

APPENDIX D

SYSTEMIC SAFETY ANALYSIS MEMORANDUM

Memorandum

Date: September 9, 2022
To: Devin Joslin, City of Boulder
From: Fehr & Peers
Subject: Draft Systemic Safety Analysis for Boulder Vision Zero Action Plan

DN18-0589.04

The purpose of this technical memorandum is to document the process used to complete a Systemic Safety analysis of five years of crash data provided by the City of Boulder and to identify trends and potential risk factors. With a set of risk factors, we will map overlapping risk factors citywide to identify area of focus for more detailed crash analysis and countermeasure identification.

Attachment A contains the Systemic Safety analysis matrices. The matrices summarize crash data as provided by the City of Boulder from 2016 through 2020. The matrices are:

- All crashes
- KSI crashes (fatal or incapacitating injury)
- Bike crashes
- Bike KSI crashes
- Pedestrian crashes
- Pedestrian KSI crashes



Data Definitions

Table 1 and **Table 2** show the various data sources or fields for the contextual datasets and for crash data fields.

Table 1: Contextual Datasets (Column-level Data)

Dataset	File Names/Data Source(s)
Roadway type (lanes, speed)	"Street_centerline"; City of Boulder
Location type (signal, unsignalized, midblock)	"Street_centerline"; City of Boulder "Signalizedintersections"; City of Boulder
General roadway classification	"Street_centerline"; City of Boulder
Bike facility	"Onstreetbikeped"; City of Boulder "Offstreetbikeped"; City of Boulder
Sidewalks	"Offstreetbikeped"; City of Boulder "Sidewalks" (contained missing sidewalks); Fehr & Peers, derived for the Low Stress Walk & Bike Network Plan
On-street parking	"Regulations"; City of Boulder
Signals (cycle length)	Cycle length data from various sources provided by the City of Boulder, attached to "Signalizedintersections"
Crosswalk	"Crossings"; City of Boulder
Streetlights	"Streetlights"; City of Boulder
Near school, park, OSMP trailhead, bus stop, community/senior center, alcohol serving establishment	"Parks", "Schools", "OSMP_trailheads", "Communityseniorcenters", "Liquorlicenses"; City of Boulder "RTD_current_runboard"; RTD
Zoning districts	"Zoningdistricts"; City of Boulder
Wejo data	Connected vehicle data, processed by and provided by Wejo; Fehr & Peers
Daily traffic	Intersection turning movement counts from Boulder's Web-based traffic count data, converted to daily volumes using a citywide K-factor, attached to "Street_centerline"
Be Heard Boulder Web map results	From data generated through Be Heard Boulder; City of Boulder

Source: Fehr & Peers



Table 2: Crash Data (Row-level Data)

Crash Data	Data Field/Method
Alcohol, drug, or impaired	"T_Alcohol", "T_Drug", or "T_Impaired" equal to 1
Distracted	"Distracted" contained in R_Contributingfactor_V1, R_Contributingfactor_V2, or R_Contributingfactor_V3
Speeding	"Exceeded safe or posted speed" contained in Q_Driveractions_V1, Q_Driveractions_V2, or Q_Driveractions_V3
Bicyclist direction	"Bicyclistdirection_Pbcatbike"
Bicyclist position	"Bicyclistposition_Pbcatbike"
Crash type	"T_Crashtype"
Time of day	"Crashtime"
Month of year	"Crashdate"
Movement	"M_Vehiclemovement_V1"
Injured party age(s)	"Age_D1", "Age_D2", or "Age_D3", combined with "InjuryseverityD1", "InjuryseverityD2", or "InjuryseverityD3",

Source: Fehr & Peers



High-level Findings

The purpose of developing the Systemic Safety matrices is to identify crash profiles of significance and risk factors across the transportation system. In doing so, we generally look within individual crash field (rows) and contextual variable (column) categories, looking for datapoints that represent either a high overall number or high percentage of crashes.

Based on our review of the Systemic Safety analysis, we have the following high-level findings:

- Crash profiles of significance, according to the Systemic Safety matrices, generally align with the findings of the Safe Streets Report, including bicycle and pedestrian crashes, crashes involving people ages 15-29 and 65+, and left-turn crashes.
- Other profiles that stand out but are more nuanced include bicyclist-involved crashes where the bicyclist is riding against traffic or the driver is making a right-turn at signals or at multi-use paths.
- In looking at all crashes, 9 PM through 3 AM is a time period to focus on. However, in just looking bicycle and pedestrian crashes, daytime hours are the area of focus (6 AM to 6 PM for bicycle crashes, 9 AM to 9 PM for pedestrian crashes).
- The contextual data identifies some clear differences and informs potential risk factors. Some of these potential risk factors likely overlap, so in mapping risk factors to identify locations for further analysis, we may aim to select different categories of risk factors that do not overlap significantly to provide differentiation.
 - Near a signalized intersection, especially those with a maximum cycle length great than 100 seconds (this also includes crosswalks at a traffic signal), recognizing that longer cycle lengths correlate to larger intersections with higher entering volumes.
 - Near a major, unsignalized intersection (any unsignalized intersection where one approach has multiple lanes approaching); minor unsignalized intersections are also notable for pedestrian crashes.
 - Both of the above overlap with principal arterials and minor arterials, though it should be said there are a fair number of KSI crashes (including bicycle or pedestrian KSI crashes) on smaller streets (three lanes or less, residential, etc.), which is likely representative of the number of roadway miles that these streets comprise.
 - Locations with on-street bike lanes or no bike facility/shared lane.
 - Crosswalk locations with signing/markings only or unmarked (in addition to crosswalks at a traffic signal, as described above), which involve both pedestrians and bicyclists.
 - Locations where streetlights are not present.
 - Near parks, bus stops, or alcohol serving establishments.
 - Locations adjacent to business or mixed-use zone districts.



- Locations with higher speeds and more quick acceleration, according to Wejo data.
- Locations where the daily traffic per lane is <5,000 vehicles per day per lane.

Based on these high level findings, Fehr & Peers recommends detailed review of the following risk factors for determination of the final risk factors that will comprise the High Risk Network:

- Be Heard Boulder high-concern segments
- Wejo hard braking – high
- Wejo quick acceleration – high
- Wejo 85th percentile operating speeds >30 mph
- Daily traffic per lane 5,000-10,000 vehicles per lane per day
- Business and mixed-use zoning districts
- Nearby uses (parks, bus stops, alcohol serving establishments)
- Streetlight not present
- Unmarked and uncontrolled crossings
- Bicycle facility presence: on-street bike lane and no bike facility/shared lane
- Multi-use path present
- Signals with cycle length greater than 100 seconds
- Major unsignalized intersections
- Signalized intersections
- Principal and minor arterials
- Roadway type: 6+ lanes, 35 mph+ posted speeds

Fehr & Peers created a web-based GIS tool to facilitate the review of these risk factors:

<https://devapps.fehrandpeers.com/devportal/apps/webappviewer/index.html?id=75520c7253174bbab31983740038eef5>

