City of Point Arena

Local Roadway Safety Plan

06/15/2022
Final Report

City of Point Arena

Local Roadway Safety Plan

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Executive Summary

The City of Point Arena's Local Roadway Safety Plan (LRSP) is a comprehensive plan that creates a framework to systematically identify and analyze traffic safety related issues and recommend projects and countermeasures. The LRSP aims to reduce fatal and severe injury collisions through a prioritized list of improvements that can enhance safety on local roadways.

The LRSP takes a proactive approach to addressing safety needs. It is viewed as a guidance document that can be a source of information and ideas. It can also be a living document, one that is routinely reviewed and updated by City staff and their safety partners to reflect evolving collision trends and community needs and priorities. With the LRSP as a guide, the City will be able to ready to apply for grant funds, such as the federal Highway Safety Improvement Program (HSIP).

Chapter 1 – Introduction

The Introduction presents the project, describes how this report is organized, summaries the vision and goals, the study area for the LRSP, details how the report is organized and introduces the safety partners.

Chapter 2 – Existing Planning Efforts

This chapter summarizes existing City and regional planning documents and projects that are relevant to the LRSP. It ensures that the recommendations of the LRSP are in line with existing goals, objectives, policies, or projects. This chapter summarized the following documents: City of Point Arena General Plan/Local Coastal Plan (1995), Madera County Active Transportation Plan (2018), Downtown Design Guidelines (2017), Point Arena Community Action Plan (2010), City of Point Arena FY 2020-2021 Budget (2020), Capital Improvement Program 2021-2025, Mendocino County Safe Routes to School Plan (2014) and Mendocino County Regional Active Transportation Plan (2017).

Chapter 3 – Collision Data Collection and Analysis

Collision data was obtained and analyzed for a five-year period from 2015 to 2019 from the California Highway Patrol's Statewide Integrated Traffic Records System (SWITRS) and the University of California at Berkeley SafeTREC's Transportation Injury Mapping Service (TIMS).

The collision analysis identified general trends of collisions in the City of Point Arena. There were a total of 10 collisions reported City-wide from 2015 to 2019. Out of these six collisions (60 percent) were property damage only (PDO) collisions, one collisions (10 percent) led to complaint of pain injury and two collisions (20 percent) led to a visible injury. There was one F+SI (fatal and severe injury) collision, one collisions (10 percent) led to a severe injury and zero collisions led to a fatality. For collisions including collisions of all severity, 70 percent of all collisions (seven collisions) occurred at intersections whereas 30 percent (30 collisions) occurred on roadway segments. One of the top priorities of the LRSP will be to address intersection safety at all intersections where collisions have historically occurred.

For all collisions, collisions were observed to occur at the edges of city limits (three of the four injury collisions), including along Highway 1 and Riverside Drive. This suggests that placing traffic calming gateways at the edges of town may be effective at reducing traffic collisions. A gateway is a geometric or physical landmark that indicates a change in environment from major road to a lower speed residential or commercial district. It sends a clear message to motorists that they have reached a specific place and must reduce speeds. Gateways may be a combination of street narrowing, medians, signs, arches over the roadway, roundabouts, or other identifiable feature. Strong visual effects are essential to gateway feature's effect on traffic collision reduction.

For all collisions, 70 percent of collisions occurred during the nighttime, including the only fatal or severe injury collision. Nighttime collisions have been observed at the intersection of Port Road and Bluff Top Road and along the corridor Highway 1/Main Street. This may indicate that lighting at these locations should be evaluated to insure lumen levels are adequate. Many different factors can contribute to nighttime collisions, such as low lighting levels that can be targeted with countermeasure, but extraneous factors can also contribute to nighttime injury such as alcohol use, sleep and fatigue. Improvements such as installing new lighting, upgrading existing lighting to a higher lumen, installing larger signal heads, installing and upgrade signs with new fluorescent sheeting and installing pedestrian improvements with lighting elements such as RRFBs (rectangular rapid flashing beacons) and HAWKs can help make these locations safer for all road users.

For all collisions, 40 percent of collisions were hit object collisions, most of these occurred at intersections. This calls for evaluating hit object collisions along the high injury network and throughout the City with similar characteristics. Hit object collisions can be mitigated by installing reflective signs, object markers, and keeping sightlines clear at intersections.

While the above analysis is based on a small amount of collisions, ten total collisions and four injury collisions, it should be noted that some of the trends identified in the City of Point Arena are similar to trends identified in Mendocino Unincorporated County as a whole, including hit object collisions which account for 53 percent of F+SI collisions in Unincorporated Mendocino County, and DUI collisions, which account for 36 percent of F+SI collisions in Unincorporated Mendocino County.

Chapter 4 - Emphasis Areas

Emphasis areas are a focus of the LRSP that are identified through the various collision types and factors resulting in fatal and severe injury collisions within the City of Point Arena. The five emphasis areas for Point Arena are:

- Nighttime Collisions
- Collisions close to the City Boundary
- Hit Object Collisions
- Unsafe Speed Collisions
- Young Adult (Party at Fault) Collisions

Chapter 5 – Countermeasure Identification

Engineering countermeasures were selected for each of the high-risk locations and for the emphasis areas. These were based off of approved countermeasures from the Caltrans Local Roadway Safety Manual (LRSM) used in HSIP grant calls for projects. The intention is to give the City potential countermeasures for each location that can be implemented either in future HSIP calls for projects, or using other funding sources, such as the City's Capital Improvement Program. Non-engineering countermeasures were also selected using the 4 E's strategies, and are included with the emphasis areas.

Chapter 6 – Safety Projects

A set of five safety projects were identified for high-risk intersections and roadway segments, using HSIP approved countermeasures. A benefit cost ratio analysis was conducted for each of these projects. These safety projects are:

- Project 1: Systemic Improvements at Unsignalized Intersections
- Project 2: Improvements at Unsignalized Intersections
- Project 3: Systemic Roadway Segment Improvements
- Project 4: Pedestrian and Other Roadway Segment Improvements
- Project 5: Pedestrian Set Aside

Chapter 7 – Evaluation and Implementation

The LRSP is a guidance document that is recommended to be updated every two to five years in coordination with the safety partners. The LRSP document provides engineering, education, enforcement, and emergency medical service related countermeasures that can be implemented throughout the City to reduce fatal and severe injury collisions. After implementing countermeasures, the performance measures for each emphasis area should be evaluated annually. The most important measure of success of the LRSP should be reducing fatal and severe injury collisions throughout the City. If the number of fatal and severe injury collisions does not decrease over time, then the emphasis areas and countermeasures should be re-evaluate.

1. Introduction

What is a LRSP?

The LRSP is a localized data-driven traffic safety plan that provides opportunities to address unique highway safety needs and reduce the number of fatal and severe injury collisions. The LRSP creates a framework to systematically identify and analyze traffic safety-related issues, and recommend safety projects and countermeasures. The LRSP facilitates the development of local agency partnerships and collaboration, resulting in the development of a prioritized list of improvements that can qualify for HSIP funding.

The LRSP is a proactive approach to addressing safety needs and is viewed as a living document that can be constantly reviewed and revised to reflect evolving trends, and community needs and priorities.

Vision and Goals of the LRSP

- Goal #1: Systematically identify and analyze roadway safety problems and recommend improvements
- Goal #2: Improve the safety of all road users by using proven effective countermeasures
- Goal #3: Ensure coordination and response of key stakeholders to implement roadway safety improvements within Point Arena
- Goal #4: Serve as a resource for staff who continually seek funding for safety improvements
- Goal #5: Recommend how safety improvements can be made in a manner that is fair and equitable for all Point Arena residents

Study Area

The City of Point Arena is located in Mendocino County, California, covering a total area of about 1.36 square miles. It is located 32 miles west of Hopland, at an elevation of 118 feet.

The City's estimated population is 421 (ACS 2019 1-year estimate). State Route 1 is the major highway that connect the City of Point Arena to Fort Bragg to the North and also serves as the Main Street in the City. Figure 1 shows the study area.

Figure 1 City of Point Arena

Safety Partners

Safety partners are vital to the development and implementation of an LRSP. For the City of Point Arena, these include representatives from the City's Public Works and Parks, Redwood Coast Fire Protection District, Point Arena Schools, Mendocino County Sheriff and Caltrans District 1. Two stakeholder meetings among these departments/agencies were conducted to review project goals and findings, and to solicit feedback from the group during the project timelines.

This stakeholder outreach was supplemented by a project website (mendocinosaferoads.com), with an interactive map input platform. Project related info was also published on the City's website. As part of the Mendocino County Local Road Safety Plan, a public input platform called mapptionaire was published online and advertised on social media to solicit input public comments regarding traffic safety. The mapptionaire tool was open for public comments starting March 5th, 2021 and closed on September 31, 2021. During this period 324 comments were submitted, out of which 13 comments were for the City of Point Arena.

The most common commented on traffic safety issue was pedestrian safety, with a total 6 comments. Three comments regarded School Street/Main Street/Route 1 and the other three comments were on Port Road. One comment requested a rectangular rapid flashing beacon at the intersection of Lake Street and School Street. One comment requested a marked crosswalk across Main Street at the Post Office. Sight lines and blind corners were the second most common issue, with two comments, one comment of the intersection of Iverson Avenue and Main Street and the other on Port Road and Main Street. The next most common commented on traffic safety issue was speeding and bicycle safety at Port Road and Main Street/Route 1. Other responses were collected through website, email correspondence, and social media comments.

Table 1. Point Arena: Public Comments

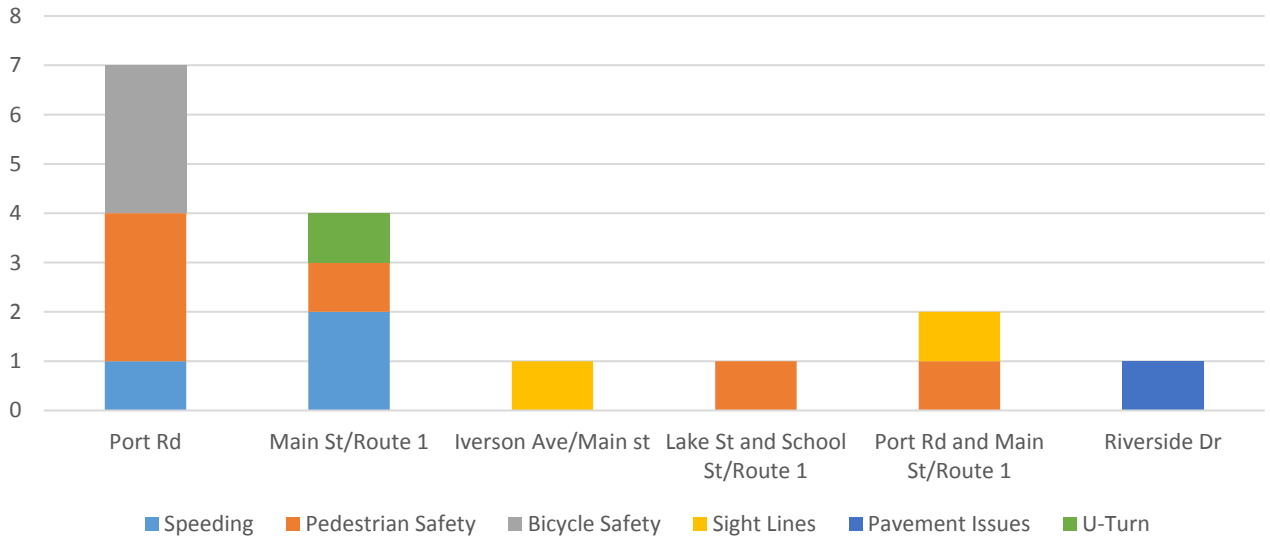


Figure 2. City's Website Posting

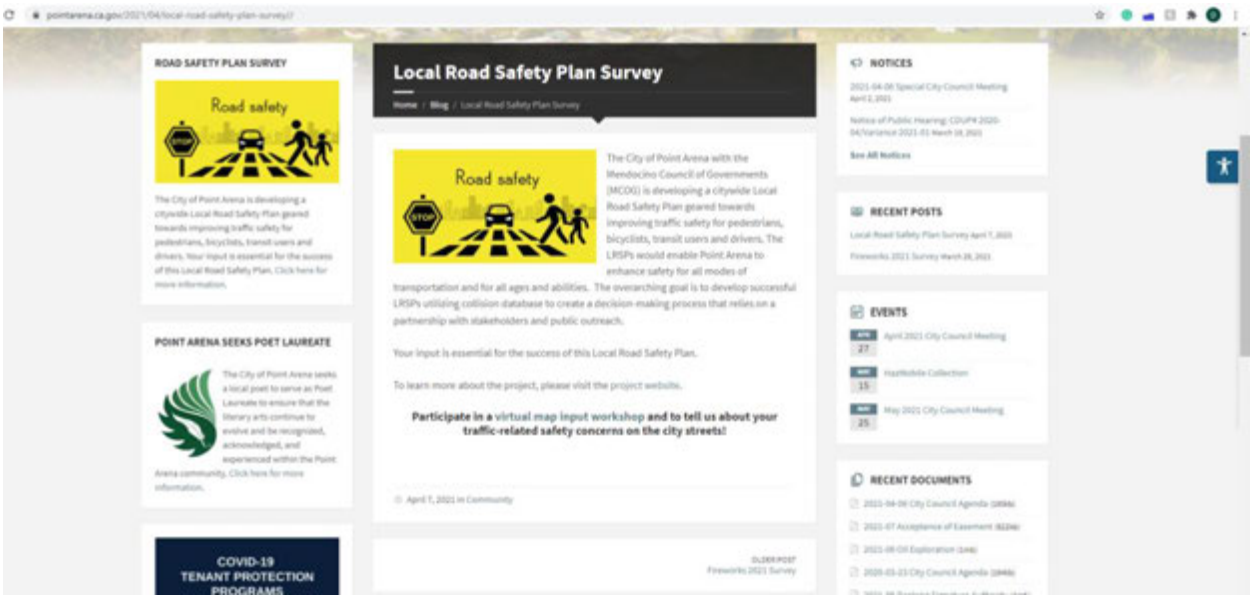
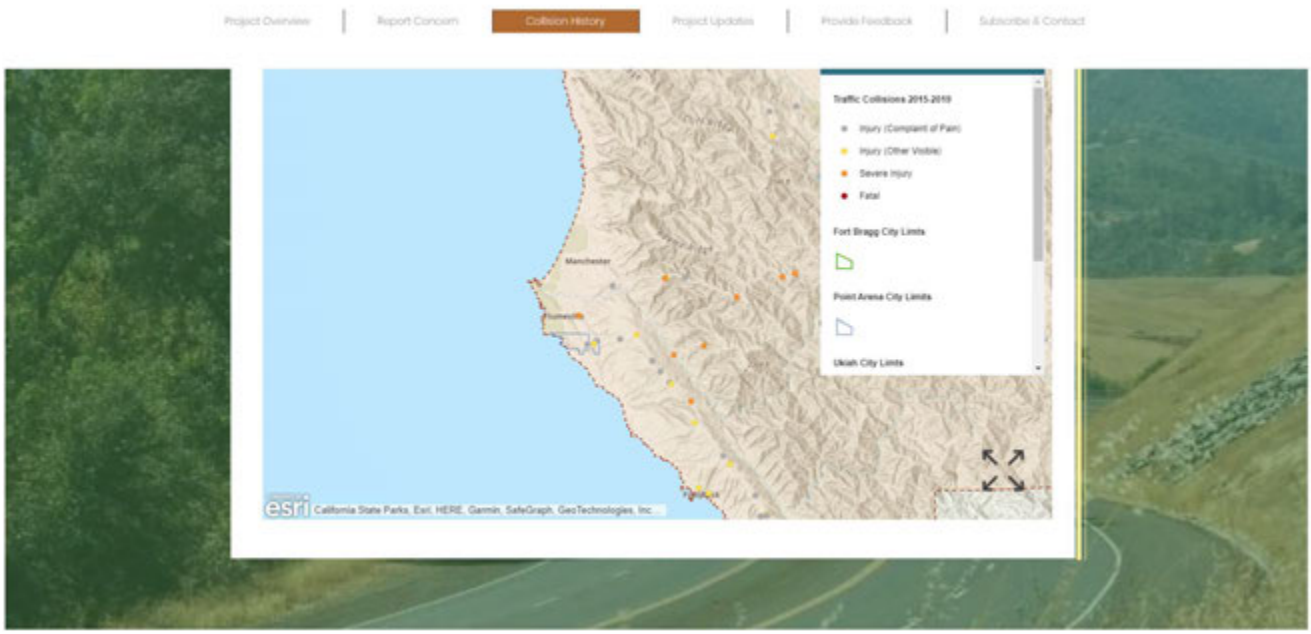


Figure 3. Project Website: mendocinosaferoads.com



2. Existing Planning Efforts

This chapter summarizes the planning documents, projects underway, and studies reviewed for the City of Point Arena's LRSP, being developed as a part of Mendocino Council of Governments LRSP's for Local Agencies. The purpose of this in-depth review is to ensure that the LRSP vision, goals, and the subsequent traffic safety strategies developed are aligned with prior planning efforts, planned transportation projects and non-infrastructure programs. This review includes both City and County level planning documents. The documents reviewed are listed below:

- City of Point Arena General Plan/Local Coastal Plan (1995)
- Point Arena Community Action Plan (2010)
- City of Point Arena FY 2020-2021 Budget (2020)
- Capital Improvement Program 2021-2025, City of Point Arena Streets and Roads
- Mendocino County Safe Routes to School Plan (2014)
- Mendocino County Regional Active Transportation Plan (2017)

The following section includes a brief descriptions of these documents and how they inform the development of the LRSP. A document description summary is provided in Table 2. A list of relevant goals, projects, and policies from each document is summarized in **Appendix A**.

Table 2. Document Review Summary

Document	Highlights
City of Point Arena General Plan/Local Coastal Plan (1995)	Traffic and circulation element of the General Plan details goals, policies and programs for the City's traffic, parking, street network, non-motorized transportation and public transportation infrastructure facilities.
Point Arena Community Action Plan (2010)	A community vision was developed, traffic circulation was analyzed, sustainable development scenarios were mapped, improvement strategies and funding sources were identified, and other issues were addressed
City of Point Arena FY 2020-2021 Budget (2020)	Report on the City of Point Arena budget for FY 2020-2021
Capital Improvement Program 2021-2025, City of Point Arena Streets and Roads	Lists the Streets and Roads improvement projects for the fiscal year of 2021-2025
Mendocino County Safe Routes to School Plan (2014)	Safe Routes to School (SRTS) is a program with a simple goal: helping more children get to school by walking and bicycling.

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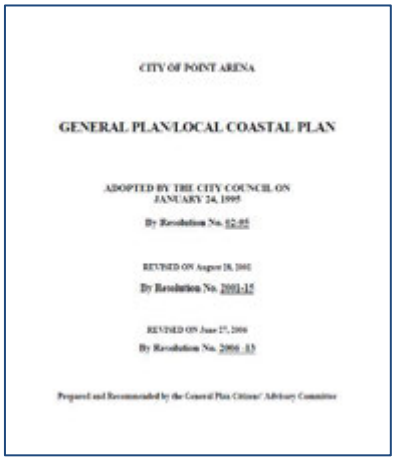
Document	Highlights
Mendocino County Regional Active Transportation Plan (2017)	Details bicycle and pedestrian improvements on County significant corridors. Includes detailed priority bike and pedestrian projects.

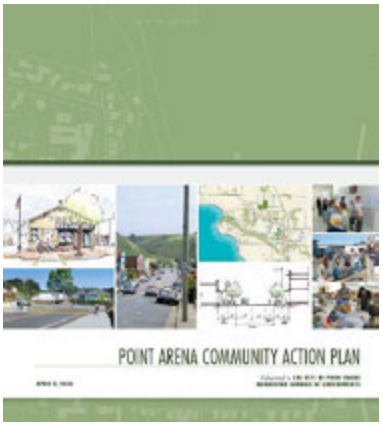
City of Point Arena General Plan/Local Coastal Plan (1995)

The Point Arena General Plan is a comprehensive, integrated, and internally consistent statement of Point Arena's environmental preservation, economic development, land use, public safety, housing, and development goals, policies, and programs. It is intended to address goals and needs for a period of approximately fifty years from the date of adoption. The plan was first adopted by the City Council in 1995 and was most recently amended in 2006. The traffic and circulation element of the General Plan entails topics associated with traffic, transportation, and Point Arena's street and pedestrian systems, and is of most relevance to the development of this roadway safety plan.



Point Arena Community Action Plan (2010)

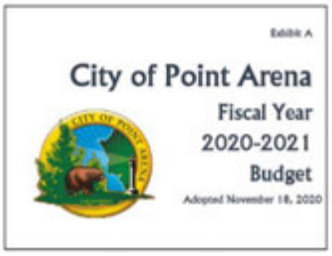
The Community Action Plan for the City of Point Arena identifies recommendations for a wide-range of transportation and circulation improvements, promotes the community character of the City, and helps visualize long-term and sustainable growth consistent with the City's General Plan and the community's vision. The Plan comprises of a Downtown Streetscape Plan, a Circulation and Parking Plan, recommendations for gateway, signage, and traffic calming elements.



The goals of the plan are to maintain and enhance Point Arena's unique character, beautify downtown, reduce speeding along Main Street and alert drivers they are entering a city, improve the Main, Lake Street, school street intersection, improve downtown circulation and parking, create new open space and trails, improve access to existing open space and create new open space and trails and improve access to existing, improve the accessibility and safety of the downtown area, encourage sustainable development and provide more employment opportunities. The plan informs the LRSP of the existing conditions and specific circulation, streetscape and parking improvements that are recommended for future development.

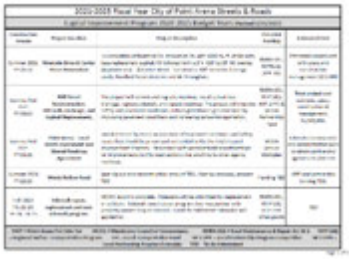
City of Point Arena FY 2020-2021 Budget (2020)

Point Arena's budget for 2020-2021 including the street and road repair budget. A number of streets were repaved and drainage and surface cracking was repaired. A number of sidewalk reconstruction and repair was done including Mill Street. The budget helps inform the LRSP of the budgeted improvements and helps ensure that no improvements are repeatedly recommended as a part of this plan.

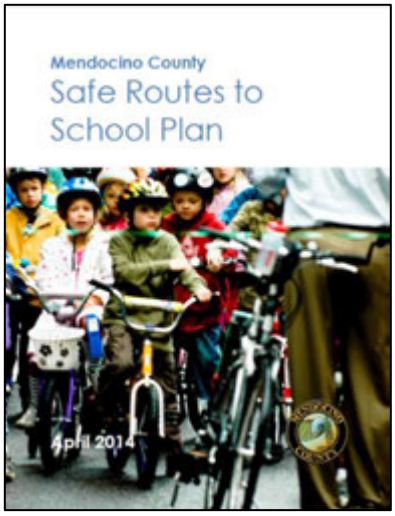


Capital Improvement Program 2021-2025, City of Point Arena Streets and Roads

This document lists the proposed streets and roads projects under the Capital Improvement Program. One of the improvements underway entails sidewalk replacement or addition and that the sidewalk construction program that may partner with property owners might be needed. The list helps inform the LRSP of the planned and funded improvements helping ensure that no improvements are repeatedly recommended as a part of this plan.



Mendocino County Safe Routes to School Plan (2014)



Safe Routes to School (SRTS) is a program with a simple goal: helping more children get to school by walking and bicycling. The plan envision kids using safe streets, helped by engaged adults (from teachers to parents, engineers, planners and police officers), surrounded by responsible drivers. The plan is the first area-wide Safe Routes to School Plan in Mendocino County, designed to serve schools in the unincorporated areas of the county. The plan includes recommendations for a Safe Routes to School program that will strive to enhance children's health and well-being, ease traffic congestion near the school to improve safety, increase the number of students getting regular physical activity, improve air quality around schools and community members' overall quality of life, increase the number of students who walk and/or bike to and from school and provide clear projects and programs for implementation.

Mendocino County Regional Active Transportation Plan (2017)

This Plan identifies priority bicycle and pedestrian improvements within all jurisdictions of Mendocino County, which include the Cities of Ukiah, Willits, Fort Bragg and Point Arena and the unincorporated areas of the County of Mendocino. It lists the existing bikeway in the City of Point Arena, Coastal Access Scenic Bikeway and Iverson/Port Road to Pier. It lists short range priority improvements for pedestrian and bicyclist infrastructure. This list will help inform the LRSP of improvements for pedestrian and bicyclists that have been previously identified.

3. Collision Data Collection and Analysis

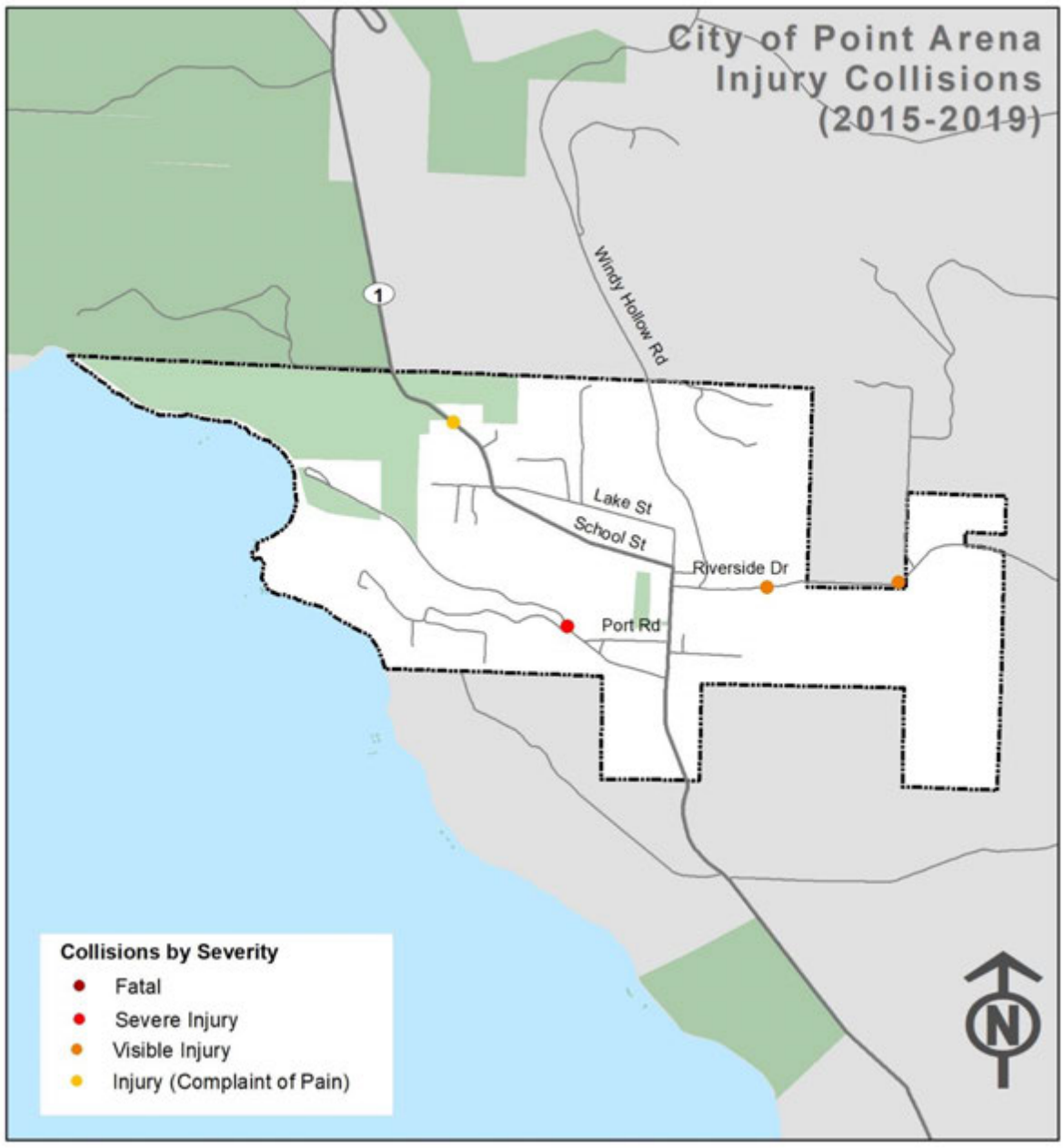
This chapter summarizes the results of a citywide collision analysis for collisions that have occurred in the City of Point Arena between January 2015 and December 2019. A five-year city-wide collision data set was retrieved from TIMS and SWITRS.

The LRSP focuses on systemically identifying and analyzing traffic safety issues to recommend appropriate safety strategies and improvements. This chapter starts with brief demographic analysis, followed by an analysis of citywide collisions of all severity, including PDO collisions, retrieved from TIMS and SWITRS. Following this, a comprehensive evaluation was conducted based on factors such as collision severity, type of collision, primary collision factor, lighting, weather and time of the day. A high-injury network of intersections and roadway segments was also identified. The following is a brief overview of the sections:

1. Demographic and Jurisdiction Characteristics
2. Data Collection
3. Collision Data Analysis
4. High Injury Network
5. Summary

Figure 4 illustrates all the injury collisions that have occurred in Point Arena from January 2015 to December 2019.

Figure 4. All Injury Collisions on City Roadways (2015 – 2019)



Demographic and Jurisdiction Information

Demographic data has been collected from the Census[1] in the City of Point Arena and Mendocino County, a summary of the population, centerline miles of roadway and commute to work characteristics are presented below.

Population

According to the 2015-2019 American Community Service (ACS) 5-year Estimate data, the population of Point Arena is 421, which is 0.5 percent of the county population. The population proportion as well as the centerline miles are shown in **Table 3**.

Table 3. Point Arena and Mendocino Population and Centerline Miles

Jurisdiction	Population	Percent of County Population	Centerline Miles	Percent of County Centerline Miles
Point Arena	421	0.5%	2.3	0.2%
Willits	4,893	5.6%	20.5	1.8%
Fort Bragg	7,302	8.4%	28.1	2.5%
Ukiah	15,943	18.4%	58.9	5.3%
Unincorporated	58,190	67.1%	1,009.9	90.2%
Total	**86,749**		**1,119.7**	

Commute to Work

In the City of Point Arena, approximately 79 percent of residents travel by cars or vans to work, out of which 70 percent drive alone and nine percent carpool. About 10 percent of residents walk to work. The different modes of transportation used to commute to work for the City are shown in Table 4.

[1] United States Census Bureau. (2021). 2015-2019 American Community Service ACS 5-year Estimate https://data.census.gov

Table 4. Mendocino County Commute to Work Census Data

Commute to Work	Point Arena
Drive alone	70%
Carpool	9%
Public Transportation	0%
Walked	10%
Bicycle	0%
Work from Home	10%
Other	0%

Office of Traffic Safety (OTS) Rankings

Additional information on collisions in the City of Point Arena is provided by the California OTS. OTS is designated by the Governor to receive federal traffic safety funds for coordinating California's highway safety programs. OTS rankings from 2018, the latest available year, indicate that the City of Point Arena ranks in the top, meaning higher collisions rates in total collisions (nine out of 32 similarly sized cities), alcohol involved collisions (four out of 32 similarly sized cities) and nighttime collisions (four out of 32 similarly sized cities). These rankings take into account fatal and injury crashes per population and per VMT. As a result of Point Arena's small population, small amounts of collisions translates to high rankings, because these rankings are produced from a small sample size the results may not be statistically significant. **Table** 5 provides a summary of the 2018 rankings[2].

Table 5. Office of Traffic Safety Ratings 2018

OTS 2018 Ranking	Point Arena
Total Fatality and Injury	9/32
Alcohol Involved	4/32
Pedestrian	8/32
Bicycle	6/32
Speed Related	11/32
Nighttime	4/32

[2] California Office of Traffic Safety. (2018). Office of Traffic Safety Rankings 2018. https://www.ots.ca.gov/media-and-research/crash-rankings-results/?wpv-wpcf-year=2018&wpv-wpcf-city_county=Point+Arena&wpv_filter_submit=Submit#

Data Collection

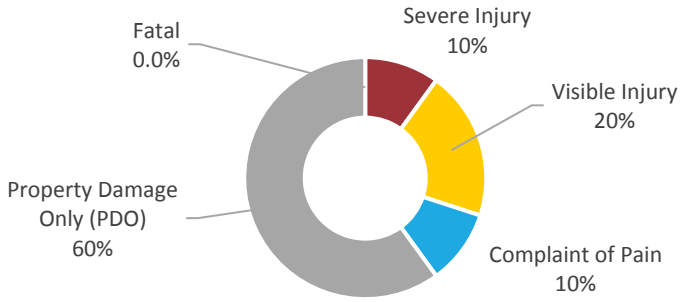
Collision data helps understand different factors that might be influencing collision patterns and various factors leading to collisions in a given area. For the purpose of this analysis, a five-year jurisdiction-wide collision data, from 2015 to 2019 was retrieved from TIMS[3] and SWITRS[4]. State route roadways were included in this analysis. The collision data was analyzed and plotted in ArcMap to identify high-risk intersections and roadways segments.

Collision Data Analysis

Collision Severity

There were a total of 10 collisions reported City-wide from 2015 to 2019. Out of these six collisions (60 percent) were PDO collisions, one collisions (10 percent) led to complaint of pain injury and two collisions (20 percent) led to a visible injury. There was one F+SI (fatal and severe injury) collision, one collisions (10 percent) led to a severe injury and zero collisions led to a fatality. **Figure 5** illustrates the classification of all collisions based on severity.

Figure 5. Collisions by Severity (2015-2019)



[3] UC Berkeley Safe TREC. (2021). Transportation Injury Mapping System https://tims.berkeley.edu/

[4] California Highway Patrol. (2021). Statewide Integrated Traffic Records System. https://www.chp.ca.gov/programs-services/services-information/switrs-internet-statewide-integrated-traffic-records-system

The analysis first includes a comparative evaluation between all collisions and F+SI collisions, based on various factors including but on limited to the collision trend, primary collision factor, collision type, facility type, motor vehicle involved with, weather, lighting, and time of the day. The collision data was segregated by facility type, i.e. based on collisions occurring on intersections and roadway segments. For the purposes of the analysis, a collision was said to have occurred at an intersection if it occurred within 250 feet of it. The reported collisions categorized by facility type and collision severity are presented in **Table 6**.

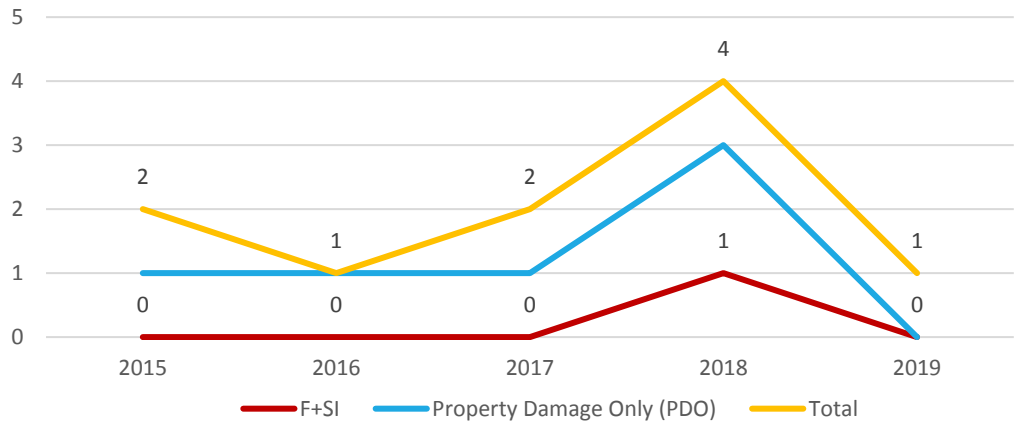
Table 6. Collisions by Severity and Facility Type

Collision Severity	Roadway Segment	Intersection	Total
Fatal	0	0	0
Severe Injury	0	1	1
Visible Injury	2	0	2
Complaint of Pain	1	0	1
Property Damage Only (PDO)	0	6	6
Total	**3**	**7**	**10**

Collision Severity by Year

For all collisions, the number increased from 2015 to 2018. The highest number of collisions (four collisions) were observed in 2018 and the lowest number of collisions (one) were observed in 2016 and 2019. A total of one F+SI collisions occurred in the City of Point Arena during the study period in 2018. **Figure 6** illustrates the five-year collision trend for all collisions, F+SI collisions and also PDO collisions.

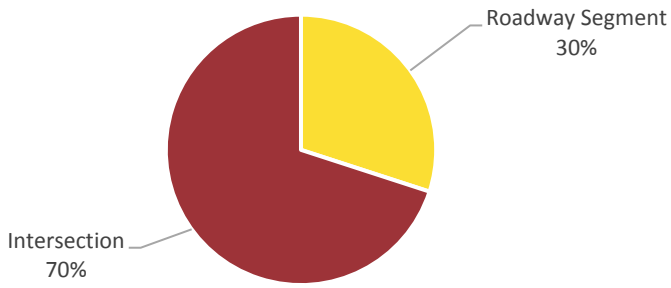
Figure 6. Five Year Collision Trend



Intersection vs. Roadway Collisions

When evaluating roadways vs intersections, it was observed that the majority of collisions occurred at intersections. In the City of Point Arena, 70 percent of all collisions (seven collisions) occurred at intersections whereas 30 percent (three collisions) occurred on roadway segments. This classification by facility type can be observed in **Figure 7**.

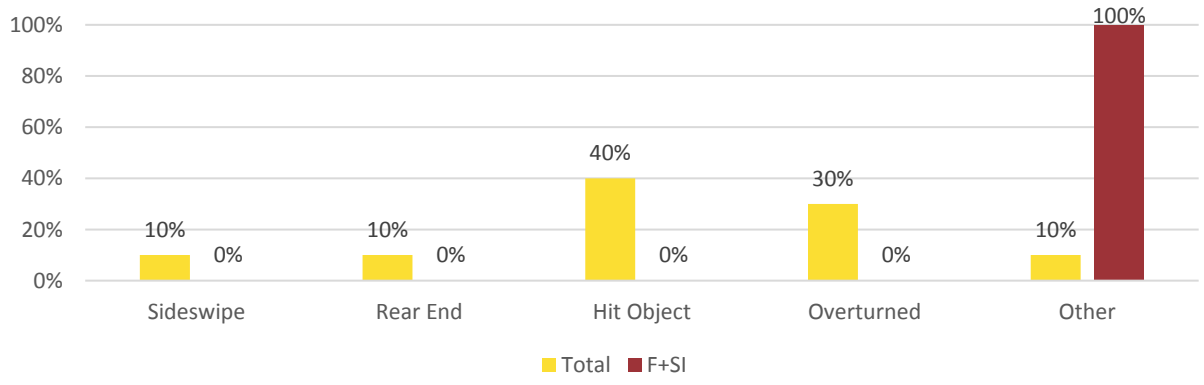
Figure 7. Intersection vs. Roadway Collisions - All Collisions



Collision Type

Considering all collision the most commonly occurring collision type was hit object collisions (40 percent) and overturned collisions (30 percent). The only F+SI collisions as type other. **Figure 8** illustrates the collision type for all collisions as well as F+SI collisions.

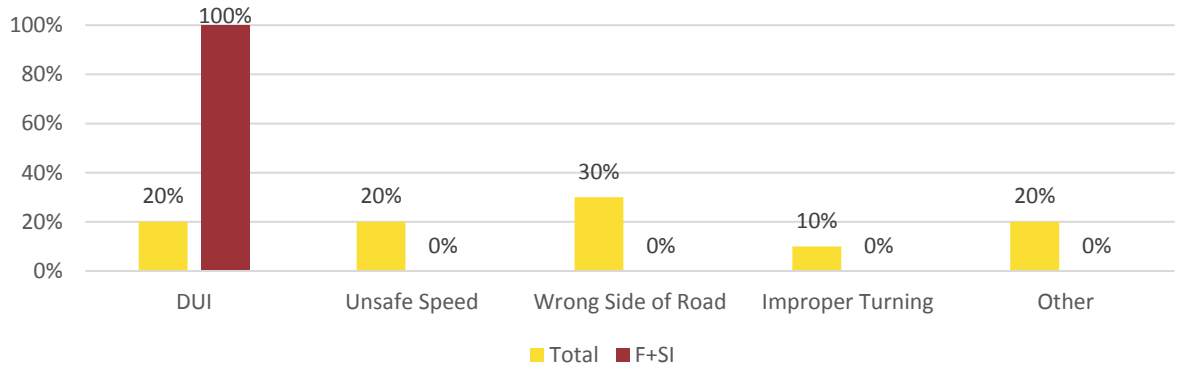
Figure 8. Collision Type – All Collisions vs. F+SI Collisions



Violation Category

Considering all collisions, the most common violation category was observed to be wrong side of road (30 percent), driving under the influence (20 percent) and unsafe speed (20 percent). The only F+SI collisions was a driving under the influence collision. **Figure 9** illustrates the violation category for all collisions and F+SI collisions.

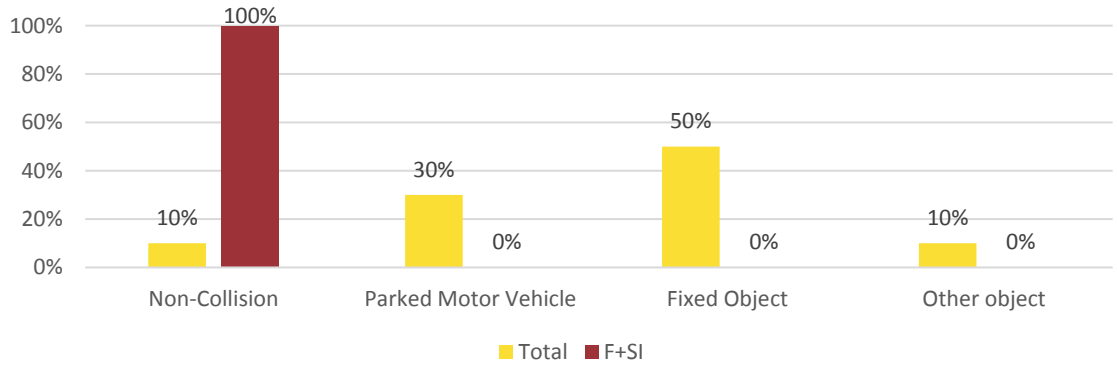
Figure 9. Violation Category: All Collisions vs. F+SI Collisions



Motor Vehicle Involved With

Considering all collisions, 50 percent of the collisions are motor vehicle involved with fixed objects and 30 percent were motor vehicle involved with parked vehicles. The only F+SI collisions was categorized as a non-collision. **Figure 10** illustrates the percentage for all collisions as well as F+SI collisions.

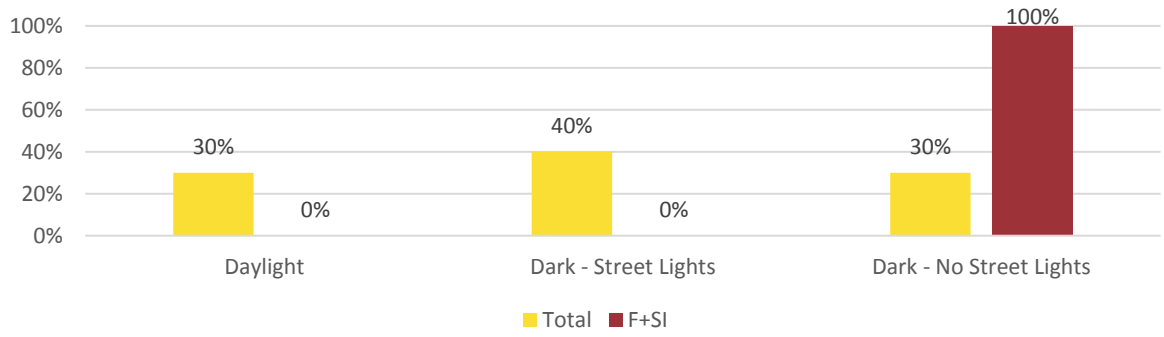
Figure 10. Motor Vehicle Involved With: All Collisions vs. F+SI Collisions



Lighting

For collisions of all severity, 70 percent of collisions have occurred in dark, including 30 percent that occurred on streets with no streetlights. The only F+SI collision occurred in the dark with no streetlights. **Figure 11** illustrates the lighting condition for all collisions and F+SI collisions.

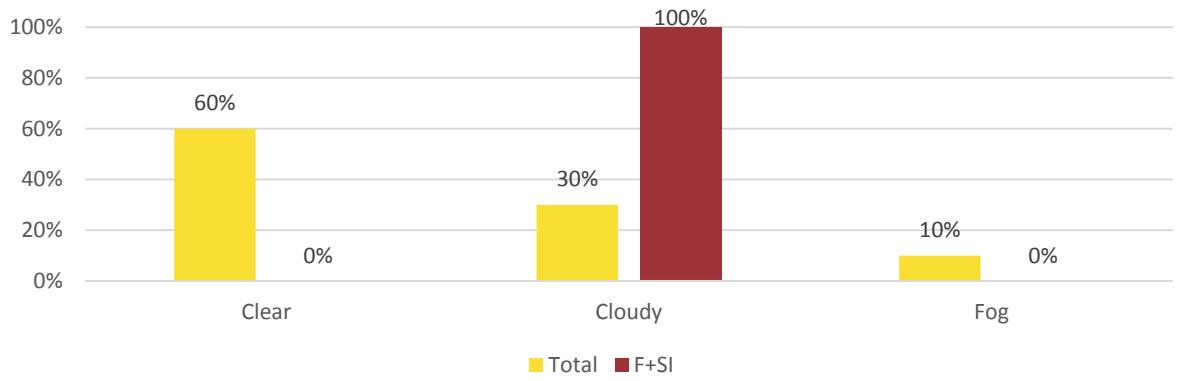
Figure 11. Lighting Conditions: All Collisions vs. F+SI Collisions



Weather

For collisions of all severity, 60 percent of the collisions have occurred during clear weather conditions, 30 percent collisions have observed to occur during cloudy weather conditions and 10 percent occurred during foggy conditions. The only F+SI collision occurred during cloudy weather conditions. **Figure 12** illustrates the percentage distribution of weather conditions during occurrence of collisions of all severity as well as F+SI collisions.

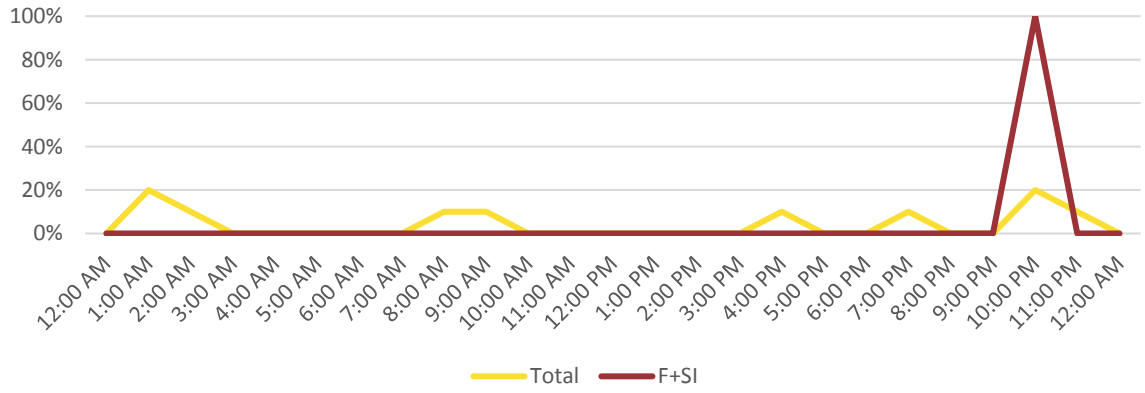
Figure 12. Weather Conditions: All Collisions vs. F+SI Collisions



Time of the Day

For collisions of all severity, the maximum number of collisions have occurred between 10:00 PM to 11:00 PM (20 percent) and 1:00 AM to 2:00 AM. The only F+SI collision occurred between 10:00 PM and11:00 PM. **Figure 13** illustrates the percentage of collisions occurring during the day for all collisions as well as F+SI collisions.

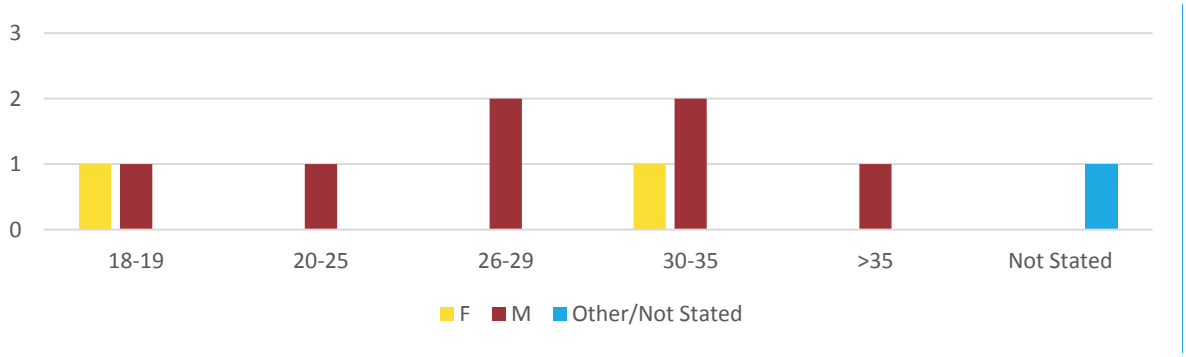
Figure 13. Time of the Day: All Collisions vs. F+SI Collisions



Gender vs. Age

For all collisions, the sex of the party at fault was much more likely to be male than female (70 percent of F+SI collisions vs 20 percent). The party at fault for collisions are also more likely to be younger, with the majority age 35 or lower (80 percent. The only F+SI collision. **Figure 14** illustrates the sex and age of the party at fault for all collisions.

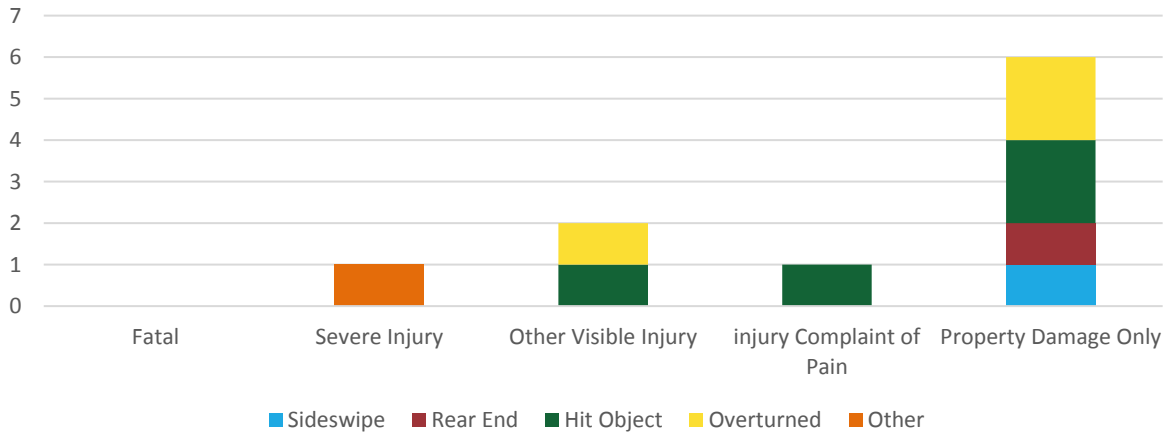
Figure 14. All Collisions: Age vs Sex



Collision Type and Severity

For all collisions, the most common collision types were hit object collisions and overturned collisions. **Figure 15** below shows the severity of collisions as well as the collision types.

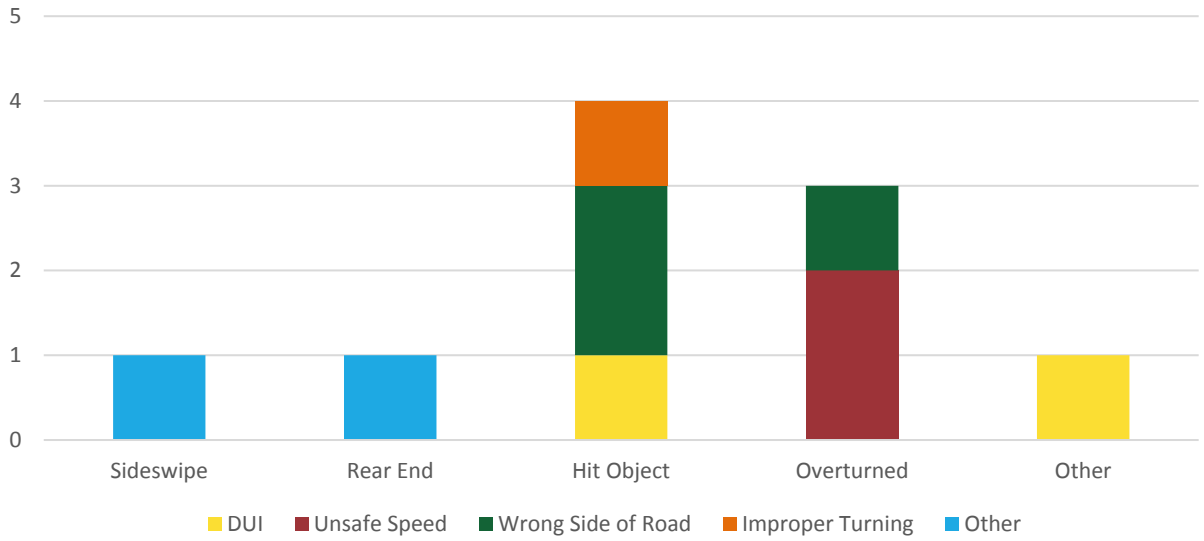
Figure 15. All Collisions: Collision Type vs Severity (2015-2019)



Collision Type and Violation Category

For all collisions, the most common violation type was hit object and overturned collisions. Hit object collisions were caused by DUI, improper turning, and wrong side of road driving, while overturned collisions resulted from unsafe speed and wrong side of road driving. **Figure 16** illustrates the type of collision as well as the violation category for all collision severities.

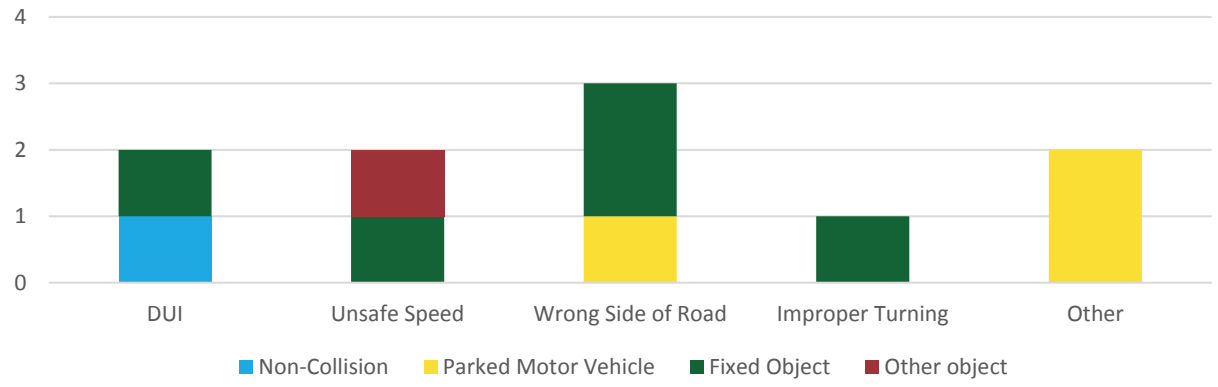
Figure 16. All Collisions: Collision Type vs Violation Category (2015-2019)



Motor Vehicle Involved with and Violation Category

For all collisions, the violation category of collisions that led to the highest amount of collisions was DUI collisions and unsafe speed collisions. The results, with violation category and motor vehicle involved with, are shown in **Figure 17.**

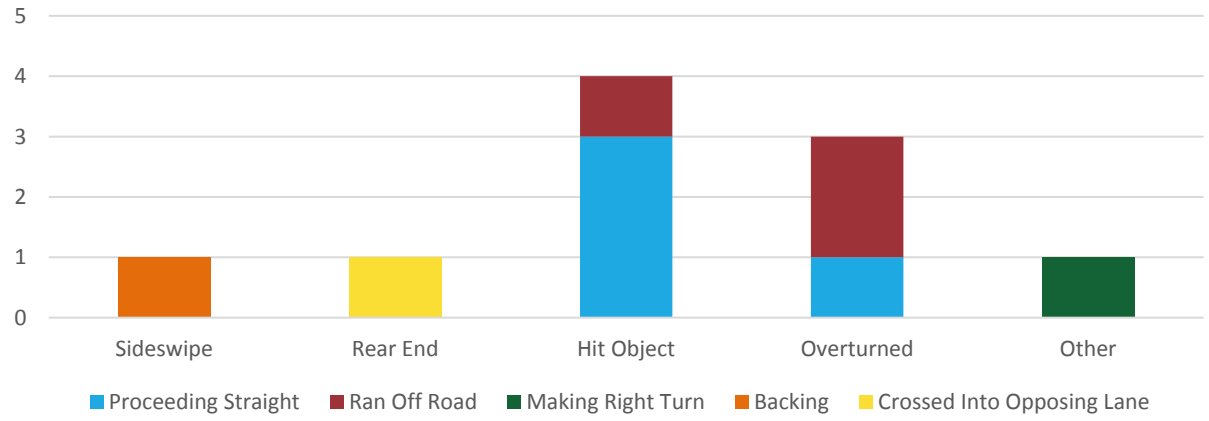
Figure 17. All Collisions: Motor Vehicle Involved with vs Violation Category



Collision Type vs. Movement Preceding Collision of Party at Fault

For all collisions, the most common collision type was hit object collisions. The most common movement of the party at fault proceeding hit object collisions is proceeding straight or ran off road. **Figure 18** illustrates the type of collisions as well as the movement of the party at fault preceding the collision for all collision severities.

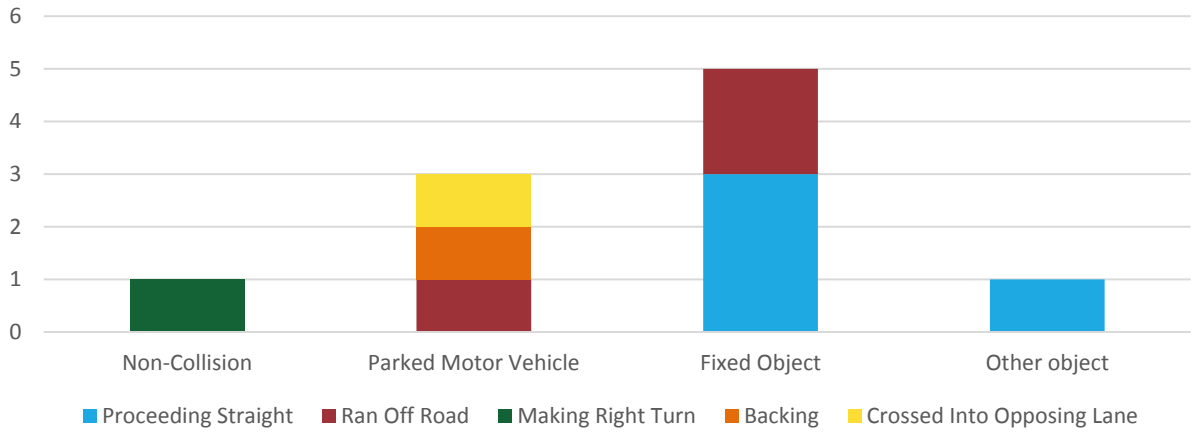
Figure 18. All Collisions: Collision Type vs. Movement Preceding Collisions of Party at Fault



Motor Vehicle Involved with vs. Movement Preceding Collision

For all collisions, 50 percent of the collisions are with fixed object and 100 percent of these collisions the party at fault was proceeding straight or ran off road. **Figure 19** illustrates the movement of the party at fault preceding the collision along with the type of object the motor vehicle was involved with for all collisions.

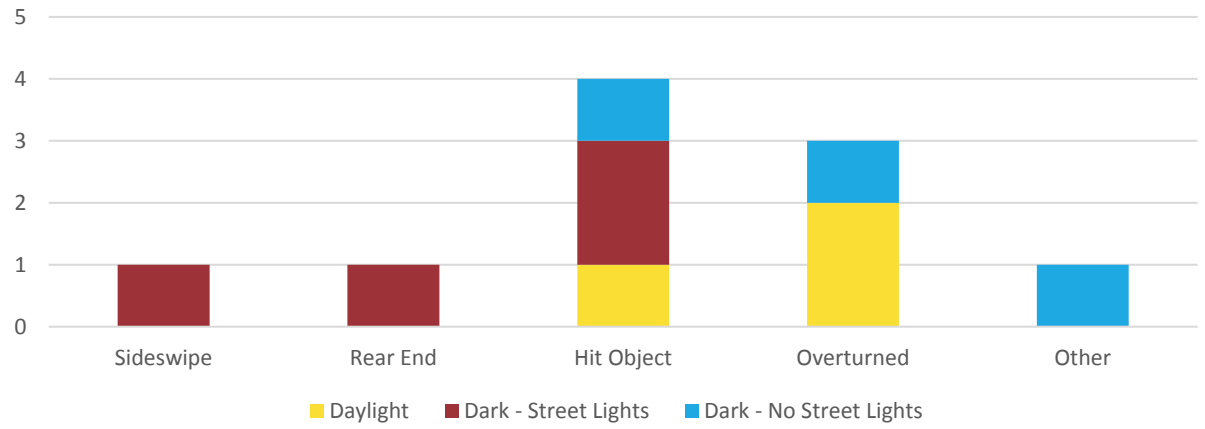
Figure 19. All Collisions: Motor Vehicle Involved With vs. Movement Preceding Collisions



Collision Type and Lighting Conditions

For all F+SI collisions, most collisions occurred in the daylight at an intersection. Hit-object collisions were the highest number of collisions that occurred in the dark. **Figure 20** illustrates the lighting condition and the collision type as observed for all collisions.

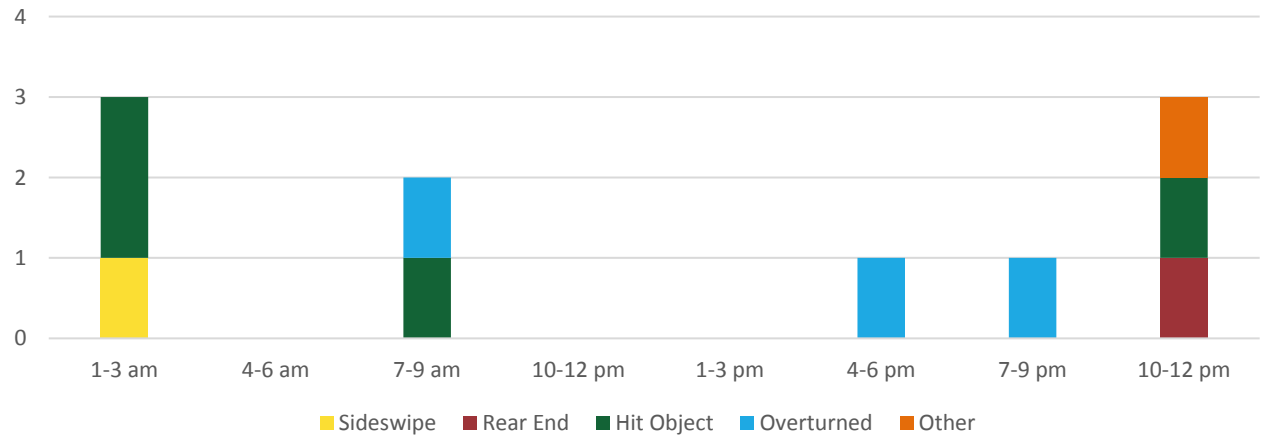
Figure 20. F+SI Collisions: Collision Type vs Lighting Conditions



Collision Type and Time of the Day

For all collisions types, the most common collision type was hit object and overturned. Hit object collisions have been observed to occur after 10:00 PM and before 3:00 AM. **Figure 21** illustrates the collision type by the time of the day for all collisions.

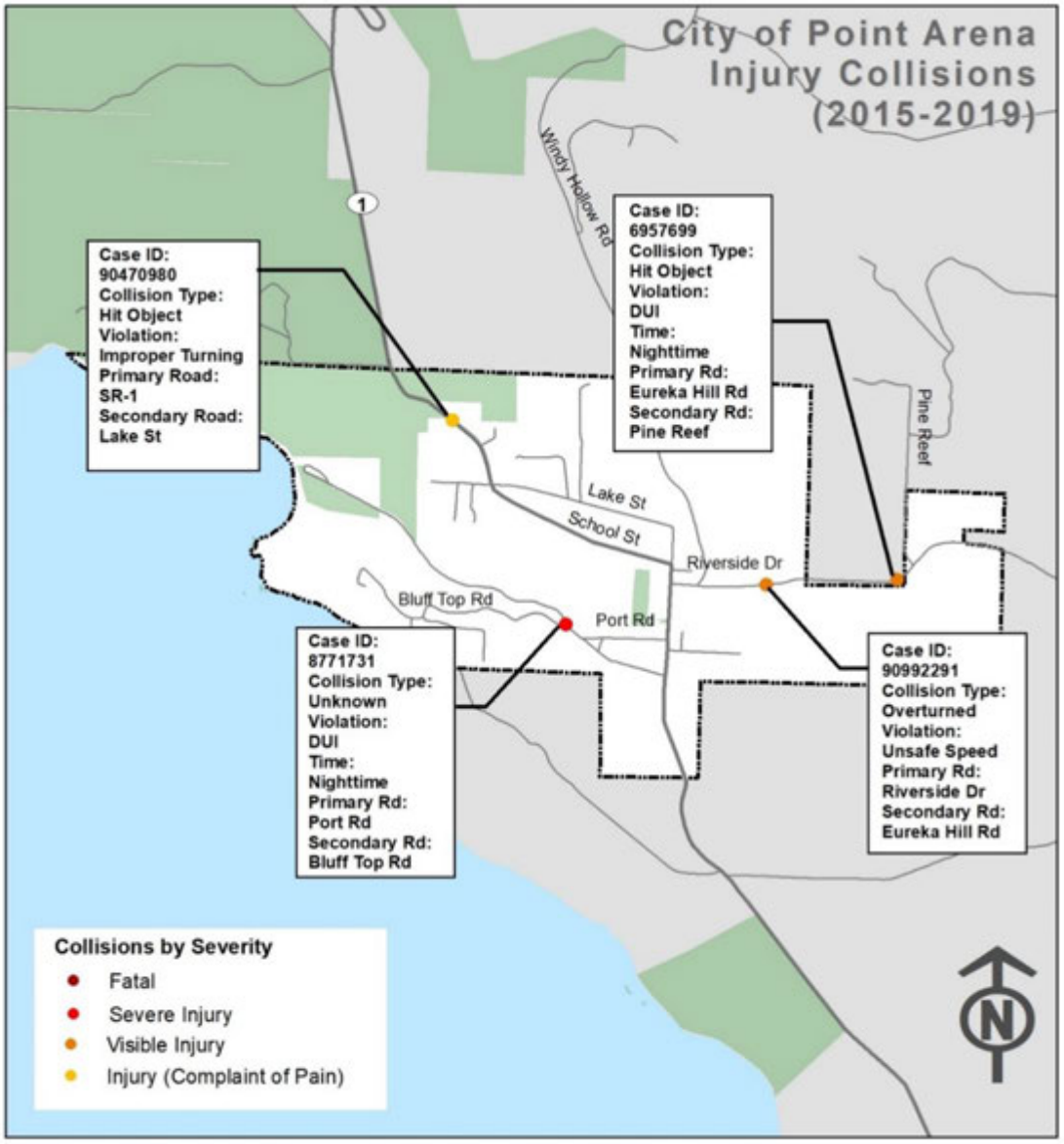
Figure 21. All Collisions: Collisions Type vs Time of the Day



Collision Locations and Trends

The above collision analysis was used to identify three main collision factors that highlight the top trends among collisions in Point Arena. These three collision factors were identified to be hit object collisions, DUI collisions, and nighttime collisions. **Figure 22** shows the location, collision type, violation type and severity for injury collisions in Point Arena.

Figure 22. Injury Collisions by Type and Violation Category



Collision Severity Weight

A collision severity weight was used to identify the high severity collision network, using the Equivalent Property Damage Only (EPDO) method. The EPDO method accounts for both the severity and frequency of collisions by converting each collision to an equivalent number of PDO collisions. The EPDO method assigns a crash cost and score to each collision according to the severity of the crash weighted by the comprehensive crash cost. These EPDO scores are calculated using a simplified version of the comprehensive crash costs per HSIP Cycle 10 application. The weights used in the analysis are shown below in **Table 7**.

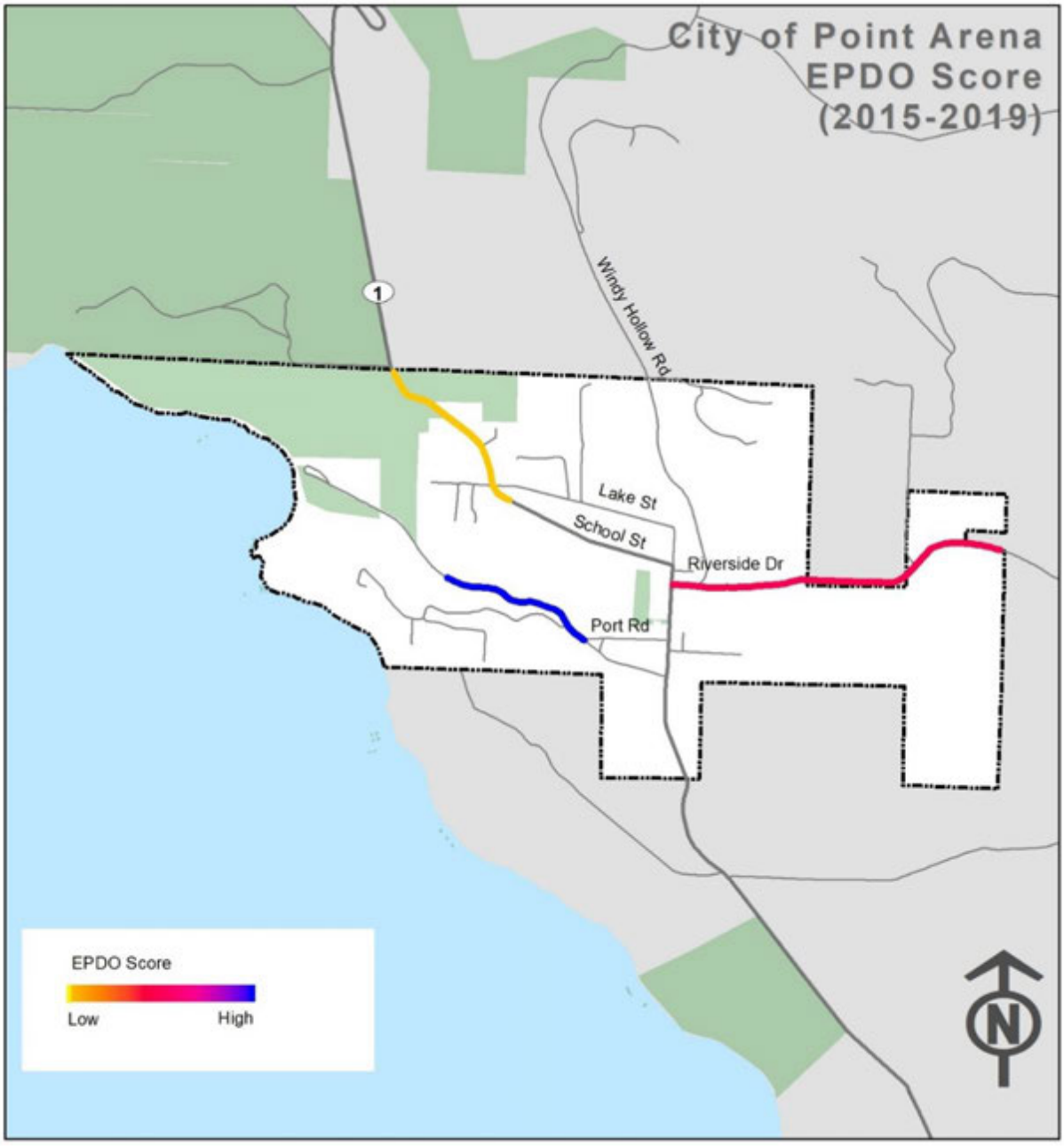
Table 7. EPDO Score used in HSIP Cycle 10

Collision Severity	EPDO Score
Fatal and Severe Injury Combined	165*
Visible Injury	11
Possible Injury	6
PDO	1

*This is the score used in HSIP Cycle 10 for collisions on roadways segments, to simplify the analysis this study uses the same score for all F+SI collisions regardless of location

The EPDO scores for all collisions can then be aggregated in a variety of ways to identify collision patterns, such as location hot-spots. The weighted collisions for the City of Point Arena were geolocated onto Point Arena's road network. **Figure 23** shows the location and geographic concentration of collisions by their EPDO score.

Figure 23. Point Arena EPDO Score



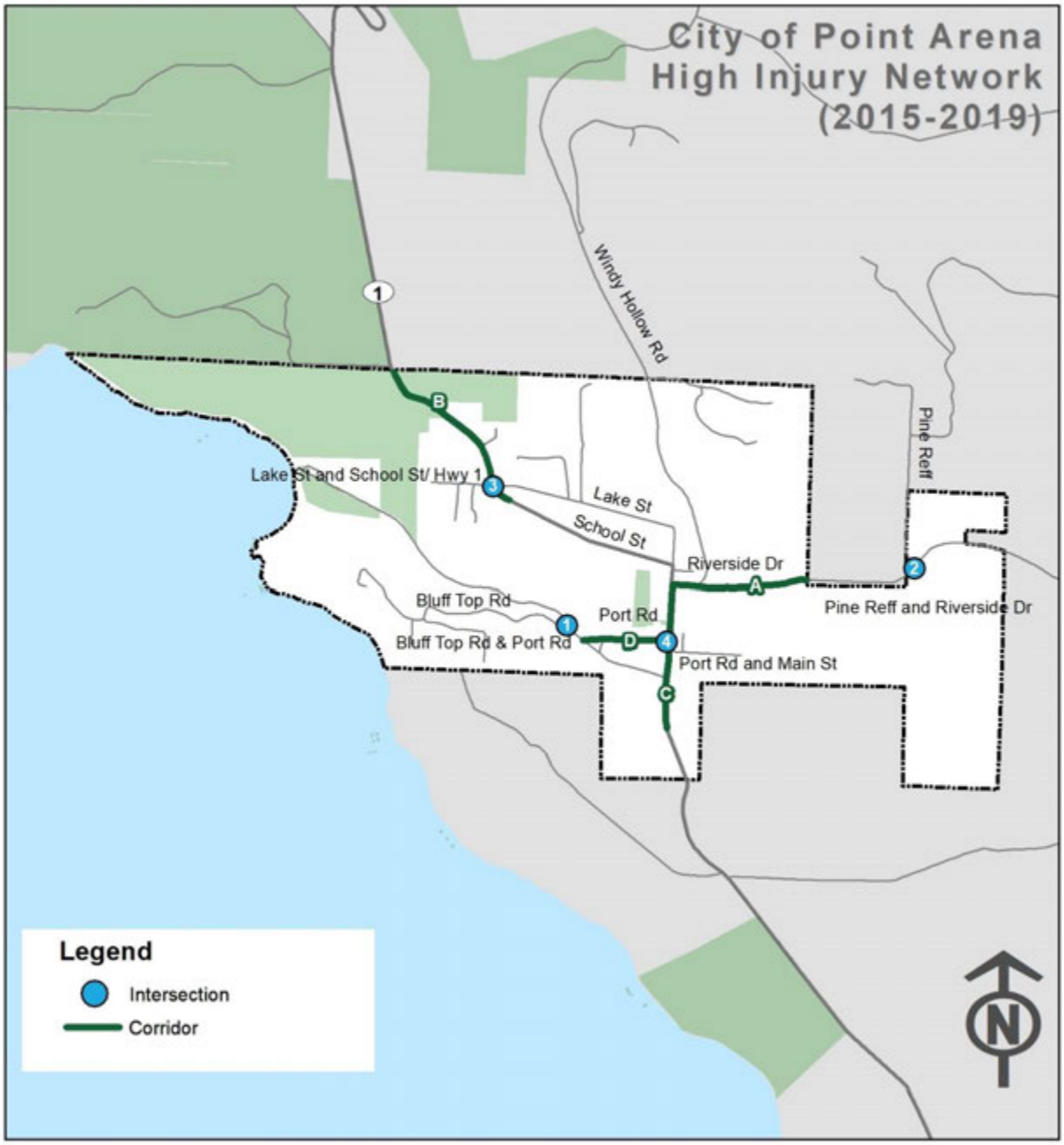
High-Injury Locations

Following the detailed collision analysis in Chapter 3 the next step was to identify the high-risk roadway segments and intersections in the City of Point Arena. The methodology for scoring the high injury locations is the same method used in the severity weight section.

Figure 24 shows the top four high-collision roadway segments, and top four high-collision intersections. This high collision network has a total of four injury collisions and one F+SI collisions, which represents 100 percent of injury collisions and 100 percent of F+SI collisions in Point Arena.

For the purposes of the high collision network analysis, intersections include collisions that occurred within 250 feet of it and roadways include all collisions that occurred along the roadway except for collisions that occurred occur directly at an intersection, or collisions that have occurred at the distance of zero feet from the intersection as per the SWITRS.

Figure 24. City of Point Arena High Injury Network



High Injury Intersections

Four intersections were identified as high injury intersections. There were a total of one F+SI collisions that occurred at these intersections. The intersection of Port Road and Bluff Top Road has the highest EPDO score. Intersections without injury collisions were chosen based on PDO collisions.

Table 8 lists the collision rate of the top four identified high-collision intersections along with their collision total and the number of F+SI collisions.

Table 8. High Injury Intersections

ID	Intersection	Total	F+SI	Hit Object	DUI	Nighttime	EPDO Score
		Collisions					
1	Port Road and Bluff Top Road	1	1	0	1	1	165
2	Pine Reef and Riverside Drive	1	0	0	1	1	11
3	Lake Street and School Street/Highway 1 (intersections without injury collisions were chosen based on property damage only collisions)	0	0	0	0	0	0
4	Port Road and Main Street (intersections without injury collisions were chosen based on property damage only collisions)	0	0	0	0	0	0

High Injury Corridors

Four corridors were identified as high injury corridors. There was a total zero F+SI collisions on these corridors. The corridor with the highest EPDO score is Riverside Drive. Corridors without injury collisions were chosen based on PDO collisions.

Table 9 lists the collision rate of the top four identified high-collision corridors along with the number of F+SI collisions and total collisions.

Table 9. High Injury Corridors

ID	Corridors	Total	F+SI	Hit Object	DUI	Night -time	Length (miles)	EPDO Score
		Collisions						
A	Riverside Drive: Main Street/Highway 1 to Pine Reef	2	0	0	1	1	1.1	22
B	School Street/Highway 1: Northern City Limits to Lake Street	1	0	0	1	1	0.6	6
C	Main Street/Highway 1: Riverside Drive to Southern City Limits (corridors without injury collisions were chosen based on property damage only collisions)	0	0	0	0	0	0.3	0
D	Port Road: Iverson Avenue to Main Street/Highway 1 (corridors without injury collisions were chosen based on property damage only collisions)	0	0	0	0	0	0.7	0

4. Emphasis Areas

Emphasis areas are focus areas for the LRSP that are identified through the comprehensive collision analysis of the identified high injury network within the City of Point Arena. Emphasis areas help in identifying appropriate safety strategies and countermeasures with the greatest potential to reduce collisions occurring at these high-risk locations. In addition, traffic safety related concerns were heard at the Stakeholders Meeting conducted for this plan on June 28, 2021.

This chapter summarizes the top five emphasis areas identified for the City of Point Arena. These emphasis areas were derived from the consolidated high injury collision database (**Appendix B**) where top injury factors were identified by combining the data manually. Along with findings from the data analysis, stakeholder input was also considered while identifying emphasis areas specific to the City of Point Arena.

- Nighttime Collisions
- Collisions close to the City Boundary
- Hit Object Collisions
- Unsafe Speed Collisions
- Young Adult Party at Fault Collisions

The Four E's OF Traffic Safety

LRSP utilizes a comprehensive approach to safety incorporating "4 E's of traffic safety": **E**ngineering, **E**nforcement, **E**ducation and **E**mergency Medical Services (EMS). This approach recognizes that not all locations can be addressed solely by infrastructure improvements. Incorporating the 4 E's of traffic safety is often required to ensure successful implementation of significant safety improvements and reduce the severity and frequency of collisions throughout a jurisdiction.

Some of the common violation types that may require a comprehensive approach are speeding, failure-to-yield to pedestrians, red light running, aggressive driving, failure to wear safety belts, distracted driving, and driving while impaired. When locations are identified as having these types of violations, coordination with the appropriate law enforcement agencies is needed to arrange visible targeted enforcement to reduce the potential for future driving violations and related crashes and injuries.

To improve safety, education efforts can also be used to supplement enforcement. Additionally, education efforts can supplement enforcement to improve the efficiency of each. Education can also be employed in the short-term to address high crash locations until the recommended infrastructure project can be implemented, addressed under Engineering improvements and countermeasures. Similarly, Emergency Medical Services entails strategies around supporting organizations that provide rapid response and care when responding to collisions causing injury, by stabilizing victims and transporting them to facilities.

Existing Traffic Safety Efforts in the City of Point Arena

The City of Point Arena has already implemented safety strategies corresponding to the 4 E's of traffic safety. The strategies detailed in this section can supplement these existing programs and concentrate them on high injury collision locations and crash types. These initiatives are summarized in the table below:

Table 10. Existing Program Summary

Document	Description	E's Addressed
Point Arena Community Action Plan (2010)	A community vision was developed, traffic circulation was analyzed, sustainable development scenarios were mapped, improvement strategies and funding sources were identified, and other issues were addressed.	Engineering
Mendocino County Safe Routes to School Plan (2014)	Safe Routes to School (SRTS) is a program with a simple goal: helping more children get to school by walking and bicycling.	Engineering
Mendocino County Regional Active Transportation Plan (2017)	Details bicycle and pedestrian improvements on County significant corridors. Includes detailed priority bike and pedestrian projects.	Engineering
Walk and Bike Mendocino	Walk and Bike Mendocino promotes walking and biking as a primary transportation choice in short distance travel in Mendocino County.	Education

Factors considered in the determination of Emphasis Areas

This section presents collision data analysis of collision type, collision factors, facility type, roadway geometries, analyzed for the various emphasized areas. Emphasis areas were determined by factors that led to the highest amount of injury collisions, with a specific emphasis on fatal and severe (F+SI) injury collisions. In addition to the collision data, emphasis areas were also determined to by the feedback received from stakeholders. This section also presents comprehensive programs, policies and countermeasures to reduce collisions in specific emphasis areas.

Emphasis Area 1 - Nighttime Collisions

The City of Point Arena experienced a total 10 reported collisions during the study period. 7 (70 percent) of these collisions occurred at nighttime, including 1 severe injury collisions.

3	3	2
Hit object collisions	**Wrong side of road collisions**	**DUI Collisions**

Table 11. Emphasis Area 1 Strategies

Objective			
Reduce the number of collisions that occur at nighttime			
	Strategy	**Performance Measure**	**Agencies/ Organizations**
Education	Conduct public information and education campaign for safety laws regarding and the larger risk of collisions during the nighttime.	Number of education campaigns	City/Police Department
Enforcement	Targeted enforcement at high-risk locations to monitor collisions that occur at nighttime.	Number of tickets issued	Police Department
Engineering	• S02, Improve signal hardware: lenses, back-plates with retroreflective borders, mounting, size and number • S10, Install flashing beacon as warning • NS06, Install/upgrade larger or additional stop signs or other intersection warning/regulatory signs • R01, Add segment lighting • R22, Install/Upgrade signs with new fluorescent sheeting (regulatory or warning) • R27, Install delineators, reflectors and/or object markers • R26, Install dynamic/ variable speed warning signs • R27, Install delineators, reflectors and/or object markers	Number of locations improved	City
EMS	S05, Install emergency vehicle pre-emption systems	EMS vehicle response time	Mendocino County Local Emergency Services Agency

Emphasis Area 2 - Collisions close to the City Boundary

The City of Point Arena experienced a total 10 reported collisions during the study period. Five (50 percent) of these collisions occurred at the close to the City Boundary.

3	3	2
Collisions occurred near School Street and Lake Street, at the north edge of the City	**Collisions were hit object collisions**	**Occurred near Riverside Drive and Pine Reef, at the east edge of the City**

Table 12. Emphasis Area 2 Strategies

Objective			
Reduce the number of collisions near the City Boundary			
	Strategy	**Performance Measure**	**Agencies/ Organizations**
Education	Conduct public information and education campaign for safety laws regarding, unsafe speeds, distracted driving, improper turning and driving under the influence	Number of education campaigns	City/School District/ Police Department
Enforcement	Targeted enforcement at high-risk locations	Number of tickets issued	Police Department
Engineering	• R01, Add segment lighting • R04, Install guard rail • R15. Widen shoulder • R21, Improve pavement friction • R22, Install/Upgrade signs with new fluorescent sheeting (regulatory or warning) • R26, Install dynamic / variable speed warnings • NS04/NS05/S16, Convert intersection to roundabout • Consider reducing speed limits at the northern edge of the City, and use prima facie to set speed limit instead of 80th percentile	Number of locations improved	City
EMS	S05, Install emergency vehicle pre-emption systems	EMS vehicle response time	Mendocino County Local Emergency Services Agency

Emphasis Area 3 - Hit Object Collisions

The City of Point Arena experienced a total 10 reported collisions during the study period. Four (40 percent) of these collisions were hit object collisions.

3	3	2
Hit Object Collisions occurred on Main Street	**Collisions occurred at night**	**Wrong side of road collisions**

Table 13. Emphasis Area 3 Strategies

Objective			
Reduce the number of collisions were hit object collisions			
	Strategy	**Performance Measure**	**Agencies/ Organizations**
Education	Conduct public information and education campaign for intersection safety laws regarding, unsafe speeds, distracted driving, improper turning and driving under the influence.	Number of education campaigns	City/School District/Police Department
Enforcement	Targeted enforcement at high-risk locations	Number of tickets issued	Police Department
Engineering	• R01, Add segment lighting • R03, Install median barrier • R04, Install guard rail • R15. Widen shoulder • R21, Improve pavement friction • R22, Install/Upgrade signs with new fluorescent sheeting (regulatory or warning) • R26, Install dynamic / variable speed warnings • R27, Install delineators, reflectors and/or object markers • R28, Install edge lines and centerlines	Number of locations improved	City
EMS	S05, Install emergency vehicle pre-emption systems	EMS vehicle response time	Mendocino County Local Emergency Services Agency

Emphasis Area 4 - Unsafe Speed Collisions

The City of Point Arena experienced a total 10 reported collisions during the study period. 2 (20 percent) of these collisions were unsafe speed.

2	1	1
Overturned Collison	**Occurred at Route 1 and Lake Street**	**Occurred on Riverside Drive and Eureka Hill**

Table 14. Emphasis Area 4 Strategies

Objective			
Reduce the number of fatal and severe injury collisions that are a result of unsafe speed			
	Strategy	**Performance Measure**	**Agencies/ Organizations**
Education	Conduct public information and education campaign for safety laws regarding unsafe speed and its dangers.	Number of education campaigns	City/ School District/ Police Department
Enforcement	Targeted enforcement at high-risk locations to monitor unsafe speed.	Number of tickets issued	Police Department
Engineering	• S16/NS04/NS05, Convert intersection to roundabout • NS06, Install/upgrade larger or additional stop signs or other intersection warning/regulatory signs • NS07, Upgrade intersection pavement markings (NS.I.) • R04, Install guard rail • R22, Install/Upgrade signs with new fluorescent sheeting (regulatory or warning) • R26, Install dynamic/ variable speed warning signs • R28, Install edge-lines and centerlines • Consider reducing speed limits at the northern edge of the City, and use prima facie to set speed limit instead of 80th percentile	Number of locations improved	City
EMS	S05, Install emergency vehicle pre-emption systems	EMS vehicle response time	Mendocino County Local Emergency Services Agency

Emphasis Area 5 - Young Adult Party at Fault Collisions

The City of Point Arena reported a total 10 reported collisions during the study period. The following is a review of the demographic data, provided in the party data of the reported collisions.

80%

Party at fault was 35 years old or younger

70%

Party fault was a male

Table 15. Emphasis Area 5 Strategies

Objective			
Reduce the number of younger adult fatal and severe injury collisions			
	Strategy	**Performance Measure**	**Agencies/ Organizations**
Education	Target education programs for younger adults. Distribute brochures/fliers with basic red light running, speeding, distracted driving, aggressive driving and stop sign violations information at driver training programs. Include statistics of younger adult larger risks of fatalities.	Number of education campaigns	City/ School District/ Police Department

5. Countermeasure Identification

This section summarizes the process of selecting countermeasures on Point Arena streets as part of the analysis for the LRSP. Countermeasures were selected for each of the identified high-risk intersections and roadway segments based on extensive review of existing conditions at the site and characteristics of identified collisions on the High Injury Network.

Identified collision factors and existing conditions were cross referenced with the Caltrans LRSM identified countermeasures that are HSIP approved. Countermeasures that best fit the site and had the highest opportunity for systemic implementation were selected. Countermeasures were selected not only for each high-risk location, but also for each identified citywide Emphasis Area.

Countermeasure Selection

In 2010, the Federal Highway Administration (FHWA) published a set of three manuals local and rural road owners to present a simple, data driven safety analysis framework for rural agencies across the country. In conjunction with these documents, California Department of Transportation (Caltrans) developed the Local Roadway Safety Manual (LRSM). The goal of this manual is to "*maximize the safety benefits for local roadways by encouraging all local agencies to proactively identify and analyze their safety issues and to position themselves to compete effectively in Caltrans' statewide, data-driven call-for-projects*."[5] Although, the LRSM identifies all of California's local roadway safety issues and the countermeasures that address them, this document only highlights the issues and countermeasures relevant to the local roads of the City of Chowchilla. This section identifies the different solutions for the City from HSIP-qualified and non-HSIP countermeasures. It also provides a brief description along with their corresponding crash reduction factors (CRF), expected life and baseline cost. An excerpt of the LRSM, detailing each available HSIP countermeasure referenced in the recommendations tables, is included as **Appendix C**.

The countermeasures have been divided into three categories:

- Signalized (S) – countermeasures only applicable for signalized intersections;
- Non-Signalized (NS) – countermeasures only applicable to stop-controlled, or uncontrolled intersections;
- Roadway Segment (RS) – countermeasures only applicable to roadway segments;
- Other (O) – countermeasures that do not qualify for HSIP funding.

[5] https://dot.ca.gov/-/media/dot-media/programs/local-assistance/documents/hsip/2020/lrsm2020.pdf

Draft Countermeasure Toolbox

Appendix D detail the draft countermeasures for each high-risk location and Emphasis Area, separated by intersections and roadway segments. While not all of these countermeasures will be included in the resulting safety projects, they are included to give the City a toolbox for implementing future safety improvements through other means, such as the City's Capital Improvement Program.

Non-Signalized Intersections Countermeasures

NS01 – Add intersection lighting. Non-signalized intersections that have a disproportionate number of night-time crashes and do not currently provide lighting at the intersection or at its approaches. Crash data should be studied to ensure that safety at the intersection could be improved by providing lighting (this strategy would be supported by a significant number of crashes that occur at night).

- Crash Reduction Factor – 40%
- Expected Life – 20 years
- Baseline Cost – Approximately $100,000 per intersection

NS06 – Install/upgrade larger or additional stop signs or other intersection warning/regulatory signs. The visibility of intersections and, thus, the ability of approaching drivers to perceive them can be enhanced by installing larger regulatory and warning signs at or prior to intersections. A key to success in applying this strategy is to select a combination of regulatory and warning sign techniques appropriate for the conditions on a particular unsignalized intersection approach.

- Crash Reduction Factor – 15%
- Expected Life – 10 years
- Baseline Cost – Approximately $4,200 per intersection

NS07 – Upgrade intersection pavement markings (NS.I.). Unsignalized intersections that are not clearly visible to approaching motorists, particularly approaching motorists on the major road. The strategy is particularly appropriate for intersections with patterns of rear-end, right-angle, or turning crashes related to lack of driver awareness of the presence of the intersection

- Crash Reduction Factor – 25%
- Expected Life – 10 years
- Baseline Cost – Approximately $900 per intersection

NS09 - Install flashing beacons as advance warning (NS.I.) Non-Signalized Intersections with patterns of crashes that could be related to lack of a driver's awareness of approaching intersection or controls at a downstream intersection. Advance flashing beacons can be used to supplement and call driver attention to intersection control signs. Flashing beacons are intended to reinforce driver awareness of the stop or yield signs and to help mitigate patterns of crashes related to intersection regulatory sign violations.

- Crash Reduction Factor – 30%
- Expected Life – 10 years
- Baseline Cost – Approximately $14,000

NS22PB – Install Rectangular Rapid Flashing Beacon (RRFB). The RRFB includes pedestrian-activated flashing lights and additional signage that enhance the visibility of marked crosswalks and alert motorists to pedestrian crossings. It uses an irregular flash pattern that is similar to emergency flashers on police vehicles. RRFBs are installed at unsignalized intersections and mid-block pedestrian crossings.

- Crash Reduction Factor – 35%
- Expected Life – 20 years
- Baseline Cost – Approximately $58,000

Roadway Countermeasures

R01 – Add segment lighting. Providing roadway lighting improves the safety during nighttime conditions by (1) making drivers more aware of the surroundings, which improves drivers' perception-reaction times, (2) enhancing drivers' available sight distances to perceive roadway characteristic in advance of the change, and (3) improving non-motorist's visibility and navigation.

- Crash Reduction Factor – 35%
- Expected Life – 20 years
- Baseline Cost – Approximately $100,000

R22 – Install/Upgrade signs with new fluorescent sheeting (regulatory or warning). The target for this strategy should be on roadway segments with patterns of head on, nighttime, non-intersection, run-off road, and sideswipe crashes related to lack of driver awareness of the presence of a specific roadway feature or regulatory requirement. Ideally this type of safety CM would be combined with other sign evaluations and upgrades (install chevrons, warning signs, delineators, markers,

- Crash Reduction Factor – 15%
- Expected Life – 10 years
- Baseline Cost – Approximately $2,000

beacons, and relocation of existing signs per MUTCD standards.).

R26 – Install dynamic/variable speed warning signs. This strategy primarily addresses crashes caused by motorists traveling too fast around sharp curves. It is intended to get the drivers attention and give them a visual warning that they may be traveling over the recommended speed for the approaching curve. Care should be taken to limit the placement of these signs to help maintain their effectiveness.

- Crash Reduction Factor – 30%
- Expected Life – 10 years
- Baseline Cost – Approximately $20,000

R27 – Install delineators, reflectors and/or object markers. Roadways that have an unacceptable level of crashes on curves (relatively flat to sharp) during periods of light and darkness. Any road with a history of fixed object crashes is a candidate for this treatment, as are roadways with similar fixed objects along the roadside that have yet to experience crashes.

- Crash Reduction Factor – 15%
- Expected Life – 10 years
- Baseline Cost – Approximately $2,000

R35PB – Install/upgrade pedestrian crossing (with enhanced safety features). Adding pedestrian crossings has the opportunity to greatly enhance pedestrian safety at locations noted as being problematic. The enhanced safety elements, which may include curb extensions, medians and pedestrian crossing islands, beacons, and lighting, combined with pavement markings delineating a portion of the roadway that is designated for pedestrian crossing.

- Crash Reduction Factor – 35%
- Expected Life – 20 years
- Baseline Cost – Approximately $25,000

6. Safety Projects

High-Collision Network Projects

This section summarizes the process of selecting safety projects as part of the analysis for the City of Point Arena's LRSP. The next step after the identification of high-risk locations, emphasis areas and applicable countermeasures was to identify location specific safety improvements for all high-risk roadway segments and intersections.

Specific countermeasures and improvements were selected from the 2020 Local Roadway Safety Manual (LRSM), where:

- S refers to improvements at signalized locations,
- NS refers to improvements at non-signalized locations, and
- R refers to improvements at roadway segments.

The corresponding number refers to the countermeasure number in the LRSM (2020). The countermeasures were grouped into safety projects for high-risk intersections and roadway segments. A total of four safety projects were developed. All countermeasures were identified based on the technical teams' assessment of viability that consisted of extensive analysis, observations, and City staff input. The most applicable and appropriate countermeasures as identified have been grouped together to form projects that can help make high-risk locations safer.

Table 16 lists the safety projects for high-risk intersections and roadway segments, along with total base planning level cost (2021 dollar amounts) estimates and the resultant preliminary Benefit-Cost (B/C) Ratio. The "Total Benefit" estimates were calculated for the proposed improvements being evaluated in the proactive safety analysis. This "Total Benefit" is divided by the "Total Cost per Location" estimates for the proposed improvements, giving the resultant B/C Ratio. The B/C Ratio Calculation follows the methodology as mentioned in the LRSM (2020).

Attachment E lists the detailed methodology to calculate B/C Ratio, the complete cost, benefit and B/C Ratio calculation spreadsheet.

These safety projects were chosen based on the previously completed collisions analysis, which was used to identify main collision attributes that were found to be leading factors of fatal and severe collisions in Point Arena. These collision factors were identified to be nighttime collisions and hit object collisions.

For all collisions, 70 percent of collisions occurred during the nighttime, including the only fatal or severe injury collision. Nighttime collisions have been observed at the intersection of Port Road and Bluff Top Road and along the corridor Highway 1/Main Street. Many different factors can contribute to nighttime collisions, such as low lighting levels that can be targeted with countermeasure, but extraneous factors can also contribute to nighttime injury such as alcohol use, sleep and fatigue. Recommended improvements at these location include installing flashing beacons as advance warning, installing and upgrade signs with new fluorescent sheeting and installing pedestrian improvements with lighting elements such as RRFBs.

For all collisions, 40 percent of collisions were hit object collisions, most of these occurred at intersections. Riverside Drive and Highway 1/School Street have more hit object collisions compared to other roads in Point Arena. Recommended improvements at these location include installing delineators, reflectors and/or object markers, and keeping sightlines clear at intersections.

Table 16. List of Viable Safety Projects

Location	CM1	CM2	CM3	Cost per Location	B/C Ratio
Project 1: Systemic Improvements at Unsignalized Intersections					
Port Road and Bluff Top Road		NS06	NS07	$3,059	22.73
Pine Reef and Riverside Drive	NS01	NS06	NS07	$35,434	
Lake Streetand School Street/Highway 1		NS06		$1,400	
Port Road and Main Street		NS06		$280	
Iverson Avenue and Main Street		NS06		$980	
Project 2: Improvements at Unsignalized Intersections					
Lake Street and School Street/Highway 1	NS09			$28,000	0.38
Iverson Avenue and Main Street	NS09			$14,000	
Project 3: Systemic Roadway Segment Improvements					
Riverside Drive: Main Street/Highway 1 to Pine Reef		R22		$7,980	43.19
Main Street/Highway 1: Riverside Drive to Southern City Limits		R22		$10,710	
Port Road: Iverson Avenue to Main Street/ Highway 1		R22		$5,040	
Project 4: Pedestrian and Other Roadway Segment Improvements					
Riverside Drive: Main Street/Highway 1 to Pine Reef		R27	R26	$16,520	35.29
School Street/Highway 1: Northern City Limits to Lake Street		R27	R26	$14,840	

Location	CM1	CM2	CM3	Cost per Location	B/C Ratio
Port Road: Iverson Avenue to Main Street/Highway 1	R01			$69,776	
Project 5: Pedestrian Set Aside					
Corner of Main Street and School Street near Methodist Church		NS22PB		$58,800	N/A
Main Street/Highway 1: Riverside Drive to Southern City Limits	R35PB			$39,200	

Notes: CM – countermeasure. B/C ratio is the dollar amount of benefits divided by the cost of the countermeasure. NS01- Add intersection lighting (NS.I.), NS06- Install/upgrade larger or additional stop signs or other intersection warning/regulatory signs, NS07- Upgrade intersection pavement markings (NS.I.), NS09- Install flashing beacons as advance warning (NS.I.), NS22PB- Install Rectangular Rapid Flashing Beacon (RRFB), R01- Add segment lighting, R22- Install/Upgrade signs with new fluorescent sheeting (regulatory or warning), R26 - Install dynamic/variable speed warning signs, R27- Install delineators, reflectors and/or object markers, R35PB - Install/upgrade pedestrian crossing (with enhanced safety features) Costs include contingency, PS&E, environmental and construction costs.

HSIP Applications

The next step will be to prepare HSIP grant ready materials, so that the City may submit them for HSIP Cycle 11 funding in 2022.

7. Evaluation and Implementation

This chapter describes the steps the City may take to evaluate the success of this plan and steps needed to update the plan in the future. The LRSP is a guidance document and requires periodic updates to assess its efficacy and re-evaluate potential solutions. It is recommended to update the plan every two to five years in coordination with the identified safety partners. This document was developed based on community needs, stakeholder input, and collision analysis conducted to identify priority emphasis areas throughout the City. The implementation of strategies under each emphasis area would aim to reduce fatal and severe injury collisions in the coming years.

Funding is a critical component of implementing any safety project. While the HSIP program is a common source of funding for safety projects, there are numerous other funding sources that could be pursued for such projects. Potential funding sources are listed below in **Table 17**.

Table 17. Potential Funding Sources

Funding Source	Funding Agency	Amount Available	Next Estimated Call for Projects	Applicable E's	Notes
Active Transportation Program	Caltrans, California Transportation Commission	~$223 million per year	2022	Engineering, Education	Can use used for most active transportation related safety projects as well as education programs
Highway Safety Improvement Program	Caltrans	TBD	Early 2022	Engineering	Most common grant source for safety projects
Surface Transportation Block Group Program	FHWA (Administered through MCTC)	Varies by FY	TBD	Engineering	Typically used for roadway projects
Congestion Mitigation and Air Quality (CMAQ)	FHWA (Administered through MCTC)	Varies by FY	TBD	Engineering	Focused on projects that improve air quality
Office of Traffic Safety Grants	California Office of Traffic Safety	Varies by grant	Closes January 31st annually	Education, Enforcement, Emergency Response	10 grants available to address various components of traffic safety

Funding Source	Funding Agency	Amount Available	Next Estimated Call for Projects	Applicable E's	Notes
Affordable Housing and Sustainable Communities Program	Strategic Growth Council and Dept. of Housing and Community Development	~$405 million	2022	Engineering, Education	Must be connected to affordable housing projects; typically focuses on bike/ped infrastructure/programs
Urban Greening	California Natural Resources Agency	$28.5 million	2022	Engineering	Focused on bike/pedestrian infrastructure and greening public spaces
Local Streets and Road Maintenance and Rehabilitation	CTC (distributed to local agencies)	$1.5 billion statewide	N/A; distributed by formula	Engineering	Typically pays for road maintenance type projects
RAISE Grant	USDOT	~$1 billion	2022	Engineering	Typically used for larger infrastructure projects
Sustainable Transportation Equity Project	California Air Resources Board	~$19.5 million	TBD; most recent call in 2020	Engineering, Education	Targets projects that will increase transportation equity in disadvantaged communities
Transformative Climate Communities	Strategic Growth Council	~$90 million	TBD; most recent call in 2020	Engineering	Funds community-led projects that achieve major reductions in greenhouse gas emissions in disadvantaged communities

Implementation

The LRSP document provides engineering, education, enforcement, and emergency medical service related countermeasures that can be implemented throughout the City to reduce F+SI collisions. It is recommended that the City of Point Arena implement the selected projects high-collision locations in coordination with other projects proposed for the City's infrastructure development in their future Capital Improvement Plans.

The success of the LRSP can be achieved by fostering communication among the City and the safety partners.

Monitoring and Evaluation

For the success of the LRSP, it is crucial to monitor and evaluate the four E-strategies continuously. Monitoring and evaluation help provide accountability, ensures the effectiveness of the countermeasures for each emphasis area, and help making decisions on the need for new strategies. The process would help the City make informed decisions regarding the implementation plan's progress and accordingly, update the goals and objectives of the plan.

After implementing countermeasures, the strategies should be evaluated annually as per their performance measures. The evaluation should be recorded in a before-after study to validate the effectiveness of each countermeasure as per the following observations:

- Number of fatal and severe injury collisions
- Number of police citations
- Number of public comments and concerns

Evaluation should be conducted during similar time periods and durations each year. The most important measure of success of the LRSP should be reduction in fatal and severe injury collisions throughout the City. If the number of F+SI collisions doesn't decrease initially, then the countermeasures should be evaluated as per the other observations, as mentioned above. The effectiveness of the countermeasures should be compared to the goals for each emphasis area.

LRSP Update

The LRSP is a guidance document and is recommended to be updated every two to five years after adoption. After monitoring performance measures focused on the status and progress of the E's strategies in each emphasis area, the next LRSP update can be tailored to resolve any continuing safety problems. The City of Point Arena's Public Works Department will be accountable for the progress of the plan goals. An annual stakeholder meeting with the safety partners is also recommended to discuss the progress for each emphasis area and oversee the implementation plan. The document should then be updated as per the latest collision data, emerging trends, and the E's strategies' progress and implementation.

Appendices:

APPENDIX A: TABLE OF POLICIES AND PROJECTS FROM THE LITERATURE REVIEW:

City of Point Arena

Local Roadway Safety Plan

Matrix of Planning Goals, Policies, and Projects

Document	Details
City of Point Arena General Plan/ Local Coastal Plan (1995)	• Goal 1: Improve safety on all streets. • Policy 3.1.1: New streets to be considered for acceptance into the Point Arena street system shall conform to design standards appropriate to their functional classification. • 3.1.3: The City shall resolve traffic and safety impacts of development at Arena Cove, and along Iversen/Port Roads. Of immediate concern is the junction of Iversen at Main Street. Safety and operational characteristics of this intersection shall be identified and problems mitigated prior to approval of new developments. • 3.1.4: The City shall investigate methods of improving sight distances at intersections. Possible solutions may include: trimming or removing weeds, shrubbery, or limbs; relocating signs or other obstructions; removing on-street parking near intersections; prohibiting large-vehicle parking near intersections; and adjusting traffic control devices to provide better views. • 3.1.6: Through traffic should be diverted from local streets insofar as possible.
Point Arena Community Action Plan (2010)	**Projects:** • **Main Street/Mill Street Intersection** By relocating the marked crosswalk, pedestrians will exit onto a sidewalk on the western side of the crosswalk, instead of a driveway as occurs today. The new marked crosswalk location also provides a more convenient crossing for the South Coast Senior Center. Bulbouts will be constructed on both the east and west sides of Main Street at the new crosswalk. • **School Street/Lake Street** Install bulb outs and realign intersection. • **School Street/Harper's Cut-off Trail** Install two new median refuge island and crosswalk enhancements. • **Roundabout Improvements** at Windy Hollow Road/Riverside Drive and Eureka Hill Road. • **Roundabout improvement** at Lake Street and Highway 1. • **Class II bike lanes** along Riverside Drive/Eureka Hill Road between Main Street and Windy Hollow Road. • **Class II bike lanes** along Windy Hollow Road between Riverside Drive and Manchester Point Arena Rancheria. • **Class II bike lanes** along Iversen Avenue between Main Street and Port Road.
Capital Improvement Program 2021-2025, City of	• Riverside Drive and Center Street Renovation: Completion of Riverside Drive, Center Street construction of 330 feet concrete drainage swale. • Mill Street Reconstruction: The project will remove and regrade roadway, install subsurface drainage, replace sidewalk, and repave roadway.

Document	Details
Point Arena Streets and Roads	• Windy Hollow Road: Overlay roadway. • Sidewalk Repair, replacement and new sidewalk program: Sidewalks will be prioritized for replacement or addition. Sidewalk construction program that may partner with property owners may be needed.
Mendocino County Safe Routes to School Plan (2014)	• Mendocino County Safe Routes to School Program Toolkit • Mendocino County SRTS Plan Framework
Mendocino County Regional Active Transportation Plan (2017)	Goals: • To improve our public spaces so the street, road and transportation system meets the needs of all surface transportation modes, including vehicular, bicycle, pedestrian and transit. • Provide a safe and useable network of bicycle and pedestrian facilities throughout the region as a means to lessen dependence on vehicular travel and improve the health of Mendocino County's residents. • Maximize investment in non-motorized transportation facilities through maintenance. **Priority Improvements:** *Short Range:* • Coastal Access Scenic Bikeway Rehabilitation • Lake Street Sidewalks *Long Range:* • Multi-use Trail from Cove (Harper's Cut-off Trail)

APPENDIX B. CONSOLIDATED COLLISION DATABASE

Case ID	Accident Year	Collision Date	Primary Road	Secondary Road	Distance	Direction	Collision Severity
8771731	2018	43453	PORT RD	BLUFF TOP RD	0		2
6957699	2015	42146	EUREKA HILL RD	PINE REEF	278	W	3
90470980	2017	42880	SR-1	LAKE ST	1056	N	4
90992291	2019	43594	RIVERSIDE DR	EUREKA HILL R	422	W	3
7086810	2015	20150917	RT 1	PORT RD	18	N	0
8105508	2016	20160805	PORT RD	MAIN ST	50	W	0
8419133	2017	20170710	RT 1	LAKE ST	40	N	0
8537340	2018	20180113	LAKE ST	MAIN ST	0		0
8574682	2018	20180223	MAIN ST	MAIN ST 365	0		0
8613635	2018	20180305	PORT RD	PORT RD 200	0		0

APPENDIX C: HSIP ELIGIBLE COUNTERMEASURES

B.1 Intersection Countermeasures – Signalized

S01, Add intersection lighting (Signalized Intersection => S.I.)

For HSIP Calls-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
100%	"night" crashes	40%	20 years
Notes:	This CM only applies to "night" crashes (all types) occurring within limits of the proposed roadway lighting 'engineered' area.		

General information
Where to use:
Signalized intersections that have a disproportionate number of night-time crashes and do not currently provide lighting at the intersection or at its approaches. Crash data should be studied to ensure that safety at the intersection could be improved by providing lighting (this strategy would be supported by a significant number of crashes that occur at night).
Why it works:
Providing lighting at the intersection itself, or both at the intersection and on its approaches, improves the safety of an intersection during nighttime conditions by (1) making drivers more aware of the surroundings at an intersection, which improves drivers' perception-reaction times, (2) enhancing drivers' available sight distances, and (3) improving the visibility of non-motorists. Intersection lighting is of particular benefit to non-motorized users. Lighting not only helps them navigate the intersection, but also helps drivers see them better.
General Qualities (Time, Cost and Effectiveness):
A lighting project can usually be completed relatively quickly, but generally requires at least 1 year to implement because the lighting system must be designed and the provision of electrical power must be arranged. The provision of lighting involves both a fixed cost for lighting installation and an ongoing maintenance and power cost which results in a moderate to high cost. Some locations can result in high B/C ratios, but due to higher costs, these projects often result in medium to low B/C ratios.

FHWA CMF Clearinghouse:	Crash Types Addressed:	Night, All	CRF:	20-74%

S02, Improve signal hardware: lenses, back-plates with retroreflective borders, mounting, size, and number

For HSIP Calls-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
100%	All	15%	10 years
Notes:	This CM only applies to crashes occurring on the approaches / influence area of the upgraded signals. This CM does not apply to improvements like "battery backup systems", which do not provide better intersection/signal visibility or help drivers negotiate the intersection (unless applying past crashes that occurred when the signal lost power). If new signal mast arms are part of the proposed project, CM "S2" should not be used and the signal improvements would be included under CM "S7".		

General information
Where to use:
Signalized intersections with a high frequency of right-angle and rear-end crashes occurring because drivers are unable to see traffic signals sufficiently in advance to safely negotiate the intersection being approached. Signal intersection improvements include new LED lighting, signal back plates, retro-reflective tape outlining the back plates, or visors to increase signal visibility, larger signal heads, relocation of the signal heads, or additional signal heads.
Why it works:
Providing better visibility of intersection signals aids the drivers' advance perception of the upcoming intersection. Visibility and clarity of the signal should be improved without creating additional confusion for drivers.
General Qualities (Time, Cost and Effectiveness):
Installation costs and time should be minimal as these type strategies are classified as low cost and implementation does not typically require the approval process normally associated with more complex projects. When considered at a single location, these low cost improvements are usually funded through local funding by local maintenance crews. However, This CM can be effectively and efficiently implemented using a systematic approach with numerous locations, resulting in low to moderate cost projects that are more appropriate to seek state or federal funding.

FHWA CMF Clearinghouse:	Crash Types Addressed:	Rear-End, Angle	CRF:	0-46%

S13PB, Install pedestrian median fencing on approaches

For HSIP Calls-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	Pedestrian and Bicycle	35%	20 years
Notes:	This CM only applies to "Ped & Bike" crashes occurring on the approaches/influence area of the new pedestrian median fencing.		

General information				
Where to use:				
Signalized Intersections with high pedestrian-generators nearby (e.g. transit stops) may experience a high volumes of pedestrians J-walking across the travel lanes at mid-block locations instead of walking to the intersection and waiting to cross during the walk-phase. When this safety issue cannot be mitigated with signal timing and shoulder/sidewalk treatments, then installing a continuous pedestrian barrier in the median may be a viable solution.				
Why it works:				
Adding pedestrian median fencing has the opportunity to enhance pedestrian safety at locations noted as being problematic involving pedestrians running/darting across the roadway outside the intersection crossings. Pedestrian median fencing can significantly reduce this safety issue by creating a positive barrier, forcing pedestrians to the designated pedestrian crossing.				
General Qualities (Time, Cost and Effectiveness):				
Costs associated with this strategy will vary widely depending on the type and placement of the median fencing. Impacts to transit and other land uses may need to be considered and controversy can delay the implementation. In general, this CM can be effective as a spot-location approach.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Pedestrian, Bicycle	CRF:	25- 40%

S14, Create directional median openings to allow (and restrict) left-turns and U-turns (S.I.)

For HSIP Calls-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	50%	20 years
Notes:	This CM only applies to crashes occurring in the intersection / influence area of the new directional openings.		

General information				
Where to use:				
Crashes related to turning maneuvers include angle, rear-end, pedestrian, and sideswipe (involving opposing left turns) type crashes. If any of these crash types are an issue at an intersection, restriction or elimination of the turning maneuver may be the best way to improve the safety of the intersection.				
Why it works:				
Restricting turning movement into and out of an intersection can help reduce conflicts between through and turning traffic. The number of access points, coupled with the speed differential between vehicles traveling along the roadway, contributes to crashes. Affecting turning movements by either allowing them or restricting them, based on the application, can ensure safe movement of traffic.				
General Qualities (Time, Cost and Effectiveness):				
Turn prohibitions that are implemented by closing a median opening can be implemented quickly. The cost of this strategy will depend on the treatment. Impacts to businesses and other land uses must be considered and controversy can delay the implementation. In general, This CM can be very effective and can be considered on a systematic approach.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	All	CRF:	51%

S20PB, Install advance stop bar before crosswalk (Bicycle Box)

For HSIP Calls-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
100%	Pedestrian and Bicycle	15%	10 years
Notes:	This CM only applies to "Ped & Bike" crashes occurring in the intersection-crossing with the new advanced stop bars.		

General information
Where to use:
Signalized Intersections with a marked crossing, where significant bicycle and/or pedestrians volumes are known to occur.
Why it works:
Adding advance stop bar before the striped crosswalk has the opportunity to enhance both pedestrian and bicycle safety. Stopping cars well before the crosswalk provides a buffer between the vehicles and the crossing pedestrians. It also allows for a dedicated space for cyclists, making them more visible to drivers (This dedicated space is often referred to as a bike-box.)
General Qualities (Time, Cost and Effectiveness):
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. When considered at a single location, these low cost improvements are usually funded through local funding by local crews. However, This CM can be effectively and efficiently implemented using a systematic approach with numerous locations, resulting in moderate cost projects that are more appropriate to seek state or federal funding.

FHWA CMF Clearinghouse:	Crash Types Addressed:	Pedestrian, Bicycle	CRF:	35%

S21PB, Modify signal phasing to implement a Leading Pedestrian Interval (LPI)

For HSIP Calls-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
100%	Pedestrian and Bicycle	60%	10 years
Notes:	This CM only applies to "Ped & Bike" crashes occurring in the intersections with signalized pedestrian crossing with the newly implemented Leading Pedestrian Interval (LPI).		

General information
Where to use:
Intersections with signalized pedestrian crossing that have high turning vehicles volumes and have had pedestrian vs. vehicle crashes.
Why it works:
A leading pedestrian interval (LPI) gives pedestrians the opportunity to enter an intersection 3-7 seconds before vehicles are given a green indication. With this head start, pedestrians can better establish their presence in the crosswalk before vehicles have priority to turn left. LPIs provide (1) increased visibility of crossing pedestrians; (2) reduced conflicts between pedestrians and vehicles; (3) Increased likelihood of motorists yielding to pedestrians; and (4) enhanced safety for pedestrians who may be slower to start into the intersection.
General Qualities (Time, Cost and Effectiveness):
Costs for implementing LPIs are very low, since only minor signal timing alteration is required. This makes it an easy and inexpensive countermeasure that can be incorporated into pedestrian safety action plans or policies and can become routine agency practice. When considered at a single location, the LPI is usually local-funded. However, This CM can be effectively and efficiently implemented using a systematic approach with numerous locations, resulting in moderate cost projects that are more appropriate to seek state or federal funding.

FHWA CMF Clearinghouse:	Crash Types Addressed:	Pedestrian, Bicycle	CRF:	59%

B.2 Intersection Countermeasures – Non-signalized

NS01, Add intersection lighting (NS.I.)

For HSIP Calls-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
100%	Night	40%	20 years
Notes:	This CM only applies to "night" crashes (all types) occurring within limits of the proposed roadway lighting 'engineered' area.		

General information				
Where to use:				
Non-signalized intersections that have a disproportionate number of night-time crashes and do not currently provide lighting at the intersection or at its approaches. Crash data should be studied to ensure that safety at the intersection could be improved by providing lighting (this strategy would be supported by a significant number of crashes that occur at night).				
Why it works:				
Providing lighting at the intersection itself, or both at the intersection and on its approaches, improves the safety of an intersection during nighttime conditions by (1) making drivers more aware of the surroundings at an intersection, which improves drivers' perception-reaction times, (2) enhancing drivers' available sight distances, and (3) improving the visibility of non-motorists. Intersection lighting is of particular benefit to non-motorized users as lighting not only helps them navigate the intersection, but also helps drivers see them better.				
General Qualities (Time, Cost and Effectiveness):				
A lighting project can usually be completed relatively quickly, but generally requires at least 1 year to implement because the lighting system must be designed and the provision of electrical power must be arranged. The provision of lighting involves both a fixed cost for lighting installation and an ongoing maintenance and power cost. For rural intersections, studies have shown the installation of streetlights reduced nighttime crashes at unlit intersections and can be more effective in reducing nighttime crashes than either rumble strips or overhead flashing beacons. Some locations can result in high B/C ratios, but due to higher costs, these projects often result in medium to low B/C ratios.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Night, All	CRF:	25- 50%

NS02, Convert to all-way STOP control (from 2-way or Yield control)

For HSIP Calls-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
100%	All	50%	10 years
Notes:	This CM only applies to crashes occurring in the intersection and/or influence area of the new control. CA-MUTCD warrant must be met.		

General information				
Where to use:				
Unsignalized intersection locations that have a crash history and have no controls on the major roadway approaches. However, all-way stop control is suitable only at intersections with moderate and relatively balanced volume levels on the intersection approaches. Under other conditions, the use of all-way stop control may create unnecessary delays and aggressive driver behavior. MUTCD warrants should always be followed.				
Why it works:				
All-way stop control can reduce right-angle and turning collisions at unsignalized intersections by providing more orderly movement at an intersection, reducing through and turning speeds, and minimizing the safety effect of any sight distance restrictions that may be present. Advance public notification of the change is critical in assuring compliance and reducing crashes.				
General Qualities (Time, Cost and Effectiveness):				
The costs involved in converting to all-way stop control are relatively low. All-way stop control can normally be implemented at multiple intersections with just a change in signing on intersection approaches, and typically are very quick to implement. When considered at a single location, these low cost improvements are usually funded through local funding by local maintenance crews. However, This CM can be effectively and efficiently implemented using a systematic approach with numerous locations, resulting in moderate cost projects that are more appropriate to seek state or federal funding.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Left-turn, Angle	CRF:	6 - 80%

NS05, Convert intersection to roundabout (from 2-way stop or Yield control)

For HSIP Calls-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
100%	All	Varies	20 years
Notes:	This CM only applies to crashes occurring in the intersection and/or influence area of the new control. The benefit of this CM is calculated using Caltrans procedure. The CRF is dependent on the ADT, project location (Rural/Urban) and the roundabout type (1 lane or 2 lanes). The benefit comes from both the reduction in the number and the severity of the crashes.		

General information				
Where to use:				
Intersections that have a high frequency of right-angle and left-turn type crashes. Whether such intersections have existing crash patterns or not, a roundabout provides an alternative to signalization. The primary target locations for roundabouts should be moderate-volume unsignalized intersections. Roundabouts may not be a viable alternative in many suburban and urban settings where right-of-way is limited.				
Why it works:				
Roundabouts provide an important alternative to signalized and all-way stop-controlled intersections. Modern roundabouts differ from traditional traffic circles in that they operate in such a manner that traffic entering the roundabout must yield the right-of-way to traffic already in it. Roundabouts can serve moderate traffic volumes with less delay than all-way stop-controlled intersections and provide fewer conflict points. Crashes at roundabouts tend to be less severe because of the speed constraints and elimination of left-turn and right-angle movements.				
General Qualities (Time, Cost and Effectiveness):				
Construction of roundabouts are usually relatively costly and major projects, requiring the environmental process, right-of-way acquisition, and implementation under an agency's long-term capital improvement program. (For this reason, roundabouts may not be appropriate for California's Federal Safety Programs that have relatively short delivery requirements.) Even with roundabouts higher costs, they still can have a relatively high effectiveness.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Left-turn, Angle	CRF:	12 - 78 %

NS06, Install/upgrade larger or additional stop signs or other intersection warning/regulatory signs

For HSIP Calls-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
100%	All	15%	10 years
Notes:	This CM only applies to crashes occurring in the influence area of the new signs. The influence area must be determined on a location by location basis.		

General information				
Where to use:				
The target for this strategy should be approaches to unsignalized intersections with patterns of rear-end, right-angle, or turning collisions related to lack of driver awareness of the presence of the intersection.				
Why it works:				
The visibility of intersections and, thus, the ability of approaching drivers to perceive them can be enhanced by installing larger regulatory and warning signs at or prior to intersections. A key to success in applying this strategy is to select a combination of regulatory and warning sign techniques appropriate for the conditions on a particular unsignalized intersection approach.				
General Qualities (Time, Cost and Effectiveness):				
Signing improvements do not require a long development process and can typically be implemented quickly. 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 local funding by local maintenance crews. However, This CM can be effectively and efficiently implemented using a systematic approach with numerous locations, resulting in moderate cost projects that are more appropriate to seek state or federal funding.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	All	CRF:	11 - 55%

NS07, Upgrade intersection pavement markings (NS.I.)

For HSIP Calls-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
100%	All	25%	10 years
Notes:	This CM only applies to crashes occurring on the approaches / influence area of the new pavement markings. This CM is not intended to be used for general maintenance activities (i.e. the replacement of existing pavement markings in-kind) and must include upgraded safety features over the existing pavement markings and striping.		

General information
Where to use:
Unsignalized intersections that are not clearly visible to approaching motorists, particularly approaching motorists on the major road. The strategy is particularly appropriate for intersections with patterns of rear-end, right-angle, or turning crashes related to lack of driver awareness of the presence of the intersection. Also at minor road approaches where conditions allow the stop bar to be seen by an approaching driver at a significant distance from the intersection. Typical improvements include "Stop Ahead" markings and the addition of Centerlines and Stop Bars.
Why it works:
The visibility of intersections and, thus, the ability of approaching drivers to perceive them can be enhanced by installing appropriate pavement delineation in advance of and at intersections will provide approaching motorists with additional information at these locations. Providing visible stop bars on minor road approaches to unsignalized intersections can help direct the attention of drivers to the presence of the intersection. Drivers should be more aware that the intersection is coming up, and therefore make safer decisions as they approach the intersection.
General Qualities (Time, Cost and Effectiveness):
Pavement marking improvements do not require a long development process and can typically be implemented quickly. Costs for implementing this strategy are nominal and depend on the number of markings. When considered at a single location, these low cost improvements are usually funded through local funding by local maintenance crews. However, This CM can be effectively and efficiently implemented using a systematic approach with numerous locations, resulting in moderate cost projects that are more appropriate to seek state or federal funding. Note: When federal safety funding is used for these installations in high-wear-locations, the local agency is expected to maintain the improvement for a minimum of 10 years.

FHWA CMF Clearinghouse:	Crash Types Addressed:	All	CRF:	13 - 60%

NS08, Install Flashing Beacons at Stop-Controlled Intersections

For HSIP Calls-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
100%	All	15%	10 years
Notes:	This CM only applies to crashes occurring on the stop-controlled approaches / influence area of the new beacons.		

General information
Where to use:
Flashing beacons can reinforce driver awareness of the Non-Signalized intersection control and can help mitigate patterns of right-angle crashes related to stop sign violations. Post-mounted advanced flashing beacons or overhead flashing beacons can be used at stop-controlled intersections to supplement and call driver attention to stop signs.
Why it works:
Flashing beacons provide a visible signal to the presence of an intersection and can be very effective in rural areas where there may be long stretches between intersections as well as locations where night-time visibility of intersections is an issue.
General Qualities (Time, Cost and Effectiveness):
Flashing beacons can be constructed with minimal design, environmental and right-of-way issues and have relatively low costs. Before choosing this CM, the agency needs to confirm the ability to provide power to the site (solar may be an option). In general, This CM can be very effective and can be considered on a systematic approach.

FHWA CMF Clearinghouse:	Crash Types Addressed:	Angle, Rear-End	CRF:	5-34%

NS19PB, Install raised medians (refuge islands)

For HSIP Calls-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	Pedestrian and Bicycle	45%	20 years
Notes:	This CM only applies to "Ped & Bike" crashes occurring in the crossing with the new islands. All new raised medians funded with federal HSIP funding must not include the removal of the existing roadway structural section and must be doweled into the existing roadway surface. This new requirement is being implemented to maximize the safety-effectiveness of the limited HSIP funding and to minimize project impacts.		

General information
Where to use:
Intersections that have a long pedestrian crossing distance, a higher number of pedestrians, or a crash history. Raised medians decrease the level of exposure for pedestrians and allow pedestrians to concentrate on (or cross) only one direction of traffic at a time.
Why it works:
Raised pedestrian refuge islands, or medians at crossing locations along roadways, are another strategy to reduce exposure between pedestrians and motor vehicles. Refuge islands and medians that are raised (i.e., not just painted) provide pedestrians more secure places of refuge during the street crossing. They can stop partway across the street and wait for an adequate gap in traffic before completing their crossing.
General Qualities (Time, Cost and Effectiveness):
Median and pedestrian refuge areas are a low-cost countermeasure to implement. This cost can be applied to retrofit improvements or if it is a new construction project, implementing this countermeasure is even more cost-effective. In general, This CM can be very effective and can be considered on a systematic approach. When agencies opt to install landscaping in conjunction with new raised medians, the portion of the cost for landscaping and other non-safety related items that exceeds 10% of the project total cost is not federally participated and must be funded by the applicant.

FHWA CMF Clearinghouse:	Crash Types Addressed:	Pedestrian and Bicycle	CRF:	30 - 56 %

NS20PB, Install pedestrian crossing at uncontrolled locations (signs and markings only)

For HSIP Calls-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
100%	Pedestrian and Bicycle	25%	10 years
Notes:	This CM only applies to "Ped & Bike" crashes occurring in the intersection/crossing with the new crossing. This CM is not intended to be used for high-cost aesthetic enhancements to intersection crosswalks (i.e. stamped concrete or stamped asphalt).		

General information
Where to use:
Non-signalized intersections without a marked crossing, where pedestrians are known to be crossing intersections that involve significant vehicular traffic. They are especially important at school crossings and intersections with right and/or left turns pockets. See Zegeer study (Safety Effects of Marked vs. Unmarked Crosswalks at Uncontrolled Locations) for additional guidance regarding when to install a marked crosswalk.
Why it works:
Adding pedestrian crossings has the opportunity to enhance pedestrian safety at locations noted as being problematic. Pavement markings delineate a portion of the roadway that is designated for pedestrian crossing. These markings will often be different for controlled verses uncontrolled locations. The use of "ladder", "zebra" or other enhanced markings at uncontrolled crossings can increase both pedestrian and driver awareness to the increased exposure at the crossing. Incorporating advanced "stop" or “yield" markings provides an extra safety buffer and can be effective in reducing the 'multiple-threat' danger to pedestrians. Nearly one-third of all pedestrian-related crashes occur at or within 50 feet of an intersection. Of these, 30 percent may involve a turning vehicle. There are several types of pedestrian crosswalks, including: continental, ladder, zebra, and standard. When agencies opt to install aesthetic enhancement to intersection crosswalks like stamped concrete/asphalt, the project design and construction costs can significantly increase. For HSIP applications, these costs must be accounted for in the B/C calculation, but these costs (over standard crosswalk markings) must be tracked separately and are not federally reimbursable and will increase the agency's local-funding share for the project costs.
General Qualities (Time, Cost and Effectiveness):
Costs associated with this strategy will vary widely, depending upon if curb ramps and sidewalk modifications are required with the crossing. When considered at a single location, these low cost improvements are usually funded through local funding by local crews. However, This CM can be effectively and efficiently implemented using a systematic approach with numerous locations, resulting in moderate cost projects that are more appropriate to seek state or federal funding.

FHWA CMF Clearinghouse:	Crash Types Addressed:	Pedestrian and Bicycle	CRF:	25 %

NS21PB, Install/upgrade pedestrian crossing at uncontrolled locations (with enhanced safety features)

For HSIP Calls-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
100%	Pedestrian and Bicycle	35%	20 years
Notes:	This CM only applies to "Ped & Bike" crashes occurring in the new crossing (influence area) with enhanced safety features. This CM is not intended to be used for high-cost aesthetic enhancements to intersection crosswalks (i.e. stamped concrete or stamped asphalt).		

General information
Where to use:
Non-signalized intersections where pedestrians are known to be crossing intersections that involve significant vehicular traffic. They are especially important at school crossings and intersections with turn pockets. Based on the Zegeer study (Safety Effects of Marked vs. Unmarked Crosswalks at Uncontrolled Locations) at many locations, a marked crosswalk alone may not be sufficient to adequately protect non-motorized users. In these cases, **flashing beacons, curb extensions, advanced "stop" or "yield" markings, and other safety features** should be added to complement the standard crossing elements.
Why it works:
Adding pedestrian crossings that include enhances safety features has the opportunity to enhance pedestrian safety at locations noted as being especially problematic. The enhanced safety elements help delineate a portion of the roadway that is designated for pedestrian crossing. Incorporating advanced "yield" markings provide an extra safety buffer and can be effective in reducing the 'multiple-threat' danger to pedestrians. Nearly one-third of all pedestrian-related crashes occur at or within 50 feet of an intersection. When agencies opt to install aesthetic enhancement to intersection crosswalks like stamped concrete/asphalt, the project design and construction costs can significantly increase. For HSIP applications, these costs must be accounted for in the B/C calculation, but these costs (over standard crosswalk markings) must be tracked separately and are not federally reimbursable and will increase the agency's local-funding share for the project costs.
General Qualities (Time, Cost and Effectiveness):
Costs associated with this strategy will vary widely, depending upon the types of enhanced features that will be combined with the standard crossing improvements. The need for new curb ramps and sidewalk modifications will also be a factor. This CM may be effectively and efficiently implemented using a systematic approach with more than one location and can have relatively high B/C ratios based on past non-motorized crash history.

FHWA CMF Clearinghouse:	Crash Types Addressed:	Pedestrian and Bicycle	CRF:	37%

NS22PB, Install Rectangular Rapid Flashing Beacon (RRFB)

For HSIP Calls-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
100%	Pedestrian and Bicycle	35%	20 years
Notes:	This CM only applies to "Ped & Bike" crashes occurring in the influence area (expected to be a maximum of within 250') of the crossing which includes the RRFB.		

General information
Where to use:
Rectangular Rapid Flashing Beacon (RRFB) includes pedestrian-activated flashing lights and additional signage that enhance the visibility of marked crosswalks and alert motorists to pedestrian crossings. It uses an irregular flash pattern that is similar to emergency flashers on police vehicles. RRFBs are installed at unsignalized intersections and mid-block pedestrian crossings.
Why it works:
RRFBs can enhance safety by increasing driver awareness of potential pedestrian conflicts and reducing crashes between vehicles and pedestrians at unsignalized intersections and mid-block pedestrian crossings. The addition of RRFB may also increase the safety effectiveness of other treatments, such as crossing warning signs and markings.
General Qualities (Time, Cost and Effectiveness):
RRFBs are a lower cost alternative to traffic signals and hybrid signals. This CM can often be effectively and efficiently implemented using a systematic approach with numerous locations.

FHWA CMF Clearinghouse:	Crash Types Addressed:	Pedestrian, Bicycle	CRF:	7 – 47.4%

B.3 Roadway Countermeasures

R01, Add Segment Lighting

For HSIP Calls-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
100%	Night	35%	20 years
Notes:	This CM only applies to "night" crashes (all types) occurring within limits of the proposed roadway lighting 'engineered' area.		

General information				
Where to use:				
Where to use: Noted substantial patterns of nighttime 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.				
Why it works:				
Providing roadway lighting improves the safety during nighttime conditions by (1) making drivers more aware of the surroundings, which improves drivers' perception-reaction times, (2) enhancing drivers' available sight distances to perceive roadway characteristic in advance of the change, and (3) improving non-motorist's visibility and navigation.				
General Qualities (Time, Cost and Effectiveness):				
It expected that projects of this type may be constructed in a year or two and are relatively costly. There are several types of costs associated with providing lighting, including the cost of providing a permanent source of power to the location, the cost for the luminaire supports (i.e., poles), and the cost for routinely replacing the bulbs and maintenance of the luminaire supports. Some locations can result in high B/C ratios, but due to higher costs, these projects often result in medium to low B/C ratios.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Night, All	CRF:	18 - 69 %

R02, Remove or relocate fixed objects outside of Clear Recovery Zone

For HSIP Calls-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	35%	20 years
Notes:	This CM only applies to crashes occurring within the limits of the new clear recovery zone (per Caltrans' HDM).		

General information				
Where to use:				
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. A clear recovery zone should be developed on every roadway, as space is available. In situations where public right-of-way is limited, steps should be taken to request assistance from property owners, as appropriate.				
Why it works:				
While this strategy does not prevent the vehicle leaving the roadway, it does provide a mechanism to reduce the severity of a resulting crash. A clear zone is an unobstructed, traversable roadside area that allows a driver to stop safely or regain control of a vehicle that has left the roadway. Removing or moving fixed objects, flattening slopes, or providing recovery areas reduces the likelihood of a crash.				
General Qualities (Time, Cost and Effectiveness):				
Projects involving removing fixed objects from highway right-of-way can typically be accomplished quickly, assuming the objects are readily moveable. Clearing objects on private property requires more time for discussions with the property owner. Costs will generally be low, assuming that in most cases the objects to be removed are within the right-of-way. This CMs can be very effective and can be implemented by agencies' maintenance staff and/or implemented on a systematic approach. High-cost removals or removals implemented using a systematic approach would be good candidates for Caltrans Federal Safety Funding.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Fixed Object	CRF:	17 - 100 %

R20, Convert from two-way to one-way traffic

For HSIP Calls-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	35%	20 years
Notes:	This CM only applies to crashes occurring within the limits of the new one-way sections.		

General information
Where to use:
One-way streets can offer improved signal timing and accommodate odd-spaced signals. One-way streets can simplify crossings for pedestrians, who must look for traffic in only one direction. While studies have shown that conversion of two-way streets to one-way generally reduces pedestrian crashes and the number of conflict points, one-way streets tend to have higher speeds which creates new problems. Care must be taken not to create conditions that cause driver confusion and erratic maneuvers.
Why it works:
Studies have shown a 10 to 50-percent reduction in total crashes after conversion of a two-way street to one-way operation. While studies have shown that con-version of two-way streets to one-way generally reduces pedestrian crashes, one-way streets tend to have higher speeds which creates new problems. At the same time, this strategy (1) increases capacity significantly and (2) can have safety-related drawbacks including pedestrian confusion and minor sideswipe crashes.
General Qualities (Time, Cost and Effectiveness):
The costs will vary depending on length of treatment and if the conversion requires modification to signals. Conversion costs can be high to build "crossovers" where the one-way streets convert back to two-way streets and to rebuild traffic signals. It's also likely that these types of modifications will require public involvement and could significantly add to the time it takes to complete the project. The expected effectiveness of this CM must be assessed for each individual location.

FHWA CMF Clearinghouse:	Crash Types Addressed:	All	CRF:	26 - 43 %

R21, Improve pavement friction (High Friction Surface Treatments)

For HSIP Calls-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
100%	All	55%	10 years
Notes:	This CM only applies to crashes occurring within the limits of the improved friction overlay. This CM is not intended to apply to standard chip-seal or open-graded **maintenance** projects for long segments of corridors or structure repaving projects intended to fix failed pavement.		

General information
Where to use:
Nationally, this countermeasure is referred to as "High Friction Surface Treatments" or HFST. Areas as noted having crashes on wet pavements or under dry conditions when the pavement friction available is significantly less than actual roadway speeds; including but not limited to curves, loop ramps, intersections, and areas with short stopping or weaving distances. This treatment is intended to target locations where skidding is determined to be a problem, in wet or dry conditions and the target vehicle is one that runs (skids) off the road or is unable to stop due to insufficient skid resistance.
Why it works:
Improving the skid resistance at locations with high frequencies of wet-road crashes and/or failure to stop crashes can result in a reduction of 50 percent for wet-road crashes and 20 percent for total crashes. Applying HFST can double friction numbers, e.g. low 40s to high 80s. This CM represents a special focus area for both FHWA and Caltrans, which means there are extra resources available for agencies interested in more details on High Friction Surface Treatment projects.
General Qualities (Time, Cost and Effectiveness):
This strategy can be relatively inexpensive and implemented in a short timeframe. The installation would be done by either agency personnel or contractors and can be done by hand or machine. In general, This CM can be very effective and can be considered on a systematic approach.

FHWA CMF Clearinghouse:	Crash Types Addressed:	Wet, Rear-End, All	CRF:	17 - 68 %

R22, Install/Upgrade signs with new fluorescent sheeting (regulatory or warning)

For HSIP Calls-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
100%	All	15%	10 years

Notes:	This CM only applies to crashes occurring within the influence area of the new/upgraded signs. This CM is not intended for maintenance upgrades of street-name, parking, guide, or any other signs without a primary focus on roadway safety. **This CM is not eligible unless** it is done as part of a larger sign audit project, including the study of: 1) the existing signs' locations, sizes and information per MUTCD standards, 2) missing signs per MUTCD standards, and 3) sign retroreflectivity. The overall sign audit scope (or a special exception from the HSIP program manager) must be documented in the Narrative Questions in the application. Based on the scope of the project/audit, it may be appropriate to combine other CMs in the B/C calculation.

General information

Where to use:

The target for this strategy should be on roadway segments with patterns of head on, nighttime, non-intersection, run-off road, and sideswipe crashes related to lack of driver awareness of the presence of a specific roadway feature or regulatory requirement. Ideally this type of safety CM would be combined with other sign evaluations and upgrades (install chevrons, warning signs, delineators, markers, beacons, and relocation of existing signs per MUTCD standards.)

Why it works:

This strategy primarily addresses crashes caused by lack of driver awareness (or compliance) roadway signing. It is intended to get the drivers attention and give them a visual warning by using fluorescent yellow sheeting (or other retroreflective material).

General Qualities (Time, Cost and Effectiveness):

Signing improvements do not require a long development process and can typically be implemented quickly. 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 local funding by local maintenance crews. However, This CM can be effectively and efficiently implemented using a systematic approach with numerous locations, resulting in moderate cost projects that are more appropriate to seek state or federal funding. When considering any type of federally funded sign upgrade project, California local agencies are encouraged to consider "Roadway Safety Signing Audit (RSSA) and Upgrade Projects". Including RSSAs in the development phase of sign projects are expected to identify non-standard (per MUTCD) sign features and missing signs that may otherwise go unnoticed. More information on RSSA is available on the Local Assistance HSIP webpage.

FHWA CMF Clearinghouse:	Crash Types Addressed:	Head on, Run-off road, Sideswipe, Night	CRF:	18 - 35%

R27, Install delineators, reflectors and/or object markers

For HSIP Calls-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
100%	All	15%	10 years
Notes:	This CM only applies to crashes occurring within the limits / influence area of the new features. {**This is not a striping-related CM**}		

General information
Where to use:
Roadways that have an unacceptable level of crashes on curves (relatively flat to sharp) during periods of light and darkness. Any road with a history of fixed object crashes is a candidate for this treatment, as are roadways with similar fixed objects along the roadside that have yet to experience crashes. If a fixed object cannot be relocated or made break-away, placing an object marker can provide additional information to motorists. Ideally this type of safety CM would be combined with other sign evaluations and upgrades (install warning signs, chevrons, beacons, and relocation of existing signs per MUTCD standards.)
Why it works:
Delineators, reflectors and/or object markers are intended to warn drivers of an approaching curve or fixed object that cannot easily be removed. They are intended to provide tracking information and guidance to the drivers. They are generally less costly than Chevron Signs as they don't require posts to place along the roadside, avoiding an additional object with which an errant vehicle can crash into.
General Qualities (Time, Cost and Effectiveness):
These improvements do not require a long development process and can typically be implemented quickly. Costs for implementing this strategy are nominal and depend on the number of locations. When considered at a single location, these low cost improvements are usually funded through local funding by local maintenance crews. However, This CM can be effectively and efficiently implemented using a systematic approach with numerous locations, resulting in low to moderate cost projects that are more appropriate to seek state or federal funding. When considering any type of federally funded sign upgrade project, California local agencies are encouraged to consider "Roadway Safety Signing Audit (RSSA) and Upgrade Projects". Including RSSAs in the development phase of sign projects are expected to identify non-standard (per MUTCD) sign features and missing signs that may otherwise go unnoticed. More information on RSSA is available on the Local Assistance HSIP webpage.

FHWA CMF Clearinghouse:	Crash Types Addressed:	All	CRF:	0 - 30 %

R28, Install edge-lines and centerlines

For HSIP Calls-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
100%	All	25%	10 years
Notes:	This CM only applies to crashes occurring within the limits of the new centerlines and/or edge-lines. This CM is not intended to be used for general maintenance activities (i.e. the replacement of existing striping and RPMs in-kind) 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, unless prior approval is granted by Caltrans staff in writing and attached to application.		

General information				
Where to use:				
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 - install where the existing lane delineation is not sufficient to assist the motorist in understanding the existing limits of the roadway. Depending on the width of the roadway, various combinations of edge line and/or center line pavement markings may be the most appropriate. Incorporating raised/reflective pavement markers (RPMs) into centerlines (and edge-lines) should be considered as it has been shown to improve safety.				
Why it works:				
Installing edge-lines and centerlines where none exists or making significant upgrades to existing lines (paint to thermoplastic, adding audible disks/bumps in the thermoplastic stripes, or adding RPMs) are intended/designed to help drivers who might leave the roadway because of their inability to see the edge of the roadway along the horizontal edge of the pavement or cross-over the centerline of the roadway into oncoming traffic. New pavement marking products tend to be more durable, are all-weather, more visible, and have a higher retroreflectivity than traditional pavement markings.				
General Qualities (Time, Cost and Effectiveness):				
These improvements do not require a long development process and can typically be implemented quickly. Costs for implementing this strategy are nominal and depend on the number and length of locations. This CM can be effectively and 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 federal funding. When considering any type of federally funded striping upgrade project, California local agencies are encouraged to consider "Roadway Safety Striping Audit and Upgrade Projects". Including wide-scale striping audits in the development phase of striping projects are expected to identify non-standard (per MUTCD) striping/marking features, no-passing zone limits needing adjustment, and missing striping/markings that may otherwise go unnoticed. More information on this concepts is available on the Local Assistance HSIP webpage under an RSSA example document. Note: When federal safety funding is used for these installations in high-wear-locations, the local agency is expected to maintain the improvement for a minimum of 10 years.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Head-on, Run-off Road, All	CRF:	0 - 44 %

R33PB, Install Separated Bike Lanes

For HSIP Calls-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	Pedestrian and Bicycle	45%	20 years
Notes:	This CM only applies to "Ped & Bike" crashes occurring within the limits of the separated bike lanes. When an off-street bike-path is proposed that is not adjacent to the roadway, the applicant must document the engineering judgment used to determine which "Ped & Bike" crashes to apply.		

General information

Where to use:

Separated bikeways are most appropriate on streets with high volumes of bike traffic and/or high bike-vehicle collisions, presumably in an urban or suburban area. Separation types range from simple, painted buffers and flexible delineators, to more substantial separation measures including raised curbs, grade separation, bollards, planters, and parking lanes. These options range in feasibility due to roadway characteristics, available space, and cost. In some cases, it may be possible to provide additional space in areas where pedestrian and bicyclists may interact, such as the parking buffer, or loading zones, or extra bike lane width for cyclists to pass one another.

Why it works:

Separated bike lanes provide increased safety and comfort for bicyclists beyond conventional bicycle lanes. By separating bicyclists from motor traffic, "protected" or physically separated bike lanes can offer a higher level of comfort and are attractive to a wider spectrum of the public. Intersections and approaches must be carefully designed to promote safety and facilitate left-turns for bicyclists from the primary corridor to cross street.

In combination with this CM, better guidance signs and markings for non-motorized and motorized roadway users should be considered, including: sign and markings directing cyclists on appropriate/legal travel paths and signs and markings warning motorists of non-motorized uses of the roadway that should be expected.

General Qualities (Time, Cost and Effectiveness):

The cost of Installing separated bike lanes can be low to medium or high, depending on whether roadway widening, right-of-way and environmental impacts are involved. It is most cost efficient to create bike lanes during street reconstruction, street resurfacing, or at the time of original construction. The expected effectiveness of this CM must be assessed for each individual location.

FHWA CMF Clearinghouse:	Crash Types Addressed:	Pedestrian, Bicycle	CRF:	3.7 - 100 %

R34PB, Install sidewalk/pathway (to avoid walking along roadway)

For HSIP Calls-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	Pedestrian and Bicycle	80%	20 years
Notes:	This CM only applies to "Ped & Bike" crashes occurring within the limits of the new walkway. This CM is not intended to be used where an existing sidewalk is being replaced with a wider one, unless prior Caltrans approval is included in the application. When an off-street multi-use path is proposed that is not adjacent to the roadway, the applicant must document the engineering judgment used to determine which "Ped & Bike" crashes to apply.		

General information

Where to use:

Areas noted as not having adequate or no sidewalks and a history of walking along roadway pedestrian crashes. In rural areas asphalt curbs and/or separated walkways may be appropriate.

Why it works:

Sidewalks and walkways provide people with space to travel within the public right-of-way that is separated from roadway vehicles. The presence of sidewalks on both sides of the street has been found to be related to significant reductions in the "walking along roadway" pedestrian crash risk compared to locations where no sidewalks or walkways exist. Reductions of 50 to 90 percent of these types of pedestrian crashes. In combination with this CM, better guidance signs and markings for non-motorized and motorized roadway users should be considered, including: sign and markings directing pedestrians and cyclists on appropriate/legal travel paths and signs and markings warning motorists of non-motorized uses of the roadway that should be expected.

General Qualities (Time, Cost and Effectiveness):

Costs for sidewalks will vary, depending upon factors such as width, materials, and existing of curb, gutter and drainage. Asphalt curbs and walkways are less expensive, but require more maintenance. The expected effectiveness of this CM must be assessed for each individual location. These projects can be very effective in areas of high-pedestrian volumes with a past history of crashes involving pedestrians.

FHWA CMF Clearinghouse:	Crash Types Addressed:	Pedestrian, Bicycle	CRF:	65 - 89 %

R35PB, Install/upgrade pedestrian crossing (with enhanced safety features)

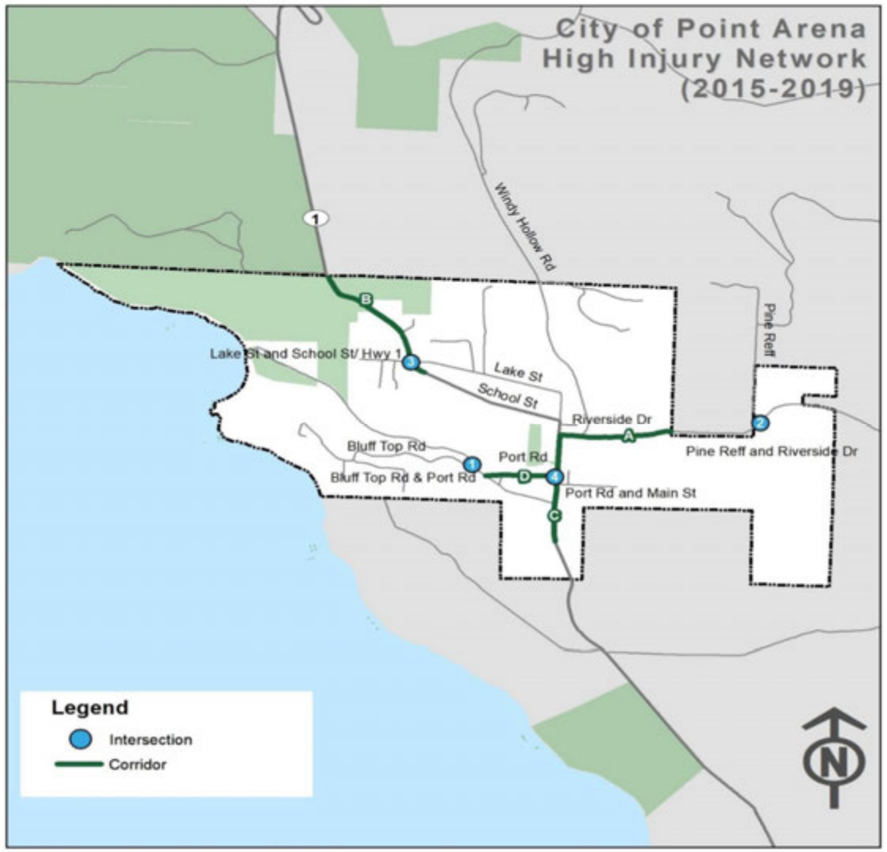
For HSIP Calls-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	Pedestrian and Bicycle	35%	20 years
Notes:	This CM only applies to "Ped & Bike" crashes occurring in the influence area (expected to be a maximum of within 250') of the new crossing which includes new enhanced safety features. Note: This CM is not intended to be combined with the "Install raised pedestrian crossing" when calculating the improvement's B/C ratio. This CM is not intended to be used for high-cost aesthetic enhancements (i.e. stamped concrete or stamped asphalt).		

General information				
Where to use:				
Roadway segments with no controlled crossing for a significant distance in high-use midblock crossing areas and/or multilane roads locations. Based on the Zegeer study (Safety Effects of Marked vs. Unmarked Crosswalks at Uncontrolled Locations) at many locations, a marked crosswalk alone may not be sufficient to adequately protect non-motorized users. In these cases, flashing beacons, curb extensions, medians and pedestrian crossing islands and/or other safety features should be added to complement the standard crossing elements. For multi-lane roadways, advance "yield" markings can be effective in reducing the 'multiple-threat' danger to pedestrians.				
Why it works:				
Adding pedestrian crossings has the opportunity to greatly enhance pedestrian safety at locations noted as being problematic. The enhanced safety elements, which may include curb extensions, medians and pedestrian crossing islands, beacons, and lighting, combined with pavement markings delineating a portion of the roadway that is designated for pedestrian crossing. Care must be taken to warn drivers of the potential for pedestrians crossing the roadway and enhanced improvements added to the crossing increase the likelihood of pedestrians crossing in a safe manner. In combination with this CM, better guidance signs and markings for non-motorized and motorized roadway users should be considered, including: sign and markings directing pedestrians and cyclists on appropriate/legal travel paths and signs. When agencies opt to install aesthetic enhancement to crossing like stamped concrete/asphalt, the project design and construction costs can significantly increase. For HSIP applications, these costs must be accounted for in the B/C calculation, but these costs (over standard crosswalk markings) must be tracked separately and are not federally reimbursable and will increase the agency's local-funding share for the project costs.				
General Qualities (Time, Cost and Effectiveness):				
Costs associated with this strategy will vary widely, depending on the extent of the curb extensions, raised medians, flashing beacons, and other pedestrian safety elements that are needed with the crossing. When considered at a single location, these improvements can sometimes be low cost and funded through local funding by local crews. This CM can often be effectively and efficiently implemented using a systematic approach with numerous locations, resulting in moderate to high cost projects that are appropriate to seek state or federal funding.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Pedestrian, Bicycle	CRF:	8 - 56%

APPENDIX D: COUNTERMEASURE TOOLBOX

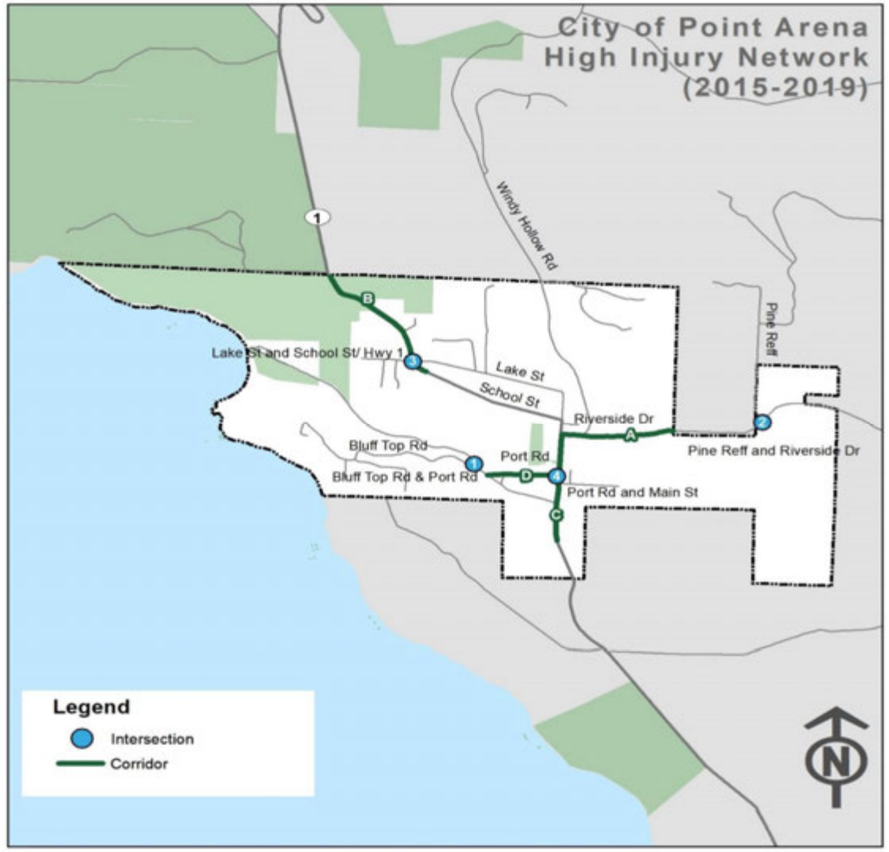
ID	Intersection	Control	Consolidated CMs (HSIP-Eligible - Refer to LRSM* 2020)			Additional CM (non-HSIP)**	EA - 1 Reduce Nighttime Collisions			EA - 2 Reduce Collisions Close to the City Boundaries			EA -3 Reduce Hit Object Collisions			EA 4 - Reduce Unsafe Speed Collisions		
			CM1	CM2	CM3		CM1	CM2	CM3	CM1	CM2	CM3	CM1	CM2	CM3	CM1	CM2	CM3
I-1	Port Rd and Bluff Top Rd	Uncontrolled	NS01	NS06	NS07		NS01	NS06					NS06	NS07				
I-2	Pine Reef and Riverside Dr	Two way stop controlled	NS01	NS06	NS07	Install stop bar and signs	NS01	NS06		NS01	NS06	NS07	NS06	NS07				
I-3	Lake St and School St/ Hwy 1	Two way stop controlled	NS06	NS09		Reduce radius of southeast corner;	NS06	NS09		NS06	NS09							
I-4	Port Rd and Main St	Uncontrolled (Stop sign)	NS06			Reduce parking near intersection;	NS06						NS06					
	Identified from Stakeholder Input																	
I-5	Iverson Ave and Main Street	One way stop controlled	NS07	NS06	NS09					NS07			NS07					
I-6	Corner of Main Street and School Street near Methodist Church	One way stop controlled	NS01	NS06	NS22PB		NS01						NS01					

Code	Countermeasure Name
NS01	Add intersection lighting (NS.I.)
NS06	Install/upgrade larger or additional stop signs or other intersection warning/regulatory signs
NS07	Upgrade intersection pavement markings (NS.I.)
NS09	Install flashing becons as advanced warning
NS18	Install left turn lane



ID	Roadway Segment	Consolidated CMs (HSIP-Eligible - Refer to LRSM* 2020)				Additional CM (non-HSIP)**	EA - 1 Reduce Nighttime Collisions			EA - 2 Reduce Collisions Close to the City Boundaries			EA -3 Reduce Hit Object Collisions			EA 4 - Reduce Unsafe Speed Collisions		
		CM1	CM2	CM3	CM4		CM1	CM2	CM3	CM1	CM2	CM3	CM1	CM2	CM3	CM1	CM2	CM3
A	Riverside Dr: Main St/Hwy 1 to Pine Reef	R02	R22	R26	R27	Repave roadway	R22	R27		R02	R22	R27	R02	R27		R22	R26	
B	School St/Hwy 1: Northern City Limits to Lake St	R02	R26	R27	R31		R27			R02	R26	R27	R02	R27		R26	R31	
C	Main St/ Hwy 1: Riverside Dr to Southern City Limits	R22	R25		R35PB		R22	R28		R22	R28	R35PB				R26	R28	
D	Port Rd: Iverson Ave to Main St/ Hwy 1	R01	R22			Restrict larger trucks from	R01	R22								R22		
	Identified from Stakeholder Input																	
E	Highway 1 through town	R35PB								R35PB								

Code	Countermeasure Name
R01	Add Segment Lighting
R02	Relocate fixed object
R22	Install/Upgrade signs with new fluorescent sheeting (regulatory or warning)
R25	Install curve advanced warning signs (flashing beacons)
R26	Install dynamic/variable speed warning signs
R27	Install delineators, reflectors and/or object markers
R28	Install edge-lines and centerlines
R31	Install edgeline rumble strips/stripes
R35PB	Install/upgrade pedestrian crossing (with enhanced safety features)



	Strategy	Performance Measure	Organizations to be involved
Education	Conduct public information and education campaign for intersection safety laws, unsafe speeds, distracted driving, improper turning and driving under the influence.	Number of education campaigns	City/ School District/ Police Department
	Conduct pedestrian safety campaigns and outreach to raise their awareness of pedestrian safety needs through media outlets, social media and Bike and Walk Mendocino. Update pamphlet for crosswalk safety for Point Arena every 3-5 years.	Number of education campaigns	City/ School District/ Police Department
Enforcement	Targeted enforcement at high-risk locations.	Number of tickets issued.	Police Department **(CHP main enforcer on Highway 1)**
	Increase the number of personnel who have completed Advanced Roadside impaired Driving Enforcement (ARIDE) training	Number of personnel who have completed Advanced Roadside impaired Driving Enforcement (ARIDE) training	Police Department **(CHP main enforcer on Highway 1)**
Emergency Medical Services (EMS)	S05, Install emergency vehicle pre-emption systems	EMS vehicle response time.	Mendocino County Local Emergency Services Agency
	Increase the number of EMS/fire controll personnel taking Traffic Incident Managmenet Traising	number of EMS/fire controll personnel taking Traffic Incident Managmenet Traising	Mendocino County Local Emergency Services Agency

APPENDIX E: B/C RATIO CALCULATION - LRSM (2020)

Benefit/Cost Ratio Calculations

This appendix includes the Benefit/Cost methodology used in the Caltrans calls-for-projects in the HSIP programs. The HSM, Part B - Chapter 7, includes more details on conducting Economic Appraisal for roadway safety projects. Local agencies will be required to utilize the HSIP Analyzer to calculate the B/C ratio as part of their application for HSIP funding. Starting in Cycle 7 call for projects, the fatality and severe injury costs have been combined for calculating the benefit. Because fatality figures are small and are a matter of randomness, this change is being made to reduce the possibility of selecting an improvement project on the basis of randomness.

1) $Benefit\ (Annual) = \sum_{s=0}^{3} \frac{CRF \times N \times CC_{ave}}{Y}$

- CRF : Crash reduction factor in each countermeasure.
- S : Severity (0: PDO, 1: Minor Injury, 2: Injury, 3: Severe Injury/Fatal). See the below table.
- N : Number of Crashes, in severity levels, related to selected countermeasure.
- Y : Crash data time period (Year).
- CC_{ave} : Crash costs in severity levels.

Severity (S)	Crash Severity *	Location Type	Crash Cost ***
3	**Fatality and Severe Injury Combined (KA)	Signalized Intersection	$1,590,000
3		Non Signalized Intersection	$2,530,000
3		Roadway	$2,190,000
2	Evident Injury – Other Visible (B)		$142,300
1	Possible Injury–Complaint of Pain (C)		$80,900
0	Property Damage Only (O)		$13,300

* The letters in parenthesis (K, A, B, C and O) refer to the KABCO scale; it is commonly used by law enforcement agencies in their crash reporting efforts and is further documented in the HSM.

** Figures were calculated based on an average Fatality (K) / Severe Injury (A) ratio for each area type, a crash cost for a Fatality (K) of $7,219,800, and a crash cost of a Severe/Disabling Injury (A) of $389,000. These costs are used in the HSIP Analyzer.

*** Based on Table 7-1, Highway Safety Manual (HSM), First Edition, 2010. Adjusted to 2020 Dollars.

2) *Benefit (Life) = Benefit (annual) x Years of service life*

3) Benefit/Cost Ratio (each countermeasure): $Benefit\ \ Cost\ Ratio_{(CM)} = \frac{Benefit\ (Life)_{(CM)}}{Total\ \mathrm{Pr}oject\ Cost_{(CM)}}$

4) Benefit/Cost Ratio (project): $Benefit/Cost\ Ratio\ (\mathrm{Pr}oject) = \frac{\sum_{CM=1}^{3} Benefit\ (Life)_{(CM)}}{Total\ \mathrm{Pr}oject\ Cost}$