City and County of Denver

Vision Zero Road Safety Audit

Final Report

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Glossary

Bicycle Crash – this crash type involves a motor vehicle and at least one person who is biking.

Broadside Crash – also known as a T-bone crash or angle crash, a broadside crash happens when the front end of one car crashes into the side of another car. This includes left-turn movements as part of the crash statistics in this document.

Countermeasure – a proven engineering solution that can be implemented to correct a crash problem or reduce the likelihood of a crash occurring.

Crash Modification Factor – used to compute the expected number of crashes after implementing a countermeasure on a street or at an intersection.

DOTI – Denver Department of Transportation and Infrastructure

Fatal Crash – a crash resulting in one or more deaths.

FHWA – Federal Highway Administration

Fixed-Object Crash – this crash type involves a motor vehicle and a stationary object such as a utility pole, guardrail, tree, or building.

Head-on Crash – a head-on crash happens when the front end of one car crashes into the front end of another car.

High Injury Network (HIN) – the Denver High Injury Network identifies the roadways with the highest number of fatal and serious bodily injuries (SBI crashes). The High Injury Network in Denver is broken into two tiers (Tier 1 and Tier 2) to further differentiate the number of serious crashes.

KSI Crash – Killed or Serious Injury (KSI); a crash resulting in a fatality (killed) or serious injury.

Left-Turn Crash – a crash that occurs when someone turns left in front of oncoming traffic without yielding the right-of-way.

Pedestrian Crash – this crash type involves a motor vehicle and at least one person who is walking or using a mobility assistive device such as a wheelchair. This crash type also included crashes involving motorized scooters.

Property Damage Only (PDO) Crash – a motor vehicle crash where no individuals involved sustain injuries, and the damage is limited solely to vehicles, personal property (like phones or laptops), or fixed objects such as mailboxes and fences.

Protected left-turn – consists of providing a separate traffic signal programming phase for left-turning traffic and allowing left-turns to be made only on a green left arrow signal indication, with no pedestrian movement or vehicular traffic conflicting with the turn.

Rear-End Crash – this crash type occurs when the front of one vehicle collides with the back of another vehicle.

Right-turn Crash – a crash that occurs when someone at fault is turning right.

Road Safety Audit (RSA) – the formal safety performance examination of an existing or future road or intersection by an independent, multidisciplinary team. It qualitatively estimates and reports on potential safety issues and identifies opportunities for improvements in safety for all road users.

Safe Streets for All (SS4A) – a federal, discretionary grant program providing $5 billion in grants from 2022 through 2026 to prevent roadway deaths and serious injuries.

Safe System Approach – a traffic safety framework aiming to eliminate fatal and serious injuries by accepting that human error is inevitable. It focuses on managing safety strategies through redundant, proactive measures across five key elements including safer people, roads, vehicles, speeds, and post-crash care to ensure mistakes do not result in death.

Serious Bodily Injury (SBI) Crash – a crash that results in an incapacitating (life altering) injury.

Through Crash – a crash that occurs when someone at fault is traveling straight through an intersection and is typically struck by a car making a through movement from an adjacent approach.

Vision Zero – a transportation strategy to eliminate all traffic fatalities and serious injuries while increasing safe mobility for all. Vision Zero recognizes humans make mistakes and therefore the transportation system should be designed to minimize the consequences of human error.

311/Denver Online Services – Denver's portal to report a non-emergency issue within the City and County of Denver.

85th percentile speed – the speed at or below which 85 percent of the drivers travel on a road segment.

1. Project Summary

1.1. Denver Vision Zero Commitment

Denver has demonstrated a strong and sustained commitment to Vision Zero, centering its transportation strategy for zero traffic fatalities and serious bodily injuries. The city employs a Safe System approach to achieve Vision Zero by prioritizing safety in all transportation investments, acknowledging that people will make mistakes and it is necessary to design infrastructure and related policy to lessen their consequences. A safe system lessens the severity of impacts on the human body and decreases the likelihood of severe injuries or death when a mistake does lead to a crash.

Denver has defined a High Injury Network (HIN) outlined in the Denver Vision Zero Action Plan representing streets in need of safety improvements. This network highlights the streets within the city that have disproportionately high rates of traffic crashes resulting in death or serious bodily injury.

1.2. Denver's Road Safety Audit Program

The Denver Vision Zero program provides traffic safety professionals with a unique opportunity to work as part of a dedicated traffic safety improvement program by collaborating with transportation planners, transportation engineers, public health professionals, law enforcement, first responders, government officials, and other stakeholders. Denver has completed RSAs on several corridors throughout the city to support the Vision Zero Program. RSA corridors were identified based on their location on the HIN, which includes corridors with an elevated number of fatal and injury crashes for all travel modes, their proximity to the Equity Index Areas, (i.e., areas of Denver where more vulnerable populations live), corridors without existing DOTI projects, and high crash rates. As outlined in Denver's Vision Zero statement, these areas are places with higher speeds, in closer proximity to schools and high school density, elderly populations, people with disabilities, and people without vehicles.

1.3. SS4A Funding

In February 2023, Denver received $576,000 for a Safe Streets and Roads for All (SS4A) Planning grant from the Federal Highway Administration (FHWA) to conduct a series of Road Safety Audits (RSAs) across seven high-risk corridors and supplemental safety analysis on two high-risk corridors. As a part of the grant agreement, Denver's Department of Transportation and Infrastructure provided a 20% match requirement of $144,000 for a total project budget of $720,000. Conducting RSAs classify as supplemental safety planning to complete or enhance an Action Plan. The RSAs identify road safety issues at existing or future road intersections that are eligible for supplemental planning activities.

These RSAs directly support and expand Denver's Vision Zero Action Plan by supplying corridor-specific findings on Denver's HIN that refine priorities, inform targeted investments, and provide a comprehensive, evidence-based approach to eliminating traffic fatalities and serious injuries.

1.4. Scope of Project

Denver undertook a comprehensive program of RSAs for nine priority corridors as part of its SS4A commitments. These corridors were selected for RSAs because they are located on Denver's HIN which represents just 5% of the city's roadways but accounts for approximately 40–50% of fatalities and currently do not have existing plans or projects underway. These factors made the nine corridors priority roadway segments for RSAs, allowing a multidisciplinary team to identify safety issues and pair them with proven safety countermeasures.

Figure 1 displays the locations of corridors for this project. The corridors include:

1. Alameda Avenue – Kearney Street to Fairmount Drive
2. Broadway – East Colfax Avenue to 29th Street
3. Colorado Boulevard – Mississippi Avenue to Iliff Avenue
4. Speer Boulevard – Federal Boulevard to Elitch Circle
5. Tower Road – 45th Avenue to 56th Avenue
6. Tower Road – 56th Avenue to 71st Avenue
7. University Boulevard – Iowa Avenue to Yale Avenue
8. 38th Avenue – Federal Boulevard to Fox Street
9. Evans Avenue – Colorado Boulevard to Quebec Street

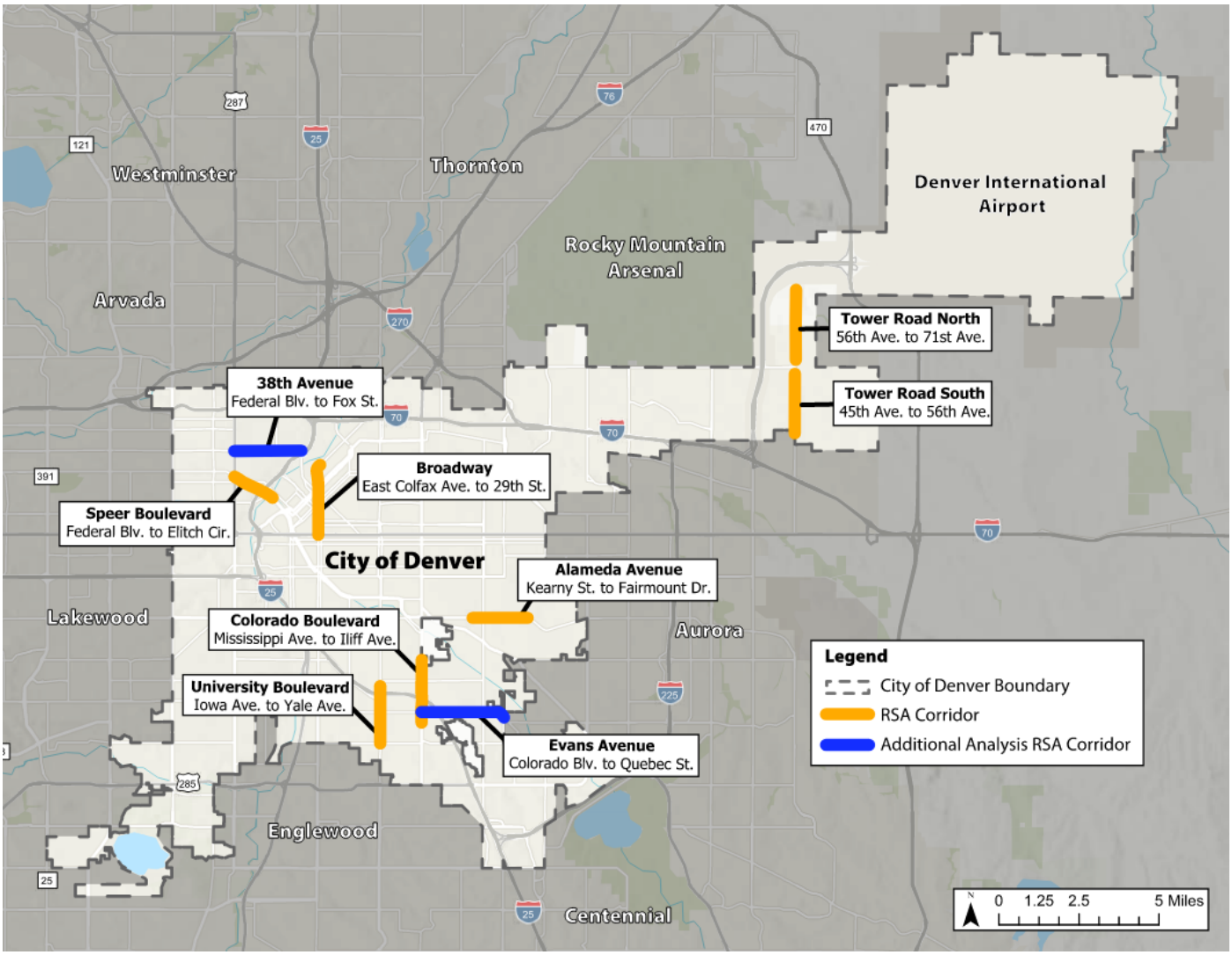


Figure 1. Location of RSA Corridors

2. RSA Procedure

2.1. What is an RSA?

RSAs are formal examinations of selected roadway entities from a safety performance viewpoint. All RSAs are performed by an independent multidisciplinary team and are highly benefited by including one or more professionals trained in performing RSAs. An RSA qualitatively estimates and reports on potential road safety issues and identifies opportunities for safety improvements for all road users.

RSAs and traditional safety review are different processes. **Table 1** displays the differences between road safety reviews that are commonly performed and RSAs. RSAs can be used in any phase of project development from planning to preliminary engineering to design to construction. RSAs can also be used on any sized project from a minor intersection and roadway retrofits to long corridors. The RSA team evaluates each corridor through a multimodal lens, considering transit, bicycle, and pedestrian activity alongside motorist activity. The team also engages key stakeholders to understand typical travel patterns and concerns along the corridor. In addition, the RSA team reviews police crash reports, analyzes local agency crash data, and conducts field observations at different times of day, including day and night and peak and off-peak hours

Table 1. What is the difference between RSA and a Traditional Safety Review?

Road Safety Audit	Traditional Safety Review
Performed by a team independent of the project	The safety review team is usually not completely independent of the design team
Performed by a multi-disciplinary team	Typically performed by a team with only design and/or safety expertise
Considers all potential road users	Often concentrates on motorized traffic
Accounting for road user capabilities and limitations is an essential element of an RSA	Safety Reviews do not normally consider human factor issues
Always generates a formal RSA report	Often does not generate a formal report
A formal response report is an essential element of an RSA	Often does not generate a formal response report

Figure 2 displays the eight steps of an RSA. Steps 1, 2, 7, and 8 are performed by the project owner (DOTI). Steps 3 through 6 were performed by the RSA team as part of this project and are described in subsequent sections.

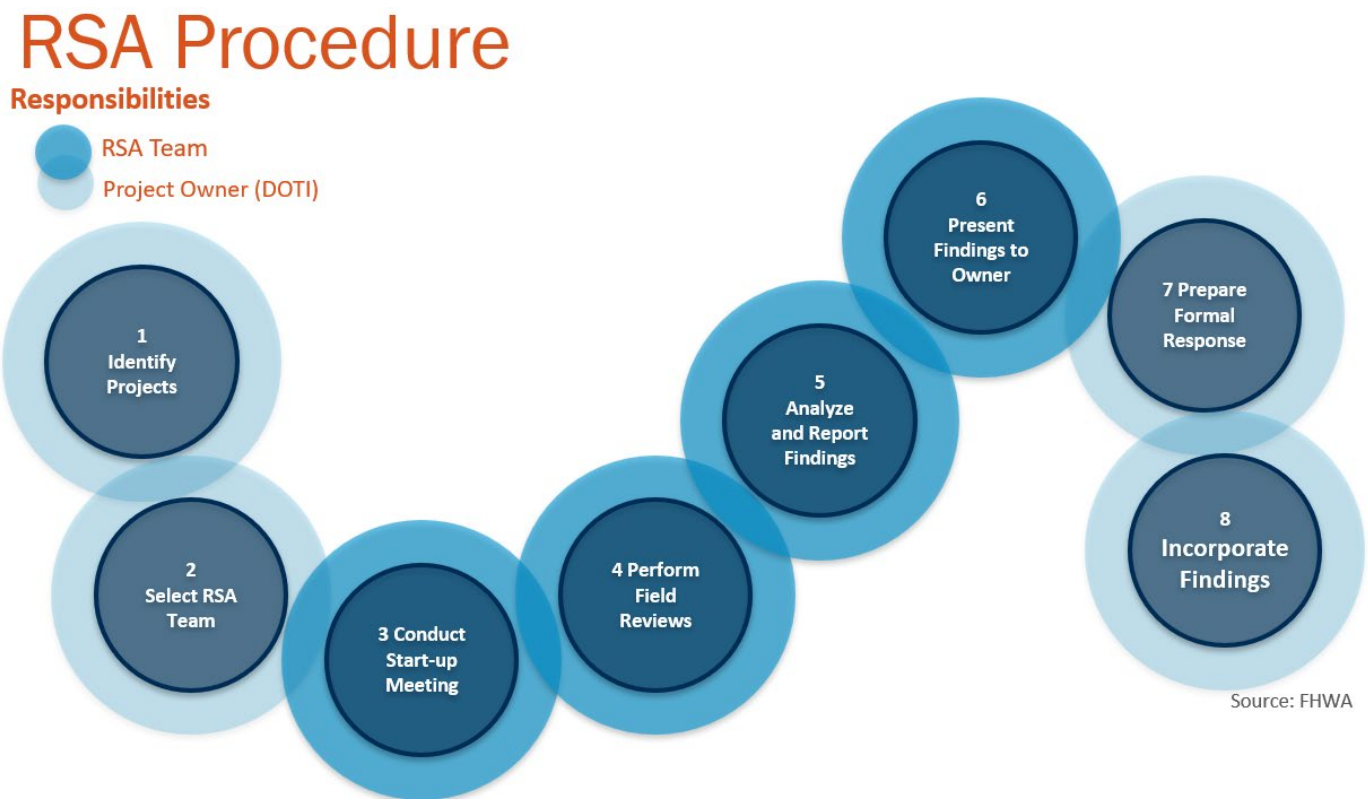


Figure 2. RSA Procedure

2.2. Pre-Audit (Step 3: Conduct a Start-up Meeting)

A Pre-Audit Meeting was facilitated for each corridor and was held the day prior to field visits to introduce all team members and stakeholders involved in the project with the safety analysis, existing conditions, and information regarding the subsequent field plan. Participants included engineers, planners, City staff, councilmembers, and Denver police. Stakeholders had the opportunity to share known concerns about the corridor. During the Pre-Audit Meeting step, the RSA team also developed a detailed plan to assign key tasks for field observations such as signal operations and pedestrian facility observations.

2.3. Field Visits (Step 4: Perform Field Reviews)

Field visits were facilitated for each corridor. Observations were performed during the following time periods: AM peak period, PM peak period, mid-day peak period, and at night. Collecting observations during these times allowed the RSA team to develop recommendations that could be used to address common issues occurring during both peak and non-peak periods as well as daylight and dark-lighted times of day. Additionally, observations were performed outside of those time periods if there was a particular land use that generated non-typical traffic patterns (example is school pick-up/drop-off or sporting events).

Rendezvous points and meeting times were agreed upon by the team prior to the field-work day. Project manager contact information was made available to all participants. Important data-collection worksheets, crash data, and clipboards were provided to all members prior to observations. Once in the field, RSA team members were required to wear safety vests and travelled in groups of at least two for safety reasons.

Field observations were obtained by walking, driving, and video recording. The team observed the entirety of the corridor on foot to collect detailed information. Select individuals drove the corridor to collect observations on the comfort of navigating the roadway and side street movements.

Items observed included the following:

- Roadway geometry (lane widths, turn lanes, medians)
- Signing and striping
- Access management (driveways, medians, turn restrictions, illegal turning movements)
- Pedestrian facilities
- Bicycle facilities
- Signal phasing, detection, and compliance
- Sun glare and weather related activity
- Transit stop locations and connectivity
- School zone activity
- Special event activity (stadium ingress/egress, late night university activity)
- ADA ramp condition and alignment
- Lighting function and shadows
- Speeding behavior and driver compliance
- General behavior of all road users
- Traffic operations and queuing
- Maintenance concerns
- Drainage during rain events

2.4. Typical Data Analyzed (Step 5: Conduct Analysis and Prepare Report)

Data was analyzed and presented at the Pre-Audit meeting prior to the field observations. It was most effective for the RSA team to have the background data available while performing field observations. Based on this review, the RSA Team identified and prioritized observations of key safety issues, including features

that could contribute to a higher frequency and/or severity of crashes. The following data was analyzed and documented along the corridor:

- Five-year crash history from DOTI's Open Data Catalog's 'Traffic Accidents' layer
    - General crash statistics (number of total crashes, serious injury, fatal)
    - Crash type by total crashes and by severity to determine locations with increased safety concerns
    - Crash contributing factors were reviewed to determine how driver behaviors may be impacting crash results
    - Temporal patterns were evaluated to determine if crashes are occurring at specific times of day
    - Crash reports for serious, fatal, pedestrian, and bicycle crashes were obtained to better understand incident details
- 24-hour speed (average speeds, 85th percentile speeds, directionality) and volume data to determine travel patterns and speeding behavior throughout the day
- Peak hour turning movement volumes
- Land use context and planned development
- Existing signal timing and operations such as clearance intervals, left-turn phasing, pedestrian walk indications, and flashing don't walk indications (confirmed in the field)
- Multimodal infrastructure inventory including bus stops, bicycle lanes, pedestrian ramps, pedestrian signals, and scooter and electric bike drop-off locations
- Lighting assessment including illuminance and functionality of luminaires on each corner and within crosswalks (completed in the field)
- Public messages from Denver's 311 City service hotline related to transportation infrastructure and traffic concerns. This included confusing lane assignment, speeding or traffic patterns concerns, damaged infrastructure, and signal phasing.
- Any concerns identified by stakeholders.

2.5. Post-Audit Meeting and RSA Reports (Step 6: Present Findings to Project Owner)

On the last day of field visits, the RSA team met to debrief about observations, formally exchange notes, and begin developing recommendations as a team. This information was expanded upon and formalized for a Post-Audit Meeting. The meeting's purpose was to reconvene and present preliminary findings and recommendations to stakeholders. The Post-Audit Meeting was intentionally facilitated within a week of the

start of field observations to maintain momentum while the RSA team and stakeholders had a fresh perspective. Presenting the preliminary findings in a meeting gave the DOTI staff an opportunity to ask questions and seek clarification on the RSA findings and also provided a useful forum for DOTI to suggest additional or alternative mitigation measures in conjunction with the RSA team. The discussion provided practical information that was subsequently used to write the RSA report.

After the Post-Audit meeting the RSA team compiled a final report over the course of two to three months. The final RSA report included documentation of all findings, photos from the field, observations, crash data and analysis, recommended countermeasures, cost guidance, and planning considerations.

3. Summary of Analysis for Each Corridor

A crash analysis was completed on each corridor to analyze the overall corridor crash trends and location-specific crashes. For each corridor, mapping was completed to understand where the crashes were occurring. Corridor-wide statistics were pulled to understand the total number of crashes, number of serious injury crashes, and number of fatal crashes. Other corridor wide analysis included identifying the crash types by total crashes and KSI crashes, as well as identifying the time-of-day that crashes were occurring.

Detailed crash analysis was conducted at each intersection and mid-block location. Intersection-specific analysis included identifying the number of crashes, crash type, and driver action contributing to the crash. Crash reports were reviewed for all fatal, serious injury, pedestrian-involved, and bicycle-involved crashes to understand the details of the crash. This section describes the key takeaways from the crash analysis on each corridor.

3.1. Summary of Crash Trends for RSA Corridors

Each corridor included as part of this study are included on Denver's HIN and exhibit elevated crash statistics. Several corridors experienced elevated numbers of high-risk crashes such as left-turn crashes, through crashes, pedestrian crashes, and bicycle crashes. **Table 2** to **Table 4** present a summary of the crash data. For each study area, the most recently available five-years of crash data was evaluated using DOTI's Open Data Catalog Traffic Accidents layer. Information on each corridor can be found in subsequent sections.

Table 2. Average Corridor Crashes Per Year

Corridor	Average Crashes Per Year		
	Total	KSI	Fatal
Alameda Avenue	64.4	2.4	0
Broadway	122.8	6.4	0.4
Colorado Boulevard	127.6	2	0
Speer Boulevard	62.6	1.4	0.2
Tower Road South	55.6	2.2	0
Tower Road North	67.2	5	0.6
University Boulevard	71.8	1.6	0.2

Table 3. Number of Total Corridor Crashes by Crash Type

Corridor	Number of Total Crashes (Type)										
	Rear End	Sideswipe	Broadside			Head On			Fixed Object	Pedestrian	Bicycle
			LT*	TH*	RT*	LT*	TH*	RT*			
Alameda Avenue	126	57	20	24	3	0	0	0	28	3	4
Broadway	135	171	24	88	27	9	11	1	21	46	14
Colorado Boulevard	257	129	26	75	8	0	0	0	28	20	6
Speer Boulevard	107	56	33	40	7	7	1	1	18	4	1
Tower Road South	92	25	52	42	9	4	4	2	5	5	3
Tower Road North	133	40	66	39	7	13	5	1	8	8	0
University Boulevard	153	66	34	30	6	13	3	0	4	6	3

Table 4. Number of KSI Corridor Crashes by Crash Type

Corridor	Number of KSI Crashes (Type)										
	Rear End	Sideswipe	Broadside			Head On			Fixed Object	Pedestrian	Bicycle
			LT*	TH*	RT*	LT*	TH*	RT*			
Alameda Avenue	1	0	5	1	0	0	0	0	2	1	0
Broadway	0	0	2	10	0	1	1	0	1	12	1
Colorado Boulevard	2	1	1	3	0	0	0	0	1	1	1
Speer Boulevard	0	1	1	1	0	0	0	0	2	0	0
Tower Road South	1	0	5	2	0	1	0	0	1	1	0
Tower Road North	4	0	7	7	0	1	1	0	0	5	0
University Boulevard	0	0	0	2	0	2	0	0	0	1	1

3.2. Alameda Avenue

The Alameda Avenue corridor included intersections and midblock locations from Kearney Street to Fairmount Drive. The corridor included sections of four-lane two-way arterial with a raised median between Kearney Street and Monaco Street, a six-lane two-way arterial with a raised median between Monaco Street and Quebec Street, and a four-lane two-way arterial with a raised median between Quebec Street and Fairmount Drive.

The corridor runs for a total length of 1.3 miles through the study area with a posted speed limit of 35 mph. The land use is primarily residential with a school zone through the middle of the corridor. The collected daily volumes were approximately 29,000 vpd.

3.2.1. Field Observations and Recommendations

Field work was completed on Tuesday, October 15, 2024, and Wednesday, October 16, 2024. The RSA team walked and drove the corridor during AM, Midday, PM, and nighttime periods.

COMMON THEMES AND OBSERVATIONS

- Wide medians and shoulders contributed to difficult crossings for both pedestrians and motorists.
- High speeds were observed throughout the corridor.
- Roadway lighting was insufficient at many locations on the corridor.

COMMON RECOMMENDATIONS

- Implement lane reduction, shoulder striping, and curb extensions to help reduce speeding and improve side street pedestrian and motorist crossing.
- Update speed feedback sign location and add speed feedback within school zones.
- Add additional lighting along corridor to improve nighttime visibility.

3.2.2. Crash Analysis

Alameda Avenue from Kearney Street to Fairmount Drive crash data was analyzed from April 2019 through March 2024. During the study period, there were 322 total crashes, 12 serious injury crashes, and no fatal crashes. **Figure 3** displays a map where the crashes on the Alameda Avenue corridor occurred. Alameda Avenue and Quebec Street experienced the highest number of total and KSI crashes (111 PDO crashes / 4 KSI crashes). Alameda Avenue and Monaco Street (90 PDO / 3 KSI) and Alameda Avenue and Fairmount Drive (42 PDO / 3 KSI) both experienced a higher number of KSI crashes. **Figure 4** displays the crash types and KSI crashes. The most common crash types were rear end (38%), broadside (27%), and sideswipe (17%)

crashes. Left-turn movements were involved in 64% of all broadside crashes. The most common crash type that resulted in a KSI crash were broadside (25%) and approach turn (25%).

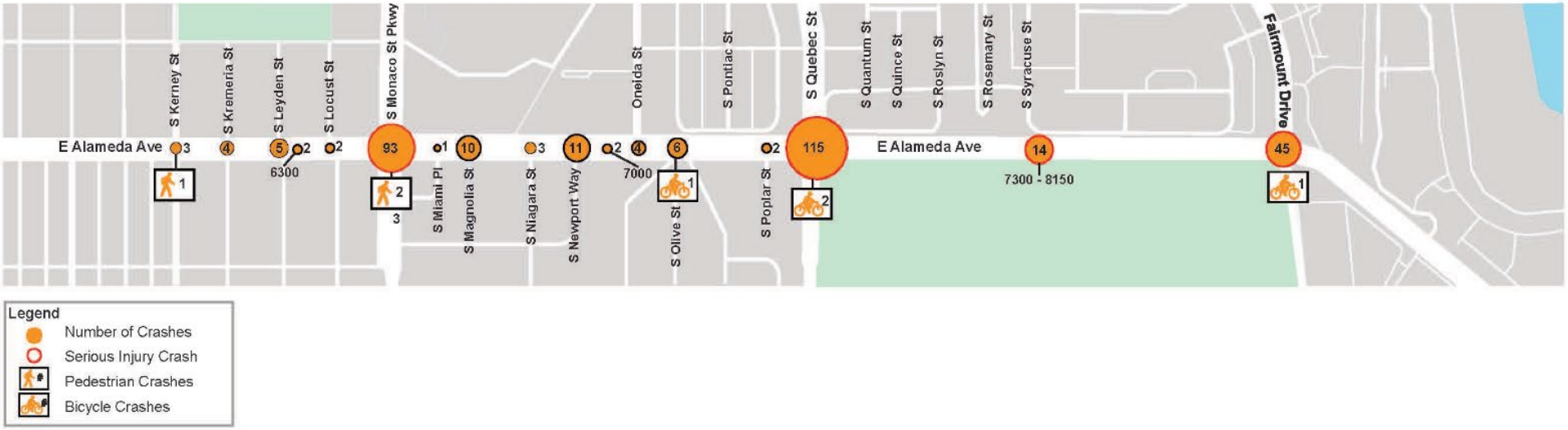
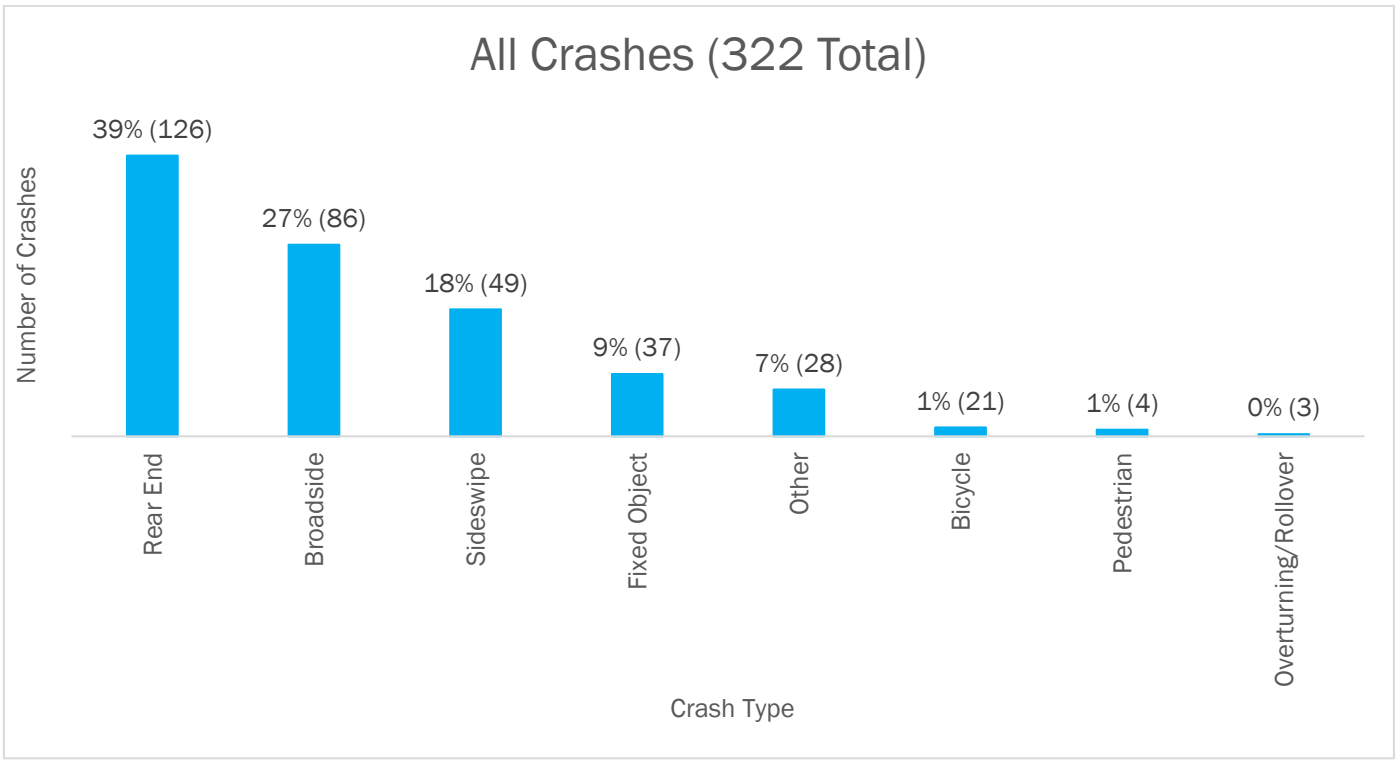


Figure 3. Map of Crashes on Alameda Avenue (April 2019 to March 2025)



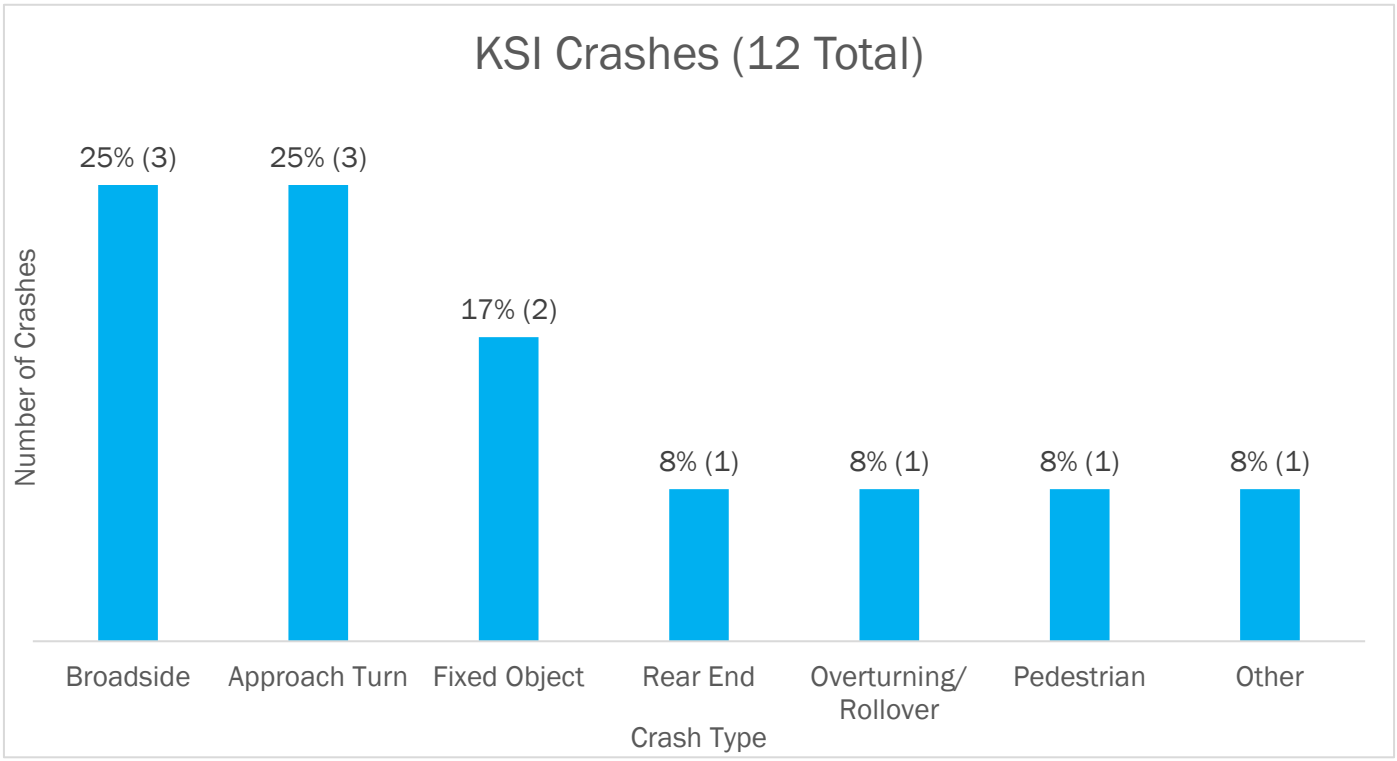


Figure 4. Top Harmful Events on Alameda Avenue by All Crashes and KSI crashes

3.3. Broadway

The Broadway corridor included intersections and midblock locations from 29th Street to Colfax Avenue. The corridor includes a four-lane two-way arterial section from 29th Street to the California/20th Street intersection. The corridor then becomes a four-lane one-way arterial through Colfax Avenue. There is a median present on the northern portion of the study area.

The corridor runs for a total length of 1.7 miles with a posted speed limit of 30 mph. This section of Broadway runs through downtown Denver and intersecting streets are laid out as a grid meeting Broadway at angles greater than 90 degrees. There is a high level of multi-modal activity including buses, pedestrians, motorists, cyclists, electric scooters, and rail on this portion of Broadway. Land use is mainly commercial, office space, and residential. The collected daily volumes were between 15,500 vpd and 23,000 vpd.

3.3.1. Field Observations and Recommendations

Field work was completed on Tuesday, March 4, 2025, and Wednesday, March 5, 2025. The RSA team walked and drove the corridor during AM, Midday, PM, and nighttime periods.

COMMON THEMES AND OBSERVATIONS

- Many intersections had more than four-legs with confusing or absent lane assignment signing and striping.
- Some locations had wide outside travel lanes and long pedestrian crossings.
- Roadway lighting was out and/or broken at many locations on the north portion of the corridor.

COMMON RECOMMENDATIONS

- Install and refresh lane assignment signing and striping to provide clear instructions. Change sign orientation if the sign is visible for adjacent movements.
- Install curb extensions to slow vehicle turning speeds and reduce pedestrian crossing lengths. Install enhanced pedestrian crossings in key locations.
- Fix and maintain broken luminaires.

3.3.2. Crash Analysis

Broadway from Colfax Avenue to 29th Street crash data was analyzed from January 2020 to December 2024. During the study period, there were 614 total crashes, 30 serious injury crashes, and 2 fatal crashes. Figure 5 displays a map where the crashes on the Broadway corridor occurred. Broadway and

Colfax Avenue experienced the highest number of total crashes and KSI crashes (66 PDO crashes / 14 KSI crashes). **Figure 6** displays the crash types and KSI crashes. The most common crash types were sideswipe (28%), broadside (26%), and rear end (22%). Left-turn movements were involved in 15% of all broadside crashes. The most common crash type that resulted in a KSI crash were broadside (41%) and pedestrian (38%).

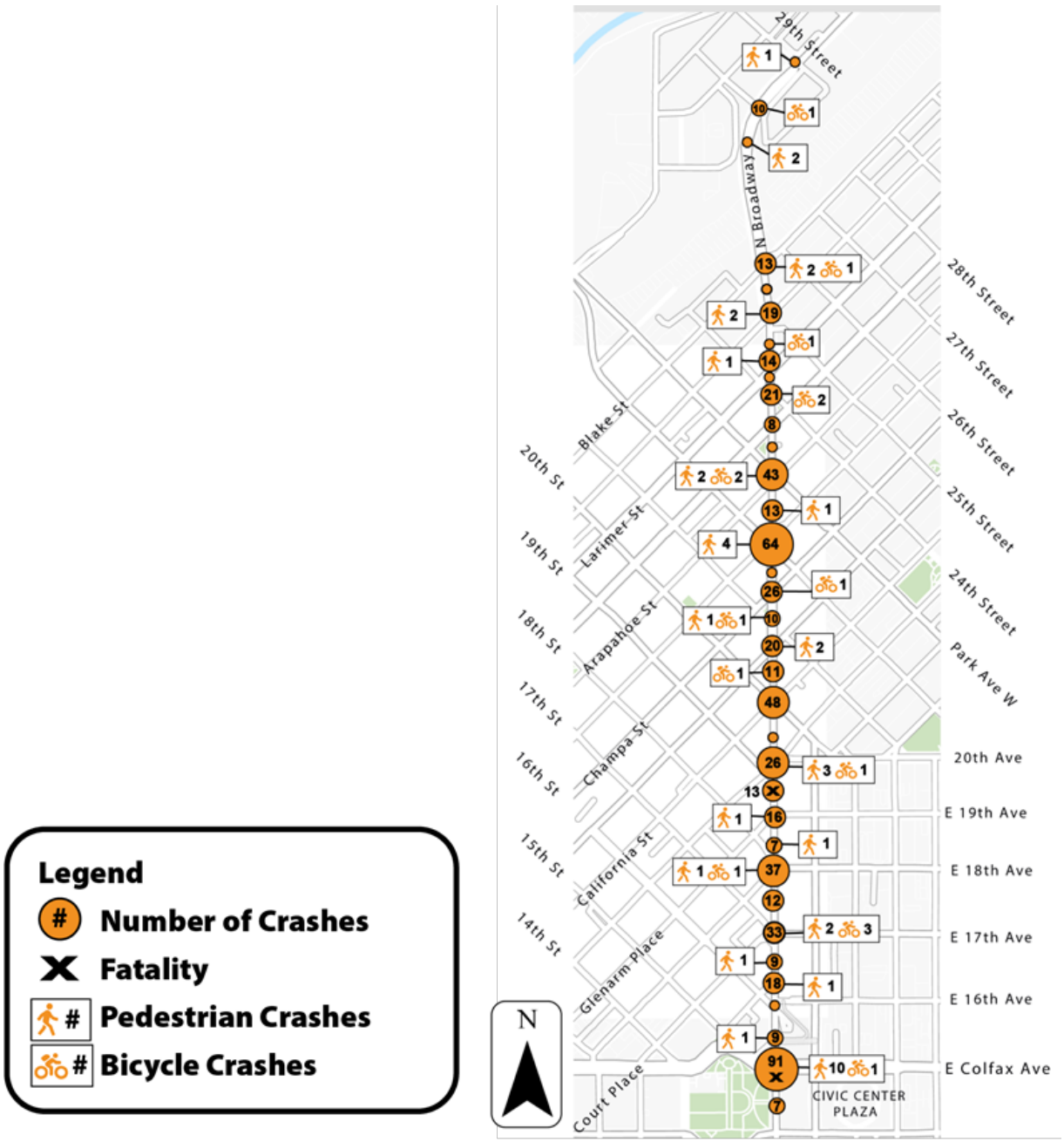
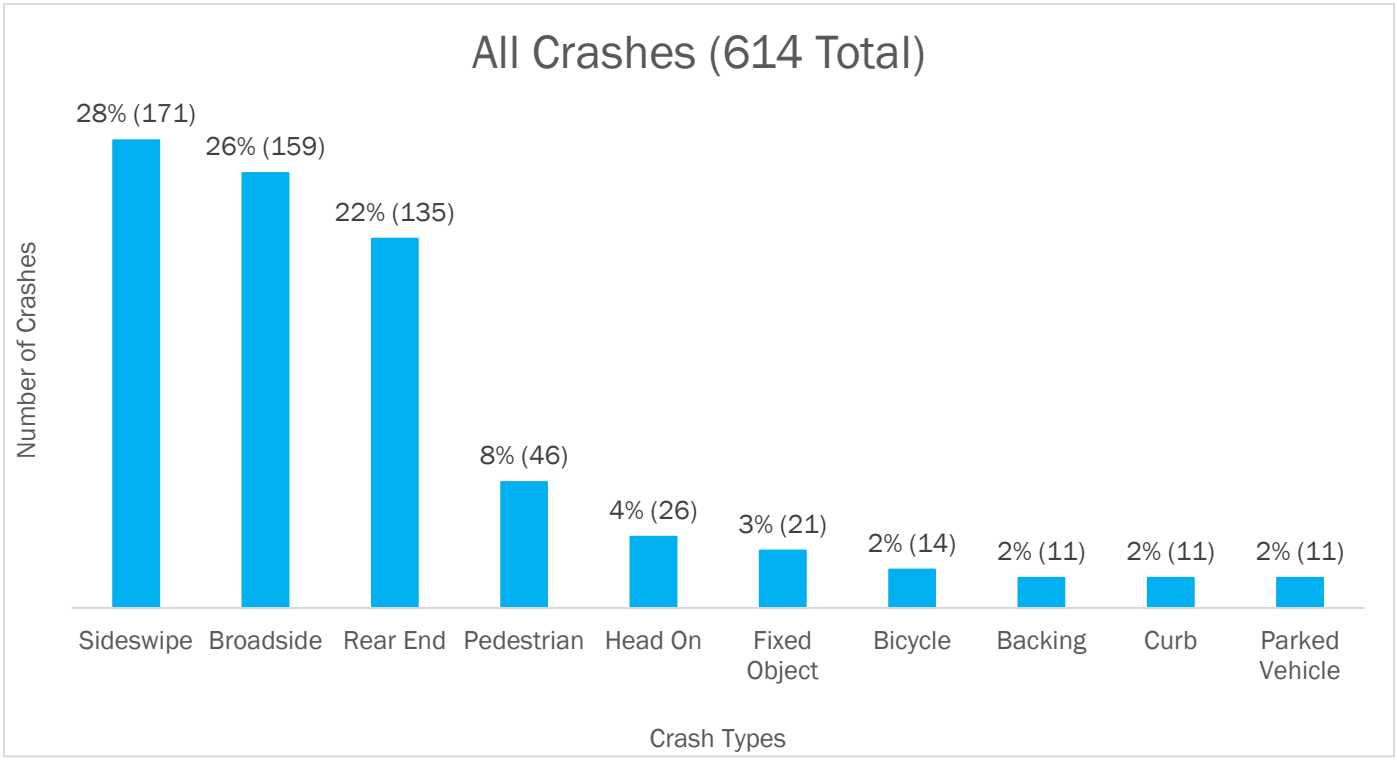


Figure 5. Map of Crashes on Broadway (January 2020 to December 2024)



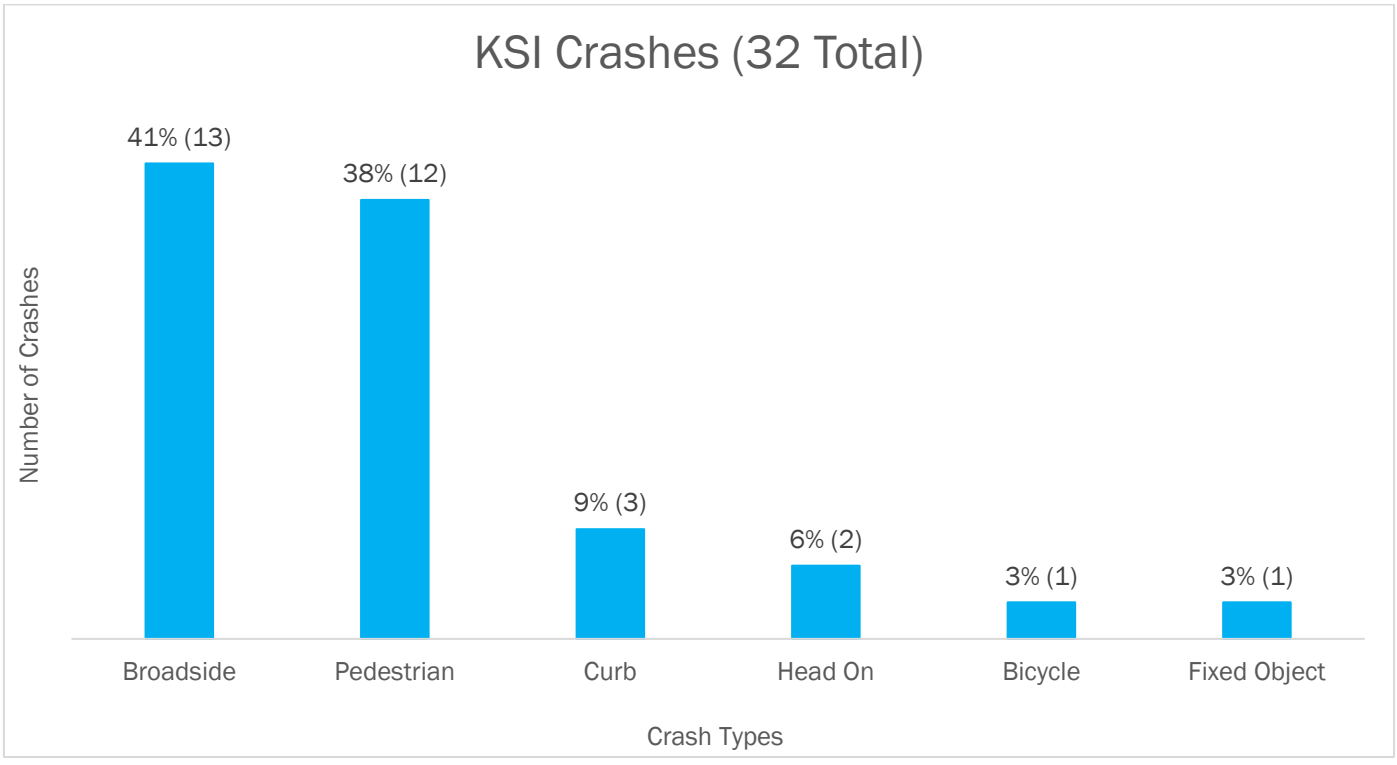


Figure 6. Top Harmful Events on Broadway by All Crashes and KSI Crashes

3.4. Colorado Boulevard

The Colorado Boulevard corridor included intersections and midblock locations from Mississippi Avenue to Iliff Avenue. The corridor is six-lane two-way arterial with a raised median for most of its length with the exception being between Florida Avenue and I-25 Ramp Intersections where it is an eight-lane two-way arterial with a raised median.

The corridor runs for a total length of 1.5 miles with a posted speed limit of 35 mph. Land use is primarily commercial with a high number of access points. I-25 intersects this section of Colorado Boulevard in the southern half of the study area. The collected daily volumes were between 25,500 vpd and 31,000 vpd

3.4.1. Field Observations and Recommendations

Field work was completed on Tuesday, May 6, 2025, and Wednesday, May 7, 2025. The RSA team walked and drove the corridor during AM, Midday, PM, and nighttime periods.

COMMON THEMES AND OBSERVATIONS

- Many right turn lanes appeared to be underutilized, contributing to longer pedestrian crossings which increases pedestrian exposure to motorists and increases the pedestrian crossing times needed to accommodate crossing movements.
- Left-turn movements warranted updates to phasing based on city guidelines and engineering judgement.
- Lane assignment signing and striping were inconsistent across the corridor.

COMMON RECOMMENDATIONS

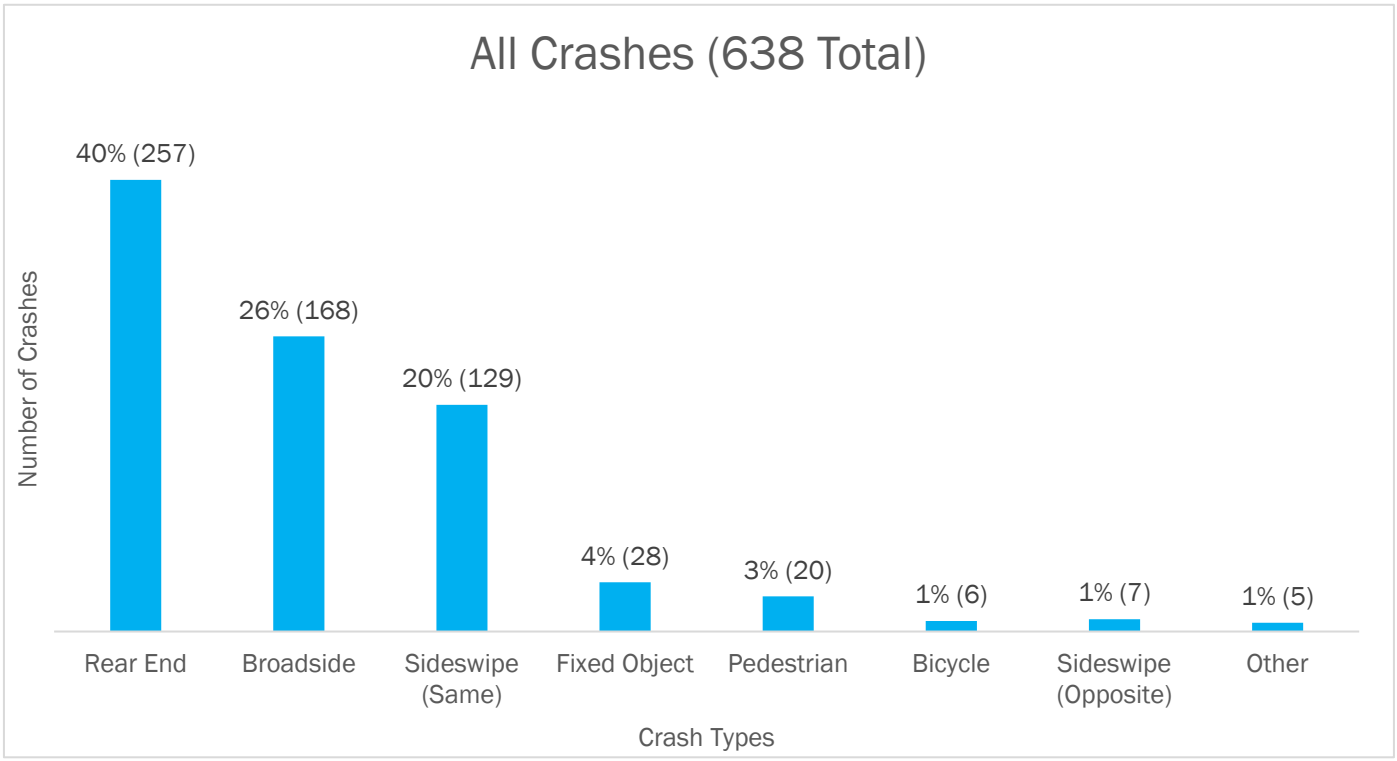
- Install curb extensions to slow vehicle turning speeds and reduce pedestrian crossing distances.
- Update left-turn phasing to include protected movements where needed.
- Install and refresh lane assignment signing and striping to provide clear instructions.

3.4.2. Crash Analysis

Colorado Boulevard from Mississippi Avenue to Iliff Avenue crash data was analyzed from January 2020 to December 2024. During the study period, there were 638 total crashes, ten serious injury crashes, and no fatal crashes. **Figure 7** displays a map where the crashes on the Colorado Boulevard corridor occurred. Colorado Boulevard and Mississippi Avenue (66 PDO / 1 KSI), Colorado Boulevard

and I-25 NB Ramps (66 PDO / 1 KSI), and Colorado Boulevard and Evans Avenue (65 PDO / 0 KSI) were the intersections that experienced the highest number of total crashes. Colorado Boulevard and Iowa Avenue, Colorado Boulevard and Buchtel Boulevard, and 1100 Block of Colorado Boulevard are the locations with the highest number of KSI crashes with two at each location in the study period. **Figure 8** displays crash types and KSI crashes. The most common crash types were rear end (40%) and broadside crashes (26%). Left-turn movements were involved in 37% of all broadside crashes. The most common KSI crash type was broadside (40%).

Figure 7. Map of Crashes on Colorado Boulevard (January 2020 to December 2024)



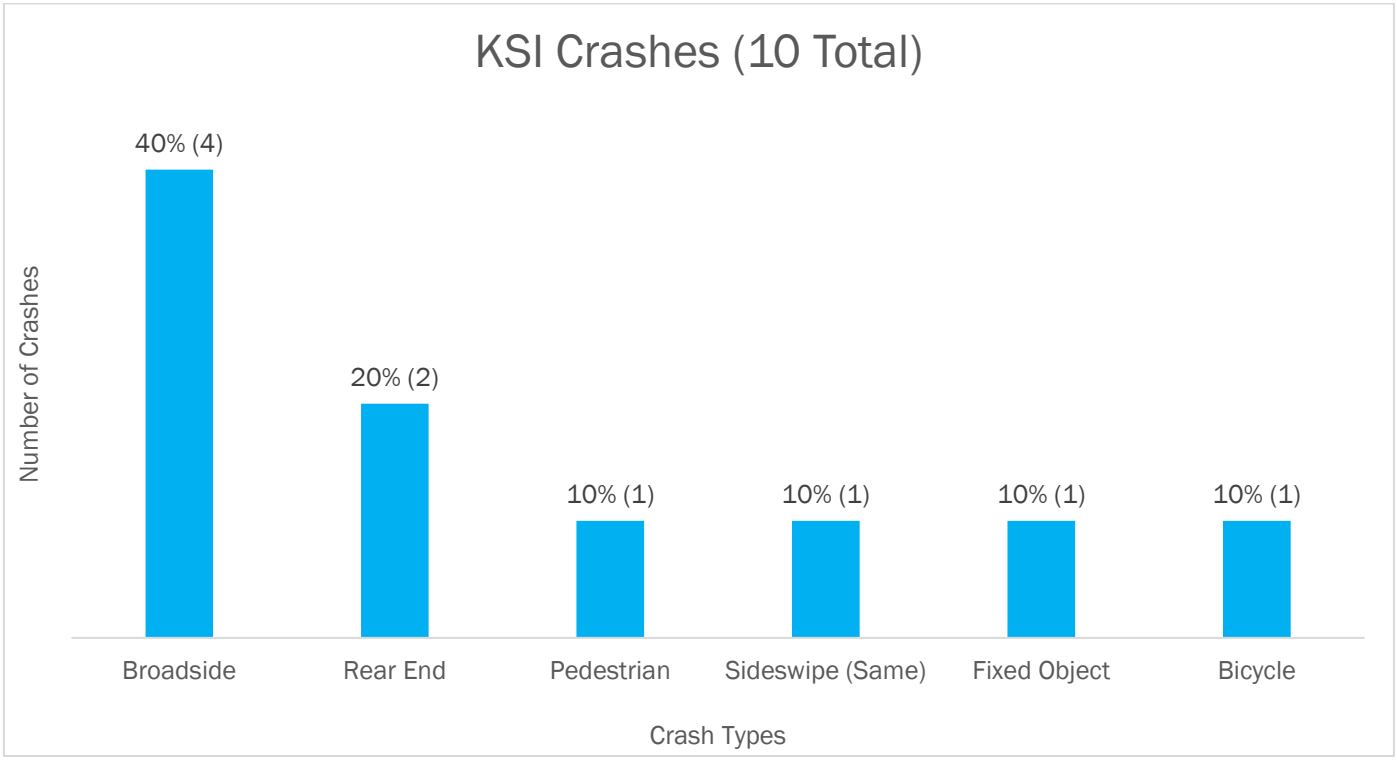


Figure 8. Top Harmful Events on Colorado Boulevard by All Crashes and KSI Crashes

3.5. Speer Boulevard

The Speer Boulevard corridor included intersections and midblock locations from Federal Boulevard to Elitch Circle. The corridor is a five-lane two-way arterial between Federal Boulevard and Bryant Street, a six-lane arterial between Byrant Street and the I-25 northbound off ramp, and a seven-lane arterial between the I-25 northbound off ramp and Elitch Circle. The corridor is median separated southeast of Zuni Street as it passes through the I-25 ramp intersections.

The corridor runs northwest and southeast for a total length of 1.1 miles and has a posted speed limit of 30 mph. Land use is mainly residential and commercial. There is a school zone in the northern portion of the study area, and I-25 intersects Speer Boulevard in the southern portion of the study area. The collected daily volumes were between 15,000 vpd and 23,000 vpd.

3.5.1. Field Observations and Recommendations

Field work was completed on Tuesday, October 14, 2025, and Wednesday, October 15, 2025. The RSA team walked and drove the corridor during AM, Midday, PM, and nighttime periods. Field observations were also made during school ingress and ingress periods and sporting event ingress and egress at Elitch Circle.

COMMON THEMES AND OBSERVATIONS

- Many traffic signs were knocked down, damaged, or faded.
- Retroreflective backplates were not installed on many signal heads along the study corridor.
- Pedestrian facilities were damaged, overgrown, and uncomfortable to maneuver in specific places. Pedestrian crossings were long in many locations due to five, six, and seven-lane cross-sections. In addition, the distance between pedestrian crossings on this corridor could be long in some sections.

COMMON RECOMMENDATIONS

- Replace and reset knocked down, damaged, and faded signs, particularly in school zone areas.
- Install retroreflective backplates on all signal heads.
- Consider lane reduction to improve multi-modal quality. This might include a raised median, wider detached sidewalks, bike lanes, or on street parking. Consider installing new or enhanced pedestrian crossings in key locations.

3.5.2. Crash Analysis

Speer Boulevard from Federal Boulevard to Elitch Circle crash data was analyzed from July 2020 to June 2025. Field work was completed on Tuesday, October 14, 2025, and Wednesday, October 15, 2025. During the study period there were 313 total crashes, six serious injury crashes, and one fatal crash. **Figure 9** displays a map where the crashes on Speer Boulevard corridor occurred. Speer Boulevard and Zuni Street experienced the highest number of total crashes (68 PDO / 1 KSI). Speer Boulevard and I-25 SB Off-Ramps (38 PDO / 2 KSI) and Speer Boulevard and Elitch Circle (36 PDO / 2 KSI) were the intersections that experienced the highest number of KSI crashes. **Figure 10** displays crash types and KSI crashes. The most common crash type was rear end (34%) and broadside (28%). Left-turn movements were involved in 40% of all broadside crashes. The most common KSI crashes were fixed object (29%) and broadside (29%).

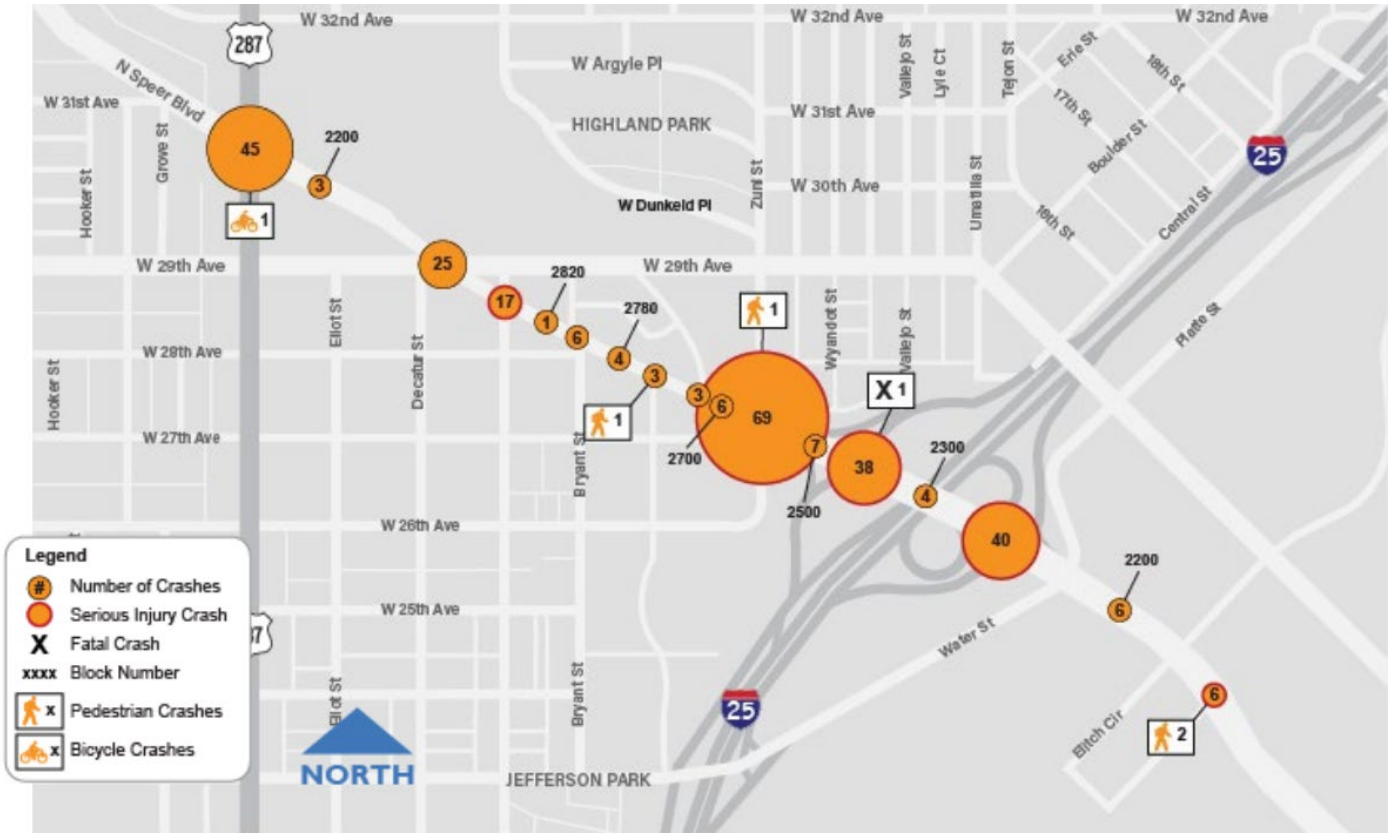
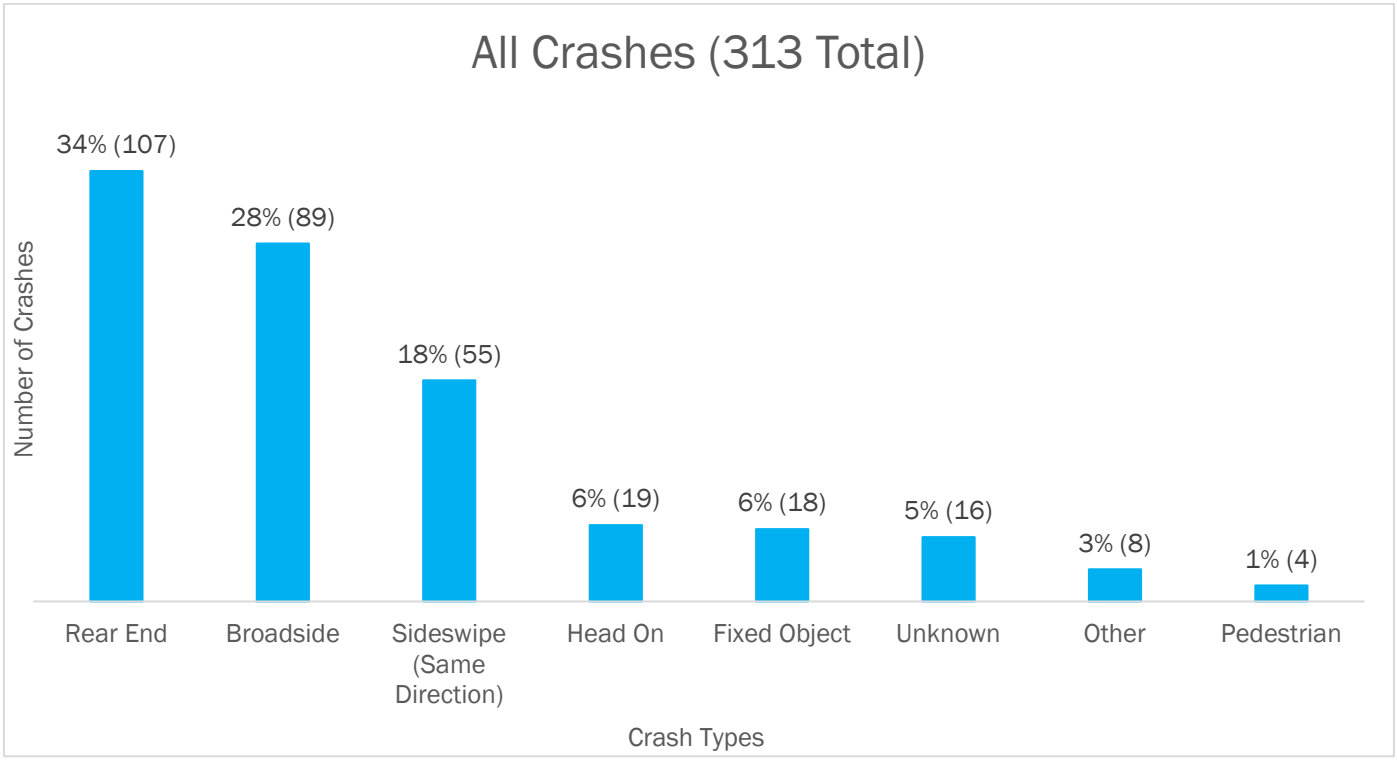


Figure 9. Map of Crashes on Speer Boulevard (July 2020 to June 2025)



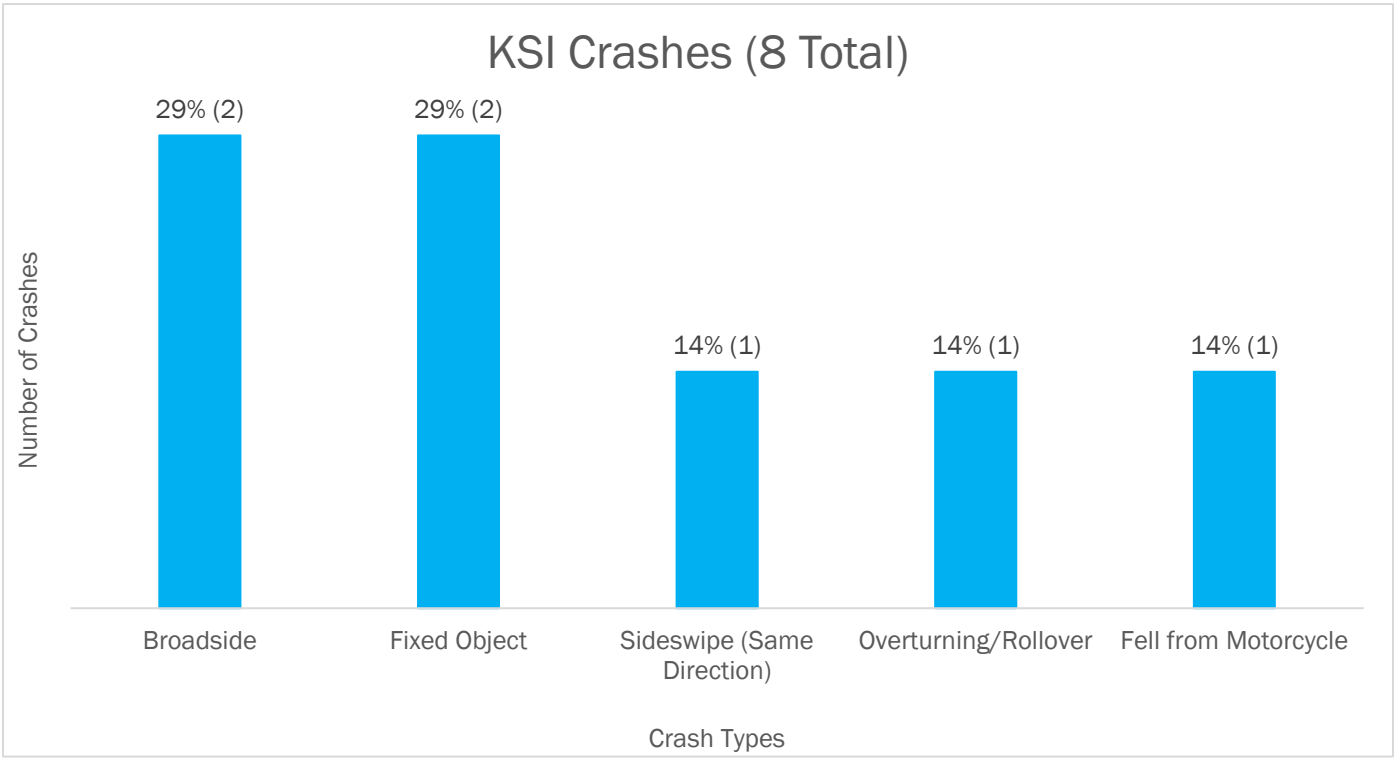


Figure 10. Top Harmful Events on Speer Boulevard by All Crashes and KSI crashes

3.6. Tower Road – 45th Avenue to 56th Avenue

The South Tower Road corridor included intersections and midblock locations from south of 56th Avenue to 45th Avenue. The corridor is four-lane two-way arterial with a raised median.

The corridor runs for a total length of 1.5 miles through the study area with a posted speed limit of 40 mph in the northern portion and 45 mph in the southern portion. Land use is mainly commercial, residential, and agricultural. The collected daily volumes were between 23,000 vpd and 32,000 vpd.

3.6.1. Field Observations and Recommendations

Field work was completed on Tuesday, September 17, 2024, and Wednesday, September 18, 2024. The RSA team walked and drove the corridor during AM, Midday, PM, and nighttime periods.

COMMON THEMES AND OBSERVATIONS

- Some left-turn lanes were negatively offset from opposing left-turn lanes, obscuring line of sight to oncoming traffic.
- Vehicles exiting business accesses and making side street movements often required dangerous maneuvers, or motorists ignored restricted movements by traversing over dirt medians.
- Speeding was observed across the entire corridor, increasing risk to motorists and pedestrians alike. Spikes in high end speeding data observed during non-peak periods.

COMMON RECOMMENDATIONS

- Improve line of sight for left-turn movements that have negative offsets by updating striping or lane geometry.
- Install high-tension cable and raised medians for locations with non-compliance of restricted movements and further restrict dangerous access movements that are currently allowed.
- Review speed limits and increase speed signage in school zones.

3.6.2. Crash Analysis

Tower Road – 45th Avenue to 56th Avenue (Tower Road South) crash data was analyzed from April 2019 to March 2024. Field work was completed for this corridor on Tuesday, September 17, 2024, and Wednesday, September 18, 2024. During the study period, there were 278 total crashes, 11 serious injury crashes, and no fatal crashes. **Figure 11** displays a map where the crashes occur. Tower Road and Green Valley Ranch experienced the highest number of crashes (90 PDO crashes / 2 KSI

crashes), and Tower Road and Elmendorf Drive experienced the highest number of serious injury crashes (27 PDO crashes / 4 KSI crashes). **Figure 12** displays crash types and KSI crashes. The most common crash types were broadside crashes (43%) and rear end crashes (35%). Left-turn movements made up 47% of all broadside crashes. The most common crash that resulted in a serious injury were broadside crashes (64%).

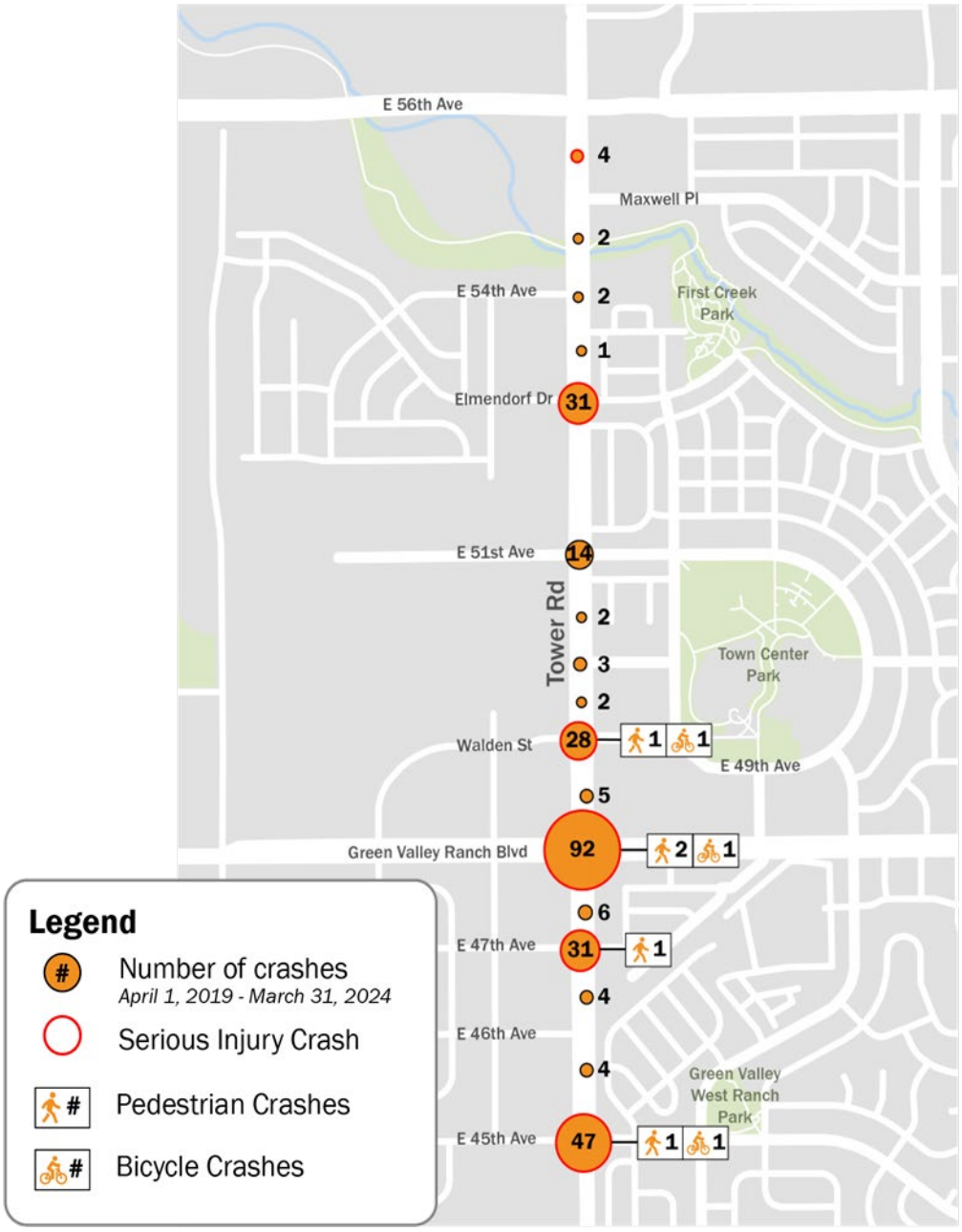


Figure 11. Map of Crashes on Tower Road South (April 2019 to March 2024)

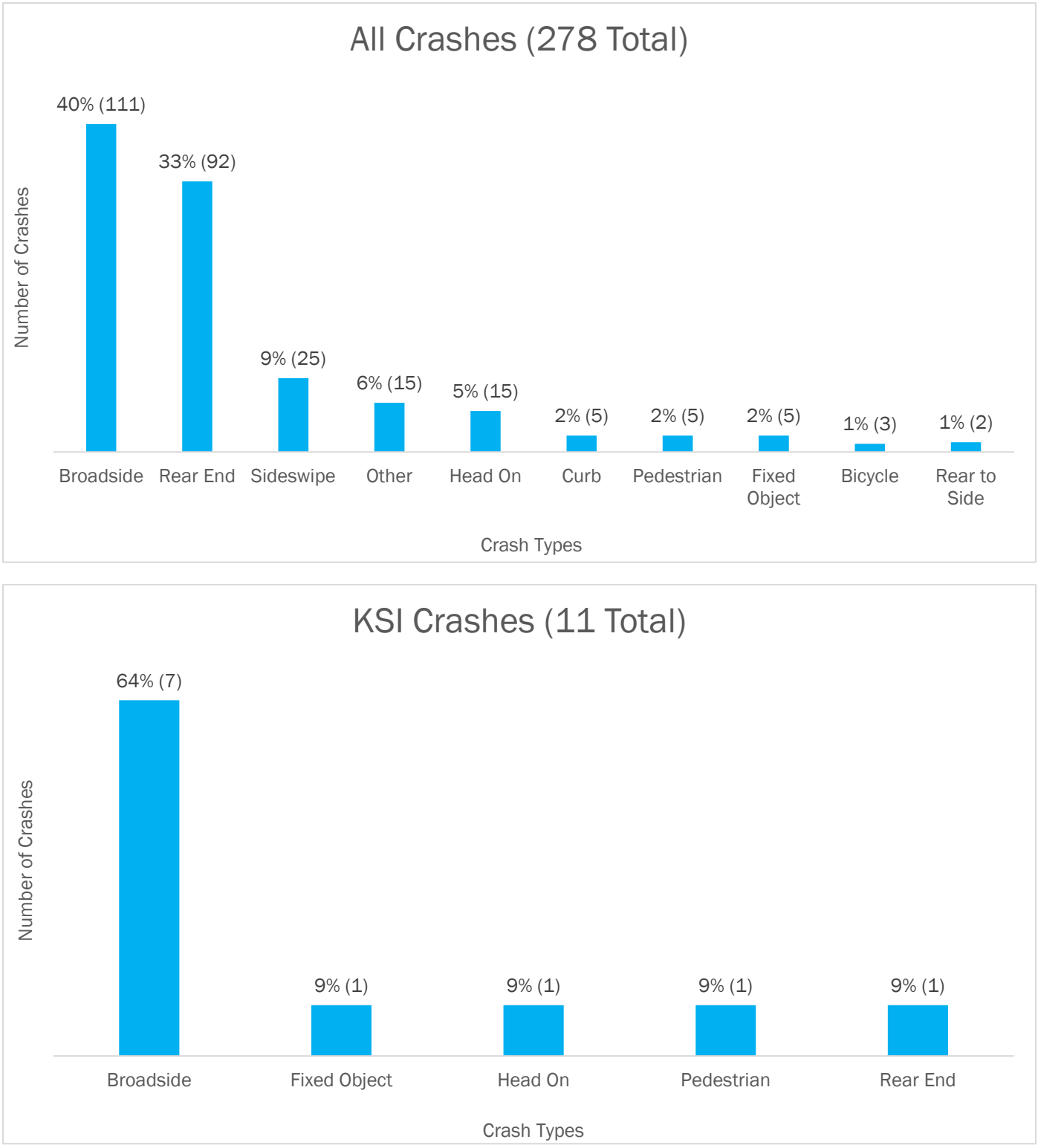


Figure 12. Top Harmful Events on Tower Road South by All Crashes and KSI crashes

3.7. Tower Road – 56th Avenue to 71st Avenue

The North Tower Road corridor included intersections and midblock locations from 71st Avenue to 56th Avenue. The corridor is four-lane two-way arterial with a raised median.

The corridor runs through the study area for a total length of 1.9 miles with a posted speed limit of 40 mph in the northern section and 45 mph in the southern section. This section of Tower Road connects to Peña Boulevard to the north which leads to Denver International Airport. Land use is mainly commercial, residential, and agricultural with a group of hotels along the northern portion of the study area. The collected daily volumes were between 15,000 vpd and 23,000 vpd.

3.7.1. Field Observations and Recommendations

Field work was completed on Tuesday, August 13, 2024, and Wednesday, August 14, 2024. The RSA team walked and drove the corridor during AM, Midday, PM, and nighttime periods.

COMMON THEMES AND OBSERVATIONS

- Some left-turn lanes were negatively offset from opposing left-turn lanes, obscuring line of sight to oncoming traffic.
- Vehicles exiting business accesses and making side street movements often required dangerous maneuvers.
- Roadway lighting was out and/or broken at many locations along the corridor.

COMMON RECOMMENDATIONS

- Improve line of sight for left-turn movements that have negative offsets by updating striping or lane geometry. Update some left-turn movements with protected phasing.
- Restrict dangerous access movements that are currently allowed.
- Review speed limits and increase speed signage in school zones.

3.7.2. Crash Analysis

Tower Road – 56th Avenue to 71st Avenue (Tower Road North) crash data was analyzed from April 2019 to March 2024. Field work was completed for this corridor on Tuesday, August 13, 2024 and Wednesday, August 14, 2024. During the study period, there were 336 total crashes, 22 serious injury crashes, and three fatal crashes. **Figure 13** displays a map where the crashes occurred. Tower Road and 56th Avenue experienced the highest number of total crashes and KSI crashes (132 PDO / 11 KSI crashes). All three fatal crashes occurred at Tower Road and 69th Avenue (19 PDO / 8 KSI crashes).

Figure 14 displays crash types and KSI crashes. The most common crash types were rear end (40%) and broadside (36%). Left-turn movements were involved in 55% of all broadside crashes. The most common crash type that resulted in a serious injury or fatality was broadside crashes (56%).

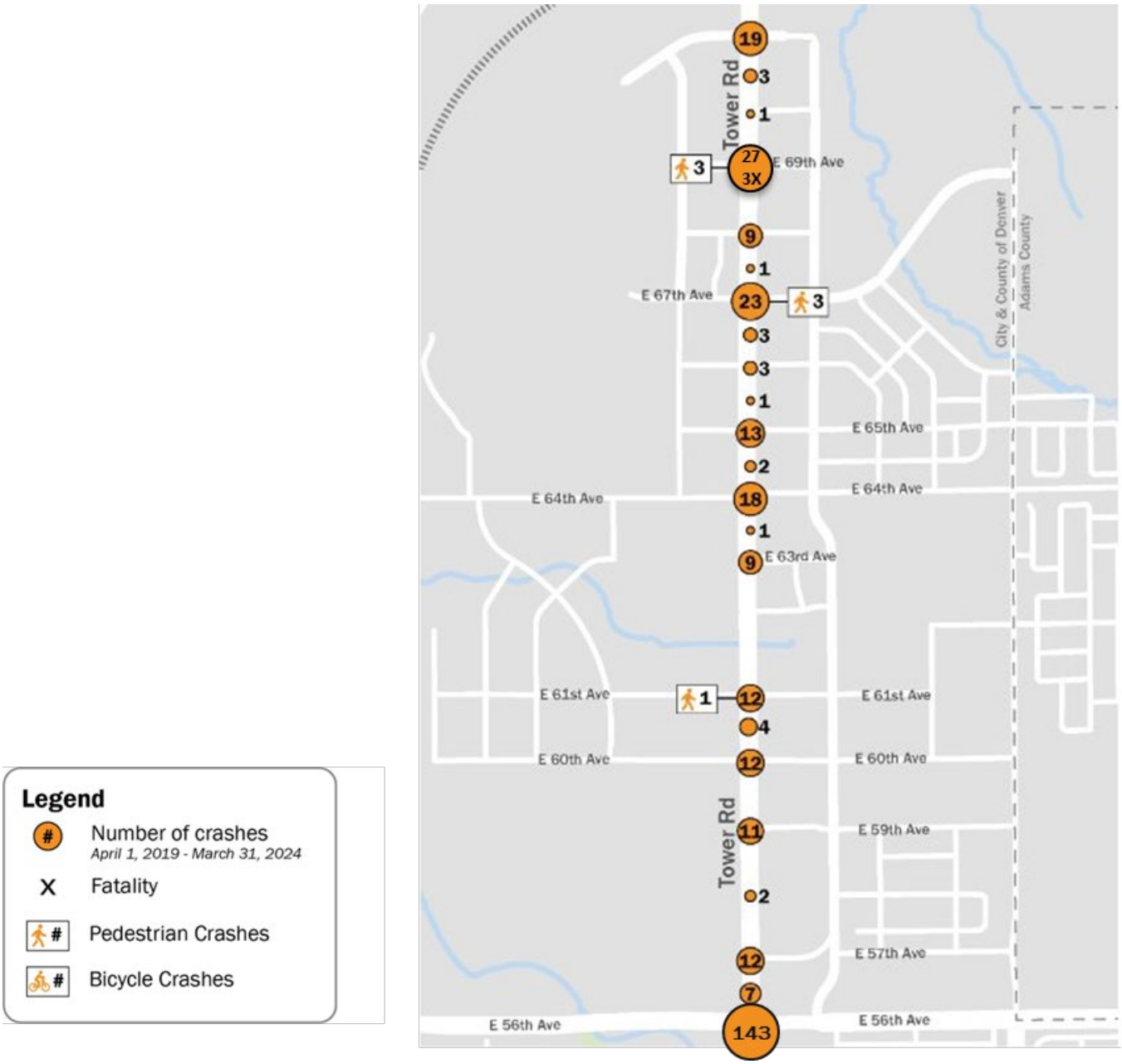
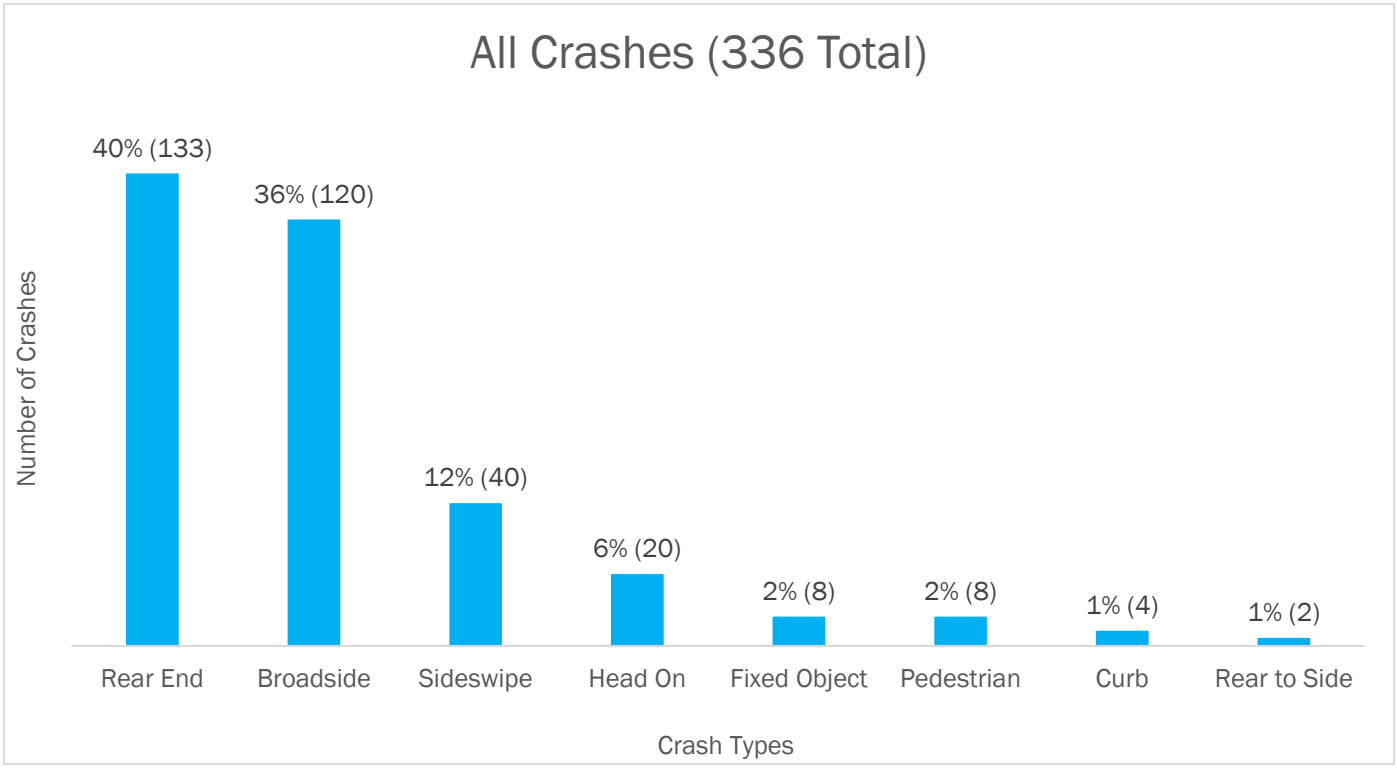


Figure 13. Map of Crashes on Tower Road North (April 2019-March 2024)



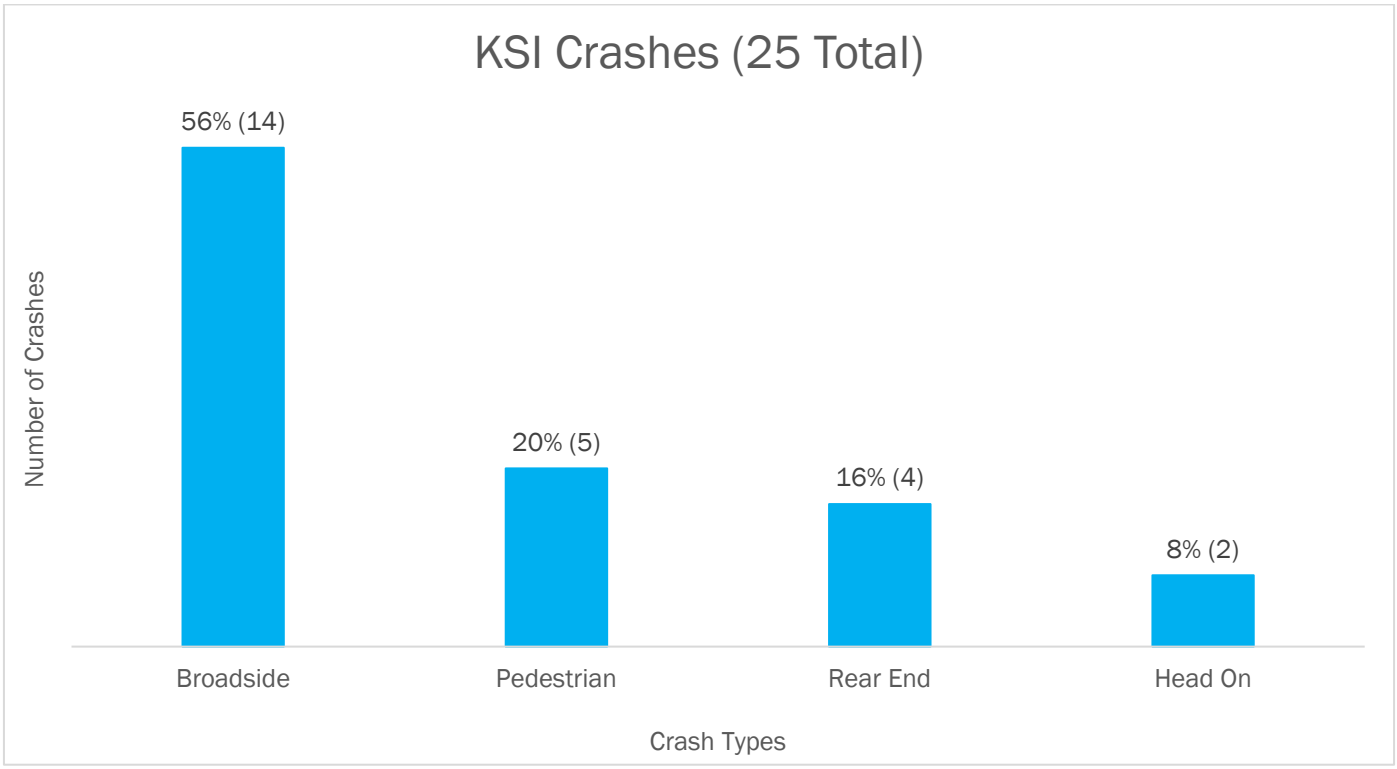


Figure 14. Top Harmful Events on Tower Road North by All Crashes and KSI crashes

3.8. University Boulevard

The University Boulevard corridor included intersections and midblock locations from Iowa Avenue to Yale Avenue. The corridor is four-lane two-way arterial with a median present only at the I-25 interchange.

The corridor runs for a total length of 1.4 miles with a posted speed limit of 30 mph. This section of University Boulevard runs through the campus of Denver University and has a significant student population. Land use is mainly commercial, academic, and residential. I-25 intersects the corridor in the northern portion of the study area. The collected daily volumes were between 23,000 vpd and 34,000 vpd.

3.8.1. Field Observations and Recommendations

Field work was completed on Tuesday, September 16, 2025, and Wednesday, September 17, 2025. The RSA team walked and drove the corridor during AM, Midday, PM, and nighttime periods. In addition, Friday night observations were conducted to gather information about student and pedestrian actions.

COMMON THEMES AND OBSERVATIONS

- Sun glare was an issue for motorists on side streets during AM and PM periods and made it difficult to see crossing pedestrians.
- There was heavy queuing and delay at both ends of the corridor and pedestrians were seen crossing against the signal.
- Speeds were high, especially during nighttime and off-peak periods.

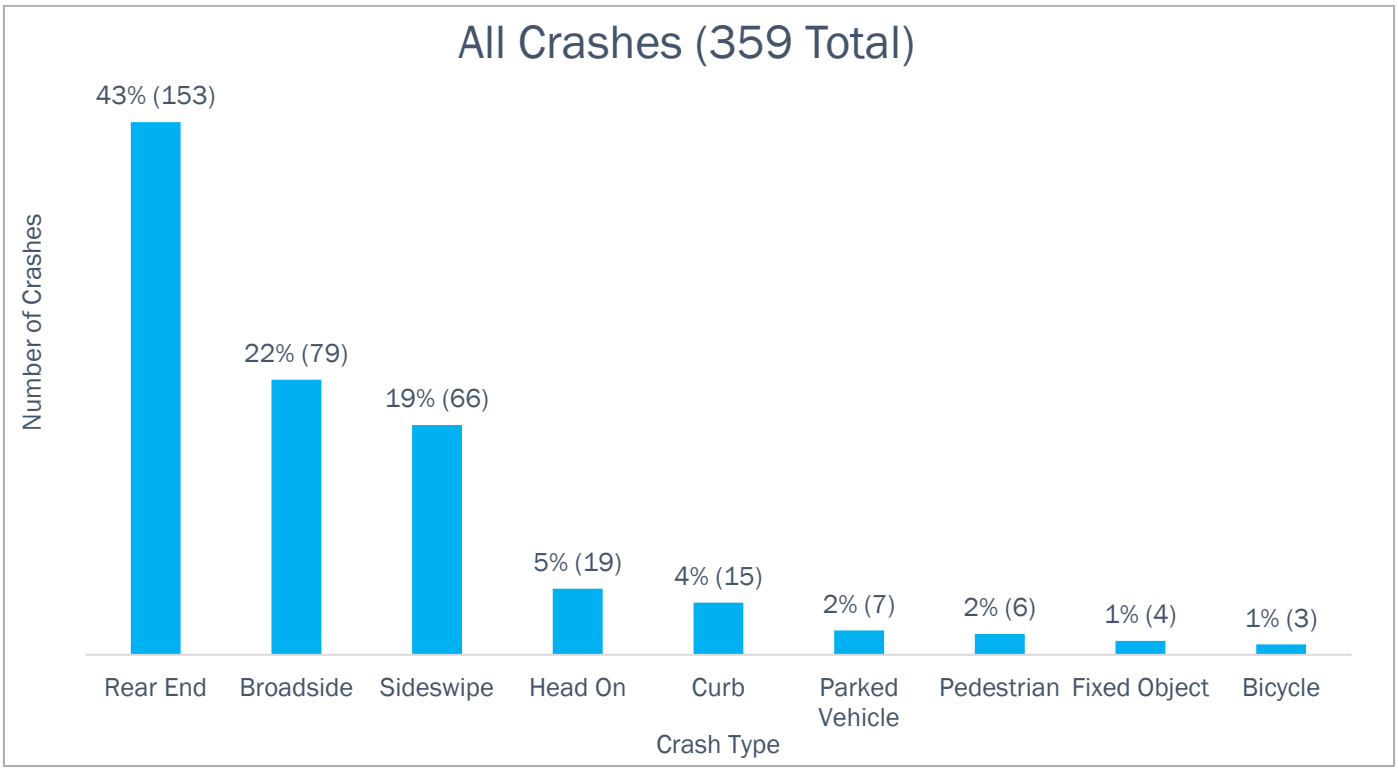
COMMON RECOMMENDATIONS

- Install Leading Pedestrian Intervals to increase pedestrian visibility.
- Re-time corridor signals and shorten cycle length to reduce pedestrian delay. Install preemption to assist emergency vehicle travel during peak periods at intersections without preemption.
- Update signal timing during off-peak periods to promote progression of slower vehicles and install speed feed-back signs.

3.8.2. Crash Analysis

University Boulevard from Iowa Avenue to Yale Avenue crash data was analyzed from June 2020 to May 2025. Field work was completed for this corridor on Tuesday, September 16, 2025, and Wednesday, September 17, 2025. During the study period there were 359 total crashes, 7 serious injury crashes, and 1 fatal crash. **Figure 15** displays a map where the crashes occurred. University Boulevard and Evans Avenue experienced the highest number of total crashes (68 PDO / 1 KSI). University Boulevard and Buchtel Boulevard (43 PDO / 2 KSI) and University Boulevard and I-25 NB Ramps (46 PDO / 2 KSI) each experienced two KSI crashes. **Figure 16** displays crash types and KSI crashes. The most common crash types were rear ends (43%) and broadsides (22%). Left-turn movements were involved in 43% of all broadside crashes. The most common crash type that resulted in a serious injury was broadside (25%), head-on (25%), and curb crashes (25%).

Figure 15. Map of Crashes on University Boulevard (June 2020 to May 2025)



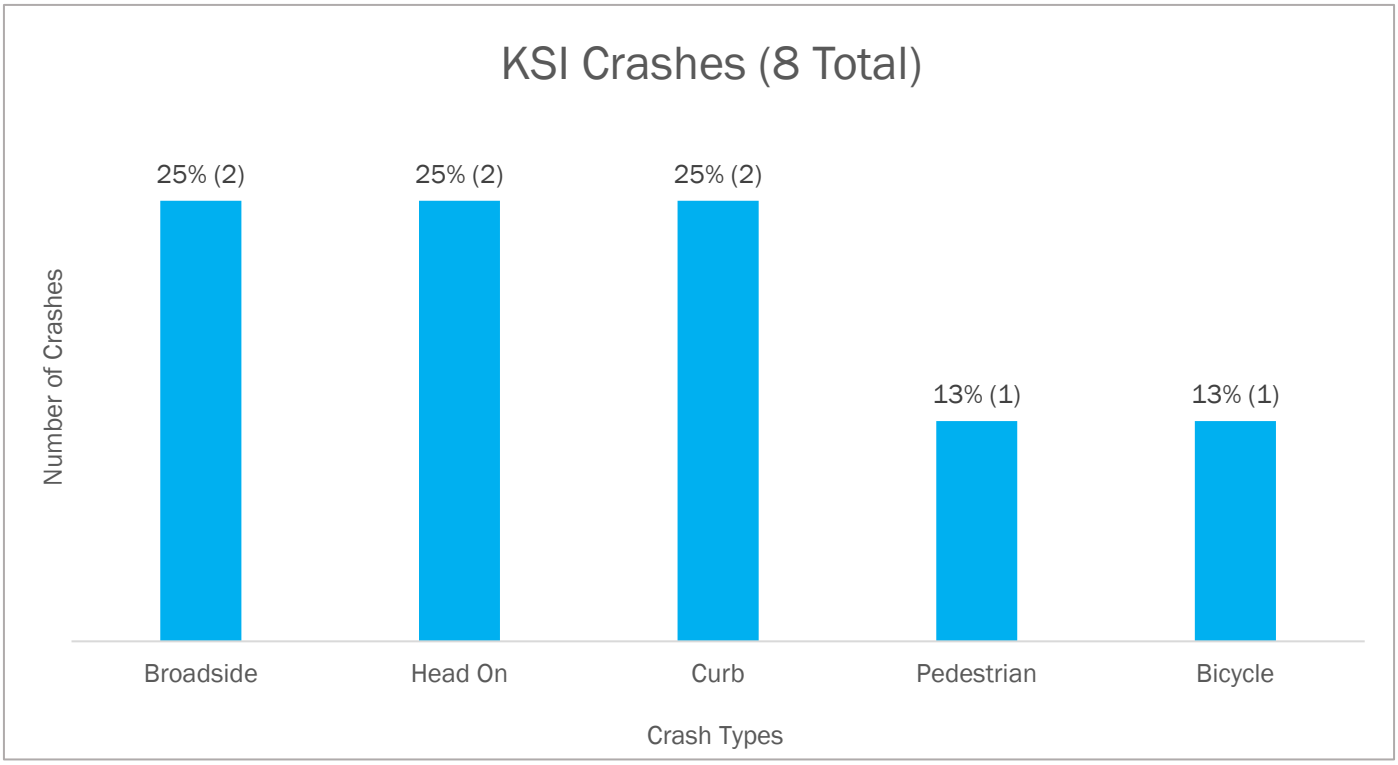


Figure 16. Top Harmful Events on University Boulevard by All Crashes and KSI crashes

3.9. 38th Avenue

DOTI completed an RSA as part of the West 38th Avenue Corridor Study. The 38th Avenue study corridor included intersections and midblock locations from Sheridan Boulevard to Fox Street. The corridor is a four-lane two-way arterial. The study area is approximately three miles in length. The 2023-2025 study resulted in a final report which included an RSA, traffic analysis, pedestrian analysis, transit analysis, green infrastructure analysis, and alternative and recommendation development.

As part of the SS4A RSA project, the team conducted a before-after study to evaluate the impacts of reducing the corridor speed limit from 35 mph to 30 mph on number of crashes, severity, and travel speeds. The purpose of the before-after study was to provide the city with a better understanding of what other actions could be taken to complement the speed reduction change and what the expectations might be for future speed limit changes elsewhere in the city.

3.9.1. Before and After Study

The speed limit reduction on 38th Avenue was implemented in November of 2024. Speed, volume, and crash data were evaluated as part of the before-after study including a five-year period before the speed limit change, and one-year period of available data after the speed limit change. The study area was broken into four segments that were in alignment with the West 38th Ave Corridor Study completed by DOTI. Thes segments included:

- West of Vrain Street
- West of Grove Street
- West of Alcott Street
- West of Fox Street

VOLUME ANALYSIS

Volumes were collected to form a baseline understanding of any potential impacts to traffic patterns. The daily volume changes after the speed limit reduction varied based on location. At the east end of the corridor, collected volumes were significantly lower due to a lane closure and construction at 38th Avenue and Fox Street. Overall, the modest changes at most locations are typical for collection periods that are close in time and reflect normal variability rather than route demand shifts. Results can be seen in **Table 5**.

SPEED ANALYSIS

Speed distributions along the corridor were consistent at each location, with a similar percentage of vehicles travelling between 30 mph and 35 mph. The average percentage of vehicles travelling above 35 mph decreased at all locations, particularly in the center of the corridor. This trend suggests that the speed limit reduction may have an impact on reducing high-end speeders. In particular, the center two segments showed shifts to fewer high-end speeders and higher low-end speeds in both directions.

The exception to this was observation was the segment west of Fox Street where speeds at the high end increased, particularly in the westbound direction as vehicles enter the corridor. It is assumed this increase in westbound speeds at Fox Street was influenced by reduction to a single lane and less congestion due to lower traffic volumes. The lane reduction was part of a permitted capital improvement project at W 38th Ave and Fox Street. Results can be seen in **Table 5**.

CRASH ANALYSIS

Crash data was obtained from the City's open data catalog "Traffic Incidents" dataset. The 5-year period prior to the speed limit reduction was from October 1, 2019 through October 31, 2024. The post-speed limit change period included data from December 1, 2024 to November 30, 2025. A month was provided in between data sets to allow for a period of normalization.

Across all six study years, the year after the speed limit reduction that had the fewest total crashes with 106 total crashes, five serious injury crashes and one fatal crash. The annual average in the before-period was 116 total crashes with four serious injuries and 1.2 fatal crashes per year. It should be noted that the general trend in total crashes had been dropping since the 2021-2022 period and the team acknowledges that a single year of data is not sufficient to draw conclusions. In addition, the overall KSI crashes did not see significant drop period to period which is a generally accepted benefit of lower vehicular speeds.

Continued monitoring of crashes in the area may see a continued downward trend, and it was recommended that additional safety mitigations be implemented to compound any benefits from the reduced speed limit. Results can be seen in **Figure 17**.

Table 5. Speed and Volume Comparisons on 38th Avenue

38th Ave Location	Metric		Before (Late 2023/Early 2024)	After (January 2026)	Outcome
West of Vrain St	**ADT**		**20,322**	**19,727**	**-595**
	85th %ile Speed	Eastbound	35.0 MPH	36.6 MPH	+1.6 MPH
		Westbound	37.0 MPH	35.3 MPH	-1.7 MPH
	95th %ile Speed	Eastbound	38.0 MPH	39.5 MPH	+1.5 MPH
		Westbound	40.0 MPH	38.2 MPH	-1.8 MPH
	% vehicles exceeding 35 mph	Eastbound	17.4%	25.2%	7.8%
		Westbound	31.4%	17.0%	-14.4%
	% vehicles exceeding 40 mph	Eastbound	2.1%	4.0%	1.9%
		Westbound	6.0%	2.4%	-3.6%
West of Grove St	**ADT**		**18,427**	**17,292**	**-1,135**
	85th %ile Speed	Eastbound	38.4 MPH	37.3 MPH	-1.1 MPH
		Westbound	39.6 MPH	36.7 MPH	-2.9 MPH
	95th %ile Speed	Eastbound	42.1 MPH	41.0 MPH	-1.1 MPH
		Westbound	44.1 MPH	40.2 MPH	-3.9 MPH
	% vehicles exceeding 35 mph	Eastbound	30.7%	26.1%	-4.6%
		Westbound	37.5%	24.8%	-12.7%
	% vehicles exceeding 40 mph	Eastbound	7.6%	6.9%	-0.7%
		Westbound	13.0%	5.4%	-7.6%
West of Alcott St	**ADT**		**17,739**	**18,175**	**+436**
	85th %ile Speed	Eastbound	39.7 MPH	35.8 MPH	-3.9 MPH
		Westbound	38.7 MPH	36.5 MPH	-2.2 MPH
	95th %ile Speed	Eastbound	43.8 MPH	38.5 MPH	-5.3 MPH
		Westbound	42.5 MPH	39.4 MPH	-3.1 MPH
	% vehicles exceeding 35 mph	Eastbound	49.9%	20.2%	-29.7%
		Westbound	34.0%	25.0%	-9.0%
	% vehicles exceeding 40 mph	Eastbound	13.1%	2.7%	-10.4%
		Westbound	8.3%	4.0%	-4.3%
West of Fox St	**ADT**		**20,144**	**13,746**	**-6,398**
	85th %ile Speed	Eastbound	38.0 MPH	40.0 MPH	+2.0 MPH
		Westbound	36.0 MPH	38.2 MPH	+2.2 MPH
	95th %ile Speed	Eastbound	41.0 MPH	45.1 MPH	+4.1 MPH
		Westbound	39.0 MPH	41.4 MPH	+2.4 MPH
	% vehicles exceeding 35 mph	Eastbound	38.6%	35.6%	-3.0%
		Westbound	17.8%	33.1%	15.3%
	% vehicles exceeding 40 mph	Eastbound	8.5%	15.0%	6.5%
		Westbound	3.8%	8.4%	4.6%

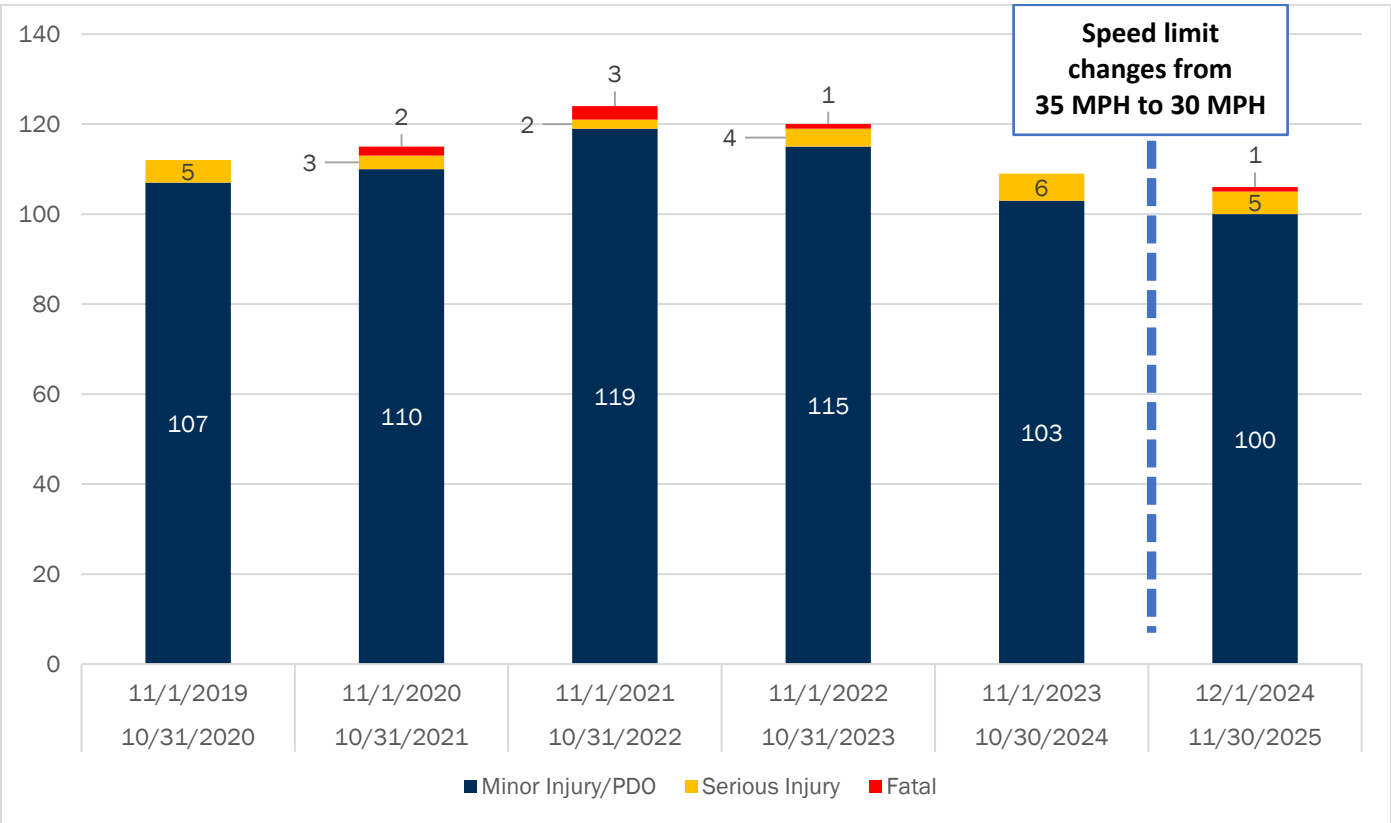


Figure 17. 38th Avenue Corridor Crashes by Study Period

3.10. Evans Avenue

DOTI conducted an RSA on Evans Avenue in September 2023 as part of the Evans Avenue Corridor Study project. The study area included Evans Avenue between Colorado Boulevard and Quebec Street with an approximate length of two miles. The RSA resulted in many recommendations, one of which included recommendations for updating left-turn phasing at several intersections.

As part of the SS4A RSA project, DOTI decided to re-visit the left-turn phasing analysis using their most recent Left-Turn Signal Warrant guidelines. This analysis included the intersections along Evans Avenue at the following intersections:

- Colorado Boulevard
- Birch Street
- I-25 Northbound Ramp Terminal Intersections
- Dahlia Street
- Holly Street

3.10.1. Evans Left-Turn Phasing Analysis

DOTI's left-turn guidelines include considerations and analysis of:

- **Geometry – Criteria A:** Geometry is recorded for the presence of specific bicycle facilities and proper sight distance.
- **Accident – Criteria B:** Crash history is analyzed for thresholds that might warrant additional left-turn phase protection.
- **Volume – Criteria C1-C3:** Volume and delay are evaluated to determine if protection is appropriate.
- **Pedestrian and Bicycle – Criteria D:** Pedestrian volumes, bicycle volumes, pedestrian accidents, and proximity to schools are evaluated.
- **Queuing and Phasing – Criteria E:** Observations on queuing and the existing left-turn phasing is considered as part of the analysis.

The analysis resulted in no recommended changes. All movements that warranted protection were either already protected-permitted or protected-only. Results of the analysis can be seen in Table 6.

Table 6. Left-Turn Phasing Analysis for Evans Avenue

Intersection	Updated Left-Turn Phasing Warranted?	Peak	Criteria							Peak Left-Turn Volumes
			A	B	C1	C2	C3	D	E	
Evans Ave and Colorado St	No	AM		WB* (Prot-Perm Threshold)	NB**, SB**, EB*, WB*	NB**, SB**, EB*, WB*				184 (EB)
		PM			NB**, SB**, EB*, WB*	NB**, SB**, EB*, WB*				135 (WB)
Evans Ave and Birch St	No	AM				SB**				19
		PM				SB**				10
Evans Ave and NB I25	No	AM				NB**, EB*				81
		PM				NB**				67
Evans Ave and Dahlia St	No	AM			EB*	EB*				62 (SB)
		PM			EB*	EB*, SB				85 (SB)
Evans Ave and Holly St	No	AM			EB*	NB*, SB*, EB*				35
		PM			EB*	NB*, SB*, EB*				38

*Movement is currently protected-permitted

**Movement is currently protected-only

4. System-Wide Summary

The audits conducted on individual corridors resulted in a wide variety of observations and recommendations. However, the RSA team noted common themes across all study areas. This included common crash patterns, common roadway geometries that may be contributing to crashes, and commonly recommended solutions to address or prevent safety issues. As part of this report, the RSA team summarized these themes in order to help future safety efforts more easily identify potential problems and identify systemic solutions. These themes can also be used to proactively identify potential problems with existing facilities before problems arise and help lead to expedited safety solutions.

4.1. Common Safety Issues

In addition to the common crash trends identified through the safety analysis, there were common safety issues identified in the field that were common among many or all study corridors:

- Left-Turns at Signalized Intersection: observed challenges with signal phasing and visibility
    - Inadequate left-turn phasing (protected versus permitted/protected versus permitted) ca increase the risk of left-turn conflict with opposing through movements. Locations operating under permitted phasing can experience higher crash potential when gaps in through traffic are insufficient.
    - Many intersections had negative left-turn offsets which impacted visibility to see oncoming traffic. This can restrict visibility making it difficult for left-turning drivers to judge gaps accurately, increasing the likelihood of angle crashes.
- Access Control (Driveways and Unsignalized Intersections): driveways, as well as unsignalized intersections created challenging conditions for vehicles attempting to make left-turns or through movements from side streets and driveways onto the RSA corridors. Drivers often faced limited gaps due to high traffic volumes and high operating speeds on the mainline, making gap selection difficult and increasing the likelihood of risky maneuvers. Many corridors required drivers to cross four or more lanes to complete through movements. These conditions can elevate the risk of broadside crashes as drivers wait for acceptable gaps, enter the major street too slowly, or attempt aggressive accelerations to merge into fast-moving traffic.
- Slip Lanes: Vehicles entering or exiting slip lanes tended to make turns at high speeds due to the free-flow design for approaching vehicles. Drivers often did not yield appropriately to

pedestrians and cyclists crossing the slip lane crosswalk, resulting in elevated exposure risk. Limited visibility, wide curb radii, and insufficient yield control can contribute to driver noncompliance and reduce the comfort and safety of non-motorized users.

- **Red Light Running:** Several intersections exhibited patterns of red-light running, likely influenced by long cycle lengths, driver frustration from congestion, clearance intervals, high approach speeds, lack of compliance, and inconsistent signal visibility. Red-light running can increase the probability of severe broadside crashes, particularly when conflicting movements include pedestrians or bicycles.
- **Inadequate Lighting:** lighting was insufficient at multiple intersection and mid-block locations. Poor nighttime visibility reduces driver ability to see pedestrians, bicyclists, and turning vehicles and decreases the time motorists might have to react to obstacles.
- **Exposed pedestrian and bicycle crossings:** Many crossings were wide or require multiple stages, leaving pedestrians and bicyclists exposed in the roadway while waiting for or completing a crossing. Short pedestrian signal times, high turning-vehicle volumes, and large intersection footprints increase vulnerability. These conditions raise the risk of conflicts with vehicles making left or right turns, particularly where yielding behavior is inconsistent.

4.2. Common Recommendations

Table 7 summarizes the common themes for mitigations that were consistently recommended as part of each RSA corridor. These recommendations were developed in many cases as a means of proactively preventing potential or future crash issues and many align with the Safe System Approach. While it can be said that each recommendation in some way reflects multiple Safe System Approach principles, the table highlights some principles that the team feels is most related to each recommendation.

Table 7. Common Corridor Recommendations Across All RSA Locations

Common Recommendation	Recommendation Description	Common Safety Issues Addressed	Safe System Approach
Retroreflective signal backplates	Improve signal visibility in bright sun conditions and nighttime by adding a contrasting border around the signal heads.	Red-light running	Proactive Safety Measure
30-60-90 channelized right turns with raised crossings	Re-designing slip lanes into 30-60-90 channelized right-turn configurations encourages slower, more controlled turning speeds by tightening the turn radius and improving driver alignment with downstream lanes. Raised crosswalks through the turn lane elevate pedestrians and cyclists into the driver's line of sight while reinforcing yield priority.	Pedestrian and bicycle safety Broadside exposure	Shared Responsibility Human Error is Inevitable
Tightening curb radii	Redesigning approaches with large curb radii to have smaller radii can help reduce vehicle turning speeds and decrease pedestrian crossing distances.	Pedestrian and bicycle safety	Human Error is Inevitable Shared Responsibility
Access management / restrict turning movements at unsignalized intersections	Reducing intersections to right-in/right-out or ¾ movement reduces conflict points and likelihood of broadside crashes.	Broadside exposure	Shared Responsibility
Upgrading left-turn operations	Improving left-turn operations may include converting permitted phasing to include a protected phase, adding flashing yellow arrows, optimizing phasing, or adjusting cycle lengths. These upgrades help reduce left-turn conflicts with opposing traffic and pedestrians and improves decision-making conditions for drivers.	Left-turn exposure	Proactive Safety Measure Deaths and Serious Injuries are Unacceptable
Positive left-turn offsets	Implementing positive left-turn offsets realigns left-turn lanes so drivers have a clear, unobstructed view of opposing through traffic. This correction helps improve visibility so drivers can more accurately judge gaps when turning left.	Left-turn exposure	Proactive Safety Measure

Common Recommendation	Recommendation Description	Common Safety Issues Addressed	Safe System Approach
			Deaths and Serious Injuries are Unacceptable
Curb extensions	Curb extensions (bulb-outs) shorten pedestrian crossing distances, tighten the corner radius, and improve sight lines between pedestrians and approaching drivers. By reducing the speed of turning vehicles and enhancing visibility, curb extensions make crossings more predictable and safer for pedestrians.	Pedestrian and bicycle safety	Vulnerability of Road Users Shared Responsibility
Signalized pedestrian crossings	These include pedestrian hybrid beacons (PHB) or full traffic signals to create a signalized crossing at mid-block locations. Implementing these crossings can significantly reduce conflict instances, enhance driver yielding behavior, and provide safer, more accessible routes for people walking.	Pedestrian and bicycle safety	Vulnerability of Road Users Deaths and Serious Injuries are Unacceptable
Lighting	This recommendation includes maintenance of existing lighting infrastructure, adding more lighting in unlit areas, and updating how luminaires are positioned. By improving lighting along corridors, visibility to pedestrians, fixed objects, and other motorists can be improved during nighttime conditions.	Night-time visibility	Vulnerability of Road Users
Speed management	These recommendations include items like geometric upgrades, speed feedback signs, signal timing updates, and improved school zone visibility to help reduce speeding. By reducing speeding and bringing more motorists within speed compliance, it reduces the risk of severe injury and fatality.	Speeding	Deaths and Serious Injuries are Unacceptable

4.3. Systematic Recommendations

In addition to providing the consolidated list of common recommendations in the previous section, the RSA team also decided to review recommendations systematically. In order to achieve this, the top three intersections with the highest number of crashes, highest number of KSI crashes, or concerning crash patterns were pulled from each corridor. Aspects and characteristics of each corridor were summarized including number of lanes, control type, main-street ADT, and surrounding land use. These characteristics can then be easily linked to common recommendations discussed throughout this report as summarized in **Table 8.** This information can be used by DOTI to identify if there are characteristics common across the city's intersections that can have easily identifiable safety mitigations used for planning purposes

Table 8. Summary of Top Crash Locations - Characteristics and Recommendations

Intersection	Total Crashes	KSI	Lanes	Median Type	Control Type	Mainstreet ADT	Land Use	Recommendations
Alameda/Monaco	93	3	6	Raised	Signalized	30,000	• Single Unit Residential • Campus	Extend median nose with pedestrian refuge. Replace through lanes with bus lanes. Improve signal operations.
Alameda/Quebec	115	4	6	Raised	Signalized	30,000	• Single Unit Residential • Campus • Open Space	Install reflective backplates on all signal heads. Install additional signal heads. Add pedestrian countdown timers.
Alameda/Fairmount	45	3	4	Raised	Signalized	30,000	• Campus • Open Space	Install reflective backplates on all signal heads. Install positive guidance pavement markings. Install curb extensions.
Broadway/Colfax Note: Broadway is 1-way Note: High number of pedestrian crashes.	80	14	3	N/A	Signalized	15,600	• Open Space • Industrial • Office	Implement separate pedestrian phases. Install paint and poste median nose for pedestrian refuge.
Broadway/22nd Note: 6 leg intersection. Note: High number of ped/bike crashes.	65	1	4	None	Signalized	23,000	• Multi-residential • Office • Commercial	Install reflective backplates on all signal heads. Install curb extensions. Restrict dangerous turning movements.
Broadway/20th Note: High number of ped/bike crashes. Note: 6 leg intersection	48	0	5	None	Signalized	23,000	• Office • Mixed-use • Parking	Install positive guidance pavement markings. Install curb extension. Review clearance intervals.
Colorado/Mississippi Note: High number of pedestrian crashes.	67	1	7	Raised Median	Signalized	33,000	• Commercial Corridor	Update left turn movement to protected-only. Install curb extensions. Install positive guidance pavement markings.

Intersection	Total Crashes	KSI	Lanes	Median Type	Control Type	Mainstreet ADT	Land Use	Recommendations
Colorado/Iowa Note: High number of pedestrian crashes.	27	2	7	Raised Median	Signalized	33,000	• Commercial Corridor	Consider protected-only phasing to protect pedestrian movements. Improve pedestrian level lighting. Consolidate lanes to reduce pedestrian exposure.
Colorado/Louisiana Note: High number of pedestrian crashes.	52	1	6	Raised Median	Signalized	33,000	• Commercial Corridor	Install hardened centerline on side streets to control access. Consolidate lanes to reduce pedestrian exposure. Add lane assignment striping for turn lanes.
Speer/Zuni	69	1	6	No Median	Signalized	26,000	• Mixed Use • Commercial	Relocate fixed objects to improve line of sight. Harden centerline on side street to control access movements. Improve lane assignment signage.
Speer/Elitch Circle	36	2	8	Raised Median	Signalized	50,000	• Open Space • Downtown	Install leading pedestrian intervals. Implement protected-only phasing to address negative offset. Install advance traffic signal warning signs.
Speer/Clay Note: Included as a stop control intersection with multiple crashes and injury.	17	1	5	No Median	Stop Controlled	23,000	• Mixed Use • Commercial	Reduce side street speed limits. Install raised median to increase ¾ movement compliance. Improve signing and striping on side street.
Tower S/Green Valley Ranch Note: High number of pedestrian crashes.	92	2	4	Raised Median	Signalized	23,000	• Commercial/Retail	Install positive lane guidance markings. Install signal heads over each lane. Install bus bulb-outs for far side bus stop.
Tower S/Elmendorf	31	4	4	Raised Median	Stop Controlled	25,000	• Single Unit Residential • Multi Unit Residential	Stripe side street approaches with centerlines and stop bars. Restrict access to ¾ movement. Improve lighting. Install signal.

Intersection	Total Crashes	KSI	Lanes	Median Type	Control Type	Mainstreet ADT	Land Use	Recommendations
Tower S/45th Ave	47	2	4	Raised Median	Signalized	32,000	• Single Unit Residential • Agriculture	Relocate bus stop to far side. Consolidate side street lanes. Install 4-section FYA signal heads.
Tower N/56th	143	11	4	Raised Median N / No Median S	Signalized	26,000	• Agriculture • Vacant	Install positive guidance lane markings. Build raised median for all approaches. Reduce curb radii.
Tower N/69th Note: High number of fatalities.	27	8	4	Raised Median	Stop Controlled	24,000	• Commercial/Retail • Mixed Use	Add lane assignment striping. Restrict access to ¾ movement. Install signal.
Tower N/67th	23	2	4	Raised Median	Signalized	24,000	• Commercial/Retail • Mixed Use	Install signal heads over each lane. Install curb extensions on side streets. Consolidate lanes on side streets.
University/Iowa	13	1	4	No Median	Stop Controlled	34,000	• Single Unit Residential	Install curb extensions. Improve lighting conditions. Install directional ramps.
University/I25	48	2	4	Raised Median	Signalized	30,000	• Single Unit Residential • Campus	Install reflective backplates on signal heads. Tighten channelized right turn lane. Improve lighting conditions.
University/Buchtel	46	2	4	No Median	Signalized	30,000	• Multi Unit Residential • Campus	Improve lighting conditions. Maintain landscaping to improve line of sight. Verify detection is working correctly.

5. Lessons Learned

The RSA process for this project provided valuable insights into safety analysis, identification of crash trends, development of recommendations, and how the audit team collects and documents field observations. Throughout the project, several opportunities emerged to strengthen future RSA workflow. The following lessons learned summarize these key takeaways and are intended to enhance the consistency, accuracy, and effectiveness of future audits.

Safety Data

- SBI (serious bodily injury) coding
    - There are columns in the crash data from the Open Data Catalog Traffic Accidents layer that list the number of serious injuries and fatalities that occurred in a crash. However, those fields are not always accurate; thus, some serious injury or fatal crashes were sometimes missed in the analysis if only this column was used. There were several columns that referenced injuries, SBIs, and fatalities and the team had to make sure every column that references these values was evaluated.
- Broadside versus approach turn (left-turn) crashes
    - A recurring challenge was distinguishing between broadside crashes due to vehicles turning from a side street or running a red light versus approach turn crashes from left-turning vehicles. Denver's crash data typically doesn't specifically code or provide crash types but rather provides harmful events, vehicle movements, and travel direction. Sometimes, travel direction indicates the original direction the vehicle was travelling while other times the travel direction indicated the direction the vehicle was making a turning movement towards. Therefore, a detailed analysis of each crash is required to determine the differences between head-on crashes, broadsides, and approach turn crashes. In some cases, crash reports are necessary to accurately determine crash types. This distinction is important because these crash types typically have different causal factors and countermeasures. For example, traditional broadside crashes involving two adjacent movements would typically be a red-light running incident and would need countermeasures meant to improve red-light compliance. As part of each RSA, approach turn crash analysis was specifically carried out to develop left-turn phasing recommendations as part of each study and often required verification of travel

direction from crash reports. In general, crashes were broken down by most harmful event and further aggregated based on turning movement, rather than assigning crash types to specifically be labelled as traditional Broadside or Approach Turn crashes. Improving the ability to distinguish between these crash types on police reports and the crash database would be beneficial so that crash type identification is less manual, which will help streamline crash trend identification.

- Scooters coded as bicycle versus pedestrians
    - Scooters were inconsistently coded as pedestrians and bicyclists which made it challenging to identify trends specific to scooters. The primary way the RSA team was able to distinguish a scooter crash was by reviewing the crash reports for each pedestrian and bicycle crash.

Field Work

- 311 tickets for maintenance concerns
    - Field reviews frequently exposed maintenance issues such as damaged signage, broken signal infrastructure, maintenance to landscaping obstructing sight lines, pavement deficiencies. Designating one person on the audit team to enter 311 maintenance tickets in real time would help confirm maintenance issues were addressed promptly. Establishing this responsibility at the outset of field activities will streamline issue reporting and reduce the likelihood of missed maintenance needs.
- Leveraging technology for photos and note taking
    - Team members used mobile devices for photos and pen-and-paper notes to document field observations. Combining each individual's photos and notes sometimes led to delays in consolidating field documentation. Future audits would benefit from standardized digital tools or shared platforms where photos, notes, and GPS-tagged observations can be uploaded automatically and organized by location.

Recommendations

- Not using words like "consider" or "evaluate" in recommendations
    - Using tentative language such as "consider" or "evaluate" can weaken recommendations and make it more difficult to take clear action. Stronger, more direct phrasing such as "Install" improves clarity and emphasizes the relevance of each recommendation.

- Providing a range of potential safety enhancements
    - Including a range of short-term low-cost (signage, markings) to long-term high-cost options (geometric changes/civil improvements) helps DOTI align safety upgrades with their funding capacity and implementation timeline.
- Tracking recommendations after the audit
    - Tracking recommendations after the RSA would help DOTI monitor progress and document decisions. Recording which recommendations are accepted or not pursued, along with the supporting rationale, improves transparency, supports future planning, and helps refine the RSA process.
- Difficulty in capturing crash causes and making recommendations
    - Many crashes within the datasets evaluated were listed as hit-and-run. The high frequency of hit-and-run crashes makes it difficult to accurately determine trends or contributing factors in crashes, such as speeding, intoxication, and distracted driving. These contributing factors can be mitigated with specific recommendations. Making recommendations that address these driver actions should be evaluated in instances of high hit-and-run frequency.
    - Speeding is included in crash data as a driver action. The risk of a serious injury or fatality is greater in crashes that occur at higher speeds and recommendations for mitigating speeding can help reduce KSI crashes. However, speeding as a contributing factor is typically subjective of the police officer and witnesses so is often coded inconsistently. If opportunities for reducing speeding related crashes exists, it is worth making recommendations regardless of if the data shows it as frequent issue.

Strategies that Enhanced the RSA Process

There were several strategies and actions that the RSA team took that were an overall benefit to the RSA process. Some of these items are listed below.

- Each RSA included members of a wide variety of stakeholders.
    - A diverse group of stakeholders were involved including planners, engineers, City staff, police, and councilmembers who provided the RSA team with additional context to the background of each corridor. This helped the RSA team provide additional recommendations and observations that targeted concerns they may not have been aware of solely relying on data and peak period observations. This also gave the RSA

team additional background of future plans, projects, goals, and objectives the City had for each study area.

- The RSA team was briefed on the City's process to incorporate recommendations.
    - The City explained to the RSA team the process the City uses to push forward recommendations after the RSA process is complete. This background inspired the RSA team to develop a more robust list of recommendations that included shorter term and less expensive recommendations that could mitigate safety concerns while also providing longer term recommendations that may require higher levels of capital. In addition, the RSA team was better equipped to provide additional information, estimates, and high-level information to support City actions.
- The RSA team was well prepared prior to field work.
    - The RSA team leaders were well prepared and organized prior to going out for field work. This included providing meeting times and locations to the field team during the Pre-Audit meeting, ensuring everyone travelled in pairs or groups, having necessary documentation and data collection worksheets printed prior to the field work, and making sure each individual had specific tasks and observations they were responsible for. This organizational structure helped keep RSA team members focused and prevented any one-individual from being overwhelmed with trying to collect multiple observations or data points.
- The length of each RSA corridor was kept to a walkable distance.
    - The length of each of the RSA corridors was short enough that the team was able to walk the entire corridor and make meaningful observations during each peak period. This ensured the RSA team was able to collect information for each intersection, approach, midblock segment, and pedestrian crosswalk within the peak period without the need to rush through each location.