San Joaquin County
LOCAL ROAD SAFETY PLAN

TECHNICAL MEMORANDUM

May 23, 2022 Project# 262470

To: Najee Zarif
Deputy Director – Engineering
San Joaquin County

From: Kittelson & Associates, Inc.

CC: Michael Shami and Jeffrey Levers, San Joaquin County Department of Public Works

RE: San Joaquin County Local Road Safety Plan – Roadway and Crash Data Analysis

Roadway and Crash Data Analysis

Kittelson & Associates ("Kittelson") is assisting San Joaquin County ("County") in preparing a Local Road Safety Plan (LRSP) to develop a holistic approach to addressing local road safety. This memorandum documents the spatial analysis which cross-references roadway and crash data to identify specific locations and roadway characteristics associated with increased crash risk for potential safety improvements. The findings in this memorandum will inform forthcoming countermeasure identification, project development, and the goals for the LRSP.

This memorandum is organized into the following sections:

- Data Summary
- Spatial Analysis Methodology
- Priority Locations
- Risk Analysis
- Next Steps

DATA SUMMARY

Crash Data

Kittelson developed a database of the most recent five years of reported crashes, representing January 1, 2015, through December 31, 2019. The County provided reported crashes from an internal, County-maintained Crossroads database. Kittelson cross-checked and supplemented the Crossroads information with the California Statewide Integrated Traffic Records System (SWITRS) and UC Berkeley's Transportation Injury Mapping System (TIMS). In order to crosswalk the Crossroads database with the SWITRS and TIMS databases to identify any missing crashes, the Crossroads database was

recoded and matched using a calculated unique identifier. There were 428 crashes in the Crossroads database not present in the SWTIRS and TIMS data, and these were added to the final combined database. There were an additional 47 crashes with mismatched severities between the Crossroads and SWITRS/TIMS databases. County staff assisted in validation of the correct severity based on the original police reports and the combined database was modified accordingly. The final dataset includes 12,139 crashes from SWITRS/TIMS and 428 crashes from Crossroads. The 428 crashes from Crossroads were recoded to fit the SWITRS data format. However, the Crossroads database does not contain some of the fields in SWITRS data. In these cases, the recoded data is blank (or "unknown").

Additionally, crashes that occurred on grade-separated freeways in the unincorporated County (Interstate 5, Interstate 580, Interstate 205, State Route 99, State Route 120, and portions of State Route 33 and State Route 132) have been excluded from the crash data. However, crashes reported at the ramp terminal intersections that are associated with grade-separated freeways and highways in the County are included in the analysis database. Finally, Kittelson identified and removed duplicate records if multiple entries appeared to represent the same crash, as identified by inspection of crash details for entries with the same time and date.

SPATIAL ANALYSIS METHODOLOGY

This section describes the network screening of the San Joaquin County roadway network. Kittelson identified the intersections and segments with the highest crash severity using the Equivalent Property Data Only (EPDO) network screening performance measure from the Highway Safety Manual (HSM). We performed the EPDO screening calculation for all public at-grade locations (intersections and roadway segments) within the County. Private roads and grade separated highways were excluded from the analysis. The EPDO performance measure is described below and moving forward throughout this document is referred to as a crash severity score.

Crash Weighting System

Table 1 shows the crash severity score weights assigned to individual crashes based on the crash severity and location of the crash. The crash weights are calculated from the crash costs provided in the 2020 Caltrans' *Local Roadway Safety Manual* (LRSM), assigning each crash with a score based on the relative crash cost to a PDO crash.

Table 1. Crash Weights by Severity and Location Type

Location Type	Crash Weights by Severity				
	Fatal	Serious Injury	Other Visible Injury	Complaint of Pain	Property Damage Only
Signalized Intersection	119.55	119.55	10.70	6.08	1.00
Unsignalized Intersection	190.23	190.23	10.70	6.08	1.00
Roadway	164.66	164.66	10.70	6.08	1.00

Source: *Caltrans, Local Roadway Safety: A Manual for California's Local Road Owners* (Version 1.5), 2020.

The provided weights prioritize fatal and serious injury crashes equally to recognize that a death versus a serious injury is often a function of the individual involved or of emergency response time. Therefore, both outcomes represent locations where the County may want to prioritize improvements. Crash weights vary by location due to the relative costs associated with the crash severity at the location types. Specifically, unsignalized intersections have a higher cost for fatal and serious crashes because fatal and serious crashes at these locations tend to result in more seriously injured persons on average.

Intersection Methodology

Kittelson first identified signalized and unsignalized intersections in unincorporated San Joaquin County and then defined crashes as intersection or segment crashes. An intersection crash is defined as a crash that occurs within 250 feet of the intersection. These crashes were spatially joined and summarized in ArcGIS to show the total number of crashes by severity at each intersection. Where intersections were less than 500 feet from each other, crashes were assigned to the nearest of the two intersections. Crashes occurring more than 250 feet from any intersection were separated to be used in the segment analysis discussed below.

Kittelson calculated the crash severity score for the intersections by multiplying each crash severity total by the associated weight (by intersection type) and summing the results, using the following formula:

> **Crash Severity Score** = Fatal weight * # of fatal crashes + serious injury weight * # of serious injury crashes + other visible injury weight * # of other visible injury crashes + complaint of pain injury weight * # of complaint of pain injury weight crashes + PDO crashes

Kittelson annualized the crash severity score by dividing the score by the number of years (5) of crash data used in the analysis.

Roadway Segment Methodology

After completing the intersection analysis, Kittelson used the crashes that occurred more than 250 feet from the nearest intersection to conduct a separate segment analysis. We used a Python script in ArcGIS to split the San Joaquin County road network into overlapping half-mile segments and incrementing these segments by one-quarter mile. This methodology helps to identify portions of roadway with the highest crash severity scores and greatest potential for safety improvements.

After splitting the network, the Python script spatially joined non-intersection crashes to each segment. Similar to the intersection methodology above, we summarized the crashes by severity, and multiplied the totals by the crash severity weights for roadway segments. The weighted crash severity scores of the crashes were totaled and annualized by the number of years of crash data (5) to generate an annualized crash severity score.

PRIORITY LOCATIONS

This section describes the priority intersections and segments through the lens of annualized crash severity score methodology. The crash severity score method considers the weighting factors related to the societal costs of fatal, injury, and property damage-only crashes to develop an equivalent severity score that considers both the frequency and severity of crashes. This method highlights the sites that have high frequencies of fatal and/or severe injury crashes which typically warrant further investigation and countermeasure application. These locations are often the most eligible for HSIP application grants, as the benefit-to-cost ratio used by HSIP relies on the crash severity scoring methodology.

Additional priority locations or alternative ways of developing priority location lists may be identified for implementation of projects. For example, the crash risk analysis conducted as part of this study helps determine the association between roadway and intersection characteristics and the risk of crash occurrence. Crash risk analyses are helpful to proactively identify the roadways or intersection features that are associated with crash risk before the crashes happen to systemic treatments at locations with certain risk factors. Hence, the crash severity scoring is often used to determine priority locations

based on historical crash patterns for quantitative safety performance while crash risk analyses are helpful in determining and recommending systemic countermeasures/treatments.

A complete crash database will be provided to the County as part of the LRSP products. This will allow the County to review additional details of crashes at specific locations, search for certain factors among the crash data, or apply an alternative approach for prioritizing locations.

Crash Severity Score Results

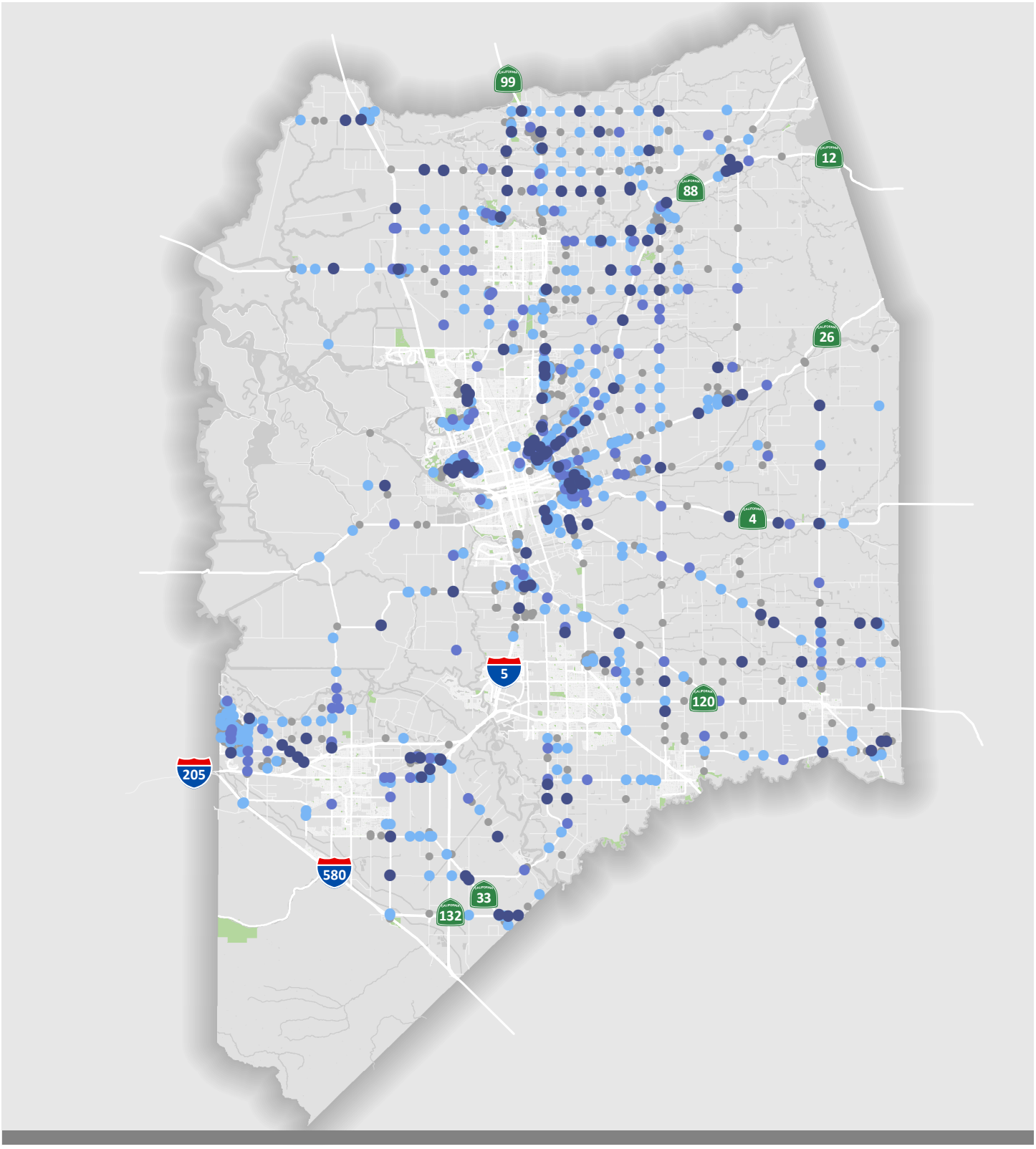
Kittelson identified priority intersections and segments using the annualized crash severity scores; the results are presented below. Figure 1 and Figure 2 show the results of the crash severity scoring by percentiles for intersection and roadway segment locations, respectively. Intersections or segments shown as not falling within one of the quartiles indicates that there were no reported crashes at that location.

The top scoring intersections and segments were reviewed to determine priority locations. For intersection locations, the crash severity scores ranged from zero (no reported crashes during the five years) to 163.66.[1] There was a large gap in the intersection crash severity score results starting just below 76 which was used to identify priority locations. This resulted in the top 41 intersections, which provides a range of location options that may have the largest benefit based on historical crash data.

For the half mile roadway segments overall, the crash severity scores ranged from zero to 202.23[2]. Looking at overall roadway segment crash severity scores, the top five overall roadway segments and top 10 non-state route roadway segments were identified. The top five overall roadways show the highest priority roadways but three of them are state routes that are outside of the County's responsibility for improvements. Thus, the top 10 non-state route roadways provide the highest priority locations within the County's responsibility.

The resulting lists of priority locations are provided in Table 2, Table 3, and Table 4, respectively. These locations are mapped in Figure 3.

[1] For reference, the intersection with a crash severity score of 163.66 was associated with the following outcomes: six fatal or serious injury crashes, five other visible injury crashes, six complaint of pain crashes, and eleven property damage only crashes.
[2] For reference, the segment with a crash severity score of 202.23 was associated with the following outcomes: five serious injury crashes, eight other visible injury crashes, fifteen complaint of pain crashes, and eleven property damage only crashes.



Collision Severity Scores

- 95th -100th Percentile (38.451 - 163.66)
- 90th - 94th Percentile (6.301 - 38.45)
- 75th - 89th Percentile (1.221 - 6.3)
- 1st - 74th Percentile (0.001 - 1.220)

Parks

County Limits

0 5 10 Miles

Figure 1

Intersections
Collision Severity Score Network Screening
San Joaquin County LRSP

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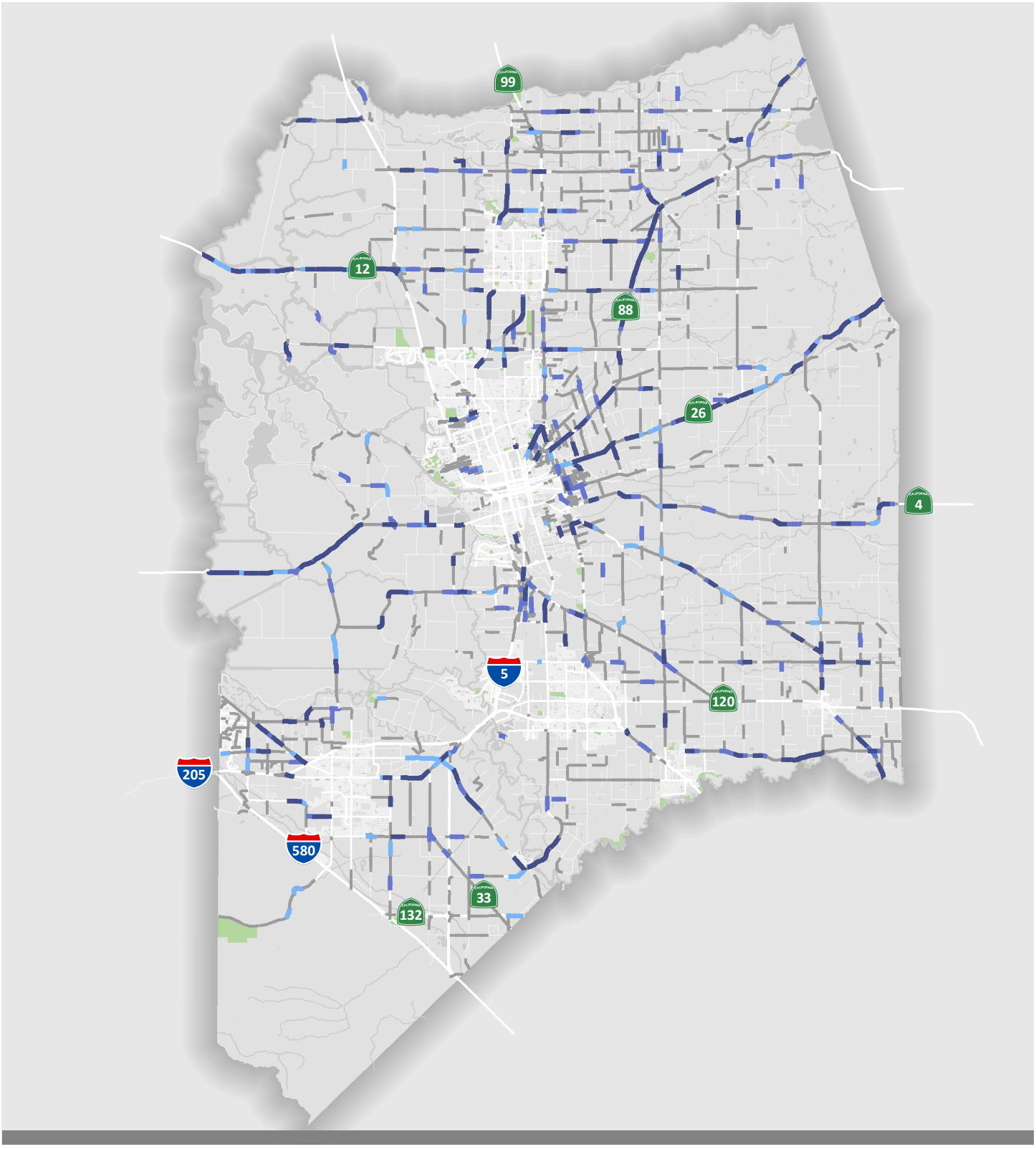

Collision Severity Score

- 95th - 100th (35.001 - 202.23)
- 92nd - 94th Percentile (18.961 - 35.00)
- 90th - 91st Percentile (5.001 - 18.96)
- 1st - 89th Percentile (0.01 - 5.00)

Parks

County Limits

0 5 10 Miles

Figure 2

Roadway Segments
Collision Severity Score Network Screening
San Joaquin County LRSP

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Table 2. Intersection Priority Locations by Crash Severity Score

Intersection	Traffic Control	Annualized Crash Severity Score	Safety Project Planned/Implemented (In the Last 5 Years)
BIRD RD & ELEVENTH ST	Signalized (Rural)	163.66	Yes (Safety project already planned)
GRANT LINE RD & BYRON RD	Not Signalized (Rural)	161.03	Yes (Roundabout will be installed in 2022)
NORTH CHEROKEE LN & COLLIER RD	Not Signalized (Rural)	121.14	
MARIPOSA RD & DODDS RD	Not Signalized (Rural)	119.09	
GRANT LINE RD, KASSON RD, & ELEVENTH STREET	Not Signalized (Rural)	107.57	
STATE ROUTE 33 OFFRAMP & VERNALIS RD	Not Signalized (Rural)	98.22	
PICCOLI RD& STATE ROUTE 88	Not Signalized (Rural)	96.87	
FRENCH CAMP RD & AUSTIN RD	Not Signalized (Rural)	87.05	
HOWARD RD & ROBERTS RD	Not Signalized (Rural)	85.44	
COTTAGE AVE & LATHROP RD	Not Signalized (Rural)	85.22	
THORNTON RD & WOODBRIDGE RD	Not Signalized (Rural)	84.22	
ALPINE AVE & FRANKLIN AVE	Not Signalized (Urban)	83.9	
PEZZI RD/BAKER RD & STATE ROUTE 88	Not Signalized (Rural)	81.76	
LIVE OAK RD & STATE ROUTE 88	Not Signalized (Rural)	81.76	
ESCALON-BELLOTA RD & COPPEROPOLIS RD	Not Signalized (Rural)	81.46	
PELTIER RD & LOWER SACRAMENTO RD	Not Signalized (Rural)	81.46	
STATE ROUTE 132 & WELTY RD	Not Signalized (Rural)	81.46	
RAY RD & PELTIER RD	Not Signalized (Rural)	81.06	
STATE ROUTE 88 & CLEMENTS RD	Not Signalized (Rural)	80.74	
LOOMIS RD & STATE ROUTE 99 W FRONTAGE RD	Not Signalized (Rural)	80.25	
DODDS RD & ESCALON-BELLOTA RD	Not Signalized (Rural)	80.05	
CHEROKEE RD & SIERRA LN	Not Signalized (Urban)	79.45	

Intersection	Traffic Control	Annualized Crash Severity Score	Safety Project Planned/Implemented (In the Last 5 Years)
FAIRCHILD LN & STATE ROUTE 88	Not Signalized (Rural)	79.12	
ACAMPO RD & BRUELLA RD	Not Signalized (Rural)	78.63	
LONE TREE RD & BRENNAN AVE	Not Signalized (Rural)	78.63	
DRAIS AVE & STATE ROUTE 4	Not Signalized (Rural)	78.63	
PEATLAND RD & STATE ROUTE 12	Not Signalized (Rural)	78.43	
TRETHEWAY RD & ACAMPO RD	Not Signalized (Rural)	78.43	
E ST & WILSON WAY	Not Signalized (Urban)	78.23	
LIBERTY RD & DUSTIN RD	Not Signalized (Rural)	78.11	Was converted to All Way Stop Control in 2015
WATERLOO RD & MYRAN AVE	Not Signalized (Urban)	77.71	
SIXTH ST & STATE ROUTE 88	Not Signalized (Rural)	77.71	
THORNTON RD & PALOMA AVE	Not Signalized (Urban)	77.51	
KETTLEMAN LN & LOCUST TREE RD	Not Signalized (Rural)	77.51	
MOKELUMNE ST & LOWER SACRAMENTO RD	Not Signalized (Urban)	77.31	
MACKVILLE RD & MEHRTEN RD	Not Signalized (Rural)	77.09	
STATE ROUTE 26 & IONE ST	Not Signalized (Rural)	76.49	
MURRAY RD & STATE ROUTE 26	Not Signalized (Rural)	76.49	
ESCALON-BELLOTA RD & FLOOD RD	Not Signalized (Rural)	76.29	
AIRPORT WAY & PERRIN RD	Not Signalized (Rural)	76.09	
STATE ROUTE 4 & HEWITT RD	Not Signalized (Rural)	76.09	

Source: Kittelson & Associates, Inc., 2022.

Table 3. Segment Priority Locations – Top Five Overall Segments

Location	Segment Length (mi)	Functional Classification	Annualized Crash Severity Score
West State Route 4 from County Line to West 1100' from River	3.39	Arterial	447.83
East State Route 26 from Shelley Road to County Line	1.49	Arterial	256.61
North Wilson Way from McAllen Road to Diverting Canal Levee Road	0.96	Principal Arterial	237.80
East State Route 26 from Baldwin Lane to Alpine Road	1.8	Arterial	214.35
Lower Sacramento Road from Eight Mile Road to Mettler Road	1.24	Major Collector	205.66

Source: Kittelson & Associates, Inc., 2022.

Table 4. Segment Priority Locations - Top Ten Unincorporated County Segments

Location	Segment Length (mi)	Functional Classification	Annualized Crash Severity Score[3]
North Wilson Way from McAllen Road to Diverting Canal Levee Road	0.96	Principal Arterial	237.80
Lower Sacramento Road from Eight Mile Road to Mettler Road	1.24	Major Collector	205.66
South Union Road from Shady Pines Street to Lovelace Road	0.72	Major Collector	168.49
East Mariposa Road from Jack Tone Road to Gawne Road	2.15	Major Collector	112.71
North Clements Road from Brandt Road to Stampede Road	1.74	Major Collector	101.63
North Empire Tract Road from Eight Mile Road to 0.78 mi South of Eight Mile Road Intersection	0.78	Local Road	100.41
North Newton Road from Wilson Way to Cherokee Road	0.83	Urban Collector	78.64
West Valpico Road from Lammers Road to Wilkinson Way	1.01	Major Collector	78.04
East Peltier Road from Des Moines Road to Kennefick Road	1.49	Major Collector	76.83
North West Lane from Armstrong Road to Ham Lane	0.97	Principal Arterial	75.3

Source: Kittelson & Associates, Inc., 2022.

[3] These scores are different from Figure 2 because of the roadway segment extents.

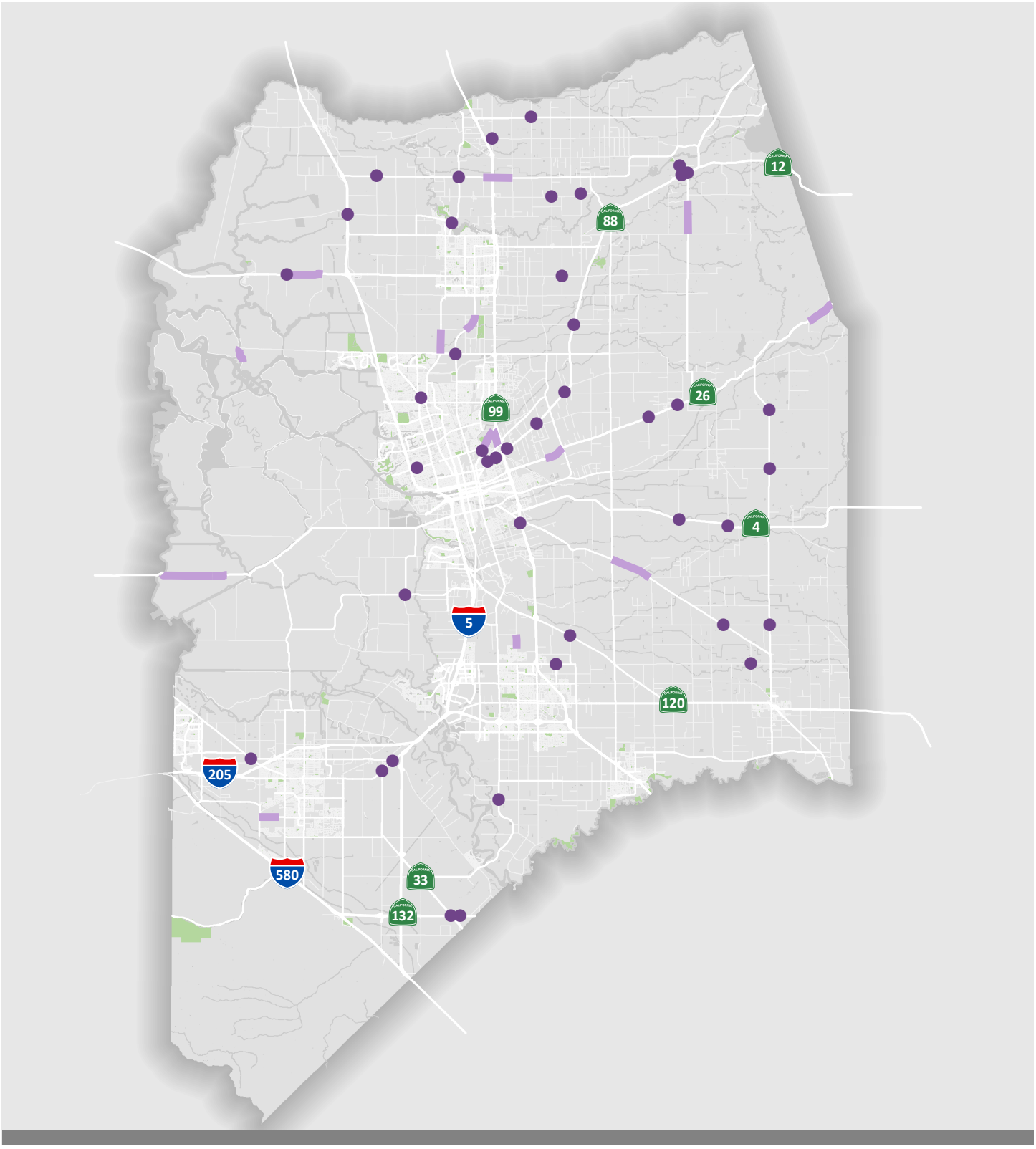

Figure 3

Priority Intersections and Segments Collision Severity Score Network Screening San Joaquin County LRSP

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CRASH RISK ANALYSIS

Kittelson conducted risk analysis to determine associations between roadway and intersection characteristics and the risk of crash occurrence. Roadway and intersection characteristics that were identified as potentially associated with more frequent or severe occurrences of crashes have been identified as crash risk factors. Findings from this analysis will help inform safety countermeasures selected in subsequent project tasks and the identification of locations for proactive systemic safety treatments in the County.

The previous memorandum described the frequency of crashes based on different roadway and intersection characteristics, and the prior section discusses network screening of the San Joaquin County roadway network to identify locations with a high crash frequency and/or severity. The crash risk analysis complements the descriptive statistics to help form an understanding of the relative risk (also known as Risk Ratio (RR)) of roadway and intersection characteristics for total crashes. This analysis uses the RR approach to calculate the risk of a particular roadway characteristic within one grouping or characteristic versus the other groups or characteristics of total reported crashes in the County. As we shift to a proactive safety approach, understanding roadway characteristics that have higher risks and implementing systemic countermeasures can prevent future crashes rather than reactively addressing high-crash locations.

The RR is the ratio of the probability of crash occurrence in one group versus the probability of crash occurrence in another group. In general, if the RR is 1.0 (or close to 1.0), it suggests no difference in risk between the analyzed groups. A RR greater than 1.0 suggests an increased risk of crash occurrence in that group when compared to the other groups, and a RR less than 1.0 suggests a reduced risk of crash occurrence in that group when compared to other groups analyzed. An example RR calculation is shown in Table 5 for reference.

Table 5: Example Risk Ratio (RR) Calculation

Intersection Type	Intersections Count	Crash Count	Risk Ratio Calculation
Signalized	a	d	(d/F)/(a/C)
Unsignalized	b	e	(e/F)/(b/C)
Total	C	F	--

Note: C=(a+b); F=(d+e), --: Not Applicable

Source: Kittelson & Associates, Inc., 2022

Crash Risk Factors

The crash risk analysis examined reported crashes across all roadways and intersections within the County. For this analysis effort, Kittelson assembled a spatial database including roadway characteristics, intersection characteristics, and reported crash data. Kittelson only included the variables for which data was available, horizontal and vertical curvature information was unavailable, hence it was not included in this analysis. These data include:

- **Intersections Characteristics:**
  - ***Number of Legs:*** Number of legs for intersection, these ranged from 3 to 6.
  - ***Intersection Control:*** The intersections were classified into two categories, signalized and unsignalized intersections (regardless of urban or rural context).
- **Roadway Characteristics:**

- ***Approximate Speed Limit:*** Approximate posted speed limit for public roadways. The speeds ranged from 30 mph to 70 mph throughout the County.
- ***FHWA Roadway Classification:*** Roadway classification information along roadway segments. The classifications included interstates, highways, arterials, collectors and local roadways throughout the County.
- ***Average Daily Traffic:*** The average daily traffic volume on roadways, ranged from 10-40,000 vehicles per day.

NUMBER OF INTERSECTION LEGS

The Risk Ratio (RR) for all intersections was calculated using total reported crashes. The results suggest crash risk increases with the number of intersection legs. Table 6 shows the RR values computed for all intersections by number of legs.

Table 6: Crash Risk Analysis by Number of Intersection Legs, San Joaquin County, January 1, 2015 – December 31, 2019

Criteria	Total Intersections	% of Total	Crash Count	% Crash Count	Risk Ratio
3 Leg	2,188	73%	1,510	45%	0.61
4 Leg	810	27%	1,789	53%	1.97
5 or 6 Leg	18	1%	89	3%	4.40
Total	**3,016**	**100.00%**	**3,388**	**100.00%**	--

Source: Kittelson & Associates, Inc., 2022

- The crash risk increases by 97% for intersections with four legs and increases by 340% for intersections with more than four intersection legs. This is consistent with our understanding of crash risk based on the increased complexity of the intersections and increased number of potential conflict points.
- The crash risk decreases by 39% for intersections with three legs, when compared to the other intersection groups.
- The higher crash risk numbers are associated with intersections with more than four intersection legs, where the sample size if relatively small when compared to other intersection groups. These intersections account for about 1 percent of all intersections within the County.

Given that fatal and severe injury collisions are of the most significant concern, the RR values were also computed for fatal and severe injury collisions only. Table 7 shows the RR values computed for all intersections by number of legs for fatal and severe injury crashes only. The RR trend for fatal and severe injury crashes follows the trend for all crashes, with the RR for 5 or 6 leg intersections decreasing slightly when compared to the total crashes.

Table 7: Crash Risk Analysis for Fatal and Severe Injury Crashes by Number of Intersection Legs, San Joaquin County, January 1, 2015 - December 31, 2019

Criteria	Total Intersections	% of Total	F+SI Crash Count	% F+SI Crash Count	Risk Ratio
3 Leg	2,188	73%	87	48%	0.66
4 Leg	810	27%	91	50%	1.87
5 or 6 Leg	18	1%	3	2%	2.78
Total	**3,016**	**100.00%**	**181**	**100.00%**	--

Source: Kittelson & Associates, Inc., 2022

APPROXIMATE POSTED SPEED

The Risk Ratio (RR) for intersections and roadway segments was calculated using total reported crashes. The results suggest crash risk increases at intersections and roadway segments as approximate posted speed increases. It should be noted that posted speed limits are set as per California Vehicle Code (CVC) Section 22349, after conducting engineering and traffic surveys. These speed limits are established by considering prevailing speeds (or 85th percentile speeds), crash history, and highway, traffic, roadside conditions that are not readily apparent to the driver. Drivers do not necessarily travel at posted speeds, and select their speeds based on individual perception of safety, and surrounding land use characteristics. The sections below present more details on the relative risk for intersections and segments.

Intersections

Analysis of the total reported crashes for intersections was based on approximate posted speed. The analysis results showed that intersections with an approximate posted speed of 45 mph, based on the maximum speed among the intersection approaches, are potentially associated with more frequent crash occurrences, as shown in Table 8. Based on a review of these locations, this grouping is primarily composed of intersections along arterials and major collectors and, as such, may be related to increased exposure (higher volumes and increased crash opportunities).

Table 8: Crash Risk Analysis by Maximum Approximate Posted Speed Among Intersection Approaches, San Joaquin County, January 1, 2015 – December 31, 2019

Max Approximate Posted Speed among Intersection Legs	Total Intersections	% of Total	Crash Count	% Crash Count	Risk Ratio
Intersections 30 mph	2,243	76%	1,509	45%	0.58
Intersections 35 mph	149	5%	47	1%	0.27
Intersections 40 mph	375	13%	1,029	30%	2.38
Intersections 45 mph	94	3%	460	14%	4.25
Intersections 50 mph	81	3%	340	10%	3.65
Total	**2,942**	**100.00%**	**3,385**	**100.00%**	--

Source: Kittelson & Associates, Inc., 2022

- When considering all intersections, crashes at intersections with an approximate posted speed of 30 mph and 35 mph, based on the maximum speed among intersection approaches, are under-represented by 42% and 73%, respectively, when evaluated on a crash per intersection basis.
- The crash risk increases by 138% for intersections with a 40 mph maximum approximate posted speed limit among intersection legs and 265% for intersections with a maximum approximate posted speed of 50 mph.
- The crash risk is highest for intersections with a 45 mph approximate posted speed limit among intersection legs. The crashes are over-represented for this group by 325%, when evaluated on a crash per intersection basis.
- The statistical correlation between crash occurrence and approximate posted speeds does not infer causation. In other words, the relative risk associated with changes in posted speed does not mean that the cause of crashes is

associated only with the posted speeds. There are several factors like driver behavior, land use characteristics, and roadway design characteristics that influence drivers' speeds on a roadway.

Roadway Segments

When considering approximate speed values, roadway segment Risk Ratios (RRs) show that roadway segments with an approximate posted speed of 50 mph are potentially associated with more frequent occurrences for crashes. Table 9 shows the RR values computed for roadway segments by approximate posted speed for total reported crashes.

Table 9: Crash Risk Analysis by Approximate Posted Speed for Roadway Segments, San Joaquin County, January 1, 2015 – December 31, 2019

Criteria	Total Length (miles)	% of Total	Crash Count	% Crash Count	Risk Ratio
Segments 30 mph	1,065.7	60%	1,362	26%	0.43
Segments 35 mph	181.0	10%	505	10%	0.93
Segments 40 mph	376.3	21%	1,784	34%	1.59
Segments 45 mph	67.9	4%	650	12%	3.21
Segments 50 mph	77.8	4%	956	18%	4.53
Total	**1,761.6**	**100.00%**	**5,257**	**100.00%**	--

Source: Kittelson & Associates, Inc., 2022

- The RR suggests that when considering all roadway segments, crashes on roadway segments with an approximate posted speed of 30 mph and 35 mph are under-represented by 57% and 7%, respectively, when evaluated on a crash per length basis.
- The crash risk increases by 59% for roadway segments with an approximate posted speed of 40 mph and 221% for roadway segments with an approximate posted speed limit of 45 mph.
- The crash risk is highest for roadway segments with an approximate posted speed of 50 mph among all roadway segments. The crashes are over-represented for this group by 353%, when evaluated on a crash per length basis.

FHWA Roadway Classification

Analysis of the total reported crashes for intersections was based on FHWA roadway classification. The analysis results showed that the intersections with a major road classification of minor arterial are potentially associated with more frequent crash occurrence, as shown in Table 10.

Table 10: Crash Risk Analysis by FHWA Roadway Classification for Intersections, San Joaquin County, January 1, 2015 – December 31, 2019

Criteria	Total Intersections	% of Total	Crash Count	% Crash Count	Risk Ratio
Principal Arterial	81	3%	340	10%	3.68
Minor Arterial	94	3%	460	14%	4.29
Major Collector	371	13%	1,029	30%	2.43
Minor Collector	117	4%	46	1%	0.34
Local Road	2,302	78%	1,511	45%	0.57
Total	**2,965**	**100.00%**	**3,386**	**100.00%**	--

Source: Kittelson & Associates, Inc., 2022

- When considering all intersections, crashes at intersections with a FHWA roadway classification of minor collector and local road, based on the major road of the intersection, are under-represented by 66% and 43%, respectively, when evaluated on a crash per intersection basis.
- The crash risk increases by 268% for intersections with a major road classification of principal arterial and 143% for intersections with a major road classification of major collector.
- The crash risk is highest for intersections with a major road classification of minor arterial. The crashes are over-represented for this group by 329%, when evaluated on a crash per intersection basis.

CRASH RISK FACTOR FINDINGS

Kittelson identified the following roadway characteristics as crash risk factors (i.e., roadway characteristics potentially associated with more frequent or severe occurrences of crashes) based on total reported crashes:

- **Intersection Number of Legs** – As the number of legs of the intersection increases, the crash risk increases.
- **Signalized Intersections** – Signalized intersections are associated with an increase in crash risk.
- **Maximum Approximate Posted Speed** – The crash risk is highest for intersections with a 45 mph approximate posted speed limit among intersection legs – corresponding to arterials and major collector roadways. In contrast, roadway segments with an approximate posted speed of 50 mph are associated with more frequent occurrences for crashes.
- **FHWA Roadway Classification** – Intersections with a major road classification of minor arterials are associated with an increase in crash risk when compared to the other roadway classifications.

NEXT STEPS

The findings presented above will be discussed, reviewed, and confirmed with San Joaquin County staff and relevant information will be shared with the Project Development Team. This information will be used to determine the locations and projects most likely to provide the greatest potential crash reduction Project scopes, concept designs, and planning-level cost estimates will be developed for the locations and projects considered to be most competitive for funding and most likely to improve roadway safety. This information can also be used to understand general risk factors on County roadways that should be considered when looking at systemic treatments or modifications to locations that have historically not had high crash frequencies or severities. Understanding high-risk factors such as 5- or 6- leg intersections and high-speed roadways can inform future policies or support for additional traffic safety investments.