



## MEMORANDUM

To: Transit Implementation Group

From: Tim Payne, Nelson\Nygaard

Date: May 11, 2015

Subject: US-36 BRT Access (Stop Spacing), Facilities, and Operations

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U.S. 36 Bus Rapid Transit (BRT) will extend on U.S. 36 from Downtown Denver to Boulder. The alignment of the BRT line within Boulder from Table Mesa Park & Ride to Depot Square at Boulder Junction continues to be discussed. This memo describes stop patterns for existing and new regional services on US 36 BRT on Broadway and 28<sup>th</sup> Street, based on discussions with the Transit Implementation Group over the past few months. The memo intended to inform discussions between the City of Boulder and other transit partners regarding local stops for US 36 BRT in Boulder.

The memo is organizing into three sections:

- BRT access, including stop locations, stop spacing, and the resulting stop walk sheds along both Broadway and 28<sup>th</sup> Street.
- BRT facilities, specifically the amenities and design for US 36 BRT stops.
- BRT operations, specifically an effort to analyze developing a business access and transit lane along a segment of Broadway.

## 1 BRT ACCESS (STOP SPACING)

BRT stop spacing varies widely in the United States, with some BRT systems stopping every quarter-mile and others stopping every mile or longer. There are several factors that influence the optimal stop spacing for a BRT line, including locations of major destinations, acceptable walking distances, trip lengths, and the presence of underlying local service. US 36 BRT will primarily serve regional trips, with local trips being served by the Boulder Community Transit Network (CTN), and maximizing operating speed along the CTN will be an important consideration. For these reasons, it is assumed that US-36 BRT in Boulder will have wide stop spacing, with a half-mile to one-mile spacing between stops. This section considers spacing along Broadway and 28<sup>th</sup> Street, and analyzes the BRT walk shed resulting from the proposed stop locations and spacing.

## BROADWAY

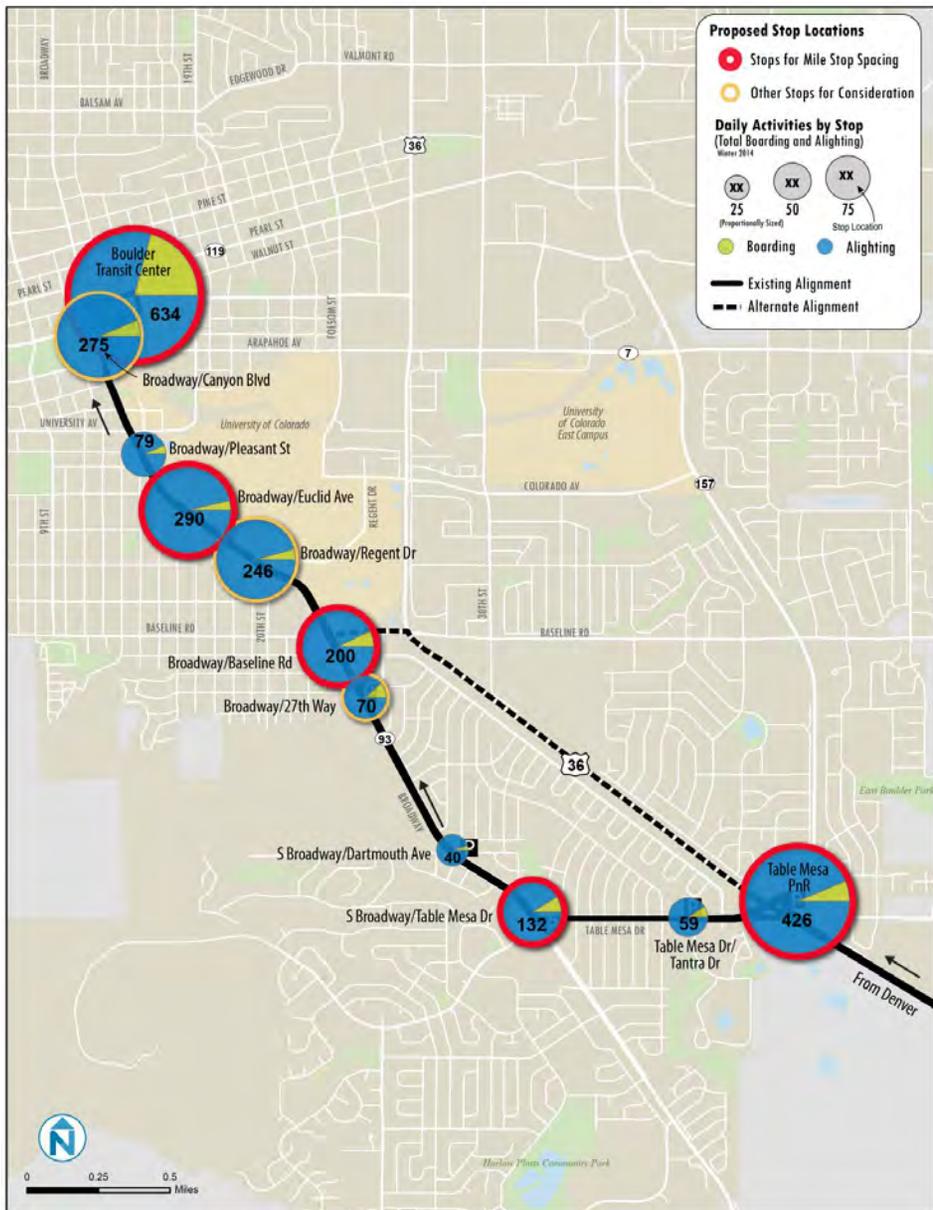
### Existing Conditions

Three RTD regional routes currently operate from Table Mesa Park & Ride to Boulder Transit Center: Routes B, DD, and DM. From Table Mesa, the routes operate on Table Mesa Dr, Broadway, and Walnut to the Boulder Transit Center, a distance of 3.8 miles. There are 15 stops in the northbound direction and 16 stops in the southbound direction, but several of the stops are only used when local services are not operating during early morning and late night hours, so for the vast majority of the day there are 11 stops in each direction. This results in an average stop spacing of 0.38 miles.

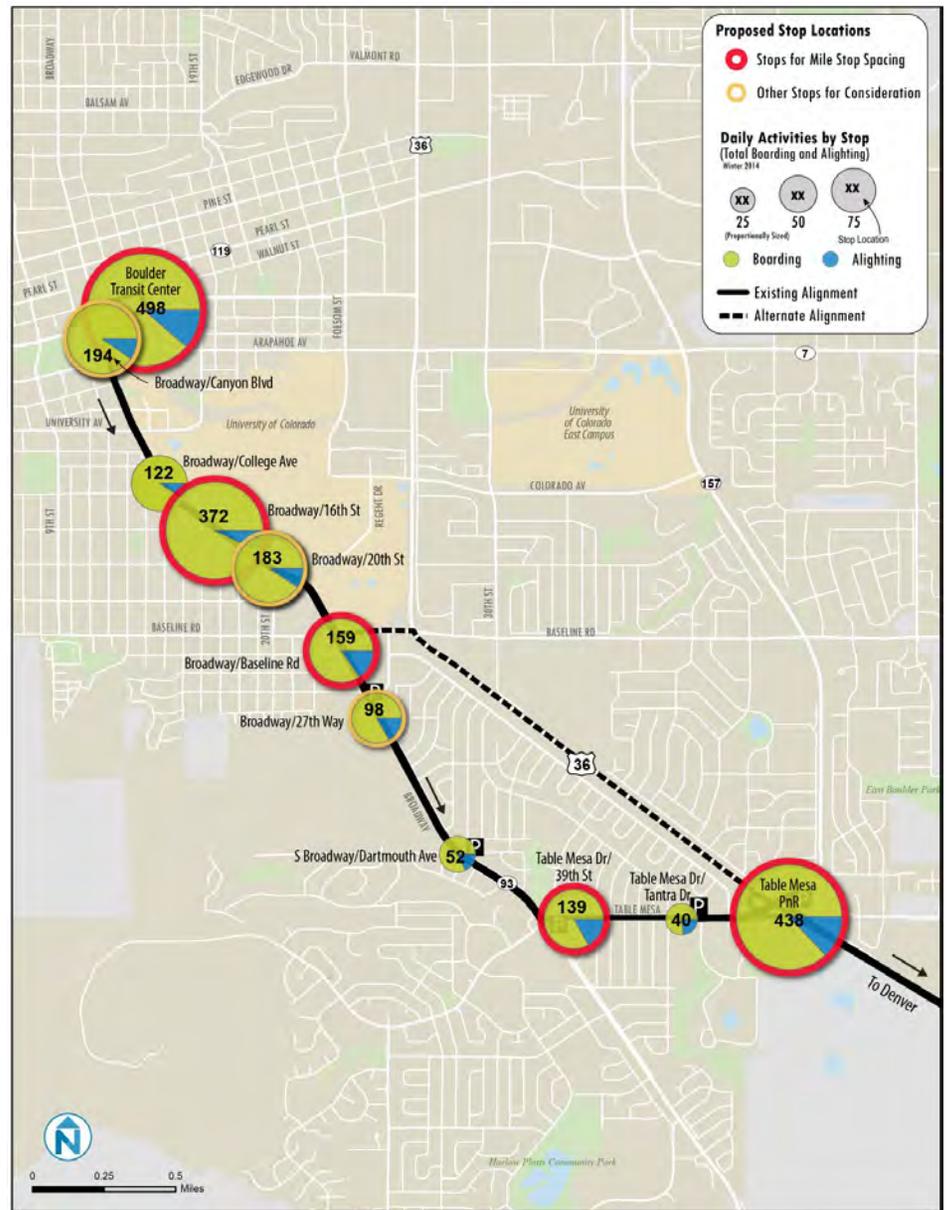
Current combined boarding and alighting activity by stop for Routes B, DD, and DM is shown in Figures 1 and 2. Ridership is strongest at Table Mesa Park & Ride, stops serving the CU campus, and Boulder Transit Center.

**US 36 BRT | Access, Facilities, and Operations**  
City of Boulder

**Figure 1 Northbound Regional Ridership and One-Mile Stop Spacing**



**Figure 2 Southbound Regional Ridership and One-Mile BRT Stop Spacing**



## US 36 BRT

### Alignment Options Considered

Earlier versions of this memo considered two alignment options for the US 36 BRT segment between Table Mesa Park & Ride and Boulder Transit Center. These options are briefly summarized below, but the current analysis assumes alignment option 1, utilizing Broadway.

#### Alignment Option 1: Table Mesa Dr and Broadway St.

Under this option, BRT would travel on Table Mesa Dr, Broadway St, and Walnut St to Boulder Transit Center like Routes B, DD, and DM do today. Of the 11 existing stops along this alignment, it is recommended that a minimum of three stops be retained Table Mesa Park & Ride and Boulder TC to serve high ridership locations and provide coverage along the alignment, at Broadway and Table Mesa Dr, Baseline, and Euclid. These stops are indicated in Figure 1 and Figure 2. Utilizing these five stops (two at each end plus three in between) for BRT would lead to an average stop spacing of 0.95 miles between Table Mesa and Boulder Transit Center. These stops account for 69% of boardings and alightings in the northbound direction and 70% of boardings and alightings in the southbound direction. Eighty-six percent of boardings and alightings are at stops within a quarter mile of these five stops, 96% are within a third of a mile, and 100% are within a half mile.

Three additional stops were considered to increase the accessibility of service, at Broadway and 27<sup>th</sup>, 20<sup>th</sup>/Regent, and Canyon. Adding these three stops would lead to an average stop spacing of 0.54 miles. These stops along with the previous five account for 93% of boardings and alightings in the northbound direction and 91% in the southbound direction. Ninety-six percent of boardings and alightings are at stops within a third of a mile of these eight stops, and 100% are within a half mile.

**Figure 3 Percentage of Boardings Served by BRT Stops – Alignment 1**

	% of Activity Directly Served	% of Activity within 1/4 Mile	% of Activity within 1/3 Mile	% of Activity within 1/2 Mile
<b>Northbound</b>				
5 Stop Scenario	69%	86%	96%	100%
8 Stop Scenario	93%	96%	96%	100%
<b>Southbound</b>				
5 Stop Scenario	70%	86%	96%	100%
8 Stop Scenario	91%	91%	96%	100%

#### Alignment Option 2: Operate via US-36, Baseline Rd, and Broadway St

A second alignment option is to travel on US 36 north of Table Mesa Dr to Baseline Rd, then west on Baseline to Broadway St. This alignment would eliminate any stops between Table Mesa Park & Ride and Broadway & Baseline, potentially decreasing travel time. Stops at Table Mesa Dr & Broadway/39<sup>th</sup> and Broadway & 27<sup>th</sup> would not be served, so the first scenario includes two stops between Table Mesa Park & Ride and Boulder TC, at Broadway and Baseline and 16<sup>th</sup> St/Euclid, for four total stops in Boulder.

Under this scenario, the average stop spacing would be 1.27 miles. The four stops include 63%-64% of ridership activity, with 80% - 81% of activity occurring at stops with a quarter mile, 90%-91% within a third of a mile, and 92% - 93% within a half mile. Two additional stops were considered, at Broadway & 20<sup>th</sup>/Regent and Canyon.

Adding these two stops would lead to an average stop spacing of 0.76 miles. These stops along with the previous four account for 84% of boardings and alightings in the northbound direction and 80% in the southbound direction. About 90% percent of boardings and alightings are at stops within a third of a mile of these six stops, and 92%-93% are within a half mile.

**Figure 4 Percentage of Boardings Served by BRT Stops – Alignment 2**

	% of Activity Directly Served	% of Activity within ¼ Mile	% of Activity within 1/3 Mile	% of Activity within ½ Mile
<b>Northbound</b>				
4 Stop Scenario	63%	81%	91%	93%
6 Stop Scenario	84%	91%	91%	93%
<b>Southbound</b>				
4 Stop Scenario	64%	80%	90%	92%
6 Stop Scenario	80%	80%	90%	92%

**Recommended US 36 BRT Stops along Broadway**

Figure 5 identifies the recommended US 36 BRT stops along Broadway in Boulder, based on discussions with the Transit Implementation Group and additional discussions between City of Boulder staff and elected officials. The stop spacing and placement are the result of conversations at several levels and, therefore, have to satisfy a large **number of interests**. **One of Boulder’s key** interests is to ensure that stop spacing in the densest urban area retains excellent access where the street linkages and pedestrian system are very strong. With the densities present in these areas maintaining access at less than ½ mile walk distance ensures the attractiveness of the BRT service, which, ultimately will generate greater ridership. Eight intermediate stops are recommended between Table Mesa and the downtown Transit Center. This results in an average stop spacing of .42, listed in Figure 5, along a Table Mesa Drive/Broadway alignment.

**Figure 5 Recommended US 36 BRT Stops between Table Mesa P&R and Boulder TC**

Northbound	Southbound
<ul style="list-style-type: none"> <li>▪ Mile 0.0 – Table Mesa Park and Ride</li> <li>▪ Mile 0.45 - Table Mesa &amp; Tantra – Park &amp; Ride</li> <li>▪ Mile 1.0 Broadway/Table Mesa</li> <li>▪ Mile 1.4 Broadway/Dartmouth</li> <li>▪ Mile 2.2 Broadway/Baseline</li> <li>▪ Mile 2.6 Broadway/Regent (with improvements)</li> <li>▪ Mile 2.9 Broadway/Euclid</li> <li>▪ Mile 3.3 Broadway/University</li> <li>▪ Mile 3.6 Broadway/Canyon</li> <li>▪ Mile 3.8 Downtown Transit Center</li> </ul>	<ul style="list-style-type: none"> <li>▪ Mile 0.0 Downtown Transit Center</li> <li>▪ Mile 0.2 Broadway/Canyon</li> <li>▪ Mile 0.6 Broadway/University</li> <li>▪ Mile 1.0 Broadway/16<sup>th</sup>/Euclid</li> <li>▪ Mile 1.3 Broadway/Regent</li> <li>▪ Mile 1.6 Broadway/Baseline</li> <li>▪ Mile 2.5 Broadway/Dartmouth</li> <li>▪ Mile 3.0 Table Mesa/39th</li> <li>▪ Mile 3.4 Table Mesa &amp; Tantra – Park &amp; Ride</li> <li>▪ Mile 3.7 Table Mesa Park and Ride</li> </ul>
# Stops: 8 intermediate stops assuming Regent is ready for opening day	# Stops: 8 stops assuming northbound Regent stop is ready for opening day; southbound is ready now

## Walk Shed Analysis

An analysis was conducted to determine the walk shed size of the different stop spacing scenarios and to compare them to the current walk shed size (using the 9 primary stops between Table Mesa and Boulder Transit Center). The walk shed was measured through the street network, so **that it represents a true walking distance and not an “as the crow flies” distance.** Both quarter mile and half mile walk sheds were calculated. The analysis presented in this section has been revised from previous memos to reflect the eight stops recommended between Table Mesa Park & Ride and Boulder TC, assuming Alignment Option 1 (Table Mesa Drive/Broadway).

Figure 6 shows the numerical results of the analysis. With the eight recommended stops (about half mile stop spacing), the walk shed is 91% of the quarter-mile walk shed of the current nine stops, and 95% of the existing half-mile walk shed.

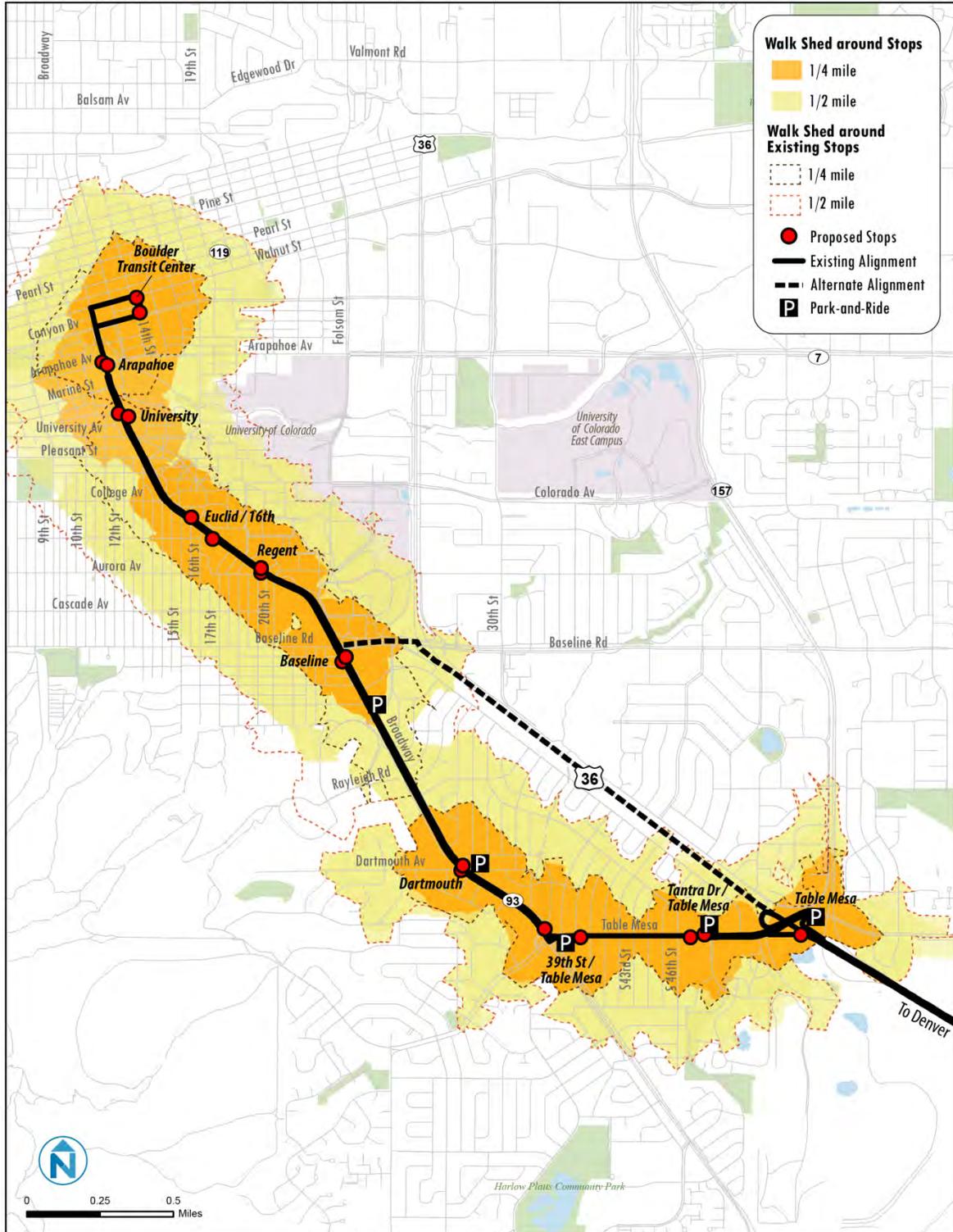
The quarter- and half-mile walk sheds are illustrated graphically in Figure 7. The map also indicates the quarter- and half-mile walk sheds of existing stops. With half-mile stop spacing, practically all portions of the corridor are within a half mile of a stop. Quarter- and half-mile walk shed coverage is lowest between the Baseline Road and Dartmouth Way. The proposed quarter-mile walk shed is reduced from existing between the Euclid and University stops, although the half-mile walk shed is comparable to existing.

**Figure 6 US 36 BRT Table Mesa P&R – Boulder TC Walk Shed Statistics – Existing and Recommended Stops**

Table Mesa Park & Ride – Boulder TC (Broadway)	Within ¼ Mile Walk		Within ½ Mile Walk	
	Area (Sq Mi)	% of Existing	Area (Sq Mi)	% of Existing
Existing (9 stops*)	1.18	--	2.89	--
Proposed (8 stops*)	1.07	91%	2.75	95%

\* Per direction, between Table Mesa Park & Ride and Boulder TC or Boulder Junction

Figure 7 US 36 BRT Broadway Quarter- and Half-Mile Walk Sheds



## 28<sup>TH</sup> STREET

Unlike the stop discussion that has been occurring with Broadway, there is very little in the way of current ridership to help shape a stop pattern for this new branch of US 36 BRT.

### Existing Conditions

BRT stops along the corridor could be shared by a number of other local and regional services such as BOLT, 205, 206, and HOP. Perhaps equally important, BRT services have an opportunity to create transfers with the STAMPEDE and JUMP as the routes cross each other.

Other than current peak-hour routes on US 36/28<sup>th</sup> Street, e.g., Route HX (destined to become the Flatiron Flyer) and Route S the new BRT route has limited opportunity to share common stops with other routes on 28<sup>th</sup> Street. Only between Canyon and Pearl, a distance of about 0.3 miles, are there opportunities to share stops. On Pearl, the potential exists to share stops with the HOP, which offers significant opportunities for community circulation. The lack of common stops underscores the importance of creating connectivity with the local system as a result of transfers to crossing routes at Colorado (STAMPEDE) and Arapahoe (JUMP).

There is one other set of circumstances worthy of note in this discussion. The potential alignment intersects two very important bicycle/pedestrian corridors in Boulder, one the pedestrian underpass at College and the other the underpass and access to the Boulder Creek Trail. Both of these facilities offer significant **connectivity into Boulder's extensive bicycle and pedestrian** system and should be given particular attention. Leveraging these existing investments by the City of Boulder ability to facilitate access between local circulation and regional transit, a very important emphasis in the Transportation Master Plan, is ready made thanks to visionary investments by the City of Boulder.

### US 36 BRT to Depot Square at Boulder Junction

The US 36 BRT alignment between Table Mesa Park & Ride and Depot Square at Boulder Junction uses US36 to 28<sup>th</sup> Street to Pearl Parkway to Depot Square. Due to conditions and pre-existing investments on these streets only existing stops were considered as possible stops for the Flatiron Flyer.

Figure 8 identifies the recommended US 36 BRT stops along 28<sup>th</sup> Street and Pearl Parkway in Boulder, based on discussions with the Transit Implementation Group. Six stops are recommended. This stop proposal results in stop spacing of about 0.6 miles between stops, very similar to the stop spacing on Broadway although with much larger variances between stops. Figure 8 includes the cumulative distance along the route in each direction in miles.

**Figure 8 Recommended US 36 BRT Stops between Table Mesa P&R and Boulder Junction**

Northbound	Southbound
<ul style="list-style-type: none"> <li>▪ <b>Mile 0.0</b> Table Mesa Park &amp; Ride</li> <li>▪ <i>Access 28<sup>th</sup> St. Frontage Road just prior to Colorado</i></li> <li>▪ <b>Mile 2.1</b> Near side of Colorado – existing stop, right at the 28<sup>th</sup> St. underpass – <b>no shelter or amenities</b></li> <li>▪ <b>Mile 2.4</b> At Boulder Creek Trail Underpass – <b>has a shelter but no bike rack</b></li> <li>▪ <i>Rejoin US-36/28<sup>th</sup> Street at Arapahoe slip lane.</i></li> <li>▪ <b>Mile 2.75</b> Far side of Arapahoe – <b>lacks shelter</b></li> <li>▪ <b>Mile 2.9</b> Farside of Canyon - <b>this is very close to the stop at Arapahoe, but is being added to facilitate connectivity with BOLT and 205. Also preserves stop pattern of existing HX route.</b></li> <li>▪ <b>Mile 3.3</b> Mid-block crosswalk on Pearl at 29<sup>th</sup> – <b>has shelter and B-Cycle station.</b></li> <li>▪ <b>Mile 3.7</b> Depot Square</li> </ul>	<ul style="list-style-type: none"> <li>▪ <b>Mile 0.0</b> Depot Square</li> <li>▪ <b>Mile 0.4</b> Pearl at 29<sup>th</sup> - mid-block crosswalk – <b>has shelter and B-Cycle station.</b></li> <li>▪ <b>Mile 0.7</b> Near side of Walnut <b>This is very close to the stop at Arapahoe, but is being added to facilitate connectivity with BOLT and 205. Also preserves stop pattern of existing HX route.</b></li> <li>▪ <b>Mile 1.1</b> Far side of Arapahoe – <b>Has a shelter (but could use improvement; bike racks needed).</b></li> <li>▪ <b>Mile 1.3</b> At Boulder Creek Trail Underpass –</li> <li>▪ <b>Mile 1.6</b> Far side of Colorado, also College St. underpass of 28<sup>th</sup> – <b>shelter has maintenance issues. Has bike racks.</b></li> <li>▪ <b>Mile 3.8</b> Table Mesa Park &amp; Ride.</li> </ul>
# Stops: 5 stops between Table Mesa Park & Ride and Boulder Junction	# Stops: 5 stops between Table Mesa Park & Ride and Boulder Junction

### Walk Shed Analysis

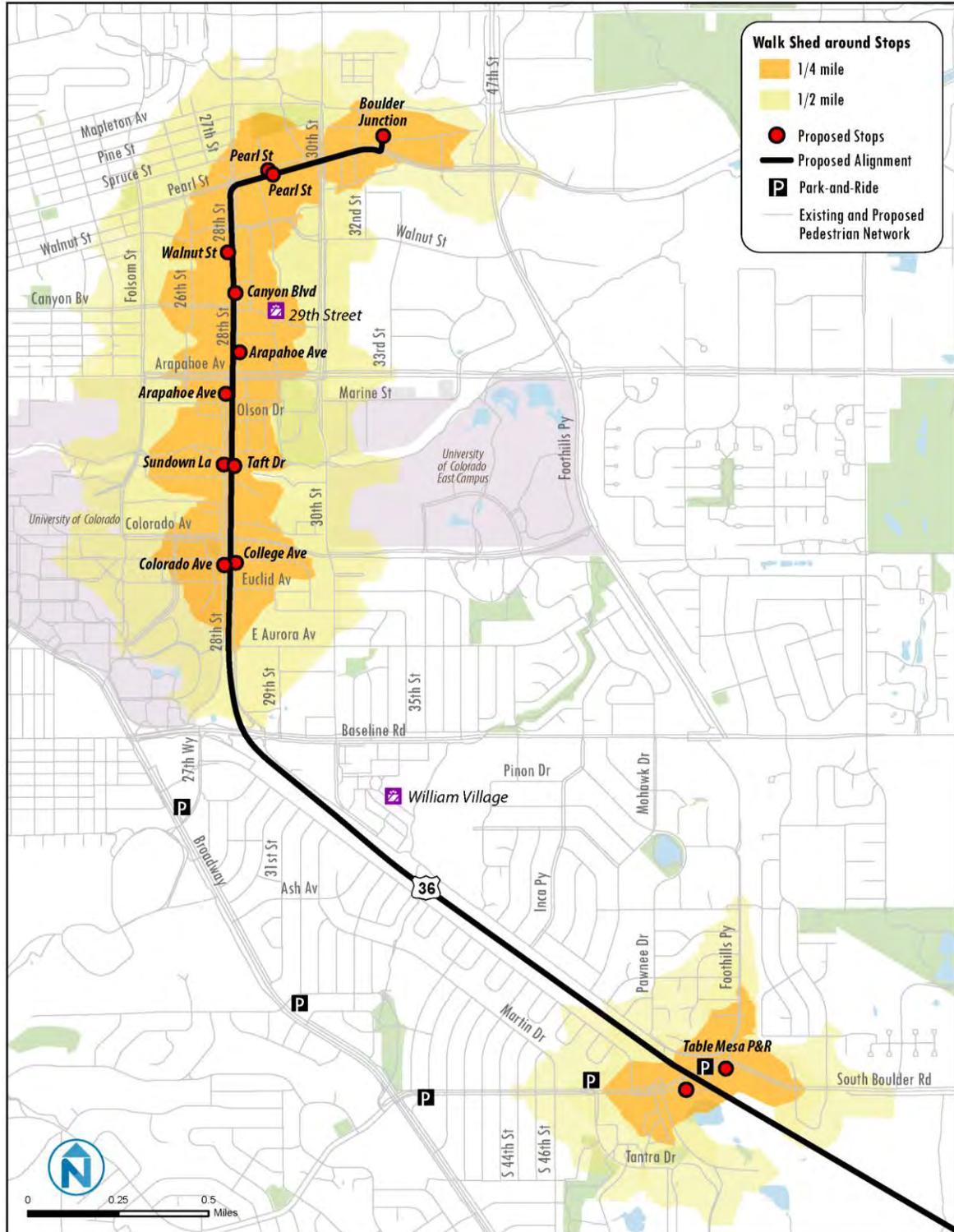
An analysis was conducted to determine the walk shed size of the recommended stops, measured through the street network to represent a true walking distance **and not an “as the crow flies”** distance. Both quarter mile and half mile walk sheds were calculated. Figure 9 shows the numerical results of the analysis. The quarter- and half-mile walk sheds are illustrated graphically in Figure 10. Practically all portions of the corridor are within a quarter- and -half mile walk of a stop, north of Colorado Avenue.

**Figure 9 US 36 BRT Table Mesa P&R – Boulder Junction Walk Shed Statistics – Recommended Stops**

Table Mesa Park & Ride – Boulder Junction (28 <sup>th</sup> Street)	Area Within ¼ Mile Walk (Sq Mi)	Area Within ½ Mile Walk (Sq Mi)
Proposed (5 stops*)	0.62	1.8

\* Per direction, between Table Mesa Park & Ride and Boulder TC or Boulder Junction

Figure 10 US 36 28<sup>th</sup> Street Quarter- and Half-Mile Walk Sheds



## COMBINED BROADWAY AND 28<sup>TH</sup> WALK SHED ANALYSIS

### Broadway and 28<sup>th</sup> Street Combined Walk Shed

Quarter mile and half mile walk sheds were also calculated for the combined US 36 BRT alignments between Table Mesa Park & Ride and Boulder Junction. Figure 11 shows the numerical results of the analysis.

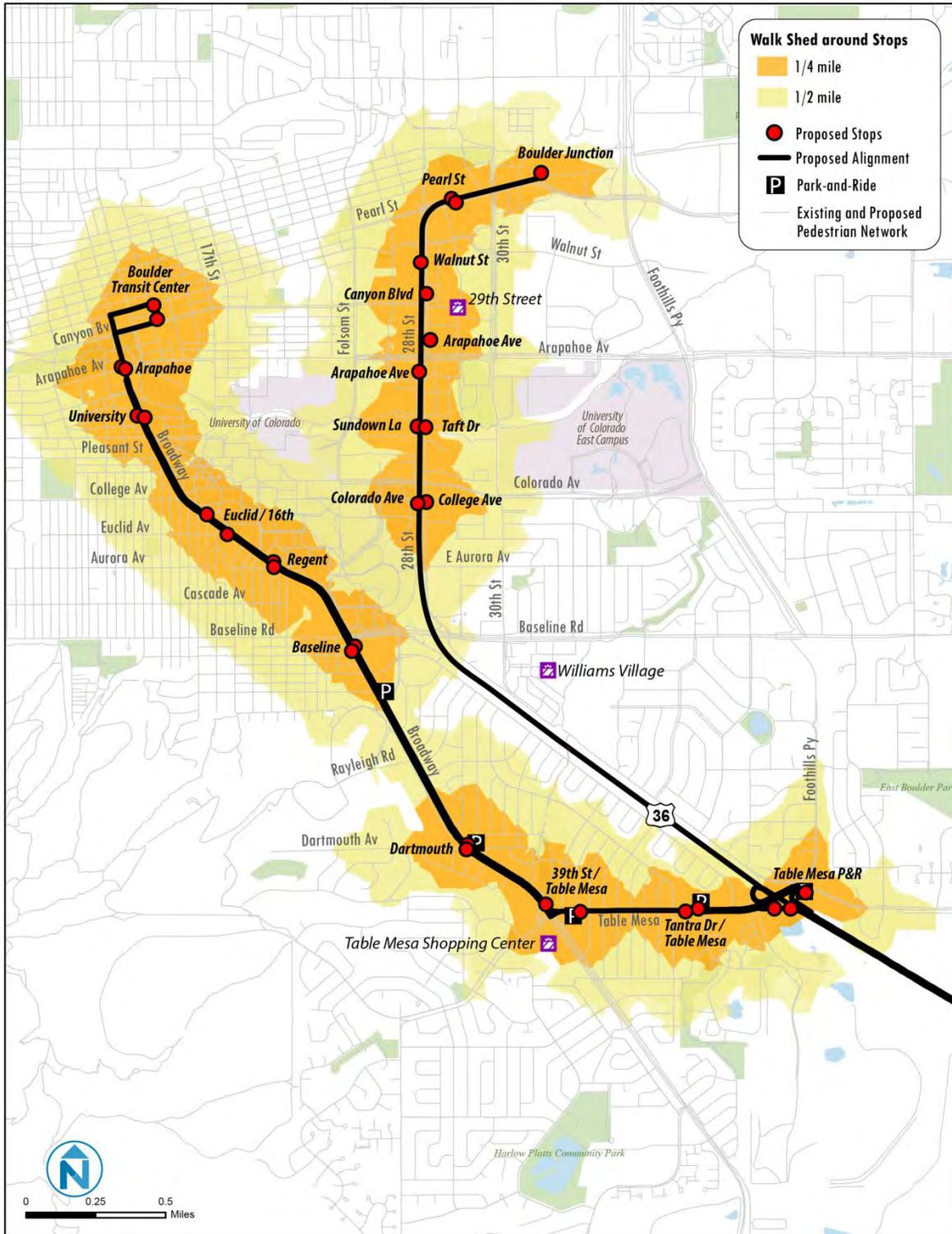
The quarter- and half-mile walk sheds are illustrated graphically in Figure 12. The combined alignments include the CU West Campus within the half-mile walk shed and extend the half-mile walk shed to south of Baseline along the 28<sup>th</sup> Street corridor.

**Figure 11 US 36 BRT Combined Table Mesa P&R – Boulder TC and Boulder Junction Walk Shed Statistics – Existing and Recommended Stops**

Table Mesa Park & Ride – Boulder TC or Boulder Junction	Area Within ¼ Mile Walk (Sq Mi)	Area Within ½ Mile Walk (Sq Mi)
<b>Boulder TC (Broadway)</b>		
Current (11 stops*)	1.18	2.89
Proposed (8 stops*)	1.07	2.75
<b>Boulder Junction (28<sup>th</sup>)</b>		
Proposed (5 stops*)	0.62	1.8
<b>Broadway/28<sup>th</sup> Combined</b>		
Proposed (8/5 stops*)	1.59	4.04

\* Per direction, between Table Mesa Park & Ride and Boulder TC or Boulder Junction

Figure 12 US 36 BRT Broadway and 28th Street Combined Quarter- and Half-Mile Walk Sheds



## Future Stop Development

The City of Boulder has been developing a grant application to secure funds to develop on-freeway stops at Williams Village. These stops would be about 1.1 miles from Table Mesa Park & Ride and about 1 mile from the stops at College, reducing overall average stop spacing to slightly more than 0.5 miles. Adding a stop at that location very closely matches the stop spacing for the Broadway branch of the Flatiron Flyer. In the longer term, the potential to add a stop at Baseline might also be a consideration, but is secondary to the stops at Williams Village.

Figure 13 provides numerical statistics for the walk shed analyses for 28<sup>th</sup> only and the combined 28<sup>th</sup>/Broadway alignments including the proposed future Williams Village stop. This stop increases the 28<sup>th</sup> Street alignment quarter-mile and half-mile walk sheds by about 25%.

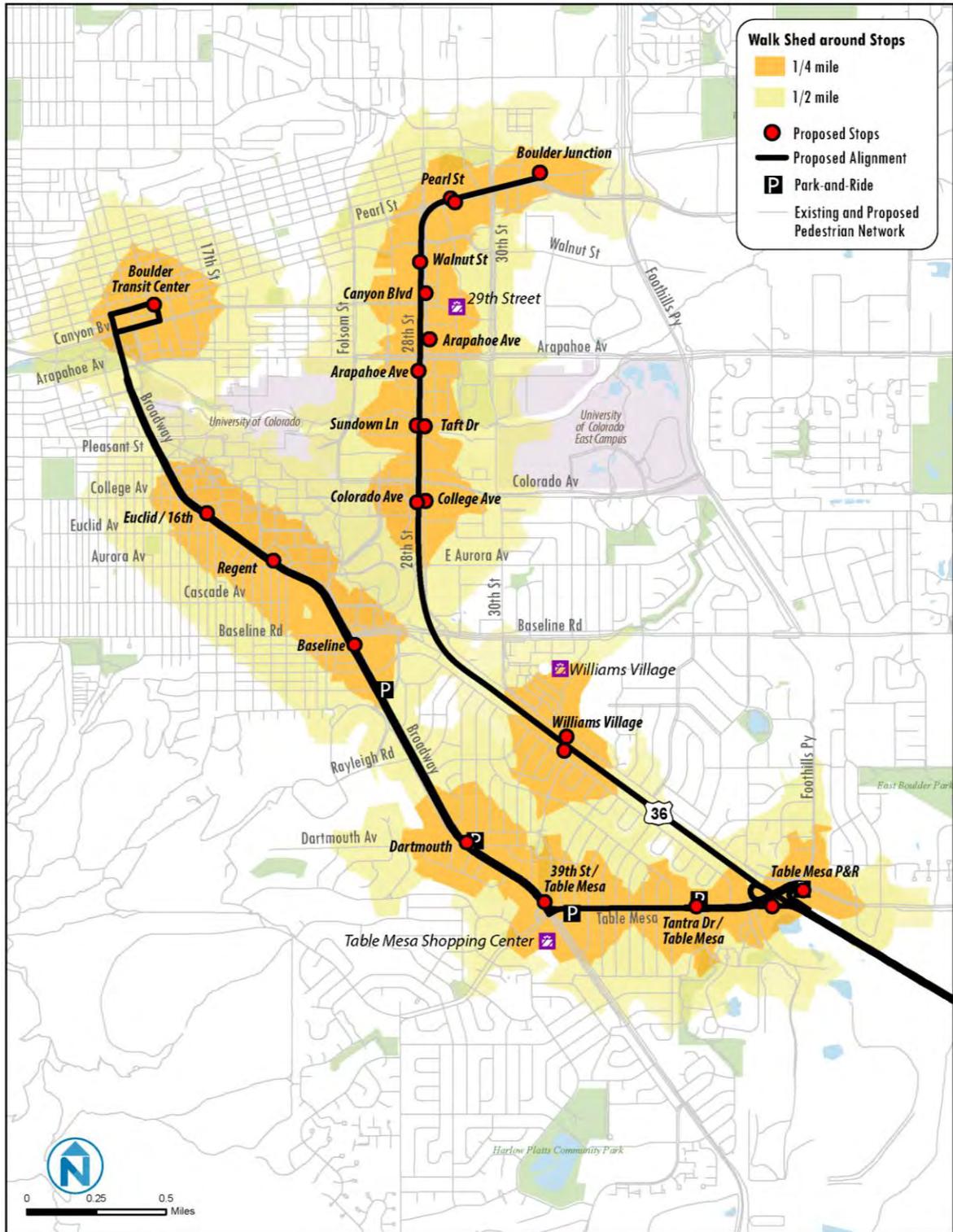
Figure 14 illustrates the quarter- and half-mile walk sheds graphically. The additional station extends the quarter- and half-mile walkshed on both sides of US 36 between Baseline and Table Mesa Park & Ride, including nearly complete half-mile walkshed coverage for the Martin Acres neighborhood between US 36 and Broadway.

**Figure 13**      **Broadway/28<sup>th</sup> Only and Combined 28<sup>th</sup>/Broadway Walk Shed Analysis with Future Proposed Williams Village Station**

Table Mesa Park & Ride – Boulder TC or Boulder Junction	Within ¼ Mile Walk		Within ½ Mile Walk	
	Area (Sq Mi)	% Change from Proposed	Area (Sq Mi)	% Change from Proposed
<b>Boulder Junction (28<sup>th</sup>)</b>				
Proposed (5 stops*)	0.62	--	1.8	--
With Williams Village (6 stops*)	0.77	24%	2.25	25%
<b>Broadway/28<sup>th</sup> Combined</b>				
Proposed (8/5 stops*)	1.59	--	4.04	--
With Williams Village (8/6 stops*)	1.73	9%	4.33	7%

\* Per direction, between Table Mesa Park & Ride and Boulder TC or Boulder Junction

Figure 14 US 36 Broadway and 28<sup>th</sup> Street Combined Quarter- and Half-Mile Walk Sheds – with Williams Village BRT Stop



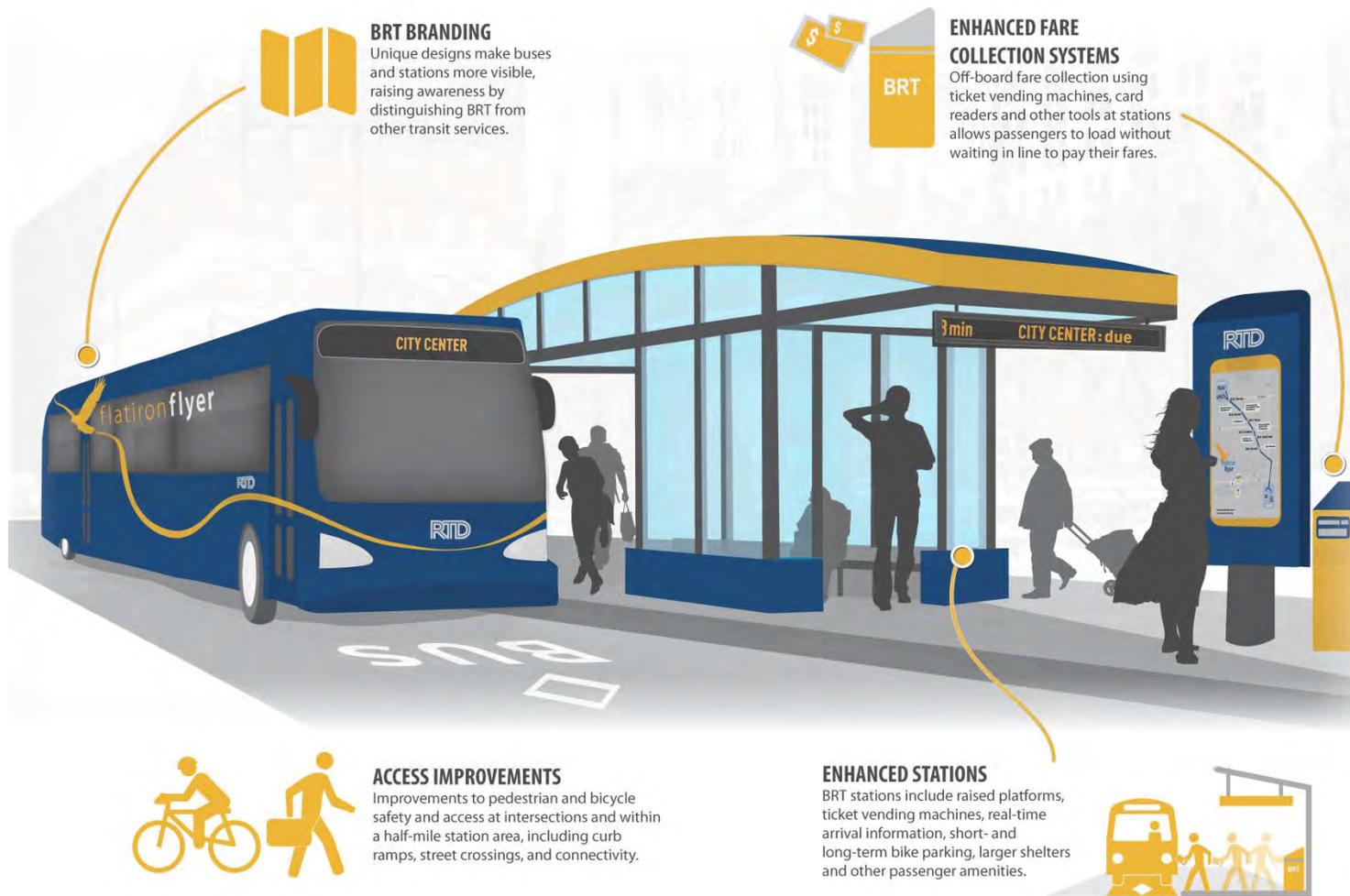
## 2 BRT FACILITIES

This section is intended to provide a general discussion of BRT station amenities as background for discussion of US 36 BRT station and other facilities. **It includes a discussion of mobility hubs...**

### BRT STATION/STOP AMENITIES

BRT stations include infrastructure and amenities that are designed to make bus service more similar to rail service and provide a higher overall level of customer experience than standard bus service and stop facilities. These amenities enhance the rider experience, making transit more enjoyable and easier to use, and function with other BRT enhancement to attract riders to BRT. Figure 15 below illustrates these amenities, which include special BRT branding to distinguish the service from other bus routes, stop access improvements, and station amenities. Although the level of station enhancement varies significantly across BRT systems, typical amenities include off-board fare payment, real-time information, level boarding platforms, and high quality passenger waiting facilities, such as spacious shelters and seating.

Figure 15 BRT Station/Stop Amenities



## TRANSIT FACILITY CHARACTERISTICS

Figure 16 on the following page, reproduced from the Boulder TMP, outlines typical amenities found at a range of transit facilities, from a basic bus stop to a transit center.

- **BRT Stations/Stops** can include the elements of high-end bus stops plus the set of features illustrated in the graphic above.
- **Transit Centers** offer additional amenities and are designed to improve integration with other modes, including walking, bicycling, and in the case of park & rides, automobiles.
- **Mobility Hubs**, a concept included in the TMP, facilitate transit connections outside of the primary transit centers and include pedestrian and bicycle improvements and other sustainable modes (e.g., car or bike sharing) designed to connect transit passengers to adjacent neighborhoods and nearby land uses. Mobility hubs are relevant to the discussion of US 36 BRT station amenities because the TMP identifies several potential Mobility Hub locations along both Broadway and 28<sup>th</sup> Street. The next section provides additional discussion of Mobility Hubs.

**Figure 16 Transit Facility Characteristics (from Boulder TMP)**

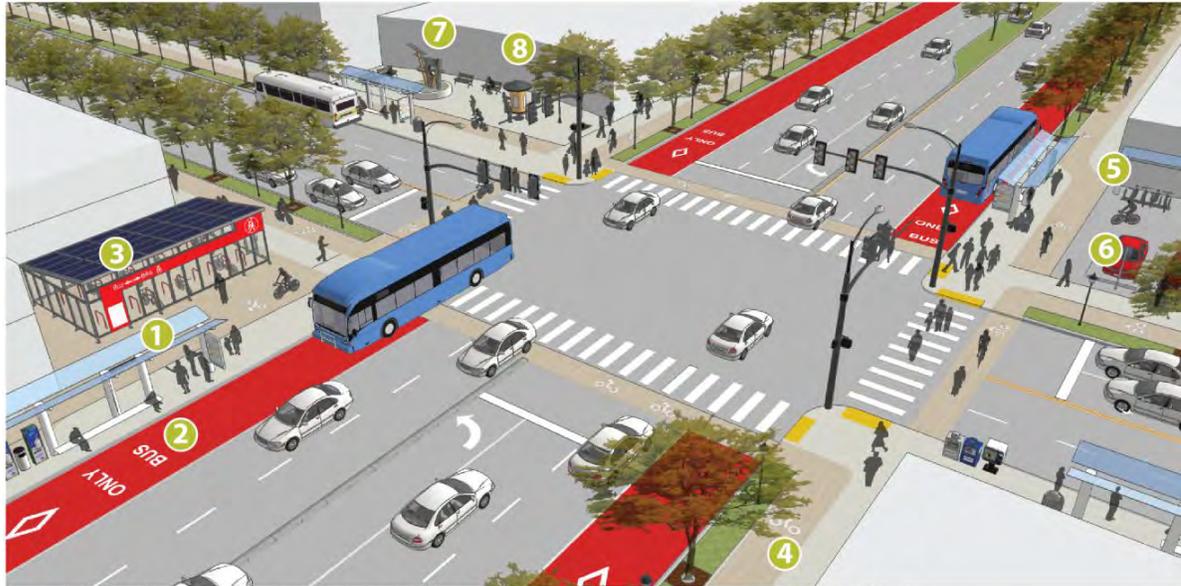
Facility Type	Characteristics
<b>Transit Center</b> <i>(Includes Park &amp; Ride)</i>	Mobility Hub and BRT/high amenity bus stop features plus: <ul style="list-style-type: none"> <li>▪ Comprehensive multimodal wayfinding and highly legible bicycle and pedestrian network integration</li> <li>▪ Bike share stations</li> </ul>
<b>Mobility Hub</b>	BRT/high amenity bus stop features plus: <ul style="list-style-type: none"> <li>▪ Transit wayfinding</li> <li>▪ Real-time travel information</li> <li>▪ High quality bike parking (long and short term)</li> <li>▪ Bicycle network integration/bike share stations</li> <li>▪ Placemaking features (street furniture, public spaces)</li> </ul>
<b>BRT Station/Stop</b>	High amenity bus stop features plus: <ul style="list-style-type: none"> <li>▪ High capacity shelters and seating at all stations</li> <li>▪ Level boarding platforms</li> <li>▪ Transit information for all routes serving area</li> <li>▪ Real-time bus arrival information</li> <li>▪ Off-board fare payment (where route appropriate)</li> <li>▪ Stop and area lighting</li> <li>▪ Passenger/disabled waiting beacon (after dark)</li> <li>▪ Curb bulbs where appropriate</li> <li>▪ Fully improved intersections including curb ramps</li> <li>▪ Bicycle parking (long and short-term)</li> <li>▪ Pedestrian improvements within ½-mile radius of stop</li> </ul>
<b>High Amenity Bus Stop</b> <i>(Prioritized for CTN and by level of boarding activity)</i>	Basic and moderate stop amenities, plus: <ul style="list-style-type: none"> <li>▪ Shelter with transit information</li> <li>▪ Crossing markings and pedestrian signals (sufficient crossing time; based on roadway width, design speed)</li> <li>▪ Bicycle parking (long and short term)</li> </ul>
<b>Moderate Amenity Bus Stop</b>	Basic amenities plus: <ul style="list-style-type: none"> <li>▪ Seat or bench</li> <li>▪ Bike rack</li> <li>▪ Trash receptacle</li> </ul>
<b>Basic Bus Stop</b>	<ul style="list-style-type: none"> <li>▪ Stop pole and sign with stop identifier</li> <li>▪ ADA accessible bus pad with sidewalks and curb ramps</li> </ul>

## MOBILITY HUBS (ADAPTED FROM TMP TRANSIT MODAL PLAN)

The goal of a Mobility Hub is to fully integrate the transit network with multimodal access and connections at the intersection of frequent transit lines, e.g., CTN or Rapid Transit, or at locally- or regionally-significant activity centers with high transit demand.

Mobility Hubs are context-sensitive solutions that are adaptable to a variety of locations. Each location requires a unique design; Figure 17 illustrates how these elements can be applied.

**Figure 17** Mobility Hub Elements



- |   |                        |   |
|---|------------------------|---|
| 1 Enhanced bus stops with real-time information | 4 Bike parking         | 7 Public art                              |
| 2 Designated bus lanes and priority signals     | 5 Car sharing          | 8 Transit and community information kiosk |
| 3 Secure bike parking                           | 6 Off-street bike path |   |

Mobility hub improvements include transit amenities to support increased transit transfer activity and incorporate placemaking features to make transit stops attractive and vibrant community elements for the surrounding neighborhood. The box below highlights key elements of the Mobility Hub concept.

### **Function of Mobility Hub Elements**

- Accessible, universal design allows people of all physical abilities easy access to transit stops/stations.
- Shared mobility services – including bike share stations, car share vehicles, and loading space for other private or public mobility services – enable access outside of the stop walkshed.
- Integrated mobility technology – including kiosks, reader boards with real-time information on transit and other modes, and shared payment interfaces – assist travelers with trip planning, arranging shared rides, and provide opportunities for other evolving applications.
- Placemaking elements, such as public art and public seating, active street environments with a mix of land uses, and strong land use anchors invite social interaction and vibrant business opportunity
- Secure, covered bicycle parking and access to the surrounding bicycle transportation network
- Excellent pedestrian infrastructure within a quarter to half-mile walkshed and connections to the bicycle network
- Context-appropriate parking, preferably consistent with the “SUMP” principles— shared, unbundled, managed, and paid parking.

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Figure 18 shows the TMP-recommended Mobility Hub locations in Boulder, including several along the US 36 BRT alignments in Boulder. These include:

- Arapahoe and Canyon at 28<sup>th</sup> Street
- Broadway near Euclid, Baseline Road, and Table Mesa Shopping Center

**Figure 18 Current and Planned Transit Facilities (From Boulder TMP)**



## Mobility Hub Case Studies

Investments in mobility hubs respond to an opportunity to link transit infrastructure investments with concentrated land uses and significant development potential. Mobility hubs are critical nodes in the regional transportation system and serve as origins, destinations, and/or transfer points. As technology and the “sharing culture” have become more ubiquitous, kiosks with real-time information and bike or car share stations are becoming standard features to connect people and modes.

### ***Bremen, Germany: Connecting modes to reduce auto ownership***

Mobility hubs first emerged in Bremen, Germany in 2003 to create better connections between transit, cycling, car sharing, and taxis in a central location. The concept began with an integrated fare card for the City’s transit and car share programs. A network of strategically located mobility hubs further integrated transit, non-motorized modes, and car share services, featuring highly visible and branded electronic kiosks to provide real-time arrival and travel time information to travelers.

The mobility hub strategy helped residents and visitors shift their travel behaviors.

Among the 550,000 central city residents in 2008, 14% commuted by public transport, 20% by walking, and 25% by bicycling.<sup>1</sup>

Residents also credit lower rates of vehicle ownership to the ease of connecting to car share services via the mobility hubs. In the first year that car sharing services were accessed at the mobility hubs, 30% of the car share customers gave up their personal vehicles.<sup>2</sup> As a result, severe on-street parking shortages have been alleviated.<sup>3</sup>

Figure 19 Mobility Hub in Bremen, Germany



Bremen’s Mobil.Punkt integrates several travel modes at one central point

Source: Flickr user North Sea Region Programme

### ***Toronto: Scaling mobility hubs according to context***

The regional government of the greater Toronto area of Ontario, Canada undertook a major transportation planning effort, The Big Move, to accommodate rapid growth. The plan identified 51 sites for mobility hubs, paired with significant investments in transit. Local governments have committed \$11.5 billion to implement the plan and several planning studies are underway for identified mobility hubs.

Key objectives of the mobility hubs are to: provide seamless connections between transportation modes, create centers of activity and entertainment, and influence land use to support residential and business development at a density that is transit-supportive.

Like Boulder, Toronto’s proposed mobility hubs differ in size and scope. Toronto developed a context-sensitive hierarchy of hubs that accounts for current and planned transportation investments, employment and residential growth, and urban form.<sup>4</sup> The hierarchy was developed in conjunction with Mobility Hub Guidelines, a framework document to guide the planning and development of the hubs.<sup>5</sup> The guidelines were developed before local governments began planning studies for individual hubs and serve as a resource for local planners, developers, and transit agencies.

The guidelines define several hub classifications:

- **Anchor Hubs.** Significant centers anchoring regional transportation systems with high potential for population and employment densities, including intermodal facilities.
- **Gateway Hubs.** Major activity centers where two or more rapid transit lines intersect and where there will be significant passenger activity—including gateways such as airports, universities, and regional shopping centers.
- **Destinations/Major Transit Stations.** Important nodes and destinations within the system but do not have the level of transit activity to support full hubs.

Candidate locations were reviewed to determine the appropriate level of infrastructure investment based on the following criteria:

- Current and planned station characteristics and number and quality of modes
- Estimated future boardings and alightings
- Growth potential (future population + employment within a half mile of the location)
- Current or planned development patterns that are transit supportive
- Institutional destinations; unique or distinctive area features
- Existing or planned placemaking elements

The James Street North Mobility Hub, depicted in the rendering below, is in the final planning stages.<sup>6</sup> The hub is located in a transitioning district of Hamilton where substantial growth is anticipated. A large mixed-use development is planned with over 1,600 new residential units and the redevelopment of City-owned industrial land.

**Figure 20** Rendering of Planned James Street North Mobility Hub in City of Hamilton



The James Street North hub (Gateway Hub type) is envisioned as a pedestrian-friendly streetscape where passenger rail lines will connect with bus rapid transit, bicycle paths, a park-and-ride, and pedestrian plazas.

Source: James North Go Mobility Hub Study

Each zone surrounding the hub represents different transportation opportunities. The innermost zone (2.5 minute walk) emphasizes high levels of pedestrian and transfer activity and balances multiple access modes. A secondary zone (up to 5 minute walk) focuses on safe and direct pedestrian and bicycle access. Beyond the secondary zone, local area bicycle connections, transit feeder service and auto access are emphasized.

**Notes:**(1) Sustainability Mobility & Accessibility Research and Transformation, "Mobil Punkt- Mobility Hubs in Bremen, Germany." <http://www.um-smart.org/resources/enews/070317.php#study1>. (2) Towards a New Mobility Culture: Reclaiming Street Space in the City through Innovative Car-Sharing, Guangzhou International Award for Urban Innovation [http://www.guangzhouaward.org/650/content\\_811.html](http://www.guangzhouaward.org/650/content_811.html). (3) <http://mobilpunkt-bremen.de/index.php?/English.html> (4) "The Big Move", [www.metrolinx.com](http://www.metrolinx.com). (5) MetroLinx, About Mobility Hubs (includes link to Guidelines document), [http://www.metrolinx.com/en/projectsandprograms/mobilityhubs/mobility\\_hubs.aspx](http://www.metrolinx.com/en/projectsandprograms/mobilityhubs/mobility_hubs.aspx). (6) James Street North Mobility Hub Study, <http://www.hamilton.ca/NR/rdonlyres/C76A1926-F266-4A71-B4E7-CF3DBD21ABA7/0/JamesSNMobilityHubStudy.pdf>.

## 3 BRT OPERATIONS

### TRANSIT PRIORITY

Providing exclusive running way for buses can greatly enhance speed and reliability by reducing interaction between buses and general-purpose traffic. By operating with less interference from general-purpose traffic, buses in exclusive lanes can operate faster and provide better travel times to riders. It may be possible to enhance speed and reliability for US 36 BRT within Boulder by converting a general-purpose lane to a transit-only lane at strategic locations. General purpose traffic is prohibited from using this type of lane except when making right turns. This type of transit lane is also known as a business-access and transit (BAT) lane.

The section of Broadway between Table Mesa Dr and Regent Dr has three lanes in each direction, and it may be possible to convert the curb lane in each direction into peak-period transit only lane. During the AM peak period, the curb lane in the northbound direction would become a transit-only lane, and at other times of day it would be a general purpose lane. In the southbound direction, the curb lane would become a transit-only lane during the PM peak period to prioritize transit leaving Boulder, and it would be a general-purpose lane at all other times.

This concept requires further study to better understand the potential benefits for transit as well as impacts to general purpose traffic. It is likely that transit travel times would decrease, and it is possible that travel times for general purpose traffic would increase. Fox Tuttle Hernandez (FTH) Transportation Group is currently conducting a study to determine the benefits and impacts.

A conceptual cross-section illustrating such as lane is provided below.

**Figure 21 Conceptual BAT Lane Illustration (Not Specific to Broadway)**

