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CIP 993 | SYSTEMIC
SAFETY ANALYSIS REPORT
**ENGINEERING AND
NON-ENGINEERING
COUNTERMEASURES MEMO**
TOWN OF COLMA, CA

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CIP993-SSAR - Town of Colma, Transportation Safety Action Plan

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PROTECTION OF DATA FROM DISCOVERY & ADMISSION INTO EVIDENCE

23 U.S.C. 148(h)(4) states "Notwithstanding any other provision of law, reports, surveys, schedules, lists, or data compiled or collected for any purpose relating to this section [HSIP], shall not be subject to discovery or admitted into evidence in a Federal or State court proceeding or considered for other purposes in any action for damages arising from any occurrence at a location identified or addressed in the reports, surveys, schedules, lists, or other data."

23 U.S.C. 409 states "Notwithstanding any other provision of law, reports, surveys, schedules, lists, or data compiled or collected for the purpose of identifying, evaluating, or planning the safety enhancement of potential accident sites, hazardous roadway conditions, or railway-highway crossings, pursuant to sections 130, 144, and 148 of this title or for the purpose of developing any highway safety construction improvement project which may be implemented utilizing Federal-aid highway funds shall not be subject to discovery or admitted into evidence in a Federal or State court proceeding or considered for other purposes in any action for damages arising from any occurrence at a location mentioned or addressed in such reports, surveys, schedules, lists, or data."

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1.0 INTRODUCTION

Kittelson & Associates, Inc. (Kittelson) is supporting the Town of Colma to identify countermeasures to improve roadway safety performance as part of a broader effort to develop the Colma Transportation Safety Action Plan. Safety performance is defined as reducing crash frequency and severity. This work is being conducted through a Caltrans Systemic Safety Analysis Report Program (SSARP) Grant. This memorandum summarizes the systemic treatments that could be implemented across the Town, potential location-specific projects, and education and enforcement strategies that could complement engineering projects to reduce severe crashes and crash risk.

The following sub-sections summarize the study corridors; systemic treatments identified for Colma; location-specific improvements; roadway safety related policies; and education and enforcement strategies.

IN THIS MEMO>>

- ▶ Systemic treatments that could be implemented at locations across the Town of Colma
- ▶ Location-specific projects
- ▶ Roadway safety-related policies the Town could adopt
- ▶ Safety education and enforcement strategies to complement engineering projects

1.1 STUDY CORRIDORS FIELD REVIEW

Kittelson performed field reviews for the study corridors identified below. The field reviews were informed by the crash and roadway data analysis conducted and documented in the *Crash and Roadway Data Analysis Memorandum* provided to the Town in January 2018.

Study corridors:

- El Camino Real (State Highway 82);
- Junipero Serra Boulevard;
- Hillside Boulevard;
- Mission Road;
- Serramonte Boulevard;
- Collins Avenue;
- Colma Boulevard;
- Lawndale Boulevard; and
- F Street.

Kittelson also conducted field visits at the following intersections, in addition to the above corridors:

- Junipero Serra Boulevard & Serra Center Entrance (North)
- Junipero Serra Boulevard & Serra Center Entrance (South)
- El Camino Real & Collins Avenue
- El Camino Real & Mission Road
- El Camino Real & F Street
- Serramonte Boulevard & Junipero Serra Boulevard

- Serramonte Boulevard & Collins Avenue

Appendix A contains a summary of the existing traffic volumes along the study corridors as well as observations from the field reviews.

KEY TERMS>>

- ▶ **Systemic Treatments** – Treatments that could be implemented at locations across the Town with similar physical characteristics and regardless of crash history. Implementing such treatments in a proactive manner could help further reduce crashes in the future.
- ▶ **Location-Specific Projects** – Potential projects, unique to specific locations that are intended reduce the likelihood of crashes.
- ▶ **Roadway Safety Related Policies** – Potential new policies the Town of Colma could adopt to further support reducing the frequency and/or severity of crashes
- ▶ **Education and Enforcement Strategies** – Non-engineering strategies targeting road user education and/or enforcement of traffic laws to help reduce the likelihood of risky road user behavior and related crashes.

1.2 SYSTEMIC TREATMENTS

Based on the systemic safety analysis approach outlined by Federal Highway Administration (FHWA) and field reviews to priority locations, Kittelson identified the following systemic treatments as those most likely to help reduce crash frequency and/or severity. Table 1 provides a summary of the systemic treatments, planning-level cost range, and potential safety effectiveness of the treatment in the form of crash modification factor (CMF).

Table 1 Summary of the Systemic Treatments and the Related Information

Caltrans LRSM ¹ ID	Treatment	Cost Range	Year, and Source for Costs	CMF [Percent Crash Reduction]		Eligibility for Federal Funding
				National Research	Caltrans LRSM	
At Signalized Intersections						
S8	a) Intersection Pavement Marking Delineation	\$1.50 - \$2.00 per linear foot	2018, Town of Colma	0.55 - 0.82 [18% - 45%]	0.90 [10%]	100%
S2	b) Backplates with Retroreflective Borders	\$6,000 - \$12,000 (per intersection)	2014, Virginia DOT	0.85 [15%]	0.85 [15%]	100%
NA.	c) Green Pavement Markings for Bicycle-Vehicle Conflicts	\$5 - \$10 per square foot	2018, Town of Colma	NA.	NA.	No
NA.	d) Leading Pedestrian Intervals at Traffic Signals	\$1,000 - \$2,000	2017, City of Oakland, Pedestrian Master Plan	0.41 [59%] for ped-veh crashes	NA.	No
NA.	e) No Right-Turn on Red	\$500 - \$5000 (per approach)	2017, City of Oakland, Pedestrian Master Plan	NA.	NA.	No
At unsignalized intersections and roadway segments						
	f) Enhanced Pedestrian Crossings					
NS17	High Visibility Markings	\$2,000 - \$8,000	2018, Town of Colma	0.81 [19%]	0.75 [25%]	100%
NS16	Pedestrian Refuge Island	\$15,000 - \$25,000	2017, City of Oakland, Pedestrian Master Plan	0.74 [26%]	0.55 [45%]	90%
NS17	Pedestrian Crossing Warning Signs	\$450-\$1,020	2017, Virginia DOT	NA.	0.75 [25%]	100%
NS8	Flashing Beacons	\$15,000 - \$40,000	2018, Town of Colma	NA.	0.70 [30%]	100%

¹ Caltrans Local Road Safety Manual

Caltrans LRSM ¹ ID	Treatment	Cost Range	Year, and Source for Costs	CMF [Percent Crash Reduction]		Eligibility for Federal Funding
				National Research	Caltrans LRSM	
NA.	Blinker Beacons	NA.	NA.	NA.	NA.	No
NA.	g) Pedestrian Hybrid Beacons (PHB) at Uncontrolled Marked Crossings	\$75,000 - \$150,000	2018, Town of Colma	0.43 [57%] for ped-veh crashes 0.88 [12%] for veh-veh crashes	NA.	No
R37	h) Sidewalks	\$15 - \$20 per square foot	2018, Town of Colma	NA.	0.20 [80%]	90%
R36	i) Bicycle Lanes (Class II)	\$10 - \$15 per linear foot	2018, Town of Colma	0.40 [60%] for ped-veh crashes 0.73 [27%] for veh-veh crashes	0.65 [35%]	90%
R30	j) Speed Feedback Signs	\$2,000 - \$11,000	2014, Hallmark & Hawkins	0.93 - 0.95 [5% - 7%]	0.70 [30%]	100%
NS10	k) Sight Distance Improvements	Varies	NA.	0.44 - 0.89 [11% - 56%]	0.80 [20%]	90%
R15	l) Road Diets (Roadway Reconfiguration)	\$6- \$10 per linear foot (changes to pavement marking only)	2018, Town of Colma	0.53 - 0.71 [29% - 47%]	0.70 [30%]	90%
R32	m) Road Segment Edgelines	\$1.50 - \$2.00 per linear foot	2018, Town of Colma	0.55 [45%]	0.75 [25%]	100%
NA.	n) Upgrade Street Name Signs	\$750 - \$1,250 per sign	2018, Town of Colma	0.98 [2%]	NA.	No

Caltrans LRSM ¹ ID	Treatment	Cost Range	Year, and Source for Costs	CMF [Percent Crash Reduction]		Eligibility for Federal Funding
				National Research	Caltrans LRSM	
NA.	o) Gateway Treatments	Varies	NA.	NA.	NA.	No
NS5	p) Upgrade Regulatory and Warning Signs	\$450 - \$1,020 (per sign)	2017 Virginia DOT	0.66 – 0.70 [30% - 34%]	0.85 [15%]	100%
NA.	q) Access Management	Varies	NA.	0.93 [7%]	NA.	No
NS1/R1	r) Street Lighting	\$5,000 - \$10,000	2018, Town of Colma	0.63 [37%]	0.60 – 0.65 [35% - 40%]	100%

1.3 LOCATION-SPECIFIC PROJECTS

Kittelson identified the following locations and corresponding potential unique, projects as a means to further help reduce the potential for crash frequency and/or severity. Some of the locations also were identified as candidates to receive one or more of the systemic treatments. These locations were identified for additional location-specific projects because either the existing geometry and/or crash patterns indicated a greater potential for safety improvement if investment beyond the systemic treatments were made. The list of locations and brief explanation of the potential location-specific projects is provided below.

- a) Intersection control evaluation at Mission Road/El Camino Real intersection;
- b) Reconfiguring roadway cross-section on Hillside Boulevard from Serramonte Boulevard/Hillside Boulevard Intersection to Hillside Boulevard/Lawndale Boulevard Intersection;
- c) Consistency in All Way Stop Control on Colma Boulevard;
- d) Reconfiguring Junipero Serra Boulevard/Serramonte Boulevard Intersection;
- e) Reconfiguring Serramonte Boulevard/Collins Avenue Intersection; and
- f) Intersection control evaluation at Collins Avenue/El Camino Real intersection.

1.4 SAFETY POLICIES, EDUCATION & ENFORCEMENT STRATEGIES

The following summarizes potential roadway related safety policies, education and enforcement strategies identified to complement and support the systemic treatments and location-specific projects.

Roadway Safety Related Policies

Kittelton previously reviewed the existing Town policies as part of a broader Document Review Memorandum. Based on that review as well as the results from the crash and roadway data analysis findings, we recommend the Town consider developing and adopting a Vision Zero policy. The purpose of such a policy is to serve as a call for action and enable collaboration across Town functions.

Education Strategies

Education strategies are focused on teaching road users traffic safety. The Town could apply for grants to help develop the content for these strategies. There are also materials readily available and distributed for free through national resources such as the National Highway Traffic Safety Administration (NHTSA). Some of these resources include interactive activities, teaching notes, and information on road safety messages and concepts that can be taught at school or in the off-school activities. The recommended strategies are as follows:

- Road Safety Education to Children;
- Speed Monitoring Awareness Radar Trailer;
- Vulnerable Road User Education.

Enforcement Strategies

Kittelton recommends the enhanced police enforcement be deployed on roadway segments with speeding-related crashes and driving under the influence of alcohol related crashes at the specific locations and during the recurring time periods identified from the crash data. The strategies recommended are as follows:

- Enhanced Police Enforcement;
- Photo Enforcement; and
- Speed Survey and Enforcement Campaigns.

2.0 SYSTEMIC TREATMENTS

The following presents the systemic treatments identified for the Town of Colma. These treatments were selected based on the crash patterns and trends from the systemic safety analysis, observations from field reviews, and professional resources such as the Caltrans Local Road Safety Manual, American Association of State Highway and Transportation Officials (AASHTO), the California Manual on Uniform Traffic Control Devices (CA MUTCD), and the National Association of City Transportation Officials (NACTO) regarding systemic safety. Some treatments are inexpensive retrofits, pavement markings, and signage that can be changed and quickly implemented. Some require greater study, coordination, and funding. Some of these countermeasures have been studied and/or researched extensively and have an associated crash modification factor (CMF).

IN THIS SECTION>>

- ▶ Description of systemic treatments
- ▶ Potential locations for systemic treatments to be implemented

KEY TERM>>

- ▶ **Crash Modification Factor (CMF):** This is a numerical value that indicates how effective a treatment is at reducing crashes.
- ▶ **CMF Clearing House:** This is a comprehensive and searchable online database of CMFs along with guidance and resources on using CMFs in road safety studies.
- ▶ When a CMF value is available for a treatment, it is noted below. Following that value in [brackets] is the corresponding estimated percent reduction in crashes.
- ▶ **Crash Reduction Factor (CRF):** This is the percentage crash reduction that might be expected after implementing a given treatment.

The first section below discusses each systemic treatment, describing the treatment, the types of locations it is intended to be used at, and why it was selected for the Town of Colma. The following section identifies locations within the Town of Colma where each systemic treatment could be implemented.

2.1 SYSTEMIC TREATMENTS

a) Intersection Pavement Marking Delineation (S8)

Planning-Level Cost Estimate: \$1.50 - \$2.00 per linear foot (Town of Colma, 2018).

Eligible for Federal Funding (Source: Caltrans Road Safety Manual): Yes (100%)

Potential Effectiveness at Reducing Crash Frequency and/or Severity: CMF = 0.55 – 0.82 [18% - 45% crash reduction] (CMF Clearing House, 2018).

Brief Description: This treatment accentuates traffic lines, pavement markings, and channelization used to direct traffic on the roadway. Kittelson proposes this treatment in places where intersections having multiple adjacent turning lanes, more than four legs, and/or are skewed. Pavement marking delineation can help guide motorists to choose and stay in the proper lane and can also be used to visually narrow the lane in support of reduced speeds. An example of the treatment is shown in Figure 1.



Figure 1 Example of Marking Delineation

Why was this selected for Town of Colma?

This treatment was selected for the Town of Colma for the wide, complex intersections with multiple adjacent turn lanes (e.g., Junipero Serra Boulevard). Installing this treatment at these intersections will help guide drivers into the appropriate lane in the through and turning movement maneuvers.

b) Backplates with Retroreflective Borders (S2)

Planning-Level Cost Estimate: \$6,000 - \$12,000 per intersection (VDOT, 2018).

Eligible for Federal Funding (Source: Caltrans Road Safety Manual): Yes (100%)

Potential Effectiveness at Reducing Crash Frequency and/or Severity: CMF = 0.85 [15% crash reduction] (CMF Clearing House, 2018).

Brief Description: This treatment improves the visibility of the illuminated face of the signal by introducing a controlled-contrast background. Signal heads with backplates equipped with retroreflective borders are more visible in daytime and nighttime conditions. This treatment is more effective when it is adopted as a standard treatment for signalized intersections across the town or jurisdiction (FHWA, 2018). Kittelson proposes this treatment to improve the visibility during the daytime (to help address glare from the sunlight) as well as nighttime. An example of the treatment is shown in Figure 2.



Figure 2 Example of Signal Backplate Framed with a Retroreflective Border [Source: (FHWA, 2018)].

Why was this selected for Town of Colma?

This treatment was selected for the Town of Colma to help improve visibility of traffic signal heads particularly for motorists traveling through the larger signalized intersections where the distance across the intersection to view the signal head is greater. The retroreflective backplates are intended to help reduce drivers' unintentional running of red lights, and other violations of traffic signals.

c) Green Pavement Markings for Bicycle-Vehicle Conflicts

Planning-Level Cost Estimate: \$5 - \$10 per square foot (Town of Colma, 2018).

Eligible for Federal Funding (Source: Caltrans Road Safety Manual): No

Potential Effectiveness at Reducing Crash Frequency and/or Severity: NA.

Brief Description: This treatment places the green pavement markings in 'conflict zones' where motor vehicles cross the bicycle lanes to move into dedicated right-turn lanes at intersections. This treatment makes the driver aware of the bicyclists on the road at the intersection. An example of this treatment is shown in Figure 3.



Figure 3 Example of Green Pavement Markings [Source: (City of Milwaukee, 2018)].

Why was this selected for Town of Colma?

This treatment was selected for the Town of Colma at intersections where motorists need to cross the bicycle lane to enter a right-turn lane. This treatment improves the visibility of bicycle lanes, helps raise motorists' awareness of potential bicyclists, and makes clear to bicyclists where they are expected to be at an intersection.

d) Leading Pedestrian Intervals at Traffic Signals

Planning-Level Cost Estimate: \$1,000 - \$2,000 (City of Oakland, 2017).

Eligible for Federal Funding (Source: Caltrans Road Safety Manual): No

Potential Effectiveness at Reducing Crash Frequency and/or Severity: CMF = 0.41 [59% crash reduction] for pedestrian-vehicle crashes (CMF Clearinghouse, 2018).

Brief Description: This treatment typically gives pedestrians a 3 to 7 second head start when crossing an intersection. The pedestrian "Walk" sign is giving in advance of the motorists green signal in the same direction of travel. The intent is to allow pedestrians to start crossing the intersection in advance of allowing motorists to turn; this makes pedestrians more visible to turning motorists to help avoid turning vehicles – pedestrian crashes. An example of this treatment is shown in Figure 4.

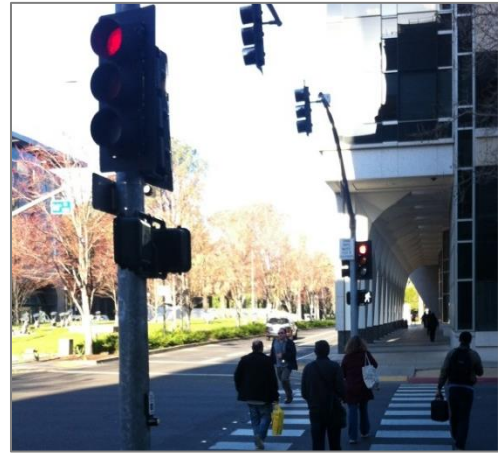


Figure 4 Example of Leading Pedestrian Interval [Source: Kittelson & Associates, Inc.].

Why was this selected for Town of Colma?

This treatment was selected for the Town of Colma signalized intersections particularly at use near transit stops and intersections with multiple vehicle-turn lanes. This treatment enhances the visibility of pedestrians at intersections and reinforces their right-of-way over turning vehicles.

e) No Right-Turn on Red

Planning-Level Cost Estimate: \$500 - \$5000 (per approach) (City of Oakland, 2017).

Eligible for Federal Funding (Source: Caltrans Road Safety Manual): No

Potential Effectiveness at Reducing Crash Frequency and/or Severity: NA.



Figure 5 Example of No Right-Turn on Red [Source: (Flickr, 2018)].

Brief Description: This treatment prohibits vehicles from turning right when pedestrians have the right-of-way to cross the adjacent street. In combination with thoughtful signal phasing, this can reduce or eliminate the conflict of turning-vehicles and pedestrians crossing the street. An example of an intersection with right-turn on red prohibited is shown in Figure 5. The no right-turn on red is a dynamic restriction that occurs only when the pedestrian push button is activated.

Why was this selected for Town of Colma?

This treatment was selected to encourage motorists to stop at the red light. This was recommended in areas where the drivers have been observed and reported as not yielding to pedestrians and/or bicyclists crossing the intersection approach to the motorists' right, resulting in crashes and/or near-misses with people attempting to cross the street.

f) Enhanced Pedestrian Crossings (NS8, NS16, NS17)

Planning-Level Cost Estimate:

High visibility markings	\$2,000 - \$8,000 (Town of Colma, 2018)
Pedestrian refuge island	\$15,000 - \$25,000 (City of Oakland, 2017)
Pedestrian crossing warning signs	\$450 - \$1,020 per sign, assuming 7' sign post (VDOT, 2018)
Flashing beacons	\$15,000 - \$40,000 (Town of Colma, 2018)
Blinker beacons	NA.

Eligible for Federal Funding (Source: Caltrans Road Safety Manual): Yes (90%,100%).

Potential Effectiveness at Reducing Crash Frequency and/or Severity: CMF = 0.74 – 0.81 [19% - 26% crash reduction] (CMF Clearing House, 2018); (City of Bristol, 2018).

Brief Description: Enhanced pedestrian crossing treatments are for uncontrolled, marked crosswalks that cross multilane arterials or collectors. The enhanced crossing alerts the drivers of crossing pedestrian by way of high visibility markings, warning signs, flashing beacons, and by providing pedestrian refuge islands. The pedestrian refuge island allows people to cross in two stages – the first stage looking for a safe gap in traffic or vehicles to yield in one direction and then the second stage to look for a safe gap in traffic or vehicles to yield in the other direction. An example of the treatment is shown in Figure 6.

Why was this selected for Town of Colma?

There are several multilane streets within Colma along which there are transit stops and other pedestrian origins/destinations. Enhanced pedestrian crossings at such locations can help increase motorists' yielding behavior and reduce the risk of pedestrian-vehicle crashes.



Figure 6 Example of Enhanced Pedestrian Crossing [Source: (NACTO, 2013)].

g) Pedestrian Hybrid Beacons

Planning-Level Cost Estimate: \$75,000 - \$150,000 (Town of Colma, 2018).

Eligible for Federal Funding (Source: Caltrans Road Safety Manual): No

Potential Effectiveness at Reducing Crash Frequency and/or Severity: CMF = 0.43 [57% crash reduction] for pedestrian-vehicle crashes and CMF = 0.88 [12% crash reduction] for vehicle-vehicle crashes (CMF Clearinghouse, 2018)

Brief Description: This treatment is designed to help pedestrians safely cross multilane streets and/or higher-speed roadways at uncontrolled, marked crosswalks. The beacon head consists of three lenses. The beacon is activated by pedestrians wanting to cross the street. Once pedestrian has crossed the street, the hybrid beacon turns dark. An example of pedestrian hybrid beacon mounted on a mast arm is shown in Figure 7.



Figure 7 Example of a Pedestrian Hybrid Beacon Mounted on a Mast Arm [Source: (FHWA, 2015)].

Why was this selected for Town of Colma?

There are two marked, uncontrolled pedestrian crosswalks across El Camino Real which is a multilane roadway with higher vehicle speeds. Kittelson recommends implementing at Pedestrian Hybrid Beacon at those two locations. The Town could also consider them for other locations with similar characteristics.

h) Install Sidewalks (R37)

Planning-Level Cost Estimate: \$15 - \$20 per square foot (Town of Colma, 2018).

Eligible for Federal Funding (Source: Caltrans Road Safety Manual): Yes (90%).

Potential Effectiveness at Reducing Crash Frequency and/or Severity: CMF = 0.20 [80%].

Brief Description: This treatment provides a separate, protected space for pedestrians to walk along the roadway. It helps to increase comfort, increase visibility of pedestrians to motorists, and can help prevent vehicles from departing the roadway and striking pedestrians. An example sidewalk is shown in Figure 8.



Figure 8 Example of Sidewalk along Corridor

Why was this selected for Town of Colma?

This treatment was selected for the Town of Colma along the corridors on one side or both sides where there sidewalk facilities are not present, and there is a greater potential for or existing pedestrian activity.

i) Install Bicycle Lanes [Class II] (R36)

Planning-Level Cost Estimate: \$10 - \$15 per linear foot (Town of Colma, 2018).

Eligible for Federal Funding (Source: Caltrans Road Safety Manual): Yes (90%).

Potential Effectiveness at Reducing Crash Frequency and/or Severity: CMF = 0.40 – 0.73 [27% - 60% crash reduction] (CMF Clearing House, 2018).

Brief Description: This treatment defines specific space within the street cross-section for bicyclists. It can increase driver awareness of the bicyclists along a street. An example bicycle lane is shown in Figure 9.

Why was this selected for Town of Colma?

To address gaps in bicycle facilities within Colma. Larger streets, with multiple vehicle lanes, should consider buffered bicycle lanes, separated bicycle lanes, or parallel multiuse paths. These could be implemented through road diets (see treatment “m” further below).



Figure 9 Example of Bike Lane on the Roadway

j) Speed Feedback Signs (R30)

Planning-Level Cost Estimate: \$2,000 - \$11,000 per sign (Hallmark & Hawkins, 2014).

Eligible for Federal Funding (Source: Caltrans Road Safety Manual): Yes (100%).

Potential Effectiveness at Reducing Crash Frequency and/or Severity: CMF = 0.93 – 0.95 [5% - 7% crash reduction] (CMF Clearing House, 2018).

Brief Description: This treatment is designed to provide a message to drivers exceeding a certain speed threshold. They are also known as dynamic warning signs, radar speed/message signs, and dynamic speed display signs. An example speed feedback sign is shown in Figure 10.

Why was this selected for Town of Colma?

Colma has several multilane streets that appear designed for peak shopping hours on the weekend. Throughout much of the weekday and other off-peak periods, the multilane streets enable motorists to travel speeds exceeding the speed limit. This is one of several systemic treatments identified to try to manage speeds during off-peak periods.



Figure 10 Example of a Speed Feedback Sign [Source: <http://images.policemag.com/articles/M-TrafficEnforcement.jpg>]

k) Sight Distance Improvements (NS10)

Planning-Level Cost Estimate: Varies

Eligible for Federal Funding (Source: Caltrans Road Safety Manual): Yes (90%).

Potential Effectiveness at Reducing Crash Frequency and/or Severity: CMF = 0.44 – 0.89 [11% - 56% crash reduction] (CMF Clearing House, 2018).

Brief Description: Sight distance improvements can often be achieved by clearing sight triangles to restore sight distance obstructed by vegetation, roadside appurtenances, buildings, bus stations, and other objects which are in the right-of-way. The other strategy to improve sight distance is to eliminate on-street parking that restricts sight distance especially on approach to or adjacent to intersections. Figure 11 is an example of a sight triangle for an intersection.

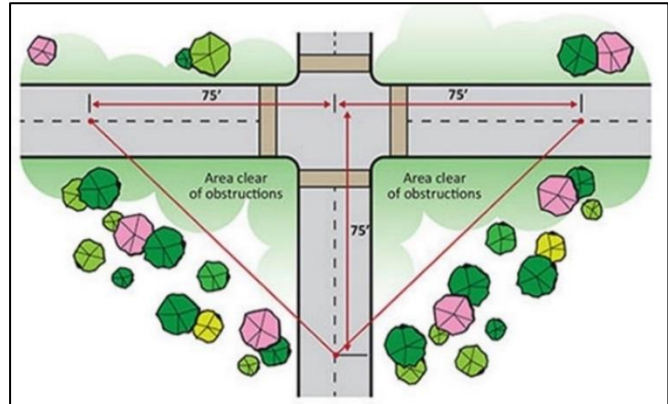


Figure 11 Example of Intersection Sight Distance
[Source: <http://www.mikeontraffic.com/sight-distance-explained/>]

Why was this selected for Town of Colma?

This treatment was selected for the Town of Colma based on community comments and

Kittelson field observations that some locations within Colma may be easier for road users to navigate if sight distance was increased.

I) Road Diets (R15)

Planning-Level Cost Estimate: \$6 - \$10 per linear foot (changes to pavement marking only) (Town of Colma, 2018).

Eligible for Federal Funding (Source: Caltrans Road Safety Manual): Yes (90%).

Potential Effectiveness at Reducing Crash Frequency and/or Severity: CMF = 0.53 – 0.71 [29% - 47% crash reduction] (CMF Clearing House, 2018).

Brief Description: Reduce the number of vehicle lanes on a roadway to manage vehicle speeds and reduce risk of crashes for all road users. A common road diet is to convert a four-lane undivided roadway to a three-lane cross-section, with one lane in each direction and a two-way center left turn lane. This enables space for bicycle lanes and sidewalks. An example three-lane cross-section, i.e. road diet is shown in Figure 12.

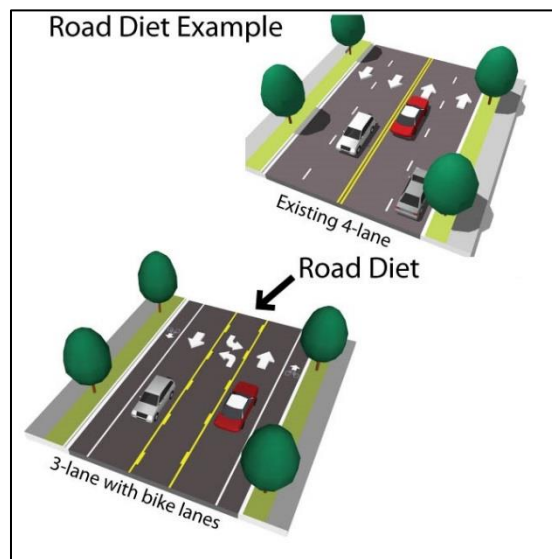


Figure 12 Road Diet Example

Why was this selected for Town of Colma?

Colma has several multilane streets that appear designed for peak shopping hours on the weekend. Throughout much of the weekday and other off-peak periods, the multilane streets enable motorists to travel speeds exceeding the speed limit. This is one of several systemic treatments identified that would reduce motorists' speeds, provide additional space for bicyclists and/or pedestrians, and help provide vehicular access for turning into and out of commercial and business driveways along streets such as Colma Boulevard and Serramonte Boulevard.

The resulting benefits of road diets include a crash frequency and/or severity reduction, reduced vehicle speed differential, improved mobility and access for all types of users, and integration of roadway into surrounding uses that enhance the quality of life of people living in the community.

m) Road Segment Edgelines (R32)

Planning-Level Cost Estimate: \$1.50 - \$2.00 per linear foot (Town of Colma, 2018).

Eligible for Federal Funding (Source: Caltrans Road Safety Manual): Yes (100%)

Potential Effectiveness at Reducing Crash Frequency and/or Severity: CMF = 0.55 [45% crash reduction] (CMF Clearing House, 2018).

Brief Description: This treatment involves installing/marking the edge lines of the roadway along the corridors. Kittelson proposes this treatment in places where the lanes are wide and edge lines can help narrow the travel lanes in support of reduced speeds. An example of the treatment is shown in Figure 13.



Figure 13 Example of Edgelines

Why was this selected for Town of Colma?

This treatment was selected for the Town of Colma to help manage vehicle speeds on roadways throughout the Town.

n) Upgrade Street name Signs

Planning-Level Cost Estimate: \$750 - \$1,250 per sign, assuming 10' long and 2' tall on average (Town of Colma, 2018).

Eligible for Federal Funding (Source: Caltrans Road Safety Manual): No

Potential Effectiveness at Reducing Crash Frequency and/or Severity: CMF = 0.98 [2% crash reduction] (CMF Clearing House, 2018).

Brief Description: At intersections with multiple lanes coming together across the two intersecting streets, larger street name signs posted on mast arms help improve wayfinding. An example of larger street name signs for such contexts is shown in Figure 14.



Figure 14 Example of Larger Street Name Sign [Source: City of Windsor, Ontario]

Why was this selected for Town of Colma?

Given some of the large intersections, increased street names could help ease wayfinding for road users.

o) Gateway Treatments

Planning-Level Cost Estimate: Varies

Eligible for Federal Funding (Source: Caltrans Road Safety Manual): No

Potential Effectiveness at Reducing Crash Frequency and/or Severity: NA.

Brief Description: This treatment involves applying the gateway treatments to the Town at the entrance and exits, i.e. boundaries and is intended to mark the transition to the town. An example gateway treatment is shown in Figure 15.



Figure 15 Example Gateway Treatment
[Source: City of Rochester, NY]

Why was this selected for Town of Colma?

There are a number of entry points to Colma along major arterials. This treatment was selected as an example of potential scale of such gateways given the scale of the roadways providing access to Colma.

p) Upgrade Stop Signs, Warning and Regulatory Signs (NS5)

Planning-Level Cost Estimate: \$450 - \$1,020 per sign, assuming 7' sign post (VDOT, 2018).

Eligible for Federal Funding (Source: Caltrans Road Safety Manual): Yes (100%)

Potential Effectiveness at Reducing Crash Frequency and/or Severity: CMF = 0.66 – 0.70 [30% - 24% crash reduction] (FHWA Office of Safety, 2018).

Brief Description: This treatment improves stop, warning and regulatory sign visibility at intersections and/or intersection approaches. An example of a regulatory is shown in Figure 16.



Figure 16 Example of a Stop Sign [Source: (FHWA Office of Safety, 2018)].

Why was this selected for Town of Colma?

During field reviews, Kittelson observed a few locations where sign height could be increased to improve visibility and sign type could be improved to clarify the messages for motorists.

q) Access Management

Planning-Level Cost Estimate: Highly variable.

Eligible for Federal Funding (Source: Caltrans Road Safety Manual): No

Potential Effectiveness at Reducing Crash Frequency and/or Severity: CMF = 0.93 [7% crash reduction] (CMF Clearing House, 2018).

Brief Description: This treatment improves access management on the corridors by implementing driveway consolidations and driveway relocations. This treatment also involves implementing driveway turn restrictions along the corridors. This is done to decrease the vehicle conflicts, while helping to clarify access to businesses.

Why was this selected for Town of Colma?

This treatment was selected for the Town of Colma because there are some corridors along which the businesses have multiple driveways and accesses that are in close proximity to each other.

r) Street Lighting (NS1/R1)

Planning-Level Cost Estimate: \$5,000 - \$10,000 (Town of Colma, 2018).

Eligible for Federal Funding (Source: Caltrans Road Safety Manual): Yes (100%)

Potential Effectiveness at Reducing Crash Frequency and/or Severity: CMF = 0.63 [37% crash reduction] (CMF Clearing House, 2018).

Brief Description: This treatment involves installing lighting on roadway segments and at unsignalized intersections. This is done to increase the visibility of non-motorized users to drivers and decrease the crashes.

Why was this selected for Town of Colma?

This treatment was selected for the Town of Colma because there are some roadway segments and unsignalized intersections that have crashes due to non-motorized users not being visible to the drivers, especially during the night time.

2.2 POTENTIAL LOCATIONS FOR SYSTEMIC TREATMENTS

Kittelton identified the following locations as candidates for receiving one or more of the systemic treatments. These locations were identified based on their crash patterns and trends, roadway characteristics present, and observations from the field reviews. Figures 17 through 19 show the different locations at which the above discussed systemic treatments could be implemented in the Town.

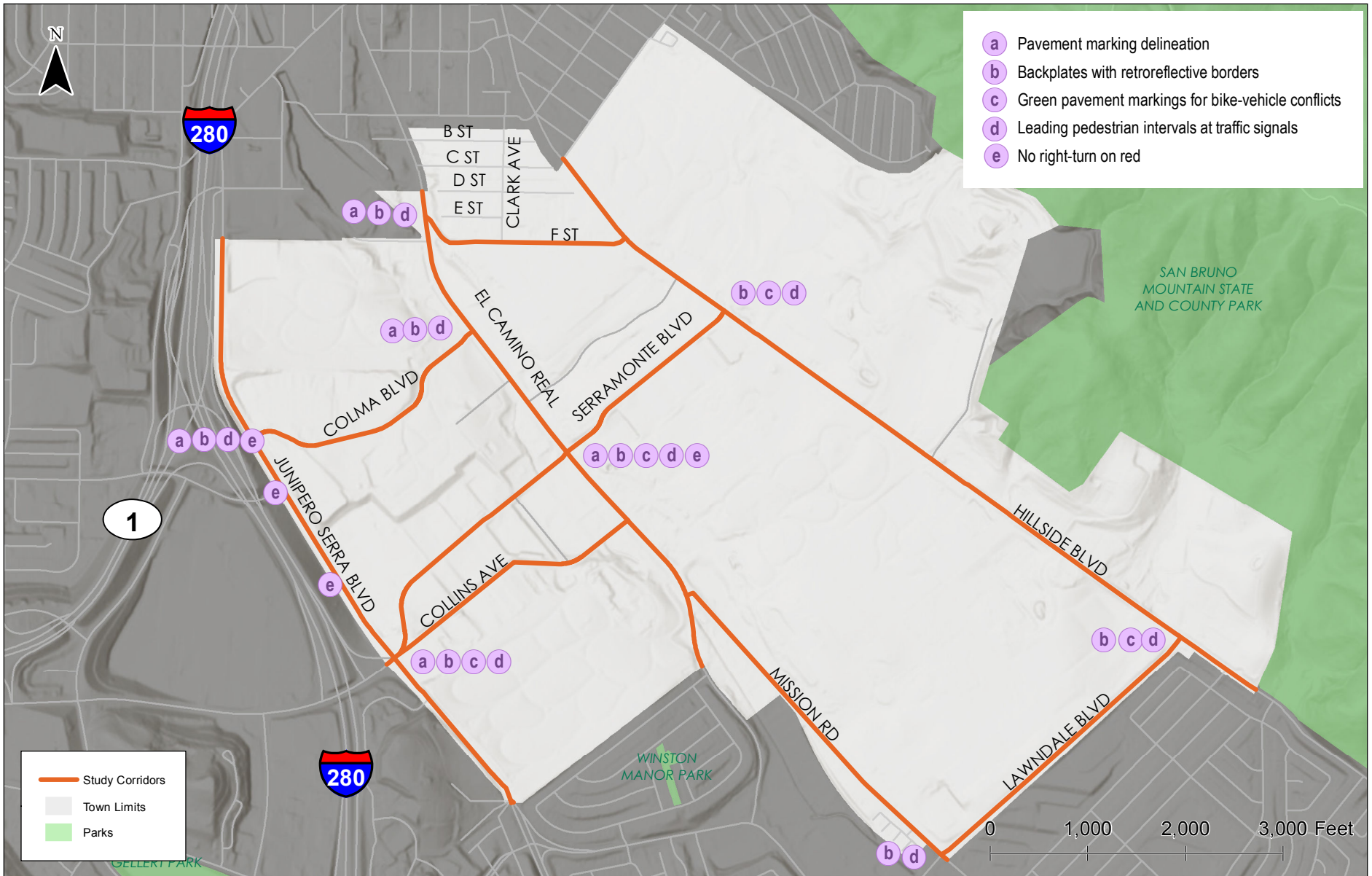


Figure 17

Town of Colma
CIP 993 Systemic Safety Analysis Report Project
Systemic Treatments at Signalized Intersections

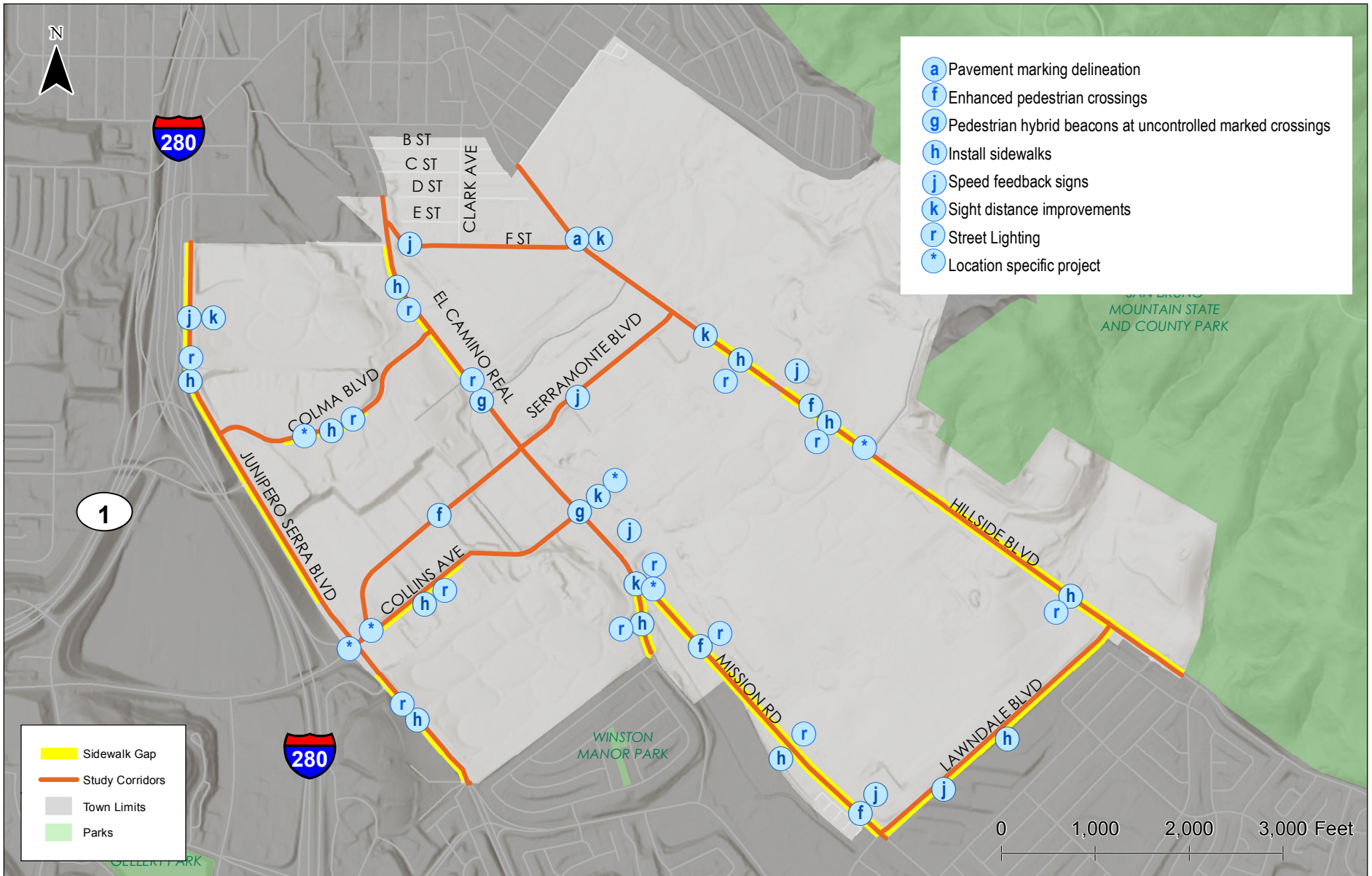


Figure 18 **Town of Colma**
CIP 993 Systemic Safety Analysis Report Project
Systemic Treatments at Unsignalized Intersections and Segments

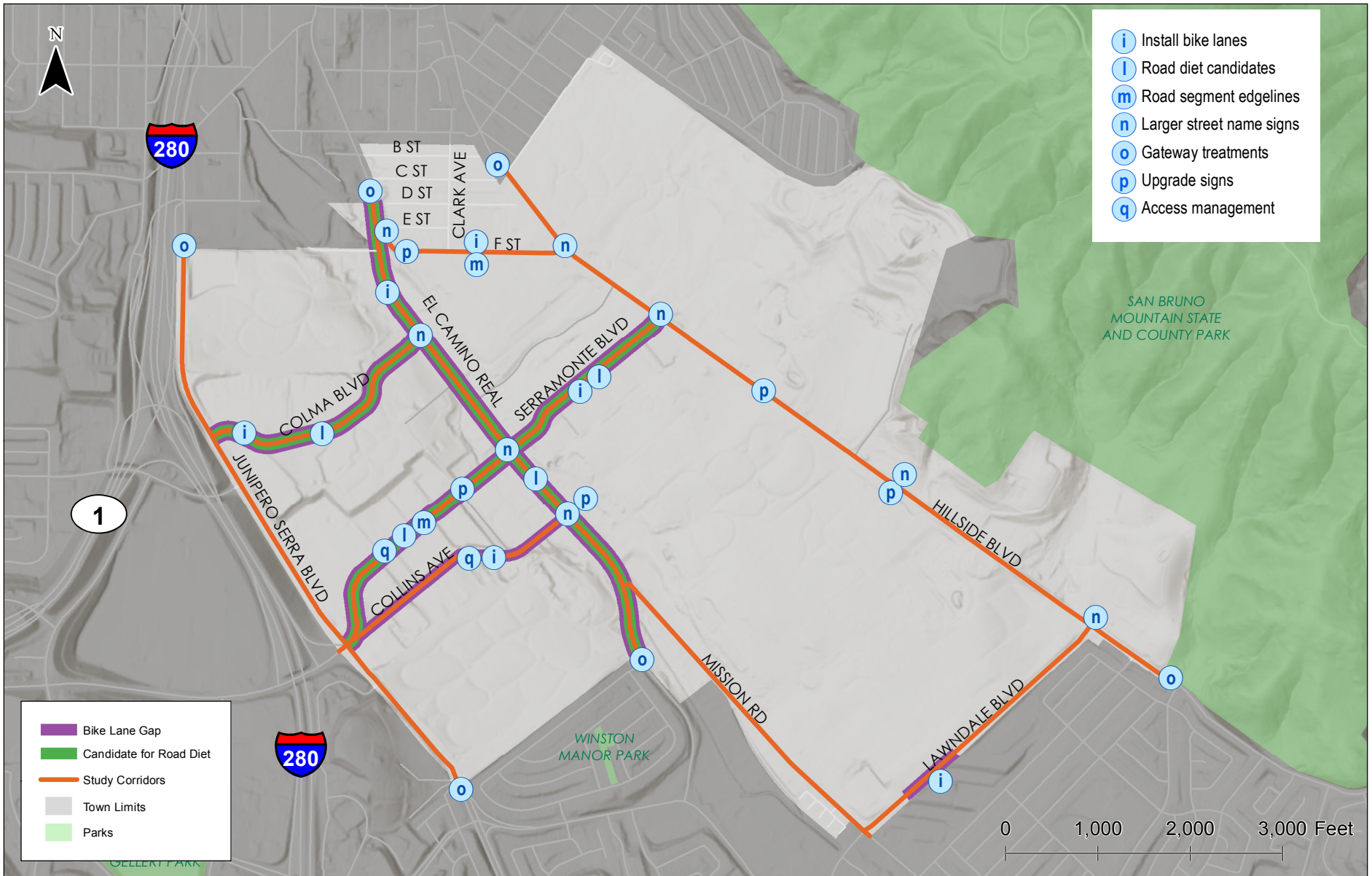


Figure 19 **Town of Colma**
CIP 993 Systemic Safety Analysis Report Project
Systemic Treatments at Unsignalized Intersections and Segments

SUMMARY>>

The following are key points regarding the systemic treatments:

- ▶ Systemic treatments are a proactive way to help reduce the potential for crashes throughout the Town.
- ▶ Systemic treatments could be first applied at priority corridors and intersections.
- ▶ The planning level cost estimates, and the estimated safety effectiveness included for each systemic treatment can inform implementation at the study corridors while serving as a basis to implement treatments at non-study locations.

3.0 LOCATION-SPECIFIC PROJECTS

Kittelson identified locations that could benefit from specific, unique (non-systemic) location-specific projects to help reduce the potential for crashes. This section identifies those locations and describes those potential improvements.

3.1 POTENTIAL LOCATIONS FOR LOCATION-SPECIFIC PROJECTS

These locations were identified based on their crash patterns and trends, roadway characteristics present, and observations from the field reviews. The following sections outline the existing conditions at the locations and the potential location-specific projects (that are different than the systemic treatments discussed in the previous section).

IN THIS SECTION >>

- ▶ Locations identified as potentially benefiting from additional improvements
- ▶ Potential location-specific projects to help reduce crash frequency and/or severity

Mission Road/El Camino Real Intersection

Existing Conditions

Kittelson observed the El Camino Real (ECR) intersection is an unusual configuration with Mission Road intersecting ECR at a skew and free flow northbound movement from Mission Road to ECR. The skew results in long crossings of conflicting movements and the 40 mph posted speed limits gaps for drivers negotiating the stop controlled movements. The free flow movement creates a weaving section northbound for Mission Road drivers that are destined for Collins Avenue and/or the cemetery or commercial uses located south of Collins Avenue on the western side of ECR.

Proposed Location-Specific Projects

a) Consider Intersection Control Evaluation

Kittelson recommends the Town evaluate the existing intersection to consider changes in the traffic control. The intersection control evaluation (ICE) should consider geometric modifications and possible applications of stop, yield (roundabout), or signalized control. This is shown in Figure 20.



Figure 20 Location along Mission Road In Need of Traffic Control.

For a Stop Control:

Planning-Level Cost Estimate: \$450 - \$1,020 per sign, assuming 7' sign post (VDOT, 2018).

Eligible for Federal Funding (Source: Caltrans Road Safety Manual): Yes (100%).

Potential Effectiveness at Reducing Crash Frequency and/or Severity: 0.49 [51% crash reduction] (CMF Clearing House, 2018).

For a Yield Control (Roundabout):

Planning-Level Cost Estimate: \$194,000 - \$500,000 (FHWA, 2018)

Eligible for Federal Funding (Source: Caltrans Road Safety Manual): Yes (100%).

Potential Effectiveness at Reducing Crash Frequency and/or Severity: 0.54 – 0.87 [13% - 46% crash reduction] (CMF Clearing House, 2018).

For a Signal Control:

Planning-Level Cost Estimate: \$50,000 - \$200,000 (ITE, 2018).

Eligible for Federal Funding (Source: Caltrans Road Safety Manual): Yes (100%).

Potential Effectiveness at Reducing Crash Frequency and/or Severity: 0.56 - 0.65 [35% - 44% crash reduction] (CMF Clearing House, 2018).

Hillside Boulevard from Serramonte Boulevard/Hillside Boulevard Intersection to Hillside Boulevard/Lawndale Boulevard Intersection

Existing Conditions

Kittelson observed people walking and biking along Hillside Boulevard in the area between Serramonte/Hillside Boulevard intersection and Hillside/Lawndale Boulevard Intersection. It was evident that some of the activity was the result of the businesses and cemeteries along Hillside. Countermeasures that accommodate these travel patterns and road users along and crossing Hillside Boulevard (including the Serramonte/Hillside Boulevard intersection) could be implemented. The existing roadway configuration is shown in Figure 21.



Figure 21 Existing Roadway Configuration on Hillside Boulevard

Proposed Location-Specific Projects

b) Reconfiguring roadway cross-section to install sidewalk and striped bike lanes

Kittelson recommends the Town consider installing sidewalk and bicycle facility along the corridor where these facilities are not present. There could be sufficient space to provide an adjacent, raised multiuse path for portions of this segment. Alternative configurations could be considered to determine the most optimal given the on-street parking needs and walking/biking needs to access the businesses and cemeteries. These changes would help increase driver awareness and visibility of the non-motorized users, and reduce motorist speeds along the corridor. The planning level cost estimate and potential effectiveness of such changes would depend on the preferred roadway cross-section configuration selected.

All Way Stop Control Consistency on Colma Boulevard

Existing Conditions

Kittelson observed that the Colma Boulevard corridor has inconsistency in the stop control. At the intersection near Best Buy, the intersection has an all-way stop control. At the immediate intersection westbound on Colma Boulevard towards Junipero Serra Boulevard, there is stop control only on the driveway to the shopping center. This inconsistency could violate driver expectancy while traveling along Colma Boulevard.

Proposed Location-Specific Projects

c) Consider all way stop control consistency

Kittelson recommends the Town consider evaluating the two intersections to determine if all-way stop control or two-way stop control are the most appropriate. The information on planning level cost estimates, funding eligibility, and the potential safety effectiveness for stop control are discussed above as part of Mission Road ICE project discussion.

Reconfiguring Junipero Serra Boulevard/Serramonte Boulevard Intersection

Existing Conditions

The Junipero Serra Boulevard/Serramonte Boulevard intersection is controlled by a traffic signal and includes access to the I-280 on-ramp. Figure 22 shows in an aerial of the five-legged Junipero Serra Boulevard/Serramonte Boulevard intersection.



Figure 22. Junipero Serra Boulevard/Serramonte Boulevard and Serramonte Boulevard/Collins Avenue Intersections [Source: Google Earth, Accessed 2018]

Serramonte Boulevard curves horizontally through the intersection with Collins Avenue and in the eastbound direction beings to drop down vertically. As a result, the current alignment creates sight distance challenges for turning motorists as well as limited time to react to the different movements and activities occurring at the intersection. The multiple legs of the intersection and access to I-280 also requires multiple lanes, overhead signs, and pavement markings on the northbound and eastbound approaches to pre-segregate motor vehicles into the proper lanes based on motorists' desired destinations.

Proposed Location-Specific Projects

d) Reconfiguring Junipero Serra Boulevard/Serramonte Boulevard Intersection

The Town could consider options to simplify the Junipero Serra Boulevard/Serramonte Boulevard intersection to reduce the amount of decisions that drivers need to make to successfully navigate the intersection. For example, one option that could be explored, would be to eliminate the connection to I-280 that occurs at the intersection and instead have motorists use the ramp access on Serramonte Boulevard that is approximately 250 feet to the west of the intersection. Signal coordination adjustments may need to be made with that adjacent signal; however, such a change would simplify the intersection and help simplify and reduce conflicts at the adjacent Serramonte Boulevard/Collins Avenue intersection as well.

Reconfiguring Serramonte Boulevard/Collins Avenue Intersection

Existing Conditions

The Serramonte Boulevard/Collins Avenue intersection is stop controlled on the Collins Avenue approach. Figure 25 shows an aerial that includes the Serramonte Boulevard/Collins Avenue intersection (intersection to the right in the figure). In addition to the sight distance challenges on Serramonte Boulevard for motorists

because of the horizontal curve alignment, the Serramonte Boulevard/Collins Avenue intersection is also missing a marked pedestrian crossing across the Collins Avenue approach.

Proposed Location-Specific Projects

e) Reconfiguring Serramonte Boulevard/Collins Avenue Intersection

Kittelson recommends the Town explore options to realign the Serramonte Boulevard/Collins Avenue intersection to try to improve sight distance, add a pedestrian marked crosswalk across Collins Avenue, and minimize the pedestrian crossing distance across Collins Avenue. The reconfiguration would need to take into account and design for the necessary large vehicles that need to access the businesses along Collins Avenue.

Collins Avenue/El Camino Real Intersection

Existing Conditions

The El Camino Real (ECR)/Collins Avenue intersection is situated between ECR/Mission Road intersection and ECR/Serramonte Boulevard intersection. There is an existing, marked, uncontrolled crosswalk at this location for pedestrians to cross ECR. On-street parking is permitted on approach to the intersection along ECR. There are three vehicle lanes southbound at the intersection, one of which is marked as being eliminated as it passes through the intersection. There are also three lanes northbound through the intersection and a center median. Figure 23 shows an aerial of the intersection.

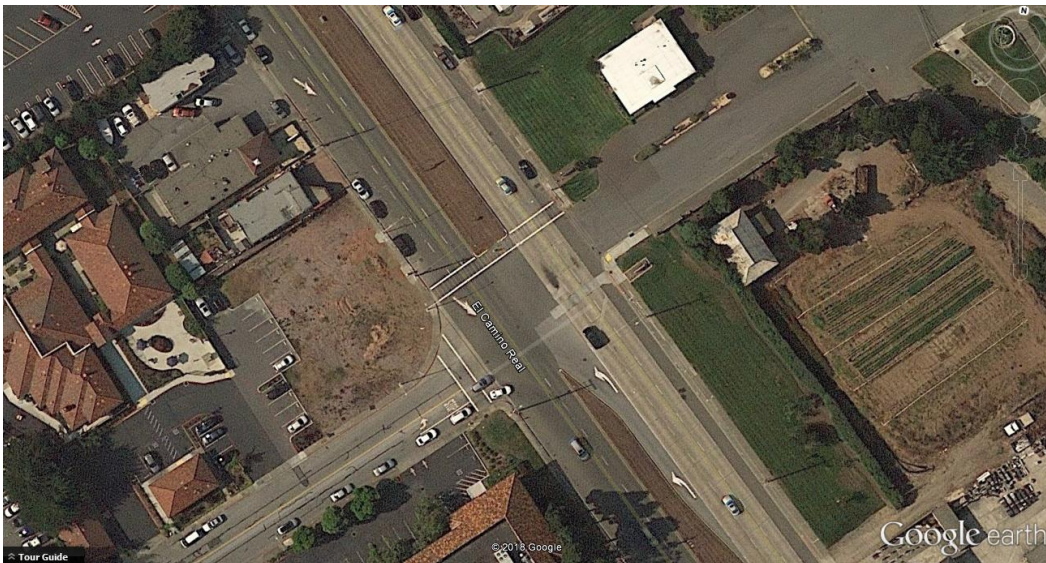


Figure 23. Collins Avenue/El Camino Real Intersection

If the need for intersection control at ECR/Mission Road is realized, it would be better to consider some intersection control at the ECR/Collins Avenue intersection as well. The additional lanes on ECR approaching Collins Avenue need to be tapered to reduce the pedestrian crossing distance at the intersection.

Proposed Location-Specific Projects

f) Consider Additional Intersection Enhancements

As part of the potential systemic treatments, Kittelson suggested considering implementing a Pedestrian Hybrid Beacon at this location to facilitate pedestrian crossings across ECR at the existing marked, uncontrolled crosswalk. To further reduce the potential risk for crashes at this location, the Town could also consider:

- ▶ Eliminating the southbound lane drop through the intersection so the lane is dropped north of the intersection to arrive at two southbound through lanes;
- ▶ Eliminating one of the northbound through lanes to shorten the crossing distance;
- ▶ Further restricting on-street parking adjacent to the crosswalk and intersection to increase the available sight distance for motorists on Collins Avenue and pedestrians waiting to cross ECR;
- ▶ Evaluating the feasibility of implementing a traffic signal at the location, which would include conducting signal warrant analysis.

Figure 24 identifies the locations for the potential unique, location-specific projects that could be implemented across the Town.

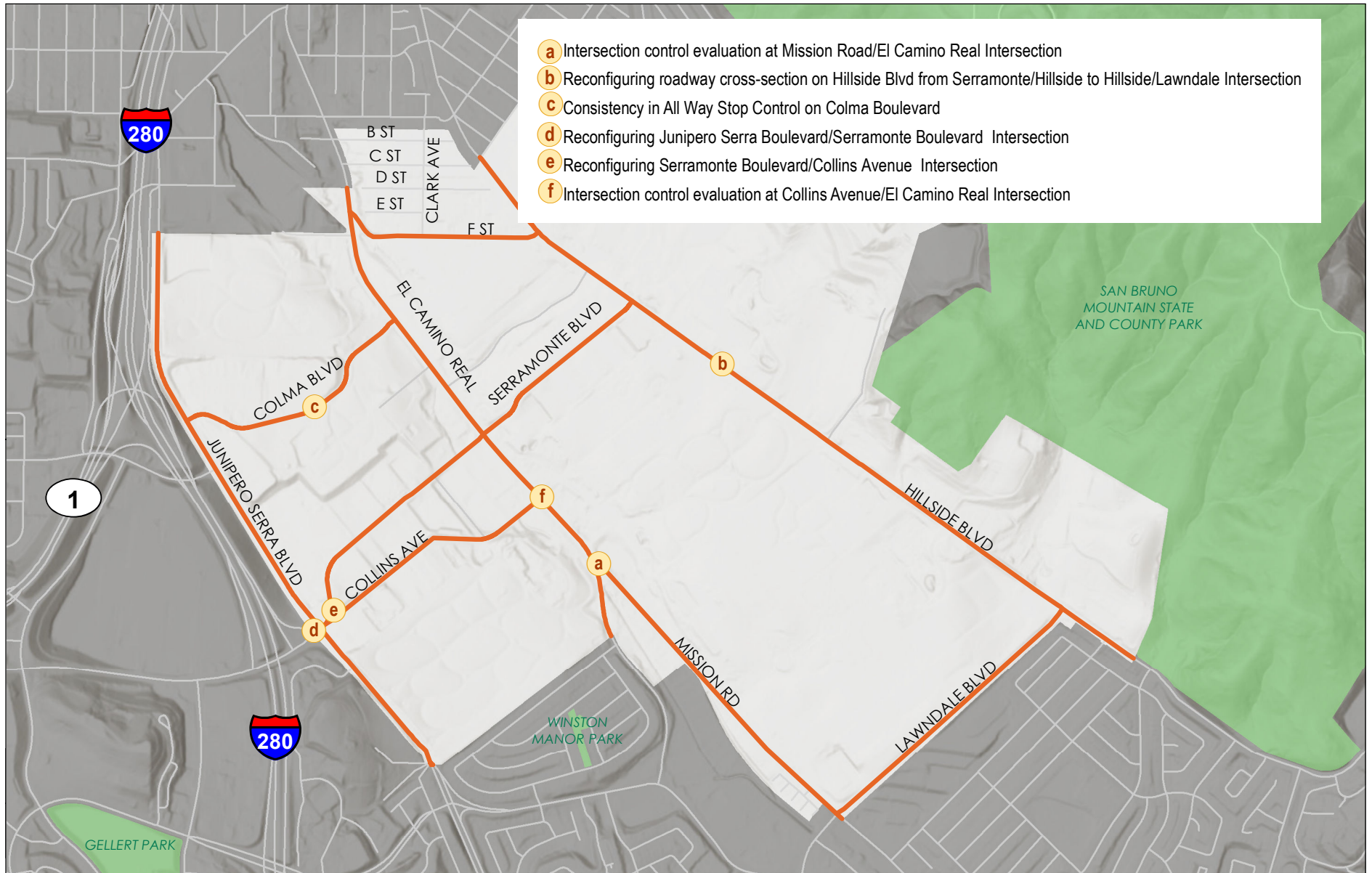


Figure 24

Town of Colma
CIP 993 Systemic Safety Analysis Report Project
Location Specific Improvements

3.2 SUMMARY OF LOCATIONS

Table 2 provides a summary of the location, brief description of the potential location-specific projects, planning-level cost range, and potential effectiveness at reducing crash frequency and/or severity.

Table 2 Summary of the Location Specific Projects and the Related Information

Treatment (With Location)	Cost Range	CMF [% Crash Reduction]
a) Intersection Control Evaluation at Mission Road/El Camino Real <ul style="list-style-type: none"> ➤ Stop Control ➤ Yield Control (Roundabout) ➤ Signal Control 	\$450 - \$1,020 per sign, assuming 7' sign post \$194,000 - \$500,000 \$50,000 - \$200,000	0.49 [51%] 0.54-0.87 [13% - 46%] 0.56-0.65 [35% - 44%]
b) Reconfiguring Roadway Cross-section on Hillside Boulevard from Lucky Chances Casino driveway to Sand Hill Road <ul style="list-style-type: none"> ➤ Sidewalks ➤ Bike lane striping 	\$8.04 - \$9.90 (per square-foot) \$250 - \$270 (per stencil)	NA. NA.
c) All Way Stop Control consistency on Colma Boulevard	\$450 - \$1,020 per sign, assuming 7' sign post	0.49 [51%]
d) Reconfiguring Junipero Serra Boulevard/Serramonte Boulevard Intersection	Varies	NA.
e) Reconfiguring Serramonte Boulevard/Collins Avenue Intersection	Varies	NA.
f) Intersection Control Evaluation at Collins Avenue/El Camino Real <ul style="list-style-type: none"> ➤ Signal Control 	\$50,000 - \$200,000	0.56-0.65 [35% - 44%]

SUMMARY>>
 The following are key findings regarding location-specific projects:

- Location-specific projects address potential changes that are unique from the systemic treatments.
- These projects are intended to help further reduce the potential of crashes for road users.

Table 3 provides a summary of the location, and brief description of the potential systemic and location-specific projects for each corridor in the town.

Table 3 Summary of the Systemic and Location Specific Projects for each Corridor

Corridor	Systemic Treatments	Location-specific Treatment
El Camino Real	<ul style="list-style-type: none"> *Pavement marking delineation *Backplates with retroreflective borders *Green pavement markings for bike-vehicle conflicts *LPs at traffic signals *Install sidewalks *Install PHBs at uncontrolled marked crossings *Sight-distance improvements *Speed-feedback signs *Gateway treatments *Larger street-name signs *Install bike lanes *Road-diet candidate *Street lighting 	<p>Intersection Control Evaluation at Mission Road/El Camino Real</p> <p>Intersection Control Evaluation at Collins Avenue/El Camino Real</p>
Junipero Serra Boulevard	<ul style="list-style-type: none"> *Pavement marking delineation *Backplates with retroreflective borders *LPs at traffic signals *No right-turn on red *Install sidewalks *Sight-distance improvements *Speed-feedback signs *Gateway treatments *No right-turn on red *Street lighting 	<p>Reconfiguring Junipero Serra Boulevard/Serramonte Boulevard/ Intersection</p>
Hillside Boulevard	<ul style="list-style-type: none"> *Pavement marking delineation *Backplates with retroreflective borders *Green pavement markings for bike-vehicle conflicts *LPs at traffic signals *Install sidewalks *Sight-distance improvements *Speed feedback signs *Enhanced pedestrian crossings *Larger street-name signs *Upgrade signs *Gateway treatments *Street lighting 	<p>Reconfiguring roadway cross-section from Serramonte/Hillside Boulevard Intersection to Hillside/Lawndale Boulevard Intersection</p>

Corridor	Systemic Treatments	Location-specific Treatment
Mission Road	<ul style="list-style-type: none"> *Backplates with retroreflective borders *LPs at traffic signals *Sight-distance improvements *Speed feedback signs 	Intersection Control Evaluation at Mission Road/El Camino Real
Serramonte Boulevard	<ul style="list-style-type: none"> *Pavement marking delineation *Backplates with retroreflective borders *Green pavement markings for bike-vehicle conflicts *LPs at traffic signals *No right-turn on red *Larger street-name signs *Enhanced Pedestrian Crossings *Install bike lanes *Road-diet candidate *Upgrade signs *Access management *Road segment Edgelines 	Reconfiguring Serramonte Boulevard/Collins Avenue Intersection Reconfiguring Junipero Serra Boulevard/Serramonte Boulevard/ Intersection Reconfiguring roadway cross-section from Serramonte/Hillside Boulevard Intersection to Hillside/Lawndale Boulevard Intersection
Collins Avenue	<ul style="list-style-type: none"> *Pavement marking delineation *Backplates with retroreflective borders *Green pavement markings for bike-vehicle conflicts *LPs at traffic signals *Install sidewalks *Larger street-name signs *Install bike lanes *Upgrade signs *Access management *Install PHBs at uncontrolled marked crossings *Sight-distance improvements *Street lighting 	Reconfiguring Serramonte Boulevard/Collins Avenue Intersection Intersection Control Evaluation at Collins Avenue/El Camino Real
Colma Boulevard	<ul style="list-style-type: none"> *Pavement marking delineation *Backplates with retroreflective borders *LPs at traffic signals *No right-turn on red *Install sidewalks *Larger street-name signs *Install bike lanes *Road-diet candidate 	Consistency in All Way Stop Control

Corridor	Systemic Treatments	Location-specific Treatment
	*Street lighting	
Lawndale Boulevard	*Backplates with retroreflective borders *Green pavement markings for bike-vehicle conflicts *LPs at traffic signals *Install sidewalks *Speed-feedback signs *Install bike lanes *Larger street name signs *Street lighting	Reconfiguring roadway cross-section from Serramonte/Hillside Boulevard Intersection to Hillside/Lawndale Boulevard Intersection
F Street	*Pavement marking delineation *Backplates with retroreflective borders *LPs at traffic signals *Sight-distance improvements *Speed-feedback signs *Larger street-name signs *Install bike lanes *Road segment edgelines *Upgrade signs	NA.

4.0 POLICY, EDUCATION, & ENFORCEMENT STRATEGIES

Kittelton identified the following potential roadway safety related policies; education strategies; and enforcement strategies to complement engineering treatments and projects discussed above.

IN THIS SECTION >>

Potential policy, education, and enforcement strategies that could be pursued by the Town

4.1 ROADWAY SAFETY RELATED POLICIES

Kittelton recommends the Town of Colma consider establishing a Vision Zero policy to place an emphasis on improving roadway safety.

'Vision Zero' Policy

The goal of Vision Zero is based on the institutionalized, system-level change for the Town of Colma. This Vision Zero policy will build safety and livability into the streets of the Town of Colma, protecting the people who move about the Town every day. The key priorities for road safety culture in the Town of Colma include:

- Eliminating the fatal and severe injury crashes, and promoting safe road user behavior throughout the Town;
- Protecting non-motorized users, pedestrians and bicyclists, through infrastructure improvements;
- Using different forms of education to inform road users of the risks posed to the non-motorized users;
- Using education and enforcement strategies to discourage motorists from driving under the influence of alcohol, dangerous drugs, or other substances; and
- Using roadway design and enforcement strategies to encourage motorists to travel the posted speeds or slower on the roadways.

An example Vision Zero purpose statement that the Town of Colma can modify or develop further.

"The Town of Colma's commitment to Vision Zero is based on the principle of Crash Severity, i.e. fatalities and serious injuries on our roadways, which are not acceptable and preventable. The Town of Colma and its partner jurisdictions commit to achieve a vision of zero fatalities and serious injuries on our roadways. This will be accomplished through developing, implementing and monitoring a comprehensive and multidisciplinary Transportation Safety Action Plan that is data informed and facilitates routine investment in roadway safety improvements."

4.2 EDUCATION STRATEGIES

Education strategies are focused on teaching road users road safety principles. These strategies can be developed to include interactive activities, comprehensive teaching notes, and information on road safety messages and concepts that can be taught at school or in the off-school activities.

a) Road Safety Education to Children

The road safety education to children includes strategies such as safe routes to school, walking school bus, and bicycle trains that promote road safety to all users, particularly the non-motorized users. A 'safe routes to school' program encourages and enables children to walk and bike to school. This can improve their health, well-being, and safety. This also results in less traffic congestion and emissions caused by school-related travel. Walking school buses and bicycle trains encourage groups of children walking or biking to school, with one or more adults. The walking school buses and bicycle trains have been put into practice by some of the schools in Sacramento, California; Chapel Hill, North Carolina; and Duluth, Georgia (SRTS Guide, 2018). These strategies or practices have shown communities and families that walking and biking can be a viable and safe transportation option, and thus can be incorporated into their own daily travel patterns.

b) Speed Monitoring Awareness Radar Trailer

The speed trailer is an educational device that helps drivers become more aware of their speed in relation to the posted speed. This awareness tool can also help residents survey the traffic speeds in their own neighborhood. This trailer is usually deployed in a street or neighborhood for a few days so the residents can monitor the speeds on their own streets and become aware of their own driving behaviors.

c) Vulnerable Road User Education

The road safety education regarding vulnerable road users like pedestrians, bicyclists, and motorcyclists includes strategies involving education from police officer. If the driver encroaches into the bike lane or fails to yield to the pedestrian at the crossing, the police officer pulls the driver over and hands them a flyer that has the information for drivers to adapt their behavior towards all road users; this can be in addition to a citation.

4.3 ENFORCEMENT STRATEGIES

Crash data can help identify the priority locations and/or road segments and the times of the day when the crashes have occurred. This information can inform and guide the type of enforcement strategy to be selected at the most appropriate locations and time periods. Kittelson suggests the Town consider three types of enforcement strategies. They are as follows:

a) Enhanced Police Enforcement

Deploy enhanced police enforcement on Hillside Boulevard near the casino. The crash data showed 40% of crashes on Hillside Boulevard were classified as driving under the influence of alcohol or drugs (DUI). There were two fatal crashes over the last five years along this corridor, and one of them was associated with a DUI. Enhanced police enforcement in this corridor and other corridors with speeding-related crashes, may reduce fatal and severe injury crashes.

b) Photo Enforcement

Deploy safety cameras solely to assist in reducing fatal and severe injury related crashes. The Town of Colma could use camera enforcement at traffic signals to detect drivers' red light running or along priority corridors to identify speeding-drivers.

c) Speed Survey and Enforcement Campaigns

Focus enforcement using data to pinpoint streets exhibiting speeding and crashes with non-motorized users. The Town could launch a campaign with a series of radio or television advertisements to raise awareness about the dangers of speeding and encourage safe driving behavior.

SUMMARY>>

The following are the potential education and enforcement strategies:

- ▶ Vision Zero Policy
 - Encourage and enable consistent, intentional investment in reducing the risk of crashes
 - Monitor progress to be able to continually reassess and adjust, as needed
- ▶ Education Strategies
 - Road Safety Education to Children; and
 - Speed Monitoring Awareness Radar Trailer; and
 - Vulnerable Road User Education.
- ▶ Enforcement Strategies

5.0 NEXT STEPS

The findings above regarding the systemic treatments and location-specific projects will be used to determine which locations are most likely to be competitive for grant funding. Those locations will be assessed in more detail to scope the specifics of improvements at those locations and to help inform grant applications. The potential new roadway safety related policies and education and enforcement strategies will be documented in the final Systemic Safety Analysis Report. That document will serve as a resource for the Town to reference as it seeks either funds for education and enforcement activities or when conducting other activities such as General Plan or Specific Plan updates.

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APPENDIX A

The following summarizes recent traffic volume data collected in Colma as well as Kittelson's observations from field reviews.

F Street from El Camino Real to Hillside Boulevard

F Street is a east-west corridor, and the segment in between El Camino Real and Hillside Boulevard is the study corridor. The corridor has cemeteries on the south side, and residential development on the north side. The corridor branches off of El Camino Real with a steep up grade and then levels off. The entire segment has brick surface, on-street parking and sidewalk on both the sides. The visibility of the 'stop ahead' warning signs could be improved given the adjacent trees. There are 'stop ahead' warning signs on the pavement augmenting the street signs. There is a horizontal curve on F Street on the approach to Hillside Boulevard. The traffic volume information for this corridor is shown in Figure 25. This information helps in understanding the hourly vehicular traffic patterns on the corridor throughout the day.

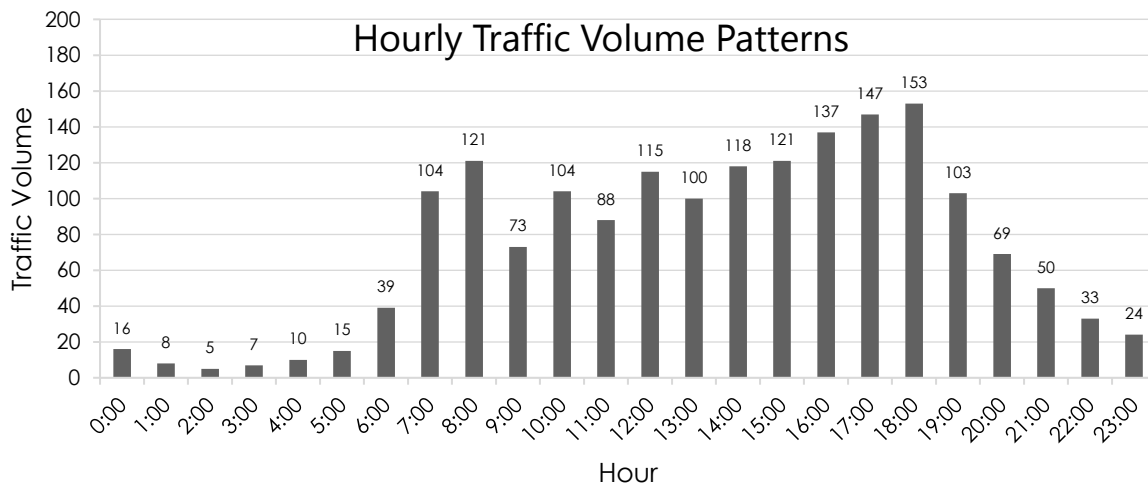


Figure 25 Traffic Volume Information for F Street [Source: Tube Count Data Collected by Quality Counts, 2017].

Existing Features

i. Pavement Markings

F Street has no pavement markings. Lane delineation could be helpful near the Hillside Boulevard intersection because of the presence of horizontal curve at the approach. The community input included comments on vehicle speeds. Adding pavement markings allocate and define roadway space. Adding right edge lines or parking "T"s visually narrow the travel lanes which could reduce vehicle drift and support lower travel speeds along the corridor.

ii. Street Signs

Some stop signs, warning signs, and streetname signs are obscured by vegetation. Others are placed at a relatively low height. Signing examples are shown in Figure 26.



Lack of intersection markings (i)



Obscured sign (ii)

Figure 26 Photos Show Existing Features on F Street

El Camino Real from Northern Town Limits to Southern Town Limits

El Camino Real (ECR), State Highway 82, is a north-south through the Town of Colma. The corridor has cemeteries on the east and west sides until Colma Boulevard and industrial and/or commercial developments around Serramonte Boulevard/ECR intersection. ECR has a posted speed of 35 mph in South San Francisco area that changes to 40 mph in the Town of Colma. The hourly traffic volume information for this corridor is shown in Figure 27. This information helps in understanding the hourly vehicular traffic patterns on the corridor throughout the day.

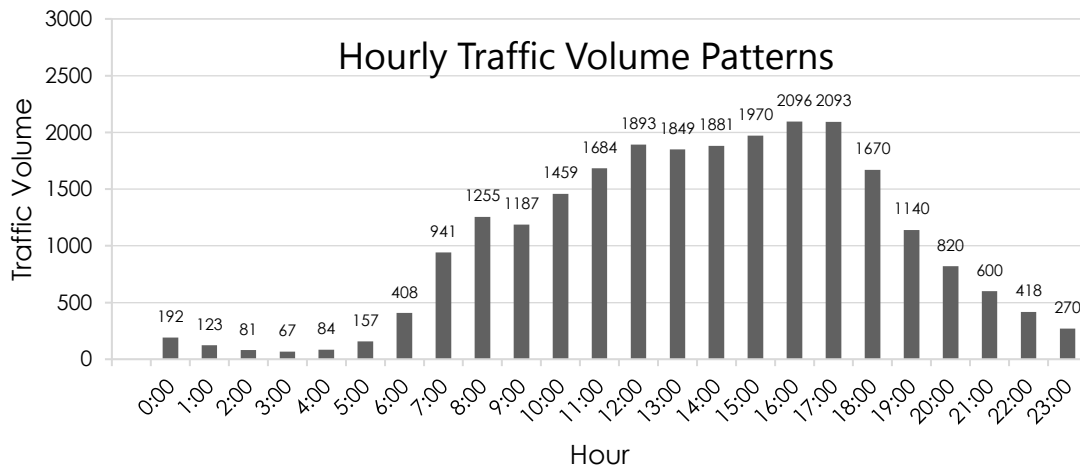


Figure 27 Traffic Volume Information for El Camino Real [Source: Tube Count Data Collected by Quality Counts, 2017].

Existing Features

- iii. Traffic Signals

The traffic signals at ECR intersections do not have reflective backplates on the signal heads. This limits the traffic signal visibility during the daytime.

iv. Pedestrian Crossing

Community members provided comments about cars traveling on ECR not yielding to pedestrians. There are two specific locations on ECR where there are marked, uncontrolled pedestrian crosswalks that could benefit from additional treatments such as a pedestrian hybrid beacon.

Examples of the limited signal visibility is shown in Figure 28.



Figure 28 Limited Signal Visibility

Colma Boulevard from Junipero Serra Boulevard to El Camino Real

Colma Boulevard is an east-west study corridor between ECR and Junipero Serra Boulevard (JSB) . The corridor has cemeteries near the ECR intersection and commercial development to the west approaching JSB. The corridor has four lanes at ECR that widens at the JSB intersection. The roadway is inclined going west from ECR and vehicle speeds are higher traveling east, down hill toward ECR. The corridor has sidewalk on the north side the entire length of the corridor and on both sides from the commercial development westward. The hourly traffic volume information this corridor is shown in Figure 29.

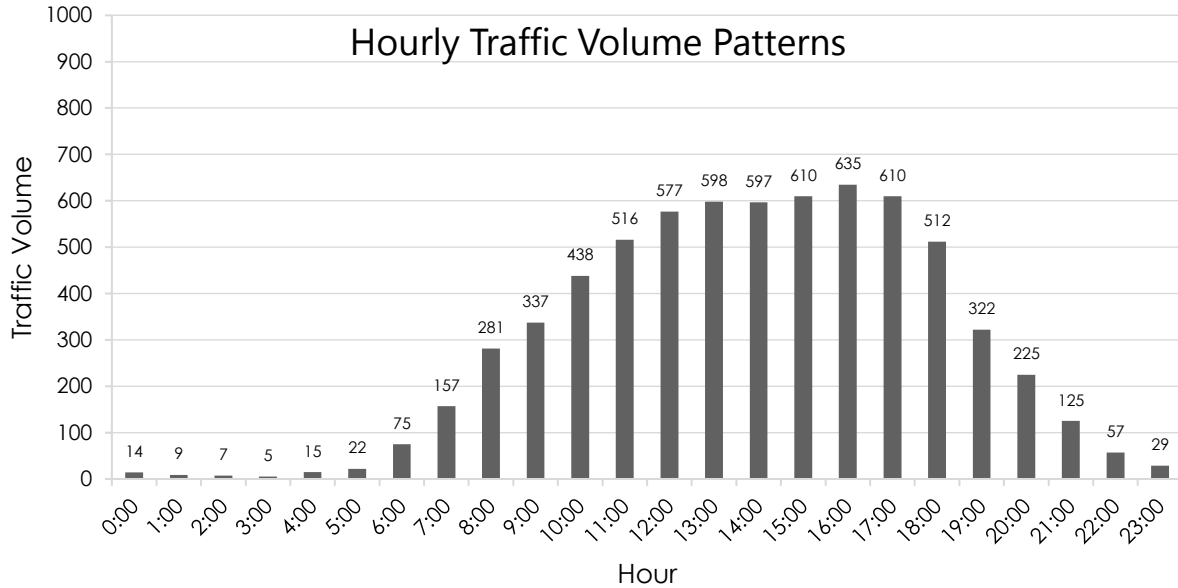


Figure 29 Traffic Volume Information for Colma Boulevard [Source: Tube Count Data Collected by Quality Counts, 2017].

Existing Features

v. Traffic Signals

The traffic signals at ECR/Colma Boulevard and JSB/Colma Boulevard do not have reflective backplates limiting visibility of the signal display when drivers are heading in the direction of sun.

Junipero Serra Boulevard from Northern Town Limits to Southern Town Limits

JSB is a north-south study corridor running in parallel to ECR and I-280 running between the northern and southern town limits. The corridor has Sam Trans Bus stops and Colma BART Station on the north limit and commercial development at the Serramonte Center on the south corridor limit. Serramonte Boulevard interchanges with I-280 providing a freeway connection to the town. A northbound I-280 entrance ramp connects directly to JSB. The corridor segment has a rolling grade with up and downgrades. The corridor has sidewalk on the east side of the corridor until the Serramonte Boulevard/JSB intersection. The corridor has sidewalk on both sides from the Serramonte Boulevard/JSB intersection to the southern town limit. The hourly traffic volume information for this corridor is shown in Figure 30.

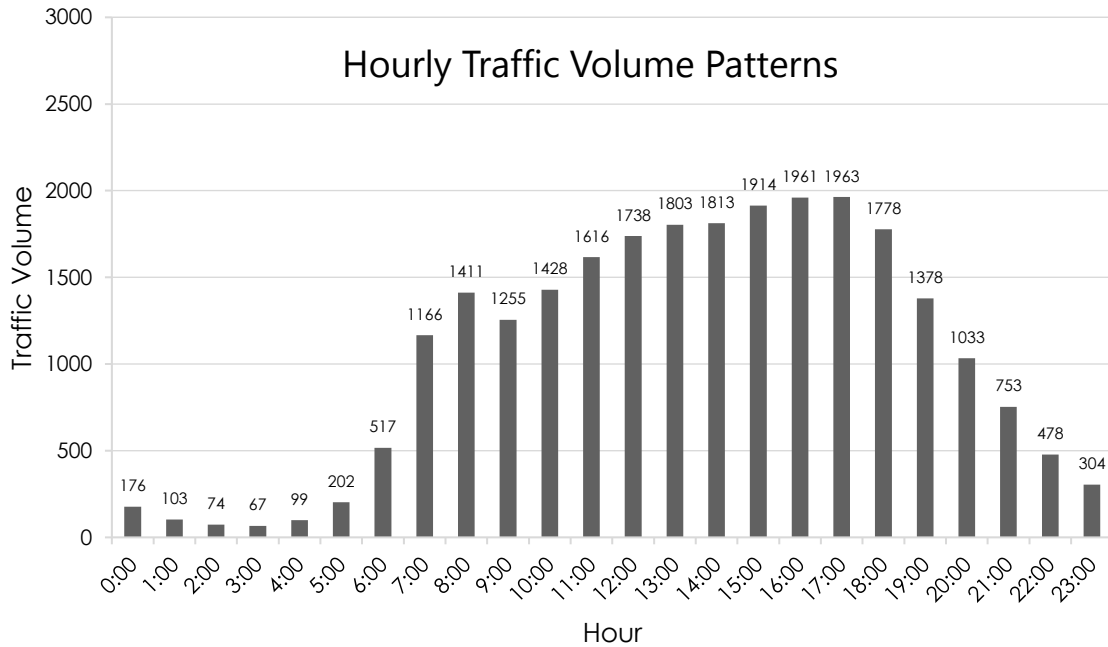


Figure 30 Traffic Volume Information for Junipero Serra Boulevard [Source: Tube Count Data Collected by Quality Counts, 2017].

Existing Features

vi. Warning Signs

The crash data shows that improper turning was reported for 39% of crashes along this corridor. The driveways at the Extra Space storage driveway are not conspicuous and can go unnoticed by northbound JSB driver. Southbound drivers turning into left-in only turn pocket have limited sight distance to northbound vehicles on JSB.

vii. Pedestrian Crossing

Pedestrian crossings are some times limited in visibility and drivers are inconsistent in yielding to the pedestrian crossings on the street because of the operating speeds. Community members provided input about the cars not yielding to pedestrians at some corridor locations.

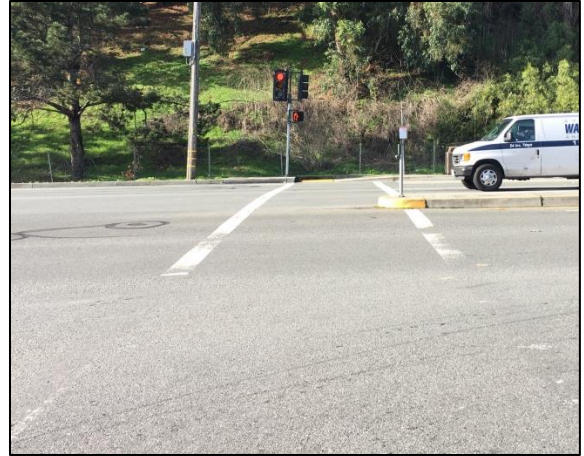
viii. Traffic Signals

The traffic signals do not have reflective backplates limiting visibility of the signal display when drivers are heading in the direction of sun.

Examples from the corridor are shown in Figure 31.



Left-in only driveway access (vi)



Limited visibility of crosswalk (vii)



Limited signal visibility (viii)

Figure 31 Photos show Existing Features on Junipero Serra Boulevard

Serramonte Boulevard from Hillside Boulevard to Northbound I-280

Serramonte Boulevard is a east-west corridor providing access to I-280 and commercial development on either side of I-280. The study corridor is between JSB and Hillside Boulevard. The corridor has commercial development, i.e. shopping center near the JSB/Serramonte Boulevard and Collins intersection. The corridor later transitions to auto dealerships near the eastern limit. There is a casino at the Serramonte Boulevard terminus with Hillside Boulevard. The hourly traffic volume information for this corridor is shown in Figure 32.

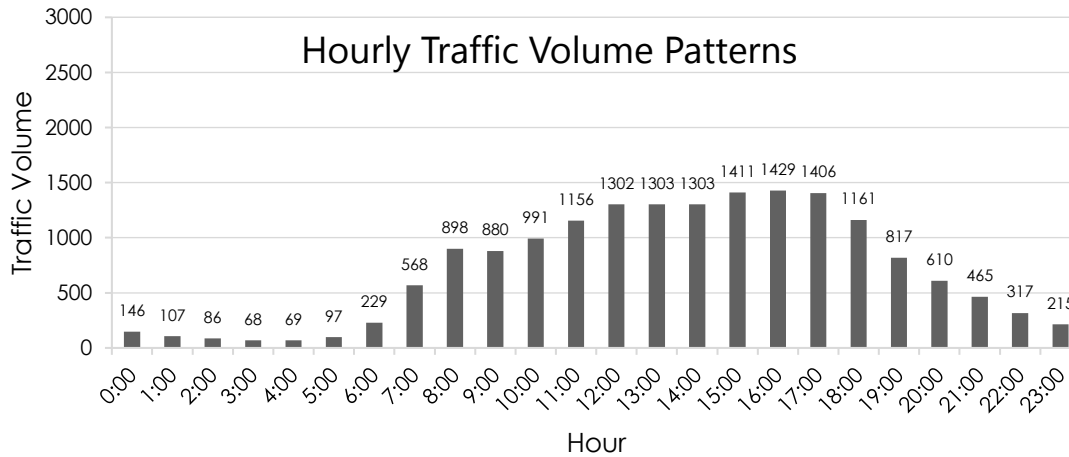


Figure 32 Traffic Volume Information for Serramonte Boulevard [Source: Tube Count Data Collected by Quality Counts, 2017].

Existing Features

- ix. Pedestrian Crossing/Enhanced Pedestrian Crossing

The crash data shows that 30% of reported crashes on Serramonte Boulevard are associated with speeding. Community input indicates motorists do not yield consistently to pedestrians.

- x. Street Signs

Some streetname signs, and warning signs are less visible due to vegetation. Others are placed at a relative low height.

Hillside Boulevard from Northern Town Limits to Southern Town Limits

Hillside Boulevard is a north-south study corridor between the northern and southern town limits. The corridor has residential development and school zone at the north limit just beyond the Colma limit. Heading south into Colma, the land uses consist of cemeteries on either side of the corridor near F Street. The 'Lucky Chances' casino is near the Serramonte Boulevard intersection which is followed by cemeteries on either sides of the corridor until Lawndale Boulevard. The hourly traffic volume information for this corridor is shown in Figure 33.

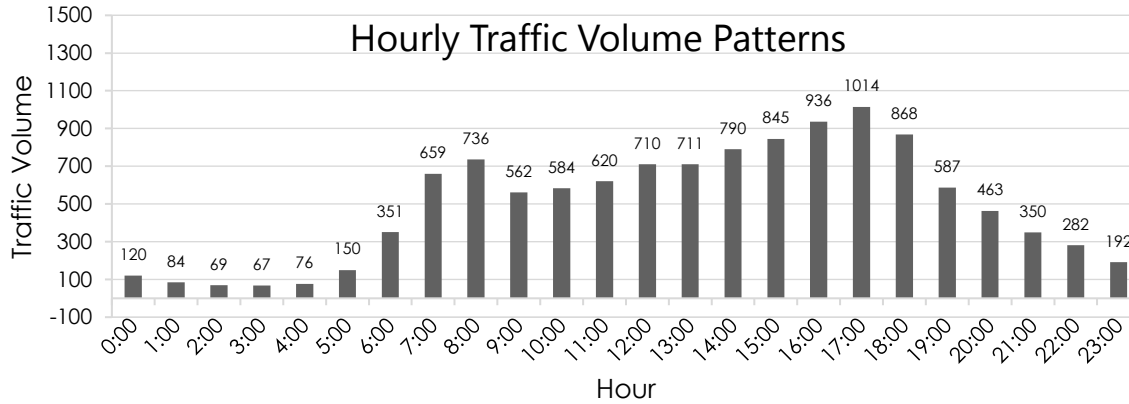


Figure 33 Traffic Volume Information for Hillside Boulevard [Source: Tube Count Data Collected by Quality Counts, 2017].

Existing Features

xi. Pedestrians

Pedestrian activity seems common along Hillside Boulevard particularly near the cemeteries with people needing to park on-street and walk to the cemeteries or other nearby businesses.

xii. Street Signs

Some speed limit signs, and warning signs are obscured by vegetation. Others are placed at a relative low height relative to on-street parked cars and other roadside conditions. Examples of these conditions are shown in Figure 34.



Undefined crossing (xi)



Obscured sign (xii)

Figure 34 Photos show Existing Features on Hillside Boulevard

Collins Avenue from Junipero Serra Boulevard to El Camino Real

Collins Avenue is an east-west study corridor between Serramonte Boulevard and ECR. The corridor has industrial development with car dealerships near Serramonte Boulevard on the south side, and some car dealerships and a shopping center (i.e. Kohl's) near the ECR/Collins Avenue intersection on the north side of

the corridor. There is on-street parking on one side of the corridor on the west side, and on both sides near the Serramonte Ford Body Shop along the Collins Avenue corridor. The hourly traffic volume information for this corridor is shown in Figure 35.

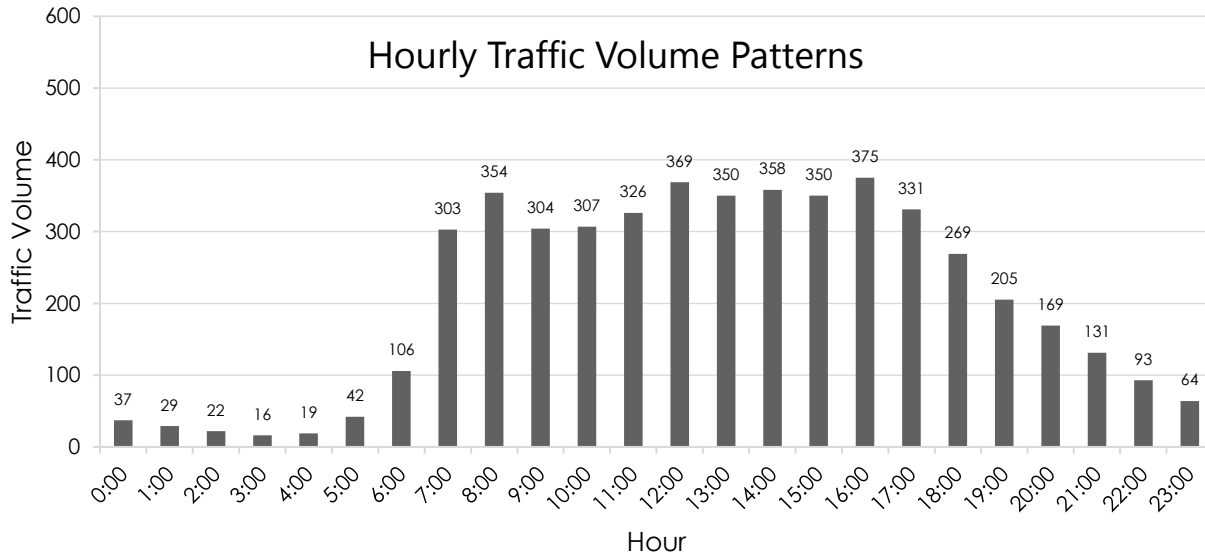


Figure 35 Traffic Volume Information for Collins Avenue [Source: Tube Count Data Collected by Quality Counts, 2017].

Existing Features

- xiii. Warning, speed limit Signs

During the field visit, Kittelson noticed the need for larger street signs near Collins Avenue and ECR intersection. Kittelson also noticed that the warning signs, and speed limit signs need to be upgraded along the corridor. Some were obscured by vegetation, and placed at a relative low height when relative to on-street parking and roadside conditions.

Lawndale Boulevard from Hillside Boulevard to Mission Road

Lawndale Boulevard is an east-west study corridor in between Hillside Boulevard and Mission Road. The corridor has residential development for about quarter length of the corridor and school for the other part of the corridor. ECR High School is on the south side near Mission Road. The roadway segment has a downgrade from Hillside Boulevard to Mission Road. The hourly traffic volume is shown in Figure 36.

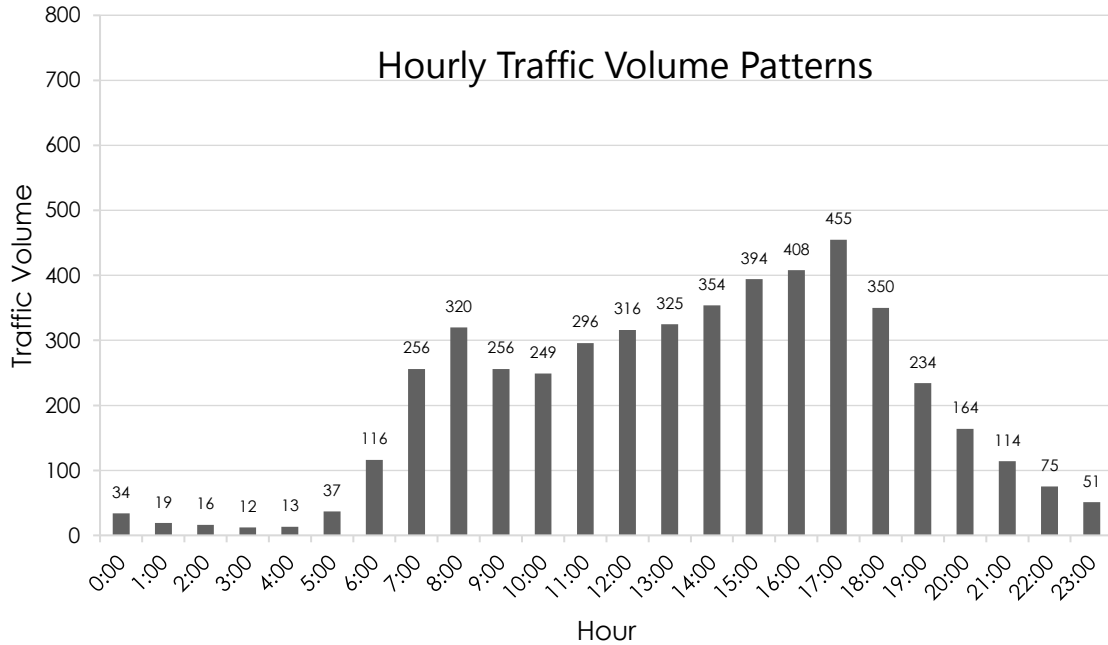


Figure 36 Traffic Volume Information for Lawndale Boulevard [Source: Tube Count Data Collected by Quality Counts, 2017].

Existing Features

- i. Cross-section

Kittelson observed there were two receiving lanes westbound on Lawndale Boulevard from Hillside Boulevard. However, there is only a single left and right turn lane from Hillside Boulevard serving these two lanes. Therefore, a single receiving lane westbound would be sufficient to serve the traffic volume coming onto Lawndale Boulevard.

Mission Road from El Camino Real to Lawndale Boulevard

Mission Road is a north-south corridor that terminates at ECR on the north and Lawndale Boulevard on the south. Mission Road has residential development on the west side and cemeteries on the east side of the corridor. The crash data for this corridor showed speeding related crashes. This finding was also validated by the community input received. The hourly traffic volume information for this corridor is shown in Figure 37.

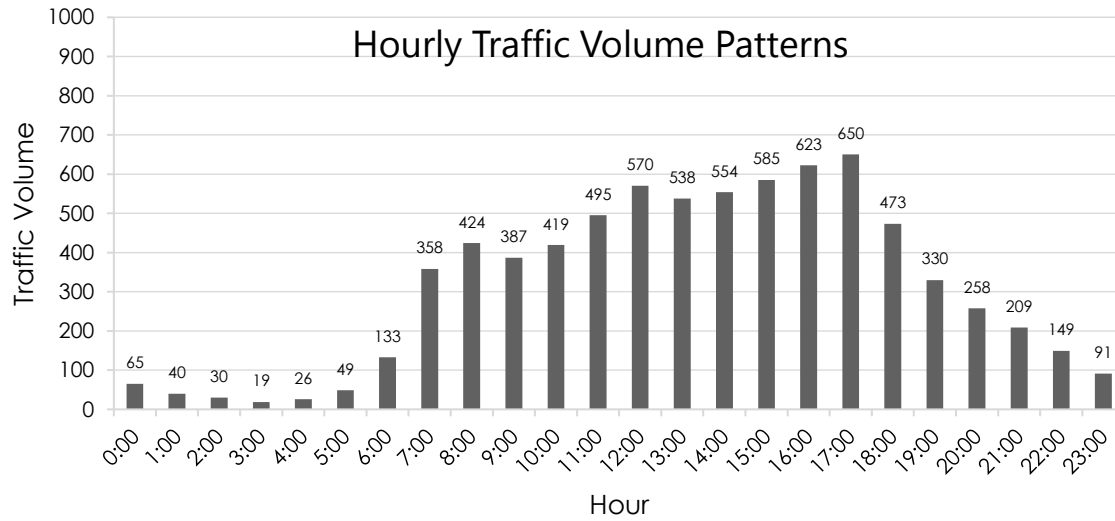


Figure 37 Traffic Volume Information for Mission Road [Source: Tube Count Data Collected by Quality Counts, 2017].