Appendix 1. Traffic Study

Future 42 Traffic Impact Study

Prepared for:
City of Louisville, Colorado and
City of Lafayette, Colorado

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DN21-0686

FEHR PEERS

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Introduction

This report provides a summary of the existing and future multimodal traffic operations along CO 42 in Louisville, Colorado and Lafayette, Colorado under the existing corridor configuration and with the improvements proposed as part of the Future 42 project led by the City of Louisville. The analysis includes a summary of motor vehicle traffic operations, traffic safety, pedestrian comfort, bicycle comfort, and transit operations along the corridor. This report is divided into four major sections:

- Methodology
- Existing Conditions (including forecasts)
- Recommended Alternative
- Conclusions

Study Area

The study area for the project is the three-mile segment of the CO 42 corridor between Arapahoe Road (CO 7) to the north and Empire Road/ Lock Street to the south as shown in **Figure 1**.

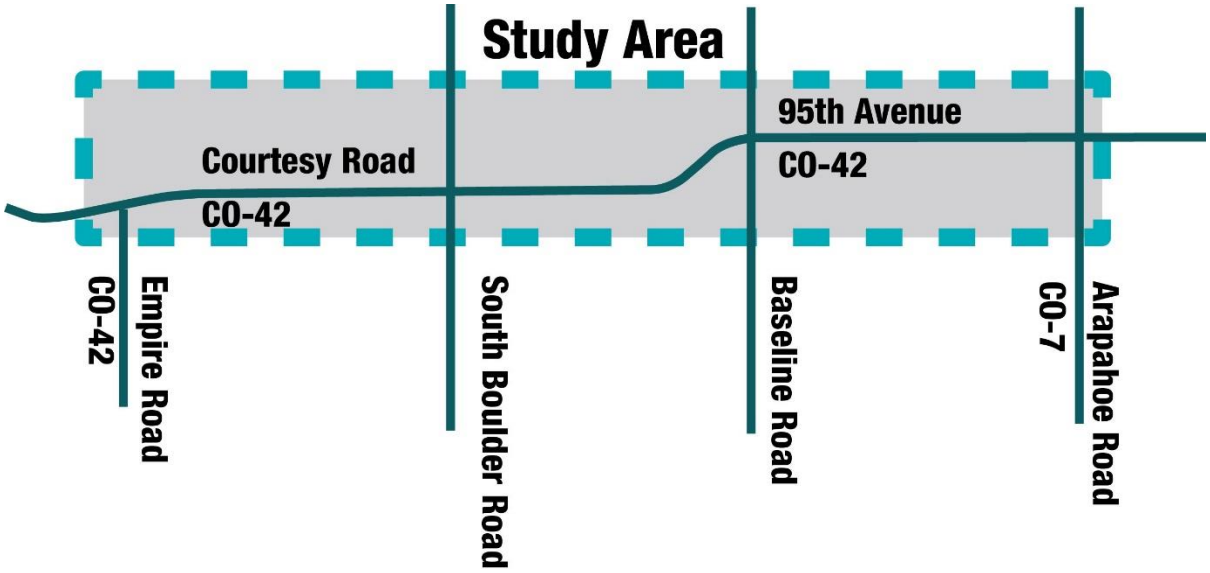


Figure 1: Future 42 Project Study Area

The following intersections along CO 42 were included in this study:

- CO 42/ Lock Street (signal),
- CO 42/ Pine Street (signal),
- CO 42/ Short Street (signal),
- CO 42/ Griffith Street (side-street STOP),
- CO 42/ South Boulder Road (signal),
- CO 42/ Hecla Drive (side-street STOP),

- CO 42/ Paschal Drive (signal),
- CO 42/ Baseline Road (signal),
- CO 42/ Beauprez Avenue (right-in, right-out),
- CO 42/ Indian Peak Trail (side-street STOP), and
- CO 42/ Northpark Drive (signal), and
- CO 42/ CO 7 (Arapahoe Road).

While this analysis included the intersections of CO 42/ Lock Street and CO 42/ CO 7, separate projects are developing the proposed improvements to those intersections. The recommended alternative incorporates the most recent proposed improvements of those projects and no additional modifications were made in the layout assumptions of those intersections.

Measures of Effectiveness

This study used individual measures of effectiveness (MOEs) to analyze multimodal traffic operations under existing conditions, for various alternatives, and under the recommended alternative. The MOEs, shown in **Table 1**, are based on four principal goals for the project: traffic safety, walking and bicycling comfort, traffic flow, and compatibility with future bus rapid transit service (BRT) in the corridor. The MOEs were used to quantify the impact of design alternatives on each mode of travel and traffic safety and ultimately guided recommendations for the recommended alternative.

Table 1: Project Goals and Measures of Effectiveness (MOEs)

Goal	Measure of Effectiveness
A safe corridor for all users	• Free flow vehicle speed • Total crashes at intersections
A comfortable corridor for walking and biking	• Pedestrian level of traffic stress (LTS) • Bicycle level of traffic stress (LTS)
Efficient motor vehicle travel	• Intersection level of service (LOS) • Corridor travel time for vehicles
Accommodate future bus rapid transit (BRT)	• Intersection approaches that can either accommodate a bus queue jump lane or where a bus queue jump lane would not be needed

Methodology

This section describes the methodology used to collect and analyze data for each MOE under both existing conditions and the various alternatives.

Traffic Safety

Two measures were used to quantify traffic safety: traffic speed and crashes.

Traffic Speed

Under the existing conditions analysis 85th percentile traffic speed was collected along CO 42 on a mid-week weekday in May 2021 at three different locations between intersections using tube counters:

- CO 42 between Northpark Drive and Indian Peaks Trail
- CO 42 between Paschal Drive and Hecla Drive
- CO 42 between Griffith Street and Short Street

The free flow vehicle speed MOE under each alternative was calculated based on the percentage of the corridor where the speed was anticipated to increase, decrease, or stay the same. Changes in speed would be impacted by design features, such as roundabouts, horizontal deflection, width of travel lanes, degree of "friction" along the roadway (from landscaping, buildings, parked cars, etc.), and number of travel lanes.

Crash Analysis

This study gathered five years of crash data from 2015 to 2019 to inform the existing conditions analysis. Crash data was quantified for each intersection and mid-block segment, as well as by severity, and by crash type (most harmful event).

To calculate the MOE for reduction in crashes under each alternative crash modification factors (CMFs) were applied to the respective number of crashes at each intersection based on the proposed intersection improvements. Examples of CMFs applied along the corridor include roundabouts, protected left-turn signal phasing, and geometric changes to right turns. CMFs were only applied to observed crashes in the five-year crash history that would be mitigated by the specific improvement. For example, the CMF for converting an intersection from a permissive left turn to a protected-only left turn was only applied to the observed number of left turns for that particular movement.

Walking and Biking Comfort Levels

Walking and biking comfort along each side of CO 42 was measured using Fehr & Peer's Streetscore+ tool, which is a modified version of the Level of Traffic Stress (LTS) criteria and scoring system developed by Mekuria, Furth, and Nixon (2012) in *Low Stress Bicycling and Network Connectivity*.[1]

Streetscore+ is a tool developed by Fehr & Peers to assess people's comfort walking and biking along a street. It considers factors such as the type of pedestrian and bicycle facility, the number of traffic lanes and traffic speed on the adjacent street, and other factors related to the quality of facilities to determine the level of stress one might experience while walking or biking in that area. Streetscore+ is a streamlined method for assessing level of traffic stress for people walking and biking and includes more factors than a traditional LTS analysis (such as buffer width from a sidewalk, and level of protection for a bike lane among others), as explained in more detail following.

The LTS and Streetscore+ system assigns a street a score from 1 to 4 based on a combination of factors. A Streetscore of 1 indicates the most comfortable, least stressful facility that accommodates people of all ages and abilities – one which a child could comfortably walk or bike, for example. A Streetscore of 4 indicates the least comfortable, most stressful facility that most people would avoid using – one in which only a very strong and fearless cyclist would ride. A facility with a Streetscore of 2 is also relatively low stress and accommodating, while a facility with Streetscore of 3 would be an environment that those familiar with biking and willing to accept a slightly more stressful environment might choose.

Figure 2: Streetscore+ Rankings

[1] Mekuria, M., Furth, P., & Nixon, H. (2012). Low Stress Bicycling and Network Connectivity. *Mineta Transportation Institute*. Retrieved from https://peterfurth.sites.northeastern.edu/2014/05/21/criteria-for-level-of-traffic-stress/.

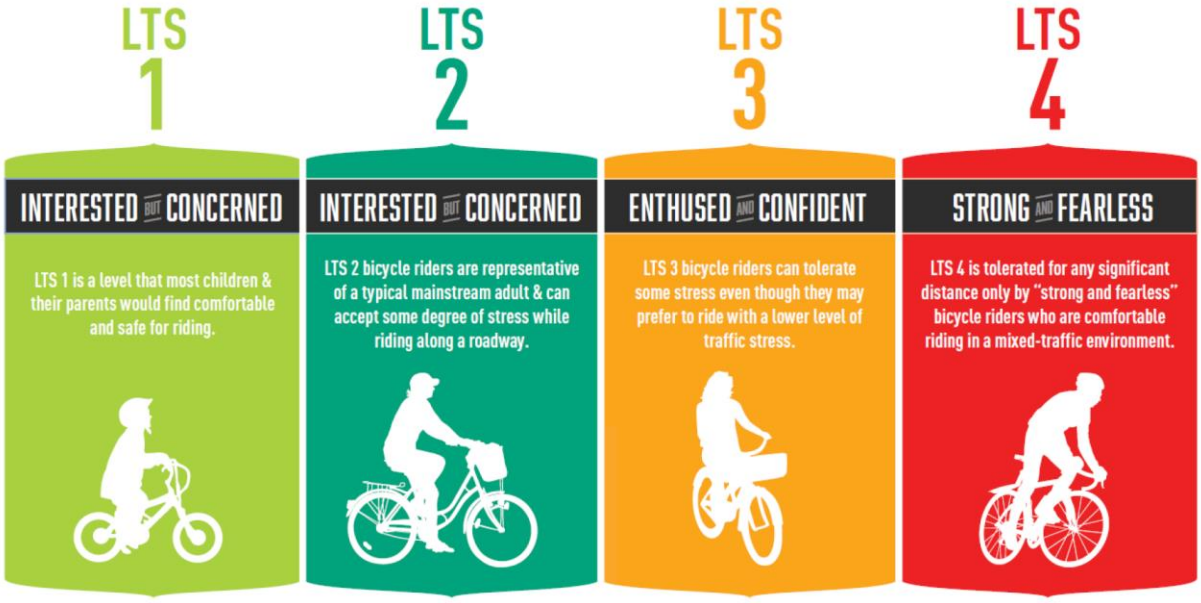


Figure 3: Level of Traffic Stress Scores

Bike Facility Methodology

Both Streetscore+ and LTS consider the type of facility, traffic speed, and number of lanes on a roadway segment to score bike paths, bike lanes with and without buffers, and bike routes. The Streetscore+ tool uses the LTS methodology for these facilities and builds upon LTS by considering additional attributes for separated bike lanes and bicycle boulevards. These attributes include items such as buffer width, barrier type, bike lane width, traffic volume, etc.

For the existing conditions analysis, these additional attributes were not necessary to collect because bike facilities on the corridor were either not provided or consisted of bike lanes or a multiuse path. Using the LTS methodology, multiuse paths are automatically given a score of 1. For bike lanes and other types of facilities, scores depend on the number of lanes and traffic speed.

Street Width

Speed Limit or Prevailing Speed	2-3 lanes	4-5 lanes	6+ lanes
Up to 25 mph	LTS 1 [a] or 2 [a]	LTS 3	LTS 4
30 mph	LTS 2 [a] or 3 [a]	LTS 4	LTS 4
35+ mph	LTS 4	LTS 4	LTS 4

Figure 4: Level of Traffic Stress Criteria

Data for each of these attributes was collected and coded for each segment of CO 42, then the Streetscore was calculated in GIS.

Pedestrian Facility Methodology

The pedestrian LTS methodology only considers the number of lanes, traffic speed, and instances of driveways on a given segment to assign a score. The existing conditions analysis went further, using Streetscore+ to rank facilities. Streetscore+ considers a more holistic range of roadway factors including number of lanes, traffic speed, sidewalk width, sidewalk quality, buffer width – and depending on facility – additional factors such as buffer quality, landscaping, driveways, and truck traffic.

Using lookup tables, such as the one below, individual attributes are given scores. Streetscore+ uses a "weakest link" approach in which the overall score is the lowest of the individual scores for a facility.

Table 2: Streetscore+ Criteria for Detached Sidewalks in Urbanized Areas

Criteria		Streetscore+ 1	Streetscore+ 2	Streetscore+ 3	Streetscore+ 4
# of Travel Lanes	***Buffer width >=14 feet***	2-3 lanes	4-5 lanes	6+ lanes	(no effect)
	Buffer width <14 feet	2-3 lanes	(no effect)	4-5 lanes	6+ lanes
Usable Sidewalk Width[2]		>=10 feet	9 to 8 feet	6 to 7 feet	< 6 feet
Sidewalk Quality		Even, Smooth Surface	(no effect)	Some Cracks and Upheavals, but usable sidewalk width is maintained	Cracks, Failing Pavement, such that usable sidewalk width is not maintained
Posted Speed Limit	***Buffer width >=14 feet***	<= 30 MPH	31-35 MPH	36-40 MPH	>=40 MPH
	Buffer with <14 feet	<= 25 MPH	26-30 MPH	31-35 MPH	>=36 MPH
Landscape Buffer and Street Trees		Yes, Continuous	Yes, Discontinuous[3]	No Landscaping	(no effect)

Source: Fehr & Peers.

However, Streetscore+ was developed for urban contexts. Given the largely rural-suburban context of CO 42, a state highway with certain speed thresholds, this study amended the Streetscore+ methodology slightly. For any sidewalk segment wide enough to be considered a multiuse path (greater than or equal to 8 feet) and with a buffer, scores ignored the posted speed limit score and were assigned based on next the lowest individual attribute score. Since speeds along the corridor are 45 or 50 mph in all locations,

without this change, the pedestrian score would have been a 4 in all locations, even if the facility was a wide, well-maintained path that is highly separated from automobile traffic by a wide vegetated buffer.

Motor Vehicle Traffic

The two MOEs were used to quantify efficient motor vehicle travel along the CO 42 corridor include: traffic level of service (LOS) and corridor travel time. Intersection level traffic volumes were collected as an input for both of these analyses.

Traffic Volumes

Existing

Due to the ongoing disruptions in traffic patterns in 2021 caused by the COVID-19 pandemic, StreetLight data was used to collect intersection turning movement counts (TMCs) at each study area intersection. StreetLight is a Big Data provider that estimates vehicle origin, destination, and routing travel patterns based on anonymous smartphone data from global positioning system (GPS) enabled mobile applications. The traffic count data from StreetLight was calibrated with annual average daily traffic (AADT) data on CO 42 published by the Colorado Department of Transportation (CDOT). The data was also compared with observed counts from 2018 at two of the study area intersections (CO 42/ Baseline Road and CO 42/ Paschal) to ensure the data was reasonably close to observed counts.

StreetLight data was collected as an average of all Tuesdays, Wednesdays, and Thursdays in March, April, September, and October of 2019. This time period was chosen to represent pre-pandemic conditions, mid-week, when school is in session, and when the weather is less likely to impact roadway conditions and travel patterns.

Forecast

Future traffic operations were also analyzed using 2050 traffic forecasts. Traffic forecasts were developed by applying the growth forecasts on CO 42 and the major intersecting corridors from the DRCOG Focus travel demand model and using the Difference Method. The Difference Method is an industry standard methodology for forecasting traffic where the change in traffic volumes between the existing (2020) and future (2050) years are then applied to existing observed counts. This method was used as it relies as much as possible on observed counts and mitigates model error, as not every corridor in the DRCOG model is calibrated to existing conditions.

Using this method, traffic is forecast to grow by an average of about 36% along the CO 42 corridor by 2050, by 35% along Arapahoe Road, 69% along Baseline Road, and 48% along South Boulder Road. In general, growth was assumed to be 36% along smaller side streets, except along streets not expected to host significant future land use growth. A separate analysis was performed for the future west leg of Indian Peaks Trail based on forecast land use in that area.

Level of Service Analysis

Intersection level of service was calculated for the AM and PM peak hours on an average weekday at each study area intersection for existing conditions, future conditions, and each alternative using a SimTraffic model and post-processor. Levels range from LOS A to LOS F, which encompass a range of congestion types from uninterrupted traffic (LOS A) to highly congested conditions (LOS F). The description and intersection delay thresholds of each LOS category are described in **Table 3**. These are based on the Highway Capacity Manual. The LOS for signalized intersections is measured by the average delay per vehicle entering the intersection from all approaches, while the LOS for unsignalized intersections is measured by the average delay per vehicle on the approach with the highest average delay.

Table 3: Level of Service Description and Delay Thresholds at Intersections

Level of Service	Description	Signalized Intersection Delay (seconds)	Unsignalized Intersection Delay (seconds)
A	Free-flowing conditions.	0-10	0-10
B	Stable operating conditions.	10-20	10-15
C	Stable operating conditions, but individual motorists are affected by the interaction with other motorists.	20-35	15-25
D	High density of motorists, but stable flow.	35-55	25-35
E	Near-capacity operations, with speeds reduced to a low but uniform speed.	55-80	35-50
F	Over-capacity conditions with long delays.	> 80	>50

Source: Highway Capacity Manual 2016, Transportation Research Board

Travel Time Analysis

The SimTraffic model outputs included average travel time for vehicles driving the length of the CO 42 corridor during the AM and PM peak hour, northbound and southbound.

Transit Operations

Existing Transit

Existing transit routes, frequency, and average daily ridership (boardings and alightings) by stop was collected from the Regional Transportation District (RTD) from the fall of 2019 to represent pre-pandemic conditions.

Future BRT

The MOE included measuring the ability to accommodate future bus rapid transit (BRT) in the corridor. This was measured in this analysis by estimating the number of intersection approaches that could either accommodate a bus queue jump lane or where a bus queue jump lane would not be needed under each

alternative. A total of seven intersection approaches were identified as potentially needing a transit queue jump lane due to the possibility of traffic congestion during peak times. These included the following:

1. Baseline Road southbound approach
2. Baseline Road northbound approach
3. South Boulder Road southbound approach
4. South Boulder Road northbound approach
5. Pine Street southbound approach
6. Pine Street northbound approach
7. Lock Street southbound approach

The northbound approach of Lock Street was not analyzed because it is outside of the study area. The northbound approach to Arapahoe Road was also not included because design for that intersection is being developed as part of a separate project. All other signalized intersections in the corridor are minor streets with less traffic volume and minimal congestion, and thus were excluded from the analysis.

A multistep process was used to determine whether a bus queue jump lane was needed and could be accommodated at each of the seven intersection approaches under each alternative, as **Figure 5** shows.

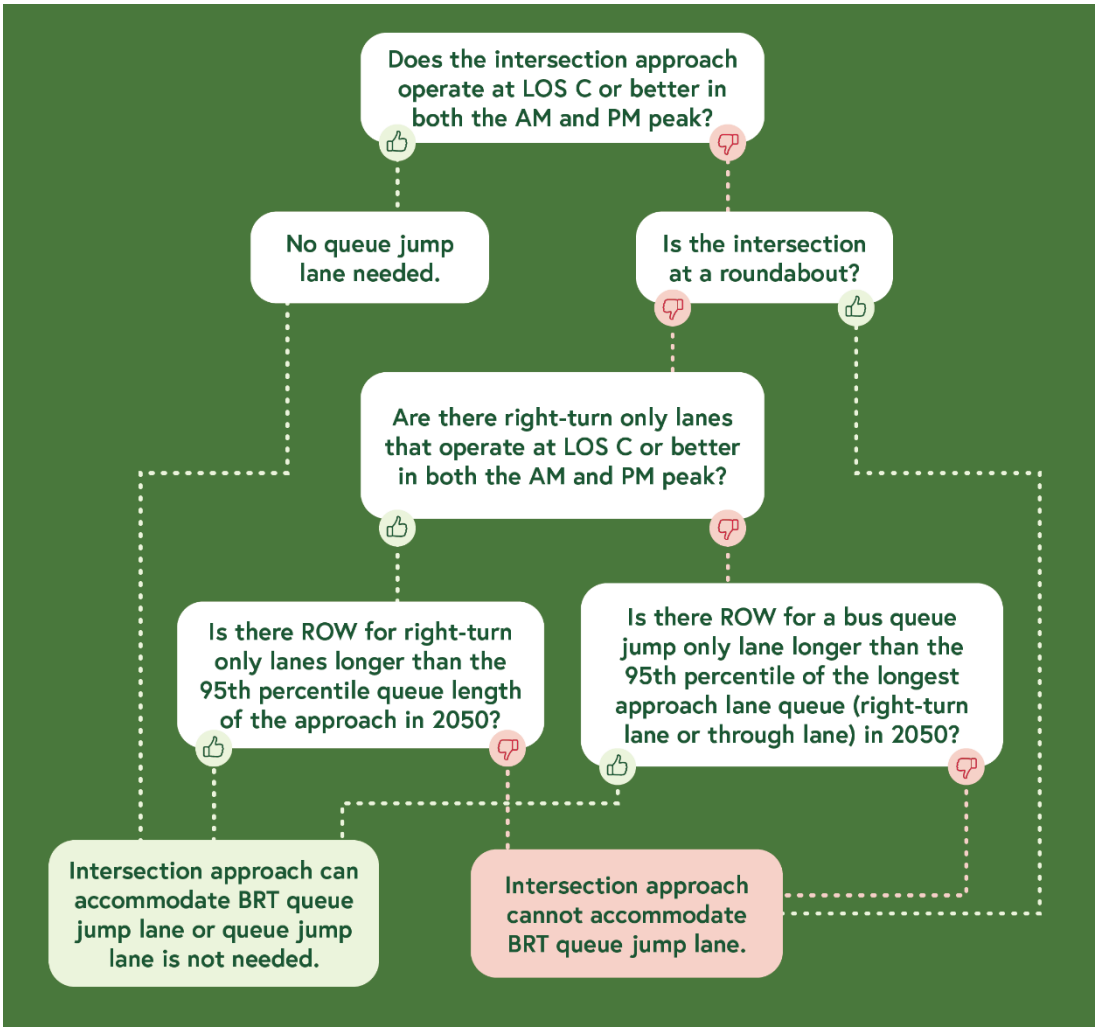


Figure 5: Methodology to Determine if an Intersection can Accommodate a Transit Queue Jump

Existing Conditions

Motor Vehicle

Lane Configurations and Traffic Volumes

Most of the CO 42 corridor has two through lanes with left-turn and right-turn lanes at many intersections. Two short segments of the corridor have four lanes on either side of the largest intersecting roads: Baseline Road and South Boulder Road. Around the Baseline Road intersection, CO 42 is four lanes between Hecla Street and Cannon Circle.

Figure 7 shows the existing lane configurations at each of the 12 study area intersections along with existing morning and afternoon peak hour turning movement traffic volumes. **Figure 8** shows forecast 2050 peak hour turning movement traffic volumes as each of the study area intersections. A few locations also have channelized right-turn lanes, including the following:

- Baseline Road (all directions)
- South Boulder Road (eastbound right and southbound right)
- Lock Street (westbound right and northbound right)

Figure 6 shows that current traffic volumes along CO 42 range from 12,000 cars per day passing through the intersection at Arapahoe Road to 20,000 cars per day at South Boulder Road. By 2050, these volumes are expected to grow to 17,000 to 28,000 vehicles per day respectively.

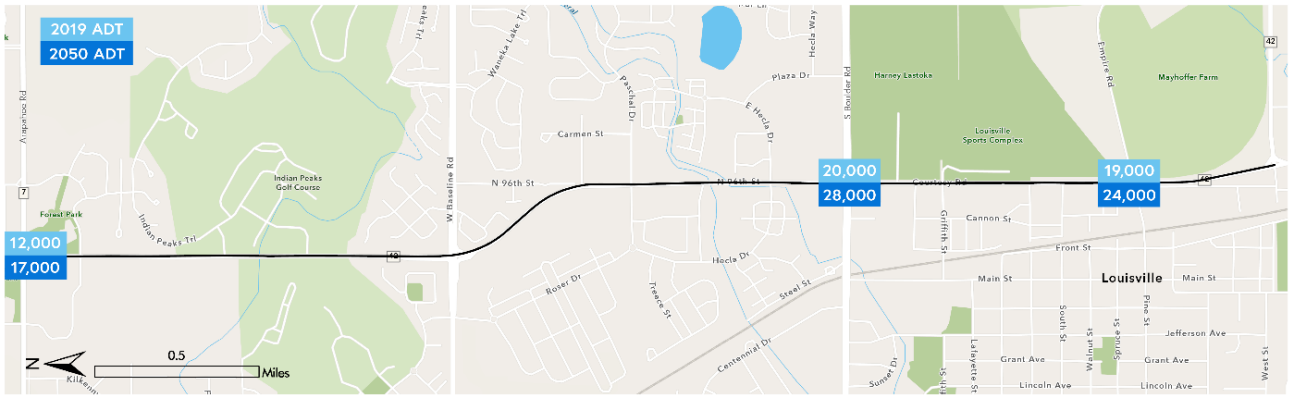


Figure 6: ADT Forecasts on CO 42

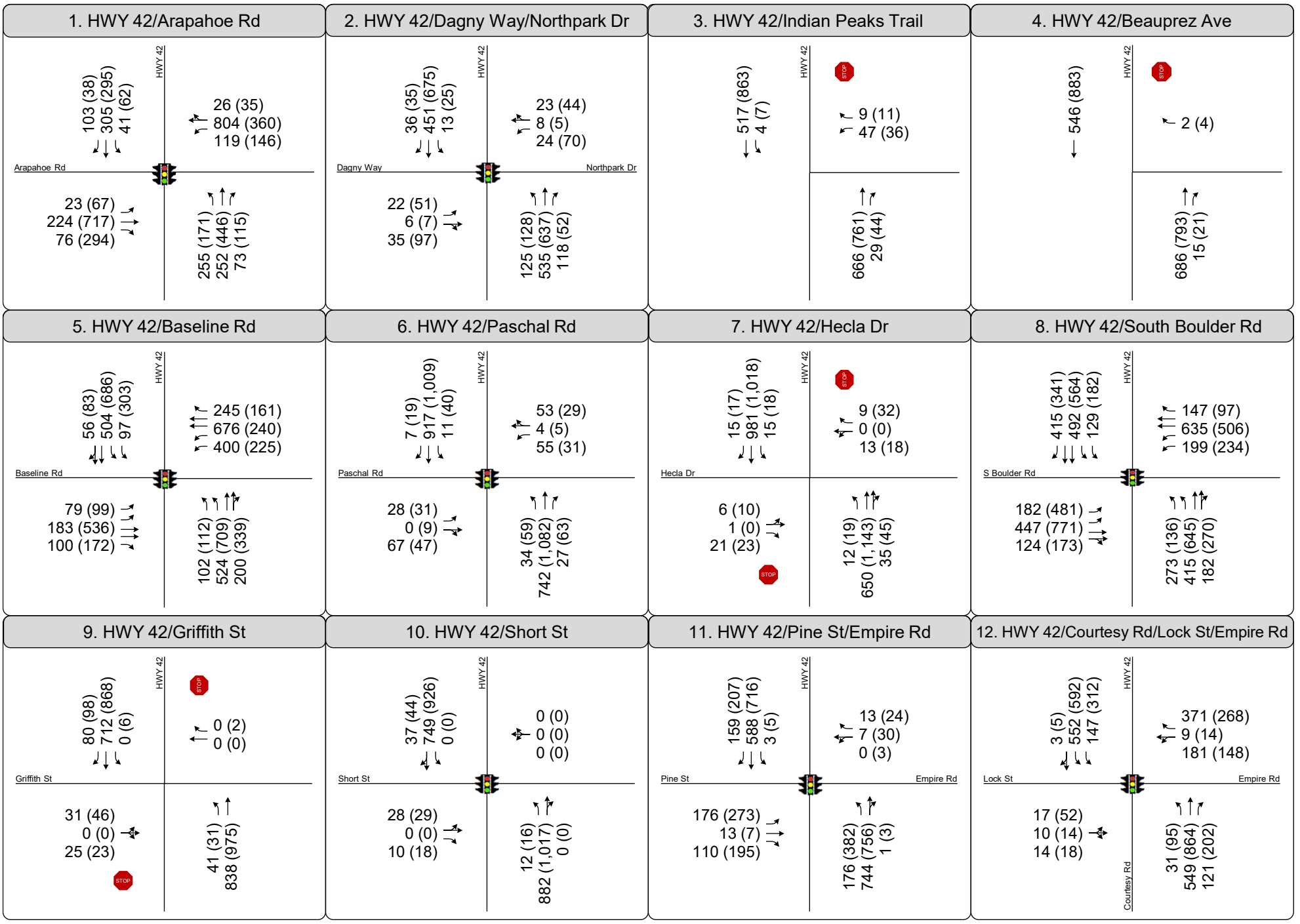
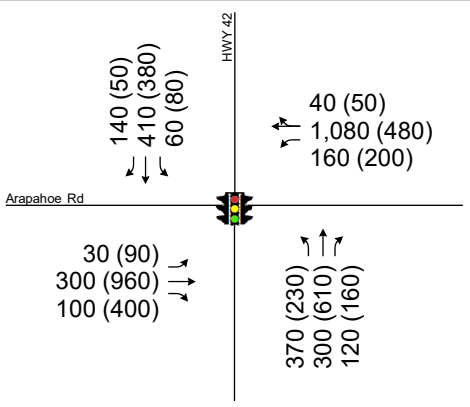


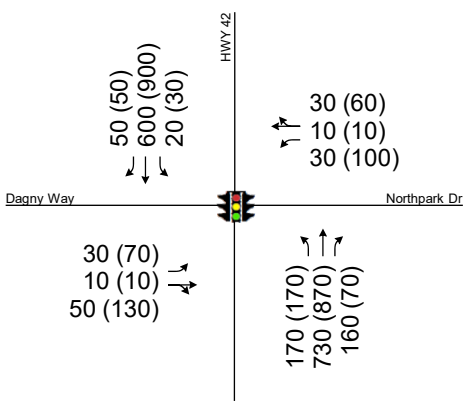
Figure 7

Peak Hour Traffic Volumes and Lane Configurations - Future 42: Existing

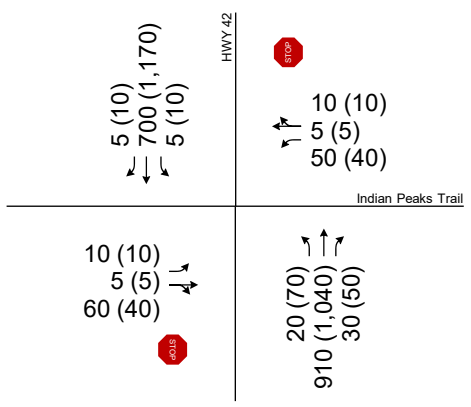
1. HWY 42/Arapahoe Rd



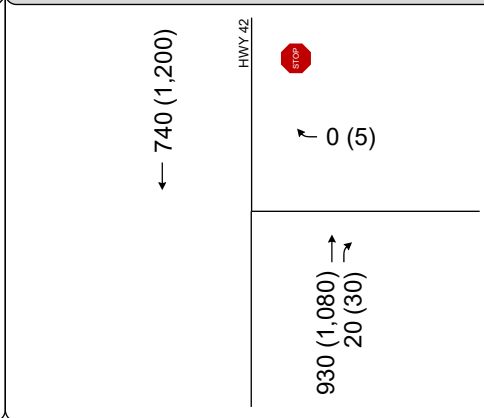
2. HWY 42/Dagny Way/Northpark Dr



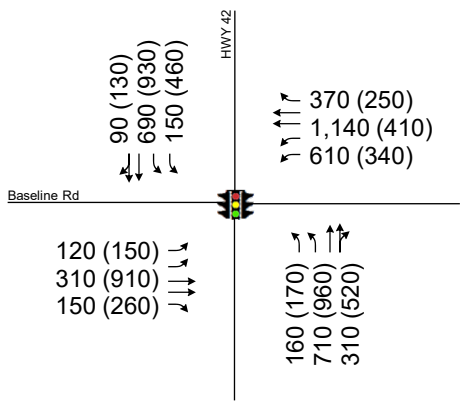
3. HWY 42/Indian Peaks Trail



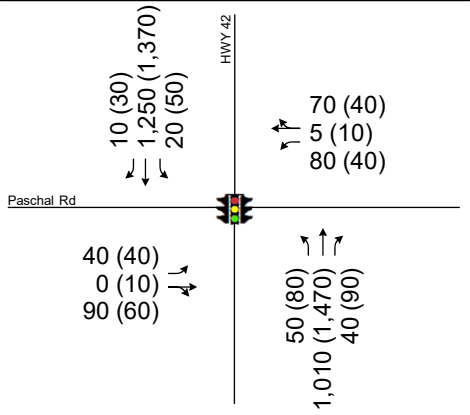
4. HWY 42/Beauprez Ave



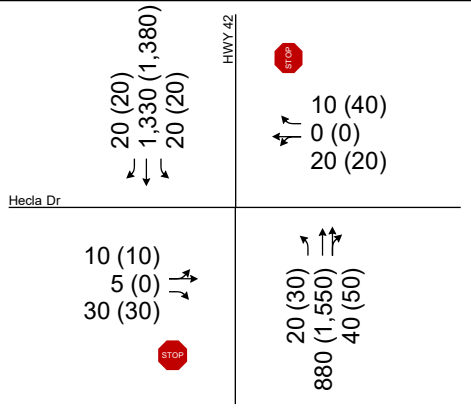
5. HWY 42/Baseline Rd



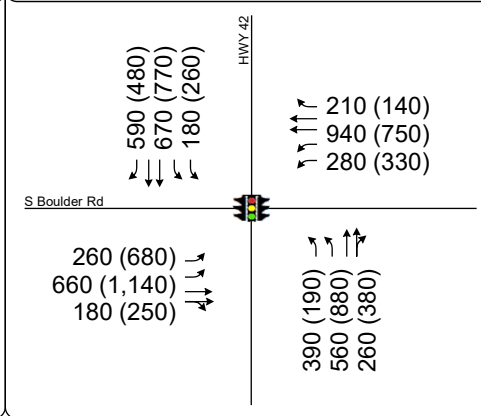
6. HWY 42/Paschal Rd



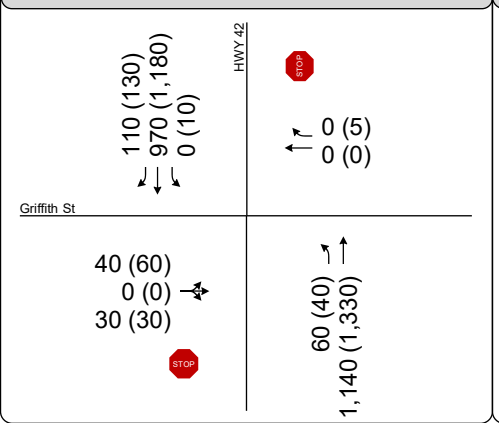
7. HWY 42/Hecla Dr



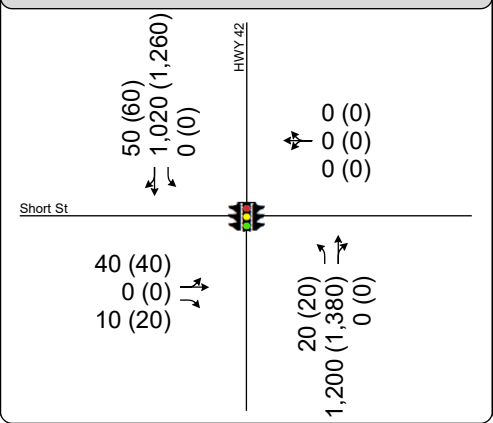
8. HWY 42/South Boulder Rd



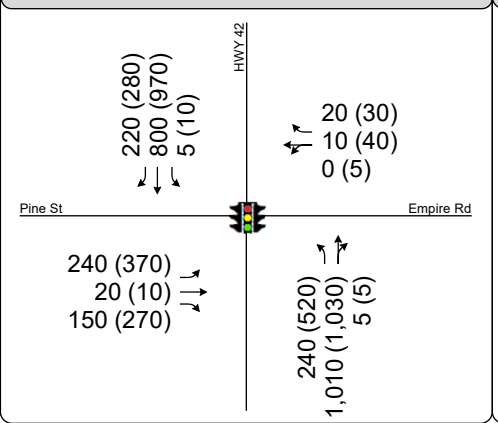
9. HWY 42/Griffith St



10. HWY 42/Short St



11. HWY 42/Pine St/Empire Rd



12. HWY 42/Courtesy Rd/Lock St/Empire Rd

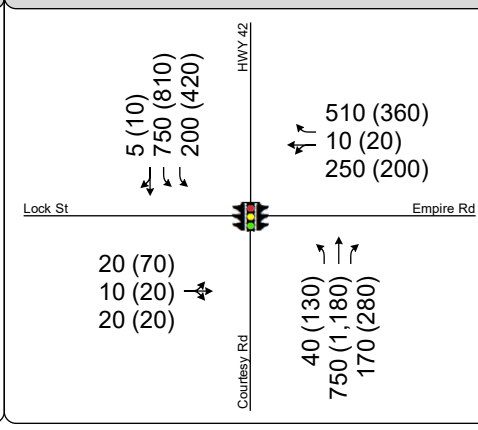


Figure 8

Peak Hour Traffic Volumes and Lane Configurations - Future 42: 2050

Table 4 shows the generalized daily volume thresholds for LOS D and LOS E conditions for a two-lane and four-lane road based on the Highway Capacity Manual. However, a more detailed traffic simulation analysis modeled from the observed operating conditions at each intersection (including peak hour turning movement volumes, intersection lane configurations, and current signal timing) will provide a more accurate LOS assessment along the corridor.

Table 4: HCM Level of Service Generalized Thresholds

Number of Lanes	LOS D Threshold	LOS E Threshold
2 Lanes	18,400 ADT	19,700 ADT
4 Lanes	36,800 ADT	37,500 ADT

Source: Highway Capacity Manual, 2010; Assumes K-factor of 0.10 and D-factor of 0.50.

Left-Turn Signal Operations

There are eight intersections in the study area that are signalized. The corridor has a mix of permitted, permitted-protected, and protected-only left-turn signal operations (illustrated in **Figure 9**) and summarized in **Table 5**.

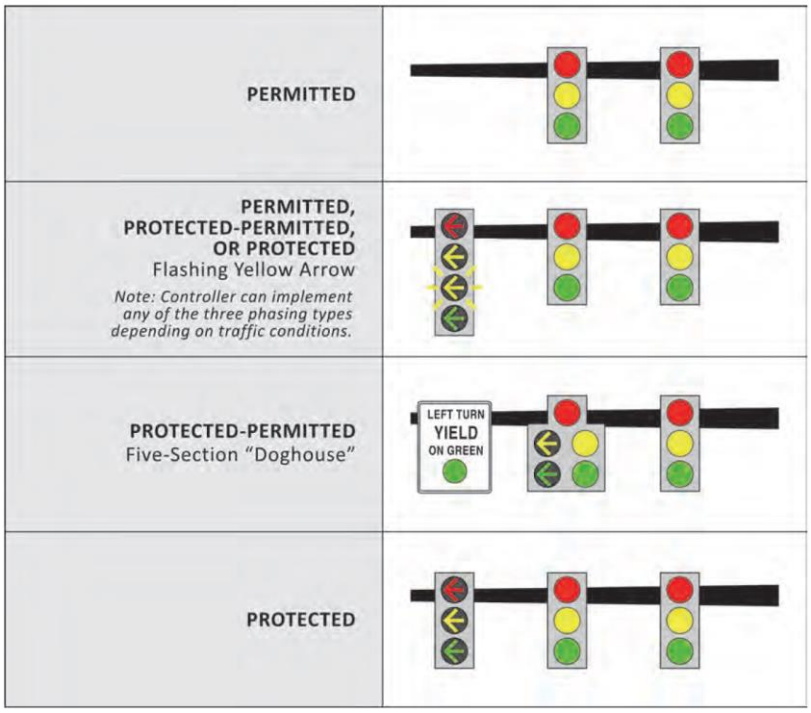


Figure 9: Example of Left-Turn Signal Phasing in the CO 42 Corridor

Source: NCHRP Report 812, Signal Timing Manual, 2nd Edition.

Table 5: Existing Left-Turn Signal Phasing by Intersection in the CO 42 Corridor

Intersection with CO 42	Westbound Left	Eastbound Left	Northbound Left	Southbound Left
Arapahoe Road	Protected-Permitted	Protected-Permitted	Protected-Permitted	Protected-Permitted
Northpark Drive/ Dagny Way	Permitted	Permitted	Protected-Permitted	Protected-Permitted
Baseline Road	Protected-Only	Protected-Only	Protected-Only	Protected-Only
Paschal Drive	Permitted	Permitted	Protected-Permitted	Protected-Permitted
South Boulder Road	Protected-Only	Protected-Only	Protected-Only	Protected-Only
Short Street	Permitted	Permitted	Protected-Permitted	Protected-Permitted
Pine Street/ Empire Road	Protected-Only	Protected-Only	Protected-Permitted	Protected-Permitted
Lock Street/ Empire Road	Permitted	Permitted	Permitted	Protected-Only

- **Protected-only** signals have an exclusive signal phase for left-turn movements (left arrow signal heads) and drivers can only turn left on a green arrow.
- **Permitted signal** operations do not have an exclusive left-turn signal phase and drivers making a left turn can proceed on a green ball, when opposing traffic and parallel pedestrian crossings are clear.
- **Protected-permitted** signal phase provides an exclusive left-turn signal phase, but also allow drivers to make a left on a green ball (when opposing traffic is clear).

There are benefits and tradeoffs for traffic safety and LOS with each type of left-turn signal phasing depending on the context. In general, permitted left-turn signal phasing has the lowest safety benefit, while protected-only has the highest safety benefit in mitigating left-turn angle crashes. The LOS of intersections with each signal phase varies depending on context, but in general, permitted-protected operations typically results in better LOS than protected-only.

Traffic Level of Service

Figure 10 summarizes the existing (2019) traffic LOS in the AM and PM peak hour at the 12 study area intersections.

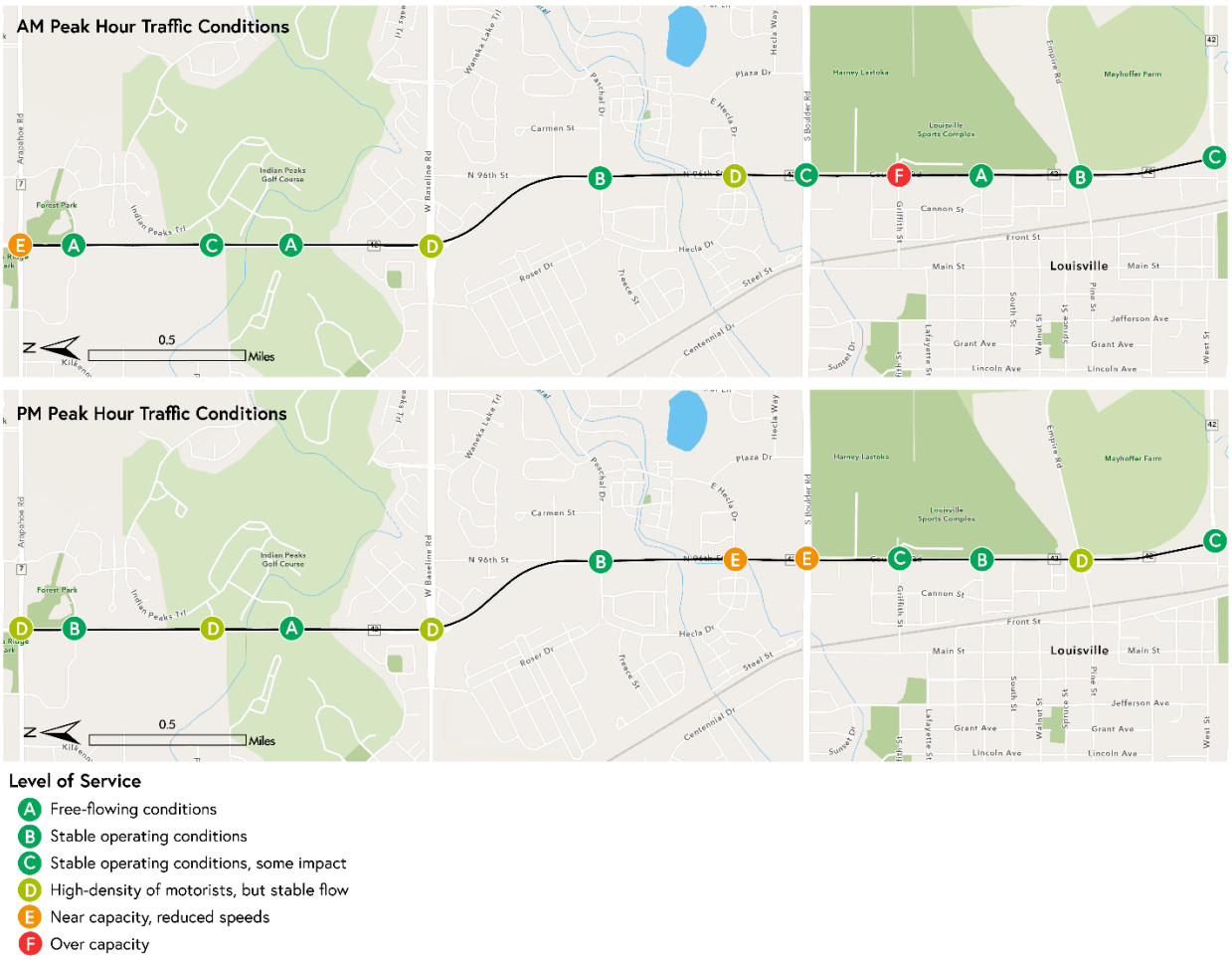


Figure 10: Existing Traffic Level of Service

During the morning peak hour, three intersections operate at LOS E:

- The CO 42 and Arapahoe Road intersection operates at LOS E due to a large volume westbound traffic as well as a large volume of northbound left traffic that competes for green time with the southbound through traffic.
- The intersection of CO 42 and Indian Peaks Trail also operates at LOS E due to the high volume of vehicles making a westbound left and the challenge in findings a gap in traffic on CO 42.
- The intersection of CO 42 and Griffith Street also operates at LOS E during the morning peak due to the high volume of eastbound left and northbound left turns and difficulty in finding a gap in traffic on CO 42 for drivers because of the high volume of southbound through movement on CO 42. The demand for these turns is high in the morning peak likely due to school drop-off at the Louisville Middle School at Main Street and Griffith Street.

In the afternoon peak five intersections in the study area were found to operate at LOS E or F:

- CO 42 and Baseline Road operates at LOS E in the afternoon peak due to high volumes of traffic along multiple approaches, particularly the northbound through and right turn, and southbound left turn. There is also poor lane utilization for the northbound through movement given a second through lane is added prior to this intersection and ends after passing through the intersection.
- CO 42 and Hecla Drive operates at LOS F in the PM peak due the delay in making an eastbound and westbound left. While these movements are not particularly high, the volume of northbound and southbound traffic on CO 42 is high resulting in few gaps to make and eastbound or westbound left.
- CO 42 and South Boulder Road operates at LOS E in the PM peak due to the high volume of northbound and eastbound volume, including particularly the high volume making an eastbound left turn.
- CO 42 and Griffith Street operates at LOS F in the PM peak due to the volume and high delay for drivers making an eastbound left and the difficulty in finding a gap in traffic along CO 42 in both directions.
- CO 42 and Pine Street operates at LOS E in the PM peak due to the high volume of traffic in the northbound through, northbound left, and eastbound left movements.

Corridor Travel Time

Table 6 summarizes the average vehicle travel time along CO 42 in each direction between Arapahoe Road and Lock Street during the peak periods. The fastest peak period travel time was found to be 7.3 minutes northbound in the morning peak. The slowest travel time was found to be the northbound direction in the afternoon peak at 11 minutes, which is nearly four minutes slower than the morning peak. The southbound travel time is about the same in both the morning and afternoon peak at around 8.5 minutes.

Table 6: Corridor Travel Time Based on Direction and Time of Day

Direction	AM Peak	PM Peak
Northbound	7.3 min	11.0 min
Southbound	8.5 min	8.3 min

Source: Fehr & Peers.

Origin-Destination Analysis

An origin-destination (O-D) analysis using mobile device data from StreetLight was performed to understand the portion of trips in the corridor that are local versus regional in nature. **Figure 11** shows the O-D profile of vehicle trips that pass-through CO 42 just north of South Boulder Road. This data shows that during peak periods, just over half of vehicle trips have one trip end in either Lafayette or Louisville and one trip end outside of those communities. Another 29% of vehicle trips on CO 42 at that location are entirely local, with both trip ends in Louisville or Lafayette. Only 19% of trips were entirely

pass-through. During off-peak times, the percent of local trips is even higher. This data suggests that CO 42 is primarily used by people with a local destination, rather than for pass-through trips.

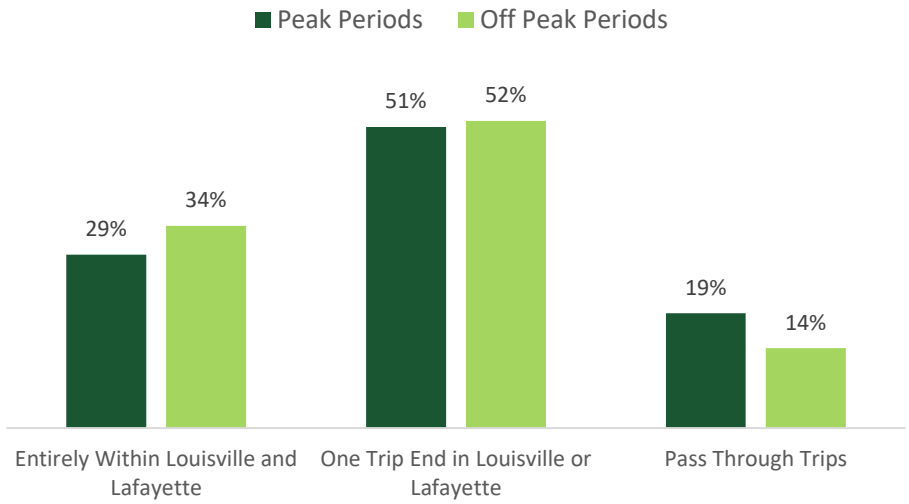


Figure 11: 2019 Origin-Destination StreetLight Data on CO 42 North of South Boulder Road

Figure 12 shows the percent of trips that are pass-through trips at four different locations along CO 42. This data shows that only a small percentage of trips are pass-through trips along most of the corridor. This data reinforces that the corridor is serving more local trips than pass-through trips.

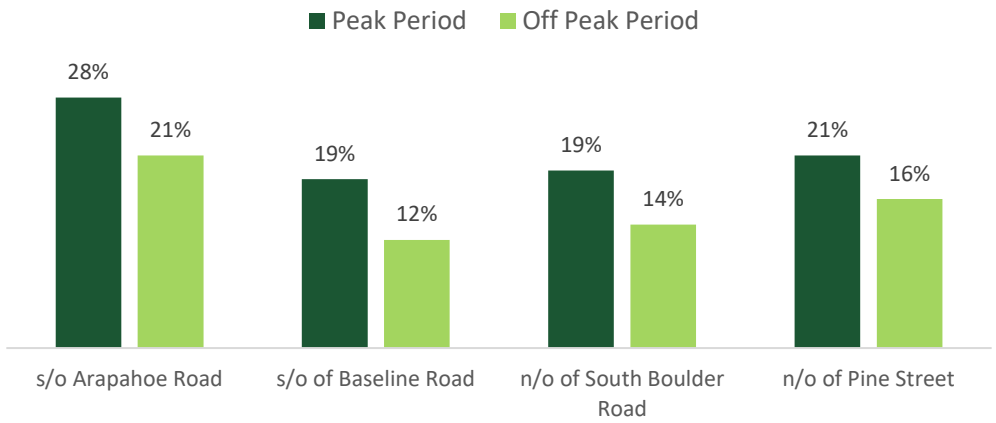


Figure 12: Percent of Pass-Through Trips in 2019 on CO 42 From StreetLight Data

Traffic Safety

Posted and Operating Speed

Posted speeds along the corridor are 50 mph north of Paschal Drive and 45 mph south of Paschal Drive, except for the northbound direction between Northpark Drive and Arapahoe Road, which is posted at 45 mph. Based on speed observations collected in the field in May 2021 at three locations in the corridor, as

shown in **Figure 13,** the 85th percentile speeds along the corridor are slightly above the posted speed limit at all three locations (about 1 - 4 mph higher).

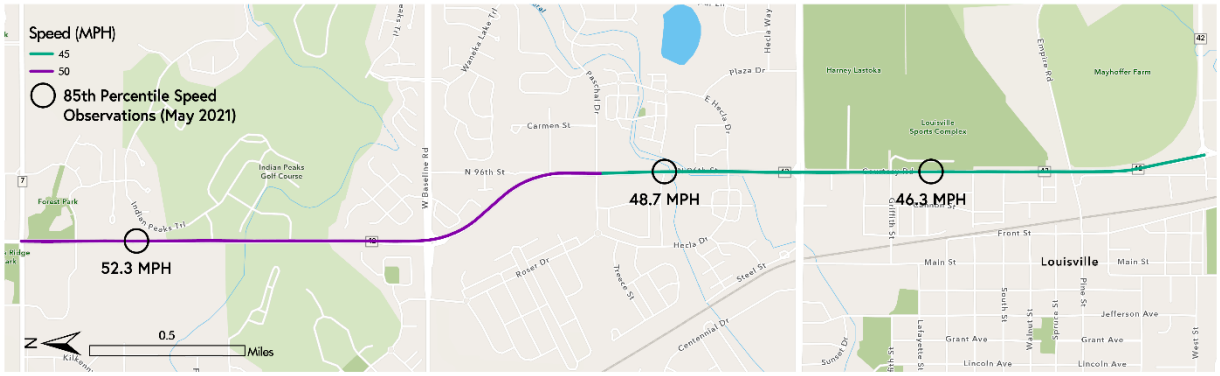


Figure 13: Posted Speeds vs. Observed Operating Speeds

Crash Analysis

Figure 14 shows that in the five-year study period (between 2015 and 2019) there were 445 crashes along the CO 42, nine of which resulted in a severe injury, including one fatality. The fatal crash occurred on February 5, 2018 at CO 42 and Hecla Drive when a northbound driver struck and killed an eastbound pedestrian walking in the roadway against traffic.

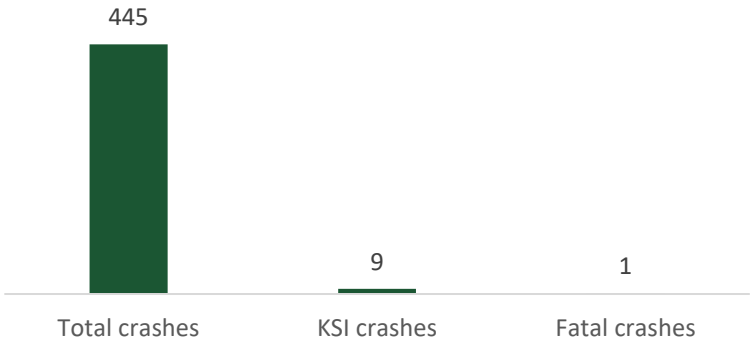


Figure 14: Corridor-Wide Crashes by Severity on CO 42, 2015 - 2019

Figure 15 shows the top harmful events for total crashes and just killed or severely injured (KSI) crashes. The profile for the two are different, which provides insight into which crash types are most concerning from a safety standpoint. While the majority of total crashes along CO 42 were rear end crashes, they represent a much smaller portion of KSI crashes. The majority of KSI crashes (about two thirds) were from broadside crashes, despite that only representing 13% of total crashes. Similarly, two of the nine KSI crashes involved a pedestrian or bicyclist, despite those crash types representing fewer than 1% of total crashes.

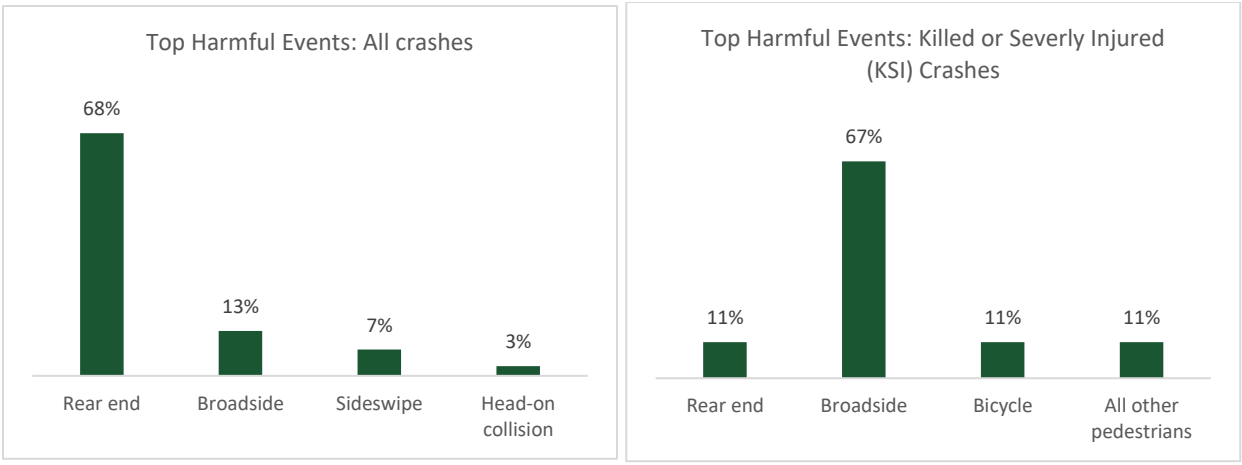


Figure 15: Top Harmful Events for Crashes on CO 42, 2015 – 2019

Figure 16 shows the concentration of crashes in the corridor by location. Crash locations are also mapped in **Figure 17** through **Figure 19**, including crashes involving a pedestrian or bicyclist and fatal crashes during the study period. The greatest number of crashes occurred at the major intersections along CO 42, including at Arapahoe Road, Baseline Road, South Boulder Road, Pine Street/Empire Road, and Lock Street/Empire Road.

However, pedestrian and bicycle crashes and KSI crashes are not concentrated at these locations, as shown in **Figure 16**. In fact, while the highest number of overall crashes occurred at Baseline Road and South Boulder Road, there were no reported KSI crashes at theses intersection during the study period. The highest concentration of KSI crashes occurred at Hecla Drive and Lock Street/ Empire Road. Notably, left turns are completely protected at both Baseline Road and South Boulder Road (with protected-only left-turn signal operation), while Hecla Drive is an unsignalized crossing, and three of the four left-turn movements at Lock Street/ Empire Road operate as permitted left turns (see **Table 5**).

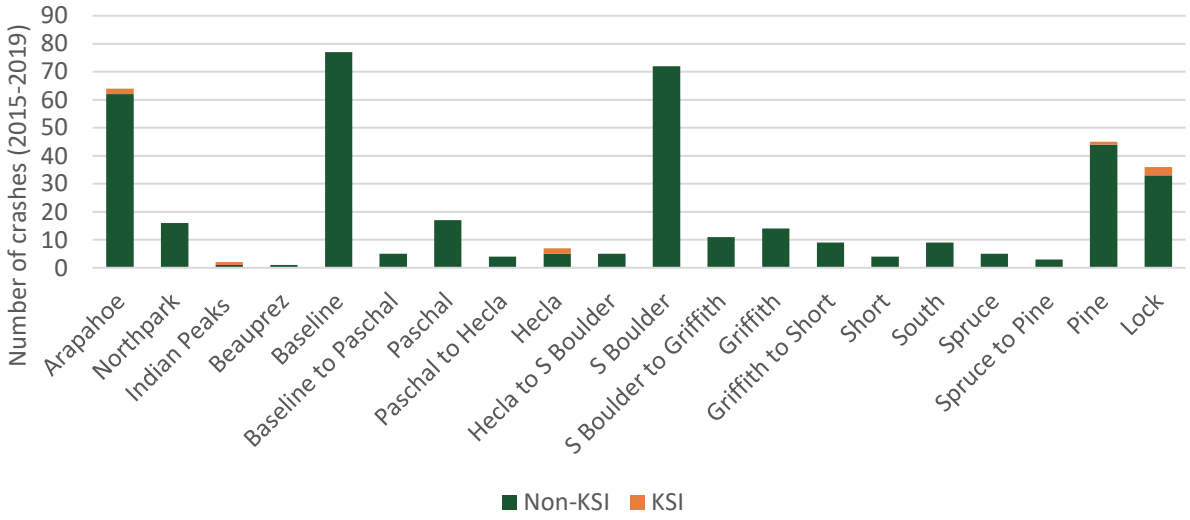


Figure 16: Crashes by Location

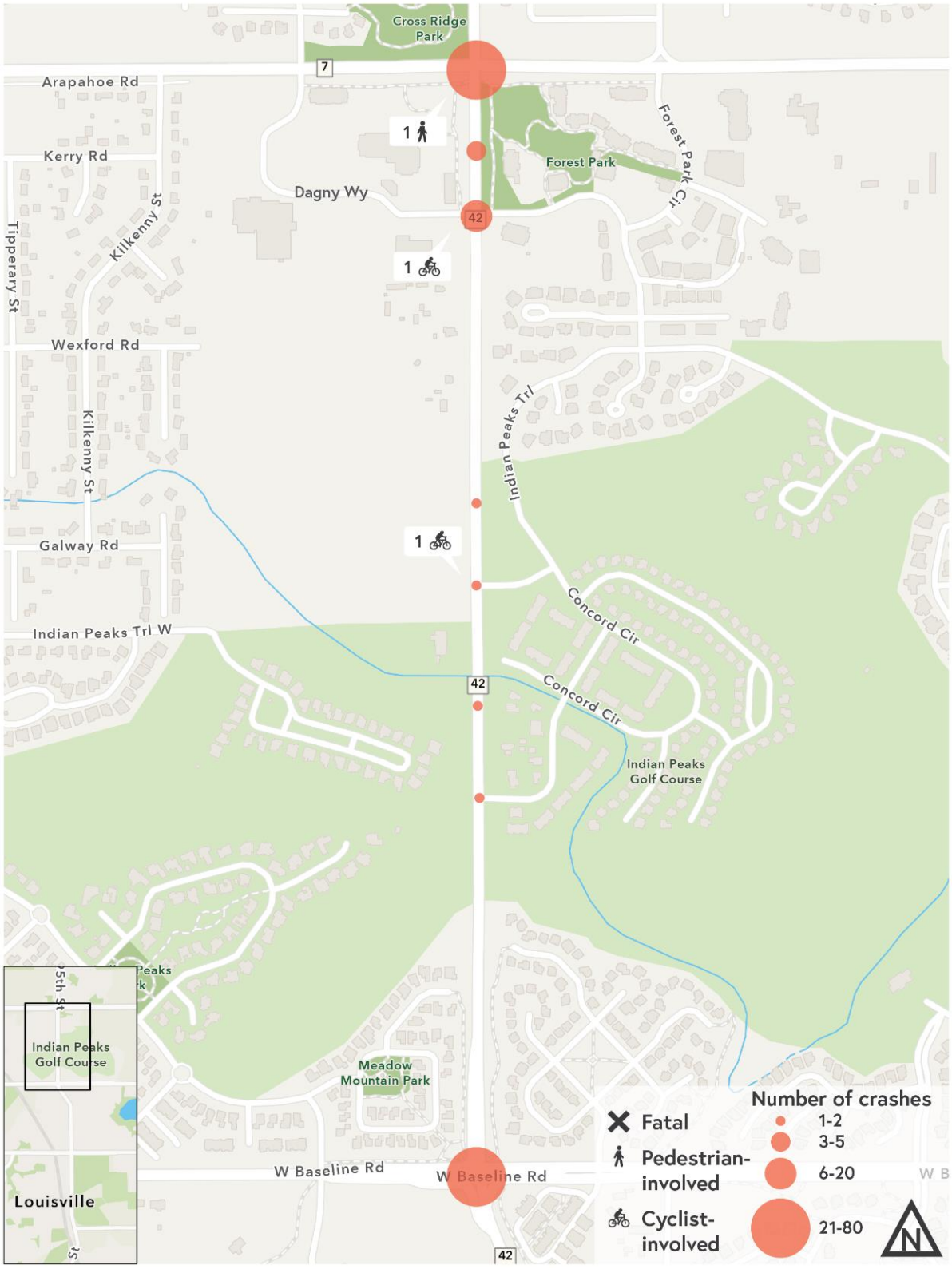


Figure 17: Crashes from Arapahoe Road to Baseline Road

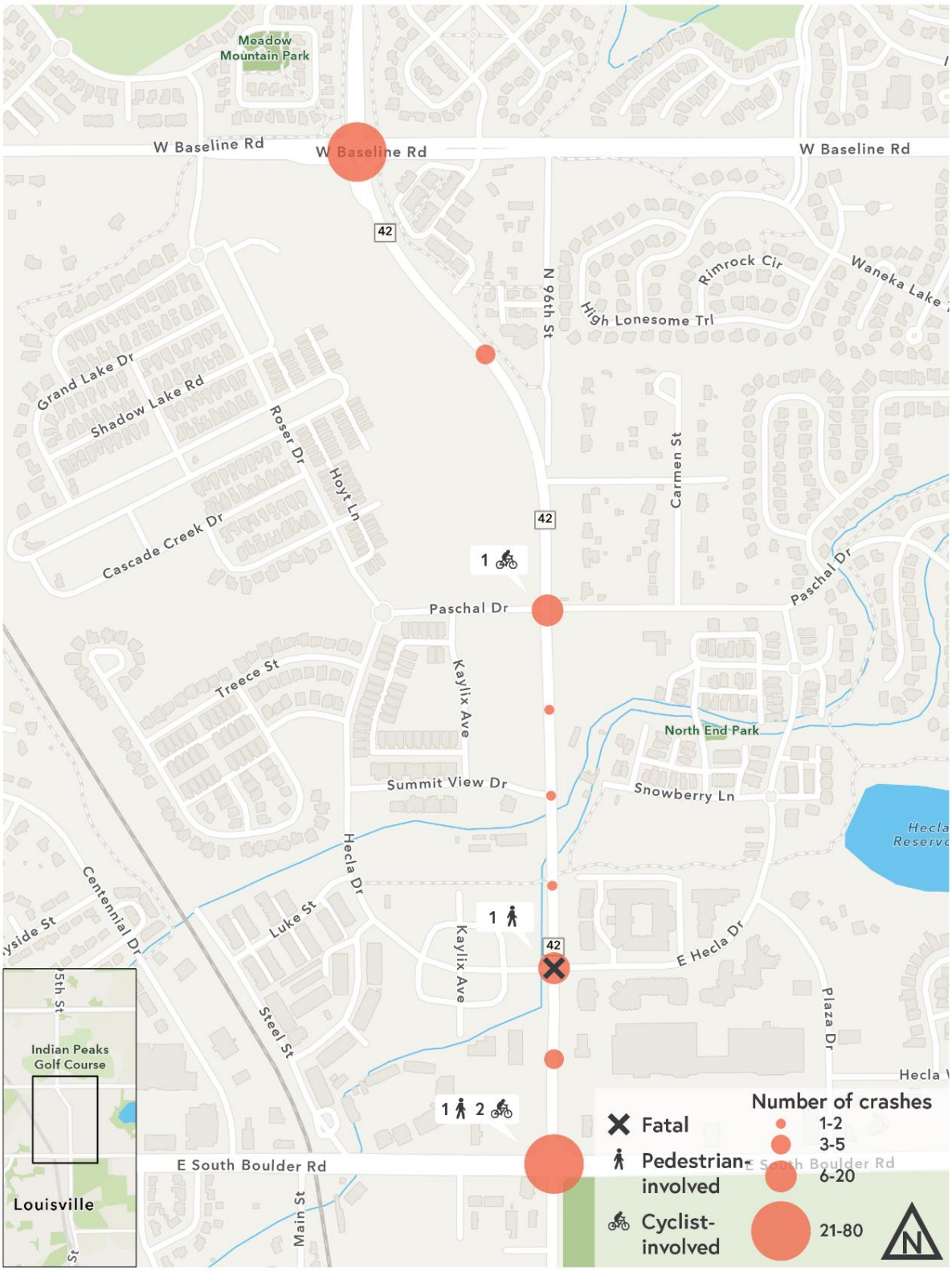


Figure 18: Crashes from Baseline Road to South Boulder Road

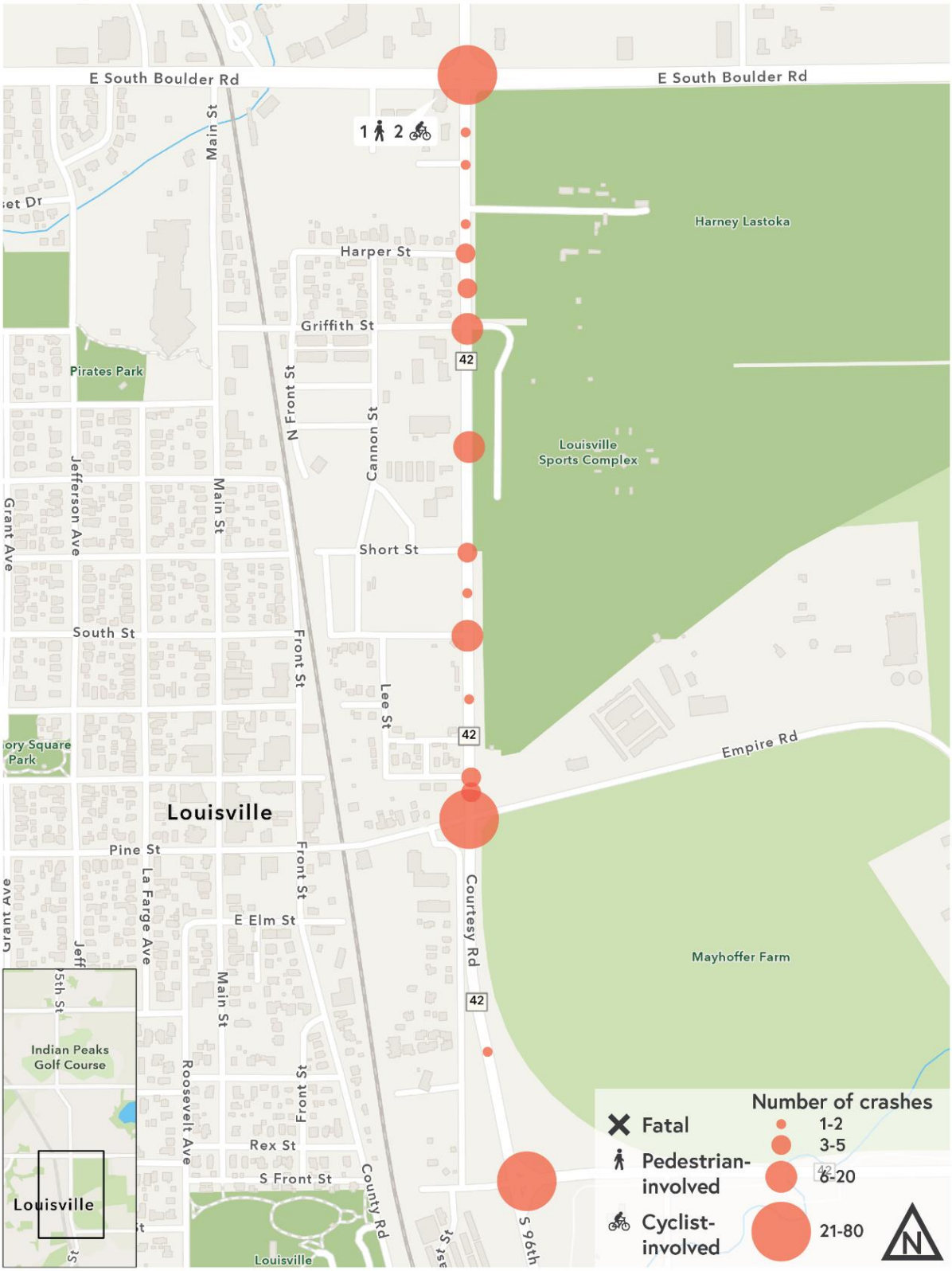


Figure 19: Crashes from South Boulder Road to Lock Street/ Empire Road

Table 7 describes the characteristics of the most common crash types and KSI crash types at several major intersections in the CO 42 corridor. Serious injury crashes occurred at Arapahoe Road, Pine Street/ Empire Road, and Lock Street/ Empire Road, but not at Baseline Road and South Boulder Road, which have protected-only left turns at all approaches. Arapahoe Road had a high percentage of left-turn related crashes, one of which was pedestrian-involved. Pine Street and Lock Street both have a high share of broadside and left-turn crashes. South Boulder Road has a high percentage of pedestrian- and bicycle-involved crashes.

Table 7: Top Crash Locations and Characteristics

Location	Characteristic
SH 42 & Arapahoe Road	High percentage of left-turn related crashes, including one pedestrian-involved
SH 42 & Hecla Drive	High percentage of broadside and left-turn crashes and one fatal crash
SH 42 & South Boulder Road	High volume of pedestrian and bicyclist-involved crashes
SH 42 & Pine Street	High volume of broadside and left-turn crashes
SH 42 & Lock Street	High volume of broadside and left-turn crashes

Source: Fehr & Peers.

There was one fatal crash and eight crashes resulting in serious injury in the corridor in the five-year data collection period:

- Arapahoe Road
    - A serious-injury crash occurred when a northbound driver disregarded a stop sign and broadsided an eastbound driver. Three people were injured, one seriously.
    - A serious-injury crash occurred when a westbound driver making an improper left turn broadsided an eastbound driver. Two people were injured, one seriously.
- Indian Peaks Trail
    - A serious-injury crash occurred when a westbound driver making a left turn failed to yield ROW and hit a northbound cyclist that.
- Hecla Drive
    - A fatal crash occurred when an eastbound pedestrian crossing the roadway was hit and killed by a northbound driver.
    - A serious-injury crash occurred when a westbound driver making a left turn broadsided a northbound driver.
- Pine Street

    - A serious-injury crash occurred when a northbound driver turning left failed to yield ROW and broadsided a southbound driver.

- Lock Street
    - A serious-injury crash occurred when a southbound driver broadsided a westbound driver stopped in traffic.
    - A serious-injury crash occurred when a southbound driver rear-ended another southbound vehicle that was stopped in traffic.
    - A serious-injury crash occurred when a northbound driver broadsided a southbound driver when making an improper U-turn.

Five bicycle- and three pedestrian-involved crashes occurred in the corridor in the five-year data-collection period (two KSI, described above):

- A pedestrian-involved crash occurred a South Boulder Road when an eastbound driver making a right turn hit a pedestrian walking east and crossing against the signal.
- A bicycle-involved crash occurred at South Boulder Road when an eastbound driver making an improper right turn hit an eastbound cyclist.
- A pedestrian-involved crash occurred at Arapahoe Rd when an eastbound driver making a right turn hit a westbound pedestrian.

Transit

This section provides a description of existing and planned transit service along and across the CO 42 corridor.

Existing Routes and Ridership

The CO 42 study area is currently served by four RTD transit routes as shown in **Table 8**, including Route 225, Route 228, the DASH, and the JUMP. Three of these four routes cross the CO 42 corridor, including Route 225 and the JUMP, which operate along Arapahoe Road and Baseline Road respectively, at 15-minute frequencies during peak service hours, and the DASH, which crosses at South Boulder Road at 30-minute frequencies. Route 228 is the only current route that operates on CO 42 for a short distance between South Boulder Road and Paschal Drive with a stop at Hecla Drive at 60-minute frequencies.

Table 8: Bus Routes and Frequency

Route	Peak	Midday
225	15	30
228	60	60
DASH	30	30
JUMP	15	30

Source: RTD.

Figure 20 and **Figure 21** show transit service including ridership by stop in the fall of 2019. The highest ridership among the stops at or near CO 42 occurred at South Boulder Road and Paschal Drive. This map also depicts RTD's tentative plan to extend the Route 228 north along CO 42 to Arapahoe Road.

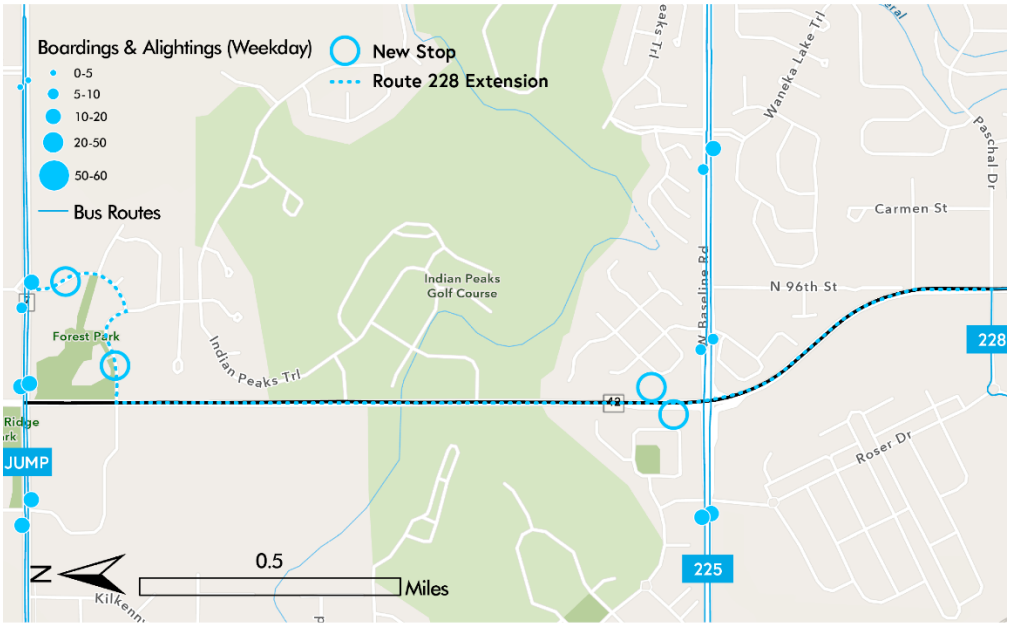


Figure 20: Existing Transit Routes and Ridership (North of Paschal Drive)

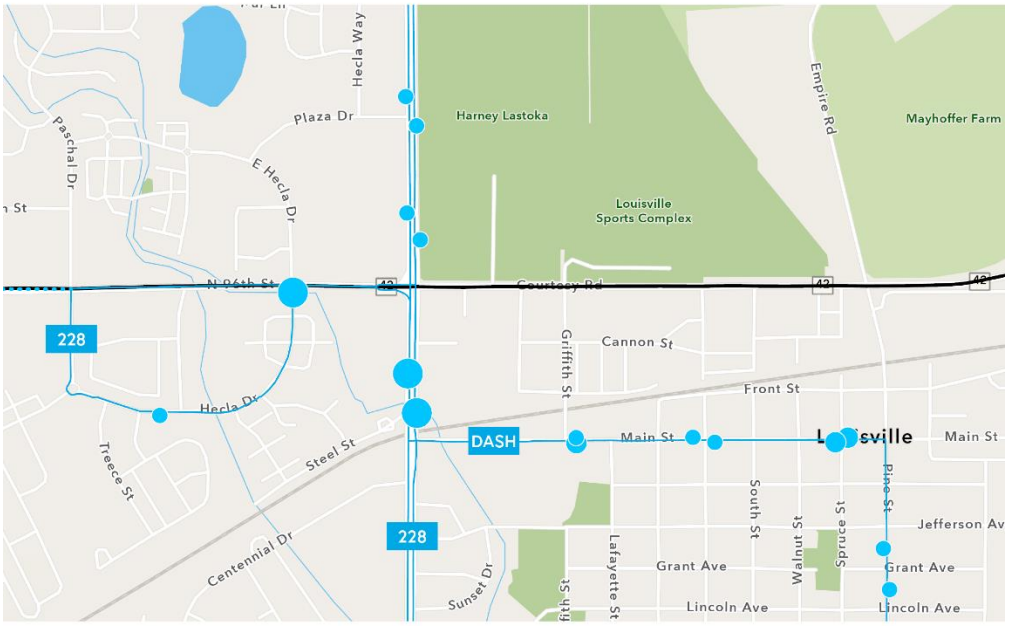


Figure 21: Existing Transit Routes and Ridership (South of Paschal Drive)

Future Transit

RTD completed the Northwest Area Mobility Study (NAMS) in 2014 to develop a priority list of mobility improvements for the northwest area of the agency's service area. NAMS identified five future bus rapid transit (BRT) corridors including a BRT along CO 42 as shown in **Figure 22**. The CO 42 BRT line would operate along CO 42 the length of the study area with termini at the intersection of Arapahoe Road and US 287 to the north and the US 36 and Broomfield Station to the south. NAMS assumed 30-minute frequencies along CO 42.

While specific station locations were not identified in NAMS, this analysis assumed that stations would at least occur at the major street crossings (including Arapahoe Road, Baseline Road, and South Boulder Road) to connect to other bus routes and near the planned Northwest Commuter Rail station in Downtown Louisville (which is preliminary planned near South Street). This study evaluated the ability for future design alternatives to accommodate a future BRT, including queue jump lanes as a core MOE.

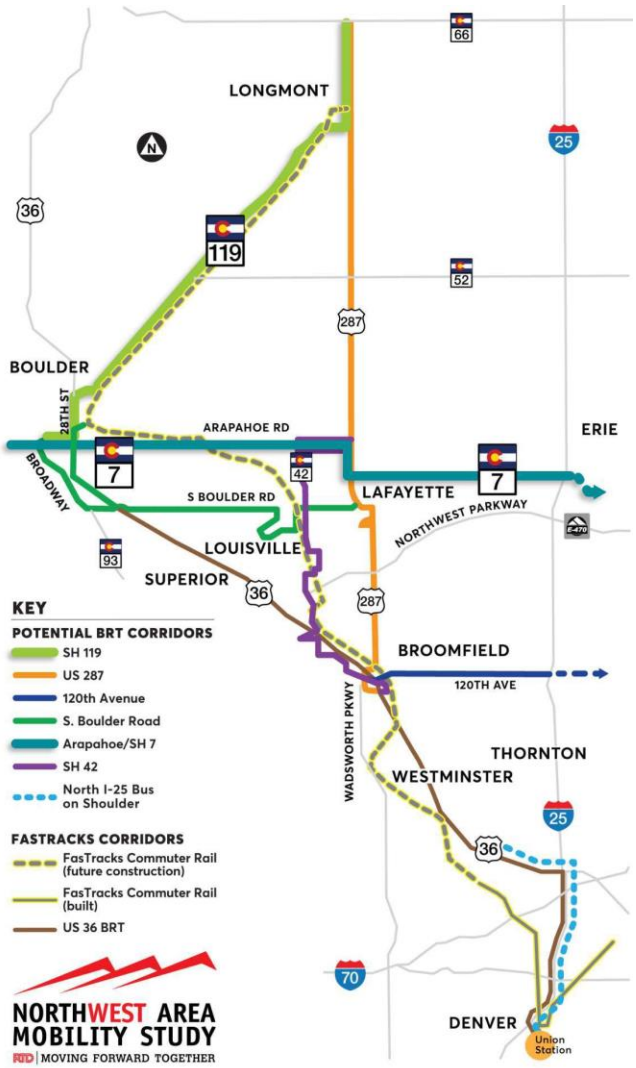


Figure 22: Future Transit Corridors Envisioned in NAMS

Walking and Biking

Existing Streetscore+ Scores

Figure 23 shows the pedestrian Streetscore rating for sidewalk and multiuse trail facilities along each side of the corridor. The white dashed line on the map indicates locations where the sidewalk is narrower than eight feet wide.

The best lowest stress facilities in the area, with a Streetscore of 2, were in areas between Baseline Road and South Boulder Road, where sidewalks have recently been upgraded to fit the standard of a multiuse path. These segments were scored did not meet the criteria for a 1 because of the lack of a wide enough buffer between the trail and the roadway.

Some segments south of South Boulder Road were scored a 4 due to the presence of narrow, attached sidewalks. However, most of the corridor lacks sidewalks entirely, particularly along the east edge of CO 42 south of Baseline Road. Sidewalks narrower than eight feet are scored no higher than a 3. Most of the segment between Baseline Road and Arapahoe Road has a Streetscore of 3 due to the narrow width of the sidewalk and the speed of the roadway in that location.

Figure 24 maps the bicycle Streetscore for on-street bike facilities in the corridor. The corridor lacks formal on-street bike facilities in all areas other than the west side of the road between South Boulder Road and Griffith Street, where there is a painted bike lane in the southbound direction. This facility has a Streetscore of 4 due to the proximity to fast, heavy vehicle traffic without a buffer.

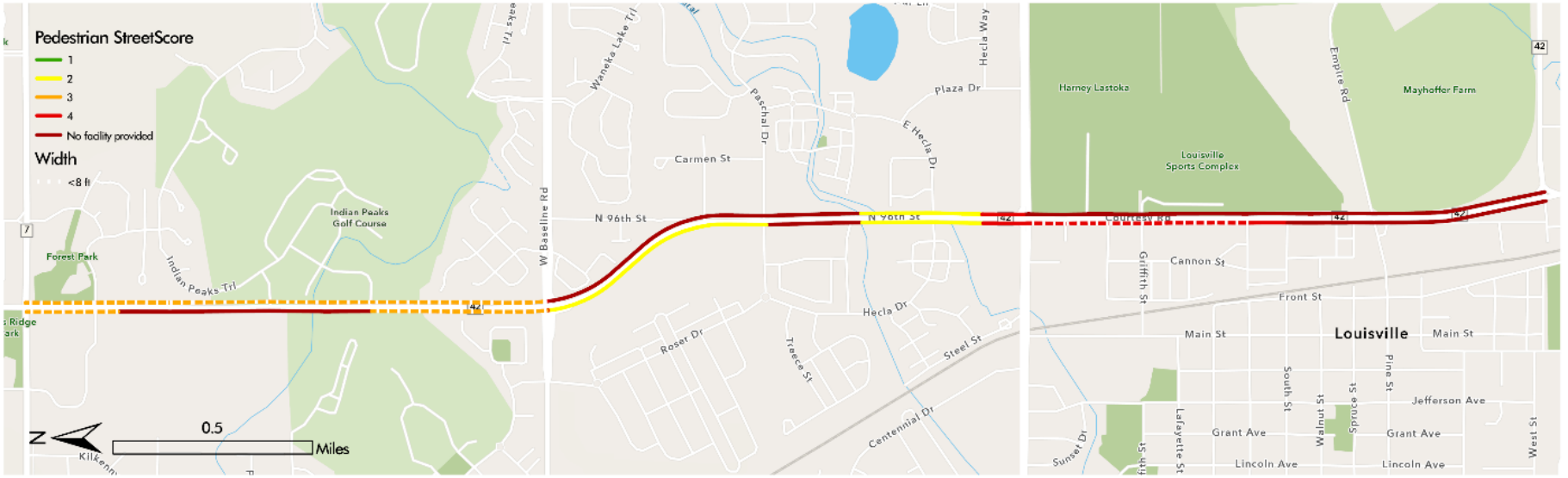


Figure 23: Sidewalk/Trail Streetscore

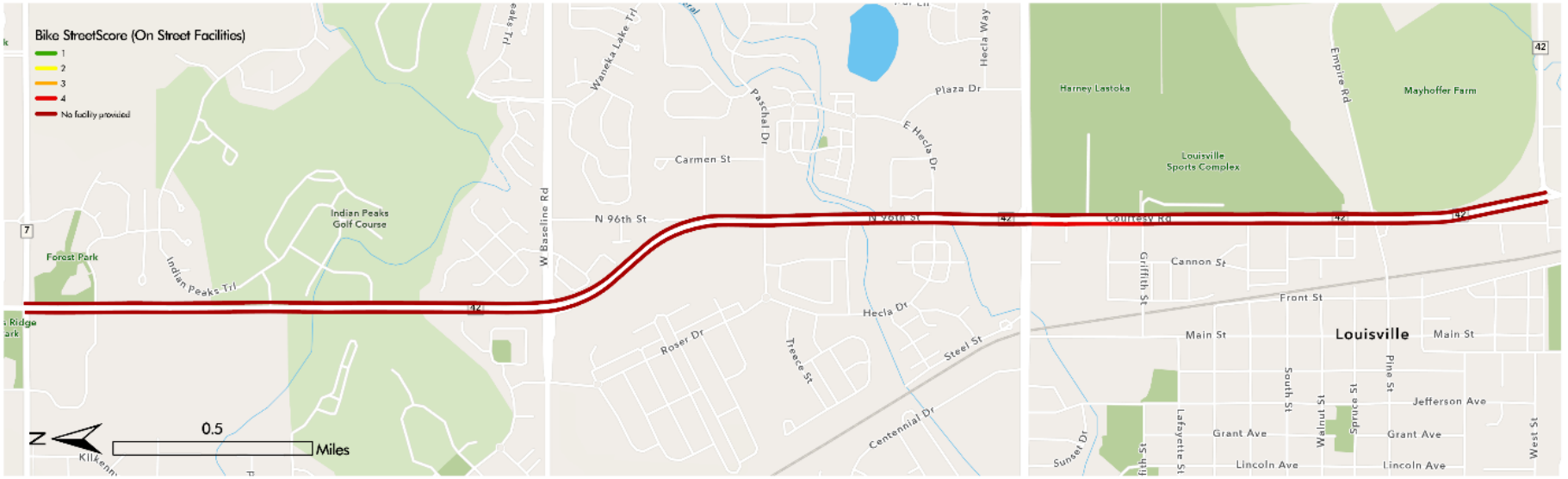


Figure 24: On-Street Bike Streetscore

Recommended Alternative

Following evaluation and analysis of three potential alternatives, including consideration of input provided by the community and the project technical team, a recommended alternative was developed for the CO 42 corridor. This section of the report provides a summary of recommended alternative as well as summary of the MOEs for the recommended alternative, organized by the four project goals summarized in **Table 1**.

Description of Recommended Alternative

The recommended alternative includes the following overarching design and operating improvements to the CO 42 corridor:

- A 7-foot raised protected bike lane on both sides of the corridor, including protected intersections at most intersections and a 7-foot landscaped buffer from the roadway.
- An 8-foot-wide sidewalk on both sides of the roadway with a 2-foot buffer from the bikeway.
- Two contiguous through travel lanes in each direction south of Hecla Drive.
- Reduction in posted and operating speeds of 10 miles per hour corridor-wide.
- Intersection improvements as summarized in **Table 9** to improve multimodal operations and safety.

A typical cross-section for the two-lane portion of the recommended alternative (north of Hecla Drive) is shown in **Figure 25**. The same general cross-section would apply south of Hecla Drive with one additional through travel lane in each direction.

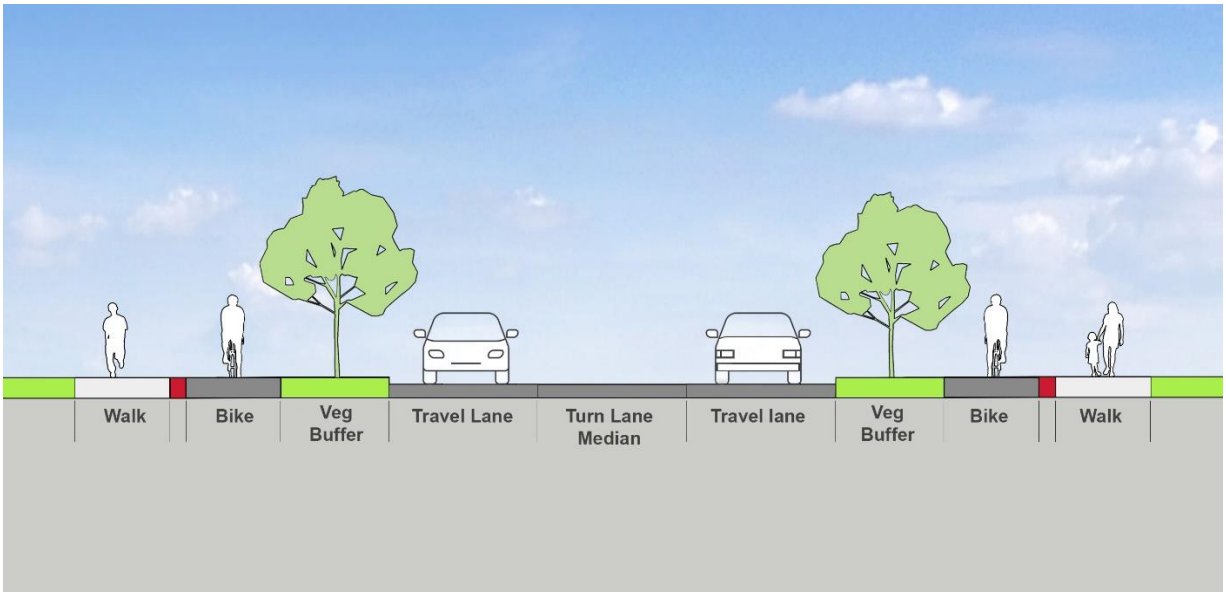


Figure 25: Recommended Alternative Cross-Section (Two-Lane Section).

Key roadway and intersection improvements included in the recommended alternative are mapped in **Figure 26** and described in **Table 9**.

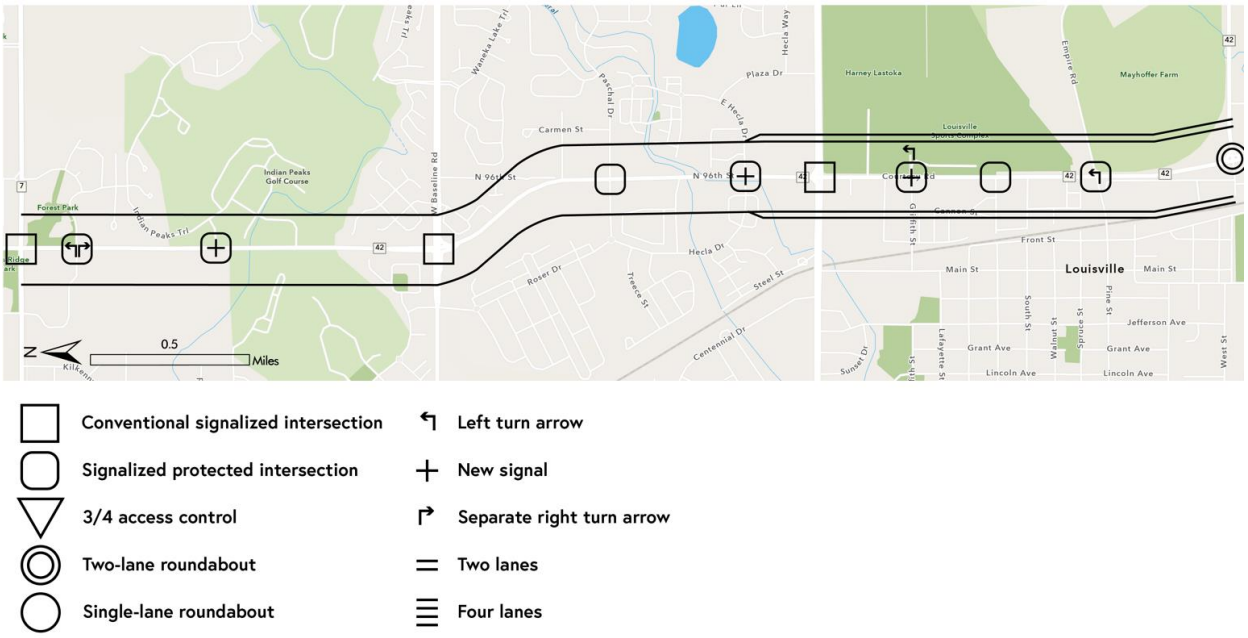


Figure 26: Recommended Alternative Graphic Description

Table 9: Recommended Alternative Intersection Improvements

Intersection with CO 42	General Design Improvements	Lane Configuration Changes	Operations/ Signal Timing
Arapahoe Road	• Channelized right turns	• Additional through lane and bus lane on Arapahoe Road	• No major changes
Northpark Drive/ Dagny Way	• Protected intersection with bike signals	• Remove southbound acceleration lane	• Protected-only northbound left turn • Protected-only northbound right turn • No right turn on red
Indian Peaks Road	• New traffic signal • Protected intersection with bike signals	• No major changes	• Permitted left turns • No right turn on red
Baseline Road	• Acute channelized right turns with raised crosswalk	• Remove acceleration lanes	• No major changes
Paschal Drive	• Protected intersection with bike signals	• Remove acceleration lanes	• No right turn on red
Hecla Drive	• New traffic signal • Protected intersection with bike signals	• Convert southbound right-turn lane to a through-right • Convert eastbound and westbound approaches to a left-turn lane and through/right-turn lane	• Permitted left turns • No right turn on red

Intersection with CO 42	General Design Improvements	Lane Configuration Changes	Operations/ Signal Timing
South Boulder Road	• Acute channelized right turns with raised crosswalk	• Add northbound and eastbound right-turn lanes	• No major changes
Griffith Street	• New traffic signal • Protected intersection with bike signals	• Convert southbound right-turn lane to a through-right • Add northbound through lane • Convert eastbound and westbound approaches to a left-turn lane and through/right-turn lane	• Protected-only northbound left turn • Permitted southbound left • No right turn on red
Short Street	• Protected intersection with bike signals	• Convert northbound and southbound right-turn lanes to through-right lanes	• No right turn on red
Pine Street/ Empire Road	• Protected intersection with bike signals	• Convert northbound and southbound right-turn lanes to through-right lanes • Change the eastbound approach to one left turn, one left-through, and one right-turn lane	• Change northbound left to protected-only • No right turn on red
Lock Street/ Empire Road	• Convert to a two-lane roundabout	• Roundabout	• Roundabout

General Design Criteria for Recommended Alternative

This section describes the design criteria used for most of the corridor to inform things like when and where is it appropriate to implement protected intersections, protected turn phases, right-turn lanes, etc.

Protected-Intersections

Figure 27 illustrates the key design features of a protected intersection for bicyclists. This includes the following key features:

- Raised corners and setback to protect pedestrians and bicyclists from traffic
- No right turn on red
- Right-turn arrow if peak hour turning volume is greater than 150 vehicles per hour[2]
- Left-turn arrow if peak hour volume is greater than 50 vehicles per hour with two travel lanes or greater than 100 vehicles per hour with one travel lane[3]
- Separate bike signal

[2] Based on guidance from the Denver Bikeway Design Manual Volume 2
[3] Based on guidance from the Denver Bikeway Design Manual Volume 2

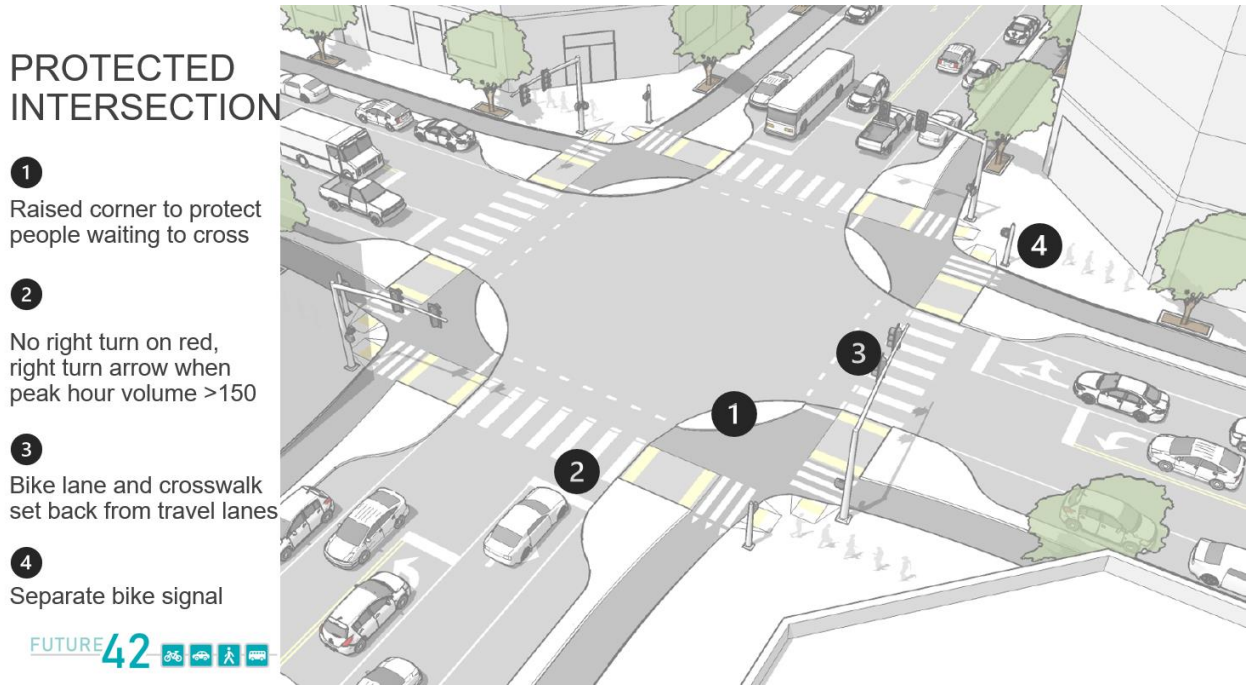


Figure 27: Example of Protected Intersection Design Elements

Source: http://www.protectedintersection.com/.

Within the CO 42 corridor, protected intersections are planned at all signalized intersections between Northpark Drive/Dagny Way and Pine Street/ Empire Road, except for Baseline Road and South Boulder Road due to the volume of right-turning traffic and use of channelized right turns at those two intersections. Given the volume of right-turning vehicles, one way to facilitate efficient pedestrian and bicycle movement through these intersections would be to construct a multiuse trail underpass. An underpass is not currently included as part of the design, but may be studied in greater detail in the future.

The only two intersections with right-turning volumes greater than 150 vehicle per hour and that require a separate right-turn phase (right-turn arrow) are the northbound right-turn movement at Northpark Drive and the southbound right-turn movement at Pine Street. A right-turn arrow was included in the design and traffic modeling for the northbound right turn at Northpark Drive, but not for the southbound right-turn movement at Pine Street. Right-of-way limitations at this location do not currently allow for an exclusive right-turn lane. If it is possible to acquire this right-of-way in the future, Louisville may wish to add a southbound right-turn lane and operate the movement with a separate right-turn phase consistent with the design recommendations for a protected intersection.

Left and Right-turn Lanes

CO 42 is designated by the Colorado Department of Transportation (CDOT) as a Non-Rural Principal Highway (NR-A). According to the Colorado State Highway Access Code, intersection designs should

incorporate left-turn lanes with a peak hour turning movement volume greater than 10 and right-turn lanes with a peak hour turning movement volume greater than 25.

The recommended alternative design includes left-turn lanes at all signalized approaches within the corridor.

The following changes to right-turn-lane approaches (compared to existing conditions) are included in the recommended alternative:

- Given right-of-way constraints, the recommended alternative does not include exclusive northbound and southbound right-turn lanes in the section of four-lane road south of Hecla Drive except at South Boulder Road.
- The recommended alternative added right-turn-only lanes to the eastbound and northbound approaches at South Boulder Road, given the volume of turning traffic.

Left-turn and Right-turn Lane Signal Operations

Thresholds for determining whether an intersection was modeled with exclusive left-turn or right-turn phases were determined based on the following criteria:

- A protected right-turn movement was added to protected intersections if the forecast right-turn volume exceeded 150 vehicles per hour:
    - Northbound right at Northpark Drive
    - Southbound right at Pine Street (not included due to ROW constraints)
- A protected-only left-turn phase was added if:
    - At protected intersections, the forecast left-turn volume was greater than 100 vehicles per hour with one lane of opposing traffic or greater than 50 vehicles per hour and two lanes of opposing traffic:
        - Northbound left at Dagny Way
        - Northbound left at Griffith Street
    - The intersection is forecast to meet the criteria of the Boulder Left-Turn Phasing Guidelines, which applies a similar method as provided in NCHRP Report 813 Signal Timing Manual, but adapts to Vision Zero safety principles. Guidelines for the appropriate signal phasing are based on traffic speeds, cross-product volumes of traffic, pedestrian and bicycle volumes, and crash history.
        - Northbound left at Pine Street

Additionally, the eastbound and westbound movements at Pine Street/ Empire Road were assumed to operate with split signal phasing and an eastbound left and left/through lane to accommodate the high volume of eastbound left-turning traffic. All three intersections that will be converted from side street stop to signalized in the recommended alternative (Indian Peak Trail, Hecla Drive, and Griffith Street) were assumed to operate with permitted left turns for modeling purposes as they did not meet the criteria listed above. However, it is recommended that these intersections be installed with a 4-section head (see

Figure 9) so they may operate as permitted, permitted-protected, or protected-only upon installation. All other locations were assumed to operate with existing left-turn signal phasing as documented in **Table 5**.

Channelized Right-turn Lanes

The recommended alternative includes modifications to channelized right-turn lanes at Arapahoe Road, Baseline Road, and South Boulder Road. The new design for channelized right-turn lanes include smaller turn radius (to slow traffic), a higher angled approach at the intersection (to increase visibility of traffic on the cross street and pedestrians crossing), and a raised pedestrian crossing (to slow traffic and improve pedestrian comfort).

Acceleration Lanes

To narrow the pedestrian crossing distance and slow traffic, acceleration lanes were removed in the following locations as part of the recommended alternative:

- Dagny Way southbound
- Baseline Road
- Paschal Drive

Measures of Effectiveness (MOEs)

The MOEs for the recommended alternative are organized by the four core goals of the project:

- A safe corridor for all users
- A comfortable corridor for walking and biking
- Efficient motor vehicle travel
- Accommodate future bus rapid transit (BRT)

A Safe Corridor for All Users

A core goal of the project was for the CO 42 corridor to be a safe corridor for all users. This section describes the outcomes of the two MOEs used to measure this goal: free flow vehicle speed, and total crashes at intersections. The safety MOEs for the recommended alternative were quantified relative to existing conditions.

Free Flow Vehicle Speed

The recommended alternative assumes a reduction in posted speeds of 10 mph corridor-wide. Several operating and design elements are included in the recommended alternative to support a reduction free-flow vehicle speed:

1. Introduction of physical medians on the 4-lane section south of Hecla Drive.
2. Addition of streetscape along the roadway, including street trees, to visually narrow the roadway.
3. Tighter radii on the corners at signalized intersections to slow turning vehicles.

4. Signal progression timed at slower speeds, which will be made more effective with more frequent signal spacing (i.e., new signals at Indian Peaks Trail, Hecla Drive, and Griffith Street).

Total Crashes at Intersections

Figure 28 shows that design and operating improvements in the recommended alternative are anticipated to reduce total crashes at intersections in the CO 42 corridor by 16%, from 354 observed over the five-year study period (2015 – 2019) to 297 with the recommended alternative.

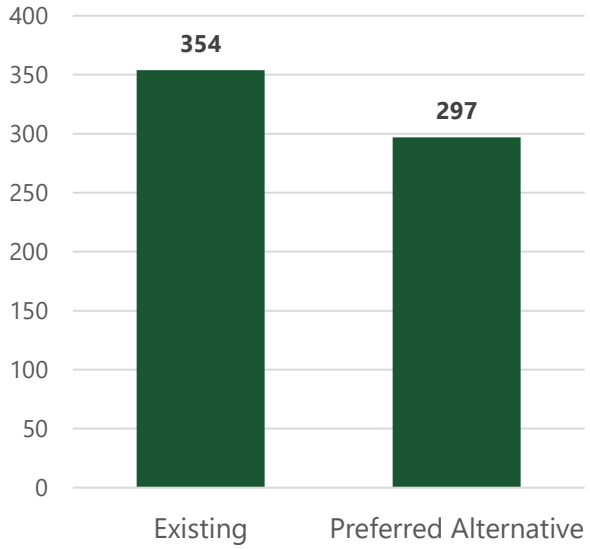


Figure 28: Anticipated Reduction in 5-Year Crash Rate at CO 42 Intersections

The primary improvements anticipated to reduce crashes include:

- Improving the angle of channelized right turns with raised crosswalks at Baseline Road and South Boulder Road (predicted to mitigate 17 crashes over 5 years).
- Converting Lock Street/ Empire Road from a signalized intersection to a multi-lane roundabout (predicted to mitigate 7 crashes over 5 years).
- Adding protected left-turn signal phasing at Pine Street/ Empire Road (predicted to mitigate 6 crashes over 5 years).
- Signalizing intersections with Indian Peaks Trail, Hecla Drive, and Griffith Street (predicted to mitigate 3 crashes over 5 years).

A Comfortable Corridor for Walking and Biking

A core goal of the project is for the CO 42 corridor to be a comfortable corridor for people walking and biking. This section describes the outcomes of the two MOEs used to measure this goal: pedestrian Streetscore and bicycle Streetscore.

Pedestrian Streetscore/Level of Traffic Stress (LTS)

The recommended alternative includes an 8-foot buffered sidewalk on both sides of the street corridor-wide. Using the Streetscore+ methodology, the corridor would change from a mix of an LTS 2, 3, 4 or no facility as shown in **Figure 23** under existing conditions to an LTS 2 in the recommended alternative, as shown in **Figure 29**. For the pedestrian Streetscore to achieve an LTS 1, the sidewalk width would need to be at least 10 feet.

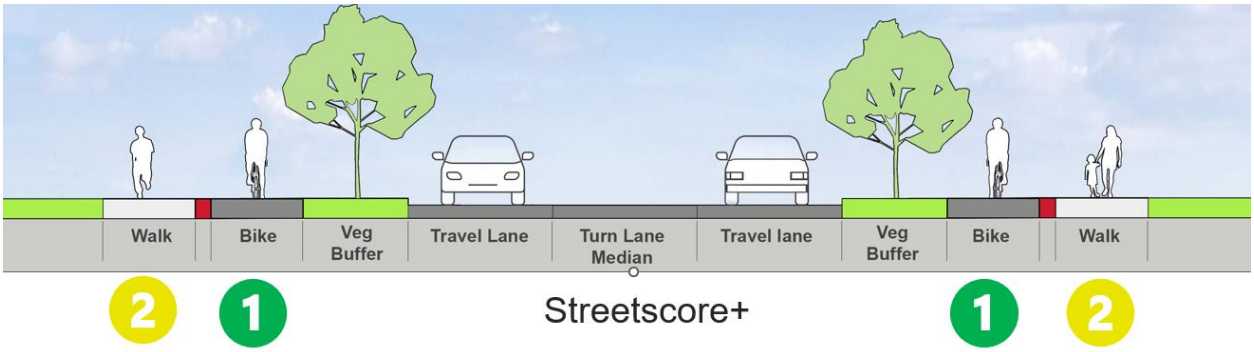


Figure 29: Pedestrian and Bicycle Level of Traffic Stress Under the Recommended Alternative

Bicycle Streetscore/Level of Traffic Stress (LTS)

The recommended alternative includes a 7-foot one-way raised protected bikeway on each side of the street corridor-wide. Using the Streetscore+ methodology, the condition of on-street bicycle facilities corridor would change the existing mix of an LTS 4 or no facility as shown in **Figure 24**, to an LTS 1 in the recommended alternative as shown in **Figure 29**.

Efficient Motor Vehicle Travel

A core goal of the project was for the CO 42 corridor to provide for efficient motor vehicle travel. This section describes the outcomes of the two MOEs used to measure this goal: intersection level of service (LOS), and corridor travel time for vehicles.

Intersection Level of Service (LOS)

Table 10 shows the anticipated intersection LOS for motor vehicles under the recommended alternative during the morning and afternoon peak hour with existing (2019) traffic volumes and with 2050 traffic volumes. Overall LOS is anticipated to improve under the recommended alternative as compared to with no improvements (no project). Under existing volumes, the LOS is anticipated to improve at Griffith Street, Hecla Drive, and Indian Peaks Trail in the recommended alternative by signalizing those intersections. LOS improvements in the recommended alternative at South Boulder Road and Baseline Road can mostly be attributed to re-optimizing the signal progression in the corridor.

Table 10: Peak Hour Motor Vehicle Level of Service (LOS) Under the Recommended Alternative

Intersection	AM				PM			
	Existing	Future (No Project)	Recommended Alternative (Existing Volumes)	Recommended Alternative (2050 Volumes)	Existing	Future (No Project)	Recommended Alternative (Existing Volumes)	Recommended Alternative (2050 Volumes)
Lock Street/ Empire Road	C	C	A	D	D	D	C	F
Pine Street	B	C	B	C	E	F	C	D
Short Street	A	A	A	A	B	B	A	A
Griffith Street	E	F	A	A	F	F	A	A
South Boulder Road	C	D	C	D	E	F	D	F
Hecla Drive	D	F	A	B	F	F	B	C
Paschal Drive	B	B	B	B	B	B	C	D
Baseline Road	D	F	C	F	E	F	D	F
Beauprez Avenue	A	B	A	B	A	A	A	A
Indian Peaks Trail	E	E	A	A	D	F	A	B
Dagny Wy/ Northpark Dr	A	C	B	B	B	B	B	C
CO 7 (Arapahoe Road)	E	F	C	D	D	F	C	F

Several intersections show an LOS F with 2050 volumes under the recommended alternative, particularly in the PM peak, although fewer than with no project. This is primarily due to the high volumes forecast for 2050 under the DRCOG Regional Travel Demand Model. Given the time frame and many unknown factors that could influence this over the next 30 years (changes in growth, travel patterns, connected/ autonomous vehicle technology, etc.), the 2050 LOS should be considered the upper end, or "worst-case" scenario. In all likelihood, the future LOS is likely to fall somewhere between the existing and 2050 forecasts.

Lastly, it should be noted that the one intersection that performs more poorly under the recommended alternative with 2050 volumes as compared to "No Project" is Lock Street/ Empire Road. The reason for this is that widening CO 42 from 2 lanes to 4 lanes would allow more southbound vehicles per hour to enter the Lock Street/ Empire Road intersection. Under the preferred scenario the Lock Street/ Empire Road intersection would be a two lane roundabout. There is a heavy southbound left movement at the Lock Street/ Empire Road and given the forecast traffic volumes by 2050, that heavy southbound left movement would cause significant delays to northbound vehicles in the PM peak trying to enter the roundabout and to some extend westbound vehicles in the PM peak trying to enter the roundabout. Thus,

under the preferred scenario (2050 volumes), LOS would improve at Pine Street from widening CO 42 but would have the negative effect of increasing the entering volume at the Lock Street/ Empire Street intersection to beyond its capacity. Therefore, under the preferred scenario with 2050 volumes the congestion point effectively shifts one intersection south from Pine Street to Lock Street in the PM peak.

Corridor Travel time for Vehicles

Figure 30 shows the change in anticipated motor vehicle travel time during the morning peak hour on CO 42 between Arapahoe Road (CO 7) and Lock Street/ Empire Road. With existing traffic volumes the travel time is expected to decrease slightly (by less than a minute) in both directions during the morning peak under the recommended alternative. With 2050 volumes the recommended alternative is expected to decrease travel time in the morning peak from 15 minutes to 11 minutes southbound and from 9 minutes to 8 minutes northbound.

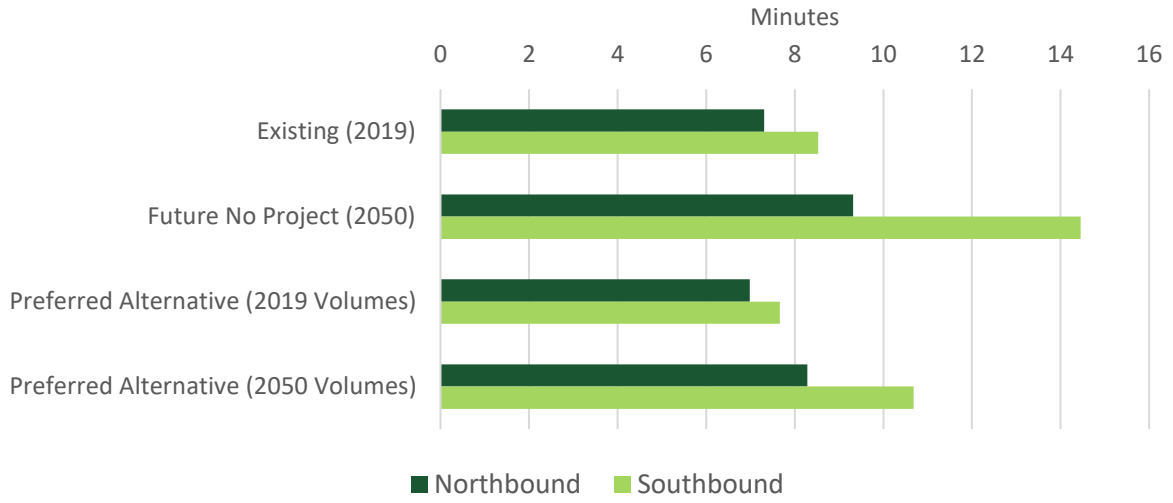


Figure 30: CO 42 AM Peak Travel Time

Figure 31 shows the change in anticipated motor vehicle travel time during the afternoon peak hour on CO 42 between Arapahoe Road (CO 7) and Lock Street/ Empire Road. With existing traffic volumes the travel time is expected to decrease from 9 minutes to 8 minutes in both directions during the afternoon peak under the recommended alternative. With 2050 volumes the recommended alternative is expected to decrease travel time in the afternoon peak from 12 minutes to 11 minutes southbound and marginally increase travel time northbound, by less than a half a minute.

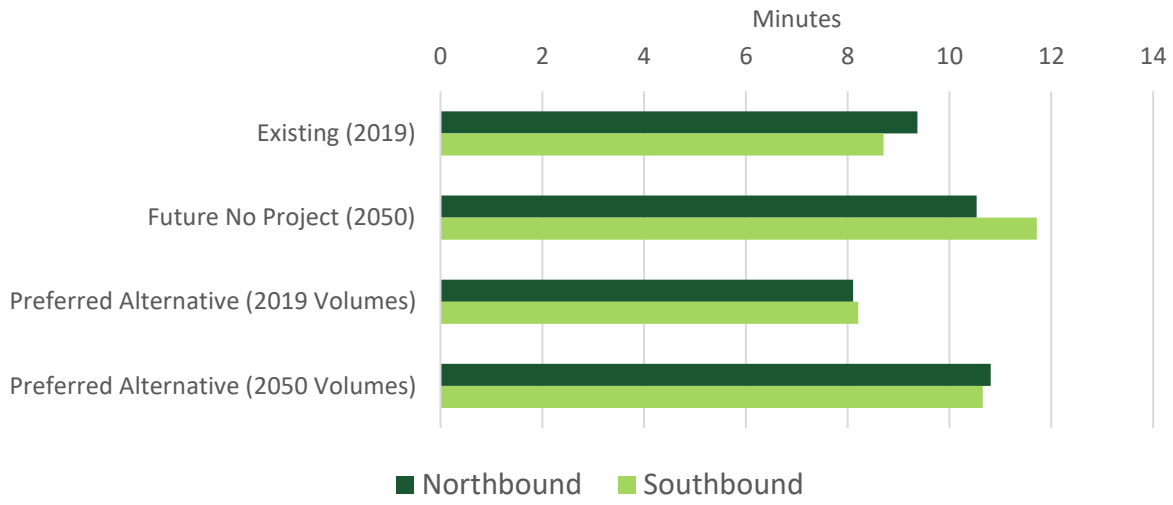


Figure 31: CO 42 PM Peak Travel Time

Accommodate Future Bus Rapid Transit (BRT)

A core goal of the project was for the CO 42 corridor to accommodate future BRT. The MOE for this goal was to identify intersection approaches that can either accommodate a bus queue jump lane (based on available right-of-way or the feasibility of purchasing additional right-of-way in the future) or where a bus queue jump lane would not be needed.

Figure 32 shows that all seven approaches analyzed would be able to accommodate a future bus queue jump lane or would not need a bus queue jump lane under the recommended alternative.

Figure 32: Results of CO 42 Bus Queue Jump Lane Analysis

Four of the approaches analyzed on CO 42 would operate at LOS C or better during peak hours (with 2019 volumes) under the recommended alternative and would therefore not need a bus queue jump lane. This includes both approaches to intersection of Lock Street/ Empire Road as well as the southbound approach of the intersection with South Boulder Road and Lock Street/ Empire Road.

Three approaches would need a bus queue jump lane to minimize delay to buses under the recommended alternative, all of which could be designed as a shared right-turn lane/ bus only lane. All three approaches were found to have sufficient availability of right-of-way to accommodate a future bus-only/ right-turn lane. This includes:

- The northbound approach of South Boulder Road, as long as the right-turn lane is at least 540 feet.
- The northbound approach of Baseline Road (a shared right-turn lane/ bus lane of at least 600 feet would need to be added)
- The southbound approach of Baseline Road (a shared right-turn lane/ bus lane of at least 410 feet would need to be added)

Summary

This report provides a summary of the MOE's for the Future 42 project in Louisville and Lafayette, Colorado that were used to assess traffic safety, walking and bicycling comfort, traffic flow, and compatibility with future bus rapid transit service (BRT) in the CO 42 corridor between Arapahoe Road (CO 7) and Lock Street/ Empire Street. The MOE's were analyzed under existing conditions and under the recommended alternative as described in this report.

The findings, summarized in **Table 11**, shows that the recommended alternative would result in an improvement to the CO 42 corridor as compared to existing conditions under all seven MOE's analyzed and thus would help advance the corridor toward achieving project's principal goals of providing:

- A safe corridor for all users
- A comfortable corridor for walking and biking
- Efficient motor vehicle travel
- Accommodate future bus rapid transit (BRT)

The Future 42 recommended alternative is expected to reduce corridor speeds, reduce the frequency of crashes, improve pedestrian and bicycle comfort, improve traffic level of service (LOS), improve motor vehicle travel time, and would be able to accommodate the bus queue jump lanes needed for a future BRT service in the CO 42 corridor.

Table 11: Recommended Alternative Measures of Effectiveness (MOE) Summary

Goal	MOE	Better/ Worse/ Same (Compared to Existing Conditions)	Reason
A safe corridor for all users	Free flow vehicle speed	Better	Corridor speed reduced by 10 mph
	Total crashes at intersections	Better	Crashes reduced by 16%
A comfortable corridor for walking and biking	Pedestrian level of traffic stress (LTS)	Better	Improved to LTS 2 Corridor-wide
	Bicycle level of traffic stress (LTS)	Better	Improved to LTS 1 Corridor-wide
Efficient motor vehicle travel	Intersection level of service (LOS)	Better	Same or improved LOS at all intersections
	Corridor travel time for vehicles	Better	Same or faster travel time during peak periods
Accommodate future bus rapid transit (BRT)	Intersection approaches that can either accommodate a bus queue jump lane or where a bus queue jump lane would not be needed	Better	Can accommodate a bus queue jump lane at all four intersection approaches where needed