Memorandum

To: Jeff Wiggins and Sreyoshi Chakraborty

From: Rory Renfro and Kim Voros, *Alta Planning + Design*

Date: August 29, 2011

Re: Working Paper #8: Collision Analysis

Local crash data are a valuable source of information for identifying difficult or dangerous areas for bicyclists. This memorandum summarizes reported crashes in the Cheyenne Metropolitan Area that involved bicyclists between 2000 and 2009. The following analysis identifies specific issues and trends indicated by national and local crash data, as well as common dangerous bicyclist and motorist behaviors.

Introduction

According to national and local surveys, safety concerns are the most common reason people do not bicycle or do not ride more often. Many bicyclists feel that motorists do not see them or are openly hostile to them on roadways, particularly at intersections. National bicycle crash research shows that the most commonly reported bicycle/vehicle crashes occur at major arterial intersections. In addition, national studies show that many bicyclists involved in crashes are younger people who have less experience riding on the road and/or cyclists who are riding the wrong way or on the sidewalk[1]. Though Cheyenne's existing crash database does not contain sufficient information to replicate this study, it is likely that a similar trend exists within the Cheyenne Metropolitan Area.

Certain caveats are necessary when interpreting crash data. First, bicycle crashes, and in particular incidents that do not result in serious injury, are generally considered to be significantly under-reported. A street or intersection that did not experience a crash during the analysis period is not an indication that people are not bicycling or walking there, nor is it evidence that the area does not present hazards to bicycling. Crash data also do not take into consideration "near misses", which characterize conditions at many high-risk locations without reported incidents. Second, in the absence of bicycle and vehicle counts, there is no way to measure "exposure" to crashes, defined as crashes per bicycle mile traveled. For example, consider two streets that experienced the same number of crashes but different cyclist volumes. The street with greater bicycle traffic is likely to be less dangerous than the street that saw the same number of crashes despite seeing little bicycle traffic (measured by crashes per bicyclist or crashes per miles traveled). Third, coding of crash data may be inaccurate, incomplete, or biased, which can limit the explanatory power of the data.

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[1] Federal Highway Administration. "Bicycle Type Manual for Bicyclists" (http://www.fhwa.dot.gov/publications/research/safety/pedbike/96104/). n.d. Web. March 1, 2011.

Study Area Summary of Reported Bicycle Crashes, 2000 – 2009

Bicycle-related crash data were collected for ten years in Cheyenne from 2000 through 2009 (Table 1). These data were provided by the Cheyenne Metropolitan Planning Organization. A crash is usually defined as "reportable" if the incident results in death or injury, or if property damage exceeds $1,000 for any single person's property and occurred between a cyclist and a motor vehicle within the road right-of-way. Crashes that occurred on the Greenway, within parks or on private property are not considered in these totals.

There were 169 reported crashes involving bicycles during the ten-year period. One crash resulted in a fatality, while 163 resulted in an injury, of which 18 were incapacitating. Only five of the reported crashes resulted in no injury and 39 crashes resulted in possible injury (additional information was not available on the status of these crashes). The single fatality occurred on a clear, dry day as a motorist overtook a cyclist. Alcohol use by the motorist was cited as a contributing factor in this crash.

Over time, the number of reported crashes is decreasing; 11 crashes were reported in 2009, down nearly 60% from the 27 reported crashes in 2000. This downward trend could indicate that the Cheyenne area is becoming increasingly safe for cyclists, or it could indicate that the same number of crashes is still occurring but reporting trends have changed significantly.

Table 1. Summary of Reported Cyclist Crashes, 2000 - 2009

	Type of Injury					
Year	Fatality	Incapacitating	Not Incapacitating	Possible Injury	No Injury	Total
2000		3	15	9		27
2001		4	14	5	1	24
2002		1	16	3		20
2003		2	8	4		14
2004			7	2	2	11
2005		3	8	6		17
2006		1	13	2		16
2007		2	15	1		18
2008		2	3	4	2	11
2009	1		7	3		11
Total	1	18	106	39	5	169

Measuring the *rate* of bicycle crashes also accounts for the number of people bicycling in the city. Data from the decennial Census and American Communities Survey indicates that approximately 136 people commuted to work via bicycle between 2005 and 2007, compared with approximately 130 riders in 2000. Since the number of reported crashes has decreased significantly during the same period while bicycling has remained constant, this represents an overall reduction in the reported bicycle crash rate of roughly 25 to 40 percent.

Crashes by Time, Day of Week, and Year

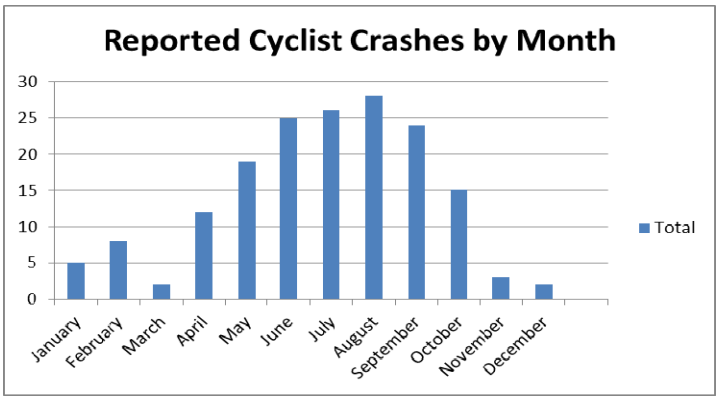

Figure 1. Reported Crashes by Month

Figure 1 through Figure 3 show reported crashes by month, day, and time of day. As shown in Figure 1, the greatest number of crashes were reported in summer months, with the frequency of reported incidents peaking in August and falling off in September. This is consistent with observed patterns of bicycle use in Cheyenne, which peaks between Memorial Day and Labor Day and roughly coincides with summer vacation and increased planned activity downtown and throughout the park system. Figure 2 shows the frequency of reported crashes by day of the week. Crashes were most frequently reported on Wednesday, while the fewest crashes were reported on the weekend. Antecdotally, this pattern matches commonly recognized trend that the reported cyclist crash rate tends to decrease as the number of cyclists on the roadway increases, also referred to as 'safety in numbers.' This trend can be confirmed in Cheyenne with the development of a bicycle count program which quantiifes the number of weekday and weekend cyclists.

Reported Cyclist Crashes Within 500 Feet

- 1 or 2
- 3 or 4
- 5 or 6
- Schools
- Funded Greenway
- Existing Greenway
- Existing Shared Use Trail
- Existing Bike Lane
- Existing Shared Roadway
- Wide Shoulder Used for Cycling
- Park
- Urban Development Boundary
- MPO Boundary
- City of Cheyenne

Note: "Wide shoulders" are not part of the official bikeway system

MPO Boundary

0 2 4 Miles

Map 1. Draft Reported Cyclist Collisions, 2000 - 2009

Cheyenne On-Street Bicycle Plan and Greenway Plan Update

Source: Cheyenne - Laramie County Cooperative GIS Program

Date: February 2010

0 0.5 1 Miles

more utilitarian trips than recreational trips. On utilitarian trips, cyclists (like motorists) generally prefer to take the shortest possible route, which generally involves travel on higher-order roadways (e.g., Lincolnway and Nationway), resulting in greater exposure to motor vehicles.

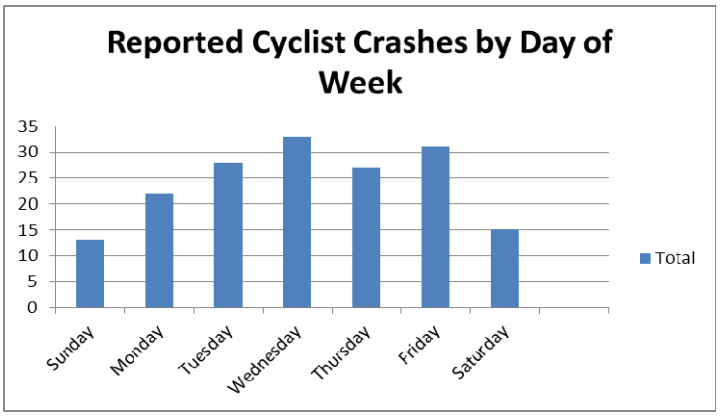

Figure 2. Reported Crashes by Day of Week

The reported collisions occurred most frequently during the afternoon hours; nearly half of all crashes occured between 1 PM and 6 PM (Figure 3), with the greatest number of crashes occuring between 4 PM and 6 PM. There were no crashes reported between midnight and 6 PM, and alcohol was only cited as a contributing factor in six instances. This is well below the national average, according to at least one study which reported alcohol was involved in nearly one-third of reported cyclist collisions[2]. This late afternoon spike in reported crashes is roughly correlated with the evening work commute as well as children traveling home from school. As mentioned previously, Cheyenne's reported cyclist crash database does not contain age information so it is not possible to compare the age of crash victims.

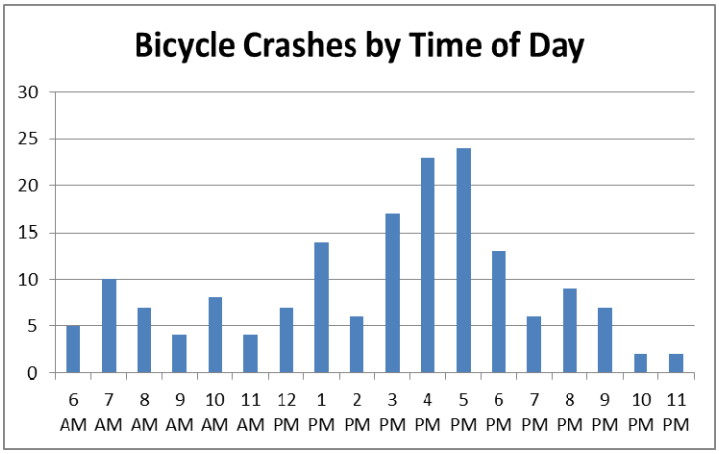

Figure 3. Reported Crashes by Time of Day

Reported Crash Locations

Map 1 shows the locations of reported crashes. These locations are likely the roadways where most bicycling occurs. These crashes are concentrated within the city boundaries and are located along several travel corridors including: Dell Range Boulevard, Lincolnway, South Greeley Highway, Yellowstone Road, 19th Street, Ridge Road and Pershing Boulevard.

[2] U.S. Department of Transportation. Traffic Safety Facts 1996: Pedalcyclists. *http://www-fars.nhtsa.dot.gov/www/library/file0022.pdf*. n.d. Web. March 1, 2011.

Table 2. Arterial Roadway Segments with Three or More Reported Cyclist Crashes

Roadway	From	To	Number Crashes	Corridor Length (MI)	Crashes per Mile
Dell Range Boulevard	Ridge Road	North College Drive	5	0.4	13.5
Yellowstone Road	Storey Boulevard	Dell Range Boulevard	10	0.7	13.4
East Lincolnway	Nationway	Converse Avenue	7	0.5	12.9
South Greeley Highway	Fox Farm Road	College Drive	13	1.0	12.7
Pershing Boulevard	Ridge Road	College Drive	5	0.4	12.5
Dell Range Boulevard	Converse Avenue	Ridge Road	10	0.9	11.2
Ridge Road	Dell Range Boulevard	Pershing Boulevard	9	1.0	8.7
East Lincolnway	Converse Avenue	Ridge Road	9	1.1	7.9
Dell Range Boulevard	Powderhouse Road	Converse Avenue	9	1.3	7.2
19th Street	Morrie Avenue	Converse Avenue	6	0.9	6.5
Lincolnway/16th Street	Ames Avenue	Central Avenue	4	0.6	6.2
Lincolnway/16th Street	Warren Avenue	Morrie Avenue	3	0.5	5.8
Yellowstone Road	Four Mile Road	Storey Boulevard	5	1.0	5.0
East 19th Street	Dey Avenue	Central Avenue	3	0.7	4.2
Dell Range Boulevard	Yellowstone Road	Powderhouse Road	4	1.1	3.6

Note: Crashes may be counted in multiple roadway segments if they occurred at a bounding intersection.

Table 2 lists roadway arterial roadway corridors where three or more crashes occurred. Corridors are defined by intersections with other arterial roadways and provide a generally homogenous travel environment for bicycles (e.g., posted speed, number of travel lanes and average daily motor vehicle volumes are typically consistent throughout the roadway segment). Roadways with greater numbers of reported crashes were generally correlated with higher crash rates, though exceptions did occur such as Dell Range Boulevard between Ridge Road and North College Drive.

Key observations from Table 2 and Map 1 include:

- The roadway segment with the highest crash rate is Dell Range Boulevard between Ridge Road and College Drive. In this area, Dell Range Boulevard is characterized as a Principal Arterial with four travel lanes, a center turn lane, with mixed retail commercial development and residential land uses. There are several driveway access points in this segment. Bicycle facilities are not defined for this section of roadway, but a shared use path runs along the south side of the roadway west of Ridge Road and Dell Range Boulevard becomes a shared roadway east of College Drive. Cyclists can cross Ridge Road along via an undercrossing of the Dry Creek Greenway approximately 200 feet south of Dell Range Boulevard.
- Dell Range Boulevard accounts for the greatest number of segments reported cyclist crashes. The roadway is characterized as a Principal Arterial with four travel lanes, a center turn lane/median and motor vehicle oriented land use. Bicycles are accommodated throughout the segments via shared use path on the south side of the roadway. Cyclists have called Pershing

Boulevard the most challenging place to bicycle in the city, but the roadway with the greatest number of crashes and highest crash rate is Dell Range Boulevard. This could be due in part to existing conditions, or the provision of existing bicycle facilities.

- The greatest number of crashes in any single segment occurred along South Greeley Highway. This roadway represents one of the few continuous travel corridors south of the railroad tracks.
- Arterial roadways within the central business district typically had lower crash rates than arterials located in areas characterized by more suburban style development.

While the higher number of reported collisions and higher crash rates create a compelling case for bicycle safety improvements, especially at roadway intersections, consideration of improvements should not be limited to only these arterial roadways. For example, four crashes occurred along Snyder Avenue, a collector roadway which provides a travel route parallel to arterial roadway couplets such as Warren Avenue and Central Avenue, which may be less comfortable for cyclists of varying ages and abilities. Additionally, Cheyenne's cyclists have reported a desire for improved facilities such as bicycle boulevards along local roadways that provide a high level of safety and comfort for many cyclists.

Table 3. Intersections with Mulitple Reported Cyclist Collisions

Number of Crashes	Roadway 1	Roadway 2
6	Dell Range Blvd	Windmill Road
4	Pershing Boulevard	Ridge Road
3	Dell Range Blvd	Ridge Road
3	Western Hills Blvd	Yellowstone Road
2	Lincolnway/16th	Capitol Avenue
2	East 19th Street	Alexander Ave
2	East 19th Street	Warren Ave
2	Big Horn Avenue	Lincolnway
2	Bluegrass Circle	Dell Range Blvd
2	Carlson Street	Yellowstone Road
2	College Drive	S Greeley Highway
2	Converse Avenue	Lincolnway
2	Dell Range Boulevard	Frontier Mall Drive
2	Dell Range Boulevard	Seminoe Road
2	Jefferson Road	S Greeley Highway
2	Logan Avenue	Nationway
2	Pershing Boulevard	Windmill Road
2	Prosser Road	S Greeley Highway

Many reported crashes (39 percent) occurred at roadway intersections while an additional one-third of crashes were somehow related to roadway intersections and approximately 14 percent were associated with a driveway.[3] Table 3 shows the 12 intersections in Cheyenne experiencing two or more reported bicycle crashes. Many of these intersections are located along the roadway corridors reported in Table 2, further indicating a potential need for bicycle safety improvements along these streets. These crashes most commonly occur at intersections of two higher-order streets (e.g., collector-collector or collector-arterial) rather than at local neighborhood streets. Intersections with more than one reported crash typically include multiple travel lanes, slip lanes that allow drivers to make right turns without slowing or high volumes of left- or right-turning vehicle traffic.

Table 4 provides a summary of cyclist and motorist actions during reported collisions. In most cases, the cyclist was traveling in a straight line and the motor vehicle was going straight or turning right.

Table 4. Cyclist and Motorist Actions During Reported Crashes

	Motorist Action									
Cyclist Action	Backing	U-Turn	Overtake	Slowing	Start	Stopped	Straight	Turn Left	Turn Right	Total
Backing							1			1
Change Lanes			1				1			2
Other							2		1	3
Slowing							1			1
Starting					1		4		1	6
Stopped							1	1		2
Straight	2	1		1	11	4	56	15	38	128
Turn Left							3			3
Turn Right							1			1
Total	2	1	1	1	12	4	70	16	40	147[4]

Key findings from Table 4 include:

- Crashes most frequently occurred with both the cyclist and motor vehicle were traveling in a straight line. Reasons for these crashes most commonly include a motorist overtaking a cyclist, or a cyclist/motorist failing to yield the right-of-way at an intersection.
- Crashes involving a right-turning motor vehicle are more frequent than those involving a left-turning motor vehicle.
- Right-hook crashes (crashes that occur when a cyclist is going straight and a motor vehicle is turning right) account for nearly 25% of incidents. These types of crashes most frequently

[3] Additional details of 'intersection related' classification was not available in the reported data.
[4] Information about Vehicle 1 or Vehicle 2 was incomplete for 22 crashes

occur in circumstances where the cyclist is not clearly visible (e.g., due to the cyclist's position in the travel lane).

A significant number of injury crashes involved turning motor vehicles. The comparatively high number of crashes attributed to vehicle turning movements is not unique to Cheyenne. This trend may indicate issues with intersection control, motorist failure to yield to bicyclists, or a lack of general awareness of bicyclists on the roadway. For instance, when a cyclist is traveling on a shoulder bikeway, they may be on the right side of a vehicle right-turn-only lane creating a direct conflict point between right-turning motorists and through bicyclists.

Conclusion

In absence of bicycle count data, collision data provides insight into the time of year, time of day and locations where people cycle. The data suggest that people bicycle at all times of the year, but that there are more bicyclists on the roads in months with better weather (May through September). The data also suggests that people bicycle all throughout the daylight hours and into the evening, but reported crashes occur with the greatest frequency in the afternoon.

Most of the streets where reported crashes occurred are major streets with multiple travel lanes in either direction that can create more challenging travel conditions for cyclists. These roadways provide access to destinations of interest for both cyclists and motorists; in several locations alternative routes do not exist, or would require significant out of direction travel. Most of the roads with frequent crashes do not have dedicated cycling facilities (e.g., West Lincolnway) and require cyclists to share a travel lane with motorists or ride on a sidewalk, circumstances that can increase the risk of a crash.

Alternate routes can be provided on lower-volume streets, while a complimentary network of signage can direct cyclists to routes that are safer for bicycling. However, while it may be desirable to provide bicycle facilities to encourage bicycle travel on less-traveled streets, key destinations such as stores, restaurants, and employment sites are often located on major streets. It is thus important to provide facilities to enable bicyclists to travel safely on streets with key destinations. Furthermore, bicyclists travel on major streets because they often provide the most direct route to their destinations. Finally, some busy streets (e.g., Dell Range Boulevard, South Greeley Highway, Ridge Road and West College Drive) do not have a lower-volume parallel street that is better suited for bicycles due to a lack of street connectivity. For the above reasons, creating multi-modal streets is a worthy goal of this planning effort.