City of Fort Bragg

Local Roadway Safety Plan

06/15/2022

Final Report

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Executive Summary

The City of Fort Bragg'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 Fort Bragg Costal General Plan (2008), Inland General Plan (2012), Fort Bragg Bicycle Master Plan (2009), 2018 Street Safety Plan, South Main Street Access and Beautification Plan (2011), City of Trails: Trails Feasibility Study (2016), City of Trails: Supplemental Trail Feasibility Studies (2017), City of Fort Bragg FY 2020-2021 Budget, Mill Site Specific Plan (2012), Mendocino County Regional Active Transportation Plan (2017), Mendocino County Safe Routes to School Plan (2014), Mendocino County Pedestrian Facility Needs Inventory and Engineered Feasibility Study (2019), and Mendocino Council of Governments 2020 Regional Transportation Improvement Program (2019)

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 Fort Bragg. There were a total of 548 collisions reported City-wide from 2015 to 2019. Out of these 470 collisions (86 percent) were property damage only (PDO) collisions, 50 collisions (9 percent) led to complaint of pain injury and 23 collisions (4 percent) led to a visible injury. There were 5 F+SI (fatal and severe injury) collisions, 4 collisions (1 percent) led to a severe injury and 1 collisions led to a fatality.

For fatal and severe injury (F+SI) collisions, 60 percent of collisions involved pedestrian. This calls for evaluating pedestrian conditions along this intersection and also throughout the City at locations with similar characteristics that are potentially unsafe for pedestrians. Improvements at these locations can include reducing pedestrian crossing distances, installing high visibility crosswalks, installing pedestrian refuge/ median islands, and installing bulb outs. The South Main Street Access and Beautification Plan contains similar proposed pedestrian improvements for South Main Street which were identified as high injury corridors. The pedestrian safety improvements identified in this plan may be used to provide the basis for a Highway Safety Improvements (HSIP) grant.

Gateway treatments and roundabouts are also identified in the South Main Street Access and Beautification Plan which can reduce speeds and provide traffic calming benefits to all road users. Automobile right of way, unsafe speed collisions and broadside collisions can be reduced with roundabouts which were also identified as being a main factor in fatal and severe injuries in Fort Bragg.

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 Fort Bragg. The nine emphasis areas for Fort Bragg are:

- Intersection Safety
    a. Collisions within 250 feet of intersections
- Pedestrian Safety
- Improper Turning Collisions
- Route 1 Collisions
- Alley Ways Collisions
- Older 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 four safety projects were created for high-risk intersections and roadway segments, using HSIP approved countermeasures. These safety projects are:

Project 1: Systemic Improvements at Unsignalized Intersections
Project 2: Pedestrian 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-evaluated.

1. Introduction

What is a LRSP?

The Local Roadway Safety Plan (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 Highway Safety Improvement Program (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 Fort Bragg
- 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 Fort Bragg residents

Study Area

The City of Fort Bragg is located in Mendocino County, California, covering a total area of about 2.931 square miles. It is the located on the coast, 24 miles west of the City of Willits at an elevation of 85 feet.
The City's estimated population is 7,302 (ACS 2019 1-year estimate). The City is accessible via CA-1 corridor. **Figure 1** shows the study area.

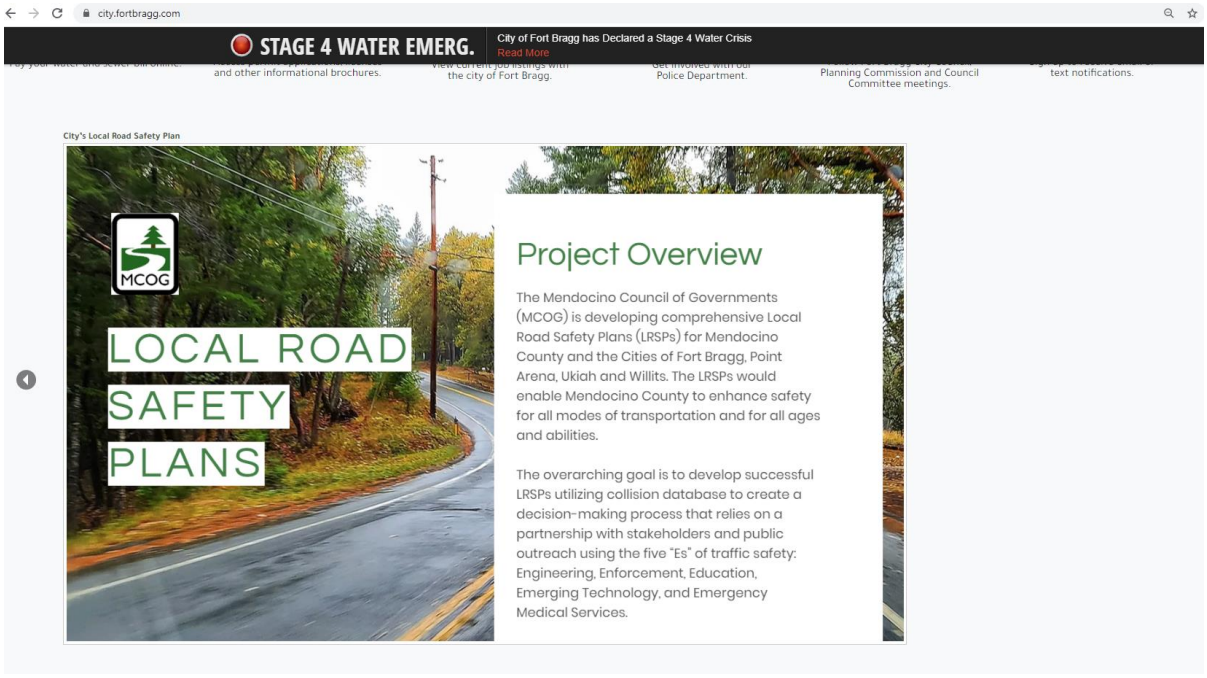
Figure 1. Study Area: City of Fort Bragg

Safety Partners

Safety partners are vital to the development and implementation of an LRSP. For the City of Fort Bragg, these include representatives from Public Works, Fire Department, School District, Mendocino Coast Hospital Ambulance Service, Community Development Department, Police Department, County Supervisor, Walk and Bike Mendocino, CHP, Cal Fire, Mendocino Transit Authority, 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 timeline.

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 21 comments were for the City of Fort Bragg.

Figure 2. City's website and social media posting



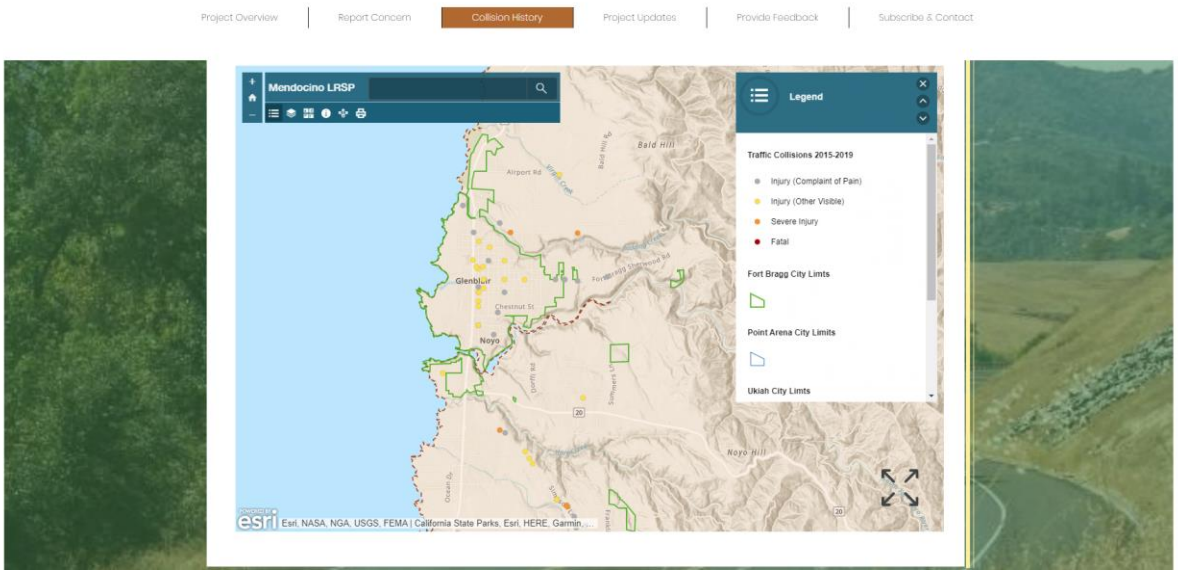
City of Fort Bragg California
Published by Davis Lynda · Just now ·

The City of Fort Bragg with the Mendocino Council of Governments (MCOG) is developing a citywide Local Road Safety Plan geared towards improving traffic safety for pedestrians, bicyclists, transit users and drivers. To learn more about the project, please visit the project website.
Participate in a virtual workshop to tell us about your traffic-related safety concerns on the city streets!
Visit https://www.mendocinosaferoads.com/ for more!

La Ciudad de Fort Bragg con el Consejo de Gobiernos de Mendocino (MCOG) está desarrollando un Plan de Seguridad Vial Local para toda la ciudad orientado a mejorar la seguridad del tráfico para peatones, ciclistas, usuarios de tránsito y conductores. Para obtener más información sobre el proyecto, visite el sitio web del proyecto.
¡Participe en un taller virtual para contarnos sus preocupaciones de seguridad relacionadas con el tráfico en las calles de la ciudad!
Visite la pagina https://www.mendocinosaferoads.com/

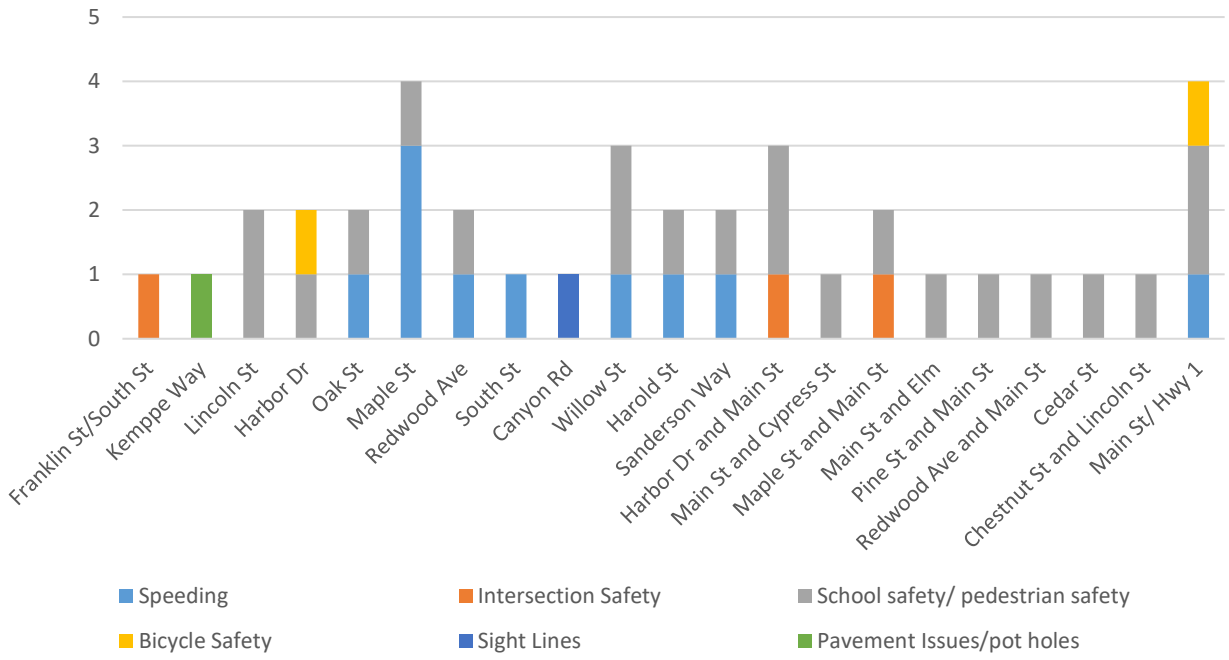
MENDOCINOSAFEROADS.COM
Mendocino Safe Roads
The Mendocino Council of Governments (MCOG) is developing co...

Figure 3. Project Website: www.mendocinosaferoads.com



The most common commented on traffic safety issue pedestrian/school safety, with 14 comments. Main Street/Hwy 1 was the most commented on street with pedestrian safety issues, followed by Willow Street and Lincoln Street. Maple Street was referred to the most as a street with speeding issues, with 3 comments. Other streets were South Street, Redwood Avenue, Willow Street, Oak Street, Harold Street and Sanderson Street.

Figure 4. City of Fort Bragg - Public Comments



2. Existing Planning Efforts

This chapter summarizes the planning documents, projects underway, and studies reviewed for the City of Fort Bragg Local Road Safety Plan (LRSP) being developed as a part the Mendocino Council of Governments' LRSPs for local agencies. The purpose of this review is to ensure the LRSP vision, goals, and E's strategies are aligned with prior planning efforts, planned transportation projects and non-infrastructure programs. The documents reviewed are listed below:

- City of Fort Bragg Costal General Plan (2008)
- Inland General Plan (2012)
- Fort Bragg Bicycle Master Plan (2009)
- 2018 Street Safety Plan
- South Main Street Access and Beautification Plan (2011)
- City of Trails: Trails Feasibility Study (2016)
- City of Trails: Supplemental Trail Feasibility Studies (2017)
- City of Fort Bragg FY 2020-2021 Budget
- Mill Site Specific Plan (2012)
- Mendocino County Regional Active Transportation Plan (2017)
- Mendocino County Safe Routes to School Plan (2014)
- Mendocino County Pedestrian Facility Needs Inventory and Engineered Feasibility Study (2019)
- Mendocino Council of Governments 2020 Regional Transportation Improvement Program (2019)

The following sections include brief descriptions of these documents and how they inform the development of the LRSP. A summary of each document is provided in **Table 1**. A more detailed list of relevant policies and programs is provided in **Appendix A**.

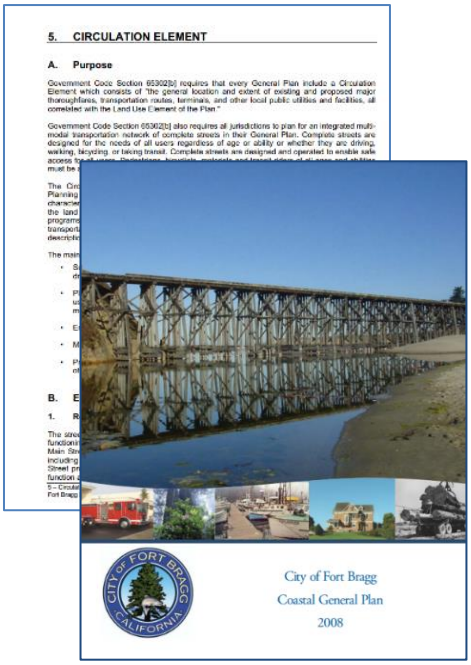
Table 1 Document Review Summary

Document	Highlights
City of Fort Bragg Costal General Plan (2008)	Circulation element of the coastal General Plan details long range plans for the City of Fort Bragg including bicycle, pedestrian, vehicle and transit policies.
Inland General Plan (2012)	This general plan regulates land use for inland properties that are within City limits but not in the Coastal Zone.
Fort Bragg Bicycle Master Plan (2009)	This plan establishes goals and policies, analyzes existing conditions, proposes recommended standards and identifies potential projects for guiding the improvement of the City's bicycle facilities.

Document	Highlights
2018 Street Safety Plan	This plan recommends infrastructure improvements that will enhance the safety of pedestrians, bicyclists and motorists on residential neighborhoods and commercial streets in Fort Bragg.
South Main Street Access and Beautification Plan (2011)	This project enhances pedestrian crossings of Highway 1, with curb extensions, high visibility striping, stop bars, pedestrian signage and strategically placed median refuge islands. It also improves safety by reducing vehicle speeds, as well as beautifies the streetscape with trees and landscape strips.
City of Trails: Trails Feasibility Study (2016)	This City of Trails Feasibility Study evaluates three potential new priority trails which could be developed to expand the existing trail network in Fort Bragg.
City of Trails: Supplemental Trail Feasibility Studies (2017)	The City of Trails supplement evaluates engineering and geotechnical challenges associated with implementation of two segments of costal trails.
City of Fort Bragg FY 2020-2021 Budget	The City of Fort Bragg's fiscal year 2020 – 2021 Budget outlines the funds the city has allocated to various departments and project include street and road maintenance and improvements.
Mill Site Specific Plan (2012)	The Mill Site Specific Plan is a community-based vision for the redevelopment of the old mill site in Fort Bragg.
Mendocino County Regional Active Transportation Plan (2017)	Details bicycle and pedestrian improvements on County significant corridors. Includes many detailed priority bike and pedestrian projects.
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 including the schools Westport Village Community School and Three Rivers Learning Center.
Mendocino County Pedestrian Facility Needs Inventory and Engineered Feasibility Study (2019)	The project's goal is to improve sidewalks, paths, and safe crossings in Mendocino County so it's easier to walk where you need to travel.
Mendocino Council of Governments 2020 Regional Transportation Improvement Program (2019)	The Regional Transportation Improvement Program (RTIP) is a program of highway, local road, transit and active transportation projects that a region plans to fund with State and Federal revenue.

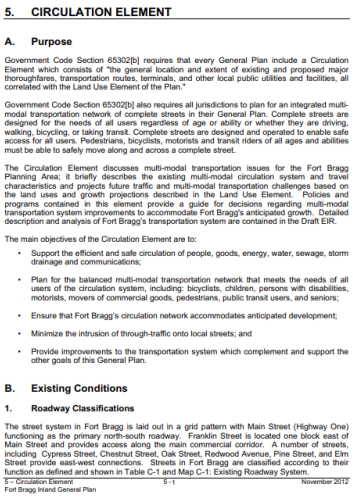
City of Fort Bragg Coastal General Plan (2008)

The General Plan presents a consolidated framework of decisions for guiding where and how development should occur in Fort Bragg. The Coastal General Plan applied to all projects in the Coastal Zone. Circulation Element discusses transportation issues for the Fort Bragg Planning Area; it briefly describes the existing circulation system and travel characteristics and projects future traffic based on the land uses and growth projections described in the Land Use Element. The Circulation Element ensure that Fort Bragg's circulation network is sufficient to accommodate anticipated development.



Inland General Plan (2012)

This General Plan regulates land use for inland properties that are in city limits, but not in the Coastal Zone. The policy framework of the Inland General Plan has a long range perspective and is intended to address development concerns for the next ten years (2022). The Circulation Element contains policies for public transit, bicycle facilities, parking and transportation for the mobility impaired, taking into account the relationship between land use and transportation needs of the community.



5. CIRCULATION ELEMENT

A. Purpose

Government Code Section 65302[b] requires that every General Plan include a Circulation Element which consists of "the general location and extent of existing and proposed major thoroughfares, transportation routes, terminals, and other local public utilities and facilities, all correlated with the Land Use Element of the Plan."

Government Code Section 65302[b] also requires all jurisdictions to plan for an integrated multi-modal transportation network of complete streets in their General Plan. Complete streets are designed for the needs of all users regardless of age or ability or whether they are driving, walking, bicycling, or taking transit. Complete streets are designed and operated to enable safe access for all users. Pedestrians, bicyclists, motorists and transit riders of all ages and abilities must be able to safely move along and across a complete street.

The Circulation Element discusses multi-modal transportation issues for the Fort Bragg Planning Area; it briefly describes the existing multi-modal circulation system and travel characteristics and projects future traffic and multi-modal transportation challenges based on the land uses and growth projections described in the Land Use Element. Policies and programs contained in this element provide a guide for decisions regarding multi-modal transportation system improvements to accommodate Fort Bragg's anticipated growth. Detailed description and analysis of Fort Bragg's transportation system are contained in the Draft EIR.

The main objectives of the Circulation Element are to:

- Support the efficient and safe circulation of people, goods, energy, water, sewage, storm drainage and communications;
- Plan for the balanced multi-modal transportation network that meets the needs of all users of the circulation system, including: bicyclists, children, persons with disabilities, motorists, movers of commercial goods, pedestrians, public transit users, and seniors;
- Ensure that Fort Bragg's circulation network accommodates anticipated development;
- Minimize the intrusion of through-traffic onto local streets; and
- Provide improvements to the transportation system which complement and support the other goals of this General Plan.

B. Existing Conditions

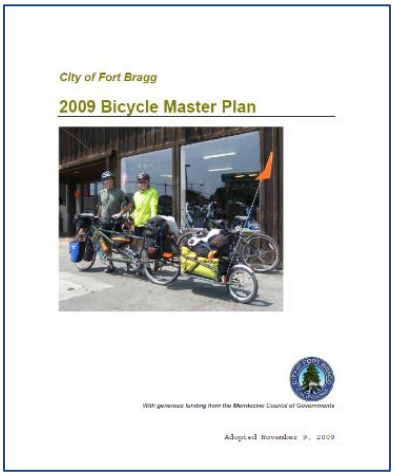
1. Roadway Classifications

The street system in Fort Bragg is laid out in a grid pattern with Main Street (Highway One) functioning as the primary north-south roadway. Franklin Street is located one block east of Main Street and provides access along the main commercial corridor. A number of streets, including Cypress Street, Chestnut Street, Oak Street, Redwood Avenue, Pine Street, and Elm Street provide east-west connections. Streets in Fort Bragg are classified according to their function as defined and shown in Table C-1 and Map C-1: Existing Roadway System.

5 – Circulation Element 5 - 1 November 2012
Fort Bragg Inland General Plan

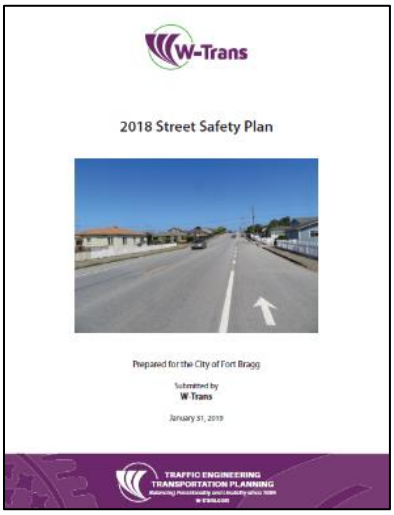
City of Fort Bragg 2009 Bicycle Master Plan

In 2009, the City adopted a Bicycle Master Plan that incorporated the development of bike paths, bike lanes, and bike routes throughout the City. The City's Bicycle Master Plan builds on the existing Bicycle Circulation Plan. Bicycling is an important transportation option that offers many benefits to the Fort Bragg community. The Bicycle Master Plan was prepared to direct the City's efforts to improve the cycling environment in Fort Bragg.



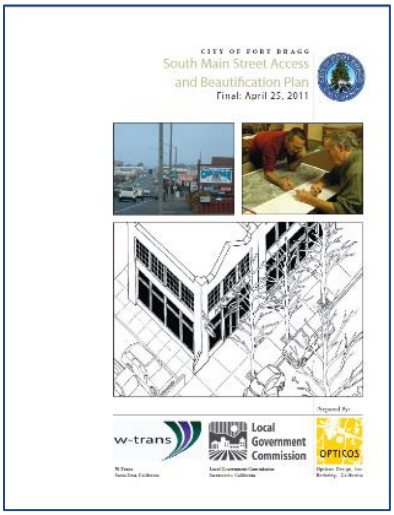
2018 Street Safety Plan

The City of Fort Bragg completed a Residential Streets Safety Plan (RSSP) in 2005. The 2018 Street Safety Plan is an expansion and update of the 2011 Residential Streets Safety Plan that also address commercial street safety. The roadways evaluated in this study are Maple Street, Elm Street, Pine Street, Main Street (SR 1), Fir Street and Harold Street. This plan will provide guidance on countermeasures selected for the LRSP.



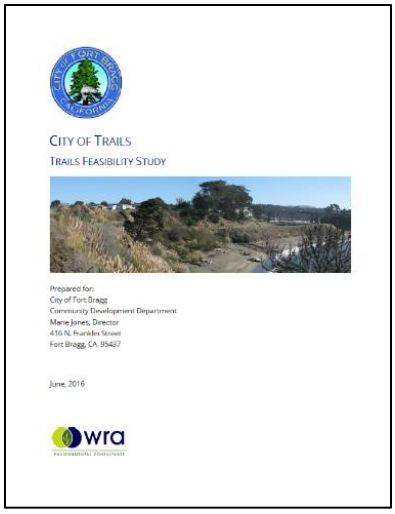
South Main Street Access and Beautification Plan (2011)

This plan's primary focus is to improve safety, mobility, and access between central Fort Bragg and its southern business, recreational, and residential areas and to improve the aesthetic qualities of the South Main corridor through design recommendations that positively impact the overall urban design of the project area.



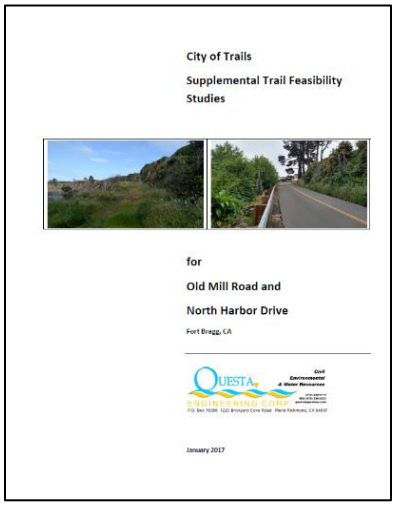
City of Trails: Trails Feasibility Study (2016)

The City of Trails Feasibility Study evaluates three potential new priority trails which could be developed to expand the existing trail network in Fort Bragg. The purpose of the City of Trails Feasibility Study is to identify trail opportunities that are beneficial and of interest to the community; provide detailed feasibility and development cost information for the selected priority trails; and identify permitting requirements. Trails benefit communities by providing healthy opportunities to walk and ride to daily destinations and recreational activities. The availability of trails can, over time, reduce a community's dependence on cars, total vehicle miles traveled (VMTs) and greenhouse gas emissions. This plan will provide guidance on countermeasures selected for the LRSP.



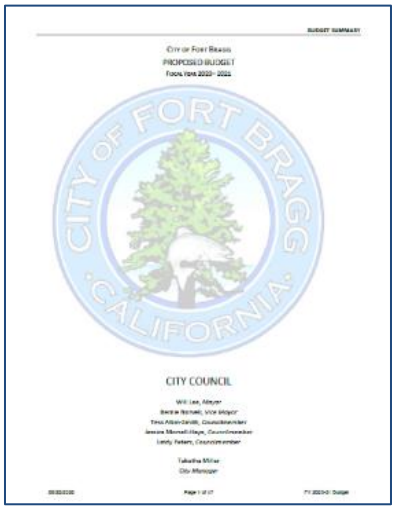
City of Trails: Supplemental Trail Feasibility Studies (2017)

The City of Trails Supplemental Trail Feasibility Study evaluates engineering and geotechnical challenges associated with implementation of two segments of a coastal trail to connect the existing Coastal Trail-South Segment, with Noyo Harbor. This document builds on the City of Trails Feasibility Study, in which the Old Mill Road Multi-use Trail to North Noyo Harbor is described as a priority trail, in addition, this Study also addresses the feasibility of placing either a Class I or II bicycle trail parallel to North Harbor Drive. This plan will provide guidance on countermeasures selected for the LRSP.



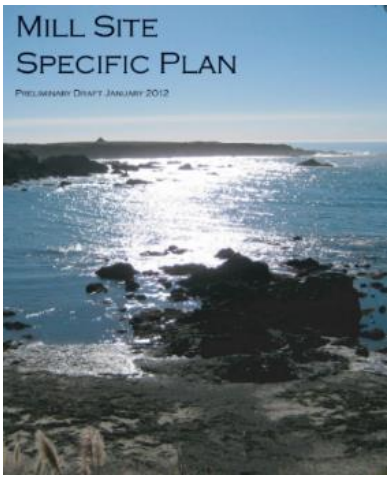
City of Fort Bragg FY 2020-2021 Budget

The City of Fort Bragg's fiscal year 2020 – 2021 Budget outlines the funds the city has allocated to various departments and project include street and road maintenance and improvements. Street maintenance, along with traffic and safety improvement cost along with their funding sources have been listed under the FY 2021-2025 Capital Improvement Program.



Mill Site Specific Plan (2012)

The Mill Site Specific Plan is the result of a community-based vision for the redevelopment of the old mill site in Fort Bragg that defines the framework for future redevelopment. The Mill Site Specific Plan Study Area includes the Plan Area and the adjacent 82-acre coastal trail and parkland area to the west. The central elements to the Specific Plan's central vision are the coastline, walkability, public spaces, a central business district extension, opens space and habitat restoration.

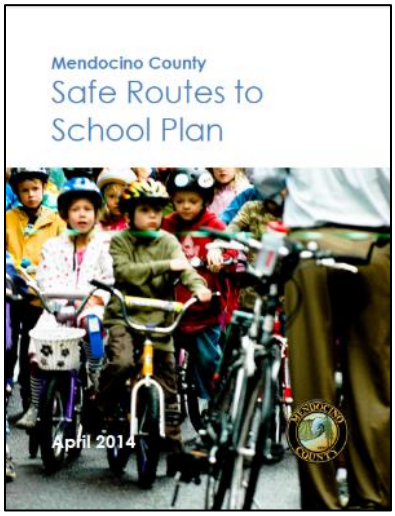


Mendocino County Regional Active Transportation Plan (2017)

This Plan is intended to identify 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.

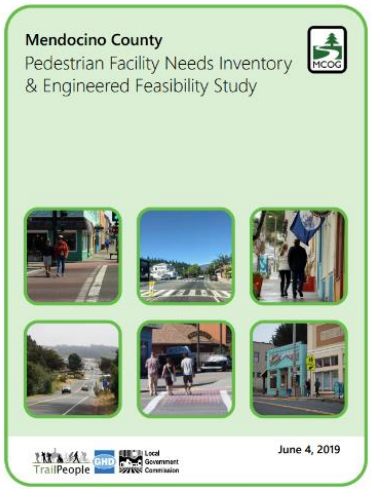
Mendocino County Safe Routes to School Plan (2014)

Safe Routes to School (SRTS) is a program with a simple goal: helping more children get to school by walking and bicycling. The plan envisions active 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 and improve air quality around schools.



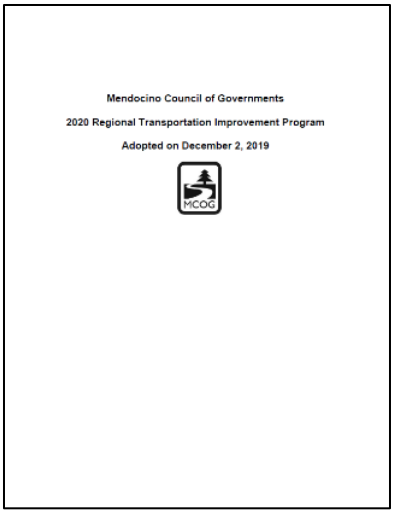
Mendocino County Pedestrian Facility Needs Inventory and Engineered Feasibility Study (2019)

The Mendocino County Pedestrian Facility Needs Inventory and Engineered Feasibility Study has a simple goal: to improve sidewalks, paths, and safe crossings in Mendocino County so it's easier to walk where you need to. This study covers all of Mendocino County; a vast amount of territory and many communities from large to tiny. This report describes all the potential pedestrian access improvement projects identified through the review of past studies, the inventory and analysis of existing conditions for pedestrian access, agency staff input, and the public input from workshops, meetings and on-line surveys



Mendocino Council of Governments 2020 Regional Transportation Improvement Program (2019)

The Regional Transportation Improvement Program (RTIP) is a program of highway, local road, transit and active transportation projects that a region plans to fund with State and Federal revenue programmed by the California Transportation Commission in the State Transportation Improvement Program (STIP).


Mendocino Council of Governments

2020 Regional Transportation Improvement Program

Adopted on December 2, 2019

MCOG

3. Collision Data Collection and Analysis

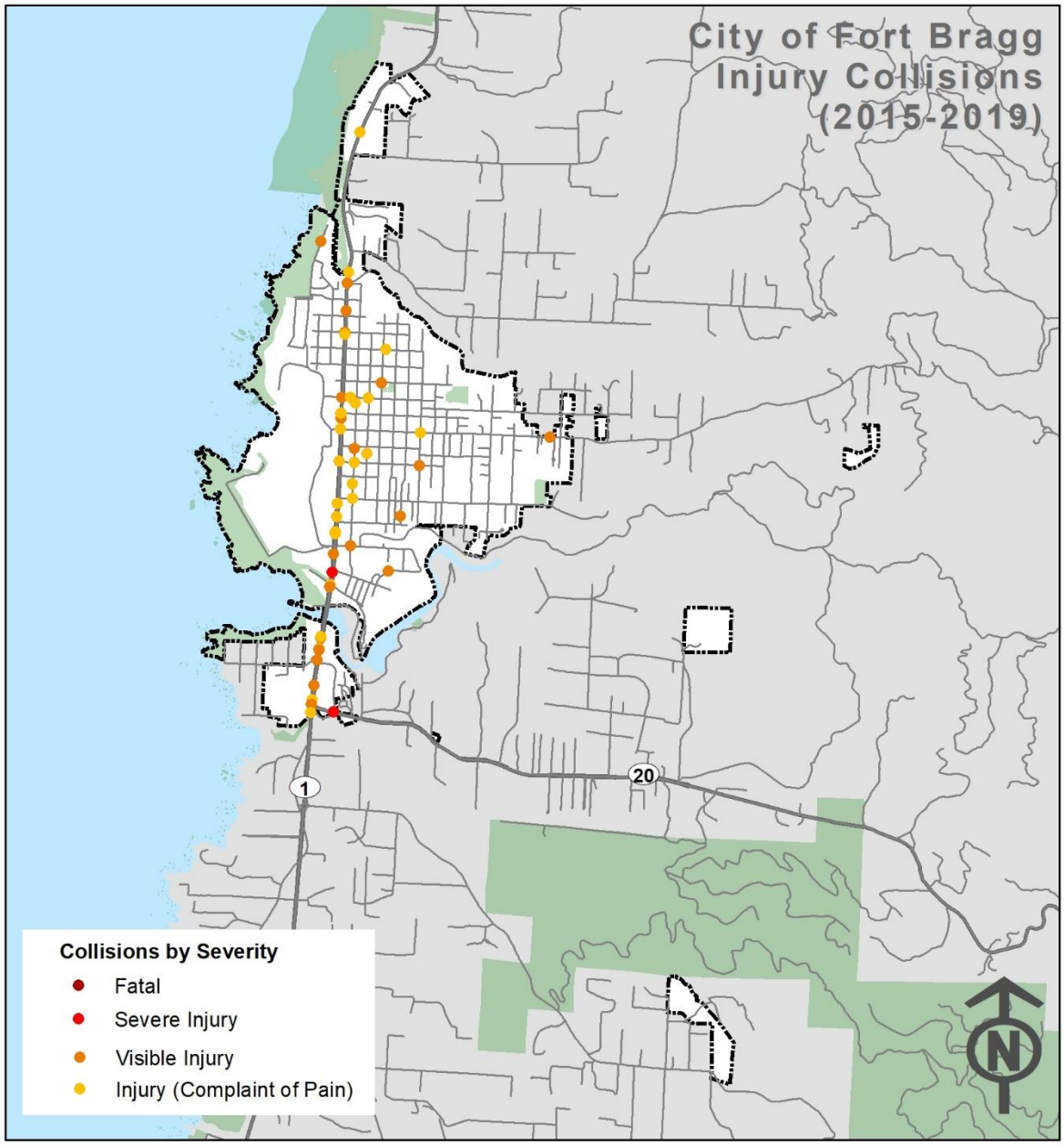
This chapter summarizes the results of a citywide collision analysis for collisions that have occurred in the City of Fort Bragg between January 2015 and December 2019. A five-year city-wide collision data set was retrieved from Transportation Injury Mapping System (TIMS) and Statewide Integrated Traffic Records System (SWITRS).

The LRSP focuses on systemically identifying and analyzing traffic safety issues to recommend appropriate safety strategies and improvements. This chapter starts with an analysis of citywide collisions of all severity, including Property Damage Only (PDO) collisions, retrieved from Transportation Injury Mapping System (TIMS) and Statewide Integrated Traffic Records System (SWITRS). Further on, a detailed analysis was conducted for high-injury collisions, including fatal and severe injury (F+SI) collisions that have occurred on Fort Bragg's roadways. After this data was separated, 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. The following is a brief overview of the sections:

- Demographic and Jurisdiction Information
- Data Collection
- Collision Data Analysis
- Fatal and Severe Injury Collision Analysis
- Geographic Collision Analysis
- High Injury Network
- Summary

Error! Reference source not found. illustrates all the injury collisions that have occurred in Fort Bragg from January 2015 to December 2019.

Figure 5. All Injury Collisions on Fort Bragg Roadways (2015 – 2019)



Demographic and Jurisdiction Characteristics

This section provides an understanding of the demographics of the City of Fort Bragg and Mendocino County, including characteristics like the population, centerline miles of roadway and commute to work. The data was collected from the United States Census Bureau[1].

Population

According to the 2015 - 2019 American Community Service (ACS) 5-year Estimate data, the population of Fort Bragg is 7,302, which is 8.4 percent of the county population. The population as well as the centerline miles are listed in **Table 2**.

Table 2. Fort Bragg and Mendocino Population and Centerline Miles

	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 Fort Bragg, approximately 78 percent of residents travel by cars or vans to work, out of which 64 percent drive alone and 14 percent carpool. About 14 percent of residents walk to work and 1 percent of residents take transit. The different modes of transportation used to commute to work for the City are shown in **Table 3**.

Table 3. City of Fort Bragg Commute to Work Census Data

Commute to Work	Fort Bragg	Commute to Work	Fort Bragg
Drive alone	64%	Bicycle	0%
Carpool	14%	Work from Home	8%
Public Transportation	1%	Other	0%
Walked	14%		

Jurisdiction Rankings

Between 2015 and 2019, Mendocino County had 112 fatal traffic collisions, with 2 occurring in Fort Bragg, with a traffic fatality rate per 100,000 population of 25.82 for the County as a whole, and 5.28 for Fort Bragg. These rates are less than the California average and the country

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

average with 8.95 and 10.28, respectively. **Table 4** shows the comparison of traffic fatality rates and population.

Table 4. Jurisdiction Ranking

Jurisdiction	Fatal Traffic Collisions (2015-2019)	Population	5 year Fatality Rate per 100,000
Fort Bragg	2	7,302	5.48
Mendocino County	112*	86,749	25.82
California	17,684	39,512,223	8.95
United States	168,742	328,239,523	10.28
***Note: These numbers include all state route collisions fatalities** **Source: TIMS, Census, NHTSA**			

Office of Traffic Safety Rankings

Additional information on collisions in the City of Fort Bragg is provided by the California Office of Traffic Safety (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 Fort Bragg ranks in the top, meaning higher collisions rates in alcohol involved collisions (3 out of 75 similarly sized cities), pedestrian collisions (15 out of 75 similarly sized cities) and speed related collisions (16 out of 75 similarly sized cities). These rankings take into account fatal and injury crashes per population and per vehicle miles traveled (VMT). Overall Fort Bragg ranks 46 out 102 similarly sized cities in California in fatal and injury collisions. **Table 5** provides a summary of the 2018 rankings[2].

Table 5. Office of Traffic Safety Ratings 2018

OTS 2018 Ranking	Fort Bragg	OTS 2018 Ranking	Fort Bragg	OTS 2018 Ranking	Fort Bragg
Total Fatality and Injury	13/75	Pedestrian	15/75	Speed Related	16/75
Alcohol Involved	3/75	Bicycle	36/75	Nighttime	28/75

[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=Fort+Bragg&wpv_filter_submit=Submit

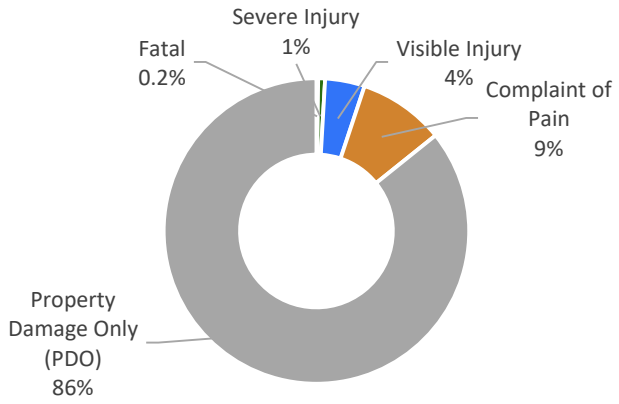
Collision Data Collection

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 Transportation Injury Mapping System (TIMS) and Statewide Integrated Traffic Records System (SWITRS)[3]. State route roadways in Fort Bragg 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

There were a total of 548 collisions reported City-wide from 2015 to 2019. Out of these 470 collisions (86 percent) were property damage only (PDO) collisions, 50 collisions (9 percent) led to complaint of pain injury and 23 collisions (4 percent) led to a visible injury. There were 5 F+SI (fatal and severe injury) collisions, 4 collisions (1 percent) led to a severe injury and 1 collisions led to a fatality. **Figure 6** illustrates the classification of all collisions based on severity.

Figure 6. Collisions by Severity (2015-2019)



The analysis first includes a comparative evaluation between all collisions and F+SI collisions, based on various factors including but not limited to the collision trend, primary collision factor, collision type, facility type, motor vehicle involved with, weather, lighting, and time of the day. Further on, a comprehensive analysis is conducted for only F+SI collisions. F+SI collisions cause the most damage to those affected, infrastructure and the aftermath of these collisions lead to great expenses for jurisdiction administration. The LRSP process thus focuses on these collision locations to proactively identify and counter their respective safety issues.

[3] 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 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

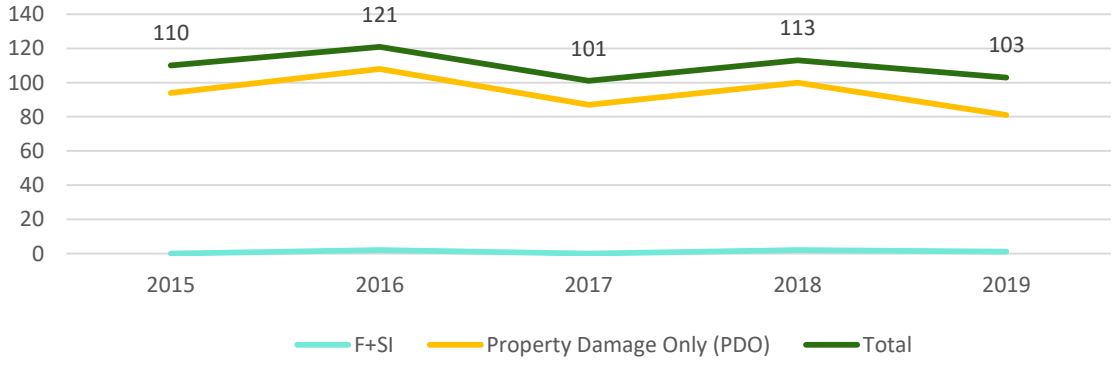
Collision Severity	Roadway Segment	Intersection	Total
Fatal	0	1	1
Severe Injury	0	4	4
Visible Injury	7	16	23
Complaint of Pain	5	45	50
Property Damage Only (PDO)	43	427	470
Total	**55**	**493**	**548**

Preliminary Analysis

Collision Severity by Year

For all collisions, the number of collisions decreased from 2015 to 2019. The highest number of collisions (121 collisions) were observed in 2016 and the lowest number of collisions (101) were observed in 2017. A total of 5 F+SI collisions occurred in the City of Fort Bragg during the study period. No F+SI collisions occurred in 2015 and 2017. Overall, F+SI collisions were observed to rise from 2017 to 2019, with the highest number of F+SI collisions (2 collisions) occurring in the years 2016 and 2018. **Figure 7** the five-year collision trend for all collisions, F+SI collisions and also PDO collisions.

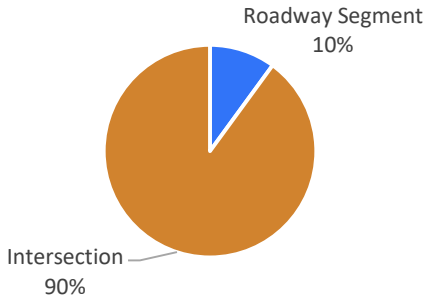
Figure 7. Five Year Collision Trend



Intersection vs. Roadway Collisions

When evaluating roadways vs intersections, it was observed that the majority of collisions occurred at intersections. In the City of Fort Bragg, 90% of all collisions (493 collisions) occurred at intersections whereas 10% (55 collisions) occurred on roadway segments. This classification by facility type can be observed in **Figure 8**.

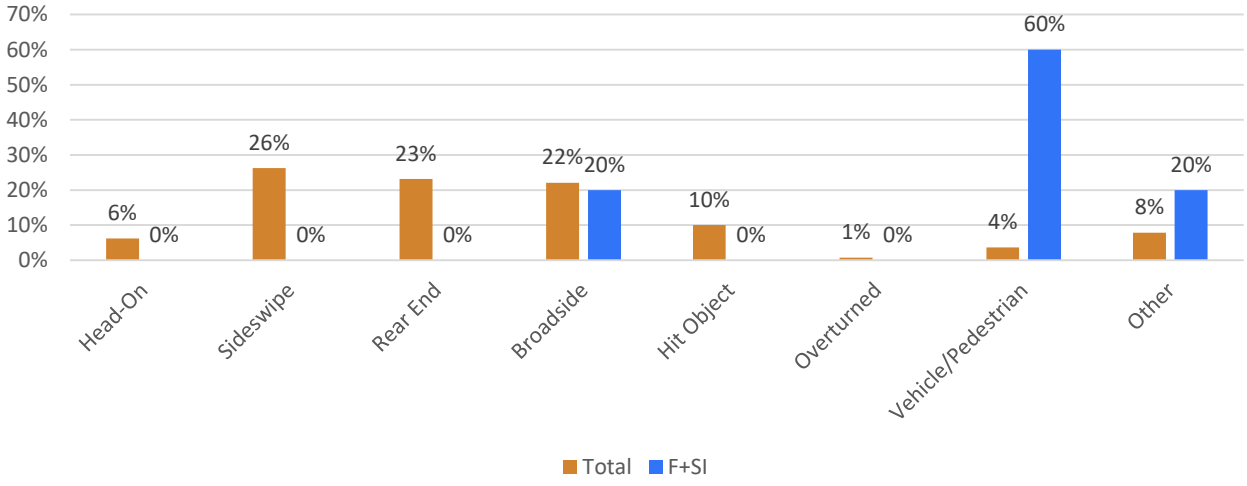
Figure 8. Intersection vs. Roadway Collisions - All Collisions



Collision Type

Considering collisions of all severity the most commonly occurring collision type was sideswipe collisions (26 percent) and rear end collisions (23 percent). The collision type for F+SI collisions are noticeably different. For F+SI collisions, the most commonly occurring collision type was vehicle/pedestrian collisions (60 percent) and the second most common was broadside collisions (20%). **Figure 9** illustrates the collision type for all collisions as well as F+SI collisions.

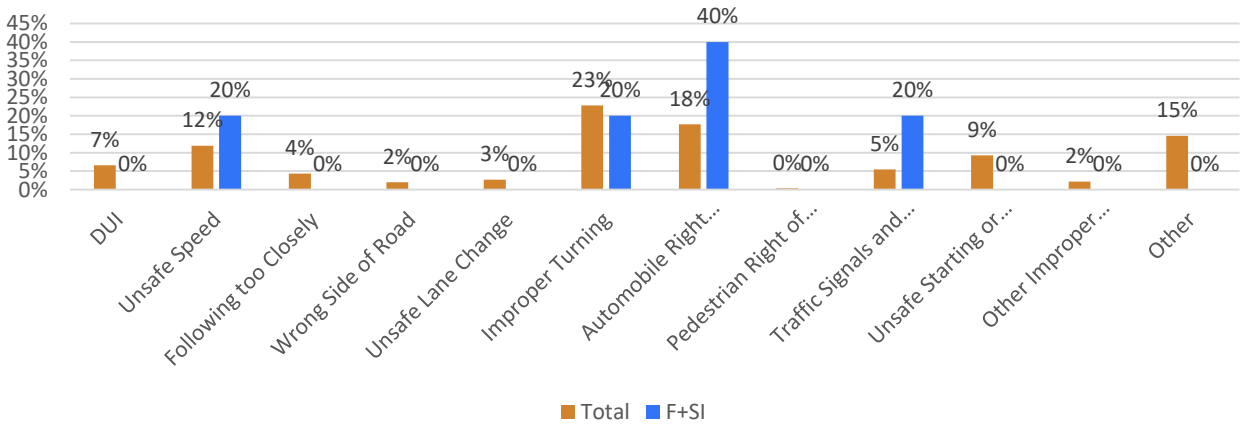
Figure 9. Collision Type – All Collisions vs. F+SI Collisions



Violation Category

Considering collisions of all severity, the most common violation category was observed to be improper turning (23 percent) and automobile right of way (18 percent). For F+SI collisions, automobile right of way (40 percent) was also observed to be the main violation categories. **Figure 10** illustrates the violation category for all collisions and F+SI collisions.

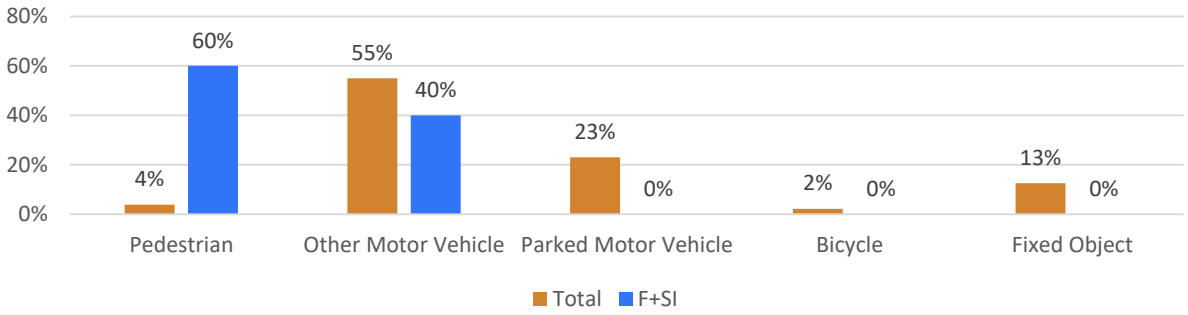
Figure 10. Violation Category: All Collisions vs. F+SI Collisions



Motor Vehicle Involved With

Considering all collisions, 55 percent of the collisions are motor vehicle involved with another motor vehicle. The remaining collisions include motor vehicle involved with parked vehicles (23 percent) and motor vehicle involved with fixed object (13 percent). The trends for F+SI collisions are noticeably different. For F+SI collisions, 60 percent of the collisions involved a pedestrian and 40 percent involved another vehicle, indicating these collision types are more likely to result in a fatal or severe collision. **Figure 11** illustrates the percentage for all collisions as well as F+SI collisions.

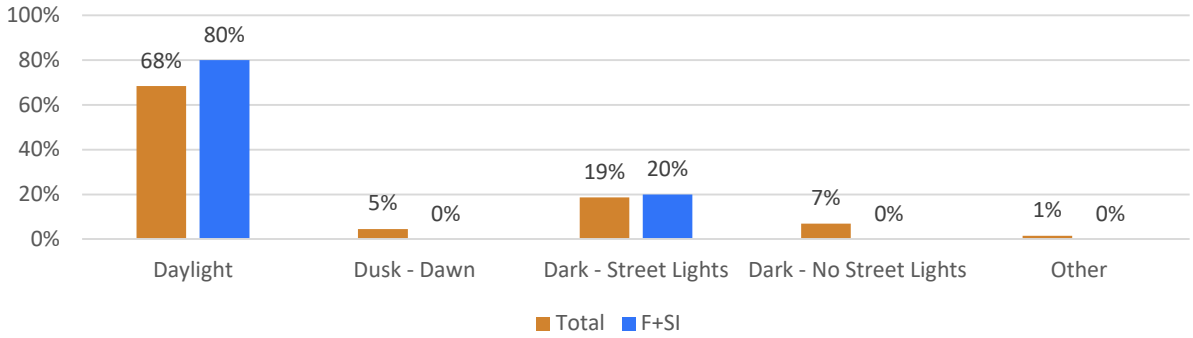
Figure 11. Motor Vehicle Involved with: All Collisions vs. F+SI Collisions



Lighting

For collisions of all severity, 68 percent of collisions have occurred in daylight and 19 percent of collisions have occurred in the dark on streets with street lights. For F+SI collisions, 80 percent of collisions have occurred in daylight and 20 percent of collisions occurred in the dark on streets with street lights. **Figure 12** illustrates the lighting condition for all collisions and F+SI collisions.

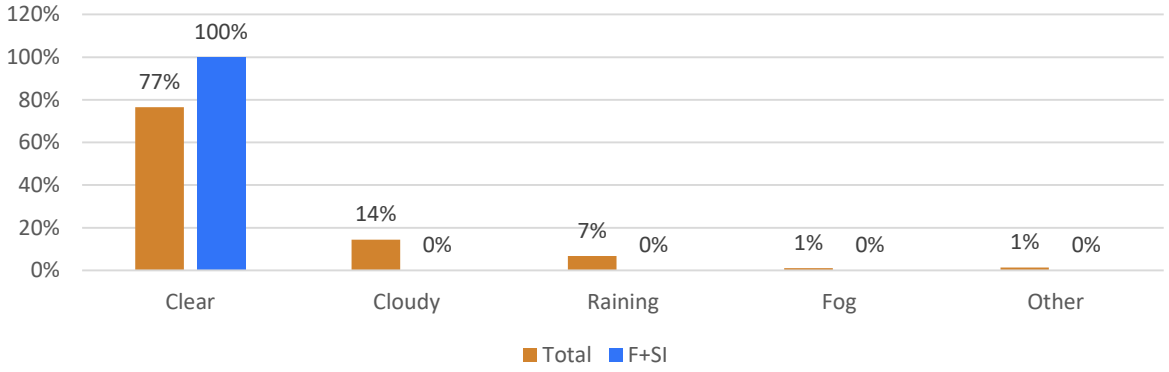
Figure 12. Lighting Conditions: All Collisions vs. F+SI Collisions



Weather

For all collisions, 77 percent of the collisions have occurred during clear weather conditions and 14 percent collisions have observed to occur during cloudy weather conditions. For F+SI collisions, 100 percent of the collisions have occurred during clear weather conditions. **Figure 13** illustrates the percentage distribution of weather conditions during occurrence of collisions of all severity as well as F+SI collisions.

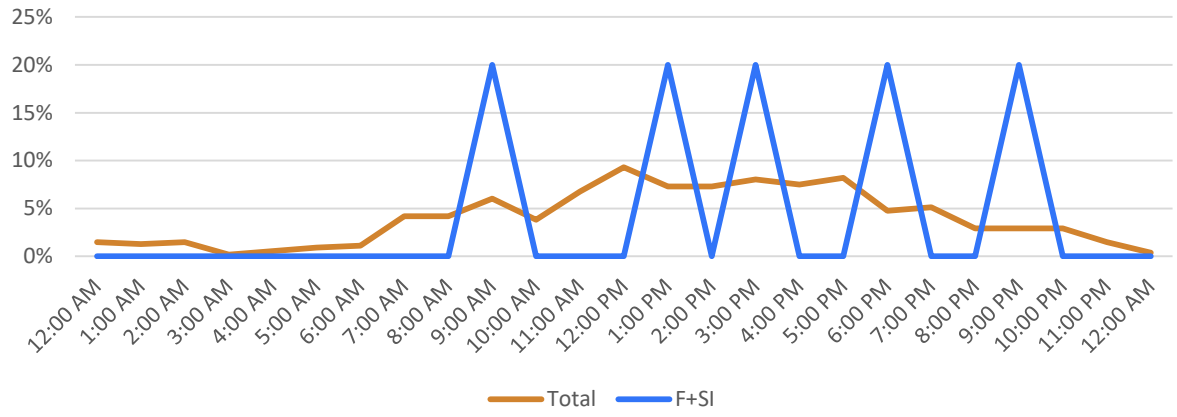
Figure 13. Weather Conditions: All Collisions vs. F+SI Collisions



Time of the Day

For collisions of all severity, maximum number of collisions have occurred between 12:00 p.m. to 1:00 p.m. (9 percent) and the minimum number of collisions have occurred between 3:00 a.m. to 6:00 a.m. (0 percent). For all F+SI collisions, the collisions occurred throughout the day. **Figure 14** illustrates the percentage of collisions occurring during the day for all severity collisions as well as F+SI collisions.

Figure 14. Time of the Day: All Collisions vs. F+SI Collisions



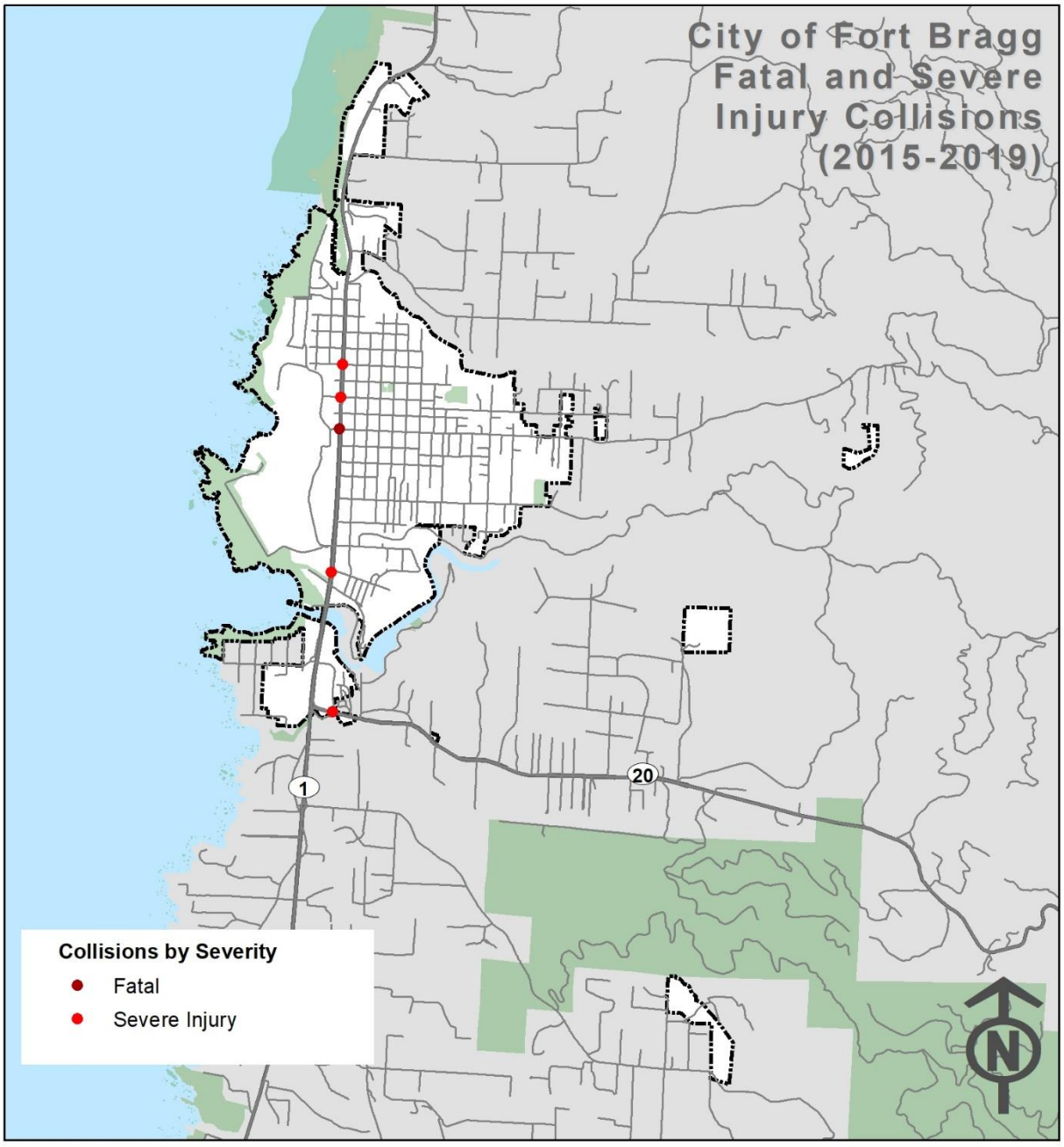
Fatal and Severe Injury Collision Analysis

The detailed collision analysis is effective for identifying high-risk locations by evaluating collisions that have led to a fatality or a severe injury. Collisions have been further analyzed taking into account the following collision attributes:

- Location
- Violation Category
- Collision Type vs. Violation Category
- Collision Type vs. Motor Vehicle Involved With
- Motor Vehicle Involved With vs. Violation Category
- Collision Type vs. Lighting Conditions
- Collision Types vs. Time of Day
- Gender vs. Age

Figure 15 illustrates all the location of the fatal and severe injury collisions that have occurred in the City from 1/1/2015 to 12/31/2019.

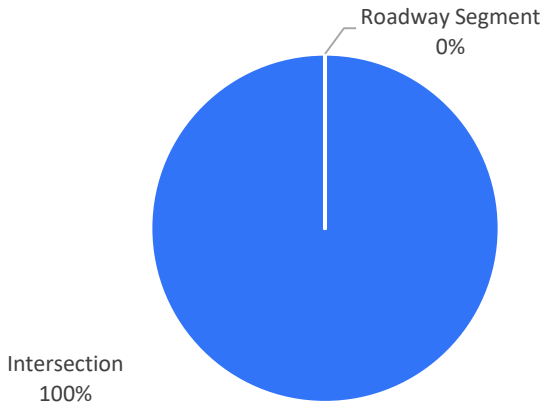
Figure 15. Fort Bragg F+SI Collisions (2015-2019)



Facility Type

Of the total 5 F+SI collisions that occurred in Fort Bragg, 5 collisions (100 percent) occurred at intersections (within 250 feet of an intersection) and none occurred on roadways segment or at mid-block locations. This distribution is illustrated in **Figure 16**.

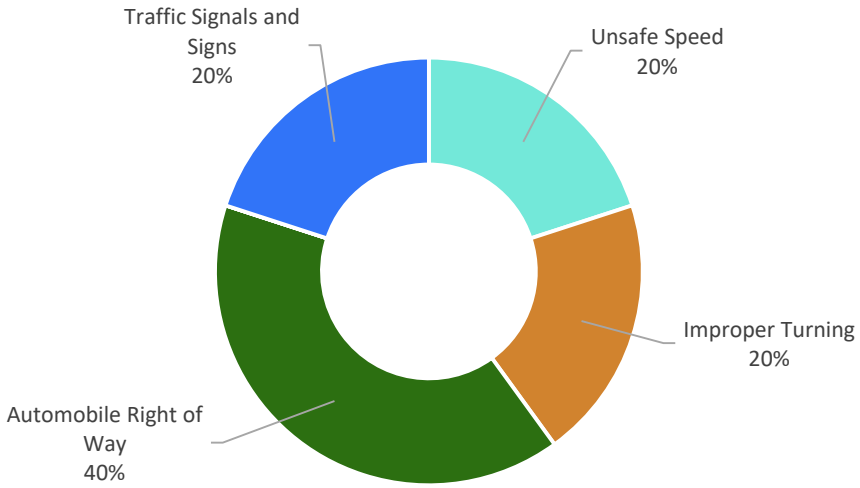
Figure 16. F+SI Collisions: Roadway Segments and Intersections



Violation Category

For F+SI collisions, automobile right of way (40 percent) was observed to be major violation categories. **Figure 17** illustrates the violation category for F+SI collisions.

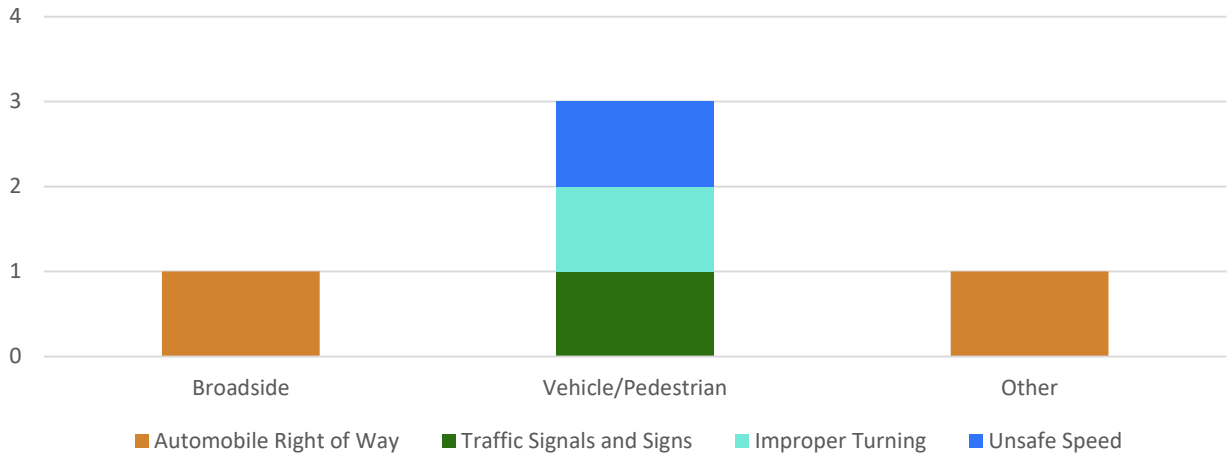
Figure 17. F+SI Collisions: Violation Category



Collision Type and Violation Category

For all collisions that led to a fatality or severe injury, the most common violation types were automobile right of way. **Figure 18** illustrates the type of collision as well as the violation category for F+SI collisions.

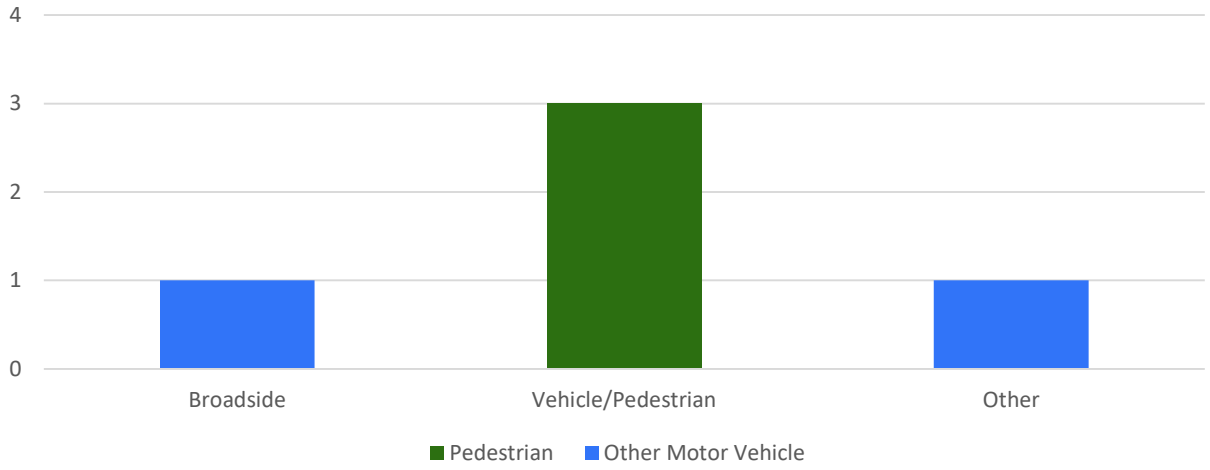
Figure 18. F+SI Collisions: Collision Type Vs Violation Category (2015-2019)



Collision Type and Motor Vehicle Involved With

For all F+SI collisions, the most common collision types were vehicle/pedestrian collisions and broadside collisions that occurred between two motor vehicles. **Figure 19** illustrates the type of collision as well as the motor vehicle involved with for F+SI collisions.

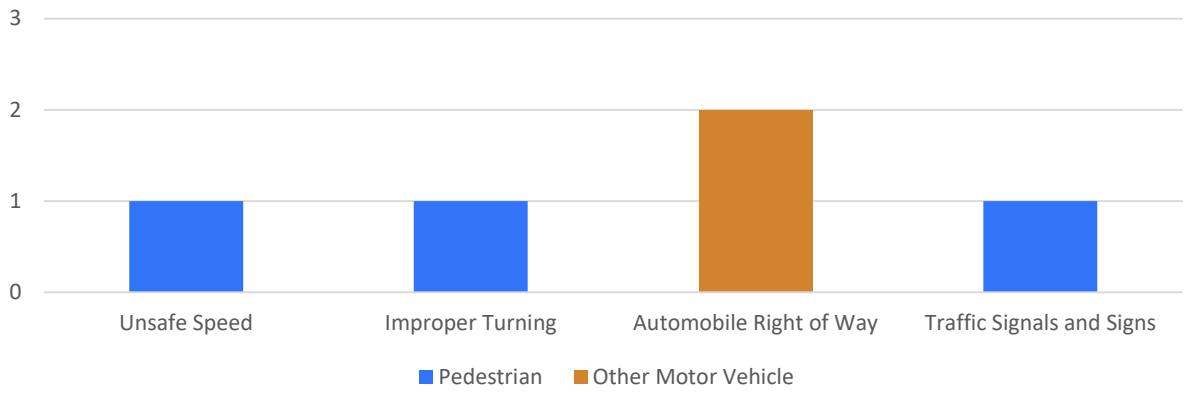
Figure 19. F+SI Collisions: Type and Motor Vehicle Involved with



Motor Vehicle Involved with and Violation Category

For all collisions that led to a fatality or severe injury, the collision violation category of collisions that led to the highest amount of collisions was automobile right of way collisions. The results, with violation category and motor vehicle involved with, are shown in **Figure 20.**

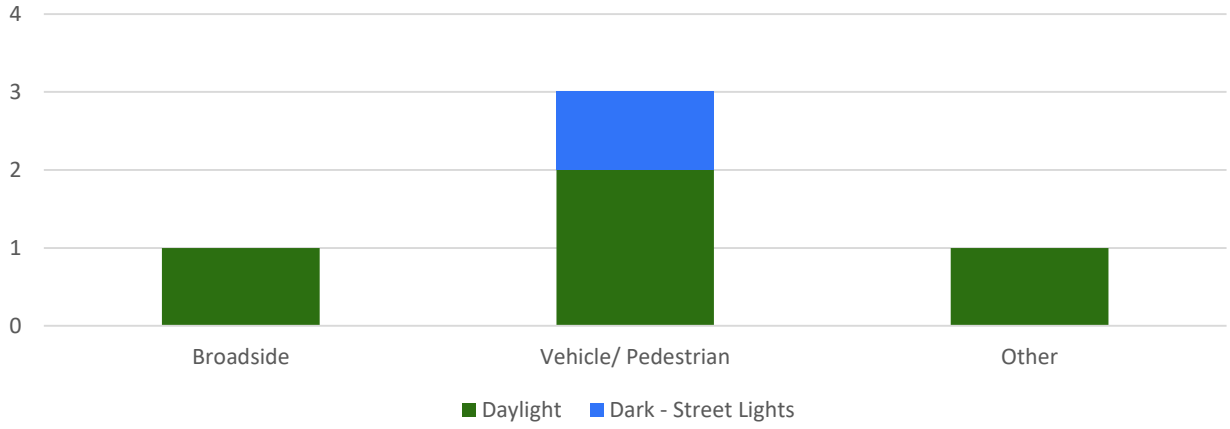
Figure 20. F+SI Collisions: Motor Vehicle Involved with vs Violation Category



Collision Type and Lighting Conditions

For all F+SI collisions, 4 collisions occurred in the daylight. The only collisions that occurred in the dark was a vehicle/pedestrian collision. **Figure 21** illustrates the lighting condition and the collision type as observed for F+SI collisions.

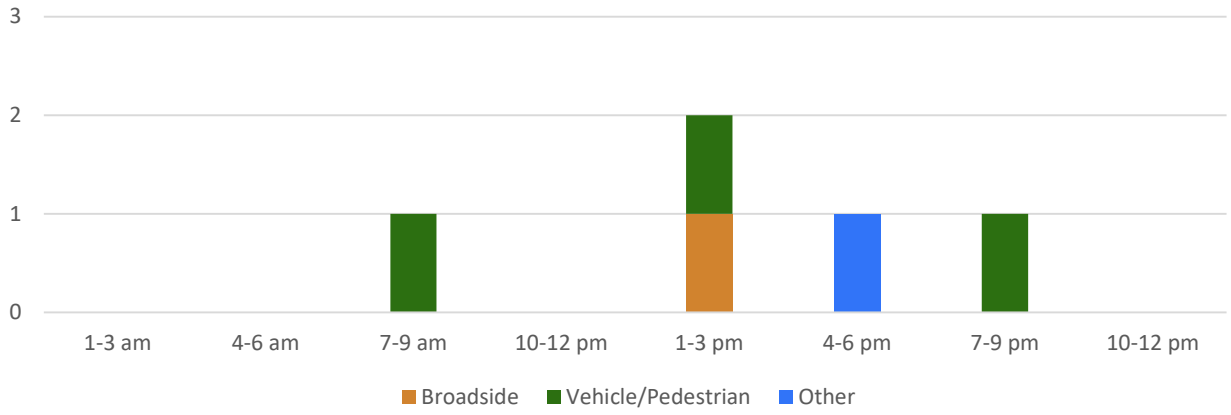
Figure 21. F+SI Collisions: Collision Type Vs Lighting Conditions



Collision Type and Time of the Day

For all the F+SI collisions, the most common collision type was vehicle pedestrian collisions, which occurred throughout the day. The only broadside collision occurred during the afternoon. **Figure 22** illustrates the collision type by the time of the day for all F+SI collisions.

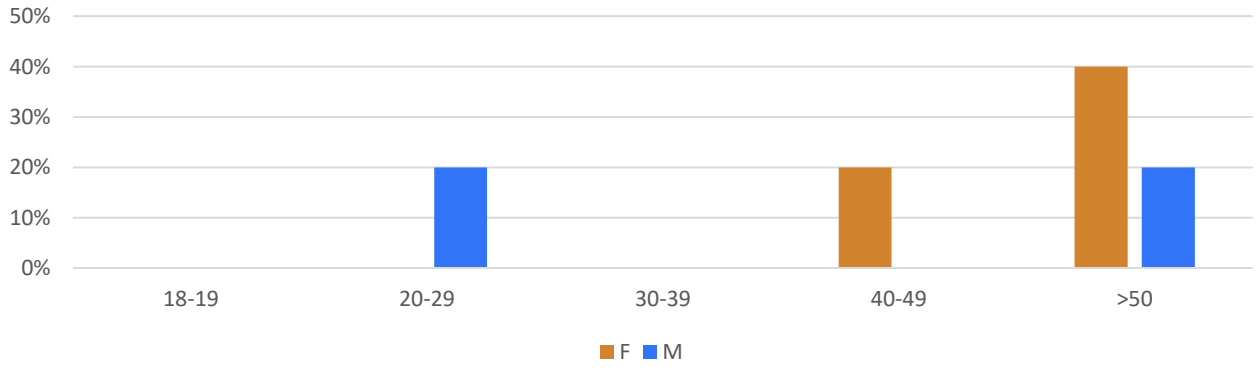
Figure 22. F+SI Collisions: Collisions Type vs Time of the Day



Gender vs. Age

For F+SI collisions, the sex of the party at fault was slightly more likely to be female than male (60 percent of F+SI collisions vs 40 percent). The party at fault for F+SI collisions are also more likely to be older, with the majority age 40 or older (80 percent). **Figure 23** illustrates the sex and age of the party at fault for F+SI collisions.

Figure 23. F+SI Collisions: Age vs Sex



Geographic Collision Analysis

This section describes a detailed geographic collision analysis performed for injury collisions occurring at roadway segments and intersections in the City of Fort Bragg. The above collision analysis was used to identify four main collision factors that highlight the top collision trends in the City of Fort Bragg. These four collision factors were identified to be vehicle pedestrian collisions, automobile right of way violation collisions, unsafe speed collisions and broadside collisions.

Vehicle/Pedestrian Collisions

For F+SI collisions in the City of Fort Bragg, 60 percent of collisions were pedestrian involved collisions, compared to just 4 percent for collisions of all severity, meaning pedestrian collisions are more likely to result in a fatal or severe injury. **Figure 24** shows the distribution of pedestrian collisions throughout the City of Fort Bragg between 2015 and 2019. Redwood Avenue, Highway 1, Franklin Street and Harold Street have a higher concentration of pedestrian collisions, compared to other roads in Fort Bragg. The Office of Traffic Safety ranked Fort Bragg 15th out of 75 similarly sized cities with high levels of pedestrian collisions (one being the highest, or worst)[4].

Automobile Right of Way Collisions

For F+SI collisions in the City of Fort Bragg, 40 percent of collisions were automobile right of way collisions compared to 18 percent of collisions of all severity, meaning automobile right of way collisions are more likely to result in a fatal or severe injury. **Figure 25** shows the distribution of automobile right of way collisions throughout Fort Bragg between 2015 and 2019. South Main Street, East Bush Street, East Laurel Street, East Oak Street and Highway 20 have a higher concentration of automobile right of way collisions, compared to other Fort Bragg roads.

Unsafe Speed Collisions

For F+SI collisions in the City of Fort Bragg, 20 percent of collisions were unsafe speed collisions compared to 12 percent of collisions of all severity, meaning unsafe speed collisions are more likely to result in a fatal or severe injury. **Figure 26** shows the distribution of unsafe speed collisions throughout Fort Bragg between 2015 and 2019. South Main Street, West Oak Street, East Fir Street and South Harold Street have a higher concentration of unsafe speed collisions, compared to other Fort Bragg roads. The Office of Traffic Safety ranked Fort Bragg 16th out of 75

[4] 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=Fort+Bragg&wpv_filter_submit=Submit

similarly sized cities with high levels of speed related collisions (one being the highest, or worst) [2].

Broadside Collisions

For F+SI collisions in the City of Fort Bragg, 20 percent of collisions were broadside collisions. **Figure 27** shows the distribution of broadside collisions throughout Fort Bragg between 2015 and 2019. Main Street, Laurel Street, Oak Street and Maple Street have a higher concentration of broadside collisions, compared to other Fort Bragg roads.

Figure 24. Vehicle/Pedestrian Collisions

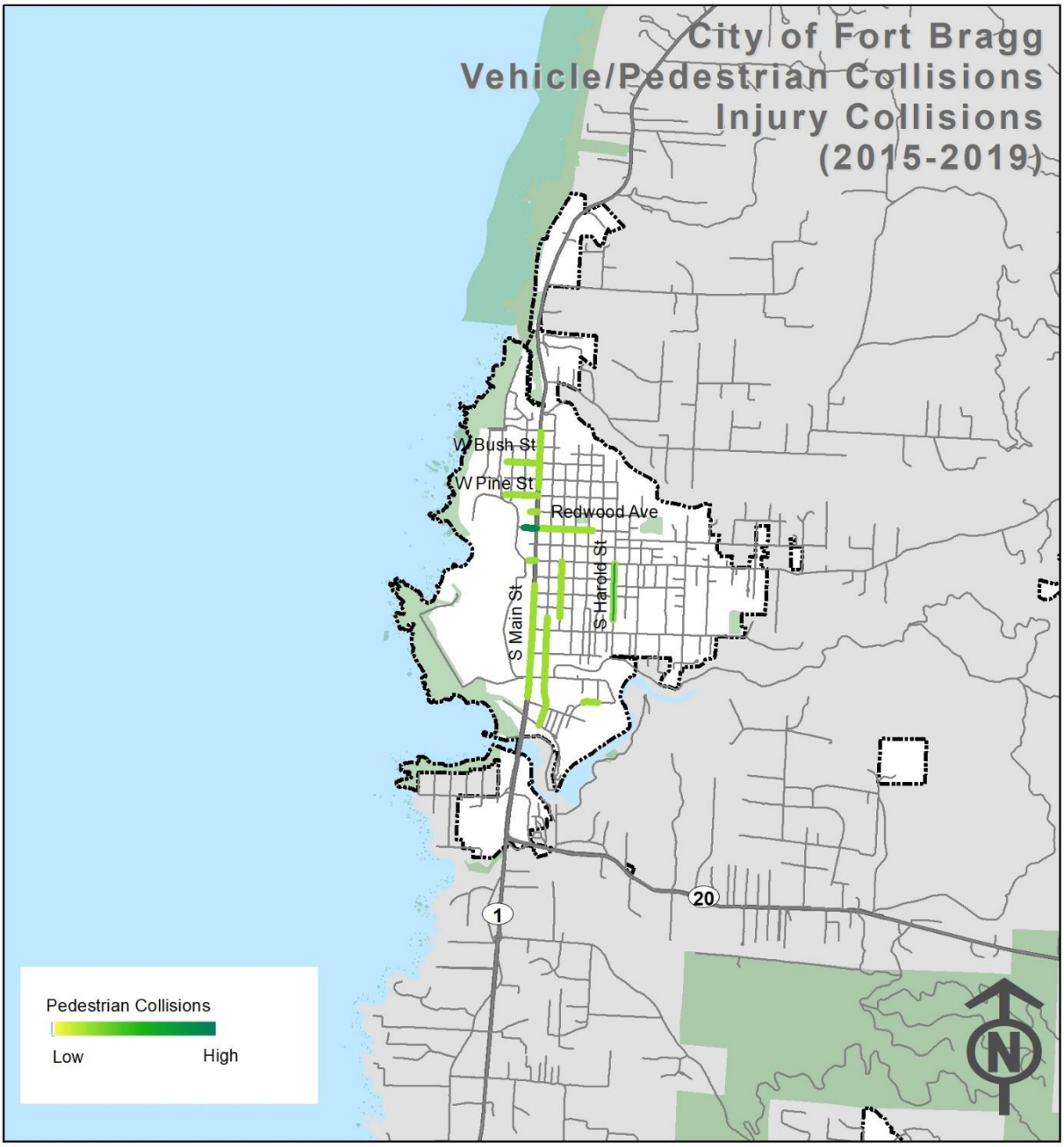


Figure 25. Automobile Right of Way Collisions

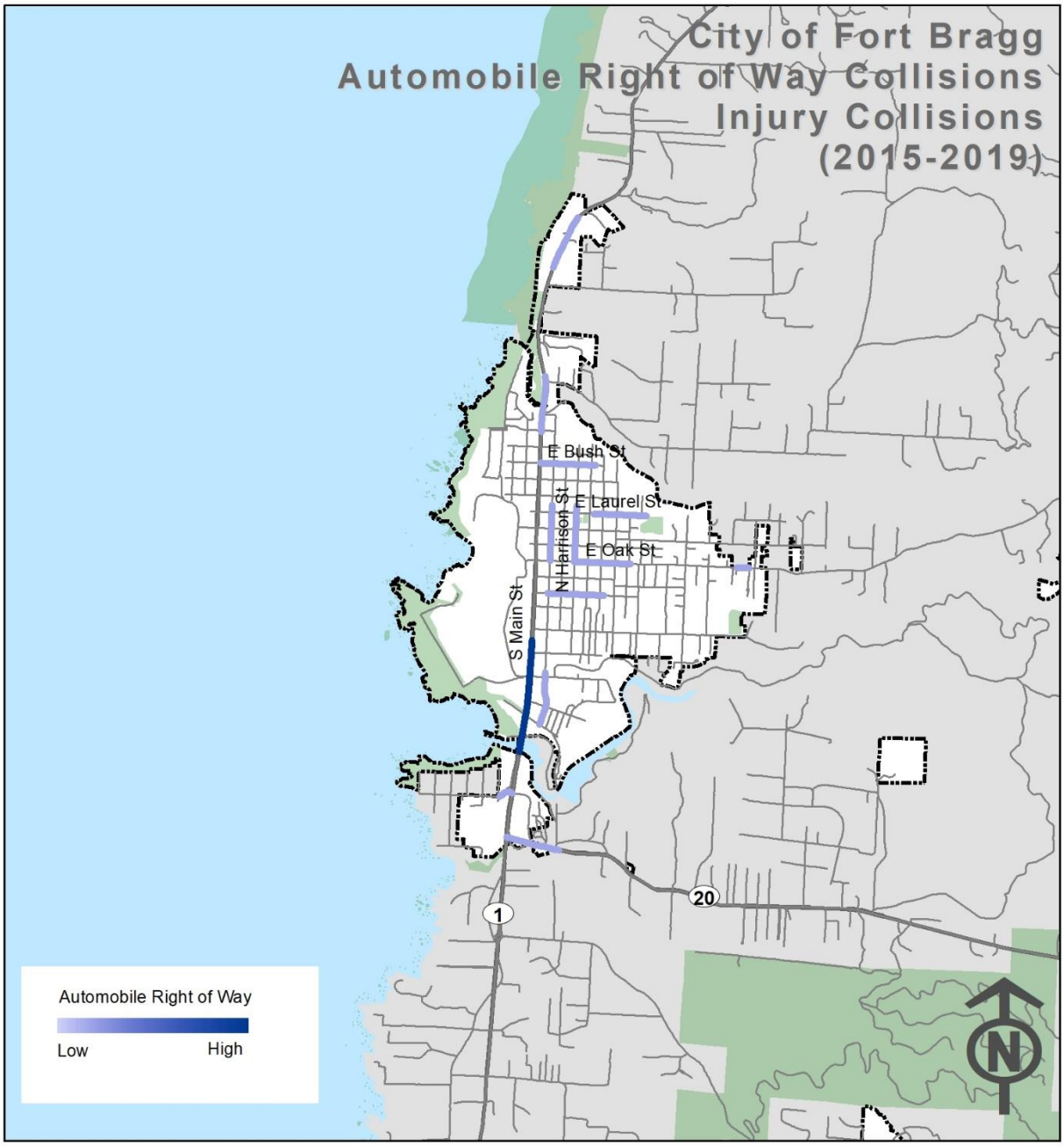


Figure 26. Unsafe Speed Collisions

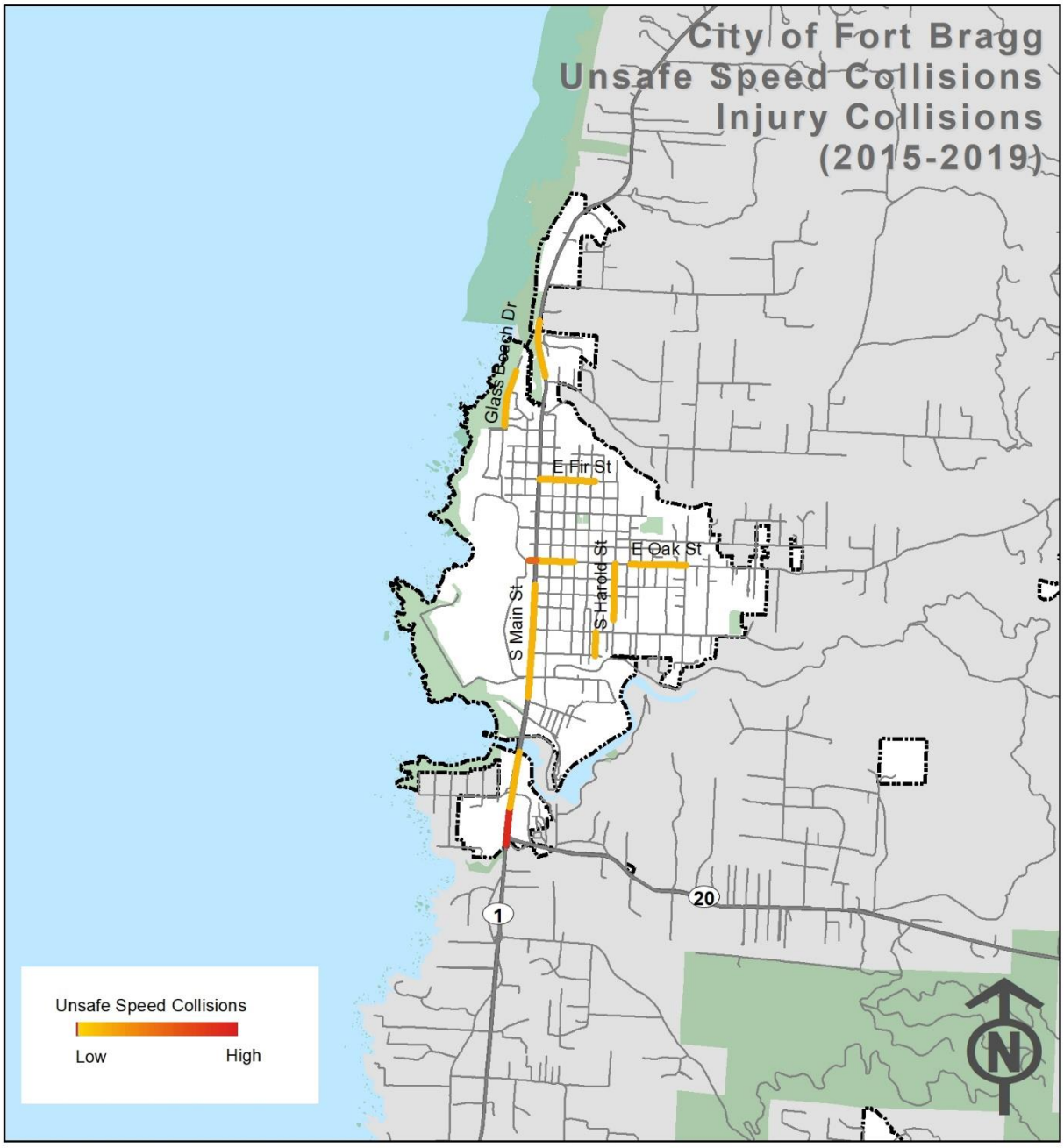
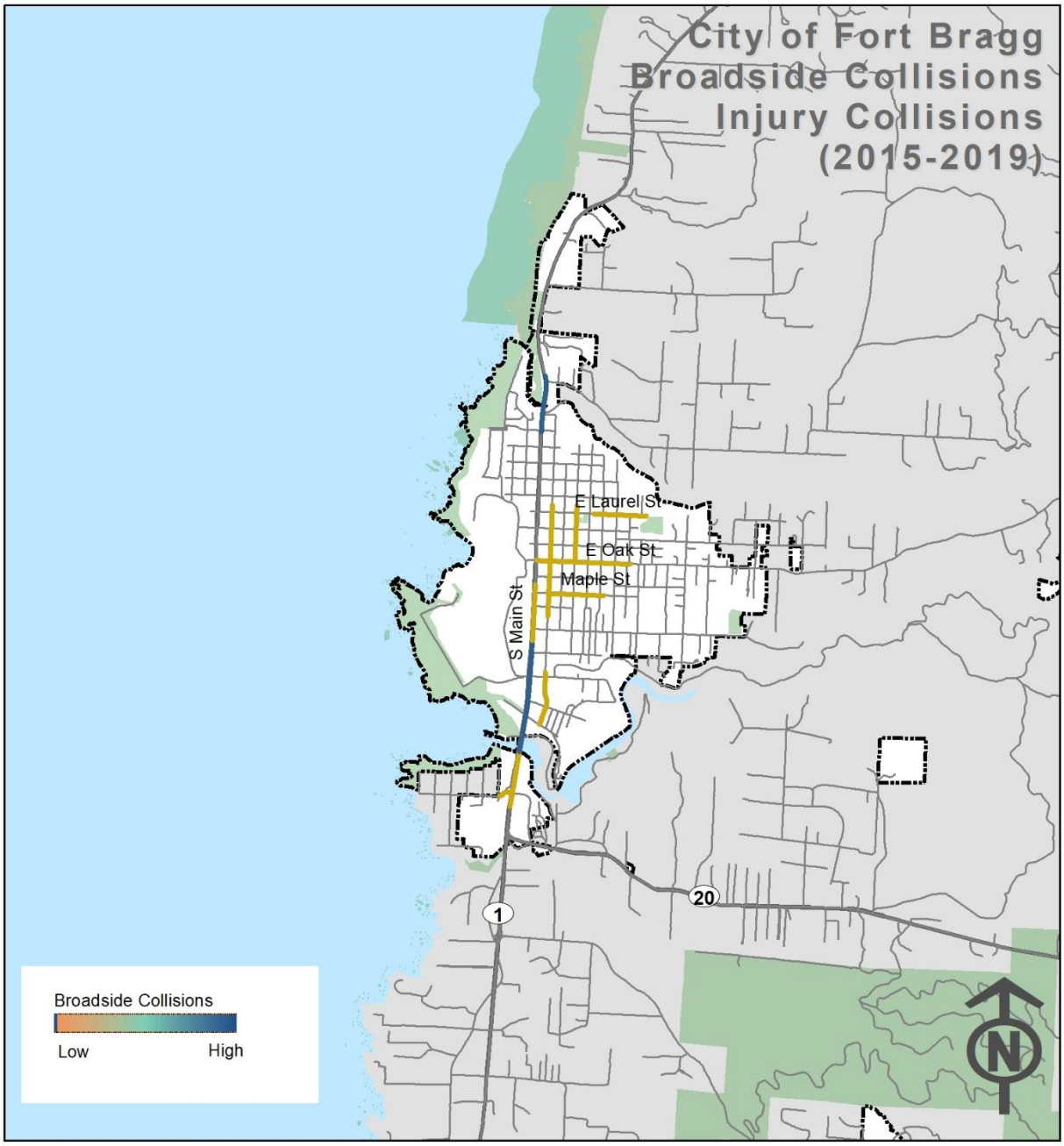


Figure 27. Broadside Collisions



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 property damage only (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**.

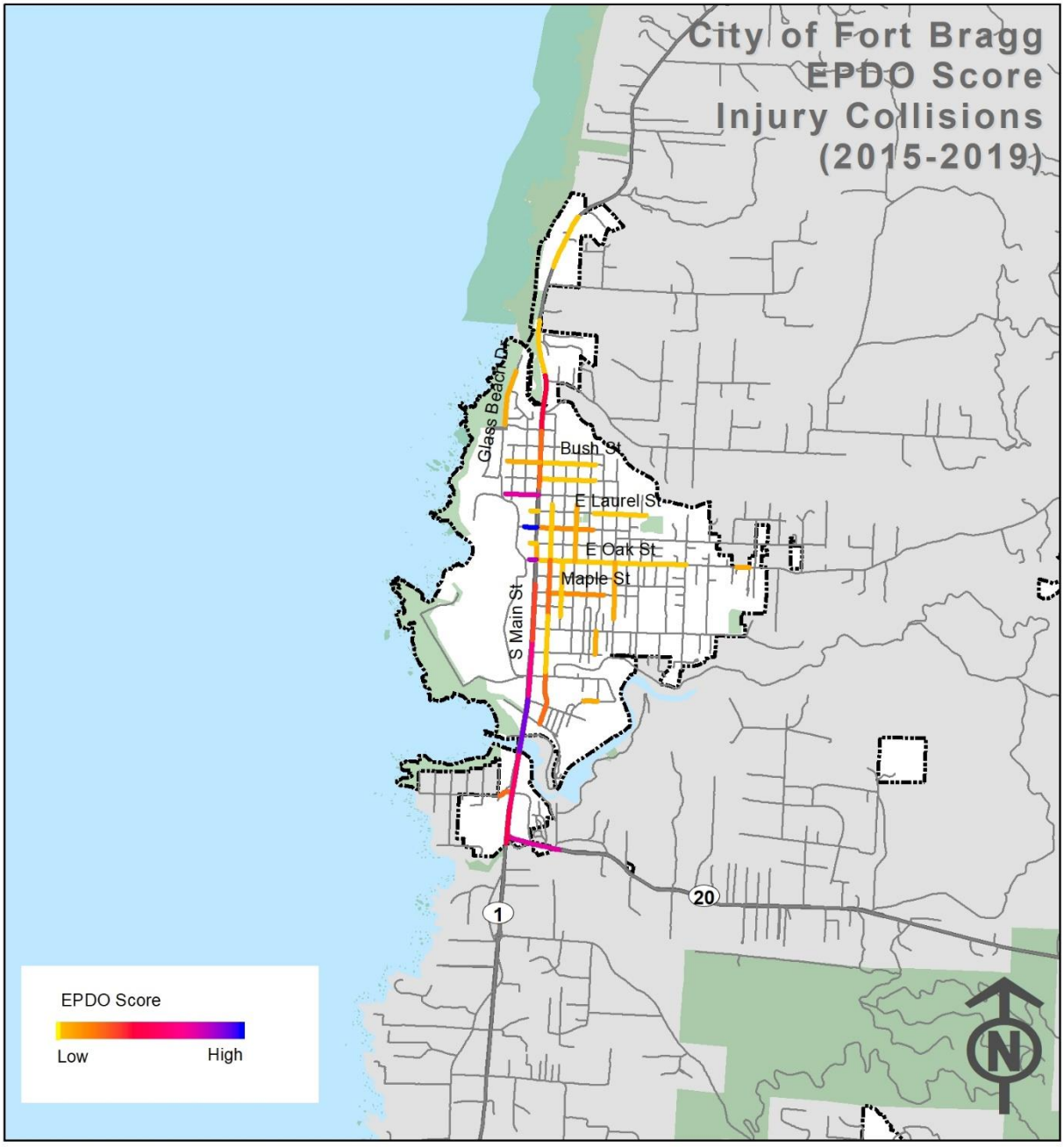
Table 7. EPDO Score used in HSIP Cycle 10

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 Fort Bragg were geolocated onto Fort Bragg's road network. **Figure 28** shows the location and geographic concentration of collisions by their EPDO score.

Figure 28. Fort Bragg EPDO Score

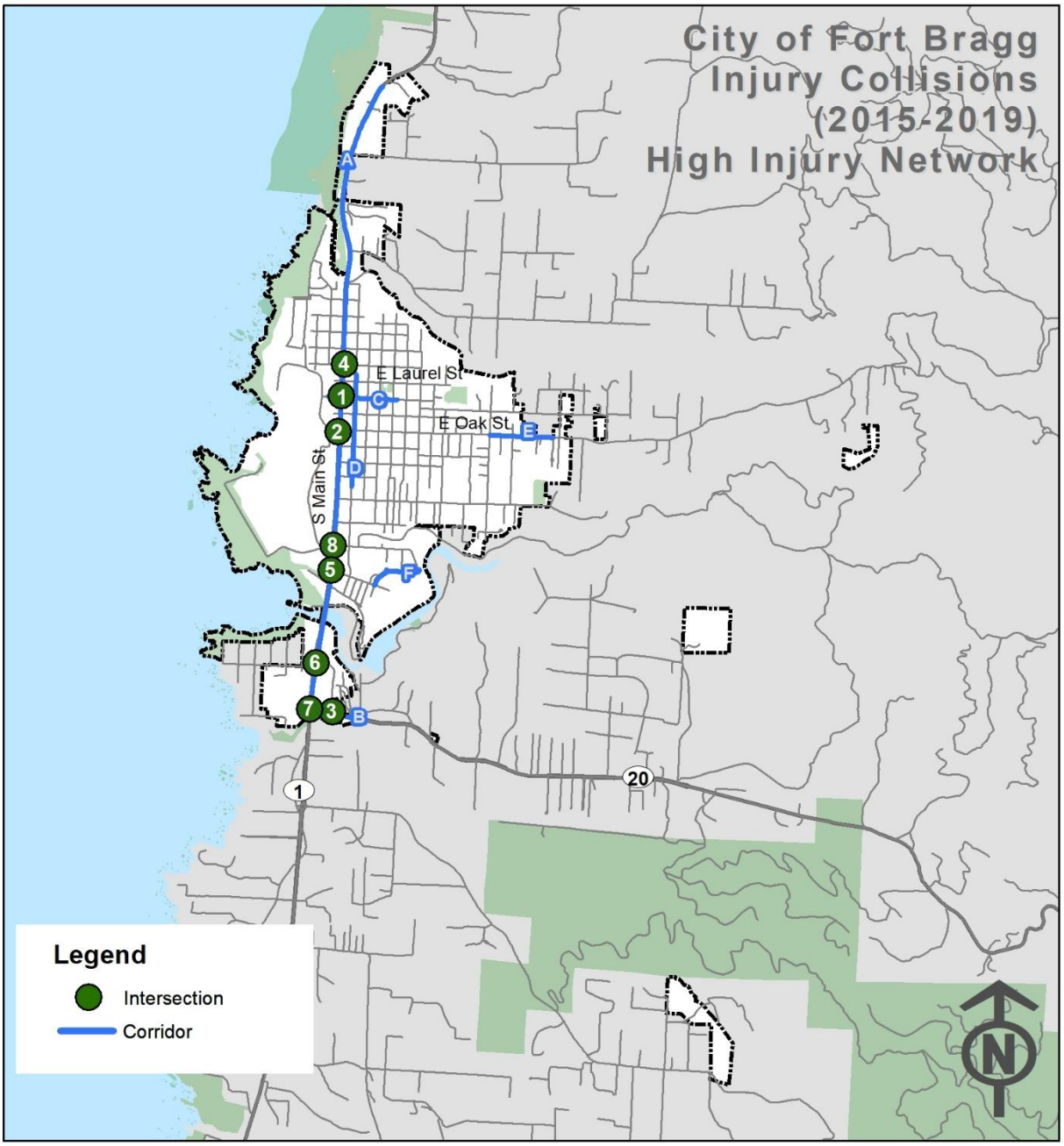


High-Injury Locations

Following the detailed collision analysis in Section 4 and 5 the next step was to identify the high-risk roadway segments and intersections in the City of Fort Bragg. The methodology for scoring the high injury locations is the same method used in the severity weight section. **Figure 29** shows the top 6 high-collision corridors, and top 8 high-collision intersections. This high collision network has a total of 49 injury collisions with 5 F+SI collisions, which represents 62 percent of injury collisions and 100 percent of F+SI collisions in Fort Bragg on about 2 percent of Fort Bragg's roadway network.

For the identification of the high collision network, 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 occurred at a distance of 0 feet as listed in the statewide integrated traffic records system (SWITRS).

Figure 29. City of Fort Bragg High Injury Network



High Injury Intersections

A total of eight intersections were identified as high injury intersections. There were a total of 5 F+SI collisions that occurred at these intersections. The intersection of Redwood Avenue and South Main Street/Route 1 has the highest EPDO score.

Table 8 lists the collision rate of the top 8 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	Vehicle /Ped	Auto R/W	Unsafe Speed	Broad-side	EPDO Score
		Collisions						
1	Redwood Ave and Route 1/S Main St	5	1	4	0	0	0	171
2	Oak St and Route 1/S Main St	2	1	1	0	2	0	165
3	Boat Yard Dr and Route 20	1	1	0	1	0	0	165
4	Pine St and Route 1/ S Main St	1	1	1	0	0	0	165
5	South St and Route 1/S Main St	1	1	0	1	0	1	165
6	Boat Yard Drive and Route 1/ S Main St	3	0	0	1	0	1	28
7	Route 1 and Route 20	3	0	0	0	3	0	23
8	Cypress St and Route 1/ S Main St	3	0	1	0	0	1	18

High Injury Corridors

Six corridors were identified as high injury corridors. There were a total 2 F+SI collisions on these corridors. The corridor with the highest number of F+SI collisions is Main Street/Route 1 and Fort Bragg-Willits Road/Highway 20 with 1 F+SI collision each.

Table 9 lists the collision rate of the top 6 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	Vehicle/ Ped	Auto R/W	Unsafe Speed	Broadside	Length (miles)	EPDO Score
		Collisions							
A	Main St/Route 1: Jane Ln to Highway 20/ Fort Bragg Willits Rd	29	1	2	5	6	6	3.6	383
B	Highway 20/ Fort Bragg Willits Rd: Route 1 to South Harbor Dr	1	1	0	1	0	0	0.1	165
C	Redwood Ave: West Terminus to North Whipple St	5	0	4	0	0	0	0.3	35
D	Franklin St: Laurel St to E Chestnut St	3	0	0	0	0	2	0.6	23
E	Fort Bragg Sherwood Rd: California Way to Dana St	1	0	0	1	0	0	0.2	11
F	River Dr/ Kemppe Way: South St to Cypress St	1	0	1	0	0	0	0.3	11

4. Emphasis Areas

Emphasis areas are focus areas for the local roadway safety plan that are identified through the comprehensive collision analysis of the identified high injury locations within the City of Fort Bragg. Emphasis areas help in identifying appropriate safety strategies and countermeasures with the greatest potential to reduce collisions occurring at these high injury locations. In addition, traffic safety related concerns were heard at a Stakeholder's Meeting conducted for this plan on June 17th, 2021.

This chapter summarizes the top 6 emphasis areas identified for the City of Fort Bragg. 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 Fort Bragg.

The following are the identified emphasis areas –

- Intersection safety
- Collisions within 250 feet of intersections
- Pedestrian safety
- Improper Turning Collisions
- Route 1 Collisions
- Alley Ways Collisions
- Older 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 Fort Bragg

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

Table 10. Existing Programs Summary

Document/ Program	Description	E's Addressed
2018 Street Safety Plan	This plan recommends infrastructure improvements that will enhance the safety of pedestrians, bicyclists and motorists on residential neighborhoods and commercial streets in Fort Bragg.	Engineering
South Main Street Access and Beautification Plan (2011)	This project enhances pedestrian crossings of Highway 1, with curb extensions, high visibility striping, stop bars, pedestrian signage and strategically placed median refuge islands. It also improves safety by reducing vehicle speeds, as well as beautifies the streetscape with trees and landscape strips.	Engineering
City of Trails: Trails Feasibility Study (2016)	This City of Trails Feasibility Study evaluates three potential new priority trails which could be developed to expand the existing trail network in Fort Bragg.	Engineering
Mendocino County Safe Routes to School Plan (2014)	In addition to the Citywide program the countywide Safe Routes to School (SRTS) is also a resource to a program with a simple goal: helping more children get to school by walking and bicycling.	Engineering Education
Mendocino County Regional Active	Details bicycle and pedestrian improvements on County significant corridors. Includes detailed priority bike and pedestrian projects.	Engineering

Document/ Program	Description	E's Addressed
Transportations Plan (2017)		
Mendocino Council of Governments 2020 Regional Transportation Improvement Program (2019)	The Regional Transportation Improvement Program (RTIP) is a program of highway, local road, transit and active transportation projects that a region plans to fund with State and Federal revenue.	Engineering
Fort Bragg Police Department Ongoing Programs and Resources	The City Police Department has a number of programs and resources to reduce traffic fatalities and injuries including a crosswalk safety pamphlet, a bicycle safety pamphlet and an ongoing commitment to enforcing traffic violations at key location in Fort Bragg including schools.	Enforcement Education
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 identified from the feedback received from stakeholders. This section also presents comprehensive programs, policies and countermeasures to reduce collisions in specific emphasis areas.

Emphasis Area 1 – Intersections Collisions

The City of Fort Bragg experienced a total of 49 reported collisions on the high injury network. 42 (86 percent) of these collisions occurred at intersection, including 5 fatal and severe injuries (F+SI) collisions. The following collision data is based on only intersection injury collisions in the high injury network in the City of Fort Bragg.

28%
Pedestrian collisions

24%
Improper turning

66%
Occurred on Route 1

Table 11. Emphasis Area 1 Strategies

Objective:			
Reduce the number of fatal and severe injury collisions at intersections.			
	Strategy	**Performance Measure**	**Agencies/ Organizations**
Education	Conduct public information and education campaign for intersection safety laws regarding traffic signals, stop signs, and turning left or right.	Number of education campaigns	City/ School District/ Police Department
Enforcement	Targeted enforcement at high-risk intersections to monitor traffic law violations right-of-way violations, speed limit laws and other violations that occur at intersections.	Number of tickets issued.	Police Department
Engineering	• S02, Improve signal hardware: lenses, back-plates with retroreflective borders, mounting, size, and number • S03, Improve signal timing (coordination, phases, red, yellow, or operation) • S08, Convert signal to mast arm (from pedestal-mounted) • S09, Install raised pavement markers and striping (Through Intersection) • 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.) • R01, Add Segment Lighting • R22, Install/Upgrade signs with new fluorescent sheeting (regulatory or warning) • R27, Install delineators, reflectors and/or object markers	Number of intersections improved.	City
EMS	S05, Install emergency vehicle pre-emption systems	EMS vehicle response time.	Mendocino County Local Emergency Services Agency

Emphasis Area 2 – Pedestrian Safety

The City of Fort Bragg experienced a total of 49 reported collisions on the high injury network. 13 (27 percent) of these collisions were pedestrian collisions, including 3 fatal or severe injury (F+SI) collisions. The following collision data is based on only pedestrian injury collisions in the high injury network in the City of Fort Bragg.

77%
Involved a pedestrian crossing in a crosswalk

46%
Pedestrian right of way violations

15%
Traffic signals and signs violations

Table 12. Emphasis Area 2 Strategies

Objective:			
Reduce the number of fatal and severe pedestrian injury collisions.			
	Strategy	**Performance Measure**	**Agencies/ Organizations**
Education	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 Fort Bragg every 3-5 years	Number of education campaigns	City/ School District/ Police Department
Enforcement	Targeted enforcement at high-risk locations especially near schools and downtown	Number of tickets issued.	Police Department
Engineering	• S21PB, Modify signal phasing to implement a Leading Pedestrian Interval (LPI) • NS07, Upgrade intersection pavement markings (NS.I.) • NS19PB, Install raised medians (refuge islands) • NS21PB/R35PB, Install/upgrade pedestrian crossing (with enhanced safety features) • R36PB, Install raised pedestrian crossing • R37PB, Install Rectangular Rapid Flashing Beacons (RRFB) • High-visibility ladder crosswalks • Mid-block curb extension • In-road yield sign for pedestrian crossing at crosswalk • The City should apply for HSIP pedestrian set aside funds every two years	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 – Improper Turning Collisions

The City of Fort Bragg experienced a total of 49 reported collisions on the high injury network. 10 (20 percent) of these collisions were improper turning collisions, including 1 fatal or severe injury (F+SI) collisions. The following collision data is based on only improper turning injury collisions in the high injury network in the City of Fort Bragg.

60%
Involved other motor vehicle

37%
Broadside collisions

37%
Sideswipe collisions

Table 13. Emphasis Area 3 Strategies

Objective:			
Reduce the number of fatal and severe injury collisions at intersections that are a result of improper turning.			
	Strategy	**Performance Measure**	**Agencies/ Organizations**
Education	Conduct public information and education campaign for intersection safety laws regarding traffic lights, stop signs, and turning left or right.	Number of education campaigns	City/ School District/ Police Department
Enforcement	Targeted enforcement at high-risk intersections to monitor improper turning violations.	Number of tickets issued.	Police Department
Engineering	• S02, Improve signal hardware: lenses, back-plates with retroreflective borders, mounting, size, and number • S03, Improve signal timing (coordination, phases, red, yellow, or operation) • S08, Convert signal to mast arm (from pedestal-mounted) • S09, Install raised pavement markers and striping (Through Intersection) • 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.) • R01, Add Segment Lighting • R22, Install/Upgrade signs with new fluorescent sheeting (regulatory or warning) • R27, Install delineators, reflectors and/or object markers	Number of intersections improved.	City
EMS	S05, Install emergency vehicle pre-emption systems	EMS vehicle response time.	Mendocino County Local Emergency Services Agency

Emphasis Area 4 – Route 1 Collisions

The City of Fort Bragg experienced a total of 49 reported collisions on the high injury network. 36 (73 percent) of these collisions were collisions that occurred on Route 1, including 3 fatal or severe injury (F+SI) collisions. The following collision data is based on only Route 1 injury collisions in the high injury network in the City of Fort Bragg.

66%
Fatal or severe injury involved a pedestrian

34%
Read end collisions

17%
Broadside collisions

Table 14. Emphasis Area 4 Strategies

Objective:			
Reduce the number of fatal and severe injury collisions that occur on Route 1.			
	Strategy	**Performance Measure**	**Agencies/ Organizations**
Education	Conduct public information and education campaign for intersection safety laws regarding traffic lights, stop signs, turning left or right, and speeding.	Number of education campaigns	City/ School District/ Police Department
Enforcement	Targeted enforcement at high-risk intersections to monitor safety along Route 1.	Number of tickets issued.	Police Department
Engineering	• S02, Improve signal hardware: lenses, back-plates with retroreflective borders, mounting, size, and number • S03, Improve signal timing (coordination, phases, red, yellow, or operation) • S09, Install raised pavement markers and striping (Through Intersection) • S16/NS04/NS05, Convert intersection to roundabout • NS06, Install/upgrade larger or additional stop signs or other intersection warning/regulatory signs • S21PB, Modify signal phasing to implement a Leading Pedestrian Interval (LPI) • NS07, Upgrade intersection pavement markings (NS.I.) • NS19PB, Install raised medians (refuge islands) • NS21PB/R35PB, Install/upgrade pedestrian crossing (with enhanced safety features)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 5 – Alley Way Safety

The City of Fort Bragg experienced a total of 3 reported collisions on alley ways. The following collision data is based on only alley way collisions in the City of Fort Bragg.

Substandard width **Sightline issues** **Pedestrian conflicts**

Table 15. Emphasis Area 5 Strategies

Objective:			
Reduce the number of collisions at Alley Ways.			
	Strategy	**Performance Measure**	**Agencies/Organizations**
Engineering	• Pave and install mark crosswalks at alleyway driveways	Number of alley ways improved.	City

Emphasis Area 6 – Older Adult Party at Fault Collisions

The City of Fort Bragg reported a total of 49 reported collisions on the high injury network. The following is a review of the demographic data, provided in the party data of the collisions occurring on the high injury network.

60%

Fatal or severe injury collisions party at fault was between the ages of 50-69

60%

Fatal or severe injury collisions party at fault was a female

Table 16. Emphasis Area 6 Strategies

Objective:			
Reduce the number of older adult fatal and severe injury collisions.			
	Strategy	**Performance Measure**	**Agencies/Organizations**
Education	Target education programs for older 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 older adult larger risks of fatalities.	Number of education campaigns	City/ Police Department

5. Countermeasure Identification

This section summarizes the process of selecting countermeasures on Fort Bragg 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.

Countermeasures 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.

Signalized Intersections Countermeasures

S03 – Improve signal timing (coordination, phases, red, yellow, or operation) Improve signal hardware: lenses, back-plates with retroreflective borders, mounting, size, and number. Includes adding phases, lengthening clearance intervals, eliminating or restricting higher-risk movements, and coordinating signals at multiple locations.

- Crash Reduction Factor – 15%
- Expected Life – 10 years
- Baseline Cost – Approximately $11,000 per intersection

S09 – Install raised pavement markers and striping (Through Intersection) Addition of clear pavement markings, raised pavement marking to help guide motorists through complex intersections.

- Crash Reduction Factor – 10%
- Expected Life – 10 years
- Baseline Cost – Approximately $35,000 per intersection

S12 – Install raised median on approaches (S.I.) Addition of raised medians next to left-turn lanes at intersections, directly over existing pavement.

- Crash Reduction Factor – 25%
- Expected Life – 20 years
- Baseline Cost – Approximately $45,000 - $40,000

S17PB – Install pedestrian countdown signal heads A pedestrian countdown signal contains a timer display and counts down the number of seconds left to finish crossing the street. Countdown signals can reassure pedestrians who are in the crosswalk when the flashing "DON'T WALK" interval appears that they still have time to finish crossing.

- Crash Reduction Factor – 25%
- Expected Life – 20 years
- Baseline Cost – Approximately $10,000

S21PB - Modify signal phasing to implement a Leading Pedestrian Interval (LPI). A leading pedestrian interval (LPI) gives pedestrians the opportunity to enter an intersection 3-7

- Crash Reduction Factor – 15%
- Expected Life – 10 years

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.

- Baseline Cost – Approximately $4,000 per intersection

Non-Signalized Intersections Countermeasures

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

NS20 – Install pedestrian crossing at uncontrolled locations (signs and markings only). 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

- Crash Reduction Factor – 25%
- Expected Life – 10 years
- Baseline Cost – Approximately $5,000

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

- Crash Reduction Factor – 35%
- Expected Life – 20 years
- Baseline Cost – Approximately $15,000

NS22PB – Install Rectangular Rapid Flashing Beacon (RRFB) 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

- Crash Reduction Factor – 35%
- Expected Life – 20 years
- Baseline Cost – Approximately $40,000

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

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

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

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

- Crash Reduction Factor – 80%
- Expected Life – 20 years
- Baseline Cost – Approximately $150,000

in the "walking along roadway" pedestrian crash risk compared to locations where no sidewalks or walkways exist.

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

Other Countermeasures

Bulb outs/curb extensions. Curb extensions (also called bulb-outs) extend the sidewalk into the parking lane to narrow the roadway and provide additional pedestrian space at key locations; they can be used at corners and at mid-block. Curb extensions enhance pedestrian safety by increasing pedestrian visibility, shortening crossing distances, slowing turning vehicles, and visually narrowing the roadway.

Speed Feedback Signs. Speed feedback signs, also known as dynamic speed displays, provide drivers with feedback about their speed in relationship to the posted speed limit. When appropriately complemented with police enforcement, speed feedback signs can be an effective method for reducing speeds at a desired location.

In Road Yield/stop Signs. In-street pedestrian crossing signs (MUTCD R1-6 or R1-6a) are placed within the roadway, either between travel lanes or in a median. The sign may be used to remind road users of laws regarding right-of-way at an unsignalized pedestrian crossing. This countermeasure is used with other crosswalk visibility enhancements to indicate optimal or preferred locations for people to cross and to help reinforce the driver requirement to yield the right-of-way to pedestrians at crossing locations.

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 Fort Bragg's LRSP. The next step after the identification of high-risk locations, emphasis areas and applicable countermeasures is to identify location-specific safety improvements for all high-risk roadway segments and intersections.

Specific countermeasures and improvements were selected from the 2020 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 17 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). **Appendix E** lists the detailed methodology to calculate B/C Ratio, the complete cost, benefit and B/C Ratio calculation spreadsheet.

The next step in the process will be to prepare grant ready materials for HSIP Cycle 11 applications. TJKM has scoped to provide the City with materials for up to three applications. However, it should be noted that while the LRSP projects were based on high-risk locations, HSIP applications can be expanded to include many locations across the city.

Once the three desired projects are selected, our team recommends three potential options for selecting locations to include in the HSIP applications:

- Select the top projects ranked by crash cost
- City identifies desired intersections
- Apply for various intersections citywide with more generic cost estimates

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 Fort Bragg. These collision factors were identified to be pedestrian collisions, automobile right of way collisions, unsafe speed collisions and intersection collisions.

For fatal and severe injury (F+SI) collisions, 60 percent of collisions involved a pedestrian. Redwood Avenue and Highway 1/ Main Street have a higher concentration of pedestrian collisions, compared to other roads in Fort Bragg. Recommended improvements at these locations include reducing modifying signal phasing to implement a leading pedestrian interval, upgrading pedestrian crossings at uncontrolled locations, installing sidewalks and installing Rectangular Rapid Flashing Beacon.

For F+SI collisions in the City of Fort Bragg, 40 percent of collisions were automobile right of way collisions. South Main Street, East Bush Street, East Laurel Street, East Oak Street and Highway 20 have a higher concentration of automobile right of way collisions, compared to other Fort Bragg roads. Recommended improvements at these locations include improving signal timing, and installing raised pavement markers and striping (Through Intersection).

For F+SI collisions in the City of Fort Bragg, 20 percent of collisions were unsafe speed collisions compared to 12 percent of collisions of all severity, meaning unsafe speed collisions are more likely to result in a fatal or severe injury. Main Street had a higher concentration of unsafe speed collisions, compared to other Fort Bragg roads. Recommended improvements at these locations include installing dynamic/variable speed warning signs.

When evaluating roadways vs intersections, it was observed that the majority of collisions occurred at intersections. In the City of Fort Bragg, 90% of all collisions occurred at intersections whereas 10% occurred on roadway segments. Many of these collisons occurred along Route 1/ Main Street. Recommdned improvements at intersection locations include improving signal timing, installing raised pavement markers and striping and modifying signal phasing to implement a Leading Pedestrian Interval (LPI).

Table 17. List of Viable Safety Projects

Location	CM1	CM2	CM3	Cost per Location	B/C Ratio
Project 1 - Systemic Improvements at Signalized Intersections					
Redwood Ave and Route 1/S Main St	S03		S21PB	$ 18,410	46.90
Oak St and Route 1/S Main St	S03	S09	S21PB	$ 28,683	
Boat Yard Drive and Route 1/ S Main St	S03	S09		$ 48,878	
Route 1 and Route 20	S03			$ 35,210	
Cypress St and Route 1/ S Main St	S03		S21PB	$ 18,410	
Project 2: Pedestrian Improvements at Unsignalized Intersections					
(3)Boat Yard Dr and Route 20	NS06			$ 840	40.04
(2)Pine St and Route 1/ S Main St	NS06	NS21PB	NS22PB	$ 122,087	
South St and Route 1/S Main St	NS06	NS21PB		$ 32,928	
Highway 1/Main Street and Pudding Creek Road	NS06			$ 1,785	
Noyo Point Road and S Main Street	NS06			$ 1,505	
Harold/Oak St (1)	NS06	NS21PB	NS22PB	$ 88,928	
Project 3: Systemic Roadway Segment Improvements					
Main St/Route 1: Airport Road to Highway 20/ Fort Bragg Willits Rd	R22	R26	R35PB*	$ 809,445	23.04
Highway 20/ Fort Bragg Willits Rd: Route 1 to South Harbor Dr	R22	R26		$ 34,615	
Redwood Ave: West Terminus to North Whipple St	R22			$ 6,020	
Franklin St: Laurel St to E Chestnut St	R22			$ 23,310	

Location	CM1	CM2	CM3	Cost per Location	B/C Ratio
Oak Street: California Way to Harold St	R22			$ 5,740	
River Dr/ Kemppe Way: South St to Cypress St	R22			$ 6,440	
Chestnut Street		R26		$ 28,000	
**Estimated 54 locations.*					
Project 4: Pedestrian and Other Roadway Segment Improvements					
Main St/Route 1: Airport Road to Highway 20/ Fort Bragg Willits Rd	R01	R34PB		$ 1,023,901	6.59
Redwood Ave: West Terminus to North Whipple St	R01			$ 12,600	
Oak St: California Way to Dana St	R01	R34PB		$ 742,098	
River Dr/ Kemppe Way: South St to Cypress St	R01	R34PB		$ 580,580	
Project 5: Pedestrian Set Aside					
Redwood Ave: West Terminus to North Whipple St	R35PB			$ 245,000	N/A
Project 6: Pedestrian Set Aside					
Harold St, from Maple to Fir	R35PB			$ 192,500	N/A

***Notes**: CM – countermeasure. B/C ratio is the dollar amount of benefits divided by the cost of the countermeasure. S03 - Improve signal timing (coordination, phases, red, yellow, or operation), S09 – Install raised pavement markers and striping (Through Intersection), S21PB- Modify signal phasing to implement a Leading Pedestrian Interval (LPI), NS06 - Install/upgrade larger or additional stop signs or other intersection warning/ regulatory signs, NS20PB - Install pedestrian crossing at uncontrolled locations (new signs and markings only), NS21PB - Install/upgrade pedestrian crossing at uncontrolled locations (with enhanced safety features), 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, R34PB- Install sidewalk/pathway (to avoid walking along roadway), 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. Based on the discussion and recommendation from the City Staff the HSIP Application can be a combination of a few projects as identified in this plan.

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 18**.

Table 18. 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 Fort Bragg 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 Fort Bragg'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:

Document	Highlights
City of Fort Bragg Costal General Plan (2008)	• Policy C-2.12 Roadway Safety: Improve the safety of the roadway system. All safety improvements shall be consistent with the applicable policies of the LCP including, but not limited to, the wetlands, environmentally sensitive habitat area, public access, and visual protection policies. • Program C-2.12.1: Periodically analyze the locations of traffic accidents to identify problems and use this information to set priorities for improvements as a part of the City's Capital Improvement Program. • Program C-4.1.1: Consider traffic safety, the ease and safety of pedestrian movement across Main Street, and adequacy of on-street parking as key factors in evaluation of proposed roadway improvements along Main Street. • Program C-4.1.4: Consider signalizing the intersection of Pine Street and Main Street to provide adequate pedestrian safety. • Program C-9.7.1: Continue to provide traffic controls and well-lit intersections in areas with a high volume of pedestrian movement. • Program C-9.7.2: Consider expanded use of illuminated crosswalks • Policy C-10.1 Comprehensive Bikeway System: Establish a comprehensive and safe system of bikeways connecting all parts of Fort Bragg. • Program C-10.1.1: Complete the bikeway system as indicated in Map C-2: Bicycle Paths. Make the completion of the Pudding Creek Trestle/Glass Beach to Otis Johnson Park a high priority. • Program C-10.1.2: Incorporate bicycle and pedestrian facilities into the design and construction of all road improvements as feasible.
Inland General Plan (2012)	Goals and Policies: Goal C-1: Complete Street Planning Goal C-2: Coordinate land use and transportation planning Goal C-3: Develop and manage a roadway system that accommodates future growth and maintains acceptable Levels of Service while considering the other policies and programs of the General Plan. Policy C-3.1.1: When a traffic analysis of levels of service and/or safety hazards indicates the need, construct the following roadway improvements:

Document	Highlights
	a) Signalize the Main Street/Pudding Creek Road intersection; b) Signalize the Franklin Street/Oak Street intersection; c) Widen the section of Main Street from the Pudding Creek Bridge to the northern City Limits to three lanes, adding a center turn lane; d) Signalize the Main Street/Pine Street intersection; and e) Consider extending Harrison Street south from Walnut Street to Cypress Street. Policy C-3.2 Roadway Standards: Continue to provide consistent standards for the City's street system. Program C-3.2.1: Establish standards for public streets, which allow for the following: a) Traffic "calming" measures; b) Sidewalks with curbs, gutters, and a planting strip between the sidewalk and the roadway; c) Rounded street corners with "bulb-outs" at key intersections; d) Continuation of the grid street system; and e) Standards for radius returns for local, collector, and arterial streets. Policy C-3.4 Continuation and Connectivity of Streets: Require the continuation of streets, bicycle and pedestrian paths through new developments wherever possible, and require connectivity to the street grid at as many points as feasible. Program C-3.4.1: Review site plans for new development to facilitate the continuation of streets to improve local circulation. Where streets are not feasible, priority shall be given to providing pedestrian and bicycle trails that establish bicycle and pedestrian connections to streets wherever possible. Policy C-3.6 Roadway Safety: Improve the safety of the roadway system. Program C-3.6.1: Periodically analyze the locations of traffic accidents to identify problems and use this information to set priorities for improvements as a part of the City's Capital Improvement Program. Goal C-8 Improve emergency access to the City. Policy C-8.1 Emergency Access: Establish an access route out of Fort Bragg that could be used in the event of damage to the Noyo River and Pudding Creek Bridges. Program C-8.1.1: Work with the property owners to obtain temporary use, in the event of an emergency, of the logging road that begins on Cypress Street and provides access to Highway 20 (aka the A&W Haul Road), east of Fort Bragg. Program C-8.1.2: Work with the Mendocino Council of Governments and Mendocino County to upgrade Sherwood Road to Willits to provide a year-round emergency access route.

Document	Highlights
	Program C-8.1.3: Prepare an emergency evacuation route plan for the City.
City of Fort Bragg Bicycle Master Plan (2009)	Proposed Projects • Harold St (Maple to Fir Ave) – Install Class II Bike lanes • Harrison St (Walnut to Fir St) - Install Class II Bike Lanes • Madrone St (Hwy 1 to Harold St) – Install Class II Bike lanes • Main St (Oak to Hare Creek Bridge) - Install Class II Bike Lanes • Main St (Elm to N City Limits) - Install Class II Bike Lanes • Maple St (Main St to Lincoln St) - Install Class II Bike Lanes • N Franklin St (Pine St to Manzanita) - Install Class II Bike Lanes • S Lincoln St (Willow to Chestnut) - Install Class II Bike Lanes • **Mill Site Bike Trails** - A Class 1 bikeway that runs along the entire length of the Mill Site coast parallel and to the west of the proposed Ocean Bluff Drive (see proposed cross section below). Upon development this would become the new Pacific Coast Bike Route (PCBR) through Fort Bragg. • **Class Beach Drive -** As part of the Coastal Trail project, the City plans to install a ten foot wide multi-use trail (eight feet of asphalt and four feet NaturalPAVE®) in the approximately 18 feet of right of way along the western edge of Glass Beach Drive. This trail will join the Old Haul Road/Pudding Creek Trestle multi-use trail with the bikeway system on the Mill Site.
2018 Street Safety Plan	• Install a 4-way STOP at the intersection of Laurel Street and Harrison Street; • Install a 4-way STOP at the intersection of Maple Street and Harold Street; • Remove the traffic circle at the intersection of Fir Street and Harrison Street; • Initiate dialogue and negotiations with Caltrans regarding pedestrian safety on Main Street. The focus of these efforts should be: o The intersection of Redwood Avenue and N Main Street with the recommendation of an advanced pedestrian timing at signal; and o The intersection of Pine Street and N Main Street with the recommendation of enhanced pedestrian crosswalk. • **Maple Street:** **Lane Striping (Optional)** – Convert from dashed yellow to double yellow to emphasize No Passing. **Narrow Through Lanes** – Narrow travel lanes from 12 feet to 11 feet as shown in the cross-section. The cross-section would include eight feet dedicated to parking and five feet for bike lanes on both sides together with the 11-foot travel lanes. **Green Bike Lane Legend (Optional)** – Where there is a bike lane symbol, install a green background. The green markings would consist of paving materials that would not result in a

Document	Highlights
	slippery surface per the Ride-A-Way Colored Coatings Specifications. Ride-A-Way product brochure and specification details are included in Appendix E. **No Parking** – Extend parking prohibitions on "block ends" where frontage housing does not have garage access. At these locations, the bike lane would move closer to the curb frontage. A striped buffer would be installed between the bike lane and the travel lane at these locations. **Markings at Alleys** – Add cross-hatched striping in the parking lane at alley intersections. **All-Way Stop-Control –** Create all-way stop controls at the Maple Street intersections with Whipple Street and Lincoln Street. The City may consider an additional all-way stop control at Harold Street based on a recommended citywide review of stop signs on the grid system (see Next Steps). **Marked crosswalks** – Add north-south marked crosswalks at locations with new all-way stop controls, Whipple Street and Harold Street (there are already marked crosswalks at the intersection of Maple Street/ Lincoln Street). **Bulb-outs/Curb Extensions** – Add striped (painted) bulb-outs on Maple Street at the proposed crosswalk locations, except at Harold Street where a physical concrete bulb-out already exists. **Maple Street/Franklin Street** – Add high visibility ladder crosswalks on both the north and south legs of the intersection. Add advance yield markings (shark's teeth) and pedestrian warning signs on both Franklin Street approaches. • **Elm Street** **Bike Cross Markings (Optional)** – Add green NACTO-type bike lane crossing markings at the intersections with Glass Beach Drive, Stewart Street, and North Main Street. **Green Bike Lane Legend (Optional)** – Where there is a bike lane symbol, include a green background. The green markings are detailed in the Ride-A-Way pamphlet. **Crosswalk at Glass Beach Drive** – Add a marked crosswalk on the north leg of the intersection along with the bike cross markings on both the north and south legs for bike crossing maneuvers from the trailhead parking to Elm Street. **Install Ramp** – Install a curb ramp on the northwest corner of the intersection for the proposed crosswalk and bike lane crossing markings. • **Pine Street** **Stop Signs** – Convert intersections with Corry Street and Harrison Street to all-way stop control. **Pedestrian Crossing Enhancements** – Add Pedestrian Crossing Signs (W11) on the uncontrolled east and west approaches to

Document	Highlights
	McPherson Street and Whipple Street. (Optional – Install advance yield markings (shark's teeth) on the uncontrolled approaches. **(Optional) Centerline Striping** – Convert centerline striping from dashed yellow to double yellow. **Edgeline** – Add 6-inch edgeline striping, providing an 11-foot travel lane with the remaining space (approximately 10.5 feet each direction) for parking and bicyclists along the curb as shown on the cross section. Install a sharrow along the edge between the travel lane and the parking lane. **Bulb-outs/Curb Extensions** – Add striped bulb-outs at crosswalk locations. **Green Bike Lane Legend (Optional)** – Where there is a bike lane symbol,
South Main Street Access and Beautification Plan (2011)	Proposed Projects • **South Main at Madrone Street Intersection Improvements** – median refuge island, high visibility crosswalks, stripping improvements • **South Main at Maple Street -** median refuge island, high visibility crosswalks, stripping improvements • **South Main and Hazel Street –** median refuge island, high visibility crosswalks, stripping improvements • **South Main and Walnut Street –** median refuge island, high visibility crosswalks, stripping improvements • **South Main and South Street -** median refuge island, high visibility crosswalks, stripping improvements • **South Main and North Harbor Drive -** median refuge island, high visibility crosswalks, stripping improvements • **South Main and South of Noyo Bridge -** median refuge island, high visibility crosswalks, stripping improvements • **State Route at Boat Yard Drive**- bulb out, striping improvements • **South Main and Cypress Street –** Bulb outs, Striping • **South Main at State Route -** Bulb outs, Striping, remove one slip lane, reconfigure other slip lane • **Roundabout Option – South Main and North Harbor Drive**
City of Trails: Trails Feasibility Study (2016)	Projects ○ **Redwood Avenue Connection to Downtown Fort Bragg** – Pedestrian improvements are proposed for Chief Celery Drive. Redwood Avenue improvements would include new wayfinding signs leading to/from Franklin Street and information about trails for visitors. A new parking area located on the GP Mill Site due west of Alder Streets would serve the middle section of the Coastal Trail (currently in design).

Document	Highlights
	○ **Old Mill Road Redevelopment to North Noyo Harbor** – Old Mill Road is an abandoned road that drops from the southern section of the Coastal Trail (near the cemetery) down to Noyo Harbor and Noyo Beach. This report evaluates requirements for redeveloping this old road cut into a multi-use trail that would extend the Coastal Trail to the beach at Noyo Bay, and potentially beyond to North Noyo Harbor. ○ **South Noyo Harbor Trail** – An existing social trail on private property leads from Highway 1 down to South Noyo Harbor. Landowners on the alignment would like to reduce illegal activities there and employers at the Harbor have expressed interest in the trail. This report recommends installation of timber (or concrete timber) steps and surfacing with quarry fines on the inclined sections.
City of Trails: Supplemental Trail Feasibility Studies (2017)	Projects ○ **Old Mill Road** An existing route along the face of the coastal bluff south of the Coastal Trail would be converted to a multi-use trail. The trail would be located on the levee top of the existing Noyo Harbor dredge pond berm west of the cliff face roadway. ○ **North Harbor Drive** A trail separate from the roadway would be implemented on North Harbor Drive between Casa Del Noyo and the Noyo Fishing Center to connect with the lower portion of Harbor Drive. This Study addresses the feasibility of placing a Class 1 or Class II* multi-use trail parallel to the North Harbor Drive. Due to right-of-way and topographic constraints along the roadway, a trail structure cantilevered over the narrow road shoulder and adjacent retaining wall was evaluated.
City of Fort Bragg FY 2020-2021 Budget	Proposed Projects • South Main St Bike and Ped Improvements • Maple Street SD and Alley Rehabilitation
Mill Site Specific Plan (2012)	**Improvement of Pedestrian Safety has been emphasized.** **Policy MM-1. "Complete Streets."** As part of the first Master Tentative Subdivision Map for the Plan Area, the applicant shall establish a multi-modal network of "complete streets" that balances the needs for safety and comfort of pedestrians, cyclists, drivers, and transit riders and that substantially conforms to the conceptual street network design. **Policy MM-14. Complete Streets.** All streets shall be designed as complete streets for the safety and comfort of cyclists and pedestrians, including children, the elderly, and people with disabilities, consistent with US Department of Transportation complete streets guidelines. **Policy MM-16. Safe Streets.** The design speed of streets in the Central and Northern Districts shall not exceed 25 miles per hour, with typical operating speeds below 20 miles per hour. In the Southern District, design speeds may be as high as 30 miles per hour, with typical

Document	Highlights
	operating speeds below 25 miles per hour. Streets shall be designed to optimize pedestrian safety and comfort, with the minimum number of travel lanes necessary to accommodate their traffic function at Level of Service E or better, averaged over the midweek peak one hour. If unacceptable traffic congestion is identified, traffic shall be redistributed onto additional streets, or accommodated with a right- or left-turn pocket, rather than by adding a travel lane. **Specific traffic calming elements included in the site design include:** • Corner "bulb-outs" at most intersections, ensuring low-speed turning movements and improving pedestrian safety; • Ample landscape along the roadway edge; • Small blocks and stop signs at most intersections; and • Bicycle lanes on the wider streets **Policy MM-32. Additional Traffic Calming Measures.** The City engineer may require additional traffic calming features where necessary to ensure pedestrian safety.
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.
Mendocino County Safe Routes to School Plan (2014)	Goals **Goal 1:** Improve the health of Mendocino County children by focusing attention on and increasing active travel to school. *Objective A: Increase the number of students walking and bicycling to school* *Objective B: Annually increase the number of children exposed to Safe Routes to School education and encouragement activities* *Objective C: Increase the number of county residents that are familiar with SRTS and resources available* **Goal 2:** Support school travel routes that are accommodating, safe, convenient, and "complete" for all modes**.** *Objective A: Increase funding for walking, bicycling and transit investments near schools* *Objective B: Review school connections and potential SRTS needs during project development for all county roads* *Objective C: Incorporate Safe Routes to School policies, priorities, and design guidance into future county general plan updates* *Objective D: Limit traffic speeds and volumes along key routes to schools*

Document	Highlights
	Goal 3: Maximize interagency cooperation in all SRTS project and programs in an effort to build a sustainable program. *Objective A: Establish an ongoing countywide SRTS program that serves all interested schools in Mendocino County.* *Objective B: Seek and secure outside grant funding for SRTS programs and activities, and leverage local funding for school area improvements*
Mendocino County Pedestrian Facility Needs Inventory and Engineered Feasibility Study (2019)	Projects Tier 1 Projects • Elm Street Pedestrian Improvements • South Main Street Corridor Pedestrian Enhancements • Maple Street Pedestrian Improvements
Mendocino Council of Governments 2020 Regional Transportation Improvement Program (2019)	Projects • S. Main St Bicycle & Pedestrian Access Project – Fort Bragg - This project will continue pedestrian improvements along a state highway, linking to existing facilities. The project will improve access to a major shopping area, school facility, and tourist attractions. Pedestrian safety will be improved.

APPENDIX B. CONSOLIDATED COLLISION DATABASE

Case ID	Accident Year	Collision Date	Primary Road	Secondard Road	Distance	Direction
6792537	2015	1/21/2015	NORTH MAIN ST	E REDWOOD AV	3	S
7004210	2015	7/25/2015	RT 1	BOAT YARD DR	20	N
7009890	2015	7/31/2015	MAIN ST	RT 1	38	W
7010680	2015	7/24/2015	RT 1	RT 20	166	N
7062865	2015	9/27/2015	RT 1	BUSH ST	8	N
7076588	2015	9/3/2015	E REDWOOD AV	NORTH MAIN ST	0	
7113323	2015	10/28/2015	FRANKLIN ST	HAZEL ST	224	S
7114920	2015	11/2/2015	RT 1	PUDDING CREEK BRIDGE	108	N
8024052	2016	4/7/2016	RT 1	E PINE ST	0	
8025139	2016	5/12/2016	RT 1	CYPRESS ST	287	S
8050202	2016	5/27/2016	RT 1	OAK ST	310	N
8064636	2016	6/9/2016	RT 1	WALNUT ST	91	N
8064789	2016	6/10/2016	SOUTH MAIN ST	CYPRESS ST	141	N
8079801	2016	7/2/2016	RT 1	E ALDER ST	2	S
8169129	2016	11/9/2016	FRANKLIN ST	E REDWOOD AV	154	S
8204769	2016	42733	RT 1	E REDWOOD AV	0	
8290669	2017	1/12/2017	RT 1	BOAT YARD DR	29	N
8320405	2017	2/21/2017	RT 1	MAPLE ST	16	N
8351905	2017	4/14/2017	RT 1	MANZANITA ST	8	W
8420750	2017	7/25/2017	RT 1	CYPRESS ST	0	
8451084	2017	9/17/2017	RT 1	W REDWOOD AV	3	S
8462036	2017	9/28/2017	RT 1	CYPRESS ST	311	N
8469680	2018	1/14/2018	RT 1	RT 20	40	N
8471916	2017	10/8/2017	RT 1	RT 20	455	N
8472307	2017	10/9/2017	RT 1	OCEAN VIEW DR	250	N
8504330	2017	12/29/2017	RT 1	CHESTNUT ST	136	S
8504603	2017	12/29/2017	RT 1	NOYO POINT RD	10	N
8504755	2017	12/26/2017	RT 1	NORTH HARBOR DR	61	S
8524282	2017	12/18/2017	KEMPE WY	RIVER DR	35	E
8574315	2018	2/25/2018	MAPLE ST	FRANKLIN ST	15	E
8586649	2018	3/19/2018	RT 1	OCEAN VIEW DR	200	S
8599950	2018	3/30/2018	RT 1	E REDWOOD AV	6	N
8604238	2018	4/20/2018	MAPLE ST	RT 1	3	E
8660586	2018	7/5/2018	SOUTH MAIN ST	SOUTH ST	46	S
8707747	2018	7/18/2018	OAK ST	RT 1	44	E
8779995	2018	12/30/2018	OAK ST	RT 1	0	
8820623	2019	3/2/2019	FRANKLIN ST	MADRONE ST	77	S
8832627	2019	3/23/2019	OAK ST	HOCKER LN	128	W
8875476	2019	6/10/2019	RT 1	RT 20	178	S
8886037	2019	5/30/2019	BOAT YARD DR	RT 20	201	N
8896645	2019	7/1/2019	RT 1	AIRPORT RD	650	N
8898670	2019	7/6/2019	MAIN ST	SPRUCE ST	137	N
8910462	2019	8/2/2019	RT 1	CYPRESS ST	0	
8923682	2019	8/14/2019	E REDWOOD AV	N FRANKLIN ST	145	W
8924871	2019	8/13/2019	REDWOOD AV	N MCPHERSON ST	26	W

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

City of Fort Bragg LRSP

CM Toolbox for Intersections

Signalized						
Sr. No.	**Code**	**Countermeasure Name**	**CM Description**	**CRF**	**Federal Funding**	**Systemic Approach Opportunity**
	HSIP/Non-HSIP Code					
1	S02	Improve signal hardware: lenses, back-plates with retroreflective borders, mounting, size, and number	Includes 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.	15%	100%	Very High
2	S03	Improve signal timing (coordination, phases, red, yellow, or operation)	Includes adding phases, lengthening clearance intervals, eliminating or restricting higher-risk movements, and coordinating signals at multiple locations.	15%	50%	Very High
3	S08	Convert signal to mast arm (from pedestal-mounted)	Intersections currently controlled by pedestal mounted traffic signals (in medians and/or on outside shoulder) that have a high frequency of right-angle and rear-end crashes occurring because drivers are unable to see traffic signals in advance to safely negotiate the intersection.	30%	100%	Medium
4	S09	Install raised pavement markers and striping (Through Intersection)	Addition of clear pavement markings, raised pavement marking to help guide motorists through complex intersections.	10%	100%	Very High
5	S12	Install raised median on approaches (S.I.)	Addition of raised medians next to left-turn lanes at intersections, directly over existing pavement.	25%	90%	Medium
6	S17PB	Install pedestrian countdown signal heads	A pedestrian countdown signal contains a timer display and counts down the number of seconds left to finish crossing the street. Countdown signals can reassure pedestrians who are in the crosswalk when the flashing "DON'T WALK" interval appears that they still have time to finish crossing.	25%	100%	Very High
7	S21PB	Modify signal phasing to implement a Leading Pedestrian Interval (LPI)	Addition of LPI gives pedestrians the opportunity to enter an intersection 3-7 seconds before vehicles are given a green indication; only minor signal timing alteration is required.	60%	100%	Very High

Unsignalized						
Sr. No.	**Code**	**Countermeasure Name**	**CM Description**	**CRF**	**Federal Funding**	**Systemic Approach Opportunity**
1	NS03	Install signals	Installation of traffic signals	30%	100%	Low
2	NS06	Install/upgrade larger or additional stop signs or other intersection warning/regulatory	enhance the ability of approaching drivers to perceive them	15%	100%	Very High
3	NS07	Upgrade intersection pavmenet markings	perceive them can be enhanced by installing	25%	100%	Very High
4	NS17	Install right turn lane	Provision of exclusive right-turn lanes, particularly on high-volume and high-speed major-road approaches.	20%	90%	Low
5	NS21PB	features)	opportunity to enhance pedestrian safety at locations noted as being especially	35%	100%	Medium
6	NS22PB	Install Rectangular Rapid Flashing Beacon (RRFB)	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	35%	100%	Medium

CM Toolbox for Roadway Segments

Sr. No.	**Code**	**Countermeasure Name**	**CM Description**	**CRF**	**Federal Funding**	**Systemic Approach Opportunity**
1	R22	Install/Upgrade signs with new fluorescent sheeting (regulatory or warning)	Additional or new signage can address crashes caused by lack of driver awareness or compliance of roadway signing.	15%	100%	Very High
2	R26	Install dynamic/variable speed warning signs	Includes the addition of dynamic regulatory signs (also known as Radar Speed Feedback Signs)	30%	100%	High
3	R34PB	Install sidewalk/pathway (to avoid walking along roadway)	Sidewalks and walkways provide people with space to travel within the public right-of-way that is separated from roadway vehicles.	80%	90%	Medium
4	R35PB	Install/upgrade pedestrian crossing (with enhanced safety features)	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.	35%	90%	Medium

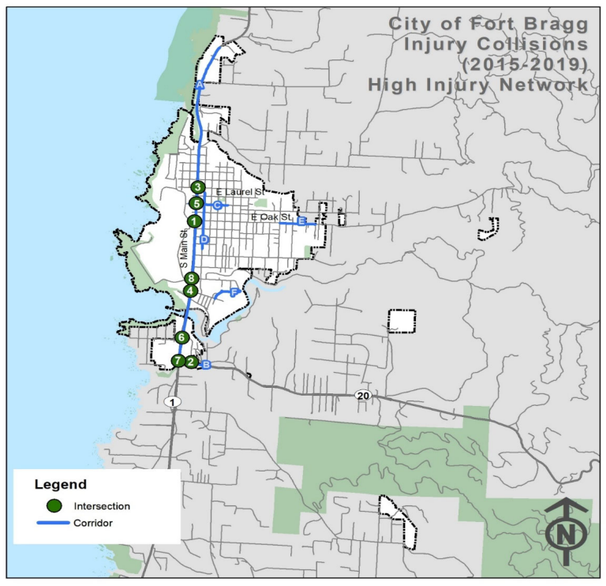
5	R36PB	Install raised pedestrian crossing		Ramped speed tables spanning the entire width of roadway or intersection	35%	90%	Medium

High-risk Intersections

ID	Intersection	Control	Consolidated CMs (HSIP-Eligible - Refer to LRSM* 2020)				Additional CM (non-HSIP)**	EA - 1 Improve Intersection Safety			EA - 2 Improve Pedestrian Safety			EA - 3 Reduce Improper Turning Collisions			EA - 4 Reduce Route 1 Collisions			EA - 5 Reduce Alley Way collisions		
			CM1	CM2	CM3	CM4		CM1	CM2	CM3	CM1	CM2	CM3	CM1	CM2	CM3	CM1	CM2	CM3	CM1	CM2	CM3
I-1	Redwood Ave and Route 1/S Main St	Signalized		S03	S08	S21PB	Install ADA curb ramps, install advance ped warning signs, verify crosswalk width		S03	S08	S17PB	S21PB			S08			S03	S08			
I-2	Oak St and Route 1/S Main St	Signalized		S03	S9	S21PB	Advance ped warning signs		S03	S09		S21PB		S09				S03	S09			
I-3	Boat Yard Dr and Route 20	Two way stop controlled	NS06				Reduce corner radius of NW and NE corners with planters or striping	NS06						NS06								
I-4	Pine St and Route 1/ S Main St	Two way stop controlled	NS21PB	NS22PB			Stripe high visibility crosswalk, update ADA ramps, radar speed feedback signs along Main St	NS21PB	NS22PB		NS21PB	NS22PB					NS21PB	NS22PB				
I-5	South St and Route 1/S Main St	One way stop controlled	NS06	NS21PB			Reduce corner radius for southeast corner	NS06	NS21PB		NS21PB						NS06	NS21PB				
I-6	Boat Yard Drive and Route 1/ S Main St	Signalized		S03	S09	S12	Install ADA curb ramps, install intersection warning signs		S03	S12					S12			S03	S12			
I-7	Route 1 and Route 20	Signalized		S03			Install intersection warning signs, radar feedback signs on SB approach		S03						S03			S03				
I-8	Cypress St and Route 1/ S Main St	Signalized	S03	S21PB			Stripe high visibility crosswalk, install ADA ramps, upgrade pavement markings		S03			S21PB						S03				
	Identified from Stakeholder Input																					
I-9	Traffic Safety around Schools		NS06	NS22PB			Other traffic calming measures near schools	NS06	NS22PB		NS22PB			NS06								
I-10	Highway 1/Main Street and Pudding Creek Road	One way stop controlled	NS03	NS06				NS03	NS06					NS03	NS06		NS03	NS06				
I-11	Noyo Point Road and S Main Street	Two way stop controlled	NS06	NS07			Restrict left turns from Noyo	NS07						NS07			NS07					

Code	Countermeasure Name
HSIP/Non-HSIP Code	
S02	Improve signal hardware: lenses, back-plates with retroreflective borders, mounting, size, and number
S03	Improve signal timing (coordination, phases, red, yellow, or operation)
S08	Convert signal to mast arm (from pedestal-mounted)
S09	Install raised pavement markers and striping (Through Intersection)
S12	Install raised median on approaches (S.I.)
S17PB	Install pedestrian countdown signal heads
S21PB	Modify signal phasing to implement a Leading Pedestrian Interval (LPI)

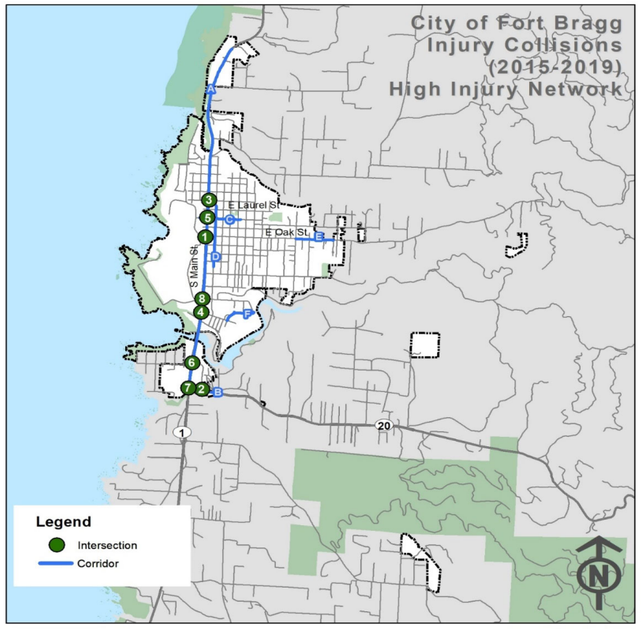
Code	Countermeasure Name
NS03	Install signal
NS06	Install/upgrade larger or additional stop signs or other intersection warning/regulatorysigns
NS07	Upgrade intersection pavement markings
NS17	Install right turn lane
NS21PB	Install/upgrade pedestrian crossing at uncontrolled locations (with enhanced safetyfeatures)
NS22PB	Install Rectangular Rapid Flashing Beacon (RRFB)



High-risk Roadway Segments

ID	Roadway Segment	Consolidated CMs (HSIP-Eligible - Refer to LRSM* 2020)				Additional CM (non-HSIP)**	EA - 1 Improve Intersection Safety			EA - 2 Improve Pedestrian Safety			EA - 3 Reduce Improper Turning Collisions			EA - 4 Reduce Route 1 Collisions			EA - 5 Reduce Alley Way Collisions		
		CM1	CM2	CM3	CM4		CM1	CM2	CM3	CM1	CM2	CM3	CM1	CM2	CM3	CM1	CM2	CM3	CM1	CM2	CM3
A	Main St/Route 1: Jane Ln to Highway 20/ Fort Bragg Willits Rd	R22	R26	R34PB	R35PB	bike route signange				R34PB	R35PB		R22			R22	R26	R35PB			
B	Highway 20/ Fort Bragg Willits Rd: Route 1 to South Harbor Dr	R22	R26			Restripe intersection corners							R22								
C	Redwood Ave: West Terminus to North Whipple St	R01	R22	R22	R22	Install ADA curb ramps; upgrade pavement markings				R35PB	R36PB		R22								
D	Franklin St: Laurel St to E Chestnut St	R22				Restrict parking near intersection to increase sight distance (red curbs)							R22								
E	Fort Bragg Sherrwood Rd: California Way to Dana St	R22	R34PB			Install Class III bike route markings, reduce parking near intersection corners				R34PB			R22								
F	River Dr/ Kempe Way: South St to Cypress St	R22	R35PB	R01		Install streetlights to increase ped visibility near hospital				R01	R35PB		R22								
	Identified from Stakeholder Input																				
G	Alleyways					Limit parking near alley exits to increase sight distance															
H	Chestnut Street	R26				traffic calming measures															

Code	Countermeasure Name
R22	Install/Upgrade signs with new fluorescent sheeting (regulatory or warning)
R26	Install dynamic/variable speed warning signs
R34PB	Install sidewalk/pathway (to avoid walking along roadway)
R35PB	Install/upgrade pedestrian crossing (with enhanced safety features)
R36PB	Install raised pedestrian crossing



	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 Fort Bragg every 3-5 years	Number of education campaigns	City/ School District/ Police Department
	Conduct bicycle safety campaigns and outreach to raise their awareness of bicycle safety needs through media outlets, social media and Bike and Walk Mendocino. Update pamphlet for bicycle safety for Fort Bragg 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
	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
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 control personnel taking Traffic Incident Management Training	number of EMS/fire control personnel taking Traffic Incident Management Training	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): $Benefit/Cost\ Ratio\ (\mathrm{Pr}oject) = \frac{\sum_{CM=1}^{3} Benefit\ (Life)_{(CM)}}{Total\ \mathrm{Pr}oject\ Cost}$