

# **Downtown Boulder Station Feasibility Study**

Facility Needs Assessment  
City of Boulder

December 14 2017 (Revised)

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# 1. Introduction

This report builds on the findings of the *Downtown Boulder Station Existing Capacity Assessment* and is part of the larger Downtown Boulder Station Feasibility Study conducted for the City of Boulder. This report documents the future conditions of the region and anticipated changes to bus service at the Downtown Boulder Station within the planning horizon of 2040 also taking into consideration an intermediary timeframe of five to ten years. Data for this report was collected from numerous sources including several of the related planning documents for the City, the Denver Metro region, and from the Regional Transportation District (RTD), in the winter of 2016/2017.

# 2. Future conditions assessment

The assessment of future conditions for the Downtown Boulder Station is based on projections for population and employment, future travel demand management as documented in the *2014 Transportation Master Plan* (TMP), anticipated changes in bus service, including additional bus-rapid-transit (BRT) service at the station and anticipated changes in existing service, as well as planned changes to the local land uses and activities in Central Park, as documented in the Civic Area Master Plan. The future conditions assessment documented here is not meant to provide detailed modeling projections for future transit demand at the Boulder Station, but instead to show a basis of understanding of the local and regional trends in transit ridership.

## 2.1. Population and employment projections

The *Boulder Valley Comprehensive Plan* (BVCP) is updated every five years to reflect the community's current conditions, changes, shared values and needs. As part of the comprehensive plan, the Land Use Plan was developed to guide the type, location, and intensity of future development. Throughout each BVCP update process, new 25-year projections on housing, jobs and population are completed. The projections are used by city departments like transportation, parks and utilities to plan for system needs in long range master plans. For the 2015 update, the projections were calculated to 2040.

Based on City of Boulder's current zoning, the city is projected to gain 6,750 housing units by 2040. During this same time period, the city forecasts the 2040 service area population to be 136,100 and employment to be 156,500. Table 2-1 summarizes the 2040 projected outcomes. The estimated growth in employment is expected to be almost three times more than the residential growth during 2015 to 2040. More than 50% of the job growth potential is in Crossroads, East Boulder (including Boulder Junction), and Gunbarrel. These forecasts suggest a significant increase in non-resident employees and a growing trend for regional commuters to the area. This trend would support a need for increasing regional transit service city-wide.

**Table 2-1 Population and employment projections**

	2015	Additional 2040	2040 Total	Percent increase
Dwelling Units	51,450	6,750	58,200	13
Population	116,840	19,260	136,100	16
Employment	101,430	55,070	156,500	54

Source: Boulder Valley Comprehensive Plan 2015-2040 Projections

## 2.2. Future conditions near to the Downtown Boulder Station

Anticipated conditions near to the Downtown Boulder Station are based on related plans and the anticipation for infill and redevelopment of land near to the station. Implications of these changes are documented most recently in the Civic Area Master Plan (2015), a plan for redeveloping the Central Park and the surrounding civic areas.

### 2.2.1. Civic Area Master Plan

The planning area for the Civic Area Master Plan extends from Canyon Boulevard to Arapahoe Avenue, and from 9<sup>th</sup> Street to 14<sup>th</sup> Street. Through the plan, this land is envisioned as an active public space with a variety of civic buildings, natural environments, and displays of art, interconnected by a modern downtown park. Some of the recommended improvements to the primary focus area may impact the land use around the Downtown Boulder Station area in the future.

Canyon Boulevard, from 9<sup>th</sup> to 17<sup>th</sup> Street, is planned to become a complete street to ensure safe and convenient street access for all users by potentially including dedicated bike lanes, increased space and protection for people walking and more street trees and landscaping, while still accommodating cars and buses. While 14<sup>th</sup> Street is currently transit-only north of Canyon Boulevard and could remain unchanged through the Civic Area Master Plan, 14<sup>th</sup> Street south of Canyon Boulevard could be converted to transit-only with bike and pedestrian access, or converted to a transit and general use street (Civic Area Master Plan, 2015). Other considerations documented in the plan include the following:

*Bicycle/Pedestrian access:* The plan states a need to maintain and expand current bicycle and pedestrian facilities for better circulation as well as connections to nearby destinations, including Pearl Street Mall, Goss Grove, the University of Colorado campus and University Hill, have been identified. Developing a fully integrated multimodal transit system will enhance the station's function, safety and capacity.

*Parking:* Over time, the surface parking will be removed. These spaces are planned to be replaced with parking structures on either or both the west and east end of the Civic Area, potentially affecting the adjacent land use. Local transit services will respond to parking supply as the area increases in visitor demand.

## 2.3. Future travel demand management

The City of Boulder is actively planning to reduce their local resident single-occupancy vehicle (SOV) mode share to 20 percent by 2035 as compared to 36 percent estimated in 2012. Transit is expected to account for 19 percent of the total shift from SOV and carpooling for resident trips and 8 percent of the shift for non-resident trips (TMP, 2014). To accomplish this, the City has committed to making several improvements related to both its local Community Transit Network (CTN) and its BRT services. Many of the implementation items from the City's TMP impact transit service and ridership in general, but several items could impact service at the Downtown Boulder Station. These potential impacts are discussed below:

- *Increased community promotion of the Eco Pass program:* increasing the availability of Eco Passes is anticipated to induce transit ridership. Increases in key card fare payment could also lead to a decrease in average bus boarding times at the Downtown Boulder Station and on routes serving the station. This would be particularly evident for local routes with high ridership by City resident transit riders.
- *Coordination with other transportation organizations including Via, E-Go CarShare, Boulder B-cycle, and Community Cycles:* establishing partnerships by building programs with transportation organizations will help encourage transit trips to achieve the SOV reduction objective set in the TMP.
- *Maintenance and/or expansion of the existing CTN transit service within the community:* The CTN routes, particularly those operating largely in Boulder, are both the most productive and cost-effective (cost per boarding) routes in the transit system serving Boulder (TMP, 2014). Maintaining and expanding the CTN has been identified in the TMP as a vital opportunity to reach local mode

share targets. The efforts to expand the CTN network and enhance the route performance are anticipated to enhance public transit accessibility and increase the ridership on those routes.

- *Implementation of BRT service to surrounding communities on US 36 and the identified Northwest Area Mobility Study (NAMS) regional corridors:* investing in new transit service to expand the system will most likely increase regional trips, considering the projected growth in the number of employees that work in Boulder but live outside city limits (TMP, 2014). The Downtown Boulder Station, serving as the major transit hub in Boulder, is a major stop/terminus to accommodate some new regional transit services.

## 2.4. Future transit operations

The Downtown Boulder Station is expected to continue to serve significant levels of bus volume and passenger demand into the future. Much of the additional service is assumed to be regional BRT service, as identified in the NAMS in 2014. Additional peak and off-peak frequencies are shown in Table 2-2. It should be noted that current planning for the East Arapahoe/SH 7 BRT is planned for implementation in the next five to ten years. The SH 119 BRT Environmental Clearance and Preliminary Engineering process is expected to begin in May 2017 and will take approximately 2 years to complete. At completion, the corridor will be in a position to apply for state/federal grant funding programs. This is likely to be ahead of implementation of the East Arapahoe/SH 7 BRT. The TMP *Transit Modal Plan* includes a service design policy for the various types of bus service operating in the city. These include service policy levels for local, CTN, BRT, commuter express, and express corridor routes. The policy identifies bus frequencies of less than ten-minute headways on CTN routes and seven-minute headways on BRT routes. The plan also documents a scheduled implementation of route designation changes and the implications for service increases on those routes. These service policy changes were applied to 208 and HOP routes.

The NAMS also identifies increases in service to the Flatiron Flyer routes between Boulder (the Downtown Boulder Station) and Denver (Union Station) through the year 2035. Assumptions for increases in bus trips and headway estimates are shown in Table 2-3. Other operational assumptions include estimates by RTD about other routes. These assumptions include estimated increases in service frequency to the 225, JUMP, and DASH routes with considerations that any or all of these lines may become arterial BRT routes in the future (RTD, 2016). BRT frequencies are likely to increase in the future due to changes in routing. Table 2-4 summarizes the assumptions for increases or service changes in the future. Although other local and regional routes are not identified to have changes, it is very likely that minor operational changes will occur that will shift trips into and out of the peak hour.

**Table 2-2 Assumed BRT peak service frequencies and implementation**

Service	Peak frequencies	Implementation Priorities
SH 119	4/hour	Short Term 3-10 years
East Arapahoe/SH 7		Medium Term 7-10 years
South Boulder Road		Long Term 7-20 years

Source: NAMS, 2014

**Table 2-3 US 36 AM Peak Service Levels**

Major destination	2016	2020	2030	2035
Boulder - Denver	15 bus/hour	16 bus/hour	20 bus/hour	24 bus/hour
Denver - Boulder	11 bus/hour	12 bus/hour	20 bus/hour	24 bus/hour
Boulder & Denver (both directions)	4 bus/hour	4 bus/hour	8 bus/ hour	8 bus/hour

Source: NAMS, 2014

**Table 2-4 Bus route change assumptions**

Route	Service change assumption	Peak hour service headways (minutes)			Existing Trips	Additional peak hour bus trips	
		Existing	Future (5-10 years)	Future (15-20 years)		Future (5-10 years)	Future (15-20 years)
<b>225<sup>1</sup></b>	Increase by 1/3 each period	10:00	8:00	6:00	6	2	5
<b>208<sup>3</sup></b>	Increase to CTN then CTN+	30:00	15:00	10:00	2	4	6
<b>JUMP<sup>1</sup></b>	Increase by 1/3 each period	-	-	-	0	0	0
<b>DASH<sup>1</sup></b>	Becomes S. Boulder Rd. BRT with increase by 1/3 each term	8:00	6:00	4:00	8	3	6
<b>FF<sup>2</sup></b>	Increase to 15 trips in near term, 20 trips in long term	4:00 to 7:00	3:00 to 5:00	3:00	11	4	9
<b>BOLT<sup>2</sup></b>	Converted to BRT at 15 minute headways	15:00	15:00	15:00	4	0	0
<b>HOP<sup>3</sup></b>	Increase to CTN in long term	12:00	12:00	7:00	5	5	9
<b>SH 7<sup>2</sup></b>	New BRT with 15-minute headways	-	15:00	15:00	0	4	4
<b>SH 119</b>	New BRT with 15-minute headways	-	15:00	15:00	0	4	4

<sup>1</sup> Service change assumptions provided by RTD (January, 2017)

<sup>2</sup> Combined Denver to Boulder FF routes. Service change assumptions from RTD Interdepartmental memorandum, 2012

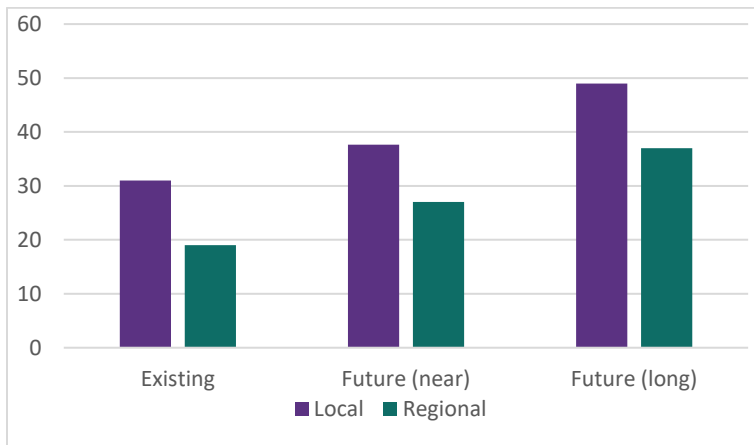
<sup>3</sup> CTN service policy is 10-minute peak hour headways over local headways of 15 to 30-minutes (TMP, 2014)

Based on these assumptions for increases in operations at the Downtown Boulder Station, the station is estimated to experience an increase from 50 trips in the peak hour to 65trips in the near term and over 85 trips in the long term. Regional routes make up the largest portion of the increase in bus trips with eight new trips added in the near term and thirteen new trips added in the long term. Table 2-5 and Figure 2-1 show the estimated increase in peak hour bus activity at the station by trip type, local or regional.

**Table 2-5 Peak hour increases in bus trips departing the Downtown Boulder Station**

Timeframe	Local and CTN routes		Regional routes		Total trips
	Bus Trips	Percent increase from existing	Trips	Percent increase from existing	
Existing	31	-	19	-	50
Future (5 to 10 years)	38	21	27	42	65
Future (10 to 15 years)	49	58	37	95	86

**Figure 2-1 Peak hour increases in bus trips departing the Downtown Boulder Station**



## 2.5. Future vehicle types

RTD is not likely to turn over their entire fleet in the next five to ten years, and some of the vehicles currently in service are likely to be used for the next 10-12 years. However, it should be assumed that the newest vehicle technology will change the vehicle fleet make-up and add to the considerations for future station needs.

While none of the buses operating through the Downtown Boulder Station require a 60-foot boarding area, RTD has stated a future need of at least two gates that can accommodate longer articulated vehicles. The existing station does not currently have any gates designed to accommodate these vehicles. It could also be assumed that some of the new BRT routes will use over-the-road coaches, as with the existing Flatiron Flyer buses. These vehicles require a 45-foot gate and have special boarding considerations for loading and unloading of mobility devices. The station currently has four gates that accommodate the over-the-road coaches. With the additional of new BRT routes, there should be a consideration for additional 45-foot gates.

Additionally, with vehicle upgrades, there is some expectation that the RTD vehicle fleet will include fully electric vehicles (RTD, 2017). Future station upgrades should not inhibit the ability to add vehicle charging infrastructure to support these vehicle types.

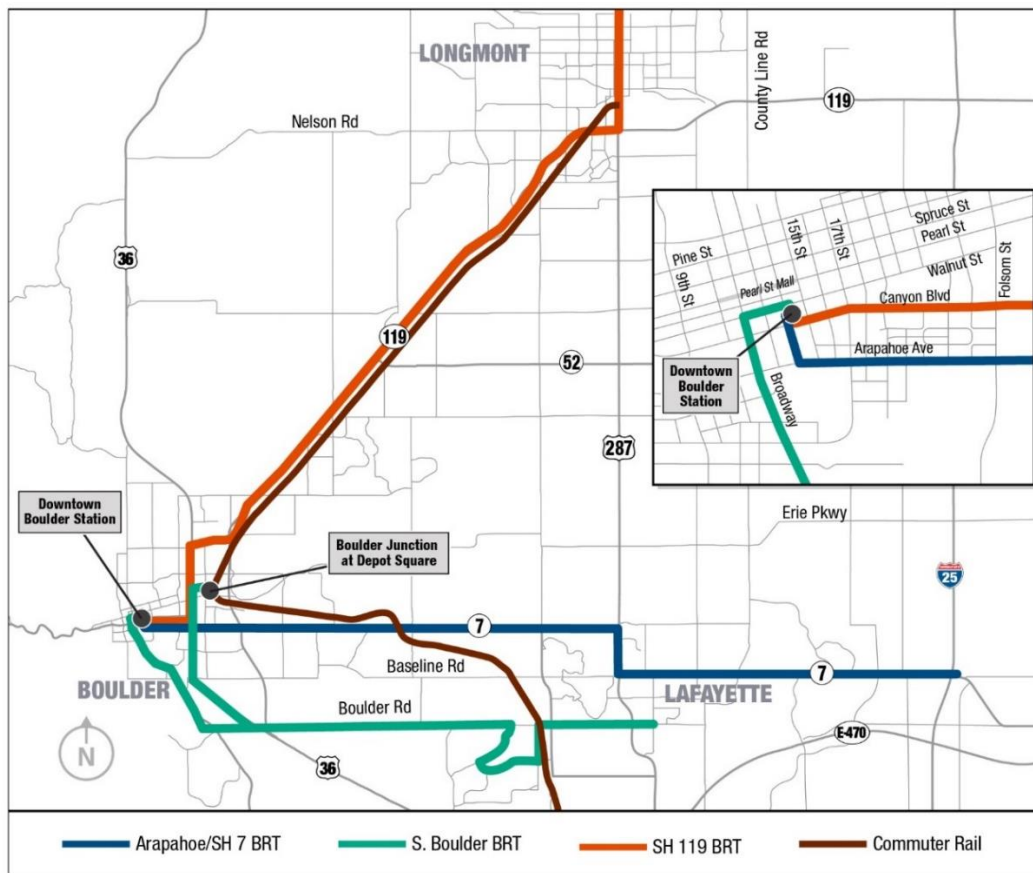
Lastly, within the 2040 planning horizon for this study, there is a high likelihood of impacts from intelligent mobility in the way of connected and autonomous vehicles and increasing evolution in Mobility as a Service transportation model. Potential future needs related to these types of impacts include the following:

- Increased space for short-term passenger drop-off and pick-up
- Increased infrastructure to support wireless and communication technologies
- Improved wayfinding
- Greater flexibility in station area gate design to accommodate a wide range of transit vehicle types

### 2.5.1. Future alignment considerations

Additional transit routes, discussed in Section 2.4, will approach the station on local roadways, many of which are already used by other transit routes. It should be noted that these planned routes are somewhat flexible, and future recommendations for station design may impact the ultimate routing used for buses near to the station. A map of the proposed new BRT routes and other potential mass transit facilities are shown in Figure 2-2.

Figure 2-2 Planned and proposed mass transit improvements



### 2.5.2. Micro-Transit and Shared Mobility

Recent trends in privatized micro-transit and shared mobility have been identified as important future considerations for the Downtown Boulder Station. Shared mobility services such as car-sharing, and alternative transit services, such as micro-transit, provide flexible transportation options and are expected to grow, particularly in urban areas. Carsharing enables users to gain temporary access to a vehicle without the cost and responsibility of ownership. Micro-transit are typically privately owned and operated, shared transportation system that can have fixed routes and schedules or flexible routes and on-demand scheduling. The Downtown Boulder Station, as a mobility hub, will need to accommodate the growth of shared mobility and alternative transit services. This will include additional considerations for flexible curb space, informal passenger loading areas, and wayfinding for these services.



## 3. Additional station capacity needs

The following discussion uses the increase in peak hour bus trips, identified in Section 2.4 to estimate facility needs at the Downtown Boulder Station. Additional station capacity needs have been developed for both the near term (five to ten years) and long term (fifteen to twenty years). This analysis identifies future needs based on the increased future transit trips during the peak hour (4:00 to 4:59 p.m.)

### 3.1. Gate capacity and layover

Traditional analysis for determining transit stop capacity is based on bus dwell and clearance times, individual loading area capacity, failure rates, and loading area effectiveness. Because the Downtown Boulder Station serves as a recovery stop for many of the bus routes, and future dwell times are assumed to be similar to existing bus recovery times, the traditional method for assessing future gate capacity is not appropriate.

Instead, average parking time, based on existing data, was used as a surrogate for dwell time. Assumptions for increases in service during the peak hour were applied to the existing average parked time; this calculates the estimated amount of time during an hour that a bus occupies the assigned gate and shows when that time is greater than the hour available in the peak. It should be noted that because of the existing sawtooth design of a majority of the station boarding areas, these gates are assumed to be fully effective, meaning that any increase in bus boarding area capacity is equal to the total increase in capacity because buses are able to move independent of each other through the station.

Table 3-1 shows how the additional bus trips create capacity shortcomings during the peak hour and how the need for additional gates increase between the near and long term. Based on this analysis, the total gates needed increases from 14 to 22 by the year 2040. This analysis also confirms conclusions of the existing conditions assessment that the station is over capacity. The current station would ideally add four additional gates, to maintain current operations. It should be restated that Gate D is not considered to be fully effective in this analysis.

As mentioned in the existing conditions assessment for the station, there are only two sites currently available for bus layover in proximity to the station. Due to the anticipated increase in transit operations, RTD estimates that the need for layover space will also increase. RTD has identified a long term need for three dedicated layover spaces in addition to the 22 gates indented through this analysis, to facilitate efficient operations at the station.

**Table 3-1 Estimated bus trips, dwell times, and additional gate needs**

Route	Bus trips			Average gate occupancy (minutes) <sup>1</sup>	Estimated gate occupancy (minutes)			Additional gates needed		
	Existing total	Future (5-10 years)	Future (15-20 years)		Existing	Future (5-10 years)	Future (15-20 years)	Existing	Future (5-10 years)	Future (15-20 years)
<b>204</b>	8	8	8	3:00	24:00	24:00	24:00	-	-	-
<b>205</b>	2	2	2	4:00	8:00	8:00	8:00	-	-	-
<b>208</b>	2	4	6	8:00	17:00	34:00	51:00	-	1	1
<b>225</b>	6	8	11	22:00	134:00	179:00	238:00	1	2	3
<b>JUMP</b>	-	-	-	11:00	-	-	-	-	-	-
<b>DASH</b>	8	11	14	10:00	81:00	108:00	144:00	1	1	2
<b>FF<sup>4</sup></b>	11	15	20	5:00	55:00	75:00	100:00	1	1	1
<b>BOLT</b>	4	4	9	8:00	32:00	32:00	69:00	1	-	1
<b>AB</b>	1	1	1	6:00	7:00	7:00	7:00	-	-	-
<b>Y</b>	1	1	1	5:00	5:00	5:00	5:00	-	-	-
<b>N</b>	1	1	1	8:00	8:00	8:00	8:00	-	-	-
<b>FLEX<sup>3</sup></b>	-	-	-	5:00	-	-	-	-	-	-
<b>GS</b>	1	1	1	4:00	4:00	4:00	4:00	-	-	-
<b>HOP<sup>3</sup></b>	5	5	9	5:00	25:00	25:00	45:00	-	-	-
<b>SH 119</b>	-	4	4	5:00	-	20:00	20:00	-	-	-
<b>SH7<sup>3</sup></b>	-	4	4	5:00	-	20:00	20:00	-	-	-
<b>Total</b>	<b>50</b>	<b>69</b>	<b>91</b>	<b>Total existing gates</b>			<b>14 (13 effective gates)<sup>2</sup></b>			
				<b>Additional gate needs</b>			<b>+ 4</b>	<b>+ 5</b>	<b>+ 8</b>	
				<b>Total gates needed</b>			<b>18</b>	<b>19</b>	<b>22</b>	

<sup>1</sup> Source: RTD, 2016

<sup>2</sup> Gate D is considered ineffective due to the geometric issues identified in the Downtown Boulder Station existing conditions assessment

<sup>3</sup> Parking data for these routes was not available for this analysis. An assumed five-minute average parking time was used in the calculation as compared to five-minute average parking time for existing BRT service of the Flatiron Flyer. Increases in recovery time for these routes may impact the overall gates needed.

<sup>4</sup> FF routes 1, 2, and 5 are combined due to data source format (See #1).

## 4. Summary

This facility assessment includes information about the future needs of the Downtown Boulder Station based on future transit demand, changing land use and public activities in the area surrounding the station, and changes in bus technology and operations as reported by the City’s TMP, RTD, in the NAMS, and through other communication with RTD about this study. It is clear that the City is actively supporting local and regional transit ridership and that the Downtown Boulder Station will remain a major terminus for bus operations into the future. The TMP provides guidance that can be applied to future station improvements. Population and employment projections, in particular, show increasing regional transportation services. To facilitate mode share and service frequency targets established in the TMP, a significant portion of this demand will be satisfied by transit.

Planned increases in bus service operating through the Downtown Boulder Station will add to the need for additional boarding areas. High-frequency BRT routes will create near- and long-term station needs, if the services are to achieve their planned service levels.

Prior to beginning this study, RTD provided the City of Boulder with estimated need for increases in gate capacity (shown in Table 4-1). Although slightly higher, these estimates are similar to the results presented in Section 3.1 and could be considered as a validation of this analysis.

**Table 4-1 RTD estimated needs in station capacity**

	Existing	Near term needs	Long term needs
Gates (40' vehicles)	10	1	2 to 3
Gates (45' vehicles)	4	1	5 to 6
Gates (60' vehicles)	0	1 to 2	3 to 4
<b>Total gates</b>	<b>14</b>	<b>4 to 5</b>	<b>10 to 13</b>

*\*Available on a limited time basis. Source: RTD (November, 2016)*

Because the Downtown Boulder Station is used for recovery, bus dwell times are scheduled to be longer as compared to other in-line stops. This function decreases the operational capacity of gate space. Potential capacity gains could be achieved if this function was changed. Other potential recommendations for physical changes to the station and operational improvements to bus routing and gate assignments will be presented in a subsequent report.