



APPENDIX C

HIGH-INJURY NETWORK (HIN) SCORING MEMORANDUM



Memorandum

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To: Boulder County Vision Zero Action Plan Project Team

From: Consor Engineers

Subject: Boulder County Vision Zero Action Plan – High-Injury Network Scoring

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Introduction

As part of the Boulder County Vision Zero Action Plan (VZAP), a High-Injury Network (HIN) and Bike & Pedestrian HIN were identified and ranked to inform implementation of safety projects. The HIN and Bike & Pedestrian HIN are compilations of the road segments and intersections on county-owned and CDOT-owned roads with the highest concentrations of historic crashes resulting in injuries or fatalities. A summary of the road segmentation and HIN development process can be found in Appendix B of the Boulder County VZAP. Each road segment and intersection on the HIN was given a score utilizing a data-driven approach informed by community engagement. These scores were used to group county-owned projects into High, Medium, and Low-scoring segments and intersections, used to guide additional analysis needs and phased implementation. While this scoring system provides a general framework, the final order of implementation will also depend on funding availability, coordination with other planned capital and maintenance projects, and further community and agency input.

Identification of Factors

Several factors were identified to highlight the segments and intersections where safety projects may provide the greatest impact on eliminating serious injury and fatal crashes in Boulder County. These factors were developed based on an understanding of crash trends and project goals, including supporting safety for all modes of travel and prioritizing equity in transportation safety investments. Factors included:

- **Equity:** To strategically implement safety interventions in locations where they will provide the highest benefit to historically disadvantaged populations, HIN locations were assigned scores based on a segment-level equity index.
- **Vulnerable Road Users:** To address crashes involving bicyclists and pedestrians, which make up over 20% of all serious injury and fatal crashes on Boulder County roads, projects were scored higher in locations with concentrations of this crash type, particularly where dedicated facilities for walking and biking are lacking.
- **Crash History:** To focus safety investment where the most severe crashes are occurring, locations with high concentrations of serious injuries or fatalities compared to minor injuries were highlighted.
- **Community-Identified Need:** To address locations where people report feeling unsafe, HIN locations received scores based on concentrations of map pins from Phase 1 of engagement.

Community Engagement

The factors were presented to the community during Phase 2 of engagement through in-person activities at pop-up events, an informational online video, and an online survey. Pop-up participants were asked to distribute seven tokens amongst the four factors according to the distribution of their priorities. At both pop-up events, the top factor for participants was to improve walking and biking safety, followed by focusing on locations with known crash history. Survey participants were asked to rank each factor on a scale from not important (1) to very important (5). Factors were assigned a weighted average based on the distribution of responses:

The results of this community engagement informed the weighting of factors once scores were assigned to each segment and intersection.

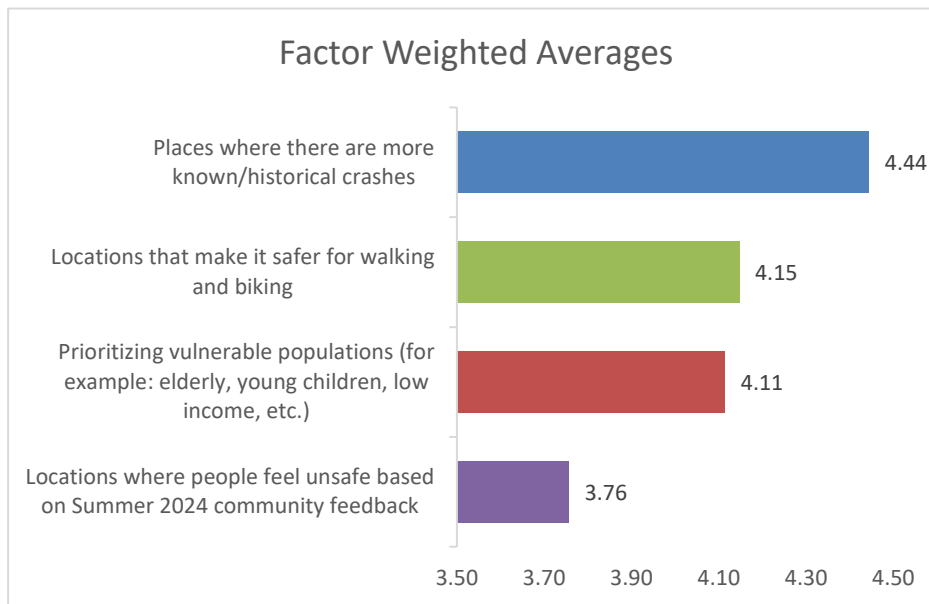


Figure 1. Phase 2 HIN Scoring Community Input

Assigning Factor Scores

Equity

To determine which projects might provide the greatest benefit to historically disadvantaged populations, segments were assigned a score according to the results of a segment-level equity analysis that resulted in a county-wide index.

EQUITY INDEX DEVELOPMENT

The creation of the segment-level index relied upon federal and state census block-level tools available at the time of development, and determination of inputs was based on analysis of peer city equity indices, inputs used in similar analyses by Boulder County, and data availability. The team also reviewed layers being developed within other SS4A efforts in Colorado, including: Larimer County, Town of Castle Rock, and Town of Silverthorne. The following inputs informed the equity index:

[Colorado EnviroScreen](#)

This state-level tool uses 35 indicators to calculate a percentile score for each census block group that provides a quantifiable measurement of combined environmental stressors. The indicators are grouped into five main categories: environmental exposures, environmental effects, climate vulnerability, sensitive populations (health indicators), and demographics. Each road segment in Boulder County was assigned a score based on the

EnviroScreen Percentile of the block group into which the majority ($\geq 50\%$ of length) of the segment fell. Scores were determined as follows:

Table 1. Equity Index EnviroScreen Scores

EnviroScreen Percentile	Equity Index Score
0 – 25th Percentile	0
25th – 50th Percentile	1
50th – 75th Percentile	2
75th – 100th Percentile	3

CDC Social Vulnerability Index

This federal tool provides an in-depth look at demographic data related to vulnerability at the census tract level. The Social Vulnerability Index determines an overall vulnerability percentile score based on 16 factors organized into four categories: socioeconomic status, household characteristics, racial and ethnic minority status, and housing type & transportation. Each road segment in Boulder County was assigned a score based on the Social Vulnerability Index Percentile of the tract into which the majority ($\geq 50\%$ of length) of the segment fell. Scores were determined as follows:

Table 2. Equity Index Social Vulnerability Index Scores

Social Vulnerability Index Percentile	Equity Index Score
0 – 25th Percentile	0
25th – 50th Percentile	1
50th – 75th Percentile	2
75th – 100th Percentile	3

[Census OnTheMap](#) Concentration of Low Wage Jobs

This federal tool visualizes where workers are employed and where they live based on LEHD Origin-Destination Employment Statistics (LODES) dataset, developed through a partnership between the U.S. Census Bureau and Local Employment Dynamics partner states, including Colorado. The tool identifies concentrations of workers making \$1,250 per month or less, defined as a “low wage job.” Each road segment in Boulder County was assigned a score if the majority ($\geq 50\%$ of length) of the segment fell into an area considered a concentration relative to the rest of Boulder County based on a quantile breakdown. Scores were determined as follows:

Table 3. Equity Index Low Wage Job Concentration Scores

Low Wage Job Concentration	Equity Index Score
≥ 473 low wage jobs/sq mi	1

Presence within 1/4mi of a school and/or transit stop

Schools and transit stops were buffered by 1/4mi to determine locations that may have higher concentrations of populations such as elderly, youth, etc.. These locations were identified using Colorado Department of Public Health and Environment (CDPHE) School Locations and Regional Transportation District (RTD) Bus Stop geospatial layers. Each road segment in Boulder County was assigned a score if the majority (≥50% of length) of the segment fell into the quarter mile buffer of schools and transit stops. Scores were determined as follows:

Table 4. Equity Index School & Transit Proximity Scores

School & Transit Proximity	Equity Index Score
Within 1/4mi of an RTD Bus Stop	1
Within 1/4mi of a CDPHE School Location	1

Equitable Transportation Community Index

This federal tool developed by the Department of Transportation (DOT) as part of the Justice40 Initiative displays location data at the census tract level based on transportation insecurity, climate and disaster risk burden, environmental burden, health vulnerability, and social vulnerability. For the purposes of the Boulder County Equity Index, only the Transportation Insecurity Indicator was included as a factor in the index as the other three indicators were addressed by the EnviroScreen and CDC Social Vulnerability Index factors. The Transportation Insecurity Indicator includes factors grouped into the categories of transportation access, transportation cost burden, and fatalities per 100,000 people. The DOT considers a census tract to be Transportation Insecure if the normalized score is in the top 65th percentile or higher of all census tracts in the state. Each road segment in Boulder County was assigned a score if the majority (≥50% of length) of the segment fell into a census tract considered Transportation Insecure. Scores were determined as follows:

Table 5. Equity Index Equitable Transportation Community Index Scores

Equitable Transportation Community Index	Equity Index Score
≥ 65th percentile	1

Each road segment was assigned a final Equity Index score based on the sum of the calculated scores for each factor, with the highest possible score being a ten and the highest achieved score in Boulder County being an eight.

Each segment and intersection was assigned an Equity Factor score based on the Equity Index score at that location. For intersections, the highest Equity Index score of the intersection segments was used. The Equity Factor Scores associated with the Equity Index Score ranges were determined based on the distribution of all scores and were as follows:

Table 6. Equity Factor Score Breakdown

Equity Index Score	Equity Factor Score
0 - 2	0
3 - 4	1
5 - 8	2

Vulnerable Road Users

To determine the locations where safety investment may have the greatest impact on eliminating serious injury and fatal crashes involving bicyclists and pedestrians, segments and intersections were elevated if they were identified on the Bike & Pedestrian HIN. They received additional scoring if they were on the Bike & Pedestrian HIN and did not have a dedicated bicycle facility, defined as a separated multiuse path or bicycle lane. Vulnerable Road User Factor Scores were assigned as follows:

Table 7. Vulnerable Road User Factor Score Breakdown

Roadway Characteristic	Vulnerable Road User Factor Score
Not on the Bicycle & Pedestrian HIN	0
On the Bicycle & Pedestrian HIN	1
On the Bicycle & Pedestrian HIN and lacking a dedicated bicycle facility	2

Crash Concentrations

To develop the HIN and Bicycle and Pedestrian HIN, minor injury crashes, serious injury crashes, and fatal injury crashes were assigned weights of 1, 2, and 4 respectively. To determine and elevate the locations along the HINs where the highest concentrations of serious injury and fatal crashes were occurring, a crash severity ratio was calculated for each segment or intersection based on the ratio of weighted injury crashes to total injury crashes. For example, an intersection with 6 minor injury crashes (total weighted crashes = 6) would have a ratio of 1 (6 weighted crashes divided by 6 total injury crashes), while an intersection with 3 minor injury crashes and 3 serious injury crashes (total weighted crashes = 9) would have a ratio of 1.5 (9 weighted crashes divided by 6 total injury crashes). Segments and intersections were assigned Crash Concentration Factor Scores based on their crash severity ratios. The Crash

Concentration Factor Scores associated with each crash severity ratio range were determined based on the distribution of all ratios and were as follows:

Table 8. Crash Concentration Factor Score Breakdown

Crash Severity Ratio	Crash Concentration Factor Score
<1.5	0
1.5 – 2.0	1
>2.0	2

Community Input

To incorporate community input about locations where people feel unsafe, the number of map pins and associated upvotes during Phase 1 of engagement on each segment and intersection informed a Community Input Factor Score. Based on the variations in range of number of pins placed on segments vs intersections and county-owned roads vs CDOT-owned roads, the Community Input Factor Scores associated with each range of number of map pins was determined differently for each of these distinct project types, as follows:

Table 9. County-Owned Intersection Community Input Factor Score Breakdown

Number of Map Pins	Community Input Factor Score
0 comments/upvotes	0
1-2 comments/upvotes	1
>2 comments/upvotes	2

Table 10. County-Owned Segment Community Input Factor Score Breakdown

Number of Map Pins	Community Input Factor Score
<3 comments/upvotes per mile	0
3 – 20 comments/upvotes per mile	1
>20 comments/upvotes per mile	2

Table 11. CDOT-Owned Intersection Community Input Factor Score Breakdown

Number of Map Pins	Community Input Factor Score
0 comments/upvotes	0
1 comments/upvotes	1
2 comments/upvotes	2

Table 12. CDOT-Owned Segment Community Input Factor Score Breakdown

Number of Map Pins	Community Input Factor Score
<5 comments/upvotes per mile	0
5 – 25 comments/upvotes per mile	1
>25 comments/upvotes per mile	2

Factor Weighting

To best align with community and county priorities, the factors were weighted differently compared to each other. The weighted averages of each factor from Phase 2 of outreach in conjunction with staff input informed the following weighting:

Factor	Weight
Equity Factor Score	2
Vulnerable Road User Factor Score	2
Crash Concentration Factor Score	4
Community Input Factor Score	1

The total HIN Score was calculated for each segment and intersection using the following formula:

$$\text{HIN Score} = (\text{Equity Factor Score} * 2) + (\text{Vulnerable Road User Factor Score} * 2) + (\text{Crash Concentration Factor Score} * 4) + (\text{Community Input Factor Score} * 1)$$

Scoring Results

The final HIN scores for each segment and intersection are listed below from highest score to lowest. Segments and intersections were categorized into High, Medium, and Low to provide a general implementation framework. However, the final order of implementation will also depend on funding availability, coordination with other planned capital and maintenance projects, and further community and agency input.

Table 13. County-Owned Intersection HIN Scores

Category	Intersecting Roadways	HIN Score
High	63 rd Street & Jay Road	16
	Lee Hill Drive & Wagonwheel Gap Road	14
	61 st Street & Valmont Road	10
	75 th Street & Hygiene Road	10
	30 th Street & Jay Road	10
Medium	51 st Street & Jay Road	9
	63 rd Street & Oxford Road	8
	65 th Street & Nelson Road	8
	76 th Street & South Boulder Road	6
Low	Golf Club Drive & Niwot Road	4
	95 th Street & Lookout Road	4
	75 th Street & Baseline Road	2
	95 th Street & Niwot Road	1
	47 th Street & Jay Road	0
	Cherryvale Road & South Boulder Road	0

Table 14. County-Owned Segment HIN Scores

Category	Intersecting Roadways	Segment Start	Segment End	HIN Score
High	Valmont Road	57th Street	6300 Block	18
	Lefthand Canyon Drive	US 36	West of Geer Canyon Drive	16
	Sunshine Canyon Drive	Timber Trail	Eagles Drive	12
	James Canyon Drive	Main Street	MM 2	10
	Jay Road	47th Street	55th Street	10
	Flagstaff Road	Gregory Lane	MM 1	10
	Olde Stage Road	Lefthand Canyon	Lee Hill Drive	10
Medium	Lee Hill Drive	57th Street	East of Reed Ranch Road	9
	83 rd Street	County Line Road	Yellowstone Road	8
	Valmont Road	Approx 0.4mi W of 75th Street	Approx 0.6mi East of 7th Street (end of curves)	8
	95 th Street	Lookout Road	Boulder County Boundary	8
	Lefthand Canyon Drive	Olde Stage Road	Crossing over Left Hand Creek	8
	Nelson Road	Clover Basin Reservoir	75th Street	8
	Nelson Road	Centennial Ranch	55th Street	6
Low	Flagstaff Road	MM 2	Flagstaff Drive	4
	73 rd Street	East of Plateau Road	North of Nimbus Road	4
	East County Line Road	North of Quicksilver Road	Pike Road	2
	South Boulder Road	McCaslin Boulevard	Ponderosa Drive	1
	63 rd Street	Oxford Road	Monarch Road	0
	75 th Street	UP Railroad	Red Deer Drive	0

Table 15. CDOT-Owned Intersection HIN Scores

Category	Intersecting Roadways	HIN Score
High	Isabelle Road & US 287	14
	US 287 & Niwot Road	8
	66 th Street, East County Line Road, & Ute Highway	8
	CO 119 & Niwot Road	8
	US 36 & Hygiene Road	8
Medium	US 287 & Lookout Road	6
	McConnell Drive, Stone Canyon Drive, & Ute Highway	6
	US 36 & Nelson Road	5
	US 287 & Mineral Road	4
	75 th Street & Ute Highway	4
	CO 119 & Jay Road	4
	83 rd Street & CO 119	4
	63 rd Street & CO 119	2
Low	Fordham Street & CO 119	0
	Monarch Road & CO 119	0
	IBM Drive, Mineral Road, & CO 119	0
	55 th Street & CO 119	0
	Airport Road, CO 119, & Ogallala Road	0
	Longhorn Road & US 36	0

Table 16. CDOT-Owned Segment HIN Scores

Category	Segment Name	Segment Start	Segment End	HIN Score
High	US 287	County Road 4	South of MM 319	16
	Arapahoe Road	West of MM 58	Boulder County Boundary	14
	CO 128	Boulder County Boundary (East of MP 2)	Boulder County Boundary (W of MP3)	13
	US 36	Nelson Road	Middle Fork Road	12
	CO 119	MM 53	MM 54	12
	CO 119	MM 45	South of MM 46	10
	US 36	Highway 7/Broadway	Jay Road	10
	US 36	Longhorn Road	Highway 7/Broadway	10
	Boulder Canyon Drive	MM 33	MM 34	10
	Boulder Canyon Drive	MP 37	MP 38	10
Medium	US 36	South Vrain Road	North of MM 26	9
	Arapahoe Road	Arapahoe Ridge High School	75 th Street	9
	Ute Highway	Boulder County Boundary	US 36	8
	US 36	Highway 128	Eldorado Springs Drive	8
	Ute Highway	Pace Street	County Line Road	8
	US 287	Boulder County Boundary	Yellowstone Road	8
	US 287	Yellowstone Road	County Road 4	8
	Mineral Road	North 115th Street	County Line Road	8
	Peak to Peak Highway	MM 37	Sugarloaf Road	8
	Peak to Peak Highway	MM 51	MM 52	8
	Saint Vrain Road	MM 15	MM 16	8
	Peak to Peak Highway	MM 44	MM 45	8
	US 287	Plateau Road	Oxford Road	7
Low	Boulder Canyon Drive	MM 27	MM 28	7
	Boulder Canyon Drive	MM 40	Boulder County Boundary	7
	Mineral Road	US 287	115 th Street	7
	US 36	MM 29	South of MM 30	6
	US 36	MM 28	MM 29	6

Category	Segment Name	Segment Start	Segment End	HIN Score
Low	Ute Highway	US 36	53rd Street	6
	US 36	MM 41	MM 42	6
	US 36	MM 42	MM 43	6
	CO 119	MM 50	MM 51	6
	US 36	MM 43	MM 44	5
	CO 119	South of MM 46	MM 47	5
	US 36	County Boundary	Highway 128	5
	Boulder Canyon Drive	MM 30	MM 31	5
	CO 119	MM 52	MM 53	5
	Peak to Peak Highway	Boulder County Boundary	Coal Creek Canyon Road	5
	Ute Highway	53 rd Street	61 st Street	5
	Boulder Canyon Drive	MM 39	MM 40	4
	112 th Street	Boulder County Boundary/144th Avenue	Boulder County Boundary	4
	US 36	Boulder County Boundary	MM 41	4
	US 36	MM 40	MM 41	4
	Saint Vrain Road	MM 25	MM 26	4
	Saint Vrain Road	MM 18	MM 19	4
	Saint Vrain Road	MM 17	MM 18	4
	Saint Vrain Road	MM 16	MM 17	4
	Ute Highway	McCall Drive	75 th Street	4
	US 36	South of MM 30	Longhorn Road	4
	CO 119	MM 48	MM 49	4
	US 287	Oxford Road	Niwot Road	3
	US 287	Niwot Road	Mineral Road	3
	Mineral Road	North 115th Street	County Line Road	3
	US 287	Mineral Road	Lookout Road	3
	Boulder Canyon Drive	MM 38	MM 39	2
	Arapahoe Road	75 th Street	East of MM 58	2
	US 36	MM 44	County Boundary	2
	Ute Highway	C & S Railroad	Pace Street	2
	Boulder Canyon Drive	MM 32	MM 33	1

Category	Segment Name	Segment Start	Segment End	HIN Score
Low	Boulder Canyon Drive	MM 29	MM 30	0
	US 36	MM 15	Eldorado Springs Drive	0
	Saint Vrain Road	MM 19	Boulder County Boundary	0
	Saint Vrain Road	MM 14	MM 15	0
	Ute Highway	North 87th Street	North 95th Street	0
	Ute Highway	75 th Street	Table Mountain Road	0