Interregional Connectivity Study
Level 2 Evaluation Report

CDOT Division of Transit and Rail

September 2013

ICS Interregional Connectivity Study

Contents

Exhibits

Appendices

Acronyms and Abbreviations

AGS	Advanced Guideway System
B/C	benefit/cost
BEA	Bureau of Economic Analysis
CML	Consolidated Main Line
CR	County Road
DIA	Denver International Airport
DUS	Denver Union Station
CADD	computer-aided design and drafting
CAPEX	capital expenditures
CDOT	Colorado Department of Transportation
COS	Colorado Springs Airport
CPI-U	Consumer Price Index – Urban Consumers
CRT	commuter rail transit
DRCOG	Denver Regional Council of Governments
EB	eastbound
EGE	Eagle County Regional Airport
EIS	Environmental Impact Statement
EOL	End of Line
FAA	Federal Aviation Administration
FAR	floor to area ratio
FRA	Federal Railroad Administration
FTA	Federal Transportation Administration
HSIPR	High-Speed Intercity Passenger Rail
HSR	high-speed rail
ICS	Interregional Connectivity Study
LRT	light rail transit
Maglev	magnetic levitation
MOS	Minimum Operable Segment
MPH	miles per hour
MPO	Metropolitan Planning Organization
NB	northbound
NEPA	National Environmental Policy Act

O&M	operations and maintenance
OPEX	operating expenditures
OR	operating ratio
PEIS	Programmatic Environmental Impact Statement
PLT	Project Leadership Team
PMT	Project Management Team
PN	Purpose and Need
PW	Present Worth
RIMS II	Regional Input-Output Modeling System
RMMA	Rocky Mountain Rail Authority
ROD	Record of Decision
ROW	right-of-way
RTD	Denver Regional Transportation District
SCC	Standard Cost Categories
SOW	Statement of Work
SP	Stated Preference
TAZ	traffic analysis zone
TOD	transit oriented development
UPRR	Union Pacific Railroad
VHT	vehicle hours of travel
VMT	vehicle miles traveled
WB	westbound

Executive Summary: Level 2 Evaluation

What is this Report?

Moving forward from the completion of the Level 1 Evaluation, this Level 2 Evaluation Report is the second of three reports that are being prepared for the Interregional Connectivity Study (ICS). Sequential reports are prepared at increasing levels of detail as the study progresses to a Final Report.

Why this Study?

On June 23, 2009, the Federal Railroad Administration (FRA) issued a Notice of Funding Availability for the High-Speed Intercity Passenger Rail (HSIPR) Program in the Federal Register. In response, CDOT, in concert with the Denver Regional Transportation District (RTD), submitted an application to conduct the Colorado ICS.

The Rocky Mountain Rail Authority (RMRA), a governmental authority made up of over 50 local governmental entities, completed a HSIPR Feasibility Study (RMRA Study) in March 2010 that examined HSIPR along the Front Range from Cheyenne, Wyoming to Trinidad, Colorado and along the I-70 Mountain Corridor from Denver International Airport (DIA) to Grand Junction, Colorado.

The RMRA Study concluded that HSIPR is feasible within FRA guidelines on an I-25 north-south corridor from Fort Collins to Pueblo and on an I-70 east-west corridor from DIA to the Eagle County Regional Airport. The most feasible segments and technologies for the HSIPR were identified for the purpose of ascertaining the most favorable benefit/cost ratio; however, no specific segment or technology was selected or recommended in the study.

Because of its broader focus, the RMRA Study did not consider the environmental and political feasibilities of the segments and technologies, nor did it evaluate the interconnectivity of HSIPR with the RTD FasTracks program or other transit systems in Colorado.

Lastly, the RMRA Study assumed that freight rail through metro Denver on the Consolidated Main Line (CML) would be moved to a new corridor on the eastern plains, something that is no longer expected to occur in the near future.

To help address these issues, and to take the analysis a step further, the RMRA Study recommended the ICS as one of the key next steps toward implementing HSIPR in Colorado.

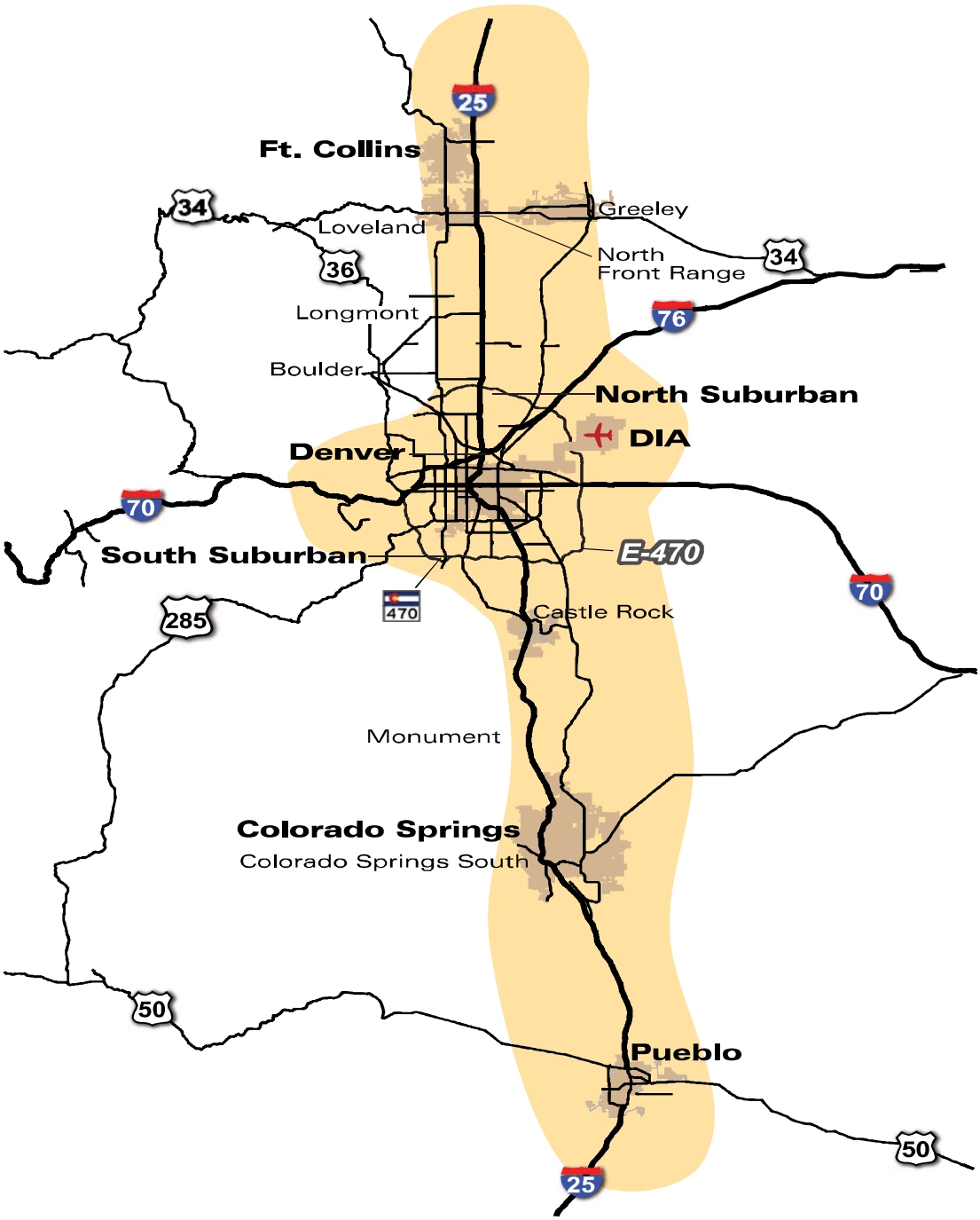
The Objectives of the Interregional Connectivity Study are to:

- Serve as a planning document and provide preliminary recommendations for HSIPR segments, technologies, and station locations in the Denver metropolitan area that would maximize ridership for the existing and proposed RTD FasTracks transit system and for future HSIPR service.
- Identify potential future HSIPR connections with the RTD FasTracks system.
- Determine optimal locations for a north-south (Front Range corridor) HSIPR segment from Fort Collins to Pueblo and an east-west HSIPR segment from DIA to the C-470/ I-70 interchange in Jefferson County.

What is the ICS Study Area?

The study area for the ICS is shown in Exhibit ES-1. The study limits are DIA to the east, the C-470/I-70 interchange to the west, the City of Fort Collins to the north, and the City of Pueblo to the south.

Exhibit ES-1: ICS Study Area



What is the Purpose of the Level 2 Evaluation?

Progressing from the completion of the Level 1 Evaluation, this Level 2 Evaluation Report is the second of three reports being prepared for the ICS. As shown below, the program is concluding the Level 2 Evaluation Phase, also referred to as the Conceptual Evaluation. At each project milestone, reports are sequentially written at increasing levels of detail as the study moves to a final recommended course of action. This document presents the findings of the Level 2 Evaluation.

Level 2 Evaluation Commitments

At the conclusion of the Level 1 Evaluation, the Next Steps described below were defined with support from the Project Leadership Team (PLT) and the public, forming the basis for the Level 2 Evaluation. Each of these commitments has been completed, and the results can be found in this document or its appendices.

Engineering Studies

The Level 2 Evaluation engineering studies involved preparing concept-level computer-aided design and drafting (CADD) for each of the scenarios in order to:

- Assess each segment making up the scenario, in particular the curvilinear constraints, to predict the possible top speed of the HSIPR technology
- Determine the general construction footprint of each segment and scenario
- Conceptually assess the quantity of aerial structures or tunnels compared to at-grade track
- Provide a conceptual estimate of the property acquisition requirements
- Assess the level of community impact
- Provide parametric cost estimates

Planning Studies

Preliminary operating plan assumptions have been prepared, including headways (interval between trains), number of trains per hour, dwell times at stations (the amount of time a train is stopped at a station for passenger boarding and alighting), and train capacity requirements.

Additional planning tasks included:

- Preparing a conceptual assessment of the overall social, economic, and environmental benefits associated with implementing HSIPR
- Developing assumptions on the types of technologies to be considered
- Defining general station locations
- Defining the general right-of-way (ROW) requirements for stations and support facilities (maintenance and layover facilities) to define ROW needs
- Preparing the travel demand model and developing preliminary ridership estimates
- Calculating preliminary revenue estimates
- Defining preliminary funding requirements
- Gaining agreement on the approach to the benefit/cost analysis
- Preparing preliminary benefit/cost estimates

Public Involvement

The study team hosted four PLT meetings throughout the Level 2 Evaluation to discuss alignments, cost estimates, early ridership forecasts, and finally, the completed Level 2 Evaluation ridership and revenue estimates.

After the fourth PLT meeting, public workshops were held in late May and early June 2013 in the cities of Colorado Springs, Pueblo, Windsor, Denver, and Silverthorne, Colorado.

The project website was updated at the conclusion of each PLT meeting and public workshop.

Scenarios Carried Forward from the Level 1 Evaluation

As a result of the Level 1 Evaluation, five scenarios were recommended for further analysis and were carried forward into the Level 2 Evaluation. These scenarios include:

- A-1: Direct through Denver
- A-5: Eastern Beltway
- A-6: Complete Beltway
- B-2A: Denver Periphery Excluding the Northwest Quadrant
- C-1: Denver Periphery Shared Track with RTD

Additional Alternatives Resulting from the Level 1 Evaluation

As a result of the public process supporting the Level 1 Evaluation, three new segments were recommended for Level 2 Evaluation:

- **I-70 ROW /I-76 ROW/96th Avenue/ DIA** – Use of the I-76 ROW from I-70 traveling east to 96th Avenue to DIA. A new station would be provided near the intersection of the North Metro Commuter Rail Line and I-76, hereafter referenced as the I-76/72nd Station. Denver Union Station (DUS) would not be accessed in the east-west direction. This became Option A for the A-1 and A-5 scenarios.
- **New Greenfield Segment from Denver to Colorado Springs and Pueblo** – Due to concerns about impacts to the Black Forest community north of Colorado Springs, a new HSIPR Greenfield segment was defined that generally follows the I-25 south and BNSF railroad ROWs from south Denver to Colorado Springs and Pueblo. This segment was re-engineered as part of the Level 2 Evaluation.
- **Revisions to Scenario C-1: Denver Periphery Shared Track with RTD** – Because it is not possible to share either the RTD Southeast or Southwest light rail transit (LRT) track with HSIPR technologies, a new routing to connect DUS to the South Suburban Station via DIA was recommended. This new segment follows the E-470 alignment.

  Sharing track with RTD's East Commuter Rail to DIA, North Metro Commuter Rail from DUS to the north, and the Gold Line Commuter Rail from DUS to Golden is still being considered as part of this scenario.

Scenarios A-1 and A-5 were carried into Level 2 Evaluation with few changes. However, because it was not possible to define the most acceptable east-west segment through the Denver metro area, two design options were retained: Option A: I-76 and Option B: US 6. These design options are defined in Section 3, Description of Level 2 Scenarios.

At over $20 billion, Scenario A-6 was found to be too costly during the initial phase of Level 2 Evaluation and was dismissed. It was replaced with a different scenario, B-5: Denver Periphery – Northwest, on the advisement of the PLT representatives from the northwestern Denver metro area.

Scenario B-2A was carried forward into the Level 2 Evaluation with no changes from Level 1.

As discussed above, Scenario C-1 was modified by adding construction of HSIPR on the E-470 ROW (defined as Segment B-3 in the Level 1 Evaluation Report) from DIA to the South Suburban Station to address the fact that HSIPR vehicles could not share track with RTD's Southeast Corridor due to incompatible technology.

What is the Level 2 Evaluation?

The Level 2 Evaluation builds upon the technical analysis and public input received during the Level 1 Evaluation. Level 2 involves more quantitative assessment of the ridership, cost, and environmental consequences of each of the five remaining scenarios. For example, the alignment for each scenario has been engineered to the level needed to document general ROW requirements, alignment and curvature to estimate train travel speeds, environmental and community impacts, and probable capital and operating costs. Ridership numbers and fare box revenues have also been calculated to prepare initial benefit-to-cost relationships. The intent of the Level 2 Evaluation is to reduce the number of scenarios to two or three that will be studied in more detail at Level 3.

The Level 2 Evaluation results provide the Project Management Team (PMT), PLT, and public with more information on the tradeoffs associated with each scenario. For example, are the high community

impacts and capital costs predicted for the urban routings though the Denver metro area worth a possible increase in ridership, compared to possible lower ridership with scenarios routed around highly developed areas?

Evaluation Criteria

The evaluation criteria for the ICS Level 2 Evaluation were vetted through the PLT and at four public open houses. These criteria have been modified as the study progressed, and were tailored to provide better information for determining the best scenarios to be further assessed in the Level 3 Evaluation. These criteria have been divided into the following categories:

- Public Benefits
- Transportation Benefits
- Other Public Benefits
- Engineering Feasibility
- Planning Feasibility
- Benefit/Cost Ratio

The detailed evaluation criteria are included in the Level 2 Evaluation matrices found in Appendix A of this report.

Results of the Level 2 Evaluation

A high-level summary of the benefits and costs associated with the implementation of the possible HSIPR scenarios is presented below.

What are the Benefits?

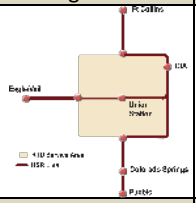
- **Purpose and Need (PN)** – At this level of evaluation, all of the scenarios fulfill the elements of the PN statement. A key element of the PN is that the HSIPR *offers statewide social, environmental, and economic benefits that are greater than the capital and operating costs of its implementation.* All five scenarios have benefit/cost (B/C) ratios of approximately 2.0 or slightly better.

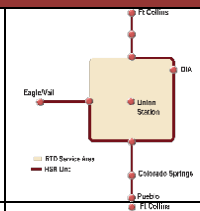
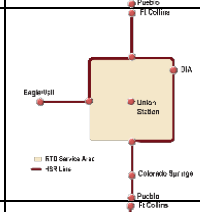
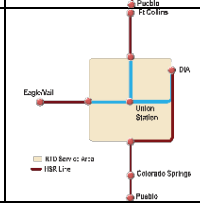
  Likewise, all five scenarios have operating ratios of greater than 1.0. A positive operating ratio is important because the surpluses can be used to help defray the annualized capital payment for the system. Compared to the B/C, there is more variability with the operating ratios realized by the five scenarios, which range from a high of 1.45 for A-1B (US 6) to 1.05 for C-1. Scenarios A-1A, A-5A, A-5B, B-2A, and B-5 have operating ratios of 1.32, 1.32, 1.35, 1.21, and 1.19, respectively. Scenarios B-2A and B-5 have lower ratios because their beltway alignments generate additional annual train miles, and hence a higher operating cost.

- **Public Support** –In general, the support for HSIPR has been strong based on the PLT and public workshop processes. That being said, routes traveling around the Denver metro area (B-2A and B5) appear to be better supported than those that travel through the metro area (A-1, A-5, A-6). Because the alignments for all of the scenarios are the same once they leave the Denver metro area, there is no public preference. The main area of public concern has been funding for the HSIPR.

- **System Ridership** – In the big picture, the expected ridership for all of the full-build scenarios is comparable, as shown in Exhibit ES-2. The scenarios that travel through the Denver metro area (A-1 and A-5) both have annual 2035 ridership of about 13 million per year. The scenarios that travel around the Denver metro area (B-2A and B-5) are projected to have ridership of 13.8 and 13.7 million per year, respectively. This result confirms that traveling around the developed metro area will not hurt ridership, but is actually expected to improve the results.

Exhibit ES-2: System Ridership and Revenue (Full System)

Scenario		Ridership (millions/year)	Revenue (million$/year)
A-1A		12.1	$293.8
A-1B	Same as A-1A but follows US 6 through Denver	13.1	$323.1
A-5A		12.9	$305.0
A-5B	Same as A-5A but follows US 6 through Denver	13.1	$306.8

Scenario		Ridership (millions/year)	Revenue (million$/year)
B-2A		13.8	$318.9
B-5		13.7	$310.3
C-1		10.8	$242.7

- **Connections to Local Transit –** Connections to local transit are largely the same for all of the Level 2 scenarios because they all share similar stations. However, there are several exceptions. The scenarios that travel around the periphery of the Denver metro area (B-2A and B-5) do not stop at DUS or at the proposed I-76/72nd Station associated with an alignment on I-76. Outside of the Denver metro area, all of the scenarios have stops at Longmont/Berthoud, Fort Collins, Colorado Springs, Fort Carson, and Pueblo. The final locations of these stations have not been determined under the assumption that the final sites selected will be based on local preference and strong connectivity with transit.
- **Livable Communities –** All of the scenarios will support livable communities and Transit Oriented Development (TOD), with only minor differences in benefits among the scenarios. The scenarios are expected to range between $2.75 billion and $3.3 billion in added real estate development.
- **Employment** – All of the scenarios would produce a large employment benefit. Since the capital costs of the full-build scenarios are within 10 percent of one another, the employment benefits will have a similar range. It is anticipated that the average construction force to build one of these scenarios would be about 11,000 jobs per year during a 10-year construction period. An additional 16,000 'spinoff' jobs are predicted as a result of the multiplier effect (multiplier = 2.0). Likewise, about 1,200 permanent jobs will be required to operate and maintain any of the scenarios considered. An additional 600 permanent jobs would be created as a result of the multiplier effect (multiplier = 1.5).
- **Environment** - Construction of any of the scenarios would have environmental impacts. On average, the full-build scenarios involve about 214 miles of guideway construction and, with stations, would require about 1,430 acres of property acquisition. Scenario C-1, which shares track with RTD in the Denver metro area, would disturb about 1,154 acres, or 276 acres less than the other scenarios. However, Scenario B-2A, which provides the highest ridership at 13.8 million/year, would only require 87 more acres of disturbance than Scenario C-1. Further, assuming that the total construction footprint is not as important as the location of the impact, the scenarios that travel through the Denver metro area (A-1 and A-5) are predicted to have a much greater impact than those that travel around the periphery (B-2A and B-5).

  Conversely, the operation of all the scenarios would encourage more compact development around the HSIPR stations, reducing urban sprawl and encouraging the use of transit. Both benefits would reduce vehicle miles traveled, resulting in a modest positive impact on air quality. Because the ridership among the full-build scenarios differs by only about 6 percent, the relative differences in benefits are also expected to be modest.
- **Engineering Feasibility** – All of the proposed scenarios are constructible. However, Scenarios A-1 and A-5 present the greatest challenges. Of the two, A-1 is the most challenging. The north-to-south alignment parallel to the Brush/CML/-Joint Line freight railroad corridor would require extensive private ROW acquisition through congested urban areas, as well as construction of large quantities of elevated structure. Similarly, the east-to-west segment along US 6 also requires acquisition of private ROW, including many single-family homes. Further, the

guideway would need to be elevated over much of the alignment, increasing both cost and noise.

Conversely, the construction of Scenarios B-2A and B-5 will occur largely in public ROWs in open, uncongested areas.

Construction of the segments north to Fort Collins and south to Pueblo is not a discriminator since those segments are common to all five scenarios. However, construction to the north is much less complicated since the majority of the construction is anticipated to take place in the I-25 ROW. Construction to the south from the South Suburban Station in Lone Tree to Colorado Springs will be much more complicated due to severe topography and restricted ROW through Castle Rock and Colorado Springs. As such, the construction cost per mile of this segment ($52.6 million) is about 44 percent more than for the segment north to Fort Collins ($36.6 million). Construction from Colorado Springs to Pueblo will be less topographically constrained and much less complicated.

Exhibit ES-3 presents the Level 2 Evaluation estimated capital and operating expenditures (CAPEX and OPEX) for each scenario. The capital estimates do not include the cost of vehicles because a technology has not been selected. It is anticipated that 25 train sets would be required at approximately $20 million each. Thus, an allowance of $500 million should be added to the costs presented below.

Exhibit ES-3: CAPEX and OPEX Costs by Scenario (ICS Projects Only)

Scenario	CAPEX	OPEX
A-1A: Direct through Denver (I-76)	$15.3 B	$183.0 M
A-1B: Direct through Denver (US 6)	$14.6 B	$183.0 M
A-5A: Eastern Beltway (I-76)	$14.1 B	$186.0 M
A-5B: Eastern Beltway (US 6)	$14.3 B	$186.0 M
B-2A: Denver Periphery Excluding the Northwest Quadrant	$13.4 B	$205.0 M
B-5: Denver Periphery Excluding the Southwest Quadrant	$13.9 B	$207.0 M
C-1: Shared Track with RTD	$11.5 B	$189.2 M

- **Planning Feasibility** – Any of the proposed scenarios are feasible from a planning standpoint; all are in conformance with the State Rail Plan, and the concept of HSIPR is consistent with regional planning documents, all of which endorse the concept of increased mode share by transit. The degree to which the scenarios will fulfill local land use plans will depend on station location. At the Level 2 Evaluation, station location specifics have not been addressed other than for general locations for the purpose of travel demand modeling.

  The greatest determinant of planning feasibility will be measured by the political will to fund any of the proposed scenarios. The implementation of any scenario will require a major non-federal funding source, such as an increase in sales tax, fuel tax, property tax, etc. Funding from sources other than the federal government will likely need to approach 50 percent of the total capital cost of the scenario to attract private and/or federal funding. Absent the political will to increase revenues, a HSIPR for Colorado will not be feasible. This conclusion holds true for all of the scenarios and is not a discriminator for selection.

Recommendations for Level 3 Evaluation

This section presents recommendations for the Level 3 Evaluation.

Scenarios Retained

Based on the Level 2 Evaluation, three of the five scenarios are recommended for further refinement in the Level 3 Evaluation:

- Scenario A-5A (I-76)
- Scenario B-2A
- Scenario C-1

Scenario A-5A (I-76) is retained because it best serves DIA with one-seat ride from all markets and provides better connections to the central Denver area better than B-2A. While it requires a transfer from RTD's North Metro commuter rail transit (CRT) to DUS, it could also provide a strong connection to the Gold Line and eventual Northwest Rail project at the Pecos Station for an alternate trip to DUS. Option A (I-76) is recommended because it results in fewer community impacts than Option B (US 6). It is

also felt that one "through Denver" scenario needed to be carried into the Level 3 Evaluation, and A-5 has lower costs and fewer impacts that A-1 while producing comparable ridership.

Scenario B-2A is recommended for the Level 3 Evaluation because it produces the best ridership at the lowest cost of all scenarios with the exception of C-1. It would avoid the impacts of construction through the Denver metro area, and it provides the best access for populations from the southern markets, as well as strong access from the northern markets. This is partially offset by the fact that travel from the mountains, while still a one-seat ride, is longer than with the A-series scenarios.

Scenario C-1 is retained because it accommodates phasing of a HSIPR program for the state.

Scenarios Set Aside

Based on the Level 2 Evaluation, the following scenarios have been set aside:

- Scenario A-1 (both Options A and B)
- Scenario A-6
- Scenario B-5

Scenario A-1 was not carried forward due to the anticipated high community impacts of constructing a HSIPR system north-south and east-west through the Denver metro area. This system is also more likely to be construed as competition and redundancy to RTD's FasTracks program. Using the less impactful Option A (I-76), the ridership is the lowest of the full-build scenarios. With Option B (US 6), the ridership is competitive but the impacts are too damaging. Further, the PLT has advised the study team that the implementation of HSIPR through the core of the Denver metro area is likely to be unimplementable due to a long and contentious environmental process.

Scenario A-6 was eliminated early in the Level 2 Evaluation because the $20-billion cost was considered unimplementable. Further, the community impact of this scenario would replicate that of A-1, with the addition of the impacts associated with the beltway segments.

Scenario B-5 was set aside because of a lack of support from the City of Golden and because it provided poor connections for travelers from the southern markets, which account for nearly twice the ridership of the northern markets.

Segments Set Aside

Based on the Level 2 Evaluation, the following segments have been placed aside:

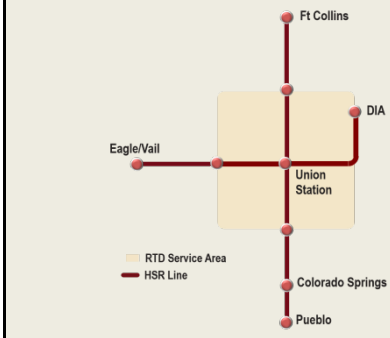
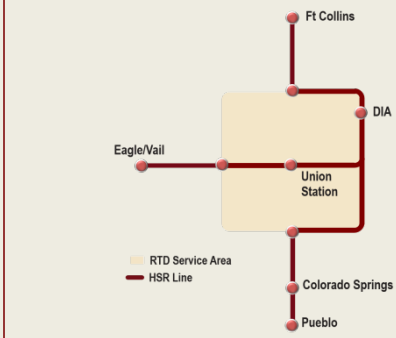
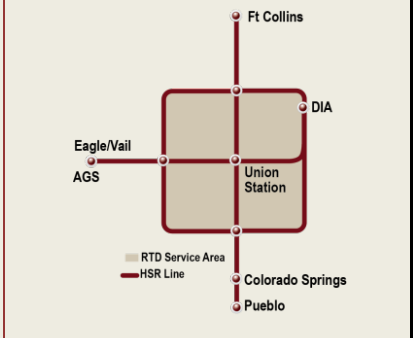
- Segment S-1 (Greenfield)
- Segment N-1 (EIS)

Segment S-1 (Greenfield) south to Colorado Springs and Pueblo was eliminated because of intensive public opposition for constructing HSIPR through the Black Forest community north of Colorado Springs. It was replaced with Segment S-3, which closely follows the I-25 alignment.

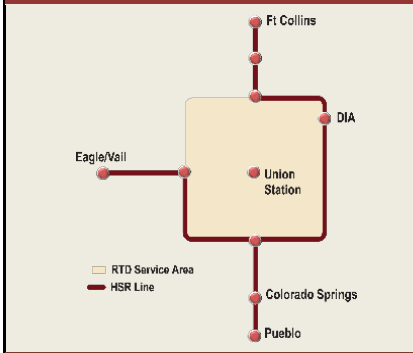
Segment N-1 (EIS) was eliminated because it is not suitable for HSIPR. Constructing HSIPR with competitive travel times through the cities of Longmont, Berthoud, Loveland, and Fort Collins would have required extensive elevated structure and private property acquisition, increasing community impacts to unacceptable levels and escalating the cost to over three times that of Segment N-2 (I-25). The operation of HSIPR was also considered unacceptable in this area due to anticipated high levels of noise. Further, the North I-25 EIS Record of Decision (ROD) has committed the SH-287 corridor to CRT, which is supported publicly and will remain in place to be implemented separately as funds become available.

Exhibit ES-4 provides a summary of the HSIPR scenarios that are recommended for Level 3 Evaluation.

Exhibit ES-4: Summary of HSIPR Scenarios Recommended for Level 3 Evaluation (Cost Values are for ICS only)

Scenarios Recommended for Level 3 Evaluation		
		
A-1 (Options A & B): Direct Routing through Denver • CAPEX - $14.6 - $15.3 billion • OPEX - $183 million/year • Ridership - 12.1 to 13.1 million/year • Revenue - $250 million/year • OPEX Ratio - 1.32/Option A to 1.45/Option B • B/C Ratio – 1.98/Option A to 2.03/Option B **SET ASIDE**: ▪ Performs well but results in high community impacts to the Denver metro area with either Option A or B. ▪ Scenarios A-5, B-2A, and B-5 perform as well or better and generally cost less. ▪ Obtaining NEPA clearances though the Denver metro area would be time consuming and contentious, eroding public support for the HSIPR program. ▪ Does not serve DIA from north or south well due to a lengthy transfer at DUS and competition from RTD's lower fares and good travel times.	**A-5 (Options A & B): Eastern Beltway** • CAPEX - $14.1 - $14.3 billion • OPEX - $186 million/year • Ridership - 12.9 to 13.1 million/year • Revenue - $257 million/year • OPEX Ratio - 1.32/Option A to 1.35/Option B • B/C Ratio - 2.0/with either Option A or Option B **CARRY FORWARD (Option A only)**: ▪ Performs as well as A-1 at lower cost and with fewer impacts, at least in the north-south direction through Denver. ▪ Impacts will be greater than for B-2A, B-5, or C-1 because it still involves construction through the Denver metro area in the east-west direction. ▪ Serves DIA best with one-seat ride from all markets, but requires more out-of-direction travel to the mountains from the north and south markets. ▪ Works well with either Option A (I-76) or Option B (US 6), but Option A has fewer community impacts.	**A-6: Complete Beltway** • CAPEX: $20.3 billion • OPEX: $588 million/year • Ridership – Not evaluated • Revenue - Not evaluated • OPEX Ratio - Not evaluated • B/C Ratio - Not evaluated **SET ASIDE**: ▪ While it would provide the most thorough transit coverage of the scenarios considered, it has extremely high capital and operating costs. ▪ Community and environmental impact of construction through and around the Denver metro area would be the highest of all of the scenarios considered and would likely prevent the implementation of this scenario. ▪ Evaluation of the Northwest Quadrant was provided with the consideration of Scenario B-5.

Scenarios Recommended for Level 3 Evaluation

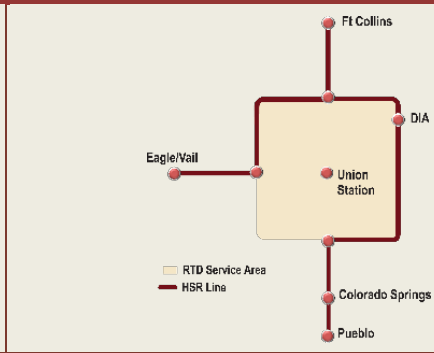


B-2A: Denver Periphery Excluding the Northwest Quadrant

- CAPEX - $13.4 billion
- OPEX - ~$205.0 million/year
- Ridership – 13.8 million/year
- Revenue - $249.0 million/year
- OPEX Ratio – 1.21
- B/C Ratio – 2.01

CARRY FORWARD:

- Generates the highest ridership and highest revenue; however, the operating ratio is lower than for A-1 or A-5.
- Lowest capital cost of any of the full-build scenarios.
- Avoids the community and environmental impacts of construction and operation through the Denver metro area.
- The key disadvantage of this scenario is that it does not provide service to DUS.



B-5: Denver Periphery Excluding the Southwest Quadrant

- CAPEX - ~$13.9 billion
- OPEX – $207.0 million
- Ridership – 13.7 million/year
- Revenue - ~$248.0 million/year
- OPEX Ratio – 1.19
- B/C Ratio – 1.99

SET ASIDE:

- While this scenario has many of the benefits of B-2A, it is not supported by many of the Northwest Quadrant stakeholders and is considered to be much more difficult to implement than Scenario B-2A.

The benefits of B-5 include:

- Generates the second highest ridership and the second highest revenue; like B-2A, the operating ratio is lower than either A-1 or A-5.
- Second lowest capital cost of any of the full-build scenarios.
- Like B-2A, avoids the community and environmental impacts of construction and operation through the Denver metro area.
- Like B-2A, the key disadvantage of this scenario is that it does not provide service to DUS.

C-1: Shared Track with RTD

- CAPEX: - $11.5 billion
- OPEX - $189.2 million/year
- Ridership - 10.8 million/year
- Revenue - $205 million/year
- OPEX Ratio – 1.05
- B/C Ratio – 1.97

CARRY FORWARD:

- Represents a possible phasing strategy to the other full-build scenarios.
- Has the lowest capital cost, but also the weakest ridership and lowest OPEX ratio.
- Maintains a B/C ratio comparable to the other scenarios.
- Provides very strong access to DIA from southeast Denver, Colorado Springs, and Pueblo due to the one-seat ride available to these locations. Because it requires a transfer to communities north and west, its ridership is weaker.

What Are The Next Steps?

Completion of the Level 3 Evaluation is the next step in the ICS planning process. This will occur during summer and fall of 2013. This step involves additional refinement of the scenarios, service plan, ridership and revenue estimation and cost estimating, and a more thorough assessment of environmental effects. A third series of public open houses is scheduled for the fall of 2013.

Specific Work Elements of the Level 3 Evaluation

The Level 3 Evaluation involves taking the engineering, planning, and public process evaluations to a higher level of detail than the Level 2 Evaluation, as described below.

Engineering Studies

The Level 3 Evaluation engineering studies will:

- Recommend a preferred technology
- Value engineer the remaining scenarios to improve cost-effectiveness
- Analyze the potential for single-track configuration
- Better define ROW requirements
- Revise the CAPEX estimates to account for engineering refinements
- Prepare a phasing strategy

Planning Studies

The Level 3 Evaluation planning studies will:

- Refine the scenarios remaining from the Level 2 Evaluation to lower costs, reduce impacts, and improve ridership performance.
- Evaluate the final three scenarios based on the engineering refinements that are anticipated to change the footprints or operating assumptions from the Level 2 Evaluation
- Better define mitigation measures for anticipated high environmental impacts
- Optimize service to improve cost-effectiveness
- Update the OPEX estimate with specific technology-based unit costs
- Define a cost-effective Minimum Operable Segment (MOS) for Phase I implementation
- Update the benefit/cost analyses with new information
- Define preliminary funding requirements and recommend a supporting financial plan

Public Involvement

Level 3 Evaluation public involvement activities will be similar to Level 2 processes and will include:

- Public meetings held in Fort Collins, Denver, Colorado Springs, and Pueblo at the conclusion of the Level 3 Evaluation
- PLT meetings held in August, September, and October 2013
- Continuous updating of the project website: http://www.coloradodot.info/projects/ICS.

Section 1. Introduction

Purpose of this Document

Moving forward from the completion of the Level 1 Evaluation, this Level 2 Evaluation Report is the second of three reports that are being prepared for the ICS. Sequential reports are prepared at increasing levels of detail as the study progresses into the subsequent levels of evaluation. This document presents the Level 2 Evaluation findings.

Level 2 Evaluation Commitments

At the conclusion of the Level 1 Evaluation, the Next Steps described below were defined, forming the basis for the Level 2 Evaluation.

Engineering Studies

The Level 2 Evaluation engineering studies will involve preparing concept-level CADD drawings for each scenarios in order to:

- Assess each segment making up the scenario, in particular the curvilinear constraints, to predict the possible top speed of the HSIPR technology
- Determine the general construction footprint of each segment and scenario
- Begin to assess the quantity of aerial structures or tunnels compared to at-grade track
- Provide a conceptual estimate of the property acquisition requirements
- Assess the level of community impact
- Provide parametric cost estimates

Planning Studies

Preliminary operating plan assumptions will be prepared, including headways (interval between trains), number of trains per hour, dwell times at stations (the amount of time a train is stopped at a station for passenger boarding and alighting), and train capacity requirements.

Additional planning tasks included:

- Preparing a conceptual assessment of the overall social, economic, and environmental benefits associated with implementing HSIPR
- Developing assumptions on the types of technologies to be considered
- Defining general station locations
- Defining the general programming requirements for stations to define ROW needs
- Determining the need for maintenance facilities and other support facilities to estimate costs and ROW needs
- Preparing the travel demand model and preliminary ridership estimates
- Calculating preliminary revenue estimates
- Defining preliminary funding requirements
- Gaining agreement on the approach to the benefit/cost analysis
- Preparing preliminary benefit/cost estimates
- Assessing the level of environmental and community impacts

Public Involvement

Additional PLT meetings were held in December 2012.

Public open houses were conducted in Colorado Springs and Pueblo on May 29 and 30, 2013, and in Winsor and Denver on June 5 and 6, 2013. A fifth meeting was held in Silverthorne on June 11, 2013.

Going forward, the study team will conduct special geography-based meetings with the PLT and stakeholders in Denver, Fort Collins, Colorado Springs, Pueblo, and Silverthorne to discuss specific issues related to the location of HSIPR through or around their communities.

The website will continue to be updated as work is developed.

Scenarios Carried Forward from the Level 1 Evaluation

As a result of the Level 1 Evaluation, five scenarios were recommended for further analysis and have been carried forward into the Level 2 Evaluation. These scenarios include:

- A-1: Direct through Denver
- A-5: Eastern Beltway

- A-6: Complete Beltway
- B-2A: Denver Periphery Excluding the Northwest Quadrant
- C-1: Denver Periphery Shared Track with RTD

Additional Alternatives Resulting from the Level 1 Evaluation

During the Level 1 Evaluation, three new segments were recommended as a result of the public process or through further review by the study team. These were refined in the Level 2 Evaluation. They include:

- **I-70 ROW /I-76 ROW/96th Avenue/DIA** – Use of the I-76 ROW from I-70 traveling east to 96th Avenue to DIA. A new station would be provided near the intersection of the North Metro Commuter Rail Line and I-76 (essentially I-76 and 72nd Avenue). DUS would not be accessed in the east-west direction. This became Option A for Scenarios A-1 and A-5.
- **New Greenfield Segment from Denver to Colorado Springs and Pueblo** – Due to concerns about impacts to the Black Forest community, a new HSIPR Greenfield segment was defined that generally follows the I-25 south and BNSF ROWs from south Denver to Colorado Springs and Pueblo. This segment was re-engineered as part of the Level 2 Evaluation.
- **Revisions to Scenario C-1: Denver Periphery Shared Track with RTD** – Because it is not possible to share either the RTD Southeast or Southwest LRT track with HSIPR technologies, a new guideway from DIA to the South Suburban Station was recommended. This new guideway will follow the E-470 ROW, exactly as configured for Scenarios A-5 and B2A.

  Sharing track with RTD's East Commuter Rail Line to DIA, North Metro Commuter Rail from DUS to the north, and the Gold Line Commuter Rail from DUS to Golden is still being considered as part of this scenario.

What is the Level 2 Evaluation?

The Level 2 Evaluation builds upon the technical analysis and public input received during the Level 1 Evaluation. Level 2 involves more quantitative assessment of the ridership, cost, and environmental consequences of each of the five surviving scenarios. For example, the alignment for each scenario has been engineered to the level needed to document general ROW requirements, alignment and curvature to estimate train travel speeds, environmental and community impacts, and probable capital and operating costs. Ridership numbers and fare box revenues have also been calculated to prepare initial benefit to cost relationships. The intent of the Level 2 Evaluation is to reduce the number of scenarios to two or three that will be studied in more detail at Level 3.

The Level 2 Evaluation results provide the PMT, PLT, and public with more information on the tradeoffs associated with each scenario. For example, are the high community impacts and capital costs predicted for the urban routes though the Denver metro area worth a possible increase in ridership, compared to possible lower ridership with scenarios that route travel around highly developed areas? It may be determined that the higher travel speeds allowed by routing through less densely populated suburban areas actually increases ridership. The goal of the Level 2 Evaluation is to answer these questions.

Evaluation Criteria

The evaluation criteria for the Level 2 Evaluation were vetted through the PLT and at four public open houses. These criteria have been modified as the study progressed, and were tailored to provide better information for determining the best scenarios to be further assessed in the Level 3 Evaluation. These criteria have been divided into the following categories:

- Public Benefits
- Transportation Benefits
- Other Public Benefits
- Engineering Feasibility
- Planning Feasibility
- Benefit/Cost Ratio

The detailed evaluation criteria are included in the Level 2 Evaluation matrices found in Appendix A of this report.

Level 2 Evaluation Methodologies

A summary of the methodologies used to evaluate the Level 2 alternatives is presented below. Greater detail on each methodology is provided in the report appendices.

Packaging of Level 2 Scenarios

During the Level 1 Evaluation, 18 segments were evaluated and packaged into 12 scenarios. Of these, five were moved forward into Level 2 Evaluation (refer to the Level 1 Evaluation Report for more details).

As listed above, the remaining scenarios subject to the Level 2 Evaluation include:

- A-1: Direct through Denver
- A-5: Eastern Beltway
- A-6: Complete Beltway
- B-2A: Denver Periphery Excluding the Northwest Quadrant
- C-1: Denver Periphery Shared Track with RTD

Scenarios A-1 and A-5 were carried into Level 2 Evaluation with few changes. However, because it was not possible to define the most acceptable east-west segment through the Denver metro area, two design options were retained: Option A: I-76 and Option B: US 6. These design options are defined in Section 2, Description of Level 2 Scenarios.

During the initial phase of Level 2 Evaluation, Scenario A-6 was found to be too costly at over $20 billion and was dismissed. It was replaced with a different scenario, B-5: Denver Periphery – Northwest, on the advisement of the PLT representatives from the northwestern Denver metro area.

Scenario B-2A was carried forward into the Level 2 Evaluation with no changes from Level 1.

Scenario C-1 was modified by adding construction of HSIPR on the E-470 ROW (defined as Segment B-3 in the Level 1 Evaluation Report) from DIA to the South Suburban Station to address the fact that HSIPR vehicles could not share track with RTD's Southeast Corridor due to incompatible technology.

Engineering and Cost Estimating

In the Level 2 Evaluation, the capital cost-estimating process included six steps:

1. The study team conducted field inspections of the alignments surviving the Level 1 Evaluation.
2. The scenarios were divided into segments.
3. Guideway and other capital improvements were defined based on the physical features of the segment.
4. Quantities were estimated for the ten FRA Standard Cost Categories (SCC), developed as part of its HSIPR Program:
   - 10 Track Structures and Track
   - 20 Stations, Terminals, Intermodal
   - 30 Support Facilities: Yards, Shops, Administrative Buildings
   - 40 Site work, Right of Way, Land, Existing Improvements
   - 50 Communications and Signaling
   - 60 Electric Traction
   - 70 Vehicles
   - 80 Professional Services
   - 90 Unallocated Contingency
   - 100 Finance Charges
5. The quantities were then multiplied by unit costs prepared by the study team based on other HSIPR programs and local conditions.
6. A conceptual plan-set was prepared for use as the basis for estimating the quantities.

Detailed Level 2 Evaluation cost information is provided in Appendix B. The CAPEX Estimating Methodology Manual was provided in Appendix B of the Level 1 Evaluation Report and is available on the ICS website: http://www.coloradodot.info/projects/ICS.

Level 2 Service Plan Methodology

Preliminary service plans were developed for each of the five Level 2 scenarios. These service plans were intended to define representative levels of rail service for use in ridership forecasting and developing general operating and maintenance cost estimates. Level 2 service plans were developed based on the following guidance:

- Service patterns were simplified as much as practical. For example, rail service along the north-south corridor assumes all trains serve the full length from Fort Collins to Pueblo, rather than defining "short lines" (e.g., Fort Collins to Colorado Springs) as a method to provide additional coverage in the core segment. Assuming service along the full length of the line allows full potential to generate ridership. For the Level 3 Evaluation, ridership results will be

analyzed to refine service plans and tailor service levels to demand in order to maximize service efficiency.

- For the east-west corridor, service to Breckenridge is assumed to be a branch, rather than an in-line station to Eagle County Regional Airport. Thus, east-west trips are split on the west end so that, while a majority of trips proceed to Eagle County Regional Airport, several trips instead serve the branch to Breckenridge. As the east-west corridor continues to be refined, this branch concept may be modified for Level 3.
- The service span for all high-speed rail corridors is assumed to be 18 hours each day (e.g., 6 a.m. to midnight), seven days per week. For the north-south corridor, service is envisioned to follow a typical commute profile where more service is offered during weekday peak periods. For service related to the I-70 mountain corridor, heavier service is likely to occur near the end of the week and on weekends, with lighter service during the earlier weekdays.
- For the north-south and east-west corridors, a basic frequency of 24 round trips per day was assumed for days requiring heavier service. This represents an 18-hour daily span (e.g., 6 a.m. to midnight), with 30-minute service in the peak period (3 hours in the morning and 3 hours in the afternoon) and hourly service for the remaining 12 hours.
- As a sensitivity test, a more aggressive level of service of 36 round trips per day also was defined. Still representing an 18-hour daily span, this level corresponds with 15-minute service in the 6-hour peak period (split between a.m. and p.m.) and hourly service for the remaining 12 hours. This level of service also supports the east-west capacity assumption of 4,900 passengers per hour and is therefore referred to as the capacity-based service plan.
- For scenarios where the north-south corridor meets the east-west corridor in the vicinity of DUS, I-76/72nd, or DIA (e.g., A-1 and A-5), transfers are required between lines as it is generally infeasible to have a train movement that turns off one corridor and onto the other at these locations.
- For scenarios using the beltway (i.e., B-2A and B-5), selected line patterns may directly connect part of a north-south corridor with part of an east-west corridor, e.g., Pueblo to Eagle County Regional Airport. In these cases, service in the trunk (common segment before service splits off) maintains the target number of round trips per day. The relative split of trips is generally advised by a preliminary ridership forecast using a complex service plan from the Rocky Mountain Rail Authority *High-Speed Rail Feasibility Study Business Plan*, March 2010 (RMRA Study), which provided direct service between numerous market combinations.

Level 2 Operations and Maintenance (O&M) Cost Methodology

Because Level 2 screening still involves a large number of scenarios, a straightforward method of quantifying O&M costs for comparison purposes is appropriate. Toward this end, the calculated unit costs per train mile from the operating cost analysis provided in the RMRA Study are applied to alternatives in the Level 2 Evaluation. The RMRA Study developed operating costs for six technology types: 79 miles per hour (mph) rail, 110 mph rail, 125 mph magnetic levitation (Maglev), 150 mph rail, 220 mph rail, and 300 mph Maglev.

The RMRA Study used a cost build-up method, adapting the costing framework developed for the Midwest Regional Rail System. Nine specific cost areas were identified, as summarized in Exhibit 1-1.

Exhibit 1-1: Operating Cost Categories and Drivers

Cost Category	Cost Driver	Technology Distinction
Train Equipment Maintenance	Train Miles	Yes
Energy and Fuel	Train Miles	Yes
Train and Engine Crews	Train Miles	Yes
Onboard Service Crews	Train Miles	No
Insurance	Passenger Miles	No
Sales and Marketing	Fixed Cost, Ridership and Revenue	No
Service Administration	Fixed Cost, Train Miles	No
Track and ROW Maintenance	Track Miles	Yes
Station Costs	Number of Stations	No
Source: RMRA *High-Speed Rail Feasibility Study Business Plan*, March 2010.		

As noted in Exhibit 1-1, the RMRA O&M cost method includes distinctions based on technology differences in several cost areas: Train Equipment Maintenance, Energy and Fuel, Train and Engine Crews, and Track and ROW Maintenance.

The unit cost for Train and Engine Crews is influenced by train speed. Technologies with higher operating speeds will have less cost for Train and Engine Crews because those technologies can operate the same service plan in less time. The RMRA Study notes that Train Equipment Maintenance is considerably less for Maglev. The RMRA unit cost used for 300-mph Maglev for Train Equipment Maintenance is 45 percent lower than for 220-mph Electric. The difference is 17 percent when comparing 125-mph Maglev to 150-mph Electric.

The unit cost used for Energy and Fuel in the RMRA Study varies depending on grade. The RMRA Study's unit cost for 300-mph Maglev is 8 to 24 percent less than for 220-mph Electric, depending on the grade. The 125-mph Maglev technology, however, has a higher unit cost than the 150-mph Electric option for Energy and Fuel. Both Electric and Maglev technologies have substantial lower Energy Fuel unit costs than diesel technology options.

It is important to note that these cost differences by technology only apply to portions of the overall cost estimate. For example, while Maglev is 45 percent less expensive than 220-mph Electric Train Equipment Maintenance, this particular cost category is just 26 percent of the overall cost for 220-mph Electric. Thus, the 45 percent cost savings associated with Maglev applies only to this particular cost category.

Associated statistics were developed for each technology option in the RMRA Study and were applied to the O&M cost model. This led to the calculation of total annual operating costs in 2008 dollars for each system option. The total costs were then divided by the total train miles in order to express an average cost per train mile. Exhibit 1-2 lists the resulting average cost per train mile as calculated in the RMRA Study, which was escalated to 2013 dollars using the Bureau of Labor Statistics Consumer Price Index – Urban Consumers (CPI-U) for the Denver-Boulder-Greeley region.

Exhibit 1-2: Average Cost per Train Mile by Technology

Technology	Cost Per Train Mile (2013 $)
79-mph Rail	$56.89
110-mph Rail	$54.61
125-mph Maglev	$49.58
150-mph Rail	$53.79
220-mph Rail	$54.73
300-mph Maglev	$41.56
Source: RMRA *High-Speed Rail Feasibility Study* Business Plan, March 2010.	

An escalation factor of 1.07 was determined by comparing the annual CPI-U from 2008 to 2012. Further escalation to 2013 dollars was achieved by assuming the same annual growth rate as 2011 to 2012, leading to an escalation of 1.09 of the 2012 dollars.

Rail operating plans were developed in order to estimate the annual train miles for each of the Level 2 scenarios. For all scenarios, a basic frequency service plan was developed, as well as the more aggressive capacity-based service plan described previously. The basic frequency service plan generally allowed for 24 daily round trips per corridor, whereas the capacity-based service plan was based on 36 daily round trips per corridor. The service plan for Scenario A-6 showed appreciably more service; use of the complete beltway allowed additional service directly linking markets outside of Denver while maintaining service patterns through Denver.

To determine the OPEX costs for the Level 2 Evaluation, the annual train-miles for each scenario were multiplied by the RMRA-calculated average cost per train mile in 2013 dollars.

Ridership and Revenue Estimation

The ICS ridership studies applied a well-established travel demand forecasting methodology to analyze ridership and revenue for the Level 2 scenarios. This methodology is quite detailed and is well suited to Level 2 Evaluation purposes.

Exhibit 1-3 illustrates the forecasting approach, which addresses four distinct travel markets (discussed below) in the ICS study area:

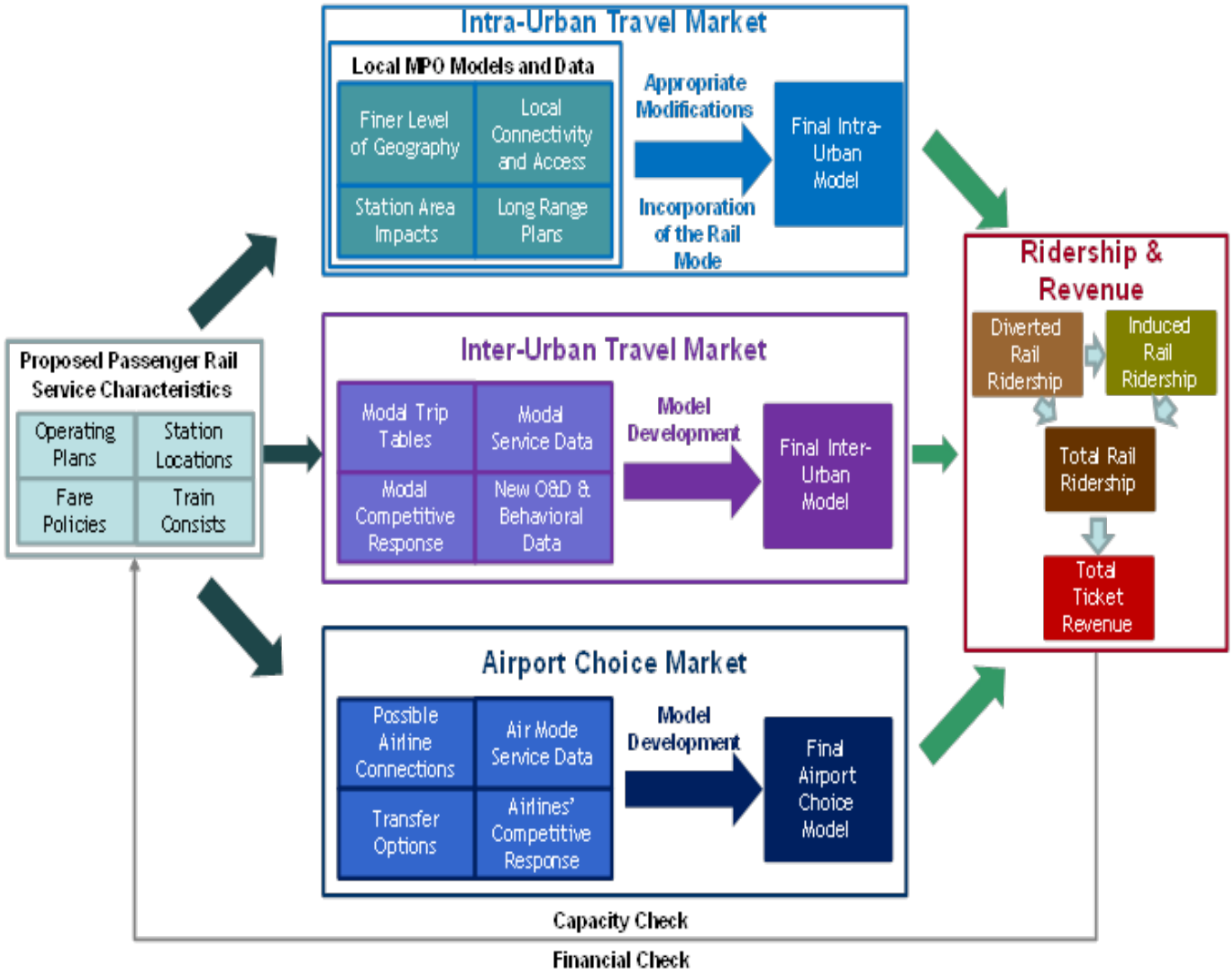
- Inter-urban travel market
- Denver area intra-urban travel market including the airport access market
- Airport choice market

- Induced demand market

To forecast demand for a rail scenario (combination of technology and speed, alignment, and stopping pattern), the model requires information on the scenario's service characteristics. These include:

- Operating characteristics - stopping patterns, running and dwell times, schedule, or frequency
- Station-to-station fares
- Station locations and connectivity/accessibility/-parking

Exhibit 1-3: Illustration of the Forecasting Approach



Inter-Urban Travel

The process that the demand model applies to forecast the inter-urban ridership and revenue of a proposed rail service entails five broad steps:

1. *Establish the study area's geographic scope and zone structure:* The intercity model covers a geographic area that generally follows the ICS corridors and extends approximately 50 miles on each side of the proposed alignments. The study area was split into 3,142 zones. In Metropolitan Planning Organization (MPO) areas, the zones were based on the local MPO model traffic analysis zones (TAZs) or some aggregation of them; in other areas, they were based on zones used in the I-70 Programmatic Environmental Impact Statement (PEIS).
2. *Develop input data including service characteristics for each mode and zone pair:* Modeling input data included the study area network, historic and future socio-economic variables (e.g., population, employment, income, general economic conditions, information on visitors, commuters, etc.), and information about the service characteristics of existing and future travel modes.
3. *Estimate the current in-scope travel market:* The inter-urban travel market includes trips by air, bus, and private automobile for different travel purposes. As part of the forecasting model development, data on the patterns and levels of trip making in these markets was prepared on a detailed zone-to-zone basis. While intercity air volume data is available from well-established sources and intercity bus volumes can be adequately estimated from published schedules, the lack of detailed up-to-date information on inter-urban automobile travel in the study corridor was a serious data gap. This prompted the study team to undertake a program of original travel data collection, using anonymous cell phone data to understand the origins and destinations of auto travelers in the corridor.
4. *Estimate how this market will grow in the future:* This step involved the development of econometric travel growth models for the automobile and bus modes, reflecting trends in socio-economic variables such as population and employment. Future-year air trip tables were prepared based on published Federal Aviation Administration (FAA) terminal area forecasts of total annual airport enplanements for each of the study area airports.
5. *Estimate the potential market share that the new rail service will capture (i.e., the ridership):* A standard model form (called a nested logit model) was used to predict the market share of each intercity mode based on the respective service characteristics of the modes in competition between each zone pair. Service characteristics include time, cost, frequency, reliability, and quality of service, with time and cost broken down into their access, egress, transfer, terminal, and line haul components. Mode-specific constants account for the effects of other (not explicitly modeled) characteristics of rail relative to other modes. These shares are then applied to the total zone-to-zone travel volume to predict the volume of travel by each mode, including the new rail mode. This process is carried out separately for the different trip purposes, and the results are aggregated.

The nested logit model incorporates information about how travelers assess and trade off different modal service characteristics. This information was obtained from Stated Preference (SP) surveys of study area residents conducted as part of the forecasting effort. This type of survey is routinely used to elicit traveler preferences and tradeoffs involving different modal attributes.

Intra-Urban Travel

As all the Level 2 scenarios include multiple stations in the Denver metro area, all will provide intra-urban as well as inter-urban service. The travel forecasting activity considered interactions between the rail project and the Denver metro transportation system both in regard to the metropolitan access/egress portion of inter-urban ICS rail trips and functioning of the ICS project as a local travel mode within the Denver metro area. The forecasting activity used the Denver Regional Council of Government's (DRCOG) Compass model to forecast Denver metro area ICS project travel demands, treating the rail project as an additional transit mode within the already-defined mix of transit modes, with adjustments as required. This approach makes maximum use of the detailed understanding of Denver metro area travel patterns and behavior already embodied in the Compass model system.

Airport Choice

DIA is an important national hub due to the large number of destinations served and the presence of major air carriers. Locally, it provides connection options for air trips that begin or end at the study area regional airports: Colorado Springs (COS) and Eagle County Regional (EGE). Because all of the Level 2 scenarios include a rail station at DIA, air travelers who begin or end their trip at COS or EGE and change planes at DIA will also have the option to access DIA by rail. The ICS travel demand forecasting effort developed an airport choice model to forecast these potential shifts by connecting air travelers.

Induced Travel

Induced travel refers to trips that were not made before a project opens, but which will be made as a result of the mobility and accessibility improvement that the project brings. Induced travel resulting from the introduction of the Level 2 rail alternatives was forecasted using a simple elasticity-based approach, where the elasticity is expressed as the percentage impact on travel volumes resulting from a percent change in accessibility. Accessibility, in turn, was defined in terms of a generalized cost or log sum variable computed from the nested logit model developed for this study from the collected SP survey data.

Public Benefits and Environmental Analysis

The ICS will develop and evaluate scenarios that build off the alternatives configured by the RMRA Study completed in March 2010. The environmental impact analysis provides a basis to evaluate, compare, and screen scenarios for implementing HSIPR in Colorado. The purpose of environmental impact analyses at this stage in corridor development is not to meet National Environmental Policy Act (NEPA) analysis standards, but to document how environmental criteria were used in making decisions.

The ICS is looking at two basic alignment options for implementing HSIPR along the Front Range:

1. Those following existing transportation corridors; and
2. Those following “Greenfield” alignments that do not significantly constrain the curvature requirements of HSIPR.

The ICS will also evaluate alignments through and around the Denver metro area. The Advanced Guideway System (AGS) alignments west of Denver will be evaluated in the AGS Feasibility Study. The ICS has three levels of evaluation, each integrating environmental factors. The ICS will consider the following environmental and social factors defined in the ICS Master Scope of Work (SOW):

- Air quality
- Noise
- Energy and congestion
- Land use and development effects, including TOD potential
- Fuel cost savings
- Initial and permanent employment changes
- Safety benefits
- Reliability
- Consumer surplus – a user benefit similar to the estimated time and cost savings often cited in evaluating highway projects
- Other environmental measures as discussed below

A high-level environmental review of each Level 2 scenario was conducted to determine sensitive communities or natural resources that may be potentially affected. These may include but are not limited to historic resources, regulated materials, wetlands, and parks or recreation resources. A calculation of “acres disturbed” has also been added to help assess the absolute impact of the construction of any considered scenario.

The Level 2 Evaluation included more detail on alignment footprints, ridership, and cost estimates. Engineering will be advanced to support evaluation of the physical characteristics of the remaining alignments, including identifying basic ROW needs, focusing on the widths and capacities of existing transportation corridors. The evaluation will define resources that may be highly sensitive to impact based on input from resource agencies, community organizations, and the public. The scenarios will be refined and evaluated using quantitative measures to compare performance and advance those options that have the potential to offer statewide social, environmental, and economic benefits that are greater than the capital and operating costs of implementation. The evaluation and measurement

of environmental impacts during the Level 2 Evaluation is supported by existing mapping and environmental data (available through recent NEPA studies) and newly developed travel demand modeling data.

It is anticipated that environmental factors will be most discriminating during the Level 2 Evaluation. While environmental factors are considered at Level 1 and Level 3, political and policy matters, cost-effectiveness, and financial issues will likely be greater drivers.

Benefit/Cost Analysis

The project Purpose and Need states that any selected HSIPR scenario will need to "*offer statewide social, environmental, and economic benefits that are greater than the capital and operating costs of its implementation.*"

Two B/C studies will be prepared:

- **Calculation of the Operating Ratio (OR) –** As required to determine FRA feasibility, the OR will be calculated by dividing the sum of all revenues by the OPEX estimate.
- **Calculation of Project Benefit/Cost Ratio (B/C Studies) –** Public support for the HSIPR will require an undisputed B/C ratio methodology, one that is endorsed by both the PLT and the public. Consequently, the methodology and the B/C results will be presented to the PLT and the public for comment.

It is anticipated that the introduction of HSIPR in Colorado will divert trips away from the highway system and, to a lesser extent, the aviation system, as well as reduce accidents and the discharge of pollutants to the atmosphere, all of which are expected to generate substantial benefits to the state's residents. As referenced in the project Purpose and Need, a B/C greater than 1.0 is a condition for acceptance of the Colorado HSIPR Program.

The B/C ratio has been calculated by comparing monetized quantitative measures of benefit to the present worth of the annualized capital and O&M costs of the system.

HSIPR benefits that were considered include the following:

1. Passenger revenue
2. Reductions in VMT
3. Reductions in highway delay
4. Reductions in accidents and fatalities
5. Reductions in atmospheric pollution
6. Reductions in aviation delay (if any)
7. Reductions in highway investment requirements
8. Reductions in aviation investment requirements
9. Increases in property tax revenue around HSIPR stations (tax increment basis)
10. Increases in employment income from the construction and operation of the HSIPR system
11. Increases in state personal income through the infusion of major federal grants assumed to partially fund the selected HSIPR scenario

HSIPR costs are expected to include the following:

1. All operating and maintenance costs (OPEX)
2. All capital costs, including ROW and soft costs (CAPEX)

The operating life assumed for the B/C studies is 30 years; long-term interest for bonding was assumed at 4 percent; and inflation is expected to average 3.5 percent per year.

Section 2. Description of Level 2 Scenarios

The five remaining scenarios are described in the following narrative. This discussion serves as the basis for the cost, operational, ridership, and environmental conclusions presented in Section 3, Evaluation of Scenarios.

Four of the scenarios – A-1, A-5, B-2A, and B-5 – involve the construction of all new alignment. These are referred to as the "full-build" scenarios. One scenario, C-1, shares track with RTD to access the Denver metro area, eliminating the need to construct approximately 40 miles of new track.

Where the scenarios share common elements, the description is not repeated but referenced to previous narratives. Consequently, descriptions for the following are not repeated:

- Segments to Fort Collins and to Pueblo are the same for all five scenarios.
- Station locations are generally the same for the five scenarios, with two exceptions that are noted in the narrative.
- One maintenance and four layover facilities are assumed for scenarios A-5, B-2A, B-5, and C-1; two maintenance and three layover facilities are assumed for scenario A-1.

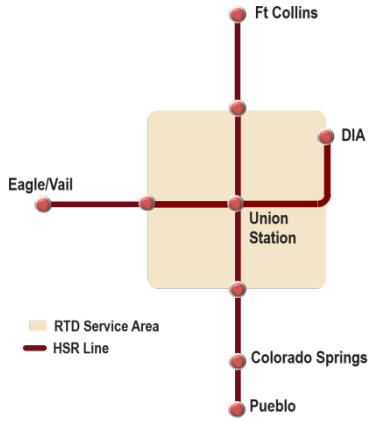
Vital statistics for all of the scenarios are presented in Exhibit 2-1. This information shows that, in the big picture, the scenarios are similar with respect to miles of alignment, acres required, number of stations, and support facilities. The major difference between the five scenarios is the configuration through the Denver metro area. Scenarios that have alignments through the metro area (A-1 and A-5) typically require about 10 more miles of elevated structure than the other scenarios. This is due to the need to "fly over" existing roadways and other urban features.

Scenario A-1: Direct Through Denver

The intent of Scenario A-1 is to run directly through the Denver metro area with the shortest routes and potentially fastest travel times possible. This scenario is also believed to most directly serve the densest population centers within the Denver metro area. The tradeoff for direct access is the need to acquire new ROW for the majority of the segments that pass through the metro area.

A schematic of Scenario A-1 is shown below.

Scenario A-1 (also refer to Exhibit 2-2)



Technology

Both FRA compliant and non-compliant technologies are possible with this scenario.

Alignment

East to West through Metro Denver

There are two design options traveling east to west through the Denver metro area:

- Option A: I-76
- Option B: US 6

Option A: I-76

From the West Suburban Station in the vicinity of I-70 and C-470, the alignment proceeds northeasterly along the south ROW of I-70 to transition to elevated structure over US 6 and then Colfax Avenue. At this point, the alignment moves to grade along the south side of I-70 to SH 58 and remains at-grade or on retained fill until it elevates over Kipling Street and Wadsworth Boulevard.

Exhibit 2-1: Level 2 Vital Statistics

		A-1		A-5		B-2A	B-5	C-1
		Option A (I-76)	Option B (US 6)	Option A (I-76)	Option B (US 6)			
	Total Cost (ICS)	$ 15.3 B	$ 14.9 B	$ 14.1 B	$ 14.3 B	$ 13.4 B	$ 13.9 B	$ 11.5 B
	Corridor Length/ Double Track length	219.4 miles	208.6 miles	214.7 miles	215.4 miles	208.4 miles	215.5 miles	172.6 miles
Right of Way	Alignment Acreage	1,267 acres	1,135 acres	1,135 acres	1,114 acres	981 acres	1,226 acres	904 acres
Right of Way	Station & Facility Acreage[2]	320 acres	310 acres	270 acres	285 acres	260 acres	270 acres	250 acres
Right of Way	Total Acreage	1,587 acres	1,445 acres	1,405 acres	1,399 acres	1,241 acres	1,496 acres	1,154 acres
Track and Structures	Miles at-Grade	119.3 miles	113.1 miles	120.7 miles	120.2 miles	113.3 miles	117.1 miles	97.4 miles
Track and Structures	Miles on Retained Fill	46.2 miles	42.5 miles	47.8 miles	47.2 miles	50.7 miles	55.3 miles	38.2 miles
Track and Structures	Miles Elevated	51.9 miles	51.0 miles	42.6 miles	44.3 miles	41.2 miles	39.5 miles	35.3 miles
Track and Structures	Miles in Retained Cut	1.4 miles	1.4 miles	2.7 miles	2.7 miles	2.3 miles	2.7 miles	1.3 miles
Track and Structures	Miles in Cut and Cover Tunnel	0.6 mile	0.6 mile	0.9 mile	1.0 mile	0.9 mile	0.9 mile	0.4 mile
Track and Structures	Miles in Bored Tunnel	0.0 mile	0.0 mile	0.0 mile	0.0 mile	0.0 mile	0.0 mile	0.0 miles
Stations	Primary	5 each	5 each	4 each	5 each	4 each	4 each	4 each
Stations	Secondary	7 each	6 each	7 each	6 each	6 each	7 each	5 each
Support Facilities	Maintenance Facilities	2 each	2 each	1 each	1 each	1 each	1 each	1 each
Support Facilities	Layover Facilities	3 each	3 each	4 each	4 each	4 each	4 each	4 each

The alignment remains elevated as it flies over the I-70/I-76 interchange and then continues on a combination of at-grade, retained fill, and elevated structure along the south side of I-76 to an elevated structure over Sheridan Boulevard. It then returns to grade for a short distance, becomes elevated over Federal Boulevard and Pecos Street, returns to grade for another short distance, and then flies over I-25. The alignment remains on the south side of I-76, then flies over I-270, remaining on the south side of I-76 to 96th Avenue, where it travels east to E-470, down the west side of the tollway to just north of Pena Boulevard. It then flies over E-470 to the north side of East 78th to the DIA Terminal Station.

Option B: US 6

West Suburban Station to DUS. From the West Suburban Station in the vicinity of I-70 and C-470, the alignment proceeds northeasterly along the south ROW of I-70 at-grade to US 6 (6th Avenue). Approaching the intersection with Indiana Street, the alignment elevates to an aerial structure that is approximately at the same elevation with the US 6 bridge over Indiana Street, but below the RTD West Line LRT flyover. East of Indiana Street, the alignment returns to grade along the south side of US 6 and continues east, crossing under the existing Union Boulevard overpass and RTD West Line LRT tied arch bridge over US 6. The alignment then rises on retained fill to an elevated guideway at approximately Parfet Street. At that point, the alignment transitions to the median of US 6 and continues easterly on the elevated guideway, crossing over the major interchanges of Kipling Street, Wadsworth Boulevard, and Sheridan Boulevard.

East of Sheridan, the alignment on elevated guideway transitions to the north side of US 6 and descends along retained fill to grade at approximately Perry Street. The alignment then continues at-grade along the north side of US 6, crossing under the existing Federal Boulevard overpass before rising on retained fill to an elevated structure just west of the South Platte River. On the elevated structure, the alignment generally parallels US 6 to cross over I-25. The alignment then begins to curve northeasterly to cross under the existing eastbound (EB) 6th Avenue to the northbound (NB) I-25 connector ramp and over the westbound (WB) 6th Avenue to the NB I-25 ramp. The alignment curve ends just after crossing over the CML. Remaining on an elevated guideway, the alignment continues northerly along the east side of the CML, crossing over Colfax Avenue and Auraria Parkway. The alignment then descends on retained fill to grade within the CML, crosses under Speer Boulevard, and continues at-grade along the CML ROW to DUS.

North to South through Metro Denver

DUS North to the North Suburban Station

From DUS, the alignment will follow the CML north and under the 20th Street viaduct, then ascend on elevated structure over Park Avenue, eventually coming to ground to the west of the Union Pacific Railroad (UPRR) 36th Street Yard. From this point, the alignment continues north under I-70, paralleling the west side of the BNSF ROW at-grade, then elevating over I-270 at Clear Creek Junction and continuing on the west side of the freight rail tracks to E-470. From here, it flies over the tollway, following the north side of the ROW to the North Suburban Station.

DUS South to the South Suburban Station

From DUS, the alignment travels south parallel to the CML and under North Speer Boulevard, just to the west of the Pepsi Center; it then transitions to elevated structure over Auraria Parkway and West Colfax Avenue, then descends to grade to near West 8th Avenue. At this point, the alignment parallels the CML, then transitions again to elevated structure over South Kalamath Street, South Santa Fe Street, West Alameda, and I-25. (The CML becomes the Joint Line at this location.) After passing over I-25, the alignment remains aerial and locates to the median of South Santa Fe Drive near West Jewell Avenue. The alignment remains elevated in the median of South Santa Fe Drive for the next 9.4 miles traveling south, coming back to grade just south of West Mineral Avenue. It then follows South Santa Fe Drive south and flies over the C-470/Santa

Fe interchange to the south side of C-470. It remains on the south side of C-470 both at-grade and elevated over South University Boulevard, South Quebec Street, South Yosemite Street, and I-25 to the South Suburban Station located east of I-25.

North to Fort Collins

There are two alignment options north to Fort Collins:

- N-1: North I-25 EIS Segment
- N-2: I-25 Segment

N-1: North I-25 EIS Segment

From the North Suburban Station in Thornton, this segment travels northwest following the UPRR ROW on retained fill until it flies over the UPRR tracks, County Road (CR) 6, and CR 11. The alignment then returns to retained fill until it flies over the I-25 North Frontage Road and I-25, landing on the west side of I-25 and following a northwesterly path to cross CR 7. The alignment follows CR 7 on the west side, alternating between retained fill and at-grade sections until just south of SH 119, where it flies to the south side of SH 119. The alignment then follows SH 119 on retained fill west to the BNSF rail alignment in Longmont and continues on the east side of the BNSF ROW through Loveland to Fort Collins. It is assumed that the HSIPR will have separation with freight rail between Longmont and Fort Collins. The maximum speed will be restricted to 90 mph in that section. The segment would terminate at the MAX Transit Center south of Harmony Road in Fort Collins.

N-2: I-25 Segment

From the North Suburban Station in Thornton, the alignment travels west along the north side of E-470, flies over NB I-25, and travels on elevated structure on the west side of I-25 until 1.2 miles south of CR 6, where it shifts into the I-25 median. The alignment remains in the I-25 median until it reaches the terminal station in Fort Collins. The alignment continues at-grade following the existing topography of the I-25 median while using retained cut/fill sections to reduce troublesome grades where necessary. Elevated structures 30 feet in height are used to fly over 23 highway crossings. The alignment ends at a station south of the East Prospect Road and I-25 interchange in Fort Collins.

South to Pueblo

From E-470, this alignment travels south on the east side of I-25 on elevated structure until Havana Street. The alignment then uses retained fill until it crosses Meadows Parkway, where elevated structure is required through urban Castle Rock. A retained fill section is used until after Bell Mountain Parkway, where the alignment lowers to grade. After Gulch Road, the alignment continues on retained fill for 1.78 miles until it can lower to grade again. At East Greenland Road, the alignment uses a retained fill section for 1 mile and lowers to grade for 2 miles. At this point, the alignment flies over to the west side of I-25 and remains on elevated structure through urban Monument for 2.6 miles, and on a retained fill section for another 2.6 miles until it crosses to the east side of I-25. A retained fill section is maintained as the alignment continues to follow I-25 south.

After Academy Boulevard, an elevated structure is required to travel through urban northern Colorado Springs. Once the alignment reaches downtown Colorado Springs, it deviates from I-25, following the UPRR alignment on an elevated structure through Colorado Springs, lowering to grade under US 24, and elevating on structure again to Fort Carson. Maintaining a 30-foot elevated structure, the alignment deviates from the UPRR alignment and crosses to the west side of I-25, where it returns to grade for 3 miles. After Santa Fe Avenue, the alignment uses retained fill for about 5.5 miles, lowers to grade for another 1.5 miles, and alternates between retained fill and at-grade sections for the next 9.3 miles. Just north of Purcell Boulevard in north Pueblo, the alignment elevates to a 30-foot structure and leaves the I-25 corridor, heading southwest. After returning to grade immediately south of Purcell Boulevard, the alignment generally follows the existing BNSF corridor at-grade, then on retained fill through populated areas of West Pueblo, and then returns to grade south of 19th Street to meet the station in downtown Pueblo.

Stations

The Level 2 Evaluation is based on the following stations:

- DIA
- DUS
- I-76/72nd Avenue (Option A – I-76 only)
- North Suburban
- West Suburban
- South Suburban
- Longmont/Berthoud
- Fort Collins
- Castle Rock
- Monument
- Colorado Springs
- Fort Carson
- Pueblo

The locations of these stations are general at the Level 2 state, as shown in Exhibit 2-2.

Operating Strategy

For the purpose of ridership forecasting, two service plans were evaluated:

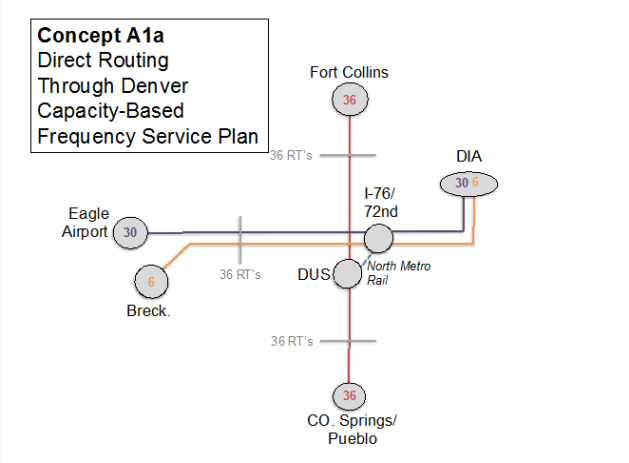
- ***Basic Service Plan:*** 30-minute headways during peak operation (6 hours/day) and 60-minute headway during the off-peak (12 hours)
- ***Capacity Service Plan***: 15-minute headways during peak operation (6 hours/day) and 60-minute headway during the off-peak (12 hours)

The Basic Service Plan assumed 24 trains per day, and the Capacity Service Plan assumed 36 trains per day. With either service plan, trains would operate from 6:00 a.m. to midnight. The Capacity Service Plan was evaluated to satisfy the I-70 PEIS ROD, which requires that any transit alternative have the capacity to carry 4,900 persons per hour, per direction. It also served as a means of testing the effects on system ridership resulting from a more aggressive service plan. The details of both service plans are presented in Appendix C.

The A-1 service plan provides a single north-south pattern from Fort Collins to Pueblo. The east-west pattern proceeds from DIA to either Eagle County Regional Airport or Breckenridge.

For A-1 with Option A (I-76), transferring from one high-speed train to another is achieved by taking the North Metro line between DUS and I-76/72nd, as shown in the A-1A schematic . As discussed later in the report, this transfer proved to have a significant negative impact on ridership. For Scenario A-1 with Option B (US 6), transfers between the two high-speed rail lines can occur at DUS, as shown in the Scenario A-1B schematic. Operating plan details for Scenario A-1 are summarized below:

- **Fort Collins to Pueblo**: 24 round trips daily - Stations: Fort Collins, Berthoud, North Suburban, DUS, South Suburban, Castle Rock, Monument, Colorado Springs, Fort Carson, Pueblo
- **DIA to Eagle County Regional Airport**: 21 round trips daily - Stations: DIA, I-76/72nd (A-1A) or DUS (A-1B), West Suburban, Georgetown, Silverthorne, Vail, Eagle Airport
- **DIA to Breckenridge**: 3 round trips daily - Stations: DIA, I-76/72nd (A-1A) or DUS (A-1B), West Suburban, Georgetown, Silverthorne, Breckenridge



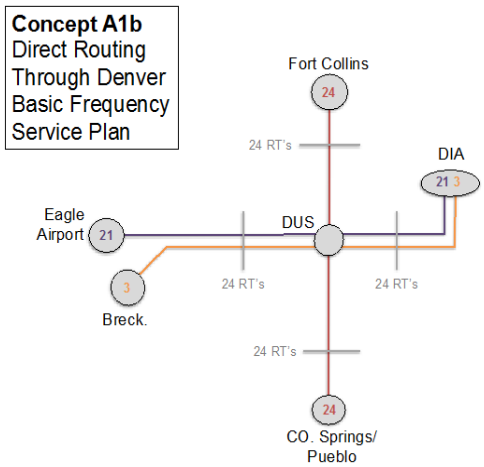
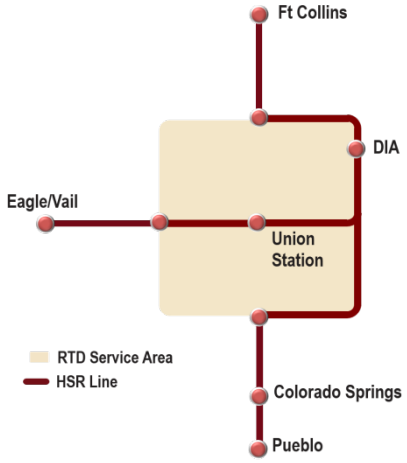


Exhibit 2-2: Scenario A-1: Direct through Denver

Scenario A-5: Eastern Beltway

The intent of this scenario is to test the effectiveness of traveling around the Denver metro area as opposed to using the railroad alignment (Segments NS-1 and NS-2) north to south through the Denver metro area as required with A-1. The east-west movements through the metro area are the same as discussed previously for A-1.

Scenario A-5 (also refer to Exhibit 2-3)



Technology

Both FRA compliant and non-compliant technologies are possible.

Alignment

East to West through Metro Denver

This scenario incorporates the same east-to-west design options (A and B) through the Denver metro area as presented for Scenario A-1.

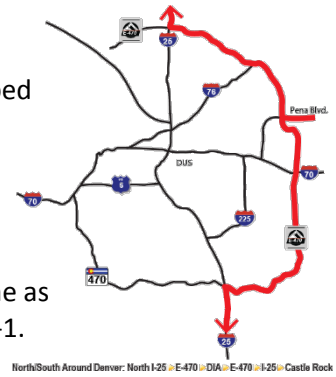
North to South around Metro Denver

Starting from the North Suburban Station, the alignment travels to the east along the north side of E-470 and flies over Quebec Street, Riverdale Road, the South Platte River, and SH 285. It then travels on grade until it flies over SH 2, where it continues to follow along the east side of E-470 until it enters DIA property. From here, the alignment turns east, north of 78th Avenue, and parallels RTD's East Rail into the Airport Terminal.

From DIA, the alignment travels out of the Airport Terminal area west and then south, flying over Pena Boulevard, then back to grade for about 1,500 feet before it elevates again over E-470, alighting on the west side of the tollway traveling south. The alignment remains on the east side of the tollway, flying over all east-west roadways and interchanges until it reaches South Parker Road, where it departs from the E-470 ROW for a short distance. It then flies over South Parker Road traveling west, and remains elevated to fly over E-470 to the south and west to the C-470/I-25 interchange. The alignment then turns south, aligned on the east side of I-25 to the South Suburban Station.

North to Fort Collins

The two alignment options traveling north to Fort Collins are the same as those described previously for Scenario A-1.



South to Pueblo

The alignment option traveling south to Colorado Springs and Pueblo is the same as that described for Scenario A-1.

Stations

The stations modeled for this scenario are the same as described above for Scenario A-1.

Operating Strategy

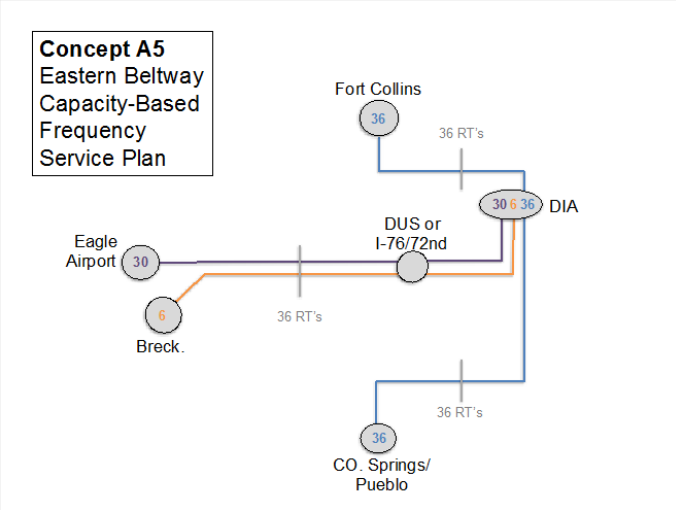
The headways and hours of service for operation are the same as described for Scenario A-1.

This operating concept provides a single north-south pattern from Fort Collins to Pueblo via E-470 and I-25. The east-west pattern proceeds from DIA west to either Eagle County Regional Airport or Breckenridge, either via I-76 (A-5A) or US-6 (A-5B) in the same configuration as described for Scenario A-1. Similar to A-1, when A-5 is paired with Option A (I-76), transferring from one high-speed train to another is achieved by taking the North Metro line between DUS and I-76/72nd. With Option B (US 6), transfers occur at DUS, which is more efficient and faster. The operating plan details for Scenario A-5 are given below:

- **Fort Collins to Pueblo**: 24 round trips daily - Stations: Fort Collins, Berthoud, North Suburban, DIA, South Suburban, Castle Rock, Monument, Colorado Springs, Fort Carson, Pueblo
- **DIA to Eagle Airport**: 21 round trips daily - Stations: DIA, I-76/72nd (A-5A) or DUS (A-5B),

West Suburban, Georgetown, Silverthorne, Vail, Eagle County Regional Airport

- **DIA to Breckenridge**: 3 round trips daily - Stations: DIA, I-76/72nd (A-5A) or DUS (A-5B), West Suburban, Georgetown, Silverthorne, Breckenridge



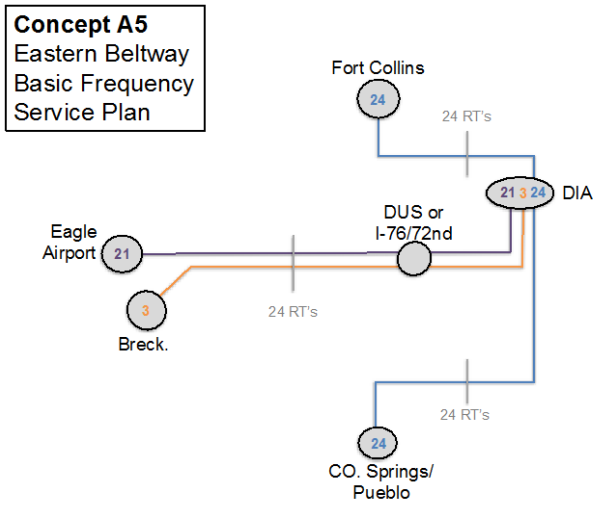


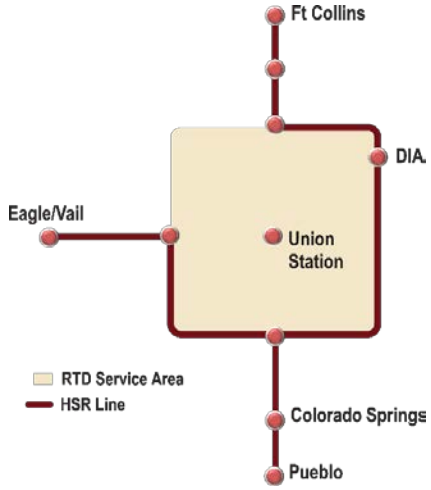
Exhibit 2-3: Scenario A-5: Eastern Beltway

Scenario B-2A: Denver Periphery Excluding Northwest Quadrant

Scenario B-2A is configured to carry HSIPR around the populated areas of the Denver metro area and rely on the RTD system to serve as a collector/distributor of transit patrons to and from the high-speed rail system.

Outside of the Denver metro area, this scenario is analogous to the other Level 2 scenarios.

Scenario B-2A (also refer to Exhibit 2-4)



Technology

Outside of the Denver metro area, both FRA compliant and non-compliant vehicles could be used. Inside the RTD service area, RTD technologies would be used.

Alignment

The alignment for Scenario B-2A is the same as for Scenario A-5 with the exception that the C-470 beltway in the southwest quadrant is added. Unlike A-1 and A-5, there are no east-west alignments through the Denver metro area. The beltway serves as the east-to-west route.

North to South around Denver

The alignment around the Denver metro area from near I-25 north to DIA and from DIA to the South Suburban Station is the same as discussed for Scenario A-5.

Beltway around the Southwest Quadrant

From West Suburban Station near the I-70 and C-470 interchange, the alignment proceeds at-grade south along the west ROW of C-470 and then flies over Alameda Parkway, Morrison Road, US 285, Quincy Avenue, Belleview Avenue, West Bowles Avenue, and Ken Caryl Avenue. From this point, it continues south along the C-470 ROW at-grade, then flies over Kipling Street and Wadsworth Avenue, and transitions to elevated structure over Santa Fe Avenue and the existing BNSF railroad corridor. The alignment transitions back to grade for a short distance, then elevates over Lucent Boulevard, Broadway Boulevard, University Boulevard, Colorado Boulevard, Quebec Street, and Yosemite Street, and finally over the C-470/I-25 interchange, terminating at the South Suburban Station east of I-25.

North to Fort Collins

The two alignment options traveling north to Fort Collins are the same as those described previously for Scenarios A-1 and A-5.

South to Pueblo

The alignment option traveling south to Colorado Springs and Pueblo is analogous to that described for Scenarios A-1 and A-5.

Stations

The stations modeled for this scenario are the same as those described for Scenarios A-1 and A-5, with one important exception: Scenario B-2A does not provide direct access to DUS.

Operating Strategy

The headways and hours of service for operation of Scenario B-2A is the same as described for Scenarios A-1 and A-5.

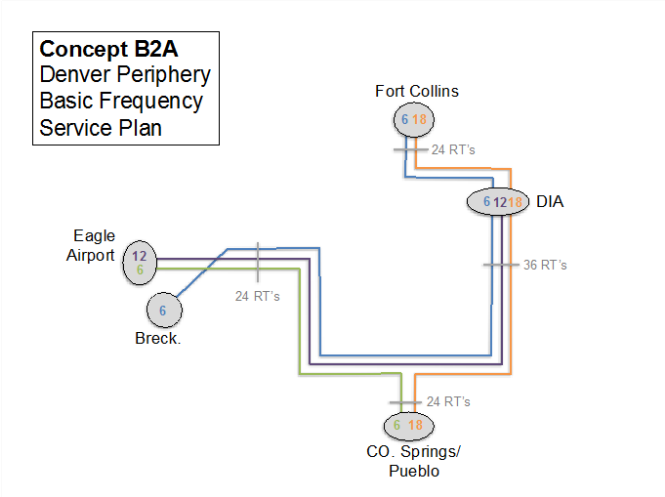
Four different service patterns are defined, all using some portion of the beltway around the Denver metro area. The operating plan details for Scenario B-2A are provided below:

- **Fort Collins to Pueblo**: 18 round trips daily - Stations: Fort Collins, Berthoud, North Suburban, DIA, South Suburban, Castle Rock, Monument, Colorado Springs, Fort Carson, Pueblo
- **DIA to Eagle Airport:** 12 round trips daily - Stations: DIA, South Suburban, West Suburban, Georgetown, Silverthorne, Vail, Eagle County Regional Airport

- **Fort Collins to Breckenridge:** 6 round trips daily - Stations: Fort Collins, Berthoud, North Suburban, DIA, South Suburban, West Suburban, Georgetown, Silverthorne, Breckenridge
- **Pueblo to Eagle Airport**: 6 round trips daily - Stations: Pueblo, Fort Carson, Colorado Springs, Monument, Castle Rock, South Suburban, West Suburban, Georgetown, Silverthorne, Vail, Eagle Airport

Resulting trunk service levels are 24 round trips for the Basic Service Plan and 36 round trips for the Capacity Service Plan, consistent with service levels defined for Scenarios A-1 and A-5.

Transfers between high-speed rail lines can occur at the North Suburban, DIA, South Suburban, and West Suburban stations.



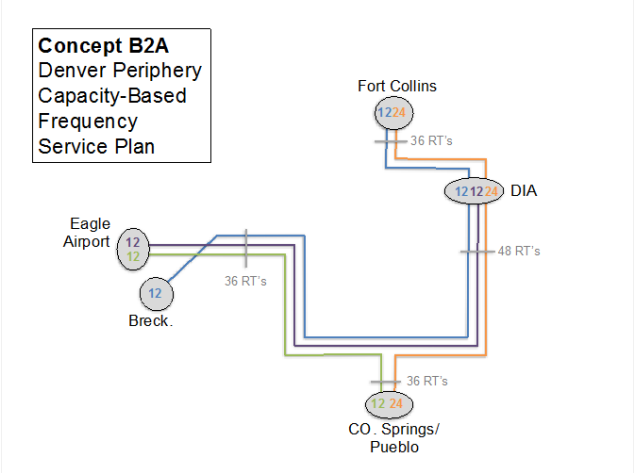
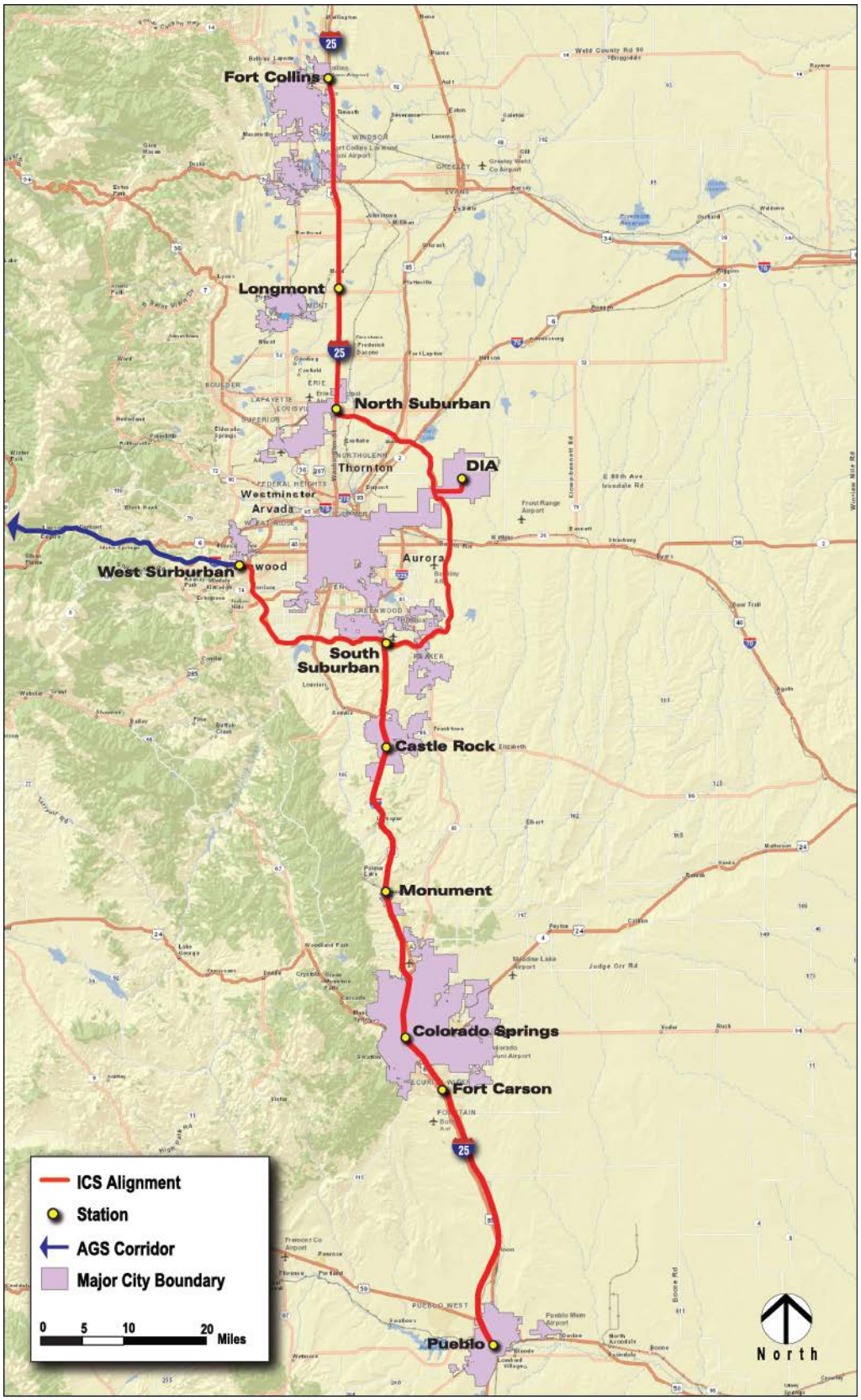


Exhibit 2-4: Scenario B-2A: Denver Periphery Excluding Northwest Quadrant

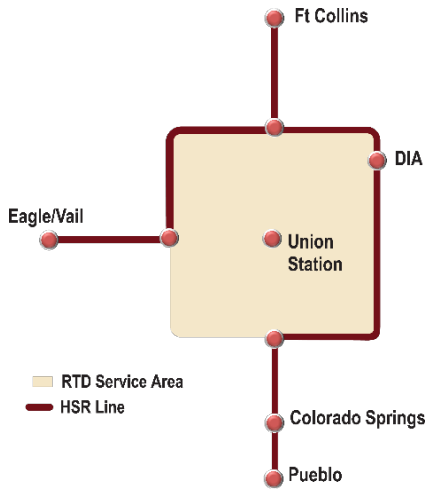


Scenario B-5: Denver Periphery Excluding the Southwest Quadrant

Similar to Scenario B-2A, Scenario B-5 is configured to carry HSIPR around the populated areas of the Denver metro area and relies on the RTD system to serve as a collector/distributor of transit patrons to and from the high-speed rail system. However, Scenario B-5 will test the differences in ridership and environmental impact by traveling across the northwest quadrant of the Denver metro area versus the southwest quadrant as Scenario B-2A does.

Outside of the Denver metro area, this scenario is analogous to the other Level 2 scenarios.

Scenario B-5 (also refer to Exhibit 2-5)



Technology

Outside of the Denver metro area, both FRA compliant and non-compliant vehicles could be used. Inside the RTD service area, RTD technologies would be used.

Alignment

The only alignment for Scenario B-5 that has not been discussed for the previous scenarios is the Northwest Quadrant, as described below.

West Suburban Station to North Suburban Station

From the West Suburban Station near the I-70/C-470 interchange, this alignment proceeds north along the west side of US 6 on a combination of at-grade, retained fill, and elevated structure until it reaches SH 58. The alignment flies over SH 58, then follows the west ROW of SH 93 to just south of Indian Head Road, where it flies over SH 93 to the south side of West 82nd Avenue. The alignment follows and crosses 82nd Avenue just west of Indiana Street. From this point, the alignment travels north and parallel to Indiana Street, then proceeds to the northeast where it flies over SH 128 at Simms Street. It continues on elevated structure to cross to the east side of Interlocken Loop and over Eldorado Boulevard, Environmental Way, Interlocken Boulevard, and East Flatirons Crossing. It then flies over US 36 and onto the south side of Northwest Parkway. The alignment follows the tollway to and over I-25 and east to the North Suburban Station.

North Suburban Station to DIA

The alignment from the North Suburban Station to DIA is analogous to that described for Scenarios A-5 and B-2A.

DIA to the South Suburban Station

The alignment from DIA to the South Suburban Station is analogous to that described for Scenarios A-5 and B-2A.

North to Fort Collins

The alignment options for Scenario B-5 is the same as those described for the previous scenarios.

South to Pueblo

The alignment option for Scenario B-5 is the same as that described for the previous scenarios.

Stations

The stations modeled for this Scenario B-5 are the same as those described above for Scenarios A-1 and A-5, with one exception: Scenario B-5 does not provide direct access to DUS.

Operating Strategy

The headways and hours of service for operation of Scenario B-5 are the same as described above for Scenario A-1. Likewise, 24 and 36 trains per day were modeled. The details of the Basic Service Plan are provided below:

- **Fort Collins to Pueblo**: 18 round trips daily - Stations: Fort Collins, Berthoud, North Suburban, DIA, South Suburban, Castle Rock, Monument, Colorado Springs, Fort Carson, Pueblo

- **DIA to Eagle Airport**: 12 round trips daily - Stations: DIA, North Suburban, West Suburban, Georgetown, Silverthorne, Vail, Eagle County Regional Airport
- **Fort Collins to Eagle Airport**: 6 round trips daily - Stations: Fort Collins, Berthoud, North Suburban, West Suburban, Georgetown, Silverthorne, Vail, Eagle County Regional Airport
- **Pueblo to Breckenridge:** 6 round trips daily - Stations: Pueblo, Fort Carson, Colorado Springs, Monument, Castle Rock, South Suburban, DIA, North Suburban, West Suburban, Georgetown, Silverthorne, Breckenridge

Resulting trunk service levels are 24 round trips, consistent with basic service levels defined for Scenarios A-1 and A-5.

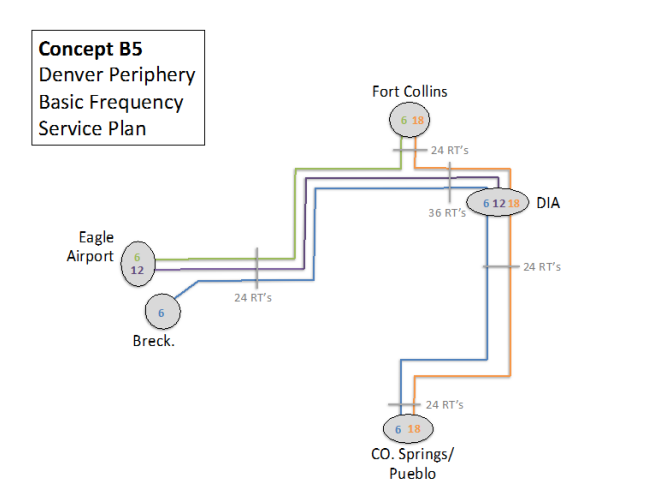
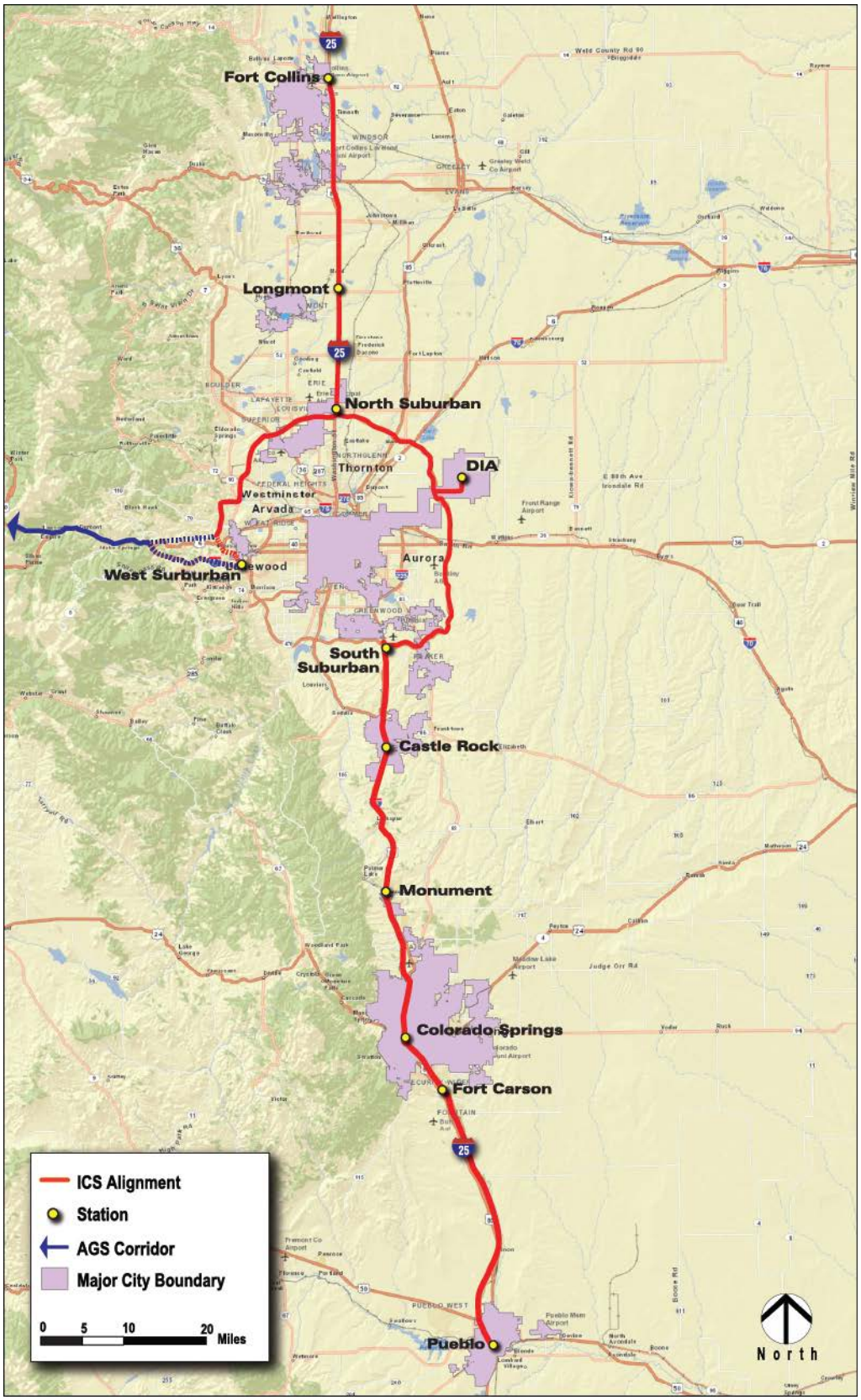


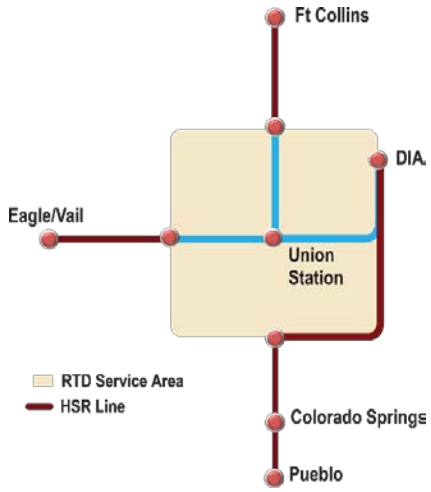
Exhibit 2-5: Scenario B-5: Denver Periphery Northwest Quadrant



Scenario C-1: Shared Track with RTD

Scenario C-1 was modeled to test the effectiveness of using RTD's rail system to move patrons through the Denver metro area, connecting to the HSIPR system. Shared track with the North Metro CRT to DUS from the North Suburban Station, the East Rail CRT from DIA to DUS, and the Gold Line CRT from DUS to the West Suburban Station is possible assuming an operating agreement that is acceptable to RTD and its Concessionaire. Because RTD's Southeast Corridor uses LRT vehicles that cannot run with FRA compliant technology, an independent alignment was provided along E-470 from DIA to the South Suburban Station.

Scenario C-1 (also refer to Exhibit 2-6)



Technology

Scenario C-1 would require FRA compliant technologies for a one-seat ride. If a different technology were deployed for the I-70 mountain corridor, a transfer at the West Suburban Station would be required.

Alignment

Around Denver Metro Area

No new alignment would be provided around the Denver metro area except for the segment from DIA to the South Metro Station, which is the same alignment along E-470 as described for Scenarios A-5, B-2A, and B-5.

North to Fort Collins

The alignment options north to Fort Collins for Scenario C-1 are the same as those described previously for the other scenarios.

South to Pueblo

The alignment option south to Pueblo for Scenario C-1 is the same as that described previously for the other scenarios.

Stations

The stations modeled forScenarioC-1 are the same as those described above for the previous scenarios. Access to DUS and DIA would be direct, with access provided by HSIPR vehicles traveling on RTD-owned track.

Operating Strategy

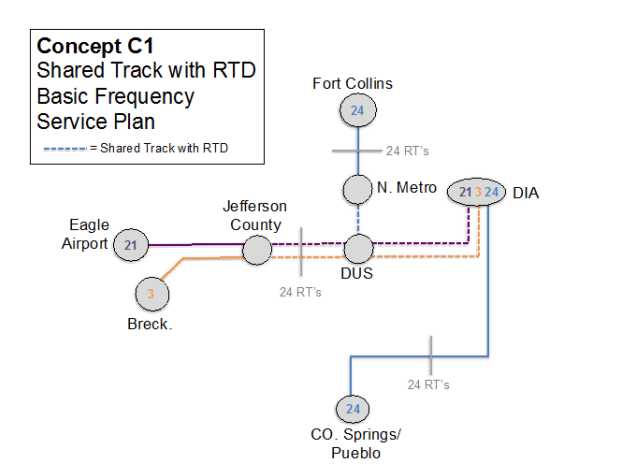
Outside of the Denver metro area, the operating strategy for Scenario C-1 is generally the same as described above for the other full-build scenarios.

Within the Denver metro area, the operating strategy is for HSIPR to share track with RTD's Eagle project (East Rail and Gold Line) and the RTD North Metro Corridor. This would require negotiation of an operating window between the HSIPR Authority and RTD and the use of FRA compliant technologies since both systems operate within freight rail corridors.

As mentioned above, HSIPR could not operate on RTD's Southwest Corridor or Southeast Corridor since both systems use LRT, which is not FRA compliant. This would require the construction of a new alignment from DIA to the South Suburban Station along the E-470 ROW, described earlier. Specific service plan details are provided below:

- **Fort Collins to DUS**: 24 round trips daily - Stations: Fort Collins, Berthoud, North Suburban, DUS
- **DIA to Pueblo**: 24 round trips daily - Stations: DIA, South Suburban, Castle Rock, Monument, Colorado Springs, Fort Carson, Pueblo
- **DIA to Eagle Airport**: 21 round trips daily - Stations: DIA, DUS, West Suburban, Georgetown, Silverthorne, Vail, Eagle County Regional Airport
- **DIA to Breckenridge**: 3 round trips daily - Stations: DIA, DUS, West Suburban, Georgetown, Silverthorne, Breckenridge

Schematics for the Basic Service Plan and Capacity Service Plan are presented below:



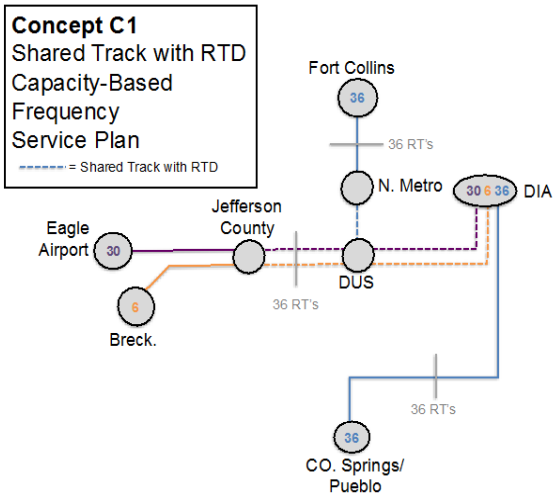
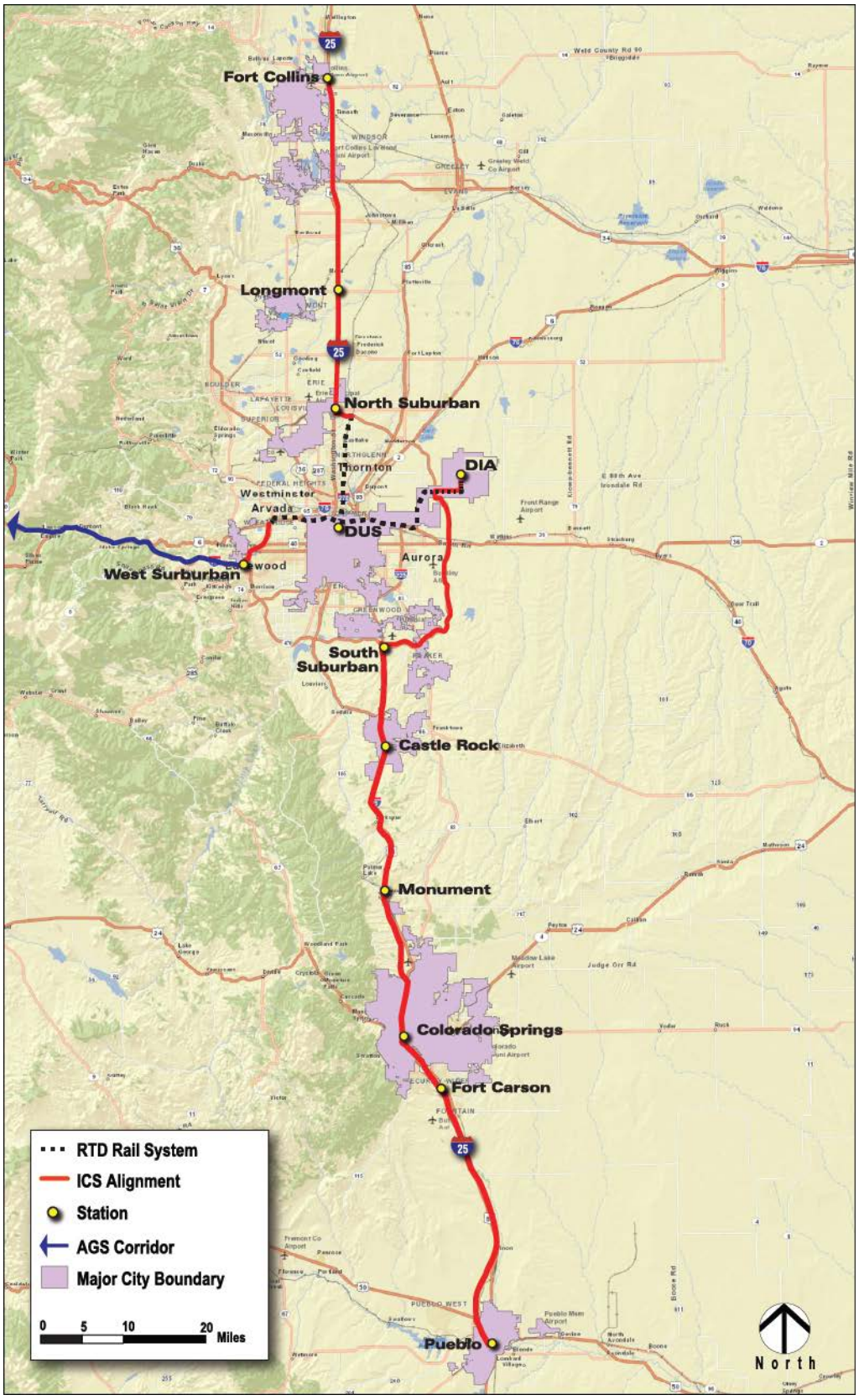


Exhibit 2-6: Scenario C-1: Shared Track with RTD



Section 3. Evaluation of Scenarios

Introduction

This section presents the Level 2 Evaluation of the remaining five scenarios and associated design options. It concludes that HSIPR scenarios that travel around the periphery of the Denver metro area have higher ridership, lower costs, and fewer impacts than those traveling directly through the metro area. Of the five scenarios:

- A-1 has the greatest community impacts and is likely environmentally infeasible with either Option A (I-76) or Option B (US 6).
- Scenario A-5 with Option A (I-76) appears to be feasible but has lower projected ridership than other scenarios.
- Scenario A-5 with Option B (US 6) is felt to be environmentally unimplementable due to the impacts associated with construction along US 6 and north to 96th Avenue, similar to Scenario A-1/Option B (US 6).
- Scenario B-2A is the most cost-effective and avoids the impacts of constructing and operating HSIPR through the Denver metro area. Further, this scenario appears to be the most widely supported by the PLT and the public.
- Scenario B-5 is also cost-effective, but has limited support from the City of Golden, reducing its political feasibility.
- Scenario C-1 appears to be feasible as a phasing strategy.

Based on the Level 2 Evaluation, this section concludes that scenarios B-2A, A-5A (I-76), and C-1 should be carried forward into the Level 3 Evaluation.

Level 2 Evaluation Criteria

The criteria used to evaluate the scenarios were presented in Section 1, Introduction. Further detail is shown in the matrix evaluation included in Appendix A; this document supports the findings presented in this section. A summary of the Level 2 findings is presented for each of the principle criteria:

- Public Benefits
- Transportation Benefits
- Engineering Feasibility and Cost
- Planning Feasibility
- Benefit/Cost Ratio

For each evaluation, only the criteria that serve as discriminators are discussed.

Public Benefits

Evaluation of the Public Benefits criterion at Level 2 focused on how well each scenario addressed:

- Purpose and Need
- The level of public and agency support

Purpose and Need (PN)

At this level of evaluation, all of the scenarios fulfill the elements of the ICS PN statement. A key element of the ICS PN is that the HSIPR ***offers statewide social, environmental, and economic benefits that are greater than the capital and operating costs of its implementation.*** All of the final five scenarios have Benefit/Cost Ratios of about 2.0, meaning that for every dollar invested, two dollars are returned. Likewise, all five scenarios have operating ratios of greater than 1.0, and most are in the range of 1.2 to 1.3.

Public and PLT Support

The degree of public support statewide for the HSIPR Program appears to be positive, but how the system will be funded presents concerns. In general, support has been strong based on our PLT and Public Workshop processes. That said, the scenarios that travel around the Denver metro area (B-2A and B-5) appear to be better supported than those that traverse the area (A-1 and A-5). Because the alignments for all of the scenarios are the same once they leave the Denver metro area, there is no public preference.

Public Workshops

The following public input was received at the Level 2 Evaluation public workshops:

- **Fort Collins Area –** Many Fort Collins area residents have a strong interest in maintaining the vision established by the North I-25 EIS. The EIS

recommended CRT on the SH 287 alignment, with direct service to Longmont, Berthoud, Loveland, and Fort Collins. HSIPR located on the I-25 alignment fulfills different objectives than the CRT, with a focus on intercity travel. However, so long as the HSIPR does not eliminate the concept of CRT along the SH 287 corridor, it appeared to be well supported. The public suggested that perhaps the CRT system could function as a feeder system to the HSIPR system. It was emphasized that there is a need to connect the HSIPR more directly to the city centers along the route, either via a bus shuttle system or some other transit mechanism.

However, if the HSIPR were implemented, residents of Fort Collins and surrounding northern communities have a preference for the scenarios that follow E-470 to DIA (A-5, B-2A, and B-5) because the access is more direct and the travel times are faster. Access to DIA is considered more important than access west to the mountain communities. Additionally, several members of the public mentioned the desire to use the system to commute to downtown Denver.

- **Denver Area –** The reaction of Denver area residents to the five scenarios is mixed. Many recognize the benefit of avoiding the impacts of constructing HSIPR through the Denver metro area, as required for Scenario A-1 and to a lesser extent Scenario A-5. Others are concerned that the scenarios that travel the beltways (B-2A and B-5) provide little direct access to the HSIPR. Some members of the PLT are concerned that omission of the DUS from the service plan will remove the economic benefits provided by a HSIPR. Other members of the PLT feel that any of the scenarios involving construction through the Denver metro area would never survive the NEPA process. There was no consensus on a preferred scenario at the public meeting.
- **Colorado Springs Area –** The public meetings in the Colorado Springs area suggest that the most significant concern revolves around an earlier segment (S-1) traveling through the Black Forest community. Once the alignment through Black Forest was eliminated, the residents' previous concerns were mollified. Some members of the public expressed concern about the high cost of the HSIPR. Based on the input, there is little appetite for a tax increase to fund the system. There was the feeling that while 100 percent of the citizens would have to pay for the system, only a small percentage would use it. Feedback from both the public and the PLT indicated a preference for Scenario B-2A, assuming it could be funded. Others at the meeting suggested that providing rail service from Colorado Springs to Denver was the number one public transportation priority that has repeatedly surfaced in all planning documents.
- **Pueblo Area –** Public meeting attendees in the Pueblo area were very supportive of HSIPR. There was some concern that funding for the program would not be available in the near future. It was also suggested that the alignment through Pueblo should not be so constrained that it precludes expansion of the HSIPR south into New Mexico.
- **Mountain Corridor Area –** The mountain corridor residents and PLT members emphasized they do not want a conventional "steel wheel" HSIPR program. There has been consistent insistence on an Advanced Guideway System (AGS) featuring Maglev technology. There is concern that the scenarios proposed in the ICS may prevent the implementation of an AGS. This is especially profound with Scenario C-1, which would require conventional FRA compliant technology since it operates on existing and planned RTD track using such technology. Scenario A-1 with either Option A or B and Scenario A-5A are favored because they provide the most direct route to DIA. Scenario B-5 is also acceptable to this community. Residents of the mountain communities generally place lower importance on accessing DUS. There is much less preference for Scenario B-2A as it would direct travelers to the southern periphery of the Denver metro area en route to DIA.

Transportation Benefits

For the purposes of Level 2 Evaluation, the assessment of Transportation Benefits included the following:

- System ridership
- Distribution of ridership
- Station boardings
- Travel times
- Impacts on freight
- Impacts on aviation

System Ridership

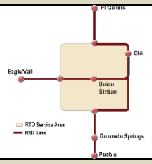
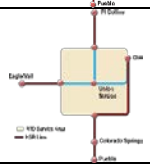
As described below, system ridership directly affects revenue, reductions in vehicle miles traveled (VMT), and vehicle hours of travel (VHT).

Ridership and Revenue

Assuming political and public support, HSIPR system ridership is the most important criterion considered in this study. Ridership drives revenue generation and the B/C studies and potentially relieves congestion from other modes of travel, especially on the highway system. There is also a direct correlation between ridership and the reduction of automobile use, resulting in air quality improvements. Exhibit 3-1 presents the results of the Level 2 ridership and revenue estimation studies.

- As shown on the exhibit, Scenarios B-2A and B-5 represent the highest ridership at 13.8 and 13.7 million per year, respectively. Scenario A-1B produces the highest revenue even though the ridership at 13.1 million per year is about 5 percent lower. This is due to the difference in trip distribution and distance, and zone to station assignment. Scenario A-1B has longer-distance trips compared to Scenarios B-2A or B-5 because, in general, station-to-station distances are longer. Because the fares are calculated on a distance basis, longer trips mean higher fares, notwithstanding the decrease in ridership for Scenario A-1B compared to Scenarios B-2A or B-5.
- Scenario A-5B performs about the same as Scenario A-1B, with about 13.2 million riders per year. Although slightly lower at 12.9 million riders per year, Scenario A-5A performs nearly as well but does not provide direct access to DUS.
- Scenario A-1B performs better than Scenario A-1A due to a long transfer between the 72nd Avenue Station and DUS.

Exhibit 3-1: AGS and ICS Annual Ridership, Revenue, Vehicle Miles Traveled, and Reduction in Hours of Travel by Scenario

Scenario		Ridership in Millions/Year	Revenue in Millions/Year	Reduction in Vehicles Miles Traveled	Reductions in Vehicle Hours of Travel (VHT)
A-1A		12,149,142	$ 293,776,963	360,441,204	868,700
A-1B		13,162,834	$ 323,101,495	395,965,041	1,233,382
A-5A		12,965,726	$305,025,470	351,230,940	949,096
A-5B		13,137,458	$306,777,970	351,361,395	992,042
B-2A		13,848,747	$318,978,788	373,844,381	1,249,621
B-5		13,714,955	$310,293,016	357,444,192	1,166,586
C-1		10,844,306	$242,698,592	271,174,960	447,918

Reduction in Vehicle Miles Traveled and Vehicle Hours of Travel

- **VMT -** Reductions in VMT and VHT represent benefits to the public in terms of reduced air emissions and traveling times, respectively. As shown on Exhibit 3-1, the results are not always intuitive. For example, the scenario with the highest ridership, B-2A, does not have the highest reduction in VMT, but is second behind Scenario A-1B. Scenario A-1A has the third highest reduction in VMT but the fifth highest ridership. Scenario B-5 has the second highest ridership but the fourth highest reduction in VMT.

  The VMT reduction is the difference between the end-to-end automobile travel distance and the sum of the access/egress distances (when the auto trip is diverted to high-speed rail [HSR]) divided by the vehicle occupancy summed over all the person trips. In this instance, Scenario A-1B has longer distance rail trips in general (as described above), which means shorter distance access/egress trips to and from rail stations by auto. As a result, diversions to the HSIPR from auto result, in general, in greater reductions in miles traveled and hence lower VMT.

- **VHT –** With respect to VHT, on the other hand, Scenario B-2A has the greatest reduction, followed by Scenarios A-1B and B-5.

  VHT reduction is the difference between the end-to-end travel time with the auto mode and the HSR mode (when the auto trip is diverted to HSR and includes the access/egress time by auto to and from the rail station, any transfer time, terminal times, and the HSR line haul times) divided by the vehicle occupancy (to get vehicle level statistics) summed over all the person trips.

  Because Scenario B-2A provides, in general, lower end-to-end travel times (and hence higher ridership) with the HSIPR option compared to Scenario A-1B, the VHT reduction is higher for B-2A (and disproportionately lower for B-5) compared to A-1B even though it is the opposite for the VMT reduction. The main reasons that the end-to-end travel time is lower for Scenario B-2A or B-5 is the shorter or no transfer times and shorter station-to-station times in many cases. The short station-to-station time is due to the reassignment of stations; for example, a DUS to Eagle County trip may now be a Suburban West to Eagle County trip. Therefore, even though the auto access/egress times to and from the HSIPR stations may be higher for Scenario B-2A or B-5 compared to Scenario A-1B, the travel time decreases related to HSR more than offset the access/egress time increases in general.

Distribution of Ridership

Of the total system ridership, approximately 80 percent represent intercity trips, with the remaining trips occurring within the Denver metro area. Overall, as discussed in more detail below, the average split of riders is 18 percent I-70 mountain corridor, 18 percent I-25 north, 43 percent I-25 south, and 20 percent Denver metro area.

Impact on Mountain Corridor Ridership (I-70)

A review of Exhibit 3-2 shows that the distribution of riders traveling to the mountains ranges from about 16 to nearly 22 percent, with the average of all scenarios being 18 percent. The highest ridership to the mountains is with Scenarios B-2A and B-5, with 21.6 and 20.4 percent, respectively; Scenarios A-1B and A-5A are close behind at about 19 percent each. The lowest ridership to the mountains is with Scenario C-1, at 15.6 percent, which is due to the slow travel times through metro Denver resulting from operations on shared RTD track.

Exhibits 3-3 through 3-9 provide a graphical display of the scenarios, showing which scenarios provide the best inter-regional and intra-regional ridership to the different markets. As discussed above, Scenarios B-2A and B-5 provide the highest inter-regional ridership to the mountains. These scenarios also provide the highest intra-regional ridership within the I-70 corridor, at 1.65 million riders per year. However, these scenarios provide the lowest ridership between the mountain corridor and downtown Denver. The highest ridership between the mountain corridor and Denver is with Scenarios A-1B and A-5B at 1.23 million riders per year (see Exhibits 3-4 and 3-6).

Impact on North Ridership (I-25)

Ridership to the north and Fort Collins averages 18 percent of the total. With 22.7 percent of the total, Scenario B-5 realizes the highest ridership due to its broad access across the northern Denver metro area. The lowest ridership traveling north is represented by Scenario C-1 because of the need to travel to DUS on the RTD East Rail, than transfer to the RTD North Metro alignment heading north.

While Scenario B-5 provides the highest inter-regional ridership to the north, Scenario A-1B provides the highest inter-regional ridership between the north and south corridors, at 1.15 million riders per year. Scenarios A-5B, B-2A, B-5, and C-1 provide equal intra-regional ridership within the I-25 north corridor, at 820,000 riders per year.

Exhibits 3-3 through 3-9 provide a graphical representation of ridership by market.

Impact on South Ridership (I-25)

The largest volumes of HSIPR riders travel south, generally averaging 43 percent of the total. The highest ridership, 6,220,862, is realized with Scenario B-2A. This is because the alignment provides strong access to both the mountains and north to DIA and Fort Collins. The highest percentage, 46 percent, is realized with Scenario C-1, due to the direct connection along E-470 to DIA. However, the absolute ridership, 4,994,421, is lower than for any of the other scenarios. The highest intra-regional ridership within the I-25 south corridor is provided by Scenario B-5 at 3.81 million riders per year (see Exhibit 3-8).

Exhibits 3-2 through 3-9 provide a graphical representation of ridership by market.

Impact on Denver Area Ridership

As stated above, the Denver metro area ridership averages about 20 percent. The best ridership is provided by Scenario A-5 with either Option A (I-76) or Option B (US 6) at 2,623,452 and 2,865,417 riders per year, respectively. The beltway scenarios, B-2A and B-5, generate the lowest ridership values, at 15 and 16 percent, respectively. The comparative absolute values are 2,133,840 and 2,218,226 per year.

To expand further on ridership between downtown Denver and the other corridors, Scenario A-5B provides the best ridership between Denver and the north corridor at 2.11 million riders, as well as the best ridership to the south corridor at 2.38 million riders per year. Scenarios A-1B and A-5B provide the best ridership to the mountain corridor at 1.23 million riders per year. Within the Denver metro area, Scenario A-1B realizes the highest ridership at 70,000 riders per year due to the transfer between the I-76/72nd Station and DUS (see Exhibit 3-4).

Exhibits 3-2 through 3-9 provide a graphical representation of ridership by market.

Exhibit 3-2: AGS and ICS Distribution of Ridership by Scenario

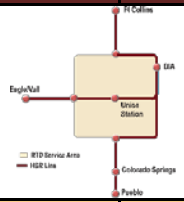
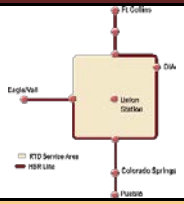
Scenario	A-1A	A-1B	A-5A	A-5B	B-2A	B-5	C-1
Ridership							
Mountains	2,168,094	2,516,754	2,430,662	2,136,961	2,995,866	2,792,520	1,696,330
Percent of Total	17.85%	19.12%	18.75%	16.27%	21.63%	20.36%	15.64%
Mountain Daily	7,227	8,389	8,102	7,123	9,986	9,308	5,654
North of Denver	2,069,642	2,472,297	2,326,763	2,620,094	2,498,178	3,107,216	1,909,081
Percent of Total	17.04%	18.78%	17.95%	19.94%	18.04%	22.66%	17.60%
North Daily	6,899	8,241	7,756	8,734	8,327	10,357	6,364
South of Denver	5,451,251	5,674,676	5,584,849	5,514,986	6,220,862	5,596,993	4,994,421
Percent of Total	44.87%	43.11%	43.07%	41.98%	44.92%	40.81%	46.06%
South Daily	18,171	18,916	18,616	18,383	20,736	18,657	16,648
Denver Metro	2,460,154	2,499,106	2,623,452	2,865,417	2,133,840	2,218,226	2,244,474
Percent of Total	20.25%	18.99%	20.23%	21.81%	15.41%	16.17%	20.70%
Denver Daily	8,201	8,330	8,745	9,551	7,113	7,394	7,482
Total	**12,149,141**	**13,162,833**	**12,965,726**	**13,137,458**	**13,848,747**	**13,714,955**	**10,844,306**

Exhibit 3-3: Scenario A-1A Ridership

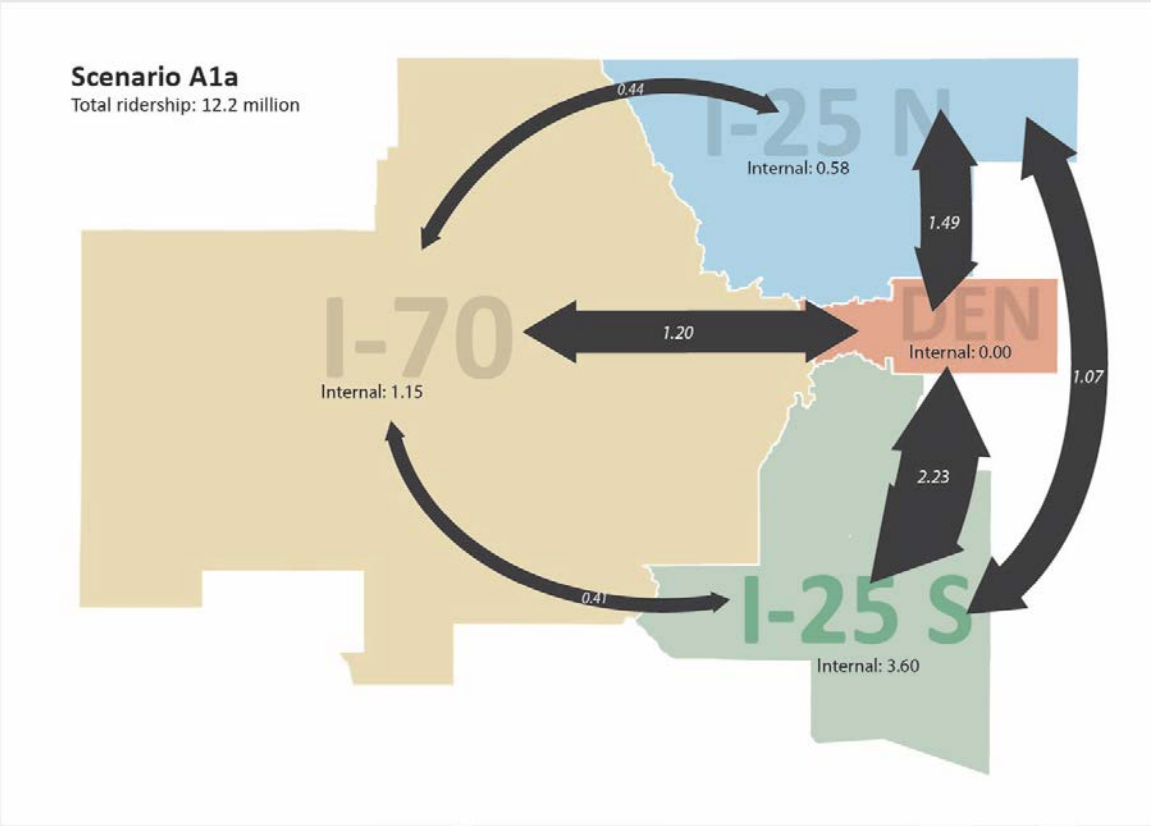


Exhibit 3-4: Scenario A-1B Ridership

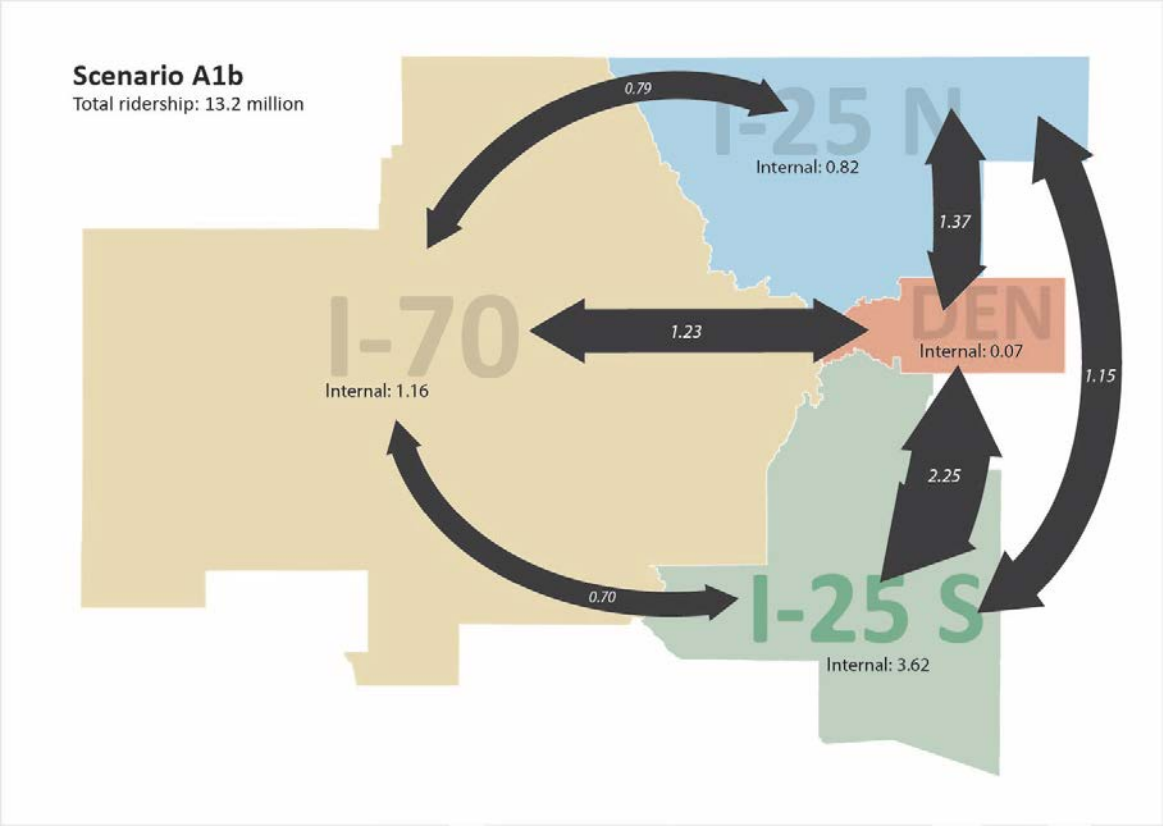


Exhibit 3-5: Scenario A-5A Ridership

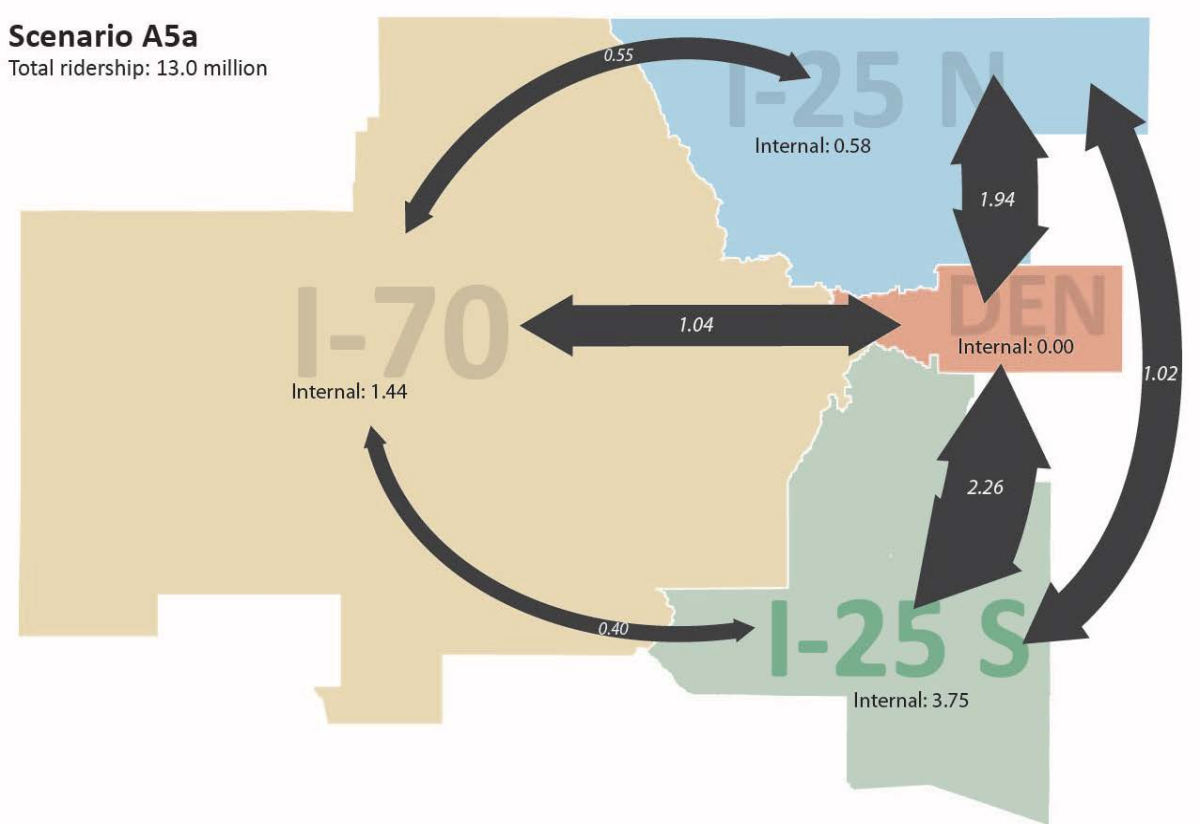


Exhibit 3-6: Scenario A-5B Ridership

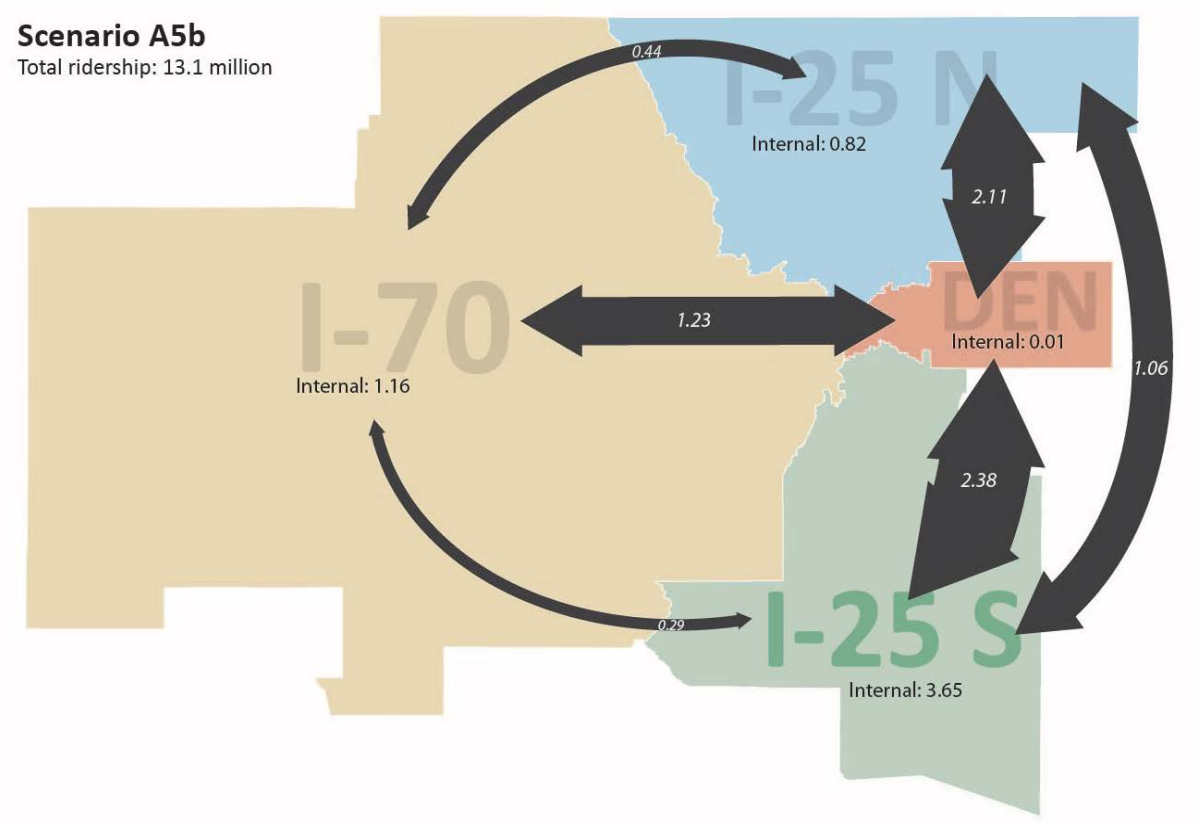


Exhibit 3-7: Scenario B-2A Ridership

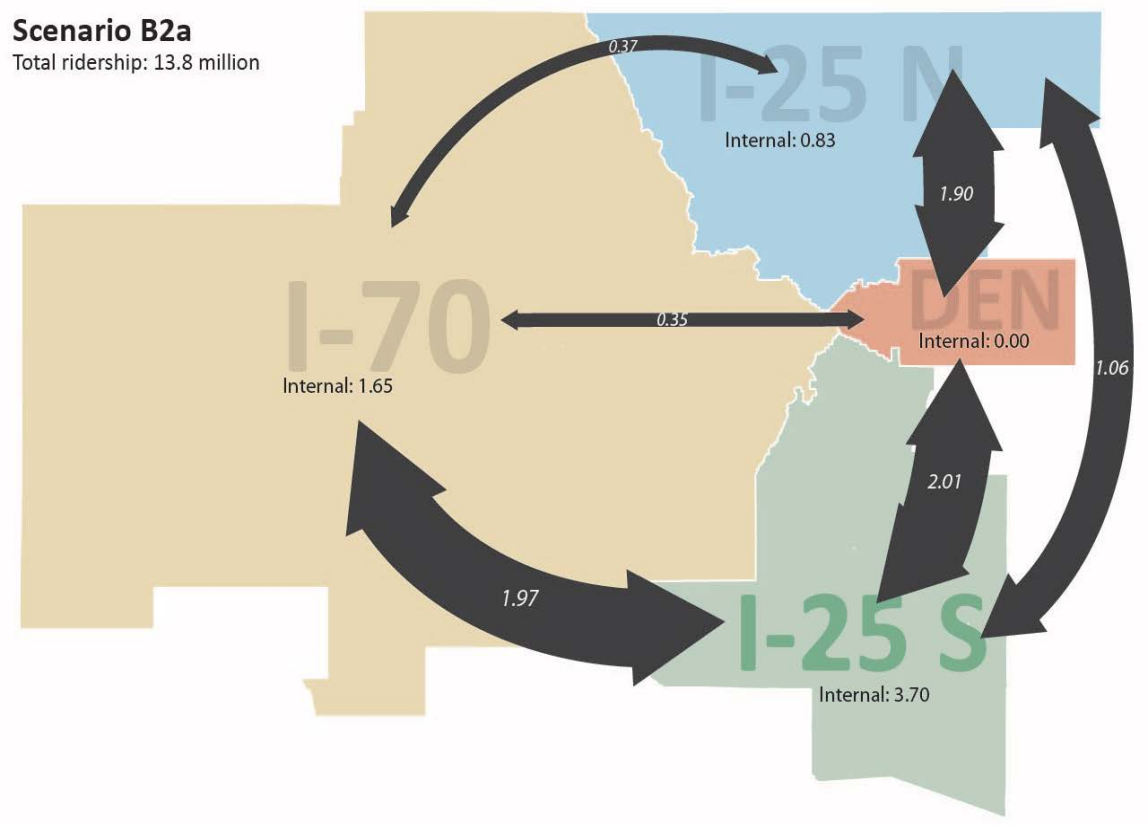


Exhibit 3-8: Scenario B-5 Ridership

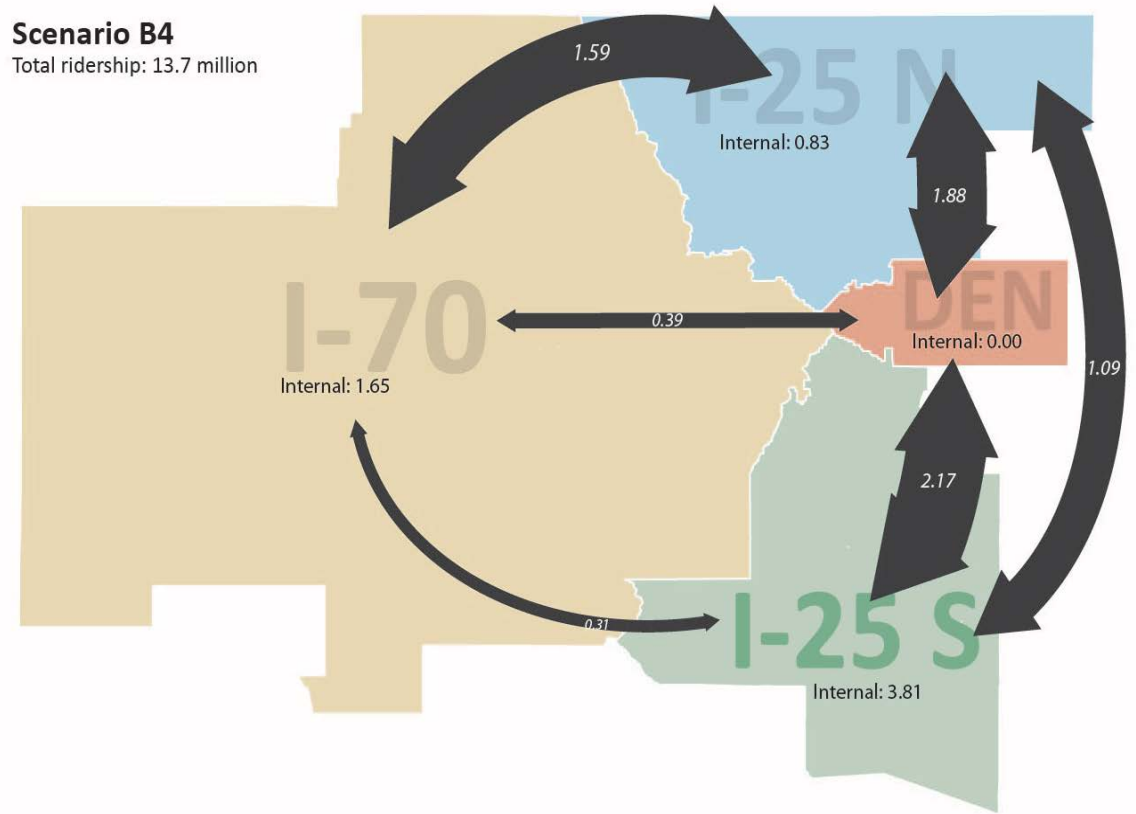


Exhibit 3-9: Scenario C-1 Ridership

Station Boarding

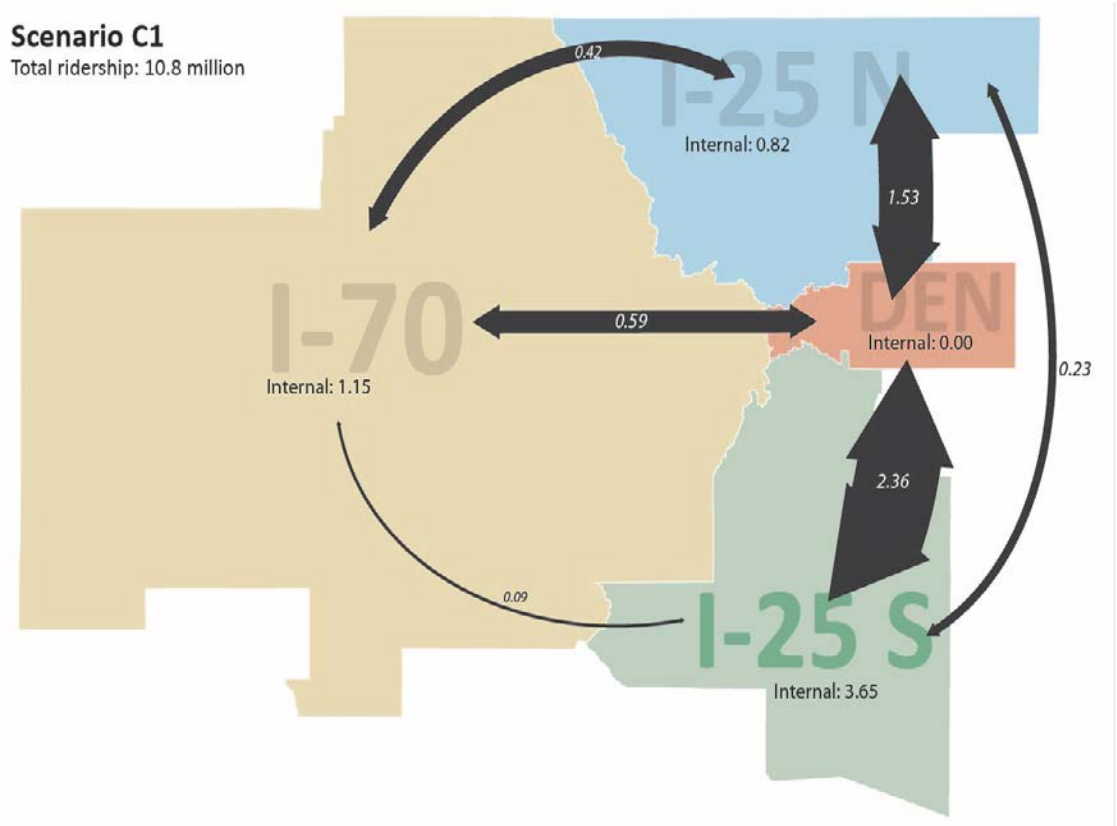


Exhibit 3-10 depicts station boarding by scenario, indicating that the major activity (defined as stations that have over 1 million riders per year) is located at the following stations:

- Fort Collins
- North Suburban
- DIA
- Denver Union Station
- South Suburban
- Castle Rock
- Colorado Springs

Busiest HSIPR Stations

Fort Collins Station – This station realizes the highest boarding levels with Scenario B-5 at 1,458,643 riders per year, 29 percent higher than Scenario C-1, which has the lowest boardings at 1,142,896 riders per year. The second highest boardings at the Fort Collins Station is with Scenario A-1B, at 1,370,281 riders per year. The higher ridership experienced with Scenarios B-5 and A-1B is the result of slightly better access to HSIPR provided by the alignment locations of these scenarios.

North Suburban Station – This station produces the highest ridership with Scenarios A-5B, B-2A, and B-5. This is due to the strong direct connections north and south that these scenarios provide. The lowest ridership is with Scenario C-1 due to the limited indirect connections north from DIA. Scenario A-1A also performs poorly for this station due to a long transfer at DUS.

DIA Station – The DIA station is the most dependent on the selection of a given scenario than any other station. The difference between the high and low ridership values is 237 percent. Scenarios A-5A, A-5B, B-2A, and B-5 all generate over 2 million riders per year. Scenario A-1B produces the lowest ridership due to the east-west transfer required at DUS for riders traveling from the area north and south of the Denver metro area.

DUS Station – This station performs the best with Scenario A-1, with ridership ranging from 1,463,284 to 1,621,610, depending on the design option chosen. Option A (US 6) produces about 158,000 more annual riders than Option B (I-76), suggesting the importance of the direct north-south access provided by the CML freight rail alignment. Scenario C-1 produces 956,729 riders per year due to the direct connection between DIA and regions south.

Scenario A-5B generates 732,198 riders per year. Scenarios A-5A, B-2A, and B-5 do not stop at DUS.

South Suburban Station – This station realizes high ridership with all the scenarios considered. The highest ridership is provided with Scenario B-2A, with 1,566,632 riders per year, due to the high level of access provided to the south, combined with high access to DIA and the north and direct routing to the mountain corridor.

Castle Rock Station – Like the South Suburban Station, this station realizes about 1 million riders per year regardless with all scenarios. The ridership is high due to the volume of trips between Denver and Colorado Springs and the growing population in the Castle Rock area. The highest ridership is with Scenario B-5, generating 1,083,894 riders per year.

Colorado Springs Station – This station receives the highest ridership with Scenario B-2A, at 1,478,361 riders per year. This is due to the high levels of access to DIA and north to Fort Collins and the direct access to the mountain corridor provided by its beltway alignment. The other full-build scenarios produce annual ridership ranging from 1,245,389 to 1,357,422. Scenario C-1 produces the lowest annual ridership at 1,128,475 due to slower travel times to central Denver, the mountain corridor, and Fort Collins resulting from the use of shared RTD track.

Other Key Stations

As the end of line (EOL) stations, the Pueblo and Eagle County Regional Airport stations also merit discussion.

Pueblo Station – The Pueblo Station performs consistently at about 750,000 riders per year regardless of the scenario. This is largely attributed to being an EOL station. The ridership is the highest with Scenario B-2A because this alternative produces the highest absolute ridership and allows for direct access to the mountain communities, DIA, and Fort Collins.

Eagle County Regional Airport Station – Again, as an EOL station, the ridership is fairly consistent among the full-build scenarios, ranging from 540,183 riders per year for Scenario B-2A to 654,587 riders per year for Scenario A-1B.

Exhibit 3-10: AGS and ICS Station Boardings by Scenario

Station	A-1A	A-1B	A-5A	A-5B	B-2A	B-5	C-1
Avon							
Berthoud	386,992	422,349	357,393	366,126	312,573	452,567	282,497
Breckenridge	169,282	185,456	172,060	164,956	189,263	165,547	130,262
Castle Rock	945,886	985,272	1,072,147	1,062,746	1,034,161	1,083,894	1,014,947
Colorado Springs	1,298,310	1,357,422	1,265,060	1,259,533	1,478,361	1,245,389	1,128,475
Denver - I-76/72nd	338,206		589,928				
Denver - Union Station	1,463,284	1,621,610		732,198			956,729
DIA	658,622	877,496	2,033,524	2,133,219	2,133,840	2,218,226	1,287,745
Eagle Airport	591,377	654,587	589,253	560,359	549,180	540,183	405,094
Fort Carson	475,121	496,857	473,112	474,407	545,265	470,728	425,272
Fort Collins	1,221,262	1,370,281	1,144,980	1,259,077	1,132,901	1,458,643	1,142,896
Georgetown	203,247	224,483	192,378	200,514	192,623	193,767	175,426
Silverthorne	260,455	303,484	275,999	268,138	301,124	281,059	204,453
South Suburban	1,295,597	1,348,359	1,415,994	1,346,603	1,566,632	1,448,317	1,200,321
Monument	677,197	709,043	617,278	620,451	794,024	599,633	512,214
North Suburban	469,738	679,667	832,686	994,891	1,052,705	1,196,005	483,687
Pueblo	767,052	777,723	749,154	751,246	802,418	749,034	713,192
West Suburban	579,968	726,573	811,194	560,457	1,364,369	1,238,402	502,542
Vail Station	369,594	422,171	395,604	382,537	399,307	373,561	278,553
Total	**12,171,190**	**13,162,834**	**12,987,744**	**13,137,458**	**13,848,747**	**13,714,955**	**10,844,306**

Travel Times

Travel times are critical to the ridership success of each scenario. The following narrative presents the travel times from each major market.

Fort Collins Market

As shown in Exhibit 3-11, the travel time from Fort Collins to the North Suburban Station is the same for all scenarios. This is because all scenarios share the same alignment south to the North Suburban Station. Scenarios A-5A, A-5B, B-2A, and B-5 all provide a travel time of 37 minutes to DIA, again because they share a common alignment along E-470 to DIA. Scenarios A-1A and A-1B produce a much slower 1 hour 22 minute and 1 hour 14 minute travel time, respectively, to DIA because of the transfer requirements at I-76/72nd Avenue and DUS. The travel time for C-1 is slowest due to the reduced travel speeds required on the shared RTD track.

Travel times from Fort Collins south to Colorado Springs and Pueblo are comparable for all of the full-build scenarios. Scenario C-1 has the longest travel time due to the reduced travel speeds required on the shared RTD track.

From Fort Collins to Eagle County Regional Airport, Scenario B-5 provides the fastest trip due to the direct routing of its alignments to the western markets. Scenario B-2A provides a slower travel time because of its indirect routing of passengers south along the beltways to the mountains. Again, Scenario C-1 is slowest because of the reduced travel speeds required on the shared RTD track.

Exhibit 3-11: Fort Collins To/From Travel Times

	A-1A	A-1B	A-5A	A-5B	B-2A	B-5	C-1
North Suburban	0:23	0:23	0:23	0:23	0:23	0:23	0:23
DIA	1:22	1:14	0:37	0:37	0:37	0:37	1:41
Colorado Springs	1:33	1:33	1:34	1:34	1:34	1:34	2:59
Pueblo	2:00	2:00	2:01	2:01	2:01	2:01	3:26
Eagle Airport	2:55	2:47	3:01	3:01	2:52	2:26	3:09

Colorado Springs Market

As shown in Exhibit 3-12, the travel time from Colorado Springs to DIA is comparable at 55 minutes for all of the scenarios with the exception of A-1A and A-1B, which are slower due to the need to transfer at I-76/72nd Avenue and DUS.

The trip to Fort Collins is similar for all scenarios except C -1, which is much slower due to the need to transfer at DIA to DUS and then again at DUS to Fort Collins.

Travel to the South Suburban Station and to Pueblo is the same for all scenarios because the alignment is the same for all scenarios.

The best travel time to the mountain communities is provided by Scenario B-2A, which has direct access along C-470. All other scenarios provide similar travel times to Eagle County Regional Airport, with the exception of Scenario C-1, which has reduced travel speeds due to the shared RTD track. Scenario B-5 has a longer travel time to Eagle County Regional Airport than Scenario B-2A because travelers from the south follow an indirect route along the beltway segments to the east, then north and northwest before heading west to the mountains.

Exhibit 3-12: Colorado Springs To/From Travel Times

	A-1A	A-1B	A-5A	A-5B	B-2A	B-5	C-1
DIA	1:34	1:26	0:55	0:55	0:55	0:55	0:55
Fort Collins	1:33	1:33	1:34	1:34	1:34	1:34	2:59
South Suburban	0:33	0:33	0:33	0:33	0:33	0:33	0:33
Pueblo	0:25	0:25	0:25	0:25	0:25	0:25	0:25
Eagle Airport	3:10	3:02	3:17	3:17	2:31	3:13	3:45

Pueblo Market

As shown in Exhibit 3-13, travel times from Pueblo to DIA are the same for Scenarios A-5A, A-5B, B-2A, B-5, and C-1 because the alignments all follow E-470 to the airport. Scenarios A-1A and A-1B are slower due to transfers required at I-76/72nd Avenue and DUS.

Travel times to Fort Collins are similar for all scenarios except C-1, which requires transfers at DIA and DUS due to the use of shared RTD track. Because all scenarios share the same alignment south, travel to the South Suburban Station and Colorado Springs is the same for each scenario.

Travel to the mountain communities is fastest with Scenario B-2A due to its direct routing. Scenario A-1B is the second fastest; although a direct route, it requires a transfer at DUS. Scenarios A-5A, A-5B, B-5, and C-1 are considerably slower due to out-of-direction routing.

Exhibit 3-13: Pueblo To/From Travel Times

	A-1A	A-1B	A-5A	A-5B	B-2A	B-5	C-1
DIA	2:01	1:53	1:22	1:22	1:22	1:22	1:22
Fort Collins	2:00	2:00	2:01	2:01	2:01	2:01	3:26
South Suburban	1:00	1:00	1:00	1:00	1:00	1:00	1:00
Colorado Springs	0:25	0:25	0:25	0:25	0:25	0:25	0:25
Eagle Airport	3:37	3:29	3:46	3:46	2:58	3:40	4:12

Mountain Markets

As shown in Exhibit 3-14, the best travel times from Eagle County Regional Airport to DIA are provided by Scenarios A-1A, A-1B, A-5A, and A-5B as these have the most direct routes. The use of I-76 versus US 6 (Scenarios A-1 and A-5) makes little difference in travel time from the mountains to DIA. Scenarios B-2A and B-5 are comparable but longer due to the more circuitous routing. Scenario C-1 has the longest travel time due to the use of RTD shared track through metro Denver.

Travel time to the West Suburban Station is equal for all scenarios as they share a common alignment.

The shortest trip to Fort Collins is with Scenario B-5 as it provides the most direct route. Scenarios A-5A and A-5B provide long trips to Fort Collins due to the transfer at DIA. The longest trip time is provided by C-1 due to slower travel times through metro Denver on the shared RTD track and a transfer at DUS.

The shortest travel times from the mountains to Colorado Springs and Pueblo is provided by Scenario B-2A because of its direct routing. Scenarios A-5A, A-5B, and B-5 are less direct since they route travelers out of direction to the E-470 alignment east of the Denver metro area before proceeding south. Scenario C-1 is the slowest because travelers need to transfer at DUS and DIA and because train speeds are slower on the RTD shared track.

Exhibit 3-14: Eagle County Airport To/From Travel Times

	A-1A	A-1B	A-5A	A-5B	B-2A	B-5	C-1
DIA	2:02	2:03	2:02	2:03	2:13	2:16	2:28
West Suburban	1:34	1:34	1:34	1:34	1:34	1:34	1:34
Fort Collins	2:55	2:47	2:59	2:59	2:52	2:26	3:09
Colorado Springs	3:10	3:02	3:17	3:17	2:31	3:13	3:45
Pueblo	3:37	3:29	3:46	3:46	2:58	3:40	4:12

Impacts on Freight

To allow the use of both FRA compliant and non-compliant technology, the scenarios for the Level 2 Evaluation have been configured to avoid freight railroads. Due to the design protocol, none of the scenarios would affect freight operations.

Impacts on Aviation

HSIPR can often relieve congestion at airports in the same market area, resulting in the deferment of new airport expansion. As shown on Exhibit 3-15, the volume of trip diversion to aviation is 4 to 5 percent. This is not sufficiently significant to defer investment in new construction at DIA, Eagle County Regional Airport, or Colorado Springs Airport.

Exhibit 3-15: Impact on Aviation by Scenario

Trip Type Breakdown			
Scenario	Intercity	Intra-Urban	Connect Air
A-1A (I-76)	84%	12%	4%
A-1B (US 6)	84%	12%	4%
A-5A (I-76)	75%	20%	5%
A-5B (US 6)	76%	19%	5%
B-2A	77%	19%	4%
B-5	75%	21%	4%
C-1	78%	16%	6%

Environmental Issues

The purpose of the Level 2 Evaluation is to ensure that environmental criteria are considered in the selection of a preferred scenario. More detailed environmental analysis that complies with NEPA and other regulations will be required as the project moves toward implementation.

The Level 2 Evaluation uses quantitative but broad measures to compare the scenarios. The environmental evaluation considered impacts to the following resource areas:

- Air quality (benefits and impacts)
- Noise
- Energy and congestion (benefits and impacts)
- Land use and development effects, including TOD potential
- Initial and permanent employment changes
- Community disruption
- Safety

- Hazardous waste
- Historic properties
- Park and recreation facilities
- Wetlands and water resources

Environmental consequences associated with the Level 2 scenarios are presented for the following areas:

- ICS Study Area
- Denver Area
- North of Denver
- South of Denver

ICS Study Area

With the exception of their configuration through the Denver metro area, the five scenarios are essentially analogous. As major projects, construction of any of the scenarios is expected to create environmental impacts. On average, the full-build scenarios involve about 214 miles of guideway construction and, with stations, would require about 1,430 acres of property acquisition. Scenario C-1, which shares track with RTD in the Denver metro area, would disturb about 1,154 acres or about 276 fewer acres than the other full-build scenarios. Of the full-build scenarios, B-2A would have the smallest construction footprint, requiring about 87 more acres of disturbance than Scenario C-1. Further, the total construction footprint is probably not as important as the location of the impact. Under this assumption, the scenarios that travel through the Denver metro area (A-1 and A-5) are predicted to have a much greater impact than the scenarios that operate in the periphery (B-2A and B-5), as discussed below.

With respect to environmental benefits, the operation of all of the scenarios would encourage more compact development around the HSIPR stations, thus reducing urban sprawl and encouraging the use of transit. Both of these benefits would reduce VMT, resulting in a modest positive impact on air quality. Because the ridership among the full-build scenarios differs only by about 6 percent, the relative differences in benefits are also modest.

Denver Area

Environmental impacts of the different scenarios vary primarily in the Denver metro area because this is the most populated area within the state. Scenarios that travel directly though the Denver metro area (A-1 and A-5) have much greater community impacts than those that traverse around the metro area (B-2A and B-5). Scenario C-1 involves minimal construction within the Denver metro area and thus has few construction impacts.

Alignments through the Denver Metro Area (Scenarios A-1 and A-5)

All of the alignments through metro Denver have the potential for adverse community impacts. High-speed trains moving through developed communities raise concerns over noise, vibration, and safety at crossings, as well as the visual impacts of tracks and guideways that are elevated to minimize ROW needs and avoid at-grade crossings with roadways, trails, and other transit lines.

Based on the current alignments, average speeds through Denver are approximately 100 to 110 mph, with top speeds in some stretches reaching 150 mph. The study team is continuing to seek input from communities about what speeds might be acceptable, and it is likely that the estimated speeds are too high to be compatible with residential neighborhood settings. However, for the Level 2 Evaluation, speeds were modeled as fast as alignment curvature and grades would allow in order to improve travel times and ridership. Reductions in speeds would increase travel times, making it difficult for HSIPR to be competitive with automobile travel times. Additionally, insufficient ROW is available within transportation corridors in the Denver metro area in both highway and rail corridors. In some stretches, HSIPR alignments can be located within the transportation corridors; however, in most locations, HSIPR alignments must parallel the corridors and would require minimum adjacent ROW of about 60 feet. Constrained areas are present throughout all of the east-west and north-south alignments through metro Denver but are especially problematic along the east-west alignments (A-1B and A-5B) into DUS and along US 6 between I-25 and Kipling Boulevard. Along US 6, ROW is constrained by the frontage road system along US 6, which provides access to homes that are located at the edge of the public ROW, as shown in Exhibit 3-16.

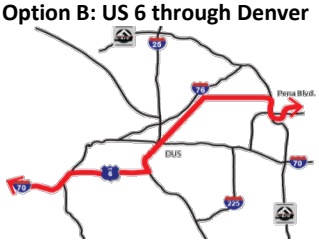
Exhibit 3-16: Constrained ROW on US 6 - Option B (US 6)

North-south alignments are also highly constrained, as development abuts the railroad corridor throughout. ROW is especially tight in the central section of the alignment into DUS to the Santa Fe corridor south of Denver. In addition, Denver's urban core is home to older, established residential neighborhoods that have many properties eligible for or listed on the National Register of Historic Places and high potential for additional historic properties and districts to be identified when intensive surveys are conducted .

Many of the neighborhoods in central Denver, particularly north and west Denver, have higher concentrations of minority or low-income populations, raising concern that these neighborhoods, many of which have been previously affected by transportation projects bisecting their communities, may be disproportionately impacted by HSIPR.

Environmental and community impacts for the alignments through metro Denver are summarized in Exhibit 3-17.

Exhibit 3-17: Environmental and Community Impacts of Options through Metro Denver

	East West Options (A-1 and A-5)		North-South Option (A-1 only)
	Option A: I-76 through Denver 	**Option B: US 6 through Denver** 	**Railroad/ Santa Fe Corridor** 
Community Disruption*	8.3 linear miles	11.32 linear miles	18.31 linear miles
Parks	• 6 parks potentially affected • 4.84 linear miles adjacent to parks	• 8 parks potentially affected • 5.35 linear miles adjacent to parks	• 1 park potentially affected • 0.15 linear miles adjacent to parks
Historic	Medium • No known sites affected • Much of corridor is adjacent to industrial and warehousing operations; some older residential homes are present between Pecos and Sheridan	High • 3 National Register listed sites potentially affected • Neighborhoods and residential homes along US 6 maintain high degree of integrity and are generally post-War or older	Medium/High • 2 National Register listed properties potentially affected • Potential for historic properties high along established neighborhoods in central Denver
Environmental Justice	Medium Low income/minority populations concentrated in central Denver, although residential development along I-76 further from corridor compared to other alignments	High Low income/minority populations concentrated along US 6 corridor between Wadsworth and I-25	High Low income/minority populations concentrated in central Denver, particularly west of I-25 and east of Sheridan
Stream Crossings	• 13 stream crossings • 1.5 linear miles adjacent to streams	• 12 stream crossings • 0.55 linear miles adjacent to streams	• 23 stream crossings • linear miles adjacent to streams

Notes:
*Community disruption is measured by (miles adjacent to residential/ mixed use development).

Alignments around Denver (Scenarios B-2A and B-5)

Alignments around Denver also traverse communities and neighborhoods, but transportation corridors are less constrained, with wider buffers between corridors and development, as depicted in Exhibit 3-18. This separation between transportation facilities and development occurred in large part because transportation corridors were developed before residential and mixed-use developments, which were planned around the transportation corridors, including planning for future expansion and even transit. The exception is the Northwest Quadrant, which is a missing link to the beltway system around Denver; disagreement about whether or how to develop the Northwest Quadrant has persisted for decades. The beltway segments serving north-south around Denver's eastern perimeter generally present fewer environmental impacts than the segments along the western perimeter, in part because a high-speed transportation facility has not been developed in the Northwest Quadrant, but also because the Southwest Quadrant alignment follows open space and developed residential areas, such as Chatfield State Park and Highlands Ranch. Exhibit 3-19 compares the environmental and community impacts of the beltway options that are included in Scenarios B-2A and B-5.

Exhibit 3-18: Open Construction on E-470

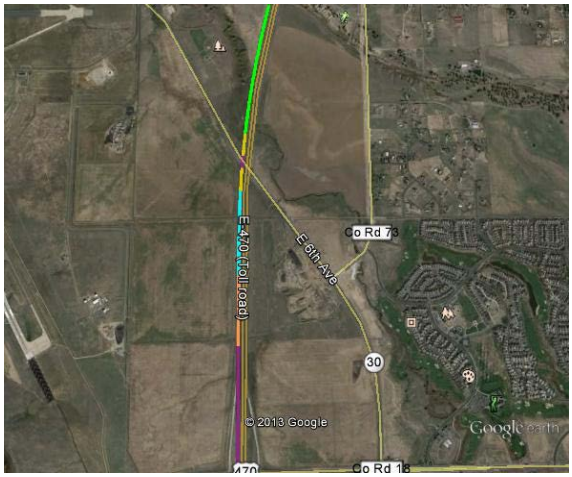


Exhibit 3-19: Environmental and Community Impacts of Options around Denver

	North-South Options (A-5, B-2A, and B-5)		East-West Option (B-5 only)
	Beltway east around Denver 	**Beltway west around Denver** 	**Beltway north around Denver** 
Community Disruption*	5.05 linear miles	9.98 linear miles	7.02 linear miles
Parks	None	• 12 parks potentially affected • 11.28 linear miles adjacent to parks	• 9 parks/open space potentially affected • 6.73 linear miles
Historic	Low • 1 National Register listed site is potentially affected • Corridor traverses newer developments with low potential for historic importance	Low • No known sites affected, • Corridor traverses newer developments with low potential for historic importance	Low • No known historic resources affected • Corridor traverses newer developments with low potential for historic importance
Environmental Justice	Low No minority or low-income populations located along alignment	Low No minority or low-income populations located along alignment	Low Corridor generally traverses less developed, newer, and more affluent areas
Stream Crossings	• 11 stream crossings • 0.49 linear miles adjacent to streams	• 20 stream crossings • 0.76 linear miles adjacent to streams	• 13 stream crossings • 0.71 linear miles adjacent to streams

Note:
*Community disruption is measured by (miles adjacent to residential/mixed-use development)

North of Denver

The N-1 alignment traverses the developed communities of Longmont, Berthoud, Loveland, and Fort Collins, and bisects numerous residential neighborhoods, as shown in Exhibit 3-20. Insufficient ROW exists on the freight corridor to allow HSIPR to be wholly within the ROW, and ROW requirements are high.

The N-2 alignment generally follows I-25, and in most locations can be fit within CDOT ROW, as shown in Exhibit 3-21. CDOT is open to considering use of the I-25 ROW for HSIPR. The relatively straight alignment allows trains to achieve high speeds, providing good travel times for northern communities making intercity trips. Even outside the highway ROW, community impacts are minimal as very few residences are located with 1,000 feet of the I-25 corridor. Stream crossings and impacts to farmlands and natural areas occur generally in the same locations that are already impacted by the corridor, and new impacts would be minimal.

Exhibit 3-20: HSIPR Construction through Longmont (N-1)

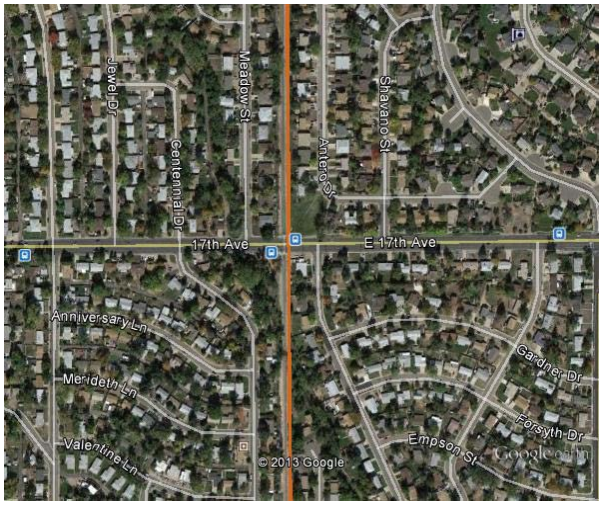


Exhibit 3-21: HSIPR along I-25 (N-2)

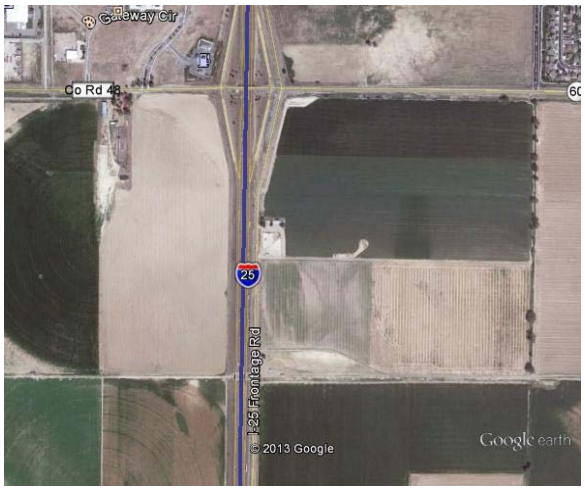


Exhibit 3-22 summarizes the impacts for the alignments north of Denver. The N-2 alignment is preferred and is common to all scenarios.

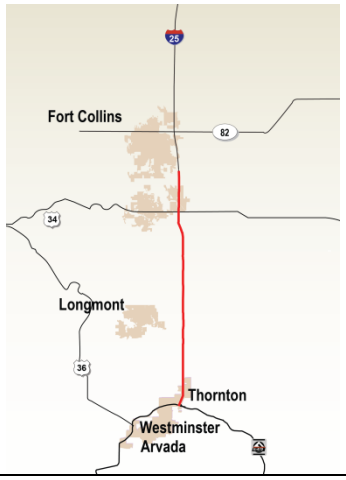
South of Denver

South of Denver, only one alignment was evaluated in Level 2; therefore, the impacts are identical for all scenarios.

The alignment generally follows I-25 and/or the freight rail corridor from Lone Tree to Castle Rock, Monument, Colorado Springs, Fort Carson, and Pueblo. The S-3 alignment was modified and refined in Level 2 engineering to reduce environmental and community impacts, especially in the Black Forest area of Colorado Springs.

As with the other ICS alignments, environmental and community impacts are greater in developed urban areas where new ROW is needed. Natural resource impacts are greater in the south corridor than the north or Denver area alignments because more open space, habitat, streams, wetlands, and other natural resources are located along this segment compared with other segments of the ICS. However, impacts are the same for all scenarios because all share the same alignment from Denver to Colorado Springs and Pueblo. Exhibit 3-23 summarizes the impacts of the alignment south of Denver common to all five scenarios.

Exhibit 3-22: Environmental and Community Impacts of N-1 versus N-2

	N-1: Railroad Alignment (I-25 North EIS Commuter Rail)	N-2: I-25 Alignment
		
Community Disruption*	10.8 linear miles	None
Parks	• 8 potentially affected parks • 4.62 linear miles adjacent to parks	• 3 potentially affected parks • 0.88 linear miles adjacent to parks
Historic	Medium • Two National Register listed potentially affected • Historic property potential in developed areas than 50 years old	Low • No known historic properties affected • Potential for historic properties within CDOT right-of-way very low
Environmental Justice	High Low income/minority populations concentrated adjacent to the US 287 corridor within communities of Longmont, Berthoud, Loveland, and Fort Collins)	Low North of Timnath, some populations exist but far from the alignment)
Stream Crossings	• 12 stream crossings • 2.77 linear miles of streams adjacent to alignment	• 12 stream crossings • 0.15 linear miles of streams adjacent to alignment

Notes:
*Community disruption measured by (miles adjacent to residential/ mixed use development).

Exhibit 3-23: Environmental and Community Impacts of the I-25 South Segment

	S-3: I-25 South Segment
	
Community Disruption*	2.01 linear miles
Parks	• 2 potentially affected properties • 1.17 linear miles adjacent to parks
Historic	Medium • 3 potentially affected National Register listed properties • Traverses older, established neighborhood in Pueblo
Environmental Justice	Medium Low income/minority populations concentrated adjacent to much of the corridor through Colorado Springs and along a small (approximately 1.5 linear miles) portion of the alignment through Pueblo
Stream Crossings	• 52 stream crossings • 4.96 linear miles of streams adjacent to alignment

Notes:
*Community disruption measured by (miles adjacent to residential/ mixed use development).

Engineering Feasibility

Engineering feasibility includes the general constructability, capital cost, and operating cost of the finalist scenarios, as discussed below.

General Constructability

Although the degree of challenge varies, all of the proposed scenarios can be constructed. The discriminators are limited to how the HSIPR negotiates the Denver metro area. Scenarios A-1 and A-5 present the greatest challenges because they both penetrate through developed urban areas. Because decisions for moving forward into the Level 3 Evaluation are needed, this evaluation focuses on the choices that have the greatest effect on these key recommendations.

Scenario A-1

Option B (US 6): The construction of Scenario A-1 paired with Option B (US 6) is the most challenging. The US 6 alignment would require property acquisition for the majority of its length. The most problematic area would be along US 6 from near Kipling Street to Sheridan Boulevard, where the HSIPR would be elevated for a distance of 4 miles. From Sheridan to I-25, a distance of about 1 mile, the alignment is largely at-grade but would still require private property acquisition. From the I-25 flyover to DUS, constructing 3 miles of elevated structure adjacent to the CML on newly acquired ROW will be highly disruptive to the adjoining industrial and commercial properties. North of DUS to I-270, the construction conditions continue to be challenging as all new ROW is required, and conflicts with existing structures, the railroads, and RTD's North Metro and East Rail alignments need to be avoided. Near Sand Creek, the alignment becomes elevated over the railroads, the creek, and I-270.

North of this point, the construction will progress through low income and minority neighborhoods from Vasquez Boulevard to East 80th Avenue, a distance of 2.7 miles. Once the alignment approaches 96th Avenue, there will be potential conflicts with residential units to the north and Rocky Mountain Arsenal to the south. As described below, configuring Scenario A-1 with Option A (I-76) would reduce many of these constructability issues.

Option A (I-76): Incorporation of this design option with Scenario A-1 also presents many construction challenges. The difference is that this option is generally more remote from development, especially east of I-25.

From I-70/C-470 to US 6, the Option A alignment is the same as Option B. From US 6 traveling north to SH 58, the alignment is located to the south of I-70 largely within the CDOT ROW. However, the construction conditions are constrained by a high potential for partial acquisition of private parcels. Most of the construction is at-grade but adjacent to residential areas. From SH 58 to the I-70/I-76 interchange, a distance of 3.4 miles, the alignment continues on the south side of I-70 in constrained ROW conditions. Approximately 1.25 miles of the alignment are adjacent to residential land uses. The alignment also needs to fly over Ward Road, Kipling Street, and the I-70/I-76 interchange, which is a major structure of approximately 1 mile including the approach ramps, as shown in Exhibit 3-24.

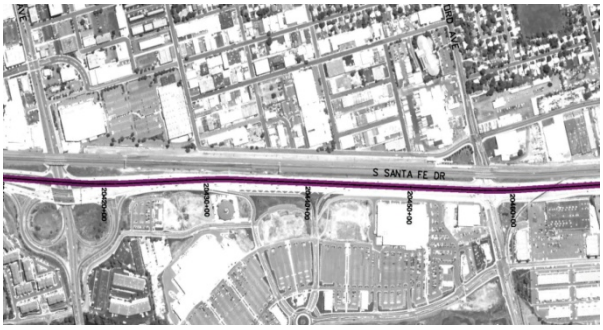
Exhibit 3-24: Threading the Alignment Through the I-70 and I-76 Interchange

The alignment continues on the south side of I-76, transitioning from retained fill to grade. It then elevates over 52 Avenue, lowers to grade, and becomes elevated over Clear Creek and Sheridan Boulevard. Near Sheridan Boulevard, construction would pass within 100 feet of a trailer park. From Tennyson Street to Federal Boulevard, a distance of about 1.2 miles, construction would be challenged by the presence of gravel ponds and other riparian areas. However, this area is fairly remote from residential areas. From Federal Boulevard to I-25, approximately 2 miles of the alignment is on structure through industrial areas with fairly open construction. After its elevation over I-25 and then I-270, the alignment is principally at-grade to 96th Avenue. This is industrial land use that includes gravel ponds and an irrigation ditch. Conflicts with residential uses are not apparent. The issues with residences along the north side of 96th

Avenue are the same as those discussed for Option B (US 6).

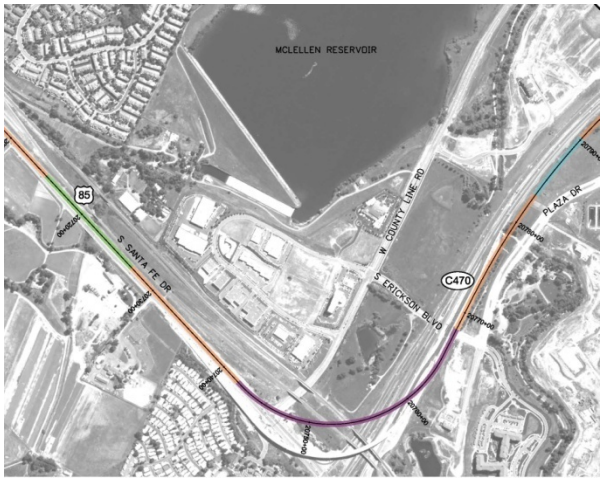
***North to South*:** The north-south alignment from DUS to DIA has the same challenges as described for Option B (US 6) as the routing is analogous. Likewise, from DUS south to US 6, the alignment is the same as described for Option B (US 6). South of US 6, construction conditions are extremely constrained as the alignment follows the CML/Joint line on a separate ROW to Jewell Avenue, a distance of nearly 4 miles. Further, the majority of the alignment is elevated in this segment, and commercial and industrial properties would need to be acquired to allow construction of the HSIPR. The impacts on private property will be lessened once the alignment transitions to the ROW of Santa Fe Boulevard. However, the guideway is elevated for the next 7 miles, generally in the median of Santa Fe Boulevard, complicating construction and reducing worker productivity due to maintenance of traffic and safety issues, as shown in Exhibit 3-25.

Exhibit 3-25: Alignment in Median of South Santa Fe between Hampden and Oxford



Access to the south side of C-470 would require a long curvilinear aerial structure over the Santa Fe/-C-470 interchange, as shown in Exhibit 3-26. Once on the south side of C-470, the alignment would follow the CDOT ROW and would be the same as required for Scenario B-2A, discussed later in this section.

Exhibit 3-26: From Median of Santa Fe, elevated Alignment over Northbound Lanes, County Line Road, Two Railroads, C-470, and the Santa Fe/C-470 Flyover Ramp



Scenario A-5

Scenario A-5 deploys the same east-west options to DIA – Option A (I-76) and Option B (US 6) – as described for Scenario A-1 above.

***North to South*:** Scenario A-5 follows the E-470 alignment from DIA northwest to the North Suburban Station and from the airport south to the South Suburban Station. It is anticipated that all of the construction would occur within the E-470 ROW. The major constructability challenges would involve elevating the alignment over 20 existing interchanges and/or other structures along E-470.

Scenarios B-2A and B-5

In contrast to Scenarios A-1 and A-5, the construction of Scenarios B-2A and B-5 will largely occur in the C-470 and E-470 ROW in comparatively uncongested areas. However, the beltway construction will involve elevating the HSIPR over numerous interchange ramps along the highway alignment. Scenario B-2A will need to clear 34 structures, and Scenario B-5 will need to clear 22 structures, as shown on Exhibit 3-27.

One key discriminator is that Scenario B-5 will involve construction through the Northwest Quadrant, where many unknowns remain regarding permitting and other environmental approvals.

Exhibit 3-27: Shifting from One Side of E-470 to the Other Through Chambers Road and Jordan Road Interchanges Sets Up Flatter Alignment to Avoid Sharp S-Curves at Parker Road Interchange

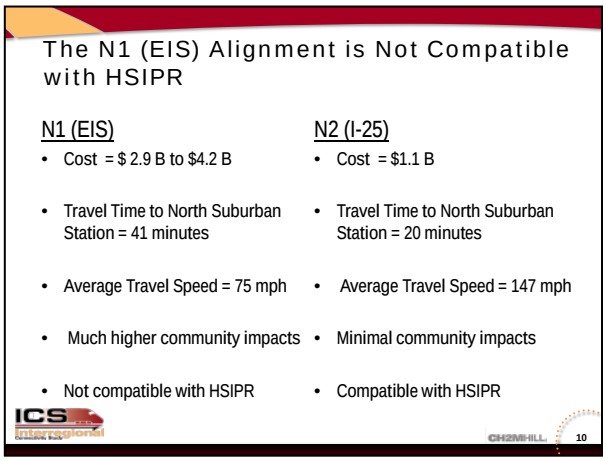
Institutional requirements aside, B-5 appears to represent a slight constructability advantage over B-2A because construction in the NW Quadrant is felt to be technically less difficult than what is anticipated along C-470 in the southwest. The C-470 alignment involves 14 structures over interchanges and other roadways and ROW conditions are expected to be constrained given CDOT's plans for highway expansion. Further, the C-470 alignment is constrained by parkland from the West Suburban station to Santa Fe Blvd and urban development from that point to I-25. The flyover of the C-470/I-25 interchange is also expected to be a complicated structure.

North to Fort Collins and South to Pueblo

North to Fort Collins: Construction of the segments north to Fort Collins and South to Pueblo is not a discriminator since these segments are common to all five scenarios. All scenarios include two options: N-1 (EIS) and N-2 (I-25). N-1 is not feasible for a HSIPR project due to the very high community impacts of passing though Longmont, Loveland, and Fort Collins, as discussed previously under the Environmental section. Additionally, the cost of this option at $4.2 billion is much greater than N-2 (I-25) at $1.1 billion, and the respective travel times to the North Suburban Station are 41 and 19 minutes. Further, of the two options, N-2 would be much more constructible because essentially all of the work would occur within the I-25 median. Although this would require extensive maintenance of traffic, it would be less complicated than constructing HSIPR through the cities of Longmont, Loveland, and Fort Collins.

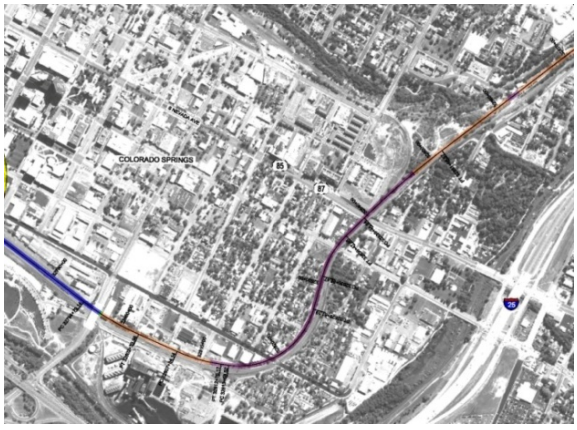
Exhibit 3-28 shows the comparison chart for the N-1 and N-2 options presented at a public workshop held in June 2013.

Exhibit 3-28: Comparison Chart for North Route to Fort Collins from Public Workshop No. 2 on June 5, 2013



South to Pueblo: Compared to the N-2 (I-25) alignment, construction to the south from the South Suburban Station to Colorado Springs will be much more complicated due to severe topography and restricted ROW through Castle Rock and Colorado Springs, as shown on Exhibit 3-29. As such, the construction cost per mile ($52.6 million) is about 44 percent more than for the segment north to Fort Collins, assuming the N-2 (I-25) alignment ($30.0 million).

Exhibit 3-29: Restricted ROW in Railroad Alignment Through Central Colorado Springs



Capital Costs (CAPEX)

This section presents a comparison of the capital costs for the five scenarios. The cost estimates were based on the alignment drawings shown in Appendix B. The values provided are "parametric" estimates – in the first step, the engineering team develops standard cross sections for at-grade track, track on retained fill, track on elevated structure, etc., and in the second step prepares a detailed estimate for each cross section. The costs can then be defined as dollars per lineal foot, dollars per mile, and so forth. In the third step of the process, the estimators determine the number of miles of each of the standard cross sections required within a given segment. The CAPEX estimates are for the ICS study area only. The AGS CAPEX costs will be added to the total when they are available.

Assumptions

The assumptions that served as the baseline for the estimates are given below, by FRA Standard Cost Category.

SCC 10: Track and Guideway

- Double ballasted track was used at all locations with the exception of elevated structures and tunnels in excess of 500 feet.
- New double track with direct fixation was used for guideway on elevated structures and tunnels in excess of 500 feet. When direct fixation track is utilized, a 100-foot transition length on either side of the structure is identified as direct fixation and the rest of the approach structure is ballasted track.
- New double track on prepared subgrade was used for retained fill sections.
- New double track on new embankment was used for guideway outside of urban areas.
- In the I-25 North corridor, since the alignment traveled within the median of the highway, the proposed track and guideway was designed to minimize the amount of cut-and-fill sections and match the existing terrain for a majority of the alignment. The maximum grade allowed was 3.64 percent for a 0.10 mile segment.
- In the I-25 South corridor, a combination of elevated structures, retained fill, and 5-foot embankment was utilized. Generally, elevated structures were used in urban areas and retained fill/5-foot embankments were used in non-urban areas. Elevated structures 30 feet in height were used to cross over single-level structures such as at-grade roadways. Elevated structures 60 feet in height were used to cross over multi-level structures such as an elevated highway crossing over I-25. In non-urban areas with relatively level terrain, 5-foot embankments were employed. Retained fill was used in non-urban areas with non-level terrain.
- Below-grade structures for railroad over roadway were used for spans up to 300 feet. Structures longer than 300 feet were considered elevated structures.
- In the Denver Metro area, the ability to get the alignment to an at-grade condition for at least 1,000 feet was considered to be a worthwhile grade change.
- New double track on cut/fill was used for at-grade conditions adjacent to major highway in the Denver Metro area where a bench situation will exist.
- Denver Metro approach structures where assumed to have a 2 percent grade. For an average 30-foot high aerial structure, 800 feet of the approach used retaining walls with 10-foot average wall height and 700-feet of the approach used retaining walls with 20-foot average wall height.
- For individual segment quantities and costs, the entire segment is included. When these are rolled up to the scenario level, any shared infrastructure was only carried on one segment. An example of this is between E-470 and DIA – while segments B-3 and B-4 and all east segments utilize the same alignment between E-470 and DIA, the infrastructure was only carried on one segment when combined into a scenario.
- Design speeds where held as high as possible within reason through the Denver Metro area. A balance between speed and impact was used in congested areas. All areas of design speeds in excess of 79 mph were assumed to have no vehicular grade crossings.

SCC 20: Stations, Terminals, Intermodal

- Two types of station facilities are assumed: Primary Stations and Secondary Stations. Primary stations are located in areas to accommodate

riders from areas where another station is not easily geographically accessible or in highly populated areas to accommodate a large service demand. Primary station sites and associated development will require 25 acres of land and will accommodate a 2,000-space parking facility. Secondary stations are located between primary stations and in areas with a smaller service demand. Secondary station sites and associated development will require 10 acres of land.

- Within the I-25 North corridor, a primary station is located in Fort Collins. In the I-25 South corridor, primary stations are assumed in Pueblo and Colorado Springs. The Denver Metro area has primary stations at DUS and DIA. Note that stations are only carried if the scenario alignments service the area.
- A secondary station for the I-25 North corridor is located in Berthoud. In the I-25 South corridor, secondary stations are located in Castle Rock, Monument, and near Fort Carson. The Denver Metro area has secondary stations at South Suburban (I-25 and E-470 intersection south of Denver) and North Suburban (I-25 and E-470 intersection north of Denver). In some scenarios, an additional secondary station is located at either the Denver Stockshow area or I-76/72nd Avenue to facilitate connections between the north-south and east-west alignments.

SCC 30: Support Facilities: Yards, Shops, Administration Buildings

- Four layover facilities are assumed for each scenario, one each in the north, south, east, and central areas. Specific locations were not identified in the Level 2 analyses. Each layover facility will require 5 acres of land.
- One maintenance facility is assumed for each scenario. A specific location was not identified in the Level 2 analyses. The maintenance facility will require 40 acres of land.

SCC 40: Sitework, Right of Way, Land, Existing Improvements

- In rural areas where open drainage can be achieved, a 100-foot ROW was applied to the entire corridor. In urban areas that are not following a major highway corridor, a 60-foot ROW width was applied to the corridor.
- In areas where the alignment is following a major highway, a 100-foot ROW width was applied in order to help facilitate realignment of any adjacent roads that might be required.
- The exception to the above is in the I-25 North corridor, where the alignment runs in the median of I-25 and no additional ROW will be required. Additionally, portions of the I-25 South corridor will utilize I-25 ROW and no additional land will be needed.

SCC 50: Communications and Signaling

- Automatic Train Control, wayside protection system, and communications with fiber optic backbone will be installed over the entire length of each alignment.

SCC 60: Electric Traction

- Electrification of track will be applied to the entire length of each alignment.

SCC 70: Vehicles

- Vehicle cost was calculated using the total number of trainsets required by the proposed operating plan. An estimate of five cars per trainset was assumed at a cost of $20 million each.

SCC 80: Professional Services

- Project elements included in the Professional Services category are environmental planning, design engineering, program management, construction management and inspection, engineering services during construction, insurance, and testing and commissioning.
- Professional services and other soft costs required to develop the project have been estimated as a percentage of the estimated construction cost as a separate line item:
  - Design Engineering 10%
  - Insurance and Bonding 2%
  - Program Management 4%
  - Construction Management and Inspection 6%
  - Engineering Services During Construction 2%
  - Integrated Testing and Commissioning 2%

- A total Professional Services cost of 26 percent of the total construction cost was applied.

SCC 90: Unallocated Contingency

- Contingency costs were added as an overall percentage of the total construction cost.
- Contingencies are an allowance added to the estimate of costs to account for items and conditions that cannot be realistically anticipated.
- An overall design and construction contingency of 30 percent of the total construction cost was applied.
- Unallocated contingency also includes reserves for utility relocation. Utility relocation costs were calculated as a percentage of the total construction cost for urban and non-urban relocation. Urban relocation is 6 percent of the total construction cost, and non-urban relocation is 3 percent of the total construction cost.
- Environmental mitigation is also considered a contingency cost. Environmental mitigation has been estimated as a percentage of the construction cost:
  - Noise Mitigation 1%
  - Hazardous Waste 1%
  - Erosion Control 0.5%

SCC 100: Finance Charges

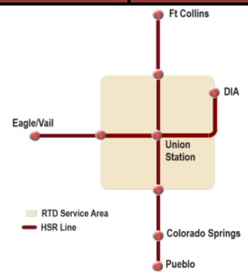
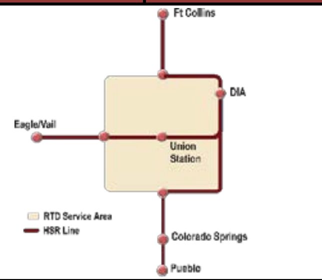
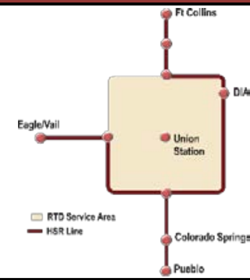
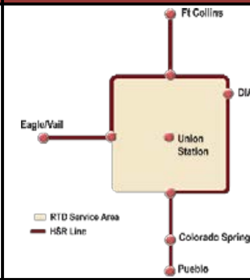
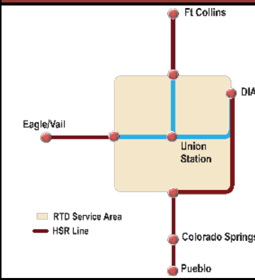
The approach to financing has not been determined for Colorado's HSIPR system. For comparison, financial charges during the construction of FTA-funded projects typically range between 5 and 10 percent of the capital cost. For the purposes of this Level 2 Evaluation, 7.5 percent is assumed.

Estimating Results

Exhibit 3-30 presents the capital cost estimates in 2013 dollars. With the exception of Scenario C-1, all of the full-build scenarios are within 12 percent in capital cost. This is because the total mileage of all four of the remaining scenarios is between 208 and 216 miles, or 4 percent. Scenario A-1 with either Option A (I-76) or Option B (US 6) has the highest cost due to the complicated construction through the Denver metro area, both east to west and north to south. The average cost per mile for this scenario is $71.4 million per mile compared to about $65 million per mile for the other scenarios.

Scenarios B-2A and B-5 have respective costs of $13.4 billion and $13.9 billion, and Scenarios A-1 and A-5 have respective costs of $14.9 billion and $14.1 billion. Scenario C-1 is estimated to cost $11.5 billion. Scenario B-2A costs approximately 17 percent more than the low-cost scenario, C-1, but has ridership that is 28 percent greater. From a capital cost standpoint, B-2A is considered the most cost-effective, and Scenario B-5 ranks second.

Exhibit 3-30: Capital Costs by Scenario (ICS Project only)

Scenario	A-1A	A-1B	A-5A	A-5B	B-2A	B-5	C-1
							
Total Miles	**219.35**	**208.63**	**214.67**	**215.42**	**208.40**	**216.00**	**173.00**
Cost Category							
10-TRACK	**$5,519,667,470**	**$5,326,576,400**	**$5,036,768,660**	**$5,141,407,060**	**$4,918,755,000**	**$5,028,948,790**	**4,099,736**
20-STATIONS	**$425,000,000**	**$400,000,000**	**$375,000,000**	**$400,000,000**	**$350,000,000**	**$375,000,000**	**325,000**
30 FACILITIES:	**$243,048,000**	**$243,048,000**	**$243,048,000**	**$243,048,000**	**$243,048,000**	**$243,048,000**	**243,048**
40- SITEWORK, RIGHT OF WAY,	**$1,151,551,490**	**$1,018,332,400**	**$965,121,920**	**$939,232,550**	**$740,776,780**	**$876,376,160**	**736,301**
50 COMM/SIGNALS	**$452,085,300**	**$429,038,360**	**$461,519,000**	**$463,131,500**	**$448,038,500**	**$463,260,500**	**371,154**
60 ELECTRIFICATION	**$1,093,415,620**	**$1,037,674,180**	**$1,116,232,000**	**$1,120,132,000**	**$1,083,628,000**	**$1,120,444,000**	**897,676**
70: PROFESSIONAL SER	**$2,265,615,810**	**$2,155,940,700**	**$2,090,410,840**	**$2,118,272,530**	**$1,083,628,000**	**$2,067,304,750**	**1,701,593**
80-UTILITY RELO	**$426,347,660**	**$398,169,040**	**$373,106,880**	**$373,975,450**	**$1,984,982,800**	**$349,571,980**	**304,002**
90-ENV. MITIGATION	**$222,199,200**	**$211,366,740**	**$204,942,240**	**$207,673,780**	**$341,563,050**	**$202,676,940**	**166,822**
CONTINGENCY	**$3,539,655,170**	**$3,366,043,770**	**$3,259,844,860**	**$3,302,061,860**	**$3,091,619,490**	**$3,217,989,330**	**2,653,600**
Total	**$15,338,505,720**	**$14,586,189,680**	**$14,125,994,410**	**$14,308,934,740**	**$13,397,017,780**	**$13,944,620,440**	**$11,498,937**
Cost Per Mile	**$69,926,370**	**$69,913,240**	**$65,803,300**	**$66,423,430**	**$64,285,110**	**$64,705,210**	**$66,606,460**

Operations and Maintenance Costs

Exhibit 3-31 shows the estimated OPEX by scenario for five different train technologies. As described earlier, the unit costs were taken from the RMRA Study and updated to 2013 dollars. In general, the Maglev technologies are predicted to have a lower cost per train mile of operation than the steel wheel rail technologies. However, this will need to be verified during the Level 3 Evaluation.

The train miles were generated based on the service plans developed for each scenario. Scenarios that require the highest number of miles to address their service plans have the highest operating cost (OPEX). Thus, because Scenarios B-2A and B-5 have the highest annual train miles, they also realize the highest OPEX. However, as noted earlier, these Scenarios also produce the highest annual ridership of 13.8 and 13.7 million, respectively.

For the purposes of the Level 2 Evaluation, the average cost per mile for the five technologies, $50.85, was used for the B/C studies since a technology has not yet been chosen.

Planning Feasibility

Each of the five remaining scenarios is feasible from a planning standpoint. All are in conformance with the State Rail Plan, and the concept of HSIPR is consistent with regional planning documents, all of which endorse the concept of increased mode share by transit. The degree to which the scenarios will fulfill local land use plans depends on station location. At the Level 2 Evaluation, station location specifics have not been addressed other than general locations for the purpose of travel demand modeling.

The greatest determinant of planning feasibility will be the political will to fund any of the proposed scenarios. The implementation of any scenario will require a major non-federal funding source, such as an increase in sales tax, fuel tax, property tax, etc. Funding from sources other than the federal government will likely need to approach 50 percent of the total capital cost of the scenario to attract private and/or federal funding. Absent the political will to increase revenues, a HSIPR for Colorado will not be feasible. This conclusion holds true for all of the scenarios and is not a discriminator for selection.

Benefit/Cost Analysis

B/C analysis is a widely used analytical technique that provides a common denominator for comparing costs and benefits of public investments in order to assist policymakers in making decisions about public expenditures. This analysis considers the benefits and costs of alternative alignments as well as whether the benefits of HSR outweigh the costs. It is a technique that considers the long-term benefits and shorter-term costs, which is important given the multi-year timeframe of the project. The B/C analysis also incorporates the time value of money in order to capture future values and benefits.

Assumptions

The B/C studies evaluate the feasibility of the ICS portion of the statewide HSIPR program only. The AGS portion of the system will be added once CAPEX estimates have been developed.

Dollar figures in this analysis are expressed in constant 2013 dollars. In order to adjust the future value of cash flows, a discount rate was used. The discount rate used for the evaluation of public projects differs from the interest rate employed in private investments and is an often-debated topic. For comparison purposes, the 10-year U.S. Treasury bond rate is currently under 2 percent. A discount rate of 4 percent was used in the analysis over a period of 30 years. The higher the discount rate, the lower the present-value estimate.

Costs

- *Capital Expenditures (CAPEX)* and *Annual Operating Expenditures (OPEX)* were based on the estimates presented earlier in this section.
- *Interest payments* were assumed at 4 percent interest and a 30-year repayment period, using a simple amortization schedule, for 50 percent of the capital costs. The analysis assumes that half of the upfront capital costs for this project will be bonded with repayment to a governmental entity. It should be noted that repayment does not typically follow a simple principal and interest schedule for these types of large capital projects; however, at this level of analysis, it was deemed an appropriate method for calculating interest. The repayment schedule is often based on the timing of grants and other factors.

Exhibit 3-31: OPEX by Scenario (ICS Project only)

Corridor	Concept		Rev. Train-Miles	110 mph Rail	125 mph Maglev	150 mph Rail	220 mph Rail	300 mph Maglev
Cost per Rev. Train-Mile Rates -->				*$54.61*	*$49.58*	*$53.79*	*$54.73*	*$41.56*
Front Corridor	A1a	Basic	3,599,400	$196,559,000	$178,462,000	$193,615,000	$196,991,000	$149,608,000
	A1b	Basic	3,610,200	$197,149,000	$178,997,000	$194,196,000	$197,582,000	$150,057,000
	A5a	Basic	3,659,600	$199,847,000	$181,447,000	$196,853,000	$200,286,000	$152,110,000
	A5b	Basic	3,670,400	$200,437,000	$181,982,000	$197,434,000	$200,877,000	$152,559,000
	B2A	Basic	4,050,500	$221,194,000	$200,828,000	$217,880,000	$221,680,000	$168,358,000
	C1	Basic	3,719,780	$203,133,000	$184,431,000	$200,091,000	$203,580,000	$154,612,000
	B5	Basic	4,067,800	$222,138,000	$201,686,000	$218,811,000	$222,626,000	$169,077,000
Mountain	A1a	Basic	1,486,900	$81,198,000	$73,722,000	$79,982,000	$81,376,000	$61,803,000
	A1b	Basic	1,485,500	$81,122,000	$73,653,000	$79,906,000	$81,300,000	$61,744,000
	A5a	Basic	1,486,900	$81,198,000	$73,722,000	$79,982,000	$81,376,000	$61,803,000
	A5b	Basic	1,485,500	$81,122,000	$73,653,000	$79,906,000	$81,300,000	$61,744,000
	B2A	Basic	1,490,300	$81,384,000	$73,891,000	$80,165,000	$81,563,000	$61,944,000
	C1	Basic	1,488,500	$81,285,000	$73,801,000	$80,068,000	$81,464,000	$61,869,000
	B5	Basic	1,490,000	$81,367,000	$73,876,000	$80,149,000	$81,546,000	$61,931,000
TOTAL	A1a	Basic	5,086,300	$277,757,000	$252,184,000	$273,597,000	$278,367,000	$211,411,000
	A1b	Basic	5,095,700	$278,271,000	$252,650,000	$274,102,000	$278,882,000	$211,801,000
	A5a	Basic	5,146,500	$281,045,000	$255,169,000	$276,835,000	$281,662,000	$213,913,000
	A5b	Basic	5,155,900	$281,559,000	$255,635,000	$277,340,000	$282,177,000	$214,303,000
	B2A	Basic	5,540,800	$302,578,000	$274,719,000	$298,045,000	$303,243,000	$230,302,000
	C1	Basic	5,208,280	$284,418,000	$258,232,000	$280,159,000	$285,044,000	$216,481,000
	B5	Basic	5,557,800	$303,505,000	$275,562,000	$298,960,000	$304,172,000	$231,008,000

Benefits

Basic Data

- *Ridership* - Calculated based on the travel demand model.
- *Ticket Revenue* - Based on an assumption of revenues of $.35 per mile and ridership.
- *Reduction in Vehicle Miles Traveled (VMT)* - VMT and the associated benefits calculations are based on the results of the travel demand model and are driven by the impacts of people switching from other modes to HSR.
- *Reduction in Vehicle Hours Traveled (VHT)* - Relates to the amount of time individuals spend traveling to their destinations. In order for benefits to be counted, vehicle-hours have been translated into dollar figures. While time can be valued at different rates depending on the activity (leisure, work, etc.), an average wage rate of $23 per hour was used for purposes of this analysis. The average wage rates for Colorado and the United States were similar at approximately $23 per hour (U.S. Bureau of Labor Statistics, 2012).
- *Fatalities Avoided* - Results from a reduction in VMT and the corresponding reduction in automobile accidents and associated fatalities. The number of fatalities is based on 1.1 fatalities per 100 million miles driven (National Highway Traffic Safety Administration 2011 estimates). Fatalities are valued at $6.2 million per life saved (Polly Trottenberg, Assistant Secretary for Transportation Policy, U.S. Department of Transportation. "Memorandum re: Treatment of the Economic Value of a Statistical Life in Departmental Analysis – 2011 Interim Adjustment," July 29, 2011).
- *Pollution Benefits* – With decreased VMT, there would be fewer harmful particulates and greenhouse gas emissions. Both businesses and the general public would benefit from a better environment and better overall public health. The benefits are estimated at $.199 per reduction in VMT based on research into public health and environmental benefits by the Victoria Transportation Policy Institute (Victoria Transportation Policy Institute, "Transportation Cost and Benefit Analysis II – Air Pollution Costs," February 22, 2012*).*

Calculated Benefits (Present Worth basis)

The Present Worth (PW) for the majority of benefits was calculated based on a 4 percent discount rate over a 30-year period, as explained above. Any exceptions are noted in the narrative.

- *Increase in Real Estate Value* – Calculated for the ICS stations only. At this level, very general assumptions were made about the development readiness of the sites and future densities since specific locations have not been discussed. It was assumed that there would be 15 to 25 acres of land immediately around the future station areas directly influenced by the presence of the station. These land areas were adjusted assuming that significant infrastructure would be needed at most of the locations. Floor to Area Ratios (FARs) were used to estimate density assuming FARs of 3 to 5; a FAR of 1 would be seen at newer pedestrian-oriented suburban mixed-use neighborhoods such as Belmar in Lakewood. Valuations of $180 per square foot were used based on commercial real estate sales in different parts of the Front Range tracked by the *Colorado Real Estate Journal* in early 2013.
- *Operations Jobs* – The value of labor or jobs was assumed to be half of the overall OPEX estimate. It was also valued at a 4 percent discount rate over a 30-year period.
- *Non-basic Jobs* – Operations jobs were assumed to have a 1.5 multiplier effect throughout the economy, creating indirect and induced benefits. These impacts include the jobs, incomes, and output of people involved in operating the system, and the additional jobs and earnings created by the operations. It also includes an estimate of the induced impacts related to the spending of operations workers. For every operations job, a total of 1.5 jobs would be created (including the original operations jobs) based on Bureau of Economic Analysis (BEA) Regional Input-Output Modeling System (RIMS II) multipliers.
- *50 Percent Federal Funding and Multiplier Effect* – It was assumed that 50 percent of the capital expenditures would come from the federal government. Because the source of the funds is from outside of the state economy, this funding would have a potentially higher multiplier than spending from local sources. Recent research conducted by economists at the Federal Reserve

Bank in San Francisco estimate the overall multiplier for these types of projects at 3 (Leduc, Sylvain and Daniel Wilson, "Highway Grants: Roads to Prosperity," FRBSF Economic Newsletter, November 26, 2012).

- *50 Percent Construction Jobs and Multiplier Effect* – It was assumed that half of the CAPEX would be for labor and that construction would take place over a 10-year time period. The present-worth calculation was adjusted accordingly. For every construction job, a total of two jobs would be created (BEA RIMS II multipliers).

B/C Results

The results from the B/C studies are not a strong discriminator at the Level 2 Evaluation, as shown on Exhibit 3-32, as all scenarios experience ratios of around 2.0. This is because the largest contributing benefits – employment and the multiplier effects of large federal grants – are comparable among the scenarios. Again, it is important to emphasize that with the exception of how the scenarios penetrate the Denver metro area, the physical configurations are the same for each.

Operating Ratio Results

A positive operating ratio is important because the surpluses can be used to help pay for the annualized capital payment for the system. Compared to the B/C, there is more variability with the operating ratios realized by the five scenarios, which range from a high of 1.45 for Scenarios A-1B and A-5B (US 6) to 1.05 for Scenario C-1. Scenarios A-1A, A-5A, A-5B, B-2A, and B-5 have operating ratios of 1.32, 1.32, 1.35, 1.21, and 1.19, respectively. Scenarios B-2A and B-5 have lower ratios because their beltway alignments generate additional annual train miles, and hence a higher OPEX. At the Level 2 Evaluation, the OPEX ratios are based on an average of the unit prices assumed for each technology.

Financial Considerations

As presented in earlier sections, project costs are anticipated to range from $11.5 billion to over $14.0 billion, not including the cost of the AGS program, which may add another $11 to $30 billion. Depending on timing, the cost of money, and the ultimate cost per mile, the annual capital requirement could range from $665 million to $815 million per year, assuming just the ICS (Front Range less the AGS) full-build program is constructed. The State of Colorado is not in a position to fund a program of this magnitude, even with federal funding.

How Much Money Is Needed To Start?

It is anticipated that the project would be phased in a series of Minimum Operable Segments (MOS) to better match potential revenues with capital requirements. Further, it is anticipated that 50 percent of the capital cost would be received in the form of federal grants, thus halving the local capital requirement.

So how much money must be generated locally? There have been some discussions on what constitutes a reasonable MOS. Our ICS study process is determining a best first project as this Level 2 Evaluation Report is being prepared. For the purposes of example, we can assume that a minimum project is likely to cost from $1 to $3 billion in 2013 dollars. The selection of the MOS will be based on B/C analysis, public support, and other factors such as potential environmental impacts. In general, what is called the capital recovery (in essence, the annual payment on the bonds also referred to as the capital recovery factor)[1] will range between just under 6 percent to around 8 percent of the loan value, depending on the interest rate assumed. For a project of $2 billion, assuming a 50 percent federal grant, the citizens of Colorado would need to fund $1 billion at a cost of $57.8 million per year over a 30-year period.

[1] For example, assuming an interest rate of 4%, the capital recovery factor, A/P, is 5.78 percent; for 6% interest, the factor is 7.26% and for 8% interest the factor is 8.88 percent.

Exhibit 3-32: Summary B/C Results by Scenario (ICS only)

B/C Element	Scenario A-1a Basic	Scenario A-1b Basic	Scenario A-5a Basic	Scenario A-5b Basic	Scenario B-2a Basic	Scenario B5 Basic	Scenario C-1 Basic
Costs							
CAPEX	15,338,506,000	$ 14,586,189,000	14,125,994,000	14,308,935,000	13,397,000,000	13,945,000,000	11,499,000,000
Annual OPEX	$ 183,047,000	$ 183,596,200	$ 186,108,600	$ 186,657,800	$ 205,988,000	$ 206,867,600	$ 189,200,000
OPEX Cost (30 year)	$ 3,164,882,630	$ 3,174,378,298	$ 3,217,817,694	$ 3,227,313,362	$ 3,561,532,520	$ 3,576,740,804	$ 3,271,268,000
Interest payments	$ 5,511,815,439	$ 5,241,474,086	$ 5,076,105,314	$ 5,141,844,248	$ 4,814,144,965	$ 5,011,066,025	$ 4,132,108,155
Total Cost	**$ 24,015,204,069**	**$ 23,002,041,384**	**$ 22,419,917,008**	**$ 22,678,092,610**	**$ 21,772,677,485**	**$ 22,532,806,829**	**$ 18,902,376,155**
Benefits							
Basic Data							
Ridership	9,981,048	10,817,411	10,486,660	10,760,464	10,853,263	10,922,590	8,811,343
Ticket Revenue	$ 241,102,808	$ 265,529,561	$ 246,469,103	$ 251,271,850	$ 249,983,676	$ 247,117,358	$ 197,850,186
Reduction in Vehicle-Miles[1]	296,118,104	325,409,895	284,075,042	287,788,682	292,981,842	284,668,554	220,233,121
Reduction in Vehicle-Hours[1]	713,675	1,013,611	767,627	812,549	979,328	929,069	357,502
VMT Benefit	$ 165,826,138	$ 182,229,541	$ 159,082,023	$ 161,161,662	$ 164,069,831	$ 159,414,390	$ 123,330,548
VHT Benefit	$ 16,414,519	$ 23,313,060	$ 17,655,427	$ 18,688,636	$ 22,524,544	$ 21,368,581	$ 8,222,543
Fatality Avoided	$ 20,195,255	$ 22,192,955	$ 19,373,918	$ 19,627,188	$ 19,981,362	$ 19,414,395	$ 15,019,899
Calculated Benefits (PW basis)							
Increase in Real Estate Value - one time deal, no PW calc.	$ 3,100,000,000	$ 3,100,000,000	$ 3,100,000,000	$ 3,100,000,000	$ 3,100,000,000	$ 3,100,000,001	$ 3,100,000,000
Fare Box Revenue (30 year)	$ 4,168,667,548	$ 4,591,006,112	$ 4,261,450,797	$ 4,344,490,279	$ 4,322,217,762	$ 4,272,659,117	$ 3,420,829,717
PW of VMT	$ 2,867,133,930	$ 3,150,748,764	$ 2,750,528,185	$ 2,786,485,134	$ 2,836,767,384	$ 2,756,274,811	$ 2,132,385,176
PW of VHT	$ 283,807,033	$ 403,082,807	$ 305,262,332	$ 323,126,524	$ 389,449,369	$ 369,462,769	$ 142,167,775
PW of Fatality Avoided	$ 349,175,954	$ 383,716,189	$ 334,975,040	$ 339,354,082	$ 345,477,742	$ 335,674,897	$ 259,694,052
Pollution benefits	$ 1,018,856,522	$ 1,119,641,078	$ 977,419,837	$ 990,197,396	$ 1,008,065,553	$ 979,461,942	$ 757,758,303
PW of Operations Jobs	$ 1,582,441,315	$ 1,587,189,149	$ 1,608,908,847	$ 1,613,656,681	$ 1,780,766,260	$ 1,788,370,402	$ 1,635,634,000
PW of Non-basic jobs (1.5 multiplier)	$ 791,220,658	$ 793,594,575	$ 804,454,424	$ 806,828,341	$ 890,383,130	$ 894,185,201	$ 817,817,000
50% Federal funding	$ 7,669,253,000	$ 7,293,094,500	$ 7,062,997,000	$ 7,154,467,500	$ 6,698,500,000	$ 6,972,500,000	$ 5,749,500,000
Multiplier effect of Federal funding (3.0 multiplier)	$ 15,338,506,000	$ 14,586,189,000	$ 14,125,994,000	$ 14,308,935,000	$ 13,397,000,000	$ 13,945,000,000	$ 11,499,000,000
Construction Employment	$ 6,219,764,183	$ 5,914,699,640	$ 5,728,090,567	$ 5,802,273,143	$ 5,432,483,500	$ 5,654,697,500	$ 4,662,844,500
Non-basic jobs (2.0 multiplier)	$ 4,105,044,361	$ 3,903,701,762	$ 3,780,539,774	$ 3,829,500,274	$ 3,585,439,110	$ 3,732,100,350	$ 3,077,477,370
Total Benefits	47,493,870,503	$ 46,826,663,575	$ 44,840,620,801	$ 45,399,314,353	$ 43,786,549,811	$ 44,800,386,990	$ 37,255,107,893
Sum of Benefits (PW Cost Basis)	**$ 47,493,870,503**	**$ 46,826,663,575**	**$ 44,840,620,801**	**$ 45,399,314,353**	**$ 43,786,549,811**	**$ 44,800,386,990**	**$ 37,255,107,893**
Sum of Costs (PW Cost Basis)	**$ 24,015,204,069**	**$ 23,002,041,384**	**$ 22,419,917,008**	**$ 22,678,092,610**	**$ 21,772,677,485**	**$ 22,532,806,829**	**$ 18,902,376,155**
B/C Ratio	**1.98**	**2.04**	**2.00**	**2.00**	**2.01**	**1.99**	**1.97**
Operating Ratio	**1.32**	**1.45**	**1.32**	**1.35**	**1.21**	**1.19**	**1.05**

What Is A Logical Source For Funding?

As part of the Level 2 Evaluation, a white paper (included as Appendix E) was prepared to determine what types of existing or new funding sources could be used to fund a logical MOS. As shown in Exhibit 3-33, the study team developed theoretical funding sources based on existing and new transportation sources. What is important to note from the table is that only a portion of any of these increases would be required to fund a serviceable MOS. For example, approximately 1/10 of 1 percent increase in sales taxes would be sufficient to fund the theoretical MOS presented earlier.

Exhibit 3-33: Potential Sources of Funding

Sources	*Increase/Change*	*Revenues Generated (M $/year)*
User Fees		
Fare-box	$0.35 per mile	$320.0
Motor Fuel Tax	$.25 per gallon	$446.9
VMT Fees	$.01 per mile	$392.9
Registration Fees	$100 per vehicle	$391.3
Utility Fees	$15/month/household	$293.6
Gen. Revenues		
State Sales Tax	1%	$571.9
State Property Tax	4 mills	$200.1
State Income Tax	1%	$1,044.1
Lodging Tax	1% statewide lodging spending	$26.5
Lottery Tax	10% of lottery profits	$11.3
Value Capture		
Development Fee	$10,000/residential 1% fee/commercial	$169.4

Further, it is recognized that many of the funding sources overlap. For instance, a gas tax or mileage-based tax might be implemented, but not both. Neither is it anticipated that all of these sources would be implemented, nor that they might be implemented at the levels evaluated. Rather, the intent of this information is to reveal the possible major funding sources that could be considered.

Recommendations for Level 3 Evaluation

This section provides recommendations for the Level 3 Evaluation.

Scenarios Retained

Based on the Level 2 Evaluation, three of the five scenarios are recommended for further refinement in the Level 3 Evaluation:

- Scenario A-5/Option A (I-76)
- Scenario B-2A
- Scenario C-1

Scenario A-5A is retained because it best serves DIA with one-seat ride from all markets and provides better connections to the central Denver area than Scenario B-2A. While it requires a transfer from RTD's North Metro CRT to DUS, it could also provide a strong connection to the Gold Line and eventual Northwest Rail project at the Pecos Station for an alternate trip to DUS. Option A (I-76) is recommended because it results in fewer community impacts than Option B (US 6). It is also felt that one "through Denver" scenario needed to be carried into the Level 3 Evaluation, and Scenario A-5 costs less and has fewer impacts than Scenario A-1 while producing comparable ridership.

Scenario B-2A is recommended for Level 3 Evaluation because it produces the best ridership at the lowest cost of all scenarios with the exception of C-1. It would also avoid the impacts of construction through the Denver metro area. It provides the best access for populations from the southern markets and strong access from the northern markets. This is partially offset by the fact that travel from the mountains, while still a one-seat ride, is longer than for the Scenarios A-1 or A-5.

Scenario C-1 is retained because it accommodates phasing of a HSIPR program for the state.

Scenarios Set Aside

Based on the Level 2 Evaluation, the following scenarios have been set aside:

- Scenario A-1 (both Options A and B)
- Scenario A-6
- Scenario B-5

Scenario A-1 was set aside due to the anticipated high level of community impacts from constructing a

HSIPR system north-south and east-west through the Denver metro area. This system is also more likely to be construed as competition and redundancy to RTD's FasTracks program. Using the less impactful Option A (I-76), the ridership is the lowest of the full-build scenarios. With Option B (US 6), the ridership is competitive but the impacts are too damaging.

Scenario A-6 was eliminated early in the Level 2 Evaluation because the $20-billion cost was not considered implementable. Further, the community impacts of this scenario are similar to those of Scenario A-1, with the addition of the impacts associated with the beltway segments.

Scenario B-5 was set aside because of a lack of support from the City of Golden and because it provided poor connections for travelers from the southern markets.

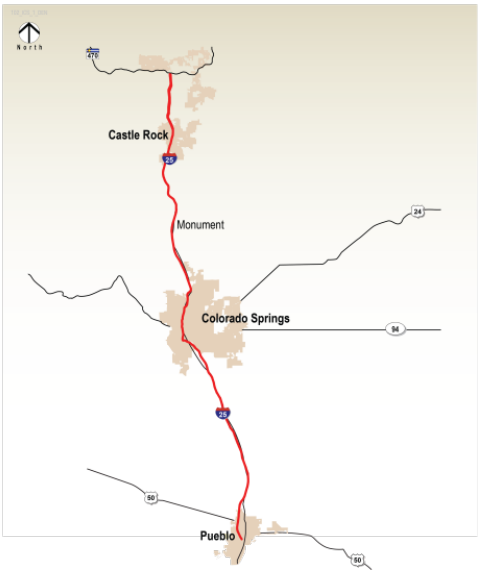
Segments Set Aside

Based on the Level 2 Evaluation, the following segments have been set aside:

- Segment S-1 (Greenfield)
- Segment N-1 (EIS)

Segment S-1 (Greenfield) south to Colorado Springs and Pueblo was eliminated between the end of Level 1 Evaluation and the initiation of Level 2 Evaluation due to intensive public opposition for constructing HSIPR through the Black Forest community north of Colorado Springs. It was replaced with Segment S-3, which closely follows the I-25 alignment.

Exhibit 3-34: Segment S-3



Segment N-1 (EIS), shown in Exhibit 3-35, was eliminated because it is not suitable for HSIPR from cost, travel time, or environmental standpoints. Constructing HSIPR with competitive travel times through the cities of Longmont, Berthoud, Loveland, and Fort Collins would have required extensive elevated structure and private property acquisition, increasing community impacts to unacceptable levels and escalating the cost to over three times that of Segment N-2 (I-25). The operation of HSIPR was also considered unacceptable. Further, the North I-25 EIS ROD has committed the SH 287 corridor to commuter rail, which is supported publicly. HSIPR on the SH 287 segment is not supported by the public.

Exhibit 3-35: Segment N-2 (EIS)

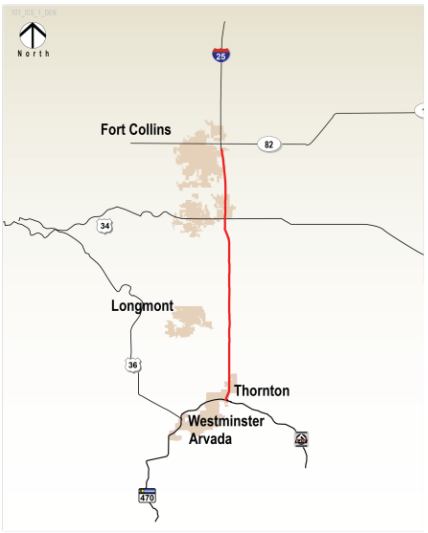


Exhibit 3-36 provides a summary of the HSIPR scenarios that are recommended for Level 3 Evaluation.

Exhibit 3-36: Summary of HSIPR Scenarios Recommended for Level 3 Evaluation

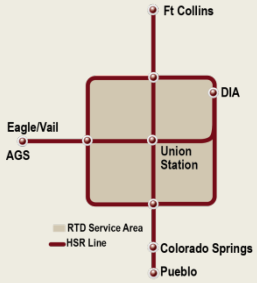
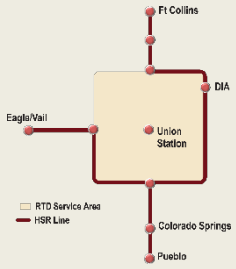
Scenarios Recommended for Level 3 Evaluation		
		
A-1: Direct Routing through Denver • CAPEX - $14.6 - $15.3 billion • OPEX - $183 million/year • Ridership - 12.1 to 13.1 million/year • Revenue - $250 million/year • OPEX Ratio - 1.32/Option A to 1.45/Option B • B/C Ratio – 1.98/Option A to 2.04/Option B **SET ASIDE**: ▪ Performs well but results in high community impacts to the Denver metro area. ▪ Scenarios A-5, B-2A, and B-5 perform as well or better and generally cost less. ▪ Obtaining NEPA clearances though the Denver metro area would take long and be contentious eroding public support for the HSIPR program. ▪ Lastly, it does not serve DIA from north or south well due to a lengthy transfer at DUS and competition from RTD's lower fares and good travel times.	**A-5: Eastern Beltway** • CAPEX - $14.1 - $14.3 billion • OPEX - $186 million/year • Ridership - 12.9 to 13.1 million/year • Revenue - $257 million/year • OPEX Ratio - 1.32/Option A to 1.35/Option B • B/C Ratio - 2.0/with either Option A or Option B **CARRY FORWARD**: ▪ Performs as well as A-1 at lower cost and with fewer impacts at least in the north to south direction through Denver. ▪ However, the impacts will be greater than for B-2A, B-5, or C-1 because it still involves construction through the Denver metro area in the east to west direction. ▪ It serves DIA best with one-seat ride from all markets but requires more out-of-direction travel to the mountains from the north and south markets. ▪ It works well with either Option a (I-76) or Option b (US 6), with the latter mitigating community impacts substantially.	**A-6: Complete Beltway** • **CAPEX: $20.3 billion** • **OPEX: $588 million/year** • **Ridership – Not evaluated** • **Revenue - Not evaluated** • **OPEX Ratio - Not evaluated** • **B/C Ratio - Not evaluated** **SET ASIDE**: ▪ While it would provide the most thorough transit coverage of the scenarios considered, it comes with extremely high capital and operating costs. ▪ Community and environmental impact of construction through and around the Denver metro area will be the highest of all of the scenarios considered and would likely prevent the implementation of this scenario.

Exhibit 3-36: Summary of HSIPR Scenarios Recommended for Level 3 Evaluation (continued)

		
B-2A: Denver Periphery Excluding the Northwest Quadrant ▪ CAPEX - $13.4 billion • OPEX - ~$205.0 million/year • Ridership – 13.8 million/year • Revenue - $249.0 million/year • OPEX Ratio – 1.21 • B/C Ratio – 2.01 **CARRY FORWARD**: ▪ Generates the highest ridership, and the highest revenue; however, the operating ratio is lower than Scenario A-1 or A-5. ▪ Lowest capital cost of any of the full-build scenarios. ▪ Avoids the community and environmental impacts of construction and operation through the Denver metro area. ▪ The one key disadvantage of this scenario is that it does not provide service to DUS.	**B-5: Denver Periphery Excluding the Southwest Quadrant** • CAPEX - ~$13.9 billion • OPEX – $207.0 million/year • Ridership – 13.7 million/year • Revenue - ~$248.0 million/year • OPEX Ratio – 1.19 • B/C Ratio – 1.99 **SET ASIDE:** ▪ While this scenario has many of the benefits of B-2A, it is not supported by many of the Northwest Quadrant stakeholders and is considered to be much more difficult to implement than Scenario B-2A. The benefits of B-5 include: ▪ Generates the second highest ridership and the second highest revenue; like B-2A the operating ratio of B-5 is lower than either A-1 or A-5. ▪ Second lowest capital cost of any of the full-build scenarios. ▪ Like B-2A, avoids the community and environmental impacts of construction and operation through the Denver metro area. ▪ Like B-2A, the key disadvantage of this scenario is that it does not provide service to DUS.	**C-1: Shared Track with RTD** • CAPEX: - $11.5 billion • OPEX - $189.2 million/year • Ridership - 10.8 million/year • Revenue - $205 million/year • OPEX Ratio – 1.05 • B/C Ratio – 1.97 **CARRY FORWARD**: ▪ Represents a possible phasing strategy to the other full-build scenarios. ▪ While is has the lowest capital cost, it also has the weakest ridership and the lowest OPEX ratio. ▪ Maintains a B/C ratio comparable to the other scenarios. ▪ Provides very strong access to DIA from southeast Denver, Colorado Springs and Pueblo due to the one-seat ride available to these locations. Because it requires a transfer to communities north and west, its ridership is weaker.

Section 4. Public Process

The public process for Level 2 Evaluation was carried forward from the Level 1 Evaluation. As described below, it included four PLT meetings and five public workshops.

Project Leadership Team Engagement

This section focuses on the continued dialogue with PLT through Level 2 and their input toward the Level 2 Evaluation. The study process continued on from the Level 1 Evaluation with a PLT workshop and 3 PLT meetings, and concluded with four public open houses to obtain public input for further evaluation.

PLT Workshop 3 – December 10, 2012

The first PLT workshop was conducted at the Jefferson County Administration Building in December 2012. The study team discussed the project update, results from Level 1 Evaluation, Level 2 evaluation criteria, ridership modeling, benefit/cost studies, an update on the AGS Study, and had break-out sessions to discuss alignment alternatives. The break-out sessions were held for the PLT members in the North Metro Area, east-west through metro Denver, north-south through metro Denver, Colorado Springs/Pueblo, and Northern/Fort Collins. During the break-out sessions, the PLT members discussed their thoughts regarding the Level 2 evaluation and criteria, and alignments that were presented by the study team. Written feedback was also provided following the meeting. Examples of a few of the key themes identified are provided below.

North Metro Area Key Comments:

- Commerce City opposes anything along 96th Avenue because of platted and soon-to-be developed land.
- Thornton will oppose the use of I-25 between the RTD ROW crossing (north of Erie exit, south of Hwy 52) and E-470. Maintain this area for auto-oriented development.
- A station at Pecos would provide connections between North West Rail, ICS and Gold Line.

East-West Through Metro Denver Key Comments:

- I-70 Mountain Corridor representatives do not support an alignment that shares track with the Gold Line as it is not technology agnostic.
- Does not make sense to model Golden to DUS to DIA because it is a duplication of RTD service and does not leverage those investments.

North-South Through Metro Denver Key Comments:

- Denver and RTD support having the passenger rail service go through downtown Denver and into the DUS.

Colorado Springs to Pueblo Key Comments:

- Castle Rock would prefer a station, not in downtown due to impacts, but further north between US 85 and I-25 near the new interchange slated to be built in 2013.
- Pueblo generally agrees with the ICS proposal to enter downtown from the northwest and affirms that CDOT should not be coming in along the railroad alignment from the northeast.

Northern/Fort Collins Key Comments:

- Longmont would prefer that the alignment serve downtown Longmont
- The North I-25 EIS identifies the 287 corridor as commuter rail with stations in each community. There is strong community support for alignment, as commuter rail.

Based on the feedback received, the study team refined the segments and began to evaluate each using criteria developed for the Level 2 Evaluation.

PLT Meeting 4 – February 26, 2013

The fourth PLT meeting was held in February 2013 at CDOT Headquarters. The PLT reviewed the progress made since the previous December workshop, discussed input received at the December workshop in more detail, and conducted a group revenue exercise. The group was also informed of the AGS Study progress. Key themes of the comments received include:

- Standards for grade separation and grade crossing protections should be a strong consideration through the Denver Metro area and would likely slow speeds significantly. (Note: the HSIPR system would have no at-grade crossings)
- Interest in the importance of a direct connection to DIA over Downtown Denver or even the Denver Tech Center. Broad origin/destination information and trip shares should be considered.
- Interest in more detail at Level 3 including cut/cover tunnel costs vs. bored tunnel costs, engineering modifications and value engineering and phasing.
- Remember to consider community impacts; elevation through Castle Rock or other communities would have big impacts, explore COS airport connections and implications.
- With regard to funding sources, the group voiced interest in oil and gas severance taxes, including the coal portion, lift ticket taxes or other visitor fees.
- Tax Increment Financing (TIF) is interesting politically
  - Suggest future slide or discussion on sharing of TIF funding with local governments.
  - Sliding scale of revenue sharing: maybe in the early years 100 percent of funds go to pay off bonds/debt for HSIPR system. Later years transition to something like 20 percent for HSR O&M costs, and 80 percent for local use on local projects.
- Most stations will be new stations, so PPP (P3) partnerships should be explored to create them. May be separate from the rail/guideway infrastructure to be the most successful.
- VMT tax or mileage-based user fee (MBUF), if implemented, would likely mean the removal of the gas tax as we know it. VMT/MBUF would be a more efficient overall solution if the privacy issues and logistical complexities of implementing it could be addressed.
- HSIPR will add to sprawl so development fees are important. Development around future stations should generate development fee revenues, TIF or other funding sources.
- Sources of funding should reflect the areas that receive service.
- Each segment needs to pay its way – geographic equity is important.
- If the effect on DIA is to reduce parking demand, then dollars that would have been used by airport to fund parking structures/service should be applied to HSIPR.

The comments received from the PLT were considered and incorporated into the Level 2 Evaluation and revenue and funding considerations.

PLT Meeting 5 – April 17, 2013

The fifth PLT meeting was held in April 2013 at CDOT Headquarters. The PLT discussed Level 2 operating expense (OPEX) estimates, preliminary ridership results, Level 2 results-scenario evaluations, and Level 2 early Benefit/Cost (B/C) results. Key themes of the meeting included the following discussion points and comments:

- PLT member voiced interest and concern over the source data for the modeling effort as a key element of buying into the results. Source data included existing local data, CDOT Traffic count data, new data developed for this effort and anonymous cell phone location data from Sprint. Data was processed for three segments of time: February, July and October and for weekend and weekday and for traveler type: resident, visitor, and through traveler. A Stated Preference Survey (SPS) was conducted in 2012, and AGS was selected as choice for time savings (30 percent), environmental or congestion reasons.

- PLT members were concerned that often SPS tend to not provide accurate results. The team worked with a specialty firm that designs these, made efforts to avoid leading questions, tried not to paint unnecessarily negative views. We did what we could to minimize those effects.
- How was RTD system demand and ridership integrated? Intra-urban model predicted connectivity between RTD routing and HSIPR routes. Possibility of completion of routes between systems, and also feeding the system.
- There would be an interface potential at Pecos Street station with Northwest and Gold Line. These are going to be major decision points, and it is important to show connecting points and pros/cons of the connecting points with the RTD system.
- Connecting with the north-south segment is also critical – connecting Fort Collins to Summit County and Vail; it will need a super intermodal center that accommodates north to south and east to west connectivity.
- Shared track option produces a reduction in cost just in the metro area. To get to the mountains, HSR would be using steel wheel which cannot get to as many destinations and would likely have lower ridership.

PLT Meeting 6 – May 1, 2013

The sixth PLT meeting was held in May, 2013 and the PLT reviewed the scenarios presented at the April PLT, along with additional scenarios that travel around the Denver metro area, rather than through it. PLT member comments about scenario preferences were captured in the break-out session:

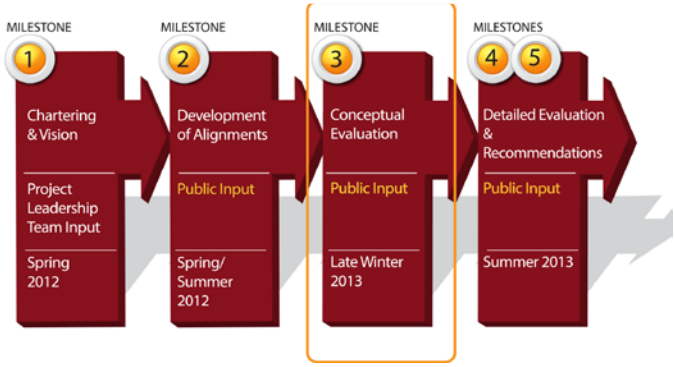
- Going through the center of Denver would have significant environmental, construction and social impacts and may delay progress of an HSR line altogether.
- Service through the Denver metro area and to DUS directly is not compatible with the density in the area.
- Scenarios B-2A and B-5 provide the best options for avoiding Denver impacts and successfully implement HSR. In fact, the majority of the PLT members stated that it is likely that the options traveling through the Denver metro area would not survive the NEPA process, or that the approvals would so dramatically delay a proposed HSIPR project, that it would kill any momentum for implementation.
- Marrying up with RTD's Denver service makes sense.
- When considering an alignment around Denver (B-2A or B-5) a 10-15 minute travel time difference to the mountains may not be unacceptable.
- The Mountain corridor stakeholders would prefer the fastest, most direct service between DIA and the mountains and would like to see Maglev modeled for all scenarios.
- Direct service from the south to DIA would be preferred; direct service from Fort Collins to DIA would also be preferred.
- The need to address access to the Central Business District in Denver is still a critical element of an overall system according to some PLT members.
- An optional Denver-based scenario would include traveling east-west on I-76 and modifying Scenario A-5A to go to Pecos Street Station rather than DUS, serving Northwest Rail and the Gold Line with a quicker transfer.
- DIA is a major state investment and connections between this facility and the rest of the state are important; airport officials strongly support more modal options to DIA.
- In general the PLT was more supportive of the scenarios that travel around the Denver metro area (Scenarios B-2A and B-5) than those that travel through it (Scenarios A-1A, A-1B, A-5A and A-5B). A key concern of the PLT, however, continues to be the need to move riders into downtown Denver in addition to DIA. All comments were incorporated into the Level 2 Evaluation.

Public Engagement

Integral to the study process is input from the public at each milestone, as illustrated in Exhibit 4-1. This input was obtained through a series of open houses with a variety of techniques used to inform and

update participants about the study and to document their thoughts regarding the potential HSIPR segments and scenarios, and criteria for the Level 2 Evaluation.

Exhibit 4-1: Milestone Workshop Process



Public Open Houses – May/June 2013

Members of the public and the media were invited to attend the second series of public open houses to learn more about the ICS, as well as the AGS and provide input to guide the team's findings on the Level 2 Evaluation.

As with the Level 1 Public Workshops, multiple CDOT databases from past projects, including the State Rail Plan, the RMRA High-Speed Rail Feasibility Study, and the I-70 Mountain Corridor PEIS, were used to notify the public of the Level 2 Evaluation of the open houses. Formal press releases were sent to multiple media outlets prior to the open houses. Media outlets across the Front Range included notices and articles in local newspapers, radio, and television news broadcasts as a result of the press release. Notifications were also sent to major business organizations (Chambers of Commerce) throughout the Front Range to encourage additional stakeholders to attend. Finally, the PLT members were requested to distribute open house announcements to their constituents.

Each of the scheduled open houses presented the same core content, with some specific issue-focused information targeted for the specific location.

All open houses were scheduled from 5 p.m. to 7:30 p.m. with a 30 minute informational presentation provided at 6 p.m. The schedule of meetings hosted is below:

- Colorado Springs Area
  - May 29th, 2013 from 5 p.m. to 7:30 p.m.
  - Pikes Peak Area Council of Governments – 15 South Seventh Street, Colorado Springs
- Pueblo Area
  - May 30th, 2013 from 5 p.m. to 7:30 p.m.
  - Pueblo Convention Center – 310 Central Main St., Pueblo
- Fort Collins Area
  - May 5th, 2013 from 5 p.m. to 7:30 p.m.
  - Windsor Recreation Center - 250 North 11th Street, Windsor
- Denver Metropolitan Area
  - June 6th, 2013 from 5 p.m. to 7:30 p.m.
  - CDOT Headquarters Auditorium 4201 E Arkansas Ave, Denver
- Mountain Corridor (ICS/AGS)
  - June 11th, 2013 from 5 p.m. to 7:30 p.m.
  - Silverthorne Library 651 Center Circle, Silverthorne

Each open house included a series of presentation boards providing a study overview, details of the segments and scenarios, the study process, the Level 1 Evaluation results, and the study schedule. Computer projections of the segments being considered were shown in Google Earth format to aid discussion. The open houses were well attended and garnered media coverage in local newspapers, radio, and television news outlets.

Comments were collected through a variety of methods. A comment area was provided at each open house. A hard copy comment form was available, as well as laptop computers for people to type comments directly into the comment database. Study team staff was available throughout the open houses to have one-on-one conversations with stakeholders. Mail-in and online website comments were also accepted following the open houses. Key stakeholder comments by geographic area are highlighted below:

- **Colorado Springs –** Public meeting participants were pleased with the dismissal of the alignment through the Black Forest. There was interest in the alignment that provided service to both DIA and the mountain corridor, although there appeared to be a preference for getting to

downtown Denver over getting to DIA on a regular basis. One key concern was that the implementation of any of the scenarios would require new taxes for funding. New taxes were not supported by most of the group.

- **Pueblo –** No real preference was stated by the group, but there was recognition that the scenarios around the Denver metro area provide access to DIA without the delays of going through the Denver metro area.
- **Fort Collins –** Stakeholders in this portion of the study area were most concerned that the commuter rail option on SH 287 be retained if HSIPR is built in the I-25 ROW. They preferred alignments that linked the northern cities with DIA and Colorado Springs but also provided a direct link to the Mountain Corridor.
- **Mountains –** The Mountain Corridor stakeholders expressed support for alignments that provide a direct link from their communities to DIA. One –seat ride and direct, convenient service between DIA and the mountain communities is preferred, with or without direct service through Downtown Denver.

Written Feedback

A comment form was provided at the workshops to focus stakeholder comments on key questions relevant for this stage of the study. The form also allowed stakeholders to add their general comments on the study. The questions on the form are included below, along with a brief summary of responses received for each question. In total, 33 responses were collected.

- Based on the information presented at the open house, please choose the three high speed rail or advanced guideway scenarios you feel would best address the state's needs:
  - What do you see as your first choice scenario for the alignments? Approximately 27 percent of the respondents chose ScenarioB-2A, 15 percent of the respondents chose Scenario A-1A (I-76), 12 percent chose Scenario A-1B (US 6), and another 12 percent chose Scenario B-5.
  - What do you see as your second choice scenario for the alignments? Approximately 27 percent of the respondents chose Scenario A-1B (US 6), 15 percent chose Scenario B-5, and 12 percent chose Scenario A-1A (I-76).
  - What do you see as your third choice scenario for the alignments? Approximately 24 percent of the respondents chose Scenario C-1, 12 percent chose Scenario B-2A, and 12 percent chose Scenario A-5.
- Do you have comments on the Northern alignments between Denver and Fort Collins? Responses to this question varied widely. Generally, most were supportive of the I-25 alignment while others were skeptical about connectivity to communities and the need for HSR.
- Do you have comments on the Southern alignments between Denver through Colorado Springs to Pueblo? Responses to this question varied widely. Generally, most were supportive of the new I-25 alignment, away from the Black Forest while others were skeptical about connectivity to communities and the need for HSR.
- Do you have any additional comments? Responses to this question varied widely. Generally, many were supportive of HSIPR while others were skeptical about the ability of CDOT to provide a workable, cost-effective high-speed rail solution for the Front Range.

The comments received from the public stakeholders were considered and incorporated into the Level 2 Evaluation.

What Are The Next Steps?

The completion of Level 3 Evaluation is the next step in the ICS planning process. This will occur from summer to fall of 2013. This step involves additional refinement of the scenarios, service plan, ridership and revenue estimation and cost estimating, and a more thorough assessment of environmental effects. A third series of public open houses is scheduled for the fall of 2013.

Specific Work Elements of the Level 3 Evaluation

The Level 3 Evaluation involves taking the engineering, planning, and public process evaluations to a higher level of detail than the Level 2 Evaluation as described below.

Planning Studies

The Level 3 Evaluation planning studies will:

- Refine the scenarios remaining from the Level 2 Evaluation to reduce costs, reduce impacts, and improve ridership performance.
- Evaluate the final three scenarios based on the engineering refinements that are anticipated to change the footprints or operating assumptions from Level 2 Evaluation.
- Better define mitigation measures for anticipated high environmental impacts
- Optimize service to improve cost-effectiveness
- Update the OPEX estimate with specific technology based unit costs.
- Define a cost-effective MOS for Phase I implementation
- Update the benefit/cost analyses with new information
- Define preliminary funding requirements and recommend a supporting financial plan

Engineering Studies

The Level 3 Evaluation engineering studies will:

- Recommend a preferred technology
- Value engineer the remaining scenarios to improve cost-effectiveness
- Analyze the potential for single-track configuration
- Better define ROW requirements
- Revise the CAPEX estimates to account for engineering refinements
- Prepare a phasing strategy

Public Involvement

Level 3 Evaluation public involvement activities will be similar to Level 2 processes:

- Public meetings will be held in Fort Collins, Denver, Colorado Springs and Pueblo at the conclusion of the Level 3 Evaluation
- PLT meetings will be held in August, September and October 2013
- Continue to update the project website