CITY SAFETY PLAN

JANUARY 2024

PREPARED FOR THE CITY OF LA CENTER

PREPARED BY DKS ASSOCIATES

Southwest Washington Regional Transportation Council

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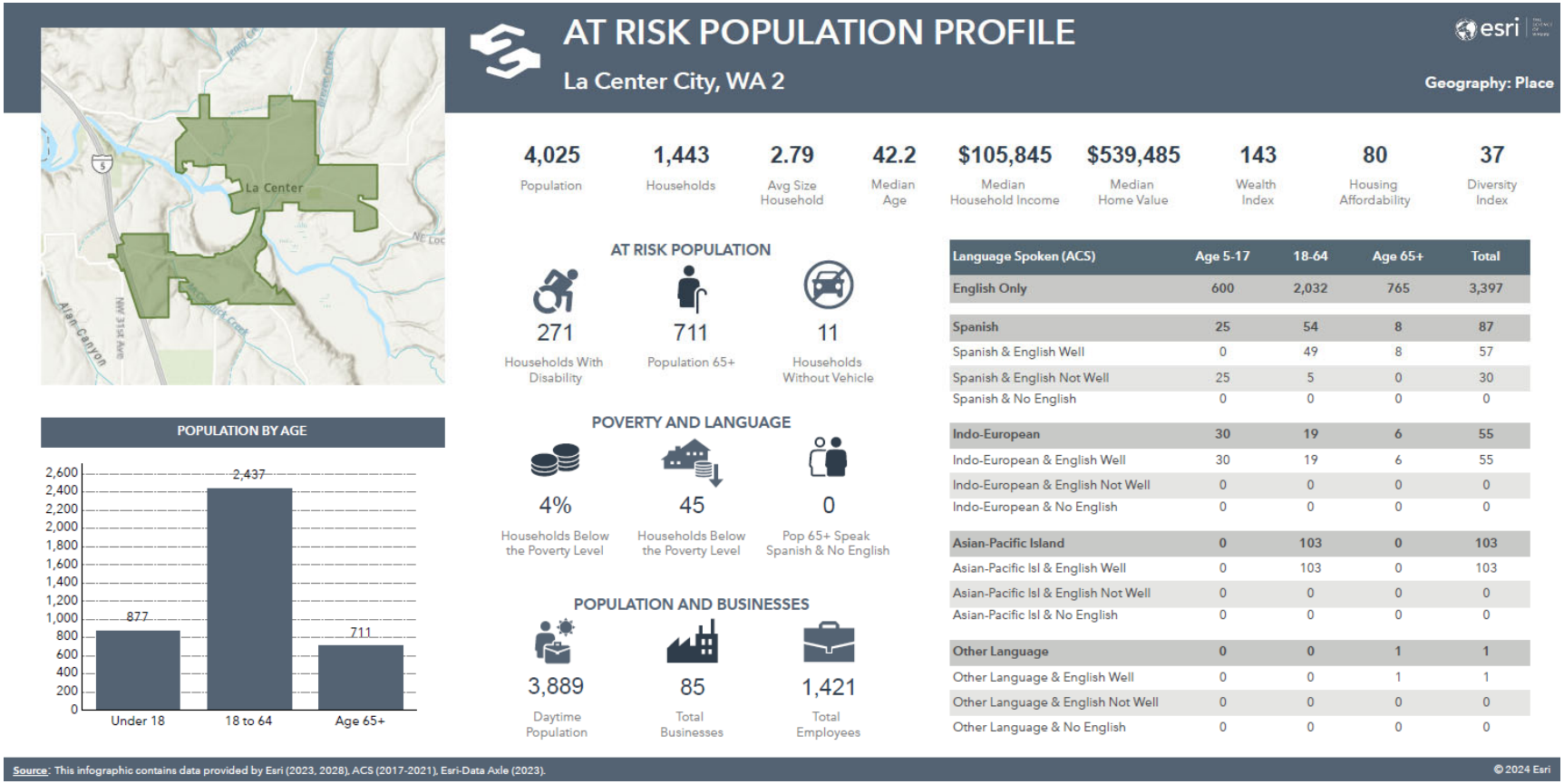
INTRODUCTION

The City of La Center is located in the northeastern portion of Clark County and east of Interstate 5. La Center is home to approximately 4,000 residents with more than 80 businesses within the city limits. The following 'At Risk Population Profile' provides key population and equity statistics based on 2023 data.[1]



Language Spoken (ACS)	Age 5-17	18-64	Age 65+	Total
English Only	600	2,032	765	3,397
Spanish	25	54	8	87
Spanish & English Well	0	49	8	57
Spanish & English Not Well	25	5	0	30
Spanish & No English	0	0	0	0
Indo-European	30	19	6	55
Indo-European & English Well	30	19	6	55
Indo-European & English Not Well	0	0	0	0
Indo-European & No English	0	0	0	0
Asian-Pacific Island	0	103	0	103
Asian-Pacific Isl & English Well	0	103	0	103
Asian-Pacific Isl & English Not Well	0	0	0	0
Asian-Pacific Isl & No English	0	0	0	0
Other Language	0	0	1	1
Other Language & English Well	0	0	1	1
Other Language & English Not Well	0	0	0	0
Other Language & No English	0	0	0	0

[1]Source: ESRI Business Analyst Tool. https://storymaps.arcgis.com/stories/52764a9948074c4b9d527a390aefdc67

CITY SAFETY PLAN PROCESS

The purpose of the City Road Safety Plan is to analyze collision data from within the City in order to effectively identify trends, contributing circumstances, associated risk factors and deficiencies present in the City's road network. Following this approach allows for the effective identification of appropriate, low cost countermeasures to be implemented for the purpose of crash reduction. The following plan includes a summary of existing safety conditions in La Center, identification of safety needs, and recommended treatments to address high-priority collision types and locations.

Figure 1 below describes the steps taken to create a prioritized list of projects, from collecting and analyzing available data to identifying safety needs, then identifying potential countermeasures before focusing on the final projects.

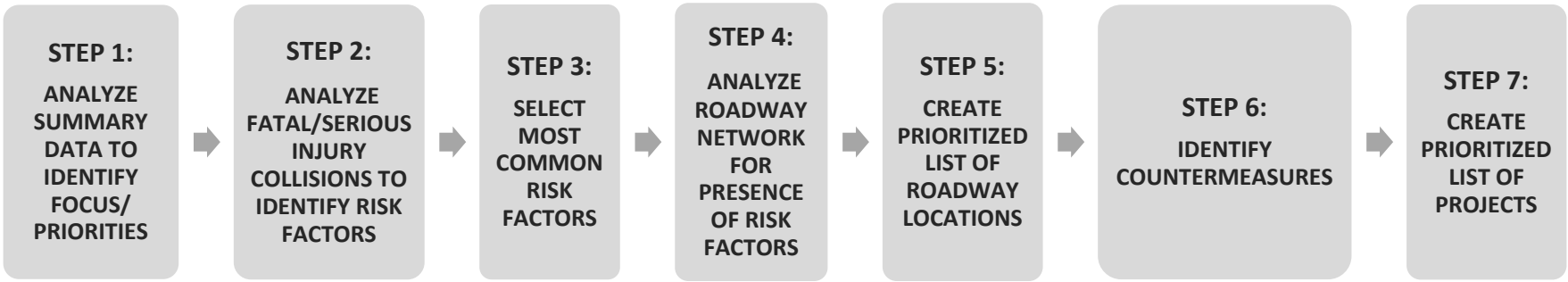


Figure 1. City Safety Plan Prioritization Process.

The data used and process followed are consistent with Washington State Department of Transportation's (WSDOT)'s guidelines from the 2024 City Safety Program. The recommended safety countermeasures are limited to infrastructure-based treatments eligible for one or more of the following grant programs:[2]

- WSDOT grant programs: City Safety, Safe Routes to School, Bicycle-Pedestrian, and Railway-Highway Grade Crossings
- Transportation Improvement Board (TIB) grants, including Complete Streets
- Several Southwest Washington Regional Transportation Council (RTC) grants

Appendix A, Safety Countermeasure Toolbox, includes a description of each treatment, when it should be used, estimated costs, and crash modification factors.

The sections below describe the process of collecting and analyzing available data and identifying safety needs from that analysis.

STEP 1: ANALYZE SUMMARY DATA TO IDENTIFY FOCUS/PRIORITIES

The consultant support team worked with the City of La Center, Southwest Washington Regional Transportation Council (RTC), and WSDOT Transportation Data to acquire the following data sets.

- WSDOT database of all collisions on City of La Center streets, January 2018 - December 2022 (provided by WSDOT Transportation Data)

The City and their consultant support reviewed the quality and accuracy of the data sets, communicated with WSDOT on discrepancies, and solicited and received the desired data from the State.

[2] Additional details regarding available grant programs are available in Appendix B, Grant Programs.

DATA ANALYSIS OVERVIEW

As illustrated in Figure 3, over the past five years, there were 81 total crashes on city streets in La Center, with no reported fatal collisions and one serious injury collision (Figure 2). The suspected serious injury collision was a roadway departure collision that was reported on August 15, 2019, at 10:23 am. It involved a 22-year-old male on a motorcycle who lost control along NW La Center Road 500 feet west of NW 18th Avenue.

The number of all reported collisions (regardless of severity) has ranged between 9 and 19, as shown in Figure 3. In the most recent year of data available, 2022, the city experienced 18 reported crashes (a 6% increase from 2018).

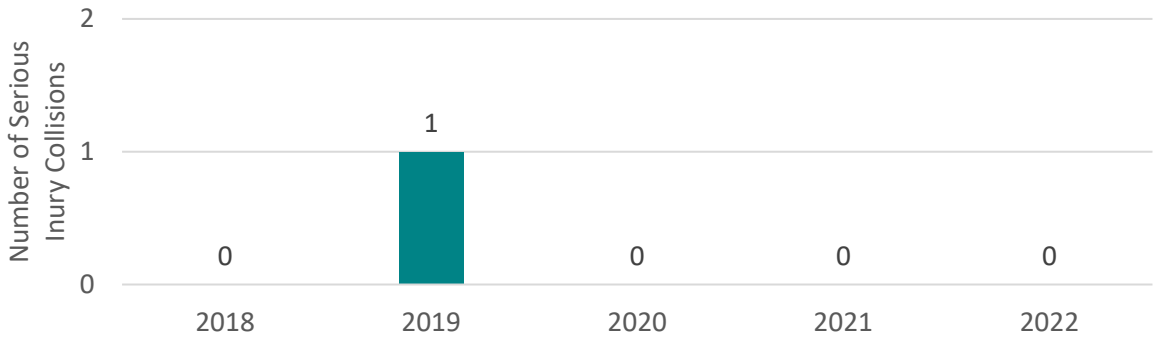


Figure 2. Fatal and Serious Injury Collisions in La Center, 2018-2022.

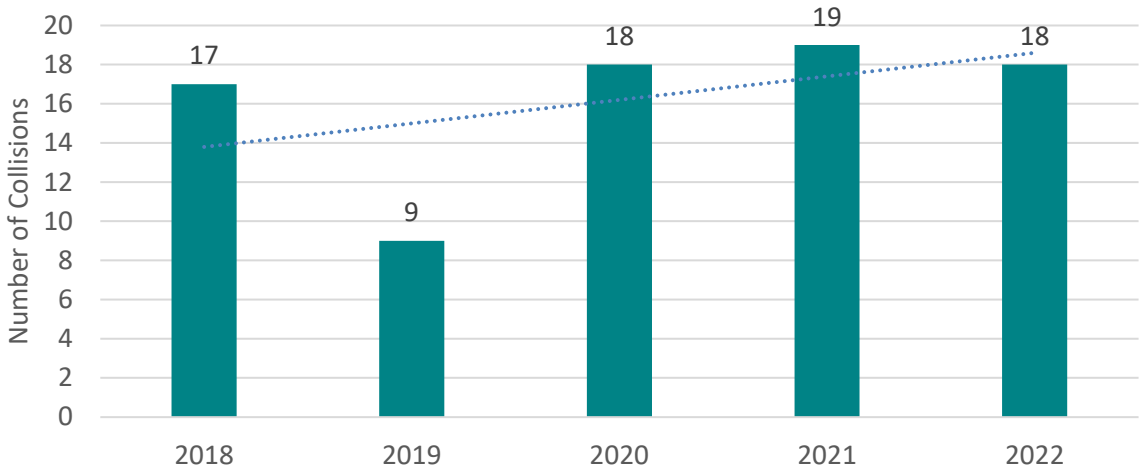


Figure 3. All Reported Collisions in La Center, 2018-2022.

Figure 4 shows the location of the serious injury collision.

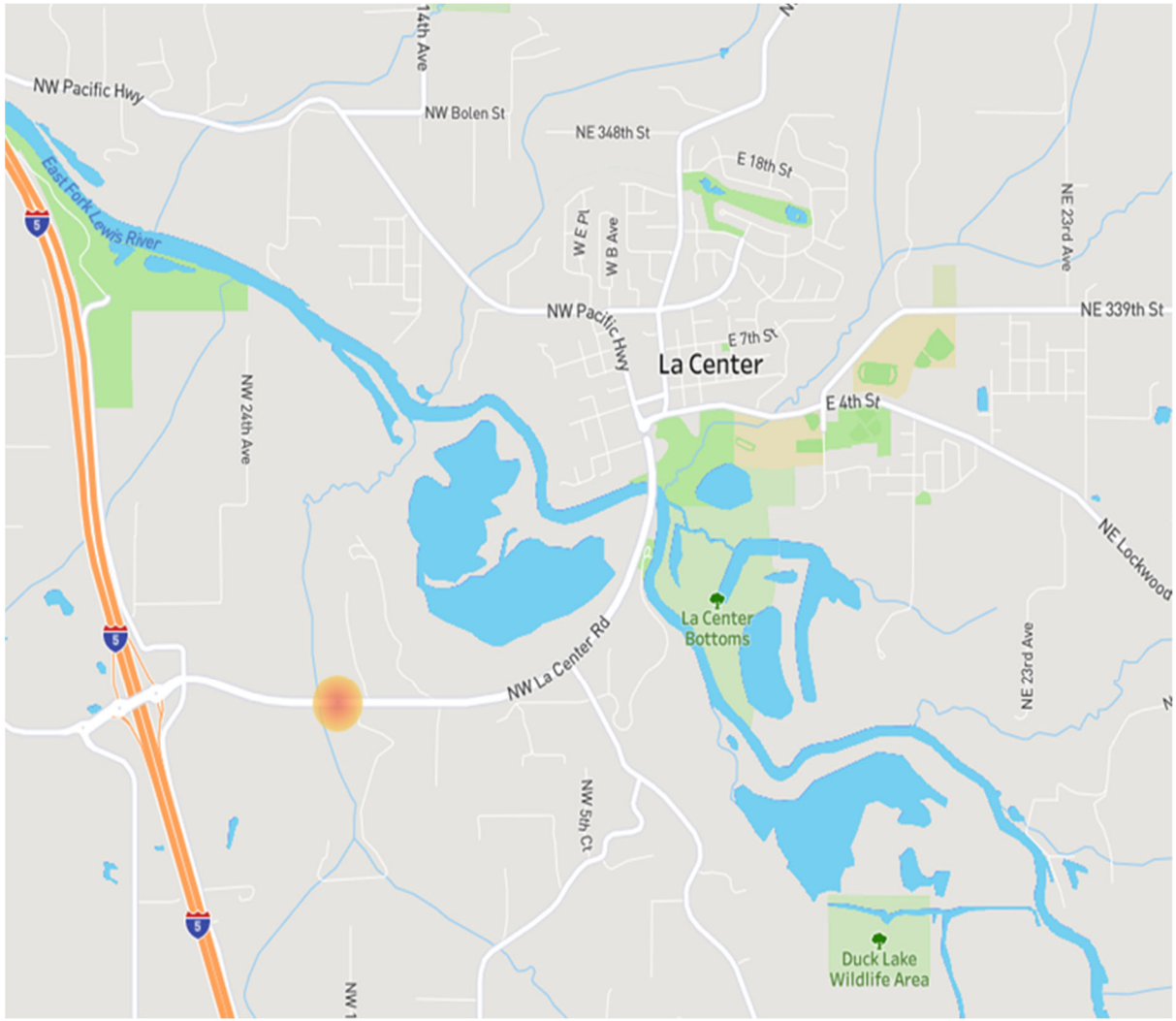


Figure 4. Heat Map of Fatal and Serious Injury Collisions in La Center, 2018-2022.

Figure 5 provides a heat map of all reported collisions that occurred on City-owned streets in La Center during the study period.

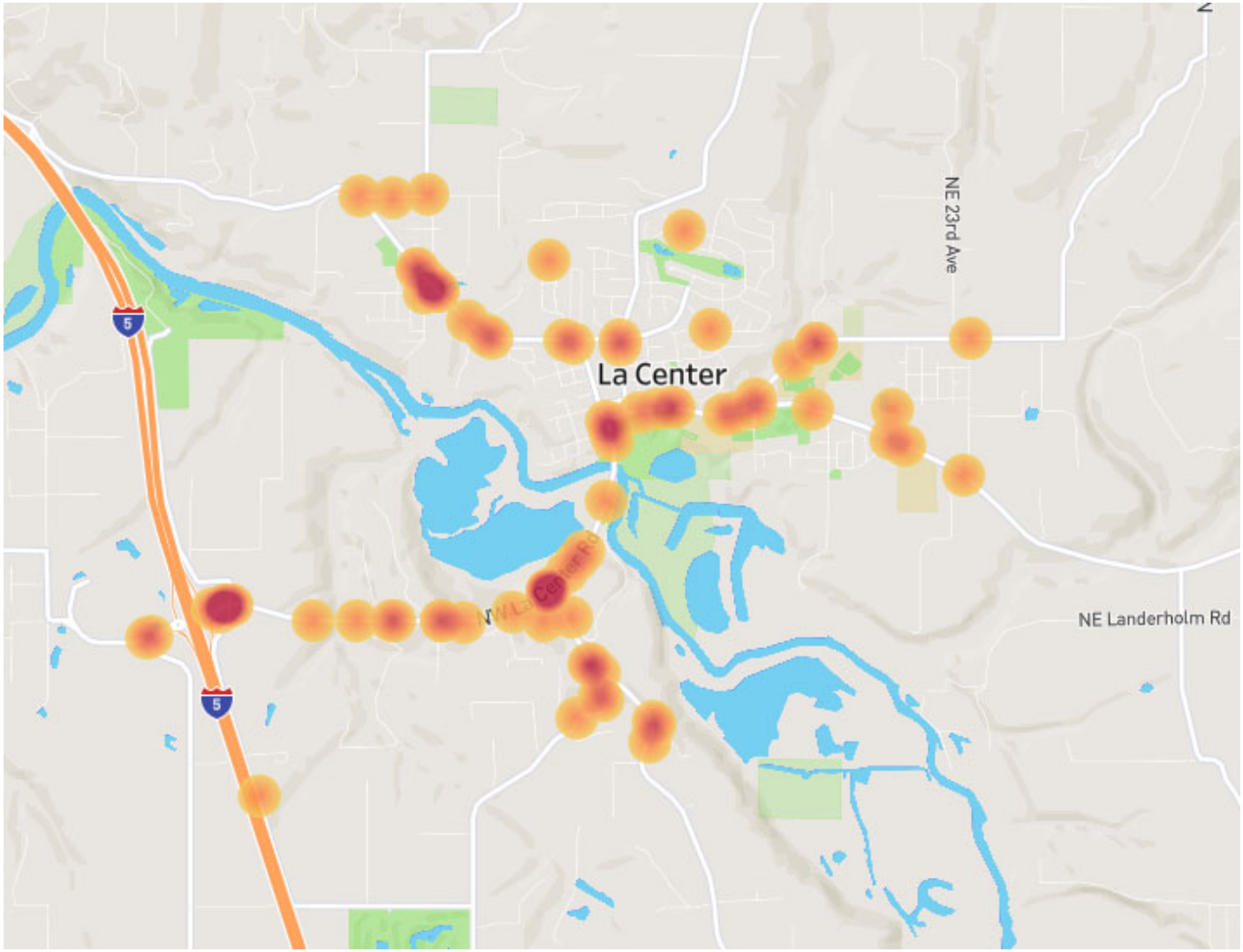


Figure 5. Heat Map of All Reported Collisions in La Center, 2018-2022

STEP 2: ANALYZE SERIOUS INJURY COLLISIONS TO IDENTIFY RISK FACTORS (COLLISION ATTRIBUTES)

The City studied each risk factor (collision attribute) to determine those most likely to contribute to future serious injury collisions in La Center. Table 1 shows some of the most common attributes present in collisions that occur on City-owned streets. Collision attributes with a notably higher percentage of serious injury collisions versus all-severity collisions have an increased likelihood of contributing to serious injury crashes.

TABLE 1. MOST COMMON COLLISION ATTRIBUTES, LA CENTER, 2018-2022

Data Element	Collision Attribute	Total Collisions	Fatal Collisions (F)	Serious Injury Collisions (SI)	Percent of all La Center Collisions with this Attribute (1)	Percent of SI La Center Collisions with this Attribute (2)
Citywide	*Any*	*81*	*0*	*1*		
Collision Type	Roadway Departure	38	0	1	46.9%	100%
	Head-On	1	0	0	1.2%	0%
	Entering at Angle	11	0	0	13.6%	0%
Contributing Circumstance (For at least one vehicle)	Exceeding Reasonable Safe Speed or Exceeding Stated Speed Limit	7	0	0	8.6%	0%
	Alcohol-Impaired (3)	8	0	0	9.9%	0%
	Drug-Impaired (3)	1	0	0	1.1%	0%
	Inattention / Distraction	22	0	1	27.2%	100%
Motor Type Involved	Motorcycle	1	0	1	1.2%	100%
	Heavy Vehicle	6	0	0	7.4%	0%

Data Element	Collision Attribute	Total Collisions	Fatal Collisions (F)	Serious Injury Collisions (SI)	Percent of all La Center Collisions with this Attribute (1)	Percent of SI La Center Collisions with this Attribute (2)
Lighting Condition	Dark/Dusk/Dawn	20	0	0	24.7%	0%
Intersection	At Intersection or Intersection Related	19	0	0	23.5%	0%
	Signalized Intersection	0	0	0	0%	0%
	Unsignalized Intersection	19	0	0	23.5%	0%
Road User	Pedestrian Involved	0	0	0	0%	0%
	Bicyclist Involved	0	0	0	0%	0%
Roadway Surface	Wet	34	0	0	42.0%	0%
	Ice	3	0	0	3.7%	0%
Age	Driver Age 16 to 25 Involved	35	0	1	43.2%	100%
	Driver Over Age 65 Involved	8	0	0	9.9%	0%
Restraint (Seat Belt) Usage	No Restraints Used	3	0	1 (motorcycle)	3.7%	0%

(1) For example, in La Center 46.9% of all collisions involved roadway departure.
(2) For example, in La Center 100% of all serious injury collisions were roadway departure.
(3) As of this writing, WSDOT has identified an issue with 2020 impaired driving data and is looking into the details.

The City identified the following notable trends from this analysis:

- Intersections are the most common type of location for collisions (all severities) to occur. Of intersection collisions, the most common sub-type was entering at an angle (8 of 19).
- Roadway departure collisions are the most common collision type (38 of 81 total collisions).
- Young drivers (age 16 to 25) were involved in nearly half of all collisions.

STEP 3: SELECT MOST COMMON RISK FACTORS (COLLISION ATTRIBUTES)

Based on the findings of Step 1 and Step 2, the City identified the following collision attributes correlated with the highest frequency or severity of collisions. These collision attributes are the focus of the network analysis in Step 4:

1. Roadway Departure
2. At Intersection or Intersection Related
3. Wet Roadway Surface Conditions
4. Dark/Dusk/Dawn Lighting Conditions
5. Inattention/Distraction
6. Exceeding Reasonable Safe Speed or Exceeding the Speed Limit

Five of the six collision attributes listed above were each involved in over 20% of all crashes in La Center during the study period. Although "Driver Age 16-25 Involved" was also involved in over 20% of all crashes, and the next highest-percentage attributes were "Driver Over Age 65 Involved," "Alcohol Impairment," and "Drug Impairment," engineering solutions cannot typically address these crash attributes. "Exceeding Reasonable Safe Speed or Exceeding the Speed Limit" was chosen as the sixth attribute because there are engineering solutions proven to decrease the risk of these collisions.

In the following steps, these six collision attributes are referred to as the most common risk factors.

STEP 4: ANALYZE ROADWAY NETWORK FOR PRESENCE OF RISK FACTORS

Following WSDOT's recommended procedure,[3] the City applied the most common risk factors in serious injury crashes to the entire network using frequency of collisions based on the most common risk factors / collision attributes.

The City mapped crash frequency based on the most common risk factors in serious injury crashes. The maps in **Appendix C** illustrate the locations of crashes with these attributes.

STEP 5: CREATE PRIORITIZED LIST OF ROADWAY LOCATIONS

Table 2 lists intersections ranked by the number of risk factors identified. Table 3 lists corridors ranked by the number of risk factors identified. A location received a "point" for a risk factor if it experienced a relatively high frequency of crashes with that attribute compared to the rest of the City of La Center roadway network. Additional points were added for locations that experienced at least one serious injury crash during the study period, which is required for the location to be eligible for a spot location treatment under the WSDOT City Safety Program.

[3] WSDOT Local Road Safety Plans Guidance, https://www.wsdot.wa.gov/sites/default/files/2021-10/LP-Local-Road-Safety-Plan.pdf

TABLE 2. PRIORITIZED INTERSECTION SAFETY NEEDS BY NUMBER OF IDENTIFIED 6 RISK FACTORS

Intersection	Number of Crashes	Roadway Departure	Inter-section Related	Wet Road Surface	Dark/Dusk/ Dawn	Distracted/ Inattention	Speeding	At Least 1 Serious Injury Crash	Total
NW Timmen Road and NW La Center Road	4	-	✓	✓	✓	✓	-	-	**4**
NW La Center Road and NW Paradise Park Road	2	-	✓	✓	✓	✓	-	-	**4**
NW Pacific Highway and W 4th Street	2	-	✓	✓	✓	-	-	-	**3**
NE 339th Street and NE 24th Avenue	1	-	✓	✓	-	✓	-	-	**3**

TABLE 3. PRIORITIZED CORRIDOR SAFETY NEEDS BY NUMBER OF IDENTIFIED 6 RISK FACTORS

Segment	Number of Crashes	Roadway Departure	Inter-section Related	Wet Road Surface	Dark/Dusk/ Dawn	Distracted/ Inattention	Speeding	At Least 1 Serious Injury Crash	Total
NW La Center Road from McCormick Creek to East Fork Lewis River Bridge	17	✓	✓	✓	✓	✓	-	✓	**6**
NW Pacific Highway from NW 9th Avenue to W 15th Street	9	✓	✓	✓	✓	-	✓	-	**5**
E 4th Street from NW Pacific Highway to Highland Road	9	✓	✓	✓	-	✓	✓	-	**5**
Highland Road from E 4th Street to NE 14th Avenue	5	✓	✓	✓	✓	-	✓	-	**5**
NE Timmen Road from NW Pollock Road to NW 310th Circle	6	✓	-	✓	✓	-	✓	-	**4**
E 4th Street / NE Lockwood Creek Road from Highland Road to NE 24th Avenue	5	✓	✓	✓	-	✓	-	-	**4**
NW Spencer Road from NW Timmen Road to NW 5th Court	3	✓	-	✓	-	✓	-	-	**3**

STEP 6: IDENTIFY COUNTERMEASURES TO ADDRESS PRIORITIZED LOCATIONS AND DEVELOP A PRIORITIZED LIST OF PROJECTS

In Step 6, potential countermeasures were identified using the list in Appendix A, which describes treatments that may be applied at intersections or along roadway segments to address specific crash patterns.

The City compared the list of prioritized intersections and corridors identified in Step 5 to recent and already-funded projects to identify the most pressing current safety needs, and then analyzed collision data and existing conditions at the following locations shown in Table 4.

TABLE 4. COMBINED PRIORITIZED SAFETY NEEDS BY LOCATION

Location	Roadway Departure	Intersection Related	Wet Road Surface	Dark/Dusk/ Dawn	Distracted/ Inattention	Speeding	Serious Injury Crash
Segment: NW La Center Road from McCormick Creek to East Fork Lewis River Bridge	✓	✓	✓	✓	✓	-	✓
Segment: NW Pacific Highway from NW 9th Avenue to W 15th Street	✓	✓	✓	✓		✓	-
Segment: E 4th Street from NW Pacific Highway to Highland Road	✓	✓	✓	-	✓	✓	-
Intersection: NW Timmen Road and NW Lacenter Road	-	✓	✓	✓	✓	-	-
Segment: NE Timmen Road from NW Pollock Road to NW 310th Circle	✓	-	✓	✓	-	✓	-

STEP 7: DEVELOP A PRIORITIZED LIST OF PROJECTS

Upon completion of the analysis and identification of potential countermeasures, the City selected the priority spot location and systemic safety projects shown below in Table 5 as well as next steps, including potential funding opportunities. Appendix B lists state and local grant funding opportunities that may be appropriate for these projects.

TABLE 5. SAFETY PROJECTS TO PURSUE

Prioritized Location or Systemic Collision Type	Safety Project Including Proven Countermeasures	Next Step
1. La Center Road corridor	Install lighting, guardrail, and signing upgrades on La Center Road corridor from McCormick Creek to East Fork Lewis River Bridge	Apply for 2024 WSDOT City Safety Program grant
2. Timmen Road corridor	Install lighting, recessed pavement markers/reflectors, and other signing and striping visibility upgrades on Timmen Road corridor from NW Pollock Road to NW 310th Circle	Consider other funding opportunities in Appendix B
3. Systemic stop-controlled intersection signing and striping upgrades	Low-cost signing and pavement marking treatments to upgrade visibility (e.g. install high-visibility sheeting, recessed pavement markers) at stop-controlled intersections	Implement low-cost treatments with City forces
4. NW Pacific Highway corridor	Widen shoulders, install speed feedback signs, and install lighting	Consider other funding opportunities in Appendix B
5. Roundabout at NW Timmen Road and NW La Center Road	Perform traffic study and install roundabout	Consider other funding opportunities in Appendix B

PRIORITY 1: LA CENTER ROAD CORRIDOR

Identified Safety Needs. La Center Road is the main route connecting Interstate 5 (I-5) to downtown La Center. From McCormick Creek to the East Fork Lewis River Bridge, La Center Road, shown in Figure 6, is not well lit, and there are gaps in guardrail on the road shoulders.

During the study period, there were 17 collisions on this segment, one of which resulted in serious injury. Over half of all collisions occurred when the roadway was wet or icy. Six collisions occurred in dark, dusk, or dawn conditions. In addition, vehicles ran off the road in six collisions, including the serious injury collision. Vehicles struck fixed objects such as an earthbank (2), guardrail (1), ditch (1), and wood sign post (1) in five of these collisions. The sixth collision was an overturn crash that resulted in no apparent injury.

Potential Safety Treatments. Installing segment lighting along with signing upgrades along the entire corridor would provide a clear safety benefit by increasing driver visibility in dark/dusk/dawn conditions. Signing upgrades would include intersection warning signs, additional speed limit signs, and other warning signs as needed. Also, filling in two major gaps in guardrail from NW 18th Avenue to NW Timmen Road and from NW Timmen Road to 0.3 miles west of the East Fork Lewis River Bridge will decrease the risk of high-severity roadway departure crashes.

Figure 6. Street view traveling southwest on La Center Road

PRIORITY 2: TIMMEN ROAD AND LA CENTER ROAD INTERSECTION

Identified Safety Needs. La Center Road connects I-5 to downtown La Center, and Timmen Road is the first major intersection to the west of the East Fork Lewis Bridge. It is a large T-intersection with nearby horizontal curves on each side that can limit sight distance for mainline and side street motorists. The mainline speed limit is 50 mph until the East Fork Lewis River Bridge, where the speed drops to 25 mph as the roadside transitions to a more suburban feel toward downtown La Center. The eastbound approach to the intersection is shown in Figure 7.

Figure 7. Eastbound La Center Road at Timmen Road

During the study period, four collisions occurred at this intersection. Two of the collisions occurred in wet conditions, and two of the collisions occurred in dark/dusk/dawn conditions. None resulted in a serious injury. Two of the collisions were angle collisions, one was a rear-end collision, and one occurred when a vehicle struck guardrail.

Potential Safety Treatments. The City should conduct a traffic study at this location to determine the best intersection control for future operations and safety, including the feasibility of a roundabout. Implementing a roundabout at this intersection will reduce vehicle speeds approaching the intersection and greatly decrease crash risk.

A roundabout at this location is on the City's CFP and is TIF eligible.

PRIORITY 3: TIMMEN ROAD CORRIDOR

Identified Safety Needs. NW Timmen Road is a major collector[4] that provides access from La Center Road to the rural area south of the city. It is a two-lane roadway, and there are many private driveway accesses on the segment from NW Pollock Road to NW 310th Circle. Street view on Timmen Road is shown in Figure 8.

During the study period, there were six collisions on this segment, with five occurring in dark, dusk, or dawn conditions and four occurring in wet road conditions. All six collisions involved roadway departure, and vehicles struck fixed objects such as utility pole (3), earthbank (1), guardrail (1), or a ditch (1).

None of the crashes resulted in fatal or serious injury; the highest severity collision resulted in possible injury.

Potential Safety Treatments. Installing segment lighting, recessed pavement markers/reflectors, and other signing and striping visibility upgrades would provide a clear safety benefit by increasing driver visibility in dark/dusk/dawn conditions.

Figure 8. Street view traveling south on Timmen Road near Pollock Road

[4] City of La Center 2016-2035 Comprehensive Plan. March 23, 2016.

PRIORITY 4: SYSTEMIC STOP-CONTROLLED INTERSECTIONS

Identified Safety Needs. In La Center, intersection and intersection-related collisions are the most common type to occur for all crash severities, with 23.5% of all collisions occurring at intersections, all of which were side-street stop-controlled. Of the nineteen total intersection-related collisions, collision types were angle (8), rear-end (4), fixed object (3), turning (2), and other (2). Eleven of the nineteen collisions listed a contributing circumstance. The two most common contributing circumstances were failing to grant right-of-way (4) and inattention/distraction (4).

Potential Safety Treatments. Low-cost systemic safety countermeasures at unsignalized intersections consist primarily of signing and pavement marking. Installing these treatments, shown in Figure 9, is a Federal Highway Administration (FHWA) Proven Safety Countermeasure. Treatments include doubled-up signs, additional pavement marking, fluorescent yellow sign sheeting, advance warning signs, and oversized signs.

To address the safety risks at intersections and the low cost of the recommended treatments, the City will consider a combination of these treatments at the following stop-controlled intersections (and others with similar features):

- NW La Center Road and NW Timmen Road
- NW Pacific Highway and W 3rd Street
- NW Pacific Highway and W 5th Street
- NW Pacific Highway and W D Avenue
- W 10th Street and Aspen Avenue

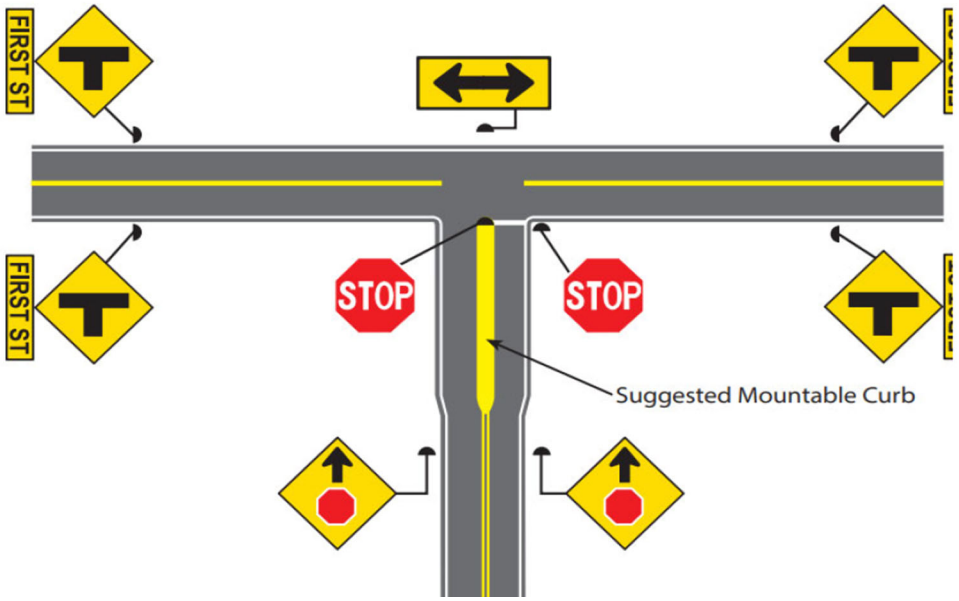


Figure 9. Typical Low-cost Intersection Treatments

PRIORITY 5: NW PACIFIC HIGHWAY FROM 9TH AVENUE TO 15TH STREET

Identified Safety Needs. The roadway is narrow, and shoulders are either narrow or non-existent throughout this corridor. Most collisions along the segment during the study period were roadway departure events in dark conditions.

During the study period, nine collisions occurred on this segment. Out of the nine collisions, eight occurred in dark, dusk, or dawn conditions, six involved roadway departure, and three involved a speeding driver. No collisions resulted in fatal or serious injury.

Potential Safety Treatments. On top of the roadway departure systemic treatments identified above, this segment of NW Pacific Highway may benefit from additional spot location treatments.

Figure 10. Northwest-bound on Pacific Highway

- ***Shoulder Widening.*** Increasing the shoulder width along the segment on the east side of the roadway can provide additional recovery area for vehicles that depart their lane, reducing the frequency and severity of collisions. (A shared-use path planned for construction along NW Pacific Highway will prohibit increased shoulder width on the west side of the roadway.)
- ***Speed Limit Signs and Speed Feedback Signs.*** Revised posted speed limits, more frequent posting of the speed limit, and speed feedback (i.e., "Your Speed Is") signs can reduce operating speeds along the segment, which in turn can reduce the frequency and severity of roadway departure collisions.
- ***Lighting.*** Due to nearly all (eight of nine) reported collisions occurring in dark, dusk, or dawn conditions, highway lighting may be appropriate on this segment to reduce the risk of future nighttime collisions.

APPENDICES

APPENDIX A: Safety Countermeasures Toolbox

APPENDIX B: Grant Programs

APPENDIX C: Collision Heat Maps

Appendix A Countermeasures Toolbox

Signalized Intersections

S1. Improve Intersection Lighting

A permanent source of artificial light applied to signalized intersections that have a disproportionate number of night-time crashes and do not currently provide sufficient lighting at the intersection or at its approaches.

Benefit-Cost

» Implementation of this treatment reduces nighttime injury crashes by 38% and nighttime pedestrian crashes by 42%. (WSDOT)

» 20 years of expected life

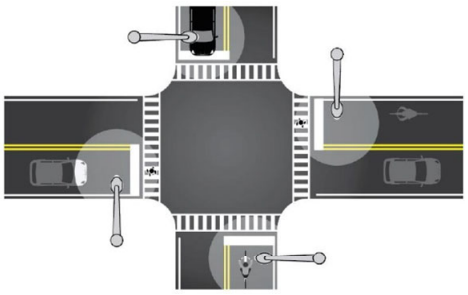
» Estimated $75,000

» The provision of lighting involves both a fixed cost for lighting installation and an ongoingmaintenance and power cost which results in a moderate to high cost.

Sources: CA-Local Roadway Safety Manual, FHWA, WSDOT

EXISTING CONDITION

IMPLEMENTATION



S2. Improve Signal Hardware (lenses, back-plates, mounting, size, number of heads)

Applicable at signalized intersections with a high frequency of right-angle and rear-end crashes because drivers are unable to see traffic signals sufficiently in advance to safely negotiate the intersection being approached. Examples include increasing the size of indications from 8 in. to 12 in. and adding supplemental heads (e.g., side-mount, near-side mount).

Benefit-Cost

» Implementation of this treatment can reduce crashes by 3-7% (WSDOT).

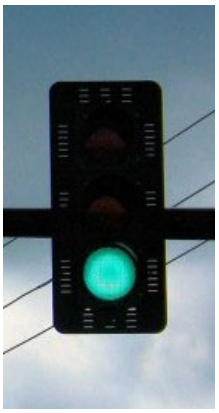
» 10 years of expected life

» Estimated $40,000 per intersection

» Cost varies based on size/number of signal heads.

Sources: CA-Local Roadway Safety Manual

EXISTING CONDITION



IMPLEMENTATION

S3. Improve Signal Timing (coordination, phasing, clearance intervals)

EXISTING CONDITION

Effective at locations that have a crash history at multiple signalized intersections. Signalization improvements may include adding phases, lengthening clearance intervals, eliminating or restricting higher-risk movements, and coordinating signals at multiple locations. This treatment addresses all types of crashes that occur on the approaches / influence area of the new signal timing. For projects coordination signals along a corridor, the crashes related to side-street movements should not be applied.

Benefit-Cost

» Implementation of this treatment reduces all crashes by 16%, and particularly angle crashes by 32% (WSDOT).

» 10 years of expected life

» Estimated $1,000 per intersection

» Cost variation based on number of signal heads and number of movements.

IMPLEMENTATION

Sources: CA-Local Roadway Safety Manual

S4. Install Left-turn Lane and Add Turn Phase

EXISTING CONDITION

Installed at signalized intersections that have a significant crash problem and the only alternative is to change the nature of the intersection itself. This treatment addresses all type of crashes and the measure can be very effective at intersection with complex geometry and intersection with frequent left-turn movements. A properly timed protected left-turn phase can also help reduce rear-end, broadside, and sideswipe crashes between left-turning vehicles and the through vehicles as well as vehicles behind them. This countermeasure only applies to crashes occurring on the approaches / influence area of the new left turn phases.

Benefit-Cost

» Implementation of this treatment reduces all crashes by 35% and head on crashes by 69% (WSDOT).

» 20 years of expected life

» Estimated $12,000 per intersection

» If the existing traffic signal only requires a minor modification to allow for a protected left-turnphase, then the cost would also be low (installation is short because no actual construction). In-house signal maintainers can perform this operation once the proper signal phasing is determined so the cost is low.

IMPLEMENTATION

Sources: CA-Local Roadway Safety Manual

S5. Pavement Marking and RPMs through Intersection

Raised Pavement Markers (RPMs) and pavement marking installed in intersections where the lane designations are not clearly visible to approaching motorists. Can also be applied at intersections noted as being complex and experiencing crashes that could be attributed to a driver's unsuccessful attempt to navigate the intersection.

Benefit-Cost

» Implementation of this treatment reduces run off road, opposite direction and night crashes by 21% (WSDOT).

» 10 years of expected life

» Estimated $2,000 per installation

Sources: CA-Local Roadway Safety Manual

EXISTING CONDITION

IMPLEMENTATION

S6. Improve Pavement Friction (High Friction Surface Treatment

Improvement for signalized Intersections noted as having crashes on wet pavements or under dry conditions when the pavement friction available is significantly less than needed for roadway approach speeds. This treatment is intended to target locations where skidding and failure to stop is determined to be a problem in wet or dry conditions and the target vehicle is unable to stop due to insufficient skid resistance. In addition, treatment also addresses night crashes all other crashes. This treatment does not apply to standard chip-seal or open-graded maintenance projects for long segments of corridors or structure repaving projects intended to fix failed pavement.

Benefit-Cost

» Implementation of this treatment reduces crashes by 40% (WSDOT).

» 10 years of expected life

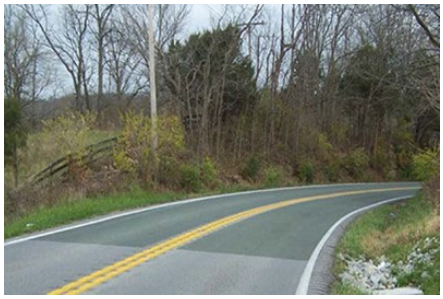
» Estimated $5,000 per intersection for materials and equipment

» Cost variation based on size of intersection and material (Estimated $30/sq.yd.).

Sources: CA-Local Roadway Safety Manual

EXISTING CONDITION

IMPLEMENTATION



S7. Add Median Openings to Allow or Restrict Left-turns and U-turns

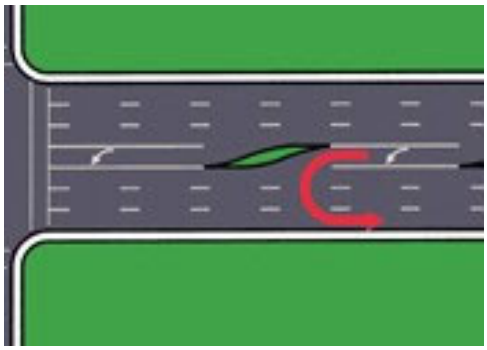
Install medians to reduce crashes related to turning maneuvers include angle, rear-end, pedestrian, and sideswipe (involving opposing left turns) type crashes. This treatment only applies to crashes occurring in the intersection/influence area of the new directional openings.

EXISTING CONDITION

Benefit-Cost

- Implementation of this treatment reduces crashes by 51% (WSDOT).
- 20 years of expected life
- Estimated $75,000 per installation
- The cost of this strategy will depend on the treatment.

IMPLEMENTATION



Sources: CA-Local Roadway Safety Manual

S8. Install Right-turn Lane

Setting up right-turn lane may be appropriate in situations where there are an unusually high number of rear-end collisions on a single major road approach. The need for right turn lanes should be assessed on an individual approach basis. It is also important to ensure that the right-turn lanes are of sufficient length to allow vehicles to decelerate and "queue up" before turning, ideally without affecting the flow of through traffic. This treatment addresses read-end crashes. When considering new right-turn lanes, potential impacts to non-motorized user should be considered and mitigated as appropriate.

EXISTING CONDITION

Benefit-Cost

- Implementation of this treatment reduces crashes by up to 8% for all crashes and 17% for fatal/injury crashes (WSDOT).
- 20 years of expected life
- Estimated $300,000 per right turn lane
- Installing right turn lanes require substantial time for development and construction that canvary the cost.

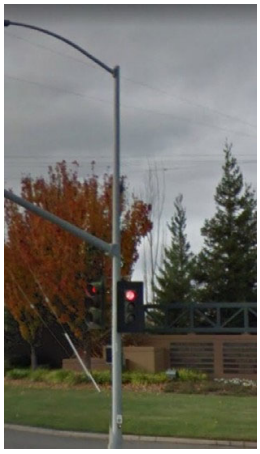
IMPLEMENTATION

Sources: CA-Local Roadway Safety Manual

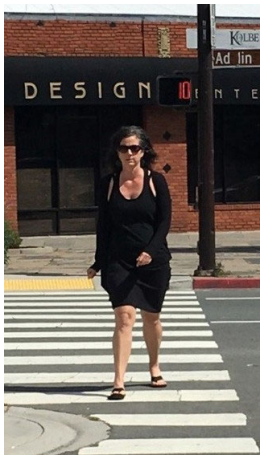
S9. Install Pedestrian Countdown Signal Heads

Install at signals that have signalized pedestrian crossing with WALK / DON'T WALK indications and where there have been pedestrian-vehicle crashes. The countermeasure addresses both pedestrian and bicycle collisions. This countermeasure only applies to "Ped & Bike" crashes occurring in the intersection/crossing with the newcountdown heads.

EXISTING CONDITION



IMPLEMENTATION



Benefit-Cost

- Implementation of this treatment reduces pedestrian crashes by 70% (WSDOT).
- 20 years of expected life
- Estimated $1,500 per signal head (does not include push button or pole cost)
- Costs and time of installation will vary based on the number of intersections included in this strategy and if it requires new signal controllers capable of accommodating the enhancement. This countermeasure can be effectively and efficiently implemented using a systematic approach with numerous locations, resulting in moderate cost projects that are more appropriate to seek stateor federal funding.

Sources: CA-Local Roadway Safety Manual

S10. Flashing Yellow Arrow Left Turn Signal

Flashing yellow arrow (FYA) traffic signals feature a flashing yellow arrow in addition to the standard red, yellow, and green arrows. When illuminated, the flashing yellow arrow allows waiting motorists to make a left-hand turn after yielding to oncoming traffic.

A national study demonstrated that drivers found flashing yellow left-turn arrows more understandable than traditional yield-on-green indications (green ball). Flashing yellow arrow treatment at signalized intersections can reduce the likelihood of left-turn crashes during permissive left-turn phasing. They can be used in either permissive-only or protected-permissive left-turn phasing schemes.

EXISTING CONDITION

IMPLEMENTATION

Benefit-Cost

- Implementation of this treatment reduces left turn crashes by 19% (WSDOT).
- 10 years of expected life
- Estimated $200,000 per intersection (assuming 4 new installations)
- Depending on the existing signal heads, signal controller, and signal cabinet, this treatment may require a controller replacement, which would increase the cost of installation.

Sources: FHWA, NACTO, Minnesota DOT

S11. Leading Pedestrian Interval

A leading pedestrian interval (LPI) gives pedestrians the opportunity to enter the crosswalk at an intersection 3-7 seconds before vehicles are given a green indication. Using this "head start," pedestrians can better establish their presence in the crosswalk before vehicles have priority to turn right or left.

LPIs provide increased visibility of crossing pedestrians and increased likelihood of motorists yielding to pedestrians. This results in reduced conflicts between vehicles and pedestrians, improving intersection safety. LPI is particularly useful at signalized intersections with a high volume of turning movements.

Benefit-Cost

» Implementation of this treatment reduces pedestrian-vehicle crashes by 13-48% (FHWA, WSDOT, City of Seattle).

» 10-20 years of expected life

» Estimated $200-10,000 (based on whether existing controller can accommodate the change)

Sources: FHWA, City of Seattle, WSDOT

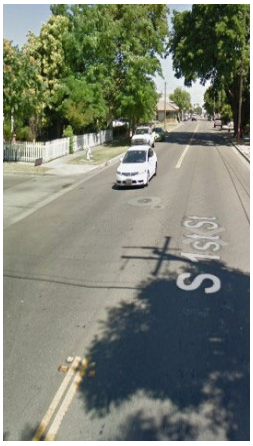
IMPLEMENTATION

Countermeasures for Non-Signalized Intersections

NS1. Add Intersection Lighting

Effective at unsignalized intersections that have a disproportionate number of nighttime crashes and do not currently have lighting. This treatment improves the safety of the intersection during nighttime by making drivers more aware of the surroundings at the intersection, enhancing driver'savailable sight distances and improving the visibility of non- motorists. This countermeasure only applies to nightcrashes (all types) occurring within limits of the proposed roadway lighting 'engineered' area.

EXISTING CONDITION



IMPLEMENTATION

Benefit-Cost

- Implementation of this treatment reduces nighttime injury crashes by 38% and nighttime pedestrian crashes by 42% (WSDOT).
- 20 years of expected life
- Estimated $8,000 per intersection
- Cost variation based on cost for lighting installation and an ongoing maintenance and powercost.

Sources: CA-Local Roadway Safety Manual

NS2. Convert to All-way Stop Control

Applicable at unsignalized intersection locations (currently with two-way stop control or two-way yield control) with a crash history and have no controls on the major roadway approaches. The all-way stop control is suitable only at intersections with moderate and relatively balanced volume levels on the intersection approaches. This treatment addresses to all type of crashes and only applies to crashes occurring in the intersection and /or influence area ofthe new control. All-way stop warrant should be considered.

EXISTING CONDITION

IMPLEMENTATION

Benefit-Cost

- Implementation of this treatment reduces crashes by 18-75% (ODOT).
- 10 years of expected life.
- Estimated $5,000 per intersection.
- Cost variation based on numbers of locations.

Sources: CA-Local Roadway Safety Manual

NS3. Install Roundabout

Effective at intersections that have a high frequency of right-angle and left-turn type crashes, primarily at unsignalized intersections with moderate-volumes. This countermeasure only applies to crashes occurring inthe intersection and/or influence area of the new control and is not eligible for use at existing all-waystop intersections.

Benefit-Cost

» Implementation of this treatment at 2-way stop controlled intersection reduces crashes by 25% and fatal/injury crashes by 35% (WSDOT).

» 20 years of expected life.

» Estimated $750,000 per intersection.

» Cost variation based on the environmental process, right-of-way acquisition and implementationunder an agency's long-term capital improvement program.

Sources: CA-Local Roadway Safety Manual

EXISTING CONDITION

IMPLEMENTATION

NS4. Implement Unsignalized Intersection Signing and Marking Improvements

Target unsignalized intersections with patterns of rear-end, right- angle, or turning collisions related to lack of driver awareness of the presence of the intersection. The set of low-cost countermeasures is designed to increase drivers' alertness to the presence of the intersection and reduce potential conflicts with other entering vehicles. These treatments can include advanced intersection warning signs, oversized signs, doubled-up signs, stop ahead signs or painted on side street to supplement STOP sign.

Benefit-Cost

» Implementation of this treatment reduces crashes by 25% (WSDOT).

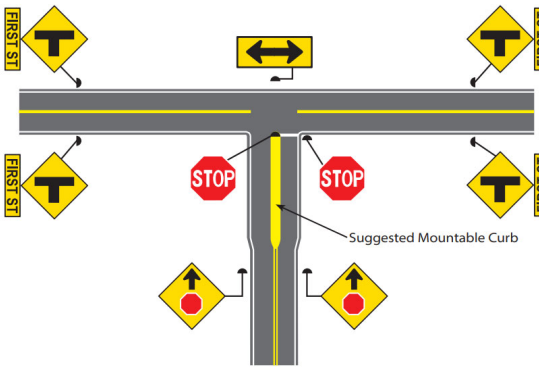
» 10 years of expected life.

» Estimated $700 per intersection.

» Cost variation based on the number of signs.

Sources: CA-Local Roadway Safety Manual

IMPLEMENTATION



NS5. Install Transverse Rumble Strips

Transverse rumble strips are installed in the travel lane for providing an auditory and tactile sensation for each motorist approaching the intersection. They can be used at any stop or yield approachintersection, often in combination with advance signing to warn of the intersection ahead. This countermeasure applies to all crashes occurring on the approach / influence area of the new rumble strips.

Benefit-Cost

- Implementation of this treatment reduces all crashes by up to 6% and fatal/injury crashes by 7% (WSDOT).
- 10 years of expected life.
- Estimated $5,000 per intersection.
- Cost variation based on the length of the rumble strips.

Sources: CA-Local Roadway Safety Manual

EXISTING CONDITION

IMPLEMENTATION

NS6. Install Raised Median

Used at Intersections noted as having turning movement crashes near the intersection as a result of insufficient access control. Application of this countermeasure should be based on current crash data and a clearly defined need to restrict or accommodate the movement. Angle crashes are addressed through this countermeasure. When agencies opt to install landscaping in conjunction with new raised medians, these locations must be excluded from their federally funded HSIP application scope. This countermeasure only applies to crashes occurring on the approaches / influence area of the new raised median.

Benefit-Cost

- Implementation of this treatment reduces all crashes by up to 39% and fatal/injury crashes by 44% (WSDOT).
- 20 years of expected life.
- Estimated $200,000+ (depends on length, right-of-way, and surface treatment).
- Cost variation based on the size of the new median.

Sources: CA-Local Roadway Safety Manual

EXISTING CONDITION

IMPLEMENTATION

NS7. Install Right-turn Lane

Applicable when many collisions at unsignalized intersections are related to right-turn maneuvers. This countermeasure provides exclusive right-turn lanes, particularly on high-volume and high-speed major-roadapproaches to minimizing the collisions and applies to crashes occurring on the approaches / influence area of the new right-turn lanes.

Benefit-Cost

» Implementation of this treatment reduces all crashes by up to 8% and fatal/injury crashes by 17% (WSDOT).

» 20 years of expected life.

» Estimated $200,000 per intersection.

» Cost variation based on how wide the new right lane.

Sources: CA-Local Roadway Safety Manual

EXISTING CONDITION

IMPLEMENTATION

NS8. Install Enhanced Pedestrian Crossing wish Advanced Features

Applicable at non-signalized intersections without a marked crossing, where pedestrians are known to cross, that involve significant vehicular traffic. They are important at school crossings and intersections with right and/or left turns pockets. Rectangular rapid flashing beacons (RRFBs), overhead flashing beacons, curb extensions, advanced stop or yield lines and other safety features should be added to complement the standard crossing elements. This countermeasure reduced pedestrian crashes occurring in the crossing (influence area) with the new enhanced safety features.

Benefit-Cost:

» Implementation of this treatment reduces pedestrian crashes by 40% (WSDOT).

» 20 years of expected life

» Estimated $ 50,000 per intersection

» Cost variation based on the length of the pedestrian crossing and the amount of safety signs.

Sources: CA-Local Roadway Safety Manual

IMPLEMENTATION

NS9. Install Pedestrian Crossing (signs and markings only)

Applicable when many collisions at unsignalized intersections are related to left-turn maneuvers. This countermeasure provides exclusive left-turn lanes, particularly on high-volume and high-speed major-road approaches to minimizing the collisions. This countermeasure applies to crashes occurring on the approaches /influence area of the new left- turn lanes, but is not eligible for use at existing all-way stop intersections.

Benefit-Cost

- Implementation of this treatment reduces pedestrian crashes by 40% (WSDOT).
- 20 years of expected life
- Estimated $200,000 per intersection
- Cost variation based on how wide the new left lane.

Sources: CA-Local Roadway Safety Manual

EXISTING CONDITION

IMPLEMENTATION

Countermeasures for Roadway Segments

R1. Add Segment Lighting

Applied to night-time crashes. In particular, patterns of rear-end, right-angle, turning or roadway departure collisions on the roadways may indicate that night-time drivers can be unaware of the roadway characteristics. This treatment addresses only to all night type crashes.

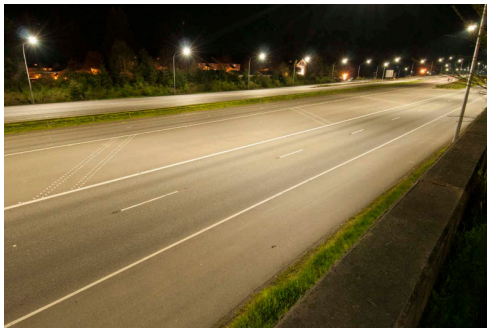
Benefit-Cost

- Implementation of this treatment reduces injury crashes by 28% (HSM).
- 20 years of estimated life
- Estimated $8,000 per installation
- Cost variation depending if lighting connected to signal box.

Sources: CA-Local Roadway Safety Manual, Highway Safety Manual

EXISTING CONDITION

IMPLEMENTATION



R2. Remove or Relocate Fixed Objects

Applicable to known locations or roadway segments prone to collisions with fixed objects such as utility poles, drainage structures, trees, and other fixed objects, such as the outside of a curve, end of lane drops, and in traffic islands. This treatment addresses fixed object crashes that occur within the current clear zone.

Benefit-Cost

- Implementation on this treatment reduces run off road crashes by 38% (WSDOT).
- 20 years of expected life
- Varies. Up to estimated $50,000 per deployment
- Costs will generally be low, assuming that in most cases the objects to be removed are within the right-of-way.

Sources: CA-Local Roadway Safety Manual

EXISTING CONDITION

IMPLEMENTATION

R3. Install Guardrail

Guardrail is installed to reduce the severity of lane departure crashes. This treatment addresses fixed object and run-off road crashes. Its value in reducing collisions should only be applied to locations where past crash data or engineering judgement suggests the guardrail may result in a few or less severe crashes because the guardrail itself is a fixed object.

Benefit-Cost

- Implementation on this treatment reduces run off road crashes by 7-34% (ODOT).
- 20 years of expected life
- Estimated $50,000 per installation

Sources: CA-Local Roadway Safety Manual

EXISTING CONDITION

IMPLEMENTATION

R4. Install Roadside Impact Attenuators

Impact attenuators are typically used to shield rigid roadside objects such as concrete barrier ends, steel guardrail ends and bridge pillars from oncoming automobiles. This treatment addresses fixed object and run-off road that occur with the limits of the new attenuators. This countermeasure and corresponding collision reduction benefits should only be applied to locations where past crash data or engineering judgement applied to existing conditions suggests the upgraded attenuators may result in a few or less severe crashes.

Benefit-Cost

- Implementation of this treatment reduces crashes by 25%.
- 10 years of expected life
- Estimated $5,000 for steel railing, $2,500 for traffic barrels
- Costs depending on the scope of the project, type(s) used, and associated ongoing maintenance costs.

Sources: CA-Local Roadway Safety Manual

EXISTING CONDITION

IMPLEMENTATION

R5. Add 2 ft Paved Shoulder

Installed in roadways that have a frequent incidence of vehicles leaving the travel lane resulting in an unsuccessful attempt to reenter the roadway. The probability of a safe recovery is increased if an errant vehicle is provided with an increased paved area in which to initiate such a recovery. This type of countermeasure addresses Fixed object, Run-off Road, and Sideswipe collisions.

Benefit-Cost

- Implementation on this treatment reduces crashes by 5-13% (ODOT).
- 20 years of expected life.
- Estimated $150,000 (cost depends on need for right-of-way or if roadside modification isneeded).
- Shoulder widening costs would depend on whether new right-of-way is required and whether extensive roadside modification is needed. Since shoulder widening can be a relatively expensive treatment, one of the keys to creating a cost-effective project with at least a medium B/C ratio is targeting higher-hazard roadways.

EXISTING CONDITION

IMPLEMENTATION

Sources: CA-Local Roadway Safety Manual

R6. Add Unpaved Shoulder

Appropriate to roadways with a frequent incidence of vehicles leaving the travel lane resulting inan unsuccessful attempt to reenter the roadway. This countermeasure addressed all types of crashes. Unless shoulder widening requires additional right-of-way and environmental impacts, these treatments can be implemented in a relatively short timeframe. This countermeasure only applies to crashes occurring within the limits of the new shoulder.

Benefit-Cost

- Implementation on this treatment reduces crashes by 3-6% (ODOT).
- 20 years of expected life
- Estimated $50,000 (varies)
- The cost of adding a navigable non-paved shoulder would depend whether extensive roadside modification and shoulder stabilization are required.

IMPLEMENTATION

Sources: CA-Local Roadway Safety Manual

R7. Install Chevron Signs on Horizontal Curves

IMPLEMENTATION

Set up on roadways that have an unacceptable level of crashes on relatively sharp curves during periods of light and darkness. Ideally this type of safety countermeasure would be combined with other sign evaluations and upgrades (install warning signs, delineators, markers, beacons, and relocation of existing signs per MUTCD standards). This treatment can address all types of crashes; but, specifically, run-offroad crashes occurring near curves. This treatment only applies to crashes occurring within the influence area of the new signs (i.e. only through the curve).

Benefit-Cost:

- Implementation of this treatment reduces crashes by 64% (WSDOT).
- 10 years of expected life.
- Estimated $1,000 per curve
- Costs for implementing this strategy are nominal and depend on the number of signs. When considered at a single location, these low-cost improvements are usually funded through localfunding by local maintenance crews. However, this treatment can be effectively and efficientlyimplemented using a systematic approach with numerous locations, resulting in moderate cost projects that are more appropriate to seek state or federal funding.

Sources: CA-Local Roadway Safety Manual

R8. Add Speed Feedback Signs

IMPLEMENTATION

This type of treatment addresses all crashes caused by motorist traveling too fast, including horizontal curves. Before choosing this treatment, the agency needs to confirm the ability to provide power to the site (solar may be an option).

Benefit-Cost

- Implementation on this treatment reduces crashes by 46% (WSDOT).
- 10 years of expected life
- Estimated $20,000-100,000
- Cost varies by type of implementation.

Sources: CA-Local Roadway Safety Manual

IMPLEMENTATION

R9. Install Edge Line and Centerline Pavement Marking

Applicable on any road with a history of run-off-road right, head-on, opposite-direction-sideswipe, or run-off-road-left crashes is a candidate for this treatment. This treatment addresses all types, specifically impacts head-on and run-off road crashes. It only applies to crashes occurring within the limits of the new centerlines and/or edge lines. The treatment is not intended to be used for general maintenance activities (i.e. the replacement of existing striping) and must include upgraded safety features over the existing striping. For two lane roadways allowing passing, a striping audit must be done to ensure the passing limits meeting the MUTCD standards. Both the centerline and edge lines are expected to be upgraded.

Benefit-Cost

» Implementation on this treatment reduces run off road, opposite direction and nighttime crashes by 21% (WSDOT).

» 10 years of expected life

» Estimated $4,000 (depends on number and length of segment, as well as striping material)

» Costs for implementing this strategy are nominal and depend on the number and length of segment as well as the striping material (paint, thermoplastic, etc.). This countermeasure can be effectively implemented using a systemic approach with numerous and long locations.

Sources: CA-Local Roadway Safety Manual

IMPLEMENTATION

R10. Install No Passing Zone

Installed on roadways that have a high percentage of head-on crashes suggesting that many head-on crashes may relate to failed passing maneuvers. No Passing Zones should be installed where drivers' "passing sight distance" is not available due to horizontal or vertical obstructions. This treatmentaddresses all types of crashes that occur when drivers cannot differentiate the centerline markings between passing and no-passing area. This treatment only applies to crashes occurring within the limits of the new or extended no-passing zones.

Benefit-Cost

» Implementation of this treatment reduces crashes by 45%.

» 10 years of expected life

» Estimated $2,000 (varies)

» When considered at a single location, these low cost improvements are usually funded through local funding by local maintenance crews. However, This treatment can be effectivelyand efficiently implemented using a systematic approach with numerous and long locations, resulting in low to moderate cost projects that are more appropriate to seek state or federalfunding.

R11. Install Centerline Rumble Strips/Stripes

IMPLEMENTATION

Center Line rumble strips/stripes should be used on segments with a history of head-on crashes. This treatment addresses head-on and opposite-direction side-swipe crashes by alerting drivers who travel into the oncoming travel lane.

Benefit-Cost

- Implementation of this treatment reduces crashes by 20%.
- 10 years of expected life
- Estimated $3,000 per mile
- Costs for implementing this strategy are nominal and depend on the number and length oflocations.

Sources: CA-Local Roadway Safety Manual

R12. Install Edge Line Rumble Strips/Stripes

IMPLEMENTATION

Shoulder and edge line milled rumble strips/stripes should be used on roads with a history of roadway departure crashes. This treatment addresses run-off road crashes by providing an auditory and tactile warning when driven on, alerting drivers drifting outside their travel lanes.

Benefit-Cost

- Implementation of this treatment reduces opposite direction crashes by 40% and fatal/injury crashes by 8%.
- 10 years of expected life
- Estimated $3,000 per mile
- Costs for implementing this strategy are nominal and depend on the number and length oflocations.

Sources: CA-Local Roadway Safety Manual

R13. Rail Crossing Treatments

IMPLEMENTATION

Four Quadrant Gates extend across all roadway lanes on both the approach and the departure side of the crossing. Unlike two-quadrant gate systems, four-quadrant gates provide additional visual constraints and inhibit most traffic movements over the crossing after the gates have been lowered. Safe guards are put in place to ensure vehicles are not trapped on the tracks.

Four Quadrant Gate

Wayside Horns can be used as an adjunct to train-activated crossing warning systems to provide audible warning of an approaching train for traffic on each approach to the highway-rail crossing. A wayside horn system consists of a horn or series of horns located at a public highway-rail crossing and directed at oncoming motorists. The wayside horn system simulates a train horn and sounds at a minimum of 15 seconds prior to the train's arrival at the highway-rail crossing, until the lead locomotive has traversed the crossing. It is typically used at locations where the train horn is not sounded.

Wayside Horn

Benefit-Cost

- Quantified benefits unknown.
- 10 Years of expected life
- Estimated $700,000 for four quadrant gate system
- Estimated $500,000 for wayside horn system

Sources: FHWA, FRA

R14. No Passing Zone Signs

IMPLEMENTATION

A No Passing Zone, indicated by a solid yellow line on the left side of the driver's direction of travel, indicates a zone through which sight distance is restricted or where other conditions make overtaking and passing inappropriate. No Passing Zones are regulatory and legally enforceable.

In situations where head-on collision history is observed, a NO PASSING ZONE pennant can provide additional information to drivers at the beginning of the No Passing Zone, discouraging passing maneuvers. The NO PASSING ZONE sign is installed on the left side of the roadway.

Additionally, DO NOT PASS signs can be added as a supplement to No Passing Zone pavement markings to emphasize the restriction on passing. It can be installed at the beginning of, and at intervals within, the No Passing Zone.

Benefit-Cost

- Quantified benefits unknown.
- 10 Years of expected life
- Estimated $200 per sign

Sources: FHWA

Figure Links

S1a https://www.aaroads.com/california/ca-238.html S1b https://www.aaroads.com/california/ca-262.html
S2a https://safety.fhwa.dot.gov/provencountermeasures/lighting.cfm
S2b http://wishtv.com/2016/02/16/new-traffic-signals-aim-to-reduce-crashes/
S3a http://www.k-state.edu/roundabouts/ada/news/USNews.htm
S3b https://parade.com/19072/marilynvossavant/what-would-traffic-light-synchronization-cost/
S4a https://www.fhwa.dot.gov/publications/research/safety/09036/index.cfm
S4b http://www.madriverunion.com/samoa-boulevard-traffic-light-system-changed-up/
S5a https://dohanews.co/qatars-civil-defense-junction-is-now-a-proper-intersection/
S5b http://www.gulf-times.com/story/461946/Ashghal-opens-signal-controlled-intersection-on-New-Rayyan-Road
S6a http://www.cochraneeagle.com/article/Cochrane-familes-celebrate-cultural-diversity-20170803
S6b https://rspcb.safety.fhwa.dot.gov/noteworthy/html/edccasestudy_ky.aspx
S7a https://bouldercolorado.gov/transportation/median-maintenance
S7b Unknown
S8a Google Streetview
S8b https://nacto.org/publication/urban-bikeway-design-guide/intersection-treatments/through-bike-lanes/
S9a Google Streetview
S9b Google Streetview
S10 https://www.sacbee.com/news/local/article239121918.html
S11 https://safety.fhwa.dot.gov/provencountermeasures/lead_ped_int.cfm

NS1a Google Streetview
NS1b Google Streetview
NS2a Google Streetview
NS2b http://www.ite.org/uiig/types.asp
NS3a https://www.flickr.com/photos/repowers/2933707788/
NS3b Google Streetview
NS4a https://alchemistsdiary.wordpress.com/2017/07/22/
NS4b https://safety.fhwa.dot.gov/intersection/other_topics/fhwasa09020/fhwasa09020.pdf
NS5a http://www.cleveland.com/berea/index.ssf/2012/11/berea_changes_stop_sign_parkin.html
NS5b https://radiobintangsembilan.com/2016/03/07/hindari-kecelakaan-anak-sekolah-warga-minta-garis-kejut/
NS6a http://www.jurist.org/hotline/2014/03/zachary-heiden-maine-panhandling.php
NS6b https://www.edmonton.ca/transportation/on_your_streets/neighbourhood-traffic-concerns.aspx
NS7a Google Streetview
NS7b https://ux.stackexchange.com/questions/42867/how-does-the-projection-angle-of-road-arrows-change-drivers-expectations-of-the
NS8a https://en.wikipedia.org/wiki/Uncontrolled_intersection
NS8b https://safety.fhwa.dot.gov/provencountermeasures/crosswalk-visibility.cfm
NS9a Google Streetview
NS9b https://nacto.org/publication/urban-bikeway-design-guide/bicycle-boulevards/major-street-crossing/

R1a https://www.shutterstock.com/nb/video/clip-9830723-4k-driving-car-on-highway-roadway-night
R1b https://www.wsdot.wa.gov/research/reports/fullreports/847.1.pdf
R2a Google Streetview
R2b Google Streetview
R3a Google Streetview
R3b https://www.reddit.com/r/funny/comments/4zcplq/a_local_plumbers_truck_decal/
R4a Unknown
R4b http://lslee.com/attenuators/Impact-Attenuators
R5a Unknown
R5b https://safety.fhwa.dot.gov/ped_bike/tools_solve/fhwasa11018/
R6b https://www.fhwa.dot.gov/publications/research/safety/15030/009.cfm

R7b https://safety.fhwa.dot.gov/provencountermeasures/enhanced_delineation.cfm
R8b https://www.fhwa.dot.gov/publications/research/safety/15030/009.cfm
R9b https://www.fhwa.dot.gov/publications/research/safety/15030/009.cfm
R10b https://www.shutterstock.com/nb/search/double+yellow+lines
R11b https://safety.fhwa.dot.gov/roadway_dept/pavement/rumble_strips/bike_ig/
R12b https://safety.fhwa.dot.gov/roadway_dept/pavement/rumble_strips/bike_ig/
R13a https://cms.cityoftacoma.org/PublicWorks/RR_Crossing/Dome_OldTown/Option4_S_C_St_Poster_1of2.pdf
R13b https://safety.fhwa.dot.gov/hsip/xings/com_roaduser/fhwasa18040/
R14a https://safety.fhwa.dot.gov/older_users/fhwasa15088/ch4.cfm
R14b https://driving-tests.org/road-signs/do-not-pass-sign/

Appendix B Grant Programs

Based on the projects included in the City Safety Plan, the City may be eligible to submit projects to the following grant programs.

WSDOT City Safety Program

WSDOT Local Programs sends out a call for projects each even-numbered year. This program's funding is for projects enhancing safety on city streets by reducing the severity of crashes and utilizing transportation engineering improvements and countermeasures.
https://wsdot.wa.gov/LocalPrograms/Traffic/CitySafetyProgram

WSDOT Pedestrian and Bicycle Program

WSDOT Active Transportation Program sends out a call for projects each even-numbered year. The Pedestrian and Bicycle Program objective is to improve the transportation system to enhance safety and mobility for people who choose to walk or bike.
https://wsdot.wa.gov/LocalPrograms/ATP/funding.htm

WSDOT Safe Routes to School Program

WSDOT sends out calls early in even numbered years for project awards in the following biennium. The purpose of the Safe Routes to Schools program is to improve safety and mobility for children by enabling and encouraging them to walk and bicycle to school. Funding from this program is for projects within two-miles of primary, middle and high schools (K-12).
https://wsdot.wa.gov/LocalPrograms/SafeRoutes/funding.htm

WSDOT Railway-Highway Crossings Program

Open call for projects depends on future federal funding and Washington State priorities. This program's funding is for projects enhancing safety at public grade crossings by reducing the severity of crashes and installing or upgrading protective mechanisms at railroad crossings.
https://wsdot.wa.gov/localprograms/traffic/railway-crossings-program

Transportation Improvement Board (TIB) Complete Streets

The Complete Streets Award is a funding opportunity for local governments that have an adopted complete streets ordinance. Board approved nominators may nominate an agency for showing practice of planning and building streets to accommodate all users, including pedestrians, access to transit, cyclists, and motorists of all ages and abilities.
http://www.tib.wa.gov/grants/grants.cfm?inav=3#other2

Surface Transportation Block Grant (STBG) - Urban

STBG – Urban is for jurisdictions above 5,000 population. The grant is approximately $6 million per year, with grant applications due in July and grant awards in September. Previous funded projects include bringing urban roads and intersections up to urban standards. Projects need to have a balance of capacity, safety, and economic development to get funding.
https://www.rtc.wa.gov/programs/tip/docs/tipcrit21.pdf

STBG - Rural

STBG – Rural is for smaller jurisdictions and rural areas awards approximately $1 million every other year (even-numbered years). Selection occurs with applications due in July and grant awards in September. Criteria are less stringent than urban, but support capacity, safety, and economic development. It has funded downtown improvements in smaller cities and for arterial preservation/safety on county road arterials that access cities.
https://www.rtc.wa.gov/programs/tip/call/

Congestion Mitigation and Air Quality (CMAQ) Improvement Program

This is available for projects that improve air quality. Available funding is approximately $3 million per year, with applications due in July and September grant awards. CAQ has the same criteria as STBG-Urban, but air quality points are tripled. Mostly funded projects are signalized intersections and transit-related projects.
https://www.rtc.wa.gov/programs/tip/call/

Transportation Alternatives (TA)

Approximately $1.3 million available every odd year (2023, 2025, etc.). Grant application due in April with grant awards in July. Criteria and process is outlined in https://www.rtc.wa.gov/programs/tap/docs/taGuidebook.pdf. Has funded pedestrian/bicycle improvements.

APPENDIX C: COLLISION HEAT MAPS

Following WSDOT's recommended procedure, the consultant support team applied the most common attributes present in serious injury collisions to the entire network by mapping collisions based on those attributes.

Figures C1 through C5 show the locations of crashes with these attributes.

Figure C1 illustrates that roadway departure collisions are most common along NW La Center Road and NW Pacific Highway with some clustering also present on NW Timmen Road and NE Lockwood Creek Road.

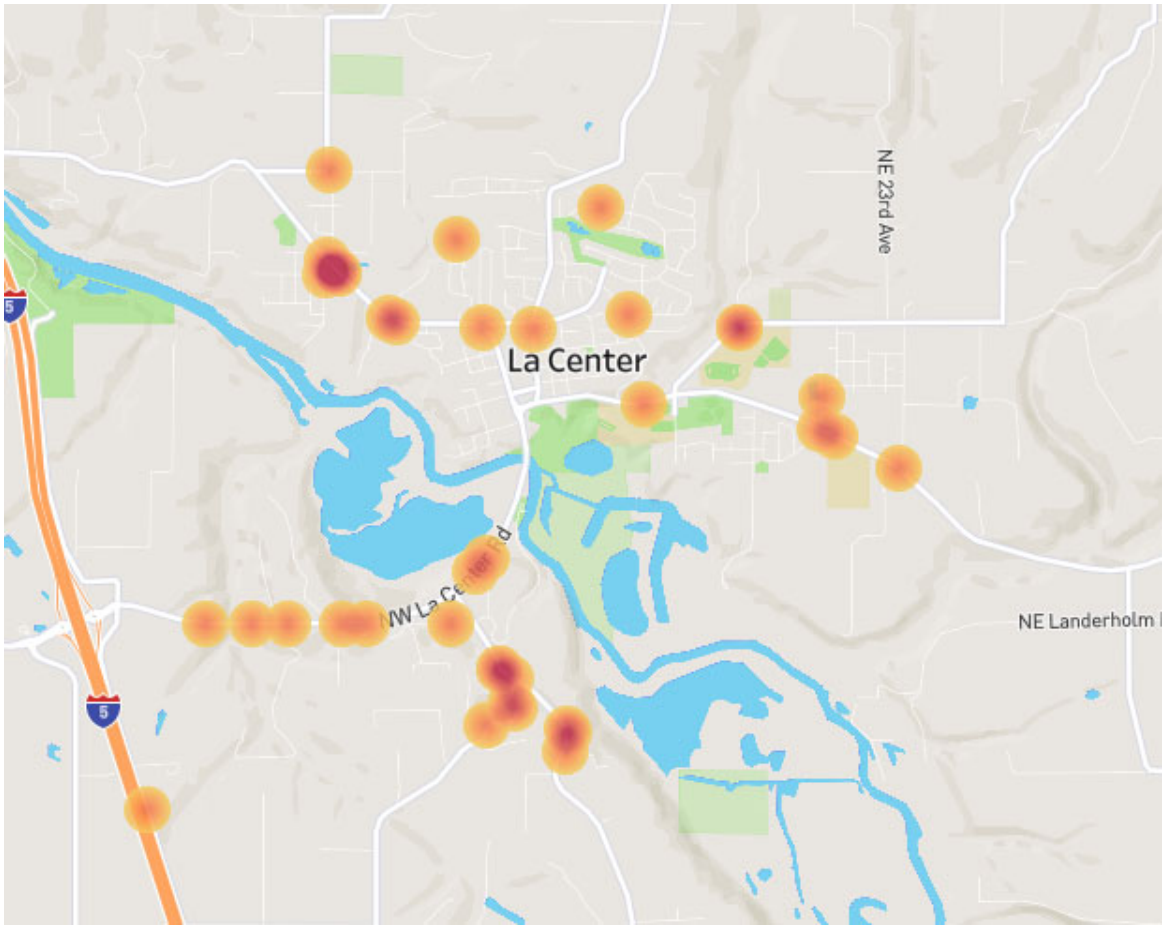


Figure C1. Roadway Departure Collisions, La Center, 2018-2022

Figure C2 shows some hot spots of intersection collisions at the following locations:

- NW La Center Rd and NB I-5 Ramp Roundabout
- NW Timmen Road and NW La Center Road
- W 4th Street and NW La Center Road Roundabout

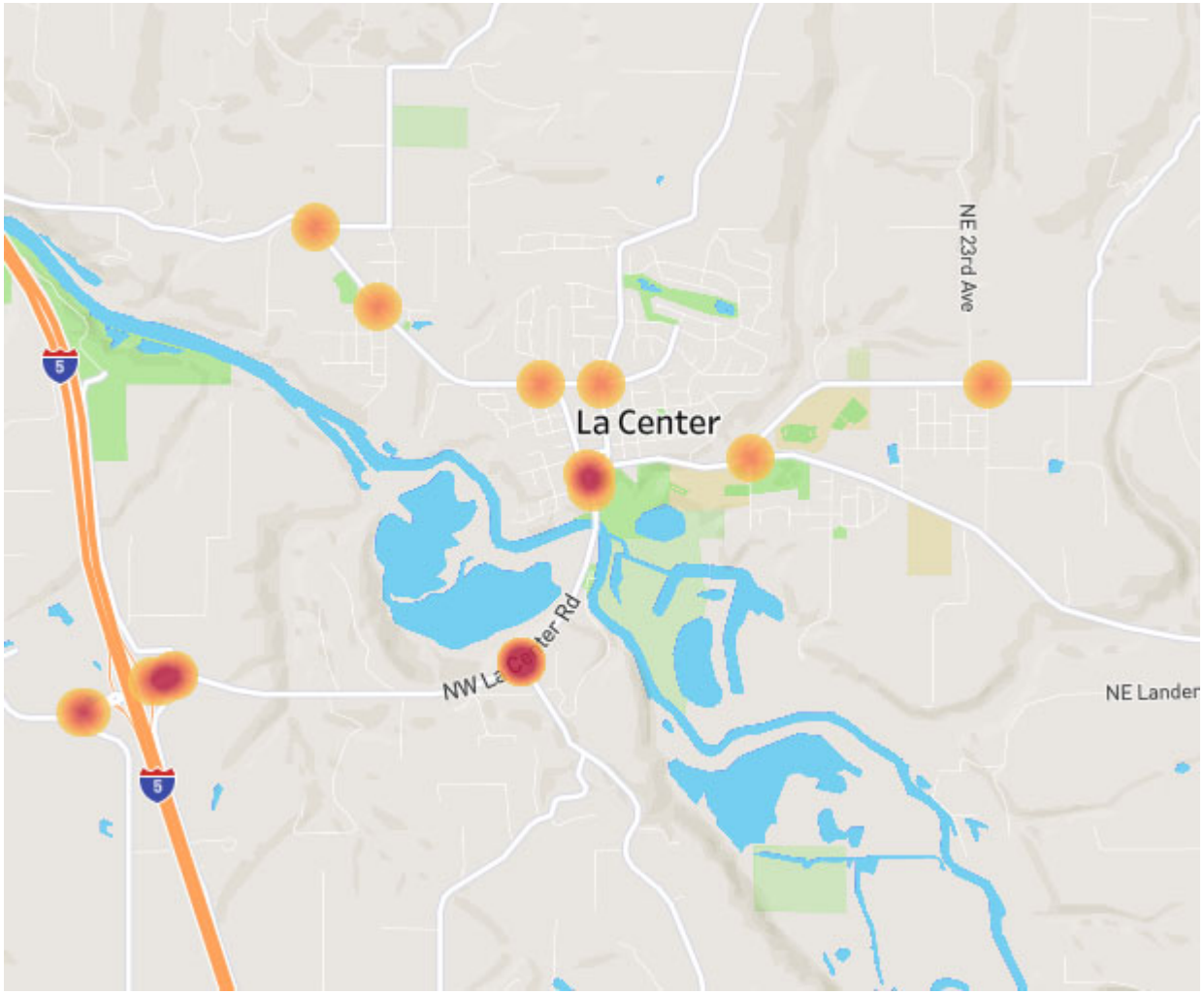


Figure C2. At Intersection or Intersection Related Collisions, La Center, 2018-2022

Figure C3 presents the heat map of all the collisions that occurred during dark, dusk or dawn lighting conditions. The majority of these collisions occurred along two corridors that do not have lighting:

- NW La Center Road
- Timmen Road
- NW Pacific Highway between NW 9th Avenue and NW Bolen Street

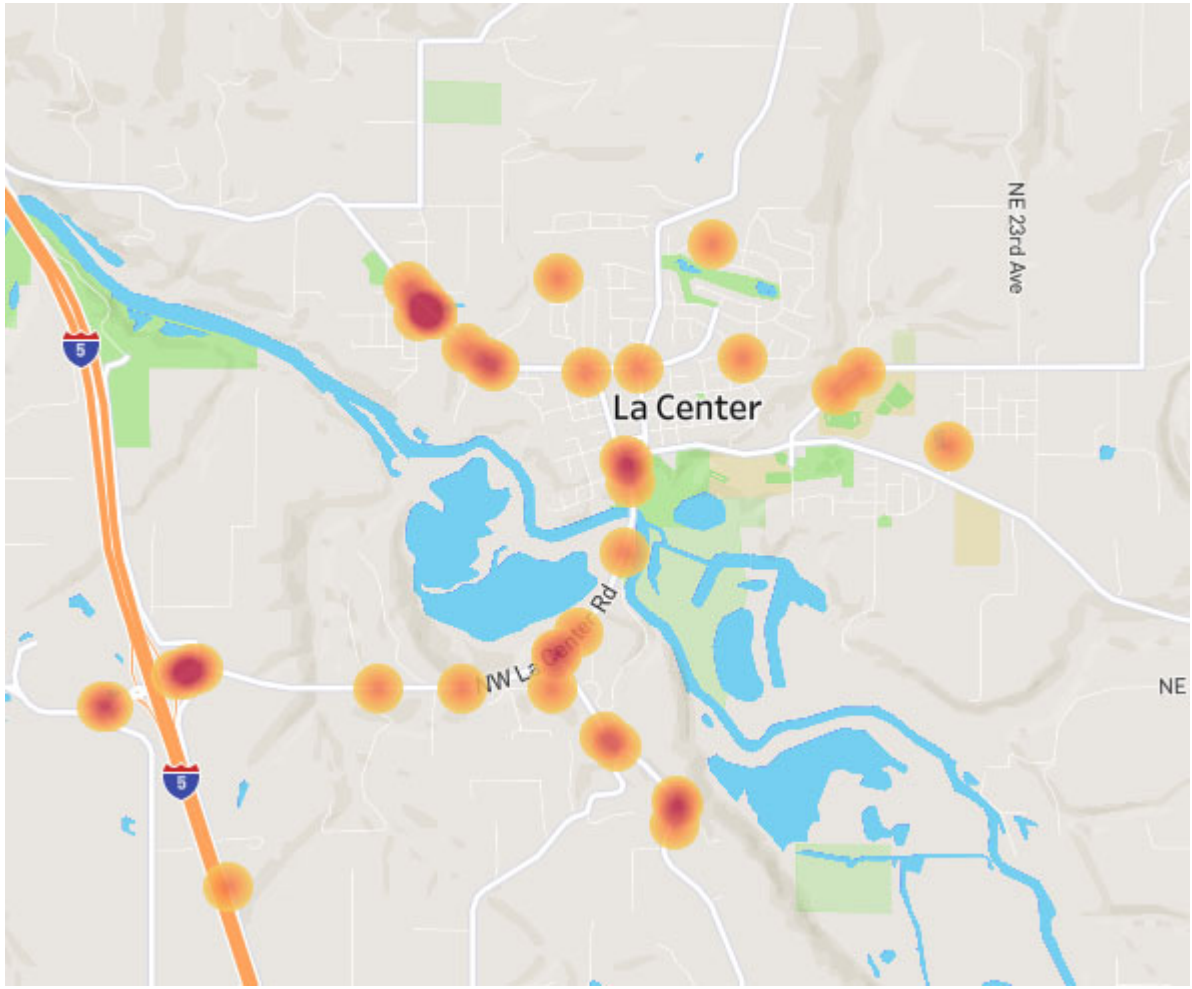


Figure C3. Dark/Dusk/Dawn Collisions, La Center, 2018-2022

There are several clusters of collisions that occurred due to distraction or inattention, as shown in Figure C4. Examples include segments and intersections along NW Pacific Highway and NE Lockwood Creek Road.

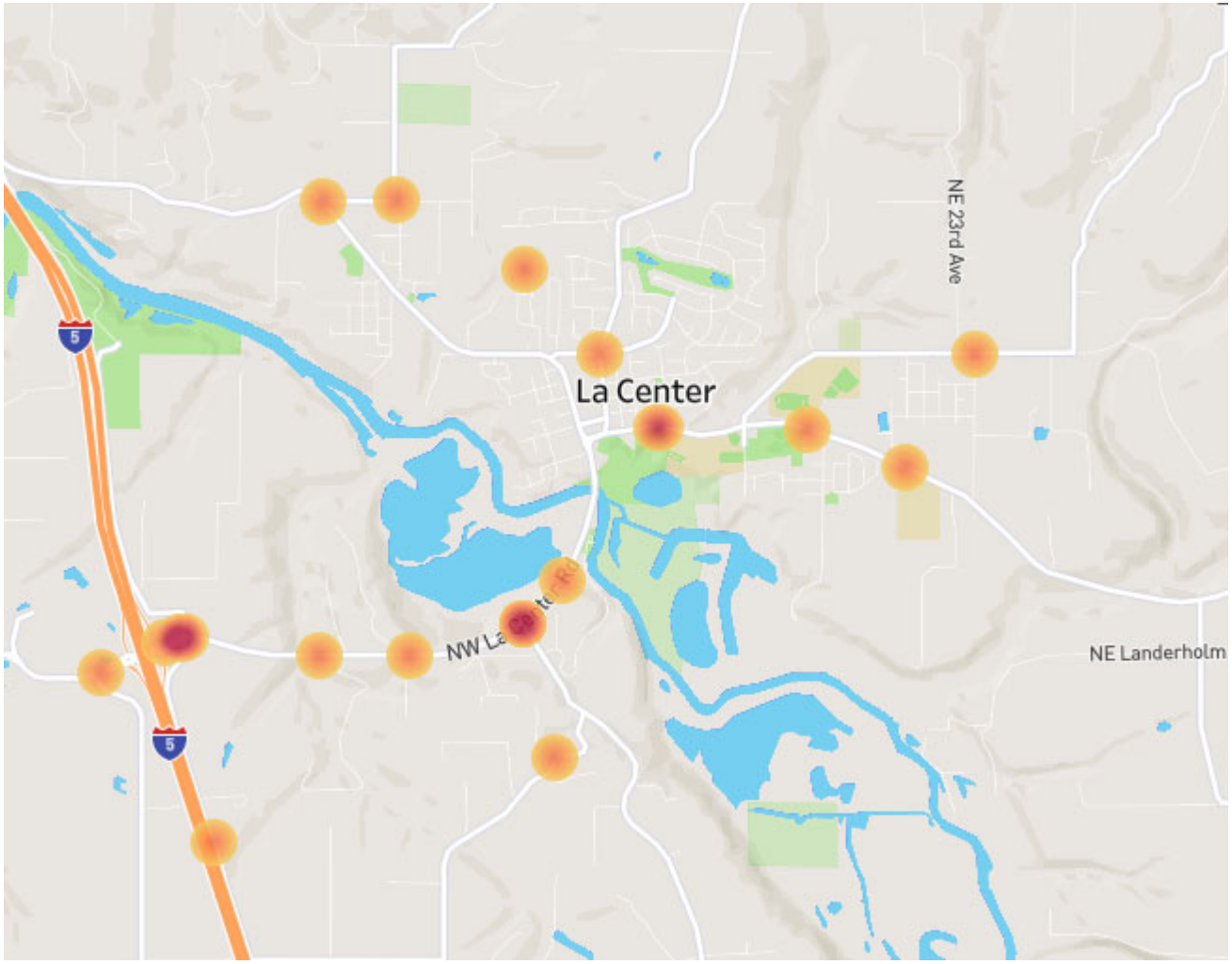


Figure C4. Distraction/Inattention Collisions, La Center, 2018-2022

There are three main clusters of speeding related collisions shown in Figure C5:

- NW Timmen Road from NW La Center Road to NW 310th Circle
- NE Highland Avenue near E 4th St
- NW Pacific Highway from W 10th Street to W 15th Street

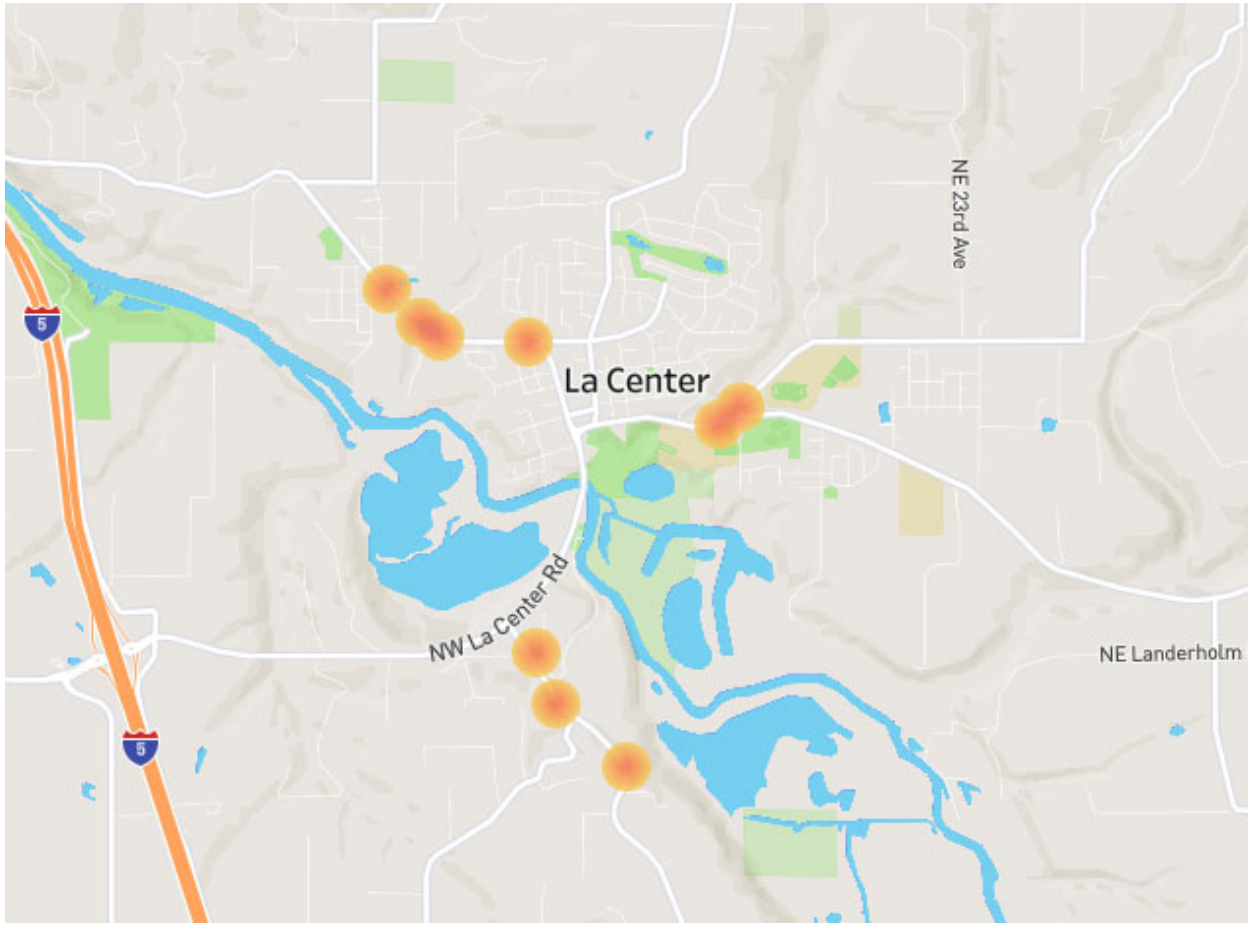


Figure C5. Speeding Related Collisions, La Center, 2018-2022