3 Infrastructure Needs

3.1 Introduction

The purpose of this chapter is to assess the level of infrastructure needed to support high-speed rail along the I-25 and I-70 corridors in Colorado. The study corridors are defined as two primary corridors and several secondary corridors as shown in Exhibit 3-1. The study corridors that were subject to engineering assessment include:

- **I-25 South**: Denver-Colorado Springs-Pueblo-Trinidad
- **I-25 North**: Denver-Fort Collins-Cheyenne (four alternate routes south of Fort Collins)
- **Denver to DIA**: downtown Denver to Denver International Airport (DIA)
- **I-70 West**: downtown Denver to Grand Junction
- **I-70 Secondary Corridors**: to Black Hawk, Winter Park, Breckenridge, Aspen and Craig

Exhibit 3-1: RMRA High-Speed Rail Feasibility Study Corridors
The infrastructure requirement was conceptually developed for “representative” routes in each study corridor, and the costs to build this infrastructure estimated. Infrastructure needs vary by alignment type and vehicle technology. In developing the representative routes for the I-25 and I-70 corridor, the following types of alignment are considered:

- **Existing rail** – a route using either the tracks or right-of-way of an existing rail corridor
- **Constrained/Highway Right-of-Way** – a route that is solely within or contiguous to the rights-of-way of the I-70 or I-25 highway
- **Unconstrained/Greenfield** – a route that is outside the I-70 and I-25 highway Rights-of-Way

Alignment variations for vehicle technology include:

- For speeds up to 110 mph in the I-25 corridor mph, use of existing rail rights-of-way owned by freight railroads has been considered. These options use diesel rail equipment.
- For speeds above 110 mph, a greenfield right-of-way option has also been developed for I-25. These options use electric rail or maglev equipment.
- For I-70 from Denver to Minturn, two different greenfield options have been developed: a low-gradient (4 percent) “Unconstrained” rail route that deviates from the I-70 highway right-of-way, and a high-gradient (7 percent) alignment within the I-70 Right-of-Way. The high-gradient route is the same one that was developed by the I-70 PEIS. While conventional trains could use the “unconstrained” 4 percent alignment, the high-gradient 7 percent alignment on I-70 is suitable only for maglev or Electric Multiple Unit (EMU, or self-propelled) rail vehicles.
- For I-70 west of Minturn, the evaluation focused on existing rail options, but short greenfield segments have also been considered from Gypsum to Mid-Valley (the “Cottonwood Pass” alternative) and from Wolcott to State Bridge (the “Route 131” option.)

This engineering assessment of the study corridors was conducted in cooperation with the RMRA, freight railroads, Colorado DOT and in coordination with both the FasTracks and Colorado Freight Rail relocations (R2C2) studies. The R2C2 study is developing an option for rerouting freight trains away from the Denver-Pueblo-Trinidad segment of the corridor by building a new north-south rail line in the eastern plains.

The engineering assessment entails a field inspection of the existing conditions within the study corridors, and a review of previous studies that were undertaken within the study corridors. Chapter 8 details the infrastructure plan and capital costs for each route considered for high-speed passenger rail service.

### 3.2 Engineering Assessment

An engineering assessment was prepared which provided an evaluation of the current condition of the proposed highway, greenfield, and railroad right-of-way; identified improvements to existing rail lines needed to support the 79-mph, 110-mph and 150-mph rail passenger service scenarios; and estimated civil engineering requirements for new greenfield routes for the 125-mph maglev, 220-mph rail and 300-mph maglev options.
The engineering assessment and its findings and recommendations relative to existing rail lines contained within this report are preliminary and were not developed in detail with the railroads. As discussed in earlier chapters, this study is at a feasibility level, the project to build a passenger rail system is un-funded and, therefore, formal negotiations with the railroads were not initiated. Future engineering assessments will require considerably more discussion to ensure railroad concurrence. Final design concepts and recommended capital plans will depend on detailed operations and capacity analyses, design coordination and in-depth discussions with the freight railroads. As the project moves beyond the feasibility phase, railroad involvement and coordination will become increasingly important.

A systematic engineering planning process was used to conduct the engineering assessment of the existing rail rights-of-way and potential greenfield routes within each study corridor, to quantify infrastructure needs and estimating the capital investment required for each route. As part of the engineering assessment the infrastructure needs were quantified by type of segment and by project element. The project elements that were assessed and quantified include:

- Guideway and track elements
- Structures
- Systems
- Crossings
- Stations/Maintenance facilities
- Special project elements

The engineering assessment of these elements was accomplished by conducting field inspections of each study corridor. A field inspection is a limited site verification without detailed surveys consisting of the sampling of critical sites along the track at crossings, bridges and stations. These field inspections were augmented by using satellite photography and GIS data to understand what lies between each view. At each location, engineering notes were compiled and the physical track conditions were compared with the latest track charts and other information provided by the railroads.

Field observations were conducted at highway/railroad crossings, overpasses and parallel roadways. The inspections focused on the condition of the track and the ability to accommodate joint freight and passenger train operations. The railroad right-of-way and highway corridors were examined for their ability to accommodate additional tracks for added capacity. Where possible, other existing facilities were observed, including bridge conditions, vertical/horizontal clearances, passenger train facilities, railroad yards and terminal operations. Photographic records were made at many locations.

As the study corridors were examined in the field, general concepts were developed and assumptions were made regarding the capacity and operational improvements needed to accommodate future passenger operations. The primary objective was to conceptualize infrastructure improvements that would improve fluidity and enhance the reliability of both passenger and freight rail operations.
During the field inspections, the condition of the right-of-way was noted and a determination was made relative to the improvements required to accommodate a specific train technology. The limited field inspections determined the existing track condition, assessed its suitability to accommodate joint rail freight and passenger operations, and gathered sufficient data to identify needed infrastructure improvements. For greenfield routes, the topographical features, waterways, and wetlands of the corridor were noted for future reference to other data sources such as GIS mapping, orthophotography and other available information.

The results of the field inspections were combined with data derived from GIS and railroad track charts to determine more precisely the recommended infrastructure improvements and to estimate capital costs. Cost estimates were then prepared through the application of appropriate unit costs and are presented in Chapter 8.

In order to ensure that the engineering assessment considered previous studies undertaken in Colorado, a review was made of the following:

- I-70 Programmatic Environmental Impact Statement and Collaborative Effort
- Colorado Railroad Relocation and Implementation Study
- FasTrack’s various Environmental Studies
- Wyoming DOT Rail Feasibility Study
- Gaming EIS (Black Hawk and Central City)
- Colorado Maglev Study
- I-25 North Environmental Impact Statement
- Intermountain Connection Study, Phase 1 and 2

Information concerning this review of previous studies can be found in Appendix D of the Existing Conditions Report.¹

### 3.3 Guidance from the Federal Railroad Administration (FRA)

For developing representative routes for the I-70 and I-25 corridors in Colorado, FRA guidelines for route development were used. FRA has produced a technical working paper: Railroad Corridor Transportation Plans (RCTP), A Guidance Manual². Section II of this FRA manual provides practical suggestions and policy guidance to aid the selection of an appropriate route for high-speed rail. The five basic requirements are:

- Geometry (horizontal and vertical curves) that impacts speed and travel time
- Capacity of the route
- Proximity of route to population centers
- Proximity of route to intermodal sites
- Cost of improvements

An Existing Conditions Report was completed for this project and is available at the RMRA website. This technical report presents results of the field inspection in the form of a review of existing

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conditions in the I-25 North, I-25 South and I-70 study corridors, and also present observations concerning several potential greenfield routes.

This chapter provides an assessment of the development of representative routes based on the FRA Guidance Manual, and using the five route evaluation criteria described above. The criteria were applied through a qualitative assessment of the physical, demographic, and potential cost of any route option for a given technology.

3.4 Technology Considerations

The field inspection of the existing rail rights-of-way and potential high-speed rail greenfield routes within the study corridors was carried out considering the use of several potential technologies. Since the field inspection was undertaken in the early stages of the project, these technologies represent a wide cross section and were only used at this stage to draw conclusions as to infrastructure needs. The technologies considered at this stage are summarized as follows:

- Conventional steel wheel on steel rail, FRA compliant, diesel locomotive hauled coaches or DMU equipment limited in speed to 79 mph, without tilting capability, suitable for use on track shared with freight trains. The system will use existing and new track in existing rail corridors.
- Steel wheel on steel rail, FRA compliant, diesel locomotive hauled coaches, limited in speed to 110 mph, with tilting capability, suitable for use on existing rail corridors. In urban conditions where right-of-way is constrained, the system may share the track and/or right-of-way with freight and operate at restricted speeds.
- Steel wheel on steel rail, FRA compliant, electrified locomotive or EMU equipment, with tilting capability, suitable for use on dedicated track at speeds from 150 to 220 mph in new, fully grade separated corridors. In urban conditions where right-of-way is constrained, the system may share the right-of-way, but not track with freight and operate at restricted speeds.
- High-speed magnetic levitation (LSM) technology, represented by the German TransRapid system with speeds from 250 to 300 mph. The system will be constructed in new fully grade separated corridors and will avoid the use of freight railroad right-of-way where possible.
- Urban magnetic levitation (LIM) technology, represented by Japanese HSST, with speeds up to 125 mph. The system will be constructed in new fully grade separated corridors, and will avoid the use of freight railroad right-of-way where possible.

This provides only a brief overview of the equipment options considered for this study. Chapter 4 of this report will be entirely devoted to a detailed examination of equipment technology issues, along with the specific route alignment options for which each technology has been evaluated.
3.5 Engineering Assessment: I-25 South Corridor - Denver to Trinidad

3.5.1 Existing Rail Rights-of-Way

In the late 1800’s, the Denver & Rio Grande Railroad built a line from Denver Union Station south through Colorado Springs to Pueblo. Similarly, the Atchison, Topeka & Santa Fe extended their line north from La Junta through Pueblo and Colorado Springs to Denver on a parallel route. After a series of mergers and acquisitions, the current owners, Union Pacific Railroad and Burlington Northern Santa Fe, have come to share the corridor, generally operating southbound on the westernmost track and northbound on the easternmost track. In most locations between Denver and Pueblo, multiple tracks exist, except from Palmer Lake south to Crews. South of Pueblo, BNSF operates a single track to Trinidad. UPRR shares the right-of-way with BNSF south from Pueblo as far as Walsenburg, where its branch-line to Alamosa diverges west. The existing rail corridor is known as the Joint Line. Details of the field inspection of the existing rail rights-of-way are provided in the Existing Conditions Report.

I-25 south of Denver reflects significant operational challenges as a result of heavy freight traffic and complex operating arrangements on the existing “Joint Line” and “Consolidated Main Line” through Denver, continuing all the way south to Pueblo.

- The Joint Line (JL) begins at the South Denver interlocker, Milepost 0.0, approximately where I-25 crosses the rail corridor south of Denver – close to RTD’s I-25 and Broadway Light Rail station – and continues to the Bragdon crossover switches, north of Pueblo. The United States Railroad Administration (USRA) established the Joint Line in 1918 during World War I. It consists of a combination of tracks originally built as two separate lines by the Denver & Rio Grande (DRGW, narrow gauge) in 1871 and by the Santa Fe (ATSF, standard gauge) in 1887.

- The Consolidated Main Line (CML) in contrast, extends from Sand Creek Junction to the South Denver interlocking at I-25, where the Joint Line officially begins. The CML resulted from abandonment of a portion of DRGW that formerly connected the Burnham yard complex to the south end of Denver Union Station (DUS). This abandonment left Burnham Yard, which was formerly on the DRGW mainline, on a looping branch line that is no longer used for through traffic, and left Union Station stub-ended. The former ATSF was double-tracked through downtown Denver to replace the capacity of the former DRGW line.

Some of the operational challenges associated with heavy Joint Line freight traffic may be mitigated by the freight rail relocation project being considered jointly by the Colorado Department of Transportation (CDOT) and the freight railroads. CDOT’s Colorado Rail Relocation Implementation Study (January 2009), known as R2C2, has examined the feasibility of building a new north-south rail line in the eastern plains, to divert a significant share of through freight away from the corridor. Regardless of the specific means of capacity mitigation, because of the criticality of the Joint Line for freight, it is essential to ensure that any proposed passenger service does not adversely affect the ability of the freight railroads to efficiently move freight and grow their own capacity in the future.
The primary user of the Joint Line is BNSF who uses it as part of a through route from Wyoming to Texas. A significant share of BNSF traffic, primarily Powder River basin coal trains, could be diverted onto the proposed R2C2 bypass. However, UP also has significant operations serving power plants and other freight customers along the Joint Line. Because nearly all of UP’s traffic is local, it is hard to divert any of UP’s traffic. Therefore, the R2C2 project offers an opportunity to reduce, but not eliminate freight from the Joint Line. Any passenger plan must recognize the continued need for freight service, and provide a level of capacity that is appropriately matched to market needs.

3.5.2 Potential Greenfield Routes

High-speed passenger rail systems require long tangents and gradual curves to achieve high operating speeds. Grades may exceed those of freight trains, as the equipment is less massive and offers relatively high power to weight ratios. A possible solution is to depart from the existing rail right-of-way to establish new rail lines that are specifically designed for high-speed passenger service. Such lines can be constructed on entirely new alignments or greenfields with the option of using segments of existing highway right-of-way. In this report the term greenfield may be applied to any rail construction outside of existing rail right-of-way. In the I-25 South corridor, the Front Range from Denver to Pueblo, and the Eastern Plains from Pueblo to Trinidad were considered as potential greenfield routes.

For potential development of greenfield routes, the I-25 South highway corridor varies in width from Denver to Trinidad. However, it is difficult to utilize the I-25 corridor through Colorado Springs and Denver due to lack of sufficient right-of-way, and the presence of frequent overpass and underpass structures. South of Denver, instead of using I-25, a separate greenfield on new alignment has been proposed. A separate alignment offers better geometry than the highway alignment could, but the highway alignment offers direct service to downtown Monument and Colorado Springs.

North of Denver, the I-25 highway corridor is very straight and using it avoids rail construction impacts to built-up areas. So in the current feasibility study, the I-25 alignment has been used north of Denver, but not in the south. However, an option for using I-25 for rail in the southern corridor could be developed in the future.

3.5.3 Findings of Field Inspection and Selection of Representative Routes

The existing rail rights-of-way and potential high-speed rail greenfield routes between Denver Union Station and Trinidad were inspected during the period of June 11-13, 2008. The inspection included the historic rail corridors owned by BNSF and UPRR (the Joint Line), I-25 highway corridor and segments of the countryside to the east of the Front Range. The findings of the inspection and the relationship to the FRA basic requirements for an efficient high-speed rail route are as follows. (The relevant FRA guideline is listed in parenthesis following each bullet point):

- Access from the south does not exist at DUS. (Proximity of route to intermodal sites. Refer to section 3.5.5 for further explanation.)
- The Joint Line segment between Denver and C-470 is constrained by limited right-of-way and capacity issues. (Route capacity)
• The Joint Line segment through Castle Rock, Palmer Lake, and Colorado Springs has limited right-of-way that limits speed and impedes construction of improvements to mitigate capacity issues. (Route capacity)
• Many segments of the Joint Line contain limited right-of-way and abrupt curvature that result in slower speeds than desired for efficient passenger rail service (Geometry of route).
• The freight traffic on the Joint Line includes slow moving and frequent coal trains. (Route capacity)
• The existing Joint Line rail right-of-way, with improvements for curve easements, may be suitable for the construction of steel wheel/steel rail technologies with speeds up to 110 mph.
• The existing rail right-of-way, the I-25 highway corridor, and the Front Range and Eastern Plains provide good conditions for upgrading track or building a new right-of-way for various types of high-speed ground transportation. (Route geometry and Proximity to intermodal sites)
• The Front Range from Denver to Pueblo and the Eastern Plains from Pueblo to Trinidad are generally suitable for the construction of a full range of high-speed rail technologies. (Route geometry and Proximity to intermodal sites)
• The I-25 Highway corridor has constraints to the development of high-speed passenger rail service in that the geometric alignment has areas of curves and grades that are not conducive to efficient high-speed passenger rail operation. (Route geometry)

Exhibit 3-2 shows the two Representative Routes that were developed for evaluation in the I-25 South corridor. Please note that these routes are consistent with the Engineering assumptions that were used in development of the Costing Segments (see Appendix E) for initial option screening, and up through the initial development and assessment of the FRA Developed Option. The maps do not reflect changes in the Colorado Springs area or stations that were later developed as part of the Freight Rail Risk analysis (See section 10.6) and subsequently incorporated into the final FRA Developed Option maps.

The existing rail representative route south of Denver, as shown in Exhibit 3-3, include the Joint Line rights-of-way either owned by BNSF and UPRR from Denver to Trinidad (existing rail). Chapter 5 presents a more detailed analysis of the two existing rail tracks concluding in most places that the BNSF (former ATSF) alignment offers better geometry than does the UPRR (former DRGW) alignment.

The representative route for the greenfield option as originally conceived is shown in Exhibit 3-4. From Denver to Littleton, the existing rail alignment is used to gain access to downtown Denver. From Littleton the greenfield alignment proceeds to Lone Tree alongside the C-470, flying over the to east side of I-25 and then along a route contiguous to the I-25 highway to Castle Rock. From Castle Rock the route moves east where better geometry can be obtained. At the crossing of the former Rock Island right-of-way north of Colorado Springs, the route follows this mostly-abandoned rail corridor into downtown Colorado Springs. It uses a route either within or contiguous to the existing Joint Line rail right-of-way through Colorado Springs area; then proceeding into the Front Range from south of Colorado Springs to north of Pueblo onto a segment either within or contiguous to the existing railroad right-of-way into downtown Pueblo. South of
Pueblo the route enters onto the Eastern Plains to Walsenburg and onto Trinidad, entering Trinidad on or contiguous to the existing rail right-of-way.

Exhibit 3-2 shows the areas where the Existing Rail and Greenfield are on different alignments, as well as the common shared segments where the Greenfield uses the existing rail right-of-way in urban areas. It should be noted that both the Existing Rail and Greenfield options assumed the same stations in downtown Colorado Springs as well as a southern suburban station serving Fountain and Fort Carson. The existing rail line does not go past the Colorado Springs airport. The opportunity for adding a station at the airport arose during the freight rail Risk Assessment which occurred identified later in the study. The recommendation to add a station at Colorado Springs airport was subsequently incorporated into the FRA Developed Option after the freight rail Risk Assessment was completed. (See Appendix I)

It should be noted that the rail alignment on the I-25 Greenfield as originally conceived lies on the eastern plain, more than 10 miles east of the town of Monument. A sensitivity analysis was performed on the impact of including a Monument station on this alignment, but because the station lies so far east, the access time actually suggested that riders would generally prefer driving north on I-25 to Castle Rock rather than east on country roads to the place where a station would need to be. As such this station location on the original greenfield alignment was found ineffective, with an essentially neutral ridership impact. It is anticipated that this issue will be addressed in a future study by shifting the alignment farther west, following the recommendations of El Paso County, so that Monument can have an effective station. (See Appendix I)
Exhibit 3-2: Map of All Representative Routes in I-25 South Corridor

LEGEND
- Greenfield Option
- Existing Rail
- Shared Route
Exhibit 3-3: Map of Existing Rail Representative Route in I-25 South Corridor

LEGEND
- Existing Rail Option
- Other Rail Option
3.5.4 Proximity of Representative Routes to Intermodal Sites

**Denver Union Station (DUS):** DUS in downtown Denver is planned to serve as a key intermodal hub for FasTracks and other RTD rail and bus service. In the event that the proposed passenger service is implemented on the existing rail right-of-way, an intercity passenger rail station connected to DUS could be constructed contiguous to the Consolidated Main Line (CML). Since the current DUS station is a stub-end design allowing service only from the north, placing the intercity platform alongside the CML tracks would also allow for direct rail service from the south. The study assumes that a footprint for the necessary intercity rail platforms and tracks alongside the CML will be preserved in development plans for the site. To minimize platform space requirements at DUS, all operating plans developed in this study assume run-through service at DUS with no intercity trains originating or terminating there. The view south from DUS, showing the current Light Rail platform, is shown in Exhibit 3-5. It should be noted that this platform will be removed and relocated approximately 1,000 feet to the west, alongside the Consolidated Main Line, based on current redevelopment plans for the site. Exhibit 3-6 shows the area between DUS and the BNSF/UPRR Consolidated Main Line.

Exhibit 3-5: View showing commercial development constructed on the southern approach to DUS
Exhibit 3-6: Area between Denver Union Station and the BNSF/UPRR Joint Line (existing rail)

**South Suburban Station:** The South Suburban Station is proposed for a location near the intersection of the Joint Line with the C-470 highway. The location is contiguous to the existing rail route, and also accessible to the proposed greenfield route that proceeds from this intersection east along the right-of-way of C-470 to Lone Tree. The proposed South Suburban Station provides intermodal opportunities for highway users and users of the RTD system.

**Lone Tree Station:** On the greenfield corridor, the Lone Tree Station is proposed at a site near the intersection of I-25 South and C-470. The existing rail route does not serve this station. The greenfield route provides better access to intermodal sites than does the existing rail route, since it reaches into Lone Tree at the intersection of C-470 and I-25. For providing access to the Denver Tech Center, this location is near an existing, as well as proposed new RTD Southeast Light Rail station.
3.5.5 Proximity of Representative Routes to Population Centers

The representative existing rail and greenfield routes in the I-25 corridor, as shown in Exhibit 3-6, connect with major population centers. The only exception is that the greenfield route does not connect into downtown Castle Rock as currently envisioned. The proposed greenfield route leaves the I-25 corridor north of Castle Rock due to topographic conditions and development within and south of Castle Rock. A greenfield station site would have to be north of the city. The proposed greenfield route also misses Monument completely since it passes so far to the east. Alternative alignments that use portions of the existing rail or I-25 highway corridors to improve access to Castle Rock and Monument could be developed as part of the NEPA process.

3.5.6 Geometry of Representative Routes

The representative route using the existing freight rail corridor consists of two rail lines the former DRGW (Union Pacific) and the former ATSF (BNSF). The geometry of the Union Pacific alignment is not appropriate for high-speed rail operations in that the curves and grades are such that development of a curve easement program for this alignment would likely be very expensive. The BNSF alignment also has geometric constraints, but not as significant as the Union Pacific alignment. Because the BNSF alignment has fewer curves to begin with, fewer easements would be required to improve this alignment than the parallel UP track. Therefore, from Littleton to Pueblo the BNSF alignment is proposed for the passenger rail route. The Spanish Peaks section between Pueblo and Walsenburg is acceptable for passenger service, but there are significant curves on the segment from Walsenburg south to Pueblo.

The geometry of the existing rail alignment from Littleton to Trinidad is challenging. Many curves along the alignment need to be reduced or flattened in order to increase efficiency of operation. However, topographic constraints in several areas constrain the existing right-of-way making geometric changes very difficult, so it will not be possible at reasonable cost to ease all the curves. In general, the geometry of the existing rail right-of-way is less than optimum for efficient high-speed rail intercity passenger operation. However, the existing rail right-of-way does provide an opportunity to minimize both the capital costs and environmental impacts by utilizing the existing track infrastructure.

The greenfield route begins at the intersection of C-470 and the existing rail right-of-way (Joint Line) and proceeds within or contiguous to C-470 right-of-way to Lone Tree as shown in Exhibit 3-6. This greenfield route crosses over I-25 and proceeds on the east side of I-25 to a vicinity north of Castle Rock. The greenfield route then proceeds toward Colorado Springs and onward to Pueblo and south to Trinidad. Although the topography is challenging, geometry is conceptually developed with minimal horizontal and vertical curves allowing for efficient high-speed intercity rail service serving downtown Denver, Colorado Springs, Pueblo, and Trinidad with intermodal sites at optimal locations along the greenfield route.

As previously noted, geometry is directly related to speed and travel time. The geometry of the existing rail route is less than desirable, whereas, the geometry of a greenfield route can be developed for efficient high-speed rail and maglev operations that optimize speed and travel time.
However, the current greenfield alignment lies so far to the east that it misses many of the established intermediate population centers. The NEPA analysis for this corridor will undoubtedly have to develop the optimal tradeoff between geometry, which favors an eastern route, and market access, which favors a more westerly route through more difficult topography.

### 3.5.7 Capacity of Representative Routes

The Joint Line segment between Denver and C-470 is constrained by limited right-of-way and capacity issues. The Southwest Corridor Light Rail Transit (LRT) operates within this corridor from DUS to Mineral. A future Light Rail extension to C-470/Lucent Blvd has been proposed. The presence of the LRT combined with a limited right-of-way in the corridor restricts the opportunity to construct additional capacity at many locations along this segment, thereby presenting significant challenges to the implementation of passenger rail without either the construction of the R2C2 or the relocation of some Light Rail segments. Exhibit 3-7 shows the Littleton Trench, which is the most significant constraint to increasing capacity. It will be difficult to construct another track in this segment, without either elevating the new track or displacing the LRT line to a street-running alignment.

**Exhibit 3-7: Littleton Trench on the BNSF/UPRR Joint Line between DUS and C-470**

As noted, previously, the greenfield route in the I-25 South corridor currently requires the use of the existing rail right-of-way between Denver Union Station and C-470. Capacity issues discussed previously apply to this segment of greenfield route. The greenfield route exits the existing rail right-of-way at C-470. The greenfield route has no capacity issues except at Colorado Springs and Pueblo. In order to enter into these cities, the greenfield route needs to make use of the existing rail
rights-of-way, thereby triggering capacity concerns. These concerns are mitigated by the proposed infrastructure improvements to the existing rail right-of-way.

Capacity for the existing rail route between Palmer Lake and Monument is a concern since the joint line in this section is limited to one track, and the BNSF portion of the Joint Line has been abandoned in this area. Exhibit 3-8 is a view south at Palmer Lake showing the abandonment of the old Santa Fe line on the east side of the lake and the construction of a park and residential area. The abandonment continues from Palmer Lake through Colorado Springs to Crews, presenting significant challenges to the construction of efficient high-speed rail service on the existing rail route. Exhibit 3-9 is a view north in Monument displaying the “New Santa Fe Trail.” Possible options for dealing with these segment constraints will be discussed in Chapter 5.

The segment of existing rail route between Denver and Littleton has significant capacity issues that need solution with or without the construction of R2C2. This segment is common to both the existing rail and greenfield routes. The capacity issues on the existing rail route between Littleton and Denver are reduced by the construction of R2C2 but not fully alleviated.

Also, the section of existing rail between Palmer Lake and Crews provides challenges since the joint line only operates on the UP tracks since the BNSF property through Colorado Springs in this area has been abandoned. If the existing rail alignment is used, then consideration should still be given to development of a new greenfield alignment from Palmer Lake to Colorado Springs, to bypass the difficult geometry that exists on the current rail line on Monument Hill.

The greenfield route south of Littleton has no capacity issues except in Colorado Springs and Pueblo where the route leaves the greenfield and joins with the existing rail route to enter the urban areas. However, these capacity issues could be eliminated if Colorado Springs and Pueblo were served by suburban stations rather than following the current rail corridors downtown.
Exhibit 3-8: View south at Palmer Lake near MP 52.0 County Line Rd

Exhibit 3-9: View north at Route 105 of Abandoned BNSF in Monument

As can be seen in Exhibit 3-10, the topography of the Front Range and the Eastern Plains could allow for the development of a greenfield route with minimum horizontal and vertical curves. Exhibit 3-11 shows a site about 2 miles east of I-25 at Exit 91 south of Pueblo. As can be seen, the existing rail right-of-way and a proposed greenfield route are within a relatively flat, sparsely populated landscape. This situation permits optimum geometric design of a greenfield route, although it can be seen that the existing rail line in this area is fairly straight as well.
Exhibit 3-10: I-25 at MP 125 South of Colorado Springs, View North

Exhibit 3-11: BNSF at Lime Road View North
Exhibit 3-12 demonstrates the openness of the Eastern Plains and favorable topographic conditions for the development of a greenfield route. This site along the BNSF Spanish Peaks subdivision is approximately 10 miles north of Walsenburg and 5 miles east of I-25 in the Eastern Plains. The eastern plains are relatively flat with eroded waterways posing the only obstacle to rail construction. The population is very sparse except for occasional small towns between Pueblo and Trinidad.

Exhibit 3-12: BNSF Spanish Peaks Sub at County Rd 103 View North

3.6 Engineering Assessment: I-25 North Corridor – Denver to Cheyenne

3.6.1 Existing Rail Rights-of-Way

**UPRR Greeley Subdivision**

In 1868 the Denver Pacific Railway began construction of a rail line linking the City of Denver to the transcontinental line at Cheyenne, WY. The line followed the South Platte River through Greeley and was completed in 1870. In 1880, the railroad merged the Kansas Pacific and Union Pacific, eventually becoming a Union Pacific property. Currently, the line is operated as Union Pacific’s Greeley Subdivision, serving as a freight line. Historically the route of Amtrak’s Pioneer, no passenger service currently operates on the line.

**Great Western Railway of Colorado (GWRCO) Greeley to Ft. Collins**

In 1881, the Greeley, Salt Lake and Pacific Railway constructed a railroad between Greeley and Ft. Collins, connecting to the Denver Pacific Railway at Greeley. It is reported that the line was originally intended to become a southern branch of Union Pacific’s transcontinental railroad operating through northern Colorado. In 1898, the line was incorporated in the Colorado and Southern Railway, eventually becoming part of the Chicago, Burlington and Quincy Railroad, predecessor to the BNSF. The BNSF sold the line to OmniTrax, which operates the property as a short line railroad, the Great Western Railway of Colorado.
BNSF Front Range Subdivision

BNSF’s Front Range Subdivision runs north from the Denver Union Station (DUS) to Cheyenne, WY through Boulder, Longmont and Ft Collins, a distance of approximately 120 miles. The Denver RTD is planning to construct a new transit system segment from Denver to Longmont on the BNSF property employing DMU technology and sharing the track with the existing freight service. Generally, RTD will construct a second track adjacent to the existing track, except where constrained by very narrow right-of-way. RTD plans to operate up to 66 trains per day, making this a very busy corridor. This route has extremely poor geometry and urban speed restrictions south of Ft Collins.

Milliken Line

The Union Pacific operates a branch line roughly paralleling the GWRCO line described above, but on a more southerly alignment. The line starts at LaSalle heading southwest to Dent, where it turns northwest to Fort Collins. For passenger service, only the Dent to Fort Collins segment has been evaluated, along with a proposed new greenfield segment that would connect from Dent to Platteville on the Greeley Subdivision. Although this alignment misses downtown Greeley, the potential North Front Range station at I-25 and US-34 would improve service to Loveland and south Fort Collins. The same North Front Range station location is also served by the proposed I-25 North greenfield alignment. The Milliken option is the one that was carried forward as the 110-mpq representative route for existing rail on I-25.

3.6.2 Potential Greenfield Routes

The I-25 North highway corridor is wide from an area north of Denver to the Wyoming border, with the exception in urban areas south of the E-470. It is possible to construct a high-speed rail mode, either in the median or adjacent to the highway on either side. The I-25 North median is typically 40 feet in width, which satisfies the minimum requirement for constructing a passenger rail system.

3.6.3 Findings of Field Inspection and Selection of Representative Routes

The I-25 North Corridor was inspected between Denver and Cheyenne during the summer of 2008. The inspection included the rail corridors owned by BNSF, GWRCO and UPRR and the I-25 highway corridor. The inspection served to document the observed existing conditions and identify any significant challenges to the construction of new high-speed rail infrastructure. Specific photos and observations of the route from Denver Union Station north to Greeley and Cheyenne are included in the Existing Conditions Report. The findings of the field inspection and the relationship to the FRA basic requirements for a high-speed rail route are as follows:

- The BNSF route from Denver to Boulder and Longmont included a number of sharp curves, which will serve to limit the speed of passenger service. (Geometry of route)
- The Greeley route is very straight and wide, offering very good geometry for high-speed rail operations. (Geometry of route)
- The I-25 corridor offers a wide right-of-way, although reconstruction will be required of some grade separation structures. (Geometry and Capacity of route)
• Access to downtown Denver from the north is constrained by limited rail right-of-way and minimal availability of the median within the I-25 corridor. (Capacity of route)
• The existing rail right-of-way through Boulder, Longmont, and Loveland is limited (Capacity and Geometry of route)
• Commuter rail service is planned for the BNSF line to Boulder. (Capacity of route)
• The BNSF alignment through Fort Collins is “street running” which is not compatible with the needs of high-speed passenger rail service. (Capacity and Geometry of route)

Exhibit 3-13 shows the Representative Routes that were evaluated in the I-25 North corridor:

• The BNSF existing rail route consists of a route within or contiguous to the BNSF right-of-way through Boulder, Longmont, and Fort Collins to Cheyenne (existing rail). The portion of this route from Denver to Fort Collins was screened early on in the evaluation process as described in Chapter 5; however the northern portion from Fort Collins to Cheyenne is fairly straight and could serve as a viable route option for a possible service extension to Cheyenne. This is highlighted in Exhibit 3-14.

• The UP existing rail route consists of the Greeley subdivision from the Denver area to Greeley (existing rail). Three variants of the UP route option have been considered. The first option was to continue north from Greeley to Cheyenne. This route is fast but misses all the major markets, particularly in Fort Collins, that lie farther west. As a result, the use of the UP corridor north of Greeley was also screened early in the evaluation process. This is highlighted in Exhibit 3-15.

• A variant on the UP existing rail option would use the Great Western Railroad of Colorado (GWRCCO) from Greeley to Fort Collins. This option was retained, but the Milliken line option was found to perform better. The GWRCCO option is highlighted in Exhibit 3-16.

• A second variant on the UP existing rail option would use the UP Milliken line. This option would require a greenfield connector from Platteville to Dent, and then use the existing rail branch line on to Fort Collins. Either of the GWRCCO or Milliken line options could continue north to Cheyenne over the BNSF railroad. Another variant that could be considered would be the use of the Milliken line to Fort Collins with a short branch line into downtown Greeley. The Milliken route is highlighted in Exhibit 3-17. The Milliken option is the one that was carried forward as the 110-mph representative route for existing rail on I-25.

• For access to DIA from downtown Denver, the representative route follows the BNSF Brush subdivision right-of-way (existing rail) to the north side of the Rocky Mountain Wildlife Refuge. It would then continue east on a greenfield alignment along the north side of the preserve to reach a station at DIA. This route was developed at the recommendation of the RTD because the narrow width of the East Line Corridor right-of-way would not accommodate the additional tracks needed to add express intercity rail service to the corridor. The DIA access route is highlighted in Exhibit 3-18.
One greenfield option has also been developed for the I-25 North corridor. From downtown Denver, this route would share the BNSF Brush line route proposed for DIA access. Beyond the airport spur, the route would continue north along the Brush line to the E-470. At this point the alignment would leave the rail right-of-way and follow E-470 and I-25 to Fort Collins. The option that was developed for this study follows the highway right-of-way to fly over to the west side of I-25 at the E-470/I-25 junction. This greenfield route option is highlighted in Exhibit 3-19. However another option for connecting the alignment between the two highways would be to use a section of the Boulder Industrial Lead, which was just purchased from UP by RTD. This would allow a joint station with the proposed RTD North Metro corridor. This interconnection option is shown in Exhibit 3-20.
Exhibit 3-13: Potential Routes within the I-25 North Corridor

LEGEND
- Greenfield
- Existing Rail
- Shared Route
Exhibit 3-14: Screened Alternative, BNSF Route Denver to Cheyenne
Exhibit 3-15: Screened Alternative, UP Route Denver to Cheyenne
Exhibit 3-16: Retained Alternative, UP Route Denver to Fort Collins GWRCO Option
Exhibit 3-17: Representative Existing Rail, UP Route Denver to Fort Collins Milliken Option
Exhibit 3-18: Airport Access route Denver to DIA
Exhibit 3-19: Greenfield Option following E-470 and I-25 Denver to Fort Collins
The I-25 corridor has been evaluated from Denver to Cheyenne as a potential corridor for High-Speed rail or maglev service. As can be seen in Exhibit 3-21, north of the E-470 the I-25 median for the most part provides sufficient width for installation of a guideway. However, on I-25 south of the E-470 this median has been taken or reserved for future highway expansion, and there are several complex interchanges crossing other interstate highway that form a barrier to rail development. For this reason the greenfield alignment follows the E-470 over to the BNSF Brush Line, which offers easier access to downtown Denver than would proceeding further south on I-25.
One issue for the utilization of any highway right-of-way is the occasional conflict with highway overpasses. If a pier in the median supports an overpass, the overpass may require reconstruction to remove the obstacle. However, most of the overpasses along I-25 do not appear to require reconstruction. Exhibit 3-22 shows a highway overpass that would not require reconstruction in order to install a high-speed rail alignment in the median. The existing overhead clearance of this overpass is sufficient for passenger trains on a dedicated alignment but it would not be sufficient for freight trains.
3.6.4 Proximity of Representative Routes to Intermodal Sites

Three intermodal sites in the I-25 North Corridor are the North Suburban Station, the North Front Range station at I-25 and US-34, and the Fort Collins station, which can be located either downtown, or else on the I-25 highway along the proposed greenfield route. Only the Milliken Line existing rail route and the I-25 greenfield options serve the North Front Range station. Only the I-25 greenfield option could serve the North Suburban Station at the intersection of E-470 and I-25. Ridership modeling has shown that this highway interchange is close enough to Boulder and Longmont to attract some ridership from those cities. A North Suburban station could be provided on the existing rail option, but it would have to be located much farther east in the vicinity of the E-470 and US-85. This location is in a relatively depopulated area that is too far away to effectively serve the Boulder and Longmont areas. Accordingly, the I-25 greenfield option provides the best Intermodal connectivity and station site options, followed by the Milliken existing rail option. The GWRCS option has the weakest stations since it can only serve the Fort Collins market effectively, but misses the important Loveland, Longmont and Boulder markets farther south. This reflects in the ridership projections that have been developed for each of these route alternatives.

3.6.5 Proximity of Representative Routes to Population Centers

The existing rail right-of-way of the UPRR Greeley subdivision does not serve any major population centers with the exception of Greeley. From the Greeley line, use of either the Great Western or Milliken lines would be required to link to Fort Collins. The BNSF existing rail right-of-way connects with Boulder, Longmont, Loveland, and Fort Collins but has poor geometry and restricted speed. The I-25 greenfield route connects with major population centers in the I-25 corridor.

A brief review of the population centers north of Denver confirms the BNSF existing rail route serves more population than the UPRR existing rail routes. However as described previously, the I-25 greenfield also serves all population centers, and it could offer much better geometry for supporting high-speed operations than does the BNSF existing rail route.

3.6.7 Geometry of Representative Routes

The BNSF existing rail right-of-way from Denver to Boulder and Longmont has numerous sharp curves, which limit the speed of the passenger service. Therefore the BNSF existing rail right-of-way does not offer efficient high-speed rail service in the I-25 corridor, and this route was screened early in the evaluation process. The geometry of the Union Pacific existing rail rights-of-way is excellent. It would provide efficient high-speed rail service with the maximum speed of 110 mph but misses the main population centers. The proposed greenfield route in the I-25 corridor provides an opportunity to develop optimum geometry for efficient high-speed passenger rail service, as well as to effectively serve the entire population base of the north Front Range communities.
3.6.8 Capacity of Representative Routes

The BNSF Front Range subdivision existing rail right-of-way from Denver to Boulder to Fort Collins has significant capacity issues. Although the right-of-way in rural areas allows expansion of the track structure, the right-of-way is constrained in urban areas. Additionally, as shown in Exhibit 3-23 the right-of-way through Fort Collins is “street running” which would reduce capacity and the opportunity to add additional track. The length of this segment is approximately one mile. Also, RTD FasTracks is planning to implement commuter rail service on the BNSF right-of-way from Longmont to Denver, further reducing the available capacity of this corridor for intercity rail purposes.

Exhibit 3-23: View north along Mason St in Fort Collins near MP 73.54
(BNSF Front Range Subdivision)

For access to DIA, several existing rail routes were considered including the UP Kansas Pacific subdivision between downtown Denver and Airport Boulevard. RTD has purchased 40 feet of the UP right-of-way in this subdivision and plans to construct an East Corridor service to DIA. However, UP is planning to add a second freight track to the remaining right-of-way. Therefore, the opportunity to utilize this existing rail route for high-speed passenger rail service to DIA is very limited.

As an alternative, the use of the BNSF Brush subdivision from DUS to Sand Creek Junction proceeding to 96th Avenue was considered. From 96th Street junction with BNSF to DIA, a greenfield route along the south side of 96th Avenue on the property of the Rocky Mountain Arsenal is considered as a reasonable route. Sufficient area exists to permit an at-grade guideway for rail or maglev technology as shown in Exhibit 3-24. This greenfield route connects to the BNSF Brush Line right-of-way (existing rail route) and parallels State Highway 2 (SH-2) along the BNSF right-of-way into DUS. Exhibit 3-25 shows the crossing of 96th Street with the existing rail route. Exhibit 3-26 shows the BNSF right-of-way on the east side with sufficient area to construct additional capacity as needed for passenger rail service.
Exhibit 3-24: View east toward DIA along 96th Street

Exhibit 3-25: View east toward DIA at crossing of BNSF existing route with 96th St
The capacity issue on both the UPRR right-of-way and the BNSF right-of-way from Denver Union Station to the Sand Creek Junction is a concern. RTD is planning to build the North Metro Corridor on the east side of the BNSF Brush Line tracks from Sand Creek to DUS further complicating capacity issues on this segment of track. The Sand Creek Junction offers a significant capacity challenge to the implementation of high-speed passenger rail service in that it is a potential bottleneck. Exhibit 3-27 shows that the UPRR Greeley Subdivision and BNSF Brush Subdivision cross at this point under the I-270 highway overpass proceeding into the Denver urban area. In addition, Sand Creek passes under the tracks in the same vicinity as the highway overpass. This makes it difficult to depress any of the tracks as an option for implementing grade separation. The capacity of the existing rail routes of UPRR and BNSF from Sand Creek to DUS needs to be increased by the addition of at-grade tracks or elevated structure to provide for efficient passenger rail operations.
From Sand Creek to the Wyoming border, sufficient land exists along UPRR rights-of-way to Fort Collins and BNSF right-of-way from Fort Collins to Cheyenne in the rural areas providing the opportunity to increase capacity of the route by the installation of additional tracks. Exhibit 3-28 displays that ample space is available within or contiguous to the UPRR Greeley subdivision in the vicinity of 120th Avenue, which is typical of existing conditions in rural areas. Exhibit 3-29 shows that similar conditions exist along the GRWCO between Greeley and Fort Collins. However, because of limiting constraints within urban areas along the existing rail routes, cooperation by the freight railroads is still needed to allow for efficient passenger rail service operations using the existing rail rights-of-way.

Exhibit 3-28: View south, UPRR Greeley sub MP 13.6 at 120th Ave.
The development of any greenfield route from Denver Union Station to the fringe of the Denver metropolitan area is challenging. Significant improvements to existing rail infrastructure and/or the construction of elevated guideways within the Denver metropolitan area will be needed to clear the metropolitan area of Denver. Once clear of the metropolitan area, there is sufficient land contiguous to or within the rights-of-way of E-470 and I-25 from outside the Denver metropolitan area to Wyoming.

3.7 Engineering Assessment: I-70 Corridor – Denver to Grand Junction

The existing and proposed greenfield right-of-way alternatives in the I-70 corridor, from Denver International Airport to Eagle Airport, and secondary route extensions to Craig, Aspen and Grand Junction. This section develops the I-70 options on a segment by segment basis. It is envisioned that a through rail service will be developed to allow a single-seat ride from DIA to I-70 destinations. Nonetheless from a physical infrastructure point of view, it made more sense to address DIA access as part of the I-25 North system so this segment has already been introduced. The presentation of I-70 segments will start in Denver and proceed west in three major sections, as follows:

- From Denver to Golden there are one existing rail option and several possible highway options. The US-6 highway option was preferred and used as the basis for this evaluation.

- From Golden to Minturn, west of Vail, no rail lines exist. Two greenfield route alternatives, one based on the existing I-70 highway right-of-way, the other independent of the highway, have been developed. This includes service to Breckenridge.
From Minturn west to Grand Junction, Aspen and Craig, the existing rail options were evaluated, along with two “Cut off” options for shortening the routes to Aspen and Craig. These segments are shown in the overall corridor map in Exhibit 3-30.

Exhibit 3-30: I-70 Corridor from Denver to Grand Junction, Aspen and Craig

3.7.1 Access to I-70 Corridor from Denver to Golden

The two options evaluated from Denver to Golden were the BNSF existing rail option using the BNSF Golden subdivision via Arvada and the US -6 greenfield alignment. I-70 and I-76 highway options were examined but were more circuitous than the US-6 option, rail access to the I-70 and I-76 corridors was more difficult than to US-6, and there were problems with geometry. In some cases sufficient median space or right-of-way for economical construction of a guideway was lacking. Accordingly the evaluation focused on the US-6 highway alternative from Denver to Golden which provides both a straight and direct means of linking to either the I-70 mountain corridor or the Clear Creek Canyon. Exhibit 3-31 shows these two options in more detail.
US-6 Highway Corridor to Golden

To access the I-70 mountain corridor from downtown Denver, the proposed high-speed passenger rail service could use the existing rail Joint Line from DUS to the vicinity of the intersection of I-25 and US-6. This existing rail portion would be shared with the I-25 south corridor. From the junction of US-6, a new greenfield route would be developed that uses extensive elevated structure to take high-speed trains west to a Golden suburban station in the vicinity of the US-6/I-70/C-470 highway interchange. From here, routes could be developed either heading directly west up the I-70 corridor via El Rancho, or else linking over to a lower-gradient alignment option up the Clear Creek canyon.

Along US-6, Exhibit 3-32 shows that frontage roads are available for the construction of either at-grade or elevated guideways for passenger rail service. Exhibit 3-33 shows a very constrained area of US-6, which would require elevated guideways for passenger rail service. Furthermore, RTD has started construction of the West Corridor for Light Rail Transit service within the US-6 right-of-way near the Jefferson County Courthouse.
Exhibit 3-32: US-6 with frontage roadways on each side of the alignment

Exhibit 3-33: US-6 near Denver city limits in a very constrained area
**BNSF Golden subdivision from Denver Union Station to Ford Street in Golden**

The existing rail route of the BNSF Golden subdivision is also considered as a candidate route for passenger rail service from DUS to Ford St in Golden. Starting at DUS, the alignment follows the BNSF Front Range Subdivision (not the Brush Line) to Utah Junction, where it parallels the UP Moffat line for a short distance. The BNSF Golden Subdivision then diverges toward the south and west. The existing rail route passes through Arvada and ends at Ford Street in Golden. BNSF uses it to provide freight service to Coors Brewery as well as other local freight customers along the line. This existing rail route will also be used by the RTD FasTrack’s planned Gold Line. Exhibit 3-34 is a view of the BNSF existing rail route near the Coors Brewery in Golden. However, the route through Arvada would require a tunnel or covered trench in order to mitigate concerns of local residents.

**Exhibit 3-34: View west along BNSF Golden Subdivision near Golden**

Beyond the end of existing track, a greenfield route would be required to connect the end of the BNSF Golden subdivision with the US-6 greenfield route up the Clear Creek canyon. The length of this connection is approximately 1 mile. Exhibit 3-35 shows the area that is traversed by the route.
3.7.2 I-70 Corridor from Golden to Minturn

Whereas the I-25 South Corridor and I-25 North Corridor have existing rail rights-of-way, no rail lines exist from Golden to Minturn. As such, the development of a new greenfield route would be necessary.

The geometry of the I-70 highway is consistent with any highway through a mountainous area, consisting of numerous curves and gradients of up to 7 percent. This type of geometry is not ideally conducive to high-speed rail operations. In order to optimize the performance of high-speed rail in the I-70 corridor, two different options for development of a greenfield route have been developed by this study: both the use of the existing I-70 highway Right-of-Way, as well as routes that are off the I-70 right-of-way. The greenfield route that is within or contiguous to the I-70 right-of-way limits is defined as constrained. Any greenfield route that is not within the existing highway corridor of I-70 is defined as unconstrained. These two route options are shown in Exhibit 3-36, and described as follows:

- **The Constrained or I-70 Right-of-Way option** stays on the I-70 right-of-way the entire distance from the US-6/I-70 station, across El Rancho, past Georgetown and the Eisenhower Johnson Memorial Tunnel (EJMT), through Silverthorne, Frisco and Copper Mountain, across Vail Pass, through Vail to Minturn. However, a branch line was added from Silverthorne following US-6 back to Keystone, then tunneling under Swan Mountain south of Lake Dillon, and ending at Breckenridge. This allows the “Constrained” option the ability to serve these two important resorts directly.

- The intent of the unconstrained option is to minimize horizontal and vertical curves and maintain gradients at 4 percent or less. To comply with these geometric constraints, more tunnels are utilized as compared to the previous option. The alignment follows a connector line along US-6 up Clear Creek canyon to Floyd Hill.
This bypasses a severe segment of 7 percent gradient and also allows convenient access to Black Hawk just by continuing a branch line up the canyon. From Floyd Hill to Loveland Pass, the unconstrained alignment parallels I-70, but can be located anywhere in the valley to optimize route geometry and minimize cost. A tunnel is used from Georgetown to Silver Plume to reduce the gradient to 4 percent. From Loveland Pass the alignment tunnels directly to Keystone, then follows an alignment around the south end of Lake Dillon directly to Breckenridge. It then tunnels directly to Copper Mountain. From here, rather than going across Vail Pass, the route parallels State Route 91 south, to link up with the existing UP rail line at Pando.

Exhibit 3-36: I-70 Corridor from Golden to Avon showing two Greenfield Route Options

The earlier I-70 Mountain Corridor Programmatic Environmental Impact Statement extensively researched the concept of implementing passenger rail service, either with steel wheel/street rail technology or using an Advanced Guideway System based on urban magnetic levitation technology. The steel wheel steel rail technology considered in that study was an “on-grade electrified facility with elevated sections where needed for wildlife crossings and geologic hazards”. The I-70 Mountain Corridor PEIS assumed that the infrastructure required for each technology would be constructed within the right-of-way limits of I-70 and was constrained by these limits. Information related to infrastructure needs and the capital cost estimates provided by this earlier study from C-470 to Vail were reviewed and used in this engineering assessment.

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3 I-70 Mountain Corridor, Tier 1 Draft PEIS, December 2004
As an alternative to 7 percent grades via El Rancho, a Clear Creek Canyon alternative was developed for the unconstrained alignment. Exhibit 3-37 shows the difficult geometry and terrain in Clear Creek Canyon. In order to minimize the geometric limitations of the route, ten tunnels are needed for nearly 40 percent of the entire length of this route. This allows an average train speed at about 60 mph through the canyon. The geometry of SH-119 continuing from US-6 to Black Hawk is similarly severe. If the I-70 Highway alignment via El Rancho were selected instead of the Clear Creek Canyon route, then a tunnel parallel to the proposed highway tunnel from Floyd Hill to SH-119 would provide an alternative means for linking to Black Hawk.

**Exhibit 3-37: View west on US-6 in the Clear Creek Canyon**

![View west on US-6 in the Clear Creek Canyon](image)

This RMRA Feasibility Study differs from the I-70 PEIS since it also considers an unconstrained option. The route studied between the US-6 Interchange at MP 244 and Loveland Pass Interchange at MP 216 considers the use of the entire I-70 corridor; i.e., land contiguous to the I-70 right-of-way limits. The engineering assessment of the contiguous portion of I-70 was undertaken for the purpose of determining the optimum route to select for high-speed passenger rail service using either steel wheel or maglev technology and also for the purpose of restricting the grade to 4 percent or less. Exhibit 3-38 shows a view west along I-70 highway and the potential for construction of a guideway within the right-of-way limits. Exhibit 3-39 shows a view of land contiguous to the I-70 right-of-way that could be utilized for the construction of a guideway. The corridor route developed in this segment includes an option for construction of the Georgetown Tunnel (14,000 ft.) in order to maintain a 4 percent grade. The gradient of I-70 at this location is greater than 6 percent.
Exhibit 3-38: View west in the vicinity of MP 230 approaching Georgetown

Exhibit 3-39: View of south of I-70 in vicinity of Georgetown
The unconstrained alignment leaves the I-70 corridor in the vicinity of the I-70/Loveland Pass interchange into the North Fork Tunnel (length of 30,000 ft) and proceeds to Keystone. From Keystone the greenfield route either reconnects to the I-70 corridor at Silverthorne or proceeds directly toward Breckenridge and SH-9 through a proposed Swan Mountain Tunnel (12,000 ft) to serve Breckenridge. The unconstrained route either enters the Breckenridge Tunnel (22,000 Ft.) directly to Copper Mountain or proceeds north to Frisco through the Frisco tunnel (6,000 ft.) to rejoin the I-70 corridor. Exhibit 3-40 shows the conditions along SH-9 between Frisco and Breckenridge and is also representative of the conditions along US-6 between Keystone and Silverthorne. These conditions permit the construction of a guideway that is contiguous to either US-6 or SH-9.

Exhibit 3-40: Typical condition of SH-9 and US-6 with space for guideway

Beyond Copper Mountain, the unconstrained route proceeds south along SH-91 and through the National Forest on a series of elevated structures, meeting with the UPRR Tennessee Pass subdivision (existing rail) at Pando. The route proceeds on existing rail to Minturn with a possible greenfield link to Vail. Further analysis of the route through the National Forest is needed to determine the optimum alignment and infrastructure to maintain a grade a 4 percent or less. Exhibit 3-41 shows area along SH-91 available for a guideway. Exhibit 3-42 shows the National Forest with mine tailing ponds where elevated structures and/or tunnels are likely needed to traverse this area.
3.7.3  I-70 Corridor from Minturn to Grand Junction

West of Minturn to Grand Junction, Aspen and Craig, the evaluation primarily focused on existing rail options although two cutoffs, the “131 Option” from Wolcott to State Bridge, and the Aspen Tunnel option from Gypsum to Mid-Valley, were also evaluated as potential means for shortening the routes. Exhibit 3-43 shows the Existing Rail plus two greenfield cutoff options in more detail.
The UPRR Tennessee Pass Subdivision from Pando Junction and Minturn to Dotsero is considered as a candidate route for passenger rail service connecting the I-70 corridor with stations to the West. UPRR has suspended freight service on the Tennessee Pass existing route with the exception of minimal freight service from Dotsero to Gypsum. Exhibit 3-44 shows a typical view of the UPRR existing route.

**Exhibit 3-44: Typical View of condition of UPRR Tennessee Pass Subdivision**
Amtrak passenger rail service currently operates on right-of-way of UPRR from Dotsero to Grand Junction. Exhibit 3-45 shows the right-of-way of the UPRR on the south side of I-70 clinging to the Glenwood Canyon wall. At this point, there is approximately 7.5 miles of single-track rail line through very challenging terrain. As shown in Exhibit 3-46, consideration was also given to development of a greenfield route following I-70 through Glenwood Canyon to Grand Junction for potential use as a maglev guideway. This exhibit shows that the corridor within Glenwood Canyon is severely constrained by canyon walls. These constraints would present a severe challenge for construction of a guideway following the highway alignment through this area. It would be possible to close the 7.5 mile gap of single track rail line in the canyon by constructing a new rail alignment on an expensive combination of bridges and tunnels.

Exhibit 3-45: View west of UPRR and I-70 through Glenwood Canyon

Exhibit 3-46: View east along the I-70 corridor (MP 124) through Glenwood Canyon
The UPRR segment between Dotsero and Bond provides a possible connection for passenger rail service on a secondary corridor from the I-70 corridor to Steamboat Springs and Craig. This segment currently has Amtrak passenger service connecting to Denver and destinations to the East and Grand Junction and destinations to the West. This segment lies within challenging terrain as seen in Exhibit 3-47. Providing passenger service to Steamboat Springs and Craig would require the use of the Moffat and Craig Subdivisions. Although this existing rail route has freight service, the rail right-of-way, as shown in Exhibit 3-48, is in rural areas providing area for addition of track structure as required to add passenger service.

Exhibit 3-47: View west toward Dotsero along the UPRR

Exhibit 3-48: View south on the UP Branch line to Bond at CP 153 near Toponas
In 1997, the Roaring Fork Railroad Holding Authority purchased the Denver and Rio Grande Western Rail line between Glenwood Springs and Aspen to preserve the corridor for future rail and trail development. This right-of-way is considered as a route for passenger rail service. Exhibit 3-49 shows a bike trail along the right-of-way.

Exhibit 3-49: View north on the Rio Grande bike trail near Aspen