SEPARATED BICYCLE LANES
Butler and Beaver Pilot Projects

A review of the functionality of the separated bicycle lanes along Butler Avenue and Beaver Street based on staff, stakeholder, and user observations and analysis.

6/9/2022

ENGINEERING DIVISION

TRANSPORTATION
ENGINEERING SECTION

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1. INTRODUCTION

In November 2021, the City installed separated bicycle lanes and additional green pavement markings along the Butler Avenue and Beaver Street corridors with the purpose of testing the operation and maintenance of a vertical separation between bicycles and vehicles, while also improving bicyclist safety and increasing bicyclist ridership.

This project was funded through the Pedestrian and Bicycle portion of the City's Transportation Sales Tax. Butler Avenue construction cost $513,000, and Beaver Street cost $269,382 for a total cost of $782,382. The contractor will be back this summer (summer of 2022) to install final pavement markings because temperatures were too cold during original construction, and this work is estimated to cost $69,756. We have also asked that the contractor replace all delineators with a new style and this work is estimated at $8,000, while the material cost is $5,000.

Due to the urgency of getting this project completed in 2021, and working through winter, the construction costs were higher than they typically would be. The Butler Avenue and Beaver Street separated bicycle lane project is the first of possibly other pilot projects in the City of Flagstaff.

The Butler Avenue separated bicycle lanes extend from Milton Road to Sawmill Road and the Beaver Street separated bicycle lanes extend from Forest Avenue to Cherry Avenue. Green pavement markings were added to the conflict points at intersections along the Beaver Street corridor and two-stage bicycle left-turn boxes were added to the intersections along the Butler Avenue corridor.

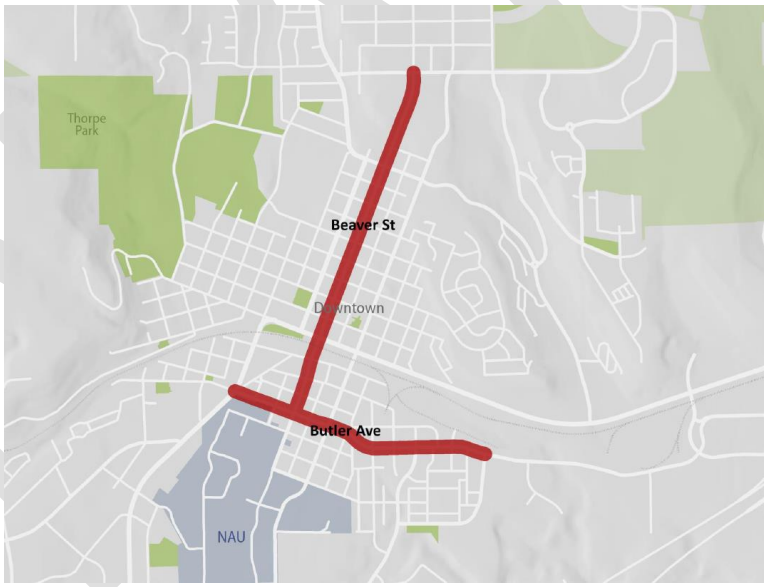


Figure 1: Butler Avenue and Beaver Street Pilot Project Extents

This report will examine how the pilot separated bicycle lanes have affected safety, bicycle ridership, vehicular volumes, and vehicular speeds. This report will also examine how the pilot project has affected stakeholders, including City of Flagstaff (COF) Streets, COF Parks, COF Solid Waste, COF Risk Management, COF Police Department (PD), COF Fire Department, Mountain Line transit, and Flagstaff Unified School District (FUSD).

The Butler Avenue corridor between Milton Road and Sawmill Road redesign included the following primary elements:

- Obliterating the white edge line stripe and narrowing the outer lanes to accommodate a wider bicycle lane.
- Installing white concrete parking curbs to act as a barrier between the bicycle lane and the travel lane, while leaving gaps for intersections, driveways, and bus stops.
- Installing white reflective delineators on top of the concrete parking curbs.
- Placing two-stage bicycle turn boxes (found in the new version of the MUTCD) at all signalized intersection approaches.
- Placing green bicycle lane extensions through each intersection, including adding green at each dedicated right-turn lane conflict point.

The Beaver Street corridor between Forest Avenue and Cherry Avenue consisted of the following primary elements:

- Obliterating the white edge line stripe, and in some locations the centerline skip stripe, to narrow the lanes to accommodate a wider bicycle lane.
- Installing white concrete parking curbs to act as a barrier between the bicycle lane and the travel lane, while leaving gaps for intersections, driveways, and bus stops.
- Installing white reflective delineators on top of the concrete parking curbs.
- Addition of shared lane markings where no bicycle lane was present.

Lastly, the Beaver Street corridor between Cherry Avenue and Butler Avenue consisted of the following elements:

- Addition of shared lane markings where no bicycle lane was present.
- Refreshing and striping new green bicycle lanes at intersection conflict points.

Separated Bicycle Lanes

Benefits

Help make bicycling a comfortable option for more of the population. Separated facilities appeal to the "interested-but-concerned" segment of the population, who would like to bicycle more for transportation but are not comfortable on busy roadways. A 2014 survey found that 85 percent of bicyclists in the interested-but-concerned category would be more likely to ride a bicycle if they were physically separated from traffic by a barrier[1]. Numerous studies of separated bike lanes in other communities have found evidence of increased ridership following implementation of separated facilities.[2]

Benefit all road users. Pedestrians on the sidewalk benefit from an extra layer of separation from traffic. And a comfortable separated facility for bicyclists also may encourage bicyclists to not ride on sidewalks. Drivers may be benefit as well; a San Francisco area survey of 265 drivers and bicyclists found that most drivers reported greater comfort with more separation from bikes. Barrier-separated bike lanes were the most popular.[3] A 13-year study of crashes in 12 large U.S. cities found that the cities with good bicycle infrastructure, and particularly bike lanes with physical

[1] Lessons from the Green Lanes: Evaluating Protected Bike Lanes in the U.S. (2014) https://trec.pdx.edu/research/project/583/Lessons_from_the_Green_Lanes:_Evaluating_Protected_Bike_Lanes_in_the_U.S._
[2] https://www.peopleforbikes.org/statistics/economic-benefits
[3] https://www.sciencedirect.com/science/article/abs/pii/S0965856416305018

barriers, had lower fatalities and serious injuries for all users.[4] A survey of residents near nine protected bike lane projects in five cities found that 75 percent of residents, and 69 percent of the residents who drive, supported building additional protected bike lanes in other locations. Fifty-six percent of residents felt the street works better for all people due to the protected bike lanes.[5]

Preferred by bicyclists. A 2014 survey of more than 1,000 bicyclists in five cities finds that only 10 percent would feel very comfortable riding in a bike lane on a four-lane commercial street with speeds of 35 mph. That number increases to 58 percent for a physically separated bike lane and to 83 percent for a separated path. The same study found that 85 percent of respondents who identified as interested-but-concerned said they would be more likely to ride a bicycle if motor vehicles and bicycles were physically separated by a barrier.[6]

Part of an overall low stress bikeways network. A comprehensive bikeways network in Flagstaff functions as an overall system rather than a series of individual components or segments. This network will be made up of a wide variety of bicycle facilities. For streets with lower speeds and volumes, more traditional facilities like conventional bike lanes are sufficient, but on higher speed and volume streets physical separation may be needed to help bicyclists feel comfortable.

Supports other community objectives. Robust bicycle infrastructure supports a number of community goals, including meeting carbon neutrality targets, managing traffic congestion, supporting health and wellness, promoting equity and inclusion, and enhancing community character and quality of life.

In other communities

People for Bikes (www.peopleforbikes.org/) maintains an inventory of separated bike lane facilities across the United States: https://docs.google.com/spreadsheets/d/11H0gArHxo6kMop1I18yMcq7ArbNrwaGBLmIXgqI1Gjk/edit?usp=sharing

The inventory includes separated bike lanes in a variety of configurations and designs, but all of the segments on the list share several features: some form of physical, vertical separation from traffic, exclusive use for people on bikes, and located on or adjacent to a street.

More than 600 examples are included, representing 472 miles of separated bike lanes in 129 communities across 44 states. Some of Flagstaff's peer communities are on the list, including Davis, Santa Cruz, Boulder, Fort Collins, Missoula, Bend, and Eugene.

Resources

- Separated Bike Lane Planning and Design Guide, Federal Highway Administration (2015) https://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/separated_bikelane_pdg/page00.cfm
- Bikeway Selection Guide, Federal Highway Administration (2019) https://safety.fhwa.dot.gov/ped_bike/tools_solve/docs/fhwasa18077.pdf

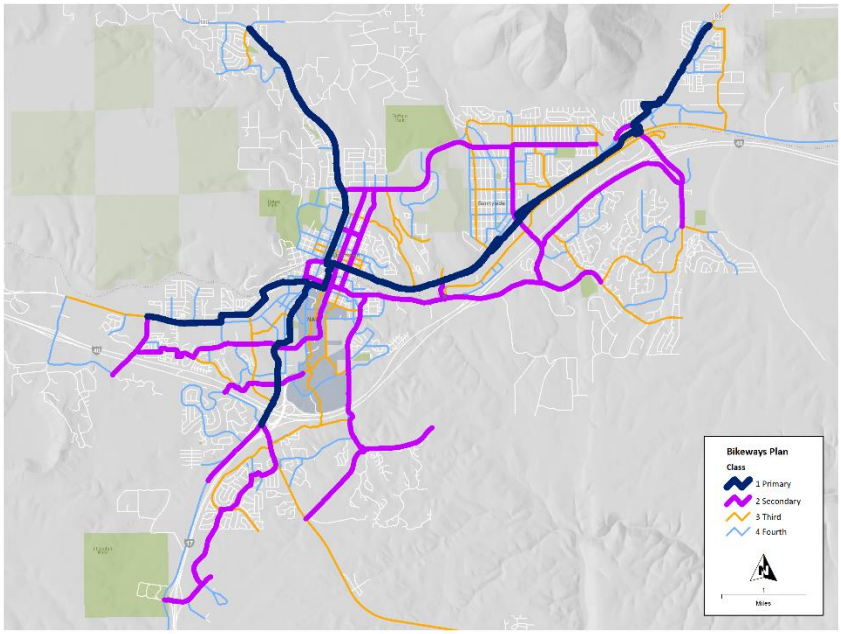
[4] Why cities with high bicycling rates are safer for all road users (2019) https://doi.org/10.1016/j.jth.2019.03.004
[5] Lessons from the Green Lanes: Evaluating Protected Bike Lanes in the U.S. (2014)
[6] Lessons from the Green Lanes: Evaluating Protected Bike Lanes in the U.S. (2014)

- Urban Bikeway Design Guide, National Association of City Transportation Officials (2014) https://nacto.org/publication/urban-bikeway-design-guide/
- Designing for All Ages & Abilities, National Association of City Transportation Officials (2017) https://nacto.org/publication/urban-bikeway-design-guide/designing-ages-abilities-new/
- Don't Give Up at the Intersection, National Association of City Transportation Officials (2019) https://nacto.org/publication/dont-give-up-at-the-intersection/
- Protected Bikeways Practitioners Guide, Institute of Transportation Engineers (2017) https://ecommerce.ite.org/IMIS/ItemDetail?iProductCode=IR-144-E
- Cycle Tracks: Lessons Learned, Alta Planning + Design (2009) https://nacto.org/wp-content/uploads/2011/03/Cycle-Track-Lessons-Learned.pdf

Flagstaff Bikeways Plan

City staff and the Bicycle Advisory Committee are currently working on a draft Bikeways Plan, which will guide implementation of a comprehensive low-stress network of bikeways in Flagstaff. Low stress means that most people will feel comfortable riding a bicycle.

The network will be hierarchical, so primary and secondary bikeways form a backbone system for bicycle travel around town.



The planned network will be comprised of a variety of bicycle facilities, including shared streets (bike routes, bike boulevards, shared lane markings), dedicated facilities (bike lanes, buffered bike lanes), and separated facilities (separated bike lanes, cycletracks, and FUTS trails). Both corridors and intersections are addressed in the plan

In general, shared street facilities are planned for low volume and low speed streets, like neighborhood residential streets. As traffic speeds and volumes increase, dedicated space for bicyclists in the form of a conventional bike lane or a buffered bike lane is needed. On streets with high traffic speeds and volumes, separated bicycle facilities are desired.

On existing streets, adding new or upgrading existing bicycle facilities required some level of retrofit to the street. This means that existing space or width may preclude some bikeway options or make them prohibitively expensive. On new or reconstructed streets there is more flexibility to build the street with desired bicycle facilities.

The bikeways plan includes options to transition from basic facilities that can be implemented more readily to enhanced facilities that may take more time or resources. For example, intersections can

be provided with two-way left turn boxes in the short term, while a full protected intersection may be a long-term option. Similarly, some streets may be striped with buffered bike lanes in the short term but may be candidates for separated bike lanes in the long term.

A number of streets in Flagstaff, including Butler Avenue and Beaver Street, are identified as candidates for the buffered to separated transition. A citizen petition calling for eight new miles of separated bikeways was received in the summer of 2021, and hastened a pilot program to explore options for implementing barriers on existing streets.

Figure 2: Butler Avenue Before Conditions (Google image)

Figure 3: Butler Avenue After Conditions

Figure 4: Butler Avenue Before Conditions (Google image)

Figure 5: Butler Avenue After Conditions

Figure 6: Beaver Street Before Conditions (Google image)

Figure 7: Beaver Street After Conditions

2. DATA ANALYSIS

Crashes

Crash data was limited to crash frequency because detailed crash information is not yet available for Butler Avenue or Beaver Street through the state website for the study period of November 2021 to May 2022. The COF PD provided the number of crashes that occurred along both roads within the boundaries of the pilot project during the study period. The COF PD stated that none of the reported crashes along either roadway during the study period were serious injury or fatal crashes. This data was compared to historical data from the Arizona Crash Information System (ACIS) website. It should be noted that this is a preliminary review of the crashes along both roadways, and it is recommended that more time passes to gain a better understanding of how crashes are impacted by the separated bicycle lanes.

Table 1 below compares the reported crashes between November and May for each year starting in 2012 with the last interval being the pilot program period.

Table 1: November - May Crash Comparisons

November - May	Beaver Street Reported Crashes	Butler Avenue Reported Crashes
2012-2013	8	27
2013-2014	10	36
2014-2015	4	36
2015-2016	10	35
2016-2017	6	30
2017-2018	8	23
2018-2019	7	36
2019-2020	3	16
2021-2022*	**10**	**30**

*Study period, crash data obtained from the COF PD

Table 2 below shows the yearly reported crashes along both roads from 2012 to 2020. The ACIS website only has complete crash data up to the year 2020.

Table 2: Yearly Reported Crashes

Year	Beaver Street Reported Crashes	Butler Avenue Reported Crashes
2012	16	45
2013	12	56
2014	14	60
2015	16	50
2016	13	57
2017	8	62
2018	12	51
2019	11	58
2020*	4	29

*Low number of crashes a result of COVID stay at home orders

This demonstrates that crashes occurring on both roadways are consistent with historical crash data trends. The separated bicycle lanes do not seem to impact crash severity or frequency; however, more time is needed to draw a more definite conclusion.

Speed

Pneumatic tubes were placed on Butler Avenue, just west of San Francisco Street, to collect vehicular speeds before and after the separated bicycle lane installs. The placement of the traffic counter was close to the intersection, and at certain peak times of the day the vehicle queues would back up past the count location. To capture only free-flow, or unimpeded vehicles, a minimum gap time of 5 seconds was applied. As seen below in *Table 3,* there was no significant change in vehicle speeds after the concrete barriers where installed.

Table 3: Butler Avenue Vehicle Speeds

Butler Ave. Vehicle Speeds		Before (October 2021)	After (April 2022)	Percent Change
Westbound	85th Percentile (mph)	34	35	3%
Eastbound	85th Percentile (mph)	36	35	-3%

Vehicle Volumes

Pneumatic tubes were placed on Butler Avenue, just west of San Francisco Street, to collect vehicular volumes before and after the corridor redesign. Butler Avenue average daily traffic (ADT) slightly increased in the westbound direction, while slightly decreasing in the eastbound direction. Peak hour vehicular volumes increased in both the westbound and eastbound directions, as seen below in *Table 4*. This demonstrates that vehicle volumes were not significantly impacted by the concrete barriers.

Table 4: Butler Avenue Vehicle Volumes

Butler Ave. Vehicle Volumes	Before (October 2021)	After (April 2022)	Percent Change
Westbound (ADT)	10913	11813	8%
Eastbound (ADT)	10996	10407	-5%
Westbound (Peak Hour)	806	910	13%
Eastbound (Peak Hour)	910	974	7%

A camera was placed along Beaver Street for one 12-hour day (7:00AM to 7:00PM) in October 2021 and April 2022. As shown below in *Table 5*, Beaver Street 12-hour count and peak hour volumes both slightly decreased.

Table 5: Beaver Street Vehicle Volumes

Beaver St. Vehicle Volumes	Before (October 2021)	After (April 2022)	Percent Change
Southbound (12-Hour Period)	5090	4772	-6%
Southbound (Peak Hour)	564	525	-7%

Bicycle Volumes

Bicycle volumes were collected before and after the implementation of the project. A camera was placed along Butler Avenue and Beaver Street for one 12-hour day (7:00AM to 7:00PM) in October 2021 and April 2022. On Butler Avenue, counts have shown a decrease in bicycle ridership in the 12-hour period and a decrease in the peak hour for the westbound direction. It should be noted that wind speeds where higher during the April bicycle counts, and this could have been a factor in the decrease in bicycle ridership. Also, a single day of data collection may not provide a complete picture of how bicycle volumes were affected by the separated bike lanes.

Table 6: Butler Avenue Bicycle Volumes

Butler Ave. Bicycle Volumes	Before (October 2021)	After (April 2022)	Percent Change
Westbound (12-Hour Period)	47	48	2%
Eastbound (12-Hour Period)	53	26	-51%
Westbound (Peak Hour)	10	11	10%
Eastbound (Peak Hour)	10	5	-50%

On Beaver Street, counts have shown an increase in bicycle ridership by 8% in the 12-hour period and an 31% in the peak hour period, as shown in Table 7 below.

Table 7: Beaver Street Bicycle Volumes

Beaver St. Bicycle Volumes	Before (October 2021)	After (April 2022)	Percent Change
Southbound (12-Hour Period)	77	83	8%
Southbound (Peak Hour)	13	17	31%

3. STAKEHOLDER INPUT

City Transportation Engineering staff spoke with eight (8) stakeholder groups to collect feedback on the pilot bicycle lane projects. The stakeholder groups include City of Flagstaff (COF) Streets, COF Parks, COF Solid Waste, COF Risk Management, COF Police Department (PD), COF Fire Department, Mountain Line transit, and Flagstaff Unified School District (FUSD). The sections below summarize the conversations with these groups.

City of Flagstaff Streets

The Streets Department has been performing all maintenance on the curbs and delineators, snow removal, and street sweeping efforts on both corridors. The web application known as Cartegraph is utilized by the City to keep track of assets and work. As of June 1, 2022, the following illustrate the quantities of various work performed by City Streets in the approximate five (5) months that the project has been constructed.

- 609 labor hours
- 609 delineators maintained (stood back up by bending metal bracket)
- 131 delineators destroyed
- 73 delineators replaced
- 151 delineators added (new version)
- 38 curbs damaged
- 24 curbs destroyed
- 2 curbs replaced

One of the main issues with the maintenance of the delineators was the hardware that was used, shown in Figure 8. When a delineator was hit, it would bend the bracket and after multiple hits, the bracket would eventually become brittle and break. After more research, the City found a better solution for delineator hardware. Shown below in Figure 9, the new hardware can now take multiple hits and will pop back into an upright position. Another issue to note from meeting with the Streets crew was when a delineator was hit, it would often lean into vehicular or bicycle traffic and cause the drivers/riders to swerve around the device to avoid hitting it. Since the new hardware has been tested on site, there has been a significant decrease in delineator maintenance/replacements. To date, the City has spent $11,719 on maintenance of the curbs and delineators.

Figure 8: Delineator Hardware - First Attempt

Figure 9: Delineator Hardware – Final Solution

Snow operations were also performed by the City Streets crews. Along Butler Avenue, where medians were present, snow was blown from the bicycle lanes to the travel lanes, then plowed to the median, and later scooped into a dump truck and removed from the site (illustrated in Figure 10 below). The 2021/2022 winter season was minimal compared to previous years, but the City did have a couple storms that produced enough snow to test the operations. To date, the City has spent $21,373 on snow operations associated with the pilot project, this does not include the purchase of two (2) new Toolcats and the three (3) new snow removal attachments (per piece of machinery).

City plowing crews noted:

- Witnessing drivers pulling up onto the median snow berms
- Narrow lane widths due to pilling snow in the median for future removal
- Problems with snow storage along Butler Avenue where ***no*** medians were present
- Issues keeping up with snow removal
- Some possible recommendations include removing the curbs and just using delineators, or using the delineators with a striped buffer, also, using green delineators versus the white.

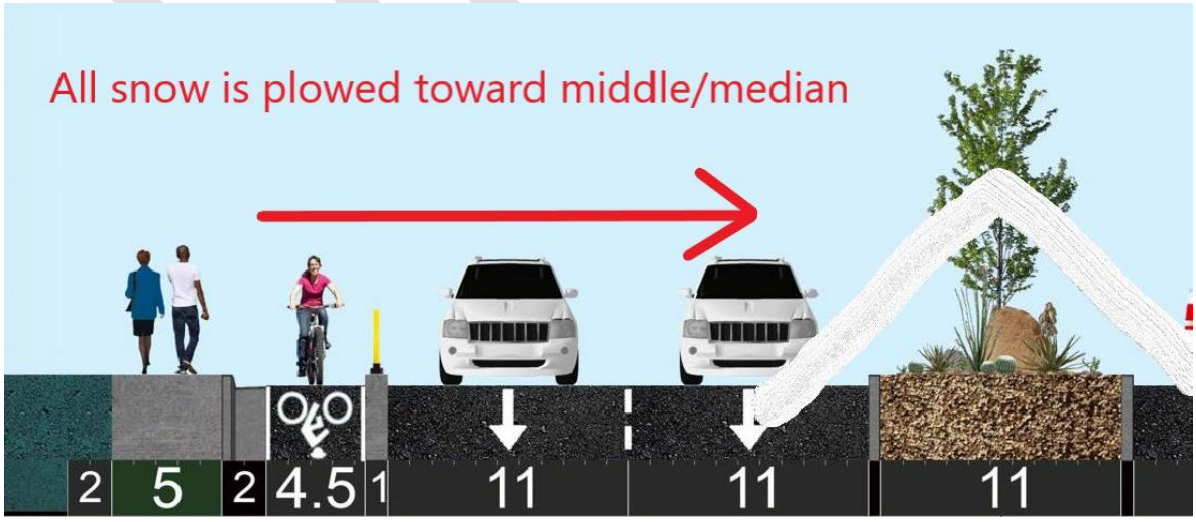


Figure 10: Butler Avenue Plow and Haul

Sweeping operations, performed by City Streets crews, consisted of removing cinders from the bicycle lanes. A sweeper attachment was added to a Toolcat. This attachment picks up the cinders, but it only sweeps what is directly in front of it, so it misses the cinders that collect right at the curb line. To date, the City has spent $6,905 on street sweeping operations associated with the pilot project, this includes purchasing one (1) new Toolcat sweeping attachments.

This summer, City Streets Staff plan to restripe the white lines adjacent to the bicycle curbs. Also, the contractor will be back out updating the green bicycle lane extensions and two-stage turn boxes with the permanent thermoplastic striping/markings. While they are out there, we have also asked that they remove all old delineators and hardware and replace them with the new devices.

City of Flagstaff Parks

During the meeting on April 28, 2022, with the City Parks Department, it was noted that along Butler Avenue plowing to the center medians had caused damage to plants, shrubs, trees, and irrigation. It is estimated that the costs to maintain this damage is approximately $4,000 per season. Plowing to the center median also caused gallons of cinders to be piled in the medians. The maintenance cost to remove these cinders is estimated at $2,000 per season. These costs are estimated using an average amount of storm events and include fully burdened labor rates and all materials needed to complete the maintenance.

City of Flagstaff Solid Waste

City Solid Waste services nine (9) residential units along Butler Avenue and 24 residential units along Beaver Street. Before the pilot separated bicycle lanes were installed, residents were encouraged to place their trashcans along the curb, in the bicycle lane. Since the project has been implemented, the trashcan either needs to be placed in the bicycle-way or in the pedestrian-way. Most residents have learned to place their cans on the sidewalk, although not all abide by this. Currently, the City only has one solid waste truck that can reach far enough, across the separated bicycle lane, to pick-up the cans from the sidewalk. During the meeting on April 26, 2022, City Solid Waste Staff noted:

- Drivers have seen bicyclists kicking over trashcans that are left in the bicycle lanes.
- Solid Waste trucks used to be able pull over to allow vehicles to pass, but now the bicycle curb is hindering them from pulling over. They are trying to miss rush hour and get to Butler Avenue earlier in the morning to prevent back-ups.
- In rental units, Staff is constantly re-training residents where to place their trashcans.
- Drivers have seen bicyclists' handlebars hitting the trashcans.
- Requesting more space for maneuvering on Butler Avenue near the Speedway gas station and along the driveways near Aspen Place at The Sawmill.
- In general, drivers have not had the best experience.
- Butler Avenue now feels too tight during snowstorms.
- On Beaver Street, Solid Waste requested some residents move their trashcans to the side streets (Dale Avenue, Elm Avenue, Fine Avenue, etc.). Some residents complied, and others refused because it was further for them to walk.
- Since the current Solid Waste trucks can only pick-up on the passenger side, residents on the east side of Beaver Street are forced to drag their trashcan over the bicycle curb to the west side of the roadway to be serviced. Staff is working on a solution to this issue, which includes purchasing a different style truck with a trashcan tipper attachment.

City Transportation Engineering Staff will meet onsite with Solid Waste to determine which bicycle curbs need to be removed to better accommodate the solid waste trucks. Also, on Beaver Street, we will work together to determine other locations where curbs can be removed for residents on the east side to not have to lift their trashcans over the curbs. Solid Waste staff are working on combining trash and recycle pick up to occur on the same day, so cans are not in the bicycle lanes over multiple days.

City of Flagstaff Risk Management

City Transportation Engineering met with City Risk Management to discuss claims that have been submitted to the City. As of May 23, 2022, the City had received one (1) claim, although, they had received two (2) other calls inquiring how the claim process works. The claim received involved a vehicle popping their tire on the curb. The case was reviewed with the legal team, and it was determined not compensable because "we will not compensate for hitting a curb/median". Curbs are designed to delineate traffic flow (e.g., medians, turn bays, sidewalks). The first inquiry involved a driver running onto the bicycle curb and the caller stated the vehicle was considered totaled due to oil pan damage, which caused the engine to cease up. The second inquiry involved a driver who stated a metal "spike", from the separated bicycle lane, shredded two of the vehicles' tires.

City of Flagstaff Police Department

The COF PD has noticed more near misses, dangerous driving, and destruction since the bicycle lanes have been installed. The police did an analysis of all crashes since 2019 along Beaver Street and Butler Avenue that involved bicycles. Eight (8) crashes involving bicycles were identified, and none of the crashes were overtaking crashes, which are the main types of crashes prevented by the concrete barriers. The police state that the new snow removal procedure along Butler Avenue and Beaver Street have resulted in two (2) vehicle crashes, and results in severely narrower travel lanes during snow events due to the snow being piled in the median. They have seen more dangerous driving for vehicles resulting from the installation of the separated bike lanes that outweighs safety benefits for bicyclists.

The police emphasized that education is essential to improving bicyclist safety. Teaching citizens how to properly use bike lanes, rules for yielding, and the dangers of riding bicycles on sidewalks are essential lessons that need to be conveyed to the public. They recommended installing rumble strips instead of curbs, more green paint calling out bike lanes, and additional signs that promote yielding to bicycles. The main concerns pertaining to the separated bike lanes identified by the police department are summarized below:

- Increases in near misses and dangerous driving behavior.
- Dangerous driving conditions during snow removal because of narrowed lanes resulting from the snow being pushed to the median.
- The separated bike lanes do not prevent bicycle crashes that occur at driveways and intersections, which are historically the areas with the highest number of bicycle related crashes.

City of Flagstaff Fire Department

The separated bicycle lanes have impeded COF Fire Department operations along Beaver Street and Butler Avenue. During times of high traffic volumes, emergency response times have increased due to drivers being unable to pull off to the right for fire trucks. This is more of an issue on Butler

Avenue than Beaver Street due to the difference in volumes on those roads. Fire truck drivers are using oncoming travel lanes more frequently to navigate past the traffic and bicycle lane curbs. This has resulted in one instance of a fire truck being wedged in oncoming traffic because the vehicles could not pull off to the right due to the bicycle lane curbs. The new bicycle lanes have also resulted in significantly narrower travel lanes during snow events due to new snow removal procedures, and this exacerbates already poor winter driving conditions. Debris from the concrete barriers is often seen in the roadway, and bicyclists are taking the whole vehicle travel lane during trash day to avoid trashcans in the bicycle lane, resulting in congestion and slower speeds. The main concerns identified by the COF Fire Department are summarized below:

- Increased emergency response times due to drivers caught between the bicycle lanes and other vehicles
- Challenging winter driving conditions due to narrow lanes and snow accumulation in the median
- Debris in the roadway from the struck concrete barriers
- More bicycle riders taking the full lane on trash day

Mountain Line

Mountain Line is the local Northern Arizona transit agency. On Butler Avenue, within the improvement zone, Mountain Line has six (6) bus stops, three (3) on the south side of the street (eastbound direction) and three (3) on the north side of the street (westbound direction). Four (4) different routes utilize this section of corridor. On Beaver Street, within the separated bicycle zone, they have four (4) bus stops, with two (2) routes utilizing the corridor. During a meeting with Mountain Line on April 28, 2022, staff noted the following feedback:

- Overall, Mountain Line is very supportive of increased safety for bicyclists including through protected bike lanes. Mountain Line is excited to see the City take on the pilot to look at ways to enhance biking in the City. Most transit riders begin their trips on bike or foot and as such, infrastructure to make that safer and more comfortable is important to Mountain Line.
- Some feedback for improving the pilot project is below and pertains to the Butler Avenue section. We have not had issues on the Beaver Street portion.
    - Perceived narrowing of lanes: the 11’ foots lanes are the same as others Mountain Line regularly uses but roadway configuration including street trees and curves creates a perception of them being even narrower. Requesting the consideration of reducing speed limits in certain narrow, curvy sections of Butler Avenue.
    - Mountain Line has hit curbs and candlesticks midblock on two occasions. One incident was to avoid another vehicle drifting into our lane and the curb and candlestick were impacted. There was little room to maneuver to avoid the other vehicle. One other incident resulted in no damage to bus or curbs.
    - Requesting more space to exit their bus stop at Regent Street and Butler Avenue, to reduce the likelihood of impeding into the adjacent lane of travel. Candlestick and curb have been hit on different occurrences as we exit.
    - Requesting that the roadways and bicycle lanes are plowed better, quicker, and more frequently.

        - During a snow event, bicycles are forced to drive in the main throughfare before the bicycle lanes are cleared of snow.
        - Drivers are having to drive in the middle of the lane due to snow berms being left at both curb edges.
    - Requesting better maintenance in general.
        - Broken delineators ended up in the travel lane and buses had to move over into the adjacent lane of traffic to maneuver around them.
        - Debris is often in the bike lane; it would assist bike safety to manage roadway upkeep/cleaning so they are not forced into the travel lanes.

City Transportation Engineering Staff has sent the plan set to Mountain Line and will meet onsite to determine which bicycle curbs need to be removed to better accommodate the buses.

Flagstaff Unified School District

Flagstaff Unified School district (FUSD) does not currently stop along either of the Butler Avenue or Beaver Street separated bicycle lane corridors, but these roadways are on their daily school routes. During the meeting on May 6, 2022, FUSD noted:

- They have not had the best experience
- Lanes too narrow on Butler Avenue
- One instance where FUSD bus & Mountain Line transit bus hit mirrors
- Drivers have seen bicyclists bending over the delineators into traffic
- Drivers have seen vehicular traffic running over the curbs and delineators
- Maneuvering turns is more difficult

4. SURVEY RESULTS

A survey to gather community feedback on the separated bicycle lane pilot project was hosted on the Flagstaff Community Forum (www.flagstaff.az.gov/fcf) from May 2 through May 23, 2022 (22 days total). A total of 602 surveys were completed, which is an excellent response compared to typical community surveys.

A copy of the complete survey results can be downloaded from this link: LINK TO COME

Survey Organization

The survey was divided into four main parts:

Experience with separated bike lanes

The first part of the survey asked respondents about their use of and experience with the pilot project, from four different perspectives:

- Riding a bicycle in the separated bike lanes
- Making a left turn on a bicycle using the two-stage left turn boxes
- Driving a vehicle adjacent to the separated bike lanes
- Walking on the sidewalk along the separated bike lanes

For each of the four, respondents were asked if they have used the separated bike lanes, how frequently they were used, and to rate their experience as positive or negative. Respondents were also given an opportunity to share their throughs and comments in an open-ended question.

General thoughts and comments

The second section asked a series of follow-up questions, including several open-ended, to solicit more specific feedback on the separated bike lane pilot.

- How comfortable were the separated lanes for bicyclists?
- How does the presence of the separated lanes change how you think about riding along the two streets?
- How would you rate the maintenance?
- What did you like about the separated lanes?
- What could be improved?
- Was you experience different on one street compared to the other?

Ratings of different types of bike lanes

For this section, respondents were asked to rate how comfortable they would be on four different types of bicycle facilities with varying degrees of separation:

- Conventional bike lanes
- Buffered bike lanes
- Vertically separated bike lanes
- Horizontally separated bike lanes

Respondents were asked to imagine riding a bike in the different types of bike lanes along a busy street, like Cedar Avenue, Fourth Street, Butler Avenue, University Avenue, or Lone Tree Road, and then rate how comfortable they would feel.

Bicyclist experience/type

The final set of questions asked respondents to indicate how often they ride a bike for both recreation and transportation, and to rate themselves regarding their comfort level on busy streets with or without bicycle facilities.

The survey also included several optional demographic questions for respondents; however, these results are not made public but used internally to gauge how well the survey reached all populations and parts of the community.

Survey Results and Highlights

Experience with separated bike lanes

Bicyclist's experience with the separated lanes was both polarized and evenly split. About 30 percent of those who rode a bike in the separated lanes reported that the experience was mostly positive, while the same number said the experience was mostly negative

Almost all survey respondents drove along the separated lanes, and for most the experience was negative. Almost half of respondents reported a mostly negative experience with driving along the lanes. Common concerns include narrowing of the travel lanes and difficulty with making turns from or onto the street.

General thoughts and comments

Separated bike lanes help cyclists feel more comfortable and can help encourage more people to ride. More than half of respondents who bicycled in the separated lanes reported that the lanes made them feel somewhat comfortable or very comfortable. For those who rode in the bike lanes, about 40 percent said they were more, somewhat or much more likely to bicycle on Butler or Beaver as a result of the bike lanes.

What users liked about the lanes. Respondents listed several positive aspects of the separated lanes, including enhanced safety for bicyclists, preventing vehicles from encroaching into the bike lane, better accommodation and a dedicated space for cyclists on the street, and more awareness of bicyclists.

What could be improved. Suggestions to improve the lanes include better maintenance of the curbs and delineators, regular snow plowing and cinder removal, more robust delineators, enhanced visibility for the barriers, and reconfigured openings at side streets and driveways.

Many survey respondents expressed strong disapproval of the separated lanes. For all of the open-ended survey questions, there were a significant number of responses, often representing half or more of the comments, that expressed strong opposition to the separated lanes and a desire to have them removed.

Ratings of different types of bike lanes

Horizontally separated bike lanes were rated as most comfortable. Respondents were asked to indicate how comfortable they would feel on four different types of bike lanes. Horizontally separated bike lanes were rated as most comfortable, while conventional and vertically separated bike lanes were rated as least comfortable.

There is support for separating bike lanes from traffic. About half of the comments submitted in this section expressed support for facilities that separate bicyclists from vehicular traffic.

Bicyclist experience and types

Bicyclists were well represented in the survey, but "interested but concerned" bicyclists may be underrepresented. More than a quarter of survey respondents ride a bicycle for transportation at least twice per week. Only a quarter of respondents fall into the "interested but concerned" category, while almost 60 percent identify as somewhat or highly confident cyclists.

5. CONCLUSION

Butler Avenue and Beaver Street construction cost equaled $782,382. The contractor will be back this summer (summer of 2022) to install final pavement markings and replace all delineators with the new style at an estimated cost of $82,756. Maintenance of curbs and delineators equated to approximately $11,719, snow removal operations were $21,373, and median restoration costs by the City Parks crews were $6,000. See Table 8 below for a summary of all costs, including labor. It should be noted that this does not include the cost of the Toolcat purchases for snow and cinder removal.

Table 8: Separated Bicycle Lane Cost Summary

Item	Cost
Butler Avenue Installation	$513,000
Beaver Street Installation	$269,382
Summer 2022 Final Pavement Markings	$69,756
Install New Delineators	$13,000
Maintenance of Curbs and Delineators	$11,719
Snow Operations	$21,373
Sweeping Operations	$6,905
Parks Department Median Restoration	$6,000
Total*	**$911,135**
***Does not include Toolcat purchases**	

Crashes occurring on both roadways are consistent with historical crash data trends. The separated bicycle lanes do not seem to impact crash severity or frequency; however, more time is needed to draw a definite conclusion.

The operating speeds have not experienced a change, suggesting that the concrete curbs alone have not impacted the operating speeds on Butler Avenue. Vehicle volumes have fluctuated less than 10%, which is a typical day to day variation, so the concrete curbs have little effect on vehicle volumes.

Bicycle volumes have increased by 31% on Beaver Street during the peak hour, suggesting the concrete curbs are promoting bicycle ridership on Beaver Street. Butler Avenue saw bicyclist volumes maintained in the westbound direction, but also saw a 51% decrease in the eastbound direction. This drastic decrease in ridership may be contributed to the higher wind speeds observed in April 2022 that were not present in the original count in October 2021. It should be noted that bicycle counts where taken on only one day in each study year and may not be completely representative of average bicycle riding behavior. For future pilot projects, it is recommended that bicycle counts be performed over a longer study period to gain a better understanding of ridership patterns.

All City of Flagstaff stakeholders have expressed issues with the separated bicycle lanes. The main issues are as follows:

- Limited staff and budget to properly maintain and clean the separated bicycle lanes

- Limited staff and budget to properly perform snow removal during large (4-ft plus) snow events
- Dangerous driving conditions during winter snow events due to narrowed travel lanes that result from the new snow removal procedures
- Dangerous driving conditions due to narrowed lanes
- Slower emergency response times along both roadways

City Transportation Engineering Staff will meet onsite with Solid Waste and Mountain Line to determine which bicycle curbs need to be removed to accommodate the trucks and busses. Transportation Staff will also keep following up with City PD and City Risk Management for up-to-date crashes and claims. The contractor will be back out updating the green bicycle lane extensions and two-stage turn boxes with permanent thermoplastic striping and markings. The City has also hired the original contractor to remove the old delineators and hardware and replace them with the newer design delineators. This summer, City Streets Staff plan to restripe the white lines adjacent to the bicycle curbs, but are having difficulty with the close placement of the stripe to the vertical curb and are exploring new equipment or contract services to perform this maintenance.

The community survey elicited a strong negative reaction from many respondents, as well as a list of concerns and problems with operation and maintenance. However, the survey also showed that separated bicycle facilities encourage bicyclists to ride and make bicyclists more comfortable on the road. The survey also found support for facilities that separated bicycles from traffic.

Nearer term pilot projects on already identified ATMP priority bike corridors should include buffered bike lanes and two-way separated facilities, if adequate space is available on the road surface.

Current recommended practice is suggesting a 6-foot buffer (with raised curbing) and a 6.5-foot one-way bike lane. Butler and Beaver are several feet short of this combined 12.5-foot total bike facility dimension. Buffered facilities are less space intensive with dimensions of 2-foot for the buffer and 5-foot for the bike lane, which is similar to what is available on most sections of Butler Avenue today.

Recommendations. There are three (3) recommended next steps for the Beaver and Butler Pilot Bike Lanes project:

1. Keep the separated bicycle lane pilot project on Beaver Street up over the summer to collect more data, including analyzing the maintenance and operational impacts of adjusting the delineators and curb limits, and continue collecting bicycle ridership trends.
2. Modify the Butler Avenue pilot project from a parking curb separated facility type to a buffered bike lane facility type. This cross section will more closely match the current recommended practice for buffered facilities. This is consistent with the short-term planning contained in the Bikeways Master Plan and the Active Transportation Master Plan (ATMP).
3. Install buffered bike lanes on Butler Avenue from the eastern terminus of the pilot project at Sawmill to Ponderosa Parkway.

During the June 1, 2022 meeting, the Transportation Commission recommended removal of the Butler Avenue separated bicycle lanes and replacing them with an 18-inch striped buffered bicycle lane. The new buffered bicycle lane would be analyzed for ridership and safety, similar to the

separated bicycle lanes. The Beaver Street separated bicycle lanes should remain for further bicycle ridership and crash trend analysis.

During the June 2, 2022 meeting, the Bicycle Advisory Committee recommended keeping Butler Avenue and Beaver Street separated bicycle lanes in place to capture at least one full year of analysis. They further requested making small changes to the curbs to allow our stakeholders easier access into certain driveways and bus pullouts. Also, they asked that City Staff research further speed reducing mitigations for the Butler Avenue corridor.

The Pedestrian Advisory Committee cancelled their June meeting.

City Council discussion and recommendation placeholder.