

# MEMORANDUM



125 W. Main St  
Bozeman, MT 59715  
(406) 600-0595  
www.altaplanning.com

**To:** Ben Weiss, Bicycle/Pedestrian Program Manager, City of Missoula

**From:** Joe Gilpin, Alta Planning + Design

**Date:** 10/28/2016

**Re:** Transportation Function and Safety Analysis of S 5<sup>th</sup> St W and S 6<sup>th</sup> St W, Higgins Ave to Russell St

This memo provides a Transportation Function and Safety Analysis of S 5<sup>th</sup> Street W and S 6<sup>th</sup> Street W from Russell Street on the west end to Higgins Avenue on the east and explores several roadway reconfiguration alternatives. This memo includes a qualitative analysis of several surveys given to Missoula area residents and a quantitative analysis of existing crash data, speed data, volume to capacity ratios, as well as the function of the three main intersections (Russell Street, Orange Street, and Higgins Avenue). The reconfiguration scenarios were defined with the City of Missoula and include:

1. **Option 1A** – Reconfiguration of S 5<sup>th</sup> Street W and S 6<sup>th</sup> Street W to single-lane operation with large buffered bicycle lanes on the right side of the street.
2. **Option 1B** – Reconfiguration of S 5<sup>th</sup> Street W and S 6<sup>th</sup> Street W to single-lane operation with auxiliary left-turn lanes at each of the signalized intersections in the form of shared bike/turn lanes. Buffered bike lanes could be configured as either left or right running with this configuration.
3. **Option 1C** – Reconfiguration of S 5<sup>th</sup> Street W and S 6<sup>th</sup> Street W to single-lane operation with auxiliary left and right-turn lanes at each of the signalized intersections. Buffered bike lanes would be configured as either a through bike lane on S 5<sup>th</sup> Street W or a shared bike/turn lane on S 6<sup>th</sup> Street W.
4. **Option 2A** – Reconfiguration of S 5<sup>th</sup> Street W and S 6<sup>th</sup> Street W to two-way traffic flows with a dedicated left-turn lane at each signalized intersection.
5. **Option 2B** – Reconfiguration of S 5<sup>th</sup> Street W and S 6<sup>th</sup> Street W to two-way traffic flows with a single approach lane.

The City of Missoula contracted Alta Planning + Design to perform these analyses upon hearing several safety and performance concerns raised by the Riverfront Neighborhood residents and business operators.

## 1 Existing Conditions

### 1.1 Role of S 5<sup>th</sup> and S 6<sup>th</sup> Streets

S 5<sup>th</sup> and S 6<sup>th</sup> Streets make up an east-west one-way couplet just south of the Clark Fork River linking western portions of Missoula to the University of Montana. Within the 1 mile study area, between Russell Street and S Higgins Avenue, both streets have two travel lanes but are otherwise significantly different.

**S 5<sup>th</sup> Street W** has two on-street parking lanes and a bike lane and is approximately 40 feet wide between curbs.

**S 6<sup>th</sup> Street W** is much narrower at 30 feet wide between curbs and currently does not have a bike lane in the study area, with a parking lane on only the north side of the street.

The major intersections are at Russell Street, Orange Street, and Higgins Avenue. The distance between Russell Street at the western edge of the study area and Higgins Avenue on the eastern edge is exactly 1 mile.

**Russell Street** is a north-south roadway with varying cross-sections. Russell Street is a two-lane facility south of S 6<sup>th</sup> Street; from 6<sup>th</sup> to 5<sup>th</sup>, Russell transitions to a two-lane street with a two-way left-turn lane. North of S 5<sup>th</sup> St, Russell transitions to four lanes with a two-way left-turn lane. The intersection of Russell and 6<sup>th</sup> Streets is not currently signalized, but the Russell and 5<sup>th</sup> Street intersection is signalized.

**Orange Street** is a five-lane north-south roadway featuring a striped two-way left-turn lane and a 3'-4' shoulder in each direction. The intersections at 5<sup>th</sup> and 6<sup>th</sup> Streets are signal controlled.

**Higgins Avenue** is a four-lane north-south roadway. The intersections at 5<sup>th</sup> and 6<sup>th</sup> Streets are signal controlled. Shared lane markings are present in all four lanes along this section of Higgins.



Figure 1 – Study Area

### Role in Auto Network

S 5<sup>th</sup> Street W and S 6<sup>th</sup> Street W, part of the City's arterial street network, are classified as two-lane minor arterials and are on the federal aid system. They serve a significant role in east-west traffic circulation with their connection to the University of Montana and by virtue of intersecting with three principal arterials.



Figure 2 – Functional Classification

### Role in Bicycle Network

Many of the same characteristics that make 5<sup>th</sup> and 6<sup>th</sup> Streets attractive to people driving also apply to people on bicycles. These streets present direct, cross-town connections, with the only traffic control at the signalized intersections: Russell, Orange, and Higgins. East of Higgins, both streets have bike lanes, but, west of Higgins, only 5<sup>th</sup> Street does. The lack of dedicated facilities on 6<sup>th</sup> Street is consistently seen by local bicyclists as a major gap that detracts from the overall bicycle network. There have been discussions of upgrading 4<sup>th</sup> Street as a Neighborhood Greenway, which would

prioritize east-west bicycle travel on that street with crossing improvements; however, this has not been funded and would potentially require significant changes to make it attractive for all users.



Figure 3 – Bicycle Network

### Role in Transit Network

S 5<sup>th</sup> Street W and S 6<sup>th</sup> Street W are served by two different bus services. Route 8 of the Mountain Line Transit District connects the Russell corridor with University of Montana and downtown Missoula and has half-hour frequency around the peak hours and one-hour frequency during other times of the day. The University of Montana also operates its Udash purple line service over 5<sup>th</sup> and 6<sup>th</sup>, connecting western neighborhoods with the university. These two services combine to provide four buses per hour during peak commute periods and three per hour off-peak.

## 1.2 Quantitative Analysis of Existing Conditions

The existing conditions of S 5<sup>th</sup> Street W and S 6<sup>th</sup> Street W can be evaluated on a variety of metrics to gauge how they are currently functioning, in regards to both traffic and safety.

### Traffic Volumes

Average Annual Daily Traffic (AADT) counts have been collected annually for the Montana Department of Transportation<sup>1</sup> (MDT) at two locations within the study area. Data is collected at different times of the year, so it is unknown when these counts occurred.. The western count location is between Ivy and

<sup>1</sup> <https://mdt.maps.arcgis.com/home/webmap/viewer.html?webmap=8a0308abed8846b6b533781e7a96eedd&extent=-116.2848,43.146,-103.8043,50.0897>

Oak Streets, with the eastern count location between Hazel and Myrtle Streets. The AADT counts are one of several metrics that define how the streets are performing.

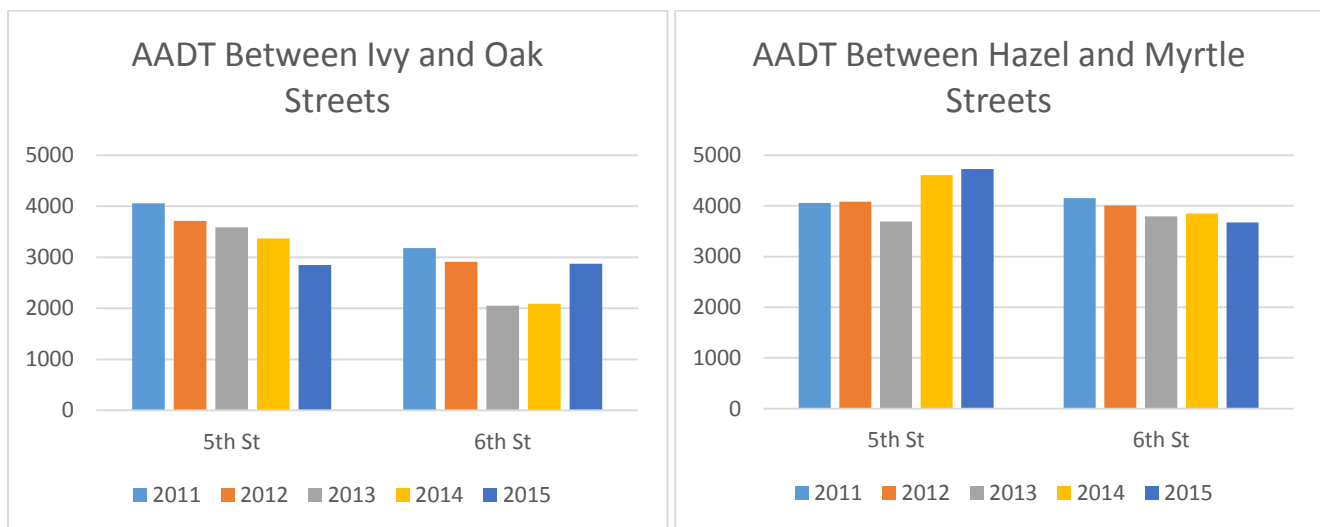


Figure 4 – Annual Average Daily Traffic

The data collected from MDT show the AADT trends over the past five years. Overall, average volumes ranged from 2,000 to 4,700 vehicles per day. From the data, 5<sup>th</sup> Street appears to be carrying more traffic than 6<sup>th</sup>. Though traffic on 5<sup>th</sup> has been declining between Russell and Orange, it has been slightly increasing between Orange and Higgins. Not only does 6<sup>th</sup> Street carry less traffic than 5<sup>th</sup>, volumes appear to be generally declining at both count locations, with a slight rebound in 2015 at Ivy

and Oak. AADT volumes at 5<sup>th</sup> between Oak and Ivy street may be artificially depressed due to a nearby road closure in 2015.

### Volume to Capacity Analysis

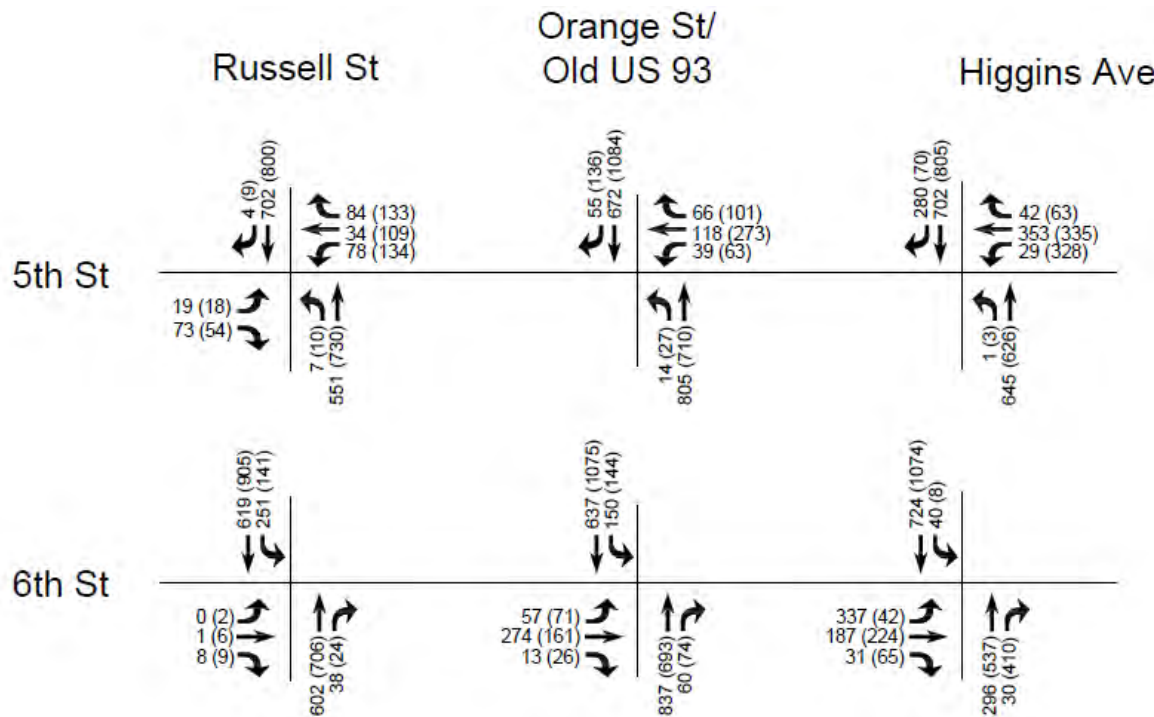
The capacity of a roadway is based on a number of features including the number of lanes, intersection function, access and intersection spacing, vehicle fleet mix, roadway geometrics, and vehicle speeds. This analysis does not calculate an exact capacity but uses a more general planning level estimate based on a 6,000 vehicle per day per lane theoretical capacity. A roadway's capacity and volume-to-capacity (v/c) ratio can be used as a comparison tool when looking at the transportation system. The v/c ratio of a roadway is defined as the traffic volume on the roadway divided by the capacity of the roadway. A roadway with a v/c ratio above 1 is said to be exceeding its capacity. For a two-lane one-way street, a v/c ratio below .5 may indicate that a lane drop is feasible. Based on the most recent 2015 traffic volumes from the preceeding section, the v/c ratios for 5<sup>th</sup> and 6<sup>th</sup> Streets are summarized in Table 1.

**Table 1. Volume to Capacity Ratios**

|                              | Between Oak and Ivy Streets | Between Hazel and Myrtle Streets |
|------------------------------|-----------------------------|----------------------------------|
| <b>5<sup>th</sup> Street</b> | .24                         | .39                              |
| <b>6<sup>th</sup> Street</b> | .23                         | .31                              |

### Turning Movement Counts

At each of the six intersections with Russell Street, Orange Street, and Higgins Avenue, turning movement counts were collected in February 2016 using Miovision. This data depicts the busiest time during the day and where vehicles are turning from and to.



**Figure 5 - Turning Movement Counts – AM (PM)**

Comparing peak hour volumes collected with MDT collected volumes nearby, it appears that S 5<sup>th</sup> Street W and S 6<sup>th</sup> Street W indeed are functioning as heavy commuter corridors. The highest peak hour for each street often represents approximately 25 percent of the daily traffic at a variety of locations. Considering traffic engineers usually estimate 10 percent of daily traffic to occur during peak hour, this indicates that S 5<sup>th</sup> Street W and S 6<sup>th</sup> Street W are experiencing significant peak hour traffic.

### Speeds

The City of Missoula conducted speed counts in June 2016. Both 5<sup>th</sup> and 6<sup>th</sup> Streets have a posted speed limit of 25 mph.

For 5<sup>th</sup> Street, a study location was chosen at Myrtle Street. Over a 24 hour period the average speed was 26.3 mph with the 85 percentile speed at 30.4 mph. Of the over 3,500 vehicles observed during this period, thirteen exceeded 45 mph, with three of those exceeding 55 mph. The highest speed observed was 63.5 mph. In total, these extreme speeds represent less than half a percent of observed vehicles. Approximately 50 percent of the vehicles observed were travelling at or below the posted speed limit. Given that the 85<sup>th</sup> percentile speed is 30.4 mph this indicates that 5<sup>th</sup> Street does experience some speeding.

**Table 2. Percentile Speeds on 5<sup>th</sup> Street**

| Percentile Speeds | 10%  | 15%  | 50%  | 85%  | 90%  |
|-------------------|------|------|------|------|------|
| (mph)             | 20.6 | 22.5 | 26.8 | 30.4 | 31.3 |

For 6<sup>th</sup> Street, which is 10 feet narrower and lacks a bike lane, observed speeds were lower. This observation seems to support national research that has found that a more enclosed and narrower street typically exhibits slower speeds. On 6<sup>th</sup> Street, only eleven of nearly 1,900 observed vehicles exceeded 35 mph, or 0.6 percent. 85<sup>th</sup> percentile speeds were slightly lower than 5<sup>th</sup> Street at 28.8 mph.

**Table 3. Percentile Speeds on 6<sup>th</sup> Street**

| Percentile Speeds | 10%  | 15%  | 50%  | 85%  | 90%  |
|-------------------|------|------|------|------|------|
| (mph)             | 12.9 | 14.3 | 25.0 | 28.8 | 29.6 |

### Existing Intersection Level of Service

Level of Service (LOS) analysis is a means of determining the ability of an intersection to accommodate vehicular traffic volumes. The analysis is based on intersection geometrics, traffic controls, and traffic (vehicle, pedestrian, and bicycle) volumes. The analysis provides an indication of the LOS at which an intersection is functioning or is expected to function in the future.

LOS is defined by letter characters that range from A to F, with A representing the best traffic operating conditions that have little or no delay to vehicles utilizing the intersection and F characterizing poor conditions that have significant delay. LOS A through D is considered acceptable, and LOS E is considered representative of conditions where improvements may be needed. LOS F operating conditions are unacceptable and indicate that improvements are needed, in the form of traffic control modification, geometric changes, or a combination of both, for the purpose of reducing vehicle delay. The delay limits for each LOS category, based on the Transportation Research Board's *Highway Capacity Manual* (HCM), are shown below.

**Table 4. Level of Service Delay Limits**

| Level of Service (LOS) | Signalized Intersection<br>Delay per Vehicle (sec/veh) | Unsignalized Intersection<br>Delay per Vehicle (sec/veh) |
|------------------------|--------------------------------------------------------|----------------------------------------------------------|
| A                      | ≤10.0                                                  | ≤10.0                                                    |
| B                      | 10.1 - 20.0                                            | 10.1 - 15.0                                              |
| C                      | 20.1 - 35.0                                            | 15.1 - 25.0                                              |
| D                      | 35.1 - 55.0                                            | 25.1 - 35.0                                              |
| E                      | 55.1 - 80.0                                            | 35.1 - 50.0                                              |
| F                      | > 80.0                                                 | > 50.0                                                   |

Russell, Orange, and Higgins are all principal arterials in the north-south direction and are currently part of a coordinated signal system. Traffic travelling north-south is heavily prioritized in the current signal timing. Existing levels of service in the north-south direction are nearly all operating at LOS A with east and westbound travel on 5<sup>th</sup> and 6<sup>th</sup> showing ranges of C through F. For a more detailed existing condition summary, see Table 8.

### Crash History

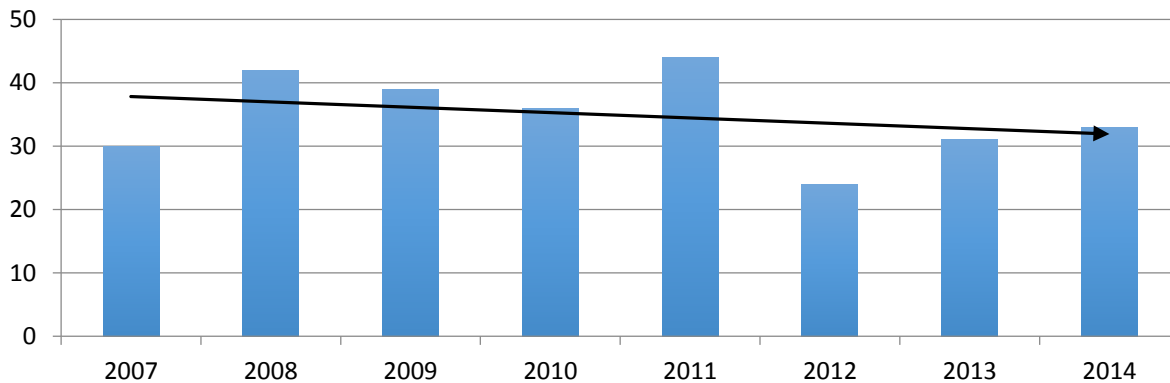
This section provides an analysis of historical trends of crashes occurring along S 5<sup>th</sup> and S 6<sup>th</sup> Streets W from Russell Street to Higgins Avenue over an eight-year period from 2007 to 2014. Raw crash data was collected through the Missoula MPO Long Range Transportation Plan and sorted for crashes happening within this analysis' study area and summarized to identify trends in collision types and locations for crashes involving vehicles, pedestrians, and bicycles. It is likely that more crashes have occurred that were not reported to the police. Data analyzed includes crashes that occurred along 5th and 6th Street W, as well as crashes that occurred along cross-streets at intersections. It should also be noted that, for the data analyzed, the specific street the crash occurred on was not listed in the crash records. Many of the reported crashes, therefore, may not be directly related to 5<sup>th</sup> or 6<sup>th</sup> but to conditions along the principal arterials.

### When Crashes Occurred

Figure 5 displays the total number of crashes by year between 2007 and 2014. A total of 279 motor vehicle crashes were reported within the study area, averaging about 35 crashes a year. Motor vehicle collisions peaked in 2011, with forty-four total crashes. The following year, twenty-four crashes were

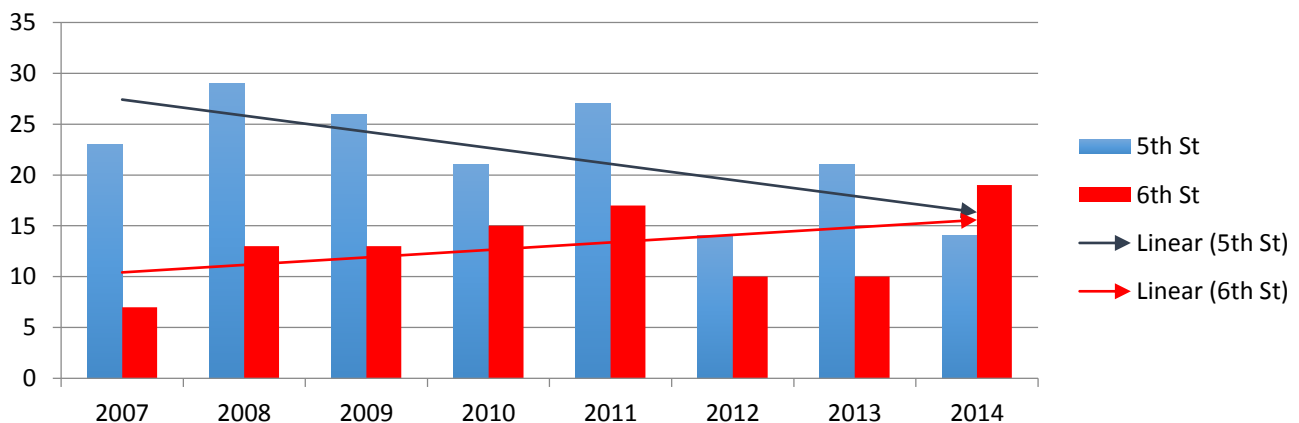
recorded, representing the lowest number of crashes in a single year during the period studied. Over the course of the eight-year study period, the crash trend on both streets decreased by about 16%.

Figures 6 and 7 show the crashes in the study area and by street.



**Figure 6 – Total Number of Crashes per Year**

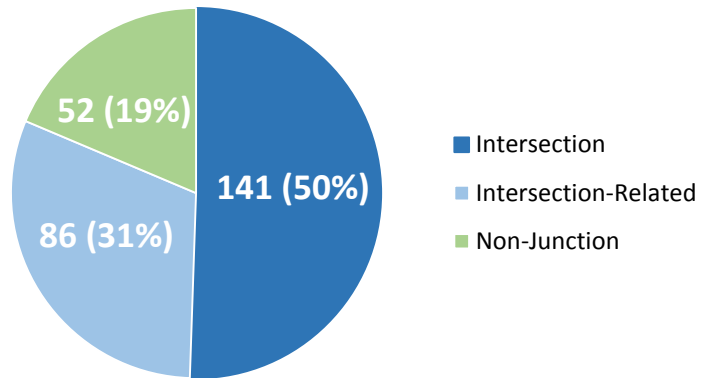
In total, 175 crashes were recorded along 5<sup>th</sup> Street W. The total number of crashes along 5<sup>th</sup> Street W decreased by 40% over the study period. Along 6<sup>th</sup> Street W, 104 crashes were recorded, and the number of crashes increased by 50% over the study period from 2007 to 2011.



**Figure 7 – Number of Crashes per Street**

## Where Crashes Occurred

Within the corridor, the majority of motorist collisions occurred at intersections. Of all 279 crashes, 227 (over 80%) were reported as intersection or intersection-related crashes, with 52 (19%) occurring mid-block. Understanding the types of crashes that occurred at intersections and mid-block locations provides information about crash trends within the corridor.



**Figure 8 - Where Crashes Occured**

Of *intersection crashes*, over 42% were right-angle crashes, where vehicles drove through the intersection and hit another vehicle at a right-angle. Rear-end collisions accounted for another 35% of intersection crashes, and the third most common cause of intersection crashes were sideswipe crashes with two vehicles moving in the same direction, constituting 12% of intersection-related crashes.

For *mid-block collisions*, rear-end crashes were the most frequent cause, representing 36% of mid-block crashes. There could be a variety of contributing causes for rear end crashes including a vehicle running into another while attempting a parking maneuver, or when yielding to a pedestrian. Generally, these crashes would still be possible even with a single through lane. Thirteen crashes (26% of mid-block, 3% of total) were logged as sideswipe crashes with two vehicles moving in the same direction; this type of crash could be reduced considerably with a single lane of travel. There were also 6 collisions (12% of mid-block, 1.3% of total) with a parked motor vehicle.

Table 5. Types of Intersection Crashes

| Type of Crash                     | Total Crashes | Percent of Total |
|-----------------------------------|---------------|------------------|
| #1: Right Angle                   | 96            | 42.3%            |
| #2: Rear End                      | 80            | 35.2%            |
| #3: Sideswipe, Same Direction     | 27            | 11.9%            |
| #4: Left Turn, Opposite Direction | 11            | 4.8%             |
| Other**                           | 13            | 5.7%             |
| <b>Total</b>                      | <b>227</b>    | <b>100%</b>      |

\*inclusive of Intersection and Intersection related crashes

\*\*Other Crash Types: sideswipe opposite direction, roll over, right turn same direction, pedestrian, not fixed object or debris, left turn same direction, fixed object, backing vehicle

Table 6. Types of Midblock Crashes

| Type of Crash                 | Total Crashes | Percent of Total |
|-------------------------------|---------------|------------------|
| #1: Rear End                  | 18            | 36%              |
| #2: Sideswipe, Same Direction | 13            | 26%              |
| #3: Parked Vehicle            | 6             | 12%              |
| #4: Right Angle               | 4             | 8%               |
| Other*                        | 9             | 18%              |
| <b>Total</b>                  | <b>50</b>     | <b>100%</b>      |

\*Other Crash Types: backing vehicle, fixed object, head on, left turn same direction, lost control, not fixed object or debris, other

**Severity of Collisions and Contributing Factors** The severity of crashes along the corridor ranged from property damage only to fatal collisions. The majority of crashes, 73%, resulted in only property damage, while 25% resulted in some degree of bodily harm. Two fatalities (less than 1% of total crashes) occurred during the period studied, one in 2010 and the other in 2011. Challenging roadway conditions, such as snow or wet roads and other contributing factors, were responsible for 23% of all crashes.

### Crashes Not Involving Two Moving Vehicles

While the majority of crashes within the study corridor involved two or more moving vehicles, 6 percent of crashes involved one moving vehicle and a fixed object (such as a light pole or parked vehicle), pedestrian, or bicycle. In total, five bicycle crashes (1.8% of total crashes) were reported over the study period. Of these crashes:

- Four occurred at intersections and only one occurred mid-block.
- Two were caused by left turns in the opposite direction, two were caused by right hooks, and one was caused by a sideswipe movement in the same direction.
- All bicycle crashes resulted in some form of bodily injury, ranging from a minor to incapacitating injury.

One crash (0.4% of all crashes) was reported involving a pedestrian and a motor vehicle. This occurred at an intersection, was a right-angle collision, and resulted in a non-incapacitating injury. Of all crashes, 11 (4% of total crashes) involved parked motor vehicles.

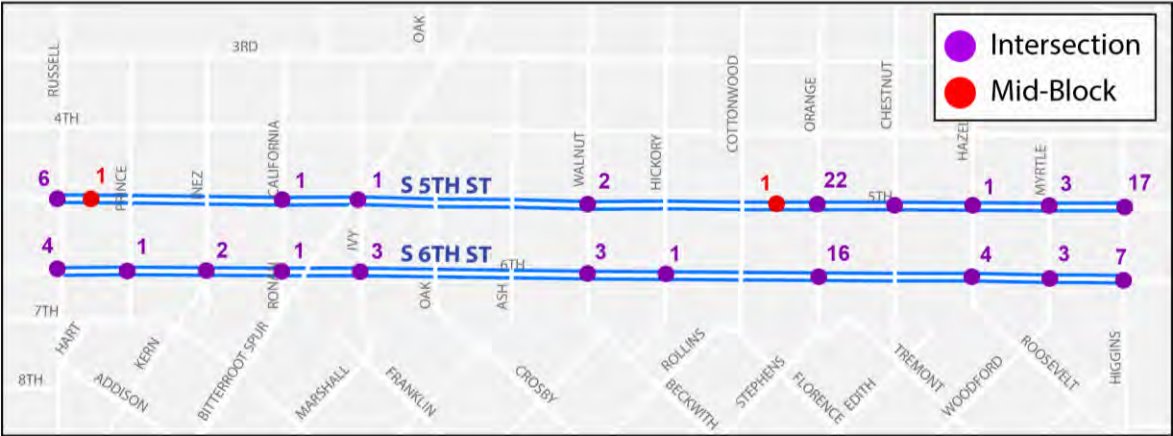
### **Crash Analysis Conclusion**

The analysis of crashes along 5<sup>th</sup> and 6<sup>th</sup> Streets provide insight into where and why crashes occurred along the corridor. From 2007 to 2014, the total number of crashes along the corridor studied decreased by 16%. In total, 279 crashes were recorded along the corridor, including 175 along 5<sup>th</sup> Street and 104 along 6<sup>th</sup> Street. The number of crashes occurring along 5<sup>th</sup> Street seems to coincide with the higher speeds recorded there. The majority of crashes (81%) occurred at intersections. Of the remaining 19% of mid-block crashes, the three most common crash types, also in order of frequency, were rear-end and sideswipe/same-direction crashes, followed by collisions with parked vehicles.

Safety is an issue in the corridor. Approximately one in four collisions, or 25 percent, result in some degree of bodily harm. Over the period studied, two fatalities occurred. Additionally, five bicyclists and one pedestrian were hit by motor vehicles. Each of these crashes resulted in some degree of bodily harm to the bicyclists/pedestrian, highlighting the injury-risk of a pedestrian/bicyclist being struck by a motor vehicle in the corridor.

Crashes of all types were concentrated where 5<sup>th</sup> and 6<sup>th</sup> intersected with Russell, Orange, and Higgins. From the data it is impossible to tell if crashes recorded at these intersections are attributable to travel in the north-south direction or along 5<sup>th</sup> and 6<sup>th</sup>. Figure 9 displays where crashes occurred along the corridor, highlighting both the type and locations of crashes. Right-angle collisions primarily occurred at intersections throughout the corridor. Rear-end and sideswipe/same direction crashes were concentrated on the eastern side of the corridor, between Walnut and Higgins. Lowering vehicle speeds along 5<sup>th</sup> and 6<sup>th</sup> could be an effective solution to reduce the number and severity of crashes along these corridors. The potential of each reconfiguration alternative to impact motor vehicle speeds is discussed later in this analysis. The posted speed limit of 25 mph is not proposed to be altered.

5th and 6th - Right Angle Collisions



5th and 6th - Rear End Collisions



5th and 6th - Side Swipe Collisions

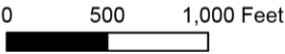


Figure 9 – Types and Locations of Crashes

### 1.3 Qualitative Analysis of Existing Conditions

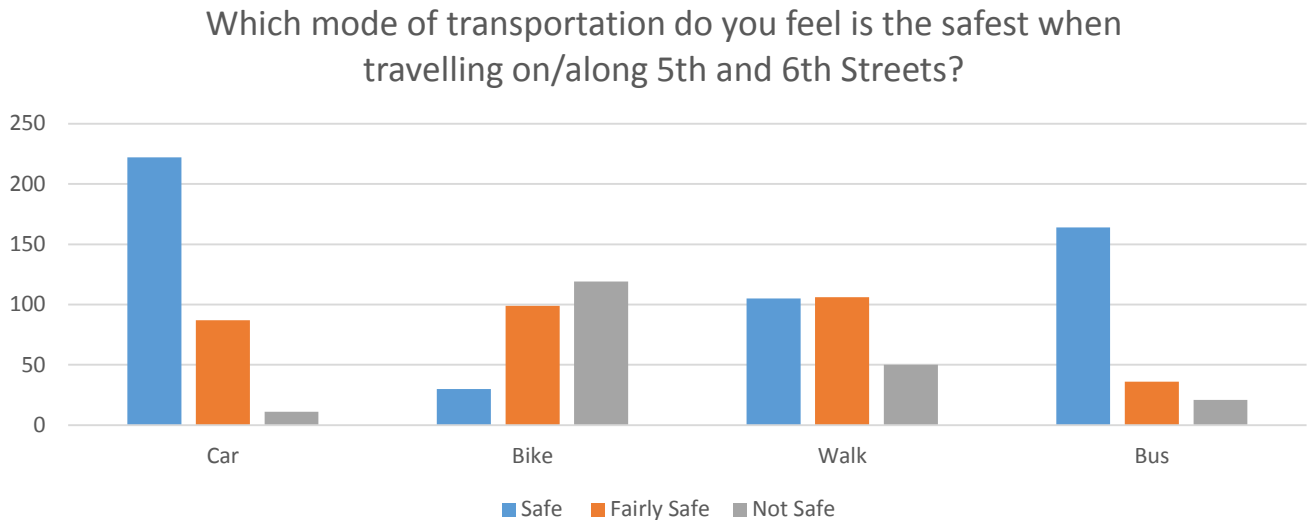
Two separate surveys of residents were conducted to solicit opinions on the 5<sup>th</sup> and 6<sup>th</sup> Street corridor. In both surveys, respondents in the community identified safety for all road users, efficient east/west connection for people on bicycles, and slower traffic speeds as positive outcomes for the proposed reconfigurations; however, some residents responded negatively with concerns about parking, campus events, traffic, and existing east/west routes for bicyclists.

A University of Montana Geography class conducted a survey in the fall of 2015 by intercepting neighborhood residents and users of S 5<sup>th</sup> Street W and S 6<sup>th</sup> Street W. It collected data on neighborhood residency, modes and respective frequency of transportation usage, reasons for using 5<sup>th</sup> and 6<sup>th</sup> Streets, safety concerns and opinions, ranking of usage along 5<sup>th</sup> and 6<sup>th</sup> Streets, and qualitative responses regarding what participants would change about 5<sup>th</sup> and 6<sup>th</sup> Streets. In total, 377 surveys were completed as part of this effort.

Separately, the City of Missoula hosted an online survey between 2013 and 2015 on behalf of the Riverfront Neighborhood. The survey presented the concept of dropping S 5<sup>th</sup> Street W and S 6<sup>th</sup> Street W to single lanes and asked participants if they are or are not in support of proposed changes including one travel lane, maintaining on-street parking lanes, and a wide buffered bike lane. In total, 364 individual responses were logged by 320 city residents, 63 within the Riverfront Neighborhood, and 54 outside the Missoula city limits.

## UMT Geography Survey Key Takeaways

For the fall 2015 area-wide survey respondents indicated that they felt least safe when on a bike along 5<sup>th</sup> and 6<sup>th</sup> Streets.

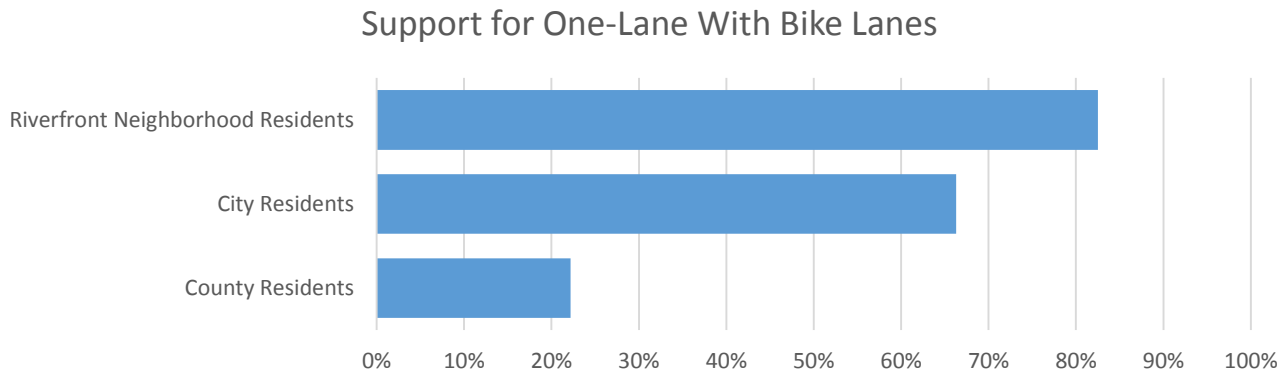


**Figure 10 – Respondent Perceptions of Safety**

Additionally, a majority of respondents indicated that they sometimes avoid 5<sup>th</sup> and 6<sup>th</sup> Streets due to congestion and perceiving it to be unsafe for bikes/pedestrians. A majority of respondents have experienced speeding cars along 5<sup>th</sup> and 6<sup>th</sup> Streets, a majority believe cars to be the most efficient form of travel along 5<sup>th</sup> and 6<sup>th</sup> Streets, and regarding infrastructure quality, bikes lanes were ranked the lowest with sidewalk being the highest. When asked what changes they would like to see to 5<sup>th</sup> and 6<sup>th</sup> Streets, the most common responses were to add or widen bike lanes, improve maintenance on the streets, and provide more and better street lighting.

## Neighborhood Survey Key Takeaways

The Riverfront Neighborhood survey asked responding Missoulians if they would support a one-lane cross-section with buffered bike lanes. Over 80 percent of neighborhood residents who responded supported this proposal and over 68 percent of general city residents were also in support. County residents who responded were less supportive. As the survey was voluntary and online, it is not statistically valid.



**Figure 11 – Respondent Support for Option 1**

Survey respondents were asked to provide comments about the buffered bike lane reconfiguration option, which is similar to Option 1B in description. Eighty-seven open-ended text-based comments were provided in support, eighty-four in opposition and a further nine comments that had elements of support or opposition, but there was no clear majority. These comments were frequently passionate, and they have resulted in nearly 25 pages of fine print text. Generally, comment support appears to be largely from people who ride bicycles frequently, opposition largely from people who often drive; many respondents were concerned about peak traffic associated with campus games and events. Some respondents noted other existing east-west trails and routes that bikers can use instead of 5<sup>th</sup> and 6<sup>th</sup> Streets. Many respondents noted the role of 5<sup>th</sup> and 6<sup>th</sup> Streets in regards to the street's value to serving commuter traffic.

#### 1.4 Summary of Existing Conditions

Quantitative data analysis shows that 5<sup>th</sup> Street is carrying more vehicles per day than 6<sup>th</sup> Street and is experiencing a slight speeding problem. Both streets have substantial excess capacity when the overall daily traffic is considered with volume to capacity ratios of 0.2 to 0.4. Despite the good volume to capacity ratios, volumes are concentrated around the peak periods with approximately 25 percent of the day's traffic occurring in the busiest hour. Exacerbating this is that current traffic control at Russell, Orange, and Higgins favors north-south traffic with the majority of green time. This results in delay and queuing along 5<sup>th</sup> and 6<sup>th</sup> before the signals release large platoons of traffic.

These conditions are supported by the qualitative analysis, which includes public observations and perceptions.

- Lower speeds were the third highest supporting theme from neighborhood survey; speeding cars were the greatest concern to the UMT survey respondents.
- Many survey respondents believe the existing east-west trails and roadways provide safe and adequate access to bicyclists without interrupting existing traffic flows and that new bikes lanes are not necessary.
- Congestion and traffic were major complaints/issues from surveys, especially during university events; this was the third largest concern from the UMT survey and the largest complaint against lane reduction from the neighborhood survey. Based on the existing traffic analysis, this concern appears to be more of a result of the high percentage of daily traffic occurring during the peak hour and the existing intersection timing at Russell, Orange, and Higgins favoring north-south flows rather than an intrinsic property of the roadway capacity.

Crash data shows a minority of crashes happening mid-block that could be due to speeding or overtaking vehicles. Changing the configuration of the streets may result in a small decline in crashes mid-block, however these crashes amounted to 19% of all crashes. It is unclear if, or to what extent, any reconfiguration option would impact intersection crashes. It is likely that Option 1A would reduce intersection crashes as only one through lane would remain.

## 2 Reconfiguration Options

### 2.1 Introduction

Two potential reconfigurations with five total intersection configuration options each have been proposed for reconfiguring S 5<sup>th</sup> Street W and S 6<sup>th</sup> Street W with the objective of making the streets safer and more functional roadways. There is also a “do nothing” option represented by the existing conditions in the analysis. Reconfiguration options include:

1. **Option 1A** – Reconfiguration of S 5<sup>th</sup> Street W and S 6<sup>th</sup> Street W to single-lane operation with large buffered bicycle lanes on the right side of the street.
2. **Option 1B** – Reconfiguration of S 5<sup>th</sup> Street W and S 6<sup>th</sup> Street W to single-lane operation with large buffered bicycle lanes on the left side of the street with auxiliary left-turn lanes at each of the signalized intersections in the form of shared bike/turn lanes.
3. **Option 1C** – Reconfiguration of S 5<sup>th</sup> Street W and S 6<sup>th</sup> Street W to single-lane operation with auxiliary left and right-turn lanes at each of the signalized intersections. Buffered bike lanes would be configured as either a through bike lane on S 5<sup>th</sup> Street W or a shared bike/turn lane on S 6<sup>th</sup> Street W.

4. **Option 2A** – Reconfiguration of S 5<sup>th</sup> Street W and S 6<sup>th</sup> Street W to two-way traffic flows with a dedicated left-turn lane at each signalized intersection.
5. **Option 2B** – Reconfiguration of S 5<sup>th</sup> Street W and S 6<sup>th</sup> Street W to two-way traffic flows with a single approach lane.

Synchro version 8, a software program that implements concepts from the Highway Capacity Manual (HCM) for signalized and un-signalized intersections, was utilized to analyze and provide Level of Service (LOS) and average delay for each movement, approach, and intersection. Analysis results were based on the HCM 2000 method. Signal timings and Synchro files were provided by the Montana Department of Transportation for use in the analysis. Traffic volumes from a February 2016 data collection effort using the Miovision service were utilized for peak hour turning movement counts.

### **Option 1 – Buffered Bike Lane**

In this option, 5<sup>th</sup> and 6<sup>th</sup> Streets would be reconfigured to one vehicle travel lane, a buffered bike lane, and their existing parking lane configuration (parking on each side along 5<sup>th</sup> Street and one on the north side along 6<sup>th</sup> Street).

Three versions of this approach were looked at in this analysis: 1A involves a single travel lane and buffered bike lane throughout the corridor, with the bike lane remaining intact up to and through the intersections. This lane would be configured on the right side of the street as right turning movements are generally far fewer than left turns. Option 1B locates the buffered bike lane on the left side of the street and utilizes the buffered bike lane as a shared bike lane/ left-turn lane to provide additional capacity for heavy left turn volumes. This configuration is presented as a shared bike lane/turn lane in the NACTO *Urban Bikeway Design Guide*. Option 1C locates the buffered bike lane on the right side of the street and removes some parking on the approaches to the signalized intersections in order to fit a right turn lane on 5<sup>th</sup> and a left turn lane on 6<sup>th</sup>.

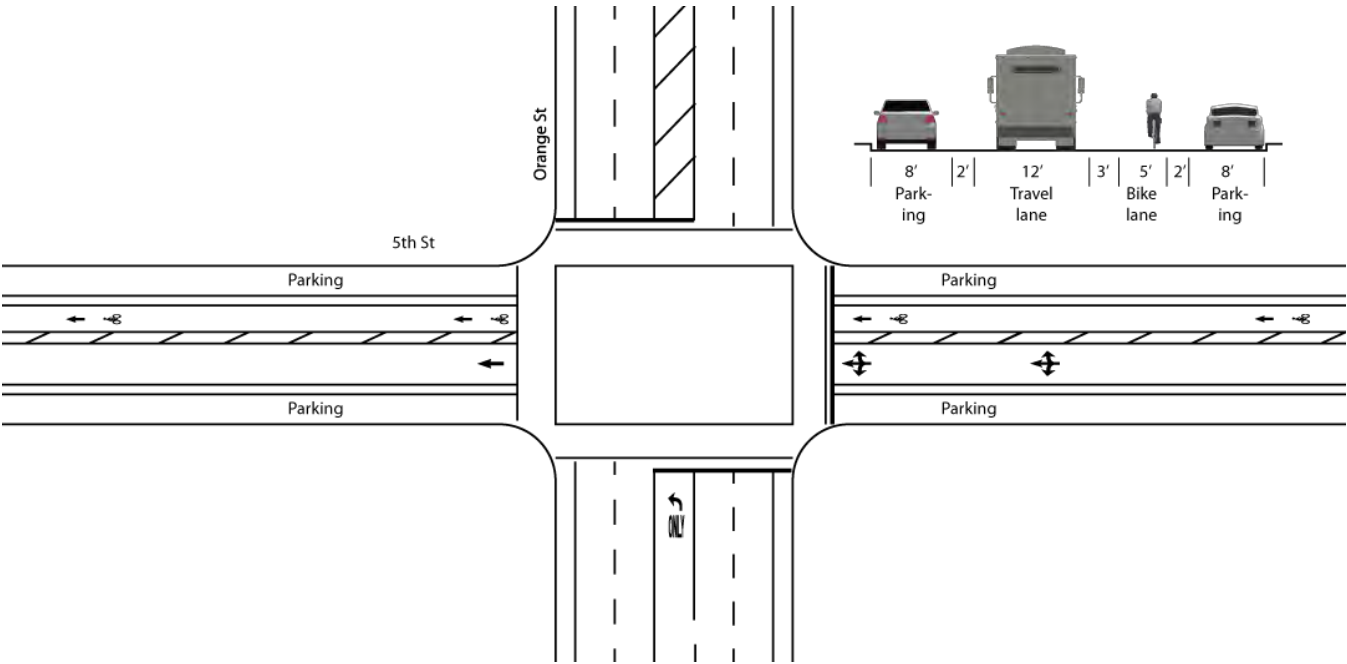


Figure 12 – Option 1A Schematic

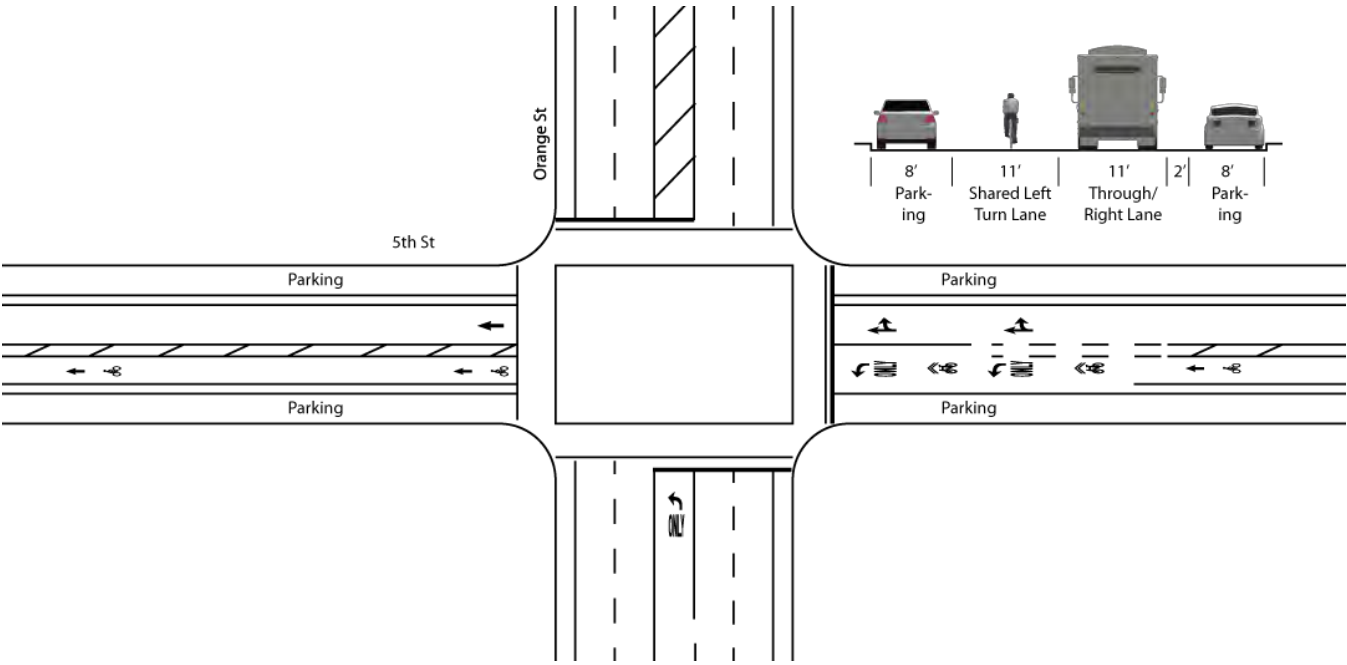
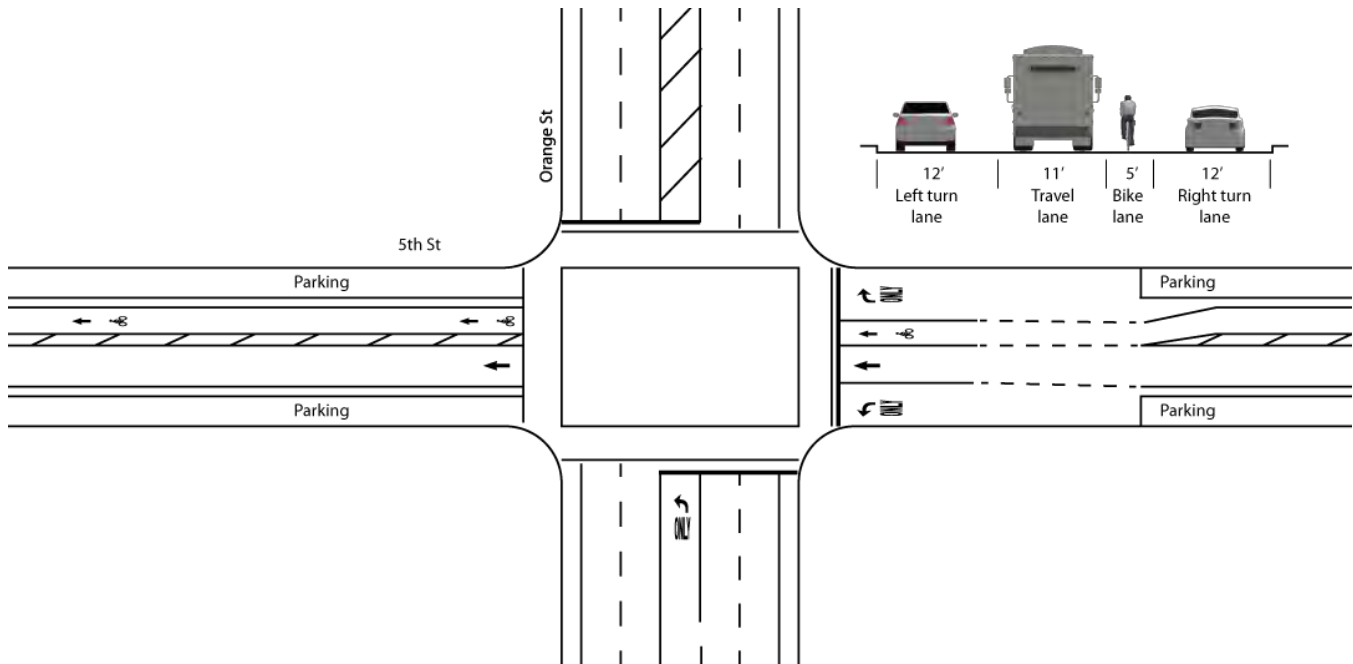


Figure 13 – Option 1B Schematic



**Figure 14 – Option 1C Schematic**

Signals will need to be modified if option 1A were to be selected by removing a series of traffic signal heads positioned over the removed travel lane. Option 1B essentially maintains existing lane configurations at intersections, no signal adjustments will need to be made. Option 1C would potentially require the addition of one signal head at each signalized intersection.

### **Option 2 – Two-Way Conversion**

In this option, 5<sup>th</sup> and 6<sup>th</sup> Streets will be converted from a one-way couplet into a pair of two-way streets (between Russell Street and Higgins Avenue). Option 2A involves providing a left-turn lane at each signalized intersection, which will require some parking removal approximately half a block on both sides of S 5<sup>th</sup> St W and the north side of S 6<sup>th</sup> St W. Option 2B maintains a single travel lane in each direction with no left-turn lane. Bicycle lanes are not feasible in both directions with either option unless parking is removed on at least one side of the road on S 5<sup>th</sup> Street W and completely from S 6<sup>th</sup> Street W.

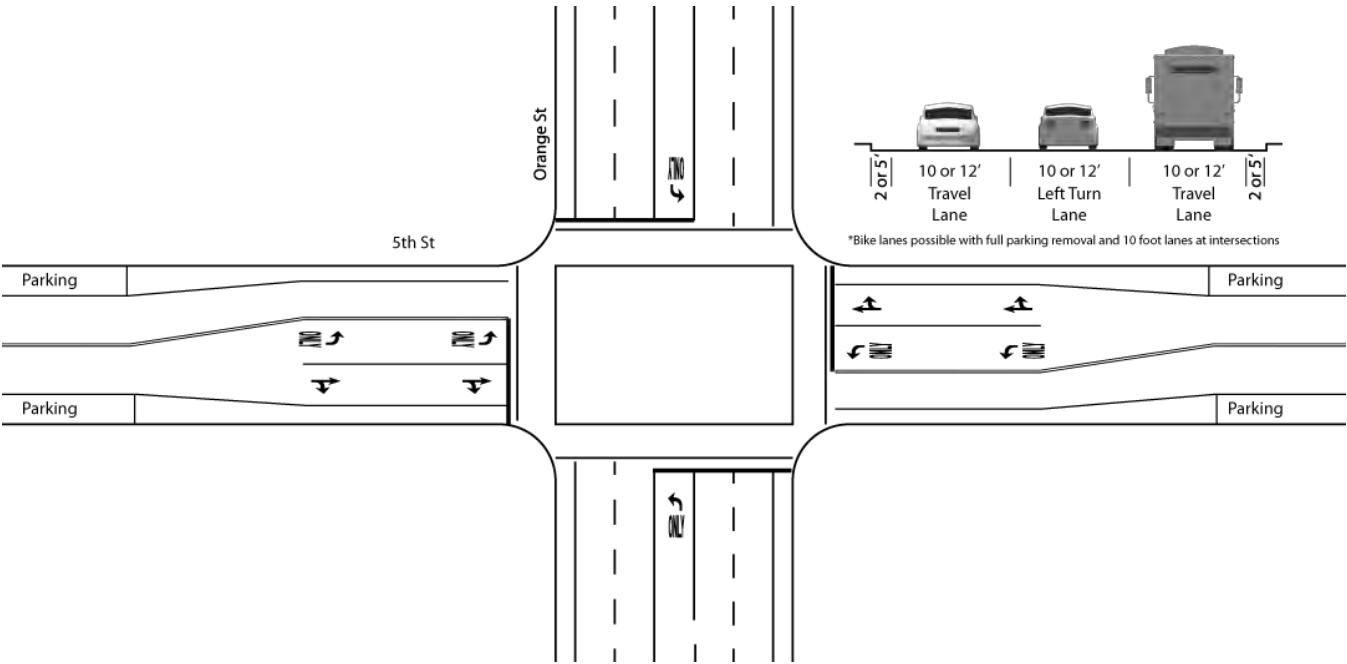


Figure 15 – Option 2A Schematic

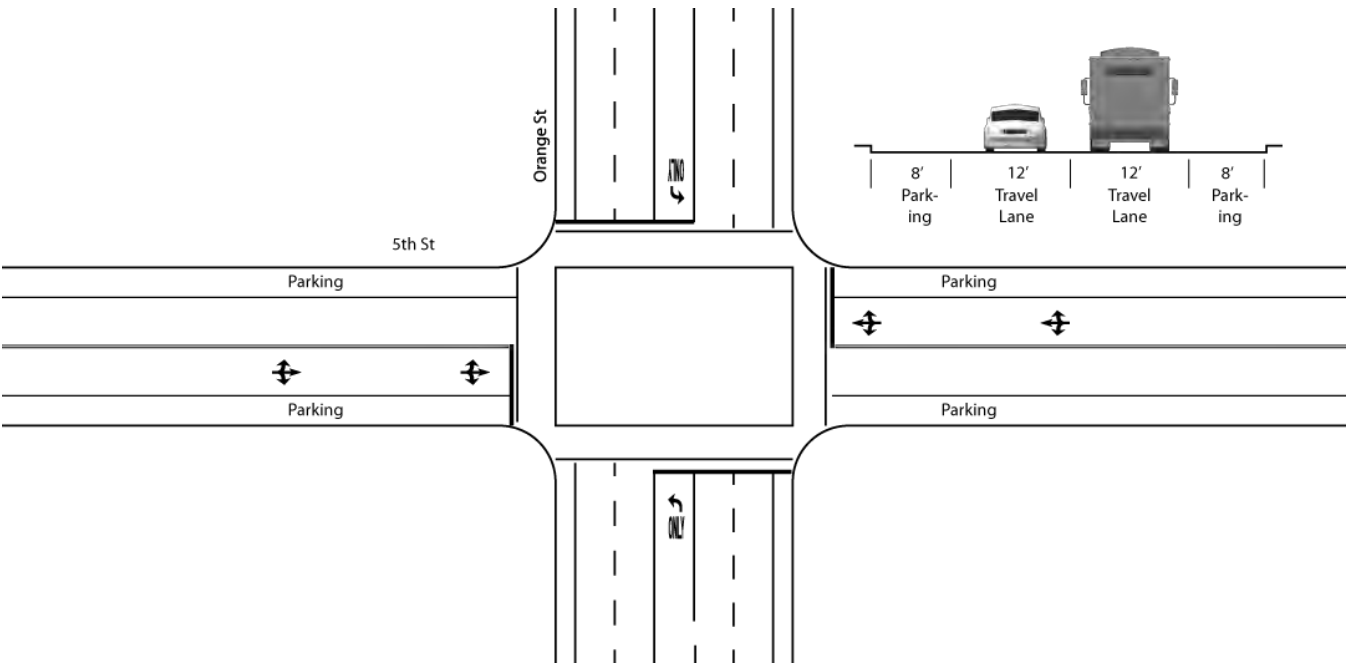


Figure 16 – Option 2B Schematic

## 2.2 Considerations

### Bicycle Network

Option 1 provides a wide dedicated buffered bike lane on 5<sup>th</sup> and 6<sup>th</sup> Streets, which will improve comfort and the value of the streets as commuter connections for people bicycling. Current bicycle counts west of Higgins were not substantial. Counts taken in February 2016 from the Miovision service show 1.5 percent of vehicles using 5<sup>th</sup> Street (with a bike lane) are bikes. Very few bicycles were counted using 6<sup>th</sup> Street (no bike lane). February is typically a lower month for bicycle use; counters elsewhere in Missoula showed that February has approximately one third the activity as the warmer months. This is locally confirmed at Orange and 5<sup>th</sup> Streets as manual counts taken in May 2015 at Orange and 5<sup>th</sup> show approximately thirty-five bikes an hour during the peak hour—February counts were thirteen, or a third of the May count. These manual counts were taken using a nationally accepted methodology.

The addition of the buffered bike lanes would certainly increase bicycle counts along these corridors. 3<sup>rd</sup> Street also has bicycle lanes for some of its length, and there are proposals to turn 4<sup>th</sup> Street into a Neighborhood Greenway. Pursuing Option 2, which would remove bike lanes entirely from 5<sup>th</sup> and 6<sup>th</sup> Streets, should be accompanied by implementing the 4<sup>th</sup> Street Neighborhood Greenway to provide an alternate facility. This option may potentially require new signals or other substantial crossing enhancements at the same three signalized intersections.

### Transit Implications

During peak periods, 5<sup>th</sup> and 6<sup>th</sup> Streets have 15-minute bus frequency. It is possible that converting these streets to one lane or to two-way operations will impact transit progression and increase travel times. This increase would not be uniform on 5<sup>th</sup> or 6<sup>th</sup> streets and would depend on which option, if any, is implemented. Table 8 shows how delay for through travelling vehicles increases or decreases by option and by intersection.

### Signal Modifications

Each of the build options with the exception of Option 1B will require some degree of signal modifications. This mainly is present with the conversion of 5<sup>th</sup> and 6<sup>th</sup> Streets to two-way operations. Additional signal masts, conduit and head modifications will be required to control the new direction of

travel. Additionally, with two-way operations, a new signal would potentially be required at Russell and 6<sup>th</sup> Streets where no signal currently exists if volumes increase substantially.

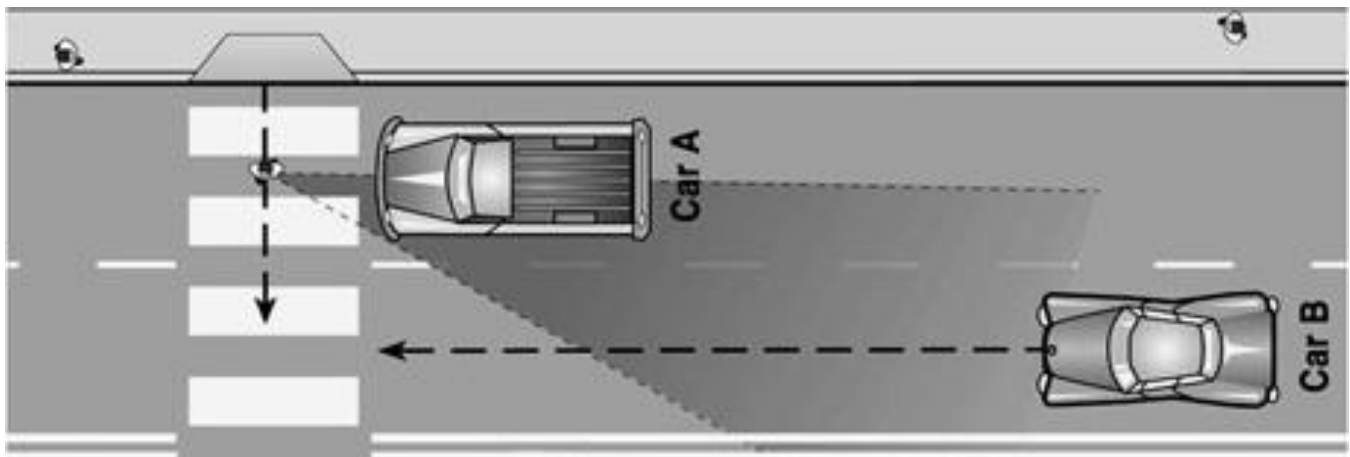
Both of the Option 2 scenarios require new signals to be installed. These modifications trigger the requirements of accessible pedestrian features. Currently only 3 of the 24 street corners are fully compliant. All four corners at 6<sup>th</sup> Street and Russell Street would need constructing. The remaining 17 street corners have older ramps, which may or may not meet cross-slope requirements. These remaining ramps also lack detectable warnings. A more thorough evaluation will be required to determine upgrade needs and extents.

### Parking

Option 1A will not impact on street parking at all. Option 1B may require a few parking spaces be removed at the approaches to the signalized intersections. Option 1C will require some parking removal at the approaches to the signalized intersections. Option 2A will require some amount of parking removal to facilitate the provision of left-turn lanes. Both versions of Option 2 would require complete parking removal to add bike lanes.

### Pedestrian Double Threat

The existing conditions feature two lanes of one-way travel. This results in what is known as a “double threat” for pedestrians crossing the street. One lane of traffic may yield, which could block view of a crossing pedestrian to the second lane. This uncertainty and lack of visibility make these pedestrian crossings uncomfortable and unsafe. All four of the potential reconfiguration options would eliminate this circumstance at unsignalized pedestrian crossing locations.



**Figure 16 – Schematic Illustrating Pedestrian Double Threat****Speeding**

The existing conditions feature two lanes of through traffic where it is the fastest vehicle that establishes the highest speed. Vehicles may change lanes to pass slower moving vehicles as well. With a single lane of through traffic, which is a feature of all four alternatives, it is the slowest vehicle that establishes the prevailing speed. It stands to reason that any of the four alternatives will reduce average speeds along both 5<sup>th</sup> and 6<sup>th</sup> Streets.

**Projected Safety Impacts**

A number of factors could impact safety including signal timing and phasing of the intersections with principal arterials, lane configuration along 5<sup>th</sup> and 6<sup>th</sup> Streets and presence of side friction (such as parking or tree canopy). It is unknown how any of the configuration options may impact overall crash frequency or severity. A two-way street increases the potential for head-on collisions. One of the most important factors may be lowering speeds so that there is more margin for error in avoiding collisions and those that do occur will tend to be less severe.

**Traffic Analysis Results**

Table 8 shows the LOS results of each of the alternative reconfigurations. The light grey highlights cross-street, north-south traffic movements. Yellow highlights movements that have degraded in LOS, but are still “passing”—at LOS D or greater. Red highlights movements that have degraded (or maintained) to a failing LOS—LOS E or F. Green highlights movements that have improved in LOS. Values that are not highlighted show movements that have maintained the same LOS (although delay times may differ).

It should be noted that under existing conditions and volumes, the intersection of Russell and 5<sup>th</sup> Streets has many failing east-west movements, even though the intersection overall is passing with LOS B or C in the morning and evening peak hours, respectively. The eastbound movement fails at Russell and 6<sup>th</sup> Streets, due to the intersection currently being stop controlled in the east- and westbound directions.

With both configuration options—a lane reduction maintaining one-way traffic flow or a two-way conversion—the overall LOS of the intersections still pass (are at LOS D or better). Regarding individual

traffic movements, Option 1—a lane reduction, with or without a dedicated LT lane—causes more movements to be at a lower LOS. Option 2—a two-way conversion, with or without a dedicated LT lane—causes many movements to improve but others to degrade in LOS.

Turning movement counts and ADT volumes were provided from Miovision.

In this analysis, the signals were optimized to balance current LOS A conditions in the north-south direction with poorer performing east west movements along 5<sup>th</sup> and 6<sup>th</sup>. The optimization feature in Synchro determines the most efficient changes to minimize overall delay. In this case signal optimization reduces the overall cycle length from 100 seconds to 90 seconds and provides a small 3 second increase to east-west operations. This optimization keeps the signals in coordination with the other signals on their respective systems. The signalized intersections were also analyzed without optimization, however this resulted in much degraded performance for 5<sup>th</sup> and 6<sup>th</sup> Streets. The appendix contains model output for optimized and unoptimized scenarios.

Queue lengths were also calculated as part of the synchro analysis. The block length along 5<sup>th</sup> and 6<sup>th</sup> Streets is 350 feet. 95<sup>th</sup> percentile queue lengths for options 1C and 2A are shown in Table 7. This data represents the most efficient of the one and two-way scenarios. Queues increase in length with fewer dedicated turn lanes as is a feature of the other options. These lengths can be found in the reports in the Appendix. As Table 7 indicates, none of the approaches will experience any queues significant enough to back up past a block length. The longest 95<sup>th</sup> percentile queue is 266 feet at Higgins and 5<sup>th</sup> Streets. This intersection occurs outside of the resurfacing extents and has been assumed to become a westbound left and a through/right combination lane. Should this be converted to be similar to the rest of the proposed corridor as shown in Option 1C, these queues would reduce in length.

Table 7 – 95<sup>th</sup> Percentile Queue Lengths

| Int.<br>/# | Lane<br>Group                            | Existing Conditions   |     | Option 1C: Lane Reduction<br>w/ L, T, R Lanes at<br>Intersections |     | Option 2A: Two-Way<br>Conversion w/ Signal at<br>Russell & 6th w/ LT Lane |     |
|------------|------------------------------------------|-----------------------|-----|-------------------------------------------------------------------|-----|---------------------------------------------------------------------------|-----|
|            |                                          | Max Queue Length (ft) |     | Max Queue Length (ft)                                             |     | Max Queue Length (ft)                                                     |     |
|            |                                          | AM                    | LOS | LOS                                                               | LOS | LOS                                                                       | LOS |
| <b>1</b>   | Russell St & 5th St                      |                       |     |                                                                   |     |                                                                           |     |
|            | EB                                       | 38                    | 43  | 34                                                                | 36  | 42                                                                        | 45  |
|            | WBL                                      | 109                   | 196 | 100                                                               | 167 | 43                                                                        | 64  |
|            | WBT                                      | 83                    | 320 | 52                                                                | 137 | 36                                                                        | 69  |
|            | WBR                                      | --                    | --  | 36                                                                | 59  | --                                                                        | --  |
| <b>3</b>   | Orange St/Old US 93 & 5 <sup>th</sup> St |                       |     |                                                                   |     |                                                                           |     |
|            | EBL                                      | --                    | --  | --                                                                | --  | 38                                                                        | 35  |
|            | EB                                       | --                    | --  | --                                                                | --  | 136                                                                       | 66  |
|            | WBL                                      | --                    | --  | 46                                                                | 42  | 30                                                                        | 22  |
|            | WB                                       | 101                   | 184 | 112                                                               | 224 | 77                                                                        | 143 |
|            | WBR                                      | --                    | --  | 26                                                                | 46  | --                                                                        | --  |
| <b>4</b>   | Orange St/Old US 93 & 6 <sup>th</sup> St |                       |     |                                                                   |     |                                                                           |     |
|            | EBL                                      | --                    | --  | 57                                                                | 58  | 42                                                                        | 38  |
|            | EB                                       | 171                   | 107 | 239                                                               | 114 | 147                                                                       | 71  |
|            | EBR                                      | --                    | --  | 7                                                                 | 15  | --                                                                        | --  |
|            | WBL                                      | --                    | --  | --                                                                | --  | 30                                                                        | 28  |
|            | WB                                       | --                    | --  | --                                                                | --  | 82                                                                        | 119 |
| <b>5</b>   | Higgins Ave & 5 <sup>th</sup> St         |                       |     |                                                                   |     |                                                                           |     |
|            | EBL                                      | --                    | --  | --                                                                | --  | 143                                                                       | 14  |
|            | EB                                       | --                    | --  | --                                                                | --  | --                                                                        | --  |
|            | EBR                                      | --                    | --  | --                                                                | --  | 8                                                                         | 6   |
|            | WBL                                      | --                    | --  | 21                                                                | 221 | --                                                                        | --  |
|            | WB                                       | 131                   | 221 | 232                                                               | 266 | 90                                                                        | 207 |
| <b>6</b>   | Higgins Ave & 6 <sup>th</sup> St         |                       |     |                                                                   |     |                                                                           |     |
|            | EBL                                      | --                    | --  | 147                                                               | 39  | 52                                                                        | 14  |
|            | EB                                       | 193                   | 105 | 75                                                                | 177 | 58                                                                        | 88  |
|            | EBR                                      | --                    | --  | 11                                                                | 26  | --                                                                        | --  |

## Option 1

Reducing 5<sup>th</sup> and 6<sup>th</sup> Streets to a single lane generally results in the same volume of through traffic to move through half of the existing travel space. Unsurprisingly, this constriction causes a degradation in LOS. During morning or evening peaks where nearly 25 percent of the total daily traffic on each street is operating, delay is increased. The conversion would have little impact outside of this peak period. Providing auxiliary turn lanes at the intersections can mitigate the constriction in through traffic and improve delay. Also impacting delay during peak periods is the north-south coordination and significant prioritization at Higgins, Orange, and Russell.

Without a dedicated turn lanes at the three signalized intersections in option 1A, the negative impact is much greater with more individual traffic movements being affected. Looking at the intersections overall, Russell and 5<sup>th</sup>, Russell and 6<sup>th</sup>, and Orange and 5<sup>th</sup> all maintain both morning and evening peak hour Levels of Service, but experience increased delays for individual movements. During the morning peak hour at Russell and 5<sup>th</sup>, eastbound traffic improves to LOS D, but westbound traffic drops from LOS D to E, a failing rating. During the evening peak, eastbound improves (to LOS C), westbound maintains a failing LOS E, and northbound and southbound both drop one LOS, from B to C and A to B, respectively. The intersection still operates at overall passing Levels of Service of B and C during the morning and evening peak hours. The only change at Russell and 6<sup>th</sup>, which is stop controlled, is that the eastbound delay—already at a failing LOS F—greatly increases. During both peak hours, however, Russell and 6<sup>th</sup> still operates at LOS A for an unsignalized intersection. At Orange and 5<sup>th</sup>, negative individual traffic movement impacts are experienced during the evening peak hour: westbound traffic improves slightly to LOS C, while northbound left and southbound through traffic decrease to LOS B.

The remaining intersections—Orange and 6<sup>th</sup> and Higgins at 5<sup>th</sup> and 6<sup>th</sup>—experience greater LOS degradations. At Orange and 6<sup>th</sup>, the morning peak LOS drops from B to C, due to eastbound and southbound left traffic failing at LOS F. The evening peak maintains its LOS A, with improved eastbound movement and only a slight decrease in northbound traffic to LOS B. Both intersections at Higgins decline during both peak hours. At 5<sup>th</sup>, all individual traffic movements drop (with the exception of morning northbound), and evening westbound fails at LOS F. These changes cause Higgins and 5<sup>th</sup> to drop to LOS C and D for morning and evening peak hours, respectively. Higgins and 6<sup>th</sup> drops to LOS C

and B, again due to declines in all movements, especially morning eastbound failing at LOS E. These results show that Option 1A, a lane drop without a left-turn lane, causes the greatest negative impact to the existing transportation network.

Option 1B adds a dedicated left-turn lane at signalized intersections and, only causes two intersections to have an overall decline: Orange and 6<sup>th</sup> in the morning peak hour, which drops from LOS B to C due to southbound left traffic dropping to LOS F; and Higgins and 6<sup>th</sup> in the evening peak hour, dropping to LOS B due to eastbound traffic lowering to LOS D. All other intersections maintain their overall Levels of Service. There are minor degradations of only one level within these remaining intersections.

Option 1C adds an additional right turn lane at the signalized intersections and generally provides a significant improvement to traffic operations over options 1A and 1B. Only two individual movements experience any failure, the eastbound approach at Russell and 6<sup>th</sup> in the PM peak, which is already failing and the southbound left at Orange and 6<sup>th</sup> in the AM peak. Overall signal performance is also better with Russell and 5<sup>th</sup> actually improving over existing. Orange and 6<sup>th</sup> drops slightly from B to C in the AM peak, and Higgins and 6<sup>th</sup> drops from an A to a B.

The left turn movement is significant as turning movement counts have shown in Figure 5. If a single lane option is desired, allowing for dedicated left and right-turn lanes as in option 1C creates the least impact.

## **Option 2**

For the two-way conversion, the changes to traffic circulation will likely be substantial. To better understand the impacts of this change to the way the streets operate, the Missoula MPO provided anticipated ADT counts from TransCAD software, which looks at traffic circulation at a network level. The change in daily volumes projected for 5<sup>th</sup> and 6<sup>th</sup> were normalized to the hourly counts that were being used in Synchro 8. Accounting for the relative increase or decrease from volumes previously provided from Miovision, east- and westbound volumes were split between 5<sup>th</sup> and 6<sup>th</sup> Streets. North- and southbound turning movements were also split between the two streets to balance out the volume on each street. This 50/50 split is an assumption; differing travel behavior would have an impact on the LOS results. Signal timings were optimized, with a permitted left turn for Option 2A (dedicated left-turn lane). Phasing scenarios including split, protected, and permitted phases were run,

with the permitted option having the least impact to the overall network. It should be noted that although the permitted left-turn strategy results in the lowest overall delay, it may exhibit more crashes than a protected left-turn strategy. This tradeoff should be evaluated in greater detail before implementation.

According to the analysis, a two-way conversion without a left-turn lane (option 2B) causes three of the six intersections drop in LOS: Russell and 5<sup>th</sup> (B to C) in the morning peak hour, Russell and 6<sup>th</sup> (A to B with a new signal) in the evening peak hour, and Higgins and 5<sup>th</sup> (B to C) in the morning peak hour. All of the intersections have an overall LOS of C or better under this reconfiguration. Many of the movements maintain or improve their existing LOS. With the addition of a left-turn lane in option 2A, the two-way conversion only causes one intersection to drop in overall LOS: Russell and 6<sup>th</sup> (A to B) in the evening peak hour. This option actually improves overall LOS at Russell and 5<sup>th</sup> in the evening peak hour, Orange and 5<sup>th</sup> in the evening peak hour, Higgins and 6<sup>th</sup> in the morning peak hour.

Signal phasing was examined as permissive, protected, and split-phase operations. With permissive phasing, most individual movements maintain their existing LOS or drop slightly but still maintain a passing LOS of D or better. The only exceptions are at Russell and 6<sup>th</sup>, with failing westbound movements; however, this intersection is currently not signalized so changes in LOS are not easily compared for individual movements. It is unclear if the intersection would warrant the installation of a signal. Higgins and 5<sup>th</sup> also experiences some failing movements, with the introduction of eastbound traffic, but the overall LOS is still B for both peak hours.

From purely a traffic operations perspective, option 2A functions the most efficiently, with less failing individual movements and less drops in general. The two-way option also allows the east-west volume to balance out between the two streets during peak (and all) hours.

### Table 8 – Traffic Analysis Results

| Lane<br>Group                  | Existing Conditions |       |     |       |     |       | Option 1A: Lane Reduction w/ Single Lane - Optimized |       |     |       |     |       | Option 1B: Lane Reduction w/L, T/R Lanes - Optimized |       |     |       |     |       | Option 2A: Two-Way Conversion w/ Signal at Russell & 6th w/ LT Lane-Optimized |       |     |       |     |       | Option 2B: Two-Way Conversion w/ Signal at Russell & 6th - No Turn Lane |       |     |       |  |  |    |      |    |      |  |
|--------------------------------|---------------------|-------|-----|-------|-----|-------|------------------------------------------------------|-------|-----|-------|-----|-------|------------------------------------------------------|-------|-----|-------|-----|-------|-------------------------------------------------------------------------------|-------|-----|-------|-----|-------|-------------------------------------------------------------------------|-------|-----|-------|--|--|----|------|----|------|--|
|                                | AM                  |       |     | PM    |     |       | AM                                                   |       |     | PM    |     |       | AM                                                   |       |     | PM    |     |       | AM                                                                            |       |     | PM    |     |       | AM                                                                      |       |     | PM    |  |  |    |      |    |      |  |
|                                | LOS                 | Delay | LOS | Delay | LOS | Delay | LOS                                                  | Delay | LOS | Delay | LOS | Delay | LOS                                                  | Delay | LOS | Delay | LOS | Delay | LOS                                                                           | Delay | LOS | Delay | LOS | Delay | LOS                                                                     | Delay | LOS | Delay |  |  |    |      |    |      |  |
| 1 Russell St & 5th St          |                     |       |     |       |     |       |                                                      |       |     |       |     |       |                                                      |       |     |       |     |       |                                                                               |       |     |       |     |       |                                                                         |       |     |       |  |  |    |      |    |      |  |
| Overall                        | B                   | 14.3  | C   | 23.8  |     |       | B                                                    | 16.7  | C   | 31    |     |       | B                                                    | 13.2  | C   | 20.8  |     |       | B                                                                             | 13.1  | B   | 17.3  |     |       | B                                                                       | 18.9  | B   | 13    |  |  | C  | 28.5 | B  | 15.3 |  |
| EB                             | E                   | 58.4  | E   | 73.6  |     |       | D                                                    | 37    | C   | 30.8  |     |       | D                                                    | 43.9  | D   | 40.1  |     |       | D                                                                             | 43.5  | D   | 43.6  |     |       | D                                                                       | 54.7  | D   | 53.2  |  |  | C  | 34   | D  | 47.7 |  |
| WBL                            | E                   | 55.5  | E   | 57.5  |     |       | --                                                   | --    | --  | --    |     |       | D                                                    | 49.5  | D   | 45    |     |       | D                                                                             | 49.5  | D   | 54.5  |     |       | E                                                                       | 58.9  | E   | 57.3  |  |  | E  |      |    |      |  |
| WBT                            | E                   | 51.4  | E   | 76.8  |     |       | E                                                    | 57.9  | E   | 73.5  |     |       | D                                                    | 45.8  | E   | 55.5  |     |       | D                                                                             | 44.6  | D   | 48.3  |     |       | D                                                                       | 54.1  | D   | 55.3  |  |  | D  | 36.8 | E  | 56.7 |  |
| WBR                            | --                  | --    | --  | --    |     |       | --                                                   | --    | --  | --    |     |       | --                                                   | --    | --  | --    |     |       | --                                                                            | 44.3  | D   | 44.2  |     |       | --                                                                      | --    | --  | --    |  |  | -- | --   |    |      |  |
| NBL                            | A                   | 2.3   | A   | 6     |     |       | A                                                    | 4.3   | A   | 9.2   |     |       | A                                                    | 2.4   | A   | 4.8   |     |       | A                                                                             | 2.4   | A   | 3.5   |     |       | A                                                                       | 1.2   | A   | 1.2   |  |  | A  | 1.7  | A  | 1.8  |  |
| NBLT                           | A                   | 4.6   | B   | 12.5  |     |       | A                                                    | 9.4   | C   | 24.1  |     |       | A                                                    | 5.6   | B   | 12.8  |     |       | A                                                                             | 5.6   | A   | 9.6   |     |       | A                                                                       | 3.6   | A   | 3.4   |  |  | A  | 3.6  | A  | 4.2  |  |
| SBL                            | A                   | 5.5   | A   | 8.5   |     |       | A                                                    | 8.5   | B   | 17.9  |     |       | A                                                    | 5.7   | A   | 9.1   |     |       | A                                                                             | 6.1   | A   | 7.5   |     |       | C                                                                       | 25.1  | B   | 14.7  |  |  | D  | 45.1 | B  | 18.8 |  |
| SBR                            | A                   | 1.2   | A   | 0.7   |     |       | A                                                    | 1.3   | A   | 2.2   |     |       | A                                                    | 1.1   | A   | 1     |     |       | A                                                                             | 0.9   | A   | 0.8   |     |       | A                                                                       | 0     | A   | 0.4   |  |  | A  | 1.7  | A  | 0.7  |  |
| 2 Russell St & 6th St          |                     |       |     |       |     |       |                                                      |       |     |       |     |       |                                                      |       |     |       |     |       |                                                                               |       |     |       |     |       |                                                                         |       |     |       |  |  |    |      |    |      |  |
| Overall                        | A                   | 1.9   | A   | 2.7   |     |       | A                                                    | 1.9   | A   | 5     |     |       | A                                                    | 1.9   | A   | 3.5   |     |       | A                                                                             | 1.9   | A   | 2.9   |     |       | A                                                                       | 7.1   | A   | 11.2  |  |  | A  | 5.6  | B  | 15.8 |  |
| EB App.                        | C                   | 23.1  | F   | 106.7 |     |       | C                                                    | 24.6  | F   | 441.1 |     |       | C                                                    | 22.8  | F   | 207.6 |     |       | C                                                                             | 22.8  | F   | 218.6 |     |       | D                                                                       | 46.5  | D   | 48.4  |  |  | C  | 31.4 | D  | 41.3 |  |
| WBL                            | --                  | --    | --  | --    |     |       | --                                                   | --    | --  | --    |     |       | --                                                   | --    | --  | --    |     |       | --                                                                            | --    | --  | --    |     |       | E                                                                       | 53.1  | E   | 60.3  |  |  | -- | --   | -- | --   |  |
| WB App.                        | --                  | --    | --  | --    |     |       | --                                                   | --    | --  | --    |     |       | --                                                   | --    | --  | --    |     |       | --                                                                            | --    | --  | --    |     |       | D                                                                       | 48.1  | E   | 61.6  |  |  | D  | 37.6 | E  | 75.5 |  |
| NBL                            | --                  | --    | --  | --    |     |       | --                                                   | --    | --  | --    |     |       | --                                                   | --    | --  | --    |     |       | --                                                                            | --    | --  | --    |     |       | A                                                                       | 1.3   | A   | 1.9   |  |  | A  | 1.9  | A  | 3.7  |  |
| NBLTR                          | --                  | --    | --  | --    |     |       | --                                                   | --    | --  | --    |     |       | --                                                   | --    | --  | --    |     |       | --                                                                            | --    | --  | --    |     |       | A                                                                       | 3.7   | A   | 5.6   |  |  | A  | 5    | A  | 9.7  |  |
| SBL                            | --                  | --    | --  | --    |     |       | --                                                   | --    | --  | --    |     |       | --                                                   | --    | --  | --    |     |       | --                                                                            | --    | --  | --    |     |       | A                                                                       | 3     | A   | 1.6   |  |  | A  | 1.1  | A  | 2.6  |  |
| SB App.                        | A                   | 3.1   | A   | 1.4   |     |       | A                                                    | 3.1   | A   | 1.4   |     |       | A                                                    | 3.1   | A   | 1.4   |     |       | A                                                                             | 3.1   | A   | 1.4   |     |       | A                                                                       | 3.6   | A   | 5.2   |  |  | A  | 1.2  | A  | 8.4  |  |
| 3 Orange St/Old US 93 & 6th St |                     |       |     |       |     |       |                                                      |       |     |       |     |       |                                                      |       |     |       |     |       |                                                                               |       |     |       |     |       |                                                                         |       |     |       |  |  |    |      |    |      |  |
| Overall                        | A                   | 7.9   | B   | 11.3  |     |       | A                                                    | 8.2   | B   | 18.3  |     |       | A                                                    | 7.4   | B   | 16.1  |     |       | A                                                                             | 6.8   | B   | 11.9  |     |       | A                                                                       | 8.6   | A   | 9.4   |  |  | A  | 9.7  | B  | 13.2 |  |
| EBL                            | --                  | --    | --  | --    |     |       | --                                                   | --    | --  | --    |     |       | --                                                   | --    | --  | --    |     |       | --                                                                            | --    | --  | --    |     |       | D                                                                       | 36.4  | C   | 27.7  |  |  | -- | --   | -- | --   |  |
| EB                             | --                  | --    | --  | --    |     |       | --                                                   | --    | --  | --    |     |       | --                                                   | --    | --  | --    |     |       | --                                                                            | --    | --  | --    |     |       | D                                                                       | 44.9  | C   | 27.8  |  |  | C  | 34.8 | D  | 38.4 |  |
| WBL                            | --                  | --    | --  | --    |     |       | --                                                   | --    | --  | --    |     |       | C                                                    | 30.3  | B   | 18.6  |     |       | C                                                                             | 33.8  | C   | 20.4  |     |       | D                                                                       | 36.8  | C   | 21.9  |  |  | -- | --   | -- | --   |  |
| WB                             | D                   | 49    | D   | 41.5  |     |       | D                                                    | 41.2  | C   | 34.4  |     |       | D                                                    | 41.2  | D   | 45.4  |     |       | D                                                                             | 39.6  | C   | 31.4  |     |       | D                                                                       | 37.8  | C   | 27    |  |  | C  | 27.9 | D  | 51.8 |  |
| WBR                            |                     |       |     |       |     |       |                                                      |       |     |       |     |       |                                                      |       |     |       |     |       |                                                                               |       |     |       |     |       |                                                                         |       |     |       |  |  |    |      |    |      |  |
| NBL                            | A                   | 0.9   | A   | 6.9   |     |       | A                                                    | 1.8   | B   | 19.5  |     |       | A                                                    | 1.4   | B   | 12    |     |       | A                                                                             | 1.5   | A   | 7.5   |     |       | A                                                                       | 1.2   | A   | 3.4   |  |  | A  | 1.1  | A  | 7.8  |  |
| NBLT                           | A                   | 1.3   | A   | 6.1   |     |       | A                                                    | 2.6   | A   | 8.4   |     |       | A                                                    | 2.2   | A   | 7     |     |       | A                                                                             | 2     | A   | 5.3   |     |       | A                                                                       | 1.8   | A   | 4.7   |  |  | A  | 2    | A  | 7.2  |  |
| SBL                            | --                  | --    | --  | --    |     |       | --                                                   | --    | --  | --    |     |       | --                                                   | --    | --  | --    |     |       | --                                                                            | --    | --  | --    |     |       | --                                                                      | --    | --  | --    |  |  | -- | --   | -- | --   |  |
| SB                             | A                   | 2.8   | A   | 3.5   |     |       | A                                                    | 4.5   | B   | 18.3  |     |       | A                                                    | 3.4   | B   | 12.5  |     |       | A                                                                             | 3.2   | A   | 9.9   |     |       | A                                                                       | 4.6   | A   | 7.6   |  |  | A  | 10   | A  | 7.8  |  |
| 4 Orange St/Old US 93 & 6th St |                     |       |     |       |     |       |                                                      |       |     |       |     |       |                                                      |       |     |       |     |       |                                                                               |       |     |       |     |       |                                                                         |       |     |       |  |  |    |      |    |      |  |
| Overall                        | B                   | 15.2  | A   | 8.9   |     |       | C                                                    | 30.7  | A   | 9.8   |     |       | C                                                    | 23.1  | A   | 8.7   |     |       | C                                                                             | 21.5  | A   | 8.4   |     |       | B                                                                       | 10.1  | A   | 9.3   |  |  | A  | 10.2 | A  | 9.7  |  |
| EBL                            | --                  | --    | --  | --    |     |       | F                                                    | 90.5  | C   | 34.7  |     |       | C                                                    | 26    | C   | 27.6  |     |       | C                                                                             | 26.3  | C   | 28.2  |     |       | D                                                                       | 36    | C   | 27.5  |  |  | -- | --   | -- | --   |  |
| EBR                            | D                   | 47    | D   | 40.2  |     |       | F                                                    | 90.5  | C   | 34.7  |     |       | D                                                    | 54.6  | C   | 32.4  |     |       | D                                                                             | 50.3  | C   | 31.5  |     |       | D                                                                       | 45    | C   | 27.2  |  |  | C  | 34.4 | D  | 36.7 |  |
| EBR                            | --                  | --    | --  | --    |     |       | --                                                   | --    | --  | --    |     |       | --                                                   | --    | --  | --    |     |       | --                                                                            | --    | --  | --    |     |       | C                                                                       | 34    | C   | 26.1  |  |  | -- | --   | -- | --   |  |
| WBL                            | --                  | --    | --  | --    |     |       | --                                                   | --    | --  | --    |     |       | --                                                   | --    | --  | --    |     |       | --                                                                            | --    | --  | --    |     |       | C                                                                       | 34    | C   | 26.1  |  |  | -- | --   | -- | --   |  |
| WB                             | --                  | --    | --  | --    |     |       | A                                                    | 8.6   | B   | 14.3  |     |       | A                                                    | 8     | B   | 12.1  |     |       | --                                                                            | --    | --  | --    |     |       | D                                                                       | 35.5  | C   | 31.5  |  |  | C  | 25.6 | D  | 45   |  |
| NB                             | A                   | 6.8   | A   | 5.7   |     |       | A                                                    | 8.6   | B   | 14.3  |     |       | A                                                    | 8     | B   | 12.1  |     |       | A                                                                             | 7.7   | B   | 11.7  |     |       | A                                                                       | 3.8   | B   | 12.1  |  |  | A  | 5.6  | A  | 6.7  |  |
| SBL                            | D                   | 45.2  | A   | 5.2   |     |       | F                                                    | 125   | A   | 2.7   |     |       | F                                                    | 114.9 | A   | 3.1   |     |       | F                                                                             | 108   | A   | 3.2   |     |       | A                                                                       | 8.3   | A   | 1.3   |  |  | B  | 11.8 | A  | 1.5  |  |
| SST                            | A                   | 2.9   | A   | 4.1   |     |       | A                                                    | 7.5   | A   | 1.6   |     |       | A                                                    | 28.6  | A   | 1.6   |     |       | A                                                                             | 7.6   | A   | 1.7   |     |       | A                                                                       | 4.9   | A   | 1.5   |  |  | A  | 6.5  | A  | 1.7  |  |
| 5 Higgins Ave & 5th St         |                     |       |     |       |     |       |                                                      |       |     |       |     |       |                                                      |       |     |       |     |       |                                                                               |       |     |       |     |       |                                                                         |       |     |       |  |  |    |      |    |      |  |
| Overall                        | B                   | 15.4  | B   | 15.6  |     |       | C                                                    | 20.9  | D   | 53.7  |     |       | B                                                    | 19.1  | B   | 16.3  |     |       | B                                                                             | 18.8  | B   | 16.5  |     |       | B                                                                       | 16.8  | B   | 16.2  |  |  | C  | 19.7 | B  | 19.6 |  |
| EBL                            | --                  | --    | --  | --    |     |       | --                                                   | --    | --  | --    |     |       | --                                                   | --    | --  | --    |     |       | --                                                                            | --    | --  | --    |     |       | D                                                                       | 48.4  | B   | 18.5  |  |  | -- | --   | -- | --   |  |
| EB                             | --                  | --    | --  | --    |     |       | --                                                   | --    | --  | --    |     |       | --                                                   | --    | --  | --    |     |       | --                                                                            | --    | --  | --    |     |       | --                                                                      | --    | --  | --    |  |  | E  | 59.4 | B  | 13.9 |  |
| EBR                            | --                  | --    | --  | --    |     |       | --                                                   | --    | --  | --    |     |       | --                                                   | --    | --  | --    |     |       | --                                                                            | --    | --  | --    |     |       | B                                                                       | 13.3  | B   | 18.2  |  |  | -- | --   | -- | --   |  |
| WBL                            | --                  | --    | --  | --    |     |       | --                                                   | --    | --  | --    |     |       | B                                                    | 14.5  | C   | 27.4  |     |       | --                                                                            | --    | --  | --    |     |       | --                                                                      | --    | --  | --    |  |  | -- | --   | -- | --   |  |
| NB                             | C                   | 29.6  | C   | 26.6  |     |       | D                                                    | 41.8  | F   | 103.1 |     |       | D                                                    | 37    | C   | 32.5  |     |       | C                                                                             | 33.5  | C   | 30.2  |     |       | B                                                                       | 16.3  | C   | 25.9  |  |  | B  | 15.9 | C  | 29.8 |  |
| WB                             | B                   | 13.6  | A   | 8     |     |       | A                                                    | 7.9   | B   | 16.9  |     |       | A                                                    | 8.2   | A   | 7     |     |       | A                                                                             | 9.2   | B   | 7.7   |     |       | B                                                                       | 13.1  | B   | 10.3  |  |  | B  | 12.5 | B  | 12.6 |  |
| SB                             | B                   | 10.4  | B   | 12    |     |       | C                                                    | 20.4  | D   | 39.2  |     |       | B                                                    | 8.5   | B   | 11.5  |     |       | B                                                                             | 18.6  | B   | 11.5  |     |       | B                                                                       | 19.4  | B   | 13.2  |  |  | C  | 21.4 | B  | 17.7 |  |
| 6 Higgins Ave & 6th St         |                     |       |     |       |     |       |                                                      |       |     |       |     |       |                                                      |       |     |       |     |       |                                                                               |       |     |       |     |       |                                                                         |       |     |       |  |  |    |      |    |      |  |
| Overall                        | B                   | 18.5  | A   | 8.8   |     |       | C                                                    | 34.8  | B   | 12.4  |     |       | B                                                    | 13.2  | B   | 10.8  |     |       | B                                                                             | 12.8  | B   | 10.8  |     |       | A                                                                       | 6     | A   | 7     |  |  | A  | 8.5  | A  | 6.5  |  |
| EBL                            | --                  | --    | --  | --    |     |       | --                                                   | --    | --  | --    |     |       | C                                                    | 32.4  | C   | 23.8  |     |       | C                                                                             | 21.4  | C   | 25.1  |     |       | C                                                                       | 27.9  | C   | 29    |  |  | -- | --   | -- | --   |  |
| EB                             | D                   | 39.1  | C   | 31.2  |     |       | E                                                    | 56.3  | D   | 40.8  |     |       | B                                                    | 18.2  | D   | 41.8  |     |       | B                                                                             | 13.2  | D   | 36.8  |     |       | C                                                                       | 28.3  | C   | 32.9  |  |  | C  | 28.5 | C  | 32.4 |  |
| EBR                            | --                  | --    | --  | --    |     |       | --                                                   | --    | --  | --    |     |       | --                                                   | --    | --  | --    |     |       | B                                                                             | 11    | C   | 31.1  |     |       | --                                                                      | --    | --  | --    |  |  | -- | --   | -- | --   |  |
| NB                             | A                   | 6.1   | A   | 5.9   |     |       | B                                                    | 14.4  | B   | 11.6  |     |       | A                                                    | 8.4   | A   | 9.6   |     |       | B                                                                             | 10.7  | A   | 7.6   |     |       | A                                                                       | 2.4   | A   | 6     |  |  | A  | 5.6  | A  | 6.3  |  |
| SB                             | A                   | 9.8   | A   | 4.6   |     |       | --                                                   | --    | --  | --    |     |       | --                                                   | --    | --  | --    |     |       | --                                                                            | --    | --  | --    |     |       | A                                                                       | 2.5   | A   | 6     |  |  | A  | 6.2  | A  | 6.2  |  |

Table 9 – Analysis of Options

|                          | Option 1A<br>Single Vehicle Lane                                                                                                                                           | Option 1B<br>Single Lane<br>midblock with L and<br>TR Lanes                                                                                                               | Option 1C<br>Single Lane mid<br>block with L, R and<br>T Lanes                                                                                                             | Option 2A<br>2-Way Conversion<br>With Left Turn Lane                                                                                                                                                          | Option 2B<br>2-Way Conversion -<br>Single Lane<br>Approach                                                                                                                                          |
|--------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Bicycle Network</b>   | Buffered bike lanes on right-hand side "will improve comfort and value of the streets for commuter connections...would certainly increase bicycle counts along corridors." | Buffered bike lanes on left-hand side "will improve comfort and value of the streets for commuter connections...would certainly increase bicycle counts along corridors." | Buffered bike lanes on right-hand side "will improve comfort and value of the streets for commuter connections...would certainly increase bicycle counts along corridors." | Would require either removing on-street parking from both streets to fit standard bike lanes. If parking remains, no dedicated bike facilities, could necessitate development of 4th as neighborhood greenway | Would require either removing on-street parking from both streets to fit standard bike lanes. Or keeping parking, no bike facilities, could necessitate development of 4th as neighborhood greenway |
| <b>Transit Impacts</b>   | Likely to impact transit progression and increase travel times                                                                                                             | Small likely impact to transit progression                                                                                                                                | Negligible impact to transit progression                                                                                                                                   | Likely to impact transit progression and increase travel times                                                                                                                                                | Likely to impact transit progression and increase travel times                                                                                                                                      |
| <b>Signal Changes</b>    | Requires removal of signal heads at Russell, Orange, and Higgins                                                                                                           | No changes                                                                                                                                                                | No changes, may require additional signal head at each intersection                                                                                                        | Addition of new masts and signal modifications at Orange and Higgins, new signal at 6th/Russell and modifications to 5th/Russell                                                                              | Addition of new masts and signal modifications at Orange and Higgins, new signal at 6th/Russell and modifications to 5th/Russell                                                                    |
| <b>ADA Ramp Upgrades</b> | Potentially required depending on interpretation of signal improvement                                                                                                     | Not Required                                                                                                                                                              | Potentially required depending on interpretation of signal improvement                                                                                                     | Significant upgrades required. 3 of 24 corners currently meet full ADA requirements.                                                                                                                          | Significant upgrades required. 3 of 24 corners currently meet full ADA requirements.                                                                                                                |

|                                         | Option 1A<br>Single Vehicle Lane                                                                                                                                                                                                    | Option 1B<br>Single Lane<br>midblock with L and<br>TR Lanes                                                                                                    | Option 1C<br>Single Lane mid<br>block with L, R and<br>T Lanes                                                                                                                                      | Option 2A<br>2-Way Conversion<br>With Left Turn Lane                                                                                                                                               | Option 2B<br>2-Way Conversion -<br>Single Lane<br>Approach                                                                                                                                |
|-----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                         |                                                                                                                                                                                                                                     |                                                                                                                                                                |                                                                                                                                                                                                     | Additional 4 corners<br>have no ramps at<br>all.                                                                                                                                                   | Additional 4 corners<br>have no ramps at all                                                                                                                                              |
| <b>Parking</b>                          | Parking unchanged                                                                                                                                                                                                                   | Parking unchanged                                                                                                                                              | Parking removal at<br>signalized<br>intersection<br>approaches                                                                                                                                      | Parking removal at<br>signalized<br>intersection<br>approaches                                                                                                                                     | Would require<br>removal of parking<br>to add bike facilities,<br>no parking removal<br>if bike lanes omitted                                                                             |
| <b>Traffic<br/>Analysis<br/>Results</b> | Would reduce LOS<br>for 5 of the 12<br>intersection peak<br>hours (6<br>intersections, 2 peak<br>hours), improve LOS<br>for 1, and maintain<br>LOS for 6. little/no<br>impact outside of<br>peak period, see<br>Table 8 for details | Would reduce LOS<br>for 2 of 12<br>intersection peak<br>hours, maintain LOS<br>for 10. little/no<br>impact outside peak<br>periods, see Table 8<br>for details | Would reduce LOS<br>for 2 of 12<br>intersection peak<br>hours, improves LOS<br>for 1 of 12, maintain<br>LOS for 9 of 12.<br>little/no impact<br>outside peak<br>periods, see Table 8<br>for details | Would reduce LOS<br>for 1 of 12<br>intersection peak<br>hours, improve LOS<br>for 3, and maintain<br>LOS for 8. Could<br>balance traffic at<br>peak and other<br>hours. See Table 8<br>for details | Would reduce LOS<br>for 3 intersection<br>peak hours, improve<br>LOS for 3, and<br>maintain LOS for 6.<br>Could balance traffic<br>at peak and other<br>hours. See Table 8<br>for details |
| <b>Speeding</b>                         | May reduce                                                                                                                                                                                                                          | May reduce                                                                                                                                                     | May reduce                                                                                                                                                                                          | Would reduce                                                                                                                                                                                       | Would reduce                                                                                                                                                                              |
| <b>Safety<br/>Impacts</b>               | Reduces risk of<br>crashes for non-<br>motorized users,<br>eliminates risk of<br>sideswipes, reduces<br>risk of midblock rear<br>ends                                                                                               | Reduces risk of<br>crashes for non-<br>motorized users,<br>eliminates risk of<br>sideswipes, reduces<br>risk of midblock rear<br>ends                          | Reduces risk of<br>crashes for non-<br>motorized users,<br>eliminates risk of<br>sideswipes, reduces<br>risk of midblock rear<br>ends                                                               | Tough to measure,<br>may reduce risks<br>midblock but would<br>add conflicts at<br>intersections                                                                                                   | Tough to measure,<br>may reduce risks<br>midblock but would<br>add conflicts at<br>intersections                                                                                          |

|                          | Option 1A           | Option 1B                                | Option 1C                                   | Option 2A                            | Option 2B                               |
|--------------------------|---------------------|------------------------------------------|---------------------------------------------|--------------------------------------|-----------------------------------------|
|                          | Single Vehicle Lane | Single Lane midblock with L and TR Lanes | Single Lane mid block with L, R and T Lanes | 2-Way Conversion With Left Turn Lane | 2-Way Conversion - Single Lane Approach |
| <b>Ped Double Threat</b> | Would eliminate     | Would eliminate                          | Would eliminate                             | Would eliminate                      | Would eliminate                         |

## Conclusion

From purely a motorized traffic operations perspective, options 1B, 1C and 2A perform acceptably. The two-way conversion with dedicated left-turn lanes and some parking removal (Option 2A) will function better than options 1A and 1B. Converting both streets to two-way operations would likely lower speeds and make them feel more like residential streets; however, the cost of conversion will be considerably higher and it will not be possible to include dedicated bicycle facilities unless most or all of the parking is eliminated. Option 2 may also force the improvement of 4<sup>th</sup> Street to a neighborhood greenway, which would potentially require additional crossing enhancements over these three streets to provide a bicycle facility as one would be removed from 5<sup>th</sup> Street.