

The graphic features a dark blue background with a white grid. A white line graph is overlaid on the grid, showing a line that starts at the bottom left, rises to a peak, dips slightly, and then rises again towards the top right. The text 'Appendix F: Technical Memos' is written in white on the left side of the graphic.

Appendix F: Technical Memos

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Appendix F-1

Logical Termini Memo



Project: CO 52 Planning and Environmental Linkages Study
To: Brian Dabling-Federal Highway Administration, Project Manager
From: Chad Hall, PE-CDOT R4, Project Manager
Date: May 13, 2020
Subject: Logical Termini Memo for State Highway 52 PEL Study in Boulder and Weld Counties, CO

On July 23, 2019, CDOT and FHWA held a pre-scoping to determine the appropriate study approach for the State Highway (CO) 52 corridor within Boulder and Weld Counties, Colorado. Participants of the meeting concluded that a Planning and Environmental Linkages (PEL) study is an appropriate study method, and that the extents of project logical termini should be CO 119 on the west and CO 79 on the east. The FHWA guidance on NEPA implementation and transportation decision-making includes guidance on criteria to frame selection of transportation improvements (23 CFR 771.111[f]). Those three guiding principles are identified below:

1. Connect logical termini and be of sufficient length to address environmental matters on a broad scope;
2. Have independent utility or independent significance, i.e., be usable and be a reasonable expenditure even if no additional transportation improvements in the area are made; and
3. Not restrict consideration of alternatives for other reasonably foreseeable transportation improvements.

In order to streamline subsequent analysis during NEPA, the CO 52 PEL Study will apply the above FHWA general principles. This memo addresses a requirement of the CDOT PEL process, which includes a description of the selection and rationale of the PEL logical termini and justification for independent utility for a given PEL corridor. Logical project termini are defined as rational end points for a transportation improvement that allow for evaluation of environmental matters on a broad scope (23 CFR 771.111[f]). Meeting participants determined that the CO 52 PEL corridor between CO 119 and CO 79 would connect logical termini to address environmental matters on a broad scope, provide independent utility for a reasonable expenditure on future transportation improvements, and would not require additional study corridor outside of these extents to consider alternatives for all reasonably foreseeable transportation improvements.

The following factors contributed to the justification of logical termini:

1. There is a decline in traffic volumes outside of the eastern terminus since residential development decreases east of Hudson.
2. An Access Control Plan was scoped and funded along the corridor between CO 119 and US 85 in 2017. The PEL corridor was lengthened to include corridor communities anticipated to experience further development and growth.
3. The PEL corridor was lengthened to include corridor communities anticipated to experience further development and growth.
4. A resurfacing project is planned for the corridor east of CO 79.

Should you have any additional questions please reach out to Chad Hall at chad.hall@state.co.us or 970-350-2227



Appendix F-2

Project Terminology Memo

Project: CO 52 Planning and Environmental Linkages Study / Access Control Plan
To: Chad Hall, Project Manager, CDOT R4
From: Kelly Maiorana, Muller
Date: June 4, 2020
Subject: CO 52 Project Terminology

This memo describes the CO 52 Planning and Environmental Linkages Study (PEL) / Access Control Plan (ACP) general project terminology. CDOT suggested this memo to help the project team organize early-stage project components and to provide a consistent terminology framework when producing deliverables for the project. This memo specifically presents definitions and descriptions for the project Reason, Vision, Purpose and Need, and Goals.

Reason

The project Reason is driven by the desires and concerns of project stakeholders. Project stakeholders have identified various issues along the corridor which resulted in the creation of the SH 52 Coalition. The Reason for this PEL is a high-level overview that explains why we are doing this project and what outcomes need to be included in the PEL to make it a success. The Reason drives the development of the Vision, which drives the Purpose and Need.

Vision

The Vision is a unifying statement that will reflect a long-term view for the corridor. It considers regional planning efforts as well as local desires for how CO 52 will function in the future. The Vision is developed by combining stakeholder Reasons for the project and finding common themes that unite the interests of all project stakeholders.

Purpose and Need

The project Purpose is an action statement that expresses the attainment of the project Vision. Existing conditions data will identify the greatest Needs along the corridor. This is the foundation for the alternative analysis process and will provide a way to determine the project's short-term and long-term transportation priorities. The Purpose and Need addresses transportation related themes and is crafted in a way to allow it to be carried forward into NEPA for future federally funded projects along the CO 52 study corridor.

Goals

Project Goals are specific, actionable statements that support the Purpose and Need. These Goals are identified by stakeholders and may include non-transportation related concepts. Goals can be used to help focus the range of improvements.



Appendix F-3

Purpose and Need Memo



COLORADO
Department of Transportation

Region 4

CDOT R4
10601 W 10th Street
Greeley, CO 80634

October 28, 2020

Troy Halouska
CDOT Environmental Programs Branch
2829 W Howard Place
Denver CO, 80204

Subject: CO 52 Planning and Environmental Linkages (PEL) Study – Final Purpose and Need Memo

Dear Mr. Halouska:

The Colorado Department of Transportation (CDOT) has revised the Purpose and Need Memo to address FHWA comments for CO 52 PEL Study (CO 119 to CO 79). Please submit to Stephanie Gibson, Environmental Program Manager and Brian Dabling, FHWA Area Engineering, as acknowledgement and completion of this second FHWA Coordination Point as a part of the Planning and Environmental Linkages process.

Should you have any additional questions or comments please do not hesitate to reach out through email, chad.hall@state.co.us or 970-350-2227.

Sincerely,

Chad Hall
Project Manager

Attachment:

CO 52 PEL Final Purpose and Need Memo



Project: CO 52 Planning and Environmental Linkages Study (PEL) / Access Control Plan (ACP)
To: Brian Dabling, FHWA; Stephanie Gibson, FHWA
From: Chad Hall, CDOT R4; Troy Halouska, CDOT HQ
Date: October 28, 2020
Subject: CO 52 PEL Purpose and Need Memo

CDOT initiated this PEL Study to identify and assess potential transportation solutions along the CO 52 corridor in Weld and Boulder Counties. The Purpose and Need statement was developed in coordination with stakeholders, including the state and local jurisdictions located along the corridor and those represented in the CO 52 Coalition

Purpose of Transportation Improvements

The purpose of the recommended transportation improvements is to increase safety, accommodate increased travel and freight demand, and support multi-modal connections.

Need of Transportation Improvements

This section summarizes the transportation needs for the CO 52 corridor with a more detailed description that supports each of the needs from the Existing Conditions Report. In summary, transportation improvements are needed to:

- **Increase Safety** – Increased highway access from continued development, high percentages of truck traffic, poor pedestrian and bicycle facilities, and geometric issues have resulted in safety concerns along the corridor.
- **Accommodate increased travel and freight demand** – Traffic congestion from additional commuter and freight traffic has decreased travel time reliability. Increased corridor use requires roadway improvements to accommodate the movement of people, goods, and services.
- **Support multimodal connections** – Stakeholder input and prior planning efforts identified the need to improve north-south pedestrian mobility and support enhanced parallel connectivity.

Increase Safety

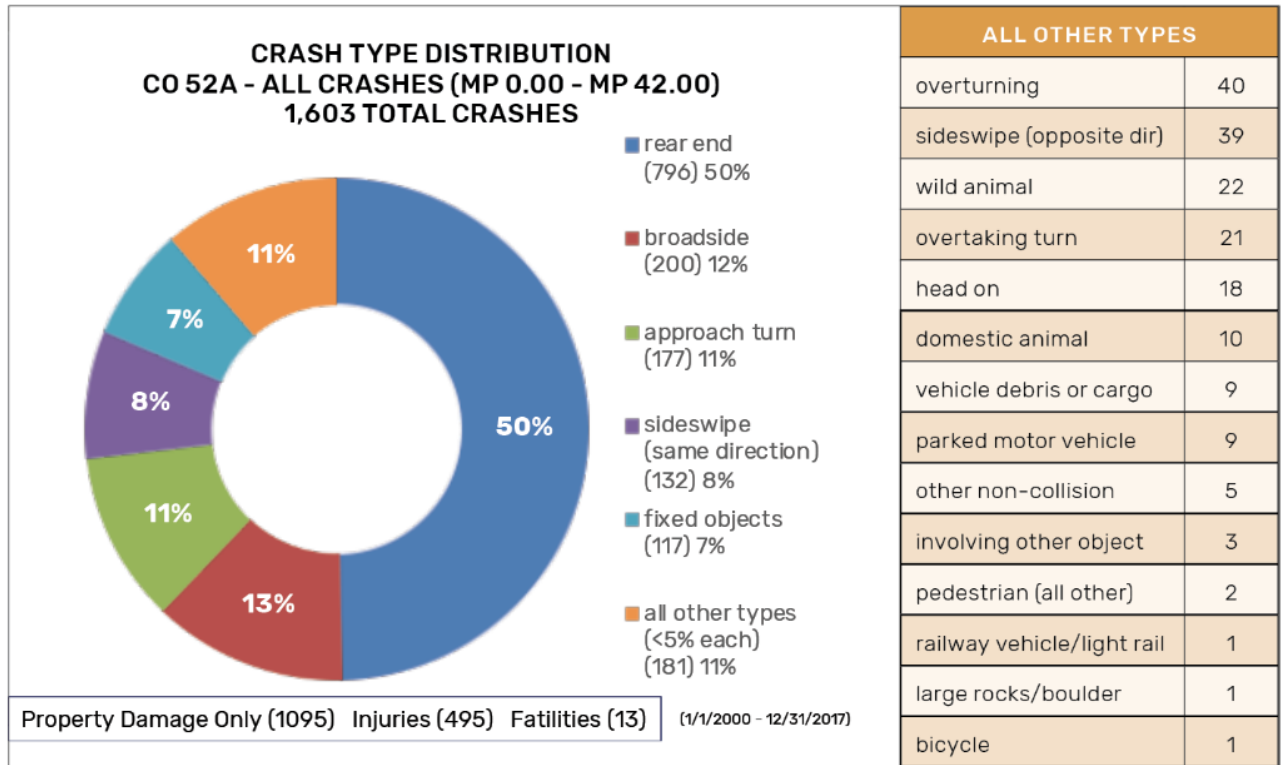
The need for corridor improvements to support the increases in development has resulted in safety concerns at intersections and other locations along the CO 52 corridor.

Crash Data

A review of CDOT's statewide crash history between July 1, 2014 to June 30, 2019 indicates that 1,603 crashes were reported on CO 52 in the study corridor. Of the total crashes, 1,095 were property damage only (PDO), 495 resulted in injuries, and 13 crashes resulted in 15 fatalities (

Figure 1). Rear-end crashes accounted for 50 percent of all crashes, primarily occurring near intersections and urban areas with concentrated access points. Overall, the frequency and severity of crashes at intersection locations were about average when compared to similar facilities. The next most common crash types were broadside and approach turn at 13 percent and 11 percent, respectively. These crashes were focused at intersections, both signalized and stop-controlled side street approaches, where gaps in traffic are less frequent for motorists attempting to turn onto or cross CO 52. Of the total crashes, 69 percent were classified as intersection or intersection-related crashes. Most crashes occurred in the western half of the corridor and tend to be clustered near major intersections and adjacent development. As development continues, there is concern that crashes will continue to rise near major intersections and adjacent to developments.

Figure 1 CO 52 Crash Distribution Breakdown



CDOT’s Safety Performance Function (SPF) analysis procedure revealed 17 intersections that exhibited high crash frequency and have a high potential for crash reduction. Two intersections were rated with a level of service safety (LOSS) III but were the location of a fatal crash occurrence and could be considered at an equal priority level for improvement recommendations as intersections with a LOSS IV (**Table 1**).

Table 1 Intersections with High Potential for Crash Reduction

MP	DESCRIPTION	LEGS	SIGNAL	NUMBER OF CRASHES				LOSS TOTAL	LOSS SEVERE
				PDO ¹	INJURY	FATAL	TOTAL		
4.67	US 287	4	Yes	47	59	1	107	III	IV
8.17	WCR 3	3	No	12	3	0	15	IV	III
10.39	Puritan Way	3	No	28	7	0	35	IV	IV
10.95	West Frontage Road (I-25)	4	Yes	26	17	0	43	IV	IV
11.08	SB I-25 Ramps	4	Yes	28	6	0	34	IV	II
11.21	NB I-25 Ramps	4	Yes	99	23	0	122	IV	IV
11.45	East Frontage Road (I-25)	4	Yes	79	29	0	108	IV	IV
12.81	Flying Circle Boulevard	3	Yes	20	11	0	31	IV	IV
13.19	Colorado Ave (WCR 13)	4	Yes	40	15	1	56	III	III
13.45	Cherry Street	3	No	5	2	1	8	III	III
13.64	Forest Street	3	No	10	2	0	12	IV	III
13.9	Mac Davidson Drive	3	No	3	3	0	6	IV	IV
16.42	WCR 19	4	No	20	5	0	25	IV	IV
25.46	WCR 37	4	No	4	7	1	12	IV	IV
27.46	WCR 41	4	No	5	6	3	14	IV	IV
29.07	West Frontage Road (I-76)	4	No	11	1	0	12	IV	II
36.92	WCR 59	4	No	3	2	0	5	IV	III
37.92	WCR 61	4	No	3	1	0	4	IV	IV
41.94	CO 79 (WCR 69)	4	No	4	0	0	4	IV	II

Although non-intersection crashes are less prevalent (31 percent of total crashes), three head-on collisions and one fatality occurred near the reverse curves segment situated in the vicinity of WCR 17 (MP 15.50 and MP 15.70). Field observations also identified two non-standard intersections on the reverse curves (MP 15.00 and MP15.65).

Truck Freight

The presence of truck freight varies along the corridor. In the Boulder County portion of the corridor, the percentage of truck traffic varies from 2.8 percent near CO 119 to 5 percent at County Line Road. A large increase in truck traffic occurs along the Weld County portion of the corridor from west to east. Truck traffic accounts for 6.5 percent of traffic at I-25 and increases to 19 percent in the final section nearing CO 79. In addition to truck freight, CO 52 is designated as a hazardous materials and oversize vehicle route from CO 119 to CO 79. The corridor provides an east-west freight route for the northern Denver metropolitan area that has relatively few horizontal and vertical clearance issues. Among the types of oversized cargo are wind turbine blades from the Windsor and Greeley area.

Due to the corridor’s crucial role in moving freight, CO 52 improvements must ensure that freight mobility is maintained in a safe and efficient manner. Intersections, turning paths, lane widths, horizontal and vertical clearances, and shoulders should be designed to accommodate the frequent movement of semi-tractor trailer trucks and oversized loads. Stretches of the corridor with higher truck traffic can significantly increase travel time and bottleneck situations which can lead to safety concerns and impact the travel time reliability of the corridor.

Geometric Issues

Geometric issues result in a significant safety issue along CO 52. Spot deficiencies were identified throughout the corridor where headwalls, narrow bridges, or irrigation features are located directly adjacent to the roadway or within the clear zone. Ditches and trees were observed encroaching on the clear zone along corridor stretches east of Fort Lupton. These geometric deficiencies increase the risk and severity of potential crash occurrences.

Poor pavement conditions were observed from east of I-25 through Dacono to WCR 19 and from east of US 85 through Fort Lupton to WCR 29 ½. Shoulder widths are inconsistent along the corridor, ranging from 2- and 10-feet throughout most of the corridor and no shoulders east of Hudson. Improved pavement conditions and consistent shoulder widths are necessary should a motorist need to take evasive action, recover control of their vehicle, or pull a disabled vehicle out of the path of traffic.

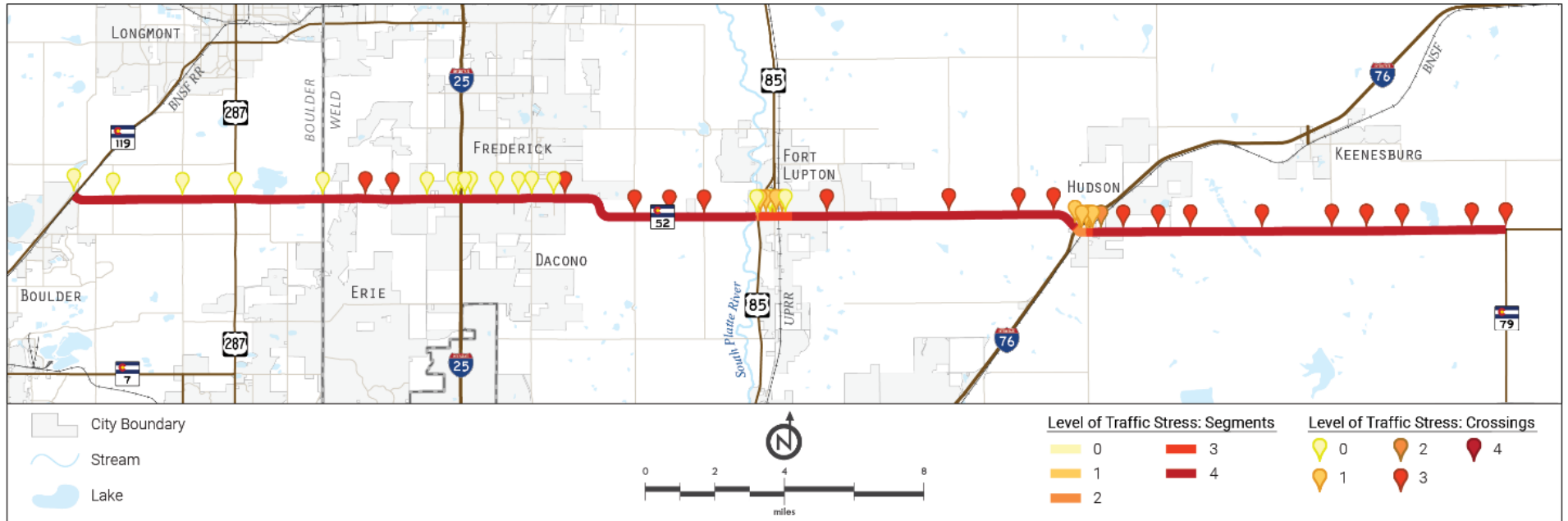
Safety concerns occur at locations along the corridor where vertical curves do not meet design criteria (MP 21.5, WCR 43, MP 32.15, WCR 53, and WCR 55). Vertical sight issues can increase the risk and severity of crashes due to lowered sight distances decreasing reaction times and ability to safely evade obstacles. Noncompliant grades can also cause issues with safely braking a vehicle or with rider comfort.

There are 51 bridge structures along the project corridor. Major structures account for 22 of the identified structures. Results of a structures field visit identified an absence of guardrail at several major and minor structures along the corridor. The presence of guardrail helps cars to maintain travel along the roadway prism, as well as prevent major accidents where vehicles leave the roadway prism along major structures (span length of 20 feet or greater) and minor structures (span length between 4 feet and 20 feet).

Bicycle and Pedestrian Facilities

High traffic volumes and high travel speeds along CO 52, paired with a lack of bicycle and pedestrian facilities along the corridor, create safety concerns for bicyclists and pedestrians traveling along and across CO 52. There are currently no designated bicycle routes along CO 52; however, shoulders along much of the western section from CO 119 to US 85 are 4-feet or greater. The shoulders provide some physical infrastructure for east-west bicycle connectivity between CO 119 and Fort Lupton, but high vehicle travel speeds result in a level of traffic stress (LTS) of 4 (**Figure 2**). In addition, gaps in shoulders at major intersections (95th St, US 287, I-25, and US 85) make it challenging for bicycle crossings. Shoulders east of Fort Lupton to CO 79 vary from less than 2-feet to not present. Bicyclists are forced to mix with vehicular traffic in these sections, further increasing difficulty and discomfort.

Figure 2 Level of Traffic Stress (LTS) Analysis



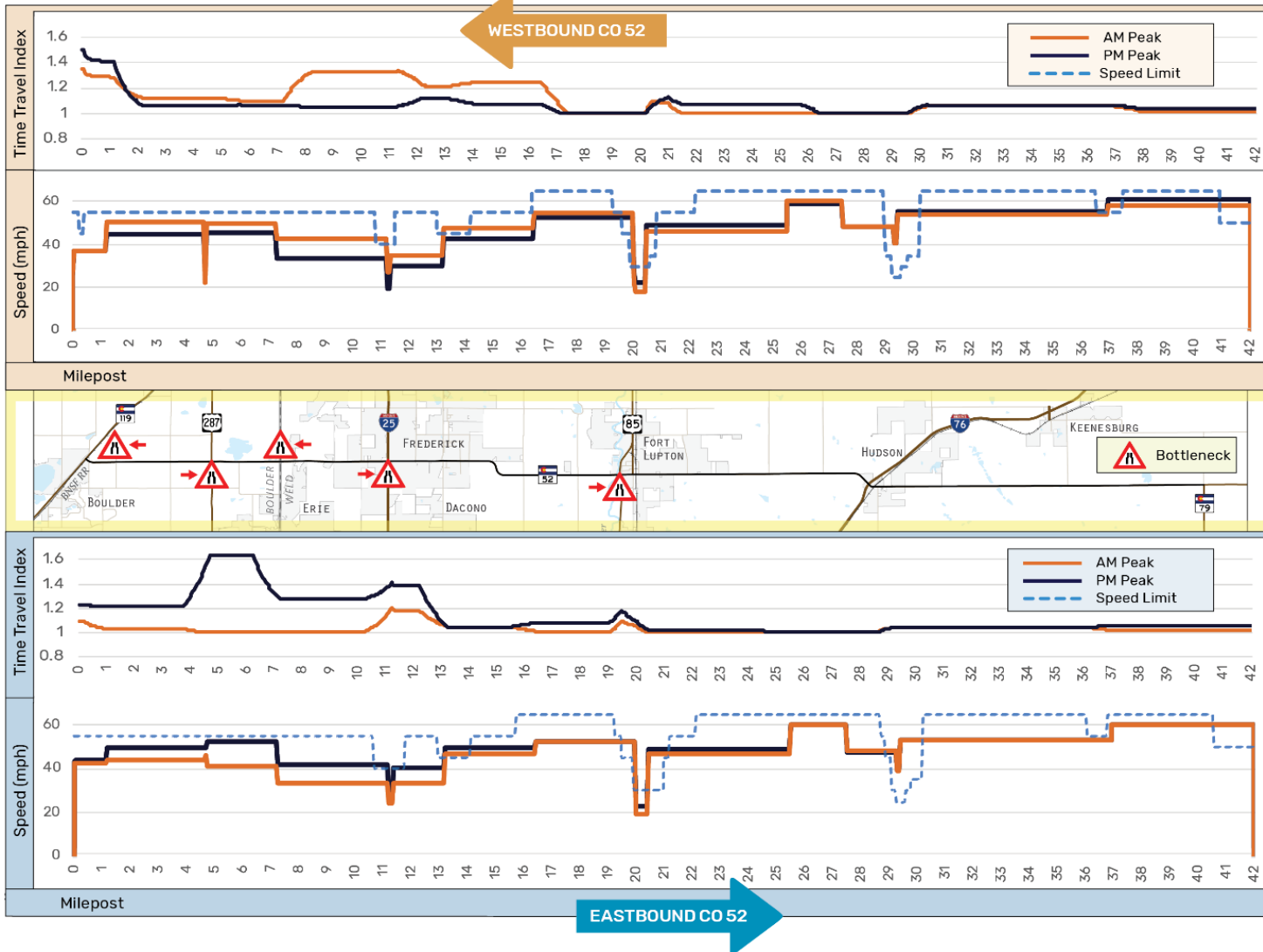
Crossing CO 52 is a significant challenge for bicyclists and pedestrians. Of 80 intersections, only 20 are signalized intersections and only two existing multi-use trails cross CO 52; the LOBO Trail crosses at an underpass just west of 79th St, and the Firestone/Legacy/Old Railroad Trail crosses CO 52 at-grade at Colorado Boulevard.

Accommodate Increased Travel and Freight Demands

A review of data from the Existing Conditions Report supports the need for improvements to anticipate the continued growth of both residential communities and freight movement along the project corridor.

Traffic Volumes

Existing traffic volumes create areas of congestion throughout the CO 52 corridor; lack of capacity at major signalized intersections is a major contributor. The result is delay to the traveling public with lengthy queues forming at multiple locations along the corridor. Between CO 119 and WCR 19 there are current delays with travel time indices at 1.3 (AM, in westbound direction) and 1.2 (PM, in eastbound direction). By 2045 they are expected to range from 1.8 to 2.1. From WCR 19 to WCR 31, the travel time index will increase to 1.2 to 1.4 (**Figure 3**). East of this location, the travel time index is expected to remain at or near 1.0. In the 2045 No Action scenario, travel times for the entire corridor are expected to increase by 22 percent to 31 percent during peak hours, with the western half expected to see increases of up to 71 percent in travel times.

Figure 3 CO 52 Segment Operations - September 2019


Corridor Growth and Development

CDOT's travel demand model, StateFocus (Version 1.4), uses socioeconomic growth projections to generate projected travel demand. 2045 No Action traffic volumes are projected to increase 40 to 55 percent in Boulder County, and over 90 percent in Weld County between Colorado Boulevard and US 85. Between US 85 and I-76, an increase of 6,000-7,000 vehicles per day is projected; east of I-76 will see an increase of 1,500 vehicles per day or less. Vehicle miles traveled (VMT) on CO 52 is projected to increase 74 percent between CO 119 and CO 79, from 308,000 VMT in 2015 to 534,000 in 2045.

This growth is due in part to increases in residential development along the corridor. As current agricultural or undeveloped land along the corridor becomes developed, into mostly residential areas, CO 52 will be utilized more frequently to connect to employment centers within the region. This is accentuated due to CO 52 serving as one of the main east-west corridors in the area. This may particularly affect connections to major north-south roadways such as CO 119, I-25, US 85, and I-76. Improvements will need to anticipate the projected traffic volumes to identify potential improvements that will increase travel time reliability along the project corridor.

CDOT's StateFocus model projects that the number of households within the corridor study area (defined as 3-mile buffer on either side of CO 52 extending from CO 119 to CO 79) will more than double by 2045, adding over 30,000 households for a total of nearly 54,000. As current agricultural or undeveloped land along the corridor is developed, CO 52 will be utilized more and more to connect employment centers within the region, significantly increasing the commuter traffic in the area. This growth could further increase congestion and reliability issues near major intersections.

Freight

The Upper Front Range 2045 Regional Transportation Plan identified CO 52 as a freight corridor in Colorado, which is a critical route that facilitates the movement of goods. Approximately 35-miles of CO 52 is located in Weld County, which is one of the state's top three agricultural producers and the number one producer of oil and gas in the state of Colorado. These industries require substantial amounts of heavy, lower-speed, and oversized vehicles. When roadway characteristics do not accommodate vehicle travel around slow-moving equipment, bottlenecks occur.

Freight rail lines traverse the corridor at three locations. The western crossing is located immediately east of CO 119, is 56-feet wide, has one set of tracks, and averages 6 trains per day. The central crossing is in Fort Lupton, is 56-feet wide, has one set of tracks, and averages 10 trains per day. The eastern crossing is in Hudson, is 40-feet wide, has three sets of tracks, and averages 18 trains per day. All crossings are at grade and have active signalization. Rail crossings slow traffic as trains traverse the corridor and are an additional cause for low travel time reliability.

Burlington Northern Santa Fe (BNSF) is building a Logistics Center at I-76 and CR 49, just north of the CO 52 corridor. This 430-acre facility will feature 15 sites for customers to ship via individual railcars and a unit train site for customers to ship entire trainloads. The improvements are designed to help customers more easily reach Denver and the surrounding markets via new rail-served sites. It is anticipated that this Logistics Center will increase the number of trains as well as motor vehicle freight in the surrounding area, directly impacting the CO 52 corridor.

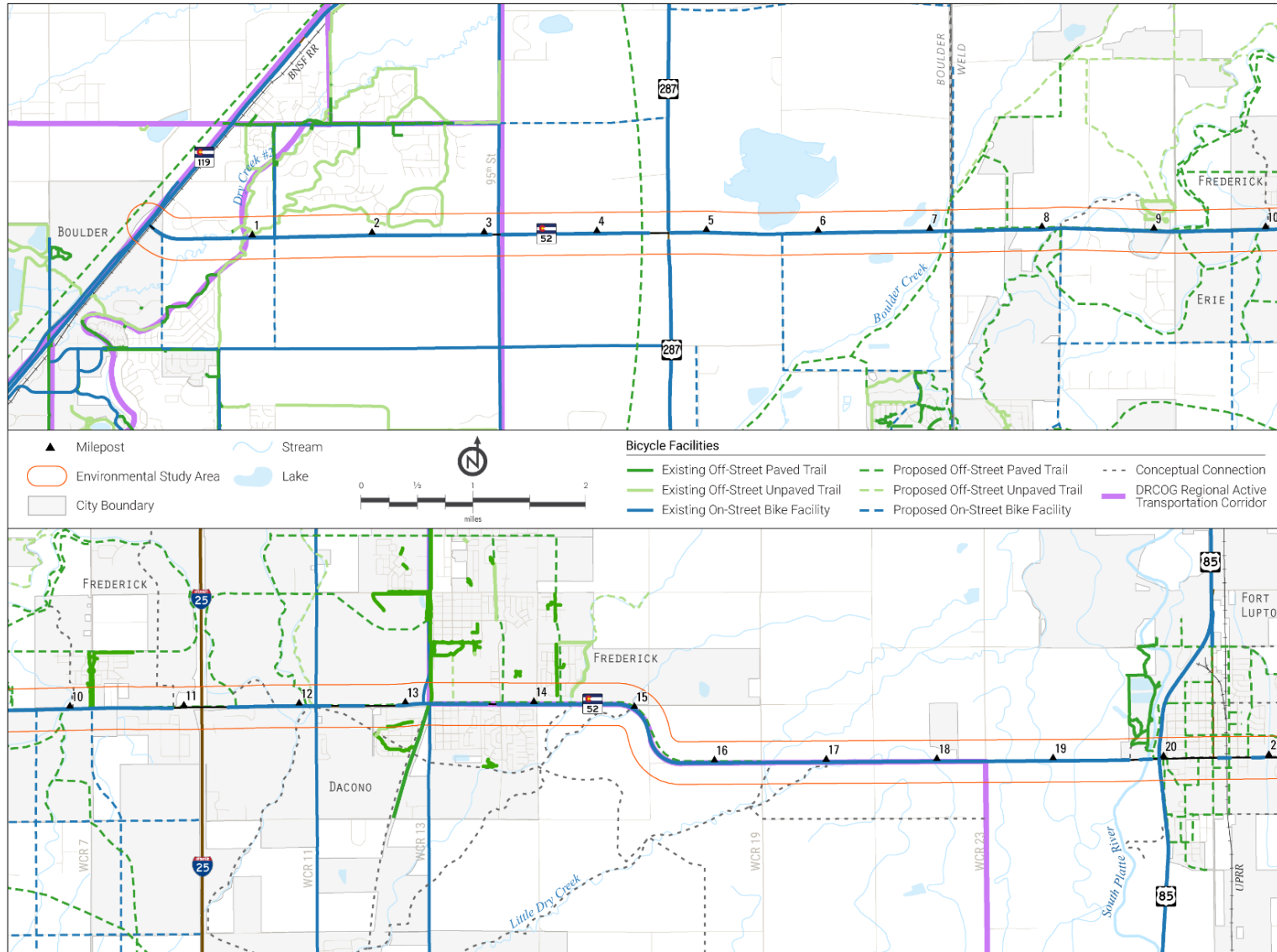
SUPPORT MULTIMODAL CONNECTIONS

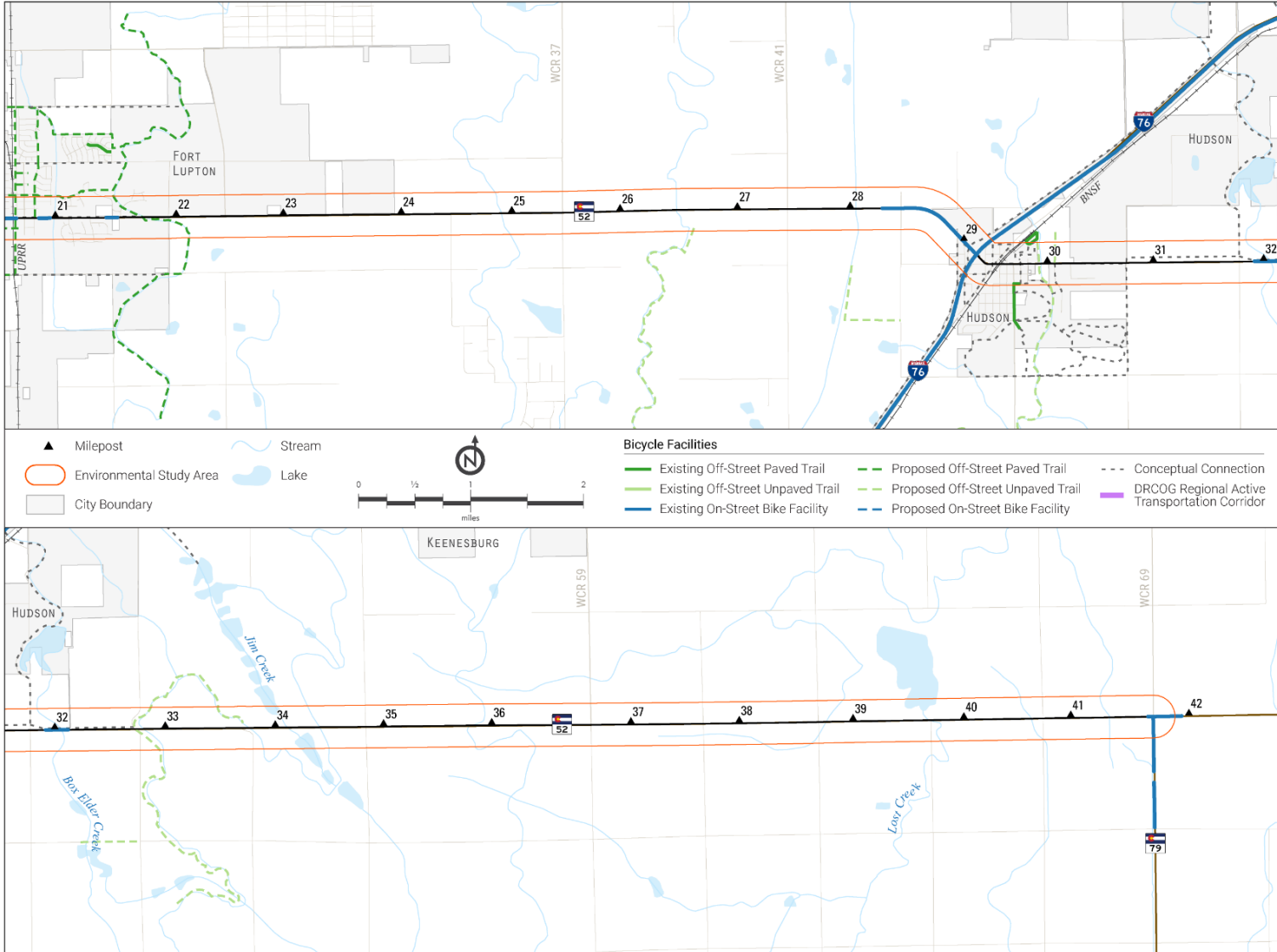
Stakeholder input and prior planning efforts identified the need to improve north-south mobility and support enhanced parallel connectivity.

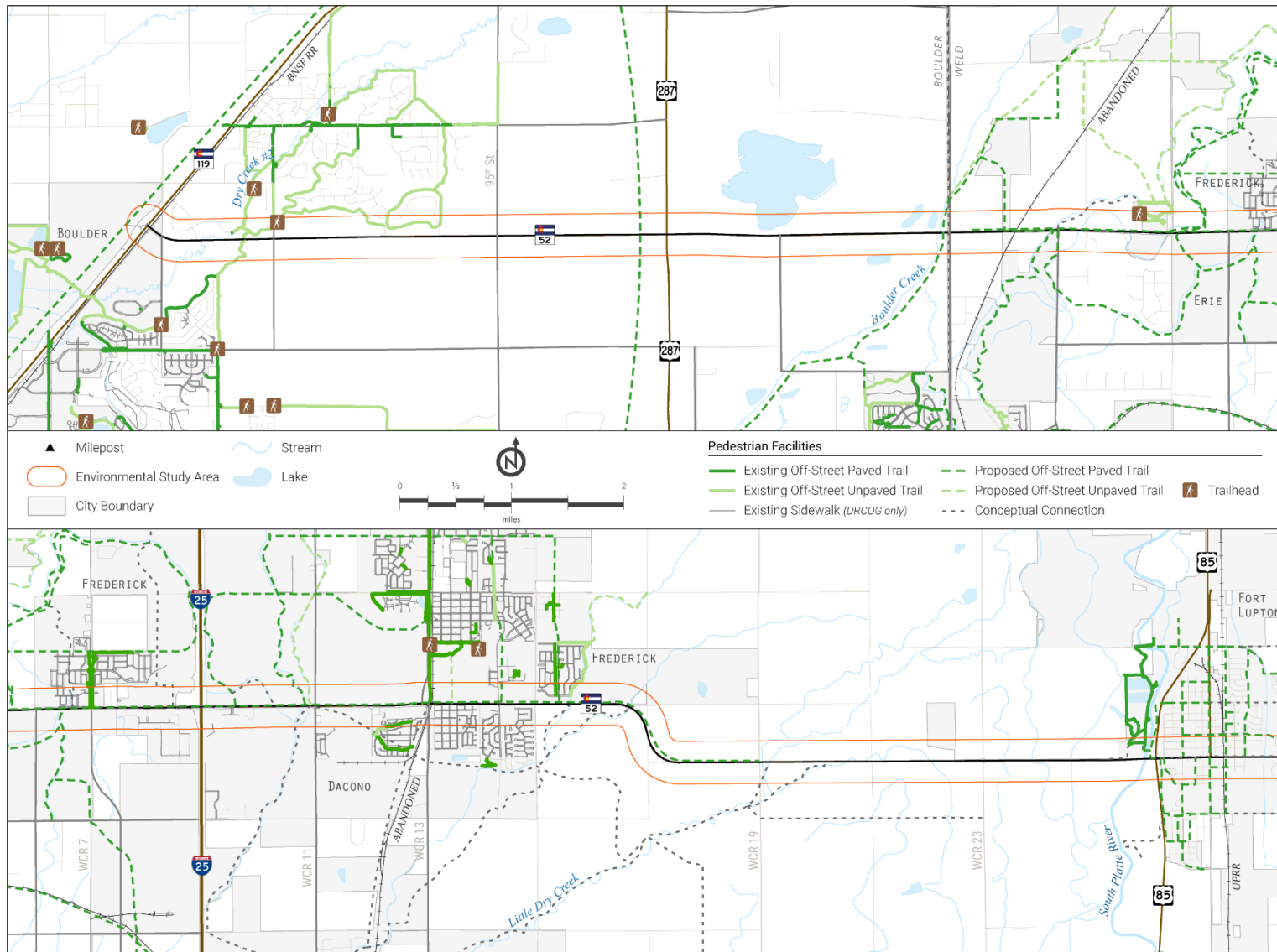
Multimodal Plans

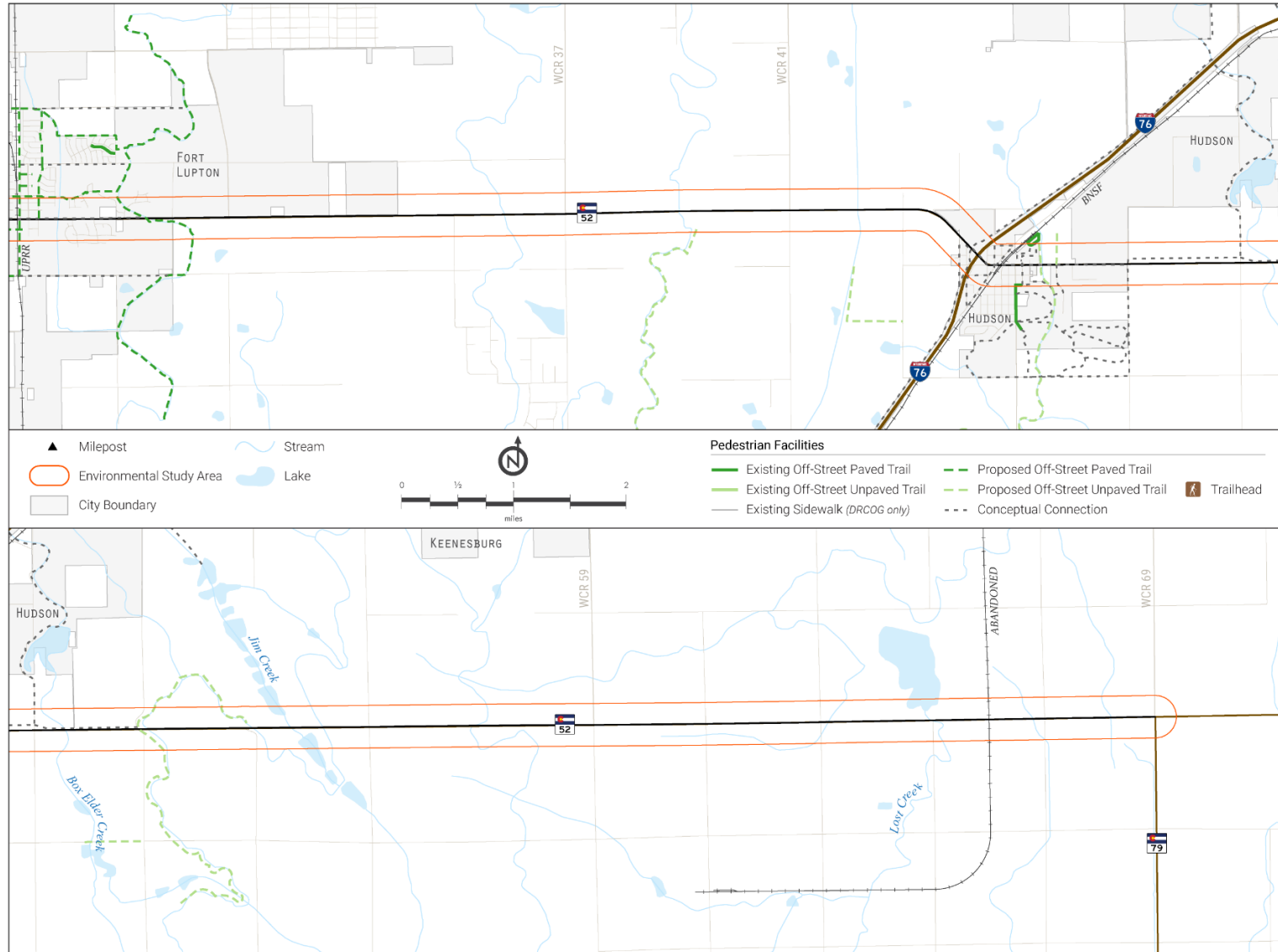
It is anticipated that increased multimodal use of the corridor will continue to occur as local agencies plan for additional pedestrian and bicycle facilities parallel to and crossing the corridor. CO 52 is a critical link between many communities from east to west. However, in several communities the corridor acts as a multimodal barrier between residential areas on one side and schools, parks, or businesses on the other.

The few existing pedestrian and bicyclist facilities that cross or run parallel to CO 52 are mostly located near Dacono, Frederick, Fort Lupton, and Hudson (**Figure 4**). Pedestrian needs are limited to these municipalities that are bisected by the corridor. Pedestrian travel is generated by schools, parks, and commercial use. In Frederick, Thunder Valley K-8 and Carbon Valley Parks and Recreation District have facilities located adjacent to or in the vicinity of CO 52. Within Fort Lupton, Fort Lupton Middle School, Butler Elementary, and Community Center Park and Recreation Center are located close to the corridor. The proximity of these facilities requires many students to cross CO 52 from the northern residential areas to these schools south of the corridor. Similar conditions exist in Hudson with Hudson Elementary and most residential areas to the south, and Hudson Memorial Park and many commercial uses primarily to the north. Overall needs of this corridor include improvements to safety and comfort level of existing pedestrian facilities by means of expanding sidewalk networks, increasing widths, detaching sidewalks from roadway edges, and installing controlled crossings where demand exists, and physical conditions allow.

Figure 4 Bicycle and Pedestrian Facilities






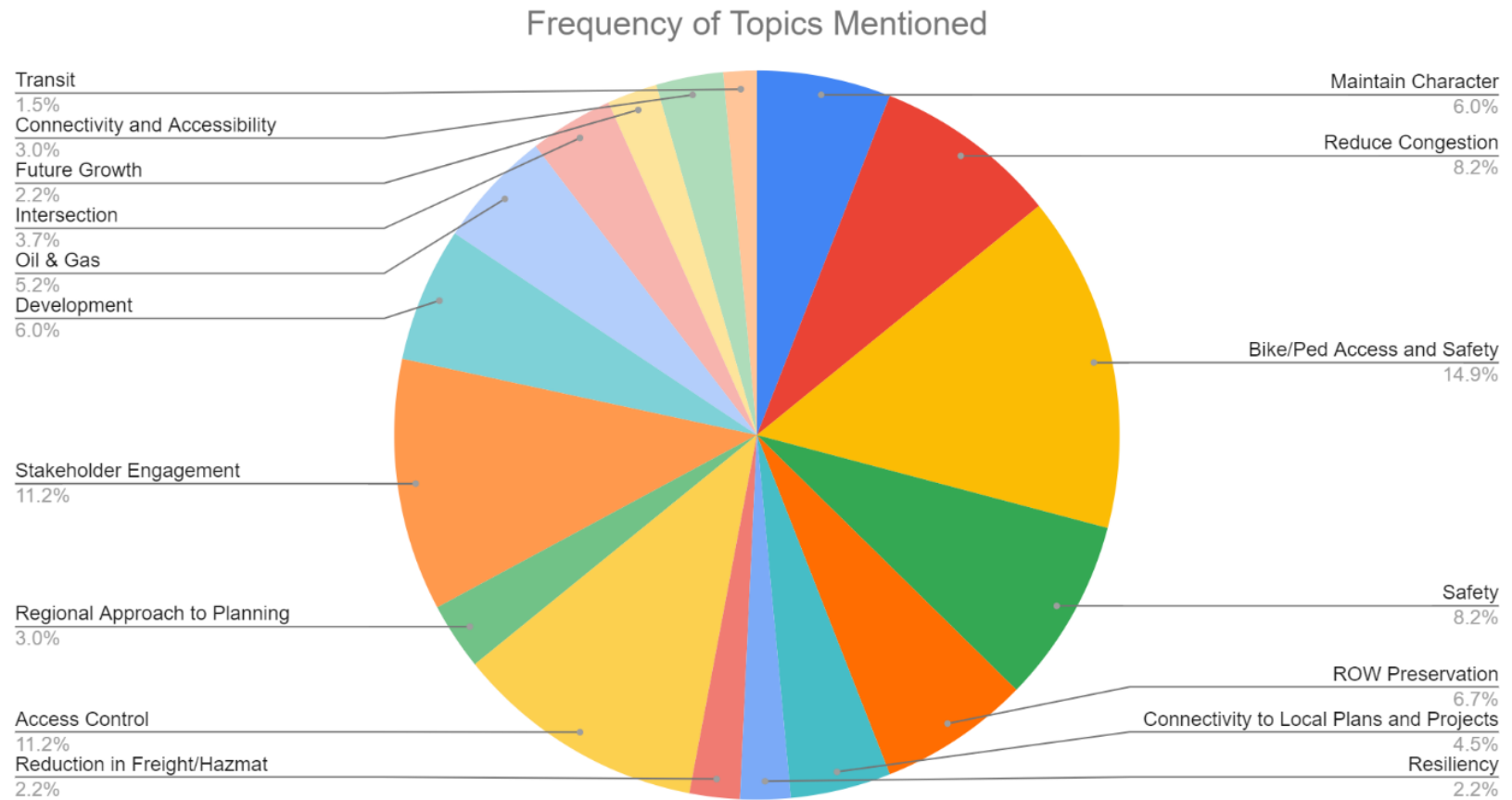


Each of the individual municipalities has proposed regional bicycle facilities and improvements, including extending and building new paths as the jurisdictional populations grow (**Figure 4**).

Stakeholder Interviews

Many project stakeholders, including Fort Lupton, Hudson, Dacono, Frederick, Erie, Keenesburg, and Boulder County, have expressed a strong desire to increase the pedestrian and bicycle facilities along and across the corridor (**Figure 5**). An assessment of the frequency of stakeholder mentions of corridor concerns indicates that multimodal improvements has the highest number of mentions during stakeholder discussions about the project. Specific multimodal needs mentioned by stakeholders include safe crossings and connectivity to existing trails, and safe travel between residential neighborhoods, business districts, parks, and schools. On the eastern end of the corridor, Keenesburg highlighted the lack of available shoulders or bicycle facilities. As described above, the CO 52 corridor provides a critical connection for bicyclists traveling east since bicycles are not allowed on I-76. Expanded shoulder widths are essential for cyclist safety on the eastern end of the corridor. Overall, improvements are needed to meet the expected growth in travel demand for pedestrians and bicyclists between communities along and across the corridor.

Figure 5 Frequency of Stakeholder Topic Mentions



GOALS OF TRANSPORTATION IMPROVEMENTS

The recommended transportation improvements were developed to support the project needs. The project goals should:

- **Consider the natural and built environment** – Improvements should minimize impacts to documented environmental resource constraints to the greatest extent possible. Environmental resource constraints documented in the Existing Conditions Report included wetlands, stream channels, floodplains, potential habitat for threatened and endangered (T&E) species and general wildlife, underground and above ground utilities, historic resources, and hazardous materials. Improvements should consider the built environment through a context-sensitive approach to land uses and character along the corridor that should consider both function and aesthetic of the surrounding land uses and character.
- **Support local and regional planning efforts** – Improvements should consider planning efforts by recognizing spatial recommendations for future and proposed local agency plans, such as multimodal connections, adjacent multi-use paths, and streetscape plans.
- **Identify estimated ROW needs** – Recommended project alternatives will be used to define the estimated ROW needs to support future growth along the corridor. Although a separate and concurrent process, the ACP will show the estimated ROW line developed during the PEL process to support local agencies in land use decision making.
- **Accommodate future technology** – Improvements should consider that increases in development and traffic volumes will result in changes in implementation and advancement of technology along the corridor. Transportation technology is anticipated to change within the next 20 to 30 years and improvements should consider the potential for technological advancement.

Appendix F-4

State Policy Memo



Project: CO 52 Planning and Environmental Linkages Study
To: Colorado Department of Transportation, Region 4
From: CO 52 PEL/ACP Project Team
Date: 7/14/2021
Subject: State Policy: Safety and Greenhouse Gas Emissions

Introduction

This white paper provides an overview of recent policy initiatives directed by Colorado's Governor, the state legislature, and state agencies in an effort to improve safety and reduce greenhouse gas emissions. These statewide priorities should be considered as part of the project development process and are integral for consideration relative to any outcomes resulting from the CO 52 Planning and Environmental Linkages (PEL) Study planning efforts.

Safety

Transportation safety policy in Colorado focuses on Vision Zero, a strategy to eliminate all traffic fatalities and severe injuries, while increasing safe, healthy, equitable mobility for all.¹ The Colorado Department of Transportation (CDOT) launched Vision Zero in 2015 with the 2014-2019 CDOT Strategic Highway Safety Plan which guided Colorado agencies and other stakeholders in taking action on improving transportation safety (CDOT, 2015). This was adopted after Governor Hickenlooper announced the vision of zero deaths for every individual, family and community using Colorado's transportation network, *Moving Colorado Towards Zero Deaths*, in 2015 (CDOT, 2015). Recent safety policy initiatives include the CDOT's Whole System, Whole Safety strategy (CDOT, 2019-2020) and the state's *2020-2023 Colorado Strategic Transportation Safety Plan* (CDOT, 2020), both described in more detail below. Recent legislation related to safety includes Colorado Senate Bill 21-260. This section provides an overview of these policy initiatives and legislation and covers how safety has been addressed in the CO 52 PEL planning process.

Whole System, Whole Safety (2019)

Whole System, Whole Safety (CDOT, 2019-2020) is a CDOT strategy launched in 2019 that includes both current and planned safety efforts to help reduce traffic injuries and deaths. This initiative takes a systematic, statewide approach to safety combining the benefits of CDOT's programs that address driving behaviors, the built environment, and the organization's operations. The goal is to improve the safety of Colorado's transportation network by reducing the rate and severity of crashes and improving the safety of all transportation modes. The program includes an effort to fully integrate safety in everything that CDOT does and supports real time operations. This program supports the overall strategy for Vision Zero (Vision Zero Network).

2020-2023 Colorado Strategic Transportation Safety Plan (STSP)

The *2020-2023 Colorado Strategic Transportation Safety Plan* (STSP) (CDOT, 2020) established a collaborative and shared vision and mission for transportation safety in Colorado. This plan reflects an extensive and cooperative planning effort by a multidisciplinary partnership of public agencies, private sector organizations, and advocacy groups representing transportation and safety interests statewide.

CDOT, the Colorado Department of Health and Environment, Colorado State Patrol, and the Colorado Department of Revenue are the lead agencies that directed the development of the STSP.

Through collaborative discussion, data-driven analysis, and contribution of time and expertise, the STSP identifies unique, yet achievable strategies and goals to minimize fatalities and serious injuries statewide in Colorado's current transportation system. The STSP embodies the state's new safety targets for 2023 - a reduction in fatalities and serious injury crashes by 15%. It relies on the premise that every agency and jurisdiction has a role in enhancing transportation safety to the benefit of our citizens and travelers for any transportation mode and facility in Colorado through policy, planning, funding design and construction, operations, and maintenance.

The STSP includes 15 Tier I (highest priority) Strategies that focus on proven countermeasures and targeted deployment, utilize current technologies, and identify roles and responsibilities for implementation. Tier II and Tier III supporting strategies are also included in the STSP. The STSP identifies performance targets for these measures to be achieved over the 2020 to 2023 period of the plan. Achieving the performance targets is dependent upon the lead agencies' attention and devotion of resources to implement the strategies. The performance targets can be achieved by successful implementation of the Tier I Strategies.

Colorado Senate Bill 21-260 (2021)

In June 2021, Colorado Senate Bill 21-260 *Sustainability Of The Transportation System*, was signed into law (https://leg.colorado.gov/sites/default/files/2021a_260_signed.pdf). This legislation establishes the Freight Mobility and Safety Branch in the Division of Transportation Development, which is designed to plan, design, and implement programs and projects that enhance freight mobility and safety within the state. This branch is funded through a portion of the new electric vehicle fees.

Addressing Safety in the CO 52 PEL Report

The strategy from the STSP that is most applicable for the CO 52 PEL Report is to "Prioritize Safety in Transportation Planning, Facility Design, and Project Selection." The CO 52 PEL Report does this by incorporating Safety as a part of the Purpose and Need for the project and as part of the screening criteria for the alternatives evaluation process. The consideration and prioritization of performance metrics applicable to safety along the CO 52 corridor ensures future improvements will align with the vision and mission set forth in the STSP.

Greenhouse Gas Emissions Reduction

In recognition of the role that transportation plays in greenhouse gas emissions, recent legislation and state agency policy initiatives have set the path toward reducing greenhouse gas emissions through transportation measures. These include Colorado House Bill 19-1261, the *Greenhouse Gas Pollution Reduction Roadmap* (Roadmap) (Colorado Energy Office, 2021), and Colorado Senate Bill 21-260 *Sustainability Of The Transportation System*. The *Pollution Reduction Planning for Transportation: Briefing Update* (CDOT, 2021) highlights CDOT initiatives being considered to implement the recent greenhouse gas emissions legislation. This section provides an overview of policy initiatives and legislation and covers how greenhouse gas emissions reduction has been addressed in the CO 52 PEL planning process.

Colorado House Bill 19-1261 (2019)

In 2019 Colorado legislature passed Colorado House Bill 19-1261, the *Climate Action Plan to Reduce Pollution* (https://leg.colorado.gov/sites/default/files/2019a_1261_signed.pdf), which set ambitious

greenhouse gas emissions reduction targets to combat climate change. This includes targets of reducing statewide greenhouse gas emissions from 2005 levels by 26% by 2025, 50% by 2030, and 90% by 2050. This bill enabled Colorado to establish itself as a global leader on climate policy. However, Colorado House Bill 19-1261 does not include many of the specifics of how Colorado will attain the goals. It requires the Colorado Department of Public Health and Environment's Air Quality Control Commission to promulgate rules to achieve the targeted reductions. It also requires the Air Quality Commission to track progress, reduce co-pollutants, and solicit input from frontline communities already experiencing harmful climate impacts. The Air Quality Control Commission is also permitted to coordinate with other jurisdictions and adopt their strategies (Denver Law Review, 2019).

Greenhouse Gas Pollution Reduction Roadmap (2021)

The *Greenhouse Gas Pollution Reduction Roadmap* (Colorado Energy Office, 2021) describes actions Colorado has taken to address climate change, analyzes the current trajectory for greenhouse gas emissions, and presents a suite of actions the state can pursue in the near term to make progress toward the Colorado House Bill 19-1261 goals. This report was led by multiple agencies—the Colorado Energy Office and the Colorado Departments of Agriculture, Natural Resources, Public Health and Environment, and Transportation. Additional support was provided by the Colorado Department of Local Affairs, the Colorado Resiliency Office, and the Office of Just Transition.

The goals for achieving greenhouse gas emissions reduction targets include increasing the number of electric vehicles and reducing the growth in vehicles miles traveled. The Roadmap envisions transitioning the vehicle fleet in Colorado to almost 100% zero emissions vehicles by 2050 and 100% market share for new vehicle sales of zero emissions trucks and buses by 2050. Achieving this will require close to 100% of new car sales to be electric by 2040. To reduce vehicle miles traveled, the Roadmap suggests changing the way development decisions are made regarding land use, housing, and infrastructure, which can enhance accessibility, cut pollution, and reduce the need to drive. The Roadmap implores the state to ensure that this transition is equitable and broad-based by developing policies and programs that will benefit communities that have been most heavily impacted by the pollution from transportation infrastructure, including highways and refineries.

The Roadmap introduces the following potential policy solutions:

- Trip reduction/Transportation Demand Management requirements and encouraging telecommuting for large employers.
- Clean trucking strategy with multiple components, including infrastructure investments incentives for fleet turnover, and evaluation of regulatory options.
- Secure new revenue to fund infrastructure and incentives to transition to electric cars, trucks, and buses.
- Offer incentives for land use decisions by local governments that reduce vehicles miles traveled, reduce greenhouse gas emissions and other pollutants, and support greater access to housing near jobs.
- Indirect emission source standards for some types of new development.
- Expand public transit, including Front Range Passenger Rail and completion by the Regional Transportation District (RTD) statutorily required FasTracks system that voters passed in 2004, including the Northwest Rail.
- Develop an Electric Vehicle Equity study to ensure access to electric vehicles for all Coloradans.
- Provide input into development of new clean car standards by both the federal government and for state-based standards.

The sum of emissions reductions from all of the strategies, once fully developed, is designed to meet the 2030 transportation sector reduction targets set in the Roadmap and to align with the 2050 goals adopted in Colorado House Bill 19-1261.

Colorado Senate Bill 21-260 (2021)

In June 2021, Governor Polis signed Colorado Senate Bill 21-260, *Sustainability Of The Transportation System*, into law. The bill includes an extensive transportation fee and spending measure, with more than \$5 billion to be spent over the next decade. The bill emphasizes electric vehicle adoption and expansion of mass transit, including the potential Front Range Passenger Rail system (Durango Herald, 2021).

In terms of transportation-related greenhouse gas emissions reductions, the legislation includes the following strategies:

- Implements air quality mitigation measures before federal and state sanctions occur. (CDOT, 2021)
- New requirements for regionally significant projects, including: (CDOT, 2021)
 - Requirements for CDOT and the Colorado Transportation Commission to develop and implement new procedures and guidelines that account for the impact these projects will have on statewide greenhouse gas emissions and vehicle miles traveled. At a minimum, these procedures and guidelines must:
 - Implement rules issued pursuant to C.R.S. § 5-7-105 (Air Quality Control Commission).
 - Otherwise reduce greenhouse gas emissions to help achieve targets established in C.R.S. § 25-107-2 (g) (Colorado House Bill 19-1261 greenhouse gas emissions reduction goals).
 - Apply same level of analytical scrutiny to greenhouse gas emissions as other pollutants of concern.
 - Consider the role of land use.
 - CDOT (and Denver Regional Council of Governments and North Front Range Metropolitan Planning Organization) must update their plans to comply with these policies by October 1, 2022.
 - Use models to determine air pollutant emissions impacts and provide monitoring and measurement of criteria pollutants prior to construction.
 - Develop and implement a Particulate Matter Construction Plan to provide continuous monitoring, public alerts, and action plans to prevent emission exceedances (focus on disproportionately impacted communities and develop and implement a plan to mitigate air quality impacts on communities).
 - With the exception of I-270, applies only to projects that do NOT have a signed National Environmental Policy Act document as of July 1, 2022.
 - Requires a review and update to the Department's public engagement plan for capacity projects.

Draft Pollution Reduction Planning for Transportation: Briefing Update (2021)

In response to the new legislative language in Colorado Senate Bill 21-260 and months of stakeholder discussions, CDOT is currently planning to propose to the Colorado Transportation Commission that it undertake a formal rulemaking process for pollution reduction planning, which would amend the current state planning rules in order to reduce pollution and greenhouse gas emissions levels for transportation. This would separate targets for CDOT and metropolitan planning organization transportation plans. This rule will include establishment of a processes to demonstrate and enforce

compliance. The Transportation Commission rule would focus on the connection between public sector-funded transportation projects and vehicle travel.

At the June 2021 Transportation Commission Meeting, CDOT staff presented *Pollution Reduction Planning for Transportation: Briefing Update* (Briefing). The Briefing stated that the purpose of establishing greenhouse gas emissions pollution standards for transportation projects is to create a standardized framework for assessing the expected impacts that a project or plan will have on consumer driving behavior. The goal is for project level decisions and planning level decisions to consider these impacts, among other considerations, and ensure that as state and metropolitan planning organization plans are updated and developed, projects within them fit within a fixed target when measuring cumulative emissions impacts.

The Briefing also outlines CDOT's new approach to the National Environmental Policy Act, which seeks to go above and beyond the minimum federal requirements. This includes modeling additional metrics such as fine particulate matter (PM_{2.5}) and induced demand for major projects currently underway, and such analysis will become a consistent expectation in project reviews moving forward. CDOT is exploring advanced mitigation to proactively identify ways to offset negative impacts of projects, as well as include elements that yield positive benefit for the community during construction and beyond. CDOT is also improving internal policies, such as requiring for the first time that communities follow the Department's process for approving new interchanges, which includes consideration and incorporation of transportation demand management strategies.

Other proposed implementation strategies in the draft rule include:

- Guidance on how different types of projects "score" in terms of greenhouse gas footprint, as well as a clear process for how those calculations are established and then updated.
- Outline a process for evaluating different categories of projects that can serve as mitigations, primarily by virtue of showing a reduction in vehicle miles traveled.
- Scope an evaluation process for how modeling for mitigations should be conducted and approved -- including transparency measures -- to ensure a public conversation about that process as well as a resulting policy that can be nimble and iterative.

As of the June 2021 Transportation Commission meeting, the Proposed Resolution #11: Greenhouse Gas is on hold (CDOT, 2021). This document will be updated to include feedback provided at the June 2021 Transportation Commission.

Addressing Greenhouse Gas Emissions in the CO 52 PEL Report

These greenhouse gas emissions reduction strategies are applicable to the CO 52 PEL Report, as the report will consider long-term transportation planning and project implementation along the corridor. Transportation infrastructure planning, funding, engineering, and construction can take several years, and it is imperative that the implementation process is consistent with Colorado House Bill 19-1261, the Roadmap, and Colorado Senate Bill 21-260. The CO 52 PEL Report recommendations for improvements are generally provided at a high level, without much detail on the design of the improvements. Because the recommendations are at a high-level, no air quality or greenhouse gas emissions metrics were used; however, next steps and the environmental process scoping recommendations will emphasize air quality and greenhouse gas emissions considerations and analyses. Projects that result from the recommendations set forth in the CO 52 PEL Report will be subject to applicable federal and state air quality and greenhouse gas emissions environmental regulations and processes, including those established in Colorado House Bill 19-1261, *Greenhouse Gas Pollution Reduction Roadmap*, and Colorado Senate Bill 21-260, as applicable.

References

- Colorado Department of Transportation (CDOT). 2019-2020. *Whole System, Whole Safety Fact Sheet*. <https://www.codot.gov/safety/assets/wsws-fact-sheet.pdf>
- Colorado Department of Transportation (CDOT). 2020. *CDOT's new campaign reminds drivers to drop the distraction as they head back out on the roads*. <https://www.codot.gov/news/2020/june-2020/cdots-new-campaign-reminds-drivers-to-drop-the-distraction-as-they-head-back-out-on-the-roads>
- Colorado Department of Transportation (CDOT). 2020a. *2020-2023 Colorado Strategic Transportation Safety Plan*. <https://www.codot.gov/safety/safetydata/safetyplanning/assets/strategictransportationsafetyplan.pdf>
- Colorado Department of Transportation (CDOT). 2020. *Strategic Transportation Safety Plan*. <https://www.codot.gov/safety/safetydata/safetyplanning/stsp>
- Colorado Department of Transportation (CDOT). 2021. *Performance Plan, Fiscal Year 2020-2021*. <https://www.codot.gov/performance/assets/cdotperformanceplan.pdf>
- Colorado Department of Transportation (CDOT). 2021. *June Transportation Commission Materials*. <https://www.codot.gov/about/transportation-commission/meeting-agenda.html>
- [Colorado Department of Transportation \(CDOT\). 2021. *CDOT Launches Moving Towards Zero Deaths*. <https://www.codot.gov/safety/cdot-launches-moving-towards-zero-deaths>](https://www.codot.gov/safety/cdot-launches-moving-towards-zero-deaths)
- Colorado Energy Office. 2021. *Colorado Greenhouse Gas Pollution Reduction Roadmap*. https://drive.google.com/file/d/1jzLvFcrDryhhs9ZkT_UXkQM_0LiiYZfq/view
- Denver Law Review. 2019. Implementation of HB 1261. <https://www.denverlawreview.org/dlr-online-article/implementation-of-hb-1261>
- The Durango Herald. 2021. *Colorado Legislature sends transportation bill to governor*. <https://www.durangoherald.com/articles/colorado-legislature-sends-transportation-bill-to-governor/>
- Vision Zero Network. *What is Vision Zero?* <https://visionzeronetwork.org/about/what-is-vision-zero/>
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Appendix F-5

Transit Memo



Project: 21656: CO 52 Planning and Environmental Linkages Study
To: Colorado Department of Transportation, Region 4
From: CO 52 PEL/ACP Project Team
Date: April 16, 2021 updated June 15, 2021
Subject: Transit Analysis Methodology and Results

Executive Summary

As a part of the CO 52 PEL study, an analysis was performed to explore the viability of transit options along the CO 52 corridor. The analysis considered transit route options along the western portion of the corridor, providing ridership estimates for year 2045 under differing scenarios.

Analysis of the CO 52 corridor of daily ridership forecasts from the travel demand model in year 2045 indicates fewer than 200 riders per day for a transit route along CO 52. This is relatively low compared to other routes in the region despite the generous route frequencies, addition of PnRs along the corridor, and direct connections to other routes in the region. A lack of dense employment/population centers along the corridor is likely the greatest factor in the ridership forecasts. The following documents the methodology, assumptions, and results of the transit analysis.

Background

CDOT's travel demand model was used to forecast future travel along the CO 52 corridor for the CO 52 PEL study. The travel demand model, StateFocus (Version 1.4), uses socio-economic projections for the State of Colorado to generate travel demand and distribute trips across the state's roadway and transit network.

Currently, there are only a handful of transit routes that cross or travel along CO 52 through the study area. They are described below:

- L Route – A regional route between downtown Denver and Longmont, the L is a north-south route traveling along US 287 through the study area. The L stops at the US 287 / CO 52 intersection.
- Bolt and J Routes – At the far west end of the CO 52 corridor, the Bolt and J routes travel along CO 119 between Boulder and Longmont. Both routes stop at the CO 119 / CO 52 intersection.
- LSX/LNX Routes – LSX connects downtown Denver and Longmont via I-25 and US 287. This route travels along CO 52 between US 287 and I-25 but has no stops on CO 52. The LNX also connects downtown Denver and Longmont but travels along I-25 through the study area. It also has no stops at CO 52.

- FLEX – A regional north-south route between Boulder and Ft Collins, the FLEX travels along CO 119 at the west end of the study area. The route has no stops at CO 52.
- Northline – A regional north-south route between downtown Denver and Ft Collins, the Northline travels along I-25 through the study area. The route has no stops at the CO 52 interchange.

In the year 2045, the following new services are included in the planned transit system:

- 119 BRT – A new bus rapid transit (BRT) service between Boulder and Longmont, the 119 BRT replaces the Bolt and J routes. This new service includes stops at the CO 119 / CO 52 intersection.

Other changes in 2045 include adjustments to the L route to new route versions (LD1 and LD2) and the LX routes (LX1 and LX2). None of these adjustments changes the route stops or alignments through the CO 52 study area.

Additional transit improvements in the area have been discussed but are not included in transit plans or the statewide travel demand model. This includes a CDOT Bustang route from Sterling to Denver with a stop in Hudson and a potential RTD BRT route along US 287. The Bustang route under consideration from Sterling to Denver would operate one to three days per week with one stop in the AM and one in the PM in Hudson. The RTD BRT route along US 287 was identified in the RTD Northwest Area Mobility Study of 2014 but is not in the DRCOG 2050 Fiscally Constrained Regional Transportation Plan. It is less defined at this time but would most likely replace current service along US 287 and could include a stop at the CO 52 / US 287 intersection.

In addition to the fixed routes discussed above, RTD operates the FlexRide program which provides extended bus service in specific Denver metro areas, including in Longmont north of the study area. Additionally, some curb-to-curb and door-through-door services operate in the area provided by private providers such as Via Mobility Services. These services commonly serve older adults, people with disabilities, and others with mobility limitations.

Methodology Overview

For the analysis of transit along the corridor, the project team performed multiple transit model scenarios in order to develop a range of ridership for the corridor. Three travel demand model runs were performed with the year 2045 travel demand model. The three scenarios include adding new bus service along the western portion of the corridor with variations to the route extents, service type, frequency, and stop locations.

Additionally, the project team examined land uses along the corridor to identify population and employment centers that may be attractive for transit service.

Transit Assumptions

In order to identify potential benefits resulting from transit along the CO 52 corridor, three transit scenarios were performed using the 2045 model. Each scenario includes an east-west bus route serving the corridor, with a range of service types and frequencies. The route alignments, service types, and route frequencies were chosen in hopes of providing a range of potential ridership for year 2045. Each terminate at the western end of the corridor to connect to the BRT service on CO 119. Different eastern endpoints were tested. The three scenarios are listed below:

1. Scenario 1: Local CO 52 Route – CO 119 to/from Frederick/Dacono
2. Scenario 2: Regional CO 52 Route – CO 119 to/from Ft Lupton
3. Scenario 3: Regional CO 52 Route – CO 119 to/from Brighton

A local route typically provides greater accessibility than a regional route as it has more stops and a higher frequency, along with a lower ridership fare. A regional route will have fewer stops at select locations in order to minimize travel time. Regional routes generally operate at lower frequencies and often only during peak periods.

Scenario 1: Local CO 52 Route – CO 119 to/from Frederick/Dacono

Scenario 1 includes a local route with extents on the west at CO 119 and on the east at Frederick/Dacono, as shown illustrated in Figure 1.

The west extent is located at CO 119, providing a connection to the 119 BRT. The route does not continue southwest along CO 119 into Boulder as RTD typically avoids providing overlapping services that compete with one another. On the east end, the route ends at WCR 15, providing service to/from the Frederick/Dacono area. This terminus point provides accessibility to the route for most of the existing and future development in the Frederick/Dacono area zones along CO 52. Zones further east have low existing and future population and employment totals.

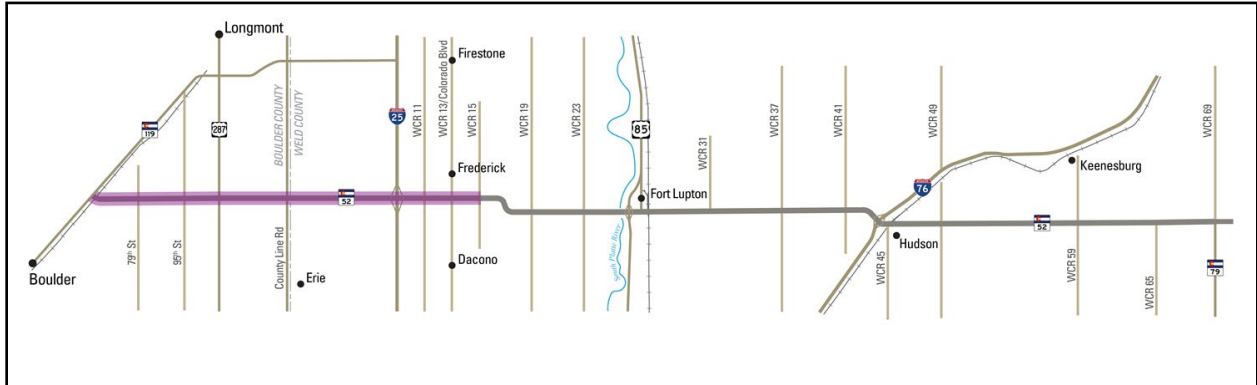
The route was given a relatively high frequency, similar to high-frequency local routes in the DRCOG region and the Boulder/Longmont area. The route frequency is 15 minutes during the peak, 30 minutes during off-peak, and 60 minutes during early morning and late evening hours.

Stops are located frequently along the bus route, at all major intersections and development access points along CO 52. To promote ridership, new Park-n-Rides (PnRs) were also included along the transit line at US 287, I-25, and WCR 15.

Transit routes in the 2045 model that cross CO 52 at CO 119, US 287, and I-25 were adjusted, as necessary, to include stops at CO 52 to allow for transfers with the CO 52 route. This includes the Northline, which for the sake of this analysis, now exits I-25 at CO 52, stops at the PnR locations at the interchange ramp terminals, and then continues back onto I-25. Though

not a planned improvement to the Northline, this adjustment, as with the addition of PnRs along the corridor, was included to support ridership along the CO 52 route.

Figure 1 Local CO 52 Route – CO 119 to Frederick/Dacono



Scenario 2: Regional CO 52 Route – CO 119 to/from Ft Lupton

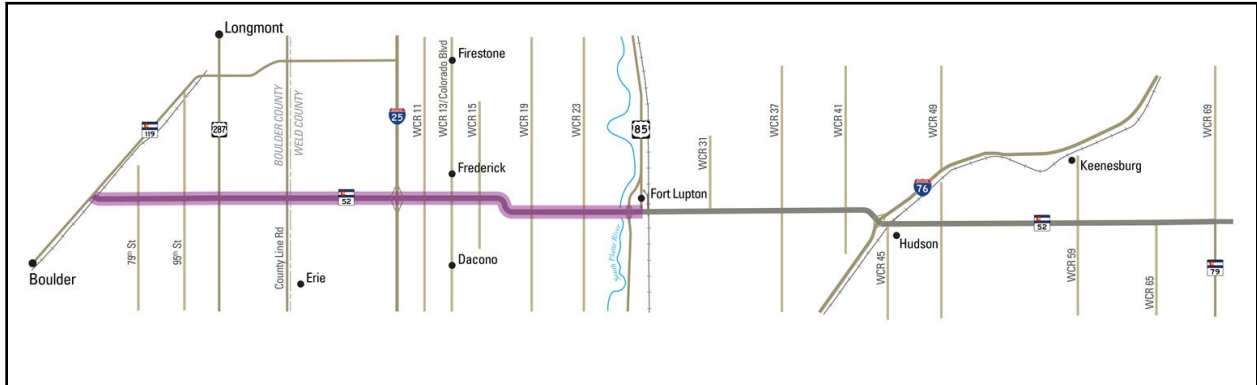
Scenario 2 includes a regional route with extents on the west at CO 119 and the east at Ft Lupton, as illustrated in Figure 2. East of Ft Lupton, land use density is quite sparse. Continuing the route further east was considered unnecessary as it would result in very low ridership.

The route was given a relatively high frequency for a regional route. The route frequency is 30 minutes during the peak, 60 minutes during off-peak, and 120 minutes during early/late hours. Typically, regional routes have peak hour frequencies between 30 and 90 minutes and off-peak or early/late frequencies of at least 120 minutes or no service at all. This includes both the N and Y routes which serve Boulder to/from Nederland and Lyons, respectively. The multiple L routes, which serve Longmont to/from Denver via various alignments, have combined frequencies similar to the frequencies proposed for the CO 52 route.

Stops are located at select locations along the route, including the major roadways (SH 119, US 287, I-25, and US 85) and at a handful of development access points including in Ft Lupton, Frederick/Dacono, and Niwot. Park-n-Rides (PnRs) were also included along the transit line at similar locations to those in Scenario 1. This includes PnRs at US 287, I-25, and at the east end of the route, which in this scenario is at the US 85 interchange just west of Ft Lupton.

All adjustments to connecting north-south routes from Scenario 1 have been carried forward into Scenario 2. This includes the addition of stops along the Northline route at the I-25/SH52 interchange PnR.

Figure 2 Regional CO 52 Route – CO 119 to Fort Lupton

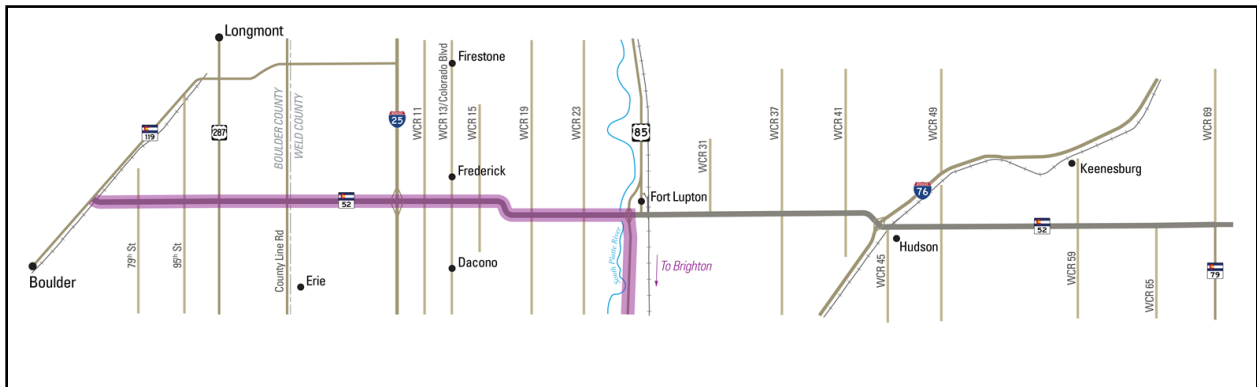


Scenario 3: Regional CO 52 Route – CO 119 to/from Brighton

Scenario 3 is a regional route between CO 119 and Brighton, as illustrated in Figure 3. This route is the same as the route from Scenario 2, except that it extends south from Ft Lupton along US 85 to Brighton. The route connects to other local and regional routes in Brighton.

All other attributes of the Scenario 2 regional route, including frequency, stop locations, PnR locations, and adjustments to north-south connecting routes, are included in Scenario 3.

Figure 3 Regional CO 52 Route – CO 119 to Brighton



Forecasting Results/Comparisons

Daily ridership forecasts from the travel demand model runs are illustrated in Table 1. The table shows ridership forecasts for year 2045 under the three transit scenarios described above as well as under the 2045 Base scenario, which is based on the planned transit network per the CDOT StateFocus model.

Table 1 Daily Transit Ridership – Two-Way Total

PROVIDER	ROUTE ID	DESCRIPTION	DAILY RIDERSHIP BY ALTERNATIVE			
			2045 BASE	2045 TRANSIT #1	2045 TRANSIT #2	2045 TRANSIT #3
NA	CO 52	Local or Regional per Scenario	NA	171	71	141
RTD	Y	Regional – Boulder to Lyons	34	32	34	37
RTD	N	Regional – Boulder to Nederland	77	81	83	88
RTD	119 BRT	BRT – Boulder to Longmont	2632	2836	2789	2800
Transfort	FLEX	Regional – Boulder to Ft Collins	1908	1915	1891	1853
RTD	Long Jump (A+C)	Local – Boulder to Erie/Lafayette	2264	2169	2239	2143
RTD	LSX/LNX	Regional – Longmont to Denver	1351	1199	1169	1231
Bustang	Northline	Regional – Ft Collins to Denver	283	1006	846	831

Source: CDOT StateFocus Model

Two-way ridership forecasts for the CO 52 transit routes range from 71 to 171 daily riders. The highest ridership, at 171 riders, is under Scenario 1, the local route extending from CO 119 to Frederick/Dacono. Scenario 3, the regional route extending to Brighton, has the second greatest ridership at 141 daily riders while Scenario 2, the regional route ending at Ft Lupton, has the lowest ridership at 71 daily riders. Conservatively assuming each of these transit riders would be a single-occupant vehicle driver, the models suggest that a transit route along CO 52 would decrease traffic volume by up to about 170 vehicles per day. This drop in passenger vehicle trips would be partially offset by an increase in buses, anywhere between 20 and 80 daily depending on the service, along CO 52 serving the transit route. This would also result in at least a partial offset to emissions reduction benefits from the decrease in passenger vehicles.

In addition to daily ridership forecasts along the CO 52 transit route, Table 1 illustrates ridership forecasts along other routes serving the region surrounding the study area.

The planned 119 BRT and the FLEX routes see slight variations in overall ridership under the three CO 52 transit scenarios, presumably from a shift in route choice and/or transfers related to the CO 52 route. The Jump A and Jump C routes, which extend east to Erie and Lafayette to/from Boulder, decrease slightly with the CO 52 route in place. This decrease is likely the result of the CO 52 route providing an east-west transit service that competes for certain trips.

The Northline experiences a significant increase in riders under the CO 52 route alternatives. This bump in ridership is related to the additional stop and PnR provided at the I-25/CO 52 interchange rather than from riders traveling along the CO 52 route that transfer to the Northline. Meanwhile, the drop in ridership on the LSX/LNX is likely due to travelers shifting from the LSX/LNX to the Northline, boarding at the I-25/CO 52 stop/PnR.

Socioeconomic Analysis

Transit ridership is typically greater in areas with denser population and employment. As a part of this transit analysis, employment density along the project corridor was reviewed. Figure 4 illustrates the employment density by traffic analysis zone for years 2015 and 2045, according to the CDOT StateFocus travel demand model.

Figure 4 Employment Density



Source: CDOT StateFocus Model

As Figure 4 shows, the vast majority of the CO 52 corridor exhibits employment density of less than 1 employee per acre in both years 2015 and 2045. Within the study area, growth in employment density from 2015 to 2045 occurs primarily along the CO 119 and I-25 corridors.

RTD Service Standards

To be consistent in the evaluation of service proposals and to ensure service is cost-effective, RTD has developed the *Transit Service Policies & Standards*, approved in July 2016. The document outlines RTD's current service "standards, the targets or minimum/maximum values for the standards, and a procedure for applying these standards." The standards are periodically updated. It is important to note that service expansion may occur if funds are available, just as

contraction of service may occur with a lack of funds. A route meeting the minimum required service standards does not guarantee implementation.

Routes are evaluated based on ridership and on a subsidy per passenger economic measure that combines fare revenue and total cost impacts. Productivity standards, separated by service class, are illustrated in Figure 5.

Figure 5 RTD Year 2019 Service Standards

Service Class	Subsidy Per Boarding			Boardings Per Hour		
	Average	10% Max	25% Max	Average	10% Min	25% Min
CBD Local	\$5.04	\$8.77	\$6.99	30.9	17.7	24.0
Urban Local	\$5.09	\$9.46	\$7.38	29.1	15.1	21.8
Suburban Local	\$7.67	\$12.80	\$10.36	19.5	10.1	14.6
Regional	\$6.68	\$15.16	\$10.90	32.2	10.4	20.8
FlexRide	\$22.60	\$34.09	\$28.61	3.5	1.9	2.7
Rail	\$10.52	\$17.82	\$14.34	126.5	62.0	92.7
Mall	\$1.25			181.8		
Access-a-Ride&Cab	\$48.44			1.4		
Vanpool	\$2.90			2.7		
System	\$7.19			32.6		
System 2018	\$6.07			31.1		

With a projected ridership of fewer than 200 riders per day, varying depending on the type and scope of service, a transit route along CO 52 would most likely not meet the minimum requirements of RTD's.

The RTD Service Standards also describe an area coverage standard (outside the Denver Central Business District) that combines population and employment to determine an area's potential demand for transportation. The minimum service levels for some form of transit route is 12 or more residents and employees per acre. The minimum service level for a Call-n-Ride service or Park-n-Ride service along a route is 3 to 12 residents and employees per acre. The CO 52 corridor does not meet this standard except for at the west end of the corridor at CO 119.

Summary

The ridership forecasts in year 2045 indicate fewer than 200 riders per day for a transit route along CO 52. This is relatively low compared to other routes in the region despite the generous route frequencies, addition of PnRs along the corridor, and direct connections to other routes in the region. A lack of dense employment/population centers along the corridor is likely the greatest factor in the ridership forecasts.

There are other factors that, when met, increase ridership along transit corridors. One of these factors is having a "one-seat ride" from origin to destination, i.e. no transfers. The transfer on the west end of CO 52 to the CO 119 BRT to reach Boulder likely results in fewer potential riders.

Additionally, a competitive travel time on transit can contribute to a boost in ridership. Having designated transit lanes may provide a slightly better travel time. However, eliminating transfers and providing dedicated transit lanes is unlikely to result in a meaningful boost to ridership totals when population and employment centers are so sparse along the corridor.

Traffic volume projections along the CO 52 corridor from CO 119 to US 85 range from 16,300 to 36,200 daily vehicles under the 2045 No Action scenario. A shift of fewer than 200 persons from auto trips to transit trips would result in less than a 1% decrease in daily traffic along any given segment of the corridor.



Appendix F-6

Traffic Forecasting and Screenline/ Parallel Routes Analysis Memo

Project: 21656: CO 52 Planning and Environmental Linkages Study
To: Colorado Department of Transportation, Region 4
From: CO 52 PEL/ACP Project Team
Date: July 7, 2021
Subject: Traffic Forecasting and Screenline/Parallel Routes Analysis

Executive Summary

This document summarizes the travel demand model traffic forecasting analysis and screenline/parallel routes analysis for the CO 52 Planning and Environmental Linkages (PEL) Study. The document includes an analysis of traffic volumes under existing conditions for year 2020, the 2045 No Action alternative, and four 2045 action alternatives using the CDOT travel demand model. Additionally, a summary of traffic volumes at screenline locations along CO 52, and parallel routes to CO 52 is included.

Currently, traffic along CO 52 from US 287 to the Dacono/Frederick area is approaching, and in some cases exceeding capacity. Under the No Action alternative, traffic volumes are expected to increase by 40% to 90% total capacity in this area by 2045. Under the 4-Lane action alternatives, volumes along CO 52 west of Dacono/Frederick are approximately 35% to 55% greater than volumes under the No Action scenario. Despite the increase in traffic along CO 52 under the 4-lane action alternatives, the major highways that parallel the highway, CO 119 and CO 7, experience minimal impact to daily volumes. The greatest impact from the 4-lane scenarios is that parallel roadways immediately adjacent to CO 52 experience daily volumes 5%-25% lower as compared to the No Action.

East of the Dacono/Frederick area, under the No Action scenario, volumes along CO 52 generally increase 30% to 80% by 2045. Under the 4-lane scenario, volumes between Dacono/Frederick and Ft Lupton increase nearly 50% while volumes east of Ft Lupton increase by less than 10%.

Background

The basis for the development of the CO 52 travel demand model was the CDOT StateFocus (Version 1.4) model (CDOT Model). The CDOT Model uses socio-economic projections for the State of Colorado to generate travel demand and distribute trips across the state's roadway and transit network. For the CO 52 PEL study, the 2015 model was used as the base year and the 2045 model was used as the horizon year.

The detailed travel demand forecasting methodology for the CO 52 PEL Study can be found in the *Travel Demand Forecasting Methodology Technical Memorandum*.

Travel Demand Model Scenarios

This section details the travel demand model runs performed for the alternatives analysis and summarizes the results, including the daily volumes along CO 52 and the Vehicle Miles Traveled (VMT) and the Vehicle Hours Traveled (VHT) in the study area.

Base Model Scenario Definitions

A base year model and horizon year model were developed for the CO 52 PEL travel demand forecasting effort based on the CDOT Model. The model scenarios are described below:

- 2015 Base Scenario – Roadway network adjusted to match existing 2020 conditions. Socioeconomic conditions are year 2015.
- 2045 No Action Scenario – Roadway network includes existing conditions and any improvements identified in regional transportation planning documents. CO 52 is generally two lanes throughout the corridor.

Because the CDOT Model does not include a year 2020 model, the CDOT 2015 Model was used as a basis for development of the CO 52 2015 Base Scenario model. To compare the 2015 Base Scenario model volumes to observed conditions, the model outputs will be factored to year 2020 to correspond with the 2020 count estimates.

For the factored volumes to be comparable to existing conditions, the CDOT 2015 Model's roadway network was reviewed and adjusted where necessary to replicate 2020 roadway conditions. The roadway network within the CO 52 Study Area and surrounding area was adjusted based on recent aerial photography and known roadway improvements.

The detailed steps used to develop the 2015 Base Scenario model and factor results to year 2020 volumes for comparison to real-world existing conditions are outlined in *Travel Demand Forecasting Methodology Technical Memorandum*.

2045 Alternative Model Scenario Definitions

Using the 2045 No Action Scenario model as a basis, four action scenario models were developed for the CO 52 PEL alternatives analysis. The alternatives analysis scenarios included the following:

- 2045 Full Four-Lane Scenario – CO 52 improved to four lanes from CO 119 to I-76.
- 2045 West Four-Lane Scenario – CO 52 improved to four lanes from US 287 to WCR 15 (east of Frederick/Dacono).
- 2045 Middle Four-Lane to US 287 Scenario – CO 52 improved to four lanes from US 287 to Denver Ave in Ft. Lupton.
- 2045 Middle Four-Lane to County Line Rd Scenario – CO 52 improved to four lanes from County Line Rd to Denver Ave in Ft. Lupton.

The four action alternatives each include widening CO 52 to four lanes along various stretches of the highway. The extents of those four-lane segments are illustrated in Figure 1.

Daily Volumes

Daily volumes from the travel demand model runs were post-processed using standard travel demand forecasting methods, as outlined in the *Travel Demand Forecasting Methodology Technical Memorandum*. The daily volumes from the travel demand model runs at select locations along the 42-mile corridor are shown in Table 1. Red text indicates the four-lane segments of CO 52. In addition, Figure 2 illustrates the volumes from west to east along the corridor under the various scenarios.

Table 1 includes 2020 daily volumes that were estimated based on traffic counts from 2017 to 2019. At the time the travel demand model forecasting was performed, the Covid-19 pandemic was impacting travel patterns and obtaining year 2020 traffic counts was not viable as the counts would not reflect “normal”, non-pandemic conditions. Historic counts were used instead, collected from the CDOT OTIS website, CDOT Model, and the Denver Regional Council of Governments’ Focus travel demand model (DRCOG Model). The 2020 volume estimates were developed, on a location by location basis, by factoring counts to 2020 based upon historic count patterns and growth rates observed in the CDOT Model.

Figure 1 2045 4-Lane Action Scenarios

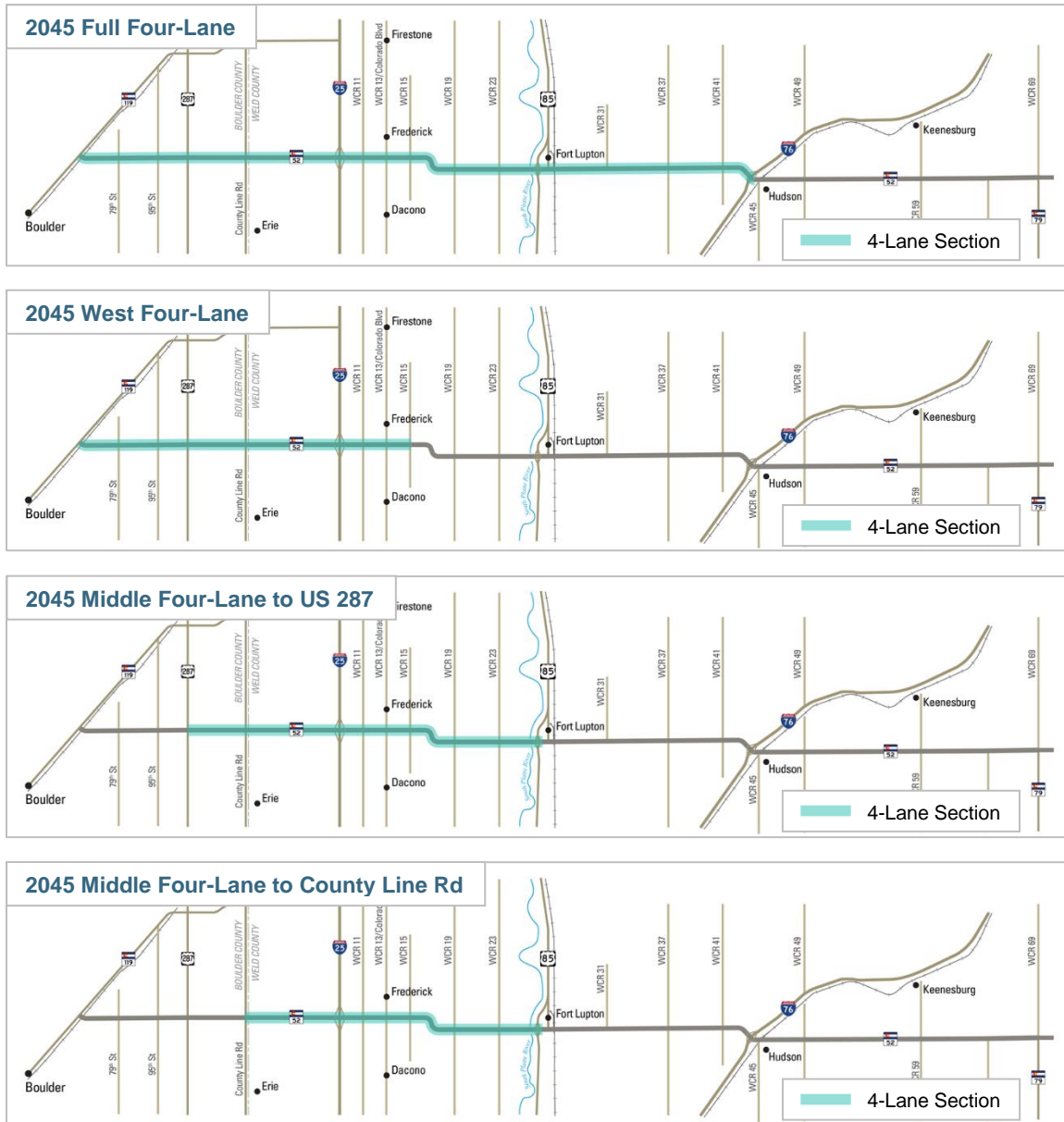
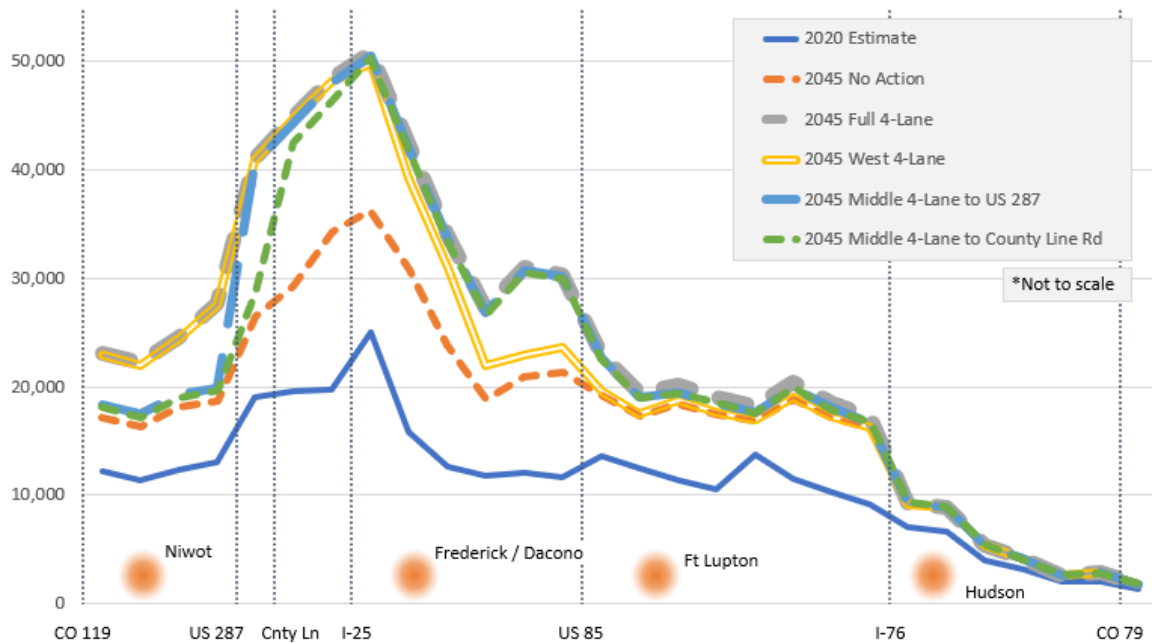


Table 1 Existing Counts & 2045 Daily Volume Forecasts

CO 52 Segment	Town	Segment Begin / End		Daily Two-Way Volumes					
				2020 Estimate	2045 No Action	2045 Full 4-Lane	2045 West 4-Lane	2045 Middle 4-Lane to US 287	2045 Middle 4-Lane to County Line
CO 119 to US 287	Niwot	CO 119	71st St	12,200	17,200	23,100	22,900	18,400	18,100
		71st St	Monarch Park Pl	11,400	16,300	22,200	22,000	17,500	17,200
		79th St	Somerset Dr	12,400	18,100	24,600	24,500	19,300	19,000
		95th St	US 287	13,000	18,700	27,700	27,600	19,900	19,600
US 287 to I-25		US 287	115th St	19,000	26,500	41,100	41,000	40,700	28,700
		CR 5	CR 7	19,600	29,300	45,000	44,800	44,400	42,500
		CR 7	W I-25 Frontage	19,800	34,300	48,400	48,200	48,100	46,500
I-25 to US 85	Frederick / Dacono	E I-25 Frontage	CR 11 (York St)	25,100	36,200	50,900	49,800	50,600	50,300
		Colorado Blvd	Glen Creighton Dr	15,800	30,800	42,400	39,200	42,100	41,700
		Glen Creighton Dr	CR 15 (Ridgeway)	12,600	23,800	34,000	31,100	33,700	33,500
		CR 15 (Ridgeway)	CR 14	11,800	18,900	27,200	22,000	26,900	26,600
		CR 19	CR 21	12,000	20,900	31,100	23,000	30,800	30,600
		CR 23	US 85 SB Ramps	11,600	21,300	30,400	23,600	30,200	30,000
US 85 to I-76	Ft Lupton	US 85 NB Ramps	Grand Ave	13,600	19,300	22,900	19,600	22,600	22,600
		Grand Ave	Fulton Ave	12,500	17,300	19,400	17,500	19,000	19,000
		Park Ave	Denver Ave	11,400	18,400	20,200	18,700	19,500	19,400
		Denver Ave	Main St	10,500	17,500	19,100	17,700	18,500	18,500
		Harrison Ave	Rollie Ave	13,700	16,900	18,200	17,000	17,600	17,600
		Rollie Ave	CR 29.5	11,500	18,800	20,400	19,000	19,900	19,900
		CR 35	CR 37	10,300	17,100	18,500	17,200	18,000	17,900
		CR 12.5	I-76 Frontage W (N)	9,200	16,200	17,200	16,300	16,700	16,700
I-76 to CO 79	Hudson	I-76 NB	Dahlia	7,000	9,200	9,300	9,200	9,300	9,300
		Cedar/Hudson	RR Xing	6,600	8,800	8,900	8,800	8,900	8,900
		Beech St	Cherry St	4,000	5,400	5,400	5,400	5,400	5,400
		CR 49	CR 51	3,100	4,100	4,100	4,100	4,100	4,100
		CR 59	CR 61	2,000	2,600	2,600	2,600	2,600	2,600
		CR 67	CO 79	2,000	2,800	2,800	2,800	2,800	2,800
		CO 79	East of CO 79	1,300	1,800	1,800	1,800	1,800	1,800

Source: CDOT StateFocus Model Version 1.4, 2020; model operation and volumes post-processing by HDR
 Note: Red text indicates CO 52 as a 4-lane section.

Figure 2 CO 52 Corridor – Daily Two-Way Volume Forecasts



Source: CDOT StateFocus Model Version 1.4, 2020; model operation and volumes post-processing by HDR

Existing Conditions

As Table 1 shows, between CO 119 and US 287, estimated daily volumes in 2020 range from 11,400 to 13,000 daily vehicles. East of US 287 to I-25, volumes are between 19,000 and 20,000 vehicles daily. CO 52 experiences the greatest traffic volumes through the I-25 interchange. Just east of the interchange, daily volumes exceed 25,000 vehicles between the East I-25 Frontage Rd and York St. Daily traffic volumes are generally in the 10,000 to 13,000 vehicle range between the Frederick/Dacono area and US 85/Ft. Lupton. East of Ft Lupton, volumes decline to about 9,000 vehicles approaching I-76. Volumes drop from about 7,000 to 2,000 vehicles between Hudson and CO 79. East of CO 79, estimated volumes in 2020 are just over 1,000 daily vehicles.

Traffic from US 287 to the Dacono/Frederick area is approaching, if not exceeding, capacity in 2020. Volumes are heavy between CO 119 and US 287 and east of Dacono to I-76, but do not generally exceed the capacity of a two-lane highway. East of I-76 and Hudson, daily volumes are very low and capacity constraints are not of concern.

2045 No Action

In 2045, traffic volumes under the No Action scenario generally increase between 30% and 70% with some locations nearly doubling in volume. Daily volumes between US 287 and US 85 generally exceed 20,000 vehicles with volumes over 36,000 just east of I-25. West of US 287 volumes grow by around 5,000 vehicles daily, or about a 40% to 50% increase over existing conditions. Between US 85 and I-76, daily volumes increase about 5,000 to 7,000 vehicles, or about a 40% to 75% increase. East of I-76, growth is more modest at no more than 2,200 daily vehicles and increases of less than 40%.

2045 Full 4-Lane Scenario

The 2045 Full 4-Lane Scenario assumed CO 52 as a four-lane highway from CO 119 to I-76/Hudson. East of Hudson CO 52 remains a two-lane facility. The four-lane scenario sees substantial increases in daily volumes along much of the corridor. West of US 287, daily volumes increase by up to 9,000 vehicles resulting in volumes between 23,000 and 28,000. Between US 287 and Frederick/Dacono, volumes increase by 11,500 to 16,000 vehicles (about 40% to 55%). Volumes through this stretch of CO 52 range from 41,000 to 51,000. East of Frederick/Dacono to US 85, volumes increase by 8,000 to 10,000 vehicles to between 27,000 and 34,000 vehicles.

East of US 85, volumes increase at a much lower rate. Through Ft. Lupton, volumes increase between about 1,500 and 3,500 vehicles per day, a 10% to 20% increase over the No Action scenario. East of Ft Lupton to I-76, daily volumes increase by about 1,000 vehicles to a range of 17,000 to 18,500. East of I-76 there is essentially no change in traffic volumes along CO 52 under the four-lane scenario. Even if CO 52 were a four-lane facility east of Hudson, volumes would be relatively unchanged as the two-lane facility provides more than enough capacity.

An increase in the capacity along CO 52 associated with the 4-lane scenario results in an increase in traffic volumes along the corridor, especially between US 287 and US 85.

Other 2045 4-Lane Scenarios

The other three 2045 4-lane scenarios include the West 4-Lane scenario, the Middle 4-Lane to US 287 scenario, and the Middle 4-Lane to County Line Rd scenario. These scenarios were modeled to gauge the varying levels of demand in 2045. Daily volumes along the 4-lane segments of each of these alternatives mirror the increased volumes reflected in the Full 4-Lane scenario, though the increases are generally a little lower.

Under the West 4-Lane scenario, CO 52 is a four-lane facility from CO 119 to WCR 15 just east of Dacono. Daily volumes from CO 119 to I-25 are nearly the same as in the Full 4-Lane scenario with daily volumes only 100 to 200 vehicles lower (less than a 1% difference). East of I-25 to WCR 15 in Dacono where the four-lane segment ends, volumes are up to 10% lower than in the Full 4-Lane scenario, but are still much greater than the No Action scenario by between 7,000 and 14,000 two-way daily vehicles at 31,000 to 50,000. The new four-lane segment west of WCR 15 influences volumes to the east of WCR 15. Daily volumes along the two-lane segment between WCR 15 and US 85/Ft Lupton are between 22,000 and 24,000 daily vehicles, up to 3,000 vehicles greater than the No Action scenario. East of Ft Lupton, volumes along CO 52 are essentially the same as the No Action volumes.

Under the Middle 4-Lane to US 287 scenario, CO 52 is a four-lane facility from US 287 to Ft Lupton. Daily volumes along the four-lane section are nearly the same as in the Full 4-Lane scenario with daily volumes between 200 and 700 vehicles lower. West of US 287 to CO 119, the daily volumes along the two-lane segment of CO 52 are about 1,000 vehicles greater (about 7% greater) than under the No Action scenario as the increased capacity along CO 52 to the east draws greater traffic volumes to/from the area. Similarly, east of Ft Lupton to I-76, daily volumes along this two-lane segment of CO 52 increase between about 500 and 1,000 vehicles compared to the No Action scenario, an increase around 3% to 6%. East of I-76, daily volumes are the same as the No Action scenario.

Under the Middle 4-Lane to County Line Road scenario, CO 52 volumes are very similar to the Middle 4-Lane to US 287 scenario. Only the segment between US 287 and I-25 sees much variation. From I-25 to County Line Rd, where CO 52 is a four-lane facility, daily volumes are up to 2,000 vehicles lower (up to 5% lower) than the Middle 4-Lane to US 287 scenario. Between US 287 and County Line Rd, where CO 52 remains a two-lane facility, volumes are about 29,000 vehicles, much closer to No Action volumes.

Corridor and Buffer Area Statistics

Statistics from each of the travel demand model runs were compiled for the 42-mile CO 52 corridor as well as for a three-mile buffer area surrounding the corridor. Year 2020 statistics were developed based on annual growth observed from the 2015 Base Scenario model to the 2045 No Action Scenario model. Table 2 shows the VMT, VHT, and average speed along CO 52 from CO 119 to CO 79.

Table 2 CO 52 Corridor Statistics

Scenario		2020 Base	2045 No Action	2045 Full 4-Lane	2045 West 4-Lane	2045 Middle 4-Lane to US 287	2045 Middle 4-Lane to County Line
Daily VMT	Miles	344,100	547,600	790,800	740,400	752,300	708,600
	vs 2015	n/a	+203,500 (+59%)	+446,700 (+130%)	+396,300 (+115%)	+408,200 (+119%)	+364,500 (+106%)
	vs 2045 No Action	n/a	n/a	+243,200 (+44%)	+192,800 (+35%)	+204,700 (+37%)	+161,000 (+29%)
Daily VHT	Hours	8,000	17,200	21,700	21,000	21,200	20,100
	vs 2015	n/a	+9,200 (115%)	+13,700 (+171%)	+13,000 (+163%)	+13,200 (+165%)	+12,100 (+151%)
	vs 2045 No Action	n/a	n/a	+4,500 (+26%)	+3,800 (+22%)	+4,000 (+23%)	+2,900 (+17%)
Daily Avg Speed	MPH	42.9	31.8	36.4	35.2	35.5	35.2
	vs 2015	n/a	-11.1 (-26%)	-6.5 (-15%)	-7.7 (-18%)	-7.4 (-17%)	-7.7 (-18%)
	vs 2045 No Action	n/a	n/a	+4.6 (+14%)	+3.4 (+11%)	+3.7 (+12%)	+3.4 (+11%)

Source: CDOT StateFocus Model Version 1.4, 2020; 2020 Base statistics estimated from CDOT Model by HDR

Comparing the 2045 No Action Scenario to the 2020 Base, VMT along the corridor is projected to increase by 203,500 miles, a 59% increase. This equates to a 1.9% annual increase in VMT. VHT along the corridor is expected to increase by 9,200 hours daily, a 115% increase or 3.1% annual increase. The greater increase in hours traveled compared to miles traveled is reflected in the substantial decline in average speed along the corridor from 42.9 MPH to 31.8 MPH, a 26% drop.

The four build scenarios show that there is substantial unserved demand to utilize the corridor in 2045. VMT under the 2045 Full 4-Lane scenario is over 240,000 miles greater than the 2045 No Action scenario, or 44% greater. VHT is greater by 26% and average speed along the corridor is 36.4 MPH, 4.6 MPH greater than the No Action. The other build scenarios exhibit VMT 29% to 37% greater than the No Action, VHT 17% to 23% greater, and average speeds about 11% or 12% greater.

Statistics were also compiled for the three-mile buffer area surrounding the CO 52 corridor. Table 3 shows the VMT, VHT, and average speed within the buffer area for each of the travel demand model scenarios.

Similar to the CO 52 corridor, the three-mile buffer area shows substantial growth from 2020 to 2045 in the No Action scenario. VMT is projected to increase by 61% (1.9% annually) while VHT is projected to increase by 100% (2.8% annually). The average speed in the buffer area is projected to decline by 20%, a little less than the CO 52 corridor's decline by 26%.

Table 3 CO 52 Three-Mile Buffer Statistics

Scenario		2020 Base	2045 No Action	2045 Full 4-Lane	2045 West 4-Lane	2045 Middle 4-Lane to US 287	2045 Middle 4-Lane to County Line
Daily VMT	Miles	2,861,600	4,597,000	4,806,100	4,766,700	4,778,300	4,741,400
	vs 2015	n/a	+1,735,400 (+61%)	+1,944,500 (+68%)	+1,905,100 (+67%)	+1,916,700 (+67%)	+1,879,800 (+66%)
	vs 2045 No Action	n/a	n/a	+209,100 (+5%)	+169,700 (+4%)	+181,300 (+4%)	+144,400 (+3%)
Daily VHT	Hours	60,100	120,100	123,000	122,800	122,700	122,300
	vs 2015	n/a	+60,000 (+100%)	+62,900 (+105%)	+62,700 (+104%)	+62,600 (+104%)	+62,200 (+103%)
	vs 2045 No Action	n/a	NA	+2,900 (+2%)	+2,700 (+2%)	+2,600 (+2%)	+2,200 (+2%)
Daily Avg Speed	MPH	47.6	38.3	39.1	38.8	39.0	38.8
	vs 2015	n/a	-9.3 (-20%)	-8.5 (-18%)	-8.8 (-18%)	-8.6 (-18%)	-8.8 (-18%)
	vs 2045 No Action	n/a	n/a	+0.8 (+2%)	+0.5 (+1%)	+0.7 (+2%)	+0.5 (+1%)

Source: CDOT StateFocus Model Version 1.4, 2020; 2020 Base statistics estimated from CDOT Model by HDR

The four build scenarios have VMT increasing between 140,000 and 210,000 over the 2045 No Action, a 3% to 5% increase. VHT and speeds are projected to increase by 1% to 2% under all four scenarios compared to the No Action. The VMT increase is about 85% to 90% of the VMT increase along the CO 52 corridor itself. This is an indication that some portion of trips are shifting from parallel corridors along the CO 52 corridor, but much of the VMT increase is due to a shift in trip patterns resulting from the increased capacity along the corridor.

Screenline Analysis

A screenline analysis reviews and compares traffic volumes along alternate parallel roadways that cross an imaginary line on a map. The analysis is used to understand regional traffic flow patterns, by providing information regarding the proportion of traffic utilizing various roadways and how these ratios/proportions may change during various forecasting years or under various roadway network conditions.

Methodology

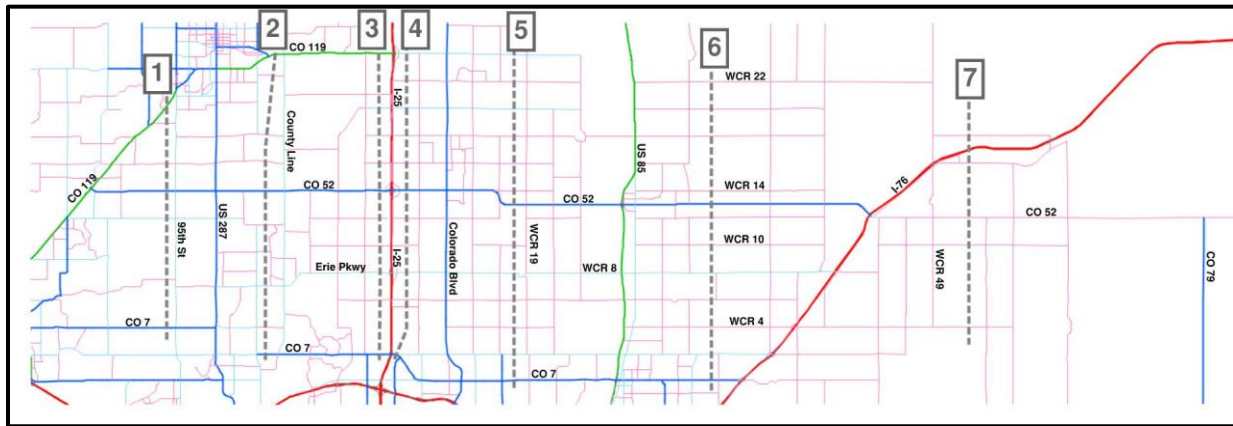
For CO 52, the project team compared traffic volumes from the CO 52 PEL 2045 No Action model and the 2045 Full Four-Lane model. The Full Four-Lane Model included CO 52 as a four-lane facility from CO 119 through the I-76 interchange.

For this analyses, the daily traffic volumes from the two models were reviewed and compared along the screenlines illustrated in Figure 3. Because this was a high-level analysis and post-processing of model volumes was not performed along roadways other than CO 52, the

analysis compared raw model volumes. Additionally, the focus was on the proportion of traffic along the roadways and how those proportions shifted under the two scenarios.

Also of note, volume increases along CO 52 under the 4-lane scenario do not exactly match volume decreases along parallel facilities. Many trips will use local facilities (not included in the analysis) or roadways outside the analysis area. Additionally, some trips may change destination based on the change in travel times associated with the differing roadway networks. Therefore, there may be an increase or decrease in trips crossing the screenline that is not directly associated with a “shift” from another route.

Figure 3 CO 52 Screenline Locations



Findings

The following section summarizes results from the individual screenline analyses.

West of Frederick/Dacono Area

Screenlines #1, #2, #3 and #4 are all located between CO 119 on the west and just east of I-25 on the east. Screenline #1 is west of US 287, #2 is west of County Line Road, #3 is west of I-25, and #4 is east of I-25. Major facilities crossing these screenlines include CO 119 and CO 7. These four screenlines tell a similar story in regard to the change in overall volumes crossing the screenlines and how volumes shift between the various roadways.

Total daily traffic volumes crossing the four screenlines increase between 5,000 vehicles and 12,000 vehicles under the 2045 Full Four-Lane scenario compared to the 2045 No Action scenario, as shown in Table 4. Screenline #4, east of I-25, experiences an increase in daily volumes of about 7% while the other three screenlines all experience daily volumes about 4% greater under the 4-lane scenario.

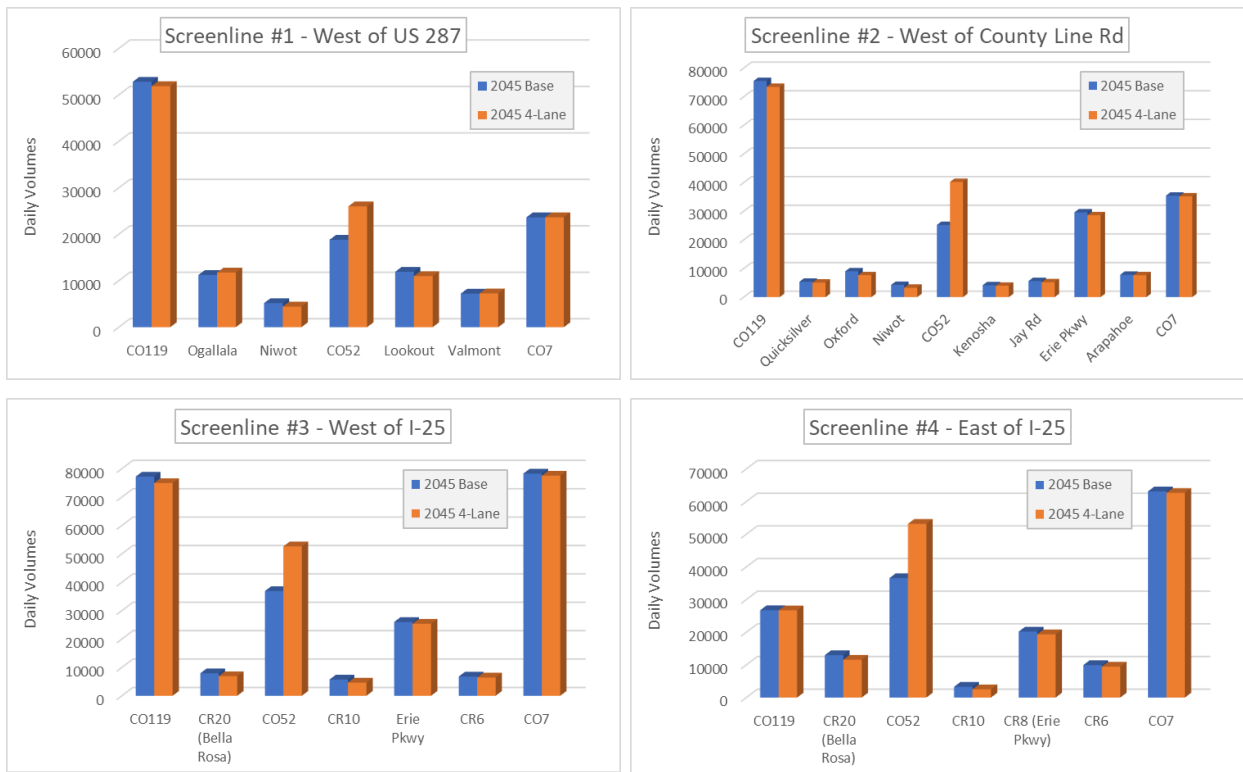
The major parallel highways crossing the screenlines, CO 119 and CO 7, experience little change in daily traffic volumes under the two 2045 scenarios. Figure 4 illustrates the daily volumes along the major roadways crossing Screenlines #1, #2, #3, and #4.

Table 4 West Screenline Daily Volumes

SCREENLINE		SCREENLINE DAILY VOLUME		DAILY VOLUME CHANGE	
ID	LOCATION	2045 BASE	2045 4-LANE	+/-	%
1	West of I-25	131,000	136,000	5,000	4%
2	West of County Line Rd	202,000	210,000	8,000	4%
3	West of I-25	239,000	248,000	9,000	4%
4	East of I-25	173,000	185,000	12,000	7%

Source: CDOT StateFocus Model

Figure 4 Screenlines #1-#4 – Focus Model Raw Daily Volumes



Source: CDOT StateFocus Model, Raw Model Volumes

Volumes along CO 119 are about 2% to 3% less under the 4-lane scenario at the three screenlines west of I-25. CO 119 just east of I-25 experiences essentially no volume change under the 4-lane scenario. Meanwhile, volumes along CO 7 are about 0% to 1% less under the 4-lane scenario at all four screenlines.

The greatest difference in volumes generally occurs along parallel roadways in close proximity to CO 52. West of US 287, Niwot Rd and Lookout Rd experience a relief in traffic as volumes are about 10% to 15% lower under the 4-lane scenario. West of County Line Rd, Niwot Rd and

Oxford Rd experience volumes about 15% to 20% lower. East and west of I-25, CR 10 and CR 20 experience volumes about 10% to 25% lower.

East of Frederick/Dacono Area

Screenlines #5, #6, and #7 are all located between CR 15 on the west (just east of the Frederick/Dacono area) and CO 79 on the east. Screenline #5 is located east of the Frederick/Dacono area, just west of CR 19. Total daily traffic volumes crossing this screenline increase about 5,000 vehicles (5%) from 95,000 under the 2045 No Action to 100,000 under the 2045 Full Four-Lane scenario, as shown in Table 5.

Table 5 West Screenline Daily Volumes

SCREENLINE		SCREENLINE DAILY VOLUME		DAILY VOLUME CHANGE	
ID	LOCATION	2045 BASE	2045 4-LANE	+/-	%
5	West of CR 19	95,000	100,000	5,000	5%
6	East of CR 31	31,000	32,000	1,000	3%
7	East of CR 49	22,500	23,000	500	2%

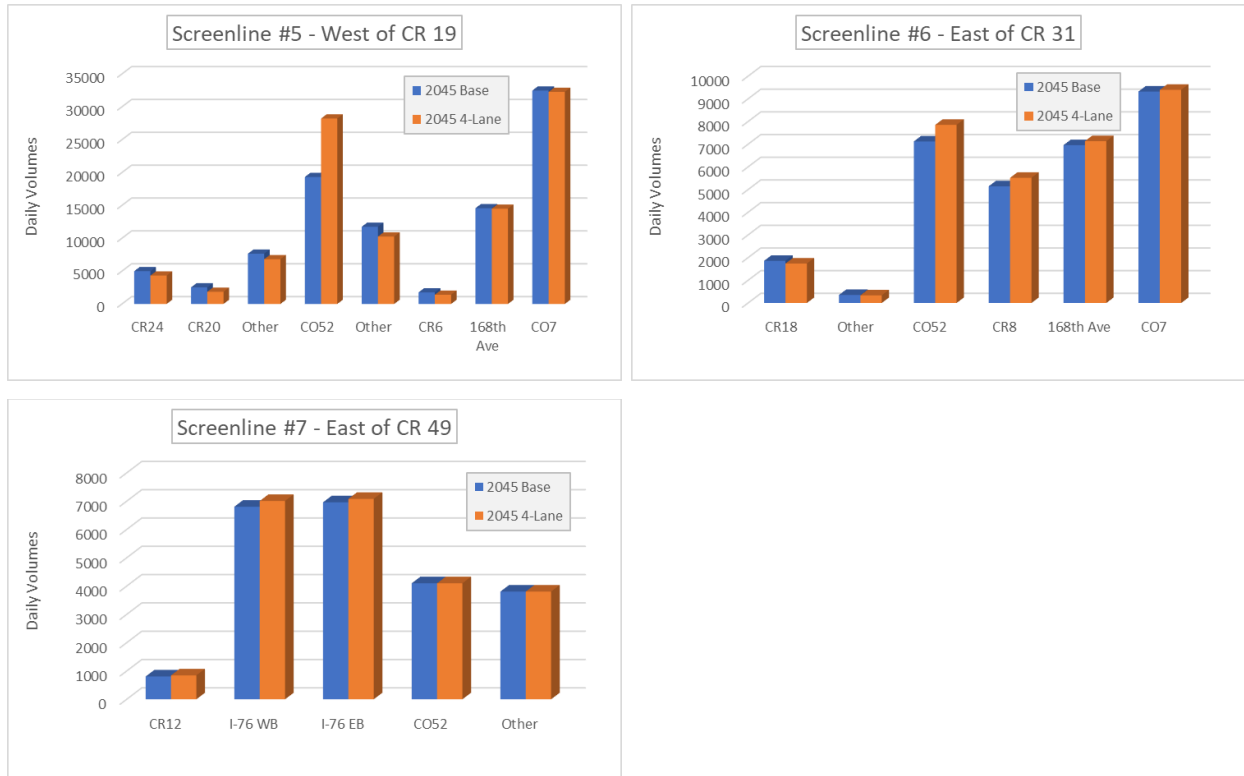
Source: CDOT StateFocus Model

Screenlines #6 and #7 are located east of CR 31 and east of CR 49, respectively. These two screenlines experience daily volume increases of 1,000 vehicles or less under the 2045 Full Four-Lane scenario compared to the 2045 No Action scenario, as shown in Table 5. It should be noted, under the 2045 Full Four-Lane scenario, the entire CO 52 corridor is four lanes *except* east of Hudson where the facility would remain two lanes. However, because the overall volumes in this area are relatively low, there would be no change expected to traffic volumes with a four-lane section east of Hudson as there is plenty of available capacity with a two-lane section.

At Screenline #5, west of CR 19, the major roadways to the south of CO 52, including CO 7 and 168th Ave, experience virtually no change in daily volumes under the 4-lane scenario compared to the 2045 No Action. Other facilities closer to CO 52 experience volumes that are between 10% and 25% lower under the 4-lane scenario. Figure 5 illustrates the daily volumes along the major roadways crossing Screenline #5.

At Screenlines #6 and #7, roadways crossing the screenlines generally experience minimal changes in daily volumes. At Screenline #6, east of CR 31, daily volumes are about 5% less on facilities north of CO 52 under the 4-lane scenario while some facilities to the south actually increase up to about 5%. This is likely due to increased accessibility to the area from the four-lane CO 52 sections to the west. Meanwhile, daily volumes along Screenline #7 east of CR 49 generally are unchanged or slightly increased under the 4-lane scenario. Again, improved access to the area via the 4-lane sections of CO 52 to the west are the likely cause for volumes increasing along the various roadways. Daily volumes along the major roadways crossing Screenlines #6 and #7 are illustrated in Figure 5.

Figure 5 Screenlines #5-#7 – Focus Model Raw Daily Volumes



Source: CDOT StateFocus Model, Raw Daily Volumes *except* along CO 52 east of CR 49 which are post-processed.

Summary

Alternatives Analysis

Today, traffic along CO 52 is approaching and, in some locations, exceeding capacity from US 287 to the Dacono/Frederick area. By 2045, traffic volumes are expected to increase by 40% to 90% under the No Action scenario in this area. West of US 287 to CO 119, traffic will increase by about 40% to 50%. East of Dacono to I-76 volume increases under the No Action scenario are generally in the 60% to 70% range. East of I-76, though volume increases are generally in the 30% to 40% range, volumes are expected to be below 10,000 daily vehicles.

With CO 52 as a four-lane facility, volumes between CO 119 and US 85 would increase compared to the No Action scenario by 35% to 55% depending on the location and specific scenario. East of US 85 to I-76, with CO 52 as a four-lane facility, volumes would increase by 5% to 20% compared to the No Action scenario. Volumes east of I-76 would essentially be unchanged under any of the 4-lane scenarios compared to the No Action as there is excess capacity available with CO 52 as a two-lane facility.

The CO 52 corridor is expected to see daily VMT totals under the 2045 No Action Scenario that are 203,500 miles greater than the 2020 Base, a 59% increase. Daily VHT is expected to grow to increase by about 115%. The result is daily average speeds along the corridor that drop 26%

from 2015, from 42.9 MPH to 31.8 MPH. The four-lane scenarios would result in even greater VMT and VHT as the new capacity would draw more trips. However, average speeds would improve to between 35.2 and 36.4 MPH depending on the alternative.

The three-mile buffer area would experience an increase in VMT and VHT from 2020 to 2045 similar to the percentage growth observed along the CO 52 corridor itself. The buffer area would experience absolute VMT and VHT growth similar to the CO 52 corridor under the four action alternatives compared to the 2045 No Action Scenario. Generally, the increased VMT and VHT is attributable to a shift in patterns resulting from the increased capacity along the corridor.

Screenline Summary

Though volumes along CO 52 increase by approximately 35% to 55% at the screenlines west of Dacono/Frederick compared to the No Action scenario, the major highways that parallel the highway, CO 119 and CO 7, experience minimal impact to daily volumes. The greatest impact from the 4-lane scenario is to parallel roadways in close proximity to CO 52 which experience daily volumes between 10% to 25% lower under the 4-lane scenario compared to the No Action scenario.

East of Dacono/Frederick at Screenline #5, west of CR 19, daily volumes along CO 52 increase by over 40% under the 4-lane scenario compared to the No Action scenario. A decline in traffic along parallel facilities close to CO 52 is evident and generally ranges from 10% to 25% of the No Action daily volume. Major roadways to the south, including 168th Ave and CO 7, experience virtually no change in volumes under the 4-lane scenario compared to the No Action scenario.

Screenlines #6 and #7, east of Ft Lupton and Hudson, respectively, experience small increases in overall daily volumes compared to the No Action scenario. Volumes along CO 52 increase under the 4-lane scenario by no more than 10% compared to the No Action scenario. Parallel facilities crossing the screenlines increase or decrease in volume generally by less than 10% compared to the No Action scenario.

Appendix F-7

Telework Analysis – Sensitivity

Model Run Memo



Project: CO 52 Planning and Environmental Linkages Study
To: Colorado Department of Transportation, Region 4
From: CO 52 PEL/ACP Project Team
Date: May 12, 2021
Subject: Telework Analysis – Sensitivity Model Run

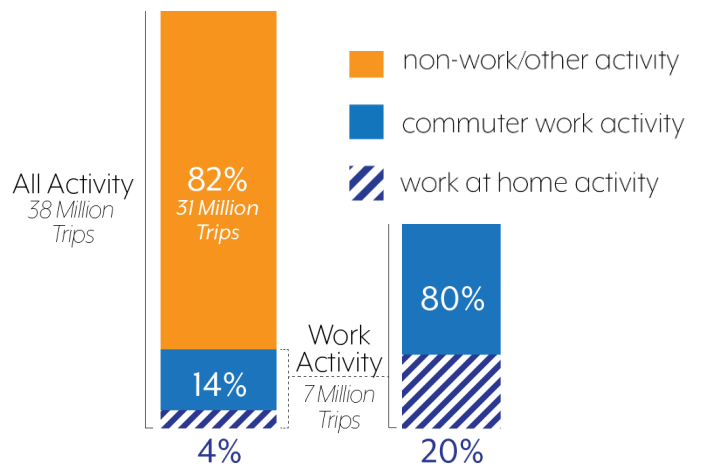
Executive Summary

During the COVID-19 pandemic, travel patterns shifted, including a portion of the work force shifting to telecommuting instead of commuting to an employment site. The shift in traffic volumes resulted in less total traffic on the roadway network, especially during traditional peak hours. The CO 52 Planning and Environmental Linkages (PEL) Study project team prepared this Telework Analysis – Sensitivity Model Run Memo (memo) to describe how the presumed increase in telework resulting from COVID may impact the level of traffic along the CO 52 project corridor.

The project team researched the CDOT StateFocus travel demand model’s telework assumptions (6.3% in future year models) as well as other Metropolitan Planning Organizations (MPOs) and regional models to identify trends in telecommuting, both before and after the pandemic. Telework percentages in the Denver Regional Council of Governments’ (DRCOG’s) travel demand model were adjusted in the newly released version from a target of 12% in future year models to 20%. DRCOG states that this adjustment was based upon observed data from 2010 to 2019 as well as from “an extensive literature and research review of expectations for the future.” Based on the findings in this research, the project team determined that it was necessary to perform a sensitivity model run for the corridor that targets 20% of work trips as Work at Home (WAH) trips in year 2045 to better reflect anticipated post COVID traffic patterns. It is important to note that WAH trips assume that the worker is not leaving their home to work. It can be presented that the “trip” is performed by telecommuting.

For this analysis, the telework assumptions in the CDOT StateFocus model were increased to 20% - consistent with the DRCOG adjustment. The sensitivity model adjustment to 20% of all work trips to WAH trips (or about 4% of all trips) resulted in daily traffic volumes on CO 52 that are, on average, 2.5% lower than without the WAH work trip adjustment. The following documents the methodology, assumptions, and results of the Telework Sensitivity Model Run.

2045 Statewide Telework Model Trip Estimations



2045 Telework Model

Background

Future traffic volumes were modeled along CO 52 using CDOT’s travel demand model. The travel demand model, StateFocus (Version 1.4), uses socio-economic projections for the State of Colorado to generate travel demand and distribute trips across the state’s roadway and transit network. The statewide model is an activity-based model, where activities can include commuting to work using vehicles, transit, micro-transit, bikes, etc.; freight and truck traffic; remotely working from your home via zoom or other virtual tools; and traveling to the grocery store. All activities are used to predict traffic outcomes along transportation corridors.

The project team requested a review of the CDOT StateFocus travel demand model’s telework assumptions and that a sensitivity model run be performed that assumes a greater percentage of work trips as WAH trips in year 2045. During the COVID-19 pandemic, travel patterns shifted, including a portion of the work force shifting to telecommuting instead of commuting to an employment site. The shift in traffic volumes resulted in less total traffic on the roadway network, especially during traditional peak hours.

The Telework Sensitivity Model Run was performed with a greater percentage (20%) of work trips designated as WAH trips as an output target based on the assumption included in the DRCOG sensitivity adjustment. The project team reviewed the current CDOT model’s WAH assumptions and researched other Metropolitan Planning Organizations (MPOs) and regional models to identify trends in telecommuting, both before and after the pandemic.

Existing Telework Assumptions

The percentage of work trips that are WAH trips in the CDOT travel demand models (without DRCOG sensitivity) are illustrated in **Table 1**. In the base year 2015 CDOT model, 6.0% of work trips statewide are WAH trips. In the 2045 model, the percentage of WAH trips increases to 6.3%. As noted earlier, 6% of work trips equates to about 1% of all trips, which includes non-work trips and commercial/freight trips. In Boulder and Weld Counties, where the CO 52 corridor resides, the percentages of WAH trips is slightly higher at 6.2% in 2015 and 7.2% in 2045.

Table 1 Travel Demand Model Work-at-Home Trip Percentages

MODEL	YEAR	WORK-AT-HOME TRIPS AS PERCENTAGE OF WORK TRIPS	
		REGIONWIDE	BOULDER & WELD
CDOT	2015	6.0%	6.2%
	2045	6.3%	7.2%

Sources: CDOT StateFocus Model

Telework percentages in the Denver Regional Council of Governments' (DRCOG's) travel demand model were adjusted in the newly released version from a target of 12% in future year models to 20%. DRCOG states that this adjustment to Focus 2.3 was based upon observed data from 2010 to 2019 as well as from "an extensive literature and research review of expectations for the future."

Prior to the COVID-19 pandemic, other planning agencies were anticipating growth in the percentage of telework. The San Diego Regional Planning Agency's (SANDAG's) travel demand model documentation from 2018 shows that telework is expected to grow into the future from 12.1% in 2016 to 15.5% in 2050. The telework trendline developed for the SANDAG model was based on multiple sources including the National Household Travel Survey (NHTS), California Household Travel Survey (CHTS), SANDAG Regional Transportation Study, and the Census American Community Survey (ACS).

Telework Sensitivity Model Run Results

The project team adjusted the WAH target to 20% in the travel demand model's telework inputs. The sensitivity model run was performed under the 2045 No Action conditions.

The project team reviewed the traffic volumes along the CO 52 corridor with the sensitivity adjustment and compared the results to the raw model volume outputs from the 2045 No Action model. The change in traffic volumes along the CO 52 corridor are illustrated in **Table 2**.

As the results show, daily traffic volumes along the CO 52 corridor are, on average, 2.5% lower in the Telework Sensitivity model run. The segments west of WCR 31, which carry higher volumes, are lower by 1.2% to 2.4%. The segments further east are lower by 3.3% and 9.0%. The PM peak hour exhibits a similar pattern. Volumes west of WCR 31 are lower by 3% or less while to the east, volumes are up to 11% lower. The AM peak hour experiences even greater declines throughout the corridor than the PM peak hour. Segments 1, 2, and 3 experience volumes 2.6% and 4.7% lower than the 2045 No Action, just about double the daily decline exhibited in this area. Further east along Segments 4 and 5 the volumes are lower by an even greater amount at 7.3% and 20.5%, respectively.

Table 2 Traffic Volume Difference – 2045 Telework Model vs 2045 No Action Model

SEGMENT	LOCATION	% DIFFERENCE IN VOLUMES		
		AM PEAK	PM PEAK	DAILY
1	Between CO 119 and County Line Road	-4.7%	-3.0%	-2.4%
2	Between County Line Road and WCR 19	-2.6%	-2.3%	-1.2%
3	Between WCR 19 and WCR 31	-3.6%	-1.8%	-2.4%
4	Between WCR 31 and WCR 49	-7.3%	-2.9%	-3.3%
5	Between WCR 49 and CO 79	-20.5%	-10.8%	-9.0%
Total Corridor		-5.4%	-3.3%	-2.5%

Note: Telework analysis utilized the 2045 No Action model as a basis. Percentages are based on raw model outputs.

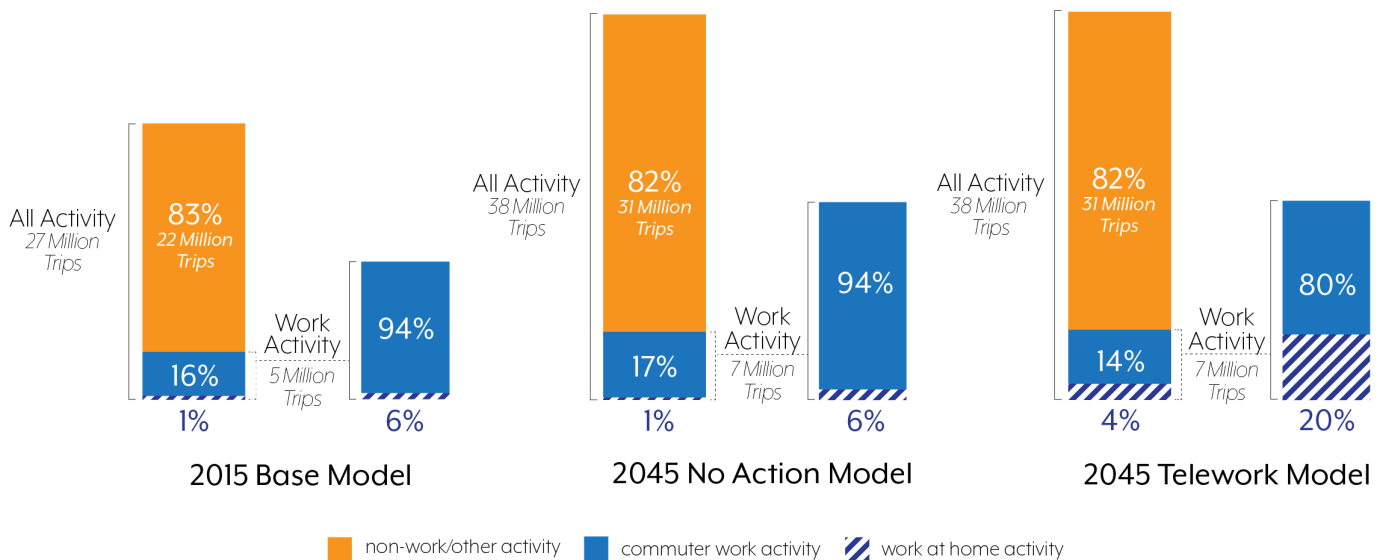
The greater declines in volumes along the eastern end of the corridor, particularly along Segment 5 east of WCR 49, are likely more a reflection of the variability and uncertainty exhibited in the travel demand model in this area, rather than an indication that there is a large shift to WAH trips in the eastern portion of the corridor. The model roadway network and traffic analysis zones in this area are not as refined as the rest of the CO 52 corridor and therefore may be more responsive to adjustments to model inputs.

Conclusion

The sensitivity model adjustment to 20% of all work trips to WAH trips (or about 4% of all trips) resulted in 2045 traffic forecasts that are lower than the 2045 No Action model forecasts. The forecasted volumes, on average, are about 2.5% lower during the day, 5.4% lower during the AM, and 3.3% lower during the PM. Along the CO 52 corridor west of WCR 31, the daily volumes are lower by approximately 1.2% to 2.4%. In the east, the forecasted volumes are lower by greater amounts, though this may be more a reflection of variability and uncertainty in the model in this area.

The overall impact on volumes along the corridor are in alignment with expectations with the DRCOG sensitivity adjustment. Average changes for the region are depicted in **Figure 1**.

Figure 1 Model Trip Estimations (Statewide)



As the figure shows, non-work and commercial/freight trips combined are more than 80% of all trips in the 2015 and 2045 models. The Telework Sensitivity model resulted in WAH trips increasing as a percentage of all trips from about 1% to approximately 4%. Thus, 2045 daily traffic forecasts that are approximately 2% to 3% lower, as observed in the model results, should be expected.

The background of the header section features a faint, light blue graphic of a road network. A specific path is highlighted in a darker blue, starting from the bottom left and moving towards the top right. The path consists of several segments: a diagonal line, a horizontal line, another diagonal line, and a final curved segment that rises sharply towards the top right corner. Vertical grid lines are also visible in the background.

Appendix F-8

Origin-Destination Trip Pattern Analysis Memo

Project: CO 52 Planning and Environmental Linkages Study
To: Colorado Department of Transportation, Region 4
From: CO 52 PEL/ACP Project Team
Date: September 22, 2021
Subject: Origin-Destination Trip Pattern Analysis

Origin-Destination Trip Pattern Analysis

This document summarizes the origin-destination trip pattern modeling analysis performed for the CO 52 Planning and Environmental Linkages (PEL) Study. The document includes analysis of travel patterns using the CDOT travel demand model. The analysis includes select link and subarea model runs that consider where trips enter/exit the CO 52 corridor as well the origins and destinations of trips along the corridor.

Background

The basis for the development of the CO 52 travel demand model was the CDOT StateFocus (Version 1.4) model. The StateFocus model uses socio-economic projections for the State of Colorado to generate travel demand and distribute trips across the state's roadway and transit network. For the CO 52 PEL study, the 2015 model was used as the base year and the 2045 model was used as the horizon year. Adjustments to the roadway networks were made where necessary.

Methodology

Select link, subarea, and trip table analyses were performed using the CO 52 PEL 2015 Base Model and 2045 No Action model. For the analyses, the 2015 Base and 2045 No Action models were performed and travel patterns recorded for the PM peak hour from 5 to 6pm.

A select link analysis (also known as a critical link analysis) records the origin and destination for each trip that traverses a target (select) link. For CO 52, various locations along the corridor were analyzed. The select link analysis results include various trip attributes, such as origin and destination locations, trip lengths, and travel times.

For the subarea analysis, the CO 52 corridor was selected as a whole and all trips, entering and exiting the corridor, were recorded during the PM peak hour. The subarea analysis results provide all trip entry and exit points along the corridor, providing insight into travel patterns and the length that trips travel along the CO 52 corridor.

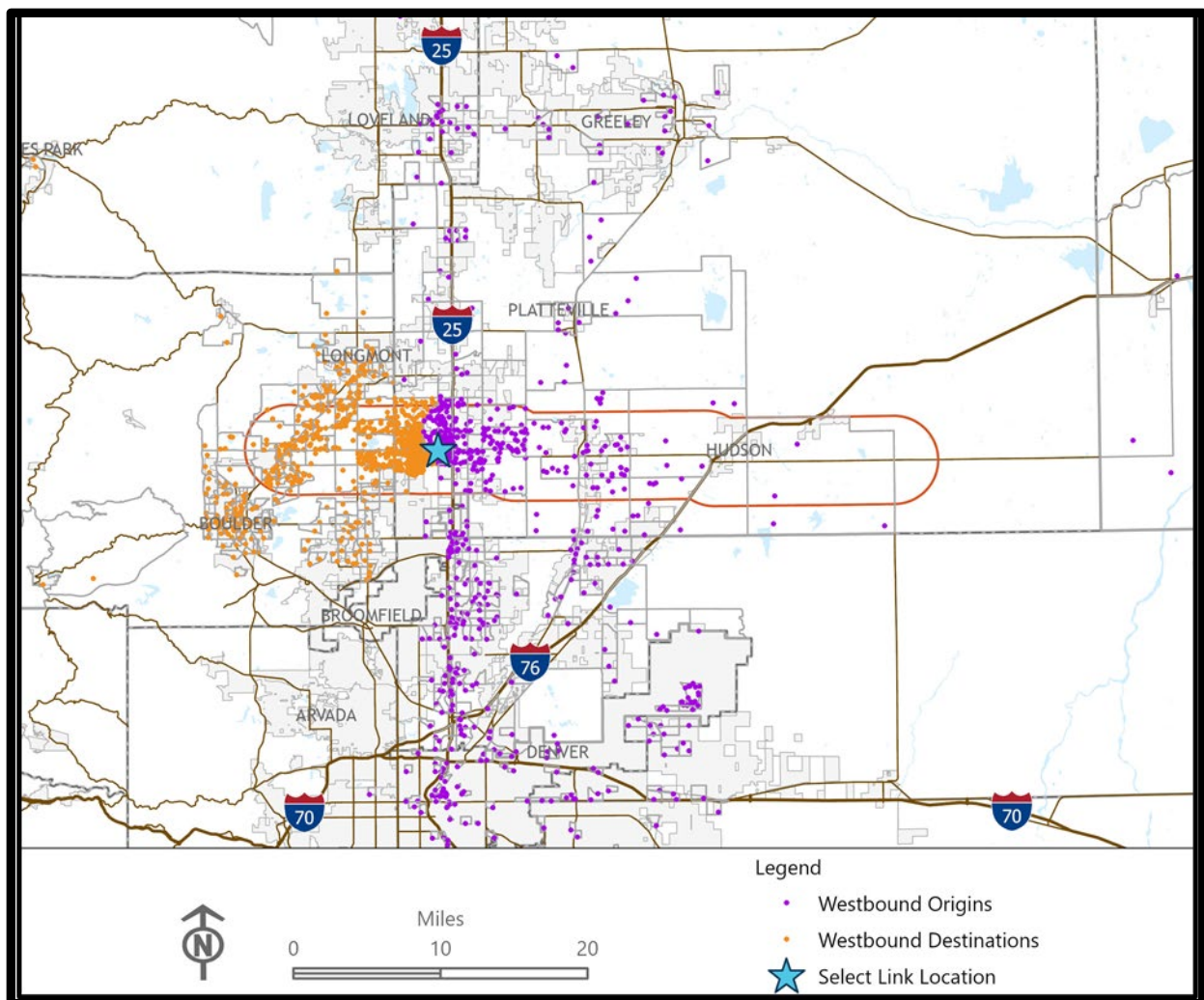
The trip table analysis examined daily work trips between counties using the CO 52 PEL 2015 Base Model and 2045 No Action model.

Trip Origins and Destinations

The select link analysis provides a glimpse into trip origin and destination locations. Dot-density graphics were developed that illustrate the distribution of origins and destinations during the PM peak hour in 2045. Each dot on the graphic represents ten origins or destinations of trips that travel along the I-25 select links.

Two locations were selected for this analysis: 1) west of CR-7 and 2) west of WCR-19 (east of Dacono/Frederick). Origins and destinations of westbound trips along CO 52 just west of CR-7 are illustrated in Figure 1.

Figure 1 WB CO 52 West of CR-7 – PM Peak Hour Trip Origins/Destinations



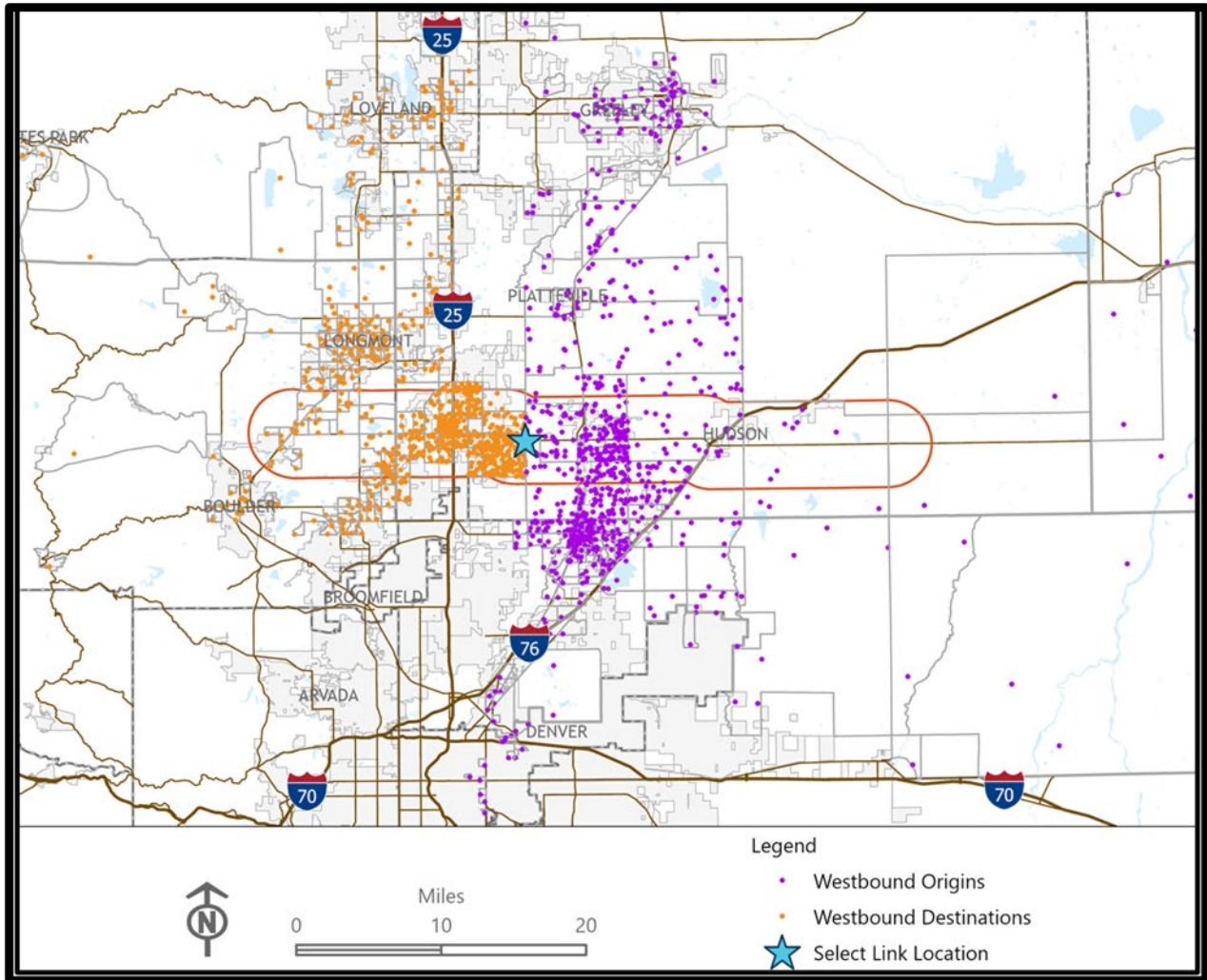
Source: CDOT StateFocus Model, 2020

Takeaways for westbound trips on CO 52 west of CR-7 during the PM peak hour from Figure 1:

- Trip origins and destinations are most dense in the immediate vicinity of the select link, with many trips originating in Dacono/Frederick/Ft Lupton and ending immediately west of the select link.
- Many trip origins are to the south along the I-25 and US-85, and Denver International Airport; trip origins in the northern front range communities are less frequent.
- Destinations are most dense in Longmont, Boulder, and along CO 119.
- Origins to the east are 60% Weld County, 20% Adams County, 10% Denver County, and all other counties approximately 10%.
- Trip destinations to the west of CR-7 along CO 52 are approximately 40% Weld County and 60% Boulder County. All other counties account for less than 1% of destinations.

Origins and destinations of westbound trips along CO 52 just west of WCR-19 (east of Dacono/Frederick) are illustrated in Figure 2 .

Figure 2. WB CO 52 West of WCR19 – PM Peak Hour Trip Origins/Destinations



Source: CDOT StateFocus Model, 2020

Takeaways of westbound PM peak hour trips along CO 52 just west of WCR-19 from Figure 2:

- Trip origins are most dense in the Ft Lupton and Brighton area, and to a lesser extent Greeley.
- Destinations are dense immediately west of the select link in Dacono/Frederick, around the I-25 interchange area, and to a lesser degree in Longmont and Loveland.
- Relatively few trips from this location have a destination in the City of Boulder.
- Origins to the east are 60% Weld County and 35% Adams County. All other counties account for less than 5% with Denver and Morgan Counties the primary origins.

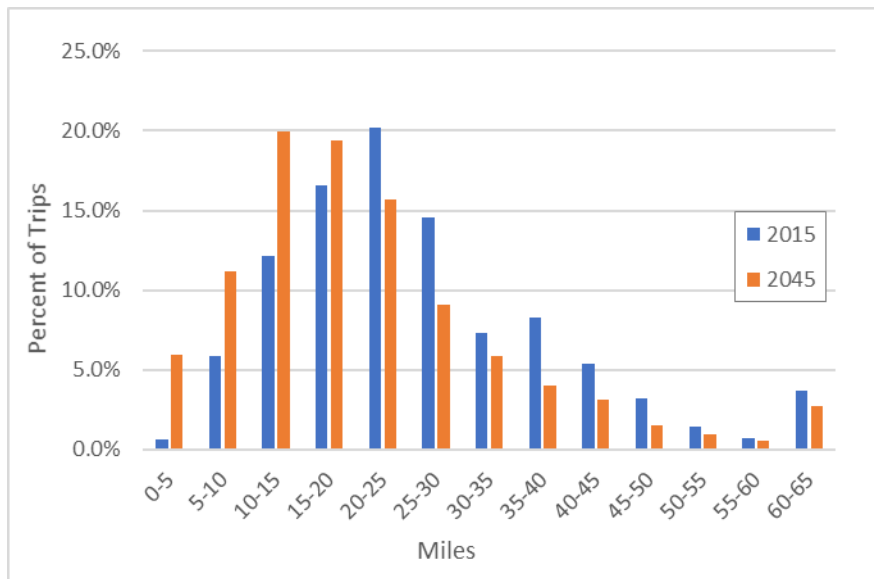
- Trip destinations to the west of CR-19 along CO 52 are approximately 60% Weld County, 30% Boulder County, and 10% Larimer County. All other counties are less than 1% of destinations.

Trip Length

CO 52 West of CR7

The select link analysis provides origin-to-destination trip length information for those trips traveling along a specific section of roadway. The chart shown in Figure 3 illustrates the distribution of PM peak hour trips, by distance between origin and destination, that travel along CO 52 west of CR-7 (west of I-25). The figure shows the trips during this period in 5-mile bins in year 2015 and 2045. As was noted in the earlier methodology discussion, the 2045 results were developed under the 2045 No Action condition.

Figure 3 WB CO 52 at CR7 – Trip Lengths



Source: CDOT StateFocus Model, 2020

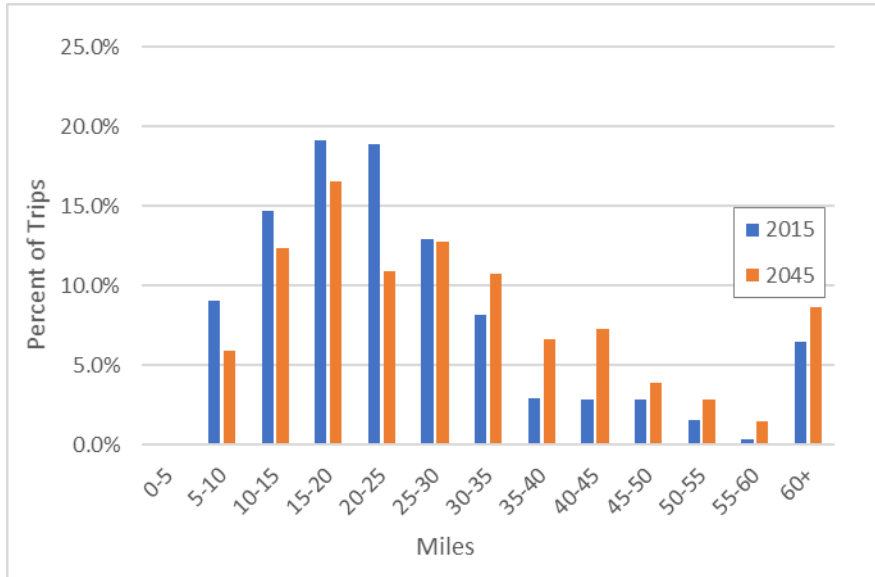
The results of the select link analysis indicate that trips traveling along CO 52 have an average end-to-end trip length of 27.6 miles in 2015. In 2045, the average trip length drops by 5.4 miles to 22.2 miles. As Figure 3 shows, in 2015, the greatest percentage of trips, at just over 20%, falls between 20 to 25 miles. In 2045, the greatest percentage of trips, at 20%, shifts to between 10 to 15 miles.

The decrease in average trip length of nearly 20% in the future may be the result of multiple factors. There appears to be an increase in short trips related to increased development in the area. Additionally, the limited capacity of CO 52 through the I-25 interchange and to the west may deter longer trips in 2045.

CO 52 West of CR19

The chart shown in Figure 4 illustrates the PM peak hour trip distribution along CO 52 west of WCR19 (east of Dacono/Frederick). Trips at this location have an average length of 28.5 miles in 2015. In 2045, the average end-to-end trip length increases by 4.4 miles to 32.9 miles. The greatest percentage of trips in year 2015 along WB CO 52 falls within the 15- to 20-mile bin. This holds true in 2045 as well, but at a lower percentage. In fact, all percentages in the 5- to 30-mile range show a decline in percentage as trip lengths shift to longer lengths.

Figure 4 WB CO 52 at CR-19 – Trip Lengths



Source: CDOT StateFocus Model, 2020

As opposed to west of I-25 where average trip length declines, CO 52 east of Dacono/Frederick experiences an increase in average trip length of over 15% during the PM peak hour from 2015 to 2045. This is likely the result of increased commuter trips utilizing CO 52 and its available capacity along CO 52 allowing for these longer trips.

Corridor Trip Entry/Exit Patterns

The subarea analysis provides trip patterns along the CO 52 corridor itself. Major roadway crossings of CO 52, as well as the east and west ends of the corridor, were analyzed to illustrate trip entry/exit points and general trip patterns along CO 52 during the PM peak hour in 2045. The analysis locations included CO 119, US 287, I-25, US 85, and I-76.

The following section provides analysis of trip patterns beginning at or near either end of the corridor (CO 119 and I-76) and analysis of trips traveling through the I-25 interchange. All other analysis locations and their projected year 2045 trip patterns, in both AM and PM peak hours, are summarized graphically in Appendix A.

2015 vs 2045 Trip Patterns

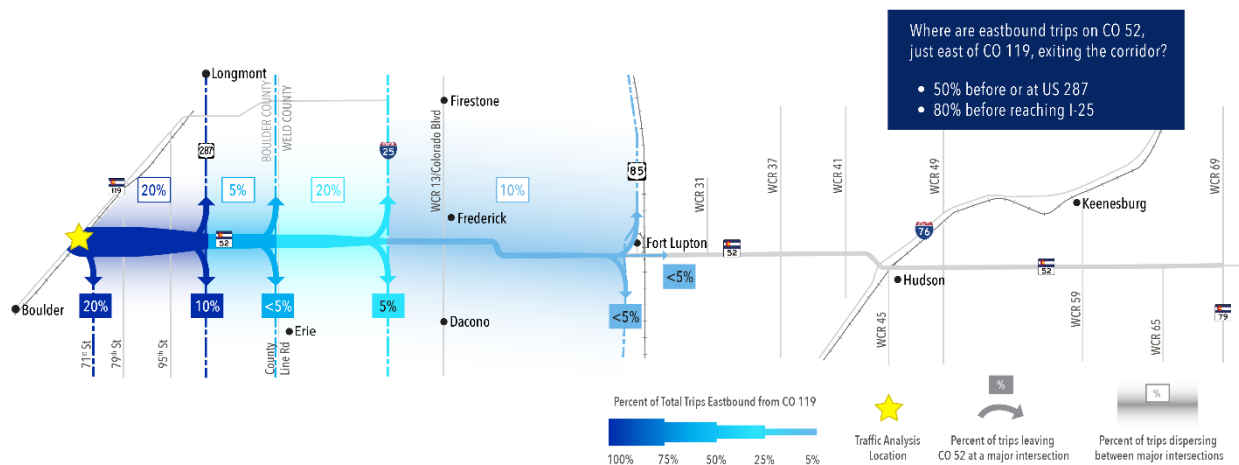
The analysis focuses on future trip patterns as seen in the 2045 No Action model. However, a comparison to 2015 PM peak hour trip patterns was performed to document any significant differences between existing and future trip patterns.

In general, trip patterns were similar along CO 52 in 2015 and 2045. 2045 exhibits an increase in the percentage of trips destined for the area surrounding the CO 52/I-25 interchange, between County Line Road and York Street. Additionally, an increase in the relative amount of trips is projected for the Ft Lupton area. Both areas experience increased development in the 2045 model.

Eastbound from CO 119

Trips entering CO 52 on the west end from CO 119 were analyzed. The year 2045 PM peak hour travel patterns are illustrated in Figure 5.

Figure 5 EB CO 52 from CO 119 – 2045 PM Peak Hour Trip Distribution



Source: CDOT StateFocus 2045 Model, 2020

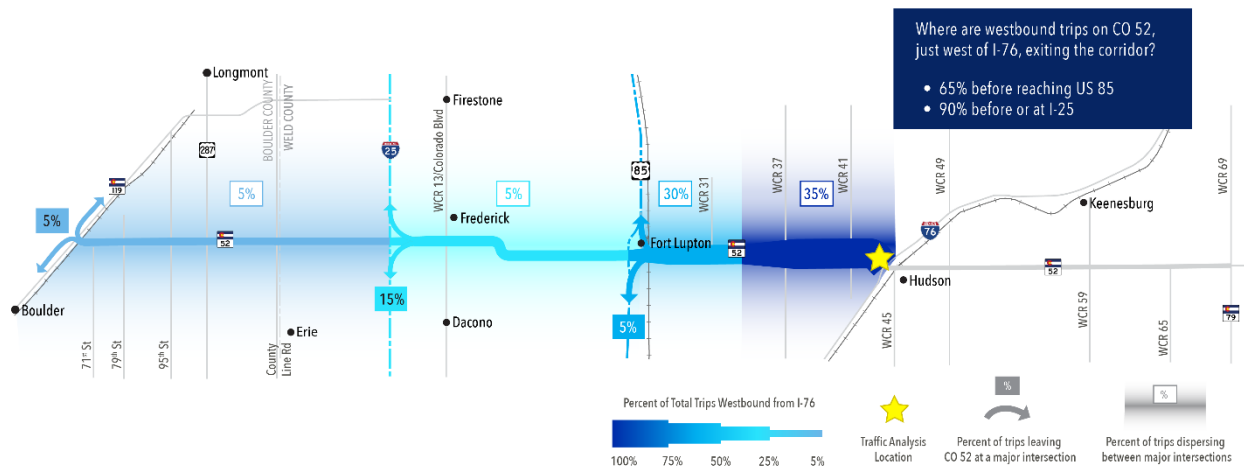
Takeaways from eastbound trips entering CO 52 from CO 119 (Figure 5):

- Approximately 50% of trips exit the corridor at or before US 287.
- Only about 5% of trips access I-25.
- Less than 20% of trips from CO 119 travel beyond the I-25 interchange.
- Less than 10% of trips could be considered “through” trips traveling beyond US-85.

Westbound from I-76 and CO 52 to the East

Trips entering CO 52 on the east from I-76 or from CO 52 east of I-76 were analyzed. The 2045 PM peak hour travel patterns are illustrated in Figure 6.

Figure 6 WB CO 52 from I-76 and CO 52 to the East – 2045 PM Peak Hour Trip Distribution



Source: CDOT StateFocus 2045 Model, 2020

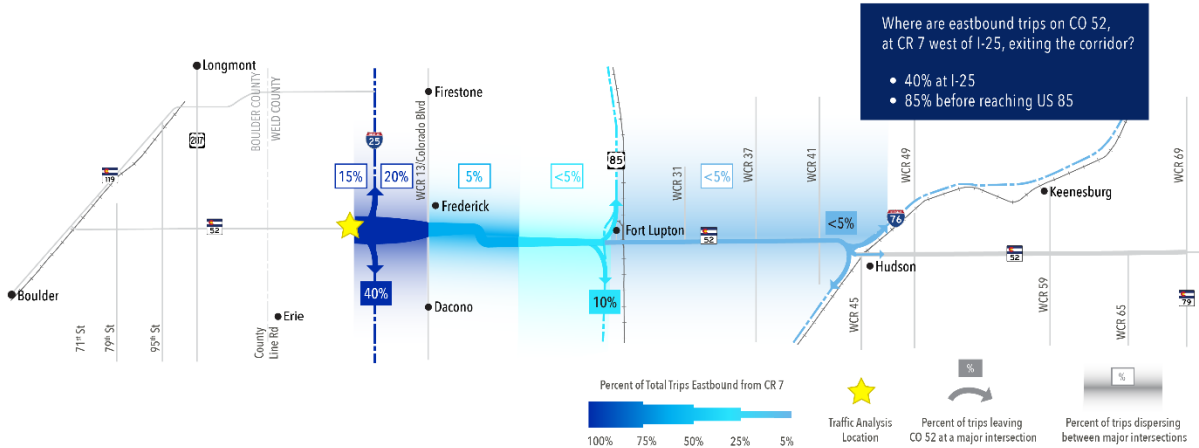
Takeaways from westbound trips on CO 52, west of I-76 (Figure 6)Figure 5:

- Approximately 65% of trips exit the corridor before US 85.
- Only about 15% of trips access I-25.
- About 30% of trips travel beyond US 85.
- Only 10% of trips could be considered “through” trips that travel beyond I-25.

Eastbound from West of I-25

Travel patterns of 2045 PM peak hour trips along eastbound CO 52 approaching I-25 from the west are illustrated in Figure 7.

Figure 7 EB CO 52 from CR-7 West of I-25 – 2045 PM Peak Hour Trip Distribution



Source: CDOT StateFocus 2045 Model, 2020

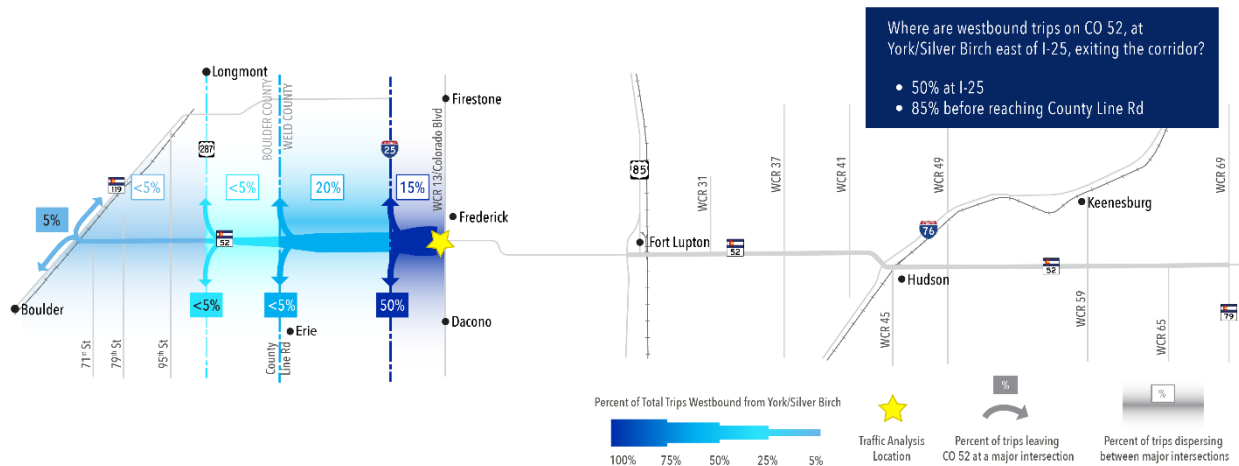
Takeaways from eastbound trips approaching I-25 (Figure 7):

- Approximately 60% of trips exit the corridor at or before I-25.
- Approximately 30% of trips are destined for Dacono/Frederick and the immediate area to the east.
- 90% of trips exit the corridor before US 85

Westbound from East of I-25

Travel patterns of 2045 PM peak hour trips along westbound CO 52 approaching I-25 from the east (just west of York St) are illustrated in Figure 8.

Figure 8 WB CO 52 from York/Silver Birch East of I-25 – 2045 PM Peak Hour Trip Distribution



Source: CDOT StateFocus 2045 Model, 2020

Takeaways from westbound trips approaching I-25 (Figure 8)Figure 5:

- Approximately 65% of trips exit the corridor at or before the I-25 interchange.
- Fewer than 5% of trips are destined for US 287 or County Line Rd, the major north-south facilities between I-25 and CO 119.
- Only 5% of trips reach CO 119.

In general, year 2045 trip patterns at the locations described above, and at the other locations illustrated in Appendix A, are projected to be similar in the AM and PM periods along CO 52. Trips west of I-25 tend to travel along CO 52 for a relatively short distance compared to trips along CO 52 further to the east. Trips along CO 52 tend to disperse from the roadway at or before major north-south crossings like I-25, US 287, and US 85.

County-to-County Trip Patterns

Daily work trips in 2015 and 2045, traveling from Weld County to Boulder County, were analyzed. According to the travel demand model, daily work trips to Boulder County from Weld County totaled about 21,000 in 2015. This is projected to increase over 70% to approximately 36,000 in 2045. These trips may choose to use roadways other than CO 52 but are indicative of overall growth and travel patterns in the region. The growth in work trips to Boulder County from Weld County is much greater than the growth in work trips to Boulder County from other eastern counties. Work trips from Adams, Broomfield, and Morgan Counties are projected to be about the same or decline from 2015 to 2045.

Overall Trip Pattern Observations

The following section summarizes some general observations of the analysis.

Trip Lengths

Most trips on CO 52 are relatively short trips, traveling just a few miles on CO 52 before turning off to another highway or reaching their destination. In 2045, trips lengths are expected to decline west of I-25, likely the result of increased development in the area and increased demand along CO 52. In contrast, trip lengths in the future are expected to increase east of Dacono/Frederick, likely due to increased trips drawn to the available capacity along CO 52.

Trip Patterns

I-25 is a major connection for trips originating along CO 52 near I-25, from both the east and west side of I-25. I-25 is generally not a major connection from longer trip distances along CO 52. In general, most trips traveling along CO 52 exit the corridor at or before the next major facility crossing, i.e. I-25, I-76, or US 85. For example, almost two-thirds of eastbound trips west of CR-7 exit the corridor before or at the I-25 interchange with only 10% reaching US 85.

PM peak hour trip patterns along CO 52 were found to be similar in 2015 and 2045. Year 2045 exhibits an increase in the percentage of trips destined for new development areas to the east and west of the CO 52/I-25 interchange and in the Ft Lupton area.

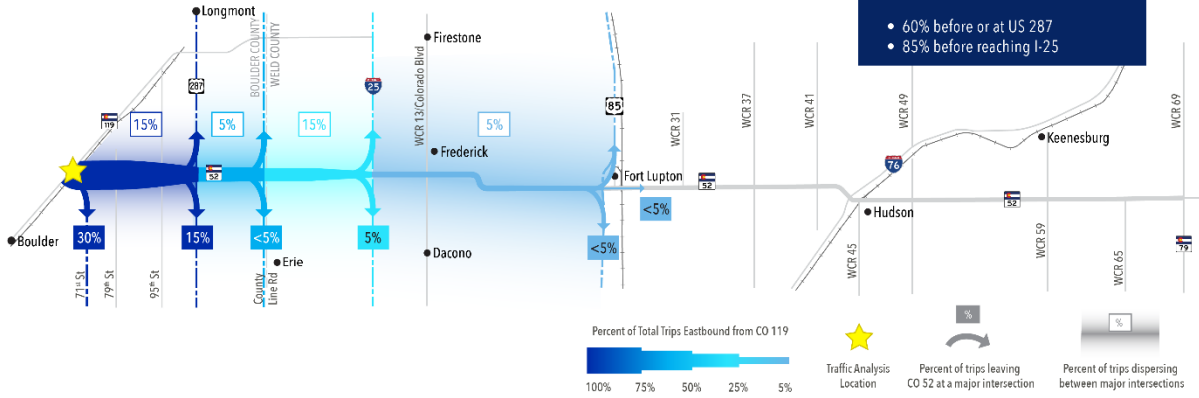
Origins-Destinations

While most trips originate and terminate near CO 52, some are regional trips that have trip ends many miles away, in Weld, Larimer, Adams, Denver, and other counties in the general vicinity of the corridor. West of I-25, trip ends are more densely concentrated along the corridor, in Boulder and Longmont, and along I-25 to the south. East of I-25, trip ends exhibit both density along the CO 52 corridor and wide dispersion regionally, with trip ends located in areas from Boulder to Loveland on the west and Brighton to Greeley on the east.

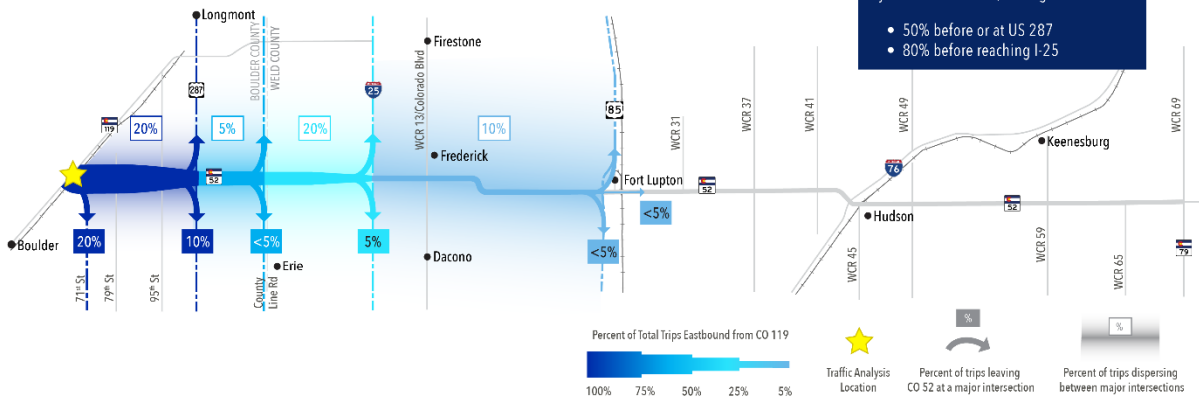
Appendix A

Eastbound CO 52 from CO 119

EB CO 52 from CO 119 – 2045 AM Peak Hour Trip Distribution

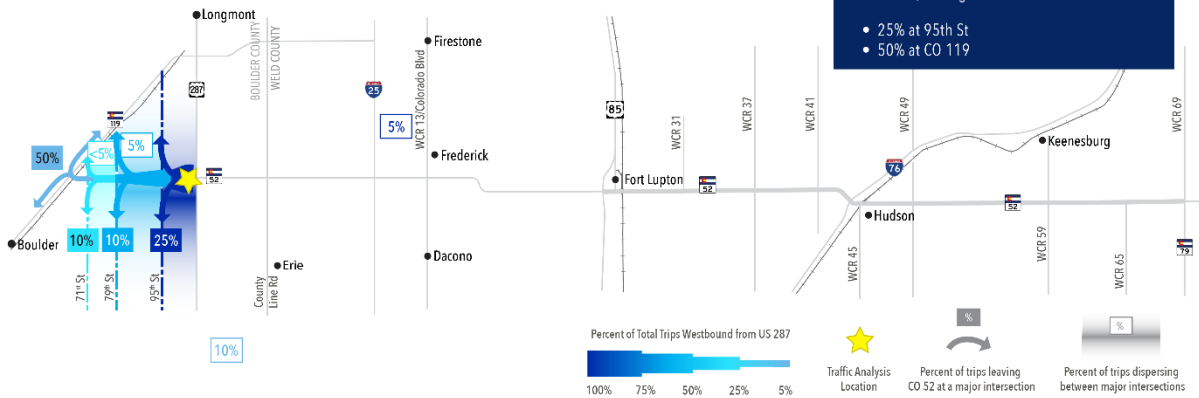


EB CO 52 from CO 119 – 2045 PM Peak Hour Trip Distribution

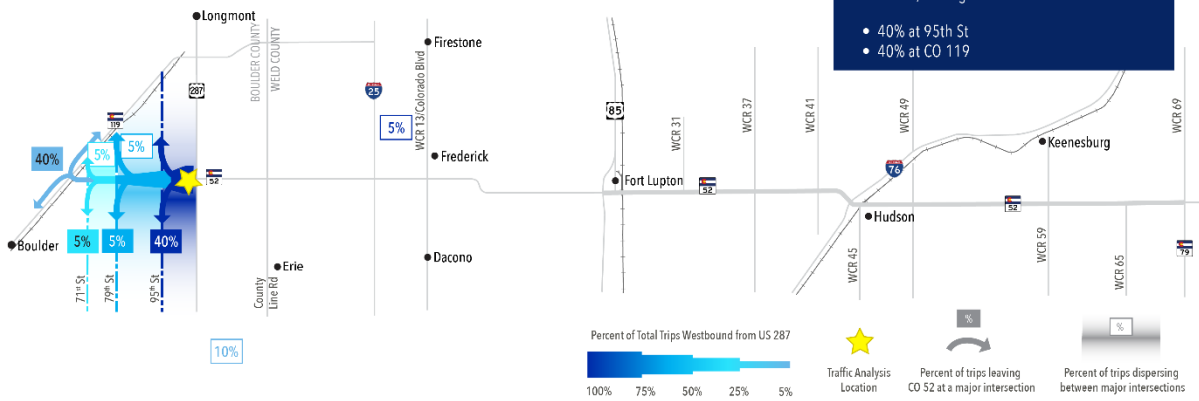


Westbound from US-287

WB CO 52 from US 287 – 2045 AM Peak Hour Trip Distribution

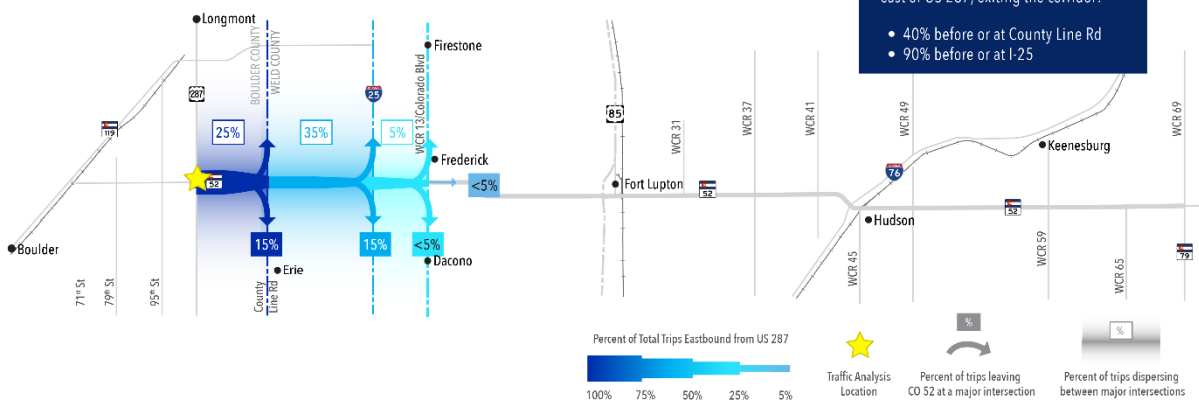


WB CO 52 from US 287 - 2045 PM Peak Hour Trip Distribution

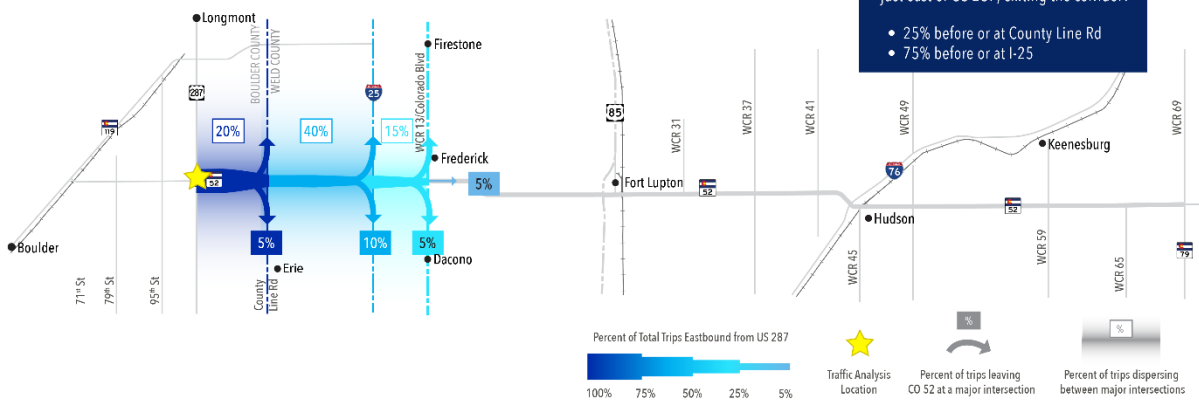


Eastbound from US-287

EB CO 52 from US 287 - 2045 AM Peak Hour Trip Distribution

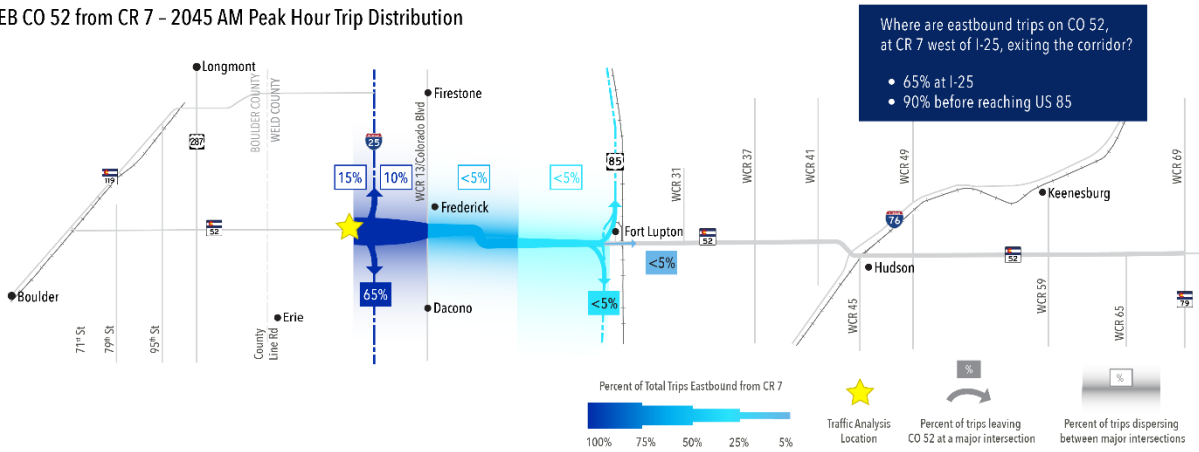


EB CO 52 from US 287 - 2045 PM Peak Hour Trip Distribution

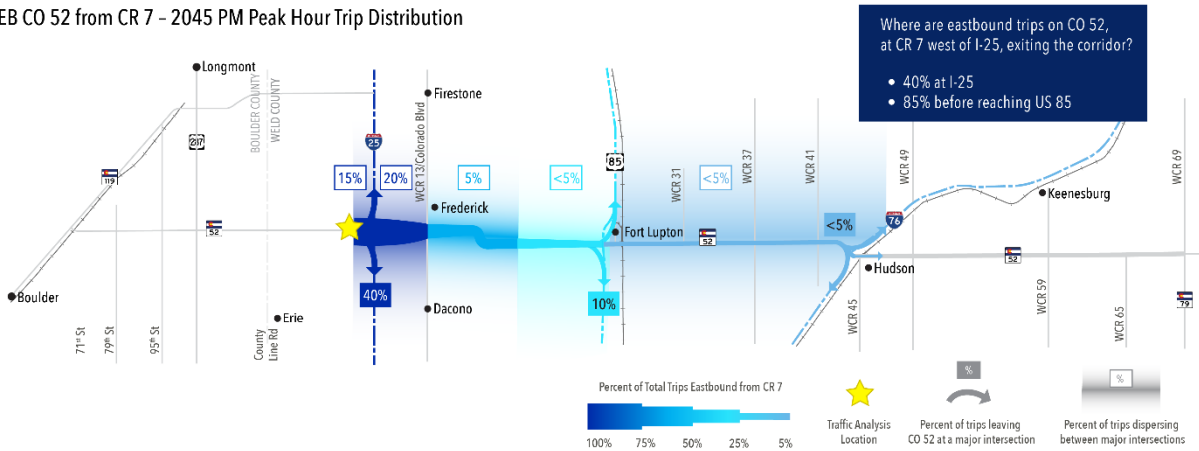


Eastbound from CR-7 (West of I-25)

EB CO 52 from CR 7 - 2045 AM Peak Hour Trip Distribution

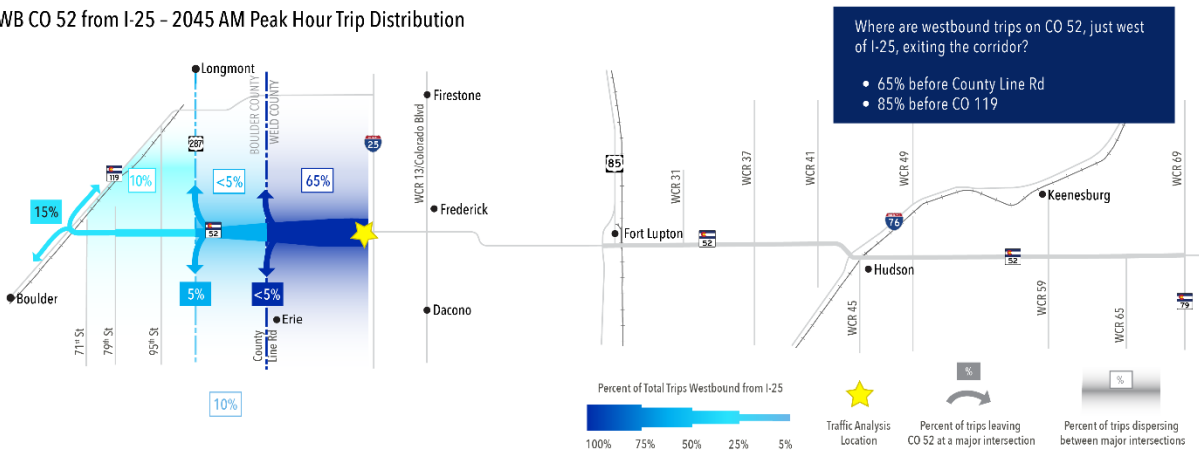


EB CO 52 from CR 7 - 2045 PM Peak Hour Trip Distribution

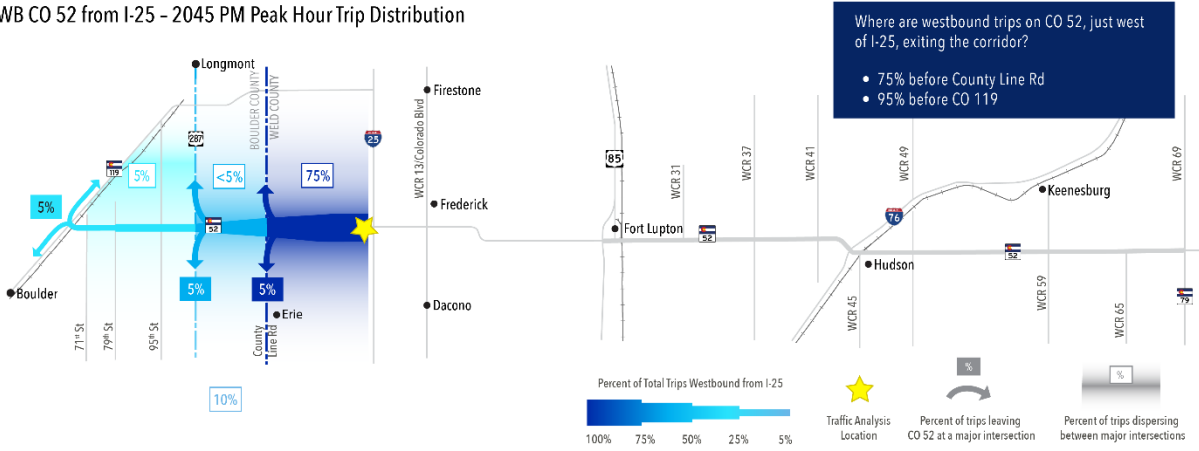


Westbound from I-25

WB CO 52 from I-25 - 2045 AM Peak Hour Trip Distribution

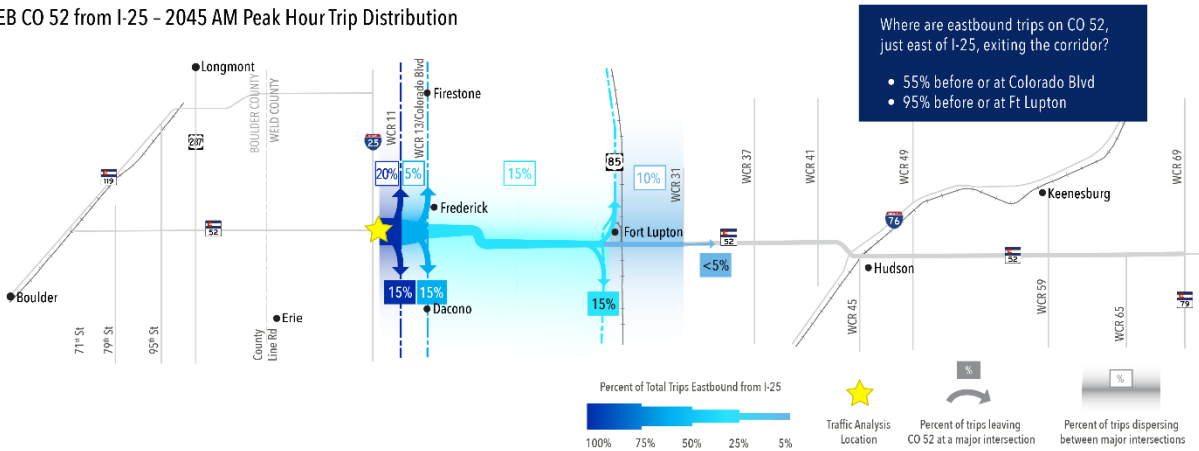


WB CO 52 from I-25 – 2045 PM Peak Hour Trip Distribution

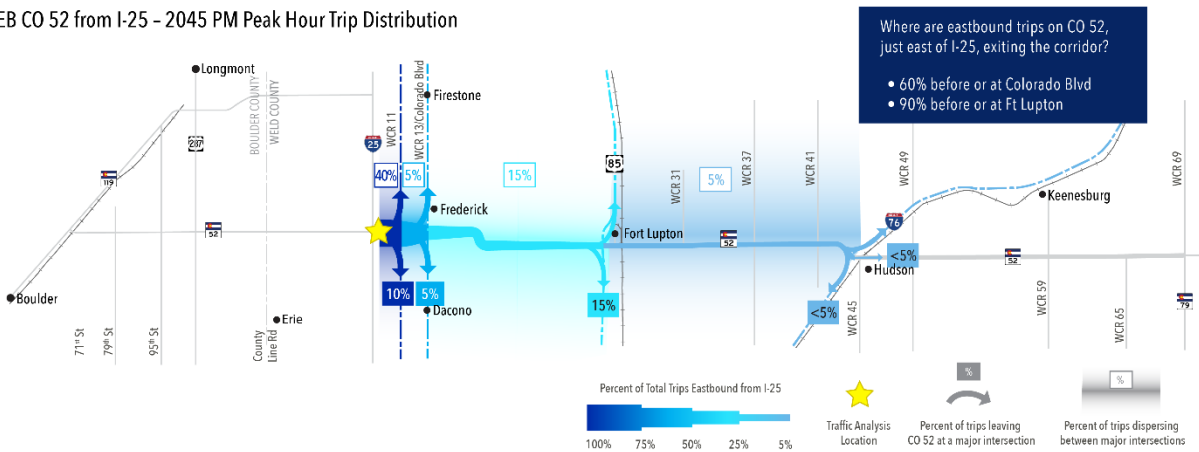


Eastbound from I-25

EB CO 52 from I-25 – 2045 AM Peak Hour Trip Distribution

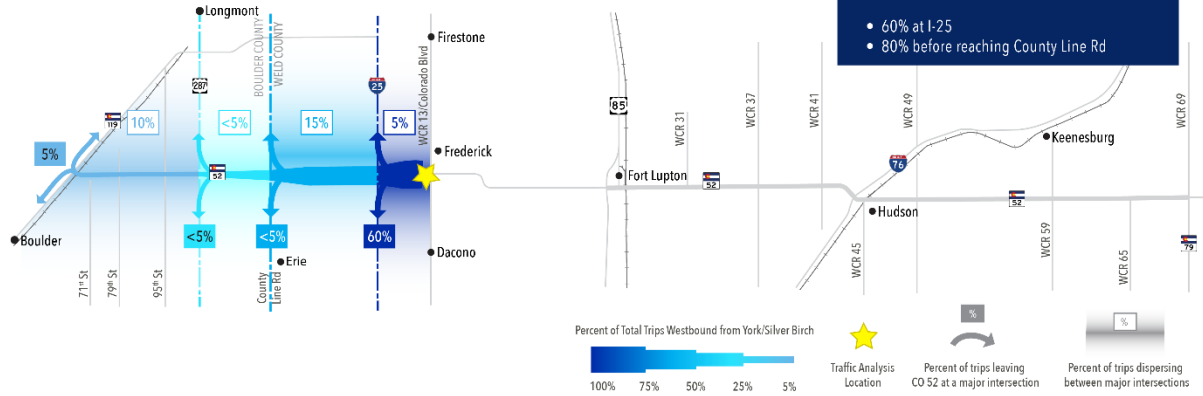


EB CO 52 from I-25 – 2045 PM Peak Hour Trip Distribution

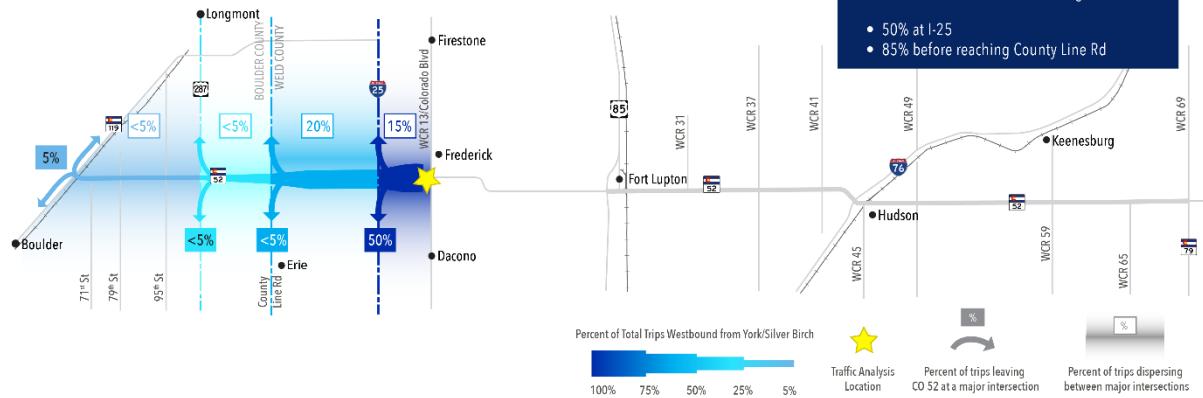


Westbound from York/Silver Birch (East of I-25)

WB CO 52 from York/Silver Birch – 2045 AM Peak Hour Trip Distribution

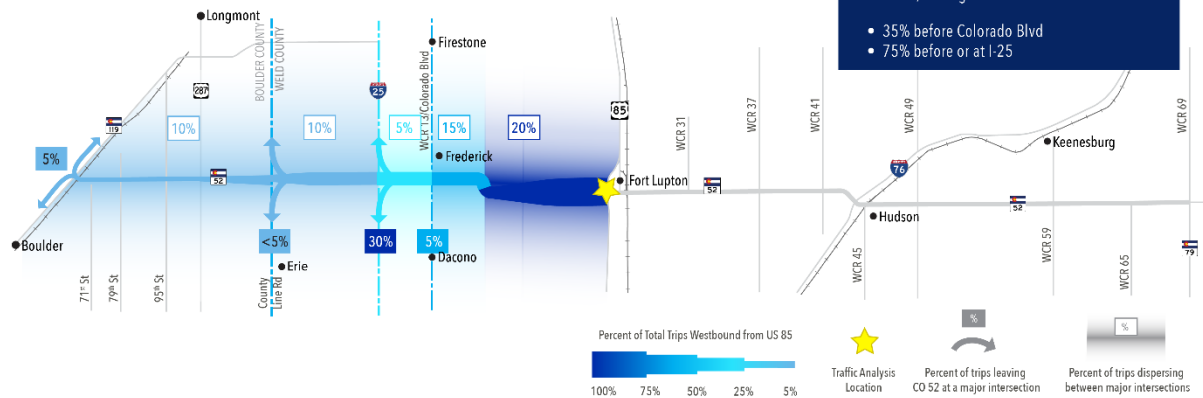


WB CO 52 from York/Silver Birch – 2045 PM Peak Hour Trip Distribution

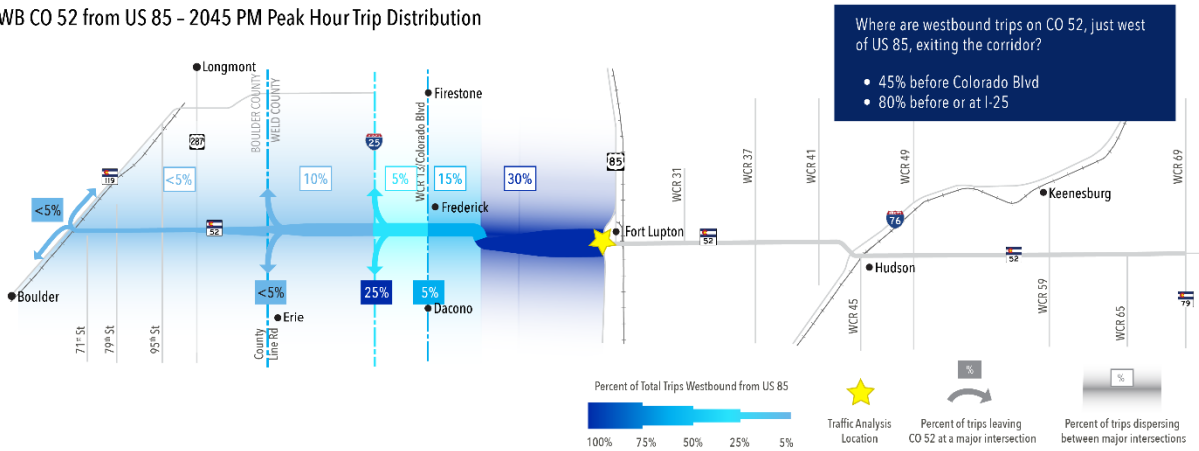


Westbound from US 85

WB CO 52 from US 85 – 2045 AM Peak Hour Trip Distribution

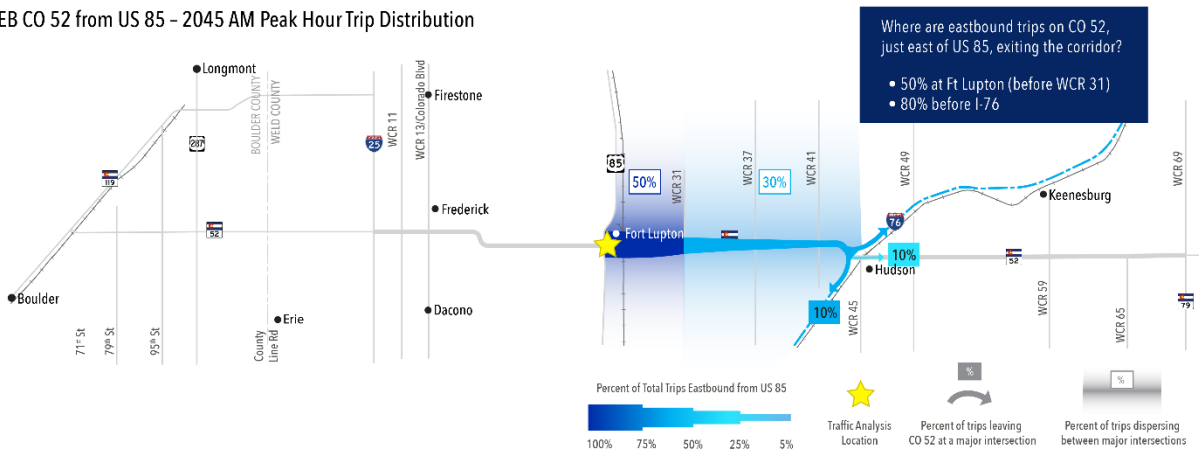


WB CO 52 from US 85 - 2045 PM Peak Hour Trip Distribution

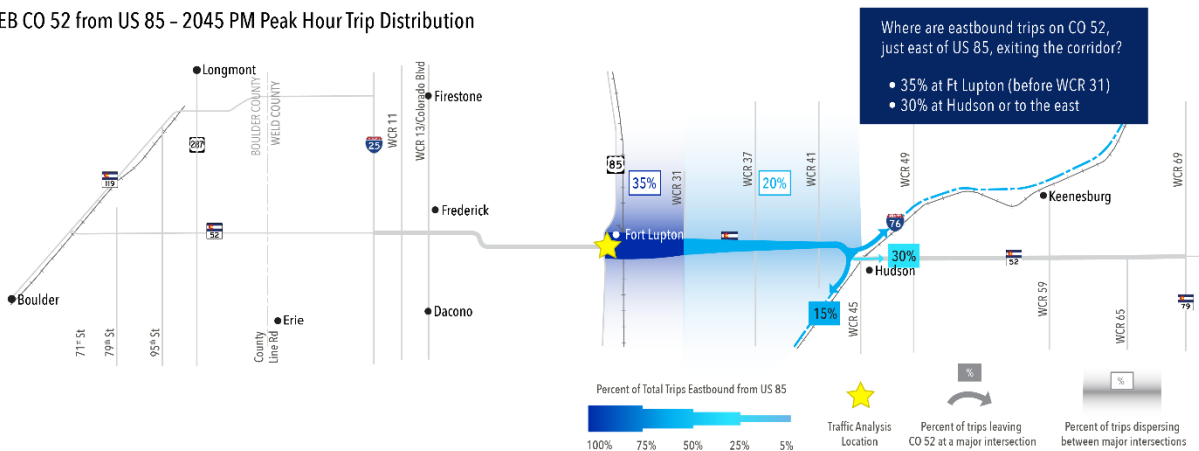


Eastbound from US 85

EB CO 52 from US 85 - 2045 AM Peak Hour Trip Distribution

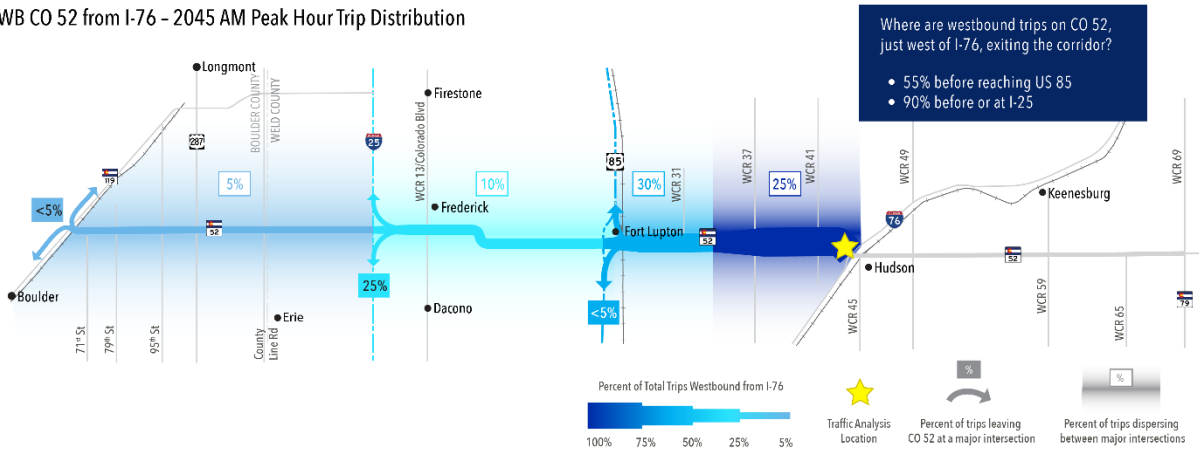


EB CO 52 from US 85 - 2045 PM Peak Hour Trip Distribution

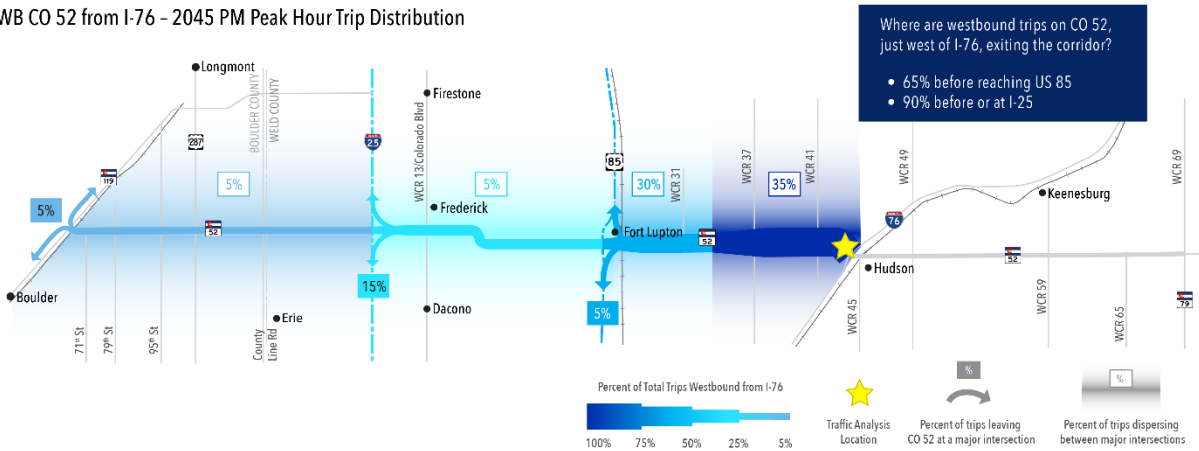


Westbound from I-76

WB CO 52 from I-76 - 2045 AM Peak Hour Trip Distribution



WB CO 52 from I-76 - 2045 PM Peak Hour Trip Distribution



Appendix F-9 Freight Memo



Project: CO 52 Planning and Environmental Linkages Study
To: Colorado Department of Transportation, Region 4
From: CO 52 PEL/ACP Project Team
Date: September 24, 2021
Subject: Freight Memo

Freight Existing Conditions

Background

The Upper Front Range 2045 Regional Transportation Plan identifies CO 52 as a freight corridor in Colorado. CO 52 has been identified as a route that facilitates the movement of critical goods, such as farm-to-market products and oil and gas.

Approximately 35 miles of CO 52 is located in Weld County. Weld County is one of the state's top three agricultural producers, it is nationally ranked for its animal products, and is Colorado's leading producer of beef cattle, grain, sugar beets, and dairy products. Weld County prides itself on being the number one producer of oil and gas in the State of Colorado. According to the County's website, 88% of all crude oil production and 40% of all natural gas production in Colorado comes from Weld County, thus requiring a substantial amount of heavy and oversized vehicles in order to access the wells.

Methodology

Existing freight data for CO 52 was collected using the CDOT Online Transportation Information System (OTIS) database. OTIS uses a system of CDOT traffic data stations to gather and record data along state highways. Along CO 52, within the limits of the PEL, there are a total of fifteen traffic data stations. The most recent data available at these stations was recorded and separated by location along the corridor. Both the existing freight data and station breakdown is shown in Table 3-1.

Motor Carrier Freight

CO 52 has been divided into five subsections as shown in Table 3-1. Truck percentages fluctuate along the CO 52 corridor, ranging from 3 percent to 19 percent. Along the western end of the corridor, between CO 119 and County Line Road, truck percentages generally fall between 3 and 5 percent. Along the next two sections of CO 52 from County Line Road to WCR 31, which include crossings with I-25 and US 85, truck percentages average between 6 and 10 percent. The easternmost stretches of CO 52 are much more rural and exhibit the highest truck percentages, averaging between 14 and 20 percent of all traffic.

Table 3-1 Percent Truck Trips of Total Vehicle Volume

CO 52 SECTION	LOCATION	TRUCK PERCENTAGE*
		2018
CO 119 to County Line Road	Between CO 119 and 95th Street	2.8
	Between 95th Street and US 287	3.9
	Between US 287 and County Line Road	5.0
	Segment 1 Average	3.9
County Line Road to WCR 19	Between County Line Road and I-25	5.9
	Between I-25 and Colorado Boulevard	6.5
	Between Colorado Boulevard and Ridgeway Boulevard	7.8
	Between Ridgeway Boulevard and WCR 19	10
	Segment 2 Average	7.6
WCR 19 to WCR 31	Between WCR 19 and US 85	10
	Between US 85 and Rollie Avenue	7.4
	Between Rollie Avenue and WCR 31	6.4
	Segment 3 Average	7.9
WCR 31 to WCR 49	Between WCR 31 and WCR 37	6.4
	Between WCR 37 and I-76	13.6
	Between I-76 and WCR 49	13.6
	Segment 4 Average	11.2
WCR 49 to CO 79	Between WCR 49 and WCR 59	13.6
	Between WCR 59 and CO 79	19.0
	Segment 5 Average	16.3

* The most recent year of truck percentage data in the CDOT OTIS database is 2018.

Designated Hazmat and Oversized Truck Route

CO 52 within the study area is designated as a hazardous materials and oversize vehicle route from CO 119 to CO 79. Roughly 80 percent of hazardous material cargo along the corridor are petroleum trucks serving the oil and gas industry and its commercial delivery. The corridor provides an east-west freight

route for the northern Denver metropolitan area that has relatively few horizontal or vertical clearance restrictions. The only overpass above CO 52 within the study area is located at US 85 with a vertical clearance of 16'-10", high enough for many oversized vehicles. Interstates 76, 70, and 25 and US 36 all are underpasses to CO 52 with restricted bridge heights ranging from 14'-7" to 16'-0" for vehicles traveling along those facilities. In June 2020, the Project Team met with CDOT's Oversize/Overweight (OS/OW) permits section and learned there is limited data on the amount of hazardous and oversize trucks. Single-use and annual use permits are issued to motor carriers. The number of single-use permits distributed annually is approximately 4,000 while the number of trips exercised under annual use permits is not recorded.

Freight Railroads

The project corridor includes three active railroad track segments that cross CO 52. Two of the railroad tracks are owned by Burlington Northern Santa Fe Railway (BNSF) and one is owned by Union Pacific Railroad (UP). One of the railroad track segments owned by BNSF, located in Hudson, has three individual railroad tracks crossing CO 52. The UP railroad track segment, located in Niwot, and the BNSF railroad track segment located in Fort Lupton each have only one railroad track crossing CO 52. Therefore, there are a total of five active individual railroad tracks crossing CO 52. Table 3-2 shows the detailed location and approximate number of trains per day for each crossing.

Table 3-2 Percent Truck Trips of Total Vehicle Volume

Crossing Name	City/Town	Railroad	Milepost	Railroad Subdivision	Maximum Train Speed (MPH)	Number of Tracks	Approx. Trains per Day (Year of Data)	Crossing Description
West Crossing	Niwot	BNSF	36.679	Front Range	49	1	6 (2019)	Active Signalization (Gates/Flashers)
Central Crossing	Ft Lupton	UP	25.51	Greely	50	1	10 (2017)	Active Signalization (Gates/Flashers)
East Crossing	Hudson	BNSF	512.981	Brush	79	3	18 (2019)	Active Signalization (Gates/Flashers)

The BNSF railroad through Niwot, which crosses CO 52 just east of CO 119, carries approximately six trains daily. The crossing has active signalization and crosses four travel lanes on CO 52 including left and right turn lanes approaching CO 119 from the east. According to Federal Railroad Administration (FRA) accident/incident reports, no crashes have occurred at the crossing since May 1995.

The UP railroad crossing CO 52 in Ft Lupton carries approximately 10 trains daily. The crossing has active signalization and crosses two travel lanes on CO 52. No crashes have occurred at the crossing since July 1995.

The BNSF railroad crossing CO 52 in Hudson carries approximately 18 trains daily. The crossing has active signalization and crosses two travel lanes on CO 52. Only one crash has occurred at the crossing in the past ten years. The crash involved a car stopped on the crossing that was struck by a train causing property damage but no injuries or fatalities. There have been two incidents resulting in fatalities at the crossing that involved pedestrians. The first incident occurred in 2005 involving a pedestrian running in front of a train. The other incident involved two pedestrians that were both killed crossing the railroad in 2006.

Freight Alternative Evaluation-Methodology Results

Proposed alternatives were advanced to the Level 2 Screening process. The alternatives were qualitatively evaluated for their potential effect on accommodating freight movements along the CO 52 corridor, including hazmat and oversized vehicles. It is important to consider the size and types of trucks utilizing a facility in order to properly accommodate these vehicles. Performance grades assessed for the various alternatives included “Improves,” “Neutral,” and “Limits” in regards to the effect upon freight movements. The performance evaluation included the following elements:

- Turn radii
- Shoulder Width (safety)
- Vertical clearance
- Passing Opportunities
- Roadway grade
- Intersection control
- Rail crossings

Turn Radii

Truck turn radii are greater than passenger vehicles. Truck movements are limited along roadways and at intersections/access points with limited space and tight turns. For this evaluation, the following alternative amenities were considered:

- Additional travel lanes (e.g. four lanes vs two lanes) – an additional travel lane provides trucks with a greater cross-section for turning, including right turns where a truck can swing wide into the second general purpose lane if necessary
- Median – provides additional space for left-turns
- Turn lanes, shoulder – provides designated lanes and additional space for turns

For the alternatives screening, alternatives that provide an additional travel lane, turn lane, or space for a median were given an “Improves” grade. Improvements to shoulder width were given an “Improves” or “Neutral” grade dependent upon the amount of widening. The No Action scenario was given a “Limits” grade as it does not provide improved freight accommodation.

Shoulder width

Roadway facilities with wider shoulders are generally considered safer as they provide a refuge for trucks and other vehicles to safely pull out of the flow of traffic. For the alternatives screening, shoulder widening as a stand-alone improvement was given a “Neutral” grade as this does not provide marked

improvement to overall freight movement. Shoulder widening coupled with other improvements including additional through lanes, turn lanes, or median space resulted in an “Improves” grade. The No Action scenario was given a “Limits” grade as it does not provide improved freight accommodation.

Vertical Clearance

It is critical for a freight corridor to provide adequate vertical clearance at grade-separated crossings. The only existing overpass above CO 52 within the study area is located at US 85 and already adequately accommodates most oversized vehicles. None of the major alternative elements include grade-separated vertical elements that would limit truck travel; any intersection improvement that would include grade-separation needs to consider vertical clearance for oversized vehicles.

Passing Opportunities

Passing opportunities along a corridor provide vehicles with the ability to pass slower moving or turning vehicles, improving overall flow of travel. Freight truck traffic is commonly slower moving traffic, especially at locations with steeper grades. However, freight movement also benefits from passing opportunities in that it also allows trucks to pass slower moving or turning vehicles and the overall improvement in traffic flow benefits all vehicles, including trucks.

For the alternatives screening, alternatives that include additional travel lanes and two-way left turn lanes were considered beneficial to freight movement and were given an “Improved” grade. Alternate passing lanes were given a “Neutral” grade as this improvement is intermittent and less likely to have meaningful impact to overall freight movement along the corridor. The No Action scenario was given a “Limits” grade as it does not provide improved freight accommodation.

Roadway Grade

Roadway grade affects vehicle speed and control, particularly for heavier vehicles like trucks. Steeper grades can cause truck speeds to decline quickly on the incline while posing a safety concern for trucks descending steep grades. For the CO 52 corridor, roadway grades are generally flat or at grades with negligible impact to vehicle speeds. For the alternatives screening, alternatives that include additional travel lanes or passing lanes on steeper grades were graded as “Improved” per the passing opportunities factor discussed above. Overall grades along the various roadway segments are expected to be the same throughout the various alternatives.

Intersection Control

Intersection controls can positively or negatively impact freight movement. Traditional intersections with stop of signal control can result in intersection delay and limitations to freight movements. Non-traditional intersection improvements can benefit freight movement to varying degrees. Turning lanes, medians, or increased turning radii benefit the movement of freight if designed accordingly, though negative impacts can occur when freight movement is not considered in the design process.

For the alternatives screening, alternatives with additional turn lanes or medians at various intersections along the corridor were considered “Neutral” in their benefit to freight as these are for spot locations. However, when considering alternatives specific to individual intersections, individual grades can be applied for freight movement. Any grade-separated interchange would be given an “Improves” grade. Traditional intersection improvements are considered “Neutral.” Non-traditional improvements, such as

continuous-flow intersections (CFI's), roundabouts, etc.) are also considered "Neutral" until design elements are clarified that would have a positive or negative effect upon freight movement.

Rail Crossings

Rail crossings can impact truck freight movement by causing frequent delays at rail crossings. In general, grade-separated crossings benefit freight movement by reducing vehicle delays. Along the CO 52 corridor there are only three active railroad crossings. For the alternatives screening, any alternative that includes a grade-separated rail-crossing would be given an "Improves" grade. All other alternatives are considered "Neutral."

Freight Evaluation Summary

The qualitative evaluation of the proposed alternatives found improved conditions for freight movements through the CO 52 corridor under select alternatives. Generally, freight movements benefit from alternatives that include improved truck turn radii and additional roadway capacity. Alternatives that were considered to "improve" freight movement include:

- additional travel lanes (general purpose, managed lanes, or peak period shoulder lanes)
- two-way left turn lanes
- widened medians (improved cross-sections for turns)

Alternatives that were considered "neutral" in their impact to freight movements include:

- alternating passing lanes
- shoulder widening
- median widening or turn lane improvements only at major intersections

The No Build alternative and any alternative that results in shoulder widening alone is considered "limiting" in its impact to freight movements.

Appendix F-10

Traffic Technical Memorandum

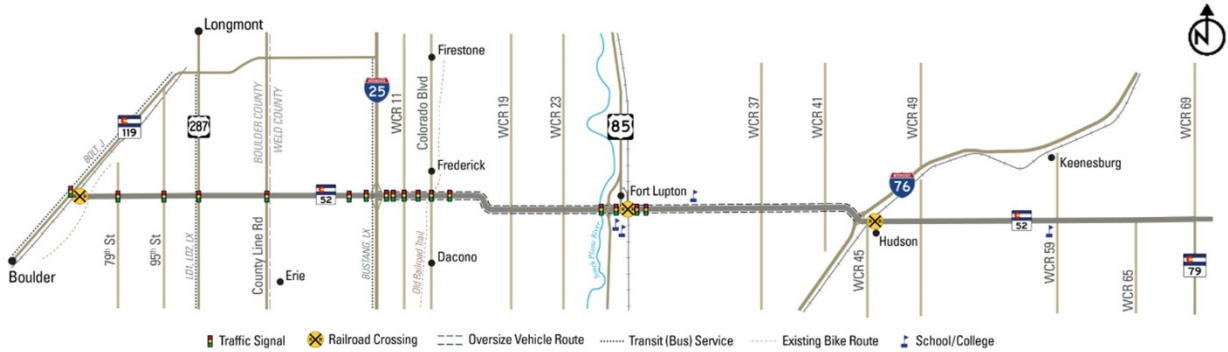


MEMORANDUM

Project: CO 52 Planning and Environmental Linkages Study
To: Colorado Department of Transportation – Region 4
From: Kenneth A. Ryan, PE, PTOE – Muller Engineering Company
Date: November 2, 2021
Subject: Traffic Technical Memorandum

This technical memorandum documents the traffic operational analysis completed in support of the CO 52 Planning and Environmental Linkages Study (CO 52 PEL, or PEL). The PEL study provides an understanding of the transportation problems in the corridor, a collaboratively developed vision for the future, and potential projects to implement that vision. CDOT and PEL partners initiated this study to explore a range of improvements for the corridor. The study supports CDOT, the local agencies, stakeholders, and the public to determine improvements that should be made and estimate a corridor preservation footprint for future projects. The project limits extend approximately 42 miles (milepost [MP] 0 to MP 41.94) along CO 52, from CO 119 in Boulder County to CO 79 east of Hudson in Weld County (**Figure 1**).

Figure 1: Corridor Map



ANALYSIS DETAILS

For the CO 52 PEL, a two-level evaluation process was developed to evaluate alternatives. Evaluation criteria were developed for each screening level and were used to assess alternatives relative to the Purpose & Need. Goals of the project were also considered in this process during the second level of evaluation. The goal of the Level 1 Evaluation was to assess a full range of alternatives based on Existing Conditions to determine whether alternatives would meet Purpose & Need. The needs defined for the corridor were to increase in safety, accommodation of increased travel and freight demand, and support of multimodal connections. During the Level 2 analysis, alternatives were evaluated based on more detailed criteria related to project needs as well as how well they met the project goals.

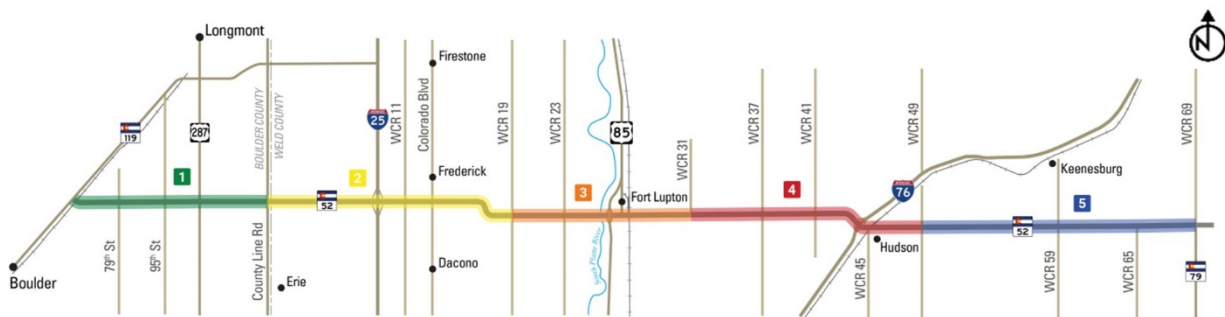
The purpose of the traffic analysis was to evaluate the conceptual roadway layouts and intersection configurations to help guide the PEL Level 2 recommendations. The primary intent was to provide a comparative analysis of the alternatives over the length of the study corridor in a reasonably efficient manner to gather a combination of intersection and roadway corridor metrics. As the corridor primarily experiences congestion during the peak periods, the traffic analysis helped determine to what degree the conceptual layouts will affect future operations on this regional facility.

Study Segments

In order to better analyze the 42-mile-long CO 52 study corridor, the study team divided the corridor into meaningful segments. Segment divisions considered jurisdictional boundaries, community characteristics, and land use similarities (**Figure 2**). Other than Segment 2, which includes the communities of Erie, Frederick, and Dacono, the other segments only include one community allowing individual community desires to be considered in the context of the overall corridor vision.

- Segment 1: CO 119 to Boulder/Weld County line
- Segment 2: Boulder/Weld County line to Weld CR 19 (eastern DRCOG planning boundary)
- Segment 3: Weld CR 19 to Weld CR 31 (East of Fort Lupton)
- Segment 4: Weld CR 31 to Weld CR 49 (East of Hudson)
- Segment 5: Weld CR 49 to CO 79.

Figure 2: Study Segment Map



Study Intersections

The intersections that were specifically analyzed within each segment are listed in **Table 1**. Traffic operations were reviewed in the context of the corridor operations using TransModeler™ to model intersection and corridor conditions simultaneously. TransModeler is a microsimulation traffic operations software tool that provides detailed analysis results regarding the operational performance of integrated roadway segments and intersections. The TransModeler output provided a more comprehensive picture of the impacts of the PEL alternatives as opposed to analysis methods that review intersections and corridor elements separately. As such, improvements at one location that may impact traffic flow to other locations are explicitly accounted for throughout the analysis.

Table 1: Study Intersections by Segment

Study Intersections by Segment				
Segment 1	Segment 2	Segment 3	Segment 4	Segment 5
CO 119	WCR 3	WCR 19	WCR 37	WCR 53
71ST ST	WCR 5	WCR 23	WCR 41	WCR 59
DRY CREEK PKY	WCR 7	SB US 85	LOVES/W I-76 FR	SH 79/WCR 69
MONARCH PARK PL	W I-25 FRONTAGE	NB US 85	WB I-76	
79TH ST	SB I-25	GRAND AVE	EB I-76	
HOVER/95TH	NB I-25	FULTON AVE	WCR 45	
US 287	E I-25 FRONTAGE	MCKINLEY AVE		
COUNTY LINE RD	YORK/SILVER BIRCH	DENVER AVE		
	FLYING CIRCLE	ROLLIE AVE		
	COLORADO AVE	WCR 29.5		
	GLEN CREIGHTON	WCR 31		
	WCR 15			

Excluded Areas

Specific areas along the study corridor are excluded from the study because of other projects or studies (**Figure 3**). While these areas weren't specifically studied, the study team did consider proposed improvements in the context of the PEL. These corridor sections include:

- *CO 119 to immediately west of 71st Street* - Alternatives will be considered by teams for the CO 119 improvement project.
- *I-25 (between southbound frontage road to northbound frontage road)* – PEL recommended alternatives will tie into I-25 recommendations.
- *US 85 (between northbound and southbound ramps)* – Recommendations are not expected to impact the bridge structure or conflict with US 85 PEL recommendations.
- *I-76 (WCR 43 to Dahlia St.)* – I-76 Interchange constructed in 2020/2021.

Figure 3: Exclusion Areas



No Action Improvements

The No Action Alternative anticipates future conditions of the CO 52 corridor without completing any transportation improvements that are recommended by this PEL. The No Action Alternative does include required safety and maintenance improvements to maintain an operational transportation system, as well as those fiscally constrained projects that have committed funding sources that will be built regardless of other improvements recommended in this PEL. The No Action alternative is used as a baseline for comparison to the operational and safety benefits that would result from recommended transportation improvements resulting from this PEL.

Table 2 provides information on 2045 fiscally constrained projects that were included in the No Action Model.

Table 2: 2045 Fiscally Constrained Projects Considered in No Action Alternative

Facility	Project Name	Project Description
CO 52	CO 52 & US 287 Intersection	Intersection Capacity and Safety Improvements
CO 52	CO 52 & I-76 Interchange	Intersection Capacity and Safety Improvements
CO 52	CO 52 & WCR 41 Intersection	Intersection Safety Improvements
I-25	MP 214-269	Congestion, Safety, and Freight Reliability Improvements
N 71 st St	Lookout Rd to CO 52	Realignment and Widening of Intersection
WCR 7	CO 52 to Erie Pkwy	Realignment and Widening to 4-Lanes

Measures of Effectiveness

The PEL performance measures were determined early in the project and documented in the PEL Evaluation Criteria matrix finalized as of 12/14/2020. The operations-based measures of effectiveness (MOE) are summarized in **Table 3**.

Table 3: PEL Evaluation Criteria (Operations)

Category	Criteria	Performance Measure Evaluation	
		Level 1	Level 2
Accommodate Increased Travel and Freight Demand	<ul style="list-style-type: none"> • Congestion • Corridor capacity • Travel times • Travel reliability • Quality of Traffic Operations 	Potential to accommodate projected travel and freight demand (Y/N)	Decrease Travel Time Index Increase Reliability Decrease Travel Time Decrease Delay Accommodate Freight Movements

The specific MOEs used to evaluate these performance measures are generally straightforward, measuring the change in the stated performance measure, with the exception of “Increase Reliability”. This was initially expected to use the relative change in the TTI as its basis. However, this was later changed to use the Planning Time Index (PTI), a more traditional MOE used for reliability.

NOMENCLATURE

An important word regarding the nomenclature used with the technical analysis for the CO 52 PEL to distinguish between the use of the terms **model**, **alternative**, and **scenario**:

Model: The term model has the broadest scope and refers to the input, output (results), or files used to perform the technical analysis for the CO 52 PEL project. The program TransCAD™ was used to perform the Travel Demand Modeling (TDM), thus the TDM results are referred to as the “model results”. While the files used for microsimulation modeling in TransModeler may also be referred to as “models”, the term model is typically used when referring to the TDM generated traffic volumes (e.g. – The Full 4-Lane Model Volumes).

Alternative: The use of the term alternative is used more versatilely and refers to the physical changes to the roadway geometry and its related impacts. In terms of the CO 52 PEL, a 2-Lane alternative may include wider shoulders, a multi-use path, and additional median treatments. However, in terms of the traffic analysis, the alternatives are limited to the relevant features that are expected to have a direct, measurable impact on traffic operations. The traffic volumes from several different models could apply to a particular alternative in terms of the traffic analysis, depending on the location along the corridor. For example, west of US 287 the Full 4-Lane and West 4-Lane model volumes apply to the 4-Lane alternative.

Scenario: This is the most specific term and refers to the combination of TDM volumes (model) and geometric features (alternative) used in the TransModeler analysis. Thus a “modeled scenario” or “scenario model” refers to the TransModeler input or output (results) for a discreet combination of TDM volumes and roadway alternative. The results from multiple scenarios can be combined or aggregated within specific segments to provide average results for an alternative, but an alternative cannot be readily split without creating a new scenario.

EXISTING TRAFFIC CONDITIONS

The *Existing Conditions Report* (Muller 2020) was prepared in early 2020 to provide vital context on the current conditions along the corridor. Roadway characteristics, traffic operations, travel demand modeling, socioeconomic projections, safety, transit, railroad crossings, freight, and structures were all considered along the CO 52 study corridor.

However, the COVID-19 pandemic and the stay-at-home orders significantly impacted traffic operations nationwide when this report was prepared, delaying the data collection effort necessary for the detailed traffic operations analysis.

DATA COLLECTION EFFORT

The data collection effort was postponed to the Fall 2020 due to the COVID-19 pandemic. The data collected in support of the traffic operations analysis included vehicle classification data, speed data, pedestrian and bicycle counts. The intersection turning movement counts and link volume counts collected in the field were reviewed in detail and adjusted to account for the impact of the COVID-19 pandemic. The field collected turning movement counts are provided in **Appendix A**.

Vehicle Classification

The link volumes collected included vehicle classification data based on September and October 2020 traffic counts. This information was used to inform the truck percentages assumptions used during the traffic operations analysis performed for the corridor. A summary of the vehicle classification data at select locations is provided in **Table 4**. Link volume, speed, and classification data is provided in **Appendix B**.

Table 4: Vehicle Classification Data

Location	AM Peak Period				PM Peak Period			
	Count ¹	%L ²	M% ³	A% ⁴	Count ¹	%L ²	M% ³	A% ⁴
Westbound								
West of US 287	350	79%	20%	1%	160	90%	9%	0%
East of Colorado Blvd.	570	72%	22%	6%	450	78%	19%	3%
West of US 85	410	69%	20%	10%	350	84%	13%	3%
West of I-76	200	69%	22%	9%	200	76%	19%	5%
East of WCR 59	120	71%	21%	9%	80	65%	31%	4%
Eastbound								
West of US 287	230	81%	18%	1%	400	91%	8%	1%
East of Colorado Blvd.	380	73%	20%	7%	670	82%	16%	2%
West of US 85	370	66%	27%	7%	380	75%	21%	4%
West of I-76	160	66%	29%	5%	210	76%	21%	2%
East of WCR 59	100	79%	16%	5%	90	71%	24%	4%

¹ Two-Day Peak Period Average (vehicles per hour)

² Light Vehicles (Cars, SUVs, Pick-Ups): AASHTO Classes 1-3

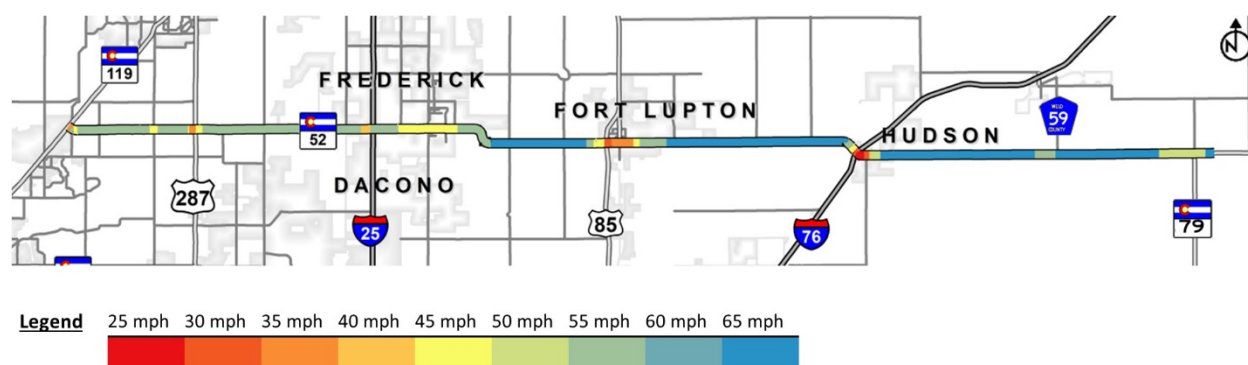
³ Medium Trucks (Single-Unit Trucks, Busses, RVs): AASHTO Classes 4-7

⁴ Articulated Trucks (Semi-Trucks): AASHTO Classes 8-13

Speed Distribution

The data collection effort also recorded vehicle speeds at 19 locations across the CO 52 study corridor. This information was used to inform the speed distribution of vehicles relative to the posted speed limit input into the traffic analysis models. For reference, **Figure 4** displays the posted speed limit along a map of the corridor.

Figure 4: Posted Speed Limits



A representative sample of the speed distribution data, provided in terms of the deviation from the posted speed limit, are provided in **Table 5**.

Table 5: Speed Distribution – Deviation from Posted Speed Limit

Location	Speed Limit	Free Flow ¹			AM Peak Period ²			PM Peak Period ²		
		< 5 mph	±5 mph	> 5 mph	< 5 mph	±5 mph	> 5 mph	< 5 mph	±5 mph	> 5 mph
Westbound										
West of US 287	55	2%	63%	35%	6%	59%	35%	2%	41%	57%
East of Colo. Blvd.	45	2%	77%	21%	11%	78%	11%	3%	71%	26%
West of US 85	65	18%	76%	6%	36%	63%	1%	23%	76%	1%
West of I-76	65	23%	70%	7%	16%	75%	9%	13%	78%	9%
East of WCR 59	65	25%	61%	14%	18%	80%	2%	23%	75%	2%
Eastbound										
West of US 287	55	2%	64%	34%	1%	30%	69%	6%	72%	22%
East of Colo. Blvd.	45	2%	83%	15%	3%	74%	23%	5%	85%	10%
West of US 85	65	11%	63%	26%	19%	75%	6%	16%	78%	6%
West of I-76	65	17%	58%	25%	8%	72%	20%	2%	70%	28%
East of WCR 59	65	11%	56%	33%	14%	68%	18%	17%	59%	24%

¹ Free-Flow based on speeds recorded late evening to early morning (10 p.m. to 3 a.m.)

² AM 6:30 a.m. to 8:30 a.m., PM 4:30 p.m. to 6:30 p.m.

Pedestrian and Bicycle Activity

There was some degree of pedestrian or bicycle activity measured at 28 of the 40 intersections included in the data collection effort. Weather conditions were partly cloudy and warm with temperatures between 77°F and 88°F with no precipitation.

Pedestrian Counts

The highest hourly crossing pedestrian volume for each peak period, by approach, is shown in **Table 6**. As expected, pedestrian counts are highest in the areas of higher land-use density, notably in the areas of Frederick/Dacono, Fort Lupton, and Hudson.

Table 6: Pedestrian Activity

LOCATION	AM PEAK HOUR					PM PEAK HOUR				
	E	W	N	S	Σ	E	W	N	S	Σ
SH119	1	0	0	1	2	1	0	0	1	2
71ST ST	0	0	0	0	0	0	0	0	0	0
DRY CREEK PKY	0	0	0	0	0	0	0	0	0	0
MONARCH PARK PL	0	0	0	0	0	0	0	0	0	0
79TH ST	1	1	0	0	2	0	0	0	0	0
HOVER/95TH	0	0	0	0	0	0	0	0	0	0
US 287	0	0	0	0	0	0	0	0	0	0
COUNTY LINE RD	0	0	0	0	0	0	0	0	0	0
WCR3	0	0	0	0	0	0	0	0	0	0
WCR5	0	0	0	0	0	0	0	0	0	0
WCR7	0	0	1	1	2	0	1	0	0	1
W I-25 FRONTAGE	0	1	1	0	2	0	0	0	0	0
SB I-25	0	0	1	0	1	0	0	0	0	0
NB I-25	0	0	1	0	1	0	0	0	0	0
E I-25 FRONTAGE	0	1	0	0	1	1	1	0	0	2
YORK/SILVER BIRCH	0	0	1	0	1	0	0	0	0	0
FLYING CIRCLE	0	0	0	0	0	0	0	0	0	0
COLORADO AVE	0	2	2	0	4	3	9	6	3	21
GLEN CREIGHTON/FREDERICK	0	2	0	0	2	1	4	0	5	10
WCR15	0	0	0	0	0	2	0	0	2	4
WCR19	0	0	0	0	0	0	0	0	0	0
WCR23	0	0	0	0	0	0	0	0	0	0
SB US 85	0	0	0	0	0	0	0	0	0	0
NB US 85	0	0	0	0	0	0	0	0	0	0
GRAND AVE	1	1	0	1	3	2	1	1	0	4
FULTON AVE	0	5	0	1	6	2	2	2	1	7
MCKINLEY AVE	11	1	1	7	20	9	1	1	3	14
US 85 BUS/DENVER	2	2	0	2	6	3	3	2	0	8
ROLLIE AVE	6	0	1	0	7	8	0	0	3	11
WCR29.5	0	0	0	0	0	0	0	0	0	0
WCR31	0	0	0	0	0	0	0	0	0	0
WCR37	0	0	0	0	0	0	0	0	0	0
WCR41	0	0	0	0	0	0	0	0	0	0
LOVES/W I-76 FRONTAGE	0	0	0	0	0	0	0	0	0	0
WCR45	0	0	1	0	1	0	1	0	0	1
WCR53	0	0	0	0	0	0	0	0	0	0
WCR59	0	0	1	0	1	0	0	0	0	0
SH79/WCR69	0	0	0	0	0	0	0	0	0	0

Note: Pedestrian volumes represent bidirectional activity crossing the indicated approach.

Bicycle Counts

The highest hourly approach bicycle volume for each peak period, by approach, is shown in **Table 7**. In general, intersections towards the west end of the corridor (west of US 287) have more bicycle activity than the central and eastern portions.

Table 7: Bicycle Activity

LOCATION	AM PEAK HOUR					PM PEAK HOUR				
	EB	WB	NB	SB	Σ	EB	WB	NB	SB	Σ
SH119	0	0	4	4	8	0	0	4	8	12
71ST ST	1	1	0	0	2	0	2	1	0	3
DRY CREEK PKY	2	1	0	0	3	1	1	0	1	3
MONARCH PARK PL	2	1	0	0	3	2	1	0	0	3
79TH ST	1	2	0	0	3	1	1	8	6	16
HOVER/95TH	0	1	2	1	4	4	0	3	3	10
US 287	0	0	0	0	0	0	0	1	2	3
COUNTY LINE RD	0	2	0	2	4	1	1	1	0	3
WCR3	0	0	0	0	0	0	0	0	0	0
WCR5	0	1	0	0	1	2	1	1	0	4
WCR7	0	0	0	0	0	0	2	1	1	4
W I-25 FRONTAGE	0	1	0	0	1	1	2	1	1	5
SB I-25	0	1	0	0	1	2	2	0	0	4
NB I-25	0	1	0	0	1	1	2	0	0	3
E I-25 FRONTAGE	0	0	0	0	0	2	2	0	0	4
YORK/SILVER BIRCH	0	0	0	0	0	2	1	0	0	3
FLYING CIRCLE	1	0	1	0	2	2	2	0	0	4
COLORADO AVE	0	0	1	1	2	0	2	0	0	2
GLEN CREIGHTON/FREDERICK	0	2	0	0	2	2	2	0	1	5
WCR15	0	0	0	1	1	2	2	0	0	4
WCR19	0	0	0	0	0	0	0	0	0	0
WCR23	0	0	0	0	0	0	0	0	0	0
SB US 85	0	0	0	0	0	0	0	0	0	0
NB US 85	0	0	0	0	0	0	0	0	0	0
GRAND AVE	0	0	0	0	0	0	0	0	0	0
FULTON AVE	0	0	0	0	0	0	0	2	0	2
MCKINLEY AVE	0	0	0	0	0	0	0	0	0	0
US 85 BUS/DENVER	0	0	0	0	0	0	0	0	0	0
ROLLIE AVE	0	0	0	0	0	0	0	1	1	2
WCR29.5	0	0	0	0	0	0	1	0	0	1
WCR31	2	1	0	0	3	1	1	0	1	3
WCR37	0	0	0	0	0	0	0	0	0	0
WCR41	0	0	0	0	0	0	0	0	0	0
LOVES/W I-76 FRONTAGE	0	0	0	0	0	0	0	0	0	0
WCR45	0	0	0	0	0	0	0	0	0	0
WCR53	0	0	0	0	0	0	0	0	0	0
WCR59	0	0	0	0	0	0	0	0	0	0
SH79/WCR69	0	0	0	0	0	0	0	0	0	0

Note: Bicycle traffic counted approaching the intersection in the indicated direction.

EXISTING TRAFFIC VOLUMES

As part of the project, traffic data was collected along the corridor, cross-streets and frontage roads for the purpose of analyzing traffic conditions, adjusting traffic models, and supporting other design needs. Data collection focused on weekdays and included turning movement count data (TMC), as well as link volume, classification, and speed data. The primary field data collection effort occurred on Tuesday, Wednesday, and Thursday during the week of September 20th, 2020 (9/22/2020 – 9/24/2020). Secondary data collection (corrections and refinements) occurred on the following dates: 9/29/2020, 9/30/2020, 10/28/2020, and 10/29/2020.

COVID-19 Pandemic Volume Adjustments

The purpose of this section is to summarize the steps taken to adjust the SH52 volumes for COVID-19. Evidence indicated that 2020 volumes were consistently lower than in previous years due to COVID. The following data was used in this evaluation process:

Available Data

- Current 2020 Traffic Counts:
 - 40 TMCs and 19 Link Counts
- CDOT Short Duration Counts from OTIS:
 - 21 Link Counts Locations (some overlap):
 - 2015 @ 11 Locations
 - 2016 @ 7 Locations
 - 2017 @ 15 Locations
 - 2018 @ 10 Locations
 - 2019 @ 8 Locations
- CDOT Continuous Count Locations from OTIS:
 - None on CO 52 or a truly similar facility.
- Link Counts from Other Sources:
 - 4 Link Count Locations
 - 2017 @ 1 Location
 - 2019 @ 3 Locations
- TMC from Other Sources:
 - 10 TMC Count Locations:
 - 2015 @ 5 Locations
 - 2016 @ 1 Location
 - 2018 @ 3 Locations
 - 2019 @ 2 Locations

The historic data is spread out across five years and were collected in different months of the year. This methodology used seasonal and annual adjustment factors based on Continuous Count data locations to adjust the historic counts to represent **2019 Average Weekday Daily Traffic (AWDT)** equivalent. The 2020 counts were adjusted to approximate **2020 AWDT** levels for the purpose of this comparison.

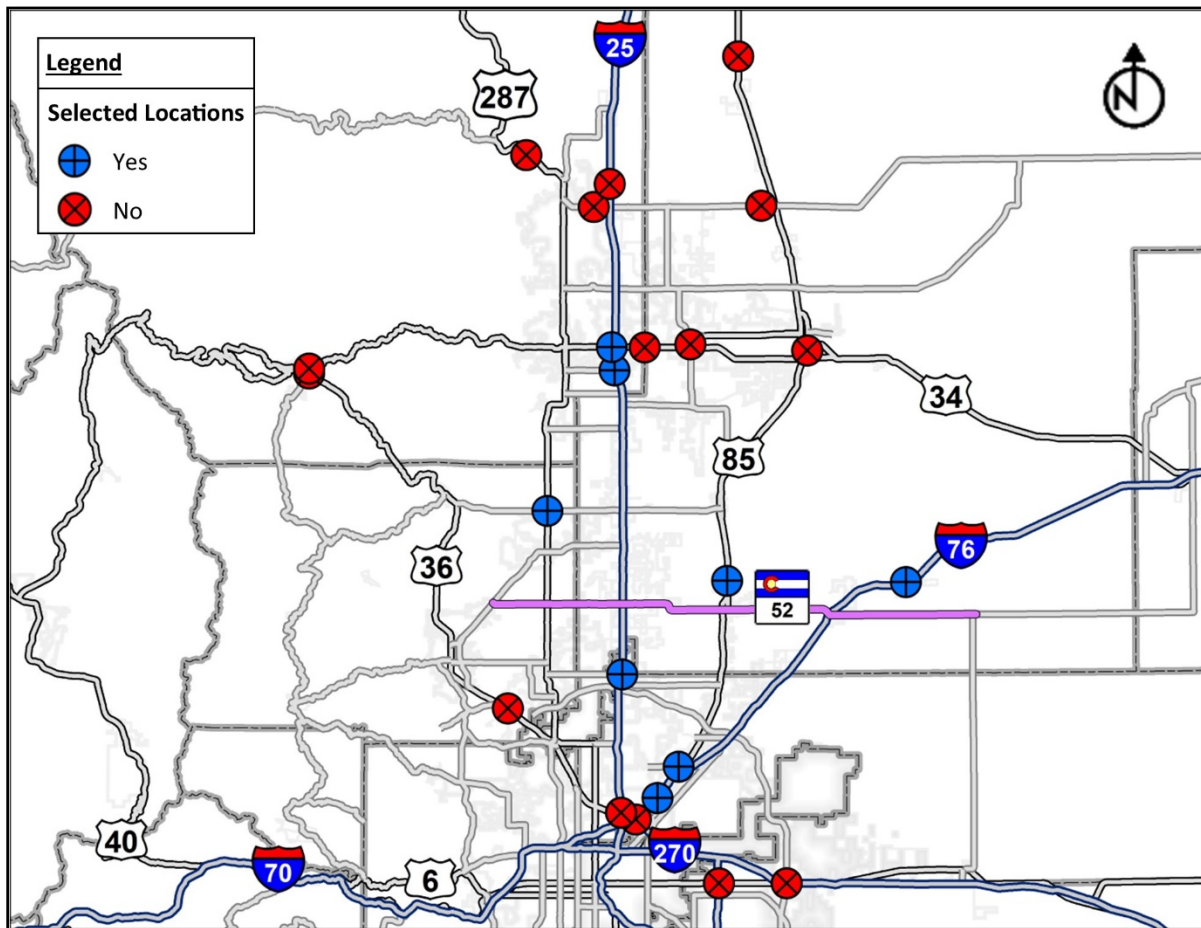
Developing Annual and Seasonal Adjustment Factors

The Continuous Count Locations, or Automated Traffic Recorder (ATR) locations collect hourly count data daily, by direction, and were downloaded from the OTIS website. There are many such ATRs located throughout the State. For the purpose of this analysis, the following eight (8) locations shown in **Table 8** were selected; these locations are also shown in **Figure 5** with the selected locations in red and the available locations in blue.

Table 8: Selected Automated Traffic Recorder Stations

ROUTE	MP	DESCRIPTION
287C	318.33	ON SH 287 107TH ST N/O SH 66 UTE HWY LONGMONT
085C	244.21	ON SH 85 N/O CR 18
034A	96.03	ON SH 34 EISENHOWER BLVD W/O I-25 LOVELAND
044A	2.24	ON SH 44 104TH AVE W/O BRIGHTON RD COMMERCE CITY
076A	9.48	ON I-76 NE/O 88TH AVE COMMERCE CITY
076A	38.92	ON I-76 EN/O SH 76 SPUR MARKET ST KEENESBURG
025A	255.27	ON I-25 S/O SH 34 JOHNSTOWN
025A	229.11	ON I-25 N/O SH 7 BASELINE RD BROOMFIELD

Figure 5: Selected and Available Automated Traffic Recorder Stations



Annual Adjustment Factors

The Average Annual Weekday Daily Traffic (AAWDT) is the average of the daily volumes on Tuesday, Wednesday, and Thursday. **Table 9** shows the calculated AAWDT based on the ATR data:

Table 9: Average Annual Weekday Traffic Volumes by Year

Route	MP	Year				
		2015	2016	2017	2018	2019
287C	318.33	23,300	25,700	26,800	27,600	27,900
085C	244.21	21,500	21,200	24,000	23,900	22,700
034A	96.03	51,800	53,200	53,800	54,800	56,300
044A	2.24	13,600	14,400	15,000	15,900	16,300
076A	9.48	87,900	91,100	92,200	97,700	95,900
076A	38.92	11,400	11,000	10,900	13,200	13,100
025A	255.27	79,100	81,700	84,000	86,000	83,300
025A	229.11	113,700	117,500	126,000	129,100	127,000

This was used to create a factor that could be applied to any year to adjust the traffic volumes to a 2019 equivalent value using the following formula:

$$Annual\ Factor_{Year} = \frac{AAWDT_{2019}}{AAWDT_{Year}}$$

The resulting factor is >1.0 when AAWDT is lower than the 2019 AAWDT and <1.0 when the annual AAWDT was greater than the 2019 AAWDT. The resulting factors are shown in **Table 10** along with the average annual factor across all eight locations:

Table 10: Annual Weekday Traffic Factor by Year

Route	MP	Year				
		2015	2016	2017	2018	2019
287C	318.33	1.20	1.09	1.04	1.01	1.00
085C	244.21	1.06	1.07	0.95	0.95	1.00
034A	96.03	1.09	1.06	1.05	1.03	1.00
044A	2.24	1.20	1.13	1.09	1.03	1.00
076A	9.48	1.09	1.05	1.04	0.98	1.00
076A	38.92	1.15	1.19	1.20	0.99	1.00
025A	255.27	1.05	1.02	0.99	0.97	1.00
025A	229.11	1.12	1.08	1.01	0.98	1.00
AVERAGE:		1.12	1.09	1.05	0.99	1.00

It was interesting that 2018 AAWDT was a bit higher than the 2019 AAWDT fairly consistently. There are a couple of odd patterns here that could be considered outliers, such as the I-76 count in Keensburg where the traffic decreased from 2015 to 2017 then increased significantly in 2018.

The Average Annual Factor was applied to CO 52 count data to adjust the historic counts to 2019 equivalent values.

Seasonal Adjustment Factors

The seasonal adjustment factors compare the monthly AWDT to the AAWDT for each year. A separate seasonal adjustment factor is calculated for each month and year using the ATR data. This calculation is performed separately for each year using the following formula:

$$Seasonal\ Factor_{Month,Year} = \frac{AAWDT_{Year}}{AWDT_{Month,Year}}$$

Similar to the annual factor, this is >1.0 when the monthly AWDT was lower than the AAWDT for that year, and <1.0 when the monthly AWDT is greater. The factors calculated for 2019 are shown in **Table 11** along with the average seasonal factor across all eight locations:

Table 11: Seasonal Adjustment Factor, 2019 by Month

Route	MP	2019 by Month											
		1	2	3	4	5	6	7	8	9	10	11	12
287C	318.33	1.11	1.07	1.04	1.02	0.98	0.92	0.91	0.89	0.94	1.01	1.14	1.08
085C	244.21	1.09	1.05	1.04	1.03	0.97	0.90	0.91	0.90	0.93	1.01	1.11	1.15
034A	96.03	1.11	1.07	1.03	1.01	0.99	0.93	0.90	0.91	0.93	1.01	1.13	1.04
044A	2.24	1.12	1.08	1.03	1.01	0.98	0.95	0.95	0.92	0.92	0.98	1.07	1.03
076A	9.48	1.07	1.04	0.98	1.00	0.98	0.93	0.95	0.93	0.94	1.03	1.11	1.08
076A	38.92	1.18	1.25	1.07	1.03	0.95	0.86	0.80	0.84	0.93	1.06	1.18	1.10
025A	255.27	1.10	1.07	0.97	0.99	0.96	0.90	0.91	0.93	0.96	1.09	1.11	1.04
025A	229.11	1.11	1.09	0.99	1.02	0.98	0.91	0.90	0.90	0.92	1.04	1.10	1.05
2019 AVERAGE:		1.11	1.09	1.02	1.01	0.97	0.91	0.90	0.90	0.93	1.03	1.12	1.07

This was repeated for each of the five years (2015 through 2019) to create the average seasonal factors, by year, shown in **Table 12**.

Table 12: Annual Seasonal Adjustment Factor, by Month

YEAR	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
2015	1.11	1.08	1.03	1.00	1.00	0.94	0.92	0.92	0.96	0.99	1.06	1.06
2016	1.09	1.12	1.06	1.02	0.97	0.93	0.93	0.95	0.97	0.98	1.01	1.02
2017	1.15	1.10	1.02	1.00	0.97	0.93	0.96	0.93	0.98	0.99	1.02	1.03
2018	1.10	1.11	1.03	1.00	0.96	0.93	0.95	0.93	0.97	1.00	1.03	1.08
2019	1.11	1.09	1.02	1.01	0.97	0.91	0.90	0.90	0.93	1.03	1.12	1.07
AVERAGE:	1.11	1.10	1.03	1.01	0.98	0.93	0.93	0.93	0.96	1.00	1.05	1.05

The Seasonal Adjustment Factor was applied to the historic counts by month and year. Therefore, the 2019 AWDT equivalent is calculated using the following formula:

$$2019\ AWDT\ Equivalent = COUNT\ DATA_{Month,Year} * Seasonal\ Factor_{Month,Year} * Annual\ Factor_{Year}$$

Special Provision for 2020 Counts

As the intent was to compare 2020 data directly to the calculated 2019 AWDT equivalent value, it was not necessary to apply an annual factor to the 2020 counts. However, the field data collection, which primarily occurred in September, was adjusted to an equivalent AWDT level. Therefore, the Average Seasonal Factor was applied to the 2020 counts.

CO 52 COVID Adjustment Factors

The 2019 AWDT Equivalent volumes were compared to the seasonally adjusted 2020 traffic counts to create the COVID adjustment factors along the CO 52 corridor. Where possible, the 2019 AWDT Equivalent from multiple historic counts were used in this comparison. Historic counts were included if the location description and count characteristics were consistent with other historic counts in the vicinity.

The calculated COVID adjustment factors for these discreet count locations were evaluated individually and in terms of how to apply the factors to the 2020 traffic count data. **Table 13** provides a summary of the count comparison locations with the seasonally adjusted 2020 counts, average 2019 AWDT counts, and the resulting factors applicable to traffic along the CO 52 corridor.

Table 13: Historic Link Volume Data Comparison

LOCATION	2020 Counts ¹	Average 2019 Equivalent ²	%DIFF	FACTOR	APPLIED FACTOR
SH 119 and 79th Street	7,290	11,230	-43%	1.54	1.40
79th Street and 95th Street	7,980	11,520	-36%	1.44	
95th Street and US 287	8,880	11,750	-28%	1.32	1.25
US 287 and County Line	16,450	18,830	-13%	1.14	
Aggregate and SB I-25 Ramp	18,840	20,650	-9%	1.10	1.10
I-25 Frontage and York-Silver Birch	20,700	22,910	-10%	1.11	
Colorado Blvd and Frederick St	16,460	16,300	1%	0.99	
Frederick St and WCR 19	11,260	12,480	-10%	1.11	
WCR 19 and US 85	12,530	12,120	3%	0.97	1.10
US 85 and Denver Street	12,710	15,280	-18%	1.20	
Denver St and WCR 31	6,520	N/A	-	-	
WCR 37 and Loves Access - I76 Frontage	6,610	8,990	-31%	1.36	1.30
EB I76 and Beech St	6,180	8,230	-28%	1.33	
Beech St and WCR 51	3,730	5,090	-31%	1.36	
WCR 51 and WCR 59	3,980	3,520	12%	0.88	1.00
WCR 59 and WCR 69-SH 79	3,490	2,430	36%	0.70	

¹ 2020 counts adjusted with average seasonal adjustment factors.

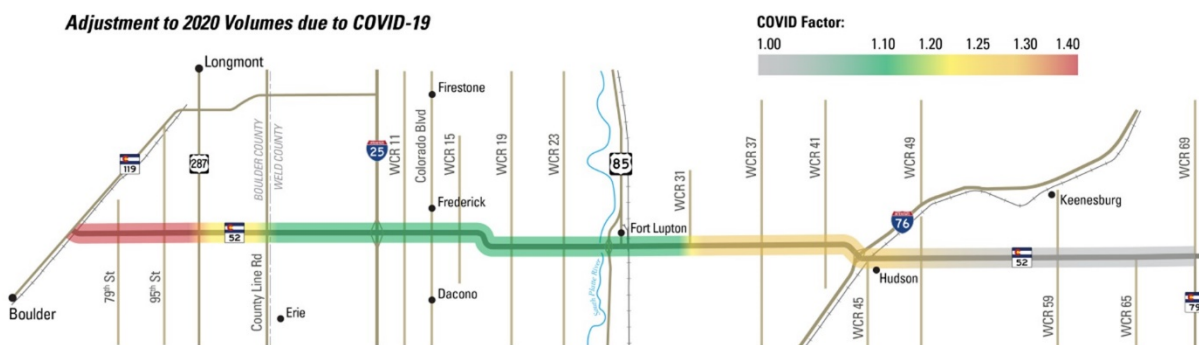
² Average 2019 AWDT Equivalent factors based on annual and seasonal adjustment factors.

There are several interesting patterns indicated here. The observed difference between the 2019 equivalent volumes and the 2020 traffic counts steadily increases between I-25 and SH 119, more-so west of US 287. The difference between I-25 and US 85 was less consistent but generally low (less than 10%),

going back up between Ft. Lupton and Hudson. There was significantly less data to use for comparison east of Hudson, which shows an increase in 2020 traffic during COVID conditions; therefore the 2020 data was used without adjustment in this area.

These factors were generalized to apply to multiple links and intersections within six zones. The resulting COVID-19 adjustment factors are shown graphically in **Figure 6**.

Figure 6: COVID-19 Adjustment Factors



Intersection Peak Hour Turning Movement Review

In addition to the link-count comparisons, there were six locations where historic turning movement count data was available to compare to the Fall 2020 data collected for the CO 52 PEL study. There were four other locations available that were excluded from this review due to the age of the count data (2015 or older), or due to inconsistencies in the source data.

The eastbound and westbound CO 52 approach traffic was adjusted using the annual and seasonal adjustment factors to 2019 equivalent levels to compare to the seasonally adjusted 2020 count data. The resulting comparison with the percent differences by peak period are shown in **Table 14**.

Table 14: Historic Turning Movement Data Comparison

LOCATION	Eastbound and Westbound CO 52 Approach Volumes					
	AM PEAK			PM PEAK		
	2020 Counts ¹	2019 Equivalent ²	% Diff.	2020 Counts ¹	2019 Equivalent ²	% Diff.
US287 and SH52	2920	3720	-24%	3070	3930	-25%
I25 W Frontage and SH52	2250	2590	-14%	2240	2530	-12%
I25 NB Ramp and SH52	2450	2650	-8%	2640	2770	-5%
I25 E Frontage and SH52	2180	2290	-5%	2380	2610	-9%
WCR19 and SH52	970	1040	-7%	1070	1140	-6%
WCR41 and SH52	440	700	-46%	530	810	-42%

¹ 2020 counts adjusted with calculated average seasonal adjustment factor.

² Historic counts adjusted using annual and seasonal factors to 2019 equivalent levels.

This comparison indicates that while the 2020 counts were lower than the 2019 equivalent levels, there is not a substantial shift between the AM and PM peak periods. Observations made in the Denver Metro

Area have shown different shifts based on time of day, often with the AM peak period showing a larger decrease in 2020 than during the PM peak period. That does not appear to be the case for the intersections along CO 52, therefore, the same COVID-19 adjustment factors will be applied to both peak periods.

COVID-19 Adjusted 2020 Peak Hour Traffic Volume Estimates

Intersection turning movement counts were adjusted using NCHRP 255 volume balancing procedures, with manual adjustments to the applied factors where the applied factor changes. The resulting volumes were then balanced along the corridor to limit the differences in peak hour link volumes between intersections based on the relative amount of access between intersections. For example, a ±10% difference was allowed between Colorado Boulevard and Glen Creighton Boulevard as there are multiple access points between the two locations, while no change was allowed between WCR 5 and WCR 7 due to the minimal amount of access between the two locations.

The resulting peak hour and daily link volumes estimated are provided in the following five figures:

- **Figure 7:** Segment 1 – COVID Adjusted 2020 Turning Movement Volumes
- **Figure 8:** Segment 2 – COVID Adjusted 2020 Turning Movement Volumes
- **Figure 9:** Segment 3 – COVID Adjusted 2020 Turning Movement Volumes
- **Figure 10:** Segment 4 – COVID Adjusted 2020 Turning Movement Volumes
- **Figure 11:** Segment 5 – COVID Adjusted 2020 Turning Movement Volumes

Figure 7: Segment 1 – COVID Adjusted 2020 Turning Movement Volumes

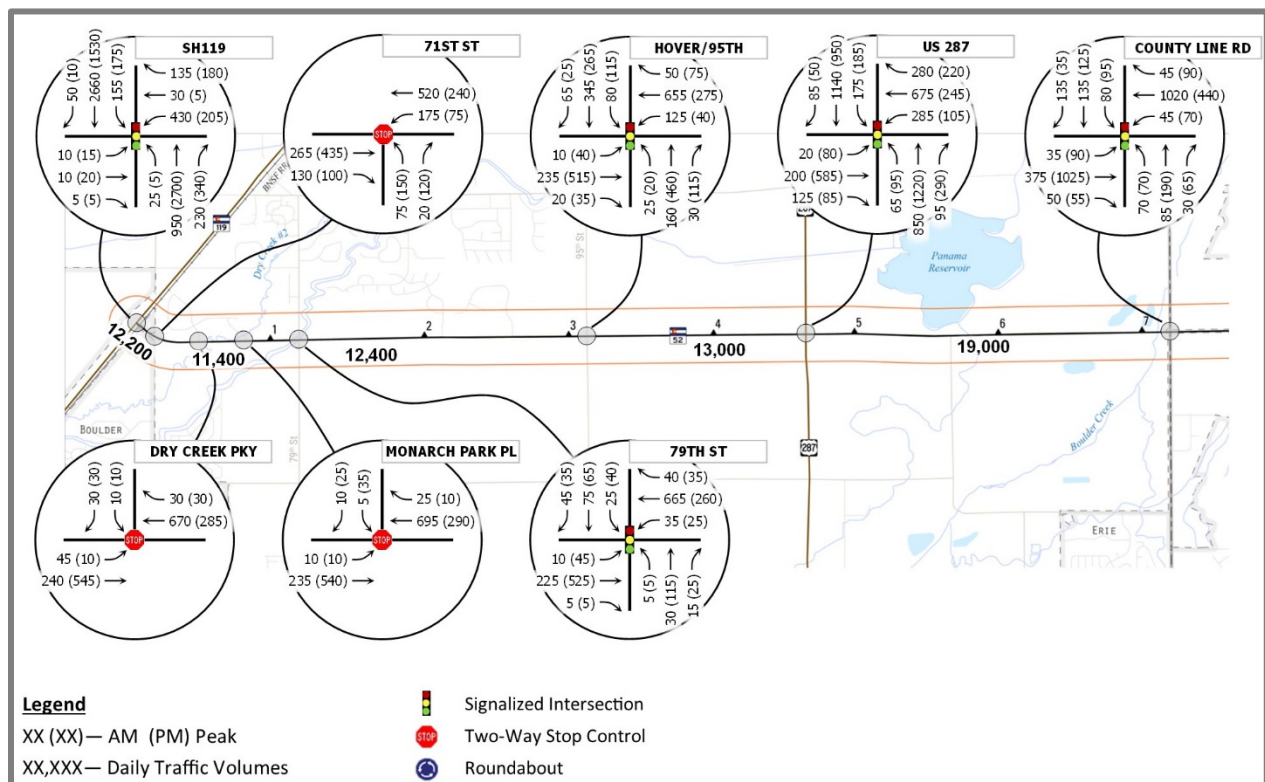


Figure 8: Segment 2 –COVID Adjusted 2020 Turning Movement Volumes

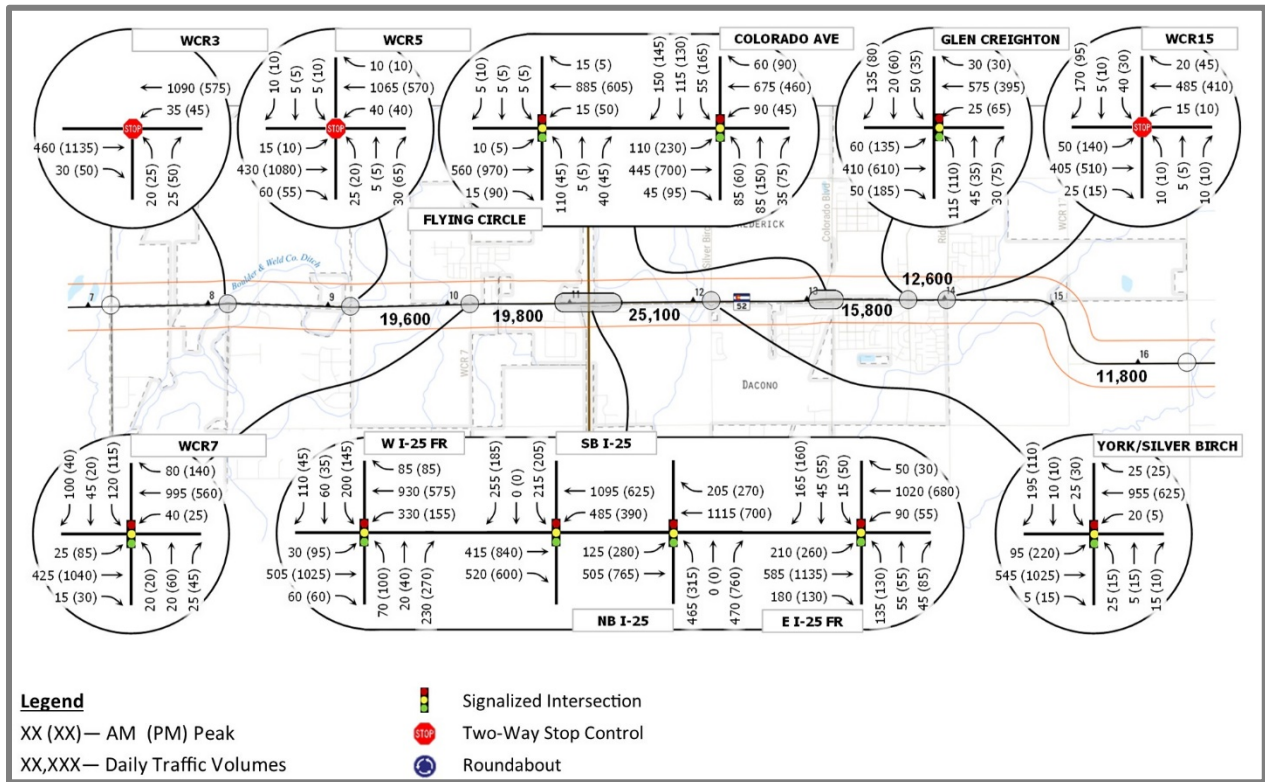


Figure 9: Segment 3 –COVID Adjusted 2020 Turning Movement Volumes

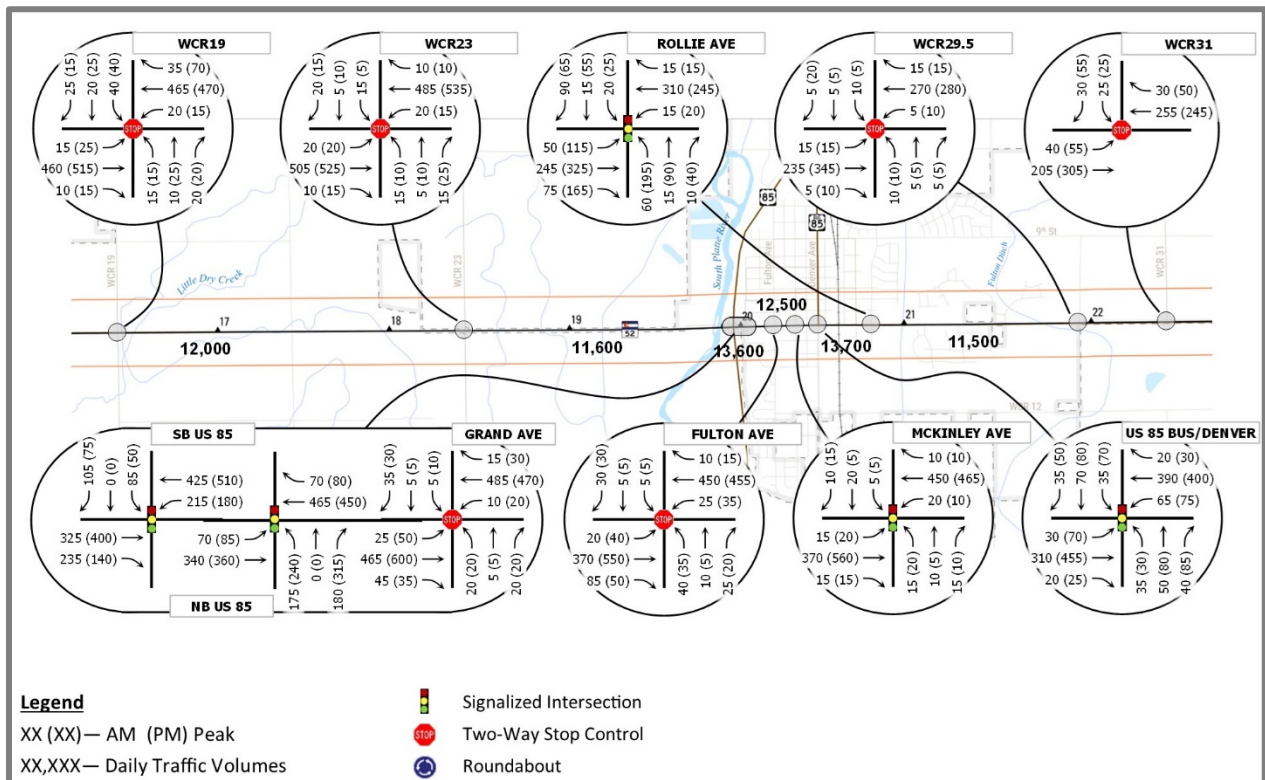


Figure 10: Segment 4 – COVID Adjusted 2020 Turning Movement Volumes

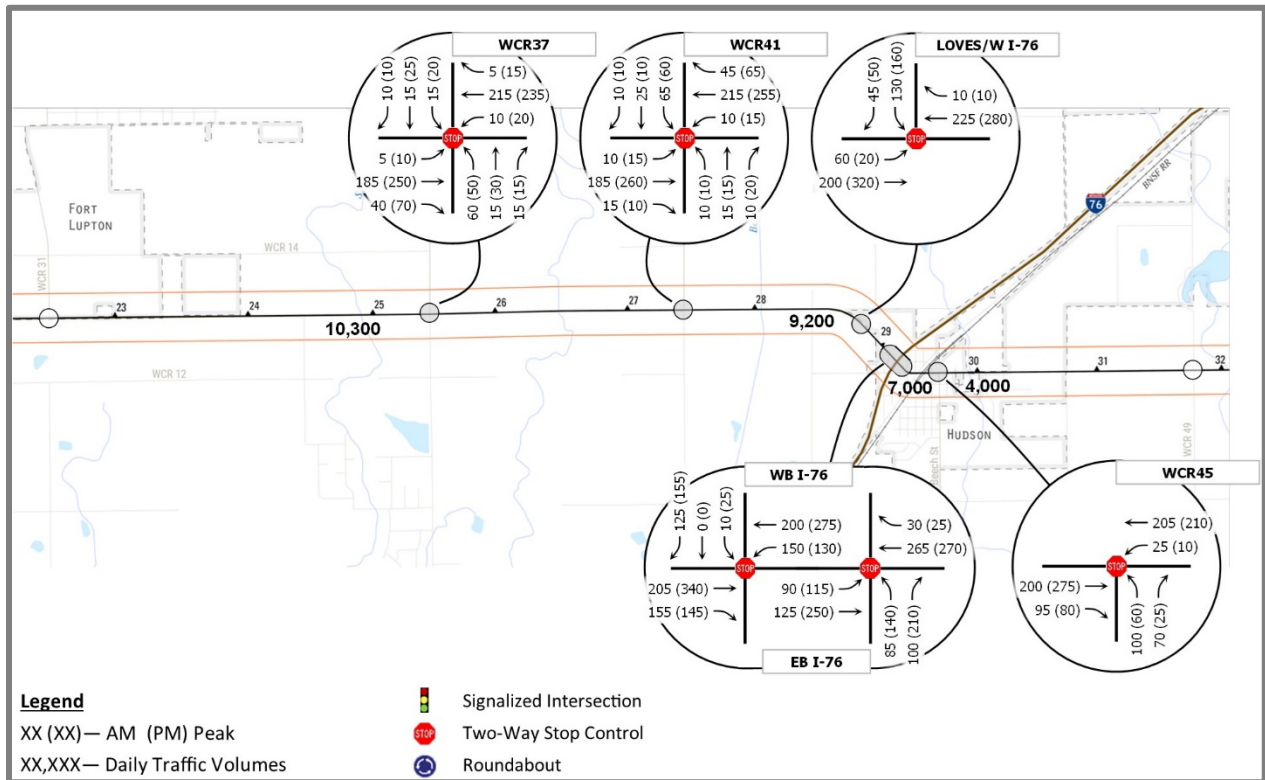
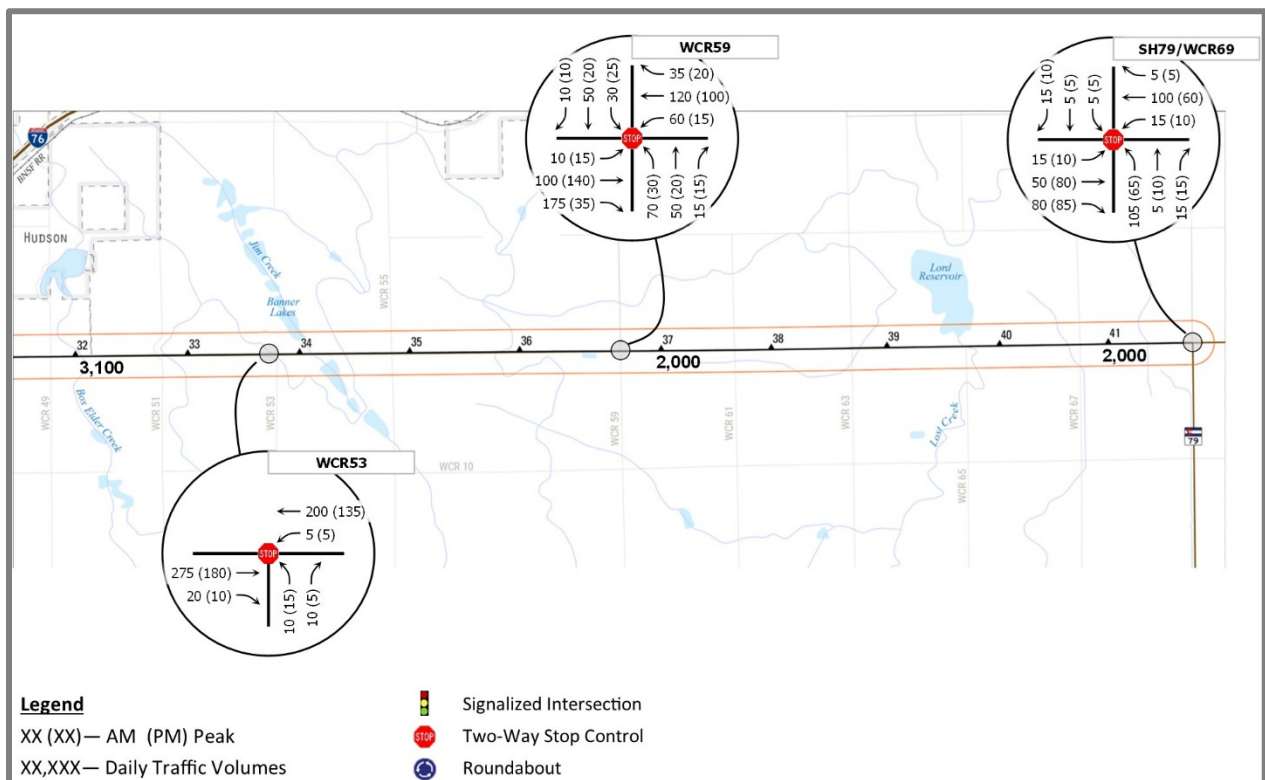


Figure 11: Segment 5 – COVID Adjusted 2020 Turning Movement Volumes



EXISTING TRAFFIC OPERATIONS

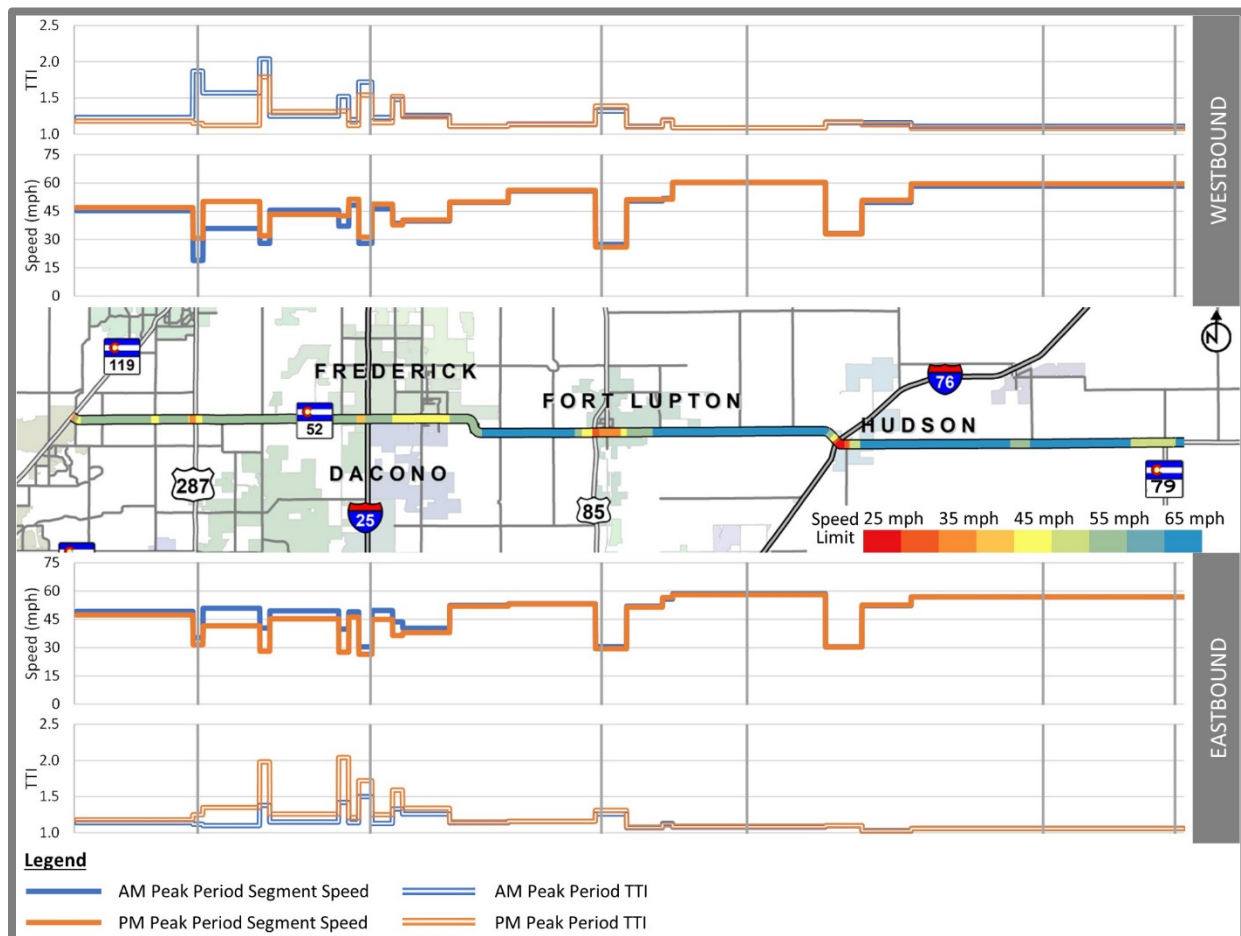
The *Existing Conditions Report* (Muller 2020) provided a review of corridor operations using data from the INRIX Probe Data Analytics Suite. INRIX uses anonymized data collected from mobile networks and other sources to provide location-based traffic data and analytics. The analysis focused primarily on the segment speed and travel time index (TTI) in September 2019, but also evaluated the historic trends between 2013 and 2019. In addition, the Existing Condition Report provided travel time data based on the preliminary Travel Demand Model results for the existing (Year 2019) and 2045 No Action peak period conditions.

The detailed traffic analysis is based on the COVID-adjusted traffic data collected in Fall 2020, which was analyzed using the TransModeler simulation software to evaluate the combined impact of intersection and segment delays across the full 42-mile length of the CO 52 study corridor. There are inherent differences in how this detailed analysis tool quantifies traffic operations compared to either INRIX or TDM, thus the results of the TransModeler analysis will not necessarily match those shown in the previous report.

Segment Speed and Travel Time Index

The following graphic (Figure 12) shows the peak hour segment speed and Travel Time Index along the study corridor, by direction.

Figure 12: Existing (Adjusted 2020) Segment Speed and Travel Time Index



There are several bottleneck locations along the CO 52 corridor where intersection delay leads to low speeds and potentially extensive queuing. These generally align with the known trouble spots along the corridor such as the US 287 intersection, County Line Road, and the I-25 interchange area.

Intersection Operations

The intersection levels of service (LOS) were also evaluated in support of the CO 52 Access Control Plan (ACP). Though simulation based, the delay-based LOS values are measured in a similar fashion to the methodology used in Highway Capacity Manual software.

The resulting LOS results are provided in the following five figures:

- **Figure 13:** Segment 1 – Existing (Adjusted 2020)
- **Figure 14:** Segment 2 – Existing (Adjusted 2020) Levels of Service
- **Figure 15:** Segment 3 – Existing (Adjusted 2020) Levels of Service
- **Figure 16:** Segment 4 – Existing (Adjusted 2020) Levels of Service
- **Figure 17:** Segment 5 – Existing (Adjusted 2020) Levels of Service

Figure 13: Segment 1 – Existing (Adjusted 2020) Levels of Service

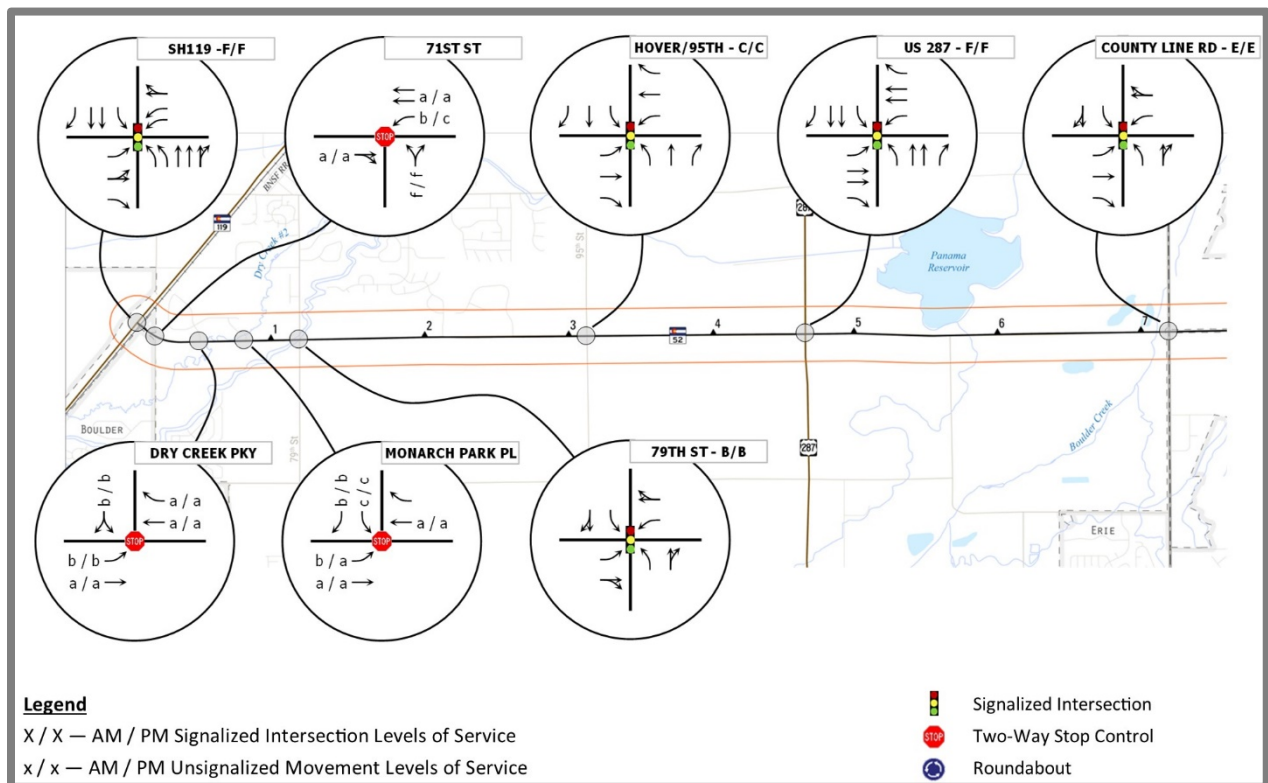


Figure 14: Segment 2 – Existing (Adjusted 2020) Levels of Service

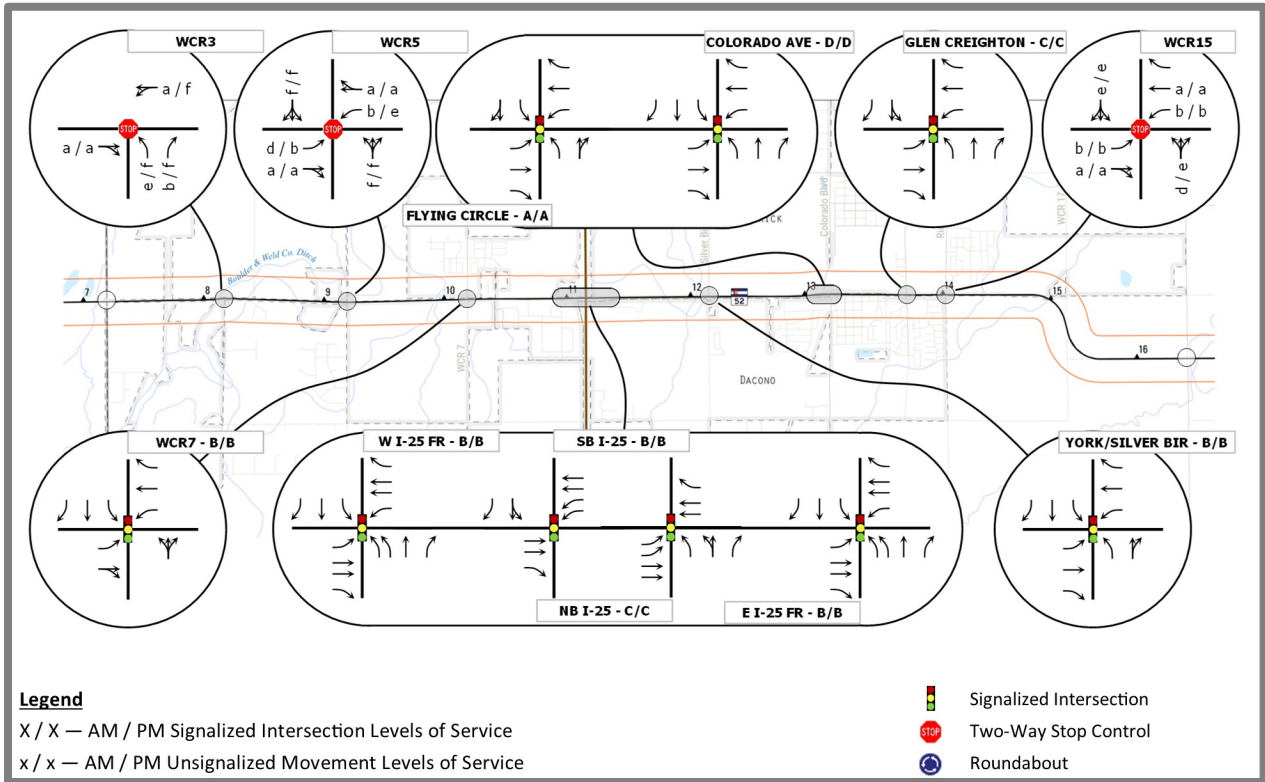


Figure 15: Segment 3 – Existing (Adjusted 2020) Levels of Service

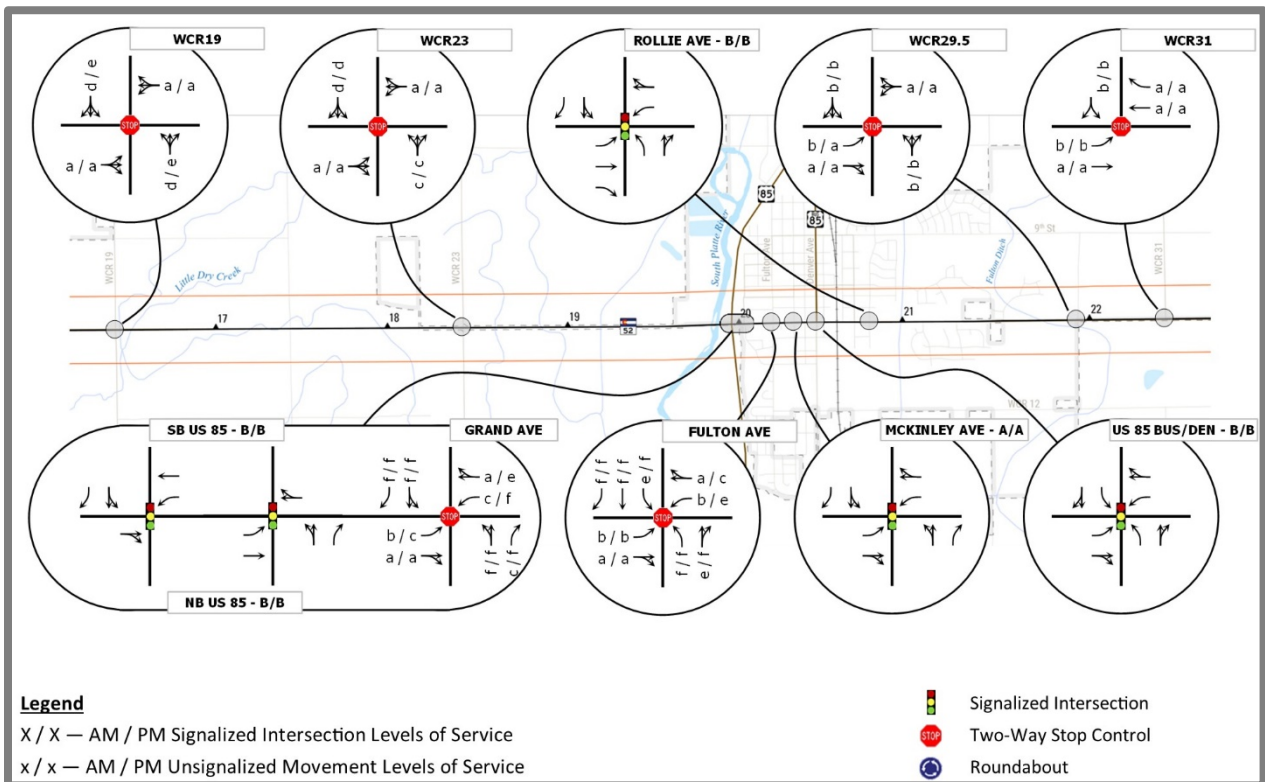


Figure 16: Segment 4 – Existing (Adjusted 2020) Levels of Service

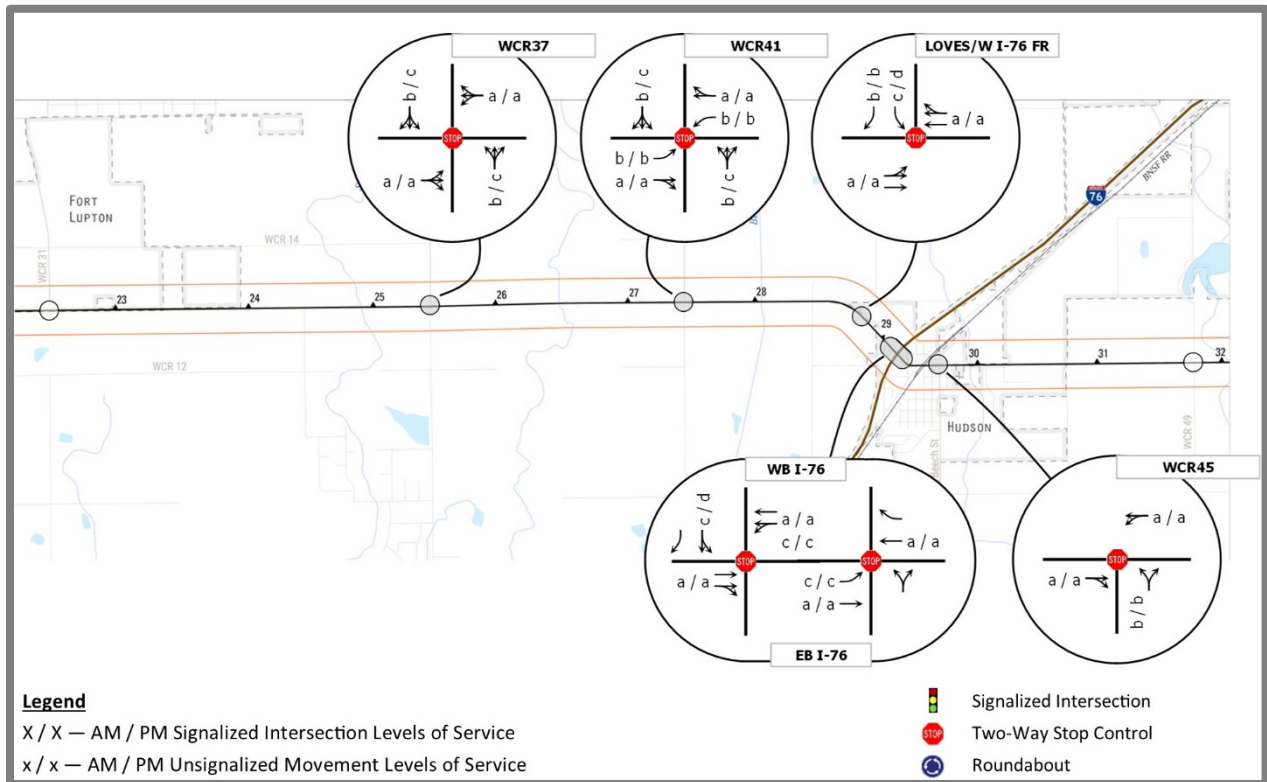
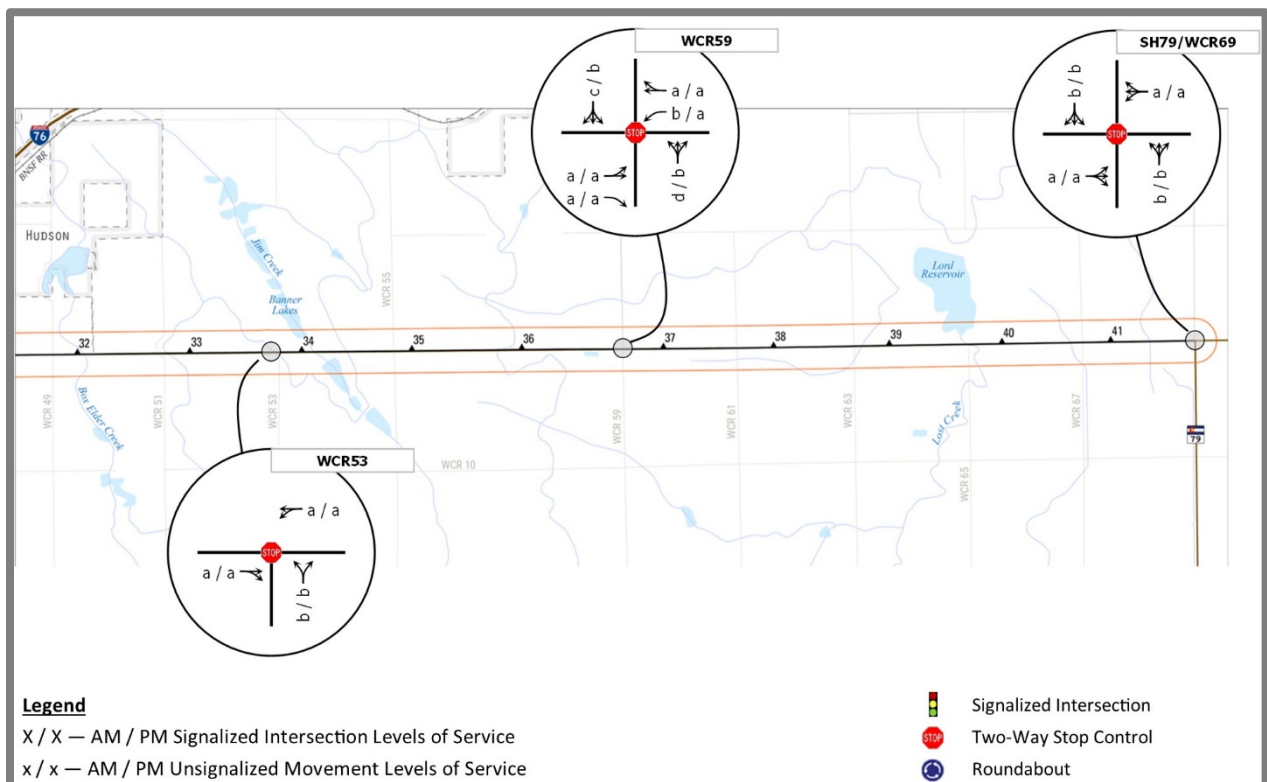


Figure 17: Segment 5 – Existing (Adjusted 2020) Levels of Service



SAFETY REPORT RECOMMENDATIONS

The crash analysis was performed in a separate effort and is documented in the *Safety Assessment Report* (Muller, 2020). A summary of the operations-related recommendations from the conclusions and recommendations section of the safety report is provided here for reference:

- General Patterns
 - *Rear End Crashes*
 - Widen the roadway at two-lane, undivided intersections to provide turn lanes, where feasible.
 - Provide additional through lanes at high-traffic signalized intersections to reduce queuing.
 - *Approach Turn Crashes*
 - Conduct signal studies for unsignalized intersections with a pattern of *approach turn* crashes.
- SH 119 – *Broadside* Crash Pattern
 - There is a current project to reconstruct this intersection into two one-way intersections. This improvement should have a positive impact on safety and is expected to reduce the potential of broadside crashes.
- US 287 – *Approach Turn* Crash Pattern
 - The Region should consider protected-only left-turn phasing to address the potential for *approach turn* type crashes.
- County Line Road – *Rear End* Crash Pattern
 - As a short-term project, consider widening the east leg of the intersection to include a separate right-turn lane and expand the shoulders on the east leg approach.
 - Consider widening CO 52 to provide two through lanes in each direction in the vicinity of this intersection to help reduce queue lengths.
- WCR 3 – *Rear End* Crashes
 - Widen intersection to provide an eastbound right-turn lane and a westbound left-turn lane.
- WCR 5 – *Broadside* Crashes
 - Consider conducting a periodic review of the traffic volumes to determine if a signal warrant analysis is appropriate to address conditions at this location.
- W. I-25 Frontage Road – *Approach Turn* Crashes
 - Install four-section flashing yellow arrow signal heads in place of the five-section signal heads and consider protected-only phasing or protected-only phasing by time of day.
- Silver Birch Boulevard – *Rear End* Crashes
 - Dilemma zone detection should be considered here to provide more time for vehicles to proceed safely through the intersection.
- Flying Circle Boulevard – *Rear End* Crashes
 - Dilemma zone detection should be considered here to provide more time for vehicles to proceed safely through the intersection.
 - Review the signal timing and coordination with Colorado Boulevard to help reduce the frequency of westbound crashes.
- Forest Avenue – *Rear End* Crashes
 - A long-term improvement of widening CO 52 through the Town of Dacono to four lanes should reduce the pattern of *rear end* crashes at this location.

- Glen Creighton/Frederick Way – *Rear End* Crashes
 - Check clearance intervals for base speeds and expected speeds at this intersection.
- Mac Davidson Circle – *Broadside* Crashes
 - Install a raised-curb island to channelize the eastbound right-turn lane and move the stop bar closer to the intersection to improve sight distance to conflicting traffic for northbound drivers.
 - A long-term solution, consider access control for this intersection when CO 52 is widened to a 4-Lane roadway section.
- WCR 19 – *Culvert/Headwall* Crashes
 - Extend the culvert on the east side of the intersection and widen the adjacent approaches to provide for adequate truck turning.
 - Consider providing left-turn lanes on CO 52 to address the general frequency of crashes at this intersection.
- WCR 41 – *Broadside* Crashes
 - The intersection priority study for CDOT Region 4 determined that signalization of this intersection is necessary to reduce the frequency of *broadside* crashes at this location. This intersection satisfied Warrant 1, Condition B and Warrant 2 for signalization based on a preliminary assessment.
- WCR 59 – *Broadside* Crashes
 - Due to the irregular peak traffic associated with the schools in the southwest quadrant of the intersection, and associated safety concerns, the Region may wish to consider a high-speed roundabout in lieu of a traffic signal (assuming signal warrants are not met).

TRAVEL DEMAND MODELING

The travel demand modeling effort is summarized in the *Travel Demand Forecasting Methodology Technical Memorandum*, (HDR 2021). The overview explains:

Travel demand forecasting is the process of estimating the amount of travel along the facilities within a transportation system, be it roadways, transit lines, or multimodal facilities. A travel demand model is a planning tool used to estimate future travel within the transportation system and to assess alternative improvements to a transportation system. Its primary inputs are the region's transportation network and future socioeconomic data consisting of population, household, and employment data. The model produces various outputs including estimated future traffic volume forecasts along roadways.

The CDOT StateFocus (Version 1.4) travel demand model (CDOT Model) was used as the basis for the development of the CO 52 travel demand model. The CDOT Model uses socio-economic projections for the State of Colorado to generate travel demand and distribute trips across the state's roadway and transit network. For the CO 52 PEL study, the 2015 model was used as the base year and the 2045 model as the horizon year.

A detailed description of the base year, 2020 existing year, and alternative model development is provided in the referenced and accompanying memoranda.

2045 FORECAST MODELS

In terms of the CO 52 PEL, the TDM effort focuses on how significant changes to capacity along CO 52 will affect traffic patterns on a large scale. Providing additional capacity between major crossing routes will generally have a greater impact than shorter capacity improvements that only connect local crossing routes. However, it is important to note that a capacity *limitation* along shorter segments between the same major crossing routes can affect regional traffic patterns.

For the purpose of the CO 52 PEL study, the following five horizon year model runs were performed for the purpose of the alternatives analysis:

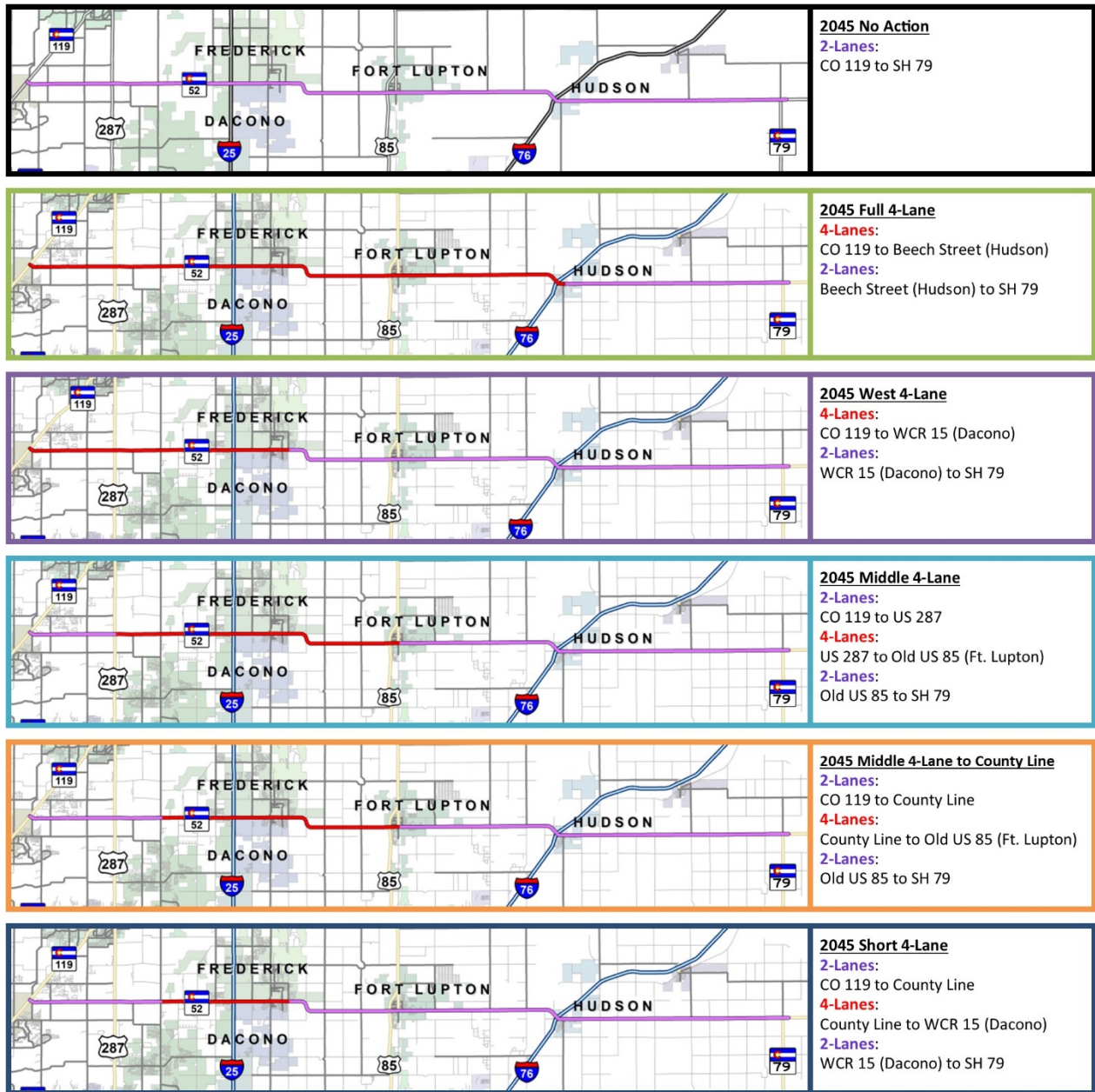
- 2045 No Action (NA) – No capacity improvements to CO 52.
- 2045 Full 4-Lane (F4L) – CO 52 improved to 4-lanes from CO 119 to I-76.
- 2045 West 4-Lane (W4L) – CO 52 improved to 4-lanes from US 287 to WCR 15
- 2045 Middle 4-Lane to US 287 (M4L) – CO 52 improved to 4- lanes from US 287 to Denver Ave.
- 2045 Middle 4-Lane to County Line (M4CL) – CO 52 improved to 4-lanes from County Line Rd. to Denver Ave

An additional model was added after the TDM effort to explore the potential impact of more limited widening, and was crafted by combining the M4CL volumes west of I-25 and the W4L volumes east of I-25:

- 2045 Short 4-Lane (S4L) – CO 52 improved to 4-lanes from County Line Rd. to WCR 15.

Figure 18 provides a graphical representation of the TDM models created for the purpose of this analysis.

Figure 18: Travel Demand Models



2045 DAILY VOLUME FORECASTS

The methodology detailing the development of the daily traffic volume forecasts for estimated 2020 traffic conditions and the 2045 forecast horizon is provided in the *Traffic Forecasting and Screenline/Parallel Routes Analysis* (HDR 2021) technical memorandum (excluding the S4L variation). The resulting daily volumes at select locations along the corridor are provided in **Table 15** and **Figure 19**.

Table 15: Existing (2020 Estimate) and 2045 Daily Volume Forecast

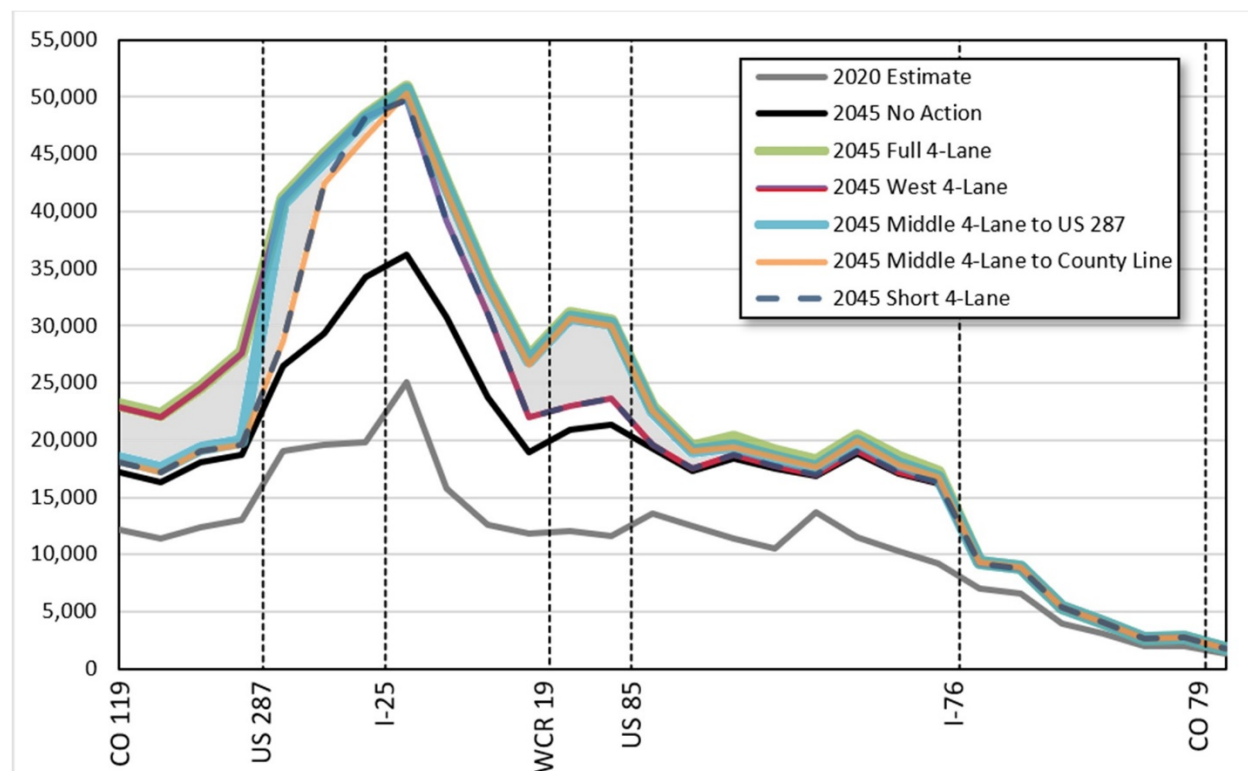
CO 52 Segments		2020 Estimate	2045 No Action	2045 Full 4-Lane	2045 West 4-Lane	2045 Middle 4-Lane (US 287)	2045 Middle 4-Lane (C. Line)	2045 Short 4-Lane ¹	
		EX	NA	F4L	W4L	M4L	M4CL	S4L	
Segment 1	CO 119	71ST ST	12,200	17,200	23,100	22,900	18,400	18,100	18,100
	71ST ST	MONARCH PARK	11,400	16,300	22,200	22,000	17,500	17,200	17,200
	79TH ST	SOMERSET DR	12,400	18,100	24,600	24,500	19,300	19,000	19,000
	95TH ST	US 287	13,000	18,700	27,700	27,600	19,900	19,600	19,600
	US 287	115TH ST	19,000	26,500	41,100	41,000	40,700	28,700	28,700
Segment 2	WCR 5	WCR 7	19,600	29,300	45,000	44,800	44,400	42,500	42,500
	WCR 7	W I-25 FR	19,800	34,300	48,400	48,200	48,100	46,500	48,200
	E I-25 FR	YORK/SILVER BIRCH	25,100	36,200	50,900	49,800	50,600	50,300	49,800
	COLORADO BLVD	GLEN CREIGHTON	15,800	30,800	42,400	39,200	42,100	41,700	39,200
	GLEN CREIGHTON	WCR 15	12,600	23,800	34,000	31,100	33,700	33,500	31,100
	WCR 15	WCR 19	11,800	18,900	27,200	22,000	26,900	26,600	22,000
Segment 3	WCR 19	WCR 21	12,000	20,900	31,100	23,000	30,800	30,600	23,000
	WCR 23	US 85 SB	11,600	21,300	30,400	23,600	30,200	30,000	23,600
	US 85 NB	GRAND AVE	13,600	19,300	22,900	19,600	22,600	22,600	19,600
	GRAND AVE	FULTON AVE	12,500	17,300	19,400	17,500	19,000	19,000	17,500
	PARK AVE	DENVER AVE	11,400	18,400	20,200	18,700	19,500	19,400	18,700
	DENVER AVE	MAIN ST	10,500	17,500	19,100	17,700	18,500	18,500	17,700
	HARRISON AVE	ROLLIE AVE	13,700	16,900	18,200	17,000	17,600	17,600	17,000
	ROLLIE AVE	WCR 29.5	11,500	18,800	20,400	19,000	19,900	19,900	19,000
Segment 4	WCR 35	WCR 37	10,300	17,100	18,500	17,200	18,000	17,900	17,200
	WCR 12.5	W I-76 FR	9,200	16,200	17,200	16,300	16,700	16,700	16,300
	I-76 NB	DAHLIA ST	7,000	9,200	9,300	9,200	9,300	9,300	9,200
	HUDSON	RR XING	6,600	8,800	8,900	8,800	8,900	8,900	8,800
	BEECH ST	CHERRY ST	4,000	5,400	5,400	5,400	5,400	5,400	5,400
Segment 5	WCR 49	WCR 51	3,100	4,100	4,100	4,100	4,100	4,100	4,100
	WCR 59	WCR 61	2,000	2,600	2,600	2,600	2,600	2,600	2,600
	WCR 67	CO 79	2,000	2,800	2,800	2,800	2,800	2,800	2,800
	CO 79	EAST OF CO 79	1,300	1,800	1,800	1,800	1,800	1,800	1,800

Source: CDOT StateFocus Model Version 1.4; model operation and volume post-processing by HDR

Note: Red text indicates 4-Lane Sections

¹ Short 4-Lane scenario combines M4CL from CO 119 to I-25 and W4L from I-25 eastward.

Figure 19: Existing (2020 Estimate) and 2045 Daily Volume Forecast



Source: CDOT StateFocus Model Version 1.4, 2020; model operation and volumes post-processing by HDR

The shaded areas under the curves highlight the difference between the higher and lower volume build alternatives. Specifically, these are segments where the 4-Lane alternative models result in a significant amount of additional growth compared to the 2-Lane alternative models. Key locations are:

- **SH 119 to US 287:** The F4L and W4L scenarios increase travel demand by approximately 26%.
- **US 287 to County Line:** The M4L scenario increases travel demand over M4CL by around 35%.
- **Dacono to Ft. Lupton:** The F4L, M4L, and M4CL scenarios increase travel demand by about 25%.

These differences represent how growth can be affected by the roadway capacity in these areas and affect how traffic is managed and what improvements are necessary to meet demand throughout the network.

2045 TURNING MOVEMENT VOLUMES

The peak hour turning movement volumes were developed using the NCHRP 255 volume balancing methodology and growth factors based on the TDM model data. The COVID-19 adjusted 2020 turning movements were used as the base volumes for this process, with turning movements developed for each of the forecasted TDM volume models. The resulting turning movement volumes were also loosely balanced to account for mid-block intersections without allowing for drastic changes to occur between modeled intersections. Where necessary, there were also minor adjustments made based on engineering judgment.

The modeled turning movements are provided in **Appendix C** of this technical memorandum.

TRAFFIC OPERATIONS ANALYSIS

The traffic operations analysis was performed using the TransModeler microsimulation software. This allowed both intersection and corridor operations to be modeled simultaneously over the course of the morning and evening peak periods.

Analysis Periods

After reviewing the preliminary traffic data evaluated in the Existing Conditions Report, the traffic analysis focused on peak weekday traffic conditions. The focus of this study is to determine the peak travel times along the corridor during the morning and evening peak periods:

- **AM Peak Period:** 6:30 a.m. to 8:30 a.m.
- **PM Peak Period:** 4:30 p.m. to 6:30 p.m.

Measures of Effectiveness

The MOEs shown in **Table 3** provided the framework for the TransModeler analysis results. This section provides a general overview of how the model data was collected and aggregated for reporting.

Intersection MOEs

This MOE is based on reducing intersection delay. While a critical factor in reducing travel times along CO 52, the intersection delay (and by extension, the LOS), was not used as part of the Level 2 evaluation when comparing alternatives. Improved intersection operations (reduced delay) were an expected outcome of the intersection recommendations and refinements.

Travel Time Related MOEs

Three of the key MOEs, Decrease Travel Time, Decrease Travel Time Index, and Increase Reliability are related to vehicular travel time within the network. Data from segment statistics output and sensor records were used to calculate the average travel time and the 95th percentile travel time, which when compared to the free-flow travel time provide the TTI and PTI, respectively. The latter used as a surrogate for the reliability MOEs.

GEOMETRIC AND OPERATIONAL COMPONENTS

The Level 2 evaluation performed for the CO 52 PEL were developed during several brainstorming and workshop sessions, and included insight and suggestions from the public, local agencies, CDOT, and several other stakeholders. The improvements including geometric configurations with traffic operational components were included in the models at various stages throughout the process.

Cross Section Improvements

One of the key differentiators through most of the corridor is whether the cross section includes two or four through lanes within a segment. While the presence and type of median relevant to the cross section was considered at intersections, the number and type of through lanes has the most bearing on the operational analysis. The cross-section related alternatives analyzed as part of this analysis were:

- **2-Lane Alternative:** Two general purpose through lanes along CO 52.
- **4-Lane Alternative:** Four general purpose through lanes along CO 52.

- Peak Period Shoulder Lane: Two general purpose through lanes along CO 52 plus one shoulder lane configured to act as a second through lane in only one direction for each peak period.
 - Only applied in Segment 1: Westbound AM, Eastbound PM
- HOV Lane: Two general purpose through lanes along CO 52 plus one HOV lane in each direction.
 - Only applied in Segment 1: 2+ persons per vehicle.
- Alternating Passing Lane: Two general purpose through lanes along CO 52 plus one passing lane in each direction, alternating between eastbound and westbound directions.
 - Applied to Segment 3 between WCR 19 and US 85 and Segment 4 between WCR 31 and WCR 43.

Intersection Improvements

Intersection improvements are critical to the operations and safety of the CO 52 corridor. The modeled traffic volumes were considered along with the geometric alternative (cross-section) when determining the intersection improvements along the CO 52 corridor. Several methodologies were used:

Unsignalized Lane Additions

Additional turn lanes at unsignalized locations, including vehicle storage and speed change distances, were outlined as per the CDOT Access Code unless also warranted by other factors such as crash experience.

Intersection Signalization

Future signalization was considered for locations along the corridor that might be expected to meet signal warrants in the long-term future. This determination was primarily made using engineering judgement, with consideration for the MUTCD signal warrant factors.

Critical Lane Analysis

At signalized intersections, the lane geometry was determined through several iterations to meet critical traffic demands (critical lane analysis) and an acceptable LOS. In some cases, additional through lanes were used at intersections along 2-Lane segments to improve traffic flow during the peak periods. Dual turn lanes and auxiliary right-turn lanes were also evaluated on a case-by-case basis. Widening along the side-street approaches was also considered to improve operations, reduce queuing, or in some cases to allow for better signal timing along CO 52.

Signal Timing Refinement

Throughout the TransModeler analysis, signal timing and corridor optimization techniques were used to refine intersection operations. This was performed in an iterative manner over sections of the roadway with similar characteristics (i.e. – the section through Ft. Lupton) and included cycle length analysis and signal progression. In most cases, the analysis focused CO 52 operations with an emphasis on reducing queues and improving travel times without unduly impacting side-street operations.

CAP-X Analysis

Specifically used for the US 287 intersection, the FHWA CAP-X tool was used to provide insight into possible alternative lane configurations. Based on this, the partial CFI was selected for analysis as an alternative to the conventional signal configuration. While the CAP-X also indicated that a grade separated interchange would be effective, only a cursory operational review was performed as it is an undesired configuration.

ALTERNATIVES ANALYSIS

This section summarizes the results of the TransModeler analysis after incorporating geometric improvements and intersection operational refinements. The corridor analysis subsection provides the segment speeds over the full 42-mile CO 52 study corridor based on the primary TDM volumes developed for the study. The detailed segment analysis subsection details the travel time, TTI, and reliability metrics for each alternative by segment.

Corridor Analysis

The corridor analysis uses the link data output to estimate segment speeds under future traffic conditions. Average vehicle speed is inversely proportional to travel time, so higher speeds are an indication of better corridor performance (reduced travel time). This information was primarily used during build model development to help refine corridor performance prior to aggregation. Directional speed profiles representing the link data output derived from the model during development are provided in **Appendix D**.

Detailed Segment Analysis

The TransModeler analysis scenarios represent a combination of the TDM volumes (model) and the build geometry (alternative) over the full 42-mile corridor. Thus, within each segment, multiple scenarios may apply to the same alternative. For example, within Segment 1 the 4-Lane alternative was analyzed using traffic volumes from both the Full 4-Lane and West 4-Lane models. In general, the results from overlapping scenarios such as this proved quite similar. For comparing alternatives, the results from overlapping scenarios such as this proved too similar to be helpful separately, so the results were combined as appropriate for evaluation and documentation.

No Action

The No Action scenario explores the result of traffic growth with no improvements beyond those that are currently in-progress or funded and slated for construction in the near future. **Table 16** details the resulting change in travel time, TTI, and reliability (PTI) for the no action scenario.

Table 16: Existing (Adjusted 2020) to 2045 No Action Corridor Operations

Segment	Travel Time (minutes)			Travel Time Index (TTI ¹)			Reliability (PTI ²)		
	EX	NA	Change ³	EX	NA	Change ³	EX	NA	Change ³
Segment 1 (West of 71st Street to County Line Road)									
West of 71st St. to County Line Rd.	13.4	16.1	Worsens +18%	1.56	1.98	Worsens +24%	2.73	2.98	Worsens +9%
Segment 2 (County Line Road to WCR 19)									
County Line Rd. to WCR 7	5.4	11.3	Worsens +71%	1.70	3.53	Worsens +70%	3.54	7.92	Worsens +76%
WCR 7 to SB I-25 Frontage Rd.	0.5	0.9	Worsens +57%	1.16	2.20	Worsens +62%	1.34	6.34	Worsens +130%
NB I-25 Frontage Rd. to WCR 15	4.6	9.5	Worsens +70%	1.47	3.00	Worsens +68%	1.75	5.68	Worsens +106%
WCR 15 to WCR 19	2.7	2.9	Worsens +7%	1.14	1.2	Worsens +5%	1.29	1.47	Worsens +13%
Segment 3 (WCR 19 to WCR 31)									
WCR 19 to US 85	3.3	4.1	Worsens +22%	1.13	1.38	Worsens +20%	1.23	2.50	Worsens +68%
US 85 to WCR 31 (Ft. Lupton)	5.6	16.4	Worsens +98%	1.44	4.19	Worsens +98%	2.75	10.61	Worsens +118%
Segment 4 (WCR 31 to WCR 49)									
WCR 31 to Loves/I-76 Frontage Rd.	6.2	6.5	No Change +5%	1.08	1.14	Worsens +5%	1.21	1.28	Worsens +6%
Dahlia St. to WCR 49	2.2	2.2	No Change +0%	1.08	1.09	No Change +1%	1.25	1.23	No Change -2%
Segment 5 (WCR 49 to CO 79)									
WCR 49 to CO 79/WCR 69	10	10.1	No Change +1%	1.08	1.09	No Change +1%	1.23	1.21	No Change -2%

¹ Travel Time Index = Average Travel Time / Free-Flow Travel Time

² Planning Time Index = 95th Percentile Travel Time / Free-Flow Travel Time

³ Significant > 15% reduction, Moderate > 5% reduction, No Change ±5%, or Worsens > 5% increase

Build – Segment 1 (West of 71st Street to County Line Road)

The model volumes through Segment 1 are significantly higher under the 4-Lane alternatives versus the 2-Lane and No Action alternatives. The 2045 No Action volumes are approximately 35% higher than the existing volumes; the 2-Lane build alternatives could result in another 6% increase due to increased volume elsewhere along the corridor, with the 4-Lane build alternatives about 34% higher than No Action.

The Middle 4-Lane to US 287 forecast model extends the 4-Lane cross section west of County Line Road to the US 287 intersection. The 4-Lane connection between US 287 and I-25 allows for significantly more growth through the last couple of miles of Segment 1, with somewhat different traffic patterns than the other 4-Lane options that extend to CO 119.

The results of the detailed operations analysis are summarized by alternative in **Table 17**. The model volumes included for the alternative evaluation are defined as:

- 2-LN: Two through lanes from CO 119 to County Line Road
 - Middle 4-Lane to County Line Road Volumes
 - Short 4-Lane Volumes
- 2-LN+: Four through lanes from CO 119 to US 287; 2-Lanes from US 287 to County Line Road
 - Middle 4-Lane to US 287
- 4-LN: Four through lanes from CO 119 to County Line Road
 - Full 4-Lane Volumes
 - West 4-Lane Volumes
- PPSL: Two through lanes with peak period shoulder lanes between CO 119 and County Line Road
 - Full 4-Lane Volumes
- HOV: Two through lanes with one HOV lane in each direction between CO 119 and County Line Road
 - Full 4-Lane Volumes

Table 17: Segment 1 2045 Build Alternatives Corridor Operations

Measure of Effectiveness	No Action	Segment 1 – 2045 Build Alternatives									
		2-LN	Change ⁴	2-LN+ ³	Change ⁴	4-LN	Change ⁴	PPSL	Change ⁴	HOV	Change ⁴
West of 71st St. to County Line Rd.											
Travel Time (min)	16.1	14.1	Moderate -13%	14.3	Moderate -12%	11.6	Significant -32%	13.1	Significant -21%	13.6	Significant -17%
Travel Time Index (TTI ¹)	1.98	1.75	Moderate -12%	1.77	Moderate -11%	1.46	Significant -30%	1.60	Significant -21%	1.71	Moderate -15%
Reliability (PTI ²)	2.98	2.65	Moderate -12%	3.18	Worsens +6%	2.11	Significant -34%	2.69	Moderate -10%	3.94	Worsens +28%

¹ Travel Time Index = Average Travel Time / Free-Flow Travel Time

² Planning Time Index = 95th Percentile Travel Time / Free-Flow Travel Time

³ Higher traffic volumes due to 4-Lane section between US 287 and County Line Road

⁴ Significant > 15% reduction, Moderate > 5% reduction, No Change ±5%, or Worsens > 5% increase

The intersection improvements were configured and optimized separately for each TransModeler analysis scenario. A summary of the Segment 1 final recommendations for intersection configurations are provided in **Table 18**; results based on Middle 4-Lane to County Line Road scenario.

Table 18: Segment 1 2045 Intersection Improvements

Intersection	Improvement Details ¹	LOS ² (AM/ PM)	
		No Action	Build
71 st Street	Base Condition: Unsignalized; 2-Lane cross section, existing project to realign 71 st Street to right-angle and to add a northbound right-turn lane. <ul style="list-style-type: none"> Signalize intersection when warrants are met. 	WBL: e / c NBL: f / f NBR: f / f	C / F
79 th Street	Base Condition: Signalized; 2-Lane cross section <ul style="list-style-type: none"> No required capacity improvements: however, consider adding right-turn lanes as conditions warrant. 	C / C	C / C
Hover / 95 th Street	Base Condition: Signalized; 2-Lane cross section <ul style="list-style-type: none"> Add a second through lane in each direction (secondary through lanes terminate) 	D / F	D / D
US 287 ²	Base Condition: Signalized; 2-Lane cross section, dual left-turns on all approaches, secondary through lanes terminate. <ul style="list-style-type: none"> Analyzed as a partial CFI in primary model. No change to CO 52 lane geometry. 	D / F	D / C

¹ Improvements evaluated for Middle 4-Lane to County Line Road scenario

² Signalized intersection Levels of Service or unsignalized movement Levels of Service

³ US 287 also analyzed as a traditional intersection with minor improvements (LOS F/F)

Build – Segment 2 (County Line Road to WCR 19)

Based on the 2045 No Action model, traffic volumes are expected to increase over existing levels by 40% to 50% west of I-25, by about 63% east of I-25 through Dacono to WCR 15, and by around 45% east of WCR 15 through the end of Segment 2. The build conditions which widen CO 52 to 6-Lanes in the vicinity of I-25 are expected to increase volumes by another 30% over the No Action alternative, with a lesser increase of 15% anticipated out to WCR 19 in the West 4-Lane model that drops CO 52 to a 2-Lane cross section at WCR 15.

The Middle 4-Lane to US 287 forecast model extends the 4-Lane cross section west of County Line Road to the US 287 intersection. This 4-Lane connection between US 287 and I-25 allows for significantly more growth through the last couple of miles of Segment 1, with somewhat different traffic patterns than the other 4-Lane options that extend to CO 119.

The results of the detailed operations analysis are summarized by alternative in **Table 19**. The model volumes included for the alternative evaluation are defined as:

- 4-LN: Four through lanes from County Line Road to WCR 15
 - Full 4-Lane Volumes
 - West 4-Lane Volumes
 - Middle 4-Lane to County Line Road Volumes
 - Short 4-Lane Volumes
- 4-LN+: Four through lanes from County Line Road to WCR 19 with 4-Lanes US 287 to County Line Road
 - Middle 4-Lane to US 287
- 2-LN: Two through lanes from WCR 15 and WCR 19
 - West 4-Lane Volumes
 - Short 4-Lane Volumes
- 4-LN: Four through lanes from WCR 15 to WCR 19
 - Full 4-Lane Volumes
 - Middle 4-Lane to County Line Road Volumes

Table 19: Segment 2 2045 Build Alternatives Corridor Operations

Measure of Effectiveness	No Action	Segment 2 – 2045 Build Alternatives					
		2-LN	Change ⁴	4-LN	Change ⁴	4-LN+ ³	Change ⁴
County Line Rd. to WCR 7							
Travel Time (min)	11.3	-	-	4.3	Significant -90%	5.9	Significant -63%
Travel Time Index (TTI ¹)	3.53	-	-	1.35	Significant -89%	1.83	Significant -63%
Reliability (PTI ²)	7.92	-	-	1.86	Significant -124%	4.46	Significant -56%
WCR 7 to SB I-25 Frontage Rd.⁵							
Travel Time (min)	0.9	-	-	0.5	Significant -57%	1.1	Worsens +20%
Travel Time Index (TTI ¹)	2.20	-	-	1.24	Significant -56%	2.59	Worsens +16%
Reliability (PTI ²)	6.34	-	-	6.17	No Change -3%	11.11	Worsens +55%
NB I-25 Frontage Rd. to WCR 15⁵							
Travel Time (min)	9.5	-	-	5.9	Significant -47%	-	-
Travel Time Index (TTI ¹)	3.00	-	-	1.86	Significant -47%	-	-
Reliability (PTI ²)	5.68	-	-	2.55	Significant -76%	-	-
WCR 15 to WCR 19							
Travel Time (min)	2.9	3.6	Worsens +22%	3.0	No Change +3%	-	-
Travel Time Index (TTI ¹)	1.20	1.50	Worsens +22%	1.27	Worsens +6%	-	-
Reliability (PTI ²)	1.47	2.04	Worsens +32%	1.57	Worsens +7%	-	-

¹ Travel Time Index = Average Travel Time / Free-Flow Travel Time

² Planning Time Index = 95th Percentile Travel Time / Free-Flow Travel Time

³ Higher traffic volumes due to 4-Lane section between US 287 and County Line Road

⁴ Significant > 15% reduction, Moderate > 5% reduction, No Change ±5%, or Worsens > 5% increase

⁵ 6-Lane cross section from WCR 7 to Silver Birch/York Street

The intersection improvements were configured and optimized separately for each TransModeler analysis scenario. A summary of the Segment 2 final recommendations for intersection configurations are provided in **Table 20**; results based on Middle 4-Lane to County Line Road scenario.

Table 20: Segment 2 2045 Intersection Improvement Recommendations

Intersection	Improvement Details ¹	LOS ² (AM/ PM)	
		No Action	Build
County Line Road	Base Condition: Signalized; 2-Lane cross section to west, 4-Lane cross section to east. <ul style="list-style-type: none"> Add second eastbound through lane Add dual southbound left-turn lanes Add northbound and southbound right-turn lanes Add second through lane in each direction on County Line Road (secondary lanes terminate) 	F / F	C / E
WCR 3	Base Condition: Unsignalized; 4-Lane cross section <ul style="list-style-type: none"> Add eastbound right-turn lane Add eastbound accel lane for northbound right-turns Add westbound left-turn lane 	NBL: f / f NBR: f / f	WBL: d / f NBL: f / f NBR: f / f
WCR 5	Base Condition: Unsignalized; 4-Lane cross section <ul style="list-style-type: none"> Signalize intersection when warrants are met Add eastbound and westbound right-turn lanes Add left- and right-turn lanes on WCR 5 	EBL: e / c WBL: f / f NBT: f / f SBT: f / f	B/C
WCR 7	Base Condition: Signalized; 4-Lane cross section to west, 6-Lane cross section to east. <ul style="list-style-type: none"> Add eastbound right-turn lane Outside westbound lane drops (right-turn) Add eastbound lane from northbound right-turn 	F / F	C/C
Silver Birch Road	Base Condition: Signalized; 6-Lane cross section to west, 4-Lane cross section to east. <ul style="list-style-type: none"> Add eastbound left-turn lane and northbound receiving lane (terminates) for dual left-turns Add northbound right-turn lane Outside eastbound lane drops (right-turn) Add westbound lane from southbound right-turn 	F / F	D/D
Colorado Boulevard	Base Condition: Signalized; 4-Lane cross section <ul style="list-style-type: none"> Reconfigure to allow dual left-turn lanes and channelized right-turn lanes on all approaches. 	F / F	D/D
Glen Creighton	Base Condition: Signalized; 4-Lane cross section <ul style="list-style-type: none"> Add southbound left-turn lane Extend northbound left-turn storage Configure northbound approach with a left-turn lane, shared left-turn/through lane, and right-turn lane (split phasing) Add eastbound and westbound right-turn lane 	F / F	D/C
WCR 15	Base Condition: Unsignalized <ul style="list-style-type: none"> Add northbound and southbound left-turn lanes Add southbound and westbound right-turn lanes 	EBL: c / c WBL: c / c NBT: f / f SBT: f / f	C/D

¹ Improvements evaluated for Middle 4-Lane to County Line Road scenario

² Signalized intersection Levels of Service or unsignalized movement Levels of Service

Build – Segment 3 (WCR 19 to WCR 31)

The traffic volumes through Segment 3 west of Ft. Lupton are expected to increase by around 57% in the 2045 No Action model, with an additional increase of 10% forecast with the 2-Lane build alternatives up to an additional 35% with the 4-Lane build alternatives. It should be noted that the shift in traffic patterns due to the 4-Lane segment between US 287 and County Line Road was no longer distinguishable at this point along the corridor.

Traffic forecasts east of US 85 through the Town of Ft. Lupton indicated a 30% to 40% increase in volume with No Action alternative, but significantly less additional growth under build conditions; the 2-Lane alternatives were only 1% to 2% higher than No Action, while the 4-Lane alternatives were only about 11% higher than No Action. However, it is important to note that the US 85 interchange operations were drastically worse because of the No Action traffic growth, resulting in standing queues and bottleneck operations through Ft. Lupton. All alternatives included an additional westbound through lane between the northbound and southbound ramps to accommodate the 2045 growth projection, as well as widening the bridge immediately west of US 85 to include two lanes in each direction. In addition, due to its proximity to the northbound US 85 ramp intersection, Grand Avenue was converted to a RIRO access in all build alternatives and the displaced turning movements were re-assigned at the Fulton Avenue intersection. Without these improvements to US 85 and Grand Avenue, the bottleneck conditions effectively cause gridlock conditions.

The results of the detailed operations analysis are summarized by alternative in **Table 21**. The model volumes included for the alternative evaluation are defined as:

- 2-LN: Two through lanes from WCR 19 to WCR 31
 - West 4-Lane Volumes
 - Short 4-Lane Volumes
- 4-LN: Four through lanes from WCR 19 to WCR 31
 - Full 4-Lane Volumes
 - Middle 4-Lane to US 287 Volumes
 - Middle 4-Lane to County Line Road Volumes
- APL: Two through lanes from WCR 19 to WCR 31 with one alternating passing lane west of US 85
 - Short 4-Lane Volumes

Table 21: Segment 3 2045 Build Alternatives Corridor Operations

Measure of Effectiveness	No Action	Segment 3 – 2045 Build Alternatives					
		2-LN	Change ⁴	4-LN	Change ⁴	APL ³	Change ⁴
WCR 19 to US 85							
Travel Time (min)	4.1	4.2	No Change +2%	3.3	Significant -22%	3.8	Moderate -8%
Travel Time Index (TTI ¹)	1.38	1.40	No Change +1%	1.13	Significant -20%	1.30	Moderate -6%
Reliability (PTI ²)	2.50	3.10	Worsens +21%	1.25	Significant -67%	1.72	Significant -37%
US 85 to WCR 31 (Ft. Lupton Segment)⁵							
Travel Time (min)	16.4	9.6	Significant -52%	6.6	Significant -85%	-	-
Travel Time Index (TTI ¹)	4.19	2.48	Significant -51%	1.72	Significant -84%	-	-
Reliability (PTI ²)	10.61	5.31	Significant -67%	3.29	Significant -105%	-	-

¹ Travel Time Index = Average Travel Time / Free-Flow Travel Time

² Planning Time Index = 95th Percentile Travel Time / Free-Flow Travel Time

³ Alternating Passing Lane compared to variant of No Action with modeled passing zones.

⁴ Significant > 15% reduction, Moderate > 5% reduction, No Change ±5%, or Worsens > 5% increase

⁵ Except for the Full 4-Lane alternative, the models only have 2-Lanes from Denver Ave to WCR 31

The intersection improvements were configured and optimized separately for each TransModeler analysis scenario. A summary of the Segment 3 final recommendations for intersection configurations are provided in **Table 22**; results based on Middle 4-Lane to County Line Road scenario.

Table 22: Segment 3 2045 Intersection Improvement Recommendations

Intersection	Improvement Details ¹	LOS ² (AM/ PM)	
		No Action	Build
WCR 19	Base Condition: Unsignalized; 4-Lane cross section <ul style="list-style-type: none"> Signalize intersection when warrants are met Add eastbound and westbound left-turn lanes Add eastbound and westbound right-turn lanes Add northbound and southbound left-turn lanes 	NBT: f / f SBT: f / f	B/C
WCR 23	Base Condition: Unsignalized; 4-Lane cross section <ul style="list-style-type: none"> Location may not meet signal warrant volumes Add eastbound and westbound left-turn lanes Add eastbound and westbound right-turn lanes Add northbound and southbound left-turn lanes 	NBT: f / f SBT: f / f	EBL: e / e WBL: c / d NBL: f / f NBTR: f / f SBL: f / f SBTR: f / f
US 85 Interchange	Base Condition: Signalized; 4-Lane cross section <ul style="list-style-type: none"> Side-by-side left-turn lanes under bridge. Inside eastbound lane feeds directly into northbound US 85 left-turn lane. Outside eastbound lane continues. Extend westbound left-turn to US 85 storage through Grand Avenue intersection 	SB: D/B NB: F/F	SB: C/C NB: B/C
Grand Avenue	Base Condition: Unsignalized; 4-Lane cross section <ul style="list-style-type: none"> Restrict access to RIRO access 	EBL: c / c WBL: f / f NBT: f / f NBR: f / f SBT: f / f SBR: f / f	NBR: b / c SBR: d / f
Fulton Street	Base Condition: Unsignalized; 4-Lane cross section <ul style="list-style-type: none"> Signalize intersection when warrants are met Add northbound and southbound left-turn lanes Add southbound right-turn lane 	EBL: b / c WBL: f / f NBL: f / f NBT: f / f SBL: f / f SBT: f / f SBR: f / f	B/D
WCR 29.5	Base Condition: Unsignalized; 2-Lane cross section <ul style="list-style-type: none"> Add eastbound and westbound right-turn lanes Add westbound left-turn lane and extend eastbound left-turn lane Add northbound and southbound left-turn lanes 	EBL: a / a NBT: d / d SBT: d / d	EBL: a / b WBL: b / b NBL: d / e NBTR: d / e SBL: d / e SBTR: c / e

¹ Improvements evaluated for Middle 4-Lane to County Line Road scenario

² Signalized intersection Levels of Service or unsignalized movement Levels of Service

Build – Segment 4 (WCR 31 to WCR 49)

The No Action traffic volume forecasts through Segment 4 represent a 50% increase west of I-76 and the Town of Hudson, dropping to an increase of 29% east of I-76. Only the Full4-Lane alternative was modeled with 4-Lanes through the Town of Hudson to Beech Street with 2-Lanes farther to the east; the remaining alternatives include 2-Lanes throughout Segment 4. The 4-Lane cross section resulted in a 7% average increase in volume over the No Action alternative, while 2-Lane cross sections only increased by 1% to 3% over No Action volumes.

The results of the detailed operations analysis are summarized by alternative in Table 23. The model volumes included for the alternative evaluation are defined as:

- 4-LN: Four through lanes from WCR 31 to Beech Street.
 - Full 4-Lane Volumes
- 2-LN: Two through lanes from Beech Street to WCR 49
 - Full 4-Lane Volumes
- 2-LN: Two through lanes from WCR 31 to WCR 49
 - West 4-Lane Volumes
 - Middle 4-Lane to US 287 Volumes
 - Middle 4-Lane to County Line Road Volumes
 - Short 4-Lane Volumes

Table 23: Segment 4 2045 Build Alternatives Corridor Operations

Measure of Effectiveness	No Action	Segment 4 – 2045 Build Alternatives					
		2-LN	Change ⁴	4-LN	Change ⁴	APL ³	Change ⁴
WCR 31 to Loves/I-76 Frontage Road							
Travel Time (min)	6.5	6.4	No Change -2%	6.0	Moderate -8%	6.3	No Change -3%
Travel Time Index (TTI ¹)	1.14	1.14	No Change +0%	1.09	No Change -4%	1.13	No Change -1%
Reliability (PTI ²)	1.28	1.27	No Change -1%	1.23	No Change -4%	1.26	No Change -2%
Beech St. to WCR 49							
Travel Time (min)	2.2	2.2	No Change +0%	-	-	-	-
Travel Time Index (TTI ¹)	1.09	1.11	No Change +2%	-	-	-	-
Reliability (PTI ²)	1.23	1.25	No Change +2%	-	-	-	-

¹ Travel Time Index = Average Travel Time / Free-Flow Travel Time

² Planning Time Index = 95th Percentile Travel Time / Free-Flow Travel Time

³ Alternating Passing Lane compared to variant of No Action with modeled passing zones.

⁴ Significant > 15% reduction, Moderate > 5% reduction, No Change ±5%, or Worsens > 5% increase

The intersection improvements were configured and optimized separately for each TransModeler analysis scenario. A summary of the Segment 4 final recommendations for intersection configurations are provided in **Table 24**; results based on Middle 4-Lane to County Line Road scenario.

Table 24: Segment 4 2045 Intersection Improvement Recommendations

Intersection	Improvement Details ¹	LOS ² (AM/ PM)	
		No Action	Build
WCR 31	Base Condition: Unsignalized; 2-Lane cross section <ul style="list-style-type: none"> Add southbound right-turn lane Extend accel and decel lanes 	EBL: a / b WBR: a / a SBL: b / b	EBL: a / b SBL: c / d SBR: a / a
WCR 37	Base Condition: Unsignalized; 2-Lane cross section <ul style="list-style-type: none"> Add eastbound and westbound left-turn lanes Add eastbound and westbound right-turn lanes Add northbound and southbound left-turn lanes 	NBT: e / f SBT: d / e	EBL: a / b WBL: b / b NBL: d / f NBTR: c / d SBL: c / d SBTR: c / e
WCR 41	Base Condition: Planned improvements include signalization and additional turn lanes. <ul style="list-style-type: none"> No additional recommendations 	B/B	B/B
WCR 45	Base Condition: Unsignalized; 2-Lane cross section <ul style="list-style-type: none"> Add eastbound right-turn lane Add westbound left-turn lane 	NBL: d / c	WBL: b / b NBL: f / e

¹ Improvements evaluated for Middle 4-Lane to County Line Road scenario

² Signalized intersection Levels of Service or unsignalized movement Levels of Service

Build – Segment 5 (WCR 49 to CO 79)

Only 2-Lane alternatives were modeled through Segment 5. The No Action model forecasts indicate about a 30% increase in traffic volumes by 2045, with very little change (0% to 1%) as a result of build conditions along the CO 52 corridor.

Special consideration was given to the WCR 59 intersection due to the school located in the southwest quadrant of the intersection and the history of *broadside* crashes observed at this location. The school alters the peak hour characteristics due to student drop-off in the morning peak period and creates a secondary peak period during student pick-up in the afternoons, prior to the evening peak hour with busses present for both time periods. The operations analysis focused on unsignalized conditions as the intersection is not expected to meet signal warrants based on the current forecasted volumes, though development in the area could alter that in the future. The recommended single-lane roundabout would most likely operate at an acceptable level (LOS B or better) during all peak periods, including mid-afternoon school pick-up, but should be reviewed in greater detail in the future once details of the high-speed roundabout design are confirmed.

The results of the detailed operations analysis are summarized by alternative in **Table 25**. The model volumes included for the alternative evaluation are defined as:

- 2-LN: Two through lanes from WCR 49 to CO 79/WCR 69
 - Full 4-Lane Volumes
 - West 4-Lane Volumes
 - Middle 4-Lane to US 287 Volumes
 - Middle 4-Lane to County Line Road Volumes
 - Short 4-Lane Volumes
- APL: Two through lanes from WCR 49 to CO 79/WCR 69 plus one alternating passing lane.
 - Short 4-Lane Volumes

Table 25: Segment 5 2045 Build Alternatives Corridor Operations

Measure of Effectiveness	No Action	Segment 5 – 2045 Build Alternatives			
		2-LN	Change ⁴	APL ³	Change ⁴
WCR 49 to CO 79/WCR 69					
Travel Time (min)	10.1	10.1	No Change +0%	9.9	No Change -2%
Travel Time Index (TTI ¹)	1.09	1.10	No Change +1%	1.10	No Change +1%
Reliability (PTI ²)	1.21	1.23	No Change +2%	1.23	No Change +2%

¹ Travel Time Index = Average Travel Time / Free-Flow Travel Time
² Planning Time Index = 95th Percentile Travel Time / Free-Flow Travel Time
³ Alternating Passing Lane compared to variant of No Action with modeled passing zones.
⁴ Significant > 15% reduction, Moderate > 5% reduction, No Change ±5%, or Worsens > 5% increase

The intersection improvements were configured and optimized separately for each TransModeler analysis scenario. A summary of the Segment 5 final recommendations for intersection configurations are provided in **Table 26**; results based on Middle 4-Lane to County Line Road scenario.

Table 26: Segment 5 2045 Intersection Improvement Recommendations

Intersection	Improvement Details ¹	LOS ² (AM/ PM)	
		No Action	Build
WCR 53	Base Condition: Unsignalized; 2-Lane cross section <ul style="list-style-type: none"> • Add eastbound right-turn lane • Add westbound left-turn lane 	NBL: c / b	WBL: a / a NBL: b / b
WCR 59 ³	Base Condition: Unsignalized; 2-Lane cross section <ul style="list-style-type: none"> • Location may not meet signal warrant volumes • Install Single-Lane Roundabout • As an interim improvement, consider adding northbound and southbound left-turn lanes (with caution for sight distance issues) 	EBR: a / a WBL: a / a NBLTR: d / b SBLTR: d / b	Roundabout: A/A ⁴ Unsignalized: WBL: a / a NBLTR: d / b SBLTR: d / b
CO 79	Base Condition: Unsignalized; 2-Lane cross section <ul style="list-style-type: none"> • Add eastbound and westbound left-turn lanes • Add eastbound right-turn lane 	NBLTR: c / b SBLTR: a / a	EBL: a / a WBL: a / a NBL: c / b NBT: a / b SBT: b / a

¹ Improvements evaluated for Middle 4-Lane to County Line Road scenario

² Signalized intersection Levels of Service or unsignalized movement Levels of Service

³ Recommended high-speed single-lane roundabout expected to operate at LOS B or better.

⁴ Based on HCS 7 Roundabout analysis using 2045 volumes; not included in primary analysis models.

CONCLUSIONS AND RECOMMENDATIONS

The Level 2 evaluation incorporates information from multiple disciplines, public input, and agency recommendations. As a result, there are minor differences between the CO 52 PEL recommendations and the traffic analysis scenarios. However, the Middle 4-Lane to County Line analysis model most closely matches the configuration outlined in the project recommendations.

Table 27 provides a summary comparison for the recommended scenario versus the No Action scenario.

Table 27: 2045 No Action and 2045 Build Conditions (M4CL) Corridor Operations

Segment	Travel Time (minutes)			Travel Time Index (TTI ¹)			Reliability (PTI ²)		
	NA	BUILD	Change ³	NA	BUILD	Change ³	NA	BUILD	Change ³
Segment 1									
West of 71st St. to County Line Rd.	16.1	14.1	Moderate -13%	2	1.7	Substantial -16%	3	2.7	Moderate -11%
Segment 2									
County Line Rd. to WCR 7	11.3	4.2	Substantial -92%	3.5	1.3	Substantial -92%	7.9	1.5	Substantial -136%
WCR7 to SB I-25 Frontage Rd.	0.9	0.5	Substantial -57%	2.2	1.1	Substantial -67%	6.3	1.3	Substantial -132%
NB I-25 Frontage Rd. to WCR 15	9.5	5.8	Substantial -48%	3	1.8	Substantial -50%	5.7	2.4	Substantial -81%
WCR 15 to WCR 19	2.9	3	No Change +3%	1.2	1.3	Worsens +8%	1.5	1.6	Worsens +6%
Segment 3									
WCR 19 to US 85	4.1	3.4	Substantial -19%	1.4	1.1	Substantial -24%	2.5	1.2	Substantial -70%
US 85 to WCR 31 (Ft. Lupton)	16.4	6.8	Substantial -83%	4.2	1.8	Substantial -80%	10.6	3.3	Substantial -105%
Segment 4									
WCR 31 to Loves/I-76 Frontage Rd.	6.5	6.4	No Change -2%	1.1	1.1	No Change +0%	1.3	1.3	No Change +0%
Dahlia St. to WCR 49	2.2	2.2	No Change +0%	1.1	1.1	No Change +0%	1.2	1.2	No Change +0%
Segment 5									
WCR 49 to CO 79/WCR 69	10.1	10.1	No Change +0%	1.1	1.1	No Change +0%	1.2	1.2	No Change +0%

¹ Travel Time Index = Average Travel Time / Free-Flow Travel Time

² Planning Time Index = 95th Percentile Travel Time / Free-Flow Travel Time

³ Significant > 15% reduction, Moderate > 5% reduction, No Change ±5%, or Worsens > 5% increase

INTERSECTION OPERATIONS (RECOMMENDED ALTERNATIVE)

The operational analysis performed for the Middle 4-Lane to County Line scenario most closely match the recommendations for the PEL and are presented graphically in the following graphics:

- **Figure 20:** Segment 1 – 2045 Build Conditions (M4CL) Levels of Service
- **Figure 21:** Segment 2 – 2045 Build Conditions (M4CL) Levels of Service
- **Figure 22:** Segment 3 – 2045 Build Conditions (M4CL) Levels of Service
- **Figure 23:** Segment 4 – 2045 Build Conditions (M4CL) Levels of Service
- **Figure 24:** Segment 5 – 2045 Build Conditions (M4CL) Levels of Service

Figure 20: Segment 1 – 2045 Build Conditions (M4CL) Levels of Service

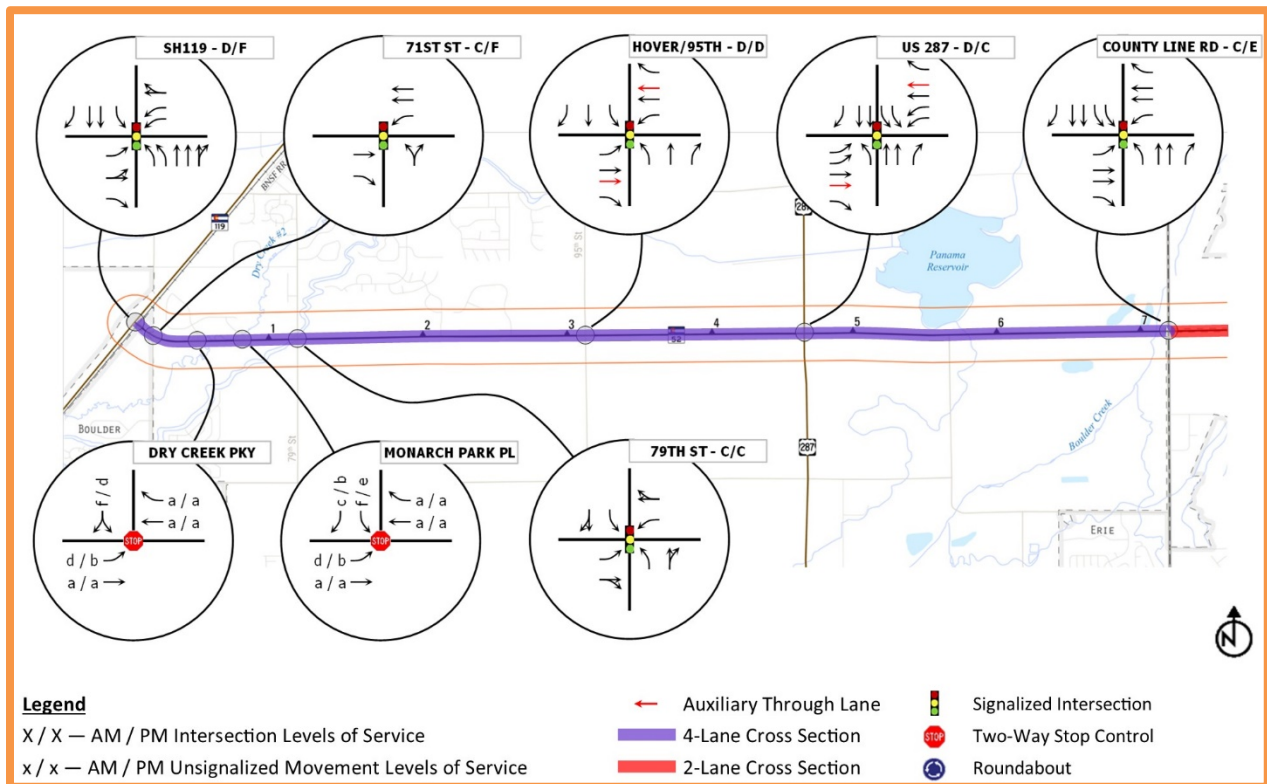


Figure 21: Segment 2 – 2045 Build Conditions (M4CL) Levels of Service

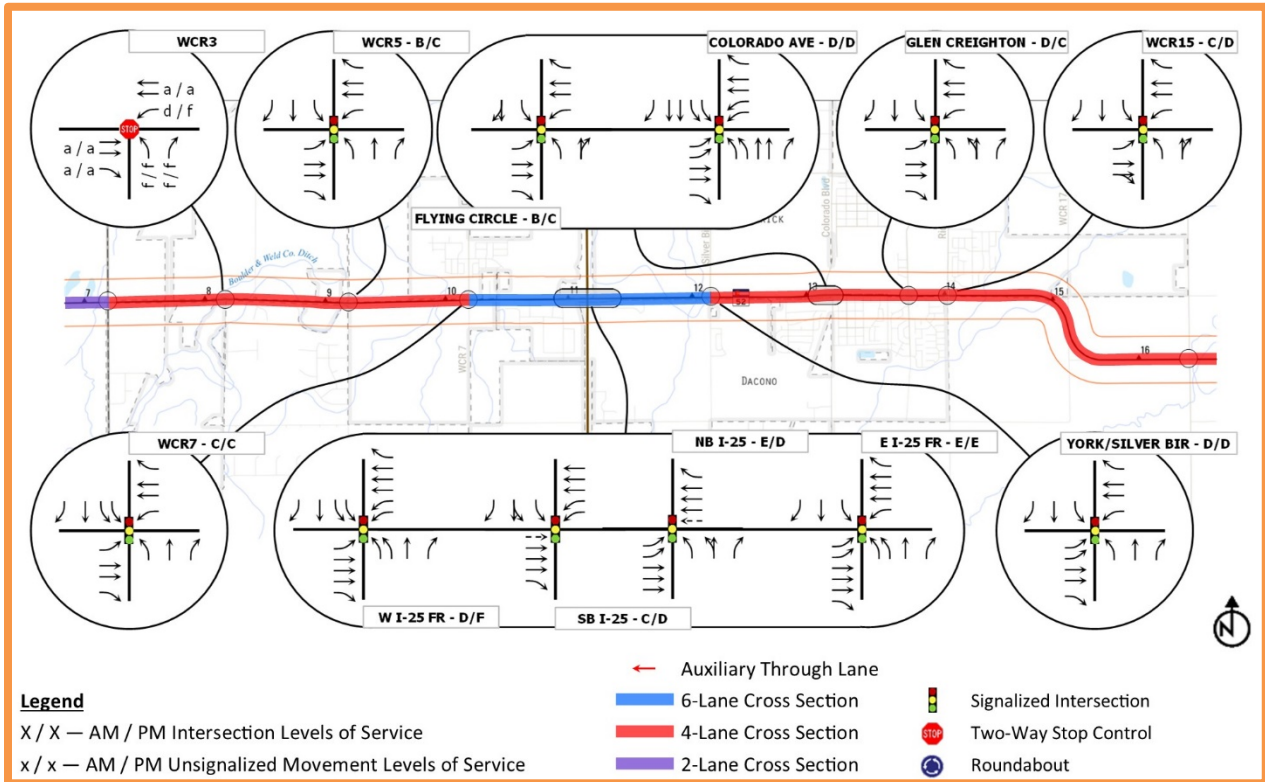


Figure 22: Segment 3 – 2045 Build Conditions (M4CL) Levels of Service

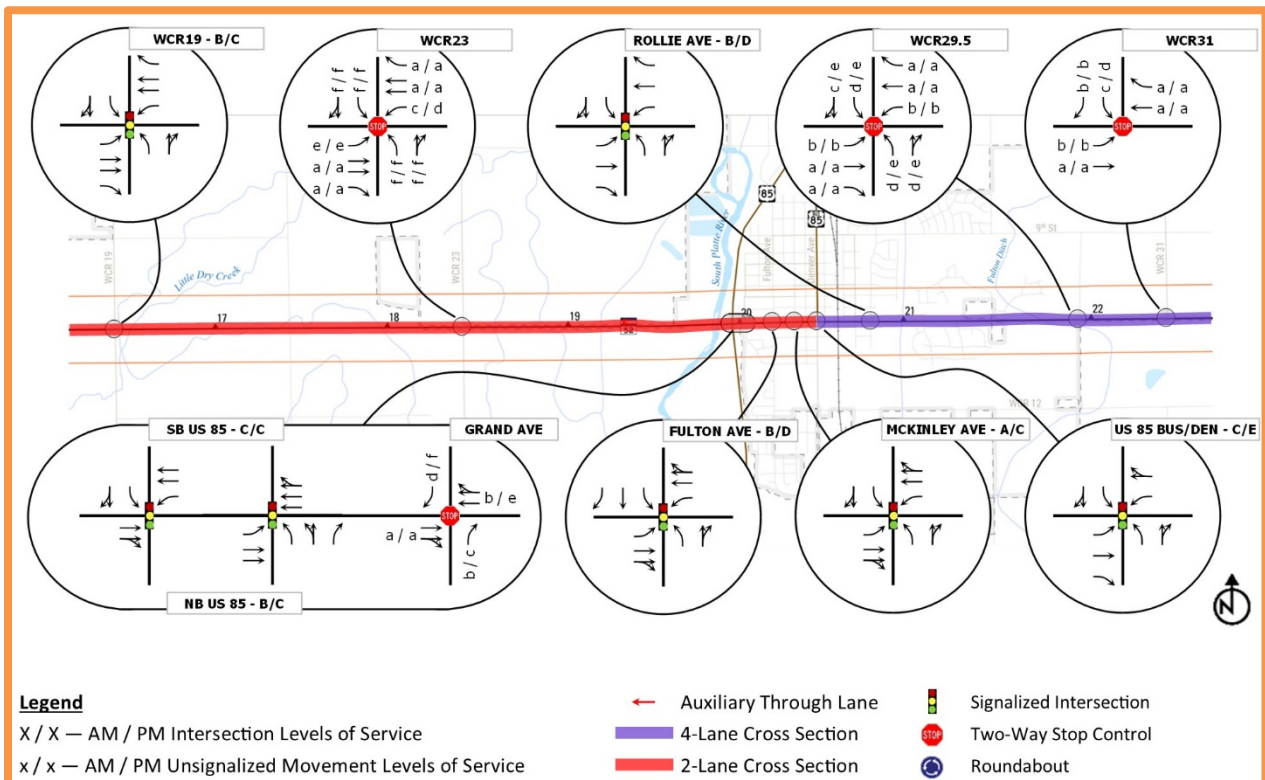


Figure 23: Segment 4 – 2045 Build Conditions (M4CL) Levels of Service

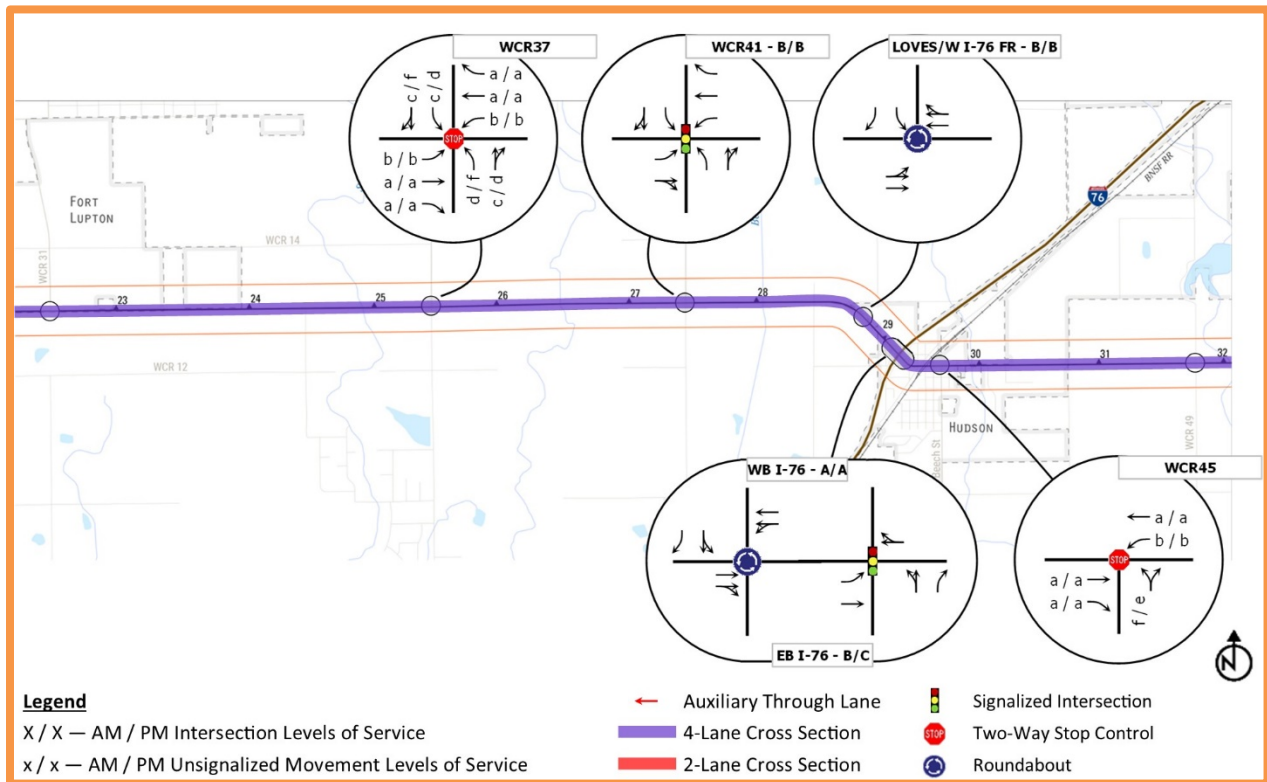
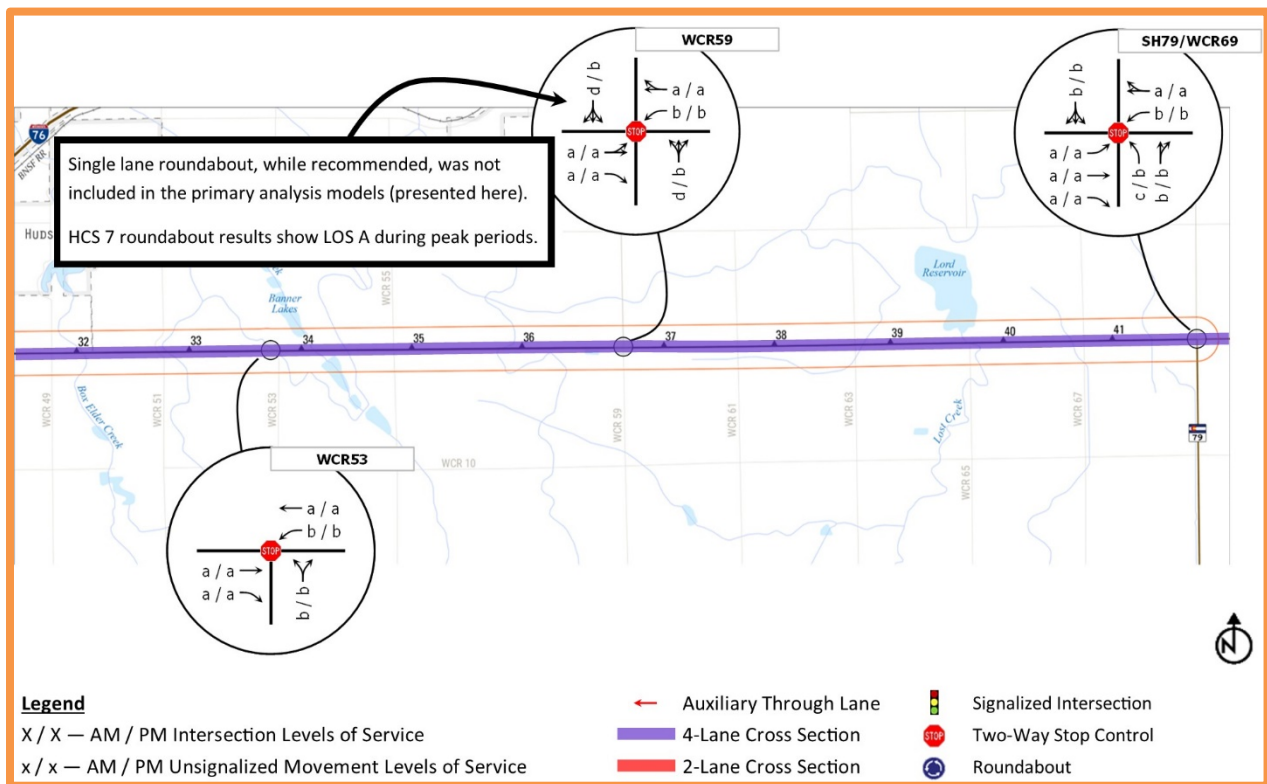


Figure 24: Segment 5 – 2045 Build Conditions (M4CL) Levels of Service



APPENDIX A – TURNING MOVEMENT COUNTS

Field Collected Turning Movement Count Data

APPENDIX B – LINK VOLUME, SPEED, AND CLASSIFICATION COUNTS

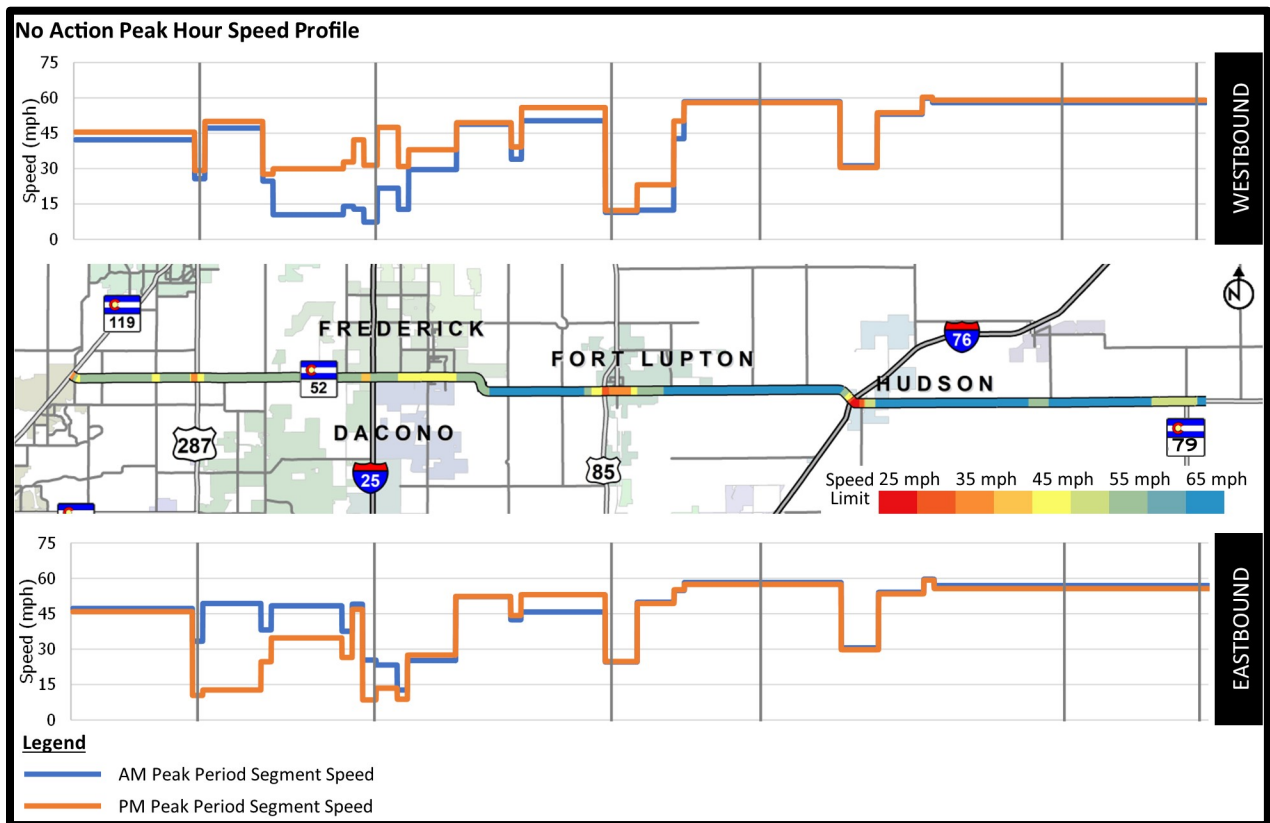
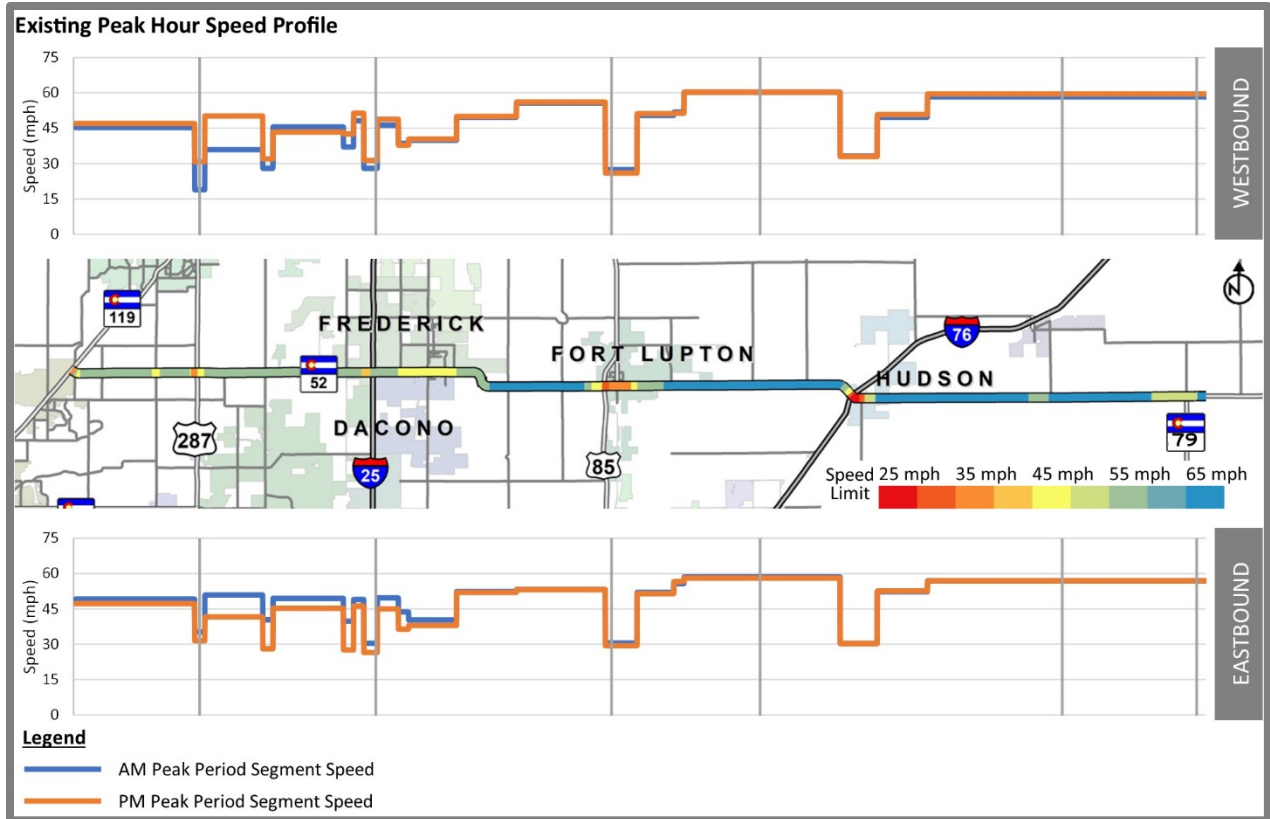
Field Collected Volume, Speed, and Classification Data

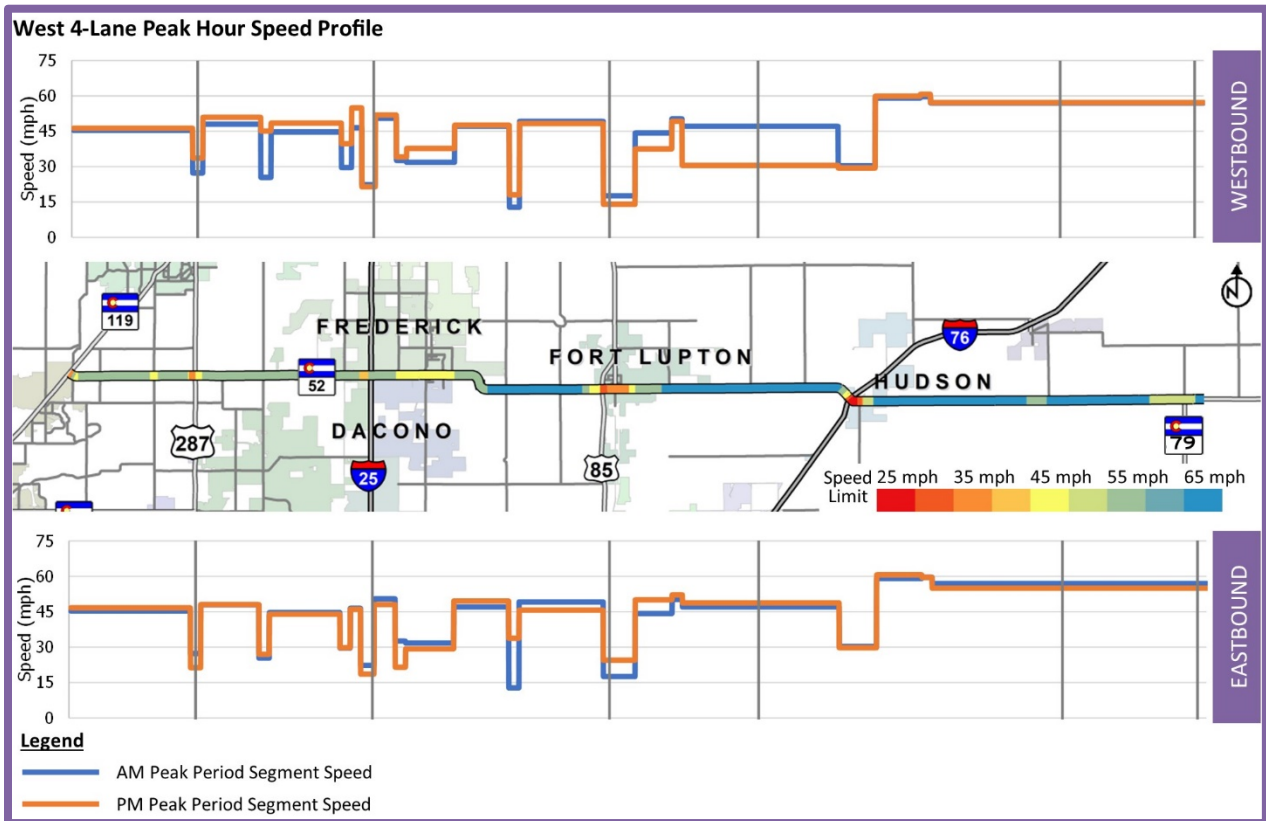
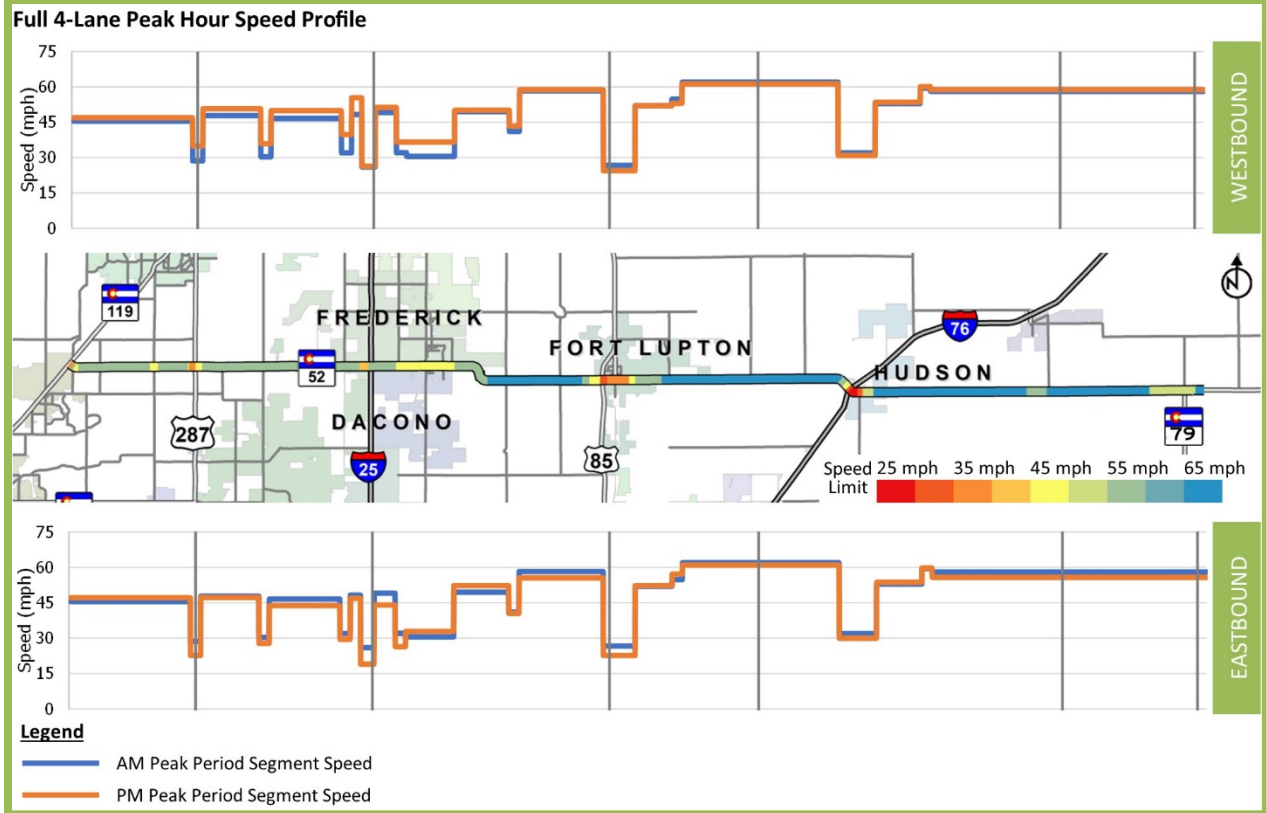
APPENDIX C – MODELED 2045 TURNING MOVEMENT COUNTS

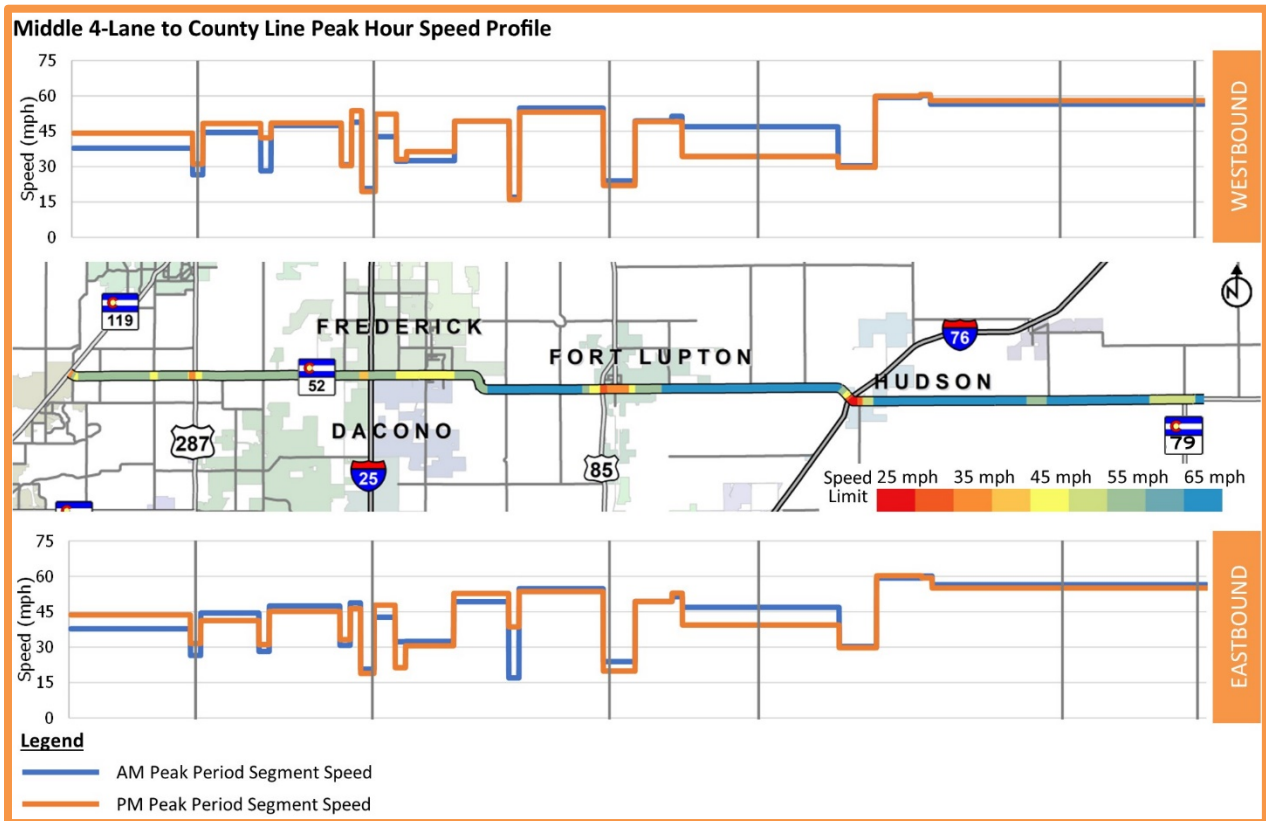
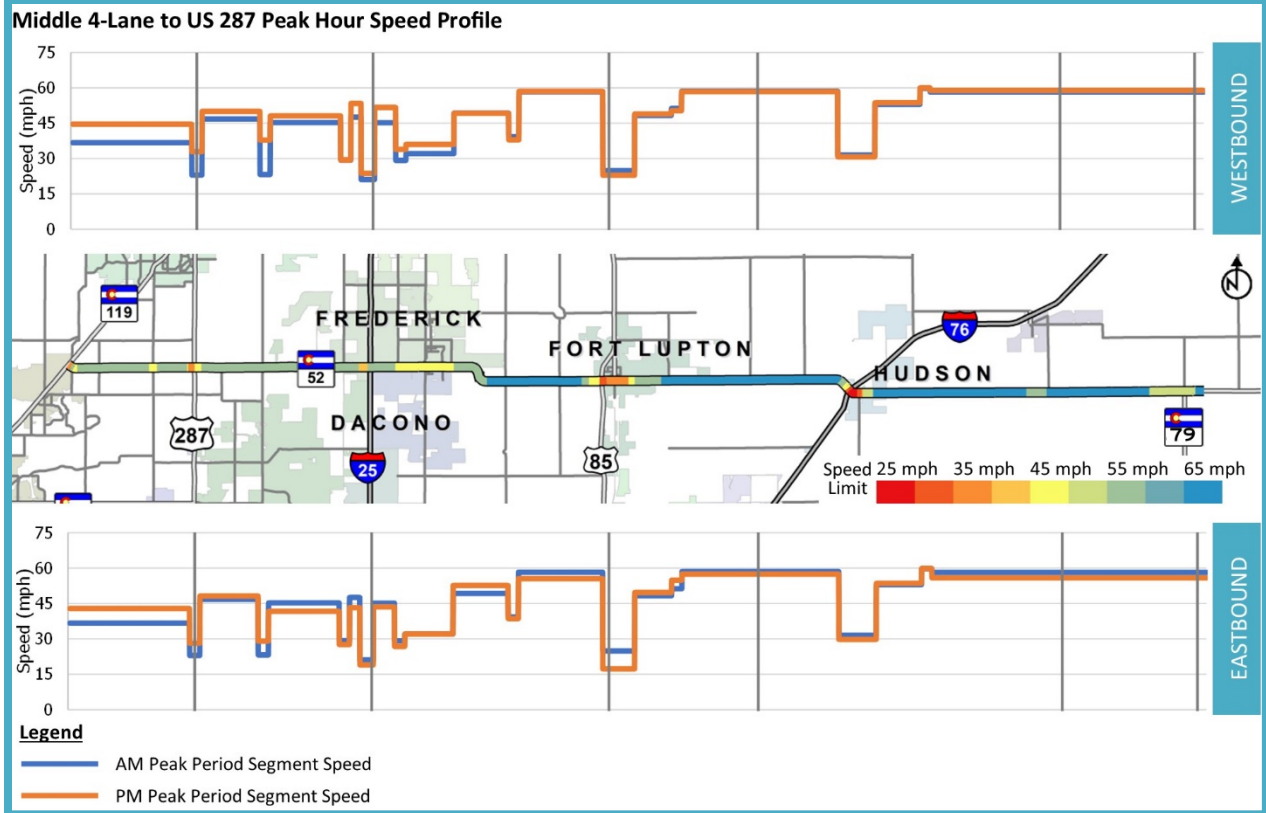
Calculated 2045 Modeled Turning Movement Count Data

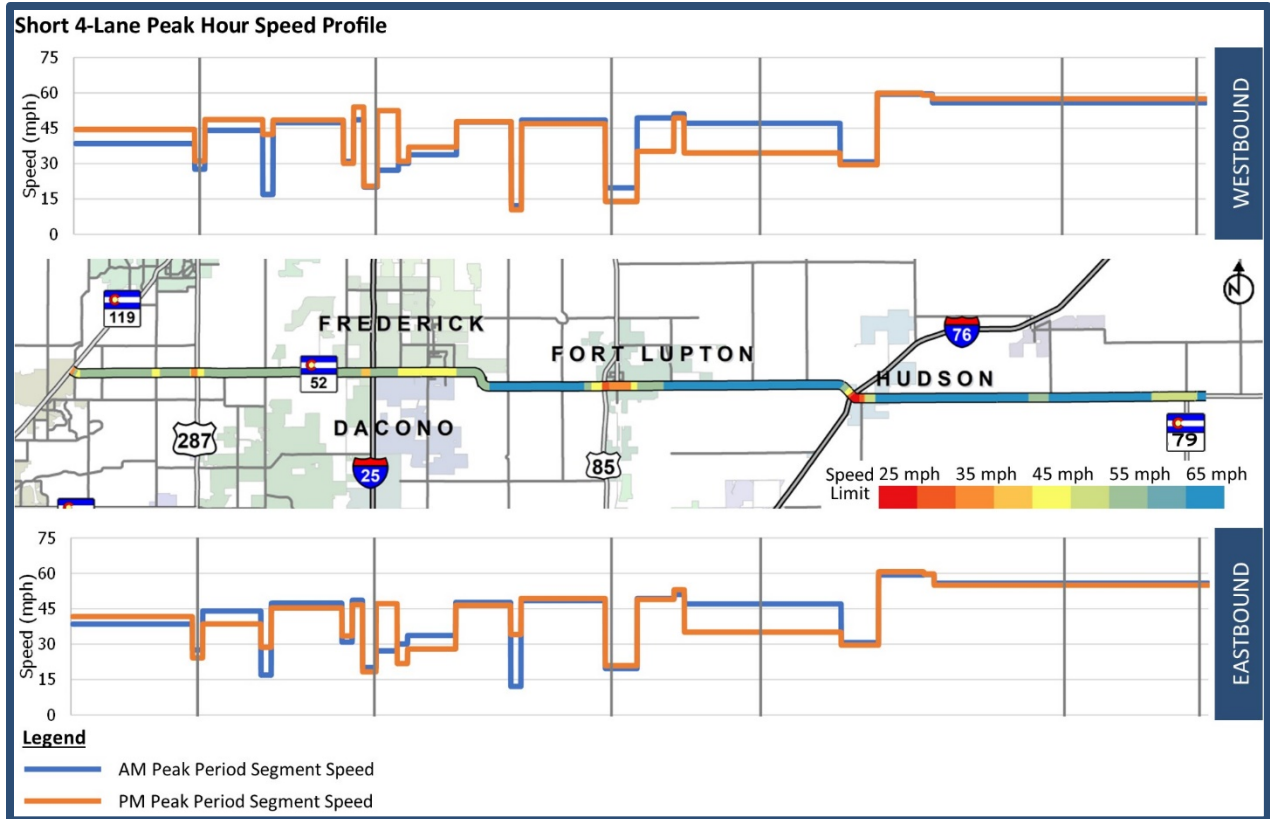
APPENDIX D – MODELED 2045 LINK SPEED DISTRIBUTIONS

Graphics showing link speed distribution used to refine build model development.











Appendix F-11

Travel Demand Forecasting Methodology Technical Memo

Project: CO 52 Planning and Environmental Linkages Study
To: Colorado Department of Transportation, Region 4
From: CO 52 PEL/ACP Project Team
Date: June 30, 2021
Subject: Travel Demand Forecasting Methodology Technical Memo

Background

This technical memorandum documents the travel demand forecasting methodology performed for the CO 52 Planning and Environmental Linkages (PEL) Study. The methodology outlines the existing year data sources, existing and future year model inputs, and future year outputs and post-processing methods. A summary of forecast volumes is also provided.

In addition to this technical memorandum, the following CO 52 PEL Study travel forecasting documents have been prepared for this project:

- *Traffic Forecasting and Screenline/Parallel Routes Analysis Memorandum* – This document summarizes year 2020 and 2045 travel demand model results and summarizes traffic volumes at screenline locations along CO 52 and parallel routes.
- *Origin-Destination Trip Pattern Analysis* – This memo documents the origin-destination trip pattern modeling analysis performed for the study to identify where trips enter/exit the CO-52 corridor as well as trip origins and destinations along the corridor.
- *Transit Analysis Methodology and Results* – This document summarizes the methodology, assumptions, and results of the analysis of transit options along the CO 52 corridor.
- *Telework Analysis - Sensitivity Model Run* – This document summarizes the telework modeling analysis that included research into telework assumptions for travel demand modeling and the adjustment to targets for work trips that are Work-at-Home (WAH).

Travel Demand Forecasting Overview

Travel demand forecasting is the process of estimating the amount of travel along the facilities within a transportation system, be it roadways, transit lines, or multimodal facilities. A travel demand model is a planning tool used to estimate future travel within the transportation system and to assess alternative improvements to a transportation system. Its primary inputs are the region's transportation network and future socioeconomic data consisting of population, household, and employment data. The model produces various outputs including estimated future traffic volume forecasts along roadways.

The CDOT StateFocus (Version 1.4) travel demand model (CDOT Model) was used as the basis for the development of the CO 52 travel demand model. The Denver Regional Council of

Governments' Focus travel demand model (DRCOG Model) was considered for use on the project, however, because the CO 52 corridor extends through the far northeastern portion of the DRCOG Model's coverage, the CDOT Model was deemed more suitable.

The CDOT Model uses socio-economic projections for the State of Colorado to generate travel demand and distribute trips across the state's roadway and transit network. For the CO 52 PEL study, the 2015 model was used as the base year and the 2045 model as the horizon year.

Methodology

The following outlines the travel demand forecasting process used for the CO 52 PEL study.

Data Collection

At the time the travel demand model forecasting was initiated in the late spring/early summer of 2020, the Covid-19 pandemic was substantially impacting travel patterns. Obtaining year 2020 traffic counts was not viable as the data would not reflect "normal", non-pandemic conditions. In lieu of year 2020 data, historic daily traffic counts were collected from the CDOT OTIS website, CDOT Model, and the DRCOG Model. The historic counts used for the CO 52 PEL forecasting effort were all from years 2017, 2018, and 2019.

In September 2020, a data collection effort along the corridor was finally performed to obtain turning movement counts for the micro-simulation effort. The data included daily counts along the CO 52 corridor and peak period turning movement counts at select intersections and access points. In general, the daily counts along CO 52 were consistently lower than historic counts. A Covid-19 adjustment procedure was developed and applied to the traffic counts in an effort to adjust counts to "normal" 2020 conditions. The procedure involved developing seasonal and annual adjustment factors based on CDOT continuous count and short-duration count location data. These locations included data from before and during the pandemic. The September 2020 counts were then adjusted based on factors developed for five segments along CO 52.

Year 2020 Count Estimates

Year 2020 was selected as the base year for the project. In the late spring/early summer of 2020, well prior to the data collection effort in September, year 2020 daily count estimates were developed at locations along CO 52 based on the historic daily counts. Historic counts were factored to 2020 based upon observed historic patterns, where available, and growth rates observed in the CDOT Model from year 2015 to year 2045. Where traffic counts were unavailable along CO 52, the 2020 counts were estimated based upon counts at upstream/downstream locations.

Once the September 2020 data was available, a review of the year 2020 count estimates was performed as a quality check. The comparison to the Covid-19 adjusted daily counts was a high-level effort that confirmed that the 2020 count estimates along the corridor were within an acceptable range.

Using the September 2020 turning movements counts, cross-street daily count estimates along the CO 52 corridor were developed. The daily count estimates were based on the proportion of

peak hour counts observed on each leg of a given intersection. The cross-street counts were estimated based on the proportion applied to the 2020 estimated daily counts along CO 52, resulting in 2020 estimated daily counts on the cross-streets.

Existing Year Travel Demand Model

A travel forecasting model is developed for the existing year with the goal of replicating real-world conditions as best as possible. The network and socio-economic inputs are reviewed for accuracy within the project's study area, compared to observed conditions, and adjusted where deemed necessary.

The CDOT Model includes a base year 2015 model and two horizon year models for year 2030 and year 2045. To develop a CO 52 base year model, the CDOT Model's 2015 base year was used as a basis. The 2015 CDOT Model's roadway coded network was reviewed and corrected where necessary to replicate 2020 roadway conditions. The roadway network within the CO 52 Study Area and surrounding area was adjusted based on recent aerial photography and known roadway improvements. Corrections and additions to the roadway network included the following:

- Added 79th St as two-lane collector south of CO 52 to Lookout Rd
- CO 52 laneages adjusted from two to four (two each direction) between West I-25 Frontage Rd to East I-25 Frontage Rd
- Removed WCR 12 grade-separated crossing of I-25 (parallel facility north of CO 52)
- Removed WCR 16 grade-separated crossing of I-25 (parallel facility south of CO 52)
- Realigned CO 52 / Colorado Blvd intersection as four-leg intersection, rather than two three-legged intersections
- Added WCR 29.5 as two-lane collector crossing CO 52, extending from WCR 14 on the north to WCR 12 on the south
- Added I-76 Frontage as two-lane collector east of I-76, from CO 52 to WCR 49

Though the roadway network matches 2020 conditions, the socioeconomic inputs remain unchanged and represent 2015 conditions. For this reason, and for simplicity sake, the existing year model is referred to as the CO 52 2015 Base Scenario (2015 Base Scenario).

Horizon Year Travel Demand Model

A horizon year travel demand model is used to project the future year travel patterns and volumes. The horizon year model inputs include the future transportation system, based upon expected improvement projects as specified in fiscally-constrained regional transportation plans and estimates of the future socioeconomic conditions. As with the existing year model, the future transportation network is refined if necessary.

For the CO 52 2045 No Action Scenario (2045 No Action Scenario), the 2045 CDOT Model's roadway network was used as a basis. The roadway network was modified to include all adjustments made in the development of the 2015 Base Scenario (listed above). Additionally, the DRCOG 2040 Regional Transportation Plan (2040 RTP) was reviewed to ensure any roadway and transit projects within the area were included in the 2045 No Action Scenario's transportation network. No additional adjustments to the roadway and transit networks were found to be necessary.

2020 Model Volume Development

To compare CO 52 model volumes to observed conditions, the 2015 Base Scenario outputs were factored to year 2020, on a location by location basis, to correspond with the 2020 count estimates. The factors were developed from annual growth rates calculated based on output volumes from the 2015 Base Scenario and the 2045 No Action Scenario. The annual growth rates were applied to the 2015 model volumes to get estimated 2020 model volumes.

Post-Processing Methodology

As with all travel demand forecasting models, the CDOT Model is not expected to provide precise traffic volume forecasts throughout the roadway system due to the complexity of the real world. Per industry practice, the model's horizon year traffic volumes were adjusted based on actual traffic counts. The methodology of adjustment compared the 2020 estimated model traffic volumes to the 2020 estimated traffic counts throughout the project area. These comparisons highlight the expected variation associated with the model's representation of travel conditions along roadways in the region.

2045 No Action Scenario daily traffic forecasts were adjusted based on percentage and absolute differences between the 2020 estimated model volumes and the 2020 estimated counts, as prescribed in the Transportation Research Board's publication NCHRP 765 post-processing adjustment methodology.

2045 Model Alternatives

Along with the 2015 Base Scenario and 2045 No Action Scenario, four additional horizon year model runs were performed for the alternatives analysis:

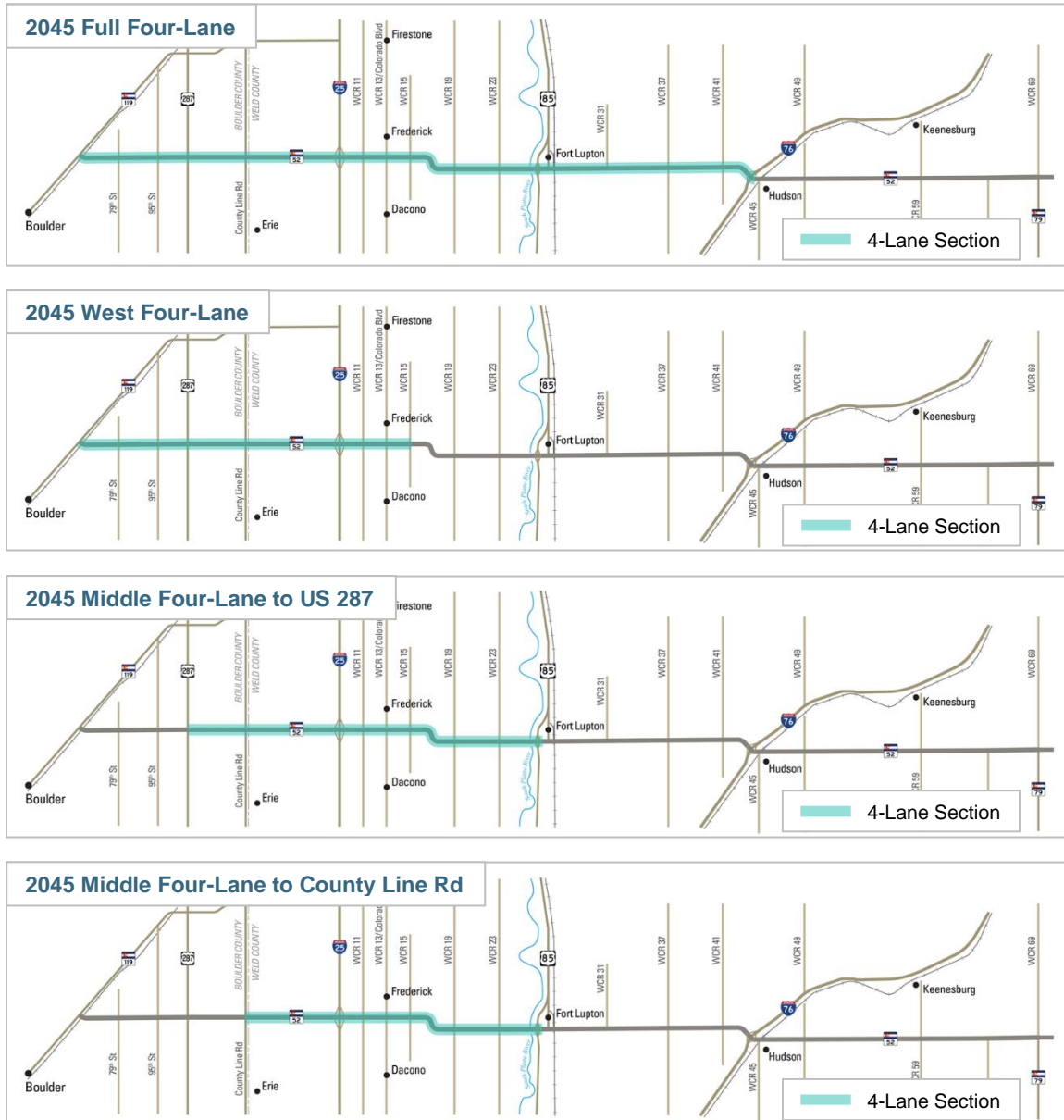
- 2045 Full Four-Lane Scenario – CO 52 improved to four lanes from CO 119 to I-76.
- 2045 West Four-Lane Scenario – CO 52 improved to four lanes from US 287 to WCR 15 (east of Frederick/Dacono).
- 2045 Middle Four-Lane to US 287 Scenario – CO 52 improved to four lanes from US 287 to Denver Ave in Ft. Lupton.
- 2045 Middle Four-Lane to County Line Rd Scenario – CO 52 improved to four lanes from County Line Rd to Denver Ave in Ft. Lupton.

The four action scenarios each include widening CO 52 to four lanes along various stretches of the highway. The extents of those four-lane segments are illustrated in As noted earlier, a

detailed summary of results of the travel demand modeling analysis can be found in the *Traffic Forecasting and Screenline/Parallel Routes Analysis Memorandum*.

Figure 1. As noted earlier, a detailed summary of results of the travel demand modeling analysis can be found in the *Traffic Forecasting and Screenline/Parallel Routes Analysis Memorandum*.

Figure 1 2045 4-Lane Action Scenarios



Appendix F-12

Alternatives Analysis

Terminology Memo





Project: CO 52 Planning and Environmental Linkages Study / Access Control Plan
To: Chad Hall, Project Manager, CDOT R4
From: Kelly Maiorana, Muller
Date: January 29, 2021
Subject: CO 52 Alternative Analysis Terminology

This memo describes the CO 52 Planning and Environmental Linkages Study (PEL) terminology that will be used to describe the outcomes of Level 1 and Level 2 evaluations of the Alternatives Analysis. Alternative outcomes are described to provide nomenclature guidelines for the Alternatives Analysis and to provide the most flexibility as projects move forward after the PEL study is completed.

Level 1

Carried Forward: Meets Purpose and Need, considered reasonable and feasible, and may be considered for further evaluation in this study or subsequent NEPA and Project development.

Retained as an Element: Does not fully meet Purpose and Need, but will be evaluated as a packaged element of a larger-scale alternative.

Eliminated: Does not meet Purpose and Need, has a fatal flaw, and/or is considered unreasonable. A project alternative that is Eliminated is removed from further consideration in the PEL Study.

Level 2

Recommended: Considered reasonable and feasible and recommended for consideration as the Preferred Alternative during subsequent NEPA and project development.

Carried Forward: Considered reasonable and feasible and may be considered for further evaluation in this study or subsequent NEPA and project development

Not Recommended: Will not be evaluated further in this study due to comparatively negligible benefits and higher impacts than other alternatives, but may be studied further with subsequent NEPA and project development

Eliminated: Does not meet Purpose and Need, has a fatal flaw, and/or is considered unreasonable. A project alternative that is Eliminated is removed from further consideration in the PEL Study.

Design Option: Alternative design variation to the typical that can be presented but will not be evaluated until future design phase.

Appendix F-13

Bicycle and Pedestrian Connectivity Memo



Project: CO 52 Planning and Environmental Linkages Study
To: Colorado Department of Transportation, Region 4
From: CO 52 PEL/ACP Project Team
Date: September 14, 2021
Subject: Bicycle and Pedestrian Connectivity Memo

Bicycle and Pedestrian Connectivity Memo

OV Consulting has prepared a bicycle and pedestrian connectivity analysis for the Colorado State Highway (CO) 52 corridor as a supplement to the Planning and Environmental Linkages Study (PEL). The following memorandum summarizes the PEL process as it relates to multimodal connections, documents the multimodal evaluation criteria, and provides recommendations for bicycle and pedestrian improvements, both regional (corridor-wide) and local (location specific).

Introduction

CO 52 is one of the few continuous and straight east-west connections between CO 119 in Boulder County and the eastern towns of Wiggins and Fort Morgan. As a result, this corridor is a critical link in the transportation network not only for vehicles, but also for bicycles. No other continuous bicycle route or trail exists in close proximity that provides similar east-west connectivity for this area. Additionally, the corridor is located in between many growing communities to the north and south. Therefore, providing north-south connectivity across CO 52 is equally important to ensure connectivity and provide safe crossings within these growing communities.

PEL Multimodal Process

The PEL process included an evaluation of existing conditions throughout the corridor, which involved collecting local agency and stakeholder comments to gain an understanding of their priorities in terms of bicycle and pedestrian mobility needs, challenges, and desires around the corridor. Early feedback indicated a general community desire for multimodal facilities. Following the development of the Existing Conditions Report, the project team developed the Purpose and Need Memo which identified the need to support multimodal connections as one of three governing needs.

Summary of Existing Conditions

Bicycle and pedestrian facilities and operations were analyzed by dividing the corridor into three areas: CO 119 to County Line Road within Boulder County (West Area), County Line Road to WCR 37 within Weld County (Central Area), and WCR 37 to CO 79 within Weld County (East Area).

Bicycle and pedestrian analysis involved a desktop review of existing and planned facilities, online resources, and available GIS data from local and regional agencies as well as a Bicycle Level of Traffic Stress (LTS) analysis. Figures 3-11 and 3-13 of the Existing Conditions Report show existing and proposed bicycle and pedestrian facilities proximate to CO 52, respectively. The LTS for most of the corridor was found to be very high due to the high vehicle speeds. Similarly, the LTS crossing rating indicates that bicycle travel across CO 52 is difficult at many of the unsignalized intersections due to the high volume and/or high speed of vehicular traffic along CO 52.

Bicycle and Pedestrian Connectivity Memo

Stakeholder and Agency Input

In addition to the desktop reviews, agency and stakeholder input was collected. The analysis allowed for specific needs in each of the three areas to be identified as well as overall corridor needs. Input received is summarized in Table 1.

Table 1 Agency and Stakeholder Input

Agency and Stakeholder Input		
Corridor Area	Bicycle Facilities	Pedestrian Facilities
Overall Corridor Needs	<ul style="list-style-type: none"> • Improve bicycle mobility because there are no other existing or proposed parallel bicycle routes that connect the CO 52 communities • Improve the existing gaps in the shoulders near major intersections • Upgrade the existing infrastructure and operations to improve level of comfort for cyclists • Supplement the bicycle network by implementing proposed regional trails along CO 52 • Improve crossings of CO 52 as development starts to occur along the corridor 	<ul style="list-style-type: none"> • Improve safety and comfort level of existing pedestrian facilities by expanding the sidewalk network, increasing sidewalk width, and separating sidewalks from the roadway • Install controlled pedestrian crossings where demand exists and physical conditions allow
West Area Needs	<ul style="list-style-type: none"> • Explore shifting CO 52 to the north or south to provide a shared use trail parallel to the corridor • Consider bicycle crossing enhancements at CO 119 and 95th Street (and other important multimodal nodes) since both roadways are designated proposed Regional Active Transportation Corridors by DRCOG • Provide a continuous and safe bicycle facility on CO 52 through the I-25 interchange area 	<ul style="list-style-type: none"> • Explore shifting CO 52 to the north or south to create a shared use path parallel to the corridor that is within the available right-of-way

Bicycle and Pedestrian Connectivity Memo

Central Area Needs	<ul style="list-style-type: none"> • Consider the proposed regional trails and bicycle routes near the municipalities of Erie, Frederick, and Dacono, with special consideration for the crossings of CO 52 • Consider the proposed Regional Active Transportation Corridor (85-25 Trail/Front Range Trail) that travels from the south along WCR 23, to the west along CO 52, and connects with the existing Firestone Trail • Consider a connection along the corridor from Fort Lupton to the 85-25 Trail/Front Range Trail • Improve connections across CO 52 between Dacono and Frederick and within Fort Lupton that serve community amenities such as schools, recreation centers, trails, and retail establishment 	<ul style="list-style-type: none"> • Provide connections to planned regional and local trails within Dacono, Frederick and Erie
East Area Needs	<ul style="list-style-type: none"> • Improve crossings within Hudson where CO 52 intersects the street grid and is a barrier for north-south mobility • Provide bicycle safety enhancements east of Hudson 	<ul style="list-style-type: none"> • Improve crossings of CO 52 within Fort Lupton and Hudson, especially near the schools and parks • Implement proposed trail network within Fort Lupton and Hudson, including the crossings of CO 52

Expected User Groups

Most land uses adjacent to the CO 52 corridor are agricultural or industrial uses. However, the corridor is experiencing an increase in commercial and residential development and it provides critical east-west connectivity for several rural communities and business centers. The majority of proposed bicycle facility alternatives are in-road facilities such as roadway shoulders and bicycle lanes along CO 52. These types of facilities are in close proximity to high-speed and high-volume vehicular traffic. There are a couple of exceptions including the shared use path alternatives throughout Boulder County and Fort Lupton. For these reasons, the corridor is anticipated to attract high-speed, long-distance bicycle trips throughout the length of the corridor as well as a variety of users within lower-speed residential and commercial areas. It is expected that most bicycle trips along the extents of the corridor will be recreational or commute trips. Therefore, bicycle facilities along CO 52 should be designed to appeal to bicyclists that currently use the roadway shoulders while also appealing to and safely accommodating all user groups.

Methodology for Improvements

As discussed in the PEL, evaluation criteria, consistent with the Purpose and Need and Goals, were developed prior to beginning the alternatives screening process. The Level 1 performance measures assess the ability of each alternative to meet Purpose and Need at a high level. The Level 2 performance measures delve into more detail as well as evaluate how well alternatives meet project goals. Evaluation

Bicycle and Pedestrian Connectivity Memo

of the Level 2 performance measures was informed by Chapter 14 of CDOT's *Roadway Design Guide Rev. 2, 2015*, AASHTO's *A Policy on Geometric Design of Highways and Streets 6th Edition, 2011*, and AASHTO's *Guide for the Development of Bicycle Facilities, 2012*.

Level 1 Evaluation Criteria

The Level 1 performance measures evaluated alternatives at a high level based on whether or not the alternatives have the potential to increase and not preclude multimodal mobility. The following provides a description of the criteria and a summary of how they were evaluated:

- Local and Regional Route Connectivity – This criterion evaluates the alternatives based on their connectivity to existing and planned bicycle/pedestrian facilities near the CO 52 corridor.
- Bicycle Connectivity – Alternatives were evaluated per the bicycle connectivity criterion based on whether or not they would provide improvements to bicycle infrastructure.
- Pedestrian Connectivity – Similar to the bicycle connectivity criterion, the pedestrian connectivity criterion evaluates the CO 52 alternatives based on whether or not they would provide improvements to pedestrian infrastructure.

For a summary of alternatives that were eliminated as a result of Level 1 screening, please refer to the PEL.

Level 2 Evaluation Criteria

After evaluation of Level 1 criteria, alternatives that advanced were evaluated based on Level 2 performance measures. The Level 2 performance measures added criteria that reflect components of the project goals which address local and regional planning efforts. Description of the criteria and a summary of how they were evaluated are provided below. The criteria evaluation rankings were split into substantial improvement, moderate improvement, minor improvement, or no change for all criteria except the “bicycle design guidelines” criterion, which ranked alternatives based on whether they exceed/meet/or do not meet the minimum standard.

- Improve North/South Pedestrian and Bicycle Travel Connections – This included a review of existing and planned north-south bicycle facilities along the CO 52 corridor and evaluated how the alternatives would improve connectivity for bicyclists travelling north-south. Alternatives were evaluated based on their cross-section (how many lanes left-turning north-south bicyclists would need to cross), proposed bicycle facility type (e.g., widened shoulder, bike lanes, or multi-use path), and based on the presence of a roadway median which could provide width at intersection for potential crossing treatments.
- Improve Continuity for East/West Bicycle and/or Pedestrian Travel – Evaluation of alternatives under this criterion was based on the proposed bicycle and pedestrian facility types along CO 52. The provision of a multi-use path or bike lanes along a segment was considered a substantial improvement as bicycles would have a dedicated space. Additionally, the provision of roadway shoulders greater than four feet in width where shoulders do not currently exist was considered a substantial improvement because this alternative would create a bicycle facility that previously did not exist. Shoulder widening with the installation of rumble strips was considered a moderate improvement and, lastly, shoulder widening in areas that already included eight-foot shoulders was considered a minor improvement.

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- Improves Bicycle Level of Service – For the alternatives which include bicycle facilities on roadway shoulders, bicycle level of service (LOS) was evaluated based on Chapter 14 of CDOT’s *Roadway Design Guide Rev. 2, 2015*. The methodology considers the speed limit, average daily traffic, percentage of heavy vehicles, and shoulder width to determine bicycle LOS. Alternatives that include dedicated bicycle facilities such as bike lanes or a multi-use path were considered to substantially improve bicycle LOS. Additionally, alternatives that introduce shoulders greater than four feet where none currently exist were considered to substantially improve bicycle LOS. The remaining alternatives that included shoulder widening were found to have no change on bicycle LOS.
- Reduce Vehicle/Pedestrian Conflict – The potential to reduce vehicle/pedestrian conflicts was evaluated for each alternative based on the cross-section and number of lanes pedestrians would be required to cross, the presence of a roadway median which could provide room for potential crossing treatments, as well as proposed pedestrian facility type (e.g., sidewalk, roadway shoulder, or multi-use path).
- Reduce Bicycle Level of Traffic Stress (LTS) - A Bicycle Level of Traffic Stress (LTS) analysis following the methodology developed by the Mineta Transportation Institute (Maaza C. Mekuria, 2012) was performed to assess the comfort of the bicycle facilities proposed in each alternative. Because any corridor stretch with a speed limit of 40 mph or higher will have an LTS of 4 regardless of the other criteria (street width, bike lane width, bike lane blockage), speed limit was used as the primary LTS screening criteria for the majority of the CO 52 corridor. The most desirable LTS score of 1 applies to facilities that are separated from motorized traffic; therefore, alternative with multi-use paths provide a substantial reduction to LTS.
- Reduce Vehicle/Bicycle Conflict – An alternatives potential to reduce vehicle/bicycle conflicts was evaluated based on the proposed bicycle facility type using Crash Modification Factors (CMF) published in the Federal Highway Administrations CMF Clearinghouse website. The CMF for shoulder widening was calculated per the methodology outlined in a study published by Park and Abdel-Aty in 2016 titled “Evaluation of Safety Effectiveness of Multiple Cross Sectional Features on Urban Arterials.” The CMF associated with the installation of bicycle lanes was referenced from a FHWA study published in 2021 titled “Development of Crash Modification Factors for Bicycle Lane Additions While Reducing Lane and Shoulder Widths.” Alternatives that resulted in crash reductions between zero and 25-percent were considered to have a moderate reduction and those above 25-percent were ranked as having a substantial reduction.
- Incorporates Bicycle Design Standards/Guidelines – Design widths for roadway shoulders, bicycle lanes, and two-directional shared used paths are provided in Chapter 14 of CDOT’s *Roadway Design Guide Rev. 2, 2015*. The alternatives were evaluated based on whether they exceed, met, or did not meet the standards provided in the guide.

Corridor Improvements

The proposed east-west multimodal alternatives along the CO 52 corridor include roadway shoulders for bicycle/pedestrian use in rural areas and either bicycle lanes and sidewalks or a shared use path in higher activity areas. The few existing pedestrian and bicyclist facilities that run parallel to CO 52 are mostly located near Dacono, Frederick, Fort Lupton, and Hudson. Pedestrian travel along the corridor is generated by schools, parks, and commercial uses and needs are limited to these municipalities that are bisected by the corridor. Selection of bicycle facility types was informed by AASHTO’s *Guide for the*

Bicycle and Pedestrian Connectivity Memo

Development of Bicycle Facilities, 2012, and Table 2-3 of the report is included below which summarizes general consideration for different bikeway types.

Type of Bikeway	Best Use	Motor Vehicle Design Speed	Traffic Volume	Classification or Intended Use	Other Considerations
Paved Shoulders	Rural highways that connect town centers and other major attractors.	Variable. Typical posted rural highway speeds (generally 40–55 mph).	Variable.	Rural roadways; inter-city highways.	Provides more shoulder width for roadway stability. Shoulder width should be dependent on characteristics of the adjacent motor vehicle traffic, i.e., wider shoulders on higher speed and/or higher-volume roads.
Bike Lanes	Major roads that provide direct, convenient, quick access to major land uses. Also, can be used on collector roads and busy urban streets with slower speeds.	Generally, any road where the design speed is more than 25 mph.	Variable. Speed differential is generally a more important factor in the decision to provide bike lanes than traffic volumes.	Arterials and collectors intended for major motor vehicle traffic movements.	Where motor vehicles are allowed to park adjacent to bike lane, provide a bike lane of sufficient width to reduce probability of conflicts due to opening vehicle doors and objects in the road. Analyze intersections to reduce bicyclist/motor vehicle conflicts.
Shared Use Path; Independent Right of Way	Linear corridors in greenways, or along waterways, freeways, active or abandoned rail lines, utility rights-of-way, unused rights-of-way. May be a short connection, such as a connector between two cul-de-sacs, or a longer connection between cities.	N/A	N/A	Provides a separated path for nonmotorized users. Intended to supplement a network of on-road bike lanes, shared lanes, bicycle boulevards, and paved shoulders.	Analyze intersections to anticipate and mitigate conflicts between path and roadway users. Design path with all users in mind, wide enough to accommodate expected usage. On-road alternatives may be desired for advanced riders who desire a more direct facility that accommodates higher speeds and minimizes conflicts with intersection and driveway traffic, pedestrians, and young bicyclists.

The following sections provide guidance for regional and local corridor improvements.

Bicycle Use of Roadway Should

Due to the expected user type, land use mix, and development density, roadway shoulders are the primary bicycle facility type proposed along the majority of the CO 52 corridor. All of the shoulder alternatives include at eight- to ten-foot-wide shoulders exceeding the minimum standard of four feet for shoulders where bicyclists and pedestrians are to be accommodated. Regardless of the width, the shoulders should be continuous to provide bicyclists an area to operate without obstructing and conflicting with faster moving motor vehicle traffic. Additionally, shoulders on structures should have the same width as usable shoulders on the roadway approaches. At intersections that include right-turn lanes on the approach, the introduction of a bike lane placed to the left of the right-turn lane is recommended to avoid conflicts. Rumble strips along the edge of the vehicular traveled way can be implemented with wider shoulders to reduce run-off-road collisions; however, a minimum clear path of four feet from the rumble strip to the outside edge of the paved shoulder, or five feet to the curb/guardrail, must be provided for bicycle use.

Bicycle Lanes

Bicycle lanes are proposed along CO 52 from WCR 7 to I-25 and through Dacono, Frederick, and Hudson. The posted speed limit along CO 52 east of I-25 is 40 miles per hour (mph). Speed limits through Dacono and Frederick range from 45 – 55 mph and Hudson is posted at 25 – 30 mph. The CDOT *Roadway Design Guide Rev. 2* recommends a minimum bike lane width of four feet on roadways with no curb and gutter and a minimum width of six feet where a two-foot gutter is present. It is noted that buffered bicycle lanes should be considered in place of standard bicycle lanes on roadways with high volumes and travel speeds such as CO 52 between WCR and I-25 and throughout Dacono and Frederick.

Shared Use Path

A shared use paths is a bikeway physically separated from motorized vehicular traffic by either an open space or a barrier. Shared use paths are proposed within Boulder County and Fort Lupton. The CDOT *Roadway Design Guide Rev. 2* recommends a minimum 10-foot width of pavement for a two-directional shared use path, which is met by both alternatives. The shared use path alternative in Fort Lupton would be located adjacent to CO 52 on the north side due to right-of-way constraints; therefore, additional consideration will be required on reducing conflicts at junctions.

Location-Specific Improvements

Several locations along the CO 52 corridor have been identified as locations that could benefit from the addition of bicycle and pedestrian improvements and these improvements have been categorized into five general improvement categories. These include bicycle crossing improvements, pedestrian crossing improvements, bicycle and pedestrian crossing improvements, railroad crossing improvements, and network connections. It is noted that the selection of specific pedestrian and bicycle crossing treatments should be selected based on location-specific characteristics and that these improvement categories were developed for general application and to identify the need for improvements, rather than to identify design-level treatments at each location.

Bicycle and Pedestrian Connectivity Memo

Refer to Appendix A and B for a table listing the location-specific improvements is attached and maps of recommended location-specific improvements.

Conclusions

Due to the expected user mix, land use mix, and development density along the CO 52 corridor, pedestrian and bicycle facility alternatives primarily include the provision of continuous, widened roadway shoulders for pedestrian and bicycle use. At high-activity areas such as Boulder County, Dacono, Frederick, and Hudson, bike lanes with sidewalks and shared use path facilities are proposed for bicycle and pedestrian use. Crossing improvements are recommended at several locations along the corridor, which were identified in this evaluation.

Appendix A

Location Specific Improvements List

#	City/County	Location	Control	Improvement Type	Improvement Description
1	Boulder County	CO 52 at LOBO Trail Undercrossing	Trail Undercrossing	Network Connection	<ul style="list-style-type: none"> • Connect to existing LOBO trail
2	Boulder County	CO 52/N 79th St	Signalized	Bicycle Crossing Improvements	<ul style="list-style-type: none"> • Provide bicycle crossing improvements east-west and north-south. • Evaluate bicycle detection for on-shoulder alternative and potential signal for multiuse path alternative. • Improve crossing for left-turning bicyclists • Include bike lanes through the intersection located left of right-turn lanes for on-shoulder alternative.
3	Boulder County	CO 52/N 95th St	Signalized	Bicycle Crossing Improvements	<ul style="list-style-type: none"> • Evaluate bicycle detection for on-shoulder alternative and potential signal for multiuse path alternative. • Improve crossing for left-turning bicyclists • Include bike lanes through the intersection located left of right-turn lanes for on-shoulder alternative.
4	Boulder County	CO 52/US 287	Existing - Signalized Proposed - Continuous Flow Intersection	Bicycle Crossing Improvements	<ul style="list-style-type: none"> • Evaluate bicycle detection for on-shoulder alternative and potential signal for multiuse path alternative. • Include bike lanes through the intersection located left of right-turn lanes for on-shoulder alternative.
5	Boulder County	CO 52 at Boulder Creek	-	Network Connection	<ul style="list-style-type: none"> • Connect to planned trail along railroad
6	Boulder County	CO 52/E County Line Rd	Signalized	Bicycle Crossing Improvements	<ul style="list-style-type: none"> • Include bike lanes through the intersection located left of right-turn lanes for on-shoulder alternative.
7	Erie	CO 52 at Boulder and Weld County Ditch	-	Network Connection	<ul style="list-style-type: none"> • Connect to planned trail along Boulder and Weld County Ditch

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#	City/County	Location	Control	Improvement Type	Improvement Description
8	Erie	CO 52/CR 3	Minor Street Stop Controlled	Bicycle Crossing Improvements	<ul style="list-style-type: none"> • Include bike lanes through the intersection located left of right-turn lanes for on-shoulder alternative.
9	Erie	CO 52/CR 5	Minor Street Stop Controlled	Bicycle Crossing Improvements	<ul style="list-style-type: none"> • Include bike lanes through the intersection located left of right-turn lanes for on-shoulder alternative.
10	Erie	CO 52 east of CR 5	-	Network Connection	<ul style="list-style-type: none"> • Connect to planned trail connecting Sullivan Ditch and Cottonwood Extension Ditch
11	Erie	CO 52/Aggregate Blvd	Signalized	Bicycle Crossing Improvements	<ul style="list-style-type: none"> • Evaluate bicycle detection for on-shoulder alternative and potential signal for multiuse path alternative. • Include bike lanes through the intersection located left of right-turn lanes for on-shoulder alternative. • Improve bicycle connections to the north.
12	Frederick	CO 52 east of E I-25 Frontage Rd	-	Network Connection	<ul style="list-style-type: none"> • Connect to planned trail
13	Frederick	CO 52 at Sullivan Ditch immediately west of York St	-	Network Connection	<ul style="list-style-type: none"> • Connect to planned trail along Sullivan Ditch
14	Frederick	CO 52/York St - Silver Birch Blvd	Signalized	Bicycle and Pedestrian Crossing Improvements	<ul style="list-style-type: none"> • Evaluate bicycle detection for on-shoulder alternative. • Include bike lanes through the intersection located left of right-turn lanes for on-shoulder alternative or bring bikes to the intersection and have them cross with pedestrians. • Install turn islands and provide pedestrian accessibility improvements at intersection.
15	Frederick	CO 52/Flying Circle Blvd - William Bailey Ave	Signalized	Bicycle and Pedestrian Crossing Improvements	<ul style="list-style-type: none"> • Evaluate bicycle detection for on-shoulder alternative. • Include bike lanes through the intersection located left of right-turn lanes for on-shoulder alternative or bring bikes to the intersection and have them cross with pedestrians. • Provide pedestrian accessibility improvements

Bicycle and Pedestrian Connectivity Memo

#	City/County	Location	Control	Improvement Type	Improvement Description
16	Dacono	CO 52/Colorado Blvd	Signalized	Bicycle Crossing Improvements	<ul style="list-style-type: none"> Evaluate bicycle detection for on-shoulder alternative. Include bike lanes through the intersection located left of right-turn lanes for on-shoulder alternative or bring bikes to the intersection and have them cross with pedestrians. Consider tunnel or ped/bike bridge for Old Railroad Trail.
17	Frederick	CO 52/Glen Creighton Dr - Frederick way	Signalized	Bicycle and Pedestrian Crossing Improvements	<ul style="list-style-type: none"> Evaluate bicycle detection for on-shoulder alternative. Include bike lanes through the intersection located left of right-turn lanes for on-shoulder alternative or bring bikes to the intersection and have them cross with pedestrians. Future connection to proposed off-street paved trail to the north. Provide pedestrian accessibility improvements at intersection
18	Frederick	CO 52/CR 15-Ridgeway Blvd	Minor Street Stop Controlled	Bicycle and Pedestrian Crossing Improvements	<ul style="list-style-type: none"> Include bike lanes through the intersection located left of right-turn lanes for on-shoulder alternative Provide pedestrian accessibility improvements at intersection. Future connection to proposed off-street paved trail north. Install crossing visibility improvements.
19	Weld County	CO 52/CR 19	Minor Street Stop Controlled (Potential Future Signal)	Bicycle Crossing Improvements	<ul style="list-style-type: none"> Include bike lanes through the intersection located left of right-turn lanes for on-shoulder alternative
20	Weld County	CO 52 east of CR 19	-	Network Connection	<ul style="list-style-type: none"> Connect to planned trail

Bicycle and Pedestrian Connectivity Memo

#	City/ County	Location	Control	Improvement Type	Improvement Description
21	Ft. Lupton	CO 52/CR 23	Minor Street Stop Controlled	Bicycle Crossing Improvements	<ul style="list-style-type: none"> • Include bike lanes through the intersection located left of right-turn lanes for on-shoulder alternative
22	Ft. Lupton	CO 52/Pearson Park Driveway	Minor Street Stop Controlled	Pedestrian Crossing Improvements	<ul style="list-style-type: none"> • Provide pedestrian improvements dependent on development and transit station connection.
23	Ft. Lupton	CO 52/US 85	Interchange Overcrossing	Pedestrian Crossing Improvements	<ul style="list-style-type: none"> • Pedestrian underpass identified as part of the US 85 PEL
24	Ft. Lupton	CO 52/Grand Ave	Minor Street Stop Controlled	Bicycle and Pedestrian Crossing Improvements	<ul style="list-style-type: none"> • Multiuse path and pedestrian crossing improvements
25	Ft. Lupton	CO 52/Fulton Ave	Minor Street Stop Controlled	Bicycle and Pedestrian Crossing Improvements	<ul style="list-style-type: none"> • Multiuse path and pedestrian crossing improvements
26	Ft. Lupton	CO 52/McKinley Ave	Signalized	Bicycle Crossing Improvements	<ul style="list-style-type: none"> • Install multiuse path crossing improvements. • Consider a bicycle signal for the proposed multi use path on the north side
27	Ft. Lupton	CO 52/Park Ave	Minor Street Stop Controlled	Bicycle and Pedestrian Crossing Improvements	<ul style="list-style-type: none"> • Multiuse path and pedestrian crossing improvements
28	Ft. Lupton	CO 52/Denver Ave	Signalized	Bicycle Crossing Improvements	<ul style="list-style-type: none"> • Install multiuse path crossing improvements. • Consider a bicycle signal for the proposed multi use path on the north side
29	Ft. Lupton	CO 52/Union Pacific RR in Ft. Lupton	RR Crossing	Railroad Crossing Improvements	<ul style="list-style-type: none"> • Install crossing improvements at railraod tracks
30	Ft. Lupton	CO 52/Pacific Ave	Minor Street Stop Controlled	Bicycle and Pedestrian Crossing Improvements	<ul style="list-style-type: none"> • Connect the existing north-south trail with a crossing

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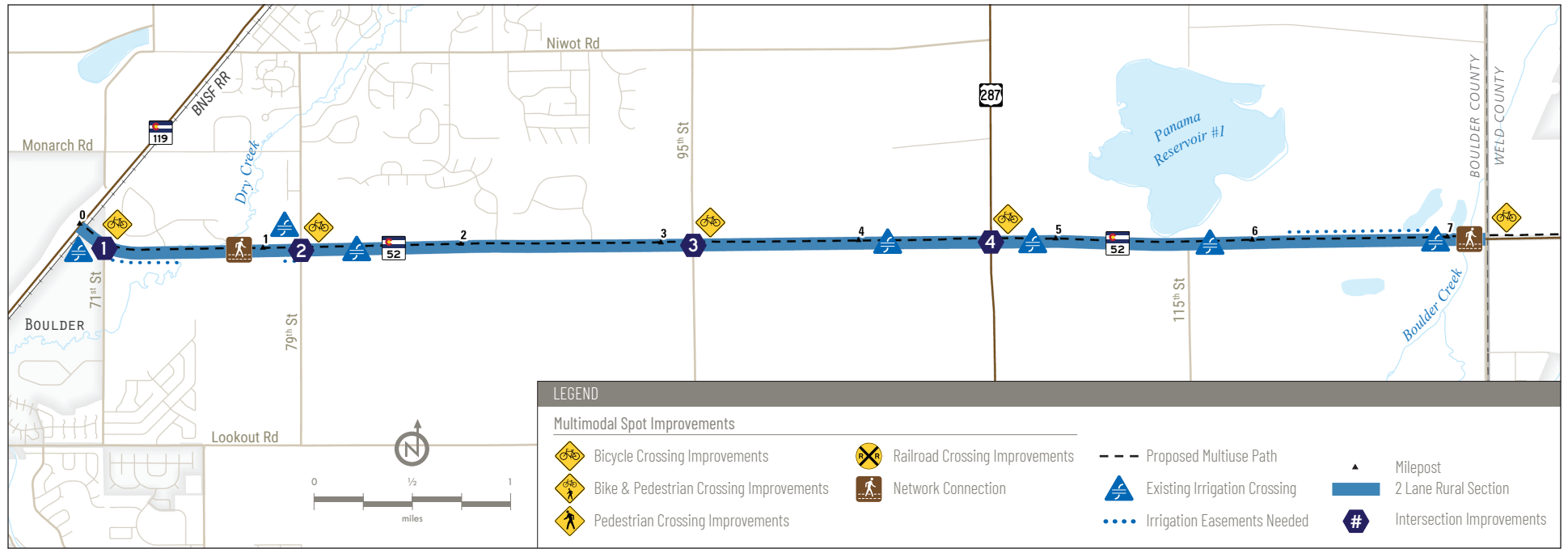
#	City/County	Location	Control	Improvement Type	Improvement Description
31	Ft. Lupton	CO 52/Harrison Ave	Minor Street Stop Controlled	Bicycle and Pedestrian Crossing Improvements	<ul style="list-style-type: none"> • Multiuse path and pedestrian crossing improvements
32	Ft. Lupton	CO 52/Rollie Ave	Signalized	Bicycle Crossing Improvements	<ul style="list-style-type: none"> • Install multiuse path crossing improvements. • Consider a bicycle signal for the proposed multi use path on the north side
33	Ft. Lupton	CO 52 east of Coyote Creek Dr	-	Network Connection	<ul style="list-style-type: none"> • Connect to planned trail
34	Ft. Lupton	CO 52/CR 31	Minor Street Stop Controlled	Bicycle Crossing Improvements	<ul style="list-style-type: none"> • Multiuse path begins to the west. Bicycles on shoulder to the east. • Provide bicycle crossing improvements for eastbound bicyclists to transition from multiuse path to shoulder.
35	Weld County	CO 52/CR 37	Minor Street Stop Controlled	Bicycle Crossing Improvements	<ul style="list-style-type: none"> • Include bike lanes through the intersection located left of right-turn lanes for on-shoulder alternative
36	Weld County	CO 52/CR 41	Minor Street Stop Controlled (Future Signal)	Bicycle Crossing Improvements	<ul style="list-style-type: none"> • Include bike lanes through the intersection located left of right-turn lanes for on-shoulder alternative. • Evaluate bicycle detection for on-shoulder alternative.
37	Hudson	CO 52/Hudson Dr	Minor Street Stop Controlled	Pedestrian Crossing Improvements	<ul style="list-style-type: none"> • Provide pedestrian crossing improvements
38	Hudson	CO 52/BNSF RR in Hudson	RR Crossing	Railroad Crossing Improvements	<ul style="list-style-type: none"> • Ensure bike facility crosses tracks at 60 - 90 degrees. • Include similar treatment for westbound bicyclists as the existing path on the south side for eastbound bicyclists. • Potential to utilize existing trail on the south side of 52 (would require wayfinding/guiding westbound bicyclists to use existing crossings at Beech St and Hudson Dr).

Bicycle and Pedestrian Connectivity Memo

#	City/County	Location	Control	Improvement Type	Improvement Description
39	Hudson	CO 52/Beech St	Minor Street Stop Controlled	Bicycle and Pedestrian Crossing Improvements	<ul style="list-style-type: none"> • Provide crossing improvements
40	Hudson	CO 52 at irrigation ditch east of Evergreen St	-	Network Connection	<ul style="list-style-type: none"> • Connect to planned trail along ditch
41	Weld County	CO at irrigation ditch east of CR 51	-	Network Connection	<ul style="list-style-type: none"> • Connect to planned trail along creek
42	Weld County	CO 52/CR 53	Minor Street Stop Controlled	Bicycle Crossing Improvements	<ul style="list-style-type: none"> • Include bike lanes through the intersection located left of right-turn lanes for on-shoulder alternative
43	Weld County	CO 52 east of CR 53	-	Network Connection	<ul style="list-style-type: none"> • Connect to planned trail
44	Weld County	CO 52/CR 59	Existing - Minor Street Stop Controlled Proposed - Roundabout	Bicycle Crossing Improvements	<ul style="list-style-type: none"> • Install bicycle crossing treatments for left-turns onto/off of CO 52
45	Weld County	CO 52/SH 79	Minor Street Stop Controlled	Pedestrian Crossing Improvements	<ul style="list-style-type: none"> • Provide pedestrian accessibility improvements

Appendix B

Preferred Intersection Improvements



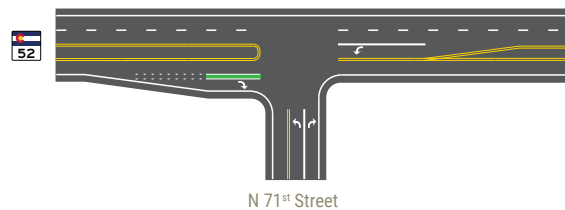
LEGEND			
Multimodal Spot Improvements			
	Bicycle Crossing Improvements		Railroad Crossing Improvements
	Bike & Pedestrian Crossing Improvements		Network Connection
	Pedestrian Crossing Improvements		Proposed Multiuse Path
			Existing Irrigation Crossing
			Irrigation Easements Needed
			Milepost
			2 Lane Rural Section
			Intersection Improvements

1 N 71st Street:

Existing project to realign 71st to right-angle and add northbound right-turn lane. Signalize intersection when warrants are met.

Pedestrian/Bicycle Improvements:

- Include bike lanes through the intersection located left of right-turn lanes for on-shoulder alternative.



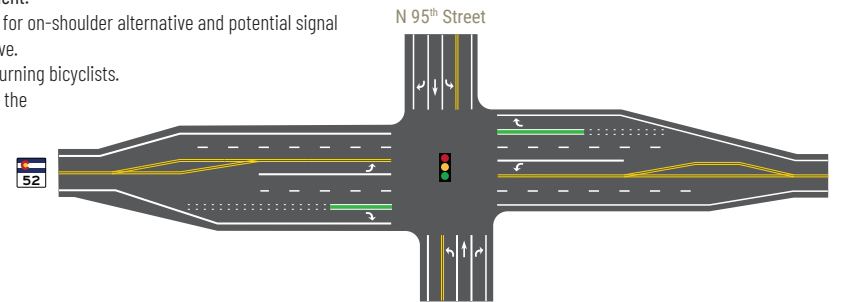
3 N 95th Street:

Assuming 2-Lane Cross Section:

- Add second through lane in each direction on CO 52 (secondary through lanes terminate).

Pedestrian/Bicycle Improvement:

- Evaluate bicycle detection for on-shoulder alternative and potential signal for multiuse path alternative.
- Improve crossing for left-turning bicyclists.
- Include bike lanes through the intersection located left of right-turn lanes for on-shoulder alternative.



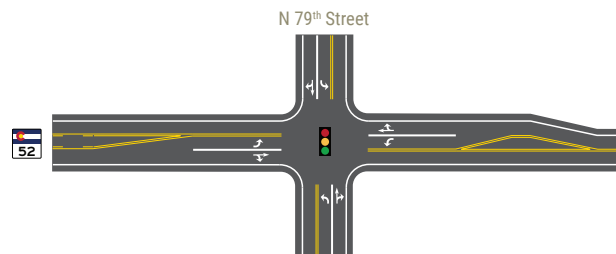
2 N 79th Street:

Currently signalized.

No required capacity improvements; however, consider adding right-turn lanes as conditions warrant.

Pedestrian/Bicycle Improvement:

- Provide bicycle crossing improvements east-west and north-south.
- Evaluate bicycle detection for on-shoulder alternative and potential signal for multiuse path alternative.
- Improve crossing for left-turning bicyclists
- Include bike lanes through the intersection located left of right-turn lanes for on-shoulder alternative

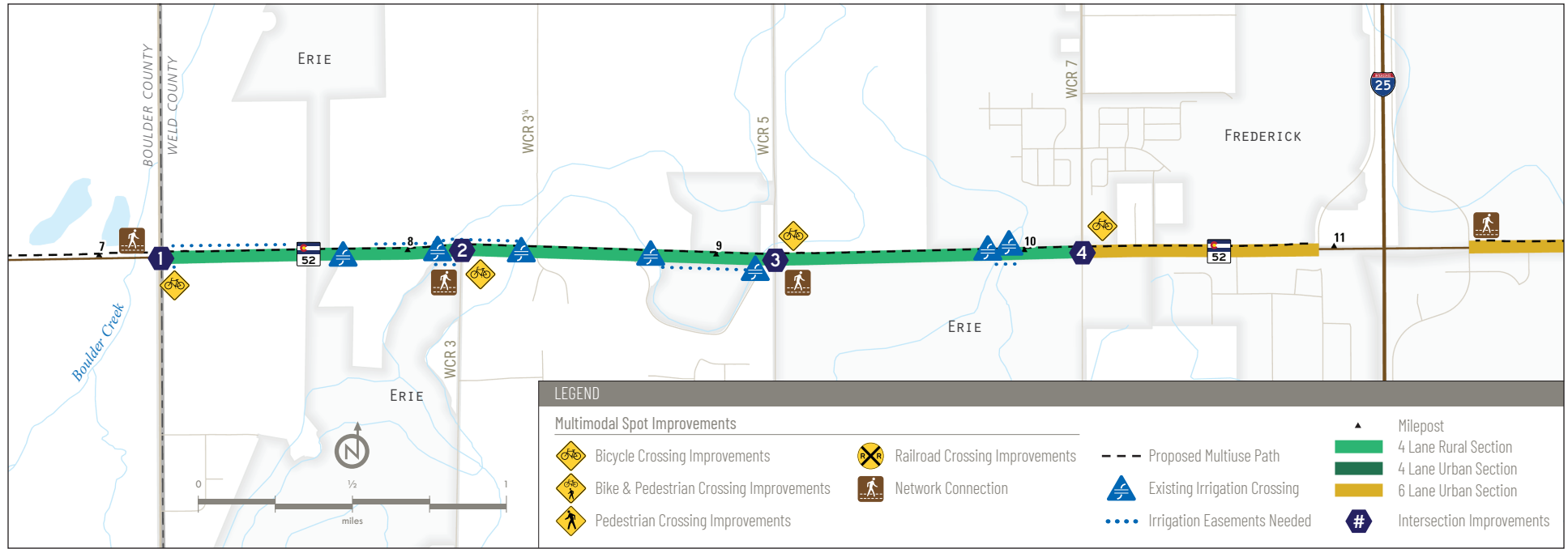


4 US Highway 287:

Base Condition (Traditional Intersection Improvements): Dual left-turns on all approaches, two-through lanes, channelized right-turn lanes. (CO 52 secondary through lanes terminate in 2-Lane alternatives).
 - Significant queuing, in particular due to heavy southbound left-turn movements (550 - 800 vph), result in bottleneck/gridlock conditions.
 - These conditions could be mitigated through implementation of non-traditional intersection such as quadrant road or CFI.

Pedestrian/Bicycle Improvements:

- Evaluate bicycle detection for on-shoulder alternative and potential signal for multiuse path alternative.
- Include bike lanes through the intersection located left of right-turn lanes for on-shoulder alternative.

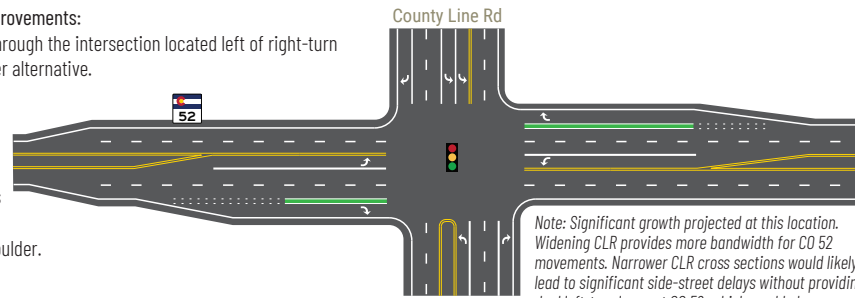


1 County Line Road:

- Currently signalized
 Assuming 4-Lane cross section (2-Lanes west of intersection):
- Add second through lane in each direction on CO 52 (secondary lanes to terminate on 2-Lane approaches)
 - Maintain separate left and right-turn lanes.
 - Add dual southbound left-turns, maintain single northbound left-turn lane, add right-turn lanes.
 - Add second through lane in each direction on CLR (secondary lanes terminate beyond intersection).

Pedestrian/Bicycle Improvements:

- Include bike lanes through the intersection located left of right-turn lanes for on-shoulder alternative.
- For multiuse path alternative, provide bicycle crossing improvements for eastbound bicyclists to transition from multiuse path to shoulder.



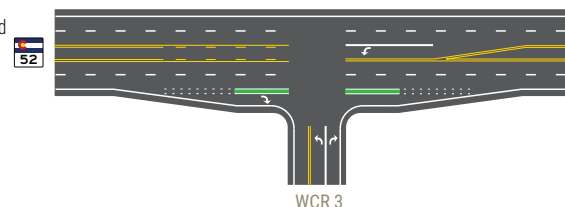
2 Weld County Road 3

- Expected to remain unsignalized.
- Add eastbound right-turn decel, and accel lane on eastbound CO 52 for northbound to eastbound right-turn movement.
 - Add westbound left-turn lane.

Note: Lane recommendations per CDOT access code.

Pedestrian/Bicycle Improvement:

- Include bike lanes through the intersection located left of right-turn lanes for on-shoulder alternative.

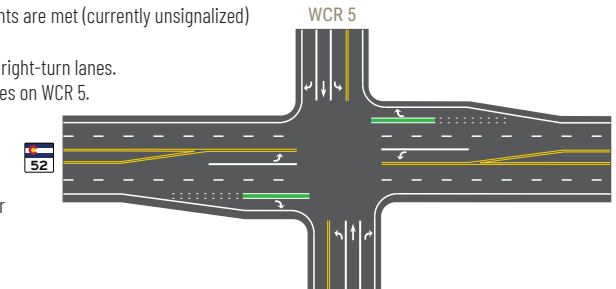


3 Weld County Road 5

- Signalize intersection when warrants are met (currently unsignalized)
 Assuming 4-Lane Cross Section:
- Add eastbound and westbound right-turn lanes.
 - Add left-turn and right-turn lanes on WCR 5.

Pedestrian/Bicycle Improvement:

- Include bike lanes through the intersection located left of right-turn lanes for on-shoulder alternative.

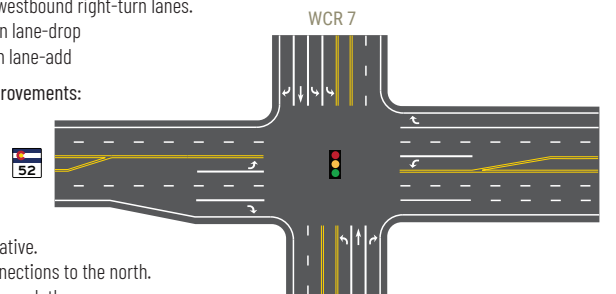


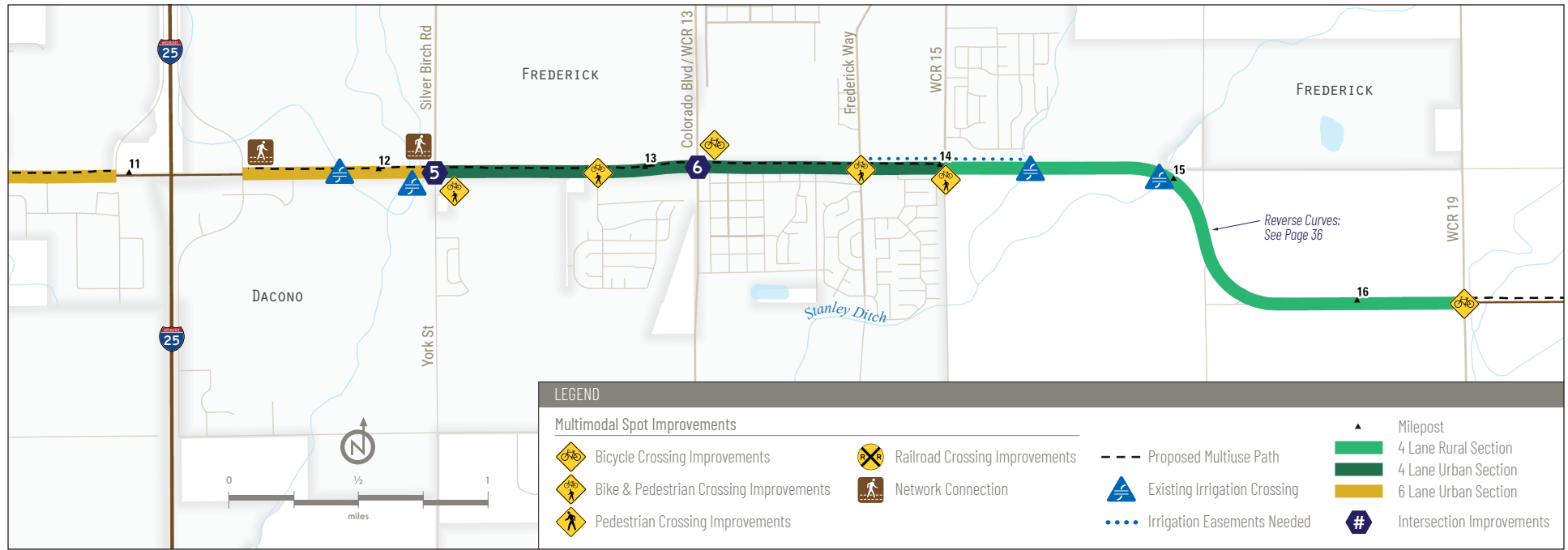
4 Weld County Road 7:

- Currently signalized.
- Add eastbound and westbound right-turn lanes.
 - Westbound right-turn lane-drop
 - Eastbound right-turn lane-add

Pedestrian/Bicycle Improvements:

- Evaluate bicycle detection for on-shoulder alternative and potential signal for multiuse path alternative.
- Improve bicycle connections to the north.
- Include bike lanes through the intersection located left of right-turn lanes for on-shoulder alternative.

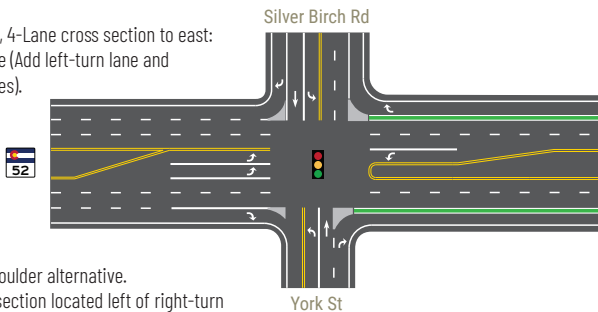




5 Silver Birch Road / York St:

Currently signalized
 Assuming 6-Lane cross section to west, 4-Lane cross section to east:

- Provide eastbound dual left-turn lane (Add left-turn lane and northbound receiving lane (terminates)).
- Add northbound right-turn lane.
- Eastbound right-turn lane-drop.
- Westbound right-turn lane-add.
- Expand northbound and southbound storage to accommodate queues.



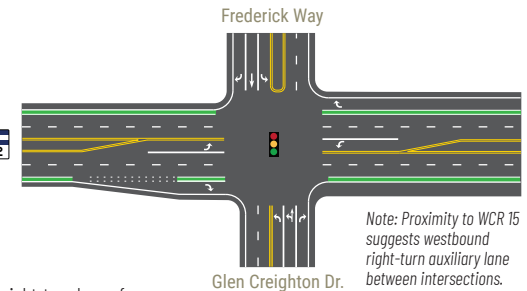
Pedestrian/Bicycle Improvement(s)

- Evaluate bicycle detection for on-shoulder alternative.
- Include bike lanes through the intersection located left of right-turn lanes for on-shoulder alternative or bring bikes to the intersection and have them cross with pedestrians.
- Install turn islands and provide pedestrian accessibility improvements at intersection.

7 Glen Creighton Dr. / Frederick Way:

Currently signalized
 Assuming 4-Lane Cross Section:

- Add southbound left-turn lane.
- Extend northbound storage and modify lane designations for one left-turn, shared left-turn/thru lane, and right-turn lane (maintains split phasing).
- Maintain eastbound and westbound right-turn lanes.



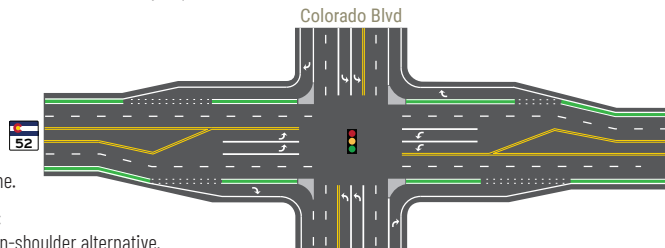
Pedestrian/Bicycle Improvement(s)

- Evaluate bicycle detection for on-shoulder alternative.
- Include bike lanes through the intersection located left of right-turn lanes for on-shoulder alternative or bring bikes to the intersection and have them cross with pedestrians.
- Future connection to proposed off-street paved trail to the north.
- Provide pedestrian accessibility improvements at intersection

6 Colorado Boulevard / WCR 13:

Currently signalized
 Assuming 4-Lane Cross Section:

- All approaches to have dual left-turn lanes, two thru lanes, and a channelized right-turn lane.



Pedestrian/Bicycle Improvements:

- Evaluate bicycle detection for on-shoulder alternative.
- Include bike lanes through the intersection located left of right-turn lanes for on-shoulder alternative or bring bikes to the intersection and have them cross with pedestrians.
- Consider tunnel or ped/bike bridge for Old Railroad Trail.

8 Weld County Road 15:

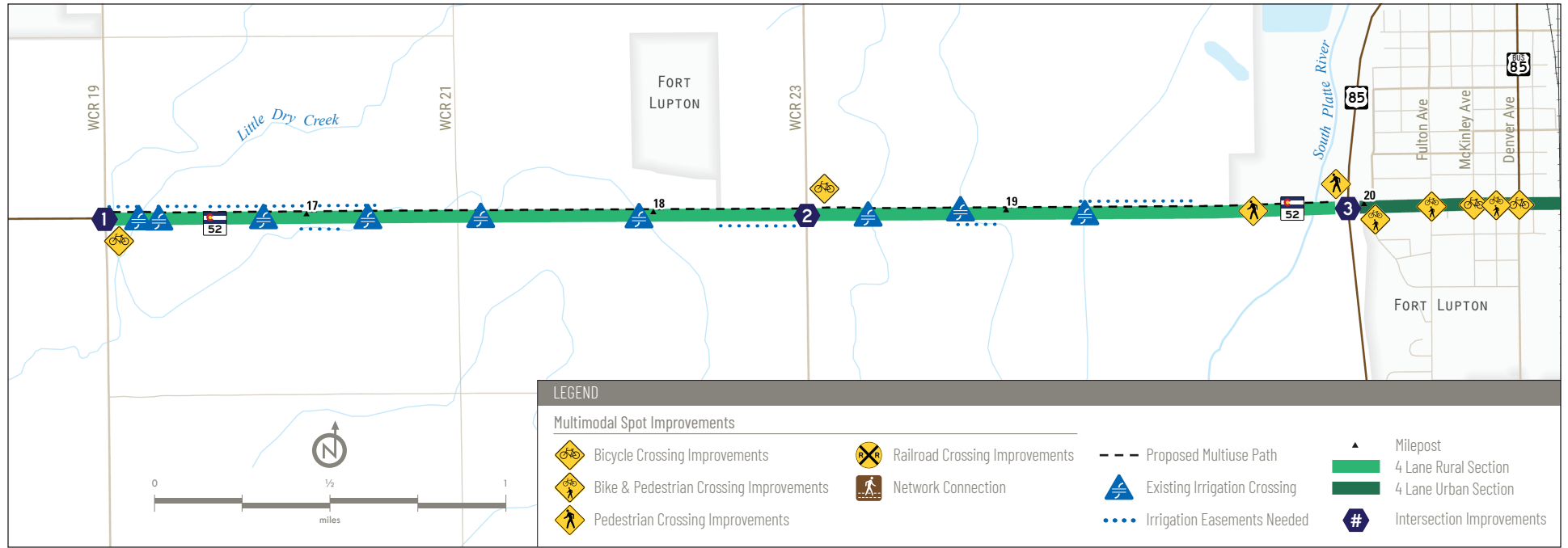
Signalize intersection when warrants are met (currently unsignalized).
 Assuming 4-Lane Cross Section:

- Secondary through lane terminates east of intersection in 2-Lane alternatives
- Add northbound left-turn lane
- Add southbound left-turn and right-turn lanes
- Maintain westbound right-turn lane



Pedestrian/Bicycle Improvements:

- Provide pedestrian accessibility improvements at intersection.
- Future connection to proposed off-street paved trail north.
- Install crossing visibility improvements.
- Include bike lanes through the intersection located left of -turn lanes for on-shoulder alternative
- Provide pedestrian accessibility improvements at intersection



1 Weld County Road 19:

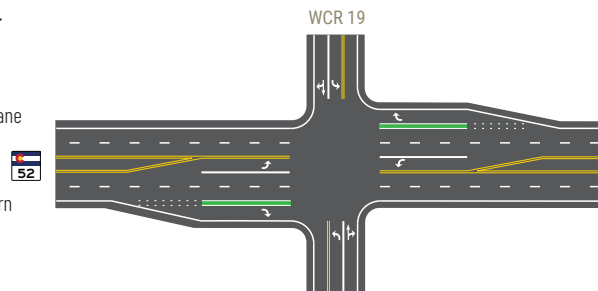
Signalize intersection when warrants are met (currently unsignalized).
 Assuming 2-Lane Cross Section:

- Add eastbound and westbound left-turn and right-turn lanes
- Add northbound and southbound left-turn lane

Note: High volume for 2-Lane facility. Consider adding auxiliary thru lane at intersection in 2-Lane alternative.

Pedestrian/Bicycle Improvements:

- Include bike lanes through the intersection located left of right-turn lanes for on-shoulder alternative.



2 Weld County Road 23:

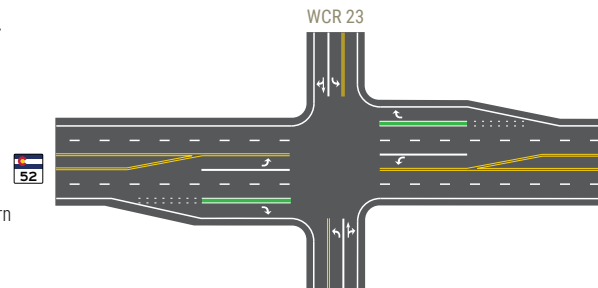
Signalize intersection when warrants are met (currently unsignalized).
 Assuming 2-Lane Cross Section:

- Add eastbound and westbound left-turn and right-turn lanes
- Add northbound and southbound left-turn lane

Note: High volume for 2-Lane facility. Consider adding auxiliary thru lane at intersection in 2-Lane alternative.

Pedestrian/Bicycle Improvement:

- Include bike lanes through the intersection located left of right-turn lanes for on-shoulder alternative

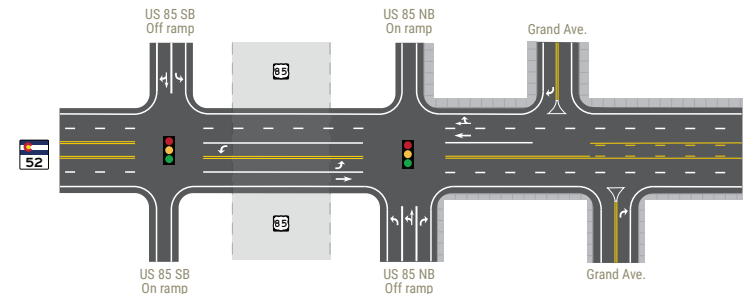


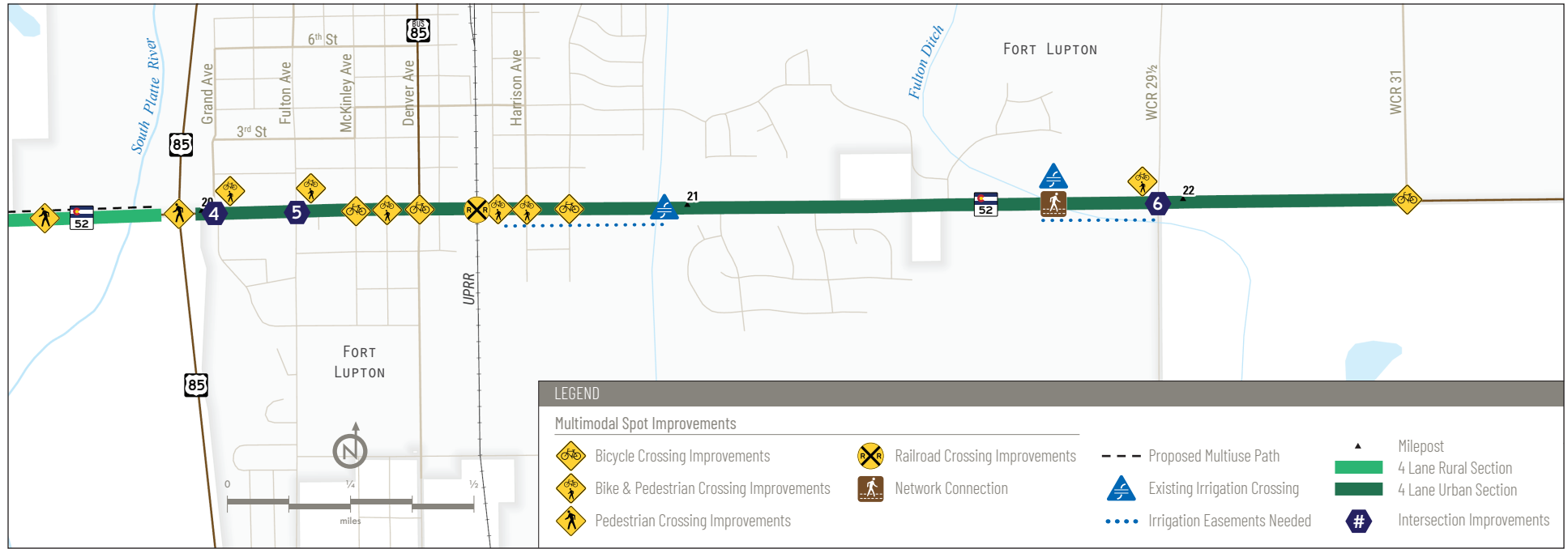
3 US 85 Interchange:

Currently Signalized

Assuming 2-Lane Cross Section:

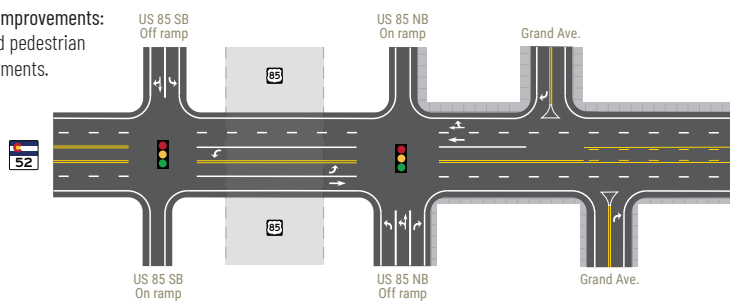
- Widen bridge west of interchange to 4-Lanes to extend eastbound storage and westbound auxiliary lane.
- Add westbound thru lane under bridge to allow for northbound dual-left-turn lanes.
- Consider adding northbound right-turn lane on ramp.
- Extend westbound left-turn lane storage through Grand Avenue intersection (Grand Avenue to RIRO).





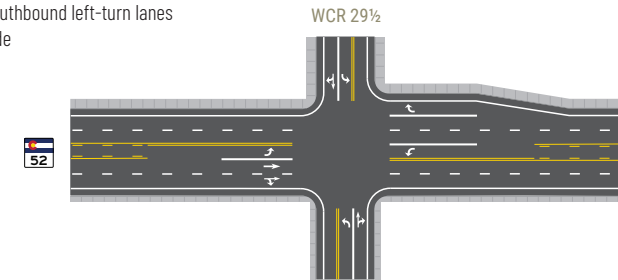
4 Grand Avenue:
 Currently unsignalized, offset intersection within 250-ft of US 85 ramps.
 - Restrict access to 3/4 movement (not recommended) or RIRO (recommended)
 - Accommodating left-turns from sidestreet would require signal to be combined with US 85 signal due to proximity (not recommended).
 Note: Assumed Right-in, Right-out in models due to excessive delay for side-street movements. Traffic rerouted to Fulton Avenue.

Pedestrian/Bicycle Improvements:
 - Multiuse path and pedestrian crossing improvements.



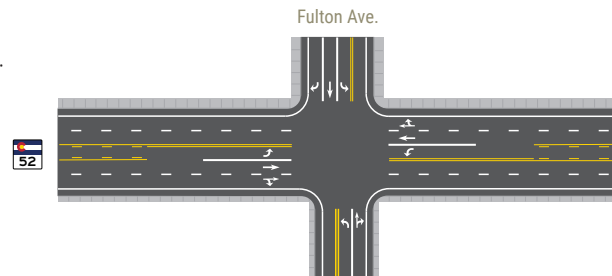
6 Weld County Road 29 1/2:
 Currently Unsignalized
 Assuming 2-Lane Cross Section:
 - Add eastbound and westbound right-turn lanes
 - Extend eastbound and westbound left-turn lanes
 - Add northbound and southbound left-turn lanes
 Note: Per CDOT Access Code

Pedestrian/Bicycle Improvements:
 - Multiuse path and pedestrian crossing improvements.



5 Fulton Avenue:
 Signalize intersections when warrants are met (currently unsignalized).
 Assuming 2-Lane or 4-Lane Cross Section:
 - Provide left-turn lanes from Fulton Street and a southbound right-turn lane to accommodate redirected traffic.
 Note: Location has the potential to meet signal warrants with or without traffic redirected from Grand Avenue.

Pedestrian/Bicycle Improvement:
 - Multiuse path and pedestrian crossing improvements.

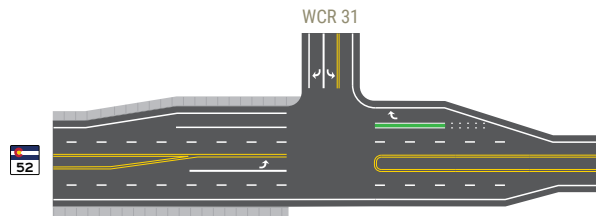




1 Weld County Road 31:

Currently Unsignalized
 Assuming 2-Lane Cross Section:
 - Add southbound right-turn lane
 - Extend lanes to Access Code standards

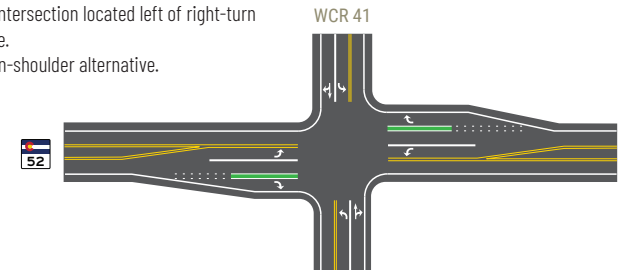
Pedestrian/Bicycle Improvements:
 - Multiuse path begins to the west.
 Bicycles on shoulder to the east.
 - Provide bicycle crossing improvements for eastbound bicyclists to transition from multiuse path to shoulder.



3 Weld County Road 41:

Being Signalized

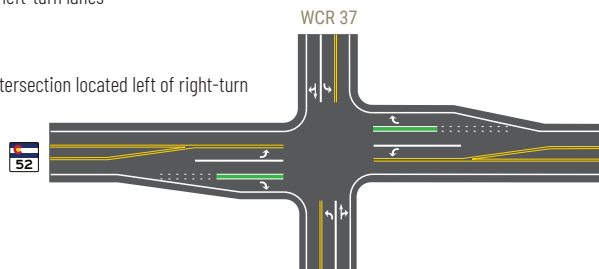
Pedestrian/Bicycle Improvement:
 - Include bike lanes through the intersection located left of right-turn lanes for on-shoulder alternative.
 - Evaluate bicycle detection for on-shoulder alternative.



2 Weld County Road 37:

Currently Unsignalized
 Assuming 2-Lane Cross Section:
 - Add eastbound and westbound left-turn and right-turn lanes
 - Add northbound and southbound left-turn lanes
 Note: Per CDOT Access Code.

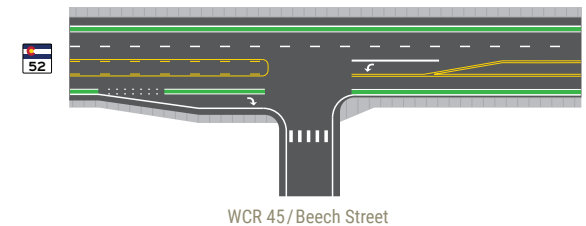
Pedestrian/Bicycle Improvement:
 - Include bike lanes through the intersection located left of right-turn lanes for on-shoulder alternative

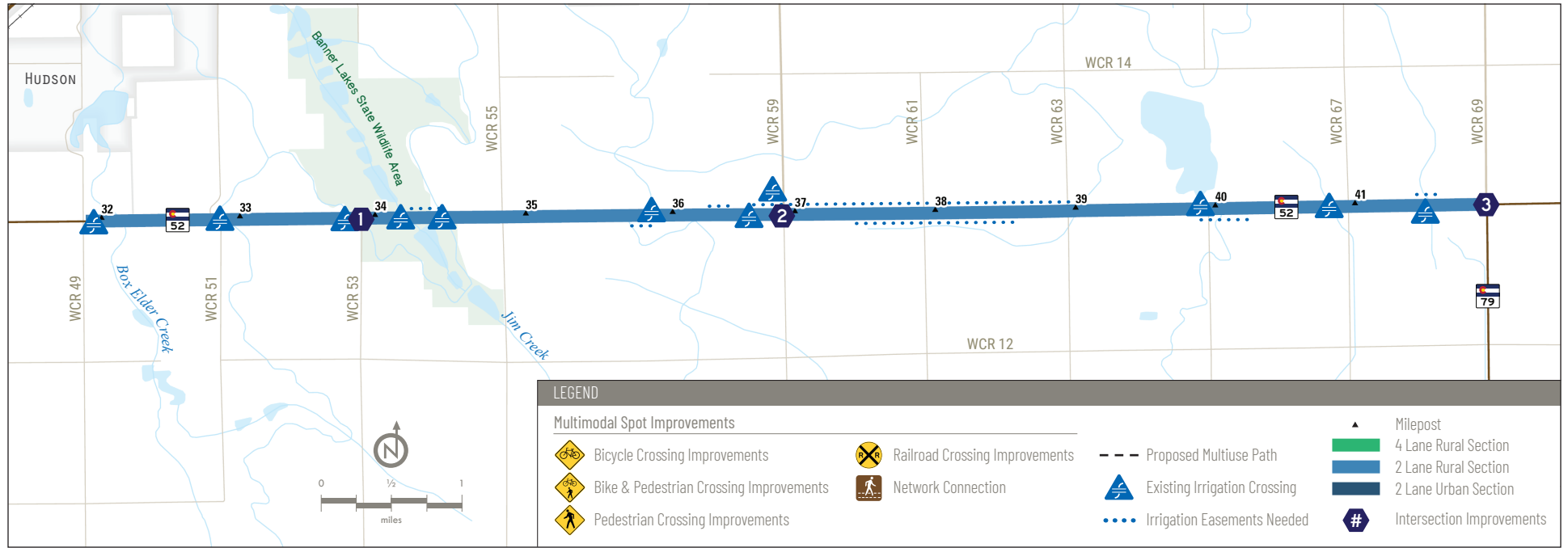


4 Weld County Road 45 / Beech Street:

Currently Unsignalized
 Assuming 2-Lane Cross Section:
 - Add eastbound right-turn
 - Add westbound left-turn
 Note: Per CDOT Access Code

Pedestrian/Bicycle Improvement:
 - Provide crossing improvements.

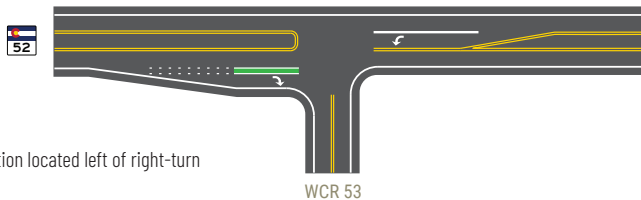




1 Weld County Road 53:

Currently Unsignalized
 Assuming 2-Lane Cross Section:
 - Add eastbound right-turn
 - Add westbound left-turn
 Note: Per CDOT Access Code

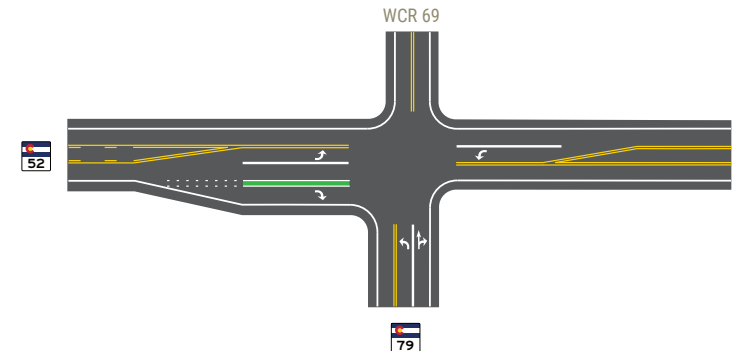
Pedestrian/Bicycle Improvements:
 - Include bike lanes through the intersection located left of right-turn lanes for on-shoulder alternative



3 Weld County Road 69 / CO 79:

Currently Unsignalized
 Assuming 2-Lane Cross Section:
 - Add lanes per access code pending evaluation of ROW impacts.
 Note: No operational deficiencies noted.

Pedestrian/Bicycle Improvement:
 - Provide pedestrian accessibility improvements



2 Weld County Road 59:

Base Condition: Stop Controlled with eastbound shared left-turn/thru lane and right-turn lane, westbound left-turn lane, westbound accel lane for northbound left-turn movement.

Signalization: Does not meet warrants (not recommended)

Unsignalized: Consideration for northbound and southbound left-turn lane could negatively impact sight distance or create conflict with turning trucks.

Roundabout: Single lane high-speed roundabout would allow for significant safety improvements while allowing consistent operation throughout the day.

Visibility Improvements: Consider overhead span wire warning signal (mainline yellow, sidestreet red) or other intersection visibility improvements.

Pedestrian/Bicycle Improvement:
 - Install bicycle crossing treatments for left-turns onto/off of CO 52

*See page 37 for WCR 59 Intersection Diagram

Appendix F-14

Emerging Technology Opportunities Memo



Project: CO 52 Planning and Environmental Linkages Study
To: Colorado Department of Transportation, Region 4
From: CO 52 PEL/ACP Project Team
Date: 8/4/2021
Subject: Emerging Technology Opportunities

Introduction

With increasing traffic volumes and congestion, the traditional capacity expansion solution to congestion management has proven that it cannot be the only solution. Typical physical transportation improvements, such as the addition of new travel lanes are expensive, require extended periods of time for construction and the construction of those improvements is very disruptive to the travelling public, typically increasing travel times, delay, and vehicle crashes. Effectively utilizing technology in conjunction with roadway capacity expansion and intersection improvements provides an opportunity to improve system wide safety, reliability, and efficiency beyond capacity expansions alone. For example, the installation of Active Traffic Management Systems (ATMS), which uses dynamic message signs over each lane of traffic to close lanes that are obstructed due to crashes and then direct vehicles to adjacent lanes to move traffic more efficiently past the crash, has shown to reduce delays and secondary traffic crashes. Other types of technology, such as fiber optic cable for fast and reliable communications, detection devices to identify and manage vehicles, pedestrians, and bicycles, and traffic controllers that communication directly with vehicles and other roadside units are increasingly being installed on roadway projects to improve operations and future proof the transportation system. The addition of these types of current transportation technology solutions, while also considering emerging and future technology, to the CO 52 corridor will help to improve the operations and safety of the corridor now and in the future. In order to take advantage of these technological solutions, the underlying infrastructure (power, communications, and sufficient publicly owned space adjacent to the roadway) utilized to operate and communicate with this technology should be acquired and installed under all build scenarios

Corridor Characteristics

The CO 52 corridor is made of up five segments with the following characteristics:

Segment 1 – CO 52 from SH 119 to County Line Road – The section of CO 52 intersects with SH 119 on the west and extends east to the Boulder County/Weld County border at Colorado Boulevard. It is characterized by high average daily traffic (ADT) volumes (between 12,400 ADT to 19,000 ADT); a high volume of congested intersections; and a high volume of crashes with three fatal crashes (over a five-year period.). In addition, this section has a regional bus route that runs between I-25 and US 287 and intersects with bus service along SH 119.

Segment 2 – CO 52 from County Line Road to Weld County Road 19 – The section of CO 52 intersects with I-25 and is characterized by high volumes (between 11,800 ADT to 25,000 ADT); minimal congestion with congestion occurring at I-25; and a high number of fatal crashes with five fatal crashes (over a five year period.);

Segment 3 - CO 52 from Weld County Road 19 to Weld County Road 31- The section of CO 52 intersects with US 85 and is characterized by consistent volumes (between 11,500 ADT to 11,600 ADT); minimal congestion with congestion occurring at US 85; and a minor volume of crashes with crashes spiking at the US 85 interchange (over a five year period.)

Segment 4 - CO 52 from Weld County Road 31 to Weld County Road 49 - The section of CO 52 intersects with I-76 and is characterized by medium to low volumes (between 10,300 ADT to 4,000 ADT); minimal congestion, and a minor volume of crashes with three fatal crashes (over a five year period.)

Segment 5 - CO 52 from Weld County Road 49 to CO 79 - The section of CO 52 is characterized by the low traffic volumes (between 2,000 ADT to 3,100 ADT); minimal congestion, and a minor volume of crashes (over a five year period.)

Technology Strategies



The emerging technology field is an ever expanding and changing landscape. Depending upon the transportation needs at an intersection or corridor, there is likely an emerging technology solution that can help improve the safety, operations, and reliability of the roadway system. A combination of both intersection-based technology solutions and corridor-based technology solutions considered will provide benefits to the safety and operations of the CO 52 corridor. Intersection-based technology solutions are geared to improving the safety and operations for vehicles, pedestrian, and bicycles at intersections. These solutions range from adding additional devices at intersections to detect vehicles, pedestrian, and bicycles to the addition of traffic controllers that can directly communicate with vehicles approaching the intersection to alert them to changing roadway conditions or potential conflicts to avoid crashes. These intersection-based technology solutions can operate independently to improve the safety and operations at the intersection or if interconnected with other intersections can improve safety and operations corridor wide.

Corridor based technology solutions can be deployed along a corridor, in spot locations along the corridor, or in conjunction with signalized intersection, to improve the safety and operations along the entire corridor. These solutions range from installing speed feedback signs to reduce crashes to the addition of smart street lighting across the corridor that can modify light levels to alert travelers to differing roadway conditions as needed.

The following summarizes current, emerging, and future infrastructure that may provide safety and operational benefits through technology along the CO 52 corridor. Many of these technology improvements can be implemented immediately, some provide the required infrastructure to enable these uses of existing or future technology applications. As such, for the CO 52 corridor there are three separate and distinct categories for emerging technology solutions.


Enabling for Future and Existing Emerging Technology – This includes the infrastructure that must be present to allow for the use and operations of current, emerging, and future technology. These include items like fiber optic cable for fast and reliable communications, conduit to safely and securely house the fiber optic cable, and Right of Way (ROW) adjacent to the roadway to place the fiber optic cable, conduit, and other supporting infrastructure. This is the infrastructure that must be available along the corridor and at

intersections to facilitate the adoption and use of current and emerging technological solutions in the future. This infrastructure should be acquired and installed under all build scenarios.

- **Conduits and Pull Boxes** – PVC conduit is used to provide positive protection for fiber optic cable or electrical cables that are buried within the ROW of the roadway. Pull boxes are used to provide convenient access to the conduits when connections to equipment are required and to allow for shorter conduits runs when adding fiber optic cable through empty conduits. Adding in sufficient conduit for new fiber optic and electrical cable and additional spares for future communications needs will allow for the efficient adoption of current, emerging, or future technology. Placing additional pull boxes approximately every 1500 feet, and at anticipated locations that will have additional technology, such as current and future signalized intersections, will also help with the efficient adoption of current, emerging, or future technology.
 - Applicable Segments: Segments 1-5
 - Applicable Intersections: All intersections
- 
- **Fiber Optic Cable** – Fiber optic cable provides the communications backbone to efficiently transmit large amounts of data between traffic devices and /or a traffic management center. The addition of fiber optic cables along the corridor will help to facilitate the use of current, emerging, or future technology. New fiber optic cables could be used to connect to other existing communication system or ITS equipment currently in use along the corridor.
 - Applicable Segments: Segments 1-5
 - Applicable Intersections: All intersections
- 
- **ROW considerations** – Current, future, and emerging technology infrastructure will require poles, cabinets and other physical infrastructure that will need to be located in the ROW. It would be greatly beneficial to plan to accommodate this required infrastructure in the ROW now to facilitate future technology implementations. Determining current ROW needs and identify future ROW needs will help to ensure that there is sufficient room for the addition of current, emerging, or future technology.
 - Applicable Segments: Segments 1-5
 - Applicable Intersections: All intersections

Current Emerging Technology Opportunities – This includes infrastructure that is currently available and has the potential to make an immediate impact on the safety and operations. Many of these technologies have been installed and are currently operational in Colorado, while others have been installed and tested in other parts of the country and are rapidly gain traction as a proven traffic technology. These include items such as Blank Out Signs, to alert drivers to crossing pedestrian or bicyclists and temporarily restrict that vehicle movement; Adaptive Signal Control, to allow for better traffic flow based upon current traffic volumes; and Active Traffic Management Systems (ATMS), to better alert drivers to traffic crashes upstream and to efficiently open and close those affected lanes.

- Blank Out Signs at Intersection for Pedestrian Safety - Blank out signs restrict right or left turns at signalized intersections when pedestrians or bicycles are crossing and can improve awareness and safety for pedestrians and bicyclists. The blank out can be activated by means such as a pedestrian push buttons or passively through infrared, video, radar, or LiDAR, to detect the presence of crossing pedestrians and bicyclists. The detection data, whether active or passive, can be shared and utilized by CV's in the future to convey the presence of a pedestrian or bicyclist to oncoming vehicles.


 - Applicable Intersections: All currently signalized intersections and future signalized intersections within Segments 1, 2 and 3. With the addition of new pedestrian and bicycle facilities the blank out signs will help to increase the visibility of pedestrian and bicyclist at these critical locations.


- Adaptive Signal Control - Adaptive traffic signals can improve the flow of traffic along certain corridors. The traffic signal controllers dynamically adjust signal timing, coordination, and progression of vehicles based on the actual traffic demand along the corridor. Modifying these factors can improve the flow of traffic, improve travel speeds, and improve safety along the corridor. CDOT Region 4 assessed CO 52 and identified it as a corridor that could benefit from adaptive traffic signal control.

 - Applicable Intersections: All Signalized Intersection along the corridor to dynamically improve the overall flow of traffic along the corridor.


- Commercial Vehicle Signal Priority - Commercial Vehicle Signal Priority utilizes advance detection at signalized intersections to determine the distance and travel speed of commercial vehicle and extend the length of the green time to allow the vehicle to safely pass through the intersection without having to stop. Not only does the extended green time help reduce the start-up loss time associated with large commercial vehicles, but the extension also helps to reduce and prevent crashes including broadside and rear end crashes, which are typically severe at high speeds. With the high volume of commercial vehicles on CO 52, the entire corridor could benefit from the use of Commercial Vehicle Signal Priority. As CV capabilities become increasingly present in commercial vehicles, the CV applications can be integrated into the system to gain additional benefits.

 - Applicable Intersections: All Signalized Intersection along the corridor to dynamically reduce unnecessary stops for commercial vehicles, improve the overall flow along the corridor and reduce the potential for broadside and rear end accidents at signalized intersections.

- Passive Detection at Signals for Pedestrians and Bicycles – The addition of passive detection, such as infrared, video, radar, or LiDAR, to detect the presence of crossing pedestrians and bicyclists at intersection, mid-block crossings or shared use paths. This passive detection data can be used to activate pedestrian crossing signals at intersections, and flashers at mid-block crossings or shared use paths in advance of the intersection or crossing greatly improving safety for those users. It can also be used to extend crossing times to



accommodate pedestrians, such as the young or elderly who may require more time to safely cross the road.

- Applicable Intersections: All currently signalized intersections and future signalized intersections within Segments 1, 2 and 3 to better detect pedestrians and bicyclists at intersections, mid-block crossings and shared use paths.
- Adaptive curve warning signs, speed feedback signs and radar detection - Adaptive curve warning signs provide positive feedback to drivers prior to and through a curve that the roadway condition is non-typical and the flashers are only active when a motorist is approaching the curve helping to increase the awareness. Pairing these signs and flashers with a speed feedback sign, alerting drivers to the current speed, will help to reduce excessive speeding through the curves and vehicles that depart the roadway as a result of these excessive speeds.
 
 - Applicable Segments: Segment 2 to improve the visibility of the reverse curves between Ridgeway Boulevard and Weld County Road 19
- Queue detection/warning – Queue detection, through passive detection and warning through dynamic message signs can help alert drivers to upstream congestion reducing the likelihood of a rear end crash. By providing this information to drivers prior to the congested section of roadway will benefit the safety of all travelers through reduced crashes.
 - Applicable Intersections – Those intersections with current congestion including:
 - CO 52 at SH 119
 - CO 52 at US 287
 - CO 52 at County Line Road
 - CO 52 at I-25
 - CO 52 at US 85
- Transit signal priority – Transit signal priority at signalized intersections is utilized to detect transit vehicles to allow those vehicles to receive a green signal prior to the other non-transit vehicles receive the green signal. This additional time allows the transit vehicles to move more efficiently between stops, enter traffic more easily, get up to operating speed quicker and improves the overall efficiency of transit operations.
 - Applicable Intersections:
 - CO 52 at CO 119 – To accommodate and enhance the current bus service along CO 119
 - CO 52 at US 287 - - To accommodate and enhance the current bus service along US 287
- Adaptive/Smart Street Lighting – The addition of a communications capable module on top of a streetlight allows LED street light to communicate with a central server and become “smart” and adapt to varying conditions. Adaptive Street Lights can improve safety and sustainability through energy and dark sky savings. Light output can be varied to change brightness based on the presence or absence of vehicles, pedestrians, or bicycles. The Adaptive Street Light can also increase the communications network in a very efficient manner to provide additional communications where none previously existed. This

additional communication capability can help improve access to Internet of Things devices such as CCTV cameras, detectors, on-street parking systems and public Wi-Fi. With their communications capabilities, Adaptive Street Light will help provide much needed communications infrastructure for CAV's.

Applicable Segments: Segments 1, 2 and 3

Preparing for Emerging Technology Opportunities – This includes infrastructure that will accommodate future technologies and systems that have the potential to positively impact the transportation system. As this new technology becomes available, it is anticipated it will be transformative. It is beneficial to include infrastructure that can accommodate this future technology when possible so that it is ready for the adoption of the technology. These include items such as Connected Vehicle (CV) capable traffic controller and Larger Signal Cabinets to accommodate additional hardware required to support new technologies.

- Larger Traffic Signal Cabinets – With new technology comes the need for additional space in a safe and secure enclosures to protect sensitive electronic equipment. At intersections with traffic signals, the traffic signal cabinet can provide this safe and secure enclosure, however current traffic signal cabinets are sized to just accommodate the existing signal control equipment. As traffic signal equipment is upgraded, the size of the traffic signal cabinet should be upsized to provide the opportunity to accommodate additional equipment required to support emerging and future technology.
 - Applicable Intersections: All Signalized Intersection along the corridor
- Connected Vehicle (CV) capable enabled traffic controller – To take full advantage of the safety and operational improvements associated with CV's at intersections, the traffic signal controller will need to be upgraded to talk to and receive information from CV's and other connected devices such as detectors and handheld devices. While CV technology is still in the early adoption stage, the technology will soon have wider adoption and those that are preprepared can quickly experience the benefits. As such, when current traffic controllers reach their obsolescence, upgrading those traffic controllers to controllers that have the capability to communicate with nearby vehicles will better prepare the corridor for the benefit of CVs.
 - Applicable Intersections: All Signalized Intersection along the corridor



Appendix F-15

Potential Funding Technical Memo

Project: CO 52 Planning and Environmental Linkages Study
To: Colorado Department of Transportation, Region 4
From: CO 52 PEL/ACP Project Team
Date: May 12, 2021
Subject: Potential Funding Technical Memo

Introduction

Purpose

The purpose of this technical memorandum is to initiate the funding analysis component of the Colorado State Highway (CO) 52 Planning and Environmental Linkages (PEL) / Access Control Plan (ACP). Specifically, this memorandum provides summary descriptions of existing and potential federal, state, local, and private funding sources, which could be used to support investments that will benefit different users throughout the corridor: roadway (vehicles), active transportation (bicycle and pedestrian), transit, and freight. Depending on the investment category, the Colorado Department of Transportation (CDOT) could pursue funding opportunities for specific projects with local (cities and counties), regional (Regional Transportation District (RTD), Denver Regional Council of Governments (DRCOG), or North Front Range Metropolitan Planning Organization (NFRMPO)), and federal partners.

Preparing for Funding Asks

As described in Sections 2 through 5, there are a variety of existing funding source and a likely significant increase in federal funding over the next five years. To maximize the possibility for successfully obtaining funds for the CO 52 improvements, there is a significant advantage in conducting upfront analysis to understand how future roadway, active transportation, transit, and freight investments fit within the criteria of different potential funding programs.

Some funding programs are broad enough to match well with most types of investments, while others are targeted to a very specific functional category or strategic priority. In either case, CO 52 corridor partners can improve their chances of securing outside funding by developing a clear understanding of what sets apart a given project, whether it is serving a critical population or addressing a clear deficiency of the transportation network.

Funding program evaluation criteria generally fall within three categories: existing conditions, planning process, and the anticipated benefits of proposed improvements. These categories are summarized in the following sections. The data needed to address the program evaluation criteria evolves as specific investments move through the project development process. For the proposed CO 52 improvements, the work associated with data collection, planning, and project definition described in the sections below has started as part of the PEL process and will continue to be refined as the corridor program moves forward.

The goal of the following sections is to provide a framework for obtaining information and developing key messages that will support targeting the most promising funding programs for the future corridor investment categories.

Existing Conditions

Existing conditions include metrics related to operations of the existing transportation facility, such as crash rates, delay, usage (across all modes), and demographic conditions. It is also important to understand likely changes in the future (such as forecasts for population, employment, and travel demand). These are important data points for several reasons:

1. Many funding programs prioritize projects that serve specific kinds of communities. For example, the United States Department of Transportation (USDOT) Infrastructure for Rebuilding America (INFRA) discretionary program for fiscal year (FY) 2021 awarded projects that serve Opportunity Zones, Empowerment Zones, Promise Zones, or Choice Neighborhoods. The USDOT's Rebuilding American Infrastructure with Sustainability and Equity (RAISE) discretionary program for FY 2021 focused on Areas of Persistent Poverty – namely, those areas that consistently had greater than or equal to 20 percent of the population living in poverty or were located in any territory or possession of the United States. Other funding mechanisms (including the DRCOG Transportation Improvement Program (TIP) process) prioritize projects that fall within identified urban centers or locations with a strong population or employment base.
2. These existing data points form the basis for defining and estimating the benefits expected to result from planned infrastructure improvements (No Build versus Build comparison). For example, the most common method of determining safety benefits is through crash modification factors (CMF), which use existing quantitative research to anticipate a reduction in crashes associated with a given improvement. This methodology requires an understanding of both the rate and type of existing crashes. Similarly, many funding programs associated with transit improvements use existing ridership to determine demand for the proposed facility or improvements.
3. The adopted land-use forecast (and associated travel demand model) can also address questions likely to be asked by funding programs. These forecasts help determine the likely users of a given facility in the future, and funding applications frequently request specific forecasts for population and employment bases as well as expected demand on facilities.

Typical data needs:

- **Crash Rates.** Including specific crash types or causes and severity of crashes.
- **Demographics.** Specific socioeconomic variables and desired geographies vary from program to program, but the focus of data collection should be on communities directly affected by the project, either through proximity to the project area or connection to the new infrastructure.
- **Delay.** Many programs – especially those with any kind of formal benefit-cost analysis (BCA) – are interested in the likely travel time savings associated with improvements (for all modes).
- **Travel Patterns.** Including existing traffic volumes, transit ridership, and/or bicycle and pedestrian counts, as applicable. These data points can be used both to set the baseline for expectations about what might change because of the project and to quantify the impact of the project in terms of affected transportation facility users.

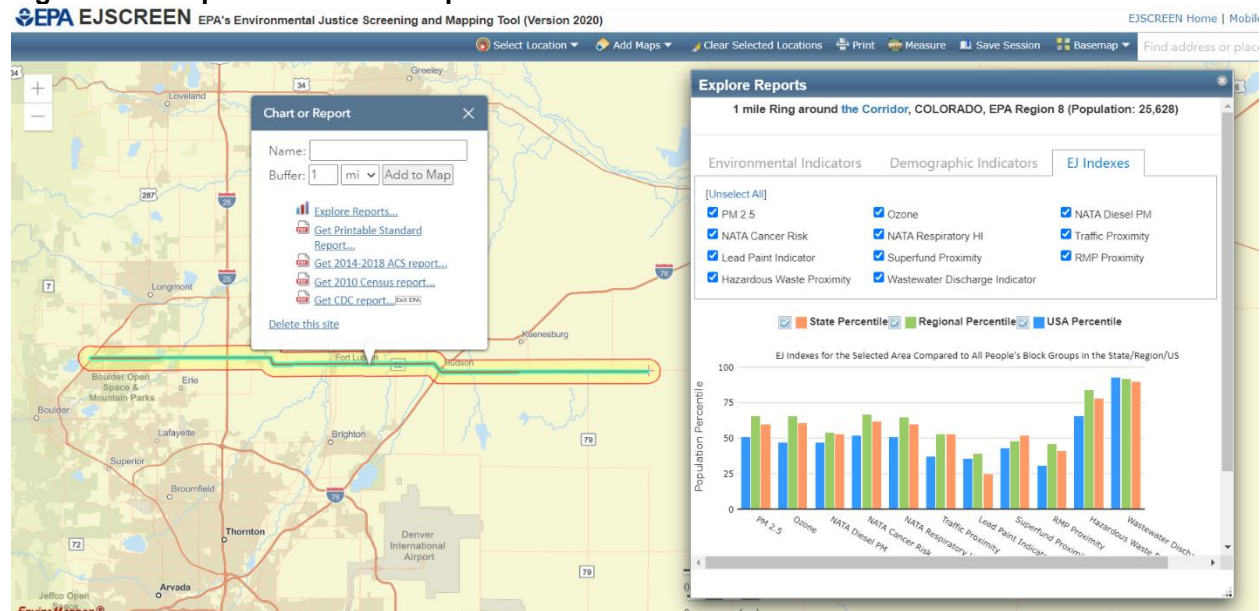
Planning Process

Many funding programs evaluate the process by which the capital project has been identified and defined. The typical emphasis of this evaluation focuses on how the project sponsor has built support with the community, partner agencies, and/or the private sector.

This support can be demonstrated through documentation of the public engagement process, as well as documented outcomes such as funding commitments or letters of support. Both elements can be much easier to strategize during project development – if a particular funding source is a likely target, project sponsors should work to understand the goals of that source or program. Often, even if the project itself is not a perfect match for the criteria of a specific funding program, the engagement or partnership building efforts of the project can offer a pathway to alignment. For example, many state and federal programs focus on the involvement and empowerment of disadvantaged communities. As the CO 52 project team engages with these communities through the PEL process, maintaining clear and concise records of that engagement can greatly facilitate future grant applications or funding requests.

Demonstration of the commitment of various partners is also critical in securing funds. This can take the form of obtaining or establishing a pathway toward required approvals (such as NEPA clearances or secured right-of-way). It can also be more generalized support for the project – the more “binding” the agreement, the better. Commitment of funding support or formalized agreement (e.g. intergovernmental agreements) are valuable, but even simply thinking through possible letters of support writers can be helpful. Additionally, recent USDOT competitive grant applications have requested documentation that projects incorporate considerations of climate change and environmental justice in the planning stage and in project delivery. This would include use of environmental justice tools such as EJSCREEN to minimize adverse impacts to relevant communities.

Figure 1: Example EJSCREEN Output for the CO 52 PEL Corridor



Data Sources

- Documentation that local funding sources have been or will be approved
- Documentation of public engagement efforts, including summaries of the process undertaken, the participants and their roles, and any significant findings
- Racial equity impact analysis
- Project is included in regional planning and programming documents:
 - TIP
 - State Transportation Improvement Program (STIP)
 - State and Metropolitan Planning Organization (MPO) Long Range Transportation Plan (LRTP)
 - State Freight Plan
 - Local/Regional/State Climate Action Plan
 - Local/Regional/State Equitable Development Plan
 - Local/Regional/State Energy Baseline Study
- Equity and inclusion program related to project procurement, material sourcing, construction, inspection, hiring, or other project delivery and implementation activities

Proposed Improvements

The final component of positioning for funding sources is clearly defining what the project intends to do – the physical improvements, the anticipated cost, and the expected use of the facility. This involves developing a very clear Build scenario to be compared against a No-Build scenario derived from the existing conditions analysis.

The first aspect of defining the proposed improvements is establishing a project definition that is approved by the necessary stakeholders (in many cases, just the sponsor agency). This should include as much detail about the project scope as possible, but at a minimum, it is important to document the specific improvements proposed as well as the exact location and alignment of the project. Many funding sources prioritize certain kinds of improvements – for example, nearly all federal discretionary programs reward “innovative” project elements such as intelligent transportation systems (ITS) and transportation system management and operations (TSMO). The State of Colorado has also emphasized projects that support the goal of emission reduction, and specifically a shift toward electric vehicles.

Eligibility for most funding sources also requires a clear implementation plan, focused on capital cost estimates and a milestone implementation schedule (NEPA/Preliminary Engineering, final design, right-of-way (ROW), utilities, procurement, and construction). These details help make the case for the “shovel readiness” of a project, which is key to demonstrating the quality of the investment from the perspective of the agency responsible for allocating funds.

Figure 2. Example Funding Table (taken from DRCOG TIP Application)

*The proposed funding plan is not guaranteed if the project is selected for funding. While DRCOG will do <u>everything</u> it can to accommodate the applicants' request, final funding will be assigned at DRCOG's discretion within fiscal constraint. Funding amounts must be provided in year of expenditure dollars using an inflation factor of 3% per year from 2021.					
Funding Breakdown (year by year)*	FY 2022	FY 2023	FY 2024	FY 2025	Total
Federal Funds	\$	\$	\$	\$	\$0
State Funds	\$	\$	\$	\$	\$0
Local Funds	\$	\$	\$	\$	\$0
Total Funding	\$0	\$0	\$0	\$0	\$0
4. Phase to be Initiated Choose from Design, ENV, ROW, CON, Study, Service, Equip. Purchase, Other	Choose an item	Choose an item	Choose an item	Choose an item	

Clear documentation of anticipated operations and maintenance (O&M) costs, as well as a plan for paying these lifecycle costs (such as a dedicated O&M fund and/or asset management plan), is another common requirement.

Finally, defining the anticipated benefit categories and level of benefit is critical to making the case of the project in most funding applications. More specifically, the ability to provide quantitative or monetized analysis results provides a stronger justification than qualitative discussions on potential benefits. The quantitative results are typically generated through a BCA based on the data sources listed below. While monetized benefits are critical to conducting a formal BCA, most funding programs also consider clearly articulated qualitative benefits as well.

Data Sources

- **Project definition** – the more specific or advanced, the better, although even a defined scope of work is sufficient for some metrics.
- **Project costs** – including capital and O&M costs as well as implementation schedules. Again, specificity is helpful, but even general estimates broken down by major design elements (such as utility relocation, ROW acquisition, and overall construction costs) and a generalized cost curve (i.e. how much of the cost is expected to be incurred per year of construction) are often enough to allow for defensible BCA.
- **Anticipated benefits** – typically in the form of forecasted *demand* for the improvement demonstrating how many users (auto, bike, pedestrian, transit, freight) would benefit from the project, as well as the calculations of the actual benefit such as minutes saved per user or number of crashes reduced per VMT

Remaining Sections of Memo

Following this introduction, the remaining sections provide descriptions of potential federal, state, and regional/local funding sources that could be targeted for specific investment categories within the corridor. Section 2 includes a matrix that provides summary descriptions of the potential sources and an indication of the investment types (roadway, active transportation, transit, and freight) that are eligible for funding. Sections 3 through 5 provide detailed descriptions of the potential federal, state, and local funding sources and programs, respectively. For each source, a brief description is provided including eligible uses and if available, a summary of the range of funding that may be available.

Potential Funding Source Summary

Table 1 through

Table 4 provide an overview of the potential federal, state, local, and private funding sources identified to date. For each source, a brief description is provided along with an indication of which investment category is eligible for the funding.

- **Table 1: Existing Federal Competitive Grant Programs** – Provides a brief description of each program, eligible costs, key evaluation criteria, most recent or current application schedule, a summary of the range of funding that may be available, and a preliminary indication of the type of project that might be eligible. As shown in the tables, Federal competitive grant programs are largely administered by the Federal Transit Administration (FTA), Federal Highway Administration (FHWA), Federal Railroad Administration (FRA), and the USDOT.
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- **Table 2: Existing Federal Formula Funds** – Indicates which agency receives and is responsible for programming the annual formula funds (RTD, DRCOG, NFRMPO, or CDOT). Additionally, the table provides a description of the program and eligible expenses, an estimate of budgeted or programmed funding levels, and a preliminary indication of the investment categories that would be eligible.
- **Table 3: Existing State Funding Programs** – The majority of funding summarized in this table is based on the CDOT Final Budget Allocation Plan for Fiscal Year 2021-2022. The table includes a description of each program and eligible expenses, budgeted or programmed funding levels, and a preliminary indication of the investment categories that would be eligible. This section also provides a preliminary review of the recently enacted Senate Bill (SB) 60 Transportation Funding legislation.
- **Table 4: Other Potential Revenue Sources** – Provides a brief description of other revenue sources that have been considered or used in other parts of the country to support implementation of transportation infrastructure. The categories of other potential revenue sources include value capture mechanisms, one-time revenue generating event (property sale), general user-based fees, and private sector funding.

Table 1: Federal Competitive Grant Programs

Federal Competitive Grants	Description	Key Criteria	Schedule	Total Funds Available / Typical Award	Applicable Project Categories
USDOT RAISE Grant	Projects that leverage resources, encourage partnership, catalyze investment and growth, fill a critical void in the transportation system or provide a substantial benefit.	Merit criteria include safety, environmental sustainability, quality of life, economic competitiveness, state of good repair, innovation, and partnership. Within these criteria, USDOT will prioritize projects that can demonstrate improvements to racial equity, reduce impacts of climate change, and create good-paying jobs.	Current application cycle: July 12, 2021	Total available nationwide (this cycle): \$900 million; historically the largest awards have been approximately \$20 million, and the average award has been \$10 to \$12 million.	Capital: Roadway, Transit, and Active Transportation
USDOT INFRA Grant	Projects that address critical issues facing our nation's highway and bridges, specifically highway and freight projects of national or regional significance.	Criteria focus on economic vitality, climate change and environmental justice, racial equity, leveraging Federal funding to attract non-Federal sources, innovation, and performance.	Most recent application cycle: March 19, 2021	Total available nationwide (last cycle): \$889 million in 2021 funds, and up to \$150 million remaining from prior authorizations; 2020 awards ranged from \$6 million to \$35 million (20% to 56% of total costs) in the Small Project category, and from \$25 million to \$135 million (4% to 60% of total costs) in the Large Project category	Capital: Roadway (specifically improving freight and goods movement)
FHWA Competitive Highway Bridge Program	By law, the funds are restricted to states with a population density of less than 100 people per square mile. Colorado is one of the 25 states that qualify. The funds must be used for highway bridge replacement or rehabilitation projects on public roads that leverage the efficiencies associated with "bundling" at least two highway bridge projects into a single contract.	Selection criteria include innovation, support for economic vitality, lifecycle cost and state of good repair, and project readiness.	Most recent application cycle: December 4, 2018	Total available nationwide (last cycle): \$225 million 2019 awards ranged from \$2 million to \$33 million	Capital: Roadway
FRA Consolidated Rail Infrastructure & Safety Improvements (CRISI)	Funding for projects that: address congestion that increase rail capacity; add or upgrade the condition, clearances, and capacity of rail mainlines; enhance capacity and service with less conflict between freight and intercity passenger rail; reduce delays and risks associated with highway-rail grade crossings; and provide more effective rail equipment; enhance multimodal connections or facilitate	Four tracks for eligible projects: Track 1—Planning; Track 2—PE/NEPA; Track 3—FD/Construction; or Track 4—Research, Safety Programs and Institutes. Selection criteria include economic vitality, leveraging Federal funding, preparing for future O&M and other lifecycle costs, innovation, and performance.	Most recent application cycle: June 19, 2020	Total available nationwide (last cycle): \$312 million 2020 awards ranged from \$0.2 million to \$47.6 million	Capital: Freight rail and intercity passenger rail

	service integration between rail service and other modes.				
FTA Section 5309 Capital Investment Grant Program (New Starts / Small Starts)	Provides funding through a multi-year competitive process for transit capital investments, including heavy rail, commuter rail, light rail, streetcars, and bus rapid transit. Federal transit law requires transit agencies seeking CIG funding to complete a series of steps over several years to be eligible for funding.	Projects are evaluated and rated based on a set of defined project justification criteria (mobility improvements, environmental benefits, cost effectiveness, economic development effects, and public transportation supportive land use policies) as well as local financial commitment criteria.	Most recent application cycle: Rolling application process	Total available nationwide: \$2.5 billion (FY 2022), including funds for New Starts, Small Starts, and Core Capacity projects Note: FTA has told project sponsors pursuing New Starts (costs >\$300 million) that maximum Full Funding Grant Agreement will cover 40% of costs.	Capital: Transit

Table 2: Federal Formula (Annual) Funds

FTA Formula Grants: Programmed by RTD	Description / Eligible Expenses	Annual Funding Estimates	Applicable Project Categories
FTA Section 5307 Urbanized Area Formula Funds	Makes federal resources available to urbanized areas and to governors for transit capital and operating assistance in urbanized areas and for transportation-related planning.	Programmed Funding • 2019: \$58.4 M	Capital: Transit Operations: Capitalized preventive maintenance activities
FTA Section 5339 (a) Bus and Bus Facilities Formula Program	Makes federal resources available to states and direct recipients to replace, rehabilitate, and purchase buses and related equipment and to construct bus-related facilities including technological changes or innovations to modify low or no emission vehicles or facilities.	Programmed Funding • 2019: \$5.2 M	Capital: Transit Operations: Capitalized preventive maintenance activities
FHWA Formula Grants: Programmed by DRCOG & NFRMPO	Description / Eligible Expenses	Annual Funding Estimates	Applicable Project Categories
FHWA - Surface Transportation Program (STP)-Metro	Provides funds for constructing new streets or widening, improving, or reconstructing existing streets classified as Federal Aid Eligible (FAE) freeways, highways, arterials, or collectors. Funds can also be used for bridge replacement; intersection improvements; projects which reduce traffic demand, such as transit capital improvements and active transportation; and other projects as provided for in federal law.	Programmed Funding • 2019: \$41.7 M	Capital: Roadway, Transit, and Active Transportation
FHWA – Congestion Mitigation and Air Quality (CMAQ) Improvement Program	Provides a flexible funding source to State and local governments for transportation projects and programs to help meet the requirements of the Clean Air Act. Funding is available to reduce congestion and improve air quality for areas that do not meet the National Ambient Air Quality Standards for ozone, carbon monoxide, or particulate matter (nonattainment areas) and for	Programmed Funding • 2019: \$42.6 M	Capital: Roadway, Transit, and Active Transportation

	former nonattainment areas that are now in compliance (maintenance areas).		
FHWA – Transportation Alternatives Program (TAP) (note: CDOT also awards TAP Funding – see below)	Provides funding for a variety of smaller-scale transportation projects such as pedestrian and bicycle facilities, recreational trails, safe routes to school projects, community improvements such as historic preservation and vegetation management, and environmental mitigation related to stormwater and habitat connectivity.	Programmed Funding • 2019: \$2.4 M	Capital: Active Transportation
FHWA Formula Grants: Programmed by CDOT	Description / Eligible Expenses	Annual Funding Estimates	Applicable Project Categories
FHWA –TAP (Note: DRCOG and NFRMPO also award TAP Funding- see above)	Provides funding for projects that enhance safety and expand options for non-drivers, mitigate environmental impacts, and convert former interstate facilities to new uses. Examples include on- and off-road pedestrian and bicycle facilities, infrastructure projects for improving non-driver access to public transportation and enhanced mobility, community improvement activities (historic preservation and vegetation management, and environmental mitigation related to storm water and habitat connectivity); recreational trail projects; and safe routes to school projects.	Programmed Funding • FY 2018-19: \$13.9 M	Capital: Active Transportation

Table 3: CDOT Revenue Allocation Programs

CDOT Revenue Allocation Programs	Description / Eligible Expenses	Annual Funding Estimates	Applicable Project Categories
Construction Programs (Asset Management, Safety, and Mobility)			
Asset Management: Surface Treatment	Provides funding to maintains the quality of the pavement on state highways at the highest possible level. Department staff utilizes pavement management software and annual data collection to make recommendations on the segments of the state highway system should be prioritized for rehabilitation.	Programmed Funding • FY 2021-22: \$223M	Capital: Roadway
Asset Management: Structures	Provides funding for the inspection and inventory of the statewide structures, manages all essential repairs and critical findings for statewide structural asset programs, and evaluates permits required for oversize and overweight vehicles.	Programmed Funding • FY 2021-22: \$62M	Capital: Roadway
Asset Management: Systems Operations	Funding to implement new and innovative technology, deploy and integrating statewide Intelligent Technology Systems (ITS), incorporate automated performance measures, and extend technical resources to CDOT regions in the areas of traffic signal and ramp metering. This program also leads and/or participates in the development and implementation of arterial and freeway management strategies throughout the state..	Programmed Funding • FY 2021-22: \$34M	Capital: Roadway

Asset Management: Geohazards Mitigation	Funding to design mitigation plans, review consultant designs, perform site inspections during construction, respond to rock falls, and other geological hazards-related emergencies. Other work includes responding to requests from Maintenance, Engineering, and the public when slope issues are observed.	Programmed Funding • FY 2021-22: \$10M	Capital: Roadway
Asset Management: Permanent Water Quality Management	Provides funding to treat pollution in stormwater from CDOT roadways before it flows into Colorado's rivers, lakes and streams. Pollutants from CDOT roadways includes oil and grease, copper, any fluids from vehicles, lead and chloride.	Programmed Funding • FY 2021-22: \$7M	Capital: Roadway
Safety: Highway Safety Improvement Program	Funding for project that will achieve a significant reduction in fatalities and serious injuries on all publicly maintained roads. This includes public roads not owned by the state and roads on tribal lands.	Programmed Funding • FY 2021-22: \$33M	Capital: Roadway
Safety: Rail-Highways Crossings Program	Funds projects that eliminate the hazards at railway-highway crossings. The purpose of this program is to reduce the number of injuries and fatalities at public crossings throughout the state.	Programmed Funding • FY 2021-22: \$4M	Capital: Roadway
Safety: Hot Spots	Provides funding to mitigate minor unforeseen issues that need immediate attention, as well as add funding to ongoing projects for unforeseen safety issues discovered during the project implementation process.	Programmed Funding • FY 2021-22: \$2M	Capital: Roadway
Safety: FASTER Safety	Funding for road safety projects including pavement and other asset management projects, intersection and interchange improvements, shoulders and safety-related widening, and wildlife fencing	Programmed Funding • FY 2021-22: \$69M	Capital: Roadway
Safety: ADA Compliance	Funds ADA programs or activities including but not limited to roadways, contiguous walkways, intersections, rest areas, roadside emergency telephones, public conveyances such as buses and light rail, and literature related to any of these.	Programmed Funding • FY 2021-22: \$7M	Capital: Roadway, Transit, and Active Transportation
Mobility: Regional Priority Program	Supplements the formula-driven funding allocations to the five CDOT engineering regions with flexible state funding. This funding is used at the discretion of each Regional Transportation Director, in consultation with local elected officials and other stakeholders in each region. RPP funds are distributed to the CDOT Regions according to a formula that is weighted on these factors: 50 percent population, 35 percent state highway system lane miles, and 15 percent state highway system truck Vehicle Miles Traveled (VMT).	Programmed Funding • FY 2021-22: \$48M	Capital: Roadway, Freight, Transit and Active Transportation
Mobility: Strategic Projects	Funding from General Fund transfers that primarily goes to strategic construction projects.	Programmed Funding • FY 2021-22: \$450M	Capital: Roadway, Freight, Transit and Active Transportation
Mobility: National Highway Freight Program	Funding to improve the efficient movement of freight on the National Highway Freight Network (NHFN). The NHFN includes the interstates, several small segments of other corridors important to freight movement, and approximately	Programmed Funding • FY 2021-22: \$23M	Capital: Freight

	240 miles of Critical Urban and Critical Rural Freight Corridors to be designated by the state		
Suballocated Programs (Highway and Transit/Multimodal)			
Highway: STP - Metro	DRCOG and NFRMPO select project to receive funding (see Table 2)		
Highways: CMAQ Program	DRCOG and NFRMPO select project to receive funding (see Table 2)		
Highways: Bridge Off-System	The Joint Highway Commission oversees the program and accepts project applications on an annual basis. The program improves public safety and reduces ongoing maintenance costs associated with aging infrastructure. The structure must be a location on a rural minor collector or urban or rural local road.	Programmed Funding • FY 2021 -22: \$11 M	Capital: Roadway
Transit and Multimodal: Safe Routes to School	Funds projects that improve safety for pedestrians and bicyclists in school areas, and encourage children in K-8 to safely bicycle and walk to and from school.	Programmed Funding • FY 2021-22: \$3 M	Capital: Active Transportation
Transit and Multimodal: TAP (Note: DRCOG and NFRMPO also award TAP Funding- see above)	Provides funding for projects that enhance safety and expand options for non-drivers, mitigate environmental impacts, and convert former interstate facilities to new uses. Examples include on- and off-road pedestrian and bicycle facilities, infrastructure projects for improving non-driver access to public transportation and enhanced mobility, community improvement activities (historic preservation and vegetation management, and environmental mitigation related to storm water and habitat connectivity); recreational trail projects; and safe routes to school projects.	Programmed Funding • FY 2021-22: \$12 M	Capital: Active Transportation
Transit and Multimodal: Transit Grant Program	Funding for projects to purchase or replacement of transit vehicles, construction of multimodal stations, and acquisition of equipment for consolidated call centers.	Programmed Funding • FY 2021-22: \$50 M	Capital: Transit
Transit and Multimodal: Multimodal Options Program	Senate Bill 18-001 allocated \$94.25 million to the Multimodal Transportation Options Fund. Of this funding, 85 percent (\$80.12 million) must be used for local multimodal projects, and 15 percent (\$14.13 million) must be used for statewide multimodal projects	Programmed Funding FY 2021-22: \$0 M (funding authorized in SB 18-001 totaled \$94.25 M)	Capital: Transit

Table 4: Other Potential Local Sources

Existing Taxes	Description	Initial Comments
Property Tax	For a specific project or projects, increase city-wide property tax to fund the improvements.	
Value Capture Sources	Description	Initial Comments
Tax Increment Financing (TIF) District	Property tax revenues generated beyond an established baseline are pledged specifically for infrastructure-related improvements within an area or district.	
Development Mitigation / Impact Fees	A one-time charge imposed by local governments to mitigate the impact on local infrastructure caused by new development. Growth in the form of new homes and businesses requires expansion or enlargement of public facilities to maintain the same level and quality of public services for all residents of a community. Impact fees help fund expansion of public facilities necessary to accommodate new growth	
Real Estate Transfer Tax	A tax is collected whenever the ownership of a property changes. This tax typically reflects a percentage of the sale price.	Current rate is 0.01% in Colorado
Land Contribution or Other Asset Sales	Revenues generated from the disposition of excess land owned by counties, cities, or local agencies. Right-of-way contributions are also possible.	
Private Sector Funding	Description	Initial Comments
Developer Contributions	Private developers along project alignments may pay for enhanced access/connection to transportation facilities. Especially applicable to adjacent retail developments.	

Potential Funding Sources

This section provides descriptions of potential federal funding sources that could support implementation of roadway, transit, active transportation, and freight improvement projects. The sources reflect both discretionary (competitive) and formula programs.

The federal sources described in Section 3.2 and Section 3.3 reflect existing funding programs. The current federal transportation authorization legislation for these programs (Fixing America's Surface Transportation Act, or the FAST Act) expired in September 2020. A Continuing Resolution was passed in October 2020 which maintained all existing transportation funding programs at their current levels through September 2021. Congress is currently negotiating transportation reauthorization legislation. Section 3.1 provides an overview of new funding programs that are in the House version of the reauthorization that could provide additional funding opportunities for the CO 52 corridor if included in the final legislation.

Potential Programs in Reauthorization Bill

While most of the national discussion related to increased transportation funding is tied to the "Infrastructure Bill," as noted above, Congress is also working on the multi-year surface transportation funding legislation to replace the FAST Act. More information on the House of Representative's version of the reauthorization legislation, the Investing in a New Vision for the Environment and Surface Transportation (INVEST) Act is currently available. The following provides summaries of potential new funding programs and expansion of existing programs included in the House version of the INVEST Act that could benefit the CO 52 improvements. While the final version of the reauthorization legislation will not be available for several months, it will be important to track the programs listed below and review the final legislation for other opportunities to target over the next five years.

- **NEW: Section 107 - Member designated project authorizations:** Authorizes projects designated by members of Congress for allocation from amounts made available under Section 103.

The House version of the INVEST Act reintroduces congressional "earmarks," whereby members of a given congressional delegation submitted requests for funding for specific projects in their districts. The benefits of having a project identified through this process go beyond the actual allocated funding. Historically, earmarked funds ensured an identifiable funding stream and an advantage for any project named in federal legislation. The named projects carry the special intent of Congress which means that these projects move ahead of others in the funding queue. Thus, Congressional earmarks often indicate a money trail and preference for key projects which can also be a catalyst to attract funding from other sources because these projects are given greater visibility and credibility in the eyes of both public and private sector organizations.

The current House version of the Invest Act includes 1,475 named projects designated for funding (out of 2,383 projects submitted) if the current version of the bill is signed into

law. As shown in **Table 5**, 19 Colorado projects were named in the House version of the INVEST Act. The funding request ranged from \$0.8 million to \$10.0 million and averaged \$4.0 million. While there is still a small opportunity for local projects (such as the CO 52 corridor investments) to be included in the final version of the bill through Senate negotiations, that effort would likely have to occur in the next few months. However, if Congress continues the use of earmarks in the future, the CO 52 corridor partners could work with their local delegation to name specific projects or a program of projects in future legislation.

Table 5: Colorado Project Named in the House Version of the INVEST Act

Project	City	Request
16th Street Mall Reconstruction Program	Denver	\$6.5
Aurora Bicycle and Pedestrian Master Plan Update	Aurora	\$0.8
Big Barnes Ditch Trail Improvements	Loveland	\$0.5
Cameron Peak Post-Fire Emergency Funding	Larimer	\$2.0
Central Corridor Rail Replacement	Denver	\$7.9
CO 9 Widening from Iron Springs to Frisco	Summit	\$1.0
Easter/Havana Intersection Improvements	Centennial	\$6.0
Eisenhower Johnson Memorial Tunnel Repairs and Upgrades	Dillon	\$4.0
Expansion of Gun Club Road	Aurora	\$1.5
Federal Parkway Multimodal Transportation Improvements	Westminster	\$4.1
Frisco Transit Center	Frisco	\$6.7
I-25 Valley Highway: Phases 3 and 4 ROW Acquisition	Denver	\$5.5
I-25/Belleview Avenue Interchange Improvements	Greenwood Village	\$10.0
I-70 and 32nd Ave. Bridge Replacement	Wheat Ridge	\$2.0
SH-72 (Indiana St) Widening at UPRR	Arvada	\$1.1
State Highway 119 and State Highway 52 Multimodal Intersection Improvements	Boulder County	\$5.0
US 36 and Community Drive Roundabout	Estes Park	\$0.9
Wadsworth Widening: 35th Avenue to I70	Wheat Ridge	\$10.0
West Colfax Pedestrian Safety and Infrastructure Project	Lakewood	\$1.8
Total Colorado Requests		\$77.2

- **NEW: Section 1204 - Railway Crossings:** Establishes a standalone railway crossing program, based on the railway-highway grade crossing set aside, raising the overall level of investment in safety projects under the bill. Requires railroads to contribute the share for projects that provide a benefit to the railroad and removes the statutory cap on these contributions. Expands eligibilities to projects to mitigate lost access from a crossing closure and strategies to prevent or reduce trespasser fatalities and injuries along railroad rights-of-way. Clarifies that replacement of functionally obsolete protective devices is eligible under the program. Allows railway crossing funds to be used toward the cost of projects selected for the FRA's CRISI discretionary grant program.
- **Expanded Existing: Section 1205 - Surface Transportation Program:** Adds eligibilities for resilience improvements, natural infrastructure, reducing carbon pollution, bus frequency and ridership enhancement projects, and wildlife crossings. Allows for up to 15 percent of STP funds suballocated to rural areas and small cities to be expended on local roads and rural minor collectors.
- **Expanded Existing: Section 1206 - Transportation Alternatives Program:** Provides funding for the Transportation Alternatives Program (TAP) as a 10 percent set-aside out of STP. Increases the share of the program's funds that must be suballocated to areas of the state based on population from 50 percent to 66 percent. A state may suballocate up to 100 percent of its TAP funding if certain conditions are met and upon approval of the Secretary. Boosts the recreational trails set-aside in proportion to the increase for TAP. Requires states to provide sufficient obligation authority over the life of the bill to ensure this suballocation can be obligated in a timely manner, consistent with the requirement under STP.
- **NEW Section 1301 - Projects of National and Regional Significance:** Establishes a Projects of National and Regional Significance (PNRS) program, which provides more than \$12 billion over the life of the bill for large highway, transit, and passenger and freight rail projects that reduce congestion on roadways and that cannot be funded through annual apportionments or other discretionary sources. Includes the authority for the Secretary to award large grants over multiple years. Directs the Secretary to make grant selections based on merit criteria specified in statute, including the extent to which a project contributes to a state of good repair; cost savings generated by the project over the life of the asset; safety, mobility, economic, resilience, and environmental benefits generated by the project; benefits to all users of the project; and the average number of people or volume of freight supported by the project. The Secretary is also directed to consider whether the project serves an area of persistent poverty; the degree to which the project utilizes innovative technologies or construction and whether the project improves connectivity between modes of transportation.
- **NEW Section 1302 - Community Transportation Investment Grant Program:** Establishes a \$600 million per year grant program to support local investments in projects to improve safety, state of good repair, accessibility, and environmental quality through infrastructure investments. Sets aside a minimum of 25 percent of program

funds for projects in rural communities and a minimum of 25 percent of program funds for projects in communities between 50,000 and 200,000 in population.

Requires the Secretary to evaluate projects on their benefits to transportation safety, including reductions in traffic fatalities and serious injuries; to state of good repair, including improved condition of bridges and pavements; to transportation system access, including improved access to jobs and services; and to reducing greenhouse gas emissions, and to rate each project based on these criteria. Allows the Secretary to use different weighting of these criteria based on project type, population served by the project, and other context-sensitive considerations. Instructs the Secretary to compare each project's benefits with its costs, rank projects based on that comparison, and to select grant recipients from among those projects ranked most highly.

- **NEW: Section 1305 - Metro Performance Program.** Provides \$1 billion over the life of the bill for direct allocations to MPOs to advance locally-selected projects. Authorizes the Secretary to designate a high-performance tier of MPOs based on technical capacity to manage federal-aid highway funds. Provides between \$10 and \$50 million per year for the MPOs designated. Projects are subject to all federal-aid highway requirements, including environmental laws, labor projections, and Buy America. Participating MPOs will report annually on the status of the program and the projects advanced with program funds to FHWA, and FHWA will report to Congress on the lessons learned from the program and provide recommendations on ways to improve suballocation of federal-aid highway funds under STP.
- **NEW Section 1306 - Gridlock Reduction Grant Program:** Establishes a \$500 million grant program to reduce traffic gridlock in large metropolitan areas. Supports projects to reduce and mitigate the adverse impacts of traffic congestion; make better use of existing capacity; and employ innovative, integrated, and multimodal solutions to reducing gridlock. Includes eligibility for intelligent transportation systems, real-time traveler information, transportation demand management, and multimodal solutions. Dedicates half of program funds for freight-specific projects including first-mile and last-mile delivery solutions, use of centralized delivery points, curb space management, and real-time freight parking and routing. Prioritizes projects in areas that are experiencing a high degree of recurrent congestion.
- **NEW: Section 1309 - Active Transportation Connectivity Grant Program:** Provides \$1.0 billion over the life of the bill for a grant program to support infrastructure investment in connected active transportation networks. Requires 30 percent of the funds to develop active transportation networks to connect points within a community, and 30 percent of the funds to be used for active transportation spines to connect communities to one another, including nationally and regionally significant greenway trails. Supports the development of complete streets and the use of safe systems approaches to enhance safety for vulnerable road users. Includes considerations for the environmental justice and equity impacts of a project and the extent to which the project improves connectivity to public transportation.

Existing Federal Discretionary/Competitive Grants

As the preferred program of projects for the CO 52 corridor is defined and starts to move through the planning, environmental and design process, there may be opportunities to leverage federal funds for entire projects or specific cost elements of projects through competitive grant opportunities offered by the USDOT, FTA, FHWA, and FRA. A brief overview of competitive grant programs used to support the planning, engineering, and/or construction of roadway, transit, active transportation, and freight investments is provided below.

Finally, as indicated in the descriptions, there are a limited number of competitive federal grant programs and due to the volume of applications received from across the country, grant awards are typically less than \$15 million for individual projects.

USDOT RAISE Grant Program (Formerly known as the BUILD & TIGER Grant Program)

Description: The RAISE discretionary grant program, provides a unique opportunity for the USDOT to invest in road, rail, transit and port projects that promise to achieve national objectives. Previously known as the Better Utilizing Investments to Leverage Development (BUILD) and Transportation Investment Generating Economic Recovery (TIGER) discretionary grants, Congress has dedicated over \$9.0 billion for twelve rounds of National Infrastructure Investments to fund projects that have a significant local or regional impact. The eligibility requirements of RAISE allow project sponsors at the state and local levels to obtain funding for multi-modal, multi-jurisdictional projects that are more difficult to support through traditional USDOT programs.

As shown in **Table 6. RAISE/BUILD/TIGER Program Size, Applicants, and Projects Funded (FY 2009-2016)**

Fiscal Year (FY)	Program Size	Applicants	Projects Funded	Percent of Projects Funded
2009	\$1.5 billion	1,366	51	3.7%
2010	\$600 million	1,639	75	4.6%
2011	\$510 million	833	46	5.5%
2012	\$500 million	708	47	6.6%
2013	\$474 million	583	52	8.9%
2014	\$600 million	798	72	9.0%
2015	\$500 million	627	39	6.2%
2016	\$500 million	585	41	7.0%
2017	\$500 million	452	40	8.8%
2018	\$1.5 billion	851	41	4.8%
2019	\$900 million	666	55	8.3%
2020	\$1.0 billion	656	70	10.7%

Source: USDOT

, the RAISE/BUILD/TIGER program is extremely competitive with 9,700 applications submitted to USDOT requesting \$175 billion in RAISE/BUILD/TIGER funds over the program's twelve rounds. USDOT has awarded a total of \$9.6 billion to 624 projects, which is approximately six

percent of all applicants. **Table 6** illustrates overall supply and demand for the program since it was first authorized under the American Recovery and Reinvestment Act of 2009 (ARRA). While there have been annual appropriations for RASIE/BUILD/TIGER every FY since 2009, including the most recent BUILD Notice of Funding Opportunity (NOFO) released in April 2021, the program is not specifically authorized in federal legislation and must be approved each year as part of the annual federal budget process.

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2016	\$500 million	585	41	7.0%
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2018	\$1.5 billion	851	41	4.8%
2019	\$900 million	666	55	8.3%
2020	\$1.0 billion	656	70	10.7%

Source: USDOT

Relevance to CO 52: Roadway, Transit, Active Transportation, and Freight

Revenue Potential: Despite the program's \$25 million statutory maximum grant amount, the typical grant awarded to projects is between \$10 and \$15 million. USDOT rarely awards close to its maximum allowed award of \$25 million to any one project.

Most recent application cycle: July 12, 2021

Example Projects: The table below provides a summary of projects like what is being considered for the CO52 corridor, including an example of Butler County, PA that was successful in obtaining two grant awards for the same corridor.

Table 7. Similar Projects Recently Awarded BUILD/TIGER Grants

Applicant	Project Summary	Grant Award/ Share of Total Costs	Project Type
Miami-Dade County	Expand and improve two existing park-and-ride facilities along the South Dade Bus Rapid Transit (BRT) line. The project includes additional sidewalks, improved pedestrian access, bicycle parking facilities, a kiss-and-ride, additional parking for individuals with disabilities, and electric vehicle parking with charging stations.	\$9.5 M (50%)	Transit

Maquoketa, IA	The project will make several roadway improvements including new and resurfaced street pavement; replacement curbs, gutters, pedestrian curb ramps, and sidewalks for compliance with the Americans with Disabilities Act (ADA); repair and replacement of the storm sewer, sanitary sewer, and water main; installation of a new broadband fiber-optic network; and traffic signal upgrades.	\$3.8 M (40%)	Roadway
City of Blair, NB	This project will construct a new connection between US 75 and the US 30 in Blair, NB to bypass the community's existing downtown. The proposed corridor will be a three-lane section, configured as a "Super 2" with passing lanes constructed in the uphill direction to reduce conflicts between passenger vehicles and trucks. The project will also construct a bicycle and pedestrian trail adjacent to the new roadway.	\$7.6 M (42%)	Roadway, Active Transportation and Freight
Calloway County, KY	The project will widen an approximately 5.7-mile section of US 641 South from a two-lane divided highway to a four-lane divided highway between the Kentucky/Tennessee state line at Hazel north to the Middle Fork of the Clarks River.	\$23 M (41%)	Roadway
Hickory, NC	The project will develop an approximately 1.7-mile bicycle and pedestrian trail and a bridge over US 321, and construct a 1.2-mile complete streetscape loop in downtown Hickory that will add designated space for bicycles and pedestrians and concurrently incorporate underground fiber cable systems.	\$17 M (77%)	Active Transportation
Butler County, PA	The project will realign and widen to 4 lanes the approximately 1.5-mile Balls Bend and the approximately 0.75-mile Haines School-Commonwealth sections of Route 228, including adding turn lanes, medians, connecting access roads, and pedestrian/bicycle facilities. This project is part of a larger to widen approximately 26 miles of Route 228 in Butler County.	\$20 M (47%)	Roadway and Active Transportation
Butler County, PA	The project will construct roadway, intersection, and pedestrian improvements along three segments of State Route 228 (Freedom Road) as part of a larger project on the 26.4-mile corridor. Various improvements include widening lanes, adding turn lanes, converting intersections to roundabouts or jug handles, installing ADA ramps, adding multi-use paths, upgrading signals, and adding pavement markings. Improvements will be made on segments from Lovi Road to Powell Road, Powell Road to Haine School Road, and at the intersection with Three Degree Road. This project connects to the BUILD 2018 Gateway 228 project. (prior row)	\$25 M (43%)	Roadway and Active Transportation

Source: USDOT, BUILD Grant Award Fact Sheets

USDOT INFRA Grant Program (Formerly known as the FASTLANE Grant Program)

Description: The INFRA grant program, formerly known as the Fostering Advancements in Shipping and Transportation for the Long-term Achievement of National Efficiencies (FASTLANE) grant program, provides dedicated, discretionary funding for projects that address critical issues facing our nation's highway and bridges. Most specifically, the INFRA program provides Federal financial assistance to highway and freight projects of national or regional significance. Eligible costs include reconstruction, rehabilitation, acquisition of property, environmental mitigation, construction contingencies, equipment acquisition, and operational improvements directly related to system performance.

Relevance to CO 52: Freight

Revenue Potential: In FY 2020, USDOT awarded over \$900 million in INFRA awards to 20 projects, or an average award of \$45 million. Each year, 90 percent of available INFRA funds are awarded to large projects, or those with a minimum grant size of \$25 million. The remaining 10 percent of available funds are reserved for small projects, which have a minimum grant size of \$5 million.

Most recent application cycle: The FY 2021 INFRA NOFO was released on January 22, 2021 and the application deadline was March 19, 2021. The FY 2021 awards have not yet been announced.

FHWA Competitive Highway Bridge Program

Description: The Competitive Highway Bridge Program provides \$225 million for highway bridge replacement and rehabilitation projects on public roads. Applicants must demonstrate cost savings through bundling multiple bridge projects. Funding is only eligible to states with a population density of less than 100 people per square mile; Colorado falls well below this threshold. Only state DOTs are eligible to apply.

“Bundling” is defined as two or more similar bridge projects that are eligible under Section 119 or 133, awarded to a single contractor or consultant, and included as a single bundled project in the applicable TIP or STIP. Bundled projects must have the same funding category or subcategory and the same Federal share.

Selection criteria include innovation, support for economic vitality, lifecycle cost and state of good repair, and project readiness.

Relevance to CO 52: Roadway – capital costs only

Revenue Potential: For FY 2019, \$225 million was available nationwide

Most recent application cycle: The most recent NOFO was published on September 5, 2018, with an application deadline of December 4, 2018. During this cycle, CDOT was awarded a \$12.5 million grant to replace 14 culverts across southern and western Colorado, along key corridors providing rural mobility and connections to interstate commerce. State Highway 9 provides access for tourists to recreation destinations in the Rocky Mountains, US-24 provides access across the Rocky Mountains as a major east/west corridor and US 350 provides a connection between I-25 and US-50.

FRA Consolidated Rail Infrastructure & Safety Improvements

Description: The Consolidated Rail Infrastructure and Safety Improvements (CRISI) program provides a comprehensive solution to leverage private, state, and local investments to support safety enhancements and general improvements to infrastructure for both intercity passenger and freight railroads. The CRISI program invests in a wide range of projects to improve railroad safety, efficiency, and reliability; mitigate congestion at both intercity passenger and freight rail chokepoints; enhance multi-modal connections; and lead to new or substantially improved intercity passenger rail transportation corridors. Additionally, the program includes rail safety

projects, such as grade crossing enhancements, and rail line relocations and improvements which could be targeted for the CO52 corridor.

Evaluation criteria include key FRA objectives such as supporting economic vitality; leveraging federal funds to attract other sources of funding; preparing for project life-cycle costs; using innovative approaches to improve safety and expedite project delivery; and holding recipients accountable for achieving specific, measurable outcomes.

Relevance to CO 52: Freight and Roadway at-grade crossings

Revenue Potential: The CRISI program does not have any minimum or maximum thresholds for awards. The FY 2020 application cycle resulted in 29 awards totaling nearly \$320 million, or an average award of \$11.0 million.

Most recent application cycle: The FY 2020 NOFO was published on April 20, 2020, grant applications were due on June 19, 2020, and awards were announced on September 23, 2020.

FTA Section 5309 Capital Investment Grant Program (New Starts / Small Starts)

Description: This FTA discretionary grant program funds transit capital investments, including heavy rail, commuter rail, light rail, streetcars, and bus rapid transit. Federal transit law requires transit agencies seeking CIG funding to complete a series of steps over several years. For New Starts and Core Capacity projects, the law requires completion of two phases in advance of receipt of a construction grant agreement – Project Development and Engineering. For Small Starts projects, the law requires completion of one phase in advance of receipt of a construction grant agreement – Project Development. The law also requires projects to be rated by FTA at various points in the process according to statutory criteria evaluating project justification and local financial commitment.

Relevance to CO 52: Transit (High-Capacity Transit Corridors)

Revenue Potential: The FAST Act authorized \$2.3 billion in CIG funding annually through 2020. New Starts projects require a total project cost of greater than \$300 million and CIG funding of at least \$100 million. Small Starts projects have total project costs of less than \$300 million and less than \$100 million in CIG funds. Maximum CIG share of total project cost is 60 percent for New Starts and 80 percent for Small Starts. Most recently, RTD successfully pursued \$92 million in CIG funds for the Southeast Rail Extension to Lone Tree.

Most recent application cycle: Ongoing

Existing Federal Formula Programs

The following section provides an overview of FTA and FHWA formula grant programs that could be pursued separately or in combination with the previously described competitive grant programs. While there is no limitation on the number of federal funding programs that can be included in a project's financial strategy, the maximum federal funding participation that can be used on a project is 80 percent of the total capital costs.

If there is interest to pursue funding from any of these programs, CO 52 Corridor Partners will need to coordinate with the RTD, DRCOG, NFRMPO or CDOT. Use of these funds is typically identified several years in advance and is documented in the region's transportation planning and programming documents, including the Regional Transportation Plan (RTP) and the TIP. More specifically, the current TIP for DRCOG and NFRMPO programs federal funds for the 2022 to 2025 period. If FTA or FHWA formula programs are to be targeted for investment categories, the funds would have to be programmed after the current TIP period (2025), or there would need to be coordination with DRCOG or NFRMPO to reprogram and transfer funds from projects in the current TIP.

Formula Programs Administered by RTD

FTA SECTION 5307 URBANIZED AREA FORMULA PROGRAM

Description: The Urbanized Area Formula Funding program (49 U.S.C. 5307) makes federal resources available to urbanized areas for transit capital and operating assistance and for transportation-related planning.

Eligible activities for Section 5307 funds include planning, engineering, design, and evaluation of transit projects and other technical transportation-related studies; crime prevention and security equipment; vehicle acquisition and replacement; construction of maintenance and passenger facilities; and capital investments in new and existing fixed guideway systems including rolling stock, overhaul and rebuilding of vehicles, track, signals, communications, and computer hardware and software.

Relevance to CO 52: Transit (passenger facilities)

Revenue Potential: FY 2021 FTA apportionment: \$62.9 million

Formula Programs Administered by DRCOG and NFRMPO through the TIP Process

DRCOG and NFRMPO program the use of federal funds on four-year cycles through the TIP. The TIP programs the federally funded transportation improvements and management actions to be completed by CDOT, transit agencies such as RTD, local governments, and other project sponsors over a four-year period within the MPO region. As required by federal and State law, the TIP must be fiscally constrained to funds expected to be available. All projects selected to receive federal and State surface transportation funds, and all regionally significant projects regardless of funding type, must be identified in the TIP.

The CO 52 corridor falls within two MPO boundaries – the NFRMPO and DRCOG. These organizations are responsible for developing and approving the TIP. NFRMPO and DRCOG directly selects projects to receive federal and state funding, and reviews projects by CDOT and other agencies (such as RTD) for consistency with regional plans.

DRCOG Project Selection and Programming Approach

Selection Process: DRCOG selects projects in three phases:

1. **Set-Asides:** "Off-the-top" regional programs, most with Calls for Projects. Includes Community Mobility Planning & Implementation, TDM Services, Regional Transportation Operations & Technology, Air Quality Improvements, and Human Service Transportation
2. **Regional Share:** Transformative projects with benefits to the entire region; 20 percent of available funds. Submitted through subregions. DRCOG evaluates and selects.

3. **Subregional Share:** 80 percent of available funds. Subregions receive targeted amounts. Subregions submit, evaluate, select, and recommend projects to the DRCOG Board

The subregional model is new as of the 2020-2023 TIP cycle. It divides the region into 8 subregions according to county boundary. The subregional funding pool is distributed according to a formula weighing population, employment, and vehicle miles traveled (VMT) within each county. All DRCOG-member local governments who are partially or entirely within a given county boundary must be invited to participate in the subregional forum.

Scoring criteria for both regional and subregional share is based on the following categories (although subregional forums may choose to alter the criteria or weighting for the subregional share):

1. Regional Significance (40 percent of score)
2. TIP Focus Area (30 percent of score)
3. Consistency with Metro Vision Objectives (20 percent of score)
4. Leveraging of funds (10 percent of share)

Relevance to CO 52: Roadway, Transit, and Active Transportation – capital costs

Revenue Potential: Total funding programmed by the TIP varies from cycle to cycle. However, the 2020-2023 DRCOG TIP includes approximately \$50 million in set-asides, \$32 million in regional projects, and \$160 million in subregional projects.

NFRMPO Project Selection and Programming Approach

The NFRMPO holds periodic Calls for Projects to award federal funding to transportation projects. The most recent Call for Projects was held in 2018-2019 for funding in FY 2022 and 2023. The previous Call for Projects was held in 2016 for funding in FY2020 and 2021.

During each Call for Projects, member communities can apply for funding from three federal programs: CMAQ; STBG (formerly STP-Metro); and TA (formerly TAP). The NFRMPO process requires sponsors to apply for a specific federal program (as opposed to submitting a general TIP application, as in the DRCOG region).

Projects are scored by a subcommittee composed of TAC members and the Northern Colorado Bicycle and Pedestrian Collaborative. NFRMPO staff lead the discussion and the process, but are not involved in project selection.

Relevance to CO 52: Roadway, Transit, and Active Transportation – capital costs

Revenue Potential: Total funding programmed by the TIP varies from cycle to cycle. However, NFRMPO awarded \$18.7 million in federal funds to projects in as part of the FY 2022-2023 cycle.

EXISTING FEDERAL FORMULA FUNDS PROGRAMMED BY DRCOG AND NFRMPO FHWA Surface Transportation Program

Description: The STBG program provides funding for projects that preserve and improve the conditions and performance on any federal-aid highway, bridge, and tunnel projects on any

public road, pedestrian and bicycle infrastructure, and transit capital projects. Potential project elements that could be eligible for STBG funds include:

- Construction, reconstruction, rehabilitation, resurfacing, restoration, preservation, or operational improvements for highways;
- Capital costs for transit projects;
- Corridor parking facilities;
- Improvements at intersections with high crash rates or levels of congestion; and
- Infrastructure-based ITS capital improvements.

Relevance to CO 52: Roadway, Transit, and Active Transportation – capital costs

Revenue Potential: \$36.1 million in FY 2018, \$41.7 million in FY 2019

FHWA Congestion Mitigation and Air Quality

Description: CMAQ Program funds are available for transportation projects likely to contribute to the attainment or maintenance of a national ambient air quality standard, with a high level of effectiveness in reducing air pollution and congestion. More specifically, to be eligible for CMAQ funding, a transportation project must generate an emissions reduction, and it must be located in or benefit a nonattainment or maintenance area. Potential project elements that could be eligible for CMAQ funds are summarized below. Further, as noted in the list, CMAQ can be used to cover a portion of the increased operating costs associated with the introduction of expanded transit service.

- Planning and engineering activities;
- New or rehabilitation of existing transit facilities (e.g., lines, stations, terminals, transfer facilities) if associated with new or enhanced public transit, passenger rail, or other similar services that will increase transit service capacity;
- Advanced signal and communications systems for transit;
- Fuel, whether conventional or alternative fuel, if part of a project providing operating assistance for new or expanded transit service under the CMAQ program; and
- Operating assistance to introduce new transit service or expand existing transit service.

Relevance to CO 52: Roadway, Transit, and Active Transportation – capital costs

Revenue Potential: \$31.6 million in FY 2018, \$42.6 million in FY 2019

FHWA Transportation Alternatives Program

Description: The TAP is a competitive grant program that provides funding for non-motorized elements of high capacity transit projects. Potential eligible expenses for the corridor could include planning, design, and construction of facilities for pedestrians and bicyclists.

Relevance to CO 52: Active Transportation – capital costs

Revenue Potential: \$2.8 million in FY 2018, \$2.4 million in FY 2019

Existing State Funding Allocation Programs

CDOT receives revenue from five primary sources: state revenues, federal revenues, grants, miscellaneous sources (including the sale of property, permits, and fines), and enterprise revenues. CDOT distributes its funds through a variety of programs, and most of its funding programs are only eligible on state-owned highways. Currently, the three largest sources of revenue for CDOT (FY 2021-2022 Final Budget Allocation Plan, April 2021) are:

1. FHWA revenue – the Highway Trust Fund (\$642 million)
2. The Highway User Tax Fund (HUTF), which is comprised of a combination of federal and State motor fuel taxes, vehicle registration fees, and other sources (\$547 million)
3. SB 17-267 Lease Purchase Agreements (\$500 million)

In addition to the revenue estimates in the FY 2021-22 Budget, CDOT will benefit from the recently passed SB 21-260: Sustainability of the Transportation System. As summarized below, this bill implements several new transportation fees and General Fund transfers, and creates or modifies four state enterprises. Final details and decisions on how the additional funds will be allocated are still being finalized, however it is likely the new funding could benefit the proposed CO 52 corridor projects.

- **New Transportation Fees:** Creates new fees for purchases of gasoline and diesel fuel, electric vehicle registrations, retail deliveries, passenger ride services, and short-term vehicle rentals. It phases in many of the new fees over time and indexes new and existing fees to inflation. Revenue collection for the new fees created in the bill begins in FY 2022-2023.
- **General Fund Transfers:** Authorizes the following transfers from the General Fund:
 - \$170.0 million to the State Highway Fund on July 1, 2021
 - \$10.5 million to the Multimodal Transportation and Mitigation Options Fund annually from 2024 through 2031
 - \$7.0 million to the Revitalizing Main Streets program annually from 2024 through 2031
 - \$100.0 million to the State Highway Fund annually from 2024 through 2028
 - \$82.5 million to the State Highway Fund annually from 2029 through 2031

Additionally, SB 21-260 authorizes the transfer of \$380 million from the federal American Rescue Plan Act of 2021 to transportation:

- \$182.2 million to the State Highway Fund
- \$161.3 million to the Multimodal Transportation and Mitigation Options Fund
- \$36.5 million to the Highway Users Tax Fund – 55 percent to counties and 45 percent to municipalities
- **New and Modified State Enterprises**
 - **Community Access Enterprise:** Creates the Community Access Enterprise in the Colorado Energy Office to support the widespread and equitable adoption of electric vehicles by investing in transportation infrastructure, providing grants or other financing options to fund the construction of electric vehicle charging

- infrastructure, and incentivizing the acquisition of electric vehicles. Revenue from the Community Access Retail Delivery Fee is deposited in the Community Access Enterprise Fund, which is continuously appropriated to the Enterprise.
- Clean Fleet Enterprise: Creates the Clean Fleet Enterprise in the Colorado Department of Public Health and Environment to incentivize and support the use of electric and alternative fuel vehicles by business and governmental entities that own or operate motor vehicle fleets. Revenue from the Clean Fleet Retail Delivery Fee and the Clean Fleet Per Ride fee are deposited in the Clean Fleet Enterprise Fund, which is continuously appropriated to the Enterprise.
 - Clean Transit Enterprise: Creates the Clean Transit Enterprise in CDOT to reduce and mitigate the adverse environmental impacts and health impacts of air pollution and greenhouse gas emissions by supporting the replacement of existing gasoline and diesel transit vehicles with electric motor vehicles. Revenue from the Clean Transit Retail Delivery Fee is deposited in the Clean Transit Enterprise Fund, which is continuously appropriated to the Enterprise. The Transportation Commission is authorized to loan money to the Clean Fleet Enterprise to defray expenses incurred by the enterprise before it receives fee revenue or bond proceeds.
 - Nonattainment Area Air Pollution Mitigation Enterprise: Creates the Nonattainment Area Air Pollution Mitigation Enterprise in CDOT to mitigate the environmental and health impacts of increased air pollution for motor vehicle emissions in nonattainment areas resulting from the growth in transportation network company rides and retail deliveries. Revenue from the Air Pollution Mitigation Retail Delivery Fee and the Air Pollution Mitigation Per Ride Fee are deposited in the Nonattainment Area Air Pollution Mitigation Enterprise Fund, which is continuously appropriated to the Enterprise. The Transportation Commission is authorized to loan money to the Nonattainment Area Air Pollution Mitigation Enterprise to defray expenses incurred by the enterprise before it receives fee revenue or bond proceeds.
 - Colorado Bridge and Tunnel Enterprise: Changes the name and scope of the Statewide Bridge Enterprise to the Statewide Bridge and Tunnel Enterprise and authorizes it to impose a Bridge and Tunnel Impact Fee on diesel fuel and a Bridge and Tunnel Retail Delivery Fee. Revenue from the Bridge and Tunnel Retail Delivery Fee and the Bridge and Tunnel Impact fee are deposited in the existing Statewide Bridge Enterprise Special Revenue Fund.

The following section summarizes how CDOT's allocates annual revenues across several funding programs. The proposed CO 52 corridor improvements would be eligible for funding under CDOT's Core Functions: Capital Construction, Suballocated Programs and Multimodal Services. As the projects within the corridor move through planning and design, it will be important to coordinate with CDOT Region and Headquarter staff to pursue funding from these programs at the appropriate time. Additionally, where applicable the categories and descriptions of the Revenue Allocation Programs should be revisited as purpose and need statements are

developed for individual investments to make an early connection between the objective of the investment and potential CDOT funding.

Capital Construction

CDOT's construction program includes 14 construction programs organized into three categories: Asset Management, Safety, and Mobility.

Asset Management: Surface Treatment

Description: The Department's surface treatment program maintains the quality of the pavement on state highways at the highest possible level. Department staff utilizes pavement management software and annual data collection to make recommendations on the segments of the state highway system that should be prioritized for rehabilitation. The main sources of funding for the surface treatment program are State Highway Funds and federal reimbursement for eligible expenditures.

Relevance to CO 52: Roadway (pavement rehabilitation only)

Revenue Potential (statewide): \$223.0 million (FY 2021-2022)

Asset Management: Structures

Description: This program provides inspection and inventory of the statewide structures, manages all essential repairs and critical findings for statewide structural asset programs, and evaluates permits required for oversize and overweight vehicles. The main sources of funding for the surface treatment program are State Highway Funds and federal reimbursement for eligible expenditures.

Relevance to CO 52: Roadway (bridge repairs)

Revenue Potential (statewide): \$62.0 million (FY 2021-2022)

Asset Management: System Operations

Description: This program is focused on implementing new and innovative technology, deploying and integrating statewide Intelligent Technology Systems (ITS), incorporating automated performance measures, and extending technical resources to CDOT regions in the areas of traffic signal and ramp metering. This program also leads and/or participates in the development and implementation of arterial and freeway management strategies throughout the state.

Relevance to CO 52: Roadway (ITS and TSMO)

Revenue Potential (statewide): \$34.0 million (FY 2021-2022)

Asset Management: Geohazards Mitigation

Description: Mountain and canyon corridors are affected by several geologic hazards such as debris flow, embankment distress, landslides, rockfalls, rockslides, and sinkholes. The Geohazards Mitigation program designs mitigation plans, reviews consultant designs, performs

site inspections during construction, and responds to rock falls, and other geological hazards-related emergencies. Other work includes responding to requests from Maintenance, Engineering, and the public when slope issues are observed. The current inventory of recognized geological hazards throughout the state is just over 3,000.

Relevance to CO 52: Roadway (recognized geohazards in the corridor only)

Revenue Potential (statewide): \$10.0 million (FY 2021-2022)

Asset Management: Permanent Water Quality Mitigation

Description: The primary goal of the Permanent Water Quality (PWQ) program is to treat pollution in stormwater from CDOT roadways before it flows into Colorado's rivers, lakes and streams. Pollutants from CDOT roadways include oil and grease, copper, any fluids from vehicles, lead and chloride. The PWQ Control Measures (CMs) that clean these pollutants from stormwater include swales, basins or ponds, and porous surfaces. Each of these CMs capitalizes on natural mechanisms, such as sediment removal or infiltrating water through the ground, to eliminate roadway pollutants from entering surface and ground water. The PWQ program is a regulatory program that is evaluated by the Colorado Department of Public Health and Environment through CDOT's storm water (MS4) permit. CDOT Headquarters staff support Regions in assessing whether or not PWQ CMs are required on transportation projects, in tracking CMs in a statewide inventory, and in ensuring CMs are inspected and maintained to promote healthy Colorado water. The scenic byways throughout Colorado are maintained and improved through CDOT's PWQ program.

The main source of revenue for this program is the State Highway Fund and federal reimbursement for eligible expenditures.

Relevance to CO 52: Roadway (water quality and stormwater improvements only)

Revenue Potential (statewide): \$6.5 million (FY 2021-2022)

Safety: Highway Safety Improvement Program

Description: The primary goal of the Highway Safety Improvement Program (HSIP) is to achieve a significant reduction in fatalities and serious injuries on all publicly maintained roads. This includes public roads not owned by the state and roads on tribal lands. To comply with this program, CDOT is required to:

- Develop a strategic highway safety plan (SHSP) that identifies and analyzes highway safety problems and opportunities
- Create projects to reduce the identified safety problems
- Evaluate and update the SHSP on a regular basis

Relevance to CO 52: Roadway, Freight and Active Transportation

Revenue Potential (statewide): \$33.1 million (FY 2021-2022)

Safety: Railway-Highway Crossings Program

Description: The Railway-Highway Crossings Program, also referred to as the Section 130 program, is a federally mandated program for the elimination of hazards at railway-highway crossings. The purpose of the Section 130 program is to reduce the number of injuries and fatalities at public rail crossing throughout the state. Nationwide, since the program's inception in 1987 through 2014, fatalities at public crossings have decreased by 57 percent. The overall reductions in fatalities come despite an increase in the vehicle miles traveled on roadways and an increase in the passenger and freight traffic on the railways.

Relevance to CO 52: Roadway and Freight

Revenue Potential (statewide): \$3.6 million (FY 2021-2022)

Safety: Hot Spots

Description: Hot Spots is a CDOT safety program that is funded in a statewide pool with planning estimates from each Region. The purpose of the Hot Spots program is to:

- Mitigate minor unforeseen safety issues that need immediate attention.
- Add money to an ongoing project to mitigate unforeseen safety issues discovered during the project process.

Relevance to CO 52: Roadway – capital and operating costs

Revenue Potential (statewide): \$2.2 million (FY 2021-2022)

Safety: FASTER Safety

Description: FASTER Safety funding is used for road safety projects, defined in statute as a construction, reconstruction, or maintenance project the Transportation Commission, a county, or a municipality determines is needed to enhance roadway safety. Projects that have been funded with FASTER safety funding include pavement and other asset management projects, intersection and interchange improvements, shoulders and safety-related widening, and wildlife fencing.

In 2014, the Transportation Commission approved new administration of the FASTER Safety program. CDOT FASTER road safety funding is now allocated to two statewide programs administered by CDOT headquarters: FASTER Safety Asset Management and FASTER Safety Mitigation. CDOT headquarters coordinates with the Regions to select projects for delivery by the regions.

Relevance to CO 52: Roadway (must be defined as addressing a safety issue)

Revenue Potential (statewide): \$68.0 million (FY 2021-2022)

Safety: ADA Compliance

Description: For CDOT and its sub-recipients, ADA services or activities are any that are transportation related, including but not limited to: roadways, contiguous walkways, intersections, rest areas, roadside emergency telephones, public conveyances such as buses and light rail, and literature related to any of these. CDOT is pursuing an aggressive strategy of upgrading curb

ramps through regular program delivery, as well as committing dedicated funding toward curb ramp upgrading to achieve ADA compliance within five years.

Relevance to CO 52: Roadway and Active Transportation (must address ADA needs and requirements)

Revenue Potential (statewide): \$21.4 million (FY 2021-2022)

Mobility: Regional Priority Program

Description: The objective of the Regional Priority Program (RPP) is to supplement the formula-driven funding allocations to the five CDOT engineering regions with flexible funding for use at the discretion of each Regional Transportation Director in consultation with local elected officials and other stakeholders in each region. This is accomplished through the transportation planning process. RPP funds are distributed to the CDOT Regions according to a formula based on 50 percent population, 35 percent state highway system lane miles, and 15 percent state highway system truck Vehicle Miles Traveled (VMT). The RPP is funded through annual Transportation Commission allocations of State Highway Funds with federal reimbursement for eligible expenditures.

Relevance to CO 52: Roadway

Revenue Potential (statewide): \$48.4 million (FY 2021-2022)

Mobility: Strategic Projects

Description: Funding from General Fund transfers that primarily goes to strategic construction projects. This category currently includes funding from: SB 17-267, SB 18-001, and SB 19-262.

Relevance to CO 52: Roadway, Transit, Freight, and Active Transportation

Revenue Potential (statewide): \$450 million (FY 2021-2022)

Mobility: National Highway Freight Program

Description: The National Highway Freight Program (NHFP) is a formula-based program with the purpose of improving the efficient movement of freight on the National Highway Freight Network (NHFN). The NHFN includes the interstates, several small segments of other corridors important to freight movement, and approximately 240 miles of Critical Urban and Critical Rural Freight Corridors to be designated by the state.

Relevance to CO 52: Freight

Revenue Potential (statewide): \$23 million (FY 2021-2022)

Suballocation Process

CDOT administers several suballocated programs, passing funds through to local agencies to prioritize and deliver transportation improvements, including the previously described DRCOG and NFRMPO project selection processes. This includes transit grant programs and programs such as STP-Metro and CMAQ that are used for a variety of highway and multimodal improvements. The following provides an overview of the suballocated programs for Highways and Transit and Multimodal

Highways: STP-Metro

Description: The STP is a federally mandated program that provides flexible funding to states and localities for projects to preserve and improve the conditions and performance on:

- any Federal-aid highway, bridge, and tunnel projects on any public road;
- pedestrian and bicycle infrastructure; and
- transit capital projects, including intercity bus terminals.

STP-Metro is a sub-program of STP for urbanized areas with populations greater than 200,000. Project selection for STP-Metro funds is conducted by federally designated regional Transportation Management Areas (TMAs) comprised of local governments. As described earlier, DRCOG and NFRMPO would select CO 52 corridor projects funded with STP-Metro funds.

Relevance to CO 52: Roadway, Transit, Freight, Active Transportation

Revenue Potential (statewide): \$56 million (FY 2021-2022)

Highways: Congestion Mitigation & Air Quality

Description: CMAQ is a federally mandated program, the objective of which is to improve air quality in nonattainment and maintenance areas for ozone, carbon monoxide, and particulate matter. These include the areas of the NFRMPO and DRCOG Funds may be used for transportation projects designed to contribute to the attainment or maintenance of national ambient air quality standards (NAAQS), with a high level of effectiveness in reducing air pollution.

Eligible activities include:

- Establishment or operation of a traffic monitoring, management, and control facility, including advanced truck stop electrification systems, if it contributes to attainment of an air quality standard;
- Projects that improve traffic flow, including projects to improve signalization, construct HOV lanes, improve intersections, add turning lanes, improve transportation systems management and operations that mitigate congestion and improve air quality, and implement ITS and other CMAQ eligible projects, including projects to improve incident

and emergency response or improve mobility, such as real-time traffic, transit, and multimodal traveler information;

- Purchase of integrated, interoperable emergency communications equipment;
- Projects that shift traffic demand to nonpeak hours or other transportation modes, increase vehicle occupancy rates, or otherwise reduce demand;
- Complete diesel retrofits of fleet vehicles;
- Development of alternative fueling infrastructure and assistance in the conversion of public and private fleets to alternative fuel vehicles such as compressed natural gas (CNG), propane, or electric vehicles; and
- Expanded authority to use funds for transit operations.

As described in Section 3.3.2, DRCOG and NFRMPO would select CO 52 corridor projects funded with CMAQ funds.

Relevance to CO 52: Roadway, Transit, and Active Transportation

Revenue Potential (statewide): \$51 million (FY 2021-2022)

Highways: Off-System Bridge Program

Description: The Joint Highway Commission oversees the program and accepts project applications on an annual basis. The program improves public safety and reduces ongoing maintenance costs associated with aging infrastructure. The structure must be located on a rural minor collector or urban or rural local road.

Relevance to CO 52: Roadway

Revenue Potential (statewide): \$11 million (FY 2021-2022)

Transit and Multimodal: Safe Routes to School

Description: Colorado established the Safe Routes to School (SRTS) program in 2004 to distribute federal and state funding to eligible projects that improve safety for pedestrians and bicyclists in school areas, and encourage children in kindergarten through 8th grade to safely bicycle and walk to and from school.

Eligible activities include but are not limited to:

- planning, design, and construction of safe school routes for children to walk and bike to and from school;
- planning, design, and construction of facilities for pedestrians and bicyclists to travel to and from school; and
- educating children, parents, and communities about safe walking and bicycling practices and the health benefits that result from walking and bicycling to and from school.

Funds are awarded through a statewide competitive process for construction and education projects chosen by an advisory committee appointed by CDOT's executive director.

Relevance to CO 52: Active Transportation

Revenue Potential (statewide): \$3.1 million (FY 2021-2022)

Transit and Multimodal: Transportation Alternatives

Description: The TAP is a program established under Section 1122 of MAP-21 and continued as a set-aside under Section 1109 of the FAST Act. The TAP provides funding for bicycle, pedestrian, historic, scenic, and environmental mitigation transportation projects. Eligible activities include but are not limited to:

- Construction, planning, and design of facilities for pedestrians and bicyclists
- Construction of turnouts, overlooks and viewing areas, and preservation of historic transportation facilities
- Some environmental mitigation activities, including vegetation management, and archeological and storm water mitigation related to highway projects
- The recreational trails program

Relevance to CO 52: Active Transportation

Revenue Potential (statewide): \$12 million (FY 2021-2022)

Transit and Multimodal: Transit Grant Programs

Description: Each year CDOT provides funding to local entities for transit projects. This funding comes from federal transit funding and state FASTER funding. The FASTER legislation authorized \$15 million each year for transit funding. Of this funding, \$5 million in local transit grants are awarded competitively by CDOT regional offices. Local recipients are required to provide a minimum 20 percent local match. Among the types of projects that have been awarded are the purchase or replacement of transit vehicles, construction of multimodal stations, and acquisition of equipment for consolidated call centers. The remaining \$10 million in FASTER transit funding is used for statewide, interregional, and regional projects.

Relevance to CO 52: Transit

Revenue Potential (statewide): \$62 million (FY 2021-2022)

Transit and Multimodal: Multimodal Options Program

Description: SB 18-001 allocated \$94.25 million to the Multimodal Transportation Options Fund. Of this funding, 85 percent (\$80.12 million) must be used for local multimodal projects, and 15 percent (\$14.13 million) must be used for statewide multimodal projects.

Senate Bill 18-001 directed the Transportation Commission to develop a distribution formula based on population and ridership for local government funding. The formula for the local distribution of funding was developed in consultation with the Transit and Rail Advisory Committee, the Statewide Transportation Advisory Committee, transit advocacy organizations, and bicycle and pedestrian organizations. Generally, each funding recipient must match an equal amount to the award they receive from CDOT. However, the Transportation Commission

may reduce or exempt the matching requirement for certain local governments due to size or special circumstances.

Relevance to CO 52: Transit

Revenue Potential (statewide): \$0 (FY 2021-2022) – no additional funding beyond initial SB 18-001 allocation.

Potential Local and Regional Sources

Transportation Funding Entities

This section describes the transportation funding entities that are authorized in Colorado and have the authority to collect one or more of the following revenue sources: property tax; visitor benefit tax; cost assessments; charges, rates, and tolls; vehicle registration fees; and sales tax. The intent of this section is to provide an overview regional entities that could be pursued to support implementation of multi-jurisdictional projects. Additionally, there are different types of improvement districts that local property owners could establish to support local infrastructure improvements that would benefit a specific geographic location.

Metropolitan District

Metropolitan districts provide two or more of the following services: traffic and safety control devices, street improvements, and public transportation. These districts are governed by boards of directors and are formed by a petition and a vote.

The district has the authority to condemn; form a public-private partnership; operate and maintain facilities; collect property taxes; assess costs; collect charges, rates, and tolls; and issue general obligation bonds and revenue bonds.

Association of Metropolitan Districts

An association of metropolitan districts is any combination of metropolitan districts that are authorized to own and operate streets and other transportation facilities. The association may establish by an IGA a new political subdivision to effect the development of transportation facilities in whole or in part for the benefit of the inhabitants of such contracting parties or others at the discretion of the Board of Directors.

If provided for in the IGA establishing the association of metropolitan districts, the various metropolitan districts may be given different weights when voting.

The association has the authority to condemn; operate and maintain facilities; collect property taxes; collect charges, rates, and tolls; and issue general obligation bonds and revenue bonds.

Public Highway Authority

A public highway authority may finance, construct, operate, or maintain all or a portion of a highway or other transportation improvements if the infrastructure is located in more than one municipality or county and therefore cannot be feasibly financed, operated, or maintained by a

single jurisdiction. The authority is governed by a board of directors comprised of at least one elected member from each jurisdiction.

If provided for in the contract establishing the authority, the various jurisdictions may be given different weights when voting. This is beneficial if, for example, a 20-mile highway corridor is spread among three jurisdictions in one 10-mile and two 5-mile sections. The jurisdiction that contains 10 miles of highway may be given more weight in any votes.

The authority is able to condemn; form a public-private partnership; operate and maintain facilities; assess costs; collect charges, rates, and tolls; require vehicle registration fees; and issue revenue bonds.

An example of a public highway authority is E-470.

Regional Transportation Authority

A regional transportation authority (RTA) may finance, construct, operate, or maintain regional transportation systems within or without the boundaries of the authority. An RTA may be formed with an establishing contract and a vote and is governed by a board of directors. Weighted voting is permitted if established within the contract creating the RTA.

An RTA has the authority to condemn; form a public-private partnership; operate and maintain facilities; collect property taxes, visitor benefit taxes, sales taxes, charges, rates, tolls, and vehicle registration fees; and issue revenue bonds.

An example of an RTA is the Pikes Peak Regional Transportation Authority (PPRTA), which was approved in 2004 by voters in the cities of Colorado Springs and Manitou Springs, El Paso County, and the towns of Green Mountain Falls and Ramah. With the approval of the RTA, collection of a 1 percent sales tax started in 2005. Based on the referendum language, the maintenance and transit portion of the sales tax is in perpetuity and the capital portion had a 10-year lifespan. Funding is allocated 10 percent to transit, 55 percent to a defined list of capital projects, and the remainder (35 percent) goes to maintenance. There is a 1 percent administration cap, which has never been reached. Maintenance dollars are allocated among PPRTA members based upon population and adjusted with every new census. Capital dollars are roughly based on population but tend to be allocated more based on the project list.

Public Improvement District

A public improvement district (PID) is formed through a county petition and governed through the county's governing board. A PID may construct, install, acquire, operate, or maintain any public improvement or service if the county is authorized to perform such services or improvements under the county's home-rule charter.

A PID has the authority to condemn; form a public-private partnership; operate and maintain facilities; collect property taxes, charges, rates, and tolls; assess costs; and issue general obligation bonds, revenue bonds, and special assessment bonds.

Local Improvement District

A local improvement district (LID) may construct or improve any street or provide street lighting or drainage facilities in the unincorporated area of a county, or within a municipality, with municipality consent. A LID may also construct sidewalks adjacent to any streets where drainage facilities are provided.

A LID is formed through a petition and resolution or ordinance and is governed by the county or city and county governing board. The LID is dissolved after completion of project and payment of debt and therefore cannot operate and maintain facilities.

A LID has the authority to assess costs; issue general obligation bonds, revenue bonds, and special assessment bonds; and collect sales taxes.

General Improvement District

A general improvement district (GID) is formed through a petition and governed through the municipality's governing board. The GID may acquire, install, construct, operate, or maintain any "public improvement" if the municipality is authorized to perform such services or improvements under the municipality's home-rule charter.

A GID has the authority to condemn; operate and maintain facilities; assess costs; collect property taxes, charges, rates, and tolls; and issue general obligation bonds, revenue bonds, and special assessment bonds.

Business Improvement District

A business improvement district (BID) may acquire, construct, finance, install, operate, and maintain public improvements, including streets, sidewalks, curbs, gutters, pedestrian malls, street lights, drainage facilities, landscaping, decorative structures, identification signs, traffic safety devices, bicycle paths, off-street parking facilities, benches, restrooms, and public meeting houses.

A BID is formed through a petition and resolution or ordinance and is governed by the municipality's governing board.

A BID has the authority to operate and maintain facilities; collect property taxes, charges, rates, and tolls; assess costs; and issue general obligation bonds, revenue bonds, and special assessment bonds.

Regional Service Authority

A regional service authority (RSA) can be formed through a citizen petition or resolution of the majority of counties within the territory, an organization commission, and a vote. The RSA can own and operate public surface transportation and is governed by a 5-, 9-, or 15-person board of directors (depending on population) elected by eligible electors.

An RSA has the authority to condemn; operate and maintain facilities; collect property taxes, charges, rates, and tolls; and issue general obligation bonds, revenue bonds, and special

assessment bonds. However, to date there are no RSAs in Colorado that are transportation focused

Other Potential Local Sources

Temporary Mill Levy Increase for Specific Projects:

Description: Temporarily increase the local mill levy for a specific transportation improvement. This approach would require voter approval. An example of this approach is Larimer County, which temporarily increased the Road & Bridge Fund Mill Levy share of the total current county-wide mill levy to implement the I-25 Improvement Project.

Relevance to CO 52: Roadway, Transit, and Active Transportation

Tax Increment Financing District

Description: Tax Increment Financing (TIF) is a mechanism for capturing the future tax benefits of real estate improvements, in order to pay for the present cost of those improvements. TIF is generally used to channel funding toward improvements in distressed or underdeveloped areas where development would not otherwise occur. TIF is a popular development finance tool generally used to address blight, promote neighborhood stability and inspire district-oriented development.

TIF uses the increased property or sales taxes (increment) generated by new development to finance costs related to the development such as public infrastructure, land acquisition, demolition, and planning. The life of a district can be anywhere from 10 to 40 years, or enough time to pay back the costs or bonds issued to fund the improvements. The tax increment from a TIF district is created without raising taxes, and also without dipping into the base tax revenues present at the time of adoption. The increment thus becomes a repayment stream for debt used to finance some aspects of what is driving the increase.

State law in Colorado authorizes urban renewal authorities (URAs) and downtown development authorities (DDAs) to use TIF for projects that improve blighted areas. TIF allows an authority to issue and repay redevelopment bonds by using the "increment" of increased taxes collected within the TIF district after improvements are made (Section 31-25-101 et seq., C.R.S.). Tax increment revenue may be generated from property or sales taxes.

Relevance to CO 52: Roadway, Transit, and Active Transportation

Development Mitigation/Impact Fees

Description: An impact fee is a one-time charge imposed by local governments to mitigate the impact on local infrastructure caused by new development. Growth in the form of new homes and businesses requires expansion or enlargement of public facilities to maintain the same level and quality of public services for all residents of a community. Impact fees help fund expansion of public facilities necessary to accommodate new growth.

Impact fees may be assessed by cities, counties, and special districts. The governing body approves an impact fee ordinance imposing the fees, following the requirements of the Impact Fees Act.

Relevance to CO 52: Impact fees may be used for permanent buildings and other physical facilities owned by the local government which have a life expectancy of more than 10 years. A local government may charge impact fees to fund the following public facilities:

- Water systems and water rights

- Roads
- Wastewater systems
- Stormwater control systems
- Parks
- Municipal power facilities
- Public safety facilities (e.g. police and fire facilities)

Real Estate Transfer Tax

Description: Real estate transfer taxes are taxes imposed on the transfer of title of real property. In most cases it is an ad valorem tax that is based on the value of the property transferred. A majority of states and the District of Columbia provide for this tax, and the state statutes may or may not stipulate who (buyer or seller) is responsible for paying the tax. In addition, most statutes list a number of cases where the transfer is exempt from taxation.

A real estate transfer tax ensures that a city/jurisdiction benefits financially from any major speculative land purchases prior to the implementation of any of the major transportation projects, as developers may seek to acquire parcels adjacent to the future alignments/locations.

Revenue Potential: The Colorado transfer fee rates is 0.01 percent, the lowest in the nation among states that provide for this tax. This type of revenue source is subject to wide year-to-year fluctuations due to real estate cycles.

Relevance to CO 52: Roadway, Transit, and Active Transportation

Land Contribution or Other Asset Sales

Description: Revenues generated from the disposition of excess land owned by cities or local agencies, including right-of-way contributions. Disposition agreements by affected agencies should dedicate proceeds from sales toward specific projects.

Relevance to CO 52: Roadway, Transit, and Active Transportation

Developer Contributions

Description: Developers along or adjacent to a proposed infrastructure alignment that offer to provide right-of-way to the project to support implementation.

Relevance to CO 52: Roadway, Transit, and Active Transportation