



## Structuring Elements

**Major Structuring Elements**

Four major structuring elements will influence how Denver Union Station evolves into a multimodal transportation hub. They are:

- the physical requirements, size, and configuration of the site itself and existing infrastructure,
- the transportation program,
- the development program, and
- the regulatory structure imposed by zoning and landmark designation.

This section explores the implication of each structuring element for redeveloping Denver Union Station according to the Master Plan's goals.

**The Site**

The 19.5-acre Denver Union Station site has many assets, as well as elements that challenge proposed transportation improvements and redevelopment.

The site's most prominent feature is the 72,000-square-foot historic station, which houses restaurants, offices, and waiting, ticketing, and baggage facilities for Amtrak and Ski Train. The historic building is one of the site's greatest assets. Its distinctive architecture, rich history, and grand public spaces will play an important role in attracting and serving future travelers, office workers, downtown residents, shoppers, and tourists.

Adjacent to the Station on the west side of the site lay five passenger-rail tracks, including Amtrak and Ski Train rail services with "tail tracks" that cross 16<sup>th</sup> Street and extend to Cherry Creek.

The RTD Light Rail 'C' line terminates at the site, with the 16<sup>th</sup> Street Mall Shuttle drop-off area located next to the light rail (LRT) platforms. One active tunnel connects below the passenger-rail tracks between the LRT platforms and the historic station.

The Wynkoop Street side of the building is occupied by two parking lots and a vehicle turnaround/drop-off at the terminus of 17<sup>th</sup> Street, facing Wynkoop Street.

Improvements proposed under the Master Plan must consider the site's access, utility, and shape. The site's long linear shape derives from its origins as a station and rail yard. While this size and shape works for today's transportation needs, the configuration poses challenges to the Master Plan's programs of transportation and development.

The site is a space-constrained parcel surrounded by existing and planned street and development infrastructure. Since the project's early stages, it has been apparent that, due to the limited size of the site footprint, the nature of the existing transportation and development infrastructure, and the type and extent of new facilities needed, the site's transportation improvements would have to be configured on multiple levels.

As the surrounding area has developed, the site has become a physical barrier between Downtown Denver

and the Central Platte Valley. Recent improvements to the Central Platte Valley and the South Platte River underscore the need to improve connections. Plans for Denver Union Station redevelopment should be sensitive to this objective and avoid exacerbating the area's connectivity challenges.

The site also has access issues for autos, buses, and rail. The HOV lane provides direct access from 20<sup>th</sup> Street to I-25. While private autos must exit the HOV lane at 19<sup>th</sup> Street, RTD buses now run next to Denver Union Station to access the 16<sup>th</sup> Street Mall to Market Street Station.

All other vehicular access to the site from I-25 uses less direct routes from Auraria Parkway, Speer Boulevard, 20<sup>th</sup> Street, and 23<sup>rd</sup> Street. Wewatta Street is slated to become an arterial road connecting Speer to 23<sup>rd</sup> Street. Wynkoop Street runs the length of the site's eastern edge. Because of its abbreviated length and lack of connections to highways or major arterials, Wynkoop Street carries relatively little traffic. Passenger-rail access is provided to the site only from the north, over the 20<sup>th</sup> Street grade-separation structure. Light-rail access occurs from the south.



Aerial photo of the 19.5-acre site with boundaries superimposed, ca 2000.

**The Multimodal Transportation Program**

The multimodal hub must blend many different transportation modes in one place with convenient transfers and connections. This critical mass of

transportation services will encourage dynamic redevelopment and give the region's residents and visitors a compelling variety of transportation choices.

Site Transportation Program						
2025 Build-out						
	Number of req'd tracks/ Track No. /share with	Platform Req'd Length	Track Req'd Length	Frequency	Remarks	Source / Document
<b>RAIL</b>						
Amtrak	1 req / track #1 / track #2	1540'	1835'	2/day	18 cars @ 85' + 3 loco + 10' for a stub end	RTD agreement w/Amtrak
Ski Train	1 req / track #2 / track #1	1540'	1835'	2/day (seasonal)	18 cars @ 85' + 3 loco + 10' for a stub end	RTD agreement w/Ski Train
East Corridor	1 req / track #3 / NA	870'	970'	4/hr.	2 (4 cars trains @ 85' + 1 loco) for stub station	Fastracks Program / DUS Rail Capacity Sim.
Boulder Commuter Rail	1 req / track #4 / NA	870'	970'	4/hr.	2 (4 cars trains @ 85' + 1 loco) for stub station	Fastracks Program / DUS Rail Capacity Sim.
Intercity Rail (North Front Range)	1 req / track #5 / NA	870'	970'	2/hr.	2 (4 cars trains @ 85' + 1 loco) for stub station	Fastracks Program / DUS Rail Capacity Sim.
Intercity Rail (South Front Range)	1 req / track #6 / #6	870'	970'	2/hr.	2 (4 cars trains @ 85' + 1 loco) for stub station	Fastracks Program / DUS Rail Capacity Sim.
North Metro	1 req / track #6 / #6	870'	970'	4/hr.	2 (4 cars trains @ 85' + 1 loco) for stub station	Fastracks Program / DUS Rail Capacity Sim.
Light Rail C Line/West	3 req / track #B, C / all	360'	460'	12/hr.	4 cars @ 80'	EIS / West
Light Rail Gold Line	1 req / track #B, C / all	360'	460'	8/hr.	4 cars @ 80'	RTD Program
Light Rail SE/SW Corridors	1 req / track #A / all	360'	460'	8/hr.	4 cars @ 80'	EIS / Southeast
Platte Valley Trolley	NA	NA	NA		separate operation on Wynkoop Street	Trolley Feasibility Study
Total Additional Capacity						
Future Expansion	1 req / track #6 / #6	870'	970'	NA	2 (4 cars trains @ 85' + 1 loco) for stub station	RTD
Future Expansion	1 req / track #1 / LRT	200'	270'	TBD	Excess cap. for future technology	
<b>BUS</b>	<b>No. of Bays</b>					
Regional Bus	16	(10) 45' slips, (6) 65' slips	-	-	-	RTD Program
Commercial Bus Facility	18	(18) 45' slips	-	-	-	Greyhound / Tour / Charter providers
Local Bus	None	None	-	-	assumed on street	RTD Program
Downtown Circulator	6	50'	-	-	space provided for on-site	Draft DMAP
16th Street Mall Shuttle	6	(6) 45' slips	-	-	space provided for on-site	RTD
Tour Buses	share w/Commercial Bus	8 potential carriers	-	-	share w/Commercial Bus	Transsystems memo.
Charter Buses	share w/Commercial Bus	-	-	-	share w/Commercial Bus	Transsystems memo.
<b>COMMERCIAL CARRIERS</b>	<b>No. of Bays</b>					
Taxi	15 positions	-	-	-	Taxi positions utilizing drop-off areas	TS Addl Carriers Memo
Taxi queuing at Commercial Bus	6 positions	-	-	-	Taxi positions utilizing on-street curb side	TS Addl Carriers Memo
Rental Car	30 parking spaces	-	-	-	In parking structure	TS Addl Carriers Memo
Vans and Shuttles	3 positions	-	-	-	Utilizing drop off areas West side of DUS	TS Addl Carriers Memo
Ski Area Shuttles	1 dedicated bay	-	-	-	Utilizing drop off areas West side of DUS	TS Addl Carriers Memo
Van Pool	drop off area	-	-	-	Utilizing drop off areas West side of DUS	TS Addl Carriers Memo
Limo	designated loading zone	-	-	-	Utilizing drop off areas West side of DUS	TS Addl Carriers Memo
Courier Services	designated loading zone	-	-	-	Drop off area or curb side	TS Addl Carriers Memo
Private Vehicle Drop off @ Commercial Bus	8 spaces or positions	-	-	-	-	TS Addl Carriers Memo
<b>OTHER MODES</b>	<b>No. of Spaces</b>					
Bicycle	Bike Station	-	-	-	1 space per 200 auto parking spaces required	-
PediCab	On Street (16th /or designated site)	-	-	-	-	-
Motorcycles / Scooters	In Parking Structure	-	-	-	-	-
Small Electric Vehicles	In Parking Structure	-	-	-	-	-
Horse Drawn Carriage	On Street (16th /or designated site)	-	-	-	-	-
Pedestrians	Incorporate into circulation system	-	-	-	-	-
<b>Parking for Transit</b>	<b>No. of Spaces</b>					
Commercial Bus Facility	40 spaces	-	-	-	-	Greyhound Program
Ski Train	200 spaces	-	-	-	-	Ski Train
Amtrak	100 spaces	-	-	-	-	Amtrak
Transit Parking (RTD)	250 spaces	-	-	-	-	RTD memo
Rental Car	30 spaces	-	-	-	-	TS Addl Carriers Memo
<b>Total Transit Related Parking</b>	<b>620 spaces</b>	-	-	-	-	-

**CATEGORIES OF TRANSPORTATION MODES AT DUS**

- Passenger rail
- Light rail
- RTD express and regional bus services
- RTD local and limited bus services
- Commercial intercity, international, tour and charter bus service
- 16<sup>th</sup> Street Mall Shuttle and Downtown Circulator
- Commercial vans and shuttles
- Taxis and limos
- Bikes and scooters
- Platte Valley Trolley
- Rental cars
- Pedestrians
- Automobiles and other privately owned vehicles

**Passenger Planning Goals**

A multimodal transportation facility must be designed around passenger movement and convenience. This means placing modes with connecting heavy passenger volumes close together, while removing as many physical and visual barriers to pedestrians as feasible. Quantitative and qualitative goals for designing stations around these principles follow.

**Quantitative Goals***Minimize walking distances*

The station design should locate travel modes with heavy interchange volumes close together. This will minimize the time and distance each passenger spends walking through the facility.

*Facilitate level changes*

Level changes using stairs, elevators, or escalators should be convenient, accessible, and easily identifiable for passengers, with direct routes to connect major modes.

*Improve legibility and wayfinding*

Direct routes through the station minimize the amount of time passengers need to spend orienting themselves to the space and choosing their travel path. Introducing turns, and blocking sightlines, increase passenger travel times and make the station experience less “legible.”

**Qualitative Goals***Maintain universal accessibility*

For disabled passengers, level changes and steep grades can be barriers to movement, unless elevators are provided. Facilitating level changes and flattening grades make travel easier for disabled passengers and others.

**Passenger Rail**

The passenger rail program for Denver Union Station includes regional commuter service, and longer-distance intercity and excursion service such as existing Amtrak and Ski Train service.

Amtrak and Ski Train passenger platforms are 1,540 feet long, assuming an 18-car, three-locomotive train. These carriers run on infrequent schedules and have the longest “dwell time” in the station. Their schedule gaps may allow flexibility to share platforms with other carriers. Denver Union Station will need a service platform for these long tracks for baggage handling and in-station maintenance.

The multimodal hub may add such passenger services as a commuter-rail service to Denver International Airport, commuter rail to Boulder via the US 36 corridor, and an intercity connection to the north metro area.

The Master Plan also recognizes the potential of two commuter-rail connections to the north, an intercity link to Colorado Springs and points south, Fort Collins to the

north, and expansion space for transportation to the I-70 mountain corridor. A mode has not been identified for the I-70 mountain corridor. The operational program for the passenger-rail elements recommends six tracks. These tracks include two long tracks for Amtrak and Ski Train with 1,540-foot platforms and four shorter rail tracks with 970-foot platforms for commuter, intercity, and DIA service. The program includes switches and pocket tracks at the station. These tracks and platforms will be about 170 feet wide. (For the intensity of track use for each rail service, see the Station Simulation chart in the Appendix.)

Station capacity is also affected by the available width for the lead track at the throat (a “pinch point” as the tracks converge entering and leaving the station) just north of 20<sup>th</sup> Street. This area is constrained by Wewatta Street on the west and Coors Field on the east. The throat width can be designed for up to five parallel track leads. Additional lead tracks in the throat for passenger rail will generally improve operational capacity and efficiency at the stub-end station.



Diesel Multiple Unit (DMU).



Amtrak train at Denver Union Station.



Denver Ski Train.



Denver light-rail train.

**Future Expansion Option: Through Rail Service**

Denver Union Station now functions as a “stub-end” station for passenger rail. This stub-end configuration requires all trains to enter and exit the station from the same direction (to and from the north). Trains either back into the station, or the pulling locomotive switches ends at the station to exit.

In its heyday, Denver Union Station was a through-station, with a direct connection to the south, allowing trains to pass through the station without reverse-direction movements from south to north or north to south. In the 1980s, this through-movement option was eliminated when the rail yards were reconfigured and southbound track leads out of the station removed. The remaining southbound tracks in the Central Platte Valley were condensed into the Consolidated Main Line (CML) closer to the South Platte River and away from the station. Along with relocating the CML and removing yard tracks, the City began to remove or replace many viaducts in the valley to restore grade-level streets at Speer Boulevard and 15<sup>th</sup> and 16<sup>th</sup> Streets, and to rebuild grade-separated facilities at 20<sup>th</sup> and 23<sup>rd</sup> Streets (Park Avenue).

Of alternatives considered, only the Vision Plan, where passenger rail is located underground, provides the future option of creating passenger-rail through-service at Denver Union Station. An at-grade south connection is not possible due to numerous at-grade crossings of major arterial streets south of Denver Union Station. Both the City and the Public Utilities Commission (PUC) have indicated that they would object to new at-grade rail crossings. RTD has

indicated that such crossings would pose significant operational and maintenance problems for rail-service providers.

There are a number of possible through-connection options with the Vision Plan that have been determined to be technically feasible, if and when the additional capacity is needed, and funding is available. Each of the possible options allows for a direct south connection to the CML for connections to Colorado Springs and Pueblo, and a north loop connection to the CML so trains from the north would not need to change direction when returning to the north.

The benefits of increased operational flexibility, increased capacity, increased rail speeds, safety enhancement, and redundancy provided by passenger-rail through-service at Denver Union Station were studied and verified as part of this Master Plan process. While it is possible to reestablish Denver Union Station as a through station, there will be numerous challenges to overcome before this can be realized. They include limited track tangents at the CML, which are required for a CML connection; required tunneling under 16<sup>th</sup> Street, Wewatta Street, 15<sup>th</sup> Street, Cherry Creek, Speer Boulevard, and private property; utility conflicts; easements and land acquisitions; and the high costs of the underground improvements.

Before passenger-rail through-service can be pursued, a more detailed study is needed to identify precise alignments, as well as improvements and requirements needed to implement such service.

**Stub-Station Passenger-Rail Capacity**

The capacity and demand analysis performed as part of this project, based on projections to 2025, demonstrated that either basic station configuration--stub-end or through--could work in terms of programs and operations.

The chart in the Appendix shows a simulation for a stub-end station. The simulation shows a six-track configuration, with each horizontal bar depicting a specific train, its dwell time, and the time the track is empty. This evaluation shows the peak-hour volume at the station from 7 a.m. to 8 a.m. The capacity of the stub-end station is 60 percent more than needed for the 2025 program using a three-track throat north of 20<sup>th</sup> Street. The addition of tracks at the throat north of 20<sup>th</sup> Street would increase this capacity significantly.

**Light Rail (LRT)**

RTD has determined that the future light-rail program needs a through station. This will allow trains to connect to the north (Gold Line) and the south (Southeast, Southwest, and West Lines) through a new loop linking the 16<sup>th</sup> and 18<sup>th</sup> Street legs of the system at the CML and at the station.

Under this scenario, up to 24 LRT trains an hour may pass through the station. The new light-rail corridors will require a three-track station with associated switching movements, train storage, and platforms.

The station must accommodate four-car LRT trains with 360-foot-long platforms. The width needed for the LRT tracks and platforms is about 90 to 100 feet. (For each line’s intensity of track use, see the LRT Simulation chart.) Each track at the station must also include a 50-foot tangent at each end of the platform.

Because of the frequency and number of LRT trains using Denver Union Station, the tracks will need to be grade-separated from Wewatta Street. An at-grade crossing with perhaps 48 trains an hour, crossing Wewatta Street at 16<sup>th</sup> and 18<sup>th</sup> Streets at peak times, would cause major conflicts with auto traffic.

**RTD Express and Regional Bus Service**

Regional and express bus routes from the north and northwest metro area now access Downtown Denver via the HOV lanes next to 20<sup>th</sup> Street, and circulate adjacent to Denver Union Station to access the Market Street Station via the 16<sup>th</sup> Street Mall.

A new regional and express bus facility at Denver Union Station will replace Market Street Station. This will reduce the number of buses using the 16<sup>th</sup> Street Mall connection through Lower Downtown. The new station facility will increase current capacity by six gates. The regional and express bus program for Denver Union Station requires space for six articulated buses, 10 standard line-haul buses, and Bus Rapid Transit (BRT).

This new facility needs to be near the 16<sup>th</sup> Street Mall and the proposed Downtown Circulator. Regional and express buses also need direct access to the HOV lanes on 20<sup>th</sup> Street and to the street grid.

**RTD Local Bus Service**

Many local bus routes will serve Denver Union Station and LoDo. These routes include the 20, 0, 6, 15, and 10B. Buses will be accommodated on local streets. The 20 route will continue to serve Wynkoop Street. The other routes will be rerouted to Wewatta Street.



Local RTD bus service.



Typical Greyhound Bus associated with commercial bus service.

**Commercial Bus Facility Service**

A new facility for commercial bus service providers will accommodate intercity, international, charter, and tour buses.

Commercial intercity and international buses have different needs for gate layout, passenger waiting areas, operations and administrative space, and baggage handling. They also require:

- direct private auto access to its passenger terminal for drop-off and pick-up,
- direct bus access to the city street grid,
- bus access to HOV lanes, if possible, and
- fueling capability on site.

The bus program includes space for eighteen 45-degree bus gates and related space for bus maneuvering and circulation, passenger waiting areas, a lobby, fast-food service, package express, and support spaces. Greyhound also requires 40 parking spaces for employees.

Denver Union Station may serve as Downtown Denver's main location for charter and tour buses, including buses that coordinate service with Amtrak and the Ski Train. These buses would share the Commercial Bus Facility with Greyhound and other bus carriers.

To coordinate all these companies and their equipment, services, schedules, and space needs, Denver Union Station will need a full bus-operations plan before the new bus facility is open.

**16<sup>th</sup> Street Mall Shuttle/Downtown Circulator**

The Denver Union Station multimodal hub must include new transportation services to help distribute passengers to their Downtown destinations.

The 16<sup>th</sup> Street Mall shuttle now terminates at the station next to the "C" Line light-rail platform. The Master Plan program for the mall shuttle requires two bus positions for passenger loading and unloading, and new space to stage four mall-shuttle vehicles.

When Denver Union Station reaches its full multimodal capacity, the Mall Shuttle will lack the capacity to carry all passengers to their Downtown destinations from the station. The station therefore must provide space for a new service—the proposed downtown circulator—to augment the Mall Shuttle. The circulator will serve the Civic Center Regional Bus Station and planned Central Connector transportation service, as well as Denver Union Station. The DMAP project team has proposed a circulator similar to the 16th Street Mall Shuttle that will circulate on 18th/19th Streets and Lincoln/Broadway Streets between DUS and the Civic Center.



16th Street Mall Shuttle is a free service.

**Commercial and Private Carriers (Non-Bus)**

Additional private carriers will support the Denver Union Station multimodal hub, and may include taxis, shuttle and van services, limousine services, auto rentals, and vans to mountain destinations. These carriers add breadth, variety, flexibility, and convenience to the facility's program. Space is needed for private carriers to pick up and drop off passengers.

The program for these services follows:

**Commercial & Private Carriers Program**

Taxi	15 positions
Taxi at Commercial Bus Facility	6 positions
Rental Car	30 parking spaces
Vans and Shuttles	3 dedicated bays
Ski Area Shuttles	1 dedicated bay
Van Pool	Drop-off area
Limousines	Designated loading zone
Courier Services	Designated loading zone
Private Vehicle Drop-off at Commercial Bus	8 spaces

**Pedestrian and Nonmotorized Modes**

Nonmotorized modes are also vital to the Denver Union Station program. Many transportation riders become pedestrians when they arrive Downtown. Many Downtown destinations are within easy walking distance of the station.



Commercial and private carriers (Super Shuttle, Yellow Cab, and Oxford Hotel limousine service.)



Examples of pedestrian and nonmotorized modes of transportation.

The multimodal hub must be designed to allow passengers to get around on foot with ease and safety. In addition, the pedestrian experience must be attractive, enjoyable, legible, and safe. The site design will include pedestrian walkways and circulation, bicycle access, and storage. A new Bike Station, including bicycle storage, lockers, showers, and repair area will be included at the facility. This use should be easy to access from the bike access routes at 16th, Wewatta, and Wynkoop Streets. Access and space for pedicabs and horse-drawn carriages will also need to be provided.

**Automobiles and Other Privately Owned Vehicles**

This multimodal hub must include access and parking for autos and other privately operated vehicles. These also may include spaces for passenger drop-off, 'Kiss-n-Ride' facilities, service vehicles, emergency access, delivery vehicles, motorcycles, and small electric vehicles.

Parking for redevelopment must meet the standards of T-MU-30 zoning. This zoning allows for parking reductions of up to 50-percent because alternative transportation and shared parking opportunities are so abundant. Amtrak, Ski Train, RTD, and commercial buses also require some parking for passengers who will drive to the station.

RTD Peak Hour Transit Transfers					
From	To				
Mode	Pedestrian	Mall Shuttle	Local, Limited, Circulator	Regional Express	Rail (LRT & CRT)
Pedestrian	0	180	17	14	1,269
Mall Shuttle	116	0	16	13	1,125
Local, Limited, Circulator	1	2	0	0	7
Regional & Express	94	130	12	0	874
Rail (LRT & CRT)	3,719	5,118	475	403	1,565
<b>Total</b>	<b>3,930</b>	<b>5,430</b>	<b>520</b>	<b>430</b>	<b>4,840</b>