EAST ARAPAHOE (SH 7) TRANSPORTATION PLAN

APPENDIX C: EVALUATION OF ALTERNATIVES - SUMMARY REPORT

February 2018

INTRODUCTION

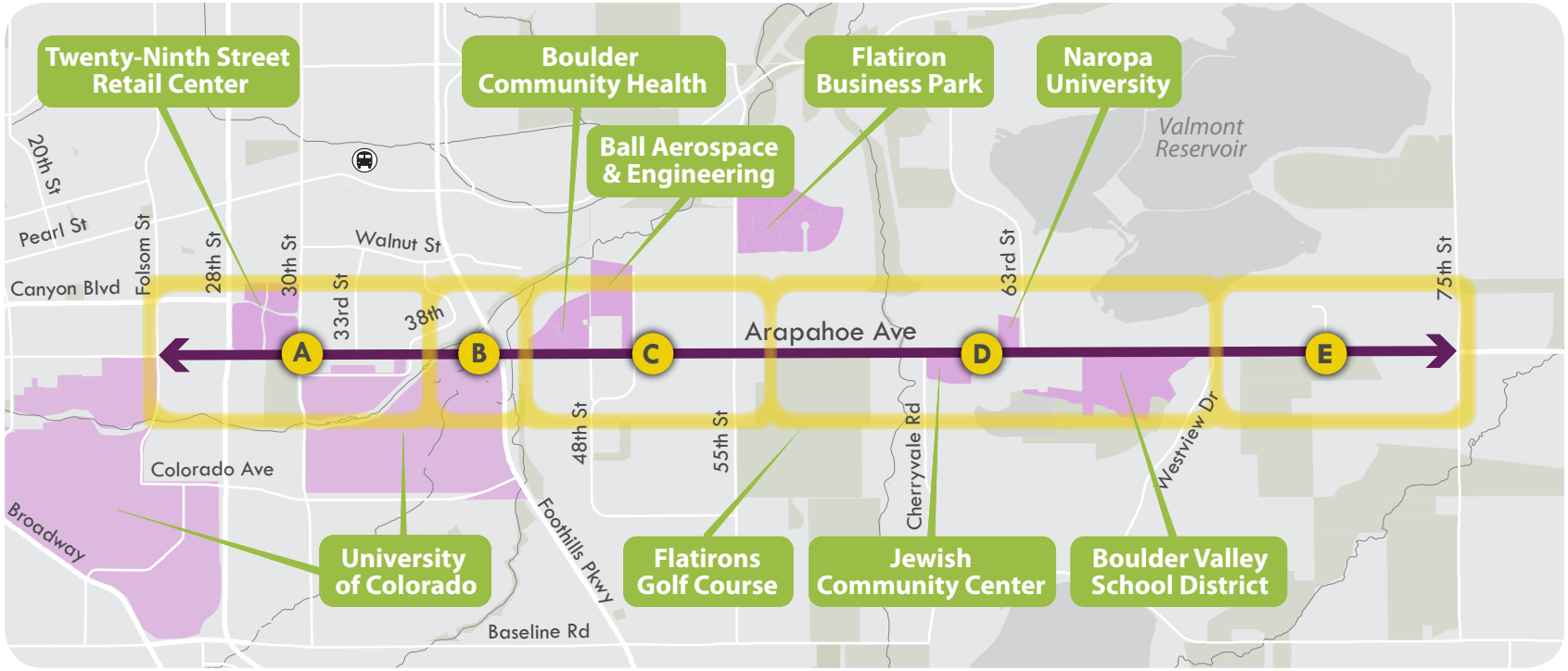
This document provides preliminary evaluation results for a set of draft alternatives that were developed for the East Arapahoe corridor. Each alternative is a package of design and management elements that can help achieve the stated purpose and goals of the East Arapahoe Transportation Plan within each character district.

Preliminary alternatives were developed using the results of an initial screening of potential corridor design and management elements. The preliminary alternatives were refined based on input received at the East Arapahoe Transportation Plan Community Working Group (CWG) Meeting #5 on December 5, 2016. The alternatives were evaluated using criteria that measure how well the draft alternatives meet the Plan goals and objectives.

The following sections describe the draft alternatives and preliminary evaluation results:

- **Character Districts.** Summarizes the five character districts, their existing conditions, and the vision for each developed with input from the Community Working Group.
- **Alternatives.** Describes the No-Build and Build alternatives (packages of design and management elements) for the corridor. It includes revised cross-section drawings for each district.
- **Plan Goals and Evaluation Areas.** Summarizes the Plan Goals and Objectives and lists the evaluation areas and measures.
- **Evaluation Results.** Provides preliminary evaluation results, with an emphasis on the Vehicular and Transit areas and including parts of the Safety and Sustainability areas. As described on p. 20, the evaluation results were presented at CWG Meetings #6 and #7 in March and April 2017, respectively.

EAST ARAPAHOE CHARACTER DISTRICTS



A Folsom - Boulder Creek

Land Use: Higher density retail and mixed use

Auto:
- 6 travel lanes + turn lanes
- ADT: 28,300

Bike/Ped: Multi-use path with small gaps

Transit: Queue jumps for buses at selected intersections

B Boulder Crk.-E. of Foothills

Land Use: Riparian wetland

Auto:
- 6 travel lanes+ 2-3 turn lanes
- ADT: 32,100 (W) 31,300 (E)

Bike/Ped: Multi-use path

Transit: Queue jumps at intersection

C E. of Foothills - E. of 55th

Land Use: Medium density institutional & light industrial

Auto:
- 6 travel lanes + turn lanes
- ADT: 31,300

Bike/Ped: Multi-use path incomplete on south side

Transit: No special transit treatments

D E. of 55th - Westview

Land Use: Low density office, light industrial & retail

Auto:
- 5 travel lanes + turn lanes
- ADT: 26,200

Bike/Ped:
- Multi-use path incomplete on both sides
- On street bike lanes

Transit: Transit lanes east of 63rd

E Westview - 75th

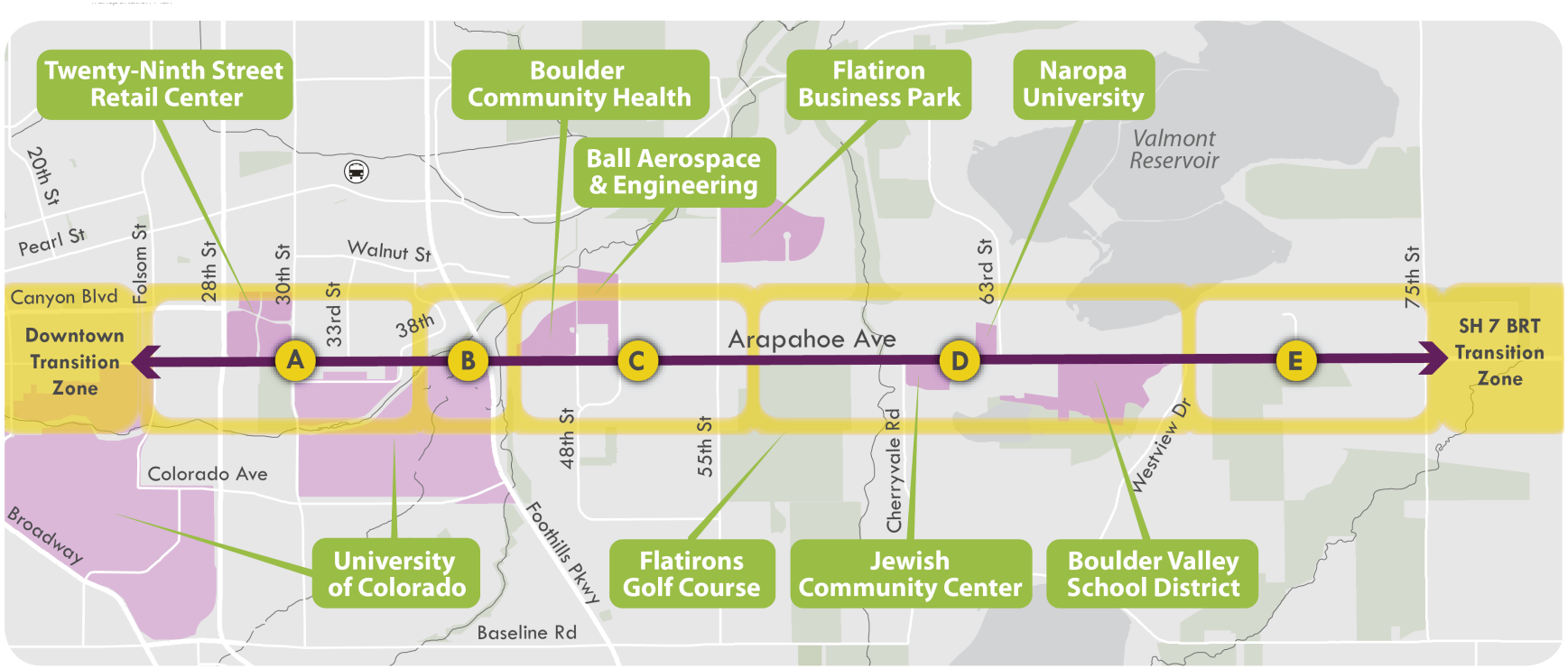
Land Use: Open space / farmland with clusters of other land uses

Auto:
- 2 travel lanes + center turn lane

Bike/Ped:
- Multi-use path on north side only
- On-street bike lanes or wide shoulders

Transit: No special transit treatments

EAST ARAPAHOE CHARACTER DISTRICT VISION



A 29th Street District

- Pedestrian-oriented
- Urban boulevard
- Commercial town center
- Destination

B Transition Zone

- Green space
- Transition zone

C Innovation & Health District

- Intensified
- Supportive mix of uses/services
- Ped/bike accessible/ permeable
- Mobility hub

D Industry & Education District

- Enhanced cultural & education
- Recycle row
- Adaptive industrial (arts)
- Complete facilities for all users
- Land use setback & buffered

E Gateway District

- Gateway & view features
- Community connector
- Rural land use

ALTERNATIVES

The project team developed four alternatives for the East Arapahoe corridor that will be evaluated both end-to-end and within in each character district. This would allow "mix-and-matching" of alternatives along the corridor (e.g., Alternative 3 in Districts A-D and Alternative 2 in District E) and/or options within each district (e.g., Alternative 4 pedestrian/bike option with Alternative 3 transit option in District A) to identify a preferred alternative for the corridor.

The alternatives consist of (1) a transit and vehicular option and (2) pedestrian/bike option.

NO-BUILD ALTERNATIVE

Alternative 1 represents the future "No-Build" condition, which assumes improvements that are likely to be realized in the year 2040 without the project being considered (Build alternatives). The No-Build alternative includes a completed multi-use path and/or sidewalk and a continuation of existing transit service along Arapahoe Avenue:

- Vehicular. The No-Build alternative maintains the existing designations of travel lanes (no changes to existing lanes available for general-purpose travel).
- Transit. The future No-Build conditions for transit are assumed to be the existing bus service (RTD Short and Long JUMP routes) with some enhancements to frequency (additional midday service on the Long JUMP and additional weekend service) and service span (additional late night service) with existing bus stop facilities.
- Pedestrian/Bike. The future No-Build conditions for the pedestrian/bike realm are assumed to be a completed multi-use path and/or sidewalk network along Arapahoe Avenue, and the existing bike lanes (or wide shoulders) in Districts D and E. This includes:
  - Completing gaps in the sidewalk network along Arapahoe Avenue at 33rd Street (south side), at Old Tale Road (north side), and between 55th Street and Cherryvale Road (south side).
  - Completing gaps in the multi-use path between 30th Street and the Boulder Creek Greenway (south side), between MacArthur Drive and 48th Street, and between Eisenhower Drive and 55th Street.

BUILD ALTERNATIVES

Alternatives 2, 3, and 4 pair Enhanced Bus service, Side-Running BRT, and Center-Running BRT, respectively, with a pedestrian/bike option. Each pedestrian-bike option is included in at least one alternative. The following sections describe the assumptions for the options.

BUILD ALTERNATIVE ASSUMPTIONS AND DEFINITIONS

TRANSIT/VEHICULAR

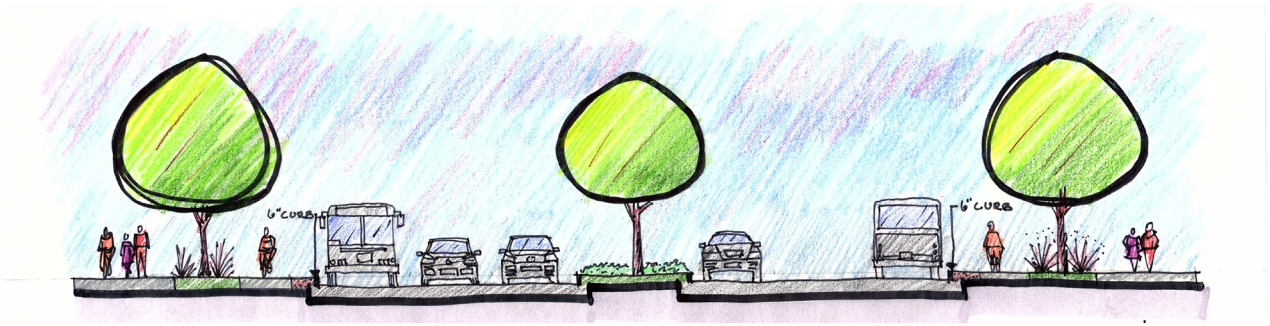
Enhanced Bus (Alternative 2) maintains all existing general-purpose travel lanes and assumes transit service operates in mixed-traffic with the following types of enhancements:

- Enhanced vehicles with all-door boarding
- Enhanced shelters, benches, and other passenger amenities at stops
- Off-board fare payment and real-time arrival information

Enhanced Bus primarily differs from the BRT alternatives in that there is no dedicated right-of-way allocated to transit (as there is in Alternatives 3 and 4).

Side-Running BRT (Alternative 3) re-purposes the existing travel lane closest to the curb as a business-access and transit (BAT) lane that allows vehicle access for right-turns.

Center-Running BRT (Alternative 4) re-purposes the center travel lanes as dedicated transit-only lanes.



ENHANCED BUS OR SIDE-RUNNING BRT - EXAMPLE CROSS-SECTION

CENTER-RUNNING BRT - EXAMPLE CROSS-SECTION

BUILD ALTERNATIVE ASSUMPTIONS AND DEFINITIONS

PEDESTRIAN, BIKE & TRANSITION ZONE

Pedestrian/bicycle options include a combination of the following elements:

- Bicycle Facility
  - Raised bicycle lane, inside of the curb at the level of the sidewalk or multi-use path (see illustrations at top left and right)
  - Street-level bicycle lane, outside of the curb, separated from travel lanes by a painted or vertical buffer (see illustrations at bottom left and right)
- Amenity zone: 5 to 6 feet with shrubs, or 8 feet with street trees. The amenity zone provides separation between other facilities and is able to accommodate other uses such as transit stops and seating.
- Sidewalk: 6 to 12 feet or more, based on context.
- Multi-use path: 10 to 12 feet, shared by people walking and biking.

CURBSIDE RAISED PROTECTED BICYCLE LANE
Separated from the sidewalk/multi-use path by an amenity zone.
(Example cross section - Option 1)

CURBSIDE AMENITY ZONE WITH RAISED PROTECTED BICYCLE LANE
Separated from both the travel lanes and the sidewalk/multi-use path by an amenity zone.
(Example cross section Option 2)

STREET-LEVEL PROTECTED BICYCLE LANE
Separated from travel lanes by a physical barrier.
(Example cross section - Option 3)

STREET-LEVEL BUFFERED BICYCLE LANE
Separated from travel lanes by a striped buffer.
(Example cross section - Option 4)

ALTERNATIVES FOR EVALUATION

RELATIONSHIP BETWEEN TRANSIT/VEHICULAR ALTERNATIVE AND PED/BIKE OPTION WITHIN EACH CHARACTER DISTRICT

Pedestrian/Bike/Transition Zone Option	Alt 1 (No-Build)	Alt 2	Alt 3	Alt 4
	Transit/Vehicular Alternative			
	Existing Bus (Mixed Traffic)	Enhanced Bus (Mixed Traffic)	Side-Running BRT (BAT Lane)	Center-Running BRT (Dedicated Lane)
	Existing Travel Lanes	Existing Travel Lanes	Repurposed Lane	Repurposed Lane
District A: 29th Street District (3 vehicle lanes/direction)				
Option 0: Completed multi-use path (No-Build)	X			
Option 1a: Curbside raised protected bike lane with amenity zone and multi-use path				X
Option 2: Curbside amenity zone with raised protected bike lane separated from sidewalk		X	X	
District B: Transition Zone (3 vehicle lanes/direction)				
Design options to be determined based on preferred facilities in Districts A and C	TBD	TBD	TBD	TBD
District C: Innovation & Health District (3 vehicle lanes/direction)				
Option 0: Completed multi-use path (No-Build)	X			
Option 1a: Curbside raised protected bike lane with amenity zone and multi-use path			X	X
Option 3: Street-level protected bike lane with amenity zone and multi-use path		X		
District D: Industry & Education District (2-3 lanes/direction)				
Option 0: Existing bike lanes and multi-use path (No-Build)	X			
Option 1a: Curbside raised protected bike lane with amenity zone and multi-use path			X	X
Option 3: Street-level protected bike lane with amenity zone and multi-use path		X		
District E: Gateway District (1-2 vehicle lanes/direction)				
Option 0: Existing bike lanes and/or multi-use path (No-Build)	X			
Option 1b: Curbside raised protected bike lane with amenity zone and sidewalk				X
Option 4: Street-level buffered bike lane with curbside amenity zone and sidewalk (south) or existing multi-use path (north)		X	X	

DISTRICT A CROSS SECTIONS

This section provides cross-section illustrations for Character District A.

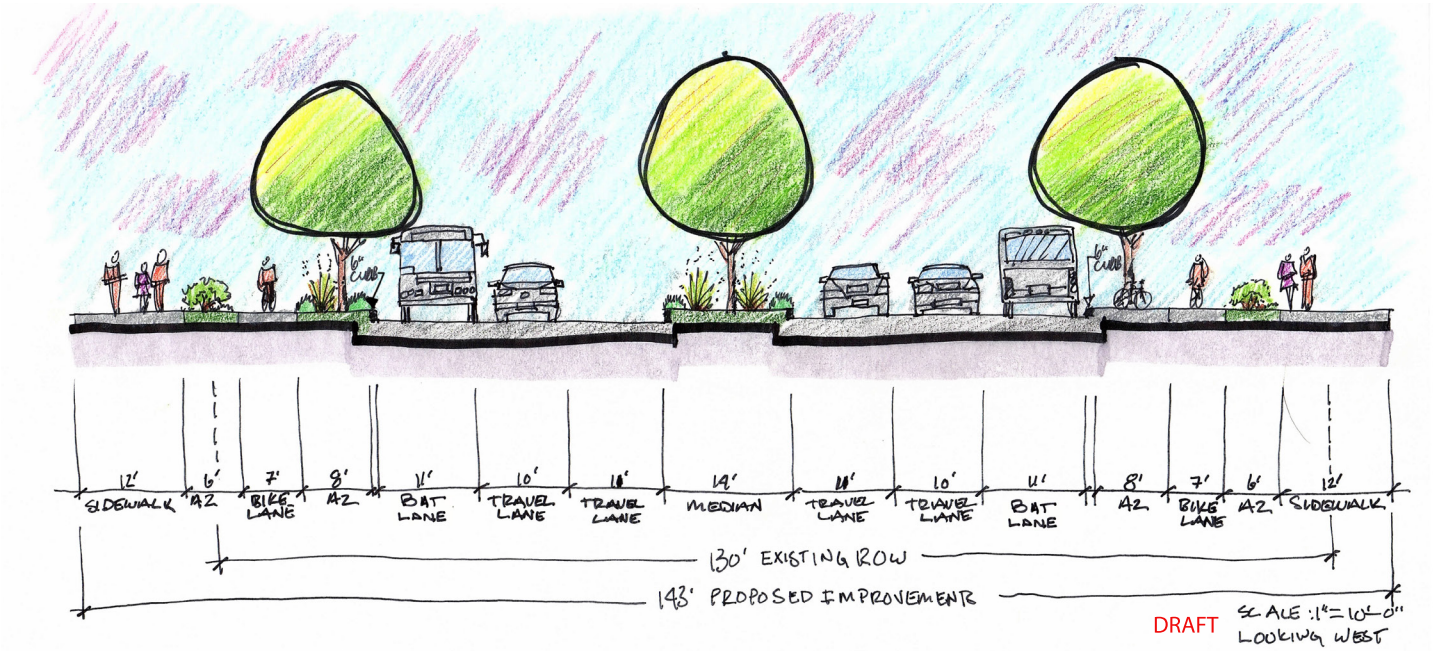
Attachment H provides renderings of the alternatives.

ALTERNATIVE 2 WITH PED/BIKE OPTION 2

Enhanced bus, curbside amenity zone with raised protected bike lane separated from sidewalk

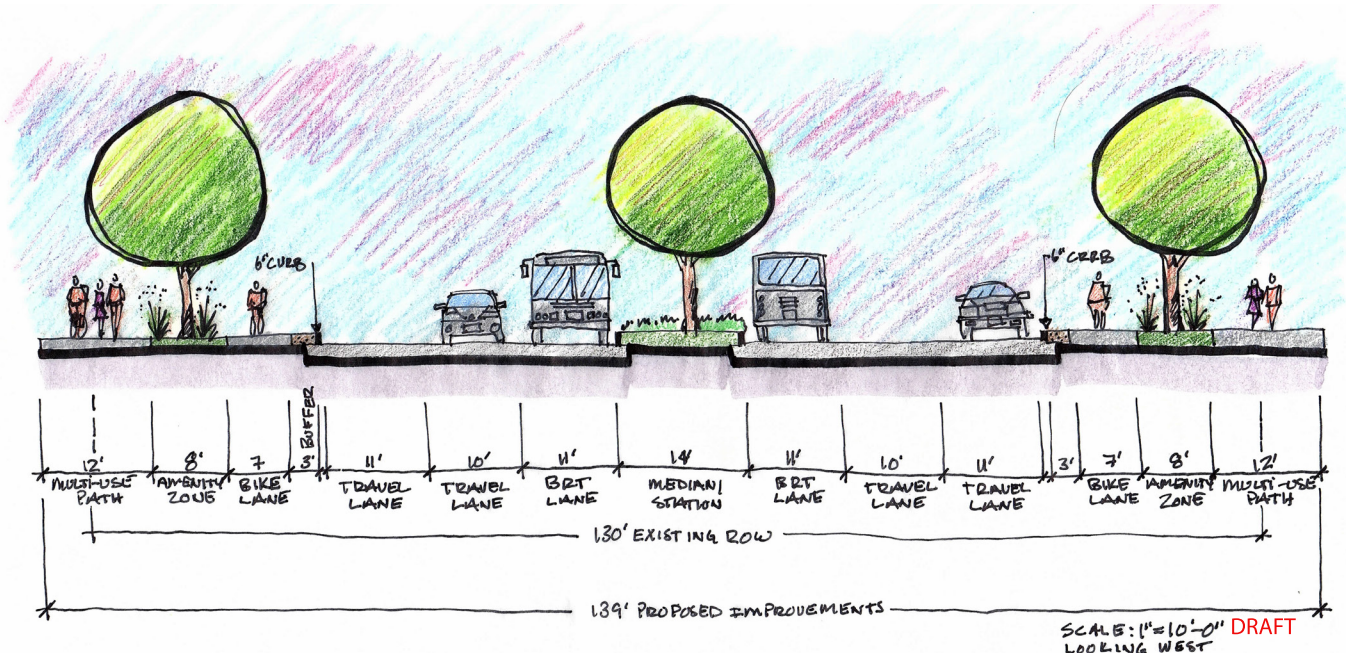
ALTERNATIVE 3 WITH PED/BIKE OPTION 2

Side-Running BRT, curbside amenity zone with raised protected bike lane separated from sidewalk



ALTERNATIVE 4 WITH PED/BIKE OPTION 1a

Center-Running BRT, curbside raised protected bike lane with amenity zone and multi-use path



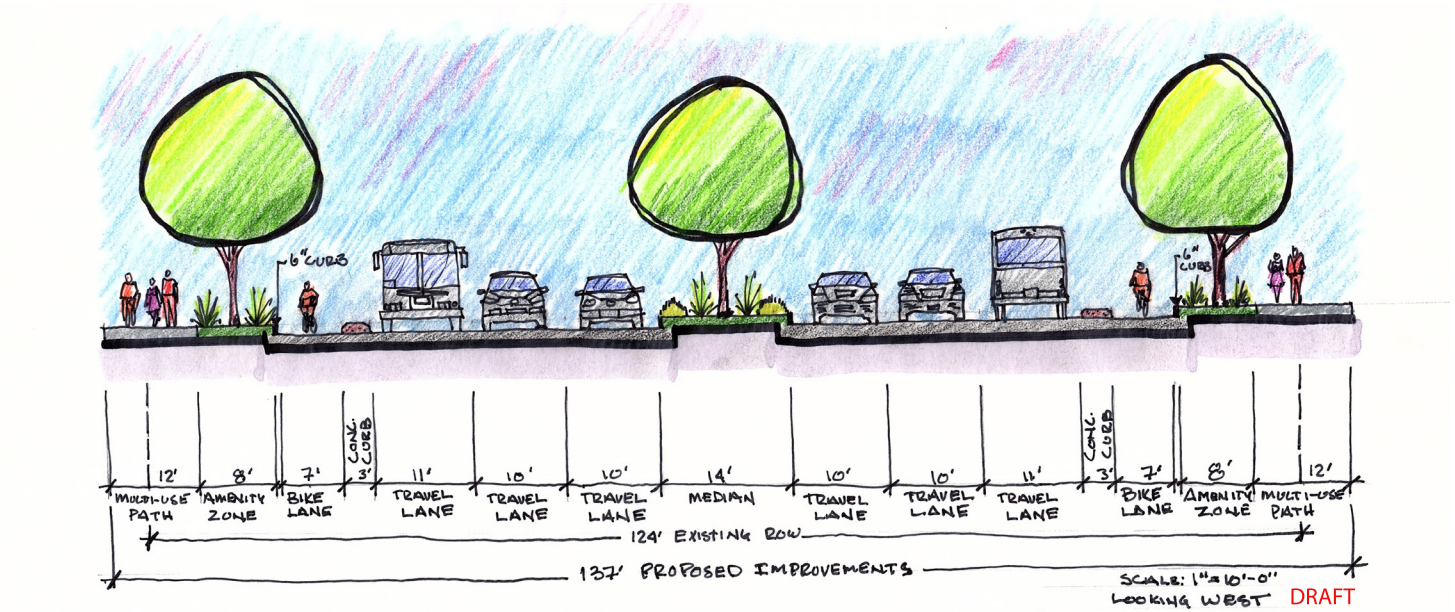
DISTRICT C CROSS SECTIONS

This section provides cross-section illustrations for Character District C.

Note: Cross-sections have not yet been developed for Character District B, which will be a transition zone between Districts A and C.

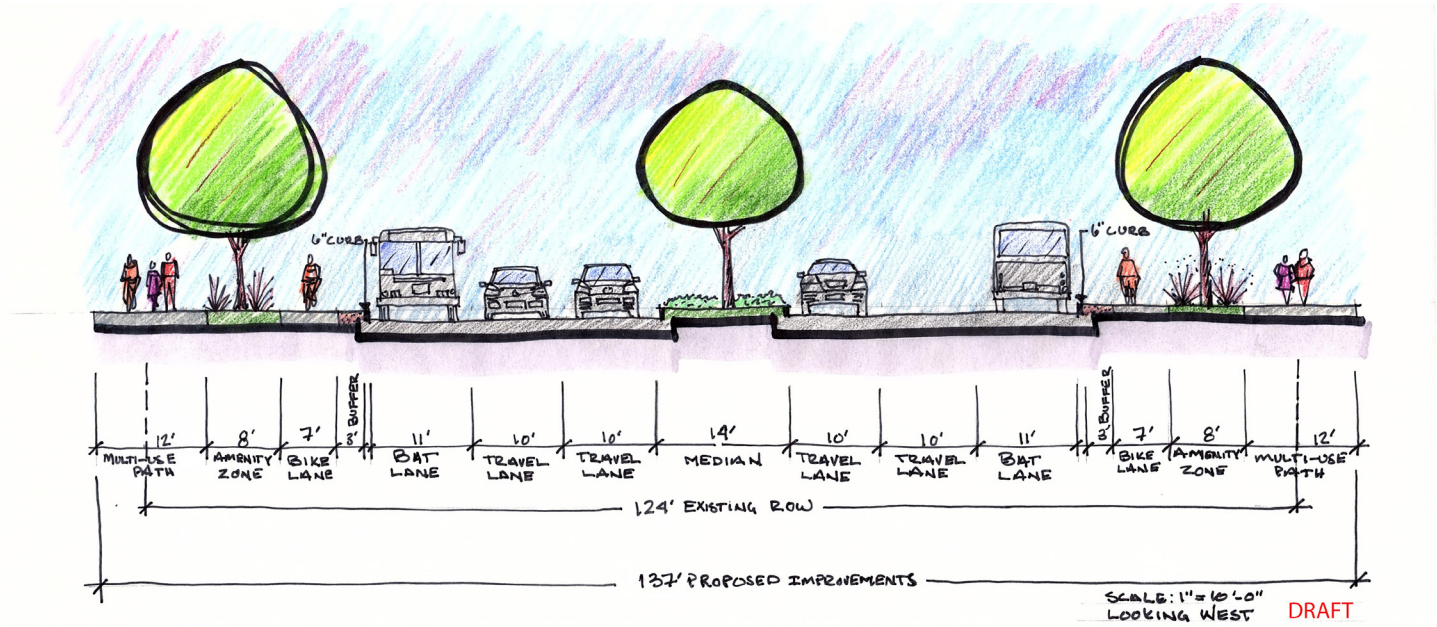
ALTERNATIVE 2 WITH PED/BIKE OPTION 3

Enhanced bus, street-level protected bike lane with amenity zone and multi-use path



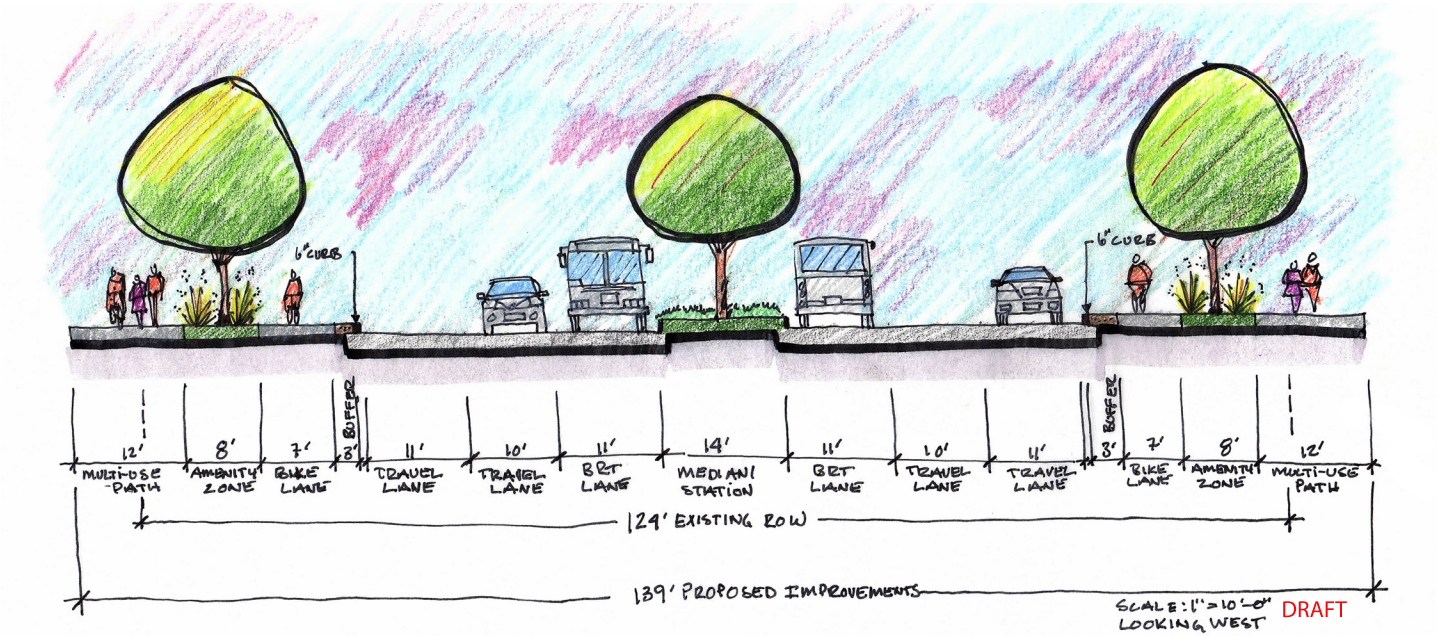
ALTERNATIVE 3 WITH PED/BIKE OPTION 1a

Side-Running BRT, curbside raised protected bike lane with amenity zone and multi-use path



ALTERNATIVE 4 WITH PED/BIKE OPTION 1a

Center-Running BRT, curbside raised protected bike lane with amenity zone and multi-use path

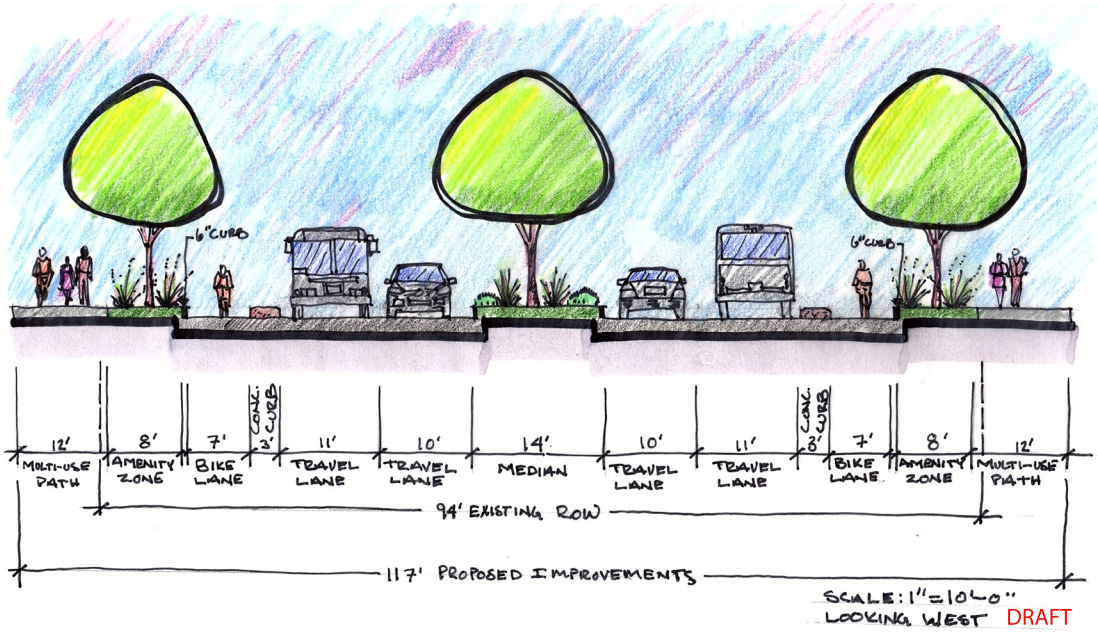


DISTRICT D CROSS SECTIONS

This section provides cross-section illustrations for Character District D.

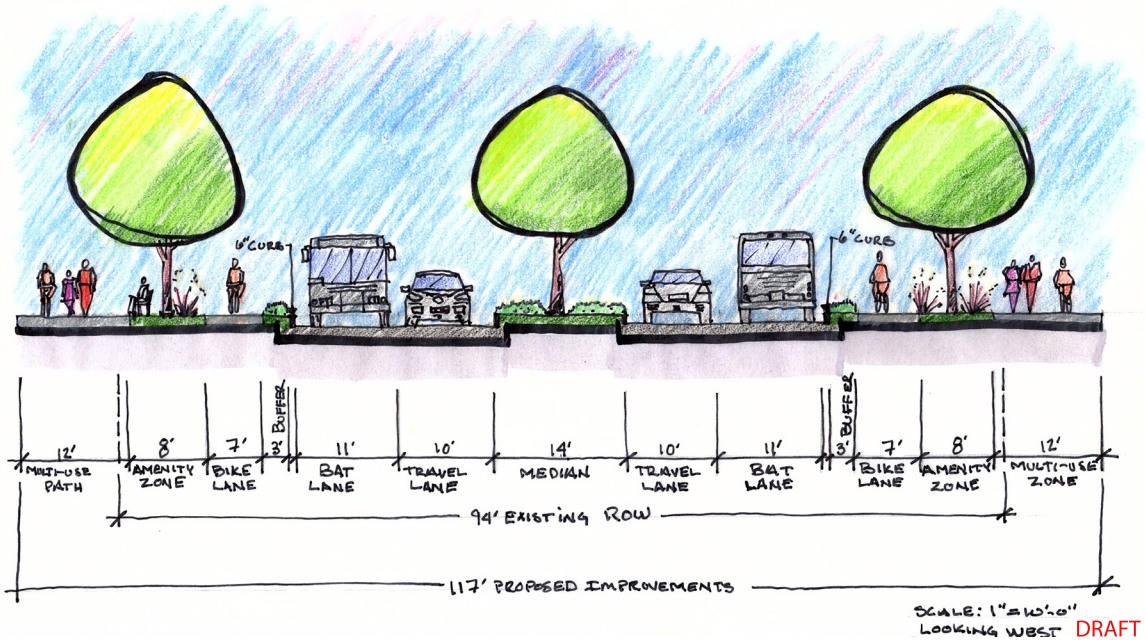
ALTERNATIVE 2 WITH PED/BIKE OPTION 2

Enhanced Bus, street-level protected bike lane with amenity zone and multi-use path



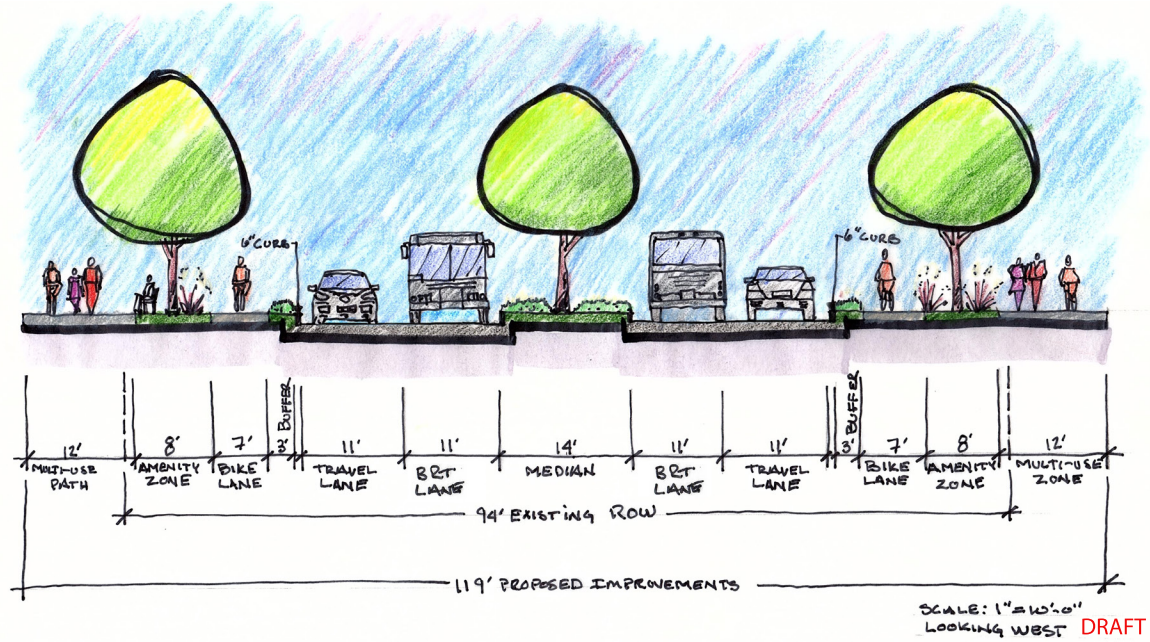
ALTERNATIVE 3 WITH PED/BIKE OPTION 1a

Side-Running BRT, curbside raised protected bike lane with amenity zone and multi-use path



ALTERNATIVE 4 WITH PED/BIKE OPTION 1a

Center-Running BRT, curbside raised protected bike lane with amenity zone and multi-use path

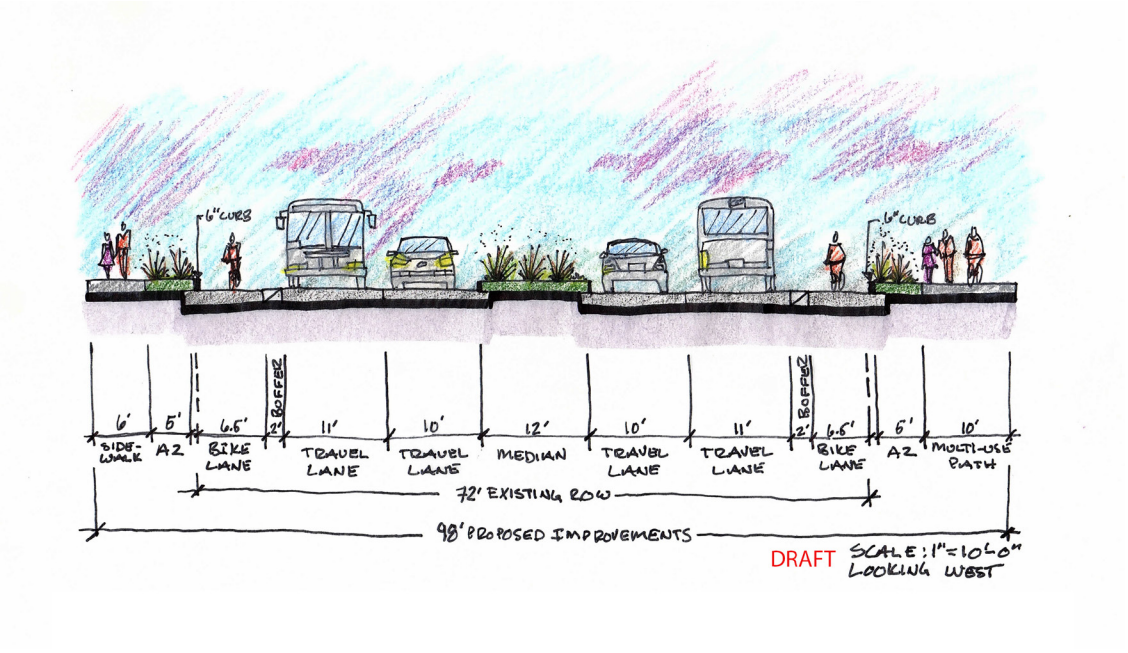


DISTRICT E CROSS SECTIONS

This section provides cross-section illustrations for Character District E.

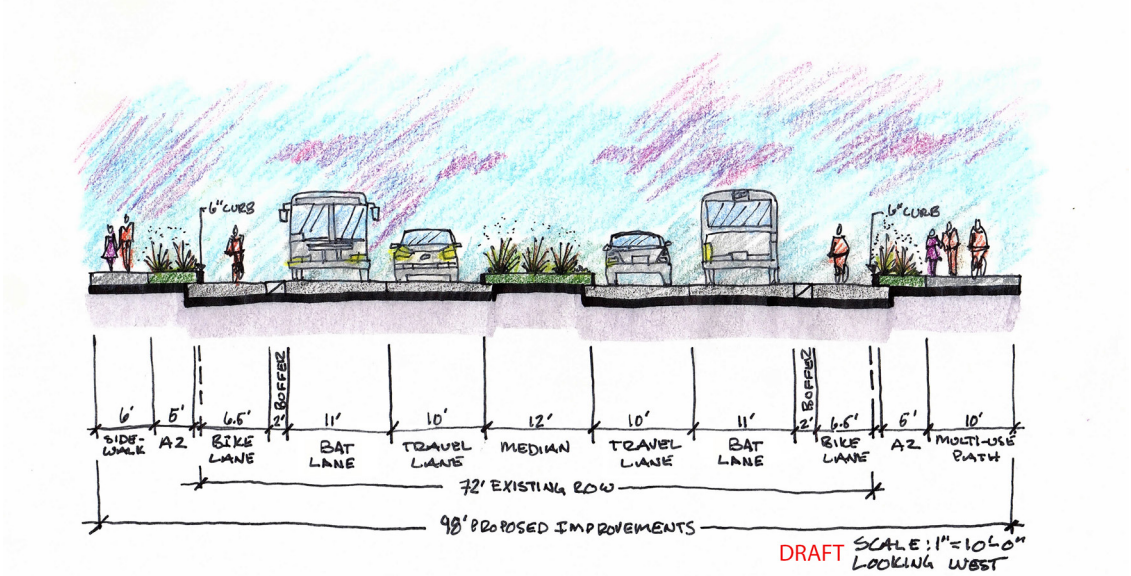
ALTERNATIVE 2 WITH PED/BIKE OPTION 2

Enhanced Bus, street-level buffered bike lane with amenity zone and sidewalk (south side) or multi-use path (north side)



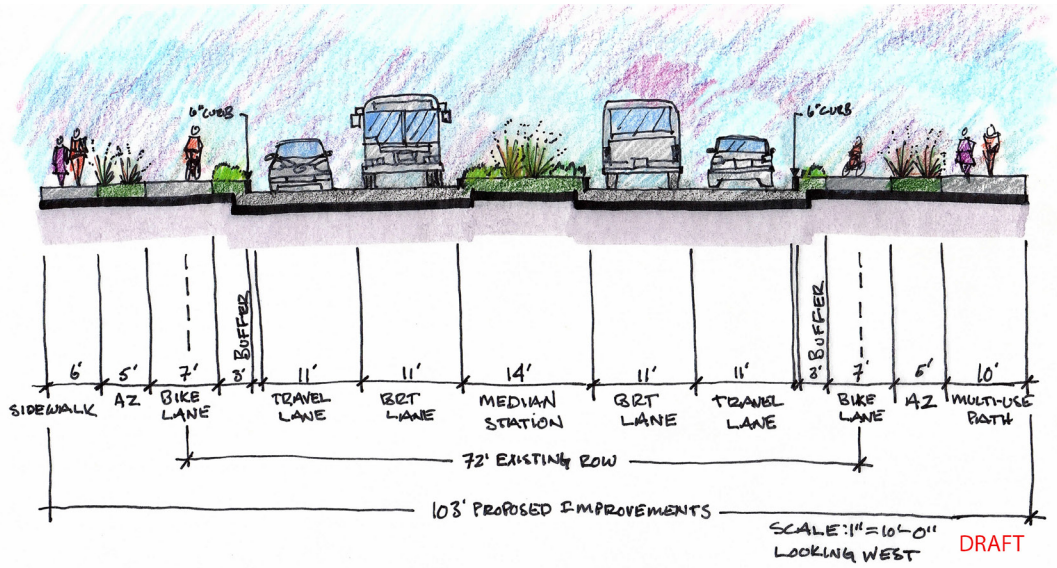
ALTERNATIVE 3 WITH PED/BIKE OPTION 2

Side-Running BRT, street-level buffered bike lane with amenity zone and sidewalk (south side) or multi-use path (north side)



ALTERNATIVE 4 WITH PED/BIKE OPTION 1b

Center-Running BRT, curbside raised protected bike lane with amenity zone and sidewalk (south side) or multi-use path (north-side)



PLAN GOALS

Plan goals and objectives were developed to guide development of the plan. They are based on analysis of existing and projected conditions for the East Arapahoe corridor, and City of Boulder plans and policies (e.g., Boulder Valley Comprehensive Plan, Boulder Transit Master Plan, Boulder Sustainability Framework, etc.). The Plan goals were refined based on input received at Community Working Group Meeting #2 on June 15, 2016.

Goal 1. Complete Streets: Provide Complete Streets in the East Arapahoe corridor that offer people a variety of safe and reliable travel choices.

- Provide safe travel for all modes using the East Arapahoe corridor, including supporting the "Toward Vision Zero" effort to eliminate fatalities and serious injuries from traffic collisions.
- Improve the ease of access and comfort for people walking in the East Arapahoe corridor, and incorporate "placemaking" and urban design features that make the corridor an inviting place to travel and spend time.
- Broaden the appeal of bicycling along the East Arapahoe corridor to people of all ages and bicycling abilities.
- Make transit a convenient and practical travel option in the East Arapahoe corridor.
- Move drivers efficiently through the East Arapahoe corridor.

Goal 2. Regional Travel: Increase the number of trips the East Arapahoe corridor can carry to accommodate growing local transportation needs and projected growth in surrounding communities.

- Improve local travel options within the East Arapahoe corridor for residents, employees, and visitors.
- Improve regional travel options between Boulder and communities to the east for work and other regional trips.

Goal 3. Transportation Demand Management (TDM): Promote a more efficient use of the transportation system and offer people travel options within the East Arapahoe corridor.

- Improve "first-and-last-mile" connections to help people conveniently and safely walk, bike, or make shorter car trips to and from transit.
- Promote the use of multiple transportation options in East Boulder by residents and workers.

Goal 4. Funding: Deliver cost-effective transportation solutions for the East Arapahoe corridor that can be phased over time.

- Coordinate with public and private entities, including adjacent land owners, to implement cost-effective transportation improvements.

Goal 5. Sustainability: Develop transportation improvements in the East Arapahoe corridor that support Boulder's Sustainability Framework (desired outcomes include a community that is Safe, Healthy & Socially Thriving, Livable, Accessible & Connected, Environmentally Sustainable, and Economically Vital Community and provides Good Governance).

- Reduce greenhouse gas (GhG) emissions and air pollution from vehicle travel within the East Arapahoe corridor.
- Improve travel options that promote public health for residents and workers along the East Arapahoe corridor.
- Provide access to affordable transit and other travel options to low- and moderate-income residents and workers along the East Arapahoe corridor.
- Preserve and improve economic vitality in the East Arapahoe corridor.
- Promote and improve water quality, and reduce the urban heat island effect through roadway and landscape design.

EVALUATION AREAS AND CRITERIA

Evaluation criteria were developed to analyze how well the alternatives meet the Plan goals and objectives within the following evaluation areas:

Pedestrian and Bicycle Comfort and Access

- Perceived ease of access or comfort for walking along or across the corridor
- Perceived ease or comfort for bicycling along/across the corridor

Safety

- Safety Evaluation
- Access Management

Travel Mode Share

- Estimated pedestrian, bicycle, transit, auto mode share

Transit Operations

- Transit Travel Time, Service Reliability, and Service Quality
- Transit Ridership in Corridor
- Transit Operating Costs

Vehicle Operations

- Auto Travel Time and Level of Service (LOS)
- Auto Vehicle Miles Traveled
- Freight Impacts

Capital Costs/Implementation

- Capital Costs and Right-of-Way
- Cost-Effectiveness
- Ability to Phase Improvements / Complexity of Implementation

Community Sustainability

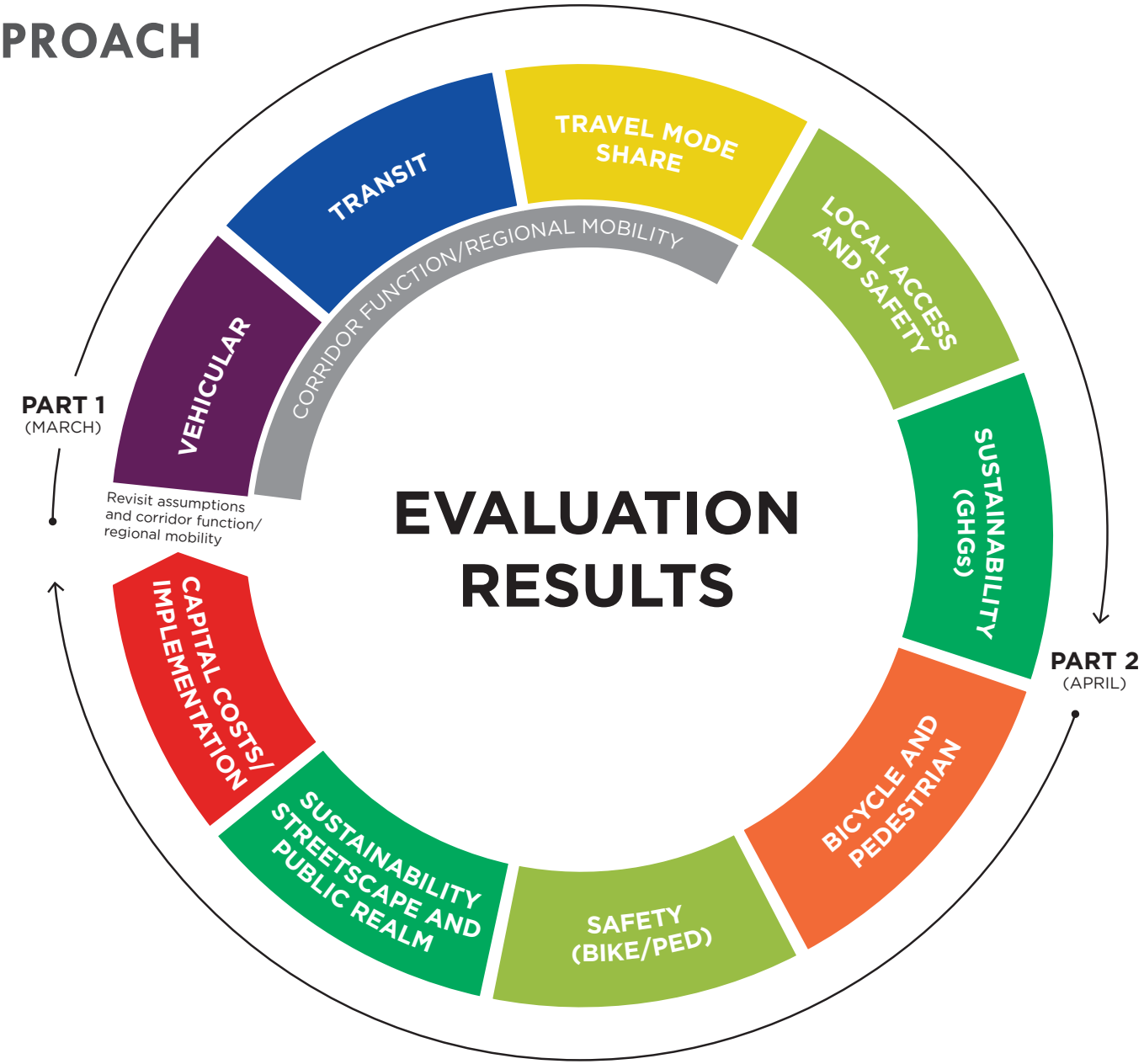
- Streetscape Quality
- GhG Emissions from Transportation

EVALUATION RESULTS

PRESENTATION APPROACH

The project team discussed results with the Community Working Group over two meetings in Spring 2017:

- The March meeting was used to present vehicular and transit results.
- The April meeting focused on the bicycle/ pedestrian environment and public realm.
- The project team and the Community Working Group then circled back to revisit assumptions and assess the overall corridor function and regional mobility given the evaluation results.



EVALUATION SUMMARY

SCORE -3 -2 -1 0 1 2 3

Worse → Better

[1] 0% Traffic Growth (Historic Trends)

X / X

[2] 20% Traffic Growth (Regional model projection)

Alternatives are scored on a -3 to 3 scale relative to existing conditions. Scores of -3 through -1 indicate that the alternative is worse than existing, 0 means the alternative has a neutral effect, and scores of 1 through 3 signify an improvement over existing conditions.

		Auto Operations		Transit Operations				Bicycle and Pedestrian Comfort and Access	
		Auto Level of Service	Auto Travel Time	Transit Travel Time	Transit Ridership	Operating Costs	Lifecycle Cost per Rider	Walking	Biking
2015	**Existing** Existing Bus Existing Travel Lanes Existing Multi-use Path	0	0	0	0	0	0	0	0
2040	**Alt 1: No-Build** Local Bus (Mixed Traffic) Existing Travel Lanes Completed Multi-use Path	+20% Traffic Growth[2]: -1	+20% Traffic Growth[2]: -2	+20% Traffic Growth[2]: -1	+: 1	$	3	1	1
2040	**Alt 2** Enhanced Bus (Mixed Traffic) Existing Travel Lanes Typically Street-Level PBL (2,3,4)	+20% Traffic Growth[2]: -1	+20% Traffic Growth[2]: -2	+20% Traffic Growth[2]: 1	2	$$$	1	3	Assumes substantial intersection enhancements: 3
2040	**Alt 3** Side-Running BRT Curbside lanes repurposed as BAT lanes (right-turns allowed) Typically Raised PBL (1a,2,4)	0%/20% Traffic Growth[1,2]: 0 / -2	0%/20% Traffic Growth[1,2]: -1 / -2	0%/20% Traffic Growth[1,2]: 2 / 2	3	$$$	2	3	Assumes substantial intersection enhancements: 3
2040	**Alt 4** Center-Running BRT Center lanes repurposed as dedicated transit lanes Typically Raised PBL (1a/1b)	0%/20% Traffic Growth[1,2]: -1 / -3	0%/20% Traffic Growth[1,2]: -2 / -3	0%/20% Traffic Growth[1,2]: 3 / 2	3	$$$	2	3	Assumes substantial intersection enhancements: 3

EVALUATION SUMMARY

SCORE -3 -2 -1 0 1 2 3

Worse → Better

[1] 0% Traffic Growth (Historic Trends)

X / X

[2] 20% Traffic Growth (Regional model projection)

Alternatives are scored on a -3 to 3 scale relative to existing conditions. Scores of -3 through -1 indicate that the alternative is worse than existing, 0 means the alternative has a neutral effect, and scores of 1 through 3 signify an improvement over existing conditions.

		Travel Mode Share	Safety			Community Sustainability		Capital Costs/Implementation	
		Transit, Bike, Ped Trips	Bicycle/ Pedestrian	Transit	Auto	Streetscape Quality	GhG Emissions	Capital Costs	Ability to Phase
2015	**Existing** Existing Bus Existing Travel Lanes Existing Multi-use Path	0	0	0	0	0	0	0	0
2040	**Alt 1: No-Build** Local Bus (Mixed Traffic) Existing Travel Lanes Completed Multi-use Path	1	1	0	0	1	+20% Traffic Growth[2] -2	$	0
2040	**Alt 2** Enhanced Bus (Mixed Traffic) Existing Travel Lanes Typically Street-Level PBL (2,3,4)	2	2	0	0	3	+20% Traffic Growth[2] -2	$$	-1
2040	**Alt 3** Side-Running BRT Curbside lanes repurposed as BAT lanes (right-turns allowed) Typically Raised PBL (1a,2,4)	3	2	1	1	3	0%/20% Traffic Growth[1,2] 0 / -1	$$$	-2
2040	**Alt 4** Center-Running BRT Center lanes repurposed as dedicated transit lanes Typically Raised PBL (1a/1b)	3	2	1	1	2	0%/20% Traffic Growth[1,2] 0 / -1	$$$$	-3

VEHICLE OPERATIONS: AUTO LEVEL OF SERVICE & VOLUMES

Key Assumptions

- 2040 +0% traffic growth scenarios assume that BRT has been implemented along with additional Transportation Demand Management (TDM) measures, allowing the traffic volume along East Arapahoe to remain approximately the same as today.
- 2040 +20% traffic growth scenarios are based on the DRCOG regional travel model which predicts a 20% growth in traffic in the corridor.
- In the 2040 +20% traffic growth scenarios, it is assumed that BRT service will result in reducing daily traffic along Arapahoe by between 3,400 and 3,700 vehicles per day along the corridor.
- Side-running BRT lanes are repurposed from the existing outside travel lane (typically) and this lane is shared between buses and right-turning vehicles.
- Center-running BRT lanes are repurposed from the inside travel lanes and are used exclusively by BRT vehicles. However, it is assumed that left-turning automobiles cross over the BRT lanes upstream of the intersections to allow left-turning traffic to do so from the center of the roadway.

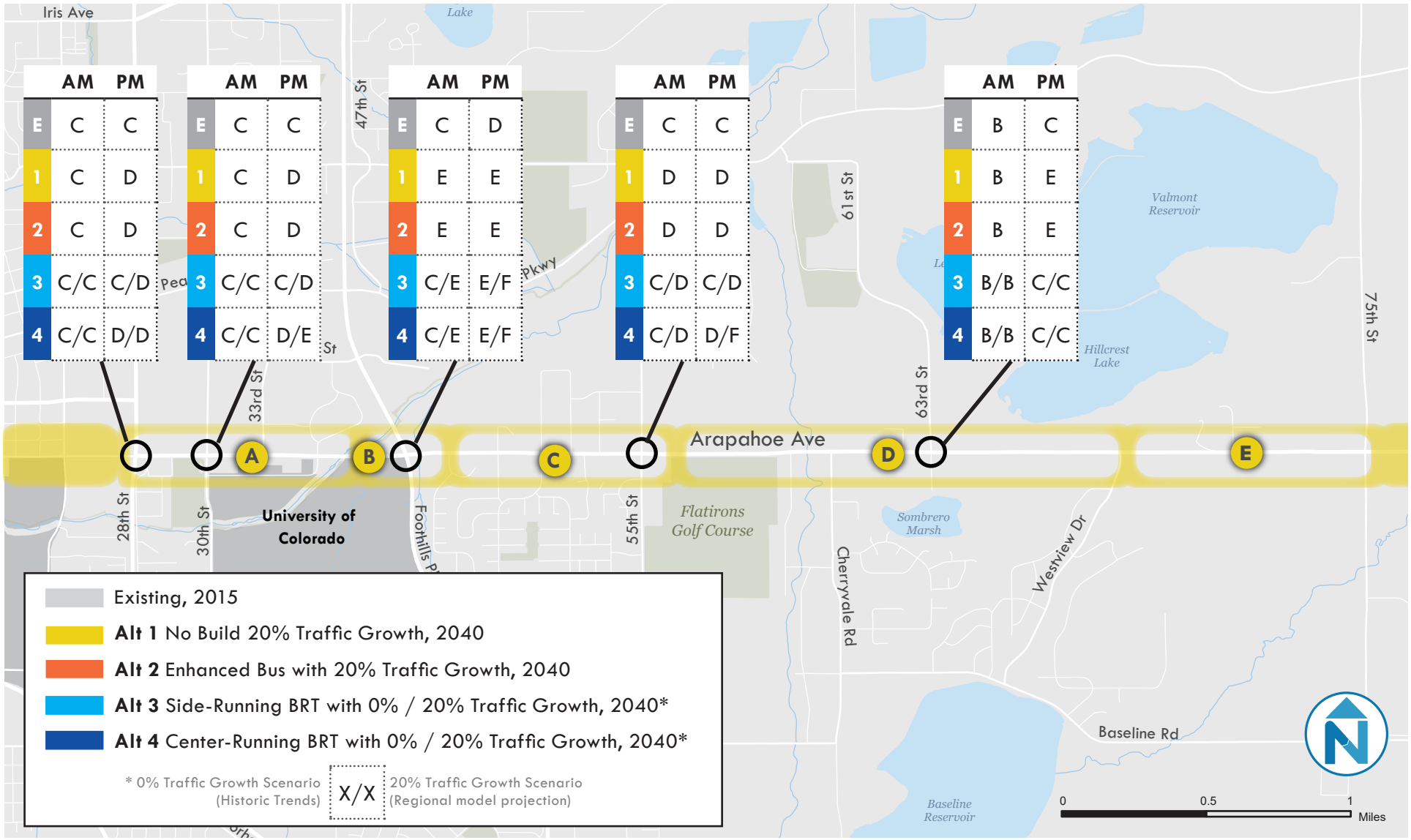
Attachment A provides additional detail on vehicle operations analysis.

Key Findings

- There are 14 signalized intersections in the corridor. The "big five" (28th, 30th, Foothills, 55th, and 63rd) are the most influenced by geometric changes in the alternatives. The remaining nine intersections with smaller side street traffic loads are typically less impacted from a Level-of-Service (LOS) perspective (except as noted below).
- The map on the following page summarizes LOS at the five key intersections for the different analysis horizons, alternative configurations, and low/high traffic volume forecasts.
- Without BRT in the future, if traffic grows by approximately 20% (as predicted by DRCOG models), the PM peak hour LOS at key intersections typically degrades by one to two letter grades (from C to D or E).
- With a lane repurposed for side-running BRT in the 0% traffic growth scenario, the peak hour LOS is typically the same as today, except at Foothills where the PM peak degrades from D to E.
- With a lane repurposed for center running BRT in the 0% traffic growth scenario, the PM peak hour LOS at 4 of the 5 key intersections degrades by a letter grade.
- With a 20% increase in traffic, the addition of side-running BRT results in a letter grade reduction in LOS at only the Foothills intersection, which degrades from E to F.
- With a 20% increase in traffic, the addition of center-running BRT results in one or two letter degradation in LOS at the 30th, Foothills, and 55th intersections.

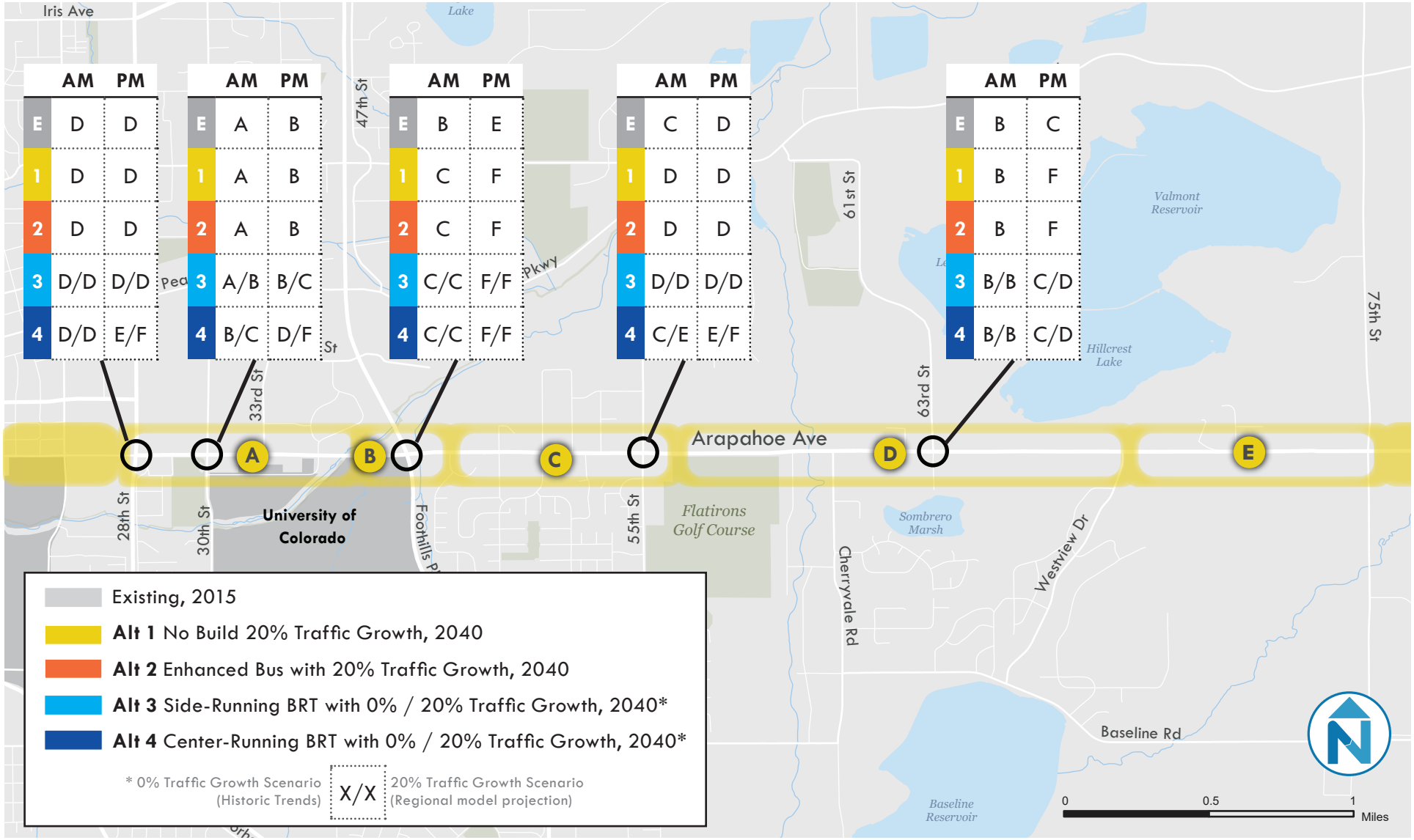
VEHICLE OPERATIONS: AUTO LEVEL OF SERVICE

AUTO LEVEL OF SERVICE, PEAK HOUR, ALL DIRECTIONS, 2040



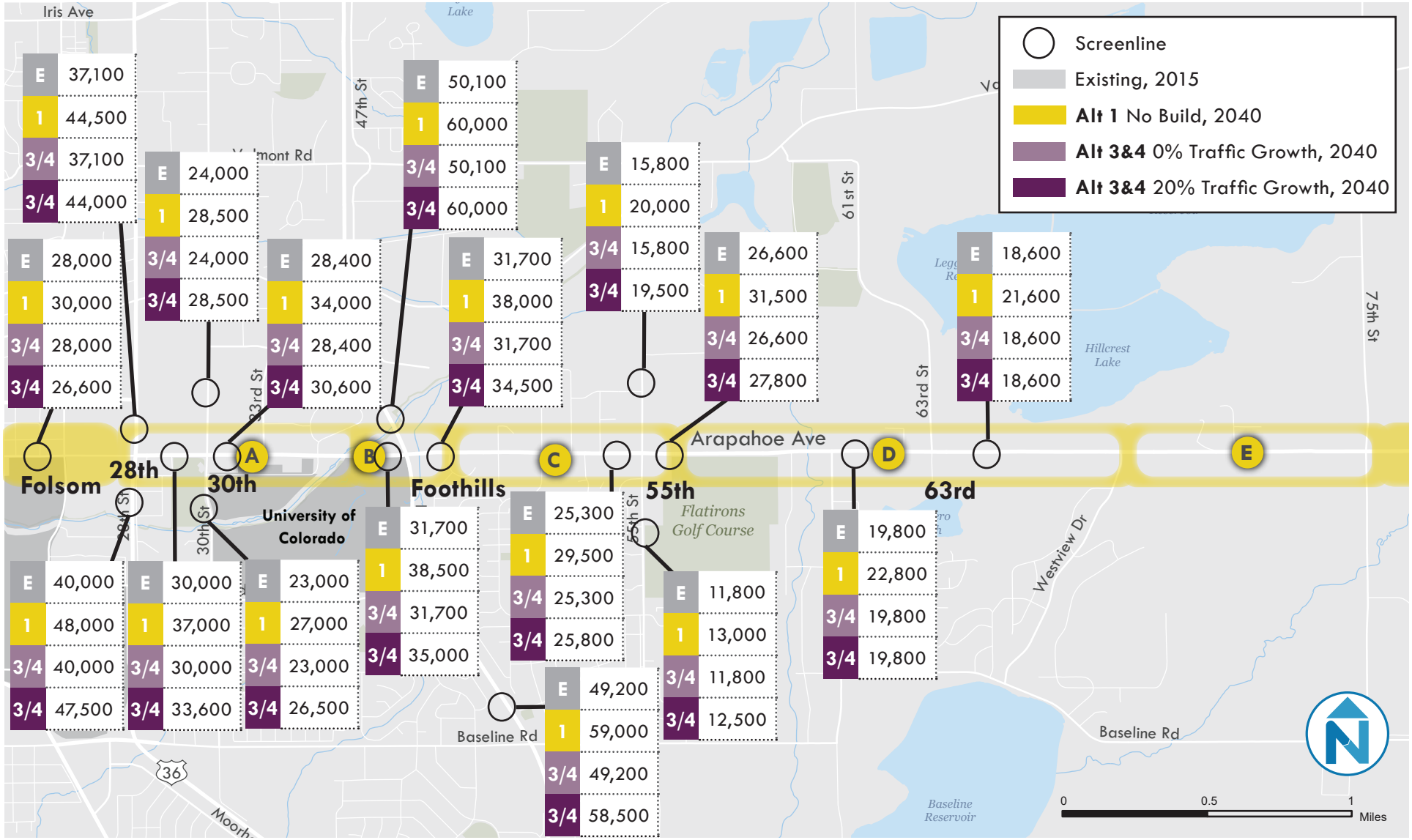
VEHICLE OPERATIONS: AUTO LEVEL OF SERVICE

AUTO LEVEL OF SERVICE, PEAK HOUR, EAST-WEST PEAK DIRECTION ONLY, 2040



VEHICLE OPERATIONS: AUTO VOLUMES

AUTO VOLUMES, AVERAGE DAILY, FOLSOM TO 75TH STREETS, 2040



VEHICLE OPERATIONS: AUTO TRAVEL TIME

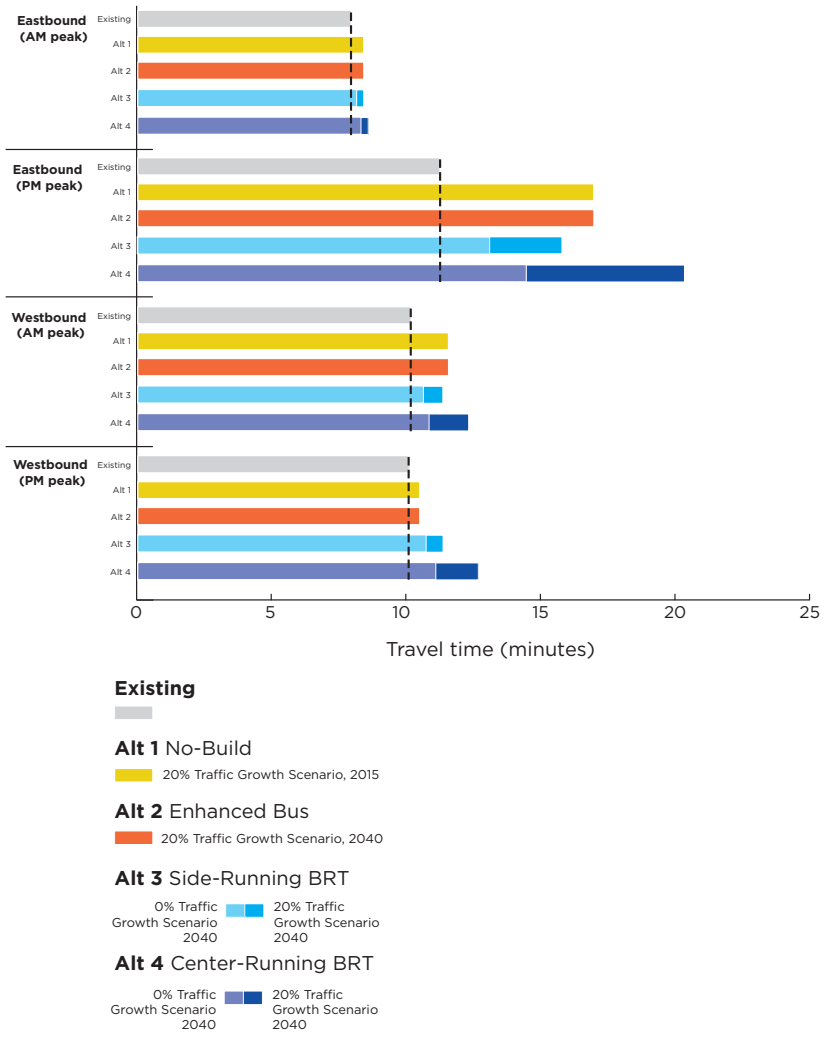
Key Assumptions

- The travel time on Arapahoe Avenue has been relatively constant based on historic data collected by the City of Boulder. The existing travel time and the calculated increase or decrease in future intersection delay (from the LOS model for each alternative) were utilized to project future travel time.
- Auto travel times will be impacted by future increases in traffic volume and congestion, and by any potential lane utilization changes at signalized intersections for BRT.
- BRT scenarios include lane repurposing, which takes away some of the through auto capacity at intersections, but BRT ridership reduces auto traffic, which can have a balancing effect on travel time.

Key Findings

- Travel times are projected to increase in the future in Alt 1 (No-Build) where corridor traffic increases by approximately 20% (see chart at right).
- Alt 1 and Alt 2 will likely function the same with travel times determined by the projected 20% increase in traffic in the corridor.
- In Alt 3 (Side-Running BRT) with the future 0% traffic growth scenario, the travel times are longer than today, but typically lower than the future 20% traffic growth scenario without BRT, particularly in the direction of peak flows (westbound in the AM and eastbound in the PM).
- Alt 4 (Center-Running BRT) with the 0% traffic growth scenario is also projected to result in shorter auto travel times in peak-hour, peak-directional flows when compared to the 20% traffic growth scenario without BRT (Alt 1).
- In the 20% traffic growth scenario, the peak-direction travel times with side-running BRT are also less than the No-Build scenario without BRT.
- The influence of center-running BRT operation in the 20% traffic growth scenario results in automobile travel time that is longer in all cases.

AUTO TRAVEL TIMES, FOLSOM TO 75TH STREETS, 2040



VEHICLE OPERATIONS: VMT

Key Findings

- There are 2.5 million vehicle miles traveled (VMT) citywide as of 2015. This is 8% higher than 2012 (2.3 million) but 10% lower than the peak level in 2002 (2.8 million).[1]
- Future 20% traffic growth projections (Alts. 1 & 2) result in VMT estimates that are approximately 18% higher than existing.
- As expected, the future year 0% traffic growth scenarios with BRT result in VMT that is approximately equal to today's corridor VMT.
- BRT ridership in the 20% traffic growth scenarios is successful in reducing VMT growth such that the corridor VMT is only 5% more than existing.

Key Assumptions

- Vehicle miles of travel by automobile is a useful measure in determining corridor mobility and differences between alternatives, impacts on air quality, success toward TMP goals, etc.
- Person miles of travel by automobile also allows a measure of total person trip mobility in the corridor when combined with estimates of travel by transit, bicycle and as pedestrians.
- An auto occupancy factor of 1.15 was used to convert from auto miles of travel to person miles of travel in automobiles.
- The 0% traffic growth scenario is based on historic trends (similar to today.

DAILY AUTO VEHICLE MILES OF TRAVEL AND PERSON MILES OF TRAVEL IN AUTOS, FOLSOM TO 75TH STREETS (BOTH DIRECTIONS), 2040

Alternative	Vehicle Miles of Travel (VMT)	Person Miles of Travel in Autos	Auto Person Miles of Travel Comparison to Existing (% Increase)
Existing (2015)	110,500	127,075	n/a
Alt 1: No-Build with 20% Traffic Growth	130,100	149,615	17.7%
Alt 2: Enhanced Bus with 20% Traffic Growth	130,100	149,615	17.7%
Alt 3 and 4 Side or Center-Running BRT with 0% Traffic Growth	111,300	127,995	0.7%
Alt 3 and 4 Side or Center-Running BRT with 20% Traffic Growth	116,000	133,400	5.0%

Source: Estimated based on Federal Transit Administration (FTA) data and tendency for commuting trips in the corridor.

[1] https://bouldercolorado.gov/boulder-measures/vehicle-miles-of-travel

VEHICLE OPERATIONS: FREIGHT

Key Assumptions

- It is likely that multi-modal improvements and traffic access control measures will result in continuous medians between signalized intersections, which will restrict unsignalized left-turn access.
- Driveway consolidation between adjacent parcels is likely to minimize motorized crossings of bicycle and pedestrian facilities.
- Access control measures will minimize crashes and enhance safety in the corridor.
- Side-running BRT will allow right-turning trucks to access driveways from the outside business-access-and-transit (BAT) lane with less interaction with through traffic but buses and trucks will have to mix in the outside lane.
- Center-running BRT will allow buses to avoid most interaction with trucks in the corridor. However, now trucks will need to interact with through traffic in the busy outside through-right-turn lanes.
- In this context, it will be important to still allow efficient truck access to the businesses along the East Arapahoe corridor. Intersections and driveways will need to be designed to accommodate the turning paths of the truck traffic serving the corridor.

Key Findings

- The East Arapahoe corridor serves much of Boulder's service commercial and light industrial uses. In this context freight access by truck is important.
- Trucks on Arapahoe typically represent only 3% to 4% of the daily traffic according to CDOT data.
- Traffic access control will be a key component of implementing multi-modal improvements in the corridor. Access control measures will need to consider maintaining efficient truck access. With narrower travel lanes, trucks will need to make slower right turns into driveways, potentially slowing corridor travel times.

QUALITATIVE ASSESSMENT OF FREIGHT OPERATIONS

Alternative	Character Districts A, B, C, D, and E	Overall Assessment
Alt 1: No-Build	Freight access similar to today	Little change in freight access
Alt 2: Enhanced Bus	Freight access similar to today	Little change in freight access unless access control measures are implemented
Alt 3: Side-Running BRT with outside lane repurposed as a BAT lane (right-turns allowed)	Trucks will make right-turning access from BAT lane. Will need to mix with BRT and local buses.	Less friction with turning trucks than today
Alt 4: Center-Running BRT with inside lane repurposed as a dedicated transit lane	Trucks will make right turns from congested through-right turn lanes, but interaction with BRT is minimized. Local buses likely to continue to operate in curbside lane in many parts of the corridor.	Most congested access for right turning trucks in to driveways along the corridor

TRANSIT OPERATIONS: SERVICE SPAN AND FREQUENCY

Key Assumptions

- Existing JUMP bus service in the Arapahoe/SH 7 corridor within Boulder runs every 10 minutes during peak hours and midday and every 30 minutes in the evenings, between approximately 5 AM and midnight (varies depending on travel direction).
- A potential operating plan for Enhanced Bus or BRT in the Arapahoe corridor would connect the Downtown Boulder Transit Center (TC) on the west end with I-25 and Brighton on the east end.
- The Long JUMP is assumed to operate between the Downtown Boulder TC and Erie/Lafayette in all alternatives with enhancements to midday and weekend frequency. The Short JUMP (Downtown Boulder TC to 65th Street) is eliminated in the Build alternatives (2, 3, and 4). The Long JUMP would continue to operate every 30 minutes to Erie and every 30 minutes to Lafayette, resulting in a combined 15 minute headways at non-BRT stops in Boulder.
- BRT and local buses would run every 6 to 7.5 minutes during the day and every 15 minutes in the early mornings and evenings. Service would run slightly later than existing service, approximately 1 AM.

Attachment B provides additional detail on transit evaluation measures.

BRT OPERATING PLAN ASSUMPTIONS - HEADWAY (MINUTES)*

Alternative	AM	Midday	PM	Early AM/ Evening
Existing: Existing Bus	-	-	-	-
Alt 1: No-Build	-	-	-	-
Alt 2: Enhanced Bus	10	15	10	30
Alt 3: Side-Running BRT	10	15	10	30
Alt 4: Center-Running BRT	10	15	10	30

LOCAL BUS (JUMP) OPERATING PLAN ASSUMPTIONS - HEADWAY (MINUTES)*

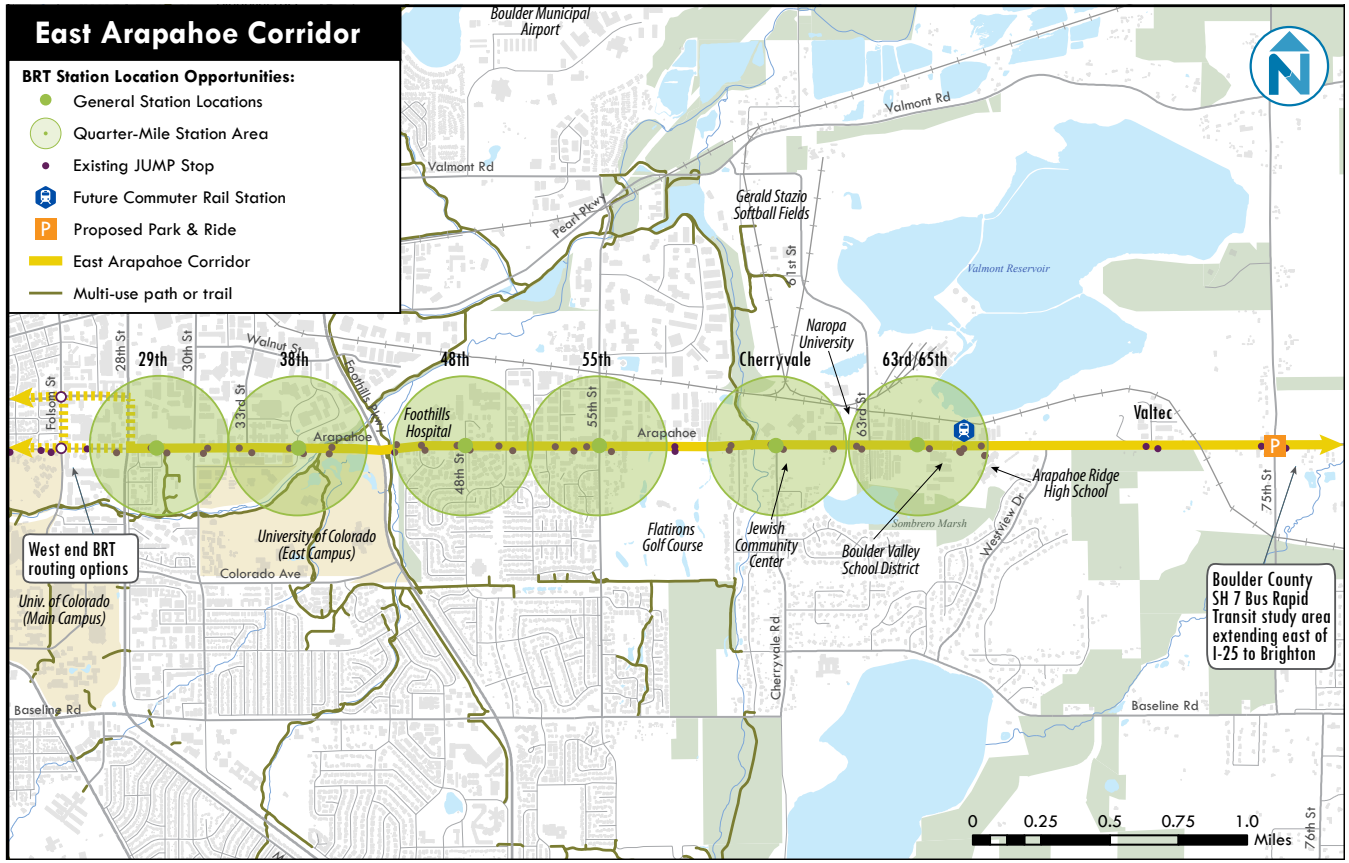
Local JUMP Pattern	AM	Midday	PM	Early AM/ Evening
Long JUMP to Erie (All Alternatives)	30	30 §	30	60
Long JUMP to Lafayette (All Alternatives)	30	30	30	60
Short JUMP to 65th St (Existing & No-Build Only†)	30	30	30	-

Notes: * Headway is the amount of time between bus arrivals in each direction. § There is no existing midday service to Erie. † The Short JUMP is assumed to be eliminated in the Enhanced Bus and BRT alternatives; the Long JUMP would maintain service at least every 15 minutes at local bus stops in Boulder.

TRANSIT OPERATIONS: CONCEPTUAL STATION LOCATIONS

Key Assumptions

- BRT or Enhanced Bus stations would be located at least a quarter-mile apart and preferably between a third of a mile and a half-mile (or more) from adjacent stops.
- The project team assumed six stations with a minimum half-mile distance between Folsom and 75th Streets:
  - 29th Street
  - 38th Street
  - 48th Street
  - 55th Street
  - Cherryvale Road
  - 63rd/65th Street
- Criteria for siting station areas include the presence of major generators (such as the 29th Street Mall), important transit and multimodal connections (such as US 36 BRT), land use, right-of-way feasibility, existing ridership, and stop spacing considerations.
- Local buses would continue to serve existing stops.



TRANSIT OPERATIONS: TRAVEL TIME AND RELIABILITY

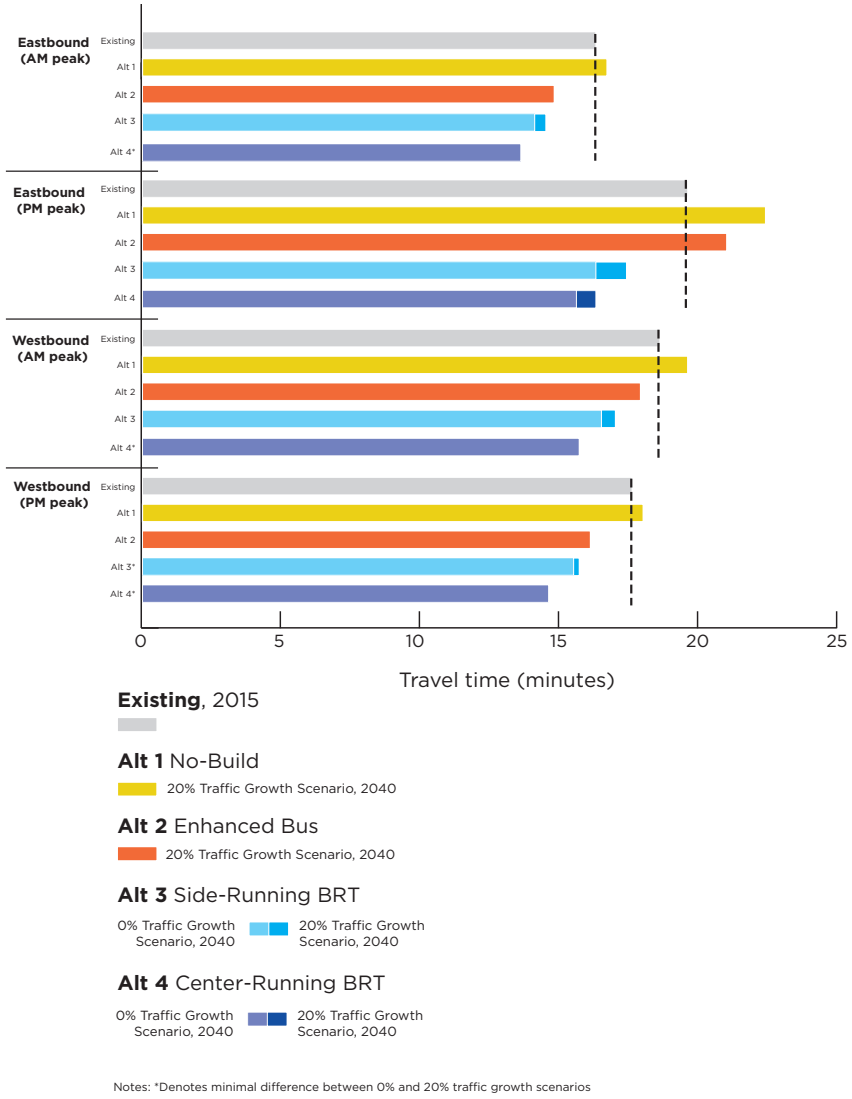
Key Assumptions

- Enhanced Bus and BRT would have station and vehicle features that reduce dwell time at stations—off-board fare payment and all-door boarding.
- Enhanced Bus would operate in mixed-traffic with existing transit priority (e.g., queue jumps at Foothills Parkway and a transit-only lane between approximately 63rd Street and 65th Street).
- Side-running BRT would operate in a curbside business-access-and-transit (BAT) lane that is shared with right-turning vehicles.
- Center-running BRT would operate in dedicated lanes in the roadway median.
- BRT is assumed to use transit-signal priority (TSP) to reduce delay at intersections.
- Transit priority features implemented east of 75th Street would provide travel time savings that are included in ridership projections and end-to-end operating costs estimates.

Key Findings

- No-Build alternative: Peak period transit travel times between Folsom and 75th Streets increase by up to 14% (eastbound PM Peak).
- Alt 2, Enhanced Bus: Travel times decrease by slightly less than a minute or 6% (eastbound PM peak) relative to No-Build bus service, due to limited stops and reduced dwell time.
- Alt 3, Side-Running BRT: Travel times decrease by up to 2.5 minutes or 22% (eastbound PM peak, 0% traffic growth scenario) and 3 minutes or 27% (eastbound PM peak, 20% traffic growth). Local buses would operate in the curbside BAT lane. Congestion from right-turning vehicles could reduce reliability compared to center-running BRT.
- Alt 4, Center-Running BRT: Travel times decrease by up to 3 minutes or 27% (eastbound PM peak, 0% traffic growth scenario) and 3.5 minutes or 30% (20% traffic growth scenario). Local buses would likely run in the curbside mixed-traffic lane. In the 20% traffic growth scenario, longer travel times are projected to slightly increase local bus operating costs and vehicle requirements.

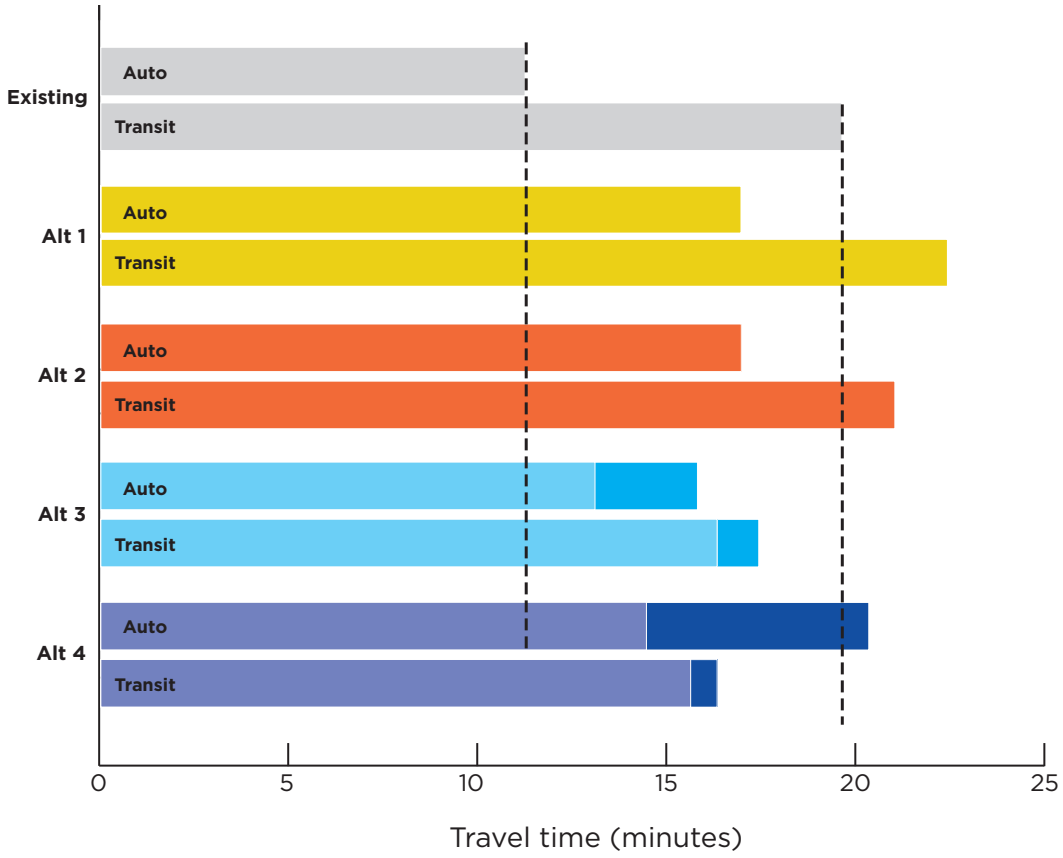
ONE-WAY TRANSIT TRAVEL TIMES, FOLSOM TO 75TH STREETS, 2040



Notes: *Denotes minimal difference between 0% and 20% traffic growth scenarios

TRANSIT OPERATIONS: TRAVEL TIME AND RELIABILITY

ONE-WAY TRANSIT TRAVEL TIMES COMPARED TO AUTO TRAVEL TIMES, FOLSOM TO 75TH STREETS, 2040, EASTBOUND PM PEAK



Existing, 2015

Alt 1 No-Build

20% Traffic Growth Scenario, 2040

Alt 2 Enhanced Bus

20% Traffic Growth Scenario, 2040

Alt 3 Side-Running BRT

0% Traffic Growth Scenario, 2040 — 20% Traffic Growth Scenario, 2040

Alt 4 Center-Running BRT

0% Traffic Growth Scenario, 2040 — 20% Traffic Growth Scenario, 2040

Key Findings

- All of the Build alternatives reduce the amount of time it takes to ride transit in the corridor compared to driving.
- Alt 3 (Side-Running BRT) and Alt 4 (Center-Running BRT) reduce transit travel times in the corridor to within 1 to 3 minutes of auto travel times in the Eastbound PM peak.
- In the 20% traffic growth scenario, Center-Running BRT provides shorter travel times than auto travel in the Eastbound PM Peak.

TRANSIT OPERATIONS: RIDERSHIP IN CORRIDOR

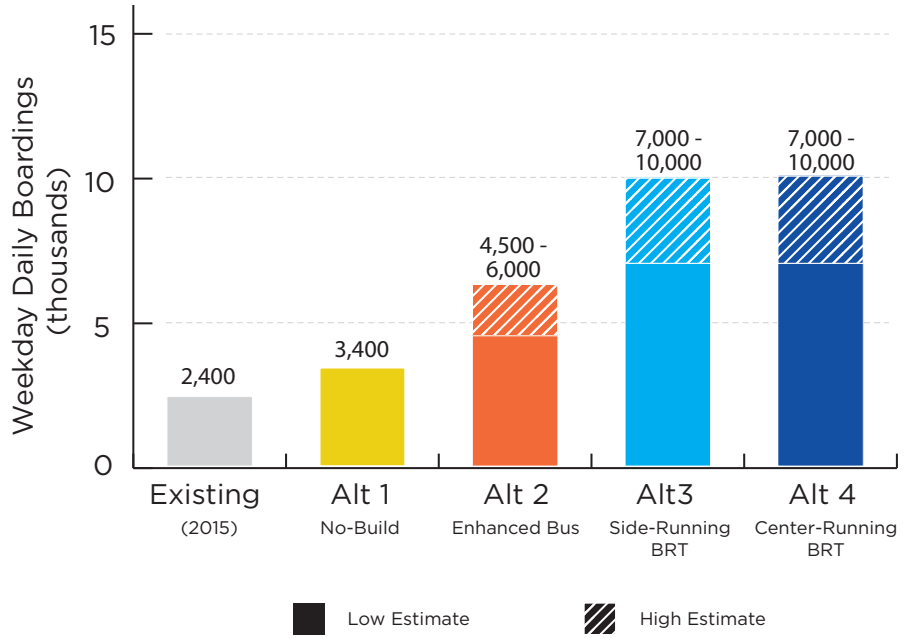
Key Assumptions

- Ridership estimates are end-to-end, from Downtown Boulder to Brighton east of I-25 for Alts 2, 3, and 4. No-Build ridership is based on the existing JUMP route between Downtown Boulder and Lafayette/Erie.
- Build alternative ridership includes both Enhanced Bus or BRT and local JUMP service.
- "Sketch-level" ridership estimates are based on existing JUMP ridership, adjusted for population and employment growth, travel time improvements, and increased service levels
- Up to 1,700 new boardings are projected on the new service east of Boulder, based on analysis of trips to within 1/2 mile of the Arapahoe corridor in Boulder (from regional model travel pattern data and Census employment data) and assumptions for mode shift to new/extended regional service.
- The high-end ridership estimate is based on analysis of the potential of transportation and land use policy changes to reduce vehicle trips and attract new riders (e.g., providing transit passes, parking management, etc.).

Key Findings

- Existing ridership on the JUMP is about 2,400 daily boardings, and about 3,400 boardings are projected in Alt 1.
- Side and center-running BRT ridership is projected to be from 7,000 to 10,000 daily boardings (combined BRT and local), with either Alt 3 or 4 within in a +/– 10% margin, regardless of the traffic growth scenario.
- Ridership would be lower in the Enhanced Bus scenario (4,500 to 6,000 daily boardings), with limited stop service and enhanced vehicles, stations, and amenities, but without exclusive right-of-way.

PROJECTED WEEKDAY DAILY BOARDINGS, DOWNTOWN BOULDER TO BRIGHTON, 2040



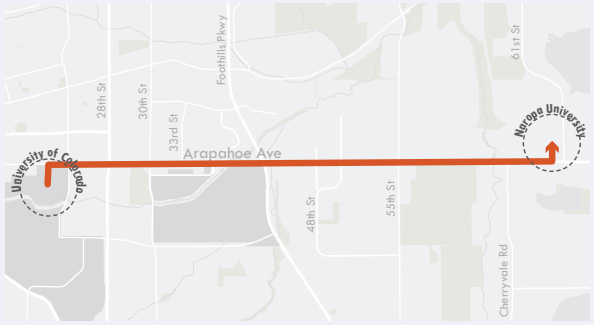
Source: Sketch-level local ridership model. RTD ridership data for JUMP, January 2015. DRCOG regional travel demand model data, 2013/2035. US Census Longitudinal Household Dynamics (LEHD), 2014.

TRANSIT OPERATIONS: SAMPLE TRAVEL TIMES

COMPARISON OF TRANSIT AND AUTO TRAVEL TIMES

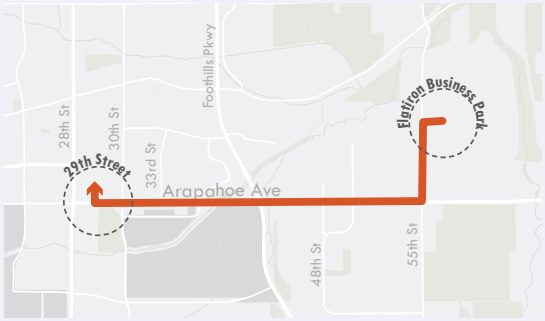
A trip along Arapahoe from the University of Colorado (CU) campus at Folsom to the Naropa University Campus at 63rd St. during the evening rush hour takes . . .

- **9** minutes driving or **18** minutes on transit in 2015
- **12** minutes driving or **20** minutes on bus in 2040 in the **No-Build** scenario
- **12** minutes driving or **18** minutes on **Enhanced Bus** in 2040
- **12** minutes driving or **14** minutes on **Bus Rapid Transit** in 2040



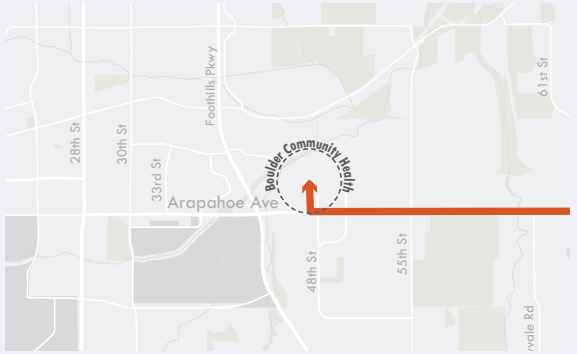
A trip along Arapahoe from the Flatiron Business Park on 55th St. to the Twenty-Ninth Street Retail Area around lunch time takes . . .

- **6** minutes driving or **18** minutes on transit in 2015
- **6** minutes driving or **18** minutes on bus in 2040 in the **No-Build** scenario
- **6** minutes driving or **17** minutes on **Enhanced Bus** in 2040
- **7** minutes driving or **16** minutes on **Bus Rapid Transit** in 2040



A trip along Arapahoe from US 287 to Boulder Community Health at 48th St. during the morning rush hour takes . . .

- **14** minutes driving or **22** minutes on transit in 2015
- **17** minutes driving or **25** minutes on bus in 2040 in the **No-Build** scenario
- **17** minutes driving or **23** minutes on **Enhanced Bus** in 2040
- **17** minutes driving or **19** minutes on **Bus Rapid Transit** in 2040



Approximate departure times are:
AM peak: 8 am; Midday: noon; PM peak: 5 pm

Transit travel times assume an average wait time of 1/4 of headway, and a walk time of 8 minutes from Flatiron Business Park to Arapahoe Ave & 55th Street

Bus Rapid Transit travel times assume side-running BRT

TRANSIT OPERATIONS: SAMPLE TRAVEL TIMES

COMPARISON OF TRANSIT AND AUTO TRAVEL TIMES

Origin	Destination	Scenario*	Time Period**	Driving (Min)	Transit (Min) ***	Transit to Drive Time Ratio
CU (Folsom & Arapahoe)	Naropa University Nalanda Campus (63rd and Arapahoe)	Existing, 2015	PM Peak	9	18	2.1
		Alt 1 - No Build, 2040		12	20	1.7
		Alt 2 - Enhanced Bus, 2040		12	18	1.5
		Alt 3 - Side Running BRT, 2040 (20% Traffic Growth)		12	14	1.2
		Alt 4 - Center Running BRT, 2040 (20% Traffic Growth)		17	13	1.1
US 287 & Arapahoe	Boulder Community Health (48th and Arapahoe)	Existing, 2015	AM Peak	14	22	1.5
		Alt 1 - No Build, 2040		17	25	1.5
		Alt 2 - Enhanced Bus, 2040		17	23	1.3
		Alt 3 - Side Running BRT, 2040 (20% Traffic Growth)		17	19	1.1
		Alt 4 - Center Running BRT, 2040 (20% Traffic Growth)		17	17	1.0
Flatiron Business Park (55th & Central)	Twenty Ninth Street Retail Area	Existing, 2015	Midday	6	18	3.0
		Alt 1 - No Build, 2040		6	18	2.9
		Alt 2 - Enhanced Bus, 2040		6	17	2.7
		Alt 3 - Side Running BRT, 2040 (20% Traffic Growth)		7	16	2.3
		Alt 4 - Center Running BRT, 2040 (20% Traffic Growth)		7	15	2.3

* 0% Traffic Growth is the historic trend, 20% Traffic Growth is the regional model projection

** Approximate departure times are:
AM peak - 8 am, Midday - noon, PM peak - 5 pm

*** Transit travel times assume an average wait time of 1/4 of headway, and a walk time of 8 minutes from Flatiron Business Park to Arapahoe Ave

TRANSIT OPERATIONS: TRANSIT SERVICE QUALITY

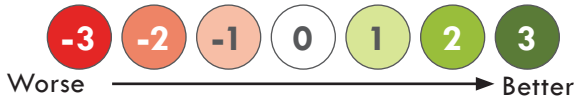
Key Assumptions

- A transit Level of Service (LOS) measure (analogous to auto LOS letter grade scores) was calculated to assess overall service quality in the corridor, based on a methodology adapted from the Transit Capacity and Quality of Service Manual, 3rd Edition (TCRP Report 165).
- Inputs address various factors related to transit service quality such as frequency, level of amenities, and quality of the pedestrian environment:
  - Transit frequency by alternative, including local bus, Enhanced Bus, and/or BRT trips.
  - Factors that affect perceived travel time, including:
    - » Presence of existing shelters and benches, and new shelters/benches at Enhanced Bus and BRT stations
    - » Transit travel speed by street segment.
    - » Excess waiting time, based on RTD data for scheduled and actual bus departure times and transit priority assumptions for each alternative
  - Pedestrian environment factors including peak-direction, mid-block vehicle volume in the outside lane for each alternative and vehicular travel speeds. In Alt 3, the curbside BAT lane carries only buses and right-turning vehicles.

Key Findings

- Existing transit service along the East Arapahoe corridor is very frequent (every 10 minutes during the day) and all segments in all alternatives score "C" or better.
- The No-Build score is slightly lower in some cases, e.g., due to higher traffic volumes.
- Enhanced Bus increases quality of service and facilities to a "B" or better. Both BRT alternatives score "A" along the full corridor.
- The map on the following page provides scores at the locations of proposed BRT stations along the corridor. The matrix below illustrates the component scores for a particular point along the corridor.

SCORE

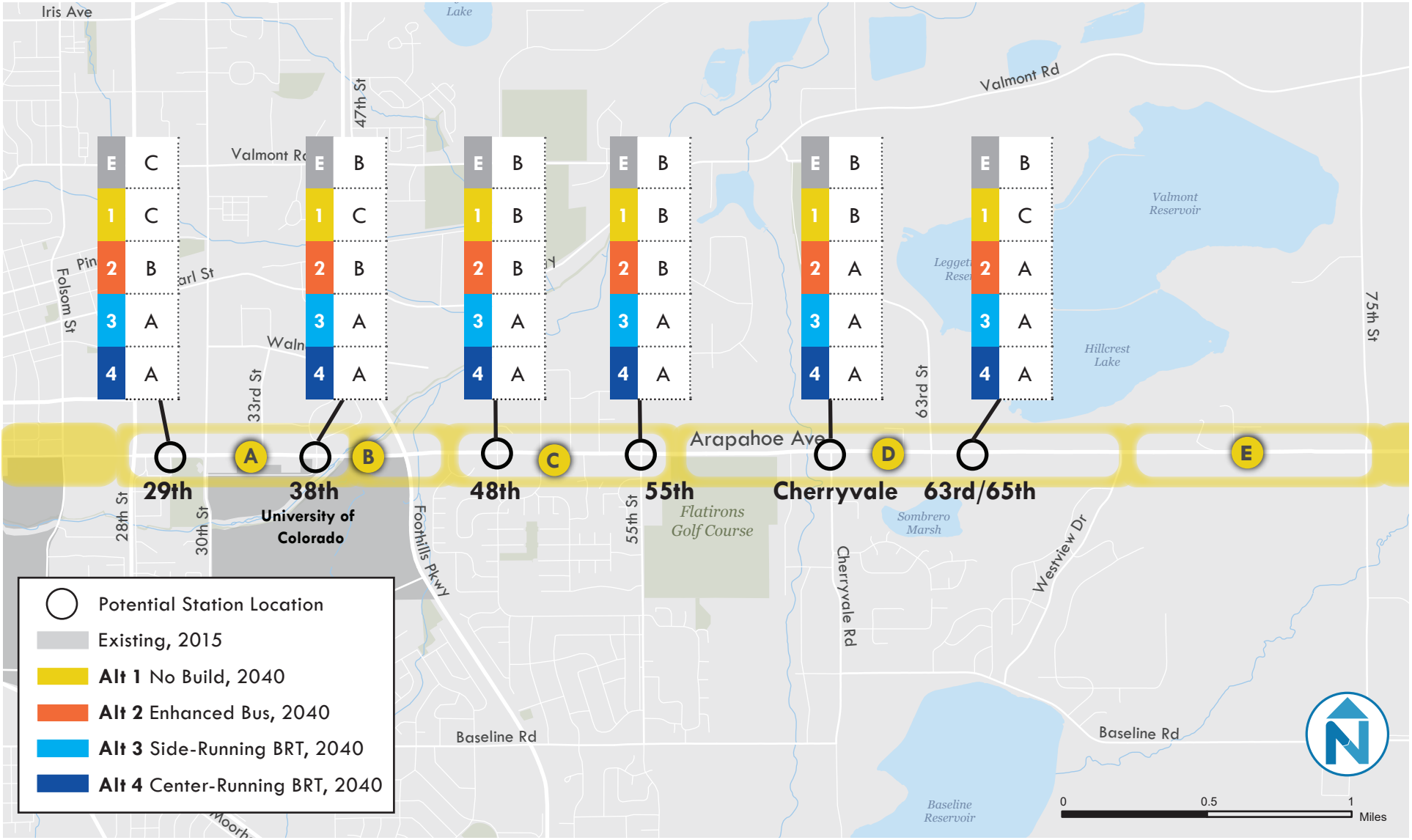


TRANSIT LEVEL OF SERVICE SCORING MATRIX FOR 29TH AND ARAPAHOE, 2040

Scenario	Frequency	Perceived Travel Time	Transit Travel Speed	Excess Wait Time	% of Stops with Benches	% of Stops with Shelters	Cross-Section Adjustment	Traffic Volume (outside lane)	Average Traffic Speed	Pedestrian Environment Score
Existing, 2015	0	0	0	0	0	0	0	0	0	0
Alt 1: No-Build	0	-1	-1	-1	0	0	0	-1	2	-1
Alt 2: Enhanced Bus	2	1	1	-1	0	0	2	-1	2	1
Alt 3: Side-Running BRT	2	2	1	3	0	0	2	2	2	2
Alt 4: Center-Running BRT	2	3	3	2	0	0	2	-2	3	1

TRANSIT OPERATIONS: SERVICE QUALITY

TRANSIT LEVEL OF SERVICE, 2040



TRANSIT OPERATIONS: OPERATING COSTS

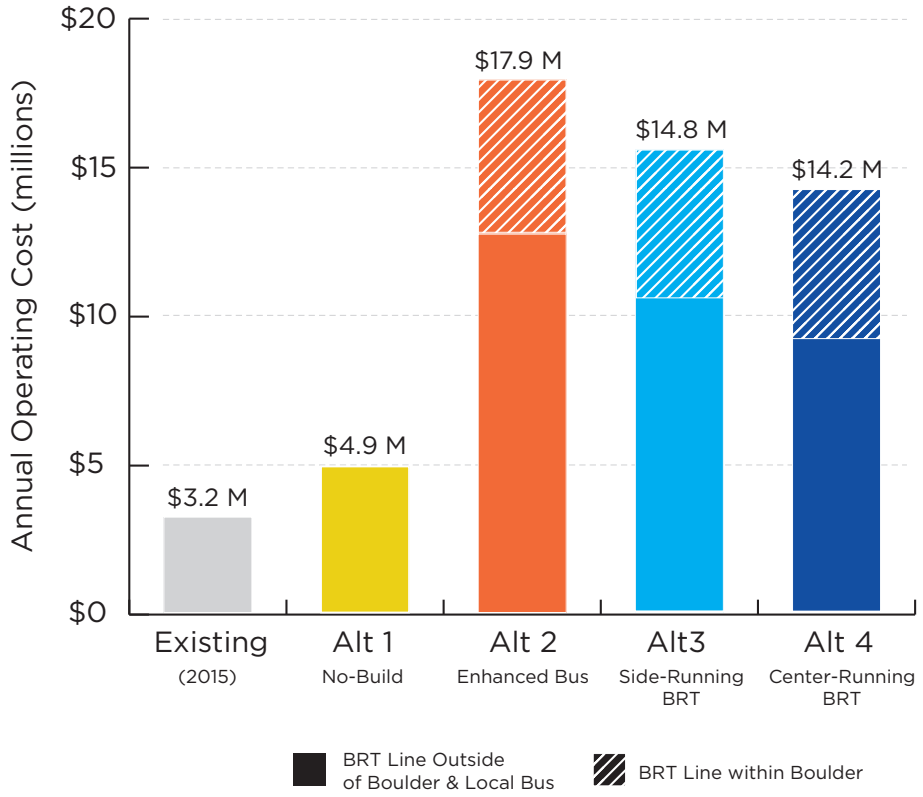
Key Findings

- Approximately $5 million of the annual cost of operating Enhanced Bus or BRT is associated with the Boulder portion of the line (based on service hours).
- Enhanced Bus (Alt 2) is likely to be the most expensive to operate (nearly $18 million annually end-to-end); longer travel times require more vehicles and operators.
- End-to-end operating costs are slightly higher for Side-Running BRT (Alt 3) (nearly $15 million) compared to Center-Running BRT (Alt 4) (over $14 million).
- Local bus service hours and costs are likely to increase slightly in Alt 4 due to longer travel times in the mixed-traffic lanes.

Key Assumptions

- Operating costs are end-to-end (Boulder to Brighton), based on the operating plan assumptions (hours and frequency) and conceptual station locations. Approximately a third of Enhanced Bus or BRT service hours are in Boulder.
- Hourly costs for Enhanced Bus and BRT are based on the 2016 RTD Regional BRT cost of $135, adjusted to $151 per service hour including security and fare enforcement costs. A station maintenance cost is also assumed.
- Hourly costs for local buses are based on the 2016 RTD marginal local operating cost of $101, adjusted to $104 per service hour.
- Operating costs are adjusted to 2017 dollars.
- Layover assumed to be 15% of base travel time.

ANNUAL TRANSIT OPERATING & MAINTENANCE COSTS, BOULDER-BRIGHTON, 2040 (IN 2017 DOLLARS)



$ COST-EFFECTIVENESS: LIFECYCLE TRANSIT OPERATING & CAPITAL COSTS WITHIN BOULDER

Key Findings

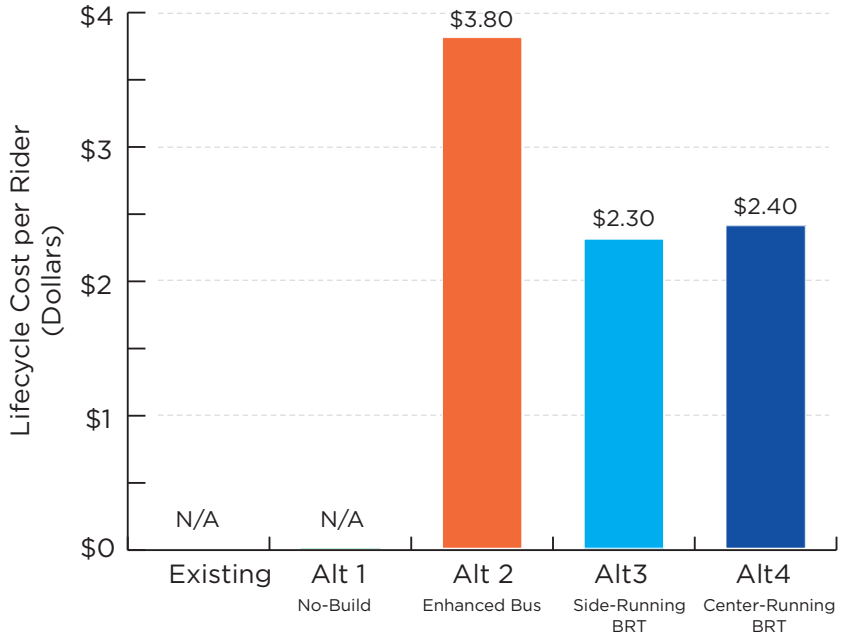
- Alt 2 has the highest transit lifecycle cost compared to side-running and center-running BRT (Alts 3 and 4) due to higher operating costs (see transit travel time measure), a larger number of vehicles required, and lower projected ridership.

Key Assumptions

- Transit capital costs are only for Enhanced Bus or BRT in the City of Boulder portion of the Arapahoe Corridor (Districts A-E). This calculation includes only costs that are directly transit-related. For this measure, costs are spread over a 30-year period, except for vehicles (12 years).
- Annual transit operating and maintenance costs and vehicle capital costs are for a share of the end-end Enhanced Bus or BRT service in Alts 2, 3, and 4 (estimated based on the proportion of service hours in Boulder).
- Ridership is end-end for a transit project operating between Boulder TC and Brighton.

Appendices B and G provide additional detail on the cost-effectiveness measure.

TRANSIT LIFECYCLE COSTS (WITHIN BOULDER) PER TRANSIT RIDER, 2040
(ANNUAL OPERATING & ANNUALIZED CAPITAL COST, 2017 DOLLARS)



Alternative	Annual Operating and Annualized Capital Cost for Enhanced Bus or BRT	Annual Transit Riders	Annual Lifecycle Cost Per Transit Rider
Existing (2015)	N/A	720,000	N/A
Alt 1: No-Build	N/A	1,020,000	N/A
Alt 2: Enhanced Bus	$6.0 M	1,575,000	$3.80
Alt 3: Side-Running BRT	$5.8 M	2,550,000	$2.30
Alt 4: Center-Running BRT	$6.2 M	2,550,000	$2.40

PEDESTRIAN AND BICYCLE COMFORT AND ACCESS ANALYSIS METHODOLOGY

The four proposed active transportation options were analyzed using a Streetscore+ methodology*, which reflects the following factors.

For people walking:

- Sidewalk width, quality and accessibility
- Landscape buffer and street streets
- Number of roadway lanes
- Roadway prevailing speed
- Lighting
- Heavy vehicles

For people biking:

- Bikeway type (bike lane, protected bike lane, shared-use path, etc.)
- Bikeway width
- Vertical separation from roadway lanes
- Horizontal separation from roadway lanes
- Visibility at minor streets
- Roadway prevailing speed
- Conflicting turn treatments
- Bikeway blockage (by vehicles)

*StreetScore+ methodology is similar to Level of Traffic Stress (LTS) but incorporates new methodologies to quantify level of stress on separated bikeways, bikeways on neighborhood streets, and pedestrian facilities.

Attachment C provides additional detail on pedestrian and bicycle measures.

EXPLANATION OF PEDESTRIAN AND BICYCLE SCORES (1 TO 4) AND EXISTING EXAMPLES IN BOULDER

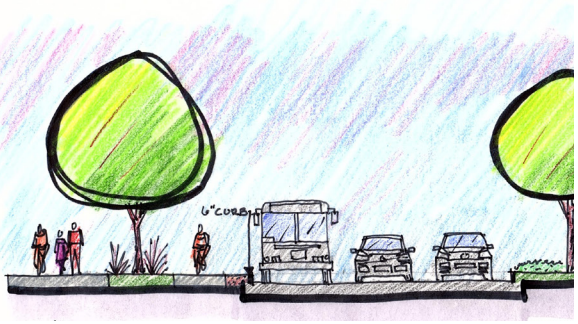
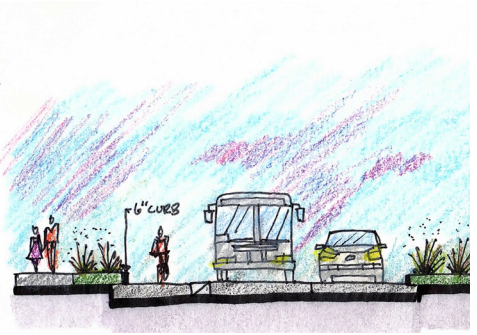
Boulder Creek Path	19th Street (Iris-Balsam) 9th Street (Balsam-Canyon)	55th Street (Arapahoe-Valmont) Valmont Road (Folsom-Foothills)	Existing bike lanes on Arapahoe (55th-Westview)

PEDESTRIAN AND BICYCLE COMFORT AND ACCESS: OPTIONS ANALYZED BY CHARACTER DISTRICT

The table below shows the Build options that were evaluated within each Character District.

The maps on the following pages illustrate the analysis results for pedestrian facilities, on-street bicycle facilities, and off-street bicycle facilities.

PEDESTRIAN AND BICYCLE OPTIONS EVALUATED BY CHARACTER DISTRICT

DISTRICT A	DISTRICT C	DISTRICT D	DISTRICT E
Option 1a: Curbside Raised Protected Bicycle Lane with Amenity Zone and Multiuse Path 	**Option 1a: Curbside Raised Protected Bicycle Lane with Amenity Zone and Multiuse Path** 		**Option 4: Street-level Buffered Bicycle Lane with Curbside Amenity Zone and Sidewalk (south side) or Existing Multiuse Path (north side)** 
Option 2: Curbside Amenity Zone with Raised Protected Bicycle Lane Separated from Sidewalk 	**Option 3: Street-level Protected bicycle Lane with Amenity Zone and Multiuse Path** 		Note: A variation of Option 1a was initially developed for District E. Based on Community Working Group input, the project team focused on developing an option that better fit the character of District E. This resulted in Option 4, which was evaluated as part of both groups.

PEDESTRIAN AND BICYCLE COMFORT AND ACCESS

Key Findings - Pedestrian

- The Build options equally increase pedestrian comfort in the corridor.
- There is less improvement in Character District E due to high vehicular speeds.
- The maps on page 43 illustrate the pedestrian analysis results.

Key Findings - Bicycle

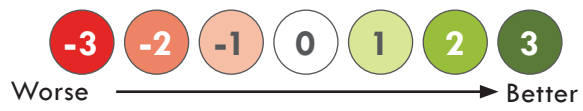
- The Build options provide on-street protected bike facilities in Districts A through D. In District E buffered bike lanes are proposed.
- The maps on page 44 illustrate anaysis results for on-street bicycle facilities.
- Off-street bicyle facilities (i.e., multi-use paths shared by people walking and biking) are more comfortable for some users. A tradeoff with shared facilities is the potential for increased conflicts betweeen bicyclists and pedestrians, and between autos and bicycles crossing driveways in the opposite direction as traffic.
- Off-street bicycle facilities are proposed in all options/districts except as noted below:
  - Option 2, considered in District A, includes a sidewalk instead of a multi-use path.
  - Option 4 includes a sidewalk instead of a multi-use path on the south side of Character District E (east of Westview Dr.).
- The maps on page 45 illustrate the analysis results for off-street bicycle facilities.
- Enhancements at intersections are critical to achieiving a high level of user comfort. Two scenarios were considered and can apply to any of the Build options.
  - Minimal enhancements, i.e., no significant changes to intersection geometry or signals (e.g., protected right or left turns) would not significantly increase delay for vehicles, but generally result in lower levels of bicyclist comfort.
  - Substantial enhancements would include whatever intersection geometry or signal operations improvements are necessary to achieve a high level of bicyclist comfort, but these changes may result in increased intersection delay for vehicles.*

PEDESTRIAN RESULTS, 2040

Option	Score
Existing (2015)	0
No-Build	1
Build Options	3

BICYCLE RESULTS, 2040

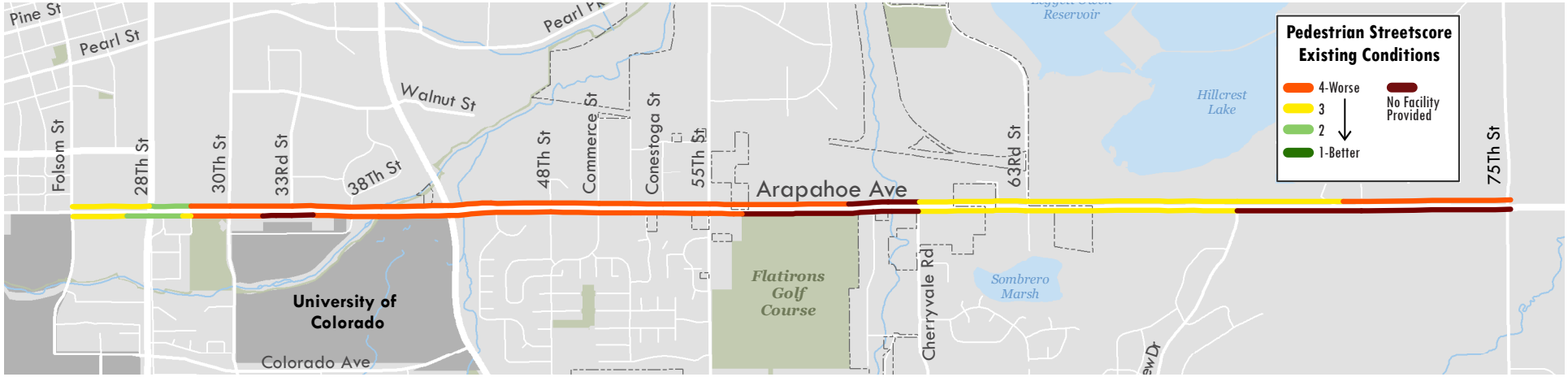
Option	Score
Existing (2015)	0
No-Build	1
Build Options - with Minimal Enhancements at Intersections	2
Build Options - with Substantial Enhancements at Intersections	3



Note: *Individual intersection improvements and their benefits/impacts are not analyzed as part of this plan. It is assumed that they will be considered on a case-by-case basis going forward.

PEDESTRIAN COMFORT AND ACCESS

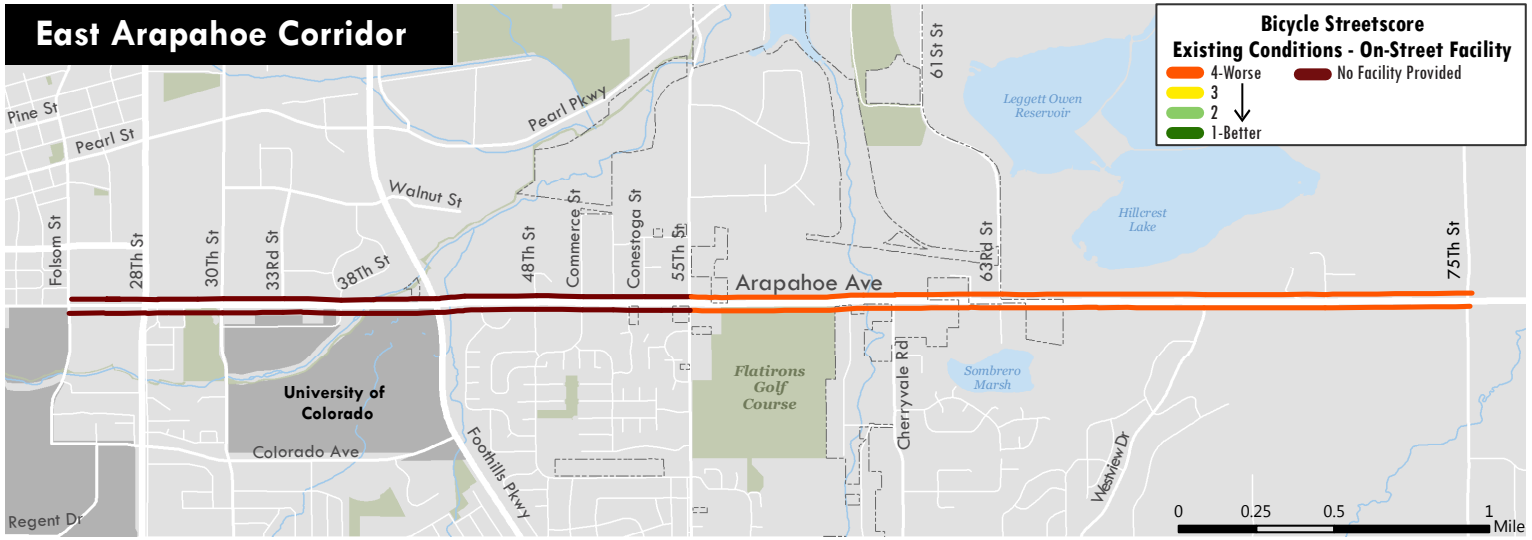
PEDESTRIAN LEVEL OF SERVICE, EXISTING



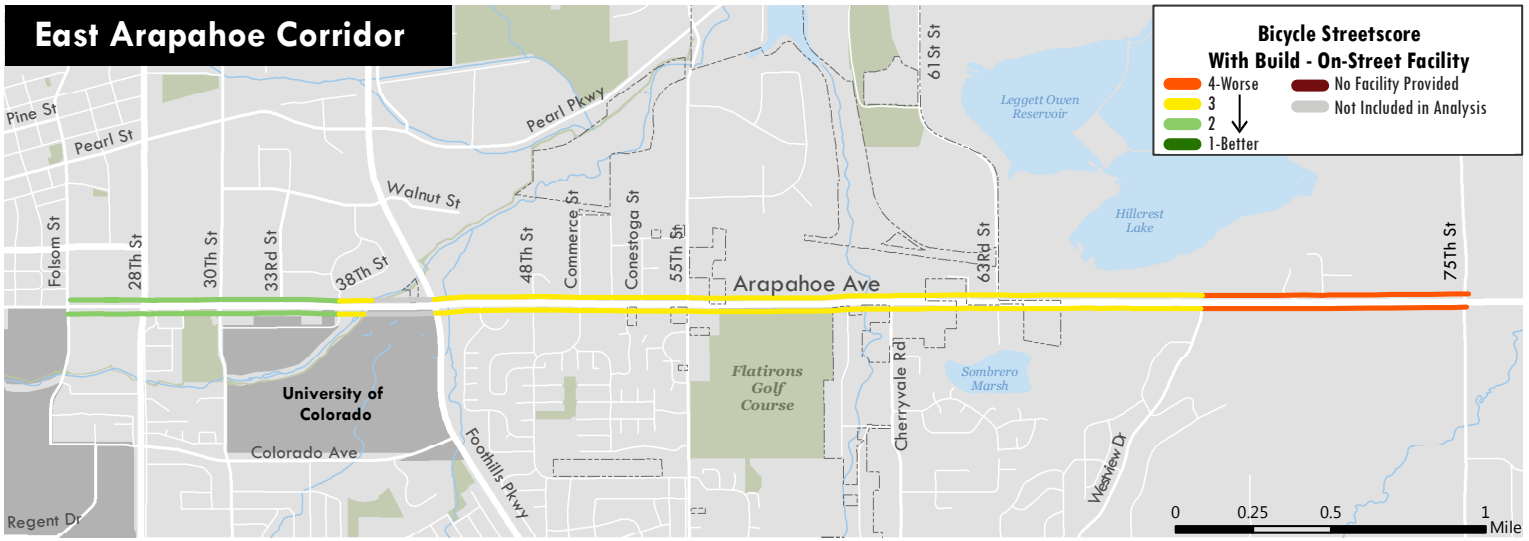
PEDESTRIAN LEVEL OF SERVICE, BUILD ALTERNATIVES (2, 3, AND 4)

BICYCLE COMFORT AND ACCESS: ON-STREET

BICYCLE LEVEL OF TRAFFIC STRESS, ON-STREET, EXISTING



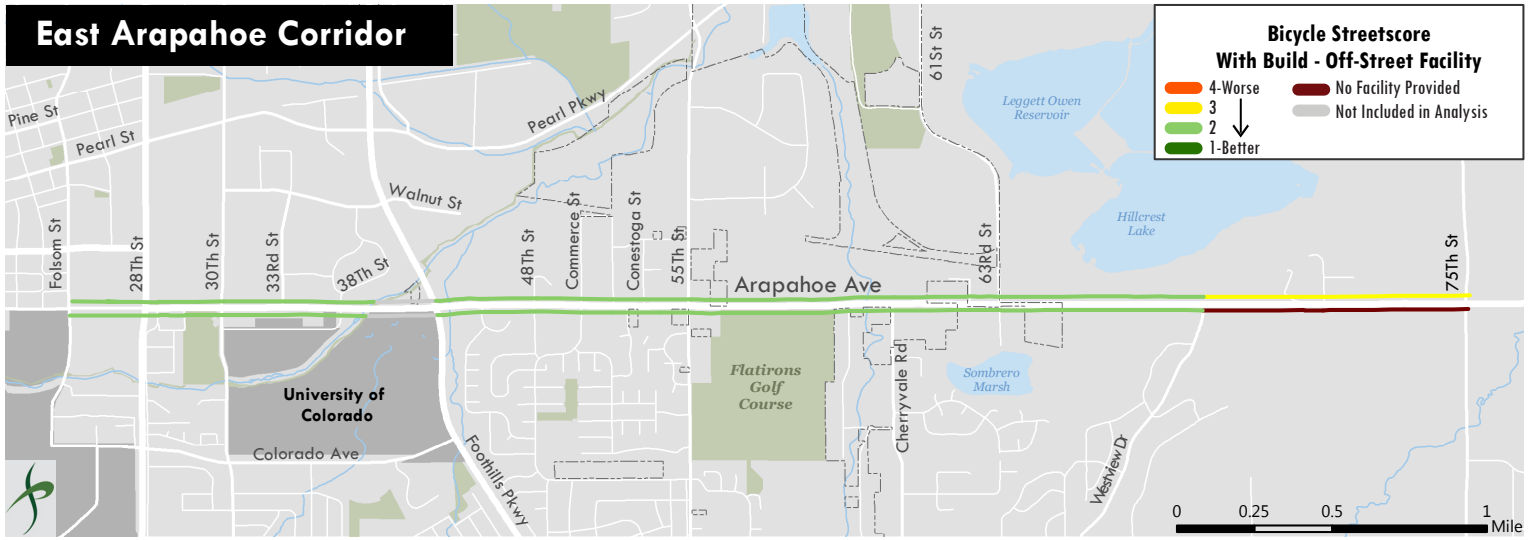
BICYCLE LEVEL OF TRAFFIC STRESS, ON-STREET, BUILD ALTERNATIVES (2, 3, AND 4)



BICYCLE COMFORT AND ACCESS: OFF-STREET

BICYCLE LEVEL OF TRAFFIC STRESS, OFF-STREET, EXISTING

BICYCLE LEVEL OF TRAFFIC STRESS, OFF-STREET, BUILD ALTERNATIVES (2, 3 AND 4)



TRAVEL MODE SHARE: PEOPLE ON TRANSIT, IN VEHICLES, ON BICYCLES, AND WALKING

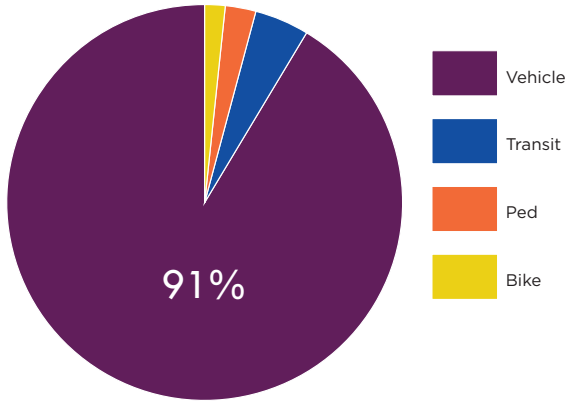
Key Findings

- Each of the Build alternatives would reduce auto mode share and increase transit, pedestrian, and bicycle mode share, moving the city closer to its TMP goal of reducing single occupant vehicle travel to 20% of all trips for residents and to 60% of work trips for non-residents. For example, of trips on Arapahoe at 30th Street, 92% of all trips are made in autos today. In 2040, with the BRT Alternatives, the auto mode share is reduced to 82%, the share of trips made by people walking or biking increases from a current mode share of 3% to 6% and transit trips increase from 5% to between 10-12% of all trips.
- BRT (Alts. 3 & 4) would increase transit mode share the most, while there would be a more moderate increase in transit use with enhanced bus (Alt 2).
- All of the pedestrian and bicycle Build options would approximately double trips by biking and walking compared to the No-Build condition, which assumes a completed multi-use path.

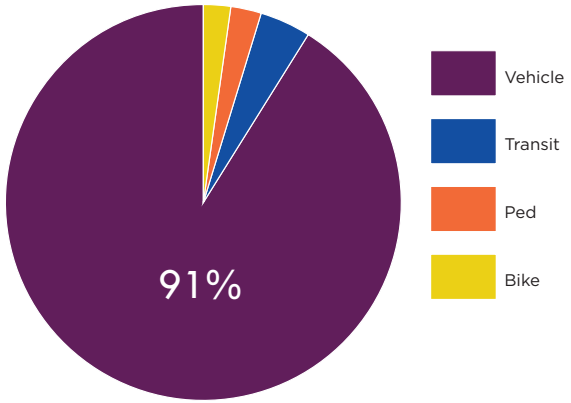
Attachment D provides additional detail on the travel mode share measure.

ARAPAHOE AND 30TH

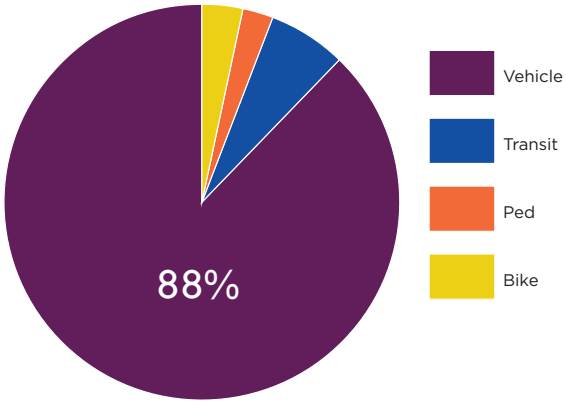
EXISTING MODE SHARE, 2015



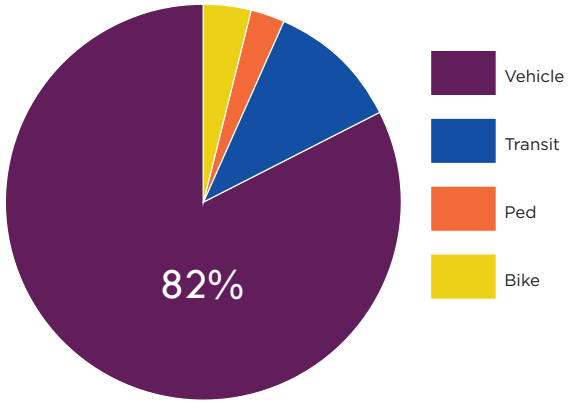
ALTERNATIVE 1 (NO-BUILD) MODE SHARE, 2040



ALTERNATIVE 2 (ENH. BUS) MODE SHARE, 2040



ALTERNATIVE 3 & 4 (BRT) MODE SHARE, 2040*



*Transit mode share is average of low and high-end BRT ridership and 0% and 20% traffic growth scenarios.

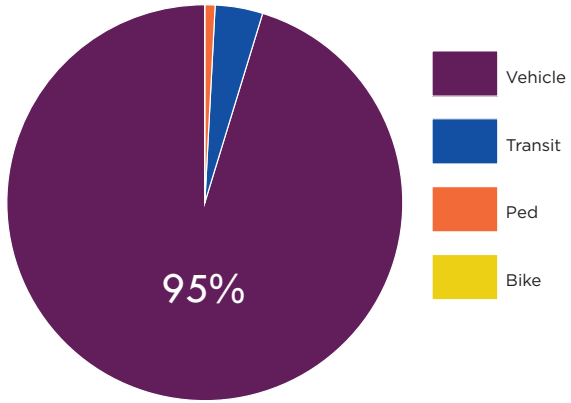
TRAVEL MODE SHARE: PEOPLE ON TRANSIT, IN VEHICLES, ON BICYCLES, AND WALKING

Key Assumptions

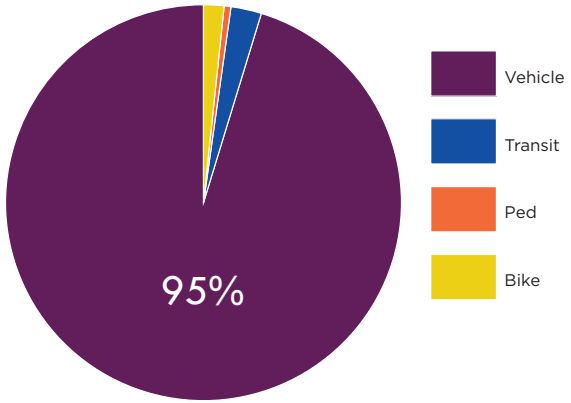
- All-day trips by people on transit, in vehicles, on bicycles, and walking were estimated at several "screenlines" along Arapahoe, including 30th and 55th Streets.
- An auto occupancy factor of 1.15 was used to convert from vehicles to persons traveling in automobiles (person trips).
- Transit travel patterns (boardings and alighting) were estimated based on existing RTD ridership data for the JUMP. Trips on BRT are projected to be within +/- 10% for either Side-Running or Center-Running BRT.
- Bicycle and pedestrian trips were projected based on count data along Arapahoe and other locations in Boulder with similar types of facilities.

ARAPAHOE AND 55TH

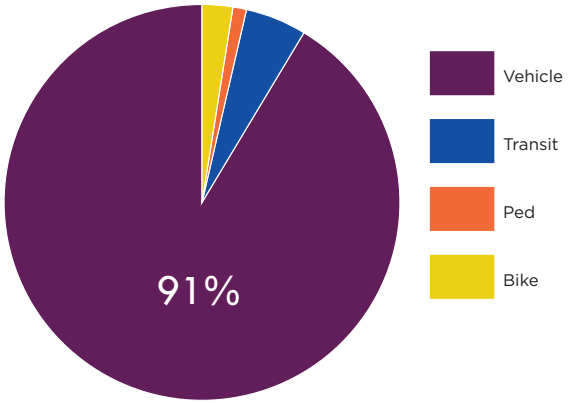
EXISTING MODE SHARE, 2015



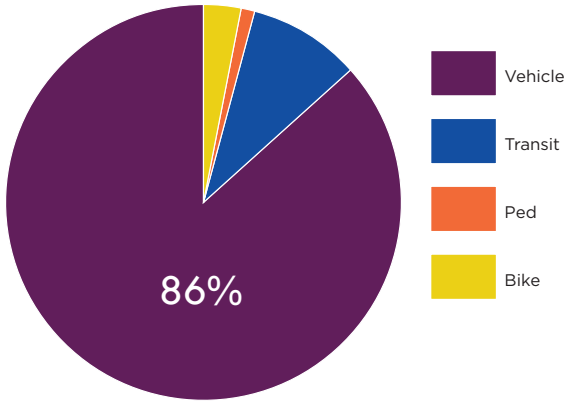
ALTERNATIVE 1 (NO-BUILD) MODE SHARE, 2040



ALTERNATIVE 2 (ENH. BUS) MODE SHARE, 2040



ALTERNATIVE 3 & 4 (BRT) MODE SHARE, 2040*

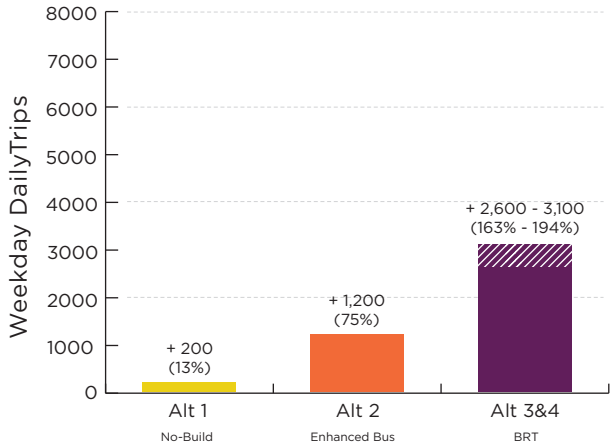


*Transit mode share is average of low and high-end BRT ridership and 0% and 20% traffic growth scenarios.

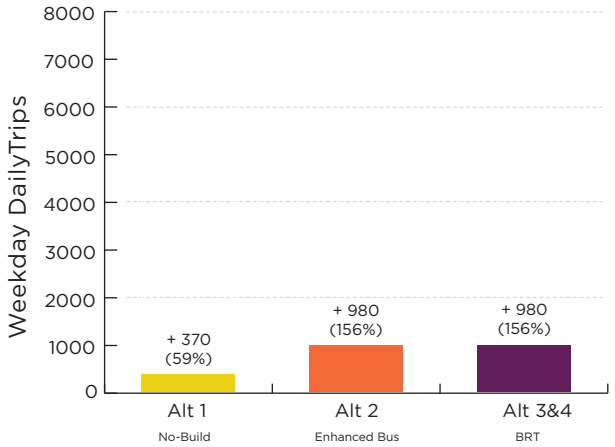
TRAVEL MODE SHARE: CHANGE IN TRIPS BY PEOPLE IN VEHICLES, ON TRANSIT, WALKING AND BIKING

ARAPAHOE AND 30TH

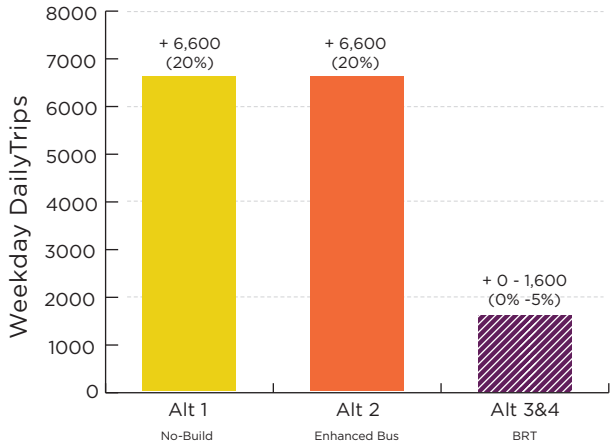
CHANGE IN TRANSIT TRIPS BY ALTERNATIVE, 2040



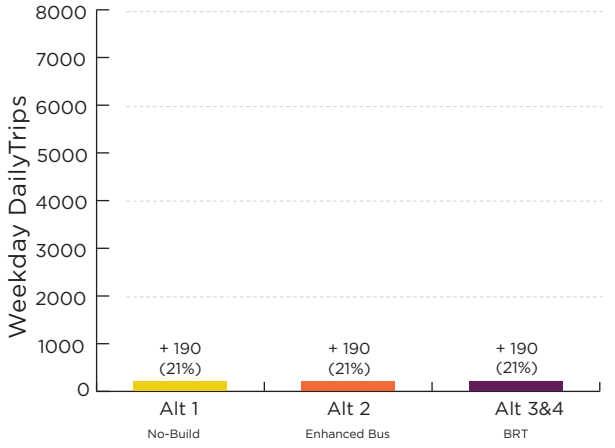
CHANGE IN BICYCLE TRIPS BY ALTERNATIVE, 2040



CHANGE IN AUTO TRIPS BY ALTERNATIVE, 2040



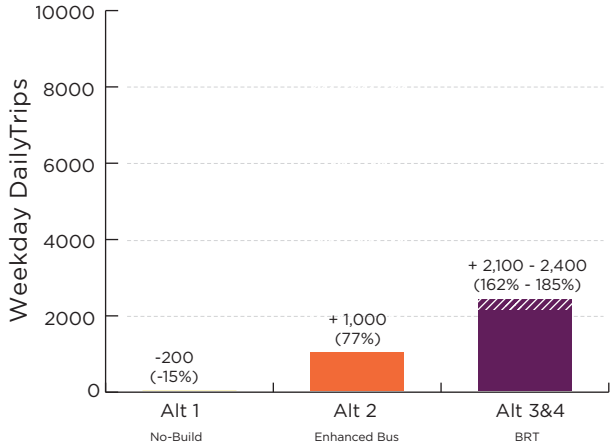
CHANGE IN PEDESTRIAN TRIPS BY ALTERNATIVE, 2040



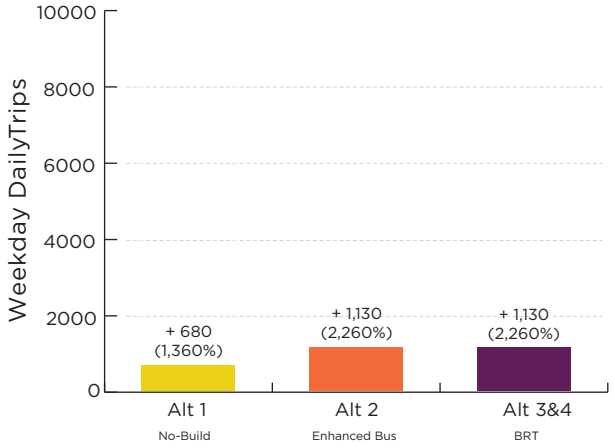
TRAVEL MODE SHARE: CHANGE IN TRIPS BY PEOPLE IN VEHICLES, ON TRANSIT, WALKING AND BIKING

ARAPAHOE AND 55TH

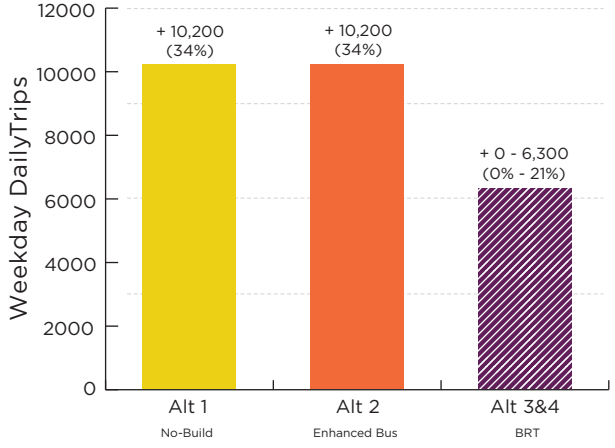
CHANGE IN TRANSIT TRIPS BY ALTERNATIVE, 2040



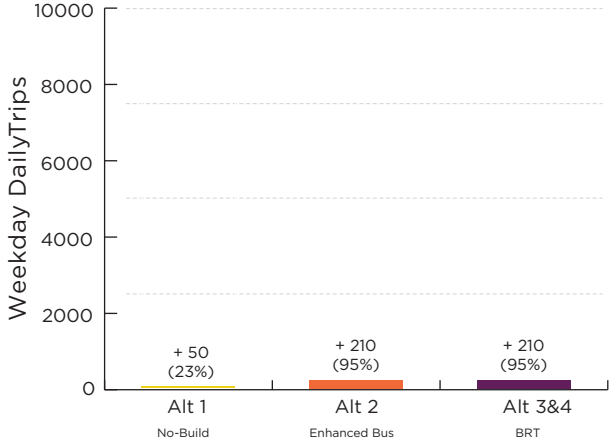
CHANGE IN BICYCLE TRIPS BY ALTERNATIVE, 2040



CHANGE IN AUTO TRIPS BY ALTERNATIVE, 2040



CHANGE IN PEDESTRIAN TRIPS BY ALTERNATIVE, 2040



TRAVEL MODE SHARE: CHANGE IN TRIPS BY PEOPLE IN VEHICLES, ON TRANSIT, WALKING AND BIKING

WEEKDAY DAILY TRIPS BY MODE AND SCREENLINE, 2040

PEOPLE ON TRANSIT

Alternative	30th	55th
Existing (2015)	1,600	1,300
Alt 1: No-Build with 20% Traffic Growth	1,800	1,100
Alt 2: Enhanced Bus with 20% Traffic Growth	2,800	2,300
Alt 3 & 4 Side or Center-Running BRT 0%-20% Traffic Growth	4,200 - 4,700	3,400 - 3,700

PEOPLE ON BICYCLES

Alternative	30th	55th
Existing (2015)	630	50
Alt 1: No-Build with 20% Traffic Growth	1,000	730
Alt 2: Enhanced Bus Alt 3 Side-Running BRT Alt 4 Center-Running BRT	1,610	1,180

PEOPLE IN VEHICLES

Alternative	30th	55th
Existing (2015)	32,500	30,100
Alt 1: No-Build with 20% Traffic Growth	39,100	40,300
Alt 2: Enhanced Bus with 20% Traffic Growth	39,100	40,300
Alt 3 & 4 Side or Center-Running BRT 0%-20% Traffic Growth	32,500 - 34,100	30,100 - 36,400

PEOPLE WALKING

Alternative	30th	55th
Existing (2015)	900	220
Alt 1: No-Build	1,090	270
Alt 2: Enhanced Bus Alt 3 Side-Running BRT Alt 4 Center-Running BRT	1,090	430

SAFETY

Key Findings

- The City of Boulder works to provide a safe transportation system for people using all modes of travel. "Toward Vision Zero" is the city's effort to eliminate fatalities and serious injuries from future traffic collisions.
- Arapahoe Avenue is one of the higher speed (posted speed limits between 35 and 45 mph) and higher volume roadways within the city.
- An analysis of crash data from 2012-2014 showed that crashes affect all modes of travel along Arapahoe Avenue. Several intersections (28th St., 30th St., and Foothills Pkwy.) have particularly high crash rates. The data indicates a need to minimize conflict points, including intersections and driveways, and identify and mitigate safety issues for people walking, biking, and driving.
- In general, the vehicular, bicycle, and pedestrian infrastructure changes required to implement the build alternatives would be expected to provide safety benefit or have a neutral impact to safety (see table at right).
- Dedicated bicycle facilities are expected to improve safety compared to no facilities or multi-use paths (see table on following page). The design of bicycle facility crossings at intersections and driveways will be an important aspect of the final design to ensure positive safety impacts. Examples of treatments are provided on page 53.

AUTO AND TRANSIT SAFETY CONSIDERATIONS

Alternative	Safety Considerations*	
Alt 1: No-Build	-	Increased traffic congestion likely to result in more rear-end crashes
Alt 2: Enhanced Bus with Existing Number of GP Lanes	+	Increased traffic congestion may also reduce travel speeds which could improve safety overall.
Alt 3: Side-Running BRT with Curbside Lanes Repurposed as BAT Lanes Alt 4: Center-Running BRT with Center Lanes Repurposed as Dedicated Transit Lanes	+	Bus priority measures: use of queue jumps and transit signal priority shown to have positive safety impacts.
	+	BAT lanes and center-lane busways remove transit vehicles from mixed traffic.
	-	BAT lanes and center-lane busways change the interaction between buses and left-turning vehicles (BAT lanes) or left-turning vehicles (center-lane busway).
	-	Lane repurposing may increase congestion which could result in more rear-end crashes
	+	Lane repurposing may also reduce travel speeds which could improve safety overall.

Key Assumptions

- Left-turns would not be prohibited in the center-running BRT alternative. Vehicles would be allowed to cross over the center bus lane in advance of an intersection to enter the left-turn lane.

* Safety Considerations Rating Key:

+ = likely positive impact - = potential concerns

Attachment E provides additional detail on the safety evaluation.

SAFETY

* Safety Considerations Rating Key:

(+) = likely positive impact (-) = potential concerns

BICYCLE AND PEDESTRIAN SAFETY CONSIDERATIONS BY OPTION

OPTION #1: CURBSIDE RAISED PROTECTED BICYCLE LANE WITH AMENITY ZONE AND MULTI-USE PATH	KEY CONSIDERATIONS*	OPTION #2: CURBSIDE AMENITY ZONE WITH RAISED PROTECTED BICYCLE LANE SEPARATED FROM SIDEWALK	KEY CONSIDERATIONS*
	(+) On-street bicycle facility: dedicated bicycle facility expected to improve safety compared to no facilities or multi-use path. (-) Potential bike/ped conflicts: multi-use path shared by people walking and biking.		(+) On-street bicycle facility: dedicated bicycle facility expected to improve safety compared to no facilities or multi-use path. (+) Sidewalk provides separate facility for people walking.
OPTION #3: STREET-LEVEL PROTECTED BICYCLE LANE WITH AMENITY ZONE AND MULTI-USE PATH	**KEY CONSIDERATIONS***	**OPTION #4: STREET-LEVEL BUFFERED BICYCLE LANE WITH AMENITY ZONE AND SIDEWALK OR MULTI-USE PATH**	**KEY CONSIDERATIONS***
	(+) On-street bicycle facility: dedicated bicycle facility expected to improve safety compared to no facilities or multi-use path. (-) Potential bike/ped conflicts: multi-use path shared by people walking and biking.		Applied only in District E (-) Buffered bicycle lane is not a protected facility. (-) Potential bike/ped conflicts: north-side multi-use path shared by people walking and biking. (-) Bikes against traffic on north-side multi-use path: bikes more likely to be involved in crashes with vehicles at driveways/ intersections when traveling against traffic.

SAFETY:
BICYCLE AND PEDESTRIAN INTERSECTION TREATMENTS

The intersection treatments described below can be implemented along with any of the alternatives in the East Arapahoe corridor to increase pedestrian and bicyclist comfort, and potentially safety, at signalized intersections. There may be reductions in intersection capacity associated with changes to signal phasing and turn permissions.

DIRECTIONAL CURB RAMP

- This treatment is recommended at all intersections consistent with standards and best-practices for accessible design.

CHANNELIZED RIGHT-TURN LANE WITH SPEED TABLE

- Channelized right-turn lanes shorten effective crossing distances by adding a pedestrian refuge island, and can reduce turning speeds. Speed tables further reduce turning speeds and increase yield compliance. This treatment typically requires more space than non-channelized right-turn lanes.
- The City of Boulder has already successfully implemented several channelized right-turn lanes with speed tables on the East Arapahoe Avenue corridor and elsewhere in the City.

ADD SPEED TABLE TO EXISTING CHANNELIZED RIGHT-TURN LANE

- This treatment is recommended at existing locations with channelized right-turn lanes that do not feature speed tables. The only East Arapahoe Avenue location where this applies is at 75th Street.

SEPARATE RIGHT-TURN SIGNAL PHASING

- Separate right-turn signal phasing reduces conflicts between right-turning vehicles and bicyclists proceeding straight through the intersection in the protected bike lane. It is recommended at intersections where the peak hour right-turning volume is greater than 150 vehicles per hour.

NO RIGHT-TURN ON RED

- This treatment is recommended at intersections where neither a channelized right-turn lane /speed table nor a protected right-turn signal phase is feasible. Prohibiting right-turns on red increases pedestrian comfort by decreasing driver encroachment into crosswalks during the “Walk” phase.

TWO-STAGE TURN QUEUE BOX

- Turn queue boxes are recommended at intersections with protected bike lanes (either in-street or raised), particularly where people on bicycles turn to access other bike facilities or a major destination. Two-stage turn queue boxes provide a dedicated space for bicyclists to wait outside of the flow of traffic until it is safe to cross traffic lanes and turn left.

PROTECTED LEFT-TURNS

- Protected left-turns eliminate potential conflicts between left-turning automobiles and people using the crosswalk by giving each a separate signal phase. This is especially recommended at multi-use path crossings.

COMMUNITY SUSTAINABILITY: GREENHOUSE GAS EMISSIONS

Key Findings

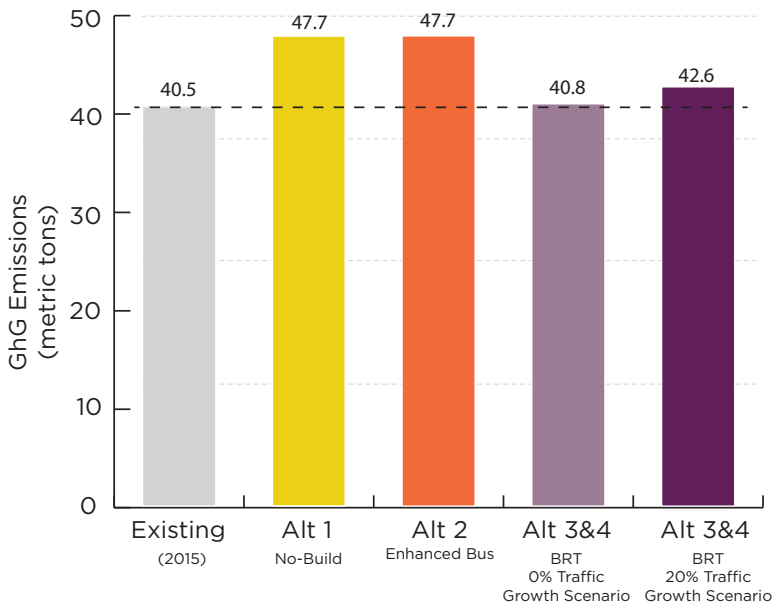
- Based on regional projections for 20% traffic growth, the No-Build and Enhanced Bus alternatives are likely to increase emissions relative to existing conditions.
- The BRT alternatives would reduce emissions to near existing levels if they can help maintain the historic trend of 0% traffic growth.
- BRT with the 20% traffic growth scenario would still increase emissions moderately relative to existing.

Key Assumptions

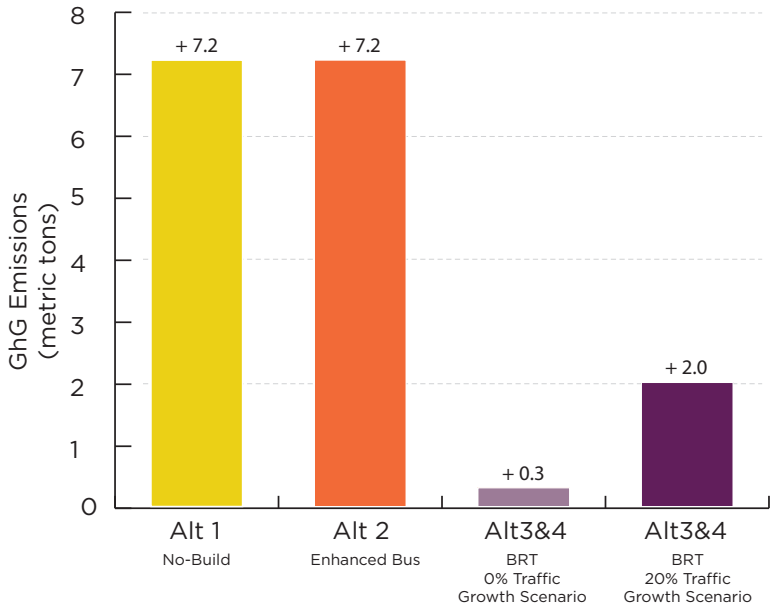
- VMT converted to GhG emissions based on 0.000367 Metric Tons CO_2e per mile.
- Assumes 2013 vehicle inventory and average fuel efficiency/emissions.

Attachment F provides additional detail on the GhG analysis.

DAILY AUTO GREENHOUSE GAS EMISSIONS, 2040



INCREASE IN DAILY GHG OVER EXISTING, 2040



COMMUNITY SUSTAINABILITY: STREETSCAPE QUALITY

Key Findings

- All Build alternatives would designate a larger percentage of street right-of-way to streetscaping features than the No Build condition.
- Alternatives 2 and 3 create the most streetscaping space (see charts on the following page).
- The bike/pedestrian option has the most significant effect on the streetscape space. These options can be "mixed and matched" with the various BRT alternatives to create different results. The table below provides the conceptual width of the bike/pedestrian option for each alternative by Character District.
- In Character District E, Alternatives 2 and 3 create less streetscaping space than Alternative 4 (this reflects Community Working Group feedback to avoid excessive landscaping due to the rural character of this part of the corridor).
- In every alternative, except District E Alternatives 2 and 3, the curb-to-curb pedestrian crossing distance is shorter than existing conditions.
- Examples of amenity zone treatments are provided on p. 57.

Attachment F provides additional detail on the streetscape analysis.

Key Assumptions

- Elements of the conceptual design considered for this analysis are roadway (asphalt or concrete, lanes for autos and transit), medians, and the space at the street edge which contains pedestrian and bicycle infrastructure, and amenity zones.
- Medians and roadway cross-sections may change near intersections based on the preferred alternative. This analysis assumes that 14' landscaped medians would be reduced to 4' concrete medians approaching major intersections to accommodate left turn lanes. Landscaped medians may be reduced further in the final design.
- Center-Running BRT may reduce the size of the landscaped median based on more detailed design; this would reduce the streetscape space estimated for Alt 4.
- The analysis assumes that many driveways would be consolidated, and breaks in the median would be removed. It includes driveways in the "bicycle/pedestrian/landscape" category for existing conditions, and the No-Build and Build alternatives.
- The analysis assumes reconstruction of the roadway from Cherryvale Avenue east to 75th Street. If the recently built multi-use paths are maintained in their current configuration (adjacent to the roadway curb with no amenity zone), this would reduce streetscape space assumed in Alt 2, 3, & 4.
- For purposes of this analysis, Character District A runs between 28th Street and Foothills Parkway. Character District C begins at Foothills Parkway. Because of this, Character District B is summarized as part of Character Districts A and C.

STREETSCAPE WIDTH BY CHARACTER DISTRICT, ALTERNATIVE, AND BIKE/PED OPTION

Scenario	A	C	D	E
Existing (2015)	43'	39'	23'	10.5'
Alt 1 - No Build	N/A	N/A	N/A	N/A
Alt 2 - Enhanced Bus	67' Option 2	61' Option 3	61' Option 3	27' Option 4
Alt 3 - Side Running BRT	67' Option 2	61' Option 1a	61' Option 3	27' Option 4
Alt 4 - Center Running BRT	61' Option 1a	61' Option 1a	61' Option 1a	47' Option 1b

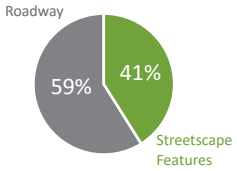
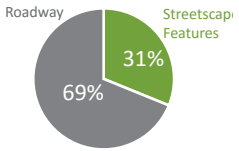
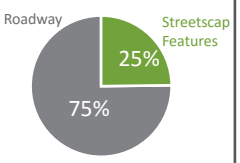
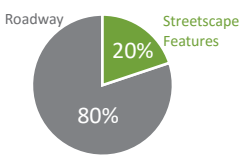
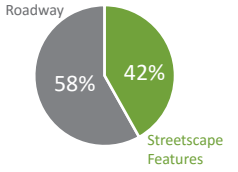
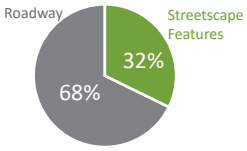
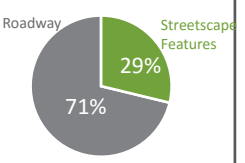
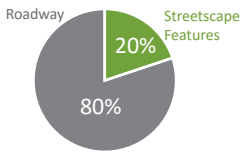
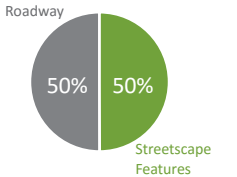
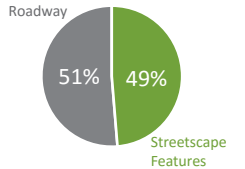
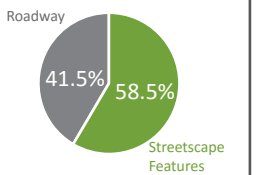
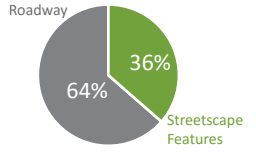
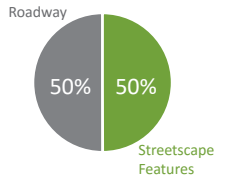
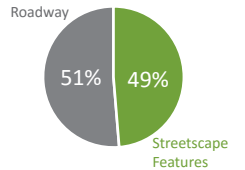
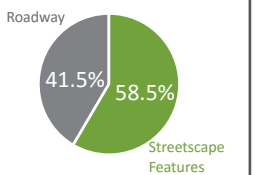
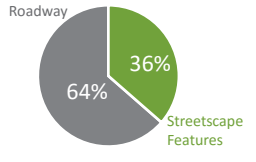
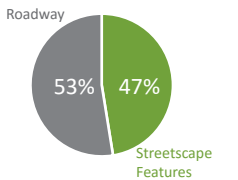
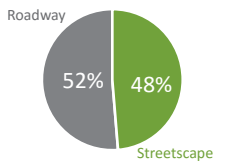
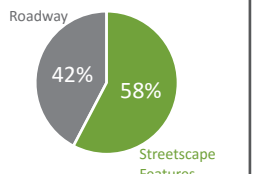
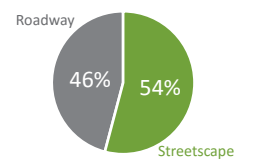
COMMUNITY SUSTAINABILITY: STREETSCAPE QUALITY

ROADWAY AND STREETCAPE BY CHARACTER DISTRICT AND ALTERNATIVE

SCORE

-3 -2 -1 0 1 2 3

Worse → Better

	District A	District C	District D	District E	Score
Existing (2015) • Existing Bus • Existing Travel Lanes • Existing Multi-use Path					0
Alt 1: 2040 No Build • Local Bus (Mixed Traffic) • Existing Travel Lanes • Completed Multi-use Path					1
Alt 2: 2040 Enhanced Bus • Enhanced Bus (Mixed Traffic) • Existing Travel Lanes • Typically Street-Level Protected Bike Lane (Options 2,3,4)					3
Alt 3: 2040 Side Running BRT • Curbside lanes repurposed as BAT lanes (right-turns allowed) • Typically Raised Protected Bike Lane (Options 1a,2,4)					3
Alt 4 - 2040 Center Running BRT • Center lanes repurposed as dedicated transit lanes • Typically Raised Protected Bike Lane (Options 1a/1b)					2

COMMUNITY SUSTAINABILITY: STREETSCAPE QUALITY

Methodology

- The alternatives were evaluated at a conceptual level using GIS to provide an order-of-magnitude assessment of the street right-of-way allocated to streetscape features.

CHARACTER DISTRICT A STREETSCAPE EXAMPLES

EXISTING

CONCEPTUAL: ALTERNATIVES 2 & 3

COMMUNITY SUSTAINABILITY: STREETSCAPE QUALITY

CHARACTER DISTRICT C STREETSCAPE EXAMPLES

EXISTING

CONCEPTUAL:
ALTERNATIVES 2 & 3

COMMUNITY SUSTAINABILITY: STREETSCAPE QUALITY - AMENITY ZONE ELEMENTS

The elements described below can be implemented in the amenity zone in any of the alternatives for the East Arapahoe corridor.

STREET LIGHTING

WAYFINDING

PLANTERS/LANDSCAPING

SEATING

PUBLIC ART

BICYCLE PARKING

$ CAPITAL COSTS/IMPLEMENTATION

Key Findings

- The capital costs include constructing the transit and bicycle/pedestrian/streetscape alternatives as well as other long-term infrastructure needs, identified for the corridor in the TMP and other studies, that could be implemented in phases.
- Transit Costs:
  - Enhanced bus (Alt 2) would be the least expensive transit alternative to construct (only stations and vehicles); side-running BRT (Alt 3) is moderately more expensive.
  - Center-running BRT (Alt 4) is likely to be the most expensive transit alternative due to median reconstruction.
  - Transit vehicle costs are lowest for side-running and center-running BRT, due to shorter travel times that make transit more efficient to operate, and are the highest for enhanced bus.
- Bicycle-Pedestrian and Streetscape:
  - All protected bike lane options are assumed to be generally comparable in cost (with the exception of the buffered bike lane option in District E).
  - Right-of-way costs are most significant in District A.

Attachment G provides additional detail on capital costs.

Key Assumptions

Transit:

- Construction of transit stations a half-mile (or more) apart within Boulder for Alts 2, 3, & 4. Stations include branding, enhanced shelters, real-time information, off-board fare payment, and other amenities.
- Vehicle capital costs include BRT-type vehicles for Alts 2, 3, and 4
- Transit signal priority is assumed for Alts 3 and 4.
- Median reconstruction is assumed to be required for the length of the corridor for Alt 4. This is required for center-running BRT, but also facilitates streetscape improvements.

Bike/Pedestrian/Streetscape:

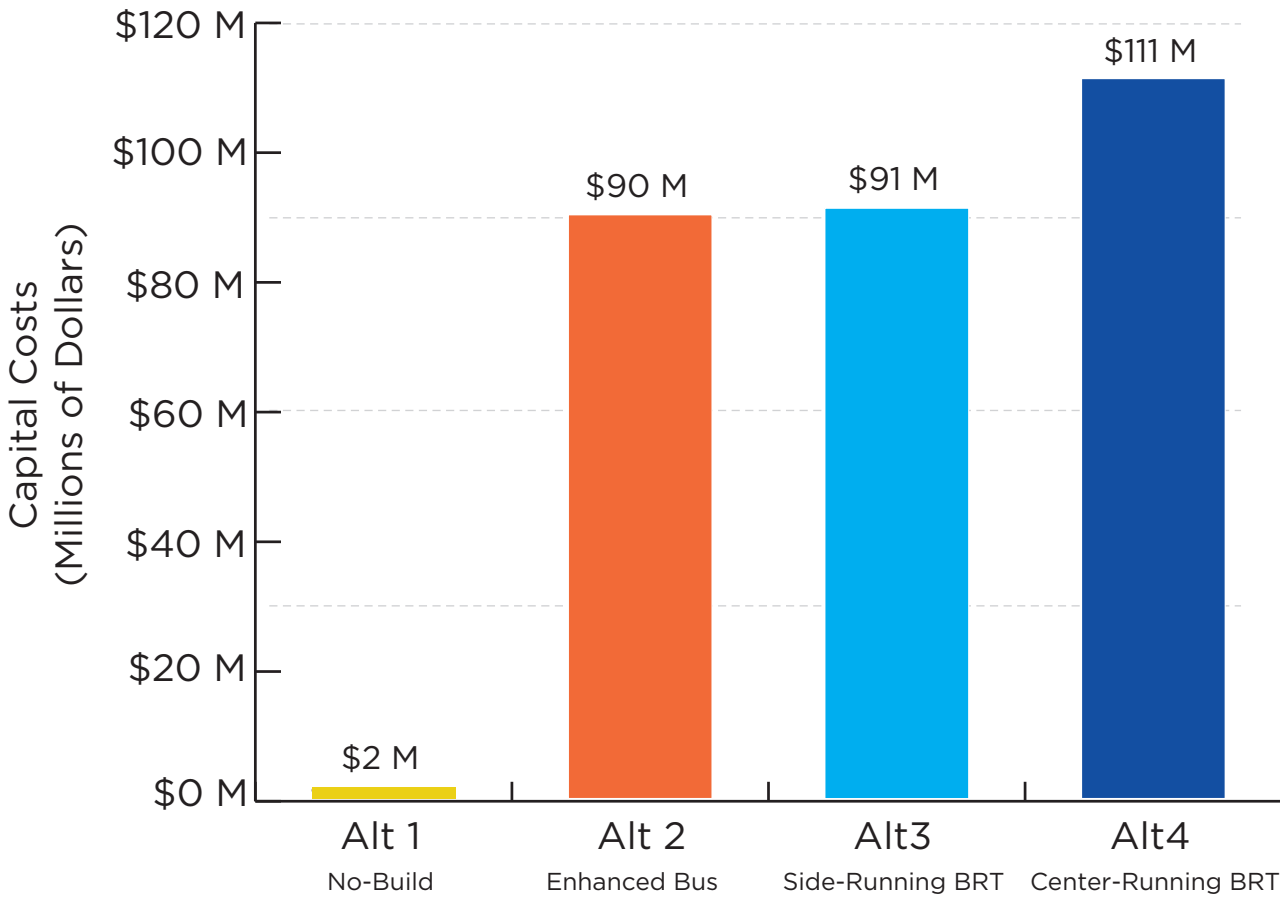
- Costs to complete sidewalk and/or multi-use path gaps along Arapahoe Avenue are assumed in the No-Build alternative:
  - Character District A: 38th Street – Boulder Creek (south side)
  - Character District C: East of Foothills Parkway – 55th Street (south side)
  - Character District D: 55th Street – Cherryvale Road (north and south side)
- Full curb demolition and reconstruction is assumed for raised protected bike lanes in Districts A through D.
- A concrete barrier is assumed for costing purposes for street-level protected bike lanes in Districts A through D.
- An allowance for amenity zone elements is included in the costs (e.g., benches, bicycle parking and trash bins).

General:

- Order-of-magnitude cost estimates are based on unit costs from other projects, including recent projects in Boulder such as the Diagonal Highway Transportation Improvements Project, and the Arapahoe Avenue Reconstruction Report, 28th-Cherryvale Road (2014).
- Various construction items (clearing, excavation, landscaping, traffic control, utility contingencies, etc.), and project development and administration are assumed on a percentage basis consistent with the Arapahoe Avenue Reconstruction Report, which based these elements on the Boulder TMP cost model.
- 40% contingency on construction costs is assumed at this highly conceptual level of design.
- Costs for all build alternatives include bridge widening/replacement and traffic signal replacement as identified in the Arapahoe Avenue Reconstruction Report, as well as communications infrastructure.

$ CAPITAL COSTS/IMPLEMENTATION: TOTAL CAPITAL COSTS

CAPITAL COSTS, FOLSOM - 75TH STREETS, 2040 (IN 2017 DOLLARS)



* Alt 2, 3, and 4 assume a share of the total vehicle costs to operate Enhanced Bus or BRT service between Downtown Boulder and Brighton (east of I-25), based on the proportion of service hours required to operate between Downtown Boulder and 75th Street.

$ CAPITAL COSTS/IMPLEMENTATION: NON-VEHICLE AND VEHICLE CAPITAL COSTS

CAPITAL COSTS BY CATEGORY, FOLSOM TO 75TH STREETS, 2040 (IN 2017 DOLLARS)

Alternative	Site Work	Bridge Replacement	Bike/Ped/ Streetscape	Traffic Signals / Communications	Transit Running Way	Transit Stations	Vehicles*	Right-of-Way	Adminis-tration / Services	Contingency	Total Capital Cost	Cost Per Mile
Alt 1: No-Build	$0 M	$0 M	$1.1 M	$0 M	$0 M	$0 M	$0 M	$0 M	$0 M	$0.6 M	$1.7 M	$0.6 M
Alt 2: Enhanced Bus	$15 M	$3 M	$11 M	$5 M	$0 M	$3 M	$5 M	$8 M	$17 M	$24 M	$90 M	$30.1 M
Alt 3: Side-Running BRT	$16 M	$3 M	$10 M	$5 M	$1 M	$3 M	$4 M	$8 M	$17 M	$24 M	$91 M	$30.3 M
Alt 4: Center-Running BRT	$21 M	$3 M	$10 M	$5 M	$5 M	$4 M	$4 M	$8 M	$22 M	$29 M	$111 M	$37.1 M

* Alt 2, 3, and 4 assume a share of the total vehicle costs to operate Enhanced Bus or BRT service between Downtown Boulder and Brighton (east of I-25), based on the proportion of service hours required to operate between Downtown Boulder and 75th Street.

$ COMPLEXITY OF IMPLEMENTATION/PHASING

Key Findings

- The overall right-of-way requirement compared to available right-of-way drives need for phased implementation of improvements.
- In developing a phasing plan for the eventual preferred alternative, some improvements (such as signal timing or transit signal priority) could be implemented shorter-term without need for expanding the public right-of-way (i.e., through dedication or easements).
- Side-running transit alternatives (Alt 2 and Alt 3) will likely be easier to implement in phases than center-running BRT (Alt 4). Center-running BRT could more easily be implemented on the far eastern portion of the corridor, which generally does not have a separated median.
- The phasing plan can consider where spot improvements are most feasible and beneficial, such as peak-direction transit lanes in Alt 3 (side-running BRT).
- There is likely to be little variance between bicycle/pedestrian alternatives, and they offer the greatest opportunity to work towards implementation as redevelopment occurs.
- District A has the most limited right-of-way compared to what would be required.

Key Assumptions

Considerations include:

- Availability of right-of-way relative to what is required to implement each alternative
- Major constraints:
  - District B: Bridge over Boulder Creek
  - District D: Bridge over South Boulder Creek
  - District E: Railroad bridge (likely affecting Alt 4 only)
  - Overhead electric transmission lines between Foothills Parkway and Cherryvale Road (south side)
  - Potential for underground contamination from old gas station and/or industrial uses.
- Ability to implement improvements in a phased approach