The Colorado Department of Transportation (CDOT) **Region 1**

BICYCLE & PEDESTRIAN SAFETY STUDY

Final Report

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Table of Contents

List of Figures

List of Tables

List of Appendices

EXECUTIVE SUMMARY

The goal of this study is to improve the safety of the bicycle and pedestrian network on CDOT roads within Region 1 (Adams, Arapahoe, Broomfield, Clear Creek, Denver, Douglas, Gilpen and Jefferson Counties). A Technical Advisory Committee (TAC) consisting of up to two staff from each of the Cities and Counties within Region 1, plus Colorado Department of Transportation (CDOT), Federal Highway Administration (FHWA) and Denver Regional Council of Governments (DRCOG) staff guided the inputs and assumptions during the study, while local agencies and the public provided feedback on areas of concern and ideas for improvement through a robust online survey called MetroQuest. This document provides a guide to identifying areas of higher potential risk, areas of bicycle and / or pedestrian concern, and a list of safety countermeasures that could apply to state or local roadways.

HOW TO USE THIS DOCUMENT

This document is intended to serve as a tool to help municipal staff, elected officials, and community stakeholders improve bicycle and pedestrian safety on CDOT roads throughout Region 1. This study evaluated all CDOT roads within Region 1 and identified a set of priority locations for which safety countermeasures and conceptual designs were developed. While many locations within the region were identified as having an elevated level of risk or high demand for bicycle and pedestrian improvements, the scope of this project was limited to 11 top locations. Despite the limited number of top locations selected, there are several elements of this study that cities, counties, and stakeholders can use in pursuing transportation safety grants and prioritizing and budgeting for safety improvements on state and local roadways within the region.

Corridor Risk

The process for identifying top locations included two steps: 1) crash identification, and 2) systemic evaluation. Figure 5 within this report shows the crash scores for every ½ mile segment of state roads within the region. The segments with the highest scores are those with the largest number and/or severity of crashes, representing an elevated level of risk and likely a greater need for the introduction of safety countermeasures.

The second piece of the study included a systemic evaluation which looked at the roadways where crashes occurred and identified specific features (i.e. speed, volume, number of lanes, shoulder width, etc.) that correlated to an increased level of risk. These risk factors were scored and the combined score by ½ mile segment of road is shown in Figure 38 of this report. The roads with the highest scores are associated with the highest level of systemic risk. When preparing safety grant applications, this report can be referenced to show the level of risk (crash and/or systemic) a specific corridor was shown to exhibit.

Bicycle/Pedestrian Demand & Areas of Concern

During this study, an online survey tool was used to gather feedback from local agency staff, advocacy groups, and the general public. Over 2,300 people responded to the survey, providing over 5,800 data points on the mapping portion of the survey. The full dataset of responses was provided to the TAC members during this project and can be used to identify areas of concern, interest, or demand for bicycle and pedestrian improvements. Once this project is complete, CDOT can be contacted directly for the dataset, which includes a map showing where comments were located and the comments themselves.

Safety Countermeasures

Reviewers can consider and apply the countermeasures identified in this report to improve bicycle and pedestrian safety at intersections or along roadway segments. While CDOT roadways were the focus of this project, countermeasures may be considered for both state and local facilities.

As previously indicated, the project team identified 11 specific locations throughout the region. For each location, a set of countermeasures was identified to address specific crash patterns, risk factors, or field observations. Users of this report should review the 11 locations and their identified crash patterns and field observations to determine if they are dealing with comparable facilities or intersections. Figures 44 through 57 provide detail on the crash data, field observations and potential countermeasures for each of the top locations. As users of this report identify comparable facilities, the countermeasures, concept designs and cost estimates on Figures 58 through 74 may prove valuable for future planning / design work and budgeting purposes.

As requested by the TAC, the final section of the report "Acceptable Countermeasures" provides a sample of acceptable countermeasures, resources where additional measures can be found, and links to sites containing design guidance, cost estimates, research, and case studies

NETWORK SCREENING

The primary analysis for this study was a network screening comprised of two components, 1) bicycle and pedestrian crash analysis and 2) systemic safety analysis was conducted to identify roadways with a history of severe bicycle and pedestrian crashes, high crash density, or potential for a higher risk of crashes.

The crash analysis included the latest five (5) years of available bicycle and pedestrian crash data (July 2015 thru June 2020). Only bicycle and pedestrian crashes on CDOT roads within Region 1 were evaluated due to the size of the region and CDOT's ability to program state funds and maintenance. A total of 2,222 bicycle and pedestrian crashes were identified.

As shown on Figures ES1 and ES2, pedestrian crashes accounted for 68 percent of the 2,222 crashes and 94 percent of the fatalities, indicating that pedestrians are at higher risk for fatalities. Figures ES3 and ES4 show the regional distribution of bicycle and pedestrian crashes. Pedestrian crashes were more distributed across the region than bicycle crashes.

Figure ES 1: Bicycle & Pedestrian Crashes

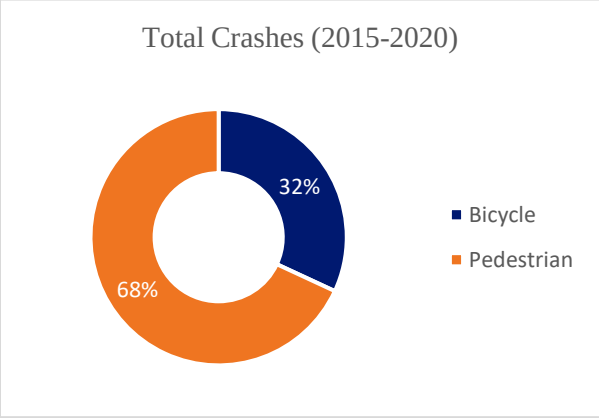


Figure ES 2: Bicycle & Pedestrian Fatalities

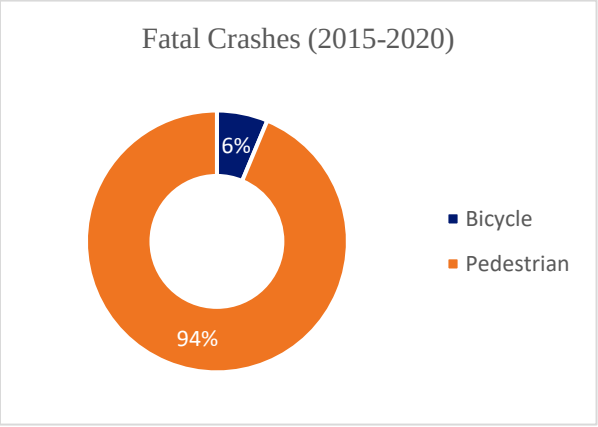


Figure ES 3: Bicycle Crash Locations (2015-2020)

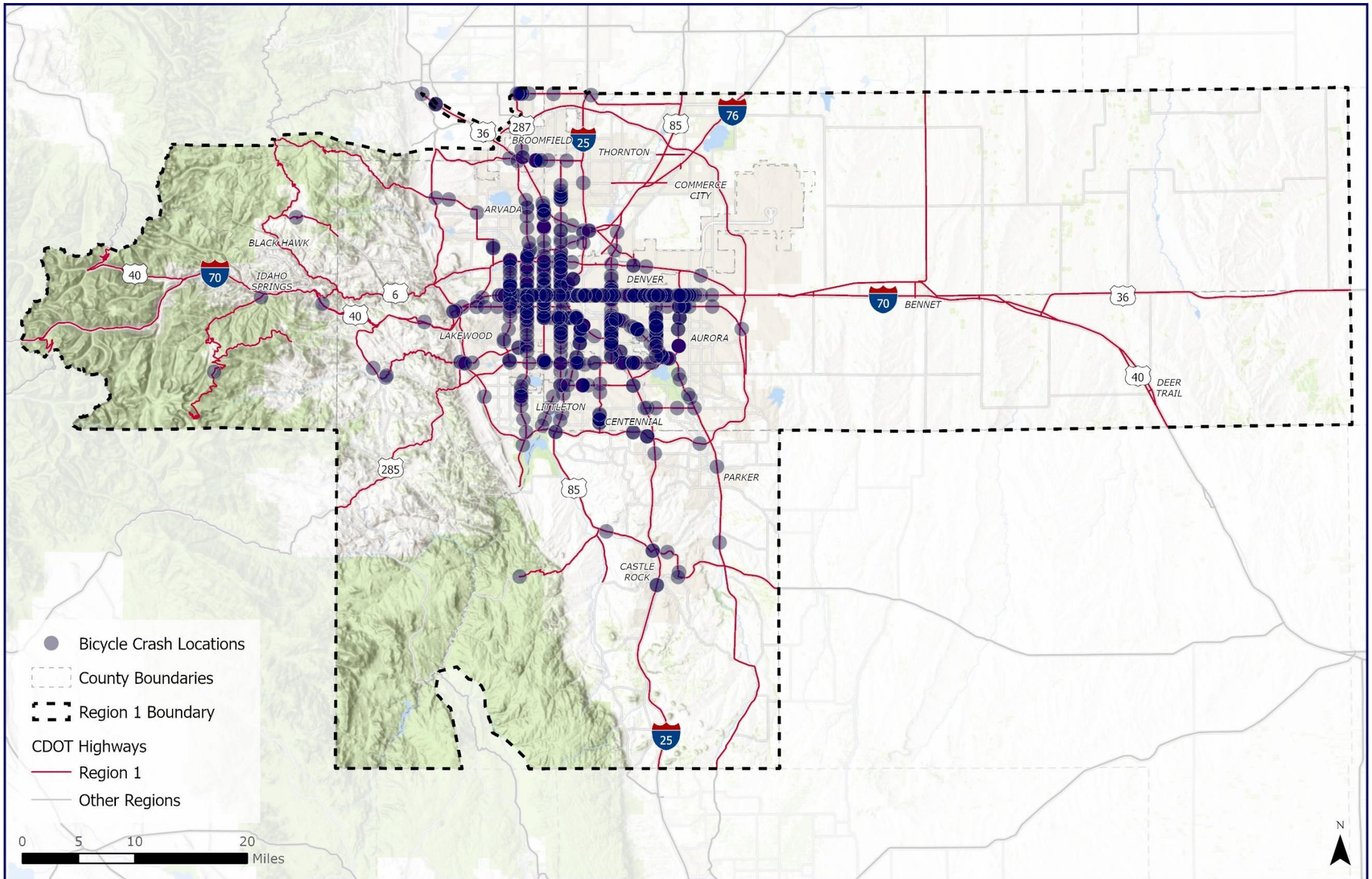
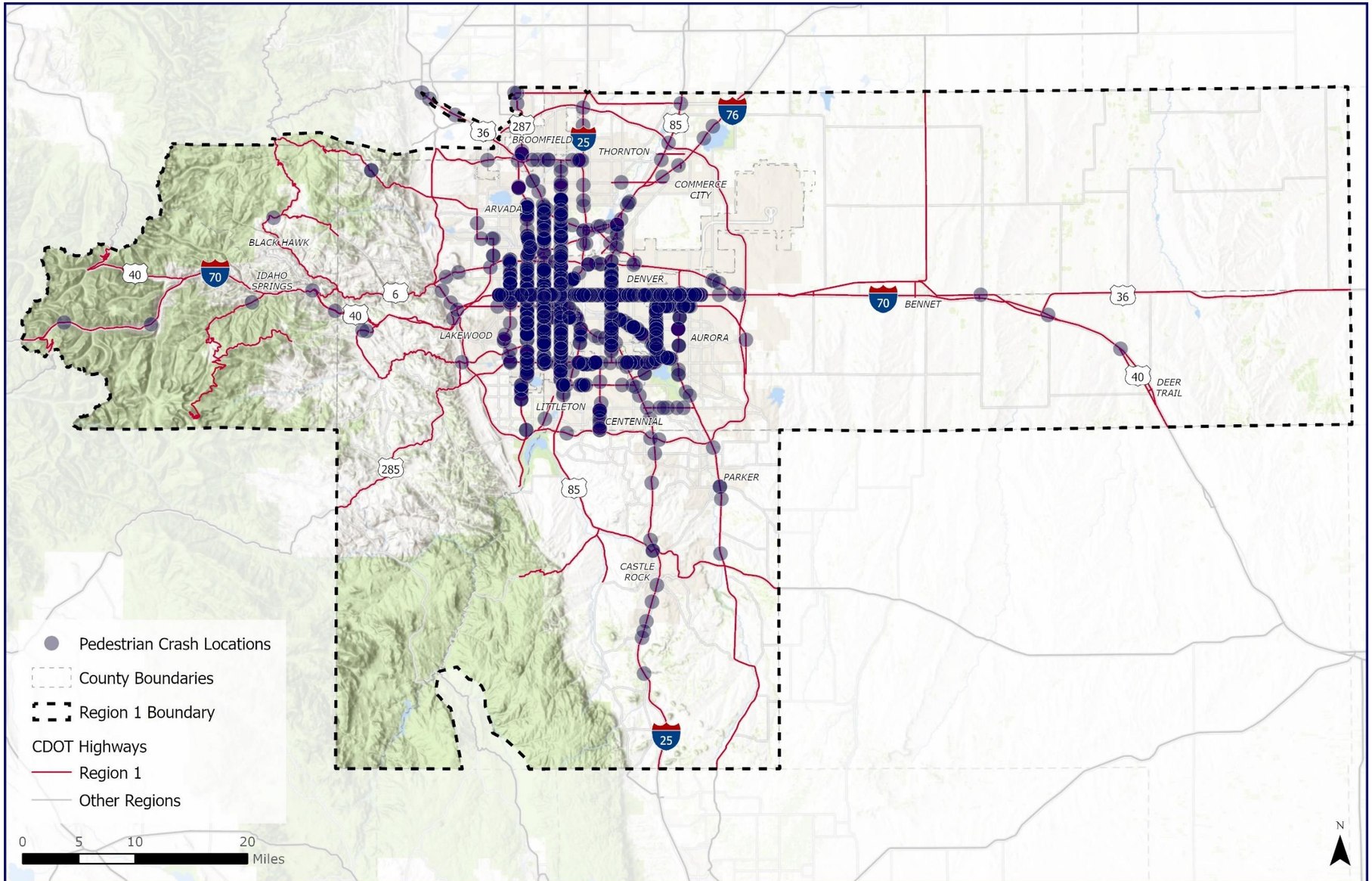


Figure ES 4: Pedestrian Crash Locations (2015-2020)



Pedestrian Crash Locations (2015 - 2020)

For the network screening, the roadway network was divided into ½ mile segments. Each segment was assigned a crash score based on the presence and severity of bicycle and pedestrian crashes. Segments and intersections with high crash scores were evaluated and a list of top crash locations identified. Systemic risk features were developed based on the roadway characteristics of the high scoring crash segments and each ½ mile segment of the network was scored for risk. Figure ES 5 illustrates the resulting systemic risk score per segment for the region.

Concurrent with the network screening and risk analysis, a MetroQuest interactive online survey was conducted. The survey resulted in over 2,300 people identifying over 5,800 points of concern associated with pedestrian and bicycle travel in Region 1. Concentrations of comments within MetroQuest were evaluated and added to a list of MetroQuest hot spot locations that were cross referenced with the systemic risk scores and placed in order of highest to lowest systemic risk score. The resulting list is referenced throughout the report as the top systemic locations.

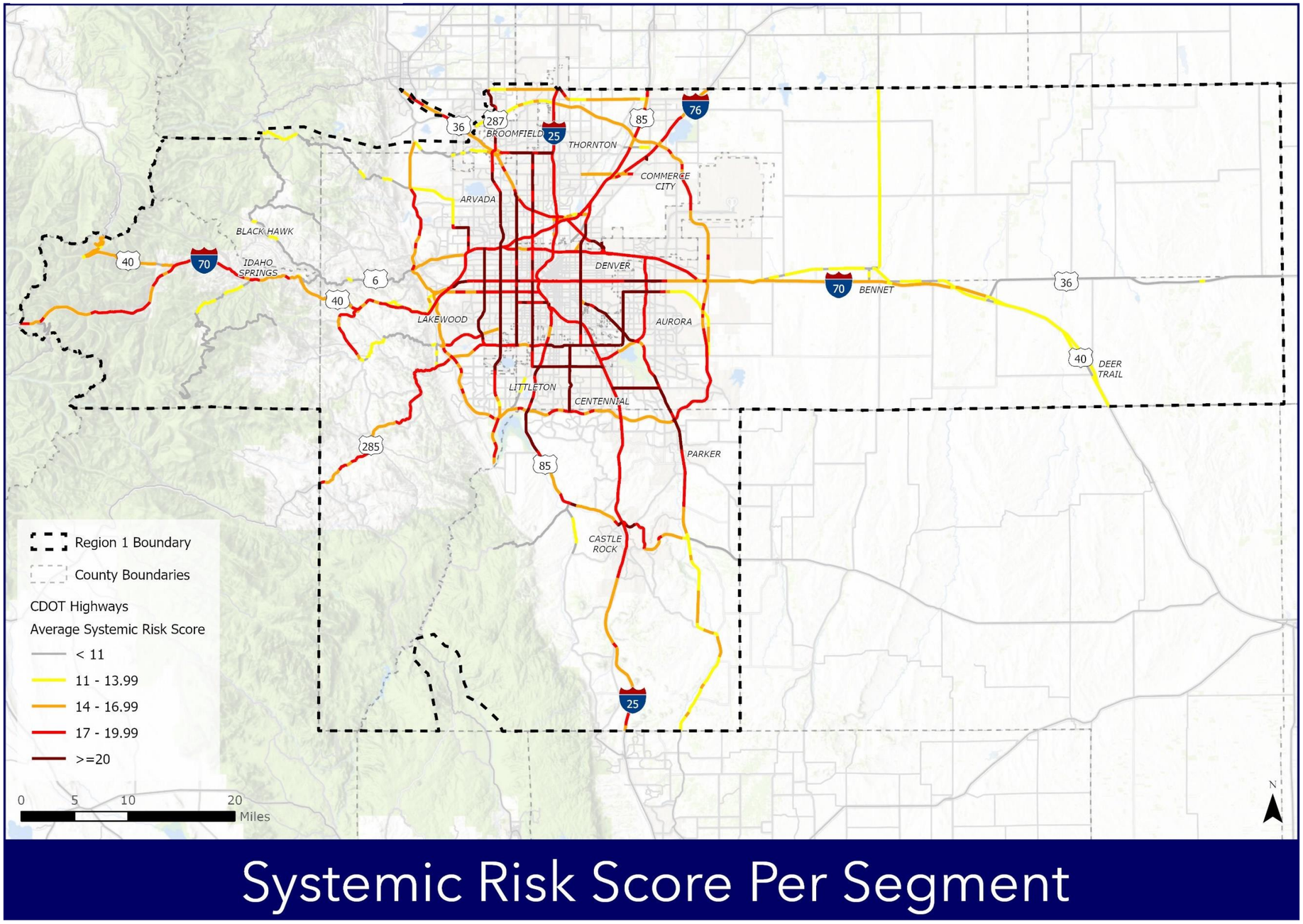
TOP LOCATIONS

CDOT's goal for this study was to identify top locations both from the crash analysis, and the more proactive approach to safety, the systemic analysis. Five of the top locations came from the list of bicycle and pedestrian crash hot spots, and the remaining six locations were selected from the top systemic locations. The list of top locations is shown in Table ES1, below.

Table ES 1: Top Locations

Local Agency	*Top Locations*	*Type*
Aurora	Segment of Colfax from Moline to Peoria	Crash
Aurora	Intersection of Colfax/Havana	Crash
Glendale	Intersection of Colorado/Mississippi	Crash
Aurora	Intersection of Colfax/Moline	Crash
Aurora	Intersection of Colfax/Chambers	Crash
Westminster / Adams Co	Intersection of US 287 (Federal Blvd) / 70th Ave	Systemic
Wheat Ridge	Intersection of Wadsworth / 32nd and Wadsworth from 32nd to 35th	Systemic
Wheat Ridge / Lakewood	Intersection of Wadsworth / 26th and Wadsworth from 26th to 29th	Systemic
Bennett	Intersection of Colfax / Adams	Systemic
Bennett	Palmer Ave from Colfax to 8th	Systemic
Bennett	Intersection of 1st St / Centennial	Systemic

Figure ES 5: Systemic Risk Score Per Segment



SAFETY COUNTERMEASURES

An evaluation of the top locations was completed, available bicycle and pedestrian crash data were reviewed to identify any patterns in the data or unique characteristics related to each location, and MetroQuest comments were reviewed to better understand existing concerns. Traffic counts were collected and reviewed, and field evaluations were conducted to gather a better understanding of the specific conditions of each site. Traffic patterns were observed, site specific challenges noted, and various safety countermeasures were considered. For each of the top locations, a detailed summary of the bicycle and pedestrian crash results, field observations, and safety countermeasures are provided in Figures 44 thru 57 of the final report. Concept designs, crash modification factors, cost estimates, and benefit to cost ratios for each of the top locations are included in Figures 58 through 74 of the report. A summary of the top countermeasures for each location is included in Table ES2 below.

Table ES 2: Top Countermeasures by Location

Local Agency	*Top Locations*	*Top Countermeasure*
Aurora	Segment of Colfax from Moline to Peoria	• Add a marked crossing with a pedestrian refuge and HAWK signal between Nome Street and Oswego Street
Aurora	Intersection of Colfax/Havana	• Curb extensions in the northwest and southeast corners and queue jumps for eastbound and westbound buses • Evaluate the feasibility of passive pedestrian detection
Glendale	Intersection of Colorado/Mississippi	• Modify left turn signal phase to protected by pedestrian call
Aurora	Intersection of Colfax/Moline	• Curb extensions in the northwest and southeast corners
Aurora	Intersection of Colfax/Chambers	• Add right-turn channelization from Colfax Avenue to Chambers Road
Westminster / Adams Co	Intersection of US 287 (Federal Blvd) / 70th Ave	• Complete sidewalk connectivity on the west side and southeast side of Federal Boulevard ○ Update the northwest pedestrian ramp to allow access for pedestrians with disabilities
Wheat Ridge	Intersection of Wadsworth / 32nd and Wadsworth from 32nd to 35th	• Remove northbound right turn lane, tighten southeast corner radius and add a curb extension in the northeast corner • Widen 32nd Avenue to the south to provide east/west bike connectivity at the intersection • Add 6' sidewalk on Wadsworth between 32nd and 35th (both sides)
Wheat Ridge / Lakewood	Intersection of Wadsworth / 26th and Wadsworth from 26th to 29th	• Widen the east leg to connect bike lanes on 26th Avenue in both directions • Add sidewalks on Wadsworth from 26th to 29th (west side) • Fill the sidewalk gap from 26th Ave to 175' south (east side)
Bennett	Intersection of Colfax / Adams	• Curb extension in the southwest corner • Convert intersection to all-way stop with flashing beacons

Bennett	Palmer Ave from Colfax to 8th	• Enlarge triangle median island and extend curb between 5th Street and 6th Street
Bennett	Intersection of 1st St / Centennial Dr	• Widen the raised median island and shift the crosswalk north • Install high-visibility crosswalk striping and add an RRFB

ACCEPTABLE COUNTERMEASURES

TAC members indicated that identification of countermeasures acceptable to CDOT was something they hoped would come out of this study. As a result, Tables 24 and 25, within this report provide a list of resources for identifying acceptable countermeasures, design guidance, best practices, research, and case studies. Many of the countermeasures provided are also great candidates for safety grant funding. Local agencies should work with their respective response team to better understand the cause of crashes so that appropriate countermeasures can be implemented.

Additionally, this section outlines potential funding sources to progress projects into design and implementation. These include the Highway Safety Improvement Program (HSIP), Funding Advancements for Surface Transportation and Economic Recovery Act (FASTER), Revitalizing Main Streets, Safe Routes to School, and the DRCOG Transportation Improvement Program.

NEXT STEPS

This section outlines how CDOT is progressing all of the top locations forward. Improvements for five of the locations will be designed using vision zero funds, HSIP / FASTER grant applications for three of the locations will be prepared, two of the locations were awarded funding during this project, and the final location CDOT will work with the City and County of Denver to implement signal timing adjustments.

IMPROVING THE PLAN

The final section of the report outlines ways that this plan could be improved in the future. Suggestions include enhancing the crash data set by following the Model Minimum Uniform Crash Criteria Guideline (MMUCC)[1]. MMUCC identifies a minimum set of motor vehicle crash data elements and their attributes that States should consider collecting and including in their state crash data system. Additionally, it is suggested that for future studies, datasets such as intersection locations, intersection control (signal versus stop control or roundabout), intersection geometry, on-street parking, access spacing, location of sidewalks to the vehicle travel lane (separated versus adjacent) would be helpful in identifying additional risk factors.

[1] MMUCC | NHTSA

FINAL REPORT

INTRODUCTION

CDOT has historically focused on safety and mobility of vehicles on CDOT roadways. More recently CDOT has shifted to a mentality of improved safety and mobility for all users. Policy Directive 1602 and Procedural Directive 1602.1 state that CDOT will promote transportation mode choice by enhancing safety and mobility for bicyclists on or along the state highway system. Additionally, in 2015, CDOT launched Moving Colorado Towards Zero Deaths, which sets a goal of zero deaths for every individual, family or community using Colorado's transportation network.

The goal of this study was to improve the safety of the bicycle and pedestrian networks on all CDOT roads within Region 1 through the identification of a program of projects and working collaboratively with local agencies on funding opportunities. This study starts with network screening which is an evaluation of crash history and available roadway data to identify roadways with the potential for higher risk. From the network screening and public engagement results, a list of top locations was identified for development of safety countermeasures. The top locations excluded the City and County of Denver as they were working on a similar study that addressed bicycle and pedestrian safety. The top countermeasures were advanced into conceptual designs with estimates of cost.

ENGAGEMENT

Overview

Engagement for this project included a robust online MetroQuest survey and regular meetings with the Technical Advisory Committee (TAC). The MetroQuest survey was made available to the public in both English and Spanish from January 7, 2022 through February 18, 2022, and received over 2,300 responses across the region. A summary of the MetroQuest results is discussed later in this report.

The purpose of the TAC was to discuss progress and assumptions, and garner support on various elements of the project. The TAC consisted of up to two staff from each of the Cities and Counties within Region 1, plus multiple staff from Colorado Department of Transportation (CDOT), Federal Highway Administration (FHWA) and Denver Regional Council of Governments (DRCOG). In order to allow all voices to be heard, the TAC was originally broken into East and West, and each TAC meeting held twice. This method was used for the first two TAC meetings, after which it was determined that a single TAC meeting would provide more benefit to the members and subsequent meetings were each held once. A summary of the first round of TAC meetings is provided below. Summaries of the remaining TAC meetings are provided in the relevant sections of the report.

TAC #1 – Project Overview

The first round of TAC meetings was held on January 6, 2022 and included a discussion of TAC roles & responsibilities and the project study area, goals, overview, and schedule. During this meeting participants were polled on their thoughts regarding what they hoped the project would achieve, their top two project selection priorities and how the project could benefit their municipality in the long-term. The TAC's top

two priorities for selecting projects were safety and network connectivity. TAC members' goals for this project and ways they said the project could support the local agencies included:

- Coordinating with Local Agencies
  - To work together on projects where CDOT and County/City roads interface or roads that form the border of two local agencies
  - Improving the bike/pedestrian network on Sheridan between 17th and 41st
  - To provide connectivity between jurisdictions
  - To have consensus with local agencies on areas where improvements are needed
- Safety/Multimodal
  - Provide safety for all users
  - To make downtowns multimodal
  - Incorporate safe bikeways that reduce traffic
  - Increase safety and access on CDOT roads and arterial streets
  - Focus on multimodal safety on/across CDOT roads
- Countermeasures
  - Provide connectivity to existing resources or resources under development
  - Ensure consistency in evaluation and identification of countermeasures
  - Provide innovative countermeasures
  - Provide a better understanding of contributing factors of crashes
  - Develop a data-driven approach to addressing crash patterns
  - Provide adaptations for municipalities
  - Identify proactive rather than reactive improvements
  - Develop a uniform approach for safety throughout the region with a focus on individual locations
  - Identify relevant and applicable improvements for urban versus rural roads
- Other
  - Identify hot spots and prioritize areas of need
  - Develop a strategy for maintenance of separated bikeways
  - Revisit CDOT standards to incorporate bicycle and pedestrian safety
  - Develop Community Education that focuses on Vision Zero, Complete Streets, and Multimodal Transportation

NETWORK SCREENING

Overview

A network screening is the process by which high-risk roadways or intersections are identified. The network screening was completed in two steps; 1) an analysis of bicycle and pedestrian crashes was completed to identify locations with a history of severe crashes, and/or high crash density (hot spots), and 2) a systemic safety analysis was conducted to identify roadways with higher risk for bicycle and pedestrian crashes based on the general roadway characteristics.

The goal for the network screening was to identify locations on the CDOT Region 1 roadway network where the implementation of safety countermeasures would result in a significant increase in safety for bicyclists and pedestrians. The results from the network screening were used to prioritize locations for further study.

Data Collection

Before crash analysis or systemic safety analysis could be completed, available data was gathered and reviewed. Available data from the Colorado Department of Transportation's Online Transportation Information System (CDOT OTIS) and the Denver Regional Council of Governments (DRCOG) was reviewed to determine applicability and usability for this study. Data sources that were associated with a CDOT route and milepost were generally applicable to this study. Route and milepost fields connected the data back to the CDOT highways network in a cohesive manner that enabled route event overlays (dynamic segmentation) to analyze multiple sets of attributes together. Additionally, it should be noted that location (intersection versus non-intersection) and light condition (daylight versus dark) information reported in this study comes directly from the crash database. Many of the linear attributes (AADT, speed, thru lanes, etc.) were sourced directly from the CDOT Highways dataset. In addition, CDOT provided data from their Bicycle Level of Stress analysis, conducted in 2018, which allowed for the incorporation of bike lane and sidewalk data. The complete list of datasets used in the analysis is provided in Table 1.

Table 1: Datasets Used in the Analysis

Datasets Used in the Analysis
Bicycle and Pedestrian Crash Data (July 2015 – June 2020)
Jurisdictional Classification
Functional Classification
Lighting
Speed Limit
Number of Thru Lanes
AADT (2019)
Shoulder Width and Type
V/C Ratio
Sidewalks
Bike Lanes
Median Type

Additional data was identified though DRCOG and was referenced to help prioritize the top locations. Those datasets include:

- Vulnerable Populations by Tract ACS 2015-2019
- Regional High Injury Network and Critical Corridors
- Pedestrian Focus Areas
- Bicycle Facility Inventory

Crash Analysis

Overview

The bicycle and pedestrian crash data was evaluated to identify locations with a history of severe crashes and/or high crash density (hot spots). The crash analysis included the latest five (5) years of available bicycle and pedestrian crash data (July 2015 to June 2020). The year-to-year data indicates that approximately 450 bicycle and pedestrian crashes occur annually, however, between January 1, 2020 and July 1, 2020, only 144 crashes had been reported, indicating either a potential decline in bicycle and pedestrian crashes or fewer crashes occurring in the first half of the year. Only crashes on CDOT roads within Region 1 were evaluated due to the size of the region and the availability of crash data on local roads. It is important to note that the crash analysis only included reported crashes. Some cities across the U.S. have compared crash reports with hospital discharge, noting that a large percentage (45%) of bicycle/pedestrian injuries resulting from a traffic crash have not been reported.

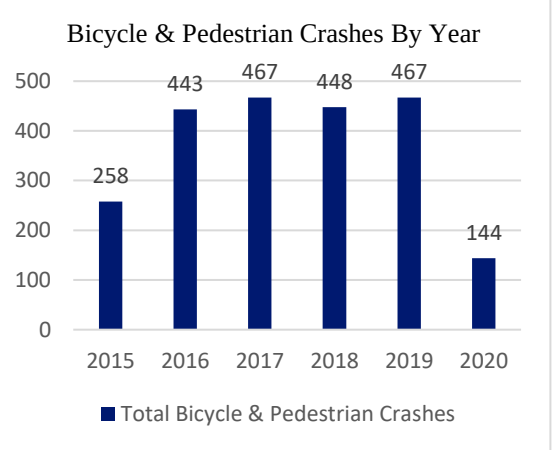
Crash Severity and Distribution

A total of 2,222 crashes (1,513 involving pedestrians and 709 involving bicycles) were identified. Crash severity was evaluated to identify the proportion of severe crashes (defined as fatal and injury) to property damage only (PDO) crashes on the network. As shown in Figure 1, of the 2,222 bicycle and pedestrian crashes recorded along CDOT Region 1 highways, 143 were fatal, 1,733 resulted in injury, and 346 resulted in property damage only. The percent of crashes resulting in an injury were similar between bicycle and pedestrian crashes; however, the percent of crashes resulting in a fatality were higher for pedestrian crashes. There were 134 fatal pedestrian crashes and 9 fatal bicycle crashes; pedestrian crashes exhibit a higher probability of fatality than bicycle crashes.

Figure 1: Bicycle & Pedestrian Crashes by Severity

Looking for trends in the data, the bicycle and pedestrian crashes were distributed over the study years (Figure 2). Between 2016 and 2019, bicycle and pedestrian crashes consistently totaled around 450 crashes annually. Both 2015 and 2020 data only included half of the year, but it appears that bicycle and pedestrian crashes were lower than normal in 2020. This could be the result of fewer crashes during certain seasons, but it is also likely the result of fewer vehicles, pedestrians and bicyclists on the road at the beginning of the COVID pandemic due to restaurant and business closures. The reduction in users on the transportation network reduced the hazard between vehicles and pedestrians.

Figure 2: Bicycle & Pedestrian Crashes by Year



Figures 3 and 4 below show the distribution of bicycle and pedestrian crashes across the region (darker dots represent a higher density of crashes). Most of the crashes occurred within the area generally formed by the E-470 boundary but crash density was higher in the central area. The crashes were observed to be highly concentrated on major corridors in the area, such as Colfax Avenue, Federal Boulevard, Sheridan Boulevard, Wadsworth Boulevard, Colorado Boulevard, Parker Road, Havana Street, US 285, Kipling Street and 6th Avenue.

Bicycle and pedestrian crashes were also mapped based on level of severity (fatal, injury and PDO) and are evaluated later in this report. Although national safety approaches typically focus on severe crashes, CDOT has determined that bicyclists and pedestrians are vulnerable users, and that there is a fine line between fatal, injury, and PDO crashes for these types of users. As such, the presence of any bicycle or pedestrian crash indicates some level of risk, and all levels of crash severity were included in the crash analysis.

Figure 3: Bicycle Crash Locations (2015-2020)

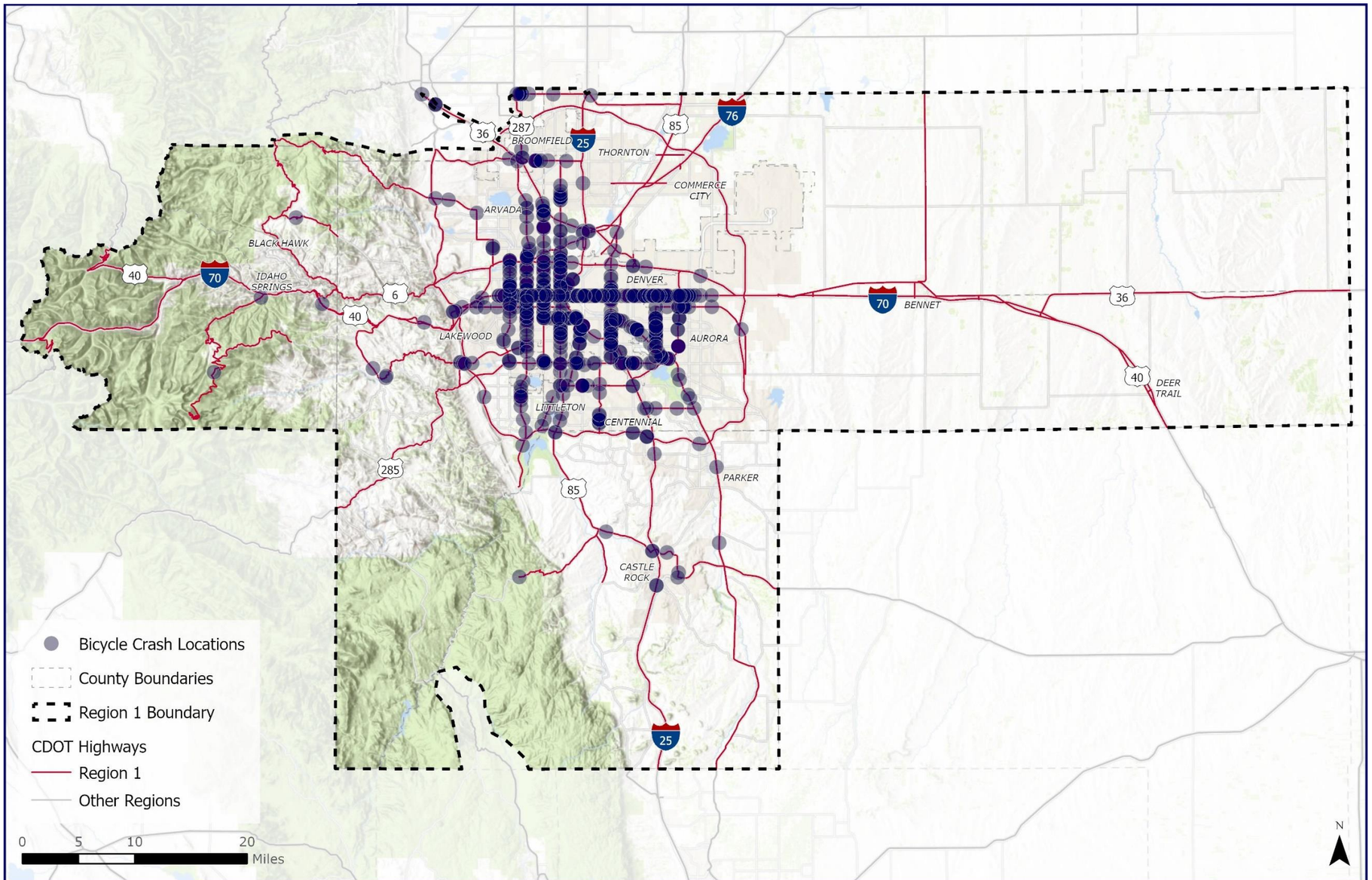
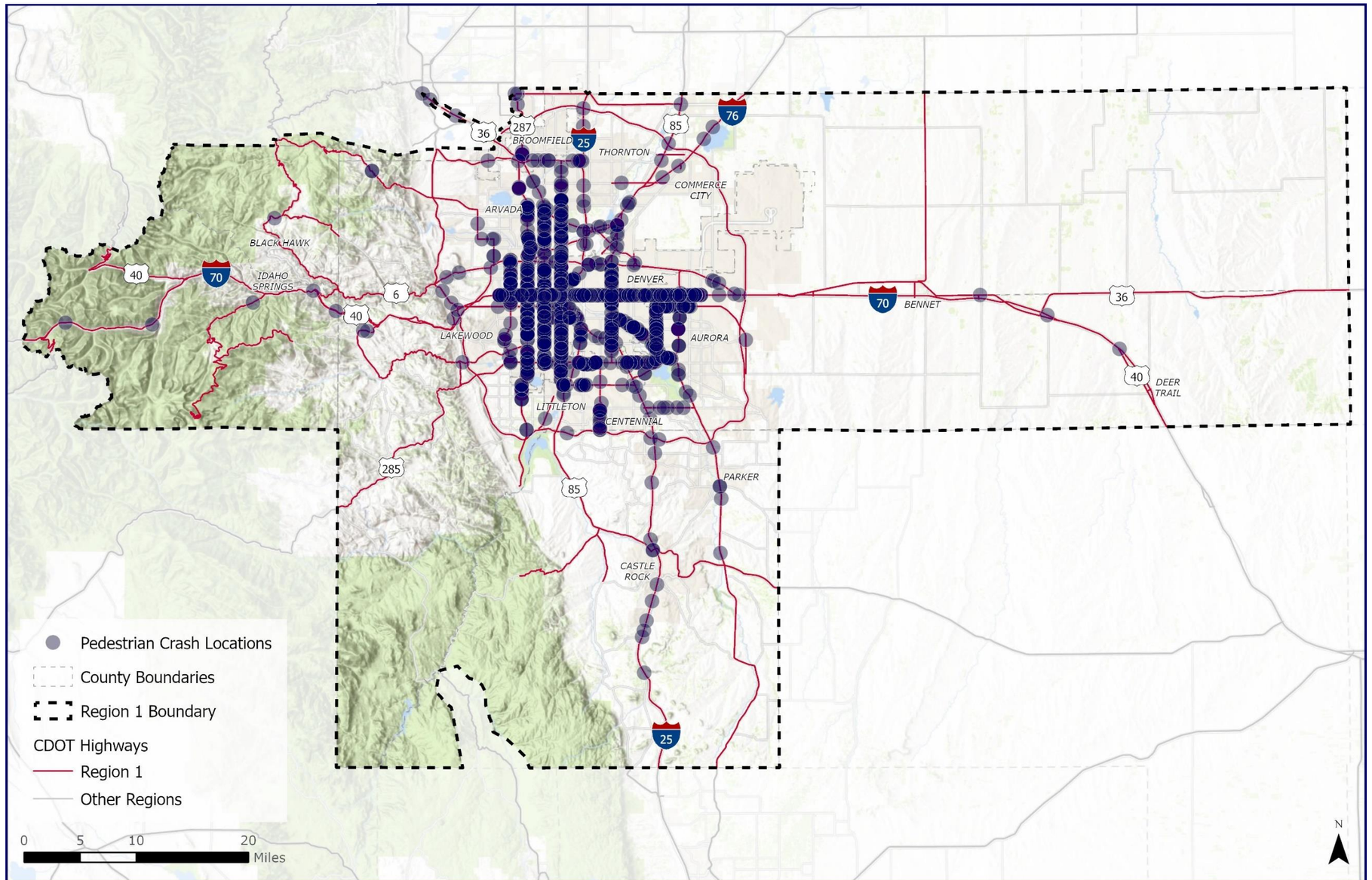


Figure 4: Pedestrian Crash Locations (2015-2020)



Pedestrian Crash Locations (2015 - 2020)

Crash Score

Identifying the location of crashes was helpful to understand geographically where the crashes occurred, but further evaluation was needed to identify the areas with the highest number of severe crashes and/or the highest density of crashes (hot spots). In order to identify these locations, crash scores were applied to the entire network through the following process.

The roadway network was broken into ½ mile segments based on milepost. Segmentation of the roadway allowed for consistency between segments to simplify scoring of the roadway network. On each ½ mile segment, the total number of fatal, injury and PDO bicycle and pedestrian crashes was identified. A score was assigned to each crash type. Each fatal crash received 100 points, each injury crash received 50 points, and each PDO crash received 25 points. The points for each segment were added, and the segments with the highest scores were identified as the locations with inherently higher risk. Figure 5 below shows the segments that resulted in the highest crash score for the entire region based on crash history.

Figure 5 shows that, the segments in Region 1 with the highest crash scores are on Colfax Avenue, Federal Boulevard, Colorado Boulevard, 6th Avenue, Havana Street, Sheridan Boulevard, and Wadsworth Boulevard. These roadway segments are located in Denver, Lakewood, and Aurora. Based on discussions with the City and County of Denver (CCD), at the time of this study, they were working on a similar study that was intended to address bicycle and pedestrian safety. As a result the locations within CCD were not evaluated further during this study.

Crash Hot Spots

The next step in narrowing down bicycle and pedestrian hot spot locations within the region was to identify whether the segments identified in Figure 5 were risky because of the geometry of the segment, or because of an intersection along the segment. Since a comprehensive intersection dataset was not available, a detailed review of crash reports in the highest scoring crash segments within the Cities of Lakewood, Aurora and Glendale were conducted. Figures 6 through 13 provide more detail about the specific location and severity of crashes within the segments scoring over 400 points. Using the same scoring of 100 points for a fatal crash, 50 points for an injury, and 25 points for a PDO crash, intersections received a crash score based on the crashes that were reported as intersection related. The remaining crashes were reported as either non-intersection or driveway related. These crashes made up the new segment scores. Table 2 provides the final crash hot spots and their associated scores. As discussed later in this report, the segment of Colfax Avenue from Allison Street to Sheridan Boulevard was already selected for funding of improvements to address bicycle and pedestrian safety, so that location was also not evaluated further.

Figure 5: Crash Scores Per Segment

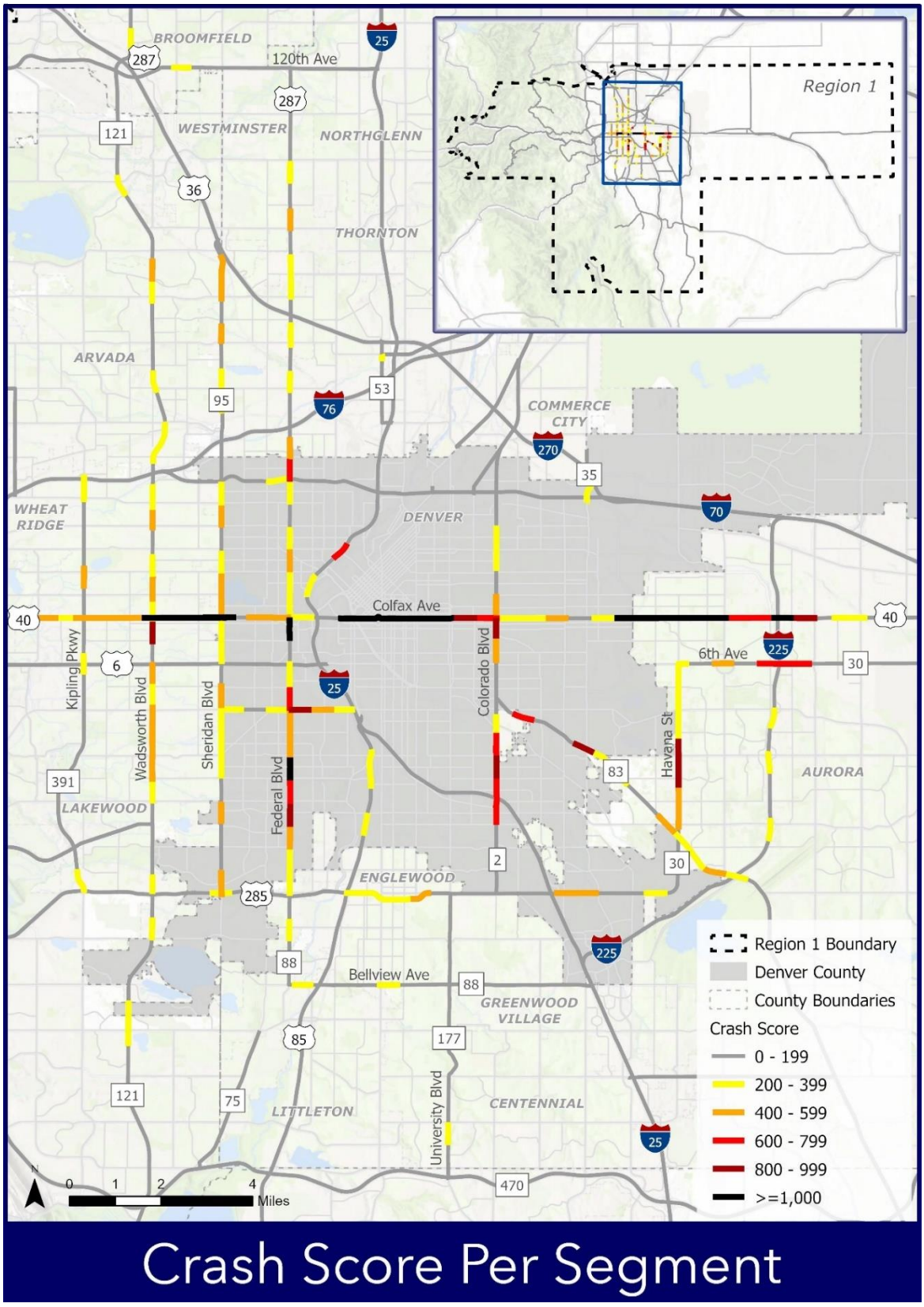
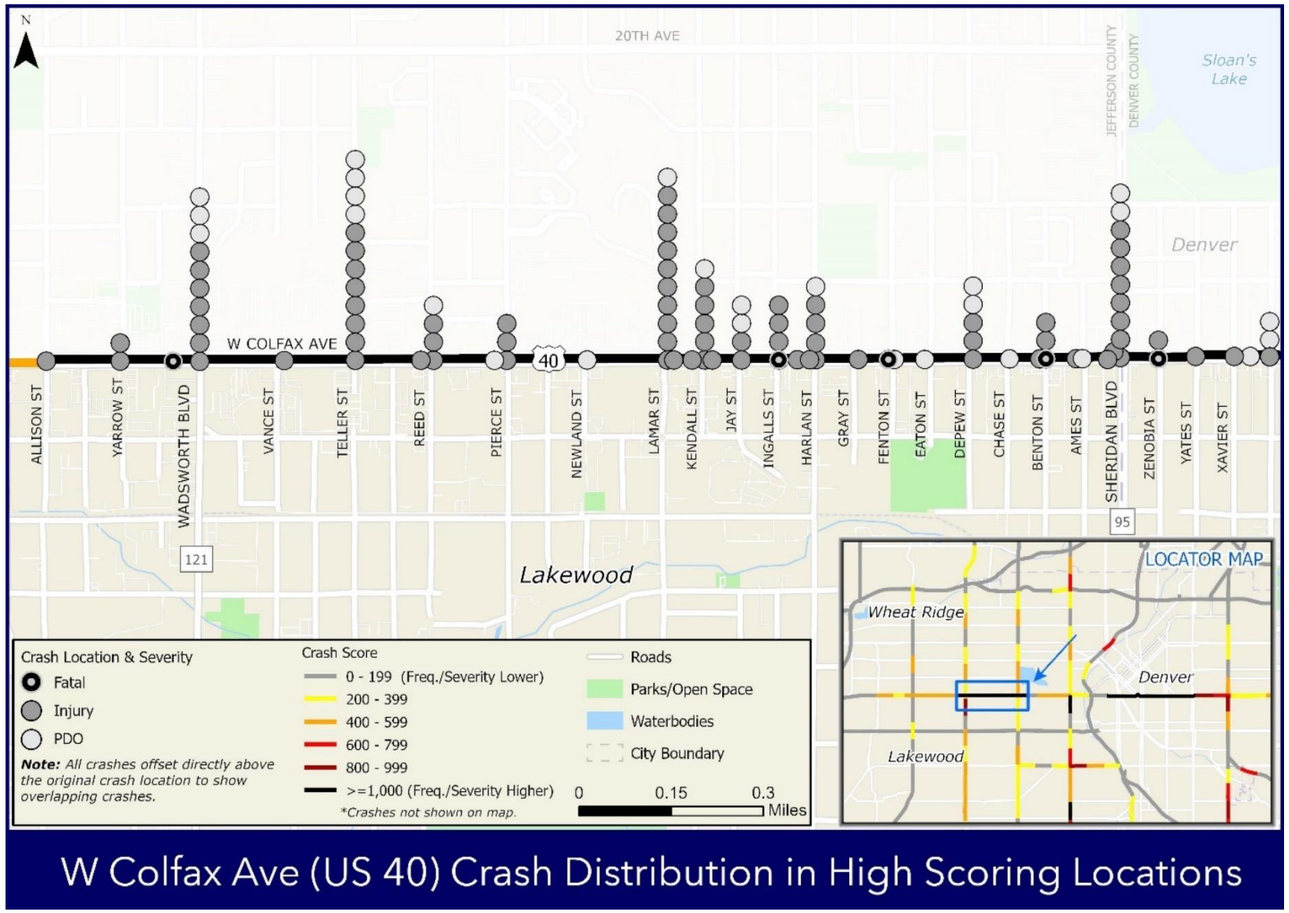


Figure 6: Lakewood – Colfax Avenue Crash Hot Spot

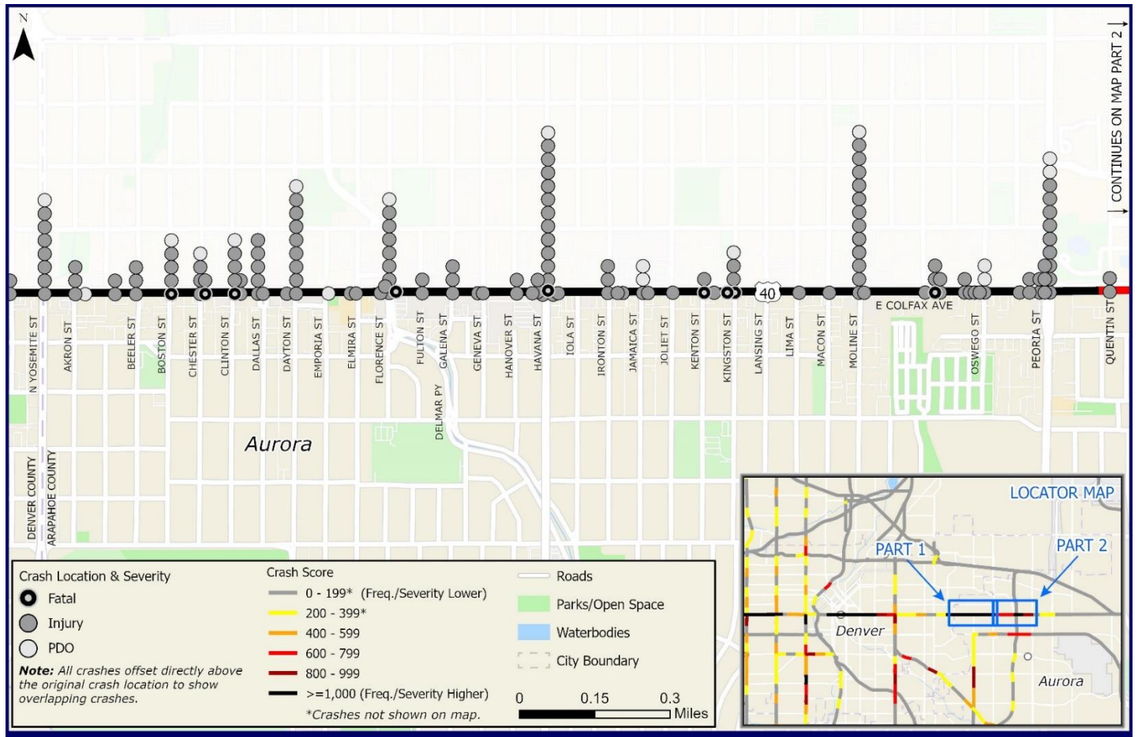


W Colfax Ave (US 40) Crash Distribution in High Scoring Locations

Figure 7: Lakewood – Wadsworth Boulevard Crash Hot Spot

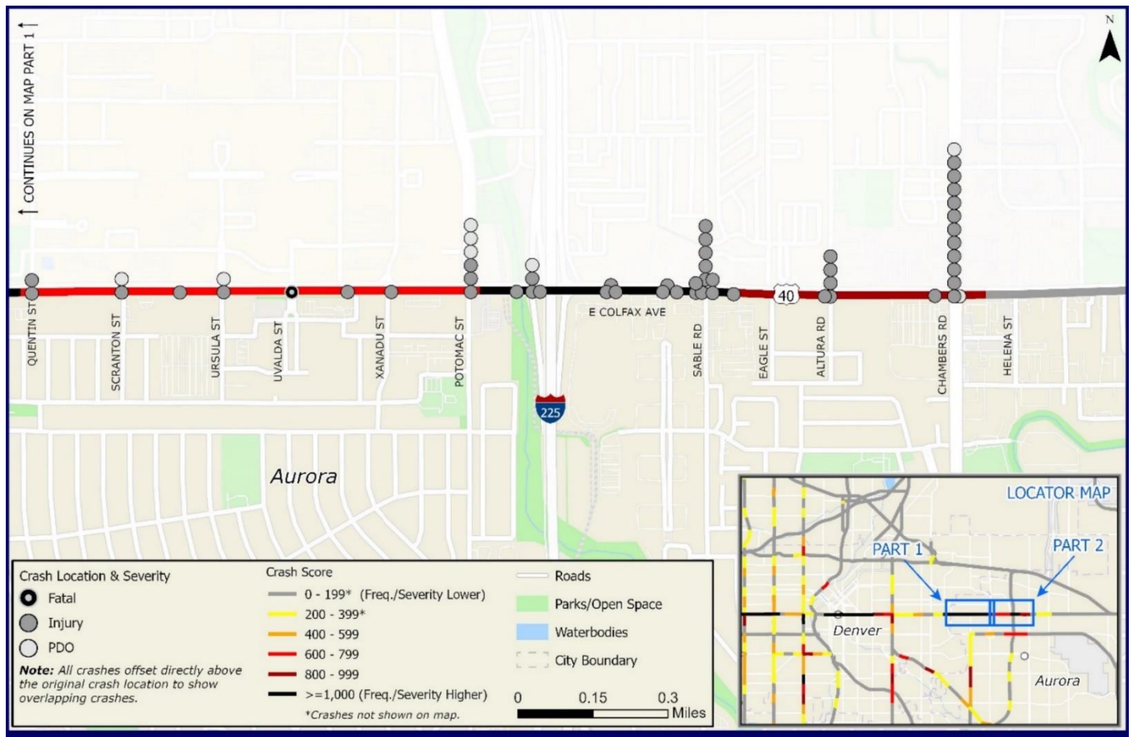
Wadsworth Blvd (CO 121) Crash Distribution in High Scoring Locations

Figure 9: Aurora – Colfax Avenue Crash Hot Spot (Part 1)



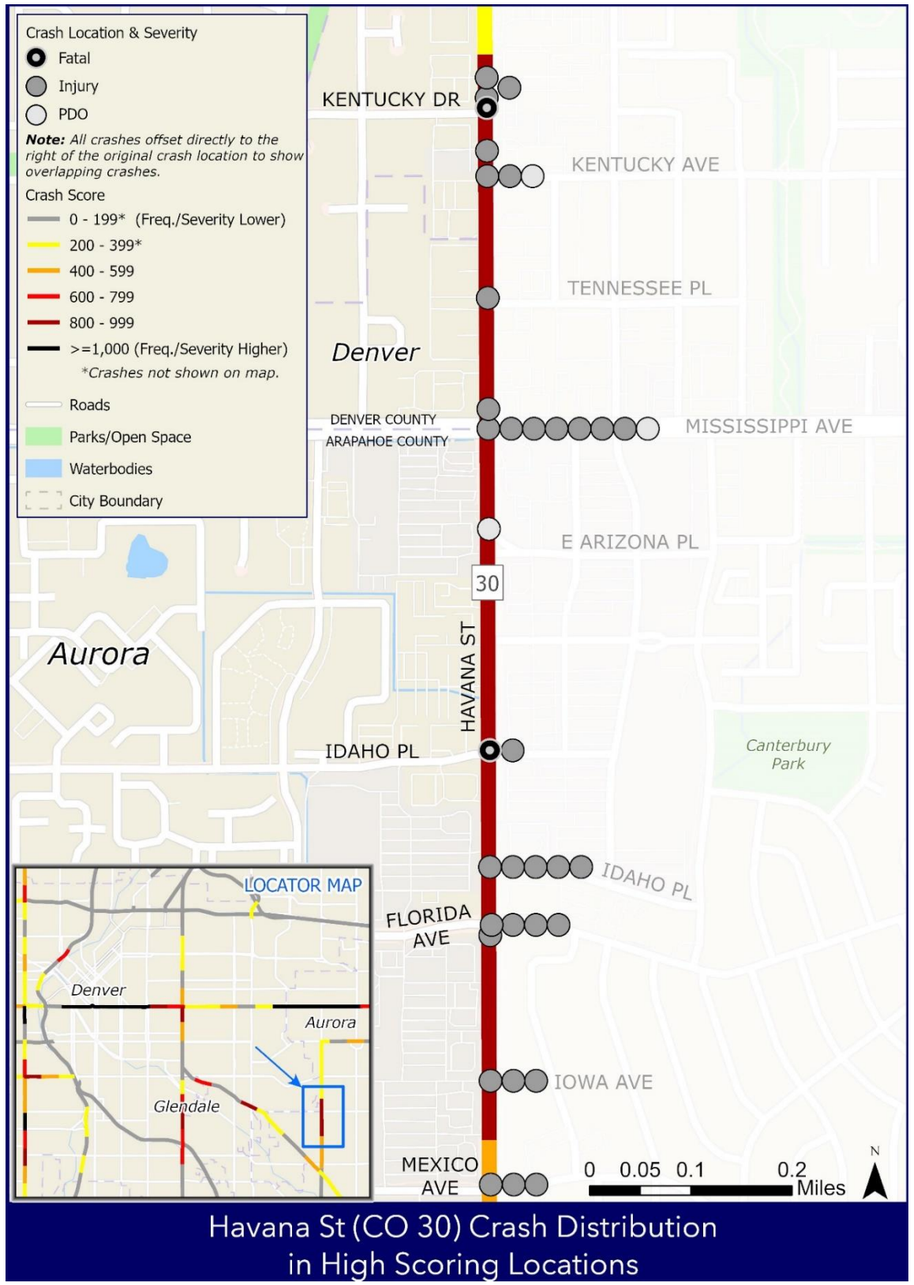
Part 1: E Colfax Ave (US 40) Crash Distribution in High Scoring Locations

Figure 8: Aurora – Colfax Avenue Crash Hot Spot (Part 2)



Part 2: E Colfax Ave (US 40) Crash Distribution in High Scoring Locations

Figure 10: Aurora – Havana Street Crash Hot Spot



Havana St (CO 30) Crash Distribution in High Scoring Locations

Figure 11: Aurora – 6th Avenue Crash Hot Spot

E 6th Ave (CO 30) Crash Distribution in High Scoring Locations

Figure 12: Glendale – Colorado Boulevard Crash Hot Spot

Colorado Blvd (CO 2) Crash Distribution in High Scoring Locations

Figure 13: Glendale – Leetsdale Drive Crash Hot Spot

Leetsdale Dr (CO 83) Crash Distribution in High Scoring Locations

Table 2: Crash Hot Spots (400 points and above)

City	Segment/Intersection	Crash Score
Aurora	Colfax from Moline to Peoria	1000
Lakewood	Colfax from Allison St to Sheridan Blvd	925
Aurora	Colfax/Havana	675
Glendale	Colorado Boulevard/Mississippi	675
Aurora	Colfax/Moline	625
Aurora	Colfax/Chambers	625
Lakewood	Colfax/Wadsworth	575
Aurora	Colfax/Peoria	550
Lakewood	Colfax/Teller	500
Lakewood	Colfax/Sheridan	500
Lakewood	Colfax/Lamar	475
Lakewood	Wadsworth/14th Ave	450
Glendale	Colorado Boulevard/Ohio Ave	450
Aurora	Colfax/Dayton	400
Aurora	6th Ave from Billings to Chambers	400

Crash Summary

Bicycle and pedestrian crash data from 2015 to 2020 was evaluated to identify the severity of crashes and their locations across the region. Pedestrian crashes accounted for approximately 68 percent of the total crashes and 94 percent of the total fatalities; this indicates that pedestrians are at higher risk for fatalities. Additionally, pedestrian crashes were more distributed across the region than bicycle crashes.

Dividing the roads in the region into ½ mile segments and applying scores for each crash based on severity, the crash analysis identified the segments with the highest crash scores as shown in Figure 5. The top 15 bicycle and pedestrian crash hot spots scoring 400 points or more are listed in Table 2, above. The full list of crash hot spots scoring 250 points or more are included in Appendix A.

Systemic Safety Analysis

Overview

The second step in the network screening process was to perform a systemic safety analysis. Systemic analysis looks at the characteristics of the roadways (i.e., speed limit, AADT, shoulder width/type, number of lanes, presence of bike lanes and sidewalk) associated with hot spot crash locations, and then uses those roadway characteristics to identify additional roads with similar characteristics that may or may not have a crash history. The resulting roadways are identified as having inherently more risk than other roads in the region. This approach is a more proactive approach to safety than the historically reactive approach which relies on crash history to implement safety improvements. Additionally, systemic analysis is becoming an acceptable approach to securing safety grant funding such as Highway Safety Improvement Program (HSIP) and Funding Advancements for Surface Transportation and Economic Recovery Act of 2009 (FASTER) funds.

FHWA's Systemic Safety Project Selection Tool[2] was used as a guide to complete this systemic safety analysis and presents a process for incorporating systemic safety planning into traditional safety management processes. Per FHWA's tool, the first steps in identifying systemic improvements are to identify crash types that represent potential for crash reduction on the roadway network and then identify where (under what conditions) they typically occur. For purposes of this study, the crash types that are being evaluated are bicycle and pedestrian crashes. The conditions, or risk factors, under which those crashes occur are discussed in more detail below.

Identification of Risk Factors

The 2,222 bicycle and pedestrian crashes identified within Region 1 were broken down based on a list of potential risk factors. Risk factors are defined as variables that either on their own, or in combination with each other, can be associated with an increased or decreased risk of crashes occurring. Table 3 shows the percent of the 2,222 bicycle and pedestrian crashes associated with each of the potential risk factors. Highlights from this analysis are noted below and discussed in more detail in the "Evaluation of Risk Factors" section of the report.

- 99% occurred in urban areas
- 71% occurred at intersections, 24% at non-intersections, and 5% at driveways
- 87% occurred on roadways with functional class "Principal Arterial – Other"
- 57% occurred during daylight and 33% occurred in dark-lighted conditions
- 97% occurred on roadways with greater than or equal to 4 vehicle travel lanes
- 94% occurred on roadways with an AADT greater than or equal to 25,000
- 78% occurred on roadways with a curbed shoulder of 0 FT in width
- 99.95% occurred on roadways without bike lanes
- 90% occurred on roadways with sidewalks

[2] *Systemic Safety Project Selection Tool, FHWA, SA-13-019*

Table 3: Summary of Crash Types

Potential Risk Factor	Categories	2015 - 2020 Crash History					
		Bicycle		Pedestrian		Total # of Crashes	Total % by Type
		# Crashes	% by Type	# Crashes	% by Type		
	Total # of Crashes	709	100%	1,513	100%	2,222	100%
Jurisdictional Classification	Urban	702	99%	1,496	99%	2,198	99%
	Rural	7	1%	17	1%	24	1%
Location	Intersection	558	79%	1,018	67%	1,576	71%
	Driveway	61	9%	43	3%	104	5%
	Non Intersection	90	13%	452	30%	542	24%
Functional Classification	Interstate	37	5%	96	6%	133	6%
	Freeway & Expressway	49	7%	51	3%	100	5%
	Principal Arterial - Other	598	84%	1,345	89%	1,943	87%
	Minor Arterial	21	3%	19	1%	40	2%
	Major Collector	2	0%	2	0%	4	0%
	Minor Collector	2	0%	0	0%	2	0%
Light Condition	Daylight	550	78%	719	48%	1,269	57%
	Dark - Lighted	106	15%	617	41%	723	33%
	Dark - Unlighted	18	3%	93	6%	111	5%
	Dawn or Dusk	35	5%	84	6%	119	5%
Speed Limit	<=30 mph	94	13%	222	15%	316	14%
	35 mph	253	36%	542	36%	795	36%
	40 mph	166	23%	371	25%	537	24%
	>=45 mph	196	28%	378	25%	574	26%
Number of Lanes	2	34	5%	16	1%	50	2%
	3	3	0%	4	0%	7	0.3%
	4+	672	95%	1,493	99%	2,165	97%
AADT	< 15,000	31	4%	17	1%	48	2%
	15,000 - 24,999	35	5%	53	4%	88	4%
	25,000 - 34,999	263	37%	612	40%	875	39%
	>= 35,000	380	54%	831	55%	1,211	55%
Shoulder Width / Type	No Shoulder	25	4%	52	3%	77	3%
	Curbed (0 FT)	528	74%	1,199	79%	1,727	78%
	Curbed (>0 FT)	30	4%	65	4%	95	4%
	Narrow (<= 6 FT) and Gravel	4	1%	3	0%	7	0%
	Narrow (<= 6 FT) and Paved	21	3%	14	1%	35	2%
	Wide (>6 FT) and Gravel	20	3%	25	2%	45	2%
	Wide (>6 FT) and Paved	81	11%	155	10%	236	11%
Presence of Sidewalk	Yes	622	87.7%	1,370	90.5%	1,992	90%
	No	87	12.3%	143	9.5%	230	10%
Presence of Bike Lanes	Yes	1	0%	0	0%	1	0%
	No	708	100%	1,513	100%	2,221	100%

Median Type	Depressed / HOV Reversible	43	6%	82	5%	125	6%
	Raised	85	12%	156	10%	241	11%
	Channelized - Raised Curb	272	38%	594	39%	866	39%
	Painted	78	11%	218	14%	296	13%
	Level	37	5%	58	4%	95	4%
	None	194	27%	405	27%	599	27%
V/C Ratio	<0.65	136	19%	225	15%	361	16%
	0.65-0.84	236	33%	572	38%	808	36%
	0.85-0.99	252	36%	576	38%	828	37%
	>=1	85	12%	140	9%	225	10%

Another way to evaluate the data is to look at the density of crashes associated with each of the risk factors. Table 4 takes the total number of crashes for each of the risk factors and divides that by the total number of lane miles associated with the same risk factor, resulting in number of crashes per lane mile.

Across Region 1, there were a total of 2,222 crashes and 973.9 miles of CDOT roadway, resulting in an average of 1 crash every 0.44 miles, or 2.28 crashes/mile. For comparison purposes, factors that resulted in a number greater than 2.28 crashes/mile experienced a higher density of crashes than the roadway network as a whole. The crash density for each of the factors ranged from 0 to 12.09 crashes per mile.

In theory, the higher the crashes/mile, the riskier that factor is to the network. However, much research has been done on many of the potential risk factors identified and that data/research must also be considered to determine whether each of these factors actually represent a risk on the roadway network. This concept is referred to as the dilemma of correlation versus causation which speaks to two things happening at the same time and mistakenly concluding that one causes the other. The evaluation of each of the potential risk factors is discussed below, in the order in which they are presented in Tables 1 and 2. The location and light condition risk factors were not included in the crash/mile evaluation since they are attributes obtained from the crash reports and not the roadway segments.

Table 4: Crashes per Lane Mile

		2015 - 2020 Crash History		
Potential Risk Factor	**Categories**	**Total # Crashes**	**Total # Lane Miles**	**Crashes / Lane Mile**
	Total # of Crashes	2,222	973.9	2.28
Jurisdictional Classification	Urban	2,198	569.1	3.86
	Rural	24	404.7	0.06
Functional Classification	Interstate	133	228.3	0.58
	Freeway & Expressway	100	160.6	0.62
	Principal Arterial - Other	1,943	313.2	6.2
	Minor Arterial	40	155.3	0.26
	Major Collector	4	72.9	0.05
	Minor Collector	2	25.8	0.08
	Local	0	17.9	0

Speed Limit	<=30 mph	316	49.4	6.4
	35 mph	795	79.0	10.06
	40 mph	537	94.2	5.7
	>=45 mph	574	751.3	0.76
Number of Lanes	2	50	321.5	0.16
	3	7	33.6	0.21
	4+	2,165	618.7	3.5
AADT	< 15,000	48	330.9	0.15
	15,000 - 24,999	88	105.5	0.83
	25,000 - 34,999	875	122.6	7.13
	>= 35,000	1,211	414.8	2.92
Shoulder Width / Type	No Shoulder	77	35.2	2.19
	Curbed (0 FT)	1,727	147.7	11.69
	Curbed (>0 FT)	95	21.8	4.36
	Narrow (<= 6 FT) and Gravel	7	116.1	0.06
	Narrow (<= 6 FT) and Paved	35	71.7	0.49
	Wide (>6 FT) and Gravel	45	84.2	0.53
	Wide (>6 FT) and Paved	236	497.2	0.47
Presence of Sidewalk	Yes	1,992	270.6	7.36
	No	230	703.3	0.33
Presence of Bike Lanes	Yes	1	2.9	0.34
	No	2,221	970.9	2.29
Median Type	Depressed / HOV Reversible	125	295.8	0.42
	Raised	241	61.3	3.93
	Channelized - Raised Curb	866	71.6	12.09
	Painted	296	34.0	8.71
	Level	95	108.8	0.87
	None	599	402.5	1.49
V/C Ratio	<0.65	361	451.6	0.8
	0.65-0.84	808	223.9	3.61
	0.85-0.99	828	230.6	3.59
	>=1	225	67.8	3.32

Evaluation of Risk Factors

Jurisdictional Classification

Table 5: Jurisdictional Classification Crash Summary

Potential Risk Factor	Categories	Total # Crashes	Total % By Type	Total # Crashes	Total # Lane Miles	Crashes / Lane Mile
Jurisdictional Classification	Urban	2,198	**99%**	2,198	569.1	**3.86**
	Rural	24	**1%**	24	404.7	**0.06**

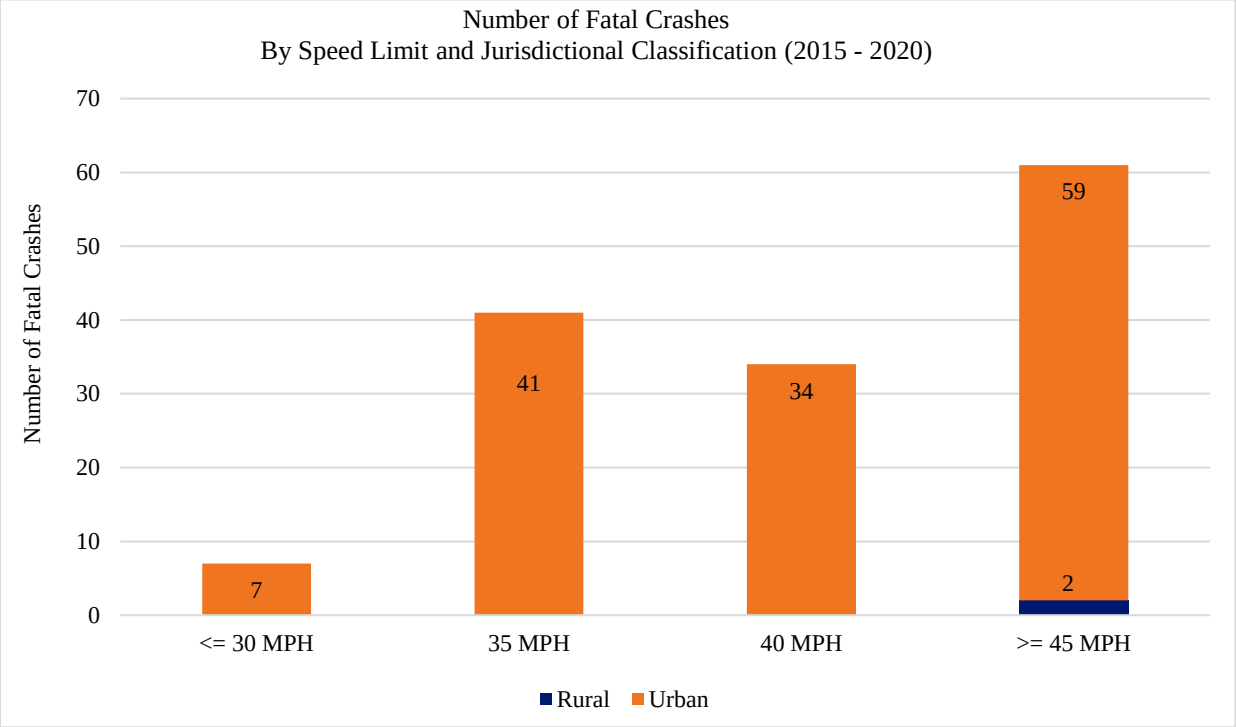
***Defined**: Jurisdictional classification refers to CDOT's classification of urban versus rural roadways, which is based on the US Census Bureau's categorization of a geographic area by the population count.*

Of the 2,222 bicycle and pedestrian crashes that occurred on CDOT Region 1 roadways between 2015 and 2020, 99% occurred on urban classified roadways although only 58% of the total lane miles are classified as urban. As a result, the crashes per lane mile for urban roads is much higher than it is for rural roads. This is likely a result of larger populations in urban areas and more conflicts between bicyclists/pedestrians and vehicles.

As shown in Figure 14, despite a smaller proportion of total bicycle and pedestrian crashes occurring on rural roads, the crash severity on rural and urban roads shows a similar distribution: PDO crashes accounted for 13% (rural) and 16% (urban); injury crashes accounted for 79% (rural) and 78% (urban); and fatal crashes accounted for 8% (rural) and 6% (urban). Figure 15 illustrates the relationship between fatal crashes, speed limits and urban versus rural classified roadways. Nearly all the fatalities occurred on urban roads. Seven fatalities occurred on roadways with lower speed limits (less than or equal to 30 MPH). The number of fatal crashes significantly increases with higher speed limits. A total of 59 of the 141 (42%) urban fatalities occurred on roadways where posted speed limits are greater than or equal to 45 MPH. The two rural fatal crashes also occurred where posted speed limits are greater than or equal to 45 MPH. Multiple studies have found that higher speeds are associated with more severe crash outcomes, particularly for vulnerable road users such as pedestrians and bicyclists.

Figure 14: Urban and Rural Crashes by

Figure 15: Number of Fatal Crashes by Speed Limit and Jurisdictional Classification



Location

Table 6: Location Crash Summary

Potential Risk Factor	Categories	Total # Crashes	Total % By Type
Location	Intersection	1,576	**72%**
	Driveway	104	**5%**
	Non-Intersection	542	**24%**

***Defined**: Location refers to where the crash happened along the road as defined in the crash reports. Intersection crashes include those identified on the crash reports as "intersection" or "intersection related," driveway crashes include all crashes that occurred near a curb cut serving residential or commercial businesses/complexes, and non-intersection crashes represent all other crashes in the crash reports. The location of crashes was not included in the crash/mile evaluation since it is an attribute obtained from the crash reports and not the roadway segments.*

In the crash database provided by CDOT, the majority (72%) of bicycle and pedestrian crashes occurred at (or related to) intersections. Since intersections represent a juncture of two roadways where different modes of travel (vehicles, bicycles, pedestrians) intersect and experience increased conflict points, it is logical that the majority of crashes occurred at these locations.

Figure 16: Summary of Bicycle Crashes by Location

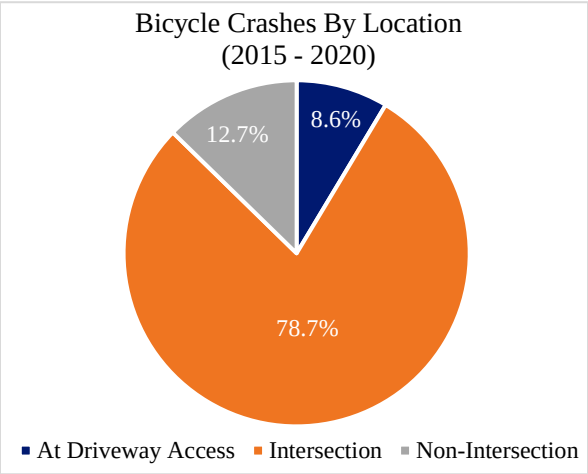
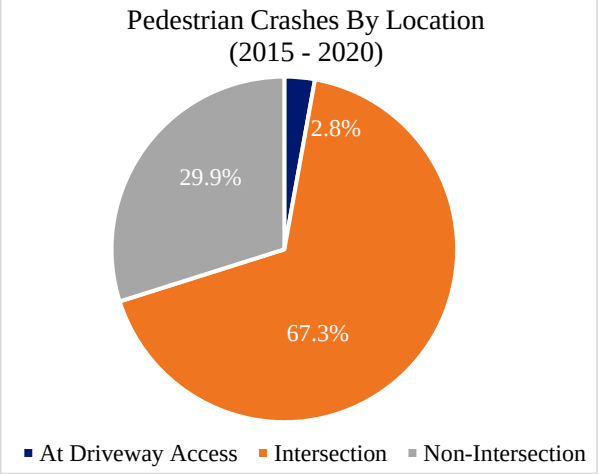


Figure 17: Summary of Pedestrian Crashes by Location



The crash tree in Figure 18 breaks down the number of crashes by severity at each location (intersection, driveway access, non-intersection) for both bicycles and pedestrians. For bicycles, all but one of the fatal crashes happened at intersection or non-intersection locations and the distribution of fatal crashes occurred equally at these locations with 4 fatal crashes each. For pedestrians, 59.7% of pedestrian fatalities occurred at non-intersection locations, and 38.1% occurred at intersection locations. Bicycle injuries generally occurred at intersection locations (79.6%) while 69.7% of pedestrian injuries occurred at intersections and 27.2% occurred at non-intersection locations. For both bicycles and pedestrians, the majority of severe crashes occurred at intersection and non-intersection locations, as compared to driveway access locations.

Figure 18: Bicycle and Pedestrian Crash Severity by Location

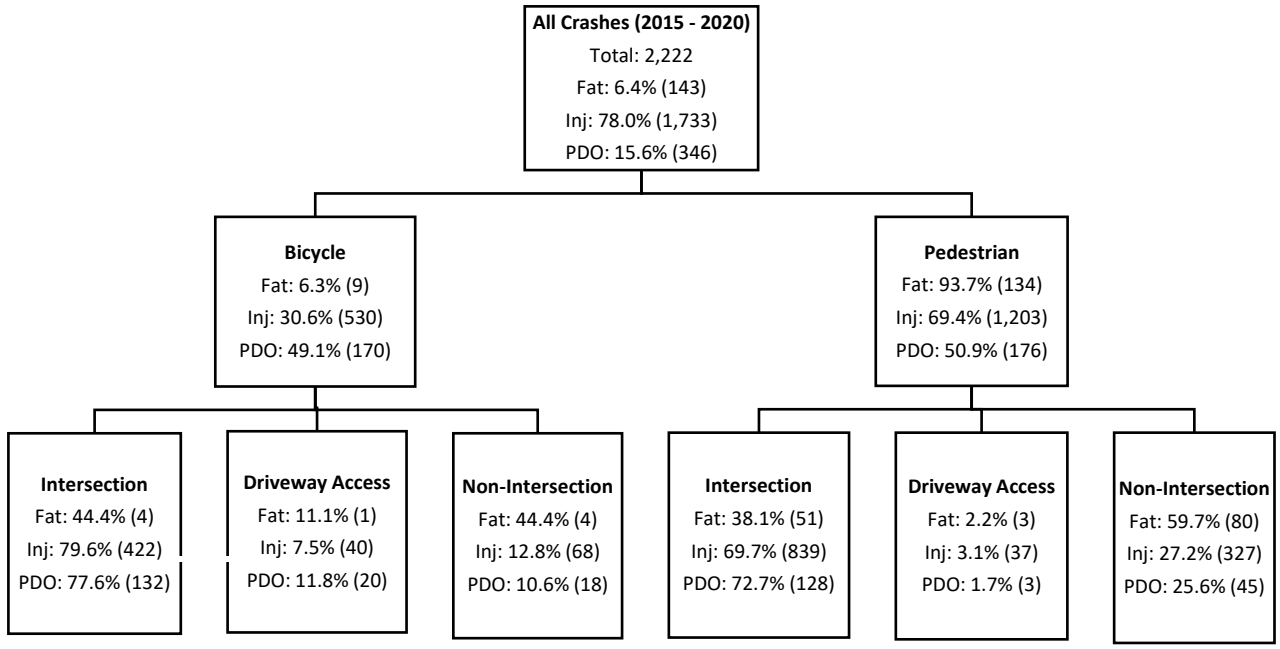
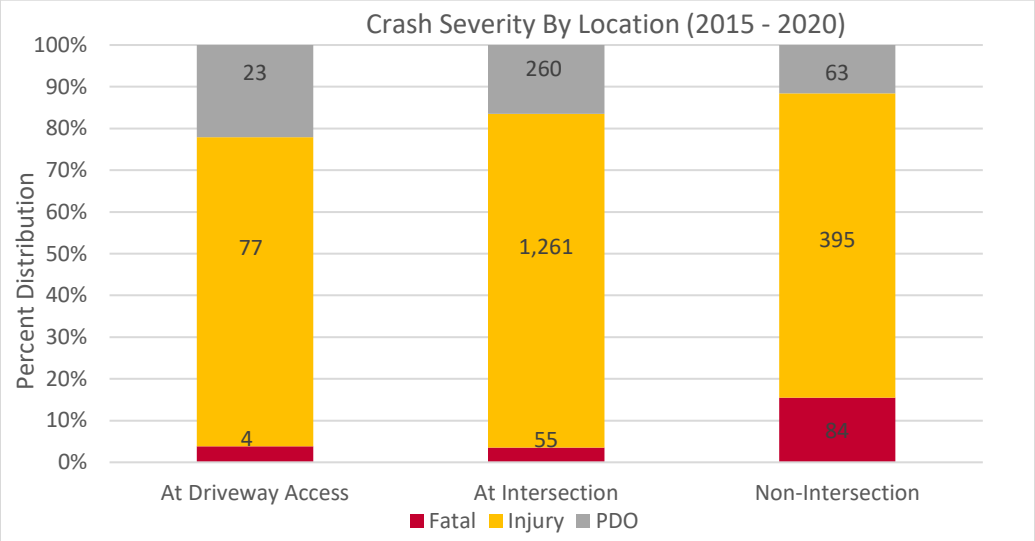


Figure 19 presents the combined bicycle and pedestrian crashes by severity and location. Non-intersection crashes experienced the highest risk for fatalities (15%), compared to intersection crashes (3.5%) and driveways (4%). According to a May 2021 report by the US Department of Transportation[3] non-intersection crashes also experience the highest percentage of pedestrian fatalities in the US (73%), compared to intersection crashes (18%) and other crash types (9%).

Figure 19: Crash Severity by Location



Functional Classification

Table 7: Functional Classification Crash Summary

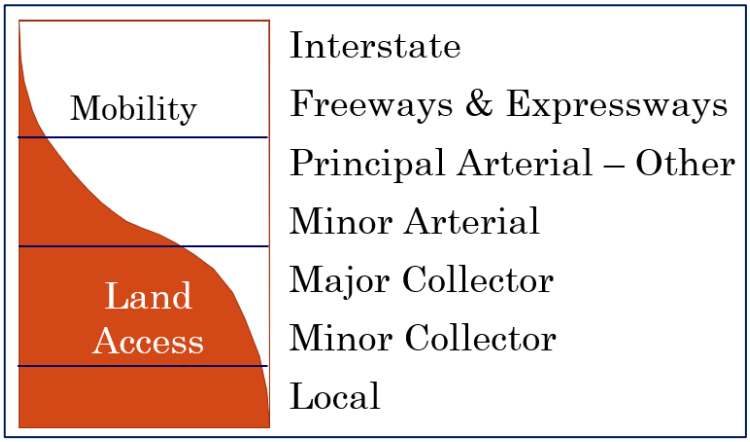
Potential Risk Factor	Categories	Total # Crashes	Total % By Type	Total # Crashes	Total # Lane Miles	Crashes / Lane Mile
Functional Classification	Interstate	133	**6%**	133	228.3	**0.58**
	Freeway & Expressway	100	**5%**	100	160.6	**0.62**
	Principal Arterial - Other	1,943	**87%**	1,943	313.2	**6.2**
	Minor Arterial	40	**2%**	40	155.3	**0.26**
	Major Collector	4	**0%**	4	72.9	**0.05**
	Minor Collector	2	**0%**	2	25.8	**0.08**
	Local	0	**0%**	0	17.9	**0**

***Defined**: Functional classification is an ordering system for roadways that defines how a road should function within the network. The classifications listed have varying relationships between traffic mobility and access to adjacent properties, where mobility of traffic decreases in priority from top to bottom and access to properties increases in priority from top to bottom.*

[3] *2019 Data: Pedestrians (dot.gov)*

As shown in Figure 20, interstates prioritize mobility of traffic through the corridor over access, thereby resulting in fewer driveway cuts and higher speed traffic. On the other hand, local roads prioritize land access over mobility and provide many curb cuts resulting in slower moving traffic. The majority of crashes (87%) occurred on roadways classified by CDOT as *Principal Arterial – Other*. When comparing total crashes for each classification to the respective number of miles (Table 7), *Principal Arterial – Other* generated the most crashes per mile (6.2). The remaining roadway classifications experienced significantly fewer crashes per mile (0-0.62). This implies that the introduction of access on higher speed roads such as Principal Arterials results in significantly higher risk for crashes. While minor arterial and major collector roadways are typically designed to have more access than *Principal Arterial – Other* roadways, the speed of traffic on these roads is typically less, allowing for more time to react when vehicles and vulnerable users intersect.

Figure 20: Mobility & Access by Functional Classification

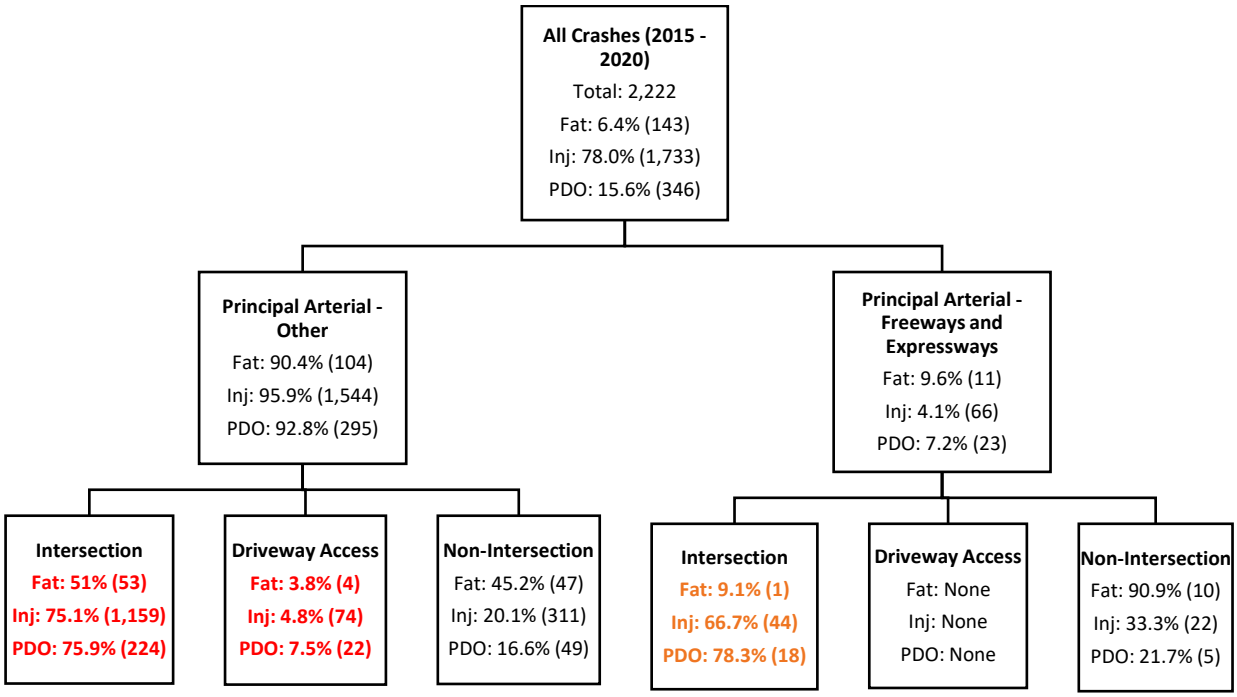


Understanding CDOT's intended function of this high crash roadway helps to provide insight into what may be the cause of these crashes. *Principal Arterial – Other* is defined by CDOT as a roadway that serves activity centers and provides a high degree of mobility. It also provides additional access to parcels and has at-grade intersections. *Freeways & Expressways* are defined by CDOT as looking similar to Interstates in that they have full access control (i.e. no direct access to adjacent properties). Freeways provide access via on/off ramps and no at grade intersections while Expressways are more common in rural settings and at grade intersections are permitted to varying degrees depending on context. Figure 21 shows the location where crashes occurred on *Principal Arterial – Other* roadways. As shown on Figure 21 in orange, since direct access and at grade intersections are restricted on *Freeways & Expressways*, fewer severe crashes (9% of fatalities and 67% of injuries) occurred at intersections on these types of roads. This data indicates that access and intersection density likely playing a role in the risk for crashes on *Principal Arterial – Other* roadways.

Other considerations for the high number of crashes per lane mile on Principal Arterial – Other roadways as compared to Freeways and Expressways include:

- Fewer bicyclists and pedestrians travel on Freeways & Expressways as they are typically restricted, or users prefer not to travel alongside high volumes of very fast-moving vehicles.
- Activity centers on Principal Arterial – Other roadways provide destinations that attract all modes of traffic.
- Multiple destinations with individual access points increase the number of conflict points between vulnerable users and vehicles.
- As shown in red on Figure 21, 55% of fatalities, 79% of injuries, and nearly 74% of PDO crashes on *Principal Arterial – Other* roadways occurred at driveways or intersections.

Figure 21: Breakdown of Crash Severity by Functional Classification

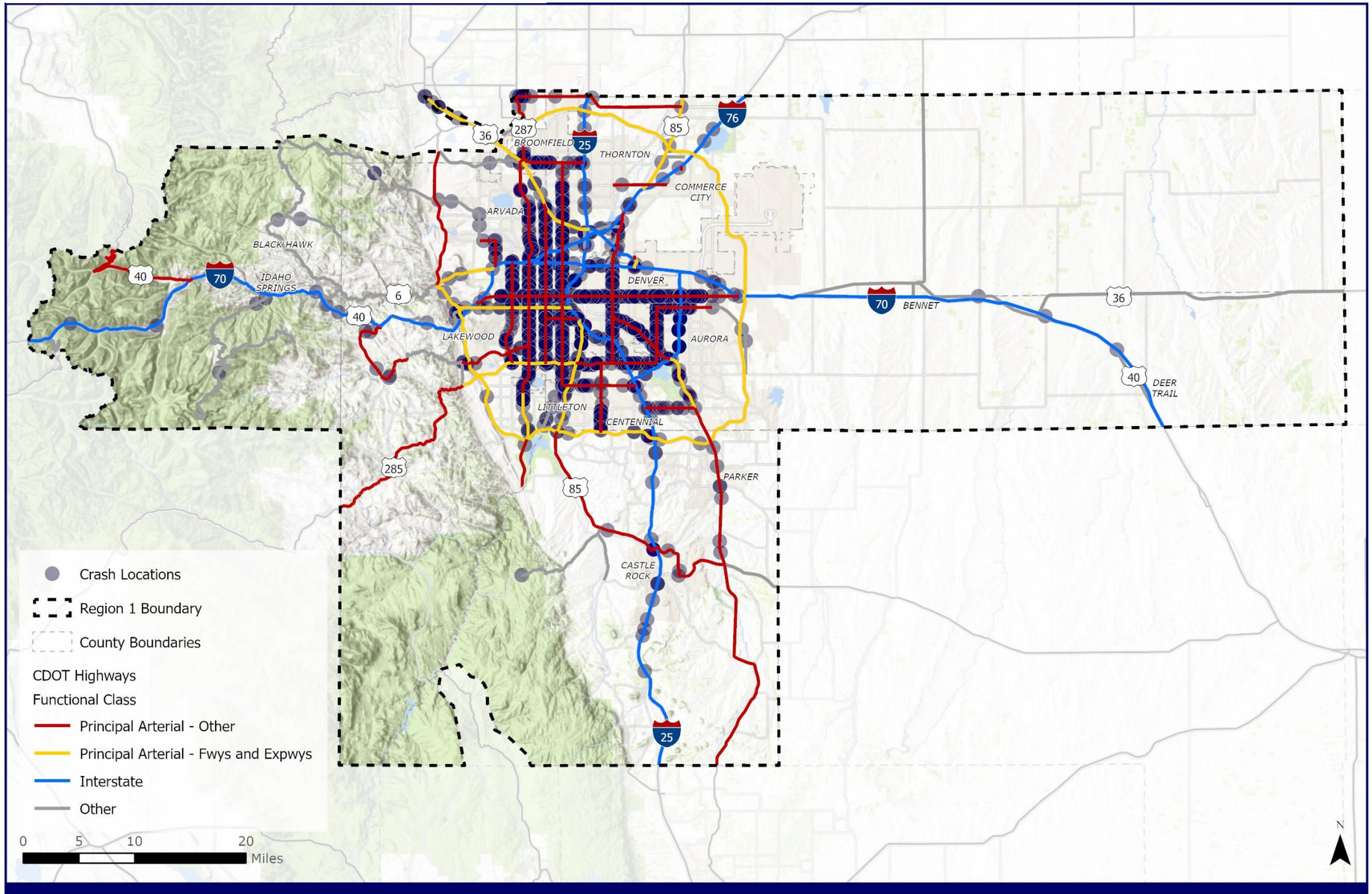


While freeways are designed to provide limited access and minor arterials are designed to provide connectivity between communities (indicating they provide a higher degree of access), speed, intersection density, and volume of users (vehicle, bicycle and pedestrian) likely play a role in the number and severity of crashes on these types of roads. According to CDOT, roadways classified as *Principal Arterial – Other* provide a similar service in both urban and rural areas. The primary difference between urban and rural areas is that urban areas have a higher quantity of arterials serving a particular area (higher intersection density), whereas rural areas are typically served by one arterial. However, as the *Principal Arterial – Other* roadways travel through rural towns, increases in access on these high-risk arterial roadways likely increased risk for all users on the roadway. FHWA's Safe System Approach[4] notes that redundancy is crucial to reducing risks, which requires that all parts of the transportation system are strengthened so that if one part fails, the other parts still protect people. A couple of ways to achieve redundancy are to reduce the number of access points (and hence conflict points) where bicyclists and pedestrians are present, and/or reduce speed in areas of higher access density.

Figure 22 shows the relationship between crashes and roadways functionally classified as *Principal Arterial – Other*. This Functional Classification experiences significantly more crashes than other classified roadways.

[4] THE SAFE SYSTEM (dot.gov)

Figure 22: Functional Class & Crash Locations



Functional Class & Crash Locations (2015 - 2020)

Lighting Conditions

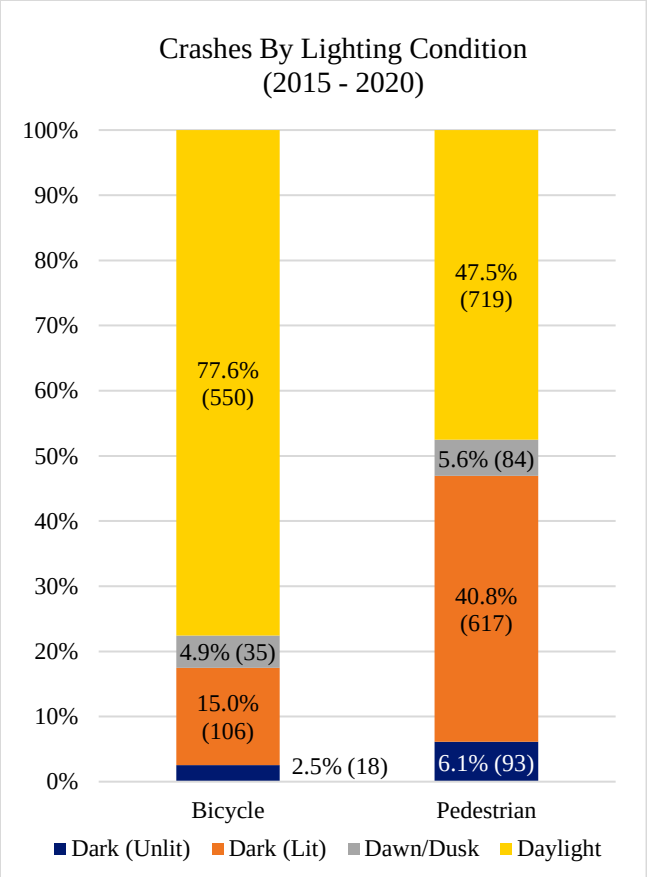
Table 8: Light Condition Crash Summary

Potential Risk Factor	Categories	Total # Crashes	Total % By Type
Lighting Conditions	Daylight	1,269	**58%**
	Dark - Lit	723	**33%**
	Dark - Unlit	111	**5%**
	Dawn or Dusk	119	**5%**

***Defined**: The categories of light condition were defined in the crash reports based on the presence of light from the sun or other sources. Lighting was not included in the crash/mile evaluation since it is an attribute obtained from the crash reports and not the roadway segments.*

Lighting condition data for each crash was recorded in the crash database and provided by CDOT. Dark conditions can be either lit or unlit with streetlights. Other lighting conditions include dawn/dusk or daylight. Figure 23 shows that 78% of bicycle crashes and 48% of pedestrian crashes occurred in daylight, and pedestrians experienced more crashes during dark (lit and unlit) conditions than bicyclists. A total of 47% of pedestrian crashes occurred in dark (lit and unlit) conditions whereas only 18% of bicycle crashes occurred in dark conditions. The requirement for bicycles to have lights and reflectors may explain why they experience fewer crashes in dark conditions. It is also plausible that more bicyclists are outside during the daylight hours which could correlate with the higher volume of bicycle crashes during daylight hours. As for pedestrians, it is plausible that there are more pedestrians than bicyclists outside during the nighttime hours and that dark conditions present a higher risk factor to pedestrians. Of the 93 pedestrian crashes that occurred during dark unlit conditions, 60 (65%) occurred at non-intersection locations. Of those same 93 pedestrian crashes, 87 (94%) occurred in the urban areas.

Figure 23: Crashes by Lighting Condition



It was previously noted that pedestrian crashes have a higher fatality rate than bicycle crashes. To further explore a possible correlation between fatal accidents and lighting conditions, Figures 24 and 25 summarize the lighting conditions for fatal accidents.

Over half (56%) of fatal bicycle crashes occurred in daylight conditions with only 11% occurring in dark unlit conditions. Contrary to this,

pedestrian crashes show a correlation between fatal crashes and dark conditions, where 64% of fatal crashes occurred in dark lit conditions and 14% occurred in the dark unlit conditions. This data indicates that dark conditions correlate more strongly with pedestrian fatalities than bicycle fatalities.

Figure 24: Percent of Fatal Bicycle Crashes by Lighting Condition

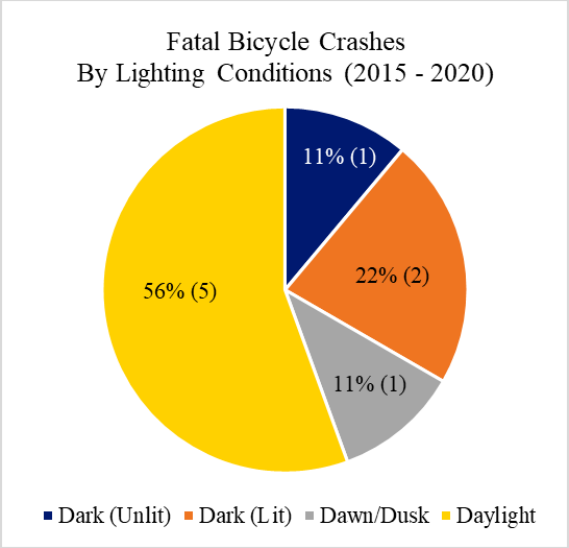
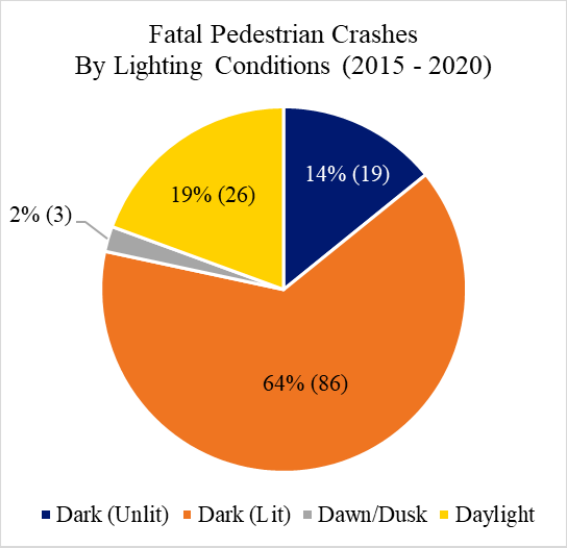


Figure 25: Percent of Fatal Pedestrian Crashes by Lighting Condition



Speed Limit

Table 9: Speed Limit Crash Summary

Potential Risk Factor	Categories	Total # Crashes	Total % By Type	Total # Crashes	Total # Lane Miles	Crashes / Lane Mile
Speed Limit	<=30 mph	316	**14%**	316	49.4	**6.4**
	35 mph	795	**36%**	795	79.0	**10.06**
	40 mph	537	**24%**	537	94.2	**5.7**
	>=45 mph	574	**26%**	574	751.3	**0.76**

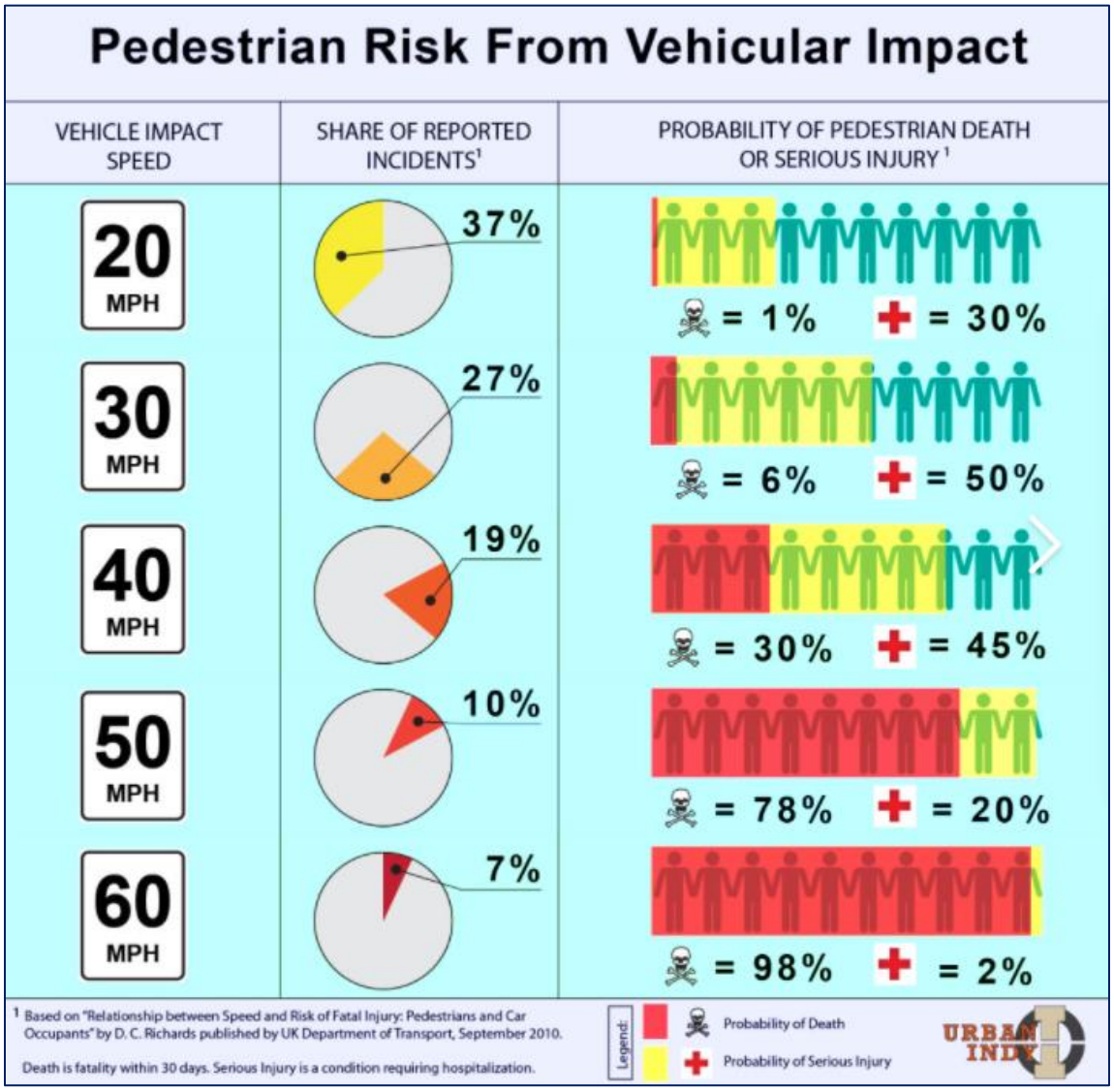
***Defined**: Speed limit is the posted speed limit as seen when driving on the road.*

Of the 2,222 bicycle and pedestrian crashes that occurred on CDOT Region 1 roadways, 50% occurred on roads with posted speeds of 40 mph or higher. When considering the total number of lane miles, significantly more crashes per lane mile occurred on roads posted at 35mph or less. It is possible that this is a result of higher volumes of bicycles and pedestrians traveling on lower speed roadways. With the exception of central urban areas, lower speed roads typically have fewer vehicles than higher speed roads, but if this is where the most vulnerable users are traveling, then this is reflected in where the most vulnerable user crashes are occurring. On the other hand, higher vehicle travel speeds increase risk for vulnerable road users due to the physics of speed and weight difference with a vehicle during a crash.

Higher speed roads typically have a higher volume of vehicles, thereby increasing potential exposure to accidents for vulnerable road users who are using those roadways.

A study provided by NACTO (National Association of City Transportation Officials) that evaluates the relationship between speed and risk of fatal injury[5] concluded that the risk of fatality for a pedestrian "increases slowly until impact speeds of around 30mph. Above this speed, risk increases rapidly – the increase is between 3.5 and 5.5 times from 30mph to 40mph." Additionally, this report states that "even though the risk of pedestrians being killed at 30mph is relatively low, approximately half of pedestrian fatalities (and injuries) occur at this impact speed or below." Figure 26 provides a visual representation of these statistics from the report.

Figure 26: Pedestrian Risk from Vehicular Impact



[5] *Relationship between Speed and Risk of Fatal Injury: Pedestrians and Car Occupants. Transport Research Laboratory; Department for Transport. September 2010*

A study[6] from the AAA foundation also shows the average risk of severe injury and death for a pedestrian struck by a vehicle at varying speeds. Table 10, below, shows the results from the study.

Table 10: Pedestrian Risk of Severe Injury or Death based on Speed

Percent Risk of Severe Injury	Speed	Percent Risk of Death	Speed
10%	16 mph	10%	23 mph
25%	23 mph	25%	32 mph
50%	31 mph	50%	42 mph
75%	39 mph	75%	50 mph
90%	46 mph	90%	58 mph

The Safe Systems Approach speaks to vehicle and infrastructure redundancy in the transportation system so that if one part fails, the other part still protects people. There are 5 elements that correspond to an improved safety strategy: safer people, safer roads, safer vehicles, safer speeds, and post-crash care. An example of this would be pedestrians or drivers that are under the influence. When the people in the system are not being safe, redundancy in the other elements is even more important to reduce crashes on the network. With half of Region 1 crashes occurring on roads with a posted speed of 40 mph or higher, and data showing that at 40 mph, 45-75% of crashes will result in injury and 30-50% will result in fatality, assessing and possibly reducing posted speed limits is one way to improve the system. However, when people don't travel at the posted speed, redundancy is needed to effectively reduce risk for all pedestrians, impaired or not. CDOT is currently updating their process for setting speed limits. The new procedure is expected to be less focused on the 85th percentile speed and more in line with the upcoming MUTCD standards that will look at historical data and roadway specifics. The new procedure may also require changes to the roadway design if posted speed limits are reduced significantly below observed speeds, getting to the Safe Systems approach of redundancy in the transportation system.

While reducing the posted speed limit may be desired on some roads, the design speed of the road and the drivers' level of comfort typically dictate the speed in which vehicles travel, thus requiring additional modifications to the geometry or police enforcement to physically slow vehicles. Some resources identify reduced vehicle lane width as a way to reduce vehicle speeds and improve safety. For example, FHWA's PEDSAFE[7](Pedestrian Safety Guide and Countermeasure Selection System) program identifies "lane narrowing" as a countermeasure that is tied to reduced speeds on roadways where there are safety and speeding problems, and vehicle lane widths are greater than recommended minimums. They also note that reducing lane widths can help improve the safety and comfort for pedestrians, bicyclists, transit riders and motor vehicles. The following outlines PEDSAFE's recommended minimum lane widths:

- 9 feet lanes on rural roadways
- 10 feet for most vehicular travel lanes
- 10 feet for turn lanes
- 11 feet for lanes that accommodate a large volume of trucks, buses or large vehicles (greater than 8%)

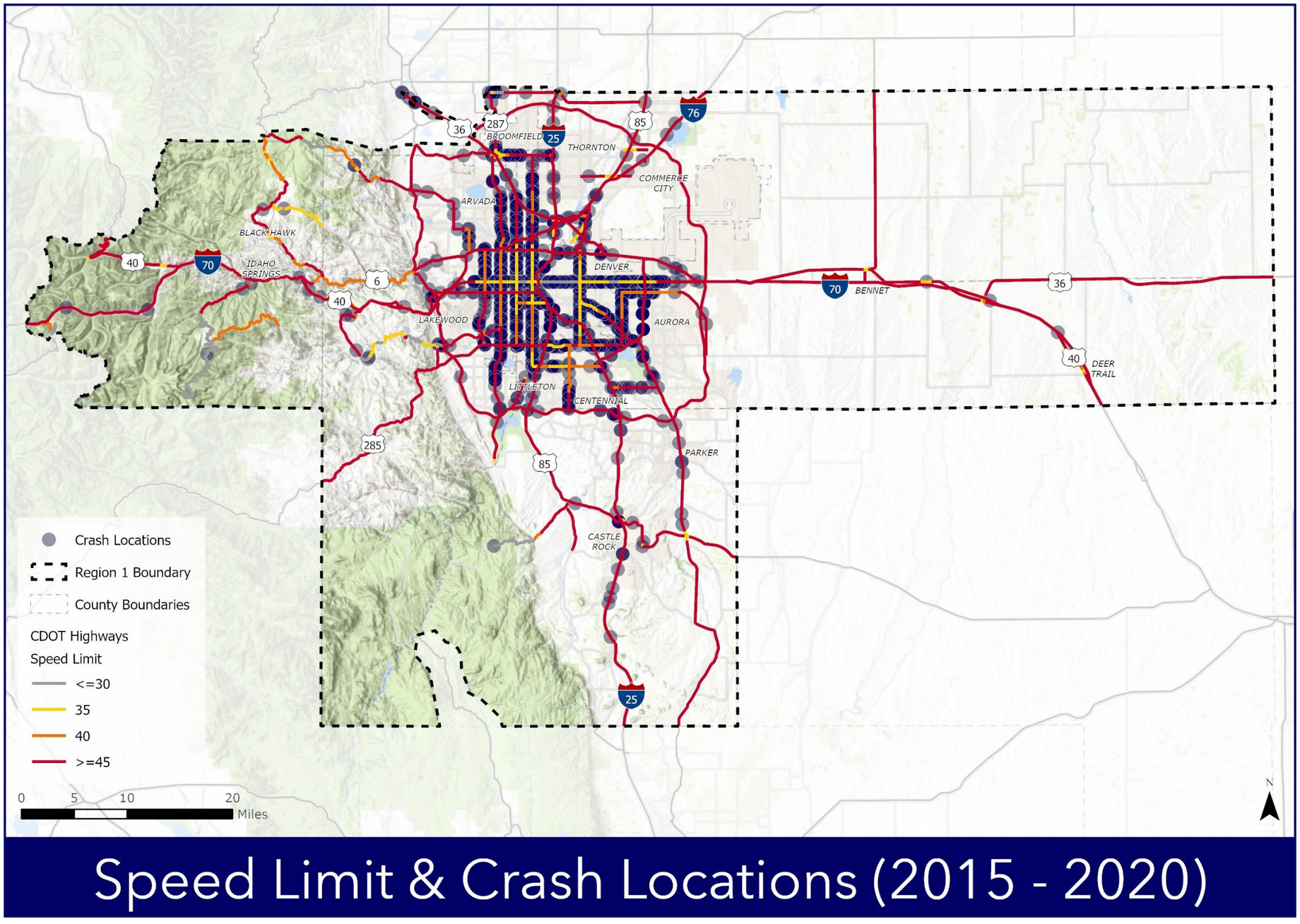
However, in some cases reduced lane widths can increase crashes. Data from the Crash Modification Clearinghouse (CMF) clearinghouse indicates that reducing lane width from 12-feet to 10-feet on 4-lane median divided rural roads can reduce crashes (CMF ID 7827) by 42 percent, but on urban roads with

[6] *Impact Speed and a Pedestrian's Risk of Severe Injury or Death. AAA Foundation for Traffic Safety. September 2011*

[7] Pedestrian Safety Guide and Countermeasure Selection System (pedbikesafe.org)

speeds between 20 and 55mph, CMF 8157 indicates that a reduction in lane width from 12-feet to 10-feet would result in a 28 percent increase in all crashes and all levels of severity. Lane reductions should be assessed on a case-by-case basis and additional treatments considered to slow vehicles when a reduction in speed is desired. Other treatments that may be appropriate to reduce speeds include roundabouts, speed humps, bulb outs / curb extensions, and on-street parking. Figure 27 shows the relationship between posted speed limits and reported crashes. As discussed above, half of crashes occurred on roads that are 35mph or less (grey or yellow in color) despite only 13 percent of the roads having these speeds.

Figure 27: Speed Limit & Crash Locations



AADT (Average Annual Daily Traffic)

Table 11: AADT Crash Summary

Potential Risk Factor	Categories	Total # Crashes	Total % By Type	Total # Crashes	Total # Lane Miles	Crashes / Lane Mile
AADT	< 15,000	48	**2%**	48	330.9	**0.15**
	15,000 - 24,999	88	**4%**	88	105.5	**0.83**
	25,000 - 34,999	875	**39%**	875	122.6	**7.13**
	>= 35,000	1,211	**55%**	1,211	414.8	**2.92**

***Defined**: AADT is the Average Annual Daily Traffic, or an annual average of the total demand on a road in both directions within a 24-hour period.*

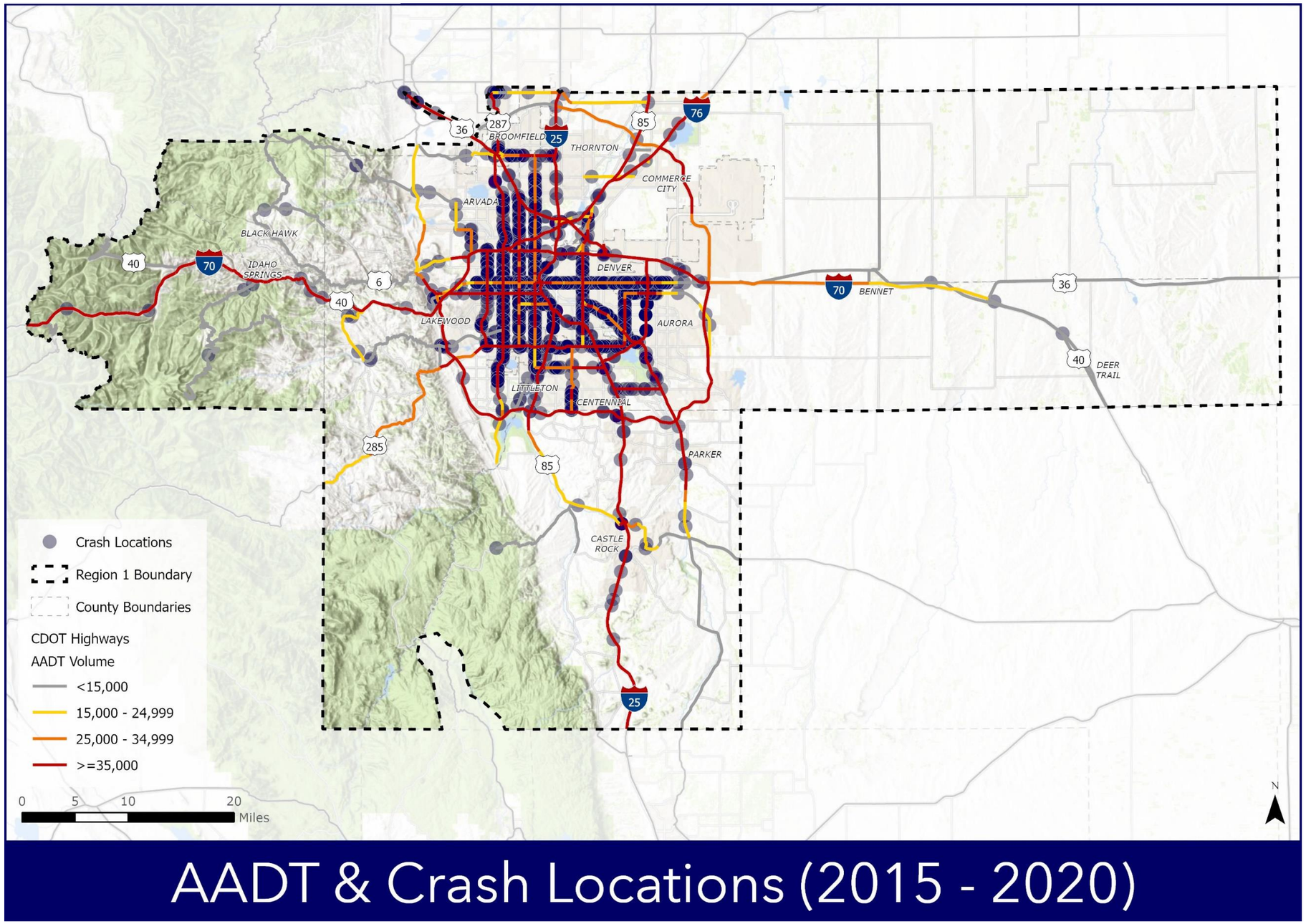
Over 94% of crashes occurred on roadways with an Average Annual Daily Traffic (AADT) of greater than 25,000 vehicles per day (vpd). The AADT is an average of daily traffic for an entire year, whereas ADT (Average Daily Traffic) is a measure of any 24 (or more) hour period where traffic volumes are measured. The former is data that was available through CDOT's database. The latter is typically used to measure peaks in travel, such as when school is in session or when counts for an entire year are not feasible to obtain. Typically, case studies are based on ADT's because it is not feasible to have traffic counters across an entire road network.

The Highway Safety Manual (HSM)[8] has historically been the approach used to justify where safety funds should be applied. The HSM uses a method of predicting average crash frequency for a segment or intersection through safety performance functions (SPF's). SPF's are equations that estimate expected crash frequency as a function of traffic volume and roadway characteristics such as number of lanes, median type, intersection control (i.e. stop, signal or roundabout), or number of approach legs. This analysis is used to identify sites with the most potential for crash frequency or severity reduction. The focus on traffic volume in the HSM points to the level of risk associated with higher volume roads.

In Figure 28, AADT is displayed against crash locations to show the relationship between AADT and crash occurrence. The map illustrates that a high density of crashes occurred on roadways with an AADT of 25,000 and above. Increased AADT exposes bicyclists and pedestrians to a higher number of vehicles which may increase the likelihood of a crash occurring. Wider roads are almost always associated with higher traffic volumes. They also bring the added challenge of reduced sight distance to and from pedestrians and traveling vehicles, and longer crossing distances for pedestrians.

[8] An Introduction to the Highway Safety Manual

Figure 28: AADT & Crash Locations



AADT & Crash Locations (2015 - 2020)

Number of Lanes

Table 12: Number of Lanes Crash Summary

Potential Risk Factor	Categories	Total # Crashes	Total % By Type	Total # Crashes	Total # Lane Miles	Crashes / Lane Mile
Number of Lanes	2	50	**2%**	50	321.5	**0.16**
	3	7	**0.3%**	7	33.6	**0.21**
	4+	2,165	**97%**	2,165	618.7	**3.5**

***Defined**: Number of lanes describes the combined quantity of vehicle travel lanes in both directions.*

Nearly all (97%) of the crashes occurred on roadways with 4+ vehicle lanes. Figure 29 shows the relationship between the number of vehicle travel lanes and reported crashes. More travel lanes result in wider roads for pedestrians and bicycles to cross as well as reduced visibility between vehicles and bicycles/pedestrians. In FHWA's *Safety Effects of Marked Versus Unmarked Crosswalks at Uncontrolled Locations*[9] report (2005) data was collected at 2,000 sites. 1,622 sites were at uncontrolled intersections, and 278 sites were at midblock crossings. Conclusions from that report indicate:

- On 2-lane roads, there was no significant difference in pedestrian crash rates between marked and unmarked sites;
- On multilane roads with an Average Daily Traffic (ADT) of 12,000 vpd or less, there was no difference in pedestrian crash rates between marked and unmarked sites;
- On multilane roads with no raised median and an ADT greater than 12,000 vpd, marked crosswalks had a higher crash rate than unmarked crossings; and
- On multilane roads with an ADT greater than 15,000 vpd and raised medians, a significantly higher crash rate was associated with marked crosswalks as compared to unmarked.

The results of this study appear counterintuitive as they indicate that marked crosswalks result in higher crash rates than unmarked crosswalks. However, the simple act of marking a crosswalk results in pedestrians and bicyclists feeling more confident about stepping into traffic as they technically have the right-of-way over vehicles. The reality is that vehicles do not always stop for pedestrians and proper signage and roadway markings are necessary to provide safe crossings at these locations. Multilane highways have the added effect of creating blind spots from the pedestrian crosswalk to the vehicle on the inside lane of travel when multiple vehicles are present. In these cases, treatments such as Pedestrian Hybrid Beacons (PHB) are recommended to stop traffic so that the pedestrian can safely cross the road.

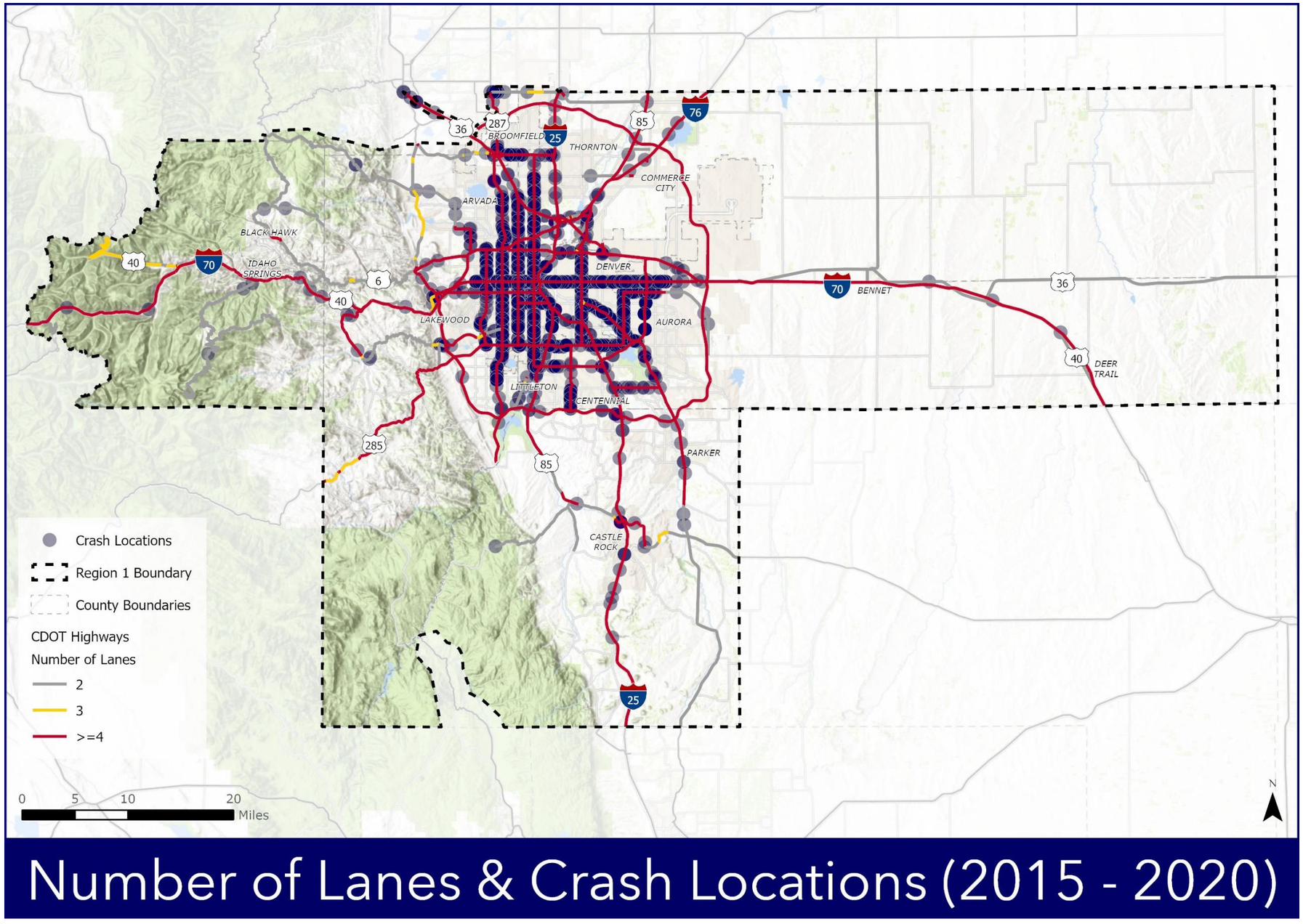
FHWA identifies PHB's as a proven safety countermeasure[10] that provides a 55% reduction in pedestrian crashes, 29% reduction in total crashes, and 15% reduction in serious injury and fatal crashes. They further state that PHB's are very effective at locations where three or more lanes will be crossed, or traffic volumes exceed 9,000 AADT. In addition to the installation of a PHB, marked crosswalks and pedestrian countdown signals are recommended. FHWA's Safe Transportation for Every Pedestrian Program[11] also notes that PHB's address safety concerns regarding conflicts at crossing locations, excessive vehicle speed, inadequate visibility, drivers not yielding and insufficient separation from traffic.

[9] Safety Effects of Marked versus (dot.gov)

[10] Pedestrian Hybrid Beacons - Safety | Federal Highway Administration (dot.gov)

[11] EDC-5: Safe Transportation for Every Pedestrian (STEP) 2.0 | Federal Highway Administration (dot.gov)

Figure 29: Number of Lanes & Crash Locations



Number of Lanes & Crash Locations (2015 - 2020)

Shoulder Width and Type/Sidewalks/Bike Lanes

Table 13: Shoulder Width/Sidewalk/Bike Lane Crash Summary

Potential Risk Factor	Categories	Total # Crashes	Total % By Type	Total # Crashes	Total # Lane Miles	Crashes / Lane Mile
Shoulder Width / Type	No Shoulder	77	**3%**	77	35.2	**2.19**
	Curbed (0 FT)	1,727	**78%**	1,727	147.7	**11.69**
	Curbed (>0 FT)	95	**4%**	95	21.8	**4.36**
	Narrow (<= 6 FT) and Gravel	7	**0%**	7	116.1	**0.06**
	Narrow (<= 6 FT) and Paved	35	**2%**	35	71.7	**0.49**
	Wide (>6 FT) and Gravel	45	**2%**	45	84.2	**0.53**
	Wide (>6 FT) and Paved	236	**11%**	236	497.2	**0.47**
Presence of Sidewalk	Yes	1,992	**90%**	1,992	270.6	**7.36**
	No	230	**10%**	230	703.3	**0.33**
Presence of Bike Lanes	Yes	1	**0%**	1	2.9	**0.34**
	No	2,221	**100%**	2,221	970.9	**2.29**

***Defined**: Shoulders are the additional pavement found adjacent to the outside of vehicle travel lanes. Sidewalks are paved paths for pedestrians adjacent to a roadway. Sidewalks can either be directly adjacent to the vehicle travel lane or can have separation, usually grass, providing additional space between pedestrians and vehicles. Bike lanes are typically found adjacent to the vehicle travel lane and are marked off with painted lines, for use by cyclists.*

The presence of a "walkway" is shown to improve safety for bicyclists and pedestrians. Walkways are one of FHWA's Proven Safety Countermeasures and are defined as "any type of defined space or pathway for use by a person traveling by foot or using a wheelchair". These may be pedestrian walkways, shared use paths, sidewalks, or roadway shoulders"[12]. They go on to state that pedestrians should have direct and connected walking routes to desired destinations without gaps or abrupt changes, and in areas where sidewalks are not feasible, such as rural and suburban areas, roadway shoulders provide an area for pedestrians to walk next to the roadway. Adding sidewalks, where none currently exist, is shown to reduce crashes involving pedestrians walking along roadways by 65-89%. On rural roads, the addition of paved shoulders, to a minimum of 4 feet in width[13], is said to reduce the same crashes by 71%. According to CDOT's 2018 Roadway Design Guide, the minimum recommended shoulder width on CDOT roadways is 4 feet.

As shown in Table 13, above, most crashes occurred on roadways with a curbed shoulder of zero feet in width, followed by roadways with wide (>6 ft), paved shoulders. The later seems counterintuitive based on FHWA's "walkway" safety countermeasure. To evaluate further, the total number of crashes was compared to the total lane miles of wide, paved shoulders. The result of 0.47 crashes/lane mile shows that the total number of crashes on these types of roadways is less than the roadway network as a whole,

[12] Proven Safety Countermeasures - Walkways - Safety | Federal Highway Administration (dot.gov)

[13] *Desktop Reference for Crash Reduction Factors*, FHWA-SA-08-011, Table 11

and likely not a risk factor for Region 1 roads. Additionally, Table 14 shows that the vast majority of crashes on roads with wide, paved shoulders were interstates (52.5%) and Freeways / Expressways (25.9%), not rural roads, further substantiating that wide, paved shoulders do not result in increased risk on Region 1 roads. It is likely that that many of these interstate and Freeway / Expressway crashes are due to pedestrians with stalled vehicles on the shoulder, or from crashes on the interchange ramps.

Table 14: Functional Classification of Crashes on Roads with Wide, Paved Shoulders

Functional Classification	Crashes with Wide and Paved Shoulders	
	Number	Percent
Interstate	124	52.5%
Principal Arterial – Freeways / Expressways	61	25.9%
Principal Arterial – Other	38	16.1%
Minor Arterial	12	5.1%
Major Collector	1	0.4%

On the contrary, when evaluating the crashes per lane mile for roadways with curbed shoulders, zero feet in width, these roadway types experience 11.69 crashes per lane mile (Table 13, above), the highest of any shoulder type. It should be noted that this type of shoulder is predominant in urban areas where the volume of traffic (vehicle, bicycle and pedestrian) and possibility for conflicts that result in crashes is also typically higher. To better understand whether adequate "walkways" were present on the urban and rural roadways where crashes occurred, Table 15, below, shows the relationship between urban and rural crashes, shoulder type, and the presence of sidewalk. Based on this information, sidewalks were present at nearly all urban crash locations where the shoulder was lacking or was less than six feet in width. Where crashes occurred on urban roads with wide (>6 ft), gravel shoulders, 76% of these roads also had sidewalks, but on roads with wide, paved shoulder, it appears that the majority (71%) did not have sidewalks. While wider shoulders could improve safety for bicycles and pedestrians on some urban roads within Region 1, this data indicates that the majority of urban crashes were not the result of a lack of sidewalks and / or wide shoulders.

On rural roads, one crash occurred where neither a shoulder nor a sidewalk was present, and one crash occurred where the shoulder was curbed and a sidewalk was present. The remaining rural crashes occurred on roads with a gravel or paved shoulder. In these cases, none of the crash locations with gravel shoulders, and 86% of locations with wide, paved shoulder, had sidewalks present. This indicates that shoulder width / type could be a risk factor on rural roads. Figure 30 shows the relationship between shoulder width and crash locations.

Table 15: Crashes on Urban and Rural Roads in Relation to Type of Shoulder and Presence of Sidewalks

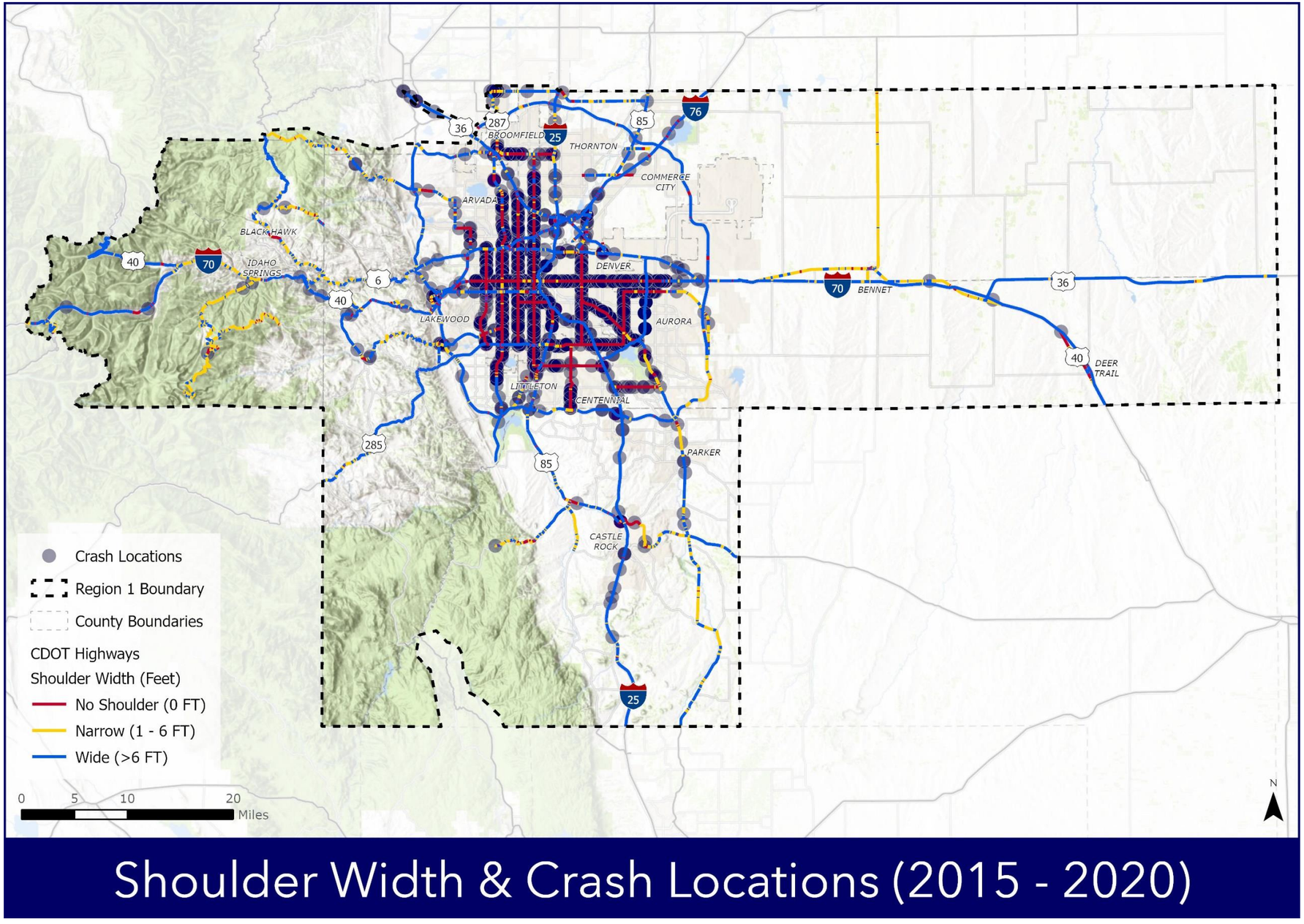
Number of Crashes								
	URBAN				RURAL			
Shoulder Type	Sidewalk	%	No Sidewalk	%	Sidewalk	%	No Sidewalk	%
No Shoulder	70	92%	6	8%	0	0%	1	100%
Curbed (0 FT)	1,703	99%	23	1%	1	100%	0	0%
Curbed (>0 FT)	94	99%	1	1%	0	-	0	-
Narrow (<= 6 FT) and Gravel	2	100%	0	0%	0	0%	5	100%
Narrow (<= 6 FT) and Paved	24	69%	11	31%	0	-	0	-
Wide (>6 FT) and Gravel	32	76%	10	24%	0	0%	3	100%
Wide (>6 FT) and Paved	64	29%	158	71%	2	14%	12	86%
Total	**1989**		**209**		**3**		**21**	
% of Total	**90%**		**9%**		**0%**		**1%**	

Figures 31 and 32 show the location of sidewalks and bike lanes, respectively, on CDOT roads within Region 1. It should be noted that only 2.9 miles of CDOT roads within Region 1 provide dedicated bike lanes and 270.6 miles (28%) of CDOT roads within Region 1 provide sidewalks. On the remainder of the roadway network, it is assumed that pedestrians and bicyclists will use the shoulders to travel the length of the roadway where no sidewalk or bike lane exists.

Only 28% of CDOT roadways in Region 1 have sidewalks, but crashes generally occurred where sidewalks were present. There were 1,992 crashes on roadways with sidewalks, and 270.6 miles of roadway with sidewalks in the region. Thus, when comparing the total number of crashes to the miles of roadway with sidewalks, the crashes per lane mile is relatively high at 7.36 crashes/mile of sidewalk (Table 13, above). This could be explained by the fact that 99% of crashes occurred in urban areas where sidewalks are primarily located (Table 15).

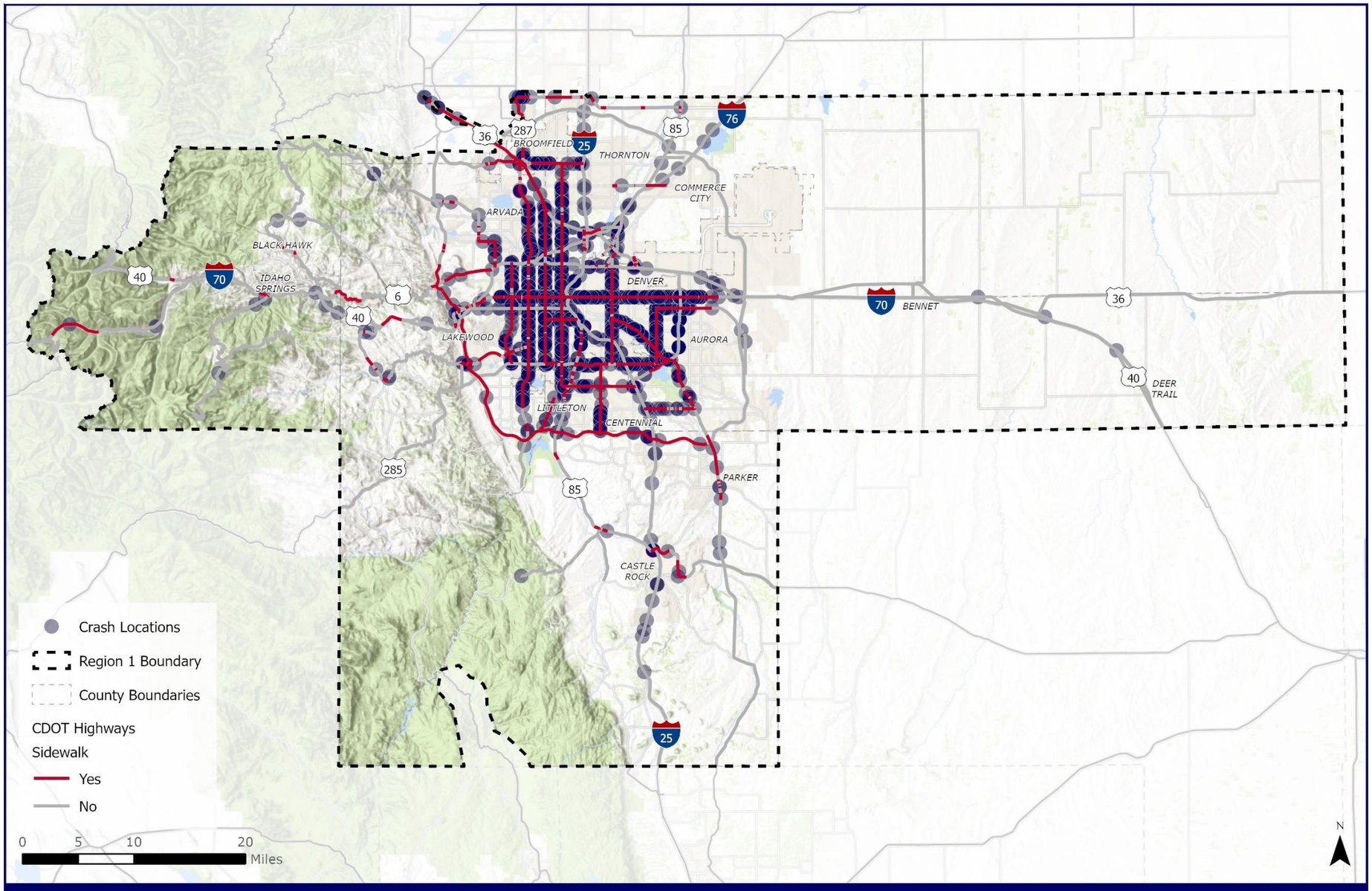
The crash analysis indicated that 74% of bicycle crashes occurred on roadways with curbed shoulders of 0 feet in width (Table 3). As would be expected with the small quantity of bike lanes present on the roadway network, a large number (99.95%) of bicycle crashes occurred at locations without bike lanes present. Conversely, 87.7% of bicycle crashes occurred at locations where sidewalks ***are*** present. While sidewalks are important for reducing bicycle and pedestrian crashes, this data indicates that the majority of crashes that have occurred on CDOT Region 1 roadways were not the result of a lack of sidewalks.

Figure 30: Shoulder Width & Crash Locations



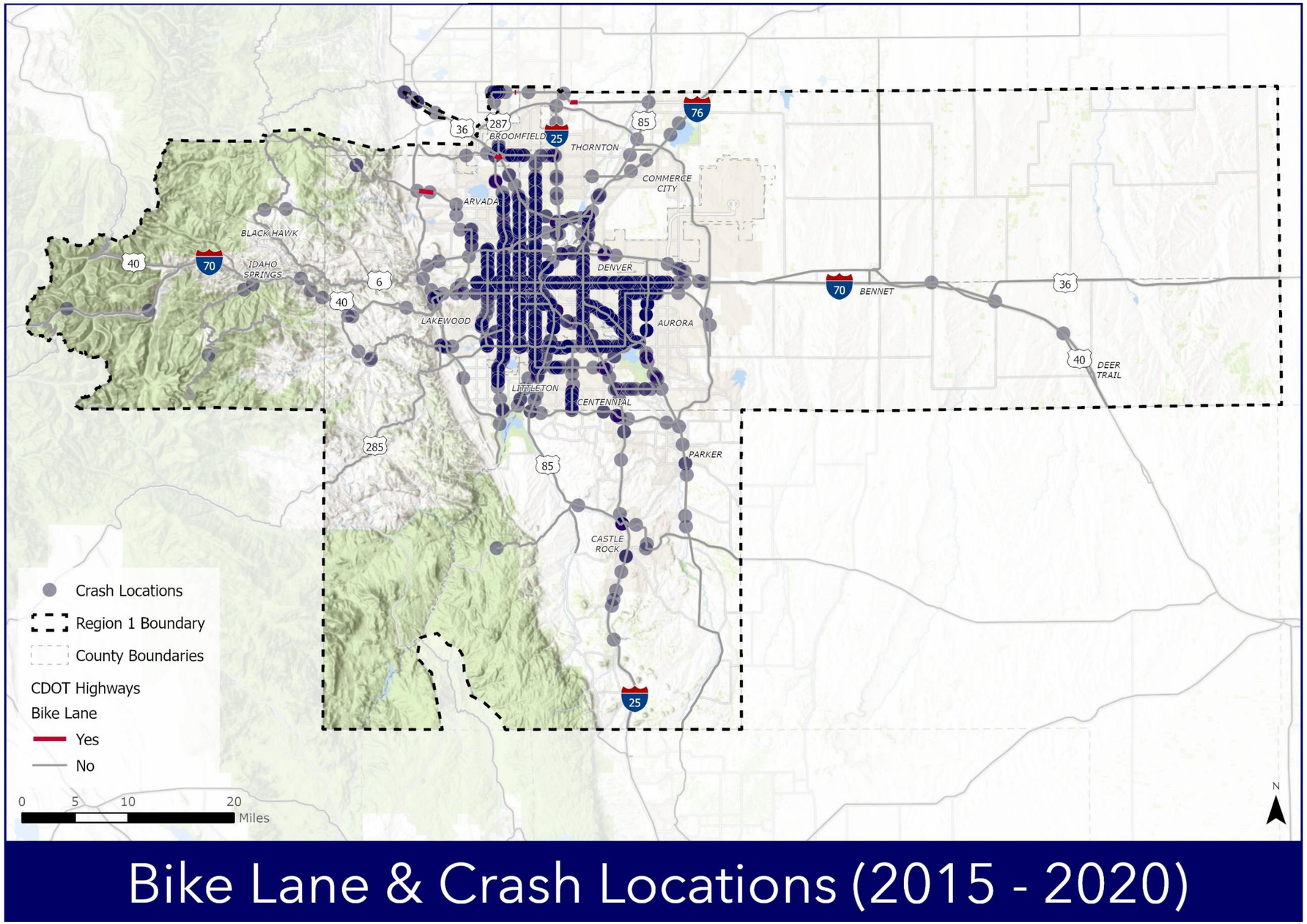
Shoulder Width & Crash Locations (2015 - 2020)

Figure 31: Sidewalk & Crash Locations



Sidewalk & Crash Locations (2015 - 2020)

Figure 32: Bike Lane & Crash Locations



Median Type

Table 16: Median Type Crash Summary

Potential Risk Factor	Categories	Total # Crashes	Total % By Type	Total # Crashes	Total # Lane Miles	Crashes / Lane Mile
Median Type	Depressed / HOV Reversible	125	6%	125	295.8	0.42
	Raised	241	11%	241	61.3	3.93
	Channelized - Raised Curb	866	39%	866	71.6	12.09
	Painted	296	13%	296	34.0	8.71
	Level (Barrier Separated)	95	4%	95	108.8	0.87
	None	599	27%	599	402.5	1.49

***Defined**: Medians provide separation between vehicles driving in opposing directions. Interstates and freeways generally have depressed medians and two-lane roads typically have none. Two unique median types included in CDOT's data are "channelized-raised curb" which is generally a 4-foot-wide median that provides channelization between opposing left turn lanes, and "level" which appears to be freeways/expressways or interstates with jersey barriers separating opposing travel.*

As shown on Figure 33, the crash analysis shows that the majority of crashes occurred on either roads with a Channelized - Raised Curb (39%), or no median (27%). Channelized – Raised Curbs (Figure 34) are typically found in areas where high concentrations of access to adjacent properties are provided. They designate where left turn access can be provided or where access will be restricted to only right-in and right-out movements. While these types of medians are helpful for restricting some conflicting turning movements, the left turn restrictions typically result in additional U-turn movements and weaving maneuvers as vehicles cut across traffic to get into the turn lane so they can make a U-turn and head in the opposite direction. The shorter the distance between allowable left turn movements, the less time a vehicle has to get across the road, but the more distributed the U-turn movements. Roadways with Channelized – Raised Curbs should be evaluated to identify whether providing additional distance between median openings and allowable left turn movements would improve safety. Some considerations that should be evaluated include, proximity of access points to the median opening (this will influence the danger of weaving movements), volume of traffic at the intersection (U-turn maneuvers take longer to make than left turn movements), and space to comfortably make a U-turn maneuver.

Since *Channelized - Raised Medians* typically occur in areas with a high density of driveways and intersections, this indicates that driveway density could be a high-risk factor. During the functional classification discussion, it was also noted that the introduction of access points on higher speed roads results in more crashes, so managing access may be a solution to improve safety on these types of roads. One of FHWA's proven safety countermeasures is "Corridor Access Management"[14], which is proven to reduce fatal and injury crashes on urban/suburban arterials by 25-31%. FHWA states that every intersection, from a signalized intersection to an unpaved driveway, has the potential for conflicts between vehicles, pedestrians, and bicycles. Additionally, they state that the number and types of conflict

[14] Proven Safety Countermeasures - Corridor Access Management - Safety | Federal Highway Administration (dot.gov)

points, and locations where the travel paths of two users intersect, influence the safety performance of the intersection or driveway. Figure 35 shows the location of each of the median types in relation to the reported crashes.

Figure 33: Number of Crashes by Median Type

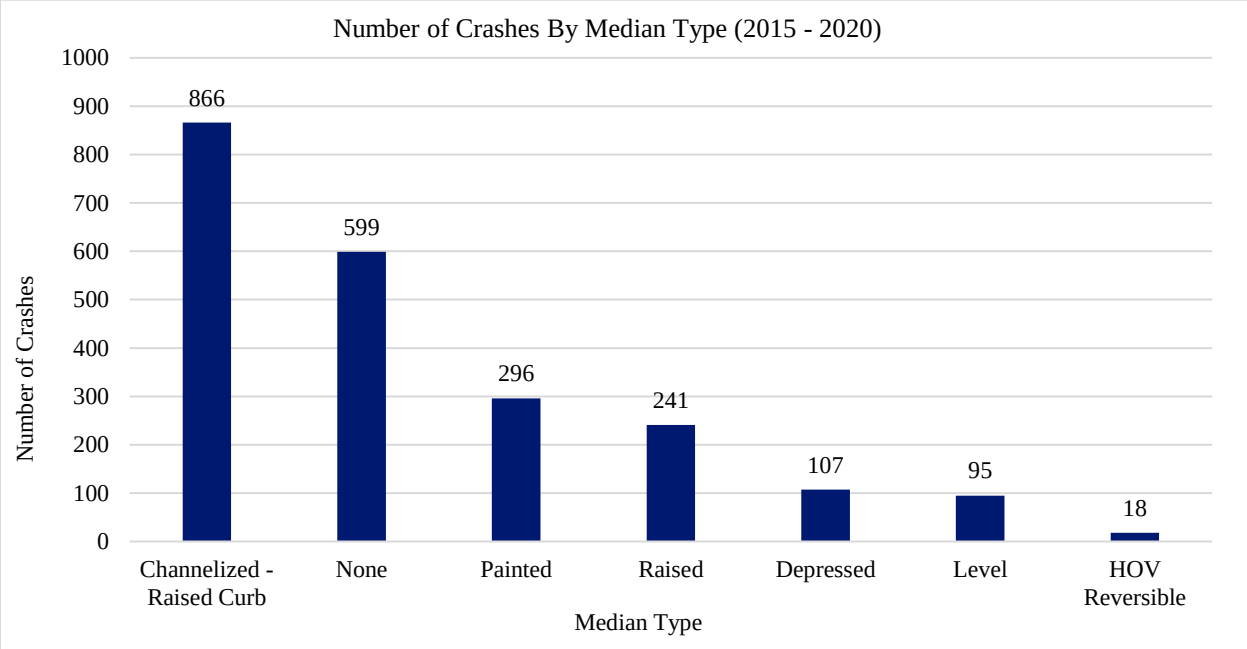
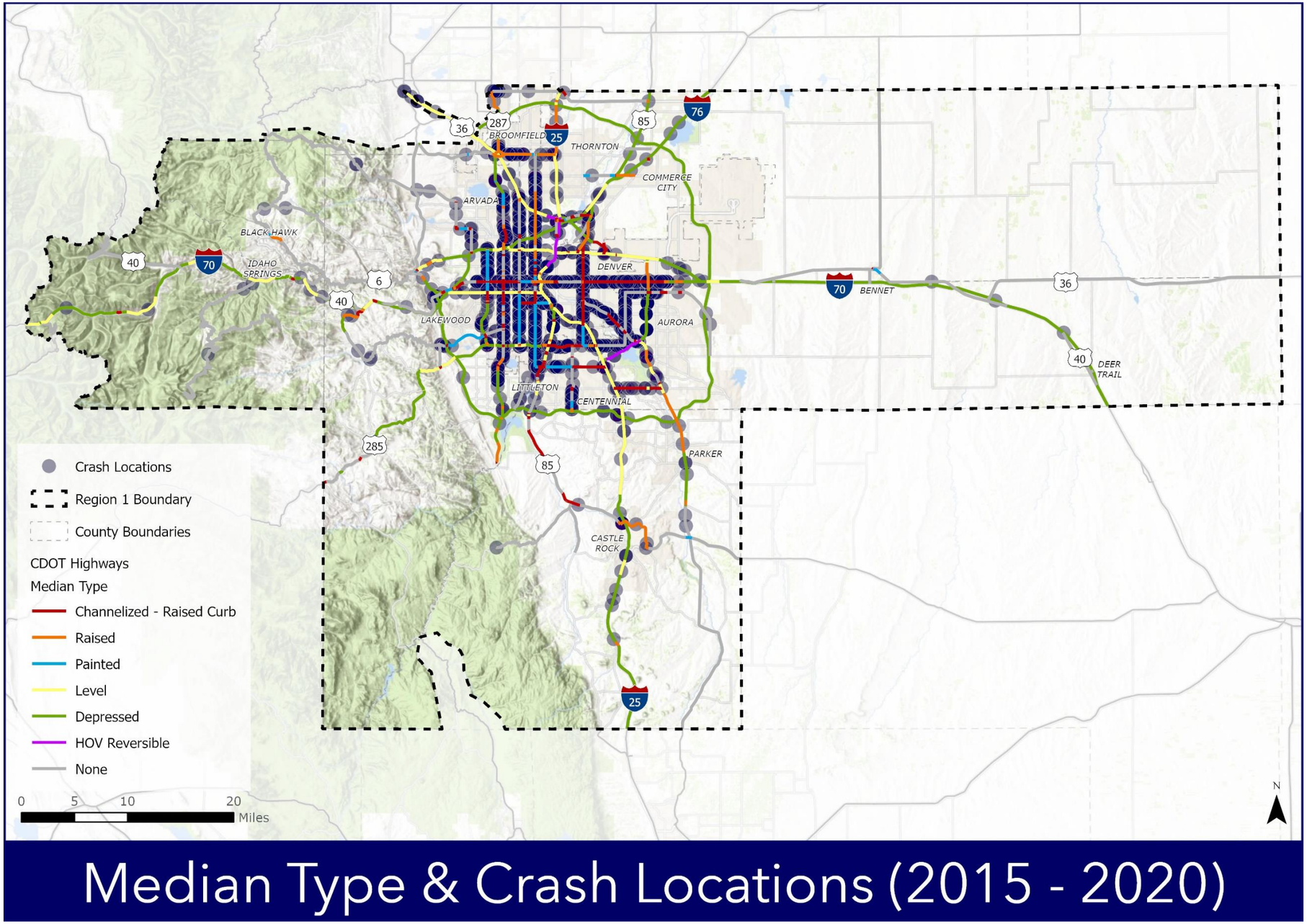


Figure 34: Example of Channelized – Raised Curb (Colfax Avenue west of Garrison Street)

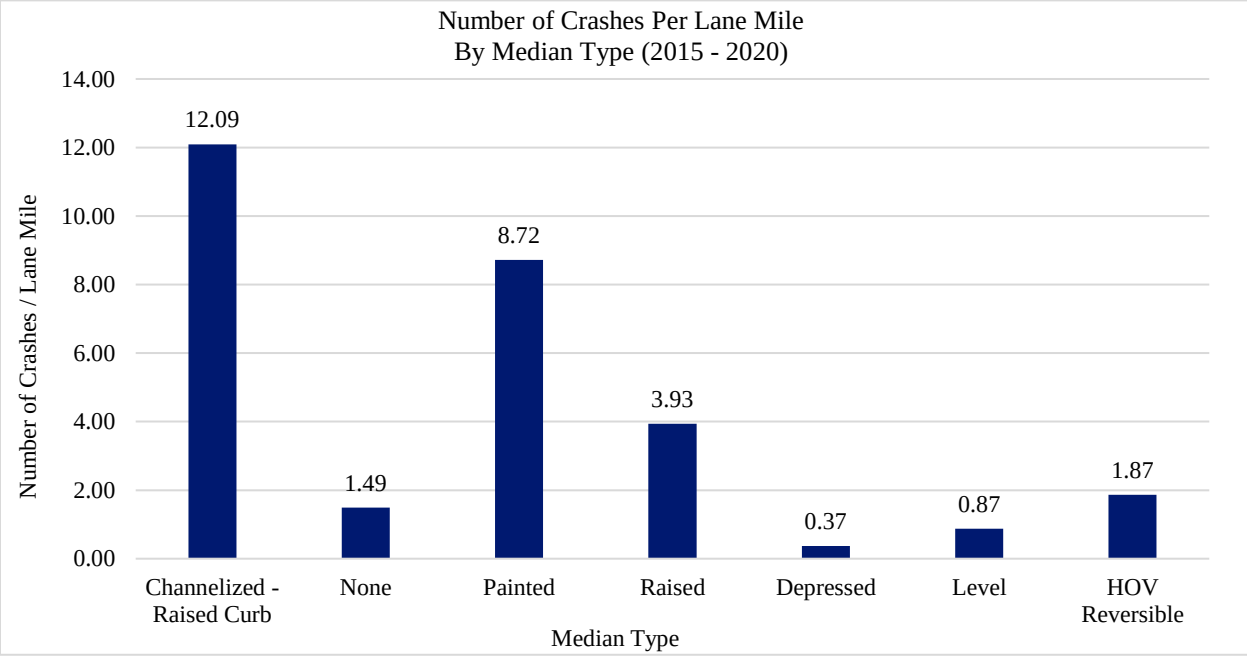
Figure 35: Median Type & Crash Locations



Median Type & Crash Locations (2015 - 2020)

As shown on Figure 36, when comparing the total number of crashes to the total lane miles of each median type, *Channelized-Raised Curb* and *Painted* medians experience the highest crashes per lane mile (12.09 and 8.72, respectively). Roadways with no median experienced 27% of crashes and 41% of roads do not have a median, so the ratio of crashes per lane mile is smaller for this type of road (1.49 crashes/mile).

Figure 36: Number of Crashes Per Lane Mile



As shown on Table 17, painted medians include medians with a TWLTL (Two-Way-Left-Turn-Lane), those where vehicles are not permitted, and channelized painted medians. *Painted* medians only consist of 34 lane miles of roadway, but 296 crashes occurred on these roads. Similar to the *Channelized-Raised Curb* medians, channelized painted medians and painted medians with a TWLTL are typically located in areas where more access is provided. Of the three types of painted medians, painted medians with a TWLTL experience the highest number of crashes per lane mile, likely because there is a higher number of conflict points than the other painted median types.

Table 17: Breakdown of Painted Median Crashes

Painted Median Types	Crashes	Lane Mile	Crashes/Lane Mile
Painted – Vehicles Allowed (TWLTL)	173	15.2	11.4
Painted – No Vehicles	11	3.6	3.1
Channelized - Painted	112	15.2	7.4

Volume to Capacity (V/C) Ratio

Table 18: Volume to Capacity Ratio Summary

Potential Risk Factor	Categories	Total # Crashes	Total % By Type	Total # Crashes	Total # Lane Miles	Crashes / Lane Mile
V/C Ratio	<0.65	361	**16%**	361	451.6	**0.8**
	0.65-0.84	808	**36%**	808	223.9	**3.61**
	0.85-0.99	828	**37%**	828	230.6	**3.59**
	>=1	225	**10%**	225	67.8	**3.32**

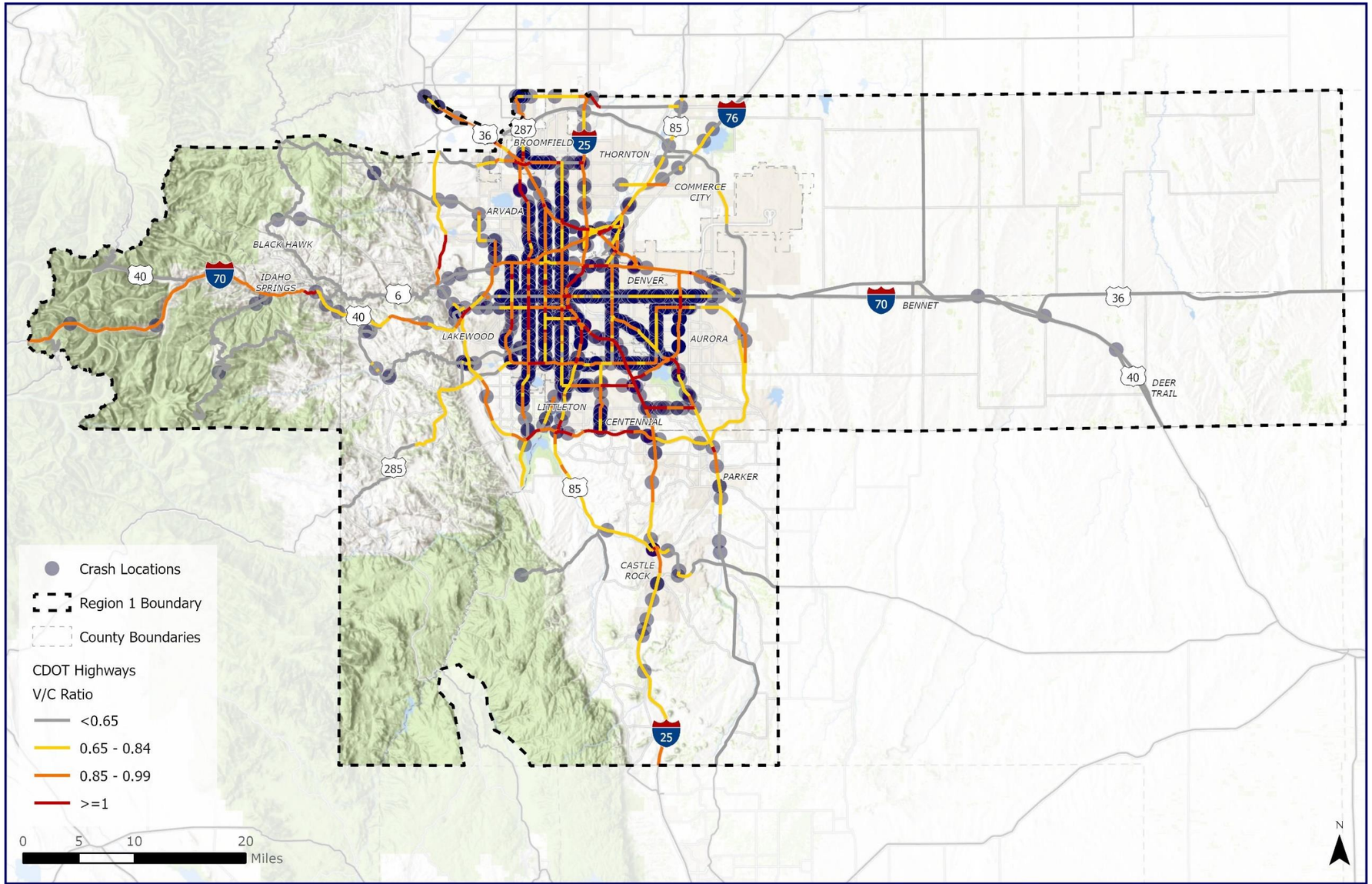
***Defined**: The V/C ratio is the hourly traffic volume divided by the capacity of a roadway segment and is a measure of the amount of delay vehicles would experience. A V/C Ratio of 1.0 means that the roadway segment is at capacity and is likely experiencing long delays at controlled intersections. A V/C ratio of 0.65 means that no delay is experienced, and the driver can travel at the posted speed.*

As shown in Table 18, a third (37%) of bicycle and pedestrian crashes occur on roads with a V/C ratio between 0.85 and 0.99 and 10% occur on roads with a V/C ratio greater than or equal to one. These roads are either approaching capacity or over capacity. While data indicates that the rate of vehicle-to-vehicle crashes is generally consistent up to a V/C ratio of 0.65, and more than double when the V/C ratio exceeds 1.0[15], this does not appear to be the case for bicycle and pedestrian crashes. This is likely due to the types of roads that are currently over capacity. As shown in Figure 37, some of the roads that are experiencing V/C >=1 are Interstate-25, E470, and US 36. A couple of the *Principal Arterial – Other* roadways such as Arapahoe Road and Wadsworth Boulevard also show segments in which the volume of the road is more than the capacity of the road. Bicycles and pedestrians are not permitted on interstates, and likely avoid riding on freeways and expressways if permitted, thereby reducing the potential for crashes on these types of roads.

Another factor that may result in fewer bicycle and pedestrian crashes on congested roadways is the lack of comfort these vulnerable users likely feel while traveling on these types of roads. While some studies indicate that the severity of crashes decrease as congestion increases and vehicle speeds are reduced[16] [17], another study notes that traffic congestion is more likely to lead to aggressive driving behavior which is associated with increased crash risks[18]. An increase in aggressive driving may increase bicycle and pedestrian risk as they pass a driveway or cross an intersection and vehicles are concerned with approaching vehicles, or looking for a gap in traffic to exit a driveway, thereby not focusing on the approaching bicycle or pedestrian. As population projections continue to rise, congestion on the Region 1 roadways will likely increase. As congestion increases, bicyclists will either limit their travel to less congested roadways (reducing the size of their network), reduce the amount of travel they do by bike, or increase travel on more congested roadways which could increase risk for bicycles and pedestrians at locations where they intersect with vehicles. Considering that the majority of (76%) of R1 bicycle and pedestrian crashes during the last five years occurred at intersections and driveways, new and innovative intersection treatments are needed to bring attention to vulnerable users on CDOT Region 1 roadways.

[15] 1112-005.pdf (trb.org)
[16] The relationship between road safety and congestion on motorways (swov.nl)
[17] 1112-005.pdf (trb.org)
[18] Influence of traffic congestion on driver behavior in post-congestion driving - PubMed (nih.gov)

Figure 37: V/C Ratio & Crash Locations



V/C Ratio & Crash Locations (2015 - 2020)

TAC #2 – Discuss Crash Analysis and Network Screening

The second TAC meeting was held on March 31, 2022, and included an overview of the results of the crash analysis and network screening elements. The TAC was polled after showing the crash results and crash scoring. When asked whether the results made sense, 100 percent of participants responded affirmatively. After providing an overview of all risk factors studied, the TAC was asked what three elements they believed were the highest risk factors. The results showed location as the highest perceived risk factor (twice as many votes as any of the other risk factors) followed by a tie for speed limit, number of lanes, AADT, functional classification, and presence of sidewalks.

Systemic Risk Scores

To better understand which roads on the CDOT roadway network have greater potential risk to bicyclists and pedestrians, risk scores were applied to each of the risk factors outlined in the sections above. The scores were developed based on the relative level of risk (as described below) that each risk factor adds to the roadway network. Risk scores were not included for Location and Lighting factors since they are attributes obtained from the crash reports and not the roadway segments. In place of lighting, the presence of streetlights was included in the risk factor. Additionally, the presence or absence of bike lanes was also not scored due to the low presence of crashes (1) and lane miles (2.9) with existing bike lanes. The risk scores were reviewed and approved by the Technical Advisory Committee (TAC) during the third TAC meeting before proceeding forward. The applied risk scores are included in Table 19, below. The risk scores range from a low of 0 to a high of 5 points.

Systemic Analysis Summary

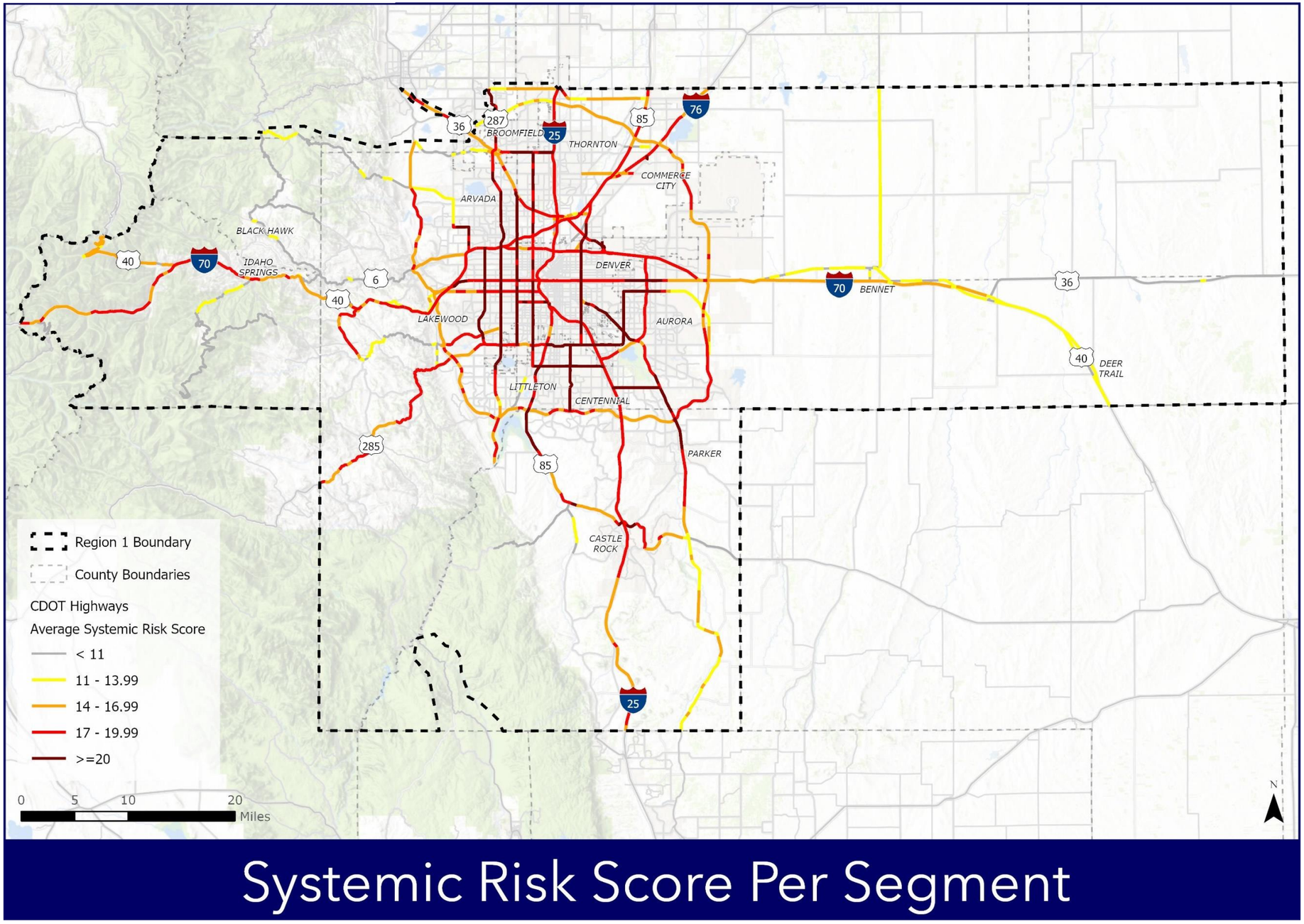
A total of ten potential risk factors were evaluated to identify the level of risk they pose to bicyclists and pedestrians on the Region 1 roadway network. The evaluation included research on proven safety countermeasures, national statistics, existing reports and studies, and crash reduction factors to determine the true correlation between the analysis results and the level of risk for bicyclists and pedestrians. Considering all the relevant information, scores were applied to each of the risk factors indicating a relative level of risk. The scores were then applied to each of the ½ mile roadway segments created during the crash analysis to show those roads with an increase in level of risk. The combined risk scores by segment, which apply the scores for each factor shown in Table 19, are shown in Figure 38.

Table 19: Systemic Risk Scoring

		2015 - 2020 Crash History		
Potential Risk Factor	**Categories**	**Total # of Crashes**	**Total % by Type**	**Risk Score**
	Total # of Crashes	2,222	100%	N/A
Jurisdictional Classification	Urban	2,198	99%	1
	Rural	24	1%	0
Functional Classification	Interstate	133	6%	1
	Freeway & Expressway	100	5%	1
	Principal Arterial - Other	1,943	87%	3
	Minor Arterial	40	2%	0
	Major Collector	4	0%	0
	Minor Collector	2	0%	0

	Local	0	0%	0
Presence of Street Lights	No Street Lights	60	-	1
	<=26 Street Lights	1,442	-	0.5
	>26 Street Lights	720	-	0
Speed Limit	<=30 mph	316	14%	2
	35 mph	795	36%	3
	40 mph	537	24%	4
	>=45 mph	574	26%	5
Number of Lanes	2	50	2%	0
	3	7	0.3%	2
	4+	2,165	97%	4
AADT	< 15,000	48	2%	1
	15,000 - 24,999	88	4%	2
	25,000 - 34,999	875	39%	3
	>= 35,000	1,211	55%	4
Shoulder Width / Type	No Shoulder	77	3%	2.0
	Curbed (0 FT)	1,727	78%	2.0
	Curbed (>0 FT)	95	4%	1.5
	Narrow (<= 6 FT) and Gravel	7	0%	1.5
	Narrow (<= 6 FT) and Paved	35	2%	1.5
	Wide (>6 FT) and Gravel	45	2%	0.5
	Wide (>6 FT) and Paved	236	11%	0
Presence of Sidewalk	Yes	1,992	90%	0
	No	230	10%	1
Median Type	Depressed / HOV Reversible	125	6%	0
	Raised	241	11%	1
	Channelized - Raised Curb	866	39%	3
	Painted	296	13%	3
	Level	95	4%	0
	None	599	27%	2
V/C Ratio	<0.65	361	16%	0
	0.65-0.84	808	36%	0.5
	0.85-0.99	828	37%	1
	>=1	225	10%	1

Figure 38: Systemic Risk Score Per Segment



MetroQuest Online Survey

Overview

The MetroQuest survey was distributed through the TAC members to local agency staff and the general public. The goal of the survey was to ensure that those who are the most familiar with issues on the roadway network (e.g. Police, Fire, Public Works, Administration, Advocacy Groups, and those who use the roads every day) were able to contribute to this study and the recommendations. The MetroQuest survey was open for 6 weeks, between January 7, 2022 and February 18, 2022. Over 2,300 people participated in the online survey. The majority of survey participants were white, and the primary language spoken was English.

Survey participants were asked to provide general input and ideas, thoughts on obstacles they face walking and biking within the region, and general input and ideas on a map of the region. Participants provided over 5,800 data points on the mapping portion of the survey. The feedback received indicated preferences for types and locations of safety improvements, areas where safety was of concern, and locations where bicycle and pedestrian demand exists. A summary of the survey results is provided below. A comprehensive overview of the survey and the respective results are provided in Appendix B.

Survey Summary

What Obstacles Do You Face?

Participants were asked to rank the obstacles they faced regarding bicycle and pedestrian movement and safety. The highest survey responses were 'Unsafe Traffic Conditions' (2,004 responses), 'Unsafe Crossings' (1,950 responses), and 'Lack of Sidewalks/Paths (1,890 responses). 'Unsafe Traffic Conditions' was defined as vehicle speeds being too high or vehicles not yielding to bicycles or pedestrians. Many participants pointed to the need for distinct spaces for bicycles, pedestrians, and vehicles and general education about how various modes should interact when encountering one another. The next tier of responses included 'Poor Lighting', 'Distance to Destination', 'Safe Routes to School', and 'Lack of Accessible Features'. At the bottom of the ranking was 'Physical Health' with 232 responses.

Tell Us What You Think

The survey collected demographic data about each participant and asked them questions about how they traveled, if they currently bike and walk in Region 1, and how easy they find biking and walking. The majority of survey participants live in households with other adults or children. Around 300 participants live alone, and over 200 respondents live with one or more senior citizen. Very few youth and children participated in the survey and many more participants were aged 55-64 and 65-74 than are demographically represented in the US bell curve. Most survey respondents own both a bike and a car, and walk or bike for exercise, leisure, or as a means of transportation. More survey respondents found it "Very Easy" or "Somewhat Easy" (1206 participants) to bike and walk in Region 1, compared to the survey respondents who found it "Somewhat Difficult" or "Very Difficult" (740 respondents). Given that the majority of respondents bike for exercise or leisure, it makes sense that facility barriers are not preventing people from using the CDOT Region 1 roadways to walk and bike.

Table 20 shows participants responses when asked where they would like to see improvements in Region 1 for biking and walking.

Table 20: MetroQuest Requested Locations for Improvements

I would like to see improved conditions for bikes and pedestrians (select top 2):
Number of Responses by Selection

	I would like to see improved conditions for bikes and pedestrians (select top 2):	Responses
1	Across high-speed/volume roads	1331
2	On Downtown/Main Streets	376
3	At intersections	834
4	Within my immediate neighborhood	255
5	Between my community and adjacent communities	689
6	On rural roads	184
7	Other (write details below)	86

The survey also provided open ended questions allowing participants to provide ideas for improvement. There were over 4700 additional ideas for how to improve connections for bikes and pedestrians. These ranged from physical improvements like detached bike lanes, wider shoulders, signage to inform and educate drivers and multi-modal trail users about walking and biking, underpasses at high-traffic crossings, and flashing crossing signals to ideas about connections and complete biking and walking networks that link neighborhoods and nodes through a robust system for walking and biking that parallels the current vehicular connection network.

Participants were asked "What can CDOT do?". The replies to this question mirrored the answers to the question about how to improve conditions for bikes and pedestrians. The top responses (by category) were:

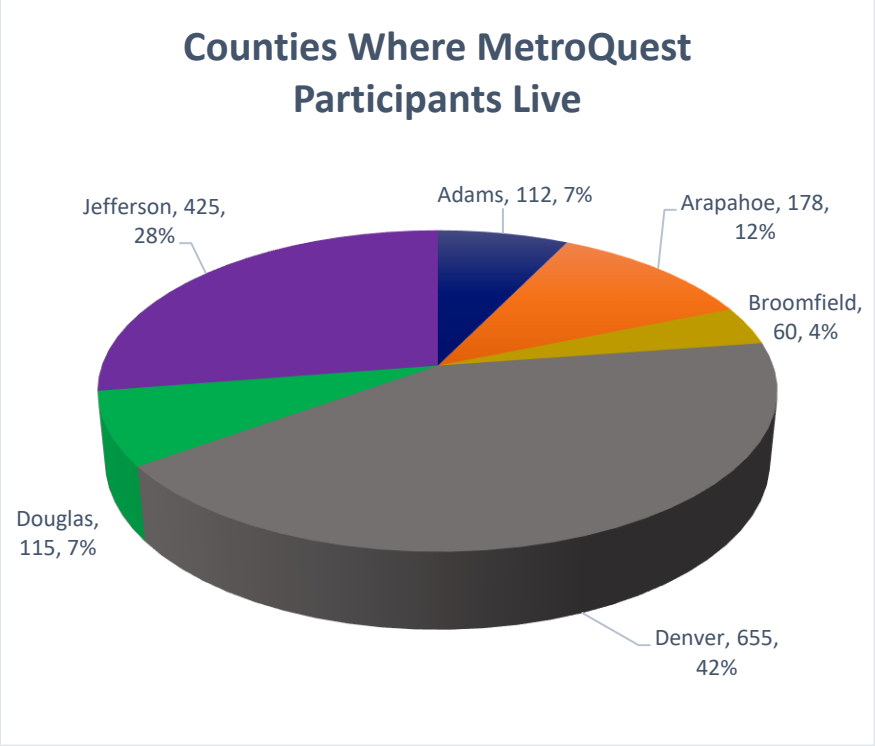
- Complete & connect the network
- Separate bicycle and pedestrian facilities
- Make biking and walking a systemwide priority
- Ensure adequate maintenance
- Improve the user experience, and
- Encourage driver etiquette, awareness and education & increase policing along roadways / trail networks
- Reduce auto speeds with multi-modal 'Complete Street' improvements to prioritize pedestrian / bike safety
- Communicate and engage with community members during visioning, planning and design
- Increase internal and external funding for bicycle / pedestrian improvements
- Develop safety marketing campaigns and public service announcements to increase driver awareness of walkers and bicyclists

Participants were also asked where they would like to see bicycle or pedestrian connections on or across CDOT roads. There were many specific examples of locations where survey respondents would most like to see bicycle or pedestrian improvements along CDOT Region 1 roads, but the common thread among survey respondents was the desire to prioritize these improvements where crash data indicates a need.

Tell Us About You

The final questions on the survey were intended to better understand where participants were from and whether they were associated with or representing a bicycle or pedestrian advocacy group. The majority of participants were from City and County of Denver (655 participants) and Jefferson County (425 participants), followed by Arapahoe County (178 participants), Douglas County (115 participants), and Adams County (58 participants). The remaining counties had less than 25 participants each. This distribution is representative of the heavy population centers within the region.

Figure 39: Counties Where Most MetroQuest Participants Live



Of the participants that responded to the question about whether they were associated with an advocacy group, just over 300 participants answered 'yes', and nearly 1,300 participants answered 'no'. The most common advocacy group mentioned was Bicycle Colorado.

Interactive Map

Participants were directed to drag and drop at least three map markers on the interactive map. A total of 5,832 markers were placed. The heat map shown in Figure 40 shows where the highest clusters of comments were placed. As shown in Figure 41, the top marker placed was 'poor biking condition' and the reasons stated for 'What makes it hard to bike here?' (Figure 42) included the lack of bike lanes or bike pavement markings, followed by narrow roadway shoulders and high traffic volume / speed.

Figure 40: MetroQuest Interactive Map Comment Density

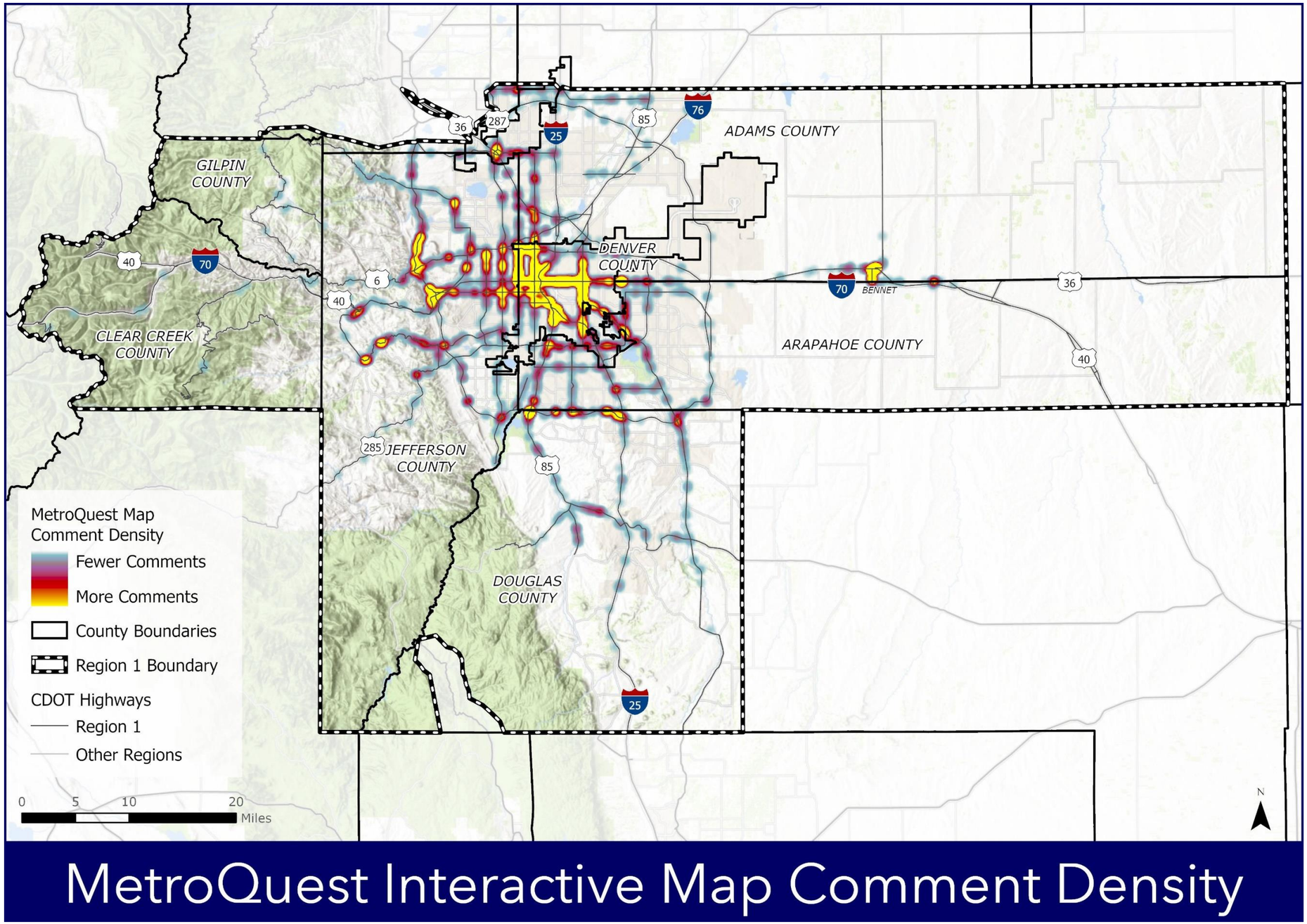


Figure 41: MetroQuest Map Marker Summary

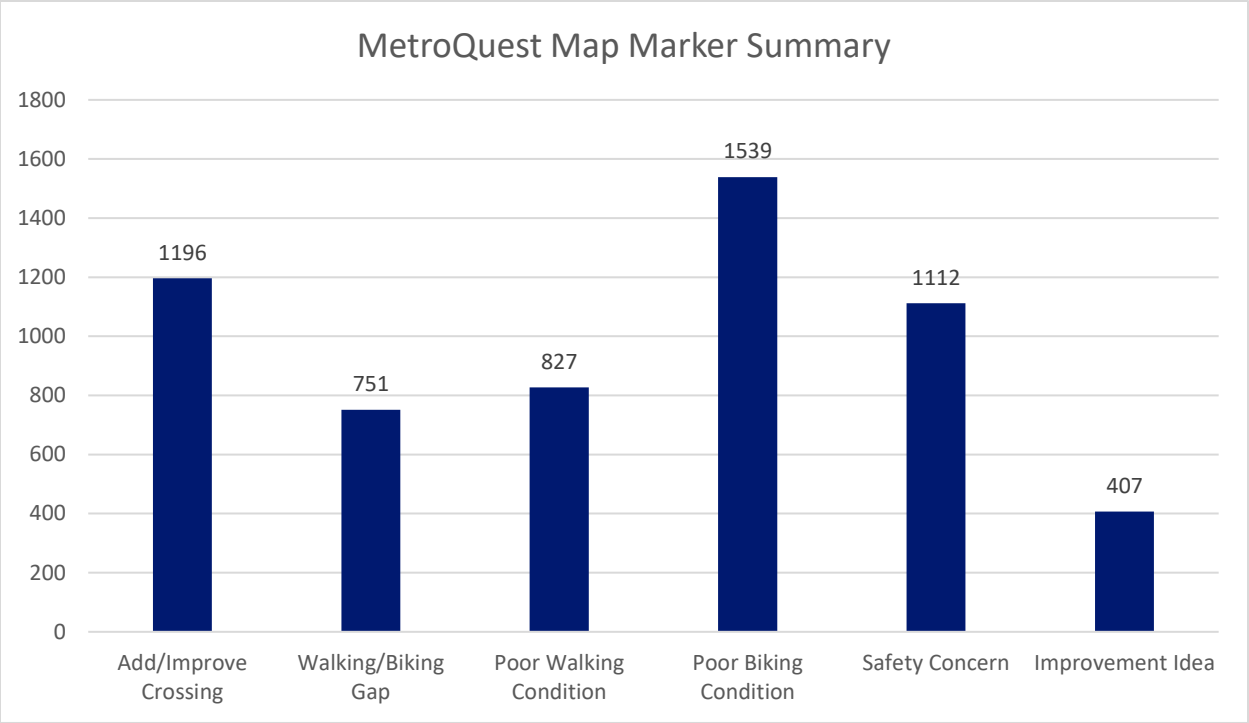
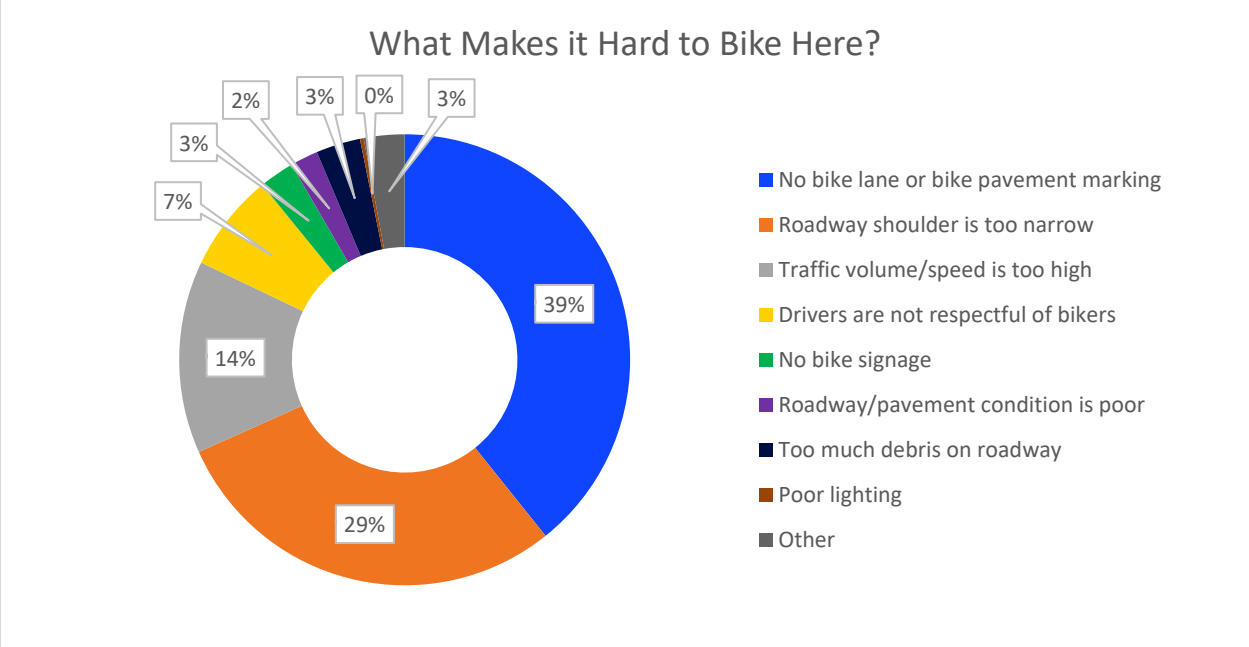
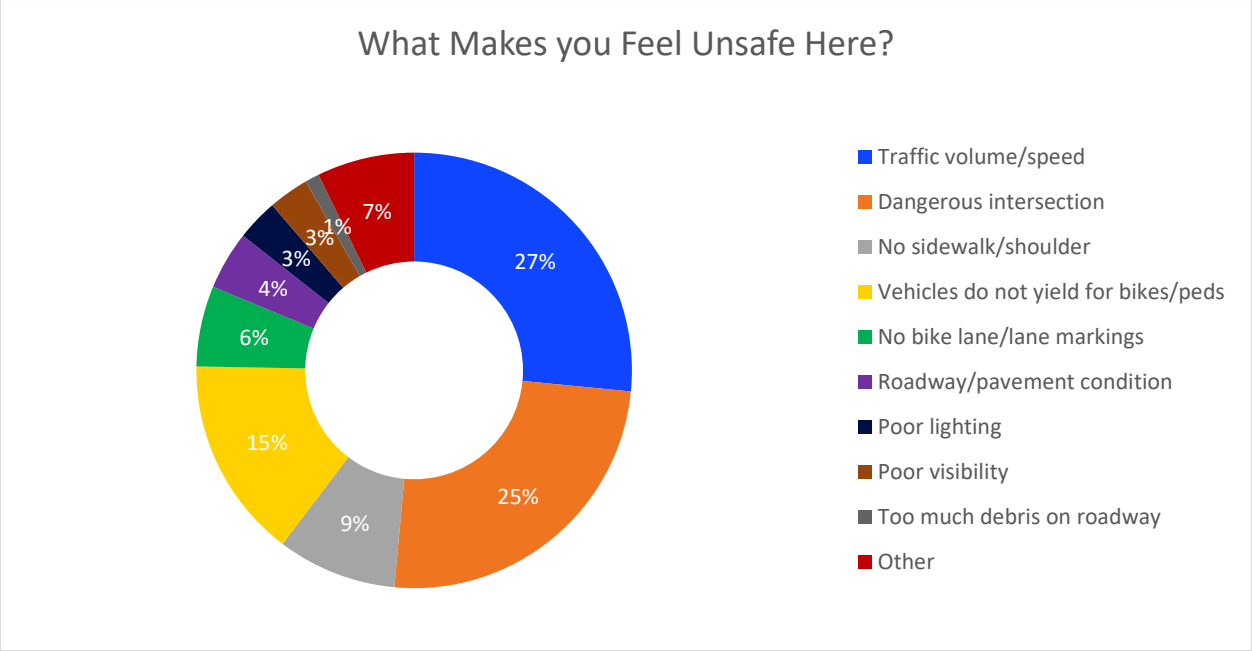


Figure 42: MetroQuest Response to 'What Makes it Hard to Bike Here?'



The second and third highest number of map markers were placed for 'add / improve crossing' and 'safety concern'. When asked for whom the crossing should be provided, nearly 75% of participants responded with 'both' bicycles and pedestrians. As shown on Figure 43, below, when asked 'what makes you feal unsafe here?' participants top three responses were 'traffic volume/speed', 'dangerous intersection', and 'vehicles do not yield for bikes/peds'.

Figure 43: MetroQuest Response to 'What Makes you Feel Unsafe Here?



MetroQuest Heat Mapping

The 5,800 map markers placed on the interactive map and the open-ended responses provided on some of the map markers prompted a focus on factors that could not be measured with available data. Concentrations of map markers point to areas of demand for biking and walking within the region, while some of the open-ended responses point to other risk factors such as poor intersection sight distance between motor vehicles and bicycles / pedestrians that were not measured during the systemic safety analysis.

Absent bicycle and pedestrian counts across the region, the MetroQuest data demonstrated where demand existed for bicycle and pedestrian infrastructure and where support for improvements was likely high due to the volume of comments received. Concentrations of participant comments were identified and are listed as MetroQuest hot spots in Table 21 below. Approximately 25 hot spot locations were identified across the region. With awareness of data required to provide a successful safety grant application, the MetroQuest hot spot locations were cross referenced with the systemic risk scores. A higher risk score combined with data indicating demand and support for improvements is expected to produce a successful outcome when safety grant funding is sought. The resulting hot spot locations and respective systemic risk scores are outlined in Table 21 below and referred to throughout the remainder of this report as the top systemic locations.

Table 21: Top Systemic Locations

City	Location	Systemic Risk Score
Lakewood	Intersection of US 6 and Wadsworth Blvd at underpass and on/off ramps*	22.5
Wheat Ridge	CO 391 (Kipling St) South of W 44th Ave Near Clear Creek Trail Crossing to 41st Ave**	22
Wheat Ridge	Intersection of Wadsworth Blvd and 32nd Ave	22
Wheat Ridge	Wadsworth Blvd from 26th Ave to 29th Ave and from 32nd Ave to 35th Ave	21-22
Wheat Ridge / Lakewood	Intersection of Wadsworth Blvd and 26th Ave	21
Edgewater / Denver	Sheridan Blvd from W Colfax Ave to W 25th Ave/W Byron Pl**	20-21
Unincorporated Douglas County	US 85 and C 470 EB On/Off Ramps*	20.5
Broomfield / Westminster	US 287 (W 120th Ave) from Main Street to Federal Blvd*	20-21
Littleton	US 85 and West Mineral Ave**	20
Aurora	Intersection of US 40 (Colfax Ave) & Florence St	18-21
Lakewood	US 40 (Colfax Ave) from Wadsworth Blvd to Sheridan Blvd*	19-20
Westminster / Adams County	Intersection of US 287 (Federal Boulevard) and 70th Ave	19
Broomfield	CO 121 (Interlocken Loop) between CO 128 and W Midway Blvd	19
Golden	Intersection of 6th Ave and Johnson Rd	16.5
Golden	US 6 and Heritage Rd/W 10th Ave Intersection*	16
Golden	US 93/Washington Ave/Washington St**	14.5
Golden	US 93/Iowa Dr	14.5
Golden	US 40 (Colfax Ave) from roughly the Park-N-Ride north to Rooney Rd. (1.6 miles)*	13-15
Arvada	SH 72 (Indiana St) Near Railroad…South of W 86th Pkwy	13

Kittredge (Unincorporated JeffCo)	SH 74 from Myers Gulch Rd to Lines Lane. (1,000 ft) (possibly extend further into town)	11.5
Bennett	S 1st Street from Colfax Ave to I-70 (1.25 miles)*	10-12
Evergreen (Unincorporated JeffCo)	SH 74 in Downtown Evergreen from Hwy 73 to Meadow Drive. (1,800 ft)**	10-12
Bennett	Intersection of E Colfax Ave and Adams St	9-12
Bennett	Palmer Ave from Colfax Ave to 8th St (0.28 miles)	9-12
Bennett	Intersection of 1st Street & Centennial Dr	9-12

The projects noted above with a * or ** were not advanced to the top ten prioritization list for reasons explained below:
* Improvements currently in progress/funded that will address bicycle and pedestrian needs
** Several studies and projects have been identified and are currently in progress along this corridor that will address bicycle, pedestrian, and transit needs.

TAC #3 – Discuss Priority Crash Locations, Risk Scores, and MetroQuest

The third TAC meeting was held on May 5, 2022, and included an overview of bicycle and pedestrian crash hot spots, the MetroQuest results, and MetroQuest hot spots. TAC members were presented with graphics showing the distribution of crashes on the high scoring crash locations and a list of crash hot spots that resulted from this evaluation. When asked about the level of support members had for the process by which bicycle and pedestrian crash hot spot locations were selected, members either agreed or were neutral. Those who were neutral indicated a desire to evaluate locations based on a crash rate rather than total number of crashes.

Members were then presented with the proposed scoring for the risk factors discussed in the prior TAC meeting, an overview of the MetroQuest results, and a list of top systemic locations based on a combination of hot spots in the MetroQuest data and risk scores. Over 80 percent of TAC members supported the process for selecting top systemic locations, while 17% disagreed. One member expressed a concern with rewarding those populations that were more engaged, rather than addressing those populations that are as high in need but may not have responded. Another concern revolved around the need to consider the behavior of bicyclists, pedestrians, or drivers to reduce severe crashes and fatalities. In the end, none of the members disagreed with the final systemic locations that were discussed.

At the end of the call, it was requested that TAC members be able to submit additional locations for consideration of top crash or systemic locations. This was allowed and both the Cities of Lakewood and Sheridan submitted a few locations. Several of the locations from the City of Lakewood were added to the list of top crash locations, and three locations from the City of Sheridan were added to the list of top MetroQuest locations.

TOP LOCATIONS

Overview

CDOT's goal for this study was to identify top locations based on typical crash analysis, but also to include systemic improvement locations based on the evaluation of roadway characteristics that indicate a higher level of risk for bicycles and pedestrians.

Top Crash Locations

Table 22: Top Crash Locations

Local Agency	*Top Crash Locations*
Aurora	**Segment of Colfax from Moline to Peoria**
Aurora	**Intersection of Colfax/Havana**
Glendale	**Intersection of Colorado/Mississippi**
Aurora	**Intersection of Colfax/Moline**
Aurora	**Intersection of Colfax/Chambers**

Starting with the list of the bicycle and pedestrian crash hot spot locations provided in Table 2, five top locations were identified. The top crash locations were selected based on the locations with the highest score. The segment of Colfax Avenue from Allison Street to Sheridan Boulevard in Lakewood was among the hot spots with the highest scores, however, Lakewood staff indicated that they were moving forward with a project at that location which would include bicycle and pedestrian improvements, as such that location was not included in the selection of top projects. The top five bicycle and pedestrian crash locations are shown in Table 22, above.

Top Systemic Locations

Committed to identifying proactive safety improvements, CDOT selected six locations from the top systemic locations identified in Table 21, above. In addition to considering the systemic risk score given to each of these locations, considerations were also made for context factors such as surrounding land uses, proximity to transit, connections to existing / proposed bicycle and pedestrian facilities, the distribution of selected locations (urban versus rural), and roadways that serve as a boundary between two local agencies. Each location was further evaluated using the following DRCOG data layers as they are important elements to score well on many safety grants.

- Vulnerable Populations by Tract ACS 2015-2019
- Regional High Injury Network and Critical Corridors
- Pedestrian Focus Areas
- Bicycle Facility Inventory

Upon completing the evaluation above, staff from each of the local agencies were asked to provide feedback and information regarding their respective top locations. This information was used to eliminate locations that already had current projects, studies or grant funding which would result in the evaluation or improvement of bicycle and pedestrian improvements. The resulting locations and considerations for selection are outlined in Table 23.

Table 23: Top Systemic Locations

Local Agency	Top Systemic Locations	Notes
Westminster / Adams Co	Intersection of US 287 (Federal Blvd) / 70th Ave	• High Network Risk Score • Pedestrian Focus Area • Med/High Vulnerability • High Injury Network • Within ¼ mile of RTD Station
Wheat Ridge	Intersection of Wadsworth / 32nd and Wadsworth from 32nd to 35th	• Very High Network Risk Score • Pedestrian Focus Area • Medium Vulnerability • High Injury Network • Connection to planned multiuse trail
Wheat Ridge / Lakewood	Intersection of Wadsworth / 26th and Wadsworth from 26th to 29th	• Very High Network Risk Score • Medium Vulnerability • High Injury Network • Listed as #27 on top crash locations
Bennett	Intersection of Colfax / Adams	• Medium Vulnerability • Rural • Provides connection to schools, park, library
Bennett	Palmer Ave from Colfax to 8th	• Medium Vulnerability • Rural • Provides connection to schools, park, library
Bennett	Intersection of 1st St / Centennial	• Medium Vulnerability • Rural • Provides connection to schools and park across a high-speed road

SAFETY COUNTERMEASURES

Overview

After selecting the top locations, an evaluation of each location was completed. Available bicycle and pedestrian crash data were reviewed to identify any patterns in the data or unique characteristics related to each location, and MetroQuest comments were reviewed to better understand existing concerns. Traffic counts were collected and reviewed, and field evaluations were conducted to gather a better understanding of the specific conditions of each site. Traffic patterns were observed, site specific challenges noted, and various safety countermeasures were considered. A high-level discussion of the evaluation is included below.

Crash Patterns, Field Observations, Countermeasures

During the evaluation of bicycle and pedestrian crash data, crashes involving pedestrians or bicyclists not yielding to vehicles were common, as were approach turn crashes. On the segment of Colfax from Moline to Peoria, many of the crashes involved pedestrians crossing mid-block at undesignated locations. It is important to note that understanding the cause of a crash is key to ensuring that the proposed improvements will address the actual cause of the crash. During the review of crash data, all available data was reviewed, but in some cases was limited, so the recommended countermeasures were based on best practices and knowledge gained in the field or through discussions with the local agencies.

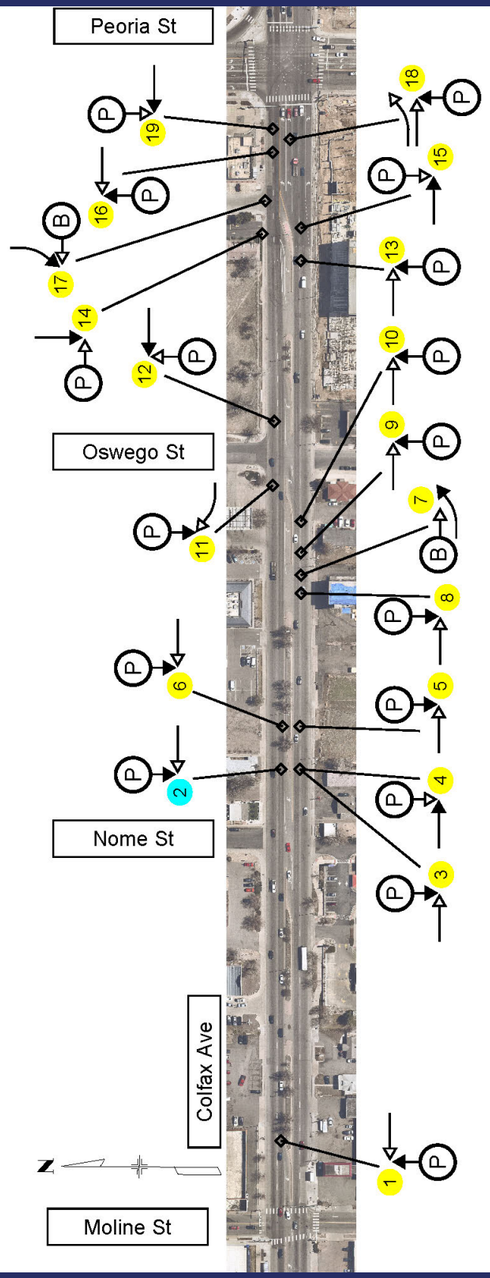
While observing the top locations in the field, a few common themes were noted:

- High-volume, high-speed intersections result in long crossing distances for bicyclists and pedestrians, and less focus on vulnerable users at the intersection,
- Landscaping, traffic controller boxes and fences adjacent to the intersections resulted in poor sight distance to bicycles and pedestrians, or a lack of focus on bicycles and pedestrians,
- Several locations currently have negative left turn offsets that require drivers to focus more on approaching traffic than bicyclists and pedestrians crossing the street,
- The Colfax Avenue locations typically involved wide outside vehicle lanes and excessive access points,
- Intersection illuminance appeared lacking or poor in many cases,
- Many of the existing signals were old and unable to accommodate updated lighting, signage or upgrading signal heads,
- General maintenance was needed at many of these locations to bring existing conditions up to current standards.

A list of potential countermeasures for each site was identified based on an understanding of available data, including crash patterns and field observations. For each of the top locations, a detailed summary of the crash results, field observations, and safety countermeasures are provided in Figures 44 thru 57, below.

Figure 44: *Colfax from Moline to Peoria Crash Summary, Field Observations & Countermeasures*

Crash Diagram



Legend

- P Pedestrian
- B Bicycle
- X PDO
- X Injury
- X Fatality
- Vehicle 1
- Vehicle 2
- Turning
- Angle

Crash Summary

- There was one fatal pedestrian crash that occurred at a midblock crossing.
- Most midblock crashes were the fault of pedestrians unlawfully crossing or not yielding to the right-of-way of vehicles.
- More than half of the midblock crashes occurred between Nome Street and Oswego Street.
- More than half of the crashes occurred in dark-lit conditions.
- More than one quarter of the crashes on this segment involved alcohol.

MetroQuest Summary

- East of Oswego Street vehicles do not yield to bicycles or pedestrians.
- At Peoria Street there are long crossing distances, and the traffic volume/speed is high.

Field Observations

- The crash history indicates that pedestrians are crossing midblock illegally and this was observed in the field.
- Marked crosswalks are roughly 1900 feet apart (Peoria Street and Moline Street).
- Nome Street and Oswego Street are unmarked crossings with pedestrian landing ramps. These locations do not provide pedestrian refuges.
- There were a lot of access points that did not lead anywhere.
- The outside vehicle travel lanes were extra wide and may give drivers a false sense of security to drive faster than the posted speed limit. It seemed that cars were travelling faster than the posted speed in the field.

TOP Countermeasure(s)

1. Add a marked crossing with a pedestrian refuge and HAWK signal between Nome Street and Oswego Street

Additional Countermeasures

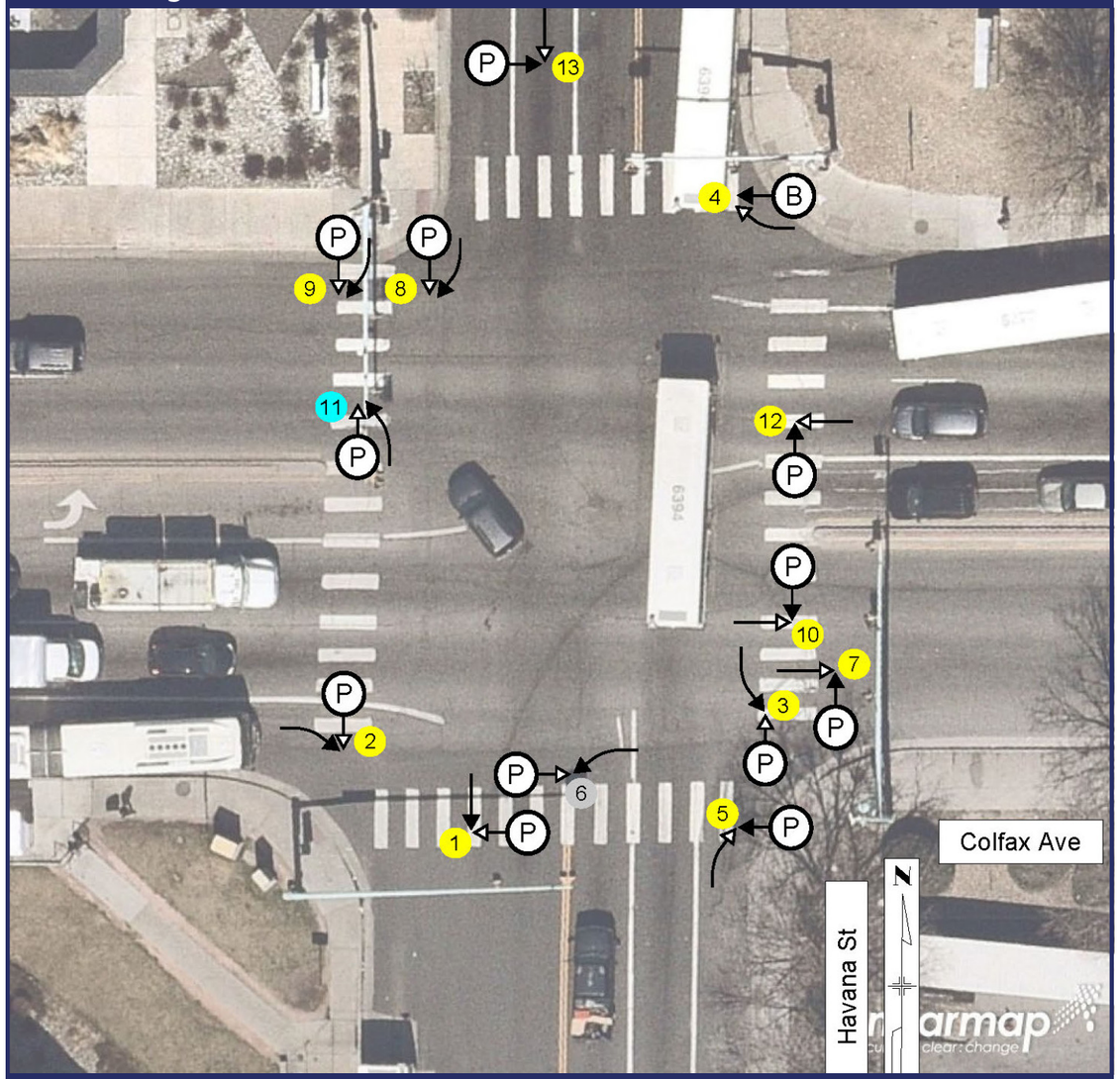
- Increase corridor illuminance
- Reduce the size and quantity of median openings
- Restrict access at Nome Street and Oswego Street to three-quarter (left-in, right-in, and right-out) movements
- Access control or access management plan to further consolidate/eliminate accesses as the area redevelops

Agency Coordination

- The City supports access management to help reduce conflicts to the highway.
- Options included various turn movement restrictions / access management concepts for intersections between Peoria and Moline.
- The proposed alternative has the least impact to area traffic and pedestrian mobility.

Figure 45: *Colfax & Havana Crash Summary, Field Observations & Countermeasures*

Crash Diagram



Legend

- (P) Pedestrian
- (B) Bicycle
- (X) PDO
- (X) Injury
- (X) Fatality
- Vehicle 1
- Vehicle 2
- Turning
- Angle

Crash Summary

- Nearly half of crashes occurred in dark-lit conditions.
- Crashes occurred throughout the day and night, not during a specific peak hour(s).
- Nearly half of crashes were the fault of the bicyclist or pedestrian and the violation code associated with the crashes indicated the pedestrian either walked into the path of the vehicle, didn't yield the ROW of the vehicle or didn't obey the signal.

MetroQuest Summary

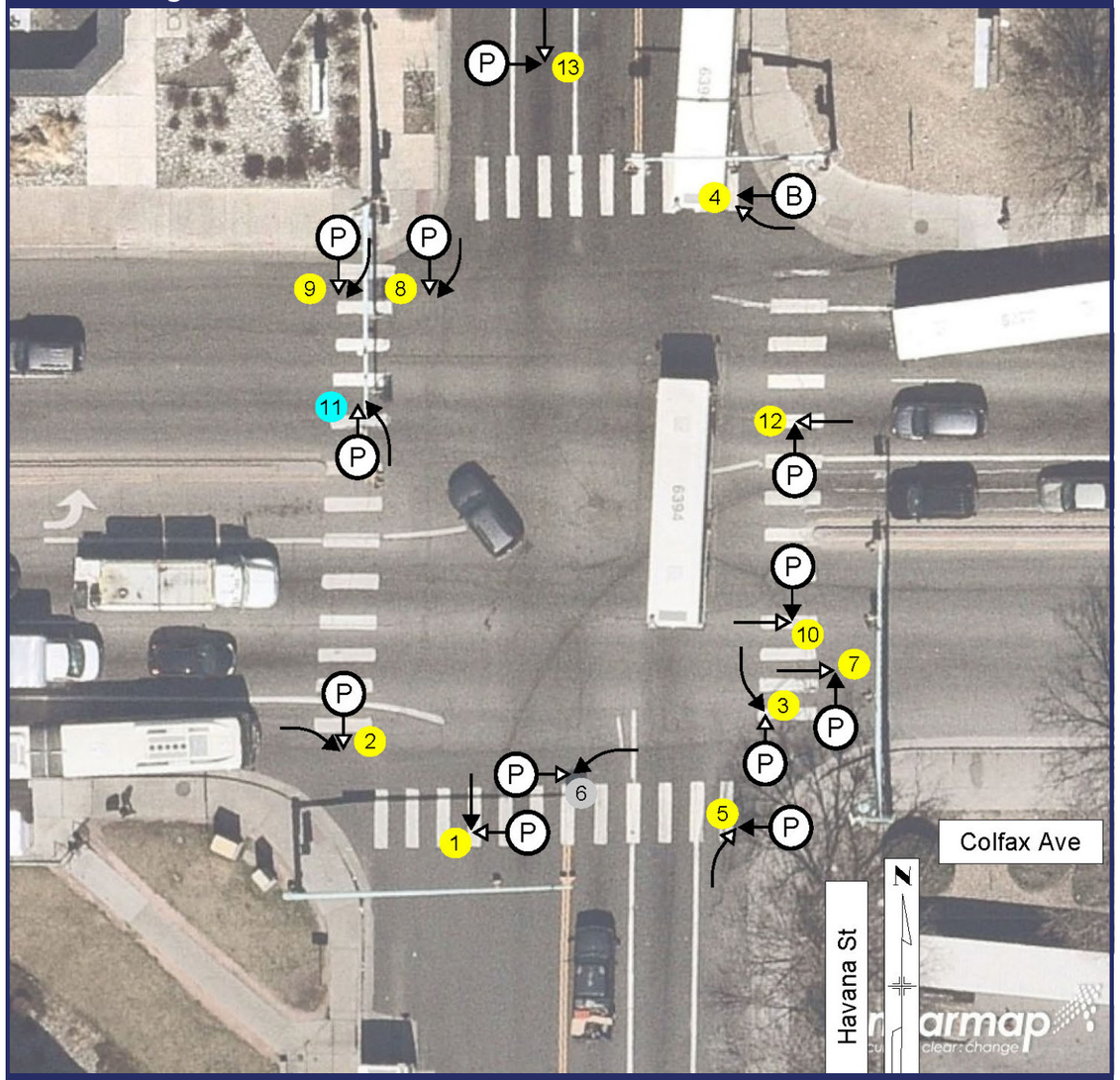
- The intersection feels unsafe because vehicles do not yield to bicycles and pedestrians.
- There are no bicycle lanes or bicycle pavement markings.
- There is poor visibility to drivers.
- The intersection needs left turn signals.

Field Observations

- Havana Street north and south of the intersection was VERY dark. Colfax Avenue had some lighting in the median and the bus shelters were lit, but the area was generally very dark. The northeast and southwest corners of the intersection did not have overhead lighting and lighting in the other two corners was warm, where cooler toned LED lights could improve color rendition and brightness.
- A high volume of pedestrians do not activate the pedestrian signal and many others cross against the signal.
- Many pedestrians were observed crossing outside of the designated crosswalks and/or wandering aimlessly into the road.
- Observed a near miss where the pedestrian crossed against the signal and was nearly hit by both left and right turning vehicles simultaneously.
- Bicycle and pedestrian volumes at this intersection were very high, and the vast majority of pedestrians within this intersection were transit patrons.
- The northwest corner had severe sight obstructions between southbound right turning vehicles and pedestrians on the corner. The dense landscaping was overgrown and extended up to the edge of the curb line.
- The signal pole in the northwest corner was located in the middle of the sidewalk/ramps.
- Pedestrian ramps generally did not meet ADA requirements for slopes and directional ramps.
- The "Right Lane Must Turn Right" sign for the northbound right turn on Havana Street was partially obstructed by low hanging tree branches.
- The majority of exclusive turn lanes did not have pavement marking arrows or signage to define the intended lane usage.
- The outside, southbound receiving lane on Havana Street was not defined very well and was confusing.
- It appeared that most of the left turn signal phases were operating on minimum recall. Many cars were observed making left turns on or after receiving the yellow arrow, creating potential near miss crashes.
- Westbound pedestrians in the south crosswalk were observed crossing half of Havana Street prior to the walk phase coming up and were nearly hit by fast moving northbound right turning vehicles.
- Pedestrian "walk" time was not adequate for all users.

Figure 46: Colfax & Havana Crash Summary, Field Observations & Countermeasures (Cont.)

Crash Diagram



Legend

- (P) Pedestrian
- (B) Bicycle
- (X) PDO
- (X) Injury
- (X) Fatality
- Vehicle 1
- Vehicle 2
- Turning
- Angle

TOP Countermeasure(s)

1. Curb extensions in the northwest and southeast corners and queue jumps for eastbound and westbound buses
2. Evaluate the feasibility of passive pedestrian detection

Additional Countermeasures

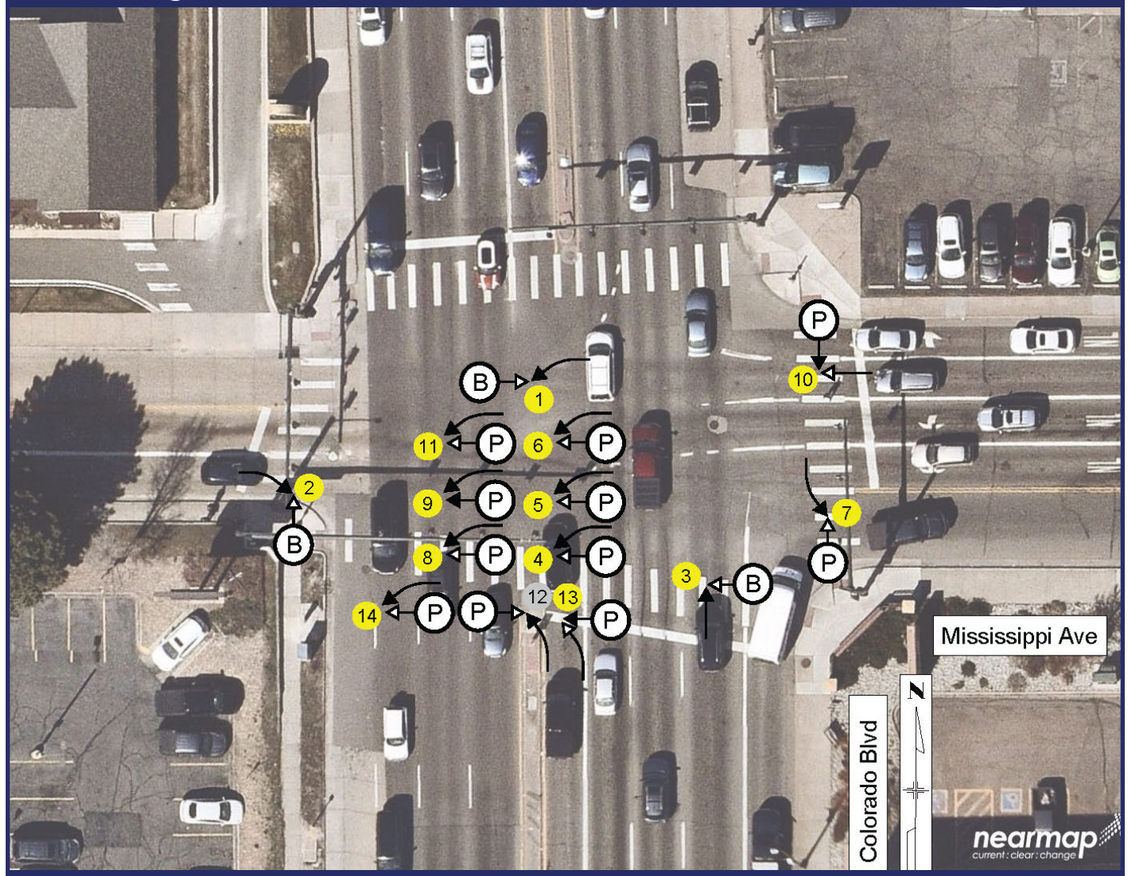
- Signage/Striping
  - Add stop bars and lane use markers in dedicated turn lanes
  - Add retroreflective tape to backplates
  - Add "turning vehicles yield to pedestrian" signage
- Maintenance
  - Trim trees/bushes that are blocking signs or creating poor sight distance to pedestrians
- Signal Rebuild
  - Add flashing yellow arrow signal heads and protect by pedestrian call
  - Improve intersection lighting
  - Add overhead lane use signage
  - Upgrade curb ramps
- Signal Timing
  - Fix left turn detection so that it isn't running on minimum recall
  - Evaluate pedestrian clearance interval for slower moving pedestrians
  - Evaluate whether the northbound right turn overlap should be eliminated due to pedestrians crossing the south crosswalk during the overlap phase

Agency Coordination

- The City is currently working on a TIP Improvements project that includes a queue jump for northbound buses, a bus bulb in the SW corner and amenity upgrades.
- The City and CDOT are pursuing funding for a signal rebuild at this location.
- RTD reviewed the concept designs for the curb extensions and indicated that with the addition of queue jumps, they would support the curb extensions.

Figure 47: *Colorado & Mississippi Crash Summary, Field Observations & Countermeasures*

Crash Diagram



Legend

- Pedestrian
- Bicycle
- PDO
- Injury
- Fatality
- Vehicle 1
- Vehicle 2
- Turning
- Angle

Crash Summary

- Nearly all crashes resulted in an injury.
- Most crashes involved vehicles making a left turn from westbound Mississippi Avenue to southbound Colorado Boulevard where the vehicle was at fault.
- Nearly half of the crashes occurred during late afternoon to evening.

MetroQuest Summary

- Add a crossing, the crossing distance is long.
- There is not enough time for bikes to cross.
- Mississippi Avenue on the west side of Colorado has a decent bicycle lane but it disappears at the intersection with Colorado Boulevard and does not continue on the east side of Colorado Boulevard.

Field Observations

- The permissive flashing yellow occurred with the pedestrian crossing signal.
- The pedestrian crossing push buttons do not provide an audio cue.
- The pedestrian signals are on recall for Colorado Boulevard and the push buttons actuate crossing at the location where the button was pushed (not at both crossing locations) on Mississippi Avenue.
- The left-turn phase from westbound Mississippi Avenue to southbound Colorado Boulevard may be shorter than needed.
- The "Turning Vehicles Yield to Pedestrians" signs may not be noticeable to drivers.
- The transit stop on westbound Mississippi Avenue is located on the far side and causes traffic to spill into the intersection.

TOP Countermeasure(s)

1. Update the signal phase for left-turning movements to protected by pedestrian call

Additional Countermeasures

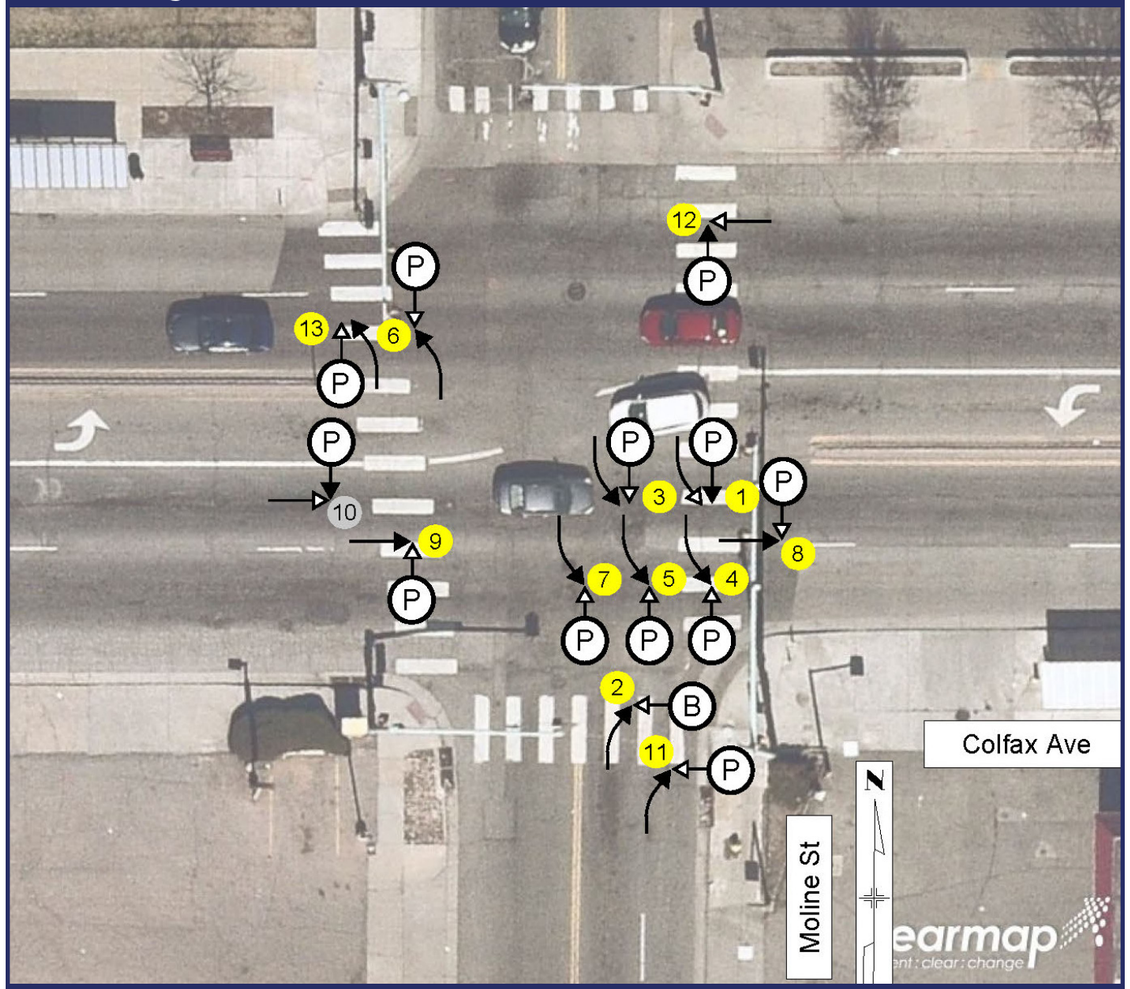
- Signage/Striping
  - Move the R10-15 "turning vehicles yield to pedestrian" signage to mast arm next to signal heads
- Add accessible pedestrian signal

Agency Coordination

- The City is reviewing the current equipment capabilities to implement a protected phase during the pedestrian call.
- Protected-only left turn phasing for westbound movements was considered but rejected in favor of the pedestrian lock-out operation (where permissive left turn is not allowed when a pedestrian call is made). Pedestrian lock-out has the least impact to traffic flow along Colorado Boulevard.

Figure 48: Colfax & Moline Crash Summary, Field Observations & Countermeasures

Crash Diagram



Legend

- P Pedestrian
- B Bicycle
- X PDO
- X Injury
- X Fatality
- Vehicle 1
- Vehicle 2
- Turning
- Angle

Crash Summary

- Nearly all crashes resulted in an injury.
- More than half of the crashes involved vehicles turning left from Moline Street.
- Nearly half of the crashes occurred in dark-lit conditions.
- Most crashes were at the fault of the driver due to careless driving or failing to yield to the right-of-way to the pedestrian/bicyclist.

MetroQuest Summary

- The traffic volume/speed is too high.
- Vehicles do not yield for bicycles and pedestrians.
- There are long crossing distances.
- The lack of safe streets prevents pedestrians from frequenting the area.

Field Observations

- A protected/permissive left-turn signal phase is provided only for the westbound Colfax Avenue approach. All other approaches do not have a left-turn phase.
- The pedestrian crossing connection on the west side of the intersection is offset.
- The northeast and southwest corners of the intersection are missing overhead lighting.
- There are trees in the northeast corner and utility boxes in the southwest corner that obstructs a driver's view of pedestrians waiting to cross.
- All vehicle approaches are missing stop bars.

TOP Countermeasure(s)

1. Curb extensions in the northwest and southeast corners

Additional Countermeasures

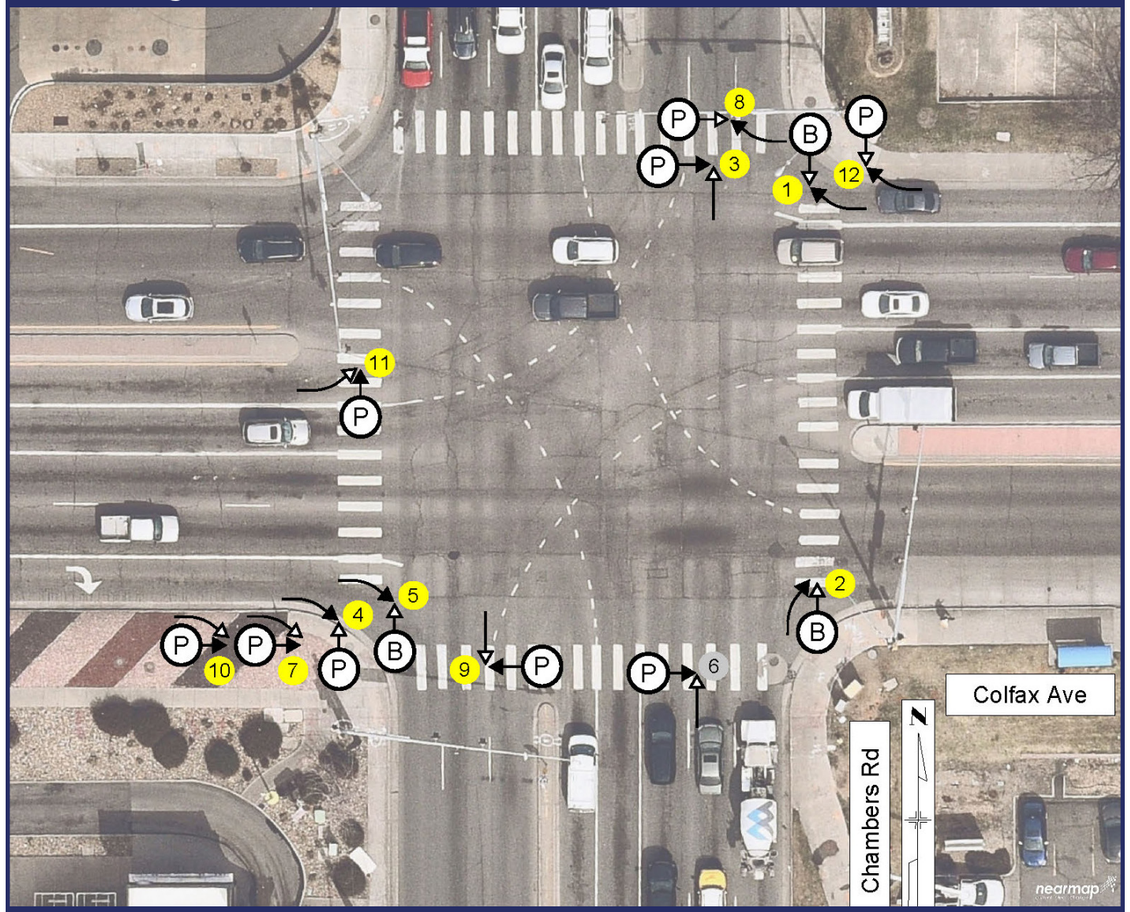
- Signal Rebuild
  - Add flashing yellow arrow signal heads and protect by pedestrian call
  - Improve intersection lighting
  - Add overhead lane use signage
  - Upgrade curb ramps
- Signage/Striping
  - Restripe the southbound Moline Street approach to 2-lanes to provide a left-turn only lane.
  - Add stop bars and lane use markers in dedicated turn lanes
  - Add retroreflective tape to backplates
  - Add "turning vehicles yield to pedestrian" signage
- Maintenance
  - Remove trees in the northeast corner that are creating poor sight distance to pedestrians
- Access Management
  - Remove access in the southeast corner to the mechanic shop. There are multiple accesses to a single business.

Agency Coordination

- The City and CDOT are pursuing funding for a signal rebuild at this location.
- The City will restripe southbound Moline Street to two lanes to define a left-turn lane on the approach.
- Various geometric options were evaluated including bike lanes along Moline Street. Insufficient roadway width exists to accommodate on-street bicycle lanes.

Figure 49: Colfax & Chambers Crash Summary, Field Observations & Countermeasures

Crash Diagram



Legend

- Pedestrian
- Bicycle
- PDO
- Injury
- Fatality
- Vehicle 1
- Vehicle 2
- Turning
- Angle

Agency Coordination

- The City supports adding stop bars on all approaches.
- Looked at various right turn channelization improvements for northbound and southbound Chambers Road. Options that converted a shared through and right turn lane into a right-turn only lane were eliminated due to intersection capacity concerns.
- During design, consider whether raised pedestrian crossings in the channelized right turn lanes would be feasible.
- Identify whether a HAWK signal east or west of this intersection is feasible to provide additional options for pedestrians to cross.

Crash Summary

- More than half of the crashes involve right-turning vehicles from Colfax Avenue.
- Half of the crashes occurred in dark-lit conditions.
- Half of the crashes were the fault of the bicyclist or pedestrian failing to obey the pedestrian signal or traffic device.

Field Observations

- The crash history indicates that there is a problem with pedestrians and bicyclists crossing against the signal/traffic device and this was observed in the field.
- Not all pedestrians used the push buttons to actuate the crossing cycle.
- Pedestrians were required to wait 2-minutes in between cycles.
- This intersection lacks stop bars on all vehicle approaches and the "turning vehicles yield to pedestrians" sign.
- The signal pole placement in the northwest corner of the intersection was mounted in the pedestrian ramp and could impede the path of wheelchairs and larger bicycles.
- The pull box cover at the northeast pedestrian ramp is depressed and may be a tripping hazard for pedestrians that are trying to use the pedestrian push button to actuate the crossing.
- The southwest corner of the intersection lacks overhead lighting and the landscaping protruding into the pedestrian ramp is a tripping hazard.
- The push button located on the southeast corner is roughly 10-feet from the top of the pedestrian ramp flair. This may cause pedestrians to be unwilling to actuate the pedestrian crossing signal.

TOP Countermeasure(s)

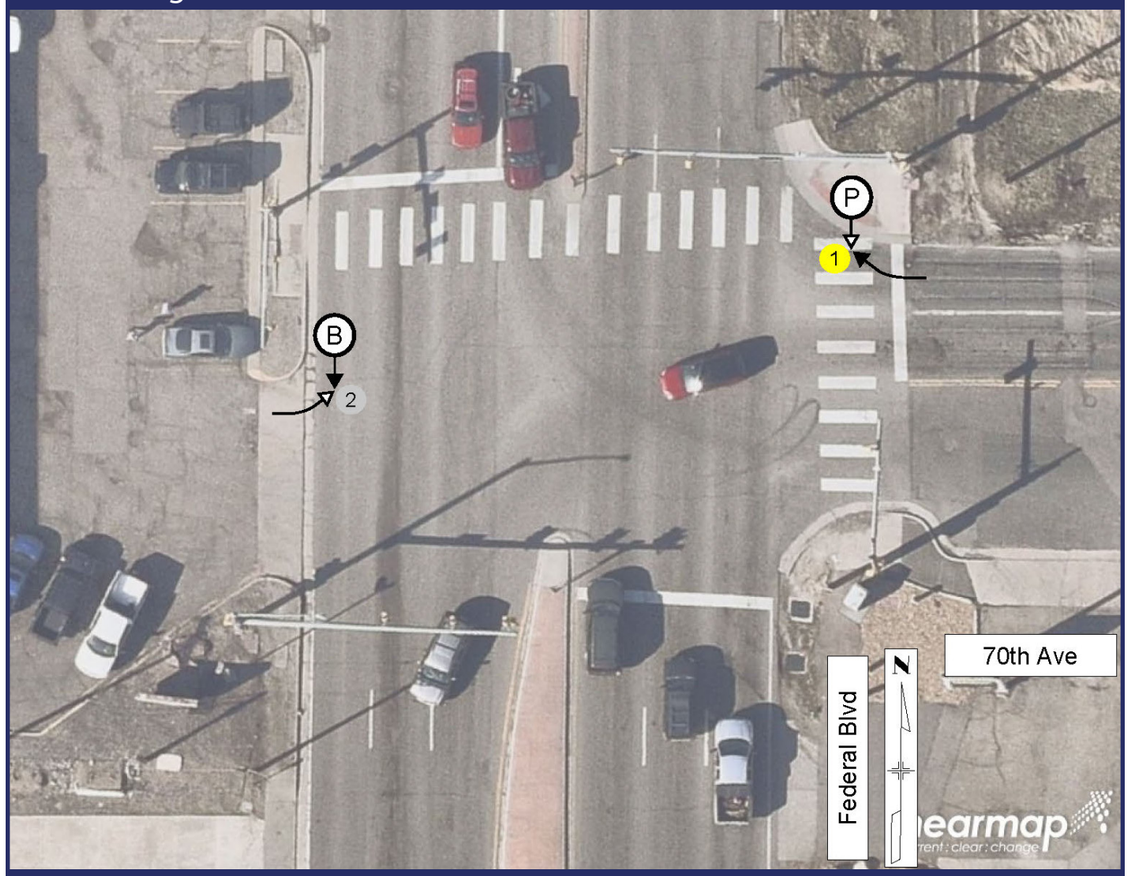
1. Add right-turn channelization from Colfax Avenue to Chambers Road.

Additional Countermeasures

- Increase intersection illuminance
- Install pedestrian push button posts in the southwest and northeast corners
- Signage/Striping
  - Add stop bars and lane use markers in dedicated turn lanes
  - Add retroreflective tape to backplates
  - Add "turning vehicles yield to pedestrian" signage to mast arms next to signal heads
- Maintenance
  - Remove landscaping in the southwest corner that may be a tripping hazard

Figure 50: Federal Blvd & 70th Ave Crash Summary, Field Observations & Countermeasures

Crash Diagram



Legend

- Pedestrian
- Bicycle
- PDO
- Injury
- Fatality
- Vehicle 1
- Vehicle 2
- Turning
- Angle

Agency Coordination

- Adams County is completing sidewalk connectivity on 70th Avenue east of Federal Boulevard.
- The City requires new development to provide sidewalk connectivity where it is missing.
- Relocation of the RTD stop closer to the intersection was considered but not pursued due to the way the stop is currently used by RTD (no pedestrians using the stop cross Federal Blvd).

Crash Summary

- There were two crashes at this location within the study period. Of the two crashes, one resulted in an injury.
- There was a fatal pedestrian crash in 2021 where the vehicle traveling southbound ran a red light striking a pedestrian in the crosswalk. This crash occurred at night.

MetroQuest Summary

- Desire for protected bike lanes, fewer lanes of car traffic, slower speeds and more safe crossings.
- This is within ¼ mile of the train station and there are no ramps present.
- There is a lack of sidewalks in this area.
- Poor drainage infrastructure causes the area to flood and be unusable.
- Traffic volumes/speed make it uncomfortable to be here.
- There is a desire to stop/slow traffic.
- The curb arrangement on the west side makes crossing for wheelchairs difficult.

Field Observations

- The "no pedestrian crossing" signs were small and worn.
- There were missing sidewalk connections along Federal Boulevard.
- The pedestrian crossing push buttons did not have audible cues.
- The pedestrian crossing ramp in the northwest corner did not provide access for disabled pedestrians.
- The northwest corner was missing overhead lighting.

TOP Countermeasure(s)

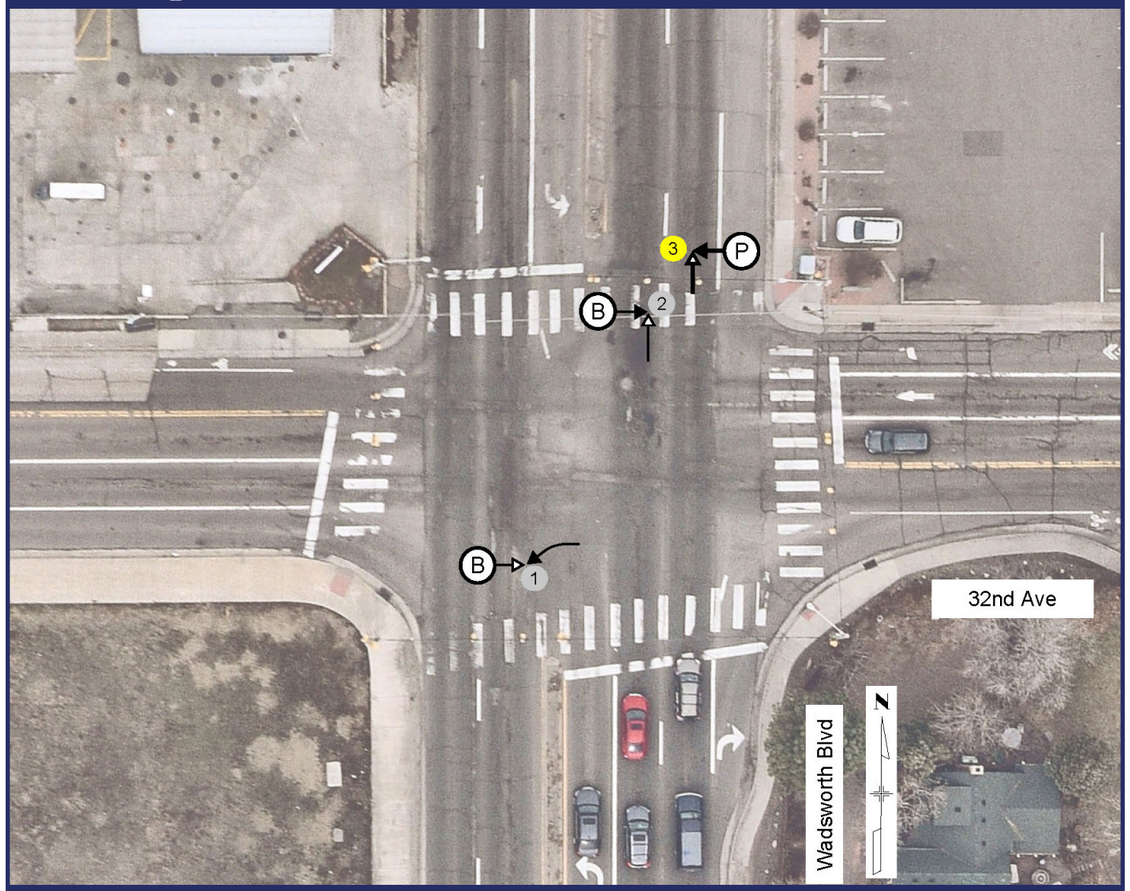
1. Complete sidewalk connectivity on the west side and southeast side of Federal Boulevard
   - Update the northwest pedestrian ramp to allow access for pedestrians with disabilities

Additional Countermeasures

- Signal Rebuild
  - Add flashing yellow arrow signal heads and protect by pedestrian call
  - Improve intersection lighting
  - Add overhead lane use signage
  - Upgrade curb ramps
- Signage/Striping
  - Add retroreflective tape to backplates
  - Replace small and worn R9-3 "no pedestrian crossing" signage
  - Replace worn R9-3bp "use crosswalk (plaque)" signage

Figure 51: Wadsworth & 32nd Ave Crash Summary, Field Observations & Countermeasures

Crash Diagram



Legend

- Pedestrian
- Bicycle
- PDO
- Injury
- Fatality
- Vehicle 1
- Vehicle 2
- Turning
- Angle

Crash Summary

- A total of three crashes were reported at this intersection. Two involved bicycles and one involved a pedestrian.
- Two of the crashes involved a bicyclist or pedestrian crossing Wadsworth Avenue during dawn/dusk or dark-lit conditions, against the pedestrian signal, when a NB vehicle hit them.

MetroQuest Summary

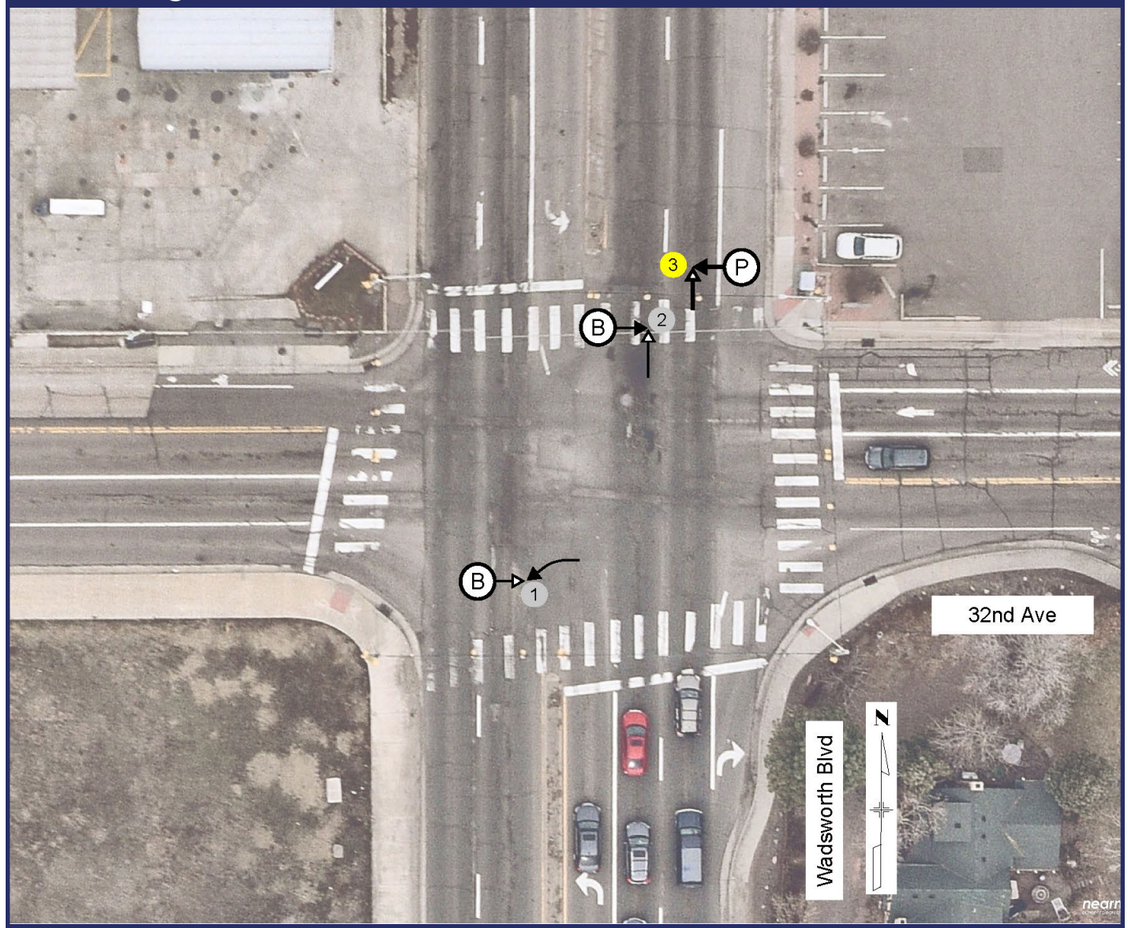
- The intersection has long crossing distances.
- Need improved crossings for ADA.
- There is poor drainage and flooding during storm events.
- The signal does not respond to cyclists when there is no car in the lane.
- The bicycle lane dissolves into the right turn lane for vehicles. This intersection needs a bicycle box.
- There is missing sidewalk between 32nd and 35th on both sides and 32nd Avenue is a regional bicycle corridor and transit corridor.
- Wheat Ridge is investing in a multiuse trail that will connect 35th Avenue to I-70/Clear Creek Trail.
- Between 32nd Avenue and 35th Avenue there are no bicycle lanes or bicycle pavement markings. On street is not advised due to the grade/traffic volume.
- South of 32nd Ave the roadway shoulder is too narrow.

Field Observations

- Utilities created obstructions to bicycles and pedestrians in the northeast corner. They may also cause poor sight distance from westbound right turning vehicles to bicycles and pedestrians at the corner.
- The southeast corner had a large turning radius with limited sight distance for northbound right turning vehicles to pedestrians standing at the corner.
- The eastbound and westbound bicycle lanes approaching the intersection were narrow and transitioned into the right turn lanes with sharrow markings.
- The eastbound and westbound right turn lanes were only 10 feet in width.
- Overall lighting was poor despite luminaires on three of the four signal poles.
- None of the curb ramps were ADA compliant.
- There was very poor sidewalk connectivity and a lack of pedestrian curb ramps in the northwest corner.
- The southbound approach had a crest vertical curve that may impact sight distance to the intersection.
- Vehicles in the northbound and southbound left turn lanes experienced negative offsets which created sight obstructions during permissive left turns when vehicles occupied the opposing left turn lane at the same time.
- The pedestrian walk phase across 32nd Avenue appeared to be only 4 to 5 seconds, but the walk phase would come up immediately upon pushing the button if there was enough time in the cycle to process.
- The "Begin Right Turn Lane Yield to Bikes" sign for the westbound right turn was obstructed by trees.
- From 32nd Avenue to 35th Avenue there were no sidewalks, and the Rocky Mountain Ditch created a hazardous condition for bicyclists and pedestrians on both sides. There was limited space for sidewalks in some areas and vehicles parked parallel to Wadsworth Boulevard would block potential sidewalks. Right-of-way may be a concern.
- Vehicles traveled at high speeds along Wadsworth Boulevard.

Figure 52: Wadsworth & 32nd Ave Crash Summary, Field Observations & Countermeasures (Cont.)

Crash Diagram



Legend

- Pedestrian
- Bicycle
- PDO
- Injury
- Fatality
- Vehicle 1
- Vehicle 2
- Turning
- Angle

TOP Countermeasure(s)

1. Curb extension in northeast corner.
2. Remove northbound right turn lane and tighten southeast corner radius.
3. Widen 32nd Avenue to the south to provide east/west bicycle lane connectivity at the intersection.
4. Add a 6-foot sidewalk on Wadsworth Avenue from 32nd Avenue to 35th Avenue (both sides).

Additional Countermeasures

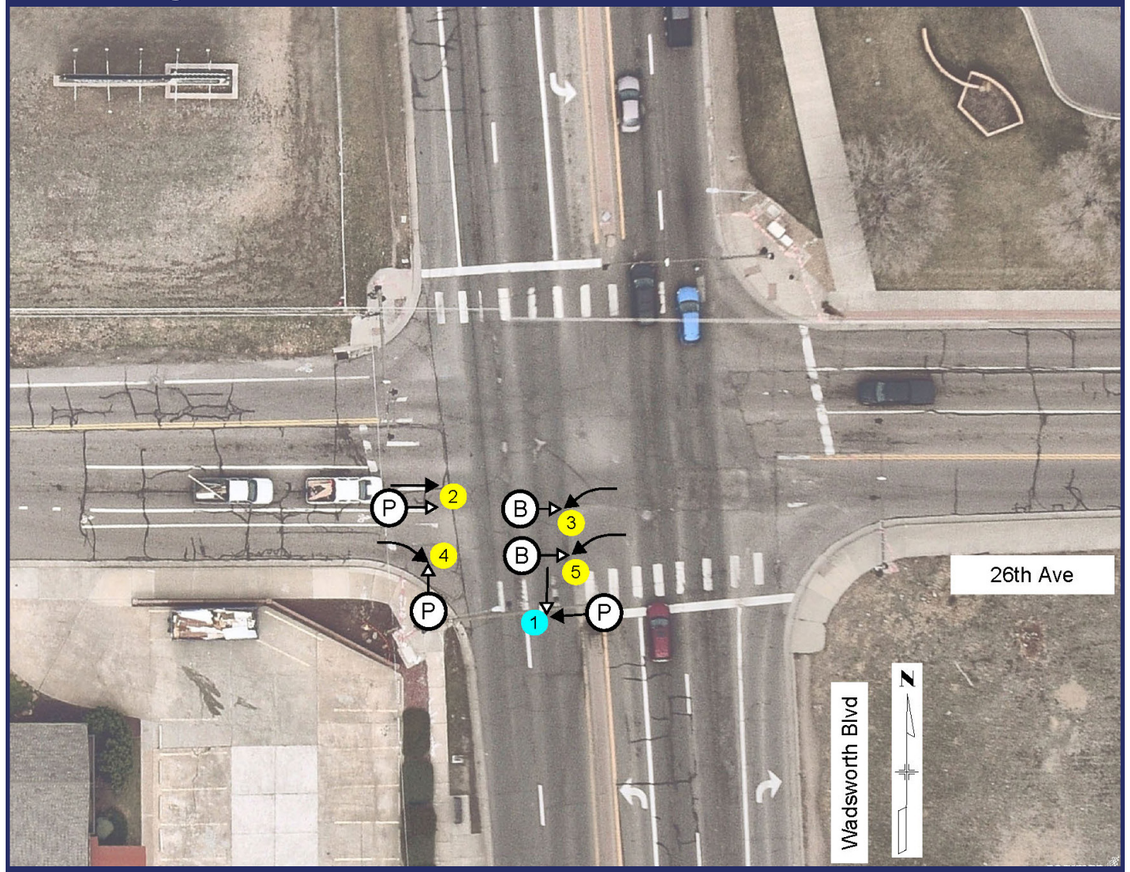
- Modify the northbound left turn lane to remove the negative offset and reduce the 15-foot wide southbound through lane.
- Add intersection crossing markings for the bicycle lanes
- Close the two access points in the northwest corner that are closest to the intersection
- Implement a signal rebuild.
  - Improved lighting
  - Add flashing yellow arrow signal heads
  - Upgrade bicycle detection
  - Upgrade curb ramps for ADA compliance
  - Updated signage/striping
  - Provide a longer pedestrian walk phase to cross 32nd Avenue
  - Implement lag-lag left turn phasing for minor street approaches.

Agency Coordination

- CDOT is working on the design for a signal rebuild at this location. CDOT staff indicated that updating curb ramps, improved lighting and signage and striping are all proposed to be included in the signal rebuild. Wheat Ridge is interested in incorporating bicycle detection with the upgraded signal.
- CDOT staff indicated that the property on southeast corner of Wadsworth Boulevard and 32nd Avenue is historic.
- Wheat Ridge submitted a TIP application to build 8-foot wide, detached sidewalks on the west side of Wadsworth Avenue from 32nd Avenue to 35th Avenue.
- CDOT is open to removing the median on the northbound approach to Wadsworth Boulevard and 32nd Avenue but would like to retain the median on the southbound approach as it provides access control.
- CDOT and RTD both support removal of the northbound right turn lane and reduction of the corner radii to 30 feet. The right turn lane does not function as intended and cannot be extended due to the historic property. The 30-foot radii could accommodate buses without forcing them into opposing traffic.
- The eastbound and westbound approach lanes were adjusted to reduce lane offsets going through the intersection.

Figure 53: Wadsworth & 26th Ave Crash Summary, Field Observations & Countermeasures

Crash Diagram



Legend

- P Pedestrian
- B Bicycle
- X PDO
- X Injury
- X Fatality
- Vehicle 1
- Vehicle 2
- Turning
- Angle

Crash Summary

- A total of 5 crashes were reported at this intersection. One crash resulted in a fatality.
- The vehicle was at fault in 4 of the crashes.
- Two of the crashes involved different vehicles hitting the same pedestrian.
- One of the crashes was an officer that was handling a separate crash and was hit by a moving vehicle, resulting in injury.
- The fatality involved a teenager that failed to yield to traffic.
- Four of these crashes occurred in 2017 and one occurred in 2018.

MetroQuest Summary

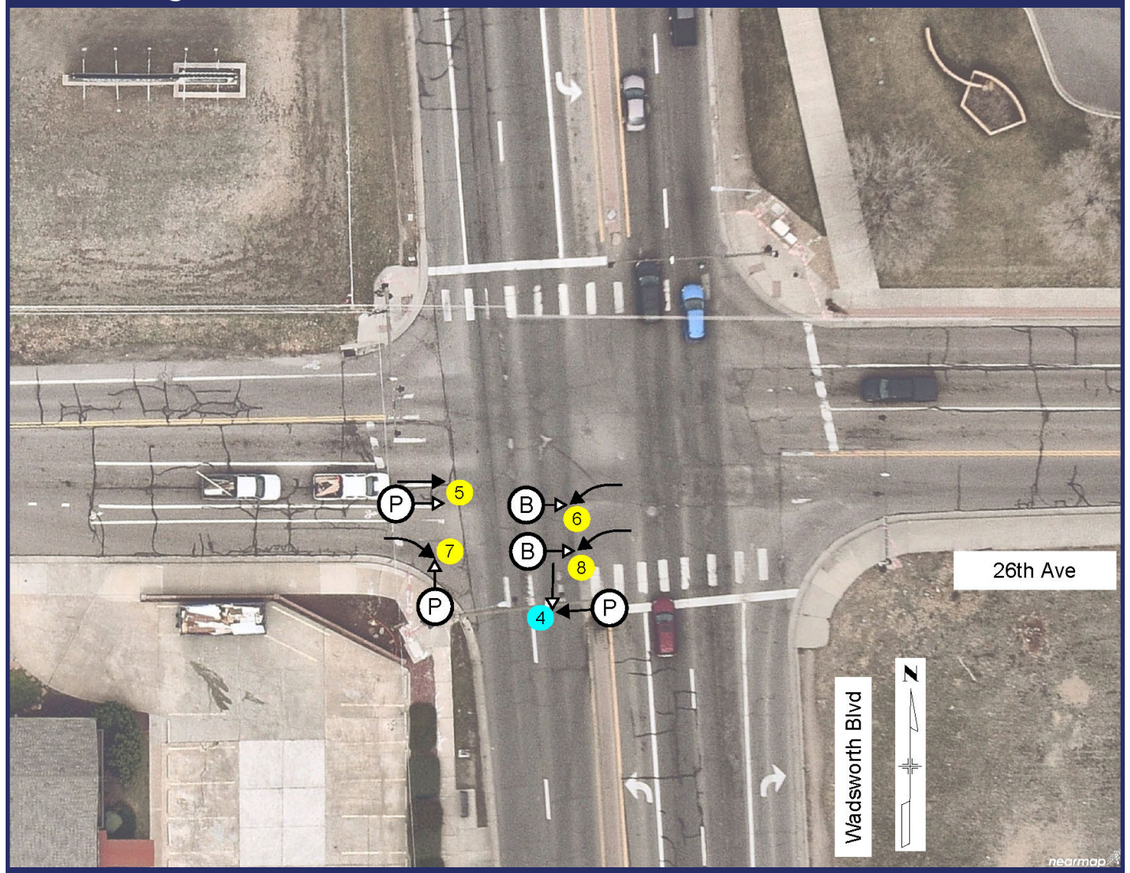
- Would like to improve the crossings for bikes and pedestrians to make vehicles slow/stop, and provide better visibility to drivers.
- There are missing sidewalks and bike lanes.
- Flashing yellow arrows result in vehicles paying more attention to the signal than to bikes present.
- Bike lanes merge into the right turn lanes.
- Between 26th Avenue and 29th Avenue there are no sidewalk connections on the west side.

Field Observations

- An eastbound bicycle lane did not exist east of the intersection and the westbound bicycle lane merged into the westbound right turn lane at the intersection.
- Between 26th Avenue and 29th Avenue sidewalk was missing on the west side but appeared feasible within the existing space. The sidewalk on the east side was comfortable and wide but occasionally pulled away from Wadsworth Avenue.
- There was a missing sidewalk connection in the southeast corner.
- Only the northeast and southwest corners were lit but the bulbs were different tones and the location of the lighting in the northeast corner resulted in pedestrians being backlit. Overhead utilities were observed in the vicinity of the signal pole but appeared to be outside of the minimum 10-foot clearance halo from Xcel lines, allowing for a luminaire to be added to the signal pole.
- There were many obstacles in the northeast corner that resulted in an accessible path that was less than 48 inches in width.
- The signal pole in the southwest corner created an obstruction for bicyclists and pedestrians and the curb ramp was not ADA compliant.
- Lane use pavement markings were missing on the eastbound and westbound approaches and crosswalk striping was nearly gone.
- The southbound approach had a crest vertical curve that may impact sight distance to the intersection.
- The placement of the bench at the bus stop in the northeast corner did not allow room for ADA access from the sidewalk to the bus loading area.
- Vehicles in the northbound and southbound left turn lanes experienced negative offsets which create sight obstructions during permissive left turns when vehicles occupied the opposing left turn lane at the same time.
- The southbound through traffic resulted in a long queue of vehicles but the queue appeared to clear within one cycle.
- Vehicles traveled at high speeds along Wadsworth Boulevard.

Figure 54: Wadsworth & 26th Ave Crash Summary, Field Observations & Countermeasures (Cont.)

Crash Diagram



Legend

- Pedestrian
- Bicycle
- PDO
- Injury
- Fatality
- Vehicle 1
- Vehicle 2
- Turning
- Angle

TOP Countermeasure(s)

1. Widen the east leg to connect bike lanes on 26th Avenue in both directions.
2. Add sidewalks from 26th Avenue to 29th Avenue (west side) and upgrade curb ramp in the northwest corner.
3. Fill in the sidewalk gap from 26th Avenue to 175 feet south (east side).

Additional Countermeasures

- Remove the medians and shift the northbound and southbound left turn lanes to remove the negative offset.
- Tighten curb radii in the southwest corner and upgrade curb ramp.
- Signage and striping improvements such as pavement markings for exclusive turn lanes.
- Shift the bench at the bus stop in the northeast corner to provide an ADA compliant connection from the sidewalk to the loading area.
- Upgrade bicycle detection.
- Relocate obstructions in the northeast corner for ADA compliance.
- Improve intersection lighting by adding luminaires, upgrading to cooler tone LED's and relocating the luminaire in the northeast corner so that it does not backlight pedestrians.

Agency Coordination

- This intersection spans both Wheat Ridge (north side) and Lakewood (south side). Lakewood maintains the signal.
- Lakewood staff indicated that signal timing upgrades, which likely resulted in the reduction in bicycle and pedestrian crashes, had been made since the time of the 2017 and 2018 crashes identified here.
- It was recommended that widening of the east leg happen to the south because grades to the north would require a wall and Lakewood was given additional right-of-way to the south. The proposed design was made to fit within the available right-of-way.
- Wheat Ridge indicated that the existing right-of-way lines in the northwest corner of this intersection may not be correct, and that right-of-way may be required in order to complete the sidewalk connection between 26th Avenue and 29th Avenue.
- The width of all lanes on the east leg were adjusted to reduce lane offsets going through the intersection.
- Wheat Ridge strongly supports 10 foot wide through and right-turn lanes on all arterial roads to reduce vehicle speeds.
- CDOT supports removal of the median on Wadsworth Boulevard at this location.

Figure 55: Colfax & Adams Crash Summary, Field Observations & Countermeasures

Location Map

MetroQuest Summary

- Vehicles do not yield for bicyclists and pedestrians in the crosswalk. It is very dangerous for children.
- This is a very busy street and a major road for kids to cross to go to school.
- The crossing is too long. Add channelizing islands for simpler pedestrian crossing.
- Need improved visibility to drivers at the crossing.
- Would like to see a traffic signal here.
- This area is very poorly lit.
- Traffic gets extremely backed up from the school. A stop light would make it go smoother.

Field Observations

- The crosswalk at this intersection was the only marked, north/south pedestrian crossing of Colfax Avenue.
- The Rectangular Rapid Flashing Beacon (RRFB) was difficult to see due to the placement, far from the vehicle travel lanes. The flashing lights on the RRFB could get washed out visually during daylight hours.
- Some pedestrians were observed crossing Colfax Avenue without pushing the pedestrian push button.
- The southbound movement operated under STOP control. The vehicle queue was observed extending back to 6th Street. Staff indicated that it extends back to 8th Street when school is in session.
- There was a high volume of southbound truck traffic at this intersection.
- There were a lot of southbound left and westbound left turning vehicles at this intersection.
- There was only one overhead light in the southwest corner of the intersection. The placement of the light resulted in backlighting pedestrians. There was no pedestrian scaled lighting.
- Curb ramps were not compliant on the southwest and southeast corners of the intersection.
- The diagonal shoulder striping in the southwest corner of the intersection was meant to signify no parking and provide a walkway for pedestrians, but was worn out.
- A raised crosswalk was determined to be unfeasible due to the heavy truck traffic at this intersection.
- The existing stop bars on the east and west approaches caused confusion for drivers.
- The northbound approach has poor sight distance due to parked vehicles east of this intersection.
- Traffic counts show a high volume (20 AM/40 PM) of pedestrians crossing Colfax at this intersection.

TOP Countermeasure(s)

1. Curb extension in the southwest corner
2. Convert intersection to all-way stop control with flashing beacons on Colfax Avenue
   - Add dedicated eastbound left turn and southbound right turn lanes
   - Signage and striping improvements/upgrades
   - Add a raised triangle median island in the northwest corner

Agency Coordination

- The Town has a dark sky ordinance that restricts the type and location of lighting that can be installed.
- Staff indicated that approximately 130 new residential units are planned directly south of this intersection which would increase demand on the northbound approach of the intersection.
- A roundabout was considered at this intersection but the footprint needed to accommodate the large trucks traveling the area deemed it unfeasible.

Additional Countermeasures

- Curb extension in southeast corner
- Sidewalk connectivity from Elm Street to Adams Street
- Increase vehicle and pedestrian scaled intersection illuminance

Figure 56: Palmer from Colfax to 8th Crash Summary, Field Observations & Countermeasures

Location Map

MetroQuest Summary

- Traffic backs up onto SH 79 during drop-off and pickup times. As a result, eastbound vehicles are passing in the westbound through lane to continue east, then north on SH 79.
- Kids leaving the school on foot and on bikes have a hard time navigating this area due to the high volume of cars at school pick up times.
- Kids cross through the fields. There is high traffic which is difficult for cars and pedestrians.
- Traffic volume and/or speeds are too high and there is poor visibility to drivers.
- There is no sidewalk or shoulder and no bicycle lane or lane markings.
- Vehicles do not yield for bicyclists and pedestrians.
- Crossings are faded or missing and crossing distances are long.

Field Observations

- The triangle median island at the corner of Palmer Avenue and Adams Street were small, the vehicle travel lanes were very wide and striping to provide direction to vehicles was lacking.
- The offset curb lines and overgrown landscaping at 8th Street and 6th Street created poor sight distance between vehicles coming from the east and pedestrians crossing, as well as between southbound vehicles and westbound vehicles.
- The crosswalks on 7th Street were setback, so vehicles naturally extended into the crosswalk to see approaching traffic on Palmer Avenue.
- Bennett elementary, middle, and high school were all located north of Palmer Avenue and accessed via 7th Street and 8th Street. School times were the same for all three schools.
- Bennett Community Park was updated with a paved parking lot and covered seating.
- The posted speed limit on Palmer Avenue was 35mph west of 8th Street and 45 mph east of 8th Street.
- A significant percentage of traffic on Palmer Avenue was large tractor trailers.
- The traffic count data indicated a high volume of pedestrians and some bicyclists along Palmer Avenue during school drop-off and pick-up.
- The north/south crosswalk on the east side of Palmer Avenue & 7th Street, as shown in Google Streetview, was no longer in place.
- Southbound vehicles from the Colfax Avenue & Adams Street intersection queue back to 6th Street.
- Lighting was poor along the corridor.
- Railroad crash data showed one crash at the crossing north of Colfax Avenue & Adams Street.

Agency Coordination

- Town staff confirmed that motor vehicles back up on SH 79 resulting in drivers bypassing in the opposing travel lane.
- Town staff indicated that parents do not support offsetting school times which would reduce traffic congestion in and around the schools.
- CDOT and Town staff have identified a route for the future SH 79 bypass that would remove truck traffic from Palmer Avenue, Adams Street, Colfax Avenue (thru town), and the northern section of 1st Street. No funding is currently available for final design or construction of this road.
- The north/south crosswalk at 7th Street was removed. According to staff this was done because a sidewalk and curb ramp did not exist on the south side of Palmer Avenue, and they didn't want to promote illegal crossing of the tracks that occurs today.
- Staff indicated that the local elementary, middle and high schools are all at or over capacity.
- Town staff indicated that southbound vehicle queuing from the Colfax Avenue and Adams Street intersection extends back to 8th Street during school drop-off and pick-up times.
- The Town has a dark sky ordinance that restricts the type and location of lighting that can be installed.
- A roundabout was considered at the intersection of Adams Street and Palmer Avenue but the footprint needed to accommodate the large trucks traveling the area deemed it unfeasible due to the required size and expected cost.

TOP Countermeasure(s)

1. Enlarge triangle median island and extend curb between 5th Street and 6th Street
   - Improve pavement markings and shift southernmost crosswalk closer to SH 79
   - Upgrade curb ramps for ADA compliance

Additional Countermeasures

- Restripe the north/south crosswalk at 7th Street, add a curb ramp and a sidewalk to access the park
- Restripe SH 79 to provide an eastbound left turn lane at 8th Street
- Implement the proposed SH 79 bypass
- Improve traffic circulation around the schools to prevent traffic backups onto SH 79

Figure 57: 1st & Centennial Crash Summary, Field Observations & Countermeasures

Location Map

MetroQuest Summary

- Vehicles do not yield for bicyclists and pedestrians.
- Improve visibility to drivers.
- The signage and/or striping is faded or missing.
- Add a pedestrian refuge island and pedestrian scale lighting.
- Needs a signal or flashing sign for the crosswalk.
- Add lighting.
- A child was hit here in 2021.

Field Observations

- The speed limit on the 1st Street approach was posted at 45 mph.
- The crosswalk on the west leg was faded and the curb ramps were not ADA compliant.
- There was a guardrail on the east side of the intersection and the reason for the guardrail was not apparent. There was an opening in the guardrail that vehicles would not expect to see a pedestrian come out of.
- The raised median on the north leg of the intersection was tight for eastbound left turning movements.
- There was only one overhead light in this intersection.
- The crosswalk markings were narrow (1 foot by 10 foot).

TOP Countermeasure(s)

1. Widen the raised median island and shift the crosswalk north to provide a pedestrian refuge
   - Remove guardrail
2. Install high-visibility crosswalk striping and add an RRFB and associated signage and striping
   - Install advanced warning signage and yield markings
   - Back mount the signage at the crosswalk
   - Replace faded, undersized signage and enlarge crosswalk striping to 2 feet by 10 feet

Additional Countermeasures

- Upgrade non-compliant curb ramps on the west side.
- Improve vehicle and/or pedestrian scaled lighting in the crosswalk.

Agency Coordination

- The Town has a dark sky ordinance that restricts the type and location of lighting that can be installed.
- Town staff indicated that this intersection was far from meeting the signal warrants.
- Town staff indicated that there was dense residential development west of this intersection that was outside of the school bus pickup zone. Staff also noted that there were a high number of students that walk or bike from this neighborhood.
- The multiuse path on the east side of 1st Street has an existing culvert that would be impacted with significant relocation of the path to the north.

Top Countermeasures, Concept Designs, Cost Estimates, & Crash Modification Factors

Upon completing the field evaluations and reviewing available data, a list of countermeasures was identified for each of the top locations. The lists of countermeasures were reviewed by CDOT and the local agencies and revised based on agency preferences, such as lane width, type of preferred mid-block crossing or presence of stop bars at the intersection.

Top countermeasures were identified based on how well the specific countermeasure could address an existing bicycle and/or pedestrian crash pattern. In some cases systemic improvements were included in the top countermeasures when obvious bicycle or pedestrian amenities were lacking. Where crash data was limited, a summary of MetroQuest comments related to the top locations was reviewed and improvements considered. Designs and cost estimates for the top countermeasures were prepared and Crash Modification Factors (CMF's) identified. Detailed planning level cost estimates are provided in Appendix C. When considering Crash Modification Factors (CMF's), some countermeasures did not have an established CMF, so the most applicable CMF was selected.

In cases where existing crash data was not available, the Highway Safety Manual predictive method was used to identify expected crashes at the specific location based on predicted crashes for similar intersection or segment types.

Benefit to Cost Ratios

It should be noted that the list of countermeasures associated with each of the top locations were intended to limit right-of-way impacts while still improving bicycle and pedestrian safety. The reason for this is that right-of-way impacts and high-cost improvements can result in a benefit to cost ratio that is not competitive for typical safety grant funding.

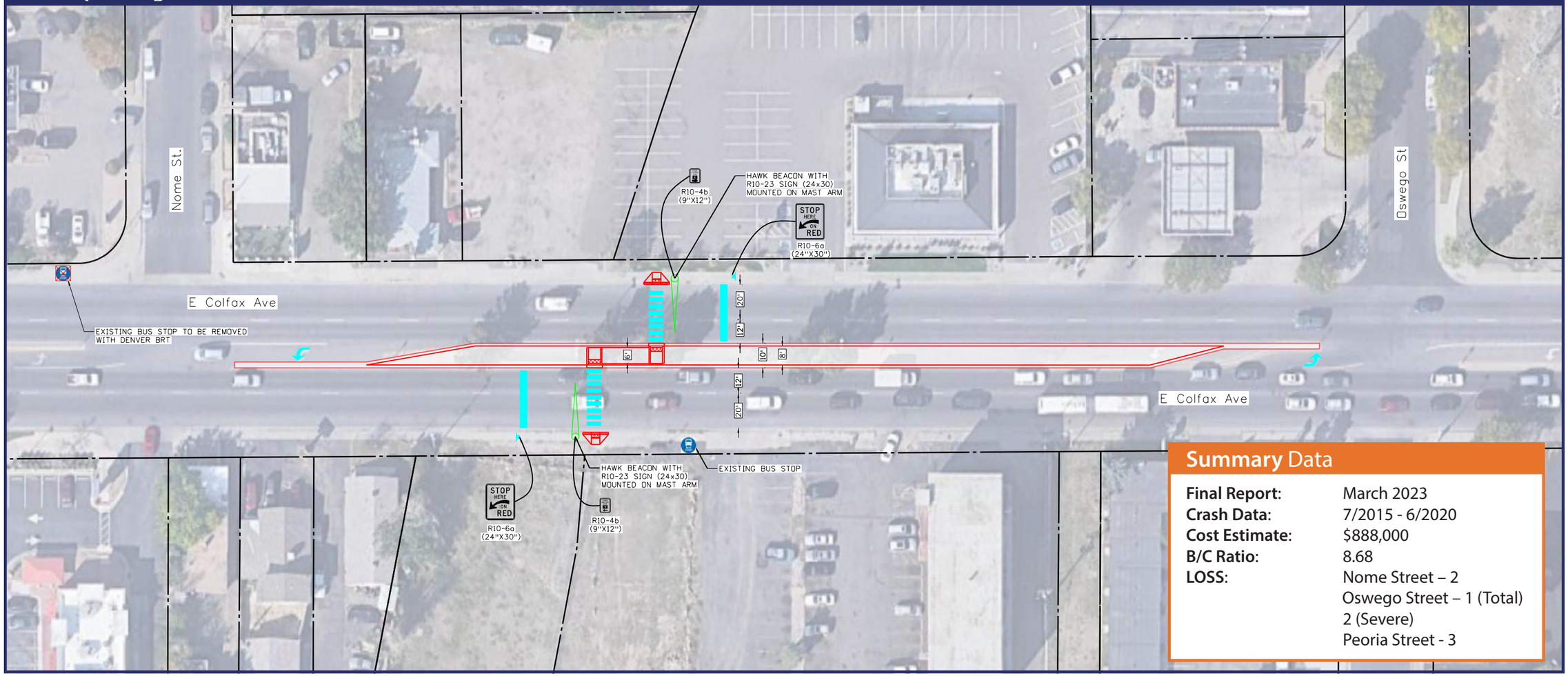
Benefit to cost ratios for the top countermeasures were calculated using the Colorado Highway Safety Improvement Program (HSIP) methodology. This methodology was used as it is consistent with the type of grant funding that is likely applicable to many of the proposed countermeasures. An annual interest rate of five percent and an applicable service life of 5, 10 or 20 years was applied to the cost of each of the top countermeasures and an Estimated Uniform Annual Cost (EUAC) was calculated. CMFs were applied to the PDO, Injury and Fatal crashes for each of the top locations and an Estimated Uniform Annual Benefit (EUAB) was calculated. The EUAB was divided by the EUAC to determine a benefit to cost ratio for each project. In those cases where the CMF Clearinghouse indicated that it would be appropriate to include motor vehicle to motor vehicle crashes when calculating the anticipated crash reduction of a proposed improvement, that crash data was pulled and included in the calculation. The detailed benefit to cost calculations are included in Appendix D. Concept designs, crash modification factors, cost estimates, and benefit to cost ratios for each of the top locations are included in Figures 58 through 74, below.

TAC #4 – Discuss Countermeasures, Concept Designs and Cost Estimates

The fourth TAC meeting was held on August 25, 2022 and started with a review of the lists of bicycle and pedestrian crash hot spots and MetroQuest hot spots, including a discussion of how the top locations were selected. For each of the top locations, crash history, field observations, lists of countermeasures, concept designs for the top countermeasure, and cost estimates were provided.

Figure 58: *Colfax from Moline to Peoria Concept Design & Cost Estimate*

Concept Design



Summary Data

Final Report:	March 2023
Crash Data:	7/2015 - 6/2020
Cost Estimate:	$888,000
B/C Ratio:	8.68
LOSS:	Nome Street – 2 Oswego Street – 1 (Total) 2 (Severe) Peoria Street - 3

TOP Countermeasures

1. Add a marked crossing with a pedestrian refuge.

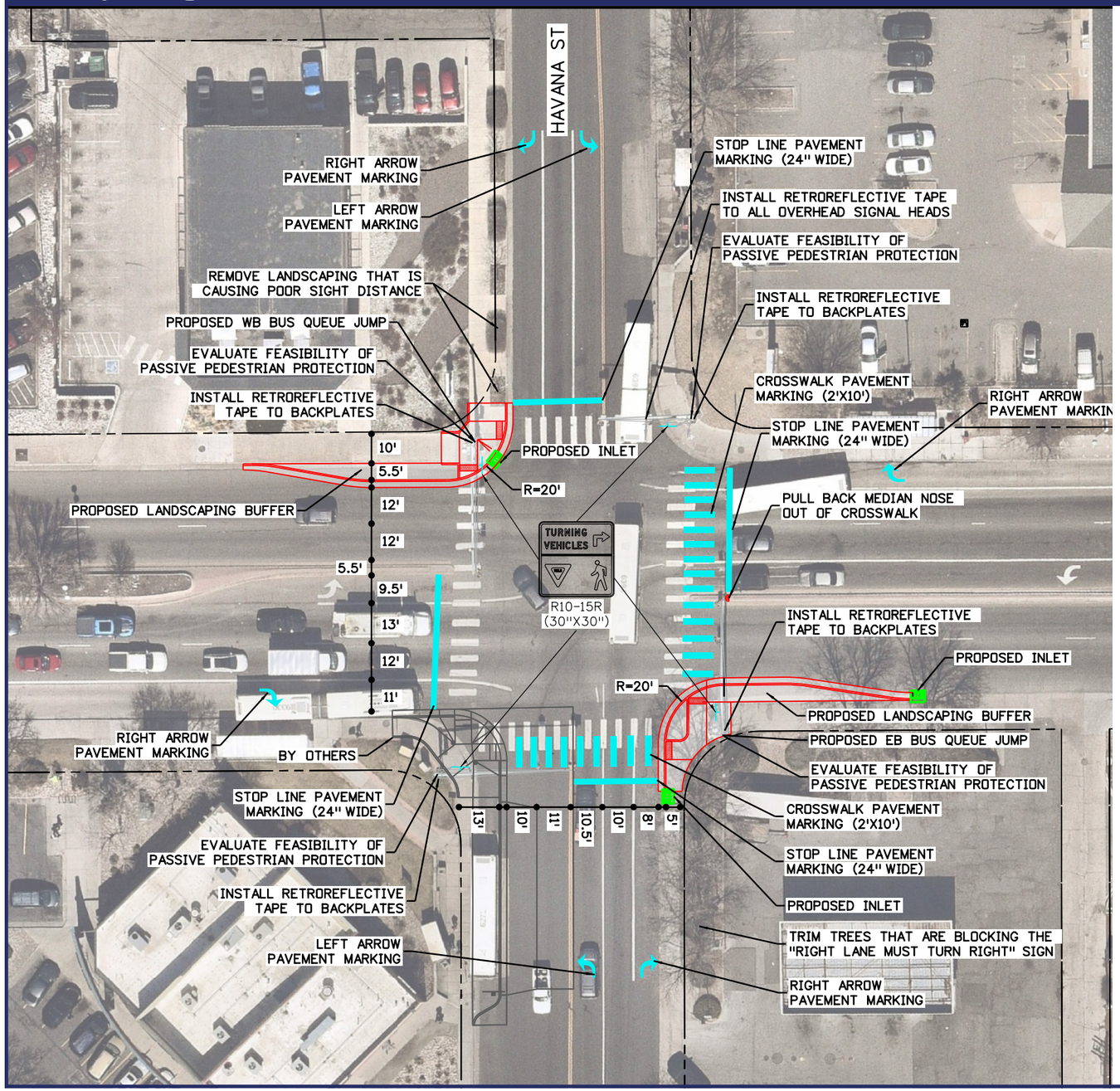
CMF Reference:	Install raised median with or without crosswalk (uncontrolled) (http://www.cmfclearinghouse.org/detail.cfm?facid=8799)
CRF:	31.5% (vehicle to pedestrian)
Explanation:	This improvement will provide a refuge for pedestrians navigating crossings between two directions of traffic.

2. Install a HAWK signal with advanced stop markings and signs.

CMF Reference:	Install pedestrian hybrid beacon (PHB or HAWK) with advanced yield or stop markings and signs. (http://www.cmfclearinghouse.org/detail.cfm?facid=9021)
CRF:	56.8% (vehicle to pedestrian)
Explanation:	This improvement will provide visibility to the crosswalk allowing pedestrians to safety cross a roadway.

Figure 59: Colfax & Havana Concept Design & Cost Estimate

Concept Design



TOP Countermeasures

1. Curb extensions in the northwest and southeast corners and queue jumps for eastbound and westbound buses

   CMF Reference: Increase triangle sight distance (http://www.cmfclearinghouse.org/detail.cfm?facid=307) (http://www.cmfclearinghouse.org/detail.cfm?facid=308)

   CRF: 11% (all PDO), 48% (all injury)

   Explanation: This improvement will shorten pedestrian crossing distances and make pedestrians more visible to vehicles. Buses currently use the extra wide lane to transition back into traffic. The queue jumps would provide the ability for buses to proceed into traffic in advance of other vehicles, thereby improving efficiency of bus operations.

2. Evaluate the feasibility of passive pedestrian detection

   CMF Reference: Convert pelican crossing or farside pedestrian signal to puffin crossing (http://www.cmfclearinghouse.org/detail.cfm?facid=3889)

   CRF: 24% (vehicle to pedestrian)

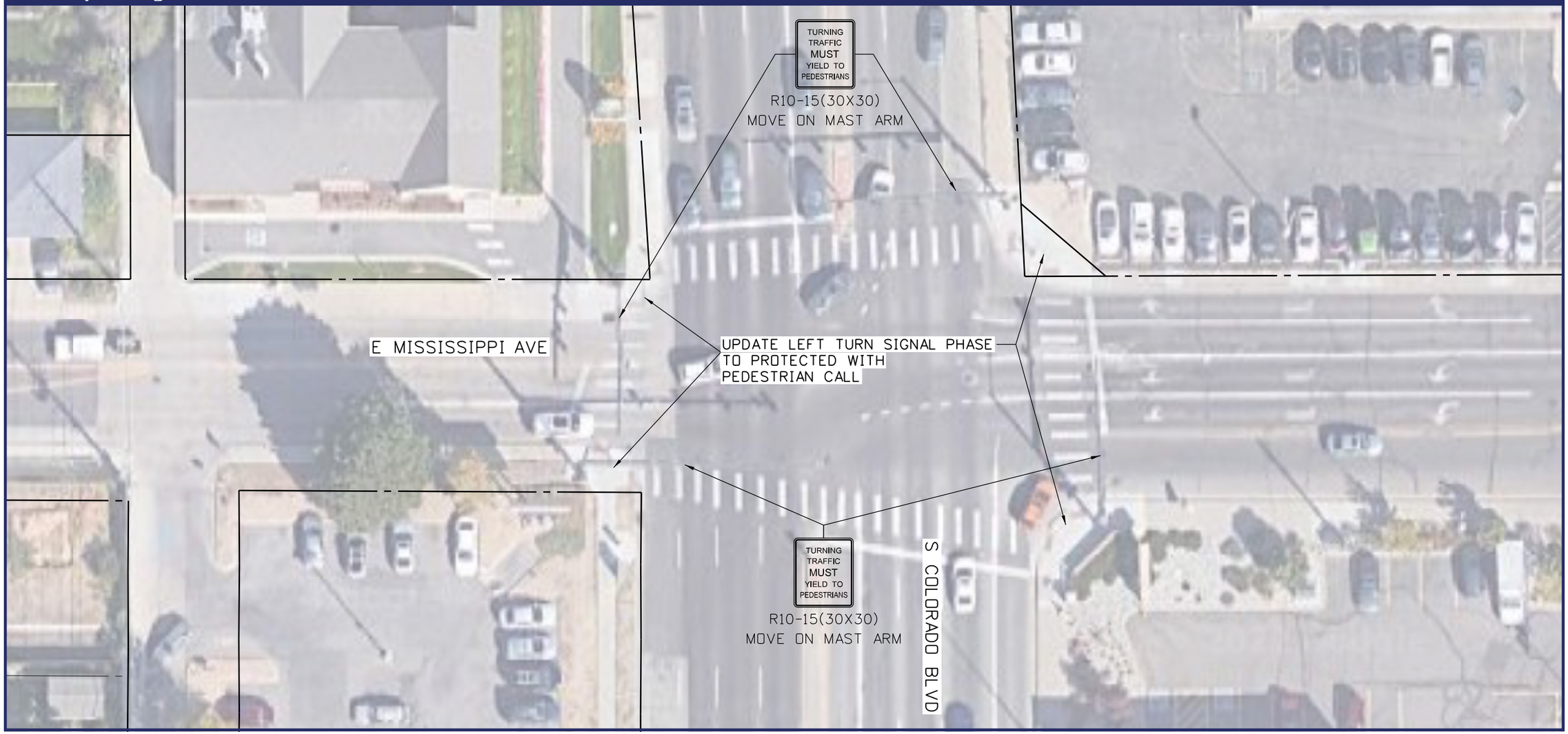
   Explanation: Many pedestrians do not activate the pedestrian signal by pushing the button. Passive pedestrian detection would detect the pedestrian through video and put in a call to provide pedestrians with a protected phase. Once the signal is upgraded and flashing yellow arrow signal heads are installed, this would also prevent left turn vehicles from turning permissively if a pedestrian was detected.

Summary Data

Final Report:	March 2023
Crash Data:	7/2015 - 6/2020
Cost Estimate:	$551,000
B/C Ratio:	Curb extensions and queue jumps - 12.90 Passive detection - 37.36
LOSS:	2

Figure 60: *Colorado & Mississippi Concept Design & Cost Estimate*

Concept Design



TOP Countermeasures

1. Update the signal phase for left-turning movements to protected by pedestrian call.

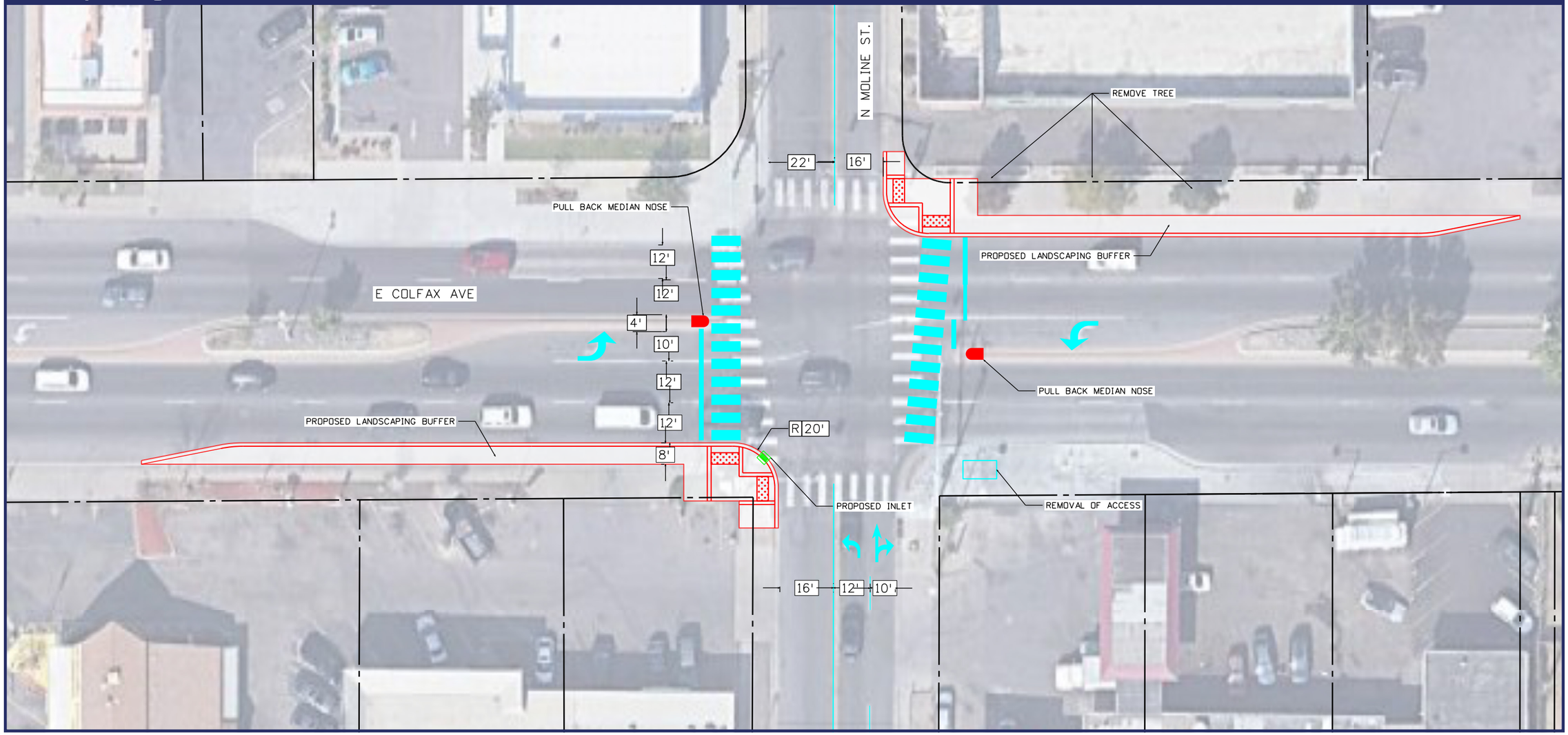
CMF Reference:	Leading protected left-turn phase (https://www.pedbikeinfo.org/cms/downloads/PedestrianLitReview_April2014.pdf)
CRF:	56% (vehicle to pedestrian)
Explanation:	This improvement will allow pedestrians to cross without conflict with left-turning vehicles.

Summary Data

Final Report:	March 2023
Crash Data:	7/2015 - 6/2020
Cost Estimate:	$12,000
B/C Ratio:	110.71
LOSS:	1

Figure 61: *Colfax & Moline Concept Design & Cost Estimate*

Concept Design



TOP Countermeasures

1. Curb extensions in the northeast and southwest

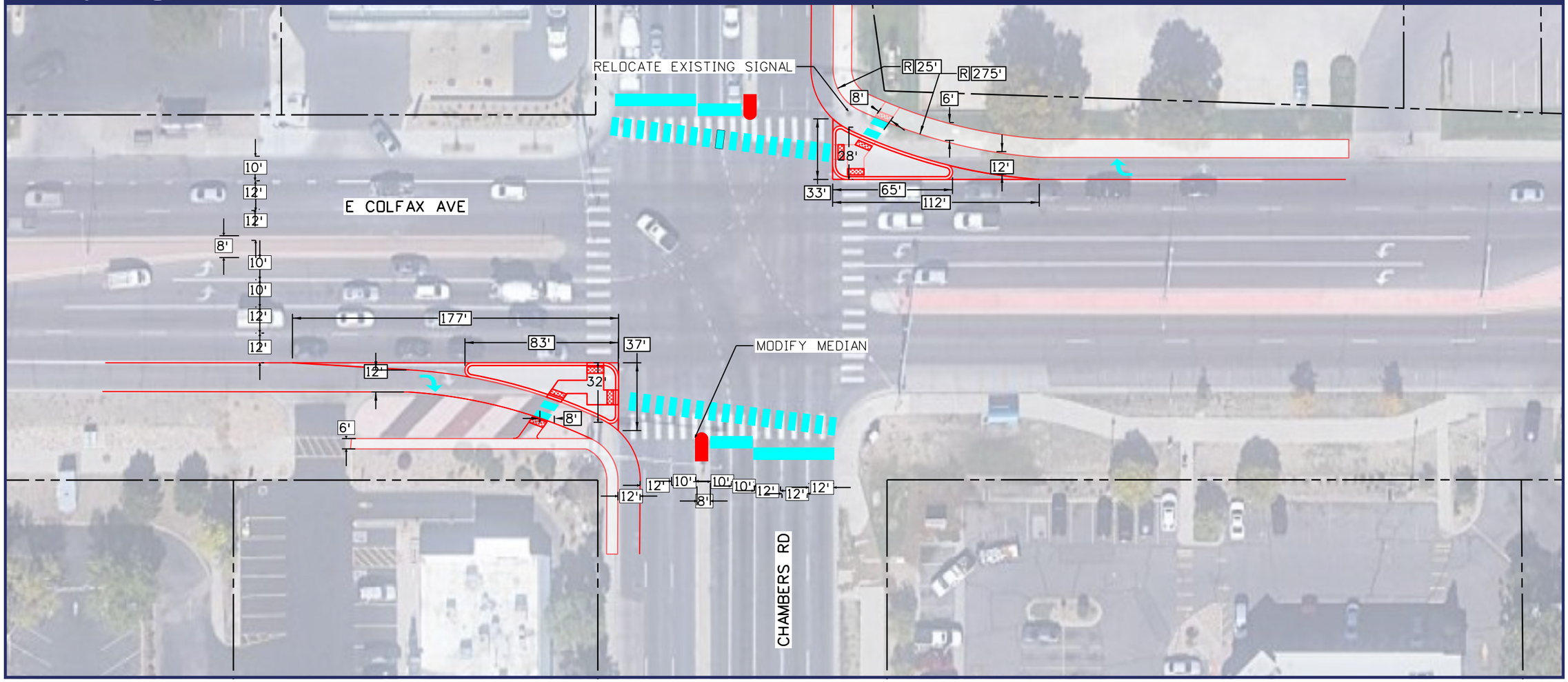
CMF Reference:	Install raised median with or without crosswalk (http://www.cmfclearinghouse.org/detail.cfm?facid=8799)
CRF:	32% (vehicle to pedestrian)
Explanation:	This improvement will shorten pedestrian crossing distances and make pedestrians more visible to vehicles.

Summary Data

Final Report:	March 2023
Crash Data:	7/2015 - 6/2020
Cost Estimate:	$2,329,000
B/C Ratio:	Curb Extensions - 1.27 Signal Upgrade - 0.33
LOSS:	2 (Total), 3 (Severe)

Figure 62: *Colfax &Chambers Concept Design & Cost Estimate*

Concept Design



TOP Countermeasures

1. Add right-turn channelization from Colfax Avenue to Chambers Road

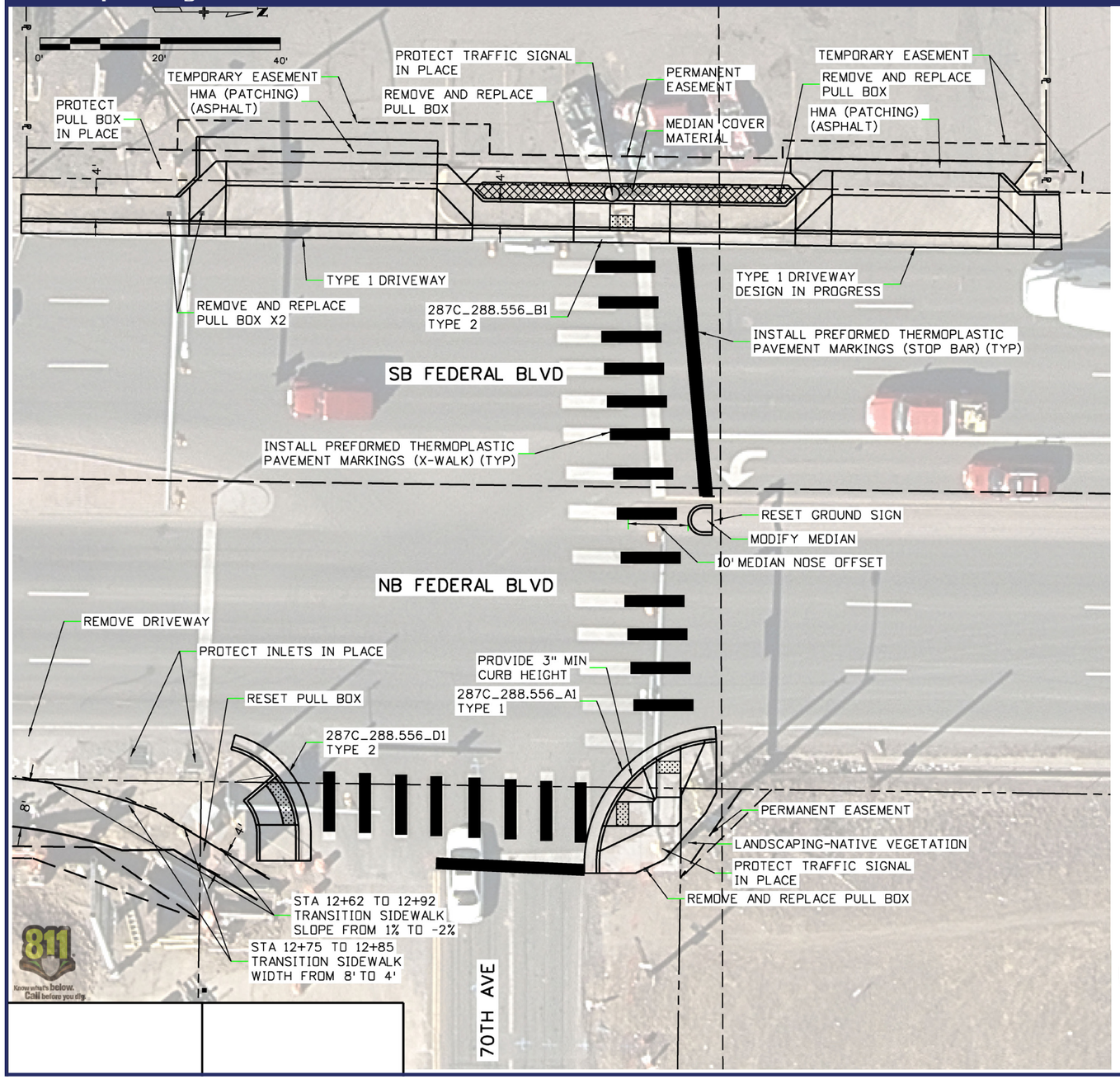
CMF Reference:	Improve angle of channelized right turn lane (http://www.cmfclearinghouse.org/detail.cfm?facid=8428)
CRF:	44.2% (all crashes)
Explanation:	This improvement will shorten pedestrian crossing distances, make pedestrians more visible to vehicles, and slow the vehicle speeds approaching the intersection to make right-turn maneuvers.

Summary Data

Final Report:	March 2023
Crash Data:	7/2015 - 6/2020
Cost Estimate:	$802,000
B/C Ratio:	11.56
LOSS:	3

Figure 63: Federal Blvd & 70th Ave Concept Design & Cost Estimate

Concept Design



TOP Countermeasures

1. Complete sidewalk connectivity on the west side and southeast side of Federal Boulevard.

CMF Reference:	Add sidewalk (https://safety.fhwa.dot.gov/provencountermeasures/walkways.cfm)
CRF:	65% (vehicle to pedestrian crashes on roadway)
Explanation:	This improvement will separate pedestrians from vehicles. This improvement includes updating the northwest pedestrian ramp to allow access for pedestrians with disabilities.

Summary Data

Final Report:	March 2023
Crash Data:	7/2015 - 6/2020
Cost Estimate:	$343,000
B/C Ratio:	0.37
LOSS:	Not Available

LEGEND:

- Detectable Warning
- Pedestrian Push Button
- Median Concrete Material

Figure 64: Federal Blvd & 70th Ave Concept Design & Cost Estimate (Cont.)

Concept Design

Summary Data

Final Report:	March 2023
Crash Data:	7/2015 - 6/2020
Cost Estimate:	$343,000
B/C Ratio:	0.37
LOSS:	Not Available

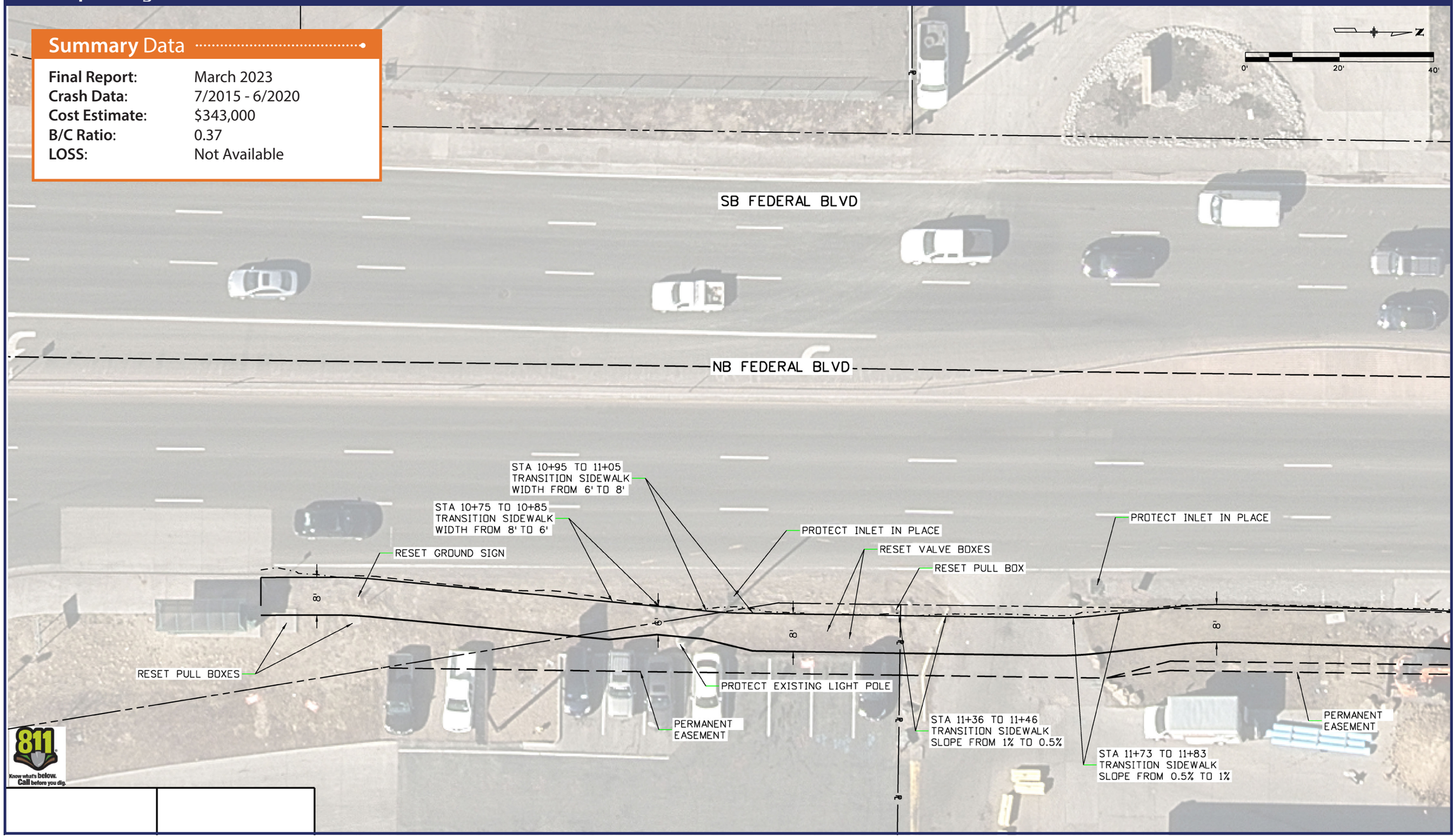
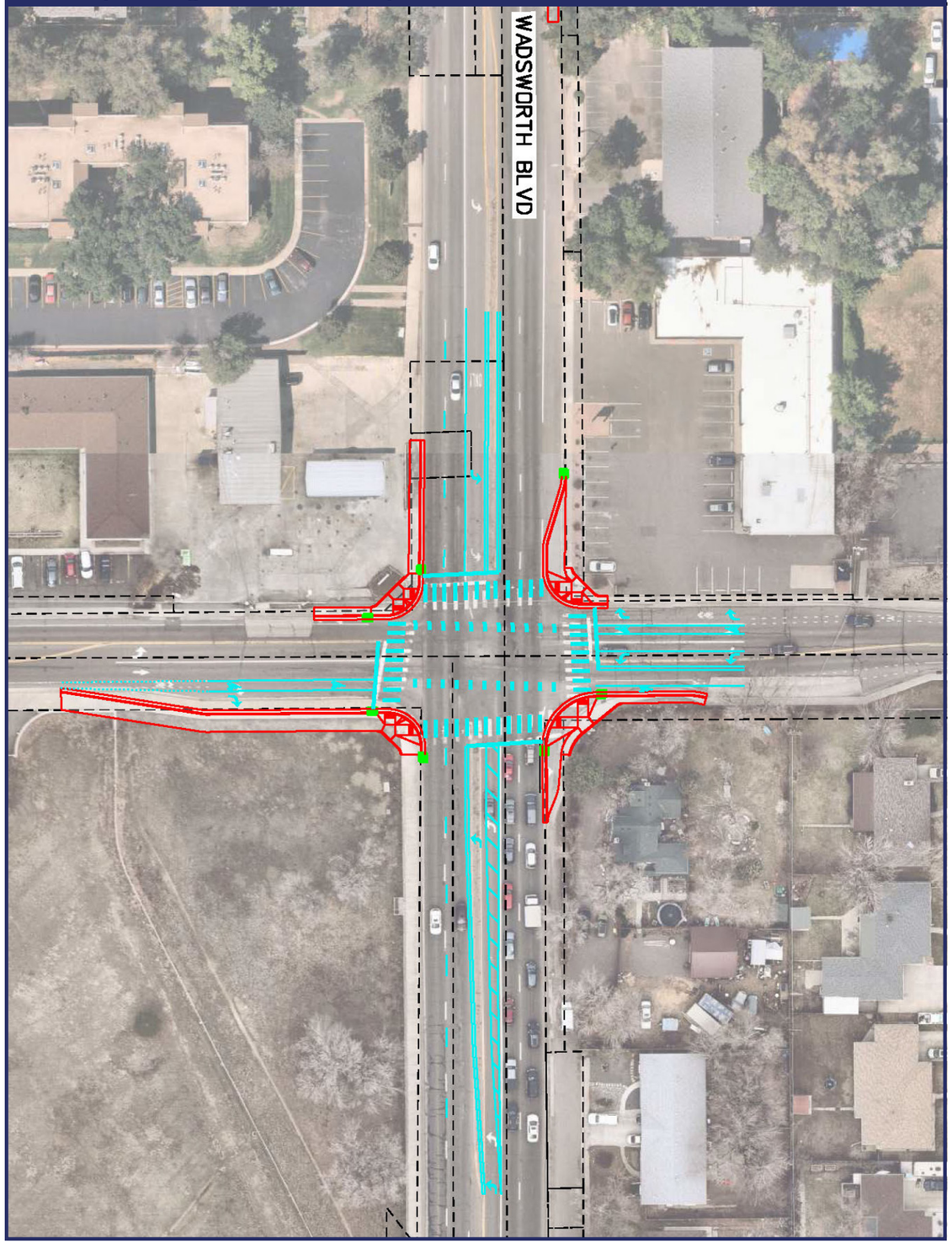


Figure 65: *Wadsworth & 32nd Ave Concept Design & Cost Estimate*

Concept Design - **Extent of Improvements**



TOP Countermeasures

1. Remove northbound right turn lane, tighten southeast corner radius and add a curb extension in the northeast corner

   CMF Reference: Increase triangle sight distance
   (http://www.cmfclearinghouse.org/detail.cfm?facid=307)
   (http://www.cmfclearinghouse.org/detail.cfm?facid=308)

   CRF: 11% (all PDO), 48% (all injury)

   Explanation: This improvement will shorten the pedestrian crossing distance, improve sight distance between vehicles and pedestrians, reduce the speed of turning vehicles, and provide additional space to place a new signal pole and ADA compliant curb ramps that are not obstructed by utilities.

2. Widen 32nd Avenue to the south to provide east/west bicycle lane connectivity at the intersection

   CMF Reference: Installation of bicycle lanes at signalized intersections with exclusive right turn lanes
   (http://www.cmfclearinghouse.org/detail.cfm?facid=3257)

   CRF: 3% (vehicle to bicycle)

   Explanation: This improvement will provide dedicated space for bicyclists and separation from vehicles at the intersection.

3. Add a 6-foot sidewalk on Wadsworth Avenue from 32nd Avenue to 35th Avenue (both sides)

   CMF Reference: Add sidewalk
   (https://safety.fhwa.dot.gov/provencountermeasures/walkways.cfm)

   CRF: 65% (vehicle to pedestrian crashes on roadway)

   Explanation: This improvement will provide a dedicated space for pedestrians to travel along Wadsworth Avenue and improve ADA compliance at curb ramps that are touched by the new sidewalk.

Summary Data

Final Report:	March 2023
Crash Data:	7/2015 - 6/2020
Cost Estimate:	$2,341,000
B/C Ratio:	Curb extensions - 12.69 Bike lanes - 0.05 Sidewalk (32nd-35th) - 0.0
LOSS:	4 (32nd Ave.) 3 (32nd-35th)

Figure 66: *Wadsworth & 32nd Ave Concept Design & Cost Estimate (Cont.)*

Concept Design

Summary Data

Final Report:	March 2023
Crash Data:	7/2015 - 6/2020
Cost Estimate:	$2,341,000
B/C Ratio:	Curb extensions - 12.69
	Bike lanes - 0.05
	Sidewalk (32nd-35th) - 0.0
LOSS:	4 (32nd Ave.)
	3 (32nd-35th)

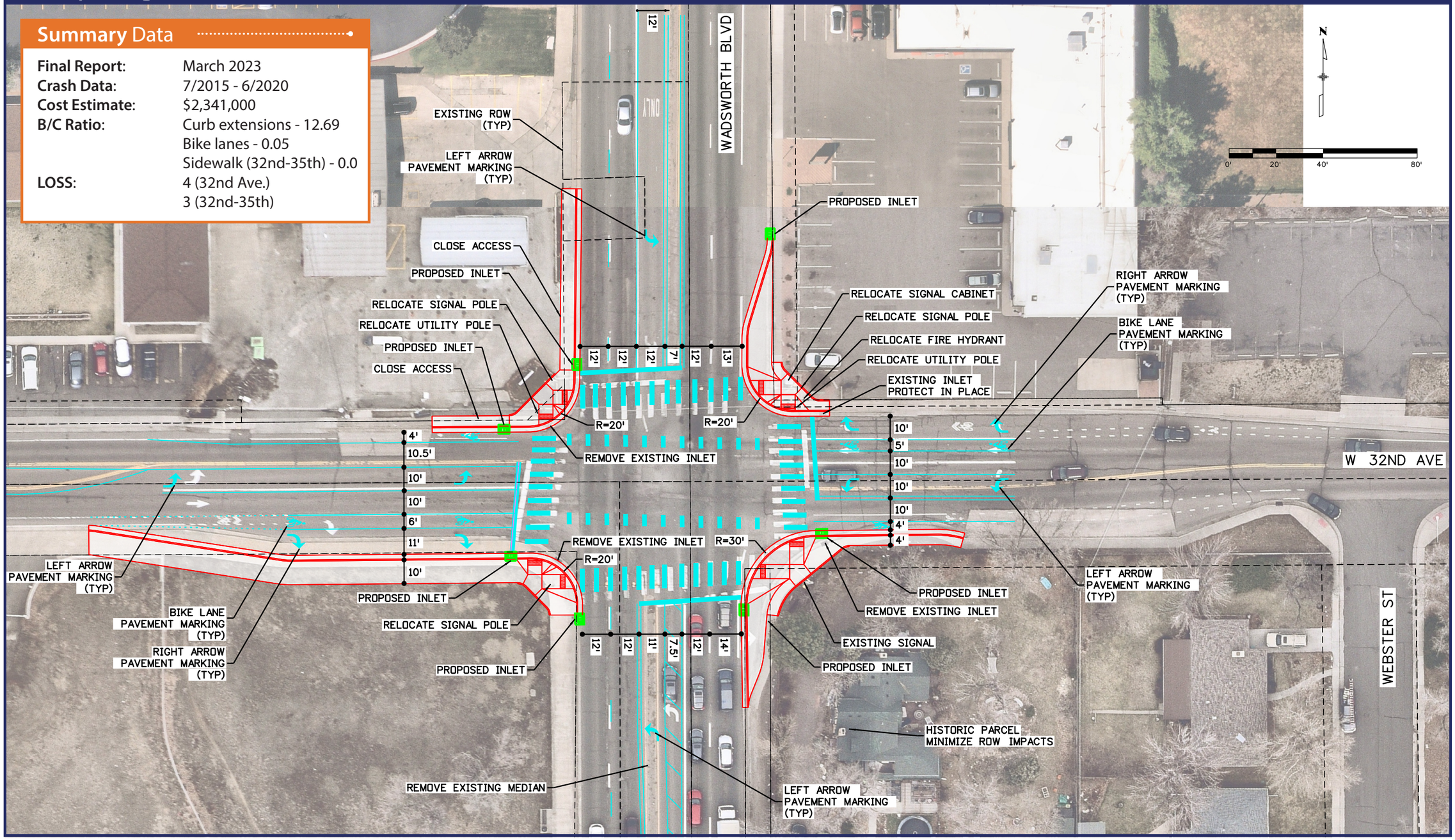


Figure 67: Wadsworth & 32nd Ave Concept Design & Cost Estimate (Cont.)

Concept Design - 32nd Avenue to 35th Avenue

Summary Data

Final Report:	March 2023
Crash Data:	7/2015 - 6/2020
Cost Estimate:	$2,341,000
B/C Ratio:	Curb extensions - 12.69
	Bike lanes - 0.05
	Sidewalk (32nd-35th) - 0.0
LOSS:	4 (32nd Ave.)
	3 (32nd-35th)

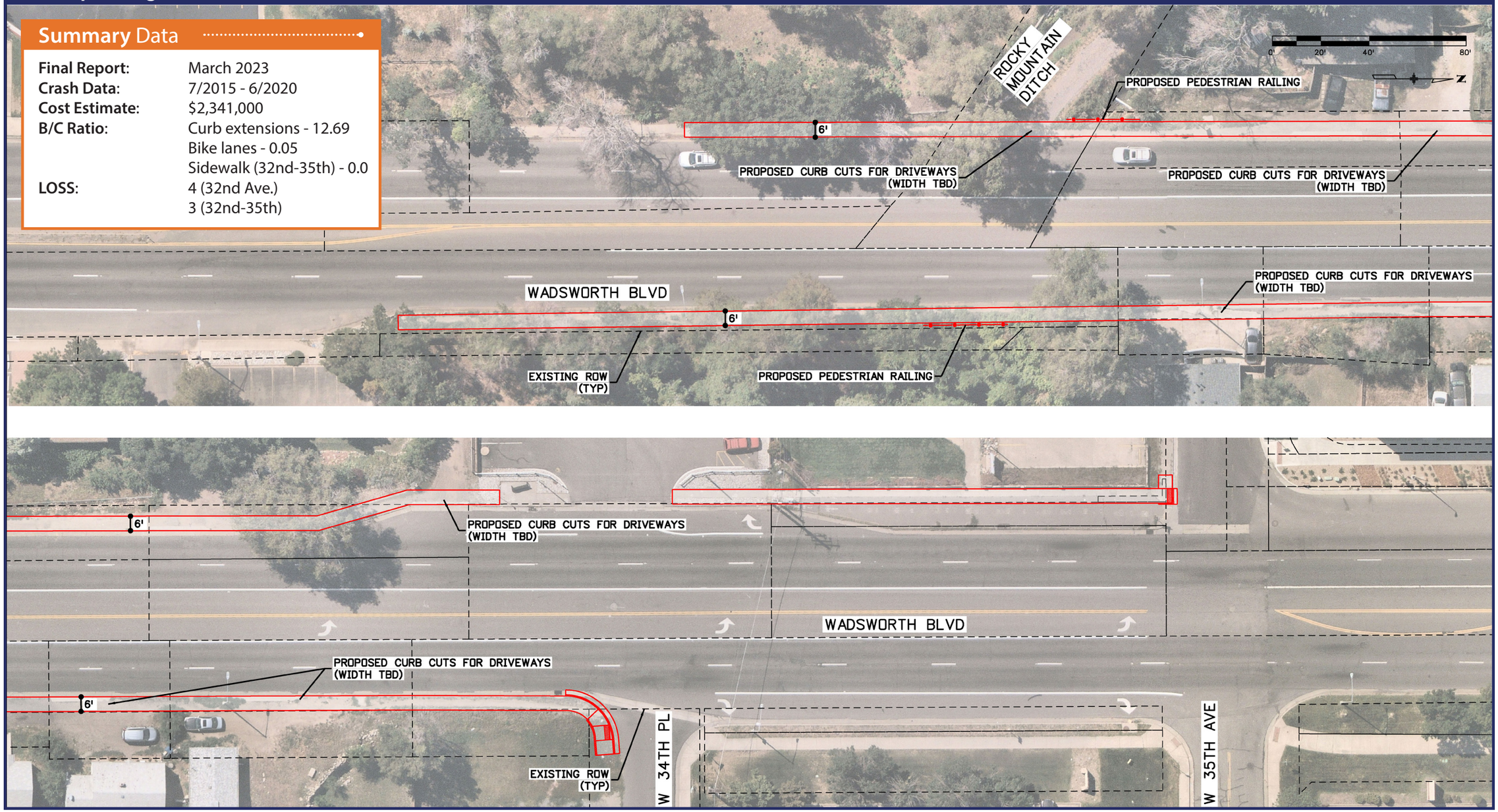
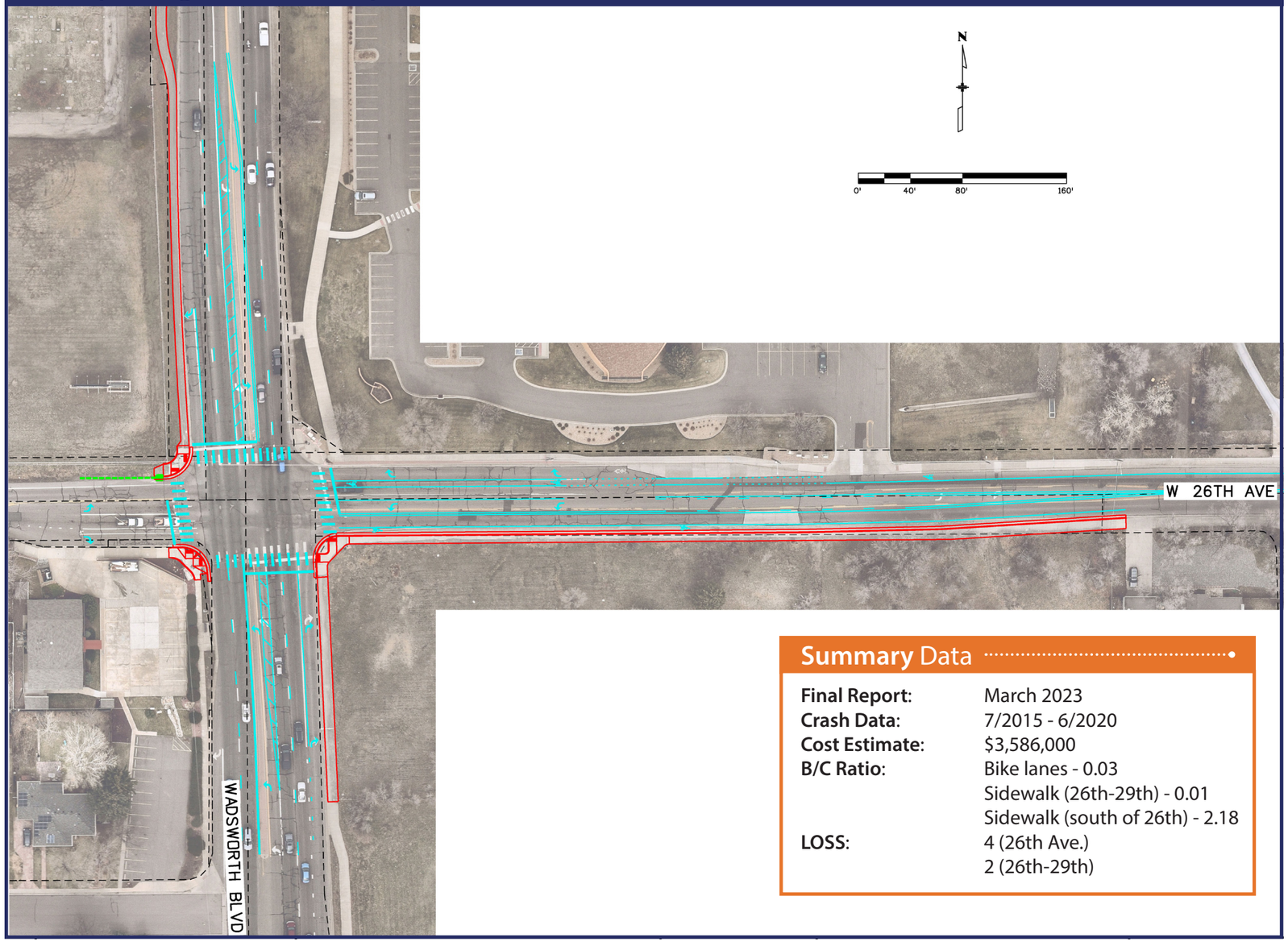


Figure 68: *Wadsworth & 26th Ave Concept Design & Cost Estimate*

Concept Design - **Extent of Improvements**



Summary Data

Final Report:	March 2023
Crash Data:	7/2015 - 6/2020
Cost Estimate:	$3,586,000
B/C Ratio:	Bike lanes - 0.03 Sidewalk (26th-29th) - 0.01 Sidewalk (south of 26th) - 2.18
LOSS:	4 (26th Ave.) 2 (26th-29th)

TOP Countermeasures

1. Widen the east leg to connect bike lanes on 26th Avenue in both directions

CMF Reference:	Installation of bicycle lanes at signalized intersections with exclusive right turn lanes (http://www.cmfclearinghouse.org/detail.cfm?facid=3257)
CRF:	3% (vehicle to bicycle)
Explanation:	This improvement will provide dedicated space for bicyclists and separation from vehicles at the intersection.

2. Add sidewalks from 26th Avenue to 29th Avenue (west side) and upgrade curb ramp in the northwest corner

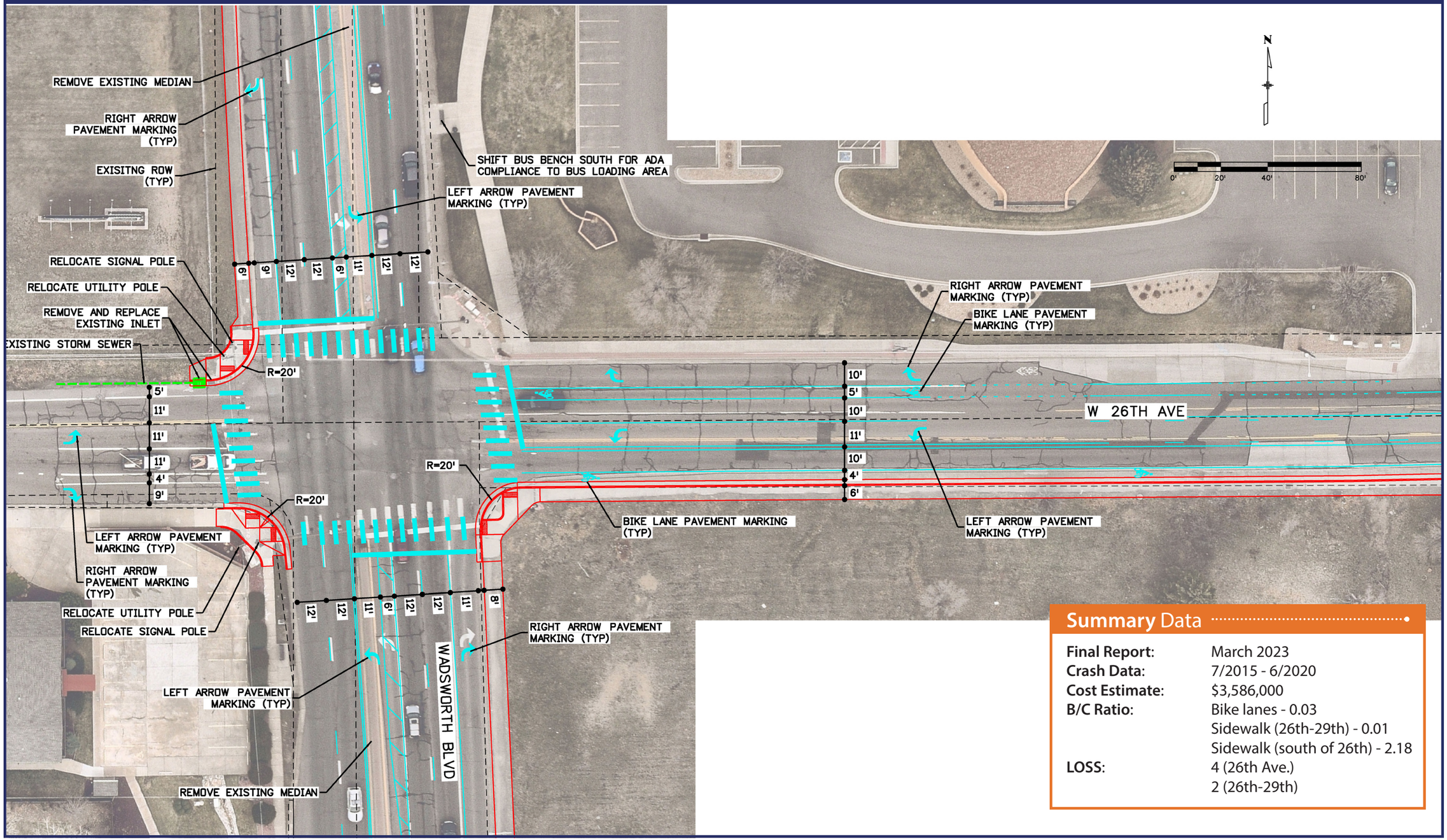
CMF Reference:	Add sidewalk (https://safety.fhwa.dot.gov/provencountermeasures/walkways.cfm)
CRF:	65% (vehicle to pedestrian crashes on roadway)
Explanation:	This improvement will provide a dedicated space for pedestrians to travel along Wadsworth Avenue and improve ADA compliance at curb ramps that are touched by the new sidewalk.

3. Fill in the sidewalk gap from 26th Avenue to 175 feet south (east side)

CMF Reference:	Add sidewalk (https://safety.fhwa.dot.gov/provencountermeasures/walkways.cfm)
CRF:	65% (vehicle to pedestrian crashes on roadway)
Explanation:	This improvement will provide connectivity in the pedestrian network and a dedicated facility for pedestrians to travel along Wadsworth Avenue.

Figure 69: *Wadsworth & 26th Ave Concept Design & Cost Estimate (Cont.)*

Concept Design



Summary Data

Final Report:	March 2023
Crash Data:	7/2015 - 6/2020
Cost Estimate:	$3,586,000
B/C Ratio:	Bike lanes - 0.03 Sidewalk (26th-29th) - 0.01 Sidewalk (south of 26th) - 2.18
LOSS:	4 (26th Ave.) 2 (26th-29th)

Figure 70: *Wadsworth & 26th Ave Concept Design & Cost Estimate (Cont.)*

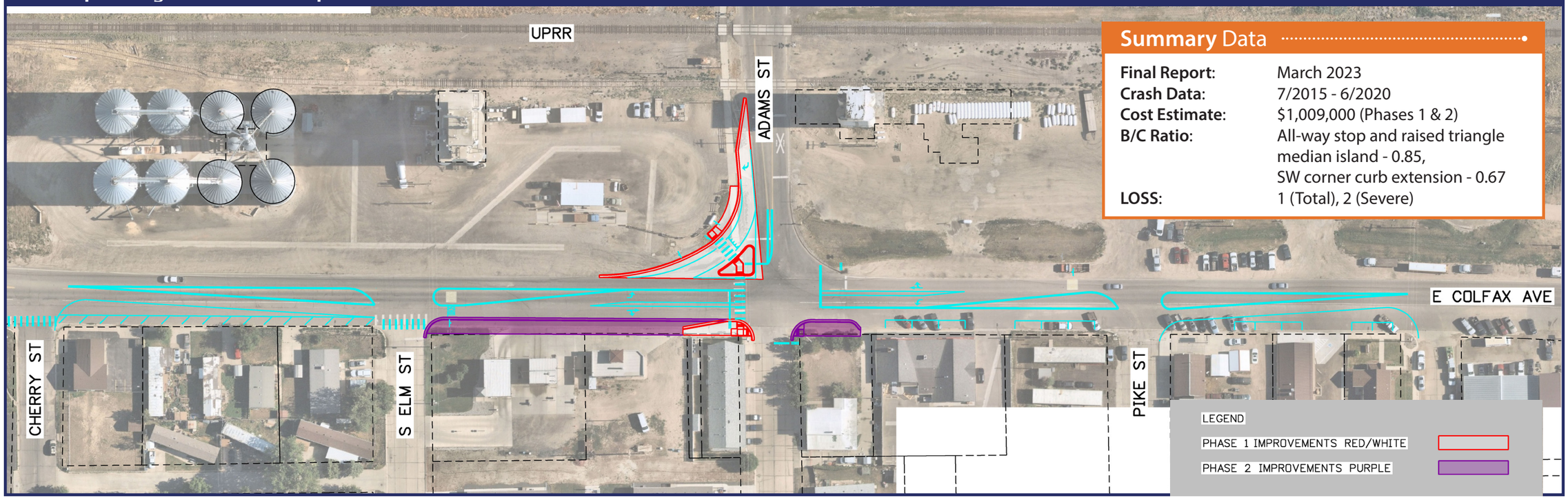
Concept Design - 26th Avenue to 29th Avenue

Summary Data

Final Report:	March 2023
Crash Data:	7/2015 - 6/2020
Cost Estimate:	$3,586,000
B/C Ratio:	Bike lanes - 0.03
	Sidewalk (26th-29th) - 0.01
	Sidewalk (south of 26th) - 2.18
LOSS:	4 (26th Ave.)
	2 (26th-29th)

Figure 71: *Colfax & Adams Concept Design & Cost Estimate*

Concept Design - Extent of Improvements



Summary Data

Final Report:	March 2023
Crash Data:	7/2015 - 6/2020
Cost Estimate:	$1,009,000 (Phases 1 & 2)
B/C Ratio:	All-way stop and raised triangle median island - 0.85, SW corner curb extension - 0.67
LOSS:	1 (Total), 2 (Severe)

TOP Countermeasures

1. Curb extension in the southwest corner

   CMF Reference: Increase triangle sight distance (http://www.cmfclearinghouse.org/detail.cfm?facid=307) (http://www.cmfclearinghouse.org/detail.cfm?facid=308)

   CRF: 11% (all PDO), 48% (all injury)

   Explanation: This improvement will shorten the pedestrian crossing distance, improve sight distance between vehicles and pedestrians, and provide a protected area to place a new stop sign and flashing beacon to slow vehicles.

2. Convert intersection to all-way stop control with flashing beacons on Colfax Avenue and add a raised triangle median island in northwest corner

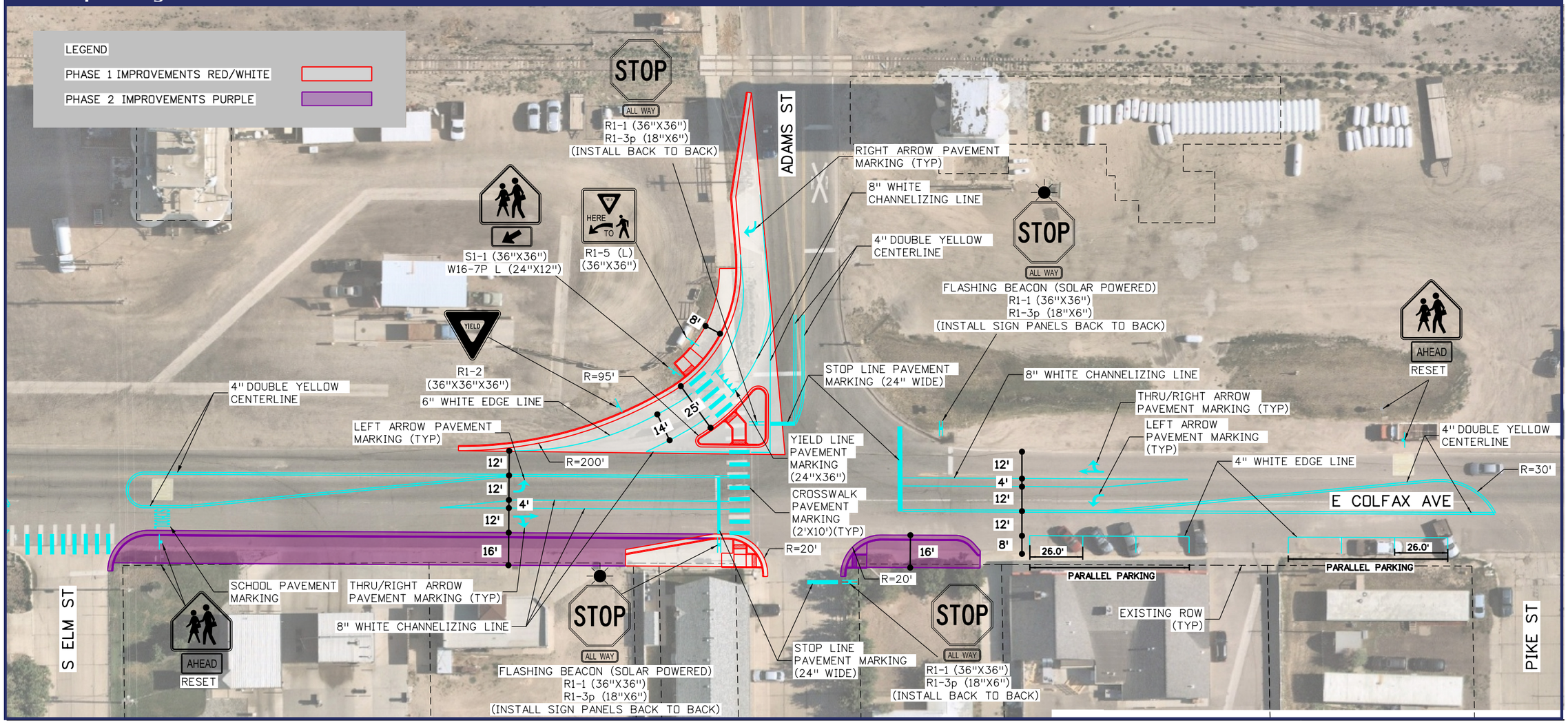
   CMF Reference: Convert two-way (without flashing beacons) to all-way stop (with flashing beacons) (http://www.cmfclearinghouse.org/detail.cfm?facid=3136)

   CRF: 82% (all crashes)

   Explanation: This improvement will force vehicles to stop on Colfax Avenue, and improve visibility to crossing pedestrians, thereby reducing the differential speed between pedestrians and vehicles and improving safety. This improvement will also shorten the pedestrian crossing distance, improve sight distance between vehicles and pedestrians, and provide area to place a new stop sign and flashing beacon to slow vehicles.

Figure 72: *Colfax & Adams Concept Design & Cost Estimate (Cont.)*

Concept Design

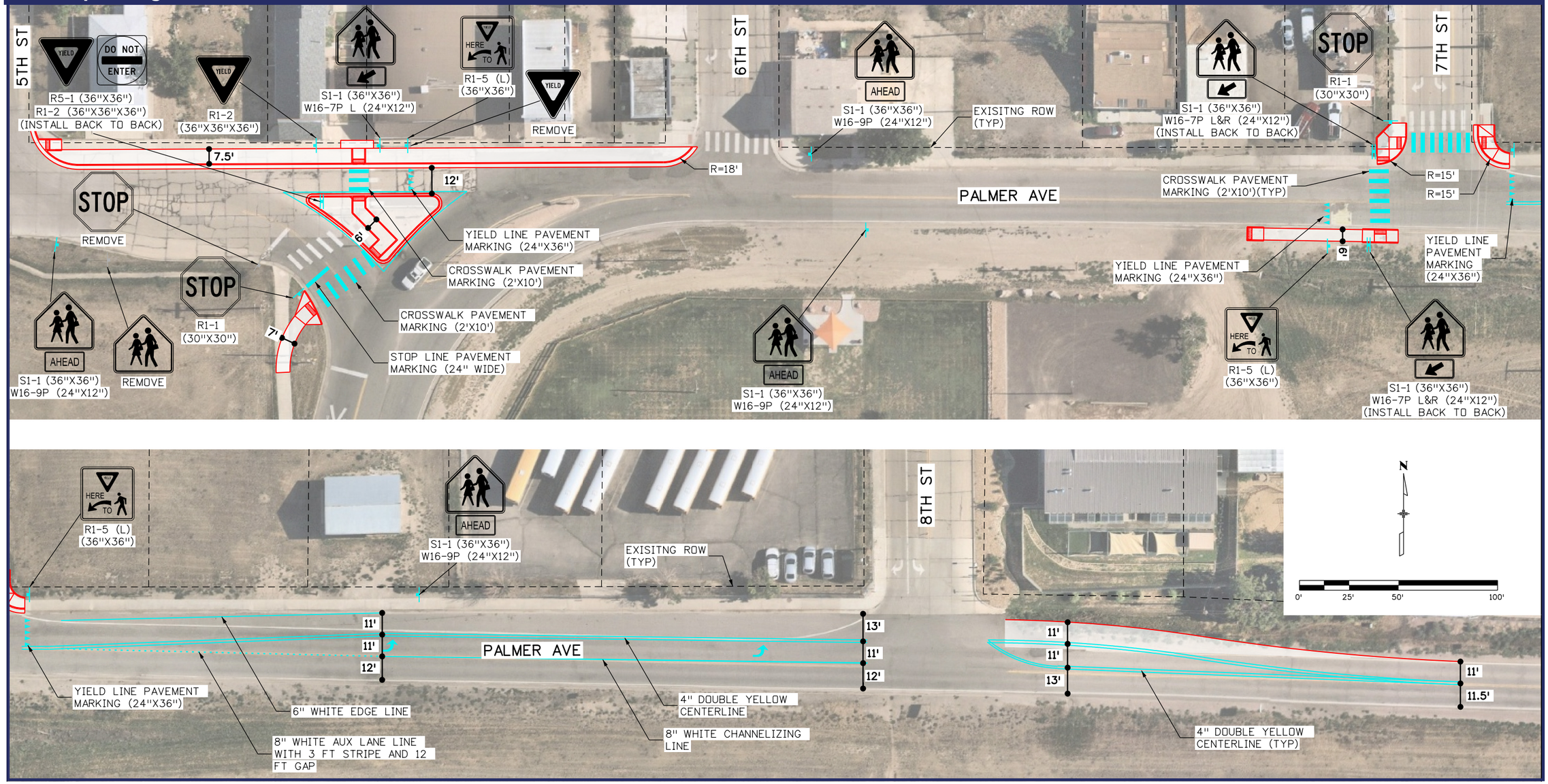


Summary Data

Final Report:	March 2023
Crash Data:	7/2015 - 6/2020
Cost Estimate:	$1,009,000 (Phases 1 & 2)
B/C Ratio:	All-way stop and raised triangle median island - 0.85, SW corner curb extension - 0.67
LOSS:	1 (Total), 2 (Severe)

Figure 73: *Palmer from Colfax to 8th Concept Design & Cost Estimate*

Concept Design



TOP Countermeasures

1. Enlarge triangle median island and extend curb between 5th Street and 6th Street

   CMF Reference: Install raised median with or without marked crosswalk (uncontrolled) (http://www.cmfclearinghouse.org/detail.cfm?facid=8799)

   CRF: 31.5% (vehicle to pedestrian)

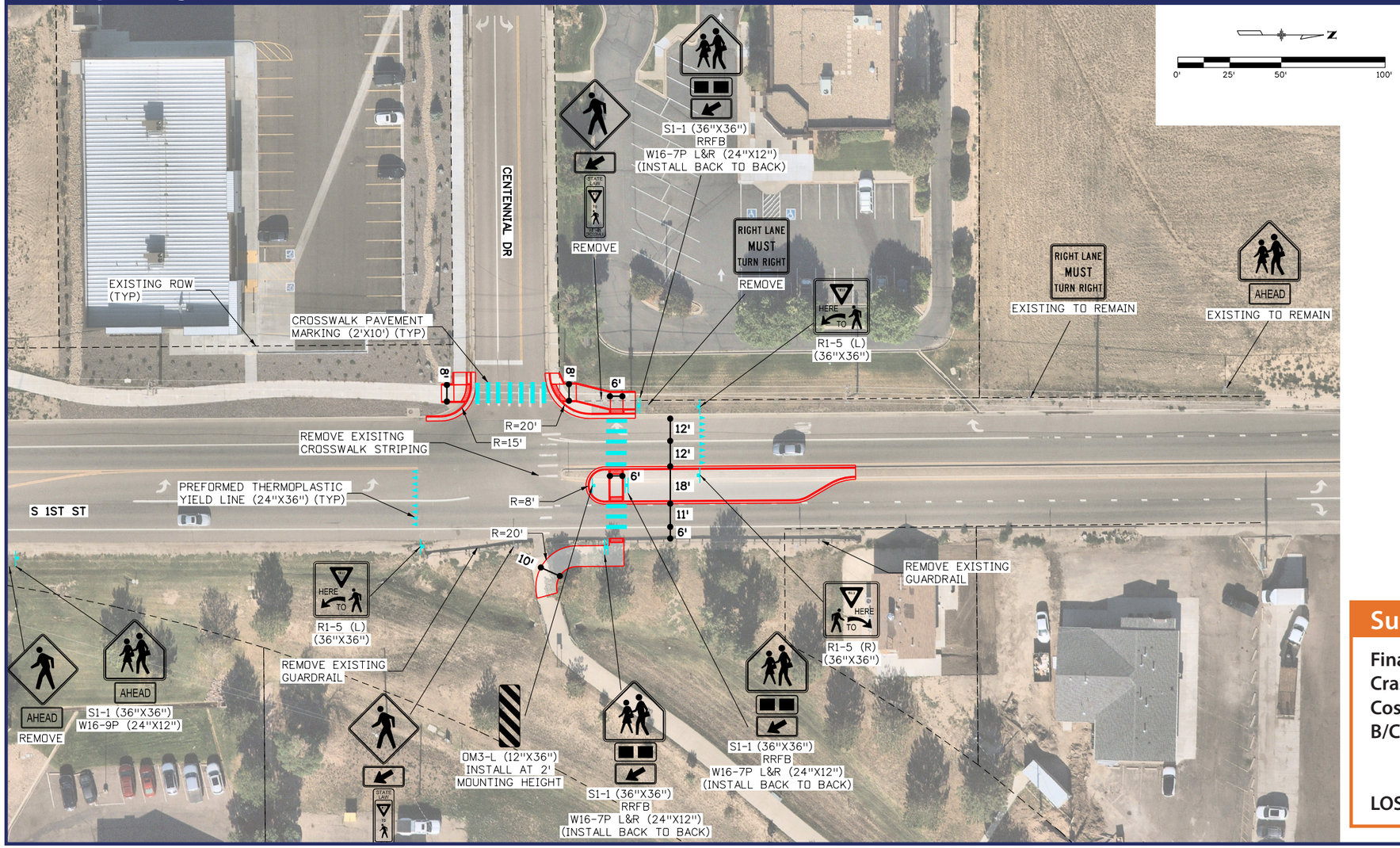
   Explanation: This improvement will shorten the pedestrian crossing distances, provide an ADA compliant sidewalk connection between 5th Street and 6th Street, upgrade curb ramps for ADA compliance, and shift the southernmost crosswalk closer to SH 79 for improved visibility of pedestrians to turning vehicles.

Summary Data

Final Report:	March 2023
Crash Data:	7/2015 - 6/2020
Cost Estimate:	$788,000
B/C Ratio:	0.01
LOSS:	2 (at Adams & Palmer Intersection)

Figure 74: *1st & Centennial Concept Design & Cost Estimate*

Concept Design



Summary Data

Final Report:	March 2023
Crash Data:	7/2015 - 6/2020
Cost Estimate:	$445,000
B/C Ratio:	Raised median - 0.33, Crosswalk striping and RRFB - 0.01
LOSS:	2

TOP Countermeasures

1. Widen the raised median island and shift the crosswalk north to provide a pedestrian refuge

   CMF Reference: Install raised median with or without marked crosswalk (uncontrolled) (http://www.cmfclearinghouse.org/detail.cfm?facid=8800)

   CRF: 25.8% (all crashes)

   Explanation: This improvement will increase safety for pedestrians to cross opposing travel lanes one direction at a time. By shifting the crosswalk north, it allows the median to be pulled back to accommodate the eastbound left turning vehicles and provides a median refuge to protect pedestrians as they wait in the median. It is also recommended that the existing guardrail be removed with the relocation of the crosswalk.

2. Install high-visibility crosswalk striping and add an RRFB and associated signage and striping and back mount the signage

   CMF Reference: Install rectangular rapid flashing beacon (RRFB) (http://www.cmfclearinghouse.org/detail.cfm?facid=9024)

   CRF: 47.4% (vehicle to pedestrian)

   Explanation: The wider median better protects signage within the median from being hit. This improvement includes back mounting signage for increased visibility to drivers, plus replacement of the existing faded and undersized signage. This improvement will increase visibility of the crosswalk and those using it.

ACCEPTABLE COUNTERMEASURES

At the first TAC meeting for this project, members were asked how this project could benefit them if none of the top locations selected were located within their City, Town, or County. The responses included identifying acceptable countermeasures for CDOT roads and local roads, and a desire to prioritize multimodal on CDOT Roads. During this project many acceptable countermeasures and some innovative solutions were identified for the top locations. Additionally, CDOT has indicated an openness in discussing proposed improvements on CDOT roads and has shown a willingness during this process to consider some innovative solutions to challenging conditions. Table 24 summarizes resources that provide guidance, research, best practices, and safety countermeasures to improve the roadway network. The first three resources listed in Table 24 come from FHWA and include generally acceptable countermeasures that could apply to a variety of CDOT and local roads. Many of the countermeasures listed on these sites are also great candidates for safety grant funding. Local agencies should work with their respective response team to better understand the cause of crashes so that appropriate countermeasures can be implemented.

Table 24: Safety Countermeasure Resources

Resource	Description	Link
Safe Transportation for Every Pedestrian (STEP) Studio	Comprehensive compilation of resources, design guidance, research, and best practices for practitioners to identify appropriate countermeasures for improved pedestrian safety.	STEP STUDIO - Tools for Selecting and Implementing Countermeasures for Improving Pedestrian Crossing Safety (dot.gov)
FHWA Proven Safety Countermeasures	Provides a collection of countermeasures and strategies for reducing fatalities and serious injuries. Includes guidance for placement of countermeasures and expected percentage reduction in crashes.	Proven Safety Countermeasures | Federal Highway Administration - Safety | Federal Highway Administration (dot.gov)
PEDSAFE	Identifies 67 countermeasures for engineering, education, and enforcement. Includes preliminary cost estimates.	Pedestrian Safety Guide and Countermeasure Selection System (pedbikesafe.org)
pedbikeinfo	Provides facts, resources, and webinars around bicycle and pedestrian health, safety, environment, economics, and equity.	Pedestrian & Bicycle Information Center (pedbikeinfo.org)
walkinginfo.org	Provides facts, statistics, guidance for implementing solutions, case studies and training opportunities.	walkinginfo.org: School Zone Improvements
bicyclinginfo.org	Provides facts, statistics, guidance for implementing solutions, case studies and training opportunities.	bicyclinginfo.org
Crash Modification Factors (CMF) Clearinghouse	Provides a searchable database of CMF's along with guidance and resources on using CMFs.	Crash Modification Factors Clearinghouse (cmfclearinghouse.org)
National Association of City Transportation Officials (NACTO)	Provides design guides for Urban Streets, Urban Bikeways and Transit Streets that include guidance on these types of facilities and all relevant elements such as intersection signal timing details.	National Association of City Transportation Officials | National Association of City Transportation Officials (nacto.org)

The challenge in applying safety countermeasures is that while many countermeasures are considered acceptable by CDOT, they are not necessarily acceptable on every road or intersection. For example, while a Rectangular Rapid Flashing Beacon (RRFB) is considered an acceptable countermeasure by CDOT, available guidance states that it is not an acceptable countermeasure on roads with 4 or more lanes, or high volume 2-lane roads that don't provide gaps in traffic. On wider roads or those with high volumes, other countermeasures would likely be more appropriate. When applying safety countermeasures it is critical to ensure that the countermeasure is appropriate for the proposed location and will not cause unforeseen safety concerns. Table 25 provides a list of acceptable countermeasures that could apply to state and local roads within the region and guidance on where they would apply, although it is not inclusive and other countermeasures could be considered. Cities, Counties and Towns that are interested in discussing these countermeasures on their state highways should reach out to CDOT to discuss the appropriateness and level of support for specific locations.

Table 25: Acceptable Countermeasures

Safety Countermeasure	When to Apply	Pros	Cons
Access Control *(Consolidating or reducing the number of access points)*	On arterial and collector roads, high speed roads, adjacent to major intersections, where access does not meet current spacing standards, and/or where a high volume of bicycles and/or pedestrians are present. At locations where motorists are known to make higher speed turns into or out of driveways.	• Reduced conflict points between vehicles and bicycles/pedestrians. • Can help with continuity of sidewalk or multiuse path. • Can reduce the speed of turning vehicles into and out of driveways.	• Potential opposition from property owners. • Could increase vehicle speeds on the mainline when there is less friction caused by vehicles entering and exiting the roadway.
Improve Lighting *(horizontal and vertical illuminance, luminance, and uniformity)*	Where lighting is lacking, the quality of the lighting is poor, lighting is not uniform, or where there is a history of nighttime crashes.	• Increased visibility of key roadway features such as lane markings, crosswalk markings, curbs, and vulnerable users. • Increased perception of safety.	• The installation and maintenance of lighting in rural areas provides a lower return on investment. • May require a system of installation to ensure consistent illuminance.

Safety Countermeasure	When to Apply	Pros	Cons
Traffic Calming *(i.e. narrowing travel lanes, changing from 2-way to all-way stop control, bulb-outs at intersections, reducing turning radii, raised crosswalks, reducing posted speed limits, reducing number of lanes)*	On local roads with an 85th percentile speed that is more than 4mph over the posted speed. On main streets or other roads where a high volume of bicycles and/or pedestrians are present. Roads with a history of crashes involving vulnerable users. All-way stops must meet MUTCD compliance. Reduced speed limits would be required to meet CDOT's updated process for setting speed limits, currently in process at the time of this writing. The new procedure is expected to be less focused on the 85th percentile speed and more in line with the upcoming MUTCD standards that look at historical data and roadway specifics. Reduced number of lanes are appropriate when traffic volumes can adequately be accommodated on fewer motor vehicle lanes.	• Increases safety for all roadway users, especially bicyclists and/or pedestrians. • May improve compliance with posted speed limits. • Provides opportunity for streetscape design (i.e. ADA compliant pedestrian ramps, landscaping, lighting, street furniture, etc.).	• May be challenging for large vehicles including trash trucks and buses to make turns where radii have been reduced. • May reduce response times by emergency vehicles depending on changes to roadway.
Protected Mid-Block Crossing *(i.e. Pedestrian Hybrid Beacon [PHB], Rectangular Rapid Flashing Beacon [RRFB], Raised median for refuge plus signage and striping)*	Mid-block crossings are generally recommended where long distances exist between stop or signal-controlled intersections, or in locations where vulnerable users are known to cross. Adequate sight distance to a mid-block crossing is necessary for safe crossing. On roads with more than 2 lanes of travel, high speeds or high volume, HAWK signals are recommended. RRFB's or raised medians with a pedestrian refuge and adequate signage and striping are more appropriate on lower speed, lower volume, 2-lane roads. It is generally recommended that protected mid-block crossings are not installed until pedestrian volumes reach 20 pedestrians per hour for two hours of the day. Additional guidance is provided in *CDOT's Pedestrian Crossing Installation Guide (2021)*.	• Reduce instances of users crossing roads in unprotected, potentially dangerous locations. • Increases motorist awareness of where vulnerable users will be crossing the road. • Reduces distances between bicycle/pedestrian destinations.	• Consideration of existing access could limit feasibility of mid-block crossing locations. • Using the wrong type of mid-block crossing can result in poor motorist compliance.

Safety Countermeasure	When to Apply	Pros	Cons
Signal Improvements *(i.e. leading pedestrian interval, countdown pedestrian signal heads, passive pedestrian / bicycle detection, exclusive phasing for bicyclists or pedestrians)*	Leading pedestrian interval is appropriate when there is a history of approach turn crashes or near misses between motor vehicles and bicycles / pedestrians. Countdown pedestrian signal heads are appropriate at all signalized intersections and passive detection for bicycles and pedestrians is appropriate at high-volume, high-speed intersections, or those where sight distance between motorists and bicycles / pedestrians is poor. Exclusive phasing should be considered at intersections where counts demonstrate a consistently high volume of pedestrians and / or bicyclists, on local roads, or in Central Business District areas.	• Can be comparatively affordable in relation to other countermeasures. • Requires less time to achieve improvements. • Less disruption to existing traffic operations than countermeasures requiring construction in roadway.	• Bicycle/pedestrian detection is a comparatively newer treatment so data on effectiveness is not as established. • Bicycle-only phasing is fairly unique so some people traveling by bike may not be looking for the signal and understand that it provides a selective phase for their crossing.
Widen Shoulders	When shoulder widths are less than 4 feet in width. On higher speed and/or volume roadways, or those with a high percentage of heavy vehicles, wider shoulders are recommended.	• Increase distance between motorists and vulnerable users on shoulder, particularly when going around curves.	• Regular maintenance required to address collection of debris, snow, and water on shoulders. • In rural areas, requires a process to determine adequate locations.
Improved Signage and Striping for Bicyclists and Pedestrians *(i.e. High Visibility crosswalks, 3 feet clearance signage, warning signs such as 'Watch for Bicycles, Bicycle Crossing, Caution - Watch for Pedestrians and Bicyclists')*	At locations, namely intersections or crossing points, where motorists are likely to encounter a comparatively high volume of bicyclists and pedestrians. This may include, but isn't limited to roadway intersections with more heavily used trail crossings, near parks, near schools, or retail / employment nodes frequented by pedestrians and bicyclists.	• Comparatively affordable in relation to other countermeasures requiring construction such as new sidewalk, mid-block crossings, or shoulder widenings. • Less likely to require right-of-way and require coordination / permitting with other agencies or stakeholders (i.e. property owners)	• Due to amount signage and striping already present in some locations, additions may be less distinguishable from what's already in place, which can reduce effectiveness. • Requires regular maintenance.

Safety Countermeasure	When to Apply	Pros	Cons
Add Sidewalks and Fill Gaps	Where sidewalks would connect pedestrian destinations such as bus stops and retail centers, and in areas where demand for walking is likely higher due to factors such as lack of access to a vehicle, disability, age, etc.	• Provides greatest number of potential users with enhanced mobility options. • Provides connections to pedestrian destinations. • Provides a predictable facility on which motorists expect pedestrians to be. • Reduces potential for conflict that is higher when separation does not exist.	• Comparatively expensive to construct and maintain, in relation to other countermeasures. • Installation in physically constrained areas can be challenging.
Reduce Sight Line Obstructions *(i.e. traffic signal cabinets, bushes, trees, etc.)*	In locations where fixed objects or vegetation obstruct the ability of motorists, bicyclists, or pedestrians to effectively see and make decisions (i.e. turn movements, reduction in speed, yielding) based on the location and distance from other vehicles, bikes, or people walking.	• Increased visibility across thru lanes and at turn points (including driveways) reduces the potential for conflict between roadway users.	• Relocation of utilities can be an expensive undertaking and coordination with utility providers can be time-consuming. • Stakeholders may be opposed to the removal of vegetation (i.e. mature trees) even if within the public right-of-way and required to address a safety hazard.
Add Protected Bike Lanes *(on segments and at intersections)*	Where vehicle speeds or volumes are high, or where demand exists to connect to destinations. Bike lanes can be substituted for wider shoulders on rural roadways. Protected bike lanes should be provided at intersections where shoulders are limited.	• Provides separation from adjacent travel lanes and motorists increasing real and perceived safety for a wider range of bicyclists. • Provides predictability for motorists about bicyclist's location. • Reduces potential for conflict that is higher when separation does not exist.	• Some installations require frequent maintenance costs (i.e. plastic flex bollards). • May be confusing to some motorists. • Are not typically plowed/shoveled in the winter. • When placed adjacent to on-street parking, conflicts due to car door openings may present a hazard.

Resources for Funding

After selecting appropriate safety countermeasures, concept designs need to be prepared and funding identified to implement design and construction. If no identified funding is available, grants are a great way to fund projects. In most cases a match of 10-20 percent is required, resulting in an 80-90 percent reduction in implementation costs.

There are several grants that open up on a recurring cycle and are expected to be available over the long term. A list of those that are good candidates for safety funding are listed below. Other opportunities to fund safety projects are available but may not be reoccurring or long term.

Table 26: Safety Funding Opportunities

Safety Funding Opportunities	***Link***
Highway Safety Improvement Program (HSIP)	Highway Safety Improvement Program — Colorado Department of Transportation (codot.gov)
Funding Advancements for Surface Transportation and Economic Recovery Act (FASTER)	FASTER — Colorado Department of Transportation (codot.gov)
Revitalizing Main Streets	Revitalizing Main Streets — Colorado Department of Transportation (codot.gov)
Safe Routes to School	Safe Routes to School — Colorado Department of Transportation (codot.gov)
DRCOG Transportation Improvement Program (TIP)	Transportation Improvement Program | DRCOG

NEXT STEPS

CDOT is invested in improving the safety of bicyclists and pedestrians in Region 1 and has sought out ways to progress each of the top 11 locations, both as part of this project and through other contracts. While this project was underway, it was determined that two of the top locations had been awarded funding to progress the design. One of those locations is being designed by CDOT (Federal Boulevard and 70th Avenue) and the other will be part of a larger project with Wheat Ridge (Wadsworth and 32nd Avenue). Of the remaining 9 locations, CDOT is using vision zero funds to support design of improvements at five locations, they are having HSIP / FASTER grant applications prepared for design and construction funding at three of the locations, and they will be working with the City and County of Denver to implement signal timing improvements at the final location. A brief summary of next steps for each of the top locations is shown in Table 27 below.

Table 27: Top Location Next Steps

Local Agency	Top Locations	Next Steps
Aurora	Segment of Colfax from Moline to Peoria	Design
Aurora	Intersection of Colfax/Havana	Design
Glendale	Intersection of Colorado/Mississippi	CDOT/CCD Coordination
Aurora	Intersection of Colfax/Moline	HSIP / FASTER Application
Aurora	Intersection of Colfax/Chambers	Design
Westminster / Adams Co	Intersection of US 287 (Federal Blvd) / 70th Ave	HSIP Funded
Wheat Ridge	Intersection of Wadsworth / 32nd and Wadsworth from 32nd to 35th	Wheat Ridge was Awarded TIP Funding
Wheat Ridge / Lakewood	Intersection of Wadsworth / 26th and Wadsworth from 26th to 29th	HSIP / FASTER Application
Bennett	Intersection of Colfax / Adams	Design
Bennett	Palmer Ave from Colfax to 8th	HSIP / FASTER Application
Bennett	Intersection of 1st St / Centennial	Design

IMPROVING THE PLAN

The plan described in this report identifies a method of selecting bicycle and pedestrian safety projects within CDOT Region 1. With new bicycle and pedestrian safety funding opportunities becoming available through new transportation funding bills, CDOT may consider updating the plan every 2-3 years to account for updated crash history and new data that may be available for use in systemic safety analysis. There are additional opportunities to improve the results of this plan in the future through improved crash data collection and the addition of new datasets.

Crash Data Collection

Crash pattern analysis and network screening were both limited by data availability and format. One resource for improving crash data is the Model Minimum Uniform Crash Criteria Guideline (MMUCC)[19]. MMUCC identifies a minimum set of motor vehicle crash data elements and their attributes that States should consider collecting and including in their state crash data system. The 5th Edition was made available in 2017 and increased the number of data elements to 115. On the National Highway Traffic Safety Administration (NHTSA) website, they state that the 5th Edition was "the result of an 18-month collaboration between NHTSA, the Federal Highway Administration (FHWA), the Federal Motor Carrier Safety Administration (FMCSA), the National Transportation Safety Board (NTSB), the Governors Highway Safety Association (GHSA), and subject matter experts from State DOT's, local law enforcement, emergency medical services, safety organizations, industry partners, and academia." A crash report form showing all 115 elements is also available on the NHTSA website[20]. Specific elements from this report that would have been beneficial to understanding the nature of crashes in Region 1 include:

[19] MMUCC | NHTSA

[20] mmucc5_crashreportform2017.pdf (nhtsa.gov)

- Contributing circumstances in the roadway environment (i.e. obstructed crosswalks, related to a bus stop, shoulders, visual obstructions, etc.)
- Specific location of a crash (i.e. acceleration/deceleration lane, shared use path or trail, etc.)
- Overall intersection geometry (i.e. angled/skewed, roundabout, or perpendicular)
- Overall traffic control device (i.e. signalized, stop-all way, stop-partial, yield)
- Trafficway description (i.e. travel directions, divided, barrier type, etc.)
- Roadway alignment and grade
- Traffic control device data (i.e. signs, signals, pavement markings, any inoperative or missing)
- Motor vehicle maneuver/action (i.e. backing, negotiating a curve, stopped in traffic, etc.)
- Person type (i.e. motorist, non-motorist, incident responder)
- Driver actions at time of crash
- Access control (i.e. no access control, partial access control, full access control)
- Non-motorist action/circumstance prior to crash
- Non-motorist location at time of crash

Specific to this study, the following could also help improve future bicycle and pedestrian analyses.

- Indicating the location of the pedestrian when struck (i.e., on sidewalk, in road, etc.), the direction of pedestrian travel, and the type of collision that occurred (i.e., motor vehicle struck pedestrian from behind, from front, from side, etc.)
- Improving the completeness of reports that are submitted. Narratives are very helpful for understanding exactly what happened during a crash, but many crash reports do not include the narrative.

Limitations of the Data

The data available for this study did not include certain roadway characteristics that would be helpful in identifying high risk locations. As noted earlier in this study, data sources that were associated with a CDOT route and milepost were generally applicable to this study. Route and milepost fields connected the data back to the CDOT highways network in a cohesive manner that enabled route event overlays (dynamic segmentation) to analyze multiple sets of attributes together. For future studies, datasets such as intersection locations, intersection control (signal versus stop control or roundabout), intersection geometry, on-street parking, access spacing, location of sidewalks to the motor vehicle travel lane (separated versus adjacent) would be helpful in identifying additional risk factors.

Appendix A

Crash Hot Spots (250 Points or more)

CDOT R1 Bicycle Pedestrian Safety Study

Appendix A - Top Crash Locations Scoring 250 Points or More

City		Location	Crash Score	What we know/What we need feedback on	Local Agency Response
Aurora	1	Colfax from Moline to Peoria (0.38M)	1000	• Are there any projects identified, in design, fully designed, or funded to address bike/ped safety at this location?	No
Lakewood	2	Colfax from Allison St to Sheridan Blvd (1.75M)	925	• Safer Main Streets funding from Teller to Sheridan that includes bike/ped improvements • This also shows up on the top MetroQuest Locations	$12 million project already underway e/o Wads. Allison does not meet warrants for a traffic signal. Fatal crash involved super-speeder motorcycle (approx +40mph over posted speed limit vs elderly driver).
Aurora	3	Colfax/Havana	675	• The TIP project is upgrading bus stops/amenities. Havana corridor study identifies some improvements for this intersection. Are there any projects designed and/or funded that could address the crash history at this location? A lot of transfers from bus lines.	COA and CDOT are working on requesting FASTER funding to rebuild this signal. The City also has a current Havana TIP project that is starting construction now that includes a bulb out on one corner.
Glendale	4	Colorado Boulevard/Mississippi	675	• Signal maintained by Denver.	
Aurora	5	Colfax/Moline	625	• Are there any projects identified, in design, fully designed, or funded to address bike/ped safety at this location?	No
Aurora	6	Colfax/Chambers	625	• Signal project underway. Does it include bike/ped improvements that might address the crash history? People crossing against green lights	CDOT had a funded signal rebuild project that was pulled due to utility conflicts. COA has a project to install a NB right turn lane. I think the signal is still planned to be rebuilt, but I don't think CDOT still has funding for this.
Lakewood	7	Colfax/Wadsworth	575	• Are there any projects identified, in design, fully designed, or funded to address bike/ped safety at this location?	Primary issue is pedestrians cross against the signal/red into active traffic. Night time impairment issues (impaired pedestrian) also a problem. Ped signals on recall x4 corners with protected-only left turns. Intersection was recently redesigned by CDOT. Most crashes are rear-end vehicle crashes NB and SB, which will be reviewed with upcoming signal timing coordination project.
Aurora	8	Colfax/Peoria	550	• Are there any projects identified, in design, fully designed, or funded to address bike/ped safety at this location?	This was just rebuilt by CDOT last year using HSIP funding to address crash patterns. I think the crash data in DiExSys through 6/30/2020 wouldn't reflect the recent changes.
Lakewood	9	Colfax/Teller	500	• Safer Main Streets funding from Teller to Sheridan that includes bike/ped improvements	$12 million project already underway.
Lakewood	10	Colfax/Sheridan	500	• Safer Main Streets funding from Teller to Sheridan that includes bike/ped improvements	$12 million project already underway, but CCD operates/maintains this intersection.
Lakewood	11	Colfax/Lamar	475	• Safer Main Streets funding from Teller to Sheridan that includes bike/ped improvements	$12 million project already underway.
Lakewood	12	Wadsworth/14th Ave	450	• Are there any projects identified, in design, fully designed, or funded to address bike/ped safety at this location?	Signal modified for WB protected-only ops, NB and SB run P.O. during most times of day. One bike fatal related to setting sun, motorist blinded by sun.
Glendale	13	Colorado Boulevard/Ohio Ave	450	• Signal maintained by Denver.	no, relatively newish approach alignment changed during pandemic.
Aurora	14	Colfax/Dayton	400	• Pending for FASTER funding. Does this include bike/ped improvements that may address the crash history?	COA and CDOT are working on requesting FASTER funding to rebuild this signal.
Aurora	15	6th Ave from Billings to Chambers (0.6M)	400	• Are there any projects identified, in design, fully designed, or funded to address bike/ped safety at this location?	No
Aurora	16	Colfax/Yosemite	375	• Are there any projects identified, in design, fully designed, or funded to address bike/ped safety at this location?	Denver's signal

CDOT R1 Bicycle Pedestrian Safety Study

Appendix A - Top Crash Locations Scoring 250 Points or More

City		Location	Crash Score	What we know/What we need feedback on	Local Agency Response
Aurora	17	Colfax/Florence	375	• Are there any projects identified, in design, fully designed, or funded to address bike/ped safety at this location? • This also shows up on the top MetroQuest Locations	No
Aurora	18	Havana/Mississippi Ave	375	• Are there any projects identified, in design, fully designed, or funded to address bike/ped safety at this location?	No, relatively newish signal. All protected only heads.
Lakewood	19	Kipling St/26th Ave	375	• Signal project in design. Does this include bike/ped improvements that might address the crash history? What is the timing of construction/implementation?	There are already e/w bike lanes. Crashes are predominantly N/S and related to approach-turn and rear-end crashes (veh vs veh). "Bike improvements" would not address the context of the crashes occurring at this intersection.
	20	Sheridan Blvd/Alameda Ave	350		
	21	Sheridan Blvd/1st Ave	350		
	22	Sheridan Blvd/84th Ave	350		
	23	6th Ave/Peoria	350		
	29	I-76 north and south of 88th Ave	300	• 3 fatalities	
	24	Colfax/Dallas St N	300		
	25	Leetsdale Drive/Forest Street	300		
	26	Sheridan Blvd/Dartmouth Ave	300		
	27	Wads/26th	300		
	28	Federal Blvd/92nd Ave	300		
	30	Parker/Iliff	300		
	31	Wadsworth Blvd from Mississippi Ave to Mexico Place	300		
	32	Hampden/Gilpin St	275		
	33	Wads/Mississippi	250		
	34	Sheridan Blvd/25th Ave	250	• There is a concept for paint and post at 25th. Looking at 17th to 26th for additional countermeasures.	
	35	Sheridan Blvd/38th Ave	250		
	36	Parker/Peoria	250		
	37	Sheridan Blvd from 8th Ave to Lakewood Gulch	250		

Appendix B

MetroQuest Survey Results Summary

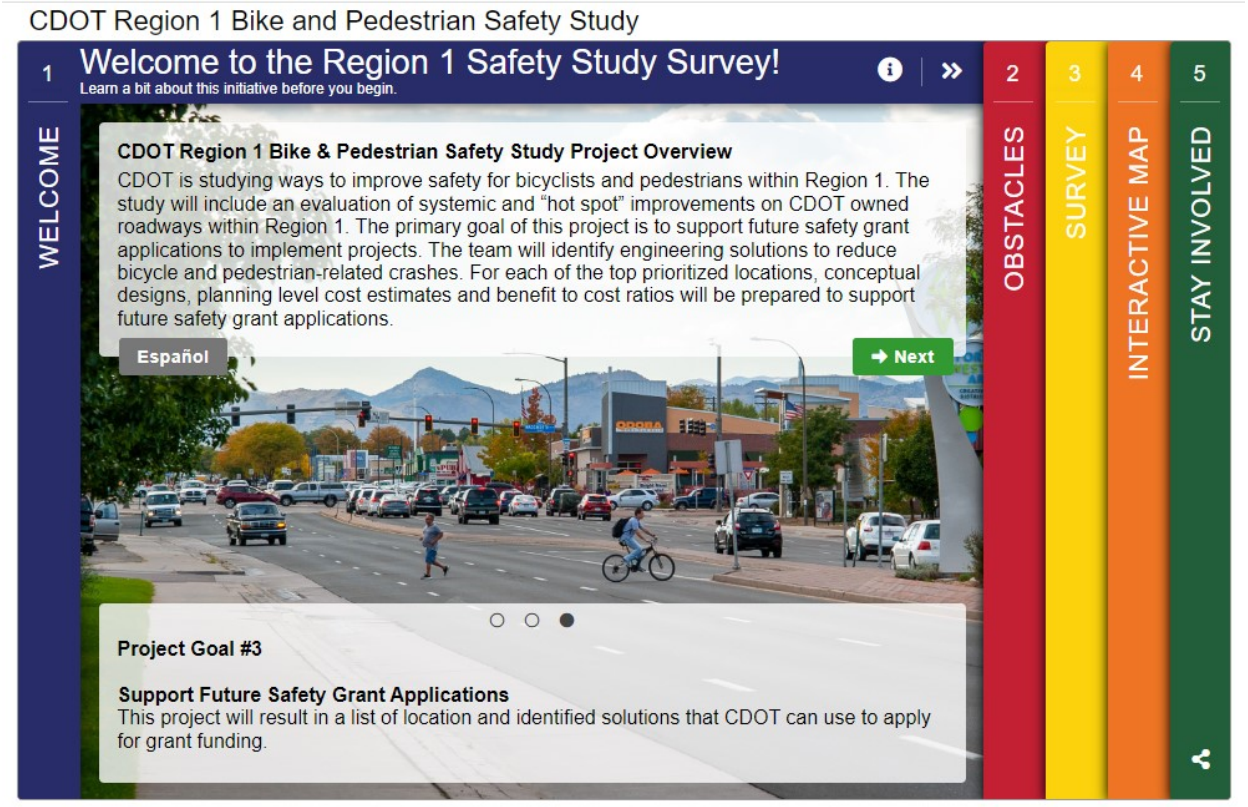
Appendix B – MetroQuest Survey Results Summary

Survey Open Timeframe & Number of Participants

The online survey was open for 6 weeks, between January 7, 2022 and February 18. 2022. 2352 people completed the English survey, and 7 people completed the Spanish survey, for a total of 2,359 participants.

Survey Organization

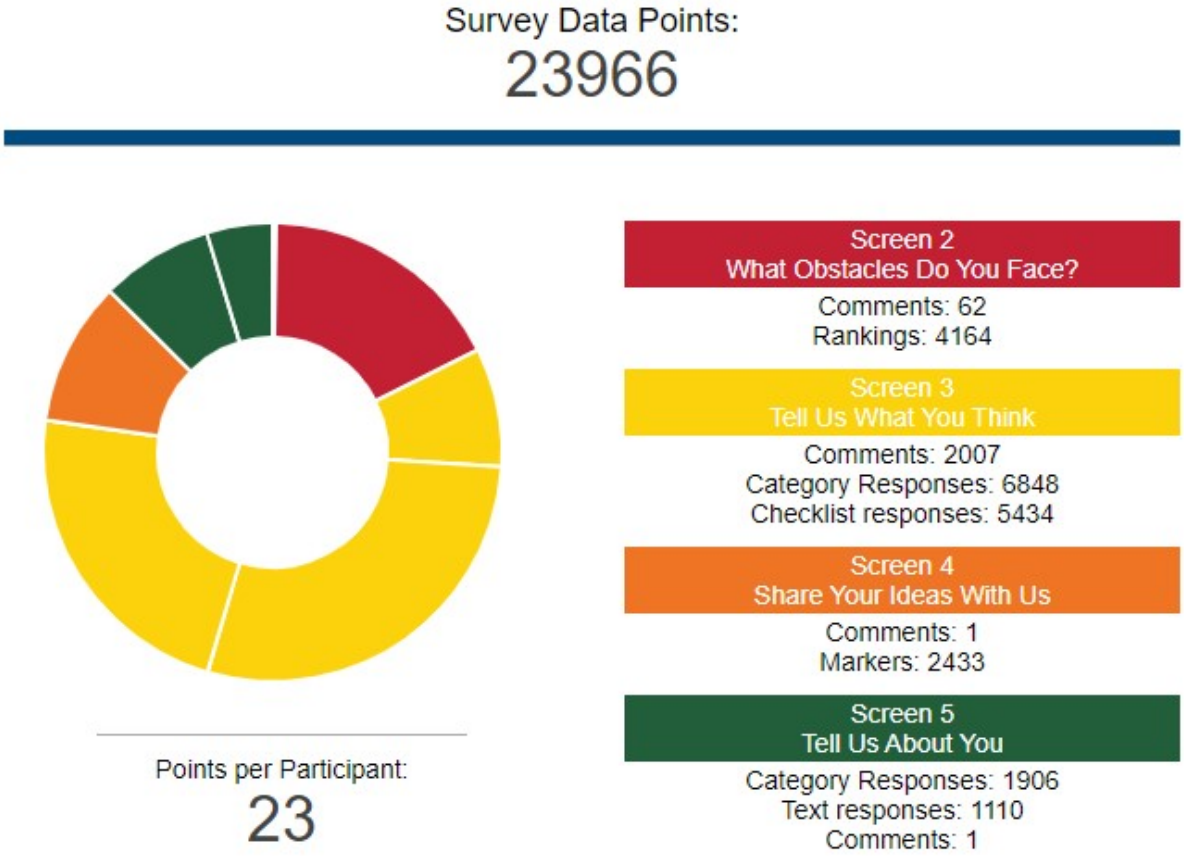
The survey used a 5-tab organizational system to gather data, with each tab asking a different set of themed questions. Survey participants were able to move back-and-forth between the tabs as needed, and their data could be changed and updated until they clicked the 'finish' button on the last survey page. On each tab, the title and information about each survey section was found at the top of the page, and a white circle information button could be used to help answer questions about how to interact with the survey.



SURVEY PARTICIPANTS WERE GREETED WITH A 'WELCOME TO THE REGION 1 SAFETY STUDY SURVEY' INTO TAB, WHICH PROVIDED AN OVERVIEW OF THE PROJECT AND SUMMARIZED THE PROJECT GOALS. THE GREEN "NEXT" BUTTON ALLOWED PARTICIPANTS TO ADVANCE THROUGH THE TABS, OR PARTICIPANTS COULD ALSO CLICK ON EACH COLORED TAB (1-5) TO BE TAKEN TO THE QUESTIONS FOR THAT PAGE.

Overall Survey Data Points

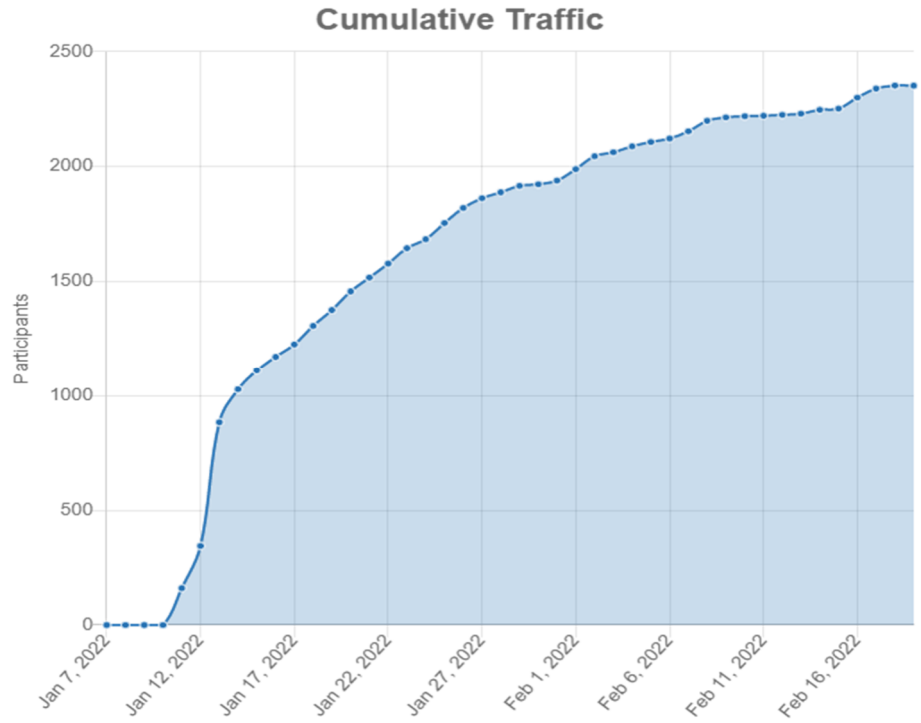
The survey participants provided the largest number of comments and responses in the middle three sections of the survey, where they were asked to provide general input and ideas, and share the obstacles they face to biking and rolling in CDOT Region 1.



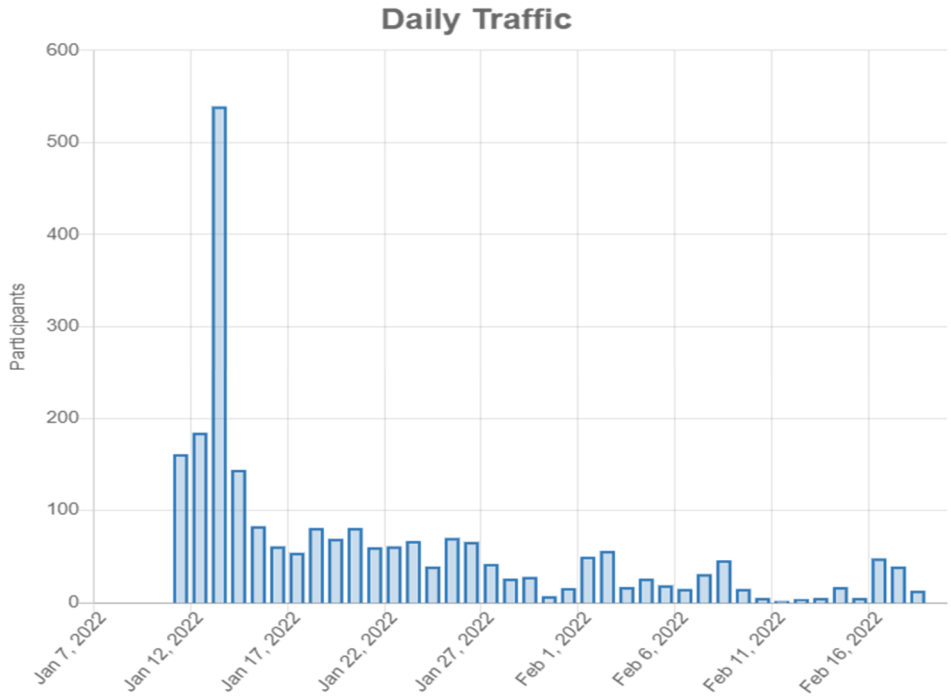
Welcome Page Summary – Tab 1

Number of Survey Visitors: 5018
Number of Survey Participants: 2359

Three-fourths (75.75%) of the survey participants completed the survey through a web interface, like their laptop or desktop computer. The other quarter of the survey participants (24.25%) completed the survey on their mobile devices.



THE CUMULATIVE TRAFFIC SUMMARY ILLUSTRATES ENGAGEMENT WITH THE SITE GREW STEADILY, PLATEAUED, AND THEN GREW SLIGHTLY TOWARD THE END OF THE 6-WEEK PERIOD IN WHICH THE SURVEY WAS OPEN



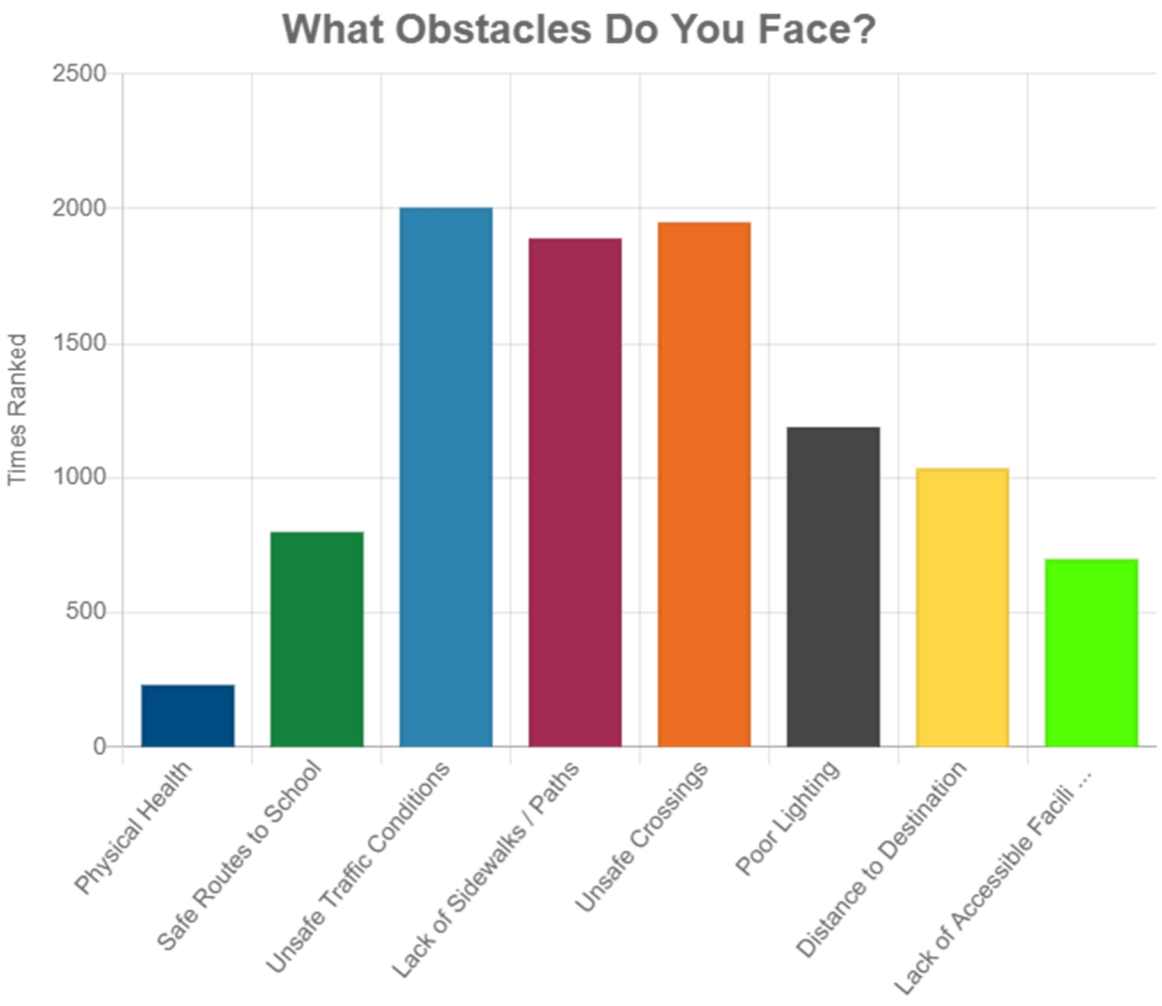
DAILY TRAFFIC SPIKES ROUGHLY CORRESPOND TO THE SURVEY LAUNCH AND TO SEVERAL SOCIAL MEDIA ADVERTISEMENTS POSTED THROUGHOUT THE PROJECT:

What Obstacles Do You Face? – Tab 2

Tab 2 of the survey asked participants to rank the obstacles they faced regarding bike and pedestrian movement and safety by their top 5. For each of the top 5 selections, participants were given the option of adding additional comments about each selection using the white 'text bubble' icon.

Top 5 Survey Responses

The highest survey responses for what obstacles are exist to safe bike and pedestrian movements within Region 1 were 'Unsafe Traffic Conditions' (2004 responses), 'Unsafe Crossings' (1950 responses), and 'Lack of Sidewalks/Paths' (1890 responses). At the next tier of concerns were 'Poor Lighting' (1188 responses), 'Distance to Destination' (1036 responses), and 'Safe Routes to School' (799 responses). At the bottom of the ranking was 'Physical Health' (232 responses).



1st Priority Obstacle: 'Unsafe Traffic Conditions'

The above chart illustrates that unsafe traffic was the highest barrier to pedestrian and bike movements and safety within Region 1. Many of the respondents pointed to the need for clarity for how roadways are divided to create distinct spaces for bikes, pedestrians, and autos. The sentiment that many of the roadways are designed for drivers and there is little signage or information posted to alert drivers to pedestrian and bike facilities was mentioned by several survey participants. In general, the idea that drivers need to be educated about what bike and pedestrian facilities exist, where they could expect to encounter bikers and pedestrians, and how to ensure they are following the safety and ettiquette rules for driving in areas with bikes and pedestrians (especially the 3' distance rule) were listed as the improvements that would make the most impact in reducing unsafe traffic conditions. Several participants noted specific roadways or intersections where they've experienced unsafe conditions, especially speeding (which was the most common noted contributor to unsafe conditions). Participants stated that the design of the roadways as wide and open encouraged speeding, regardless of the posted speed limit.

Unsafe Traffic Conditions - Summary of Participant Comments
This is a huge deterrent for walking, bike and taking transit. Better engineered roadways that control traffic speed and movement in addition to providing active transportation facilities are safer for all road users.
100th and Federal Blvd desperately needs turn signals to allow safe left hand turns in and out of neighborhood. I have almost been hit numerous times at this intersection.
I wish traffic planners got on a bike more often, to see personally how awful and scary much of the street infrastructure is
Many Denver area roads have rather high speeds- not speed limits but actual driving. Some like MLK and Central Park and Montview are built for higher than posted speeds and people feel this and drive too fast. Drivers roll through stop signs blocking bike lanes and sidewalks while waiting to turn meaning we need curb areas extended to slow traffic and lower the distance pedestrians need to cross. Places like 29th between CPB and Beeler need another stop sign to slow traffic.
The biggest issue is with existing bike infrastructure. All of the bike lanes through downtown are highly likely to result in a left/right hook. There is zero enforcement of traffic law and drivers are ignorant to right of way laws. 15th, 14th, Arapaho, and etc. All “protected” bike lanes block line of sight of cars to bicycles. I was almost hit by a cop on duty turning right across a bike lane downtown, they did not stop. Also cars don’t stop for ped crossing without flashing lights.
Cars are in a hurry, especially at busy intersections. Cell phones are a distraction.
As long as traffic rules are no longer enforced, the cars are out of control. Accidents contain no consequences or some slap on wrist is all. No cops are seen cruising my District 1. I have no idea where they all go when the leave the cop shop onW 46.
Lincoln Street between I-25 and Speer is notorious for this. The highest speeds tend to be between I-25 and Cedar. The street is designed like a highway instead of the residential arterial that it is. Many families and kids live on this street. The concrete and four lanes make drivers think they are driving on the freeway and don't slow down once they exit the on ramp. Accidents happen every week due to the speeds. We really need to slow traffic and improve this corridor for everyone.
Not enough bike lanes that separate from heavy traffic for bicyclists who are not comfortable biking very close to cars.
The CDOT controlled streets within Denver are the deadliest streets in the city. The traffic engineers who approve of their design and year after year fail to fix them ought to have their licenses revoked.
Traffic is congested and fast moving on Alameda and Downing streets and creates unsafe conditions for walkers, including students trying to get to Steele.
Far too many heavy trucks, dump trucks, 2 ton and greater pick ups hauling trailers with heavy equipment such as skid steer's, flowing past belching diesel smoke with very wide mirrors

Pervasive red light running
Historically CDOT has prioritized moving as many cars as possible at high speeds, and this has resulted in deadly, loud, unpleasant roads in my community. It's time for CDOT to prioritize the experiences of people outside cars, specifically around safety, and do so seriously.
Streets like Colorado Blvd, Colfax, and Federal that are designed as wide unsafe highways (or "stroads") slicing through neighborhoods. They need reconfiguration so that general traffic lanes are narrowed, reducing speeds, replacing car lanes with bus lanes, bike lanes, and pedestrian crossing islands.
Provide safer routes for bikes. More severe punishment for cars hitting bikers. Better education around drivers encountering bikers.
By this I mean poor repair of bicycle lanes, snow plowed into lanes, driver's using bike Lanes to park or turn
As a driver, bicyclists do not follow laws when using the street. It makes it unsafe for both parties. Bicyclists fly through stop signs and red lights. They ride 2-3 wide on 1 lane roads.
We need speed bump for all neighborhoods
Biking to work, I have to take Havana street, which has a narrow sidewalk, no bike paths, and 40mph 2 lane traffic.
#1
Way too many people speed through idledale, Kittredge, evergreen downtown. Slow em down more effectively in the towns especially with such little parking.
Crossing Speer, Colorado Blvd., Colfax, Or Federal is a nightmare. Sheridan is worse. Everyone speeds and turns even if they have a red light without looking to see if anyone is crossing.
Lack of vehicle adherence to Three-Feet requirement. Seeming road rage behavior prevalence.
Drivers are seeming to have become more risky in their behavior. Many lapses in the three-foot rule are creating more risk, as well as a seeming increase in distracted driving!
On Broadway, drivers routinely ignore the speed limits and are confused by the two-way bike lane and the traffic lights regulating left-hand turns. Drivers recklessly cross lanes to make turns. No police presence ever to deter these hazards.
High-volume is not so much a problem as high speeds and reckless driving. A high volume of vehicles could mean stopped vehicles in traffic, which are frankly very safe for me when biking or walking. It's the high speeds and reckless driving behavior that are concerning. I'd rather see a bunch of stopped traffic than clear roadways.
Unsafe to bike along Highway 7 in Thornton
Protected bike lanes and bike traffic signals crossing state roads would help a lot

16th avenue between Colorado and Detroit is a narrow two-way street with parking on both sides. Cars often speed from block to block and only a minority of vehicles come to a full stop at the stop signs. There are many children, dog walkers, and baby strollers crossing this street. 16th could be pedestrian only except for local traffic or have four ways stop signs at each intersection.

For unsafe traffic, I emphasize the latter in the brief definition - "vehicles do not yield to bikes or pedestrians". A real danger at intersections is right turning vehicles. Many do not stop at the stop bar, but stop in the crosswalk in order to have a better view of traffic, putting people in the crosswalk at risk.

More protected bike lanes and bike/pedestrian-friendly redesigns, please!

First of all bicyclists need to obey the traffic laws when riding on the streets in order to be safe. Stop at all stop signs, stop at all red lights, and ride single file. When the bicyclists do not obey the traffic laws they put everyone in danger, especially running stop signs and red lights. Bicyclists need to obey all traffic laws just the same as vehicles have to.

West Marketplace is difficult to navigate and there are lots of exit and entry points right off the main thorofare into town.

In many places, bike lanes will randomly end and cyclists are required to merge with traffic at unsafe times. Look at Hess Rd. as it exits the town of Parker. For some reason for about 200 yards the bike lane ends while traffic is traveling at around 50 mph. This also happens at Castle Pines Prkw when approaching Buffalo trail from the east. The bike lane drops and thrusts cyclists into traffic for different periods. On top of this, numerous stoplights allow for opportunities to get sideswiped.

Vehicles do not pass cyclists with adequate space (at least 3 ft) or honk, startling and triggering me

the construction of roads in general feels like it facilitates unsafe driving, such as speeding, rolling into intersections, taking turns before there is enough visibility to see pedestrians crossing, etc. And, because there are often no sidewalks or protected bike lanes, the unsafe traffic conditions directly impact my ability to bike/walk as I do not feel like the infrastructure will aid in my safety.

Cycle lanes on Heritage rd are dangerous and mostly unused.

Speed limits are too fast for safe multimodal transport. Walking and biking feels incredibly dangerous and risky on most roads

US 40 93 to Genesee, excellent repaving job (Kudos to CDOT!), however, drivers now feel like they can go faster over the speed limit which makes it now more challenging for cyclists.
Lack of cycling safety signage especially on canyon roads. Accelerate replacement of Share the Road with 3 FEET CLEARANCE.
evaluate speed limits on other bike route roads.

Fix the damn roads

2nd Priority Obstacles: 'Lack of Sidewalks/Paths' and 'Unsafe Crossings'

At the top of the reported obstacles were missing physical design elements along roadways, like sidewalks, walking paths, and designated pedestrian and bike crossings. Connectivity between nodes like residential areas and employment/retail areas, residential areas and schools, and urban areas and outdoor recreation areas were noted. Participants stated that the lack of physical facilities for bikes and peds not only made traveling by these modes less safe, few contiguous walking and biking networks between destinations made it difficult to access work, schools and daily retail needs without a car. This was especially true in formerly rural areas with new residential communities that were not connected to existing bike and pedestrian networks.

Where bike lanes exist, participants noted several areas where these networks abruptly end, forcing bicyclists to merge into fast-moving multi-lane roadways. Another unsafe feature noted by multiple participants was a lack of driver awareness of pedestrians and bicyclists at intersection right-hand turns.

Participants also stated that the lack of robust biking and walking networks contributed to a lack of driver awareness of how to be respectful and careful around multi-modal roadway users, which made them feel unsafe. It was repeatedly noted that adding dedicated and separated bike and pedestrian facilities was preferred, since these facilities felt safer and more user-friendly. Where sidewalks exist, participants made note that narrow sidewalks (that didn't even allow for two people to walk side-by-side) that were directly adjacent to traffic made it feel uncomfortable and unsafe to walk. Several notes were also made about the timing of existing crossings, and how extending times for pedestrians and bicyclists to cross the road would made it easier to walk and bike. It was also noted that flashing pedestrian crossings were preferred.

Lack of Sidewalks/Paths and Unsafe Crossings - Summary of Participant Comments
The comfort level of routes are not consistently family friendly so I chose to drive my kids when I could bike or walk.
This needs to include both signalized crossings that aren't optimized for active transportation AND insufficient controlled crossings.
Weird that after riding in PBLs, you get shunted into intersections like any other vehicle
Fewer lanes = safer crossings
100th and Federal Blvd desperately needs turn signals to allow safe pedestrian crossings. I witnessed a pedestrian get killed by a car in front of me turning left from 100th on to South bound Federal. Pedestrian had a walk signal, but the vehicle turning left also had a green light and didn't see the pedestrian. Providing clear signals that allows all traffic, pedestrian and vehicle, to cross safely must be priority!
East side of Federal Blvd between 96th and 104th needs a sidewalk.
Unsafe crossings throughout Central Park. Crossings meant to allow for safer crossing have failed... making kids feel more confident, when they're safer.
Drivers don't yield at crosswalks. Need signed reminding drivers it is state law. Plus Golden needs MOR crosswalks!
We definitely need more off-street multimodal paths, away from cars
I'd like to see more bike sensors at stop lights. Often it's inconvenient and difficult to navigate a bike to the beg button up on the sidewalk.
Denver area has some good bike infrastructure but not enough. Too much is painted lanes on otherwise busy roads. Not enough bike lane parking enforcement.

Some lights won't change for cyclists. They may have car sensors but don't pick up cyclists. This means cyclists either wait for a car, have to dismount and push the button, or go through on red when traffic clears. None of those are acceptable. Other places have walk signals that are WAY too short. 29th crossing Central Park is a prime example of that. Unless you hurry a pedestrian has to cut it close or wait through two light cycles. No good reason for that.
We need more protected bike lanes. Sharrows and painted lines do nothing to protect bikers.
Sidewalk width throughout the city is a joke. Barely ada compliant. How often do you see electric wheelchair users using the steet because of sidewalk width.
Bike paths separate from pedestrian and road traffic.
Again the light runners and Hollywood stops are gonna keep killing riders as rules are ignored. Cameras could be utilized way more often in many intersections. The round a bouts were sort of a failure as nobody knows which lane to be in so it is afree for all. Bigger vechicle wins
Bike lanes seem so rando. Not done by cyclists. Real riders quit W 32 years ago and switched to W 26 to get to Golden. Yet the $ was dumped into 32by ?? Slowly some work was done on W 23 from REI going W to Fed/Lowell i thinks. That took foreverto get that bridge over 25 done by the Aquarium. Lowell going north from 32nd to what, 88th? Still a speedway all day and worse at rush hour. i wont' even drive on Lowell anymore. All of the 1 mile sections of W 48, W50 and W52 from Lowell to Tennyson!
Dakota Ave / S Lincoln Street has an accident every single week. This is a very common walking path for people in the WWP neighborhood to walk to Natural Grocers. We worry every night when someone will be hit and killed. We need a stoplight here desperately.
The Gates Development is going to be a prime area for everyone in the neighborhood and we all want to walk there. The sidewalks between Virginia Ave and I-25 on Lincoln Street are inferior and dangerous. They are especially dangerous due to the high speeds. Bollards or other safety measures need to be installed before a family or someone walking their dog is killed. This path is well used and will be used more when the developments come in and people walk to Broadway Station Lightrail/bus stop.
In addition to crosswalks, more care needs to be placed in safe harbor islands in the middle of wide or high-speed streets and signage/signals to indicate when a pedestrian has the right of way since few vehicles seem to want to stop at even a well marked crossing.
And, quality of bike lane/path matters. Many bike lanes have shared parking, which means a bike must serve into traffic to get around parked cars,and more protected/buffered lanes are needed around high-speed streets and those that have cars frequently turning across a lane, like in downtown.
I don't see any obstacles. I think you're doing generally doing great with bike trails.
Crossing downing to Steele elementary at Dakota is unsafe. It is hard to see around parked cars and traffic is fast moving and very busy. The alternative route along Alameda is also unsafe as many car accidents happen on this street including cars that run off the road into houses. The sidewalk is extremely close to the road and it is unsafe for children.
Safer, more accessible sidewalks would increase my walking around the city.
If there are no cars at an intersection going in my direction on a bicycle I will not be given a greenlight until a car comes up and often there isno cross signal has a pedestrian that I can engage

Lack of designated bike lanes and shoulders and us being squeezed over the white line into car debris, gravel, ice and snow residue
Hampden/285 & S. University in Denver /Englewood is a disaster. Frequent red light runners, frequent glass debris in sidewalk from past crashes, when it snows the sidewalks get plowed in.
The sidewalks in Wheat Ridge are simply not ADA compliant
Crossings are unsafe because even if a beg button exists, vehicle traffic is still prioritized over the experience of those walking or biking.
CDOT should start building physically separated bike paths on or adjacent to state highways.
Extremely large crossing distances due to ridiculously wide streets, stoplights that do not detect bicycles, lack of crossing islands for pedestrians and bicyclists, lack of crosswalks - large distance between crosswalks making walking routes verylong/indirect and inconvenient. This all makes the CDOT roads massive barriers to walking and bicycling.
Poorly maintained sidewalks next to high speed traffic with no buffer (see: Arapahoe Rd), or sidewalk just ends and no longer exists. Lack of safe bikeways or bike lanes on the streets.
With the amount of people moving to Denver streets are becoming more congested making it more difficult to cross a smaller street like Knox and first
Many of neighborhood side walks are horrible. Some don't even have sidewalks
Lack of good maintenance on the C470 trail (CDOT owned)
Washington Ave and HWY 58. Cars do not stop at cross walks, they creep out into the crosswalks to see. Cars to not look for pedestrians as they use the ramps to get on highway 58.
Lack of bike lanes and bike paths often put bicyclists on the sidewalk with pedestrians.
I am a bicyclist. Sidewalks aren't part of a solution for me, and painted bike paths have their own issues (accumulated debris, snow, ice). Having a right lane simply wide enough to accommodate a bike and a motor vehicle side by side would be my preference.
Parker Road at Quincy is difficult to cross. A pedestrian/bike bridge to Cherry Creek Park would be wonderful. Thank you for considering.
Na
My neighborhood especially (East Colfax) has a couple main thoroughfares that are wide enough but there are no sidewalks or paths
US 74 has little or no paths from Morrison to Evergreen. This is a major bike and pedestrian route because of the numerous open space and mountain parks in the region. Community members in Kittredge and Evergreen have expressed concern about the unsafe conditions for access to these parks.
2
3
Not enough areas to cross where cars have to safely stop. I wish funds were given to provide those solar powered push button cross walks that don't have a stop light but a flashing light so cars see it and actually stop. Way too many people almost getting hit or never getting to cross in Morrison and Evergreen. If the crosswalk were more effective it would get used more and less people would try to dash across when cars have the right of way.

Zero sidewalks up here. Some shoulders are good for walking but not consistently. It’s built for bikes and cars and even then, not easily both.
Lack of a bike lane or path on hwy 74 between kittredge and o fallon park makes it incredibly unsafe for both the driver's and the bikers.
There are not enough pedestrian crossings across Federal and Colfax. And many times I have to cross so far without much time. The light at 13th and Federal is awful.
Many sidewalks in my area are only half size and the is a lot of over growth with trees and shrubs so I can't use the sidewalks and I have to walkin the road.
Lack of bike lanes / sufficient shoulder / cleared shoulder of debris/snow.
Need consistent intersection protocols across jurisdictions, as advocated in Controlled Intersections legislation fir 2022.
Standardize intersection protocols across the State. Currently if I ride N, S, E or W from my municipality there are different protocols, and among them they are different! The Controlled Intersection legislation during 2022 would gor far to achieve this.
Bike lanes should be cleared of snow and debris, and drivers made aware that cyclists have a right to travel in traffic lanes when bike lanes are not present or are dangerous with debris!
Unsafe speeds in town
Witness the intersection of Cherokee and Alameda, where cars race through the lights at unsafe speeds. Anyone crossing the street at this intersection is at risk.
In addition to them not being present or in poor condition, they are often far too narrow. Even pedestrians have a hard time walking side by side with narrow sidewalks, let alone pedestrians crossing in opposite directions, or bicyclists hopping onto the sidewalk to avoid unsafe road conditions.
There are no bike lanes in either direction on highway 7 from Lowell Blvd. A path or sidewalk would be heavily used, The bike lane from about 150th south ends abruptly for no treason. The bike lane on Sheridan Blvd, heading N. to Sheridan Pkwy.is full of potholes.
There is no cross walk on 17th avenue between Colorado and Steele, thus limited safe access to City Park from the south. A cross walk that has a flashing pedestrian light when activated (such as on Holly just north of Alameda) would be very helpful - perhaps at Monroe- where access from Sprouts to the Park would be direct for Jazz in the Park.
Eastbound 104th Ave at Federal. North side of104th. This pedestrian signal has never changed for me. Yes, I pushed the button. Waited through multiple light rotations, multiple times.
Pedestrian signals should be automatic (i.e. you don't have to press a button).
I don't understand why sidewalks aren't considered public infrastructure. We need a complete, safe, accessible sidewalk system and I'd love to see the city/CDOT step in and make that happen. Would love to see more bike lanes and protected bike lanes in D1, particularly that allow us to get to the other side of I-25 and to access bike paths.
Along Gartrell across E-470 to connect with the bike trail that follows E-470 towards Parker Road / Cottonwood, the Kingsgate development I think.
Please finish the bike path that follows E-470 southwest towards Parker Road near Costco.

Unsafe crossings is due to pedestrians and bicyclists disobeying traffic lights and crossings. example, running red lights, running stop signs, jay walking since they refuse to go to a intersection to cross, and crossing against the no crossing signs.
adding designated bike paths to major road ways that are separate from the main road or wider bike lanes. There are to many close calls with bicycles riding in the middle of the road and not riding on the edge of the road, which causes motorists to swerve into oncoming traffic or cause traffic backup when they refuse to move over. Sharing the road has become more of a hassle when bicyclist do not obey traffic laws and move over, ride single file. Seen too many riding double or triple up.
Not many sidewalks along the north side of E Colfax. Issues with cruising at S 1st and Colfax.
I almost always feel unsafe crossing large/busy roads, even when they have crosswalks & pedestrian symbols. Often, this is because I'm given a very short time to cross the road, or there is a very long wait until the signal allows pedestrians to cross - there's one intersection where I've given up and jaywalked after waiting 10+ minutes. Drivers turning right on red without looking for pedestrians, especially when there is a right-hand turn merge lane, is also a factor.
Similar to my other response most networks do not connect and those that do tend to cater to walkers. Lots of blind corners, speed limits, and other hazards are making the trails much less favorable to use as a function of transportation by bicycle. The addition of trails as a function of transportation rather than purely recreational would bake a commute by bike much more appealing.
Crossings along the 470 trail are often problematic. They often involve crossing streets in multiple directions. Jamaica and Yosemite both have this problem.
In the winter, snow gets plowed into the bike path and then when I am riding to school I am forced into the car lane
this is my primary concern as both a pedestrian and a cyclist. In both cases there are many destinations that are within walking or biking distance from where i live that i do not feel safe going to as there are either no sidewalks or there are no bike lanes/lack of sufficiently safe bike lanes.
unsafe crossings feel similar to unsafe traffic conditions. cars often roll into pedestrian crossings, take right or left hand turns without looking for cyclists and pedestrians, etc. there are also times where bike lanes merge into traffic or disappear around intersections and require merges that i do not feel are safe.
Ped crossings around traffic circles on Heritage rd are unsafe
West Colfax, from Heritage rd all the way to Morrison could really use cycle lanes and pedestrian paths.
We gotta get more bike paths installed everywhere. Protected bike lanes, dedicated bike paths, things that don't involve being 18 inches from cars without a physical barrier. I commute by bike, yes even in winter, and we need the bike lanes that do exist plowed so I'm not biking in ice and snow in traffic. Otherwise, I'ma get the squish one day.
SAFE Bicycle access feels incredibly lacking across all denver metro area. I want to be able to bike to any commercial location from any residential area
Many intersections lack adequate crossings, distances too far, stopping lines often ignored by motorists

1. 56th Ave/US93 (Busy and fast - hard for a cyclists to get actoss safely) 2. Rooney/Morrison (hard for a cyclist to get across during rush houror on a busy weekend.) 3. 32nd Ave/Wadsworth (can't be triggered by a bike)
Along The Lariat Loop and in between biking destinations. Also bike lanes exist for brief distances and then end and bicyclist are forced to ride on heavy trafficked roads.
Lack of pedestrian crossings.

3rd Priority Obstacles: 'Distance to Destination' 'Poor Lighting' and 'Safe Routes to School'

Below the top tier of obstacles faced by pedestrians and bicyclists were several physical improvements (Poor Lighting and Safe Routes to School), and concerns that physical distances between nodes in Region 1 make walking and biking more challenging.

Regarding physical improvements, ideas like utilizing regional trails for safe biking and walking between destinations was noted, especially since many roadways do not have biking and walking infrastructure. It was mentioned that trail amenities, like lighting and signage, would make the longer distances needed to travel along trails more appealing. However, it was pointed out that participants would prefer to walk and bike in more direct routes along CDOT roadways (rather than use trails), but they currently do not feel safe doing so due to a lack of dedicated walking and biking networks. Multiple participants noted that longer routes should be given to cars, and walking and biking routes should be given priority as the shortest distances between destinations.

Distances to destinations and safe routes to school were interlinked, with many participants noting that it's often too far for their children (and them) to bike or walk from their homes to schools or other destinations, and that where biking and walking facilities exist, they are directly adjacent to high volume roadways where cars are going very fast compared to the pace of walkers and bikers, or require crossing high-volume and wide roadways. Several participants noted that increased land use densities would help reduce the obstacle of distances between destinations being too far, and encouraged a more mixed-use approach to planning and zoning that would intermix retail, work, and schools with a variety of residential densities.

Multiple participants made note of specific locations in Region 1 where lighting is needed, and stressed the importance of lighting biking and walking routes so they could be safely used for commuting (with many commuting trips needing to begin-and-end before the sun comes up or after it sets).

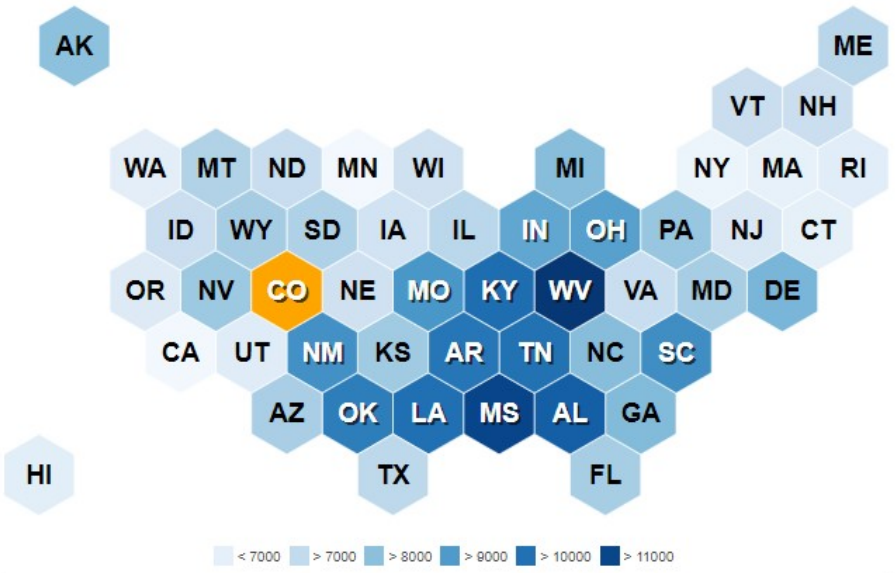
Distance to Destination, Poor Lighting, and Safe Routes to School – Summary of Participant Comments
I am an adult who bikes to schools for work, so this is a lesser priority for me, but I think all the time how scary it would be to be younger than I am and make the same treks.
The bike paths along Dartmouth are horrible and dangerous. We would benefit from having something separating the bike path from the street!
DPS bussing is based off of distance but this falls short. You can live close enough to not qualify for a bus but across multiple busy roads meaning it isn't safe for a kid to ride their bike. This defaults us to more cars on the road. Going from the west part of the Central Park neighborhood to Mcauliffe middle school in Park Hill is a prime example. I'd love for my kids to ride to school but painted bike lanes are insufficient with that traffic. So we drive. Let us bus or safely bike.

Lighting is not an issue for me, but the options provided was a poor selection of obstacle options. 1. Roads designed for cars convenience and not safety of all users, 2. drivers ignorant or laws, 3. zero enforcement strategy emboldens ignorant drivers, 4. Cycling infrastructure makes conditions less safe, 5. Pedestrian safety is a joke. been honked at in crosswalk with lights flashing. Vision zero advertising is insulting given actual effort to achieve that goal.
Lights should be required on all bicycles, difficult to see them especially at dusk. Red taillights don't show up as bright as the white headlights that some have on the front of their bicycles.
Not an issue, if its too far I take the car.
too many dark areas, or just short sections in NW Den. Dark alley exits, dark creepy places where pervs hang out.
Bike paths have lots of homeless….lights are essential for safety when practical. I've even seen drug dealing on sand creek trail.
Bike trails sure cut this down to size, but itis an issue in areas.
Walking on Alameda to Steele elementary is unsafe due to the sidewalk being so close to fast moving traffic. Over the years many cars have gotten in accidents on Alameda between Emerson and Downing, many times running into the houses across the sidewalk. The alternative is going down Dakota and across Downing which has no light, fast moving, consistent traffic and it is very hard to see as you cross due to parked cars.
Riding public transportation is difficult because of the number of transfers or the distance from the transit stop to the final destination. I would absolutely ride public transportation if it didn't triple my commute time. It would be great to prioritize increased public transport options though I know funding is a challenge.
I would only let my kids bike to school on their own if it was on a protected path away from high-speed car traffic. Drivers are so impatient and distracted these days that I don't trust any of them around my kids on bikes.
CDOT roads are massive obstacles for children walking or biking to school, a major safety concern with high speeds and inattentive drivers, lack of traffic calming and crosswalks, wide unsafe intersections. I am not a parent but this is important and I expect parents often will forbid their children from crossing CDOT roads - leading to parents needing to drive their kids, which brings more traffic and lower child independence.
Part of the issue here is zoning laws that regulate land use - much of our laws require separated uses, low density detached homes, large parking requirements which keep destinations far from sources. Legalize shops mixed with housing, and denser housing to support walkable retail and 15-minute neighborhoods where you can access all your daily needs within a quick walk or bike ride.
With it getting dark early in the si yet many neighborhoods have poor lighting making it unsafe for all pedestrians
I have none of these concerns. I feel Jefferson county is doing well.
Street lights in neighborhoods are minimal and it can be very dark with lack of visibility at night. Especially with no moon or cloud coverage.
Crossing Central Park Boulevard from Central Park West neighborhood (ie 35th) does not feel safe for my kids to get to school. In fact a child was hit at that intersection this past fall.
Not an issue but I had to choose 5

For example: the corner of Montview Ave and Quebec St by Denver School of the Arts with no left turn arrows. I'm surprised there have not been fatal crashes involving students driving or being driven to school or walking. Also people drive at 40 mph on 13th and 14th Avenues east of Colorado Blvd
There are paths that lead right up to roses without crosswalks or safe ways to cross the street.
56th Ave need more lights
Clean sidewalks of snow in winter
I commute to work and work begins at 7:30. In the winter, many of my traveled roads - within Denver city limits - are not well lit.
4
5
We live in Kittredge with Parmalee as a school. Part of the road between has a big shoulder but not all of it and there are zero places to expect to cross.
I know lighting costs money but I'd be curious how much it would improve things. At least in town and at the safer crossing spots. Solar powered lighting would be ideal and if it's ever not enough, it's not like it's worse than the current of none.
Way too far to walk as an older adult. If I can't take care of myself there will be no food at my house
Absolutely true. Bikers are asked to take deeply circuitous routes by memory - the path is long, arduous, and not obvious. They are often kept away from primary commercial centers, although that's their destination! It's hard to know where a storeis when you aren't permitted on the road the store is on (or it's unsafe to be there).
I don't have children but live close to Denver North and Brown Elementary. Sidewalks and crosswalks seem insufficient near these schools.
Bike and pedestrian-friendly neighborhoods need to be supported by better and more frequent bus service to get us to other parts of town. Denver isa big city!
There are areas that have poor lighting when dealing with bicyclists running stop signs/red lights without lights on their person or bicycle and pedestrians jaywalking or walking down middle of the street that have side walks. Again disobeying traffic laws.
adding more bike paths and crossings for children on school routes.
Lacking night time illumination even on main roads like S 1st St.
Most routes from point a to point b using the safer bike infrastructure take up to twice as long due to poor connection in bike path and lane networks. Ei: The Pinery and East Parker. Both have nice networks but to get between the two one has to go all the way to the cherry creek trail or ride the approximately one mile of Hilltop along side traffic with no room for bikes. Similar to this is the networks of Castle Pines and Daniels Park and the Meadows of Castle Rock. One must ride Santa Fe.
this would be aided if i could take more direct paths because those pathways facilitated walking/biking instead of having to take roundabout ways to travel safely due to a lack of infrastructure for bikes/pedestrians. it feels like cars have direct access prioritized and not pedestrians/cyclists which is totally backwards
R1 zoning in surrounding areas make distances needed to travel increasingly unsustainable for motorists and ped/bicycles
It is my ideal vision that all kids can transport themselves to any school safely so that they can be healthy and build independence
Maintaining bike paths along side mountain roads are expensive and dangerous to both vehicle operators and cyclists. You need to cut funds, cut them there.

4th Priority Obstacle: 'Physical Health'

Nationally, Colorado consistently ranks high in regard to physical health (see chart below, reference: https://worldpopulationreview.com/state-rankings/healthiest-states). Few participants ranked physical health as a barrier to walking and biking, however several participants commented that pollution from cars poses a risk to physical health for everyone (especially bikers and walkers), and reducing the number of cars by encouraging multimodal transportation would help reduce pollution. There was also a comment about CDOT roadways being among the highest-injury roadways in Colorado (need to verify this).



Colorado	Smoking Rate: 13.5	Obesity Rate: 23.8	Premature Death Rate (per 100K): 6,261	Physical Inactivity Rate: 18.70%	Public Health Funding per Capita: 104	Excessive Drinking Rate: 19.60%	Uninsured Residents: 8.00%	Primary Care Physicians per 100K: 256

Healthiest States 2021

However, although physical health was ranked at the bottom of the list of survey obstacles, it's worth noting that Colorado's population (and that of the entire United States) is rapidly aging, and there is projected deficit in housing and service facilities for the growing number of older members of our society. One in 7 Coloradans is age 65 or older (in 2019 data), and by 2050, this number will grow to 1 in 5. Of people over 65 who receive Medicare, over 80% have at least one chronic health disease that impacts their physical health (https://www.coloradohealthinstitute.org/blog/aging-communities-colorado). Therefore, although physical health was not listed as a significant concern for survey participants today, the need for facilities that accommodate people as they age and can no longer drive, is important, and directly linked to allowing older adults to be independent, secure, and productive.

It is also worth noting that the demographics of people who are inclined to take a survey about walking and biking are interested in that topic and more likely to be walkers and bikers themselves, which can be correlated with higher levels of health and a lower level of concern about physical health as a barrier to walking and biking.

Physical Health – Summary of Comments
In Denver, most of our high injury streets and roads are CDOT controlled. We see the most injuries here because the throughput of vehicles is prioritized over people outside of a vehicle. This vehicle-centric view needs to end.
Not an issue for me.
The terrible air quality in Denver in the summer means it's not a good idea to ride or do other physical activity outside most days
My physical health is currently ok, but threatened by the constantly polluted air thanks to our city full of highways and constant pollution from cars. In case you're not aware, electric cars do not solve this problem. Particulate pollution from tires and brakes is some of the most harmful pollution. The only solution is to drastically reduce the number of cars in our city.
This isn't a concern for me, personally, right now, but I'm aware that it could become an issue, and that it's a significant barrier for many individuals.

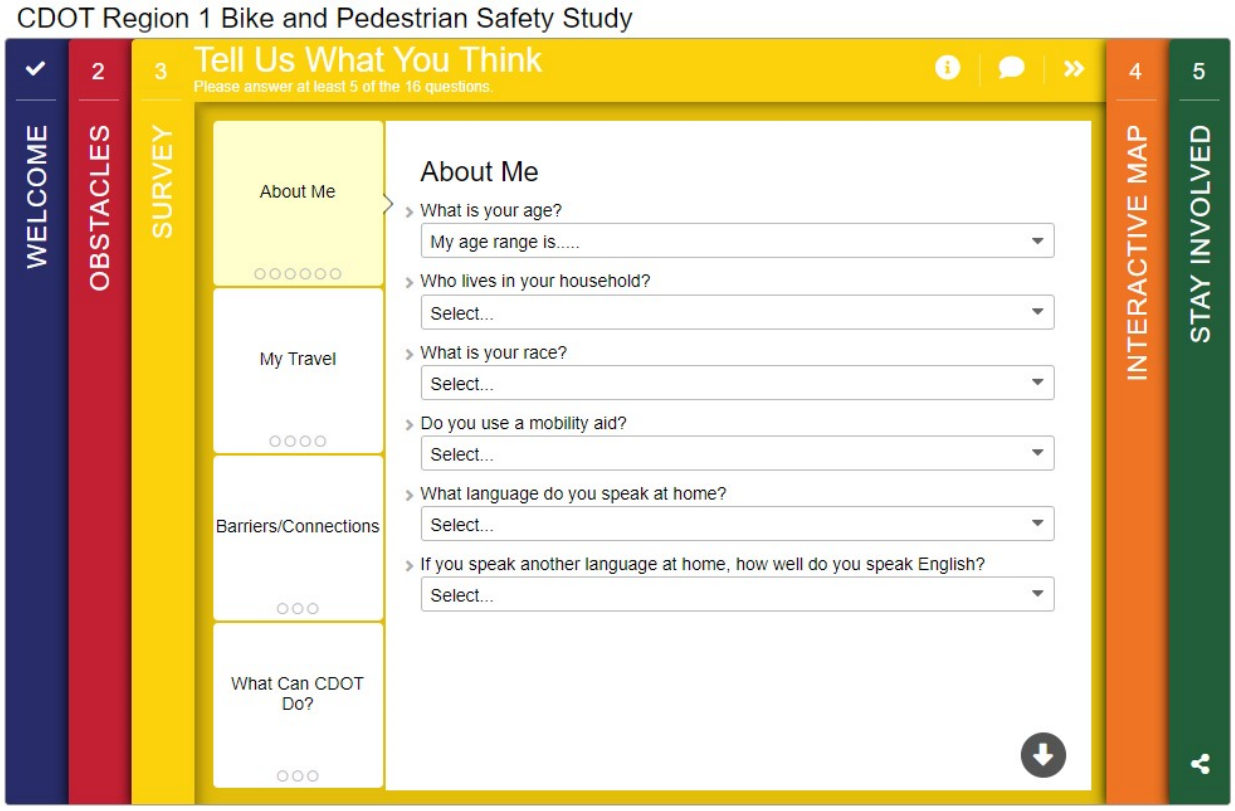
What Obstacles Do You Face: General Comments

What Obstacles Do You Face – General Comments
There are insufficient low stress bike routes that are well connected. CDOT fails to maintain the C-470 Bike Trail which is frequently unrideable in the summer as storms wash silt over the trail, and in the winter where snow and runoff freezes in the shadows created by the new sound walls which shade formerly sunny trails. CDOT needs to survey this trail for opportunities to properly drain the trail, and must plow the trail!
Cars = poor use of space, inequitable use of resources. The problem is primacy of cars, lack of viable alternatives
I only have these 3. Ideally, I'd like more bike paths or spaces where I'm not sharing the road with giant motor vehicles going very fast with distracted operators.
Tough to combine walking with cycling here. Sidewalks are great for peds but obviously not for bikes.
The lighting at intersections is insufficient.
Other obstacles: crossings are too far apart from each other, cars always exceed the posted speed limit, drivers are inattentive, snow removal prioritizes car lanes not bike lanes, not bike paths, not sidewalks.
Even where there are bike lanes or trails, having them end for random blocks, or utilities damaging them, or not having them connect to safe routes are issues. The tendency to not plow side streets or bike lanes in winter often leads to roads that are drivable, but not bikeable, or bike lanes filled with ice and snow, for weeks after.
Some of these choices I could care less about but it's not letting me move ahead with just 2 or 3 selections.
Crossing CDOT highways and arterials is the largest obstacle to. Safe biking.
Trail maintenance issues along the C470 trail: needs improved snow/ice removal, debris removal/landscaping improvements along C470 trail underI-25 in Arapahoe/Douglas County

I often use the path that runs parallel to the W line light rail. Lighting is nonexistent on stretches of the path making it dangerous to bike on as there are often unknown hazards and obstacles. These include trash, broken glass, and even people sleeping on the path, etc.
The crossing of east colfax and the high line trail of four lanes of traffic is dangerous and needs a crossing light.
I don't have five obstacles, only three
As I don't ride or walk, my comments relate to the idiot bike riders. 99% of them are discourteous and do not follow the rules of the road. While I do believe there needs to be improvement concerning the list of "obstacles" I do find that many, many bicyclists prefer not to take a designated bike path, and like to go screaming through intersections against a red light, run stop signs. Someone also needs to hold them accountable.
Distance to destination, lack of sidewalks/paths, unsafe crossings, and unsafe traffic conditions are all major obstacles. Poor lighting is rarely a concern for me, but I had to pick something as #5, and it's slightly more relevant than the other 3 options.

Tell Us What You Think – Tab 3

Tab 3 of the survey collected demographic information about each participant, and asked them questions about how they traveled, if they currently bike and walk in Region 1, and how easy they find walking and biking. Tab 3 also asked participants to share their ideas for the actions and physical improvements/routes that CDOT Region 1 could add or improve that would strengthen walking and biking in the region.

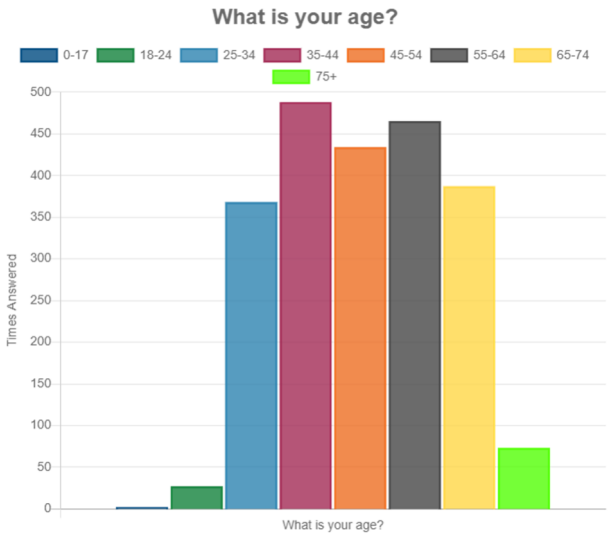


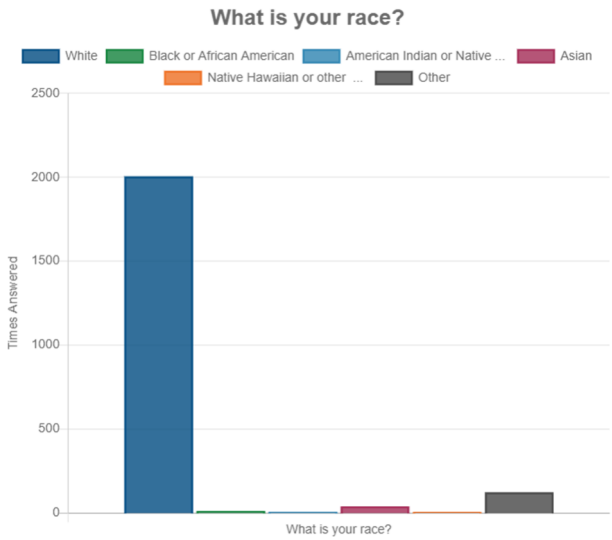
About Me – Age, Race, Household and Mobility Aid Use

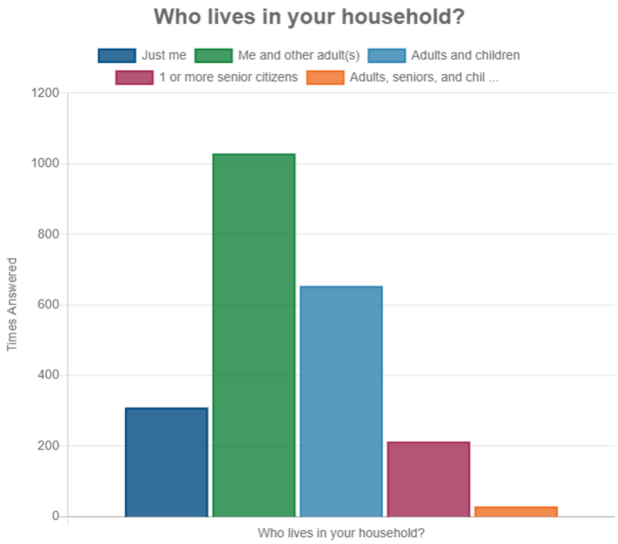
The majority of survey respondents live in households with other adults (1029 respondents) or children (653 respondents). 309 respondents live alone, and 213 respondents live with 1 or more senior citizens. The smallest number of respondents (29) live in mixed-households of adults, seniors, and children. Demographically, the overview of survey respondents reflects some differences from the overall population ages in the United States, which has a higher number of people under the age of 24 (30%), and a lower number of people from age 55-64 (over 12%, source: https://www.cia.gov/the-world-factbook/countries/united-states/#people-and-society). In the Region 1 survey, very few youth and children participated in the survey (only 2). There was a total of 1,290 people aged 25-54 who completed the survey, and many more participants aged 55-64 and 65-74 (852 people) took the survey than are demographically represented in the US bell curve. It can be surmised that a greater number of older adults in Region 1 are interested in walking and biking than the national average, based on the survey responses.

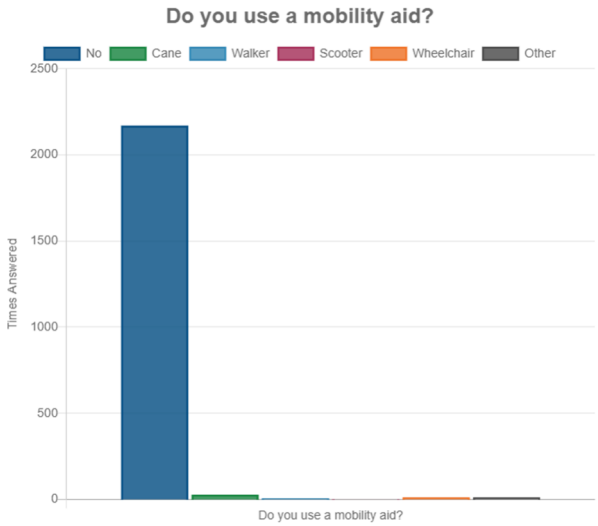
From an ethnic group perspective, the majority of participants (2005) identified as White. 'Other' was the second-largest ethnic group (123), followed by Asian (40), Black or African American (13), American Indian or Native Alaskan (8), and Native Hawaiian or other Pacific Islander (4). These numbers roughly parallel the US Census data for Colorado (https://www.census.gov/quickfacts/CO) with the exception of the percentages of survey participants who are Black or Asian. There were fewer Black survey respondents than the overall percentage of people in Colorado (4.6% of the Colorado population is Black), and there were also fewer Asian survey respondents than the overall percentage of people in Colorado (3.5%).

Of the respondents who said they used a mobility aid (only 57 of the 2352 respondents to this question said they used a mobility aid), the majority use a cane or a wheelchair (39). Although the number of people in Colorado under 65 who have a disability is 7.2%, this number is higher than the percentage of survey respondents (less than 3%) who said they required a mobility aid.



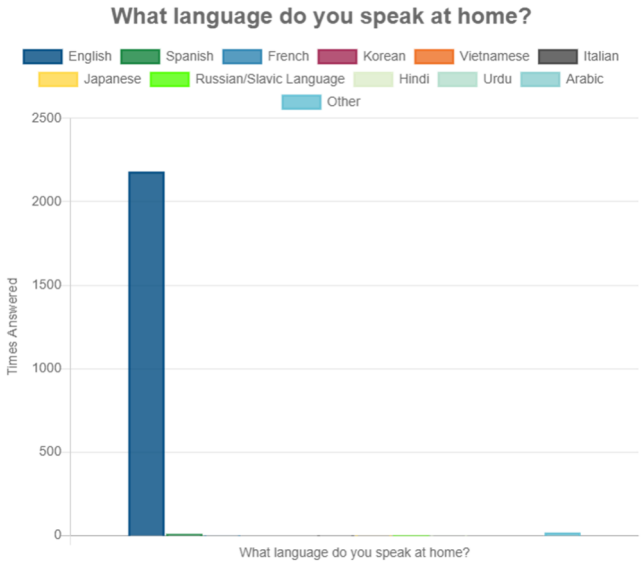


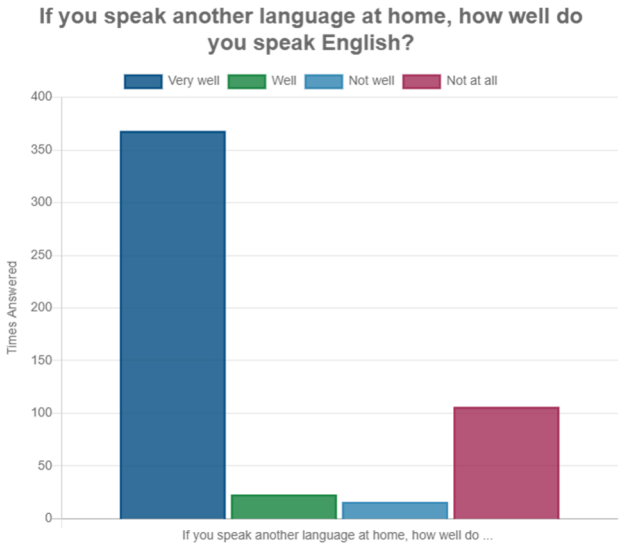




About Me – Languages

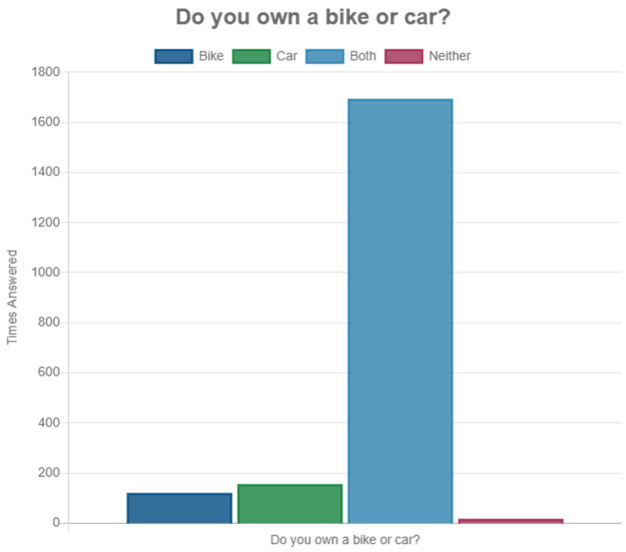
The majority of survey respondents to the English-only survey spoke English at home. Of the 32 respondents who said they didn't speak English at home, Spanish was the most common response (9), followed by Russian/Slavic (2). There were also 4 people who spoke languages like French, Italian, Japanese, and Hindi. For those respondents who did not speak English at home, the majority identified as speaking English "Very Well" but over 100 (106) people who are not English speakers at home said they speak English "Not at all."

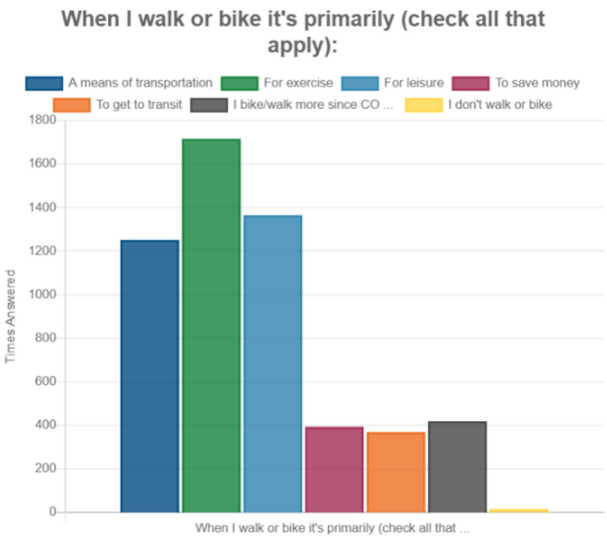




My Travel

Most survey respondents own both a bike and a car, and walk or bike for exercise, leisure, or as a means of transportation. When asked their comfort level with walking and cycling in Region 1, participants stated they are okay with cycling in traffic sometimes, but prefer bike lanes or wide shoulder. Almost 770 survey participants stated they are only comfortable walking or cycling on quiet streets or on trails away from traffic. Only 162 survey participants said they do not walk or cycle in Region 1.





Barriers and Connections

More survey respondents found it “Very Easy” or “Somewhat Easy” (1206 participants) to bike and walk in Region 1, compared to the survey respondents who found it “Somewhat Difficult” or “Very Difficult” (740 respondents). 7 survey respondents said it was neither easy nor difficult to walk and bike in the region. Given that earlier data shows that the majority of respondents bike for exercise or leisure (over 3079 respondents), it makes sense that biking and walking facility barriers are not preventing people from using the CDOT Region 1 roadways to walk and bike.

How easy or difficult is it to bike or walk in your community?
Number of Responses by Selection

	How easy or difficult is it to bike or walk in your community?	Responses
1	Very easy	295
2	Somewhat easy	911
3	Somewhat difficult	567
4	Very difficult	173
5	I don't know	7

What is your comfort level with biking (select up to 2 choices)?
Number of Responses by Selection

	What is your comfort level with biking (select up to 2 choices)?	Responses
1	I am only comfortable biking on quiet streets or on trails, away from traffic	770
2	I am OK biking in traffic sometimes, but prefer bike lanes or wide shoulders	1298
3	I am comfortable biking in traffic on almost any road, without bike lanes or wide shoulders	318
4	I do not bike in the area	162

When asked what improved condition locations for walking and biking they’d like to see in Region 1, survey participants said the following:

I would like to see improved conditions for bikes and pedestrians (select top 2):
Number of Responses by Selection

	I would like to see improved conditions for bikes and pedestrians (select top 2):	Responses
1	Across high-speed/volume roads	1331
2	On Downtown/Main Streets	376
3	At intersections	834
4	Within my immediate neighborhood	255
5	Between my community and adjacent communities	689
6	On rural roads	184
7	Other (write details below)	86

This data tells us that improvements would be most valuable along high-speed and volume roads and main streets, and that areas of connection (like the macro-scale linkages between communities and the micro-scale linkages at intersections) are another high priority for Region 1 improvement locations.

Ideas for Improvements

There were over 4700 additional ideas for how to improve connections for bikes and pedestrians. These ranged from physical improvements like detached bike lanes, wider shoulders, signage to inform and educate drivers and multi-modal trail users about walking and biking, underpasses at high-traffic crossings, and flashing crossing signals, to ideas about connections and complete biking and walking networks that link neighborhoods and nodes through a robust system for walking and biking that parallels the current vehicular connection network.

The noted ideas also included the need for legislation and education about the importance of walking and biking networks, and the ability to build these into new developments and neighborhoods as they are constructed or improved. The educational component of raising awareness for drivers of how to alter their attitudes and behaviors around pedestrian and bicycle courtesy and tolerance was a central theme, with ideas like using signage to post cyclist and vehicular etiquette and expectations, and either lowering of vehicular speeds and/or greater policing of known speed zones. The idea of changing driver's license tests to include questions related to safe driving around bicyclists and pedestrians was also noted as a means to raise awareness of walking/biking for drivers, and increasing the fuel tax to provide a funding source for bike and pedestrian improvements was mentioned as a way to install more connected networks.

Anther common theme among survey respondents was the desire to invest in larger bike and pedestrian infrastructure improvements like underpasses and overpasses that help separate travel modes when crossing high-volume roadways, roundabouts to allow for shorter and safer bike and pedestrian crossings at intersections, and a preference for dedicated and separated spaces for people to walk and bike that are wide enough to accommodate multiple bikers and walkers at once. Globally, survey respondents repeated the need for more robust and connected biking and walking facilities, stating specific examples of existing facilities that are inadequately wide, not separated from auto traffic, not painted/maintained, or which abruptly end with no warning and no connections between destinations. The desire to "complete the network" was a universal rallying cry among survey respondents who were asked for their improvement ideas. Many survey respondents noted specific gaps in the network, but the universal theme when describing gaps was the isolation felt by neighbors who live in communities that are very walkable and bikeable within their borders, but who do not have walking and biking facilities that connect them to transit, schools, grocery stores, and the larger regional network.

When describing the facilities they'd prefer, the survey respondents pointed to elements like flashing lights at roadway crossings, and features like bike boxes at intersections to remind drivers that bike lanes are not turn lanes. The most common facility improvement noted by respondents was a desire for separated and/or buffered bike/pedestrian and auto facilities, and a move away from bikeable shoulders.

Maintenance of bike facilities was also noted by survey participants, with respondents expressing concerns about both existing maintenance practices not keeping current bike and pedestrian facilities clear of debris and regularly painted, and worries that future installed facilities will not have proper maintenance. A need to have a dedicated maintenance budget for current and future biking/walking improvements was noted.

Broadly, the following categories summarize the most-mentioned survey respondent categories for improvement, and some specific examples given within each idea category that were repeated by multiple survey respondents:

Improvement Idea 1 - Connect the walking and biking multimodal network, beginning with connecting the missing links in existing facilities: As active users of the existing biking and walking networks, the survey respondents were very aware of gaps in the current system and their negative impacts on both current and potential future walking and biking network users. Although the expressed goal was to significantly grow the walking and biking network beyond its current scale, there was also a desire to begin with the current 'missing links' in the existing network. Some specific examples of how to connect the existing network are:

- Prioritize connections across large barriers that divide the network, like large (greater than 2-lane) highways.
- Ensure that filling in the network connections starts by linking people to the things they need regularly, like transit stations, grocery stores, schools, and parks.
- Where possible, require new developments to help complete the existing network by installing dedicated bike lanes and/or widened and improved shoulders (dedicated bike lanes preferred) as part of their improvements.
- An important part of the existing network are sidewalks. Prioritize making sidewalks accessible, ADA compliant, and wide enough for two people to walk side-by-side. Separated sidewalks that are buffered from auto traffic are preferred. Pay particular attention to ensuring adequate sidewalk ramps exist at all intersection.

Improvement Idea 2 - Create dedicated, separate, and protected bike lanes: The survey participants were overwhelmingly in favor of dedicated and protected bike and pedestrian paths that were buffered from auto traffic and roadways. The comment of 'paint is not protection' was mentioned many times in response to the idea of painting sharrows on the roadways, which was not a preferred amenity option. Where space constraints exist that do not allow for separated 'green' buffers like tree lawns or planted areas, survey participants said they would prefer larger and more permanent slim barriers, like jersey barriers and bollards. There was a strong preference for permanent, solid barriers between drivers and walkers and bikers.

Improvement Idea 3 - Reduce auto speeds with traffic calming measures: Survey participants stated that fast-moving traffic was one of the most significant barriers to feeling safe while walking and biking in Region 1. Some survey respondent ideas for reducing auto traffic speeds included the following:

- Speed bumps
- Speed tables
- Narrower streets
- Delayed traffic signals for bikes and peds

- Photo radar
- 15mph speed limits on residential streets
- More traffic cameras at intersections
- Traffic islands
- Longer timing for yellow/red lights
- More electronic signs warning people of their speeds
- Rumble strips between car lanes and bike lanes

Improvement Idea 4 - Control vehicular movements at intersections to reduce crashes: Many survey respondents pointed to the higher accident rates at intersections, and the dangers of intersection designs that favored cars over walkers and bikers. Intersections were one of the most recommended areas for improvement. Some specific ideas for how to make intersections safer included the following:

- Red light cameras/speed cameras
- No right turns on red
- Parking removed adjacent to intersections (the width of preferred no-parking areas ranged from 10' to 30' away from the intersection, to allow drivers and walkers/bikers to see each other from further away)
- Stop/controlled intersection treatments at all intersection
- Adjust signal timing to give bikers a 'head start' at intersections

Improvement Idea 5 - Make walking and biking a higher priority than driving along CDOT-managed roadways: Survey respondents want CDOT place a greater emphasis on walking and biking than driving, which they viewed as being the opposite of how CDOT currently manages their Region 1 network. The ideas that survey respondents felt would reflect a great emphasis on walking and biking improvements along CDOT roadways included the following:

- Reduce the amount of right-of-way given to cars only, and use the reclaimed space for dedicated transit lanes, protected bike lanes, and wider sidewalks
- Where traffic speeds are too high or more non-auto amenity space is needed, make the roadways narrower by reducing lane widths or reducing the overall number of travel lanes (or both)
- Reduce crossing distances at intersections
- Design streets with pedestrians and bikes FIRST (rather than beginning with how the roadway will work best for cars
- Prioritize the most vulnerable roadway users first (walkers and bikers)
- Design physical biking and walking infrastructure that is robust and long-lasting (rather than temporary painted bikes lanes/sharrows)
- Reduce the amount of free on-street parking
- Although separated bike lanes are preferred, if on-street facilities are designed, ensure the shoulders are larger than the minimum
- Create 'bike superhighways' that are on-par with the existing auto travel roadways
- Add bicycle signals to existing and new traffic lights
- Install grade separated crossings across major thoroughfares or wide streets
- Time the length of lights for slow-moving walkers and bikers (many crossing times are too short for older people or people with disabilities or mobility limitations)
- Provide dedicated traffic lanes for buses
- Install separated 'bicycle boulevards' that are exclusively for walkers and bikers

- Require property owners to build ADA complaint sidewalks on their property
- Make programming at stop lights favor pedestrians (traffic signal priority for pedestrians)

Improvement Idea 6 - Provide consistent maintenance for existing walking and biking facilities: Survey respondents stated that existing walking and biking facilities are not consistently maintained and pose safety risks to bikers and walkers. The overall preference of survey respondents was to have biking and walking routes receive equal levels of maintenance to existing roadways. The specific examples of how walking and biking networks could be more consistently maintained were:

- Pay more attention to trail connections between jurisdictions after storms or other weather events that create detritus on trails
- Eliminate frozen puddles or frozen water areas by documenting the location of standing water areas and creating better drainage in these areas
- Remove obstructions like trees, vines, rocks, and snow on or across sidewalks and bike paths
- Create a routine cleaning/repair schedule for current sidewalks and bikeways
- When a trail or sidewalk is ending, create signage for detours or to alert walkers and bikers that the trail/sidewalk is ending
- Police summer tubing along the South Platte River to ensure the trails are kept clear
- Don't pile snow or debris so that it blocks ADA ramps

Improvement Idea 7 - Raise driver awareness of walkers and bikers: Survey participants noted that a large number of drivers do not seem to be aware of walkers and bikers or the safety/etiquette rules that apply to driver/walker/biker interactions. The following are survey participant ideas for how to improve driver awareness along CDOT Region 1 roadways

- Signage that highlights driver rules in regard to walkers and bikers
- Lighted crosswalks
- Greater driver education on things like safe distances between cars and bicyclists/pedestrians – public information campaign for drivers that educates them about topics like bicyclists rights, safe travel spaces between autos and bikes sharing the same roadway, and "door awareness" campaigns that shine a spotlight on the risk of injury to bikers and walkers from parked cars opening their doors into ROW traffic
- Flashing lights for pedestrians on busy roads
- Better enforcement by PD when drivers violate laws that put bikers and pedestrians at risk
- Education about green bikes lanes
- More signs and roadway labels to remind drivers that cyclists and pedestrians are in the area
- Signage altering drivers of bike lanes and to look out for bikers during right-hand auto turning movements

Improvement Idea 8 - More robust amenities along biking and walking facilities: Participants felt that walking and biking would be an easier choice if there were a larger number of amenities located along CDOT Region 1 roadways. Some examples of survey respondent amenity ideas included:

- Lighting
- Signage
- More bike specific traffic signals
- High comfort bike facilities
- Heated sidewalks and bike lanes

- Pedestrian/bike bridges & tunnels under busy roads
- Parking garages with secure bicycle storage
- Automatic detection of bicycles at signalized intersections
- Intersection bulb outs
- Vendor/brand-funded vending machines with tubes and other amenities along paths
- Accessible buttons for crossing lights that are easy for bikers to reach
- Green bike boxes at intersections
- Roll on/roll off access for light rail
- Bike parking and places to lock bikes (especially at businesses and destinations)
- Bathrooms/toilet facilities along bike paths/trails
- Designated signs for cycling lanes
- Expanded bike directions on Google and other map/directional apps to include tips from riders about preferred routes
- Bike sensors at traffic crossings
- Mid-block HAWK signals
- Reflective centerlines and/or edgelines along paths
- Permission to allow bikes on the backs of buses when outside racks are full
- 8' sidewalks to bus stops and transit
- Where walking and biking paths end, provide signage directing walkers and bikers to where to find the next path
- Ebike charging stations, bike parking at businesses and destinations)

Improvement Idea 9 - Dedicated policing of trails and walking paths to increase safety: Survey participants stated they were uncomfortable being approached or delayed by unhoused campers along trail networks, and felt that bike theft crimes have risen during the past few years. They felt that more consistent policing of trails would make them feel safer and reduce their risks as users. Multiple participants stated they no longer feel safe using trail and walking networks that have large, unhoused populations occupying spaces adjacent to the trail or on the sidewalks.

What Can CDOT Do?

The replies to 'What Can CODT Do?' mirrored the answers to the question of how to improve conditions for bikes and pedestrians. The top responses (by category) to this question were:

Complete & Connect the Network – Install improvements that make dedicated bike lanes and multi-modal paths a complete network within the region. At both a macro and micro scale, connect communities, amenities, destinations, workplaces and services with walking and biking networks. Ensure bike racks and bike facilities on buses and transit, and have secure bike parking available at businesses, transit stops, parking areas and other accessible destinations. As a first priority, identify needed connections across major highways and other significant barriers, and install safe multi-model connections in these areas right away.

Separate Bike and Ped Facilities - Design and install more barriers and separations between bike/pedestrian facilities and auto facilities. Ideas for this include separated and buffered bike lanes and sidewalks, pedestrian and bike underpasses/tunnels and overpasses, and enhancement of trail networks so they function as parallel travel facilities for bikes and pedestrians. The overall preference was to physically

separate biking a walking from auto traffic with separated facilities that protected vulnerable walkers and bikers from fast-moving or high-volume roadways. Bike lanes raised to the height of sidewalks are preferred.

Make Biking and Walking a Systemwide Priority - Prioritize walking and biking facilities when planning for new communities or new roadway improvements. Build standards into the planning and regulatory processes that require biking and walking improvements, and partner with municipalities to coordinate the installation and maintenance of biking and walking networks and fund missing gaps in the system through opportunities like grants or incentives. Adopt complete streets for all future CDOT Region 1 projects, regardless of current roadway demands or levels of current bike and ped volumes. Make biking and walking have equal priority to driving, and allocate adequate funding for a connected

and user-friendly biking and pedestrian network that is equal to that of autos. In the near-term, shift funding away from highway expansion projects to a focus on installing protected bike lanes and sidewalks. When faced with issues of increased congestion, prioritize getting people out of cars by growing the walking and biking network (rather than increasing the roadway capacity). Consider a marketing campaign within CDOT that emphasizes "We Value Bikes and Pedestrians!"

Ensure Adequate Maintenance - Dedicate funds, personnel and equipment to maintaining both existing and planned biking and walking facilities. Maintain sidewalks and bike paths to the same level as roadways – plow them for snow and ensure they have a dedicated/funded inspection and maintenance schedule.

Improve the User Experience - Make the biking and walking facilities more user-friendly and high-comfort by installing signage, maps, lighting and other amenities that make them functional, safe, and appealing. Where bike and pedestrian paths cross intersections or roadways, install flashing lights and painted crosswalks, or use underpasses and overpasses to allow bikers and walkers to safely avoid crossing wide or high-volume auto corridors. Have bike boxes at intersections. Provide attractive and easy-to-use signage that directs people from walking and biking facilities to destinations and amenities (including distances and travel times). Design maps that illustrate how the larger and smaller biking and walking trails interconnect and can be accessed, and standardize the signage messaging for bikeway networks that span multiple municipalities.

Encourage Driver Etiquette, Awareness and Education & Increase Policing Along Roadways/Trail Networks – Take driver speeding along roadways with multi-modal biking and walking facilities seriously, and ticket drivers for speeding and not yielding to walkers and bikers. Post signage alerting drivers to walkers and bikers, and include a driver awareness section in the Colorado driver's exam. At intersections, create bike boxes and stripe/raise intersection crossings to make pedestrian and bike movements more visible. Consider legislation and enforcement of distracted driving. For trail networks with a history of unhoused populations camping along the trail, increase policing to ensure safe spaces for walkers and bikers. For roadways, install speed cameras, and ticket speeders or drivers at fault in driver-bike/ped crashes.

Reduce Auto Speeds with Multi-Modal 'Complete Street' Improvements to Prioritize Pedestrian/Bike Safety – Rethink corridors across Region 1 so they're safer and more welcoming to multimodal travel. Reduce the number of auto travel lanes, and replace them with dedicated transit lanes, separated bike paths, and protected/separated sidewalks. Use bump outs and other traffic calming features at intersections, and be willing to redesign and/or lower speed limits along city streets and densely populated areas.

Communicate and Engage with Community Members During Visioning, Planning, and Design – Work collaboratively with communities to prioritize improvements that are meaningful to them, and reach out to communities to better understand user experiences of roadways, trails, and sidewalks. Incorporate qualitative measurements that document how safe and comfortable people feel along CDOT Region 1 managed roadways, and use this data to prioritize improvements that will make walking and biking more

comfortable for users. Work with communities to amend zoning laws to make connected networks of sidewalks and trails a priority.

Increase Internal and External Funding for Bike/Ped Improvements – Allocate funds for bike and pedestrian improvements at higher internal CDOT levels, and also provide additional funding to land use agencies and other partners to fund pedestrian and bike safety/comfort improvements. Invest in multimodal networks, understanding that raising bike and pedestrian levels of service up to those of auto service will require higher levels of funding for separated bike paths and sidewalks (and may mean fewer funds are available for roadway expansions).

Develop Safety Marketing Campaigns and Public Service Announcements to Increase Driver Awareness of Walkers and Bikers – Invest in billboards and clever advertisements that raise awareness and understanding of how drivers should interact with bikers and walkers.

Where Would You Most Like to See Bike or Pedestrian Connections on or Across CDOT Roads?

There were many specific examples of locations where survey respondents would most like to see bike or pedestrian improvements along Region 1 CDOT roads, but the common thread among survey respondents was the desire to prioritize these improvements where crash data indicates a need.

Where locations were noted, the following area themes emerged:

Downtowns and Community Centers – Participants wanted more pedestrian and bicycle connections in the more urban centers of Region 1, including smaller connections between neighborhoods within the larger Denver metro area.

Schools and Workplaces – Many survey respondents commuted regularly to work and for daily trips, and they advocated to make corridors between neighborhoods and major employment centers more complete and connected. Survey participants with school-age children stated they would like complete routes from their communities to local schools, and pointed out that currently there are significant network and safety gaps that prevent them from allowing their children to walk/bike to school.

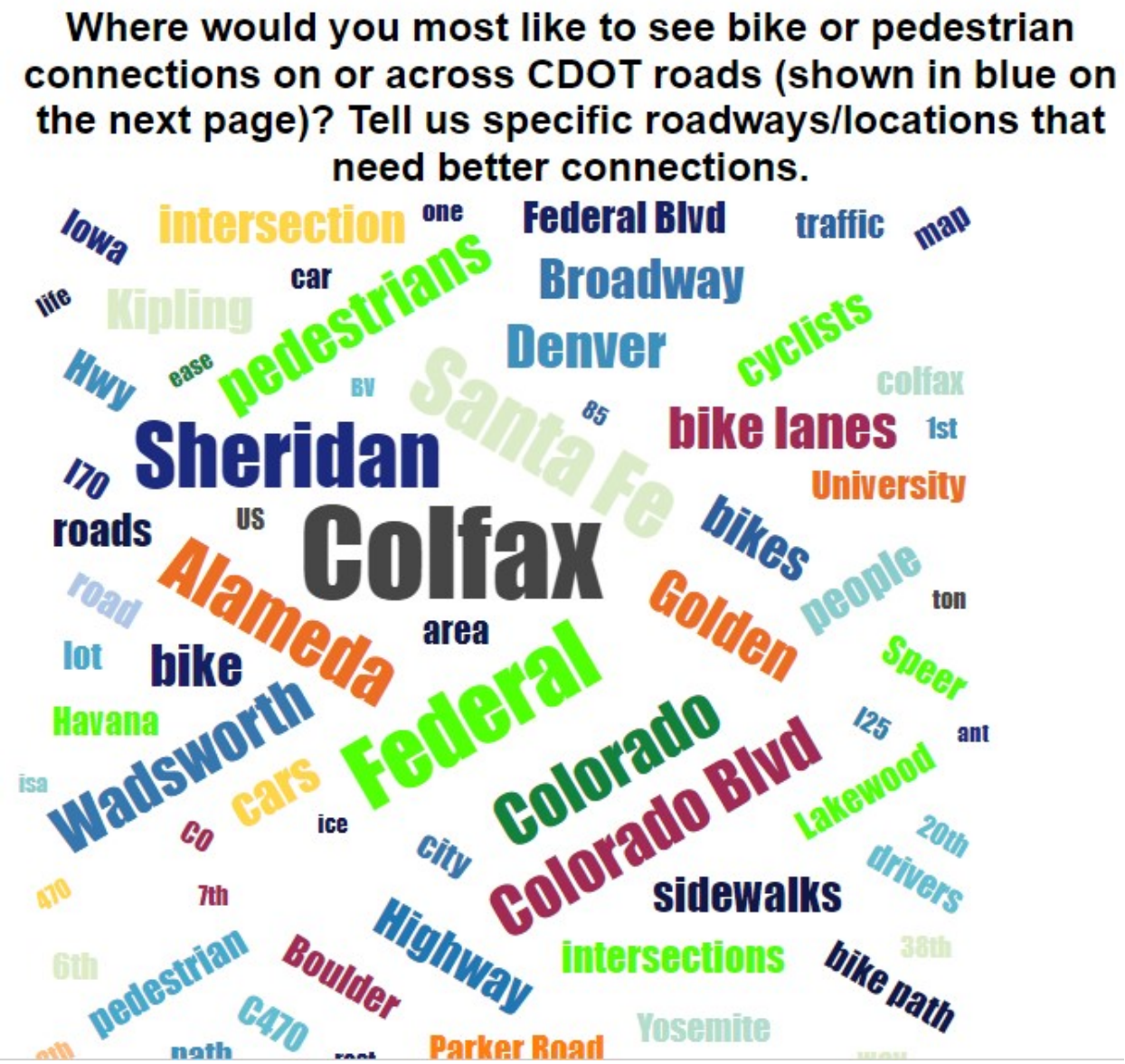
Intersections of Major Roadways – Participants highlighted the need to create safe crossings at the intersections of major high-volume CDOT roadways, or where CDOT roadways intersected with other significant roadway networks. Traffic speeds were noted as a major barrier to pedestrian and bicycle crossings, and there was a desire to separate pedestrian and bicycle traffic from auto traffic at major roadway intersections (with raised facilities or underground tunnels/underpasses).

At Entrances to Communities and Large Development Areas – Participants noted that connections across CDOT roadways are needed at the entrances to communities/developments like Central Park. It was noted that many (especially new) residential communities are disconnected from walking and biking networks due to CDOT roadway barriers and unsafe crossings.

At Connections to Parks, Trails, Open Spaces and Recreation Areas – Survey participants noted that more pedestrian crossings are needed in locations that provided access to open space and recreational amenities like the Cherry Creek Trail. Denver metro residents also noted gaps in the walking and biking networks between neighborhoods and parks.

In High-Crash Areas – Prioritize pedestrian and bike connections/improvements in locations with high crash numbers. Use the available data to help prioritize where to begin.

Along Corridors Classified as 'Urban' – Consider starting improvements along roads like Colfax, Colorado Boulevard, 6th Avenue, Santa Fe, Havana Street, Parker Road, etc. that pass through urban areas and are barriers to walkers and bikers.



What CDOT Route Would You Most Like to See Space Added for Bikes and Pedestrians?

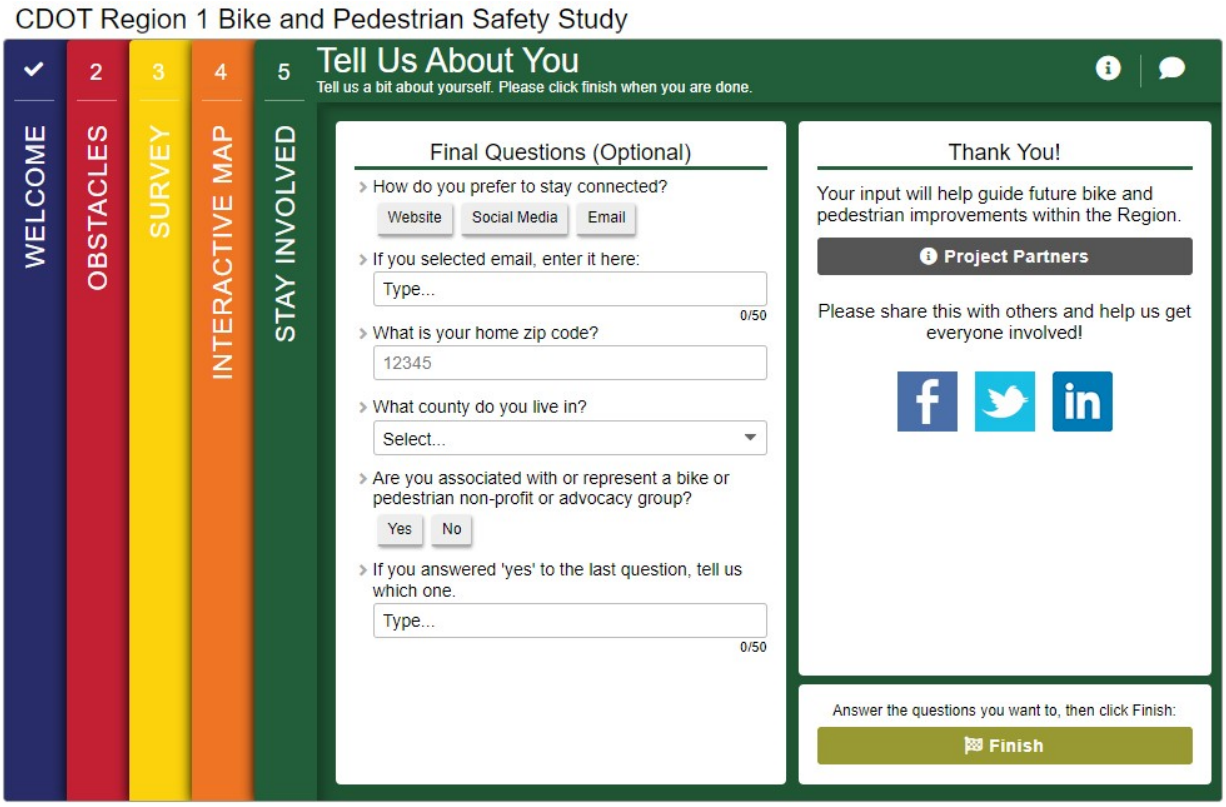
Most of this data was gathered in the mapping tab (tab 4), but several key routes were mentioned repeatedly by survey participants:

- 120th Avenue
- 13th Street
- 14th Street
- 15th Street
- 20th Avenue
- 20th Street
- 23rd Avenue
- 26th Avenue

- 32nd Avenue
- 33rd Avenue
- 44th Avenue
- 6th Avenue
- 72nd Avenue
- 7th Street
- Alameda
- Arapahoe
- Baseline
- Bear Creek Canyon
- Belleview
- Brighton Street
- Broadway & Lincoln
- Bromley Lane
- Buchtel Avenue
- C470
- Central Park Boulevard
- Chambers Road
- Clear Creek Canyon
- CO 119
- Colfax (East & West Colfax)
- Colorado Boulevard
- County Line Road
- Dartmouth
- Downing Street
- Evergreen Parkway
- Federal
- Gun Club Road
- Hampden/285
- Highway 105
- Highway 40
- Highway 50
- Highway 7
- Highway 72
- Highway 85
- Highway 93
- Huron Street
- I-70 Corridor
- I-76
- Indiana
- Iowa
- Johnson Road
- Ken Caryl
- Kipling
- Leetsdale
- Littleton Boulevard
- Lookout Mountain Road
- Lowell
- McIntyre
- Mississippi
- Monaco
- Montview
- Morrison Road
- North Pinery Parkway
- Old Golden Road
- Peoria
- Quebec
- Quincy
- Santa Fe
- Sheridan
- Simms
- South Parker Road/Main Street in Parker
- South Windermere
- Speer Boulevard
- Tejon
- Tower Road
- University
- Virginia Avenue
- Wadsworth
- Ward Road
- Weir Gulch
- Yale
- York Street
- Youngfield

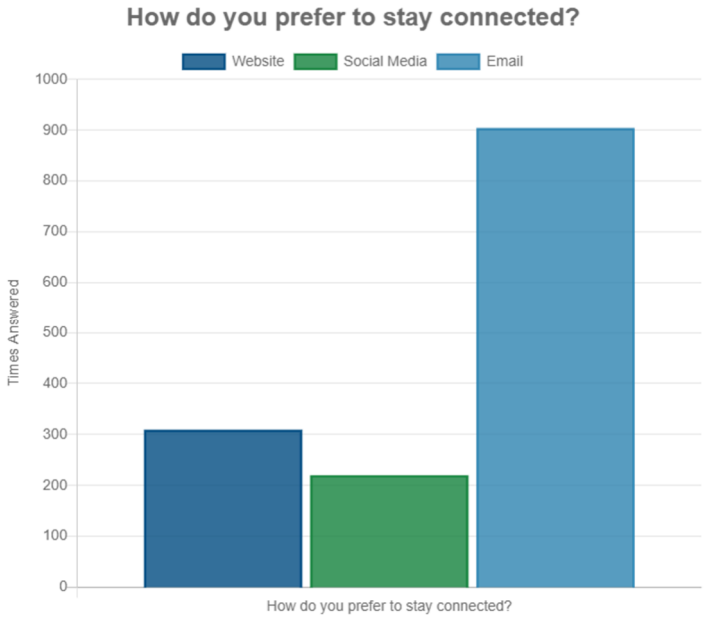
What CDOT route (shown on the next page in blue) would you most like to see space added for bikes or pedestrians? Tell us the specific section of the route you would like to bike or walk on.

Tell Us About You – Tab 5



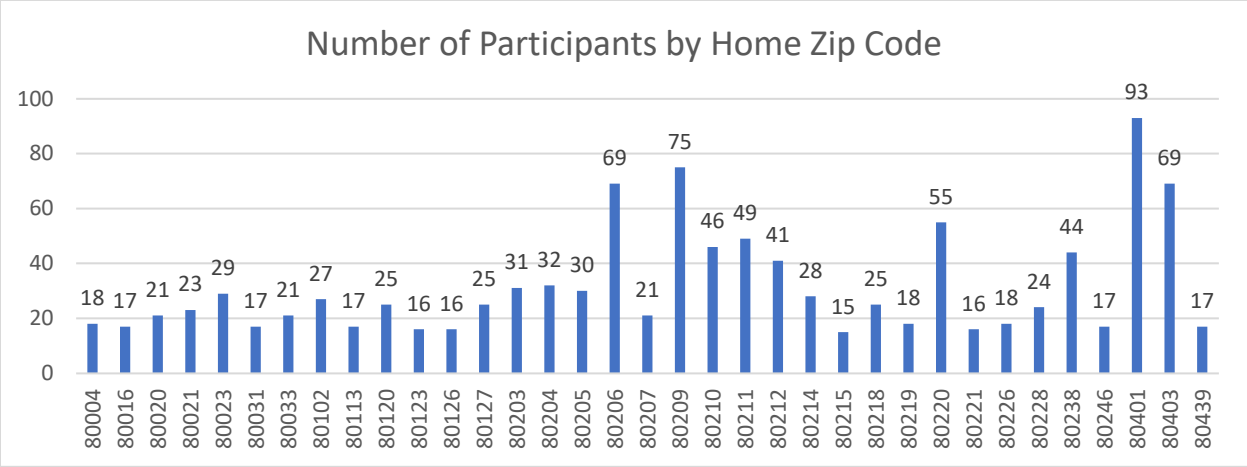
How Do You Prefer to Stay Connected?

Email is the most preferred method for staying connected to survey participants, followed by the project website and social media.



What Is Your Home Zip Code?

Participants identified their home zip code. Those zip codes that were noted 15 times or more are shown below.



A full list of home zip codes and the number of responses is included below.

Zip Codes	Count
80002	10
80003	5
80004	18
80005	14
80007	13
80010	12
80011	7
80012	7
80013	10
80014	10
80015	8
80016	17
80017	1
80018	3
80019	1
80020	21
80021	23
80022	2
80023	29
80026	3
80027	1
80030	3
80031	17

80033	21
80038	1
80102	27
80103	2
80104	7
80108	10
80109	5
80110	3
80111	10
80112	11
80113	17
80116	1
80117	1
80118	1
80120	25
80121	5
80122	11
80123	16
80124	12
80125	8
80126	16
80127	25
80128	12
80129	14

80130	13
80134	14
80135	1
80136	9
80137	1
80138	7
80202	14
80203	31
80204	32
80205	30
80206	69
80207	21
80209	75
80210	46
80211	49
80212	41
80214	28
80215	15
80216	2
80218	25
80219	18
80220	55
80221	16
80222	13

80223	13
80224	12
80226	18
80227	7
80228	24
80229	2
80230	3
80231	14
80232	5
80233	3
80234	4
80236	3
80237	7
80238	44
80239	3
80241	6
80246	17
80247	14
80249	2

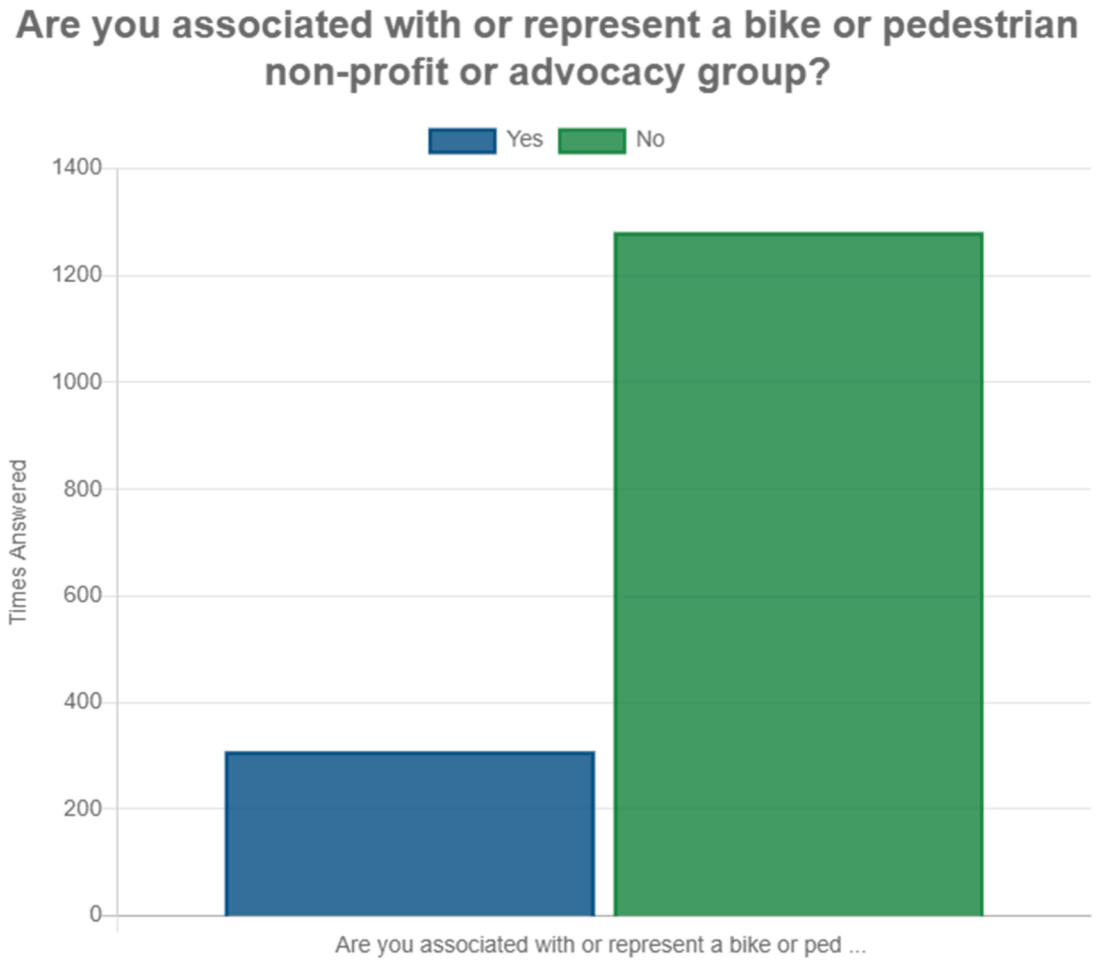
80260	2
80301	1
80302	3
80303	2
80304	6
80305	2
80315	1
80324	1
80401	93
80402	1
80403	69
80433	1
80436	1
80439	17
80453	1
80457	7
80465	8
80475	1
80491	1

80498	1
80501	2
80503	1
80504	3
80513	1
80516	2
80601	13
80602	9
80614	1
80621	1
80640	3
80904	1
80906	1
80921	1
81212	1
89403	1
89439	1
89516	1

What County Do You Live In?

Item	Count
Adams	58
Arapahoe	109
Boulder	20
Broomfield	22
Clear Creek	1
Denver	519
Douglas	80
El Paso	3
Elbert	1
Fremont	1
Jefferson	329
Larimer	1
Park	1
Weld	5

Are You Associated With or Represent a Bike or Pedestrian Non-Profit or Advocacy Group?



If You Answered 'Yes' to the Last Question, Tell Us Which One

Answer
Bicycle Colo, Wheat Ridge Active Transportation
LBAT
Wheat Ridge Active Transportation Advisory Team
PeopleForBikes
Lakewood Bicycle Advisory
MBAC
Denver Bicycle Lobby. YIMBY Denver.
Denver Bicycle Lobby
Denver Bicycle Lobby
Bicycle Colorado
Bicycle Colorado and Bike Jeffco
Denver Mayor's Bicycle Advisory Cmte
Denver Bike Lobby
Bike Jeffco
Denver Bike Lobby
Denver Bike Lobby, Denver Streets Partnership
Bicycle Colorado
Denver Bicycle Lobby
Denver Bicycle Lobby
Denver Bicycle Lobby

Bicycle Colorado	Bicycle Colorado
Bike Jeffco	Bicycle Colorado
Vibrant Littleton	Bicycle Colorado
Bicycle Colorado	COMBA, Bicycle CO
PeopleForBikes	Bicycle Colorado
Broomfield Bikes	Denver Streets Partnership
Bike	Colorail
Bicycle Colorado	People for Bikes
Golden Optimists Bicycle Recycle Program	Bicycle Colorado
Bicycle Colorado	Bicycle Colorado
COMBA	Bicycle Colorado
All of the bike advocacy groups.	Avout Racing Juniors Cycling
Bike Walk Golden	Denver Streets Partnership, Bicycle Colorado, DBL
Bicycling Colorado	Lakewood Bicycle Advisory Team
Bicycle Colorado	Bicycle Colorado
6202 Cycling	Wheels of Justice cycling
Bicycle Colorado	Bicycle Colorado
Bicycle Colorado	COMBA
Bicycle Colorado	Bicycle Colorado, Bicycle Douglas County
BikeStreets	Denver Streets Partnership, just joined
Bicycle Colorado	Imba, adventure cycling
Bicycle Colorado	Bicycle Colorado
Bicycle Colorado	Modern Market Racing Team
Bicycle Colorado	Team Evergreen, Bicycle Colorado
Bicycle CO	Bicycle Colorado
Bicycling Colorado, Adventure Bicycling,	Denver Mayor's Bike Advisory Committee
OUTspokin' Bike Club	Mayors Pedestrian Advisory Committee
Bicycle Colorado	Polar Planet, an adopter of Weir Gulch thru DPR
Bicycle Colorado	Bicycle Colorado
Bicycle colorado	BikeJeffco,TeamEvergreen,SocialClimbers, BicycleCo
Bicycle Colorado	Member of bicycle colorado
Bicycle Colorado	Bicycle Colorado
Bicycle CO	Bicycle Olorado
BICYCLE COLORADO	n/a
Bicycle Colorado	Bicycle Colorado
Bicycle Colorado	Colorado Tandem Club, Bicycle Colorado
Boulder Mountainbike Alliance & Bicycle Colorado	Bicycle Colorado
Denver bicyclists lobby	Bicycle Colorado
Colorado Bicycle Policy Team	Bicycle Colorado
a member of Bicycle Colorado	Bicycle Colorado
Bicycle Colorado	People for Bikes

Exploryst	COMBA
West Line Corridor, Cranmer-Hilltop Civic Assoc	On email list for People for Bikes and CO bike
Bicycle Colorado	Bike Colorado member
Vision Zero.Bike Den.Bicycle CO.Den Strt. Prtnrshp	I am a member of Team Evergreen bicycle Colorado
Village Idiots	Denver Streets
I'm not, but would like to be!	Bicycle Colorado
Denver Bike Lobby & Bicycle Colorado	Bicycle Colorado
Denver Streets Partnership / Bicycle Colorado	Bicycle Colorado
Bicycle Colorado	American League of Bicyclists
Bicycle Colorado	People for Bikes
Bicycle colorado	Bicycle Colorado
Team Evergreen	Bicycle Colorado
Bicycle Racing Assoc of Colorado	Regis MTB team
Bicycle Colorado	Golden Optimist Bicycle Recycling Program
bicycle colorado - Comba	altitude multisport club
bicycle colorado	Bicycle Colorado
Bicycle Colorado	Colorado Bicycle Association
bicyclecolorado.org	Racing Team
Team Evergreen	Bicycle Aurora
Denver Streets Partnership	bicycle colorado
Bicycle Aurora, Bicycle Colorado	Golden Optimists Bicycle Recycle Program
Bicycle Colorado	Bicycle Colorado
Bicycle Colorado	Bicycle Colorado, Bike Jeffco, Bike Dougco
Bicycle Colorado	Bicycle Colorado
Team Evergreen	Bicycle Colorado
Lincoln/Broadway RNO	Bicycle Colorado
Pedestrian Dignity	Bicycle Colorado
Bicycle Colorado	Bicycle Colorado
Bicycle Colorado	Team Evergreen
Bicycle Colorado	Active Transportation Advisory Team (Wheat Ridge)
Bicycle Colorado	Bicycle Colorado / People for Bikes
Bicycle Colorado	Bicycle Colorado
Bicycle colorado	Bicycle Colorado
Bicycle Colorado (member)	donor to Bicycle Colorado
Bicycle Colorado, League of American Bicyclists	Bike Friendly Arvada
Freedom Flight Foundation	Bicycle Colorado
Bicycle Colorado	Bicycle Colorado
Bicycle Colorado / Denver Street Partnership	OSI Racing
Lakewood Bicycle Advisory Team	Bicycle Colorado
Bicycle Colorado	Bicycle Colorado
Thornton Bicycle Advocacy, Bicycle Colorado	Bicycle Colorado

Bicycle Colorado
Bicycle Colorado, Groove Subaru cycling, DBCC
Bike Streets
Mayors Bike Advisory Committee
Bicycle Colorado
Bike Friendly Arvada
Denver Bicycle Lobby
Bicycle Colorado
Pedestrian Dignity
Bicycle Colorado
Colorado Cycling
Bike Colorado, Rails to Trails
Bicycle Colorado
Bicycle Colorado
adventure cycling, and bike colorado
BroomfieldBikes.org
Bicycle Colorado
Bicycle Colorado member
Bicycle Colorado
Bicycle Colorado
TAC with CDPHE
Highlands Ranch Cycling Club
Rocky Mountain Cycle Club
Bicycle Colorado
Bicycle Colorado
Active Transport, Chicago and Rails-to-Trails
Outspokin
Highlands Ranch Cycling Club

Village Idiots Cycling Club
Bike Jeffco, Inc
Bike Jeffco
Bicycle Colorado
Lone tree volunteer recreational commitee
Golden Bicycle Cruise
Bicycle Colorado
Bicycle Colorado
Cuchara Mountain Trails Alliance
Colorado Cross-Disability Coalition
Bicycle Colorado
Bicycle Colorado
Sustainable Wheat Ridge
Bicycle Colorado
Bicycle Colorado
Bicycle Colorado
Bicycle colorado
Bicycle Colorado
Colorado Cyclist
Denver Streets Parnership
Bikes Together and Bicycle Colorado
Bicycle Colorado, Denver Streets partnership
Bicycle Colorado
Rails to Trails
Bike Colorado

Survey Sharing (if people shared the survey, how did they share it?)

Facebook Share – 15 shares

Twitter Share – 9 shares

Appendix C

Planning Level Cost Estimates for Top Locations

Project Cost Estimate

CDOT Region 1 Safety Study

Location: ***E Colfax Ave (US 40) from Moline St to Peoria St***

Project Number: N/A

County :

Sub-Account Number: N/A

Route: US 40

Region: 1

Begin MP:

Project Description

End MP:

Add median island between Nome Street and Oswego Street with a pedestrian refuge. Install HAWK signal with advanced stop markings and signs.

PROJECT MAJOR CONSTRUCTION ITEMS

Major Construction Items	Unit	Unit Cost	Quantity	Cost
202-00195 Removal of Median Cover	SY	$16	312	$5,029.44
610-00030 Median Cover Material (Concrete)	SF	$14	5,850	$84,123.00
202-00203 Removal of Curb and Gutter	LF	$10	565	$5,864.70
609-21020 Curb and Gutter Type 2 (Section II-B)	LF	$38	1,180	$44,415.20
608-00010 Concrete Curb Ramp	SY	$216	21	$4,542.09
202-00010 Removal of Tree	EA	$500	6	$3,000.00
202-00220 Removal of Asphalt Mat	SY	$9	280	$2,618.00
				$0.00
				$0.00
				$0.00
				$0.00
				$0.00
				$0.00
				$0.00
				$0.00
Estimated Cost:Remaining Major Items			5.00%	$7,479.62
		Estimated Cost Major Items		**$157,072**

Traffic Items	Unit	Unit Cost	Quantity	Cost
627-30410 Preformed Thermoplastic Pavement Marking (Xwalk-Stop Li	SY	$11	280	$3,116.40
614- Hawk Beacon	LS	$150,000	1	$150,000.00
				$0.00
				$0.00
				$0.00
				$0.00
			A. Total Major Items	**$310,188**

		% Major Item Cost		Category Cost
B-1	**Drainage/Utilities**	10.0%	**of A**	$31,019
B-2	**Earthwork**	2.0%	**of A**	$6,204
B-3	**Environmental**	5.0%	**of A**	$15,509
B-5	**Miscellaneous**	5.0%	**of A**	$15,509
B-6	**Mobilization**	10.0%	**of A**	$31,019
B-7	**Removals/Resets**	5.0%	**of A**	$15,509
B-8	**Roadway**	2.0%	**of A**	$6,204
B-9	**Signing and Striping**	5.0%	**of A**	$15,509
B-10	**Traffic/Lighting/ITS**	7.0%	**of A**	$21,713
B-11	**Traffic Control/Detour**	15.0%	**of A**	$46,528
B-12	**Structural - Minor Structural/Walls**	0.0%	**of A**	$0
B-13	**Bid Force Accounts**	10.0%	**of A**	$31,019
B.	**TOTAL OF BID CONSTRUCTION ITEMS**			**$545,932**
C-1	**Force Account - Misc.**	5.0%	**of B**	$27,297
C-2	**Minor Contract Revisions**	5.0%	**of B**	$27,297
C.	**TOTAL BID CONSTRUCTION & FORCE ACCOUNT ITEMS**			**$600,525**
D-1	**Design Engineering**	16.7%	**of C**	$100,000
D-2	**Construction Engineering**	15.0%	**of C**	$90,079
D.	**TOTAL PROJECT DESIGN AND CONSTRUCTION**			**$790,604**
E-1	**Right-of-Way**	0.0%	**of D**	$0
E-2	**Utilities**	5.0%	**of D**	$39,530
E.	**TOTAL PROJECT DESIGN AND CONSTRUCTION**			**$830,134**
F.	**CONTINGENCY**	25.0%	**of D1,D2,E1,E2**	$57,402
G.	**TOTAL PROJECT COST ESTIMATE**			**$888,000**

Project Cost Estimate

CDOT Region 1 Safety Study

Location: ***E Colfax Ave (US 40) and Havana St***

Project Number: N/A

County :

Sub-Account Number: N/A

Route: US 40

Region: 1

Begin MP:

Project Description

End MP:

Add curb extensions in the northwest and southeast corners and queue jumps for eastbound and westbound buses. Evaluate the feasibility of passive pedestrian detection. Install retroreflective tape to signal backplates. Add stop line and turn arrow pavement markings.

PROJECT MAJOR CONSTRUCTION ITEMS

Major Construction Items	Unit	Unit Cost	Quantity	Cost
202-00019 Removal of Inlet	EA	$1,500	1	$1,500.00
202-00220 Removal of Asphalt Mat	SY	$50	122	$6,077.78
202-00190 Removal of Concrete Median Cover Material	SY	$20	2	$31.11
202-00203 Removal of Curb and Gutter	LF	$30	247	$7,410.00
202-00200 Removal Of Sidewalk	SY	$35	47	$1,629.44
202-00206 Removal of Concrete Curb Ramp	SY	$55	27	$1,503.33
202-00210 Removal of Concrete Pavement	SY	$55	0	$0.00
304-06000 Aggregate Base Course (Class 6)	TON	$75	0	$0.00
403-00721 Hot Mix Asphalt (Patching) (Asphalt)	SY	$45	49	$2,210.00
403-34841 Hot Mix Asphalt (Grading SX) (100) (PG 64-22)	TON	$100	0	$0.00
603-01240 24 Inch Reinforced Concrete Pipe (CIP)	LF	$190	100	$19,000.00
604-16005 Inlet Type 16 (5 Foot)	EA	$6,000	3	$18,000.00
608-00000 Concrete Sidewalk	SY	$80	0	$0.00
608-00010 Concrete Curb Ramp	SY	$180	85	$15,220.00
609-21020 Curb and Gutter Type 2 (Section II-B)	LF	$45	221	$9,945.00
Estimated Cost:Remaining Major Items			5.00%	$4,126.33
		Estimated Cost Major Items		**$86,653**

Traffic Items	Unit	Unit Cost	Quantity	Cost
614-00011 Sign Panel (Class I)	SF	$35	35	$1,225.00
613-10000 Wiring	LS	$2,000	1	$2,000.00
614-XXXXX Pedestrian Detection System	LS	$28,000	1	$28,000.00
614-70225 Trafffic Signal Face (12)(12)	EA	$1,900	2	$3,800.00
627-30405 Preformed Thermoplastic Pavement Marking (Word-Symbol)	SF	$30	589	$17,670.00
627-30410 Preformed Thermoplastic Pavement Marking (Xwalk-Stop Lin	SF	$20	296	$5,920.00
			A. Total Major Items	**$145,268**

		% Major Item Cost		Category Cost
B-1	**Drainage/Utilities**	10.0%	**of A**	$14,527
B-2	**Earthwork**	2.0%	**of A**	$2,905
B-3	**Environmental**	5.0%	**of A**	$7,263
B-5	**Miscellaneous**	5.0%	**of A**	$7,263
B-6	**Mobilization**	10.0%	**of A**	$14,527
B-7	**Removals/Resets**	5.0%	**of A**	$7,263
B-8	**Roadway**	2.0%	**of A**	$2,905
B-9	**Signing and Striping**	5.0%	**of A**	$7,263
B-10	**Traffic/Lighting/ITS**	7.0%	**of A**	$10,169
B-11	**Traffic Control/Detour**	15.0%	**of A**	$21,790
B-12	**Structural - Minor Structural/Walls**	0.0%	**of A**	$0
B-13	**Bid Force Accounts**	10.0%	**of A**	$14,527
B.	**TOTAL OF BID CONSTRUCTION ITEMS**			**$255,672**
C-1	**Force Account - Misc.**	5.0%	**of B**	$12,784
C-2	**Minor Contract Revisions**	5.0%	**of B**	$12,784
C.	**TOTAL BID CONSTRUCTION & FORCE ACCOUNT ITEMS**			**$281,239**
D-1	**Design Engineering**	53.3%	**of C**	$150,000
D-2	**Construction Engineering**	15.0%	**of C**	$42,186
D.	**TOTAL PROJECT DESIGN AND CONSTRUCTION**			**$473,425**
E-1	**Right-of-Way (10,000sf @ $6/sf)**	0.0%	**of D**	$0
E-2	**Utilities**	5.0%	**of D**	$23,671
E.	**TOTAL PROJECT DESIGN AND CONSTRUCTION**			**$497,096**
F.	**CONTINGENCY**	25.0%	**of D1,D2,E1,E2**	$53,964
G.	**TOTAL PROJECT COST ESTIMATE**			**$551,000**

Project Cost Estimate

CDOT Region 1 Safety Study

Location: ***S Colorado Blvd and E Mississippi Ave***

Project Number: N/A

Sub-Account Number: N/A

Region: 1

Project Description

County :

Route: US 40

Begin MP:

End MP:

Control box and wiring to update left turn signal phase to protected with pedestrian call.

PROJECT MAJOR CONSTRUCTION ITEMS

Major Construction Items	Unit	Unit Cost	Quantity	Cost
				$0.00
				$0.00
				$0.00
				$0.00
				$0.00
				$0.00
				$0.00
				$0.00
				$0.00
				$0.00
				$0.00
				$0.00
				$0.00
				$0.00
				$0.00
Estimated Cost:Remaining Major Items			5.00%	$0.00
		Estimated Cost Major Items		**$0**

Traffic Items	Unit	Unit Cost	Quantity	Cost
614- Control Box & Wiring	LS	$10,000	1	$10,000.00
				$0.00
				$0.00
				$0.00
				$0.00
				$0.00
		A. Total Major Items		**$10,000**

		% Major Item Cost		Category Cost
B-1	Drainage/Utilities	0.0%	of A	$0
B-2	Earthwork	0.0%	of A	$0
B-3	Environmental	0.0%	of A	$0
B-5	Miscellaneous	0.0%	of A	$0
B-6	Mobilization	0.0%	of A	$0
B-7	Removals/Resets	0.0%	of A	$0
B-8	Roadway	0.0%	of A	$0
B-9	Signing and Striping	0.0%	of A	$0
B-10	Traffic/Lighting/ITS	0.0%	of A	$0
B-11	Traffic Control/Detour	0.0%	of A	$0
B-12	Structural - Minor Structural/Walls	0.0%	of A	$0
B-13	Bid Force Accounts	0.0%	of A	$0
B.	TOTAL OF BID CONSTRUCTION ITEMS			**$10,000**
C-1	Force Account - Misc.	0.0%	of B	$0
C-2	Minor Contract Revisions	0.0%	of B	$0
C.	TOTAL BID CONSTRUCTION & FORCE ACCOUNT ITEMS			**$10,000**
D-1	Design Engineering	0.0%	of C	$0
D-2	Construction Engineering	15.0%	of C	$1,500
D.	TOTAL PROJECT DESIGN AND CONSTRUCTION			**$11,500**
E-1	Right-of-Way (10,000sf @ $6/sf)	0.0%	of D	$0
E-2	Utilities	0.0%	of D	$0
E.	TOTAL PROJECT DESIGN AND CONSTRUCTION			**$11,500**
F.	CONTINGENCY	25.0%	of D1,D2,E1,E2	$375
G.	TOTAL PROJECT COST ESTIMATE			**$12,000**

Project Cost Estimate

CDOT Region 1 Safety Study

Location: ***E Colfax Ave (US 40) and Moline St***

Project Number: N/A
County : Arapahoe

Sub-Account Number: N/A
Route: US 40

Region: 1
Begin MP: 305.23

Project Description
End MP: 305.23

Provide curb extensions on the northeast and southwest corners of the intersection to reduce pedestrian crossing exposure. Replace the existing traffic signal and lighting and provide flashing yellow arrow left turn signal phases. Update the curb ramps and provide signing & striping upgrades.

PROJECT MAJOR CONSTRUCTION ITEMS

Major Construction Items	Unit	Unit Cost	Quantity	Cost
202-00010 Removal of Tree	EA	$600	3	$1,800.00
202-00019 Removal of Inlet	EA	$1,086	2	$2,172.26
604-19105 Inlet Type R L 5 (5 foot)	EA	$10,000	2	$20,000.00
202-00206 Removal of Concrete Curb Ramp	SY	$33	45	$1,492.20
608-00010 Concrete Curb Ramp	SY	$216	45	$9,733.05
202-00203 Removal of Curb and Gutter	LF	$10	500	$5,195.00
609-21020 Curb ans Gutter Type 2 (Section II-B)	LF	$38	747	$28,221.66
202-00200 Removal of Sidewalk	SY	$50	300	$14,913.00
608-00000 Concrete Sidewalk	SY	$137	852	$116,487.29
202-00010 Removal of Tree	EA	$500	4	$2,000.00
202-00250 Removal of Pavement Marking	SF	$5	1,700	$8,500.00
202-00220 Removal of Asphalt Mat	SY	$9	513	$4,796.55
				$0.00
				$0.00
				$0.00
Estimated Cost:Remaining Major Items			5.00%	$10,765.55
		Estimated Cost Major Items		**$226,077**

Traffic Items	Unit	Unit Cost	Quantity	Cost
627-00008 Modified Epoxy Pavement Marking	GAL	$350	20	$7,000.00
627-30410 Preformed Thermoplastic Pavement Marking (Xwalk-Stop Lin	SF	$20	1,000	$20,000.00
627-30405 Preformed Thermoplastic Pavement Marking (Word-Symbol)	SF	$30	120	$3,600.00
614- Traffic Signal W/ Luminaire	EA	$145,000	4	$580,000.00
614-00011 Sign Panel (Class I)	SF	$40	75	$3,000.00
				$0.00
			A. Total Major Items	**$839,677**

		% Major Item Cost		Category Cost
B-1	**Drainage/Utilities**	10.0%	**of A**	$83,968
B-2	**Earthwork**	2.0%	**of A**	$16,794
B-3	**Environmental**	5.0%	**of A**	$41,984
B-5	**Miscellaneous**	5.0%	**of A**	$41,984
B-6	**Mobilization**	10.0%	**of A**	$83,968
B-7	**Removals/Resets**	5.0%	**of A**	$41,984
B-8	**Roadway**	2.0%	**of A**	$16,794
B-9	**Signing and Striping**	5.0%	**of A**	$41,984
B-10	**Traffic/Lighting/ITS**	7.0%	**of A**	$58,777
B-11	**Traffic Control/Detour**	15.0%	**of A**	$125,951
B-12	**Structural - Minor Structural/Walls**	0.0%	**of A**	$0
B-13	**Bid Force Accounts**	10.0%	**of A**	$83,968
B.	**TOTAL OF BID CONSTRUCTION ITEMS**			**$1,477,831**
C-1	**Force Account - Misc.**	5.0%	**of B**	$73,892
C-2	**Minor Contract Revisions**	5.0%	**of B**	$73,892
C.	**TOTAL BID CONSTRUCTION & FORCE ACCOUNT ITEMS**			**$1,625,614**
D-1	**Design Engineering**	13.2%	**of C**	$215,000
D-2	**Construction Engineering**	15.0%	**of C**	$243,842
D.	**TOTAL PROJECT DESIGN AND CONSTRUCTION**			**$2,084,456**
E-1	**Right-of-Way**	0.0%	**of D**	$0
E-2	**Utilities**	5.0%	**of D**	$104,223
E.	**TOTAL PROJECT DESIGN AND CONSTRUCTION**			**$2,188,679**
F.	**CONTINGENCY**	25.0%	**of D1,D2,E1,E2**	$140,766
G.	**TOTAL PROJECT COST ESTIMATE**			**$2,329,000**

Project Cost Estimate

CDOT Region 1 Safety Study

Location: ***E Colfax Ave (US 40) and Chambers Rd***

Project Number: N/A

County :

Sub-Account Number: N/A

Route: US 40

Region: 1

Begin MP:

Project Description

End MP:

Add right turn channelization in the southwest and northeast corners.

PROJECT MAJOR CONSTRUCTION ITEMS

Major Construction Items	Unit	Unit Cost	Quantity	Cost
202-00206 Removal of Concrete Curb Ramp	SY	$33	37	$1,226.92
608-00010 Concrete Curb Ramp	SY	$216	90	$19,466.10
202-00203 Removal of Curb and Gutter	LF	$10	300	$3,117.00
609-21020 Curb and Gutter Type 2 (Section II-B)	LF	$38	639	$24,141.42
202-00200 Removal of Sidewalk	SY	$50	120	$5,965.20
608-00000 Concrete Sidewalk	SY	$137	138	$18,870.12
610-00030 Median Cover Material (Concrete)	SF	$14	1,950	$28,041.00
202-00250 Removal of Pavement Marking	SF	$8	1,040	$8,320.00
210-00848 Reset Traffic Signal Controller and Cabinet	EA	$7,000	1	$7,000.00
210-00840 Reset Traffic Signal Pole	EA	$6,000	1	$6,000.00
503-00048 Drilled Caisson (48 inch)	LF	$1,000	19	$19,000.00
202-00220 Removal of Asphalt Mat	SY	$9	296	$2,767.60
403-00721 Hot Mix Asphalt (Patching) (Asphalt)	SY	$14	120	$1,689.60
				$0.00
				$0.00
Estimated Cost:Remaining Major Items			5.00%	$7,280.25
		Estimated Cost Major Items		**$152,885**

Traffic Items	Unit	Unit Cost	Quantity	Cost
614-72863 Pedestrian Push Button Post Assembly	EA	$2,959	4	$11,837.64
613-10000 Wiring	LS	$12,000	1	$12,000.00
613 - Bored Conduit	LF	$50	1,000	$50,000.00
613-07004 - Type Four Pull Box	EA	$3,000	2	$6,000.00
627-30410 Preformed Thermoplastic Pavement Marking (Xwalk-Stop Li	SF	$20	2,000	$40,000.00
627-30405 Preformed Thermoplastic Pavement Marking (Word-Symbol)	SF	$30	75	$2,250.00
			A. Total Major Items	**$274,973**

		% Major Item Cost		Category Cost
B-1	**Drainage/Utilities**	10.0%	**of A**	$27,497
B-2	**Earthwork**	2.0%	**of A**	$5,499
B-3	**Environmental**	5.0%	**of A**	$13,749
B-5	**Miscellaneous**	5.0%	**of A**	$13,749
B-6	**Mobilization**	10.0%	**of A**	$27,497
B-7	**Removals/Resets**	5.0%	**of A**	$13,749
B-8	**Roadway**	2.0%	**of A**	$5,499
B-9	**Signing and Striping**	5.0%	**of A**	$13,749
B-10	**Traffic/Lighting/ITS**	7.0%	**of A**	$19,248
B-11	**Traffic Control/Detour**	15.0%	**of A**	$41,246
B-12	**Structural - Minor Structural/Walls**	0.0%	**of A**	$0
B-13	**Bid Force Accounts**	10.0%	**of A**	$27,497
B.	**TOTAL OF BID CONSTRUCTION ITEMS**			**$483,952**
C-1	**Force Account - Misc.**	5.0%	**of B**	$24,198
C-2	**Minor Contract Revisions**	5.0%	**of B**	$24,198
C.	**TOTAL BID CONSTRUCTION & FORCE ACCOUNT ITEMS**			**$532,347**
D-1	**Design Engineering**	18.8%	**of C**	$100,000
D-2	**Construction Engineering**	15.0%	**of C**	$79,852
D.	**TOTAL PROJECT DESIGN AND CONSTRUCTION**			**$712,200**
E-1	**Right-of-Way (10,000sf @ $6/sf)**	0.0%	**of D**	$0
E-2	**Utilities**	5.0%	**of D**	$35,610
E.	**TOTAL PROJECT DESIGN AND CONSTRUCTION**			**$747,810**
F.	**CONTINGENCY**	25.0%	**of D1,D2,E1,E2**	$53,866
G.	**TOTAL PROJECT COST ESTIMATE**			**$802,000**

Project Cost Estimate

CDOT Region 1 Safety Study

Location: ***Federal Blvd (US 287) and W 70th Avenue***

Project Number: N/A
County : Adams

Sub-Account Number: N/A
Route: US 287

Region: 1
Begin MP: 288.56

Project Description
End MP: 288.56

Improve accessibility and safety for pedestrians by extending / constructing sidewalk, curb & gutter, and ADA-compliant curb ramps. Improve signing and pavement markings.

PROJECT MAJOR CONSTRUCTION ITEMS

Major Construction Items	Unit	Unit Cost	Quantity	Cost
608-00000 Concrete Sidewalk	SY	$137	167	$22,835.58
202-00206 Removal of Concrete Curb Ramp	SY	$33	18	$596.88
608-00010 Concrete Curb Ramp	SY	$216	18	$3,893.22
202-00203 Removal of Curb and Gutter	LF	$10	130	$1,350.70
609-21020 Curb and Gutter Type 2 (Section II-B)	LF	$38	130	$4,911.40
202-00195 Removal of Median Cover	SY	$16	40	$644.80
				$0.00
				$0.00
				$0.00
				$0.00
				$0.00
				$0.00
				$0.00
				$0.00
				$0.00
Estimated Cost:Remaining Major Items			5.00%	$1,711.63
		Estimated Cost Major Items		**$35,944**

Traffic Items	Unit	Unit Cost	Quantity	Cost
				$0.00
				$0.00
				$0.00
				$0.00
				$0.00
				$0.00
			A. Total Major Items	**$35,944**

		% Major Item Cost		Category Cost
B-1	Drainage/Utilities	10.0%	of A	$3,594
B-2	Earthwork	2.0%	of A	$719
B-3	Environmental	5.0%	of A	$1,797
B-5	Miscellaneous	5.0%	of A	$1,797
B-6	Mobilization	10.0%	of A	$3,594
B-7	Removals/Resets	5.0%	of A	$1,797
B-8	Roadway	2.0%	of A	$719
B-9	Signing and Striping	5.0%	of A	$1,797
B-10	Traffic/Lighting/ITS	7.0%	of A	$2,516
B-11	Traffic Control/Detour	15.0%	of A	$5,392
B-12	Structural - Minor Structural/Walls	0.0%	of A	$0
B-13	Bid Force Accounts	10.0%	of A	$3,594
B.	TOTAL OF BID CONSTRUCTION ITEMS			**$63,262**
C-1	Force Account - Misc.	5.0%	of B	$3,163
C-2	Minor Contract Revisions	5.0%	of B	$3,163
C.	TOTAL BID CONSTRUCTION & FORCE ACCOUNT ITEMS			**$69,588**
D-1	Design Engineering	215.6%	of C	$150,000
D-2	Construction Engineering	15.0%	of C	$10,438
D.	TOTAL PROJECT DESIGN AND CONSTRUCTION			**$230,026**
E-1	Right-of-Way (4674 sf @ $10 per sf)	$46,740		$46,740
E-2	Utilities	5.0%	of D	$11,501
E.	TOTAL PROJECT DESIGN AND CONSTRUCTION			**$288,267**
F.	CONTINGENCY	25.0%	of D1,D2,E1,E2	$54,670
G.	TOTAL PROJECT COST ESTIMATE			**$343,000**

Project Cost Estimate

CDOT Region 1 Safety Study

Location: ***Wadsworth (SH 121) & W 32nd Ave plus W 32nd Ave to W 35th Ave***

Project Number: N/A | County : Jefferson

Sub-Account Number: N/A | Route: SH 121

Region: 1 | Begin MP:

Project Description | End MP:

Remove northbound right turn lane, tighten southeast corner radius and add a curb extension in the northeast corner. Widen 32nd Ave to the south to provide east/west bicycle lanes through the intersection. Remove the Wadsworth median on the south leg and shift left turn lane to provide zero offset for left turning vehicles. Upgrade curb ramps on all corners. Add a 6-foot sidewalk on Wadsworth Avenue from 32nd Avenue to 35th Avenue.

PROJECT MAJOR CONSTRUCTION ITEMS

Major Construction Items	Unit	Unit Cost	Quantity	Cost
202-00019 Removal of Inlet	EA	$1,500	3	$4,500.00
202-00220 Removal of Asphalt Mat	SY	$50	307	$15,350.00
202-00190 Removal of Concrete Median Cover Material	SY	$20	104	$2,071.11
202-00203 Removal of Curb and Gutter	LF	$30	1,146	$34,380.00
202-00200 Removal Of Sidewalk	SY	$35	313	$10,958.89
202-00206 Removal of Concrete Curb Ramp	SY	$55	40	$2,187.78
202-00210 Removal of Concrete Pavement	SY	$55	75	$4,106.67
304-06000 Aggregate Base Course (Class 6)	TON	$75	175	$13,122.11
403-00721 Hot Mix Asphalt (Patching) (Asphalt)	SY	$45	107	$4,800.00
403-34841 Hot Mix Asphalt (Grading SX) (100) (PG 64-22)	TON	$100	134	$13,447.33
603-01240 24 Inch Reinforced Concrete Pipe (CIP)	LF	$190	229	$43,510.00
604-16005 Inlet Type 16 (5 Foot)	EA	$6,000	7	$42,000.00
608-00000 Concrete Sidewalk	SY	$80	1,841	$147,253.33
608-00010 Concrete Curb Ramp	SY	$180	124	$22,300.00
609-21020 Curb and Gutter Type 2 (Section II-B)	LF	$45	680	$30,600.00
514-00100 Hand Rail	LF	$200	30	$6,000.00
601-01000 Concrete Class B (For Ditch Headlwall/Railing Support)	CY	$1,000	360	$360,000.00
Estimated Cost:Remaining Major Items			5.00%	$37,829.36
		Estimated Cost Major Items		**$794,417**

Traffic Items	Unit	Unit Cost	Quantity	Cost
627-00008 Modified Epoxy Pavement Marking	GAL	$400	28	$11,200.00
627-30405 Preformed Thermoplastic Pavement Marking (Word-Symbol)	SF	$30	1,249	$37,470.00
627-30410 Preformed Thermoplastic Pavement Marking (Xwalk-Stop Lin	SF	$20	330	$6,600.00
				$0.00
			A. Total Major Items	**$849,687**

		% Major Item Cost		Category Cost
B-1	Drainage/Utilities	10.0%	of A	$84,969
B-2	Earthwork	2.0%	of A	$16,994
B-3	Environmental	5.0%	of A	$42,484
B-5	Miscellaneous	5.0%	of A	$42,484
B-6	Mobilization	10.0%	of A	$84,969
B-7	Removals/Resets	5.0%	of A	$42,484
B-8	Roadway	2.0%	of A	$16,994
B-9	Signing and Striping	4.0%	of A	$33,987
B-10	Traffic/Lighting/ITS	0.0%	of A	$0
B-11	Traffic Control/Detour	10.0%	of A	$84,969
B-12	Structural - Minor Structural/Walls	0.0%	of A	$0
B-13	Bid Force Accounts	10.0%	of A	$84,969
B.	TOTAL OF BID CONSTRUCTION ITEMS			**$1,384,989**
C-1	Force Account - Misc.	5.0%	of B	$69,249
C-2	Minor Contract Revisions	5.0%	of B	$69,249
C.	TOTAL BID CONSTRUCTION & FORCE ACCOUNT ITEMS			**$1,523,488**
D-1	Design Engineering	16.4%	of C	$250,000
D-2	Construction Engineering	15.0%	of C	$228,523
D.	TOTAL PROJECT DESIGN AND CONSTRUCTION			**$2,002,011**
E-1	Right-of-Way (6288 sf @ $12 per sf)	$75,456		$75,456
E-2	Utilities	5.0%	of D	$100,101
E.	TOTAL PROJECT DESIGN AND CONSTRUCTION			**$2,177,568**
F.	CONTINGENCY	25.0%	of D1,D2,E1,E2	$163,520
G.	TOTAL PROJECT COST ESTIMATE			**$2,341,000**

Project Cost Estimate

CDOT Region 1 Safety Study

Location: ***Wadsworth Blvd (SH 121) & 26th Ave plus 26th Ave to 29th Ave***

Project Number: N/A | County : Jefferson

Sub-Account Number: N/A | Route: SH 121

Region: 1 | Begin MP:

Project Description | End MP:

Widen the east leg to allow space for bike lanes in both directions. Remove medians on Wadsworth and shift left turn lanes to provide a positive offset. Upgrade curb ramps in NW, SW and SE corners. Add a sidewalk on the west side of Wadsworth from 26th Ave to 29th Ave. Fill the sidewalk gap from 26th Avenue to 175 feet south (east side). Traffic signal upgrade.

PROJECT MAJOR CONSTRUCTION ITEMS

Major Construction Items	Unit	Unit Cost	Quantity	Cost
202-00019 Removal of Inlet	EA	$1,500	1	$1,500.00
202-00220 Removal of Asphalt Mat	SY	$50	164	$8,200.00
202-00190 Removal of Concrete Median Cover Material	SY	$20	209	$4,188.89
202-00203 Removal of Curb and Gutter	LF	$30	1,688	$50,640.00
202-00200 Removal Of Sidewalk	SY	$35	631	$22,077.22
202-00206 Removal of Concrete Curb Ramp	SY	$55	49	$2,719.44
304-06000 Aggregate Base Course (Class 6)	TON	$75	561	$42,044.63
403-00721 Hot Mix Asphalt (Patching) (Asphalt)	SY	$45	28	$1,270.00
403-34841 Hot Mix Asphalt (Grading SX) (100) (PG 64-22)	TON	$100	517	$51,709.11
603-01240 24 Inch Reinforced Concrete Pipe (CIP)	LF	$190	10	$1,900.00
604-16005 Inlet Type 16 (5 Foot)	EA	$6,000	1	$6,000.00
608-00000 Concrete Sidewalk	SY	$80	1,479	$118,346.67
608-00010 Concrete Curb Ramp	SY	$180	135	$24,360.00
609-21020 Curb and Gutter Type 2 (Section II-B)	LF	$45	738	$33,210.00
Utility Relocations	LS	$250,000	1	$250,000.00
Estimated Cost:Remaining Major Items			5.00%	$30,908.30
			Estimated Cost Major Items	**$649,074**

Traffic Items	Unit	Unit Cost	Quantity	Cost
627-00008 Modified Epoxy Pavement Marking	GAL	$350	76	$26,600.00
627-30405 Preformed Thermoplastic Pavement Marking (Word-Symbol)	SF	$30	1,129	$33,870.00
627-30410 Preformed Thermoplastic Pavement Marking (Xwalk-Stop Lin	SF	$20	354	$7,080.00
Traffic Signal Replacement W/ Luminaires	LS	$145,000	4	$580,000.00
Bicycle Ped Detection	LS	$100,000	1	$100,000.00
				$0.00
			A. Total Major Items	**$1,396,624**

		% Major Item Cost		Category Cost
B-1	Drainage/Utilities	5.0%	of A	$69,831
B-2	Earthwork	2.0%	of A	$27,932
B-3	Environmental	5.0%	of A	$69,831
B-5	Miscellaneous	5.0%	of A	$69,831
B-6	Mobilization	10.0%	of A	$139,662
B-7	Removals/Resets	5.0%	of A	$69,831
B-8	Roadway	2.0%	of A	$27,932
B-9	Signing and Striping	4.0%	of A	$55,865
B-10	Traffic/Lighting/ITS	0.0%	of A	$0
B-11	Traffic Control/Detour	10.0%	of A	$139,662
B-12	Structural - Minor Structural/Walls	0.0%	of A	$0
B-13	Bid Force Accounts	10.0%	of A	$139,662
B.	TOTAL OF BID CONSTRUCTION ITEMS			**$2,206,666**
C-1	Force Account - Misc.	5.0%	of B	$110,333
C-2	Minor Contract Revisions	5.0%	of B	$110,333
C.	TOTAL BID CONSTRUCTION & FORCE ACCOUNT ITEMS			**$2,427,333**
D-1	Design Engineering	13.4%	of C	$325,000
D-2	Construction Engineering	15.0%	of C	$364,100
D.	TOTAL PROJECT DESIGN AND CONSTRUCTION			**$3,116,433**
E-1	Right-of-Way (6843 sf @ $12 per sf)	$82,116		$82,116
E-2	Utilities	5.0%	of D	$155,822
E.	TOTAL PROJECT DESIGN AND CONSTRUCTION			**$3,354,371**
F.	CONTINGENCY	25.0%	of D1,D2,E1,E2	$231,759
G.	TOTAL PROJECT COST ESTIMATE			**$3,586,000**

Project Cost Estimate

CDOT Region 1 Safety Study

Location: ***Colfax Ave & Adams Street***

Project Number: N/A

County :

Sub-Account Number: N/A

Route: US 40

Region: 1

Begin MP:

Project Description

End MP:

Curb extension in the southwest corner and triangle median island in northwest corner. Convert intersection to an all way stop, remove the RRFB and add flashing beacons over the stop signs on Colfax. Add a southbound right turn lane.

PROJECT MAJOR CONSTRUCTION ITEMS

Major Construction Items	Unit	Unit Cost	Quantity	Cost
202-00200 Removal Of Sidewalk	SY	$35	67	$2,341.11
202-00203 Removal of Curb and Gutter	LF	$30	586	$17,580.00
202-00210 Removal of Concrete Pavement	SY	$55	31	$1,705.00
202-00220 Removal of Asphalt Mat	SY	$50	548	$27,400.00
304-06000 Aggregate Base Course (Class 6)	TON	$75	253	$18,952.50
403-00721 Hot Mix Asphalt (Patching) (Asphalt)	SY	$45	131	$5,895.00
403-34841 Hot Mix Asphalt (Grading SX) (100) (PG 64-22)	TON	$100	194	$19,422.22
410-01000 (Concrete Pavement (10 Inch)	SY	$200	31	$6,200.00
608-00000 Concrete Sidewalk	SY	$80	452	$36,160.00
608-00010 Concrete Curb Ramp	SY	$180	65	$11,700.00
609-21010 Curb and Gutter Type 2 (Section I-B)	LF	$40	109	$4,360.00
609-21020 Curb and Gutter Type 2 (Section II-B)	LF	$45	747	$33,615.00
610-00020 Median Cover Material (Patterned Concrete)	SF	$40	380	$15,200.00
				$0.00
				$0.00
Estimated Cost:Remaining Major Items			5.00%	$10,026.54
			Estimated Cost Major Items	**$210,557**

Traffic Items	Unit	Unit Cost	Quantity	Cost
614-00012 Sign Panel (Class II)	SF	$35	129	$4,515.00
614-01573 Steel Sign Support (2-1/2 Inch Round NP-40)(Post & Slipbase	EA	$775	9	$6,975.00
614-80001 Flashing Beacon (Solar Powered)	EA	$6,000	2	$12,000.00
627-00008 Modified Epoxy Pavement Marking	GAL	$400	36	$14,400.00
627-30405 Preformed Thermoplastic Pavement Marking (Word-Symbol)	SF	$30	359	$10,770.00
627-30410 Preformed Thermoplastic Pavement Marking (Xwalk-Stop Lin	SF	$20	180	$3,600.00
			A. Total Major Items	**$262,817**

		% Major Item Cost		Category Cost
B-1	**Drainage/Utilities**	10.0%	**of A**	$26,282
B-2	**Earthwork**	2.0%	**of A**	$5,256
B-3	**Environmental**	5.0%	**of A**	$13,141
B-5	**Miscellaneous**	5.0%	**of A**	$13,141
B-6	**Mobilization**	10.0%	**of A**	$26,282
B-7	**Removals/Resets**	5.0%	**of A**	$13,141
B-8	**Roadway**	2.0%	**of A**	$5,256
B-9	**Signing and Striping**	10.0%	**of A**	$26,282
B-10	**Traffic/Lighting/ITS**	0.0%	**of A**	$0
B-11	**Traffic Control/Detour**	12.0%	**of A**	$31,538
B-12	**Structural - Minor Structural/Walls**	0.0%	**of A**	$0
B-13	**Bid Force Accounts**	10.0%	**of A**	$26,282
B.	**TOTAL OF BID CONSTRUCTION ITEMS**			**$449,418**
C-1	**Force Account - Misc.**	5.0%	**of B**	$22,471
C-2	**Minor Contract Revisions**	5.0%	**of B**	$22,471
C.	**TOTAL BID CONSTRUCTION & FORCE ACCOUNT ITEMS**			**$494,359**
D-1	**Design Engineering**	50.6%	**of C**	$250,000
D-2	**Construction Engineering**	15.0%	**of C**	$74,154
D.	**TOTAL PROJECT DESIGN AND CONSTRUCTION**			**$818,513**
E-1	**Right-of-Way (3860 sf @ $12 per sf)**	$46,320		$46,320
E-2	**Utilities**	5.0%	**of D**	$40,926
E.	**TOTAL PROJECT DESIGN AND CONSTRUCTION**			**$905,759**
F.	**CONTINGENCY**	25.0%	**of D1,D2,E1,E2**	$102,850
G.	**TOTAL PROJECT COST ESTIMATE**			**$1,009,000**

Project Cost Estimate

CDOT Region 1 Safety Study

Location ***Palmer Avenue from Colfax Avenue to 8th Street***

Project Number: N/A

County :

Sub-Account Number: N/A

Route: US 40

Region: 1

Begin MP:

Project Description

End MP:

Enlarge triangle median island and extend curb between 5th St and 6th St. Shift crosswalk closer to Palmer Ave. Upgrade ramps at Palmer & 7th St, add a sidewalk that connects to the park (south side) and install crosswalk signage and striping. Restripe to add a new eastbound left turn lane at 8th Street and add pavement for the shift east of 8th St.

PROJECT MAJOR CONSTRUCTION ITEMS

Major Construction Items	Unit	Unit Cost	Quantity	Cost
202-00220 Removal of Asphalt Mat	SY	$50	254	$12,711.11
202-00190 Removal of Concrete Median Cover Material	SY	$20	67	$1,333.33
202-00203 Removal of Curb and Gutter	LF	$30	513	$15,390.00
202-00200 Removal Of Sidewalk	SY	$35	84	$2,943.89
202-00206 Removal of Concrete Curb Ramp	SY	$55	66	$3,648.33
202-00210 Removal of Concrete Pavement	SY	$55	346	$19,042.22
304-06000 Aggregate Base Course (Class 6)	TON	$75	107	$8,004.94
403-00721 Hot Mix Asphalt (Patching) (Asphalt)	SY	$45	51	$2,290.00
403-34841 Hot Mix Asphalt (Grading SX) (100) (PG 64-22)	TON	$100	82	$8,203.33
608-00000 Concrete Sidewalk	SY	$80	313	$25,013.33
608-00010 Concrete Curb Ramp	SY	$180	128	$23,060.00
609-21010 Curb and Gutter Type 2 (Section I-B)	LF	$40	334	$13,360.00
609-21020 Curb and Gutter Type 2 (Section II-B)	LF	$45	374	$16,830.00
610-00020 Median Cover Material (Patterned Concrete)	SF	$40	870	$34,800.00
609-24004 Gutter Type 2 (4 Foot)	LF	$65	327	$21,255.00
				$0.00
Estimated Cost:Remaining Major Items			5.00%	$10,394.27
			Estimated Cost Major Items	**$218,280**

Traffic Items	Unit	Unit Cost	Quantity	Cost
614-00012 Sign Panel (Class II)	SF	$35	166	$5,810.00
614-01573 Steel Sign Support (2-1/2 Inch Round NP-40)(Post & Slipbase	EA	$775	14	$10,850.00
627-00008 Modified Epoxy Pavement Marking	GAL	$400	25	$10,000.00
627-30405 Preformed Thermoplastic Pavement Marking (Word-Symbol)	SF	$30	512	$15,360.00
627-30410 Preformed Thermoplastic Pavement Marking (Xwalk-Stop Lin	SF	$20	30	$600.00
			A. Total Major Items	**$260,900**

		% Major Item Cost		Category Cost
B-1	**Drainage/Utilities**	10.0%	**of A**	$26,090
B-2	**Earthwork**	2.0%	**of A**	$5,218
B-3	**Environmental**	5.0%	**of A**	$13,045
B-5	**Miscellaneous**	5.0%	**of A**	$13,045
B-6	**Mobilization**	10.0%	**of A**	$26,090
B-7	**Removals/Resets**	5.0%	**of A**	$13,045
B-8	**Roadway**	2.0%	**of A**	$5,218
B-9	**Signing and Striping**	5.0%	**of A**	$13,045
B-10	**Traffic/Lighting/ITS**	0.0%	**of A**	$0
B-11	**Traffic Control/Detour**	8.0%	**of A**	$20,872
B-12	**Structural - Minor Structural/Walls**	0.0%	**of A**	$0
B-13	**Bid Force Accounts**	10.0%	**of A**	$26,090
B.	**TOTAL OF BID CONSTRUCTION ITEMS**			**$422,658**
C-1	**Force Account - Misc.**	5.0%	**of B**	$21,133
C-2	**Minor Contract Revisions**	5.0%	**of B**	$21,133
C.	**TOTAL BID CONSTRUCTION & FORCE ACCOUNT ITEMS**			**$464,923**
D-1	**Design Engineering**	32.3%	**of C**	$150,000
D-2	**Construction Engineering**	15.0%	**of C**	$69,739
D.	**TOTAL PROJECT DESIGN AND CONSTRUCTION**			**$684,662**
E-1	**Right-of-Way (404 sf @ $12 per sf)**	$4,848		$4,848
E-2	**Utilities**	5.0%	**of D**	$34,233
E.	**TOTAL PROJECT DESIGN AND CONSTRUCTION**			**$723,743**
F.	**CONTINGENCY**	25.0%	**of D1,D2,E1,E2**	$64,705
G.	**TOTAL PROJECT COST ESTIMATE**			**$788,000**

Project Cost Estimate

CDOT Region 1 Safety Study

Location: ***1st Street & Centennial Drive***

Project Number: N/A

County :

Sub-Account Number: N/A

Route: US 40

Region: 1

Begin MP:

Project Description

End MP:

Widen the raised median island and shift the crosswalk north to provide a pedestrian refuge. Upgrade curb ramps and sidewalk connections on west side. Add an RRFB and associated signage and striping.

PROJECT MAJOR CONSTRUCTION ITEMS

Major Construction Items	Unit	Unit Cost	Quantity	Cost
202-00019 Removal of Inlet	EA	$1,500	0	$0.00
202-00220 Removal of Asphalt Mat	SY	$50	258	$12,883.33
202-00190 Removal of Concrete Median Cover Material	SY	$20	63	$1,262.22
202-00203 Removal of Curb and Gutter	LF	$30	96	$2,880.00
202-00200 Removal Of Sidewalk	SY	$35	20	$692.22
202-00206 Removal of Concrete Curb Ramp	SY	$55	34	$1,851.67
202-00210 Removal of Concrete Pavement	SY	$55	0	$0.00
304-06000 Aggregate Base Course (Class 6)	TON	$75	0	$0.00
403-00721 Hot Mix Asphalt (Patching) (Asphalt)	SY	$45	82	$3,680.00
608-00000 Concrete Sidewalk	SY	$80	46	$3,688.89
608-00010 Concrete Curb Ramp	SY	$180	82	$14,840.00
609-21010 Curb and Gutter Type 2 (Section I-B)	SY	$40	272	$10,880.00
609-21020 Curb and Gutter Type 2 (Section II-B)	LF	$45	96	$4,320.00
610-00020 Median Cover Material (Patterned Concrete)	SF	$40	364	$14,560.00
				$0.00
Estimated Cost:Remaining Major Items			5.00%	$3,576.92
			Estimated Cost Major Items	**$75,115**

Traffic Items	Unit	Unit Cost	Quantity	Cost
614-00012 Sign Panel (Class II)	SF	$35	107	$3,745.00
614-01573 Steel Sign Support (2-1/2 Inch Round NP-40)(Post & Slipbase	EA	$775	8	$6,200.00
614-80003 Rectangular Rapid Flashing Beacon	EA	$10,000	1	$10,000.00
627-30405 Preformed Thermoplastic Pavement Marking (Word-Symbol)	SF	$30	351	$10,530.00
				$0.00
				$0.00
			A. Total Major Items	**$105,590**

		% Major Item Cost		Category Cost
B-1	**Drainage/Utilities**	10.0%	**of A**	$10,559
B-2	**Earthwork**	2.0%	**of A**	$2,112
B-3	**Environmental**	5.0%	**of A**	$5,280
B-5	**Miscellaneous**	5.0%	**of A**	$5,280
B-6	**Mobilization**	10.0%	**of A**	$10,559
B-7	**Removals/Resets**	5.0%	**of A**	$5,280
B-8	**Roadway**	2.0%	**of A**	$2,112
B-9	**Signing and Striping**	4.0%	**of A**	$4,224
B-10	**Traffic/Lighting/ITS**	0.0%	**of A**	$0
B-11	**Traffic Control/Detour**	12.0%	**of A**	$12,671
B-12	**Structural - Minor Structural/Walls**	0.0%	**of A**	$0
B-13	**Bid Force Accounts**	10.0%	**of A**	$10,559
B.	**TOTAL OF BID CONSTRUCTION ITEMS**			**$174,224**
C-1	**Force Account - Misc.**	5.0%	**of B**	$8,711
C-2	**Minor Contract Revisions**	5.0%	**of B**	$8,711
C.	**TOTAL BID CONSTRUCTION & FORCE ACCOUNT ITEMS**			**$191,646**
D-1	**Design Engineering**	78.3%	**of C**	$150,000
D-2	**Construction Engineering**	15.0%	**of C**	$28,747
D.	**TOTAL PROJECT DESIGN AND CONSTRUCTION**			**$370,393**
E-1	**Right-of-Way (426 sf @ $12 per sf)**	$5,112		$5,112
E-2	**Utilities**	5.0%	**of D**	$18,520
E.	**TOTAL PROJECT DESIGN AND CONSTRUCTION**			**$394,025**
F.	**CONTINGENCY**	25.0%	**of D1,D2,E1,E2**	$50,595
G.	**TOTAL PROJECT COST ESTIMATE**			**$445,000**

Appendix D

Benefit to Cost Calculations

CDOT R1 Bicycle and Pedestrian Safety Study

Safety Assessment

Appendix D - Benefit to Cost Calculations

Constants	
Interest Rate, i	5%
20 year TF	1.30
ADT Growth Rate, a	2.0%
Begin Date	7/1/2015
End Date	6/30/2020
PDO Cost	$ 11,500
INJ Cost	$ 106,100
FAT Cost	$ 1,906,200

Location	Improvement	PDO count	INJ count	FAT count	Crash Count Comment	PDO rate before	INJ rate before	FAT rate before	Service Life	Estimated Cost	EUAC	CRF Name	CRF Crash Types	CRF Comment (why this one)	CRF Reference	CRF (PDO)	CRF (INJ)	CRF (FAT)	PDO rate after	INJ rate after	FAT rate after	EUAB (PDO)	EUAB (INJ)	EUAB (FAT)	EUAB Total	Benefit to Cost Ratio (B/C)	LOSS
Colfax and Havana	Add curb extensions in the NW and SE corners and queue jump for eastbound and westbound buses	125	40	0	All crashes (all severity) (CMF ID's 307 and 308)	25.0	8.0	0.0	20	$ 517,200	$ 41,501	Increase triangle sight distance	All crashes	Most applicable CMF's that can be found for this countermeasure with a 3 star rating in the clearinghouse.	http://www.cmfclearinghouse.org/detail.cfm?facid=307 http://www.cmfclearinghouse.org/detail.cfm?facid=308	11%	48%		27.1	5.1	0.0	$ 38,565	$ 496,829	$ -	$ 535,394	12.90	2
Colfax and Havana	Evaluate Feasibilty of Passive Pedestrian Detection	1	11	1	All vehicle/pedestrian crashes (all severity)	0.2	2.2	0.2	10	$ 33,800	$ 4,377	Convert pelican crossing or farside pedestrian signal to puffin crossing	Vehicle/pedestrian	This is the closest CMF to what is being proposed. It is a 3 star CMF in the clearinghouse.	http://www.cmfclearinghouse.org/detail.cfm?facid=3889	24%	24%	24%	0.2	1.8	0.2	$ 610	$ 61,874	$ 101,058	$ 163,541	37.36	2
Wadsworth & 32nd Avenue	Remove NBR turn lane and tighten SE corner radius to improve triangle sight distance, and curb extension in NE corner	142	45	0	All crashes (all severity) (CMF ID's 307 and 308)	28.4	9.0	0.0	20	$ 592,000	$ 47,504	Increase triangle sight distance	All crashes	Most applicable CMF's that can be found for this countermeasure with a 3 star rating in the clearinghouse.	http://www.cmfclearinghouse.org/detail.cfm?facid=307 http://www.cmfclearinghouse.org/detail.cfm?facid=308	11%	48%		30.8	5.7	0.0	$ 43,810	$ 558,933	$ -	$ 602,742	12.69	4
Wadsworth & 32nd Avenue	Provide dedicated bike lanes for E/W connectivity at the intersection	0	2.66	0	All vehicle/bicycle crashes (all severity)	0.0	0.5	0.0	20	$ 540,000	$ 43,331	Install bicycle lanes	Vehicle/bicycle	There are several "add bike lane" CMFs in the clearinghouse. However, this is the most applicable two star CMF.	http://www.cmfclearinghouse.org/detail.cfm?facid=3257	3%	3%	3%	0.0	0.6	0.0	$ -	$ 2,061	$ -	$ 2,061	0.05	4
Wadsworth & 32nd Avenue	Remove negative offset	33	25	0	All severity angle crashes	6.6	5.0	0.0	20	$ 138,000	$ 11,073	Introducing zero or positive offset left -turn lane on crossing roadway	Angle crashes	4 star CMF in clearinghouse	https://www.cmfclearinghouse.org/detail.cfm?facid=276	26%	26%	26%	6.0	4.5	0.0	$ 24,064	$ 168,197	$ -	$ 192,262	17.36	4
Wadsworth from 32nd to 35th	Add sidewalks on both sides	0	0.01	0	All vehicle/pedestrian crashes (all severity)	0.0	0.0	0.0	20	$ 1,071,000	$ 85,940	Add sidewalk	Vehicle/pedestrian only	Absent any Colorado specific "add sidewalk" CMF, this was the most reliable CMF available.	https://safety.fhwa.dot.gov/provencountermeasures/walkways.cfm	65%	65%	65%	0.0	0.0	0.0	$ -	$ 180	$ -	$ 180	0.00	3
Wadsworth & 26th	Provide dedicated bike lanes E/W at the intersection	0	2	0	All vehicle/bicycle crashes (all severity)	0.0	0.4	0.0	20	$ 634,000	$ 50,874	Install bicycle lanes	Vehicle/bicycle	There are several "add bike lane" CMFs in the clearinghouse. However, this is the most applicable two star CMF.	http://www.cmfclearinghouse.org/detail.cfm?facid=3257	3%	3%	3%	0.0	0.5	0.0	$ -	$ 1,553	$ -	$ 1,553	0.03	4
Wadsworth & 26th	Add misssing sidewalk in SE corner on Wadsworth	0	0.76	0	All vehicle/pedestrian crashes on roadway (all severity)	0.0	0.2	0.0	20	$ 73,000	$ 5,858	Add sidewalk	Vehicle/pedestrian only	Absent any Colorado specific "add sidewalk" CMF, this was the most reliable CMF available.	https://safety.fhwa.dot.gov/provencountermeasures/walkways.cfm	65%	65%	65%	0.0	0.1	0.0	$ -	$ 12,798	$ -	$ 12,798	2.18	4
Wadsworth & 26th	Positive offset	35	13	0	All severity angle crashes	7.0	2.6	0.0	20	$ 239,200	$ 19,194	Introducing zero or positive offset left -turn lane on crossing roadway	Angle crashes	4 star CMF in clearinghouse.	https://www.cmfclearinghouse.org/detail.cfm?facid=276	26%	26%	26%	6.3	2.3	0.0	$ 25,523	$ 87,463	$ -	$ 112,985	5.89	4
Wadsworth & 26th	Upgrade signal (plus utility relocations)	120	14	0	Night-time fatal and injuries, daytime PDO	24.0	2.8	0.0	25	$ 2,116,550	$ 150,174	Improve signal visibility, including signal lens size upgrade, installation of new back-plates, addition of reflective tapes to existing back-plates, and installation of additional signal heads	Nighttime KABC and daytime PDO	Most applicable CMF that can be found for this countermeasure with a 4 star rating in the clearinghouse.	http://www.cmfclearinghouse.org/detail.cfm?facid=4111 http://www.cmfclearinghouse.org/detail.cfm?facid=4112	10%	10%	10%	27.7	3.2	0.0	$ 35,011	$ 37,304	$ -	$ 72,315	0.48	4
Wadsworth from 26th to 29th	Add a sidewalk on the west side	0	0.02	0	All vehicle/pedestrian crashes on roadway (all severity)	0.0	0.0	0.0	20	$ 523,250	$ 41,987	Add sidewalk	Vehicle/pedestrian only	Absent any Colorado specific "add sidewalk" CMF, this was the most reliable CMF available.	https://safety.fhwa.dot.gov/provencountermeasures/walkways.cfm	65%	65%	65%	0.0	0.0	0.0	$ -	$ 274	$ -	$ 274	0.01	2
Colfax and Adams	Curb extensions on south side	1.65	1.75	0	All crashes (all severity) (CMF ID's 307 and 308)	0.3	0.4	0.0	20	$ 411,000	$ 32,980	Increase triangle sight distance	All crashes	Most applicable CMF's that can be found for this countermeasure with a 3 star rating in the clearinghouse.	http://www.cmfclearinghouse.org/detail.cfm?facid=307 http://www.cmfclearinghouse.org/detail.cfm?facid=308	11%	48%		0.4	0.2	0.0	$ 509	$ 21,736	$ -	$ 22,245	0.67	1 (Total), 2 (Severe)
Colfax and Adams	Convert intersection to All-Way Stop control with flashing beacons and add a raised triangle median island in NW corner	1.65	1.75	0	All crashes (all severity) Uses Dominant Effect Method	0.3	0.4	0.0	20	$ 598,000	$ 47,985	Convert two-way (without flashing beacons) to all-way stop control (with flashing beacons)	All crashes	Most recent and applicable 3 star rating in the CMF clearinghouse.	http://www.cmfclearinghouse.org/detail.cfm?facid=3136	82%	82%	82%	0.1	0.1	0.0	$ 3,795	$ 37,133	$ -	$ 40,928	0.85	1 (Total), 2 (Severe)
Palmer Ave from Colfax Avenue to 8th Street	Enlarge triangle median island and curb extension between 5th and 6th	0	0.05	0	All vehicle/pedestrian crashes (all severity)	0.0	0.0	0.0	20	$ 788,000	$ 63,231	Install raised median with or without crosswalk (STEP states this is typically used with bulb outs)	Vehicle/pedestrian	4 star CMF in clearinghouse. Most up to date study addressing vehicle/pedestrian crashes.	http://www.cmfclearinghouse.org/detail.cfm?facid=8799	32%	32%	32%	0.0	0.0	0.0	$ -	$ 368	$ -	$ 368	0.01	2 (at Adams & Palmer Intx)
1st & Centennial	Widen raised median island and shift crosswalk to provide pedestrian refuge	1.15	0.55	0	All crashes (all severity)	0.2	0.1	0.0	20	$ 172,000	$ 13,802	Install raised median with or without crosswalk (uncontrolled)	All crashes	Most recent and applicable 4 star rating in the CMF clearinghouse.	http://www.cmfclearinghouse.org/detail.cfm?facid=8800	26%	26%	26%	0.2	0.1	0.0	$ 832	$ 3,672	$ -	$ 4,504	0.33	2
1st & Centennial	Install high-visibility crosswalk striping and an RRFB with associated signage and striping	0	0.04	0	All vehicle/pedestrian crashes (all severity) Uses Dominant Effect Method	0.0	0.0	0.0	10	$ 273,000	$ 35,355	Install rectangular rapid flashing beacon (RRFB)	Vehicle/pedestrian	CMF specific for vehicle/pedestrian crashes for urban/suburban arterial with 2 to 8 lanes.	http://www.cmfclearinghouse.org/detail.cfm?facid=9024	47%	47%	47%	0.0	0.0	0.0	$ -	$ 397	$ -	$ 397	0.01	2
Colfax and Moline	Add curb extensions (bulb-out) in the NE and SW corners.	1	11	0	All vehicle/pedestrian crashes (all severity)	0.2	2.2	0.0	20	$ 889,000	$ 71,336	Install raised median with or without crosswalk (STEP states this is typically used with bulb outs)	Vehicle/pedestrian	4 star CMF in clearinghouse. Most up to date study addressing vehicle/pedestrian crashes. The pedestrian refuge island is evaluated as one of the pedestrian treatment for intersection and mid-block crossings. Note: the CMFs found in clearinghouse are all for uncontrolled pedestrian crossings and no CMF for bulbouts, this is the closet to most of the conditions.	http://www.cmfclearinghouse.org/detail.cfm?facid=8799	32%	32%	32%	0.2	1.8	0.0	$ 883	$ 89,662	$ -	$ 90,546	1.27	2 (Total), 3 (Severe)
Colfax and Moline	Upgrade signal	51	7	0	Night-time fatal and injuries, daytime PDO	10.2	1.4	0.0	25	$ 1,440,000	$ 102,172	Improve signal visibility, including signal lens size upgrade, installation of new back-plates, addition of reflective tapes to existing back-plates, and installation of additional signal heads	Nighttime KABC and daytime PDO	Most applicable CMF that can be found for this countermeasure with a 4 star rating in the clearinghouse.	http://www.cmfclearinghouse.org/detail.cfm?facid=4111 http://www.cmfclearinghouse.org/detail.cfm?facid=4112	10%	10%	10%	11.8	1.6	0.0	$ 14,880	$ 18,652	$ -	$ 33,532	0.33	2 (Total), 3 (Severe)
Colfax Moline to Peoria	Add raised center median for pedestrian refuge & Install a pedestrian hybrid beacon (HAWK) with advanced stop markings and signs	0	16	1	All vehicle/pedestrian crashes (all severity)	0.0	3.2	0.2	20	$ 888,000	$ 71,255	1. Install rasied median with or without crosswalk (uncontrolled) 2. Install pedestrian hybrid beacon (PHB or HAWK) with advanced yield or stop markings and signs	Vehicle/pedestrian	4 star CMF in clearinghouse. Most up to date study addressing vehicle/pedestrian crashes.	http://www.cmfclearinghouse.org/detail.cfm?facid=9021, http://www.cmfclearinghouse.org/detail.cfm?facid=8799	70%	70%	70%	0.0	1.2	0.1	$ -	$ 291,506	$ 327,326	$ 618,832	8.68	Nome - 2 Oswego - 1 (total), 2 (severe) Peoria - 3
Colfax and Chambers	Add right-turn channelization from Colfax (both directions) to Chambers	148	49	0	All Crashes (all severity)	29.6	9.8	0.0	20	$ 802,000	$ 64,355	Improve angle of channelized right turn lane	All crashes	Most applicable CMF that can be found for this countermeasure with a 4 star rating in the clearinghouse.	http://www.cmfclearinghouse.org/detail.cfm?facid=8428	44%	44%	44%	20.1	6.7	0.0	$ 183,473	$ 560,433	$ -	$ 743,906	11.56	3
Colorado and Mississippi	Update signal phasing to protected with ped call	1	13	0	All vehicle/pedestrian crashes (all severity)	0.2	2.6	0.0	10	$ 12,000	$ 1,554	Leading protected left-turn phase	Vehicle/pedestrian	Most applicable CMF that could be found for this countermeasure (Page 80)	https://www.pedbikeinfo.org/cms/downloads/PedestrianLitReview_April2014.pdf	56%	56%	56%	0.1	1.3	0.0	$ 1,423	$ 170,622	$ -	$ 172,045	110.71	1
Federal and 70th	Add sidewalks where missing to improve connectivity and update pedestrian ramp for ADA accessibility	0	0.6	0	All vehicle/pedestrian crashes on roadway (all severity)	0.0	0.1	0.0	20	$ 343,000	$ 27,523	Add sidewalk	Vehicle/pedestrian only	Absent any Colorado specific "add sidewalk" CMF, this was the most reliable CMF available.	https://safety.fhwa.dot.gov/provencountermeasures/walkways.cfm	65%	65%	65%	0.0	0.1	0.0	$ -	$ 10,111	$ -	$ 10,111	0.37	N/A

Note: Values in blue were calculated using the Highway Safety Manual.