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**Appendix E**  
**Purpose and Need Technical Memorandum**

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**COLORADO**  
Department of  
Transportation

**I-25 PEL: CO Springs Denver South  
Connection**

# **Purpose and Need**

**I-25 PEL: Colorado Springs Denver South Connection**

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## What is the Scope of the PEL Study and Reasons for Completing It?

The Colorado Department of Transportation (CDOT) initiated the [Interstate 25] I-25 Colorado Springs Denver South Connection Planning and Environmental Linkages (PEL) Study to develop a plan of action to move projects forward along I-25 between the Town of Monument (Monument) and C-470, a critical corridor for regional and statewide travel between the metropolitan areas of Colorado Springs and Denver. This study aims to identify transportation priorities in advance of secured construction funding, positioning CDOT to accelerate the environmental analyses and to save time in implementing projects when construction funds are identified. The PEL Study has been structured with robust involvement from the public, elected officials, and local, state, and federal agencies to develop partnerships and support for implementing future transportation improvements.

This PEL Study lays the ground work for future improvements on I-25 by doing the following:

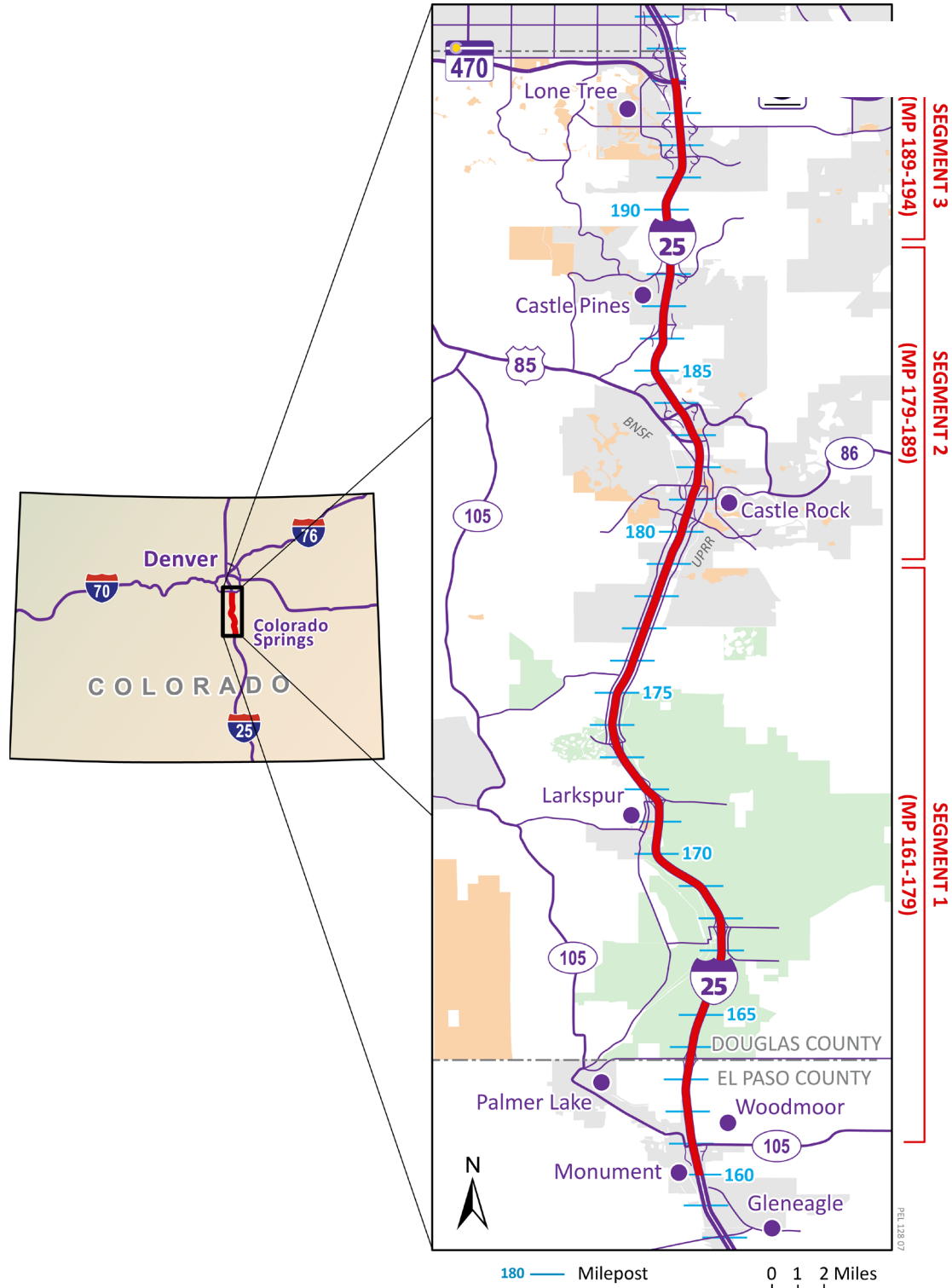
- Defining and prioritizing projects in the corridor
- Determining project costs, funding, financing, and delivery options
- Engaging with local corridor communities, regional travelers, and other interested stakeholders about corridor issues and priorities
- Identifying significant environmental constraints that may influence design options and/or delay project development with lengthy environmental reviews
- Supporting an efficient transition to National Environmental Policy Act (NEPA) processes, final design, and construction once funding is identified

The vision for the PEL Study was to conduct an open and transparent PEL process to build partnerships and provide a roadmap to implement projects that improve safety, travel time reliability, and mobility on this vital stretch of I-25.

## What is the PEL Study Area?

The Study Area extends along I-25 from Monument (mile post [MP] 161) north to the I-25/C/E-470 interchange (MP 194) (Figure 1).

Figure 1. PEL Corridor Limits



The southern limit, at Monument, was the northern limit of the I-25 design-build widening project completed in 2014. Although this is the southern physical limit of the PEL Study, the limits of travel demand modeling and analyses extended farther south to approximately Academy Boulevard in Colorado Springs because of the predominance of regional traffic originating from the south and the importance of the corridor for travelers south of Monument in El Paso County and beyond.

The northern limit, at the I-25/C/E-470 interchange, was determined because it includes the existing heavy traffic volumes destined for locations within the Denver metropolitan area and the continued population and traffic growth in the Town of Castle Rock (Castle Rock) and the City of Lone Tree (Lone Tree). In addition, the C/E-470 interchange is a major element in the southern Denver travel market representing a key link in modeling travel patterns, with the C/E-470 corridors connecting regional I-25 travelers to important destinations including the I-70 mountain corridor and Denver International Airport (DIA).

Approximately three-quarters of the trips on this corridor are pass-through trips with origins and destinations outside the Study Area, indicating that the primary travel demand through the corridor is between the urban areas of Colorado Springs and Denver. This trend is expected to continue as the primary travel demand is strongest in the Colorado Springs area and El Paso County, which by 2040 is projected to be the state's most populous county (Birkeland and Hubbard 2015).

The Study Area was divided into three distinct segments from south to north (Figure 2):

- Segment 1, Monument to Castle Rock, MP 161 to MP 179, is characterized by large tracts of protected open spaces and conservation easements, limited existing and planned development, and the lowest traffic volumes within the PEL corridor.
- Segment 2, Castle Rock to Castle Pines, MP 179 to MP 189, recognizes the important and distinct role of I-25 as a transportation artery through the growing town of Castle Rock and city of Castle Pines, and is characterized by the mix of local and regional travel and significant planned local development.
- Segment 3, Castle Pines to C/E-470, MP 189 to MP 194 is the entry into the Denver South region and experiences the highest existing and projected traffic volumes in the PEL corridor. Segment 3 is home to major regional employment and residential connections at RidgeGate Parkway and Lincoln Avenue.

Although travel demand is largely regional, the segment analysis recognizes the distinct land use and travel characteristics along the corridor that frame existing and future transportation needs. This Purpose and Need memorandum details corridor-wide and segment-specific needs.

**Figure 2. Corridor Segments**

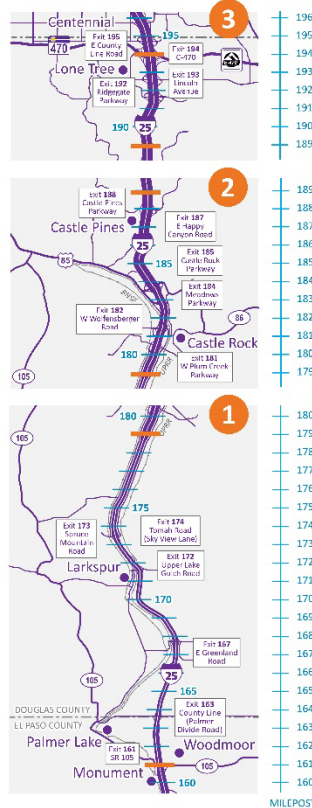
**Segment 1**  
**MP 161 to MP 179:**  
**The Gap**

**Transportation Characteristics**

- 2 lanes each direction
- Narrow shoulders
- Steady gradual southbound incline
- Hills, steep slopes, and vertically offset travel lanes
- 6 interchanges, mostly original (1960s)
- 2017 Average Annual Daily Traffic (AADT): 77,000-86,000
- Trucks make up 8.4% of traffic

**Environmental Characteristics**

- High incidence of wildlife conflicts
- Many stream crossing, PMJM habitat
- Protected open space throughout



**Segment 2**  
**MP 178 to MP 189:**  
**Castle Rock to**  
**Castle Pines**

**Transportation Characteristics**

- Urban 6-lane
- Narrow shoulders
- 6 interchanges
- 2017 Average Annual Daily Traffic (AADT): 99,000-133,000
- Trucks make up 6.7% of traffic

**Environmental Characteristics**

- Developed and growing communities
- Nearby Plum Creek runs parallel to the highway and includes PMJM habitat

**Segment 3**  
**MP 189 to MP 194:**  
**Denver South**

**Transportation Characteristics**

- Urban 8-lane, recently widened
- 3 interchanges
- 2017 Average Annual Daily Traffic (AADT): 133,000-150,000
- Trucks make up 5.3% of traffic

**Environmental Characteristics**

- Rapidly developing commercial and residential area

## **What is the Purpose and Need for transportation improvements in the corridor?**

The purpose for transportation improvements in this corridor is to enhance safety and improve travel time reliability and mobility of I-25 between Monument and Denver South. Corridor improvements should be compatible with the built and natural environment; support corridor communities' land use, development, and economic goals; and integrate and leverage technological innovations and advanced transportation system management strategies.



## What are the needs in the corridor?

### Enhance Safety and Improve Incident Management

Safety enhancements relate to the potential to reduce crashes, improve infrastructure, and address physical deficiencies that contribute to crashes in the corridor. Incident management relates to the ability to respond to and recover from incidents that contribute to secondary crashes, long travel delays, and dangerous conditions for highway workers and motorists responding to incidents.

CDOT conducted a safety assessment for the I-25 corridor between Monument and C-470 to assess the magnitude and nature of safety problems, analyze the causes of crashes, and suggest mitigation measures to reduce crashes and improve safety in the corridor (CDOT 2017a). The safety assessment evaluated crash data in the corridor over a 5-year period from 2011 through 2015.<sup>1</sup>

A total of 4,710 crashes were reported between MP 160 and MP 194 during the analyzed period (Figure 3). CDOT determined a moderate to high potential to reduce crashes and improve safety along a majority of the corridor length (Table 1).

**Table 1. Potential for Crash Reduction on I-25**

MP Range	Segment Description	AADT	Rural/ Urban	Potential for Crash Reduction	Number of Crashes			
					PDO	INJ	FAT	TOT
160.76 to 163.81	SH 105 to County Line Road	63,000	Urban	Moderate to High/High	265	141	1	407
163.82 to 166.96	County Line Road to Greenland Road	63,000	Rural	Moderate to High/ Moderate to High	161	97	1	259
166.97 to 167.95	Greenland Road	63,000	Rural	High/High	85	43	0	128
167.96 to 171.32	Greenland Road to Upper Lake Gulch Road	63,000	Rural	Moderate to High/ Moderate to High	169	108	1	278
171.33 to 172.81	Upper Lake Gulch Road to Spruce Mountain Road	63,000	Rural	High/High	134	68	0	202
172.82 to 173.03	Spruce Mountain Road	65,000	Rural	<sup>a</sup>	16	4	0	20
173.04 to 174.29	Sky View Lane	65,000	Rural	Low to Moderate/Low to Moderate	59	22	0	81
174.30 to 178.99	Sky View Lane to MP 179.00	68,000	Rural	Low to Moderate/Low to Moderate	227	107	2	336

<sup>1</sup> The southern limit of the safety assessment extended to MP 157.7 (Baptist Road); the crash data within the PEL corridor limits of MP 161 (SH 105) and MP 194 (C/E-470) are reported here.

MP Range	Segment Description	AADT	Rural/ Urban	Potential for Crash Reduction	Number of Crashes			
					PDO	INJ	FAT	TOT
179.00 to 180.87	MP 170.00 to Plum Creek Parkway	68,000	Urban	Moderate to High/ Moderate to High	91	36	1	128
180.88 to 181.84	Plum Creek Parkway to Wolfensberger Road	79,000	Urban	Low to Moderate/ Moderate to High	47	28	0	75
181.85 to 184.20	Wolfensberger Road to Meadows/Founders Parkway (SH 85 and SH 86B)	96,000	Urban	Low to Moderate/Low to Moderate	135	53	1	189
184.21 to 186.93	Meadows/Founders Parkway (SH 85B and SH 86B) to Happy Canyon Road	110,000	Urban	Low to Moderate/Low to Moderate	182	77	0	260
186.94 to 188.48	Happy Canyon Road to Castle Pines Parkway	110,000	Urban	Low to Moderate/Low to Moderate	121	57	0	178
188.49 to 192.07	Castle Pines Parkway to RidgeGate Parkway	114,000	Urban	Moderate to High/ Moderate to High	488	189	3	680
192.08 to 192.98	RidgeGate Parkway to Lincoln Avenue	130,000	Urban	High/Low to Moderate	249	44	0	293
192.99 to 194.31	Lincoln Avenue to C/E-470	162,000	Urban	High/Low to Moderate	453	69	1	523

PDO – Property Damage Only, INJ – Injury, FAT – Fatal, TOT – Total

<sup>a</sup> Segment length insufficient for SPF analysis

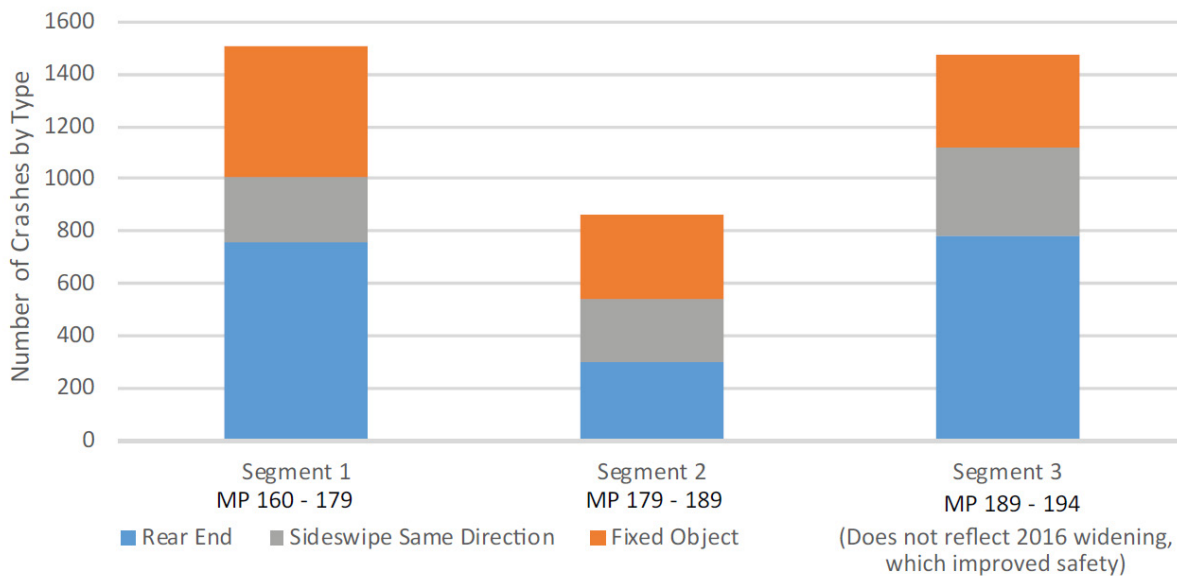
## Crash Types

Of the total crashes in the corridor, 27 percent resulted in injuries and less than 1 percent resulted in fatalities. Figure 3 shows the distribution of crashes by crash type. The most common crash type was rear-end, followed by fixed object and sideswipe same direction. Rear-end and sideswipe same direction crashes involve multiple vehicles and can be indicative of traffic congestion and turbulence or variability in traffic stream because of incident-induced queueing, transitions between the 2- and 3-lane sections, interchange influence areas, speed limit changes, and topography (such as slower moving vehicles on steep grades). Most of the crashes occurred when the speed of the primary vehicle was below the posted speed limit of 65 or 75 miles per hour (mph), further suggesting that these factors influencing traffic flow were likely present and forced a reduction in operating speed.

Although they accounted for the majority of the crashes, multiple-vehicle crashes occurred in a lower proportion throughout the corridor than expected when compared to similar facilities statewide. However, single-vehicle crashes occurred in a higher proportion than expected,

accounting for 34 percent of the total corridor crashes. Likewise, the proportion of crashes that occurred off the road is higher than expected since most single-vehicle crashes result when a driver departs the travelway. Some of the same contributing factors to multiple-vehicle crashes may also contribute to single-vehicle crashes because some of these crashes occur as drivers overcorrect or attempt to avoid a rear-end collision. The most commonly struck objects in this corridor were concrete barrier, guardrail, and cable rail, all of which are adjacent to the narrow shoulders present along most of the corridor. Because turbulence is not a typical contributing factor to single-vehicle crashes, this can help explain the higher proportion of single-vehicle crashes in this corridor. The frequent occurrence of crashes related to congestion and narrow shoulders suggests the need for improvements along the length of the corridor that will reduce the potential for these crash types.

**Figure 3. Number of Crashes by Segment and Type**



## Crash Conditions

Corridor-wide, crashes occurred more often than expected during weather events and when roadway surfaces were wet or snowy with drivers losing control as a result of driving too fast for conditions or because of reduced traction. At 7,352 feet, Monument Hill is the crest of the Palmer Divide and is the high point on I-25 between New Mexico and Wyoming. Monument Hill creates its own micro-scale weather patterns, often resulting in significantly more precipitation than the Denver or Colorado Springs areas. Combined with the physical characteristics of Segment 1, weather events often result in lengthy delays or full closure of this stretch of I-25. The Gap construction project will allow travelers to better navigate weather issues and maintain reliable travel through this segment.

A higher than expected number of crashes (approximately one-third of the total crashes) occurred in low-light conditions, suggesting implementing improvements to enhance visibility of the roadway and fixed objects adjacent to the roadway could prevent some of these low-light crashes.

## Crashes by Month and Day of Week

Although the distribution of crashes is fairly even among most months of the year (particularly in the second half of the year), the highest proportions of crashes occur in the months of June, July, and August. Since 1999, these 3 months have also been the highest traffic volume months, indicating a relationship between exposure (average daily traffic) and crash frequency in this corridor. The highest proportions of daily crashes occurred in the 7 a.m. to 8 a.m. and 3 p.m. to 4 p.m. hours. The travel time reliability analyses show that the higher frequency of crashes between 3 p.m. and 4 p.m. seemed to initiate delay that takes several hours to recede, extending delays to 6 p.m.

Saturday was the most common day for crashes, followed by Friday; these are the two highest travel days in the corridor. Saturday was also the day of the week that had the highest occurrence of multiple crashes on the same day. Saturday as the highest crash day is unexpected because it is nationally the second-lowest crash day. Over the 5-year crash history period, there were 65 Saturdays that had 5 or more crashes on a single day within close proximity. This finding suggests that secondary crashes are likely occurring as a result of the primary crash and ensuing congestion caused by it. Travel time reliability analyses also clearly show more travel time variability over the weekends, with crashes as a major cause of travel delays. Improving safety to reduce the potential for primary crashes would likely reduce incident-caused congestion and subsequent crashes. The prevalence of Saturday crashes and higher traffic volumes, along with the higher crash frequencies in the summer months, suggests a higher number of recreational/non-commuting drivers unfamiliar with the corridor conditions (grades and mix of traffic), or the variation in the traffic stream induced by recreational vehicles (whether standalone vehicles or travelers pulling campers/trailers/boats), could be contributing factors to the crashes. These crash data indicate a need to improve driver expectation and reduce turbulence in the corridor.

## Fatal Crashes

Thirteen fatal crashes occurred during the 5 years of collected data. Six of the crashes involved a driver under the influence of alcohol, which is a higher proportion than national crash statistics. In one of these crashes, a pedestrian was under the influence of alcohol. Large trucks were involved in four of the fatal crashes, which is a higher proportion than the truck crashes in the overall dataset of crashes in the I-25 corridor between Monument and C-470. Thus, heavy trucks are overrepresented in fatal crashes in this corridor. Half of the crashes occurred in darkness conditions, with the 10 p.m. hour as the most common time period. Seven of the crashes occurred on the weekend days of Friday, Saturday, and Sunday. Excessive speed does not appear to be a contributing factor in most of these crashes.

## Segment-Specific Issues

In addition to the corridor-wide safety issues, there are unique safety-related needs within the individual segments. The safety assessment concluded that throughout Segments 1 and 3, overall safety performance was worse or much worse than expected, and performance throughout Segment 2 was generally higher than expected.

Within Segment 1, conflicts between slower and faster moving vehicles in the 2-lane section are a cause of higher-than-expected crashes. A concentration of crashes occurred between the

SH 105 interchange and the Monument Weigh Station. The unique weather conditions at the top of Monument Hill (the location of the weigh station) transition between 3- and 2-lane capacity, and the terminus of the northbound truck climbing lane contributes to turbulence in the traffic stream and likely contributes to lower-than-expected safety performance. Another concentration of crashes occurs near the Greenland Road interchange, where curves, sight distance, and presence of deer and elk contribute to higher-than-expected crashes. Wildlife-vehicle collisions occur at higher-than-expected numbers throughout the 13 miles of Douglas County open space and privately-owned land protected by conservation easements, where I-25 bisects habitat for resident elk and deer populations. In Segment 1, wildlife-vehicle crashes account for approximately 10 percent of recorded crashes with 27 percent resulting in injuries to vehicle occupants. Dark, unlighted roadway conditions were also noted in these locations of higher-than-expected wildlife-vehicle crashes, most of which occurred in low-light times of day.

Outside of the area around Plum Creek Parkway (MP 179), safety performance on I-25 through Segment 2 was generally better than expected when compared to roadways with similar traffic conditions in other areas of the state (CDOT 2017a). At Plum Creek Parkway, wet and snowy road conditions contribute to a higher-than-expected crash frequency. In addition, crashes at two interchanges were higher than the statewide average for similar intersections. At the Wolfensberger Road/W Road interchange (MP 182), crashes are attributed to signals and drivers making unsafe left turns. At the Meadow/Founders Parkway interchange (MP 184), higher-than-expected crashes were attributed primarily to drivers not staying in their designated lanes, turning from the wrong lanes, or making unsafe lane changes.

In Segment 3, I-25 performance in the reported years was generally worse than expected. This is primarily attributed to higher traffic volumes and congestion. Some of these issues were likely related to the lane balancing construction project between Lincoln Avenue and County Line Road, which occurred during the 5-year reporting period. Interchange safety performance was also noted as worse than expected for the RidgeGate Parkway (MP 192) and C-470 (MP 194) intersections and ramps.

## **Incident Management**

Incidents are occurrences on a roadway that impede normal flow including crashes, planned special events, maintenance activities, and weather events. The lack of alternate routes, narrow shoulders, and limited crossover opportunities, challenge emergency responders to reach incidents efficiently or safely, especially through Segment 1. Incidents can delay travel through the corridor substantially, and long closures because of crashes that occur regularly (travel time reliability is discussed in the following section). The loss of two on-duty Colorado State Patrol troopers in 2015 and 2016 near Tomah Road highlighted the safety concerns and importance of providing safe spaces for emergency responders and maintenance staff to conduct operations.

Throughout the corridor, limited alternate routes, discontinuous frontage roads, and unpaved roads connecting between I-25 and alternate routes further challenge incident management on I-25. This is particularly true when vehicles are diverted off I-25 at the Greenland Road interchange (MP 167) where the detours follow local Noe Road and Spruce Mountain Road, routes that include dirt roads and a passive railroad crossing without an active warning device, such as flashing lights. Dynamic message signs between Monument and Castle Rock do not

provide adequate coverage for drivers to get the necessary information in a timely fashion to make informed travel decisions. When drivers do divert to local roads to avoid delays or incidents on I-25, they often travel circuitously through local communities on roads not designed for highway volumes or mix of vehicles, such as heavy trucks. Figures 4 and 5 show the intermittent adjacent frontage roads, numerous roads with dirt or gravel pavement surface, and regional alternate routes.

Figure 4. Frontage Roads

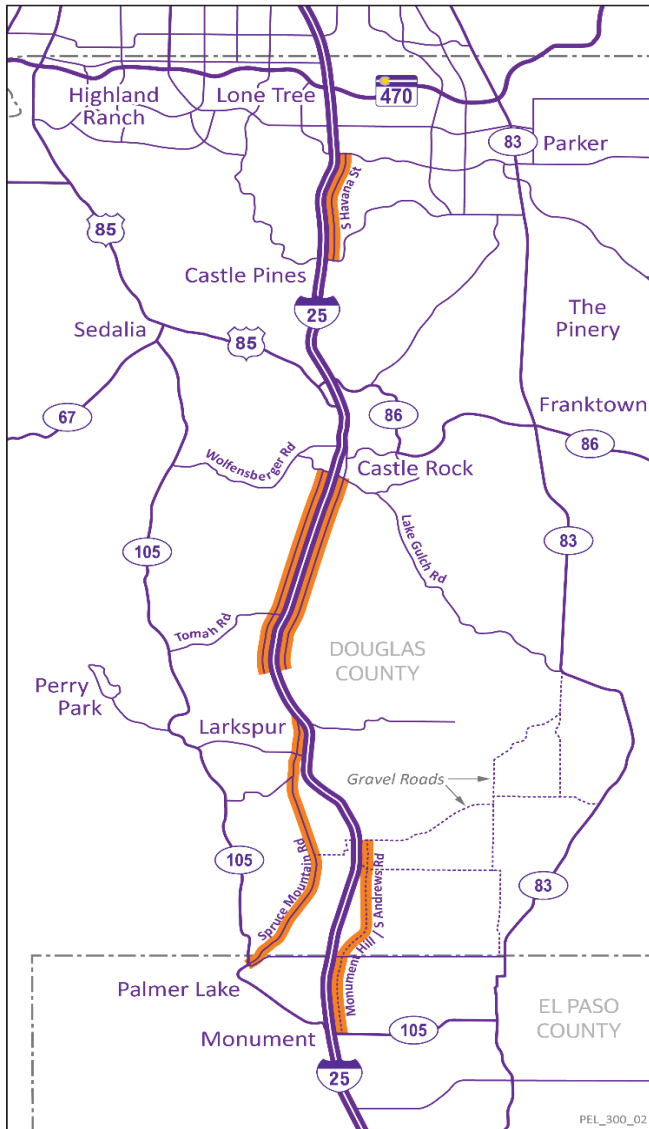
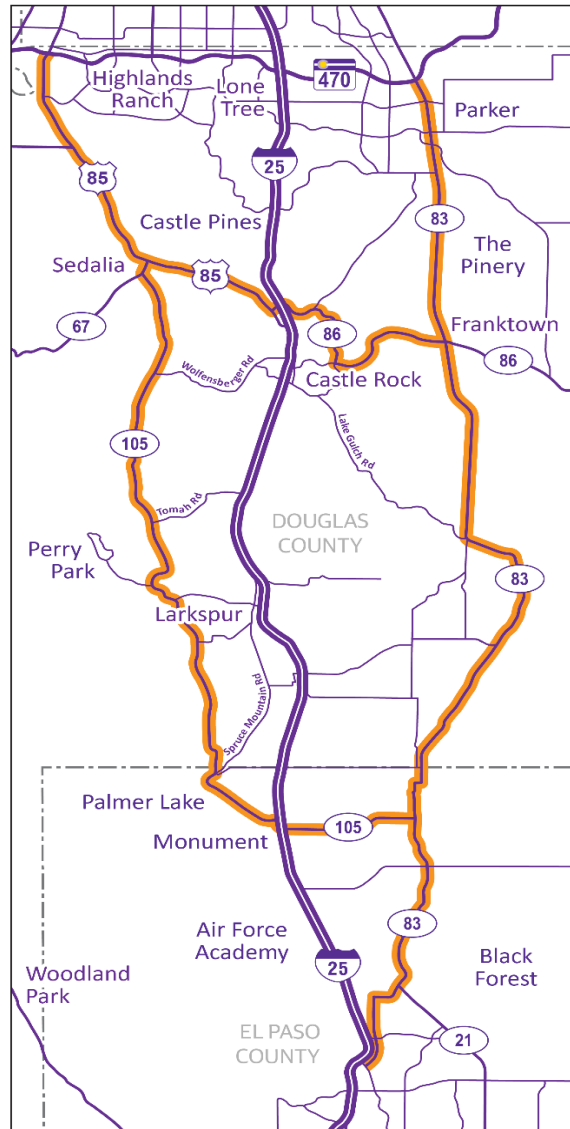


Figure 5. Alternate Routes



## Improve Travel Time Reliability

Improving reliability of travel and predictability of travel times in the I-25 corridor is important now and will become even more critical as the region grows. Volatility of I-25 travel times and conditions hinder economic vitality for the region. The region's ability to serve and support projected employment growth and sustain important freight, military, and tourism sectors is critical. Travel time reliability is especially important for regional corridors like the I-25 Gap, where motorists traverse longer distances and parallel roads do not exist to provide suitable alternate options for getting to destinations on time. Providing reliable travel times on I-25 is paramount to sustaining a healthy economy and maintaining a good quality of life for Front Range residents, businesses, commerce, and military.

FHWA (2006) defines travel time reliability as the consistency or dependability in travel times, as measured from day to day and across different times of the day. Reliable travel requires providing more dependable travel times. Travel through the PEL Study corridor in free-flow conditions takes 30 minutes, but travel times of 120 minutes or more are recorded regularly (CDOT 2017b). Frustrated drivers report that even without incidents, corridor conditions such as limited maneuverability and passing opportunities, variable speeds, and more aggressive and distracted drivers on the road make an 'average' drive time through the corridor rare. With no alternate routes available, there is no easy relief to the unpredictable travel times that exist today in the corridor. Because travel times are unpredictable, drivers must allow extra time to get to their destination but how much time is not easy to calculate.

CDOT prepared a travel time reliability assessment for the I-25 corridor between Monument and C/E-470 to understand the level of congestion, changing traffic conditions, and factors contributing to delay in the corridor (CDOT 2017b). The assessment reviewed data from 2015 and 2016 and defined "poor" travel time as more than twice as long as free-flow travel time, and "fair" travel time as 1.4 to 2 times longer than free-flow travel time. The corridor was divided into a rural segment and an urban segment, divided at Meadows/Founders Parkway/US 85. This distinction was made based on the anticipated differences in trip purposes and types in these areas because of the current land uses.<sup>2</sup>

In the rural south section, poor travel times occur most commonly on weekends, especially during summer months. The longest travel times occurred on Friday afternoons in the southbound direction, and both northbound and southbound on Saturdays and Sundays. From 2015 to 2016, there was a 20 percent increase in the total number of days with congestion as the causal factor in fair and poor travel times. The increased travel times as a result of *events* predominantly occurred on weekends. Events can be broadly defined as incidents (crashes, police action), weather, special events, or regularly occurring congestion. Table 2 identifies the contributing factors to fair and poor travel times in the rural setting area.

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<sup>2</sup> Although the PEL study segments differentiate a distinct area through Castle Rock (Segment 2), the current land uses (and INRIX data available) do not reflect the anticipated growth in the south Castle Rock area that is envisioned in 2040. Therefore, the data were thought to be more representative of current land uses and travel times with only two segments. This approach was supported by the consideration of origins and destinations in the Streetlight dataset, which showed a change in travel patterns in the Castle Rock area.

**Table 2. Fair and Poor Travel Time Causal Factors: Rural Setting**

Event Type	Number of days		Percentage of Days	
	2015	2016	2015	2016
Incidents	106	96	29	28
Weather	17	10	5	3
Special Events	12	25	3	7
Congestion	108	130	30	38
Uncongested	122	83	33	24
Total Days Analyzed	365	344 <sup>a</sup>	100	100

<sup>a</sup> Data were recorded by INRIX for only 344 days of the year.

Source: CDOT, 2017b

For the suburban northern segment, poor travel time periods occur most commonly in the northbound lanes in the weekday mornings and in the southbound lanes weekday evenings, indicative of one-way commuting patterns. From 2015 to 2016, there was a 16 percent decrease in the total number of days with congestion as the causal factor in fair and poor travel times. This decrease can be primarily attributed to the completion of the I-25 Lane Balance Project, which widened I-25 to four lanes in each direction from Lincoln Avenue to County Line Road. Table 3 indicates the causal factors in fair and poor travel times identified during the evaluation for the urban areas, which corresponds to the northern PEL Study segments.

**Table 3. Fair and Poor Travel Time Causal Factors: Urban Setting**

Event Type	Number of days		Percentage of Days	
	2015	2016	2015	2016
Incidents	111	91	30	25
Weather	11	1	3	1
Special Events	37	36	10	10
Congestion	153	128	42	35
Uncongested	53	107	15	29
Total Days Analyzed	365	363*	100	100

\* Data were recorded by INRIX for only 363 days of the year.

Source: CDOT, 2017b

Feedback from corridor stakeholder groups and daily travelers reinforces the need to provide more reliable travel times. Corridor drivers have consistently provided input that the drive between Colorado Springs and Denver is uncomfortable and unpredictable. Travel times are highly variable and driving conditions are stressful. In addition to incidents, drivers report issues with the variability and volatility in speeds because of posted speed limits that seem too high for conditions (especially around curves), aggressive drivers that speed and follow too close trying to pass slower drivers, and the mix of slow-moving trucks with passenger vehicles negotiating through two lanes.



## Improve Mobility

FHWA defines mobility as the ability to move or be moved from place to place (FHWA 2017). This includes the ability to reach destinations and access goods and services. I-25 is the only continuous north-south interstate through Colorado and serves as the backbone for travel across Colorado's Front Range as well as interstate travel through the state. No alternate routes serve these travel needs. I-25 is also the only major travel corridor between the Colorado Springs and Denver metropolitan areas, and travel alternatives regarding alternate routes and modes are lacking within this segment. Traffic congestion and associated travel delays through the PEL corridor exacerbate mobility challenges.

## Travel Volumes

As shown in Table 4, traffic volumes on I-25 are high today and projected to increase notably by 2040.

**Table 4. I-25 Daily Bi-Directional Traffic Volumes at Select Locations in the Study Area**

I-25 Location	2017	2040	Percentage Increase
Baptist Road to SH 105	95,540	145,340	52
Greenland Road to Upper Lake Gulch Road	78,140	94,840	21
Crystal Valley Parkway to Plum Creek Parkway	79,000	151,740	92
Meadows/Founders Parkway to Castle Rock Parkway	132,750	195,130	47

Source: CDOT 2017c

Without increased capacity or travel options, the increases in traffic volumes are projected to increase average travel times through the corridor dramatically. In the northbound direction, I-25 travel times are projected to increase in the peak morning travel period (8 a.m.) from less than approximately 36 minutes in 2017 to approximately 56 minutes in 2040. In the southbound direction, travel times are projected to increase even more substantially in the peak hour (5 p.m.) from approximately 32 minutes in 2017 to approximately 71 minutes in 2040.

## Transit and Modal Choices

Intercity bus service has been offered intermittently between Colorado Springs and Denver since 2004. From 2004 to 2012, the Front Range Express (FREX) service operated between Colorado Springs and Denver, with stops in Monument, Castle Rock, and Greenwood Village, serving nearly 500 daily passengers. In 2010, the service was reduced, and the stop in Castle Rock was eliminated. In 2012, the service, which carried approximately 200 daily passengers, was discontinued. In 2015, CDOT began providing regional bus service between Colorado Springs and Denver through its Bustang interregional express bus service. Growth and popularity of the service have continued to grow over the past 3 years, and CDOT added service between Colorado Springs and the Denver Tech Center in 2019. The Denver Regional Council of Governments (DRCOG) and Pikes Peak Area Council of Governments (PPACG), along with the Regional Transportation District (RTD) and Mountain Metro Transit, report high demand for regional transit and vanpool choices statewide, and public input into the PEL Study support high interest and demand for transit options to improve overall mobility choices in the region.

Providing travel time reliability and schedule certainty for Bustang would likely attract and retain regular transit riders, especially if the service was outside of the highway's general-purpose travel lanes where it is affected by corridor congestion, delay, and unpredictability.

### **Geometric Conditions**

The corridor was evaluated for its geometric health, which can also be categorized as the physical characteristics of the corridor. Factors included in the evaluation were evaluated including horizontal curve radius, vertical grade, length of grades, stopping sight distance, lane continuity, and other physical elements impacting mobility through all three project segments (CDOT 2017c). Consistent with the travel time reliability analysis, geometric factors were given a poor, fair, or good rating based on predefined thresholds. The results of the geometric health analysis indicate poor ratings were the most prevalent for the following areas: stopping sight distance, lack of adequate lane width, onramp and exit design, and lane balance.<sup>3</sup> Each project segment presents its own unique physical conditions, which should be considered with the operational and natural characteristics to more completely understand the need for mobility improvements.

### **Segment 1: MP 161-179**

The Gap presented the most acute need for mobility improvements of any of the three PEL Study segments. Before the early action project adding an Express Lane in each direction, which started construction in 2018, the Gap was the last remaining 4-lane (2 lanes in each direction) segment of I-25 between Denver and Colorado Springs. Narrow shoulders on the inside and outside lanes created and compounded mobility issues. The shoulder was not wide enough to move disabled vehicle(s) out of travel lanes or to move traffic around accidents. Steep grades adjoining the shoulder added to this width restriction. First responders faced increased response times without the ability to use a shoulder or for traffic to move onto the shoulder. The same was true for disabled commercial trucks and recreational vehicles, which ended up closing an entire lane of travel when breakdowns occurred. The problems created by the lack of shoulders were further compounded by cable guardrail, which rendered the median area useless for turnaround movements. The shoulders through Segment 1 were so narrow that routine maintenance work could not be conducted without closing a travel lane. The Gap construction project solved these problems by constructing wider shoulders through the length of the Gap.

The long, continuous grade of the Monument Hill area makes it difficult for commercial trucks, or any vehicle pulling a trailer, to maintain speed. The resulting speed differential, combined with the lack of passing lanes, creates congestion. These continuous grades also contribute to poor ratings for stopping sight distance. Rear-end collisions are the most common type of crash in Segment 1. The poor sight distance on vertical curves is compounded by the lack of a shoulder for drivers to perform an emergency stop and swerve maneuver.

### **Segments 2 and 3: MP 179-194**

The Castle Rock area north to Lone Tree has been the subject of numerous recent widening and interchange improvement projects, which have had a beneficial effect on mobility. However, Segments 2 and 3 do have a need for improved mobility. Nearly all the interchanges in these

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two segments have deficiencies, including short exit ramps, tight horizontal curves, narrow ramp shoulders, or steep vertical grades.

Segments 2 and 3 are also subject to the many of the same operational challenges of Segment 1. The hill north of Castle Rock climbs for approximately 2.5 miles before plateauing near the Happy Canyon Road interchange. Commercial trucks and vehicles pulling trailers have difficulty maintaining highway speeds.

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