KITTELSON & ASSOCIATES
851 SW 6th Avenue, Suite 600
Portland, OR 97204
P 503.228.5230

Technical Memorandum

December 5, 2023 Project# 214640.029

To: Matt Egeler, Project Engineer
Jeannie Little, Senior Engineering Technician
Susie Serres, Traffic and Roadway Principal Engineer
City of Hillsboro

From: Kittelson & Associates, Inc.

RE: Transportation Safety Action Plan 2023 Update: Final Existing Conditions Summary

INTRODUCTION

This memorandum summarizes the existing conditions analysis, which includes an overall analysis of crash patterns and a network screening to identify intersections and corridors with high crash history. Based on this analysis, this memorandum outlines the potential emphasis areas and high priority locations.

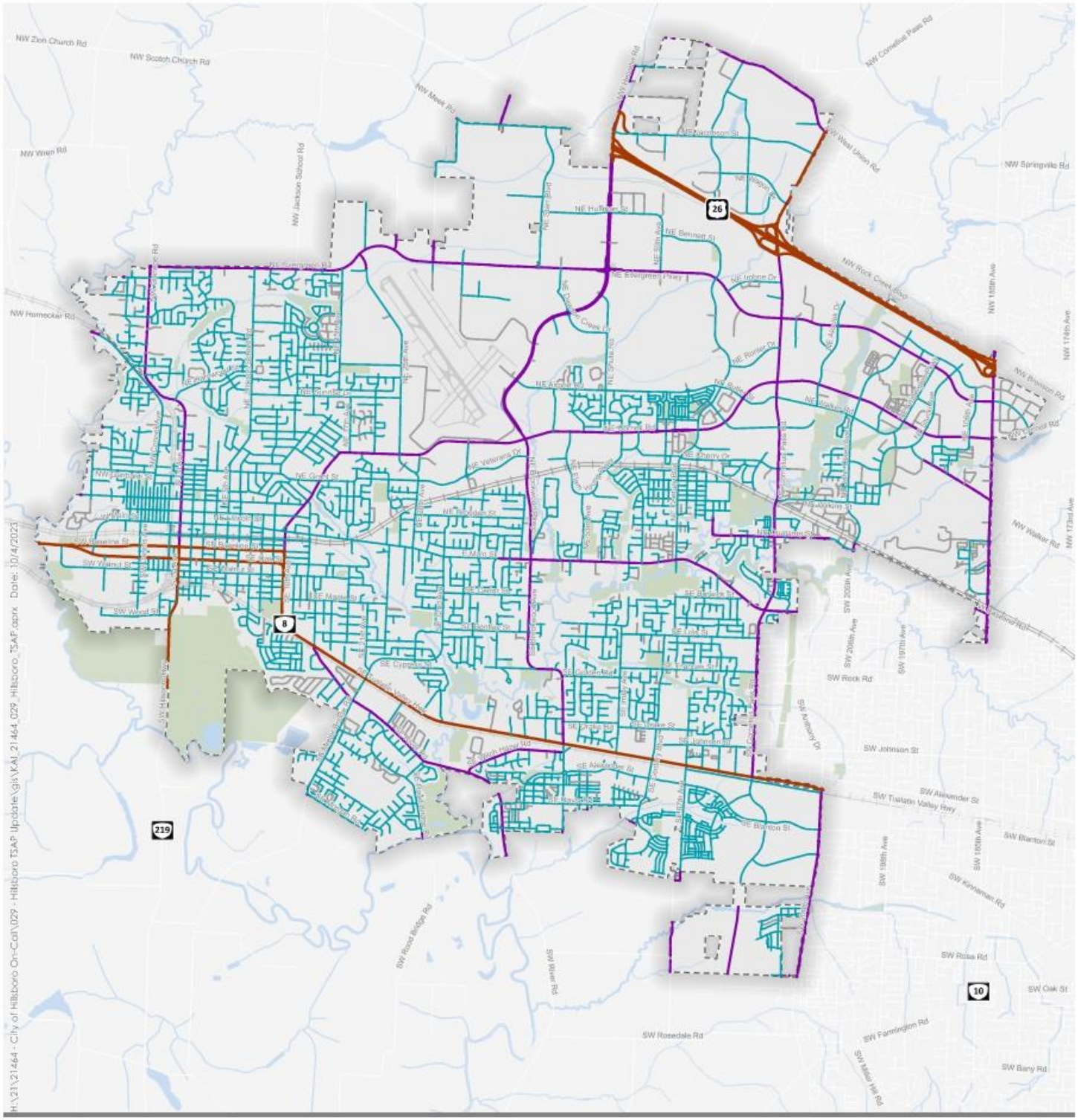
This memorandum is organized into the following sections:

- Progress Since 2017 TSAP
- Citywide Crash Patterns and Characteristics
- Potential Emphasis Areas
- Network Screening
- Potential High Priority Locations
- Next Steps

Study Area

The City of Hillsboro is located in Washington County in northwest Oregon. The study area for the TSAP is the roads located within the city limits. These roads are operated and maintained by three primary jurisdictions: the City of Hillsboro, Washington County, and Oregon Department of Transportation (ODOT).

This Transportation Safety Action Plan (TSAP) Update analyzes the public roads within the City of Hillsboro's city limits to identify and prioritize safety countermeasures to support achieving zero fatal and serious injury crashes. Figure 1 presents the existing roadway network by roadway jurisdiction and study area for this TSAP Update.



H:\21\21464 - City of Hillsboro On-Call\029 - Hillsboro TSAP Update\gis\KAI_21464_029_Hillsboro_TSAP.aprx Date: 10/4/2023

City of Hillsboro
Washington County
ODOT
Private or Unknown

City Limits (Study Area)
Waterbodies
Parks and Open Spaces
Light Rail Transit
Freight Rail

0 0.5 1 1.5 Miles

Figure 1

Study Area
City of Hillsboro

KITTELSON & ASSOCIATES

PROGRESS SINCE 2017 TSAP

Table 1 summarizes the engineering and enforcement strategies identified in the 2017 City of Hillsboro TSAP. This TSAP Update recognizes which of these strategies have been implemented, which have not been implemented, and which can be improved on.

Table 1. 2017 City of Hillsboro TSAP Systemic Engineering and Enforcement Strategies

Crash Trend Identified	Improvement Strategy	Progress Made
Pedestrian and bicycle related crashes	Implement a Safe Routes to Schools (SRTS) Program	– Developed a SRTS plan that outlines strategies related to the 6 E's – encouragement, enforcement, education, engineering, evaluation, and equity – Implemented SRTS education that includes classroom and in-the-field education – Identified funding for the program – Hired a SRTS Coordinator to champion the SRTS program and guide implementation of events, projects, and strategies – Installed speed feedback signs for school zones – Worked with current county and statewide SRTS coordinators to identify lessons learned – Worked with Washington County to supplement work completed as part of the School Access Improvement Study – Updated walkshed maps have been developed for all elementary schools within city limits
	Pedestrian and Bicycle Specific Studies	– Pedestrian and bicycle crashes are reviewed to identify potential safety improvements
	Pedestrian and Bicycle Operational Improvements	– The Transportation System Plan (TSP) identifies projects and routes that best accommodate people walking and biking. TSP Update completed in 2022. – Conducting a pedestrian and bicycle wayfinding project (in process) – Leading pedestrian intervals and bicycle detection zones are considered when upgrading intersections
	Pedestrian and Bicycle Focused Design Improvements	– Creating a pedestrian and bicycle toolkit (in process)
Crashes involving turning movements at signalized intersections	Gap Dependent Flashing Arrow	– Implemented onset delay for Flashing Yellow Arrow activation – Implemented enforcement assistant lights ("tattle tale lights") for all thru phases at new traffic signals and modified traffic signals implemented by City of Hillsboro Design and Construction Standards
	Geometric Improvements for Turns	– New infrastructure is built to current best practices for geometric design and reconstruction projects bring outdated infrastructure up to current standards.
Crashes involving younger drivers	Education and Law Enforcement Campaigns	– Traffic and Public Information Officer Units have worked together to create social media campaigns focusing on traffic safety issues
	Focused Enforcement	– Traffic and Public Information Officer Units have worked together to conduct directed enforcement for impaired driving and seatbelt use
Rear-end collisions	Signal Timing Improvements	– Implemented enforcement assistant lights ("tattle tale lights") for all thru phases at new traffic signals and

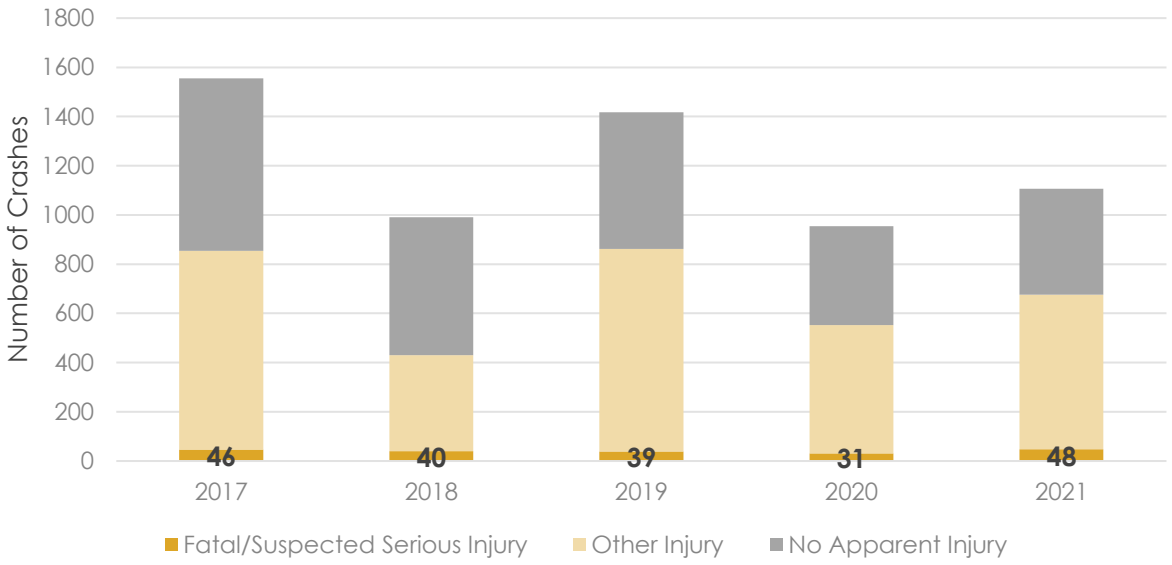
Crash Trend Identified	Improvement Strategy	Progress Made
		modified traffic signals implemented by City of Hillsboro Design and Construction Standards
	Speed Reduction	– Implemented program to rotate speed feedback signs through school zones prioritized based on annual speed data
Angle crashes	Red Light Improvements	– Implemented radar detection that can extend red and green phases
	Signal Timing Improvements	– Implemented enforcement assistant lights ("tattle tale lights") for all thru phases at new traffic signals and modified traffic signals implemented by City of Hillsboro Design and Construction Standards
High critical crash rate intersection locations	Intersection Evaluation to Develop Improvements	– Completed improvements to several intersections and are working on improvements at other intersections
Crashes where the driver disregarded traffic laws (i.e., did not yield the right-of-way, disregarded the traffic signals, followed too closely)	Focused Enforcement	– Traffic Sergeant identifies locations within the city based on crash data as well as citizen complaints and assigns officers to work those location on a rotating basis.
	Police Staff Dedicated to Safety Coordination within the City	– Not implemented
	Adequate Police Staff	– Not implemented
	Education Campaigns	– Informational brochures concerning rules of the road that highlight some of the most common traffic errors that result in serious injuries or fatalities are provided at public events – Rules of the road messages are provided intermittently through social media – Joint project underway with traffic division and municipal court to provide discounted auto repair for those with faulty vehicle equipment and to restart the Fix-It Ticket Program, where drivers receive a ticket and an educational brochure and then are given the opportunity to take a safety related class to have the ticket fee reduced – Continued the educational program Safety Town, which is a week-long, half-day safety camp for five- and six-year-olds that focuses on different safety concepts including bike, pedestrian, and motor vehicle safety
Crashes involving fixed objects	Remove fixed objects from within the clear zone	– AASHTO Roadside Design Guide is implemented wherever possible – The City trims and removes vegetation when identified as having the potential to contribute to crashes.
General Purpose Strategy	Annual Hot Spot/Systemic Safety Study Program	– Not implemented
General Purpose Strategy	Support Washington County's Safety Policy Development Effort	– Not implemented

CITYWIDE CRASH PATTERNS & CHARACTERISTICS

The crash data analysis evaluates historical crash patterns within the study area, including crash severity, location, and type, contributing factors, behavioral characteristics, and vulnerable road users. The intent of this analysis is to identify overall emphasis areas to reduce fatal and serious injury crashes. This section summarizes crash patterns directly related to potential emphasis areas, additional patterns and characteristics explored in this analysis are provided in Appendix A.

The crash analysis is primarily based on the most recent five years of available ODOT crash data (January 1, 2017 to December 31, 2021). Figure 2 shows the crash count by severity and year between 2017 and 2021. Overall, there is a downward trend in reported crashes between 2017 and 2021, however the total number of fatal and suspected serious injury crashes has remained relatively constant.

Figure 2. Crash Count by Crash Severity and Year (2017-2021)



The most recent five years of available ODOT crash data is mapped in Figure 3.

Figure 4 summarizes the crash data between 2017 and 2021 by location and road user type. During this period, there were 6,413 total reported crashes on roadways within the City of Hillsboro city limits, including 15 fatal and 179 suspected serious injury crashes (about 3% of all crashes). Intersection crashes accounted for most reported crashes (61%) and fatal and suspected serious injury crashes (61%) during this period. Pedestrian, bicycle, and motorcycle crashes represented a small proportion of total crashes (5%) but had a higher risk of serious injuries or fatalities, comprising 21% of fatal and suspected serious injury crashes.

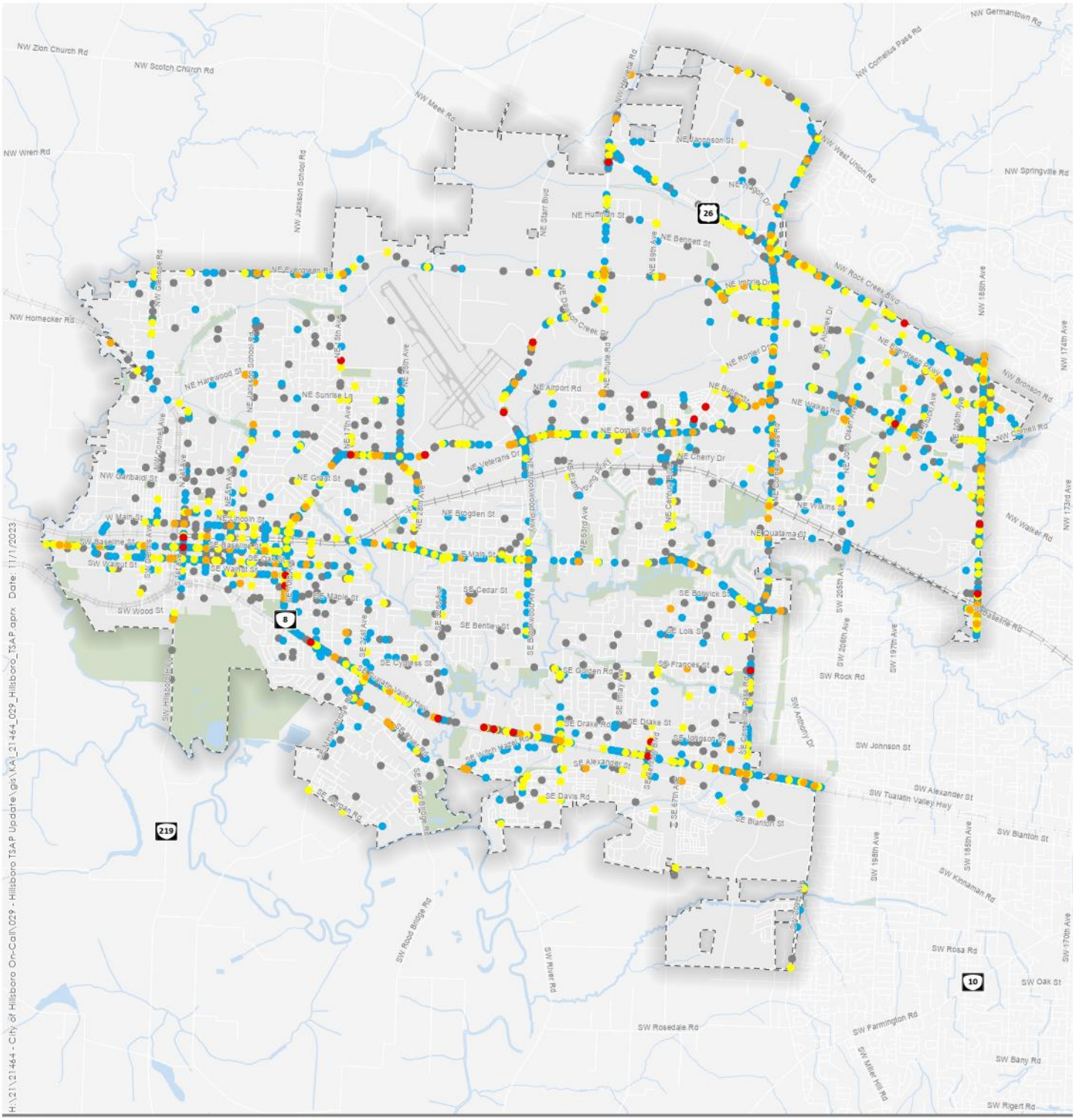
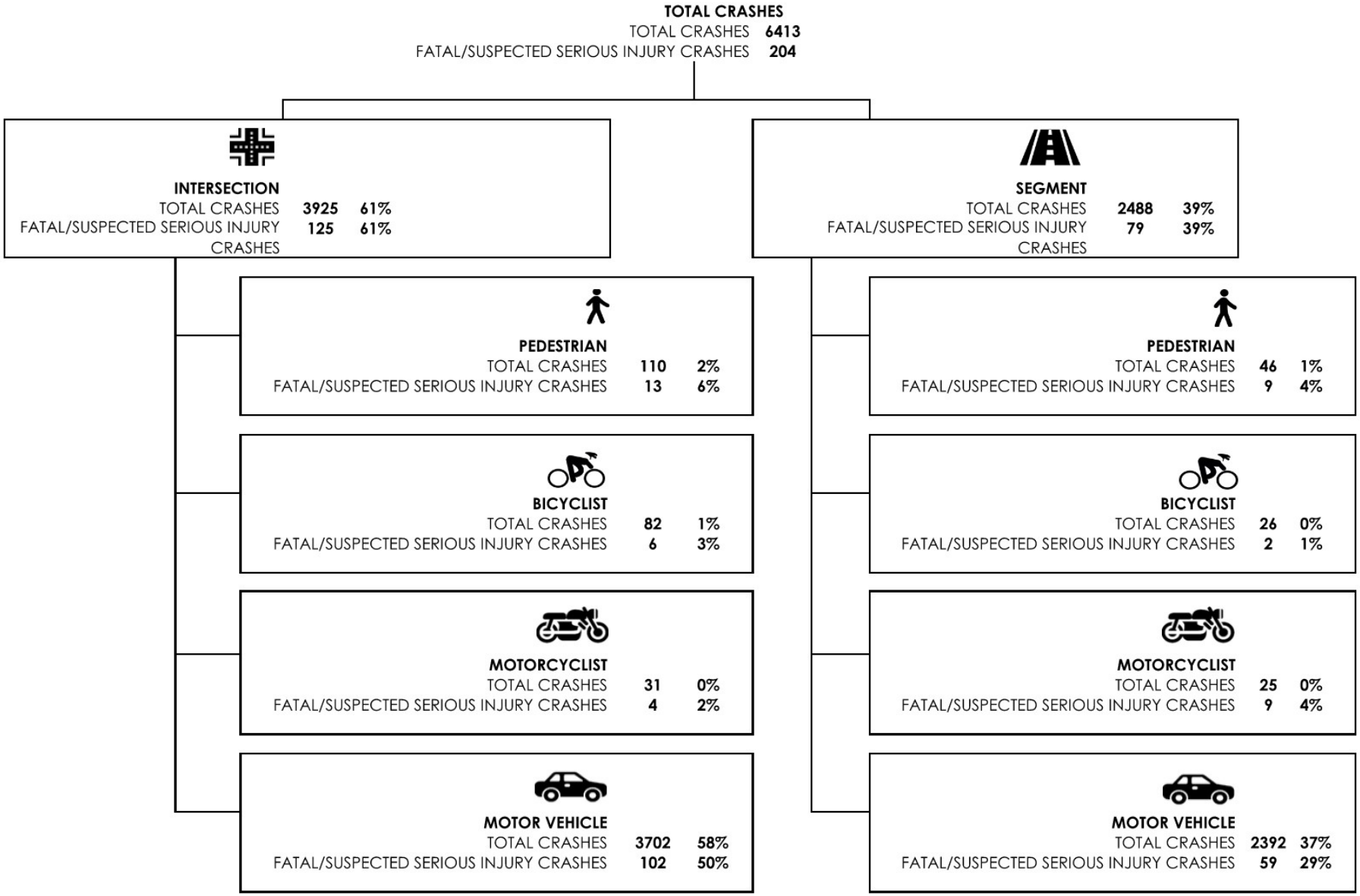


Figure 3

Reported Crashes (2017-2021)
City of Hillsboro

KITTELSON & ASSOCIATES

Figure 4. Reported Crashes (2017-2021) by Intersections and Segments[1]



[1] The percentages for segment crashes do not appear to add up to 39% due to rounding.

Equity and Safety

ODOT's Social Equity Index covers the entire state. It uses American Community Survey date to evaluate the degree to which Oregonians are likely experiencing disparities in service, access, and investments. It considers age, ability, income, language, race/ethnicity, and household access to vehicles.

As shown in Figure 5, there is a higher portion of fatal and suspected serious injury crashes occurring in areas of high and medium high disparity relative to the proportion of the city in high and medium disparity areas.

Figure 5. Social Equity Index

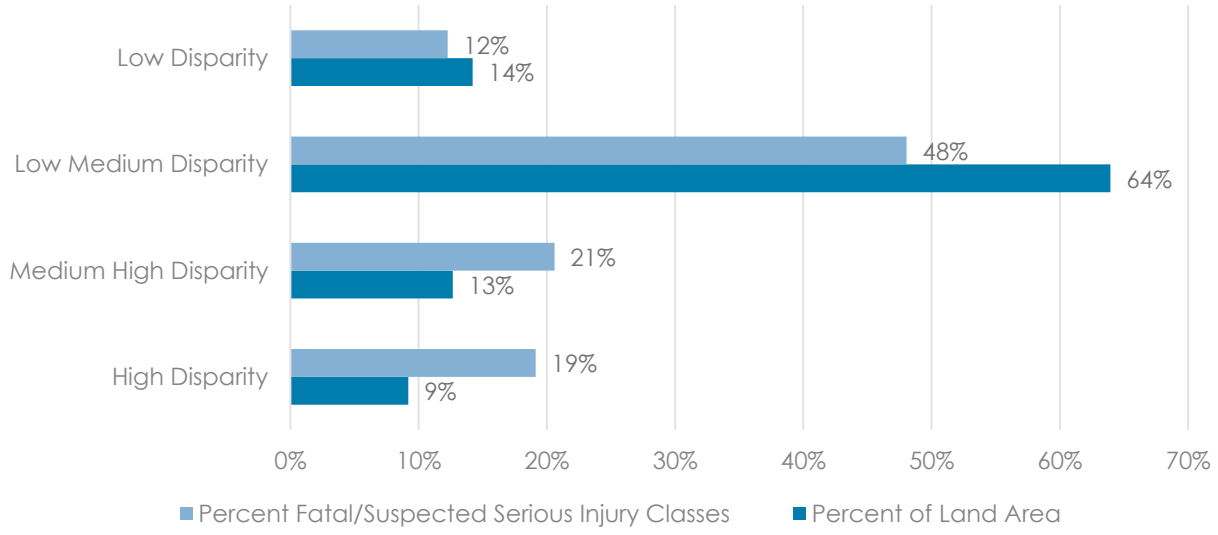


Figure 6 illustrates the location of fatal and suspected injury crashes overlayed on the Social Equity Index zones.

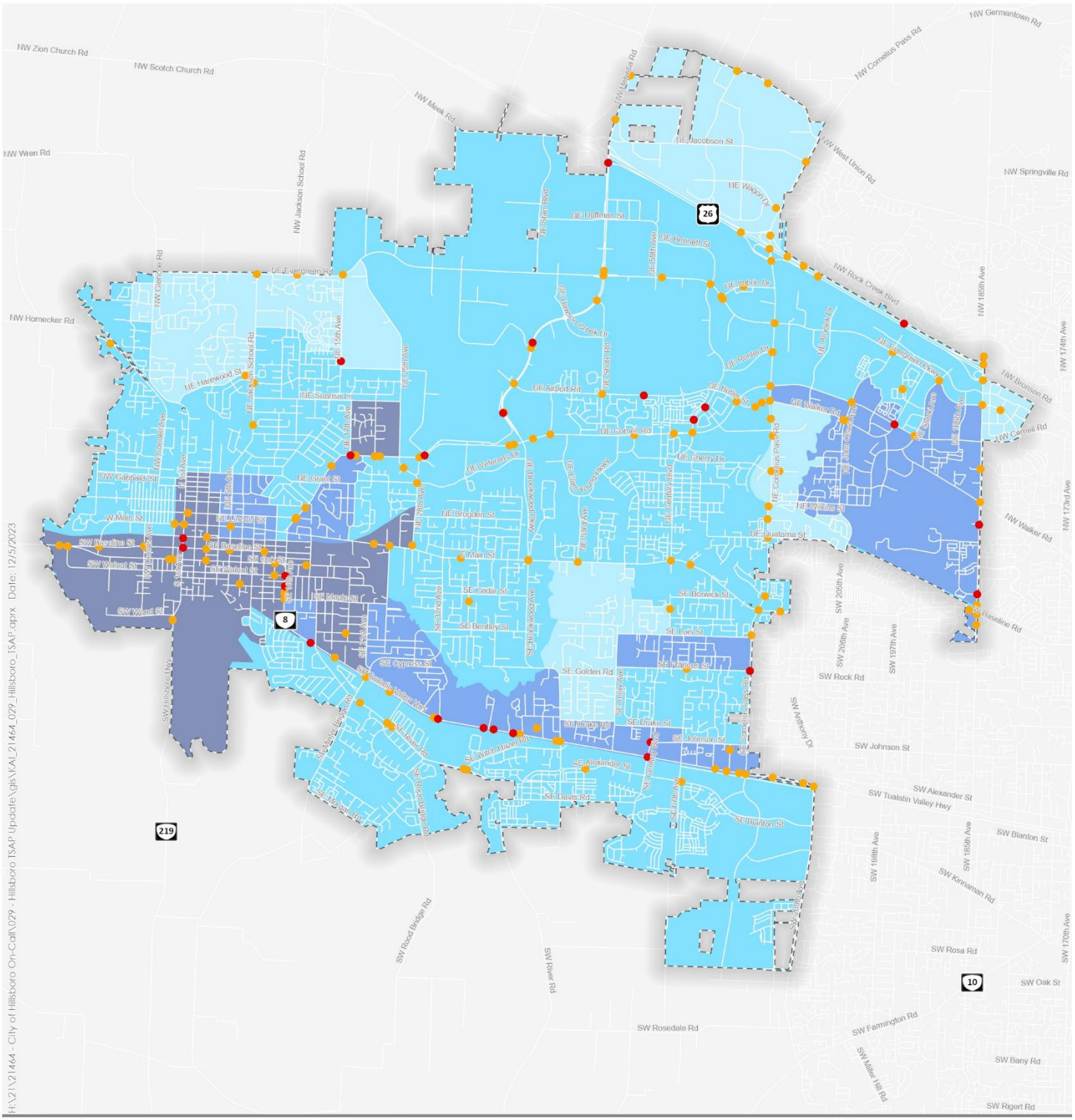


Figure 6

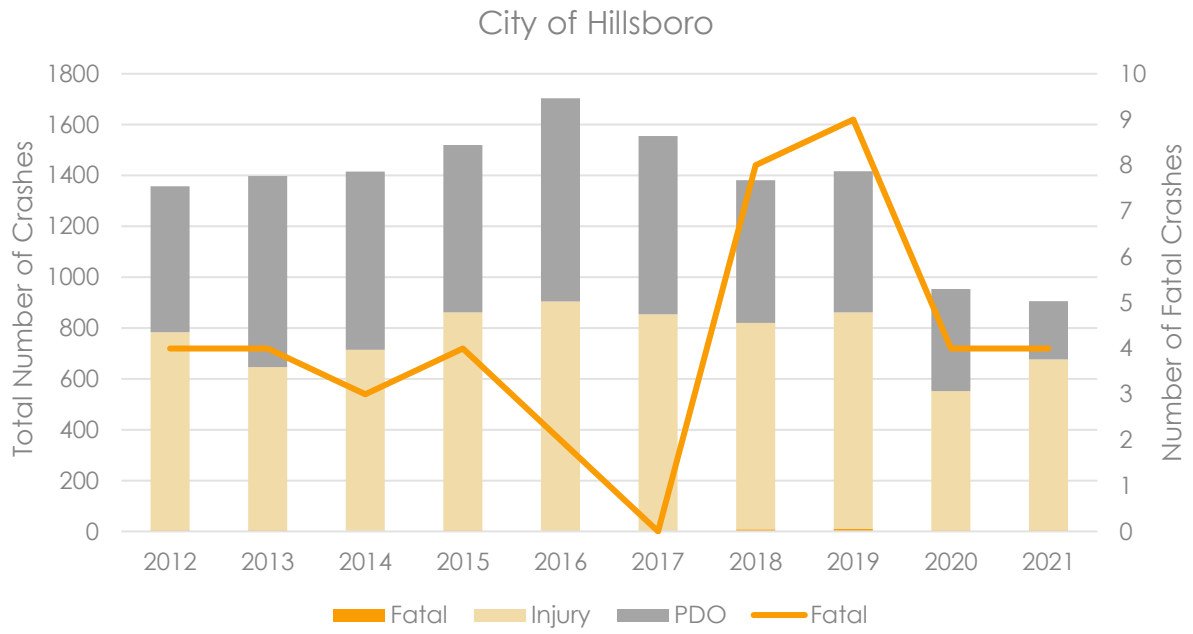
Fatal and Suspected Serious Injury Crashes (2017-2021) City of Hillsboro

KITTELSON & ASSOCIATES

Temporal Trends

Figure 7 shows crash count by severity and year between 2012 and 2021 in the City of Hillsboro. Overall, there is a downward trend in reported crashes; however, the total number of serious injury crashes has remained generally constant.

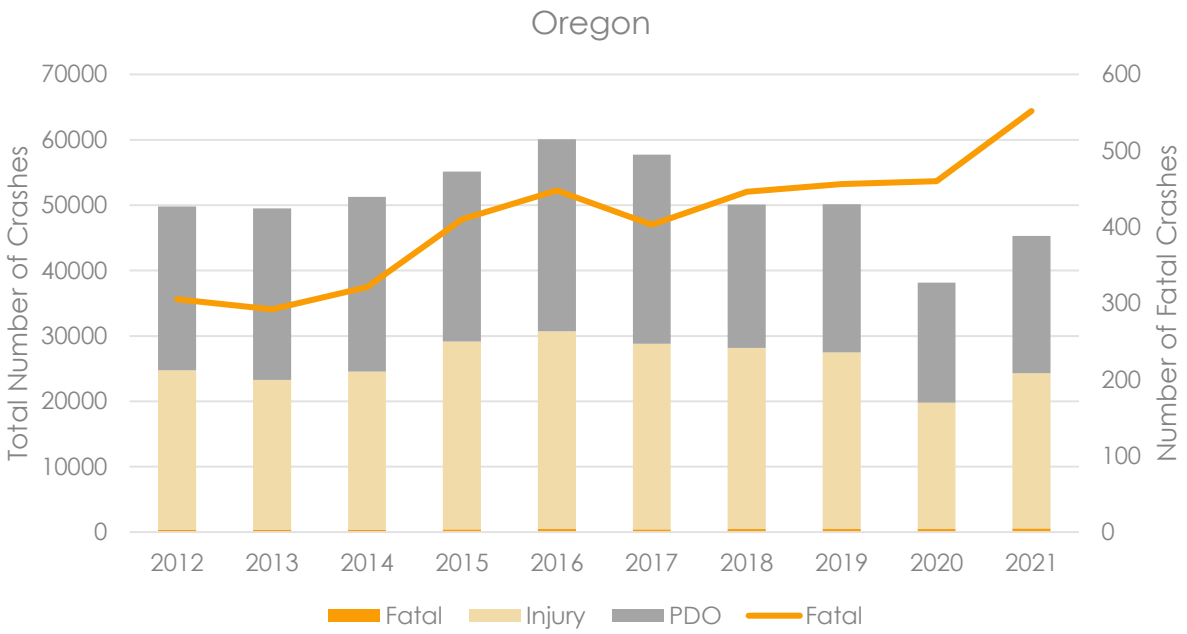
Figure 7. Crash Count by Crash Severity and Year in the City of Hillsboro (2012-2021)



Source: 2012-2021 Oregon Traffic Crash Summary (ODOT)

Figure 8 shows crash count by severity and year between 2012 and 2021 in the State of Oregon. Overall, similar trends are observed between the City of Hillsboro and Oregon for reported serious injury crashes; however, statewide fatal injury crashes have continued to increase.

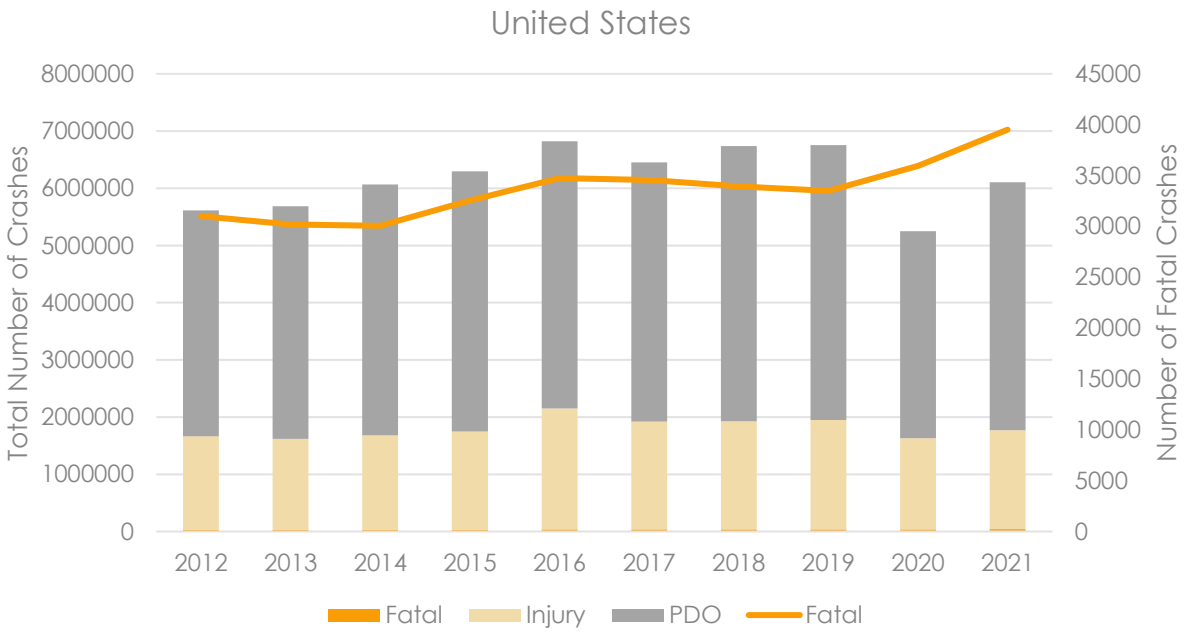
Figure 8. Crash Count by Crash Severity and Year in Oregon (2012-2021)



Source: 2012-2021 Oregon Motor Vehicle Traffic Crashes Quick Facts (ODOT)

Figure 9 shows crash count by severity and year between 2012 and 2021 across the United States. Overall, similar trends are observed between the Oregon and the United States for reported serious injury and fatal crashes. A larger proportion of overall reported crashes in the United States are property damage only compared to Oregon and the City of Hillsboro.

Figure 9. Crash Count by Crash Severity and Year in the United States (2012-2021)



Source: 2021 Summary of Motor Vehicle Traffic Crashes (NHSTA)

As shown in Figure 7, Figure 8, and Figure 9 trends in injury crashes in the City generally align with those observed statewide. Trends in fatal crashes in the city of Hillsboro are difficult to establish due to the low

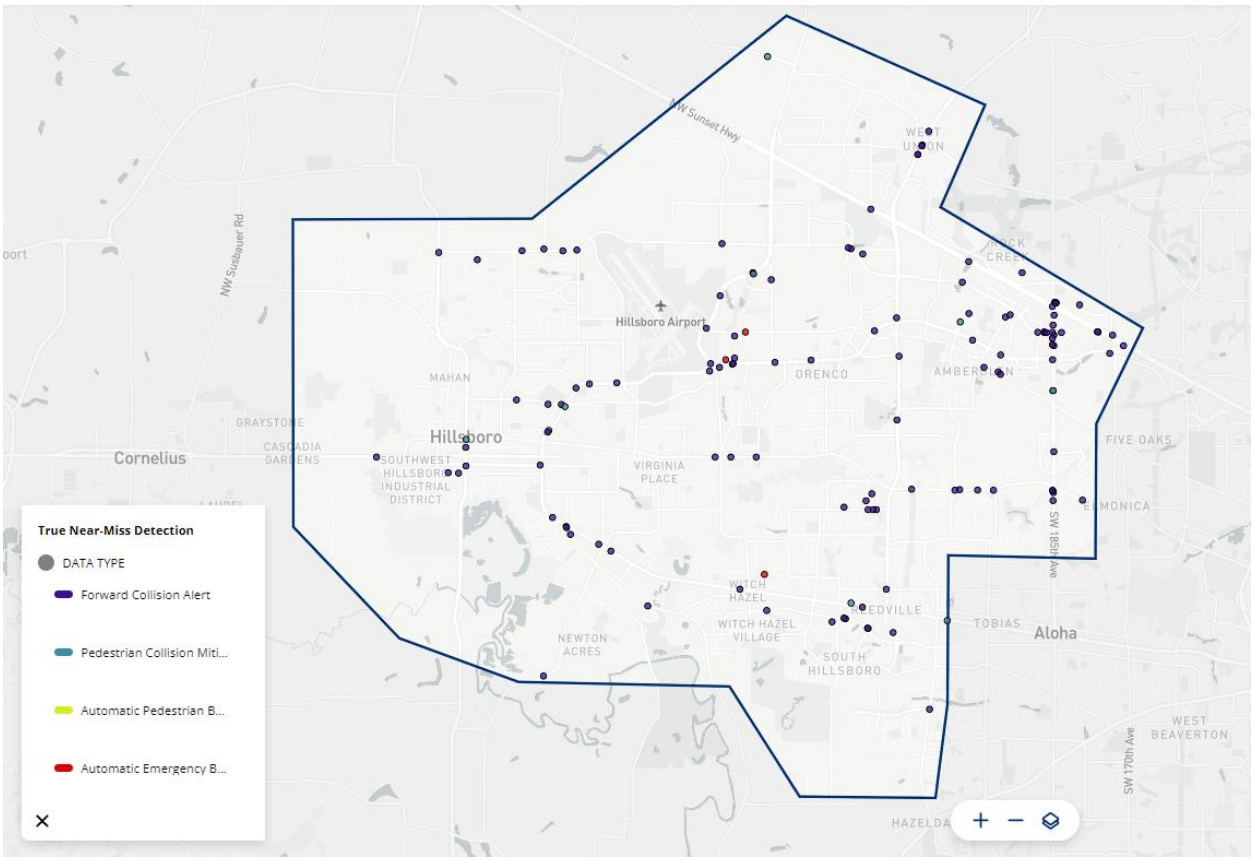
number of fatal crashes per year. Statewide and nationwide there has been an overall increase in fatal crashes between 2012 and 2021.

There was a decrease in total crashes in 2020 citywide, statewide, and nationwide when traffic volumes were lower due to the COVID-19 pandemic. It is worth noting that during the years 2020 and 2021, the percentage of serious injury crashes in the City of Hillsboro increased.

Figure 10 illustrates the near-miss detection from Q2 (April 1 – June 30) 2023. INRIX gathers these data from General Motors (GM) vehicles when the following are activated:

- Forward Collision Alert
- Pedestrian Collision Mitigation Alert
- Automatic Pedestrian Breaking
- Automatic Emergency Breaking

Figure 10. Near-Miss Detection



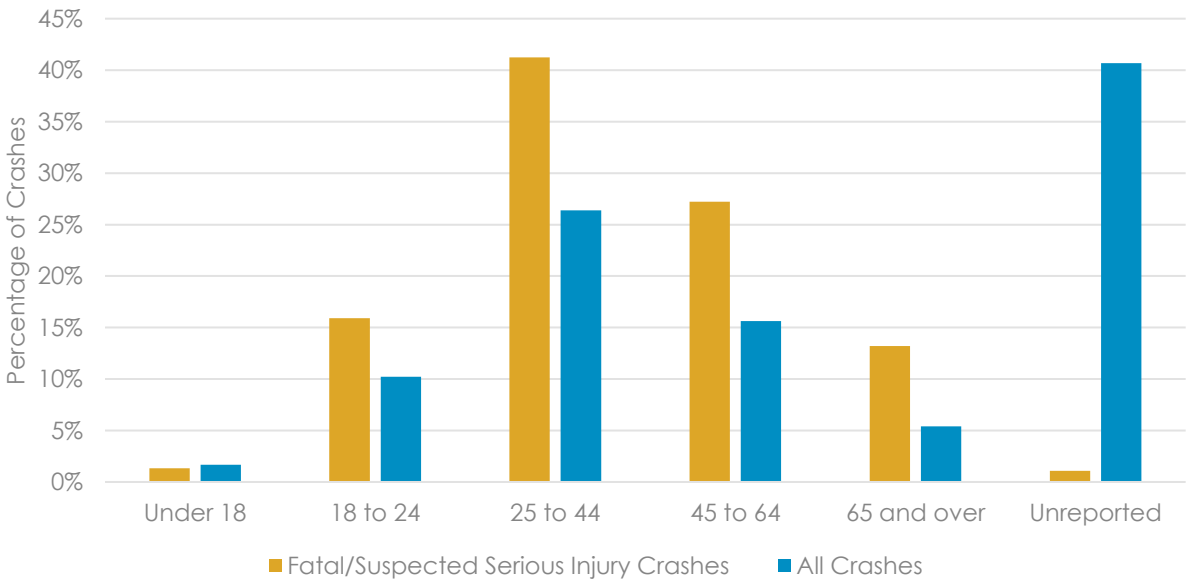
Source: Safety View by INRIX and GM Future Roads

Trends in near-miss detection in the city of Hillsboro are difficult to establish due to the low number of true near-miss detection; however, based on the INRIX data available, more instances of near-miss detection were reported along streets with higher speeds and volumes, such as Tualatin Valley Highway (OR-8), NE Cornell Road, NE Cornelius Pass Road, SW 185th Avenue, and NW Sunset Highway (US 26).

Driver Age

Figure 11 illustrates the percentage of drivers by age involved in fatal and suspected serious injury crashes compared to the general population (all crashes).

Figure 11. Crash Severity by Driver Age (2017-2021)



The distribution of percentage of drivers by age group involved in fatal and suspected serious injury crashes generally align with the distribution of drivers by age group involved in all crashes for most age groups[2]. When only considering reported crashes where the driver age is known, the percentage of drivers involved in fatal and suspected serious injury crashes is higher than the percentage of drivers involved in reported crashes for people aged 45 and older, particularly for those aged 65 and over.

Driving Behaviors

Figure 12 illustrates the percentage of crashes reported due to aggressive driving behaviors, including not yielding the right-of-way, exceeding the posted speed limit or speeding too fast for conditions, and following too closely. Forty-one (41%) percent of crashes and 55% of fatal and suspected serious injury crashes were reported to be caused by aggressive driver behaviors. These numbers may not fully represent the role speed plays in crashes since speed data is not obtained from each motor vehicle in every crash. For comparison with INRIX[3] data, motor vehicle 85th percentile speeds and drivers exceeding the posted speed by >10 mph is included in Appendix A.

[2] Note that 41% of drivers involved in all crashes had unreported ages.
[3] INRIX speed data and instances of speeding are aggregated based on aggregations of connected vehicles and connected devices.

Figure 12. Crash Reported due to Aggressive Driving Behaviors (2017-2021)

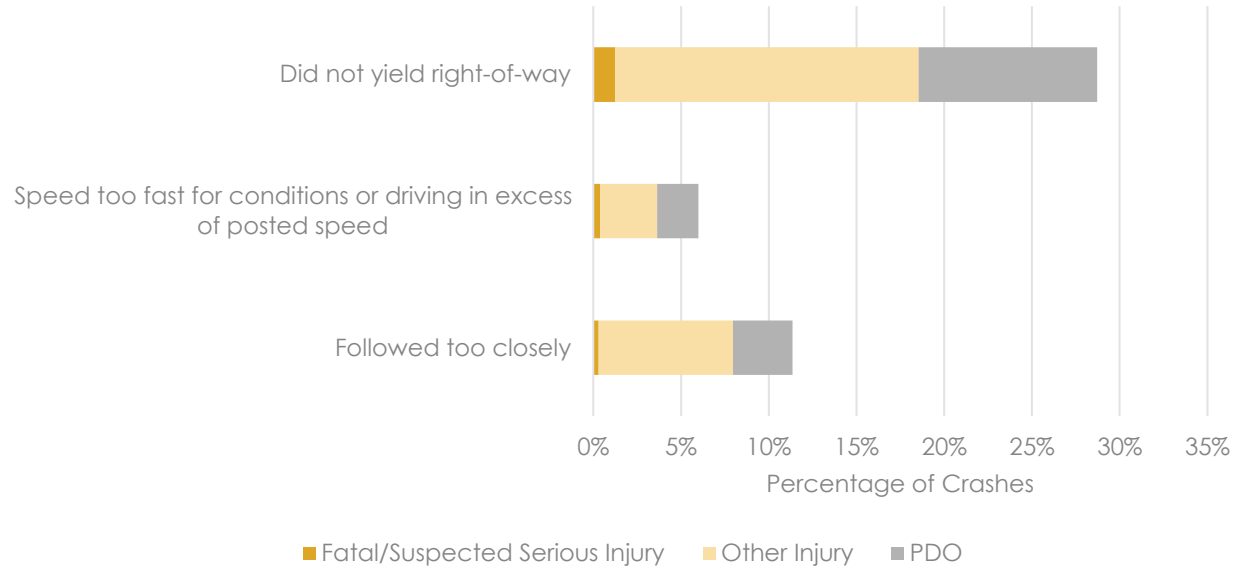
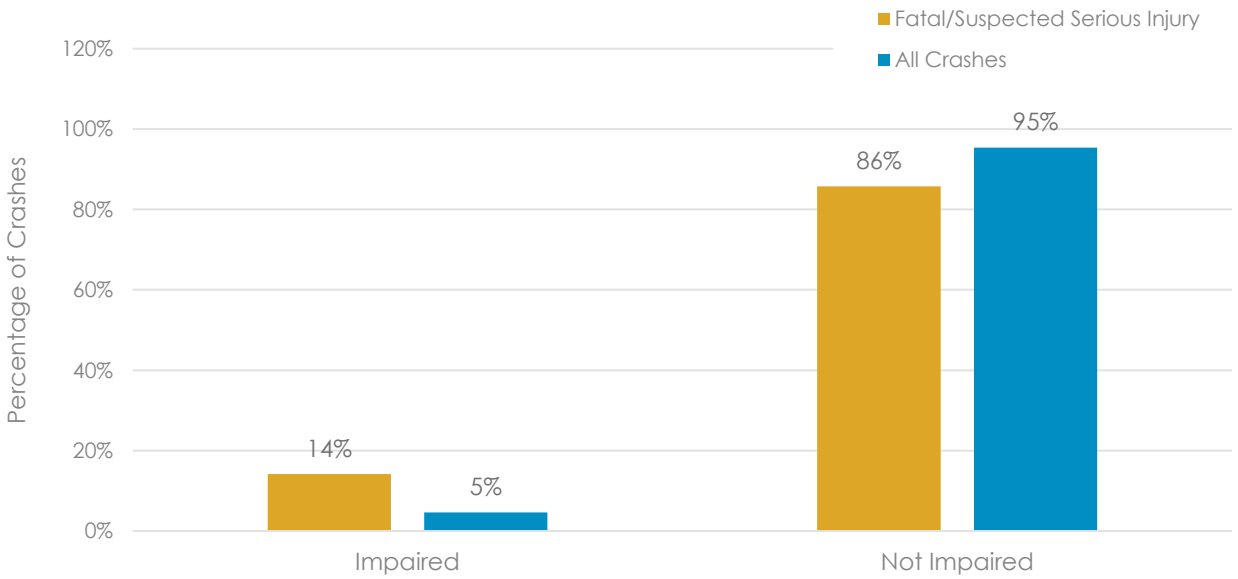


Figure 13. Impaired Driving Crash Share (2017-2021)



As shown in Figure 13 in drivers are reported operate under the influence of alcohol and/or drugs for 5% of all crashes and 14% of fatal and suspected serious injury crashes.

Crash Type

Figure 14 and Figure 15 show the crash severity by reported crash type. Turning and rear-end crashes were the most common reported crash types in the study area for all crashes and for fatal and suspected serious injury crashes. Proportionally, pedestrian and bicycle crashes are most likely to result in fatal and suspected serious injury crashes, followed by fixed-object or other object, turning movement, and angle crashes.

Figure 14. Crash Severity by Type (2017-2021)

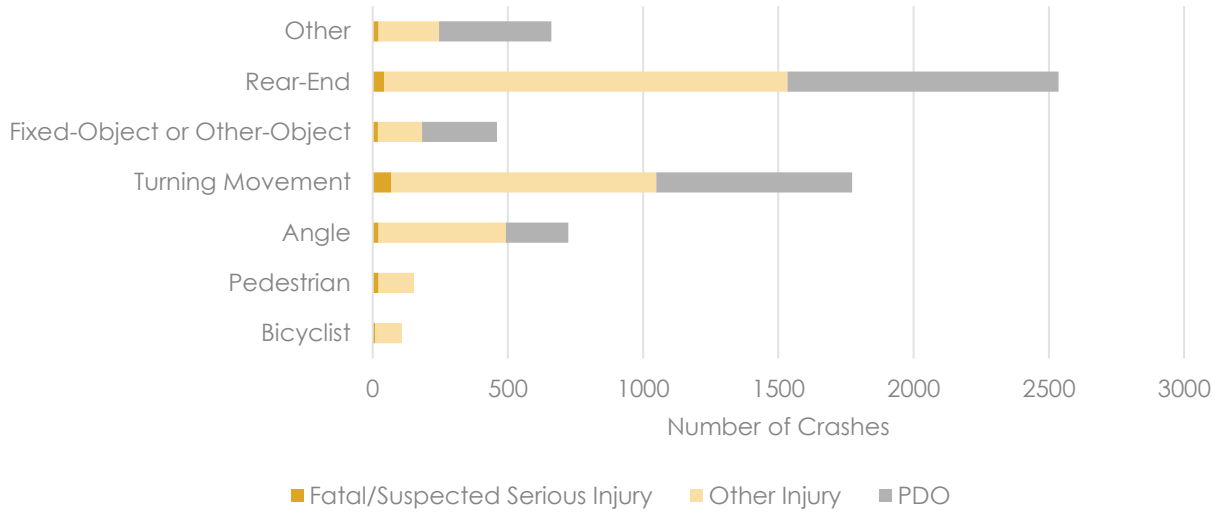
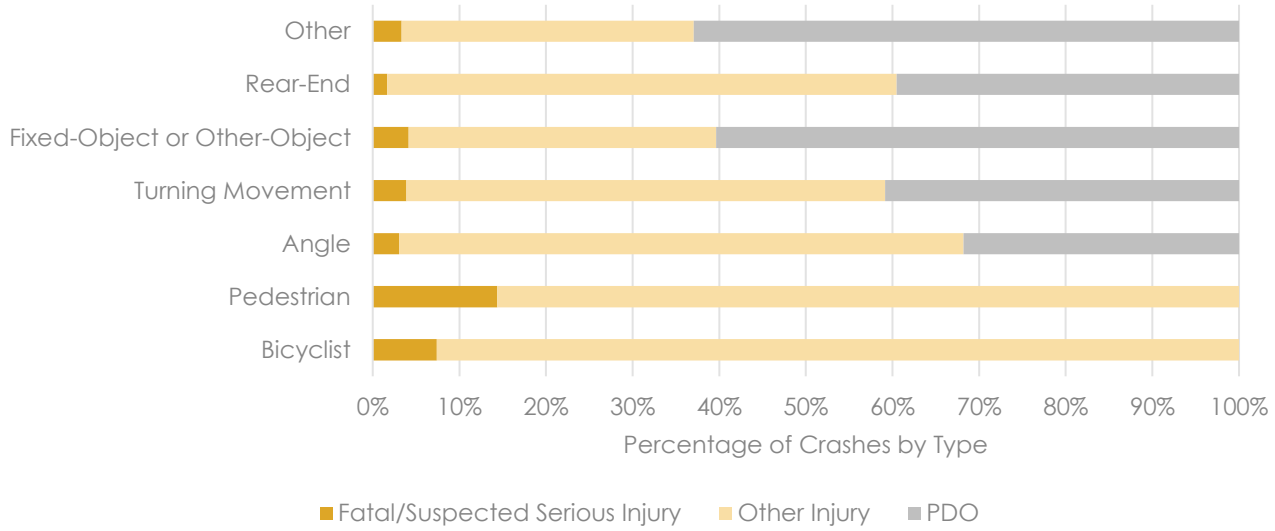


Figure 15. Crash Severity Percentage by Type (2017-2021)



Rear-end crashes accounted for a relatively large number of suspected serious injury crashes; however, a relatively low percentage of rear-end crashes resulted in suspected serious injuries. Therefore, the location and severity of rear-end crashes was compared to the speed limit of roadways to narrow down situations in which rear-end crashes tend to result in fatal and suspected serious injury crashes. Figure 16 illustrates the location of rear-end crashes by severity and roadway speed. Rear-end crashes are more likely to result in suspected serious injuries along roadways with speeds over 40 MPH.

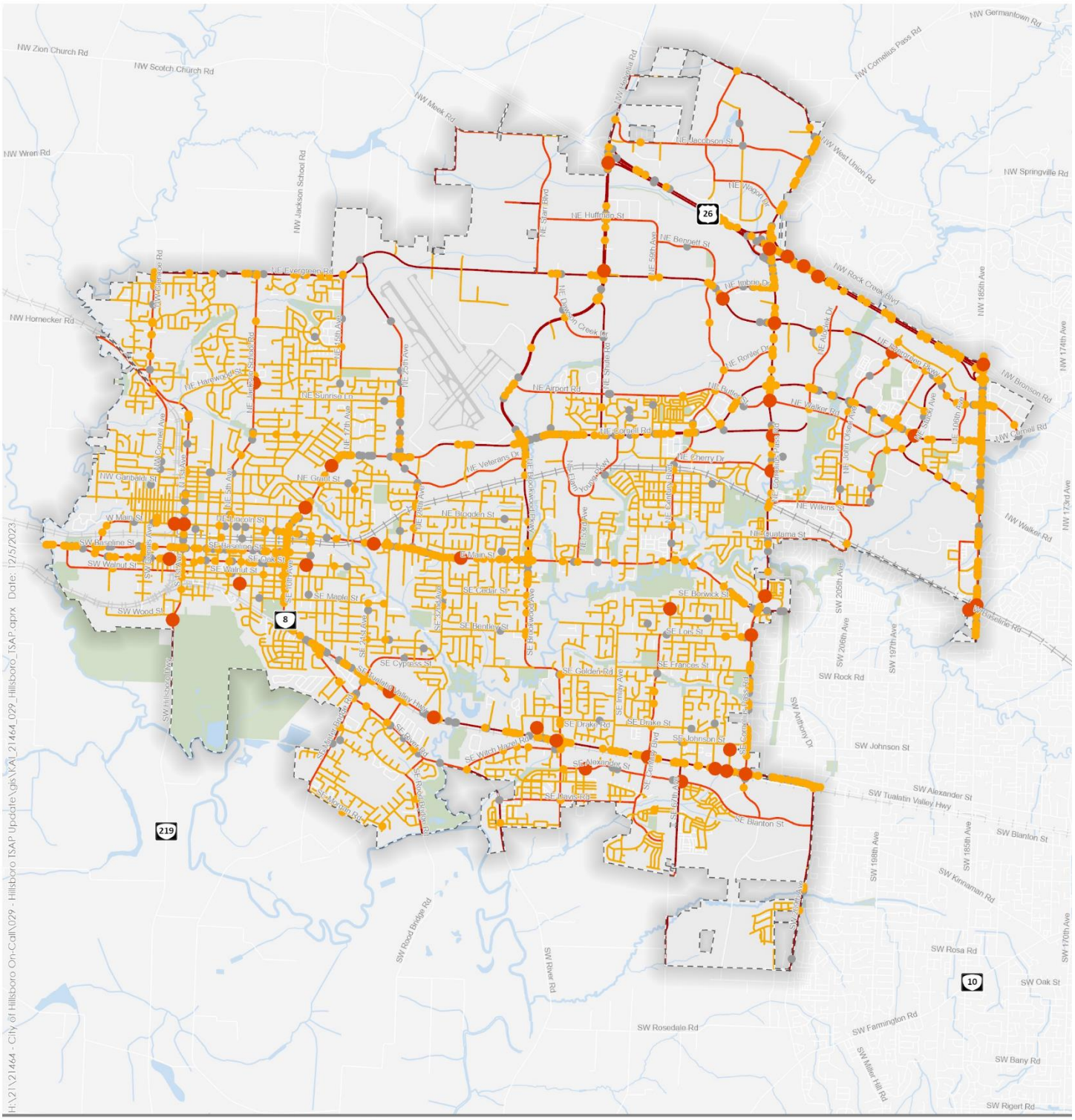


Figure 16

Rear-End Crashes by Severity and Roadway Speed (2017-2021)
City of Hillsboro

KITTELSON & ASSOCIATES

POTENTIAL EMPHASIS AREAS

Based on the crash data analysis summarized in the sections above, Kittelson has identified the following potential emphasis areas for the City of Hillsboro TSAP:

- **Pedestrian and Bicycle Crashes:** Pedestrians and bicycle crashes represented a small proportion of total crashes but had a higher risk of serious injuries or fatalities.
- **Aggressive Driving:** Failure to yield right-of-way, speed, and following too closely were cited as contributing factors in 41% of all crashes and 55% of fatal and suspected serious injury crashes.
- **Impaired Driving**: 5% of all crashes and 14% of fatal and suspected serious injury crashes involved impaired driving.
- **Intersection Crashes**: Intersection crashes accounted for most of all reported crashes (61%) and fatal and suspected serious injury crashes (61%) between 2017 and 2021.
- **Turning Movements and Rear End (on 40+ MPH roadways) Crashes**: Turning and rear-end crashes were the most common crash types in the study area for all crashes and for fatal and suspected serious injury crashes. Rear-end crashes are more likely to result in suspected serious injuries along roadways with speeds over 40 MPH.
- **Older Drivers:** Excluding drivers with unreported ages, drivers aged 65 and over are more likely to be involved in fatal and suspected serious injury crashes than all crashes.

Table 2 compares the potential emphasis areas identified based on citywide crash patterns and characteristics and compares them to the emphasis areas and crash trends identified in the most recent TSAPs for the City, County, and State.

Table 2. Potential Emphasis Areas Compared to Past TSAPs

Potential Emphasis Areas	City of Hillsboro TSAP (2017) Crash Trend	Washington County TSAP (2016) Safety Focus Areas	Oregon TSAP Emphasis Areas
Pedestrian and Bicycle Crashes	– Pedestrian and bicycle related crashes	– Pedestrians	– Vulnerable Users
Aggressive Driving	– Crashes where the driver disregarded traffic laws (i.e., did not yield the right-of-way, disregarded the traffic signals, followed too closely)	– Speeding	– Risky Behaviors
Impaired Driving	– N/A	– Alcohol and Drug Impairment	– Risky Behaviors
Intersection Crashes	– High critical crash rate intersection locations	– Intersections	– Infrastructure
Turning Movements and Rear End (on 40+ MPH roadways) Crashes	– Crashes involving turning movements at signalized intersections – Rear-end collisions	– N/A	– N/A
Older Drivers	– N/A	– N/A	– Vulnerable Users

Safe System Approach

The Safe System approach aims to eliminate fatal and serious injuries for all road users through a holistic view of the road system that uses redundancy to create layers of protection. The Safe System approach outlines the following strategies related to the "6 Es" of safety: education, emergency medical services,

enforcement, engineering, evaluation, and equity. Figure 17 summarizes the key principles and focus areas of this strategy.

Figure 17. Safe System Approach

Source: USDOT

As part of Task 5: Recommendations, the project team will frame infrastructure and non-infrastructure countermeasures around the Safe System Approach.

NETWORK SCREENING

Network screening identifies intersections and segments within the study area with the greatest potential for safety benefits. As outlined in the Project Framework Memorandum, the Equivalent Property Damage Only (EPDO) performance measure from the Highway Safety Manual (HSM, Reference 1) is used to locate intersections and segments within the entire system that have the highest overall crash severity.

The following section describes and presents the results of the EPDO analysis.

Methodology

Kittelson performed the EPDO network screening for public roads within the study area, separating intersections from roadway segments. The EPDO performance measure is described below and is referred to as a crash severity score for the remainder of this memorandum.

A crash severity score is assigned to an individual crash and is weighted based on the severity of the crash (Table 3). Weights are relative to property-damage-only (PDO) crashes, with a PDO crash having the lowest

cost to society (e.g., cost of infrastructure repair, medical costs, work-loss costs, and value of quality of life) and fatal and suspected serious injury crashes having the greatest cost to society.[4]

Table 3. Crash Weights by Severity

Crash Severity	Crash Severity Score Weight
Fatal	100
Suspected Serious Injury	100
Suspected Minor Injury	10
Possible Injury	10
No Apparent Injury (PDO)	1

Source: ODOT Safety Priority Index System (SPIS)

The weights prioritize fatal and suspected serious injury crashes equally to recognize that a death versus a serious injury may be a function of the health of the individual involved or of emergency response time.

Intersections

Kittelson first identified the signalized and unsignalized intersections in the study area and then defined crashes as intersection or segment crashes. This evaluation used ODOT crash data reporting to identify intersection and segment crashes[5]. Crashes occurring outside of these parameters were used in the segment analysis summarized in the next section.

Kittelson calculated the crash severity score for the intersections by multiplying each weight and the total crashes for the associated severity and summing the results, as follows:

$$\begin{aligned}\boldsymbol{Crash\ Severity\ Score} &= (Fatal\ Weight \times \#\ of\ Fatal\ Crashes) \\ &+ (Suspected\ Serious\ Injury\ Weight \times \#of\ Suspected\ Serious\ Injury\ Crashes) \\ &+ (Suspected\ Minor\ Injury\ Weight \times \#of\ Suspected\ Minor\ Injury\ Crashes) \\ &+ (Possible\ Injury\ Weight \times \#of\ Possible\ Injury\ Crashes) + (PDO\ Weight \times \#of\ PDO\ Crashes)\end{aligned}$$

Kittelson annualized the crash severity score by dividing it by the number of years (five) of crash data used in the analysis. The intersection EPDO network screening results are summarized and illustrated under the 'Potential High Priority Locations' section.

Segments

Kittelson applied the crashes that occurred outside of the intersection definitions described above to the roadway segment network screening. Kittelson used a sliding-window approach[6] to identify crash patterns on segments. Kittelson used a Python script in ArcGIS to split the street network into overlapping half-mile segments, incrementing the segments by one-quarter (1/4) of a mile. After splitting the network, the Python script spatially joined non-intersection crashes to each segment. Kittelson calculated the crash severity

[4] National Highway Traffic Safety Administration. *The Economic and Societal Impact of Motor Vehicle Crashes*, 2019 (Revised). https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/813403
[5] Crashes where the reported road character is street, road, or highway intersection or that were reported as intersection related were coded as intersection crashes.
[6] The sliding-window approach splits roadways into smaller segments with overlapping "windows" to analyze crash patterns while ensuring that segments are not over- or under-represented based on how the segments were split.

scores for segments in the same way as for intersections; results are summarized and illustrated under 'Potential High Priority Locations.'

POTENTIAL HIGH PRIORITY LOCATIONS

This section presents the results of the EPDO network screening, highlighting the intersections and segments with the highest crash severity scores. The sites presented in this section are provided for consideration by the City of Hillsboro and partner agencies in prioritizing locations for potential capital improvement projects as part of Task 5: Recommendations. Task 5: Recommendations will further utilize INRIX data to understand site specific behavioral characteristics which may lead to the identification of contributing factors of risk high locations and countermeasures to address areas of concern.

Intersection Results

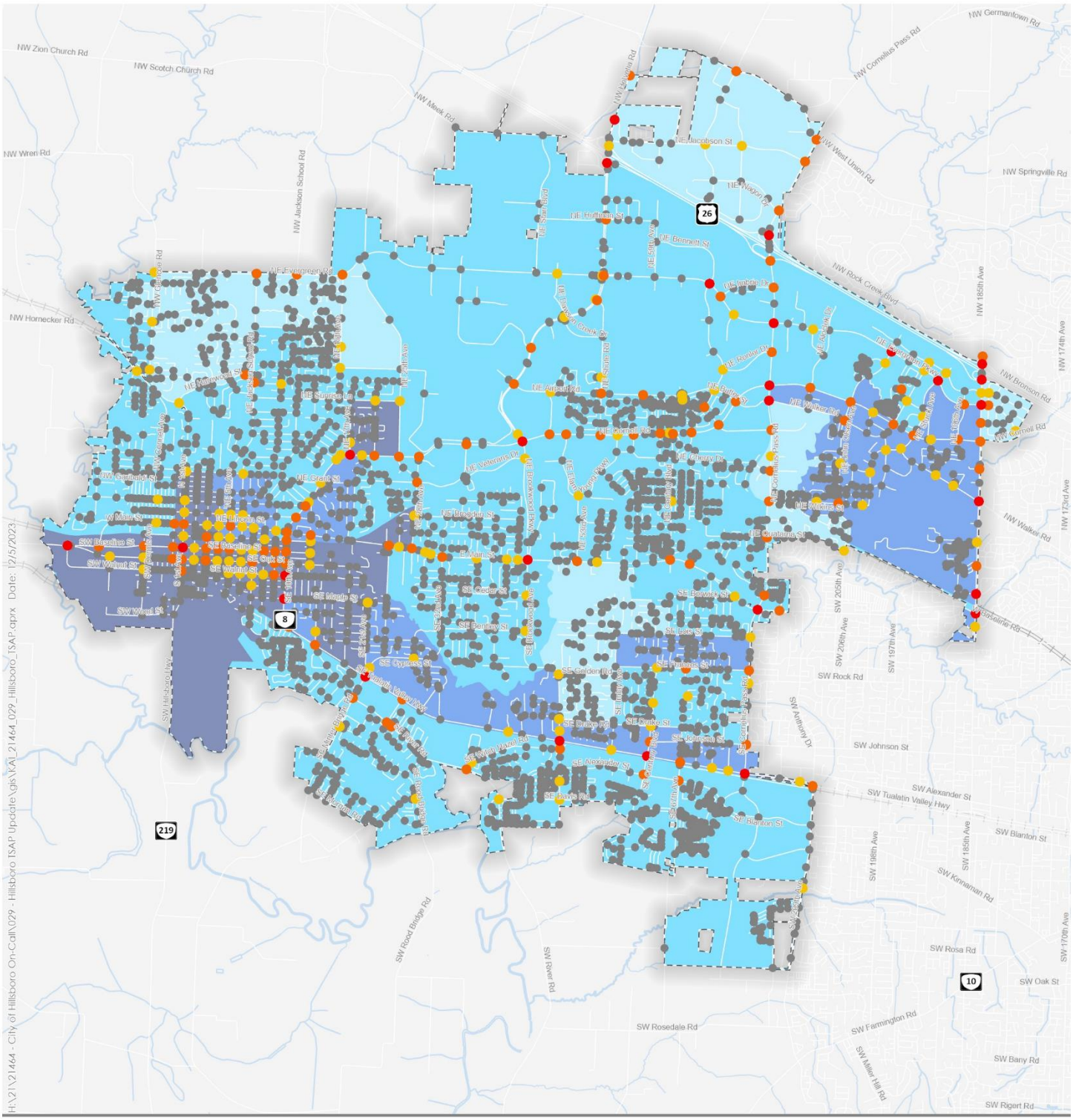
Table 4 presents the top 1% of intersections within the study area in terms of highest crash severity score. The results of the intersection EPDO network screening, overlayed with ODOT's Social Equity Index, are illustrated in Figure 18, including the top 1% sites identified in Table 4 below. Further, Table 5 lists the top-scoring 10 intersections with both intersecting roadways under the City's jurisdiction because the City has more direct influence to apply safety countermeasures at these locations.

Table 4. Intersections with Highest Crash Severity Scores (Top 1% Sites)

Rank	Intersection	Traffic Control	Jurisdiction(s)	Crash Severity Score	Total Crashes			Social Equity Index
					Fatal/ Suspected Serious Injury	Suspected Minor/ Possible Injury	No Apparent Injury (PDO)	
1	SE Cornelius Pass Rd / E Main St – W Baseline St	Signal	Washington County	159	4	38	15	Low Medium Disparity
2	SE Brookwood Ave / E Main St	Signal	Washington County	157.2	3	47	16	Low Medium Disparity
3	SW 185th Ave / W Baseline Rd	Signal	Washington County	153.2	3	45	16	Medium High Disparity
4	SE Tualatin Valley Hwy / SE Cornelius Pass Rd	Signal	ODOT / Washington County / City of Hillsboro	121.6	2	39	18	Medium High Disparity
5	NE Cornell Rd / NE Cornelius Pass Rd	Signal	Washington County	121.2	3	29	16	Low Medium Disparity
6	NE Stucki Ave / NE Evergreen Pkwy	Signal	City of Hillsboro / Washington County	105	3	21	15	Medium High Disparity
7	NW 185th Ave / NE Evergreen Pkwy	Signal	Washington County / City of Hillsboro	104.6	1	40	23	Low Medium Disparity
8	SE Walnut St / SE 10th Ave	Signal	City of Hillsboro / ODOT	102.6	3	20	13	High Disparity
9	SE Tualatin Valley Hwy / SE Brookwood Ave	Signal	ODOT / Washington County / City of Hillsboro	97.2	1	37	16	Medium High Disparity
10	Sunset Hwy / NE 185th Ave	Signal (Interchange Ramp	ODOT / Washington County	96.8	1	36	24	Low Medium Disparity
11	SE Tualatin Valley Hwy / SE Century Blvd	Signal	ODOT / City of Hillsboro	95.6	2	26	18	Medium High Disparity

Rank	Intersection	Traffic Control	Jurisdiction(s)	Crash Severity Score	Total Crashes			Social Equity Index
					Fatal/ Suspected Serious Injury	Suspected Minor/ Possible Injury	No Apparent Injury (PDO)	
12	Sunset Hwy / NE Cornelius Pass Rd	Signal (Interchange Ramp)	ODOT	95.0	3	16	15	Low Disparity
13	NE Evergreen Pkwy / NE Century Blvd	Signal	Washington County /City of Hillsboro	94.4	2	26	12	Low Medium Disparity
14	SE Tualatin Vally Hwy-SW Baseline St / SW 17th Ave	Signal	ODOT / City of Hillsboro	90.2	3	14	11	High Disparity
15	NE Cornell Rd / NE Brookwood Pkwy	Signal	Washington County	86.2	0	41	21	Low Medium Disparity
16	NE Evergreen Pkwy / NE Cornelius Pass Rd	Signal	Washington County	86.0	2	22	10	Low Medium Disparity
17	SE Tualatin Valley Hwy / SE Minter Bridge Rd – SE Cypress St	Signal	ODOT / City of Hillsboro	84.6	1	31	13	High Disparity
18	NE Walker Rd – NE Butler St / NE Cornelius Pass Rd	Signal	City of Hillsboro / Washington County	84.4	3	11	12	Low Medium Disparity
19	SE Baseline St / S 1st Ave	Signal	ODOT / Washington County	84.4	2	21	12	High Disparity
20	SW 185th Ave / SE Edgeway Dr – SW Salix Ter	Signal	Washington County / City of Hillsboro	74.4	2	16	12	Medium High Disparity
21	NW Sunset Hwy / NE 185th Ave	Signal (Interchange Ramp)	ODOT / Washington County	71.4	1	24	17	Low Disparity
22	NW Sunset Hwy / NE Brookwood Pkwy	Signal (Interchange Ramp)	ODOT / Washington County	71.4	2	14	17	Low Medium Disparity

Rank	Intersection	Traffic Control	Jurisdiction(s)	Crash Severity Score	Total Crashes			Social Equity Index
					Fatal/ Suspected Serious Injury	Suspected Minor/ Possible Injury	No Apparent Injury (PDO)	
23	NE Evergreen Pkwy / NE John Olson Ave	Signal	Washington County / City of Hillsboro	71.0	2	15	5	Low Disparity
24	NE Cornell RD / NE 17th Ave	Two-Way Stop-Controlled (TWSC)	Washington County / City of Hillsboro	70.6	2	14	13	High Disparity
25	NW Helvetia Rd / NE Jacobson St	TWSC	Washington County / ODOT	66.6	1	22	13	Low Disparity
26	NW 185th Ave / NE Walker Rd	Signal	Washington County	66.4	1	22	12	Low Medium Disparity
27	SE 10th Ave / SE Maple St	Signal	ODOT / City of Hillsboro	66.0	1	22	10	High Disparity



H:\21\21464 - City of Hillsboro On-Call\029 - Hillsboro TSAP Update\gis\KAI_21464_029_Hillsboro_TSAP.aprx Date: 12/5/2023

Intersections: Crash Severity Score

- > 10% (<2.4)
- > 5 - 10% (>2.4 to 65.6)
- > 1 - 5% (>15.6 to 65.6)
- Top 1% (>65.6 to 159)

Social Equity Index

- High Disparity
- Medium High Disparity
- Low Medium Disparity
- Low Disparity
- City Limits
- Light Rail Transit
- Freight Rail

0 0.5 1 1.5 Miles

Figure 18

Intersection Screening Results
City of Hillsboro

KITTELSON & ASSOCIATES

Table 5. Top 10 Intersections – City of Hillsboro Facilities

Rank	Intersection	Traffic Control	Crash Severity Score	Total Crashes			Social Equity Index
				Fatal/ Suspected Serious Injury	Suspected Minor/ Possible Injury	No Apparent Injury (PDO)	
1	SE Johnson St / SE Century Blvd	TWSC	48.4	2	4	2	Medium High Disparity
2	NE John Olsen Ave / NE Wilkins St	Signal	43.6	0	21	8	Medium High Disparity
3	E Main St / NE 5th Ave	TWSC	43.4	1	11	7	Medium High Disparity
4	NE John Olsen Ave / NE Walker Rd	Signal	38.6	1	9	3	Medium High Disparity
5	E Main St / SE 24th St	Signal	32.8	1	6	4	Low Medium Disparity
6	SE 9th Ave / SE Walnut St	TWSC	30.6	1	5	3	High Disparity
7	E Main Street / SE 32nd Ave	Signal	27.4	0	13	7	Low Disparity
8	NE 28th Ave / NE Veterans Dr – NE Grant St	Signal	26.6	1	3	3	Low Medium Disparity
9	NE Shute Rd / NE Airport Rd – NE Butler St	Signal	22.6	1	1	3	Low Medium Disparity
10	NE Walbridge St – NE Rosebay Dr / NE Century Blvd	TWSC	22.4	1	1	2	Low Medium Disparity

Potential Priority Intersections

From the EPDO network screening, the following intersections have the highest EPDO scores and/or Social Equity Indices and are under the City's jurisdiction to make improvements. These intersections are the top five priority locations that will be considered for potential project recommendations as part of the TSAP Update:

- SE Johnson St / SE Century Blvd
- NE John Olsen Ave / NE Wilkins St
- E Main St / NE 5th Ave
- NE John Olsen Ave / NE Walker Rd
- SE 9th Ave / SE Walnut St

Segment EPDO Network Screening Results

Table 6 presents the top 1% roadway segments within the study area that resulted in the highest crash severity score[7]. The results of the segment EPDO network screening, overlayed with ODOT's Social Equity Index, are illustrated in Figure 19, including the top 1% sites identified in Table 6. Table 7 lists the top-scoring 5 roadway segments under the City's jurisdiction because the City has more direct influence to apply safety countermeasures at these locations.

Table 6. Roadway Segments with the Highest Crash Severity Scores (Top 1% Sites)

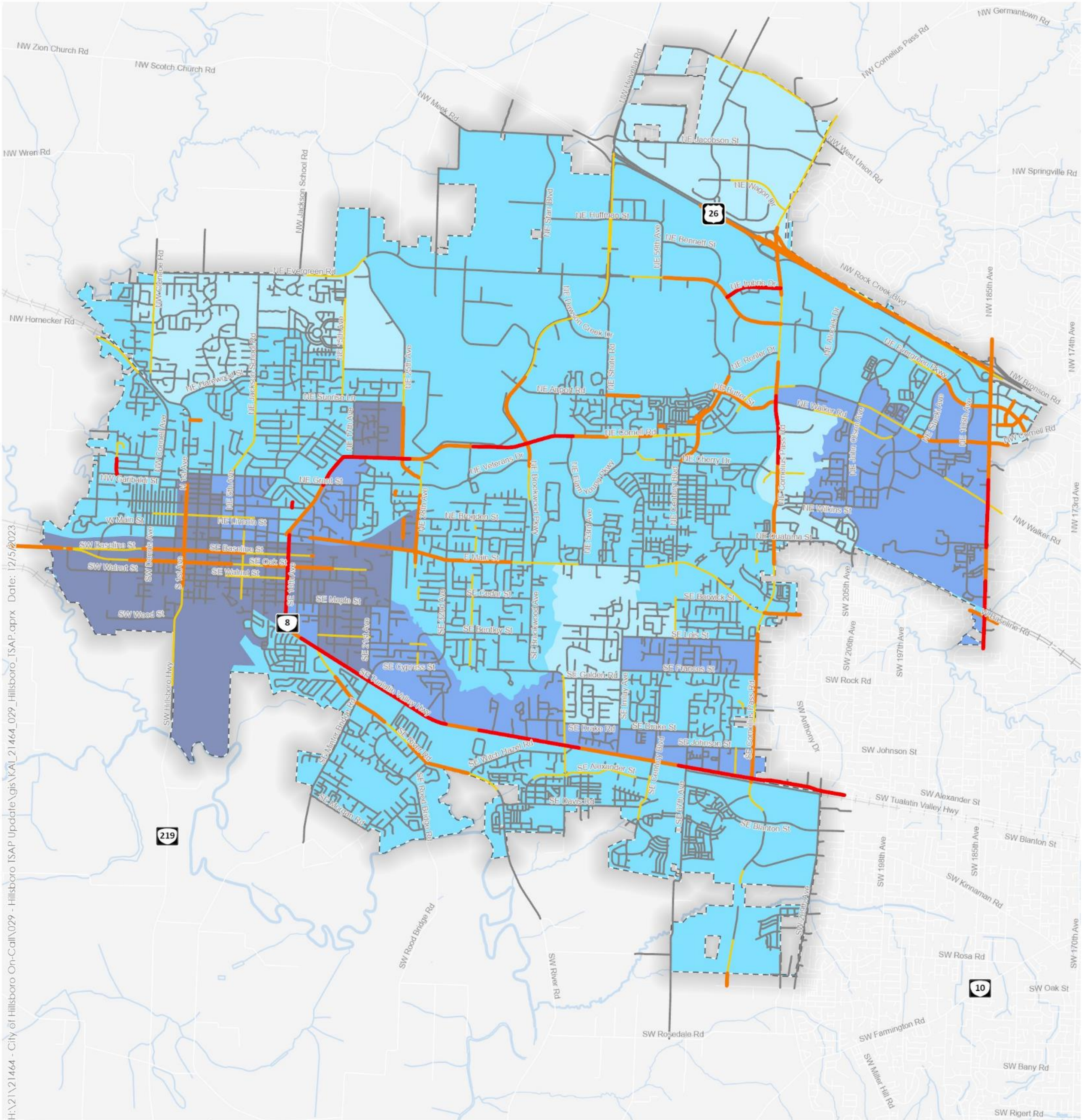
Rank	Roadway Segment	Functional Classification	Total Milage	Jurisdiction	Crash Severity Score Normalized by Mileage	Total Crashes			Social Equity Index
						Fatal/ Suspected Serious Injury	Suspected Minor/ Possible Injury	No Apparent Injury (PDO)	
1	*Tualatin Valley (OR8): 520 feet west of SE 40th Ave to 560 feet east of Brookwood Ave*	*Urban Arterial*	*0.75*	*ODOT*	*237.1*	*5*	*37*	*19*	*Medium High Disparity*
2	*NE Imbrie Dr: NE Evergreen Pkwy to NE Cornelius Pass Rd*	*Major Collector*	*0.4*	*City of Hillsboro*	*209.0*	*1*	*30*	*18*	*Low Medium Disparity*
3	*SW 185th Ave: 670 feet north of SW Salix Ter to city limits*	*Urban Arterial*	*0.5*	*Washington County*	*198.8*	*2*	*27*	*27*	*Medium High Disparity*
4	*Tualatin Valley (OR8): 215 feet west of SE 11th Ave to 60 feet East of SE 32nd Ave*	*Urban Arterial*	*1.25*	*ODOT*	*169.3*	*5*	*53*	*28*	*Medium High Disparity*
5	*SE 10th Avenue: From E Main Street to 480 feet south of Maple St*	*Urban Arterial*	*0.59*	*ODOT*	*165.4*	*2*	*26*	*28*	*High Disparity*
6	*Cornelius Pass: 230 feet north of NE Walker Rd to*	*Urban Arterial*	*0.5*	*Washington County*	*146.4*	*3*	*6*	*6*	*Low Medium Disparity*

[7] Since segments were split the street network into overlapping half-mile segments and incrementing the segments by one-quarter (1/4) of a mile, some overlapping segments appeared in the top 1% of sites. Overlapping segments were combined into a complete segment.

Rank	Roadway Segment	Functional Classification	Total Milage	Jurisdiction	Crash Severity Score Normalized by Mileage	Total Crashes			Social Equity Index
						Fatal/ Suspected Serious Injury	Suspected Minor/ Possible Injury	No Apparent Injury (PDO)	
	210 feet south of NE Nicholas Ct								
7	*SW 185th Ave: 200 feet north of Sunset Square Main Entr to 110 feet south of NE Holly Street*	*Urban Arterial*	*0.5*	*Washington County*	*142.8*	*1*	*24*	*17*	*High Disparity*
8	*Tualatin Valley (OR8): 260 feet west of SE 73rd Ave to city limits*	*Urban Arterial*	*1.27*	*ODOT*	*129.8*	*5*	*31*	*14*	*Medium High Disparity*
9	*NE Cornell Rd: 100 feet east of NE 34th Ave to 60 feet east of NE Elam Young Pkwy*	*Urban Arterial*	*0.84*	*Washington County*	*120.7*	*3*	*18*	*27*	*Low Medium Disparity*
10	*NE Cornell Rd: from NE Grant Street to 260 feet east of NE 25th Ave*	*Urban Arterial*	*1.26*	*Washington County*	*98.9*	*3*	*30*	*23*	*Medium High Disparity*

Table 7. Top 5 Roadway Segments - City of Hillsboro Facilities

Rank	Roadway Segment	Functional Classification	Total Milage	Crash Severity Score Normalized by Mileage	Total Crashes			Social Equity Index
					Fatal/ Suspected Serious Injury	Suspected Minor/ Possible Injury	No Apparent Injury (PDO)	
1	*NE Imbrie Dr: NE Evergreen Pkwy to NE Cornelius Pass Rd*	*Major Collector*	*0.4*	*209.0*	*1*	*30*	*18*	*Low Medium Disparity*
2	*NE Butler St: 280 feet west of NE Century Blvd to NE Cornelius Pass Rd*	*Urban Collector*	*0.5*	*112.0*	*2*	*7*	*10*	*Low Medium Disparity*
3	*NE Century Blvd: from 90 feet north of NE Walbridge St to NE Cherry Dr*	*Major Collector*	*0.5*	*88.0*	*2*	*2*	*0*	*Low Medium Disparity*
4	*SE Oak St: 30 feet west of SE 8th Ave to SE 15th Ave*	*Major Collector*	*0.5*	*77.2*	*1*	*8*	*13*	*High Disparity*
5	*E Main Street: NE 14th Ave to 40 feet west of NE 31st Ave*	*Urban Arterial*	*1.3*	*66.6*	*2*	*20*	*33*	*Low Medium Disparity*



Segments: Crash Severity Score

- > 10% (<11.5)
- > 5 - 10% (>11.5 - 27.2)
- > 1 - 5% (>27.2 - 69.0)
- Top 1% (>69.0 - 122.8)

Social Equity Index

- High Disparity
- Medium High Disparity
- Low Medium Disparity
- Low Disparity
- City Limits
- Light Rail Transit
- Freight Rail

0 0.5 1 1.5 Miles

Figure 19

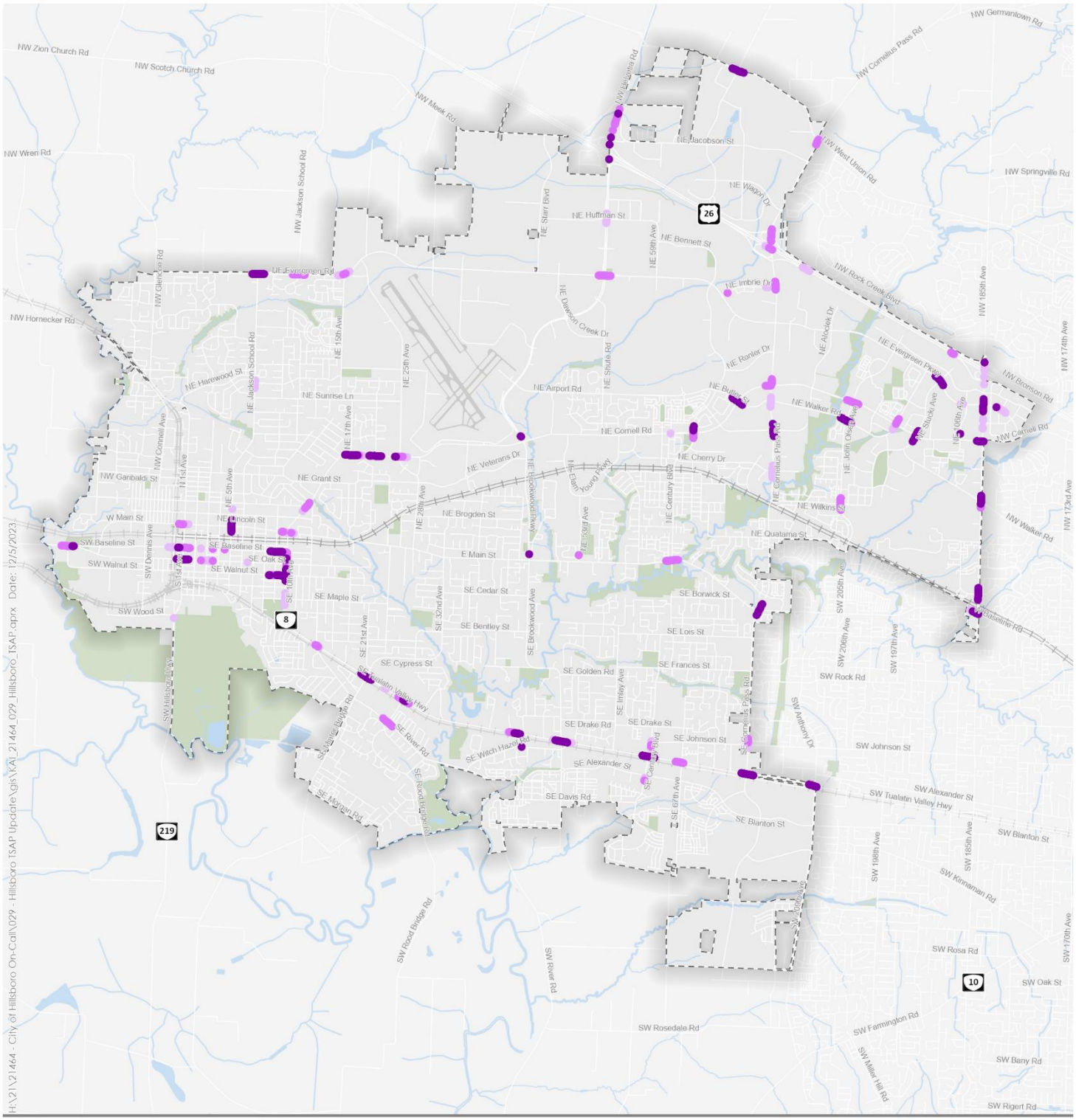
Segment Screening Results City of Hillsboro

KITTELSON & ASSOCIATES

Safety Priority Index System

The ODOT Safety Priority Index System (SPIS) identifies sites along State highways where crash history may warrant further investigation. It identifies locations by considering crash frequency, crash rate, and crash severity. Sites identified within the top 5% are investigated by ODOT staff and reported to the Federal Highway Administration (FHWA).

Figure 20 illustrates the locations identified within the top 15% of statewide SPIS sites. Since crash history and crash severity are two of the primary factors for identifying sites, the map of SPIS sites corresponds to the top 1% of locations identified in the EPDO screening.



SPIS Percentile

- 95% - 100%
- 90% - 94.99%
- 85% - 89.99%

- City Limits
- Waterbodies
- Parks and Open Spaces
- Light Rail Transit
- Freight Rail

0 0.5 1 1.5 Miles

Figure 20

SPIS 2019 (2016-2018 Crashes)
City of Hillsboro

KITTELSON & ASSOCIATES

NEXT STEPS

This memorandum documents the crash patterns, potential emphasis areas, and potential priority locations based on the most recent five-year crash history in the City of Hillsboro.

This memorandum will serve as the basis for identifying risk factors and developing systemic safety countermeasures to address the potential emphasis areas across the study area as well as potential project recommendations for the top five priority locations that will be identified on City streets. Potential funding sources to address engineering and non-engineering solutions will be identified as part of Task 5: Recommendations.

REFERENCES

1. American Association of State Highway Transportation Officials. *Highway Safety Manual*. 2010.

Appendix A: Detailed Crash Data Analysis

CRASH DATA ANALYSIS

The crash data analysis summarized in the following sections includes an evaluation of historical crash patterns within the study area, including temporal trends, contributing factors, intersection control, roadway characteristics, risky behaviors, vulnerable road users, and age.

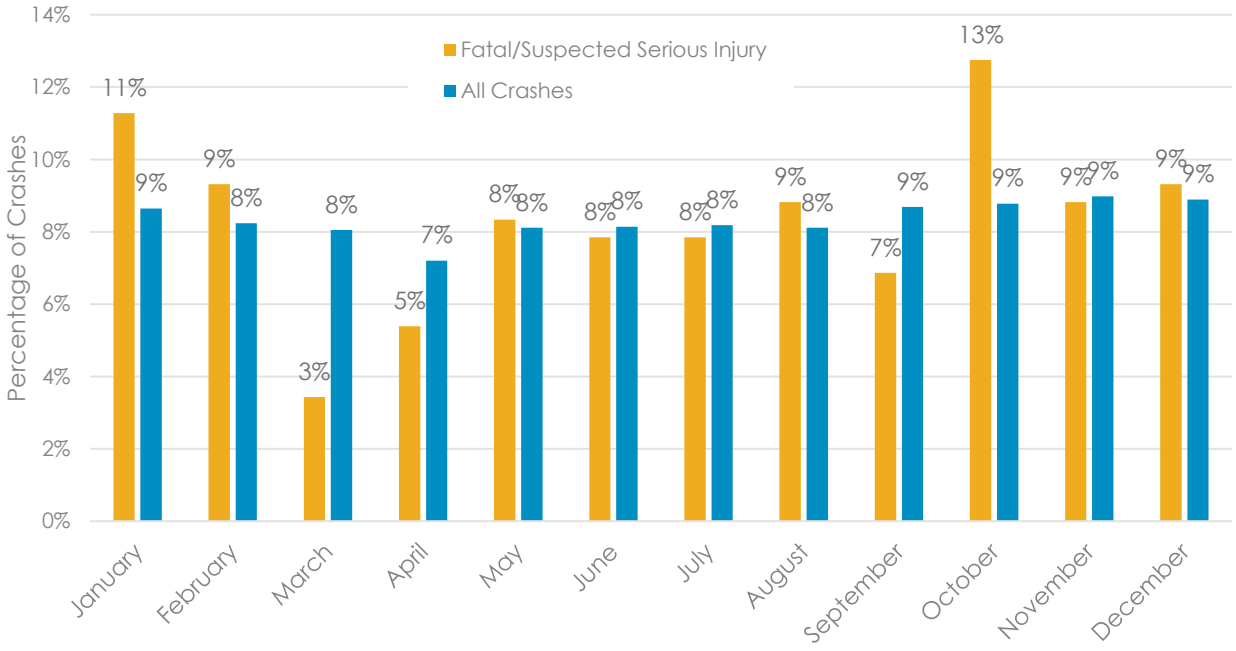
The crash analysis for the City of Hillsboro TSAP Update is primarily developed based on the most recent available five years of ODOT Crash data (January 1, 2017 to December 31, 2021).

Temporal Trends

The temporal crash trends summarized in the following sections include crashes by month and time of day reported in the study area over the study period.

Crashes by Month

Figure 21. Crash Count by Month (2017-2021)



As shown in Figure 21, the crash share by month is relatively consistent overall for all crashes. The crash share by month was slightly higher than average for fatal and suspected serious injury crashes in January and October.

Crashes by Time of Day

Figure 22. Crash Share by Time of Day on an Average Weekday/Weekend (2017-2021)

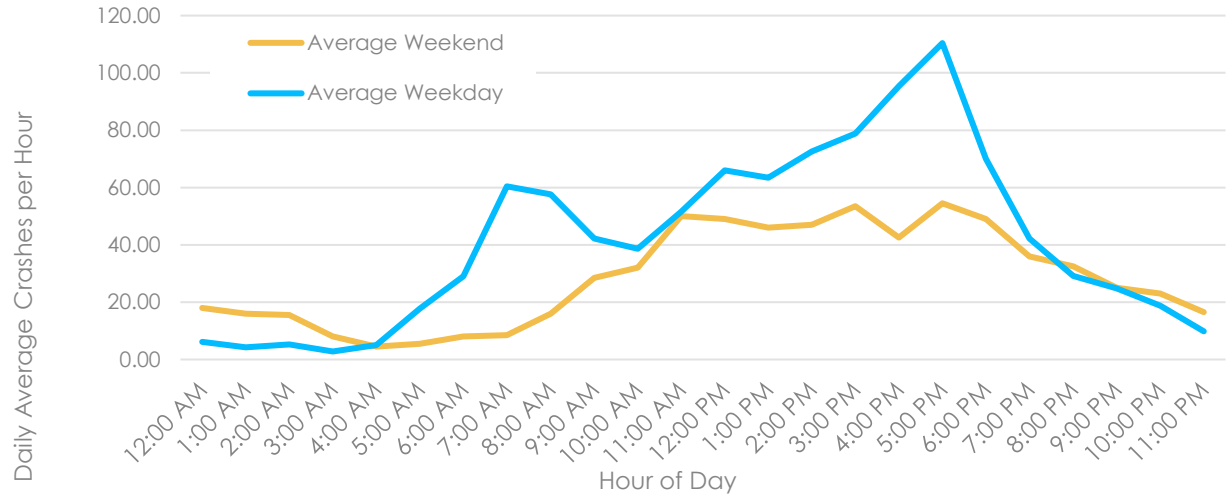


Figure 22 shows the crash share by time of day. On weekdays the daily average crashes per hour peak around 7:00 AM and 5:00 PM when people are commuting to and from work. On weekends the daily rate of average crashes per hour is more consistent throughout the day. The weekend daily crash rate is lower than the weekday daily crash rate.

Contributing Factors

The following section summarizes contributing factors including driving conditions for crashes reported in the study area over the study period.

Driving Conditions

Figure 23. Crash Share by Road Surface Condition (2017-2021)

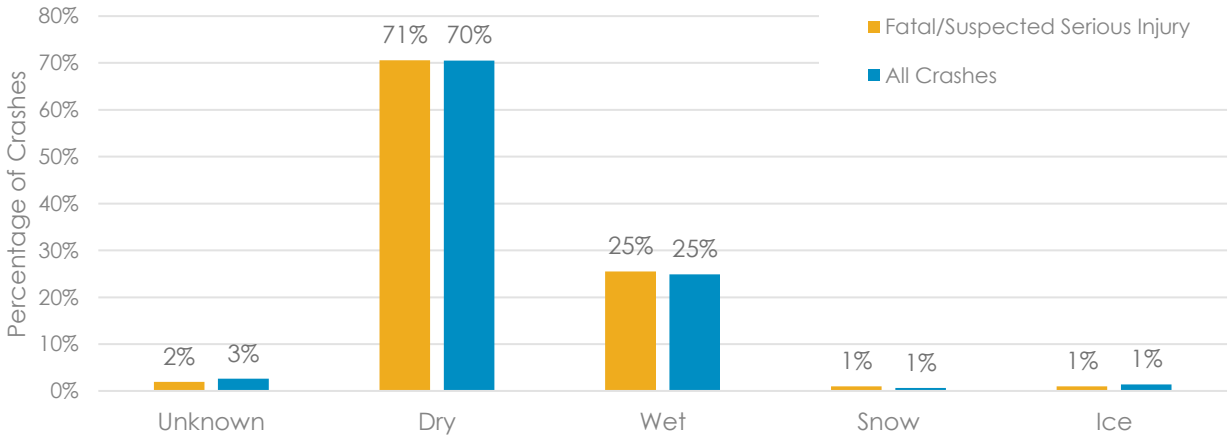
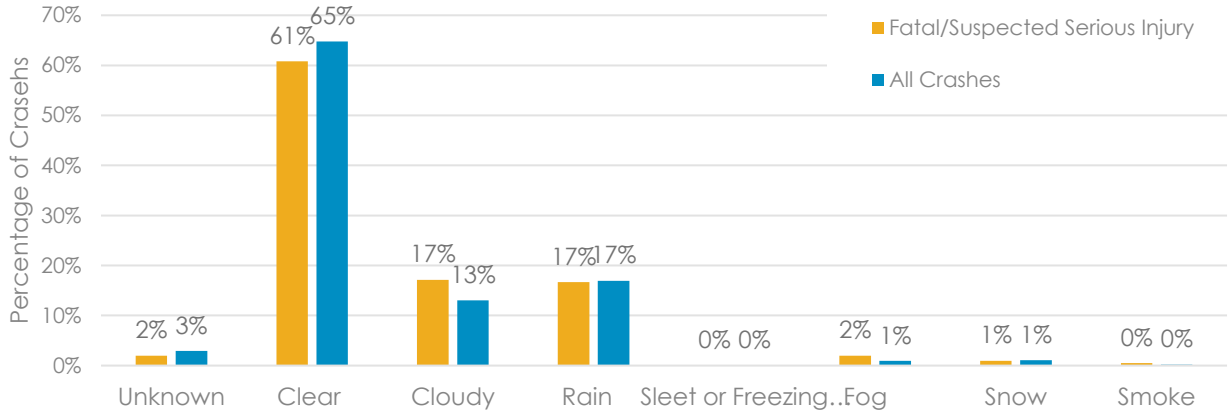


Figure 24. Crash Share by Weather Condition (2017-2021)

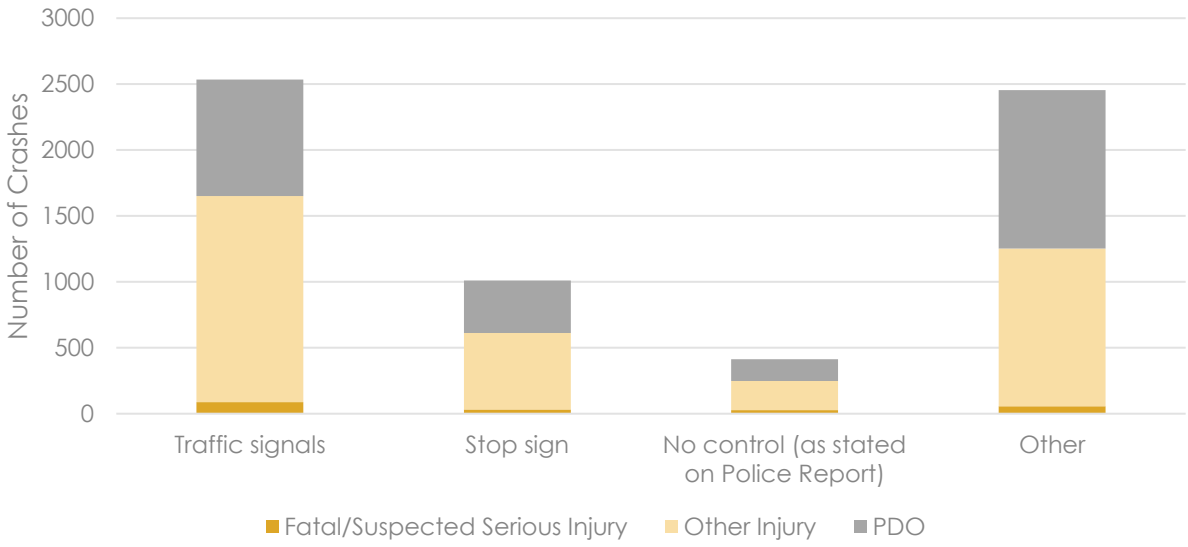


Most crashes reported during the study period occurred on clear days and dry surfaces. However, higher percentages of fatal and suspected injury crashes than percentages of all crashes happened during cloudy and foggy conditions (Figure 23 and Figure 24).

Intersection Control

This section overviews crash trends based on intersection control type.

Figure 25. Crash Severity by Intersection Control



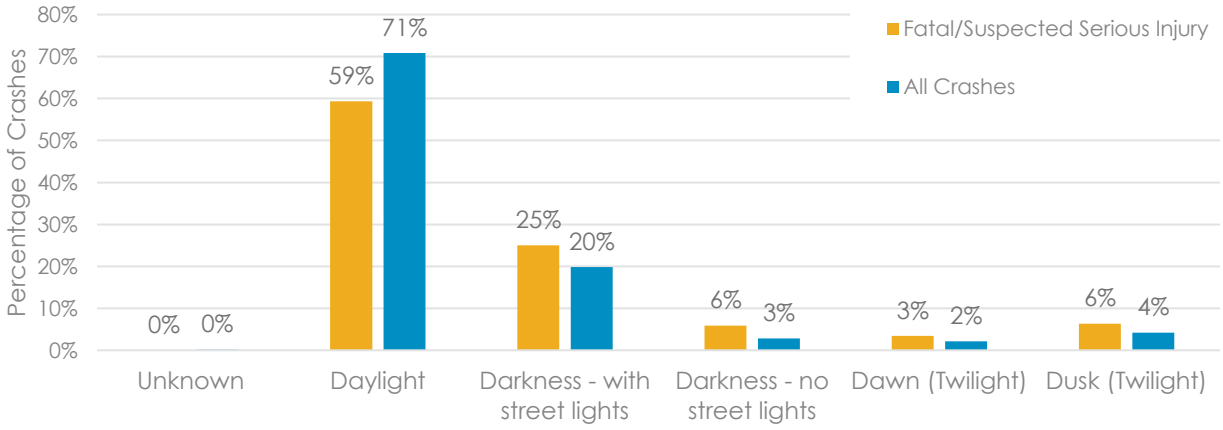
As shown in Figure 25, most crashes occurred at traffic signals. The "other" intersection control includes undefined intersections, yield signs, and other specific treatments at stop control and signalized intersections (e.g. flashing beacons).

Roadway Characteristics

This section provides an overview of the features of study area roadways as they relate to crashes, including lighting conditions at the time of crash occurrence and posted speed[8].

Lighting Conditions

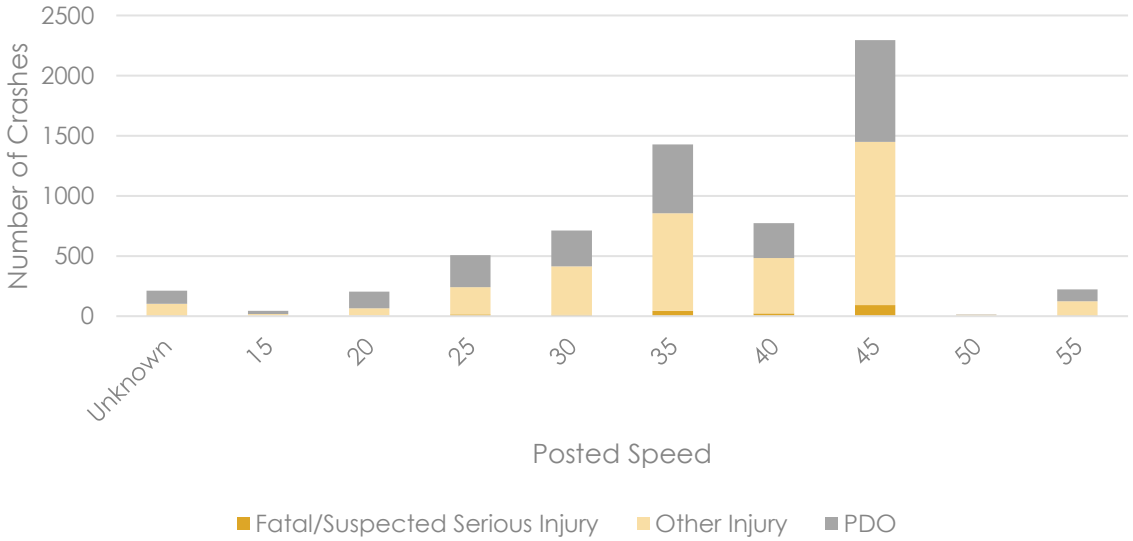
Figure 26. Crash Share by Light Condition (2017-2021)



As shown in Figure 26, more fatal and suspected serious crashes occurred during darkness, dawn, and dusk than during the daytime as compared to all crashes.

Posted Speed

Figure 27. Crash Severity by Posted Speed



[8] At intersections with multiple posted speeds, the higher posted speed is selected for this analysis.

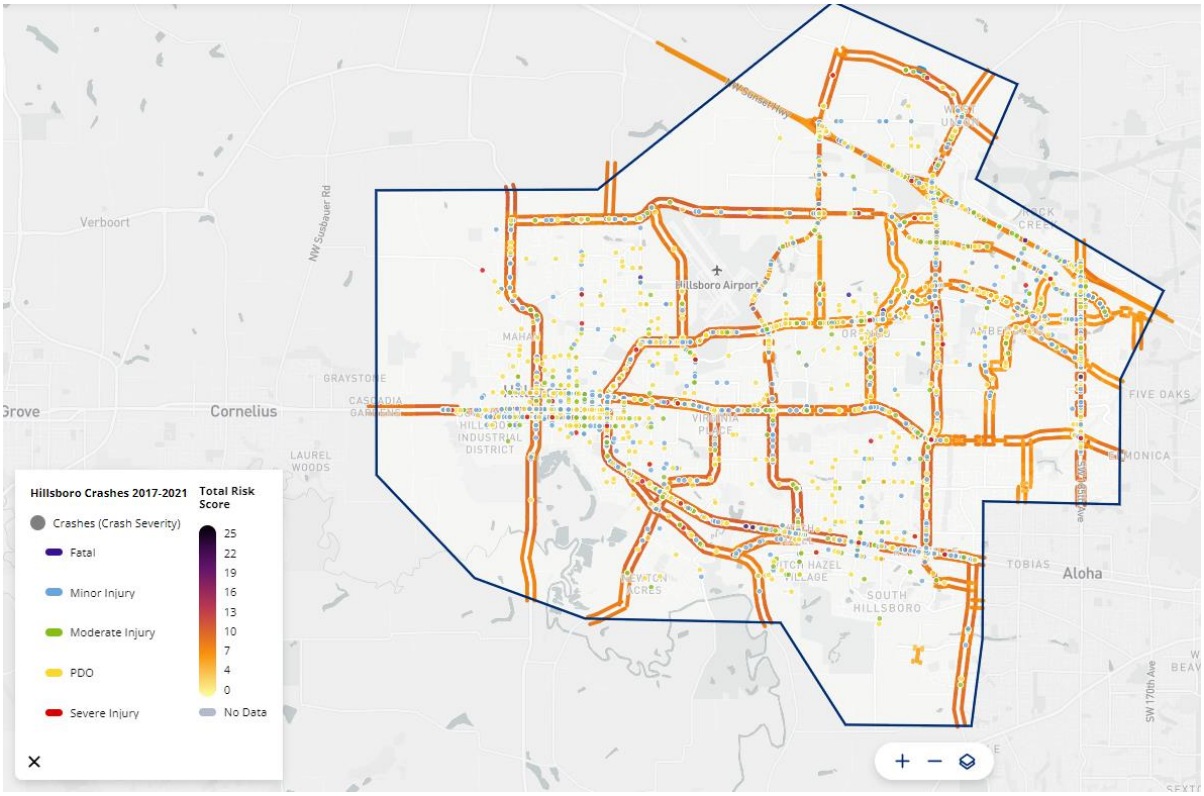
As shown in Figure 27, most crashes (70%) occurred on roadways with posted speeds between 35-45 mph. Additionally, half of fatal and suspected serious injury crashes occurred on roadways with posted speeds of 45 mph or above.

Risky Behaviors

This section summarizes the characteristics of crashes reported over the study period related to driver behavior, including speeding. While engineering solutions can help address these factors, education and enforcement programs targeted at unsafe driving behaviors are also needed to help reduce crashes stemming from human error. For Figure 28 through Figure 34, crash data from January 1, 2017 to December 31, 2021 is overlayed on INRIX data[9] from Q2 2023. INRIX data at the citywide scale is visualized for higher functional classification roadway segments. INRIX data for lower functional classification streets can be viewed in larger scales in the INRIX Safety View platform.

Figure 28 illustrates the total Risk Score at the citywide level. Factors that contribute to risk include crash history, seatbelt usage, hard braking, speed, and vehicle body type. In Safety View Risk Score each of those factors is assigned a score from 0-5, and the sum of those scores equates to the total Risk Score of each segment. Higher quantiles result in higher scores. The quantiles are aggregated by GM from all counties across the entire United States. Details on each individual risk factor are provided below.

Figure 28. Total Risk Score

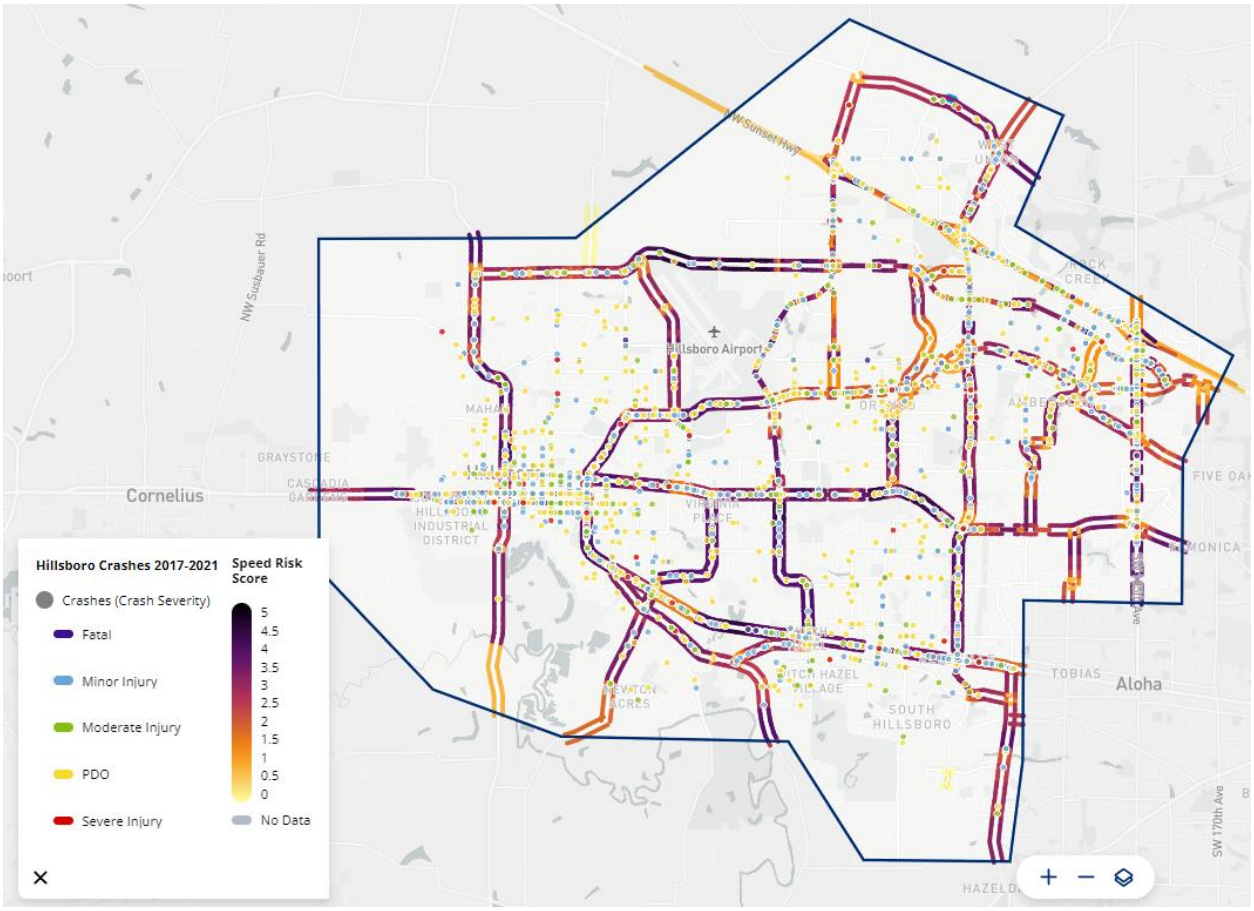


Source: Safety View by INRIX and GM Future Roads

[9] The Risk Score, True Near Miss, and Risky Maneuvers are all based only on the GM connected-vehicle fleet. The speed, instances of speeding, volumes, and Vulnerable Road Users is based on INRIX datasets, which are various aggregations of connected vehicles and connected devices.

Figure 29 illustrates the Speed Risk Score at the citywide level. Each road segment is assigned to a specific quantile according to its own aggregated difference between actual speed and road speed limit, then it gets assigned a Speed Risk Score.

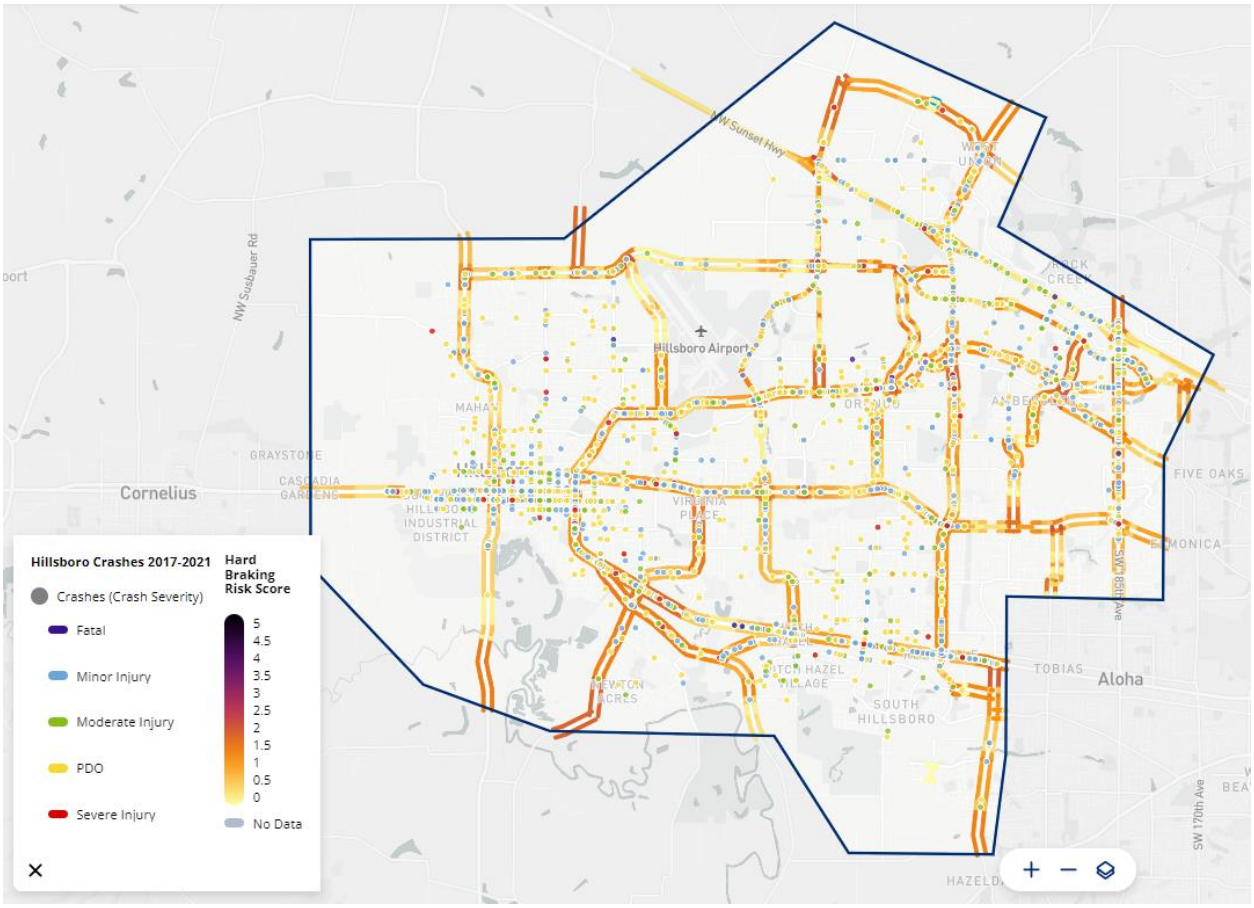
Figure 29. Speed Risk Score



Source: Safety View by INRIX and GM Future Roads

Figure 30 illustrates the Hard Braking Risk Score at the citywide level. Each road segment is assigned to a specific quantile according to its own aggregated hard brake counts, then it gets assigned a Hard Braking Risk Score.

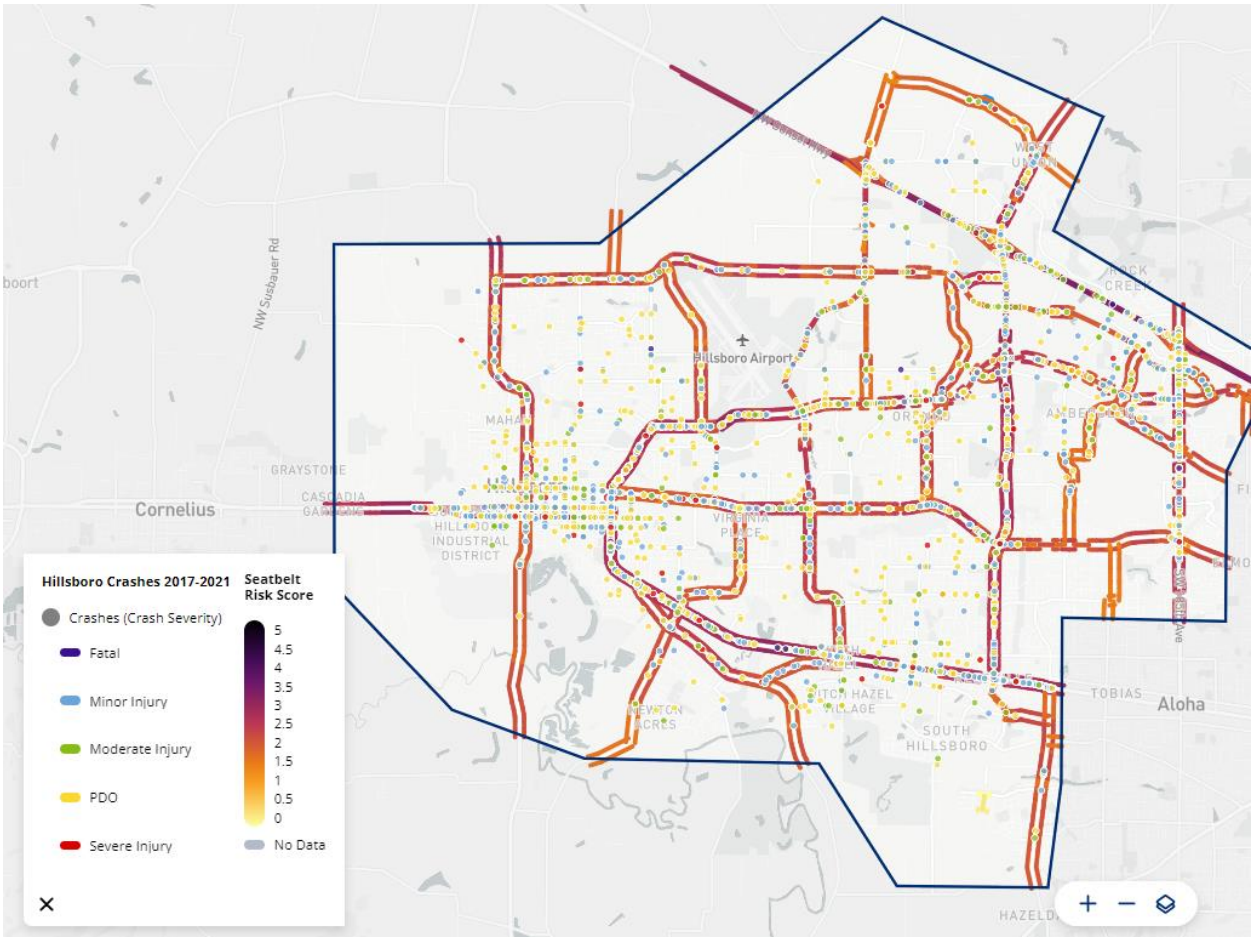
Figure 30. Hard Braking Risk Score



Source: Safety View by INRIX and GM Future Roads

Figure 31 illustrates the Seatbelt Risk Score at the citywide level. Each road segment is assigned to a specific quantile score according to its own Seatbelt Utilization percentage, then it gets assigned a Seatbelt Risk Score accordingly.

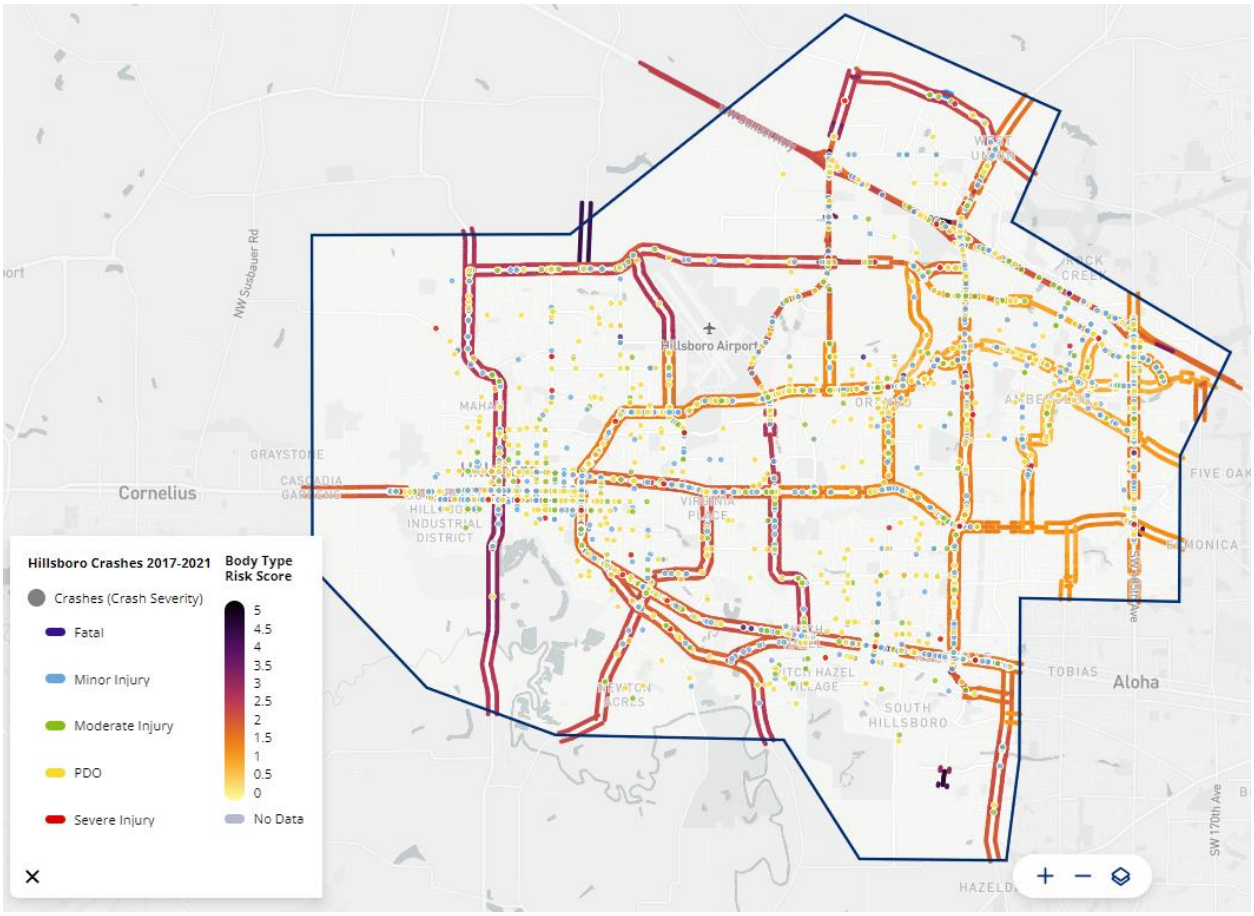
Figure 31. Seatbelt Risk Score



Source: Safety View by INRIX and GM Future Roads

Figure 32 illustrates the Vehicle Body Type Risk Score at the citywide level. Vehicle body types include sedan, mid-size SUV, full SUV, and truck. Each road segment is assigned to a specific quantile according to its own aggregated counts of vehicle body types, then it gets assigned a Vehicle Body Type Risk Score. A segment which has traffic composed of mostly larger vehicles results in a higher score.

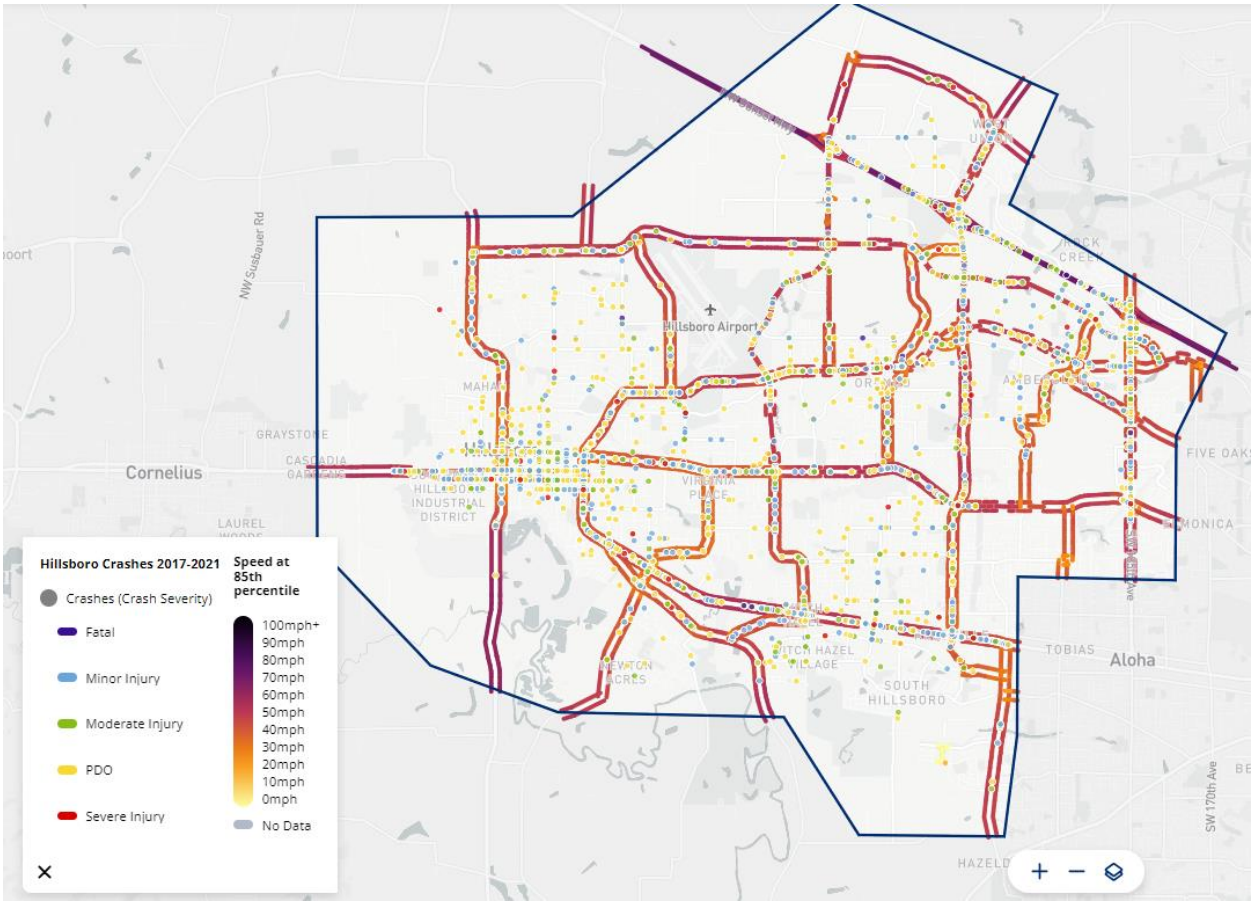
Figure 32. Vehicle Body Type Risk Score



Source: Safety View by INRIX and GM Future Roads

Figure 33 overlays crash data over INRIX 85th percentile speed data. Speed data at the citywide scale is visualized for higher functional classification roadway segments but can be viewed on local streets by zooming in further in the INRIX Safety View platform.

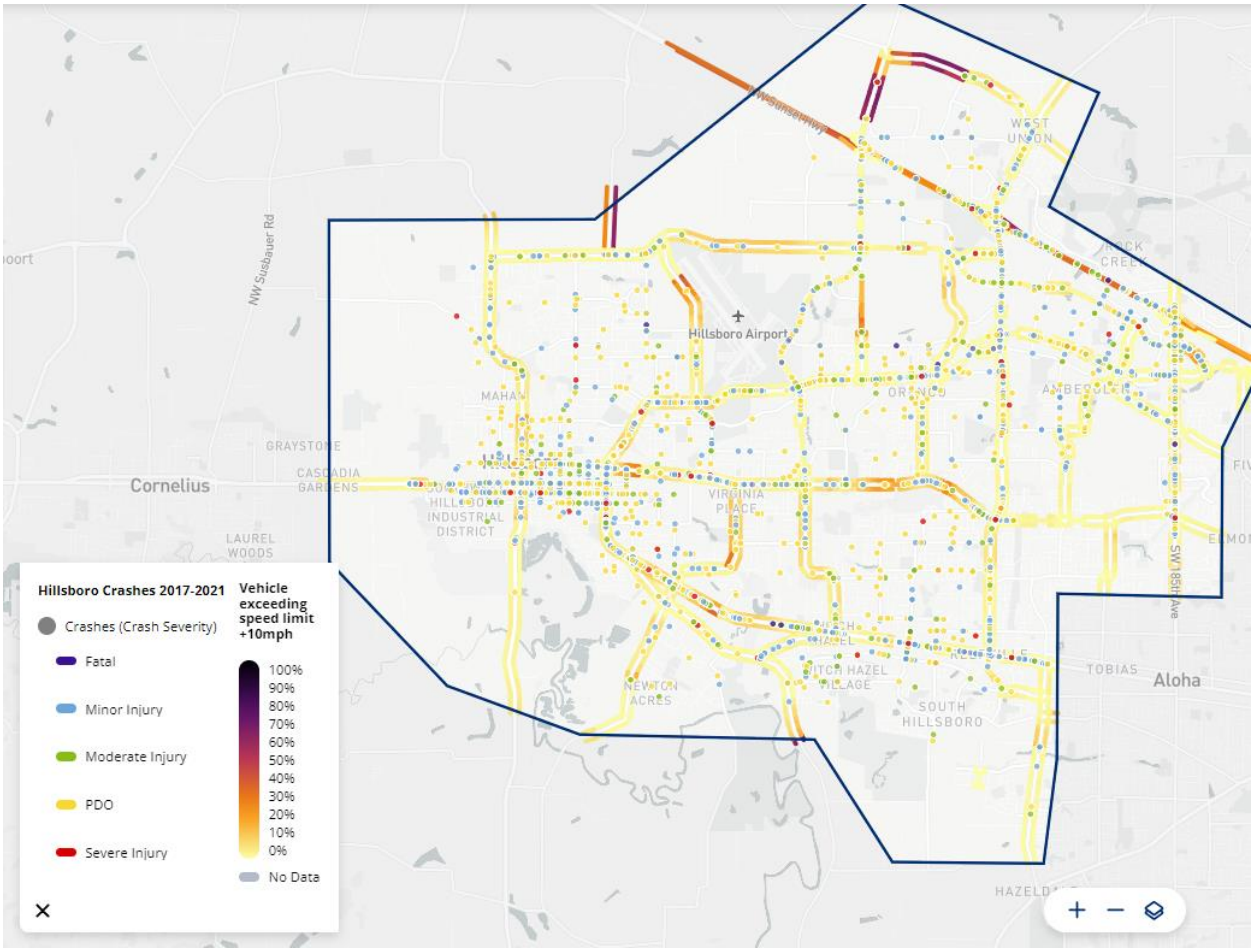
Figure 33. Motor Vehicle 85th Percentile Speeds



Source: Safety View by INRIX and GM Future Roads

Figure 34 overlays crash data over INRIX speed data. Speed data at the citywide scale is visualized for higher functional classification roadway segments but can be viewed on local streets by zooming in further in the INRIX Safety View platform. These data will be considered when zooming into priority sites and identifying systemic recommendations for traffic calming as part of *Task 5: Recommendations*.

Figure 34. Drivers Exceeding the Posted Speed by >10mph



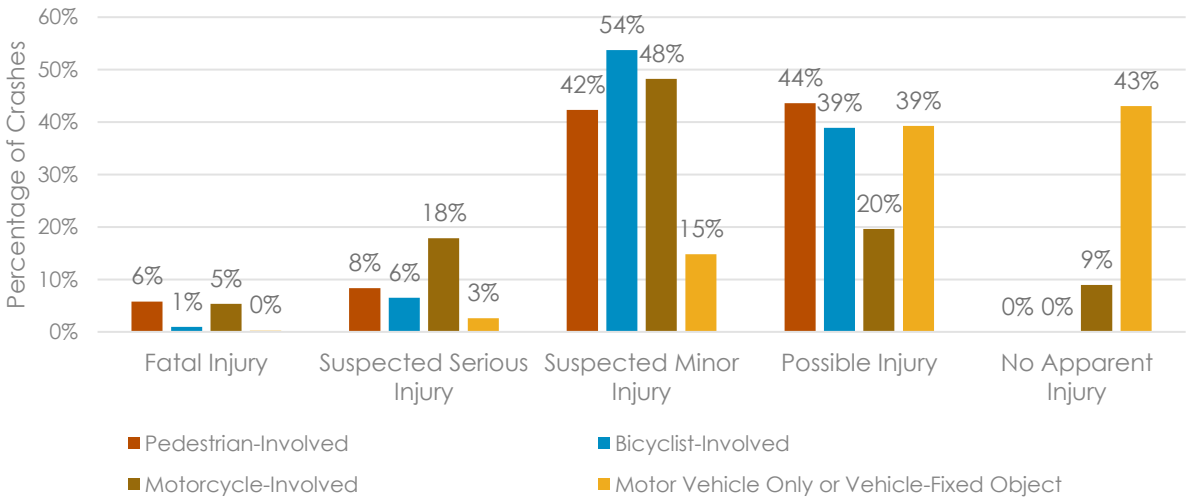
Source: Safety View by INRIX and GM Future Roads

Vulnerable Road Users

Figure 35 illustrates the percentage of crashes resulting in different crash severities by road user.

Vulnerable road users, including pedestrians, bicyclists, and motorcyclists, are exposed to higher risk of fatalities and injuries on roadways. Pedestrian and motorcycle crashes were especially likely to lead to fatal or suspected serious injuries. All pedestrian and bicyclist crashes resulted in injuries, along with 91% of motorcycle crashes. In contrast, around 57% of crashes involving solely motor vehicles resulted in injuries.

Figure 35. Crash Proportions by Road User (2017-2021)

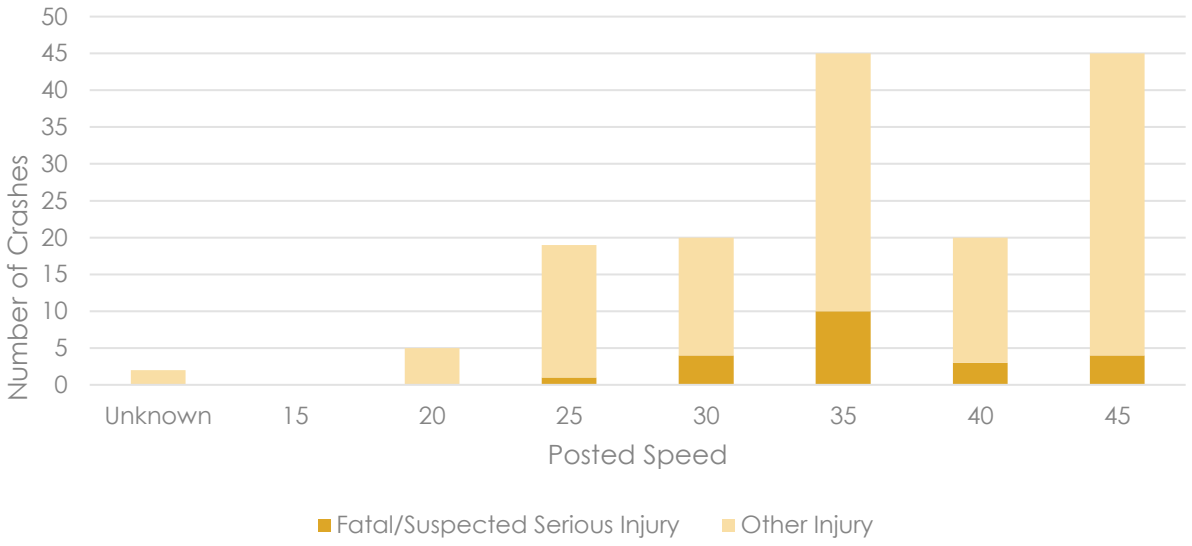


Potential countermeasures to enhance the safety of these vulnerable groups rely on engineering solutions, along with education and enforcement initiatives. Figure 40 and Figure 41 show the location and severities of pedestrian and bicycle crashes, respectively.

Posted Speed

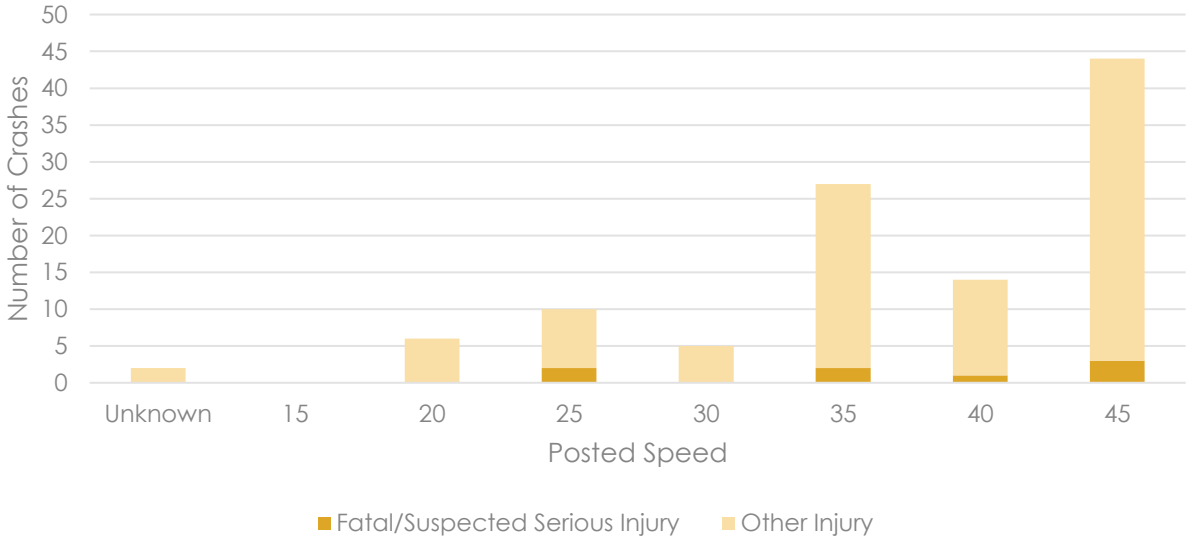
Figure 36 and Figure 37 show the crash severity by posted speed[10] for crashes involving pedestrian and bicyclists, respectively.

Figure 36. Crash Severity by Posted Speed (Crashes Involving Pedestrians)



As shown in Figure 36, most crashes involving pedestrians (71%) occurred on roadways with posted speeds between 35-45 mph. Additionally, 77% of fatal and suspected serious injury crashes involving pedestrians occurred on roadways with posted speeds of 35mph or above.

Figure 37. Crash Severity by Posted Speed (Crashes Involving Bicyclists)



[10] At intersections with multiple posted speeds, the higher posted speed is selected for this analysis.

Figure 37 most crashes involving bicyclists (79%) occurred on roadways with posted speeds between 35-45 mph. Additionally, 75% of fatal and suspected serious injury crashes involving bicyclists occurred on roadways with posted speeds of 35mph or above.

Facility Type

Figure 38. Crash Severity by Presence of Sidewalks (Crashes Involving Pedestrians)

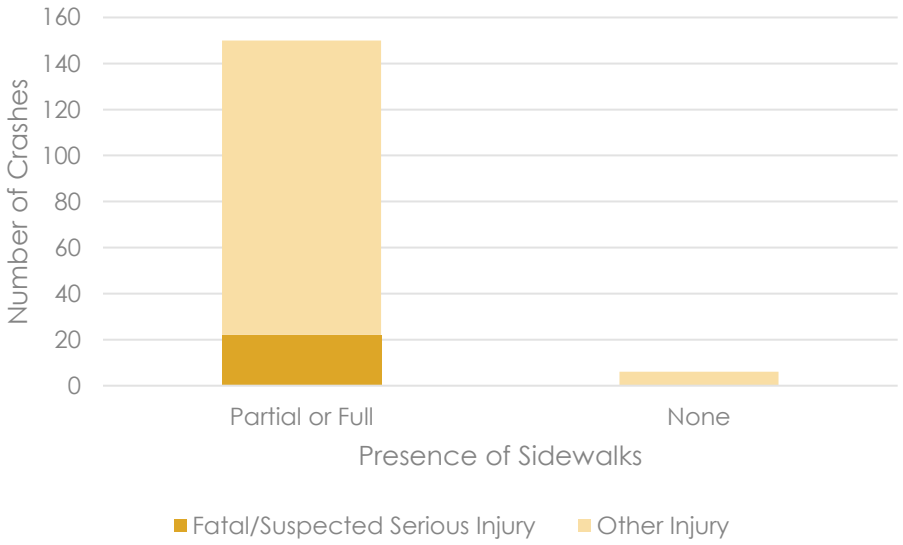


Figure 39. Crash Severity by Presence of Bicycle Facilities (Crashes Involving Bicyclists)

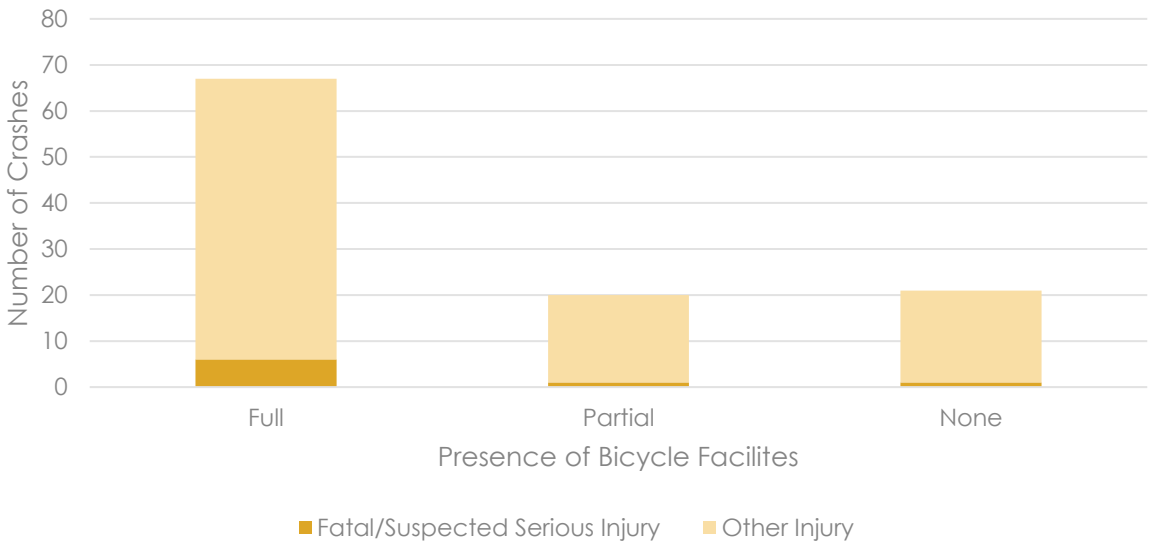


Figure 38 and Figure 39 show the crash severity by presence of pedestrian and bicycle facilities for crashes involving pedestrians and bicyclists, respectively. More crashes occur where facilities exist; this indicates that people are not walking and biking as often where there are not pedestrian or bicycle facilities.

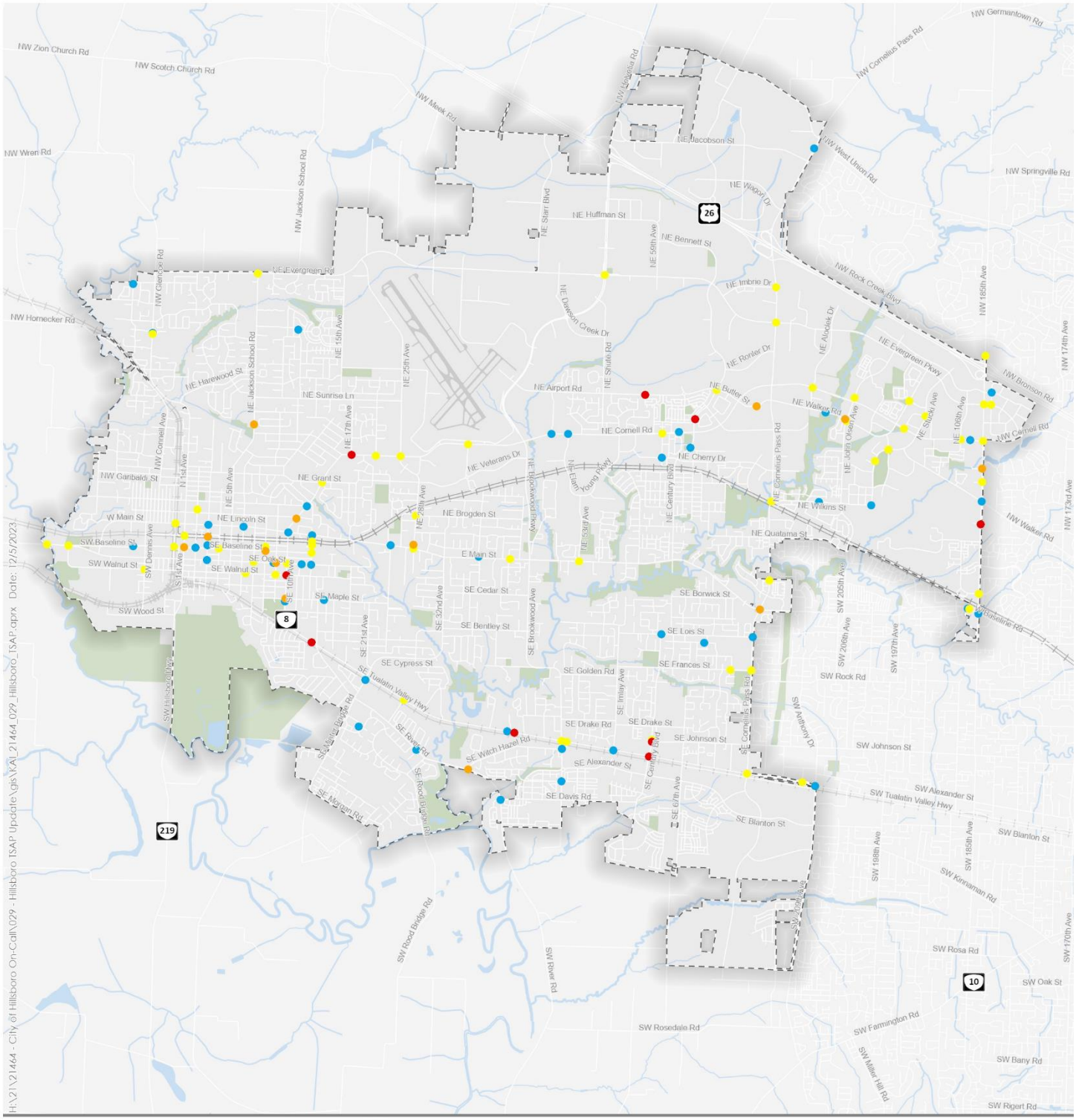
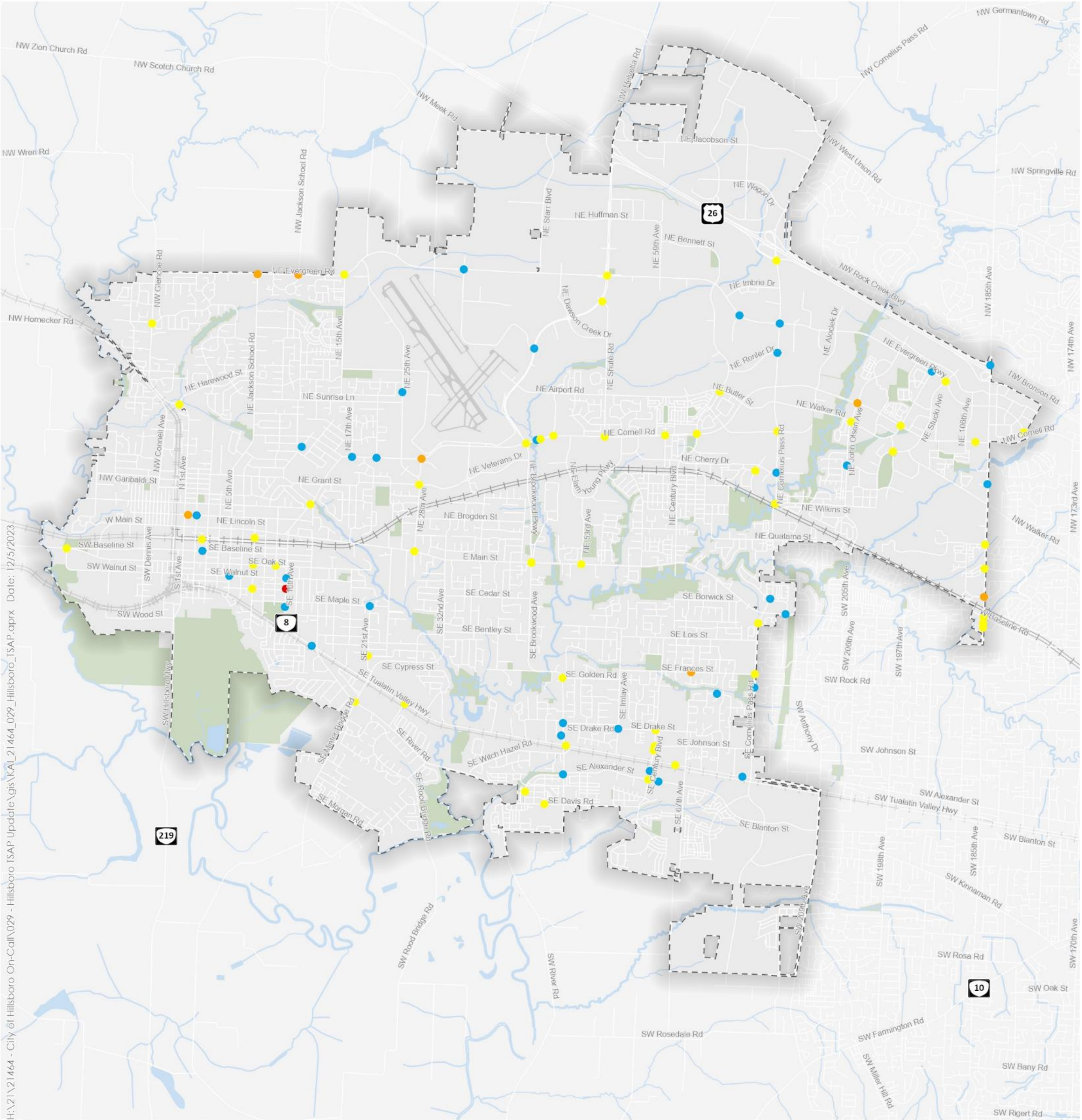


Figure 38

Location and Severities of Pedestrian Crashes (2017-2021) City of Hillsboro

KITTELSON & ASSOCIATES



Fatal

Suspected Serious Injury

Suspected Minor Injury

Possible Injury

City Limits

Waterbodies

Parks and Open Spaces

Light Rail Transit

Freight Rail

0 0.5 1 1.5 Miles

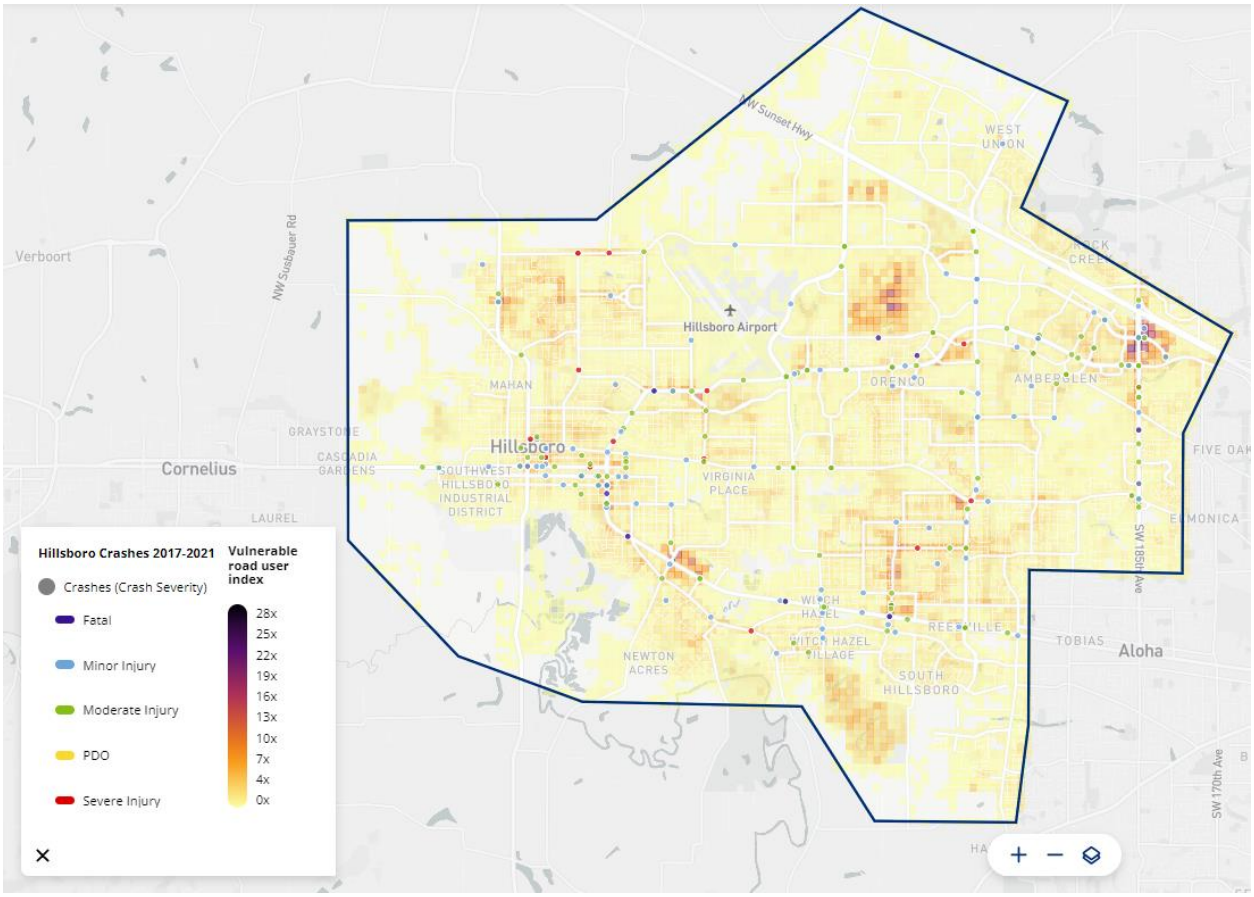
Figure 39

Location and Severities of Bicycle Crashes (2017-2021)
City of Hillsboro

KITTELSON & ASSOCIATES

Figure 42 illustrates the Vulnerable Road User (VRU) Index and the location of crashes involving pedestrian and/or bicyclists. The VRU index provides an aggregated and relative perspective on where people not traveling by car or truck are most active. The index takes total trips (people moving agnostic of mode) across a 12-month period in 2022, uses machine learning to classify those trips as made by a VRU, calculates the average VRU activity by road segment for a total area or sub-region, and then compares each segment's activity to the average for the City to provide a score of where these is relatively more or less activity than the area as a whole. This can be particularly useful for understanding where bike, pedestrian and other vulnerable road users are most active in an area.

Figure 42. Vulnerable Road User Index



Source: Safety View by INRIX and GM Future Roads

As shown in Figure 42, higher VRU indices are observed in downtown, in Hillsboro Town Center, in the Intel campus, and in Tanasborne Town Center.

Figure 43 shows that the age group representing the most frequent crashes, whether as drivers or pedestrians, is 25 to 44 years old, accounting for 26% of vehicle crashes, 30% of pedestrian crashes, and 29% of bicycle crashes. This is followed by the 45 to 64 age group at 16% (vehicle crashes), 23% (pedestrian crashes), and 25% (bicycle crashes).

Age

Figure 43. Crash Share by Age of Collision Party (2017-2021)