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SECTION 1
INTRODUCTION

1.1 Purpose of Guidelines and Standards

Transit access is defined by the American Public Transit Association (APTA) as “the segment of an individual trip that occurs between an origin or destination point and the transit system.”\(^1\) When access is of a high quality (safe, convenient and attractive) it makes transit easier to use by those with limited transportation options and more likely to draw riders of choice.

Every transit trip begins and ends with a pedestrian trip regardless of the travel mode between origin or destination and the transit system. Therefore, the conditions that support transit access have the ancillary benefit of supporting pedestrian and bicycle trips for shorter distances. By creating more choices for travel, high quality transit access maximizes the benefits of the infrastructure investment in transit (both capital and operating).

RTD’s adopted access hierarchy, which encourages an optimal balance of modes to get to the transit system, recognizes these conditions by giving pedestrians the highest priority. Balancing the modes of access to transit serves as a way to manage system and site capacity constraints. For example, the marginal cost of adding ridership with new auto parking (which tends to generate peak usage) could be significantly greater than adding ridership through improved linkages to pedestrian paths or bicycle routes, or generating ridership through transit-oriented development (TOD) (which tends to produce usage throughout the day).

While RTD makes decisions regarding the siting and design of its facilities, community access is often beyond the immediate purview or direct control of transit agencies. RTD can, however, coordinate with other parties—such as local governments and the development community—that are responsible for the development and regulation of the physical infrastructure and built environment surrounding those facilities. The impact of those parties’ actions on transit suggests that RTD’s interests would be served by collaborating with them on access concerns.

What follows provides the rationale and guidelines for the design of transit access at rapid transit stations where pedestrians, bicyclists, transit buses, and private autos provide portions of the transit accessibility. The guidelines are intended to support implementation of the access hierarchy with the goal of achieving an optimal balance of access to the transit system. Since each site is unique, guidelines are meant to be flexible and to be employed holistically when used to evaluate transit design. Flexibility will be granted under conditions such as physical constraints or when there is a trade-off that can be measured

\(^1\) APTA Urban Design Guidelines for Transit Agencies (Draft 2008)
or reasonably estimated between ridership and other benefits. Standards are meant to be minimum criteria that have to be met. However, variances from standards that do not compromise public safety and that are otherwise in compliance with applicable law may be granted by RTD’s design review processes. Through its internal review process, the RTD Transit Access Committee will provide inter-disciplinary recommendations for any access-related design changes.

These guidelines and standards are intended to be used by RTD planners, designers and engineers—or those contracted on behalf of RTD—as well as by any other entity (public or private) that proposes development plans that would tend to have an effect on or result in alterations to existing RTD facilities whether such plans are proposed in response to community development efforts, an RTD-issued request for development, or as an unsolicited proposal. The guidelines and standards herein are intended to strike a balance between the sometimes competing objectives of transit design that needs to provide efficient movement between modes and community design that needs to ensure a high-quality built environment.

1.2 Existing Guidance for Transit Access

There are several adopted policies and documents to provide guidance on the topic of transit access. The most relevant documents are RTD’s design criteria manuals for light rail, commuter rail and bus facilities. This document is intended to supplement those manuals. Also of major relevance is RTD’s Transit Oriented Development Strategic Plan, which includes the adopted transit access hierarchy. Finally, there are agency policies regarding safety and security as well as federal laws governing access for persons with physical disabilities that require compliance.

1.2.1 Design Criteria Manuals

RTD has adopted design criteria manuals for light rail, commuter rail and bus facilities that may be amended from time to time. Each is described in summary below in relation to transit access.

1.2.1.1 Light Rail Design Criteria

The Light Rail (LRT) Design Criteria directs design “toward minimum feasible costs for design, construction, capital facilities and operation; minimum energy consumption and minimum disruption of local businesses and communities.” It also calls for design to be consistent with “system reliability, passenger comfort, mode of operation, type of light rail vehicle (LRV) to be used and maintenance,” identifying safety for passengers, workers and the public of primary importance.²

The criteria address civil engineering relating to facility clearance, street design, signage, protective barriers, pavement, traffic signals, curb cuts and at-grade crossings, among others. They also address station design related to site planning, circulation, access,

² RTD Light Rail Design Criteria
historic preservation, platforms, plazas, shelters and other furniture. Please see the manual for complete information and references.

1.2.1.2 Commuter Rail Design Criteria
The Commuter Rail Design Criteria include the same purpose and scope as the LRT criteria. However, where RTD’s commuter rail operates on railroad trackage or shares right-of-way with freight rail trackage, “construction plans and specifications shall generally follow the AREMA Manual for Railway Engineering and Portfolio of Trackwork Plans. Commuter rail track construction and maintenance standards shall meet or exceed the current track safety standards of the Federal Railroad Administration (FRA). When operating adjacent to but not in freight ROW, extensive coordination is required between RTD and the Class 1 railroad to insure that the adherence to proper clearances, drainage and utility standards are achieved by both railroads.”

As does the LRT criteria, the commuter rail manual addresses access in its sections on civil engineering and station design. Please see the manual for complete information and references.

1.2.1.3 Bus Transit Facility Design Guidelines and Criteria
The Bus Transit Facility Design Guidelines and Criteria notes that, “Differing transit facility design views are held within engineering and planning professions. At one extreme, the primary goal is to maximize its efficiency as an extension of the highway or transit network. At the other extreme, the primary goal maximizes community integration characteristics and reduces regional transportation connectivity needs. RTD integrates both extremes and provides a coordinated design that equally serves the highway transit network and community integration. The level of coordinated design shall be appropriate to the surrounding existing and planned roads and land uses.”

The manual observes that RTD bus transit facilities are by definition intermodal transfer facilities. They provide collection and distribution points for travelers who transfer between auto and transit (bus or rail) modes, single occupant vehicles and high occupancy vehicle (vanpools or carpools) modes, transit modes (bus to bus, bus to rail and rail to bus) or by other means. It directs design professionals to “consider the various access, circulation and service modes of the transit facility” and include pedestrian and bicycle movements calling these concerns and design requirements “the top of the design priority list.” The manual also observes that “close attention to these issues will produce a superior facility with reduced maintenance requirements, lower operating costs and manageable security risks.”

The bus criteria cover access issues in sections relating to bus transit facility design, civil design, urban-landscape design, bicycle facilities, and signage. Please see the manual for complete information and references.

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3 RTD Commuter Rail Design Criteria
4 RTD Bus Facility Design Guidelines and Criteria
1.2.2 Transit Oriented Development
The goals of RTD’s TOD Policy include encouragement of development that supports the transit system with ridership and infrastructure, and supports multimodal access to the transit system by all users. Strategies to achieve these goals include:

- Collaborating with local jurisdictions on station area planning and TOD for areas within 10-minute walk of stations
- Advocating for new development around stations meeting the following principles:
  - It is denser than existing development patterns in the area
  - It contains a mix of uses
  - It has a compact and attractive urban design
  - It is oriented to allow easy pedestrian access to transit facilities
- For joint development projects, protecting and enhancing station ridership and providing the opportunity for building or improving infrastructure to support transit should be evaluated in the context of both the function and relationship of transit stations to the surrounding community.
- Creating a hierarchy of access which considers the following modes in order of priority: pedestrians, bus riders, bicyclists, vehicles (short-term parking), and vehicles (long-term parking)
- Considering access needs beyond RTD property in the planning and design of transit stations, including:
  - Pedestrian connections to destinations within a 5- to 10-minute walk
  - Regional and local bus transit and bicycle connections
  - Vehicular access for the station catchment area

1.2.2.1 Role of TOD in Transit Facility Design
TOD provides benefits to transit operators by creating ridership, as well as by encouraging more cost-efficient ridership patterns. Several statewide studies in California have documented the ridership impacts of TOD:

- Residents who live within a 5-minute walking distance of transit stations are five times more likely to commute by rail.
- Workers whose jobs are within a 5-minute walking distance of transit stations are 2.7 times more likely to commute by rail.
- About 40% of people who live in TODs choose to reside near transit because they are regular riders.

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5 RTD TOD Policy, adopted April 18, 2006.
7 Ibid.
TOD can be an important part of developing a sustainable transit system. People who live in TODs are more likely to use transit for non-work and off-peak trips, which helps balance system demand and generates additional farebox revenue. Evidence of this exists within RTD’s light-rail system, where the highest ridership outside of the CBD is generated by CityCenter Englewood, which was designed to be a TOD integrated with the station.

By emphasizing pedestrian, bicycle and transit access over private autos, TOD also enables transit operators to increase ridership without paying to build and maintain additional parking capacity. Where joint development potential exists, TOD also offers the opportunity to enhance transit infrastructure through a partnership with a development partner.

TOD can also provide broader community benefits through its placemaking aspect. By developing the built environment to create an actual place—in comparison to a parking lot—around a transit station, TOD offers communities the potential to develop new identities and distinct neighborhoods around transit, which can enhance property values and provide fiscal benefits to local governments. By integrating the transit station with the surrounding community, TOD can improve physical access as well as create a sense of pride and ownership in transit facilities, which in turn deters vandalism and crime—lowering operating costs.

1.2.3 Safety and Security
Walk access to rail transit should be designed to provide a safe and secure environment for the pedestrian. Some important items to consider referenced in RTD’s design criteria manuals include: the minimization or elimination of conflicts between pedestrians and competing modes of access and vehicles, providing visibility from the walk path and transit facilities and major destination points, incorporate principles of Crime Prevention through Environmental Design (CPTED) that include a multi-disciplinary approach to deterring criminal behavior, providing appropriate illumination and signage, encouraging adjacent land uses that activate streets and provide strong visibility to the transit facilities, and considering the use of surveillance cameras and emergency telephones.

1.2.4 Disability Rights Laws
Specific attention must be given to the Americans with Disabilities Act (ADA), the ADA Accessibility Guidelines for Building and Facilities (ADAAG), the ADA Accessibility Guidelines for Transportation Vehicles and to any succeeding modifications that may be issued. Adherence to ADA and ADA-related guidelines is required for all areas of this document, regardless of explicit, implied or lack of reference herein.

1.3 Roles of Other Entities

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9 RTD ridership data
As stated above, while RTD makes decisions regarding the siting and design of its facilities, access is often beyond the immediate purview or direct control of transit agencies. Other parties—such as local governments and the development community—are responsible for the development and regulation of the physical infrastructure and built environment surrounding those facilities.

For example, the design of the primary station elements (platforms, plazas, parking, patron amenities, etc.) are RTD’s responsibility. But these should be designed in tune with the larger vision for the station type and function when such is articulated by adopted local plans. Local jurisdictions have the responsibility of planning for TOD, including an implementation map to achieving their stated goals for the station area.

The City and County of Denver’s TOD Strategic Plan, for instance, created a station area typology system to define the kind of development desired around stations based on factors including level and quality of transit service, quality of the surrounding pedestrian environment, land use, density, and market susceptibility to change. Typology, as an adopted local government policy, provides input into how RTD designers should approach integrating the transit facility design with the surrounding community. For example, a station in an urban center or urban neighborhood typology would have less park-n-Ride access emphasis than one in a commuter town center typology (see Table 1-1).10

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RTD has a responsibility to connect to the larger street network that either currently exists or is envisioned by adopted subarea, development and capital improvement plans. But the local jurisdiction is responsible for building or requiring property owners to construct a continuous network of sidewalks that link from the surrounding neighborhood to the station.

<table>
<thead>
<tr>
<th>TOD Typology</th>
<th>Desired Land Use Mix</th>
<th>Desired Housing Types</th>
<th>Commercial/ Employment Types</th>
<th>Proposed Scale</th>
<th>Transit System Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Downtown</td>
<td>Office, retail, residential, entertainment, and civic uses</td>
<td>Multi-family and low density</td>
<td>Prime office and shopping location</td>
<td>5 stories and above</td>
<td>Intermediate facility/transfer hub. Major regional destination with high quality feeder bus/streetcar connections.</td>
</tr>
<tr>
<td>Major Urban Center</td>
<td>Office, retail, residential, entertainment</td>
<td>Multi-family and townhome</td>
<td>Employment emphasis, with more than 250,000 office &amp; 50,000 sf retail</td>
<td>5 stories and above</td>
<td>Sub-Regional destination. Some Park-n-ride. Linked with district circulator transit and express feeder bus.</td>
</tr>
<tr>
<td>Urban Center</td>
<td>Office, retail, residential</td>
<td>Multi-family and townhome</td>
<td>Limited office. Less than 25,000 sf office. More than 50,000 sf retail</td>
<td>3 stories and above</td>
<td>Sub-Regional destination. Some Park-n-ride. Linked with district circulator transit and express feeder bus.</td>
</tr>
<tr>
<td>Urban Neighborhood</td>
<td>Residential, neighborhood retail</td>
<td>Multi-family townhome, small lot single-family</td>
<td>Local-serving retail. No more than 50,000 sf</td>
<td>2-7 stories</td>
<td>Neighborhood walk-up station. Very small Park-n-ride, if any. Local bus connections.</td>
</tr>
<tr>
<td>Commuter Town Center</td>
<td>Office, retail, residential</td>
<td>Multi-family townhome, small lot single-family</td>
<td>Local and commuter-serving. No more than 25,000 sf</td>
<td>2-7 stories</td>
<td>Capture station for in-bound commuters. Large Park-n-ride with local and express bus connections.</td>
</tr>
<tr>
<td>Main Street</td>
<td>Residential, neighborhood retail</td>
<td>Multi-family</td>
<td>Main street retail infill</td>
<td>2-7 stories</td>
<td>Bus or streetcar corridors. District circulator or feeder transit service. Walk-up stops. No transit parking.</td>
</tr>
<tr>
<td>Campus/Special Events Station</td>
<td>University, Campus, Sports Facilities</td>
<td>Limited multi-family</td>
<td>Limited office/retail</td>
<td>Varies</td>
<td>Large Commuter destination. Large parking reservoirs but not necessarily for transit.</td>
</tr>
</tbody>
</table>
Research shows that individual urban design features by themselves are not significant in influencing the access decisions of transit patrons. The local jurisdiction has the responsibility of planning and implementing a mix of uses at an appropriate density and scale to facilitate an environment that encourages all modes of access. This means that a cohesive strategy, as well as a solid understanding of the existing station area conditions, is necessary to successfully address transit access. Therefore close coordination between transit designers and local jurisdiction staff is essential for assuring quality transit access. Transit designers should utilize local jurisdiction staff’s knowledge of existing conditions, current projects and adopted future plans for station areas.
SECTION 2
ACCESS RESEARCH & OBSERVED BEHAVIOR

2.1 Travel Characteristics of RTD Patrons

The key function of a rail station is to provide access to transit for its users. The mix of access options offered for rail stations is highly dependent on the characteristics of a particular location and is determined by projected parking demand, frequency and extent of feeder bus service, degree that adjacent development is transit supportive and pedestrian oriented, and level of connections to bicycle paths and networks, among non-access considerations such as available land, construction and maintenance costs, engineering feasibility, and environmental impacts.

In 2006, the majority of light rail passengers (56%) rode RTD for commuting to/from work. A significant percentage of the light rail passengers (15%) were commuting to school/college.\textsuperscript{11} Driving to park-n-Rides comprises the greatest share of transit access modes (45% on the Southeast Corridor and 35% on the Southwest Corridor—although the Southwest park-n-Ride share dropped by 20 percentage points from 2001 to 2006, while the share of those walking to these stations increased by 16 percentage points over the same period).\textsuperscript{12} See Table 2-1 below for an access mode breakdown by corridor.

<table>
<thead>
<tr>
<th>Access Mode</th>
<th>SW Corridor 2001</th>
<th>SE Corridor 2006</th>
<th>SE Corridor 2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drove alone</td>
<td>48%</td>
<td>35%</td>
<td>40%</td>
</tr>
<tr>
<td>RTD bus</td>
<td>29%</td>
<td>29%</td>
<td>21%</td>
</tr>
<tr>
<td>Walked</td>
<td>12%</td>
<td>28%</td>
<td>25%</td>
</tr>
<tr>
<td>Carpooled</td>
<td>7%</td>
<td>-</td>
<td>5%</td>
</tr>
<tr>
<td>Bicycle</td>
<td>2%</td>
<td>3%</td>
<td>1%</td>
</tr>
<tr>
<td>call-n-Ride</td>
<td>n/a</td>
<td>-</td>
<td>3%</td>
</tr>
<tr>
<td>Dropped off</td>
<td>n/a</td>
<td>5%</td>
<td>5%</td>
</tr>
<tr>
<td>Other</td>
<td>2%</td>
<td>-</td>
<td>n/a</td>
</tr>
</tbody>
</table>

Such destinations and access mode shares are not unexpected based on the existing rail transit system, which provides service from suburban park-n-Rides in the southwest and southeast portions of the metro area to a concentration of jobs and educational facilities in downtown Denver and the southeast suburban-based Denver Tech Center. As FasTracks is built out and more regional destinations such as Denver International Airport and Boulder are added to the system and new regional TOD destinations are constructed along the lines such as the Gates redevelopment, the share of work destination trips is likely to be smaller, which should result in more off-peak ridership. This trend is already underway:

\textsuperscript{11} RTD Spring 2006 Light Rail Customer Satisfaction & Trip Characteristics, July 2006
\textsuperscript{12} RTD Customer Satisfaction Survey, 2001, 2006 and 2007
with the opening of the Southwest Corridor and the Central Platte Valley Spur, the share of work trips on light rail decreased from 62% to 56% while non-work (and non-school) trips increased from 19% to 29% between 1998 and 2006.

Transfers play a crucial role in access, particularly for the rail system. Nearly half of all LRT passengers transfer at least once during their trip (46.7% in 2005 compared to 50.3% in 2001), and one-quarter (24.8%) of all LRT riders use the Mall Shuttle to complete (or start) their trip. At 13%, LRT has the highest rate of multiple transfers (two or more) than any type of transit service RTD provides.\(^\text{13}\) Nearly 3 in 10 Southwest Corridor riders access the rail system via bus, as do more than 2 in 10 Southeast Corridor riders, but these shares vary widely by individual station.

### 2.2 Pedestrian Access

In practice, whatever their original access mode, all transit patrons are converted to pedestrians before boarding and immediately after alighting. Pedestrian access, therefore, is the highest priority access mode, and transit facilities should reflect this in their design and layout.

At stations without park-n-Rides, such as the Central Corridor stations in downtown Denver, pedestrian access is often the plurality access mode. According to the most recent RTD surveys,\(^\text{14}\) 28% of Southwest Corridor riders and 25% of Southeast Corridor riders walked to a station, which is close to the proportion that accessed these corridors by bus (although the share for each mode varies greatly by individual station).

#### 2.2.1 Pedestrian Walk Speeds

Empirical studies find that 75%-80% of passengers walk ½ mile (2,640 feet) or less to a train station, and about 50% walk 0.2 mile (1,056 feet) or less. At an average walk speed of 200 feet per minute, this translates to 13 minutes and 5 minutes respectively. However, facilities that accommodate cars and buses often impose the vehicular scale on their design, requiring the allocation of vast amounts of space for movement and storage while isolating pedestrians in a limited, disconnected environment. Grades, steps and the need to accommodate elderly and disabled riders can also reduce the speed and, therefore, coverage of pedestrian access.

The following summarizes information on pedestrian walk speeds from various sources:

- One study shows that nearly all pedestrians have free flow walking speeds of about 145 feet per minute (or 2.42 feet per second). This speed is affected by the trip path - sight distance, street crossing, grades and stairs; trip purpose; and crowding. Older or disabled persons have lower average speeds. Pedestrian outdoor stair speeds (based

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\(^{13}\) RTD Customer Satisfaction Survey, 2001 and 2005

\(^{14}\) RTD Customer Satisfaction Surveys for 2006 and 2007
on horizontal component of travel speed) averages: down direction 152 feet per minute; up direction 113 feet per minute.\textsuperscript{15}

- The National Fire Protection Association (NFPA) uses a travel speed of 200 feet per minute (or 3.33 feet per second) on platforms, corridors and ramps of 4% grade or less for evacuation time calculations. Travel speeds (vertical component of travel speed) for stairs, stopped escalators, and ramps of over 4% slope are as follows: up direction – 50 feet per minute; down direction – 60 feet per minute.\textsuperscript{16}

- The Manual on Uniform Traffic Control Devices (MUTCD) provides guidance regarding pedestrian clearance time in a crosswalk; it uses a walking speed of 240 feet per minute (or 4 ft per second).\textsuperscript{17} Where elderly pedestrians make up a significant (20% or more) portion of travelers, a 200 feet per minute (or 3.3 ft per second) speed should be used.\textsuperscript{18}

- The American Association of State Highway and Transportation Officials (AASHTO) Guide for Park-and-Ride Facilities does not specifically address walk speed, but does offer acceptable walking distances to transit stations for various situations:
  - Mobility impaired – under 100 feet
  - Average pedestrian – 300 feet average
  - Average commuter to park-and-ride – 500 to 1000 feet
  - Average high capacity transit commuter – 1320 to 1750 feet

\subsection*{2.2.2 Factors in Walk Decisions}

Success in attracting people to walk to stations depends on many different factors. For purposes of classification, the variables influencing walk trips have been divided into hard factors and soft factors. Hard factors are the overarching infrastructure and land use characteristics within a station area. Soft factors are those social elements, such as planning for TOD, or others that apply to the street scale comfort and level of amenities. Both the hard and soft factors discussed in a number of studies conducted in the US and nations with similar transit systems are listed in the table below. The factors are described in further detail in the sections that follow.

\textsuperscript{15} “Pedestrian Planning and Design”, John J. Fruin, Ph.D.
\textsuperscript{16} NFPA 130 – Standard for Fixed Guideway Transit and Passenger Rail Systems
\textsuperscript{17} Manual on Uniform Traffic Control Devices – 2003 Edition
### TABLE 2-2: Variables that Influence Walking Behavior

<table>
<thead>
<tr>
<th>Hard factors</th>
<th>Soft factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Street Network:</td>
<td>TOD-friendly Master Plan in place</td>
</tr>
<tr>
<td>- Grid pattern</td>
<td>Quality of the pedestrian experience</td>
</tr>
<tr>
<td>- Sidewalk connections</td>
<td>Time</td>
</tr>
<tr>
<td>- Adequate pedestrian crossing signals</td>
<td>Comfort:</td>
</tr>
<tr>
<td>Land Use:</td>
<td>- Weather</td>
</tr>
<tr>
<td>- Density</td>
<td>- Landscaping and street trees</td>
</tr>
<tr>
<td>- Diversity (mix of uses)</td>
<td>- Flat Terrain</td>
</tr>
<tr>
<td>Station Design:</td>
<td>- Station condition (maintenance)</td>
</tr>
<tr>
<td>- Station served by multiple modes (bus and rail)</td>
<td>- Lighting</td>
</tr>
<tr>
<td>- Transit frequencies/headways</td>
<td>- Adequate station and platform cover</td>
</tr>
<tr>
<td>- Number of parking spaces</td>
<td>- Lack of crime</td>
</tr>
<tr>
<td>- Cost of parking/parking prices</td>
<td></td>
</tr>
<tr>
<td>- Commercial services for transit users</td>
<td></td>
</tr>
</tbody>
</table>

Source: PB PlaceMaking, February 2008

### 2.2.2.1 Street Network

One of the most significant hard factors in influencing walk trips is the presence of a cohesive and efficient street network. The key to providing pedestrian access is to reinforce the principle that streets should be designed for all travel modes, not just cars. Cervero stated that a grid network is the “simplest, most rudimentary street pattern.”

Walkability increases if pedestrians have a better sense of direction. If streets are formed in cul-de-sacs, dead ends or indirect routes, pedestrians are forced to take circuitous routes and thus transit usage suffers. Research has demonstrated that grid network designs can result in more direct routing of vehicles than suburban street networks. Comparisons of activity areas with similar land uses have shown that vehicle miles traveled can be reduced by between 10-40% where streets are interconnected along a system of small blocks.

Based on this research, the Puget Sound Regional Council (PSRC) in Washington state, as a policy statement, lists the most important influences on how far people will walk are whether the walkway system is direct and complete and the walk environment is enjoyable and safe. In a Montgomery County, Maryland survey, transit riders said they were more likely to walk to stations in settings with fairly complete sidewalk networks. This was measured through the ratio of sidewalk miles to road miles. Intersection density, which ties to a grid network pattern and strong street connectivity, also promoted walking access. A neighborhood with a fine grain mesh of intersections provided more possibilities for conveniently connecting origins and destinations by foot.

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21 Ibid.
2.2.2.2 Land Use

Another important variable influencing access mode behavior is land use. Land use may be categorized into both land use density and land use diversity (mix of uses). Numerous studies have found that transit ridership increases significantly with increased land use density. A concentration of people living and working within a half-mile of a station has been proven to increase ridership levels. In an example of a transit-supportive policy land-use recommendation, the PSRC recommends considering the following general guidelines in establishing density targets:

- Household densities should reach 10-20 dwelling units per gross acre close to a transit station.
- Employment densities of 25 jobs per gross acre will support frequent high-capacity transit service if employment is clustered close to the facility.
- Commercial uses with surface parking should strive to achieve a floor area ratio (FAR—the ratio of total floor space to lot size) of between 0.5 and 1.0. Density is less important for commercial retail than is a mix of appropriate services.

Research completed for nine Metra stations in suburban Cook County in the Chicago region demonstrated a relationship between the ratio of dwelling units per acre and the percentage of commuters that walk or bike to the station. The authors list a strong grid pattern, condition of the station (maintenance), sidewalk connectivity and commercial services at the station as key walkability factors. The stations with the highest percentage of walk trips also had the highest residential densities.

The core/center/edge concept (shown in Figure 2-1) views distance differently than the ¼ and ½ mile concept. The core area of up to 600 feet in radius should have the greatest intensity of land use, with the center an intermediate intensity and the outer edge intensity greater than the community average. Walk trips are sensitive to distance, and the first 600 feet closest to the station are critical to encouraging greater walkability. The time factor and the quality of the trip are often more important than the distance. If the environment is conducive to walking (easy to cross streets, street amenities, etc), then people will walk.

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23 “Paved Over Surface Parking Lots or Opportunities for Tax-Generating, Sustainable Development”? Center for Neighborhood Technology
Land-use diversity is just as important as density: highly mixed-use settings around rail stops encourages walk trips, since residents can take care of errands on the way to and from work when shopping is located between the station and their residence. A greater mix of uses has been found to increase the percentage of walking trips.

Walkability depends on the type of use-residential, retail or office. Research shows that people will tend to walk farther between a station and residential or employment than they will to retail establishments. Figure 2-2 depicts results from a 2005 WMATA Development Related Ridership Survey. The results show that residential has a greater percentage of the mode share at the station than office. The residential mode share is 200% higher than office at a half-mile from the station.
2.2.2.3 Station Characteristics

A third variable in influencing behavior is station design and the operational characteristics. Those stations that serve multiple modes (bus and rail) have been found to comprise a greater percentage of walk trips. Cervero found that terminal stations, with multiple modes and high levels of bus and rail activity, have some of the highest percentages of walk trips. Furthermore, transit service frequencies play a role in the decision to walk or drive. People will walk farther to transit stations that provide a very high level of service (such as a light rail station). People will walk only very short distances (less than 500 feet) to transfer between travel modes (e.g., between car and bus, or bus and rail).\textsuperscript{24}

The elements that comprise a station, such as the parking, platforms and amenities, play a role in the decision to walk or drive. Recent research shows that the design and siting of station parking lots bears some influence on transit demand. Peripheral parking lots that do not sever pedestrian paths to nearby residential neighborhoods, for example, may induce transit usage, although this has not been tested empirically.\textsuperscript{25} Interestingly, the amount of parking at a station has been found to create an inverse relationship with pedestrian activity: the greater the number of parking spaces, the lesser the number of walk trips (when controlling for factors such as residential densities and land use mixes).\textsuperscript{26} Strategies to overcome this parking hurdle include dispersing the parking into separate lots, sharing parking with nearby businesses, and allocating a portion of the parking to outlying properties outside of the immediate station vicinity.

\textsuperscript{24} Creating Transit Station Communities: A Transit-Oriented Development Workbook, Puget Sound Regional Council, 1999.
\textsuperscript{25} Does TOD Housing Reduce Trips? TCRP Project H-27A, January 2008
2.2.2.4 Soft Factors

As mentioned before, certain soft factors may influence the decision to walk or drive. But the responsibility of implementing these factors may reach beyond the role of RTD. Local governments have a responsibility to plan and approve a vision for each station area. TOD plans are critical in identifying the type of station and mix of uses over the long term. This provides a direction and guidance to not only the staff and elected officials, but to the public, development community and to RTD.

The quality of the pedestrian experience shapes one’s perspective of the surrounding area. Retailers have demonstrated a keen understanding of the importance of the public realm and street activity. In short, pedestrians choose to walk where they want to spend their time. Therefore, the station itself and the connections to it must comprise a quality pedestrian experience to attract a pedestrian mode of access.

Factors related to comfort have been found to influence walking behavior. Walton and Sunseri conducted a study of transit users at two stations, one in Auckland and one in Wellington, New Zealand. The study compared both drivers and walkers who live less than 0.6 miles from a station. Their results showed that of the soft factors that influence walkability, the most significant factors in distinguishing whether people walk or drive are: the weather (chance of rain), convenience of the car, and belief that a park-n-Ride is convenient. Of these significant factors, the weather was found to be the most influential—not the presence of cold and wind but the existence of a chance of rain. A chance of rain encourages driving whereas clear weather aids the decision to walk. Therefore, the authors deduce that rain shelter infrastructure and covered walkways could encourage more walk trips.27

Attractive landscaping, civic squares, tree-lined pathways, and other amenities are significant variables in encouraging walk trips. Research by Untermann (1984) shows the typical “maximum” acceptable suburban walking distance of one-quarter to a half-mile can be extended (perhaps even doubled) by creating pleasant and interesting urban spaces and corridors.28 Ridership may be influenced by whether the station forms a “visible point of identity.” To create a sense of place at a station, visual corridors leading to the station must be established and protected. In addition, attractive and well-maintained open space can serve as a “forecourt” for transit facilities to support the activities generated by surrounding land uses. For example, New Jersey Transit’s Planning for Transit-Friendly Land Use handbook calls for 24-hour activity, such as taxi stands, police stations, and all-night delicatessens, as well as civic uses such as libraries. This may not be feasible at low-density suburban park-n-Rides, however it demonstrates how safety and security increase with greater levels of activity.29 Terrain is also important, as inclines have been found to decrease walk trips. Walking can be such a pleasurable activity that in areas with flat

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terrain that some transit patrons may walk as far as two miles to reach a stop that has frequent service.\textsuperscript{30}

\subsection*{2.2.3 Limitations of Research}
The research cited above from RTD and other transit systems is the best data available today about transit patron behavior and preferences. Surveys regarding preferences (e.g., “Would you walk to a station if ...”) can be less accurate than those recording actual behavior. But interviews or surveys are self-reported, and the cited reasons for not walking may not always align with actual behavior. Subjective perception strongly influences the soft factors cited above, in particular. In addition, the factors for walk decisions are often found to be interdependent upon each other. As new research is published and RTD continues to learn more about the behavior and characteristics of its riders, this document will be updated to reflect the latest findings.

\subsection*{2.3 Bus Transfer Access}
Bus transfer access is the second-highest priority access only to pedestrian. As stated above, nearly half of all LRT passengers transfer at least once during their trip. At 29\%, bus access provides the second-highest share of Southwest Corridor ridership (see Table 2-3 for a breakdown by station), and at 21\% the third highest share of Southeast Corridor riders, but these shares vary widely by individual station. For example, bus access provides more than half the ridership at Colorado Station and Southmoor station, and nearly a third at Arapahoe Station, all on the Southeast Corridor (see Table 2-4).

\begin{table}[h]
\centering
\caption{Southwest Corridor Bus Access Share by Station}
\begin{tabular}{lcccccc}
Station & Mineral & Littleton & Oxford & Englewood & Evans \\
\hline
2001 & 17\% & 28\% & 12\% & 40\% & 52\% \\
2006 & 23\% & 31\% & - & 18\% & - \\
\end{tabular}
\end{table}

\begin{table}[h]
\centering
\caption{Southeast Corridor Bus Access by Station}
\begin{tabular}{lccccccc}
Station & Lincoln & County Line & Dry Creek & Arapahoe & Orchard & Bellevue & Nine Mile \\
\hline
2006 & 8\% & 0\% & 5\% & 32\% & 12\% & 26\% & 19\% \\
\end{tabular}
\end{table}

\subsection*{2.3.1 Perception of Travel Time}
To accommodate today’s dispersed travel patterns in a sustainable fashion, transit must offer convenient transfers; no matter what service configuration is chosen, transit cannot offer direct service among all destinations. However, the quality of transit connections (as perceived by passengers) is a function of station design, service configuration and customer behavior. Restructuring of bus services to require transfers makes the service more efficient, but transfers are perceived negatively. As a planning principle for FasTracks

\textsuperscript{30} *Bursting the Bubble: Determining the TOD's Walkable Limits* Brian Canepa, 2006.
Transit Access Guidelines

service development, RTD typically truncates Express and Regional services at appropriate stations and re-routes Local routes to nearby stations; thus the new corridor is transformed into trunk-and-feeder service. Depending on total travel time, some current riders may be worse off. Both the perception and reality of making transfers must be addressed to make transferring convenient.

A key consideration is the passenger’s perception of the total travel time, which is divided into several components. The table in Table 2-5 documents the relative importance of the travel time components:

<table>
<thead>
<tr>
<th>Time Component →</th>
<th>In-Vehicle</th>
<th>Walk</th>
<th>Initial Wait</th>
<th>Transfer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
<td>1.0</td>
<td>2.2</td>
<td>2.1</td>
<td>2.5</td>
</tr>
<tr>
<td>Range</td>
<td>1.0</td>
<td>0.8 – 4.4</td>
<td>0.8 – 5.1</td>
<td>1.1 – 4.4</td>
</tr>
</tbody>
</table>

It is evident that transferring is the most negative part of the trip. Relative to a 20-minute trip on LRT, a passenger would perceive a 2-minute connection to her feeder bus as 5 minutes, a 25% increment. Thus it is crucial to minimize transfer time.

Transfer time affects the efficiency of service configuration in terms of the overall design of routes and schedules, specifically while dwelling at the station. The dwell time occurs between when the bus arrives and departs the station. There must be sufficient dwell time for all passengers to make the transfer from or to the train. If the transfer can be done in 2 minutes, then the minimum dwell time is 4 minutes (from and to the same train); to ensure reliability, a cushion of 1 minute is added for a total dwell time of 5 minutes. This time is added to the total cycle time (total round-trip time) for the bus route. For bus routes that terminate at the station, no passengers are inconvenienced by dwell time. For thru routes, on-board passengers are inconvenienced by the 5-minute wait. FastConnects calls for convenient, timed connections among multiple buses and trains at multiple stations. A single route may need to make multiple timed connections. Thus, transfer time affects dwell time, which affects cycle time, which affects service configuration, which ultimately affects ridership and service efficiency.

2.3.2 Timed Versus Grid Transfers

The number of routes serving a transfer hub is of primary importance in determining the quality of the transfer. The convenience of transferring (waiting) is directly related to the frequency of service. Thus there are two types of connections that a transit agency employs to design a network of connected routes—timed transfer and grid transfer.

For timed transfer, schedules are written on clock-face headways (multiples of 15 minutes) and transfer hubs are carefully selected so that buses on all connecting routes can be timed to arrive at the same time, thus minimizing the time a passenger has to wait. Grid transfer refers to locations where intersecting routes offer a high frequency of service.

2.3.3 Bus Transfer Facilities
The transfer facility design depends on the number of vehicles to be accommodated, traffic engineering considerations, pedestrian movements and the surrounding development. While this often requires an off-street facility, low volume needs can be accommodated with minimal on-street improvements. When transfer facilities are sited within a TOD environment, the determination of on-street versus separate facilities also considers vehicle dwell time, passenger waiting areas, the pedestrian environment and noise and exhaust from vehicles.

2.4 Bicycle Access
Bicycle accessibility design elements should be given consideration just after pedestrian and bus transfer access but ahead of other modes. Bicycle access to transit improves service quality, reduces automobile travel and increases mobility options. 32 Other transit agencies around the nation perceived that bicycle service could increase transit ridership by:

- Extending the range that customers could travel to reach transit stops and stations,
- Increasing the flexibility that customers have to reach destinations at the end of a transit trip,
- Offering an additional amenity to customers that increases the attractiveness of transit.

This opportunity to maximize ridership without a corresponding investment in more-expensive automobile infrastructure can also minimize the physical footprint of the transit facility, potentially lowering property acquisition costs and freeing up land for transit-supportive development that generates ridership all times of day. Although the current percent of customers accessing light rail stations by bicycle is low (2%), “the degree to which a transit agency actively promotes its bicycle parking facilities ... directly impacts the use [of those facilities].” 33 With planning, a supportive surrounding environment and proper facilities, bicycle-to-transit use would increase.

Similar to walking, the decision to bicycle to transit depends on a combination of factors including, but not limited to, safety, station characteristics, street network and density of development. Many of these factors were discussed in the context of the pedestrian in the previous section and also apply to biking. The station characteristics most important to a successful bike-to-transit trip are secure bicycle parking and connectivity to the surrounding roadway or bicycle network. As with walking, the grid pattern is ideal because curvilinear streets and cul-de-sacs make bicycle travel difficult since circuitous

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33 FHWA Course on Bicycle and Pedestrian Transportation, July 2006
routes and limited access increases the length of trips.\textsuperscript{34} Also, compared to auto-oriented
development, compact development increases the likelihood of bicycling.\textsuperscript{35}

2.4.1 Bicycle Connections to Transit
Without a safe system in place for cycling, would-be bicycle commuters are discouraged
from biking to the transit station, instead either opting to drive to a station or to skip
transit altogether. A safe system is one in which a transit customer can: safely connect to
the station area from surrounding communities and bicycle facilities, easily find the transit
station, and lock his/her bicycle in a secure and convenient location. According to a 2006
survey of RTD’s bicycle locker users, if bicycle lockers were not provided, 23\% indicated
they would drive and not take transit and 34\% indicated they would drive to transit.\textsuperscript{36}
About 2.5\% of passengers access light rail by bicycle.\textsuperscript{37} This proportion can only be
increased by providing safe and convenient facilities for cyclists and by increasing
awareness of the existing bicycle infrastructure.

Given that cyclists typically travel 3 to 4 times faster than pedestrians,\textsuperscript{38} the bicycle
catchment area for a transit station is 0.85-2 miles.\textsuperscript{39} Coordination with the local planning
jurisdiction and/or developer is required to ensure safe and coherent connections between
the station and adjacent neighborhoods. This can be achieved through a variety of means,
including the use of on-street bike lanes; bicycle paths and wayfinding signage (see Figure
2-3).

\textbf{FIGURE 2-3: Examples of Bicycle Wayfinding}

\begin{figure}[h]
\centering
\includegraphics[width=0.5\textwidth]{bicycle-wayfinding.png}
\end{figure}

\textsuperscript{34} Our Built and Natural Environments, EPA, January 2001
\textsuperscript{35} Ibid.
\textsuperscript{36} 2006 RTD Bicycle Locker Customer Survey Report
\textsuperscript{37} 2006 Light Rail Customer Satisfaction Survey
\textsuperscript{38} Parsons Brinckerhoff, “Ipswich to Springfield Public Transportation Corridor Study: Draft Environmental Impact Study,” October
2006, pp. 32
\textsuperscript{39} Sean O’Sullivan, John Morrall, “Walking Distances to and from Light-Rail Transit Stations,” \textit{Transportation Research Record} 1538,
Transportation Research Board of the National Academies, Washington D.C., 1995. pp. 20
2.4.2 Bicycle Parking

As with transit riders who access station in automobiles, parking is an essential component to making bicycling to transit feasible.

At a transit station, a mix of secure bicycle lockers and inverted “U” bicycle racks offer multiple options for bicycle commuters. Leased bicycle lockers provide patrons a storage option that is more secure than traditional bike racks, allowing renters to retain exclusive control over their locker for an allotted period and ensuring that users have a guaranteed parking spot when they arrive at the transit access area. Additionally, this arrangement provides security for the transit agency and other transit users by creating controlled access to these “publicly accessible receptacles.” As a storage mechanism, bicycle racks offer more flexibility than bicycle lockers and can store a larger number of bicycles while occupying a smaller footprint. Bicycle racks, however, are perceived to be less safe since the bicycle is vulnerable to vandalism or theft.

RTD provides about 325 bicycle lockers at 20 light rail stations. Of all light rail stations, currently 64% are leased but at stations without auto parking the leased percentage increases to 73%. Bicycle parking is a cost effective way to increase ridership at transit stations without auto parking. Bicycle racks are provided at nearly all light rail stations but usage information is unavailable. There is a relationship between adequate informational signage and promotion of these facilities and their usage.

2.5 Auto Access

The single largest share of access to RTD’s LRT system today is from private auto. Some 45% of Southeast Corridor and 35% on the Southwest Corridor riders drove to park-n-Rides either alone or with others, and an additional 5% of the riders on these corridors were dropped off at the stations either in formal kiss-n-Rides or on street.

While it is anticipated that the share of pedestrian and bus access to the rail system will increase over time due to both transit expansion and TOD growth, auto access will always be a critical component for ridership. The challenge is achieving the optimal balance between auto and other access modes based on factors such as the marginal cost of peak and off-peak ridership generation, cost and availability of access facilities, and community integration.

Other parties such as local governments, developers, and community groups play roles in the factor of community integration. The City and County of Denver’s TOD Strategic Plan created a station area typology system discussed in Section 1 defining the kind of development desired around stations based on factors including level and quality of transit service, quality of the surrounding pedestrian environment, land use, density, and market susceptibility to change. For example, a station in an urban center or urban neighborhood typology would have less park-n-Ride access emphasis than one in a commuter town center typology.

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40 TCRP Synthesis 62: Integration of Bicycles and Transit, December 2005
2.5.1 kiss-n-Ride
About 5% of rail passengers accessed stations from kiss-n-Ride, according to the 2006 Customer Satisfaction survey and 2007 Southeast Corridor survey. Of RTD’s 34 light rail stations, seven have designated kiss-n-Ride areas for drop-off/pick-up of passengers: I-25/Broadway on the Central Corridor, and Nine Mile, Yale, Louisiana/Pearl, County Line, Southmoor and Colorado Boulevard on the Southeast Corridor. However, another 10 stations—Arapahoe, Colfax/Auraria, Mineral, Dry Creek, Englewood, Lincoln, Alameda, Littleton, Oxford and Union Station—all have higher than average kiss-n-Ride access shares, ranging from 6%-10%.

2.5.2 park-n-Ride
RTD’s existing rail system has a total of about 11,700 spaces at 19 park-n-Ride facilities. Five of these are in structured parking garages, one has both a garage and a surface lot, and the remaining 13 are only surface parking. Six of the stations have additional overflow parking either in RTD ownership or leased from other parties. Two of the parking structures are shared with other entities, one public and another private. Three stations have large surface parking lots of at least 750 spaces. An additional five stations have medium-sized parking lots with at least 250 spaces. Another 5 stations have small parking lots of less than 130 spaces.41

Twelve of the 19 station park-n-Rides have utilization rates of nearly 85% or more,42 meaning they are full according to parking industry standards. Two have high utilization rates of between 50-85%. Two are utilized at about half of capacity. The remaining three have low levels of utilization.

Station area typology is also noted based on the FasTracks Quality of Life baseline report. The three typologies—urban centers, community centers, or neighborhood centers—are informed by urban centers identified in the DRCOG MetroVision regional plan as well as local government classifications, such as the City and County of Denver’s typology system. Station areas were further evaluated based on street design, intersection frequency, transit service, pedestrian and bicycle facilities, parking supply, land use, vehicle speeds, and regulatory tools. In general, urban centers are mixed-use destinations with a high level of pedestrian connectivity and transit service. Community centers are mixed-use areas of less development intensity and less frequent transit service. Neighborhood centers are areas with lower development intensity that are not necessarily mixed-use and may be more auto-oriented.

Utilizing the walk-speed methodology described in section 3 to account for vertical distance from steps, the distance to the furthest park-n-Ride space to the platform center was measured at each of the 19 facilities. The systemwide weighted average distance of the 100% space was 1,260 feet, with a maximum distance 1,852 feet. The systemwide weighted average distance of the furthest space was about 1,359 feet. By means of

41 2008 park-n-Ride existing conditions survey
42 RTD park-n-Ride Utilization Report, 2nd, 3rd and 4th Q 2007
comparison, RTD design criteria call for the desired maximum range for the furthest space to be 1,000 feet with a maximum of 1,500 feet, with special approval needed for greater distances. (See Figure 2-6 for a table of park-n-Ride facility typologies, utilization, capacity and maximum walk distances.)

### TABLE 2-6: RTD LRT park-n-Rides by Corridor

<table>
<thead>
<tr>
<th>LRT pnR</th>
<th>Facility</th>
<th>Typology</th>
<th>Utilization</th>
<th>Capacity</th>
<th>Max Walk Dist</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Central Corridor</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I-25/Broadway</td>
<td>Surface</td>
<td>Urban Center</td>
<td>56%</td>
<td>1,251</td>
<td>1,400’</td>
</tr>
<tr>
<td>Alameda</td>
<td>Surface</td>
<td>Urban Center</td>
<td>84%</td>
<td>508</td>
<td>1,270’</td>
</tr>
<tr>
<td>30/Downing</td>
<td>Surface</td>
<td>Neighborhood Center</td>
<td>100%</td>
<td>27</td>
<td>180’</td>
</tr>
</tbody>
</table>

| **Southeast Corridor** |          |                     |             |          |               |
| University        | Structure| Community Center    | 45%         | 540      | 726’          |
| Colorado Blvd     | Surface  | Urban Center        | 95%         | 363      | 664’          |
| Yale              | Surface  | Community Center    | 98%         | 129      | 631’          |
| Southmoor         | Surface  | Community Center    | 39%         | 788      | 1,187’        |
| Belleview         | Surface  | Urban Center        | 99%         | 59       | 850’          |
| Dayton            | Surface  | Community Center    | 61%         | 250      | 1,049’        |
| Nine Mile         | Structure| Urban Center        | 98%         | 1,225    | 1,164’        |
| Orchard           | Surface  | Community Center    | 97%         | 48       | 320’          |
| Arapahoe          | Structure| Urban Center        | 21%         | 1,586    | 1,599’        |
| Dry Creek         | Structure| Community Center    | 94%         | 235      | 950’          |
| County Line       | Surface  | Community Center    | 19%         | 388      | 1,373’        |
| Lincoln           | Structure| Community Center    | 48%         | 1,734    | 997’          |

### TABLE 2-6: RTD LRT park-n-Rides by Corridor (continued)

<table>
<thead>
<tr>
<th>LRT pnR</th>
<th>Facility</th>
<th>Typology</th>
<th>Utilization</th>
<th>Capacity</th>
<th>Max Walk Dist</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Southwest Corridor</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evans</td>
<td>Surface</td>
<td>Neighborhood Center</td>
<td>97%</td>
<td>99</td>
<td>700’</td>
</tr>
<tr>
<td>Englewood</td>
<td>Both</td>
<td>Community Center</td>
<td>91%</td>
<td>910</td>
<td>1,230’</td>
</tr>
<tr>
<td>Littleton</td>
<td>Surface</td>
<td>Community Center</td>
<td>97%</td>
<td>361</td>
<td>1,377’</td>
</tr>
<tr>
<td>Mineral</td>
<td>Surface</td>
<td>Community Center</td>
<td>98%</td>
<td>1,227</td>
<td>1,852’</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td></td>
<td></td>
<td>65%</td>
<td>11,728</td>
<td>1,359’</td>
</tr>
</tbody>
</table>

An analysis of select bus pnRs (those with high utilization and/or large capacity) will be undertaken in the future.

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43 RTD Bus Transit Facility Design Guidelines and Criteria
SECTION 3
ACCESS GUIDELINES AND STANDARDS

3.1 Intent of Guidelines and Standards

The guidelines and standards that follow by access mode are intended to support implementation of the access hierarchy with the goal of achieving an optimal balance of access to the transit system. RTD’s adopted access hierarchy encourages an optimal balance of modes to get to the transit system by creating a hierarchy which considers the following modes in order of priority: pedestrians, bus riders, bicyclists, vehicles (short-term parking), and vehicles (long-term parking). Since each site is unique, these guidelines are meant to be flexible and to be employed holistically when used to evaluate transit design. Furthermore, some of the access elements discussed below are the responsibility of other parties, such as local governments.

These guidelines and standards are intended to be used by RTD planners, designers and engineers—or those contracted on behalf of RTD—as well as by any other entity (public or private) that proposes alterations to existing RTD facilities either in response to an RTD-issued request or as an unsolicited proposal. Guidelines (recognizable by the helping verb “should”) are rules of thumb or best practices that are recommended to be followed. However, their execution can be subject to budget constraints or site context. Standards (recognizable by the helping verb “shall”) must be followed. However, variances from standards may be granted in accordance with RTD Engineering Design Guidelines manual.

The different responsibilities and roles played by RTD and local jurisdictions in transit access—which sometimes change based on site-specific context—require close coordination between transit designers and local jurisdiction staff. A cohesive strategy, as well as a solid understanding of the existing station area conditions, is necessary to successfully address transit access. Therefore transit designers should utilize local jurisdiction staff’s knowledge of existing conditions, current projects and adopted future plans for station areas.

RTD project managers are encouraged to utilize the Transit Access Committee as a resource to review access issues on an as-needed basis, but are required to check-in with the committee during the following milestones of the environmental and preliminary design process:

- During detailed stage of alternatives analysis
- Prior to completion of DEIS
- Prior to selection of a preferred alternative (could occur in DEIS)
- Prior to completion of FEIS
- Prior to completion of 65% final design (may not be applicable for design-build project)
• Prior to completion of 90% final design (may not be applicable for design-build project)

Similarly, the proposers of any joint development projects are required to present to the Transit Access Committee related to any access issues. These meetings are intended to establish a dialogue and understanding of project or issue to be addressed by the committee. When evaluating joint development projects, RTD will consider both the function and the relationship of transit stations to the surrounding community. In general, proposals should contain elements of TOD principles (pedestrian-oriented design, density that supports transit usage, mix of land uses). Specific topics that should be addressed by both solicited and unsolicited proposals should include how the project would:

• Functionally connect to the transit facility
• Increase transit ridership
• Enhance the quality of the rider experience
• Create a sense of place
• Functionally connect to the adjacent community
• Respect or advance the vision of the adjacent community
• Provide the opportunity for improved transit infrastructure for RTD
• Define a financial framework for any real estate transaction(s) and/or infrastructure improvements
• Conform with locally adopted and expressed plans

Flexibility will be granted under conditions such as physical constraints or when there is a trade-off that can be measured or reasonably estimated between ridership and other benefits. Through its internal review process, the RTD Transit Access Committee will provide inter-disciplinary recommendations for any design changes. Recommendations for design changes will then be addressed by RTD’s Executive Safety and Security Committee, which has the final decision on any design variances. Local jurisdiction code requirements may also need to be met.

3.2 Pedestrian Access Guidelines and Standards

The guidelines and standards in Table 3-1 are meant to ensure quality pedestrian access. The guidelines apply to RTD and entities outside RTD who may connect to or operate with a station area (local jurisdictions and developers with interested in developing adjacent to or at RTD facilities). The guidelines are identified based on who is responsible—RTD and/or other parties (such as local jurisdictions or developers).
### TABLE 3-1: Pedestrian Access Guidelines

<table>
<thead>
<tr>
<th>GUIDELINE</th>
<th>RESPONSIBILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pedestrian-vehicle conflicts should be minimized or eliminated by separation through plazas, treatment of at-grade crossings or, as a last resort, overpasses and underpasses (when conditions such as high-volume arterials or freight railroad tracks are present).</td>
<td>RTD</td>
</tr>
<tr>
<td>Traffic control devices should facilitate the priority of pedestrian flow over vehicles at the station.</td>
<td>X</td>
</tr>
<tr>
<td>Pedestrian paths should connect the platform to other elements of the transit facility and the surrounding community. Since pedestrians will take the shortest route between points regardless of where designated, paths should use as direct a route as practicable and barriers (such as fencing or bollards) should be sufficient to keep pedestrians out of restricted areas and control vehicle and pedestrian access. Walk paths should be free of obstructions and sized appropriately for pedestrian loading.</td>
<td>X</td>
</tr>
<tr>
<td>Landmarks or points of reference should provide pedestrians with a continued sense of orientation and relationship within the space comprising the transit facility. Signage should be considered a supplementary system message to confirm the visual statements expressed by the legibility of the transfer facility design itself.</td>
<td>X</td>
</tr>
<tr>
<td>Plazas or open space that visually connect important components of the transit facility around its perimeter should be pedestrian in scale</td>
<td>X</td>
</tr>
<tr>
<td>Shelters should meet the needs of human comfort and convenience, as well as areas of refuge from excessive sun, wind, rain or snow</td>
<td>X</td>
</tr>
<tr>
<td>Elements of the transit facility should be arranged to enhance clear observation by other pedestrians and security or police. Other security design considerations include appropriate lighting levels, unobstructed lines of sight, landscaping configurations that avoid concealment, and security camera location.</td>
<td>X</td>
</tr>
<tr>
<td>Landscaping, pavement color and texture, street furniture components, plazas, and kiosks should be designed to increase the attractiveness of the station facilities.</td>
<td>X</td>
</tr>
<tr>
<td>Paving surfaces should provide good traction to reduce the risk of slipping and falling.</td>
<td>X</td>
</tr>
<tr>
<td>Vegetation, plantings or other greenscaping should be pedestrian scale</td>
<td>X</td>
</tr>
<tr>
<td>Public art should be utilized to make the station more attractive and provide a sense of identity.</td>
<td>X</td>
</tr>
<tr>
<td>Transit functions such as bus stops and kiss-n-Ride should be considered for on-street configurations in TOD station areas if the public facilities are contextually appropriate (e.g., grid pattern streets with traffic control measures such as signalized crossings and medians, adjacent transit-supportive land use)</td>
<td>X</td>
</tr>
<tr>
<td>Planners should encourage adjacent uses that activate the street and provide good ground-floor visibility to the transit facilities</td>
<td>X</td>
</tr>
</tbody>
</table>
Standards:
The following walk speeds shall be used at station facilities for transit access:

- Level walk speed: 200 feet per minute
- Horizontal component of stair walk speed: 130 feet per minute
- Appropriate adjustments for barriers, such as an elevator or street crossing, shall be added to the walk time.

At stations where elderly or disabled persons comprise an estimated 20% or more of transfers, a horizontal walk speed of 150 feet/minute and the elevator time shall be used instead of stair walk speed.

For distance calculation purposes, the centroid of the platform shall be used—taken from the distance between the front of the trains (highblock) in each direction and the extreme edges of all the platforms. The bus connection points are the designated gates.

3.3 Bus Transfer Access Guidelines and Standards

For rail↔bus connections, knowledgeable commuters generally have above average walk speeds, but less frequent and new riders require more time to find their way. Crowding at stations during peak periods also impedes free-flow, and elderly and disabled passengers need more time to make their connections. Sight distances also affect perceived convenience.

The proximity of the bus gates to the train platforms is governed by establishing the distances (and travel times) that provide for desirable, average and maximum transfer connections. RTD’s current implementation for timed transfer allows for a maximum 2 to 5 minutes to make a transfer. This defines the range for transfer time: desirable < 2 minutes; maximum < 5 minutes; average = 3 ½ minutes. In terms of passenger perception this is 5, 12 ½ minutes and 8 ¾ minutes, respectively. Allowing for a 1 minute reliability buffer, the scheduled dwell time is respectively: minimum = 5 minutes, maximum = 11 minutes and average = 8 minutes.

The probability of making a connection is also of concern. A missed connection means the passenger will wait a time equivalent to the headway (time between buses) on the connecting route; 15 or 30 minutes for typical suburban feeder services, less time nearer the central business district (CBD). At a minimum, riders should expect to make their connections 95% of the time (miss no more than 1 in 20). Schedule reliability is important to making connections.

It would be ideal to use a distribution of passenger transfers and schedule reliability to set proximity parameters. However, these data are not yet comprehensively available. As a proxy for passengers, the number of scheduled, one-way bus trips per day will be used
instead. The gates for routes having at least 75% of scheduled trips should be located within the 2 minute desirable walk and the gates for 85% within the 3½ minutes average walk of the rail platform centroid.

Table 3-2 provides bus gate siting distances using the walk speeds in Section 3-2. The following arc distance (straight line) calculations have been adjusted for an average circuity of the walk path by a factor of 0.6 arc/path ratio from a sample of RTD stations. Actual walk path distance is always preferred, but arc distance can be used as a proxy until the actual walk path is designed. The starting point for this guideline is the most desirable transfer takes place within 100 feet of rail platform centroid to bus gate.

<table>
<thead>
<tr>
<th>Transfer Time</th>
<th>Maximum Walk Path Distance</th>
<th>Maximum Arc Distance</th>
<th>Weekday Bus Trips</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desirable &lt; 2 minutes</td>
<td>400 feet</td>
<td>240 feet</td>
<td>&gt; 75%</td>
</tr>
<tr>
<td>Average = 3 ½ minutes</td>
<td>700 feet</td>
<td>420 feet</td>
<td>&gt; 85%</td>
</tr>
<tr>
<td>Maximum &lt; 5 minutes</td>
<td>1,000 feet</td>
<td>600 feet</td>
<td>100%</td>
</tr>
</tbody>
</table>

Note: It is evident that some existing stations may not comply with these standards, and that they can not require a retrofit of existing stations. However, these standards do imply that a number of existing stations do not provide the convenient transfers expected by our riders. Indeed, this has been the source of many customer complaints and is not an indication of acceptability by either our customers or RTD. RTD will endeavor to improve these connections as may be physically and economically feasible.

RTD’s Bus Transit Facility Design Guidelines and Criteria address internal and adjacent on-street bus transfer areas (Section 2.7.1). Since TOD emphasizes the activation of streets and public and private spaces with human activity—calling for urban design principles such as smaller street widths, more compact block sizes, buildings without set backs, and parking lots located behind buildings rather than adjacent to streets—the siting of bus transfer facilities are a key to ensuring TOD that performs well for both transit and placemaking. Therefore, on-street bus configurations are preferable for TOD sites, depending on the site context and transit needs.

Guidelines:
On-street bus transfer should be considered based on the following factors:

- **Safety**: facilities should be designed in consideration of the safety of bus passengers and the general public to minimize unsafe pedestrian conditions and conflicts.
- **Physical site constraints**: some sites lack sufficient right-of-way or property for separate bus facilities.
- **Street design**: the presence of grid-pattern streets in a station area provides an opportunity for pedestrian and bicycle connectivity that supports on-street bus facilities and bus circulation on public streets.
• **Development potential:** when land that cannot otherwise be developed for transit-supportive uses due to physical, regulatory or market constraints, bus facilities might be its highest and best use.

• **Level of service and type of transfer activity:** street length and incompatible uses limit the number of buses that can stop and stage on street. Higher-volume stops with timed-transfer activity will necessitate the need for off-street boarding, alighting and staging.

**Standards:**

- Gate locations for all through bus routes shall be located within the 700-foot maximum path distance and 420-foot maximum arc distance because excessive dwell time would delay their passengers.

- Gates for all routes shall be located within the 1,000-foot maximum walk distance and 600-foot maximum arc distance based on the maximum transfer time above.

### 3.4 Bicycle Access Guidelines and Standards

Bicycle access guidelines (see Table 3-3) and standards address connections to/from station, wayfinding, and bike parking. The guidelines and standards are identified based on who is responsible—RTD and/or other parties (such as local jurisdictions or developers).
## TABLE 3-3 Bike Access Guidelines

<table>
<thead>
<tr>
<th>GUIDELINE</th>
<th>RESPONSIBILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>On-street bike lanes should be considered for street connections to/from RTD park-n-Ride facilities</td>
<td>X X</td>
</tr>
<tr>
<td>On routes where it is imprudent to implement on-street bike lanes, multi-use paths should be considered to enhance bike access</td>
<td>X X</td>
</tr>
<tr>
<td>Adequate signage should be provided directing cyclists to designated bicycle routes as well as markers showing distances to popular destinations (including transit nodes) and intersecting routes 44</td>
<td>X X</td>
</tr>
<tr>
<td>Standard RTD symbols and lettering should be used for easier identification on signs directing riders to/from bikeways to/from transit stops</td>
<td>X X</td>
</tr>
<tr>
<td>Bicycle trail and route information should be placed on station area maps to inform riders of the nearby cycling amenities 45</td>
<td>X</td>
</tr>
<tr>
<td>RTD and/or local jurisdictions should provide wayfinding signage on bicycle paths/routes in the vicinity of the transit station.</td>
<td>X X</td>
</tr>
<tr>
<td>Bicycle parking facilities should be located in a well-lit and highly visible area to enhance overall security.</td>
<td>X</td>
</tr>
<tr>
<td>Bike lockers should be located in moderately- to high-trafficked areas “no further than the closest non-ADA parking space” 46 subject to limitations of locating “publicly accessible receptacles” per safety and security concerns</td>
<td>X</td>
</tr>
<tr>
<td>Adequate signage at station entrances should provide bicycle locker information and signify their presence on the site.</td>
<td>X</td>
</tr>
<tr>
<td>Signs should be provided indicating proper bike boarding procedures for light rail trains and connecting buses to aid first-time users and heighten awareness of available bike-on-transit options</td>
<td>X</td>
</tr>
<tr>
<td>Biking information kiosks should be provided at heavily utilized locations to provide regional bicycle maps and locker information to increase the visibility of nearby cycling amenities.</td>
<td>X</td>
</tr>
<tr>
<td>Bicycle racks should be located within a convenient walk distance of transit boarding platforms in well lit and highly trafficked areas.</td>
<td>X</td>
</tr>
<tr>
<td>Standard inverted “U” bicycle racks should be used because they offer the greatest range of options given their ability to be installed individually or in clusters as deemed appropriate for the site</td>
<td>X</td>
</tr>
</tbody>
</table>

### Standards:
- All stations, regardless of whether they have park-n-Ride facilities, shall also have bike parking. Parking shall be provided in the form of bike racks, bike lockers, bike station, or a combination thereof.

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46 5.2.2, RTD Bus Transit Facility Design Guidelines and Criteria
3.5 Auto Access

These guidelines and standards cover both kiss-n-Ride drop-off/pick-up areas as well as park-n-Ride facilities. It is important to recognize that in certain instances, competing demand for space or physical site constraints may make the guidelines impractical. The kiss-n-Ride facilities at stations typically include areas used for dropping-off and picking-up transit passengers, as well as taxi stands, provisions for paratransit vehicles and private shuttle buses. It may be possible to combine kiss-n-Ride and transit areas provided that automobiles not delay transit vehicles.

3.5.1 kiss-n-Ride Access Guidelines and Standards

Guidelines:

- These facilities should be convenient for both pedestrians and motorists to use, or else they will find other locations to engage in pick-up/drop-off activity that may cause undesirable conflicts.
- The kiss-n-Ride should be designed to maximize vehicle turnover, facilitate traffic flow, and avoid conflicts between pedestrians and other access modes and vehicles.
- One-way traffic flow is recommended and the site should allow for re-circulation.

Standards:

- All stations, regardless of whether they have park-n-Ride facilities, shall also have kiss-n-Rides when practicable, that are sized to meet forecast or demonstrated demand. Stations located in TOD areas may be accommodated by on-street kiss-n-Ride facilities, subject to the review of local jurisdictions.
- Except where prevented by physical site constrains, the kiss-n-Ride shall not exceed a walk distance of 400 feet from the platform center, and a maximum arc distance of 240 feet.
- The kiss-n-Ride shall have a direct line of sight to the station entrance.
- Pedestrian crossings from the drop-off/pick-up lane shall include a stop sign and marked crosswalk.
- Signage shall direct both vehicles and passengers existing stations to drop-off/pick-up areas

3.5.2 park-n-Ride Access Guidelines and Standards

RTD determines parking requirements at stations based on a number of factors, including the corridor travel demand model, observed travel behavior at existing RTD park-n-Rides, environmental impacts, cost of land and construction, capacity of existing roadway connections, proximity of other transit parking reservoirs, adopted local plans and policies, and community input.
Expected in 2009, RTD will implement a parking management program that uses market-based mechanisms to optimize park-n-Rides utilization. Under Colorado law, RTD has the ability to charge out-of-district and overnight parkers, and reserve up to 15% of spaces in a given facility for customers who purchase monthly passes. Pricing for these conditions will be used to influence patron behavior by providing incentives to use undersubscribed park-n-Rides and costs to use oversubscribed ones.

**Guidelines:**
- The pedestrian access guidelines in Section 3.2 all apply to park-n-Ride design.
- In TOD station areas with a need for large parking capacity, it is preferable to have multiple park-n-Ride sites rather than a single facility with greater potential impacts to the pedestrian environment.

**Standards:**
At least half of station park-n-Ride capacity shall be located less than 1,000 feet walk distance from the platform center, at least 75% shall be located less than 1,500 feet walk distance from the platform center, and the remainder can be located up to 2,500 feet away. (See Table 3-4)

<table>
<thead>
<tr>
<th>Share of Capacity</th>
<th>Maximum Walk Path Distance</th>
<th>Maximum Arc Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>50%</td>
<td>1,000 feet</td>
<td>600 feet</td>
</tr>
<tr>
<td>75%</td>
<td>1,500 feet</td>
<td>900 feet</td>
</tr>
<tr>
<td>100%</td>
<td>2,500 feet</td>
<td>1,500 feet</td>
</tr>
</tbody>
</table>

The siting of parking shall be based on the factors cited in pedestrian access guidelines in Section 3.2, as well as ground conditions influencing the pedestrian environment discussed in Section 2 (street network and adjacent land use). If ground conditions for favorable pedestrian access are not present at a specific site, then all of the parking shall be within a 1,500-foot walk distance from the station.