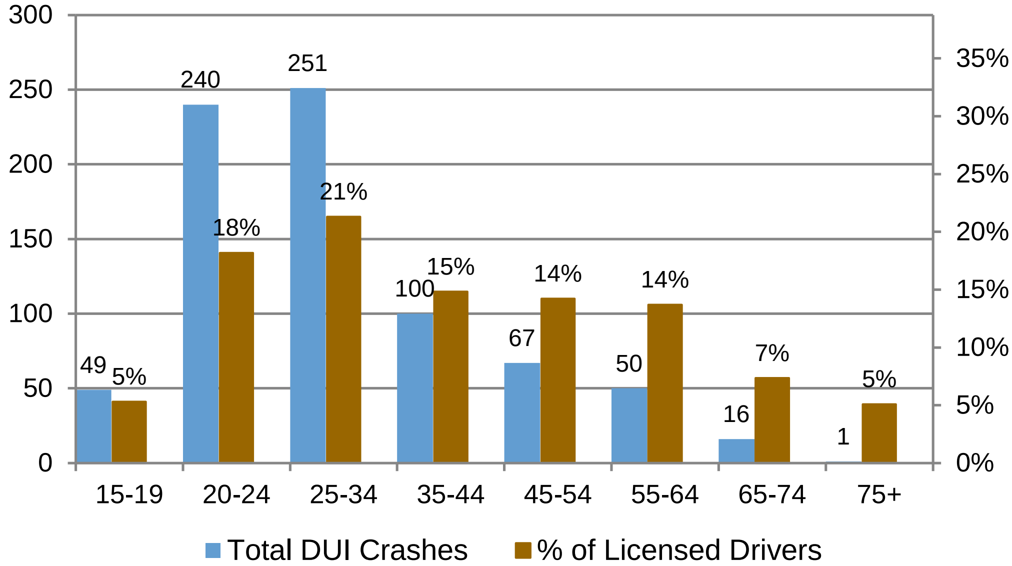


Figure 16

DUI crashes by age of at fault drivers (2012 – 2016)

Motorcycle Crashes 2012 – 2016

From 2012 - 2016 there were a total of 343 reported motorcycle crashes. Crashes in 2016 were lower than 2015.

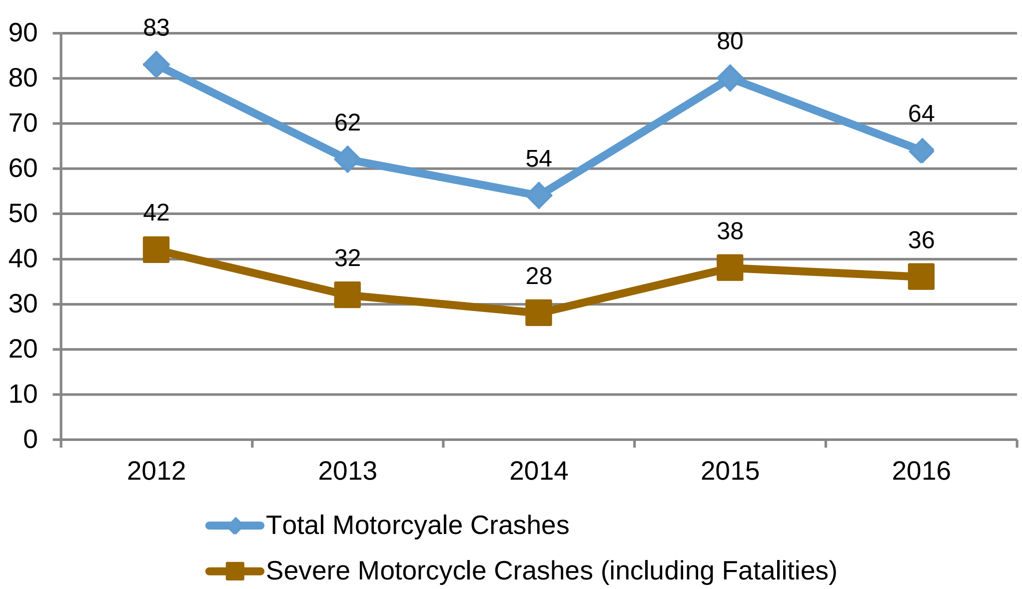
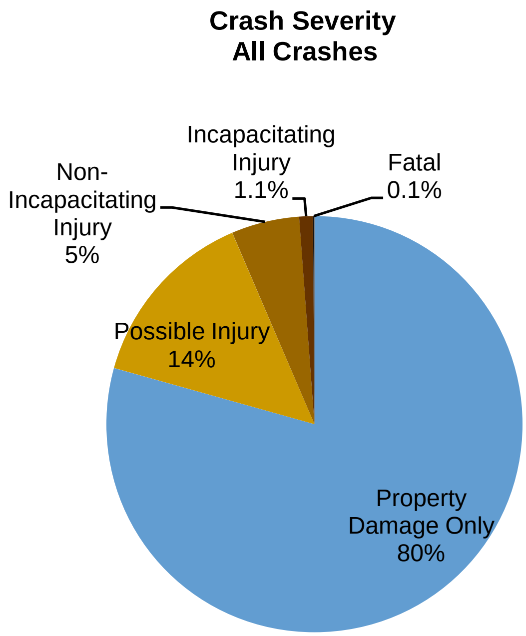


Figure 17

Motorcycle crashes (2012 – 2016)

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 70% of motorcycle crashes result in injury.

In a crash, motorcyclists are more than **three** times as likely to be injured and **13** times as likely to be killed than people in vehicles.



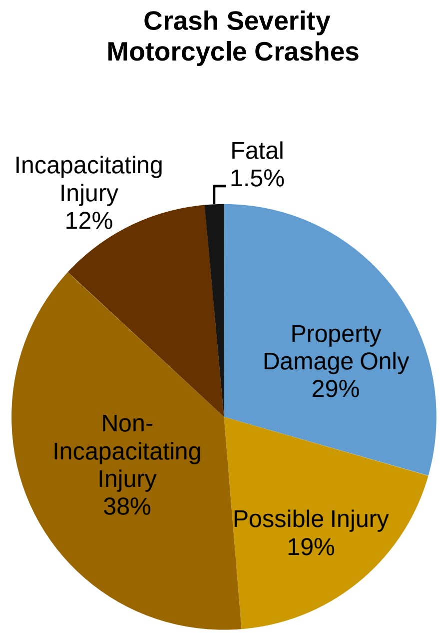


Figure 18

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 2012 – 2016

Rear end crashes make up nearly half of all crashes. Right angle, side to side, approach turn, and parking related crashes are the next most common types of crashes in the CIty. They account for about 80% of all reported crashes in Fort Collins.

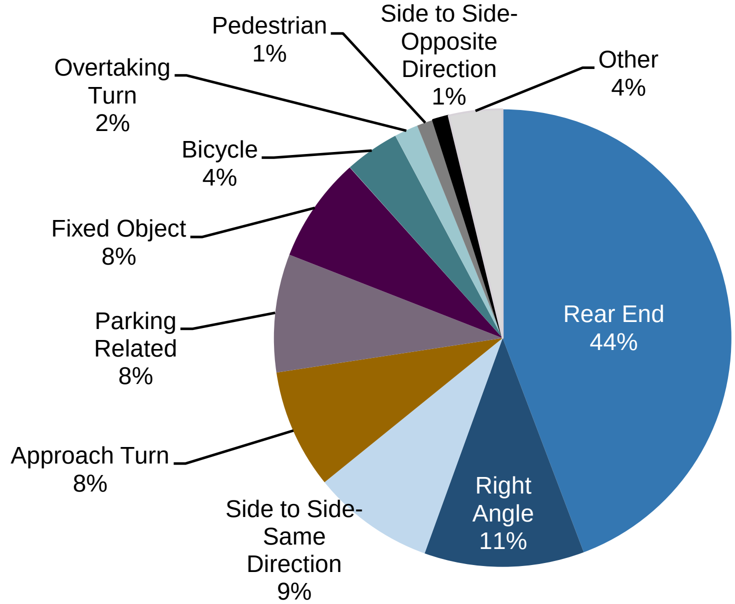


Figure 19

All Crashes by Type (2012 – 2016)

Severe Crashes by Type 2012 – 2016

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 86% 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 31% of severe crashes.

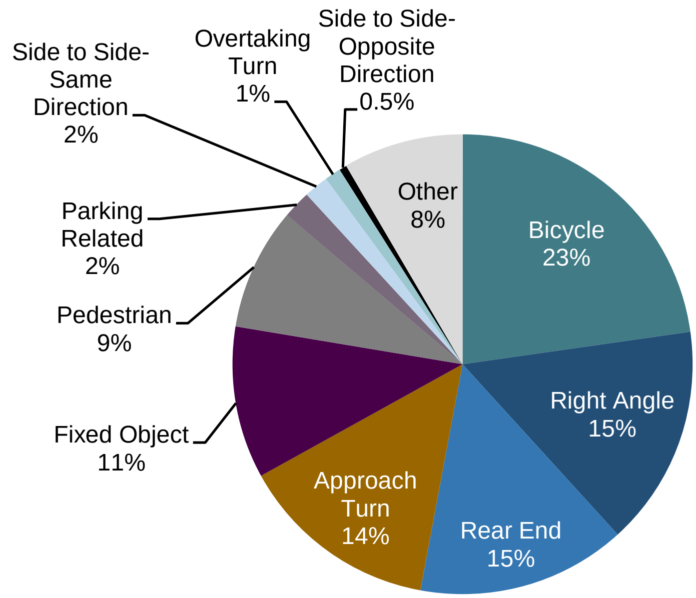


Figure 20

Severe Crashes by Type (2012 – 2016)

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 in 2014 and 2015, and up again in 2016. Overall, severe crashes have been declining since 2012.

Severe bike crashes are down **32%** since 2012.

Number of Bike Crashes

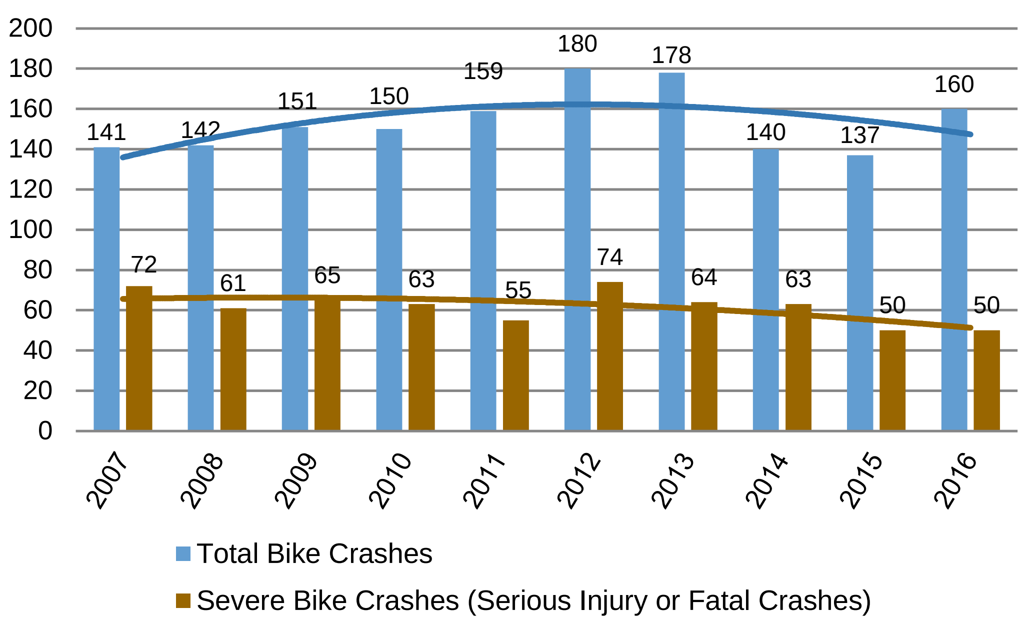


Figure 21

Historical bike crash data (10 years)

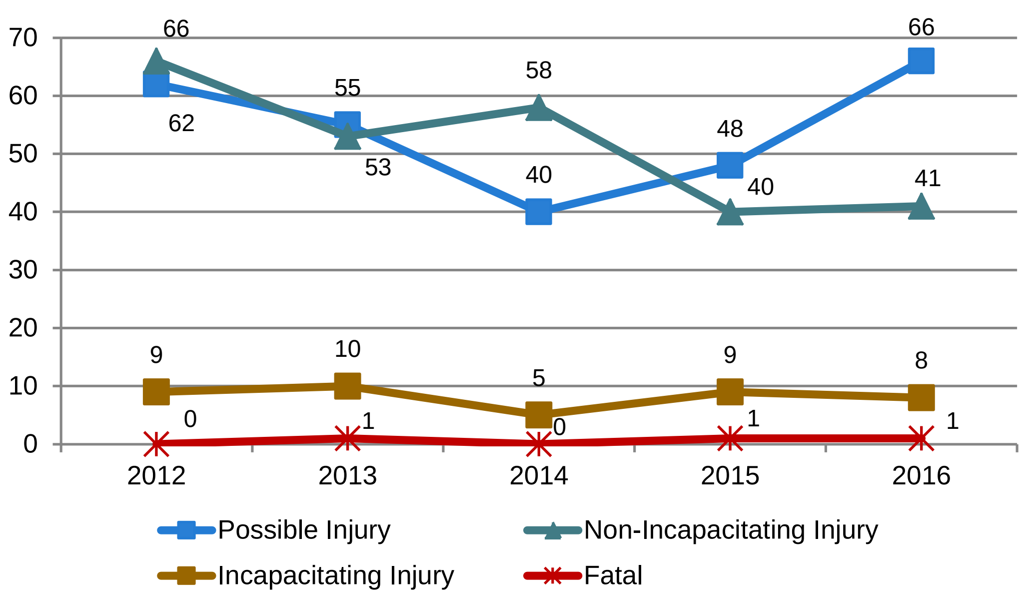
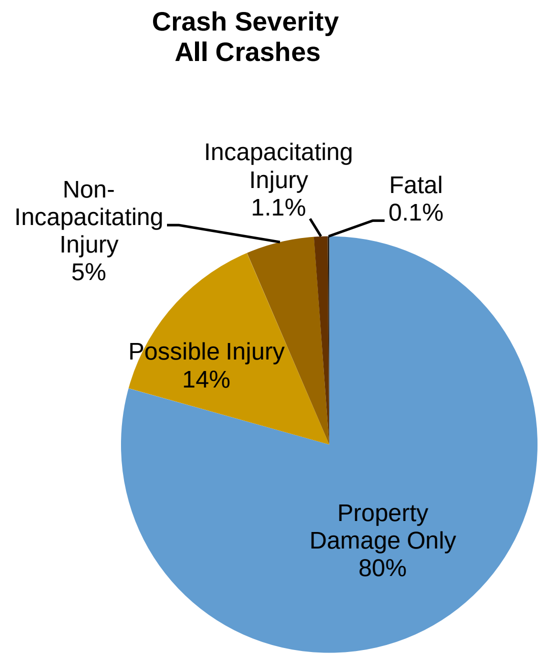


Figure 22

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

Bike Crash Severity

Overall bike crashes account for about 4% of all crashes in the City of Fort Collins. However, they account for about 23% of serious injury (non-incapacitating injury and incapacitating injury) and 13% of fatal crashes. This illustrates that bike crashes, when they do occur tend to be more serious than motor vehicle crashes.



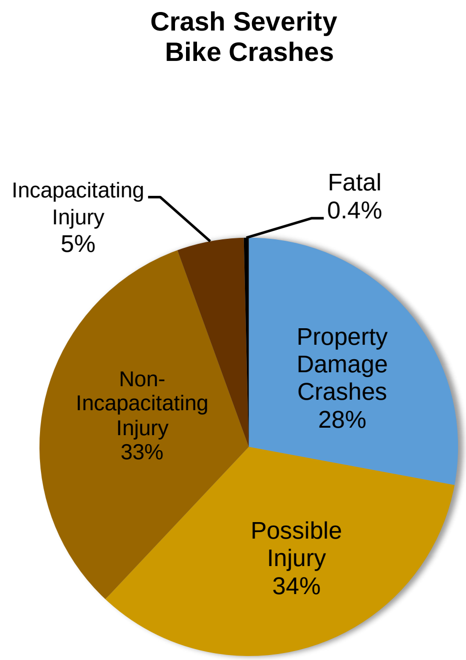


Figure 23

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 72% of all bike crashes.

72%
of all reported bike crashes involve a male cyclist

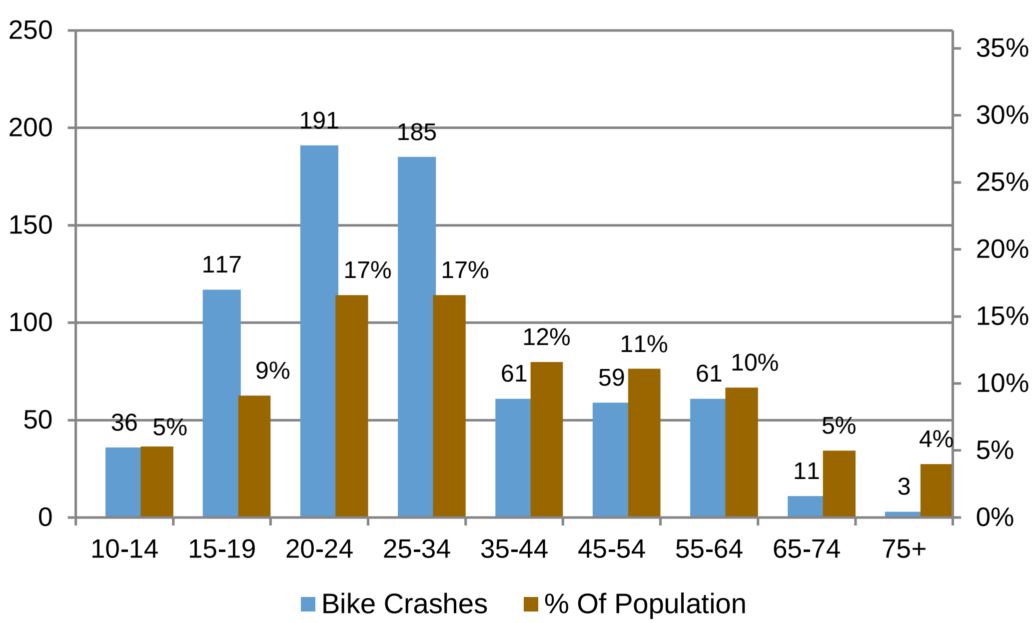
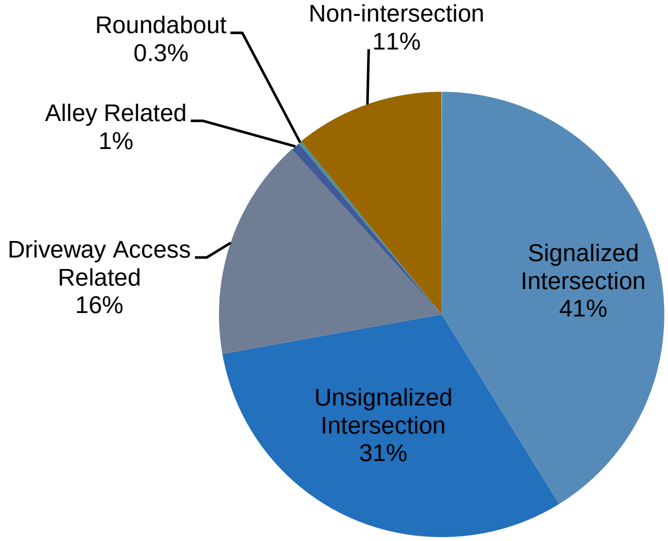


Figure 24

Bike crashes by age and percentage of population (2012-2016)

Bike Crash Location and Types (2012-2016)

Bike crashes can be further classified by location and type of collision. The following information details bike crashes in the past five years (averaged 2012-2016).



89% of all bike crashes occur at intersections or driveways.

Figure 25

Bike crashes by location (2012-2016).

Crashes at intersections, alleys or driveways account for almost 90% of all bike crashes. When reviewing yearly trends, that percentage is increasing from 86% in 2014 to 93% in 2016. It is important to note that intersections are the locations of greatest risk by far 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 also important.

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

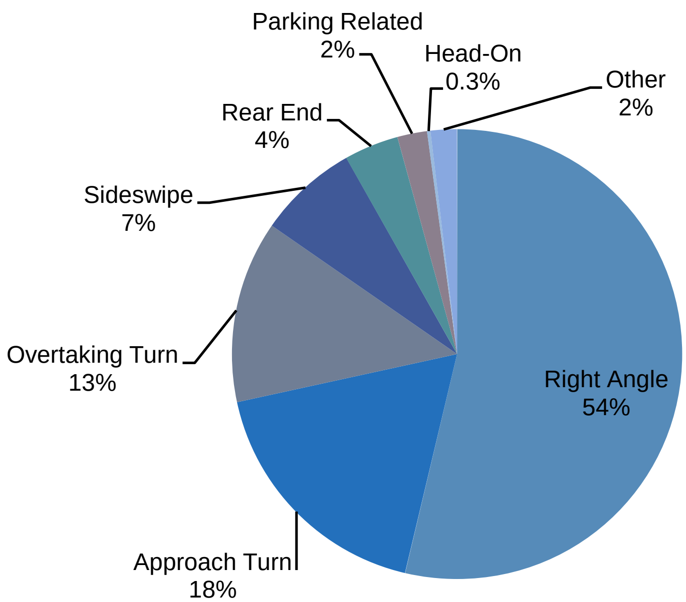


Figure 26

Bike crashes by type (2012-2016).

26% of all bike crashes involve wrong way riding

Right angle crashes are by far 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 42% of right angle crashes.

Along roadways bike crashes include 2% parking related (i.e. “door zone” crashes) and 11% rear-end or sideswipe.

Graphical Depiction of Typical Bike Crashes

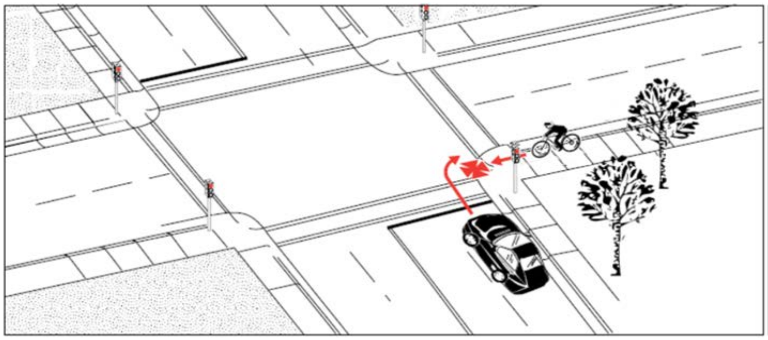


Figure 27

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-two percent (42%) of right angle crashes involve a bike riding against traffic on the sidewalk or street. (2012-2016)

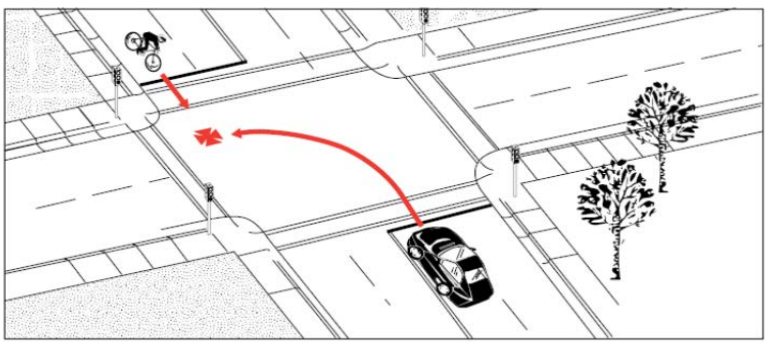


Figure 28

Approach turn crash

This type of crash represents 18% of all crashes. Almost half (48%) of approach turn crashes result in a severe crash (serious injury of fatal). (2012-2016)

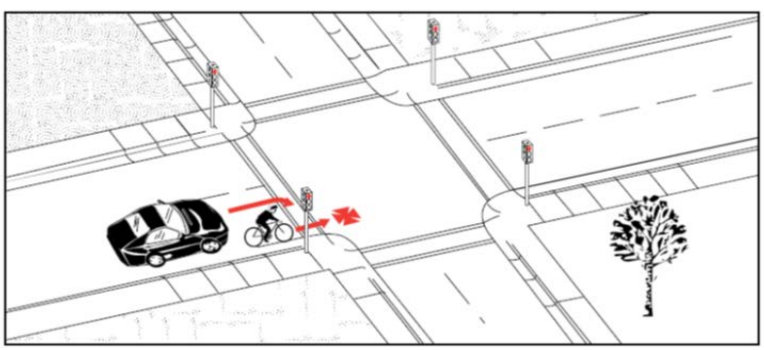


Figure 29

Overtaking turn crash

Also known as the “right hook” crash. This represents 13% of all bike crashes. (2012-2016)

Trends for Bike Crashes By Type (2012-2016)

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 prevalent crash type and are increasing after several years of decreases. The percent of sideswipe and rear-end crashes are decreasing.

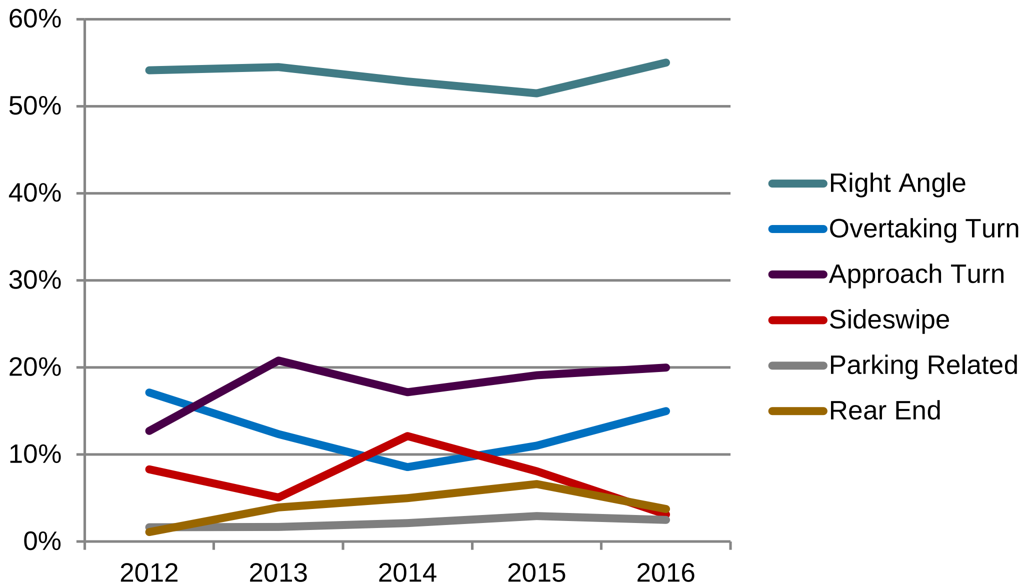


Figure 30

Trends for bike crashes by type.

Bike Crashes By Month (2016)

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.

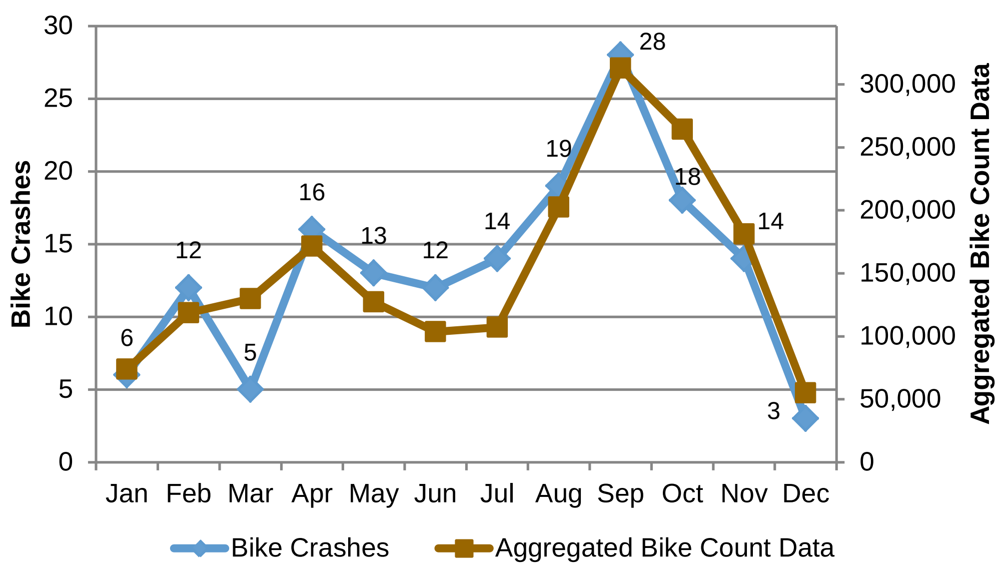


Figure 31

Bike crashes by month (2016) compared with bike volumes.

Detailed Bike Crash Tabulation (2012 – 2016)

Table 4

Detailed bike crash tabulation (2012-2016)

Type of Crash	Total Crashes	Severe Crashes
Right Angle		
Bike riding with traffic on street	127	57
Bike riding against traffic on street	35	13
Bike riding with traffic on sidewalk/crosswalk	59	23
Bike riding against traffic on sidewalk/crosswalk	145	46
Bike crossing street mid-block	10	4
Unknown Location	51	8
Right Angle Total	427	151
Overtaking Turn		
Bike riding with traffic on street	73	20
Bike riding against traffic on street	4	1
Bike riding with traffic on sidewalk/crosswalk	11	5
Bike riding against traffic on sidewalk/crosswalk	8	3
Bike crossing street mid-block	1	1
Unknown Location	7	0
Overtaking Turn Total	104	30
Approach Turn		
Bike riding with traffic on street	105	51
Bike riding against traffic on street	1	1
Bike riding with traffic on sidewalk/crosswalk	23	11
Bike riding against traffic on sidewalk/crosswalk	8	4
Unknown Location	5	1
Approach Turn Total	142	68
Sideswipe		
Bike riding with traffic on street	45	20
Bike riding against traffic on street	4	3
Bike riding with traffic on sidewalk/crosswalk	2	1
Bike crossing street mid-block	3	1
Unknown Location	3	1
Sideswipe Total	57	26
Parking Related		
Bike riding with traffic on street	15	8
Bike riding against traffic on street	1	1
Unknown Location	1	0
Parking Related Total	17	9
Rear End		
Bike riding with traffic on street	30	9
Unknown Location	1	0
Rear End Total	31	9
Head-On		
Bike riding with traffic on street	1	1
Bike riding against traffic on street	1	1
Head-On Total	2	2
Fixed Object	1	1
Other	14	6
Total Bike Crashes (2012 – 2016)	**795**	**302**

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.

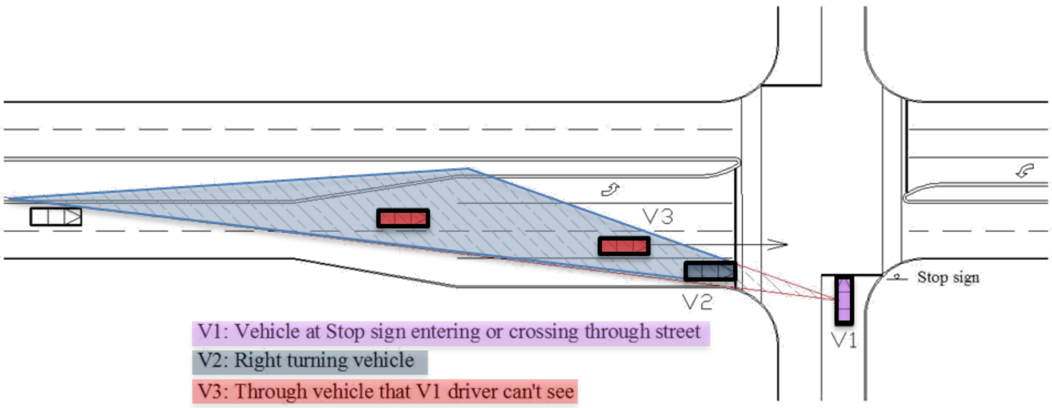


Figure 32

Depiction of typical right angle crash.

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 (2012 – 2016)

As shown, almost two-thirds (63%) 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 (35%) are the result of a motorist running a red light or stop sign (shades of brown).

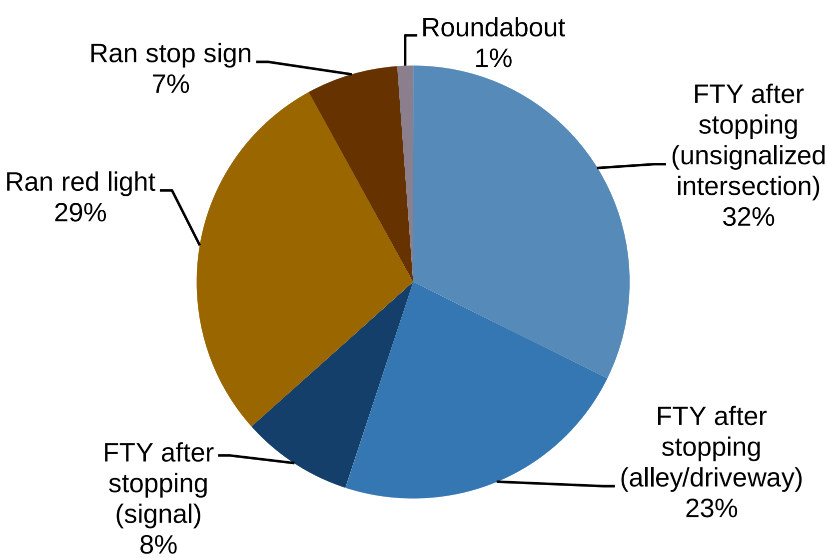


Figure 33

Right angle crashes by type (2012-2016)

FTY = Failure to Yield

Rear End Crashes

Rear end crashes are the most prevalent crash type in Fort Collins, accounting for 44% of total crashes. In 2016, there were 2,057 reported rear end crashes.

Only 2.4% of all rear end crashes in 2016 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 severe rear end crashes by location. As can be seen, the majority (40.9%) 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.

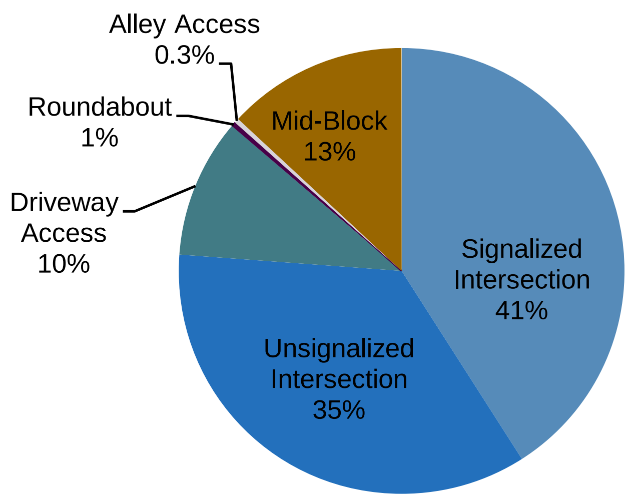


Figure 34

Severe rear end crashes by location (2012-2016)

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:

<u>Poor estimation of distance and/or speed of approaching through traffic</u> -- These accidents occur at both signalized and un-signalized 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.

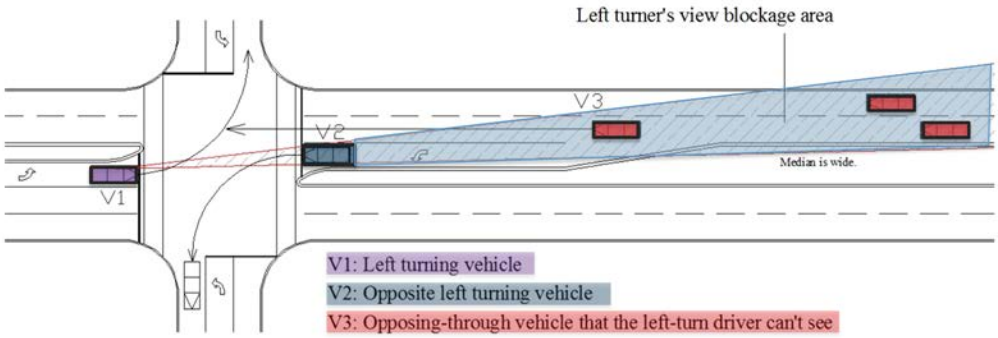


Figure 35

Depiction of typical approach turn crash.

<u>Inappropriate response to the onset of the yellow or red signal display</u> – 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.

Approach Turn Crashes by Location (2012 – 2016)

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 (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 are likely causes to this trend.

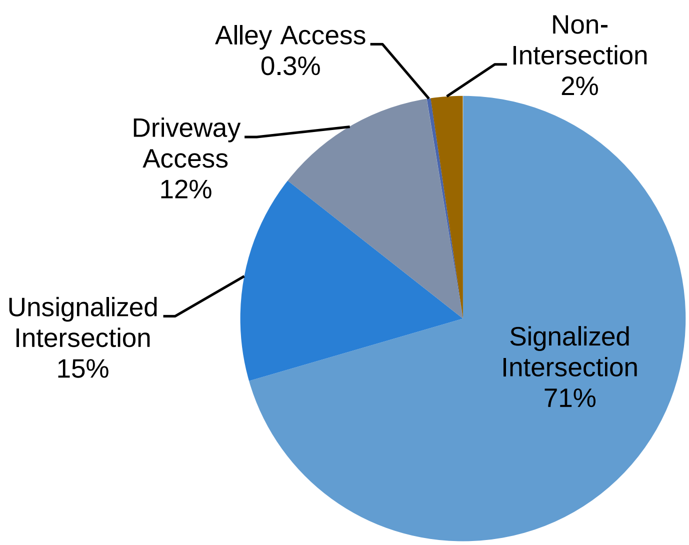


Figure 36

Location of approach turn crashes. (2012-2016)

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. 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 severe crashes the percentage related to alcohol goes up to almost 44%.

17%
of all fixed object crashes involve alcohol.

44%
of all severe fixed object crashes involve alcohol

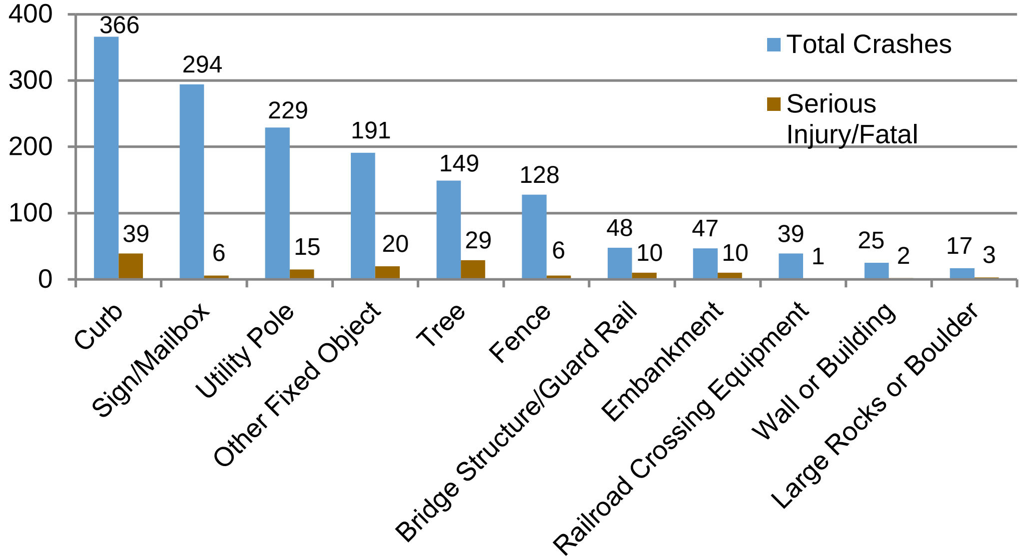


Figure 37

Type and severity of Fixed Object Crashes (2012-2016)

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. Although there is significant variation from year to year, generally the trend has been upward.

Pedestrian crashes tend to be serious crashes. Eighty-seven percent (87%) involve some level of injury and about half (47%) 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

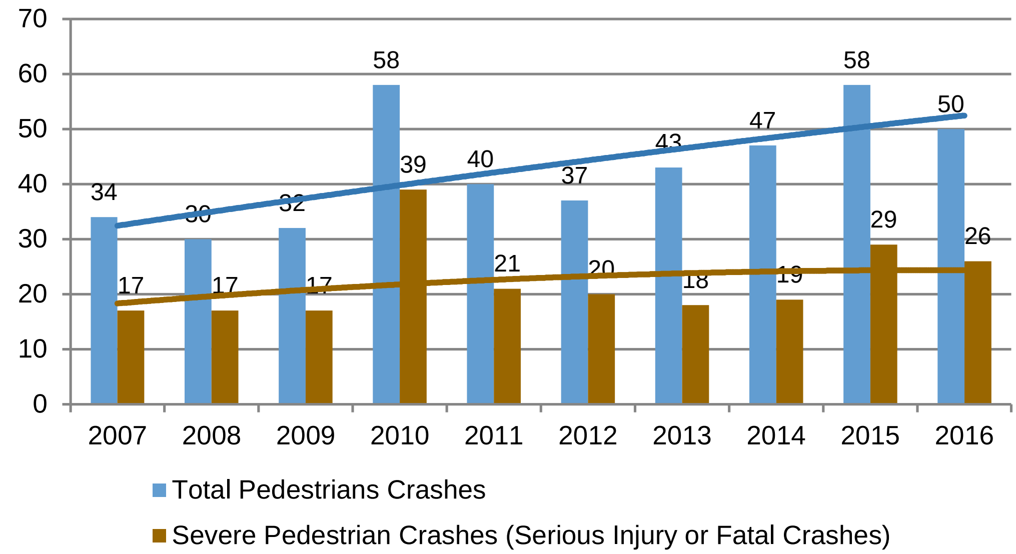


Figure 38

Historical pedestrian crash data (10 years)

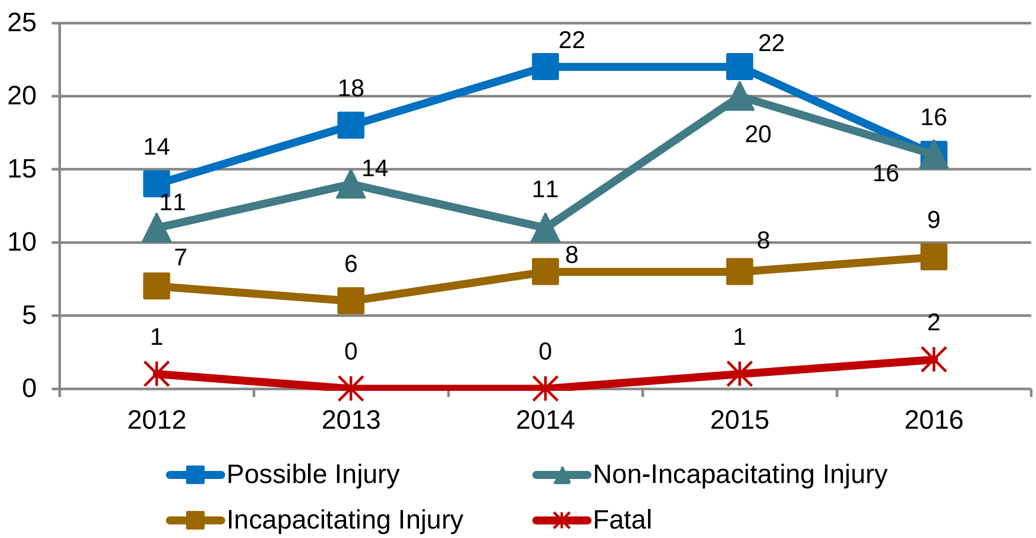


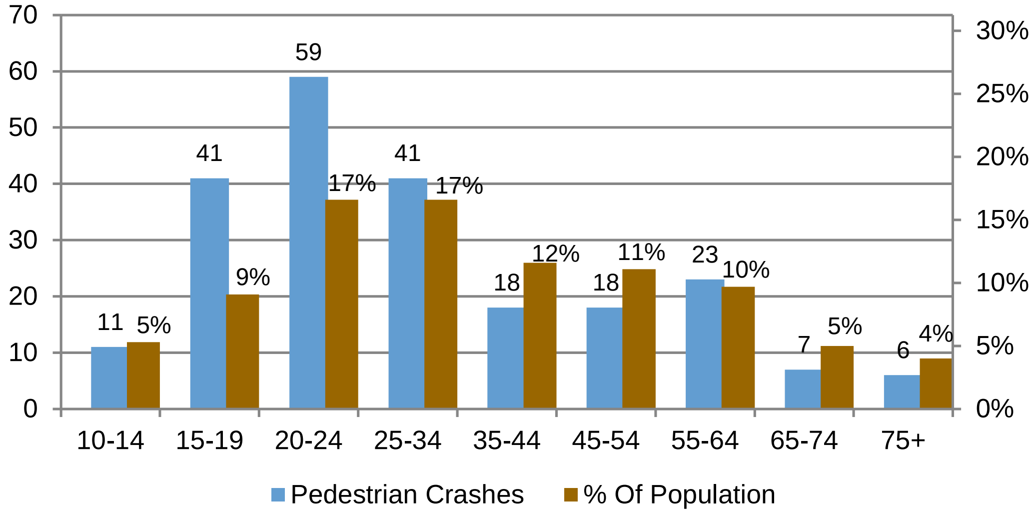
Figure 39

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

Pedestrian Crashes by Age and Gender (2012 – 2016)

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 44% 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



Note: 11 crashes are not listed due to lack of age data in report

Figure 40

Pedestrian crashes by age and percentage of population (2012-2016)

Pedestrian Crash Location and Types (2012-2016)

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).

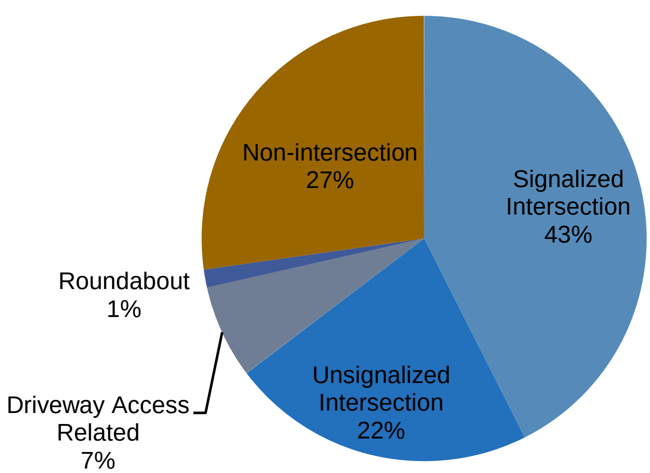


Figure 41

Pedestrian crashes by location (2012-2016)

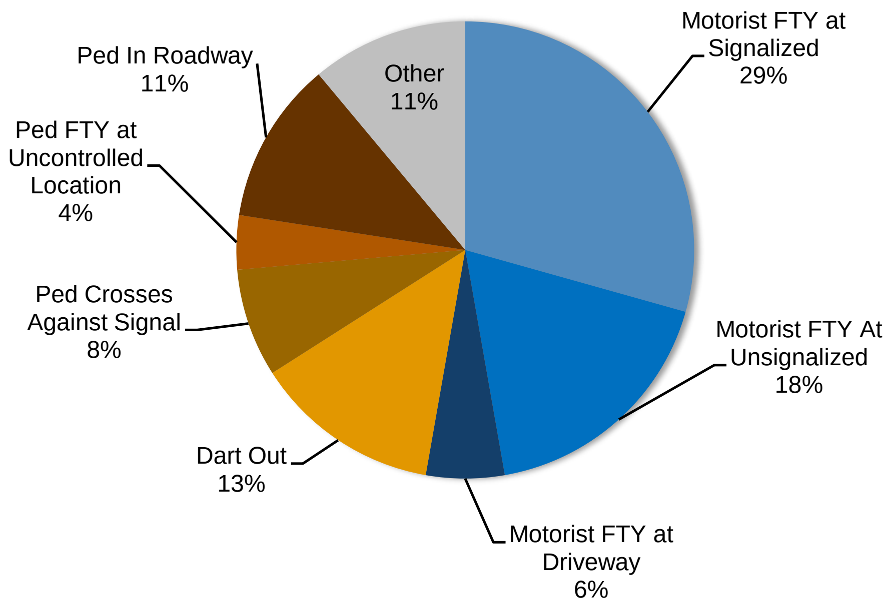


Figure 42

Pedestrian crashes by type (2012-2016)

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 (2012 – 2016)

Table 5

Detailed pedestrian crash tabulation (2012-2016)

Type of Crash	Total Crashes	Severe Crashes
Motorist Fail to Yield at Signalized Intersection		
Motorist Turning Left on Green	32	13
Motorist Turning Right on Green	9	5
Motorist Turning Right on Red	22	10
Motorist Going Straight	6	2
Total Motorist Fail to Yield at Signalized Intersection	**69**	**30**
Motorist Fail to Yield at Unsignalized Intersection	42	14
Motorist Fail to Yield Exiting Driveway	13	1
Pedestrian Fail to Yield at Uncontrolled Location	9	4
Pedestrian Crosses Against Signal	18	10
Dart Out	31	21
Pedestrian Standing/Walking in Road	27	17
Other	26	15
Total Pedestrian Crashes (2012-2016)	**235**	**112**

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: 2014 – 2016). Almost 250 intersections were evaluated with 46% having an excess crash cost (versus 54% 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 (2014 – 2016)

Table 6

Intersection excess cost (2014-2016)

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	42,432	24,689	67,121	42.4	8.0	57.2	12.4	10.41	4.41	$643,408
College Ave	Trilby Rd	33,105	13,839	46,944	25.2	5.0	32.0	9.6	2.24	4.54	$577,450
Lemay	Horsetooth (W)	29,858	24,833	54,691	21.9	4.0	25.5	6.7	0.96	2.65	$333,328
Shields St	Prospect Rd	31,372	22,015	53,387	30.5	6.0	38.4	8.0	5.84	1.99	$302,276
Lemay	Harmony Rd	48,367	15,750	64,117	35.3	6.7	44.0	8.4	7.02	1.76	$285,874
Lemay	Riverside	26,186	15,335	41,521	21.9	4.4	30.1	6.1	6.53	1.63	$265,614
Shields St	Drake Rd	29,649	22,690	52,339	29.6	5.8	38.0	7.3	6.83	1.51	$253,333
College Ave	Swallow	43,122	7,950	51,072	21.4	4.4	28.8	5.8	6.09	1.36	$227,068
College Ave	Monroe	45,743	4,858	50,601	16.5	3.5	27.0	4.5	9.48	1.02	$220,798
Mason St	Harmony Rd	32,811	7,680	40,491	18.7	3.8	29.6	4.3	10.37	0.51	$166,586
Raintree	Drake	20,902	2,410	23,312	3.2	0.9	5.3	2.2	0.79	1.26	$161,824
Mason	Mulberry St	25,983	4,913	30,896	8.2	1.6	13.8	2.5	4.74	0.85	$151,579
Shields St	Mulberry St	19,083	17,287	36,370	16.9	3.4	20.5	4.3	2.65	0.89	$135,827
Ziegler	Horsetooth	18,106	6,206	24,312	8.8	0.4	16.6	0.3	7.9	-0.1	$133,274
College Ave	Drake Rd	45,364	26,558	71,922	46.4	8.6	56.2	8.9	9.51	0.30	$133,243
City Park	Elizabeth St	16,733	4,722	21,455	7.7	1.6	9.4	2.5	0.88	0.89	$117,000
Riverside	Prospect Rd	30,122	8,877	38,999	18.8	3.9	22.8	4.5	3.39	0.61	$108,955
Timberline	Mtn Vista	7,059	5,910	12,969	1.7	0.5	4.3	1.2	1.88	0.72	$107,139
College Ave	Foothills	48,062	2,664	50,726	11.8	2.6	19.6	2.8	7.52	0.23	$103,835
Lemay	Pennock	24,896	3,970	28,866	10.7	2.3	11.7	3.1	0.26	0.83	$103,704
College Ave	Vine	26,749	6,443	33,192	9.7	1.9	11.2	2.6	0.79	0.71	$95,248
College Ave	Kensington	36,679	3,385	40,064	11.3	2.6	14.5	3.1	2.66	0.53	$92,051
Linden	Vine	6,418	2,872	9,290	1.4	0.5	3.5	1.1	1.43	0.62	$89,735
Mason St	Horsetooth	27,604	7,289	34,893	15.8	3.3	20.0	3.7	3.75	0.42	$89,298
Mathews	Mulberry	24,152	1,000	25,152	2.5	0.7	4.9	1.2	1.86	0.56	$86,961
Remington	Mulberry St	23,792	4,294	28,086	10.6	2.3	11.5	2.9	0.17	0.68	$84,692
College	Triangle	32,702	3,308	36,010	2.9	0.6	3.6	1.3	-0.07	0.70	$84,630
Manhattan	Horsetooth	26,006	4,150	30,156	11.3	2.4	11.9	3.1	-0.17	0.70	$84,240
Timberline	Horsetooth	30,092	19,995	50,087	28.2	5.6	28.3	6.3	-0.56	0.72	$82,422
McClelland	Horsetooth	28,491	2,369	30,860	5.9	1.2	9.2	1.6	2.90	0.40	$78,529
College Ave	Troutman	38,392	6,832	45,224	18.0	3.8	19.5	4.4	1.03	0.53	$75,246
Shields St	Casa Grande	31,529	1,137	32,666	4.3	0.9	6.8	1.3	2.15	0.41	$71,685
College Ave	Laurel	33,108	8,363	41,471	18.3	4.0	23.5	4.2	5.01	0.17	$71,096
College Ave	Cherry	23,036	7,405	30,441	13.5	2.8	17.9	3.1	4.13	0.24	$70,797
Snow Mesa	Harmony Rd	51,074	6,179	57,253	20.7	4.2	19.3	4.9	-2.05	0.73	$68,811
Timberline	Bighorn	29,053	1,850	30,903	3.7	1.0	5.5	1.4	1.32	0.45	$68,221
College	Smokey	37,262	500	37,762	1.9	0.4	2.2	0.9	-0.15	0.53	$62,800
9th (Lemay)	Buckingham	16,354	1,518	17,872	2.3	0.6	2.8	1.1	0.00	0.49	$60,143
Shields	Westward	37,315	882	38,197	2.2	0.5	3.4	0.9	0.79	0.41	$57,496
Shields St	Raintree	29,015	5,589	34,604	14.5	3.0	15.5	3.5	0.60	0.42	$57,229
Overland	Elizabeth	11,137	2,275	13,412	0.7	0.1	2.5	0.5	1.39	0.35	$56,723
Timberline	Vermont	32,428	2,964	35,392	11.5	2.5	9.2	3.2	-3.07	0.72	$56,665
Shields St	Plum	31,964	3,612	35,576	12.6	2.7	17.4	2.7	4.76	0.05	$53,931
Stover (E)	Prospect	24,972	1,543	26,515	1.8	0.4	6.3	0.4	4.45	0.05	$51,679
Lemay	Prospect Rd	30,114	25,038	55,152	31.5	6.2	34.1	6.4	2.39	0.22	$51,352
Lemay	Horsetooth (E)	28,664	14,989	43,653	16.2	3.0	17.6	3.4	1.10	0.33	$51,303
Shields	Wabash	27,802	893	28,695	2.6	0.7	4.5	1.0	1.61	0.29	$51,221
Shields	Davidson	30,825	1,899	32,724	3.9	1.0	4.5	1.4	0.22	0.39	$49,239
City Park	Mulberry	16,640	3,936	20,576	2.3	0.5	5.3	0.6	2.86	0.15	$46,574
College Ave	Fossil Creek	38,626	2,252	40,878	11.3	2.4	12.1	2.7	0.53	0.33	$45,127

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

XXX *= top 10 intersections*
XXX *= next 15 intersections*

Intersection Locations with Most Excess Crash Costs (2014 – 2016)

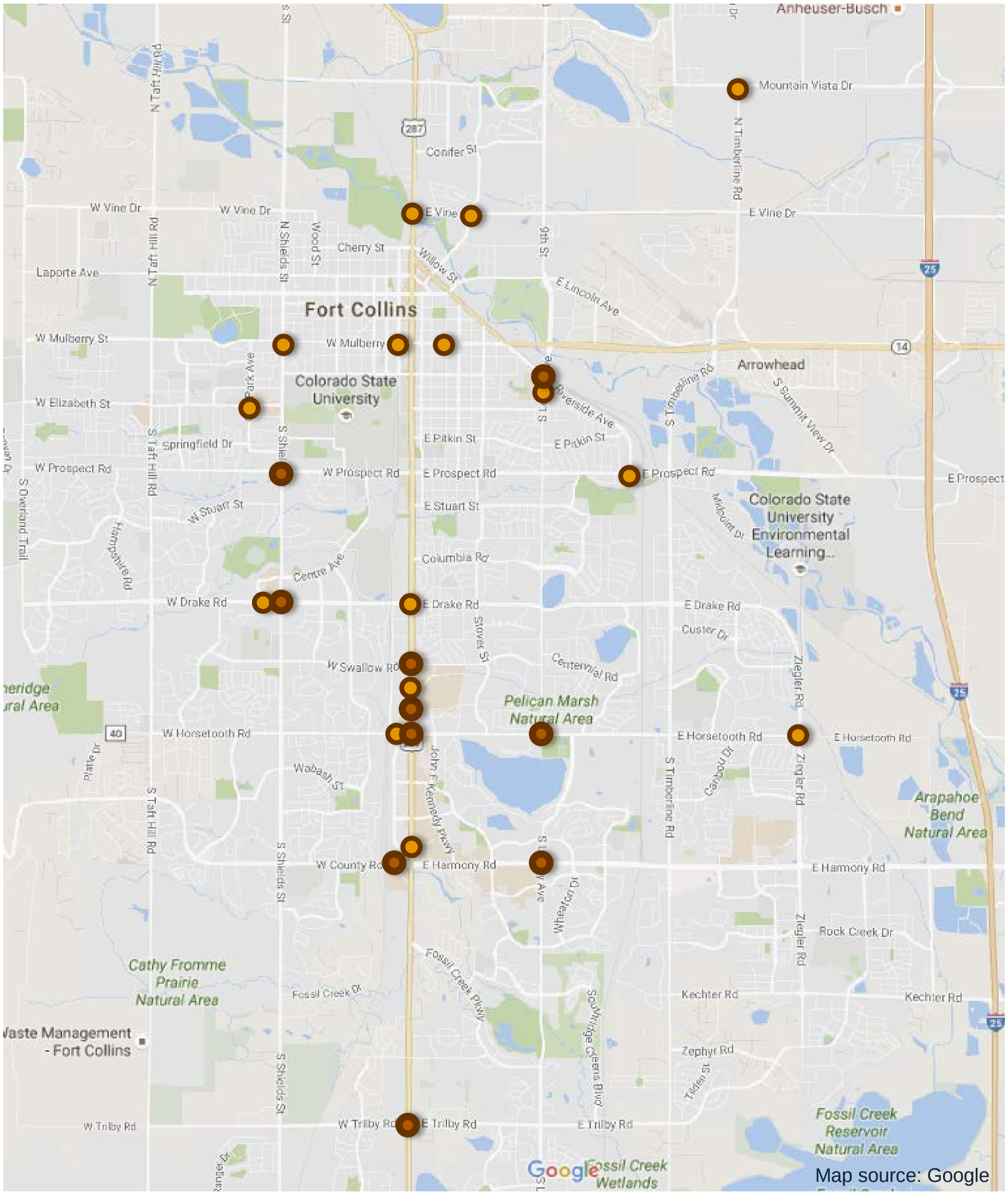


Figure 43

Map of intersections with most excess crashes (2014-2016)

Top 10 Intersections with most excess crash costs

Next 15 Intersections with most excess crash costs

Intersection Maps, Trends and Patterns

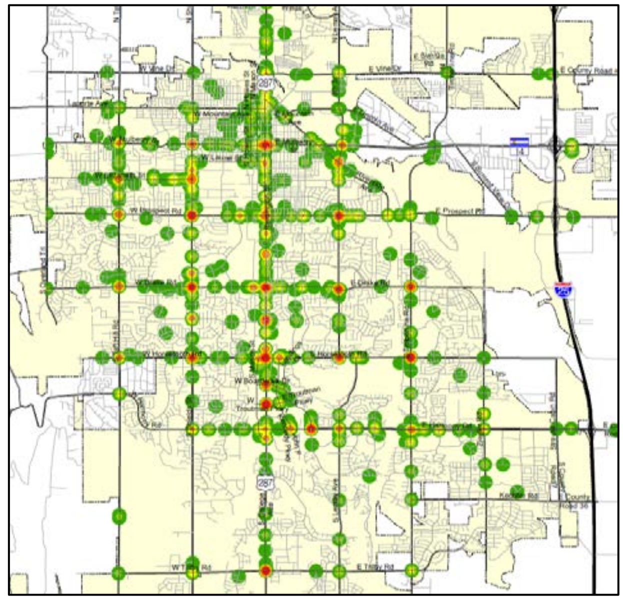
In addition to identifying intersections with higher than expected crash numbers and severity, a review of maps, trends and patterns for specific intersections can also be helpful.

GIS Based Data

Crash information is also geo-coded and can be evaluated through mapping efforts. This allows for a visual depiction of crash numbers at specific locations. 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 areas with high incidences for enforcement.

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 a case by case basis by request.



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 (2011-2016). Excess crash cost for three years of data (2011-2013) and again (2014-2016) were compared. All crash costs are adjusted to reflect 2016 dollars.

Table 7

Intersections with largest decreasing crash costs (i.e. less crashes) 2011/2013 and 2014/2016

Intersection		**2014-2016 Excess Crashes & Cost**			**2011-2013 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	
Timberline	Prospect	4.08	-0.91	-$70,305	5.49	2.68	$382,318	-1.42	-3.59	**-$452,622**	Rebuilt- summer 2016
Boardwalk	Harmony	3.28	-0.16	$13,707	1.97	3.07	$395,027	1.31	-3.23	**-$381,319**	Restriping-removed offset lefts
College	Drake	9.51	0.30	$133,243	4.30	2.80	$384,829	5.21	-2.49	**-$251,585**	
Shields	Stuart	-0.16	-0.32	-$40,100	0.80	1.31	$167,450	-0.96	-1.62	**-$207,550**	Buffered Bike Lanes, 10' Lanes
Lemay	Mulberry	3.02	-1.13	-$107,189	0.23	0.57	$72,136	2.79	-1.70	**-$179,324**	Rebuilt capital project '15.
Shields	Horsetooth	3.01	-0.84	-$72,241	-1.48	0.95	$101,258	4.50	-1.79	**-$173,499**	
Shields	Elizabeth	7.71	-0.27	$44,576	7.20	1.16	$214,119	0.51	-1.43	**-$169,543**	Underpass under constr.'17
Taft Hill	Horsetooth	-0.66	-0.05	-$12,398	2.63	0.92	$139,224	-3.29	-0.97	**-$151,622**	SB Right Turn Lane added
Timberline	Drake	-3.67	0.10	-$25,384	-3.56	1.24	$115,899	-0.11	-1.15	**-$141,283**	
JFK	Harmony	-1.32	-0.29	-$49,342	-0.68	0.79	$89,376	-0.65	-1.08	**-$138,717**	
Timberline	Horsetooth	-0.56	0.72	$82,422	5.76	1.32	$219,788	-6.32	-0.60	**-$137,365**	Intersection Capital Project 2015
Shields	Plum	4.76	0.05	$53,931	4.26	1.12	$179,657	0.50	-1.07	**-$125,726**	
College	Foothills	7.52	0.23	$103,835	7.79	1.14	$218,222	-0.27	-0.91	**-$114,387**	Mall recon. limited volumes

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

Intersection		2014-2016 Excess Crashes & Cost			2011-2013 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	
Lemay	Riverside	6.53	1.63	$265,614	-3.49	-1.55	-$224,379	10.02	3.18	**$489,993**	Added traffic - Mulberry Bridge Detour
Shields	Drake Rd	6.83	1.51	$253,333	3.10	-0.85	-$72,453	3.73	2.36	**$325,785**	Right turn lanes added - summer 2016
College	Trilby Rd	2.24	4.54	$577,450	3.94	1.99	$282,565	-1.70	2.56	**$294,885**	Safety $ for re-build received
Riverside	Prospect	3.39	0.61	$108,955	-1.52	-1.25	-$168,233	4.91	1.86	**$277,188**	Added traffic - Mulberry Bridge Detour
Shields	Prospect	5.84	1.99	$302,276	1.77	0.25	$48,238	4.07	1.74	**$254,038**	
Mason	Horsetooth	3.75	0.42	$89,298	-1.03	-1.11	-$145,661	4.78	1.53	**$234,959**	Added complexity due to MAX?
College	Harmony	7.51	-0.25	$44,921	5.44	-1.97	-$185,579	2.07	1.72	**$230,501**	
College	Horsetooth	10.41	4.41	$643,408	8.64	2.69	$415,232	1.76	1.72	**$228,177**	Safety $ for re-build received
Lemay	Horsetooth (W)	0.96	2.65	$333,328	-0.95	1.09	$123,839	1.91	1.56	**$209,489**	
Lemay	Harmony	7.02	1.76	$285,874	4.66	0.32	$85,647	2.35	1.45	**$200,226**	
Timberline	Vermont	-3.07	0.72	$56,665	-4.07	-0.75	-$133,139	1.01	1.47	**$189,804**	
Shields	Raintree	0.60	0.42	$57,229	-2.33	-0.68	-$106,690	2.93	1.10	**$163,919**	Lanes narrowed to 10 ft-added bike buffers
Lemay	Pennock	0.26	0.83	$103,704	-3.20	-0.07	-$41,369	3.46	0.90	**$145,073**	
Manhattan	Horsetooth	-0.17	0.70	$84,240	0.08	-0.48	-$58,128	-0.25	1.19	**$142,369**	
College	Swallow	6.09	1.36	$227,068	2.20	0.57	$92,180	3.88	0.78	**$134,889**	
McClelland	Horsetooth	2.90	0.40	$78,529	1.67	-0.43	-$35,898	1.23	0.84	**$114,427**	Added complexity due to MAX?
Lemay	Horsetooth (E)	1.10	0.33	$51,303	-0.75	-0.44	-$60,715	1.85	0.76	**$112,018**	

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

Table 8

Intersections with largest increasing crash costs (i.e. more crashes) 2011/2013 and 2014/2016

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. 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 (Lemay/Mulberry, and Timberline/Horsetooth)
- Intersections with significantly added traffic due to detours in other locations tend to see a significant increase in excess crash costs (Lemay/Riverside, Riverside/Prospect)
- Arterial intersections along the MAX line and Mason Trail that required added complexity to already congested areas tended to see an increase in crashes.

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, Whedbee and Mulberry is listed under both Right Angle 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 (2014-2016)

Approach Turn Crashes

Cook	Mulberry
College	Lake
College	Mason/Palmer
College	Troutman
Timberline	Carpenter
Lemay	Drake
College	Swallow
Snow Mesa	Harmony

Right Angle

Overland	Elizabeth
Lemay	Poudre River
Edinburgh	Drake
Mason	Magnolia
Shields	Wabash
Meldrum	Laporte
Mathews	Mulberry
Worthington	Centre
Mason	Maple
College	Kensington
Remington	Elizabeth
Remington	Prospect
Lemay	Oakridge
Whedbee	Mulberry
College	Mountain

Rear End

Overland	CR 42 C
College	Harmony
Lemay	Harmony
College	Monroe
Timberline	Harmony
Boardwalk	Harmony
Timberline	Prospect
College	Fossil Creek
Shields	Plum
Corbett	Harmony
McMurray	Harmony
Timberline	Kechter

Pedestrian

Shields	University
City Park	Elizabeth
Linden	Jefferson
Remington	Mulberry

Bicycle

Shields	Pitkin
Shields	Bennett
College	Lake
Lemay	Whalers/Wheaton
Lemay	Haxton
Wheaton	Harmony
College	Thunderbird
Mason	Laurel
City Park	Elizabeth

Single Vehicle

Timberline	Mtn Vista
Timberline	Custer
Taft Hill	Drake
Riverside	Mulberry

Snow and Ice

Taft Hill	Drake
College	Skyway
Loomis	Mulberry
Shields	Mountain

Alcohol

Stover	Mulberry

Red Light Running

College	Kensington
Whedbee	Mulberry
Remington	Prospect
Remington	Mulberry
Meldrum	Mulberry
Taft Hill	Mulberry

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.

Listed below are a few recent examples that specifically targeted red light running. The data indicates the before and after safety performance.

Whedbee and Mulberry:

> Crash data showed a higher than expected number of right angle crashes related to red-light running by vehicles on Mulberry. An additional signal head was added, lenses were upgraded from 8 inches to 12 inches, reflective tape added on back plates, and trees trimmed.

Whedbee / Mulberry
Before: 4.4 right angle crashes/year
After: 1.6 right angle crashes/year
Result**: 63% reduction in crashes**

College and Elizabeth

> In response to a citizen call about signal head visibility contributing to red light running (RLR), an additional northbound signal head on the pole on the right side of the road was added.

College and Elizabeth
Before: 1.4 northbound RLR crashes/yr
After: 0 northbound RLR crashes /yr
Result: **100% reduction in crashes**

College and Kengsington

> Crash data showed an identified concern about red light running crashes at this intersection just north of Harmony. Reflective tape was added to the back plates of the signal heads.

College and Kensington
Before: 6.9 RLR crashes/yr
After: 3.2 RLR crashes /yr
Result: **53% reduction in crashes**

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. Projects in 2016 included:

- Shields/Drake and Shields/Davidson: addition of turn lanes and access control improvements
- 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

These projects will be monitored in coming years for their safety impact. A capital project completed in 2015 has been in place long enough to begin to review safety data:

Timberline and Horsetooth:

This capital project was completed in 2015 and added dual left turn lanes for northbound and southbound traffic, and a dedicated right turn lane for southbound and eastbound traffic. There has been a distinct benefit in terms of operations, efficiency and emissions, but there has also been a safety benefit.

Timberline / Horsetooth
Before: 41.6 crashes/year
After: 26 crashes/year
Result: **62% 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 Trilby intersection improvements: $2,250,000
- College Avenue and Horsetooth Road intersection improvements: $1,000,000

Design will take place in the next year or so, with construction to follow.

$ 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. The update of the Transportation Master Plan In 2017 and 2018 will 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 2016, the program received 270 total requests and 143 work orders were generated. This included 86 deployments of temporary radar speed signs, two neighborhood with permanent radar speed displays, and three neighborhoods with new installations of 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 40 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 has received funding to construct a “miniature city” complete with streets, bike lanes, and traffic signs. Families, adults, and children can 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 in 2016.   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 reached more than 1,600 participants in 2016.

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 (in the past year this has included work zone efforts, and bike clubs).

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.

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. Moving Towards Vision Zero is a challenging and important goal to achieve a safe transportation system for all modes of travel within the City of Fort Collins. 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.

This report builds upon previous efforts, with the newly added commitment of Towards Vision Zero. Focus for the coming year is a review of high crash locations, locations with trending crashes, and an effort to quantify the effect of various strategies/programs. Continued monitoring and evaluation of data and results will guide the continuous refinement of the entire safety program.

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.