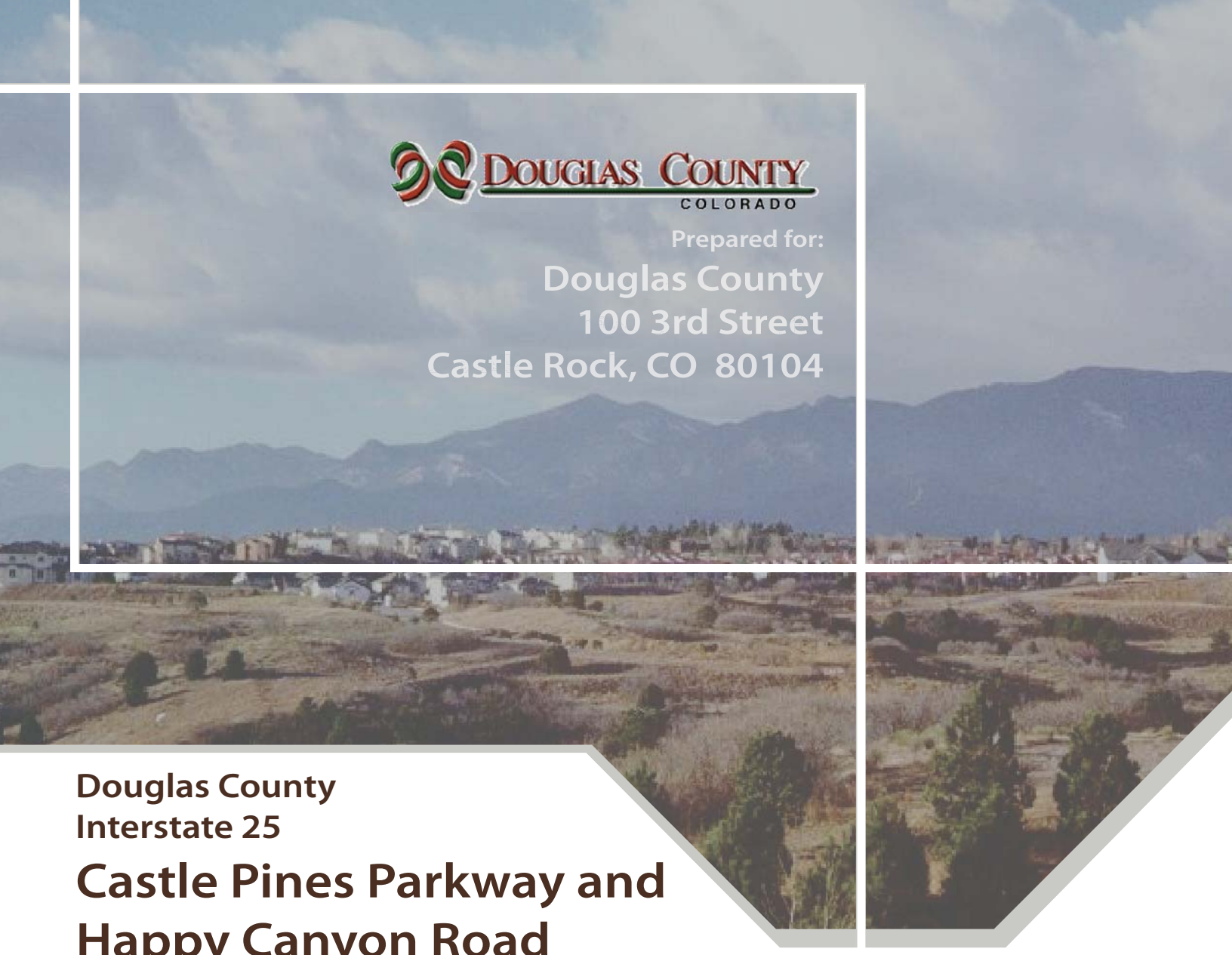

DOUGLAS COUNTY
COLORADO

Prepared for:
Douglas County
100 3rd Street
Castle Rock, CO 80104

Douglas County
Interstate 25

Castle Pines Parkway and Happy Canyon Road

Final System Level Study

August 2009

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PB 100 YEARS ®

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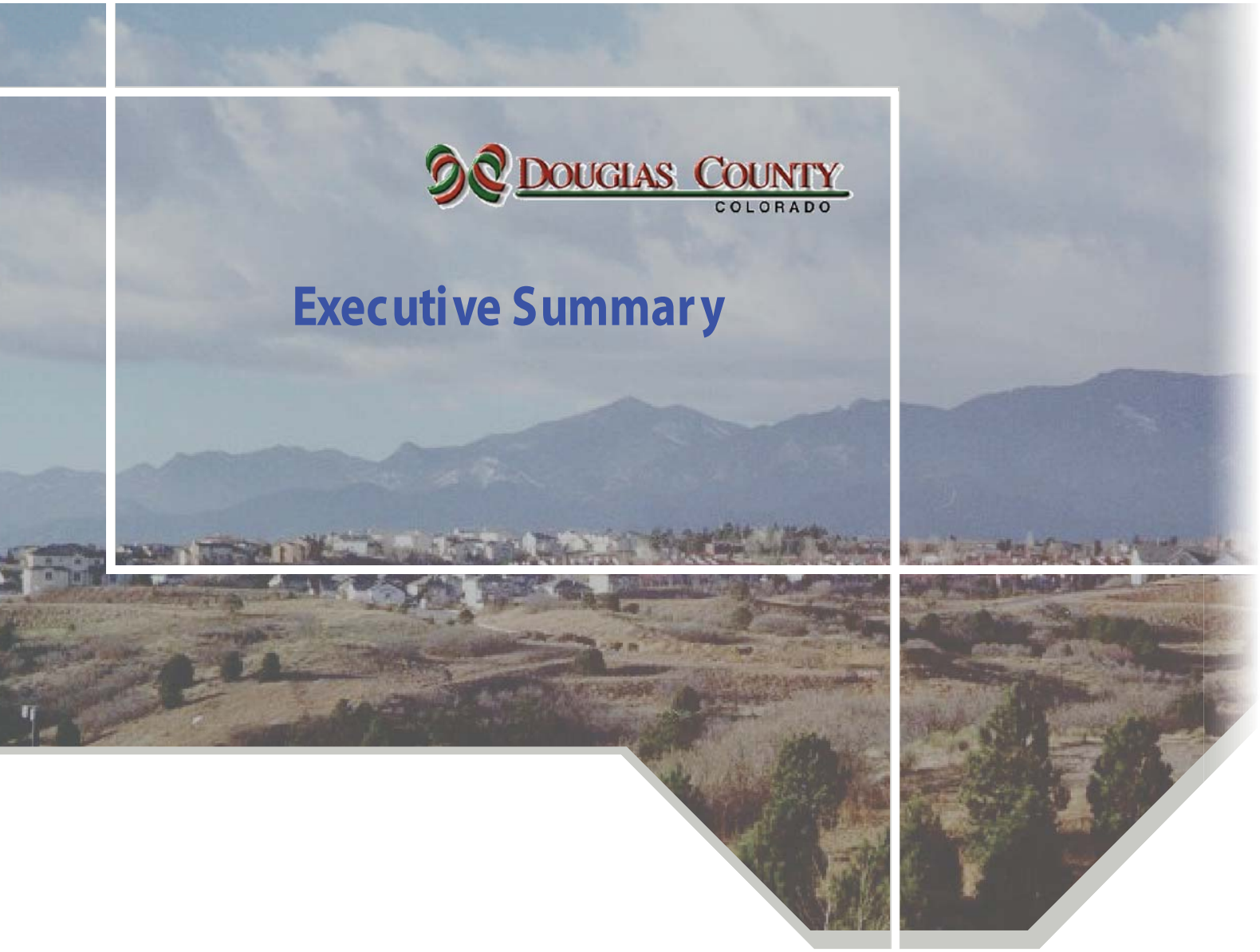
CDOT	Colorado Department of Transportation
CORSIM	CORidor microscopic SIMulation
DRCOG	Denver Regional Council of Governments
DTC	Denver Technology Center
EA	Environmental Assessment
EIS	Environmental Impact Statement
FREX	Front Range Express
HCM	High Capacity Manual
HCS	Highway Capacity Software
I-25	Interstate 25
I-225	Interstate 225
LOS	Level of Service
MOE	Measures of Effectiveness
mph	miles per hour
MUTCD	Manual of Uniform Traffic Control Devices
pc/m	passenger cars per lane mile
ROD	Record of Decision
RTD	Regional Transportation District
SH	State Highway
SPUI	Single Point Urban Interchange



DOUGLAS COUNTY
COLORADO

Executive Summary

EXECUTIVE SUMMARY

This report presents the results of a system level study conducted for a segment of Interstate-25 (I-25) corridor in Douglas County. The study corridor is bounded by Lincoln Avenue to the north and Founders/Meadows Parkway to the south. The study reflects a proposed Hess Road connection to the I-25/Castle Pines Parkway Interchange. This connection would be one of the first steps towards the completion of the overall North Central Douglas County Transportation Plan.

East-west roadway connections are limited through this portion of Douglas County. Residents west of the interstate can access I-25 via Lincoln Avenue, Castle Pines Parkway, Happy Canyon Road and Founders/Meadows Parkway. However motorists accessing the east side of the interstate are limited to two connections to I-25: Lincoln Avenue and Founders/Meadows Parkway. The limited connectivity between the local communities and the interstate, concentrated traffic and congestion on the available access points. The proposed local roadway connection of Hess Road to Castle Pines Parkway is expected to assist in distributing traffic volumes east of I-25.

The continued need for regional connectivity prompted Douglas County to initiate a comprehensive study of future land development, corresponding traffic volumes and the need for improved regional connections. Douglas County initiated this study in order to determine if the previous identified strategies would improve the operational efficiency of the corridor. A primary concern for the corridor, identified by all participating entities, is the continued growth in the region and the potential increase of congestion. The requirements for the study were to identify the benefits associated with the construction of the Hess Road connection and to quantify the reduction in congestion throughout the corridor, and especially at the Lincoln Avenue and Founders/Meadows Parkway interchanges.

The primary action that will be requested of authorizing agencies is approval of an access permit for the connection of Hess Road to the I-25/Castle Pines Parkway Interchange. The reconstruction of Castle Pines Interchange was completed in 2005 by the Colorado Department of Transportation (CDOT). The reconstruction of this interchange was funded by both CDOT and Douglas County. The proposed improvements at this interchange were identified in the I-25/US 85 Environmental Impact Statement (EIS)/Record of Decision (ROD).

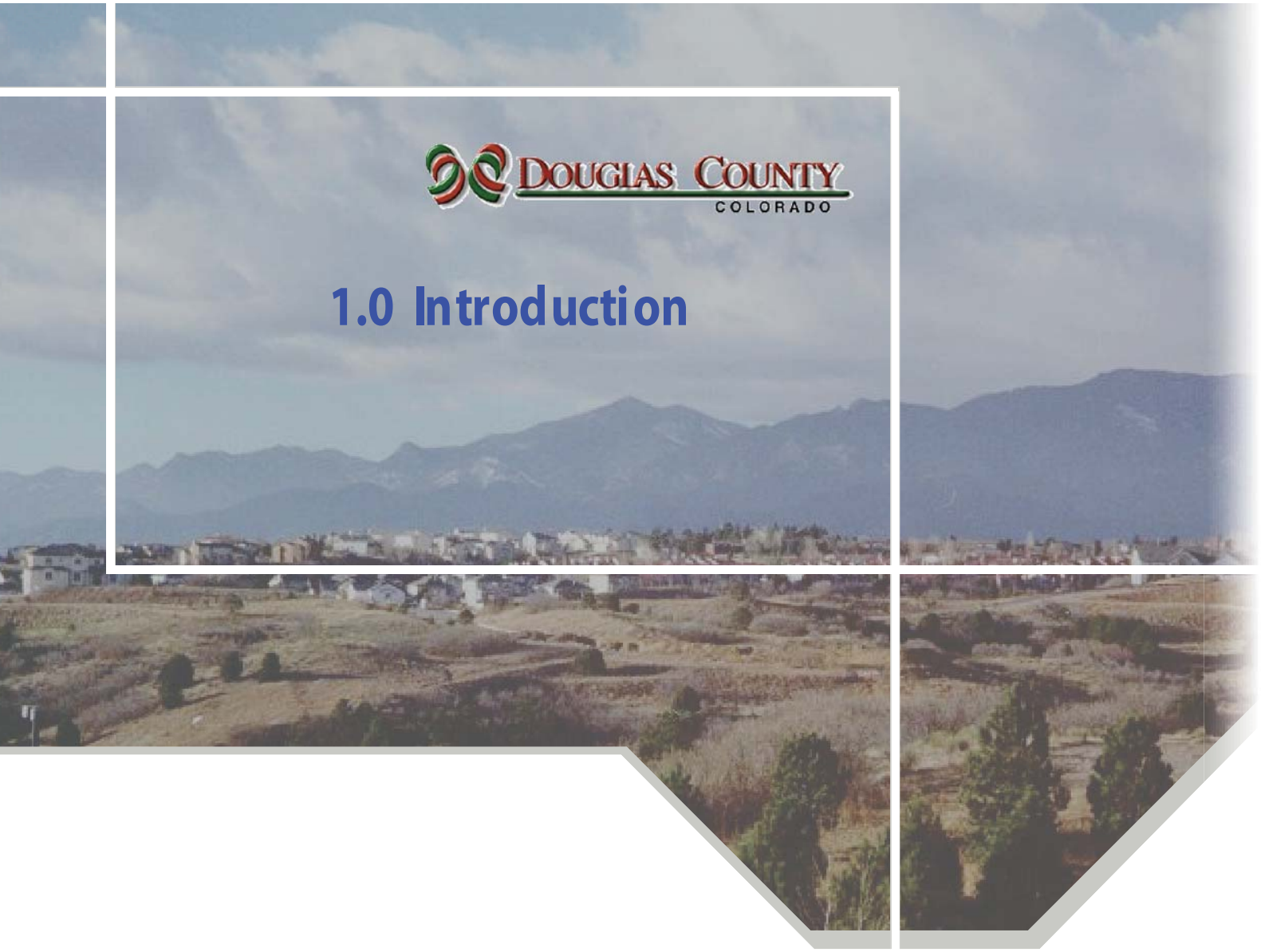
Douglas County continues to be one of the fastest growing counties in Colorado. I-25 bisects the County providing regional and national connectivity to the interstate system. Limited access to the interstate can create congestion at existing interchanges. Construction of the Hess Road connection to the existing Castle Pines Parkway Interchange would alleviate this additional burden of traffic routed to Founders/Meadows Parkway and Lincoln Avenue interchanges.

Analysis of the study corridor began with an examination of existing conditions. An iterative analysis was conducted to ascertain the level of improvements needed to increase operational efficiency through the corridor. The analysis incorporated five alternatives including:

- Existing Year
- Opening Year
- **Scenario 1:** Near-term projects (eight lanes I-25, RidgeGate Interchange, east Frontage Road as defined in the I-25/US 85 EIS/ROD, plus the proposed North Meadows Extension).
- **Scenario 2:** Improved interchange connectivity at Castle Pines Parkway via Hess Road and all roadways identified in the North Central Douglas County Transportation Plan.
- **Scenario 3:** Scenario 2 without two developer dependent local roads: Lagae Road and Happy Canyon Road extended east of I-25 to Arterial A.

Traffic operational analysis was supported by the Denver Regional Council of Governments (DRCOG) TRANSCAD travel demand forecasting model, the CORridor microscopic SIMulation model (CORSIM), SYNCHRO and the Highway Capacity Software (HCS). Travel demand forecasts for the corridor were analyzed for the approximate opening year 2011 and future year 2035. Operational efficiency was then noted for the study corridor identifying travel speed, volume, density and level of service (LOS).

After evaluating the traffic volumes and traffic conditions under each scenario, it was found that the proposed connection of Hess Road to Castle Pines Parkway will have positive affect on localized and corridor-wide operations. The connection of Hess Road to the existing interchange at Castle Pines Parkway will provide immediate improvement to overall operational efficiency by distributing traffic flow among the corridor interchanges. In the future, as development occurs on either side of I-25, the additional connectivity at Happy Canyon Road will provide additional corridor benefits. Additionally, the combined improvements to I-25 and the local roadway network identified in both Scenarios 2 and 3 provide improved operational efficiency over the committed network (Scenario 1). Construction of the recommended roadway improvements would provide a measure of relief through the corridor.



1.0 Introduction

1. 0 INTRODUCTION

The construction of the Hess Road connection to the existing Interstate 25 (I-25)/Castle Pines Parkway is expected to improve regional connectivity to the interstate highway system. Proposed local roadway connections, such as Hess Road, is also expected to distribute developed flow more equally without overburdening any single interchange. The primary concern within the study corridor is the continued growth of congestion along the I-25 corridor and concentrated at existing interchanges and the ability to distribute the demand more efficiently. This document was prepared to measure the expected benefits of the Hess Road connection.

1.1 PROJECT PURPOSE AND NEED

This report describes the findings of the System Level Study conducted along I-25 between Lincoln Avenue and Founders/Meadows Parkway (*Figure 1*). The primary purpose of the study is to analyze the effects of adding Hess Road to the existing interchange at I-25/Castle Pines Parkway. Other local connections to I-25/Happy Canyon Road were also included that represent completion of the local roadway system as identified in the North Central Douglas County Transportation Plan. The North Central Douglas County Transportation Plan recommended local road connections to regional facilities such as Lincoln Avenue, SH 83 and I-25. The System Level Study will identify any operational deficiencies that will need further improvements in order to maintain an acceptable level of efficiency within the study area and specifically any modifications to the existing I-25/Castle Pines Parkway Interchange.

Several concerns were addressed in order to fully evaluate the feasibility of connecting Hess Road to the existing I-25/Castle Pines Parkway interchange. These concerns include:

- The recurring congestion on I-25 at Lincoln Avenue and Founders/Meadows Parkway;
- The affect the addition of local roadway connections will have on the interstate congestion problems; and
- Benefits and impacts of the proposed connectivity on the surrounding roadway network, adjacent interchange ramps and nearby intersections.

The proposed roadway would provide new connectivity to the existing interchange at I-25/Castle Pines Parkway. Hess Road along with other local roadway connections would allow more even distribution throughout the I-25 corridor. Additionally, this study will show that this distribution of traffic will help reduce the localized demand experienced at I-25/Lincoln Avenue and I-25/Founders/Meadows Parkway.

This report outlines the methodology used to analyze the corridor documents the alternatives considered and identifies findings and potential concerns associated with the proposed action.

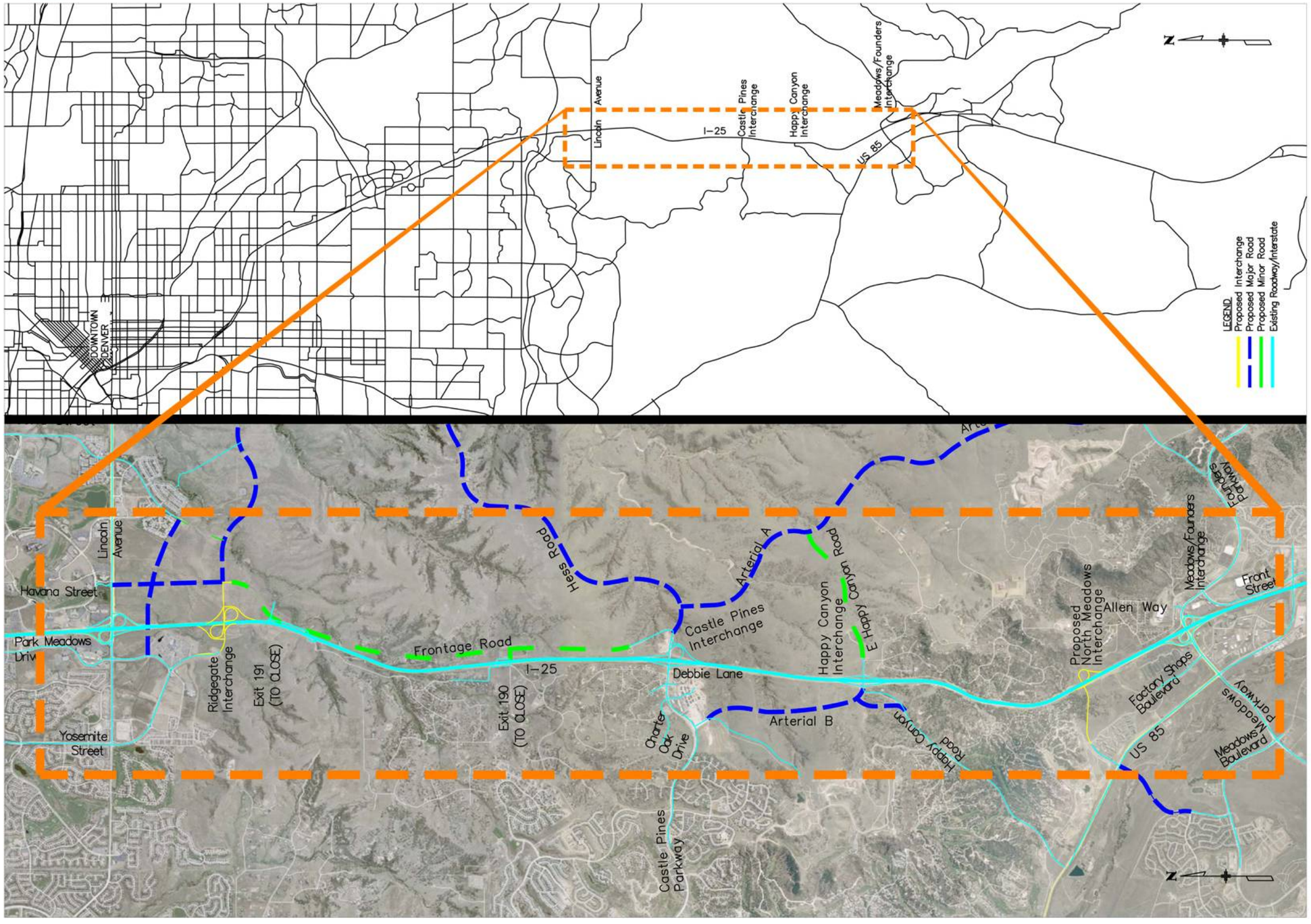
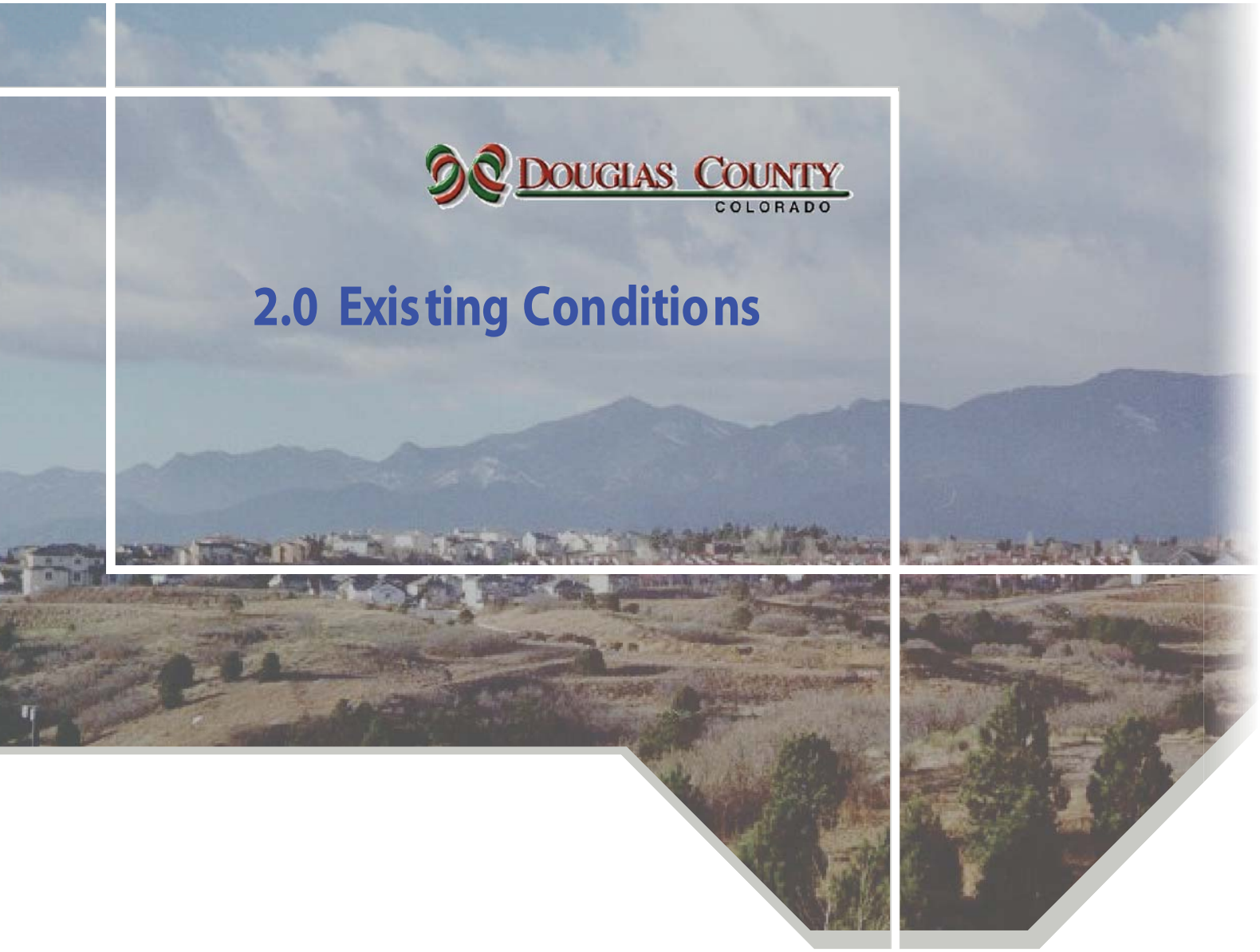


Figure 1— Project Vicinity Map



2.0 Existing Conditions

2.0 EXISTING CONDITIONS

Existing conditions establish the baseline criteria for comparing the alternative geometrics. The detailed assessments of the existing condition takes into account the operational efficiency of the corridor, adjacent land use and air quality parameters. This section presents the existing land use, traffic volumes, operational Level of Service (LOS) and includes recommendations from adopted National Environmental Policy Act (NEPA) documents of the study area.

2.1 STUDY CORRIDOR AREA

The study corridor area for this I-25 Regional Access Study lies within northern Douglas County and has the following limits:

- **Northern limit:** Immediately north of I-25/Lincoln Avenue Interchange.
- **Southern limit:** Immediately south of I-25/Founders/Meadows Parkway Interchange.
- **Eastern and Western limits:** One major intersection on either side of each interchange, except when there are no major intersections within 2,000 feet.

The study corridor area consists of four existing interchanges: Lincoln Avenue, Castle Pines Parkway, Happy Canyon Road and the Founders/Meadows Parkway.

2.2 SURROUNDING LAND USES

The land use along the I-25 corridor, within the study corridor area, consists primarily of proposed residential, office and commercial uses. There are significant areas of land that has been master planned but not yet developed.

2.3 EXISTING ROADWAY NETWORK

The major elements of the roadway network that serve the corridor are discussed below.

- I-25 is a six-lane freeway providing interstate access to Denver and Colorado Springs. It is the major north-south link for shipping and interstate travel within the Denver metropolitan area. The portion of I-25 located in Douglas County is quickly overloaded with commuter traffic during the peak hours of operation.

  For purposes of this study, eight lanes (between Lincoln Avenue and Founders/Meadows Parkway) and a frontage road on the east side of I-25 from Castle Pines Parkway to RidgeGate are assumed in the 2035 traffic model, as identified in the South I-25 Corridor Environmental Impact Statement (EIS) and improvements are anticipated to be completed by July 2010.

  Within the study corridor four existing interchanges plus two proposed interchanges were analyzed including: Lincoln Avenue; RidgeGate (currently under construction); Castle Pines Parkway; Happy Canyon Road; North Meadows (proposed) and Founders/Meadows Parkway. *Figure 2* illustrates the interchange spacing along the I-25 study corridor.

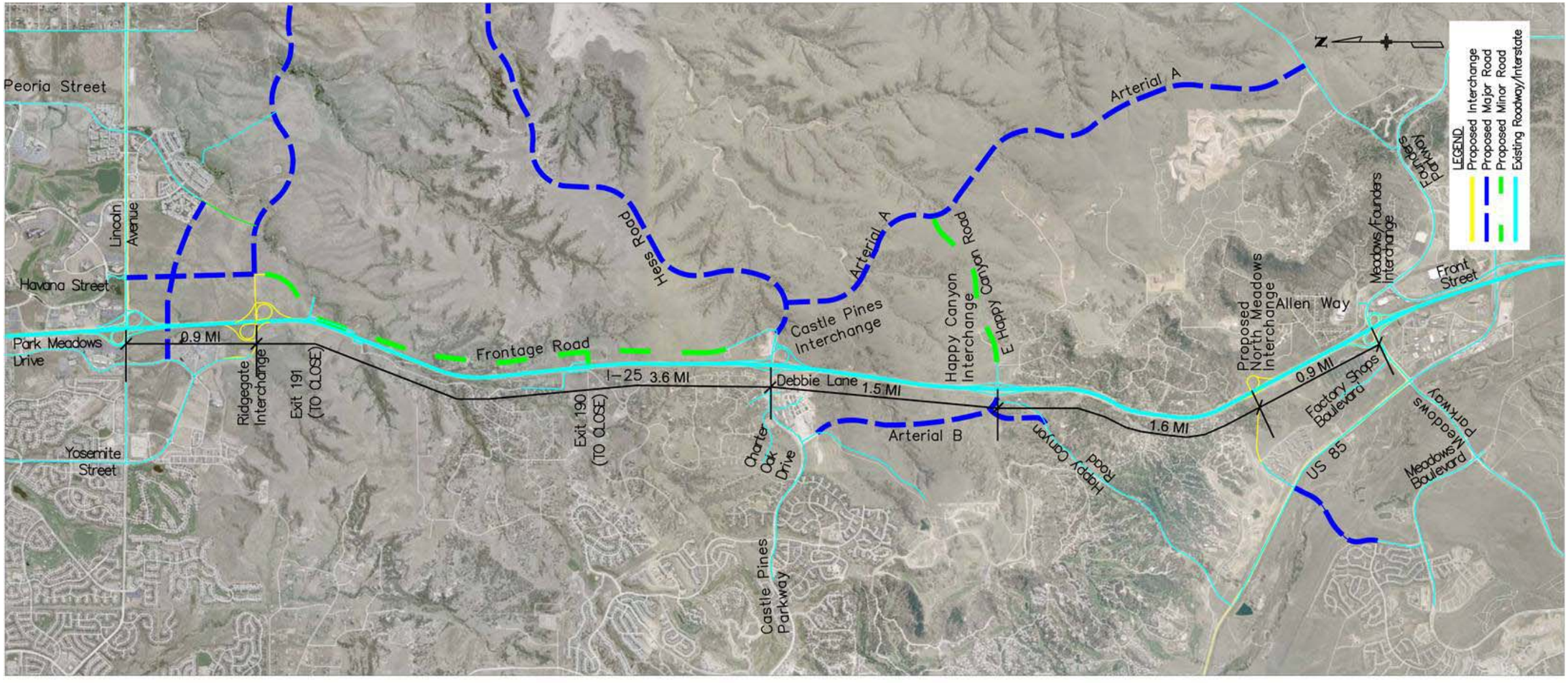
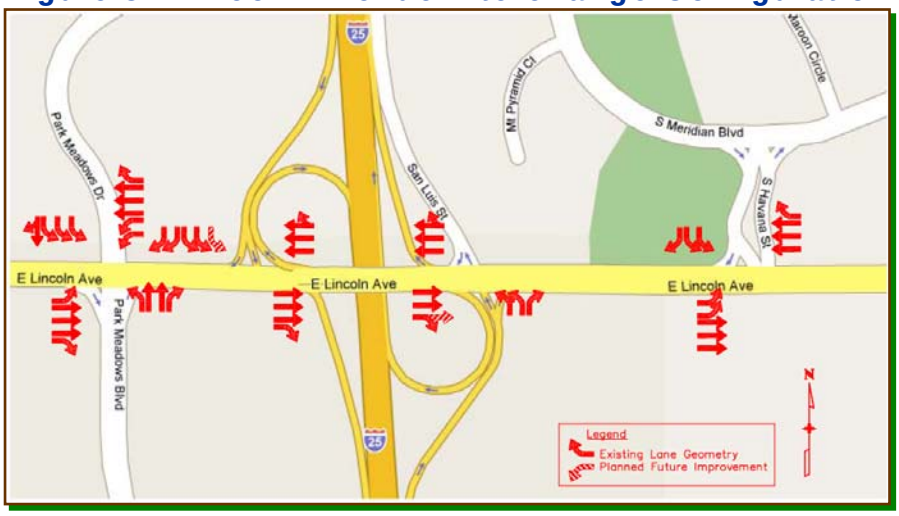


Figure 2 – I-25 Interchange Spacing

- **Lincoln Avenue** is a six-lane major arterial west of I-25 and six lane major arterial east of the interstate serving as a regional connector. Existing lane configuration for the partial clover-leaf interchange is shown in *Figure 3*. A planning study was completed December 2007 by Douglas County Public Works. Within the next 3-5 years a third left-turn lane is planned for the southbound off-ramp to Lincoln Avenue. The recommendations from the study include short-term improvements and long-term improvements. Long-term plans for this interchange include reconstruction into a Single Point Urban Interchange (SPUI) within the next 10-15 years.

Figure 3 – Lincoln Avenue Interchange Configuration



- **Castle Pines Parkway** is a four-lane roadway west of the interstate providing access for commercial, office and residential uses. Presently, Castle Pines Parkway east of the interstate serves as a local access road. As shown in *Figure 4*, the Castle Pines Parkway Interchange is a partial cloverleaf.

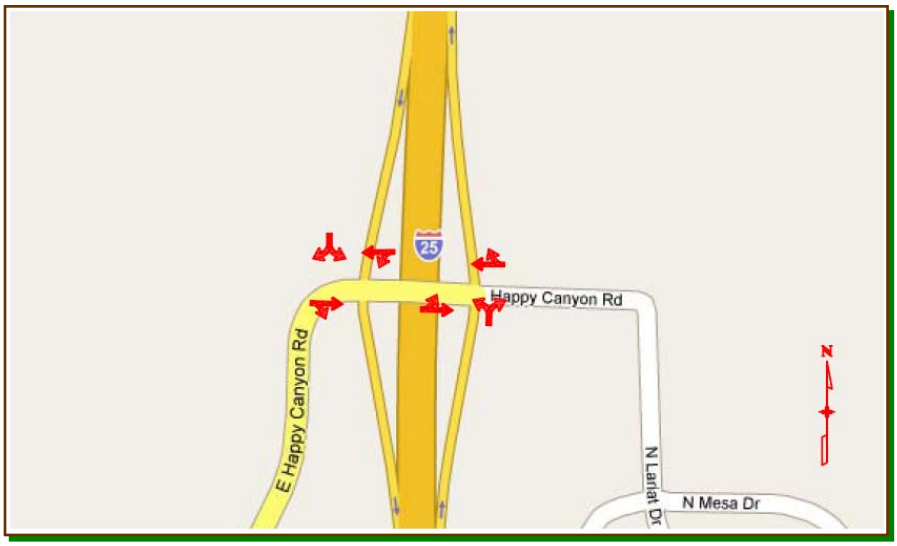
Figure 4 – Castle Pines Parkway Interchange Configuration

- **Happy Canyon Road** is a two-lane roadway providing limited access to rural residential areas.

  The Happy Canyon Road Interchange is a diamond interchange as shown in *Figure 5*.

  For purposes of this study, it is assumed that the structure will be widened and left-turn lanes provided to turn from Happy Canyon Road to I-25 per the South I-25 Corridor Record of Decision (ROD). The left-turn lanes will be included in the analysis of the 2035 scenarios.

Figure 5 – Happy Canyon Road Interchange Configuration



- **Founders/Meadows Parkway** is a four-lane arterial roadway providing connectivity to US 85 to the west and SH 86 to the east. The surrounding area is high intensity land uses; primarily mixed commercial and multi-family residential.

  The Founders/Meadows Parkway Interchange is a partial cloverleaf as shown in *Figure 6*.

Figure 6 – Founders/Meadows Parkway Interchange Configuration

2.4 EXISTING TRAFFIC VOLUMES

Existing traffic volume for the average daily traffic, morning and afternoon peak hour turning movement counts are illustrated in *Figures 7 and 8* respectively. See Section 3.1 for more information regarding results.

2.5 EXISTING TRAFFIC OPERATIONS

LOS is the standard methodology utilized to "grade" traffic operations. Operations are graded on a scale of "A" through "F" based on roadway capacity and motorist delay. The threshold levels utilized to determine the grade are defined in the Highway Capacity Manual. Colorado Department of Transportation (CDOT) defines an acceptable LOS as "D" or better. Both freeway and intersection detailed output is found in Appendix A.

2.5.1 Freeway Operations

The methodology described in the Highway Capacity Manual was utilized to analyze the operations of the existing I-25 corridor. *Tables 1 and 2* identify the resulting LOS.

To analyze the I-25 operations, the corridor was divided into 40 segments. For each on- and off-ramp a 1,500 foot merge or diverge segment was respectively assigned. In addition, a link segment was defined outside of the weaving areas between the interchange on- and off-ramps. I-25 segment information is found in *Tables 1 and 2*.

As expected, all southbound segments experience a LOS "C" or better during AM peak hours. Similarly, all northbound segments experience a LOS "C" or better during PM peak hours. As shown in *Tables 1 and 2*, however, several southbound segments experience failing LOS during PM peak hours and most northbound segments experience failing LOS during AM peak hours. Of the segments listed in *Tables 1 and 2*, 14 experience failing conditions during their corresponding peak hour. Of the 20 segments in the northbound direction during AM peak hour, 9 experience failing LOS.

Existing LOS results indicated spots of congestion along I-25 and localized congestion between Lincoln Avenue and C-470. The localized congestion within the study corridor occurs at the merge, diverge and weave areas. These poor conditions associated with intense weave areas result in the platooning of vehicles along I-25 approaching Lincoln Avenue. Platooning of vehicles adversely impacts the operational efficiency of adjacent segments, specifically the queuing of upstream vehicles. CDOT plans on investigating this weave concern as a part of an I-25 lane balance project in the near future.

Table 1
Existing Condition Southbound Highway Capacity Software Analysis Results

Southbound Freeway Segment	Number of Lanes	Analysis Type	AM Peak Hour		PM Peak Hour	
			Freeway Density pc/ln-mi	LOS Results	Freeway Density pc/ln-mi	LOS Results*
C-470/E-470 to Lincoln Ave	3	Basic	18.5	C	1615.8	**F**
Lincoln Off-Ramp	2	Diverge	29.3	D	42.7	**E**
Between Ramps	3	Basic	12.2	B	19.5	C
Lincoln WB On-Ramp	1	Merge	14.5	B	29.8	D
Lincoln WB On to EB On-Ramp	3	Basic	13.2	B	22.2	C
Lincoln EB On-Ramp	1	Merge	16.3	B	33.9	**E**
Lincoln Ave to Castle Pines Pkwy	3	Basic	14.5	B	26.2	D
Castle Pines Off-Ramp	1	Merge	15.7	B	31.3	**E**
Between Ramps	3	Basic	12.0	B	18.7	C
Castle Pines On-Ramp	1	Merge	17.6	C	31.4	**E**
Castle Pines Pkwy to Happy Canyon Rd	3	Basic	14.6	B	20.9	C
Happy Canyon Off-Ramp	1	Diverge	15.6	B	26.3	D
Between Ramps	3	Basic	13.3	B	18.6	C
Happy Canyon On-Ramp	1	Merge	16.5	B	28.4	D
Happy Canyon Rd to Meadows Pkwy	3	Basic	13.6	B	18.9	C
Meadows Off-Ramp	1	Diverge	14.7	B	25.9	D
Between Ramps	3	Basic	9.6	B	8.2	A
Meadows WB On-Ramp	1	Merge	12.7	B	15.8	B
Meadows EB On-Ramp	1	Merge	14.6	B	18.4	C
Meadows Pkwy to Wolfensberger Rd	2	Basic	12.0	B	11.3	B

* LOS results as reported by the HCS software, and does not consider HCS calculated queuing effects from downstream congestion. Therefore LOS results are some cases are being under-reported.

Table 2
Existing Condition Northbound Highway Capacity Software Analysis Results

Northbound Freeway Segment	Number of Lanes	Analysis Type	AM Peak Hour		PM Peak Hour	
			Freeway Density pc/ln-mi	LOS Results*	Freeway Density pc/ln-mi	LOS Results
Lincoln Ave to C-470/E-470	4	Basic	357.4	**F**	19.9	C
Lincoln WB On-Ramp	1	Merge	199.6	**F**	13.5	B
Lincoln EB On-Ramp	1	Merge	20.7	C	10.0	A
Between Ramps	3	Basic	28.2	D	13.3	B
Lincoln Off-Ramp	1	Diverge	32.8	**E**	12.3	B
Castle Pines Pkwy to Lincoln Ave	3	Basic	31.1	**E**	12.3	B
Castle Pines WB On-Ramp	1	Merge	35.5	**E**	15.3	B
Castle Pines EB On-Ramp	1	Merge	293.9	**F**	14.7	B
Between Ramps	3	Basic	20.3	C	10.2	B
Castle Pines Off-Ramp	1	Diverge	23.7	C	12.6	B
Happy Canyon Rd to Castle Pines Pkwy	3	Basic	23.9	D	11.7	B
Happy Canyon On-Ramp	1	Merge	28.2	**E**	13.9	B
Between Ramps	3	Basic	21.3	C	10.6	B
Happy Canyon Off-Ramp	1	Diverge	25.3	D	11.6	B
Meadows Pkwy to Happy Canyon Rd	3	Basic	20.3	C	10.8	B
Meadows WB On-Ramp	1	Merge	26.5	**E**	12.8	B
Meadows EB On-Ramp	1	Merge	24.0	**E**	10.7	B
Between Ramps	2	Basic	11.8	B	7.3	A
Meadows Off-Ramp	1	Diverge	14.1	B	10.1	B
Wolfensberger Rd to Meadows Pkwy	2	Basic	13.0	B	9.6	B

* LOS results as reported by the HCS software, and does not consider HCS calculated queuing effects from downstream congestion. Therefore LOS results are some cases are being under-reported.

Intersection Operations

At the intersections, traffic operations are based on the average delay experienced per vehicle. The average delay per vehicle is equated to an associated LOS, "A" through "F". An intersection operating at LOS "A" experiences very low levels of congestion. An intersection operating at a LOS "F" experiences very high levels of congestion and delay.

The intersection LOS analysis was conducted utilizing SYNCHRO software which replicates the actual interaction that occurs between closely spaced intersections. This dynamic analysis accurately reflects the operational LOS. *Figure 8* illustrates the existing intersection levels of service.

As noted in *Table 10 in Section 4.0*, only two signalized intersections currently operate at LOS "F" during the morning or afternoon peak hours. Both of the intersections are on Lincoln Avenue and they include Lincoln Avenue/ Havana Street in the morning peak hour and Lincoln Avenue/I-25 southbound ramps in the afternoon peak hour.

2.6 ALTERNATIVE TRANSPORTATION MODES

The Front Range Express (FREX) operates a commuter bus system between Colorado Springs and Denver via the I-25 corridor. Within the study corridor, a bus transit station has been established at the I-25/ Founders/Meadows Parkway Interchange. In addition, the Regional Transportation District (RTD) has placed a light rail station at Lincoln Avenue. This station provides northern Douglas County with alternative transportation via routes throughout the Denver area to destinations including Littleton, Englewood, the Denver Technology Center (DTC) and downtown Denver.

Douglas County has provided a carpool facility located east of I-25 and north of the Castle Pines Parkway Interchange. The carpool lot can be readily expanded if FREX chooses. Douglas County currently has provided a 100 car carpool lot which can be improved to serve 500 car surface parking if FREX or RTD should choose to provide expanded service and/or shuttle service to the existing light rail station or the proposed southeast FasTracks Extension project end of the line at RidgeGate/East Frontage Road.

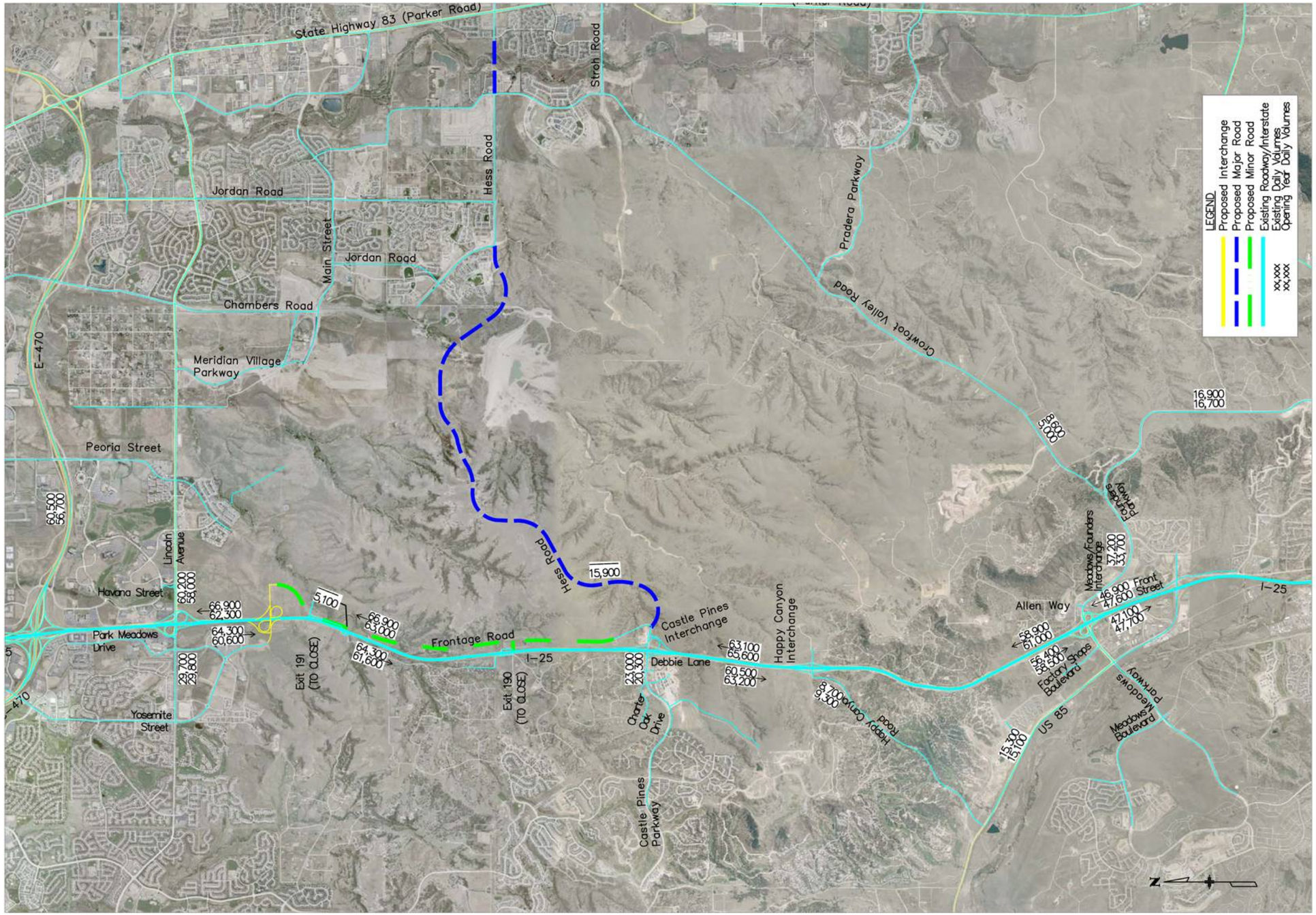


Figure 7 – Existing and Opening Year Average Daily Traffic Volumes

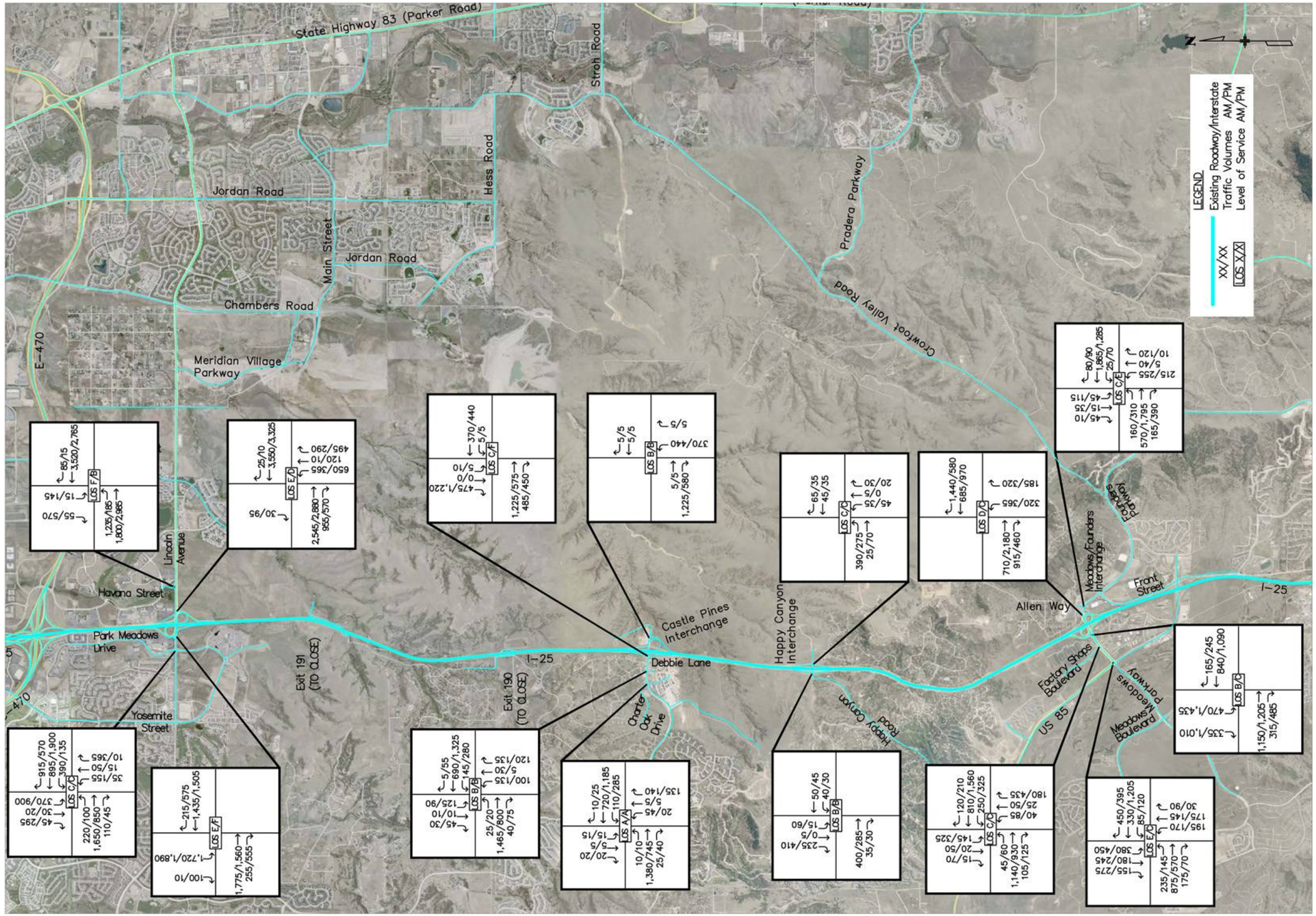
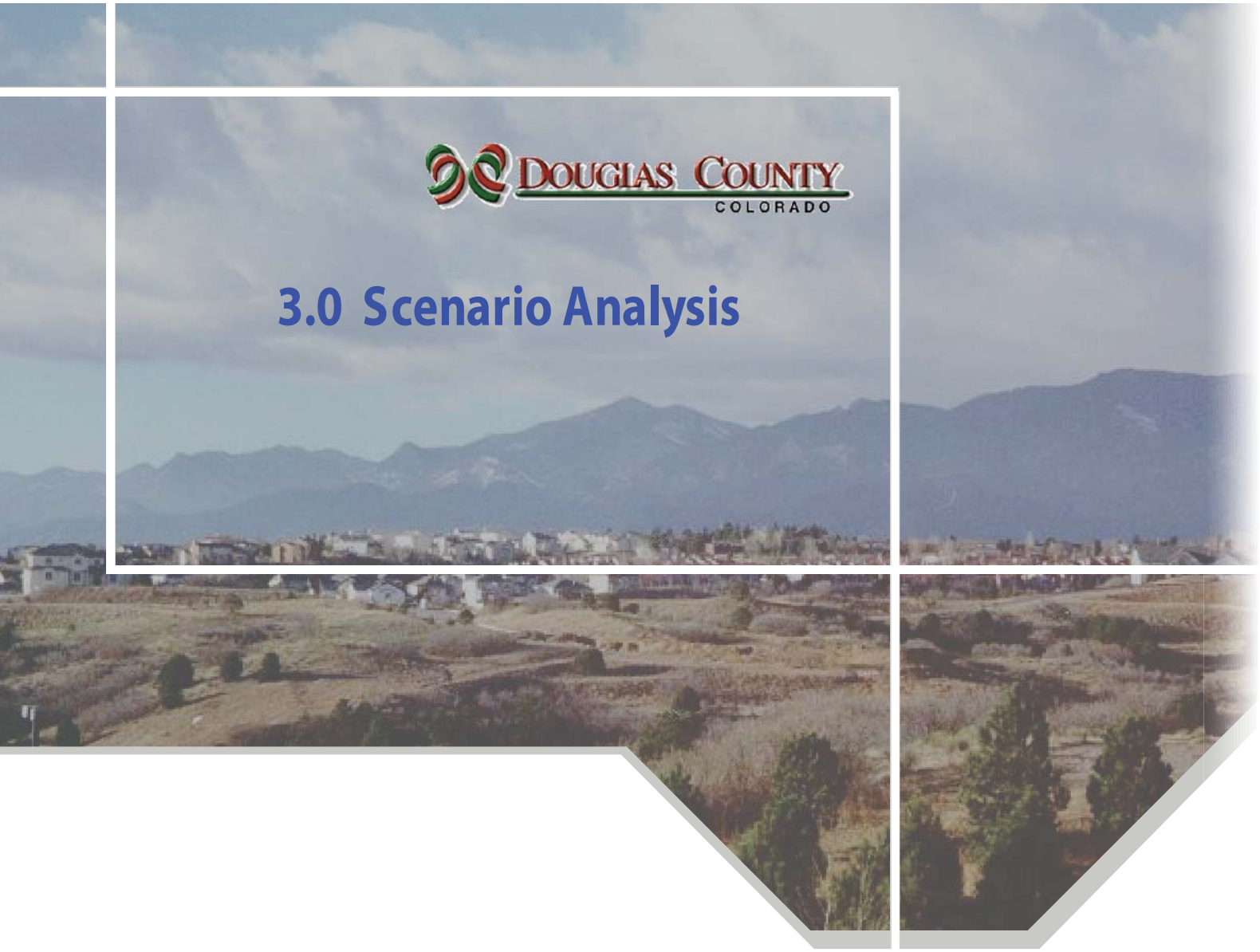


Figure 8 – Existing Turning Movement Counts/Intersection Level of Service



3.0 Scenario Analysis

3.0 SCENARIOS

Four future year scenarios were developed to measure the benefits of connecting Hess Road to Castle Pines Interchange. They included 2011 Opening Year, 2035 Scenario 1 (Baseline), 2035 Scenario 2 (North Central Douglas County Transportation Plan) and 2035 Scenario 3 (Scenario 2 without the local roads).

3.1 2011 OPENING YEAR SCENARIO

The opening year improvements include the east frontage road between Castle Pines Parkway and RidgeGate (with associated ramp closures of Exit 190 and Exit 191), the RidgeGate interchange and Hess Road connection to Castle Pines interchange. Roadway striping and signing changes along with traffic signals at the Castle Pines Parkway ramp intersections are included.

Comparing the regional model runs for the Base Year Scenario with the Opening Year Scenario finds that Hess Road diverts traffic from as far north as Interstate 225 (I-225). Hess Road is serving much more than local traffic as some traffic is heading to destinations well north of E-470. In addition, Hess Road provides a benefit to I-25. Without Hess Road, traffic that's predominantly east-west oriented must use I-25, while Hess Road provides an alternative route that avoids going north on I-25 and then east on Lincoln, E-470 or even I-225, and allows some trips to be routed to the north and northeast via State Highway (SH) 83. To compare movements, a cutline comparison was conducted. *Tables 3 and 4* illustrate cutline comparisons between the base year and opening year models of the primary corridors.

3.2 2035 SCENARIO 1

This scenario includes the improvements identified in the South I-25 Corridor EIS/ ROD. The roadway network will also include near-term Douglas County roadway improvements (RidgeGate and frontage road); three thru lanes in both directions on I-25 south of the existing Founders/Meadows Parkway Interchange; and four thru lanes in both directions on I-25 north of the existing Founders/Meadows Parkway Interchange. This scenario will also include widening of the Happy Canyon Road Interchange structure to provide left-turn lanes from Happy Canyon Road to the I-25 on-ramps, as previously cleared in the South I-25 Corridor (ROD). See *Figure 9* for an illustration of Scenario 1.

3.3 2035 SCENARIO 2

This scenario includes the proposed roadway network for the North Central Douglas County planning area. It includes the base roadway network identified in Scenario 1 plus the extension of Hess Road to Castle Pines Parkway Interchange, Arterial A from Crowfoot Valley Road to Hess Road, east Happy Canyon Road from Arterial A to the Happy Canyon Road Interchange and the extension of Monarch Boulevard from Castle Pines Parkway to Lagae Road onto Happy Canyon Road (see *Figure 10*).

3.4 2035 SCENARIO 3

This alternative modifies Scenario 2 to remove the east Happy Canyon Road from Arterial A to the Happy Canyon Road Interchange and the extension of Monarch Boulevard from Castle Pines Parkway to Lagae Road onto Happy Canyon Road. See *Figure 11* for an illustration of Scenario 3.

Table 3
Interstate 25 North Douglas County Cutline Traffic Volumes (ADT)

Road	Year 2005 Scenarios		
	Base	Opening	Difference
Interstate-225	130,100	128,600	-1,500
Cherry Creek Dam Rd.	4,300	4,400	100
Arapahoe Rd.	67,000	66,100	-900
Broncos Pkwy.	16,200	15,800	-400
E-470	60,500	56,700	-3,800
Lincoln Ave.	60,100	57,900	-2,200
Hess Rd.	0	14,900	14,900
Founders Pkwy.	28,000	24,100	-3,900
SR-86	13,400	12,400	-1,000
Lake Gulch Rd.	7,200	7,200	0
East Upper Lake Gulch Rd.	800	800	0
Cutline Total	**387,600**	**388,900**	**1,300**

Table 4
North Douglas County Cutlines

Road	Year 2005 Scenarios Traffic Volume (ADT)		
	Base	Opening	Difference
West of Interstate 25			
Interstate-225	130,100	128,600	-1,500
Cherry Creek Dam Rd.	4,300	4,400	100
Arapahoe Rd.	67,000	66,100	-900
Broncos Pkwy.	16,200	15,800	-400
E-470	60,500	56,700	-3,800
Lincoln Ave.	60,100	57,900	-2,200
Hess Rd.	0	14,900	14,900
Founders Pkwy.	28,000	24,100	-3,900
SR-86	13,400	12,400	-1,000
Lake Gulch Rd.	7,200	7,200	0
East Upper Lake Gulch Rd.	800	800	0
West Cutline Total	**387,600**	**388,900**	**1,300**
East of Interstate 25			
East Arapahoe Rd.	61,500	61,600	100
East Dry Creek Rd.	32,200	32,200	0
East County Line Rd.	27,400	27,100	-300
E-470	70,300	70,100	-200
Park Meadows Dr.	3,600	4,000	400
Lincoln Rd.	29,900	29,800	-100
Park Meadows Dr.	0	7,800	7,800
Ridgegate Circle	0	7,800	7,800
West Oak Hill Lane	0	4,700	4,700
East Castle Pines Pkwy.	20,500	17,400	-3,100
Happy Canyon Rd.	4,500	5,000	500
US-85	15,300	15,000	-300
East Cutline Total	**265,200**	**282,500**	**17,300**
North of Hess Road			
South Monarch	13,300	12,500	-800
Interstate-25	131,200	125,500	-5,700
South Jordan Rd.	2,800	5,600	2,800
SR-83	39,000	46,000	7,000
North Pine Dr.	19,800	19,100	-700
North Cutline Total	**206,100**	**208,700**	**2,600**

Figure 9 – Scenario 1, Committed Projects

Figure 10 – Scenario 2, North Central Plan

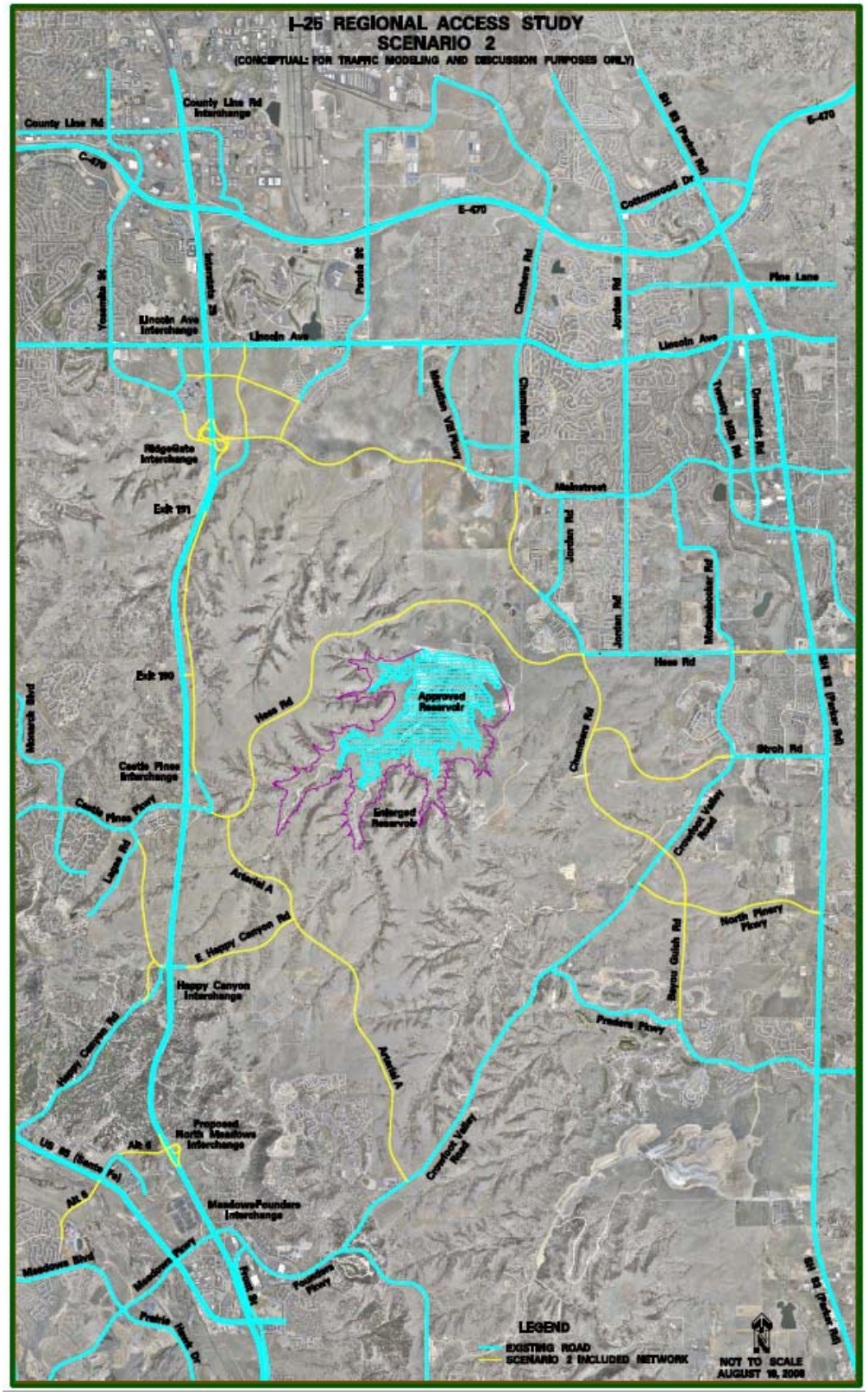
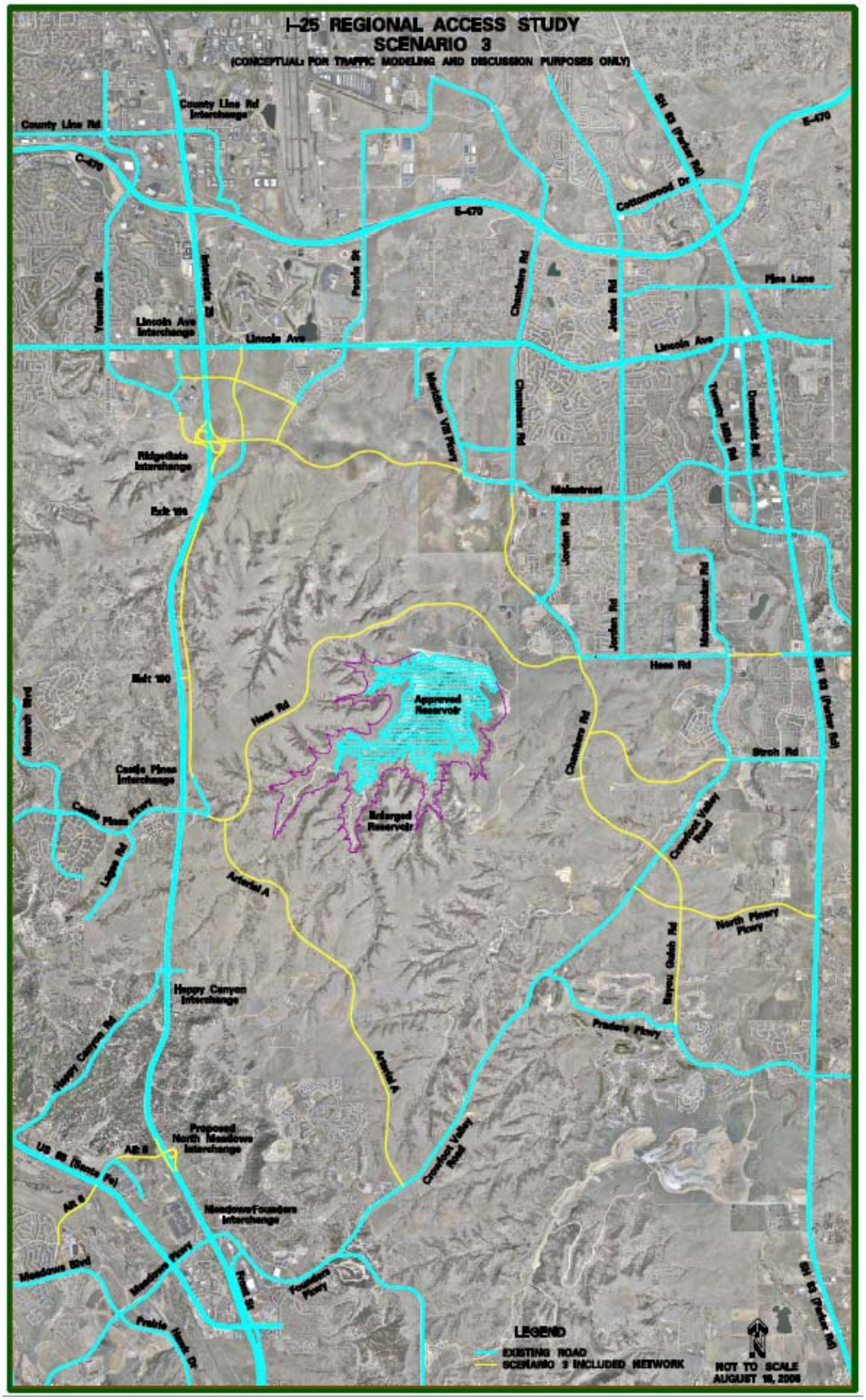


Figure 11 – Scenario 3, Without Legae and Happy Canyon



4.0 Future Analysis

4.0 FUTURE ANALYSIS

Future analysis was conducted for the 2035 planning horizon in order to ascertain any impacts the connections would have on the intersections and/or the freeway.

4.1 LAND USE

Land use classifications within the study area were prepared as part of the 2035 Metro Vision Plan developed by the Denver Regional Council of Governments (DRCOG). The socioeconomic data incorporated into the travel demand forecasting model was developed by DRCOG with input from the local agencies and represents the likelihood of future growth within the metro area and the I-25 corridor. The socioeconomic data remained constant between all 2035 scenarios.

4.2 TRAFFIC VOLUMES

The future traffic volumes generated by the DRCOG travel demand forecasting model were refined in order to convert the broad macroscopic numbers into more specific microscopic numbers. The refinement process, developed by the Transportation Research Board, is defined in the National Cooperative Highway Research Program Report 255, Chapter 4, "Refinement of Computerized Traffic Volume Forecasts." The methodology utilizes a refinement process based on a ratio adjustment and the difference adjustment between the base year assignment and the future year forecast. This average is applied to the base year counts. *Figure 7* illustrates the opening year 2011 average daily traffic volumes. *Figure 12* illustrates the forecasted 2035 average daily traffic volumes along the I-25 corridor for each scenario. Raw model output volumes are included in Appendix B.

4.3 FUTURE ROADWAY NETWORK

The future roadway network includes roadways that are planned to exist during the time period. For the 2035 analysis, the following roadway infrastructure improvements include:

The 2011 opening year improvements include the east frontage road between Castle Pines Parkway and RidgeGate (with associated ramp closures of Exit 190 and Exit 191), the RidgeGate interchange and the Hess Road connection to Castle Pines interchange. Roadway striping and signing changes along with traffic signals at the Castle Pines Parkway ramp intersections are included.

Scenario 1 includes the improvements identified in the South I-25 Corridor EIS/ ROD. The roadway network will also include near-term Douglas County roadway improvements (RidgeGate and frontage road); three thru lanes in both directions on I-25 south of the existing Founders/Meadows Parkway Interchange; and four thru lanes in both directions on I-25 north of the existing Founders/Meadows Parkway Interchange. This scenario will also include widening of the Happy Canyon Road Interchange structure to provide left-turn lanes from Happy Canyon Road to the I-25 on-ramps, as previously cleared in the South I-25 Corridor (ROD). See *Figure 9* for an illustration of Scenario 1.

Scenario 2 includes the proposed roadway network for the North Central Douglas County planning area. It includes the base roadway network identified in Scenario 1 plus the extension of Hess Road to Castle Pines Parkway Interchange, Arterial A from Crowfoot Valley Road to Hess Road, east Happy Canyon Road from Arterial A to the Happy Canyon Road Interchange and the extension of Monarch Boulevard from Castle Pines Parkway to Lagae Road onto Happy Canyon Road (see *Figure 10*).

Scenario 3 modifies Scenario 2 to remove the east Happy Canyon Road from Arterial A to the Happy Canyon Road Interchange and the extension of Monarch Boulevard from Castle Pines Parkway to Lagae Road onto Happy Canyon Road. See *Figure 11* for an illustration of Scenario 3.

4.4 FUTURE OPERATIONS

Future operational efficiency of the network was determined by applying the forecasted traffic volumes to the recommended geometric improvements. This section describes the future forecasted analysis results for both the freeway corridor and the intersections.

4.4.1 Freeway Operations

The Hess Road extension to the Castle Pines Parkway interchange was analyzed to ascertain the operational impacts on the Interstate 25 corridor. The study area was bounded by Lincoln Avenue to the north and Founders/Meadows Parkway to the south. Multiple analyses were conducted to obtain the sensitivity of improvements to increase operational efficiency through the corridor.

1. Scenario 1 (2035) Committed Network: Near-term projects (eight lanes Interstate 25, RidgeGate Interchange, east Frontage Road as defined in the I-25/US 85 EIS/ROD, plus the proposed North Meadows Extension).
2. Scenario 2 (2035) Local North Central Douglas County Transportation Plan (NCDCTP) Build-Out: Improved interchange connectivity at Castle Pines Parkway via Hess Road and all roadways identified in the NCDCTP.
3. Scenario 3 (2035) Local Partial Build: Scenario 2 without two developer dependent local roads: Lagae Road and Happy Canyon extended east of Interstate 25 to Arterial A.

Existing conditions established the baseline criteria for comparing the sensitivity of geometric improvements. The existing conditions were initially analyzed utilizing Highway Capacity Software (HCS). Due to the congested levels on Interstate 25, the HCS could not be utilized to accurately forecast sensitivity. CORidor microscopic SIMulation (CORSIM) software was subsequently selected as the tool to evaluate the operational efficiency of the Hess Road connection.

To ascertain the operational efficiency of each scenario on I-25, a CORridor microscopic SIMulation (CORSIM) analysis was conducted. Analysis of the corridor required the ability to analyze the dynamic relationships occurring within the study area utilizing both static and progressive analysis approaches. Utilizing a static analysis approach (constant volume counts) as compared to a progressive analysis approach (variable volume counts) helps to identify the segment that causes breakdown within the corridor. The drawback to static analysis is the inability to analyze the segments as a complete network. Therefore, poor operation of any one segment, using static analysis, will not adversely affect the performance of other segments as it does in the field or when applying progressive analysis techniques.

CORSIM assimilates the analysis of urban traffic and freeway traffic into the microscopic model. Microscopic simulations represent individual vehicles influenced by varying driver behaviors thus allowing for analysis of detailed strategies. The user specifies the traffic environment that consists of roadway geometry, lane channelization, motorist behavior, traffic control devices, traffic volumes, turning movements and the transportation fleet. The data generated by the CORSIM output are used in the analysis to identify weaknesses and provide the basis for identifying an optimal alternative. For this analysis, CORSIM output was compared with field observations. CORSIM analysis mirrors travel demand forecasting models, indicating an improved flow through the corridor as a result of the proposed facility enhancements.

The CORSIM analysis provided link travel speeds as well as density. These Measures of Effectiveness (MOE) provide a basis for determining the operational efficiency of the freeway. Based on this MOE information, a level of service for the segment was defined. The level of service of a segment indicates the overall performance expected. Measures of effectiveness for the freeway elements were divided into two categories: the merge area and the free-flow area. Level of service is a qualitative description of an operation based on the delay and maneuverability. Level of service can range from Level A, representing free flow conditions, to Level F, representing highly congested conditions. General level of service descriptions are presented in *Table 5*.

Accurate forecasting of the I-25 corridor operations required the calibration of the CORSIM model. To calibrate the CORSIM model, the existing conditions were modeled and compared to actual vehicle volumes. Vehicle volumes were collected on the interstate in spring 2008 via tube and manual turning movement counts. The peak one hour volumes were selected for northbound and southbound I-25 during the AM and PM time periods. Adjustments were made to the sensitivity factors within the software to accurately replicate the interstate operations. The car-following sensitivity multiplier, start-up delay, and discharge headway factors were adjusted along the corridor to replicate actual conditions. This adjustment provided the necessary factors to achieve the required ten (10) percent reliability rate.

The calibrated CORSIM model was then utilized to conduct future sensitivity analyses. The sensitivity analyses were conducted to measure the benefits of connecting Hess Road to the Castle Pines Parkway interchange and compared the committed network to local agency build scenarios. Forecasted future year scenario volumes were obtained utilizing the Denver Regional Council of Governments (DRCOG) TransCad travel demand forecasting model.

The corridor measures of effectiveness (MOE) of the committed network (Scenario 1-Committed Network) to two local agency build networks (Scenario 2-Local NCDCTP Build-Out and Scenario 3-Local Partial Build) is detailed in *Tables 6 through 9*. Detailed output is found in Appendix C.

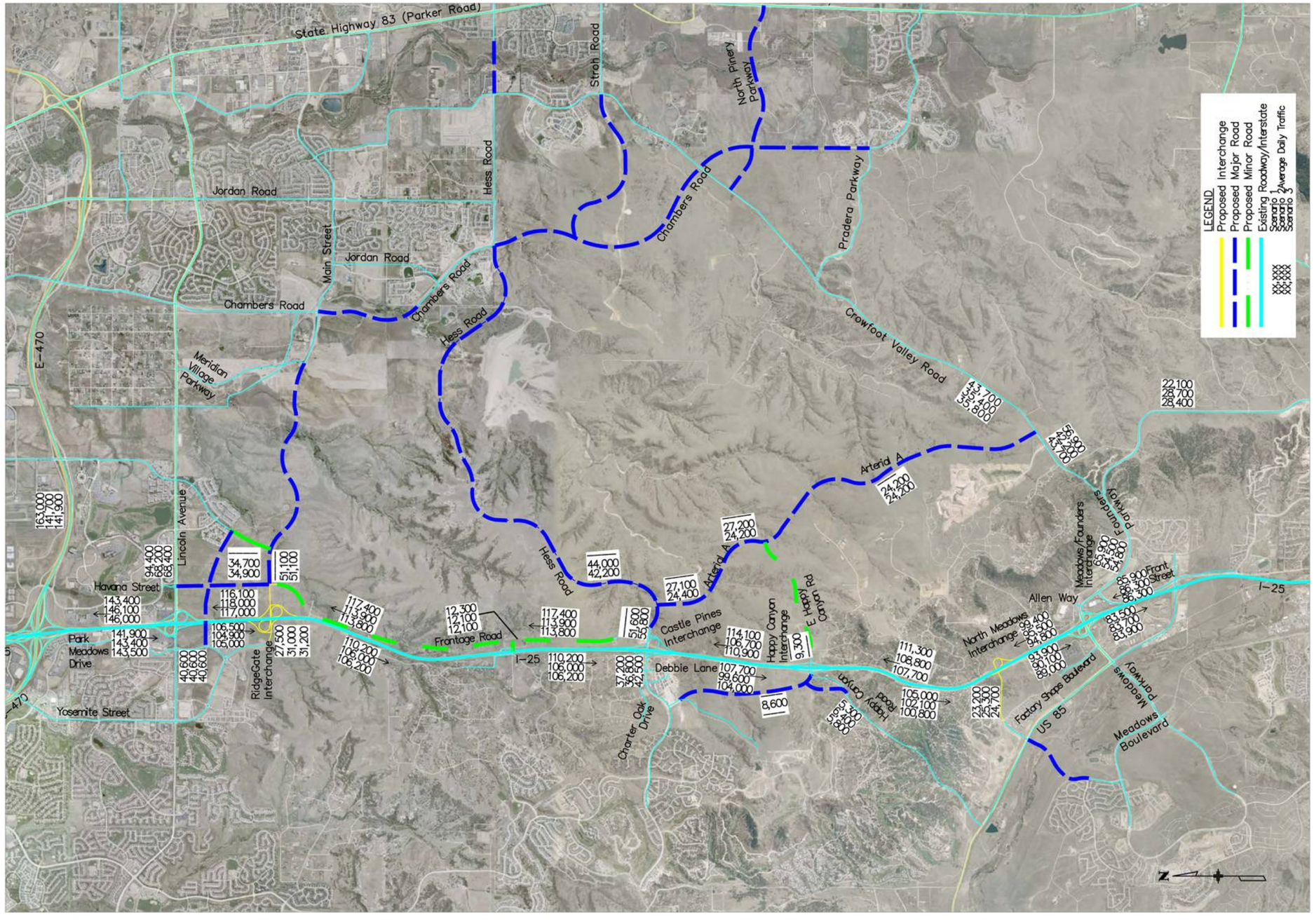


Figure 12 – 2035 Scenario 1, 2 and 3 Average Daily Traffic

Table 5
Freeway Level of Service Definitions

Level of Service	Interpretation
A	Uncongested operations, free-flow travel Delay ≤ 10.0 seconds/vehicle
B	Very light congestion, free-flow travel Delay ranges between 10.0 and 20.0 seconds/vehicle
C	Light congestion; stable flow; freedom to maneuver sometimes restricted Delay ranges between 20.0 and 35.0 seconds/vehicle
D	Moderate to heavy traffic flow; approaching unstable flows; freedom to maneuver limited Delay ranges between 35.0 and 55.0 seconds/vehicle
E	Heavy traffic flows; unstable flow; limited ability to accept additional traffic Delay ranges between 55.0 and 80.0 seconds/vehicle
F	Congested conditions; forced or breakdown flow; ranging from Stop and Go to restricted flow Delay > 80.0 seconds/vehicle

Tables 6, 7, 8, and 9 identify segment measures of effectiveness for the morning and afternoon peak hours for each scenario; where speed is given in miles per hour (mph) and density is the number of passenger cars per lane mile (pc/m).

Table 6
2035 I-25 Northbound Measure of Effectiveness (AM Peak Hour)

Analysis	2035					
	Scenario 1		Scenario 2		Scenario 3	
Segment	Speed (mph)	Density (pc/m)	Speed (mph)	Density (pc/m)	Speed (mph)	Density (pc/m)
Founders/Meadows Merge	***21***	***66.8***	***50***	27	***51***	28.1
Founders/Meadows to North Meadows	***14***	***97.9***	***58***	23.2	***57***	25
North Meadows Merge	***26***	***69.9***	***55***	26.8	***51***	30.1
North Meadows to Happy Canyon	***30***	***66.1***	***44***	36.5	***39***	43.6
Happy Canyon Merge	***59***	31.3	61	24.9	***57***	28.4
Happy Canyon to Castle Pines	***44***	***45.4***	63	26.3	61	28.8
Castle Pines Merge	***26***	***69.4***	***59***	28.5	***47***	37.2
Castle Pines to RidgeGate	***16***	***106.1***	***34***	***54***	***28***	***65.2***
RidgeGate Merge	62	23.1	***59***	28	***58***	28.2
RidgeGate to Lincoln	65	22.2	63	26	62	26.1
Lincoln Merge	64	20.8	63	23	63	23.2

* NOTE: Red highlighted number indicates segment failure where service is below acceptable levels

Table 7
2035 I-25 Southbound Measures of Effectiveness (AM Peak Hour)

Analysis	2035					
	Scenario 1		Scenario 2		Scenario 3	
Segment	Speed (mph)	Density (pc/m)	Speed (mph)	Density (pc/m)	Speed (mph)	Density (pc/m)
Lincoln Merge	63	12	64	10.3	63	10.9
Lincoln to RidgeGate	65	14.7	65	12.7	65	13.4
RidgeGate Merge	67	9.3	67	8.2	67	8.8
RideGate to Castle Pines	67	11.5	68	10.3	67	10.9
Castle Pines Merge	***60***	19.4	***51***	16.5	***51***	17.6
Castle Pines to Happy Canyon	68	11.4	68	9.7	68	10.6
Happy Canyon Merge	68	10.3	66	9.8	67	9.7
Happy Canyon to North Meadows	68	11.3	68	10.6	68	10.7
North Meadows Merge	68	8.3	68	7.6	68	7.6
North Meadows to Founders/Meadows	68	8.3	68	7.6	68	7.6
Founders/Meadows Merge	65	13.4	64	14.4	64	14.2

* NOTE: Red highlighted number indicates segment failure where service is below acceptable levels

Table 8
2035 I-25 Northbound Measures of Effectiveness (PM Peak Hour)

Analysis	2035					
	Scenario 1		Scenario 2		Scenario 3	
Segment	Speed (mph)	Density (pc/m)	Speed (mph)	Density (pc/m)	Speed (mph)	Density (pc/m)
Founders/Meadows Merge	63	15.6	58	19.4	63	16.6
Founders/Meadows to North Meadows	65	15.3	62	17.9	64	16.2
North Meadows Merge	***59***	22.8	***56***	26.5	***58***	24.3
North Meadows to Happy Canyon	***49***	29.6	***44***	36.8	***48***	32.2
Happy Canyon Merge	61	22.7	63	20.8	62	20.7
Happy Canyon to Castle Pines	63	24.2	64	22.4	64	21.9
Castle Pines Merge	64	21.8	***56***	28.5	***60***	25.8
Castle Pines to RidgeGate	***25***	***60.1***	***22***	***74.2***	***46***	37.1
RidgeGate Merge	60	22.8	***60***	24.6	***58***	26
RidgeGate to Lincoln	65	21.1	64.27	22.8	64	23.6
Lincoln Merge	64	21.2	62.85	23.4	62	24.1

* NOTE: Red highlighted number indicates segment failure where service is below acceptable levels

Table 9
2035 I-25 Southbound Measures of Effectiveness (PM Peak Hour)

Analysis	2035					
	Scenario 1		Scenario 2		Scenario 3	
Segment	Speed (mph)	Density (pc/m)	Speed (mph)	Density (pc/m)	Speed (mph)	Density (pc/m)
Lincoln Merge	***58***	21.4	***59***	22.2	***58***	22.5
Lincoln to RidgeGate	61	25.4	61	26.5	61	26.7
RidgeGate Merge	63	19.9	63	21.1	63	21.1
RideGate to Castle Pines	64	24.3	64	25.6	64	25.8
Castle Pines Merge	***44***	40.4	***54***	30.5	***52***	31.3
Castle Pines to Happy Canyon	65	23.3	65	20.3	66	20.5
Happy Canyon Merge	64	20.8	65	18.2	65	17.8
Happy Canyon to North Meadows	65	22.8	66	19.9	66	19.5
North Meadows Merge	65	15.9	64	14.1	67	13.4
North Meadows to Founders/Meadows	67	15.5	68	13.3	67	13.2
Founders/Meadows Merge	***58***	27.3	***61***	19.8	***60***	25.3

* NOTE: Red highlighted number indicates segment failure where service is below acceptable levels

Scenario 1

Scenario 1 was evaluated with 2035 traffic volumes and the following transportation infrastructure improvements: 8-lanes of I-25, RidgeGate Interchange, east Frontage Road as defined in the I-25/US 85 EIS/ROD, plus the proposed North Meadows Extension. Without the Hess Road connection, accessibility of the freeway in this area relies on Founders/Meadows Parkway, Castle Pines Parkway or Lincoln Avenue.

During the morning peak hour northbound traffic is projected to operate at unacceptable levels of service on the I-25 corridor between Founders/Meadows Parkway and RidgeGate Interchange. During this period vehicles are traveling at speeds as low as 14 mph and experiencing densities as high as 106.1 pc/m. Southbound I-25 is projected to operate at acceptable levels of service with the exception of the Castle Pines Merge which has a dip in travel speeds down to 51 mph.

The afternoon peak hour experiences pockets of congestion northbound between Castle Pines and RidgeGate, between North Meadows and Happy Canyon and at the North Meadows merge. Southbound I-25 is projected to experience congestion at the merge points of Lincoln Avenue, Castle Pines Parkway and Founders/Meadows Parkway.

Scenario 2

Scenario 2 evaluated the 2035 traffic conditions associated with development of the North Central Douglas County Transportation Plan including the connection of Hess Road to Castle Pines Interchange. In general, traffic flows are distributed more evenly throughout the roadway network and an overall improvement in I-25 operations is expected.

Results of the analysis showed traffic conditions in the morning peak were improved as travel speeds increased. The lowest northbound speed was projected at 34 mph, which is approximately twice as fast as the lowest speed projected in Scenario 1. The highest density within the same corridor is projected to be

54 pc/m. Southbound is projected to operate acceptably with the exception of Castle Pines merge which will have essentially the same travel speed of 51 mph. The southbound density levels are projected to operate at acceptable levels of service.

During the afternoon peak hour pockets of congestion northbound I-25 between North Meadows and Happy Canyon as well as Castle Pines to RidgeGate, will experience speeds and densities similar in magnitude to those anticipated in Scenario 1. Southbound I-25 will experience slightly slower speeds at the merge areas of Lincoln, Castle Pines and Meadows-Founders.

Scenario 3

Scenario 3 analysis was similar to Scenario 2 without local connections to Lagae Road and Happy Canyon Road. In general, with two local road connections no longer available the traffic is more concentrated at the interchanges. Measures of effectiveness are incrementally worse than Scenario 2, though still much improved over Scenario 1.

During the morning peak hour, traveling northbound on I-25 will experience areas of slow travel speeds with the lowest segment traveling at 28 mph. This slow northbound segment still allows motorists to travel approximately twice as fast as Scenario 1. The southbound motorists will experience acceptable levels of service with the exception of the Castle Pines merge area which sees a small dip in travel speeds to 51 mph, but similar to Scenarios 1 and 2.

The afternoon peak hour analysis indicates that Scenario 3 will see pockets of congestion along the northbound corridor between North Meadows and Happy Canyon and then again between Castle Pines and RidgeGate but similar in magnitude to those anticipated in Scenarios 1 and 2. The southbound direction will experience congestion at the merge points of the Lincoln, Castle Pines, and Founders/Meadows interchanges.

4.4.2 Intersection Operations

At the intersections, traffic operations are based on the average delay experienced per vehicle. The average delay per vehicle is equated to an associated LOS, “A” through “F”. An intersection operating at LOS “A” experiences very low levels of congestion. An intersection operating at a LOS “F” experiences very high levels of congestion and delay.

The intersection LOS analysis was conducted utilizing SYNCHRO software package. This software replicates the actual interaction that occurs between closely spaced intersections. This dynamic analysis more accurately reflects the operational LOS. *Figure 8* illustrates the existing intersection levels of service.

Figure 13 illustrates the forecasted opening year turning movement volumes and intersection levels of service. *Figures 14, 15, and 16* illustrate the forecasted 2035 turning movement volumes and the intersection levels of service. *Table 10* compares the intersection levels of service for each scenario. Detailed output summaries are found in Appendix D.

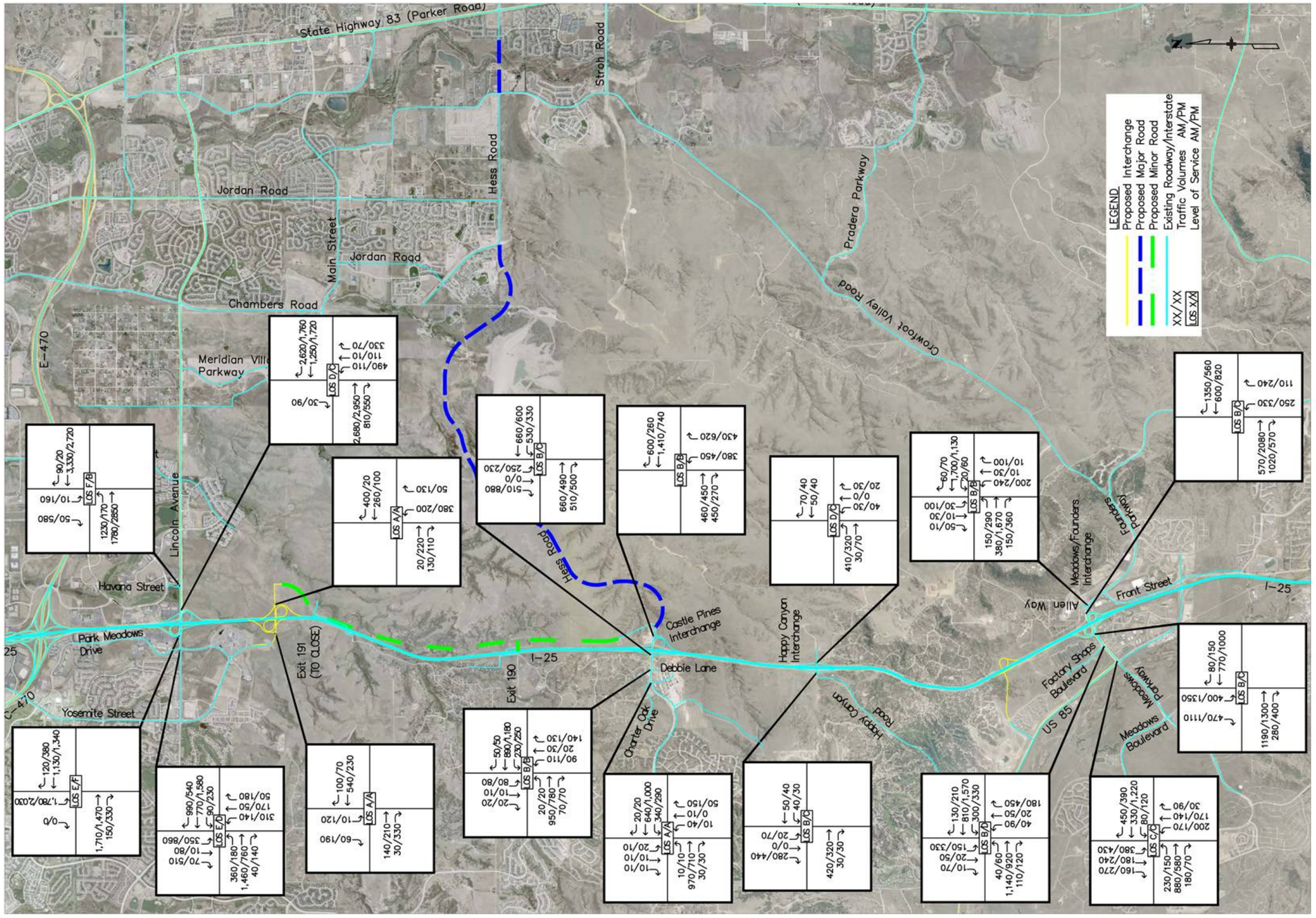


Figure 13 – Opening Year Peak Hour Turning Movement Volumes/Intersection Level of Service

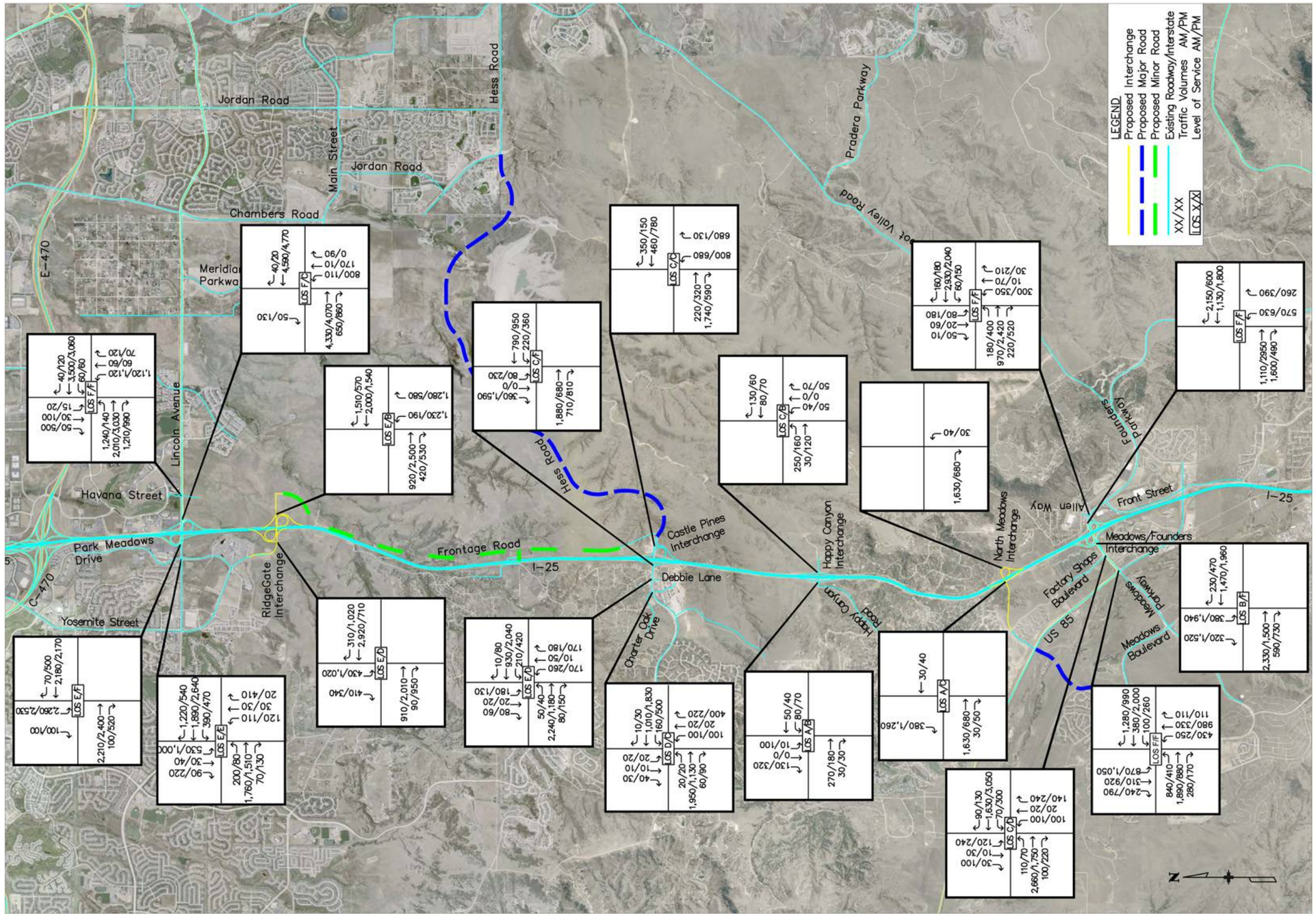


Figure 14 – 2035 Scenario 1 Peak Hour Turning Movement Volumes/Intersection Level of Service

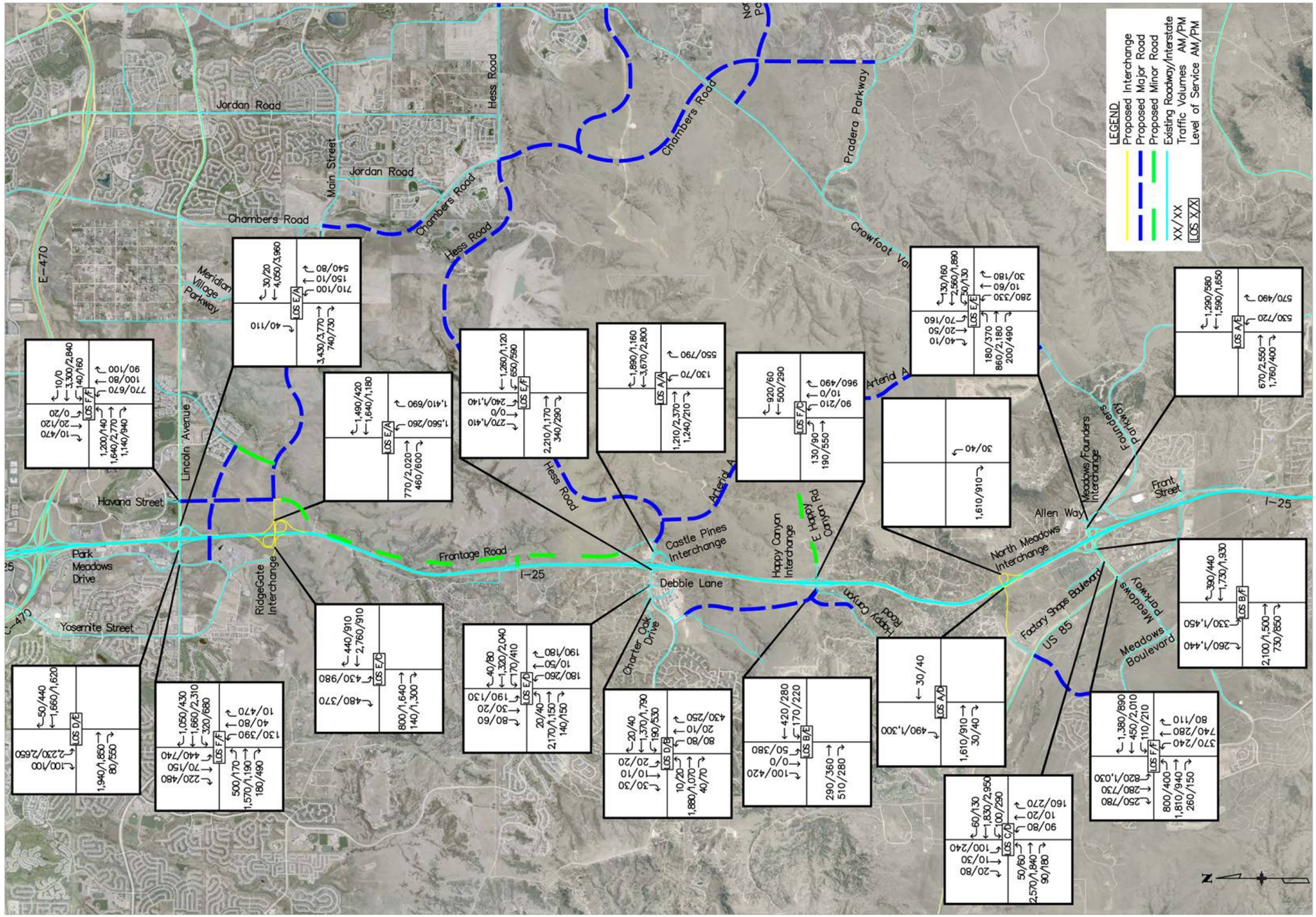


Figure 15 – 2035 Scenario 2 Peak Hour Turning Movement Volumes/Intersection Level of Service

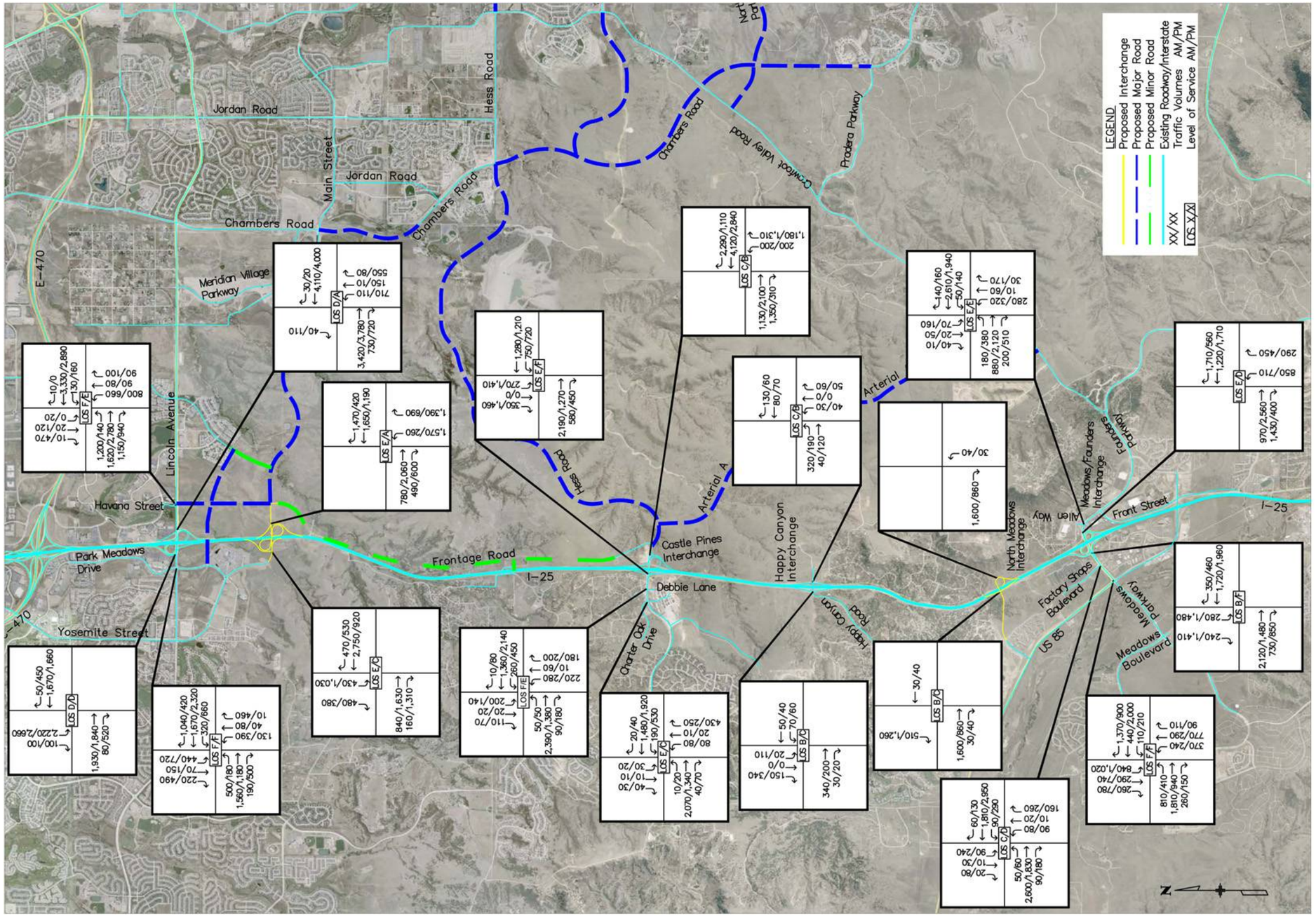


Figure 16 – 2035 Scenario 3 Peak Hour Turning Movement Volumes/Intersection Level of Service

Table 10
Existing, 2011 and 2035 Scenario Intersection Delays/Level of Service (AM/PM)

Interchange	Existing				2011				2035											
					Hess Road Opening Day				Scenario 1 Committed Projects				Scenario 2 North-Central County				Scenario 3 Without Legae/Happy			
Intersection	AM Peak		PM Peak		AM Peak		PM Peak		AM Peak		PM Peak		AM Peak		PM Peak		AM Peak		PM Peak	
	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
I-25/Lincoln Avenue																				
Lincoln Ave/Park Meadows Dr	23.1	C	25.2	C	67.2	E	44.5	D	64.8	E	71.5	E	90.6	F	144.6	F	112.2	F	155.6	F
Lincoln Ave/Southbound Ramps	71.7	E	89.5	F	64.6	E	90.5	F	55.9	E	83.1	F	40.4	D	79.5	E	49.6	D	52.9	D
Lincoln Ave/Northbound Ramps	55.1	E	46.1	D	46.2	D	22.1	C	139.1	F	34.5	C	57.6	E	8.7	A	38.9	D	9.6	A
Lincoln Ave/Havana St	136.7	F	10.6	B	117.9	F	16.7	B	279.6	F	201.8	F	210.4	F	84.8	F	201.3	F	58.4	E
I-25/Ridgegate																				
Ridgegate/Southbound Off-ramp	-	-	-	-	2.5	A	5.1	A	73.0	E	37.1	D	62.2	E	24.4	C	64.9	E	25.5	C
Ridgegate/Northbound Off-ramp	-	-	-	-	6.5	A	8.6	A	64.8	E	11.1	B	66.7	E	6.9	A	65.8	E	7.0	A
I-25/Castle Pines Parkway																				
Castle Pines Pkwy/Charter Oak Dr	5.3	A	6.7	A	9.8	A	7.2	A	46.6	D	21.1	C	45.3	D	17.8	B	60.0	E	23.0	C
Castle Pines Pkwy/Debbie Lane	10.8	B	15.2	B	12.5	B	12.0	B	56.5	E	49.1	D	58.8	E	47.7	D	107.6	F	71.8	E
Castle Pines Pkwy/Southbound	17.0*	C*	350.9*	F*	18.6	B	27.6	B	27.3	B	108.0	F	60.2	E	121.7	F	68.5	E	140.7	F
Castle Pines/Northbound Off-ramp	10.9*	B*	11.7*	B*	11.3	B	16.9	B	20.4	C	27.0	C	8.4	A	4.4	A	30.9	C	10.3	B
I-25/Happy Canyon Rd																				
Happy Canyon Rd/Southbound	10.5*	B*	14.2*	B*	11.1*	B*	15.4*	C*	9.7*	A*	14.3*	B*	13.6	B	92.7	F	10.4*	B*	15.1*	C*
Happy Canyon Rd/Northbound	25.0*	C*	15.7*	C*	26.3*	D*	16.3*	C*	15.4*	C*	12.3*	B*	301.7	F	28.1	C	17.6*	C*	12.3*	B*
I-25/North Meadows																				
North Meadows/Southbound	-	-	-	-	-	-	-	-	9.5*	A*	23.6*	C*	9.9*	A*	26.3*	D*	10.0*	B*	23.6*	C*
I-25/Meadows-Founders																				
Meadows Dr/US285	58.8	E	29.0	C	35.4	C	28.0	C	414.5	F	283.2	F	377.5	F	252.4	F	380.0	F	274.0	F
Meadows Dr/Factory Shops-	21.0	C	27.6	C	17.7	B	35.5	D	26.3	C	47.5	D	23.4	C	44.2	D	21.4	C	40.6	D
Meadows Dr/I-25 Southbound Off-	14.3	B	28.3	C	10.9	B	24.8	C	18.9	B	138.7	F	12.7	B	93.8	F	13.5	B	97.2	F
Founders/I-25 Northbound Off-	42.8	D	22.6	C	10.7	B	15.0	B	128.6	F	88.5	F	8.6	A	73.8	E	63.9	E	44.9	D
Founders/Allen Way	24.7	C	55.2	E	15.4	B	22.2	C	96.6	F	105.5	F	60.6	E	77.2	E	66.6	E	77.9	E

NOTES: 1) Signalized intersection LOS based on average delay for the overall intersection
2) *Unsignalized intersection LOS based on average delay on STOP-controlled approach

4.4.3 Intersection Analysis Findings

As shown in *Table 10*, intersections will continue to operate at acceptable levels-of-service in the 2011 time frame, the proposed opening day for Hess Road. The two intersections along Lincoln Avenue at Havana Street (morning peak) and at Park Meadows Drive (afternoon peak) are expected to operate at LOS "F", worse conditions than exist today.

Intersection levels of service will deteriorate in the 2035 time frame under all scenarios.

In Scenario 1, the intersections along Lincoln Avenue at the northbound ramps and at Havana Street will operate at LOS "F". Several intersections along Founders/Meadows at US 85, Southbound Off-ramp, Northbound Off-ramp and Allen Way will operate at LOS "F".

In Scenario 2, several intersections in the study area continue to operate at LOS "F". The connection of Hess Road to Castle Pines and the development of the Douglas County road system have the affect of distributing traffic and providing LOS improvements. The following intersections show an overall improvement in level of service, Lincoln Avenue/Havana Street and the Founders/Meadows intersections at US 85, both I-25 ramps and Allen Way.

In Scenario 3, levels of service improvements are similar to Scenario 2; however, not as extensive.

4.4.4 Minor Intersection Improvements

As a result of the analysis, several minor intersection striping or traffic signal modifications were identified that would incrementally improve traffic conditions at these intersections. Recommended improvements by intersection are identified below.

- **Lincoln Avenue/Park Meadows Drive:** Restriping to provide an additional northbound left-turn lane. This intersection improvement should be coordinated with the connection of Hess Road to Castle Pines Parkway.
- **Lincoln Avenue/Havana Street:** The south leg of this intersection will be constructed as new development occurs on the south side of Lincoln Avenue east of I-25. Currently, this approach is planned to have two left-turn lanes, one through lane and a combined through/right-turn lane. Restriping to change the through lane to a combined left-turn/through lane would improve operating conditions at this intersection. This improvement would require servicing the northbound and southbound movements ("split" phasing) separately. This intersection improvement should be coordinated with the connection of Hess Road to Castle Pines Parkway.
- **Happy Canyon Road/I-25 Southbound Ramps:** In Scenario 2, this intersection is expected to operate at LOS "F" in the afternoon peak hour with a traffic signal and the westbound left-turn lane. Addition of an eastbound right-turn lane would alleviate this condition.
- **Happy Canyon Road/I-25 Northbound Ramps:** In Scenario 2, this intersection is expected to operate a LOS "F" in the morning peak hour with a traffic signal and the westbound left-turn lane. Addition of a westbound right-turn lane would alleviate this condition.

4.5 RAMP METERING

4.5.1 Methodology

The placement of ramp meters at critical locations has been shown to increase mainline throughput, reduce travel time, reduce delay, reduce mainline queues and reduce the frequency of crashes. Additional benefits that may be experienced include travel pattern shifts during the peak periods by commuters and

the elimination or reduction of motorists utilizing the interchange as a bypass to the freeway by exiting and then re-entering.

Chapter 4H, of the Millennium Edition of the Manual of Uniform Traffic Control Devices (MUTCD), provides a guideline for determining ramp meter locations. The MUTCD supports the placement of the ramp meter to reduce overall delay if congestion recurs on a freeway segment where demand exceeds capacity. In these segments, typical travel speeds fall below 50 mph for at least a half-hour period.

4.5.2 Ramp Metering Overview

Comparing the standard guidelines with future traffic projections helped to identify potential candidates for future ramp meters. Although the traffic projections indicate candidates for future ramp metering, additional engineering analysis is warranted. Additional operational factors need to be evaluated in the future for the following: ramp volume, diversion of traffic to adjacent roadways, presence of significant truck traffic, steep grades, sight distance restrictions and ramp queue storage length. A safety evaluation will also need to be performed to determine crash history. On-ramps that are susceptible to a crash pattern near the merge area may be corrected utilizing ramp metering. In addition, on-ramps with high density merge areas and noticeable slowing due to the merge area may be considered for metering. The final check is to ensure that the on-ramp itself can accommodate the anticipated queue lengths. While ramp meters provide the greatest benefit when the ramp storage is fully utilized to queue vehicles, it is counterproductive to back up queues onto the adjacent arterials and impede the local flow of traffic.

The traffic volumes at the Happy Canyon Road interchange and the Castle Pines Parkway interchange indicate a future need for ramp metering to serve the northbound I-25 on-ramps. To serve the projected traffic volumes, the northbound I-25 on-ramps at these two interchanges will also need to be widened to two-lanes. It is recommended that these improvements to the northbound on-ramp be made as soon as traffic volumes reach 900 vehicle per hour during the peak hour. These improvements will not be required until anticipated traffic volume is reached or LOS beyond D is experienced.

5.0 Findings

5.0 FINDINGS

Transportation network improvements were identified for each scenario, beginning with Scenario 1 which included committed projects, Scenario 2 which included completion of the North-Central Douglas County Transportation Plan, to Scenario 3 which included removal of two developer-related local connections, in the event these improvements are not implemented. Completion of the North-Central Douglas County Transportation Plan begins with the connection of Hess Road to I-25 at Castle Pines Parkway. This Hess Road connection improves distribution of traffic to existing and proposed interchanges throughout the corridor.

This section identifies improvements planned along the I-25 corridor and at each interchange. In addition, recommendations that would improve traffic operations, as identified through the analysis, are described.

5.1 I-25 CORRIDOR

Freeway and on/off ramp operations should continue to be monitored and ramp metering implemented when traffic conditions and crash history indicate that ramp metering will improve operations.

A project to extend the eight lanes through the C-470 interchange should also be pursued. While this project is outside the boundary of this study area, once I-25 is eight lanes from Founders/Meadows Parkway to Lincoln Avenue, the section to the north through C-470 will become the bottle neck and congestion spillback may affect I-25 south of Lincoln Avenue.

5.2 LINCOLN AVENUE INTERCHANGE

A number of improvements are planned at this interchange including minor improvements and a possible major reconstruction. The minor improvements include an additional southbound left-turn lane at the southbound off-ramp and provision of three lanes on eastbound Lincoln Avenue through the northbound ramps section. These improvements are expected to be implemented within the next three to five years. Future plans include the reconstruction of the interchange and implementation of a SPUI in the next 10 to 15 years.

Restriping of the northbound approach of Park Meadows Drive at Lincoln Avenue to provide double left-turn lanes should be completed.

At the Lincoln Avenue/Havana Street intersection, consideration should be given to establishing two northbound left-turn lanes, a combined left-turn/through lane and a combined through/right-turn lane when future improvements to Lincoln Avenue are evaluated.

These identified improvements should be coordinated with the connection of Hess Road to Castle Pines Parkway.

5.3 RIDGEGATE INTERCHANGE

This interchange, as planned, will have adequate capacity and no further improvements are recommended.

5.4 CASTLE PINES PARKWAY INTERCHANGE

The connection of Hess Road to Castle Pines Parkway should be completed as a critical element in the implementation of the North-Central Douglas County Transportation Plan. Connection of this roadway will improve traffic distribution along the I-25 corridor, reducing congestion at the I-25/Lincoln Avenue and I-25/Founders-Meadows interchanges.

The Castle Pines Parkway/I-25 Southbound ramp intersection will be reconfigured to a southbound left-turn lane, combined southbound left-turn/right-turn lane and free-flowing right-turn lane. The structure will also be restriped to provide an additional westbound left-turn lane. A traffic signal will be required for this intersection. **It should be noted that even with these improvements, levels-of-service are expected to worsen in the long-term during the afternoon peak hour. This decrease in LOS is related to the heavy southbound left-turn from I-25 to eastbound Castle Pines Parkway. The corresponding left-turn at the Happy Canyon Interchange is expected to operate at good LOS and it is very likely that traffic would divert to this interchange should all road connections be established. This diversion would likely "balance" south to east traffic at these two interchanges and improve conditions at Castle Pines.**

The Castle Pines Parkway will be restriped to provide two through lanes in each direction, a third westbound lane to the northbound on-ramp, and a second northbound to westbound left-turn lane. This interchange will also require a traffic signal at each of the ramps when warranted, most likely when Hess Road is opened.

Traffic operations at the Castle Pines Parkway at Debbie Lane will deteriorate in all scenarios in 2035 and especially in Scenario 3, without the Lagae Road connection. Consideration should be given as to the existing eastbound right-turn-only lanes from Charter Oaks to I-25 southbound ramps and consider a combined eastbound through/right-turn lane. This would improve traffic operations during the morning peak hour at the Debbie Lane intersection.

The projected traffic volumes warrant the need to meter the two northbound I-25 on-ramps. The on-ramps will need to be widened to two-lanes to accommodate the projected traffic volumes.

5.6 HAPPY CANYON ROAD INTERCHANGE

The bridge structure is anticipated to be widened to provide left-turn lanes from Happy Canyon Road to the on-ramps at both intersections as defined in the I-25/US 85 EIS/ROD. Traffic signals will also be required when Happy Canyon Road east of I-25 is constructed as identified in Scenario 2. In addition, right-turn lanes on both approaches to the interchange will be required to achieve acceptable LOS if Happy Canyon Road is connected to the east.

It should be noted that no improvements other than the Happy Canyon Road left-turn lanes to northbound I-25 and to southbound I-25 are required in the 2035 timeframe if Happy Canyon is not extended east (Scenarios 1 and 3) and connected to Arterial A.

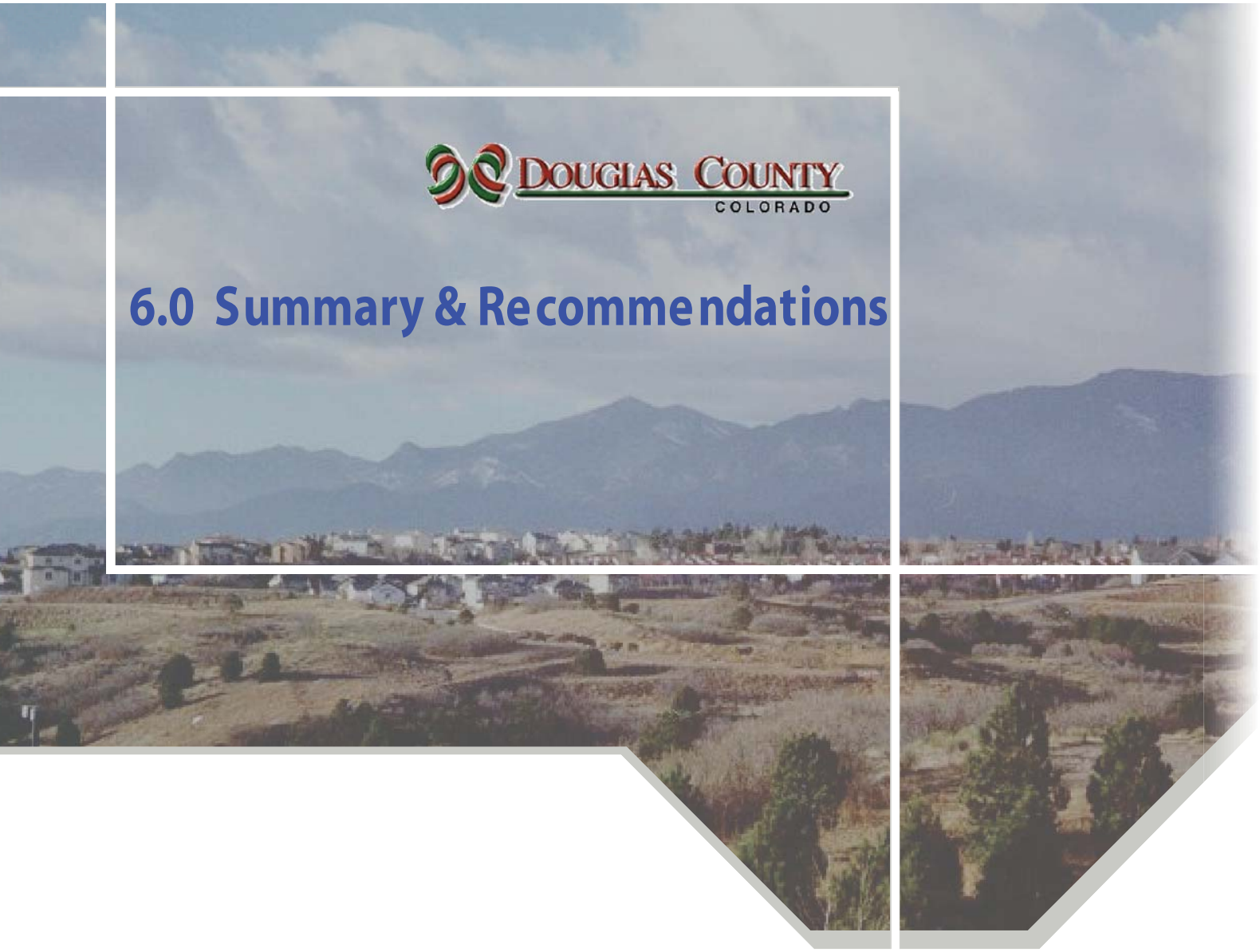
The projected traffic volumes warrant the need to meter the northbound I-25 on-ramp. The on-ramp will need to be widened to two-lanes to accommodate the projected traffic volumes.

5.7 NORTH MEADOWS INTERCHANGE

This interchange as planned will have adequate capacity and no further improvements are recommended.

5.8 FOUNDERS-MEADOWS INTERCHANGE

Existing geometric conditions were assumed to remain the same over the study period for the intersections along Founders-Meadows. Several intersections are expected to operate at poor levels-of-service during peak hours, including US 85, southbound off-ramp, northbound off-ramp and Allen Way. The connection of Hess Road to I-25 at Castle Pine Parkway results in a diversion of traffic from Founders Parkway to Hess Road. The reduction in traffic demand at these intersections results in significant improvement in LOS at the southbound off-ramp, northbound off-ramp and Allen Way intersections. Further improvements to these intersections were considered outside the scope of this study and should be pursued by others.



DOUGLAS COUNTY
COLORADO

6.0 Summary & Recommendations

6.0 SUMMARY AND RECOMMENDATIONS

The continued need for regional connectivity prompted Douglas County to initiate this comprehensive corridor study based on future land development, corresponding traffic volumes and the need for improved regional connections to I-25. The analysis of the proposed Hess Road and other local roadway connections to the existing I-25 interchanges shows that they will not negatively impact the highway system. Additionally, these proposed local roadway connections to I-25 help distribute traffic more evenly along the I-25 corridor between Founders/Meadows Parkway and Lincoln Avenue, providing intersection LOS improvements and improving overall corridor operations.

The proposed connection of Hess Road to I-25 at the Castle Pines Parkway interchange is recommended as a continuing action in the completion of the North-Central Douglas County Transportation Plan. Additionally, completion of Arterial A and Arterial B, Legae Road and Happy Canyon Road east of I-25, should also be pursued as developments are proposed. Implementation of the North Central Douglas County transportation plan create redundancy in the transportation network, help distribute traffic and provide alternative routes in the event an incident occurs on I-25 that requires closing the interstate.

I-25 is planned to be widened from six lanes to eight lanes from Founders/Meadows to Lincoln Avenue as identified in the I-25/US-85 EIS/ROD, and includes constructing a frontage road on the east side between Castle Pines Parkway and RidgeGate.

The analyses showed that connecting Hess Road to the existing Interstate 25 interchange at Castle Pines Parkway did not negatively impact the highway system. In fact, this proposed local roadway connection helped distribute traffic more evenly along the Interstate 25 corridor between Founders/Meadows Parkway and Lincoln Avenue, providing intersection LOS improvements and improving overall corridor operations. Implementation of the Hess Road connection helps to distribute traffic and provide alternative routes in the event an incident occurs on Interstate 25 that requires closing the interstate.

The proposed local agency improvements as they relate to Interstate 25:

- will **not** directly increase traffic volumes on the interstate corridor, and
- will **not** negatively impact the freeway operations.