City of Ukiah

City of Ukiah

Local Roadway Safety Plan

06/15/2022
Final Report

City of Ukiah

Local Roadway Safety Plan

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Executive Summary

The City of Ukiah's Local Roadway Safety Plan (LRSP) is a comprehensive plan that creates a framework to systemically identify and analyze traffic safety related issues and recommend projects and countermeasures. The LRSP aims to reduce fatal and severe injury (F+SI) 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 Ukiah General Plan (1995), Ukiah Bicycle & Pedestrian Master Plan (2015), City of Ukiah Safe Routes to School Plan (2014), Ukiah Downtown Streetscape Improvement Plan (2009), Downtown Ukiah Parking Improvement Study (2007), Ukiah Valley Area Plan (2011), Doolin Creek: A Vision for Restoration and Enhancement (2015), City of Ukiah Pavement Management Program Update (2010), Mendocino County Rail-with-Trail Corridor Plan (2012), Mendocino County Safe Routes to School Plan (2014), Mendocino County Regional Active Transportation Plan (2017), 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 characteristics in the City of Ukiah. There were a total of 637 collisions reported City-wide from 2015 to 2019. Out of these 422 collisions (67 percent) were PDO collisions, 124 collisions (19 percent) led to complaint of pain injury and 67 collisions (11 percent) led to a visible injury. There were 24 F+SI collisions, 24 collisions (four percent) led to a severe injury and zero collisions led to a fatality. For collisions of all severity, including PDO collisions, 87 percent collisions occurred at intersections.

One of the top priorities of the LRSP will be to address intersection safety at all intersections where collisions have historically occurred.

For F+SI collisions, 46 percent of collisions were pedestrian collisions, most of these occurred at intersections. This calls for evaluating pedestrian conditions along the high injury network and throughout the City with similar characteristics that are highly unsafe for pedestrians. Improvements at these locations can include reducing pedestrian crossing distances, installing high visibility crosswalks, installing pedestrian refuge islands, and installing bulb outs. The Downtown Ukiah Streetscape Improvements Plan contains similar proposed pedestrian improvements for State Street and 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.

For F+SI collisions, 21 percent of collisions were hit object collisions, most of these occurred at intersections. This calls for evaluating hit object collisions along the high injury network and throughout the City with similar characteristics. Hit object collisions can be mitigated by installing reflective signs, object markers, and keeping sightlines clear at intersections.

For F+SI collisions, 19 percent of collisions were unsafe speed collisions, most of these at intersections locations. This calls for evaluating unsafe speed collisions along the high injury network and other locations throughout the City with similar characteristics. Improvements at these location may consist of dynamic variable speed warning sign, advanced dilemma-zone at signalized intersection for high-speed approaches, bulb outs, raised medians, edge lines and others. The roadway with the most unsafe speed collisions of the high injury corridors was State Street and the intersections with the most unsafe speed collisions on the high injury intersection was the intersection of Perkins Street/South Orchard Avenue and Wabash Avenue/State Street.

The next steps include identifying strategies corresponding to the 4 E's of safety (Engineering, enforcement, education, and EMS) to comprehensively make the City of Ukiah safer for all modes of transportation.

Chapter 4 - Emphasis Areas

Emphasis areas are a focus of the LRSP that are identified through the various collision types and factors resulting in F+SI collisions within the City of Ukiah. The eight emphasis areas for Ukiah are:

- Improve Intersection Safety
- Improve Pedestrian Safety
- Reduce Nighttime Collisions
- Reduce Hit Object Collisions
- Reduce Unsafe Speed Collisions
- Improve Bicyclist Safety
- School Area Collisions
- Reduce Younger 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 Signalized Intersections
- Project 2: Systemic Improvements at Signalized Intersections
- Project 3: Systemic Improvements at Unsignalized Intersections
- Project 4: Systemic Roadway Segment Improvements
- Project 5: Roadway Segment Improvements
- Project 6: Pedestrian Roadway Segment Improvements
- Project 7: 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 F+SI 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 F+SI collisions throughout the City. If the number of F+SI collisions does not decrease over time, then the emphasis areas and countermeasures should be re-evaluated.

1. Introduction

What is a LRSP?

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

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

Vision and Goals of the LRSP

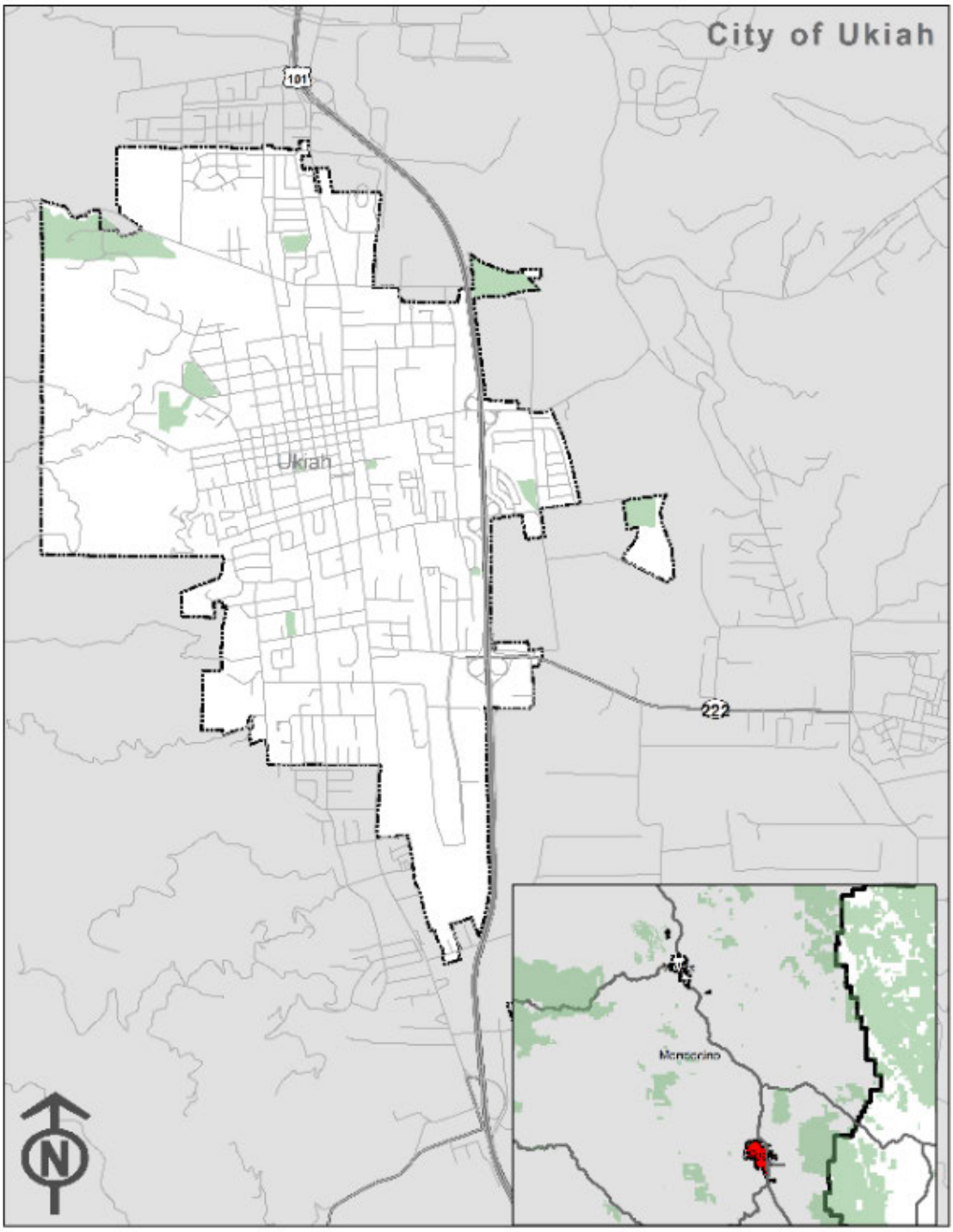
- Goal #1: Systemically identify and analyze roadway safety problems and recommend improvements
- Goal #2: Improve the safety of all road users by using proven effective countermeasures
- Goal #3: Ensure coordination and response of key stakeholders to implement roadway safety improvements within Ukiah
- 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 Ukiah residents

Study Area

The City of Ukiah is located in Mendocino County, California, covering a total area of about 4.83 square miles. It is the County seat and the largest city in Mendocino County and is located at an elevation of 633 feet.

The City's estimated population is 15,943 (ACS 2019 1-year estimate). The City is accessible via US Route 101 corridor. **Figure 1** shows the study area.

Figure 1. Study Area: City of Ukiah



Safety Partners

Safety partners are vital to the development and implementation of an LRSP. For the City of Ukiah, these include representatives from various City Departments, Chamber of Commerce, Walk and Bike Mendocino, CHP, Cal Fire, School Districts, 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 LRSP, 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 66 comments were for the City of Ukiah.

Figure 2. City Website and Social Media Postings

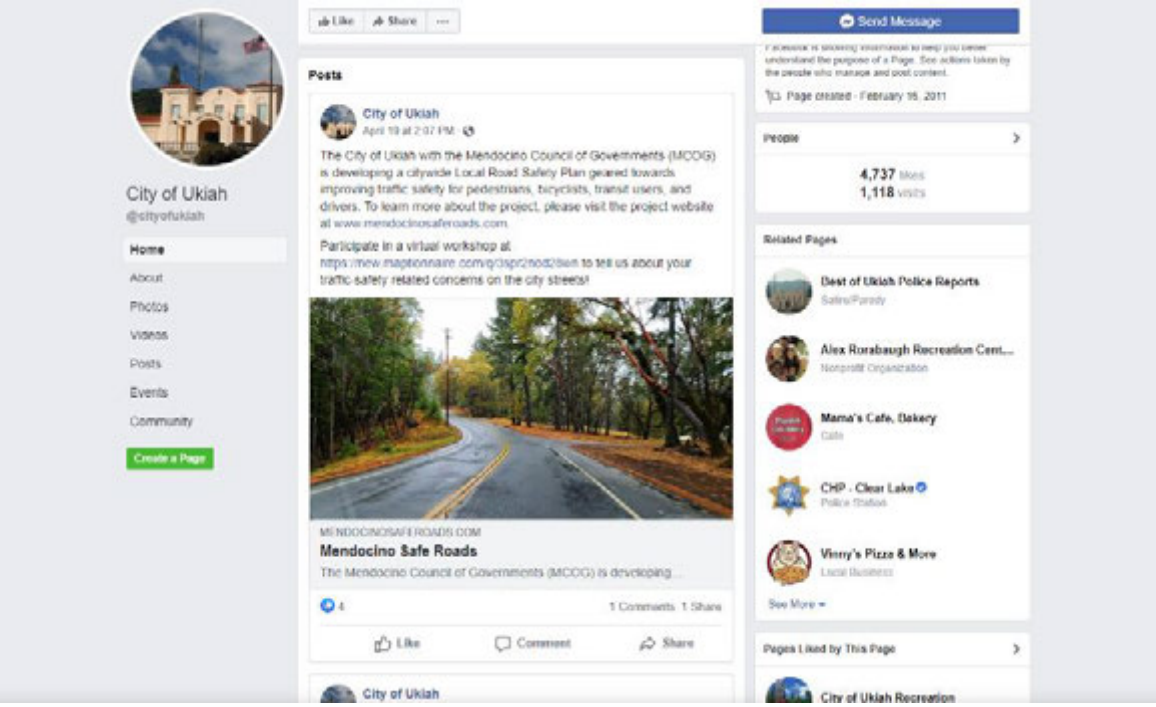
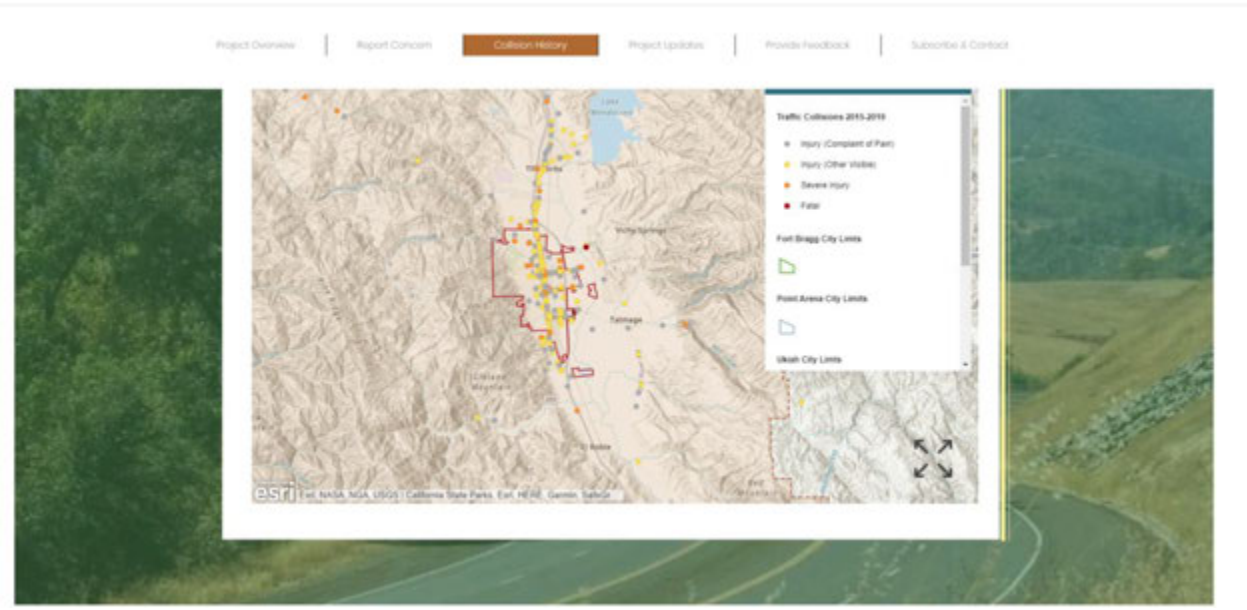
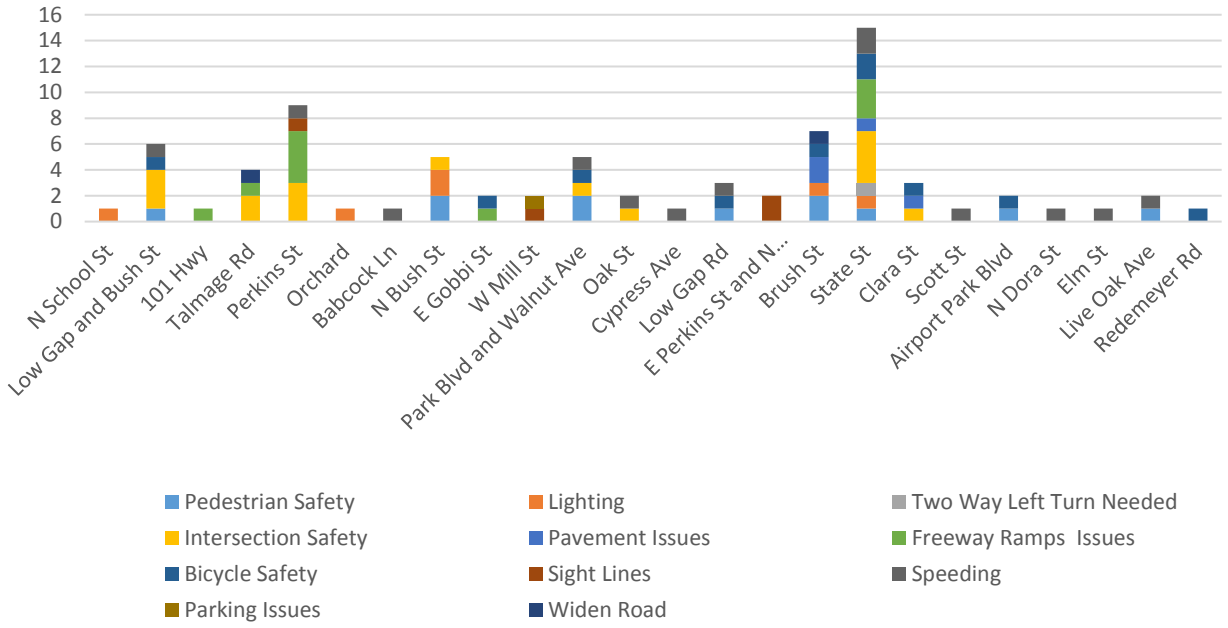


Figure 3. Project Website: mendocinosaferoads.com



The most common traffic safety issue was intersection safety, with a total 16 comments. The most commented on location with intersection issues was State Street, with four comments and the intersection of Low Gap Road and Bush Street with three comments. Intersections along Perkins Street and Talmage Road also received comments regarding intersection safety. Speeding was the second most commented on safety issue, with a total of 13 comments. The most commented on location with speeding issues was State Street and Low Gap Road.

Figure 4. City of Ukiah - Public Comments



2. Existing Planning Efforts

This chapter summarizes the planning documents, projects underway, and studies reviewed for the City of Ukiah LRSP, being developed as a part of Mendocino Council of Governments LRSP's 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 Ukiah General Plan (1995)
- Ukiah Bicycle and Pedestrian Master Plan (2015)
- City of Ukiah Safe Routes to School Plan (2014)
- Ukiah Downtown Streetscape Improvement Plan (2009)
- Downtown Ukiah Parking Improvement Study (2007)
- Ukiah Valley Area Plan (2011)
- Doolin Creek: A Vision for Restoration and Enhancement (2015)
- City of Ukiah Pavement Management Program Update (2010)
- Mendocino County Rail-with-Trail Corridor Plan (2012)
- Mendocino County Safe Routes to School Plan (2014)
- Mendocino County Regional Active Transportation Plan (2017)
- 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 brief description of each document is summarized in **Table 1**. A more detailed list of relevant policies is in **Appendix A**.

Table 1. Document Review Summary

Document	Highlights
City of Ukiah General Plan (1995)	Last updated in 2004, Circulation element of the General Plan details long range plans for the City of Ukiah including bicycle, pedestrian, vehicle and transit policies.
Ukiah Bicycle & Pedestrian Master Plan (2015)	The goal of the Ukiah Bicycle and Pedestrian Master Plan (BPMP or Plan) is to improve bicycling and walking in the City of Ukiah as a comfortable and convenient transportation and recreation option.
City of Ukiah Safe Routes to School Plan (2014)	This plan presents infrastructure and programmatic projects recommended to improve student safety and access to seven public schools in the City of Ukiah.

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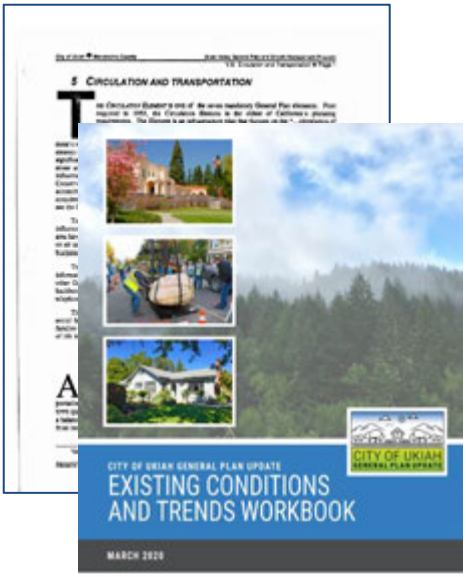
Document	Highlights
Ukiah Downtown Streetscape Improvement Plan (2009)	The purpose of this plan is to upgrade State Street and Main Street from Norton Street to Gobbi Street to provide for a cohesive, pedestrian-friendly, attractive, and complete downtown core.
Downtown Ukiah Parking Improvement Study (2007)	This report studies existing parking conditions in downtown Ukiah and identify potential solutions.
Ukiah Valley Area Plan (2011)	This plan is an element of the County General Plan governing land use and development on the unincorporated lands in the Ukiah Valley.
Doolin Creek: A Vision for Restoration and Enhancement (2015)	This report provides long term guidance for the preservation of the healthy portions of the creek, restoration and enhancement of degraded areas, and reestablishing parts of the creek as a place for human use and appreciation.
City of Ukiah Pavement Management Program Update (2010)	This report assists policy makers in utilizing MTC's StreetSaver pavement management program to improve overall maintenance and rehabilitation strategies.
Mendocino County Rail-with-Trail Corridor Plan (2012)	This plan identifies priority improvements for walking and biking facilities along the existing, currently unused, rail line running through Mendocino County. The plan's focus was on Hopland, Ukiah and Willits, with potential interregional connections, along the North Coast Railroad Authority (NCRA) railway.
Mendocino County Safe Routes to School Plan (2014)	Safe Routes to School is a program with a simple goal: helping more children get to school by walking and bicycling.
Mendocino County Regional Active Transportations Plan (2017)	Details bicycle and pedestrian improvements on County significant corridors. Includes detailed priority bike and pedestrian projects.
Mendocino Council of Governments 2020 Regional Transportation Improvement Program (2019)	The RTIP is a program of highway, local road, transit and active transportation projects that a region plans to fund with State and Federal revenue.

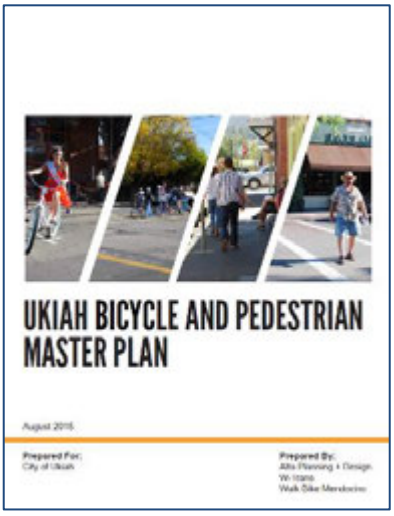
Ukiah General Plan (1995)

The General Plan presents a consolidated framework of decisions for guiding where and how development should occur in the City of Ukiah. The plan's Circulation and Transportation Element addresses the street and transportation network with its emphasis on the movement of people and products. The general plan now being updated.

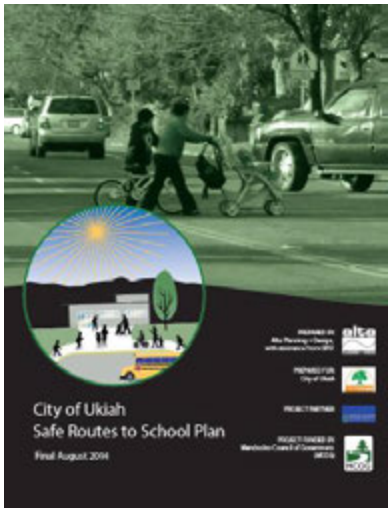


Ukiah Bicycle and Pedestrian Master Plan (2015)

The goal of the update to the Ukiah Bicycle and Pedestrian Master Plan (BPMP or Plan) is to improve bicycling and walking in the City of Ukiah as a comfortable and convenient transportation and recreation option. The plans goals include improve safety and education, greater citywide access, a high quality of life and establish an effective implementation strategy.

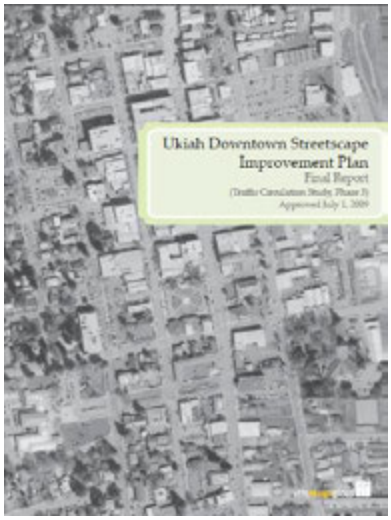


Ukiah Safe Routes to School Plan (2014)



The City of Ukiah Safe Routes to School Plan identifies and prioritizes capital projects, non-infrastructure strategies, and next steps for establishing a Safe Routes to School program in Ukiah. The Safe Routes to School Plan's recommendations are based on input gathered from the initial discussions with City and school staff, "walk audit" observations, best practices from other communities, and additional stakeholder input. School improvement concepts were identified for each of the seven Ukiah Schools and evaluated through a ranking system of five criteria (addresses a known safety issue, potential to serve the most students and increase rate of walking/biking, existing community support, feasibility and cost, communitywide benefits).

Ukiah Downtown Streetscape Improvement Plan (2009)



The Ukiah Downtown Streetscape Improvement Plan is part of the City of Ukiah's efforts to resolve traffic, circulation, and urban design issues associated with its downtown area. The purpose of this plan is to upgrade State Street and Main Street from Norton Street to Gobbi Street in order to provide a cohesive, pedestrian-friendly, attractive, and complete downtown core.

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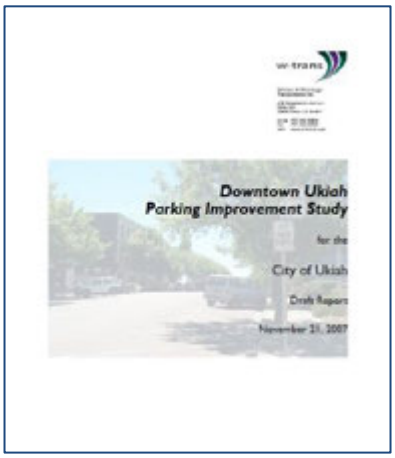
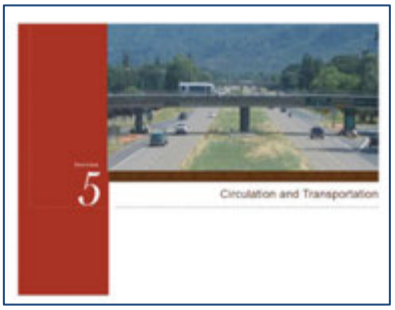
Downtown Ukiah Parking Improvement Study (2007)



The Downtown Ukiah Parking Study's purpose was to determine existing parking conditions in downtown Ukiah and identify potential solutions. This study largely does not have projects or policies related to traffic safety.

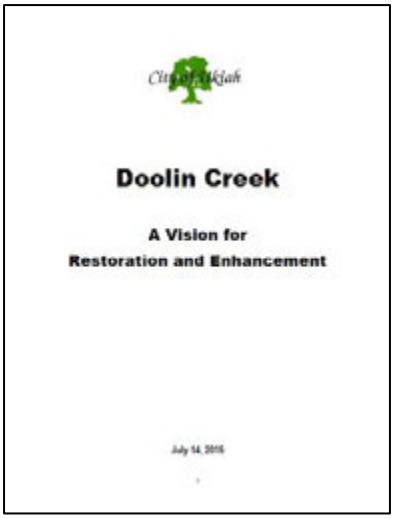
Ukiah Valley Area Plan (2011)



The Ukiah Valley Area Plan (UVAP) is an individual element of the Mendocino County General Plan and represents a commitment to a comprehensive, long-range, and inter-jurisdictional planning document designed to meet the needs of the County, as well as the shared needs of the City. The Circulation and Transportation section of the UVAP seeks to coordinate driver, pedestrian, bicyclist, and transit user needs with land use, air quality, plant and animal habitat, storm water runoff, noise, energy consumption, and greenhouse gas emission goals. The plan states that acquisition of land for road widening and new road construction is expensive and has social and environmental cost implications, and therefore, the County and City will be proactive in facilitating the use of alternative modes of transportation such as bicycling and walking.

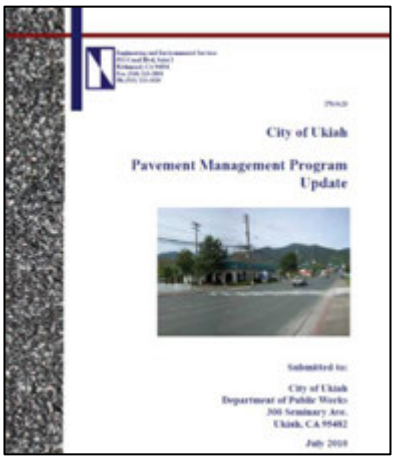
Doolin Creek: A Vision for Restoration and Enhancement (2015)

The goal of this Plan is to provide long-term guidance for the preservation of the healthy portions of the creek, restoration and enhancement of degraded areas, and reestablishing parts of the creek as a place for human use and appreciation. In attempting to manage the creek in an environmentally sensitive manner and protect it from further degradation, to prepare a conceptual restoration and enhancement plan. This study largely does not have projects or policies related to traffic safety.



City of Ukiah Pavement Management Program Update (2010)

The purpose of this report is to assist policy makers in utilizing the results of MTC's StreetSaver PMP. This report assesses the adequacy of current and projected revenues to meet the maintenance needs recommended by the PMP program. It also maximizes the return from expenditures by: implementing a multi-year road rehabilitation and maintenance program; developing a preventative maintenance program; and prioritizing and selecting the most cost effective repairs. This study largely does not have projects or policies related to traffic safety.



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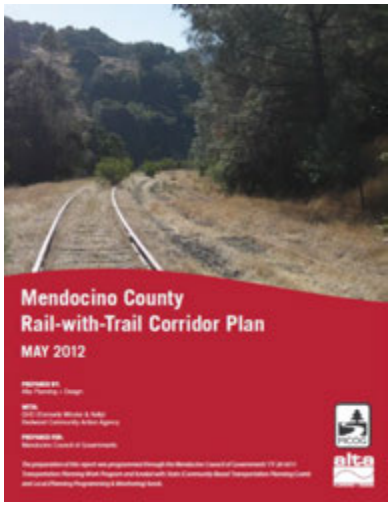
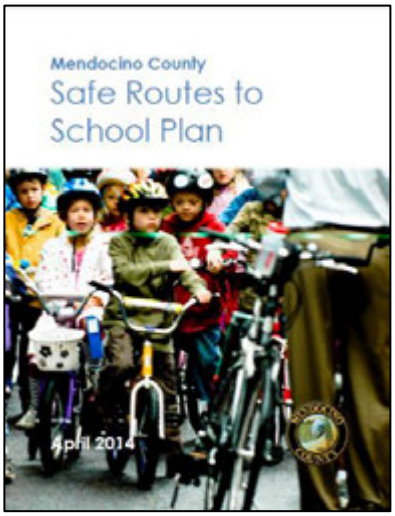
Mendocino County Rail-with-Trail Corridor Plan (2012)



The Mendocino County Rail-with-Trail Corridor Plan (Plan) provides an analysis of general conditions along the length of the 103-mile corridor and identifies priority RWT projects for the Cities of Ukiah and Willits and the County of Mendocino. The Plan provides jurisdictions along the rail corridor (City of Ukiah, City of Willits, County of Mendocino, and Caltrans) with information to assist with implementation of the RWT. This Plan is funded by Caltrans' Community Based Transportation Planning (CBTP) grant funds and local matching funds. For this Plan, MCOG consulted with representatives from the County of Mendocino, the cities of Willits and Ukiah, North Coast Railroad Authority (NCRA), and Caltrans. The Plan was developed with community, stakeholder, and public agency input throughout its preparation.

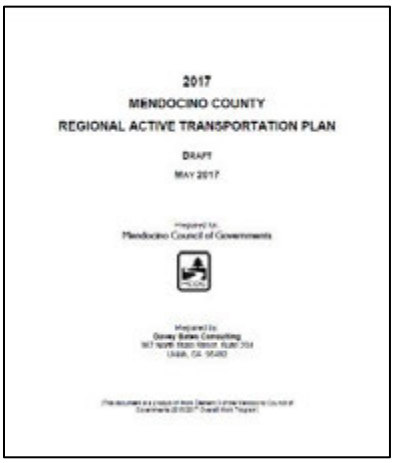
Mendocino County Safe Routes to School Plan (2014)



Safe Routes to School is a program with a simple goal: helping more children get to school by walking and bicycling. The plan envision 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, improve air quality around schools and community members' overall quality of life, increase the number of students who walk and/or bike to and from school and provide clear projects and programs for implementation.

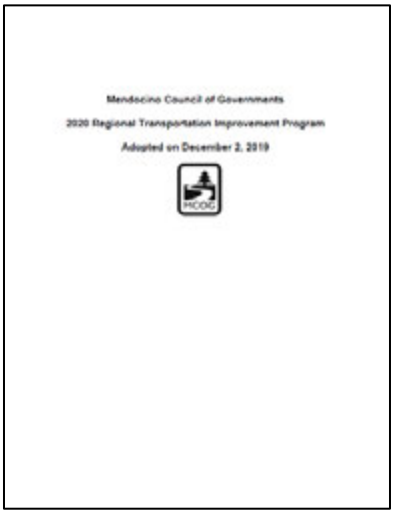
Mendocino County Regional Active Transportation Plan (2017)

This Plan 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 Council of Governments 2020 Regional Transportation Improvement Program (2019)

The 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).



3. Collision Data Collection and Analysis

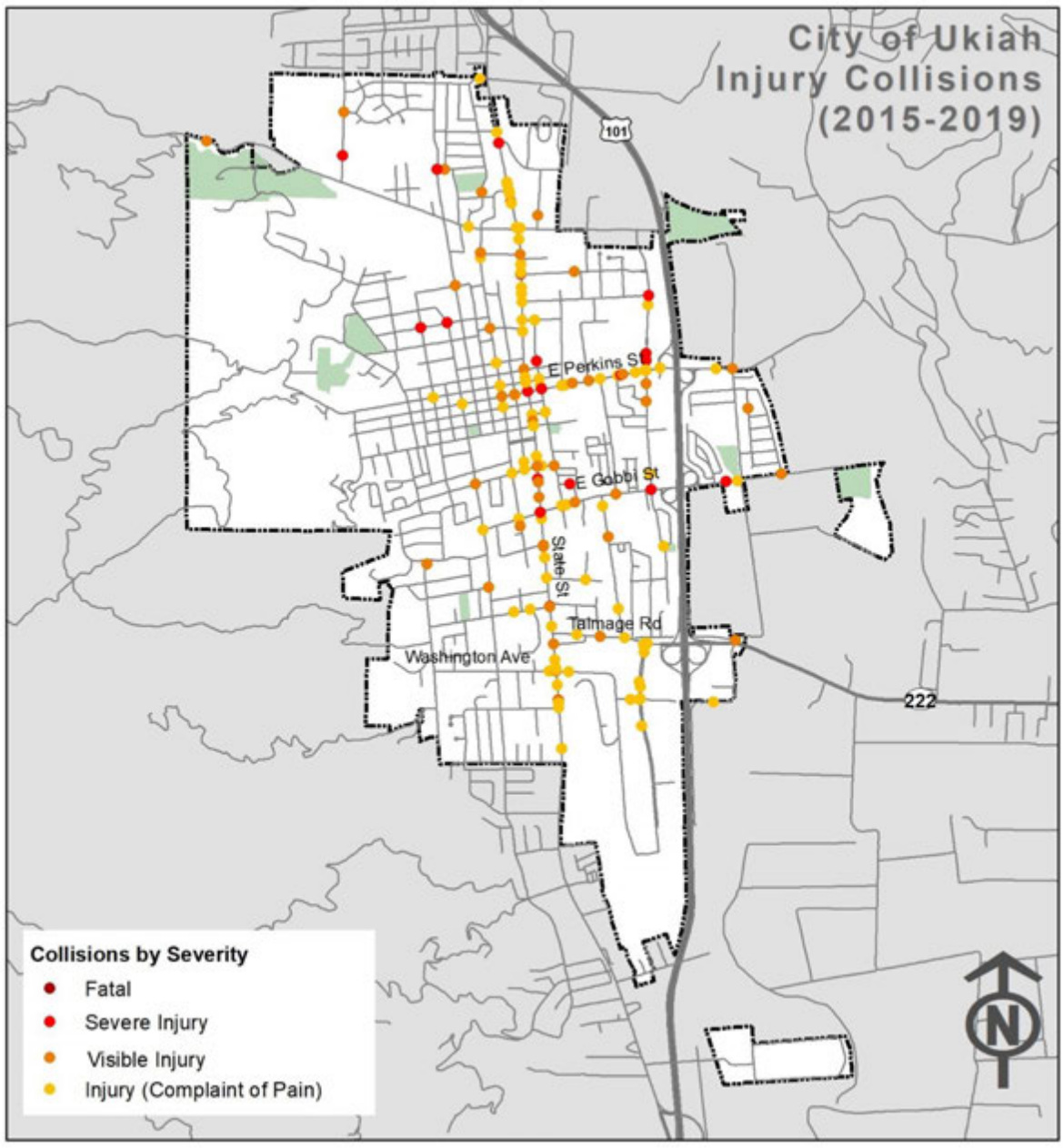
This chapter summarizes the results of a citywide collision analysis for collisions that have occurred in the City of Ukiah between January 2015 and December 2019, as part of the LRSP. A five-year city-wide collision data set was retrieved from TIMS and SWITRS.

The LRSP focuses on systemically identifying and analyzing traffic safety issues to recommend appropriate safety strategies and improvements. This chapter starts with an analysis of citywide collisions of all severity, including Property Damage Only (PDO) collisions, retrieved from TIMS and SWITRS. Further on, a detailed analysis was conducted for high-injury collisions, including F+SI collisions that have occurred on Ukiah'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:

1. Demographic and Jurisdiction Characteristics
2. Data Collection
3. Collision Data Analysis
4. F+SI Collision Analysis
5. Geographic Collision Analysis
6. High Injury Network
7. Summary

Figure 5 illustrates all the injury collisions that have occurred in Ukiah from January 2015 to December 2019.

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



Demographic and Jurisdiction Characteristics

This section provides an understanding of the demographics of the City of Ukiah 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) five-year Estimate, the population of Ukiah is 15,943, which is 18.4 percent of the County population. The population as well as the centerline miles are listed in **Table 2**.

Table 2. Ukiah 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**	

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

Commute to Work

In the City of Ukiah, approximately 85 percent of residents travel by cars or vans to work, out of which 74 percent drive alone and 11 percent carpool. About eight percent of residents walk to work, one percent of resident's rode bike to work and one percent of residents took transit. The different modes of transportation used to commute to work for the City are listed in **Table 3**.

Table 3. Ukiah Commute to Work Census Data

Commute to Work	Ukiah
Drive alone	74%
Carpool	11%
Public Transportation	1%
Walked	8%
Bicycle	1%
Work from Home	4%
Other	1%

Jurisdiction Rankings

Between the years 2015 and 2019, Mendocino County as a whole had 112 fatal traffic collisions, with two occurring in Ukiah, with a traffic fatality rate per 100,000 population of 25.82 for the County as a whole, and 2.51 for Ukiah. This collision analysis includes collisions that occurred on state routes. These rates are less than the California average and the United States 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
Ukiah	2*	15,943	2.51
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 (OTS) Rankings

Additional information on collisions in the City of Ukiah is provided by the California OTS. The 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 Ukiah ranks in the top, meaning higher collisions rates in pedestrian collisions (five out of 102 similarly sized cities), bicycle collisions (18 out of 102 similarly sized cities) and speed related collisions (37 out of 102 similarly sized cities). These rankings take into account fatal and injury crashes per population and per VMT. Overall Ukiah 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	Ukiah	OTS 2018 Ranking	Ukiah
Total Fatality and Injury	46/102	Bicycle	18/102
Alcohol Involved	54/102	Speed Related	37/102
Pedestrian	5/102	Nighttime	73/102

Collision Data

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

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[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=Ukiah&wpv_filter_submit=Submit

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

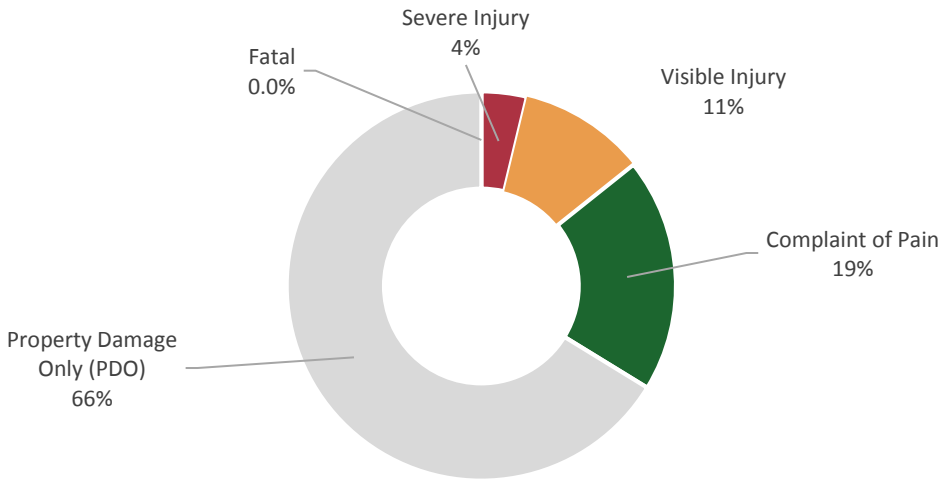
[4] California Highway Patrol. (2021). Statewide Integrated Traffic Records System. https://www.chp.ca.gov/programs-services/services-information/switrs-internet-statewide-integrated-traffic-records-system

Collision Data Analysis

Collision Severity

There were a total of 637 collisions reported City-wide from 2015 to 2019. Out of these 422 collisions (67 percent) were PDO collisions, 124 collisions (19 percent) led to complaint of pain injury and 67 collisions (11 percent) led to a visible injury. There were 24 F+SI collisions, 24 collisions (four percent) led to a severe injury and zero collisions led to a fatality. **Figure 6** illustrates the classification of all collisions based on severity. This collision analysis doesn't include collisions that occurred on state routes.

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 on 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.

The collision data was segregated by facility type, i.e. based on collisions occurring on intersections and roadway segments. For the purposes of the analysis, a collision was said to have occurred at an intersection if it occurred within 250 feet of it. The reported collisions categorized by facility type and collision severity are presented in **Table 6**.

Table 6. Collisions by Severity and Facility Type

Collision Severity	Roadway Segment	Intersection	Total
Fatal	0	0	**0**
Severe Injury	3	21	**24**
Visible Injury	11	56	**67**
Complaint of Pain	18	106	**124**
Property Damage Only (PDO)	54	368	**422**
Total	**86**	**551**	**637**

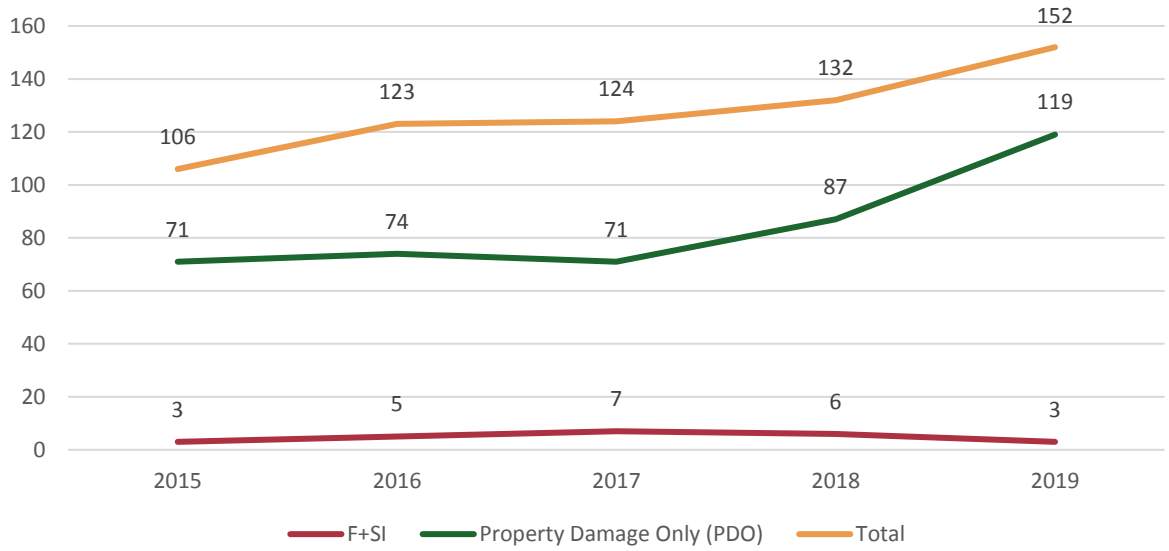
Preliminary Analysis

Collision Severity by Year

For all collisions, the number increased from 2015 to 2019. The highest number of collisions (152 collisions) were observed in 2019 and the lowest number of collisions (106) were observed in 2015.

A total of 24 F+SI collisions occurred in the City of Ukiah during the study period. They were observed to be the lowest (three collision) in 2015 and 2019. Overall, F+SI collisions were observed to rise from 2015 to 2017, with the highest number of F+SI collisions (seven collisions) occurring in the years 2017, then decreasing again in 2019. **Figure 7** illustrates the five-year collision trend for all collisions, F+SI collisions and also PDO collisions.

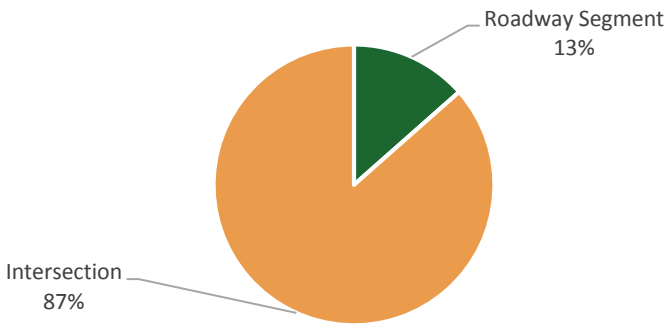
Figure 7. Five Year Collision Trend



Intersection vs. Roadway Collisions

When evaluating roadways vs intersections, it was observed that the majority of collisions occurred at intersections. In the City of Ukiah, 87 percent of all collisions (551 collisions) occurred at intersections whereas 13 percent (86 collisions) occurred on roadway segments. This classification by facility type can be observed in **Figure 8**.

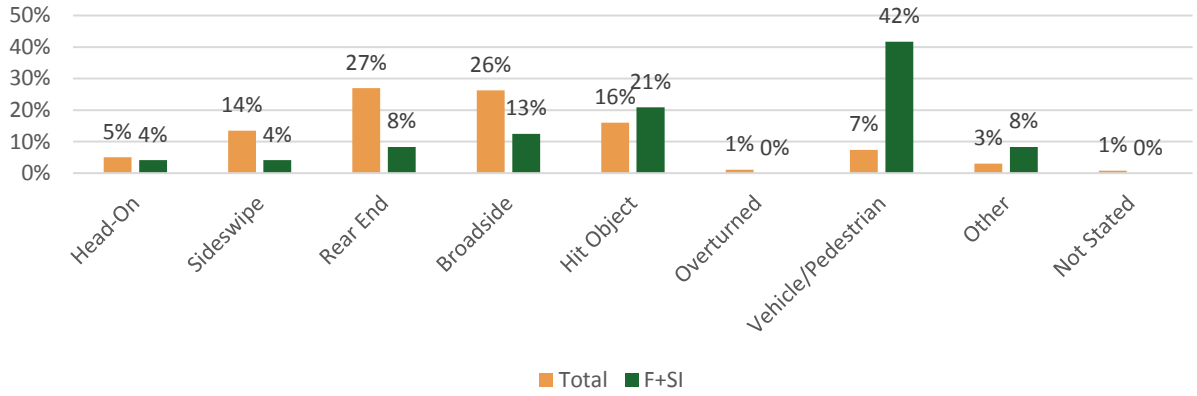
Figure 8. Intersection vs. Roadway Collisions - All Collisions



Collision Type

Considering all collisions, the most commonly occurring collision type was rear end collisions (27 percent) and broadside collisions (26 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 (42 percent) followed by hit object collisions (21 percent). **Figure 9** illustrates the collision type for all collisions as well as F+SI collisions.

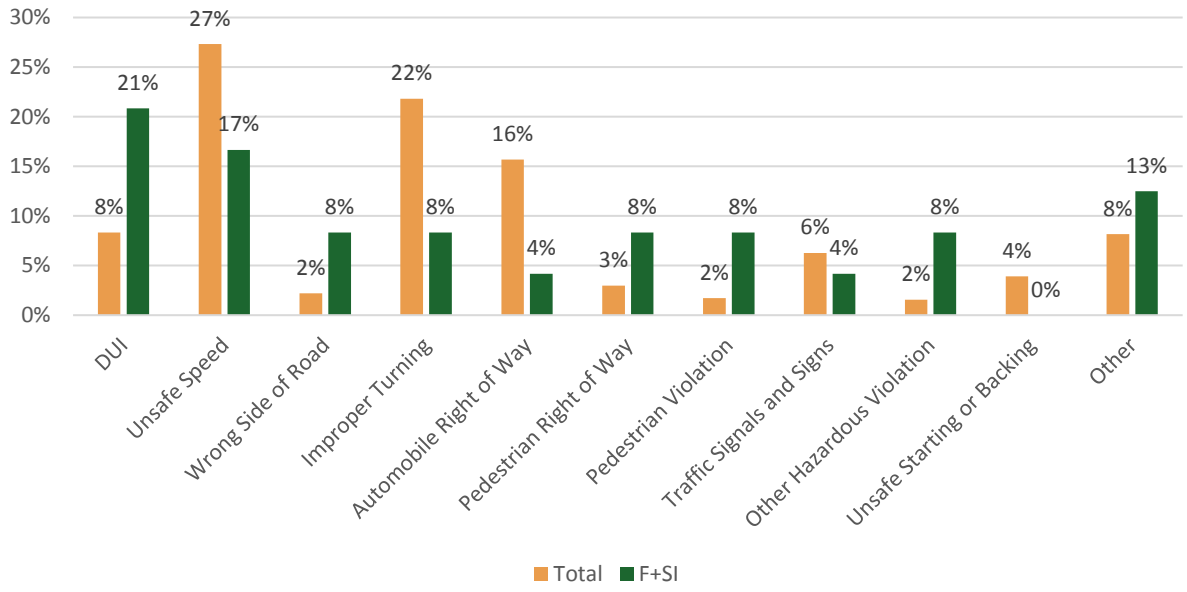
Figure 9. Collision Type – All Collisions vs. F+SI Collisions



Violation Category

Considering all collisions, the most common violation category was observed to be unsafe speed (27 percent), improper turning (22 percent) and automobile right of way (16 percent). For F+SI collisions, driving under the influence (21 percent), and unsafe speed (17 percent) was observed to be the main violation categories. **Figure 10** illustrates the violation category for all collisions and F+SI collisions.

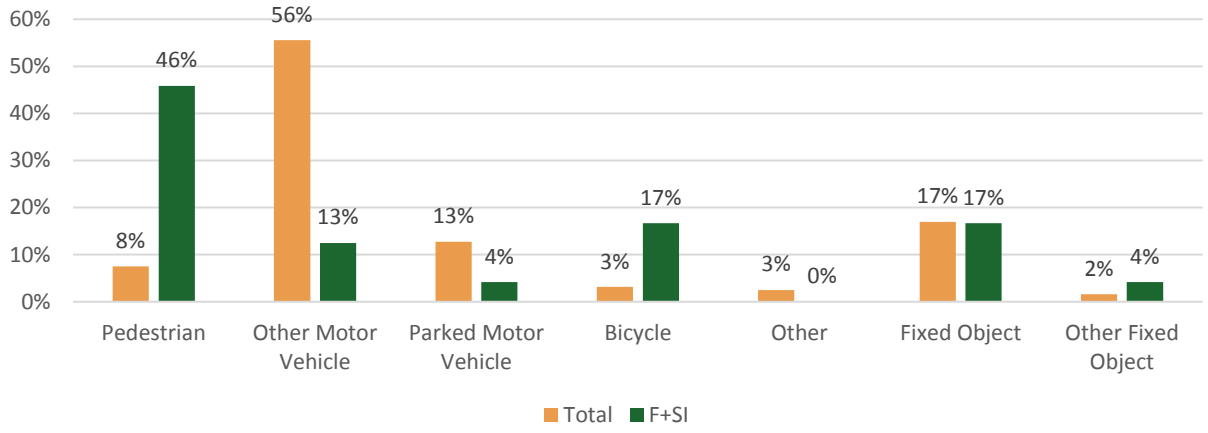
Figure 10. Violation Category: All Collisions vs. F+SI Collisions



Motor Vehicle Involved With

Considering all collisions, 56 percent of the collisions are motor vehicle involved with another motor vehicle. The remaining collisions include motor vehicle involved with fixed objects (17 percent) and motor vehicle involved with parked vehicles (13 percent). The trends for F+SI collisions are noticeably different. For F+SI collisions, 46 percent of the collisions involved a pedestrian and 17 percent involved a bicycle, indicating that pedestrians and bicyclists are more likely to be involved in a fatal or severe injury collision. **Figure** 11 illustrates the percentage for all collisions as well as F+SI collisions.

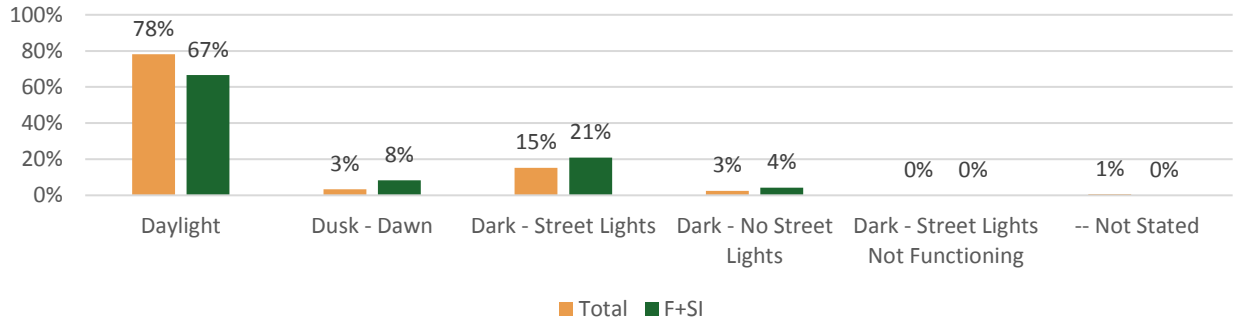
Figure 11. Motor Vehicle Involved With: All Collisions vs. F+SI Collisions



Lighting

For collisions of all severity, 78 percent of collisions have occurred in daylight and 15 percent of collisions have occurred in the dark on streets with street lights. For F+SI collisions, 67 percent of collisions have occurred in daylight and 21 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.

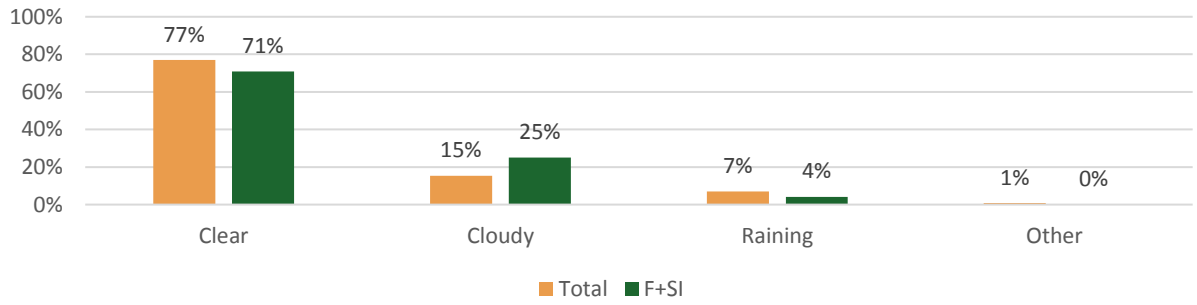
Figure 12. Lighting Conditions: All Collisions vs. F+SI Collisions



Weather

For all collisions, 77 percent of the collisions have occurred during clear weather conditions and 15 percent collisions have observed to occur during cloudy weather conditions. For F+SI collisions, 71 percent of the collisions have occurred during clear weather conditions and 25 percent of collisions occurred during cloudy weather conditions. **Figure 13** illustrates the percentage distribution of weather conditions during occurrence of collisions of all severity as well as F+SI collisions.

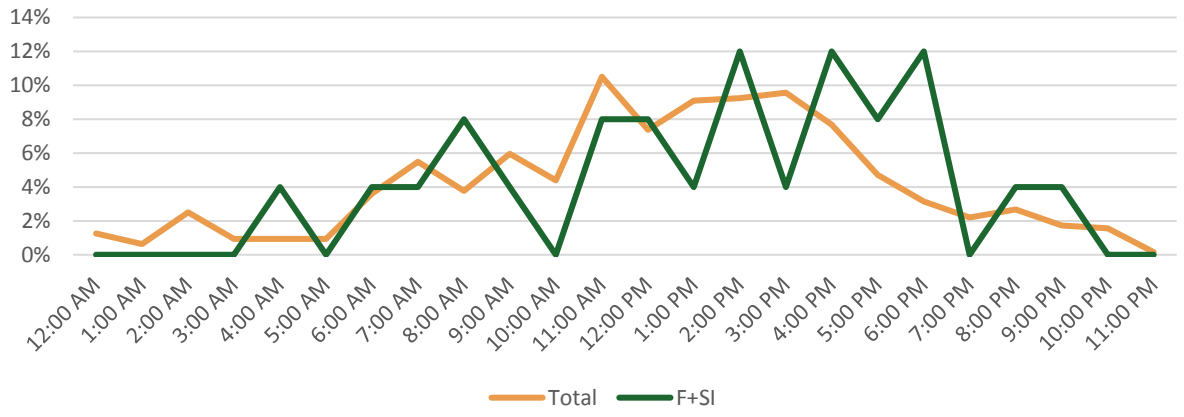
Figure 13. Weather Conditions: All Collisions vs. F+SI Collisions



Time of the Day

For collisions of all severity, maximum number of collisions have occurred between 11:00 am to 12:00 pm (11 percent) and no collisions have occurred between 11:00 pm to 12:00 am (zero percent). For all F+SI collisions, maximum number (12 percent) of collisions have occurred between 2:00 pm to 3:00 pm, 4:00 pm to 5:00 pm, and 6:00 pm to 7:00 pm. **Figure 14** illustrates the percentage of collisions occurring during the day for all collisions as well as F+SI collisions.

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

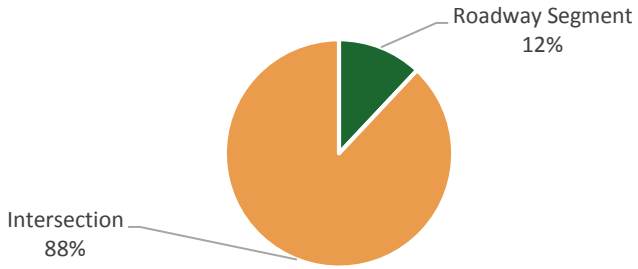


Fatal and Severe Injury Collision Analysis

General Characteristics

This section describes a detailed collision analysis performed for F+SI collisions occurring at roadway segments and intersections in the City of Ukiah. Of the total 24 F+SI collisions that occurred in Ukiah, 21 collisions (88 percent) occurred at intersections and three collisions (12 percent) occurred on roadways. This distribution is illustrated in **Figure 15**.

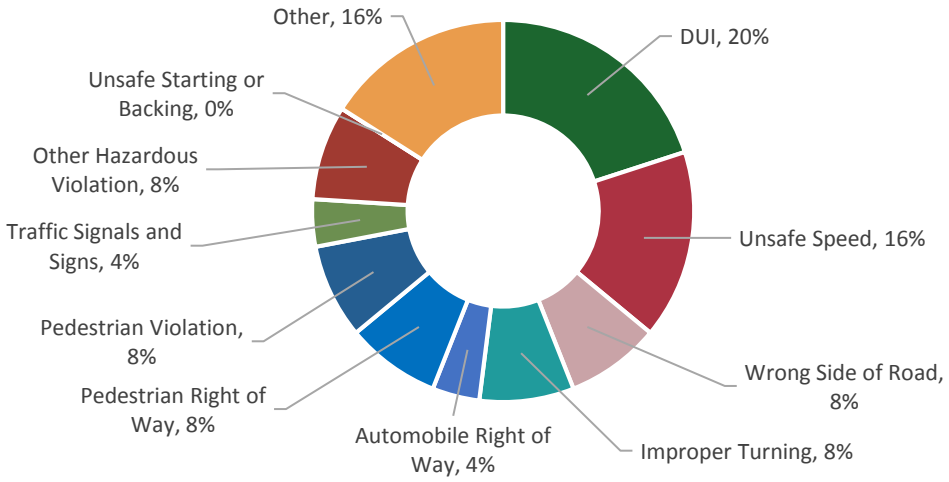
Figure 15. F+SI Collisions: Roadway Segments and Intersections



Violation Category

For F+SI collisions, driving under the influence (20 percent) and unsafe speed (16 percent) was observed to be major violation categories. **Figure 16** illustrates the violation category for F+SI collisions.

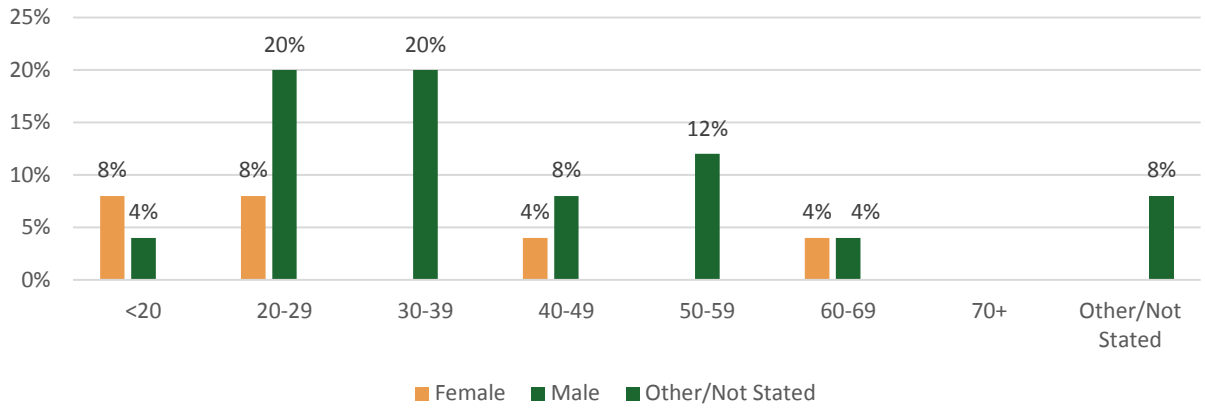
Figure 16. F+SI Collisions: Violation Category



Gender vs Age

For F+SI collisions, the gender of the party at fault was much more likely to be male than female (68 percent of F+SI collisions vs 24 percent). The party at fault for F+SI collisions are also more likely to be younger, with the majority age 40 or less (60 percent), with the largest age category involved in fatal or severe collisions 20-29 year old (28 percent). **Figure 17** illustrates the sex and age of the party at fault for F+SI collisions.

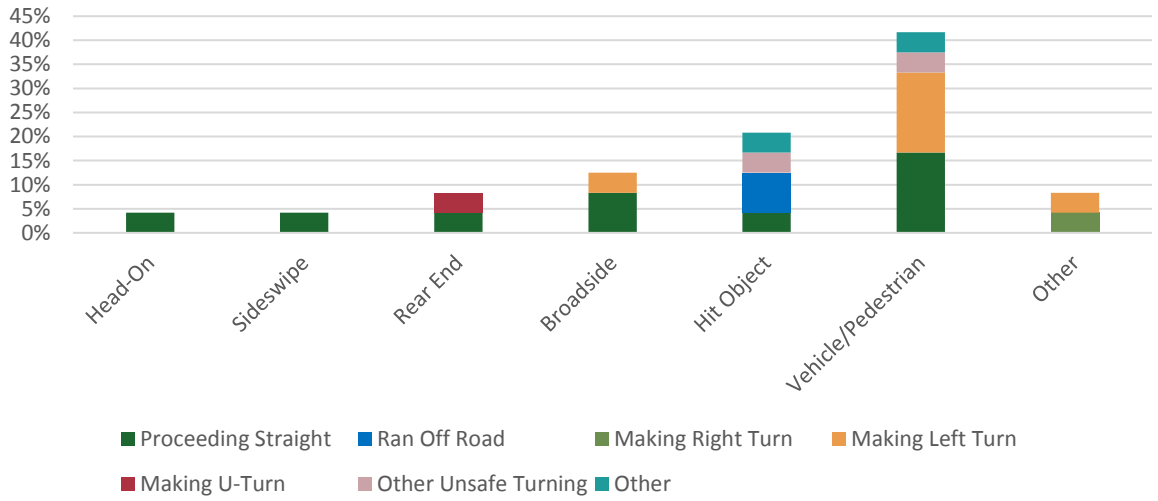
Figure 17. F+SI Collisions: Age vs Sex



Collision Type vs. Movement Preceding Collision of Party at Fault

For F+SI collisions, the most common collision type was vehicle/pedestrian collisions. The most common movement of the party at fault preceding vehicle/pedestrian collisions is proceeding straight or making a left turn. **Figure 18** illustrates the type of collisions as well as the movement of the party at fault preceding the collision for F+SI collisions.

Figure 18. F+SI Collisions: Collision Type vs. Movement Preceding Collisions



F+SI Roadway Collision Analysis

A total of 3 F+SI collisions occurred in Ukiah on roadway segments between 2015 and 2019. The following analysis details the collision attributes of roadway F+SI collisions.

Collision Type vs. Severity

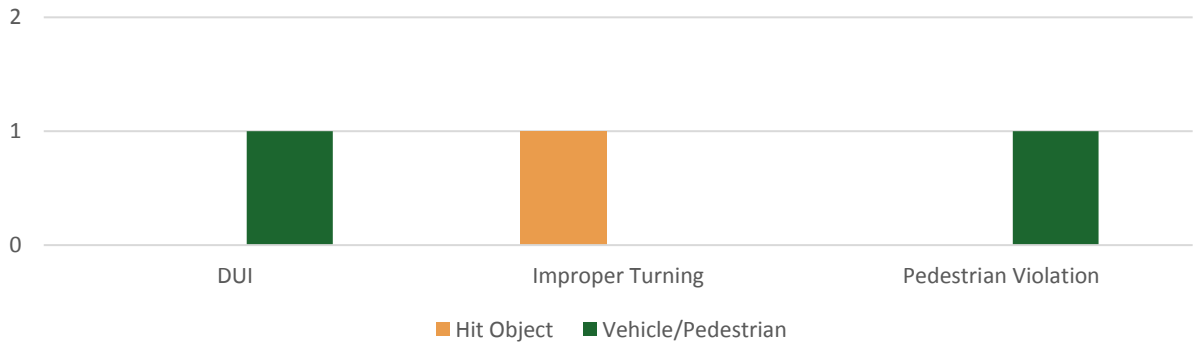
For roadway F+SI collisions, the most common collision type was vehicle/pedestrian collisions. **Figure 19** shows the severity of roadway F+SI collisions as well as the collision type.

Figure 19. F+SI Roadway Collisions by Type and Severity Ukiah (2015-2019)

Collision Type vs. Violation Category

For roadway F+SI collisions, the most common collision type was vehicle/pedestrian collisions. The violation categories that led to pedestrian collisions on roadways was pedestrian violations and DUI violations. **Figure 20** shows the violation category of roadway F+SI collisions as well as the collision type.

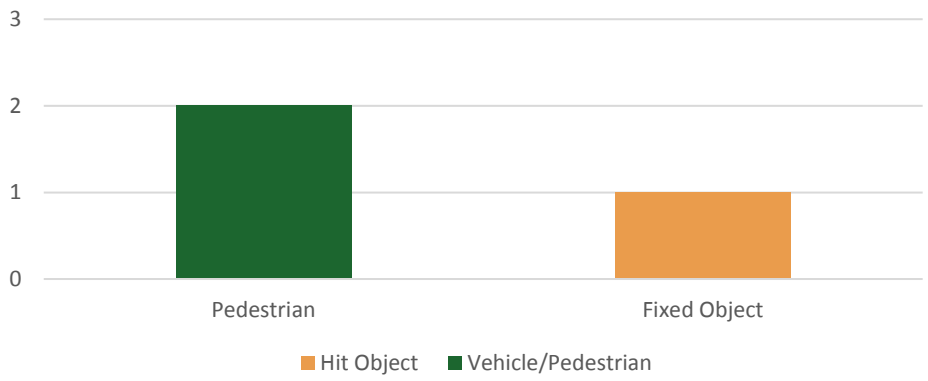
Figure 20. F+SI Roadway Collisions by Type and Violation Category Ukiah (2015-2019)



Collision Type vs. Motor Vehicle Involvement With

For roadway F+SI collisions, the most common collision type was pedestrian collisions, the second most common was a fixed object. **Figure 21** shows the violation category of roadway F+SI collisions as well as the collision type.

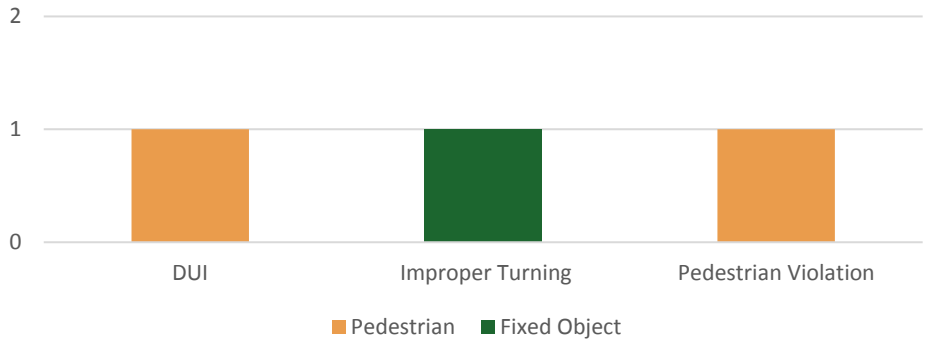
Figure 21. F+SI Roadway Collisions by Type and Motor Vehicle Involvement with Ukiah (2015-2019)



Motor Vehicle Involved With vs. Violation Category

For roadway F+SI collisions, the most common collision type was vehicle/pedestrian collisions. One pedestrian collision was a DUI collision. **Figure 22** shows the violation category of roadway F+SI collisions as well as the collision type.

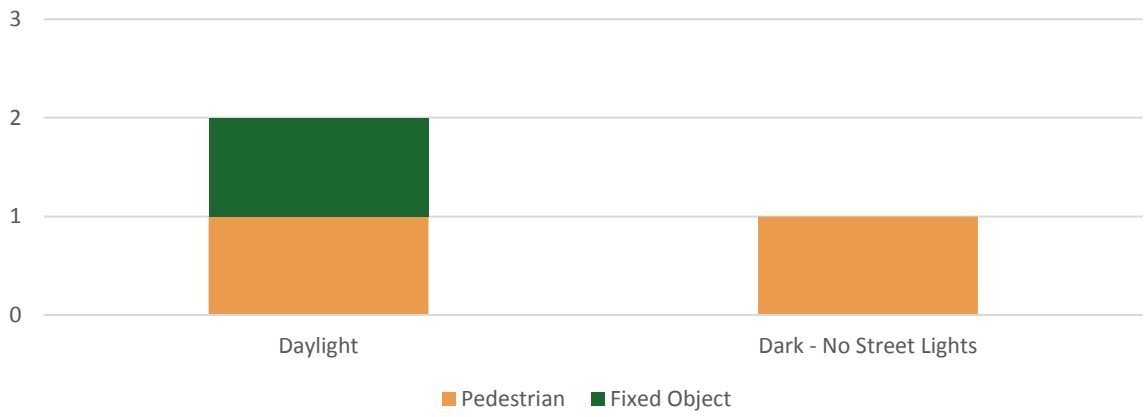
Figure 22. F+SI Roadway Collisions by Motor Vehicle Involvement and Violation Category with Ukiah (2015-2019)



Motor Vehicle Involved With vs. Lighting Conditions

For roadway F+SI collisions, the most common collision type was vehicle/pedestrian collisions. Most collisions occurred during the daylight. **Figure 23** shows the violation category of roadway F+SI collisions as well as the collision type.

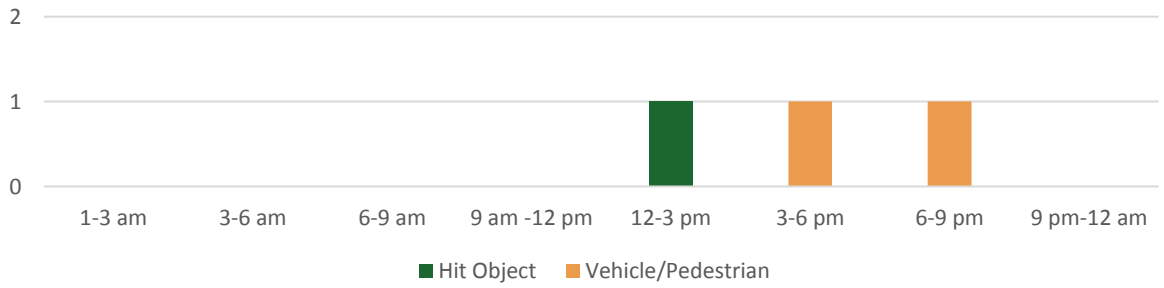
Figure 23. F+SI Roadway Collisions by Motor Vehicle Involvement and Lighting Conditions with Ukiah (2015-2019)



Collision Type vs. Time of Day

For roadway F+SI collisions, the most common collision type was vehicle/pedestrian collisions that occurred between 3:00 pm to 9:00 pm. The only hit object collision occurred between 12:00 pm and 3:00 pm. **Figure 24** shows the violation category of roadway F+SI collisions as well as the collision type.

Figure 24. F+SI Roadway Collisions by Collision Type and Time of Day with Ukiah (2015-2019)



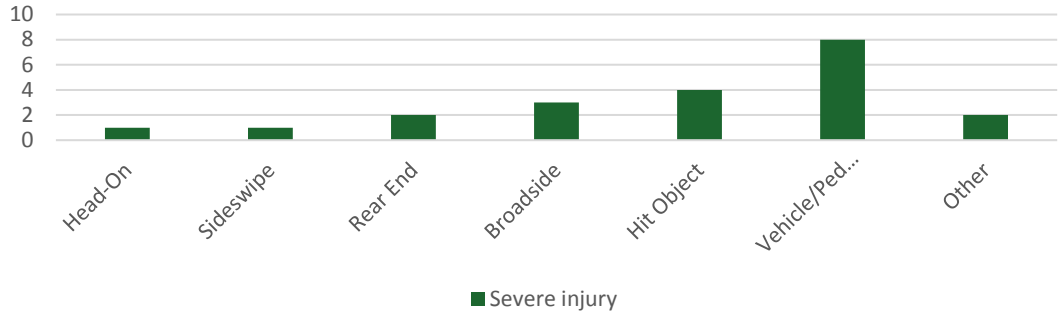
F+SI Intersection Collision Analysis

A total of 21 F+SI collisions occurred in Ukiah at intersections between 2015 and 2019. The following analysis details the collision attributes of intersection F+SI collisions.

Collision Type vs. Severity

For intersection F+SI collisions, the most common collision type was vehicle/pedestrian collisions. **Figure 25** illustrates the severity as well as the collision type.

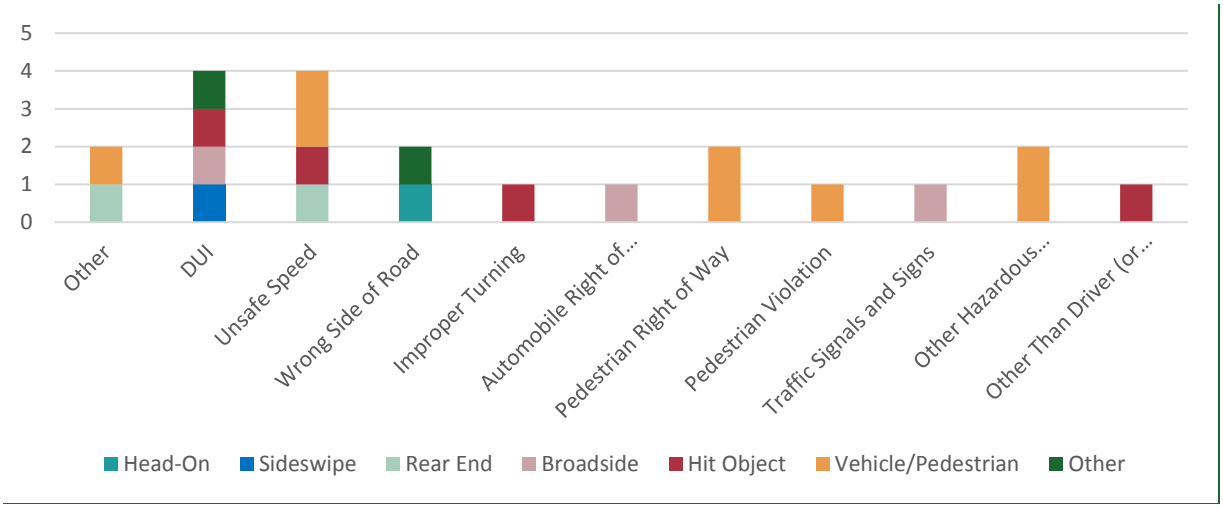
Figure 25. F+SI Intersection Collisions Ukiah by Type and Severity (2015-2019)



Collision Type vs. Violation Category

For intersection F+SI collisions, the most common collision violation category was DUI and unsafe speed collisions. **Figure 26** shows the severity of intersection F+SI collisions as well as the collision type.

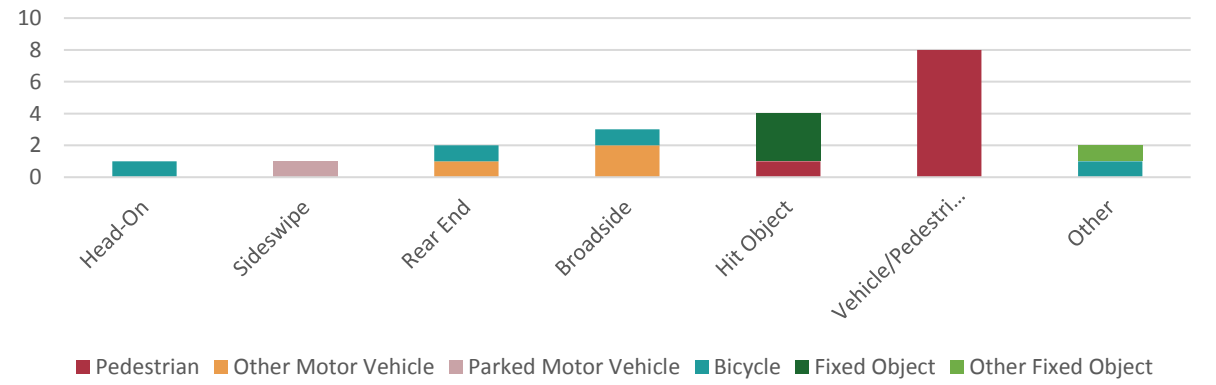
Figure 26. F+SI Intersection Collisions Ukiah by Type and Severity (2015-2019)



Collision Type vs. Motor Vehicle Involvement With

For intersection F+SI collisions, the most common collision type was vehicle/pedestrian collisions. **Figure 27** shows the violation category of roadway F+SI collisions as well as the collision type.

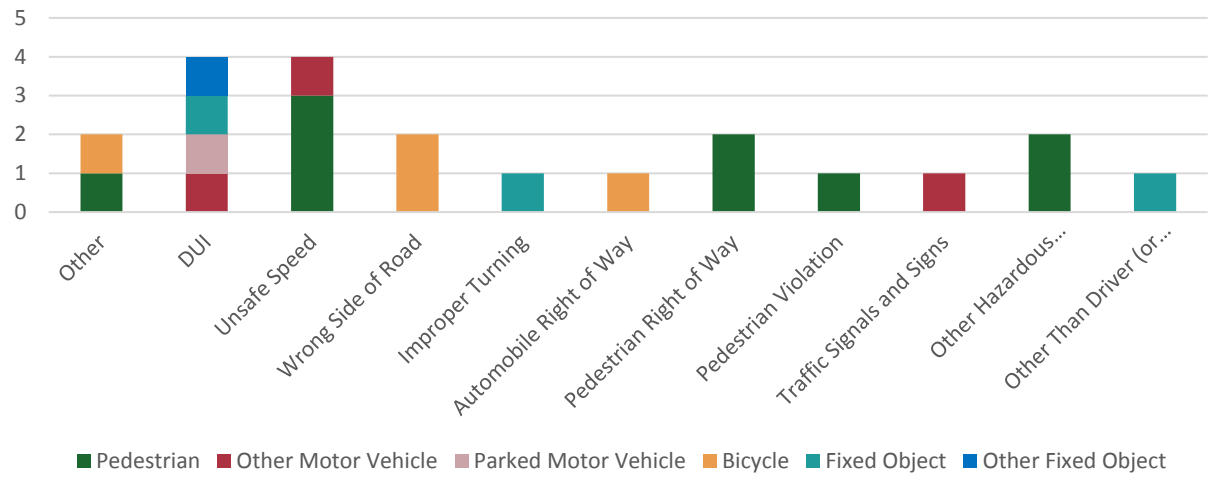
Figure 27. F+SI Intersection Collisions Ukiah by Type and Motor Vehicle Involved With (2015-2019)



Motor Vehicle Involved With vs. Violation Category

For intersection F+SI collisions, the most common violation category was DUI and unsafe speed collisions. **Figure 28** shows the severity of intersection F+SI collisions as well as the collision type.

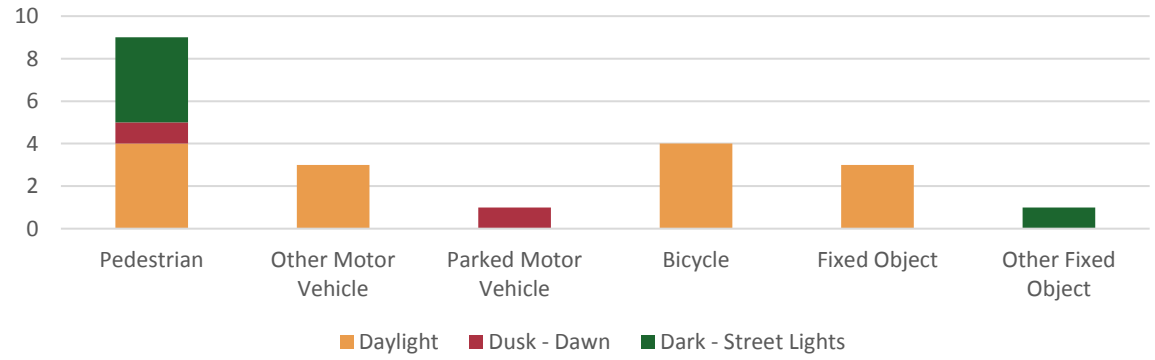
Figure 28. F+SI Intersection Collisions Ukiah by Motor Vehicle Involved With and violation category (2015-2019)



Motor Vehicle Involved With vs. Lighting Conditions

For intersection F+SI collisions, the most common collision type was vehicle/pedestrian collisions. Some vehicle pedestrian collisions occurred during the daylight and some occurred at night. **Figure 29** shows the severity of intersection F+SI collisions as well as the collision type.

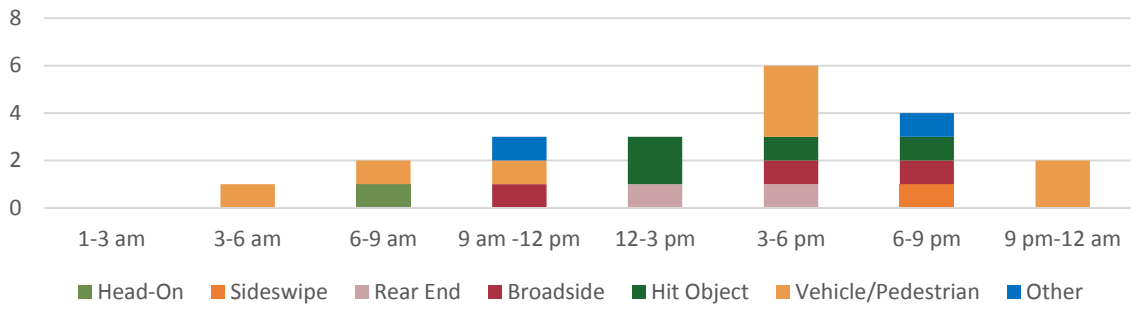
Figure 29. F+SI Intersection Collisions Ukiah by Motor Vehicle Involved With and Lighting (2015-2019)



Collision Type vs. Time of Day

For intersection F+SI collisions, the most common collision type was vehicle/pedestrian collisions. No fatal or severe collisions occurred from 1:00 am to 3:00 am. **Figure 30** shows the severity of intersection F+SI collisions as well as the collision type.

Figure 30. F+SI Intersection Collisions Ukiah by Type and Time of Day (2015-2019)



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 Ukiah. The above collision analysis was used to identify five main collision factors that highlight the top trends among collisions in the City of Ukiah. These five collision factors were identified to be vehicle pedestrian collisions, hit object collisions, DUI collisions, unsafe speed collisions, and bicycle collisions.

Vehicle-Pedestrian Collisions

For F+SI collisions in the City of Ukiah, 46 percent of collisions were pedestrian involved collisions, compared to just eight percent of all severity collisions. **Figure 31** shows the distribution of pedestrian collisions throughout the City of Ukiah between 2015 and 2019. Washington Avenue, Main Street, Orchard Avenue, and Perkins Street have a higher concentration of pedestrian collisions, compared to other Ukiah roads. The Office of Traffic Safety ranked Ukiah 5th out of 102 similarly sized cities with high levels of pedestrian collisions (one being the highest, or worst)[5].

[5] 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=Ukiah&wpv_filter_submit=Submit

Hit Object Collisions

For F+SI collisions in the City of Ukiah, 21 percent of collisions were hit object collisions compared to 16 percent of all severity collisions, meaning hit object collisions are more likely to result in a fatal or severe injury. **Figure 32** shows the distribution of hit object collisions throughout Ukiah between 2015 and 2019. State Street, Hastings Road, East Side Road, Gobbi Street, and Dora Avenue have a higher concentration of hit object collisions, compared to other Ukiah roads.

Driving Under the influence (DUI) Collisions

For F+SI collisions in the City of Ukiah, 21 percent of collisions were DUI collisions. **Figure 33** shows the distribution of DUI collisions throughout Ukiah between 2015 and 2019. Gobbi Street and Main Street have a higher concentration of DUI collisions, compared to other Ukiah roads. The Office of Traffic Safety ranked Ukiah 54th out of 102 similarly sized cities with high levels of alcohol involved collisions (one being the highest, or worst)[2].

Unsafe Speed Collisions

For F+SI collisions in the City of Ukiah, 17 percent of collisions were unsafe speed collisions. **Figure 34** shows the distribution of unsafe speed collisions throughout Ukiah between 2015 and 2019. State Street and Perkins Street have a higher concentration of unsafe speed collisions, compared to other Ukiah roads. The Office of Traffic Safety ranked Ukiah 37th out of 102 similarly sized cities with high levels of speed related collisions (one being the highest, or worst)[6].

Bicycle Collisions

For F+SI collisions in the City of Ukiah, 17 percent of collisions were bicycle collisions compared to just three percent of all collisions, meaning bicycle collisions are more likely to result in a fatal or severe injury.

[6] 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=Ukiah&wpv_filter_submit=Submit

Figure 35 shows the distribution of bicycle collisions throughout Ukiah between 2015 and 2019. Gobbi Street and Orchard Avenue have a higher concentration of bicycle collisions, compared to other Ukiah City roads. The Office of Traffic Safety ranked Ukiah 18th out of 102 similarly sized cities with high levels of bicycle collisions (one being the highest, or worst)[3].

Figure 31. Vehicle Pedestrian Collisions

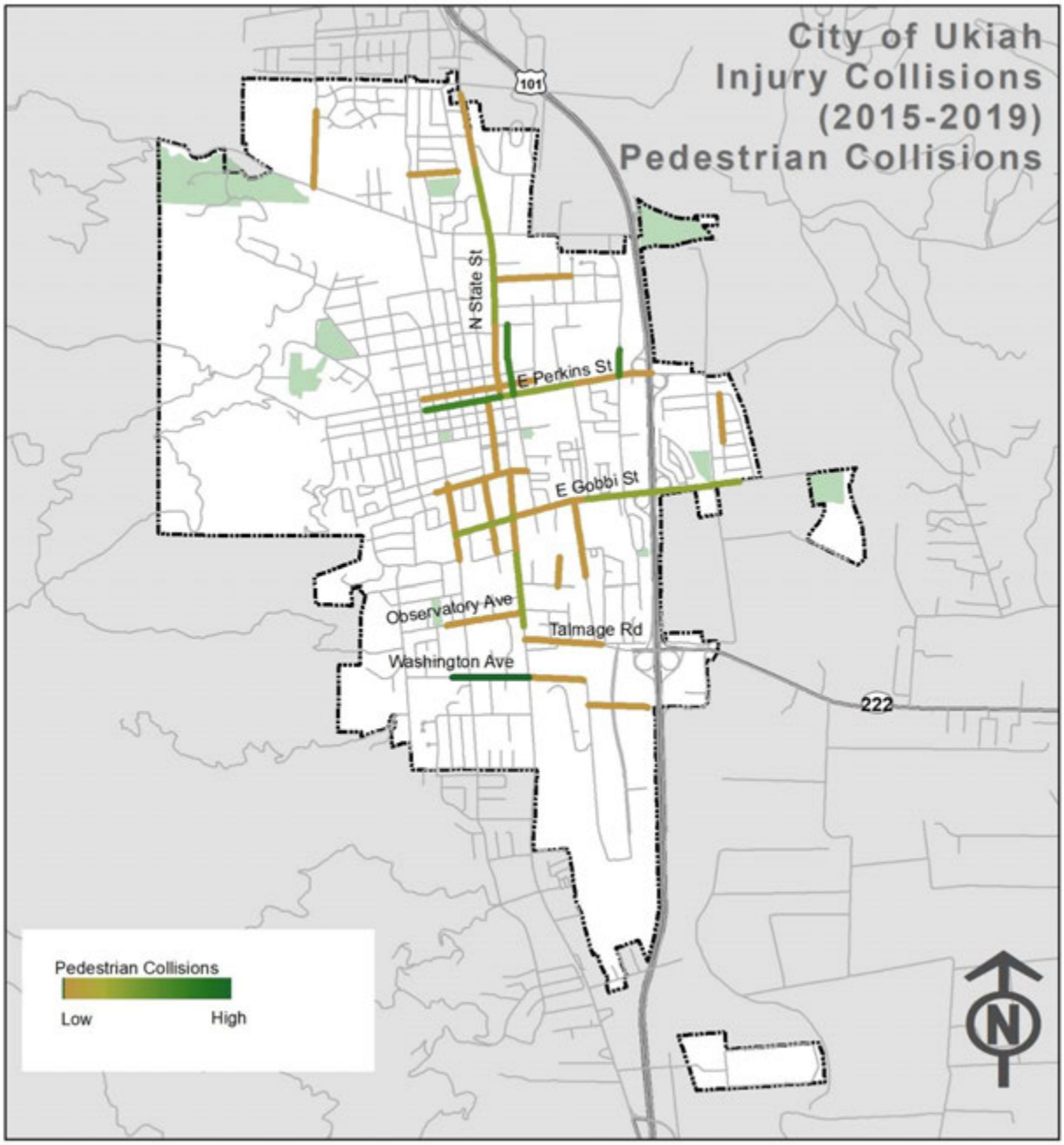


Figure 32. Hit Object Collisions

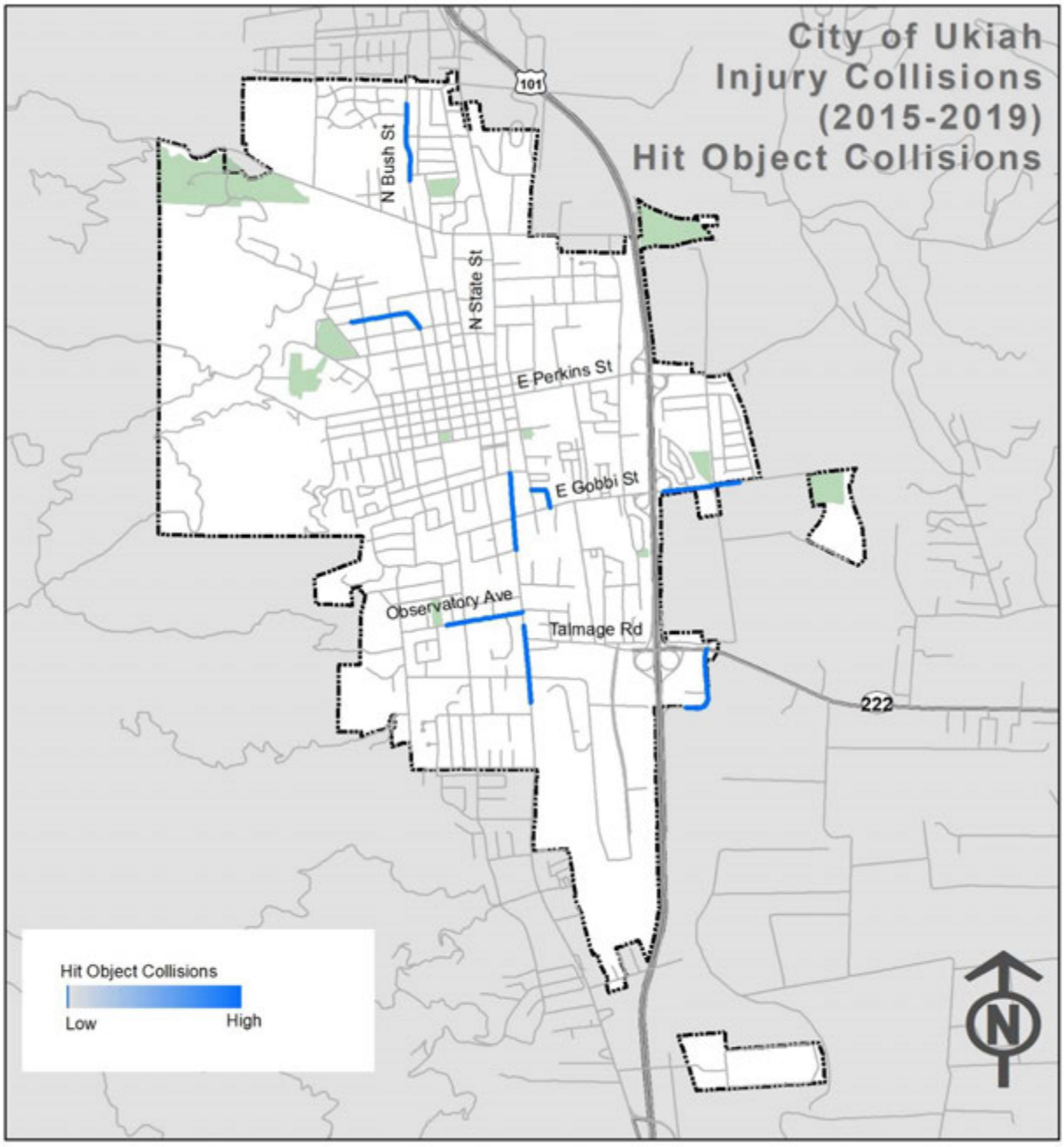


Figure 33. DUI Collisions

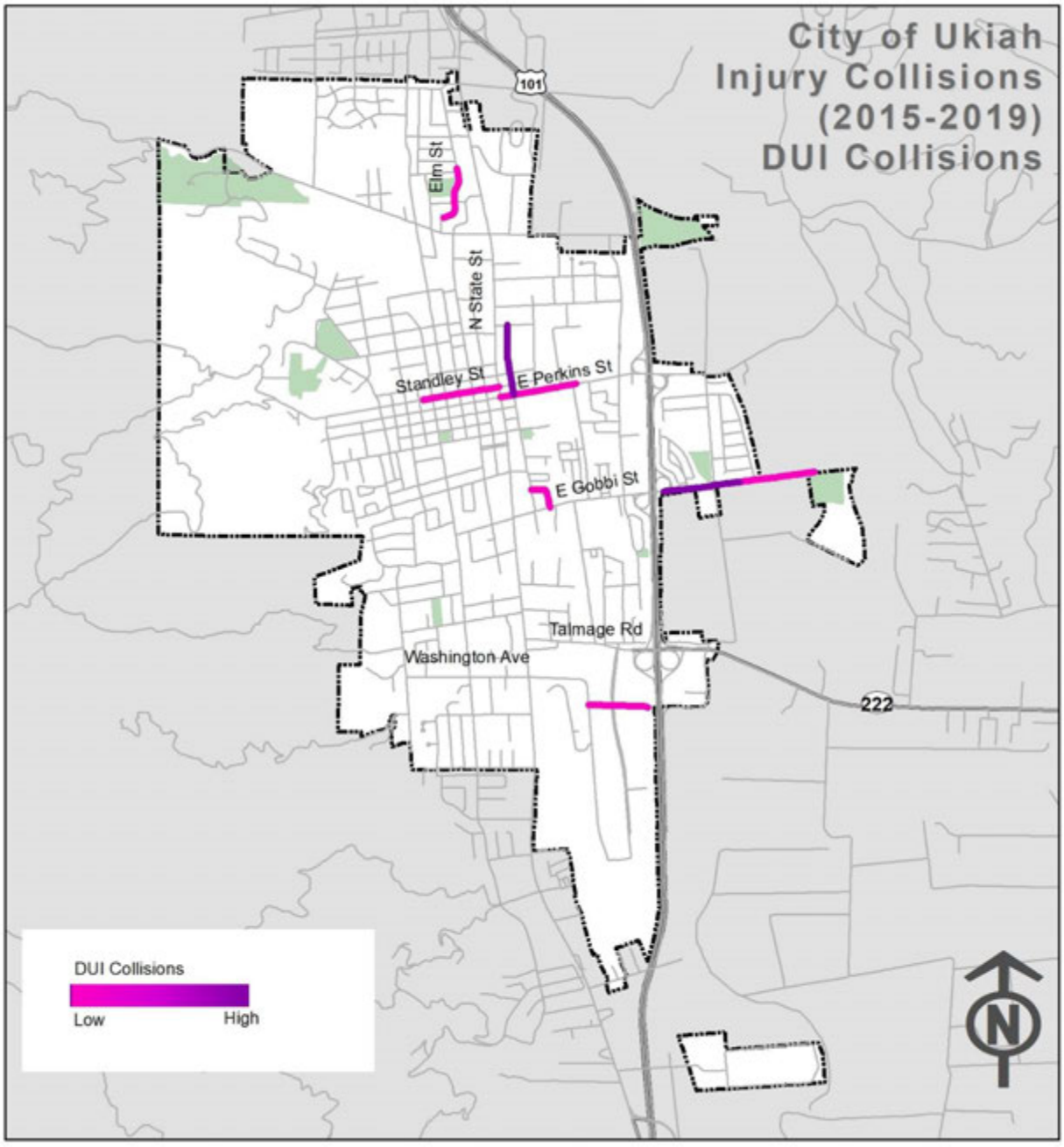


Figure 34. Unsafe Speed Collisions

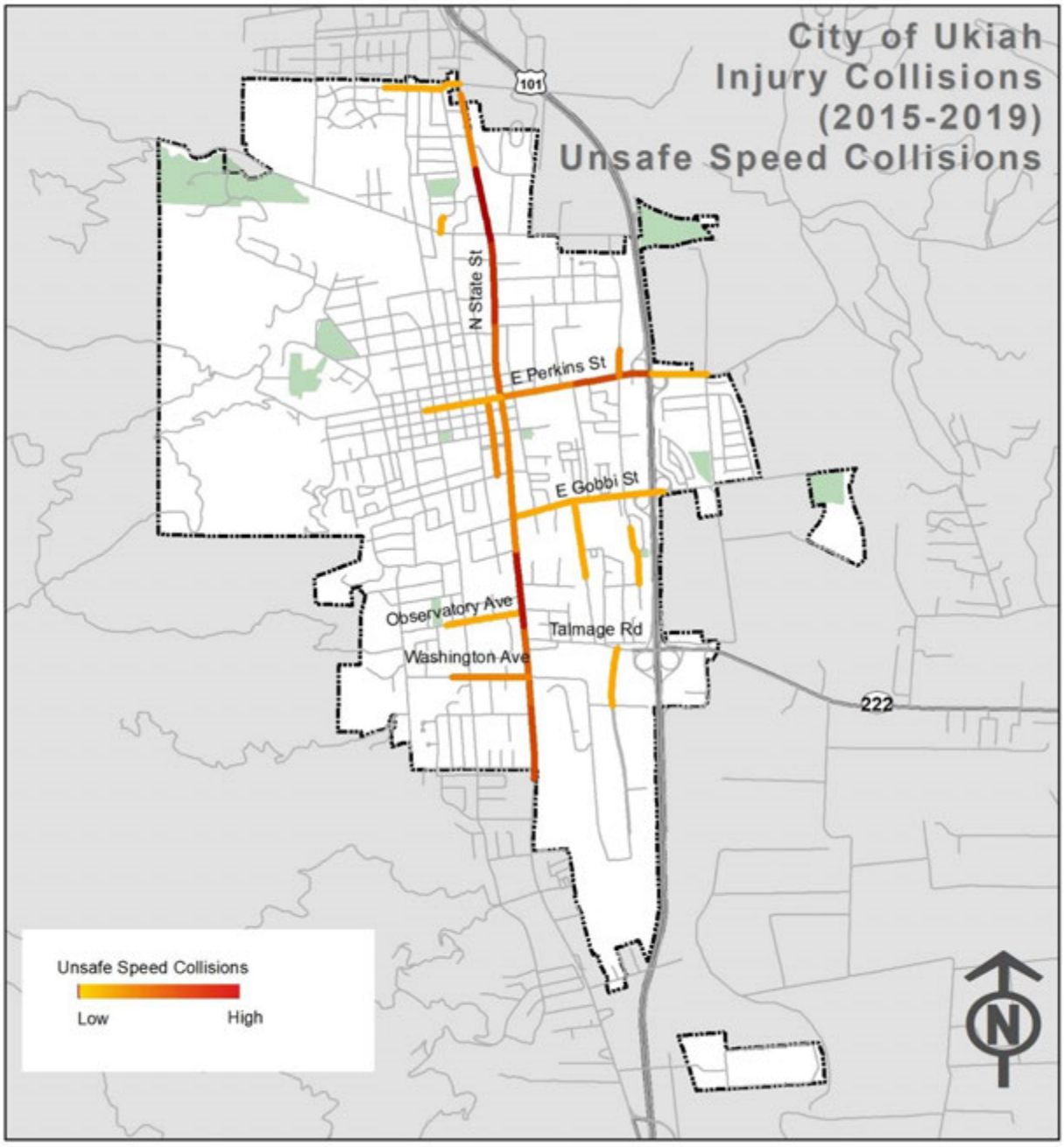
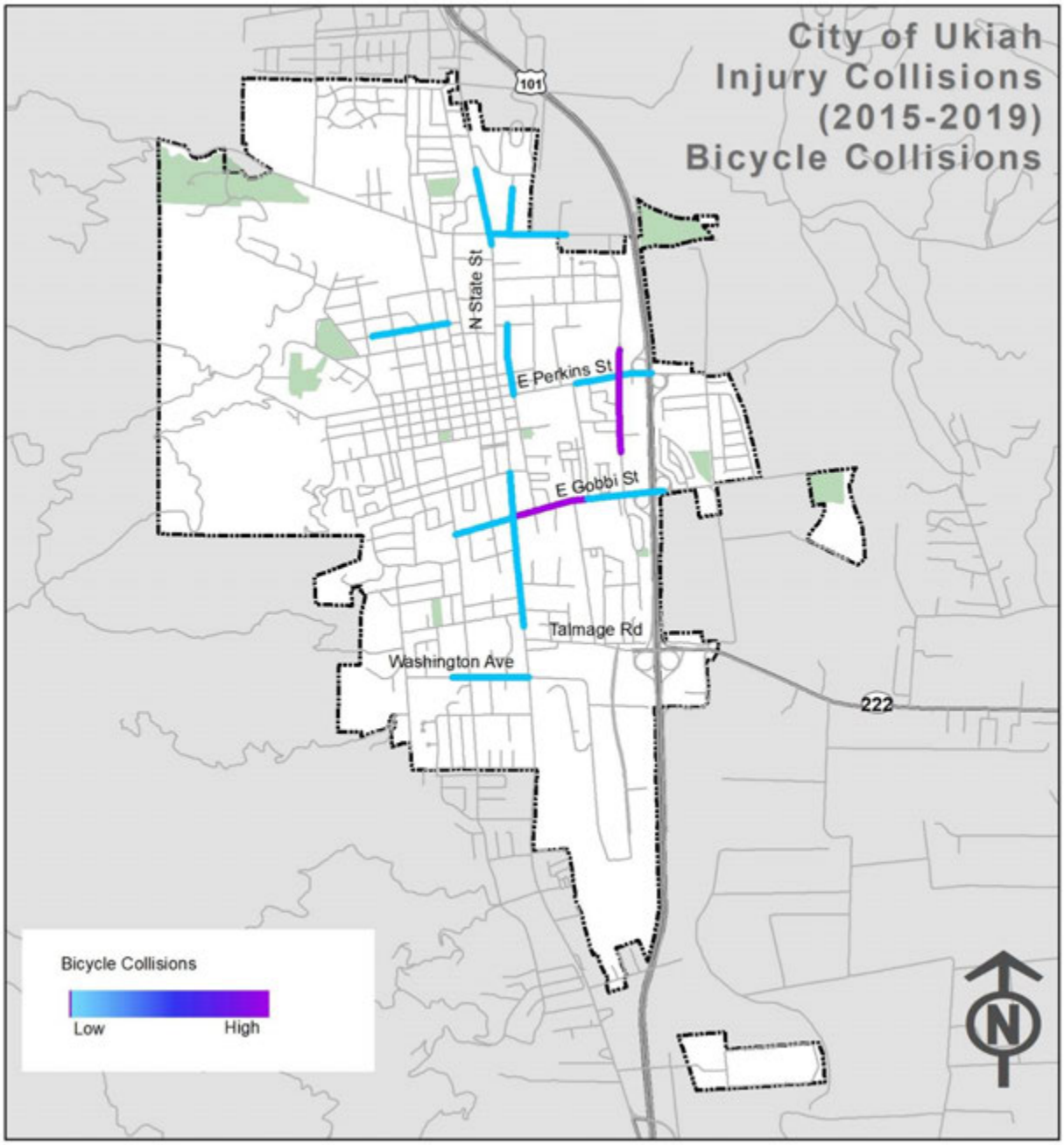


Figure 35. Bicycle Collisions



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 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**.

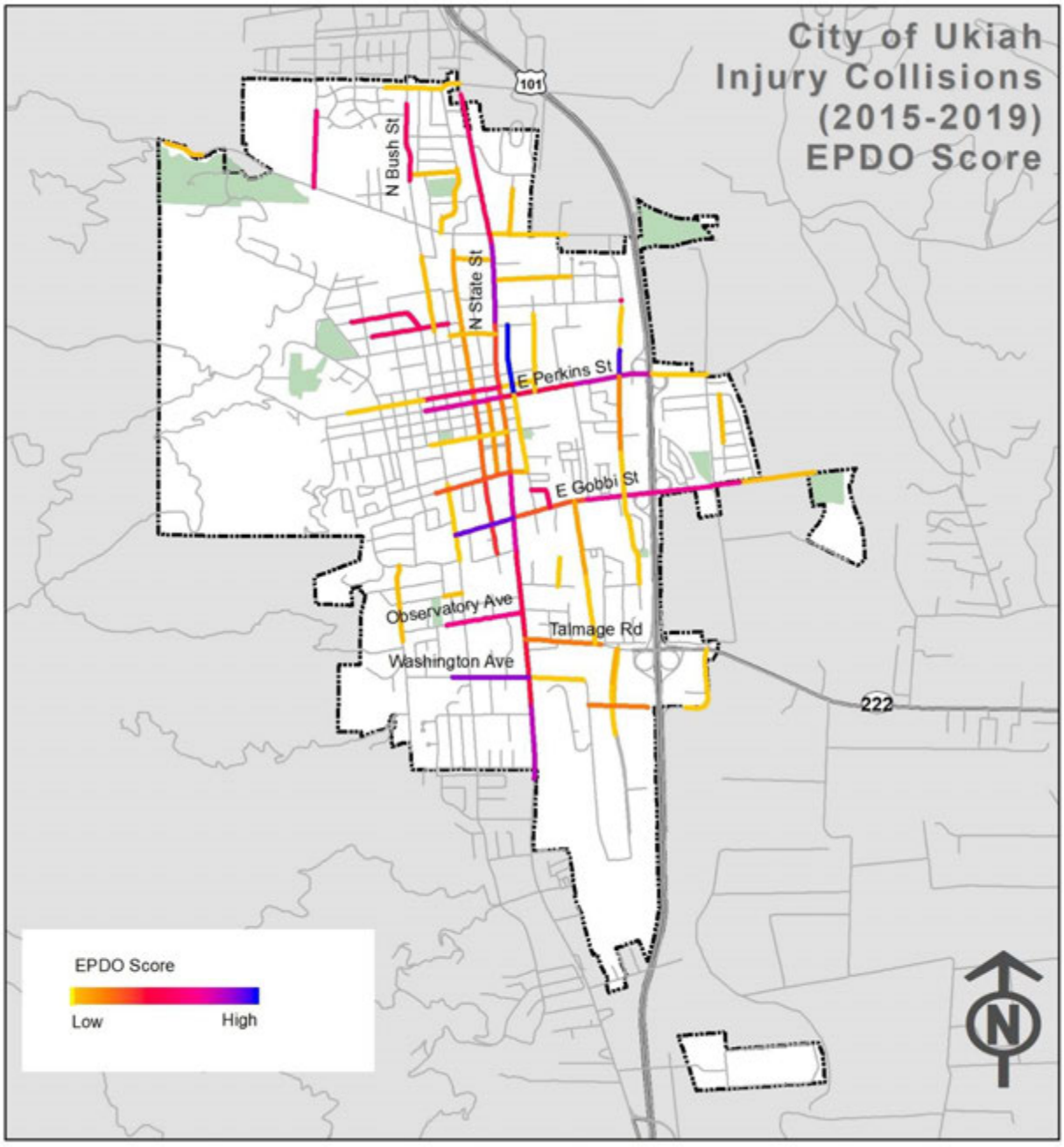
Table 7. EPDO Score used in HSIP Cycle 10

Collision Severity	EPDO Score
F+SI 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 Ukiah were geolocated onto Ukiah's road network. **Figure 36** shows the location and geographic concentration of collisions by their EPDO score.

Figure 36. Ukiah EPDO Score

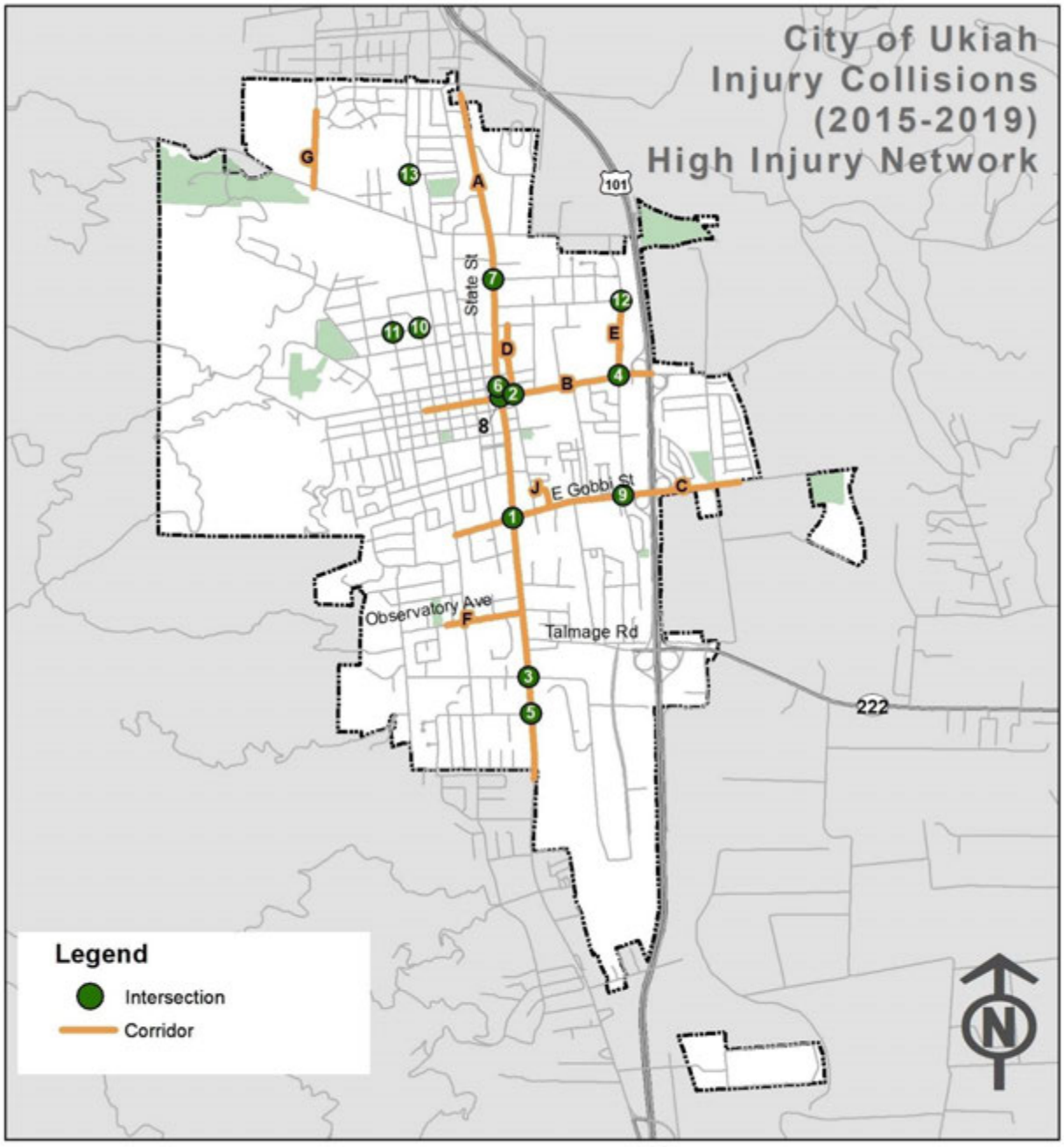


High-Injury Locations

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 Ukiah. The methodology for scoring the high injury locations is the same method used in the severity weight section. **Figure 37** shows the top eight high-collision roadway segments, and top 13 high-collision intersections. This high collision network has a total of 98 injury collisions with 24 F+SI collisions, which represents 28 percent of injury collisions and 100 percent of F+SI collisions in Ukiah on only about two percent of Ukiah's roadway network.

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

Figure 37. City of Ukiah High Injury Network



High Injury Intersections

There are 13 intersections that were identified as high injury intersections. A total of 15 F+SI collisions occurred at these intersections. The intersection of Gobbi Street and State Street has the highest EPDO score.

Table 8 lists the collision rate of the top 13 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	Veh/ Ped	Hit Object	DUI	Unsafe Speed	Bike	EPDO Score
		Collisions							
1	Gobbi St and State St	5	2	2	0	0	1	1	358
2	Main St and Perkins St	2	2	3	0	1	0	0	330
3	Washington Ave and Hastings Ave and S State St	11	1	4	1	0	0	1	245
4	Perkins St and South Orchard Ave	7	1	3	0	0	4	1	206
5	Wabash Ave and State St	6	1	0	0	0	4	0	195
6	Standley St and State St	4	1	1	0	1	2	0	183
7	Ford Rd and State St	3	1	1	0	0	1	0	182
8	Perkins St and S State St	2	1	2	0	0	0	0	176
9	East Gobbi St and South Orchard Ave	2	1	1	0	0	0	1	171
10	Dora Ave and Grove Ave	1	1	0	1	0	0	0	165
11	Grove Ave and Spring St	1	1	0	0	0	0	1	165
12	Clara Ave and North Orchard Ave	1	1	0	0	1	0	0	165
13	Arlington and North Bush St	1	1	0	1	0	0	0	165

High Injury Corridors

Eight corridors were identified as high injury corridors. There was a total 20 F+SI collisions on these corridors. The corridor with the highest number of F+SI collisions is State Street with four F+SI collisions.

Table 9 lists the collision rate of the top eight 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	Ped	Hit Object	DUI	Unsafe Speed	Bike	Length (miles)	EPDO Score
		Collisions								
A	State St: Beacon Ln to Ford Rd	36	3	5	2	0	23	3	2.5	728
B	N Orchard Ave: Clara Ave to E Perkins St	4	2	1	0	0	1	2	0.3	342
C	Perkins St: Hortense St to Redwood Hwy SR 101	11	1	4	0	1	6	1	2.3	235
D	Gobbi St: S Dora St to Washo Dr	5	1	2	0	1	1	2	3.8	199
E	Main St: Norton St to E Perkins St	3	1	2	0	1	0	1	2.8	177
F	Observatory Ave: Marwen Dr to State St	3	1	1	1	0	1	0	0.5	177
G	Despina Dr: Capps Ln to Low Gap Rd	1	1	1	0	0	0	0	0.7	165
H	Marshall St: S Main St to E Gobbi St	1	1	0	1	1	0	0	0.12	165

4. Emphasis Areas

Emphasis areas are focus areas for the LRSP that are identified through the comprehensive collision analysis of the identified high injury network within the City of Ukiah. Emphasis areas help in identifying appropriate safety strategies and countermeasures with the greatest potential to reduce collisions occurring at these high-risk locations. In addition, traffic safety related concerns were heard at the Stakeholders Meeting conducted for this plan on June 15, 2021.

This chapter summarizes the identified top eight emphasis areas, which includes a demographic analysis of the parties involved in the injury collisions that occurred in the City. These emphasis areas were derived from the systemic safety analysis of injury collisions (**Appendix B**) that occurred in the City from January 1, 2015 to December 31, 2019, along with safety concerns that were received as a part of the Stakeholder Outreach.

The following are the identified emphasis areas –

A. Improve Intersection Safety
B. Improve Pedestrian Safety
C. Reduce Nighttime Collisions
D. Reduce Hit object Collisions
E. Reduce Unsafe Speed Collisions
F. Improve Bicyclist Safety
G. School Area Collisions
H. Reduce Younger 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.

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 then to facilities.

Existing Traffic Safety Efforts in the City of Ukiah

The City of Ukiah 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 table below:

Table 10. Existing Programs Summary

Document/Program	Description	E's Addressed
Ukiah Bicycle & Pedestrian Master Plan (2015)	The goal of the Ukiah Bicycle and Pedestrian Master Plan (BPMP or Plan) is to improve bicycling and walking in the City of Ukiah as a comfortable and convenient transportation and recreation option.	Engineering
City of Ukiah Safe Routes to School Plan (2014)	Ukiah Safe Routes to School is a citywide program that encourages and enables school children to walk and bicycle to school by implementing projects and activities that improve the health, well-being, and safety of children and result in less traffic congestion and emissions caused by school-related travel.	Engineering Education
Ukiah Downtown Streetscape Improvement Plan (2009)	The purpose of this plan is to upgrade State Street and Main Street from Norton Street to Gobbi Street to provide for a cohesive, pedestrian-friendly, attractive, and complete downtown core.	Engineering
Mendocino County Safe Routes to School Plan (2014)	In addition to the Citywide program the countywide Safe Routes to School 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 Transportations Plan (2017)	Details bicycle and pedestrian improvements on County significant corridors. Includes detailed priority bike and pedestrian projects.	Engineering

Document/Program	Description	E's Addressed
Mendocino Council of Governments 2020 Regional Transportation Improvement Program (2019)	The 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
Ukiah 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 Ukiah 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 F+SI injury collisions. In addition to the collision data, emphasis areas were also determined by the feedback received from stakeholders. This section also presents comprehensive programs, policies and countermeasures to reduce collisions in specific emphasis areas.

Emphasis Area 1 – Intersection Safety

A total 98 collisions occurred on the high injury network in the City. 85 (87 percent) of these collisions occurred at an intersection, including 21 F+SI collisions. The following are major findings based on intersection injury collisions that occurred on the high injury network in the City of Ukiah followed by strategies to make these locations safer.

35%

Unsafe Speed Collisions

32%

Pedestrian Collisions

12%

Bicycle Collisions

Table 11. Emphasis Area 1 Strategies

Objective To reduce the number of F+SI 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

Objective To reduce the number of F+SI collisions at intersections			
	Strategy	**Performance Measure**	**Agencies/ Organizations**
EMS	S05, Install emergency vehicle pre-emption systems	EMS vehicle response time	Mendocino County Local Emergency Services Agency

Emphasis Area 2 – Pedestrian Safety

A total 98 collisions occurred on the high injury network. 31 (32 percent) of these collisions were pedestrian collisions, including 11 F+SI collisions. The following are major findings based on pedestrian injury collisions on the high injury network in the City of Ukiah followed by strategies to make these locations safer:

68%

Involved a pedestrian crossing in a crosswalk at an intersection

35%

Pedestrian right of way violations

27%

Severe Injury collisions involved unsafe speed violations

Table 12. Emphasis Area 2 Strategies

Objective Reduce the number of F+SI 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 Ukiah every three-five 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 • Pedestrian safety improvements at on ramp off/ramps	Number of locations improved	City

Objective Reduce the number of F+SI pedestrian injury collisions			
	Strategy	**Performance Measure**	**Agencies/ Organizations**
EMS	S05, Install emergency vehicle pre-emption systems	EMS vehicle response time	Mendocino County Local Emergency Services Agency

Emphasis Area 3 – Nighttime Collisions

A total 98 collisions occurred on the high injury network. 18 (18 percent) of these collisions were nighttime collisions, including six F+SI collisions. The following are major findings based on night-time collisions that occurred on the high injury network in the City of Ukiah followed by strategies to make these locations safer:

72%	39%	10%
Pedestrian Collisions	**Unsafe speed collisions**	**DUI Collisions**

Table 13. Emphasis Area 3 Strategies

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

Emphasis Area 4 – Hit Object Collisions

A total 98 collisions occurred on the high injury network. Six (six percent) of these collisions were hit object collisions, including five F+SI collisions. The following are major findings based on hit object collisions on the high injury network in the City of Ukiah followed by strategies to make these locations safer:

50%	20%	17%
Improper turning collisions	**Unsafe speed collisions**	**Nighttime collisions**

Table 14. Emphasis Area 4 Strategies

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

Emphasis Area 5 – Unsafe Speed Collisions

A total 98 collisions occurred on the high injury network. 35 (36 percent) of these collisions were unsafe speed collisions, including four F+SI collisions. The following are major findings based on unsafe speed collisions on the high injury network in the City of Ukiah followed by strategies to make these locations safer:

86%

Involved another motor vehicle

83%

Rear end collisions

11%

Pedestrian collisions

Table 15. Emphasis Area 5 Strategies

Objective			
Reduce the number of F+SI collisions that are due to unsafe speed			
	Strategy	**Performance Measure**	**Agencies/ Organizations**
Education	Conduct public information and education campaign for safety laws regarding unsafe speed and its dangers.	Number of education campaigns	City/ School District/ Police Department
Enforcement	Targeted enforcement at high-risk locations to monitor unsafe speed.	Number of tickets issued	Police Department
Engineering	• S16/NS04/NS05, Convert intersection to roundabout • NS07, Upgrade intersection pavement markings (NS.I.) • R22, Install/Upgrade signs with new fluorescent sheeting (regulatory or warning) • R27, Install delineators, reflectors and/or object markers • R26, Install dynamic/ variable speed warning signs • R28, Install edge-lines and centerlines • R36PB, Install/upgrade pedestrian crossing (with enhanced safety features)	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 6 – Bicycle Safety

A total 98 collisions occurred on the high injury network. 11 (11 percent) of these collisions were bicycle collisions, including four F+SI collisions. The following are major findings based on bicycle injury collisions that occurred on the high injury network in the City of Ukiah followed by strategies to make locations safer:

27%	27%	26%
Broadside collisions	**Traffic signals and signs violation collisions**	**Wrong side of road collisions**

Table 16. Emphasis Area 6 Strategies

Objective			
Reduce the number of F+SI bicycle injury collisions			
	Strategy	**Performance Measure**	**Agencies/Organizations**
Education	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 Ukiah every 3-5 years	Number of education campaigns	City/ School District/ Police Department
Enforcement	Targeted enforcement at high-risk locations especially near schools	Number of tickets issued	Police Department
Engineering	• R32PB, Install Bike Lanes • E33PB, Install Separated Bike Lanes • NS21PB/R35PB, Install/upgrade pedestrian crossing (with enhanced safety features) • R37PB, Install RRFB • S20PB, Install advanced stop bar before crosswalk (Bicycle Box) • Green thermoplastic markings through conflict zones such as freeway on ramps/off ramps • Wayfinding signs that direct cyclists to low stress routes	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 7 – School Area Safety

A total 28 collisions occurred near schools, within one block of a school, including five fatal or severe injury (F+SI) collisions. The following are major findings based on school area injury collisions that occurred on the high injury network in the City of Ukiah followed by strategies to make these areas safer.

36%

Unsafe speed collisions

32%

Pedestrian collisions

21%

Automobile of right of way collisions

Table 17. Emphasis Area 6 Strategies

Objective			
Reduce the number of F+SI collisions near school areas			
	Strategy	**Performance Measure**	**Agencies/ Organizations**
Education	Conduct school safety campaigns and outreach to raise their awareness of traffic safety needs at schools.	Number of education campaigns	City/ School District/ Police Department
Enforcement	Targeted enforcement at high-risk locations especially near schools.	Number of tickets issued.	Police Department
Engineering	• S02, Improve signal hardware: lenses, back-plates with retroreflective borders, mounting, size, and number • R26, Install dynamic/ variable speed warning signs • NS21PB/R35PB, Install/upgrade pedestrian crossing (with enhanced safety features) • R36PB, Install raised pedestrian crossing • R37PB, Install RRFB • High-visibility ladder crosswalks • Install school area signage • Mid-block curb extension • In-road yield sign for pedestrian crossing at crosswalk	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 8 – Younger Adult Party at Fault involved in Collisions

A total 98 collisions occurred 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.

42%

Fatal or severe injury collisions party at fault were under 29 years old

60%

Fatal or severe injury collisions party at fault was a male

Table 18. Emphasis Area 8 Strategies

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

5. Countermeasure Identification

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

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

Countermeasure Selection

In 2010, the Federal Highway Administration (FHWA) published a set of three manuals local and rural road owners to present a simple, data driven safety analysis framework for rural agencies across the country. In conjunction with these documents, California Department of Transportation (Caltrans) developed the 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*."[7] 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 Ukiah. 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; and
- Other (O) – countermeasures that do not qualify for HSIP funding.

[7] 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

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

- Crash Reduction Factor – 15%
- Expected Life – 10 years
- Baseline Cost – Approximately $40,000 per intersection

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

S07 – Provide protected left turn phase (left turn lane already exists. Includes addition of a properly timed protected left-turn phase, consideration of MUTCD guidelines on implementation of protected left-turn phases.

- Crash Reduction Factor – 30%
- Expected Life – 20 years
- Baseline Cost – Approximately $35,000 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

S19PB – Pedestrian Scramble. Pedestrian Scramble is a form of pedestrian "WALK" phase at a signalized intersection in which all vehicular traffic is required to stop, allowing pedestrians/bicyclists to safely cross through the intersection in any direction, including diagonally.

- Crash Reduction Factor – 40%
- Expected Life – 20 years
- Baseline Cost – Approximately $60,000

S21PB - Modify signal phasing to implement a Leading Pedestrian Interval (LPI). A LPI gives pedestrians the opportunity to enter an intersection three-seven 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.

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

Non-Signalized Intersections Countermeasures

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

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

NS03 – Install signals. Provision of a new traffic signal. All new signals must meet MUTCD safety warrants: 4,5, or 7.

- Crash Reduction Factor – 30%
- Expected Life – 20 years
- Baseline Cost – Approximately $500,00 per intersection

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

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

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

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

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

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

R14 - Road Diet (Reduce travel lanes from four to three and add a two way left-turn and bike lanes) Includes repurposing a travel lane to add bike lanes.

- Crash Reduction Factor – 30%
- Expected Life – 20 years
- Baseline Cost – Approximately $70,000-$300,000

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

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

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

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

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

R37PB – Install Rectangular Rapid Flashing Beacon (RRFB). 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 $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 chapter summarizes the process of selecting safety projects as part of the analysis for the City of Ukiah's LRSP. The next step after the identification of high-risk locations, emphasis areas and applicable countermeasures was to identify location specific safety improvements for all high-risk roadway segments and intersections.

Specific countermeasures and improvements were selected from the 2020 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 eight 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 19 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. 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 F+SI collisions in Ukiah. These collision factors were identified to be pedestrian collisions, intersection safety and unsafe speed collisions.

For F+SI collisions, 46 percent of collisions were pedestrian collisions, most of these occurred at intersections. State Street and Perkins Avenue had a higher amount of pedestrian collisions than other locations in the City of Ukiah. Recommended improvements at these locations include upgrading pedestrian crossings, installing RRFB and installing pedestrian countdown features.

For F+SI collisions, 88 percent of collisions occurred at intersections. The intersections of Gobbi Street/State Street and Main Street /Perkins Avenue had a higher amount of collisions than other intersections in the City of Ukiah. Recommended improvements at these locations include installing raised pavement markers and striping, installing raised media on approaches and upgrading signs to larger or additional stop signs or other intersection warning signs.

For F+SI collisions, 17 percent of collisions were unsafe speed collisions, most of these at intersections locations. State Street, Perkins Avenue and Gobbi Street had higher amounts of unsafe speed collisions than other location in the City of Ukiah. Recommended improvements at these locations include installing dynamic/ variable speed warning signs.

Table 19. List of Viable Safety Projects

Location	CM1	CM2	CM3	Cost per Location	B/C Ratio
Project 1: Systemic Improvements at Signalized Intersections					
Washington Ave and Hastings Ave and S State St	S02	S03	S07	$241,290	22.29
Perkins St and South Orchard Ave	S02	S03		$13,790	
Standley St and State St	S02	S03		$28,490	
East Gobbi and South Orchard Ave	S02	S03	S07	$66,290	
Airport Park Boulevard and Talmage Road	S02	S03		$24,010	
Project 2: Systemic Improvements at Signalized Intersections					
Gobbi St and State St	S09	S12	S17PB	$61,901	67.72
Washington Ave and Hastings Ave and S State St		S12		$84,140	
Perkins St and South Orchard Ave	S09	S12	S17PB	$78,638	
Standley St and State St			S17PB	$13,440	
East Gobbi and South Orchard Ave			S17PB	$13,440	
Project 3: Systemic Improvements at Unsignalized Intersections					
Main St and Perkins St	NS01	NS06	NS07	$66,920	64.75
Wabash Ave and State St		NS06		$700	
Ford Rd and State St		NS06		$700	
Dora Ave and Grove Ave		NS06		$700	
Clara Ave and North Orchard Ave		NS06		$700	
Arlington and North Bush St		NS06	NS07	$5,062	
North Bush St and Low Gap Rd	NS01	NS06	NS07	$52,875	
State St and Observatory Rd	NS01	NS06	NS07	$2,766	
Park Blvd and Walnut Ave	NS01	NS06	NS07	$2,766	
Project 4: Systemic Roadway Segment Improvements					
State St: Beacon Ln to Ford Rd	R14	R22	R26	$499,800	35.13
N Orchard Ave: Clara Ave to E Perkins St		R22	R26	$32,410	

Location	CM1	CM2	CM3	Cost per Location	B/C Ratio
Perkins St: Hortense St to Redwood Hwy SR 101	R14	R22	R26	$140,294	
Gobbi St: S Dora St to Washo Dr		R22	R26	$44,380	
Main St: Norton St to E Perkins St		R22		$1,890	
Despina Dr: Capps Ln to Low Gap Rd		R22		$3,360	
Marshall St: S Main St to E Gobbi St		R22		$3,500	
Brush St		R22		$5,040	
W Mill St		R22	R26	$33,810	
Oak St		R22	R26	$94,220	
Cypress Ave: Spring St to Oak St		R22	R26	$36,610	
Low Gap Rd		R22	R26	$92,330	
Scott St		R22		$8,330	
Airport Park Blvd		R22		$35,140	
Dora St		R22	R26	$151,200	
Elm St		R22	R26	$39,900	
Live Oak Ave		R22	R26	$25,410	
Project 5: Roadway Segment Improvements					
Brush St	R27			$1,120	387.74
Oak St	R27			$1,960	
Project 6: Pedestrian Roadway Segment Improvements					
Perkins St: Hortense St to Redwood Hwy SR 101		R37PB		$112,000	14.12
Gobbi St: S Dora St to Washo Dr	R35PB	R37PB		$371,000	
Despina Dr: Capps Ln to Low Gap Rd	R35PB	R37PB		$105,000	
State St: Beacon Ln to Ford Rd	R35PB			$518,000	
Main St: Norton St to E Perkins St	R35PB			$140,000	
Observatory Ave: Marwen Dr to State St	R35PB		R01	$72,408	
Brush Street			R01	$392,336	

Location	CM1	CM2	CM3	Cost per Location	B/C Ratio
N Bush St	R35PB	R37PB	R01	$1,197,140	
Low Gap Rd	R35PB	R37PB		$553,840	
Airport Park Blvd	R35PB			$2,100	
Project 7: Pedestrian Set Aside					
Washington Ave and Hastings Ave and S State St	S21PB			$14,000	
Perkins St and South Orchard Ave	S21PB			$14,000	
Standley St and State St	S21PB			$14,000	N/A
Perkins St and S State St	S21PB			$14,000	
Gobbi St and State St	S21PB			$14,000	
Ford Rd and State St		NS22PB	NS21PB	$39,794	
Grove Ave and Spring St		NS22PB	NS21PB	$94,898	
State Stand Observatory Rd		NS22PB	NS21PB	$54,023	

Notes: CM – countermeasure. B/C ratio is the dollar amount of benefits divided by the cost of the countermeasure. S02 – Improve signal hardware, , S03-Improve signal timing, S07 – Provide protected left turn phase, S09- Install raised pavement markers and striping, S12 – Install raised media on approaches, S17PB – Install pedestrian countdown signal head, S19PB- Pedestrian scramble, S21PB- Modify signal phasing to implement a leading pedestrian interval, NS01- Add intersection lighting (NS.I.), NS03 – Install signals, NS06- Install/upgrade larger or additional stop signs or other intersection warning/regulatory signs, NS07- Upgrade intersection pavement markings (NS.I.), NS21PB – Install/upgrade pedestrian crossing at uncontrolled locations, NS22PB- Install Rectangular Rapid Flashing Beacon (RRFB), R01- Add segment lighting, R14- Road diet, R22- Install/Upgrade signs with new fluorescent sheeting (regulatory or warning), R26 - Install dynamic/variable speed warning signs, R27- Install delineators, reflectors and/or object markers R35PB - Install/upgrade pedestrian crossing (with enhanced safety features), R37PB – Install rectangular rapid flashing beacon

Costs include contingency, PS&E, environmental and construction costs

HSIP Applications

The next step is to prepare HSIP grant ready materials, for the City to submit 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 F+SI 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 20**.

Table 20. 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	Education, Enforcement,	10 grants available to address various

Funding Source	Funding Agency	Amount Available	Next Estimated Call for Projects	Applicable E's	Notes
			31st annually	Emergency Response	components of traffic safety
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 Ukiah 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 F+SI 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 F+SI 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 Ukiah'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

Matrix of Planning Goals, Policies, and Projects

Document	Highlights
City of Ukiah General Plan (2009)	• Goal CT-1: Consider all types of circulation and transportation issues in land use decisions • Goal CT-3: Design new development and redevelopment projects to be as accessible by foot, bicycle, and transit as they are by auto. • Policy CT-6.4: Promote safe bicycle usage. • Implementation Measure CI-6.4(a): Through the Public Safety Department, maintain an educational program promoting bicycle use and bicycle safety. • Policy CJ'-7.1: Treat pedestrian access as an integrated part of all road improvements within the City and within urbanized development areas of the County. • Implementation Measure CT-7.l(b): Pedestrian walkways shall be integrated and designed to provide direct access between areas
Ukiah Bicycle & Pedestrian Master Plan (2015)	• Safety and Education Policy 1-1: Utilize the City's Traffic Engineering Committee for the identification, analysis, and resolution of safety issues related to bicycle and pedestrian travel within the City of Ukiah. The Traffic Engineering Committee includes representatives from the Mendocino Transit Authority, the public, the Public Works Department, Police Department, Planning Department, and other relevant departments. • Safety and Education Policy 1-2: Expand and support school commute safety education, marketing, and physical improvements, including educational curriculum, on-bike training, safety handbooks, helmet subsidy programs, marketing materials on the benefits of bicycling and walking, and a 'toolbox', of physical measures to improve safety on school commute routes for bicyclists and pedestrians. • Safety and Education Policy 1-3: Accommodate the needs of all travelers through a "Complete Streets" approach to designing new transportation improvements. Complete Streets are roadways designed to facilitate safe, comfortable, and efficient travel for all roadway users. Complete Streets accommodations include bike lanes sidewalks, crosswalks, curb ramps, etc. • Safety and Education Policy 1-4: Where possible, incorporate traffic calming techniques as described in published documents produced by organizations such as the Institute of Transportation Engineers, including measures to manage vehicle speeds and flows - such as traffic circles, traffic diverters, and raised crosswalks – so

Document	Highlights
	as to maximize the safety of bicycle and pedestrian movement in residential and commercial neighborhoods. • Safety and Education Policy 1-5: Educate adults on the rights and responsibilities of bicyclists and pedestrians through public information, and education of drivers, cyclists, and pedestrians. Support adult bicycle training courses, and inclusion of bicycle and pedestrian laws as part of traffic school curriculum and driving test questions. Produce a safety brochure that illustrates basic rules of the road and other good practices for distribution in schools and libraries. • Safety and Education Policy 1-6: Coordinate with the Ukiah Police Department to enhance enforcement of existing bicycle and pedestrian laws. • Safety and Education Policy 2-1: Monitor bicycle and pedestrian commute modes and accident statistics over the life of this Plan to measure the effectiveness of improvements and achievement of stated objectives. Prepare annual summary reports on mode split (the percentage of various travel modes used by citizens for work trips, shopping trips, etc.) and accident data.
City of Ukiah Safe Routes to School Plan (2014)	**Projects** • Reduced and Extended School Zone Speed Limits • Dora Street and Gobbi Street Intersection Improvements • Gobbi Street Bike Lanes • "Level 1" Uncontrolled Crosswalk Enhancement • Grove Avenue/Bush Street Buffered Bike Lanes • Dora Street Buffered Bike Lanes • North Bush Street/Low Gap Roundabout • Enhanced Uncontrolled Crosswalks • Helen Ave and Washington Ave Class III Shared Bikeways • Despina Drive/Low Gap Intersection Improvements • Clay/Peach Street Sidewalk and Bikeway Gap Closure • East Perkins Street Road Diet Study • Leslie Street Curb Extensions and Sidewalk Improvements • School Parking Lot Redesign Options • North Bush Street – Island Pathway Access Upgrades • Arlington Drive at North Bush Street Enhanced Crosswalk and Curb Extensions • Gobbi Street at Oak Street Curb Ramps and Crosswalk • Mendocino Drive at Alice Avenue Crossing Improvement • Despina Drive and Capps Lane Enhanced Intersection • Low Gap Road/Orr Creek Pathway Study

Document	Highlights
Ukiah Downtown Streetscape Improvements Plan (2009)	**Projects** • Gobbi Street Intersection: Enhanced intersection treatment. • Between Gobbi Street and Mill Street: Raised Median • Mill Street Intersection: Enhanced crosswalks to highlight pedestrian crossing. • Seminary Avenue Intersection: Enhanced intersection treatment and bulb-outs to reduce • crossing distance. • Between Stephenson Street and Church Street: Raised median/pedestrian refuge island. • Perkins Street Intersection: Signal timing changes and enhanced intersection treatment. • Standley Street Intersection: Signal timing changes. • Standley Street and Henry Street: Conversion of one-way to two-way. • Between Smith Street and Henry Street: raised median. • Gibson Creek Crossing: Gateway and pedestrian crossing with bollards or street lights. **The planned alterations to Main Street include:** • Gobbi Street Intersection: Enhanced intersection treatment. • Cleveland Lane Intersection: New crosswalks. • Clay Street to Norton Street: Dedicated bike lanes. • Smith Street Intersection: Enhanced Crosswalks. • Continuous sidewalks to fill in existing gaps. • Widened sidewalks along State Street in order to accommodate new planters, trees, street furniture, outdoor restaurant/café seating, and other pedestrian amenities.
The Ukiah Valley Area Plan (2010)	• **Goal CT-2:** Enhance pedestrian, bicycle, and transit connectivity between land use types. • **Policy CT-2.1:** Integrate pedestrian access into the circulation system of the urbanized areas of the Ukiah valley. • **Implementation Measure CT-2.1 (a);** The land development code shall develop pedestrian access design standards that address: • Accessibility to the disabled, with appropriate grades, ramps, and curb cuts. • Separation of sidewalks or paths from auto travel lanes by an appropriate combination of grade separations, parking lanes or landscaping when feasible.

Document	Highlights
	• Requirements for landscaped areas and tree shading when appropriate and with respect to solar access. • Streetscape amenities such as lighting. • **Implementation Measure CT-2.1 (b):** Pedestrian Walkways: To the extent allowed under state law, require private development projects provide pedestrian walkways that provide direct access between key destinations. • **Implementation Measure CT-2.1 (c):** When considering new development projects, the County shall require bicycle and pedestrian access across the property to provide connections for a route between the center of Calpella (along North State Street) and the Brush Street Triangle or between the City and the center of Talmage. The County will request that MCOG develop a map of these pedestrian linkages and include that map in the next Regional Transportation Plan update. • **Policy CT-2.2:** Develop a safe and integrated bicycle transportation system in order to promote the use of bicycles as a viable and attractive alternative to the automobile. • **Implementation Measure CT-2.2 (a):** Bicycle Route Standards. The land development code shall include standards for safe bicycle lanes or paths, as appropriate, for development projects. Consider bicycle safety in the design of roadways, intersections, and rights-of way encroachments. • **Implementation Measure CT-2.2 (b)** Bicycle Route Requirements. Require that roads linking residential areas with schools, shopping, services, or employment be designed to include bicycle lanes. • **Implementation Measure CT-2.2 (c):** Bicycle Route Construction. Construct and maintain bicycle routes and lanes in accordance with the Area Plan Bicycle Route map and the Mendocino County Regional Bikeway Plan. Seek funds through MCOG for the construction of bicycle lanes on routes identified in a County bicycle plan, including in conjunction with County road improvement or widening projects. • Ensure that bicycle routes connect residential, retail, and employment centers. • Work with Human Health Services (HHS) in applying for funding to plan and implement bicycle projects. • **Implementation Measure CT-2.2 (d**): Bicycle Parking. Adopt and implement standards for safe and secure bike storage in new development. Develop incentives to place

Document	Highlights
	bike storage facilities at exiting places of employment and parking lots. • **Implementation Measure CT-2.2 (e):** Bicycle Route Updates. Periodically update plans to extend the system of bicycle lanes and routes in appropriate locations throughout the Ukiah Valley. • **Policy CT-2.3:** Coordinate transportation planning needs, developer obligations, and construction responsibilities. • **Implementation Measure CT-3.2 (d):** Mitigation and Impact Fees. Require development impact fees, development agreements and other secured funding sources where necessary to fund transportation improvements to maintain an acceptable level of service on County roads and for all transportation modes. • **Implementation Measure CT-3.2 (e):** Travel Demand Management Strategies. Mitigate trips generated by new development using travel demand management strategies, such as: free transit passes, mixed use development with concentrated employment centers and residential communities, efficient walking, and bicycle connections.
Mendocino County Rail-with-Trail Plan (2012)	• GOAL 1: Improve Non-Motorized Mobility and Accessibility - Expand and enhance non-motorized mobility for persons living in, working in, and visiting Mendocino County, including access to and connections with other transportation modes. • GOAL 2: Preserve the Transportation System - Design a RWT that will efficiently utilize the NWP corridor, support the region's current blueprint planning efforts which calls for improved options for bicycling, walking, and equestrians, and allow for future rail service along the NWP line. • GOAL 3: Enhance Public Safety and Security - Design the RWT segments to respond to safety and security needs as well as neighborhood privacy concerns. • GOAL 4: Reflect Community Values - Promote community values and identity, including use by multiple user groups, such as bicyclists, pedestrians, and equestrians (where feasible) and incorporate public involvement in decision making processes. • GOAL 5: Enhance the Environment - Assist in greenhouse gas reduction by encouraging and facilitating non-motorized vehicle trips. • GOAL 6: Allow for Regional Connections- Provide non-motorized connections to adjacent streets and land uses

Document	Highlights
	including transit, shopping, institutional, office, and residential areas. • GOAL 7: Implementation Funding - Develop a funding, financing, and implementation strategy identifying eligible grant sources and/or potential development requirements supporting construction. **Projects** • Segment S10 from East Gobbi Street to Clara Avenue: The southern half of this segment between Gobbi Street and Perkins Street is funded for construction in 2015. • Segment S9 from Norgard Lane to East Gobbi Street: Along with Segment S10, this paved pathway would connect NWP Rail Trail, Phase 1 (East Gobbi Street-Clara Avenue) to the south and provide a connection from the south and north ends of the city. • Segment S11 from Clara Avenue to Brush Street: This segment would connect to Mazzoni Street which provides direct access to the current campus of Redwood Academy/Accelerated Achievement Academy.
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 Safe Routes to School 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 Safe Routes to School 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*

Document	Highlights
	Objective D: Limit traffic speeds and volumes along key routes to schools **Goal 3:** Maximize interagency cooperation in all Safe Routes to School project and programs in an effort to build a sustainable program. *Objective A: Establish an ongoing countywide Safe Routes to School program that serves all interested schools in Mendocino County.* *Objective B: Seek and secure outside grant funding for Safe Routes to School programs and activities, and leverage local funding for school area improvements*
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 Council of Governments 2020 Regional Transportation Improvement Program (2019)	**Projects** • North State Street Intersection and Interchange Improvements, Ukiah - Along North State Street, from Ford Road/Empire Drive to the northbound on/off-ramps of U.S. 101. Install medians, landscape and aesthetic features, and a roundabout at the KUKI Lane intersection • Roundabout at Low Gap and North Bush, Ukiah - Construction of a new roundabout to replace an all way STOP controlled intersection • Ukiah Downtown Streetscape, Ph 2 - Will encourage walking and biking in downtown commercial area along major arterial, increasing access to business, and beautifying downtown. In addition to implementing several objectives of the RTP, this project implements the Ukiah Downtown Streetscape improvement Plan, approved by the City of Ukiah in 2009. It is also consistent with the Ukiah Bicycle and Pedestrian Master Plan. This will add to downtown streetscape improvements funded through other sources.

APPENDIX B. CONSOLIDATED COLLISION DATABASE

Case ID	Accident Year	Collision Date	Primary Road	Secondary Road	Distance	Direction	Collision Severity
6801692	2015	1/27/2015	NORTH STATE ST	EVANS ST	122	S	4
6812062	2015	1/13/2015	SOUTH STATE ST	WASHINGTON AV	0		2
6864153	2015	3/16/2015	OBSERVATORY AV	SOUTH ST	195	E	4
6904385	2015	4/7/2015	NORTH STATE ST	GARRETT DR	245	S	2
6910818	2015	4/11/2015	EAST GOBBI ST	SOUTH ORCHARD AV	0		4
7024150	2015	7/21/2015	SOUTH ORCHARD AV	EAST PERKINS ST	0		4
7024397	2015	8/7/2015	NORTH MAIN ST	EAST STANDLEY ST	0		4
7045819	2015	5/5/2015	EAST PERKINS ST	SOUTH MAIN ST	0		3
7048424	2015	8/24/2015	EAST GOBBI ST	SOUTH MAIN ST	7	E	3
7079025	2015	10/4/2015	SOUTH STATE ST	HASTINGS ST	0		3
7123031	2015	10/26/2015	EAST GOBBI ST	GOBBI ST	0		2
7123035	2015	10/22/2015	N STATE ST	MAGNOLIA ST	217	S	3
7166643	2016	1/4/2016	SOUTH STATE ST	WASHINGTON AV	0		4
7166663	2016	1/15/2016	NORTH ORCHARD AV	EAST PERKINS ST	197	N	2
7168492	2015	12/22/2015	SOUTH STATE ST	EAST GOBBI ST	0		3
7168547	2015	12/4/2015	SOUTH STATE ST	HASTINGS RD	0		4
7170471	2016	1/5/2016	NORTH STATE ST	FORD ST	270	S	4
7198344	2016	2/26/2016	NORTH STATE ST	MAGNOLIA ST	184	N	4
7198470	2016	2/6/2016	SOUTH STATE ST	HASTINGS AV	290	S	4
7198471	2016	2/11/2016	SOUTH STATE ST	FREITAS ST	19	S	3
7201639	2016	1/29/2016	N DORA ST	W PERKINS ST	14	N	4
8012344	2016	3/9/2016	EAST PERKINS ST	WARREN DR	31	E	4
8047160	2016	4/17/2016	STATE ST	S STATE ST 700	83	N	4
8070164	2016	6/7/2016	SOUTH STATE ST	WABASH AV	165	N	4
8070166	2016	6/17/2016	SOUTH STATE ST	WABASH AV	0		4
8112396	2016	7/30/2016	SOUTH STATE ST	TALMAGE RD	148	N	4
8112447	2016	8/17/2016	NORTH ORCHARD AV	N ORCHARD AV 200	0		2
8136474	2016	9/2/2016	WASHINGTON AV	SOUTH STATE ST	141	W	4
8136626	2016	9/6/2016	SOUTH SCHOOL ST	WEST PERKINS ST	13	S	4
8136634	2016	9/9/2016	GROVE AV	NORTH SPRING ST	0		2
8181288	2016	11/23/2016	SOUTH STATE ST	WABASH AV	85	N	4
8181403	2016	11/4/2016	DESPINA DR	LOW GAP RD	550	N	2
8203688	2016	12/9/2016	EAST GOBBI ST	OAK MANOR DR	317	W	2
8203880	2016	12/25/2016	EAST PERKINS ST	MASON ST	206	E	4
8203888	2016	12/12/2016	NORTH ORCHARD AV	CLARA AV	192	S	4
8203920	2016	12/21/2016	SOUTH STATE ST	BEACON LN	292	N	4
8294575	2017	1/11/2017	BRUSH ST	NORTH STATE ST	13	E	3
8294597	2017	1/15/2017	SOUTH STATE ST	HASTINGS AV	80	N	4
8294786	2017	1/13/2017	NORTH ORCHARD AV	CLARA AV	0		2
8294790	2017	1/18/2017	EAST GOBBI ST	SOUTH MAIN ST	93	E	4
8353931	2017	3/28/2017	BRUSH ST	STATE ST	5	E	4
8355762	2017	4/20/2017	SOUTH STATE ST	WASHINGTON AV	0		3
8370121	2017	4/24/2017	NORTH STATE ST	FORD ST	0		3
8371331	2017	4/20/2017	MARSHALL ST	SOUTH MAIN ST	240	E	2
8372865	2017	4/28/2017	STATE ST	MILL ST	271	S	2
8372869	2017	4/26/2017	PERKINS ST	MASON ST	63	E	4
8416062	2017	6/30/2017	EAST PERKINS ST	WARREN DR	103	E	2
8416066	2017	6/4/2017	SOUTH STATE ST	GOBBI ST	0		3
8416070	2017	6/8/2017	SOUTH STATE ST	WABASH AV	147	N	2
8416180	2017	6/30/2017	SOUTH STATE ST	WABASH AV	121	N	4
8436211	2017	8/9/2017	STATE ST	CLAY ST	109	N	3
8436381	2017	8/23/2017	EAST PERKINS ST	SOUTH MAIN ST	0		4
8438348	2017	7/16/2017	NORTH STATE ST	FORD ST	0		2
8466326	2017	9/11/2017	NORTH STATE ST	BRUSH ST	11	W	3
8466733	2017	8/28/2017	SOUTH STATE ST	EAST PERKINS ST	0		3
8507943	2017	11/9/2017	EAST PERKINS ST	HOSPITAL DR	340	W	3
8507958	2017	10/25/2017	EAST PERKINS ST	SOUTH ORCHARD AV	28	W	4
8507966	2017	10/11/2017	SOUTH STATE ST	WASHINGTON AV	0		3
8507996	2017	10/12/2017	EAST GOBBI ST	SOUTH ORCHARD AV	0		2

Case ID	Accident Year	Collision Date	Primary Road	Secondary Road	Distance	Direction	Collision Severity
8533349	2017	12/29/2017	NORTH STATE ST	FORD ST	31	N	4
8536159	2017	11/29/2017	SOUTH STATE ST	WEST MILL ST	325	S	3
8551061	2018	1/18/2018	SOUTH STATE ST	EAST PERKINS ST	0		2
8560760	2018	1/25/2018	SOUTH MAIN ST	EAST GOBBI ST	9	N	4
8560939	2018	1/19/2018	OBSERVATORY AV	SOUTH ST	156	W	4
8573976	2018	2/9/2018	MAIN ST	E SMITH ST	138	N	2
8576410	2018	2/12/2018	SOUTH STATE ST	WASHINGTON AV	243	N	4
8649431	2018	4/15/2018	NORTH STATE ST	STANDLEY ST	0		2
8658437	2018	3/21/2018	NORTH MAIN ST	NORTON ST	371	N	4
8658441	2018	3/26/2018	EAST GOBBI ST	MARSHALL ST	61	W	3
8668554	2018	4/21/2018	NORTH STATE ST	MAGNOLIA ST	54	S	4
8668574	2018	6/18/2018	SOUTH STATE ST	FREITAS	265	S	4
8668614	2018	4/25/2018	NORTH STATE ST	WEST STANDLEY ST	28	S	4
8668714	2018	7/17/2018	SOUTH MAIN ST	EAST PERKINS ST	0		2
8742019	2018	8/6/2018	SOUTH ORCHARD AV	S ORCHARD AV 100	20	E	4
8742023	2018	8/28/2018	SOUTH STATE ST	GOBBI ST	320	N	3
8745955	2018	10/5/2018	WASHINGTON AV	SOUTH STATE ST	0		3
8745979	2018	9/18/2018	PERKINS ST	HOSPITAL DR	13	E	4
8746014	2018	9/8/2018	SOUTH STATE ST	GOBBI ST	0		2
8777040	2018	10/23/2018	NORTH STATE ST	CLARA AV	164	N	4
8777179	2018	10/11/2018	DORA AV	GROVE AV	0		2
8777590	2018	12/12/2018	NORTH MAIN ST	N MAIN ST 200	16	W	4
8787575	2018	11/1/2018	SOUTH STATE ST	WASHINGTON AV	35	N	4
8787602	2018	10/1/2018	NORTH STATE ST	STANDLEY ST	0		4
8788629	2018	12/20/2018	EAST PERKINS ST	SOUTH ORCHARD AV	222	W	4
8788633	2018	12/21/2018	NORTH STATE ST	MAGNOLIA ST	118	N	4
8814523	2019	2/9/2019	SOUTH STATE ST	WABASH AV	0		4
8814527	2019	2/24/2019	SOUTH ORCHARD AV	EAST PERKINS ST	0		3
8860181	2019	4/15/2019	NORTH STATE ST	SCOTT ST	67	S	4
8869949	2019	3/13/2019	SOUTH STATE ST	WEST MILL ST	204	N	4
8928822	2019	7/24/2019	NORTH STATE ST	WEST STANDLEY ST	79	N	4
8928830	2019	6/1/2019	NORTH STATE ST	GARRETT DR	27	S	4
8973287	2019	9/16/2019	PERKINS ST	WARREN DR	148	E	3
8973660	2019	10/4/2019	EAST PERKINS ST	SOUTH ORCHARD AV	0		4
9004620	2019	11/27/2019	SOUTH STATE ST	THOMAS ST	73	S	2
9013559	2019	10/4/2019	EAST PERKINS ST	MAIN ST	0		2
9013560	2019	10/18/2019	NORTH STATE ST	LOW GAP RD	251	S	4
9014027	2019	9/19/2019	NORTH BUSH ST	ARLINGTON DR	0		2
90328278	2016	11/15/2016	NORTH STATE ST	EMPIRE DR	2640	S	4

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%

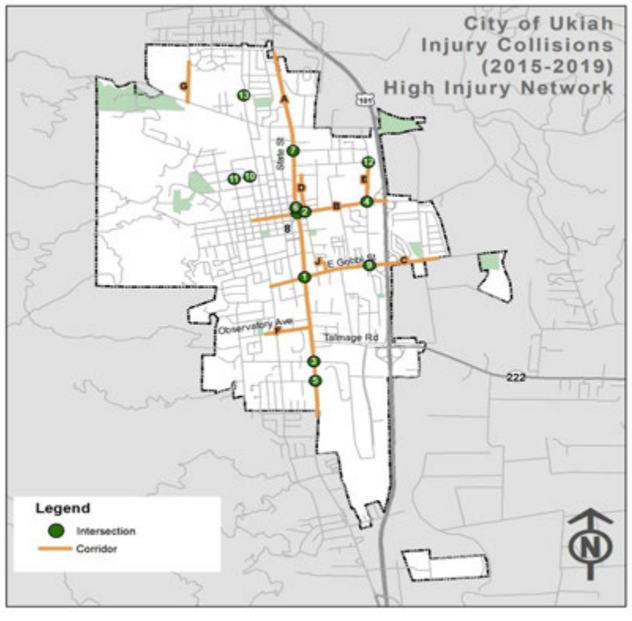
APPENDIX D: COUNTERMEASURE TOOLBOX

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 Night-Time Collisions			EA - 4 Reduce Hit Object Collisions			EA - 5 Reduce Unsafe Speed collisions			EA - 6 Improve Bicycle Safety		
			CM1	CM2	CM3	CM4	CM5	CM6		CM1	CM2	CM3	CM1	CM2	CM3	CM1	CM2	CM3	CM1	CM2	CM3	CM1	CM2	CM3	CM1	CM2	CM3
I-1	Gobbi St and State St	Signalized	S09	S12	S17PB	S21PB			Upgrade/install signage approaching intersection; crosswalk striping re	S09			S17PB	S21PB					S09						S17PB	S21PB	
I-2	Main St and Perkins St	All way stop controlled	NS01	NS06	NS07				Raised crosswalk	NS06						NS01											
I-3	Washington Ave and Hastings Ave and S	Signalized	S02	S03	S07	S12	S21PB		Install signage before intersection, decrease corner radius of south eas	S02	S03	S07		S21PB		S02			S02			S02	S03			S21PB	
I-4	Perkins St and South Orchard Ave	Signalized	S02	S03	S09	S12	S17PB	S21PB	Install bike lane or bike lane route signage	S02	S03	S09	S17PB	S21PB		S02			S02	S03	S09	S02	S03	S12	S17PB	S21PB	
I-5	Wabash Ave and State St	One way stop controlled	NS06	NS09					Traffic calming along corridor	NS06	NS09											NS06	NS09				
I-6	Standley St and State St	Signalized	S02	S03	S17PB	S19PB	S21PB		Upgrade signage before intersection approaches, refresh intersection	S02	S03		S17PB	S19PB	S21PB	S02			S02	S03		S02	S03		S17PB	S19PB	S21PB
I-7	Ford and State St	One way stop controlled	NS06	NS21PB	NS22PB				Traffic calming along corridor	NS06			NS21PB	NS22PB								NS06					
I-8	Perkins St and S State St	Signalized	S08	S21PB					High visibility crosswalk, signage before intersection approaches			S08			S21PB												S21PB
I-9	East Gobbi and South Orchard Ave	Signalized	S02	S03	S07	S17PB			Improve bicycle markings, install north-south bicycle facilities	S02	S03	S07	S17PB			S02			S02	S03		S02	S03		S17PB		
I-10	Dora Ave and Grove Ave	Two way stop controlled	NS06						Repave intersection and approaches, red curb at corners, traffic calmi	NS06						NS06			NS06								
I-11	Grove Ave and Spring St	Two way stop controlled	NS06	NS21PB	NS22PB				Repave intersection and approaches, red curb at corners, traffic calmi	NS06	NS21PB	NS22PB	NS21PB	NS22PB		NS06			NS06						NS21PB	NS22PB	
I-12	Clara Ave and North Orchard Ave	One way stop controlled	NS06						Additional traffic calming measures, reduce lane widths of north leg	NS06						NS06			NS06								
I-13	Arlington and North Bush St	All way stop controlled	NS06	NS07					Traffic calming measures, repave roadway	NS06	NS07					NS06			NS06								
	Identified from Stakeholder Input																										
I-14	North Bush Street and Low Gap Road	All way stop controlled	NS01	NS03					Repave intersection	NS01	NS03					NS01											
I-15	Airport Park Boulevard and Talmage Road	Signalized	S02	S03						S02	S03					S02						S02	S03				
I-16	North Orchard Avenue and driveway between Ross Dress for less/JC Penny	Uncontrolled	NS02						Restrict left turns from driveways, Add advance yield lines	NS02																	
I-17	On and off-ramps of Highway 101, at Perkins Street	Two way stop controlled	NS03						Repave intersection	NS03						NS03											
I-18	State Street and Observatory Road	One way stop controlled	NS01	NS21PB	NS22PB				Install bike lanes along State st	NS01	NS21PB	NS22PB	NS01	NS21PB	NS22PB	NS01									NS21PB	NS22PB	

Code	Countermeasure Name
S02	Improve signal hardware: lenses, back-plates with retroreflective borders, mounting, size, and number
S03	Improve signal timing (coordination, phases, red, yellow, or operation)
S07	Provide protected left turn phase (left turn lane already exists)
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
S19PB	Pedestrian Scramble
S21PB	Modify signal phasing to implement a Leading Pedestrian Interval (LPI)

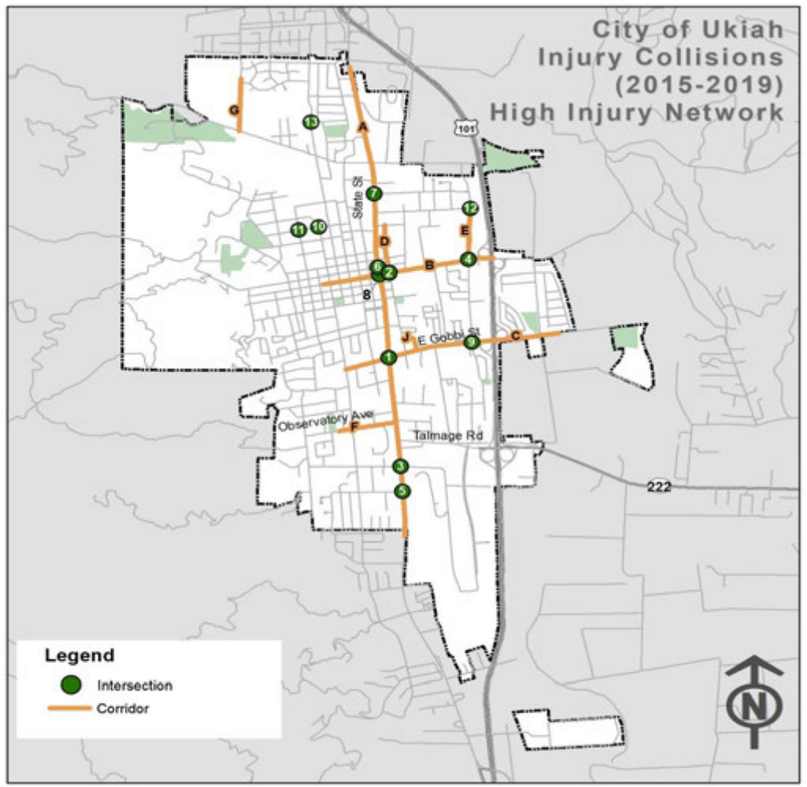
Code	Countermeasure Name
NS01	Add intersection lighting (NS.I.)
NS03	Install signals
NS06	Install/upgrade larger or additional stop signs or other intersection warning/regulatorysigns
NS07	Upgrade intersection pavement markings (NS.I.)
NS09	Install flashing beacons as advance warning (NS.I.)
NS21PB	Install/upgrade pedestrian crossing at uncontrolled locations (withenhanced safety features)
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 Night-Time Collisions			EA - 4 Reduce Hit Object Collisions			EA - 5 Reduce Unsafe Speed Collisions			EA - 6 Improve Bicycle Safety		
		CM1	CM2	CM3	CM4	CM5		CM1	CM2	CM3	CM1	CM2	CM3	CM1	CM2	CM3	CM1	CM2	CM3	CM1	CM2	CM3	CM1	CM2	CM3
A	State St: Beacon Ln to Ford Rd	R14	R22	R26	R32PB	R35PB	DT, installing yield lines for crosswalks				R35PB			R22	R26		R14	R22		R14	R26		R32PB		
B	N Orchard Ave: Clara Ave to E Perkins St	R22	R26				Refresh pavement and striping							R22	R26		R22			R26					
C	Perkins St: Hortense St to Redwood Hwy SR 101	R14	R22	R26	R37PB						R37PB			R22	R26		R14	R22		R14	R26		R37PB		
D	Gobbi St: S Dora St to Washo Dr	R22	R26	R35PB	R37PB						R35PB												R35PB	R37PB	
E	Main St: Norton St to E Perkins St	R22	R32PB	R35PB							R35PB			R22			R22						R32PB	R35PB	
F	Observatory Ave: Marwen Dr to State St	R01		R34PB	R35PB		ensure foliage doesn't block speed limit sign;				R34PB	R35PB		R01									R35PB		
G	Despina Dr: Capps Ln to Low Gap Rd	R22	R35PB	R37PB			Traffic calming measure				R35PB	R37PB		R22			R22						R35PB		
H	Marshall St: S Main St to E Gobbi St	R22	R27											R22	R27		R22	R27							
	Identified from Stakeholder Input																								
I	Brush Street	R01	R22	R27										R01	R22		R22	R27							

Code	Countermeasure Name
R01	Add Segment Lighting
R14	Road Diet (Reduce travel lanes from 4 to 3 and add a two way left-turn and bike lanes
R22	Install/Upgrade signs with new fluorescent sheeting (regulatory or warning)
R26	Install dynamic/variable speed warning signs
R27	Install delineators, reflectors and/or object markers
R32PB	Install bike lanes
R34PB	Install sidewalk/pathway (to avoid walking along roadway)
R35PB	Install/upgrade pedestrian crossing (with enhanced safety features)
R37PB	Install Rectangular Rapid Flashing Beacon (RRFB)



City of Ukiah 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 retr	Includes New LED lighting, signal back plates, retro-reflect	15%	100%	Very High
2	S03	Improve signal timing (coordination, phases, red, yellc	Includes adding phases, lengthening clearance intervals, e	15%	50%	Very High
3	S07	Provide protected left turn phase (left turn lane alreac	Includes addition of a propoerly timed protected left-turn	30%	100%	High
4	S08	Convert signal to mast arm (from pedestal-mounted)	Intersections currently controlled by pedestal mounted tra	30%	100%	Medium
5	S09	Install raised pavement markers and striping (Through	Addition of clear pavement markings, raised pavement ma	10%	100%	Very High
6	S12	Install raised median on approaches (S.I.)	Addition of raised medians next to left-turn lanes at inters	25%	90%	Medium
7	S17PB	Install pedestrian countdown signal heads	A pedestrian countdown signal contains a timer display an	25%	100%	Very High
8	S19PB	Pedestrian Scramble	Pedestrian Scramble is a form of pedestrian "WALK" phase	40%	100%	High
9	S21PB	Modify signal phasing to implement a Leading Pedestr	Addition of LPI gives pedestrians the opportunity to enter	60%	100%	Very High

Unsignalized						
Sr. No.	**Code**	**Countermeasure Name**	**CM Description**	**CRF**	**Federal Funding**	**Systemic Approach Opportunity**
1	NS01	Add intersection lighting (NS.I.)	Provision of lighting at the intersection and all it's approac	40%	100%	Medium
2	NS03	Install signals	Provision of a new traffic signal. All new signals must meet	30%	100%	Low
3	NS06	Install/upgrade larger or additional stop signs or othe	Additional regulatory and warning signs at or prior to inter	15%	100%	Very High
4	NS07	Upgrade intersection pavement markings (NS.I.)	Addition of appropriate pavement delineation in advance	25%	100%	Very High
5	NS09	Install flashing beacons as advance warning (NS.I.)	Advance flashing beacons can be used to supplement and	30%	100%	High
6	NS21PB	Install/upgrade pedestrian crossing at uncontrolled loc	Adding pedestrian crossings that include enhances safety f	35%	100%	Medium
7	NS22PB	Install Rectangular Rapid Flashing Beacon (RRFB)	Rectangular Rapid Flashing Beacon (RRFB) includes pedest	35%	100%	Medium

CM Toolbox for Roadway Segments

Sr. No.	Code	Countermeasure Name	CM Description	CRF	Federal Funding	Systemic Approach Opportunity
1	R01	Add Segment Lighting	Provision of lighting along roadways.	35%	100%	Medium
2	R14	Road Diet (Reduce travel lanes from 4 to 3 and add a t	Includes repurposing a travel lane to add bike lanes.	30%	90%	Medium
3	R22	Install/Upgrade signs with new fluorescent sheeting (r	Additional or new signage can address crashes caused by l	15%	100%	Very High
4	R26	Install dynamic/variable speed warning signs	Includes the addition of dynamic regulatory signs (also knc	30%	100%	High
5	R27	Install delineators, reflectors and/or object markers	Delineators, reflectors and/or object markers are intendec	15%	100%	Very High
5	R32PB	Install bike lanes	Bicycle lanes provide marked areas for bicyclist to travel al	35%	90%	High
6	R34PB	Install sidewalk/pathway (to avoid walking along road	Sidewalks and walkways provide people with space to trav	80%	90%	Medium
7	R35PB	Install/upgrade pedestrian crossing (with enhanced sa	The enhanced safety elements, which may include curb ex	35%	90%	Medium
8	R37PB	Install Rectangular Rapid Flashing Beacon (RRFB)	Rectangular Rapid Flashing Beacon (RRFB) includes pedest	35%	100%	Medium

	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 Ukiah 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 Ukiah 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

Location	Project	Reference
Main Street	Bike Lanes, bulb outs, intersection	Downtown Ukiah Streetscape Plan
Dora and Gobbi S	Provide high visibility crosswalks on north and south crossings, a curb extension on the west side encompassing the full intersection, and curb extensions/ramps on the northeast and southeast corners. Consider a demonstration rain garden that encompasses the west side curb extension, and integration with bike lane gap closure project on Gobbi Street	Ukiah Safe Routes to School Plan
Dora Street and (	Pedestrian crossing improvements	Ukiah Safe Routes to School Plan
Low Gap Road an	Roundabout	Ukiah Safe Routes to School Plan

nearby businesses.

C) Bicycle Lanes
Main Street would contain Class II Bicycle Lanes in both directions between Clay Street an Norton Street. On State Street, a buffer zone between parking lane and the travel lane wou provide some space for bicyclists to ride outside of the flow of traffic, though this buffer would not be wide enough to accommodate a dedicated bicycle lane. The traffic analysis recommended that State Street within the downtown corridor between Gobbi Street and Norton Street be identified as a Class III Bicycle Route.

D) Bulb-outs and Mid-Block Extensions
All of the intersections on State Street within the project area would be retrofitted with bulb-out except at Mill Street, Scott Street, Gobbi Street, and Norton Street to preserve right turn movements. Bulb-outs would reduce street crossing distances for pedestrians, slow down traffic, and provide additional space for sidewalk improvements. In addition, mid-block extensions where Seminary Avenue, Stephenson Street, and Henry Street dead-end at Stat Street would serve a similar purpose as bulb-outs and create focal points at the dead-end

E) Intersection Treatments and Gateways
The Draft Plan suggests enhancing the existing paving treatment at Perkins Street and Sta Street, one of the busiest intersections on State Street. These intersection treatments wou

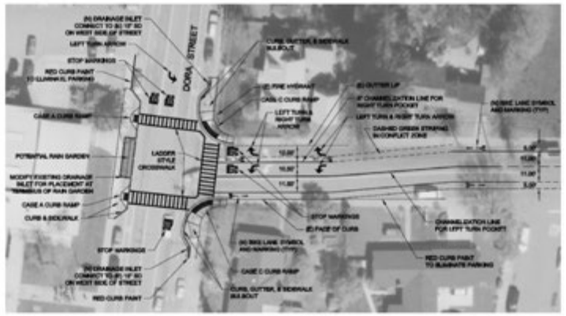
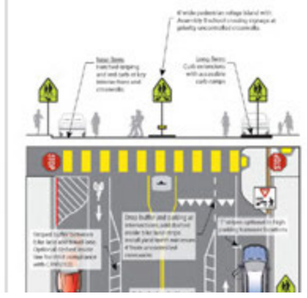
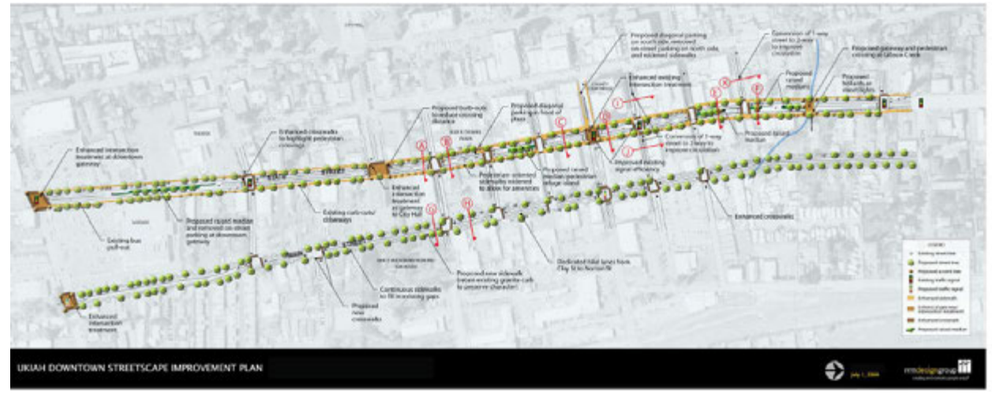


Figure 5. Preliminary concept plan (partial) for W Gobbi Street bike lanes and intersection
pt plans are provided in the individual



Project Description

Reconstruct the intersection of Low Gap Road and N Bush Street to provide a modern single-lane roundabout with pedestrian and bicycle accommodation, including median-protected crossings and bicycle ramps. Roundabouts provide traffic-calming benefits and are more sustainable than signals due to lower ongoing maintenance/energy use and reduced greenhouse gas (GHG) emissions from vehicles. This project should be considered in conjunction with Project Z2 to provide a continuous, accessible multi-use pathway from this major intersection to the school entrance.



Despina Drive/ Lc Intersection improvements

Ukiah Safe Routes to School Plan

Despina Drive / Low Gap Road Intersection Improvements(UHS Project #3)

Overall Priority Ranking: High			**Estimated Cost:**	$90,000
Addresses Known Safety Issues	Increased Student Walk/Bike Potential	In Other Plans, Supports Sustainability	Feasibility and Cost/Benefit	Serves Multiple Community Destinations
High	Medium	Medium	High	High
Related School Travel Plan Project IDs (see Appendices A and B): U3, U4, U5, Z3				

Despina Drive at Low Gap Road
Image: Google

Project Description

Install curb extensions at both sides of northern crosswalk and restripe north and east crosswalks as high-visibility with advance stop lines. These improvements will address deficient curb ramps and excessively large turning radii (to improve crossing distances and accessibility) at the school's primary, multi-modal gateway. This project should be considered in conjunction with Project #U5, which seeks to further understand the possible connections to the Orr Creek pathway/Pomolita Middle School and bikeway configurations along Low Gap Road.

Project Background: This intersection directly serves the school parking lot, bus zone(s), and connecting bikeways. Two injury collisions were recorded between 2007-2011, including a severe crash involving a bicyclist. An adjacent multi-use pathway segment provides access for pedestrians and bicyclists, which is also recommended for extension through the school parking lot.

Figure 8. Priority (Tier 1) Project Locations Map

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