Local Roadway Safety Plan

FINAL REPORT

March 1, 2023

Adopted by San Bruno City Council on March 14, 2023

TJKM

RESOLUTION NO. 2023 - 27

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF SAN BRUNO ADOPTING THE LOCAL ROADWAY SAFETY PLAN AND FINDING THE PLAN EXEMPT FROM THE CALIFORNIA ENVIRONMENTAL QUALITY ACT

WHEREAS, a Local Roadway Safety Plan (LRSP) is a comprehensive data-driven plan that creates a framework to systematically identify and analyze traffic safety issues and recommend appropriate safety improvements; and

WHEREAS, a LRSP is intended to facilitate the development of local agency partnerships and collaborations, resulting in the development of a prioritized list of improvements that can qualify for State Highway Safety Improvement Program funding from Caltrans; and

WHEREAS, beginning in 2022, a LRSP that is updated every 5 years would be required to be eligible for certain regional, state, and federal traffic safety grants; and

WHEREAS, in February of 2020, the City of San Bruno was awarded grant funding in the amount of $72,000 by the California Department of Transportation (Caltrans) Local Road Safety Program to help fund the preparation of a LRSP for the City of San Bruno; and

WHEREAS, in March 2020, a Program Supplemental Agreement was executed with Caltrans obligating the City of San Bruno to adopt the LRSP within 36 months of the agreement execution; and

WHEREAS, the draft final LRSP was prepared with the assistance of TJKM Transportation Consultant, and included developing plans and objectives, analyzing collision data, meeting with stakeholders and safety partners, determining focus areas and identifying crash reduction strategies, and prioritizing countermeasures and projects; and

WHEREAS, key community engagement consisted of a stakeholder working group meeting, an interactive website where residents can enter their traffic concerns on a digital map, a presentation to the Bicycle and Pedestrian Advisory Committee, a presentation to the Traffic, Safety and Parking Committee, and a City Council study session on February 28, 2023; and

WHEREAS, this project meets criteria set forth in State California Environmental Quality Act (CEQA) Guideline Section 15262 "Planning and Feasibility Studies" which can be used for projects or actions involving only feasibility or planning studies for possible future actions which the agency has not approved, adopted or funded and does not require preparation of an Environmental Impact Report, but does require consideration of environmental factors; and where the exceptions listed in CEQA Guidelines Section 15003.2 would not apply. Therefore, the City Council is taking action to adopt the LRSP which qualifies as a "planning and feasibility study," as no actual implementation or construction will occur as a result of the LRSP's adoption. When actual implementation or construction is proposed in the future as part of a project subject to CEQA, environmental review will be conducted at that time. Therefore, the project qualifies for a Categorical Exemption pursuant to CEQA Guidelines Section 15262 "Planning and Feasibility Studies," and none of the potential exceptions to the use of this Categorical Exemption apply to this project. This project has no potential to cause a significant effect on the environment and therefore also qualifies for a Categorical Exemption pursuant to CEQA Guidelines Section 15061 (b) (3) "Review for Exemption."; and

WHEREAS, this Resolution will serve as City adoption of the LRSP Plan. It will not include any action related to implementation, funding, or physical construction. When actual implementation or construction is proposed in the future as part of a City-initiated project, more detailed analysis, funding identification, and project-level environmental review will be conducted, as needed, at that time.

NOW, THEREFORE, BE IT RESOLVED that the City adopts the Local Road Safety Plan and finds the plan exempt from CEQA.

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I hereby certify that foregoing **Resolution No. 2023 - 27** was introduced and adopted by the San Bruno City Council at a regular meeting on March 14, 2023, by the following vote:

AYES: Councilmembers: Alvarez, M. Medina, Salazar, Hamilton, Mayor R. Medina

NOES: Councilmembers: None

ABSENT: Councilmembers: None

Vicky S. Hasha

Vicky S. Hasha, Deputy City Clerk

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EXECUTIVE SUMMARY

The City of San Bruno'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 to enhance safety for all modes of transportation. It aims to reduce fatal and severe injury (F+SI) collisions through a prioritized list of improvements that can enhance safety for all modes of transportation 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 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 ready to apply for grant funds, such as the federal Highway Safety Improvement Program (HSIP). This document summarizes an analysis of collisions that occurred in City of San Bruno, identifies high-injury locations, and recommends countermeasures at each of these high-risk locations.

GOALS OF THE LRSP

- Goal 1: Identify and analyze road safety issues from a systemic perspective and recommend improvements
- Goal 2: Improve pedestrian and bicyclist safety through the application of proven effective countermeasures
- Goal 3: Coordinate the actions of key stakeholders to implement road safety improvements and emergency response in the City of San Bruno
- Goal 4: Continually seek funding for safety improvements
- Goal 5: Ensure that all safety improvements are made in a fair and equitable manner for all residents of the City of San Bruno

PROCESS

The systemic approach in preparing the LRSP involves the following steps:

- Develop plan goals and objectives
- Analyze collision data
- Meet with stakeholders/safety partners
- Determine focus areas and identify crash reduction strategies
- Prioritize countermeasures/projects
- Prepare the LRSP

COLLISION DATA

Collision data was obtained 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). For the purpose of this report the data was analyzed for a five-year period from 2015 to 2019 from Transportation Injury Mapping Service's Traffic Collision Database.

COLLISION TREND

Key findings on patterns and trends:

- A total of 1,813 collisions occurred between 2015 and 2019.
- Three collision led to fatality, 30 collisions resulted in severe injuries, 194 resulted in a visible injury, 199 resulted in a complaint of pain injury, and 1,366 are PDO collisions.
- The year 2016 had highest number of collisions with 418 collisions, and 2019 had the lowest number of collisions with 321 collisions.
- The highest number of injury collisions occurred within 250 feet of an intersection (69%).
- Rear-end and sideswipe collisions, accounted for 31% and 29% of total collisions, respectively. 47% of pedestrian collisions resulted into F+SI collisions.
- Unsafe speed accounted for 26% of all collisions, followed by improper turning (23%).
- Most of the F+SI collisions occurred between 4:00 p.m. and 6:00 p.m.
- 59% of all collisions were motor vehicle involved with other motor vehicles followed by motor vehicle involved with a parked motor vehicle (18%), and fixed objects (14%).
- There were a total of 119 bicycle and pedestrian collisions during the study period, of which 25 were bicycle and 84 pedestrian collisions.

HIGH RISK LOCATIONS

The collision analysis was performed on all City streets. The corridors were ranked to show the top 11 high-collision intersections and top 10 high-collision roadway segments.

Key findings of identifying high-risk intersections are as follows:

- There were a total of 123 injury collisions that occurred at the intersection
- 18 collisions led to F+SI
- The intersection of El Camino Real and Sneath Lane had the highest number of injury collisions overall (21)

Key findings of identifying high-risk roadway segment are as follows:

- There were a total of 122 injury collisions that occurred on the roadway segments
- 25 collisions led to F+SI collisions
- El Camino Real between Noor Avenue and San Lucia Avenue had the highest number of injury collisions with 64

EMPHASIS AREAS

Emphasis areas are focus areas for the LRSP that are identified through the comprehensive collision analysis of the identified high injury locations within the City of San Bruno. The eight emphasis area identified for the City of San Bruno are:

1. Improve Intersection Safety
2. Reduce Unsafe Speed
3. Improve Pedestrian and Bicyclist Safety
4. Reduce Nighttime Collisions
5. Reduce Rear End Collisions
6. Reduce Broadside Collisions
7. Reduce Improper Driving
8. Reduce Collisions near Schools

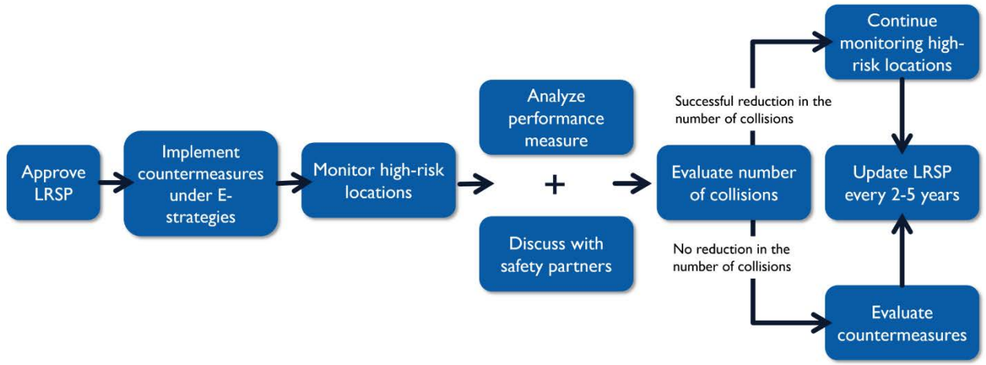
VIABLE SAFETY PROJECTS

A set of five safety projects were created for the high-risk intersections and roadway segments.

- Project 1: Signalized Intersections (improve signal hardware: lenses, back-plates with retroreflective borders, mounting, size, and number, convert signal to mast arm (from pedestal-mounted), install raised pavement markers and striping (through intersection), and improve signal timing (coordination, phases, red, yellow, or operation)).
- Project 2: Pedestrian and Bicyclist Safety at Signalized Intersections (install advance stop bar before crosswalk (bicycle box), modify signal phasing to implement a Leading Pedestrian Interval (LPI), and improve pavement friction (High Friction Surface Treatments)).
- Project 3: Safety at Unsignalized Intersections (install traffic signal, install/upgrade larger or additional stop signs or other intersection warning/regulatory signs, and upgrade intersection pavement markings (NS.I.)).
- Project 4: Roadway Segments (add segment lighting, install/upgrade signs with new fluorescent sheeting (regulatory or warning), install delineators, reflectors and/or object markers, and improve pavement friction (High Friction Surface Treatments)).
- Project 5: Pedestrian and Bicyclist Safety on Roadway Segments (install separated bike lanes, install/upgrade pedestrian crossing (with enhanced safety features), and install Rectangular Rapid Flashing Beacon (RRFB)).

IMPLEMENTATION AND EVALUATION

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. It is recommended that the City of Cupertino implement the selected projects in high-collision locations in coordination with other projects proposed for the City's infrastructure development in their future Capital Improvement Plans. 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.



REPORT ORGANIZATION

Chapter 1 – Introduction

The Introduction describes what an LRSP is and details the study area. It also summarizes the systemic approach involved in preparing the LRSP and goal and objectives of the plan.

Chapter 2 – Safety Partners and public outreach

Involvement of safety partners is critical in the success of the LRSP. For the City of San Bruno, this included the San Bruno Police Department, Fire Department, Bicycle and Pedestrian Advisory Committee (BPAC), San Bruno Traffic, Safety, and Parking Committee (TSPC), San Bruno Park School District, and City of San Bruno residents. This chapter summarizes the public outreach involvement of the stakeholders in the LRSP process.

Chapter 3 – Existing Planning Efforts

This chapter summarizes 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.

Chapter 4 – Collision Data and Analysis

This chapter summarizes the collision data analysis approach and presents preliminary as well as detailed collision analysis and findings in the study area.

Chapter 5 – Emphasis Areas

This chapter identifies the top eight emphasis areas for the City and the safety strategies for each.

Chapter 6 – Countermeasure Identification

This chapter identifies the 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 (CIP). Non-engineering countermeasures were also selected using the 4 E's (**E**ngineering, **E**nforcement, **E**ducation, and **E**mergency Medical Services (EMS)).strategies, and are included with the emphasis areas.

Chapter 7 – Safety Projects

This chapter summarizes the list of viable safety projects applicable to the high-risk intersections and roadway segments, along with the cost for implementation and their B/C ratio.

Chapter 8 – Implementation and Evaluation

This chapter summarizes the process of implementation, monitoring, evaluation, and future updates.

1 INTRODUCTION

1 INTRODUCTION

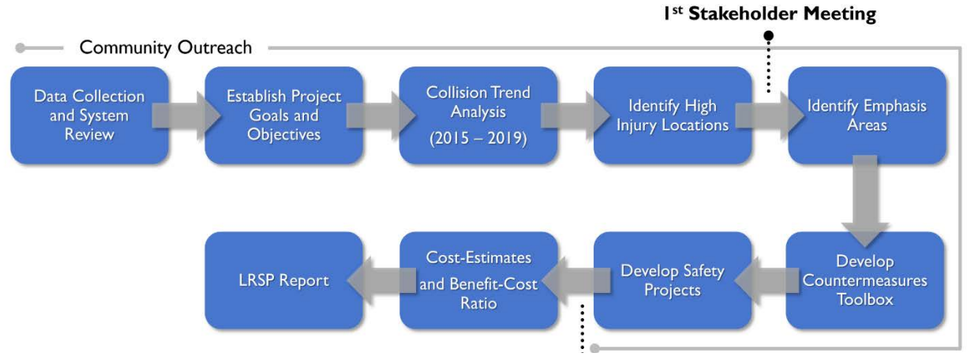
What is an LRSP?

The LRSP is a localized data-driven traffic safety plan that provides opportunities to address unique roadway safety needs and reduce the number of F+SI collisions for all modes. The LRSP creates a framework to systemically identify and analyze traffic safety-related issues, recommend safety projects, and countermeasures. It 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.

Process

The systemic approach in preparing the LRSP involves the following steps:

- Develop plan goals and objective
- Analyze collision data
- Meet with stakeholders/safety partners
- Determine focus areas and identify crash reduction strategies
- Prioritize countermeasures/projects
- Prepare the LRSP



Goals and Objectives

GOAL 1: IDENTIFY AND ANALYZE ROAD SAFETY ISSUES FROM A SYSTEMIC PERSPECTIVE AND RECOMMEND IMPROVEMENTS

Objective 1: *Determine where, when, and how F+SI collisions occur in the City of San Bruno using the data-driven Systemic Safety Analysis process and implement appropriate and proven countemeasures.*

Objective 2: *Improve roadway planning, design, operations, and connectivity to enhance safety and mobility for users of all ages and abilities.*

Objective 3: *Implement traffic calming strategies on residential streets to discourage speeding and other unsafe driving behaviors.*

Objective 4: *Ensure that all recommended improvements are consistent with City, County, State, and Federal plans (such as, California Strategic Highway Safety Plan).*

GOAL 2: IMPROVE PEDESTRIAN AND BICYCLIST SAFETY THROUGH THE APPLICATION OF PROVEN EFFECTIVE COUNTERMEASURES

Objective 1: *Identify safety concerns and hot spots in the City of San Bruno where bicycle and pedestrian collisions occur and address them with appropriate and effective engineering countermeasures.*

Objective 2: *Conduct educational programs to educate bicyclists, pedestrians, and motorists about the importance of sharing the public right-of-way safely. This can be accomplished through after-school programs, police department initiatives, or other public/privately sponsored initiatives.*

Objective 3: *Improve the safety and efficiency of sidewalks, walkways, and crossings by eliminating hazards and minimizing conflicts with vehicular traffic.*

Objective 4: *Prioritize improvements that promote Safe Routes to School efforts or are located near schools.*

GOAL 3: COORDINATE THE ACTIONS OF KEY STAKEHOLDERS TO IMPLEMENT ROAD SAFETY IMPROVEMENTS AND EMERGENCY RESPONSE IN THE CITY OF SAN BRUNO

Objective 1: *Coordinate efforts between Public Works, the Police Department, the Fire Department, and the EMS agencies to ensure a coherent approach to traffic safety issues, including:*

- *Implementation of safety improvements*
- *Public education on safely traveling in the public right-of-way, regardless of mode*
- *Enforcement of traffic safety laws in the public right-of-way*
- *Minimizing impacts to emergency response times*

Objective 2: *Collaborate with local, regional, and state partners to identify and address traffic safety issues, and ensure a coordinated response.*

GOAL 4: CONTINUALLY SEEK FUNDING FOR SAFETY IMPROVEMENTS

Objective 1: *Ensure that the LRSP complies with HSIP guidelines to apply for funding for identified countermeasures.*

Objective 2: *Provide a prioritized list of improvements that will serve as a guide for City investments and grant applications.*

Objective 3: *Continually seek funding sources to implement engineering, education, enforcement, and emergency response solutions to road safety issues in the City of San Bruno.*

GOAL 5: ENSURE THAT ALL SAFETY IMPROVEMENTS ARE MADE IN A FAIR AND EQUITABLE MANNER FOR ALL RESIDENTS OF THE CITY OF SAN BRUNO

Objective 1: *Where feasible, conduct community outreach to inform residents about upcoming safety enhancements and solicit their input.*

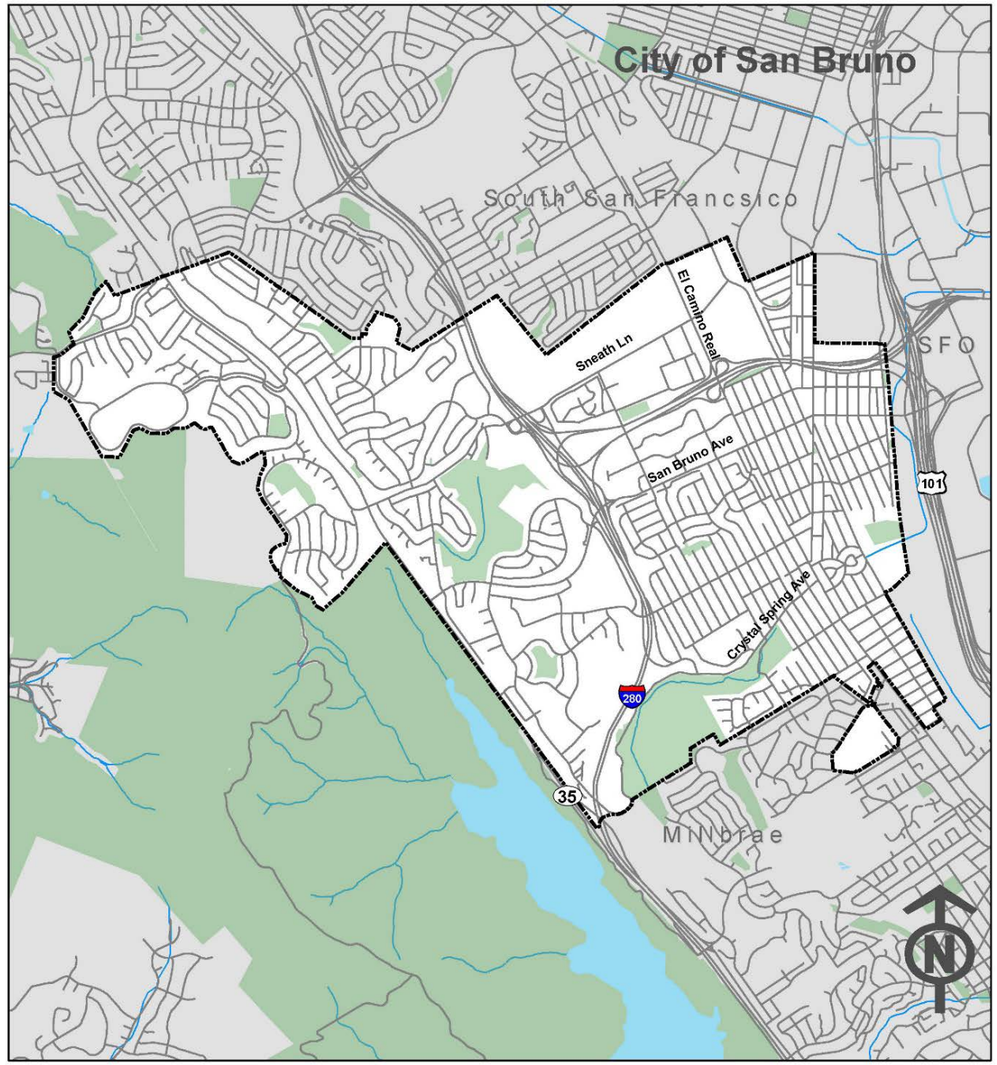
Objective 2: *Provide a forum for residents to lodge complaints about traffic safety, as well as for City officials to respond to such complaints.*

Objective 3: *Ensure that equity is a primary factor in selecting where to make traffic safety improvements.*

Study Area

The City of San Bruno is located in the San Mateo County, California. It covers a total approximate area of 5.5 square miles. The City's estimated population is approximately 43,908 (US Census 2020). The study area is mapped in **Figure 1** on the following page.

Figure 1. Study Area



According to five-year estimates from the American Community Survey (ACS)1v 2021 from the U.S. Census, 63% of City of San Bruno commuters get to work by driving alone, versus 71% statewide. The second most common method of commuting to work in San Bruno is Public Transportation at 12%. The different modes of transportation used by City of San Bruno residents to commute to work are shown in **Table 1** below.

Table 1. City of San Bruno Commute to Work Census Data

Commute to Work	City of San Bruno	California
Drive Alone	63%	71%
Carpool	11%	10%
Public Transportation	12%	4%
Walked	3%	2%
Work from Home	9%	11%
Taxicab, motorcycle, bicycle, or other means	3%	2%

1 American Community Survey (ACS) 2021 https://data.census.gov/table?q=San+Bruno+city,+California&t=Transportation&tid=ACSDT5Y2021.B08141

2 | SAFETY PARTNERS

2 SAFETY PARTNERS

Safety partners are vital to the development and implementation of an LRSP. For City of San Bruno, these include San Bruno Police Department, Fire Department, Bicycle and BPAC, TSPC, San Bruno Park School District, and City of San Bruno residents. Stakeholder meeting was conducted and stakeholders attended a virtual meeting held on January 24, 2022 to review project goals and findings, and to solicit feedback from the group.

Figure 2. Zoom Meeting from Stakeholder Meeting

This stakeholder outreach was supplemented by a project website with an interactive platform. The interactive map was used to solicit input from City of San Bruno residents and stakeholders outside the confines of traditional meetings.

Figure 3. City of San Bruno LRSP Project Website

In total, 125 comments were received through the project website for City of San Bruno LRSP of which 112 comments were received using the interactive map and 13 comments were received through the feedback section of the website. El Camino Real received the most comments, with the main concerns being pedestrian right of way and safety concerns. The comments received via the interactive map are shown in **Figure 4**, and summarized in Figure 5. In Figure 4, each dot and line represents a comment provided by a community member.

Figure 4. Comments Received via Interactive Map

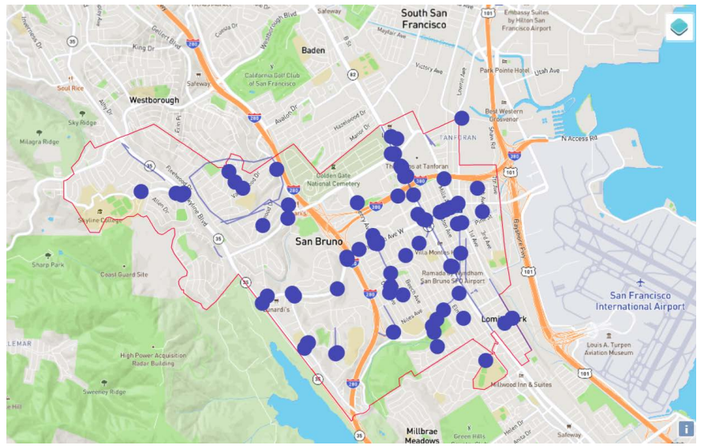
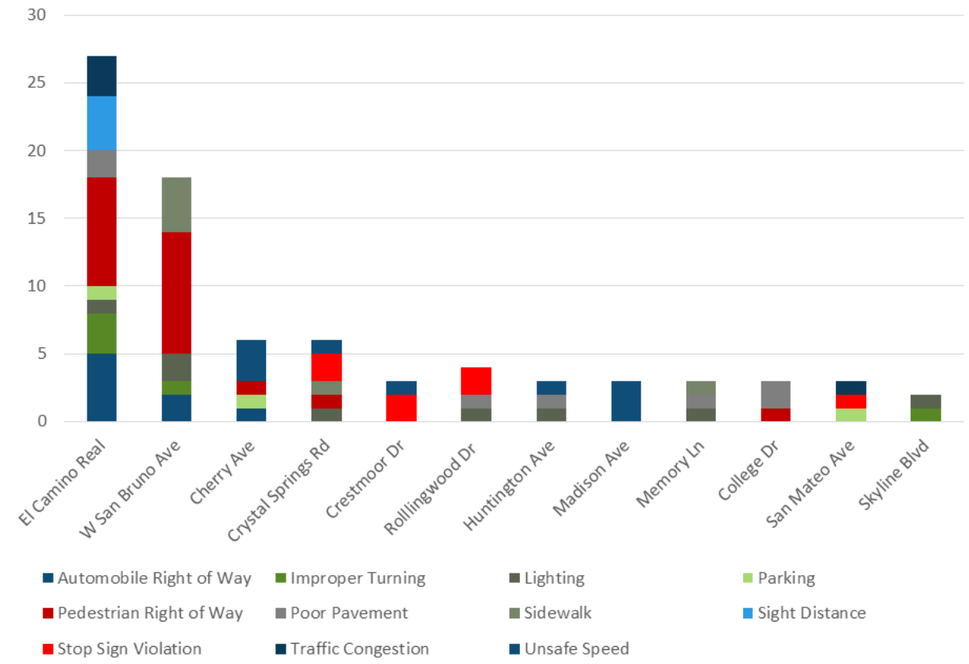


Figure 5. Public Comments on Traffic Safety by Location



Note: Corridors and Traffic Safety categories with 3 or more comments are included in this chart. Category was chosen based on the primary issue listed in the comment. Each comment was assigned to the major road if at an intersection.

The detailed summary of community comments collected through Interactive map platform is included in **Appendix A.**

3 EXISTING PLANNING EFFORTS

3 EXISTING PLANNING EFFORTS

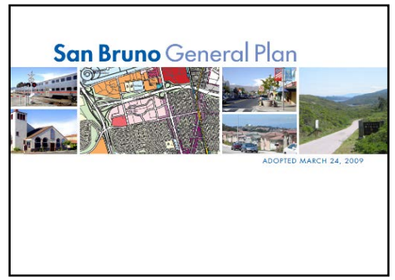
This chapter summarizes the planning documents, projects underway, and studies reviewed for the City of San Bruno LRSP. The purpose of this chapter is to ensure the LRSP vision, goals, and 4 E's strategies (**E**ducation, **E**nforcement, **E**ngineering, and **E**mergency Medical Services (EMS)) are aligned with prior planning efforts, planned transportation projects, and non-infrastructure programs for the City. The documents reviewed are listed below:

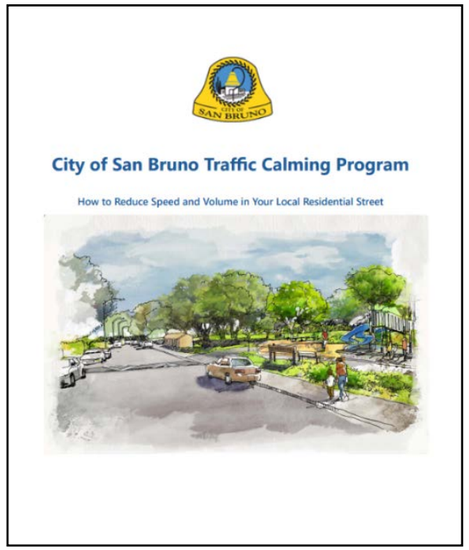
- City of San Bruno General Plan (2009)
- City of San Bruno Traffic Calming Policy and Supplement (2020)
- City of San Bruno Traffic Calming Brochure (2020)
- City of San Bruno Traffic Calming Toolkit (2010)
- San Bruno Transit Corridors Plan (2013)
- San Mateo Avenue Conceptual Streetscape Plan (2019)
- City of San Bruno Walk 'n Bike Plan (2018)
- Bayhill Specific Plan (2021)
- San Bruno/South San Francisco Community-Based Transportation Plan (2012)
- City of San Bruno Operating and Capital Budget (2021-22)
- 2021 C/CAG San Mateo County Comprehensive Bicycle and Pedestrian Plan
- San Mateo Countywide Transportation Plan 2040 (2017)

The following sections include brief descriptions of these documents and how they inform the development of the LRSP. A more detailed list of relevant policies and projects is listed in **Appendix B.**

City of San Bruno General Plan (2009)

The General Plan is intended to guide the City's long-term physical development. Guiding and implementing policies address all modes of transportation, as well as the interrelationship between the modes. These goals and policies will inform the City's Local Roadway Safety Plan to improve roadway safety for active transportation users while encouraging users to choose walking, bicycling, and transit as a mode of transportation in San Bruno.





City of San Bruno Traffic Calming Policy and Supplement (2020)

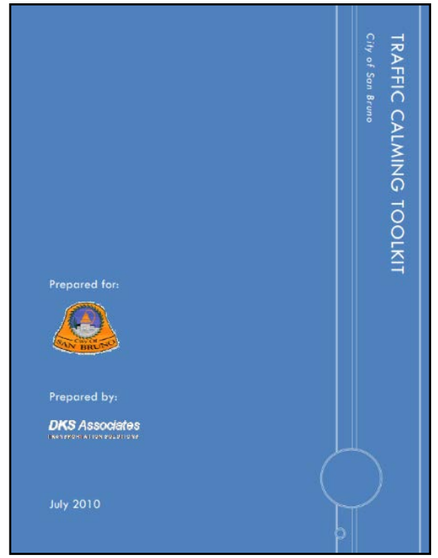
The primary goal of the Traffic Calming Program (TCP) is to provide relief from traffic-related concerns, such as excessive speed and volume on local residential streets. The process contains several steps and begins with an inquiry to the City Engineer from a resident about a traffic-related concern. Request for traffic calming will require a petition signed by majority of residents of the neighborhood. The concern is then evaluated to determine if it qualifies for the TCP. The countermeasures and processes outlined in this policy will assist in validating the LRSP's traffic safety solutions.

City of San Bruno Traffic Calming Brochure (2020)

The Traffic Calming Brochure is a concise pamphlet that defines traffic calming. The brochure details the City's Traffic Calming Program's process and how residents can get involved. Additionally, the brochure discusses the Traffic Calming Program's principles and guidelines, the various types of traffic control devices that can be used to manage traffic speed and volume, the amount of funding available each year, the duration of the project, and how to contact the City. The brochure stands as an illustration of an outreach campaign that can be used to help define educational strategies.

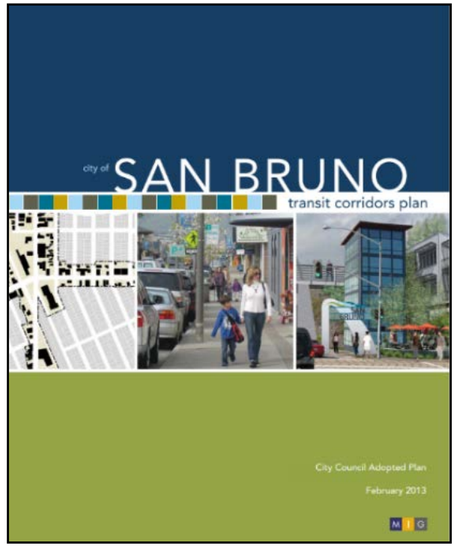
City of San Bruno Traffic Calming Toolkit (2010)

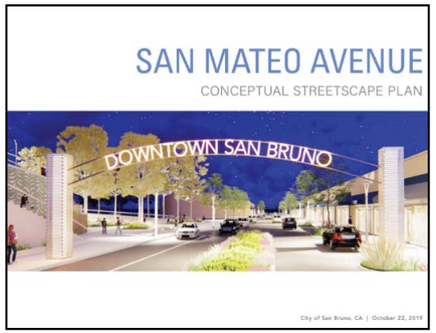
The primary purpose of this traffic calming toolkit is to educate residents and neighborhood groups about their role as active citizens in resolving traffic problems. This toolkit provides an overview of measures and devices intended to enhance pedestrian safety and encourage safe driving. Additionally, it establishes a procedure for reporting traffic concerns and requesting a traffic calming measure, as well as the steps that will be taken to address these concerns. The countermeasures and processes in this toolkit will help to confirm traffic safety solutions for the LRSP.



San Bruno Transit Corridors Plan (2013)

This plan outlines San Bruno's vision for revitalized commercial corridors adjacent to the city's Caltrain station, specifically El Camino Real, San Mateo Avenue, San Bruno Avenue, and Huntington Avenue. The plan envisions convenient transportation connections, pedestrian-friendly "green" streets, and increased housing, employment, retail, and restaurant opportunities while preserving the city's history. The plan incorporates standards and design guidelines for development projects within the plan area, and a set of strategies to improve pedestrian and bicycle safety. These design guidelines will assist in validating the LRSP's traffic safety solutions.





San Mateo Ave Conceptual Streetscape Plan (2019)

The purpose of this plan is to provide design guidance for the public right-of-way to further the City's goals of beautifying the public realm, promoting local businesses, stimulating investment in the downtown core, enhancing the downtown's character, and increasing the downtown's attractiveness as a destination. In addition, the proposed bike and pedestrian improvements on San Mateo Avenue will supplement and confirm the LRSP's traffic safety solutions.

City of San Bruno Walk 'n Bike plan (2018)

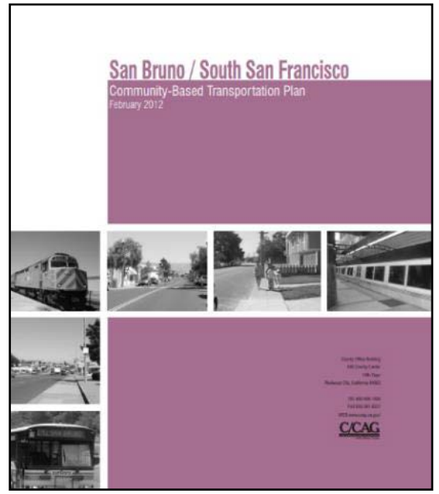
The City of San Bruno developed the Walk 'n Bike Plan, the City's first comprehensive pedestrian and bicycle master plan. The City/Council Association of Governments of San Mateo County (C/CAG) provided funding for the development of the Walk 'n Bike Plan. The plan is a long-term planning document that will guide the City's walking and biking policies for many years to come. Its ultimate goal is to make walking and biking more safe, convenient, and popular in San Bruno. In addition, the bike and pedestrian improvements included in this plan will assist in validating the LRSP's traffic safety solutions.

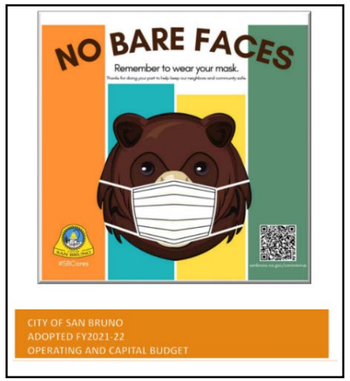
Bayhill Specific Plan (2021)

The Bayhill Specific Plan envisions integrating new and infill development into a vibrant, sustainable, and accessible neighborhood withan enhanced public realm. It establishes land use and development policies for the Planning Area, establishes design standards and guidelines that shape the public realm, and establishes transportation and infrastructure improvements that enhance accessibility and functionality. The Bayhill Specific Plan will help to confirm traffic safety solutions for the LRSP in the Bayhill area.

San Bruno / South San Francisco Community-Based Transportation Plan (2012)

The San Bruno/South San Francisco Community-Based Transportation Plan (CBTP) assesses the community's transportation needs and makes recommendations for addressing them. This Plan establishes a framework for transportation providers and other stakeholders to collaborate and better understand low-income populations' transportation needs. It enables them to implement strategies that benefit these populations and to form partnerships that ensure the feasibility and efficiency of a project or program's implementation. The Plan will help to confirm traffic safety solutions for the LRSP.



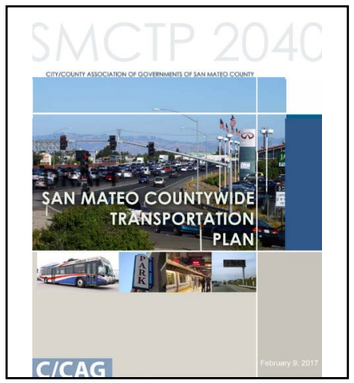


City of San Bruno Operating and Capital Budget (2021-22)

The Operating Budget is the total budget for the City's day-to-day operations and obligations. The budget details the general administration and operations of the government, debt service, capital expenditures, and transfer payments for a fiscal year. The City of San Bruno's fiscal year 2020-2021 operating budget demonstrates the City's financial capabilities in light of ongoing and future expenditures. Additionally, this budget addresses the fiscal impact of the COVID-19 situation.

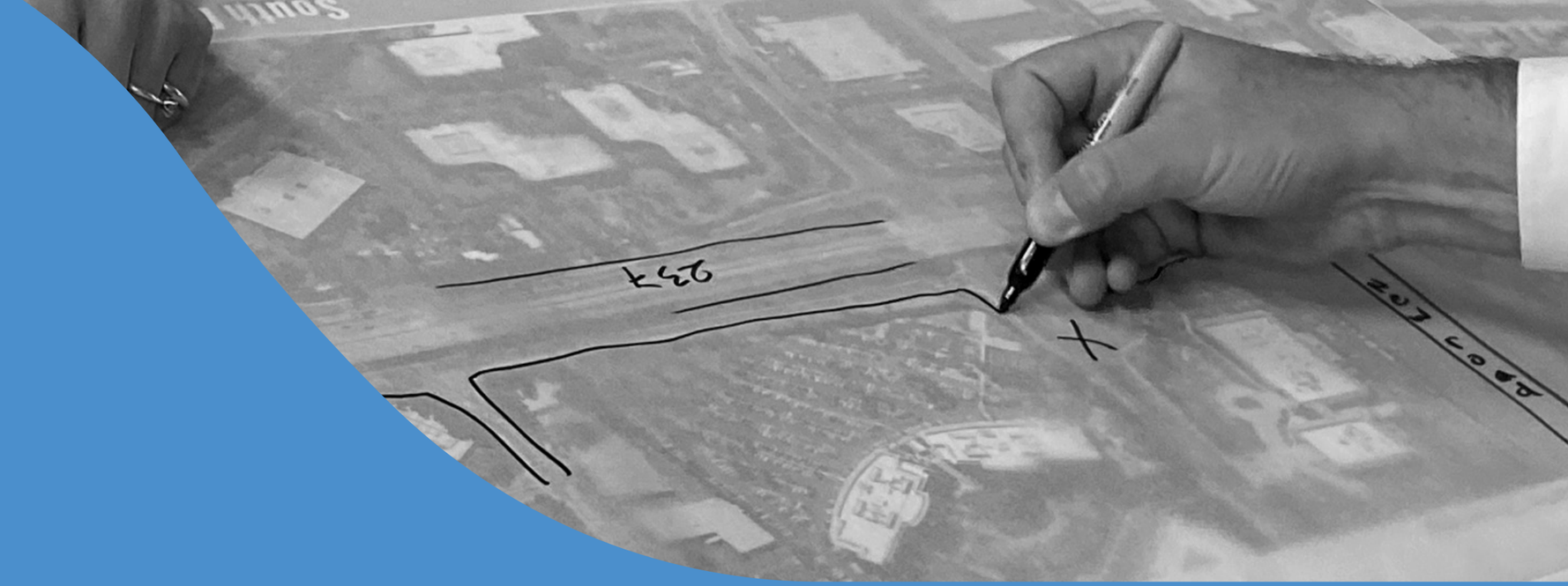
2021 C/CAG San Mateo County Comprehensive Bicycle and Pedestrian Plan

The C/CAG, in collaboration with the San Mateo County Transportation Authority (SMCTA), developed the San Mateo County Comprehensive Bicycle and Pedestrian Plan (CBPP). The Plan addresses the planning, design, funding, and implementation of county wide bicycle and pedestrian projects. The CBPP updates and expands on the prior San Mateo County Comprehensive Bicycle Route Plan (2011) by including a pedestrian component. The bike and pedestrian projects in the City of San Bruno will assist in validating the LRSP's traffic safety solutions.



San Mateo Countywide Transportation Plan 2040 (2017)

San Mateo County leaders envisioned the San Mateo Countywide Transportation Plan for 2040 (SMCTP 2040) as a long-range, comprehensive transportation planning document that establishes a coordinated planning framework and a systematic transportation planning process for identifying and resolving transportation issues. SMCTP 2040 is intended to articulate specific transportation planning objectives and policies and foster consistency and compatibility among the county's various transportation plans and programs. The objectives and policies outlined in this plan will assist in confirming the LRSP's traffic safety solutions.



4 COLLISION DATA AND ANALYSIS

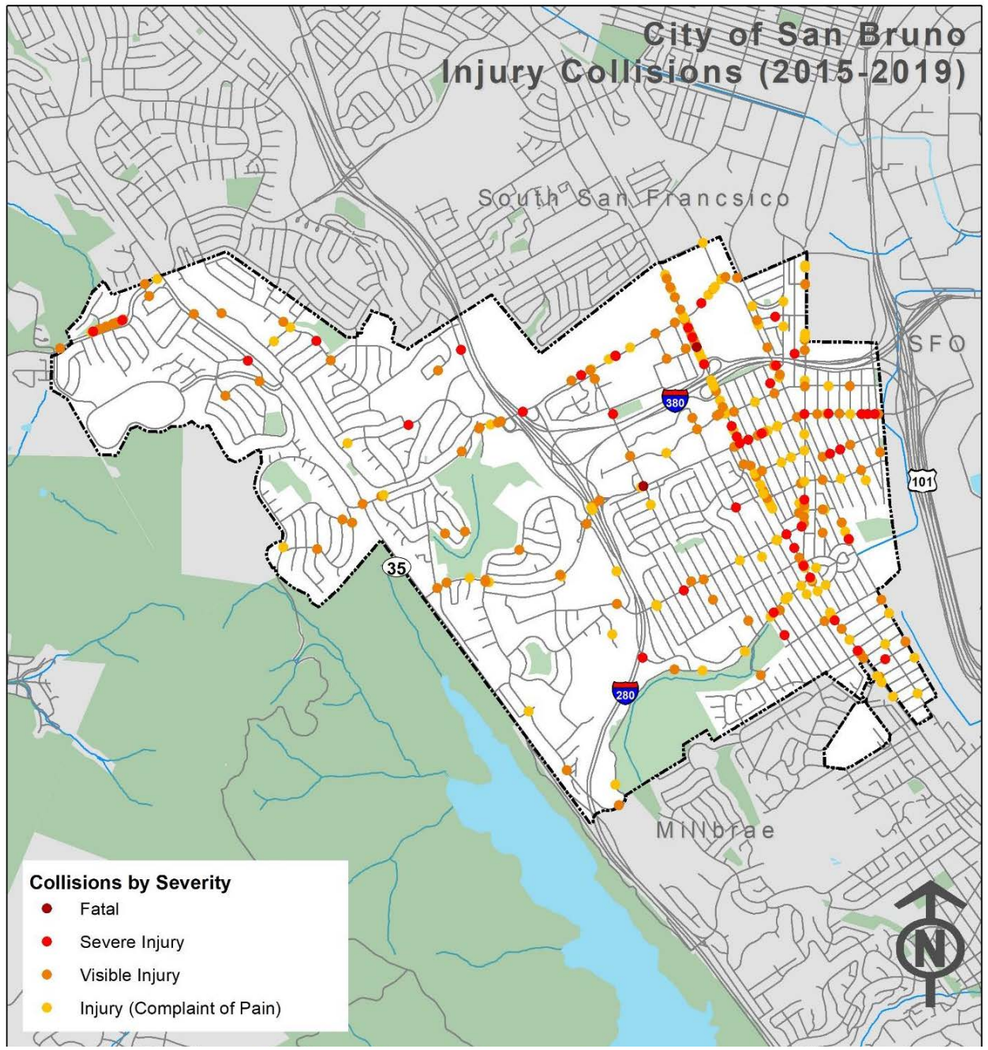
4 COLLISION DATA AND ANALYSIS

This chapter summarizes the results of the collision analysis of collisions that have occurred in the City of San Bruno between January 1, 2015 and December 31, 2019, as part of the LRSP. This chapter includes the following sections:

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

The LRSP focuses on systemically identifying and analyzing traffic safety issues and recommends appropriate safety improvements. The chapter starts with an analysis of the collisions of all severity for the City of San Bruno, including Property Damage Only (PDO) collisions. Further on, a detailed analysis was conducted for F+SI collisions that have occurred on the City's roadways. After this data was segregated, 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. **Figure 6** illustrates all the injury collisions that have occurred in the City of San Bruno from January 1, 2015 to December 31, 2019.

Figure 6. Injury Collisions in the City of San Bruno (2015-2019)



Data Collection

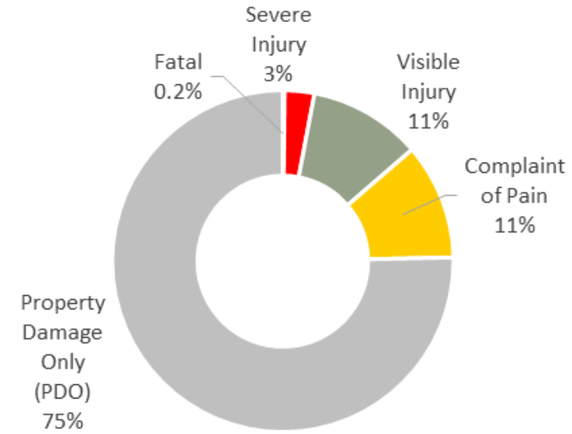
Collision data helps understand different factors that might be influencing collision patterns and various factors leading to collisions in a given area. For the purpose of this analysis, a five-year jurisdiction-wide collision data, from 2015 to 2019 was retrieved from Transportation Injury Mapping System (TIMS) and SWITRS. Collisions that occurred on state routes were excluded for this analysis, with the exception of El Camino Real. The collision data was analyzed and plotted in ArcMap to identify high-risk intersections and roadways segments.

Collision Data Analysis Results

COLLISION ANALYSIS BY SEVERITY

There were a total of 1,813 collisions reported City-wide from 2015 to 2019. Out of these 1,366 collisions (75%) were PDO collisions, 199 collisions (11%) led to complaint of pain injury and 194 collisions (11%) led to a visible injury. There were 54 F+SI collisions, 31 collisions (3%) led to a severe injury and three collisions led to a fatality. **Figure 7** on the following page illustrates the classification of all collisions based on severity.

Figure 7. 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 designated 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 2**.

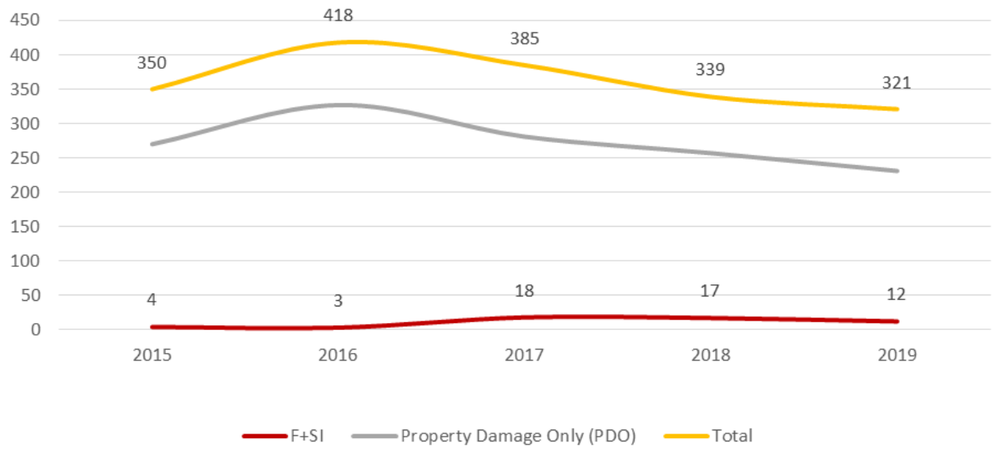
Table 2. Collisions by Severity and Facility Type

Collision Severity	Roadway Segment	Intersection	Total
Fatal	0	3	3
Severe Injury	10	41	51
Visible Injury	28	166	194
Complaint of Pain	27	172	199
Property Damage Only (PDO)	503	863	1,366
Total	**568**	**1,245**	**1,813**

TREND

For all collisions, the number of reported collisions decreased from 2015 to 2019. The highest number of collisions (418 collisions) were observed in 2016 and the lowest number of collisions (321) were observed in 2019. A total of 54 F+SI collisions occurred in the City of San Bruno during the study period. They were observed to be the lowest (three collision) in 2016, and the highest in 2017 (18 collisions). **Figure 8** illustrates the five-year collision trend for all collisions, F+SI collisions and also PDO collisions.

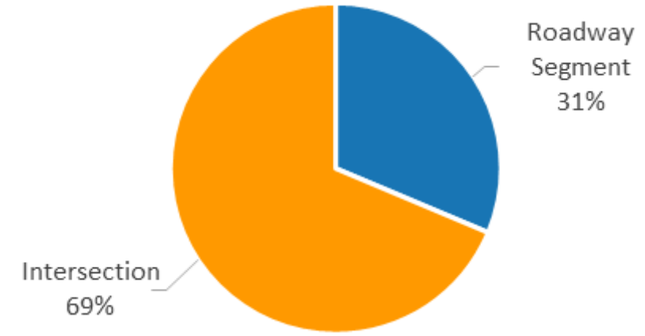
Figure 8. Five-Year Collision Trend



ROADWAY SEGMENT VS. INTERSECTION

When evaluating the roadway geometry, it was observed that the majority of collisions ocurred at intersections. In the City of San Bruno, 69% of all collisions (1,245 collisions) occurred at intersections whereas 31% (568 collisions) occurred on roadway segments. This classification by facility type can be observed in **Figure 9.**

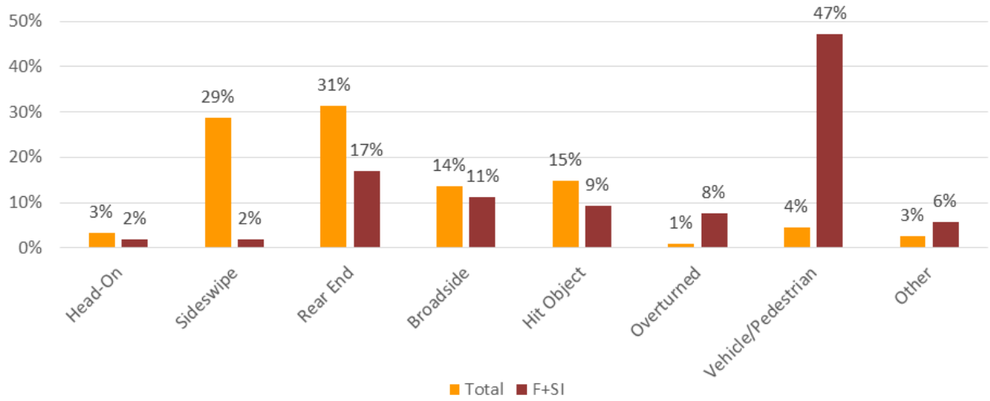
Figure 9. Intersection vs Roadway Collisions - All Collisions



COLLISION TYPE

Considering all collisions, the most commonly occurring collision type was rear end collisions (31%), and sideswipe collisions (29%). The collision type for F+SI collisions are noticeably different. For F+SI collisions, the most commonly occurring collision type was vehicle/pedestrian collisions (47%), rear end (17%) and broadside collisions (11%). **Figure 10** illustrates the collision type for all collisions as well as F+SI collisions.

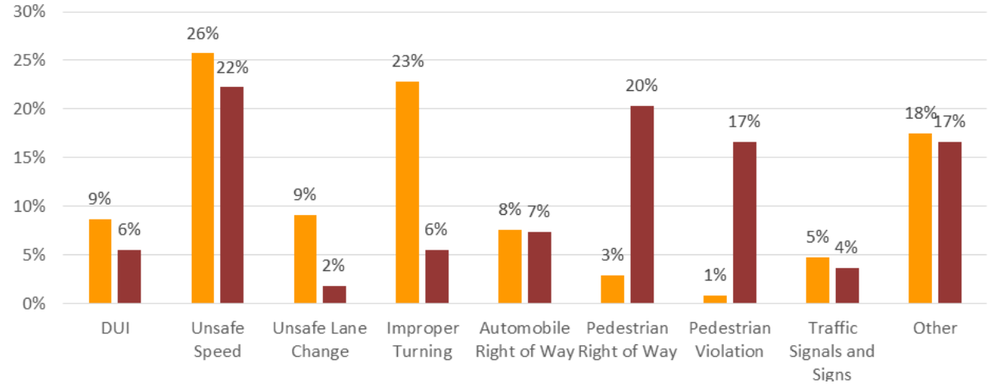
Figure 10. Collision Type – All Collisions vs. F+SI Collisions



PRIMARY COLLISION FACTOR

Considering all collisions, the most common violation category was observed to be unsafe speed (26%) and improper turning collisions (23%). For F+SI collisions unsafe speed (22%), pedestrian right of way (20%) and pedestrian right of way (17%) was observed to be the violation categories. **Figure 11** illustrates the violation category for all collisions and F+SI collisions.

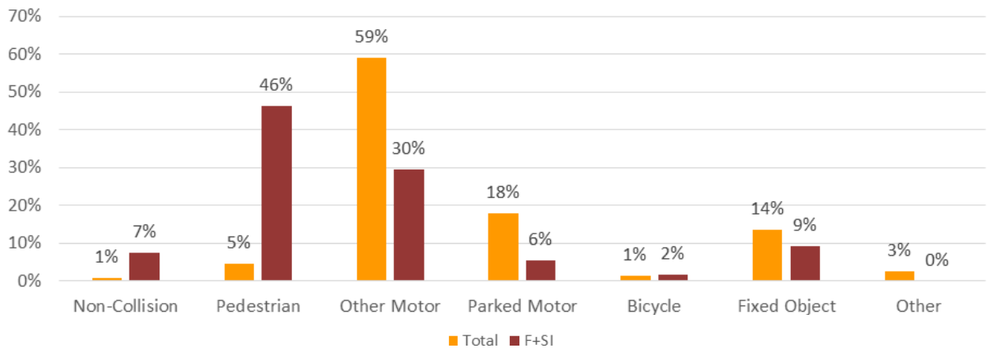
Figure 11. Violation Categories: All Collisions vs. F+SI Collisions



MOTOR-VEHICLE INVOLVED WITH

Considering all collisions, 59% of the collisions occurred between two motor vehicles. The remaining collisions include motor vehicle involved with parked vehicles (18%) and fixed object (14%). For F+SI collisions, 46% involved a pedestrian, 30% of the collisions involved another motor vehicle and 9% involved a fixed object. **Figure 12** illustrates the percentage for all collisions as well as F+SI collisions.

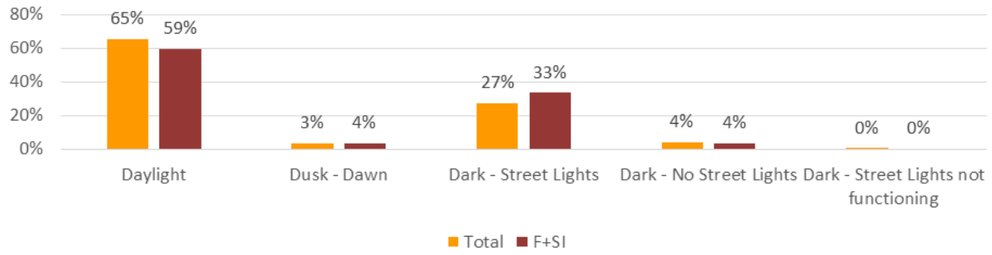
Figure 12. Motor Vehicle Involved with: All Collisions vs. F+SI Collisions



LIGHTING

For collisions of all severity, 65% of collisions have occurred in daylight and 27% of collisions have occurred in the dark on streets with street lights. For F+SI collisions, collision lighting conditions follows a similar trend, with 59% of collisions having occurred in daylight and 33% of collisions occurred in the dark on streets with street lights. **Figure 13** illustrates the lighting condition for all collisions and F+SI collisions.

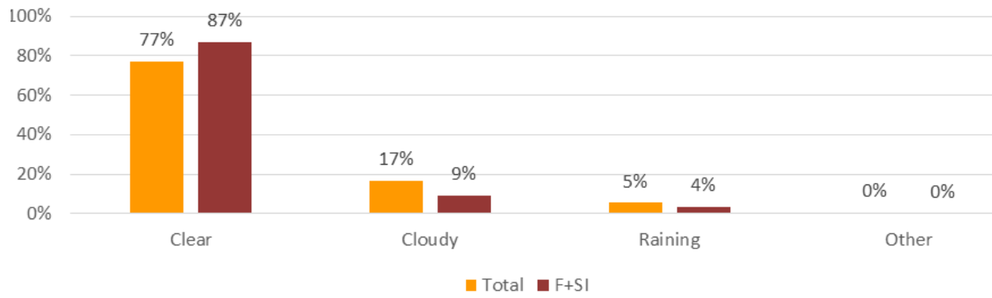
Figure 13. Lighting Conditions: All Collisions vs. F+SI Collisions



WEATHER

For all collisions, 77% of the collisions have occurred during clear weather conditions. For F+SI collisions similar trends have been observed, with 87% of the collisions having occurred during clear weather conditions. **Figure 14** illustrates the percentage distribution of weather conditions during occurrence of collisions of all severity as well as F+SI collisions.

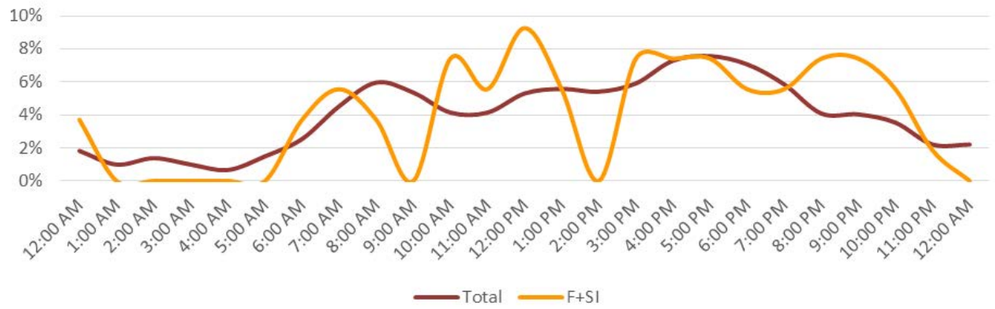
Figure 14. Weather Conditions: All Collisions vs. F+SI Collisions



TIME OF THE DAY

For collisions of all severity, maximum number of collisions have occurred between 5:00 p.m. to 6:00 p.m. (8%) and the minimum number of collisions have occurred between 4:00 a.m. to 5:00 a.m. (1%). For all F+SI collisions, maximum number of collisions have been observed to occur between 12:00 p.m. to 1:00 p.m. **Figure 15** illustrates the percentage of collisions occurring during the day for all collisions as well as F+SI collisions.

Figure 15. Time of Day: All Collisions vs. F+SI Collisions



FATAL AND SEVERE INJURY COLLISIONS

This section describes a detailed collision analysis performed for F+SI collisions occurring at roadway segments and intersections in the City of San Bruno. Of the total 54 F+SI collisions that occurred during the study period, 10 collisions (19%) occurred on roadway segments and 44 collisions (81%) occurred at intersections. This distribution is illustrated in **Figure 16**.

Figure 16. F+SI Collisions: Roadway Segment vs. Intersection

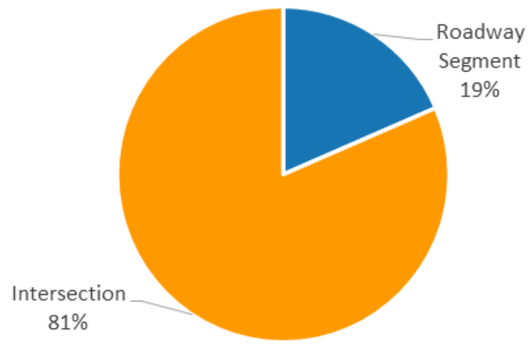
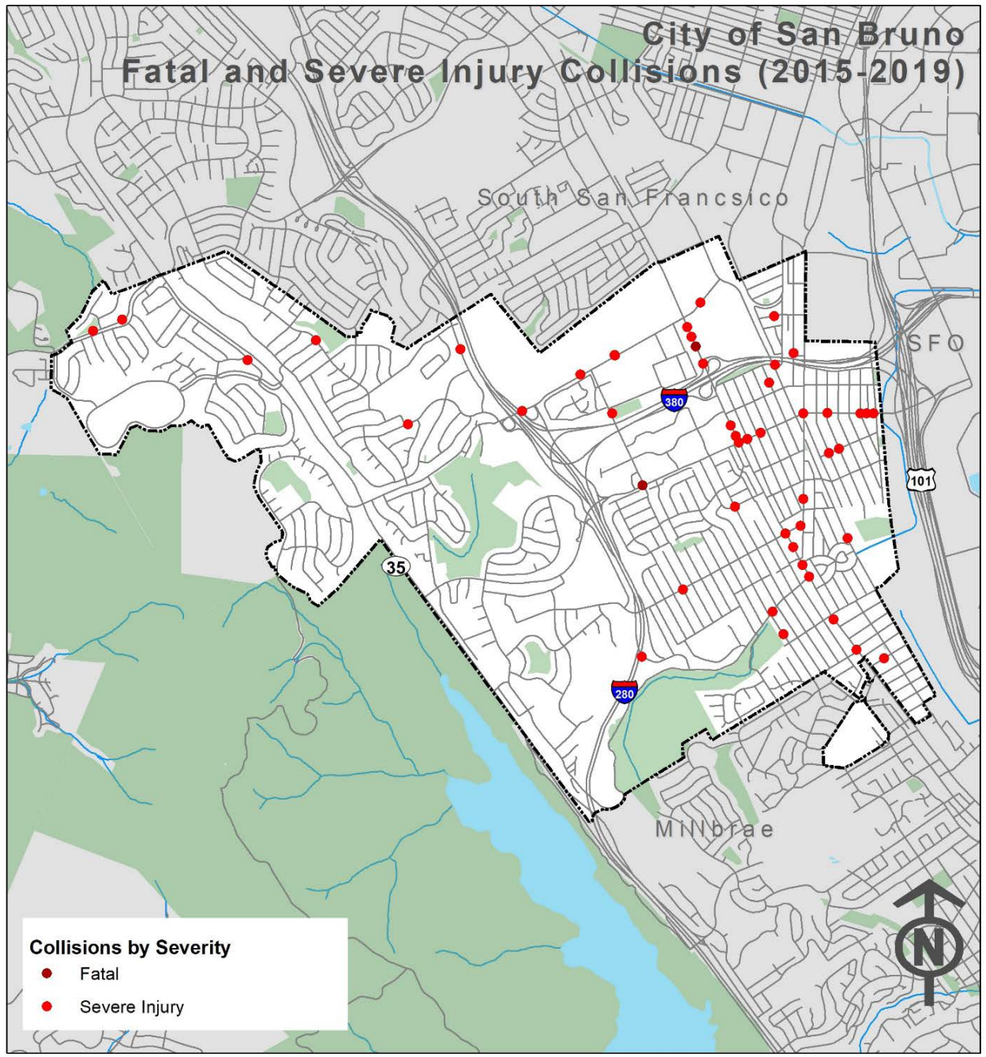


Figure 17 illustrates the F+SI collisions that occurred in the jurisdiction in the study period.

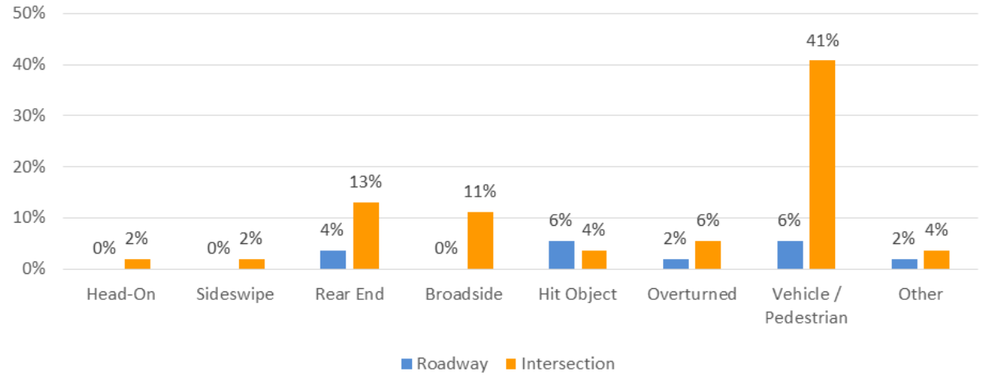
Figure 17. Fatal and Severe Injury Collisions (2015-2019)



COLLISION TYPE AND LOCATION TYPE

For F+SI collisions, the most common collision type was vehicle/pedestrian and rear end collisions. Vehicle/pedestrian and rear end collision types that led to a fatal or severe injury more commonly occurred at intersections. **Figure 18** shows F+SI collisions locations as well as the collision type.

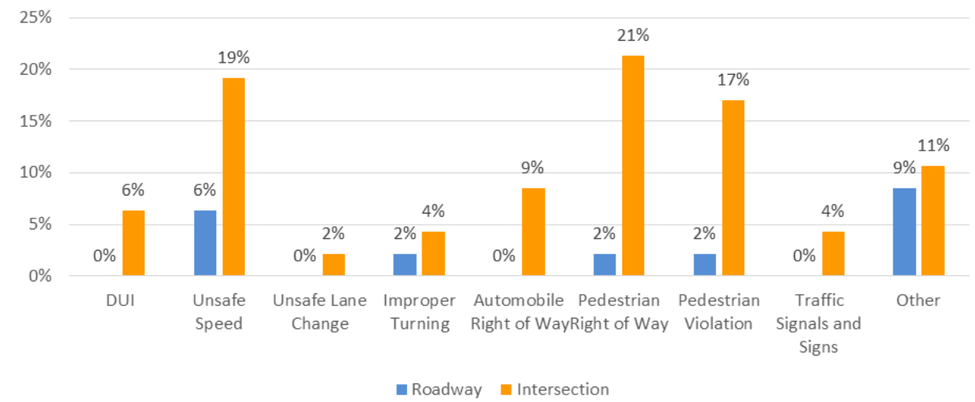
Figure 18. F+SI Collisions: Collision Type vs Location (2015-2019)



VIOLATION CATEGORY AND LOCATION TYPE

For F+SI collisions, the most common collision type was pedestrian right of way collisions, pedestrian violation collisions, and unsafe speed collisions. These F+SI collisions primarily occurred at intersection. **Figure 19** shows F+SI collisions as well as the location type and violation category.

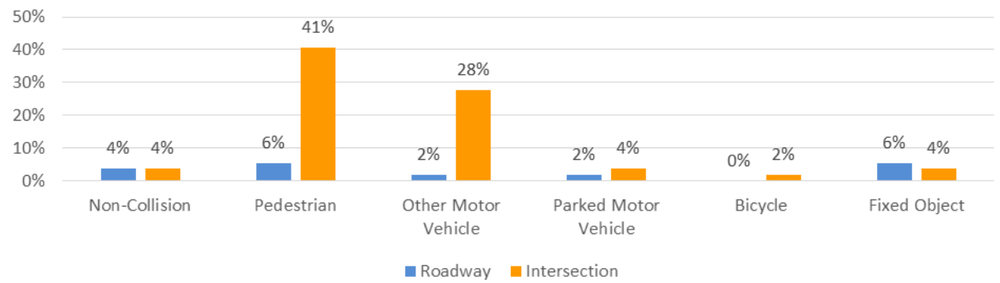
Figure 19. F+SI Collisions: Collision Type vs Violation Category (2015-2019)



MOTOR VEHICLE INVOLVED WITH AND LOCATION TYPE

For F+SI collisions, collisions involving a motor vehicle and a pedestrian was the most common type. The majority of these collisions occurred at intersections. Fixed object collisions was the only collision type to occur predominantly at roadways. **Figure 20** shows F+SI collisions locations as well as the collision type.

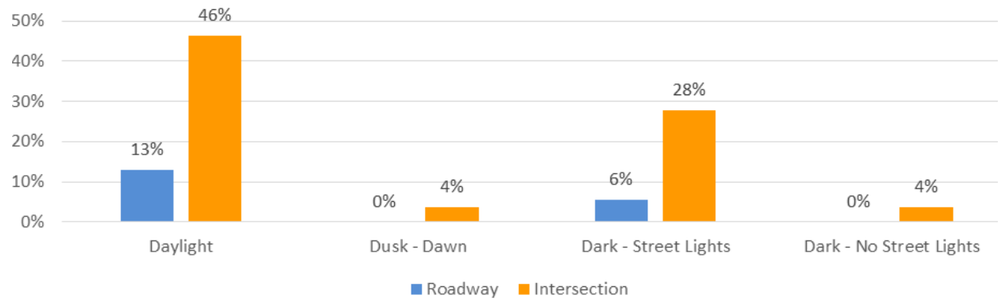
Figure 20. F+SI Collisions: Motor Vehicle Involved With vs Location Type (2015-2019)



LIGHTING AND LOCATION TYPE

For F+SI collisions, most collisions occurred in daylight at intersections. The second most common lighting for F+SI collisions was collisions that occurred in the dark with street lights. **Figure 21** shows F+SI collisions locations as well as lighting conditions.

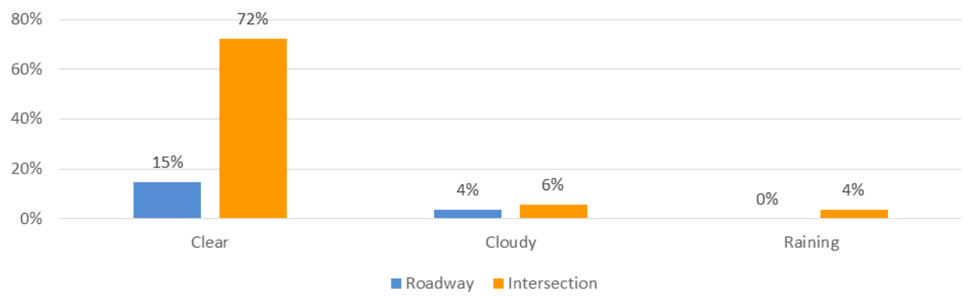
Figure 21. F+SI Collisions: Lighting vs Location Type (2015-2019)



WEATHER AND LOCATION TYPE

For intersection F+SI collisions, the majority of collisions occurred during clear weather. **Figure 22** shows F+SI collisions locations as well as weather conditions.

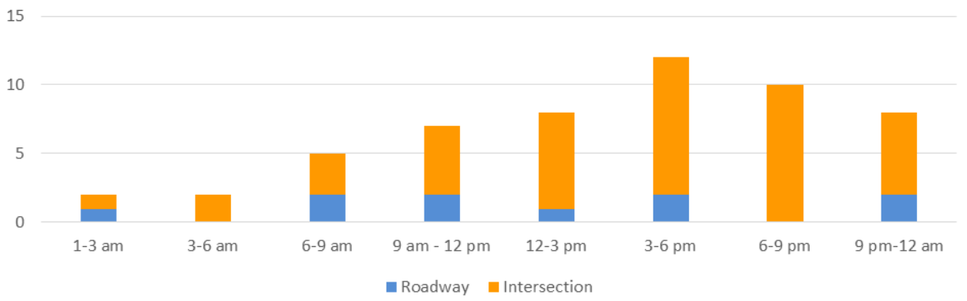
Figure 22. F+SI Collisions: Weather vs Location Type (2015-2019)



TIME OF DAY AND LOCATION TYPE

For F+SI collisions, collisions have been observed to occur in the afternoon/evening hours between 3-9 pm. **Figure 23** shows F+SI collisions as well as the location type and time of day.

Figure 23. F+SI Collisions: Time of Day vs Location Type (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 San Bruno. The above collision analysis was used to identify five main collision factors that highlight the top trends among collisions in San Bruno. These five collision factors were identified to be pedestrian collisions, nighttime collisions, unsafe speed collisions, rear end collisions, and broadside collisions.

Pedestrian Collisions

For F+SI collisions in the City of San Bruno, 47% of collisions were pedestrian collisions. **Figure 24** shows the distribution of pedestrian collisions throughout the City of San Bruno between 2015 and 2019. Sneath Lane, Jenevein Avenue, EL Camino Real, and San Bruno Avenue have a higher concentration of pedestrian collisions, compared to other San Bruno roads. The Office of Traffic Safety ranked San Bruno 11th out of 97 similarly sized cities with high levels of pedestrian collisions (one being the highest, or worst)[2].

Nighttime Collisions

For F+SI collisions in the City of San Bruno, 37% of collisions occurred at nighttime. **Figure 25** shows the distribution of nighttime collisions throughout the City of San Bruno between 2015 and 2019. El Camino Real, Sneath Lane and Sylvan Avenue have a higher concentration of nighttime collisions, compared to other San Bruno roads. The Office of Traffic Safety ranked San Bruno 10th out of 97 similarly sized cities with high levels of nighttime collisions (one being the highest, or worst)[3].

Unsafe Speed Collisions

For F+SI collisions in the City of San Bruno, 22% of collisions were unsafe speed collisions. **Figure 26** shows the distribution of unsafe speed collisions throughout the City of San Bruno between 2015 and 2019. EL Camino Real, Sharp Park Road, and Crystal Springs Road have a higher concentration of unsafe speed collisions, compared to other San Bruno roads. The Office of Traffic Safety ranked San Bruno 31 out of 97 similarly sized cities with high levels of speed related collisions (one being the highest, or worst)[4].

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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=San+Bruno&wpv_filter_submit=Submit

3 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=San+Bruno&wpv_filter_submit=Submit

4 California Office of Traffic Safety. (2018). Office of Traffic Safety Rankings 2018. https://www.ots.ca.gov/media-and-research/crash-rankings-results/?wpv-wpcf-year=2018&wpv-wpcf-city_county=San+Bruno&wpv_filter_submit=Submit

Rear End Collisions

For F+SI collisions in the City of San Bruno, 17% of collisions were rear end collisions. **Figure 27** shows the distribution of rear end collisions throughout the City of San Bruno between 2015 and 2019. El Camino Real, Sneath Lane and Santa Lucia Avenue have a higher concentration of rear end collisions, compared to other San Bruno roads.

Broadside Collisions

For F+SI collisions in the City of San Bruno, 11% of collisions were broadside collisions. **Figure 28** shows the distribution of broadside collisions throughout the City of San Bruno between 2015 and 2019. El Camino Real, San Bruno Avenue, Sneath Lane and 6th Avenue have a higher concentration of broadside collisions, compared to other San Bruno roads.

Figure 24. City of San Bruno Pedestrian Collisions (2015-2019)

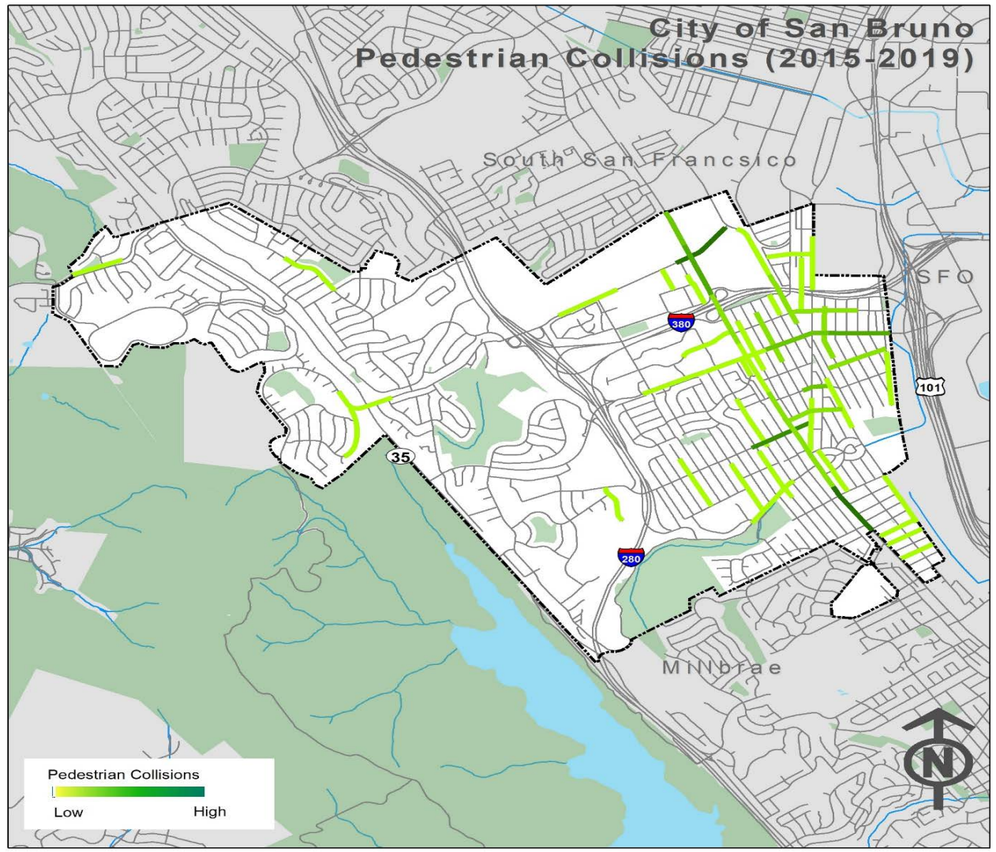


Figure 25. City of San Bruno Nighttime Collisions (2015-2019)

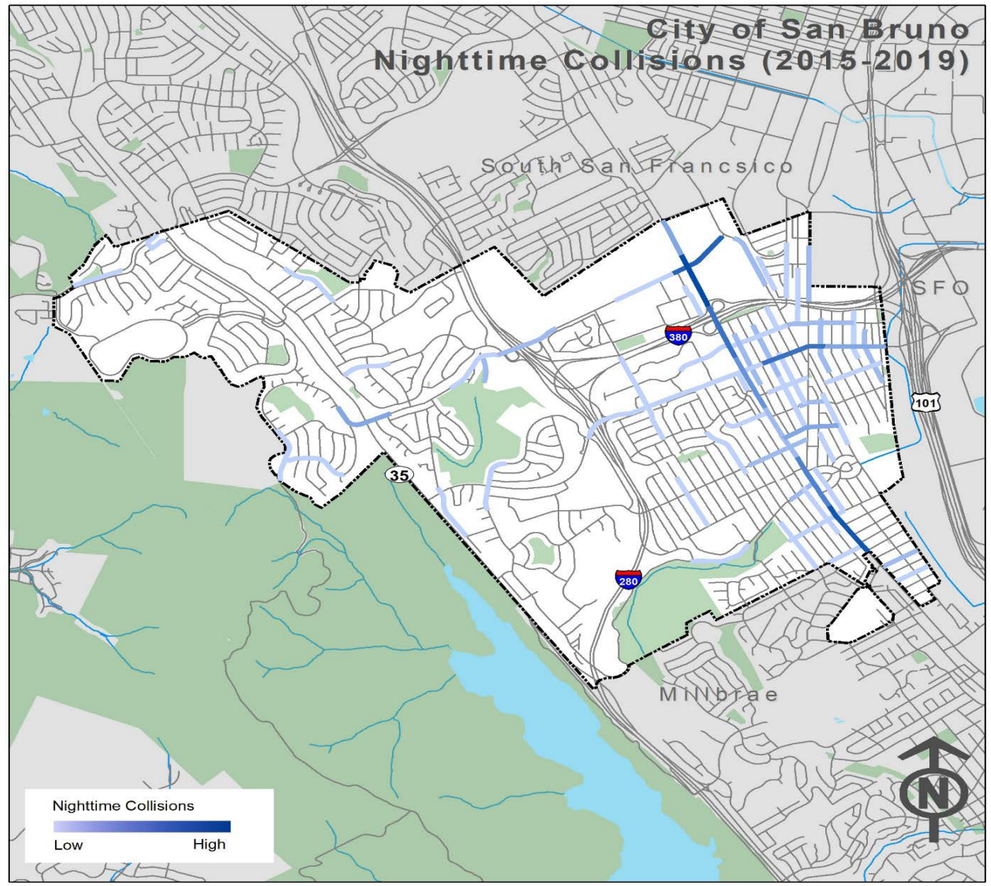


Figure 26. City of San Bruno Unsafe Speed Collisions (2015-2019)

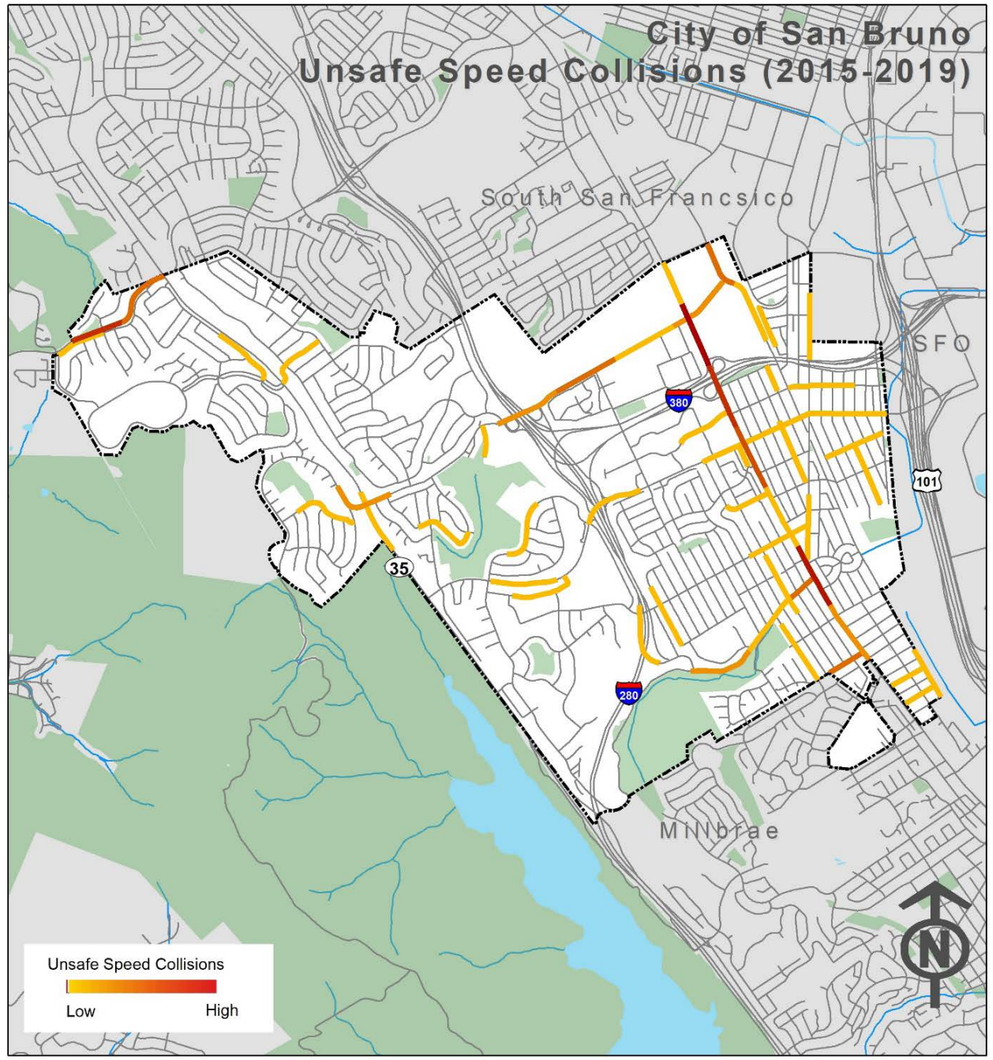


Figure 27. City of San Bruno Rear End Collisions (2015-2019)

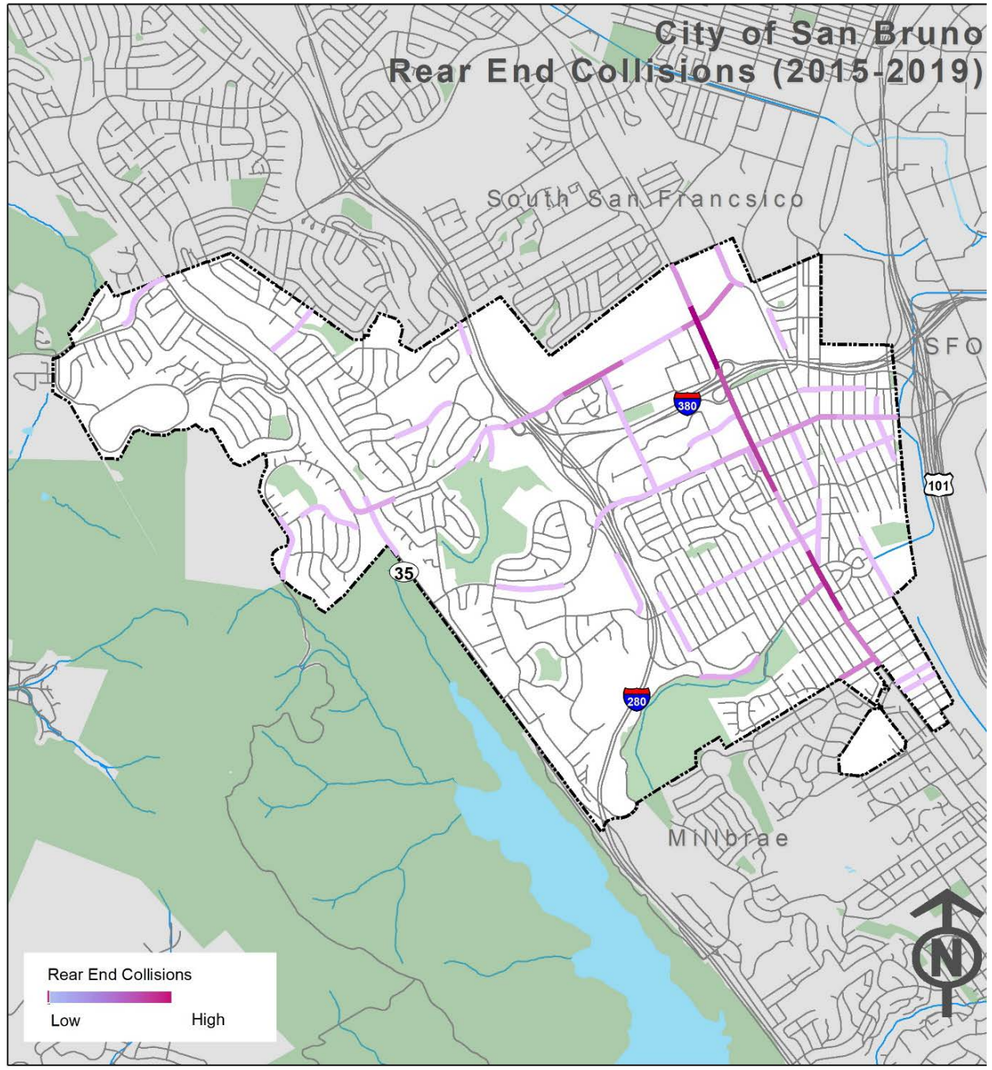
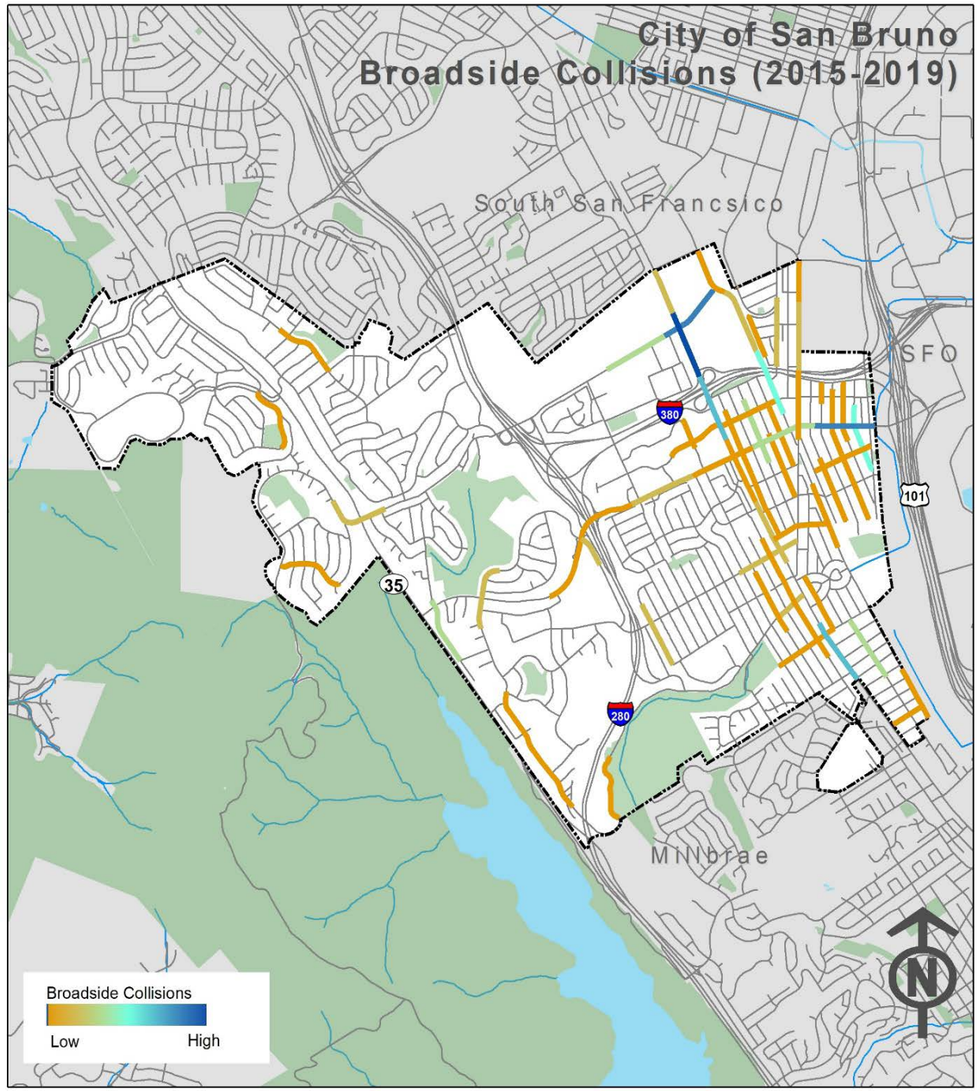


Figure 28. City of San Bruno Broadside Collisions (2015-2019)



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 11 application. The weights used in the analysis are shown below in **Table 3.**

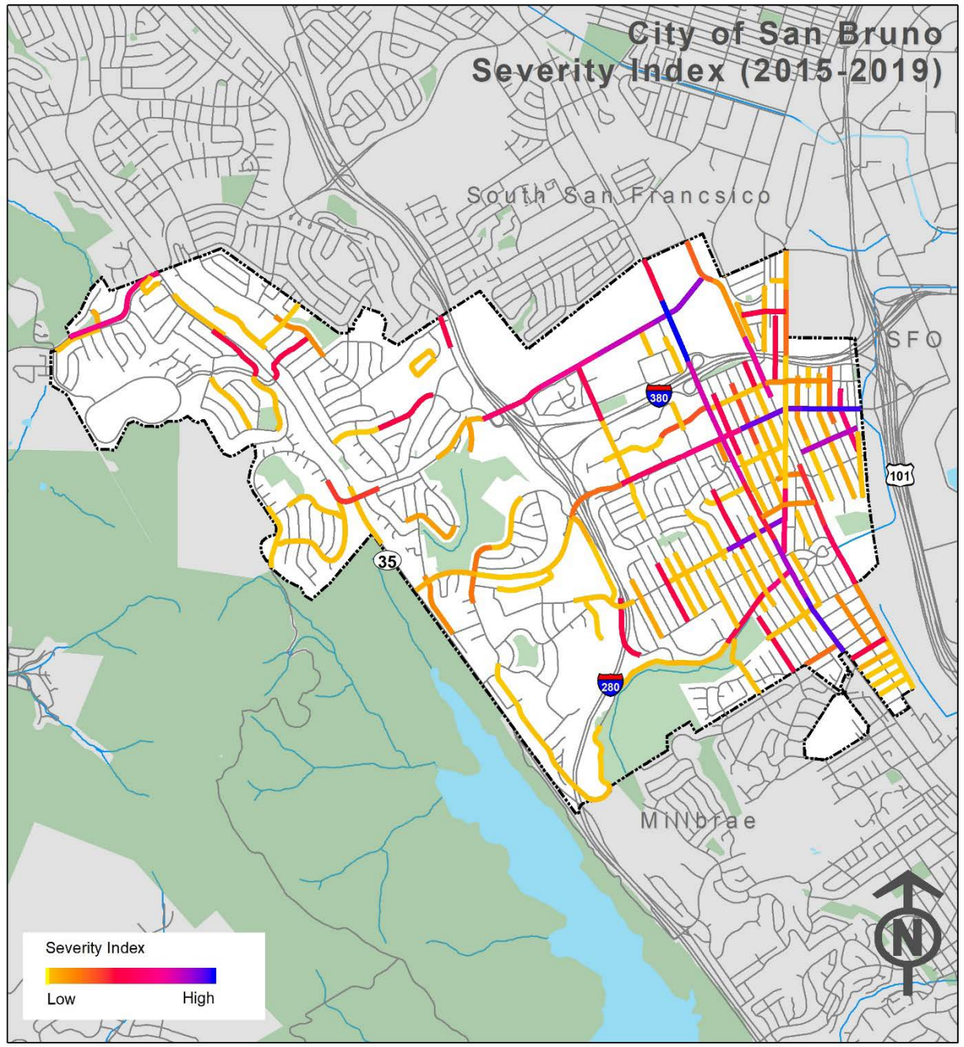
Table 3. EPDO Score used in HSIP Cycle 11

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

*This is the score used in HSIP Cycle 11 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 San Bruno were geolocated onto San Bruno's road network. **Figure 29** shows the location and geographic concentration of collisions by their EPDO score.

Figure 29. City of San Bruno Severity Index

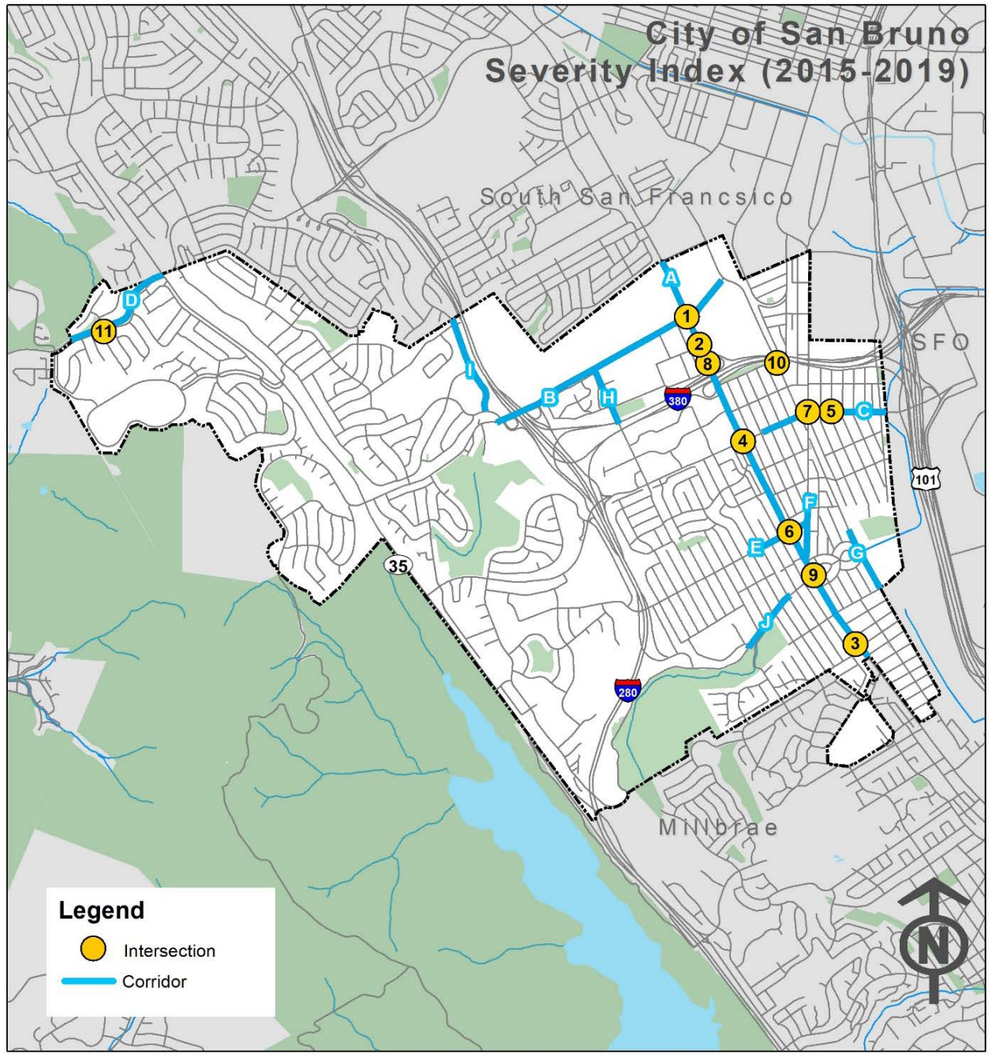


HIGH INJURY NETWORK

Following the detailed collision analysis, the next step was to identify the high-risk roadway segments and intersections in the City of San Bruno. The methodology for scoring the high injury locations is the same method as used in the severity weight section. **Figure 30** shows the top 10 high-collision roadway segments, and top 11 high-collision intersections. This high collision network has a total of 245 injury collisions and 43 F+SI collisions, which represents 55% of injury collisions and 83% of F+SI collisions in San Bruno.

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 directly at an intersection, or collisions that are assigned a zero value in distance from intersection value column in the SWITRS.

Figure 30. City of San Bruno High Injury Network



INTERSECTION RANKING

11 intersections were identified as high injury intersections. There were a total of 18 F+SI collisions that occurred at these intersections. The intersection of El Camino Real and Sneath Lane has the highest EPDO score.

Table 4 lists the EPDO score of the top 11 identified high-collision intersections along with the type of collisions and the number of F+SI collisions that occurred at these locations. The extended list of High Injury Intersections is included in the **Appendix C**.

Table 4. High Injury Intersections

ID	Intersection	Total Collision	F+SI	Veh/ Ped	Night-time	Unsafe Speed	Rear End	Broad-side	EPDO Score
1	El Camino Real and Sneath Ln	21	2	5	7	4	6	4	489
2	El Camino Real and Commodore Dr	15	2	3	8	5	7	3	458
3	El Camino Real and Santa Lucia Ave	13	2	4	6	3	4	4	431
4	El Camino Real and San Bruno Ave	14	2	1	4	5	10	1	422
5	San Bruno Ave and 3rd Ave	10	2	4	1	1	0	4	403
6	El Camino Real and Jenevein Ave	7	2	4	2	0	0	2	365
7	San Bruno Ave and San Mateo Ave	3	2	1	1	0	0	1	336
8	El Camino Real and 380 WB on/off ramps	18	1	1	7	5	7	5	302
9	El Camino Real and Crystal Springs Ave	9	1	0	4	4	5	2	238
10	Huntington Ave and Herman St	7	1	2	0	0	0	4	211
11	Sharp Park Rd and Pacific Heights Blvd	6	1	1	1	2	0	0	210

ROADWAY SEGMENT RANKING

10 corridors were identified as high injury corridors. There was a total 25 F+SI collisions on these corridors. The corridor with the highest amount of F+SI collisions is El Camino Real with nine F+SI collisions.

Table 5 lists the collision rate of the top 10 identified high-collision corridors along with the number of F+SI collisions and total collisions.

Table 5. High Injury Corridors

ID	Corridors	Total Collision	F+SI	Veh/ Ped	Night-time	Unsafe Speed	Rear End	Broad-side	Length (miles)	EPDO Score
A	El Camino Real: Noor Ave to San Lucia Ave	64	9	8	24	25	42	1	2.0	1940
B	Sneath Ln: Rollingwood Dr to Hunignton Ave	21	4	1	5	6	9	3	1.2	802
C	San Bruno Ave: Green Ave to 7th Ave	11	3	2	5	2	4	3	0.3	553
D	Sharp Park Rd: College Rd to Skyline Blvd	12	2	1	1	8	1	0	0.6	425
E	Jenevein Ave: Acacia Ave to San Mateo Ave	3	2	2	0	1	1	0	0.3	336
F	San Mateo Ave: El Camino Real to Angus Ave	4	1	1	0	1	1	0	0.4	198
G	Huntington Ave: Florida Ave to San Felipe Ave	3	1	0	0	0	1	0	0.3	182
H	Cherry Ave: San Bruno Ave to Park Ave	2	1	0	0	0	1	0	0.3	176
I	Crestwood Dr: Valleywood Dr to Rollingwood Dr	1	1	0	0	0	1	0	0.4	165
J	Crystal Springs Rd: Oak Ave to Poplar Ave	1	1	1	0	1	0	0	0.3	165

Summary

For F+SI collisions in the City of San Bruno, 47% of collisions were pedestrian collisions. Sneath Lane, Jenevein Avenue, EL Camino Real, and San Bruno Avenue have a higher concentration of pedestrian collisions, compared to other San Bruno roads. 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, installing RRFBs, and installing bulb outs.

For F+SI collisions in the City of San Bruno, 37% of collisions occurred at nighttime. The maximum number of nighttime collisions have been observed along the corridor El Camino Real, Sneath Lane, and San Bruno Avenue. This may indicate that lighting at these locations should be evaluated to insure lumen levels are adequate. Many different factors can contribute to nighttime collisions, such as low lighting levels that can be targeted with countermeasure, but extraneous factors can also contribute to nighttime injury such as alcohol use, sleep, and fatigue. This may suggest that evaluating lighting levels at these locations are needed. Improvements such as installing new lighting, upgrading existing lighting to a higher lumen, installing larger signal heads, installing and upgrade signs with new fluorescent sheeting, and installing pedestrian improvements with lighting elements such as RRFBs and High-Intensity Activated Crosswalk Beacon (HAWKs) can help make these locations safer for all road users.

The next steps include identifying strategies corresponding to the 4 E's of safety to comprehensively make the roadways of the City of San Bruno safer for all modes of transportation.

5 EMPHASIS AREAS

5 EMPHASIS AREAS

Emphasis areas are focus areas for the LRSP that are identified through the comprehensive collision analysis of the identified high injury locations within San Bruno. Emphasis areas help in identifying appropriate safety strategies and countermeasures with the greatest potential to reduce collisions occurring at the high injury locations. They can include (but not be limited to): specific collision types, human behaviors, facility types, and specific locations or corridors.

This chapter summarizes the top eight emphasis areas identified for San Bruno. These emphasis areas were derived from the consolidated high injury collision database (**Appendix D**) where top injury factors were identified by combing the data manually. The high injury collision database contains only collisions occurring at the high injury intersections or along the high injury corridors. Along with findings from the data analysis, stakeholder input was also considered to refine the emphasis areas specific to San Bruno.

The following are the identified emphasis areas –

- Improve Intersection Safety
- Reduce Unsafe Speed
- Improve Pedestrian and Bicyclist Safety
- Reduce Nighttime Collisions
- Reduce Rear End Collisions
- Reduce Broadside Collisions
- Reduce Improper Driving
- Reduce Collisions near Schools

The 4 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 the most pertinent violations and high-risk locations until the recommended infrastructure project can be implemented, addressed under Engineering improvements and countermeasures. Similarly, EMS 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 San Bruno

The City of San Bruno and partner agencies have already implemented safety strategies corresponding to the 4 E's of traffic safety. The strategies detailed in this memorandum can supplement these existing efforts and concentrate them on high injury collision locations and crash types. These initiatives are summarized in **Table 6**.

Table 6. Existing Programs Summary

Program/ Document	Description	E's Addressed
City of San Bruno Police and Fire Departments	San Bruno Police and Fire Department provide traffic enforcement and emergency response to collisions occurring within the city.	Enforcement, EMS
City of San Bruno Traffic Calming Policy, Brochure and Toolkit	The traffic calming policy, brochure and toolkit educates residents about their role as active citizens in resolving traffic problems. They provides an overview of measures and devices intended to enhance pedestrian safety and encourage safe driving. Additionally, it establishes a procedure for reporting traffic concerns and requesting a traffic calming measure, as well as the steps that will be taken to address these concerns.	Engineering, Education
San Mateo Avenue Conceptual Streetscape Plan (2019)	The plan includes projects to construct and improve sidewalks, street lights, curb realignment, gateway monuments, road striping, and signage.	Engineering
City of San Bruno Walk 'N Bike Plan (2018)	The plan makes recommendations for pedestrian facility improvements. Improvements include bulb-outs, sidewalks, crosswalks, bike lanes, road markings and turn pockets.	Engineering
Bayhill Specific Plan (2021)	The plan recommends buffered bike lanes, wider medians, sharrows, wider sidewalks, pedestrian refuge islands, bike box and high visibility crosswalks at various locations in downtown.	Engineering
San Mateo County Safe Routes to School	Safe Routes to School (SRTS) San Mateo County is a countywide 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.	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 (fatal, severe injury, visible injury, and complaint of pain) with a specific emphasis on F+SI injury collisions. The City of San Bruno data indicates a total of 1,813 collisions between 2015 and 2019, including 54 F+SI collisions, 194 visible injuries, 199 complaints of pain, and 1,366 PDO collisions. Following that, a high injury network was identified that included top 10 high-collision roadway segments and top 11 high-collision intersections. This high injury network experienced a total of 245 injury collisions, including 43 F+SI collisions. The data presented below in each emphasis area is based on the fatal, severe injury, visible injury, and complaint of pain collisions on the high injury network.

Each emphasis area is accompanied by comprehensive programs, policies and countermeasures to reduce collisions on the City roads in that specific emphasis area. It will provide the basis by which the countermeasure toolbox is developed for each identified high-risk location. Note: Engineering countermeasures are based on the Caltrans LRSM and are used in HSIP calls for projects. They are categorized as follows:

- S = Signalized Intersections Countermeasures
- NS = Non-Signalized Intersections Countermeasures
- R = Roadway Segments Countermeasures

An excerpt of the Caltrans LRSM providing additional details on each countermeasure is included in **Appendix E**.

EMPHASIS AREA 1 – INTERSECTION SAFETY

There were a total of 447 injury collisions (fatal, severe injury, other visible injury, and complaint of pain) in the City of San Bruno between 2015 and 2019, of which 382 occurred at intersections and 123 occurred at the 11 high-risk intersections. The following collision data is based on only intersection injury collisions that occurred in the high injury network in the City of San Bruno. **Table 7** describes recommended programs and countermeasures to comprehensively address intersection safety.

21%
Involved pedestrians

32%
Rear-end collisions

33%
Occurred at night

Table 7. Emphasis Area 1 Strategies

Objective: To reduce the number of F+SI collisions at intersections.			
	Strategies	**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	• S01, Install intersection lighting • 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 • NS14, Install raised median on approaches • R01, Add Segment Lighting • R22, Install/Upgrade signs with new fluorescent sheeting (regulatory or warning) • R27, Install delineators, reflectors and/or object markers • Curb extension	Number of intersections improved	City
EMS	S05, Install emergency vehicle pre-emption systems	EMS vehicle response time	City/Health Department

EMPHASIS AREA 2 – REDUCE UNSAFE SPEED COLLISIONS

Of the total 1,245 collisions in the City of San Bruno, 323 (26%) resulted due to unsafe speeding. The 54 F+SI crashes follow a similar pattern, with 12 (22%) occurring from unsafe speeding. 73 (30%) of the 245 collisions in the high injury network were caused by unsafe speeding. The following collision analysis is based on unsafe speed collisions in the high injury network in the City of San Bruno. **Table 8** describes recommended programs and countermeasures to comprehensively reduce unsafe speed collisions.

14%
Involved pedestrians

40%
Rear-end collisions

30%
Nighttime collisions

Table 8. Emphasis Area 2 Strategies

Objective: To reduce the number of collisions caused due to unsafe speeding.			
	Strategies	**Performance Measure**	**Agencies/ Organizations**
Education	• Conduct public education and outreach activities that elevate the awareness of the dangers of improper driving. • Public service announcements regarding increased and strict traffic law enforcement.	Number of public outreach events and public service announcements	City/School District/ Police Department
Enforcement	Increase enforcement, penalties and prosecution for traffic law violations.	Number of citations issued for improper driving	Police Department
Engineering	• S03, Improve signal timing (coordination, phases, red, yellow, or operation) • S04, Provide Advanced Dilemma-Zone Detection for high speed approaches • S12, Install raised median on approaches (S.I.) • S16, 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.) • NS11, Improve sight distance to intersection (Clear Sight Triangles) • R14, Road Diet • R26, Install dynamic/variable speed warning signs • Decrease width of travel lanes	Number of locations improved	City
EMS	S05, Install emergency vehicle pre-emption systems	EMS vehicle response time	City/Health Department

EMPHASIS AREA 3 – IMPROVE PEDESTRIAN AND BICYCLIST SAFETY

Of the 54 F+SI collisions, 26 (48%) involved pedestrians or bicyclists. In the high injury network, 47 of 245 collisions involved a pedestrian or bicyclist. The following collision data is based on pedestrian and bicyclist injury collisions in the high injury network in the City of San Bruno. **Table 9** describes recommended programs and countermeasures to comprehensively improve pedestrian and bicyclist safety.

40%
Involved pedestrians not crossing in a crosswalk

45%
Nighttime collisions

56%
Pedestrian violation

Table 9. Emphasis Area 3 Strategies

Objective: To improve walking environment for pedestrians and bicyclists.			
	Strategies	**Performance Measure**	**Agencies/ Organizations**
Education	• Pedestrian safety campaigns and outreach to raise their awareness of pedestrian safety needs through media outlets and public events. • Post signage along roadways in areas of anticipated or known high pedestrian activity advising motorists of zero tolerance motor vehicle law enforcement. • Provide public outreach to advice of City efforts toward zero-tolerance motor vehicle law enforcement in high pedestrian activity.	Number of outreach events for pedestrian safety campaigns	City/School District/Police Department
Enforcement	Targeted and zero-tolerance enforcement of motor vehicle speed limit violations, signal/right-of-way violations, pedestrian violations, aggressive driving, distracted driving, DUI, and illegal vehicle modifications in areas with known or anticipated high pedestrian activity.	Number of citations issued for pedestrian right-of-way, and pedestrian violations	Police Department
Engineering	• S19PB, Pedestrian Scramble • 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 • Pedestrian crossing flags • Yield sign for pedestrian crossing at crosswalk	Number of locations improved	City
EMS	Improve resource deployment for emergency responses at collision sites.	EMS vehicle response time	City/Health Department

EMPHASIS AREA 4 – REDUCE NIGHTTIME COLLISIONS

Out of the total 245 collisions on the high injury network in the City of San Bruno, 72 (29%) occurred at night (no natural lighting condition). The following collision analysis is based on nighttime injury collisions on the high injury network in the City of San Bruno. **Table 10** describes recommended programs and countermeasures to comprehensively reduce nighttime collisions.

50%
Involved pedestrians

24%
Hit object collision

36%
Driving under the influence of drugs or alcohol

Table 10. Emphasis Area 4 Strategies

Objective: To reduce the number of F+SI collisions occurring at night (no natural light).			
	Strategies	**Performance Measure**	**Agencies/ Organizations**
Education	Develop awareness program to inform residents of high-risk collision locations, the most common violations and collision types occurring at night.	Number of education campaigns	City/School District/Police Department
Enforcement	Increase patrolling during nighttime.	Number of citations and/ or warnings issued during nighttime	Police Department
Engineering	• S02, Improve signal hardware: lenses, back-plates with retroreflective borders, mounting, size, and number • S09, Install raised pavement markers and striping (Through Intersection) • NS01, Intersection Lighting • 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 • Reflective paint on roadside objects, guard walls and poles	Number of locations improved to mitigate night-time collisions	City
EMS	Improve resource of deployment at night for emergency responses to collision sites.	EMS vehicle response time at night	City/Health Department

EMPHASIS AREA 5 – REDUCE REAR END COLLISIONS

The City of San Bruno experienced a total 245 reported collisions on the high injury network, of which 101 (41%) were rear-end collisions. The following collision analysis is based on rear-end collisions on the high injury network in the City of San Bruno. **Table 11** describes recommended programs and countermeasures to comprehensively reduce rear-end collisions.

64%
Involved traffic signals and signs violation

70%
Nighttime collisions

22%
Improper turning violation

Table 11. Emphasis Area 5 Strategies

Objective: To reduce the number of rear end collisions.			
Strategies		**Performance Measure**	**Agencies/ Organizations**
Education	Conduct public education and outreach activities that elevate the awareness of the dangers of impaired and improper driving.	Number of public outreach events	City/School District/Police Department
Enforcement	• Increase the number of sobriety checkpoints and saturation patrol to increase visibility of enforcement. • Increase penalties for repeat offenders.	Number of citations issued for DUI and improper driving	Police Department)
Engineering	• S02, Improve signal hardware: lenses, back-plates with retro-reflective borders, mounting, size, and number • S03, Improve signal timing (coordination, phases, red, yellow, or operation) • S09, Install raised pavement markers and striping (Through Intersection) • S11, Improve pavement friction (High Friction Surface Treatments) • S12, Install raised median on approaches (S.I.) • NS06, Install/upgrade larger or additional stop signs or other intersection warning/regulatory signs • NS07, Upgrade intersection pavement markings (NS.I.) • NS10, Install transverse rumble strips on approaches • NS11, Improve sight distance to intersection (Clear Sight Triangles) • NS12, Improve pavement friction (High Friction Surface Treatments) • R05, Install impact attenuators • R22, Install/Upgrade signs with new fluorescent sheeting (regulatory or warning) • R27, Install delineators, reflectors and/or object markers • Add paved shoulders • Simplify turn configurations	Number of locations improved	City
EMS	S05, Install emergency vehicle pre-emption systems	EMS vehicle response time	City/Health Department

EMPHASIS AREA 6 – REDUCE BROADSIDE COLLISIONS

The City of San Bruno had a total of 245 collisions reported on the high injury network, with 37 (15%) resulting in broadside collisions. The following collision analysis is based on broadside collisions on the high injury network in the City of San Bruno. **Table 12** describes recommended programs and countermeasures to comprehensively reduce broadside collisions.

95%
Involved another motor vehicle

65%
Nighttime collisions

73%
Unsafe Speed

Table 12. Emphasis Area 6 Strategies

Objective: To reduce the number of F+SI pedestrian collisions			
Strategies		**Performance Measure**	**Agencies/ Organizations**
Education	Conduct public information and education campaign for intersection safety laws regarding traffic lights, stop signs, and turning left or right.	Number of education campaigns	City/School District/Police Department
Enforcement	• Targeted enforcement at locations with most red light running and stop sign violations, and implement strict penalties for such violations.	Number of citations issued for red light running and stop sign violations	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 • NS02, Convert to all-way STOP control (from 2-way or Yield control) • NS03, Install signals • NS06, Install/upgrade larger or additional stop signs or other intersection warning/regulatory signs • NS07, Upgrade intersection pavement markings (NS.I.) • NS08, Install flashing beacons at stop controlled intersections • NS11, Improve sight distance to intersection (Clear Sight Triangles)	Number of locations improved	City
EMS	S05, Install emergency vehicle pre-emption systems	EMS vehicle response time	City/Health Department

EMPHASIS AREA 7 – REDUCE IMPROPER DRIVING

Of the 245 total injury collisions in the high injury network, 35 (14%) were caused by improper driving actions (improper passing, improper turning, and following too closely). Additionally, the age of the driver or the party at fault was taken into account in this analysis. The following collision analysis is based on improper driving actions on the high injury network in the City of San Bruno. **Table 13** describes recommended programs and countermeasures to comprehensively reduce improper driving.

35%
Involved drivers under the age of 25

43%
Nighttime collisions

27%
Rear-end collisions

Table 13. Emphasis Area 7 Strategies

Objective: To reduce the number of collisions caused due to improper driving.			
Strategies		**Performance Measure**	**Agencies/ Organizations**
Education	• Conduct public education and outreach activities that elevate the awareness of the dangers of improper driving. • Public service announcements regarding increased and strict traffic law enforcement.	Number of public outreach events and public service announcements	City/School District/Police Department
Enforcement	• Increase enforcement, penalties and prosecution for traffic law violations.	Number of citations issued for improper driving	Police Department
Engineering	• S09, Install raised pavement markers and striping (Through Intersection) • S11, Improve pavement friction (High Friction Surface Treatments) • S12, Install raised median on approaches (S.I.) • NS06, Install/upgrade larger or additional stop signs or other intersection warning/regulatory signs • NS07, Upgrade intersection pavement markings (NS.I.) • NS10, Install transverse rumble strips on approaches • NS12, Improve pavement friction (High Friction Surface Treatments) • R03, Install Median Barrier • R22, Install/Upgrade signs with new fluorescent sheeting (regulatory or warning) • R27, Install delineators, reflectors and/or object markers • R30, Install centerline rumble strips/stripes • R31, Install edgeline rumble strips/stripes	Number of locations improved	City
EMS	Improve resource deployment for emergency responses at collision sites.	EMS vehicle response time	City/Health Department

EMPHASIS AREA 8 – REDUCE COLLISIONS NEAR SCHOOLS

Traffic congestion and pedestrian safety around schools was one of the top traffic safety concerns expressed by the LRSP stakeholders, as such, it was identified as an emphasis area. The following collision data is based on collisions that occurred at a radius of 0.5 miles from 11 school properties in the City of San Bruno. **Table 14** describes recommended programs and countermeasures to comprehensively reduce collisions near schools.

445
Total Collisions

110
Pedestrian and Bicyclist collisions

95
Unsafe speeding collisions

Table 14. Emphasis Area 8 Strategies

Objective: To reduce the number of collisions within 0.5 miles of school properties.			
Strategies		**Performance Measure**	**Agencies/ Organizations**
Education	Develop SRTS program to educate school-goers about safe walking practices and activities on road safety.	Number of schools participating in SRTS the program	City/School District/Police Department
Enforcement	• Targeted enforcement at intersections and roadway segments around schools during pickup and drop-off hours.	Number of citations issued around school properties	Police Department
Engineering	• S09, Install raised pavement markers and striping (Through Intersection) • S12, Install raised median on approaches (S.I.) • S21PB, Modify signal phasing to implement a Leading Pedestrian Interval (LPI) • NS07, Upgrade intersection pavement markings (NS.I.) • NS08, Install Flashing Beacons at Stop-Controlled Intersections • NS21PB, Install/upgrade pedestrian crossing at uncontrolled locations (with enhanced safety features) • NS22PB, Install Rectangular Rapid Flashing Beacon (RRFB) • 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) • R35PB, Install/upgrade pedestrian crossing (with enhanced safety features) • R37PB, Install Rectangular Rapid Flashing Beacon (RRFB)	Number of locations improved	City
EMS	Improve resource deployment for emergency responses at collision sites within 0.5 miles of schools.	EMS vehicle response time	City/Health Department

6 COUNTERMEASURE SELECTION

6 COUNTERMEASURE SELECTION

Identification of Countermeasures

Upon the identification of high-risk locations and Emphasis Areas, the next step was to identify appropriate safety countermeasures. The Caltrans LRSM provides 82 countermeasures, of which 20 are eligible in the current HSIP call for signalized intersections, 24 for un-signalized intersections, and 38 for roadway segments. The LRSM provides guidance on where to apply the countermeasures, including the crash types each countermeasure would address, and a Crash Reduction Factor (CRF) for each countermeasure. The Federal Highway Administration (FHWA) CMF Clearinghouse and published research papers were reviewed by the project team to gain additional insight on CRFs and effectiveness of specific countermeasures.

The project team conducted a thorough review of the high-injury locations (intersections and roadway segments) using aerial photography and Google Maps Street View software. Crash characteristics of all collisions occurring on the High Injury Network were considered. After combining the physical and collision characteristics, the project team developed a table of preliminary countermeasures that address each of the eight identified Emphasis Areas. The table was refined by selecting up to six countermeasures for each high-risk location that were most commonly recommended among all Emphasis Areas. By doing this, the project team was able to identify countermeasures with the greatest opportunity for systemic implementation.

Countermeasure Toolbox

Engineering countermeasures were selected for each of the high-risk locations and for the emphasis areas. These were based on approved countermeasures from the Caltrans 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 CIP. Non-engineering countermeasures were also selected using the 4 E's strategies, and are included with the emphasis areas. The countermeasure toolbox in **Appendix F** details 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 CIP.

Table 15 provides a description of each countermeasure appropriate for City of San Bruno along with the CRF, federal funding eligibility, and opportunity for systemic implementation. An excerpt of the LRSM, detailing each available HSIP countermeasure referenced in the recommendations tables, is included as **Appendix E**.

Table 15. Countermeasures selected for the City of San Bruno

Code	Countermeasure Name	Countermeasure Description	CRF	Federal Funding	Systemic Approach Opportunity
S02	Improve signal hardware: lenses, back-plates with retroreflective borders, mounting, size, and number	Includes New LED lighting, signal back plates, retro-reflective tape outlining the back plates, or visors to increase signal visibility, larger signal heads, relocation of the signal heads, or additional signal heads.	15%	90%	Very High
S03	Improve signal timing (coordination, phases, red, yellow, or operation)	Includes adding phases, lengthening clearance intervals, eliminating or restricting higher-risk movements, and coordinating signals at multiple locations.	15%	50%	Very High
S08	Convert signal to mast arm (from pedestal-mounted)	Providing better visibility of intersection signs and signals aids the drivers' advance perception of the upcoming intersection. Visibility and clarity of the signal should be improved without creating additional confusion or distraction for drivers.	30%	90%	Medium
S11	Improve pavement friction (High Friction Surface Treatments)	Improving the skid resistance at locations with high frequencies of wet road crashes and/or failure to stop crashes.	55%	90%	Medium
S20PB	Install advance stop bar before crosswalk (Bicycle Box)	Signalized Intersections with a marked crossing, where significant bicycle and/or pedestrians volumes are known to occur.	15%	90%	Very High
S21PB	Modify signal phasing to implement a Leading Pedestrian Interval (LPI)	Addition of LPI gives pedestrians the opportunity to enter an intersection 3-7 seconds before vehicles are given a green indication; only minor signal timing alteration is required.	60%	90%	Very High
NS01	Add intersection lighting (NS.I.)	Provision of lighting at intersection.	40%	90%	Medium
NS03	Install Signals	Installation of traffic signals	25%	90%	Low
NS06	Install/upgrade larger or additional stop signs or other intersection warning/ regulatory signs	Additional regulatory and warning signs at or prior to intersections will help enhance the ability of approaching drivers to perceive them.	15%	90%	Very High
NS07	Upgrade intersection pavement markings (NS.I.)	Typical improvements include "Stop Ahead" markings and the addition of centerlines and stop bars.	25%	90%	Very High
NS08	Install Flashing Beacons at Stop-Controlled Intersections	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.	15%	90%	High
NS12	Improve pavement friction (High Friction Surface Treatments)	Non-signalized Intersections noted as having crashes on wet pavements or under dry conditions when the pavement friction available is significantly less than needed for the actual roadway approach speeds. This treatment is intended to target locations where skidding and failure to stop is determined to be a problem in wet or dry conditions and the target vehicle is unable to stop due to insufficient skid resistance.	55%	90%	Medium
NS19PB	Install raised medians (refuge islands)	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.	45%	90%	Medium
NS21PB	Install/upgrade pedestrian crossing at uncontrolled locations (with enhanced safety features)	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. flashing beacons, curb extensions, advanced "stop" or "yield" markings, and other safety features should be added to complement the standard crossing elements.	35%	90%	Medium

Code	Countermeasure Name	Countermeasure Description	CRF	Federal Funding	Systemic Approach Opportunity
NS22PB	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. It uses an irregular flash pattern that is similar to emergency flashers on police vehicles. RRFB's are installed at unsignalized intersections and mid-block pedestrian crossings.	35%	90%	Medium
R02	Remove or relocate fixed objects outside of Clear Recovery Zone	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.	35%	90%	High
R10PB	Install pedestrian median fencing	Roadway segments with high pedestrian-generators and pedestrian-destinations nearby (e.g. transit stops) may experience a high volume of pedestrians J-walking across the travel lanes at mid-block locations instead of walking to the nearest intersection or designated mid-block crossing. When this safety issue cannot be mitigated with shoulder, sidewalk and/or crossing treatments, then installing a continuous pedestrian barrier in the median may be a viable solution.	35%	90%	Low
R14	Road Diet (Reduce travel lanes from 4 to 3 and add a two way left-turn and bike lanes)	Areas noted as having a higher frequency of head-on, left-turn, and rear-end crashes with traffic volumes that can be handled by only 2 free flowing lanes. Using this strategy in locations with traffic volumes that are too high could result in diversion of traffic to routes less safe than the original four-lane design.	30%	90%	Medium

Code	Countermeasure Name	Countermeasure Description	CRF	Federal Funding	Systemic Approach Opportunity
R21	Improve pavement friction (High Friction Surface Treatments)	Improving the skid resistance at locations with high frequencies of wet road crashes and/or failure to stop crashes.	55%	100%	High
R22	Install/Upgrade signs with new fluorescent sheeting (regulatory or warning)	Additional or new signage can address crashes caused by lack of driver awareness or compliance of roadway signing.	15%	90%	Very High
R23	Install chevron signs on horizontal curves	Roadways that have an unacceptable level of crashes on relatively sharp curves during periods of light and darkness.		90%	Very High
R26	Install dynamic/ variable speed warning signs	Includes the addition of dynamic speed warning signs (also known as Radar Speed Feedback Signs).	30%	100%	High
R27	Install delineators, reflectors and/or object markers	Installation of delineators, reflectors and/or object markers are intended to warn drivers of an approaching curve or fixed object that cannot easily be removed.	15%	90%	Very High
R28	Install edge-lines and centerlines	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.	25%	100%	Very High
R30	Install centerline rumble strips/stripes	Center Line rumble strips/stripes can be used on virtually any roadway – especially those with a history of head-on crashes.	20%	100%	High

Code	Countermeasure Name	Countermeasure Description	CRF	Federal Funding	Systemic Approach Opportunity
R33PB	Install Separated Bike Lanes	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.	45%	90%	High
R35PB	Install/upgrade pedestrian crossing (with enhanced safety features)	Roadway segments with no controlled crossing for a significant distance in high-use midblock crossing areas and/ or multilane roads locations. Flashing beacons, curb extensions, medians and pedestrian crossing islands and/or other safety features should be added to complement the standard crossing elements.	35%	90%	Medium
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. It uses an irregular flash pattern that is similar to emergency flashers on police vehicles. RRFB's are installed at unsignalized intersections and mid-block pedestrian crossings	35%	100%	Medium

* Code: S - Signalized intersection improvements
NS - Non-signalized intersection improvements
R - Roadway segment improvements

7 VIABLE SAFETY PROJECTS

7 VIABLE SAFETY PROJECTS

This chapter summarizes the process of selecting safety projects as part of the analysis for the City of San Bruno 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 2022 LRSM from Caltrans, 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 (2022). The countermeasures were grouped into safety projects for high-risk intersections and roadway segments. A total of five safety projects were developed. All countermeasures were identified based on the technical teams' assessment of viability that consisted of extensive analysis, observations, City staff input, and stakeholder/community input. The most applicable and appropriate countermeasures as identified have been grouped together to form projects that can help make high-injury locations safer.

Table 16 lists the safety projects for high-risk intersections and roadway segments, along with total base planning level cost (2022 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 (2022).

Appendix G lists the detailed methodology to calculate B/C Ratio, as well as the complete cost, benefit and B/C Ratio calculation spreadsheet.

These safety projects were chosen based on the previously completed collisions analysis, which was used to identify main collision attributes that were found to be leading factors of fatal and severe collisions in City of San Bruno. These collision factors are shown below, as well as viable safety projects that can help address these factors.

Broadside Collisions represented the 11% F+SI collisions. Viable safety projects to help address these collisions include improving signal timing, installing raised pavement markers, installing intersection lighting, improving pavement friction, installing/upgrading larger stop signs or other intersection regulatory/warning signs, and installing flashing beacons as advance warning.

Pedestrian Collisions made up 47% of F+SI collisions. Viable safety projects to help address these collisions include installing advance stop bar before crosswalk, modifying signal phasing to implement a LPI and installing RRFB.

Unsafe speed was the most common violation type among F+SI collisions (22%). Viable safety projects to help address these violations include installing raised pavement markers and striping (through intersection), improving signal timing, installing flashing beacons as advance warning, installing/upgrading signs with new fluorescent sheeting, installing dynamic/variable speed warning signs.

Nighttime Collisions represented a significant portion of F+SI collisions (41%). Viable safety projects to help address these collisions include upgrading/installing signs with new fluorescent sheeting; installing edge line and centerline; adding intersection lighting, and improving intersection pavement markings.

The next step in the process after safety projects is to prepare HSIP applications. HSIP is a competitive grant funding source based on a B/C analysis. The benefit value is calculated automatically based on crash data document by law enforcement and standard cost data. The cost of some measures may adversely impact the benefit to cost ratio making the grant application less competitive for funding.

Below is the list of identified projects for the City of San Bruno, with a preliminary cost estimate for each location and the resulting B/C ratio of the project (the title of each countermeasure is located in a separate table below). The cost per location includes construction costs, Plans, Specifications, and Estimates (PS&E), environmental reporting costs, construction engineering costs, and a 10% contingency. Construction costs are based on industry standards in the Bay Area and TJKM's knowledge and experience of the area. Our team is consistently updating our unit prices to match current construction costs.

Table 16. List of Viable Safety Projects

Location	CM1	CM2	CM3	Cost per Location	Total Cost	B/C Ratio
Project #1: Signalized Intersections (Improve signal hardware: lenses, back-plates with retroreflective borders, mounting, size, and number, Convert signal to mast arm (from pedestal-mounted), Install raised pavement markers and striping (Through Intersection), Improve signal timing[1] (coordination, phases, red, yellow, or operation))						
El Camino Real and Sneath Ln	S02		S09	$16,044	$813,260	36.9
El Camino Real and Commodore Dr	S02		S09	$15,176		
El Camino Real and San Bruno Ave	S02		S09	$21,280		
San Bruno Ave and 3rd Ave		S08	S09	$185,388		
El Camino Real and Jenevein Ave	S02		S09	$32,144		
San Bruno Ave and San Mateo Ave	S02		S09	$24,248		
El Camino Real and 380 WB on/off ramps	S02		S09	$36,456		
El Camino Real and Crystal Springs Ave	S02		S09	$32,228		
Sharp Park Rd and Pacific Heights Blvd		S08	S09	$191,576		
El Camino Real and Taylor Ave/ San Mateo Ave	S02		S09	$24,808		
San Bruno Ave and Cherry Ave		S08	S09	$233,912		
Project #2: Pedestrian and Bicyclist Safety at Signalized Intersections (Install advance stop bar before crosswalk (Bicycle Box), Modify signal phasing to implement a Leading Pedestrian Interval (LPI), Improve pavement friction (High Friction Surface Treatments))						
El Camino Real and Sneath Ln	S20PB	S21PB	S11*	$297,920	$1,767,556	33.4
El Camino Real and Commodore Dr	S20PB	S21PB	S11*	$221,620		
El Camino Real and San Bruno Ave	S20PB	S21PB	S11*	$284,060		
San Bruno Ave and 3rd Ave	S20PB	S21PB	S11*	$101,276		
El Camino Real and Jenevein Ave	S20PB	S21PB		$166,460		
San Bruno Ave and San Mateo Ave	S20PB	S21PB	S11*	$144,116		
El Camino Real and 380 WB on/off ramps	S20PB		S11*	$267,680		
El Camino Real and Crystal Springs Ave	S20PB	S21PB	S11*	$140,644		
Sharp Park Rd and Pacific Heights Blvd	S20PB	S21PB	S11*	$129,780		
El Camino Real and Taylor Ave/ San Mateo Ave		S21PB	S11*	$7,000		
San Bruno Ave and Cherry Ave		S21PB	S11*	$7,000		

Location	CM1	CM2	CM3	Cost per Location	Total Cost	B/C Ratio
Project #3: Safety at Unsignalized Intersections (Install Traffic Signal, Install/upgrade larger or additional stop signs or other intersection warning/regulatory signs, Upgrade intersection pavement markings (NS.I.))						
El Camino Real and Santa Lucia Ave	NS03#	NS06	NS07	$678,398	$2,222,388	17.7
Huntington Ave and Herman St	NS03#	NS06	NS07	$755,629		
Sneath Ln and Cemetary Access Rd	NS03#	NS06		$658,700		
San Bruno Ave and 6th Ave		NS06	NS07	$35,266		
San Bruno Ave and 7th Ave		NS06	NS07	$24,283		
San Bruno Ave and Green Ave		NS06	NS07	$29,400		
San Bruno Ave and Hensley Ave		NS06	NS07	$40,712		
Project #4: Roadway Segments (Add Segment Lighting, Install/Upgrade signs with new fluorescent sheeting (regulatory or warning), Install delineators, reflectors and/or object markers, Improve pavement friction (High Friction Surface Treatments))						
El Camino Real: Noor Ave to San Lucia Ave	R22	R27	R21*	$61,025	$258,028	171.1
Sneath Ln: Rollingwood Dr to Hunignton Ave	R22	R27	R21*	$42,688		
San Bruno Ave: Green Ave to 7th Ave	R22	R27		$34,810		
Sharp Park Rd: College Rd to Skyline Blvd	R22	R27	R21*	$26,090		
Jenevein Ave: Acacia Ave to San Mateo Ave	R22	R27		$10,350		
San Mateo Ave: El Camino Real to Angus Ave	R22	R27		$32,880		
Huntington Ave: Florida Ave to San Felipe Ave	R22	R27		$14,820		
Cherry Ave: San Bruno Ave to Park Ave	R22	R27		$8,140		
Crestwood Dr: Valleywood Dr to Rollingwood Dr	R22	R27	R21*	$7,605		
Crystal Springs Rd: Oak Ave to Poplar Ave	R22	R27		$19,620		

Location	CM1	CM2	CM3	Cost per Location	Total Cost	B/C Ratio
Project #5: Pedestrian and Bicyclist Safety on Roadway Segments (Install Separated Bike Lanes, Install/upgrade pedestrian crossing (with enhanced safety features), Install RRFB)						
El Camino Real: Noor Ave to San Lucia Ave	R33PB^	R35PB		$1,321,768	$3,900,532	48
Sneath Ln: Rollingwood Dr to Hunignton Ave	R33PB	R35PB		$717,903		
San Bruno Ave: Green Ave to 7th Ave		R35PB		$545,440		
Sharp Park Rd: College Rd to Skyline Blvd	R33PB			$71,680		
Jenevein Ave: Acacia Ave to San Mateo Ave	R33PB^		R37PB	$271,580		
Huntington Ave: Florida Ave to San Felipe Ave		R35PB		$100,100		
Cherry Ave: San Bruno Ave to Park Ave		R35PB		$156,660		
Crestwood Dr: Valleywood Dr to Rollingwood Dr		R35PB		$32,200		
Crystal Springs Rd: Oak Ave to Poplar Ave		R35PB	R37PB	$683,200		
El Camino Real: Noor Ave to San Lucia Ave	R33PB^	R35PB		$1,321,768		

Notes: CM – countermeasure. B/C ratio is the dollar amount of benefits divided by the cost of the countermeasure.
1S03 (Improve Signal Timing) countermeasure is recommended at all intersections of Project #1.
*Countermeasures are not included in the cost estimates and B/C Ratio but recommended at the respective locations.
#NS03 (Install Traffic Signal) countermeasure is subject to Signal Warrant study at respective unsignalized intersections.
^On-Street parking or travel lane needs to remove in order to install R33PB (separated bike lanes).

COUNTERMEASURE NAME

NS03	Install Traffic Signal
NS06	Install/upgrade larger or additional stop signs or other intersection warning/ regulatory signs
NS07	Upgrade intersection pavement markings (NS.I.)
R21	Improve pavement friction (High Friction Surface Treatments)
R22	Install/Upgrade signs with new fluorescent sheeting (regulatory or warning)
R27	Install delineators, reflectors and/or object markers
R33PB	Install Separated Bike Lanes
R35PB	Install/upgrade pedestrian crossing (with enhanced safety features)
R37PB	Install Rectangular Rapid Flashing Beacon (RRFB)
S02	Improve signal hardware: lenses, 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)
S11	Improve pavement friction (High Friction Surface Treatments)
S20PB	Install advance stop bar before crosswalk
S21PB	Modify signal phasing to implement a Leading Pedestrian Interval (LPI)

8 IMPLEMENTATION AND EVALUATION

8 IMPLEMENTATION AND EVALUATION

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.

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, and enforcement related countermeasures that can be implemented throughout the City to reduce F+SI collisions. It is recommended that the City of San Bruno implement the selected projects in high-collision locations in coordination with other projects proposed for the City's infrastructure development in their future CIP. 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.

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. (See **Table 17** on following page).

Table 17. List of 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, MTC	~$450 million per cycle (every two years)	2022	Engineering, Education	Can be used for most active transportation related safety projects as well as education programs. Funding available through Caltrans or MTC.
Highway Safety Improvement Program	Caltrans		2024	Engineering	Most common grant source for safety projects.
Office of Traffic Safety Grants	California Office of Traffic Safety	Varies by grant	Closes January 31st annually	Education, Enforcement, Emergency Response	10 grants available to address various components of traffic safety.
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/pedestrian 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.
Safe Streets and Roads for All (SS4A)	USDOT	$200k - $50 million	2022	Engineering	Two types of SS4A grants available: Action Plan Grants and Implementation Grants.

Monitoring and Evaluation

For the success of the LRSP, it is crucial to monitor and evaluate the 4 E-strategies continuously. Monitoring and evaluation help provide accountability, ensure the effectiveness of the countermeasures for each emphasis area, and help make decisions needed 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. 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.

Appendix A:
Public Comments

Respondent ID	#	Lat Long	Intersection	Location	What traffic-related concern do you have at this location?	Mode	Pertinent Issue
7g7w699ild96	1	POINT (-122.419752 37.624382)	Y	Cypress Ave	People do not follow stop sign regulations	Motor Vehicle	Stop Sign Violation
99ig74h9obe4	2	POINT (-122.408606 37.632693)	Y	4th Ave	People run this stop sign every day, most of the day, it's horrible.	Motor Vehicle	Stop Sign Violation
4hb47wrt7sox	3	POINT (-122.43702 37.619402)	N	W San Bruno Ave	There is no pedestrian sidewalk down San Bruno Avenue. It's very dangerous!	Pedestrian	Sidewalk
297mz8awj3u7	4	POINT (-122.445068 37.632691)	Y	Valleywood Dr	Thank you so much for allowing for this open forum. This intersection is blind because cars speed up a hill on valleywood and there are no stop signs. If there is a car parked on the street corner on valleywood it is impossible to see a car approaching traveling on valleywood until they are too close. Luckily I have not seen very many accidents but daily there are cars breaking and screeching their tires trying to maneuver around to avoid an accident. If a car is coming down Evergreen and are trying to make a left turn onto valleywood it is not safe because this section of valleywood is blind due to it being uphill.	Motor Vehicle	Sight Distance
297mz8awj3u7	5	POINT (-122.447205 37.634757)	Y	Merimont Cir	Cars driving out of the merimont community do not stop at the stop sign.	Motor Vehicle	Stop Sign Violation
82zni4bof6h8	6	POINT (-122.42485 37.626879)	Y	Cherry Ave	Very dangerous crosswalk for pedestrians. Drivers are zooming down Cherry, and it's not easy to see pedestrians in crosswalk. When Walmart employees were working from that building, their solution for their employees, who also frequent Bayhill, was a bucket of bright orange flags. Come on. Need a lit pedestrian crosswalk here.	Pedestrian	Pedestrian Right of Way
82zni4bof6h8	7	POINT (-122.424338 37.625953)	Y	W San Bruno Ave	Cherry and san bruno Ave intersection is extremely dangerous for pedestrians to cross. There are too many distractions for drivers and don't notice pedestrians until last second. I cross every time, wait and make sure cars that are turning on sb Ave are waiting for me, but some come flying around the corner from south cherry or the bay hill shopping center and don't realize a pedestrian is in the crosswalk. I frequent this intersection as I live on Cherry and 8 out of 10 times a driver ignores that there's a pedestrian and drives right on through, often times close enough for me to touch their car with my hand. The no turn on red sign that was put in after the woman was killed in that intersection is a joke because that is not addressing any problems there.We need the pedestrian light to go on before the street light turns green so the walkers have a chance to be in the intersection and be seen by drivers(as in San Mateo)	Pedestrian	Pedestrian Right of Way
6jz8bda7fv9a	8	POINT (-122.424176 37.626002)	Y	W San Bruno Ave	This is an extremely dangerous intersection for pedestrians to cross. The city needs to address these issues before we have another pedestrian fatality at this intersection. We have seen may near misses in this intersection	Pedestrian	Pedestrian Right of Way
9bl2b3rvp6i9	9	POINT (-122.424108 37.625833)	Y	W San Bruno Ave	Pedestrian crossing is very dangerous. Suggest when the pediatrician walk sign lights, the green light allowing vehicles to go is delayed 5-10 seconds to allow pedestrians a chance to enter the cross walk and become clearly visible. Vehicles move too quickly on this street and often speed up to make the light. Speed limit signs should be clearly posted. Also a large electronic sign showing drivers speed compared to the posted speed The Bayhill crossing from center to Walmart needs a pedestrian light. This is a very dangerous crossing.	Pedestrian	Pedestrian Right of Way

Respondent ID	#	Lat Long	Intersection	Location	What traffic-related concern do you have at this location?	Mode	Pertinent Issue
4dx2zdj6bmy3	10	POINT (-122.435446 37.612936)	N	Crestmoor Dr	The parents of John Muir school collectively have no regard for the residents surrounding the school. Each day at their pick up and drop off times, they act as if traffic only flows one way- theirs. They do not allow residents trying to leave their homes going against the school traffic to pass. They are aggressive and disrespectful. We need someone to direct traffic because I have seen several of them come close to colliding with anyone going against their traffic simply because they do not stop or pull off to let anyone else pass.	Motor Vehicle	Impeding Traffic
6xw64ukt7rr9	11	POINT (-122.420334 37.635233)	Y	El Camino Real	Left-turn departing Tanforan is dangerous because do not see people coming from Commodore. Left turn out of Tanforan would be safer with a Left turn arrow.	Motor Vehicle	Automobile Right of Way
6xw64ukt7rr9	12	POINT (-122.419861 37.634095)	Y	El Camino Real	People drive run the red light here Southbound on El Camino a lot. Cars turning on the left green arrow for the 380 off-ramp can get T-boned.		Traffic Signal Violation
6xw64ukt7rr9	13	POINT (-122.413728 37.633842)	Y	Huntington Ave	it is very dark here at night and difficult to see pedestrians.	Pedestrian	Lighting
2yl487jpr2d3	14	POINT (-122.441299 37.619373)	Y	Skyline Blvd	There are Many pedestrians use Skyline Blvd + San Bruno Avenue to get to the trail. Pedestrians use intersection of Skyline Blvd + Sneath to get to the 2 schools (Portola, HCS), and Church of the Highlands. San Bruno + Glenview is the way for families, cyclists, and others to cross from the Glenview neighborhood to Lunardis grocery. All 3 crosswalks need those little dots that reflect car headlights and they would benefit from a flashing signal light too.	Pedestrian	Lighting
6o262uho9ds6	15	POINT (-122.430345 37.612383)	Y	Madison Ave	I live at 180 Madison Ave. I believe there should be 3-way stop signs and/or speed bumps at the intersection of Madison and Bennington. This is a block away from John Muir school. People recklessly speed up and down this section of Madison Ave in order to cut through the Crestmoor 3 neighborhood to get to the freeway entrances that flank us. It is EXTREMELY unsafe, especially in a school neighborhood. I ask that the downhill section of madison have speed bumps or bumps and two additional stop signs be added to created a 3-way stop. Presently only the Bennington Ave side has a stop sign.	Motor Vehicle	Unsafe Speed
6o262uho9ds6	16	POINT (-122.410746 37.616655)	N	San Felipe Ave	I used to live at 889 San Felipe Ave. I believe these narrow streets are unsafe. Two cars cannot safely pass each other. I recommend utilizing a one-way approach or making one side of the street a no parking zone. Given that San Bruno has parking issues in these neighborhoods, it seems like one-way streets are a better option. I have noticed old narrow streets in Burlingame take this approach (one way).	Motor Vehicle	Narrow Street
6ee8hoo4hmh4	17	POINT (-122.412475 37.62301)	Y	El Camino Real	Road on the crosswalk nearest the curb is in poor condition. The uneven, cobblestone like road, is especially hazardous for those who have challenges walking such as people with canes, wheeled carts for walking assistance, and in wheelchairs.	Pedestrian	Poor Pavement
6ee8hoo4hmh4	18	POINT (-122.414919 37.616479)	Y	Crystal Springs Rd	Can be a very congested pedestrian crossing area with the park and St. Robert school. City should consider lighting the crosswalk and some sort of lighted stop sign to make sure that drivers see pedestrians. This is helpful in the evenings as that's a poorly lit intersection - especially on the corners away from St. Robert Church	Pedestrian	Lighting
6ee8hoo4hmh4	19	POINT (-122.424143 37.625859)	Y	W San Bruno Ave	Blind corner. Pedestrians can't be seen by cars making a right from Cherry onto San Bruno Ave.	Pedestrian	Pedestrian Right of Way
6ee8hoo4hmh4	20	POINT (-122.416955 37.628835)	Y	El Camino Real	Blind corner for cars making a right from El Camino onto San Bruno Ave. Button for the crosswalk is too far from the actual crosswalk. If a person doesn't move closer to the intersection they will not be seen cars making the right till the cars are only a few feet away. The plants/shrubs at the business doesn't help.	Pedestrian	Pedestrian Right of Way

Respondent ID	#	Lat Long	Intersection	Location	What traffic-related concern do you have at this location?	Mode	Pertinent Issue
6ee8hoo4hmh4	21	POINT (-122.419592 37.634149)	Y	El Camino Real	Blind intersection - Cars coming from the off-ramp of 380 and making a left to go South onto El Camino are hoping that cars coming South on the El Camino stop. I've seen too many near misses and cars running the red (on El Camino) in this intersection. Neither the cars making the left nor the cars coming South on the El can see each other (especially those in the far right lane) till they're in the intersection. This is because the the 380 off-ramp is graded and the shrubbery and bushes in the middle of the El Camino obstruct the view for both.	Motor Vehicle	Sight Distance
6ee8hoo4hmh4	22	POINT (-122.418513 37.631825)	Y	El Camino Real	Blind Intersection - there are two problems here. 1. Cars on the off-ramp of 380 making a left onto the El Camino can't see cars coming North on the El Camino. Conversely, cars coming North may not see cars coming from the off-ramp. This is because of the bushes in the middle of ElCamino. 2. The stop-light control unit (I think that's what they are) on the off-ramp side creates a bit of a wall that can hide cars that are coming South. This effects cars making a right onto El Camino on the red as this obstructs cars that are coming South	Motor Vehicle	Sight Distance
6ee8hoo4hmh4	23	POINT (-122.428923 37.624145)	Y	El Camino Real	The stop-light control unit (I think that's what they are) on the off-ramp side creates a bit of a wall that can hide cars that are coming West on San Bruno Ave. This effects cars making a right onto San Bruno Ave on the red as this obstructs cars that are coming from San Bruno Ave. The curve of the road doesn't help.	Motor Vehicle	Sight Distance
87ua7bgi3xi6	24	POINT (-122.413798 37.617654)	Y	Crystal Springs Rd	Crystal Springs at Cypress Ave drivers constantly ignore stop sign....	Motor Vehicle	Stop Sign Violation
78al72con6a7	25	POINT (-122.420322 37.635249)	Y	El Camino Real	Entitled drivers from Tanforan DO NOT yield to cars traveling from Commodore Drive continuing straight to Tanforan or right onto SB El Camino Real. Even more concerning is that they almost never wait for pedestrians crossing the 10 lanes of traffic going to or from the mall. This intersection needs to have a one direction green light. There are elderly, disabled, commuters on foot, students, families who use this crosswalk at all times of the day and so many near fatalities. I have lived in the Archstone area since 2008 and it is only getting worse since crime is increasing at Tanforan.	Motor Vehicle	Automobile Right of Way
78al72con6a7	26	POINT (-122.420956 37.631723)	Y	El Camino Real	Entitled drivers from Tanforan DO NOT yield to cars traveling from Commodore Drive continuing straight to Tanforan or right onto SB El Camino Real. Even more concerning is that they almost never wait for pedestrians crossing the 10 lanes of traffic going to or from the mall. This intersection needs to have a one direction green light. There are elderly, disabled, commuters on foot, students, families who use this crosswalk at all times of the day and so many near fatalities. I have lived in the Archstone area since 2008 and it is only getting worse since crime is increasing at Tanforan.	Pedestrian	Pedestrian Right of Way
78al72con6a7	27	POINT (-122.455471 37.632058)	N	College Dr	Tear up and repair the surface on College Drive between Skyline-35 and Sheryl Drive. It's old and dangerous poorly paved road in both directions that is unsafe.	Motor Vehicle	Poor Pavement
6m9oow74xsv9	28	POINT (-122.410972 37.628407)	N	Angus Ave W	Angus West has no parking on the north side	Motor Vehicle	Parking
6m9oow74xsv9	29	POINT (-122.411675 37.62827)	N	Angus Ave W	The north of Angus West has no parking from 8am to 6pm. When cars park after 6pm on the north side it creates a traffic blockage. The street is too narrow.	Motor Vehicle	Parking
38tlv39ali3u	30	POINT (-122.420316 37.635171)	Y	El Camino Real	Cars turning left out of Tanforan onto ECR do not give right of way to those driving straight from Commodore across the street. Have seen several near misses and the aftermath of collisions	Motor Vehicle	Automobile Right of Way

Respondent ID	#	Lat Long	Intersection	Location	What traffic-related concern do you have at this location?	Mode	Pertinent Issue
38tlv39ali3u	31	POINT (-122.420481 37.635434)	Y	El Camino Real	Cars do not always stop for pedestrians crossing ECR. It is also too many lanes to cross safely. ECR needs a road diet.	Pedestrian	Pedestrian Right of Way
38tlv39ali3u	32	POINT (-122.42142 37.6369)	Y	El Camino Real	Dangerous intersection for pedestrian crossing, I know of at least one person dying here. ECR needs a road diet.	Pedestrian	Pedestrian Right of Way
8in9knz23vg7	33	POINT (-122.460938 37.632248)	Y	College Dr	The city allowed a new housing development to be built (Skyline Ridge), but did not paint a crosswalk connecting it to the Marisol neighborhood across the street. People are jaywalking here quite a bit. The city installed a stop sign, making this a four-way stop, so I have no idea why they didn't also paint a cross walk at the same time. I submitted the following ticket about this a while ago and didn't get a response: https://iframe.publicstuff.com/#?client_id=1000143&request_id=11184541#request-show	Pedestrian	Pedestrian Right of Way
8in9knz23vg7	34	POINT (-122.421983 37.636903)	Y	El Camino Real	When you are on El Camino, turning right onto Sneath, the turn lane is so narrow. People constantly hit the curb here as they make that turn. Needs redesign or something. I don't know exactly, but it's a pain point for me anyway. I have to take that turn really slow in my Honda Odyssey to make sure I safely make the turn and don't hit the curb, and everyone around is in a huge rush.	Motor Vehicle	Improper Turning
9ix8nkz9czc9	35	POINT (-122.420152 37.619518)	Y	Cherry Ave	The hill grade going up onto Cherry is too steep, which causes cars to bottom out on the pavement going both up and down hill, even at very low speeds.	Motor Vehicle	Unsafe Speed
9ix8nkz9czc9	36	POINT (-122.442052 37.618467)	Y	Skyline Blvd	Intersection is insufficiently signed; better visibility as to labeling streets	Motor Vehicle	Traffic Signal and Sign
9ix8nkz9czc9	37	POINT (-122.412629 37.622978)	Y	El Camino Real	This intersection traffic light is understandable to people who live here. HOWEVER, people who are visiting get confused. The Jenevein light cycles alternate (first eastbound, then westbound). However, there is no turn arrow to make this clear. Sometimes you'll have a car waiting to turn, thinking the other side also has to go on the same cycle, because it is not clearly signed that they alternate. Adding a green left turn arrow to both cycles (westbound and eastbound) would be much clearer for everyone. The actual timing doesn't need to change, just the conveyance of information to drivers.	Motor Vehicle	Automobile Right of Way
3zr279i6gmz6	38	POINT (-122.421666 37.636849)	Y	El Camino Real	When making a right turn from El Camino south onto Sneath Ln., West the road bed of the street is so lumpy bumpy that he practically knocks the wheel out of your hand. Please pave over the street	Motor Vehicle	Poor Pavement
2vt7ntj72g36	39	POINT (-122.411393 37.619696)	Y	Crystal Springs Rd	Cars DO NOT stop at intersection for pedestrians. Area lacks safety measures for pedestrians which includes kids, the elderly and residents.	Pedestrian	Pedestrian Right of Way
3zr4moe4md77	40	POINT (-122.42441 37.626017)	Y	W San Bruno Ave	The intersection of San Bruno Ave and Cherry Ave is very dangerous for pedestrian crossing. I have witnessed pedestrians nearly getting hit in the crosswalks on multiple occasions. The intersection is dangerous to the point that I will not allow my teenage children to cross from our neighborhood to the Bayhill Shopping Center. A turn only signal, flashing crosswalks, or even a light delay so pedestrians can begin to cross before the traffic moves would make the intersection vastly more safe.	Pedestrian	Pedestrian Right of Way
2p4plt9exp43	41	POINT (-122.439808 37.634969)	N	Crestwood Dr	There is excessive speeding on this residential street with many cars driving 40+ mph and some driving 50+ mph. This is the only street in the area that is flat and straight which contributes to the problem. Many of these cars are headed to El Camino Real so using the 280 & 380 freeways would be more efficient.	Motor Vehicle	Unsafe Speed

Respondent ID	#	Lat Long	Intersection	Location	What traffic-related concern do you have at this location?	Mode	Pertinent Issue
4b7ize2mri93	42	POINT (-122.412692 37.623061)	Y	El Camino Real	Crossing this intersection from West to East is extremely dangerous to pedestrians. The Eastbound green light only lasts a few seconds. Cars pull out to the intersection and the light turns yellow, at the same time the pedestrian hits the walking midpoint. Cars behind the lead car will often honk and pressure cars into making a rushed left turn with the pedestrian still in the intersections. This happens very frequently. Additionally, many visitors do not realize the green light (Eastbound) is protected (Westbound still has red), so that causes confusion and again cars behind will honk causing a dangerous situation.	Motor Vehicle	Automobile Right of Way
4b7ize2mri93	43	POINT (-122.424485 37.625868)	Y	W San Bruno Ave	There needs to be a protected pedestrian crossing.	Pedestrian	Pedestrian Right of Way
87ja9lmv4e4a	44	POINT (-122.430607 37.612271)	Y	Madison Ave	I live near the cross-section of Madison Ave. and Bennington Ave. This area has constant speeding, as there are two downhill sections. Cars are passing through at high speeds to get to the freeway entrances flanking the edges of the Crestmoor 3 neighborhood. It is very dangerous for my family as we back out of our driveway. We are also one block from John Muir school. I propose adding a 3-way stop sign to slow the traffic, along with speed bumps. I think all of these downhill neighborhoods should have these, speeding is a big problem around this area. This will only get worse when/if the crestmoor fields are converted to housing (the old high school), as the density will increase.	Motor Vehicle	Unsafe Speed
3x4ia3shw9r8	45	POINT (-122.407772 37.629818)	Y	3rd Ave	I live on the corner of 3rd and pine at a 4 way stop sign and approximately 65 percent of the cars do not stop, some roll through and from east to west people run through from 10 to 60 miles an hour. We have had two people run over in front of our home and when I call the police to notify or complain they state that they will come out when the have time. LOLOLO	Motor Vehicle	Stop Sign Violation
4cx3t7vof6k7	46	POINT (-122.428809 37.623916)	Y	W San Bruno Ave	People accidently run this light all the time. So many accidents here. Something should be done to alert people speeding down San Bruno Avenue about the double light.	Motor Vehicle	Traffic Signal Violation
3yl3lrm94lha	47	POINT (-122.438082 37.628984)	Y	Rolllingwood Dr	50 to 75% vehicles do not bother to stop @ the intersection of Rollingwood & Catalpa	Motor Vehicle	Stop Sign Violation
8oi6u37flj69	48	POINT (-122.434883 37.613607)	Y	Crestmoor Dr	Not stopping at this stop sign	Motor Vehicle	Stop Sign Violation
8oi6u37flj69	49	POINT (-122.435025 37.613527)	Y	Crestmoor Dr	Driving fast through the stop sign at all hours of the day Not stopping Need a speed bump Need police enforcement here! Pedestrians are crossing in crosswalk!	Motor Vehicle	Unsafe Speed
2dl94nac3iv4	50	POINT (-122.404361 37.616032)	Y	San Anselmo Ave	Need a four way stop. We have had several accidents at this corner because drivers come too fast on San Anselmo , it is a long stretch, cars can't be seen coming north to south when you are coming from existing stop signs. There's a park here also.	Motor Vehicle	Unsafe Speed
2dl94nac3iv4	51	POINT (-122.40319 37.616638)	Y	San Anselmo Ave	Need four way stop signs here. Traffic traveling on San Antonio go to fast. They have a long stretch to pick up speed. We have had multiple accidents at this location	Motor Vehicle	Unsafe Speed
2vx99p2u8g28	52	POINT (-122.407262 37.611409)	N	Cypress Ave	Cypress Avenue ending in Park, is hard for pedestrians to walk on. Cars park on the sidewalk on Cypress Avenue, such that pedestrians cannot use the sidewalk.	Pedestrian	Sidewalk
2vx99p2u8g28	53	POINT (-122.414783 37.613174)	Y	Santa Lucia Ave	Bushes block the visibility of the entrance/exit to this parking lot, such that cars cannot see pedestrians on the sidewalk.	Pedestrian	Sight Distance
2vx99p2u8g28	54	POINT (-122.415279 37.614889)	N	City Park Way	This crosswalk is closed due to the construction of the new rec center. This means that there is no pedestrian crosswalk in this area for pedestrians to use to safely cross this street.	Pedestrian	Sidewalk

Respondent ID	#	Lat Long	Intersection	Location	What traffic-related concern do you have at this location?	Mode	Pertinent Issue
2vx99p2u8g28	55	POINT (-122.415608 37.615642)	Y	Crystal Springs Rd	Cars routinely do not stop at this stop sign. I have almost been hit twice by a car that does not even slow down at this stop sign. I would recommend a traffic light, as people ignore the stop sign.	Motor Vehicle	Stop Sign Violation
3rx4jga2mle6	56	POINT (-122.424555 37.626144)	Y	W San Bruno Ave	Dangerous intersection for pedestrians due to right and left turns. Solution, during pedestrian crossing, all traffic from all directions stop. Pedestrians can cross any direction, even diagonally. This currently works in Japan.	Pedestrian	Pedestrian Right of Way
7vx9kyl62sga	57	POINT (-122.438001 37.630597)	Y	Rolllingwood Dr	Three way stop signs at Rollingwood & Catalpa. I would say that about 50-75% cars actually don't stop at this intersection. Some of the ones that don't stop all the time is the Sam Trans buses.	Motor Vehicle	Stop Sign Violation
4zc9g4ky22n8	58	POINT (-122.424295 37.625902)	Y	W San Bruno Ave	This intersection baffles me. Cars heading south on Cherry who wish to turn right onto San Bruno for some reason stop and yield to cars heading north on Cherry who are turning left onto San Bruno Ave. This is backwards. The cars turning right onto San Bruno heading west have a green light and the right of way while the cars turning left onto Cherry westbound DO NOT have a green left hand turn arrow and must yield to cars proceeding south on Cherry and cars turning right, heading west, onto San Bruno Ave. It boggles the mind. The solution is a sign for northbound drivers on Cherry informing them to yield to oncoming traffic is needed. Many drivers act as if they have a green, left turn arrow when they do not.	Motor Vehicle	Automobile Right of Way
4zc9g4ky22n8	59	POINT (-122.427235 37.630908)	Y	Cherry Ave	This is an intersection that is a three way stop. The parking lot of Peninsula Place is not part of the intersection since the entrance to the parking lot is not a public road. Yet many drivers act as if the intersection is a 4 way stop. Signage is needed to make it clear to drivers whether the intersection is a three way stop and drivers exiting the parking lot need to yield to all cars in the intersection or that the intersection is a 4-way stop.	Motor Vehicle	Automobile Right of Way
4sy6si9nal4a	60	POINT (-122.421597 37.614952)	Y	Cunningham Way	This entrance/exit ramp is seemingly confusing to drivers. I often witness cars slowing down or veering in their lane while attempting to figure which direction they need to take. Also, cars often cut across or u-turn or before this intersection, regardless of the direction they are traveling in. Ive seen a number of unnecessary collisions here.	Motor Vehicle	Automobile Right of Way
4sy6si9nal4a	61	POINT (-122.412662 37.622979)	Y	El Camino Real	This is an extremely dangerous intersection to cross as a pedestrian. Cars turning onto El Camino do not see or look for pedestrians. Or, cars will even drive through while people are in the crosswalks causing many "near miss" situations.	Pedestrian	Pedestrian Right of Way
4sy6si9nal4a	62	POINT (-122.422064 37.622172)	N	Cherry Ave	Cars drive very fast on Cherry, here the road narrows as it curves making it both a tight squeeze and hard to see oncoming traffic. Also, this is a park entrance, where a lot of people are walking, crossing, or getting things from their cars.	Motor Vehicle	Unsafe Speed

Respondent ID	#	Lat Long	Intersection	Location	What traffic-related concern do you have at this location?	Mode	Pertinent Issue
4sy6si9nal4a	63	POINT (-122.424263 37.625868)	Y	W San Bruno Ave	Turning left from Cherry onto San Bruno Ave is nearly impossible since cars driving south on Cherry crossing San Bruno Ave have the right of way and do not signal if making a left turn (in their direction onto eastbound San Bruno Ave). There is heavy southbound traffic from YouTube, Wallmart, and Bayhill shopping center and not a long enough green light to make this left turn. This needs to be changed to a protected-turn (green arrow signal) intersection. It is dangerous now as cars attempting to make this left turn are often blocking the intersection or driving in front of oncoming traffic, or attempting to make the turn even if pedestrians are crossing just to their left. This is a terribly designed and fatally dangerous intersection in the busiest business park in the area.	Motor Vehicle	Automobile Right of Way
	64		Y	W San Bruno Ave	Turning left from Cherry onto San Bruno Ave is nearly impossible since cars driving south on Cherry crossing San Bruno Ave have the right of way and do not signal if making a left turn (in their direction onto eastbound San Bruno Ave). There is heavy southbound traffic from YouTube, Wallmart, and Bayhill shopping center and not a long enough green light to make this left turn. This needs to be changed to a protected-turn (green arrow signal) intersection. It is dangerous now as cars attempting to make this left turn are often blocking the intersection or driving in front of oncoming traffic, or attempting to make the turn even if pedestrians are crossing just to their left. This is a terribly designed and fatally dangerous intersection in the busiest business park in the area.	Pedestrian	Pedestrian Right of Way
9au8t2c248fl	65	POINT (-122.421623 37.614953)	Y	Cunningham Way	Lane marking are not clear and traffic coming up Cunningham to get on freeway are often speeding.	Motor Vehicle	Unsafe Speed
9au8t2c248fl	66	POINT (-122.427027 37.625129)	N	W San Bruno Ave	Bike lanes are on San Bruno Ave west of 280 but not east	Bike	Bike Lane
9au8t2c248fl	67	POINT (-122.412657 37.623001)	Y	El Camino Real	Left the turn is often blocked by pedestrians due to light timing and the 3 way light causes confusion.	Motor Vehicle	Pedestrian Right of Way
94777kvv7e29	68	POINT (-122.416617 37.628743)	N	San Mateo Ave	Double parking and running stop signs on San Mateo Ave	Motor Vehicle	Stop Sign Violation
3vf4jee8c4da	69	POINT (-122.422231 37.619778)	Y	Cedar Ave	Please add a speed bump on the 500 block on Cedar Ave. I live on 544 Cedar Ave and have seen an increase in cars speeding down the block.	Motor Vehicle	Unsafe Speed
9pm2t4z3u4m3	70	POINT (-122.421939 37.639071)	Y	El Camino Real	Center island and light pole needs removal. Adequate lighting is provided on each side. Traffic builds up excessively to exit the center. Poor design.	Motor Vehicle	Traffic Congestion
9pm2t4z3u4m3	71	POINT (-122.421133 37.638762)	Y	El Camino Real	Vehicles cannot effectively exit the lot due to improper location of center island and light standard. Causes build up of exiting vehicles and tube Locke the exit roadway. Island should be removed.	Motor Vehicle	Traffic Congestion
9pm2t4z3u4m3	72	POINT (-122.411176 37.624629)	Y	San Mateo Ave	Choking down the intersection. This not only restricts vehicle movement, but allows pedestrians to stand closer to moving vehicle traffic. This occurs at too many locations. Thank you for reading this.	Motor Vehicle	Traffic Congestion
9pm2t4z3u4m3	73	POINT (-122.411592 37.630823)	Y	E San Bruno Ave	This intersection has been constructed below surrounding subgrade which makes it Subject to flooding during heavy rains. Historicly this intersection was at surrounding subgrade and never had any flooding issues. Basically engineers constructed a lake.	Motor Vehicle	Flooding
9pm2t4z3u4m3	74	POINT (-122.412779 37.630298)	Y	W San Bruno Ave	Protruding sidewalks. Map not current. Endangers pedestrians.	Pedestrian	Sidewalk
9pm2t4z3u4m3	75	POINT (-122.413601 37.629999)	Y	W San Bruno Ave	Protruding sidewalks impact vehicular traffic and place pedestrians into the roadway.	Pedestrian	Sidewalk
9pm2t4z3u4m3	76	POINT (-122.414341 37.629692)	Y	W San Bruno Ave	Protruding sidewalks. Typical. This map not current.	Pedestrian	Sidewalk

Respondent ID	#	Lat Long	Intersection	Location	What traffic-related concern do you have at this location?	Mode	Pertinent Issue
7x2vni9z7on9	77	POINT (-122.424176 37.625969)	Y	W San Bruno Ave	No controlled left turn going West and East directions. Husband and pets neatly killed. Left turn going East onto SB Ave- need to remove center island to accommodate a dedicated left turn lane with left turn signal only.	Motor Vehicle	Improper Turning
7k69629zak76	78	POINT (-122.417678 37.625895)	Y	Kains Ave	Cars do not stop at the stop sign, especially travelling west up kains	Motor Vehicle	Stop Sign Violation
3s92wps2dwm8	79	POINT (-122.454228 37.632038)	Y	Skyline Blvd	There are two left town lanes. There should be a sign to let the inside, left lane know there are obviously two than lanes. Every day we are almost hit, since the inception of the lanes years ago, by the inside lane turning wide into the right turn lane. And the audacity that they think they always abiding by the law.	Motor Vehicle	Improper Turning
	80	LINESTRING (-122.418464 37.631739, -122.421387 37.636756, -122.418189 37.631376)	N	El Camino Real	Very dangerous for bicycles. Traffic merging onto 380 from El Camino.	Bike	Bike Lane
	81	LINESTRING (-122.463478 37.63803, -122.462847 37.637621, -122.463877 37.638188, -122.463248 37.637541, -122.462979 37.637271, -122.462844 37.63705, -122.462387 37.636687, -122.461705 37.636286, -122.461355 37.63608, -122.460942 37.635874, -122.46043 37.635582, -122.45972 37.635198, -122.459298 37.634928, -122.458948 37.634743, -122.458254 37.634378, -122.457831 37.634115, -122.457598 37.633966, -122.457299 37.633744, -122.457236 37.633659)	N	Susan Dr	Cars speed down Susan drive all the time	Motor Vehicle	Unsafe Speed
	82	LINESTRING (-122.44176 37.630072, -122.447534 37.62827, -122.450158 37.629864, -122.451995 37.631804, -122.453395 37.634021, -122.45077 37.635753, -122.447359 37.636307, -122.443334 37.635891, -122.440622 37.636515, -122.439398 37.634991, -122.438785 37.63312, -122.439485 37.631319, -122.44176 37.630626)	N	Fleetwood Dr	This area is unsafe for wheelchair users. Many sidewalks at intersections have not cut-outs for wheelchairs to get from sidewalk to street or vice versa. Trying to use driveway cut-outs is problematic as the slops is too steep or too abruptly varying to navigate in a wheelchair. Plus, many homes have short driveways and cars parked in driveways frequently stick out into sidewalks. When walking my dog in my neighborhood using the wheelchair, I have found using sidewalks to be unworkable and instead I'm out in the street with the car traffic. -Eric L:ast, 2230 Pinecrest Drive.	Pedestrian	Sidewalk
	83	LINESTRING (-122.419973 37.634151, -122.419845 37.633927)	Y	El Camino Real	Southbound el Camino going to freeway on-ramp could have more visible dividers so that it doesn't look like I am going to run into them when exiting 380 offramp	Motor Vehicle	Improper Turning
	84	LINESTRING (-122.415456 37.629274, -122.412767 37.630316)	N	W San Bruno Ave	difficult to see pedestrians on this stretch of San Bruno Ave at night because of oncoming traffic headlights	Pedestrian	Lighting
	85	LINESTRING (-122.412625 37.622462, -122.412444 37.622553, -122.412335 37.622431, -122.412391 37.622418, -122.412464 37.622505, -122.41259 37.62244, -122.412623 37.622461)	Y	El Camino Real	can be hard to see pedestrians and oncoming traffic when leaving Wendy's	Pedestrian	Sight Distance

Respondent ID	#	Lat Long	Intersection	Location	What traffic-related concern do you have at this location?	Mode	Pertinent Issue
	86		N	Memory Ln	Memory Lane needs to get repaved. The concrete blocks have been lifted up by the roots of the trees and made this walkway very unsafe for walking especially for those with disabilities or need the use of canes, walkers, or wheelchairs. Since it's only partially lit from the Honda dealer, walking at night through this area is hazardous.	Motor Vehicle	Poor Pavement
	87		N	Memory Ln	Memory Lane needs to get repaved. The concrete blocks have been lifted up by the roots of the trees and made this walkway very unsafe for walking especially for those with disabilities or need the use of canes, walkers, or wheelchairs. Since it's only partially lit from the Honda dealer, walking at night through this area is hazardous.	Pedestrian	Sidewalk
	88	LINESTRING (-122.412228 37.621112, -122.411708 37.621338)	N	Memory Ln	Memory Lane needs to get repaved. The concrete blocks have been lifted up by the roots of the trees and made this walkway very unsafe for walking especially for those with disabilities or need the use of canes, walkers, or wheelchairs. Since it's only partially lit from the Honda dealer, walking at night through this area is hazardous.	Pedestrian	Lighting
	89	LINESTRING (-122.406676 37.621467, -122.400157 37.612769)	N	Huntington Ave	Road is in poor condition. This is a designated bike roadway and it's unsafe to ride on because of the condition of the road. Needs to be repaved for the safety of bikers using this designated roadway.	Bike	Poor Pavement
	90	LINESTRING (-122.456059 37.6327, -122.456258 37.631968, -122.454554 37.631566, -122.453683 37.632025, -122.454173 37.632542, -122.456059 37.632657)	N	College Dr	Bad road conditions on College drive between Skyline and Susan Dr are contributing to a gravel problem in this area. That road needs work. It looks like the PCI (pavement condition index) is 19 ("failed"): https://www.sanbruno.ca.gov/civicax/filebank/blobdload.aspx?t=43813.19&BlobID=29837 The gravel then travels down to Skyline Blvd where it accumulates in the interested and crosswalks. The intersection is dangerous. How does the city coordinate with Caltrans on this kind of thing? I've submitted tickets to the city about this before, but without a good result. The problem basically still exists. City of San Bruno ticket (this explains in better detail what's going on): https://iframe.publicstuff.com/#?client_id=1000143&request_id=10394300#request-show Caltrans ticket: #850532 (07/09/2021)	Motor Vehicle	Poor Pavement
	91	LINESTRING (-122.424204 37.625735, -122.423931 37.62499, -122.423017 37.62338, -122.422171 37.622234, -122.420902 37.620591)	N	Cherry Ave	Cars regularly park on sidewalks, blocking pedestrians including people with strollers and wheelchairs.	Motor Vehicle	Parking
	92	LINESTRING (-122.416317 37.628892, -122.412193 37.630574)	N	W San Bruno Ave	Lighting at sidewalks is very inadequate. Difficult to see pedestrians at night, especially important on fast moving arterial road.	Pedestrian	Lighting
	93	LINESTRING (-122.423961 37.61483, -122.423054 37.614486, -122.421576 37.614814)	N	I280 Off Ramp	offramp needs better lighting at night.	Motor Vehicle	Lighting
	94	LINESTRING (-122.406204 37.615111, -122.411506 37.621433, -122.418679 37.632281, -122.423468 37.64024)	N	El Camino Real	inadequate pedestrian crossing opportunities -- dangerous, insufficient lighting and safety measures.	Pedestrian	Pedestrian Right of Way
	95		N	El Camino Real	inadequate pedestrian crossing opportunities -- dangerous, insufficient lighting and safety measures.	Pedestrian	Lighting

Respondent ID	#	Lat Long	Intersection	Location	What traffic-related concern do you have at this location?	Mode	Pertinent Issue
	96	LINESTRING (-122.411008 37.619963, -122.411262 37.619856, -122.412106 37.619147, -122.412731 37.618665, -122.413272 37.618371, -122.413508 37.617956, -122.414082 37.617287, -122.41461 37.616698, -122.415218 37.616136)	N	Crystal Springs Rd	People drive on Crystal Springs Ave. at extremely high rates of speed. This makes the crosswalks, most of them “blind crosswalks”, very dangerous for pedestrians. Crystal Springs Ave. needs a stop sight at every cross-road intersection.	Motor Vehicle	Unsafe Speed
	97	LINESTRING (-122.412803 37.622889, -122.412487 37.623035)	Y	El Camino Real	Eastbound drivers will turn into pedestrians due to short green light.	Motor Vehicle	Improper Turning
	98		Y	Crestmoor Dr	In addition (and this isn't within the line I drew), I cannot understand why there is no stop sign at the top of Princeton where it meets Crestmoor.	Motor Vehicle	Stop Sign Violation
	99	LINESTRING (-122.430696 37.615446, -122.43062 37.612113)	N	Madison Ave	With young new families moving with small children, we really need a speed bump between Rosewood and Bennington at the very least. In addition (and this isn't within the line I drew), I cannot understand why there is no stop sign at the top of Princeton where it meets Crestmoor.	Motor Vehicle	Unsafe Speed
	100	LINESTRING (-122.447263 37.62869, -122.448462 37.628473, -122.444242 37.62932, -122.442449 37.63035, -122.440903 37.631289, -122.439385 37.630556, -122.439053 37.63035)	N	Rolllingwood Dr	Road needs repaving. So many cracks...worried about sink holes.	Motor Vehicle	Poor Pavement
	101	LINESTRING (-122.449455 37.625365, -122.449529 37.625475, -122.449338 37.625171, -122.449178 37.624994, -122.448923 37.624598, -122.44872 37.624395, -122.448348 37.624193)	N	Sneath Ln	People speed on this road frequently, easily going 40-50mph. I think putting speed bumps would definitely remedy this problem. There are always kids walking in this area, thus the concern for people speeding.	Motor Vehicle	Unsafe Speed
	102	LINESTRING (-122.410324 37.621544, -122.4104 37.621484, -122.410343 37.626456)	N	Mastick Ave	Speeding traffic all hours of the day and night	Motor Vehicle	Unsafe Speed
	103	LINESTRING (-122.41126 37.621368, -122.411342 37.629018)	N	San Mateo Ave	Many many people double parking causing traffic issues and making it hard to see pedestrians trying to cross the streets downtown.	Motor Vehicle	Parking
	104		Y	Hazel Ave		Motor Vehicle	Narrow Street
	105	LINESTRING (-122.417206 37.620855, -122.417087 37.62091, -122.41705 37.620947, -122.417081 37.620983, -122.417312 37.620886, -122.4173 37.620848, -122.417239 37.620881)	Y	Janevein Ave	2 concerns: First, turing onto Jenevein from Hazel dangerous due to the poor visibility and the speed of the traffic on Jenevein. Visibility at this intersection is poor both when driving north on Hazel to turn at Jenevein, and also when turning south onto Hazel from Jenevein. It is similarly difficult to see pedestrians walking on the sidewalk. Second, cars turning south onto Hazel from Jenevein drive at opposing traffic coming north down the steep Hazel hill. There is physically not enough room for 2 cars to pass if a car is driving south on Hazel due to the narrow street and cars parked right up to the corner on both streets. Both issues would be solved by small red-curb zones at the corner of Jenevein and Hazel.	Motor Vehicle	Sight Distance

Respondent ID	#	Lat Long	Intersection	Location	What traffic-related concern do you have at this location?	Mode	Pertinent Issue
	106	LINESTRING (-122.423094 37.618162, -122.421341 37.615723)	N	Hawthorne Ave	Speeding during school hours. Our street sees heavy traffic before and after school hours as folks from across San Bruno drop their children at the only middle school. Most folks drive at safe speeds, however some others drive at reckless speeds. A 15mph, speed limit with signage, and a once per year speed trap would be much safer.	Motor Vehicle	Unsafe Speed
	107	LINESTRING (-122.409548 37.619698, -122.409261 37.619842)	Y	Chapman Ave	Seeking to add a four way stop here in this intersection. There is no four way stop signs here. With several popular restaurants around the neighborhood, we've been seeing drivers coming from mastick not realizing that there is no stop signs on Chapman every weekend.	Motor Vehicle	Stop Sign Violation
	108	LINESTRING (-122.409008 37.619975, -122.408789 37.620169, -122.408593 37.619926)	N	Mastick Ave	I've asked the city to kindly consider painting parallel parking lines similar to the ones in downtown San Bruno. The neighbors in this area have lived here for 30+ years and have become very territorial. Sometimes taking up two spots on the block on purpose so their families can park there later at night. Asking the city to consider parallel parking lines on the entire block of east ave and mastick ave.	Motor Vehicle	Parking
	109	LINESTRING (-122.410555 37.620332, -122.410606 37.620402, -122.410629 37.620432)	Y	El Camino Real	Suggesting to paint the curb red here. Reason is cars turning from crystal springs rd have been getting into close call accidents as people leave from the parallel parking spots on el camino real.	Motor Vehicle	Parking
	110	LINESTRING (-122.415502 37.638225, -122.415917 37.638158)		Huntington Ave	Needs a speed bump cars go way to fast for a neighborhood and some cars even go down Huntington Ave east the wrong way and is dangerous AF	Motor Vehicle	Unsafe Speed
	111		N	Camino Plaza	Constant double parking, unsafe u-turns, and open drug sales.	Motor Vehicle	Parking
	112	LINESTRING (-122.41649 37.626659, -122.416185 37.627323, -122.416517 37.627827)	N	Camino Plaza	Constant double parking, unsafe u-turns, and open drug sales.	Motor Vehicle	Improper Turning
10b03b2f-7958-45b1-bc2c-e6dfc963f52a	113	Email	Y	W San Bruno Ave	I have observed very pedestrian safe intersections in Japan. All traffic halts from all directions during the pedestrian crossing time. Pedestrians can safely cross from any direction even, diagonally. A simple and effective solution. Will work well at Cherry and San Bruno ave.	Pedestrian	Pedestrian Right of Way
40d58261-9b9f-4f12-a02f-d7e81f5274a9	114	Email	Y	6th Ave	Big rigs constantly use 6th Avenue to get to SSF. The roads are constantly broken,. Rigs hit parked cars at corner for 6th and Walnut . Weight capacity not respected and enforced.	Motor Vehicle	Improper Turning
42e7a71d-9560-4222-a4b7-179bfc1fd979	115	Email	N	Niles Ave	The roads around Parkside middle school (NILES AVE, CEDAR AVE, REDWOOD AVE, HAWTHORN AVE, MAPLE AVE CHERRY AVE) are awful, before school and when it let's out. This has been an ongoing problem since the school expa fed to take on 6th graders. Neighbors like myself have been asking for improvements. The police department never have an answer besides " we are looking into the situation to improve thing". I have heard that a swer from the police department the last few years. I have witness many near missed of kids almost getting hit by speeding cars or cars making illegal u turns on these narrow streets. It seems like the city doesn't care and the do not value the residents of the area concerns and also that doesn't value the concern of public safety or life. We are lucky no one has been killed by one of these motorist. I invite everyone of you to visit the area on a school day specifically when school let's outs (especially on half days when it's even worse). When someone is actually seriously hurt or killed by a car then I'm sure San Bruno will take action. Seems like the moto of the city, instead of prevention things thing are only addressed after a serious incident.	Pedestrian	School Safety

Respondent ID	#	Lat Long	Intersection	Location	What traffic-related concern do you have at this location?	Mode	Pertinent Issue
43694741-be9d-4c40-9a0c-7a8b59c3db57	116	Email	Y	Sneath Ln	The T-shape intersection is confusing, with the free left turn from Sneath Lane into Monterey Drive, which might be a cause for the slightly elevated accident history. The line across Sneath Lane when coming from Skyline Blvd adds to the confusion. Perhaps changed road markings or in the extreme an all-way stop could be considered?	Motor Vehicle	Automobile Right of Way
630669c7-87ff-4103-8404-2bff38176b17	117	Email	N	Cherry Ave	58 years ago when I moved from San Francisco to Cherry Ave, it was a big deal when 1 car a day drove by my home at 521 Cherry. Occasionally 2 cars would go by. How times have changed. Now Cherry is a very busy street and we even have busses! The cars go much too fast, especially between Jenevein and Park. The hill seems to make drivers feel like it's a roller coaster so they go fast no matter what direction they are traveling. The speed continues between Park and Kains. Some years ago, a little girl who lived next door was hit by a car and suffered broken bones. It was extremely concerning. I hope you can find a way to reduce speeds on Cherry.	Motor Vehicle	Unsafe Speed
82f0f9e5-4611-42c3-8882-b18f0ed1fe86	118	Email	Y	3rd Ave	85% do not use the stop signs on the corner of 3rd and Pine even the police roll through.	Motor Vehicle	Stop Sign Violation
835f2100-0cee-44f8-96db-729609231ff0	119	Email	N	Cedar Ave	I've lived in 544 Cedar Ave almost 15 years and have witness a high increase in cars speeding. It's only a matter of time that an injury will happen. Please add a speed bump on the 500 Cedar Ave block.	Motor Vehicle	Unsafe Speed
8c362a17-2ba5-41a1-9485-13bf535e40a5	120	Email	N	El Camino Real	First step is to pass an EQUITABLE STREETS RESOLUTION to repurpose on-street parking on El Camino Real to protected micro-mobility device lanes. San Bruno's Bike & Pedestrian Master Plan already mentions it, and Caltrans already gave their blessings, but the last step before any changes can be made is for city councils to pass a resolution. The absolute most important segment that needs repurposing is the 2.7 miles of ECR between San Bruno Ave and Millbrae Ave, because it closes the Bay Trail Gap! Existing 🚗 🚗🚗🚗 __🌲__🚗🚗🚗 🚗 14' 12' 12' 12' turn 12' 12' 12' 14' = 100+ INDUCED DEMAND: There is never enough room for cars! They still want more space! There is only one solution - EQUITY! Proposal 🚲🛴 🌳 🚌🚗 ___i 🚗🚌 🌳🛴🚲 9' 9' 5' 11' 10' 10'2' 10' 11' 5' 9' 9' = 100' Slow 🌳 Fast Fast 🌳 Slow (Reducing width is the ONLY way to slow the fast lanes) Middle is 10' turn lane + 2' crash barrier. Two 5' raised medians serve as bus stop, pedestrian island, and barrier between SLOW micromobility devices and FAST automobile + buses	Motor Vehicle	Traffic Congestion
9725b6cc-a45e-4e5c-91b2-59ed9ee096d5	121	Email	N	Crystal Springs Rd	I couldn't get the map to go where I wanted to draw a line, so I will just tell you. On Crystal Springs road the sidewalk stops at the rec center. Pedestrians are expected to walk around the rec center and take an uneven asphalt path over the creek and through the woods if they want to walk to the senior center. Sometimes pedestrians don't realize this or don't like that option and try to walk along Crystal Springs Road in that area. Very dangerous! It may become an even bigger problem if SamTrans discontinues Service to the senior center. We need a sidewalk along Crystal Springs Road going to the senior center.	Pedestrian	Sidewalk

Respondent ID	#	Lat Long	Intersection	Location	What traffic-related concern do you have at this location?	Mode	Pertinent Issue
be993642-35fe-4c7e-a7b7-19334e14ea0b	122	Email	N	Rolllingwood Dr	Street lights have been out for about 3 months in Rollingwood area and Rolllingwood Dr needs some kind of reflectors or lines in the middle of the street. The yellow line is non existent and when it's foggy it's a dangerous drive in the dark down the hill.	Motor Vehicle	Lighting
d2d6e1c7-cd55-41b1-b391-691d98f9a4df	123	Email	N	E San Bruno Ave	Cars speed in this stretch constantly, pedestrians are not able to feel safe crossing the street.	Motor Vehicle	Unsafe Speed
e3bc083d-b760-48dd-b82f-1e05d11e6d36	124	Email	N	Masson Ave	About once a week, I notice excessive speed on the 700 block of Masson, north or southbound.	Motor Vehicle	Unsafe Speed
f67f90d1-f1c0-4ff7-bd77-7fe70da0ee17	125	Email	Y	El Camino Real	I've always felt that while traveling South on El Camino and making a right turn onto Jenevein while the light is red is a very dangerous situation for pedestrians crossing El Camino on the North side of Jenevein. They are very hard to see with the other cars continuing South stopped at the light. More pedestrian signage or lights might save a life there.	Pedestrian	Pedestrian Right of Way

Appendix B:
Summary of Planning Documents

Table 1: Matrix of Planning Goals, Policies, and Projects

Document	Highlights

City of San Bruno General Plan (2009)	• Policy T-E - Focus San Bruno's efforts on improvements to the non-motorized transportation system (i.e., bicycles, pedestrians, strollers, etc) adjacent to transit corridors and stations, and their connections to those systems.
	• Policy T-J - Develop a safe, convenient, and continuous network of sidewalks and pedestrian paths within the city
	• T-10 - Improve signage and access at the intersection of San Mateo Avenue, Taylor Avenue, and El Camino Real.
	• T-13 - Study ways to separate through-traffic from local traffic on Euclid Avenue to eliminate its use as both an alternative route to the I-380 onramp, and a shortcut between Huntington Avenue and El Camino Real.
	• T-14 - Use traffic-calming measures to reduce speeding in residential areas, rather than limiting through-street connections. Traffic-calming measures may include:
	  ○ Narrowing travel lanes and allowing on-street parking;
	  ○ Using different paving materials at pedestrian crosswalks;
	  ○ Planting street trees and other vegetation;
	  ○ Building corner bulb-outs and intersection roundabouts;
	  ○ Installing stop and/or yield signage; and
	  ○ Speed limit enforcement or other mitigation measures.
	• HS-15 Implement traffic-calming measures along College Drive and Skyline Boulevard.HS-16 Install safety improvements along Sneath Lane to improve visibility of signals. Such improvements may include signage and lighting.
	• HS-17 Synchronize traffic signals between El Camino Real, Sneath Lane, Huntington Avenue, and San Bruno Avenue, to improve traffic flows into and out of the San Bruno BART Station.
	• T-43 - Create a "pedestrian-friendly" environment surrounding the BART and Caltrain stations by installing additional street trees, lighting, signage, and widening sidewalks along streets adjacent to these stations.
	• T-48 - Incorporate a dedicated pedestrian crossing and flashing street markers at the new four-way signal installed on El Camino Real connecting The Crossing with The Shops at Tanforan and the San Bruno BART station.
	• T-79 - Prioritize improvements to sidewalks and other walking paths adjacent to public school facilities where children and youth are likely to use them on a daily basis.
	• T-80 Install safety improvements for pedestrian crossings along El Camino Real. Such improvements may include bulb-outs at the corners, crossing medians, and signal synchronization.

Document	Highlights
City of San Bruno Traffic Calming Policy and Supplement (2020)	A list of devices available for implementation includes: • Speed & Warning Signs • Electronic Speed Radar Signs • Turn Restriction Signs • Speed Humps • Narrow Median Islands • Chokers & Bulb-outs • Landscape Trees • Traffic Circles • Forced Channelization • One-Way Entrances/Exits • Cul-de-Sacs • One-Way Chicanes
City of San Bruno Traffic Calming Brochure (2020)	What are the Principles and Guidelines of the Traffic Calming Program? • The TCP process only applies to local residential and collector streets; not larger streets such as arterials. • Some diversion of traffic is expected and a low ambient level of non-neighborhood traffic always exists. • Emergency vehicle access as well as pedestrian and bicycle access should be maintained on traffic-managed streets. • Removal of some street parking may be necessary to implement traffic calming tools. • Requests for traffic calming tools shall be evaluated on a first-come first- served basis as signed petitions are received. • Traffic calming tools need simple-majority (50%+1) approval of the responding neighborhood residents and property owners. • Stop signs and traffic signals are not traffic calming measures.
City of San Bruno Traffic Calming Toolkit (2010)	Traffic Calming Measures and Devices • Community Outreach • High Visibility Crosswalks • Police Enforcement • Roadway Striping • Speed Display Units • Signed Turn Restrictions

Document	Highlights
	• Chicanes • Chokers • Medians • Speed Humps and Speed Tables • Traffic Circles/Roundabouts • Diverters • Median Barriers • Street Closures
San Bruno Transit Corridors Plan (2013)	**A1 ROADWAYS** • A1-1 Reduce pedestrian crossing distance at crossing locations by utilizing features such as bulbouts in parking lanes between parking spaces and at corners. Provide well-designed traffic calming devices on along corridors, including traffic circles, bollards, bulbouts and chicanes to create pleasant livable environment. • A1-2 Reassess best urban design for El Camino Real, San Bruno Avenue, Huntington Avenue and San Mateo Avenue to reach proper balance between driving, parking, walking and biking interests. • A1-3 Provide adequate buffer between pedestrian zones and vehicle driving zones consisting of landscaping and/or curbside parking to ensure safe and appealing pedestrian environment within the Pedestrian Emphasis Zone. **A2 CROSSWALKS AND BULBOUTS** • A2-1 Provide clearly marked minimum 10-foot wide crosswalks at all controlled intersections and at intersections of key streets, as described in the Transportation Chapter. • A2-2 Ensure that all crosswalks have ramps and warning strips that comply with Americans with Disabilities Act (ADA) standards. • A2-3 Explore using special paving materials, colors, and/or patterns for crosswalks to heighten visibility and lend identity to the area while creating an attractive pedestrian environment. • A2-4 Explore the use of in-pavement flashers and crosswalk signage that flashes to alert drivers of a crossing, especially at key intersections along El Camino Real and San Bruno Avenue and San Mateo Avenue. • A2-5 Provide bulbouts along El Camino Real, San Bruno Avenue, and Huntington Avenue at intersections and pedestrian crossing locations. • A2-6 Consider development of new mid-block pedestrian crossing locations on El Camino Real, San Bruno Avenue and Huntington Avenue when justified by

Document	Highlights
	pedestrian traffic study, in conjunction with site development or in response to existing pedestrian demand. • A2-7 Encourage the design of corner bulbouts at intersections to function as pocket plazas with pedestrian amenities such as landscaping, seating, trash receptacles, and bicycle racks. **A3 SIDEWALKS AND LANDSCAPING** • A3-1 Ensure that all streets have continuous sidewalks conforming to the ADA standard of a minimum width of five feet. Where possible, encourage a minimum six-foot wide pedestrian zone to provide comfortable pedestrian circulation. • A3-2 Locate street trees and planter strips between sidewalks and roadway to provide a safety buffer for pedestrians from traffic. Allow tree wells and planters to be used instead of planter strips in cases where parking or bicycle lanes are located next to sidewalks. • A3-3 Ensure that planters and tree wells are at least four feet wide to allow for healthy street trees. Incorporate well designed tree grates in tree wells • A3-4 Landscape planter strips with shade-providing trees and shrubs. For sidewalks, select tree species that do not create excess shade and obstruct pedestrian circulation • A3-5 Select tree species for street medians consistent with scale and design theme for roadway segment. Ensure that tree canopies are high and airy to create a pleasant streetscape without impeding roadway visibility. • A3-6 Use low-maintenance native or drought tolerant plant species in streetscape landscaping to minimize water consumption and maintenance. • A3-7 Discourage use of turf, grass or landscaping that requires high water usage. • A3-8 Promote outdoor dining and display of selected goods (i.e. fruit and vegetable stands, flowers, clothing standards, etc.) on sidewalks, where sidewalk width is sufficiently wide, to activate the streetscape. Maintain a pedestrian zone of five feet in addition to sidewalk seating, displays or activity areas. • A3-9 Ensure at least a 12-foot tree canopy clearance from the finished sidewalk elevation to provide clear emergency and service access, allow light penetration from pedestrian-scale street lights, and create visual connections between buildings, signage, the sidewalk and the roadway. • A3-10 Place new street trees in appropriate locations to avoid blocking views and access to building entrances or signage.

Document	Highlights
	• A3-11 Ensure that trees do not obstruct ADA access, or infringe on pedestrian and/or bicycle circulation.
San Mateo Avenue Conceptual Streetscape Plan (2019)	**Recommended Improvements Tier 1** • Sidewalk replacement, ramps • Bus stop improvements • Street trees (with tree grates) • Street lights (pole-mounted, 60' spacing) • Trash and recycling receptacles • Benches • Seatwalls • Bike racks • Wayfinding signage • Planting and irrigation • Waterline relocation/ demolition and earthwork **Recommended Improvements Tier 2** • Permeable paving along sidewalks • Curb realignment • Suspended pavement for street trees • Gateway monuments • Paseo gateway monuments • Road striping • Planting and irrigation at existing bulb outs • Paseo improvements/art installation **Recommended Improvements Tier 3** • Centennial Park improvements • Artistic expression lighting at benches • Additional storm water management

City of San Bruno Walk 'n Bike Plan	**Priority Pedestrian Facility Improvement Recommendations:**
	• El Camino Real / I-380
	  ○ Yield signs and yield lines
	  ○ Pedestrian crossing warning signs
	  ○ RRFB
	  ○ High visibility crosswalk markings
	  ○ Relocated curb ramp

Document	Highlights

	• El Camino Real / I-380 ramps—longer term
	  ○ Bulb out with reduced corner curb radius
	  ○ On-ramp realignment
	  ○ Right turn pocket
	  ○ New sidewalk
	• El Camino/San Bruno Ave
	  ○ Lane narrowing
	  ○ Turn pocket removal with bulb out
	  ○ Pedestrian refuge island
	• San Bruno Ave/ Easton AVE
	  ○ Yield lines
	  ○ High visibility crosswalk
	  ○ Bulb out
	  ○ Shared lane markings
	• Huntington Ave from Centennial Way Trail to Downtown
	  ○ Shared lane markings
	  ○ Raised buffer
	  ○ Two way separated bikeway
	  ○ Pedestrian streetscape
	• Cherry Ave at Grundy Lane
	  ○ Two stage left turn box
	  ○ Pedestrian refuge island
	  ○ Pedestrian warning signs
	• El Camino Real at Bay Hill Dr/ Euclid Ave
	  ○ Bicycle signal
	  ○ Buffered bike lane
	  ○ Bay Hill Road diet
	  ○ Separated bike left turn pocket
	• San Bruno at Elm Avenue
	  ○ Widened roadway
	  ○ Buffered bike lane
	  ○ Relocated vehicular lanes
	  ○ Road diet Elm Ave
	  ○ Shared Lane markings
	• San Bruno under I-280
	  ○ Buffered bike lanes
	  ○ Road diet

Bayhill Specific Plan (2021)	Cherry Avenue Proposed Conditions

Document	Highlights
	• Buffered bike lane • Green thermoplastic through conflict zones • Median refuge island Cherry Avenue/ Grundy Lane Proposed Conditions • Sharrows • Wider median Cherry/ San Bruno Avenue Proposed Conditions • Class II Bike lanes • Wider sidewalks with planers • New bus shelters • Corner curb radii tightened • Pedestrian refuge islands • Bike box • High visibility crosswalks Bay Hill Drive Proposed Conditions • Buffered Bike lane • Wider sidewalk • Storm water planters Traeger Avenue Proposed Conditions • Wider sidewalk • Storm water planers San Bruno Avenue Proposed Conditions • Buffered bike lane • Median refuge island • Wider sidewalk • Stormwater planer
San Bruno / South San Francisco Community-Based Transportation Plan (2012)	**Transportation Strategies:** • Improve Transit Stop Amenities and Security • Improve the Affordability of Public Transit for Low-income Users • Improve Bicycle Amenities • Provide Free or Low-cost Bicycles • Improve Pedestrian Amenities

Document	Highlights
	○ Pedestrian countdown signals; Additional crossing time for pedestrians; Improved crosswalk visibility such as flashing beacons and high visibility striping; Benches; Traffic calming; New sidewalks or improve/repair existing sidewalks; Curb ramps; Curb extensions or pedestrian bulb-outs; Street lighting; Wayfinding signage; and Median refuges. • Increase Public Access to Information about Transportation Options • Increase SamTrans Bus Service • Improve Connectivity of Existing Transit Service • Improve access to the South San Francisco Caltrain Station
City of San Bruno Operating and Capital Budget (2021-22)	**FY 2020-2021 Accomplishments** • Huntington Avenue/San Antonio Avenue Street Rehabilitation Project • Lara Field and Senior Center Parking Lot Rehabilitation Project Budgeted Expenditures • San Bruno Avenue/Cherry Avenue Intersection Modification Project • Scott Street Grade Separation Project Study Report • Senior Center Trash Enclosure Project • Spyglass Drive Storm Drain Improvements Project **FY 2021-22 Goal and Objectives** Complete Design/ Study for the following: • 2020-21 Sidewalk Replacement Project • 2021 Street rehabilitation Project • Acapella Well replacement Project • Avenues 2-1 Sewer and Water Replacement Project • Huntington Avenue/San Antonio Avenue Pedestrian/Bicycle Corridor Improvements Project • Sweeny Ridge Tank Replacement Project • Oak Avenue and Crystal Springs Road Traffic Signal Project Complete Construction for the following: • 2020-21 Sidewalk Replacement Project • Advanced Water Meter Installation Project • Florida Avenue Park Project • Huntington Avenue/ San Antonio Avenue Pedestrian/ Bicycle Corridor Improvements Project • Lara Field and Senior Center Parking Lot Rehabilitation Project • San Bruno Avenue/Cherry Avenue Intersection Modification Project • Senior Center Trash Enclosure Project

Document	Highlights
	• Standby Emergency Generators for Whitman and Princeton Pump Stations
2021 C/CAG San Mateo County Comprehensive Bicycle and Pedestrian Plan	Proposed Projects • Sneath Ln: Interstate Highway 280 to Rollingwood Dr- Class 2 Bicycle Lane • Sneath Ln: El Camino Real to 1st St W – Class 2 Bicycle Lane • San Mateo Ave: El Camino Real to E San Bruno Ave – Class 3 Bicycle Route • Huntington Ave, San Anselmo Ave, San Antonio Ave, Santa Helena Ave, S San Anselmo Ave: Center St to San Mateo Ave – Class 3b Bicycle Blvd • Center St: San Anselmo Ave to Centennial Way Trail – Class 2 Bicycle Lane • Angus Ave: Huntington Ave to Bay Trail – Class 3 Bicycle Route • Bay Trail: E San Bruno Ave to Angus Ave – Class 2 Bicycle Lane
San Mateo Countywide Transportation Plan 2040 (2017)	Policies Improve the efficiency of the existing roadway system in San Mateo County • Increase the connectivity of the roadway system to provide more direct routes between origins and destinations. • Develop a more complete system of managed lanes to provide an incentive for ridesharing and to increase transit operating speeds. • Improve freeway interchanges at key locations. Focus capacity-increasing program on the most congested commute corridors • Construct key highway projects that remove or reduce bottlenecks in the most congested commute corridors. • Give consideration to the VMT-inducing impacts of roadway projects that increase capacity, consistent with state law. Improve connections with regional transportation facilities • Construct or improve roadways that connect major inter-county highway facilities and transit stations. Enhance safety for travel by motorized modes • Identify and eliminate roadway and intersection hazards. • Improve the geometric design of roadways where current design is creating vehicle conflicts and crashes. • Consider the use of roundabouts, where appropriate, to improve safety at intersections. • Create separate lanes or facilities for non-motorized modes where feasible. • Provide grade separation for Caltrain where feasible. Maintain the roadway system • Maintain an inventory of roadway facilities and maintenance needs.

Document	Highlights

	• Provide adequate funding for roadway maintenance. Roadway System Objectives:
	  ○ Improve the person throughput of the roadway system.
	  ○ Reduce the number and severity of crashes on roadways in San Mateo County.
	  ○ Reduce the rate of growth of roadway congestion.
	  ○ Maintain the roadway system at an acceptable level.
	  ○ Reduce the per capita vehicle miles travelled on the roadway system.

Appendix C:

Extended List of High Injury Intersections Ranking in City of San Bruno

Name	Int ID (Based on EPDO Ranking)	Pedestrian	Nighttime	Unsafe Speed	Rear End	Broadside	Total Injury Collisions	KSI	Fatal Collisions	Severe Injuy Collsions	Injury (Visible Injury)	Injury (Complaint of Pain)	Severity Weight
El Camnio Real and Sneath Ln	1	5	7	4	6	4	21	2	0	2	9	10	489
El Camnio Real and Commodore Dr	2	3	8	5	7	3	15	2	1	1	10	3	458
El Camino Real and Santa Lucia Ave	3	4	6	3	4	4	13	2	1	1	7	4	431
El Camnio Real and San Bruno Ave	4	1	4	5	10	1	14	2	0	2	4	8	422
San Bruno Ave and 3rd Ave	5	4	1	1	0	4	10	2	0	2	5	3	403
El Camino Real and Jenevein Ave	6	4	2	0	0	2	7	2	0	2	1	4	365
San Bruno Ave and San Mateo Ave	7	1	1	0	0	1	3	2	0	2	0	1	336
Sneath Ln and Cemetary Access Rd	8	0	0	1	1	0	3	2	0	2	0	1	336
El Camnio Real and 380 WB on/off ramps	9	1	7	5	7	5	18	1	0	1	7	10	302
El Camnio Real and Crystal Springs Ave	10	0	4	4	5	2	9	1	0	1	5	3	238
Huntington Ave and Herman St	11	2	0	0	0	4	7	1	0	1	2	4	211
Sharp Park Rd and Pacific Heights Blvd	12	1	1	2	0	0	6	1	0	1	3	2	210
San Bruno Ave and 6th	13	0	3	0	2	4	6	1	0	1	2	3	205
El Camnio and Taylor	14	1	1	3	4	0	5	1	0	1	2	2	199
San Bruno Ave and Cherry	15	1	1	0	1	2	6	1	1	0	0	5	195
San Bruno Ave and 7th	16	0	1	0	1	1	3	1	0	1	1	1	182
3rd St and Pine St	17	2	1	0	0	0	2	1	0	1	1	0	176
San Bruno Ave and Green Ave	18	2	1	0	0	0	2	1	0	1	1	0	176
San Bruno Ave and Hensley Ave	19	1	2	0	0	1	2	1	0	1	1	0	176
San Mateo Ave and Jenevein Ave	20	1	0	0	0	0	2	1	0	1	1	0	176
El Camnio and 380 EB on off ramps	21	0	0	0	0	0	9	0	0	0	4	5	74
Sneath and Cherry	22	1	0	0	0	0	6	0	0	0	3	3	51

Appendix D:

Consolidated High Injury Collision Database

CASE_ID	ACCIDENT_Y	COLLISION_	COLLISION_Time	PRIMARY_RD	SECONDARY_	DISTANCE
6781832	2015	2015-01-17	1831	SAN BRUNO AV E	6TH AV	64
6805483	2015	2015-01-08	636	RT 82	JENEVEIN AV	0
6805484	2015	2015-01-22	33	RT 82	COMMODORE DR	10
6816634	2015	2015-01-30	1522	HUNTINGTON AV	HERMAN ST	0
6826092	2015	2015-02-20	1221	SAN MARCO AV	SAN ANTONIO AV	0
6827132	2015	2015-01-30	715	RT 82	CITATION AV	190
6828360	2015	2015-02-04	1525	CYRSTAL SPRINGS AV	ELM AV	93
6828712	2015	2015-02-24	2055	SNEATH LN	CLAREMONT DR	30
6835691	2015	2015-02-12	1315	RT 82	SANTA LUCIA AV	83
6837648	2015	2015-02-17	605	SAN BRUNO AV WEST	HENSLEY AV	0
6860530	2015	2015-03-12	2000	SAN MATEO AV	ANGUS AV	0
6872708	2015	2015-03-09	1316	RT 82	SAN BRUNO AV	25
6893576	2015	2015-03-31	1750	SNEATH LN	HUNTINGTON AV	0
6906173	2015	2015-04-13	1505	RT 82	SANTA LUCIA AV	70
6906174	2015	2015-04-14	859	SAN BRUNO AV	UPPER CRESTMOOR DR	0
6906175	2015	2015-04-16	2030	SNEATH LN	UPPER CLAREMONT DR	0
6916162	2015	2015-04-02	1315	SANTA MARIA AV	SAN ANSELMO	16
6917826	2015	2015-03-26	1531	RT 82	SANTA LUCIA AV	0
6938131	2015	2015-08-31	827	CRESTMOOR DR	BRYANT WY	0
6962225	2015	2015-05-09	2345	RT 82	RT 380	10
6975222	2015	2015-06-11	1800	RT 82	CITATION AV	0
6975570	2015	2015-06-10	1041	CRYSTAL SPRINGS RD	EL CAMINO REAL	0
6975648	2015	2015-06-14	1234	SNEATH LN	CEMETARY ACCESS RD	48
6979156	2015	2015-06-14	1230	SNEATH LN	CEMETARY ACCESS RD	46
6981335	2015	2015-06-30	749	SAN BRUNO AV	5TH AV	0
6985168	2015	2015-06-24	818	3RD AV	SAN BRUNO AV	0
6988755	2015	2015-04-13	1601	HUNTINGTON AV	NOOR AV	0
7000824	2015	2015-07-03	2136	EL CAMINO REAL	SANTA LUCIA AV	10
7014502	2015	2015-07-22	2253	SNEATH LN	RT 82	5
7018513	2015	2015-07-28	1200	RT 82	COMMODORE DR	0
7018517	2015	2015-07-17	1734	SAN BRUNO AV WEST	S ACCESS RD	0
7025967	2015	2015-08-03	1715	SAN MATEO AV	ATLANTIC AV	25
7032007	2015	2015-08-10	2100	SAN FELIPE AV	LINDEN AV	0
7035548	2015	2015-07-31	1445	SNEATH LN	RT 82	219
7049448	2015	2015-08-29	1415	EL CAMINO REAL	SNEATH LN	0
7049707	2015	2015-08-15	1428	HERMAN ST	BUENA VISTA AV	0
7050075	2015	2015-08-24	2040	SAN BRUNO AV W	MASSON AV	0
7050076	2015	2015-08-14	1941	HUNTINGTON AV	WEST ANGUS AV	0
7060170	2015	2015-08-31	1036	SAN BRUNO AV	ALPINE WY	0

CASE_ID	DIRECTION	INTERSECTION	WEATHER_1	STATE_HWY_	COL_Severity	EPDO_Score	PRIMARY_CO
6781832	E	N	A	N	4	6	A
6805483		Y	A	Y	4	6	A
6805484	N	N	A	Y	3	11	A
6816634		Y	A	N	4	6	A
6826092		Y	A	N	4	6	A
6827132	N	N	B	Y	4	6	A
6828360	E	N	A	N	4	6	A
6828712	W	N	A	N	4	6	A
6835691	S	N	A	Y	3	11	A
6837648		Y	A	N	2	165	A
6860530		Y	A	N	4	6	A
6872708	N	N	A	Y	4	6	A
6893576		Y	A	N	4	6	A
6906173	S	N	A	Y	4	6	A
6906174		Y	A	N	3	11	A
6906175		Y	A	N	4	6	A
6916162	W	N	A	N	4	6	A
6917826		Y	A	Y	3	11	A
6938131		Y	A	N	4	6	D
6962225	N	N	A	Y	4	6	A
6975222		Y	A	Y	4	6	A
6975570		Y	B	Y	4	6	A
6975648	E	N	A	N	2	165	A
6979156	E	N	A	N	2	165	A
6981335		Y	A	N	4	6	A
6985168		Y	A	N	4	6	A
6988755		Y	A	N	4	6	A
7000824	S	N	A	Y	4	6	A
7014502	W	N	A	Y	4	6	A
7018513		Y	A	Y	3	11	A
7018517		Y	A	N	4	6	A
7025967	S	N	A	N	4	6	A
7032007		Y	A	N	3	11	A
7035548	E	N	A	Y	3	11	A
7049448		Y	B	Y	4	6	A
7049707		Y	A	N	4	6	A
7050075		Y	A	N	4	6	A
7050076		Y	A	N	4	6	A
7060170		Y	A	N	4	6	A

CASE_ID	PCF_VIOL_C	PCF_VIOL_S	TYPE_OF_CO	Unsafe_Spe	Rear_End	Broadside	MVIW
6781832	4		C	0	1	0	C
6805483	10	A	G	0	0	0	B
6805484	3		C	1	1	0	C
6816634	10	A	G	0	0	0	B
6826092	10	A	B	0	0	0	B
6827132	3		E	1	0	0	I
6828360	3		C	1	1	0	C
6828712	3		C	1	1	0	C
6835691	3		C	1	1	0	A
6837648	10	A	G	0	0	0	B
6860530	10	A	G	0	0	0	B
6872708	4		C	0	1	0	C
6893576	3	A	C	1	1	0	C
6906173	3		C	1	1	0	C
6906174	12	A	D	0	0	1	C
6906175	1	A	D	0	0	1	C
6916162	3		D	1	0	1	E
6917826	9	A	D	0	0	1	C
6938131	0		D	0	0	1	C
6962225	3		C	1	1	0	C
6975222	12	A	D	0	0	1	C
6975570	12	A	D	0	0	1	C
6975648	21		H	0	0	0	C
6979156	3		C	1	1	0	C
6981335	9	A	A	0	0	0	C
6985168	12	A	D	0	0	1	C
6988755	17	B	D	0	0	1	C
7000824	3		C	1	1	0	C
7014502	1	A	E	0	0	0	I
7018513	10	A	G	0	0	0	B
7018517	9	B	D	0	0	1	C
7025967	0	A	D	0	0	1	C
7032007	9	A	D	0	0	1	C
7035548	4		H	0	0	0	G
7049448	4		C	0	1	0	C
7049707	9	A	D	0	0	1	C
7050075	3		C	1	1	0	C
7050076	11	B	G	0	0	0	B
7060170	8		B	0	0	0	C

CASE_ID	PED_ACTION	ROAD_SURFA	ROAD_COND_	LIGHTING	Nighttime	CONTROL_DE	CHP_ROAD_T
6781832	A	A	H	C	1	D	0
6805483	B	A	H	C	1	A	0
6805484	A	A	H	C	1	A	0
6816634	B	A	H	A	0	D	0
6826092	B	A	H	A	0	D	0
6827132	A	A	H	A	0	A	0
6828360	A	A	H	A	0	D	0
6828712	A	A	H	C	1	D	0
6835691	A	A	H	A	0	D	0
6837648	B	A	H	C	1	D	0
6860530	B	A	H	C	1	A	0
6872708	A	A	H	A	0	D	0
6893576	A	A	H	A	0	A	0
6906173	A	A	H	A	0	D	0
6906174	A	A	H	A	0	A	0
6906175	A	A	H	C	1	A	0
6916162	A	A	H	A	0	D	0
6917826	A	A	H	A	0	D	0
6938131	A	A	H	A	0	D	0
6962225	A	A	H	C	1	A	0
6975222	A	A	H	A	0	A	0
6975570	A	B	H	A	0	A	0
6975648	A	A	H	A	0	A	0
6979156	A	A	H	A	0	A	0
6981335	A	A	H	A	0	D	0
6985168	A	A	H	A	0	A	0
6988755	A	A	H	A	0	A	0
7000824	A	A	H	C	1	D	0
7014502	A	A	H	C	1	A	0
7018513	B	A	H	A	0	A	0
7018517	A	A	H	A	0	A	0
7025967	A	A	H	A	0	D	0
7032007	A	A	H	C	1	D	0
7035548	A	A	H	A	0	A	0
7049448	A	A	H	A	0	A	0
7049707	A	A	H	A	0	D	0
7050075	A	-	G	C	1	D	0
7050076	B	A	H	A	0	A	0
7060170	A	A	H	A	0	D	0

CASE_ID	PED	BICYCLE_AC	MOTORCYCLE	TRUCK_ACCI	NOT_PRIVAT	STWD_VEHTY
6781832	0				Y	A
6805483	1				Y	A
6805484	0				Y	A
6816634	1				Y	A
6826092	1				Y	A
6827132	0				Y	A
6828360	0				Y	H
6828712	0				Y	D
6835691	0				Y	A
6837648	1				Y	A
6860530	1				Y	A
6872708	0				Y	A
6893576	0				Y	A
6906173	0				Y	A
6906174	0				Y	A
6906175	0				Y	A
6916162	0	Y			Y	L
6917826	0				Y	A
6938131	0				Y	-
6962225	0				Y	A
6975222	0				Y	A
6975570	0				Y	A
6975648	0				Y	A
6979156	0			Y	Y	A
6981335	0				Y	A
6985168	0				Y	-
6988755	0				Y	A
7000824	0				Y	D
7014502	0				Y	A
7018513	1				Y	-
7018517	0		Y		Y	A
7025967	0				Y	A
7032007	0				Y	D
7035548	0	Y			Y	A
7049448	0				Y	D
7049707	0				Y	A
7050075	0				Y	A
7050076	1				Y	N
7060170	0				Y	A

CASE_ID	ACCIDENT_Y	COLLISION_	COLLISION_Time	PRIMARY_RD	SECONDARY_	DISTANCE
7062832	2015	2015-09-23	753	CYPRESS AV	CRYSTAL SPRINGS RD	0
7063856	2015	2015-11-02	1959	HUNTINGTON AV	TARGET ENT	0
7066933	2015	2015-09-08	1522	SAN BRUNO AV	RT 82	35
7066934	2015	2015-06-10	945	BAYHILL DR	MAHOGANY DR	0
7066935	2015	2015-09-06	1740	BERKSHIRE DR	OAKMONT DR	0
7078820	2015	2015-09-05	2052	ANGUS AV	SAN MATEO AV	0
7086473	2015	2015-09-17	1922	PRINCETON DR	SAN BRUNO AV	42
7097284	2015	2015-09-04	1450	COMMODORE DR	NATIONAL AV	0
7097359	2015	2015-09-27	1325	SNEATH LN	NATIONAL AV	0
7097376	2015	2015-09-28	913	HUNTINGTON AV	HERMAN ST	0
7097384	2015	2015-10-05	2100	RT 82	SAN FELIPE AV	0
7097570	2015	2015-09-24	1934	SAN MATEO AV	SYLVAN AV	0
7105935	2015	2015-10-11	833	EVERGREEN DR	OAKMONT DR	0
7105960	2015	2015-10-14	817	RT 82	RT 380	60
7108265	2015	2015-10-22	1602	SNEATH LN	HUNTINGTON AV	20
7108269	2015	2015-10-20	541	RT 82	SANTA LUCIA AV	0
7108273	2015	2015-10-06	1650	SNEATH LN	CHERRY AV	0
7120950	2015	2015-11-04	1520	JENEVEIN AV	LINDEN AV	0
7129424	2015	2015-11-19	1531	RT 82	ANGUS AV	0
7129529	2015	2015-11-20	908	CRYSTAL SPRINGS RD	ELM AV	0
7133902	2015	2015-11-20	1307	RT 82	SNEATH LN	0
7148089	2015	2015-11-11	1630	RT 82	COMMODORE DR	50
7149450	2015	2015-12-03	1328	RT 82	RT 380	0
7149497	2015	2015-12-10	1740	RT 82	CRYSTAL SPRINGS RD	32
7149501	2015	2015-12-05	1548	HUNTINGTON AV	BART BUS DEPOT EXIT	0
7150561	2015	2015-12-20	1859	RT 82	SANTA LUCIA AV	0
7153408	2015	2015-07-09	814	SHARP PARK RD	SPYGLASS RD	113
7155213	2015	2015-12-22	1225	HAWTHORNE AV	JENEVEIN AV	27
7160179	2016	2016-01-03	1323	SNEATH LN	CHERRY AV	10
7160231	2016	2016-01-06	1320	SAN BRUNO AV E	6TH AV	0
7160283	2015	2015-12-21	2009	HUNTINGTON AV	ARGET PARKING GARAGE EN	0
7174165	2016	2016-01-20	803	RT 82	EUCLID AV	0
7174169	2016	2016-01-14	1449	SAN BRUNO AV WEST	EL CAMINO REAL	57
7174173	2016	2016-01-05	925	EL CAMINO REAL	CRYSTAL SPRINGS RD	10
7184057	2016	2016-01-05	809	SNEATH LN	ROLLINGWOOD DR	230
7184062	2016	2016-01-27	1720	HUNTINGTON AV	FLORIDA AV	138
7186168	2016	2016-01-24	1644	SAN MATEO AV	JENEVEIN AV	65
7187387	2016	2016-02-11	2056	RT 82	COMMODORE DR	0
7193335	2016	2016-02-08	1516	EL CAMINO REAL	SNEATH LN	10

CASE_ID	DIRECTION	INTERSECTION	WEATHER_1	STATE_HWY_	COL_Severity	EPDO_Score	PRIMARY_CO
7062832		Y	A	N	4	6	A
7063856		Y	A	N	4	6	A
7066933	E	N	A	Y	4	6	A
7066934		Y	B	N	3	11	A
7066935		Y	A	N	2	165	A
7078820		Y	A	N	4	6	A
7086473	S	N	A	N	4	6	A
7097284		Y	A	N	3	11	A
7097359		Y	A	N	4	6	A
7097376		Y	A	N	4	6	A
7097384		Y	A	Y	4	6	A
7097570		Y	A	N	4	6	A
7105935		Y	A	N	3	11	A
7105960	N	N	A	Y	3	11	B
7108265	W	N	A	N	4	6	A
7108269		Y	B	Y	4	6	A
7108273		Y	A	N	4	6	A
7120950		Y	A	N	4	6	A
7129424		Y	A	Y	3	11	A
7129529		Y	A	N	4	6	A
7133902		Y	A	Y	4	6	A
7148089	N	N	B	Y	4	6	A
7149450		Y	C	Y	4	6	A
7149497	S	N	B	Y	4	6	A
7149501		Y	B	N	4	6	A
7150561		Y	C	Y	4	6	A
7153408	W	N	B	N	4	6	A
7155213	S	N	C	N	4	6	A
7160179	W	N	B	N	4	6	A
7160231		Y	B	N	4	6	A
7160283		Y	C	N	4	6	A
7174165		Y	B	Y	4	6	A
7174169	E	N	A	Y	3	11	B
7174173	S	N	B	Y	3	11	A
7184057	W	N	C	N	4	6	A
7184062	N	N	A	N	3	11	A
7186168	N	N	A	N	3	11	A
7187387		Y	A	Y	4	6	A
7193335	N	N	A	Y	4	6	A

CASE_ID	PCF_VIOL_C	PCF_VIOL_S	TYPE_OF_CO	Unsafe_Spe	Rear_End	Broadside	MVIW
7062832	9	A	B	0	0	0	C
7063856	5	1	D	0	0	1	G
7066933	7	A	B	0	0	0	C
7066934	5	A	B	0	0	0	G
7066935	3		H	1	0	0	A
7078820	10	A	G	0	0	0	B
7086473	3		A	1	0	0	C
7097284	10	A	G	0	0	0	B
7097359	12	A	D	0	0	1	C
7097376	12	A	D	0	0	1	C
7097384	10	A	G	0	0	0	B
7097570	12	A	D	0	0	1	C
7105935	0	A	G	0	0	0	B
7105960	22		E	0	0	0	J
7108265	3		C	1	1	0	C
7108269	10	A	G	0	0	0	B
7108273	21		C	0	1	0	C
7120950	9	A	D	0	0	1	C
7129424	10	A	G	0	0	0	B
7129529	3	A	D	1	0	1	C
7133902	12	A	D	0	0	1	C
7148089	7	A	B	0	0	0	C
7149450	3	A	B	1	0	0	C
7149497	3		C	1	1	0	C
7149501	3		C	1	1	0	C
7150561	9		D	0	0	1	C
7153408	1	A	E	0	0	0	I
7155213	3		C	1	1	0	C
7160179	3		C	1	1	0	C
7160231	8	A	D	0	0	1	C
7160283	10	A	G	0	0	0	B
7174165	5	1	D	0	0	1	C
7174169	22		H	0	0	0	A
7174173	3		C	1	1	0	C
7184057	4		C	0	1	0	C
7184062	1	A	B	0	0	0	E
7186168	17		B	0	0	0	E
7187387	3		C	1	1	0	C
7193335	8	A	B	0	0	0	C

CASE_ID	PED_ACTION	ROAD_SURFA	ROAD_COND_	LIGHTING	Nighttime	CONTROL_DE	CHP_ROAD_T
7062832	A	A	H	A	0	D	0
7063856	A	A	H	C	1	A	0
7066933	A	A	H	A	0	D	0
7066934	A	B	H	A	0	A	0
7066935	A	A	H	A	0	A	0
7078820	B	A	H	C	1	D	0
7086473	A	A	H	A	0	D	0
7097284	B	A	H	A	0	A	0
7097359	A	A	H	A	0	A	0
7097376	A	A	H	A	0	A	0
7097384	B	A	H	C	1	A	0
7097570	A	A	H	C	1	D	0
7105935	B	A	H	A	0	A	0
7105960	A	A	H	A	0	A	0
7108265	A	A	H	A	0	A	0
7108269	B	A	H	C	1	D	0
7108273	A	A	H	A	0	A	0
7120950	A	A	H	A	0	A	0
7129424	B	A	H	A	0	A	0
7129529	A	A	H	A	0	A	0
7133902	A	A	H	A	0	A	0
7148089	A	A	H	B	0	D	0
7149450	A	B	H	A	0	D	0
7149497	A	B	H	C	1	D	0
7149501	A	A	H	A	0	A	0
7150561	A	B	H	C	1	D	0
7153408	A	D	H	A	0	A	0
7155213	A	B	H	A	0	A	0
7160179	A	A	A	A	0	A	0
7160231	A	B	H	A	0	D	0
7160283	B	B	H	C	1	A	0
7174165	A	A	H	A	0	A	0
7174169	A	B	H	A	0	A	0
7174173	A	B	H	A	0	A	0
7184057	A	B	G	A	0	D	0
7184062	A	A	H	A	0	D	0
7186168	A	A	H	A	0	D	0
7187387	A	A	H	C	1	A	0
7193335	A	A	H	A	0	A	0

CASE_ID	PED	BICYCLE_AC	MOTORCYCLE	TRUCK_ACCI	NOT_PRIVAT	STWD_VEHTY
7062832	0				Y	A
7063856	0	Y			Y	L
7066933	0				Y	A
7066934	0	Y			Y	L
7066935	0	Y			Y	L
7078820	1				Y	A
7086473	0				Y	A
7097284	1				Y	A
7097359	0				Y	A
7097376	0				Y	A
7097384	1				Y	D
7097570	0				Y	-
7105935	1				Y	A
7105960	0		Y		Y	C
7108265	0				Y	A
7108269	1				Y	-
7108273	0				Y	A
7120950	0				Y	A
7129424	1				Y	A
7129529	0				Y	A
7133902	0				Y	A
7148089	0				Y	A
7149450	0				Y	A
7149497	0				Y	A
7149501	0				Y	A
7150561	0				Y	A
7153408	0				Y	A
7155213	0				Y	D
7160179	0				Y	A
7160231	0				Y	A
7160283	1				Y	A
7174165	0	Y			Y	L
7174169	0	Y			Y	-
7174173	0				Y	A
7184057	0				Y	A
7184062	0				Y	A
7186168	0	Y			Y	A
7187387	0				Y	A
7193335	0				Y	D

CASE_ID	ACCIDENT_Y	COLLISION_	COLLISION_Time	PRIMARY_RD	SECONDARY_	DISTANCE
7197688	2016	2016-02-11	1600	RT 82	RT 380	10
7197692	2016	2016-02-06	1631	SNEATH LN	NATIONAL AV	0
7199992	2016	2016-12-19	1730	WEST SAN BRUNO AV	CHERRY AV	0
7200059	2017	2017-02-18	1957	RT 82	COMMODORE DR	127
7204265	2016	2016-03-03	2500	RT 82	SANTA LUCIA AV	0
8003727	2016	2016-03-15	1206	RT 82	KAINS AV	200
8003952	2016	2016-02-25	603	RT 82	EUCLID AV	0
8004103	2016	2016-02-22	1830	SAN BRUNO AV WEST	EASTON AV	0
8006008	2016	2016-01-28	2107	RT 82	RT 380	20
8006009	2016	2016-01-28	1800	SNEATH LN	NATIONAL AV	0
8012372	2016	2016-03-23	1434	SAN BRUNO AV	7TH AV	15
8012682	2016	2016-03-19	312	SAN BRUNO AV	6TH AV	0
8017802	2016	2016-03-06	1456	EL CAMINO REAL	BAYHILL DR	50
8021140	2016	2016-03-21	1554	RT 82	TAYLOR AV	100
8033764	2016	2016-04-14	1653	SAN BRUNO AV WEST	CRESTMOOR DR	85
8033770	2016	2016-04-05	1803	CHERRY AV	JENEVIN AV	100
8033844	2016	2016-04-16	1410	SNEATH LN	CHERRY AV	20
8039291	2016	2016-04-29	1920	4TH AV	PINE ST	0
8039324	2016	2016-04-16	2159	RT 82	SNEATH LN	0
8039364	2016	2016-05-07	1156	MILLS AV	EUCLID AV	0
8039439	2016	2016-05-13	812	SAN ANTONIO AV	SANTA INEZ AV	0
8040387	2016	2016-04-28	1655	SAN ANTONIO AV	SAN BENITO AV	101
8040391	2016	2016-04-29	1039	SNEATH LN	CHERRY AV	0
8057521	2016	2016-05-17	1951	ANGUS AV	HUNTINGTON AV	0
8057522	2016	2016-05-15	250	N SAN ANSELMO AV	MARTIN PL	161
8057558	2016	2016-05-14	1213	EL CAMINO REAL	COMMODORE DR	0
8065483	2016	2016-04-05	1511	CAMINO PLZ	SAN BRUNO AV W	0
8065769	2016	2016-06-14	916	RT 82	SNEATH LN	0
8073489	2016	2016-05-06	1212	HERMAN ST	BAYSHORE CIR S	0
8080973	2016	2016-07-24	218	EL CAMINO REAL	SANTA INEZ AV	0
8083938	2016	2016-05-08	1335	ANGUS AV W	MASSON AV	25
8085119	2016	2016-06-19	1017	SAN BRUNO AV WEST	EASTON AV	0
8085199	2016	2016-07-04	1258	EL CAMINO REAL	SNEATH LN	140
8090405	2016	2016-07-03	1224	SAN BRUNO AVENUE	3RD AV	50
8092291	2016	2016-07-16	1407	JENEVEIN AV	LINDEN AV	20
8092295	2016	2016-07-21	1100	SAN BRUNO AV WEST	GLENVIEW DR	0
8093814	2016	2016-06-10	1958	SAN BRUNO AV WEST	CHERRY AV	0
8094621	2016	2016-07-21	1521	RT 82	SNEATH LN	0
8095916	2016	2016-07-16	302	RT 82	SNEATH LN	0

CASE_ID	DIRECTION	INTERSECTION	WEATHER_1	STATE_HWY_	COL_Severity	EPDO_Score	PRIMARY_CO
7197688	S	N	A	Y	3	11	A
7197692		Y	A	N	4	6	A
7199992		Y	A	N	1	165	A
7200059	S	N	A	Y	1	165	A
7204265		Y	A	Y	3	11	A
8003727	S	N	A	Y	3	11	B
8003952		Y	A	Y	4	6	A
8004103		Y	A	N	3	11	A
8006008	N	N	A	Y	4	6	A
8006009		Y	A	N	3	11	A
8012372	W	N	A	N	4	6	A
8012682		Y	A	N	4	6	A
8017802	N	N	B	Y	4	6	A
8021140	S	N	B	Y	4	6	A
8033764	E	N	A	N	4	6	A
8033770	N	N	A	N	3	11	A
8033844	E	N	A	N	3	11	C
8039291		Y	A	N	3	11	A
8039324		Y	A	Y	3	11	A
8039364		Y	C	N	3	11	A
8039439		Y	A	N	4	6	A
8040387	N	N	B	N	3	11	A
8040391		Y	A	N	3	11	A
8057521		Y	A	N	3	11	A
8057522	N	N	A	N	3	11	A
8057558		Y	A	Y	4	6	A
8065483		Y	A	N	4	6	A
8065769		Y	A	Y	4	6	A
8073489		Y	C	N	4	6	A
8080973		N	A	N	3	11	A
8083938	W	N	A	N	3	11	A
8085119		Y	A	N	4	6	A
8085199	S	N	A	Y	4	6	A
8090405	W	N	A	N	4	6	A
8092291	W	N	A	N	4	6	A
8092295		Y	A	N	4	6	A
8093814		Y	A	N	4	6	A
8094621		Y	A	Y	4	6	A
8095916		Y	A	Y	3	11	A

CASE_ID	PCF_VIOL_C	PCF_VIOL_S	TYPE_OF_CO	Unsafe_Spe	Rear_End	Broadside	MVIW
7197688	3		G	1	0	0	B
7197692	12	A	A	0	0	0	C
7199992	10	A	G	0	0	0	B
7200059	11	A	G	0	0	0	B
7204265	10	A	G	0	0	0	B
8003727	22		C	0	1	0	E
8003952	21		C	0	1	0	C
8004103	10	A	G	0	0	0	B
8006008	3		C	1	1	0	C
8006009	8		D	0	0	1	G
8012372	9	A	D	0	0	1	C
8012682	9		D	0	0	1	C
8017802	3		C	1	1	0	D
8021140	3		C	1	1	0	C
8033764	3		C	1	1	0	C
8033770	5		B	0	0	0	C
8033844	18		E	0	0	0	I
8039291	1	A	E	0	0	0	I
8039324	12	A	A	0	0	0	C
8039364	12	A	D	0	0	1	C
8039439	3		D	1	0	1	C
8040387	6	A	B	0	0	0	C
8040391	3		C	1	1	0	C
8057521	12	A	G	0	0	0	B
8057522	1	A	B	0	0	0	E
8057558	12	A	D	0	0	1	C
8065483	9		C	0	1	0	C
8065769	12	A	D	0	0	1	C
8073489	9	A	D	0	0	1	C
8080973	1	A	C	0	1	0	C
8083938	1	A	B	0	0	0	E
8085119	9	A	D	0	0	1	C
8085199	3		C	1	1	0	C
8090405	3		A	1	0	0	C
8092291	3		C	1	1	0	C
8092295	9	A	D	0	0	1	C
8093814	9	C	D	0	0	1	C
8094621	3		C	1	1	0	C
8095916	1	A	E	0	0	0	I

CASE_ID	PED_ACTION	ROAD_SURFA	ROAD_COND_	LIGHTING	Nighttime	CONTROL_DE	CHP_ROAD_T
7197688	C	A	H	A	0	D	0
7197692	A	A	H	B	0	A	0
7199992	B	A	H	C	1	A	0
7200059	D	A	H	C	1	D	0
7204265	B	A	H	C	1	D	0
8003727	A	A	H	A	0	D	0
8003952	A	A	H	C	1	A	0
8004103	B	A	H	C	1	D	0
8006008	A	A	H	C	1	A	0
8006009	A	A	H	C	1	D	0
8012372	A	A	H	A	0	D	0
8012682	A	A	H	C	1	D	0
8017802	A	B	H	A	0	D	0
8021140	A	B	H	A	0	A	0
8033764	A	A	H	A	0	A	0
8033770	A	A	H	B	0	D	0
8033844	A	A	H	A	0	A	0
8039291	A	A	H	A	0	A	0
8039324	A	A	H	C	1	A	0
8039364	A	B	H	A	0	A	0
8039439	A	A	H	A	0	D	0
8040387	A	A	H	A	0	D	0
8040391	A	-	H	A	0	A	0
8057521	A	A	H	A	0	A	0
8057522	A	A	H	C	1	D	0
8057558	A	A	H	A	0	A	0
8065483	A	A	H	A	0	A	0
8065769	A	A	H	A	0	A	0
8073489	A	B	H	C	1	D	0
8080973	A	A	H	C	1	A	0
8083938	A	A	H	A	0	D	0
8085119	A	A	H	A	0	A	0
8085199	A	A	H	A	0	D	0
8090405	A	A	H	A	0	D	0
8092291	A	A	H	A	0	D	0
8092295	A	A	H	A	0	D	0
8093814	A	A	H	B	0	A	0
8094621	A	A	H	A	0	A	0
8095916	A	A	H	C	1	A	0

CASE_ID	PED	BICYCLE_AC	MOTORCYCLE	TRUCK_ACCI	NOT_PRIVAT	STWD_VEHTY
7197688	1				Y	A
7197692	0				Y	A
7199992	1				Y	A
7200059	1				Y	N
7204265	1				Y	A
8003727	0				Y	A
8003952	0				Y	A
8004103	1				Y	A
8006008	0				Y	A
8006009	0	Y			Y	A
8012372	0				Y	A
8012682	0				Y	A
8017802	0				Y	I
8021140	0				Y	D
8033764	0				Y	A
8033770	0				Y	-
8033844	0	Y			Y	-
8039291	0				Y	-
8039324	0				Y	A
8039364	0				Y	A
8039439	0				Y	A
8040387	0		Y		Y	A
8040391	0				Y	A
8057521	0				Y	A
8057522	0				Y	A
8057558	0				Y	A
8065483	0				Y	A
8065769	0				Y	A
8073489	0				Y	A
8080973	0				Y	A
8083938	0				Y	A
8085119	0				Y	A
8085199	0				Y	A
8090405	0				Y	A
8092291	0				Y	A
8092295	0				Y	A
8093814	0				Y	A
8094621	0				Y	A
8095916	0				Y	A

CASE_ID	ACCIDENT_Y	COLLISION_	COLLISION_Time	PRIMARY_RD	SECONDARY_	DISTANCE
8095918	2016	2016-07-24	1108	SAN BRUNO AV	3RD AV	0
8101587	2016	2016-08-02	1600	SAN BRUNO AV	3RD AV	0
8116052	2016	2016-08-18	2240	RT 82	SAN FELIPE AV	0
8116056	2016	2016-08-10	1745	RT 82	CITATION AV	50
8116060	2016	2016-08-04	1533	SAN BRUNO AV WEST	EASTON AV	0
8116111	2016	2016-06-27	2206	EL CAMINO REAL	BAYHILL DR	0
8124102	2016	2016-08-18	1724	ANGUS AV W	HUNTINGTON AV	0
8127633	2016	2016-09-01	1445	RT 82	RT 380	0
8127677	2016	2016-09-10	1020	RT 82	CRYSTAL SPRING RD	118
8135304	2016	2016-09-19	1800	S SAN ANSELMO AV	SANTA LUCIA AV	0
8135308	2016	2016-09-12	1434	JENEVEIN AV	HAWTHORN AV	0
8144833	2016	2016-11-14	1055	SAN BRUNO AV W	EASTON AV	68
8148618	2016	2016-09-26	554	SAN BRUNO AV E	2ND AV	0
8148622	2016	2016-09-24	940	SNEATH LN	CLAREMONT DR	0
8148638	2016	2016-09-07	925	EASTON AV	SYLVAN AV	200
8149106	2016	2016-10-04	1750	SNEATH LN	SEABISCUIT WY	0
8167801	2019	2019-07-23	2330	SHARP PARK RD	PACIFIC HEIGHTS BL	53
8170887	2016	2016-10-25	617	EASTON AV	EUCLID AV	0
8170891	2016	2016-10-07	1956	EL CAMINO REAL	CRYSTAL SPRINGS RD	0
8173739	2016	2016-09-28	1708	SAN MATEO AV	WALNUT ST	132
8174840	2016	2016-11-06	1755	SNEATH LN	EL CAMINO REAL	220
8174852	2016	2016-08-30	1733	HUNTINGTON AV	FOREST LN	0
8175306	2016	2016-10-27	1650	RT 82	JENEVEIN AV	0
8184607	2016	2016-11-17	724	SNEATH LN	SEABISCUIT WY	0
8186952	2016	2016-11-08	1845	CHERRY AV	JUNIPER AV	80
8199398	2016	2016-11-30	213	RT 82	CITATION AV	0
8206945	2017	2017-01-01	2229	SAN MATEO AV	HERMOSA ST	150
8207248	2016	2016-11-28	1823	OAKMONT DR	ST CLOUD DR	0
8207352	2016	2016-12-12	1746	HUNTINGTON AV	SAN BRUNO AV	0
8283340	2016	2016-12-19	1232	RT 82	TANFORAN WY	0
8295010	2017	2017-01-16	1750	SNEATH LN	QUAIL POINT CIR	4
8311005	2017	2017-01-26	1835	EL CAMINO REAL	RT 380	0
8311013	2017	2017-01-25	1700	EL CAMINO REAL	SAN BRUNO AV	40
8316903	2017	2017-02-07	1443	MASSON AV	KAINS AV	0
8318550	2017	2017-02-09	2348	RT 82	CITATION AV	0
8319777	2017	2017-01-27	1504	EL CAMINO REAL	TAYLOR AV	0
8320275	2017	2017-01-11	1925	SAN MATEO AV	WALNUT AV	0
8320409	2017	2017-02-06	2230	MILTON AV	SYLVAN AV	15
8320413	2017	2017-02-12	1507	RT 82	SANTA LUCIA AV	0

CASE_ID	DIRECTION	INTERSECTION	WEATHER_1	STATE_HWY_	COL_Severity	EPDO_Score	PRIMARY_CO
8095918		Y	A	N	3	11	A
8101587		Y	A	N	3	11	A
8116052		Y	A	Y	4	6	A
8116056	S	N	A	Y	4	6	A
8116060		Y	B	N	3	11	A
8116111		Y	A	Y	4	6	A
8124102		Y	A	N	3	11	A
8127633		Y	B	Y	4	6	A
8127677	S	N	A	Y	3	11	A
8135304		Y	A	N	3	11	A
8135308		Y	A	N	4	6	A
8144833	W	N	B	N	4	6	A
8148618		Y	A	N	3	11	A
8148622		Y	A	N	4	6	A
8148638	N	N	A	N	4	6	A
8149106		Y	A	N	4	6	A
8167801	W	N	E	N	3	11	A
8170887		Y	C	N	4	6	A
8170891		Y	A	Y	4	6	A
8173739	N	N	A	N	4	6	A
8174840	W	N	A	N	3	11	C
8174852		Y	A	N	4	6	A
8175306		Y	B	Y	4	6	A
8184607		Y	A	N	4	6	A
8186952	N	N	A	N	4	6	A
8199398		Y	A	Y	3	11	A
8206945	N	N	C	N	3	11	A
8207248		Y	A	N	4	6	A
8207352		Y	B	N	4	6	A
8283340		Y	A	Y	3	11	A
8295010	E	N	A	N	3	11	A
8311005		Y	A	Y	4	6	A
8311013	N	N	B	Y	4	6	A
8316903		Y	B	N	4	6	A
8318550		Y	C	Y	3	11	A
8319777		Y	A	Y	3	11	A
8320275		Y	B	N	4	6	A
8320409	S	N	C	N	4	6	A
8320413		Y	A	Y	3	11	A

CASE_ID	PCF_VIOL_C	PCF_VIOL_S	TYPE_OF_CO	Unsafe_Spe	Rear_End	Broadside	MVIW
8095918	12	A	D	0	0	1	C
8101587	12	A	F	0	0	0	C
8116052	9		D	0	0	1	C
8116056	21		C	0	1	0	C
8116060	9	A	D	0	0	1	C
8116111	10	A	G	0	0	0	B
8124102	12	A	H	0	0	0	G
8127633	3		C	1	1	0	C
8127677	17		A	0	0	0	G
8135304	9	A	D	0	0	1	C
8135308	9	A	D	0	0	1	C
8144833	11	A	G	0	0	0	B
8148618	10	A	G	0	0	0	B
8148622	3		F	1	0	0	I
8148638	8		B	0	0	0	C
8149106	10	A	G	0	0	0	B
8167801	11	A	G	0	0	0	B
8170887	12	A	D	0	0	1	C
8170891	1	A	C	0	1	0	C
8173739	1	A	D	0	0	1	E
8174840	18		C	0	1	0	C
8174852	12		D	0	0	1	C
8175306	12	A	B	0	0	0	C
8184607	10	A	G	0	0	0	B
8186952	8		F	0	0	0	E
8199398	11	B	G	0	0	0	B
8206945	9	A	D	0	0	1	C
8207248	9	A	D	0	0	1	C
8207352	4		C	0	1	0	C
8283340	12	A	D	0	0	1	C
8295010	8		A	0	0	0	C
8311005	8		B	0	0	0	C
8311013	9		G	0	0	0	B
8316903	9	A	D	0	0	1	C
8318550	0	1	G	0	0	0	B
8319777	10	A	G	0	0	0	B
8320275	3		C	1	1	0	C
8320409	21		G	0	0	0	B
8320413	9	A	D	0	0	1	C

CASE_ID	PED_ACTION	ROAD_SURFA	ROAD_COND_	LIGHTING	Nighttime	CONTROL_DE	CHP_ROAD_T
8095918	A	A	H	A	0	A	0
8101587	A	A	H	A	0	A	0
8116052	A	A	H	C	1	A	0
8116056	A	A	H	A	0	A	0
8116060	A	A	H	A	0	A	0
8116111	B	A	H	C	1	A	0
8124102	A	A	H	A	0	A	0
8127633	A	A	H	A	0	A	0
8127677	A	A	H	A	0	D	0
8135304	A	A	H	A	0	A	0
8135308	A	A	H	A	0	A	0
8144833	E	A	H	A	0	D	0
8148618	B	A	H	C	1	D	0
8148622	A	A	H	A	0	D	0
8148638	A	A	H	A	0	D	0
8149106	B	A	H	A	0	A	0
8167801	E	B	H	C	1	D	0
8170887	A	B	H	C	1	A	0
8170891	A	A	H	C	1	A	0
8173739	A	A	H	A	0	D	0
8174840	A	A	H	C	1	D	0
8174852	A	A	H	A	0	A	0
8175306	A	B	H	A	0	A	0
8184607	B	A	H	A	0	A	0
8186952	A	A	H	C	1	D	0
8199398	B	A	H	C	1	A	0
8206945	A	B	H	C	1	D	0
8207248	A	A	H	D	1	A	0
8207352	A	A	H	C	1	A	0
8283340	A	A	H	A	0	A	0
8295010	A	A	H	C	1	A	0
8311005	A	A	H	C	1	D	0
8311013	F	A	H	A	0	D	0
8316903	A	B	H	A	0	A	0
8318550	D	B	H	C	1	A	0
8319777	B	A	H	A	0	A	0
8320275	A	A	H	C	1	A	0
8320409	B	B	H	C	1	D	0
8320413	A	A	H	A	0	D	0

CASE_ID	PED	BICYCLE_AC	MOTORCYCLE	TRUCK_ACCI	NOT_PRIVAT	STWD_VEHTY
8095918	0				Y	A
8101587	0				Y	A
8116052	0				Y	-
8116056	0				Y	A
8116060	0		Y		Y	A
8116111	1				Y	A
8124102	0	Y			Y	L
8127633	0				Y	A
8127677	0	Y			Y	A
8135304	0				Y	A
8135308	0				Y	A
8144833	1				Y	N
8148618	1		Y		Y	C
8148622	0		Y		Y	C
8148638	0				Y	A
8149106	1				Y	A
8167801	1				Y	N
8170887	0				Y	A
8170891	0				Y	A
8173739	0		Y		Y	A
8174840	0				Y	-
8174852	0				Y	A
8175306	0				Y	A
8184607	1				Y	A
8186952	0				Y	A
8199398	1				Y	N
8206945	0				Y	A
8207248	0				Y	A
8207352	0				Y	A
8283340	0				Y	A
8295010	0				Y	D
8311005	0				Y	A
8311013	1				Y	A
8316903	0				Y	A
8318550	1				Y	N
8319777	1				Y	A
8320275	0				Y	A
8320409	1				Y	A
8320413	0		Y		Y	A

CASE_ID	ACCIDENT_Y	COLLISION_	COLLISION_Time	PRIMARY_RD	SECONDARY_	DISTANCE
8322555	2016	2016-12-27	1608	EL CAMINO REAL	ANGUS AV	0
8327603	2017	2017-03-06	206	EL CAMINO REAL	SNEATH LN	10
8327627	2017	2017-03-05	1940	EL CAMINO REAL	COMMODORE DR	0
8332749	2017	2017-03-09	1940	CYPRESS AV	JENEVEIN AV	0
8340883	2017	2017-02-11	836	OAKMONT DR	ST CLOUD	201
8345812	2017	2017-03-17	648	PINE AV	3RD AV	0
8349888	2017	2017-04-20	2053	CRYSTAL SPRINGS RD	DONNER AV	111
8349896	2017	2017-04-14	905	SAN MATEO AV	ATLANTIC AV	0
8356646	2017	2017-04-28	1653	EL CAMINO REAL	SAN BRUNO AV	0
8356694	2017	2017-04-29	1344	HUNTINGTON AV	HERMAN ST	0
8358818	2017	2017-01-30	1831	SAN BRUNO AV	6TH AV	0
8362323	2017	2017-04-05	2009	EL CAMINO REAL	SANTA LUCIA AV	0
8365104	2017	2017-04-19	1138	EL CAMINO REAL	SANTA DOMINGO AV	0
8367448	2016	2016-12-11	900	WEST SAN BRUNO AV	CHERRY AV	0
8370981	2017	2017-04-04	1715	RT 82	RT 380	0
8371794	2017	2017-05-08	1600	EAST SAN BRUNO AV	3RD AV	0
8372857	2017	2017-04-23	14	SAN MATEO AV	KAINS AV	10
8376069	2017	2017-05-12	2145	EL CAMINO REAL	RT 380	0
8376073	2017	2017-05-08	2139	EL CAMINO REAL	RT 380	40
8376077	2017	2017-01-25	530	JENEVEIN	EL CAMINO REAL	0
8376702	2017	2017-05-20	1612	EL CAMINO REAL	SAN FELIPE AV	65
8381669	2017	2017-05-11	1745	HUNTINGTON AV	HERMAN	0
8381704	2017	2017-05-18	1630	SAN ANTONIO AV	SAN LUIS AV	65
8386227	2017	2017-05-16	756	EAST SAN BRUNO AV	HUNTINGTON AV	0
8391043	2017	2017-05-26	743	SNEATH LN	CHERRY AV	20
8391113	2017	2017-06-04	850	SHARP PARK RD	PACIFIC HEIGHTS BL	228
8400669	2017	2017-05-21	908	CRYSTAL SPRINGS RD	POLE #110007025	72
8400674	2017	2017-06-17	2123	SAN BRUNO AV	EASTON AV	79
8400678	2017	2017-06-17	1206	SHARP PARK RD	PACIFIC HEIGHTS BL	174
8408609	2017	2017-07-08	1353	SAN BRUNO AV	CHERRY AV	60
8408612	2017	2017-07-05	1115	RT 82	RT 380	0
8410380	2017	2017-07-02	510	EL CAMINO REAL	ANGUS AV	215
8413098	2017	2017-06-24	819	EL CAMINO REAL	ANGUS AV	0
8413182	2017	2017-05-20	1527	SAN MARCO AV	EL CAMINO REAL	34
8415744	2017	2017-05-31	1726	PINE ST	2ND AV	0
8418697	2017	2017-07-02	544	HUNTINGTON AV	SAN BRUNO AV	0
8419785	2017	2017-07-12	1500	106TH AV	GLENVIEW DR	0
8420948	2017	2017-05-28	2143	EL CAMINO REAL	SAN DIEGO	0
8424642	2017	2017-07-07	650	4TH AV	ANGUS AV	0

CASE_ID	DIRECTION	INTERSECTION	WEATHER_1	STATE_HWY_	COL_Severity	EPDO_Score	PRIMARY_CO
8322555		N	B	Y	4	6	A
8327603	S	N	C	Y	3	11	A
8327627		Y	B	Y	3	11	A
8332749		Y	B	N	4	6	C
8340883	N	N	A	N	3	11	A
8345812		Y	A	N	3	11	A
8349888	W	N	A	N	4	6	A
8349896		Y	A	N	3	11	A
8356646		Y	A	Y	3	11	A
8356694		Y	A	N	2	165	A
8358818		Y	A	N	3	11	A
8362323		Y	A	Y	2	165	A
8365104		Y	A	Y	3	11	A
8367448		Y	B	N	4	6	A
8370981		Y	A	Y	4	6	A
8371794		Y	A	N	4	6	A
8372857	N	N	A	N	4	6	A
8376069		Y	A	Y	4	6	A
8376073	S	N	A	Y	4	6	A
8376077		Y	A	Y	4	6	A
8376702	N	N	A	Y	4	6	A
8381669		Y	A	N	4	6	A
8381704	N	N	A	N	3	11	A
8386227		Y	A	N	3	11	A
8391043	E	N	B	N	4	6	A
8391113	W	N	A	N	4	6	D
8400669	E	N	A	N	3	11	A
8400674	W	N	A	N	4	6	A
8400678	W	N	A	N	2	165	A
8408609	W	N	A	N	4	6	A
8408612		Y	A	Y	3	11	A
8410380	N	N	A	Y	3	11	A
8413098		Y	A	Y	4	6	D
8413182	E	N	A	Y	4	6	A
8415744		Y	A	N	2	165	A
8418697		Y	A	N	3	11	A
8419785		Y	A	N	4	6	A
8420948		Y	B	Y	4	6	A
8424642		Y	A	N	3	11	A

CASE_ID	PCF_VIOL_C	PCF_VIOL_S	TYPE_OF_CO	Unsafe_Spe	Rear_End	Broadside	MVIW
8322555	7	A	C	0	1	0	C
8327603	8		B	0	0	0	C
8327627	3		C	1	1	0	C
8332749	18		E	0	0	0	I
8340883	5		A	0	0	0	C
8345812	10	A	G	0	0	0	B
8349888	3		C	1	1	0	C
8349896	9	A	H	0	0	0	G
8356646	12	A	D	0	0	1	C
8356694	0	A	G	0	0	0	B
8358818	9	A	D	0	0	1	G
8362323	10	A	G	0	0	0	B
8365104	9	A	D	0	0	1	C
8367448	12	A	D	0	0	1	C
8370981	9	B	D	0	0	1	C
8371794	12	A	A	0	0	0	C
8372857	5	A	A	0	0	0	C
8376069	12	A	D	0	0	1	C
8376073	4		C	0	1	0	C
8376077	6		G	0	0	0	B
8376702	1	A	C	0	1	0	C
8381669	9	A	D	0	0	1	C
8381704	1	A	E	0	0	0	I
8386227	5	1	H	0	0	0	G
8391043	9	B	C	0	1	0	C
8391113	0		E	0	0	0	J
8400669	3		E	1	0	0	I
8400674	1	A	C	0	1	0	E
8400678	3		F	1	0	0	A
8408609	21		C	0	1	0	C
8408612	12	A	D	0	0	1	C
8410380	8		B	0	0	0	E
8413098	0		D	0	0	1	C
8413182	5		A	0	0	0	C
8415744	6	A	D	0	0	1	C
8418697	1	A	D	0	0	1	C
8419785	9	A	D	0	0	1	C
8420948	10	A	G	0	0	0	B
8424642	3		D	1	0	1	C

CASE_ID	PED_ACTION	ROAD_SURFA	ROAD_COND_	LIGHTING	Nighttime	CONTROL_DE	CHP_ROAD_T
8322555	A	A	H	A	0	D	0
8327603	A	B	H	C	1	A	0
8327627	A	B	H	C	1	A	0
8332749	A	A	D	C	1	D	0
8340883	A	A	H	A	0	D	0
8345812	B	A	H	C	1	A	0
8349888	A	A	H	D	1	A	0
8349896	A	A	H	A	0	D	0
8356646	A	A	H	A	0	A	0
8356694	B	A	H	A	0	A	0
8358818	A	A	H	C	1	D	0
8362323	B	A	H	C	1	D	0
8365104	A	A	H	A	0	A	0
8367448	A	A	H	A	0	A	0
8370981	A	A	H	A	0	A	0
8371794	A	A	H	A	0	A	0
8372857	A	A	H	C	1	D	0
8376069	A	A	H	C	1	A	0
8376073	A	A	H	C	1	D	0
8376077	B	A	H	A	0	A	0
8376702	A	A	H	A	0	D	0
8381669	A	A	H	A	0	A	0
8381704	A	A	H	A	0	D	0
8386227	A	A	H	A	0	A	0
8391043	A	A	H	A	0	A	0
8391113	A	A	H	A	0	D	0
8400669	A	A	H	A	0	D	0
8400674	A	A	H	C	1	D	0
8400678	A	A	G	A	0	D	0
8408609	A	A	H	A	0	A	0
8408612	A	A	H	A	0	A	0
8410380	A	A	H	B	0	D	0
8413098	A	A	H	A	0	A	0
8413182	A	A	H	A	0	D	0
8415744	A	A	H	A	0	D	0
8418697	A	A	H	C	1	A	0
8419785	A	A	H	A	0	A	0
8420948	C	A	H	D	1	D	0
8424642	A	A	H	A	0	D	0

CASE_ID	PED	BICYCLE_AC	MOTORCYCLE	TRUCK_ACCI	NOT_PRIVAT	STWD_VEHTY
8322555	0				Y	A
8327603	0				Y	A
8327627	0				Y	A
8332749	0				Y	-
8340883	0				Y	-
8345812	1				Y	D
8349888	0				Y	A
8349896	0	Y			Y	A
8356646	0				Y	A
8356694	1				Y	D
8358818	0	Y			Y	L
8362323	1				Y	A
8365104	0				Y	A
8367448	0		Y		Y	C
8370981	0				Y	A
8371794	0				Y	A
8372857	0				Y	A
8376069	0				Y	A
8376073	0				Y	A
8376077	1				Y	A
8376702	0				Y	A
8381669	0				Y	B
8381704	0				Y	A
8386227	0	Y			Y	L
8391043	0				Y	A
8391113	0	Y			Y	-
8400669	0		Y		Y	C
8400674	0				Y	A
8400678	0	Y			Y	L
8408609	0				Y	D
8408612	0				Y	-
8410380	0				Y	D
8413098	0				Y	-
8413182	0				Y	A
8415744	0		Y		Y	C
8418697	0				Y	D
8419785	0				Y	A
8420948	1				Y	A
8424642	0			Y	Y	A

CASE_ID	ACCIDENT_Y	COLLISION_	COLLISION_Time	PRIMARY_RD	SECONDARY_	DISTANCE
8426224	2017	2017-06-25	1327	CRESTMOOR DR	KINGSTON AV	31
8429538	2017	2017-07-25	1015	EL CAMINO REAL	TAYLOR AV	20
8429542	2017	2017-06-20	1240	EL CAMINO REAL	JENEVEIN AV	0
8429642	2017	2017-07-02	441	SNEATH LN	ENGVALL RD	0
8429646	2017	2017-07-15	1750	HUNTINGTON AV	SNEATH LN	0
8431801	2017	2017-08-02	1252	RT 82	SANTA LUCIA AV	15
8433262	2017	2017-07-22	2020	EL CAMINO REAL	SAN BRUNO AV	15
8436199	2017	2017-08-18	1356	EL CAMINO REAL	SNEATH LN	15
8437226	2017	2017-08-28	815	EL CAMINO REAL	RT 380	0
8439916	2017	2017-08-01	654	COLLEGE DR	LONGVIEW DR	0
8441464	2017	2017-08-01	1837	SNEATH LN	SEA BISCUIT AV	0
8441810	2017	2017-08-28	1405	SAN BRUNO AV	EASTON AV	0
8458188	2017	2017-09-20	1036	SAN MATEO AV	SAN BRUNO AV	0
8458192	2017	2017-08-20	2244	WEST SAN BRUNO AV	CRESTMOOR DR	0
8458487	2017	2017-09-09	1313	HUNTINGTON AV	TARGET PARKING ENT	0
8458491	2017	2017-09-09	1228	SKYLINE BL	SNEATH LN	15
8462068	2017	2017-09-22	1104	EL CAMINO REAL	TAYLOR AV	40
8466479	2017	2017-09-11	2135	COMMODORE DR	ADMIRAL CT	0
8469533	2018	2018-01-11	2021	EL CAMINO REAL	RT 380	0
8470062	2017	2017-10-03	805	3RD AV	SAN BRUNO AV	0
8471946	2017	2017-09-15	1900	EL CAMINO REAL	JENEVEIN AV	0
8471977	2017	2017-09-27	2023	EL CAMINO REAL	CRYSTAL SPRINGS RD	0
8492363	2017	2017-11-02	2155	GLENVIEW DR	SAN BRUNO AV	0
8492367	2017	2017-11-04	1950	SYLVAN AV	EASTON AV	98
8492387	2017	2017-11-03	1606	MASTICK AV	CHAPMAN AV	0
8493211	2017	2017-11-02	2137	EL CAMINO REAL	CITATION AV	0
8493281	2017	2017-10-27	2249	EL CAMINO REAL	SAN BRUNO AV	0
8493603	2017	2017-11-09	825	EL CAMINO REAL	SAN BRUNO AV	30
8493715	2017	2017-11-17	730	SAN MATEO AV	SYLVAN AV	120
8495676	2017	2017-10-24	1913	SAN BRUNO AV WEST	HENSLEY AV	0
8499007	2017	2017-11-09	1933	EAST SAN BRUNO AV	7TH AV	55
8508568	2017	2017-11-21	1740	CHERRY AV	BAYHILL DR	115
8515400	2017	2017-11-29	759	PRINCETON DR	SAN BRUNO AV	0
8515611	2017	2017-11-30	700	EAST SAN BRUNO AV	3RD AV	0
8518274	2017	2017-11-15	1847	MONTGOMERY AV	HERMOSA AV	65
8518278	2017	2017-11-25	1413	GLENVIEW DR	WEST SAN BRUNO AV	0
8518282	2017	2017-11-23	2229	SAN BRUNO AV	GREEN AV	96
8533194	2017	2017-10-16	803	SNEATH LN	CLAREMONT DR	60
8541974	2018	2018-01-13	1959	ROLLINGWOOD DR	LOWER FLEETWOOD DR	195

CASE_ID	DIRECTION	INTERSECTION	WEATHER_1	STATE_HWY_	COL_Severity	EPDO_Score	PRIMARY_CO
8426224	S	N	A	N	3	11	A
8429538	S	N	A	Y	3	11	A
8429542		Y	A	Y	4	6	A
8429642		Y	A	N	3	11	A
8429646		Y	A	N	4	6	A
8431801	S	N	A	Y	3	11	A
8433262	N	N	A	N	4	6	A
8436199	S	N	A	Y	3	11	A
8437226		Y	A	Y	3	11	A
8439916		Y	E	N	3	11	A
8441464		Y	A	N	3	11	A
8441810		Y	A	N	4	6	A
8458188		Y	A	N	2	165	A
8458192		Y	A	N	3	11	A
8458487		Y	A	N	4	6	A
8458491	N	N	A	N	3	11	A
8462068	N	N	A	Y	3	11	A
8466479		Y	C	N	3	11	A
8469533		Y	A	Y	4	6	A
8470062		Y	A	N	3	11	A
8471946		Y	A	Y	2	165	A
8471977		Y	A	Y	2	165	A
8492363		Y	A	N	3	11	A
8492367	W	N	A	N	3	11	A
8492387		Y	B	N	4	6	A
8493211		Y	A	Y	3	11	A
8493281		Y	A	Y	2	165	A
8493603	N	N	B	Y	3	11	A
8493715	N	N	A	N	3	11	A
8495676		Y	A	N	3	11	A
8499007	W	N	A	N	2	165	A
8508568	N	N	A	N	3	11	A
8515400		Y	A	N	3	11	A
8515611		Y	A	N	3	11	A
8518274	N	N	B	N	2	165	A
8518278		Y	A	N	3	11	A
8518282	E	N	A	N	2	165	A
8533194	W	N	A	N	3	11	A
8541974	E	N	A	N	4	6	A

CASE_ID	PCF_VIOL_C	PCF_VIOL_S	TYPE_OF_CO	Unsafe_Spe	Rear_End	Broadside	MVIW
8426224	3		A	1	0	0	E
8429538	3		C	1	1	0	C
8429542	17	A	D	0	0	1	C
8429642	1	F	E	0	0	0	I
8429646	7	A	B	0	0	0	C
8431801	4		C	0	1	0	C
8433262	3		C	1	1	0	C
8436199	3	A	C	1	1	0	C
8437226	12	A	B	0	0	0	C
8439916	9	A	D	0	0	1	C
8441464	9	A	D	0	0	1	G
8441810	10	A	G	0	0	0	B
8458188	10	A	G	0	0	0	B
8458192	12	A	A	0	0	0	C
8458487	3		D	1	0	1	G
8458491	3		C	1	1	0	C
8462068	3		C	1	1	0	C
8466479	10	A	G	0	0	0	B
8469533	12	A	D	0	0	1	C
8470062	12	A	D	0	0	1	C
8471946	12	A	D	0	0	1	C
8471977	1	A	B	0	0	0	C
8492363	9		D	0	0	1	C
8492367	8		B	0	0	0	E
8492387	9		D	0	0	1	C
8493211	12	A	D	0	0	1	C
8493281	9	C	C	0	1	0	C
8493603	3		C	1	1	0	C
8493715	8		H	0	0	0	G
8495676	9	A	D	0	0	1	C
8499007	7	A	F	0	0	0	C
8508568	1	A	C	0	1	0	C
8515400	9	A	D	0	0	1	C
8515611	10	A	D	0	0	1	B
8518274	11	B	G	0	0	0	B
8518278	9	A	D	0	0	1	C
8518282	11	A	G	0	0	0	B
8533194	17	A	D	0	0	1	C
8541974	1	G	B	0	0	0	C

CASE_ID	PED_ACTION	ROAD_SURFA	ROAD_COND_	LIGHTING	Nighttime	CONTROL_DE	CHP_ROAD_T
8426224	A	A	H	A	0	D	0
8429538	A	A	H	A	0	A	0
8429542	A	A	H	A	0	A	0
8429642	A	A	H	C	1	A	0
8429646	A	A	H	A	0	A	0
8431801	A	A	H	A	0	D	0
8433262	A	A	H	A	0	A	0
8436199	A	A	H	A	0	A	0
8437226	A	A	H	A	0	A	0
8439916	A	A	H	A	0	D	0
8441464	A	A	H	A	0	A	0
8441810	B	A	H	A	0	D	0
8458188	B	A	G	A	0	A	0
8458192	A	A	H	C	1	A	0
8458487	A	A	H	A	0	A	0
8458491	A	A	H	A	0	A	0
8462068	A	A	H	A	0	D	0
8466479	B	B	H	C	1	A	0
8469533	A	A	H	C	1	A	0
8470062	A	A	H	A	0	A	0
8471946	A	A	H	A	0	A	0
8471977	A	A	H	C	1	A	0
8492363	A	A	H	C	1	A	0
8492367	E	A	H	D	1	D	0
8492387	A	A	H	A	0	A	0
8493211	A	A	H	C	1	A	0
8493281	A	A	H	C	1	A	0
8493603	A	B	H	A	0	A	0
8493715	A	B	H	B	0	D	0
8495676	A	A	H	C	1	A	0
8499007	A	A	H	C	1	D	0
8508568	A	A	H	C	1	D	0
8515400	A	A	H	A	0	A	0
8515611	B	A	H	A	0	A	0
8518274	D	A	H	D	1	D	0
8518278	A	A	H	A	0	A	0
8518282	D	A	H	C	1	D	0
8533194	A	A	H	A	0	D	0
8541974	A	A	H	C	1	D	0

CASE_ID	PED	BICYCLE_AC	MOTORCYCLE	TRUCK_ACCI	NOT_PRIVAT	STWD_VEHTY
8426224	0		Y		Y	C
8429538	0		Y		Y	C
8429542	0				Y	A
8429642	0				Y	A
8429646	0				Y	A
8431801	0		Y		Y	C
8433262	0				Y	A
8436199	0			Y	Y	F
8437226	0				Y	A
8439916	0				Y	A
8441464	0	Y			Y	A
8441810	1				Y	A
8458188	1				Y	I
8458192	0				Y	A
8458487	0	Y			Y	L
8458491	0				Y	A
8462068	0				Y	A
8466479	1				Y	A
8469533	0				Y	A
8470062	0				Y	A
8471946	0				Y	-
8471977	0		Y		Y	C
8492363	0				Y	A
8492367	1				Y	A
8492387	0				Y	A
8493211	0				Y	A
8493281	0				Y	A
8493603	0				Y	D
8493715	0	Y			Y	A
8495676	0				Y	A
8499007	0				Y	A
8508568	0				Y	D
8515400	0				Y	A
8515611	1				Y	A
8518274	1				Y	A
8518278	0				Y	A
8518282	1				Y	N
8533194	0		Y		Y	C
8541974	0				Y	D

CASE_ID	ACCIDENT_Y	COLLISION_	COLLISION_Time	PRIMARY_RD	SECONDARY_	DISTANCE
8543593	2018	2018-02-01	1813	EL CAMINO REAL	KAINS AV	0
8550595	2018	2018-01-25	811	EL CAMINO REAL	CRYSTAL SPRINGS RD	10
8550962	2018	2018-01-27	955	EL CAMINO REAL	CRYSTAL SPRINGS RD	0
8567336	2018	2018-02-24	2158	SNEATH LN	MONTEREY DR	61
8568093	2018	2018-02-10	2116	HUNTINGTON AV	ARGET PARKING GARAGE EI	0
8571088	2018	2018-02-23	2009	EL CAMINO REAL	RT 380	102
8576271	2018	2018-03-07	952	WEST SAN BRUNO AV	CRESTMOOR DR	0
8582484	2018	2018-02-22	1713	SAN BRUNO AV EAST	3RD AV	0
8585249	2018	2018-03-08	949	SAN BRUNO AV	CAMINO PLZ	15
8585352	2018	2018-02-22	2048	SNEATH LN	SEABISCUIT AV	0
8593485	2018	2018-03-03	910	EL CAMINO REAL	RT 380	247
8596937	2018	2018-03-14	1029	CRESTMOOR DR	OXFORD LN	0
8606033	2018	2018-04-12	715	MONTEREY DR	AMADOR DR	0
8606194	2018	2018-05-07	1507	SNEATH LN	LOWER CLAREMONT DR	0
8606345	2018	2018-03-19	1630	SAN BENITO AV	SAN ANSELMO AV S	195
8609363	2018	2018-04-08	1709	CHERRY AV	SNEATH LN	242
8615730	2018	2018-04-06	1243	EL CAMINO REAL	COMMODORE DR	30
8620948	2018	2018-05-07	1208	CHERRY AV	COMMODORE DR	151
8621485	2018	2018-05-03	25	SAN BRUNO AV	RT 280	248
8621489	2018	2018-05-06	1358	HUNTINGTON AV	FOREST LN	0
8631641	2018	2018-05-21	743	SHARP PARK RD	PACIFIC HEIGHTS BL	0
8648659	2019	2019-01-09	606	EL CAMINO REAL	SANTA LUCIA AV	5
8652431	2017	2017-10-08	50	EL CAMINO REAL	SAN BRUNO AV	132
8668624	2018	2018-06-21	1822	WEST SAN BRUNO AV	SHELTER CREEK LN	0
8668641	2018	2018-06-26	1918	CRYSTAL SPRINGS RD	LINDEN AV	0
8668913	2018	2018-06-14	1457	WEST SAN BRUNO AV	MASSON AV	10
8688572	2018	2018-06-11	1325	JENEVEIN AV	SAN MATEO AV	53
8688580	2018	2018-06-24	1452	HUNTINGTON AV	ARGET PARKING GARAGE EI	0
8688925	2018	2018-07-08	2245	RT 82	SAN BRUNO AV	82
8690421	2018	2018-07-07	1835	SNEATH LN	SEABISCUIT WY	0
8693328	2018	2018-07-09	1511	SUSAN DR	FASMAN DR	108
8695632	2018	2018-07-13	2325	SAN MATEO AV	WALNUT AV	0
8704662	2018	2018-09-17	2008	SAN BRUNO AV E	SAN MATEO AV	0
8718472	2018	2018-08-24	2045	EL CAMINO REAL	COMMODORE DR	100
8718510	2018	2018-08-14	1032	EL CAMINO REAL	KAINS AV	0
8718740	2018	2018-09-11	1915	EL CAMINO REAL	RT 380	0
8730936	2018	2018-09-10	1610	RT 280 ACCESS RD	SAN BRUNO AV	0
8730940	2018	2018-09-08	1732	EAST SAN BRUNO AV	5TH AV	0
8730944	2018	2018-09-11	1858	S SAN ANSELMO AV	SANTA LUCIA AV	0

CASE_ID	DIRECTION	INTERSECTION	WEATHER_1	STATE_HWY_	COL_Severity	EPDO_Score	PRIMARY_CO
8543593		Y	A	Y	3	11	A
8550595	N	N	B	Y	3	11	A
8550962		Y	A	Y	3	11	A
8567336	N	N	A	N	4	6	A
8568093		Y	A	N	3	11	A
8571088	N	N	A	Y	3	11	A
8576271		Y	A	N	3	11	A
8582484		Y	A	N	2	165	A
8585249	W	N	A	N	3	11	A
8585352		Y	A	N	2	165	A
8593485	N	N	B	Y	4	6	A
8596937		Y	B	N	3	11	A
8606033		Y	A	N	3	11	A
8606194		Y	A	N	3	11	A
8606345	W	N	A	N	2	165	A
8609363	S	N	A	N	3	11	A
8615730	S	N	B	Y	3	11	A
8620948	S	N	A	N	2	165	A
8621485	E	N	A	N	3	11	A
8621489		Y	A	N	3	11	A
8631641		Y	A	N	4	6	A
8648659	S	N	C	Y	1	165	A
8652431	N	N	A	Y	4	6	A
8668624		Y	A	N	4	6	A
8668641		Y	A	N	4	6	A
8668913	W	N	A	N	4	6	A
8688572	W	N	A	N	2	165	A
8688580		Y	A	N	3	11	A
8688925	N	N	A	Y	4	6	A
8690421		Y	A	N	2	165	A
8693328	S	N	A	N	2	165	A
8695632		Y	B	N	3	11	A
8704662		Y	A	N	2	165	A
8718472	S	N	A	Y	3	11	A
8718510		Y	B	Y	4	6	A
8718740		Y	A	Y	3	11	A
8730936		Y	A	N	3	11	A
8730940		Y	A	N	3	11	A
8730944		Y	A	N	3	11	A

CASE_ID	PCF_VIOL_C	PCF_VIOL_S	TYPE_OF_CO	Unsafe_Spe	Rear_End	Broadside	MVIW
8543593	9	A	D	0	0	1	C
8550595	3		C	1	1	0	C
8550962	3		C	1	1	0	C
8567336	1	A	C	0	1	0	E
8568093	17	A	D	0	0	1	C
8571088	4		C	0	1	0	C
8576271	12	A	D	0	0	1	D
8582484	10	A	G	0	0	0	B
8585249	3		C	1	1	0	C
8585352	12	A	D	0	0	1	C
8593485	4		C	0	1	0	C
8596937	9	A	D	0	0	1	C
8606033	10	A	G	0	0	0	B
8606194	17	A	C	0	1	0	C
8606345	11	A	G	0	0	0	B
8609363	1	A	B	0	0	0	E
8615730	21		C	0	1	0	C
8620948	8		C	0	1	0	E
8621485	1	A	E	0	0	0	I
8621489	12	A	D	0	0	1	C
8631641	9	B	B	0	0	0	C
8648659	10	A	G	0	0	0	B
8652431	3	A	C	1	1	0	C
8668624	12	A	D	0	0	1	C
8668641	9	A	D	0	0	1	C
8668913	3		C	1	1	0	C
8688572	11		G	0	0	0	B
8688580	9	A	H	0	0	0	G
8688925	1	A	C	0	1	0	C
8690421	10	A	G	0	0	0	B
8693328	3		F	1	0	0	G
8695632	10	A	G	0	0	0	B
8704662	1	A	A	0	0	0	C
8718472	4		C	0	1	0	C
8718510	8		E	0	0	0	I
8718740	12	A	D	0	0	1	C
8730936	8		B	0	0	0	C
8730940	9	A	A	0	0	0	C
8730944	12	A	D	0	0	1	C

CASE_ID	PED_ACTION	ROAD_SURFA	ROAD_COND_	LIGHTING	Nighttime	CONTROL_DE	CHP_ROAD_T
8543593	A	A	H	C	1	A	0
8550595	A	B	H	A	0	A	0
8550962	A	A	H	A	0	A	0
8567336	A	A	H	C	1	D	0
8568093	A	A	H	C	1	A	0
8571088	A	A	H	C	1	A	0
8576271	A	A	H	A	0	A	0
8582484	B	A	H	A	0	A	0
8585249	A	A	H	A	0	A	0
8585352	A	A	H	C	1	A	0
8593485	A	B	H	A	0	D	0
8596937	A	B	H	A	0	D	0
8606033	B	A	H	A	0	D	0
8606194	A	A	H	A	0	A	0
8606345	D	A	H	B	0	D	0
8609363	A	A	H	A	0	D	0
8615730	A	B	H	A	0	A	0
8620948	A	A	H	A	0	D	0
8621485	A	A	H	C	1	D	0
8621489	A	A	H	A	0	A	0
8631641	A	A	H	A	0	A	0
8648659	B	B	H	C	1	D	0
8652431	A	A	H	C	1	A	0
8668624	A	A	H	A	0	A	0
8668641	A	A	H	A	0	D	0
8668913	A	A	H	A	0	D	0
8688572	D	A	H	A	0	A	0
8688580	A	A	H	A	0	D	0
8688925	A	A	H	C	1	A	0
8690421	B	A	H	A	0	A	0
8693328	A	A	H	A	0	D	0
8695632	B	A	H	C	1	A	0
8704662	A	A	H	C	1	A	0
8718472	A	A	H	C	1	A	0
8718510	A	A	H	A	0	A	0
8718740	A	A	H	B	0	A	0
8730936	A	A	H	A	0	A	0
8730940	A	A	H	A	0	D	0
8730944	A	A	H	B	0	A	0

CASE_ID	PED	BICYCLE_AC	MOTORCYCLE	TRUCK_ACCI	NOT_PRIVAT	STWD_VEHTY
8543593	0				Y	A
8550595	0				Y	D
8550962	0				Y	A
8567336	0				Y	A
8568093	0				Y	A
8571088	0				Y	A
8576271	0				Y	-
8582484	1				Y	A
8585249	0			Y	Y	F
8585352	0				Y	A
8593485	0				Y	A
8596937	0				Y	A
8606033	1				Y	A
8606194	0				Y	A
8606345	1				Y	N
8609363	0				Y	A
8615730	0				Y	A
8620948	0				Y	A
8621485	0				Y	A
8621489	0				Y	A
8631641	0				Y	A
8648659	1				Y	I
8652431	0				Y	A
8668624	0				Y	A
8668641	0				Y	A
8668913	0				Y	A
8688572	1				Y	N
8688580	0	Y			Y	L
8688925	0				Y	A
8690421	1				Y	A
8693328	0	Y			Y	L
8695632	1				Y	A
8704662	0				Y	A
8718472	0				Y	A
8718510	0				Y	A
8718740	0				Y	A
8730936	0				Y	-
8730940	0				Y	A
8730944	0				Y	A

CASE_ID	ACCIDENT_Y	COLLISION_	COLLISION_Time	PRIMARY_RD	SECONDARY_	DISTANCE
8731338	2018	2018-06-24	1901	HUNTINGTON AV	SAN MATEO AV	100
8735720	2018	2018-10-03	850	EL CAMINO REAL	JENEVEIN AV	13
8738777	2018	2018-09-23	2113	EL CAMINO REAL	TAYLOR AV	34
8739207	2018	2018-10-30	1050	SAN BRUNO AV	6TH AV	145
8739229	2018	2018-10-06	55	JENEVEIN AV	MAPLE AV	0
8739619	2018	2018-11-05	1610	ROLLINGWOOD DR	COTTONWOOD DR	80
8739623	2018	2018-11-04	1038	CRYSTAL SPRINGS RD	CRYSTAL SPRINGS RD 2000	0
8739939	2018	2018-10-05	700	ACACIA AV	CRYSTAL SPRINGS RD	83
8749999	2018	2018-10-25	1020	EL CAMINO REAL	BAYHILL DR	100
8750092	2018	2018-10-18	940	DE SOTO WY	PORTOLA WY	10
8760006	2018	2018-11-09	1506	EL CAMINO REAL	COMMODORE DR	104
8760419	2018	2018-10-16	1330	3RD AV	PINE ST	0
8760815	2018	2018-11-13	1503	PINE ST	1ST AV	30
8761120	2018	2018-12-06	1845	WEST SAN BRUNO AV	EASTON AV	96
8765250	2018	2018-10-30	1606	EL CAMINO REAL	ANGUS AV	0
8767774	2018	2018-11-13	1504	PINE ST	2ND AV	0
8769200	2018	2018-12-12	1549	WEST ANGUS AV	ELM AV	2
8773986	2018	2018-11-21	1650	SAN BRUNO AV	5TH AV	0
8773990	2018	2018-11-04	1438	SAN BRUNO AV	7TH AV	25
8778747	2019	2019-01-09	1101	SNEATH LN	ROLLINGWOOD DR	50
8782263	2018	2018-12-15	1043	WALNUT AV	3RD AV	0
8784937	2018	2018-11-19	2218	EL CAMINO REAL	CRYSTAL SPRINGS RD	0
8785704	2018	2018-12-08	755	HUNTINGTON AV	SNEATH LN	100
8785801	2018	2018-10-05	2327	EL CAMINO REAL	SAN FELIPE AV	108
8787252	2018	2018-12-14	2034	EL CAMINO REAL	RT 380	35
8787275	2018	2018-11-26	1319	EL CAMINO REAL	RT 380	0
8787448	2018	2018-11-28	555	EL CAMINO REAL	COMMODORE DR	177
8789163	2018	2018-12-16	1752	CAMINO PLZ	KAINS AV	80
8793774	2019	2019-01-12	1606	SAN MATEO AV	SAN BRUNO AV	0
8793778	2019	2019-01-26	1455	CHERRY AV	SAN BRUNO AV	0
8794106	2019	2019-01-13	100	HIGHLAND DR	PACIFIC BAY CIR	0
8794357	2018	2018-12-13	1549	EL CAMINO REAL	ANGUS AV	0
8794386	2019	2019-01-07	1357	EL CAMINO REAL	RT 380	0
8794578	2018	2018-12-27	1110	EL CAMINO REAL	RT 380	0
8795266	2018	2018-12-17	1744	EUCLID AV	HENSLEY AV	45
8798799	2019	2019-01-18	1755	HUNTINGTON AV	SOUTH ACCESS RD	0
8803015	2019	2019-01-18	1051	ELM AV	JENEVEIN AV	184
8803278	2018	2018-12-29	1517	SAN BRUNO AV	4TH AV	0
8806315	2019	2019-01-31	1722	BAYHILL DR	EL CAMINO REAL	114

CASE_ID	DIRECTION	INTERSECTION	WEATHER_1	STATE_HWY_	COL_Severity	EPDO_Score	PRIMARY_CO
8731338	S	N	A	N	4	6	A
8735720	N	N	B	Y	2	165	A
8738777	S	N	A	Y	2	165	A
8739207	E	N	A	N	2	165	A
8739229		Y	A	N	2	165	A
8739619	E	N	A	N	2	165	A
8739623		-	A	N	4	6	A
8739939	S	N	A	N	3	11	A
8749999	N	N	A	Y	3	11	A
8750092	N	N	B	N	3	11	A
8760006	N	N	A	Y	3	11	A
8760419		Y	A	N	2	165	A
8760815	E	N	A	N	3	11	A
8761120	W	N	A	N	3	11	A
8765250		Y	A	Y	3	11	A
8767774		Y	A	N	4	6	A
8769200	E	N	A	N	2	165	A
8773986		Y	B	N	4	6	A
8773990	E	N	A	N	3	11	A
8778747	W	N	B	N	3	11	A
8782263		Y	B	N	4	6	A
8784937		Y	A	Y	3	11	A
8785704	E	N	A	N	3	11	A
8785801	S	N	A	Y	2	165	A
8787252	N	N	A	Y	4	6	A
8787275		Y	A	Y	3	11	A
8787448	N	N	C	Y	3	11	A
8789163	N	N	C	N	3	11	A
8793774		Y	B	N	4	6	A
8793778		Y	B	N	4	6	A
8794106		Y	A	N	3	11	A
8794357		Y	A	Y	3	11	A
8794386		Y	B	Y	3	11	A
8794578		Y	A	Y	3	11	A
8795266	W	N	A	N	3	11	A
8798799		Y	A	N	3	11	A
8803015	S	N	A	N	4	6	A
8803278		Y	A	N	4	6	A
8806315	W	N	A	N	3	11	A

CASE_ID	PCF_VIOL_C	PCF_VIOL_S	TYPE_OF_CO	Unsafe_Spe	Rear_End	Broadside	MVIW
8731338	1		A	0	0	0	C
8735720	11	A	G	0	0	0	B
8738777	3		C	1	1	0	C
8739207	9	A	D	0	0	1	C
8739229	11	A	G	0	0	0	B
8739619	8		C	0	1	0	E
8739623	9	A	D	0	0	1	C
8739939	8		G	0	0	0	B
8749999	8		C	0	1	0	C
8750092	8		E	0	0	0	I
8760006	6	A	D	0	0	1	C
8760419	10	A	G	0	0	0	B
8760815	3		C	1	1	0	E
8761120	8		D	0	0	1	C
8765250	12	A	D	0	0	1	C
8767774	8		B	0	0	0	C
8769200	10	A	G	0	0	0	B
8773986	9	A	D	0	0	1	C
8773990	8		C	0	1	0	C
8778747	3		C	1	1	0	C
8782263	9	B	D	0	0	1	C
8784937	12	A	D	0	0	1	C
8785704	3		E	1	0	0	J
8785801	11	A	G	0	0	0	B
8787252	8		C	0	1	0	C
8787275	12	A	D	0	0	1	C
8787448	3		C	1	1	0	C
8789163	1	A	G	0	0	0	B
8793774	12	A	D	0	0	1	D
8793778	9	A	A	0	0	0	C
8794106	1	A	E	0	0	0	I
8794357	10	A	G	0	0	0	B
8794386	3		C	1	1	0	C
8794578	12	A	D	0	0	1	C
8795266	9	A	D	0	0	1	C
8798799	10		G	0	0	0	B
8803015	8		E	0	0	0	I
8803278	9	A	A	0	0	0	G
8806315	9	A	D	0	0	1	G

CASE_ID	PED_ACTION	ROAD_SURFA	ROAD_COND_	LIGHTING	Nighttime	CONTROL_DE	CHP_ROAD_T
8731338	A	A	H	A	0	D	0
8735720	D	A	H	A	0	A	0
8738777	A	A	H	C	1	A	0
8739207	A	A	H	A	0	D	0
8739229	E	A	H	D	1	D	0
8739619	A	A	H	A	0	D	0
8739623	A	A	H	A	0	D	0
8739939	E	A	H	A	0	D	0
8749999	A	A	H	A	0	D	0
8750092	A	A	H	A	0	D	0
8760006	A	A	H	A	0	D	0
8760419	B	A	H	A	0	A	0
8760815	A	A	H	A	0	A	0
8761120	A	A	H	C	1	D	0
8765250	A	A	H	A	0	A	0
8767774	A	A	H	A	0	A	0
8769200	B	A	H	B	0	A	0
8773986	A	B	H	B	0	D	0
8773990	A	A	H	A	0	A	0
8778747	A	B	H	A	0	A	0
8782263	A	A	H	A	0	D	0
8784937	A	A	H	C	1	A	0
8785704	A	A	C	A	0	D	0
8785801	E	A	H	C	1	A	0
8787252	A	A	H	C	1	A	0
8787275	A	A	H	A	0	A	0
8787448	A	B	H	C	1	A	0
8789163	D	B	H	C	1	D	0
8793774	A	A	H	A	0	A	0
8793778	A	A	H	A	0	A	0
8794106	A	A	H	C	1	D	0
8794357	B	A	H	A	0	A	0
8794386	A	A	H	A	0	A	0
8794578	A	A	H	A	0	A	0
8795266	A	A	H	C	1	D	0
8798799	B	A	H	C	1	D	0
8803015	A	A	H	A	0	D	0
8803278	A	A	H	B	0	D	0
8806315	A	A	H	A	0	D	0

CASE_ID	PED	BICYCLE_AC	MOTORCYCLE	TRUCK_ACCI	NOT_PRIVAT	STWD_VEHTY
8731338	0				Y	A
8735720	1				Y	N
8738777	0				Y	A
8739207	0				Y	A
8739229	1				Y	N
8739619	0				Y	A
8739623	0				Y	A
8739939	1				Y	D
8749999	0				Y	A
8750092	0	Y			Y	L
8760006	0		Y		Y	C
8760419	1				Y	A
8760815	0				Y	A
8761120	0		Y		Y	A
8765250	0				Y	A
8767774	0				Y	A
8769200	1				Y	D
8773986	0				Y	A
8773990	0				Y	A
8778747	0				Y	D
8782263	0				Y	A
8784937	0				Y	A
8785704	0	Y			Y	L
8785801	1				Y	A
8787252	0				Y	A
8787275	0				Y	A
8787448	0				Y	A
8789163	1			Y	Y	F
8793774	0				Y	A
8793778	0				Y	A
8794106	0				Y	A
8794357	1				Y	A
8794386	0				Y	A
8794578	0				Y	A
8795266	0				Y	A
8798799	1				Y	A
8803015	0				Y	A
8803278	0	Y			Y	A
8806315	0	Y			Y	A

CASE_ID	ACCIDENT_Y	COLLISION_	COLLISION_Time	PRIMARY_RD	SECONDARY_	DISTANCE
8807725	2019	2019-01-31	1615	WEST SAN BRUNO AV	CHERRY AV	45
8809162	2019	2019-01-22	1022	SAN BRUNO AV	6TH AV	0
8816738	2018	2018-11-04	2126	EL CAMINO REAL	RT 380	102
8816742	2018	2018-11-26	2128	SNEATH LN	RT 280	210
8826027	2019	2019-03-02	111	EL CAMINO REAL	RT 380	100
8826062	2019	2019-02-02	1845	EL CAMINO REAL	JENEVEIN AV	0
8826717	2019	2019-02-13	2117	EL CAMINO REAL	SANTA INEZ AV	0
8848189	2019	2019-04-05	1945	LINDEN AV	CYRSTAL SPRINGS AV	243
8849661	2019	2019-02-15	736	EL CAMINO REAL	TAYLOR AV	0
8856385	2019	2019-04-12	2034	ANGUS AV	EL CAMINO REAL	36
8861044	2019	2019-03-29	2239	SYLVAN AV	MILTON AV	35
8861048	2019	2019-03-17	1005	KAINS AV	HENSLEY AV	0
8861052	2019	2019-03-29	2012	EAST SAN BRUNO AV	2ND AV	3
8867113	2019	2019-06-06	1901	JENEVEIN AV	CHESTNUT AV	23
8874068	2019	2019-05-08	1155	LINDEN AV	JENEVEIN AV	0
8879550	2019	2019-04-22	2022	EAST SAN BRUNO AV	3RD AV	0
8881869	2019	2019-05-25	1610	EL CAMINO REAL	RT 380	90
8882854	2019	2019-05-06	1810	EAST SAN BRUNO AV	6TH AV	0
8890723	2019	2019-05-25	1546	EL CAMINO REAL	RT 380	60
8890804	2019	2019-04-26	1759	EL CAMINO REAL	RT 380	0
8890808	2019	2019-05-15	1229	EL CAMINO REAL	RT 380	148
8894048	2019	2019-05-23	704	SCOTT ST	HERMAN ST	200
8895305	2019	2019-05-21	1545	JENEVEIN AV	HAWTHORNE AV	0
8895424	2019	2019-05-16	1620	SAN MATEO AV	JENEVEIN AV	227
8895428	2019	2019-05-31	2322	SNEATH LN	ROLLINGWOOD DR	30
8895848	2019	2019-06-06	850	AMADOR AV	DEL NORTE DR	32
8895945	2019	2019-06-10	1150	EL CAMINO REAL	BRUNO AV	180
8899386	2019	2019-06-21	603	CHERRY AV	SNEATH LN	0
8906905	2019	2019-06-11	1216	EL CAMINO REAL	CITATION AV	110
8907006	2019	2019-07-01	1205	2ND AV	ANGUS AV	0
8913337	2019	2019-06-28	1553	EL CAMINO REAL	SANTA LUCIA AV	0
8917218	2019	2019-04-19	2033	SNEATH LN	ENGVALL CT	20
8918410	2019	2019-06-24	1358	BAYHILL DR	TRAEGER AV	36
8920030	2019	2019-07-20	920	SAN BRUNO AV	SHELTER CREEK LN	0
8925805	2019	2019-07-11	1910	HUNTINGTON AV	HERMAN ST	0
8925813	2019	2019-07-04	2054	WALNUT ST	5TH AV	10
8925817	2019	2019-07-09	2256	MONTEREY DR	LASSEN DR	0
8940472	2019	2019-07-13	640	SHARP PARK RD	PACIFIC HEIGHTS BL	160
8940615	2019	2019-08-10	704	SAN BRUNO AV	4TH AV	0

CASE_ID	DIRECTION	INTERSECTION	WEATHER_1	STATE_HWY_	COL_Severity	EPDO_Score	PRIMARY_CO
8807725	W	N	A	N	4	6	A
8809162		Y	A	N	2	165	A
8816738	N	N	A	Y	3	11	A
8816742	E	N	A	N	2	165	A
8826027	S	N	C	Y	3	11	A
8826062		Y	C	Y	3	11	A
8826717		Y	C	Y	4	6	A
8848189	S	N	A	N	4	6	A
8849661		Y	C	Y	4	6	A
8856385	E	N	A	N	4	6	A
8861044	W	N	A	N	3	11	A
8861048		Y	A	N	3	11	A
8861052	E	N	A	N	3	11	A
8867113	E	N	A	N	3	11	A
8874068		Y	A	N	4	6	A
8879550		Y	A	N	3	11	A
8881869	S	N	A	Y	2	165	A
8882854		Y	A	N	3	11	A
8890723	S	N	A	Y	4	6	A
8890804		Y	A	Y	3	11	A
8890808	N	N	C	Y	4	6	A
8894048	W	N	B	N	2	165	A
8895305		Y	A	N	4	6	A
8895424	N	N	B	N	3	11	A
8895428	E	N	A	N	3	11	A
8895848	E	N	B	N	3	11	A
8895945	N	N	A	Y	2	165	A
8899386		Y	A	N	3	11	A
8906905	N	N	A	Y	3	11	A
8907006		Y	A	N	4	6	A
8913337		Y	A	Y	3	11	A
8917218	W	N	A	N	3	11	A
8918410	W	N	A	N	4	6	A
8920030		Y	A	N	3	11	A
8925805		Y	B	N	3	11	A
8925813	W	N	A	N	3	11	A
8925817		Y	E	N	3	11	A
8940472	E	N	B	N	3	11	A
8940615		Y	A	N	3	11	A

CASE_ID	PCF_VIOL_C	PCF_VIOL_S	TYPE_OF_CO	Unsafe_Spe	Rear_End	Broadside	MVIW
8807725	9	B	B	0	0	0	C
8809162	9	A	D	0	0	1	C
8816738	4		C	0	1	0	C
8816742	1	A	E	0	0	0	I
8826027	12	A	B	0	0	0	C
8826062	10	A	G	0	0	0	B
8826717	10	A	G	0	0	0	B
8848189	1	A	B	0	0	0	C
8849661	4		C	0	1	0	C
8856385	3		A	1	0	0	C
8861044	11	A	G	0	0	0	B
8861048	12	A	D	0	0	1	C
8861052	10	A	G	0	0	0	B
8867113	1	A	C	0	1	0	C
8874068	9	A	A	0	0	0	C
8879550	10	A	G	0	0	0	B
8881869	3		C	1	1	0	C
8882854	8	B	C	0	1	0	C
8890723	21		C	0	1	0	C
8890804	12	A	D	0	0	1	C
8890808	3		E	1	0	0	I
8894048	21		G	0	0	0	B
8895305	12		D	0	0	1	C
8895424	3	A	C	1	1	0	C
8895428	1	A	C	0	1	0	C
8895848	3		C	1	1	0	C
8895945	3		C	1	1	0	C
8899386	10	A	G	0	0	0	B
8906905	8		C	0	1	0	C
8907006	9		D	0	0	1	C
8913337	3	A	C	1	1	0	C
8917218	3		C	1	1	0	C
8918410	8		E	0	0	0	I
8920030	12	A	D	0	0	1	C
8925805	5	1	H	0	0	0	G
8925813	1	A	A	0	0	0	E
8925817	9	A	D	0	0	1	C
8940472	3		E	1	0	0	I
8940615	9		D	0	0	1	C

CASE_ID	PED_ACTION	ROAD_SURFA	ROAD_COND_	LIGHTING	Nighttime	CONTROL_DE	CHP_ROAD_T
8807725	A	A	H	A	0	A	0
8809162	A	A	H	A	0	A	0
8816738	A	A	H	C	1	A	0
8816742	A	A	H	C	1	D	0
8826027	A	B	H	C	1	A	0
8826062	B	B	H	C	1	A	0
8826717	B	B	H	C	1	A	0
8848189	A	A	H	D	1	D	0
8849661	A	B	H	A	0	A	0
8856385	A	A	H	C	1	D	0
8861044	D	A	H	D	1	D	0
8861048	A	A	H	A	0	A	0
8861052	B	A	H	C	1	D	0
8867113	A	A	H	A	0	A	0
8874068	A	A	H	A	0	D	0
8879550	B	A	H	C	1	A	0
8881869	E	A	H	A	0	A	0
8882854	A	A	H	B	0	D	0
8890723	A	A	H	A	0	A	0
8890804	A	A	H	A	0	A	0
8890808	A	B	H	A	0	A	0
8894048	F	A	H	A	0	D	0
8895305	A	A	H	A	0	A	0
8895424	A	A	H	A	0	D	0
8895428	A	A	H	C	1	A	0
8895848	A	A	H	B	0	D	0
8895945	A	A	H	A	0	D	0
8899386	B	A	H	B	0	A	0
8906905	A	A	H	A	0	A	0
8907006	A	A	H	A	0	A	0
8913337	A	A	H	A	0	A	0
8917218	A	A	H	C	1	A	0
8918410	A	A	H	A	0	D	0
8920030	A	A	H	A	0	A	0
8925805	A	A	H	A	0	D	0
8925813	A	A	H	C	1	D	0
8925817	A	A	H	C	1	D	0
8940472	A	B	H	A	0	D	0
8940615	A	A	H	A	0	A	0

CASE_ID	PED	BICYCLE_AC	MOTORCYCLE	TRUCK_ACCI	NOT_PRIVAT	STWD_VEHTY
8807725	0				Y	D
8809162	0				Y	A
8816738	0				Y	A
8816742	0				Y	A
8826027	0				Y	-
8826062	1				Y	A
8826717	1				Y	A
8848189	0				Y	A
8849661	0				Y	A
8856385	0				Y	A
8861044	1				Y	-
8861048	0				Y	A
8861052	1				Y	A
8867113	0				Y	A
8874068	0				Y	A
8879550	1				Y	D
8881869	1				Y	D
8882854	0				Y	A
8890723	0				Y	A
8890804	0				Y	A
8890808	0				Y	A
8894048	1				Y	A
8895305	0				Y	A
8895424	0				Y	A
8895428	0				Y	A
8895848	0		Y		Y	C
8895945	0				Y	A
8899386	1				Y	D
8906905	0			Y	Y	F
8907006	0				Y	A
8913337	0				Y	A
8917218	0				Y	A
8918410	0				Y	A
8920030	0				Y	D
8925805	0	Y			Y	L
8925813	0				Y	A
8925817	0				Y	A
8940472	0				Y	A
8940615	0				Y	A

CASE_ID	ACCIDENT_Y	COLLISION_	COLLISION_Time	PRIMARY_RD	SECONDARY_	DISTANCE
8944908	2019	2019-08-08	1721	HUNTINGTON AV	ANGUS AV	0
8944912	2019	2019-08-19	1831	EL CAMINO REAL	SAN LUIS AV	0
8945125	2019	2019-08-08	1605	CRYSTAL SPRINGS RD	ACACIA AV	149
8945150	2019	2019-09-09	1314	SNEATH LN	ROLLINGWOOD DR	23
8945154	2019	2019-09-06	1821	COLLEGE DR	SUSAN DR / LONGVIEW DR	0
8945417	2019	2019-08-17	1823	HUNTINGTON AV	HERMAN AV	237
8946120	2019	2019-09-06	653	SAN ANSELMO AV	SANTA LUCIA AV	0
8947219	2019	2019-09-09	2045	SNEATH LN	CLAREMONT DR	0
8953769	2019	2019-08-15	2252	SNEATH LN	SEABISCUIT LN	0
8958686	2019	2019-10-05	817	WALNUT ST	SAN MATEO AV	0
8958697	2019	2019-09-24	1745	SNEATH LN	SEABISCUIT AV	0
8958782	2019	2019-10-07	1744	ANGUS AV	SAN MATEO AV	0
8958895	2019	2019-08-07	1221	SHARP PARK RD	PACIFIC HEIGHTS BL	0
8961793	2019	2019-09-24	1142	SAN BRUNO AV	GREEN AV	0
8964467	2019	2019-09-13	808	EL CAMINO REAL	ANGUS AV	210
8972664	2019	2019-10-07	1155	RT 280	CUNNINGHAM WY	64
8975469	2019	2019-10-23	1429	SAN BRUNO AV	RT 280	0
8978664	2019	2019-10-28	1110	EL CAMINO REAL	RT 380	0
8978963	2019	2019-10-29	837	SAN BRUNO AV	3RD AV	0
9003659	2019	2019-11-21	1159	EL CAMINO REAL	PARK PL	232
9004389	2019	2019-11-26	1911	EL CAMINO REAL	COMMODORE DR	0
9004393	2019	2019-11-25	1803	EL CAMINO REAL	RT 380	48
9009540	2019	2019-12-10	2027	EASTON AV	KAINS AV	13
9011307	2019	2019-12-06	1907	ELM AV	BAYHILL DR	5
90162241	2016	2016-04-04	1515	CLAREMONT DRIVE	CONCORD WAY	12
9026709	2019	2019-12-18	647	MASTICK AV	KENSINGTON AV	0
9028980	2019	2019-11-15	920	7TH AV	6TH AV	146
9034236	2019	2019-12-16	925	EL CAMINO REAL	RT 380	0
9034382	2019	2019-12-17	250	EL CAMINO REAL	ANGUS AV	176
9035095	2019	2019-12-11	2159	EL CAMINO REAL	COMMODORE DR	0
9071953	2019	2019-11-04	1915	EL CAMINO REAL	SNEATH LN	10

CASE_ID	DIRECTION	INTERSECTION	WEATHER_1	STATE_HWY_	COL_Severity	EPDO_Score	PRIMARY_CO
8944908		Y	A	N	3	11	A
8944912		Y	A	Y	3	11	A
8945125	W	N	A	N	2	165	A
8945150	E	N	A	N	3	11	A
8945154		Y	A	N	2	165	A
8945417	S	N	A	N	3	11	A
8946120		Y	A	N	4	6	A
8947219		Y	A	N	4	6	A
8953769		Y	A	N	3	11	A
8958686		Y	A	N	3	11	A
8958697		Y	A	N	3	11	A
8958782		Y	A	N	4	6	A
8958895		-	A	N	3	11	A
8961793		Y	A	N	3	11	A
8964467	N	N	A	Y	4	6	A
8972664	W	N	A	N	2	165	A
8975469		Y	A	N	4	6	A
8978664		Y	A	Y	4	6	A
8978963		Y	A	N	2	165	A
9003659	S	N	A	Y	4	6	A
9004389		Y	C	Y	3	11	A
9004393	N	N	A	Y	4	6	A
9009540	S	N	B	N	4	6	A
9011307	N	N	B	N	3	11	A
90162241	N	N	A	N	3	11	A
9026709		Y	C	N	4	6	A
9028980	N	N	A	N	3	11	A
9034236		Y	A	Y	4	6	A
9034382	S	N	A	Y	4	6	A
9035095		Y	C	Y	2	165	A
9071953	S	N	A	Y	4	6	A

CASE_ID	PCF_VIOL_C	PCF_VIOL_S	TYPE_OF_CO	Unsafe_Spe	Rear_End	Broadside	MVIW
8944908	12		D	0	0	1	C
8944912	3		C	1	1	0	C
8945125	3		G	1	0	0	B
8945150	3		E	1	0	0	I
8945154	9	A	D	0	0	1	C
8945417	8		B	0	0	0	E
8946120	9	A	D	0	0	1	C
8947219	10		G	0	0	0	B
8953769	10	A	G	0	0	0	B
8958686	10	A	G	0	0	0	B
8958697	10	A	G	0	0	0	B
8958782	10	A	G	0	0	0	B
8958895	8		E	0	0	0	I
8961793	10	A	G	0	0	0	B
8964467	9		H	0	0	0	C
8972664	3	A	E	1	0	0	I
8975469	12	A	D	0	0	1	C
8978664	12	A	D	0	0	1	C
8978963	10	A	G	0	0	0	B
9003659	3		C	1	1	0	C
9004389	9	A	B	0	0	0	C
9004393	3		C	1	1	0	C
9009540	8		A	0	0	0	C
9011307	10	A	G	0	0	0	B
90162241	3		F	1	0	0	A
9026709	10		G	0	0	0	B
9028980	21		E	0	0	0	J
9034236	12	A	B	0	0	0	C
9034382	8		E	0	0	0	J
9035095	17	A	G	0	0	0	B
9071953	3		C	1	1	0	C

CASE_ID	PED_ACTION	ROAD_SURFA	ROAD_COND_	LIGHTING	Nighttime	CONTROL_DE	CHP_ROAD_T
8944908	A	A	H	-	0	A	0
8944912	A	A	H	A	0	D	0
8945125	F	A	H	A	0	D	0
8945150	A	A	H	A	0	D	0
8945154	A	A	H	A	0	A	0
8945417	A	A	H	A	0	D	0
8946120	A	A	H	A	0	A	0
8947219	B	A	H	C	1	D	0
8953769	B	A	H	C	1	A	0
8958686	B	A	H	A	0	A	0
8958697	B	A	H	A	0	A	0
8958782	B	A	H	A	0	D	0
8958895	A	A	H	A	0	D	0
8961793	B	A	H	A	0	D	0
8964467	A	A	H	A	0	D	0
8972664	A	A	H	A	0	D	0
8975469	A	A	H	A	0	A	0
8978664	A	A	H	A	0	B	0
8978963	B	A	H	A	0	A	0
9003659	A	A	H	A	0	D	0
9004389	A	A	H	C	1	A	0
9004393	A	A	H	C	1	D	0
9009540	A	B	H	C	1	D	0
9011307	B	B	H	C	1	A	0
90162241	A	A	H	A	0	D	0
9026709	B	B	H	C	1	D	0
9028980	F	A	A	A	0	D	0
9034236	A	A	H	A	0	A	0
9034382	A	A	H	C	1	D	0
9035095	B	B	H	C	1	A	0
9071953	A	A	H	B	0	A	0

CASE_ID	PED	BICYCLE_AC	MOTORCYCLE	TRUCK_ACCI	NOT_PRIVAT	STWD_VEHTY
8944908	0				Y	D
8944912	0				Y	A
8945125	1	Y			Y	L
8945150	0	Y			Y	L
8945154	0				Y	A
8945417	0				Y	A
8946120	0				Y	A
8947219	1				Y	A
8953769	1				Y	D
8958686	1				Y	D
8958697	1				Y	A
8958782	1				Y	A
8958895	0				Y	A
8961793	1				Y	A
8964467	0				Y	A
8972664	0				Y	A
8975469	0				Y	A
8978664	0				Y	A
8978963	1				Y	A
9003659	0				Y	A
9004389	0				Y	-
9004393	0				Y	A
9009540	0				Y	A
9011307	1				Y	I
90162241	0				Y	H
9026709	1				Y	A
9028980	1				Y	A
9034236	0		Y		Y	A
9034382	0				Y	A
9035095	1				Y	A
9071953	0				Y	A

Appendix E:

LRSM Excerpt

Local Roadway Safety

A Manual for California's Local Road Owners

Version 1.6
April 2022

Created by Caltrans in conjunction with FHWA and SafeTREC
for the express benefit of California Local Agencies.

Caltrans

U. S. Department of Transportation
Federal Highway Administration

Safe Transportation
Research & Education Center
SafeTREC

Document History

Version 1.0: 4/20/2012

The California Department of Transportation - Division of Local Assistance developed the first version of the Local Roadway Safety Manual (Version 1.0) in 2012 to support the Cycle 5 HSIP call-for-projects.

Version 1.1: 4/26/2013

Based on feedback and lessons learned from Cycle 5, Caltrans updated Appendix B: "Table of Countermeasures and Crash Reduction Factors" to better clarify text in "Where to use", "Why it works", and "General Qualities" for several of the countermeasures included in the original manual.

No other changes were made to the Local Roadway Safety Manual as part of Version 1.1

Version 1.2: 03/10/2015

Based on feedback and lessons learned from Cycle 6, Caltrans made minor updates to the text of the document as needed for achieving consistency with overall Caltrans local HSIP guidance documents. The following sections were updated: 1.2, 4.2, 5.1, 6.2, and Appendix B, E, F & G.

Version 1.3: 04/29/2016

Caltrans made updates to the text of the document as needed in the following sections: 4.2, 5.1 and Appendix B.

Version 1.4: 06/08/2018

3/30/18 - Caltrans made updates to the crash costs in Appendix D, some of the website links in Appendix G, and some other texts of the document.
6/8/18 - Countermeasure S22 ("Modify signal phasing to implement a Leading Pedestrian Interval (LPI)") is added.

Version 1.5: April 2020

Caltrans added a few more countermeasures (e.g. Pedestrian Scramble, Install Separated Bike Lanes, Reduced Left-Turn Conflict Intersections, and Curve Shoulder widening), renumbered the countermeasures and updated the crash costs in Appendix D.

Version 1.6: April 2022

For Cycle 11 Call-for-projects, Countermeasure S04 (Provide Advanced Dilemma Zone Detection for high-speed approaches) was deleted and Countermeasure NS05mr (Convert intersection to mini-roundabout) added. The HSIP Funding Eligibility was changed to 90% except for S03, of which the HSIP Funding Eligibility stays at 50%. The crash costs in Appendix D were updated.

Future Updates:

In the future, Caltrans anticipates that additional changes will be needed to keep the Local Roadway Safety Manual consistent with future Calls-for-Projects' Guidelines and Application Instructions. In addition, new local HSIP programs, improvements to California data on local roadways, data analysis tools, and the latest safety research and methodologies may give rise to the need to make more significant changes to this manual.

Table of Contents

Foreword

Why was this manual developed?

The California Department of Transportation - Division of Local Assistance's goal in developing 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.

This goal is complicated by California's wide variety of local agencies, roadway types, and project types, including: rural vs. urban, low-volume vs. high-volume, and intersection vs. roadway segment vs. network-wide. This variety makes it difficult to administer a single program and provide one set of guidelines that meets the needs of all California's local roadway owners and users. Many of California's local agencies are also challenged by the lack of a basic safety analysis framework and analysis tools specifically designed for local roadway managers with widely varying responsibilities and safety training. Currently, there is a vast range of safety documents, program guidance, and analysis tools with a wide variety of complexity and applications. Without clear and simple safety guidance for locals, many agencies take a 'reactive' approach to safety, even when research has shown 'proactive' safety analysis of roadways is more effective in making system-wide safety improvements.

The Federal Highway Administration (FHWA) Office of Safety provides national leadership in identifying, developing, and delivering safety programs and products to local governments to improve highway safety on local and rural roads.[1] In 2010, FHWA published a set of three manuals designed specifically for rural road owners; Roadway Departure Safety, Intersection Safety, and Road Safety Information Analysis.[2] These manuals present a simple, data driven safety analysis framework for rural agencies across the nation. These manuals, in conjunction with Caltrans' ongoing short-term research and development contract with the Safe Transportation Research and Education Center (SafeTREC) at the University of California, Berkeley, provided a unique opportunity for Caltrans to pursue development of this document as a mirror of FHWA's new Manuals for Local Rural Road Owners. Much of the wording, formatting and references from these FHWA manuals have been directly incorporated into this manual for California's local road owners. Individual references to the FHWA manuals have not been included; instead these documents are intended to be referenced on a wholesale basis.

With FHWA's and SafeTREC's support and expertise, Caltrans was able to expedite the completion of this manual and can now offer California's local agencies a new tool intended to provide focused roadway safety information in one manual.

1. Introduction and Purpose

The information in this document is geared towards local road managers and other practitioners with responsibility for operating and maintaining local roads, regardless of safety-specific highway training. The primary goal of this document is to provide an easy-to-use and comprehensive framework of the steps and analysis tools needed to identify locations with roadway safety issues and the appropriate countermeasures. For novice practitioners, the concepts and framework will be new, while experienced safety practitioners may find this manual to be mostly review. In both cases, the manual will provide the practitioners with a good understanding of how to complete a proactive safety analysis and ensure they have the best opportunity to secure HSIP safety funding during Caltrans calls-for-projects.

It's expected that novice and experienced practitioners will utilize this manual to help position their local agency to better compete in future Caltrans' calls-for-projects for safety programs. Inexperienced local roadway practitioners are also a target audience for this manual to gain exposure to the basic concepts that make up a proactive safety analysis of a local agency's roadway network.

The intent of this manual is to focus on key safety activities that every local agency should conduct on an annual basis (or as established by the agency) with the objective of reducing the number and severity of crashes within their jurisdiction. This manual defines this overall process as a "proactive safety analysis" approach to roadway safety. The Highway Safety Manual (HSM), documents a very similar process and refers to it as the "Roadway Safety Management Process." While the process in this document is similar and suggests the same primary elements, the HSM goes into significantly more detail, focuses more on scientific and mathematical equations behind the process, and intends to provide a comprehensive understanding of the overall processes to be applied by individual agencies across the nation. In contrast, this manual attempts to streamline the discussion; and make accommodations for the more novice safety practitioners, provide an adequate understanding of the process to complete an initial safety analysis of their roadway network, and instruct them on how to prepare applications that will compete well in Caltrans' statewide calls-for-projects. In general, this manual is intended to follow the research and methodologies presented in the HSM; however, to support Caltrans' statewide calls-for-projects process, it is important to note this manual deviates from the HSM in areas related to countermeasure selection and benefit / cost calculations. The logic behind these deviations is explained at the specific topic sections.

This manual is not intended to cover many of the day-to-day basics of traffic engineering including: maintain standard signage per the Manual on Uniform Traffic Control Devices; maintain sight distance (cut vegetation, remove parking); maintain a recovery zone; work with local traffic law enforcement; monitor collisions; address complaints; and manage litigation. These activities are understood to be critical elements of a local agency's traffic engineering responsibilities, but are not within the intended scope of this document.

1.1 California Local Roadway Safety Challenges and Opportunities

California's local roads are managed by more than 600 local agencies, including: cities, counties, and tribal governments. These local roads vary from flat multi-lane urban arterials to rural gravel roads in mountainous areas. California local agencies invest extensive resources on roadway safety every year, yet many roadways operate with outdated or insufficient safety features. A portion of these roadways even lack basic signing, pavement markings, alignment, and traffic control devices. Limited funding often prevents agencies from constructing safety projects, which can be expected. At the same time, the lack of safety data, design challenges, and lack of adequate training also hinder local agencies' accurate evaluation of their roadway network safety issues, which is more preventable.

Many small California local agencies are challenged by a lack of crash data. Without data, they have no way to identify High Crash Concentration Locations (HCCLs) or high risk roadway features, which can leave them "flying blind" with respect to the safety of their overall roadway network. Without data and analysis results, local officials may overreact when a tragic crash occurs, resulting in resources being spent in areas that will not maximize the overall application of safety funds. In conjunction with the collision mapping and analysis tools developed by UC Berkeley's SafeTREC, this document helps ensure all California local agencies have direct access to data on fatal and injury crashes within their jurisdictions and the analysis tools to effectively assess and prioritize future safety projects.

1.2 Safe System Approach

The Infrastructure Investment and Jobs Act (IIJA), aka Bipartisan Infrastructure Law (BIL), was signed into law on November 15, 2021. Under IIJA, the Highway Safety Improvement Program (HSIP), codified as Section 148 of Title 23, United States Code (23 U.S.C §148), is a core federal-aid program to States for the purpose of achieving a significant reduction in fatalities and serious injuries on all public roads. The IIJA emphasizes the "safe system approach":

Safe system approach means a roadway design that emphasizes minimizing the risk of injury or fatality to road users; and that (i) takes into consideration the possibility and likelihood of human error; (ii) accommodates human injury tolerance by taking into consideration likely accident types, resulting impact forces, and the ability of the human body to withstand impact forces; and (iii) takes into consideration vulnerable road users. (23 U.S.C. 148(a)(9)).

FHWA recognizes that the funding available through HSIP alone will not achieve the goal of zero fatalities on the Nation's roads. The Safe System approach addresses the safety of all road users, including those who walk, bike, drive, ride transit, and travel by other modes. It involves a paradigm shift to improve safety culture, increase collaboration across all safety stakeholders, and refocus transportation system design and operation on anticipating human mistakes and lessening impact forces

to reduce crash severity and save lives. FHWA encourages States to prioritize safety in all Federal-aid investments and in all appropriate projects, using not only HSIP funding but also other Federal-aid funding.

The IIJA emphasizes the importance of vulnerable road user (non-motorized road user) safety in the HSIP by adding a definition for vulnerable road users, creating a vulnerable road user special rule, and requiring States to develop and update a vulnerable road user safety assessment. All of these provisions address the increasing number of fatalities involving vulnerable road users on U.S. roads. It is imperative that States consider the needs of all road users as part of the HSIP. Investment in highway safety improvement projects that promote and improve safety for all road users, particularly vulnerable road users, aligns with the IIJA and will help Build a Better America. States and other funding recipients should prioritize projects that maximize the existing right-of-way for accommodation of non-motorized modes and transit options that increase safety, equity, accessibility, and connectivity. Projects that separate users in time and space, match vehicle speeds to the built environment, and increase visibility (e.g., lighting) advance implementation of a Safe System approach and improve safety for vulnerable road users.

1.3 The State's Role in Local Roadway Safety

The California Department of Transportation (Caltrans)—Division of Local Assistance is responsible for administering California's HSIP safety funding intended for local roadway safety improvements. This funding primarily comes to the state through two federal programs: Highway Safety Improvement Program (HSIP)—a federal-aid program focused on reducing fatalities and serious injuries on all public roads; and the Active Transportation Program (ATP)—a federal aid and state funded program focused on improving safety and the overall use of non-motorized, active transportation modes of travel. Under SAFETEA-LU, High Risk Rural Roads Program (HR3) was established to focus on addressing rural road safety needs but in MAP-21 and FAST, it is now a 'special rule' under HSIP that if triggered, directs that a certain amount of HSIP funds will need to be allocated for those rural roads that meet the definition.

Caltrans' administration of these programs encompasses many responsibilities, including: establishing program guidance; reviewing applications for improvements on local roadways; ranking applications/projects on a statewide basis; selecting projects for funding based on the greatest potential for reducing fatalities and injuries; programming the selected projects in the Federal Statewide Transportation Improvement Program (FSTIP); and assisting with programming and delivery issues throughout the delivery of the local agency projects. One goal for developing this document is to improve Caltrans' overall data-driven approach to statewide project selection of safety projects and to maximize the long-term safety improvements across California. To show the relationship between Caltrans' project selection process and this manual, a diagram showing the HSIP Call-for-Projects Process is provided in Appendix A.

Many State Departments are also actively engaged in California's Strategic Highway Safety Plan (SHSP). Caltrans developed the SHSP in a cooperative process with local, State, federal, and private sector safety stakeholders. The SHSP is a data-driven, comprehensive plan that established statewide goals, objectives, integrated the five E's of traffic safety— engineering, enforcement, education, emergency response, and emerging technologies. This manual directly supports many of the emphasis areas of the California SHSP. Local agencies are encouraged to participate in ongoing SHSP update efforts and can find more information on the SHSP at the following website: https://dot.ca.gov/programs/safety-programs/shsp.

Local Roadway Safety Plan (LRSP) and Systemic Safety Analysis Report Program (SSARP)

The state-funded Systemic Safety Analysis Report Program (SSARP) was established in 2016. The intent of the SSARP was to assist local agencies in performing a collision analysis, identifying safety issues on their roadway networks, and developing a list of systemic low-cost countermeasures that can be used to prepare future HSIP and other safety program applications. Late 2019, the program was evolved to Local Roadway Safety Plan (LRSP) so that the focus is not just engineering solutions but also include safety improvements in other areas such as enforcement, Education and emergency response.

The state funding for the LRSP/SSARP program is made available by exchanging the local Highway Safety Improvement Program (HSIP) federal funds for State Highway Account (SHA) funds.

For more information, please visit the LRSP/SSARP webpage at https://dot.ca.gov/programs/local-assistance/fed-and-state-programs/highway-safety-improvement-program/local-roadway-safety-plans.

1.4 The Local Roadway Crash Problem

Approximately 3,000 people die in California traffic crashes every year, representing nearly 10% of all traffic fatalities in the United States. Fifty-seven percent of these fatalities occur on local roadways, while only forty-three percent occur on the California State Highway System. A comparison of rural and urban roadways shows that local rural roadways have fatality rates 2 to 3 times higher than urban roadways per vehicle miles traveled. Based on these statistics, the total annual cost of local roadway fatal crashes to California is over $6 billion, while only $100 million is available annually in HSIP safety funds.

These statistics demonstrate the large and complex safety issues facing California. Through the development of this document, Caltrans is striving to help local agencies proactively identify high risk roadway features, roadway network locations/corridors with the highest safety needs, and encourage them to select effective low-cost improvements, whenever appropriate.

1.5 Reactive vs. Proactive Safety Issue Identification

Safety issues are identified on local roadways through a wide range of approaches. Although no single approach works best for all local agencies, some are far more effective at improving long-term roadway safety. Many agencies, often larger ones, have staff whose full-time job is dedicated to roadway safety; allowing them to focus on safety initiatives, be trained in the latest safety research, and have access to safety analysis data, tools and procedures. These agencies often utilize a 'proactive' approach to analyze their roadway network and identify safety issues.

At the same time many agencies, often the smaller ones, lack the financial ability to dedicate large portions of their staff resources to analyze safety issues and their staff has limited access to roadway safety training, safety expertise, and the latest safety analysis tools and procedures. Unfortunately, this can often result in identifying their safety issues in 'reaction' to tragic events.

The following is a basic outline of the differences in proactive vs. reactive identification approaches used by local agencies:

Reactive Approach

For this document, an agency is considered to be utilizing a reactive approach to roadway safety if they primarily identify safety improvements in reaction to:

- Recent crashes triggering safety investigations
- Specific crash concentrations triggering safety investigations
- Stakeholder identification of locations with safety issues and requests for improvements
- New funding becoming available

Crash concentrations and crash trends may be missed if local agencies rely exclusively on these identifiers for their roadway safety effort. They may also miss many opportunities to effectively utilize low-cost, systemic type improvements. This document encourages local agencies to adopt a more proactive approach to their roadway safety.

Proactive Approach

An agency is considered to be using a proactive approach to roadway safety if they go beyond the elements of a reactive approach and identify safety improvements by analyzing the safety of their entire roadway network, in one of the following ways:

- One-time, network-wide safety analysis of their roadways driven by new source of funding.
- Routine safety analyses of the roadway network (Preferred Approach!)

Agencies with a proactive approach utilize both systemic and spot location improvements (as defined in section 1.5 below). Applying improvements systemically across an entire corridor or network allows an agency to proactively address locations that have not had crash concentrations in the past, but have

similar features as those currently experiencing high levels of crashes. In addition, even though a spot location improvement may be based on 'past' crashes, agencies making improvements based on countermeasures with proven crash reduction factors at their highest crash locations often have the best chance of proactively reducing future crashes.

This document encourages safety practitioners to pursue a proactive approach and routinely analyze the safety of their roadway networks to yield the best overall safety results.

1.6 Implementation Approaches

When an agency proactively identifies their safety issues throughout their roadway network, it is likely they will find high crash concentrations at intersections, roadway segments, and corridors. The safety practitioner should consider which implementation approach to utilize. Typical approaches include:

- Systemic Approach
- Spot Location Approach
- Comprehensive Approach incorporating human behavior issues

Each of these approaches has benefits and drawbacks. As Local agency practitioners identify their safety issues and analyze the data for crash patterns, they should be open to implementing a combination of these approaches, as documented in Sections 2 and 3 of this manual.

Systemic Approach

The Systemic Approach is primarily based on application of proven safety countermeasures at multiple crash locations, corridors, or geographic areas. Implementation of the Systemic Approach is generally based on 'system-wide' crash data with the estimates of the impacts being made in terms of benefits measured in traffic crash reduction and deployment cost. Identified locations experiencing high levels of crashes and locations with similar geometric features can be treated systemically with low-cost, proven safety countermeasures. *Note: The term "Systemic" used throughout in this manual is often exchanged with the term "Systematic" in many national safety documents and research studies. In general, safety practitioners will find these terms interchangeable. This manual uses "Systemic" to match the new HSM and the FHWA CMF Clearinghouse.*

Benefits of the Systemic Approach may include:

- Widespread effect. The Systemic Approach addresses safety issues at a large number of locations or on an entire local roadway network. It can also generate projects that combine HCCLs and locations with the potential for crashes and still have high Benefit to Cost (B/C) ratios. An example of this type of project could be upgrading pavement delineation and warning signs along a rural corridor: crashes may not have occurred on every curve or segment along the corridor, but all of the corridor's pavement delineation and warning signs can be upgraded at one time. For urban applications, an example could be protecting the left-turn phase of signalized intersections with

existing left-turn pockets: severe crashes may not have occurred at each of the left-turn movements, but with minor changes to the signal hardware and signing, all or many of a city's unprotected left-turn phases can be protected with one safety project.

- Crash type prevention. By focusing on a predominant crash type, an agency can address locations that have not experienced significant numbers of these types of crashes, but have similar characteristics or conditions as existing HCCLs. The resulting B/C ratios for these types of projects will be less than if only HCCLs are included; but by using low-cost countermeasures and including as many high crash locations as possible, the resulting B/C ratios should still be high enough to allow agencies to proactively address locations that have not experienced high numbers of these types of crashes. For urban areas, projects improving pedestrian crossings can be good examples of the Systemic Approach. By applying the countermeasures systemically, the agency can often justify these projects based on relatively high B/C ratios, even though some of the improvement locations have not experienced enough crashes to yield moderate-to-high B/C ratios on their own.
- Cost-effectiveness. Implementing low-cost solutions across an entire system or corridor can be a more cost-effective approach to addressing system-wide safety issues. Even though this approach does not address all (or total) safety issues for a given location, the deployment of low-cost countermeasures often result in the highest overall safety benefit for an agency with limited safety funding. An example of this would be an agency choosing to install rumble stripes along an entire corridor for equal or less money than realigning a small portion the roadway to fix a single curve.
- Reduced data needs. The Systemic Approach can be used without a detailed crash history for specific locations, thereby reducing data needs. For example, consider a long rural corridor, which includes a section that passes through an Indian Reservation: Even if there is no documented crash data for the portion of the corridor that passes through the reservation, the entire limits can be treated with the same low-cost improvements. As long as there are sufficient past crashes documented for the entire corridor, the project will still have a reasonably high B/C ratio.

Drawbacks of the Systemic Approach may include:

- Justifying improvements can be difficult. Because this approach does not always address locations with a history of crashes and active stakeholders, it can be difficult to justify the improvements. The Systemic Approach will rarely include a recommendation for a large-scale safety improvement at a single location. Since large-scale projects usually garner attention from decision makers, the media, elected officials, and the general public, safety practitioners often need to make additional efforts to explain the Systemic Approach and its benefits to those groups. Safety practitioners can utilize the high B/C ratios of these systemic projects to convey their benefits compared to high-profile, single location projects with lower B/C ratios.

Spot Location Approach

The Spot Location Approach is typically based on an analysis of crash history to identify locations that have significantly higher crashes and treat them accordingly. It is important to practitioners to

understand that for many locations, safety issues can be complicated and sometimes the most appropriate fixes are not quick, easy or cheap.

Benefits of the Spot Location Approach may include:

- Focus on demonstrated needs. The Spot Location Approach focuses directly on locations with a history of crashes and specifically addresses those crashes. Intersection improvements are some of the most common spot location projects. Intersections tend to have higher concentrations of crashes resulting from opposing traffic movements. These high crash concentrations often require stand-alone improvements to adequately resolve the safety issues.
- Justifying improvements can be easy. Because this approach addresses locations with a history of crashes, it is usually easy to justify improvements. For urban areas, reconfiguring/ reconstructing an entire intersection can be a good example of an effective Spot Location Approach. Large urban intersections can have extremely high crash concentrations, making major changes to the intersection the only way to significantly reduce future crashes. With these types of scenarios, even the highest cost countermeasures can be cost effective.
- If low-cost countermeasures are used, this approach can prove very cost effective. The Spot Location Approach does not always have to include moderate or high cost improvements. It is often appropriate for local agencies to make low-cost improvements at one location at a time. Ongoing maintenance and development projects offer great opportunities for these low-cost improvements to be constructed with no additional expense to local agencies.

Drawbacks of the Spot Location Approach may include:

- Assumption that the past equals the future. This approach assumes locations with a history of crashes will continue to experience the same number and type of crashes in the future. When agencies do not account for the random nature of roadway crashes (i.e., Regression to the Mean), moderate to high cost projects can be erroneously justified. Practitioners can mitigate this by using 5 years of crash data when analyzing their roadways. In addition, significant changes to land use or roadway characteristics in or around proposed projects can either increase or decrease the expected number of future crashes.
- Minimal overall benefit to the roadway network. Some local agencies use this approach with medium and high cost improvements at locations which do not represent their worst high crash concentration locations. The result can be projects with low B/C ratios and overall safety benefits that are not as high as if they utilized a Systemic Approach. This drawback can be minimized by safety practitioners who analyze their entire roadway network, propose spot location fixes only at their highest crash locations, and utilize lower cost countermeasures wherever appropriate.

The Spot Location Approach to traffic safety is ideally implemented along with the Systemic Approach to provide the best combination of safety treatments. For instance, the Spot Location Approach can be applied at locations where low-cost countermeasures are not expected to be effective in significantly

reducing future crashes or at those locations that have had low-cost countermeasures previously installed systemically but, after an assessment, continue to show a higher-than-average crash rate.

Comprehensive Approach

The Comprehensive Approach introduces the concept of the "5 E's of Safety": Education, Enforcement, Engineering, Emergency Response and Emerging Technologies. This approach recognizes that not all locations can be addressed solely by infrastructure improvements. Incorporating the "5 E's of Safety" is often required to achieve marked improvement in roadway safety. For instance, some roadway segments will be identified for which targeted enforcement is an appropriate countermeasure. Some of the most common violations are speeding, failure-to-yield, 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 deploy visible targeted enforcement to reduce the potential for future driving violations and related crashes. To improve safety, education and outreach efforts can also be used to supplement enforcement efforts. Enforcement and/or education can also be effectively utilized as short-term ways to address high crash locations, until the recommended infrastructure project can be implemented.

1.7 Our "Safety Challenge" for Local Agencies

Caltrans, FHWA and Safe Transportation Research and Education Center (SafeTREC) "challenge" local agencies to initially commit one or more days to understanding and applying the concepts and tools outlined in this manual. Experienced safety practitioners working in agencies currently using a proactive approach can quickly review the topics in the manual and consider/test some of the new tools (e.g., TIMS) identified within it. In contrast, novice safety practitioners may need several days to better understand the underlying concepts in this manual to be able to complete the basic elements of a proactive safety analysis of their roadway network. In these situations, the room for knowledge growth, internal process improvements, and expected safety benefits will be even greater, which should more than offset the additional time invested.

By utilizing this simple framework for identifying, analyzing and implementing a proactive approach for improving safety on their roadways, practitioners will have a better understanding of their agencies' unique safety issues, the proven low-cost countermeasures that can reduce crashes, and the existing and future funding to implement the projects. This small investment of time will help local agencies achieve significant reductions in future fatalities, injuries and overall crashes. We believe these local agencies may also gain the added unexpected benefit of improved job satisfaction of those involved, as there are few more rewarding tasks than knowing that your efforts will result in future roadway users arriving safely at their destination instead of becoming statistics.

1.8 Summary of information in this Document

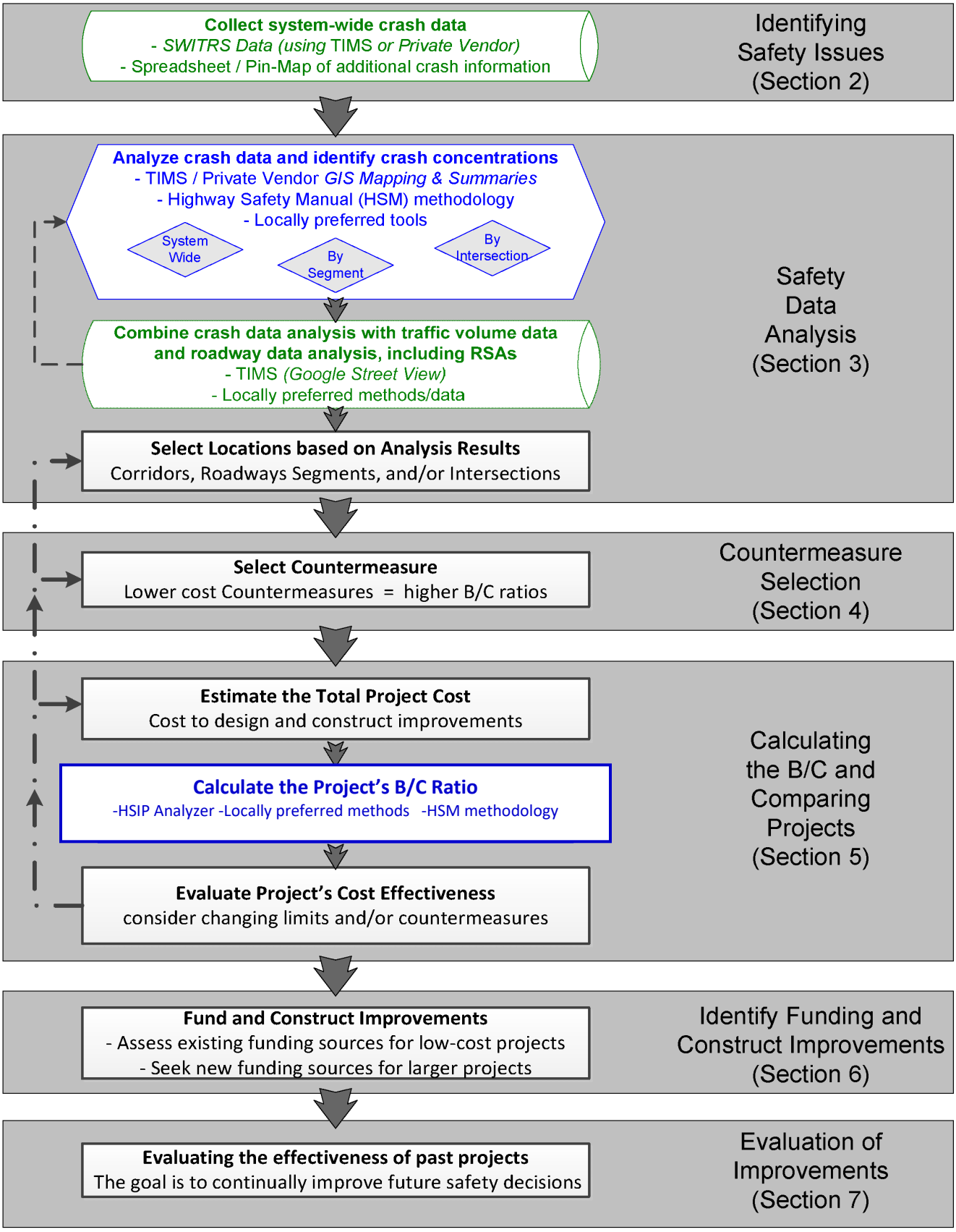
This document provides information on effectively identifying California's local roadway safety issues and the countermeasures that address them, ultimately leading to the effective implementation of safety projects that improve safety on local roadways. The document is not intended to be a comprehensive guide for roadway design and improvement or the only guide local agencies utilize for their safety analysis of their roadways.

Caltrans also expects this document will directly support its efforts in selecting local agency safety projects. The expectation is that as local agencies throughout the state utilize the proactive safety analysis approach outlined in this document, their applications for HSIP, and ATP projects will include lower cost improvements at locations with the highest safety needs. This will improve Caltrans' data-driven approach to statewide project selection of safety projects and maximize the safety benefits across California.

The proactive safety analysis framework incorporated in this document is summarized in Figure 1.

Figure 1

Local Roadway Safety: Proactive Safety Analysis Approach



The above flowchart illustrates how each of the individual sections of this document work together to make up a proactive safety analysis approach. These sections are briefly outlined below:

Section 2 of this manual provides an overview of the types of data to collect for the identification of roadway safety issues. It discusses sources of crash data and how they can be used.

Section 3 summarizes the types of analyses that can be conducted to determine what roadway countermeasures should be implemented. This section is the link between the data (Section 2) and the selection of appropriate countermeasures (Section 4). It provides definitions and examples of the qualitative and quantitative factors that should be considered when evaluating roadway safety issues.

Section 4 provides a description of selected countermeasures that have been shown to improve safety on local roads. It includes a basic set of strategies to implement at locations experiencing a history of crashes and their corresponding crash modification factors (CMF). The interrelationship between CMFs and Crash Reduction Factors (CRFs) are defined and used interchangeably throughout this document.

Section 5 defines a methodology for calculating a B/C ratio for a potential safety project. It includes sources for estimating projected costs and benefits and the specific values/formulas Caltrans uses for its statewide evaluations of HSIP projects. This section also discusses the potential value in reevaluating projects' overall cost effectiveness at this point in the safety analysis, including: refining the project's costs and/or changing the mix of countermeasures and locations.

Section 6 identifies existing and new funding opportunities for safety projects that local agencies should be considering. This section also briefly discusses some unique project development issues and strategies for safety projects as they proceed through design and construction.

Section 7 presents the process to complete an evaluation of installed treatments. After the countermeasures are installed, assessing their effectiveness will provide valuable information and can help determine which countermeasures should continue to be installed on other roadways to make them safer as well as those that should be limited or discontinued.

Appendix A presents a flowchart of the HSIP call-for-projects process. This flowchart demonstrates how this document interacts with these Caltrans calls-for-projects.

Appendix B contains Detailed Tables of countermeasures discussed in Section 4. This table includes detailed information about each countermeasure, including: where to use, why it works, general qualities (time, cost and effectiveness), crash type(s) addressed, crash reduction factor, and specific values for use in Caltrans HSIP calls-for-projects.

Appendix C includes a summary of "recommended actions" involved in a proactive safety analysis.

Appendix D contains the formulas used to calculate the B/C ratio of safety projects.

Appendix E presents TIMS tutorials that are available to assist local agencies in completing Caltrans call-for-projects application requirements and attachments. The tutorials include examples for Spot Location projects and systemic projects.

Appendix F presents a list of the abbreviations used in this document.

Appendix G presents a list of references.

2. Identifying Safety Issues

This document encourages local agency safety practitioners to proactively analyze their roadway networks with the intention of yielding the best overall safety benefits. When utilizing a proactive safety analysis approach, practitioners need to consider a wide range of data sources to get an overall picture of the safety needs.

There are a number of information sources that can be accessed to get a clearer picture of the roadway safety issues on the roadway network. These can be formal or informal sources, including:

Formal sources:

- State and local crash databases
- SafeTREC's TIMS website (or locally preferred mapping software)
- Law enforcement crash reports and citations
- Field assessments

Informal sources:

- Observational information from road maintenance crews, law enforcement, and first responders
- Citizen notification of safety concerns

Examining crash history will help practitioners identify locations with an existing roadway safety problem, and also identify locations that are susceptible to future roadway crashes. In addition to location identification, this data can provide information regarding crash causation that ultimately provides insight into identifying potentially effective countermeasures.

Emphasis on data-driven decisions is indicative of reliability and efficiency. The more reliable the data, the more likely the decisions regarding safety improvements will be effective. However, detailed, reliable crash data are not available in all areas. Under this circumstance, the practitioner should use the best available information and engineering judgment to make the best decisions. In an effort to mitigate these situations, UC Berkeley SafeTREC has developed the TIMS website, which includes GIS mapping tools to access fatal and injury crashes statewide. This site is now available to all California local agencies. See Section 2.2 for more details on TIMS.

It is generally accepted that at least 3 years, or preferably 5 years, of crash data be used for an analysis; additional years of crash data can provide better information. For low volume roadways and/or when only severe crashes are analyzed, more years of crash data may be necessary for an effective evaluation. Due to the randomness of crashes in a given year, a multi-year average of safety data will smooth outlier years of relatively high or low roadway crash rates. This concept is commonly referred to as "regression to the mean" and is critical in helping safety practitioners avoid making wrong inferences as they analyze their roadway network data. An example of this is an agency making a high-cost improvement at

a location in response to one or two tragic crashes. The Highway Safety Manual (HSM) includes more details on regression to the mean and methods to reduce the random nature of crashes.

There are some circumstances where additional years of crash data may not always be advantageous. First, it's important for practitioners to recognize that as more years of crash data are used, they need to consider changes in traffic patterns, physical infrastructure, land use, and demographics that may affect their projection of future crashes. Second, if practitioners only focus on many years of past crash data, they could miss emerging safety issues and crash trends. For these reasons, if practitioners sense one or more factors affecting crashes have changed or may be changing, they should consider looking at the crash data for the specific area on a yearly or 3-year moving average to expose any changes and crash trends that are occurring.

2.1 State and Local Crash Databases

California has a central repository for storing crash data called SWITRS, which stands for Statewide Integrated Traffic Records System. SWITRS is a comprehensive data source for doing roadway safety analysis that includes almost all public roads in the database except tribal roads which are currently not included. SWITRS information is available to California's local agencies, although many agencies have had difficulty identifying, extracting and utilizing their crash records from SWITRS. All California local agencies, especially those that currently have difficulty accessing and mapping crash data, are encouraged to utilize the SafeTREC TIMS website to access and map SWITRS data.

This document focuses on the SafeTREC TIMS website as a tool to access and map SWITRS data because TIMS is free to local agencies and the general public. At the same time, this document also acknowledges that TIMS currently does not offer some of the features currently available in some of the commercially available crash analysis software packages. For this reason, local agencies are encouraged to try TIMS, but they should not feel obligated to make a switch if they prefer using their vendor supplied crash analysis software. See section 2.2 for more details on TIMS.

Many agencies utilize one of several crash analysis software packages (e.g., Crossroads) to manage and access their crash records. Their use can be costly, but allows local road practitioners to identify locations with multiple roadway crashes, conduct an analysis that can produce predominant crash types, and identify associated roadway features that may have contributed. One drawback to agencies managing and updating their own individual databases is that the statewide database may become outdated and may not include the updated crash details like geo-coded locations. Agencies that manage and update their own individual databases are encouraged to share all updates, including any geo-coding information, with the SWITRS data managers at the California Highway Patrol. This will allow updated geo-coding and other crash features to be available on a statewide basis.

Recommended Action: Obtain at least 5 years of network-wide crash data to identify local roads that have a history of roadway crashes. This data will be used to identify predominant roadway crash locations, crash types and other common characteristics.

As practitioners gather formal and informal information relating to the safety of their roadway network, they are encouraged to develop one or more separate spreadsheets and/or pin-maps to help track and manage this data. (These spreadsheets/pin-maps should capture much of the data gathered in each of Sections 2.1 through 2.8). A spreadsheet and/or pin-map can serve as a database to help an agency identify locations and crash characteristics representing their greatest safety issues and guide them in identifying appropriate countermeasures.

The following spreadsheet is offered as an example, but each agency's spreadsheet should be reformatted to include data to meet their needs. Agencies should consider printing their spreadsheets on 'legal' or '11 x 17' paper for easy review of their data.

	General Information		Crash Information			Evaluation / Action		
Location & Date	Source/Type of information	Safety Issue/Problem	Nature of Crashes	Time of Day	Weather/Traffic Conditions	Staff Evaluation	Recommend Action	Resolution
1) Intersection "X"								
1) Feb 7, 2010	Input from law enforcement	Clearance Intervals need adjustment	V1-WB V2-SB Side-swipe	21:30	Dry, Night, Free-flowing	R. Jones 2/26/10	Increase all-red interval	Completed 2/26/10
1) Mar 9, 2010	Citizen Complaint	Ped Crossing unsafe due to RT turns	N/A	N/A	N/A	R. Jones 3/12/10	No RT on Red (Need study)	
2) Intersection "Y"								
2)								
3) Roadway Segment (PM 5.3 to PM 7.8)								
PM 6.4 to 6.8 Sep 29, 2011	Maintenance data	Extensive skid marks. Speed of Travel?	General WB: ROR	N/A	Dry Free-flowing	J. Smith 10/1/11	High Friction Overlay	Preparing HSIP App.
PM 7.1 Jan 5, 2011	Input from law enforcement	Stop Sign missing	N/A	N/A	N/A	J. Smith 1/5/11	Informed Maintenance	New sign 1/5/11

An example of a pin-map, which could be modified to capture much of the data gathered in Section 2, is shown in the following section as part of the TIMS output.

2.2 Transportation Injury Mapping System (TIMS)

The Safe Transportation Research and Education Center (SafeTREC) at the University of California, Berkeley, has developed a powerful website with tools for California's local agencies to gather data for their safety analyses. Their Transportation Injury Mapping System (TIMS) website provides safety practitioners with California crash data (SWITRS, i.e. Statewide Integrated Traffic Records System) and collision mapping and analysis tools. California local agencies are encouraged to utilize TIMS at: https://tims.berkeley.edu/

Site Features:

- Applications to query map and download geo-referenced SWITRS data.
- Summary tables based on data included in SWITRS individual crash reports. These summary tables can be generated based on specified data fields or spatial limits.
- Virtual field review by connecting the crash location to Google maps and Google Street View, allowing the examination of the existing roadway infrastructure and dimensions.
- A 'Help Tab' that provides step-by-step instructions.

Please note that SafeTREC is not able to incorporate all SWITRS crashes into TIMS due to poor crash location descriptions in the crash reports. Currently, TIMS includes the majority of California fatal and injury crashes but does not include Property Damage Only collisions.

Recommended Action: Consider augmenting your local agency's data collection approach with information available using the suite of TIMS tools. The TIMS tools (and/or purchased software applications) can help the safety practitioner complete or assist with each of the actions in Sections 2.1 through 2.8. This website includes several tutorials specifically designed to support the individual sections of this document. Local practitioners may find the TIMS output files as a great starting point to build their tracking spreadsheet discussed in the recommendation of Section 2.1.

2.3 Law Enforcement Crash Reports

Both State and local law enforcement officials can be an important source of roadway crash data. The actual law enforcement crash reports can be valuable in identifying the location and contributing circumstances to roadway crashes (e.g., did the highway hardware and features operate as intended: end treatment worked, no barrier in the passenger compartment, pavement not slippery when wet, signs visible, signal timing, etc.). The following variables can and should be extracted and compiled from the crash reports:

- Location
- Date and time
- Crash type
- Crash severity
- Weather conditions
- Lighting conditions
- Sequence of events and most harmful events
- Contributing circumstances
- Driver Variables: age of driver, DUIs, use of seat belt, etc.

Similar to the crash database, the information in the crash reports can be used to assist in the identification of potential infrastructure and non-infrastructure safety treatments and the deployment approach.

Recommended Action: Develop a working relationship with law enforcement officials responsible for enforcement and crash investigations. This could foster a partnership where sharing crash reports and safety information on problem roadway segments becomes an everyday occurrence. Practitioners with limited access to crash data are encouraged to use TIMS to assess the local crash report data.

2.4 Observational Information

Law enforcement officers, local agency maintenance crews, and Emergency Medical Services personnel can serve as valuable resources to identify problem areas. Since they travel extensively on local roads, they can continuously monitor roads for actual or potential problems (e.g., poor delineation, fixed objects near the roadway, missing signs, signs of vehicles leaving the road). Law enforcement observations of driver behavior and roadway elements can provide valuable information to the local road agency. Additionally, law enforcement officers are sometimes aware of problem areas based on citations written, even if crashes related to the violations have not yet occurred. Road maintenance crews may keep logs of their work, including sign and guardrail replacements, debris removal, and edge drop-off repairs. These logs can provide supplemental information about crashes and HCCLs that may not have been reported to law enforcement. Finally, Emergency Medical Service Crash Reports can provide an entirely different perspectives and set of observations relating to crash occurrences.

Information obtained from road maintenance crews, law enforcement officers, and Emergency Medical Services personnel can help support all three methods of implementation approaches: Spot Location treatments, systemic deployments, and the Comprehensive Approach. Often, traffic violations such as speeding and impaired driving lend themselves to education and enforcement solutions to address these behaviors and supplement the intended infrastructure countermeasures.

Recommended Action: Add information received from law enforcement, road maintenance crew, and Emergency Medical Service observations to the agency's tracking spreadsheet and/or pin-maps. Develop a system for maintenance crews to report and record observed roadway safety issues and a mechanism to address them.

2.5 Public Notifications

Occasionally, when unsafe situations are observed, local citizens may notify the local government by email, letter, telephone, or at a public meeting. Information identifying safety issues on local roads may also come from community or regional newspapers, newsletters, correspondence, and from local homeowner and neighborhood associations. These sources can serve as indicators that a safety issue may exist and may warrant further review and analysis to determine the extent of the issues. Citizen reports can be tracked along with official crash data; however, safety practitioners should not regard these reports as factual, unless proven by other methods. Local safety databases should only contain objective and verifiable data.

Recommended Action: Review and summarize information received from these sources, identifying segments or corridors with multiple notifications and record the locations, dates, and nature of the problem that are cited. Add information received from public notifications to tracking spreadsheets and/or pin-maps once confirmed.

2.6 Roadway Data and Devices

It is also valuable to obtain information about the existing roadway infrastructure. Currently, many local agencies have few of their roadway characteristics in a database. For these agencies, the establishment of a roadway database could be a long-term goal. The following roadway characteristics are often used to assist practitioners in safety analyses of roadway segments:

- Roadway surface (dirt, aggregate, asphalt, concrete)
- Roadway geometry (horizontal, vertical, flat)
- Lane information (number, width)
- Shoulder information (width, type)
- Median (type, width)
- Traffic control devices present (signs, pavement marking, signals, rumble stripes etc.)

- Roadside safety hardware (e.g., guardrail, crash cushions, drainage structures)

The TIMS site, described in Section 2.2, can provide safety practitioners with much of this roadway data virtually by using Google Maps and Google Street View. By utilizing TIMS (and/or private for-profit vendors), safety practitioners can save hours and even days of driving during the initial steps in the safety analysis of their network. Once agencies start to define individual safety projects for funding and future construction, actual field reviews are needed to ensure a complete understanding of the project location and context.

As local practitioners gather information about their existing roadway infrastructure, they need to determine whether it complies with the minimum standards for signs, breakaway supports, signals, pavement markings, protective barriers, etc. Practitioners should use the most current *California - Manual on Uniform Traffic Control Devices* (CA-MUTCD), which provides the minimum standard requirements for traffic control devices on all public streets, highways, bikeways, and private roads open to public travel.[6] In addition to ensuring compliance with the MUTCD, geometric standards for sight distance, curve radius, and intersection skew angle and roadway standards for lane width, shoulder width, clear recovery zone, and super-elevation should also be evaluated.

Roadway information can be combined with crash data to help local practitioners identify appropriate locations and treatments to improve safety. For example, if a local rural segment is experiencing a high number of horizontal curve-related crashes, analysis of the inventory of roadway elements could reveal that the roadway does not have sufficient signage installed in advance of many of those curves to give motorists warning of the pending change in roadway geometry.

Recommended Action: Identify and track roadway characteristics for the intersections, roadway segments, and corridors, including compliance with the minimum standards. At a minimum, this should be done for locations being considered for safety improvements, but ideally agencies would establish an extensive database of roadway data to help them proactively identify high risk roadway features.

2.7 Exposure Data

The number of crashes can sometimes provide misleading information about the most appropriate locations for treatment. Introducing exposure data helps to create a more effective comparison of locations. Exposure data provides a common metric to the crash data so roadway segments and intersections can be compared more appropriately, helping local agencies prioritize their potential safety improvements.

The most common type of exposure data used on roadway segments is traffic volume. Ideally, volume would be broken down by pedestrians, bicycles, cars, motorcycles, and large trucks. A count of the number of vehicles and non-motorized users can provide information for comparison. For example, if

two roadway segments have the same number of crashes but different traffic volumes, the segment with fewer vehicles (i.e., less exposure) will have a higher crash rate, meaning that vehicles were more likely to experience a crash along that roadway segment. In situations where traffic volume is not available, segment length or population can serve as an effective exposure element for comparison.

Recommended Action: Consider the availability of exposure data and track it along with the other crash data to help prioritize potential locations for safety improvements.

2.8 Field Assessments and Road Safety Audits

Local road practitioners should always consider conducting field assessments in conjunction with their collection of crash data to help identify problem locations. An assessment can be as informal as driving, walking or virtually viewing the road network looking for evidence of roadway crashes. Ideally, informal field assessments are to be performed by multidisciplinary teams that include a traffic safety expert, law enforcement personnel, and others. The team can visit several sites and document evidence of crashes or deficiencies on the roadway or roadside, including: damaged trees or fences, skid marks, ruts on the shoulder, car parts on the shoulder, and/or pavement drop-offs. This information, along with observations of actual driver-behavior, can be used to develop recommendations for improvement.

Field reviews can also be more formalized such as in conducting a Road Safety Audit (RSA). A RSA is a formal safety performance examination of an existing or future road by an independent, multidisciplinary team. The team examines and reports on existing or potential road safety issues and identifies opportunities for safety improvements for all road users. Agencies considering RSAs for the first time are encouraged to consider requesting support from FHWA. For more information on FHWA's free RSA support, go to their website at: http://safety.fhwa.dot.gov/rsa/.

Informal field assessments and more formal RSAs provide an opportunity for local safety practitioners to gather and summarize all of the information sources discussed in Section 2. They can also be used to identify potential project delivery obstacles. The field assessments/RSAs should identify major environmental, right-of-way, infrastructure, and operational issues that need to be considered when applying countermeasures.

Recommended Action: Consider completing formal or informal field assessments and RSAs at certain locations to help ensure all relevant information is collected and available for the safety practitioners to complete their safety analysis and identify the most appropriate countermeasures. It's recommended that local agencies develop simple straightforward criteria on when one of these will be undertaken. The information gathered during the assessments should be added to the agency's tracking spreadsheet, as discussed in section 2.

3. Safety Data Analysis

Proactive safety analysis will assist in making informed decisions on the type, deployment levels, and locations for safety countermeasures. This builds on the previous discussions on information sources that identify safety issues. 'Safety Data Analysis' is one of the most critical steps in an agency's overall proactive safety analysis approach. Ideally, agencies regularly analyze the safety data for their entire roadway networks to identify and prioritize the locations with the most severe safety issues. This step is often skipped by agencies reacting to a recent tragic crash and the corresponding public outcry, which may leave their most critical safety locations undetected.

As agencies analyze their safety data, they will need to select the implementation approach that most effectively address the safety issues identified; Systemic Approach, Spot Location Approach, Comprehensive Approach, or a combination of these approaches. For example, if a high number of crashes are occurring at a particular curve or along a short segment of roadway, a spot treatment may be appropriate. However, systemic treatment of multiple locations experiencing similar crash types may be necessary and most beneficial for reducing overall fatalities and injuries. These implementation approaches were described in Section 1.5. With all of the approaches, safety practitioners should be looking for patterns in the crash data and not just the total number of crashes. These patterns include: types of crashes, severity of crashes, mode of travel, pavement conditions, time of day, etc. Identifying and analyzing the patterns in the crash data will help ensure the most appropriate countermeasure is selected and the safety problems are effectively addressed.

3.1 Quantitative Analysis

Crash data analysis is used to determine the extent of the roadway safety issues, the priority for application of scarce resources, and the selection of appropriate countermeasures. The two main quantitative analysis methods for roadway crashes are crash frequency and crash rate.

Crash Frequency

Crash frequency is defined as the number of crashes occurring within a determined study area. A practitioner can determine crash volumes using methods discussed in Section 2, including: State crash database (SWITRS), TIMS, local agency crash databases, law enforcement crash reports, pin-maps, etc. The practitioner should analyze the data to identify locations and crash characteristics with the highest frequency. There are numerous methods to assist practitioners in this process. Each agency will have their own preferred methods for initially selecting their top priority locations. The following are a few examples of the methods used to determine Crash Frequency:

- Summarize the crashes by attributes such as type, severity and location to identify patterns in the crash data and the most significant problem locations.
    - Top 10 (or 20) lists of intersections and roadway segments. It is common to weight more severe crashes higher in this process.

- Spatially display the sites on a pin-map or a GIS software package.
    - For small or rural agencies with lower volume roadways, network-wide pin-maps may be all that is needed to identify the highest priority locations.
- Develop collision diagrams showing the direction of movement of vehicles, types of crashes, and pedestrians involved in the crashes.

As stated earlier, this manual acknowledges many local agency safety practitioners may have their preferred methods for completing these analyses. For those agencies that do not and for those willing to try something new, Caltrans recommends using the TIMS website along with the processes outlined in this document to complete these analyses.

Once the crash frequency information is collected and displayed, the practitioner can complete a methodical analysis by geographic area, route, or a cluster analysis to determine which locations have experienced a high or moderate level of crashes. The resulting crash information can be further analyzed for recurring patterns or events. As agencies consider their locations with high levels of crashes, they should understand the overall random nature of crashes and the concept of "regression to the mean", as discussed in Section 2. Otherwise, if the natural variations in crash occurrence are not accounted for, a site might be selected for study when the number of crashes is randomly high, or overlooked when the number of crashes is randomly low.

Crash Rate

Crash rate analysis can be a useful tool to determine how a specific roadway or segment compares with similar roadway types on the network. A simple count of the number of crashes can be inadequate when comparing multiple roadways of varying lengths and/or traffic volume. Local agencies are also encouraged to compare their crashes with those occurring in similar areas around the state; doing so will help in determining just how severe the number and types of crashes are in the local area. When working with limited budgets, Crash Rates are often used to prioritize locations for safety improvements that will achieve the greatest safety benefits with limited resources. Where traffic volume data is unavailable, other information can be used to provide exposure information. One often-used factor is the length of the roadway segment on each route studied. Comparing the number of roadway crashes per mile or per intersection can help an agency identify potential opportunities to improve safety. The FHWA Roadway Departure Safety and Intersection Safety manuals include the following formulas for calculating crash rates on roadway segments and intersections:

The crash rate for crashes on a roadway is calculated as:

R = (C x 100,000,000) / (V x 365 x N x L)

Where:

R = Crash rate for the road segment expressed as crashes per 100 million vehicle-miles of travel,
C = Total number of crashes in the study period
V = Traffic volumes using Average Annual Daily Traffic (AADT) volumes
N = Number of years of data
L = Length of the roadway segment in miles

The crash rate for crashes at an intersection is calculated as:

R = (1,000,000 x C) / (365 x N x V)

Where:

R = Crash rate for the intersection expressed as crashes per million entering vehicles (MEV)
C= Total number of intersection-related crashes in the study period
N = Number of years of data
V = Traffic volumes entering the intersection daily

Similar to Crash Frequency, there are numerous methods for local safety practitioners to utilize Crash Rate in their safety data analysis and each will have their own preferred methods for initially selecting their top priority locations. The following are a few examples:

- Top 10 (or 20) lists of roadway segments with the highest crashes in relationship to roadway length, traffic volumes, and/or population density.
- Top 10 (or 20) lists of intersections, sorted by crash rate.
- Top 10 (or 20) lists of the highest volume intersections, sorted by crash frequency or rate.

Even though crash frequency and crash rate are helpful for local agency safety practitioners to effectively rank their most critical locations for improvements, the lack of reliable statewide traffic volumes for all roadway types precludes Caltrans from using the crash rate methodology in their statewide project scoring and ranking processes for the HSIP (discussed in more detail in Section 5).

Recommended Action: Complete a quantitative analysis of the roadway data using both Crash Frequency and Crash Rate methodologies. Safety practitioners should look for patterns in the crash data, including: types of crashes, severity of crashes, mode of travel, pavement conditions, roadway characteristics, time of day, intersection control, etc.

3.2 Qualitative Analysis

Qualitative analysis considers the physical characteristics of the roadway network, through the examination of maps, photographs, and field assessments. Certain roadway infrastructure characteristics relate to design standard and compliance issues and should continually be identified and upgraded on a network-wide basis (e.g., signing and pavement delineation characteristics relating to CA-MUTCD compliance as discussed in more detail below). Other roadway characteristics are more important as they relate to locations with high crash frequencies and rates (e.g., well defined pedestrian

paths crossing the roadway or a high number of utility poles/fixed objects adjacent to the edge of travel way). All of these characteristics should to be accounted for in an agency's proactive safety analysis.

Ensuring Compliance with CA-MUTCD and Design Standards

It is important for local agencies to continually evaluate their roadways for compliance with the minimum safety standards. The CA-MUTCD provides the minimum standard requirements for traffic control devices on all public streets, highways, bikeways, and private roads open to public travel. In addition to ensuring compliance with the CA-MUTCD, geometric standards should be evaluated as they relate to sight distance, curve radius, and intersection skew angle and roadway standards for lane width, shoulder width, clear recovery zone, and super-elevation. Many local agencies have their own specific roadway design standards, while others rely on Caltrans' Highway Design Manual[7], FHWA's "Green Book" policy manual[8] and PEDSAFE guide[9], and AASHTO's Roadside Design Guide[10]. If the traffic control devices or roadway geometry are not in compliance, appropriate devices/countermeasures should be installed. Non-compliance is an important consideration that can affect road safety and may have liability implications for a jurisdiction. Using CA-MUTCD compliant devices results in uniformity among California roadways and serves to meet road user expectations.

Field Assessments

While the qualitative analysis of compliance issues should continually occur on a network-wide basis, a qualitative analysis should also occur for each of the locations and corridors identified as a result of a 'Quantitative Analysis'. The consideration of roadway infrastructure characteristics in conjunction with crash frequency or crash rate gives a more complete picture of overall safety and should be used in an agency's identification and prioritization process for locations needing safety improvements. The qualitative assessment of HCCLs can be completed through the examination of maps and photographs, but the importance of in-field assessments by multi-disciplinary teams should not be underestimated. In some cases, field reviews of all potential project locations may not be practical, so safety practitioners are encouraged to utilize internet-mapping tools to view maps and photographs and virtually visit these sites from their offices.

Actual field visits or RSAs can be done at the highest priority locations before or during the countermeasure selection process. In many cases, field assessments are often the only way for practitioners to identify potential countermeasure implementation and project delivery obstacles. Without in-field assessments, right-of-way, infrastructure, and operational constraints can be overlooked, including: sensitive environmental resources (widening may not be feasible next to wetlands), roadway users (rumble strips may not be feasible on roadways with high bicycle volumes and narrow shoulders), or nearby roadway stakeholders (flashing beacons may be problematic for adjacent residents.) Assessments can provide critical information for local practitioners as they prioritize their crash locations and select countermeasures with the greatest potential for cost effective deployment.

Recommended Action: Incorporate qualitative analysis elements into agency's proactive analysis approach. Consider completing field assessments and RSAs to identify locations with roadway

infrastructure characteristics that relate to both compliance issues and high crash frequencies/rates. As part of field assessments, common roadway and crash characteristics should be identified for the potential systemic deployment of countermeasures. Rather than reviewing all crash sites individually, agencies may find the use of Internet mapping tools offers significant time savings. For agencies without a preferred virtual field review method, the SafeTREC TIMS website automatically links the SWITRS crash locations to Google Maps and Google Street View.

Caltrans recommends all agencies complete both quantitative and qualitative analyses before starting their applications for HSIP program funding. The findings from these analyses should be documented in spreadsheets and/or pin-maps similar to the ones discussed in Section 2.

4. Countermeasure Selection

Once locations and crash problems are identified as illustrated in Sections 2 and 3, the safety practitioners will need to select the set of proposed safety improvements to reduce the likelihood of future crashes. Individual elements of standard safety improvements are referred to as countermeasures and most countermeasures have corresponding Crash Modification Factors (CMFs).

When applied correctly, CMFs can help agencies identify the expected safety impacts of installing various countermeasures to reduce crashes. CMFs are multiplicative factors used to estimate the expected number of crashes after implementing a given countermeasure at a specific site (the lower the CMF, the greater the expected reduction in crashes). Crash Reduction Factors (CRFs) are directly connected to the CMFs and are another indication of the effectiveness of a particular treatment, measured by the percentage of crashes the countermeasure is expected to reduce. The CRF for a countermeasure is defined mathematically as (1 – CMF) (the higher the CRF, the greater the expected reduction in crashes). *NOTE: Given that CRF values can be more intuitive when analyzing roadways for potential "reductions" in crashes; this document shows CRF values in the countermeasure tables. The terms CMFs and CRFs are used interchangeably throughout the text of this section and in other sections of this document.*

In an effort to stretch the limited highway safety funding, local transportation agencies are encouraged to identify and implement the optimal combination of countermeasures to achieve the greatest benefits. Combined with crash cost data and project cost information, CRFs can help safety practitioners compare the B/C ratio of multiple countermeasures and then choose the most appropriate application for their proposed safety improvement projects.

As agencies consider the overall scope/cost of their projects, they also need to consider the number of locations to which each countermeasure may be applied in order to maximize the B/C ratio and the overall effectiveness of their limited safety funding. For HCCLs with varying causes, the Spot Location Approach may be the most appropriate. In contrast, the Systemic Approach should be considered where a high proportion of similar crash types tend to occur at locations that share common geometric or operational elements. In these situations, installing the same low-cost safety countermeasure at multiple locations can increase the cost effectiveness of the safety improvement, allowing an increased number of treatments to be applied.

It is important to note that there are many safety issues and corresponding countermeasures that are more "maintenance" in nature (e.g., visibility issues relating to the need for brush clearing and roadway departure issues relating to the need to replace shoulder backing). As these issues are identified when investigating crash locations, it's expected that the local safety practitioners would take the necessary steps to remedy the situation in the short-term. For this reason, most of the common maintenance-type safety countermeasures are not included in this document.

4.1 Selecting Countermeasures and Crash Modification Factors / Crash Reduction Factors

Selecting an appropriate countermeasure and corresponding CMF is similar to choosing the right tool for a job. In some cases, a countermeasure and CMF may not be perfect, but will still work well enough to get the job done by providing a reasonable estimation of the countermeasure's effect. In other cases, using an improper countermeasure or CMF may do more harm than good. Applying a CMF that does not fit a specific situation may give a false sense of the countermeasure's safety effectiveness and may result in an increased safety problem.

The Federal Highway Administration (FHWA) is leading a concerted effort to develop information on CMFs and makes it available to State and local agencies to assist with highway safety planning. The CMF Clearinghouse, a free online database introduced in 2009 and accessible at http://www.cmfclearinghouse.org/, details the varying quality and reliability of CMFs available to transportation professionals.

FHWA has identified three main considerations to assure appropriate selection of CMFs for a given countermeasure: the **availability** of relevant CMFs, the **applicability** of available CMFs, and the **quality** of applicable CMFs. The following sections detail these considerations and describe how Caltrans recommended CRF and service life values meet these criteria.

Availability: The availability of a CMF that applies to a specific situation depends on whether research has been conducted to determine the safety effects of a particular countermeasure or combination of countermeasures, and whether researchers have documented it. The CMF Clearinghouse contains more than 2,900 CMFs and receives quarterly updates to include the latest research.

At this point, Caltrans has established a small subset of 82 countermeasures and a single CRF for each of these countermeasures that must be used when submitting applications for Caltrans statewide calls-for-projects. This methodology allows for a statewide data-driven process that facilitates a fair and accurate comparison of project applications. (The reason for limiting the number of countermeasures is further explained below under “applicability”).

Applicability: In general, once a local safety practitioner determines that one or more CMFs exist for a specific countermeasure, the next step is to determine which CMF is the most applicable. Applicability depends on how closely the CMF represents the situation to which it will be applied. Safety practitioners should evaluate the potentially applicable CMFs, eliminating any that are not appropriate for the situation. Practitioners should only choose the most appropriate CMFs for their specific project based on factors including but not limited to: urban areas vs. rural areas; low vs. high traffic volumes; 2-lane vs. 6-lane roadways; individual vs. combination treatments; signalized vs. non-signalized intersections; and minor crashes vs. fatal crashes. If practitioners choose to use a CMF outside the range of applicability, the safety effect will likely be over or underestimated.

The mix of countermeasures and CRFs included in this document is intended to meet Caltrans' goal for a data-driven award process for local agencies to follow that allows for a fair and accurate comparison of project applications. Where possible and appropriate, the CRF value intended for use in statewide calls-for-projects is based on research studies that specifically established the CRF to be used for 'all' project areas, roadway types, and traffic volumes. Where not all applicability factors have already been established by prior research, Caltrans worked closely with FHWA to approximate CRFs for countermeasures often utilized by local agencies.

Quality: Often a search of the CMF Clearing House results in multiple CMFs for the same countermeasure. A practitioner needs to examine the quality of each CMF. The quality of a CMF can vary greatly depending on several factors associated with the process of developing the CMF. The primary factors that determine the quality of a CMF are the study design, sample size, standard error, potential bias, and data source. The CMF Clearinghouse provides a star rating for each based on a scale of 1 to 5, where 5 indicates the highest quality. The most reliable CMFs in the HSM are indicated with a bold font.

Wherever possible, the CRFs included in this document are based on research that has a CMF Clearinghouse star rating of 3 or more. For countermeasures that do not have corresponding research of a star rating of 3 or more but were deemed important to provide flexibility to local practitioners, Caltrans worked closely with FHWA to establish CRFs based on the best available research.

4.2 List of Countermeasures

The list of countermeasures discussed in this section is not an all-inclusive list, and only includes those available in the Caltrans' HSIP Cycle 11 Call-for-projects. Only thoroughly researched countermeasures with a readiness to be applied by local agencies on a statewide basis are utilized. In addition, the California Local HSIP program places further restrictions on the eligibility of some countermeasures to meet the most critical needs on California local roadways. Practitioners are encouraged to utilize the FHWA CMF Clearinghouse for a more comprehensive list as they establish their local agency specific set of proposed improvements and prioritize their projects.

The countermeasures listed in the following three tables have been sorted into 3 categories: Signalized Intersection, Non-Signalized Intersection, and Roadway Segment. Pedestrian and bicycle related countermeasures have been included in each of these categories, as the consideration of non-motorized travel is important for all roadway classifications and locations. The countermeasures included in these tables are also used in the HSIP Analyzer. When selecting countermeasures and CMFs to apply to their specific safety needs, local agency safety practitioners should consider the **availability, applicability**, and **quality** of CMFs, as discussed in section 4.1.

Only Crash Types, CRFs, Expected Lives, and HSIP Funding Eligibility of the countermeasures for use in Caltrans local HSIP program are provided in this section. Fields in the countermeasure tables are:

- **Crash Types -** "All", "P & B" (Pedestrian and Bicycle), "Night", "Emergency Vehicle", or "Animal".
- **CRF -** Crash Reduction Factor used for HSIP calls-for-projects.
- **Expected Life -** 10 years or 20 years.
- **Funding Eligibility –** the maximum HSIP reimbursement ratio for HSIP Cycle 11 Call-for-projects.
    - Eighty-one (81) countermeasures: 90%
    - One (1) countermeasure: 50% (CM No. S03: Improve signal timing, as this CM will improve the signal operation rather than merely the safety.)
- **Systemic Approach Opportunity -** Opportunity to Implement Using a Systemic Approach: "Very High", "High", "Medium" or "Low".

The list of countermeasures presented in this section is intended to be a quick-reference summary. Appendix B of this manual provides more details on each of these countermeasures including Where to use, Why it works, General Qualities (Time, Cost and Effectiveness), and information from FHWA CMF Clearinghouse (Crash Types Addressed and range of Crash Reduction Factor).

Recommended Action: At this point, agencies should use all information and results obtained by completing the actions in Sections 2, 3 and 4 to select the appropriate countermeasures for their HCCLs and systemic improvements. As novice safety practitioners select countermeasures, they must realize that a reasonable level of traffic 'engineering judgment' is required and that this manual should not be used as a simple cheat-sheet for preparing and submitting applications for funding.

Table 2. Countermeasures for Non-Signalized Intersections

No.	Type	Countermeasure Name	Crash Type	CRF	Expected Life (Years)	HSIP Funding Eligibility	Systemic Approach Opportunity?
NS01	Lighting	Add intersection lighting (NS.I.)	Night	40%	20	90%	Medium
NS02	Control	Convert to all-way STOP control (from 2-way or Yield control)	All	50%	10	90%	High
NS03	Control	Install signals	All	30%	20	90%	Low
NS04	Control	Convert intersection to roundabout (from all way stop)	All	Varies	20	90%	Low
NS05	Control	Convert intersection to roundabout (from stop or yield control on minor road)	All	Varies	20	90%	Low
NS05mr*	Control	Convert intersection to mini-roundabout	All	30%	20	90%	Medium
NS06	Operation/ Warning	Install/upgrade larger or additional stop signs or other intersection warning/regulatory signs	All	15%	10	90%	Very High
NS07	Operation/ Warning	Upgrade intersection pavement markings (NS.I.)	All	25%	10	90%	Very High
NS08	Operation/ Warning	Install Flashing Beacons at Stop-Controlled Intersections	All	15%	10	90%	High
NS09	Operation/ Warning	Install flashing beacons as advance warning (NS.I.)	All	30%	10	90%	High
NS10	Operation/ Warning	Install transverse rumble strips on approaches	All	20%	10	90%	High
NS11	Operation/ Warning	Improve sight distance to intersection (Clear Sight Triangles)	All	20%	10	90%	High
NS12	Operation/ Warning	Improve pavement friction (High Friction Surface Treatments)	All	55%	10	90%	Medium
NS13	Geometric Mod.	Install splitter-islands on the minor road approaches	All	40%	20	90%	Medium
NS14	Geometric Mod.	Install raised median on approaches (NS.I.)	All	25%	20	90%	Medium
NS15	Geometric Mod.	Create directional median openings to allow (and restrict) left-turns and u-turns (NS.I.)	All	50%	20	90%	Medium
NS16	Geometric Mod.	Reduced Left-Turn Conflict Intersections (NS.I.)	All	50%	20	90%	Medium
NS17	Geometric Mod.	Install right-turn lane (NS.I.)	All	20%	20	90%	Low
NS18	Geometric Mod.	Install left-turn lane (where no left-turn lane exists)	All	35%	20	90%	Low
NS19PB	Ped and Bike	Install raised medians / refuge islands (NS.I.)	P & B	45%	20	90%	Medium
NS20PB	Ped and Bike	Install pedestrian crossing at uncontrolled locations (new signs and markings only)	P & B	25%	10	90%	High
NS21PB	Ped and Bike	Install/upgrade pedestrian crossing at uncontrolled locations (with enhanced safety features)	P & B	35%	20	90%	Medium
NS22PB	Ped and Bike	Install Rectangular Rapid Flashing Beacon (RRFB)	P & B	35%	20	90%	Medium
NS23PB	Ped and Bike	Install Pedestrian Signal (including Pedestrian Hybrid Beacon (HAWK))	P & B	55%	20	90%	Low

*CM NS05mr is a new countermeasure added for HSIP Cycle 11 Call-for-projects.

Table 1. Countermeasures for Signalized Intersections

No.	Type	Countermeasure Name	Crash Type	CRF	Expected Life (Years)	HSIP Funding Eligibility	Systemic Approach Opportunity?
S01	Lighting	Add intersection lighting (S.I.)	Night	40%	20	90%	Medium
S02	Signal Mod.	Improve signal hardware: lenses, back-plates with retroreflective borders, mounting, size, and number	All	15%	10	90%	Very High
S03	Signal Mod.	Improve signal timing (coordination, phases, red, yellow, or operation)	All	15%	10	50%	Very High
~~S04*~~	~~Signal Mod.~~	~~Provide Advanced Dilemma Zone Detection for high speed approaches~~	~~All~~	~~40%~~	~~10~~	~~90%~~	~~High~~
S05	Signal Mod.	Install emergency vehicle pre-emption systems	Emergency Vehicle	70%	10	90%	High
S06	Signal Mod.	Install left-turn lane and add turn phase (signal has no left-turn lane or phase before)	All	55%	20	90%	Low
S07	Signal Mod.	Provide protected left turn phase (left turn lane already exists)	All	30%	20	90%	High
S08	Signal Mod.	Convert signal to mast arm (from pedestal-mounted)	All	30%	20	90%	Medium
S09	Operation/ Warning	Install raised pavement markers and striping (Through Intersection)	All	10%	10	90%	Very High
S10	Operation/ Warning	Install flashing beacons as advance warning (S.I.)	All	30%	10	90%	Medium
S11	Operation/ Warning	Improve pavement friction (High Friction Surface Treatments)	All	55%	10	90%	Medium
S12	Geometric Mod.	Install raised median on approaches (S.I.)	All	25%	20	90%	Medium
S13PB	Geometric Mod.	Install pedestrian median fencing on approaches	P & B	35%	20	90%	Low
S14	Geometric Mod.	Create directional median openings to allow (and restrict) left-turns and u-turns (S.I.)	All	50%	20	90%	Medium
S15	Geometric Mod.	Reduced Left-Turn Conflict Intersections (S.I.)	All	50%	20	90%	Medium
S16	Geometric Mod.	Convert intersection to roundabout (from signal)	All	Varies	20	90%	Low
S17PB	Ped and Bike	Install pedestrian countdown signal heads	P & B	25%	20	90%	Very High
S18PB	Ped and Bike	Install pedestrian crossing (S.I.)	P & B	25%	20	90%	High
S19PB	Ped and Bike	Pedestrian Scramble	P & B	40%	20	90%	High
S20PB	Ped and Bike	Install advance stop bar before crosswalk (Bicycle Box)	P & B	15%	10	90%	Very High
S21PB	Ped and Bike	Modify signal phasing to implement a Leading Pedestrian Interval (LPI)	P & B	60%	10	90%	Very High

*CM S04 has been deleted in HSIP Cycle 11 Call-for-projects.

Table 3. Countermeasures for Roadways

No.	Type	Countermeasure Name	Crash Type	CRF	Expected Life (Years)	HSIP Funding Eligibility	Systemic Approach Opportunity?
R01	Lighting	Add segment lighting	Night	35%	20	90%	Medium
R02	Remove/ Shield Obstacles	Remove or relocate fixed objects outside of Clear Recovery Zone	All	35%	20	90%	High
R03	Remove/ Shield Obstacles	Install Median Barrier	All	25%	20	90%	Medium
R04	Remove/ Shield Obstacles	Install Guardrail	All	25%	20	90%	High
R05	Remove/ Shield Obstacles	Install impact attenuators	All	25%	10	90%	High
R06	Remove/ Shield Obstacles	Flatten side slopes	All	30%	20	90%	Medium
R07	Remove/ Shield Obstacles	Flatten side slopes and remove guardrail	All	40%	20	90%	Medium
R08	Geometric Mod.	Install raised median	All	25%	20	90%	Medium
R09	Geometric Mod.	Install median (flush)	All	15%	20	90%	Medium
R10PB	Geometric Mod.	Install pedestrian median fencing on approaches	P & B	35%	20	90%	Low
R11	Geometric Mod.	Install acceleration/ deceleration lanes	All	25%	20	90%	Low
R12	Geometric Mod.	Widen lane (initially less than 10 ft)	All	25%	20	90%	Medium
R13	Geometric Mod.	Add two-way left-turn lane	All	30%	20	90%	Medium
R14	Geometric Mod.	Road Diet (Reduce travel lanes and add a two way left-turn and bike lanes)	All	35%	20	90%	Medium
R15	Geometric Mod.	Widen shoulder	All	30%	20	90%	Medium
R16	Geometric Mod.	Curve Shoulder widening (Outside Only)	All	45%	20	90%	Medium
R17	Geometric Mod.	Improve horizontal alignment (flatten curves)	All	50%	20	90%	Low
R18	Geometric Mod.	Flatten crest vertical curve	All	25%	20	90%	Low
R19	Geometric Mod.	Improve curve superelevation	All	45%	20	90%	Medium
R20	Geometric Mod.	Convert from two-way to one-way traffic	All	35%	20	90%	Medium
R21	Geometric Mod.	Improve pavement friction (High Friction Surface Treatments)	All	55%	10	90%	High

Table 3. Countermeasures for Roadways (Continued)

No.	Type	Countermeasure Name	Crash Type	CRF	Expected Life (Years)	HSIP Funding Eligibility	Systemic Approach Opportunity?
R22	Operation/ Warning	Install/Upgrade signs with new fluorescent sheeting (regulatory or warning)	All	15%	10	90%	Very High
R23	Operation/ Warning	Install chevron signs on horizontal curves	All	40%	10	90%	Very High
R24	Operation/ Warning	Install curve advance warning signs	All	25%	10	90%	Very High
R25	Operation/ Warning	Install curve advance warning signs (flashing beacon)	All	30%	10	90%	High
R26	Operation/ Warning	Install dynamic/variable speed warning signs	All	30%	10	90%	High
R27	Operation/ Warning	Install delineators, reflectors and/or object markers	All	15%	10	90%	Very High
R28	Operation/ Warning	Install edge-lines and centerlines	All	25%	10	90%	Very High
R29	Operation/ Warning	Install no-passing line	All	45%	10	90%	Very High
R30	Operation/ Warning	Install centerline rumble strips/stripes	All	20%	10	90%	High
R31	Operation/ Warning	Install edgeline rumble strips/stripes	All	15%	10	90%	High
R32PB	Ped and Bike	Install bike lanes	P & B	35%	20	90%	High
R33PB	Ped and Bike	Install Separated Bike Lanes	P & B	45%	20	90%	High
R34PB	Ped and Bike	Install sidewalk/pathway (to avoid walking along roadway)	P & B	80%	20	90%	Medium
R35PB	Ped and Bike	Install/upgrade pedestrian crossing (with enhanced safety features)	P & B	35%	20	90%	Medium
R36PB	Ped and Bike	Install raised pedestrian crossing	P & B	35%	20	90%	Medium
R37PB	Ped and Bike	Install Rectangular Rapid Flashing Beacon (RRFB)	P & B	35%	20	90%	Medium
R38	Animal	Install animal fencing	Animal	80%	20	90%	Medium

5. Calculating the B/C Ratio and Comparing Projects

Practitioners need to consider the expected B/C ratio of their proposed projects. This is an important step in a proactive safety analysis process because it provides two key pieces of information: First, it defines the cost effectiveness of the proposed projects; and second, it gives the safety practitioner a means to help prioritize their safety projects both inside the agency's traffic safety section and against other proposed operational and maintenance projects competing for funding.

5.1 Estimate the Benefit of Implementing Proposed Improvements

Sections 2 through 4 provide the practitioner all the information needed to calculate the expected 'Benefit' of the proposed safety projects. The resulting expected benefit value is derived by applying the proposed countermeasures and corresponding CMFs to the expected crashes. It is of critical importance for the practitioner to understand that misapplication of a CMF will lead to misinformed decisions. Four main factors need to be considered when applying countermeasures and CMFs to calculate the expected benefit value: (1) how to estimate the number of expected crashes without treatment, (2) how to apply CMFs by type and severity, (3) how to apply multiple CMFs if multiple treatments are to be included in the same project, and (4) how to apply a benefit value by crash severity. The following text explains how these factors affect the expected benefit value in more detail.

Estimating expected crashes without treatment: Before applying CMFs, local safety practitioners first need to select countermeasures and CMFs. The CMF is applied to the expected safety performance (expected crashes) without any treatment in order to estimate the expected crashes with the treatment. The reduction in expected crashes multiplied by the expected costs per each crash gives the practitioner the expected benefit.

As mentioned earlier in this manual, the random nature of roadway crashes suggests that over time the number of crashes at any particular locations will change. This concept is known as "regression to the mean" and it gives rise to the concern that a site might be selected for study when the crashes are at a randomly high fluctuation, or overlooked from study when the site is at a randomly low fluctuation. The HSM presents several methods for estimating the expected safety performance of a roadway or intersection including the Empirical Bayes method, which combines observed information from the site of interest with information from similar sites to estimate the expected crashes without treatment. Another common way to minimize the impact of regression to the mean is to increase the number of years of crash data being analyzed.

For statewide calls-for-projects, Caltrans strives to ensure that all projects are fairly ranked based on a consistent statewide approach. Given this, Caltrans has avoided using methodology requiring agencies to mathematically adjust their crash data (e.g., Empirical Bayes) and instead has opted to use 5 years of "observed crashes" in estimating "expected crashes."

Applying CMFs by type and severity: Section 4.1 of this manual discusses the application of CMFs and the need for them to represent the situation to which they will be applied. It also stresses the need for

practitioners to choose the most appropriate CMFs for their specific project. In many circumstances, estimating the change in crashes by type and severity is useful; however, local safety practitioners only can use this approach when CMFs exist for the specific crash types and severities in question. If practitioners choose to use a CMF outside the range of applicability, the safety effect may be over- or underestimated. (For example: past research relating to installing a channelized left turn lane, has estimated CMFs as high as 68% for Right-Angle crashes of all severities and as low as 11% for Rear-End crashes with severities of only fatal and injury).

Applying multiple CMFs: In real-world scenarios, transportation agencies commonly install more than one countermeasure per project as part of their safety improvement program. This leads to the question, "What is the safety effect of the combined countermeasures?" The calculation methods that Transportation agencies use include: applying the CMF for the single countermeasure expected to achieve the greatest reduction, applying CMFs separately by crash type and summing them to get a project-level effect, and applying CMFs based on a review of crash patterns, etc. Regardless of the specific method employed, “engineering judgment” is required when combining multiple CMFs and it is important for local agencies to apply their method consistently throughout their analysis to ensure a fair comparison of projects.

One common practice is to assume that CMFs are multiplicative when they are applied to the same set of crash data. In other words, each successive countermeasure will achieve an additional benefit when implemented in combination with other countermeasures. The multiplicative method is a common, generally accepted method and is presented in the HSM and in the CMF Clearinghouse. This method is also used in the HSIP calls-for-projects.

To allow agencies maximum flexibility in combining countermeasures and locations into a single project while ensuring all projects can be consistently ranked on a statewide basis, Caltrans only allows up to three (3) individual countermeasures can be utilized in the B/C ratio for a project location site. The CMFs are multiplicative if there are multiple countermeasures, i.e. each successive countermeasure will achieve an additional benefit based on the remainder of the crashes after the effect of the prior countermeasures, not the original number of the crashes.

More information on these requirements and procedures are provided in the documents (Application Form Instructions, etc.) for each call-for-projects.

Applying benefit value by crash severity: The last step in estimating the overall benefit of a proposed improvement project is to multiply the expected reduction in crashes by a generally accepted value for the “cost” of crashes. In other words, the expected “benefit” value for a project is actually the expected “reduction in costs” value from reducing future crashes. There are many sources for the costs of crashes (e.g., HSM, FHWA & National Safety Council) and some of the sources vary widely depending on how they account for the economic value of a life and when the numbers were last updated.

When calculating the "benefit" to be used in calculating an improvement's B/C ratio, it is important for the practitioner to consider whether a total benefit value for the "life" of the improvement is needed or if the benefit value should be annualized (i.e., benefit per year). Whichever method is used to calculate the overall cost of the improvements must also be used for calculating the benefit.

Caltrans has currently chosen to use published Cost-of-Crash values from the first edition of the HSM and increase the values by 4% annually. These values may be updated in the future, when updated cost-of-crash values are published by FHWA or another national source. The specific values for each of the crash severities and the formulas uses to calculate the total benefit are shown in Appendix D.

Recommended Action: Prepare Total Benefit estimates for the proposed projects being evaluated in the proactive safety analysis.

5.2 Estimate the Cost of Implementing Proposed Improvements

After calculating the expected benefit of the proposed safety projects, the next step for the practitioner is to develop an estimate of the Total Project Costs. These costs need to include both the construction costs and the project development and administration costs. The most common approach to estimating construction costs is through an "Engineer's Cost Estimate." A Template for Detailed Engineer's Estimate and Cost Breakdown by Countermeasures is included in the HSIP funding application website. When calculating the administration costs for a project, the complexity of the improvements must be accounted for: Low-cost countermeasures, typically used in the Systemic Approach, often have minimal environmental and right-of-way impacts and require minimal design effort. In contrast, many medium to high cost improvements tend to have greater impacts to the environment and right-of-way and require significant design efforts. It's crucial to account for these differences to accurately determine the true B/C ratio of the projects and prioritize them correctly.

When an agency is initially evaluating several potential locations and countermeasures as part of their proactive safety analysis or in preparing for Caltrans call-for-projects, they should consider first using rough 'ballpark' cost estimates using previous projects that had similar scope, if possible. Ballpark cost estimates can allow the practitioner to quickly establish B/C ratios for all of their potential projects and identify the projects with high cost effectiveness and with a reasonable chance of receiving HSIP funding in a Caltrans call-for-projects.

Recommended Action: Prepare 'Total Project Cost' estimates for the proposed projects being evaluated in the proactive safety analysis.

5.3 Calculate the B/C Ratio

In general, the B/C ratio is calculated by taking a project's overall benefit (as calculated in Section 5.1) and dividing it by the project's overall cost (as calculated in Section 5.2). There are, however, several

methods and input-factors available for calculating a project's B/C ratio and practitioners may want to consider other methods as defined in the HSM.

Based on Caltrans' need for a fair, data-driven, statewide project selection process for HSIP call-for-projects, Caltrans requires the B/C ratio for all applications to be completed using the same process. Applicants must utilize the HSIP Analyzer to calculate the B/C ratio of the project. Additional details and formulas included in the calculation are included in this document as Appendix D.

Recommended Action: Calculate the B/C ratio for each of the proposed projects being evaluated in the proactive safety analysis.

5.4 Compare B/C Ratios and Consider the Need to Reevaluate Project Elements

By implementing a comprehensive proactive safety analysis approach, agencies will likely identify more potential safety projects than they can fund and deliver. It will be important for an agency to prioritize their projects internally before funding is sought. It is not uncommon for projects to have a B/C ratio as low as 0.1 or as high as 100. Once the relative cost effectiveness of an agency's potential projects has been established, the projects with low to mid-ranged B/C ratios should be reassessed. Projects with very low initial B/C ratios may be dropped while projects with low to mid ranged B/C ratios may be redefined by changing the limits of the proposed improvements to focus on higher crash locations or incorporating lower-cost countermeasures. This reiterative process is illustrated in Figure 1 in Section 1 of this document.

At the conclusion of this step, the local agency should have several potential safety projects ready to move into the project development and construction phases. Ideally, there will be a variety of low cost safety projects and potentially a few higher cost roadway reconstruction projects. How each local agency prioritizes their list of safety improvements will vary, but projects with the highest B/C ratios should generally have a high overall priority. It should be understood that available funding will play a key role in local agency prioritization (e.g., higher-cost projects may have to wait for funding to become available while low-cost improvements with lower B/C ratios can be constructed with in-house maintenance crews), but in the goal of maximizing overall safety benefits, the role of politics and public influence should be minimized.

Recommended Action: Compare, reevaluate, and prioritize the potential safety projects. Consider changing the project limits to maximize the number of fatal and injury crashes addressed within the limits. Consider lower cost countermeasures in areas where high and medium cost countermeasures resulted in low B/C ratios.

6. Identifying Funding and Construct Improvements

Funding strategies for implementing safety projects need to vary as widely as local agency's roadway types, project costs, and proposed improvements. At this point in the proactive safety analysis process, local agencies should have several potential safety projects ready to move into the project development and construction phases. There are likely a wide range of 'approaches' to fund each of these projects. This section of the document discusses some of the most common approaches.

6.1 Existing Funding for Low-cost Countermeasures

For projects utilizing low-cost countermeasures, the total project cost may be low enough that the agency can construct the project using its existing roadway funding by utilizing the ongoing activities of their roadway maintenance staff and equipment. Other low-cost projects (e.g., overlays, sealcoats, drainage, signing, and striping projects) may be more important to incorporate into larger maintenance projects. It is common for agencies to have 1-, 5-, and 10-year plans for making these standard maintenance improvements. With upfront planning and coordination between agency staff, the low-cost safety projects identified through the proactive safety analysis can be incorporated with minimal costs to an agency's maintenance program. Maximizing the cost effectiveness of the program may even allow the transportation managers to justify increasing the funding for their overall roadway maintenance program.

In addition to their maintenance program, transportation managers should also strategically seek out planned capital improvement and development projects that can incorporate low and medium cost countermeasures identified in their safety analysis. Local agencies may also find opportunities to partner with private enterprises and insurance companies to fund special safety projects that further both organizations' strategic goals.

Recommended Action: Survey planned maintenance, developer and capital projects to determine whether they overlap any of the proposed safety projects. Where projects overlap, leverage the existing funding sources to include safety countermeasures.

6.2 HSIP and Other Funding Sources

In addition to the HSIP Program, the Division of Local Assistance's web site includes several other Caltrans administered funding programs:
https://dot.ca.gov/programs/local-assistance

Recommended Action: Consider all potential funding opportunities to incorporate the identified safety countermeasures.

6.3 Project Development and Construction Considerations

In general, roadway safety projects don't garner the same level of attention from decision makers, media, elected officials, and the general public, that large operational and development-driven projects do. As a result, local safety practitioners and project sponsors often find their projects have difficulty in competing for the agencies' limited project delivery resources. Establishing and implementing a comprehensive safety analysis process can assist safety practitioners in delivering their safety programs in many ways, including:

- Credibility and awareness to individual projects and delivery schedules.
- Increased stakeholders tracking and delivery of a project when low-cost improvements are incorporated into ongoing maintenance and capital projects.
- An increased focus on low-cost countermeasures typically corresponds to projects with less environmental, right-of-way and other impacts; resulting in projects that have streamlined project delivery processes and short construction schedules.

Recommended Action: Safety practitioners should follow their safety projects all the way through the project delivery and construction process. In addition, they should establish a safety program delivery plan that brings awareness and support to the expedited delivery of safety projects. Where possible, safety practitioners should involve the media and even consider having their own program intended to "toot their own safety-horn."

7. Evaluation of Improvements

Evaluation of the effectiveness of roadway treatments following installation should be used to guide future decisions regarding roadway countermeasures. Field reviews should also be conducted shortly after the project is completed to insure the project is operating as intended.

A record of crash history and countermeasure installation forms the foundation for assessing how well the implemented strategies have performed. An important database to maintain is a current list of installed countermeasures with documented "when/where/why" information. Periodic assessments will provide the necessary information to make informed decisions on whether each countermeasure contributed to an increase in safety, whether the countermeasure could or should be installed at other locations, and which factors may have contributed to each countermeasure's success.

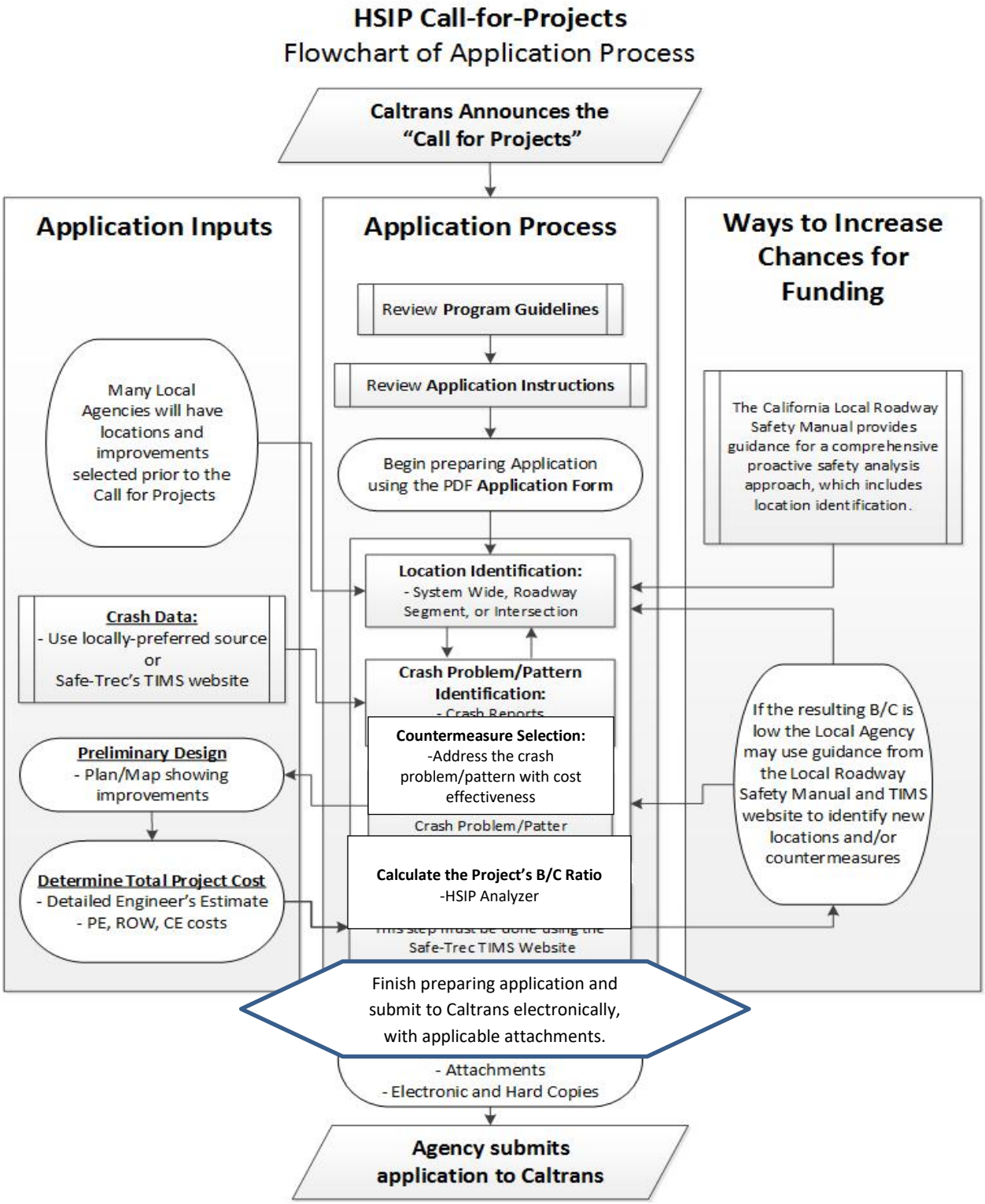
In order to perform the assessment, it is necessary to collect the required information for a certain period after strategies have been deployed at the locations. The time period varies, but whenever possible, 3 to 5 years is recommended to reduce the effects of the random nature of roadway crashes (i.e., Regression to the Mean). The information required may consist of public input and complaints, police reports, observations from maintenance crews, and local and State crash data.

It is important to keep the list of safety installations up-to-date since it will serve as a record of countermeasure deployment history (see table below for an example). By using this type of system, assessment dates can be scheduled to review the crashes and other pertinent information on segments where roadway countermeasures have been installed. Making "after" assessments will inform the practitioner on the effectiveness of past improvements and can provide data to help justify the value of continuing and expanding the local agency's safety program in the future.

Location	Type of Countermeasure Installed	Date Installed	Crashes Before (Duration and Severity)	Crashes After (Duration and Severity)	Comments

Recommended Action: Develop a spreadsheet or database to track future safety project installations and record 3 or more years of "before" and "after" crash information at those locations. Once safety countermeasures are constructed, schedule and track assessment dates to ensure they happen.

Appendix A: HSIP Call-for-Projects Process



Appendix B: Detailed Tables of Countermeasures

The intent of the information contained in this appendix is to provide local agency safety practitioners with a list of effective countermeasures that are appropriate remedies to many common safety issues. The tables in Section 4.2 present a quick summary of the specific values that the Caltrans Division of Local Assistance uses to assess and select projects for its calls- for-projects. In addition to the same information as in Section 4.2, this appendix also includes notes for Caltrans HSIP calls-for-projects and "General information" regarding where the countermeasure should be used, why it works, the general qualities that can be used to suggest the potential complexity of installation, and information from FHWA CMF Clearinghouse on the type of crashes where the countermeasure is best used and a range of their expected overall effectiveness.

The countermeasures have been sorted into 3 categories: Signalized Intersection, Non-Signalized Intersection, and Roadway Segment. Pedestrian and bicycle related countermeasures have been included in each of these categories.

Caltrans gives careful consideration to the fair application of its calls-for-projects process. Starting in 2012, the award of safety funding has been solely based on a determined benefit-to-cost ratio for each project. The fixed set of countermeasures and CRFs included in these tables are intended to allow for all projects to be evaluated consistently and fairly throughout the project selection process. However, at this time, there are no CRFs/CMFs available for several safety improvements, such as: "dynamic/variable speed regulatory signs", "non-motorized signs and markings (regulatory and warning)", "Square-up (reduce curve radius) turn lanes" and non-infrastructure elements. These safety improvement items can be included in project applications, but they will not be included into the B/C ratio calculations, unless the safety improvements meet the intent of other separate countermeasures included in the attached lists. Caltrans is interested in adding these countermeasures (and many others) to these tables once CRFs/CMFs have been established. Caltrans will continue to periodically update this list of allowable countermeasures and CRFs as new safety research data becomes available. With this in mind, Caltrans is interested in feedback and suggestions from local agency safety practitioners on the overall countermeasure list as well as specific details of individual countermeasures, including locally developed safety effectiveness information.

Caltrans used the following references to assist its team in developing the information shown in the following tables. Safety Practitioners are encouraged to utilize these references for a more expansive list of countermeasures and CRFs / CMFs.

The Crash Modification Factors Clearinghouse
https://www.cmfclearinghouse.org/

NCHRP Report 500 Series: Volumes 4, 5, 6, 7, 10, 12, 13, and others
https://www.trb.org/Main/Blurbs/152868.aspx

Highway Safety Manual (HSM)
http://www.highwaysafetymanual.org

Pedestrian and Bicycle - Tools to Diagnose and Solve the Problem
https://safety.fhwa.dot.gov/ped_bike/tools_solve/

FHWA Local and Rural Road / Training, Tools, Guidance and Countermeasures for Locals
https://safety.fhwa.dot.gov/local_rural/training/

For each countermeasure (CM):

(Title) CM No., CM Name

- CM No. is
  - S01 through S21PB for Intersection Countermeasures – Signalized,
  - NS01 through NS23PB for Intersection Countermeasures – Unsignalized, or
  - R01 through R38 for Roadway Countermeasures.

For HSIP Calls-for-projects:

- **Funding Eligibility -** 90% or 50%.
- **Crash Types Addressed -** "All", "Pedestrian and Bicycle", "Night", "Emergency Vehicle", or "Animal".
- **CRF -** Crash Reduction Factor used for HSIP calls-for-projects.
- **Expected Life -** 10 years or 20 years.
- **Notes -** Specific requirements are provided for utilizing the countermeasure on applications for Caltrans statewide calls-for-projects.
-

General Information:

- **Where to use** – Roadway segments and intersections with specific common characteristics can be addressed with similar countermeasures that are most effective.
- **Why it works** – A discussion of the benefit of a countermeasure is important to determine its appropriateness in addressing certain roadway crash types at areas with specific issues as determined by the data and roadway features.
- **General Qualities (Time, Cost and Effectiveness)** – This category is more subjective and can vary substantially. 'Time' refers to the approximate relative time it can take to implement the countermeasure. Costs can vary considerably due to local conditions, so 'cost' represents the relative cost of applying a countermeasure. A relative overall 'effectiveness' is also provided for some countermeasures. All of this subjective information may not be applicable to the unique circumstances for the agency and should not be utilized without verification by the safety practitioner.

- **FHWA CMF Clearinghouse**

- **Crash Types Addressed** – In order to effectively reduce the number and severity of roadway crashes, it is necessary to match countermeasures to the crash types they are intended to address. Depending on the type of problem, one or more of a range of countermeasures could be the most effective way to reduce the number and severity of future crashes.
- **Crash Reduction Factor** – The crash reduction factor (CRF) is an indication of the effectiveness of a particular treatment, measured by the percentage of crashes it is expected to reduce. Note: As mentioned earlier in this section, the effectiveness of a countermeasure can also be expressed as a Crash Modification Factor (CMF), which is defined mathematically as 1 – CRF. However, this document uses CRFs as they can be more insightful when analyzing roadways for potential "reductions" in crashes. There is a range of CRF values that exist for each of the countermeasures (or similar countermeasures). The range of CRFs is provided to give local safety practitioners a clear understanding that they may need to go to the FHWA CMF Clearinghouse to find the most appropriate countermeasure and CRF for their specific projects and local prioritization.

B.1 Intersection Countermeasures – Signalized

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

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	"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 Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	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%

S03, Improve signal timing (coordination, phases, red, yellow, or operation)

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
50%	All	15%	10 years
Notes:	This CM only applies to crashes occurring on the approaches / influence area of the new signal timing. For projects coordination signals along a corridor, the crashes related to side-street movements should not be applied. This CM does not apply to projects that only 'study' the signal network and do not make physical timing changes, including corridor operational studies and improvements to Traffic Operation Centers (TOCs). In Caltrans calls for projects, this CM has a HSIP reimbursement ratio of 50%, considering that it will improve the signal operation rather than merely the safety.		

General information				
Where to use:				
Locations that have a crash history at multiple signalized intersections. Signalization improvements may include adding phases, lengthening clearance intervals, eliminating or restricting higher-risk movements, and coordinating signals at multiple locations. Understanding the corridor or roadway's crash history can provide insight into the most appropriate strategy for improving safety.				
Why it works:				
Certain timing, phasing, and control strategies can produce multiple safety benefits. Sometimes capacity improvements come along with the safety improvements and other times adverse effects on delay or capacity occur. Corridor improvements often have the highest benefit but may take longer to implement. Projects focused on capacity improvements (without a separate focus on signal timing safety needs) may not result in a reduction in future crashes.				
General Qualities (Time, Cost and Effectiveness):				
In general, these low-cost improvements to multiple signalized intersections can be implemented in a short time. Typically these low cost improvements are funded through local funding by local maintenance crews. However, some projects requiring new interconnect infrastructure can have moderate to high costs making them more appropriate to seek state or federal funding. The expected effectiveness of this CM must be assessed for each individual project.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	All	CRF:	0 - 41%

~~S04, Provide Advanced Dilemma-Zone Detection for high speed approaches~~

~~For HSIP Cycle 11 Call-for-projects~~			
~~Funding Eligibility~~	~~Crash Types Addressed~~	~~CRF~~	~~Expected Life~~
~~90%~~	~~All~~	~~40%~~	~~10 years~~
~~Notes:~~	~~This CM only applies to crashes occurring on the approaches / influence area of the new detection and signal timing.~~		

~~General information~~				
~~**Where to use:**~~				
~~More rural/remote areas that have a high frequency of right-angle and rear-end crashes. The Advanced Dilemma Zone Detection system enhances safety at signalized intersections by modifying traffic control signal timing to reduce the number of drivers that may have difficulty deciding whether to stop or proceed during a yellow phase. This may reduce rear-end crashes associated with unsafe stopping and angle crashes due to illegally continuing into the intersection during the red phase.~~				
~~**Why it works:**~~				
~~Clearance times provide safe, orderly transitions in ROW assignment between conflicting streams of traffic. An Advanced Dilemma Zone Detection system has several benefits relative to traditional multiple detector systems, which have upstream detection for vehicles in the dilemma zone but do not take the speed or size of individual vehicles into account. These benefits include: Reducing the frequency of red-light violations; Reducing the frequency of crashes associated with the traffic signal phase change (for example, rear-end and angle crashes); Reducing delay and stop frequency on the major road and a reduction in overall intersection delay.~~				
~~**General Qualities (Time, Cost and Effectiveness):**~~				
~~Installation costs should be low and the time to implement short. Additional modifications to the traffic signal controller may also necessary. In general, This CM can be very effective and can be considered on a systematic approach. Video detection equipment is now available for this purpose, making installation and maintenance more efficient.~~				
~~**FHWA CMF Clearinghouse:**~~	~~Crash Types Addressed:~~	~~All~~	~~CRF:~~	~~39%~~

S05, Install emergency vehicle pre-emption systems

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	Emergency Vehicle - only	70%	10 years
Notes:	This CM only applies to "E.V." crashes occurring on the approaches / influence area of the new pre-emption system.		

General information
Where to use:
Corridors that have a history of crashes involving emergency response vehicles. The target of this strategy is signalized intersections where normal traffic operations impede emergency vehicles and where traffic conditions create a potential for conflicts between emergency and nonemergency vehicles. These conflicts could lead to almost any type of crash, due to the potential for erratic maneuvers of vehicles moving out of the paths of emergency vehicles
Why it works:
Providing emergency vehicle preemption capability at a signal or along a corridor can be a highly effective strategy in two ways; any type of crash could occur as emergency vehicles try to navigate through intersections and as other vehicles try to maneuver out of the path of the emergency vehicles. In addition, a signal preemption system can decrease emergency vehicle response times therefore decreasing the time in receiving emergency medical attention, which is critical in the outcome of any crash. When data is not available for past crashes with emergency vehicles, an agency may consider combining the E.V. pre-emption improvements into a comprehensive project that also makes significant signal hardware and/or signal timing improvements.
General Qualities (Time, Cost and Effectiveness):
Costs for installation of a signal preemption system will vary from medium to high, based upon the number of signalized intersections at which preemption will be installed and the number of emergency vehicles to be outfitted with the technology. The number of detectors, a requirement for new signal controllers, and the intricacy of the preemption system could increase costs. This CM is considered systemic as it is usually implemented on a corridor-basis.

FHWA CMF Clearinghouse:	Crash Types Addressed:	Emergency Vehicle - only	CRF:	70%

S06, Install left-turn lane and add turn phase (signal has no left-turn lane or phase before)

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	55%	20 years
Notes:	This CM only applies to crashes occurring on the approaches / influence area of the new left turn lanes. This CM does NOT apply to converting a single-left into double-left turn.		

General information
Where to use:
Intersections that do not currently have a left turn lane or a related left-turn phase that are experiencing a large number of crashes. Many intersection safety problems can be traced to difficulties in accommodating left-turning vehicles, in particular where there is currently no accommodation for left turning traffic. A key strategy for minimizing collisions related to left-turning vehicles (angle, rear-end, sideswipe) is to provide exclusive left-turn lanes and the appropriate signal phasing, particularly on high-volume and high-speed major-road approaches. Agencies need to document their consideration of the MUTCD, Section 4D.19 guidelines; the section on implementing protected left-turn phases.
Why it works:
Left-turn lanes allow separation of left-turn and through-traffic streams, thus reducing the potential for rear-end collisions. Left-turn phasing also provides a safer opportunity for drivers to make a left-turn. The combination of left-turn storage and a left turn signal has the potential to reduce many collisions between left-turning vehicles and through vehicles and/or non-motorized road users.
General Qualities (Time, Cost and Effectiveness):
Implementation time may vary from months to years. At some locations, left-turn lanes can be quickly installed simply by restriping the roadway. At other locations, widening of the roadway, acquisition of additional right-of-way, and extensive environmental processes may be needed. Such projects require a substantial time for development and construction. Costs are highly variable and range from very low to high. Installing a protected left turn lane and phase where none exists results in a high Crash Reduction Factor and is often highly effective.

FHWA CMF Clearinghouse:	Crash Types Addressed:	All	CRF:	17 - 58 %

S07, Provide protected left turn phase (left turn lane already exists)

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	30%	20 years
Notes:	This CM only applies to crashes occurring on the approaches / influence area of the new left turn phases. This CM does NOT apply to converting a single-left into double-left turn (unless the single left is unprotected and the proposed double left will be protected).		

General information				
Where to use:				
Signalized intersections (with existing left turns pockets) that currently have a permissive left-turn or no left-turn protection that have a high frequency of angle crashes involving left turning, opposing through vehicles, and non-motorized road users. A properly timed protected left-turn phase can also help reduce rear-end and sideswipe crashes between left-turning vehicles and the through vehicles as well as vehicles behind them. Protected left-turn phases are warranted based on such factors as turning volumes, delay, visibility, opposing vehicle speed, distance to travel through the intersection, presence of non-motorized road users, and safety experience of the intersections. Agencies need to document their consideration of the MUTCD, Section 4D.19 guidelines; the section on implementing protected left-turn phases.				
Why it works:				
Left turns are widely recognized as the highest-risk movements at signalized intersections. Providing Protected left-turn phases (i.e., the provision for a specific phase for a turning movement) for signalized intersections with existing left turn pockets significantly improve the safety for left-turn maneuvers by removing the need for the drivers to navigate through gaps in oncoming/opposing through vehicles. Where left turn pockets are not protected, the pedestrian and bicyclist crossing phase often conflicts with these left turn maneuvers. Drivers focused on navigating the gaps of oncoming cars may not anticipate and/or perceive the non-motorized road users.				
General Qualities (Time, Cost and Effectiveness):				
If the existing traffic signal only requires a minor modification to allow for a protected left-turn phase, then the cost would also be low. The time to implement this countermeasure is short because there is no actual construction that has to take place. In-house signal maintainers can perform this operation once the proper signal phasing is determined so the cost is low. In addition, the countermeasure is tried and proven to be effective. Has the potential of being applied on a systemic/systematic approach.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Rear-End, Sideswipe, Broadside	CRF:	16 - 99%

S08, Convert signal to mast arm (from pedestal-mounted)

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	30%	20 years
Notes:	This CM only applies to crashes occurring on the approaches / influence area of the converted signal heads that are relocated from median and/or outside shoulder pedestals to signal heads on master arms over the travel-lanes. Projects using CM "S7" should not also apply "S2" in the B/C calc.		

General information				
Where to use:				
Intersections currently controlled by pedestal mounted traffic signals (in medians and/or on outside shoulder) that have a high frequency of right-angle and rear-end crashes occurring because drivers are unable to see traffic signals in advance to safely negotiate the intersection. Intersections that have pedestal-mounted signals may have poor visibility and can result in vehicles not being able to stop in time for a signal change. Care should be taken to place the new signal heads (with back plates) as close to directly over the center of the travel lanes as possible.				
Why it works:				
Providing better visibility of intersection signs and signals aids the drivers' advance perception of the upcoming intersection. Visibility and clarity of the signal should be improved without creating additional confusion or distraction for drivers.				
General Qualities (Time, Cost and Effectiveness):				
Dependent on the scope of the project. Costs are generally moderate for this type of project. There is usually no right-of-way costs, minimal roadway reconstruction costs, and a shorter project development timeline. At the same time, new mast arms can be expensive. Some locations can result in high B/C ratios, but due to moderate costs, some locations may result in medium to low B/C ratios.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Rear-End, Angle	CRF:	12 - 74%

S09, Install raised pavement markers and striping (Through Intersection)

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	10%	10 years
Notes:	This CM only applies to crashes occurring in the intersection and influence areas of the new pavement markers and/or markings.		

General information				
Where to use:				
Intersections where the lane designations are not clearly visible to approaching motorists and/or intersections noted as being complex and experiencing crashes that could be attributed to a driver's unsuccessful attempt to navigate the intersection. Driver confusion can exist in regard to choosing the proper turn path or where through-lanes do not line up. This is especially relevant at intersections where the overall pavement area of the intersection is large, and multiple turning lanes are involved or other unfamiliar elements are presented to the driver.				
Why it works:				
Adding clear pavement markings can guide motorists through complex intersections. When drivers approach and traverse through complex intersections, drivers may be required to perform unusual or unexpected maneuvers. Providing more effective guidance through an intersection will minimize the likelihood of a vehicle leaving its appropriate lane and encroaching upon an adjacent lane.				
General Qualities (Time, Cost and Effectiveness):				
Costs of implementing this strategy will vary based on the scope and number of applications. Applying raised pavement markers is relatively low cost but can be variable and determined largely by the material used for pavement markings (paint, thermoplastic, epoxy, RPMs etc.). When using this type delineators, an issue of concern is the cost-to-service-life of the material. (Note: When HSIP 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.) 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:	Wet, Night, All	CRF:	10 - 33%

S10, Install flashing beacons as advance warning (S.I.)

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	30%	10 years
Notes:	This CM only applies to crashes occurring on the approaches / influence area of the new flashing beacons.		

General information				
Where to use:				
At signalized intersections with crashes that are a result of drivers being unaware of the intersection or are unable to see the traffic control device in time to comply.				
Why it works:				
Increased driver awareness of an approaching signalized intersection and an increase in the driver's time to react. Driver awareness of both downstream intersections and traffic control devices is critical to intersection safety. Crashes often occur when the driver is unable to perceive an intersection, signal head or the back of a stopped queue in time to react. Advance flashing beacons can be used to supplement and call driver attention to intersection control signs. Most advance warning flashing beacons can be powered by solar, thus reducing the issues relating to power source.				
General Qualities (Time, Cost and Effectiveness):				
Before choosing this CM, the agency needs to confirm the ability to provide power to the site (solar may be an option). Flashing beacons can be constructed with minimal design, environmental and right-of-way issues and have relatively low costs. This combined with a relatively high CRF, can result in high B/Cs for locations with a history of crashes and lead to a high effectiveness.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Rear End, Angle	CRF:	36 - 62%

S11, Improve pavement friction (High Friction Surface Treatments)

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	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. Signalized Intersections noted as having crashes on wet pavements or under dry conditions when the pavement friction available is significantly less than needed for the actual roadway approach speeds. This treatment is intended to target locations where skidding and failure to stop is determined to be a problem in wet or dry conditions and the target vehicle is unable to stop due to insufficient skid resistance.				
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 reductions 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, Night, ALL	CRF:	10 - 62 %

S12, Install raised median on approaches (S.I.)

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	25%	20 years
Notes:	This CM only applies to crashes occurring on the approaches / influence area of the new raised median. All new raised medians funded with HSIP funding should not include the removal of the existing roadway structural section and should be doweled into the existing roadway surface. This requirement is being implemented to maximize the safety-effectiveness of the limited HSIP funding and to minimize project impacts. Landscaping, if included in the project, is considered non-participating.		

General information				
Where to use:				
Intersections noted as having turning movement crashes near the intersection as a result of insufficient access control. Application of this CM should be based on current crash data and a clearly defined need to restrict or accommodate the movement.				
Why it works:				
Raised medians next to left-turn lanes at intersections offer a cost-effective means for reducing crashes and improving operations at higher volume intersections. The raised medians prohibit left turns into and out of driveways that may be located too close to the functional area of the intersection.				
General Qualities (Time, Cost and Effectiveness):				
Raised medians at intersections may be most effective in retrofit situations where high volumes of turning vehicles have degraded operations and safety, and where more extensive CMs would be too expensive because of limited right-of-way and the constraints of the built environment. The result is This CM can be very effective and can be considered on a systematic approach. Raised medians can often be installed directly over the existing pavement. 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:	Angle	CRF:	21 -55 %

S13PB, Install pedestrian median fencing on approaches

For HSIP Cycle 11 Call-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 Cycle 11 Call-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%

S15, Reduced Left-Turn Conflict Intersections (S.I.)

For HSIP Cycle 11 Call-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 Reduced Left-Turn Conflict.		

General information

Where to use and Why it works:

Reduced left-turn conflict intersections are geometric designs that alter how left-turn movements occur in order to simplify decisions and minimize the potential for related crashes. Two highly effective designs that rely on U-turns to complete certain left-turn movements are known as the restricted crossing U-turn (RCUT) and the median U-turn (MUT).

Restricted Crossing U-turn (RCUT):

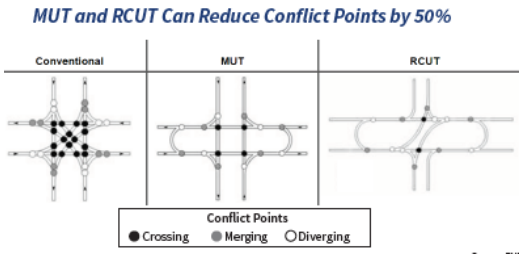
The RCUT intersection modifies the direct left-turn and through movements from cross-street approaches. Minor road traffic makes a right turn followed by a U-turn at a designated location (either signalized or unsignalized) to continue in the desired direction.

The RCUT is suitable for a variety of circumstances, including along rural, high-speed, four-lane, divided highways or signalized routes. It also can be used as an alternative to signalization or constructing an interchange. RCUTs work well when consistently used along a corridor, but also can be used effectively at individual intersections.

Median U-turn (MUT)

The MUT intersection modifies direct left turns from the major approaches. Vehicles proceed through the main intersection, make a U-turn a short distance downstream, followed by a right turn at the main intersection. The U-turns can also be used for modifying the cross-street left turns.

The MUT is an excellent choice for heavily traveled intersections with moderate left-turn volumes. When implemented at multiple intersections along a corridor, the efficient two-phase signal operation of the MUT can reduce delay, improve travel times, and create more crossing opportunities for pedestrians and bicyclists.



General Qualities (Time, Cost and Effectiveness):

Implementing this strategy may take from months to years, depending on whether additional R/W is required. Such projects require a substantial time for development and construction. Costs are highly variable and range from very low to high. The expected effectiveness of this CM must be assessed for each individual location.

FHWA CMF Clearinghouse:	Crash Types Addressed:	Angle/Left-turn/Rear-End/All	CRF:	34.8-100%

S16, Convert intersection to roundabout (from signal)

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	Varies	20 years
Notes:	This CM only applies to crashes occurring in influence area of the new roundabout. This CM is not intended for mini-roundabouts. 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:				
Signalized intersections that have a significant crash problem and the only alternative is to change the nature of the intersection itself. Roundabouts can also be very effective at intersections with complex geometry and intersections with frequent left-turn movements.				
Why it works:				
The types of conflicts that occur at roundabouts are different from those occurring at conventional intersections; namely, conflicts from crossing and left-turn movements are not present in a roundabout. The geometry of a roundabout forces drivers to reduce speeds as they proceed through the intersection. This helps keep the range of vehicle speed narrow, which helps reduce the severity of crashes when they do occur. Pedestrians only have to cross one direction of traffic at a time at roundabouts, thus reducing their potential for conflicts.				
General Qualities (Time, Cost and Effectiveness):				
Provision of a roundabout requires substantial project development. The need to acquire right-of-way is likely and will vary from site to site and depends upon the geometric design. These activities may require up to 4 years or longer to implement. Costs are variable, but construction of a roundabout to replace an existing signalized intersection are relatively high. The result is this CM may have reduced relative-effectiveness compared to other CMs.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	All	CRF:	35 - 67%

S17PB, Install pedestrian countdown signal heads

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	Pedestrian and Bicycle	25%	20 years
Notes:	This CM only applies to "Ped & Bike" crashes occurring in the intersection/crossing with the new countdown heads.		

General information				
Where to use:				
Signals that have signalized pedestrian crossing with walk/don't walk indicators and where there have been pedestrian vs. vehicle crashes.				
Why it works:				
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. Countdown signals begin counting down either when the "WALK" or when the flashing "DON'T WALK" interval appears and stop at the beginning of the steady "DON'T WALK" interval. These signals also have been shown to encourage more pedestrians to use the pushbutton rather than jaywalk.				
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:	25%

S18PB, Install pedestrian crossing (S.I.)

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	Pedestrian and Bicycle	25%	20 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:				
Signalized Intersections with no marked crossing and pedestrian signal heads, where pedestrians are known to be crossing intersections that involve significant turning movements. They are especially important at intersections with (1) multiphase traffic signals, such as left-turn arrows and split phases, (2) school crossings, and (3) double-right or double-left turns. At signalized intersections, pedestrian crossings are often safer when the left turns have protected phases that do not overlap the pedestrian walk phase.				
Why it works:				
Adding pedestrian crossings has the opportunity to enhance pedestrian safety at locations noted as being problematic. 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. Another 22 percent of pedestrian crashes involve a pedestrian either running across the intersection or darting out in front of a vehicle whose view was blocked just prior to the impact. Finally, 16 percent of these intersection-related crashes occur because of a driver violation (e.g., failure to yield right-of-way). 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 if curb ramps and sidewalk modifications are required with the crossing. When considered at a single location, these low cost improvements may be 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 to high cost projects that are appropriate to seek state or federal funding.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Pedestrian, Bicycle	CRF:	25%

S19PB, Pedestrian Scramble

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	Pedestrian and Bicycle	40%	20 years
Notes:	This CM only applies to "Ped & Bike" crashes occurring in the intersection with the new pedestrian crossing.		

General information				
Where to use:				
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. Pedestrian Scramble may be considered at signalized intersections with very high pedestrian/bicycle volumes, e.g. in an urban business district.				
Why it works:				
Pedestrian Scramble has been shown to reduce injury risk and increase bicycle ridership due to its perceived safety and comfort.				
General Qualities (Time, Cost and Effectiveness):				
Not involving any additional R/W, Pedestrian Scramble should not require a long development process and should be implemented reasonably soon. A systemic approach may be used in implementing this CM, resulting in cost efficiency with low to moderate cost.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Pedestrian, Bicycle	CRF:	-10% to 51%

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

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	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 Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	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 Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	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 Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	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%

NS03, Install signals

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	30%	20 years
Notes:	This CM only applies to crashes occurring in the intersection and/or influence area of the new signals. **All new signals must meet MUTCD "safety" warrants: 4, 5 or 7.** Given the over-arching operational changes that occur when an intersection is signalized, no other intersection CMs can be applied to the intersection crashes in conjunction with this CM.		

General information				
Where to use:				
Traffic signals can be used to prevent the most severe type crashes (right-angle, left-turn). Consideration to signalize an unsignalized intersection should only be given after (1) less restrictive forms of traffic control have been utilized as the installation of a traffic signal often leads to an increased frequency of crashes (rear-end) on major roadways and introduces congestion and (2) signal warrants have been met. Refer to the CA MUTCD, Section 4C.01, Studies and Factors for Justifying Traffic Control Signals.				
Why it works:				
Traffic signals have the potential to reduce the most severe type crashes but will likely cause an increase in rear-end collisions. A reduction in overall injury severity is likely the largest benefit of traffic signal installation.				
General Qualities (Time, Cost and Effectiveness):				
Typical traffic signal costs fall in the medium to high category and are affected by application, type of signal and right-of-away considerations. Projects of this magnitude should only be considered after alternate and lesser means of correction have been evaluated. 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:	All	CRF:	0 - 74%

NS04, Convert intersection to roundabout (from all way stop)

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	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 %

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

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	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 %

NS05mr, Convert intersection to mini-roundabout

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	30%	20 years
Notes:	This CM only applies to crashes occurring in the intersection and/or influence area of the new control.		

General information				
Where to use:				
Mini-roundabouts are characterized by a small diameter (45-90 ft) and traversable islands (central island and splitter islands). Mini-roundabouts offer most of the benefits of regular roundabouts with the added benefit of a smaller footprint. They are best suited to environments where speeds are already low and environmental constraints would preclude the use of a larger roundabout. Mini-roundabouts are most effective in lower speed environments in which all approaching roadways have posted speed of 30 mph or less and an 85th-percentile speed of less than 35 mph near the proposed yield and/or entrance line. For any location with an 85th-percentile speed above 35 mph, the mini-roundabout can be included as part of a broader system of traffic calming measures to achieve an appropriate speed environment.				
Why it works:				
Mini-roundabouts may be an optimal solution for a safety or operational issue at an existing intersection where there is insufficient right-of-way for a standard roundabout installation. The benefits of mini-roundabouts are the Compact size, operational efficiency, traffic safety improvement and traffic Calming.				
General Qualities (Time, Cost and Effectiveness):				
Construction costs for mini-roundabouts vary widely depending upon the extent of sidewalk modifications or other geometric improvements and the types of materials used. In most cases, mini-roundabouts have been installed with little or no pavement widening and with only minor changes to curbs and sidewalks. Construction costs can be minimum for an installation consisting entirely of pavement markings and signage or moderate for mini-roundabouts that include raised islands and pedestrian improvements.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	NA	CRF:	NA

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

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	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 Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	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 Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	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%

NS09, Install flashing beacons as advance warning (NS.I.)

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	30%	10 years
Notes:	This CM only applies to crashes occurring on the approaches / influence area of the new beacons placed in advance of the intersection.		

General information				
Where to use:				
Non-Signalized Intersections with patterns of crashes that could be related to lack of a driver's awareness of approaching intersection or controls at a downstream intersection.				
Why it works:				
Advance flashing beacons can be used to supplement and call driver attention to intersection control signs. Flashing beacons are intended to reinforce driver awareness of the stop or yield signs and to help mitigate patterns of crashes related to intersection regulatory sign violations. Most advance warning flashing beacons can be powered by solar, thus reducing the issues relating to power source.				
General Qualities (Time, Cost and Effectiveness):				
Use of flashing beacons requires minimal development process, allowing flashing beacons to be installed within a short time period. 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:	36 - 62%

NS10, Install transverse rumble strips on approaches

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	20%	10 years
Notes:	This CM only applies to crashes occurring on the approaches / influence area of the new rumble strips.		

General information				
Where to use:				
Transverse rumble strips are installed in the travel lane for the purposes of providing an auditory and tactile sensation for each motorist approaching the intersection. They can be used at any stop or yield approach intersection, often in combination with advance signing to warn of the intersection ahead. Due to the noise generated by vehicles driving over the rumble strips, care must be taken to minimize disruption to nearby residences and businesses.				
Why it works:				
When motorists are traveling along the roadway, they are sometimes unaware they are approaching an intersection. This is especially true on rural roads, as there may be fewer clues indicating an intersection ahead. Transverse rumble strips warn motorists that something unexpected is ahead that they need to pay attention to.				
General Qualities (Time, Cost and Effectiveness):				
Use of transverse rumble strips requires minimal development process, allowing transverse rumble strips to be installed within a short time period. In general, This CM can be very effective and can be considered on a systematic approach, although care should be taken to not over-use this CM. 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:	0 - 35%

NS11, Improve sight distance to intersection (Clear Sight Triangles)

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	20%	10 years
Notes:	This CM only applies to crashes occurring on the approaches / influence area of the significantly improved new sight distance. Minor/incidental improvements to sight distance would not likely result in the CRF shown below.		

General information				
Where to use:				
Unsignalized intersections with restricted sight distance and patterns of crashes related to lack of sight distance where sight distance can be improved by clearing roadside obstructions without major reconstruction of the roadway.				
Why it works:				
Adequate sight distance for drivers at stop or yield-controlled approaches to intersections has long been recognized as among the most important factors contributing to overall safety at unsignalized intersections. By removing sight distance restrictions (e.g., vegetation, parked vehicles, signs, buildings) from the sight triangles at stop or yield-controlled intersection approaches, drivers will be able see approaching vehicles on the main line, without obstruction and therefore make better decisions about entering the intersection safely.				
General Qualities (Time, Cost and Effectiveness):				
Projects involving clearing sight obstructions on the highway right-of-way can typically be accomplished quickly, assuming the objects are readily moveable. Clearing sight obstructions 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. In general, this CMs can be very effective and can be implemented by agencies' maintenance staff and/or implemented on a systematic approach. Usually only high-cost removals would be good candidates for Caltrans Federal Safety Funding. Note: When federal safety funding is used to remove vegetation that has the potential to grow back, the local agency is expected to maintain the improvement for a minimum of 10 years.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	All	CRF:	11 - 56%

NS12, Improve pavement friction (High Friction Surface Treatments)

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	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. Non-signalized Intersections noted as having crashes on wet pavements or under dry conditions when the pavement friction available is significantly less than needed for the actual roadway approach speeds. This treatment is intended to target locations where skidding and failure to stop is determined to be a problem in wet or dry conditions and the target vehicle is unable to stop due to insufficient skid resistance.				
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 reductions 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, Night, ALL	CRF:	10 - 62 %

NS13, Install splitter-islands on the minor road approaches

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	40%	20 years
Notes:	This CM only applies to crashes occurring on the approaches / influence area of **the new splitter island on the minor road approaches.**		

General information				
Where to use:				
Minor road approaches to unsignalized intersections where the presence of the intersection or the stop sign is not readily visible to approaching motorists. The strategy is particularly appropriate for intersections where the speeds on the minor road are high. In creation of a splitter island allows for an additional stop sign to be placed in the median for the minor approach.				
Why it works:				
The installation of splitter islands allows for the addition of a stop sign in the median to make the intersection more conspicuous. Additionally, the splitter island on the minor-road provides for a positive separation between turning vehicles on the through road and vehicles stopped on the minor road approach.				
General Qualities (Time, Cost and Effectiveness):				
Splitter islands at non-signalized intersections can usually be installed with minimal roadway reconstruction and relatively quickly. 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:	35 - 100 %

NS14, Install raised median on approaches (NS.I.)

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	25%	20 years
Notes:	This CM only applies to crashes occurring on the approaches / influence area of the new raised median. All new raised medians funded with federal HSIP funding should not include the removal of the existing roadway structural section and should be doweled into the existing roadway surface. This requirement is being implemented to maximize the safety-effectiveness of the limited HSIP funding and to minimize project impacts. Landscaping, if included in the project, is considered non-participating.		

General information				
Where to use:				
Where related or nearby turning movements affect the safety and operation of an intersection. Effective access management is key to improving safety at, and adjacent to, intersections. The number of intersection access points coupled with the speed differential between vehicles traveling along the roadway often contributes to crashes. Any access points within 250 feet upstream and downstream of an intersection are generally undesirable.				
Why it works:				
Raised medians with left-turn lanes at intersections offer a cost-effective means for reducing crashes and improving operations at higher volume intersections. The raised medians also prohibit left turns into and out of driveways that may be located too close to the functional area of the intersection.				
General Qualities (Time, Cost and Effectiveness):				
Raised medians at intersections may be most effective in retrofit situations where high volumes of turning vehicles have degraded operations and safety, and where more extensive approaches would be too expensive because of limited right-of-way and the constraints of the built environment. Because raised medians limit property access to right turns only, the need for providing alternative access ways should be considered. 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:	All	CRF:	20 - 39 %

NS15, Create directional median openings to allow (and restrict) left-turns and u-turns (NS.I.)

For HSIP Cycle 11 Call-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. Because raised medians limit property access to right turns only, they should be used in conjunction with efforts to provide alternative access ways and promote driveway spacing objectives.				
Why it works:				
Agencies are increasingly using access management techniques on urban and suburban arterials to manage the number of conflicts experienced at an intersection. A key element of access management is to restrict certain movements, create directional median openings, or close median openings that are deemed too close to an intersection.				
General Qualities (Time, Cost and Effectiveness):				
Turn prohibitions that are implemented by closing a median opening can usually be implemented quickly. Costs are highly variable but in many cases could be considered low. In some cases this strategy may involve acquiring access or constructing replacement access; those actions will significantly increase the cost of the project. 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%

NS16, Reduced Left-Turn Conflict Intersections (NS.I.)

For HSIP Cycle 11 Call-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 Reduced Left-Turn Conflict.		

General information

Where to use and Why it works:

Reduced left-turn conflict intersections are geometric designs that alter how left-turn movements occur in order to simplify decisions and minimize the potential for related crashes. Two highly effective designs that rely on U-turns to complete certain left-turn movements are known as the restricted crossing U-turn (RCUT) and the median U-turn (MUT).

Restricted Crossing U-turn (RCUT):

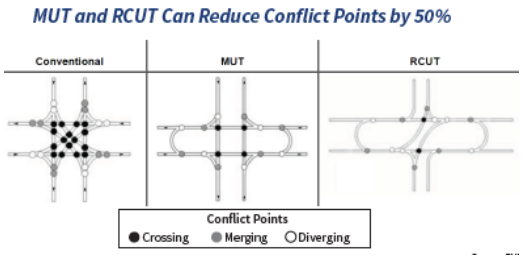
The RCUT intersection modifies the direct left-turn and through movements from cross-street approaches. Minor road traffic makes a right turn followed by a U-turn at a designated location (either signalized or unsignalized) to continue in the desired direction.

The RCUT is suitable for a variety of circumstances, including along rural, high-speed, four-lane, divided highways or signalized routes. It also can be used as an alternative to signalization or constructing an interchange. RCUTs work well when consistently used along a corridor, but also can be used effectively at individual intersections.

Median U-turn (MUT)

The MUT intersection modifies direct left turns from the major approaches. Vehicles proceed through the main intersection, make a U-turn a short distance downstream, followed by a right turn at the main intersection. The U-turns can also be used for modifying the cross-street left turns.

The MUT is an excellent choice for heavily traveled intersections with moderate left-turn volumes. When implemented at multiple intersections along a corridor, the efficient two-phase signal operation of the MUT can reduce delay, improve travel times, and create more crossing opportunities for pedestrians and bicyclists.



General Qualities (Time, Cost and Effectiveness):

Implementing this strategy may take from months to years, depending on whether additional R/W is required. Such projects require a substantial time for development and construction. Costs are highly variable and range from very low to high. The expected effectiveness of this CM must be assessed for each individual location.

FHWA CMF Clearinghouse:	Crash Types Addressed:	Angle/Left-turn/Rear-End/All	CRF:	34.8-100%

NS17, Install right-turn lane (NS.I.)

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	20%	20 years
Notes:	This CM only applies to crashes occurring on the approaches / influence area of the new right-turn lanes. This CM is not eligible for use at existing all-way stop intersections.		

General information				
Where to use:				
Many collisions at unsignalized intersections are related to right-turn maneuvers. A key strategy for minimizing such collisions is to provide exclusive right-turn lanes, particularly on high-volume and high-speed major-road approaches. When considering new right-turn lanes, potential impacts to non-motorized users should be considered and mitigated as appropriate. When considering new right-turn lanes, potential impacts to non-motorized users should be considered and mitigated as appropriate.				
Why it works:				
The strategy is targeted to reduce the frequency of rear-end collisions resulting from conflicts between vehicles turning right and following vehicles and vehicles turning right and through vehicles coming from the left on the cross street. Right-turn lanes also remove slow vehicles that are decelerating to turn right from the through-traffic stream, thus reducing the potential for rear-end collisions. Right-turn lanes can increase the length of the intersection crossing and create an additional potential conflict point for non-motorized users.				
General Qualities (Time, Cost and Effectiveness):				
Implementing this strategy may take from months to years. At some locations, right-turn lanes can be quickly and simply installed by restriping the roadway. At other locations, widening of the roadway, acquisition of additional right-of-way, and extensive environmental processes may be needed. Such projects require a substantial time for development and construction. Costs are highly variable and range from very low to high. The expected effectiveness of this CM must be assessed for each individual location.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	All	CRF:	14 - 26 %

NS18, Install left-turn lane (where no left-turn lane exists)

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	35%	20 years
Notes:	This CM only applies to crashes occurring on the approaches / influence area of the new left-turn lanes. This CM does NOT apply to converting a single-left into double-left turn. This CM is not eligible for use at existing all-way stop intersections.		

General information				
Where to use:				
Many collisions at unsignalized intersections are related to left-turn maneuvers. A key strategy for minimizing such collisions is to provide exclusive left-turn lanes, particularly on high-volume and high-speed major-road approaches. When considering new left-turn lanes, potential impacts to non-motorized users should be considered and mitigated as appropriate.				
Why it works:				
Adding left-turn lanes remove vehicles waiting to turn left from the through-traffic stream, thus reducing the potential for rear-end collisions. Because they provide a sheltered location for drivers to wait for a gap in opposing traffic, left-turn lanes may encourage drivers to be more selective in choosing a gap to complete the left-turn maneuver. This strategy may reduce the potential for collisions between left-turn and opposing through vehicles.				
General Qualities (Time, Cost and Effectiveness):				
Implementing this strategy may take from months to years. At some locations, left-turn lanes can be quickly and simply installed by restriping the roadway. At other locations, widening of the roadway, acquisition of additional right-of-way, and extensive environmental processes may be needed. Such projects require a substantial time for development and construction. Costs are highly variable and range from very low to high. The expected effectiveness of this CM must be assessed for each individual location.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	All	CRF:	9 -55 %

NS19PB, Install raised medians (refuge islands)

For HSIP Cycle 11 Call-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 should not include the removal of the existing roadway structural section and should be doweled into the existing roadway surface. This requirement is being implemented to maximize the safety-effectiveness of the limited HSIP funding and to minimize project impacts. Landscaping, if included in the project, is considered non-participating.		

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 Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	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 Cycle 11 Call-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 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 Cycle 11 Call-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 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%

NS23PB, Install Pedestrian Signal (including Pedestrian Hybrid Beacon (HAWK))

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	Pedestrian and Bicycle	55%	20 years
Notes:	This CM only applies to "Ped & Bike" crashes occurring in the intersection/crossing with the new signal. For HAWK or other pedestrian signals, the justification may be Warrant 4, 5 and/or 7, or passing the test in Figure 4F-1/4F-2 in Chapter 4F of CA MUTCD. Please refer to Chapter 4F of CA MUTCD for more details		

General information				
Where to use:				
Intersections noted as having a history of pedestrian vs. vehicle crashes and in areas where the likelihood of the pedestrian presence is high. Corridors should also be assessed to determine if there are adequate safe opportunities for non-motorists to cross and if a pedestrian signal, or a Pedestrian Hybrid Beacon (PHB) (also called High-Intensity Activated crossWalK beacon (HAWK)) are needed to provide an active warning to motorists when a pedestrian is in the crosswalk.				
Why it works:				
Adding a pedestrian signal has the opportunity to greatly enhance pedestrian safety at locations noted as being problematic. Nearly one-third of all pedestrian-related crashes occur at or within 50 feet of an intersection. 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):				
The cost of improvements are generally high, but can vary dependent on the type of signal and overall scope of the project. In most cases the project duration can be short. The expected effectiveness of this CM must be assessed for each individual location.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Pedestrian and Bicycle	CRF:	15 - 69%

B.3 Roadway Countermeasures

R01, Add Segment Lighting

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	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 Cycle 11 Call-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 %

R03, Install Median Barrier

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	25%	20 years
Notes:	Note: For Caltrans' statewide Calls-for-Projects, this CM only applies to crashes occurring within the limits of the new barrier.		

General information
Where to use:
Areas where crash history indicates drivers are unintentionally crossing the median and the cross-overs are resulting in high severity crashes. The installation of median barriers can increase the number of PDO and non-severe injuries. The net result in safety from this countermeasure is connected more to reducing the severity of crashes not the number of crashes. It is recommended to review the warrants as outlined in Chapter 7 of the Caltrans Traffic Manual when considering whether to install median barriers.
Why it works:
This strategy is designed to prevent head-on collisions by providing a barrier between opposing lanes of traffic. The variety of median barriers available makes it easier to choose a site-specific solution. The main advantage is the reduction of the severity of the crashes. The key to success would be in selecting an appropriate barrier based on the site, previous crash history, maintenance needs, and median width.
General Qualities (Time, Cost and Effectiveness):
This strategy would in many cases be possible to implement within a short period after site selection. Costs will vary depending on the type of median barrier selected and whether the strategy is implemented as a stand-alone project or incorporated as part of a reconstruction or resurfacing effort. Maintenance costs and worker exposure will also vary depending on the type of barrier selected. The expected effectiveness of this CM must be assessed for each individual location.

FHWA CMF Clearinghouse:	Crash Types Addressed:	Head-on	CRF:	0 - 94 %

R04, Install Guardrail

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	25%	20 years
Notes:	This CM only applies to crashes occurring within the limits of the new guardrail. This CM is not intended to be used for general maintenance activities (i.e. the replacement of existing damaged rail). For projects proposing to upgrade existing guardrail to current standards, this CM and corresponding CRF should only be applied to locations where past crash data or engineering judgment applied to the existing rail conditions suggests the upgraded guardrail may result in fewer or less severe crashes (justifying the use of the 25% CRF for this CM).		

General information
Where to use:
Guardrail is installed to reduce the severity of lane departure crashes. However, guardrail can reduce crash severity only for those conditions where striking the guardrail is less severe than going down an embankment or striking a fixed object. Guardrail should only be installed where it is clear that crash severity will be reduced, or there is a history of run-off-the-road crashes at a given location that have resulted in severe crashes. New and upgraded guardrail and end-treatments must meet current safety standards; see Method for Assessing Safety Hardware (MASH) for more information. Caltrans (or other national accepted guidance) slope/height criteria need to be considered and documented.
Why it works:
Guardrail redirects a vehicle away from embankment slopes or fixed objects and dissipates the energy of an errant vehicle.
General Qualities (Time, Cost and Effectiveness):
Strategies range from relatively inexpensive too costly. Costly projects may include those that upgrade existing guardrail applications to more semi-rigid and rigid barrier systems over extended distances. In general, this CMs can be effective and can be implemented by agencies' maintenance staff and/or implemented on a systematic approach.

FHWA CMF Clearinghouse:	Crash Types Addressed:	Fixed Object, Run-off Road	CRF:	11 - 78 %

R05, Install impact attenuators

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	25%	10 years
Notes:	This CM only applies to crashes occurring within the limits of the new attenuators. This CM is not intended to be used for general maintenance activities (i.e. the replacement of existing damaged attenuators). For projects proposing to upgrade existing attenuators to current standards, this CM and corresponding CRF should only be applied to locations where past crash data or engineering judgment applied to the existing attenuator conditions suggests the upgraded attenuators may result in fewer or less severe crashes (justifying the use of the 25% CRF for this CM).		

General information				
Where to use:				
Impact attenuators are typically used to shield rigid roadside objects such as concrete barrier ends, steel guardrail ends and bridge pillars from oncoming automobiles. Attenuators should only be installed where it is impractical for the objects to be removed. New and upgraded barrier end-treatments must meet current safety standards; see MASH for more information.				
Why it works:				
Attenuators bring an errant vehicle to a more-controlled stop or redirect the vehicle away from a rigid object. Attenuators are effective at absorbing impact energy and increasing occupant safety. They also tend to draw attention to the fixed object, which helps drivers steer clear of the fixed objects.				
General Qualities (Time, Cost and Effectiveness):				
Costs depending on the scope of the project, type(s) used, and associated ongoing maintenance costs. Time to install is fairly quick once site is identified.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Fixed Object, Run-off Road	CRF:	5 - 50 %

R06, Flatten side slopes

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	30%	20 years
Notes:	This CM only applies to crashes occurring within the limits of the new side slopes. Minor/incidental flattening of side slopes would not likely result in the CRF shown below and may not be appropriate for use in Caltrans B/C calculations.		

General information				
Where to use:				
Roadways experiencing frequent lane departure crashes that result in roll-over type crashes as a result of the roadway slope being so severe as to not accommodate a reasonable degree of driver correction. When there is a need to reduce the severity of lane departure crashes without installing a barrier system that could result in increased numbers of crashes.				
Why it works:				
Flattened slopes provide a greater area for a driver to regain control of a vehicle. Steep slopes, ditches or unprotected hazardous drops-offs adjacent to a travel lane offer little opportunities to correct an inappropriate action by a driver and can result in sever crashes.				
General Qualities (Time, Cost and Effectiveness):				
Roadside modifications range from relatively inexpensive to very costly. Strategies that include creating safer side slopes where none exists can be moderately expensive based on the scope of the project and the associated clearing, grading, etc. The potential for high environmental and right-of-way impacts is high which can take several years to clear. In other cases This CM can be effective and can be implemented by agencies' maintenance staff and/or implemented on a systematic approach.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Fixed Object, Run-off Road	CRF:	5 - 62 %

R07, Flatten side slopes and remove guardrail

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	40%	20 years
Notes:	This CM only applies to crashes occurring within the limits of both the removed guardrail and the new side slopes.		

General information				
Where to use:				
Locations where high number of crashes originate as a lane departure and result in collision with guardrail or a fixed object located on the side slope shielded by guardrail. The guardrail may or may not meet current standards. Even though guardrails are generally installed to reduce the severity of departure crashes, they still can result in severe crashes in some locations.				
Why it works:				
Flattened side slopes and an unobstructed clear zone provide a greater area for a driver to regain control of a vehicle. The existing guardrail may help protect the steep slopes, fixed objects, or unprotected hazardous drops-offs adjacent to a travel lane, but removing all of these obstacles generally improves safety.				
General Qualities (Time, Cost and Effectiveness):				
Roadside modifications range from relatively inexpensive to very costly. Strategies that include creating safer side slopes where none exists can be moderately expensive based on the scope of the project and the associated clearing, grading, etc. The potential for high environmental and right-of-way impacts is high which can take several years to clear.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Roll Over, Fixed Object	CRF:	42%

R08, Install raised median

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	25%	20 years
Notes:	This CM only applies to crashes occurring within the limits of the new raised median. All new raised medians funded with federal HSIP funding should not include the removal of the existing roadway structural section and should be doweled into the existing roadway surface. This requirement is being implemented to maximize the safety-effectiveness of the limited HSIP funding and to minimize project impacts. Landscaping, if included in the project, is considered non-participating.		

General information				
Where to use:				
Areas experiencing head-on collisions that may be affected by both the number of vehicles that cross the centerline and by the speed of oncoming vehicles. Installing a raised median is a more restrictive approach in that it represents a more rigid barrier between opposing traffic. Application of raised medians on roadways with higher speeds is not advised - instead a median barrier should be considered. Including landscaping in new raised medians can be counterproductive to the HSIP safety goals and should only be done in ways that do not increase drivers' exposure to fixed objects and that will maintain driver's sight distance needs throughout the life of the proposed landscaping. **Agencies need to consider and document impacts of additional turning movements at nearby intersections.**				
Why it works:				
Adding raised medians is a particularly effective strategy as it adds to or reallocates the existing cross section to incorporate a buffer between the opposing travel lanes and reinforces the limits of the travel lane. Raised median may also be used to limit unsafe turning movements along a roadway.				
General Qualities (Time, Cost and Effectiveness):				
In some cases this strategy may be a retrofit into the existing roadway by utilizing a portion of the existing paved shoulder. These raised medians can be installed directly over the existing pavement. Cost and time to implement could significantly increase if the paved area is not sufficient to include a median. The surface treatment of the raised median also significantly affects their cost-effectiveness: standard concrete or other hardscape surfaces are usually more cost effective than landscaped medians. When agencies opt to install landscaping in conjunction with new raised medians, the project design and construction costs can significantly increase due to excavation, backfill/top-soil, water-connection, irrigation, planting, maintenance needed for the landscaping. 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:	Head-on	CRF:	20 - 75 %

R09, Install median (flush)

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	15%	20 years
Notes:	This CM only applies to crashes occurring within the limits of the new flush median. The new median must be a minimum of 4 feet wide (or "wider" if a narrow median exists before the proposed project).		

General information
Where to use:
Areas experiencing head-on collisions that may be affected by both the number of vehicles that cross the centerline and by the speed of oncoming vehicles. Roadways with oversized lanes offer an opportunity to restripe the roadway to reduce the lanes to standard widths and use the extra width for the median.
Why it works:
Adding medians is a particularly effective strategy as it adds to or reallocates the existing cross section to incorporate a narrow buffer median between opposing flows, thereby providing a greater opportunity to correct an errant maneuver and further reinforce the limits of the travel lane. Application widths can vary based on the available cross section and intended application. Additional safety can be provided by combining this CM with rumble strips.
General Qualities (Time, Cost and Effectiveness):
In some cases this strategy may be retrofitted into the existing roadway by utilizing a portion of the existing paved shoulder and can ultimately be as simple as restriping the roadway. Costs and time to implement could significantly increase if the paved area is not sufficient to include a median.

FHWA CMF Clearinghouse:	Crash Types Addressed:	All	CRF:	15 - 78 %

R10PB, Install pedestrian median fencing

For HSIP Cycle 11 Call-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:
Roadway segments with high pedestrian-generators and pedestrian-destinations nearby (e.g. transit stops) may experience a high volume of pedestrians J-walking across the travel lanes at mid-block locations instead of walking to the nearest intersection or designated mid-block crossing. When this safety issue cannot be mitigated with shoulder, sidewalk and/or crossing 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 designated pedestrian 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%

R11, Install acceleration/ deceleration lanes

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	25%	20 years
Notes:	This CM only applies to crashes occurring within the limits of the new accel/decel lanes on high speed roadways. Significant improvements to the merge length for lane-drop locations is also an acceptable use of this CM.		

General information				
Where to use:				
Areas proven to have crashes that are the result of drivers not being able to turn onto a high speed roadway to accelerate until the desired roadway speed is reached and areas that do not provide the opportunity to safety decelerate to negotiate a turning movement. This CM can also be used to improve the safety of merging vehicles at a lane-drop location.				
Why it works:				
A lane that does not provide enough deceleration length and storage space for turning traffic may cause the turn queue to back up into the adjacent through lane. This can contribute to rear-end and sideswipe crashes. An acceleration lane is an auxiliary or speed-change lane that allows vehicles to accelerate to highway speeds (high speed roadways) before entering the through-traffic lanes of a highway. Additionally, if acceleration by entering traffic takes place directly on the traveled way, it may disrupt the flow of through-traffic and cause rear-end and sideswipe collisions.				
General Qualities (Time, Cost and Effectiveness):				
Costs are highly variable. Where sufficient median or shoulder space exists it may be possible to provide acceleration/deceleration lanes at a moderate cost. Where the roadway must be widened and additional right-of-way must be acquired, higher costs and a lengthy time-to-construct are likely. The expected effectiveness of this CM must be assessed for each individual location.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Sideswipe, Rear-End	CRF:	10 - 75 %

R12, Widen lane (initially less than 10 ft)

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	25%	20 years
Notes:	Note: For Caltrans' statewide Calls-for-Projects, this CM only applies to crashes occurring within the limits of the widened lanes. Widening must a minimum of 1 foot.		

General information				
Where to use:				
Horizontal curves or tangents and low speed or high speed roadways identified as having lane departure crashes, sideswipe or head-on crashes that can be attributed to an existing pavement width less than 10 feet.				
Why it works:				
Increasing pavement width can affect almost all crash types. A common practice is to widen the traveled way on horizontal curves to make operating conditions on curves comparable to those on tangents. Speed is a primary consideration when evaluating potential adverse impacts of lane width on safety. On high-speed, rural two-lane highways, an increased risk of cross-centerline head-on or cross-centerline sideswipe crashes is a concern because drivers may have more difficulty staying within the travel lane.				
General Qualities (Time, Cost and Effectiveness):				
Costs will depend on the amount of reconstruction necessary and on whether additional right-of-way is required. In general, this is one of the higher-cost strategies recommended, but it can also be very beneficial. Since this is a relatively expensive treatment, one of the keys to creating a cost effective project with at least a medium B/C ratio is targeting higher-hazard roadways.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	All	CRF:	5 - 70 %

R13, Add two-way left-turn lane

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	30%	20 years
Notes:	This CM only applies to crashes occurring within the limits of the new lane, where an existing median did not already exist.		

General information
Where to use:
Roadways having a high frequency of drivers being rear-ended while attempting to make a left turn across oncoming traffic. Also can be effective for drivers crossing the centerline of an undivided multilane roadway inadvertently.
Why it works:
Two-way left-turn lanes provide a buffer between opposing directions of travel and separate left turning traffic from through traffic. They can also help to allow vehicles to begin to accelerate before entering the through-traffic lanes. They reduce the disruption of flow of through-traffic and reducing rear-end and sideswipe collisions. For some roadways the option of converting a four-lane undivided arterials to two-vehicle-lane roadways with a center left-turn lane and bike lanes should be considered (see "Road Diet" CM.)
General Qualities (Time, Cost and Effectiveness):
In some cases this strategy may be retrofitted into the existing roadway by utilizing a portion of the existing paved shoulder and can ultimately be as simple as restriping the roadway. Costs and time to implement could significantly increase if the paved area is not sufficient to include a median, requiring new right-of-way, and having significant environmental impacts. The expected effectiveness of this CM must be assessed for each individual location as the B/C ratios will vary from low to high.

FHWA CMF Clearinghouse:	Crash Types Addressed:	All	CRF:	8 - 50 %

R14, Road Diet (Reduce travel lanes and add a two way left-turn and bike lanes)

For HSIP Cycle 11 Call-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 lane striping. "Intersection" crashes can only be applied when they resulted from turning movements that had no designated turn lanes/phases in the existing condition and the Road Diet will provide turn lanes/phases for these movements. This CM does not apply to roadway sections that already included left turn lanes or two way left turn lanes before the lane reductions. New bike lanes are also expected to be part of these projects. if any pavement is planned to be removed for the purpose of adding landscaping, planter-boxes, or other non-roadway user features, the cost should be non-participating.		

General information
Where to use:
Areas noted as having a higher frequency of head-on, left-turn, and rear-end crashes with traffic volumes that can be handled by only 2 free flowing lanes. Using this strategy in locations with traffic volumes that are too high could result in diversion of traffic to routes less safe than the original four-lane design. It may also result in congestion levels that contribute to other crashes.
Why it works:
The application of this strategy usually reduces the roadway segment speeds and serious head-on crashes. In many cases the extra pavement width can be used for the installation of bike lanes. In addition to increasing bicycle safety, these bike lanes can improve the safety of on-street parking.
General Qualities (Time, Cost and Effectiveness):
Implementation would require more time than in other low-cost treatments to complete environmental analyses, traffic studies and public input. Projects that only require new lane markings and minor signalization modifications will have relatively low cost and can be very effective and can be considered on a systematic approach. These striping and signal modification costs should be considered part of this CM and not an additional CM. (If additional signal hardware improvements are being made, over what is needed for the road diet, then the Improve Signal Hardware CM may also be used.) Often road diet projects need a seal-coat placed on the roadway to fully remove the old striping. These seal coats are considered part of the proper installation of this CM. In contrast, structural-overlays should not be considered part of this CM and are not considered eligible for funding in the California Local HSIP.

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

R15, Widen shoulder

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	30%	20 years
Notes:	This CM only applies to crashes occurring within the limits of the new paved shoulder. A minimum of 2 feet width must be added and the new/resulting shoulders must be a minimum of 4 feet wide. This CM is not eligible unless it is done as the last step of an "incremental approach", for which the agency documents that: 1) they have already pursued and installed lower cost and lower impact CMs (i.e. signing/striping upgrades to MUTCD standards/recommendations, rumble strips, etc.), 2) they have already monitored the crash occurrences after these improvements were installed, and 3) the 'after' crash rate is still unacceptably high. This 'incremental approach' (or a special exception from the HSIP program manager) must be documented in the Narrative Questions in the application and a summary of the 'before' and 'after' crash analysis must be attached to the application.		

General information				
Where to use:				
Roadways that have a frequent incidence of vehicles leaving the travel lane resulting in an unsuccessful attempt to reenter the roadway. The probability of a safe recovery is increased if an errant vehicle is provided with an increased paved area in which to initiate such a recovery.				
Why it works:				
Based on the best available research, adding shoulder or widening an existing shoulder provides a greater area to regain control of a vehicle, as well as lateral clearance to roadside objects such as guardrail, signs and poles. They may also provide space for disabled vehicles to stop or drive slowly, provide increased sight distance for through vehicles and for vehicles entering the roadway, and in some cases reduce passing conflicts between motor vehicles and bicyclists and pedestrians. The likely safety benefits for adding or widening an existing shoulder generally increase as the widening width increases - practitioners should refer to NCHRP Report 500 Series, the CMF Clearinghouse or other references for more details.				
General Qualities (Time, Cost and Effectiveness):				
Shoulder widening costs would depend on whether new right-of-way is required and whether extensive roadside modification is needed. Since shoulder widening can be a relatively expensive treatment, one of the keys to creating a cost effective project with at least a medium B/C ratio is targeting higher-hazard roadways.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Fixed Object, Run-off Road, Sideswipe	CRF:	15 - 75 %

R16, Curve Shoulder widening (Outside Only)

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	45%	20 years
Notes:	This CM only applies to crashes occurring within the limits (or influence area) of the new shoulder widening at curves. A minimum of 2-4 feet width must be added to the outside of horizontal curves and the new traversable shoulder must be a minimum of 4 feet wide.		

General information		
Where to use:		
Roadway curves noted as having frequent lane departure crashes due to inadequate or no shoulders, resulting in an unsuccessful attempt to reenter the roadway.		
Why it works:		
Adding shoulders (outside only) creates a recovery area in which a driver can regain control of a vehicle, as well as lateral clearance to roadside objects.		
General Qualities (Time, Cost and Effectiveness):		
To minimize the R/W needs and the cost, only outside shoulder at curves is to be widened. This CM can be implemented in a relatively short timeframe.		
FHWA CMF Clearinghouse:	NA	

R17, Improve horizontal alignment (flatten curves)

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	50%	20 years

Notes:	This CM only applies to crashes occurring within the limits (or influence area) of the improved alignment. **This CM is not eligible unless** it is done as the last step of an "incremental approach", including: the agency documents that: 1) they have already pursued and installed lower cost and lower impact CMs (i.e. signing/striping upgrades to MUTCD standards/recommendations, rumble strips, etc.), 2) they have already monitored the crash occurrences after these improvements were installed, and 3) the 'after' crash rate is still unacceptably high. This 'incremental approach' (or a special exception from the HSIP program manager) must be documented in the Narrative Questions in the application and a summary of the agency's 'before' and 'after' crash analysis must be attached to the application.

General information				
Where to use:				
Roadways with horizontal curves that have experienced lane departure crashes as a result of a roadway segment having compound curves or a severe radius. This strategy should generally be considered only when less expensive strategies involving clearing of specific sight obstructions or modifying traffic control devices have been tried and have failed to ameliorate the crash patterns.				
Why it works:				
Increasing the radius of a horizontal curve can be very effective in improving the safety performance of the curve. Curve modification reduces the likelihood of a vehicle leaving its lane, crossing the roadway centerline, or leaving the roadway at a horizontal curve; and minimizes the adverse consequences of leaving the roadway. Horizontal alignment improvement projects are expected to include standard/improved superelevation elements, which should be considered part of this CM and not an additional CM.				
General Qualities (Time, Cost and Effectiveness):				
This strategy is a long-term, higher-cost alternative for improving the safety of a horizontal curve because it usually involves total reconstruction of the roadway. It may also require acquisition of additional right-of-way and an environmental review. This strategy, albeit costly, has shown that increasing the radius of curvature can significantly reduce total curve-related crashes by up to 80 percent. The expected effectiveness of this CM must be assessed for each individual location.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	All	CRF:	24 - 90%

R18, Flatten crest vertical curve

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	25%	20 years
Notes:	This CM only applies to crashes occurring within the limits (or influence area) of the improved alignment. This CM is not eligible unless it is done as the last step of an "incremental approach", including: the agency documents that: 1) they have already pursued and installed lower cost and lower impact CMs (i.e. signing/striping upgrades to MUTCD standards/recommendations, rumble strips, etc.), 2) they have already monitored the crash occurrences after these improvements were installed, and 3) the 'after' crash rate is still unacceptably high. This 'incremental approach' (or a special exception from the HSIP program manager) must be documented in the Narrative Questions in the application and a summary of the agency's 'before' and 'after' crash analysis must be attached to the application.		

General information				
Where to use:				
The target for this strategy is usually unsignalized intersections with restricted sight distance due to vertical geometry and with patterns of crashes related to that lack of sight distance that cannot be ameliorated by less expensive methods. This strategy should generally be considered only when less expensive strategies involving clearing of specific sight obstructions or modifying traffic control devices have been tried and have failed to ameliorate the crash patterns.				
Why it works:				
Adequate sight distance for drivers at stopped approaches to intersections has long been recognized as among the most important factors contributing to overall intersection safety. Vertical alignment improvement projects are expected to include standard/improved superelevation elements, which should be considered part of this CM and not an additional CM.				
General Qualities (Time, Cost and Effectiveness):				
Projects involving changing the horizontal and/or vertical alignment to provide more sight distance are quite extensive and usually take several years to accomplish. If additional right-of-way is required or environmental impacts are expected, these projects will require a substantial period of time. Since this is usually an expensive treatment, one of the keys to creating a cost effective project with at least a medium B/C ratio is targeting higher-hazard locations.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	All	CRF:	20 - 51 %

R19, Improve curve superelevation

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	45%	20 years
Notes:	This CM only applies to crashes occurring within the limits (or influence area) of the improved superelevation. This CM does not apply to sections of roadways where the horizontal or vertical alignments are changing via another CM.		

General information				
Where to use:				
Roadways noted as having frequent lane departure crashes and inadequate or no superelevation. Safety can be enhanced when the superelevation is improved or restored along curves where the actual superelevation is less than the optimal.				
Why it works:				
Superelevation works with friction between the tires and pavement to counteract the forces on the vehicle associated with cornering. Many curves may have inadequate superelevation because of vehicles traveling at higher speeds than were originally designed for, because of loss of effective superelevation after resurfacing, or because of changes in design policy after the curve was originally constructed.				
General Qualities (Time, Cost and Effectiveness):				
This strategy can be a higher-cost alternative for improving the safety of a curve because it involves reconstruction to some degree. Other projects may be able to be constructed by simple overlays and minimal reconstruction of roadways features. When simple overlay fixes are pursued, a systematic installation approach may be appropriate. The expected effectiveness of this CM must be assessed for each individual location.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Run-off Road, All	CRF:	40 - 50 %

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

For HSIP Cycle 11 Call-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 Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	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 Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	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%

R23, Install chevron signs on horizontal curves

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	40%	10 years
Notes:	This CM only applies to crashes occurring within the influence area of the new signs. (i.e. only through the curve).		

General information				
Where to use:				
Roadways that have an unacceptable level of crashes on relatively sharp curves during periods of light and darkness. Ideally this type of safety CM would be combined with other sign evaluations and upgrades (install warning signs, delineators, markers, beacons, and relocation of existing signs per MUTCD standards.)				
Why it works:				
Post-mounted chevrons are intended to warn drivers of an approaching curve and provide tracking information and guidance to the drivers. While they are intended to act as a warning, it should also be remembered that the posts, placed along the roadside, represent a possible object with which an errant vehicle can crash into. Design of posts to minimize damage and injury is an important part of the considerations to be made when selecting these treatments.				
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:	Run-off Road, All	CRF:	6 - 64 %

R24, Install curve advance warning signs

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	25%	10 years
Notes:	This CM only applies to crashes occurring within the influence area of the new signs. (i.e. only through the curve)		

General information				
Where to use:				
Roadways that have an unacceptable level of crashes on relatively sharp curves during periods of light and darkness. This countermeasure may also include horizontal alignment and/or advisory speed warning signs. Ideally this type of safety CM would be combined with other sign evaluations and upgrades (install warning signs, chevrons, delineators, markers, beacons, and relocation of existing signs per MUTCD standards.)				
Why it works:				
This strategy primarily addresses problem curves, and serves as an advance warning of an unexpected or sharp curve. It provides advance information and gives drivers a visual warning that their added attention is needed.				
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:	Run-off Road, All	CRF:	20 - 30 %

R25, Install curve advance warning signs (flashing beacon)

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	30%	10 years
Notes:	This CM only applies to crashes occurring within the influence area of the new signs. (i.e. only through the curve)		

General information				
Where to use:				
Roadways that have an unacceptable level of crashes on relatively sharp curves. Flashing beacons in conjunction with warning signs should only be used on horizontal curves that have an established severe crash history to help maintain their effectiveness.				
Why it works:				
This strategy primarily addresses problem curves, and serves as an enhanced advance warning of an unexpected or sharp curve. It provides advance information and gives drivers a visual warning that their added attention is needed. Flashing beacons are an added indication that a curve may be particularly challenging.				
General Qualities (Time, Cost and Effectiveness):				
Use of flashing beacons requires minimal development process, allowing flashing beacons to be installed within a short time period. 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:	All	CRF:	30 %

R26, Install dynamic/variable speed warning signs

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	30%	10 years
Notes:	This CM only applies to crashes occurring within the influence area of the new signs. (i.e. through the curve) {**<u>This CM does not apply to dynamic regulatory speed warning signs.</u>** There are currently no nationally accepted CRFs for dynamic regulatory signs (also known as Radar Speed Feedback Signs). CRFs are being developed and Caltrans hopes to include these CMs and CRFs in future calls for projects.}		

General information				
Where to use:				
Curvilinear roadways that have an unacceptable level of crashes due to excessive speeds on relatively sharp curves.				
Why it works:				
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.				
General Qualities (Time, Cost and Effectiveness):				
Use of dynamic speed warning signs requires minimal development process, allowing them to be installed within a short time period. 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:	All	CRF:	0 - 41 %

R27, Install delineators, reflectors and/or object markers

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	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 Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	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 %

R29, Install no-passing line

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	45%	10 years
Notes:	This CM only applies to crashes occurring within the limits of the new or extended no-passing zones.		

General information
Where to use:
Roadways that have a high percentage of head-on crashes suggesting that many head-on crashes may relate to failed passing maneuvers. No-passing lines should be installed where drivers "passing sight distance" is not available due to horizontal or vertical obstructions. General restriping projects can be good opportunities to reevaluate and incorporate new no-passing zones limits. The incorporation 'No Passing Zone' pennants should also be considered when reevaluating the limits of no-passing zones. Installing no-passing limits in areas that are not warranted may reduce the overall safety of the corridor as drivers may become frustrated and attempt passing maneuvers at other locations without the necessary sight distance.
Why it works:
When the centerline markings do not differentiate between passing and no-passing areas, drivers may have difficulty determining where passing maneuvers can be completed safely. Providing clear and engineered passing and no-passing areas can encourage drivers to wait patiently for safe passing areas and avoid aggressively looking for passing opportunities.
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. 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 and long locations, resulting in low to moderate cost projects that are more appropriate to seek state or federal funding.

FHWA CMF Clearinghouse:	Crash Types Addressed:	Head-on, Side-swipe	CRF:	40 - 53%

R30, Install centerline rumble strips/stripes

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	20%	10 years
Notes:	This CM only applies to crashes occurring within the limits of the new rumble strips/stripes.		

General information
Where to use:
Center Line rumble strips/stripes can be used on virtually any roadway – especially those with a history of head-on crashes. It is recommended that rumble strips/stripes be applied systematically along an entire route instead of only at spot locations. For all rumble strips/stripes, pavement condition should be sufficient to accept milled rumble strips. Care should be taken when considering installing rumble strips in locations with residential land uses or in areas with high bicycle volumes.
Why it works:
Rumble strips provide an auditory indication and tactile rumble when driven on, alerting drivers that they are drifting out of their travel lane, giving them time to recover before they depart the roadway or cross the center line. Additionally, rumble stripes (pavement marking in the rumble itself) provide an enhanced marking, especially in wet dark conditions.
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 moderate cost projects that are more appropriate to seek state or federal funding.

FHWA CMF Clearinghouse:	Crash Types Addressed:	Head-on, Side-swipe, All	CRF:	15 - 68%

R31, Install edgeline rumble strips/stripes

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	15%	10 years
Notes:	This CM only applies to crashes occurring within the limits of the new rumble strips/stripes.		

General information				
Where to use:				
Shoulder and edge line milled rumble strips/stripes should be used on roads with a history of roadway departure crashes. It is recommended that rumble strips/stripes be applied systematically along an entire route instead of only at spot locations. For all rumble strips/stripes, pavement condition should be sufficient to accept milled rumble strips. Special requirements may apply and care should be taken when considering installing rumble strips in locations with residential land uses or in areas with high bicycle volumes.				
Why it works:				
Rumble strips provide an auditory indication and tactile rumble when driven on, alerting drivers that they are drifting out of their travel lane, giving them time to recover before they depart the roadway or cross the center line. Additionally, rumble stripes (pavement marking in the rumble itself) provide an enhanced marking, especially in wet dark conditions.				
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 moderate cost projects that are more appropriate to seek state or federal funding.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Run-off Road	CRF:	10 - 41%

R32PB, Install bike lanes

For HSIP Cycle 11 Call-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 within the limits of the Class II (not Class III) 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:				
Roadway segments noted as having crashes between bicycles and vehicles or crashes that may be preventable with a buffer/shoulder. Most studies suggest that bicycle lanes may provide protection against bicycle/motor vehicle collisions. Striped bike lanes can be incorporated into a roadway when is desirable to delineate which available road space is for exclusive or preferential use by bicyclists.				
Why it works:				
Most studies present evidence that bicycle lanes provide protection against bicycle/motor vehicle collisions. Bicycle lanes provide marked areas for bicyclist to travel along the roadway and provide for more predictable movements for both bicyclist and motorist. Evidence also shows that riding with the flow of vehicular traffic reduces bicyclists' chances of collision with a motor vehicle. Locations with bicycle lanes have lower rates of wrong-way riding. 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):				
Adding striped bicycle lanes can range from the simply restriping the roadway and minor signing to projects that require roadway widening, right-of-way, and environmental impacts. 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. For simple installation scenarios, This CM can be very effective and can be considered on a systematic approach.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Pedestrian, Bicycle	CRF:	0 - 53 %

R33PB, Install Separated Bike Lanes

For HSIP Cycle 11 Call-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 Cycle 11 Call-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 Cycle 11 Call-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%

R36PB, Install raised pedestrian crossing

For HSIP Cycle 11 Call-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 area with the new raised crossing. Note: This CM is not intended to be combined with the "Install pedestrian crossing (with enhanced safety features)" when calculating the improvement's B/C ratio.		

General information				
Where to use:				
On lower-speed roadways, where pedestrians are known to be crossing roadways that involve significant vehicular traffic. 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, raised crossings can be added to complement the standard crossing elements. Special requirements may apply and extra care should be taken when considering installing raised crossings to ensure unintended safety issues are not created, such as: emergency vehicle access or truck route issues.				
Why it works:				
Adding a raised pedestrian crossing has the opportunity to enhance pedestrian safety at locations noted as being especially problematic. The raised crossing encourages motorists to reduce their speed and provides improved delineation for the portion of the roadway that is designated for pedestrian crossing. 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.				
General Qualities (Time, Cost and Effectiveness):				
Costs associated with this strategy will vary widely, depending upon the elements of the raised crossing and the need for new curb ramps and sidewalk modifications. This CM may be effectively and efficiently implemented using a systematic approach with more than one location and can have medium to high B/C ratios based on past non-motorized crash history.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Pedestrian, Bicycle	CRF:	30 - 46%

R37PB, Install Rectangular Rapid Flashing Beacon (RRFB)

For HSIP Cycle 11 Call-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 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%

R38, Install Animal Fencing

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	Animal	80%	20 years
Notes:	This CM only applies to "animal" crashes occurring within the limits of the new fencing.		

General information				
Where to use:				
At locations with high percent of vehicular/animal crashes (reactive) or where there is a known high percent of animals crossing due to migratory patterns (proactive).				
Why it works:				
Animal fencing helps to channelize the identified animals to a natural or man-made crossing, eliminating the conflict between vehicles and animals on the same place. Animal fencing is typically installed at a bridge location with its "run of need" dependent on the surrounding terrain.				
General Qualities (Time, Cost and Effectiveness):				
Time to install fencing can be moderate to lengthy depending on the environmental commitments and agreed upon solution to mitigating project impacts. Costs will be fairly low and depend on the "run of need" length. There will be minimal reoccurring maintenance costs on keeping the fence intact. The expected effectiveness of this CM must be assessed for each individual location.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Animal	CRF:	70 - 90 %

Appendix C: Summary of "Recommended Actions"

The information contained here represent a brief summary of each section of this manual as well as the Summary of "Recommended Actions" from Sections 2 through 7. This is intended to be a quick-reference for local agency practitioners working on a "proactive safety analysis" of their roadway network.

Introduction and Purpose

As safety practitioners consider implementing a 'proactive safety analysis approach' they should consider the overall context of the safety issues facing California local agencies and Caltrans primary goals for preparing this Safety manual for California's local roadway owners. Figure 1 provides a flowchart of the process and Appendices E and F provide examples and lessons learned from recent statewide calls-for-projects.

Identifying Safety Issues

This section provides an overview of the types of data to collect for the identification of roadway safety issues. It discusses sources of crash data and how they can be used. As practitioners gather information they are encouraged to develop one or more separate spreadsheets and/or pin-maps to help track and manage this data. The following spreadsheet is offered as an example, but each agency's spreadsheet should include data and be formatted as necessary to meet their needs.

	General Information		Crash Information			Evaluation / Action		
Location & Date	Source/Type of information	Safety Issue/Problem	Nature of Crashes	Time of Day	Weather/Traffic Conditions	Staff Evaluation	Recommend Action	Resolution
1) Intersection "X"								
2) Roadway Segment (PM 5.3 to PM 7.8)								

State and Local Crash Databases

Recommended Action: Obtain at least 3 years of network-wide crash data to identify local roads that have a history of roadway crashes. This will be used to identify predominant roadway crash locations, crash types and other common characteristics.

Transportation Injury Mapping System (TIMS)

Recommended Action: Consider augmenting your local agency's data collection approach with information available using the suite of TIMS tools. The TIMS tools (and/or tools from private for-profit vendors) can help the safety practitioner access and manage their crash data.

Law Enforcement Crash Reports

Recommended Action: Develop a working relationship with law enforcement officials responsible for enforcement and crash investigations. This could foster a partnership where sharing crash reports and

safety information on problem roadway segments becomes an everyday occurrence. Practitioners with limited access to crash data are encouraged to use TIMS to assess the local crash report data.

Observational Information

Recommended Action: Gather information received from law enforcement and road maintenance crew observations. Develop a system for maintenance crews to report and record observed roadway safety issues and a mechanism to address them.

Public Notifications

Recommended Action: Review and summarize information received from these sources, identifying segments or corridors with multiple notifications and record the locations, dates, and nature of the problem that are cited.

Roadway Data and Devices

Recommended Action: Identify and track roadway characteristics for the intersections, roadway segments, and corridors, including compliance with the minimum standards. At a minimum, this should be done for locations being considered for safety improvements, but ideally agencies would establish an extensive database of roadway data to help them proactively identify high risk roadway features.

Exposure Data

Recommended Action: Consider the availability of exposure data and track it along with the other crash data to help prioritize potential locations for safety improvements.

Field Assessments and Road Safety Audits

Recommended Action: Consider completing formal or informal field assessments and RSAs at certain locations to help ensure all relevant information is collected and available for the safety practitioners to complete their safety analysis and identification of the most appropriate countermeasures. Develop simple straightforward criteria on when one of these will be undertaken.

Safety Data Analysis

This section summarizes the types of analyses that can be conducted to determine what roadway countermeasures should be implemented. This section is the link between the data (Section 2) and the selection of appropriate countermeasures (Section 4). It provides definitions and examples of the qualitative and quantitative factors that should be considered when evaluating roadway safety issues.

Quantitative Analysis

Recommended Action: Complete a quantitative analysis of their roadway data using both Crash Frequency and Crash Rate methodologies, including:

Crash Frequency

Top 10 (or 20) lists of intersections and roadway segments.

For lower volume roadways, network wide pin-maps may be more effective.

Develop collision diagrams showing the direction of movement of vehicles and pedestrians.

Crash Rate

Top 10 (or 20) lists of roadway segments in relationship to length, volumes, and/or density.

Top 10 (or 20) lists of intersections, sorted by crash rate.

Top 10 (or 20) lists of the highest volume intersections, sorted by crash frequency or rate.

Qualitative Analysis

Recommended Action: Consider completing field assessments and RSAs to identify roadway infrastructure characteristics relating to both locations with compliance issues and locations with high crash frequencies/rates. As part the field assessments, common roadway and crash characteristics should be identified for the potential systemic deployment of countermeasures.

Caltrans recommends all agencies complete both quantitative and qualitative analyses before starting their applications for HSIP program funding. The findings from these analyses should be documented in spreadsheets and/or pin-maps similar to the ones discussed in Section 2.

Countermeasures

This Section provides a description of selected countermeasures that have been shown in this manual. It includes a basic set of strategies to implement at locations experiencing a history of crashes and their corresponding crash modification factors (CMF). NOTE: Crash Reduction Factors (CRFs) are directly connected to the CMFs and are another indication of the effectiveness of a particular treatment. The CRF for a countermeasure is defined mathematically as 1 – CMF. The terms CMFs and CRFs are used interchangeably throughout this document.

Selecting Countermeasures and Crash Modification Factors / Crash Reduction Factors

Countermeasure Details and Characteristics

Recommended Action: Agencies should use all information and results obtained through completing the actions in Sections 2, 3 and 4 to select the appropriate countermeasures for their HCCLs and systemic improvements. As novice safety practitioners select countermeasures, they must realize that a reasonable level of traffic 'engineering judgment' is required and that this manual and should not be used as a simple cheat-sheet for preparing and submitting applications for funding.

Calculating the B/C ratio and Comparing Projects

This section defines a methodology for calculating a benefit to cost (B/C) ratio for a potential safety project. It includes sources for estimating projected costs and benefits and the specific values/formulas Caltrans uses for its statewide evaluations of HSIP projects. This section also discusses the potential value in reevaluating projects' overall cost effectiveness.

Estimating the Benefit of Implementing Proposed Improvements

Recommended Action: Prepare 'Total Benefit' estimates for the proposed projects being evaluated in the proactive safety analysis.

Estimating the Cost of Implementing Proposed Improvements

Recommended Action: Prepare 'Total Project Cost' estimates for the proposed projects being evaluated in the proactive safety analysis.

Calculating the B/C Ratio

Recommended Action: Calculate the B/C ratio for each of the proposed projects being evaluated in the proactive safety analysis.

Compare B/C Ratios and Consider the Need to Reevaluate Project Elements

Recommended Action: Compare, reevaluate, and prioritize the potential safety projects. Consider changing the project limits or utilizing lower cost countermeasures for projects with low initial B/C ratios.

Identifying Funding and Construct Improvements

This section identifies existing and new funding opportunities for safety projects that local agencies should be considering. This section also briefly discusses some unique project development issues and strategies for safety projects as they proceed through design and construction.

Existing Funding for Low-cost Countermeasures

Recommended Action: Survey planned maintenance, developer and capital projects to determine whether they overlap any of the proposed safety projects. Where projects overlap, leverage the existing funding sources to include safety countermeasures.

Other Funding Sources

Recommended Action: Consider all potential funding opportunities to incorporate the identified safety countermeasures including the HSIP and ATP Programs.

Project Development and Construction Considerations

Recommended Action: Safety practitioners should follow their safety projects all the way through the project delivery and construction process. In addition, they should establish a safety program delivery plan that brings awareness and support to the expedited delivery of safety projects. Where possible, safety practitioners should involve the media and even consider having their own program intended to "toot their own safety-horn."

Evaluation Improvements

This section presents the process to complete an evaluation of installed treatments. After the countermeasures are installed, assessing their effectiveness will provide valuable information and can help determine which countermeasures should continue to be installed on other roadways to make them safer as well.

Recommended Action: Develop a spreadsheet to track future safety project installations and record 3+ years of "before" and "after" crash information at those locations. Once safety countermeasures are constructed, schedule and track assessment dates to ensure they happen.

Appendix D: Benefit Cost Ratio (BCR) 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 Benefit Cost Ratio (BCR) 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	$1,787,000
3		Non Signalized Intersection	$2,843,000
3		Roadway	$2,461,000
2	Evident Injury – Other Visible (B)		$159,900
1	Possible Injury–Complaint of Pain (C)		$90,900
0	Property Damage Only (O)		$14,900

* 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 $8,112,200, and a crash cost of a Severe/Disabling Injury (A) of $437,100. These costs are used in the HSIP Analyzer.

*** Based on Table 7-1, Highway Safety Manual (HSM), First Edition, 2010. Adjusted to 2022 Dollars.

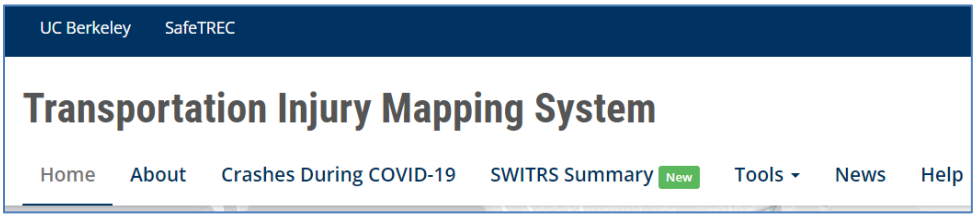
2) *Benefit (Life) = Benefit (annual) x Years of service life*

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

4) BCR (project): $BCR\ (Project) = \frac{\sum_{CM=1}^{n} Benefit\ (Life)_{(CM)}}{Total\ \ Project\ Cost}$

Appendix E: Examples of Crash Data Collection and Analysis Techniques using TIMS

As demonstrated throughout the manual, SafeTREC's TIMS website http://tims.berkeley.edu/ can be used to assist local agencies in completing a proactive safety analysis of their roadway network. *(Note: This manual focuses on TIMS as a tool to access and map SWITRS data because TIMS is free to local agencies and the general public. Local agencies are encouraged to try TIMS, but they should not feel obligated to make a switch if they prefer using their vendor-supplied crash analysis software to complete their data collection and analysis process).*



SWITRS Query & Map:

The SWITRS Query & Map application is a tool for accessing and mapping fatal and injury collision data from the California Statewide Integrated Traffic Records System (SWITRS).

SWITRS GIS Map:

The SWITRS GIS Map offers an interactive map-centric approach to viewing and querying SWITRS collision data, with the capability of multiple tasks including Rank by Intersection, Collision Diagram, etc.

Collision Diagram Tool:

The Collision Diagram tool allows users to generate an interactive collision diagram. The Collision Diagram is accessible through SWITRS GIS Map after a set of collisions is selected.

ATP Maps & Summary Data:

The ATP Maps & Summary Data tool utilizes interactive collision maps to find pedestrian and bicycle collisions hot spot and generate data summaries within specified project and/or community limits. Though it is designed to support the California Active Transportation Program (ATP), this tool may be useful in developing an HSIP project targeting pedestrian and bicycle safety issues.

Appendix F: List of Abbreviations

AASHTO	American Association of State Highway and Transportation Officials
ATP	Active Transportation Program
B/C; BCR	Benefit Cost Ratio
Caltrans	California Department of Transportation (Division of Local Assistance)
CA-MUTCD	California - Manual on Uniform Traffic Control Devices
CM	Countermeasure
CMF	Crash Modification Factor
CRF	Crash Reduction Factor
"5 E's of Safety"	Education, Enforcement, Engineering, Emergency Response and Emerging Technologies
EMS	Emergency Medical Services
FHWA	Federal Highway Administration
HCCL	High Crash Concentration Location
HR3	High Risk Rural Roads Program
HSIP	Highway Safety Improvement Program
HSM	Highway Safety Manual
RSA	Roadway Safety Audit
SafeTREC	Safe Transportation Research and Education Center (SafeTREC) at the University of California, Berkeley
SHSP	Strategic Highway Safety Plan
SWITRS	Statewide Integrated Traffic Records System
TIMS	Transportation Injury Mapping System (a product of SafeTREC)

Appendix G: References

1. FHWA, Office of Safety website: Local and Rural Road Safety Program
   - https://safety.fhwa.dot.gov/local_rural/

2. Highway Safety Manual (HSM). Product of the American Association of State Highway and Transportation Officials.
   - http://www.highwaysafetymanual.org/Pages/default.aspx

3. National Highway Traffic Safety Administration (NHTSA): National Center for Statistics and Analysis (NCSA) Motor Vehicle Traffic Crash Data Resource
   - https://crashstats.nhtsa.dot.gov/

4. California - Manual on Uniform Traffic Control Devices (CA-MUTCD)
   - https://dot.ca.gov/programs/safety-programs/camutcd

5. Caltrans' website on the Highway Design Manual
   - https://dot.ca.gov/programs/design/manual-highway-design-manual-hdm

6. FHWA, Research and Development website for Bikesafe and Pedsafe
   - https://safety.fhwa.dot.gov/ped_bike/tools_solve/

7. AASHTO - A Policy on Geometric Design of Highways and Streets ("Green Book")

   AASHTO - the Roadside Design Guide
   - https://store.transportation.org/

8. FHWA – Public Roads Magazine:
   - https://highways.dot.gov/public-roads/home

Appendix F:

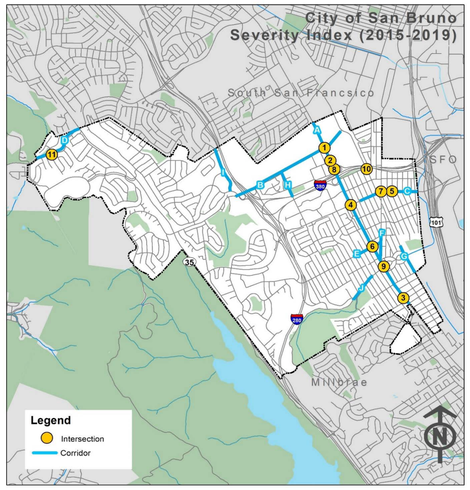
Countermeasure Toolbox

High-risk Intersections

ID	Intersection	Control	Responsible Jurisdiction	Consolidated CMs (HSIP-Eligible - Refer to LRSM* 2020)						Additional CM (non-HSIP)**	EA - 1 Improve Intersection Safety			EA - 2 Reduce Unsafe Speed			EA - 3 Improve Pedestrian and Bicyclist Safety			EA - 4 Reduce Nighttime Collisions			EA - 5 Reduce Rear End Collisions			EA - 6 Reduce Broadside Collisions			EA - 7 Reduce Improper Driving			EA - 8 Reduce Collisions near Schools		
				CM1	CM2	CM3	CM4	CM5	CM6		CM1	CM2	CM3	CM1	CM2	CM3	CM1	CM2	CM3	CM1	CM2	CM3	CM1	CM2	CM3	CM1	CM2	CM3	CM1	CM2	CM3	CM1	CM2	CM3	CM1	CM2	CM3
1	El Camino Real and Sneath Ln	Signalized	Caltrans	S02	S03	S09	S11	S20PB	S21PB		S02	S03	S09	S02	S03	S09	S20PB	S21PB		S02	S09		S03	S09	S11	S02	S03	S09	S09	S11						
2	El Camino Real and Commodore Dr	Signalized	Caltrans	S02	S03	S09	S11	S20PB	S21PB		S02	S03	S09	S02	S03	S09	S20PB	S21PB		S02	S09		S03	S09	S11	S02	S03	S09	S09	S11						
3	El Camino Real and Santa Lucia Ave	Stop Controlled	Caltrans	NS03	NS06	NS07	NS12				NS06	NS03	NS15	NS06	NS07		NS07			NS01	NS06	NS07	NS06	NS07	NS12	NS03	NS06	NS07	NS06	NS07	NS12				
4	El Camino Real and San Bruno Ave	Signalized	Caltrans	S02	S03	S09	S11	S20PB	S21PB		S02	S03	S09	S02	S03	S09	S20PB	S21PB		S02	S09		S03	S09	S11	S02	S03	S09	S09	S11						
5	San Bruno Ave and 3rd Ave	Signalized	City of San Bruno	S03	S08	S09	S11	S20PB	S21PB	Improve Pavement Condition	S03	S09	S08	S03	S09		S20PB	S21PB		S01	S09		S03	S08	S11	S08	S03	S09	S09	S11						
6	El Camino Real and Jenevein Ave	Signalized	Caltrans	S02	S03	S09	S20PB	S21PB			S02	S03	S09	S02	S03	S09	S20PB	S21PB		S02	S09		S03	S09	S11	S02	S03	S09	S09	S11						
7	San Bruno Ave and San Mateo Ave	Signalized	City of San Bruno	S02	S03	S09	S11	S20PB	S21PB		S02	S03	S09	S02	S03	S09	S20PB	S21PB		S02	S09		S03	S09	S11	S02	S03	S09	S09	S11						
9	El Camino Real and 380 WB on/off ramps	Signalized	Caltrans	S02	S03	S09	S11	S20PB		Improve Pavement Condition	S02	S03	S09	S02	S03	S09	S20PB	S21PB		S02	S09		S03	S09	S11	S02	S03	S09	S09	S11						
10	El Camino Real and Crystal Springs Ave	Signalized	Caltrans	S02	S03	S09	S11	S20PB	S21PB		S02	S03	S09	S02	S03	S09	S20PB	S21PB		S02	S09		S03	S09	S11	S02	S03	S09	S09	S11						
11	Huntington Ave and Herman St	Stop Controlled	City of San Bruno	NS03	NS06	NS07	NS12	NS01			NS06	NS03	NS15	NS06	NS07		NS07			NS01	NS06	NS07	NS06	NS07	NS12	NS03	NS06	NS07	NS06	NS07	NS12				
12	Sharp Park Rd and Pacific Heights Blvd	Signalized	City of San Bruno	S03	S08	S09	S11	S20PB	S21PB	Improve Pavement Condition	S03	S09	S08	S03	S09		S20PB	S21PB		S01	S09		S03	S08	S11	S08	S03	S09	S09	S11						
8	*Sneath Ln and Cemetary Access Rd*	Stop Controlled	City of San Bruno	NS03	NS06	NS12					NS06	NS03											NS06	NS12					NS06	NS12						
13	*San Bruno Ave and 6th*	Stop Controlled	City of San Bruno	NS06	NS07	NS08	NS12			Improve Pavement Condition	NS06	NS07								NS08			NS06	NS12		NS03	NS06	NS07	NS06	NS12						
14	*El Camnio and Taylor Ave/San Mateo Ave*	Signalized	Caltrans	S02	S03	S09	S11	S21PB			S02	S03	S09	S02	S03	S09	S21PB						S03	S09	S11	S02	S03	S09	S09	S11						
15	*San Bruno Ave and Cherry*	Signalized	City of San Bruno	S03	S08	S09	S11	S21PB			S03	S09	S08	S03	S09		S21PB			S01	S09		S03	S08	S11	S08	S03	S09	S09	S11						
16	*San Bruno Ave and 7th*	Stop Controlled	City of San Bruno	NS06	NS07	NS12				Improve Pavement Condition	NS06	NS07	NS12										NS06	NS12		NS06	NS07									
17	*3rd St and Pine St*	Stop Controlled	City of San Bruno	NS21PB							NS21PB						NS21PB																			
18	*San Bruno Ave and Green Ave*	Stop Controlled	City of San Bruno	NS22PB	NS06	NS07	NS12	NS19PB			NS06	NS07	NS12				NS22PB	NS19PB					NS06	NS12		NS06	NS07		NS06	NS12						
19	*San Bruno Ave and Hensley Ave*	Stop Controlled	City of San Bruno	NS22PB	NS06	NS07	NS19PB				NS06	NS07					NS22PB	NS19PB								NS06	NS07									

Code	Countermeasure Name
HSIP/Non-HSIP Code	
S01	Add intersection lighting
S02	Improve signal hardware: lenses, back-plates with retroreflective borders, mounting, size, and number
S03	Improve signal timing (coordination, phases, red, yellow, or operation)
S05	Install emergency vehicle pre-emption systems
S06	Install left-turn lane and add turn phase (signal has no left-turn lane or phase before)
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)
S10	Install flashing beacons as advance warning (S.I.)
S11	Improve pavement friction (High Friction Surface Treatments)
S12	Install raised median on approaches (S.I.)
S13PB	Install pedestrian median fencing on approaches
S14	Create directional median openings to allow (and restrict) left-turns and U-turns (S.I.)
S15	Reduced Left-Turn Conflict Intersections (S.I.)
S16	Convert intersection to roundabout (from signal)
S17PB	Install pedestrian countdown signal heads
S18PB	Install pedestrian crossing (S.I.)
S19PB	Pedestrian Scramble
S20PB	Install advance stop bar before crosswalk (Bicycle Box)
S21PB	Modify signal phasing to implement a Leading Pedestrian Interval (LPI)

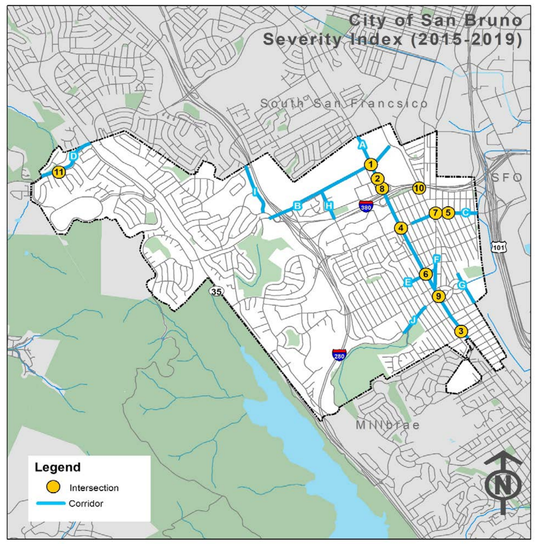
Code	Countermeasure Name
NS01	Add intersection lighting (NS.I.)
NS02	Convert to all-way STOP control (from 2-way or Yield control)
NS03	Install Signals
NS04	Convert intersection to roundabout (from all way stop)
NS05	Convert intersection to roundabout (from 2-way stop or Yield control)
NS05mr	Convert intersection to mini-roundabout
NS06	Install/upgrade larger or additional stop signs or other intersection warning/regulatory signs
NS07	Upgrade intersection pavement markings (NS.I.)
NS08	Install Flashing Beacons at Stop-Controlled Intersections
NS09	Install flashing beacons as advance warning (NS.I.)
NS10	Install transverse rumble strips on approaches
NS11	Improve sight distance to intersection (Clear Sight Triangles)
NS12	Improve pavement friction (High Friction Surface Treatments)
NS13	Install splitter-islands on the minor road approaches
NS14	Install raised median on approaches (NS.I.)
NS15	Create directional median openings to allow (and restrict) left-turns and u-turns (NS.I.)
NS16	Reduced Left-Turn Conflict Intersections (NS.I.)
NS17	Install right-turn lane (NS.I.)
NS18	Install left-turn lane (where no left-turn lane exists)
NS19PB	Install raised medians (refuge islands)
NS20PB	Install pedestrian crossing at uncontrolled locations (signs and markings only)
NS21PB	Install/upgrade pedestrian crossing at uncontrolled locations (with enhanced safety features)
NS22PB	Install Rectangular Rapid Flashing Beacon (RRFB)
NS23PB	Install Pedestrian Signal (including Pedestrian Hybrid Beacon (HAWK))



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 Reduce Unsafe Speed			EA - 3 Improve Pedestrian and Bicyclist Safety			EA - 4 Reduce Nighttime Collisions			EA - 5 Reduce Rear End Collisions			EA - 6 Reduce Broadside Collisions			EA - 7 Reduce Improper Driving			EA - 8 Reduce Collisions near Schools		
		CM1	CM2	CM3	CM4	CM5	CM6		CM1	CM2	CM3	CM1	CM2	CM3	CM1	CM2	CM3	CM1	CM2	CM3	CM1	CM2	CM3	CM1	CM2	CM3	CM1	CM2	CM3	CM1	CM2	CM3
A	El Camino Real: Noor Ave to San Lucia Ave	R22	R27	R21	R33PB	R35PB						R22	R27		R33PB	R35PB		R22	R27		R21	R22	R27				R22	R27	R30	R22	R35PB	R37PB
B	Sneath Ln: Rollingwood Dr to Hunignton Ave	R22	R27	R21	R33PB	R35PB	R10PB					R22	R27		R33PB	R35PB	R10PB	R22	R27		R21	R22	R27				R22	R27	R30	R22	R35PB	R37PB
C	San Bruno Ave: Green Ave to 7th Ave	R22	R27	R14		R35PB	R30	Improve Pavement				R22	R27	R14	R33PB	R35PB	R10PB	R22	R27		R21	R22	R27				R22	R27	R30			
D	Sharp Park Rd: College Rd to Skyline Blvd	R22	R27	R02	R33PB	R21	R23					R22	R27	R26	R33PB	R35PB		R22	R27	R23	R21	R22	R27				R22	R27	R23			
E	Jenevein Ave: Acacia Ave to San Mateo Ave	R22	R27	R33PB	R37PB	R30						R22	R27		R33PB	R35PB	R10PB	R22	R27		R21	R22	R27				R22	R27	R30	R22	R35PB	R37PB
F	San Mateo Ave: El Camino Real to Angus Ave	R22	R27		R37PB							R22	R27		R33PB	R35PB	R37PB	R22	R27		R21	R22	R27				R22	R27	R30	R22	R35PB	R37PB
G	Huntington Ave: Florida Ave to San Felipe Ave	R22	R27	R30	R35PB							R22	R27		R33PB	R35PB		R22	R27		R21	R22	R27				R22	R27	R30	R22	R35PB	R37PB
H	Cherry Ave: San Bruno Ave to Park Ave	R22	R27		R35PB			Add Lane markings				R22	R27		R33PB	R35PB		R22	R27		R21	R22	R27				R22	R27		R22	R35PB	R37PB
I	Crestwood Dr: Valleywood Dr to Rollingwood Dr	R22	R27	R28	R35PB	R21	R23					R22	R27	R26	R33PB	R35PB	R37PB	R22	R27	R23	R21	R22	R27				R22	R27	R30			
J	Crystal Springs Rd: Oak Ave to Poplar Ave	R22	R27	R28	R35PB	R37PB						R22	R27		R33PB	R35PB	R37PB	R22	R27		R21	R22	R27				R22	R27	R30	R22	R35PB	R37PB

Code	Countermeasure Name
R01	Add Segment Lighting
R02	Remove or relocate fixed objects outside of Clear Recovery Zone
R03	Install Median Barrier
R04	Install Guardrail
R05	Install impact attenuators
R06	Flatten side slopes
R07	Flatten side slopes and remove guardrail
R08	Install raised median
R09	Install median (flush)
R10PB	Install pedestrian median fencing
R11	Install acceleration/ deceleration lanes
R12	Widen lane (initially less than 10 ft)
R13	Add two-way left-turn lane (without reducing travel lanes)
R14	Road Diet (Reduce travel lanes from 4 to 3 and add a two way left-turn and bike lanes)
R15	Widen shoulder
R16	Curve Shoulder widening (Outside Only)
R17	Improve horizontal alignment (flatten curves)
R18	Flatten crest vertical curve
R19	Improve curve superelevation
R20	Convert from two-way to one-way traffic
R21	Improve pavement friction (High Friction Surface Treatments)
R22	Install/Upgrade signs with new fluorescent sheeting (regulatory or warning)
R23	Install chevron signs on horizontal curves
R24	Install curve advance warning signs
R25	Install curve advance warning signs (flashing beacon)
R26	Install dynamic/variable speed warning signs
R27	Install delineators, reflectors and/or object markers
R28	Install edge-lines and centerlines
R29	Install no-passing line
R30	Install centerline rumble strips/stripes
R31	Install edgeline rumble strips/stripes
R32PB	Install bike lanes
R33PB	Install Separated Bike Lanes
R34PB	Install sidewalk/pathway (to avoid walking along roadway)
R35PB	Install/upgrade pedestrian crossing (with enhanced safety features)
R36PB	Install raised pedestrian crossing
R37PB	Install Rectangular Rapid Flashing Beacon (RRFB)
R38	Install Animal Fencing



City of San Bruno LRSP

CM Toolbox for Intersections

Signalized						
Sr. No.	**Code**	**Countermeasure Name**	**CM Description**	**CRF**	**Federal Funding**	**Systemic Approach Opportunity**
HSIP/Non-HSIP Code						
1	S01	Add intersection lighting	Provision of lighting at intersection.	40%	90%	Medium
2	S02	Improve signal hardware: lenses, back-plates with retroreflective borders, mounting, size, an	Includes New LED lighting, signal back plates, retro-reflective tape outlining the back plates, or visors to increase signal visibility, larger signal heads, relocation of the signal heads, or additional signal heads.	15%	90%	Very High
3	S03	Improve signal timing (coordination, phases, red, yellow, or operation)	Includes adding phases, lengthening clearance intervals, eliminating or restricting higher-risk movements, and coordinating signals at multiple locations.	15%	50%	Very High
5	S05	Install emergency vehicle pre-emption systems	Corridors that have a history of crashes involving emergency response vehicles. The target of this strategy is signalized intersections where normal traffic operations impede emergency vehicles and where traffic conditions create a potential for conflicts between emergency and nonemergency vehicles. These conflicts could lead to almost any type of crash, due to the potential for erratic maneuvers of vehicles moving out of the paths of emergency vehicles	70%	90%	High
6	S06	Install left-turn lane and add turn phase (signal has no left-turn lane or phase before)	Intersections that do not currently have a left turn lane or a related left-turn phase that are experiencing a large number of crashes. Many intersection safety problems can be traced to difficulties in accommodating left-turning vehicles, in particular where there is currently no accommodation for left turning traffic. A key strategy for minimizing collisions related to left-turning vehicles (angle, rear-end, sideswipe) is to provide exclusive left-turn lanes and the appropriate signal phasing, particularly on high-volume and high-speed major-road approaches.	55%	90%	Low
7	S07	Provide protected left turn phase (left turn lane already exists)	Left turns are widely recognized as the highest-risk movements at signalized intersections. Providing Protected left-turn phases for signalized intersections with existing left turn pockets significantly improve the safety for left-turn maneuvers by removing the need for the drivers to navigate through gaps in oncoming/opposing through vehicles	30%	90%	High
8	S08	Convert signal to mast arm (from pedestal-mounted)	Providing better visibility of intersection signs and signals aids the drivers' advance perception of the upcoming intersection. Visibility and clarity of the signal should be improved without creating additional confusion or distraction for drivers.	30%	90%	Medium
9	S09	Install raised pavement markers and striping (Through Intersection)	Adding clear pavement markings can guide motorists through complex intersections. When drivers approach and traverse through complex intersections, drivers may be required to perform unusual or unexpected maneuvers	10%	90%	Very High
10	S10	Install flashing beacons as advance warning (S.I.)	Increased driver awareness of an approaching signalized intersection and an increase in the driver's time to react.	30%	90%	Medium
11	S11	Improve pavement friction (High Friction Surface Treatments)	Improving the skid resistance at locations with high frequencies of wet road crashes and/or failure to stop crashes	55%	90%	Medium
12	S12	Install raised median on approaches (S.I.)	Raised medians next to left turn lanes at intersections offer a cost effective means for reducing crashes and improving operations at higher volume intersections	25%	90%	Medium
13	S13PB	Install pedestrian median fencing on approaches	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.	30%	90%	Low
14	S14	Create directional median openings to allow (and restrict) left-turns and U-turns (S.I.)	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	50%	90%	Medium
15	S15	Reduced Left-Turn Conflict Intersections (S.I.)	Reduced left-turn conflict intersections are geometric designs that alter how left-turn movements occur in order to simplify decisions and minimize the potential for related crashes. Two highly effective designs that rely on U-turns to complete certain left-turn movements are known as the restricted crossing U-turn (RCUT) and the median U-turn (MUT).	50%	90%	Medium
16	S16	Convert intersection to roundabout (from signal)	Signalized intersections that have a significant crash problem and the only alternative is to change the nature of the intersection itself. Roundabouts can also be very effective at intersections with complex geometry and intersections with frequent left-turn movements.	Varies	90%	Low
17	S17PB	Install pedestrian countdown signal heads	Signals that have signalized pedestrian crossing with walk/don't walk indicators and where there have been pedestrian vs. vehicle crashes.	25%	90%	Very High
18	S18PB	Install pedestrian crossing (S.I.)	Signalized Intersections with no marked crossing and pedestrian signal heads, where pedestrians are known to be crossing intersections that involve significant turning movements. They are especially important at intersections with (1) multiphase traffic signals, such as left-turn arrows and split phases, (2) school crossings, and (3) double-right or double-left turns. At signalized intersections, pedestrian crossings are often safer when the left turns have protected phases that do not overlap the pedestrian walk phase.	25%	90%	High
19	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. Pedestrian Scramble may be considered at signalized intersections with very high pedestrian/bicycle volumes, e.g. in an urban business district.	40%	90%	High
20	S20PB	Install advance stop bar before crosswalk (Bicycle Box)	Signalized Intersections with a marked crossing, where significant bicycle and/or pedestrians volumes are known to occur.	15%	90%	Very High

21	S21PB	Modify signal phasing to implement a Leading Pedestrian Interval (LPI)	Addition of LPI gives pedestrians the opportunity to enter an intersection 3-7 seconds before vehicles are given a green indication; only minor signal timing alteration is required.	60%	90%	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 intersection.	40%	90%	Medium
2	NS02	Convert to all-way STOP control (from 2-way or Yield control)	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.	50%	90%	High
3	NS03	Install Signals	Installation of traffic signals	25%	90%	Low
4	NS04	Convert intersection to roundabout (from all way stop)	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.	Varies	90%	Low
5	NS05	Convert intersection to roundabout (from 2-way stop or Yield control)	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.	Varies	90%	Low
6	NS05mr	Convert intersection to mini-roundabout	Mini-roundabouts are characterized by a small diameter (45-90 ft) and traversable islands (central island and splitter islands).	30%	90%	High
7	NS06	Install/upgrade larger or additional stop signs or other intersection warning/regulatory signs	Additional regulatory and warning signs at or prior to intersections will help enhance the ability of approaching drivers to percieve them	15%	90%	Very High
8	NS07	Upgrade intersection pavement markings (NS.I.)	Typical improvements include "Stop Ahead" markings and the addition of centerlines and stop bars	25%	90%	Very High
9	NS08	Install Flashing Beacons at Stop-Controlled Intersections	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.	15%	90%	High
10	NS09	Install flashing beacons as advance warning (NS.I.)	Installation of advance flashing beacoms to call drivers attention to intersection control signs	30%	90%	High
11	NS10	Install transverse rumble strips on approaches	Transverse rumble strips are installed in the travel lane for the purposes of providing an auditory and tactile sensation for each motorist approaching the intersection.	20%	90%	High
12	NS11	Improve sight distance to intersection (Clear Sight Triangles)	Unsignalized intersections with restricted sight distance and patterns of crashes related to lack of sight distance where sight distance can be improved by clearing roadside obstructions without major reconstruction of the roadway.	20%	90%	High
13	NS12	Improve pavement friction (High Friction Surface Treatments)	Non-signalized Intersections noted as having crashes on wet pavements or under dry conditions when the pavement friction available is significantly less than needed for the actual roadway approach speeds. This treatment is intended to target locations where skidding and failure to stop is determined to be a problem in wet or dry conditions and the target vehicle is unable to stop due to insufficient skid resistance.	55%	90%	Medium
14	NS13	Install splitter-islands on the minor road approaches	The installation of a splitter island allows for the addition of a stop sign in the median to make the intersection more conspicuous.	40%	90%	Medium
15	NS14	Install raised median on approaches (NS.I.)	Effective access management is key to improving safety at, and adjacent to, intersections. The number of intersection access points coupled with the speed differential between vehicles traveling along the roadway often contributes to crashes. Any access points within 250 feet upstream and downstream of an intersection are generally undesirable.	25%	90%	Medium
16	NS15	Create directional median openings to allow (and restrict) left-turns and u-turns (NS.I.)	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.	50%	90%	Medium
17	NS16	Reduced Left-Turn Conflict Intersections (NS.I.)	Reduced left-turn conflict intersections are geometric designs that alter how left-turn movements occur in order to simplify decisions and minimize the potential for related crashes.	50%	90%	Medium
18	NS17	Install right-turn lane (NS.I.)	Many collisions at unsignalized intersections are related to right-turn maneuvers. A key strategy for minimizing such collisions is to provide exclusive right-turn lanes, particularly on high-volume and high-speed major-road approaches. When considering new right-turn lanes, potential impacts to non-motorized users should be considered and mitigated as appropriate.	20%	90%	Low
19	NS18	Install left-turn lane (where no left-turn lane exists)	Many collisions at unsignalized intersections are related to left-turn maneuvers. A key strategy for minimizing such collisions is to provide exclusive left-turn lanes, particularly on high-volume and high-speed major-road approaches. When considering new left-turn lanes, potential impacts to non-motorized users should be considered and mitigated as appropriate.	35%	90%	Low
20	NS19PB	Install raised medians (refuge islands)	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.	45%	90%	Medium
21	NS20PB	Install pedestrian crossing at uncontrolled locations (signs and markings only)	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.	25%	90%	High

22	NS21PB	Install/upgrade pedestrian crossing at uncontrolled locations (with enhanced safety features)	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.flashing beacons, curb extensions, advanced "stop" or "yield" markings, and other safety features should be added to complement the standard crossing elements.	35%	90%	Medium
23	NS22PB	Install Rectangular Rapid Flashing Beacon (RRFB)	Rectangular Rapid Flashing Beacon (RRFB) includes pedestrian-activated flashing lights and additional signage that enhance the visibility of marked crosswalks and alert motorists to pedestrian crossings. 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.	35%	90%	Medium
24	NS23PB	Install Pedestrian Signal (including Pedestrian Hybrid Beacon (HAWK))	Intersections noted as having a history of pedestrian vs. vehicle crashes and in areas where the likelihood of the pedestrian presence is high. Corridors should also be assessed to determine if there are adequate safe opportunities for non-motorists to cross and if a pedestrian signal, or a Pedestrian Hybrid Beacon (PHB) (also called High-Intensity Activated crossWalK beacon (HAWK)) are needed to provide an active warning to motorists when a pedestrian is in the crosswalk.	55%	90%	Low

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%	90%	Medium
2	R02	Remove or relocate fixed objects outside of Clear Recovery Zone	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.	35%	90%	High
3	R03	Install Median Barrier	Areas where crash history indicates drivers are unintentionally crossing the median and the cross-overs are resulting in high severity crashes. The installation of median barriers can increase the number of PDO and non-severe injuries. The net result in safety from this countermeasure is connected more to reducing the severity of crashes not the number of crashes.	25%	90%	Medium
4	R04	Install Guardrail	Guardrail is installed to reduce the severity of lane departure crashes. However, guardrail can reduce crash severity only for those conditions where striking the guardrail is less severe than going down an embankment or striking a fixed object. Guardrail should only be installed where it is clear that crash severity will be reduced, or there is a history of run-off-the-road crashes at a given location that have resulted in severe crashes.	25%	90%	High
5	R05	Install impact attenuators	Impact attenuators are typically used to shield rigid roadside objects such as concrete barrier ends, steel guardrail ends and bridge pillars from oncoming automobiles. Attenuators should only be installed where it is impractical for the objects to be removed.	25%	90%	High
6	R06	Flatten side slopes	Roadways experiencing frequent lane departure crashes that result in roll-over type crashes as a result of the roadway slope being so severe as to not accommodate a reasonable degree of driver correction. When there is a need to reduce the severity of lane departure crashes without installing a barrier system that could result in increased numbers of crashes.	30%	90%	Medium
7	R07	Flatten side slopes and remove guardrail	Locations where high number of crashes originate as a lane departure and result in collision with guardrail or a fixed object located on the side slope shielded by guardrail. The guardrail may or may not meet current standards. Even though guardrails are generally installed to reduce the severity of departure crashes, they still can result in severe crashes in some locations.	40%	90%	Medium
8	R08	Install raised median	Areas experiencing head-on collisions that may be affected by both the number of vehicles that cross the centerline and by the speed of oncoming vehicles. Installing a raised median is a more restrictive approach in that it represents a more rigid barrier between opposing traffic.	25%	90%	Medium
9	R09	Install median (flush)	Areas experiencing head-on collisions that may be affected by both the number of vehicles that cross the centerline and by the speed of oncoming vehicles. Roadways with oversized lanes offer an opportunity to restripe the roadway to reduce the lanes to standard widths and use the extra width for the median.	15%	90%	Medium
10	R10PB	Install pedestrian median fencing	Roadway segments with high pedestrian-generators and pedestrian-destinations nearby (e.g. transit stops) may experience a high volume of pedestrians J-walking across the travel lanes at mid-block locations instead of walking to the nearest intersection or designated mid-block crossing. When this safety issue cannot be mitigated with shoulder, sidewalk and/or crossing treatments, then installing a continuous pedestrian barrier in the median may be a viable solution.	35%	90%	Low
11	R11	Install acceleration/ deceleration lanes	Areas proven to have crashes that are the result of drivers not being able to turn onto a high speed roadway to accelerate until the desired roadway speed is reached and areas that do not provide the opportunity to safety decelerate to negotiate a turning movement.	25%	90%	Low
12	R12	Widen lane (initially less than 10 ft)	Horizontal curves or tangents and low speed or high speed roadways identified as having lane departure crashes, sideswipe or head-on crashes that can be attributed to an existing pavement width less than 10 feet.	25%	90%	Medium
13	R13	Add two-way left-turn lane (without reducing travel lanes)	Roadways having a high frequency of drivers being rear-ended while attempting to make a left turn across oncoming traffic. Also can be effective for drivers crossing the centerline of an undivided multilane roadway inadvertently.	30%	90%	Medium

14	R14	Road Diet (Reduce travel lanes from 4 to 3 and add a two way left-turn and bike lanes)	Areas noted as having a higher frequency of head-on, left-turn, and rear-end crashes with traffic volumes that can be handled by only 2 free flowing lanes. Using this strategy in locations with traffic volumes that are too high could result in diversion of traffic to routes less safe than the original four-lane design.	30%	90%	Medium
15	R15	Widen shoulder	Roadways that have a frequent incidence of vehicles leaving the travel lane resulting in an unsuccessful attempt to reenter the roadway. The probability of a safe recovery is increased if an errant vehicle is provided with an increased paved area in which to initiate such a recovery.	30%	90%	Medium
16	R16	Curve Shoulder widening (Outside Only)	Roadway curves noted as having frequent lane departure crashes due to inadequate or no shoulders, resulting in an unsuccessful attempt to reenter the roadway.	45%	90%	Medium
17	R17	Improve horizontal alignment (flatten curves)	Roadways with horizontal curves that have experienced lane departure crashes as a result of a roadway segment having compound curves or a severe radius. This strategy should generally be considered only when less expensive strategies involving clearing of specific sight obstructions or modifying traffic control devices have been tried and have failed to ameliorate the crash patterns.	50%	90%	Low
18	R18	Flatten crest vertical curve	The target for this strategy is usually unsignalized intersections with restricted sight distance due to vertical geometry and with patterns of crashes related to that lack of sight distance that cannot be ameliorated by less expensive methods. This strategy should generally be considered only when less expensive strategies involving clearing of specific sight obstructions or modifying traffic control devices have been tried and have failed to ameliorate the crash patterns.	25%	90%	Low
19	R19	Improve curve superelevation	Roadways noted as having frequent lane departure crashes and inadequate or no superelevation. Safety can be enhanced when the superelevation is improved or restored along curves where the actual superelevation is less than the optimal.	45%	90%	Medium
20	R20	Convert from two-way to one-way traffic	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.	35%	90%	Medium
21	R21	Improve pavement friction (High Friction Surface Treatments)	Improving the skid resistance at locations with high frequencies of wet road crashes and/or failure to stop crashes	55%	90%	High
22	R22	Install/Upgrade signs with new fluorescent sheeting (regulatory or warning)	Additional or new signage can address crashes caused by lack of driver awareness or complaince of roadway signing.	15%	90%	Very High
23	R23	Install chevron signs on horizontal curves	Roadways that have an unacceptable level of crashes on relatively sharp curves during periods of light and darkness.		90%	Very High
24	R24	Install curve advance warning signs	Addition of advance curve warning signs; may also include horizontal alignment and/or advisory speed warning signs	25%	90%	Very High
25	R25	Install curve advance warning signs (flashing beacon)	Roadways that have an unacceptable level of crashes on relatively sharp curves. Flashing beacons in conjunction with warning signs should only be used on horizontal curves that have an established severe crash history to help maintain their effectiveness.		90%	
26	R26	Install dynamic/variable speed warning signs	Includes the addition of dynamic speed warning signs (also known as Radar Speed Feedback Signs)	30%	90%	High
27	R27	Install delineators, reflectors and/or object markers	Installation of delineators, reflectors and/or object markers are intended to warn drivers of an approaching curve or fixed object that cannot easily be removed.	15%	90%	Very High
28	R28	Install edge-lines and centerlines	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.	25%	90%	Very High
29	R29	Install no-passing line	Roadways that have a high percentage of head-on crashes suggesting that many head-on crashes may relate to failed passing maneuvers. No-passing lines should be installed where drivers "passing sight distance" is not available due to horizontal or vertical obstructions.	45%	90%	Very High
30	R30	Install centerline rumble strips/stripes	Center Line rumble strips/stripes can be used on virtually any roadway – especially those with a history of head-on crashes.	20%	90%	High
31	R31	Install edgeline rumble strips/stripes	Shoulder and edge line milled rumble strips/stripes should be used on roads with a history of roadway departure crashes.	15%	90%	High
32	R32PB	Install bike lanes	Roadway segments noted as having crashes between bicycles and vehicles or crashes that may be preventable with a buffer/shoulder.	35%	90%	High
33	R33PB	Install Separated Bike Lanes	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.	45%	90%	High
34	R34PB	Install sidewalk/pathway (to avoid walking along roadway)	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.	80%	90%	Medium
35	R35PB	Install/upgrade pedestrian crossing (with enhanced safety features)	Roadway segments with no controlled crossing for a significant distance in high-use midblock crossing areas and/or multilane roads locations. flashing beacons, curb extensions, medians and pedestrian crossing islands and/or other safety features should be added to complement the standard crossing elements.	35%	90%	Medium
36	R36PB	Install raised pedestrian crossing	On lower-speed roadways, where pedestrians are known to be crossing roadways that involve significant vehicular traffic.	35%	90%	Medium

37	R37PB	Install Rectangular Rapid Flashing Beacon (RRFB)	Rectangular Rapid Flashing Beacon (RRFB) includes pedestrian-activated flashing lights and additional signage that enhance the visibility of marked crosswalks and alert motorists to pedestrian crossings. 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	35%	90%	Medium
38	R38	Install Animal Fencing	At locations with high percent of vehicular/animal crashes (reactive) or where there is a known high percent of animals crossing due to migratory patterns (proactive).	80%	90%	Medium

	Strategy	Performance Measure	Organizations to be involved
Education	Conduct public information and education campaign for intersection safety laws, unsafe speeds, distracted driving, 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 and social media.	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 and social media.	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.	Local Emergency Services Agency
	Increase the number of EMS/fire controll personnel taking Traffic Incident Managmenet Training	number of EMS/fire controll personnel taking Traffic Incident Managmenet Traising	Local Emergency Services Agency

Appendix G:

B/C Ratio Calculations

Years of Collision Data 5

CM R22 use 25%

Cost, Benefit and B/C Ratio Calculation Table

												10%	5%	25%	0%	0%	15%					1	2	3	4	
																						Collisions (2015-2019)				
FID	Location	CM 1	CM 2	CM 3	CM1_CRF	CM2_CRF	CM3_CRF	CM1_Life (Year)	CM2_Life (Year)	CM3_Life (Year)	CM Cost	Contingency Cost	Environmental Cost	PS&E Cost	Right of Way Engineering Cost	Appraisals, Acqusitions & Utilities Cost	Construction Engineering (CE) Cost	Cost Per Location	All Locations (Cost 2022)	20% More	Total #Collisions	Fatal	Severe Injury	Other Visible Injury	Complaint of Pain	Fatal
	Project 1: Safety at Signalized Intersections																									
1	El Camino Real and Sneath Ln	S02		S09	0.15		0.1	10		10	$ 11,460	$ 1,146	$ 573	$ 1,146			$ 1,719	$ 16,044			21	0	2	9	10	$ -
2	El Camino Real and Commodore Dr	S02		S09	0.15		0.1	10		10	$ 10,840	$ 1,084	$ 542	$ 1,084			$ 1,626	$ 15,176			15	1	1	10	3	$ 1,787,000.00
4	El Camino Real and San Bruno Ave	S02		S09	0.15		0.1	10		10	$ 15,200	$ 1,520	$ 760	$ 1,520			$ 2,280	$ 21,280			14	0	2	4	8	$ -
5	San Bruno Ave and 3rd Ave		S08	S09		0.3	0.1		20	10	$ 132,420	$ 13,242	$ 6,621	$ 13,242			$ 19,863	$ 185,388			10	0	2	5	3	$ -
6	El Camino Real and Jenevein Ave	S02		S09	0.15		0.1	10		10	$ 22,960	$ 2,296	$ 1,148	$ 2,296			$ 3,444	$ 32,144			7	0	2	1	4	$ -
7	San Bruno Ave and San Mateo Ave	S02		S09	0.15		0.1	10		10	$ 17,320	$ 1,732	$ 866	$ 1,732			$ 2,598	$ 24,248	$ 813,260	$ 975,912	3	0	2	0	1	$ -
8	El Camino Real and 380 WB on/off ramps	S02		S09	0.15		0.1	10		10	$ 26,040	$ 2,604	$ 1,302	$ 2,604			$ 3,906	$ 36,456			3	0	2	0	1	$ -
9	El Camino Real and Crystal Springs Ave	S02		S09	0.15		0.1	10		10	$ 23,020	$ 2,302	$ 1,151	$ 2,302			$ 3,453	$ 32,228			18	0	1	7	10	$ -
11	Sharp Park Rd and Pacific Heights Blvd		S08	S09		0.3	0.1		20	10	$ 136,840	$ 13,684	$ 6,842	$ 13,684			$ 20,526	$ 191,576			7	0	1	2	4	$ -
14	El Camnio and Taylor Ave/San Mateo Ave	S02		S09	0.15		0.1	10		10	$ 17,720	$ 1,772	$ 886	$ 1,772			$ 2,658	$ 24,808			5	0	1	2	2	$ -
15	San Bruno Ave and Cherry Ave		S08	S09		0.3	0.1		20	10	$ 167,080	$ 16,708	$ 8,354	$ 16,708			$ 25,062	$ 233,912			6	1	0	0	5	$ 1,787,000.00
	Project 2: Safety at Signalized Intersections - Pedestrian and Bicyclist Safety																									
1	El Camino Real and Sneath Ln	S20PB	S21PB	S11*	0.15	0.6		10	10		$ 212,800	$ 21,280	$ 10,640	$ 21,280			$ 31,920	$ 297,920			21	0	2	9	10	$ -
2	El Camino Real and Commodore Dr	S20PB	S21PB	S11*	0.15	0.6		10	10		$ 158,300	$ 15,830	$ 7,915	$ 15,830			$ 23,745	$ 221,620			15	1	1	10	3	$ 1,787,000.00
4	El Camino Real and San Bruno Ave	S20PB	S21PB	S11*	0.15	0.6		10	10		$ 202,900	$ 20,290	$ 10,145	$ 20,290			$ 30,435	$ 284,060			14	0	2	4	8	$ -
5	San Bruno Ave and 3rd Ave	S20PB	S21PB	S11*	0.15	0.6		10	10		$ 72,340	$ 7,234	$ 3,617	$ 7,234			$ 10,851	$ 101,276			10	0	2	5	3	$ -
6	El Camino Real and Jenevein Ave	S20PB	S21PB		0.15	0.6		10	10		$ 118,900	$ 11,890	$ 5,945	$ 11,890			$ 17,835	$ 166,460			7	0	2	1	4	$ -
7	San Bruno Ave and San Mateo Ave	S20PB	S21PB	S11*	0.15	0.6		10	10		$ 102,940	$ 10,294	$ 5,147	$ 10,294			$ 15,441	$ 144,116	$ 1,767,556	$ 2,121,067	3	0	2	0	1	$ -
8	El Camino Real and 380 WB on/off ramps	S20PB		S11*	0.15			10			$ 191,200	$ 19,120	$ 9,560	$ 19,120			$ 28,680	$ 267,680			3	0	2	0	1	$ -
9	El Camino Real and Crystal Springs Ave	S20PB	S21PB	S11*	0.15	0.6		10	10		$ 100,460	$ 10,046	$ 5,023	$ 10,046			$ 15,069	$ 140,644			18	0	1	7	10	$ -
11	Sharp Park Rd and Pacific Heights Blvd	S20PB	S21PB	S11*	0.15	0.6		10	10		$ 92,700	$ 9,270	$ 4,635	$ 9,270			$ 13,905	$ 129,780			7	0	1	2	4	$ -
14	El Camnio and Taylor Ave/San Mateo Ave		S21PB	S11*		0.6			10		$ 5,000	$ 500	$ 250	$ 500			$ 750	$ 7,000			5	0	1	2	2	$ -
15	San Bruno Ave and Cherry Ave		S21PB	S11*		0.6			10		$ 5,000	$ 500	$ 250	$ 500			$ 750	$ 7,000			6	1	0	0	5	$ 1,787,000.00
	Project 3: Safety at Unsignalized Intersections																									
3	El Camino Real and Santa Lucia Ave	NS03*	NS06	NS07	0.3	0.15	0.25	20	10	10	$ 484,570	$ 48,457	$ 24,229	$ 48,457			$ 72,686	$ 678,398			13	1	1	7	4	$ 2,843,000.00
10	Huntington Ave and Herman St	NS03*	NS06	NS07	0.3	0.15	0.25	20	10	10	$ 539,735	$ 53,974	$ 26,987	$ 53,974			$ 80,960	$ 755,629			9	0	1	5	3	$ -
8	Sneath Ln and Cemetary Access Rd	NS03*	NS06		0.3	0.15		20	10		$ 470,500	$ 47,050	$ 23,525	$ 47,050			$ 70,575	$ 658,700			3	0	2	0	1	$ -
13	San Bruno Ave and 6th		NS06	NS07		0.15	0.25		10	10	$ 25,190	$ 2,519	$ 1,260	$ 2,519			$ 3,779	$ 35,266	$ 2,222,388	$ 2,666,866	6	0	1	2	3	$ -
16	San Bruno Ave and 7th		NS06	NS07		0.15	0.25		10	10	$ 17,345	$ 1,735	$ 867	$ 1,735			$ 2,602	$ 24,283			3	0	1	1	1	$ -
18	San Bruno Ave and Green Ave		NS06	NS07		0.15	0.25		10	10	$ 21,000	$ 2,100	$ 1,050	$ 2,100			$ 3,150	$ 29,400			2	0	1	1	0	$ -
19	San Bruno Ave and Hensley Ave		NS06			0.15			10		$ 29,080	$ 2,908	$ 1,454	$ 2,908			$ 4,362	$ 40,712			2	0	1	1	0	$ -
	Project 4: Safety on Roadway Segments - Lighting and Visibility																									
A	El Camino Real: Noor Ave to San Lucia Ave	R22	R27	R21*	0.15	0.15		10	10		$ 40,000	$ 4,000	$ 2,000	$ 9,025			$ 6,000	$ 61,025			64	2	7	25	30	$ 4,922,000.00
B	Sneath Ln: Rollingwood Dr to Hunignton Ave	R22	R27	R21*	0.15	0.15		10	10		$ 28,000	$ 2,800	$ 1,400	$ 6,288			$ 4,200	$ 42,688			21	0	4	8	9	$ -
C	San Bruno Ave: Green Ave to 7th Ave	R22	R27		0.15	0.15		10	10		$ 22,700	$ 2,270	$ 1,135	$ 5,300			$ 3,405	$ 34,810			11	0	3	2	6	$ -
D	Sharp Park Rd: College Rd to Skyline Blvd	R22	R27	R21*	0.15	0.15		10	10		$ 17,050	$ 1,705	$ 853	$ 3,925			$ 2,558	$ 26,090			12	0	2	7	3	$ -
E	Jenevein Ave: Acacia Ave to San Mateo Ave	R22	R27		0.15	0.15		10	10		$ 6,750	$ 675	$ 338	$ 1,575			$ 1,013	$ 10,350			3	0	2	0	1	$ -
F	San Mateo Ave: El Camino Real to Angus Ave	R22	R27		0.15	0.15		10	10		$ 21,600	$ 2,160	$ 1,080	$ 4,800			$ 3,240	$ 32,880	$ 258,028	$ 309,633	4	0	1	3	0	$ -
G	Huntington Ave: Florida Ave to San Felipe Ave	R22	R27		0.15	0.15		10	10		$ 9,900	$ 990	$ 495	$ 1,950			$ 1,485	$ 14,820			3	0	1	1	1	$ -
H	Cherry Ave: San Bruno Ave to Park Ave	R22	R27		0.15	0.15		10	10		$ 5,300	$ 530	$ 265	$ 1,250			$ 795	$ 8,140			2	0	1	1	0	$ -
I	Crestwood Dr: Valleywood Dr to Rollingwood Dr	R22	R27	R21*	0.15	0.15		10	10		$ 5,100	$ 510	$ 255	$ 975			$ 765	$ 7,605			1	0	1	0	0	$ -
J	Crystal Springs Rd: Oak Ave to Poplar Ave	R22	R27		0.15	0.15		10	10		$ 12,900	$ 1,290	$ 645	$ 2,850			$ 1,935	$ 19,620			1	0	1	0	0	$ -
	Project 5: Safety on Roadway Segments - Centerline/Edgeline and Pedestrian Safety																									
A	El Camino Real: Noor Ave to San Lucia Ave	R33PB^	R35PB		0.45	0.35		20	20		$ 944,120	$ 94,412	$ 47,206	$ 94,412			$ 141,618	$ 1,321,768			64	2	7	25	30	$ 4,922,000.00
B	Sneath Ln: Rollingwood Dr to Hunignton Ave	R33PB	R35PB		0.45	0.35		20	20		$ 512,788	$ 51,279	$ 25,639	$ 51,279			$ 76,918	$ 717,903			21	0	4	8	9	$ -
C	San Bruno Ave: Green Ave to 7th Ave		R35PB			0.35			20		$ 389,600	$ 38,960	$ 19,480	$ 38,960			$ 58,440	$ 545,440			11	0	3	2	6	$ -
D	Sharp Park Rd: College Rd to Skyline Blvd	R33PB			0.45			20			$ 51,200	$ 5,120	$ 2,560	$ 5,120			$ 7,680	$ 71,680			12	0	2	7	3	$ -
E	Jenevein Ave: Acacia Ave to San Mateo Ave	R33PB^		R37PB	0.45		0.35	20		20	$ 193,986	$ 19,399	$ 9,699	$ 19,399			$ 29,098	$ 271,580	$ 3,900,532	$ 4,680,638	3	0	2	0	1	$ -
G	Huntington Ave: Florida Ave to San Felipe Ave		R35PB			0.35			20		$ 71,500	$ 7,150	$ 3,575	$ 7,150			$ 10,725	$ 100,100			3	0	1	1	1	$ -
H	Cherry Ave: San Bruno Ave to Park Ave		R35PB			0.35			20		$ 111,900	$ 11,190	$ 5,595	$ 11,190			$ 16,785	$ 156,660			2	0	1	1	0	$ -
I	Crestwood Dr: Valleywood Dr to Rollingwood Dr		R35PB			0.35			20		$ 23,000	$ 2,300	$ 1,150	$ 2,300			$ 3,450	$ 32,200			1	0	1	0	0	$ -
J	Crystal Springs Rd: Oak Ave to Poplar Ave		R35PB	R37PB		0.35	0.35		20	20	$ 488,000	$ 48,800	$ 24,400	$ 48,800			$ 73,200	$ 683,200			1	0	1	0	0	$ -

Updated with Local Roadway Safety Manual Version 1.6 April 2022

Fatal	Signalized	$1,787,000
	Unsignalized	$2,843,000
	Roadway Segm	$2,461,000
Severe Injury	Signalized	$1,787,000
	Unsignalized	$2,843,000
	Roadway Segm	$2,461,000
Other Visible Injury		$159,900
Complaint of Pain		$90,900

Cost, Benefit and B/C Ratio Calculation Tabl

		Crash Costs						CM Annual Benefit			CM Life Benefit			Benefit	Total Benefit		
FID	Location	Severe Injury	Other Visible Injury	Compliant of Pain	PDO	Crash Costs	Total Crash Cost	CM1_Benefit (Annual)	CM2_Benefit (Annual)	CM3_Benefit (Annual)	CM1_Benefit (Life)	CM2_Benefit (Life)	CM3_Benefit (Life)	Benefit per Location (Life)	Total_Benefit (Life)		
	Project 1: Safety at Signalized Intersections																
1	El Camino Real and Sneath Ln	$ 3,574,000.00	$ 1,439,100	$ 909,000.00	$ -	$ 5,922,100.00		$ 177,663.00	$ -	$ 118,442.00	$ 1,776,630.00	$ -	$ 1,184,420.00	$ 2,961,050.00		Combined Benefit	$ 30,021,240.00
2	El Camino Real and Commodore Dr	$ 1,787,000.00	$ 1,599,000	$ 272,700.00	$ -	$ 5,445,700.00		$ 163,371.00	$ -	$ 108,914.00	$ 1,633,710.00	$ -	$ 1,089,140.00	$ 2,722,850.00		Combined Cost	$ 813,260
4	El Camino Real and San Bruno Ave	$ 3,574,000.00	$ 639,600	$ 727,200.00	$ -	$ 4,940,800.00		$ 148,224.00	$ -	$ 98,816.00	$ 1,482,240.00	$ -	$ 988,160.00	$ 2,470,400.00		B/C	36.91
5	San Bruno Ave and 3rd Ave	$ 3,574,000.00	$ 799,500	$ 272,700.00	$ -	$ 4,646,200.00		$ -	$ 278,772.00	$ 92,924.00	$ -	$ 5,575,440.00	$ 929,240.00	$ 6,504,680.00			
6	El Camino Real and Jenevein Ave	$ 3,574,000.00	$ 159,900	$ 363,600.00	$ -	$ 4,097,500.00		$ 122,925.00	$ -	$ 81,950.00	$ 1,229,250.00	$ -	$ 819,500.00	$ 2,048,750.00			
7	San Bruno Ave and San Mateo Ave	$ 3,574,000.00	$ -	$ 90,900.00	$ -	$ 3,664,900.00	$ 43,197,900.00	$ 109,947.00	$ -	$ 73,298.00	$ 1,099,470.00	$ -	$ 732,980.00	$ 1,832,450.00	$ 30,021,240.00		
8	El Camino Real and 380 WB on/off ramps	$ 3,574,000.00	$ -	$ 90,900.00	$ -	$ 3,664,900.00		$ 109,947.00	$ -	$ 73,298.00	$ 1,099,470.00	$ -	$ 732,980.00	$ 1,832,450.00			
9	El Camino Real and Crystal Springs Ave	$ 1,787,000.00	$ 1,119,300	$ 909,000.00	$ -	$ 3,815,300.00		$ 114,459.00	$ -	$ 76,306.00	$ 1,144,590.00	$ -	$ 763,060.00	$ 1,907,650.00			
11	Sharp Park Rd and Pacific Heights Blvd	$ 1,787,000.00	$ 319,800	$ 363,600.00	$ -	$ 2,470,400.00		$ -	$ 148,224.00	$ 49,408.00	$ -	$ 2,964,480.00	$ 494,080.00	$ 3,458,560.00			
14	El Camnio and Taylor Ave/San Mateo Ave	$ 1,787,000.00	$ 319,800	$ 181,800.00	$ -	$ 2,288,600.00		$ 68,658.00	$ -	$ 45,772.00	$ 686,580.00	$ -	$ 457,720.00	$ 1,144,300.00			
15	San Bruno Ave and Cherry Ave	$ -	$ -	$ 454,500.00	$ -	$ 2,241,500.00		$ -	$ 134,490.00	$ 44,830.00	$ -	$ 2,689,800.00	$ 448,300.00	$ 3,138,100.00			
	Project 2: Safety at Signalized Intersections - Pedestrian a																
1	El Camino Real and Sneath Ln	$ 3,574,000.00	$ 1,439,100	$ 909,000.00	$ -	$ 5,922,100.00		$ 177,663.00	$ 710,652.00	$ -	$ 1,776,630.00	$ 7,106,520.00	$ -	$ 8,883,150.00		Combined Benefit	$ 59,039,940.00
2	El Camino Real and Commodore Dr	$ 1,787,000.00	$ 1,599,000	$ 272,700.00	$ -	$ 5,445,700.00		$ 163,371.00	$ 653,484.00	$ -	$ 1,633,710.00	$ 6,534,840.00	$ -	$ 8,168,550.00		Combined Cost	$ 1,767,556
4	El Camino Real and San Bruno Ave	$ 3,574,000.00	$ 639,600	$ 727,200.00	$ -	$ 4,940,800.00		$ 148,224.00	$ 592,896.00	$ -	$ 1,482,240.00	$ 5,928,960.00	$ -	$ 7,411,200.00		B/C	33.40
5	San Bruno Ave and 3rd Ave	$ 3,574,000.00	$ 799,500	$ 272,700.00	$ -	$ 4,646,200.00		$ 139,386.00	$ 557,544.00	$ -	$ 1,393,860.00	$ 5,575,440.00	$ -	$ 6,969,300.00			
6	El Camino Real and Jenevein Ave	$ 3,574,000.00	$ 159,900	$ 363,600.00	$ -	$ 4,097,500.00		$ 122,925.00	$ 491,700.00	$ -	$ 1,229,250.00	$ 4,917,000.00	$ -	$ 6,146,250.00			
7	San Bruno Ave and San Mateo Ave	$ 3,574,000.00	$ -	$ 90,900.00	$ -	$ 3,664,900.00	$ 43,197,900.00	$ 109,947.00	$ 439,788.00	$ -	$ 1,099,470.00	$ 4,397,880.00	$ -	$ 5,497,350.00	$ 59,039,940.00		
8	El Camino Real and 380 WB on/off ramps	$ 3,574,000.00	$ -	$ 90,900.00	$ -	$ 3,664,900.00		$ 109,947.00	$ -	$ -	$ 1,099,470.00	$ -	$ -	$ 1,099,470.00			
9	El Camino Real and Crystal Springs Ave	$ 1,787,000.00	$ 1,119,300	$ 909,000.00	$ -	$ 3,815,300.00		$ 114,459.00	$ 457,836.00	$ -	$ 1,144,590.00	$ 4,578,360.00	$ -	$ 5,722,950.00			
11	Sharp Park Rd and Pacific Heights Blvd	$ 1,787,000.00	$ 319,800	$ 363,600.00	$ -	$ 2,470,400.00		$ 74,112.00	$ 296,448.00	$ -	$ 741,120.00	$ 2,964,480.00	$ -	$ 3,705,600.00			
14	El Camnio and Taylor Ave/San Mateo Ave	$ 1,787,000.00	$ 319,800	$ 181,800.00	$ -	$ 2,288,600.00		$ -	$ 274,632.00	$ -	$ -	$ 2,746,320.00	$ -	$ 2,746,320.00			
15	San Bruno Ave and Cherry Ave	$ -	$ -	$ 454,500.00	$ -	$ 2,241,500.00		$ -	$ 268,980.00	$ -	$ -	$ 2,689,800.00	$ -	$ 2,689,800.00			
	Project 3: Safety at Unsignalized Intersections																
3	El Camino Real and Santa Lucia Ave	$ 2,843,000.00	$ 1,119,300	$ 363,600.00	$ -	$ 7,168,900.00		$ 430,134.00	$ 215,067.00	$ 358,445.00	$ 8,602,680.00	$ 2,150,670.00	$ 3,584,450.00	$ 14,337,800.00		Combined Benefit	$ 39,360,180.00
10	Huntington Ave and Herman St	$ 2,843,000.00	$ 799,500	$ 272,700.00	$ -	$ 3,915,200.00		$ 234,912.00	$ 117,456.00	$ 195,760.00	$ 4,698,240.00	$ 1,174,560.00	$ 1,957,600.00	$ 7,830,400.00		Combined Cost	$ 2,222,388
8	Sneath Ln and Cemetary Access Rd	$ 5,686,000.00	$ -	$ 90,900.00	$ -	$ 5,776,900.00		$ 346,614.00	$ 173,307.00	$ -	$ 6,932,280.00	$ 1,733,070.00	$ -	$ 8,665,350.00		B/C	17.71
13	San Bruno Ave and 6th	$ 2,843,000.00	$ 319,800	$ 272,700.00	$ -	$ 3,435,500.00	$ 29,396,100.00	$ -	$ 103,065.00	$ 171,775.00	$ -	$ 1,030,650.00	$ 1,717,750.00	$ 2,748,400.00	$ 39,360,180.00		
16	San Bruno Ave and 7th	$ 2,843,000.00	$ 159,900	$ 90,900.00	$ -	$ 3,093,800.00		$ -	$ 92,814.00	$ 154,690.00	$ -	$ 928,140.00	$ 1,546,900.00	$ 2,475,040.00			
18	San Bruno Ave and Green Ave	$ 2,843,000.00	$ 159,900	$ -	$ -	$ 3,002,900.00		$ -	$ 90,087.00	$ 150,145.00	$ -	$ 900,870.00	$ 1,501,450.00	$ 2,402,320.00			
19	San Bruno Ave and Hensley Ave	$ 2,843,000.00	$ 159,900	$ -	$ -	$ 3,002,900.00		$ -	$ 90,087.00	$ -	$ -	$ 900,870.00	$ -	$ 900,870.00			
	Project 4: Safety on Roadway Segments - Lighting and Visi																
A	El Camino Real: Noor Ave to San Lucia Ave	$ 17,227,000.00	$ 3,997,500	$ 2,727,000.00	$ -	$ 28,873,500.00		$ 866,205.00	$ 866,205.00	$ -	$ 8,662,050.00	$ 8,662,050.00	$ -	$ 17,324,100.00		Combined Benefit	$ 44,151,180.00
B	Sneath Ln: Rollingwood Dr to Hunignton Ave	$ 9,844,000.00	$ 1,279,200	$ 818,100.00	$ -	$ 11,941,300.00		$ 358,239.00	$ 358,239.00	$ -	$ 3,582,390.00	$ 3,582,390.00	$ -	$ 7,164,780.00		Combined Cost	$ 258,028
C	San Bruno Ave: Green Ave to 7th Ave	$ 7,383,000.00	$ 319,800	$ 545,400.00	$ -	$ 8,248,200.00		$ 247,446.00	$ 247,446.00	$ -	$ 2,474,460.00	$ 2,474,460.00	$ -	$ 4,948,920.00		B/C	171.11
D	Sharp Park Rd: College Rd to Skyline Blvd	$ 4,922,000.00	$ 1,119,300	$ 272,700.00	$ -	$ 6,314,000.00		$ 189,420.00	$ 189,420.00	$ -	$ 1,894,200.00	$ 1,894,200.00	$ -	$ 3,788,400.00			
E	Jenevein Ave: Acacia Ave to San Mateo Ave	$ 4,922,000.00	$ -	$ 90,900.00	$ -	$ 5,012,900.00	$ 73,585,300.00	$ 150,387.00	$ 150,387.00	$ -	$ 1,503,870.00	$ 1,503,870.00	$ -	$ 3,007,740.00	$ 44,151,180.00		
F	San Mateo Ave: El Camino Real to Angus Ave	$ 2,461,000.00	$ 479,700	$ -	$ -	$ 2,940,700.00		$ 88,221.00	$ 88,221.00	$ -	$ 882,210.00	$ 882,210.00	$ -	$ 1,764,420.00			
G	Huntington Ave: Florida Ave to San Felipe Ave	$ 2,461,000.00	$ 159,900	$ 90,900.00	$ -	$ 2,711,800.00		$ 81,354.00	$ 81,354.00	$ -	$ 813,540.00	$ 813,540.00	$ -	$ 1,627,080.00			
H	Cherry Ave: San Bruno Ave to Park Ave	$ 2,461,000.00	$ 159,900	$ -	$ -	$ 2,620,900.00		$ 78,627.00	$ 78,627.00	$ -	$ 786,270.00	$ 786,270.00	$ -	$ 1,572,540.00			
I	Crestwood Dr: Valleywood Dr to Rollingwood Dr	$ 2,461,000.00	$ -	$ -	$ -	$ 2,461,000.00		$ 73,830.00	$ 73,830.00	$ -	$ 738,300.00	$ 738,300.00	$ -	$ 1,476,600.00			
J	Crystal Springs Rd: Oak Ave to Poplar Ave	$ 2,461,000.00	$ -	$ -	$ -	$ 2,461,000.00		$ 73,830.00	$ 73,830.00	$ -	$ 738,300.00	$ 738,300.00	$ -	$ 1,476,600.00			
	Project 5: Safety on Roadway Segments - Centerline/Edge																
A	El Camino Real: Noor Ave to San Lucia Ave	$ 17,227,000.00	$ 3,997,500	$ 2,727,000.00	$ -	$ 28,873,500.00		$ 2,598,615.00	$ 2,021,145.00	$ -	$ 51,972,300.00	$ 40,422,900.00	$ -	$ 92,395,200.00		Combined Benefit	$ 187,363,300.00
B	Sneath Ln: Rollingwood Dr to Hunignton Ave	$ 9,844,000.00	$ 1,279,200	$ 818,100.00	$ -	$ 11,941,300.00		$ 1,074,717.00	$ 835,891.00	$ -	$ 21,494,340.00	$ 16,717,820.00	$ -	$ 38,212,160.00		Combined Cost	$ 3,900,532
C	San Bruno Ave: Green Ave to 7th Ave	$ 7,383,000.00	$ 319,800	$ 545,400.00	$ -	$ 8,248,200.00		$ -	$ 577,374.00	$ -	$ -	$ 11,547,480.00	$ -	$ 11,547,480.00		B/C	48.04
D	Sharp Park Rd: College Rd to Skyline Blvd	$ 4,922,000.00	$ 1,119,300	$ 272,700.00	$ -	$ 6,314,000.00		$ 568,260.00	$ -	$ -	$ 11,365,200.00	$ -	$ -	$ 11,365,200.00			
E	Jenevein Ave: Acacia Ave to San Mateo Ave	$ 4,922,000.00	$ -	$ 90,900.00	$ -	$ 5,012,900.00	$ 70,644,600.00	$ 451,161.00	$ -	$ 350,903.00	$ 9,023,220.00	$ -	$ 7,018,060.00	$ 16,041,280.00	$ 187,363,300.00		
G	Huntington Ave: Florida Ave to San Felipe Ave	$ 2,461,000.00	$ 159,900	$ 90,900.00	$ -	$ 2,711,800.00		$ -	$ 189,826.00	$ -	$ -	$ 3,796,520.00	$ -	$ 3,796,520.00			
H	Cherry Ave: San Bruno Ave to Park Ave	$ 2,461,000.00	$ 159,900	$ -	$ -	$ 2,620,900.00		$ -	$ 183,463.00	$ -	$ -	$ 3,669,260.00	$ -	$ 3,669,260.00			
I	Crestwood Dr: Valleywood Dr to Rollingwood Dr	$ 2,461,000.00	$ -	$ -	$ -	$ 2,461,000.00		$ -	$ 172,270.00	$ -	$ -	$ 3,445,400.00	$ -	$ 3,445,400.00			
J	Crystal Springs Rd: Oak Ave to Poplar Ave	$ 2,461,000.00	$ -	$ -	$ -	$ 2,461,000.00		$ -	$ 172,270.00	$ 172,270.00	$ -	$ 3,445,400.00	$ 3,445,400.00	$ 6,890,800.00			

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