2021 Annual Roadway Safety Report

August 2022

Prepared By:

Next Phase Engineering

Table of Contents

List of Tables

List of Figures

Section 1

INTRODUCTION

The City of Fort Collins is a vibrant city of 170,000 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 33,000 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

Like other cities, The City of Fort Collins experiences roadway crashes. With an average of almost 3,400 reported crashes each year, 285 of which involve an injury or fatality, the impact of traffic crashes touches every aspect of the physical and emotional well-being of a community including families, workplaces, emergency responders, neighborhoods, livelihoods, mobility and more. In 2021 alone, the annual societal cost of these crashes was $176 million dollars. Improving roadway safety by reducing the number and severity of crashes is a priority.

Safety Matters

In 2021, there were 321 crashes involving an injury or fatality in Fort Collins

This Roadway Safety Report is a compilation of traffic crash and safety information related to reported 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 patterns. The report also discusses specific next steps and serves as an action plan for the City in the coming year.

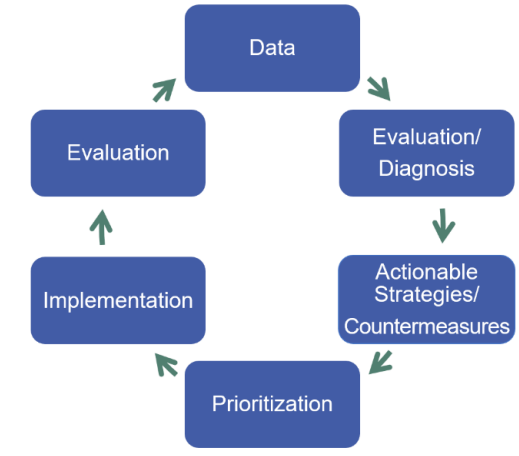
MOVING TOWARDS VISION ZERO

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 dedicated effort that focuses on actual safety and utilizes a systems-based approach that is a continuous process of data, evaluation, prioritization, countermeasures, implementation, and evaluation. See graphic at right. The mitigation strategies should specifically target a reduction of crashes.

The starting point is to fully review, analyze, and understand the locations, patterns, causes and trends among current crashes. This document provides the information needed for that data review.

The Vision Zero elements and action plan in Section 5 provide an initial roadmap to improve safety through a data driven process. It is anticipated that the Vision Zero Action Plan will be refined over time.



Systems-Based Transportation Safety Approach

COLLABORATION AND PLANNING EFFORTS

Improving roadway safety requires commitment and contributions beyond the City's Traffic Operations Department. Other city departments, including Police Services, FCMoves, Engineering, Streets, and others all play a vital role in a comprehensive roadway safety improvement program. Strategies need to be multifaceted and include all the various components including Engineering, Enforcement, Education/Encouragement and Evaluation. They should encompass all elements of the transportation system from policies and program through design, construction, operations, management and maintenance. A strong cooperative relationship among the groups is an important factor as well.

The residents of the community and everyone using the transportation system through any mode also play a critical role in supporting safety for everyone. Everyone has a right to travel around Fort Collins safely, and everyone has a responsibility to contribute towards that end. This document provides information that can be used for education and messaging to the greater Fort Collins community.

Finally, Fort Collins has invested in a number of planning documents, including the Transportation Master Plan and Active Modes Plan that provide concurrent guidance on the transportation system. Safety work and planning efforts should dovetail into one another.

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.

Traffic Operations staff reviews each crash report to ensure that data is as complete, accurate and consistent as possible. Crash narratives are used to further detail some of the fields. Crashes that go unreported and crashes on private property (such as grocery store parking lots) are not represented in this analysis. In addition, starting in 2018 non-injury crashes reported only to the State (such as during 'accident alert' status during bad weather) are not being captured by Fort Collins Police Services, and therefore not included in the analysis. This can be seen in the data for 2017 and 2018 which has slightly higher non-injury crash numbers. The change in reporting does not impact the data related to injury crashes.

Population data used in this report was from the U.S. Census Bureau. The Colorado Department of Revenue provided data showing the number of licensed drivers by age in Fort Collins.

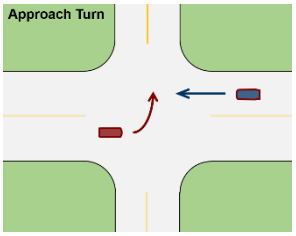
Most of the analyses represent five years of data, from 2017 to 2021. Some instances are noted and may only include three years of analysis, 2019-2021.

TYPES OF CRASHES

Throughout the document, there is detailed discussion and analysis regarding a variety of crash types. The most frequently noted crash categories are listed on the next page with an explanation and definition for each one. Some are depicted in the diagrams in ***Figure 1***.

Crash reports will often indicate "front to side" collisions (also known as broadside). As indicated in the definitions and the diagrams, the circumstances related to the front of a vehicle striking the side of another vehicle can vary, and the mitigation to address these collisions may be very different depending on the type of crash. More detailed descriptions (approach turn, right angle, and overtaking turn) are explained below and used in this report.

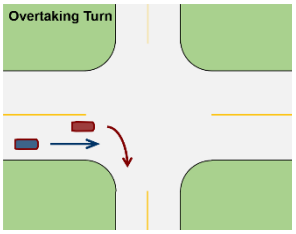
Approach Turn
Two vehicles traveling in opposite directions, one turns left (or attempts a U-turn) in front of the oncoming vehicle and is struck.



Bicycle
Any crash that involves a bicyclist.

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

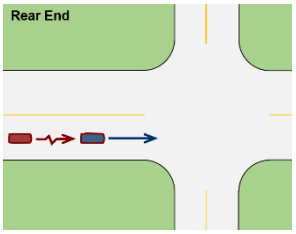
Overtaking Turn
Two vehicles traveling in the same direction, the front vehicle turns right or left and is hit as the following vehicle tries to pass on the right or left. When this type of crash involves a bicycle traveling straight and a vehicle making a right turn, it is also known as a 'right hook' crash.



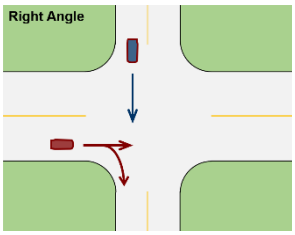
Parking Related
Any crash involving a parked vehicle or a vehicle entering/leaving a parking space.

Pedestrian
Any crash that involves a pedestrian.

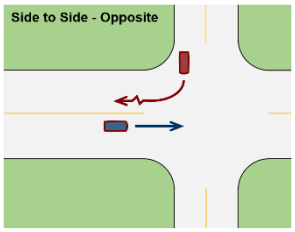
Rear End
Two vehicles traveling in the same direction, leading vehicle struck by following vehicle.



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 (frequently during icy conditions).



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.

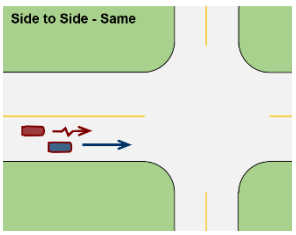


Figure 1.
Crash Type Diagrams

Section 2

GENERAL SAFETY DATA

This section of the report provides an overview of general safety data for the City of Fort Collins. Unless otherwise noted, the data represents a compilation or average of five years of data (2017-2021).

CRASH NUMBERS

Total reported crashes are shown in ***Figure 2*** and are generally declining. 2020 is understood to be a unique year due to the pandemic, with reduced travel volumes throughout the year. Compared to pre-pandemic 2019, total reported crashes declined by almost 20%.

Severe crashes are those that are coded (documented) as 'suspected minor injury', 'suspected major injury' or 'fatal'. The numbers of those crashes are generally increasing – up almost 5% since 2017, and 15% when compared to 2019 (pre pandemic). 2020 is considered to be an anomaly.

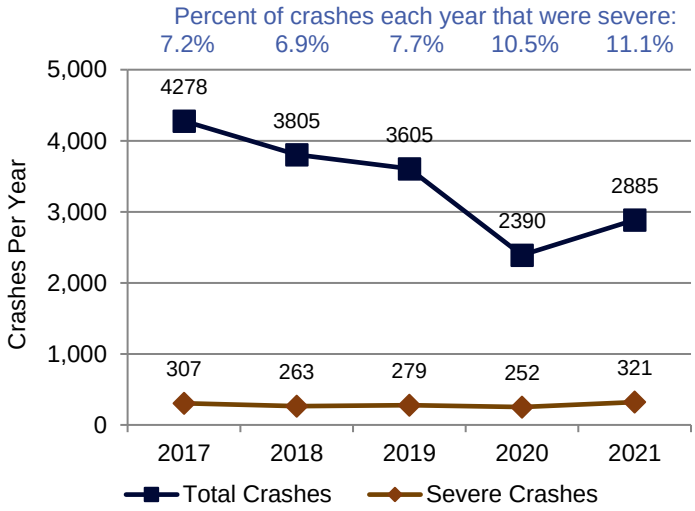


Figure 2. Total Crashes 2017-2021

Comparisons to other cities are in a later section (page 18).

Compared to 2019: Total crashes are down **20%**

But severe crashes are up **15%**

A **'severe'** crash is one that involves a non-incapacitating injury, incapacitating injury, or fatality

CRASH SEVERITY

The majority (75%) of crashes do not result in any injury. See ***Figure 3.*** Crashes that are included within the 'severe' category throughout this report include those coded in the police report as 'suspected minor injury', 'suspected major injury' or fatal crashes. Severe crashes represent 8.4% of all reported crashes.

8.4%
of crashes involve an injury/fatality

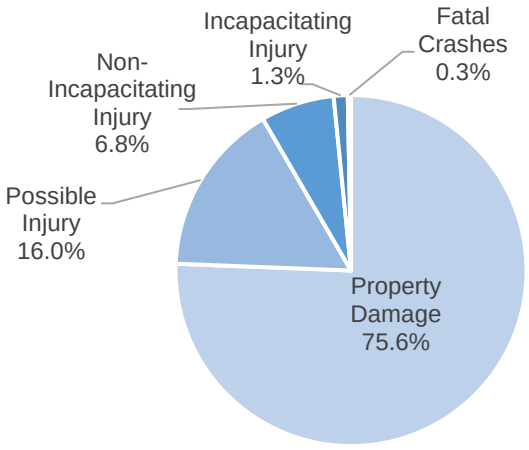


Figure 3. Overall Crash Severity

A review of whether that percentage has changed in the last years indicates that crashes in Fort Collins have become more severe (see values in the top of ***Figure 2***). Pre-pandemic the percent of severe crashes was about 7%. In 2020 the percentage was 10.5% and in 2021 the percent of crashes that were severe is 11.1%. This increase is a reflection of the combination of generally lower overall crash numbers but increasing severe crash trends. This phenomenon was seen across the United States during the pandemic – lower overall crash numbers likely due to reduced volumes, but higher severe crashes potentially due to higher speeds. The fact that in Fort Collins the trend towards more severity has continued in 2021 will need to be carefully monitored.

Figure 4 shows the five-year crash trends by severity. It is important to note that fatal crash numbers appear to fluctuate more due to the small number of crashes and due to regression to the mean. Regression to the mean is the statistical tendency for data points to adjust towards the long-term average. Because of these things, caution is needed when looking for trends in the fatal crash numbers.

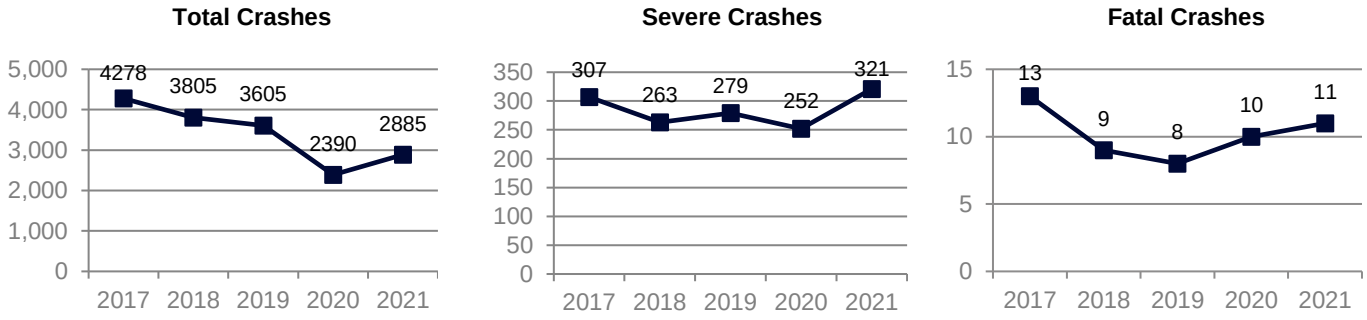


Figure 4. Crash Trends by Severity

CRASHES BY MODE

Figure 5 shows trends in severe crashes when separated by modes. Crashes involving only motor vehicles represent the largest percentage of severe crashes – about 2 of every 3 severe crashes.

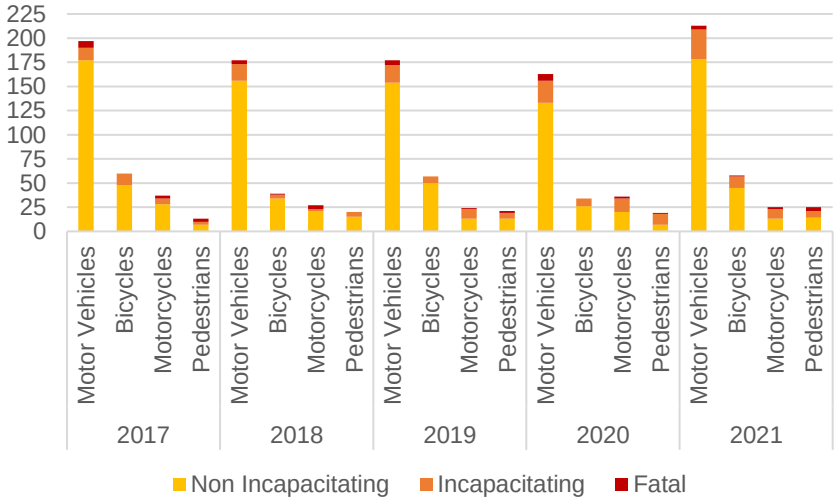


Figure 5. Severe Crash Trends by Mode

IMPACT ON VULNERABLE ROAD USERS

When vulnerable road users (motorcyclists, bicyclists, and pedestrians) are involved in a crash, it tends to be severe. While crashes involving only motor vehicles remain by far the most prevalent (94% of all crashes), they account for just 53% of fatalities. See ***Figure 6***.

Vulnerable road users are involved in
6% of all crashes but
47% of fatal crashes

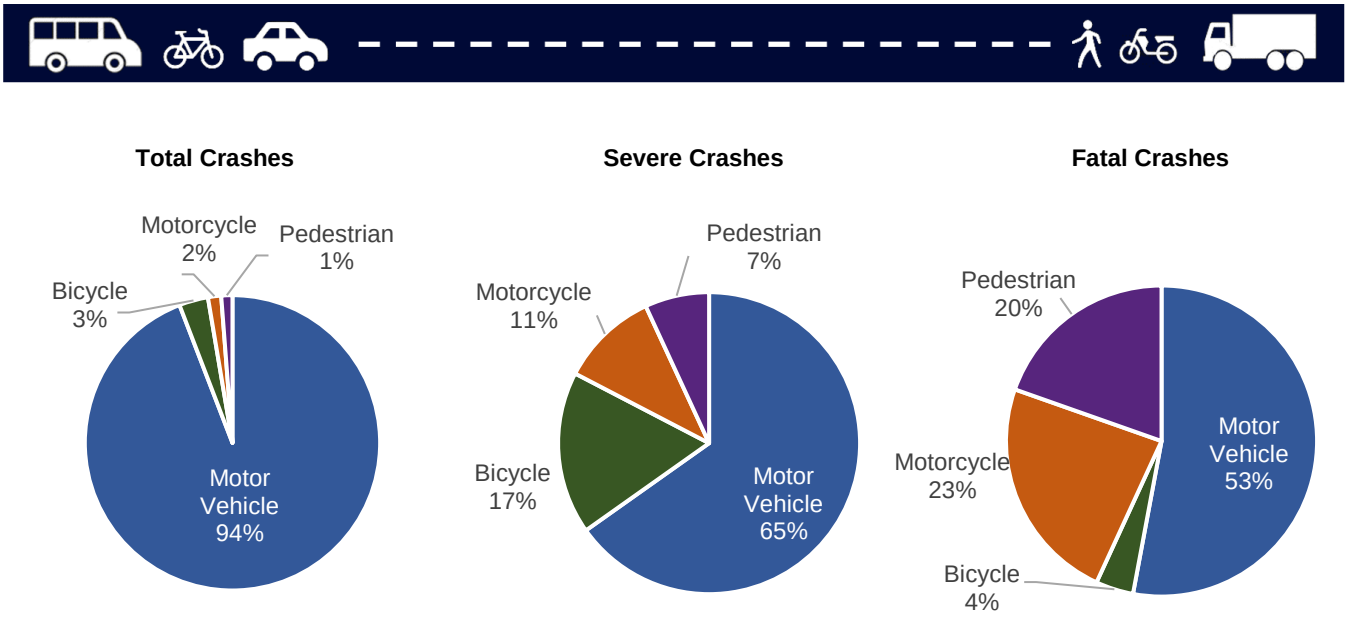


Figure 6. Severity Impact on Vulnerable Road Users

Trends in the past five years for crashes that involve a vulnerable user are shown in ***Figure 7.*** Bicycle crashes are about twice as common a motorcycle crashes or pedestrian crashes. While bicycle crashes saw a pronounced drop during the pandemic, motorcycle crashes increased. In 2021, both bicycle and pedestrian crashes increased.

The number of severe crashes by mode over the past five years is shown in ***Figure 8.*** Severe bicycle crashes vary quite a bit from year to year but are similar in 2021 to 2017 and 2019. Severe pedestrian crashes are slowly trending up, and most concerning is that there were four (4) pedestrian fatalities during 2021.

More detailed information on crashes involving bicyclists and pedestrians is presented later in this report.

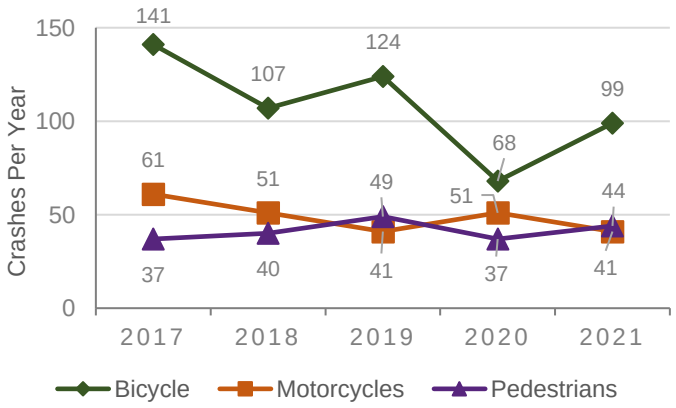


Figure 7. Vulnerable User Crash Trends (Total Crashes)

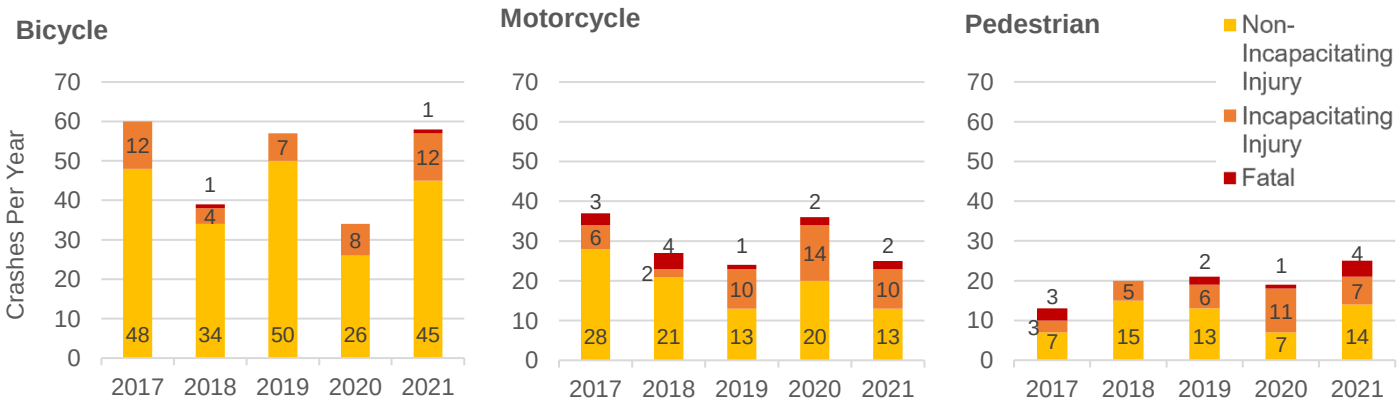


Figure 8. Vulnerable User Crash Trends By Mode (Severe Crashes)

LOCATION OF CRASHES

78%
of crashes occur at an intersection, driveway, or alley access

Crash reports generally show information on relative location such as cross streets, and an indication whether a crash was related to some type of intersection. As typical in an urban area, more than three in every four crashes (78%) occur at an intersection, driveway or alley access. See ***Figure 9.*** This illustrates the importance of focusing the traffic safety program at intersections and reducing the number of driveways/accesses (when possible).

Crash reports have begun to include a geo-coded location that can be evaluated through mapping efforts. This allows for a visual depiction of crash prevalence at specific locations or along corridors. ***Figure 10*** is a citywide heat map of crashes in the last three years in Fort Collins (2019-2021).

Care should be taken to understand that 'hot spots' on the map are simply number based, and neither correlated to volumes, nor necessarily indicative of statistically based higher than expected crash locations. These heat maps can provide an overall sense of crash locations and can be used to target enforcement areas. More detailed heat maps related to specific types of crashes (including crashes involving pedestrians and bicyclists) are shown later in this report.

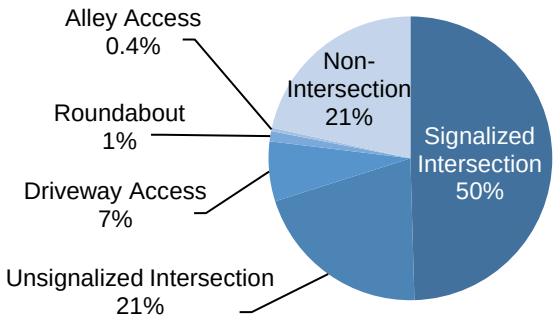


Figure 9. Location of Crashes

Arterials as Priority Corridors

The three years of data in ***Figure 10*** were reviewed to determine what types of streets are most crash prone. Arterial streets are the major streets in the city intended to provide citywide connectivity and intercity travel. Specifically, they are the streets that are classified as either a minor arterial (2 lane) or major arterial (4 lane or 6 lanes) on the City of Fort Collins' Master Street Plan (such as College Avenue, Harmony Road, Laporte Avenue, Overland Trail, etc.).

The vast majority of crashes occur on arterials, with almost nine of every 10 severe crashes occurring on an arterial. This is depicted on a map in ***Figure 11***. Arterials are those roadways with the highest traffic volumes, creating the greatest number of potential conflicts. Arterials are also the roadways with the highest traffic speeds within the City, which can result in less time for reaction, and when crashes occur the higher speeds tend to result in greater severity.

In 2019-2021

86% of **ALL** crashes occurred on an arterial

89% of **SEVERE** crashes occurred on an arterial

As the City pursues improvements to its safety performance, the priority corridors for action must be the arterial system (and especially its intersections). These are the locations where improvements have the largest opportunity for reduction in number and severity of crashes.

Although the priority is on arterials, it should be noted that roadway safety along collector roads and local neighborhood streets remains an important element of the transportation system. Crash evaluation will continue to be completed on all roadways, with programs, projects, and spot improvements made throughout the City as appropriate.

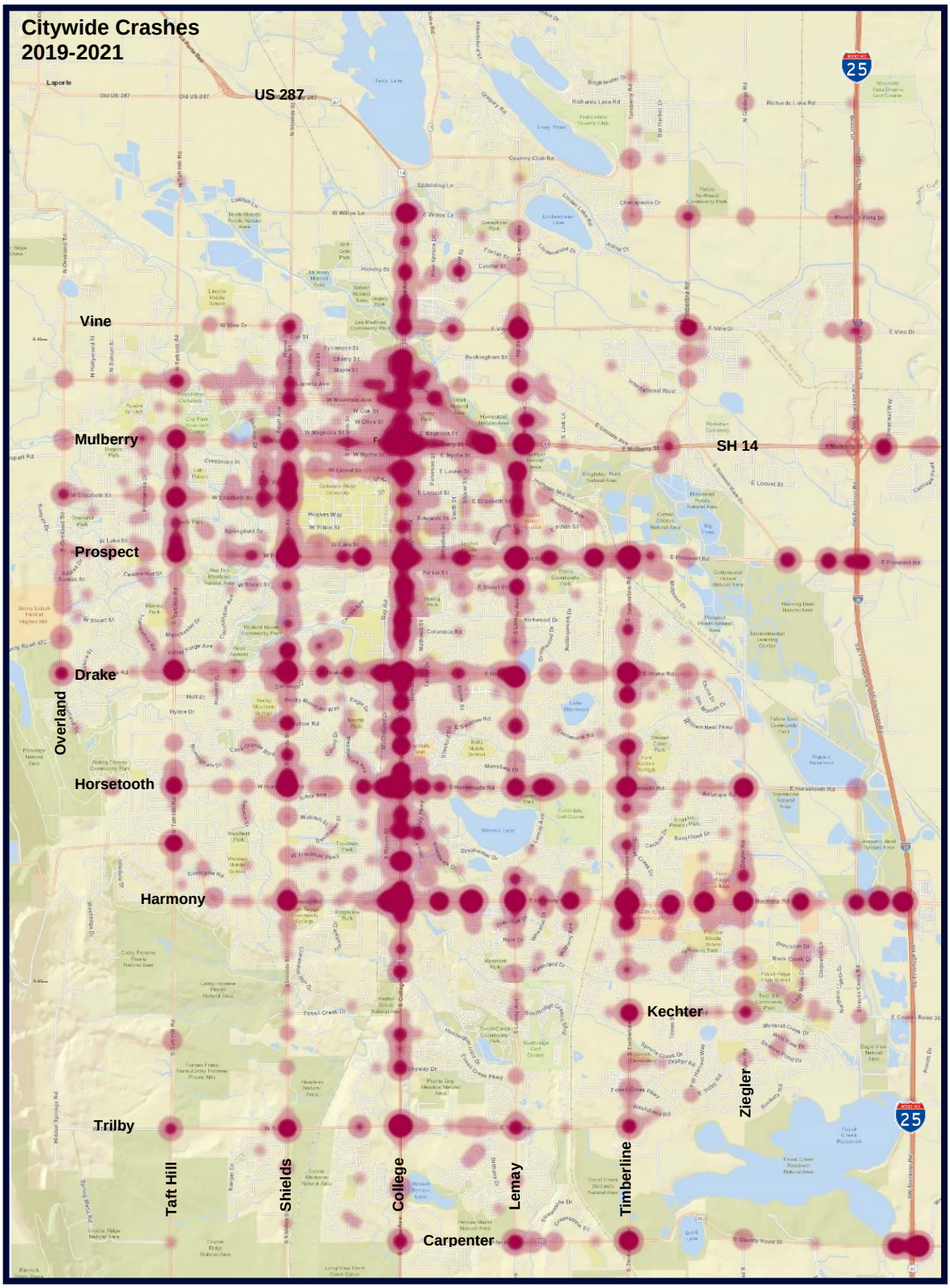


Figure 10. Citywide Heat Map of Crashes (2019-2021)

Locations of Severe Crashes

Figure 12 shows the location of severe crashes in the City in the past three years. As noted earlier, 89% of severe crashes occur on the arterial system, 70% occur at intersections, and 50% at signalized intersections.

Severe Crashes

89% along arterials

70% at intersections

The heat map also helps to identify potential locations not related to intersections where severe crashes are occurring.

Of note is that there were 29 crashes resulting in a fatality in the past three years. Seventeen of these fatal crashes (59%) were not related to an intersection and occurred midblock. The locations are shown in ***Figure 12***.

Non-Intersection Crashes

Crashes that are not specifically tied to the function or operations at an intersection are classified as non-intersection crashes. When added together with driveway related crashes, this represents about 28% of reported crashes. These include almost all parking related crashes, run-off-the-road vehicles that result in a fixed object crash, and crashes that occur at driveways. Fixed object crashes can be the result of slow speed sliding into curbs during inclement weather, or high speed impaired drivers leaving the road. The location of non-intersection crashes is shown in ***Figure 13.*** Only 61% of non-intersection crashes occur on the arterial system, with many non-intersection crashes occurring on lower classified roadways when related to parking. Other obvious 'hot spots' are heavily used driveways to commercial businesses.

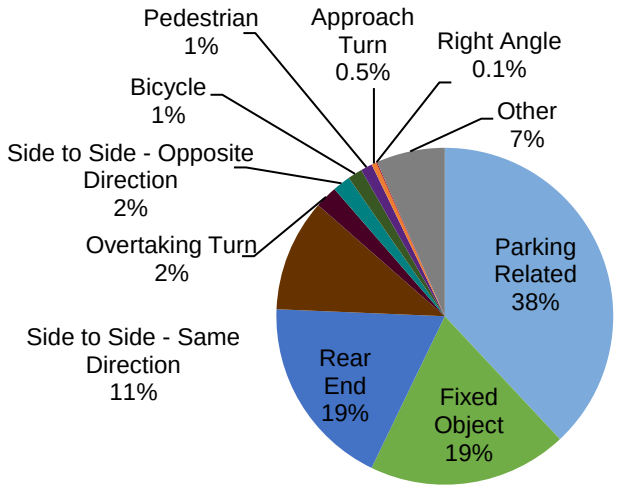
Non-Intersection Crashes

686 crashes each year

7.4% are severe

The type of non-intersection crashes for both overall non-intersection and severe non-intersection crashes is shown in ***Figure 11***. The type of crashes most prevalent are very different from the type of crashes when reviewing all crash data (See ***Figure 28*** *on page 19*).

Overall Non-Intersection Crashes



Severe Non-Intersections Crashes

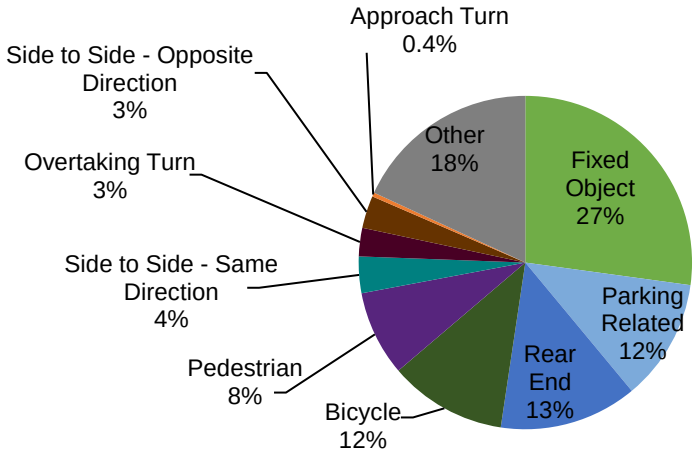


Figure 11. Crash Types For Non-Intersection Crashes

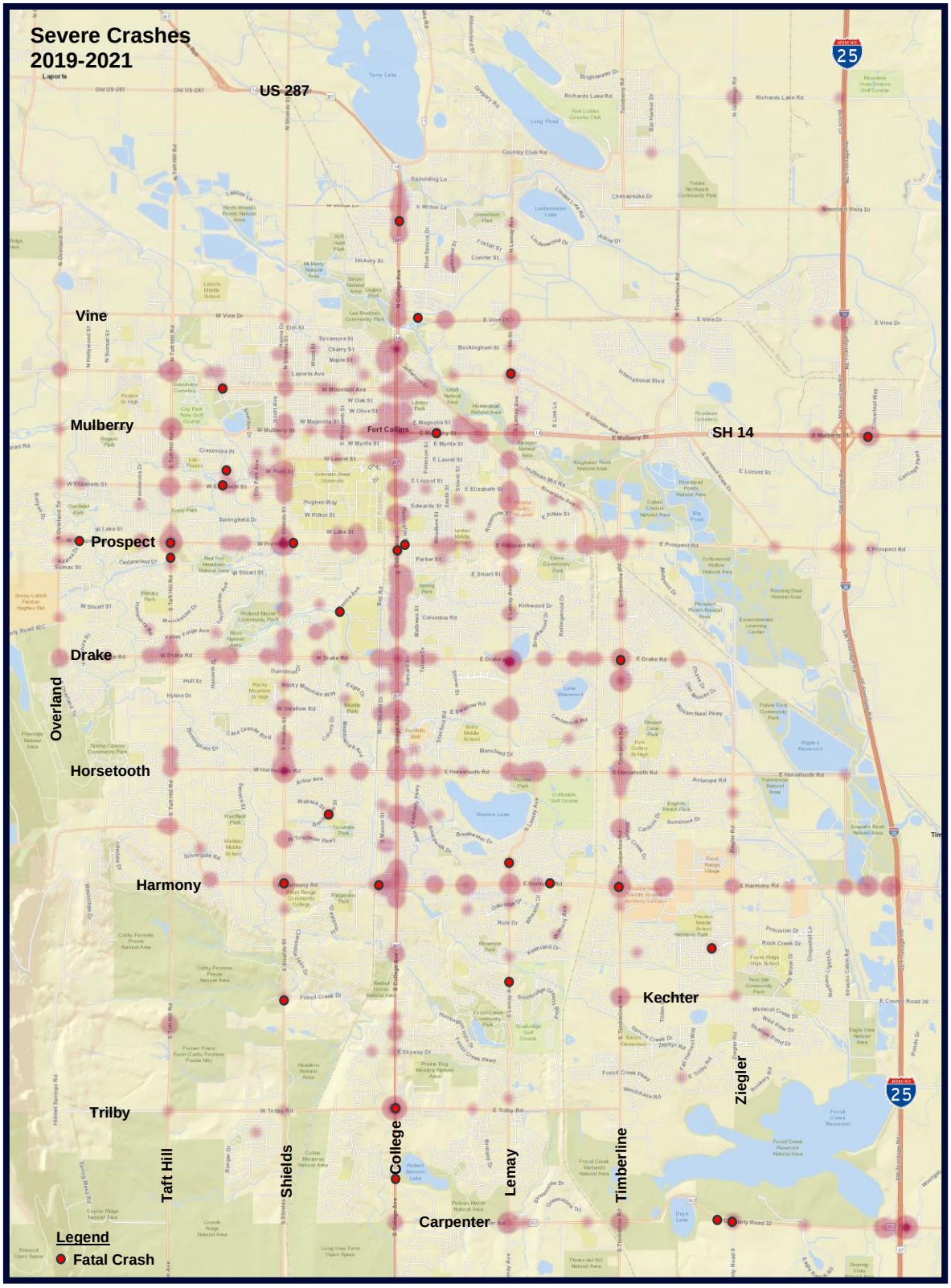


Figure 12. Severe Crash Heat Map (2019-2021)

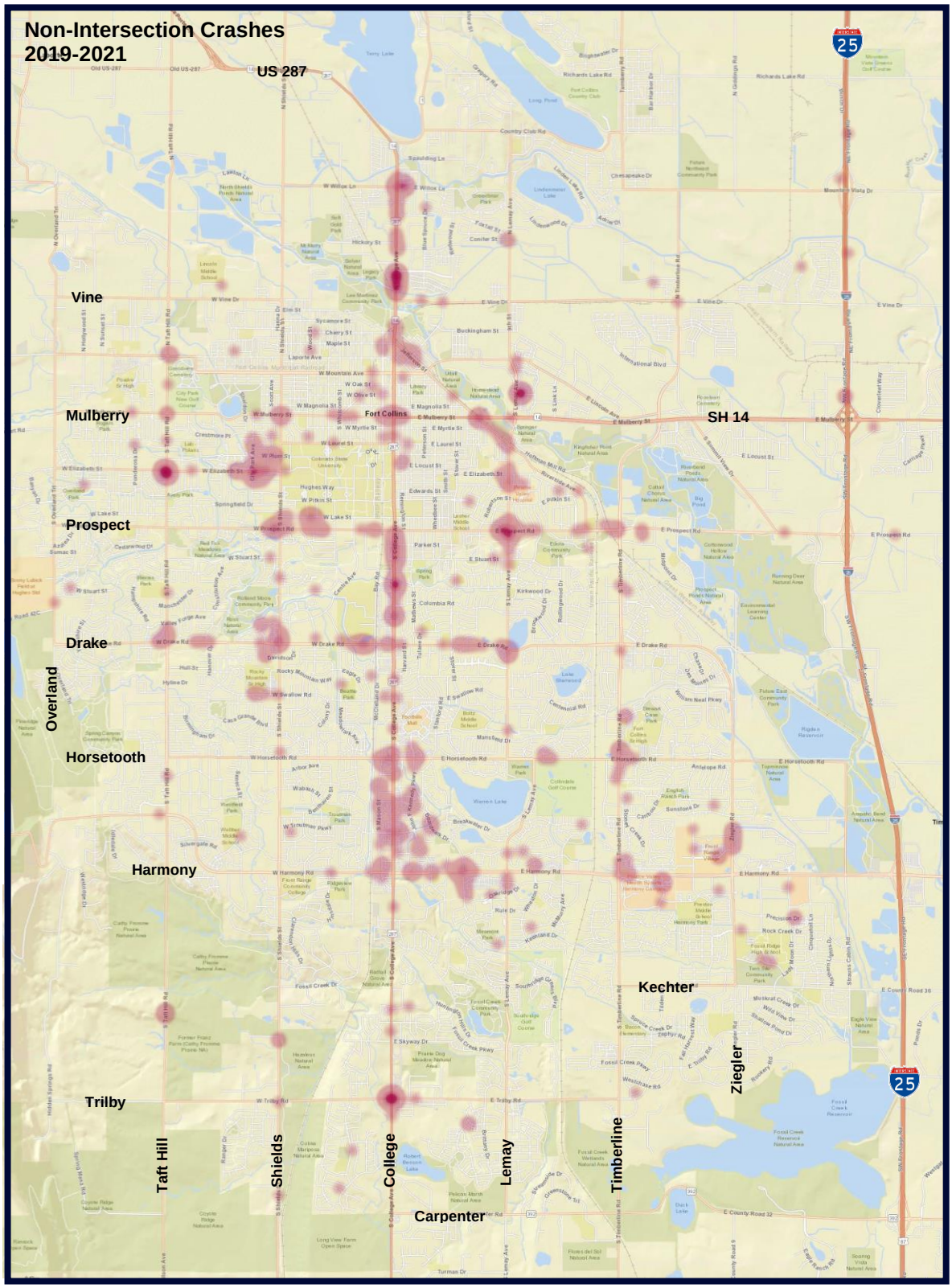


Figure 13. Non-Intersection Crash Heat Map of Crashes (2019-2021)

CRASHES BY MONTH, DAY, AND TIME

The variations of crashes in intervals of time can help identify when crashes are more prevalent, and especially when crash rates are higher than expected when compared to traffic volumes. This offers information that can be used to target educational campaigns and/or enforcement. The analysis represents an average of five years of data (2017-2021). The traffic volume data for the month and day of week analysis comes from the City of Fort Collins counts, while the hourly time of day data comes from State Highway 14 continuous counters west of I-25.

Crashes by Month of the Year

A review of injury/fatal crashes by month shows that the number of severe crashes vary substantially (between an average of 16 to 32 each month). The most crashes occur during the late summer months and into the fall (perhaps coinciding with the start of school, including the influx of university students). Although traffic volumes are highest then as well, the number of severe crashes is overrepresented. See ***Figure 14.***

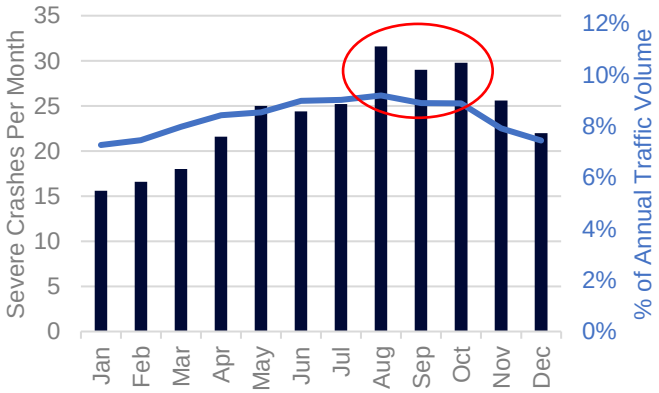


Figure 14. Injury/Fatal Crashes by Month

Crashes by Day of the Week

Figure 15 shows that more crashes occur on Fridays than any other days of the week. Weekend crashes are considerably lower than weekday crashes and are underrepresented relative to traffic volume. Daily variation in crashes generally tracks with daily variation in traffic volumes.

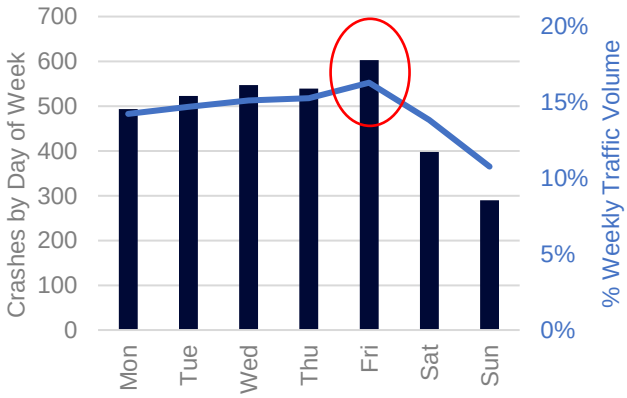


Figure 15. Crashes by Day of the Week

Crashes by Time of Day

Crashes per year are categorized by time of day in ***Figure 16***. The most striking take away for this information is the higher occurrence than expected of crashes at noon and between 3 p.m. and 5 p.m. That is also the time when traffic volumes are highest, but the increase in crashes is not proportional to the increase in volumes. During the late night hours, crashes are proportional to traffic volumes.

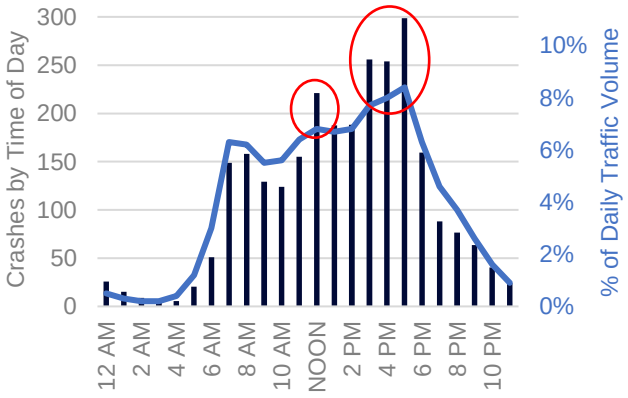


Figure 16. Crashes by Time of Day

CRASH INFORMATION BY DRIVER AGE

Figure 17 compares the number of crashes, by age of at-fault drivers with the percent of licensed drivers in that age category. Driver's aged 15-19 are almost three times as likely to be involved in a crash as would be expected given the number of licensed drivers in that age group. Driver's aged 20-24 are also more likely to be involved in crashes. All other age groups are under-represented in crashes.

This trend of higher numbers than expected of young drivers in crashes is not unique to Fort Collins. It does indicate the impact of driver inexperience as likely key factors in crashes and offers insight into potential countermeasures to address this challenge.

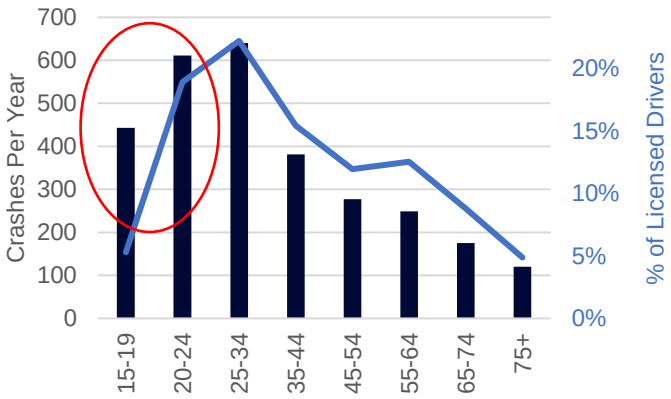
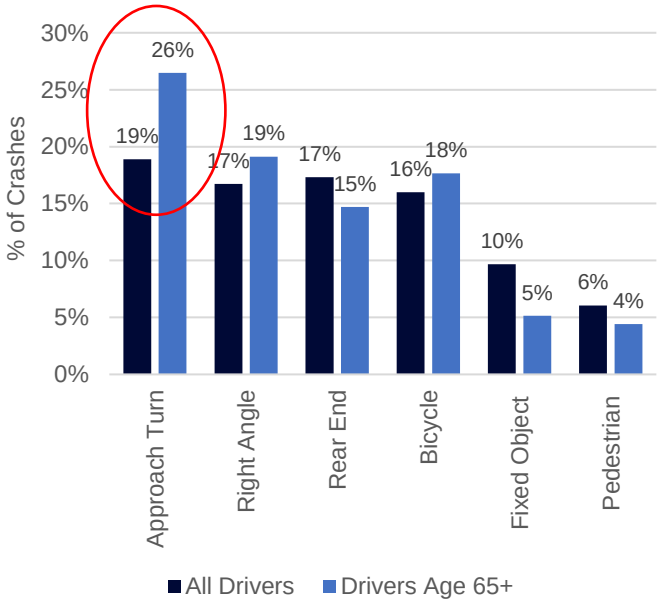


Figure 17. At Fault Drivers By Age

Teenagers represent **5%** of all drivers but are involved in **15%** of all crashes

Although older drivers are generally underrepresented in crashes, there are certain types of crashes where they are overrepresented. ***Figure 18*** compares the types of crashes that older drivers (aged 65+) are involved in against the prevalence of those crashes among all drivers. Older drivers have higher numbers of approach turn crashes than what would be expected. An approach turn crash is a left turning crash that involves judging oncoming vehicle speeds and choosing an appropriate gap. These tend to be crashes that cause more injury due to higher speeds.



ALCOHOL INVOLVED CRASHES (DRIVERS UNDER THE INFLUENCE - DUI)

Figure 19 shows the number of alcohol involved crashes (also called DUI) over the past five years. The DUI crashes represent about 4% of all crashes. However, they account for 10% of severe crashes, and 31% of fatal crashes. This suggests that crashes involving alcohol are more likely to result in serious injuries or fatalities.

The general trend for DUI crashes in the past five years has been decreasing. Crashes were down significantly during the pandemic year of 2020. But comparing 2021 with 2017, overall DUI crashes are also down 29%, and severe crashes are down 43%.

Crashes involving DUI represent

4% of all crashes

10% of severe crashes and

31% of fatal crashes

Since 2017, overall DUI crashes are down **29%** and severe DUI crashes are down **43%**

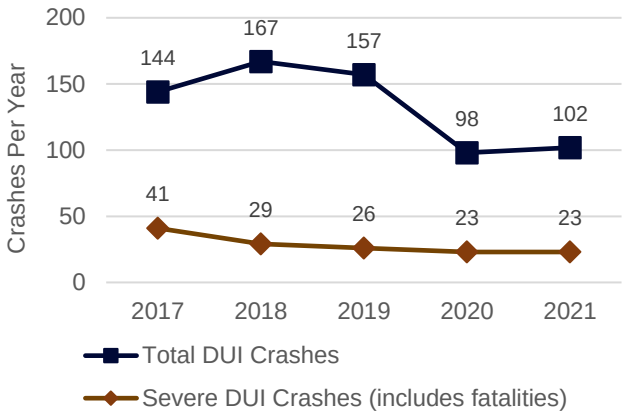


Figure 19. DUI Crash Trends

DUI Crashes by Age

Crashes in the past five years that involve DUI are shown in ***Figure 20*** by age of at-fault drivers.

Drivers below the age of 35 are significantly over-represented in alcohol involved crashes relative to the number of licensed drivers in those age groups. Also surprising is that drivers 15 – 19 years old are involved in 6% of DUI crashes even though they have not reached legal drinking age.

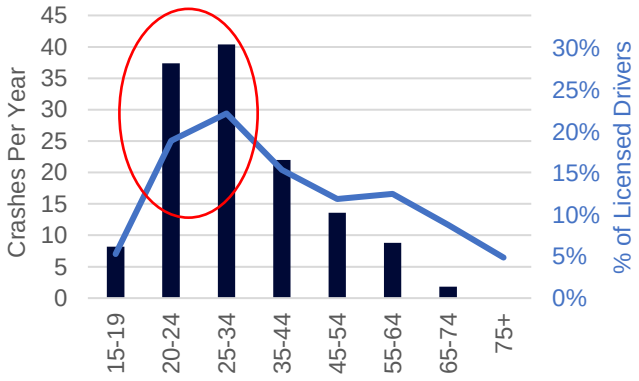


Figure 20. DUI Crashes by Age of At Fault Driver

MOTORCYCLE CRASHES

From 2017-2021 there were a total of 245 reported motorcycle crashes, including 12 fatalities. Although there was an increase in crashes during 2020, the general trend is downward in the last five years. See ***Figure 21***.

While motorcycle crashes can follow the same patterns as other crashes, they tend to be more severe as shown ***Figure 22***. Overall, only 24% of all crashes result in some type of injury while 80% of motorcycle crashes result in injury.

In a crash, motorcyclists are **3** times as likely to be injured and **16** times as likely to be killed than people in motor vehicles.

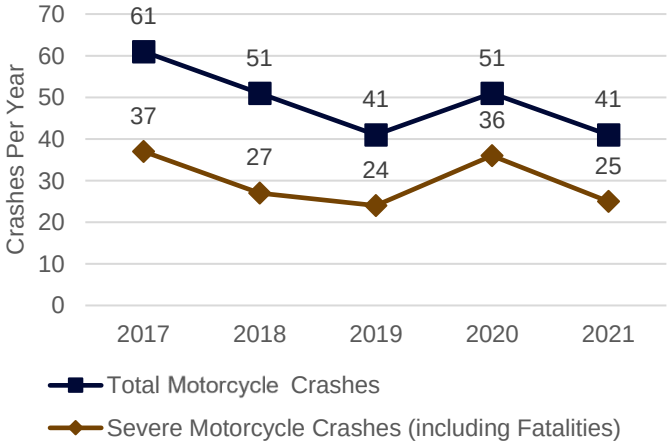
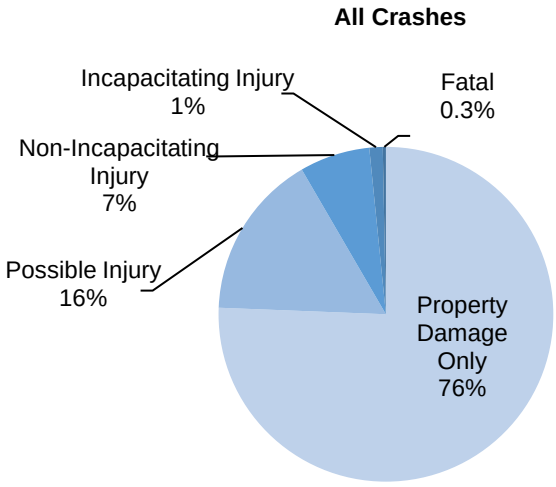


Figure 21. Motorcycle Crash Trends



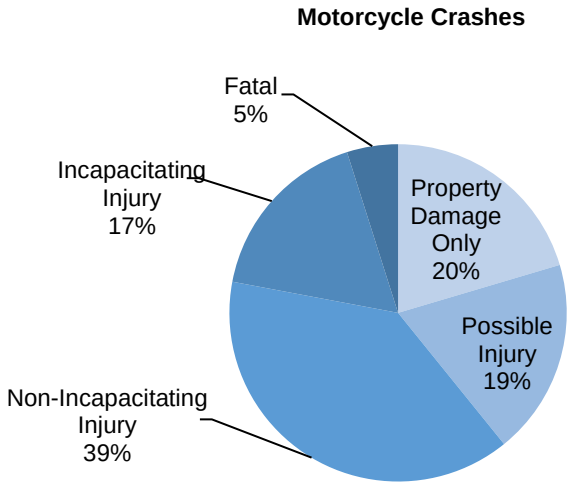


Figure 22. Severity Impact on Motorcycle Crashes

Motorcycle crashes have several idiosyncrasies that are different from traditional crash trends:

- They are the mode of travel that result in the highest percentage of severe crashes - 61%. (In comparison, only 6% of motor vehicle crashes, 46% of bicycle crashes and 47% of pedestrian crashes are severe.)
- Motorcycle crashes are also the ones that involve the most non-intersection crashes – as 30% of all motorcycle crashes occur along roadway segments (typical percentages are 21%).
- In addition, 27% motorcycle crashes are single vehicle crashes (the typical percentage of single vehicle crashes is 11%).

The takeaway for motorcycle crashes is that they tend to be severe, and more frequently that other crashes occur as single vehicle non-intersection crashes.

Motorcycle Crashes:

30%
Non-intersection

87%
on arterials

27%
Single Vehicle

CRASHES INVOLVING YOUTH

Crashes involving young people (aged 0-17) are of special interest. These crashes include crashes involving a young pedestrian, a young bicyclist, or a young motor vehicle driver. The data does not include youths that are passengers in vehicles involved in a crash.

Figure 23 shows the trends in crashes that involve youths. Like in many other instances, 2020 was an anomaly, but in general youth crashes are decreasing – overall crashes are down 24% in five years, and severe crashes are down 21%.

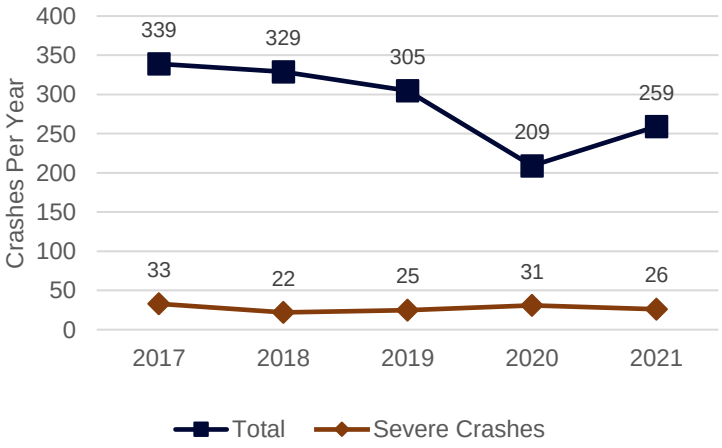


Figure 23. Trends for Crashes Involving Youths

The mode split for crashes involving youths is shown in ***Figure 24.*** Most of these crashes involve young drivers. Using five years of data, the average number of crashes per year involving youth are:

- 263 vehicle crashes
- 16 bicycle crashes
- 6 pedestrian crashes
- 2 motorcycle crashes

Figures 25, 26, and 27 show the trends in crashes involving youths by mode. Across all modes, the number of crashes involving young community members are generally trending down (discounting 2020).

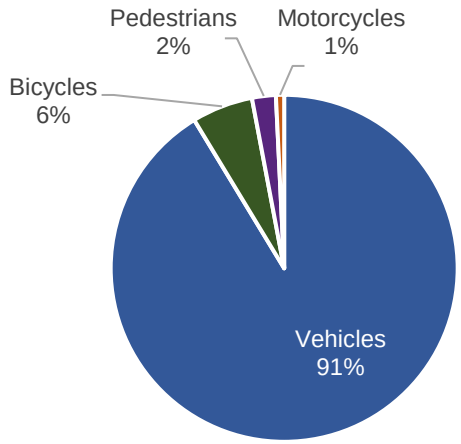


Figure 24. Mode Split for Crashes Involving Youths

Overall crashes involving youths are down

24%

in the last five years.

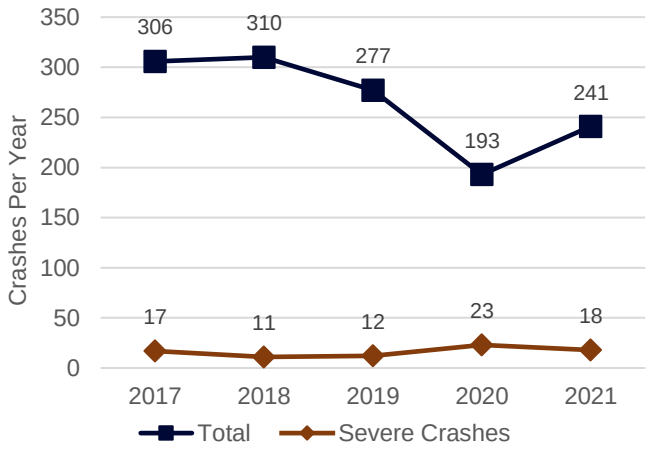


Figure 25. Crashes Involving Young Drivers

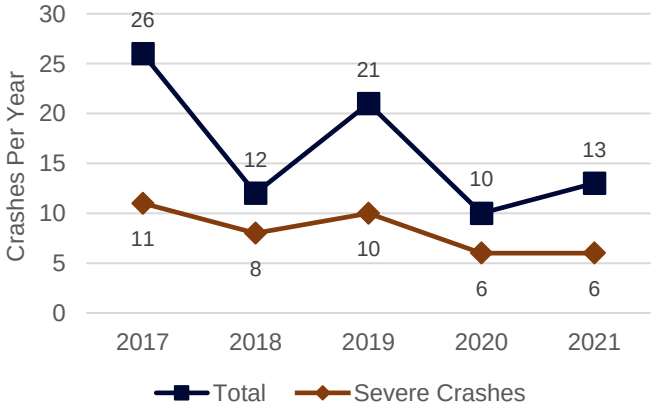


Figure 26. Crashes Involving Young Bicyclists

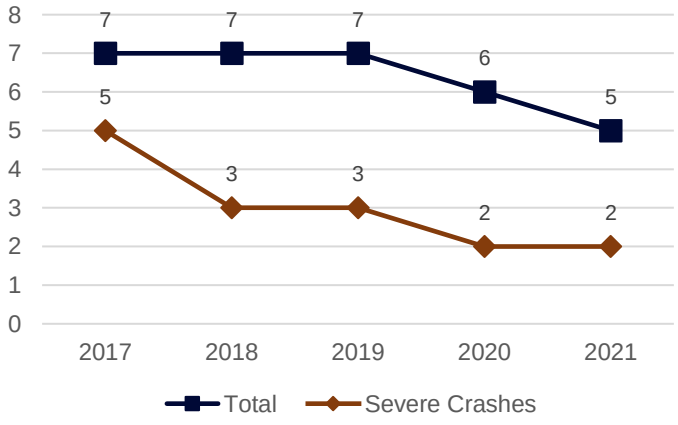


Figure 27. Crashes Involving Young Pedestrians

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 annual societal cost of traffic crashes in Fort Collins is about $176 million. See ***Table 1.*** The crash costs shown are adjusted to reflect 2021 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 Fort Collins in 2021:
$176 million

A study completed by the National Highway Traffic Safety Administration (NHTSA) identified who pays the costs of the economic impact of crashes. The NHTSA study found that society at large pays for about 75% of all costs incurred for traffic crashes. Those costs are passed on to the 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	2,211	$ 11,500	$ 25,426,500
Possible Injury Crashes	353	$ 71,400	$ 25,204,200
Non-Incapacitating Injury Crashes	250	$ 127,000	$ 31,750,000
Incapacitating Injury Crashes	60	$ 347,800	$ 20,868,000
Fatal Crashes	11	$ 6,590,600	$ 72,496,600
Total	**2,885**		**$ 175,745,300**

Table 1. Economic Impact of Traffic Crashes in Fort Collins, 2021

COMPARISON TO OTHER CITIES

The most consistent way to compare Fort Collins' crash frequency with that of other cities is to compare the fatal crash rate (crashes per 100,000 population). Fatal crashes are used for this comparison as they are most consistently reported due to federal reporting requirements. ***Tables 2 and 3*** are sorted by fatal crash rate and compare Fort Collins to other cities in Colorado and also other peer cities nationwide with similar population (90,000 to 200,000).

Colorado crash data is from the Colorado Department of Transportation (CDOT). Crash data for communities outside Colorado (peer cities) was obtained from the National Highway Traffic Safety Administration's Fatal Accident Reporting System (FARS) which contains data through 2020. Population estimates are from the U.S. Census.

Colorado Cities								
City	Population	Fatal Crashes, 2017 - 2021					Avg.	Fatal Crash Rate (Crashes / 100,000 Pop.)
		2017	2018	2019	2020	2021		
Pueblo	111,876	16	16	12	13	18	15	13.4
Lakewood	155,984	8	17	19	12	7	13	8.1
Greeley	108,795	11	9	4	13	2	8	7.2
Longmont	98,885	6	6	12	5	6	7	7.1
Fort Collins	169,810	13	9	8	10	11	10	6.0
Westminster	116,317	11	10	5	6	1	7	5.7
Thornton	141,867	9	1	13	8	3	7	4.8
Arvada	124,402	4	5	3	4	2	4	2.9
Boulder	108,250	0	2	2	3	4	2	2.0
Avg. CO Cities	126,243	8.7	8.3	8.7	8.2	6.0	8.0	6.3

Table 2. Fatal Crash Rate Comparison to Other Colorado Cities

Peer Cities								
City	Population	Fatal Crashes, 2016-2020 *					Avg.	Fatal Crash Rate (Crashes / 100,000 Pop.)
		2016	2017	2018	2019	2020		
Springfield, MO	169,176	19	17	18	15	27	19	11.3
Boca Raton, FL	97,422	18	6	10	6	11	10	10.5
Norman, OK	128,026	6	9	9	5	12	8	6.4
Fort Collins, CO	169,810	8	13	9	8	10	10	5.7
Richardson, TX	119,469	10	4	5	5	9	7	5.5
Cedar Rapids, IA	137,710	8	5	9	9	5	7	5.2
Coral Springs, FL	134,394	13	7	3	4	8	7	5.2
San Angelo, TX	99,893	3	4	5	3	9	5	4.8
Broken Arrow, OK	113,540	4	7	7	3	4	5	4.4
Olathe, KS	141,290	7	3	6	6	3	5	3.5
Overland Park, KS	197,238	7	8	2	9	7	7	3.3
Bellevue, WA	151,854	3	2	1	4	4	3	1.8
Naperville, IL	149,540	4	3	1	3	2	3	1.7
Avg. Peer Cities	139,182	8.5	6.8	6.5	6.2	8.5	7.3	5.3

Table 3. Fatal Crash Rate Comparison to Similar Peer Cities Nationwide

** Note: 2020 is most current national data available*

Section 3

REVIEW OF MOST FREQUENT SEVERE CRASH TYPES

As noted earlier, crashes are categorized into a variety of types. Definitions and explanations of those types are included in the introduction. This section provides a more detailed review of the most prevalent crash types that result in severe crashes (those that are categorized as involving non-incapacitating injury, incapacitating injury, or fatal crashes).

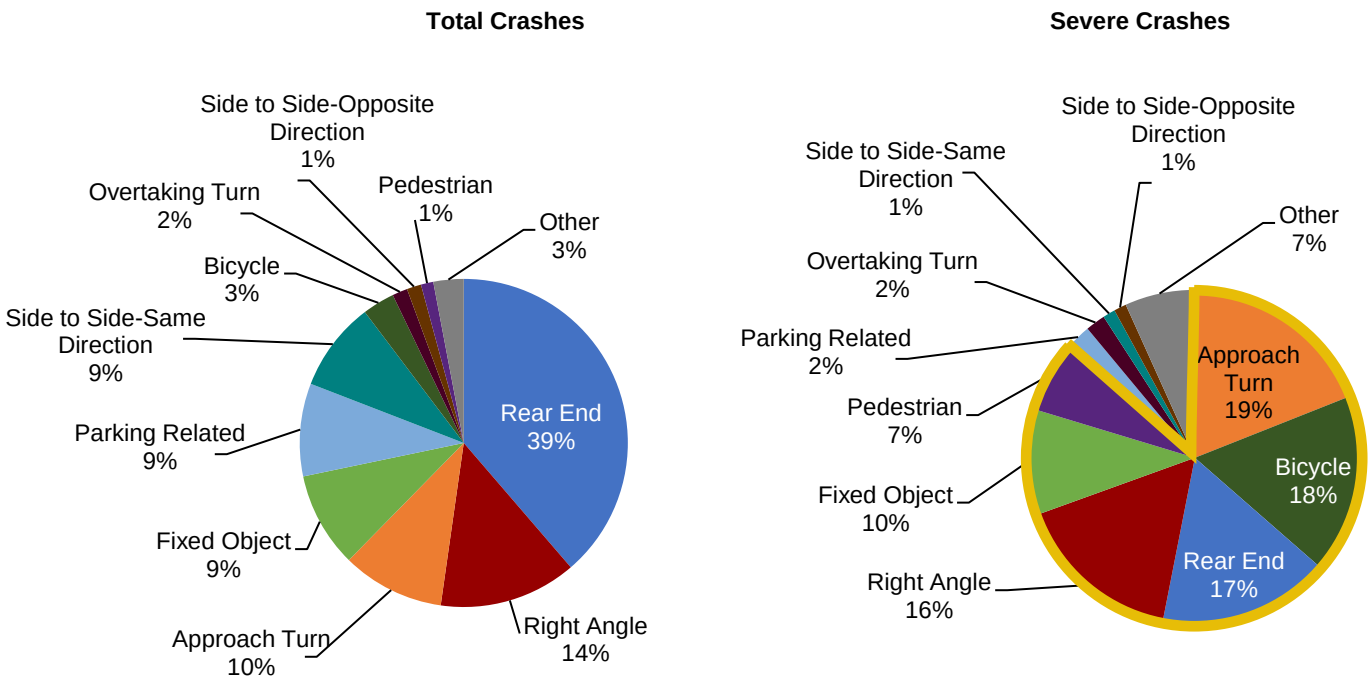


Figure 28. Crash Types by Total Crashes and Severe Crashes

Figure 28 indicates the type of crashes that occur, both when evaluated among all crashes, and then only among severe crashes. There are six types of crashes that are responsible for 87% of all severe crashes (outlined in gold color in Figure 27. While rear end crashes see large numbers in both overall crashes and severe crashes, bicycle crashes and pedestrian crashes become a larger component of the severe crash picture and join approach turns, right angle and fixed object crashes as the most prevalent.

While all traffic crashes are of concern, those that occur most often with the more serious consequences are of special interest. (Note that motorcycle crashes are not separated as a type of crash type in this analysis and are discussed in Section 2.)

6 crash types are responsible for **87%** of severe crashes:

Approach Turn
Bicycle
Rear End
Right Angle
Fixed Object
Pedestrian

Table 4 provides a numerical summary of the six crash types that are involved in highest number of severe crashes each year. These are the types of crashes that may have greater prospects for safety improvements and should be a key focus in the roadway safety program. Each one of these crash types is reviewed in more detail in subsequent pages.

Type of Crash	Ave. Number of Crashes / Year	Percent of Crashes that are Severe	Ave. Number of Crashes / Year that are Severe
Approach Turn	343	15.8%	**54**
Bicycle	108	46.0%	**50**
Rear End	1288	3.7%	**47**
Right Angle	460	10.1%	**47**
Fixed Object	308	9.4%	**29**
Pedestrian	41	47.3%	**20**

Table 4. Summary of Crash Types Involved in the Highest Number of Severe Crashes (Using 5 Years of Data: 2017-2021)

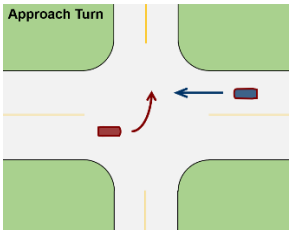
APPROACH TURN CRASHES

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:

Approach Turn Crashes

343 crashes each year

15.8% are severe



<u>Poor estimation of distance / speed of approaching through traffic</u>: These crashes occur at both signalized and unsignalized intersections. Poor visibility – often the result of offset left turn lanes – also contribute to these crashes.

<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 the green ball or flashing yellow arrow 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 and so they turn in front on oncoming traffic.

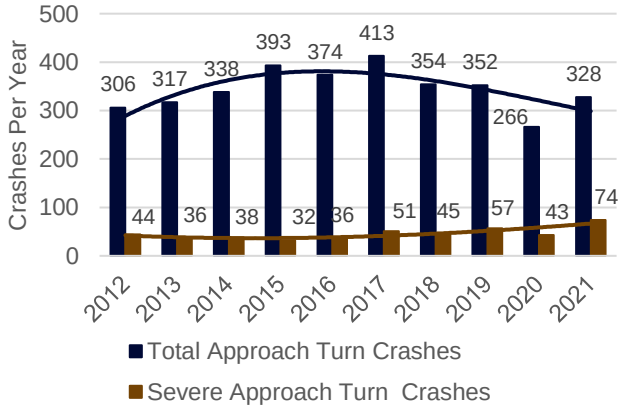


Figure 29. Historic Trend of Approach Turn Crashes

Figure 29 shows the 10 year historic trend of approach turn crashes in Fort Collins. The total number of crashes is relatively stable (discounting the 2020 pandemic anomaly), however the number of severe approach turn crashes is up 45% in the last five years.

A review of the last three years of data shows that 91% of approach turn crashes occur at intersections, and 96% occur on the arterial road system. With the highest number of severe crashes in the city in this category, a priority for safety focus should be targeted countermeasures for this type of crash discussed later in this report.

Severe approach turn crashes up

45%

In the past five years

91%

at intersections

96%

on arterials

Table 5 lists the locations with the greatest number of approach turn crashes in the last three years (2019-2021). Note that this list is sorted by the number of crashes and therefore locations with higher traffic volumes will also tend to have higher numbers of crashes. The pattern recognition section later in this report identifies locations of higher-than-expected approach turn crashes based on a statistical evaluation called 'probability of exceedance'. A combination of the two lists should be used to determine locations for further reviewed.

Facility ID	North - South Street	East - West Street	# AT Crashes in 3 years
35	College Ave	Troutman Parkway	28
111	Shields St	Horsetooth Rd	19
144	Timberline Rd	Drake Rd	19
119	Shields St	Prospect Rd	17
10	College Ave	Drake Rd	16
25	College Ave	Mulberry St	15
34	College Ave	Trilby Rd	15
59	Lemay Ave	Drake Rd	15
69	Lemay Ave	Riverside Ave	15
108	Shields St	Drake Rd	15
134	Taft Hill Rd	Drake Rd	15
68	Lemay Ave	Prospect Rd	14
4	College Ave	Boardwalk Dr	12
110	Shields St	Harmony Rd	11
7290	College Ave	Mason/Palmer	11
1	Boardwalk Dr	Harmony Rd	10
63	Lemay Ave	Horsetooth (West)	9
80	Mason St	Harmony Rd	9
239	Snow Mesa Dr	Harmony Rd	9
6591	College Ave	Lake St	9

Notes

Table is sorted by number of approach turn (AT) crashes
Locations included with at least 9 approach turn (AT) crashes in three years (20 locations total)
Additional locations may be identified through statistical analysis

Table 5. Locations with Most Approach Turn (AT) Crashes

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. This section analyzes reported bicycle crashes, which typically involve a bicycle and a motor vehicle.

Bicycle Crashes

108 crashes each year

46.0% are severe

Figure 30 shows the historic trend of bicycle crashes in Fort Collins during the past ten years. The general trend is decreasing numbers of bike crashes, with overall crashes down 30% in five years, while severe crashes consistently account for between 50-60 crashes each year (discounting the pandemic year).

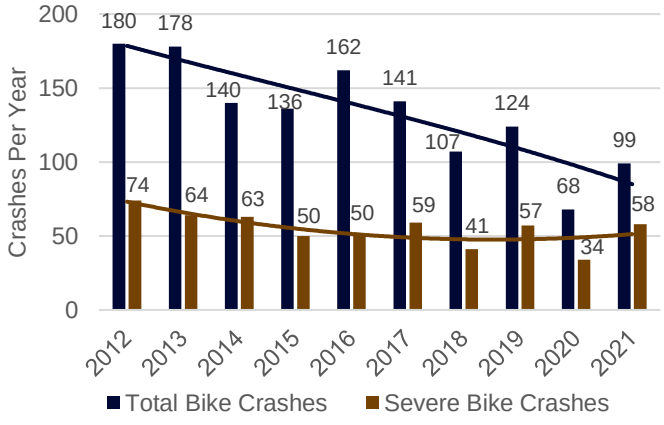
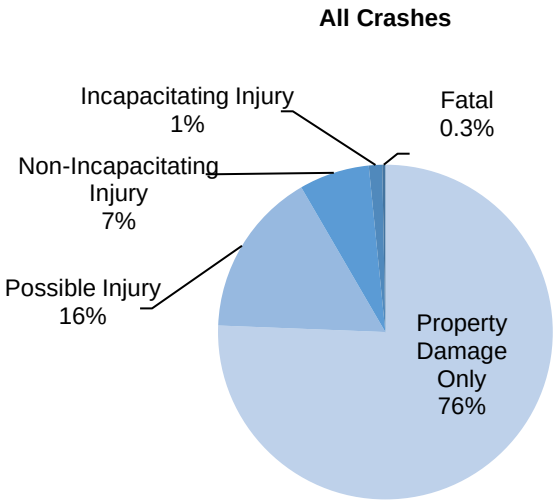


Figure 30. Historic Trend of Bicycle Crashes

Overall, bicycle crashes account for 3.2% of all crashes in Fort Collins. However, they account for 17.4% of severe crashes. This illustrates that bicycle crashes, when they do occur tend to be more serious than motor vehicle crashes. The comparison in severity is depicted in ***Figure 31***.



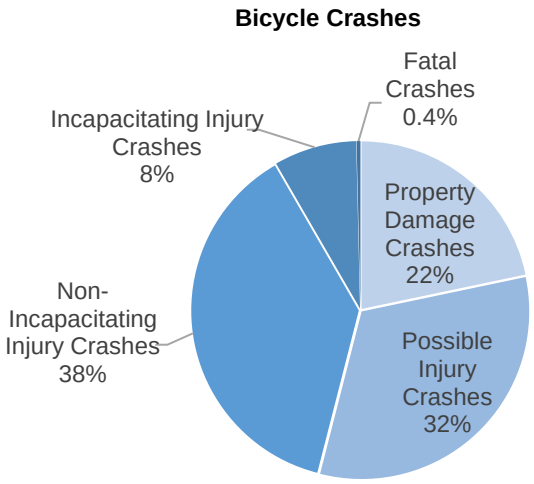


Figure 31. Severity Impact on Bicycle Crashes

The numbers related to severe bicycle crashes are shown in ***Figure 32***. Non-Incapacitating crashes vary significantly from year to year, while incapacitating injury crashes have consistently been increasing since 2018.

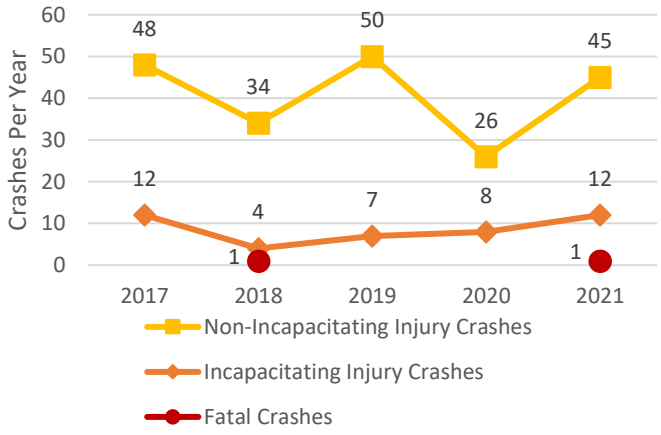


Figure 32. Numbers of Severe Bicycle Crashes

When bicycle crashes are reviewed by the age of the bicyclist, (see ***Figure 33),*** it is clear that bicyclists aged 15-34 are the most frequently involved. The figure also includes the percentage of population in that age category. People aged 15-34 account for about 43% of the population but are represented in 55% of bicycle crashes. (It should be noted that some crash reports involving a bicyclist do not list the age of the bicyclist, and as such those numbers are not included in ***Figure 33.)***

Male cyclists are involved in 71% of all bicycle crashes.

Bicycle crashes can be further evaluated by location. See ***Figures 34 and 35***.

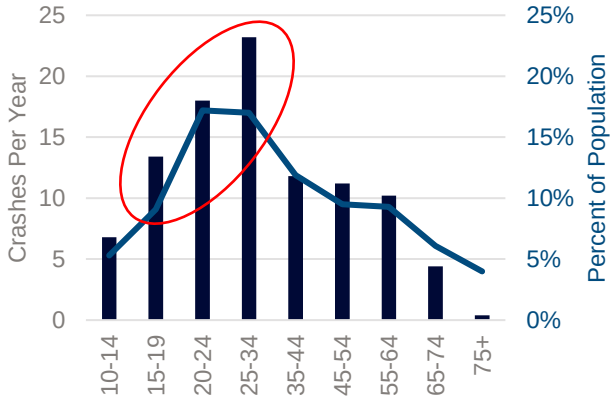


Figure 33. Bicycle Crashes by Age of Rider

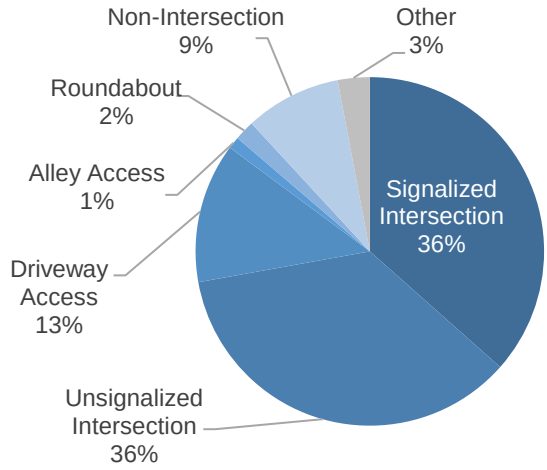


Figure 34. Bicycle Crashes by Location

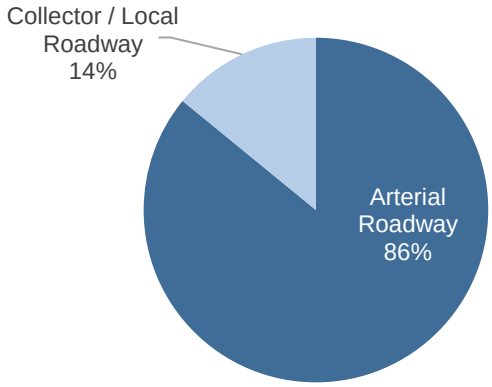


Figure 35. Bicycle Crashes by Road Classification (2019-2021)

The location of greatest risk for bicycle riders is not along various road segments (9% of bicycle crashes), but rather at locations where crossing traffic occurs such as driveways and intersections (88%).

While corridor projects such as wider bicycle lanes and features to increase comfort such as buffers and protected bicycle lanes support bicycling mobility and increase perceived safety, an emphasis on intersection safety for bicyclists is critical to reducing the number and severity of bicycle crashes.

In addition, 88% of bicycle crashes occur on the arterial roadway system, so similar to the trend in overall crashes, the priority locations for bike safety improvements should be arterial intersections.

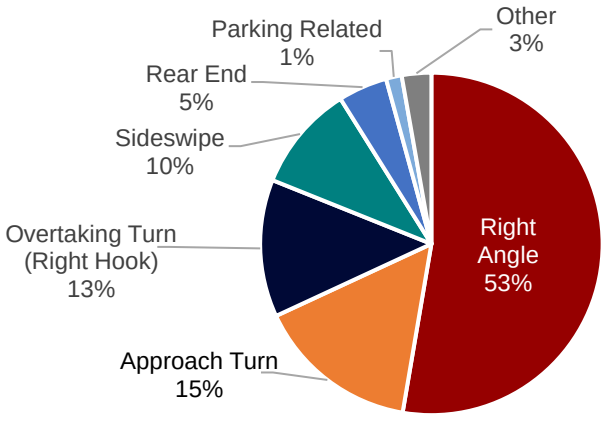
Figure 38 is the citywide heat map of bicycle crash locations in the last three years (2019-2021).

Bicycle Crashes

88%
at intersections, driveways, or alley access

86%
on arterials

Figure 36 shows the types of bicycle crashes that have occurred in Fort Collins in the past five years. Depictions of the three most frequent types of bicycle crashes are shown in ***Figure 37*** and represent 81% of all bicycle crashes. Right angle crashes are the most common type representing more than half of all bicycle crashes.



A significant contributing circumstance in bicycle crashes and especially right angle crashes involves the bicyclist riding against traffic (on sidewalk or in the street). In these instances, motorists often do not see the bicyclist as they may be looking to the left, and not to the right. Twenty-three (23%) of all crashes and 36% of right angle crashes involve bicyclists traveling against traffic.

Figure 36. Types of Bicycle Crashes

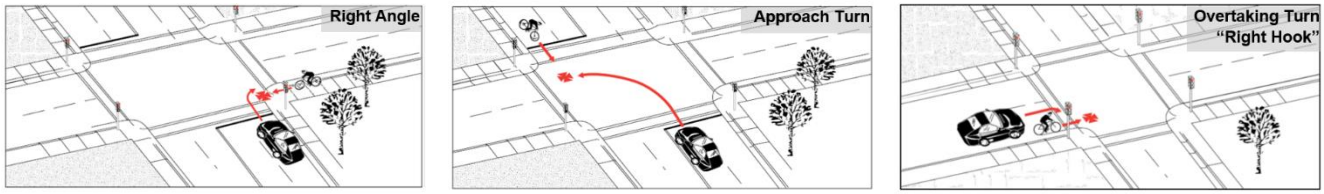


Figure 37. Visual Depiction of Types of Bicycle Crashes

Table 6 lists the location with the highest number of bicycle crashes in the past three years. Note that this list is sorted by the number of crashes and therefore locations with higher volumes (whether vehicle volumes or bicycle volumes) will also tend to have higher numbers of crashes. The pattern recognition section later in this report identifies locations of higher-than-expected bicycle crashes based on a statistical evaluation called 'probability of exceedance'. A combination of the two lists should be used to determine locations for further review.

23% of bicycle crashes involve bicyclists traveling against traffic

Table 6. Locations with Most Bicycle Crashes

Facility ID	North - South Street	East - West Street	# Bicycle Crashes in 3 years
111	Shields St	Horsetooth Rd	4
25	College Ave	Mulberry St	3
118	Shields St	Plum St	3
119	Shields St	Prospect Rd	3
142	Timberline Rd	Caribou Dr	3
15359	Centre Ave	Prospect Rd	3
8562	Overland Trail	Drake Rd	3
113	Shields St	Lake St	3
7	College Ave	Cherry St	2
16	College Ave	Horsetooth Rd	2
19	College Ave	LaPorte Ave	2
32	College Ave	Stuart St	2
64	Lemay Ave	Lincoln Ave	2
78	Loomis Ave	Mulberry St	2
79	Manhattan Ave	Horsetooth Rd	2
101	Remington St	Mulberry St	2
102	Remington St	Pitkin St	2
108	Shields St	Drake Rd	2
110	Shields St	Harmony Rd	2
140	Taft Hill Rd	Prospect Rd	2
146	Timberline Rd	Horsetooth Rd	2
155	Whitcomb Ave	Prospect Rd	2
556	Matthews St	Mountain Ave	2
42	Dunbar Ave	Drake Rd	2
72	Lemay Ave	Swallow Rd	2
6664	McClelland Dr	Horsetooth Rd	2
129	Stover St	Horsetooth Rd	2
15993	Linden St	Vine Dr	2
231	Peterson St	Mulberry St	2
15995	Shields St	University Ave	2

Notes

Table is sorted by number of bicycle crashes
Locations included with at least 2 bicycle crashes in three years (30 locations total)
Additional locations may be identified through statistical analysis

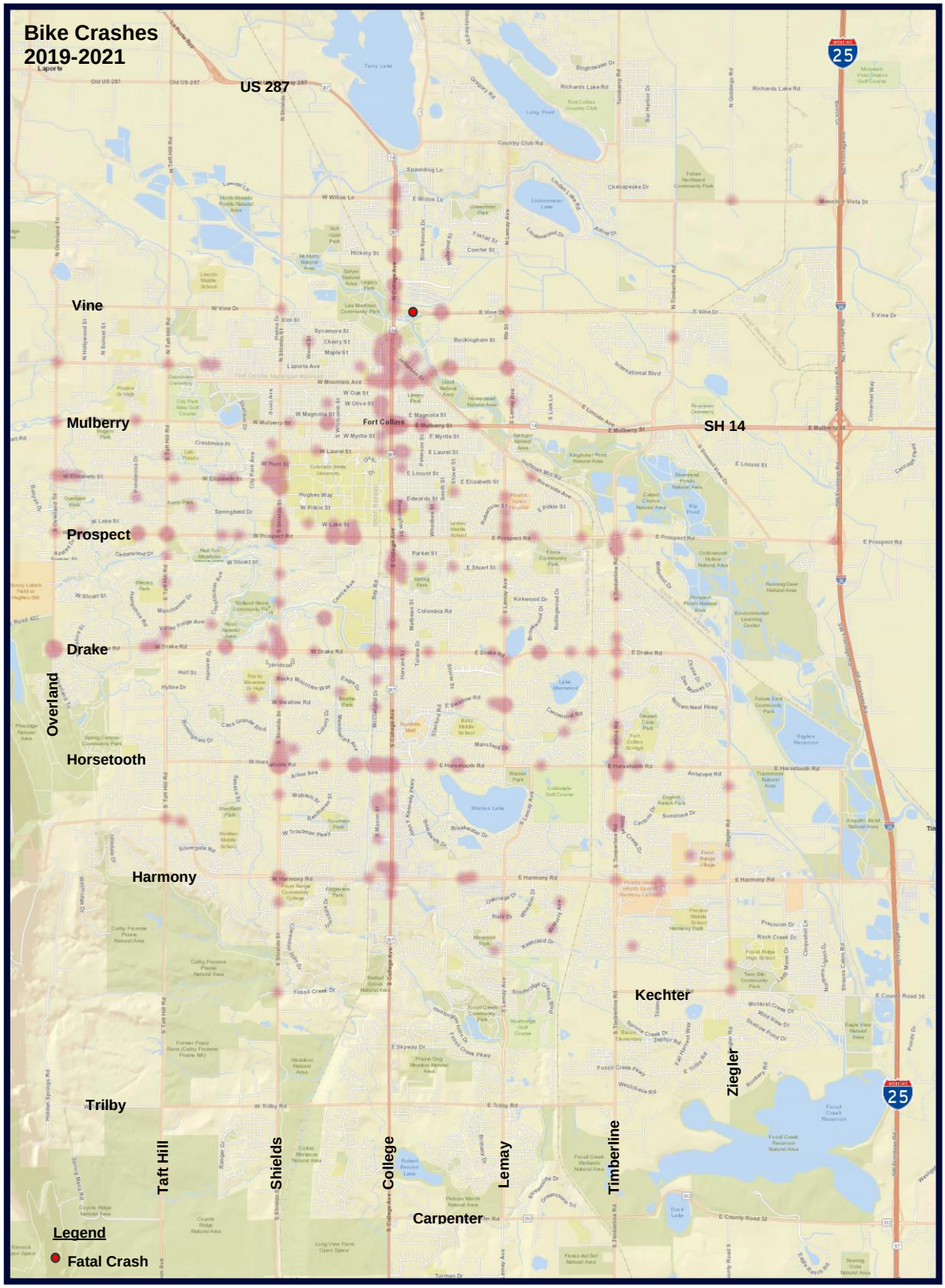


Figure 38. Bicycle Crash Heat Map (2019-2021)

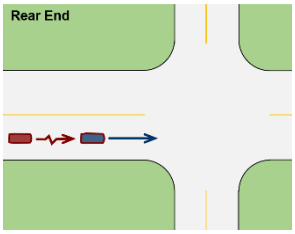
REAR END CRASHES

Rear end crashes are the most prevalent crash type in Fort Collins, accounting for 39% of all crashes with an average of 1,288 crashes each year. Only 3.7% of rear end crashes are considered severe and involve a non-incapacitating injury, incapacitating injury or fatality. However, because of the sheer number of these types of crashes, they are an important element to consider in safety reviews.

Rear End Crashes

1,288 crashes each year

3.7% are severe



The majority (66%) of rear end crashes occur at signalized intersections. Ten percent (10%) of rear end crashes occur mid-block.

The 10-year historic trend for rear end crashes is shown in ***Figure 39***. The total number of rear end crashes is down 50% from a high in 2015. Severe rear end crash number are quite steady.

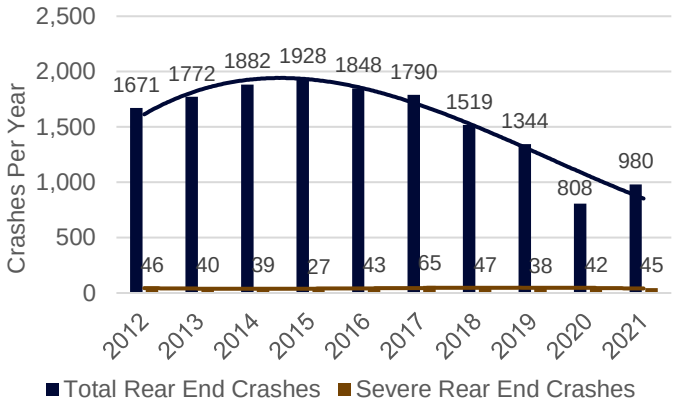


Figure 39. Historic Trend of Rear End Crashes

Table 7 lists the locations with the greatest number of rear end crashes in the three-year period. Note that this list is sorted purely by the number of crashes and therefore locations with higher volumes will also tend to have higher numbers of crashes. The pattern recognition section later in this report identifies locations of higher-than-expected rear end crashes based on a statistical evaluation called 'probability of exceedance'. A combination of the two lists should be used to determine locations for further review.

Facility ID	North - South Street	East - West Street	# RE Crashes in 3 years
14	College Ave	Harmony Rd	76
145	Timberline Rd	Harmony Rd	73
10	College Ave	Drake Rd	57
1	Boardwalk Dr	Harmony Rd	53
149	Timberline Rd	Prospect Rd	53
162	Lemay Ave	Harmony Rd	52
34	College Ave	Trilby Rd	43
16	College Ave	Horsetooth Rd	42
28	College Ave	Prospect Rd	40
40	Corbett Dr	Harmony Rd	40
25	College Ave	Mulberry St	36
66	Lemay Ave	Mulberry St	36
119	Shields St	Prospect Rd	36
143	Timberline Rd	Carpenter Rd	35
68	Lemay Ave	Prospect Rd	34
80	Mason St	Harmony Rd	33
74	Lemay Ave	Vine Dr	32
157	Ziegler Rd	Harmony Rd	30

Notes

Table is sorted by number of rear end (RE) crashes
Locations included with at least 30 rear end crashes in three years (18 locations total)
Additional locations may be identified through statistical analysis

Table 7. Locations with Most Rear End (RE) Crashes

Rear end crashes are typically the result of motorist inattention, and/or following too closely combined with unexpected stops in the traffic stream. 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, or the addition of protected only left turn signal phasing at existing traffic signals are countermeasures that may be used to reduce right angle of left turn crashes. However, they also tend to increase the potential for rear end crashes. Since right angle and approach turn crashes tend to be more severe, it may be reasonable to implement these countermeasures, but careful analysis and consideration regarding the impact on rear end crashes is critical to effective overall safety improvements.

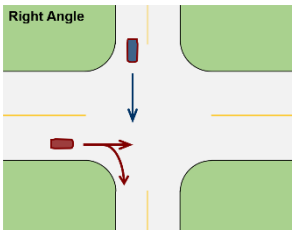
RIGHT ANGLE CRASHES

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 then proceeds inappropriately into the intersection, and one where entering traffic disregards a stop sign or signal.

Right Angle Crashes

460 crashes each year

10.1% are severe



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.

Passing a signal/STOP without stopping: Typical contributing factors to these crashes include inattention, visibility of signal heads or STOP signs, wide streets and/or "busy" areas where traffic control devices become less noticeable, and icy roads.

Figure 40 shows the historic trend for right angle crashes in Fort Collins. There has been a significant reduction in right angle crashes since 2016 (down 40%). Severe right angle crash numbers are similar from year to year.

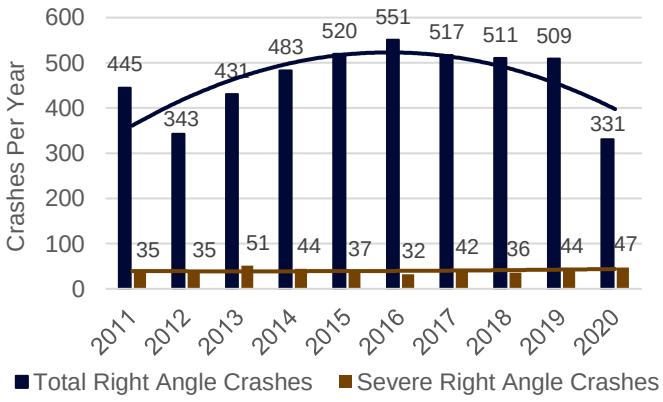


Figure 40. Historic Trend of Right Angle Crashes

Figure 41 shows that almost two-thirds (62%) of right angle crashes occur when someone stops but then proceeds into oncoming traffic. Most the remaining crashes (36%) are the result of a motorist running a red light or stop sign.

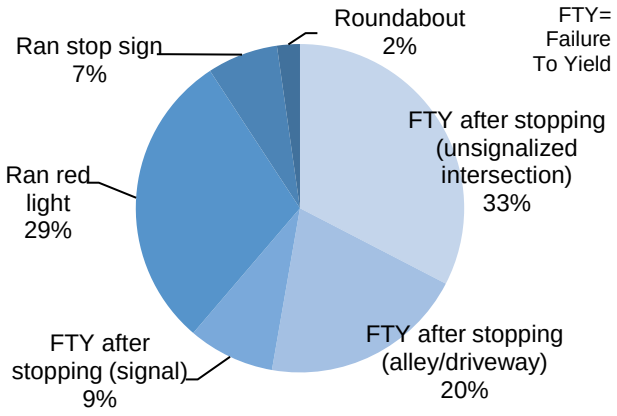


Figure 41. Right Angle Crashes by Type

Table 8 lists the locations with the greatest number of right angle crashes in the three-year period. Note that this list is sorted purely by the number of crashes and therefore locations with higher volumes will also tend to have higher numbers of crashes. The pattern recognition section later in this report identifies locations of higher-than-expected right angle crashes based on a statistical evaluation called 'probability of exceedance'. A combination of the two lists should be used to determine locations for further review.

Facility ID	North - South Street	East - West Street	# RA Crashes in 3 years
25	College Ave	Mulberry St	13
111	Shields St	Horsetooth Rd	13
6666	Mason St	Horsetooth Rd	13
145	Timberline Rd	Harmony Rd	12
80	Mason St	Harmony Rd	11
5209	Redwood St	Conifer St	11
6417	Timberline Rd	Vine Dr	11
59	Lemay Ave	Drake Rd	10
103	Remington St	Prospect Rd	9
119	Shields St	Prospect Rd	9
140	Taft Hill Rd	Prospect Rd	9
10711	Mason St	Magnolia St	9

Notes

Table is sorted by number of right angle (RA) crashes
Locations included with at least 9 right angle crashes in three years (12 locations total)
Additional locations may be identified through statistical analysis

Table 8. Locations with Most Right Angle (RA) Crashes

FIXED OBJECT CRASHES

Fixed object crashes are predominantly single vehicle crashes (97%) 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, fence or utility pole. Eighty percent (80%) occur on the arterial road system.

Fixed Object Crashes

308 crashes each year

9.4% are severe

Figure 42 shows the historic trend for fixed object crashes. Like many other crash types, the general trend is a reduction in crashes since about 2015 (with the exception of 2019). Severe fixed object crash numbers are stable.

Fixed object crashes are the crash type that occurs least frequently at intersections. Forty-one percent (41%) of fixed object crashes are identified as non-intersection crashes.

Minor fixed object crashes often occur in inclement weather. However, the other main contributor to these types of crashes, especially the higher speed crashes resulting in greater severity, is alcohol. 17% of all fixed object crashes involve alcohol. For severe crashes the percentage related to alcohol goes up to 34%.

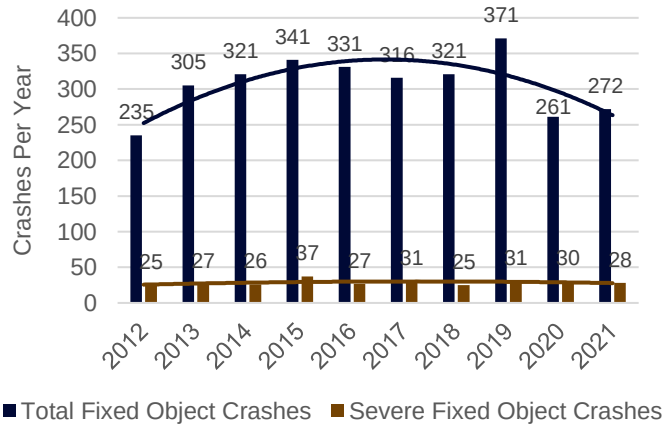


Figure 42. Historic Trends of Fixed Object Crashes

17% of all fixed object crashes involve alcohol

37% of all severe fixed object crashes involve alcohol

PEDESTRIAN CRASHES

Pedestrian crashes account for only 1.1% of all crashes; however, represent 6.9% of severe crashes. When pedestrian crashes occur, almost half (47%) will involve an injury or fatality. There have been seven (7) fatal pedestrian crashes in the last three years.

Pedestrian Crashes

41 crashes each year

47.3% are severe

Figure 43 shows the historic trends of pedestrian crashes in the last ten years in Fort Collins. The variability in pedestrian crash numbers from year to year is quite high partially due to the relatively small numbers, so care should be taken in looking for patterns or trends. Pedestrian crash numbers are quite steady, lower than highs seen in 2015, but severe crashes have increased in the past five years.

Figure 44 shows the breakdown of severe pedestrian crashes by year for the past five years.

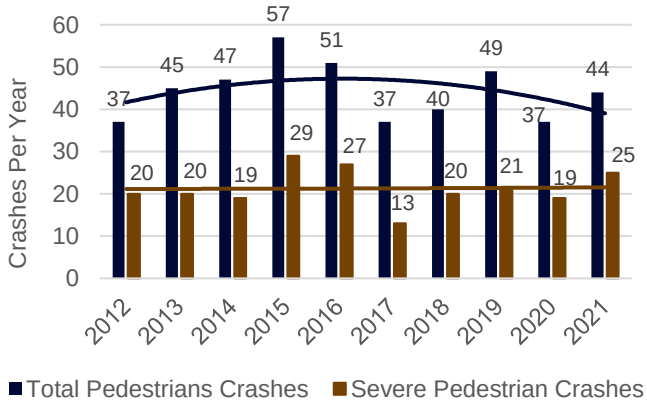


Figure 43. Historical Trends of Pedestrian Crashes

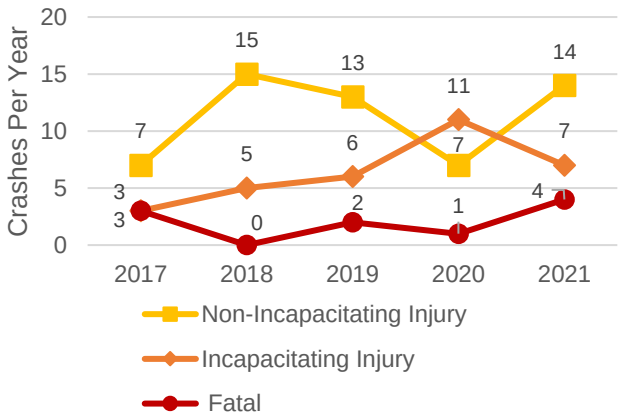


Figure 44. Numbers of Severe Pedestrian Crashes

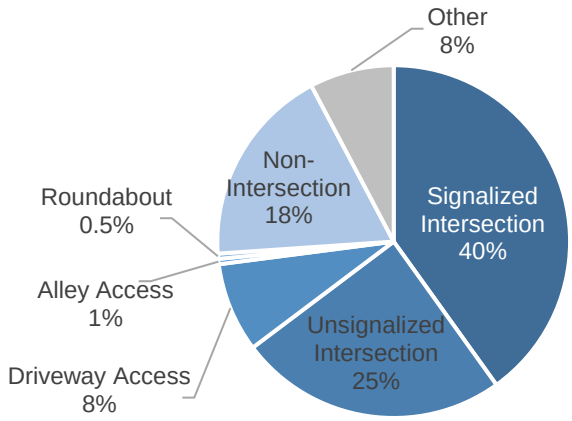


Figure 45. Pedestrian Crashes by Location

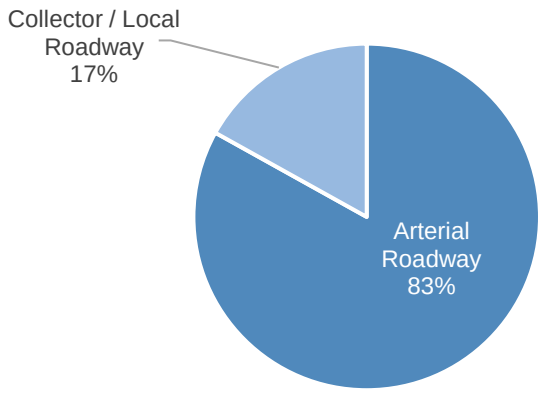


Figure 46. Pedestrian Crashes by Road Classification (2019-2021)

Categorizing locations of pedestrian crashes helps to understand locations of greatest interest in terms of pedestrian safety. ***Figures 45 and 46*** indicate where pedestrian crashes are occurring. Most pedestrian crashes occur at arterial intersections. As these major intersections are reviewed for operational and safety improvements, pedestrian safety is a critical component to consider.

Pedestrian Crashes

74% at intersections, driveways, or alley access

83% on arterials

Figure 47 shows the age of pedestrians involved in crashes. Pedestrians who are 15-19 are slightly overrepresented in crashes, while pedestrians aged 25-34 are the significantly overrepresented. Pedestrians aged 25-34 account for 24% of pedestrian crashes but represent only 17% of the population.

It should be noted that 26% of crash reports involving a pedestrian do not list the age of the pedestrian, and as such those numbers are not included in ***Figure 47.***

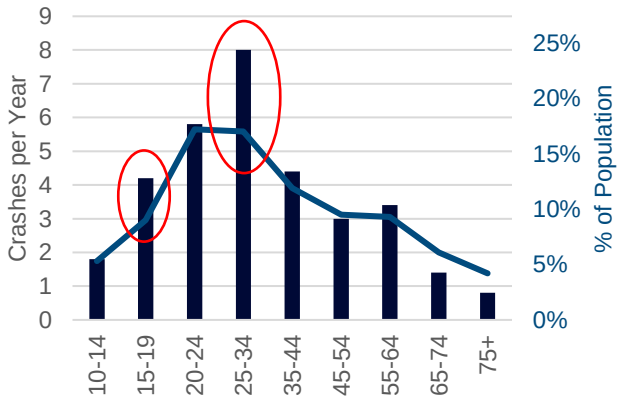


Figure 47. Pedestrian Crashes by Age of Pedestrian

When pedestrian crashes are categorized by gender of the pedestrian that was struck, males are disproportionately represented when compared to the overall population. Males are involved in 61% of pedestrian crashes. See ***Figure 48.***

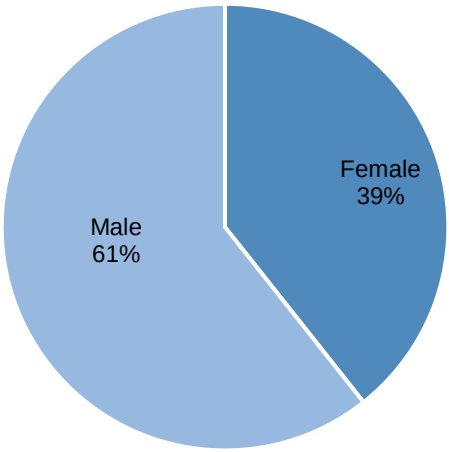


Figure 48. Pedestrian Crashes by Gender of Pedestrian

Crashes are categorized into a variety of types, and their prevalence in pedestrian crashes are shown in ***Figure 49***. 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 at Unsignalized Intersection
Crashes where a pedestrian legally in the street is hit by a motorist who does not yield the right of way. These crashes often involve a turning motorist 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 motorist who is too close to avoid a collision.

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

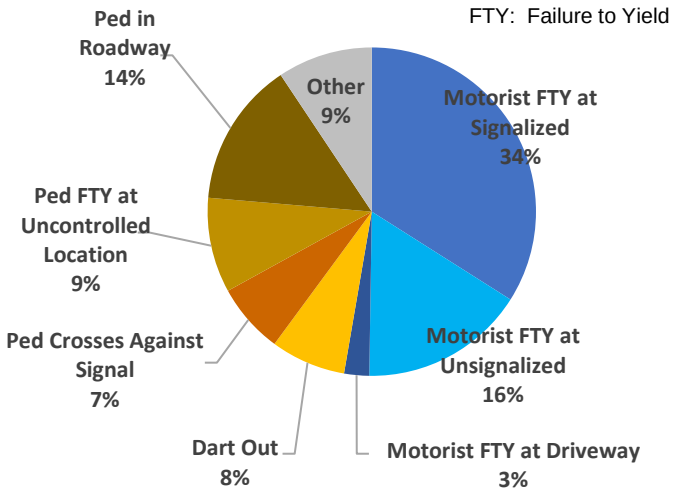


Figure 49. Pedestrian Crashes by Type

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. Many 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.

Table 9 lists the locations with the greatest number of pedestrian crashes in the three-year period. Note that this list is sorted by the number of crashes and therefore locations with higher volumes (both motor vehicle volumes and pedestrian volumes) will also tend to have higher numbers of crashes. The pattern recognition section later in this report identifies locations of higher-than-expected pedestrian crashes based on a statistical evaluation called 'probability of exceedance'. A combination of the two lists should be used to determine locations for further review.

Table 9. Locations with Most Pedestrian Crashes

Facility ID	North - South Street	East - West Street	# Pedestrian Crashes in 3 years
7	College Ave	Cherry St	3
25	College Ave	Mulberry St	3
32	College Ave	Stuart	3
84	Mason St	Mulberry St	3
1	Boardwalk Dr	Harmony Rd	2
20	College Ave	Laurel St	2
31	College Ave	Spring Park	2
58	Lemay Ave	Doctors Ln	2
101	Remington St	Mulberry St	2
119	Shields St	Prospect Rd	2
36	College Ave	Vine Dr	2

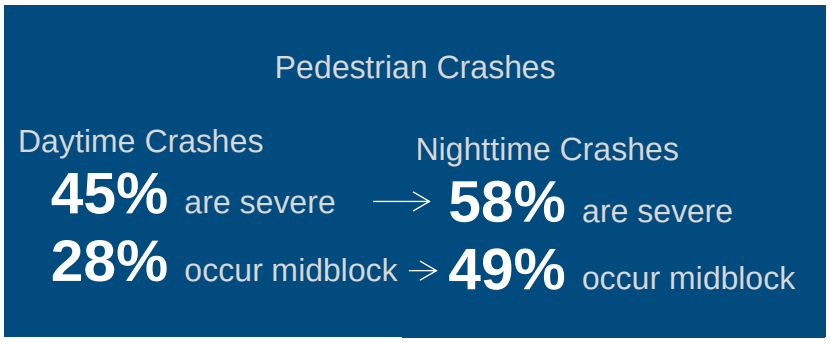
Notes
Table is sorted by number of pedestrian crashes
Locations inlcuded with at least 2 pedestrian crashes in three years (11 locations total)
Additional locations may be identified through statistical analysis

Comparing Daytime and Nighttime Pedestrian Crashes

A comparison between daytime and nighttime crashes offers an opportunity to better understand how the dynamics of pedestrian crashes change depending on lighting conditions.

In general, nighttime crashes are more severe, and much more likely to occur mid-block.

Four of the seven pedestrian fatalities in the last three years occurred at night.



Fatal Pedestrian Crashes

There have been seven fatal pedestrian crashes in the last three years. Circumstances involving the crashes vary, and the locations are scattered throughout Fort Collins without a particular pattern. However, a few items that can be noted from the data are shown below and may help in the identification of potential mitigation measures, including education.

- Six of the seven occurred on the arterial system.
- Six of the seven were in locations NOT related to an intersection (generally midblock).
- Six of the seven pedestrians were male.
- Four of the seven occurred at night (all of them midblock).

Figure 50 shows the location of pedestrian crashes in the last three years.

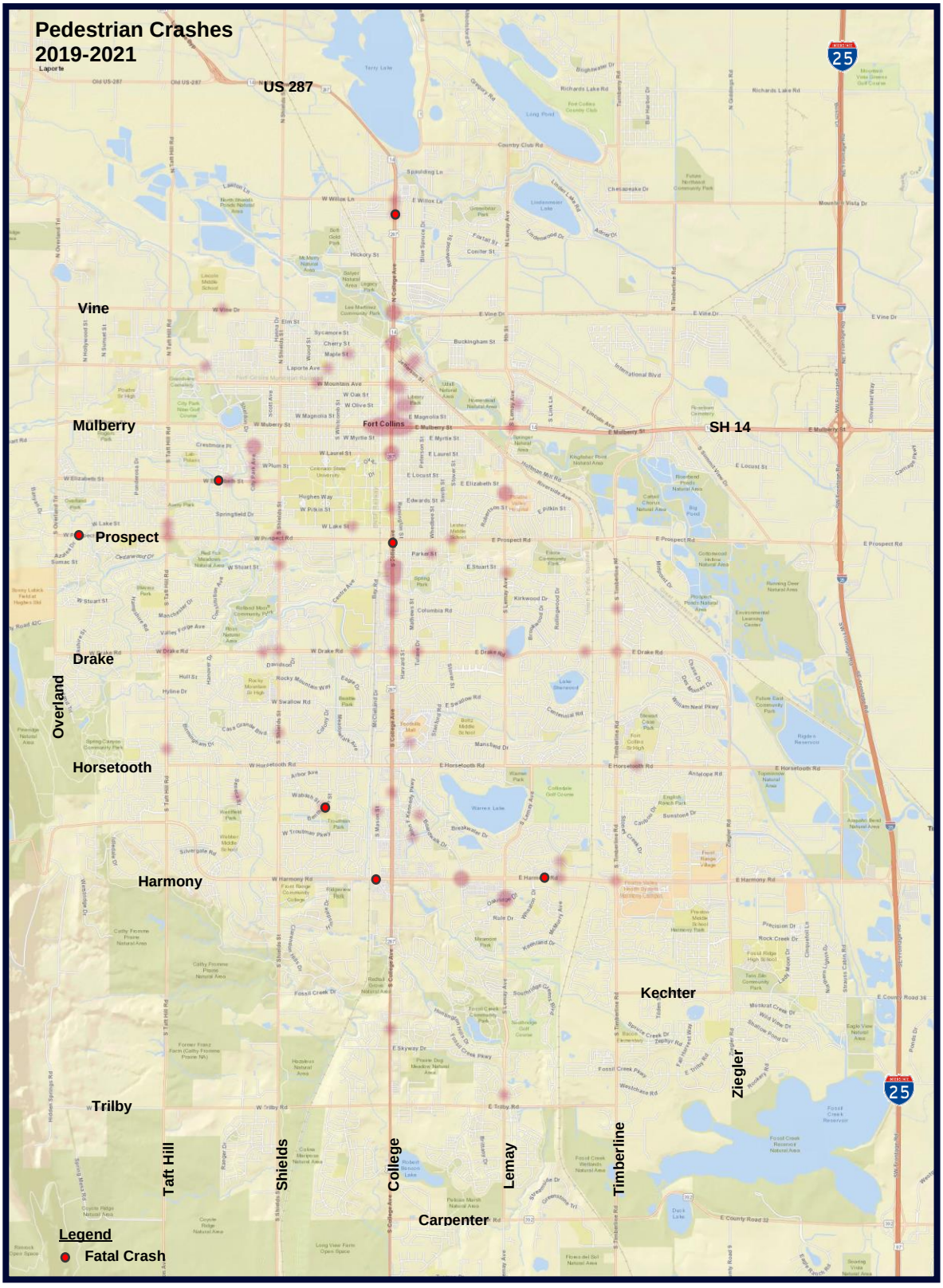


Figure 50. Pedestrian Crash Heat Map (2019-2021)

Section 4

INTERSECTION EVALUATION

Most of this report is a summary of the numbers, types, and patterns of crashes. This information can be used to identify overall trends and help to understand general mitigation and safety efforts throughout the City. The next 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 (heat maps) included in previous sections of this report) identify the locations where the most crashes occur. While helpful, because volumes and other elements at specific locations vary widely, it is difficult to draw relevant conclusions from this data. Therefore, an additional analysis is conducted to identify intersections where there are more crashes than expected considering traffic volumes, roadway geometry, type of traffic control, etc.

INTERSECTIONS BY EXCESS CRASH COST

To identify locations with the most potential for crash reduction, it is important to use methods that account for traffic volumes, roadway geometry, and type of control at intersections as those factors have an impact on the number of crashes at a given location.

It is also necessary to acknowledge that even though traffic crashes are partially deterministic (i.e., factors affecting crash potential can be controlled), crashes are, to some extent, random events. This random nature of crashes can make it more difficult to determine if a location is truly a problem versus a location where normal variation led to a high crash frequency during the analysis period. To identify locations that 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 that considers traffic volumes and intersection types while also accounting for the natural fluctuation of data called regression to the mean. The result is the identification of locations that have a higher-than-expected crash frequency even after accounting for random variation.

Crash Prediction Models

The method in the Highway Safety Manual that is applied for this evaluation uses crash prediction models to predict the number of crashes at each location given traffic volumes, roadway geometry, and type of control at each intersection. The predictions are compared to the actual number of crashes at each location (adjusted to account for regression to the mean). The more the actual adjusted number of crashes exceeds the number of predicted crashes (expressed as excess crash cost) the more likely it is that a location might benefit from targeted improvements.

Several crash prediction models were considered including those found in the Highway Safety Manual 1st edition, models developed for the Colorado Department of Transportation (CDOT) in 2009, and models developed for CDOT in 2018. Model results were compared to actual Fort Collins crash data and the models that best matched the data in each intersection category were selected for use (see ***Table 10)***.

Number of Legs *	Type of Control	Model Used
3	Stop Controlled	CDOT 2018
4	Stop Controlled	CDOT 2018
3	Signalized	CDOT 2018
4	Signalized	CDOT 2009 (total crashes) 2018 (injury crashes
All	Roundabout	NCHRP 888

Table 10. Prediction Model Used in the Analysis for Each Intersection

***** *Legs: Segments of roadway connected to an intersection*

Traffic Volumes

Traffic volumes in Fort Collins were down in 2020 by about 20% due to COVID-19. To account for this, three-year average traffic volumes used for analysis at each location were reduced by 7% to account for the reduced volumes in 2020.

Average ADT over three years = (V + V + 0.8V)/3 = 0.93V = -7%

This analysis was completed for about 300 intersections in Fort Collins using three years of data (2019-2021). The evaluation shows that 38% have an excess crash cost and 62% have a negative crash cost (indicating less crashes than predicted). This means that when aggregated and averaged, intersections in Fort Collins have less crashes and/or severity than what would be predicted.

62% of intersections in Fort Collins have fewer crashes than what would be predicted

Table 11 shows the 50 intersections with the greatest excess crash costs (grey highlighted column). 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”.

LEVEL OF SERVICE OF SAFETY (LOSS)

While excess crash cost is a quantitative approach, CDOT uses a similar but more qualitative approach to identify locations with more crashes than expected termed Level of Service of Safety (LOSS). LOSS is a scale from 1 – 4. LOSS 3 and 4 indicate locations with an above average number of crashes and above the 85th percentile number of crashes respectively compared to estimates from a crash prediction model. Calculation of LOSS was completed in this review and results are included in ***Table 11***. LOSS is included as it may identify some additional intersections – especially with lower volumes -- that may warrant further investigation. It also gives the City information needed to determine locations that may score favorably in the review process for CDOT safety funds.

TRENDS IN INTERSECTION SAFETY

In addition to identifying intersections with higher-than-expected crash numbers and severity, reviewing crash trends can identify changing conditions and safety at specific locations. ***Table 11*** lists the change in excess crash costs both positively and negatively. As noted earlier, the base calculation includes three years of data (2019-2021) and the comparison is against the previous three years of data (2016-2018). The comparisons are done to account for the volume changes in the “after” period related to COVID. Locations with more significant improvement in safety trends are shaded green, while locations with increasing excess crash costs are shaded in red. Note that in locations with few crashes, a single injury/fatal crash can create a pronounced swing in excess crash costs. In these cases, judgment is needed to determine whether a trend is significant or not.

Top 50 Intersections by Excess Crash Cost

	Fac ID	Intersection: North-South Street	Intersection: East-West Street	Traffic Vol: Total AADT	Model Predicted Crashes: Predicted Crashes/ Year	Model Predicted Crashes: Predicted FI Crashes/ Year	Actual Adjusted Crashes: Expected Crashes/ Year	Actual Adjusted Crashes: Expected FI Crashes/ Year	Excess Crashes (# and Costs): Excess PDO	Excess Crashes (# and Costs): Excess FI	Excess Crashes (# and Costs): Excess Expected Crash Value ($)	LOSS: LOSS Total Crashes	LOSS: LOSS FI Crashes	Crash Trends: 2016-2018 vs 2019-2021 Δ Crash Cost	Notes	Type Of Control	Rank
Top 10 intersections	34	College Av	Trilby Rd	45,174	16.7	4.3	24.2	7.0	4.8	2.7	$576,638	LOSS 4	LOSS 4	-$68,795	Protected Lefts in 2020, Funded Project	4SG	1
	111	Shields St	Horsetooth Rd	45,589	17.5	4.7	22.3	7.1	2.4	2.5	$498,125	LOSS 3	LOSS 4	$649,207		4SG	2
	10	College Av	Drake Rd	68,433	30.7	5.6	31.5	8.2	-1.8	2.6	$471,663	LOSS 3	LOSS 4	$68,860	Funded Project	4SG	3
	1	Boardwalk Dr	Harmony Rd	55,037	18.4	4.3	24.2	6.4	3.8	2.1	$438,886	LOSS 3	LOSS 4	-$64,926		4SG	4
	119	Shields St	Prospect Rd	46,739	17.9	4.9	23.3	7.0	3.3	2.1	$438,869	LOSS 3	LOSS 4	$3,453	Red Light Cameras in 2020, crashes trending down	4SG	5
	25	College Av	Mulberry St	49,330	19.0	5.1	27.0	7.0	6.1	1.9	$433,681	LOSS 4	LOSS 4	$481,006		4SG	6
	74	Lemay	Vine	20,363	5.0	1.7	12.1	3.4	5.5	1.7	$383,897	LOSS 4	LOSS 4	$55,351	Overpass completed 2021	4SG	7
	118	Shields St	Plum	32,196	8.3	2.0	11.9	3.7	1.9	1.7	$350,457	LOSS 4	LOSS 4	$287,795		4SG	8
	59	Lemay	Drake Rd	48,728	18.6	5.0	19.3	6.8	-1.1	1.7	$316,493	LOSS 3	LOSS 3	-$252,313	Funded Project	4SG	9
	143	Timberline Rd	Carpenter	26,800	7.8	2.6	13.0	3.9	3.9	1.3	$292,987	LOSS 4	LOSS 4	-$242,650	Funded Project	4SG	10
Next 15 intersections	162	Lemay	Harmony Rd	60,171	22.7	4.9	23.5	6.5	-0.8	1.6	$292,584	LOSS 3	LOSS 3	-$274,250	Adaptive signal timing 2019, crashes trending down	4SG	11
	80	Mason St	Harmony Rd	36,814	11.7	3.0	17.4	4.1	4.7	1.1	$259,595	LOSS 4	LOSS 3	-$354,511	Minor signal imp made.Crashes trending down	4SG	12
	18	College Av	Kensington	37,260	7.2	2.7	8.8	3.9	0.4	1.2	$233,382	LOSS 3	LOSS 4	$178,577		4SG	13
	55	JFK	Harmony Rd	46,531	13.2	3.1	12.5	4.3	-2.0	1.3	$225,055		LOSS 4	$468,280		4SG	14
	240	Timberline Rd	Custer	29,579	4.5	0.8	7.4	1.8	1.9	1.0	$206,581	LOSS 4	LOSS 4	$125,145		4SG	15
	35	College Av	Troutman	42,276	11.3	3.4	13.8	4.3	1.7	0.9	$185,912	LOSS 3	LOSS 3	-$52,738	Funded Project	4SG	16
	125	Shields St	Trilby Rd	24,445	6.7	2.3	9.8	3.1	2.3	0.8	$183,553	LOSS 4	LOSS 3	$71,753		4SG	17
	101	Remington	Mulberry St	26,805	6.8	1.8	9.4	2.7	1.7	0.8	$181,758	LOSS 4	LOSS 4	-$63,553		4SG	18
	139	Taft Hill Rd	Mulberry St	25,525	7.2	2.4	10.3	3.2	2.3	0.8	$170,433	LOSS 4	LOSS 3	$14,032		4SG	19
	140	Taft Hill Rd	Prospect Rd	33,579	11.3	3.4	10.8	4.3	-1.4	0.9	$160,773		LOSS 3	$35,166		4SG	20
	7	College Av	Cherry	36,868	12.1	3.2	12.6	4.0	-0.3	0.8	$143,432	LOSS 3	LOSS 3	$216,218		4SG	21
	8656	Shields	Richmond	31,097	2.5	0.7	4.6	1.3	1.5	0.6	$137,566	LOSS 4	LOSS 4	$189,798		4ST	22
	8835	Timberline Rd	Kechter	23,078	5.8	1.7	9.2	2.2	2.9	0.5	$131,380	LOSS 4	LOSS 3	-$169,730	Funded Project	4SG	23
	9402	Lemay	Carpenter	20,940	5.3	1.8	6.2	2.5	0.3	0.6	$126,059	LOSS 3	LOSS 3	-$47,208		4SG	24
	8	College Av	Columbia	45,829	9.7	3.2	9.0	4.0	-1.4	0.7	$120,569		LOSS 3	$183,129		4SG	25
	8432	College	Bristlecone	25,180	1.4	0.5	2.6	1.1	0.6	0.6	$113,778	LOSS 4	LOSS 4	$109,019		3ST	26
	37	College Av	Willox	30,519	9.7	2.9	12.6	3.3	2.4	0.4	$110,259	LOSS 3	LOSS 3	$159,805		4SG	27
	149	Timberline Rd	Prospect Rd	53,434	21.1	5.5	24.9	5.8	3.4	0.3	$105,998	LOSS 3	LOSS 3	$99,671	Construction 2019-20 contributes to crash increase	4SG	28
	72	Lemay	Swallow	29,477	4.8	1.3	5.7	1.8	0.4	0.5	$99,188	LOSS 3	LOSS 4	$93,884		3SG	29
	62	Lemay	Horsetooth (East)	40,597	7.2	2.2	9.7	2.6	2.1	0.3	$90,991	LOSS 4	LOSS 3	$163,689		3SG	30
	9380	Timberline	Lincoln	16,582	1.5	0.7	6.3	0.9	4.6	0.2	$88,724	LOSS 4	LOSS 3	$96,358	Improvement project in planning	4ST	31
	152	Timberline Rd	Vermont	31,899	6.0	1.2	6.9	1.7	0.5	0.4	$87,921	LOSS 3	LOSS 3	$21,800		4SG	32
	9986	Mathews	Mulberry	26,122	2.2	0.7	3.5	1.0	1.0	0.4	$84,074	LOSS 4	LOSS 4	-$18,802		4ST	33
	6171	Edinburgh	Drake	24,457	1.4	0.5	3.0	0.9	1.3	0.4	$83,893	LOSS 4	LOSS 3	$34,932		3ST	34
	8562	Overland	Drake	14,757	1.6	0.5	3.3	0.8	1.4	0.3	$82,376	LOSS 4	LOSS 4	$2,230	Safety project completed, positive trend	3ST	35
	36	College Av	Vine	34,058	5.7	1.5	7.4	1.9	1.4	0.3	$81,916	LOSS 3	LOSS 3	-$157,702	Crashes trending down	3SG	36
	193	Stover (East Int.)	Prospect	25,463	1.9	0.5	3.7	0.8	1.5	0.3	$80,126	LOSS 4	LOSS 4	-$21,342		3ST	37
	71	Lemay	Stuart	30,613	7.3	1.8	7.1	2.2	-0.7	0.4	$74,404		LOSS 3	$260,733		4SG	38
	15359	Centre	Prospect	29,039	8.7	2.5	9.7	2.8	0.7	0.3	$73,248	LOSS 3	LOSS 3	$149,158		4SG	39
	6664	Mcclelland	Horsetooth	28,839	3.8	0.9	6.2	1.1	2.1	0.2	$68,397	LOSS 4	LOSS 3	-$37,536		3SG	40
	6417	Timberline	Vine	14,151	1.5	0.6	5.5	0.7	3.9	0.1	$65,985	LOSS 4	LOSS 3	$0	Funded Project	4ST	41
	7290	College	Mason/Palmer	41,645	4.6	1.4	5.4	1.7	0.6	0.3	$61,916	LOSS 3	LOSS 3	-$45,742		4ST	42
	116	Shields St	Mountain	16,251	3.2	1.0	4.4	1.3	0.9	0.3	$60,431	LOSS 3	LOSS 3	$73,060		4SG	43
	225	Heatheridge	Prospect	21,232	1.2	0.4	2.0	0.7	0.5	0.3	$58,193	LOSS 3	LOSS 3	$24,641		3ST	44
	10247	Rigden	Drake	16,601	0.6	0.2	1.3	0.5	0.4	0.2	$52,372	LOSS 4	LOSS 4	$0		3ST	45
	5329	College	Plum	36,164	1.8	0.6	2.7	0.8	0.7	0.2	$50,739	LOSS 3	LOSS 3	$41,484		3ST	46
	110	Shields St	Harmony Rd	38,748	13.5	4.0	16.4	4.1	2.9	0.1	$47,508	LOSS 3	LOSS 3	-$54,224		4SG	47
	69	Lemay	Riverside	37,663	13.2	3.9	12.5	4.2	-1.0	0.3	$44,685		LOSS 3	$207,139		4SG	48
	9994	Taft Hill	Trilby	17,548	2.9	1.2	3.7	1.4	0.6	0.2	$44,312	LOSS 3	LOSS 3	$0		4ST	49
	6688	Automation Way	Horsetooth	25,263	1.4	0.5	1.1	0.8	-0.6	0.3	$43,382		LOSS 3	-$54,205		3ST	50

Legend:

- 10 high priority locations for review
- Additional 15 locations with potential for crash reduction
- Recently Improved - safety being monitored
- Project In Process

AADT: Annualized Average Daily Traffic
PDO: Property Damage Only
FI: Fatal or Injury
LOSS: Level of Service of Safety

Shading reflects LOSS 4

Range of -$50k to +$50k unshaded
Red shading notes increasing crash trend
Green shading identifies impoving safety trend

Table 11. Top 50 Intersections by Excess Crash Cost

PATTERN RECOGNITION

Table 12 identifies intersections where a pattern of a particular crash type is identifiable. The evaluation is a statistical analysis developed by the Colorado Department of Transportation and compares the prevalence of a particular crash type at an intersection against the typical expected proportion of that crash type at the intersection. The table indicates the control type, the location, and the number of that type of crash in three years (2019 – 2021).

Only intersections with at least three crashes in three years (average one per year) are included (except for the bicycle and pedestrian crash categories - those locations with a pattern of these crashes and two crashes or more in three years are included). Judgment is needed with this analysis as a higher-than-normal proportion of one type of crash may be caused by a lower-than-normal proportion of another type of crash. Thus, some locations that are listed, especially those with fewer crashes, may not be of concern.

Some intersections may be listed in more than one category. For instance, the intersection of College and Cherry is listed in both the Serious Injury and Pedestrian categories. The intersection of Mason and Horsetooth is listed under right angle crashes and red light running crashes. The causes may or may not be related.

This more detailed information about the types and patterns of crashes should be combined with other elements of analysis to gain a complete picture and greater understanding of the safety performance of an intersection to identify subsequent mitigation measures.

Table 12. Intersections with Statistical Pattern of Particular Crash Types (continued on next page)

Control	North - South Street	East - West Street	# crashes in 3 years
Approach Turn			
4 Signal	College	Troutman	28
4 Signal	Timberline	Drake	19
4 Signal	Shields	Horsetooth	19
4 Signal	Shields	Prospect	17
4 Signal	Lemay	Riverside	15
4 Signal	Taft Hill	Drake	15
4 Signal	Shields	Drake	15
4 Signal	Lemay	Drake	15
4 Signal	College	Boardwalk	12
4 Stop	College	Mason/Palmer	11
4 Stop	College	Lake	9
3 Signal	Lemay	Horsetooth (West)	9
4 Signal	Lemay	Horsetooth (West)	9
4 Signal	JFK	Horsetooth	8
4 Stop	College	Thunderbird	7
4 Signal	Riverside	Mountain	7
4 Stop	Shields	Richmond	6
3 Signal	Lemay	Swallow	6
Pedestrian			
4 Signal	Mason	Mulberry	3
4 Signal	College	Stuart	3
4 Signal	College	Cherry	3
4 Signal	Lemay	Doctors	2
4 Signal	College	Spring Park	2
4 Signal	Remington	Mulberry	2

Control	North - South Street	East - West Street	# crashes in 3 years
Right Angle			
4 Signal	Mason	Horsetooth	13
4 Stop	Redwood	Conifer	11
4 Signal	Remington	Prospect	9
4 Stop	Mason	Magnolia	9
4 Signal	Taft Hill	Prospect	9
4 Signal	Shields	Vine	8
4 Stop	Linden	Vine	8
4 Signal	College	Columbia	8
4 Stop	Worthington	Centre	7
4 Stop	Meldrum	Laporte	7
4 Signal	Taft Hill	Horsetooth	7
4 Signal	Research/Meadowlark	Drake	6
4 Signal	JFK	Boardwalk	6
4 Signal	Timberline	Timberwood	6
Bicycle			
4 Signal	Timberline	Caribou	3
3 Signal	Shields	Lake	3
4 Signal	Centre	Prospect	3
4 Signal	Remington	Pitkin	2
4 Signal	Matthews	Mountain	2
4 Signal	Loomis	Mulberry	2
3 Stop	Shields	University	2
4 Signal	Whitcomb	Prospect	2

Table 12 Continued. Intersections with Statistical Patterns of Particular Crash Types

Control	North - South Street	East - West Street	# crashes in 3 years
Red Light Running			
4 Signal	Mason	Horsetooth	11
4 Signal	Remington	Prospect	9
4 Signal	College	Columbia	9
4 Signal	College	Harvard	7
4 Signal	JFK	Boardwalk	6
4 Signal	Timberline	Timberwood	6
Single Vehicle			
4 Signal	Timberline	Harmony	17
4 Signal	Taft Hill	Drake	8
4 Signal	Ziegler	Harmony	8
4 Signal	College	Willox	7
4 Signal	Timberline	Custer	6
4 Signal	Lemay	Horsetooth (West)	6
3 Signal	Lemay	Horsetooth (West)	6
Snow and Ice			
4 Signal	Taft Hill	Drake	7
4 Signal	Ziegler	Harmony	7
3 Signal	College	Elizabeth	6
Serious Injury Crashes			
4 Signal	Lemay	Drake	11
4 Signal	Taft Hill	Prospect	9
4 Signal	College	Cherry	8
4 Signal	Timberline	Custer	7
4 Signal	Lemay	Carpenter	6

Control	North - South Street	East - West Street	# crashes in 3 years
Rear End			
4 Signal	College	Harmony	76
4 Signal	Timberline	Harmony	73
4 Signal	Boardwalk	Harmony	53
4 Signal	Timberline	Prospect	53
4 Signal	Lemay	Harmony	52
4 Signal	Corbett	Harmony	40
4 Signal	Timberline	Carpenter	35
4 Signal	Lemay	Vine	32
4 Signal	College	Monroe	28
4 Signal	Riverside	Mulberry	28
4 Signal	JFK	Harmony	27
4 Signal	Shields	Plum	27
4 Signal	Lady Moon	Harmony	23
4 Signal	Timberline	Kechter	22
4 Signal	Taft Hill	Harmony	21
3 Signal	McClelland	Horsetooth	18
3 Stop	Stover (east int.)	Prospect	13
4 Stop	Welch	Prospect	11
3 Signal	McClelland	Drake	9
3 Stop	Timberline	Mountain Vista	8
4 Stop	Taft Hill	Trilby	7
4 Stop	Taft Hill	Clearview	6

ROUNDABOUT SAFETY REVIEW

Fort Collins has installed several roundabouts in recent years. Roundabouts are often lauded for their roadway safety benefits due to slow speeds, and assumed reduced approach turn and right angle crashes. Reviewing crash data at the roundabouts in Fort Collins could help verify whether these claims are accurate in Fort Collins and could help direct roundabout policy in the future.

Four roundabout intersections in Fort Collins were reviewed as part of the intersection evaluation process described earlier in this report utilizing a crash prediction model developed for the National Transportation Research Board using crash data from roundabouts throughout the United States. ***Table 13*** shows the results for those four roundabout intersections. As shown in the table all four of the roundabouts reviewed had more crashes than expected (positive excess crash costs).

It's important to clarify that the expectation for roundabouts is that they will have less crashes than other types of intersections (STOP signs or traffic signals). Thus, the four roundabouts with an excess crash cost are higher than typical **when compared to other roundabouts**. While the excess crash cost may indicate an opportunity for improvement, it should not be misconstrued that the roundabouts are less safe than other types of intersections with lower crash costs because the basis for those costs is different.

To compare safety at the roundabouts relative to other types of intersections the crash prediction models for signalized or unsignalized intersections can be used to estimate the number of crashes under other types of control.

Table 13. Roundabout Intersection Comparison by Excess Crash Cost

Facility ID	North - South Street	East - West Street	Total ADT	Predicted Crashes/Year	Predicted FI Crashes/Year	Expected Crashes/Year	Expected FI Crashes/Year	Excess PDO	Excess FI	Excess Expected Crash Value ($)
6473	Ziegler	Horsetooth	25367	7.4	1.4	12.7	1.6	5.2	0.2	$89,771
559	Shields	Vine	13027	2.0	0.4	4.3	0.5	2.1	0.1	$51,440
11282	Ziegler	Kechter	14804	2.3	0.4	3.1	0.6	0.7	0.1	$34,489
100	Remington	Laurel	7673	1.4	0.2	1.1	0.3	-0.4	0.1	$11,477

ADT: Average Daily Traffic
PDO: Property Damage Only
FI: Fatal or Injury

Roundabouts
Have fewer injury crashes and less overall crash costs compared to signalized intersections with similar volumes.

Table 14 shows the predicted number of crashes and injury crashes at the four roundabout intersections if they were converted to traffic signals or, in the case of Remington/Laurel, STOP sign control.

The analysis shows that for the three intersections that could potentially be converted to traffic signals it would be predicted that they would have more crash costs with signal control than they currently do as roundabouts. This is due to the higher number of injury crashes that would be expected with signal control. Note that Remington and Laurel is not outperforming STOP control. Crashes would be expected to be about the same there either way.

The intersection of Ziegler/Horsetooth is congested and near capacity. While there have been some discussions about converting the intersection to a signalized intersection, in light of this analysis, other steps to improve roundabout operation should be considered first to maintain the reduced risk of serious injury crashes incumbent with roundabout control.

Table 14. Roundabout Intersection Crash Comparison with Change in Traffic Control

Facility ID	North - South Street	East - West Street	Expected Crashes/Year w/RBT	Expected FI Crashes/Year w/RBT	Predicted Crashes/Year w/Signal or STOP	Predicted FI Crashes/Year w/Signal or STOP	Expected Additional Crash Cost w/change
6473	Ziegler	Horsetooth	12.7	1.6	7.1	2.1	$26,457
559	Shields	Vine	4.3	0.5	2.2	0.8	$26,007
11282	Ziegler	Kechter	3.1	0.6	2.4	0.9	$59,259
100	Remington	Laurel	1.1	0.3	1.4	0.3	-$1,113

RBT: Roundabout
FI: Fatal or Injury

Section 5

IMPROVING ROADWAY SAFETY

Successful improvement of roadway safety requires collaborative efforts from numerous departments within the City, the community, and individuals. In order to systematically reduce the number and severity of crashes, there must be a commitment and focus to address specific safety concerns that are identified through data. Roadway safety is complex, and both big and small initiatives are important.

The data and recommendations in this report serve as an initial Vision Zero Action Plan. Additional efforts in coming months and years will result in ongoing refinements of the plan. It's important for these documents to acknowledge the complexity related to safety: some of the elements are policy related; some strategies are site specific and/or are identified to mitigate particular trends; and others (especially education-related efforts) are applicable across the City and address more behavioral issues.

ELEMENTS OF A VISION ZERO ACTION PLAN

Listed below are elements of a Vision Zero Action Plan, with each category being a vital component to improved safety.

Systems-Based Approach

Historically, roadway safety was often a reactive, spot review after a particular concerning event or pattern. It is now understood that there is more success when a proactive, comprehensive approach is used - one that is continuous and utilizes foundational elements of safety from a broad range of measures. Many resources such as Federal Highway Administration's Local Road Safety Process, the Highway Safety Manual, and the Federal Safe Streets For All legislation recognize that an ongoing, proactive systems-based program is best, generally reflected in the categories shown in ***Figure 51***.

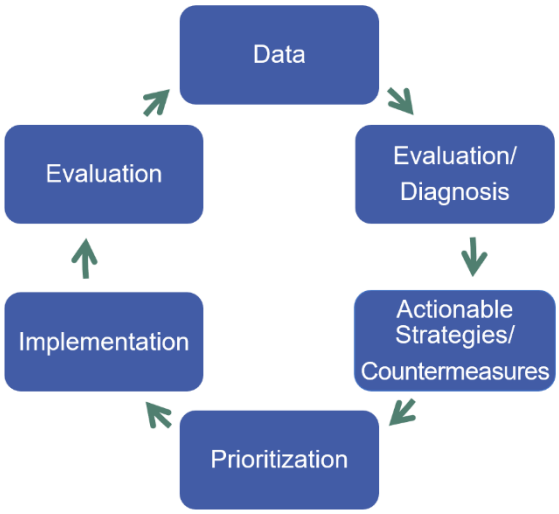


Figure 51. Systems-Based Transportation Safety Approach

Incorporating Safety into all City Efforts

Roadway safety involves multiple City department and requires collaborative partnerships. An intentional focus on safety throughout all aspects of projects from transportation planning, to adopted plans, project design, construction, operations, maintenance, enforcement incident management and more is critical. This may require a paradigm shift to add proactive elements to safety work in addition to reactive work.

Robust Annual Review, Evaluation, and Understanding of Safety Data

This Roadway Safety Report is the compilation of safety data and should be used as the foundation to identify strategies and actionable items to address existing safety concerns. While there are numerous important transportation projects and efforts underway, the focus for Vision Zero efforts should be on those that 'move the needle' on crash numbers and/or severity.

Apply All the Elements of Safety Toolbox

Application of all elements in the 'safety toolbox' reflects a holistic systems based approach to roadway safety. The toolbox incorporates the five "Es" of safety: Engineering, Education/Encouragement, Enforcement, and Evaluation.

Engineering and Technology

Engineering improvements can include low cost improvements such as the installation of flashing yellow arrows, or leading pedestrian intervals (LPIs) at intersections. Engineering improvements also include significant efforts such as capital projects.

Technology is also a component and includes vehicle safety features, improved signal systems, connected technology and more.

Education / Encouragement

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

City efforts undertaken in the past include the Bicycle and Pedestrian Safety Town, the bicycle friendly driver program, Safe Routes to School programs, and tours and presentations to interested groups about safety.

Enforcement

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

Other enforcement related efforts include:

- DUI campaigns and sobriety checkpoints are an important element.
- In the fall when school starts, a Bike Safety Week provides targeted education and enforcement by both Police Officers and Bicycle Ambassadors.

Police Services partnered with others to create 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.

Fort Collins Police Services also has Community Impact Days that 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.

Evaluation

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 should 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.

Annual Focus Areas

There are typically a wide range of strategies needed to improve transportation safety. While multiple efforts are often needed, identifying an annual 'focus area' can provide an opportunity to delve deeper into the causes and potential mitigation for certain types of crashes.

Collaborate on Best Practices

Vision Zero as a concept has gained significant traction in the public consciousness, and across the nation hundreds of Vizion Zero Action Plans are being developed. The City can learn from others, as well as share experiences related to successful efforts, and lessons learned.

It is especially important to understand the various components of safety and differentiate efforts that 'move the needle' on crashes from other also important transportation improvements that may be focused on perceived safety/comfort, accessibility, or advocacy for a particular mode.

TRACKING AND MEASURING SAFETY IMPROVEMENTS

A key component to a safety toolbox is the ongoing monitoring and continuous safety evaluation of the City's transportation system. In addition to annual data gathering and review shown earlier in this report, monitoring specific efforts/initiatives for their effectiveness and impact on safety can inform future actions, and projects. Fort Collins has a long history of implementing safety improvement projects. Significant strides have been made towards a safer transportation system.

Recent Project Evaluations

The 2020 COVID lockdown makes traditional before/after crash studies more challenging. A proper evaluation must consider the lower volume and corresponding reduction in crashes in 2020. To account for this, actual crashes at a location can be compared to the predicted number of crashes using a crash prediction model that accounts for actual traffic volumes in both the before and after period. Excess crashes in each period can then be compared and the results can be expressed in terms of change in crash cost. ***Table 15*** shows the net change in crash costs when comparing the period 2016 – 2018 to 2019 – 2021 at locations where safety improvement projects were completed.

Table 15. Monitoring Safety from Recent Improvements

Facility ID	North - South Street	East - West Street	Excess PDO Crashes Before	Excess FI Crashes Before	Project Completed	Excess PDO Crashes After	Excess FI Crashes After	Δ Expected PDO Crashes/Year	Δ Expected FI Crashes/Year	2016 - 2018 vs. 2019 - 2021 Δ Crash Cost
16	College	Horsetooth	10.4	6.1	Capital Project 2018	-2.0	0.2	-12.4	-5.9	-$1,266,187
108	Shields	Drake	4.5	0.8	Capital Project 2017	-0.4	-1.3	-4.9	-2.0	-$445,783
23	College	Monroe	9.5	1.1	Capital Project 2018	1.8	-0.1	-7.7	-1.2	-$312,142
239	Snow Mesa	Harmony	-2.1	1.1	Protected Lefts 2018	-1.0	-0.4	1.1	-1.5	-$281,795
109	Shields	Elizabeth	6.2	-0.3	Capital Project 2017	0.4	-0.7	-5.7	-0.5	-$156,400
7461	Shields	Davidson	-0.5	0.4	Capital Project 2017	-0.9	-0.3	-0.4	-0.7	-$134,103
15993	Linden	Vine	2.7	0.7	All-way STOP 2017	0.8	0.1	-1.8	-0.5	-$121,496
180	City Park	Mulberry	1.6	0.1	Road Diet 2018	0.9	-0.3	-0.7	-0.4	-$83,916

PDO: Property Damage Only
FI: Fatal or Injury
Δ: Change in

IDENTIFIED PRIORITIES AND ACTION PLAN

This report has detailed the data-driven evaluation of transportation safety in Fort Collins. It provides the basis to determine areas of opportunity for safety improvements. Based on that information, ***Table 16*** lists priorities for safety based action items. It provides a 'roadmap' of which topics and locations are recommended for further evaluation, and the identification of actionable strategies to reduce the number and severity of crashes.

The actions reflect the safe systems approach to improving roadway safety. Some elements are engineering based, while others are focused on citywide review of specific crash types. There are also items related to processes and policies, and an understanding that education and engagement is a critical element of improving a community's transportation safety.

As the information is put to use, additional analysis may be needed and helpful, and the priority list can be refined.

Table 16. List of Priorities for Safety Based Action Items

Item Priority	Concern / Topic	Action / Locations	Considerations
1. Engineering High Priority	Top 10 intersections with highest excess crash costs	Comprehensive, detailed safety audits 1. College / Trilby 2. Shields / Horsetooth 3. College / Drake 4. Boardwalk / Harmony 5. Shields / Prospect 6. College / Mulberry 7. Lemay / Vine (already improved) 8. Shields / Plum 9. Lemay / Drake 10. Timberline / Carpenter	Full safety audit including data collection, crash review, operations evaluation, field visit etc. Consider all available strategies including low cost improvement, signal timing, geometrics, capital project potential, safety grant opportunities etc.
2. Process/ Policy Priority	Incorporate safety elements into ongoing capital projects	Review and provide input to all capital projects with a lens of safety for all modes. Complete safety audit for all capital projects. Include safety as an element as projects are prioritized in Capital Improvement Program.	Consider how to elevate safety considerations in project decisions Utilize Interactive Highway Safety Design Model (IHSDM) to compare alternatives.
3. Medium Priority	Additional 15 intersection reviews	Per ***Table 11*** complete a higher level review of crash data at intersections ranked between 11 – 25 and those shaded lighter blue	Look for crash patterns, low cost improvements (i.e., striping changes)
4. Operational Priority	Approach Turn Crashes	Some locations are included in the top 10 safety audit locations, or projects in process. Additional locations: 1. College / Troutman 2. Timberline / Drake 3. Shields / Prospect 4. Lemay / Riverside 5. Shields / Drake 6. Taft Hill / Drake	Review each location individually and/or consider a citywide review of permissive / protected left turn phasing. Prioritize projects requiring longer mast arms for four-section heads Review locations for the potential of 4 second yellows.
5. High Priority	Red Light Running /Right Angle Crashes	Review locations with red light running patterns and right angle crash patterns 1. Mason / Horsetooth 2. Remington / Prospect 3. College / Columbia JFK / Boardwalk	Review visibility of signal heads, signal timing progression / offsets regarding arrival of platoon, etc.

Table 16 Continued. List of Priorities for Safety Based Action Items

	Item Priority	Concern / Topic	Action / Locations	Considerations
	6. Medium Priority	Non-Intersection Crashes	Review locations with clusters of crashes related to driveways / access locations. 1. College N of Vine 2. Magnolia E of Lemay 3. Lemay at Prospect 4. Elizabeth W of Taft Hill 5. Elizabeth at City Park 6. College N of Rutgers 7. Willox E of College	Changes in striping, access control and work with businesses on queuing impacts on arterials.
Active Mode Recommendations	7. Ongoing	Bicycle Crashes	Review all locations with multiple bicycle crashes (see Tables 6 and 12). Focus on intersection improvements to reduce conflicts / bicycle crashes.	• Conflicts with turning vehicles (both approach turns and right hook).
	8. Ongoing	Pedestrian Crashes – especially Fatalities	Review all locations with multiple pedestrian crashes (see Tables 9 and 12) for trends or countermeasures Consider how environmental factors and behavior contributes to midblock and nighttime crashes – look for opportunities to reduce these occurrences.	Fatalities: • 6 of 7 in past three years on arterials. • 6 of 7 were non-intersection related • 4 of 7 occurred during dark
	9. Education Priority	Education	Continue and enhance education and communication campaign to elevate transportation safety as community priority. Consider creation of a core team of safety champions. Partner with Poudre School District on some type of transportation safety training / outreach to all students and parents every year.	Messaging could include education for young drivers, discouraging bicyclists traveling against traffic, pedestrian safety, etc. Consider a traffic safety week in mid-August to coincide with CSU and PSD efforts.
	10. Ongoing	Enforcement	Continue to partner with Police Services on ways to work together – identifying locations for enforcement, additional red light cameras etc.	
	11. Medium Priority	Policies / Programs / Standards	Explore how a transportation safety standard could be added to LCUASS which would provide strength to addressing safety concerns in development review. Continue work with FCMoves on how to integrate operations, safety data and improvement strategies during planning projects. Support efforts to improve comfort/mobility and reduce number/severity of crashes for all modes.	
	12. Ongoing Priority	Data	Continue to work on data quality control and improving crash data especially with implementation of new statewide crash form DR3447. (See discussion in Section 6)	Coordination with Police Services on data entry training. Create arterial location designation in database.

Section 6

NEXT STEPS

Safety must be 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 ***Roadway Safety 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. The document provides a holistic and comprehensive look at roadway safety in Fort Collins.

WORKING ON PRIORITIES

The compilation of identified priorities and the action plan items in the previous section (***Table 16***) provides a starting point for safety efforts in the coming year(s). Utilizing a systems-based approach ensures that the highest priorities are incorporated into daily work within the City. Next steps may include infrastructure review through safety audits, low cost improvements, signal timing refinements, and other elements in the education, and enforcement arenas.

IMPROVING THE DATA

The City has undertaken significant efforts in partnership between Traffic Operations and Police Services to improve the available data for this document. With appreciation to all those involved, the data accuracy and level of detail is improving.

With the state's implementation of the new crash reporting form (DR 3447), collaboration should continue to further understand the complexity of the new form, the most beneficial fields for safety analysis, and the process to get that information from the form into the analysis database. Specific areas of focus include:

- Ensuring location data through geocoding is accurate
- Consistent identification of whether crashes are intersection related or not
- Details regarding crashes involving vulnerable road users (such as pedestrian and bicyclist age)
- Crashes involving impairment
- Noting whether crashes occur on an arterial or not.

The ability to 'move the needle' on numbers and severity of crashes is dependent on the continued improvement of the quality of data and analysis to develop and implement effective strategies and countermeasures.

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 transportation safety.