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SAFE TRANSPORTATION RESEARCH AND EDUCATION CENTER

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CITY OF SUISUN CITY

COMPLETE STREETS SAFETY ASSESSMENT

Issues, Opportunities, and Suggested Strategies

Assessment Team

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September 2019
Final Report Submitted January 6, 2020

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FINAL REPORT

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EXECUTIVE SUMMARY

The City of Suisun City requested that SafeTREC at the University of California, Berkeley conduct Complete Streets Safety Assessment (CSSA) study for various locations within the City. A team of two safety experts conducted the CSSA field visit for the City of Suisun City in July 23, 2019 and prepared this report. The objectives of the CSSA are to improve pedestrian and bicycle safety and to enhance walkability and accessibility for all pedestrians and bicyclists in Suisun City.

Based on the 2016 California Office of Traffic Safety (OTS) Suisun City has a population of approximately 29,000 residents, which puts it in Group D, with 93 other California cities in the same population group. Based on the OTS Collision Rankings, Suisun City ranked 17 out of 94 for the number of pedestrian collisions, and 67 for the number of bicyclists collisions (with 1st being the worst and 94 the best). This ranking is based on a number of weighted factors including population, daily vehicle miles traveled, collision records, collision trends, and others. For more information on OTS rankings, please refer to https://www.ots.ca.gov/media-and-research/collision-rankings/.

This report is organized into the following chapters:

- Chapter 1 is an introduction to the Complete Streets Safety Assessment for City of Suisun City.
- Chapter 2 presents background information on bicyclist and pedestrian safety in the City.
- Chapter 3 presents benchmarking analysis results and suggestions for potential improvement from the benchmarking analysis.
- Chapter 4 presents field walking audit results and suggestions for potential improvements from the audit.

BENCHMARKING ANALYSIS OF POLICIES, PROGRAMS, AND PRACTICES

To assess pedestrian safety conditions in Suisun City, the expert team first conducted a benchmarking analysis to understand how the City's existing conditions compared to current best practices. Through a pedestrian and bicycle safety assessment interview conducted with City staff, the expert team identified the City's pedestrian policies, programs, and practices and categorized these into three groups:

- Key strengths (areas where the City is exceeding national best practices)
- Enhancement areas (areas where the City is meeting best practices)
- Opportunity areas (areas where the City appears not to meet best practices)

While suggestions are provided for each category, cities have differing physical, demographic, and institutional characteristics that may make certain goals or policies more appropriate in some jurisdictions than others. Ultimately, City staff may determine where resources and efforts are best placed for meeting local development and infrastructure goals for pedestrians.

A discussion of the City's pedestrian and bicycle safety policies, programs, and practices, and suggestions for potential improvement or further enhancement to the City's existing programs and policies are presented in *Chapter 3*.

WALKING AUDIT SUGGESTIONS FOR POTENTIAL IMPROVEMENT

Per City's request, the following ten (10) locations were studied in this assessment:

South of Highway 12

1. Main St, Cordelia St – Hwy 12
2. Main St at train station plaza
3. Cordelia St, City limit – Main St
4. Lotz Way, Main St – Marina Blvd
5. Marina Blvd, Hwy 12 – Driftwood Dr
6. School crosswalks on Whispering Bay Lane

North of Highway 12

7. Marina Blvd north of Highway 12
8. Village Dr, Crosswalks at Pintail Dr, Nelson Community Center
9. Sunset Ave, Bike lanes, crosswalks
10. "Triangle parcel", including Railroad Avenue west of Marina Boulevard

Positive practices, as well as pedestrian and bicycle safety and accessibility issues were identified at the field audit.

Many of the strategies suggested in this report are appropriate for grant applications, including Office of Traffic Safety (OTS) or Active Transportation Program (ATP) funding. The strategies may also be incorporated into a bicycle or pedestrian master plan, documents that could set forth bicycle, pedestrian and streetscape policies for the City, identify, and prioritize capital improvement projects.

The suggestions presented in this report are based on limited field observations and time spent in Suisun City by the CSSA evaluators. These suggestions, which are based on general knowledge of best practices in pedestrian and bicycle design and safety, are intended to guide City staff in making decisions for future safety improvement projects in the City, and they may not incorporate all factors which may be relevant to bicycling safety issues in the City.

As this report is conceptual in nature, conditions may exist in the focus areas that were not observed and may not be compatible with suggestions in this report. Before finalizing and implementing any physical changes, City staff may choose to conduct more detailed studies or further analysis to refine or discard the suggestions in this report, if they are found to be contextually inappropriate or appear not to improve bicycling safety or accessibility due to conditions including, but not limited to, high vehicular traffic volume or speeds, physical limitations on space or sight distance, or other potential safety concerns.

1. INTRODUCTION

1.1. OBJECTIVE OF THE ASSESSMENT

The City of Suisun City (the City) requested that the Safe Transportation Research and Education Center (SafeTREC) at University of California, Berkeley conduct a Complete Streets Safety Assessment (CSSA) for the City. The objective of the CSSA is to improve safety and accessibility for all people walking and biking in the City of Suisun City. This assessment emphasizes safety and mobility issues associated with pedestrians and bicyclists, including a focus on older and younger road users.

The City does not have a Complete Streets policy in place, but plans on incorporating Complete Streets concepts into upcoming developments and projects currently in the planning and development stages. The City has a Downtown Marina, Park and Ride Lot, and a Train Depot. The City also is planning to develop some higher density housing within close proximity to the water way as well as the train depot. The City would like to improve downtown's business vitality and attractiveness to developers by making it more comfortable for pedestrians and bicycle users to travel along and across the street.

The City asked the following streets for considerations of Complete Streets concept: Main Street, Civic Center Blvd, Lotz Way, Marina Blvd, Whispering Bay Lane, Driftwood Drive, Sunset Ave, Pintail Ave, and Walters Road.

1.2. ASSESSMENT APPROACH

The SafeTREC Safety experts conducted a pre-visit telephone interview with City staff on June 11, 2019. The results from this interview provided the basis for the benchmarking analysis.

The experts met with City staff and conducted a walking audit at various locations in Suisun City on July 23, 2019. Before the field visit, the experts conducted an introductory meeting to discuss initial results from the benchmarking analysis and logistics for the field visit. A walking audit was conducted at locations as requested by the City staff.

Positive practices, as well as pedestrian and bicycle safety and accessibility issues were identified at the field audit. The safety experts held an exit meeting with the participants from the audit at the end of the visit. This meeting included a discussion of the observations and suggestions made during the Complete Streets audit and potential site-specific improvements based on what the group discussed during the field visit.

1.3. ACKNOWLEDGEMENTS

City of Suisun City staff members participated in the field visit and contributed to the wide range of topics addressed in this report. In particular, they organized a successful field visit on July 23, 2019. We would like to thank the following individuals who participated in the meetings and/or field audit other than the safety experts:

Name	Title	Agency
Matthew Medill	Director, Public Works	Suisun City
Tim McNamara	Director, Development Services	
Nick Lozano	Staff Engineer, Public Works	
John Kearns	Senior Planner, Development Services	
Joann Martinez	Assistant Planner, Development Services	
Dan Healy	Commander, Police Department	
Matt Tuggle	Engineering Manager, Public Works	Solano County
Jill Cooper	Co-Director	UC Berkeley SafeTREC
Nancy Wolf	Grant Coordinator	California Office of Traffic Safety (OTS)
Tim Weisberg	Public Information Officer	

1.4. DISCLOSURES

The benchmarking analysis aims to provide the City with information on current best practices and how the city compares. Cities have differing physical, demographic, and institutional characteristics that may make certain goals or policies more appropriate in some jurisdictions than others. Ultimately, City staff will determine where resources and efforts are best placed for meeting local development and infrastructure goals for people walking and biking.

The suggestions presented in this report are based on limited field observations and limited time spent in the City Suisun City by the CSSA evaluators. These suggestions, which are based on general knowledge of best practices in pedestrian and bicycle design and safety, are intended to guide City staff in making decisions for future safety improvement projects in the city, and they may not incorporate all factors, which may be relevant to the pedestrian and bicycle safety issues in the city.

As this report is conceptual in nature, conditions may exist in the focus areas that were not observed and may not be compatible with suggestions in this report. Before finalizing and implementing any physical changes, City staff may conduct more detailed studies or further analysis to refine or discard the suggestions in this report if they are found to be contextually inappropriate or appear not to improve pedestrian and bicyclist safety or accessibility due to conditions including, but not limited to, high vehicular traffic volume or speeds, physical limitations on space or sight distance, or other potential safety concerns.

2. BACKGROUND AND COLLISION HISTORY

The City of Suisun City is located in Solano County. Per 2010 census, it has a population of approximately 29,000. Per Wikipedia there are 38% White, 19% African American, 19% Asian, and 24% Hispanic or Latino. The median family income was $63,616. About 4.6% of families were below the poverty line, including 8% of those under age 18 and 6% of those age 65 or over.

The City has been exploring ways to enhance access and safety for everyone, especially for pedestrians and bicyclists. The following lists the City's efforts:

- City of Suisun City 2035 General Plan, adopted May 5, 2015
- City of Suisun City Waterfront District Specific Plan, November 2016
- Suisun City Safe Routes to School Program is under the Solano Transportation Authority (STA) https://sta.ca.gov/programs/solano-safe-routes-to-school-program-sr2s/ .
- Suisun City Bikeways Map, Existing and Planned
- Solano Transportation Authority Countywide Pedestrian and Bicycle Master Plans (https://sta.ca.gov/projects-plans/)
- City of Suisun City Capital Improvement Program (Draft), FY 2019-20 to 2013-24

2.1. PEDESTRIAN AND BICYCLISTS SAFETY OVERVIEW

The Office of Traffic Safety (OTS) collision rankings facilitate funding decisions and identify emerging traffic safety problem areas. The rankings allow cities to compare themselves to other cities with similar-sized populations and help them identify potential disproportionate traffic safety issues. OTS rankings are indicators of historical collisions; there are many factors that affect collisions in a city.

Victim and collision data for the rankings are taken from the California Highway Patrol (CHP) Statewide Integrated Traffic Records System (SWITRS), California Department of Transportation (Caltrans), California Department of Justice (DOJ), and the Department of Finance (DOF). Collision rankings are based on the Empirical Bayesian (EB) Ranking Method that gives weights to many different factors, such as population, daily vehicle miles traveled, collision records, collision trends, etc.

With a population of 29,000 residents, Suisun City is categorized as one of the 94 cities in Group D, population 25,001-50,000 people as shown in Table 2-1. The 2014, 2015, and 2016 OTS safety rankings for Suisun City are shown in Table 2-2.

TABLE 2-1: SUISUN CITY SUMMARY STATISTICS

Year	County	Population	Population Group	Daily Vehicle Miles Traveled (VMT)
2016	Solano	29,152	D	180,032

Source: California Office of Traffic Safety, https://www.ots.ca.gov/media-and-research/collision-rankings/

Based on the OTS 2016 statistics, Suisun City ranked 41, out of 94 California cities in Group D, in total fatal and injury collisions (with a ranking of "1" being the worst). It ranked 17 for pedestrian collisions, and 67 for bicyclist collisions.

TABLE 2-2: SUISUN CITY TRAFFIC COLLISIONS AND RANKINGS, 2014, 2015, 2016

	2014		2015		2016	
Type of Collision	**Victims Killed & Injured**	**OTS Ranking (of 89 cities)**	**Victims Killed & Injured**	**OTS Ranking (of 93 cities)**	**Victims Killed & Injured**	**OTS Ranking (of 94 cities)**
Total Fatal and Injury	25	86	6	91	96	41
Alcohol Involved	4	63	NA	NA	7	69
Motorcycles	1	73	NA	NA	5	35
Pedestrians	2	76	NA	NA	11	17
Pedestrians < 15	0	79	NA	NA	1	38
Pedestrians 65+	0	66	NA	NA	1	45
Bicyclists	1	76	NA	NA	3	67
Bicyclists < 15	0	61	NA	NA	0	74

Source: California Office of Traffic Safety, https://www.ots.ca.gov/media-and-research/collision-rankings/

2.2. PEDESTRIAN AND BICYCLE COLLISION DATA

The collision data for Suisun City from January 2014 to the end of 2018 was taken from the SafeTREC Transportation Injury Mapping System (TIMS) database. In this five-year period, 229 collisions occurred in City of Suisun City, 7 of which were fatal. There were 31 collisions involving pedestrians. There were 12 involving Bicyclists.

Pedestrian Collisions

Within the 5-year period analyzed from TIMS data, 31 collisions involved pedestrians, 3 of which were fatal. Of all the collisions, 14 were crossing in crosswalk at an intersection. Two were crossing in crosswalk midblock, and 7 were crossing not in a crosswalk. Most collisions happened on Thursdays and Fridays. The following charts depict this data:

Chart 2.1: Number of Pedestrian Collisions by Collision Severity

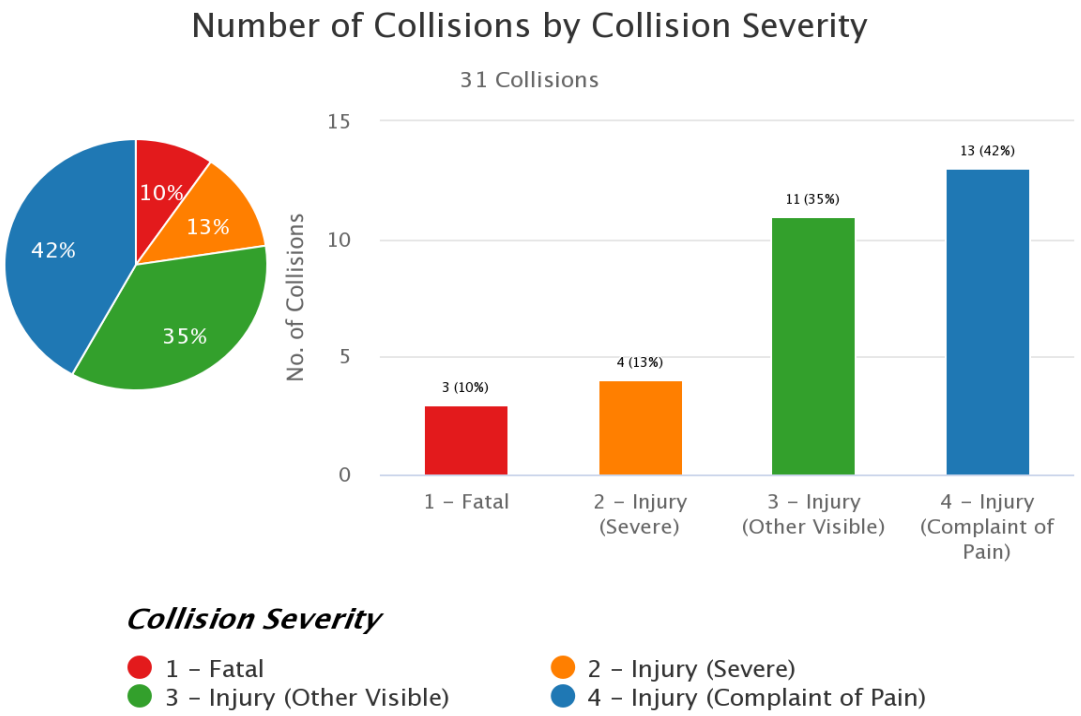


Chart 2.2: Number of Pedestrian Collisions per Day of Week per Time

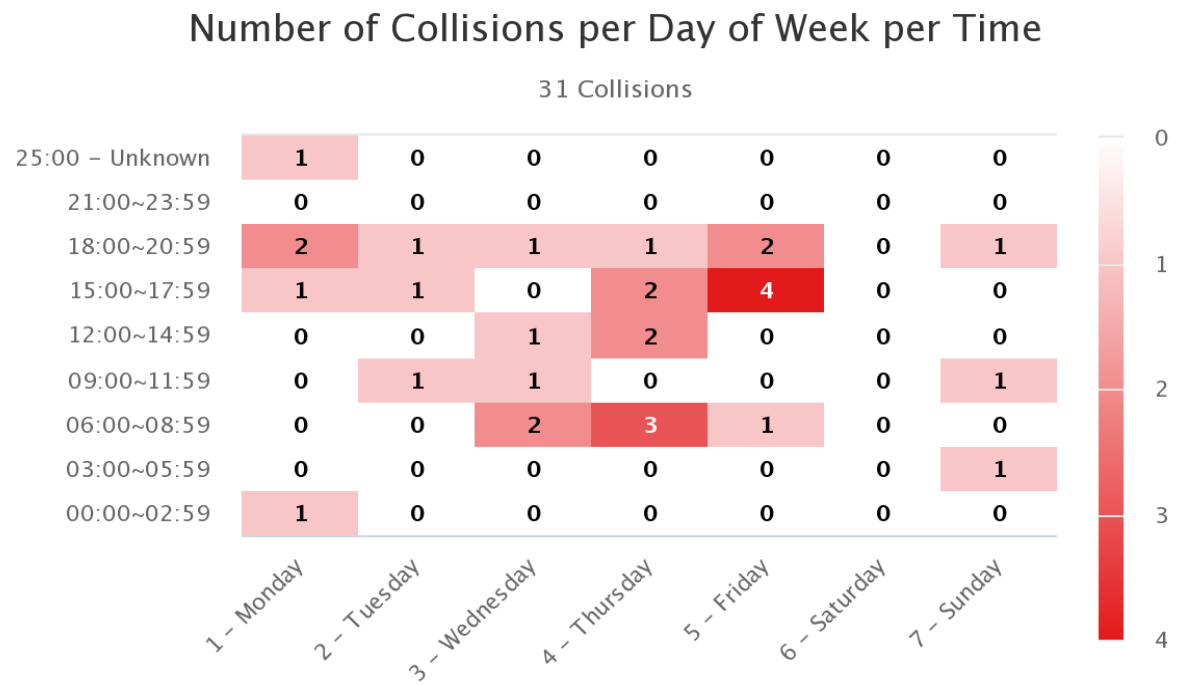
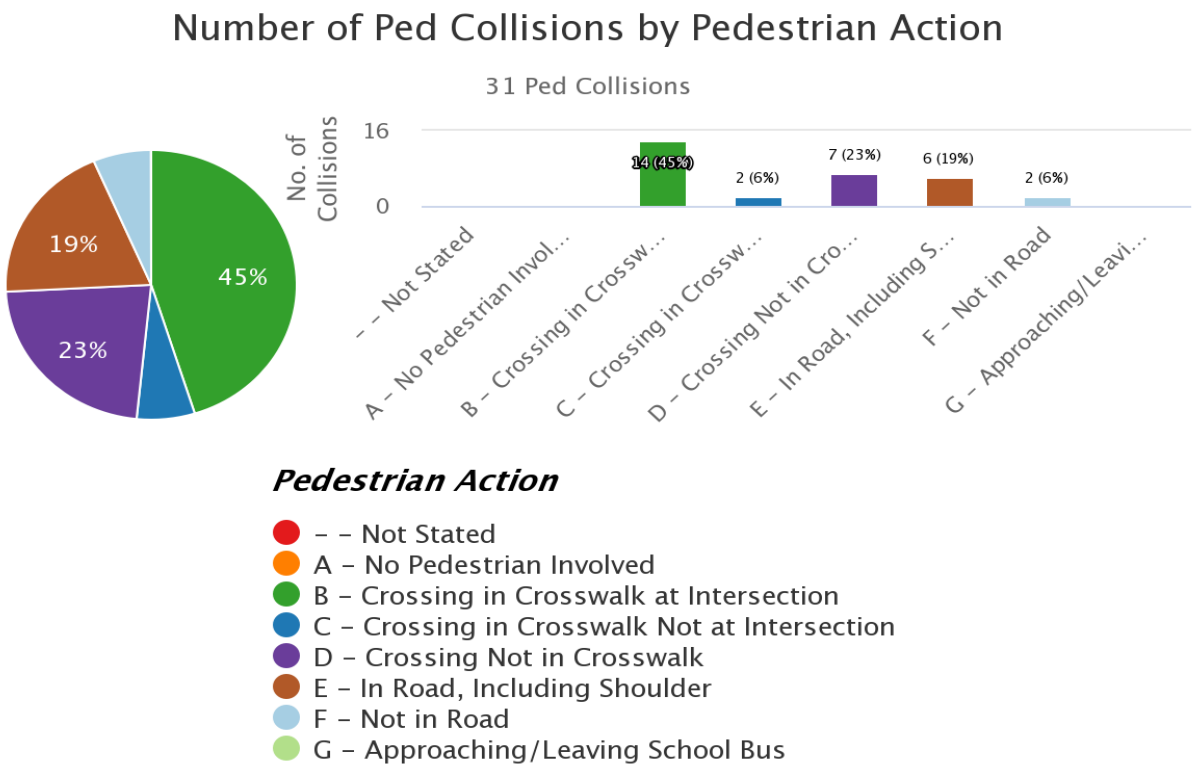


Chart 2.3: Number of Pedestrian Collisions by Pedestrian Action



Pedestrian Action	Count	%
B - Crossing in Crosswalk at Intersection	14	45.16%
C - Crossing in Crosswalk Not at Intersection	2	6.45%
D - Crossing Not in Crosswalk	7	22.58%
E - In Road, Including Shoulder	6	19.35%
F - Not in Road	2	6.45%

Bicycle Collisions:

Based on the TIMS data, within the 5-year (2014-2018) period, there were 12 collisions involving bicyclists. There was 1 fatality. Two of collisions were caused by the bicyclist riding on the wrong side of the road. One of the collisions happened due to bicycling under influence of alcohol or drugs. The highest number of collisions happened on Mondays. The following charts depict this data.

Chart 2.4: Number of Bicycle Collisions by Collision Severity

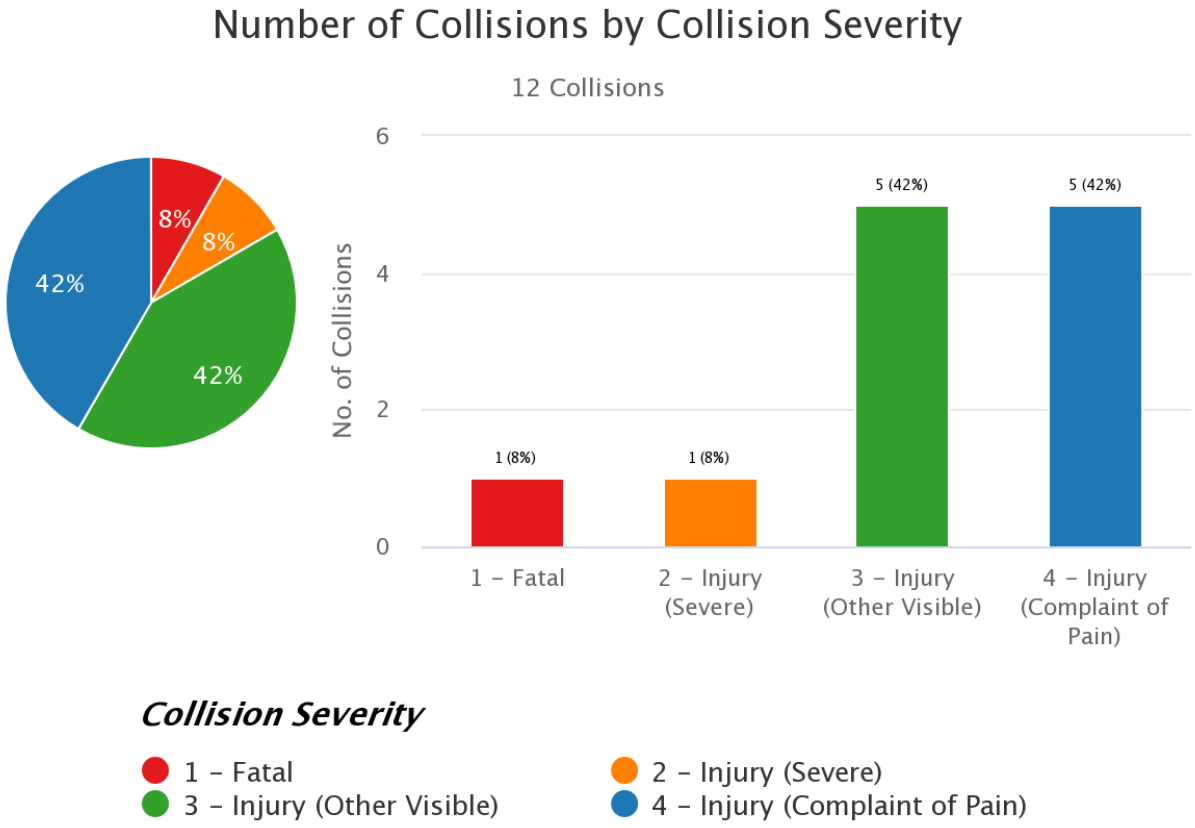


Chart 2.5: Number of Bicycle Collisions per Day of Week per Time

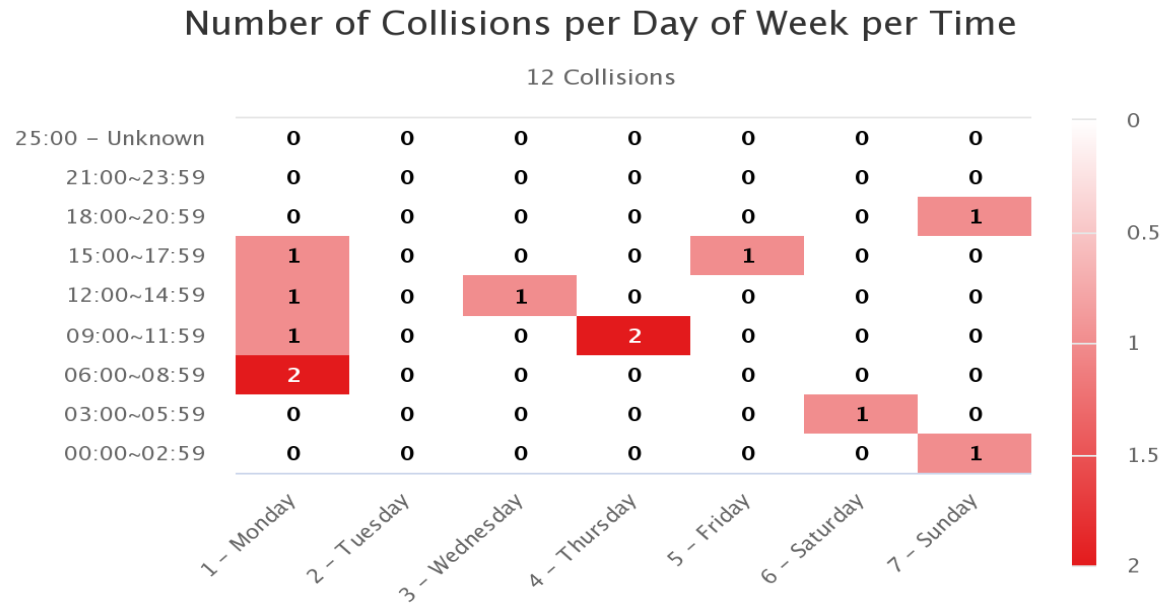
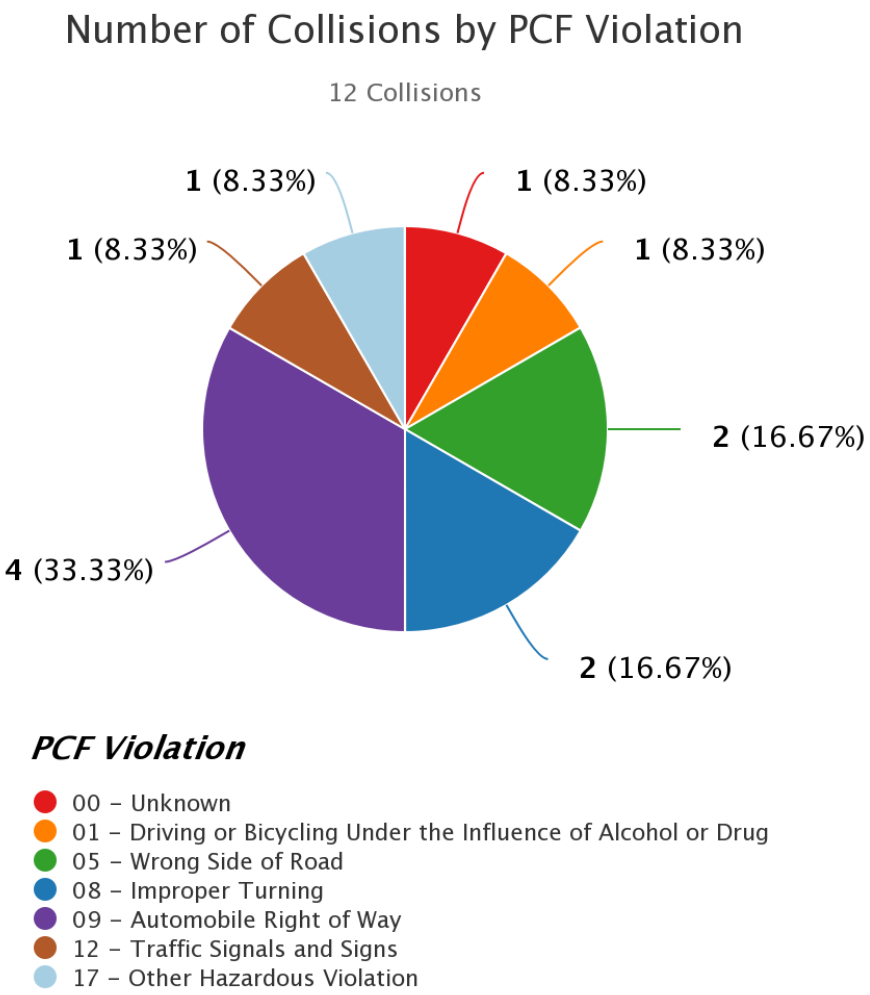


Chart 2.6: Number of Bicycle Collisions by Primary Collision Factor (PCF) Violation



PCF Violation	Count	%
00 - Unknown	1	8.33%
01 - Driving or Bicycling Under the Influence of Alcohol or Drug	1	8.33%
05 - Wrong Side of Road	2	16.67%
08 - Improper Turning	2	16.67%
09 - Automobile Right of Way	4	33.33%
12 - Traffic Signals and Signs	1	8.33%
17 - Other Hazardous Violation	1	8.33%

The type of information provided above which is obtained from SafeTREC's TIMS (https://tims.berkeley.edu/) can help City Police Department in decision making in regards to their enforcement efforts.

2.3. STREET STORY

The Street Story program (https://streetstory.berkeley.edu/) is a relatively new tool developed by UC Berkeley's Safe Transportation Research and Education Center (SafeTREC) with OTS support. Street Story is a community engagement tool that allows residents, community groups and agencies to collect information about transportation collisions, near-misses, general hazards and safe locations to travel. To promote access to the tool, SafeTREC conducts technical assistance with communities and organizations on using Street Story. Street Story is free to use and publicly accessible.

Street Story features a survey where people can record travel experiences. Once a record has been entered, the information is publicly accessible on the website with maps and tables that can be downloaded. City staff can use this information for local needs assessments, transportation safety planning efforts, safety programs and project proposals.

SafeTREC staff spoke with staff at Suisun City Department of Public Works, and Solano County Transportation Authority, on April 26, 2019 about using Street Story to collect community feedback about transportation safety issues. City staff expressed that they did not have the capacity to be heavily involved in sharing information about Street Story with community members, but were willing to put Street Story information into weekly City Council information packets, share information over social media and Next Door. They also agreed to start sharing Street Story information over social media and City Council information packets.

3. BENCHMARKING ANALYSIS RESULTS AND SUGGESTIONS

Prior to the field visit, the CSSA Team conducted an interview with City staff regarding the pedestrian and bicyclist safety policies, programs, and practices on June 11, 2019. The Team also reviewed the documents provide by the City staff. Responses were analyzed with a benchmarking matrix, as shown in Table 3-1. The City's policies, programs, and practices were then compared with national best practices. This benchmarking analysis categorizes the results into three groups:

- Key Strengths (areas where the City is exceeding statewide best practices)
- Enhancement (areas where the City is meeting best practices)
- Opportunity (areas where the City appears not to meet best practices)

This analysis shares information on current best practices and how the City compares. With differing physical, demographic, and institutional characteristics, certain goals or policies may be more appropriate in some jurisdictions than others may. Ultimately, City staff may determine where resources and efforts are best placed for meeting local development and infrastructure goals for pedestrians.

The items in Table 3-1 are further elaborated in the following sections. The City may select strategies for implementation based on local priorities.

TABLE 3-1: SUISUN CITY PROGRAMS, POLICIES, AND PRACTICES: BENCHMARKING ANALYSIS

Benchmark Topic	Key Strength	Enhancement	Opportunity
Implementation of Americans with Disabilities Act (ADA) Improvements			
Implementation of Americans with Disabilities Act (ADA) Improvements	Uses state-of-the-practice (PROWAG) ADA improvements with consistent installation practices	Has clear design guidelines but no regular practices for ADA compliance	Has minimal design guidelines and practices related to ADA requirements
ADA Transition Plan for Streets and Sidewalks	Has ADA transition plan in place and an ADA coordinator	Partial or outdated ADA transition plan or an ADA coordinator	No transition plan or ADA coordinator
Policies and Programs			
Pedestrian/Bicycle Coordinator	Has a Coordinator on staff who manages the agency's pedestrian and bicycle programs	Occasionally uses a part-time contract coordinator	Does not have a pedestrian/bicycle coordinator
Formal Advisory Committee	Has a formal, active Transportation Advisory Committee that address bicycle/pedestrian issues	Has an ad-hoc Transportation Advisory Committee	Does not have a Transportation Advisory Committee

TABLE 3-1: SUISUN CITY PROGRAMS, POLICIES, AND PRACTICES: BENCHMARKING ANALYSIS

Benchmark Topic	Key Strength	Enhancement	Opportunity
Traffic Calming Program	Has a significant traffic calming program with a dedicated funding source	Has a traffic calming program but no dedicated funding source	Does not have a traffic calming program, or the program only includes speed humps
Speed Limits and Speed Surveys	Employs comprehensive practice to proactively review speed limits such as USLIMITS2. Considers traffic calming before raising speed limits in pedestrian or bicycle zones	Reviews data only in response to reported concerns or frequent collisions	Does not have set practices for speed limit reviews
Safe Routes to Schools	Has an ongoing Safe Routes to Schools program and funding for recent projects.	Has obtained funding for recent projects, but has no community-wide Safe Routes to Schools program	Does not have a Safe Routes to Schools program and has not obtained recent funding
Crosswalk Installation, Removal, and Enhancement Policies	Has a crosswalk policy that reflects best practices for signalized and uncontrolled crosswalk treatments (FHWA Field Guide), including consideration of Pedestrian Hybrid Beacons	Has no policy, but has an established crosswalk installation, removal, and enhancement practice in place	Does not have a policy or set practices for addressing crosswalk installation, removal, or enhancement
Shared Mobility Services	Has curbside management, shared mobility, or micromobility policies (e.g. permitting, enforcement) in place that prioritize pedestrian and bicyclist safety	Has curbside management, shared mobility, or micromobility policies in place, but without a focus on safety	No curbside management, shared mobility, or micromobility policies in place
Funding			
Funding	Has a dedicated annual funding stream for pedestrian and bicycle projects and local grant matches	Depends on grant funding for projects, and is successful in obtaining grants	Only moderately successful in obtaining grant funding or has trouble spending funds when given grants
Data Collection			
Collection of Pedestrian and Bicyclist Volumes	Collects pedestrian and bicyclist volumes routinely with intersection counts and has a GIS database of counts	Collects some pedestrian and bicyclist volumes, but not routinely	Does not collect pedestrian and bicycle volumes

TABLE 3-1: SUISUN CITY PROGRAMS, POLICIES, AND PRACTICES: BENCHMARKING ANALYSIS

Benchmark Topic	Key Strength	Enhancement	Opportunity
Inventory of Bikeways, Parking, Informal Pathways, and Key Bicycle Opportunity Areas	Maintains an inventory of missing and existing bikeways in GIS and includes bikeway projects in the CIP	Maintains an inventory of missing facilities and opportunity areas	Does not have an inventory of missing/existing bikeways, parking, informal pathways, or key bicycle areas
Collision History and Collision Reporting Practices	Employs a data-driven systemic safety or Vision Zero approach to regularly analyze collision data citywide	Reviews data only following fatalities or other high-profile incidents	Does not have set practices for data review
Pedestrian and Bicycle Network Implementation			
Complete Streets Policy	Has a Complete Streets policy that includes all users and modes, affects new construction and maintenance, considers local context, and provides guidance for implementation	Has a Complete Streets policy that is narrow in scope or applies only to public works projects	Does not have a Complete Streets policy
Active Transportation Plans	Has a recently-updated Active Transportation Plan (or similar) with strategic prioritized list of projects that reflects current best practices (e.g. Level of Traffic Stress analysis, inclusion of Class IV protected bicycle facilities)	Has a Pedestrian or Bicycle Master Plan but it may be outdated and/or no recent projects from the Plan have been completed	Does not have a Pedestrian or Bicycle Master Plan
Existing pedestrian facilities	Includes current best practice ADA and safety features such as high visibility crosswalks and advance stop bars, PHBs or RRFBs, bulbouts, etc.	Narrow sidewalks or sidewalk gaps, crosswalks with few or no safety enhancements, with some pedestrian countdown signals	Missing key marked crosswalks and sidewalks, with few ADA improvements and no safety enhancements, and no pedestrian countdown signals
Bicycle Network Implementation Practices	Age 8 to 80 bicyclist considerations are applied and/or level of traffic stress is considered	Some traffic calming measures are implemented in conjunction with bikeway installation	Treatments are implemented where they fit within the right-of-way and vehicle LOS is not affected

TABLE 3-1: SUISUN CITY PROGRAMS, POLICIES, AND PRACTICES: BENCHMARKING ANALYSIS

Benchmark Topic	Key Strength	Enhancement	Opportunity
Design guidelines and standards	Uses national best practices focused on bicycle and pedestrian safety for roadway and facility design guidelines and standards	Local standards reference national best practices, but are static or out of date, with minimal customized design policies for pedestrian and bicycle accommodations	Does not have a comprehensive design guidelines or standards for pedestrian or bicyclist treatments
Roadway Surfaces	Roadway resurfacing projects and debris removal are prioritized for bicycle routes.	Roadway surface is acceptable on bicycle routes and routine maintenance, including debris removal, occurs.	Roadway surface conditions are poor on some bicycle facilities and maintenance is not prioritized for bicycle facilities
Attention to Bicycle Crossing Barriers	Colored bike lanes and other innovative treatments, including geometric enhancements, are provided at intersections and interchanges	Bike treatments are installed at some intersections and interchanges	Bike treatments are not installed at intersections or through interchanges
Attention to Pedestrian Crossing Barriers	Has a recently updated policy and comprehensive inventory of barriers. Has design guidelines for addressing barriers	Has no policy, but has identified some barriers and taken steps to improve pedestrian access	Does not have a policy or practices for pedestrian crossings at railroads, freeways, and so on
Traffic Signal	Uses relaxed warrants for traffic signals and/or all-way stops	Uses relaxed warrants for traffic signals or all-way stops	Uses MUTCD Warrants
Pedestrian and Bicycle Support Program			
Bicycling Supportive Amenities and Wayfinding	Bicycle supportive amenities (parking, routing/wayfinding, water fountains, repair stations) are found community-wide	Some bicycle supportive amenities are found in key areas	Bicyclist supportive amenities are not provided in the community
Pedestrian and Bicycle Safety Education Program	Pedestrian and bicycle education programs are data-driven and focused on local safety context; education programs are customized for different groups	Has some traffic safety education programs that include pedestrians and bicyclists	Does not have pedestrian and bicycle safety education programs

TABLE 3-1: SUISUN CITY PROGRAMS, POLICIES, AND PRACTICES: BENCHMARKING ANALYSIS			
Benchmark Topic	**Key Strength**	**Enhancement**	**Opportunity**
Enforcement	Police Department conducts sustained and data-driven enforcement efforts focused on behavior and locations related to most severe bicycle and pedestrian crashes; enforcement activities are designed to consider equity implications	Police Department conducts some enforcement activities related to bicyclist and pedestrian safety	Police Department does not have Traffic Safety Officer(s)

3.1. KEY STRENGTHS

Pedestrian/Bicycle Coordinator

A pedestrian/bicycle coordinator provides guidance for pedestrian/bicycle planning efforts and oversees implementation of plans. Suisun City has a designated Pedestrian/Bicycle Coordinator that spends at least 20% of their time on active transportation.

Suggestion for Potential Improvement

- Utilize the designated pedestrian/bicycle coordinator to write grants for both capital improvement projects and ongoing funding for walking and biking related programs as well as to act as a liaison with local non-profit advocacy groups, and schools.

Safe Routes to Schools Program

Safe Routes to School (SRTS) programs encourage children to safely walk or bicycle to school. The Marin County Bicycle Coalition was an early champion of the concept, which has spread nationally (refer to best practices at *www.saferoutestoschools.org*). SRTS programs are important both for increasing physical activity (and reducing childhood obesity) and for reducing morning traffic associated with school drop-off (as much as 30% of morning peak hour traffic).

City of Suisun City's SRTS program is under the Solano Transportation Authority (STA) https://sta.ca.gov/programs/solano-safe-routes-to-school-program-sr2s/ . They have already formed an ongoing steering committee for the program to monitor efforts and identify new opportunities.

Suggestion for Potential Improvement

- Consider a plan for all Suisun City schools to conduct walk audits, identify potential safety improvements, and secure funding for those improvements.

Funding

A dedicated, annual funding stream for bicycle and pedestrian projects ensures that these types of projects will be implemented regularly. Bicycle and pedestrian projects can also be integrated in the other work that the City does, including repaving and other routine maintenance of the roadway network.

Suisun City uses a combination of General City Funds, local and regional impact fees, local tax measure funds, Surface Transportation Program Funding, as well as competitive grants, such as Highway Safety Improvement Program (HSIP), Congestion Mitigation and Air Quality Improvement Program (CMAQ), and Active Transportation Plan (ATP), and Safe Routes to School (SRTS) grant. Other funding sources include Transportation Fund for Clean Air Program (TFCA), SB1, and One Bay Area Grant (OBAG).

Suggestion for Potential Improvement

- Collaborate with other agencies and continue applying for grant funding for both infrastructure and non-infrastructure projects.
- Integrate bicycle and pedestrian projects into the site plan review process for new developments.
- Secure additional funding for repaving projects to allow for "quick build" projects and other bicycle and pedestrian safety improvements to be integrated into those projects.
- Establish a dedicated funding source for pedestrian and bicycle projects.

Design Guidelines and Standards

Design guidelines and development standards create a clear set of documents that guide how all transportation improvements could be installed citywide. As a result, they can create a consistent, high-quality biking and walking experience.

Suisun City does not design many bicycle facilities. The City relies on CA MUTCD and Highway Design Manual (HDM) when making design decisions.

Suggestion for Potential Improvement

Other useful design guidelines and standards include:

- NACTO Urban Street Design Guide: http://www.nyc.gov/html/dot/downloads/pdf/2012-nacto-urban-street-design-guide.pdf
- FHWA Separated Bike Lane Planning and Design Guide https://nacto.org/wp-content/uploads/2016/05/2-4_FHWA-Separated-Bike-Lane-Guide-ch-5_2014.pdf
- MassDOT Separated Bike Lane Planning & Design Guide https://www.mass.gov/lists/separated-bike-lane-planning-design-guide
- ITE Recommended Practice for Accommodating Pedestrians and Bicyclists at Interchanges https://www.fehrandpeers.com/bicycle-pedestrian-interchanges/

Pedestrian and Bicycle Safety Education Program

Engineering treatments are often not enough on their own to realize full safety benefits associated with the treatment. Safety education programs complement engineering treatments and increase compliance. Education campaigns target people of all ages, especially school-age children where safe walking and biking habits may be instilled as lifelong lessons.

The City along with Solano Transportation Authority conduct pedestrian and bicycling safety education campaigns and provide traffic education within schools in the City.

Suggestion for Potential Improvement

- Continue conducting formal education campaign targeting people driving, walking, and biking about street safety. This includes advertisements on buses and bus shelters, an in-school curriculum, community school courses, public service announcements, and many other strategies. Consider a focus on speed and safe driving.

The Street Smarts program in San Jose, CA, provides a model pedestrian safety education program (see http://www.getstreetsmarts.org for details).

Enforcement

Enforcement of pedestrian and bicycle right-of-way laws and speed limits is an important complement to engineering treatments and education programs.

City of Suisun City Police Department has Traffic Safety Officers who spend time on bicycle and pedestrian safety-related responsibilities and are specifically trained on law enforcement techniques to improve pedestrian and bicycle safety and access. They do conduct bicyclist and pedestrian oriented enforcement activities.

Suggestion for Potential Improvement

- Implement sustained bicyclist and pedestrian safety enforcement efforts and involve the media. Use enforcement as an opportunity for education by distributing safety pamphlets in-lieu of, or in addition to, citations.

3.2. ENHANCEMENT AREAS

Formal Advisory Committee

Advisory committees serve as important sounding boards for new policies, programs, and practices. Responding to public concerns through public feedback mechanisms represents a more proactive and inclusive approach to bicycle and pedestrian safety compared to a conventional approach of reacting to collisions.

Suisun City is involved in the Countywide pedestrian and bicycle advisory committee that addresses bicycle and pedestrian issues throughout the Solano County.

Suggestion for Potential Improvement

- Consider establishing a Formal Advisory Committee with regular scheduled meetings to bring all transportation projects to the general committee to give opportunity for focused complete streets discussion.

Active Transportation Plans (ATP)

This type of plan includes a large menu of policy, program, and practice suggestions, as well as site-specific (and prototypical) engineering treatment suggestions. Bicycle and Pedestrian Master Plans document a jurisdiction's vision for improving walkability, bikeability, and bicycle and pedestrian safety; establish policies, programs, and practices; and outline the prioritization and budgeting process for project implementation.

City has adopted the Solano Countywide Pedestrian Master Plan as well as the Solano Countywide Master Plan, which list Suisun City's projects. However, the City is currently combining the two Plans into a single ATP. Once the ATP is completed, the City's project list will be updated. In addition to the countywide master plans, the City's 2035 General Plan includes pedestrian and bicycle facilities.

Suggestion for Potential Improvement:

- Consider developing high injury networks for walking and biking to identify routes with the highest incidences of fatal and severe injuries for pedestrians and bicyclists. This will create a systematic safety analysis that can help in prioritizing limited resources.

- Identify existing and missing bicycle and pedestrian infrastructure for safety improvements.

Speed Limits and Speed Surveys

Local municipalities have the authority to set the posted speed limit based on current speed data. The speed limit is rounded to the nearest five mile per hour (MPH) increment based on the 85th percentile speed of free-flowing traffic. School zone speed limits in California are a de facto 25 miles per hour or less, where specified. Speed is also critical for complete streets safety. Pedestrian fatality rates increase exponentially with vehicle speed. Thus, controlling vehicle speeds is one of the most important strategies for enhancing pedestrian and bicyclist safety.

The City of Suisun City does not review speed data or conduct speed survey regularly, and it only does speed studies upon request from community and neighborhoods.

Suggestions for Potential Improvement

- Install traffic calming measures, signal coordination, and similar tools to maintain slower speeds appropriate for an urban community, particularly on streets that will be reviewed in the next speed survey. Please refer to: https://www.transportation.gov/mission/health/Traffic-Calming-to-Slow-Vehicle-Speeds
- After complete streets improvements and other safety improvements are installed, conduct off-cycle speed surveys to review the speed limit and see if it needs to be reduced based on the improvements.
- Consider pedestrian volumes and known complete streets safety issues when setting speed limits and employ traffic calming strategies in locations where speed surveys suggest traffic speeds are too high for pedestrian and bicyclist safety.
- Ensure complete streets design standards have appropriate target design speeds for urban areas and do not contribute to a routine need for traffic calming.
- Consider the use of 15 MPH for school zones, as well as any area with a population of senior citizens.

Collection of Pedestrian and Bicyclist Volumes

Pedestrian and bicyclist volume data is important for understanding where people walk and bike. This establishes baseline data prior to project implementation and can help prioritize projects, develop collision rates, and determine appropriate bicycle and pedestrian infrastructure.

Suisun City collects pedestrian and bicycle counts as part of Traffic Impact Studies by consultants.

Suggestions for Potential Improvement

- Routinely collect pedestrian and bicycle volumes.
- Geocode pedestrian and bicycle volume data with GIS software along with other data such as pedestrian and bicycle control devices and collisions to analyze data for trends or hotspots related to safety.

Existing Pedestrian Facilities

The City's existing pedestrian facilities do not include current best practice ADA and safety features such as high visibility crosswalks and advance stop bars, etc. The sidewalks are narrow and the surface of the sidewalks are not smooth. The crosswalks are not clear or are faded and at some locations do not correctly direct to a sidewalk ramp.

Suggestion for Potential Improvement:

- Create a GIS database for existing pedestrian infrastructure to identify gaps, inventory assets, and create opportunities for systemic safety analysis of all sidewalks and crosswalks in the City.
- Identify funding sources for enhancement of sidewalks and crosswalks to include safety features and provide ADA compliance.

Bicycle Network Implementation Practices

Suisun City has adopted the 2012 Solano Countywide Bicycle Plan (https://sta.ca.gov/documents_and_report/countywide-bicycle-plan/) and 2012 Solano Countywide Pedestrian Plan (https://sta.ca.gov/wp-content/uploads/2019/01/Final-Ped-Transportation-Plan-01-11-12.pdf). The City has also developed a map, "Suisun City Bikeways, Existing and Planned", in which they show the existing and future trails and bikeways. It does not consider Bicycle Level of Traffic Stress (LTS) concept. Bicycle Level of Traffic Stress (LTS) was originally developed by researchers at the Mineta Transportation Institute. LTS assesses the comfort and connectivity of bicycle networks.

Suggestion for Potential Improvement:

- Consider prioritizing bicycle projects to align with roadway resurfacing and projects that are near school sites.
- Secure enough funding for repaving and other complete streets projects to allow for installation of protected bike facilities and intersection improvements.
- Consider using LTS to strategically implement bikeways and traffic calming treatments that would improve LTS of existing bikeways.

Roadway Surfaces

The quality of a roadway surface along bikeways is an important consideration when choosing to bike. Rough surface in a bike lane creates an uncomfortable bicycling experience and may pose safety hazards.

Suisun City considers existing or proposed bikeway facilities when prioritizing roadway resurfacing or repaving projects, in line with Complete Streets concepts, but there is no adopted policy.

Suggestion for Potential Improvement:

- Prioritize maintenance of roadways where bicycle facilities are present, particularly for closing gaps in the bikeway network or where improved pavement quality is needed on popular bicycle routes.
- Prioritize debris removal on roadways where bicycle facilities are present.

Attention to Bicycle and Pedestrian Crossing Barriers

Crossing barriers - such as railroads, freeways, and major arterials - may discourage or even prohibit pedestrian and bicycle access and are often associated with collisions. Large intersections and interchanges and uncontrolled crossings can often deter pedestrians and bicyclists due to high speeds, high number of conflict points with vehicles, and high level of exposure. Identifying and removing barriers and preventing new barriers is essential for improving pedestrian and bicyclist safety and access.

In City of Suisun City the major barriers for crossing for bicyclists are grade separated roadways, major arterials, large intersections, railroad tracks, waterways, and discontinuous trail systems.

The City uses the following crossing treatments at uncontrolled crossings: Rectangular Rapid Flashing Beacons (RRFB) and advance yield limit lines.

Suggestion for Potential Improvement:

- Use green color routinely to highlight conflict zones at large intersections and interchanges. See Oakland's bicycle lane striping guidance for more information: http://www2.oaklandnet.com/government/o/PWA/o/EC/s/BicycleandPedestrianProgram/OAK024653
- Coordinate with Caltrans and address interchange barriers in the City as well as barriers on local Caltrans-operated streets.
- To slow speeds at critical intersections, use smaller corner radii using small design vehicles appropriate for urban areas and updated standard plans to reflect this.
- Review design of slip/trap-right lanes at intersections and implement improvements.
- Implement best practice guidance on bicycle accommodation through interchanges and expressways, as appropriate, using the ITE's *Recommended Practice: Guidelines to Accommodate Bicyclist and Pedestrians at Interchanges* plus consideration of protected bike lane design.
- Identify and create an inventory of pedestrian barriers with targeted suggestions for phased improvements.

Bicycling Supportive Amenities and Wayfinding

In addition to designating roadway or paths in a bicycle network, supportive amenities (including parking, water fountains, and maintenance stations) can encourage bicycling. Wayfinding can both encourage bicycling and enhance safety by navigating cyclists to facilities that have been enhanced for bicyclists' use or to local retail opportunities for economic growth.

Suisun City provides racks for bicycle parking and lockers. The City historically has not considered removal of on street parking to install bike or scooter parking corrals, bike share docks, or parklets. The City requires new multi-family residential developments to provide short-term bicycle parking for visitors and long-term bicycle parking for residents.

Suggestion for Potential Improvement:

- Develop a pilot program for bicycle supportive amenities at key locations in the city, such as schools; include bicycle fix-it stations, water fountains, and similar amenities.
- Create and deploy a bicycle wayfinding strategy citywide.
- Update the "Suisun City Bikeways Existing and Planned" map to include bicycle locker and rack locations.

3.3. OPPORTUNITY AREAS

Implementation of Americans with Disabilities Act (ADA) Improvements and ADA Transition Plan for Streets and Sidewalks

Implementation of ADA improvements is key to making walking accessible and safe for everyone in Suisun City, regardless of ability or age. ADA Transition Plans identify gaps and issues in the City's current ADA infrastructure, prioritize projects for implementation, and set forth the process for bringing public facilities into compliance with ADA regulations.

The City of Suisun City does not have a formally adopted ADA transition plan, nor a specifically designated ADA coordinator on staff.

The City uses California Disabled Accessibility Guidebook for ADA improvements. The City has practices related to installation of some of the ADA improvements such as audible pedestrian signals, and high-contrast truncated domes.

Suggestions for Potential Improvement

- Consider developing an ADA Transition Plan for the City.
- Prioritize areas within the City that exhibit greatest pedestrian activity for ADA improvements
- Provide ADA standards and best practice training for engineering staff at all levels.
- Add ADA ramps at intersections that currently lack them and upgrade non-complaint ramps (replacing one ramp to two directional ramps at each corner).

Traffic Calming Program

Traffic calming programs and policies set forth a consensus threshold on neighborhood requests and approvals, as well as standard treatments and criteria. Suisun City does not have a Traffic Calming Program. They do not use any speed bumps or humps. They do use crosswalk bulbouts.

Suggestion for Potential Improvement

- Establish a Traffic Calming Program.
- Expand the City's traffic calming toolbox to include other tools, such as raised crosswalks, raised intersections, chicanes, and traffic diverters.
- Expand the City's practices to include proactive traffic calming measures. The City could consider allocating a portion of funding to proactive traffic calming, such as bicycle boulevards or safe routes to schools, and then allocate the remaining funding to react to specific community requests.
- Refer to the following resources for traffic calming best practices:
  - https://www.ite.org/technical-resources/traffic-calming/traffic-calming-measures/
  - *https://safety.fhwa.dot.gov/ped_bike/univcourse/pdf/swless11.pdf*

Crosswalk Installation, Removal, and Enhancement Policies

A formal policy for crosswalk installation, removal, and enhancement provides transparency in decision-making and adopts best practices in pedestrian safety and accommodation. It includes consideration of all kinds of crosswalks, including uncontrolled and controlled locations.

Suisun City does not have any adopted crosswalk policy.

Suggestion for Potential Improvement

- Develop a citywide crosswalk policy for installation, removal, and enhancement of crosswalks at controlled and uncontrolled intersections citywide. Ensure that it is consistent with best practices and recent research. This includes removing crosswalks only as a last resort. Consider providing midblock crossings where they serve pedestrian desire lines.

- Consider developing a treatment selection "tool" to assist staff with the identification of applicable treatments in a given context.

- When crosswalk enhancements are identified, consider adding them to a prioritized list that will be upgraded over time, as funding is available.

Crosswalk policy resources include:

  - National Cooperative Highway Research Program Application of Pedestrian Crossing Treatments for Streets and Highways: http://www.trb.org/Publications/Blurbs/175419.aspx

Shared Mobility Services

Shared mobility services are transportation services – typically offered by private companies – that offer ride-share services (e.g. Lyft or Uber) for both solo and pooled trips, bike share, and scooter share. Policies for shared mobility services can allow cities to encourage, prohibit, or direct how they want shared mobility to work in their city. They can allow for curb space management, clear organization of sidewalk space, and encourage (or discourage) private vendors to come to the city. Curb space management is a practice that requires curb access to be planned, designed, operated, and maintained to enable curb utilization with safe, convenient, and multimodal access for all transportation users.

City of Suisun City does not have any policies in regards to use of shared mobility services, but there has recently been some interest from Council Members and the City is considering the idea.

Suggestion for Potential Improvement

- Adopt a curb management plan to designate how the City will prioritize and proactive plan for curb uses (e.g. parking, passenger loading, commercial loading, ADA loading and parking, bicycle parking, bus-only lanes) and to make sure that the curb has the highest and best use of space.

- Consider micromobility policies (e.g. permitting, enforcement) in place to prioritize pedestrian and bicyclist safety and keep the sidewalk organized and usable for people of all abilities.

Inventory of Bikeways, Bike Parking, and Key Bicycle Opportunity Areas

A GIS-based bicycle infrastructure inventory enables project identification and prioritization, as well as project coordination with new development, roadway resurfacing, etc. This data set can be available on the City's website for knowledge sharing with the public as well as agencies.

City of Suisun City does not maintain any inventory of missing/existing bikeways, parking, informal pathways, or key bicycle areas.

Suggestion for Potential Improvement

- Consider establishing a system of inventory of missing infrastructure for bicycle facilities.

Collision History and Collision Reporting Practices

Safety is typically approached through both proactive and reactive measures. Identifying and responding to collision patterns on a regular basis is an important reactive approach to bicycle and pedestrian safety, which may be combined with other proactive measures. This is the traditional way most cities have approached safety. However, many are now looking to proactive safety to address safety issues on a system wide basis. This is often paired with a policy goal of getting to zero fatality or severe injury collisions (commonly referred to as "Vision Zero").

City of Suisun City does not regularly review bicycle and pedestrian collision information.

Suggestion for Potential Improvement

- Adopt a data driven systemic safety approach, which would include a systematic approach to identifying, prioritizing, and ultimately implementing safety countermeasure and/or a formal commitment to Vision Zero.

- Work with elected officials and department heads to adopt a Vision Zero policy formally stating the City's commitment to reducing the number of traffic-related fatalities and severe injuries to zero.

- Additionally, with sufficient pedestrian and bicycle volume data, the City could prioritize collision locations based on collision rates (i.e., collisions/daily pedestrian or bicycle volume), a practice that results in a more complete safety needs assessment. Treatments could then be identified for each location and programmatic funding allocated in the City's Capital Improvements Program (CIP).

- Consider utilizing SafeTREC's Transportation Injury Mapping System (TIMS) https://tims.berkeley.edu/. TIMS provides quick, easy and free access to California collision data, the Statewide Integrated Traffic Records System (SWITRS) that has been geo-coded by SafeTREC to make it easy to map out collisions.

Complete Streets Policy

Complete Streets Policies are formal statements showing a City's commitment to planning and designing for all modes of travel and travelers of all ages and abilities.

The City does not have a Complete Streets policy in place, but plans on incorporating Complete Streets concepts into upcoming developments and projects currently in the planning and development stages.

Suggestion for Potential Improvement

The following jurisdictions have established practices for complete streets, including implementation of these policies through multimodal level of service thresholds, and may serve as reference for Suisun City:

- Boston, Massachusetts, Boston's Complete Streets: http://bostoncompletestreets.org/about/
- Philadelphia, Pennsylvania, Philly Free Streets: http://www.phillyfreestreets.com/
- Baltimore, Maryland, Complete Streets Ordinance: https://transportation.baltimorecity.gov/completestreets
- Town of Ashland, Massachusetts, Complete Streets Policy: https://www.smartgrowthamerica.org/app/legacy/documents/cs/policy/cs-ma-ashland-policy.pdf

Traffic Signal

Providing signal control at an intersection may improve pedestrian safety by reducing speeds and controlling pedestrian-vehicle conflicts. Installing bicycle signals and limiting stop signs on bicycle routes may enhance bicycle mobility and safety. The CAMUTCD defines warrants for installing signals. Although following CAMUTCD warrants for installation of traffic signals is a good practice, the City may choose to define relaxed pedestrian criteria to encourage pedestrian safety.

The City considers curb extension/bulbouts at the signalized intersection for enhancing pedestrian and bicycle safety. They don't have bicycle detection at signalized intersections.

Suggestion for Potential Improvement:

- Consider developing City-specific signal and stop sign warrants that are pedestrian- and bicycle-friendly.
- Consider installing bicycle detection at signalized intersections.

4. COMPLETE STREETS AUDIT RESULTS AND SUGGESTIONS

4.1. OVERVIEW

Complete Streets audits are typically conducted as an initial step to improve the street environment for all travel modes within the selected area. Many individuals can participate: residents, stakeholders, and affiliated individuals. During the audits, positive practices are observed and issues and opportunity areas are noted. Observations are made of the interactions among motorists, pedestrians, and bicyclists. Observations are based on the behavior of these different road users, particularly at intersections. For each opportunity area, the group discusses possible suggestions to address safety and operational concerns. Complete Streets audits are highly interactive, with many observations noted in the field. The audits are a means to observing and learning how to "see through the eyes of pedestrians and bicyclists."

This chapter presents observations and suggestions made during the kickoff meeting and field audit conducted on Tuesday, July 23, 2019.

Suggestions in this chapter are based on best practices and discussions with the participants regarding local needs and feasibility. It should be noted that these suggestions are based on limited field observations and time spent in Suisun City by the CSSA evaluators. These suggestions are intended to guide City staff in making decisions for future safety improvement projects in the City; they may not incorporate all factors relevant to pedestrian and bicycling safety issues in the City. This report is conceptual in nature, and conditions may exist in the focus areas that were not observed and may not be compatible with suggestions presented below. Before finalizing and implementing any physical changes, City staff may choose to conduct more detailed studies or further analysis to refine or discard the suggestions in this report, if they are found to be contextually inappropriate or appear not to improve bicycling or pedestrian safety or accessibility due to conditions including, but not limited to, high vehicular traffic volume or speeds, physical limitations on space or sight distance, or other potential safety concerns.

4.2. BACKGROUND

Suisun City staff requested that the field audit examine 10 focal areas. These focal areas are listed in the following table. Those with asterisks ("*") after their numbers are within the Planning Area of Suisun City's 2016 Waterfront District Specific Plan (WDSP).

The City's Waterfront District Specific Plan (WDSP) Area includes all areas west of Marina Boulevard plus parcels along the east side of Marina Boulevard south of Highway 12. City staff said there was particular interest in low cost projects within 1/4 – 1/2 mile of the railroad depot.

#	Focal Area Location	Issues
South of Highway 12		
1*	Main St, Cordelia St – Hwy 12	Speeding, comfortable crossings, revitalization
2*	Main St at train station plaza	Pedestrians crossing east of Lotz Way signal
3*	Cordelia St, City limit – Main St	Speeding, crosswalks, “western gateway” feature
4*	Lotz Way, Main St – Marina Blvd	Speeding, crossings, walkability, business vitality
5*	Marina Blvd, Hwy 12 – Driftwood Dr	Crosswalks at Lotz Way, Driftwood Dr
6*	School crosswalks on Whispering Bay Lane	Bus driveway, path at bend, Francisco intersection
North of Highway 12		
7*	Marina Blvd north of Highway 12	Speeding, crosswalks
8	Village Dr	Crosswalks at Pintail Dr, Nelson Community Center
9	Sunset Ave	Bike lanes, crosswalks
10*	“Triangle parcel”, including Railroad Avenue west of Marina Boulevard	Development site, internal and through connectivity

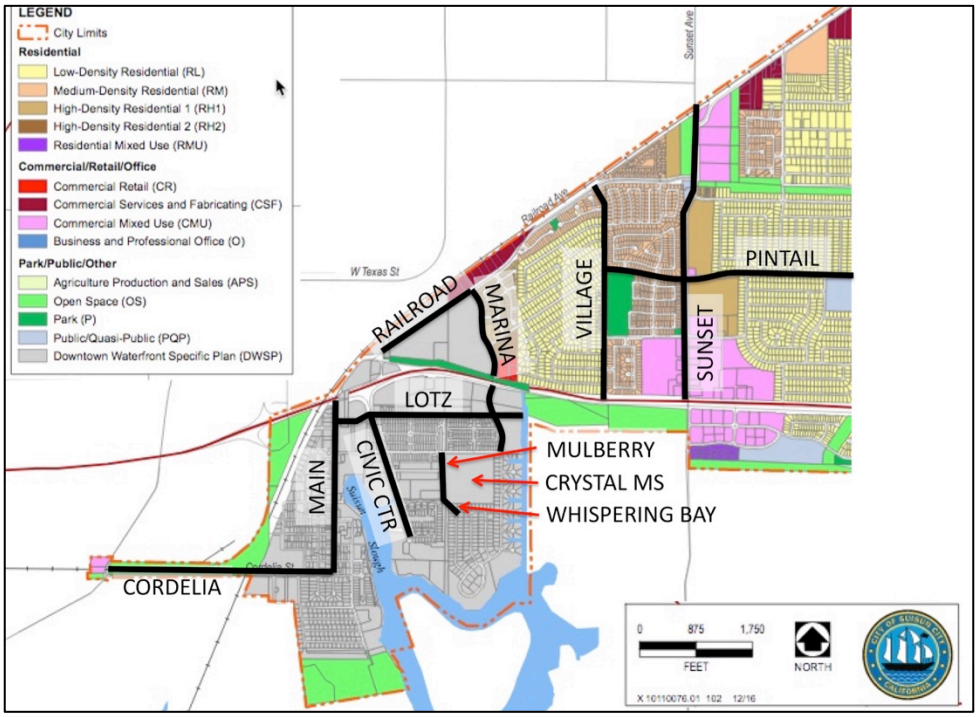


Figure 4-1 shows these areas on a portion of the zoning map (the City extends further east).

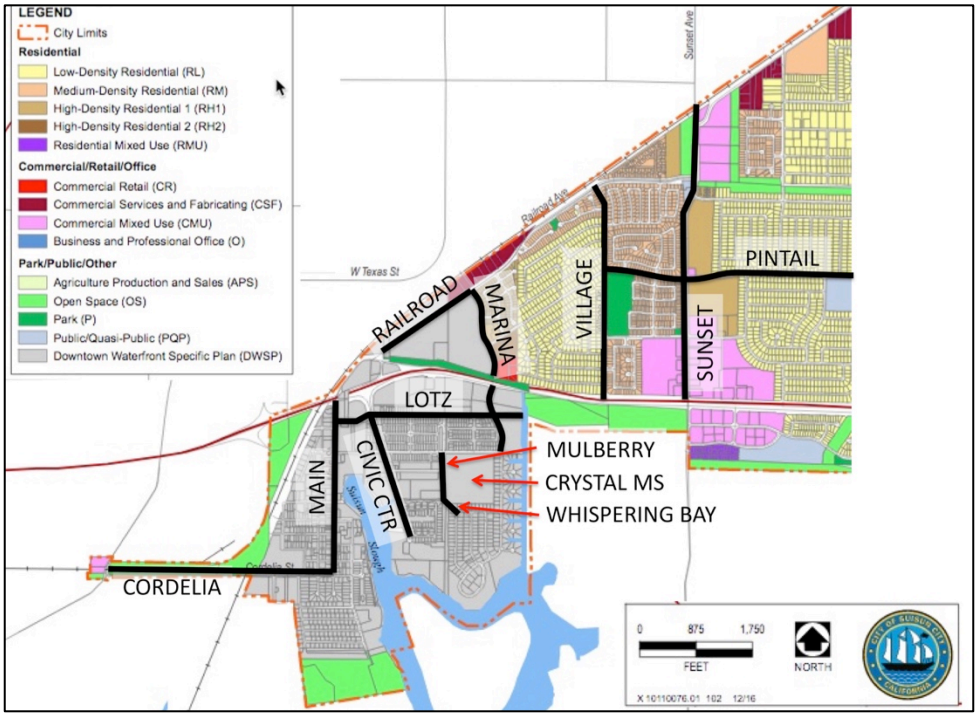


Figure 4-1: Map of focal area segments

Section 4.3 presents key issues and suggestions identified during the audit that can be applied citywide. Subsequent sections address each focal area; each concludes with a tabular and graphical summary of suggestions for that area.

4.3. GENERAL CITYWIDE SUGGESTIONS

The following general suggestions for physical enhancements are appropriate either City-wide or in two or more of the focal areas. These are discussed in detail below.

TABLE 4-1: GENERAL SUGGESTIONS FOR PHYSICAL ENHANCEMENTS

Pedestrian	Details
Left-side signs on medians	At uncontrolled locations where it is feasible to add a raised median to protect a sign, do this so that each approach sees a pair of warning signs on its side of the street.
Left-side warning signs: symbol orientation	Pedestrian symbol (W11-2) or trail crossing signs (W11-15) installed on the left side of street may depict users approaching, just as the W16-7p Downward Pointing Arrow always points into the approach. (MUTCD 2A.06 Design of Signs specifically allows mirror images. However, sign catalogs may not designate a unique product code.)
Upstream sightlines	Prohibit parking for at least 1 car length upstream of crosswalk, to keep sightlines open to approaching traffic. A curb extension can ensure compliance and is a good place for crosswalk warning signs. “Bike corrals” (in-street racks) can also utilize this area.
Advance Limit Lines	Install 4’ in advance of controlled crosswalks, to deter motorists from encroaching.

Yield Lines	Install on multi-lane approaches to uncontrolled crosswalks, 20'-50' before the crosswalk.
Curb extensions	Enable pedestrians to make a starting decision where they can see and be seen. Calm inbound right turns by reducing the physical radius. Shorten crosswalks.
Interim curb extensions	Consider Painted Safety Zone / Interim Curb Extension treatments at locations where the need is current but hardscape curb extensions are subject to future funding.
Crosswalk markings	At uncontrolled crosswalks, incorporate wide longitudinal elements (e.g. "ladder rungs") for long-distance visibility by approaching drivers.
Center islands on side streets	Calm inbound turns. May enable bicyclists preparing to turn left or proceed through to wait further forward than they otherwise would.
Directional curb ramps	Provide 2 ramps per corner, aligned with sidewalks, rather than diagonal ramps.
Accessibility	Ensure that signal actuation is ADA compliant.
Leading Ped. Interval	Display WALK phase (typically) 3 seconds before same-direction green indication, so pedestrians can occupy the curb lane.
Centerline	Install no-passing (double yellow) centerline 50' back from crosswalk.
Bicycle	**Details**
Detection	Install bicycle and motorcycle detection at through, left turn, and bicycle lanes at all actuated approaches.
Right turn lanes	Where total width is insufficient for marking an adjacent bike lane, install sharrows left-aligned in the lane and add a R118(CA) "Except Bicycles" plaque to right-turn only signs.
Wayfinding	Install bicycle guide signage to destinations served by bike routes, with the name of the destination, the direction, and optionally the distance.

Advance Limit Lines

At approaches to controlled crosswalks (i.e. at signals or STOP signs), installing an advance limit line a short distance (typically 4 feet) before the crosswalk can remind motorists to stop far enough back that their vehicle's front end does not encroach into the crosswalk. Such encroachment can be a safety issue at multi-lane approaches when the front end of a vehicle waiting hides a low pedestrian (child or wheelchair user) approaching across another lane.

One example in Suisun City is the southbound approach of Main Street to Cordelia Street.

Corner curb extensions

At intersections with conventional corners and no curb extensions, pedestrians preparing to cross a street typically make their crossing decisions before stepping off the curb, i.e. while on the sidewalk. Due to substantial corner radii at most intersections, this places them over 10 feet outside of the first travel lane they will enter. Corner curb extensions (bulb-outs) enable pedestrians to safely make their decision near the outside travel lane, where they are more visible to approaching motorists and also have a considerably shorter distance to cross. Raised curb extensions also enable crosswalk warning sign assemblies to be installed closer to the travel

lanes where they are more visible to motorists. One resource for curb extensions is NACTO's Urban Street Design Guide section:

https://nacto.org/publication/urban-street-design-guide/street-design-elements/curb-extensions/

Curb extensions attached to the street's existing curb can be expensive to construct because they must preserve drainage along the street and provide accessible slopes and curb ramps. However, the same safety benefits can be obtained with less expense and without modifying drainage if the extension area is segmented into "floating" islands between which pedestrians including wheelchair users travel at existing street grade.

"Temporary Traffic Calming Curbs" (Calgary, AB)

Figure 4-2: Segmented floating corner island treatment

Interim curb extensions

Many cities are now deploying treatments consisting only of painted lines, colored paint or epoxy fill, and tubular delineators to rapidly and inexpensively create corner-bulb installations in advance of funding availability for hardscape versions (Figure 4-3). These go by various names such as "Painted Safety Zones" (San Francisco), "Painted Curb Extensions" (Pasadena), "Painted Bulbouts" (Denver) and "Interim curb bulbs" (Seattle).

San Francisco MTA writes:

> Painted safety zones are painted road areas that wrap around sidewalk corners to make pedestrian crossing intersections more visible to people driving. Painted safety zones are often flanked by delineators (white posts) and encourage people who drive to slow down, especially when making turns.
>
> https://www.sfmta.com/getting-around/walk/pedestrian-toolkit

Seattle DOT (SDOT) writes:

> Interim curb bulbs may be appropriate in locations where there is a safety need and a permanent solution is not feasible in the short term, and/or where there is a planned capital improvement within 5 years. At intersections with curb and gutter, an interim curb bulb can only be done [where] there are existing curb ramps. In

some cases, curb bulbs may also be integrated with bioretention to manage storm water runoff from the right-of-way.

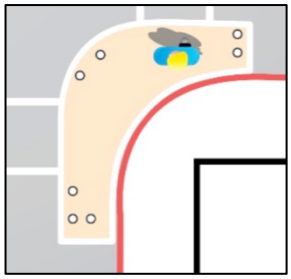
https://streetsillustrated.seattle.gov/urban-design/adaptive-design/intersection-treatments/

Crosswalk marking patterns – high visibility and contrast edge

The standard crosswalk marking scheme at controlled approaches has 2 transverse lines and no fill pattern. Many cities use the standard pattern at controlled approaches and a high-visibility pattern at uncontrolled approaches. The following description from San Francisco MTA's crosswalk design guidelines describes the safety advantages of high-visibility markings:

> *Because of the low approach angle at which drivers view pavement markings, the use of longitudinal stripes in addition to or in place of the standard transverse markings can significantly increase the visibility of a crosswalk to oncoming traffic. While research has not shown a direct link between increased crosswalk visibility and increased pedestrian safety, high-visibility crosswalks have been shown to increase motorist yielding and channelization of pedestrians, leading the Federal Highway Administration (FHWA) to conclude that high-visibility pedestrian crosswalks have a positive effect on pedestrian and driver behavior.*

Los Angeles (Cesar Chavez & St Louis)



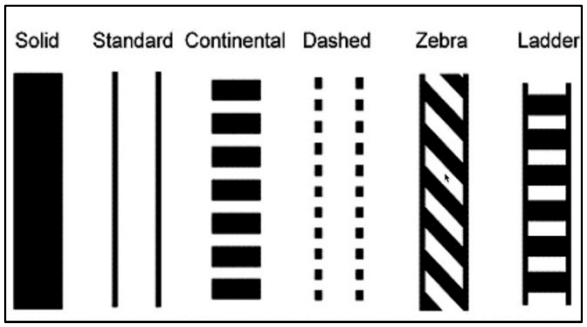
Pasadena Street Design Guide

Los Angeles – Pico & Curson

San Francisco (16th St & Kansas St)

Seattle (Burke-Gilman Trail & 40th Ave NE & NE 52nd Pl)

Figure 4-3: Paint-and-delineator curb extensions



(Figure 12 from FHWA report HRT-04-100, "Safety Effects of Marked Versus Unmarked Crosswalks at Uncontrolled Locations Final Report and Recommended Guidelines")

Figure 4-4: Crosswalk marking patterns (FHWA)

Table 4-2 lists suggested treatments for several crosswalk elements.

TABLE 4-2: SUGGESTED CROSSWALK TREATMENTS

	Approach	Controlled		Uncontrolled	
Elements	**Median**	**None or painted**	**Raised**	**None or painted**	**Raised**
Crosswalk markings		2-line		High-visibility (ladder)	
Warning signs at crosswalk		None		Curbside, 2-sided ("2-sign")	Curbside: 1-sided Median: 2-sided ("4-sign")
RRFBs on crosswalk signs		None		If needed	
Advance markings & signs		Advance limit line 4' upstream		Yield line 20'-50' upstream R1-5 Yield Here signs at yield lines	
Advance warning signs		None		If needed, per MUTCD	

Low-vision pedestrians (persons who are not completely blind) benefit from a continuous "contrast edge" for guidance when crossing streets. The solid transverse lines in the "solid", "standard", "zebra" and "ladder" patterns provide this; the "continental" and "dashed" patterns do not. For all crosswalks at uncontrolled approaches that currently use the continental pattern, it is suggested to add two solid transverse lines to create a ladder pattern.

In prior decades, "artistic" crosswalks were constructed in which the transverse border was a wide cast concrete strip with no retroreflective white marking (12-inch line). Over time the contrast between these strips and the middle of the crosswalk is reduced so the strips no longer provide an effective contrast edge for low-vision pedestrians. 12-inch transverse lines (white for non-school crosswalks, yellow for school crosswalks) may always be incorporated.

Leading Pedestrian Interval

Leading Pedestrian Interval (LPI) traffic signal phasing displays the pedestrian signal's WALK indication for 3-7 seconds before the green indication for same-direction traffic. LPI gives pedestrians a head start to occupy the crosswalk before turning vehicles. A 2000 study by the Insurance Institute for Highway Safety (IIHS) found that LPI reduces conflicts between turning vehicles and pedestrians.

> *Field Evaluation of a Leading Pedestrian Interval Signal Phase at Three Urban Intersections*. Van Houten, Retting, Farmer, Van Houten. Transportation Research Record (TRR) 2000.

It is suggested that the city consider implementing LPI at signals with high pedestrian activity, prohibiting right-turn-on-red as needed per recent research findings.

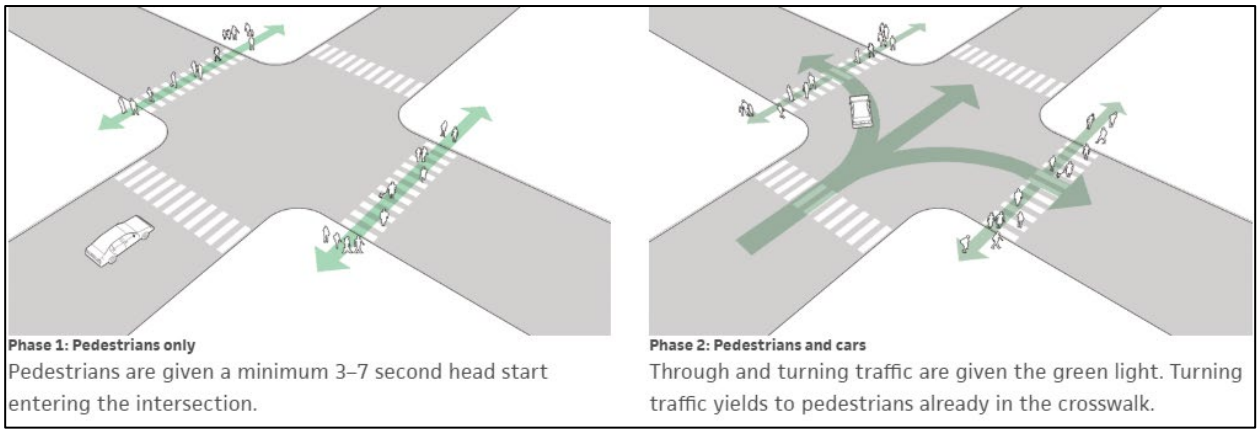


Figure 4-5: Leading Pedestrian Interval phases

Center islands on side streets

Adding pill-shaped center islands just behind the crosswalks side streets at some intersections can improve safety in several ways:

- Calm right turns from the major street
- Calm left turns onto the major street
- Calm through movements on the side street
- Provide a modest refuge for pedestrians crossing the side street, especially slow ones
- Enable the limit lines to be moved forward for better sightlines
- Provide a sheltered place for bicycle users approaching on the side street to prepare to cross or enter the major street

Figure 4-6 shows such an island on a 40-foot residential street in Sunnyvale CA (Canary Drive, at Inverness Way). The island is 6 feet wide and 20 feet long.

Figure 4-6: Median island on residential street (Canary at Inverness, Sunnyvale CA)

Bicycle guide signage

Suisun City's low-stress bicycle route network can be enhanced with state-of-the-practice MUTCD-compliant bikeway network guide signage as shown in Figure 4-7. The example shows BIKE ROUTE signs customized with the City of Oakland's "Oak Tree" logo in one corner. Custom (non-MUTCD) city-identity plaques can also be added atop the BIKE ROUTE sign, either city-wide or on particular high-profile routes.

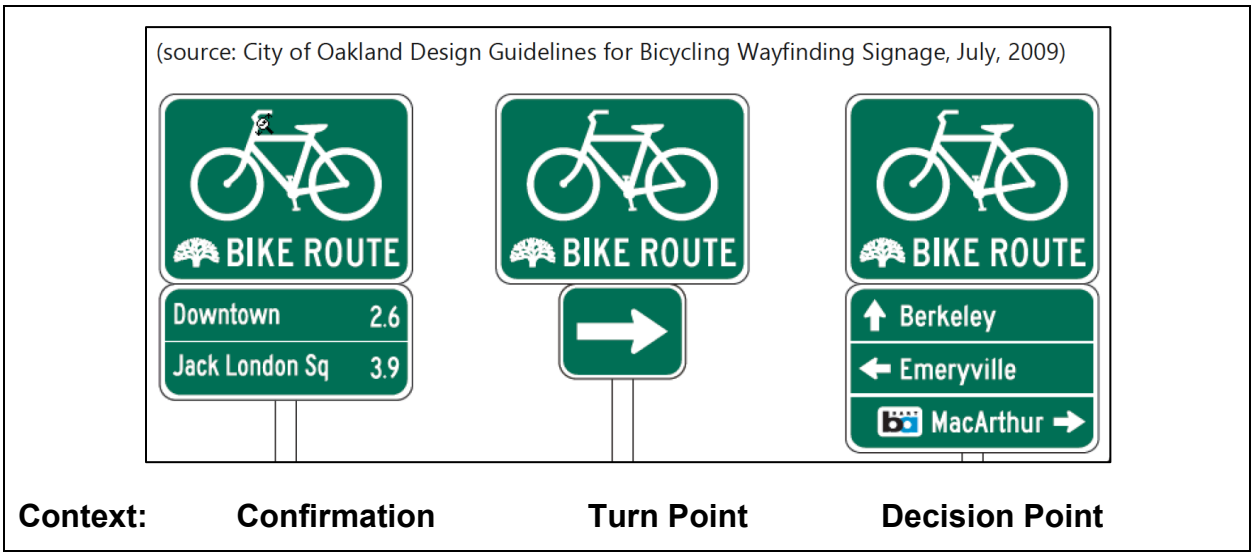


Figure 4-7: Bicycle guide signs (2017 BMP, Figure 7-13)

Decision Point signs are installed in advance of a street or path intersection where travelers may want to change course to continue on their current route or follow a different route.

Confirmation signs are installed after the decision-point intersection, to reassure users that they made the correct choice.

Turn Point signs are used as needed wherever the route does not continue straight. The destination plaques below the BIKE ROUTE signs can have arrows and optional distances as appropriate.

4.4. FOCAL AREAS

The following sections address each of the 10 locations listed in Section 4.2.

4.4.1. Area #1: Main Street between Cordelia Street and Highway 12

The City would like to improve downtown's business vitality and attractiveness to developers by making it more comfortable for pedestrians and bicycle users to travel along and across the street. This includes deterring speeding on the half-mile segment between the controlled intersections at Cordelia Street and Lotz Way, on which there is currently only one physical (deflection-producing) traffic-calming device – the raised crosswalk at the Veterans Memorial Building.

A lower speed distribution could also:

- Dissuade commuters from using Cordelia and Main to avoid congestion on Highway 12.
- Encourage window-shopping, which in turn leads to stopping and visiting businesses.

Existing conditions

Main Street runs north-south through the older downtown part of the city, south of Highway 12 and east of the railroad corridor. It extends 3,200 feet south of Highway 12, ending at a cul-de-sac 250 feet south of Cordelia Street, downtown's western gateway. The street is generally 40 feet wide, with 10-foot sidewalks, one 12-foot travel lane in each direction, and 8-foot parallel parking lanes on both sides. All intersections are minor-street stops except for the 4-way stop at Cordelia and the traffic signal at Lotz Way, 2,500 feet to the north.

Crosswalk markings

One or more crosswalks are marked at almost every intersection along Main Street. All marked crosswalks have the standard two white lines.

Figure 4-8: Uncontrolled crosswalk on Main at Sacramento Street

The crosswalks across Main at Sacramento and the Veterans Memorial Building (Common Street) and all three crosswalks at Lotz have brick-red brick-pattern stamped-asphalt infill which is attractive but does not increase visibility for approaching motorists, especially at night, except by slightly increasing the contrast of the white transverse lines. No crosswalks – controlled or uncontrolled -- have high-visibility "ladder rungs" markings, which do significantly increase conspicuity to approaching motorists. Two examples at uncontrolled crosswalks are the school crossings (yellow) on Mulberry Street at Crystal Middle School's bus loop and Pintail Drive at Crane Drive by Quail Glen Park. For improved conspicuity it is suggested to use wider stripes.

Figure 4-9: Crosswalk with "ladder rungs" (Pintail Drive at Crane Drive)

At all marked uncontrolled crosswalks throughout the City, to increase motorist awareness and yielding compliance, it is suggested to add high-visibility white "ladder rung" markings.

TABLE 4-3: CROSSWALK MARKINGS ON MAIN STREET BETWEEN CORDELIA AND LOTZ

			Marked legs		
Cross street	**Junction**	**Traffic control**	**Main St**		**Cross St**
Cordelia St	4-way	All-way STOP	N, S	Controlled	W
Line St	4-way	Minor street or driveway STOP	N	Uncontrolled	
Morgan St (W)	T (west)				W
Morgan St (E)	T (east)		S		
California St	T (west)				W
Solano St	4-way		N, S		E, W
Sacramento St	T (west)		N (colored)		W
Common St (S leg) / parking lot entry	4-way		Between legs (raised, colored)		W
Common St (N leg) / parking lot exit	4-way				W
Driftwood Dr	4-way		N		E, W
Spring St	T (west)				

Lotz Way (E leg) / commercial driveway (W leg, enter only)	4-way	Signal	N, S (colored)	Controlled	E (colored)
Railroad Ave (train station driveway)	T (west)	None (enter-only driveway)	NA	NA	

Crosswalk signage

Crosswalk warning sign assemblies (W11-2 Pedestrian Symbol + W16-7p Downward Pointing Arrow) are installed on the right side of the street on at these locations:

TABLE 4-4: CROSSWALK WARNING SIGN MOUNTING LOCATIONS ALONG MAIN STREET

Cross street	Crosswalk	Approach	Signs on	Distance to crosswalk
Solano	S	NB	Lamppost, upstream	30 feet (approx.)
	N	SB	Lamppost, upstream	Adjacent
Sacramento	N	NB	Sign post, upstream	Adjacent
		SB	Lamppost, upstream	Adjacent
Common		NB	Lamppost, upstream	Adjacent
		SB	Lamppost, upstream	Adjacent
Driftwood	N	NB	Sign post, downstream	Adjacent
		SB	Sign post, upstream	Adjacent

At Solano Street the lamppost on the northbound approach is 1.5 car lengths (approximately 30 feet) in advance of the south crosswalk, which is not optimal because the downward-pointing arrow is intended to precisely indicate the location of the crosswalk.

The section below on curb extensions offers a way to place crosswalk warning sign assemblies adjacent to a crosswalk and in the parking lane for improved visibility compared to on the sidewalk.

Awareness of uncontrolled crosswalks can be further enhanced by installing left-side warning sign assemblies, with the W16-7p Downward Pointing Arrow pointing into the street. The MUTCD permits the W11-2 Pedestrian Symbol (and all directional graphic icons) to be mirror-imaged so the left-side walker can also be shown entering the street, i.e. matching the orientation of the arrow. (Showing the left-side walker *leaving* the approach is a pet peeve of the engineering evaluator.) Because the mirrored W11-2 does not have a separate MUTCD sign number, this will need to be specifically requested from the sign supplier.

Traffic calming

The crosswalk at the Veterans Memorial Building, between the legs of Common Street, is raised to form a “speed table”. A warning sign at the northeast corner of Common Street’s north (westbound) leg says “SPEED HUMP” with a “15 MPH” plaque. Chevrons centered in the lane adjacent to the crosswalk indicate the location of the raised calming device.

Though the crosswalk markings and crosswalk warning signage along Main Street help drivers to locate the crosswalks and cue them to look for crossing pedestrians, they do not physically control speeds. The raised crosswalk does so, and this treatment is appropriate to consider for other locations along Main Street.

Physical traffic calming devices, whether they employ vertical deflection (e.g. raised crosswalk) or horizontal deflection (e.g. neighborhood traffic circle) have an effective distance that depends on the amount and abruptness of the deflection. To physically calm a long uncontrolled corridor such as Main Street between Cordelia and Lotz, deflection devices must be space close enough that motorists do not return to free-flow speeds between them.

Effective spacing of "slow points" is discussed in many traffic calming resources. ITE's Traffic Calming: State of the Practice (1999, Reid Ewing), Chapter 3, topic "Spacing of Measures", contains a figure (3.45) titled "Midpoint Speed versus Distance Between Slow Points", based on non-U.S. data. It says, "For a midpoint speed of 20 mph, slow points were typically spaced no more than 200 to 250 feet apart. For 25 mph… about 400 feet…". The intersection spacing along the business district portion of Main Street is around this range.

(A PDF slideshow for a 1-day seminar based on the ITE publication is available for download at: https://safety.fhwa.dot.gov/speedmgt/ref_mats/fhwasa09028/71.htm)

Raising several more of these crosswalks is suggested as the primary traffic calming treatment for Main Street's downtown segment.

TABLE 4-5: CROSSWALK SPACING ALONG MAIN STREET

		Distance		
Intersection	**Crosswalk**	**from Cordelia**	**Spacing**	**Notes**
Morgan	N	495	495	South edge of business area
Solano	S	905	410	Downtown's "100%" intersection?
Sacramento	N	1,250	345	
Veterans Bldg.	**Centered**	**1,605**	**355**	**Existing raised crosswalk**
Driftwood	N	2,050	445	
Lotz	S	2,520	470	Signal

Curb extensions

The discussion of painted and physically raised curb extensions in Section 4.3 is directly relevant to Main Street downtown. As that section notes:

> *Corner curb extensions… enable pedestrians to safely make their decision… where they are more visible to approaching motorists and… have a considerably shorter distance to cross*. [Upstream corners can have in-street bike parking "corrals" without blocking sightlines.]
>
> *Raised curb extensions also enable crosswalk warning sign assemblies to be installed closer to the travel lanes where they are more visible to motorists*.

Curb extensions do not directly calm through traffic because they do not deflect through vehicles vertically or horizontally. However, by calming right turns onto cross streets (horizontal deflection) they momentary slow through vehicles following the right-turner.

The crosswalk at the Veterans Memorial Building has curb extensions at both ends that do not extend to the full depth of the parking lane. Curb extensions (painted or raised) added at other intersections along Main Street could extend to the "fender line" of parked vehicles without concern for the safety of bicyclists, because bicycle users are encouraged to ride outside the door zone and at most times of day motorists can pass them across the centerline. As traffic is further calmed to bike-friendly speeds this could be increasingly comfortable.

Safely passing bicyclists across a double-yellow centerline is generally accepted behavior throughout California although the Vehicle Code's sections on passing (overtaking) contain no exception for passing bicycles. (Some other state traffic codes explicitly permit passing of traffic that is sufficiently slower than the prevailing speed as to constitute an "obstacle".)

Shared Lane Markings ("sharrows")

Main Street's 8-foot parking lanes have a door zone that extends to at least 10 feet from curb face. Bicycle users are encouraged to ride outside the door zone on a line of travel that clearly indicates that following traffic may pass on the other half of the street. The safe rideable area remaining in the lane, which excludes the door zone, extends from 10 feet (edge of door zone) to 20 feet (centerline), a total "effective lane width" of 10 feet, which is not shareable side-by-side with a motor vehicle. Shared Lane Markings, a.k.a. "sharrows", if used, may be aligned in the center of a no-shareable lane – in this case 15 feet from curb face.

On streets without parking, if the lane is too narrow for motor vehicles to pass without encroaching into the adjacent lane (lane width less than 14 feet), sharrows may again be centered in the effective lane, which without parking is the same as the physical lane. So if the lane is 11 feet wide, the sharrows would be centered 5.5 feet from curb face. This approach would apply on the segments of Civic Center Drive that have no parking.

Bikes May Use Full Lane (R4-11) signs

To reinforce the guidance provided by sharrows, informing roadway users to expect bicycles to be centered in a narrow effective lane, MUTCD R4-11 "Bikes May Use Full Lane" signs can be optionally installed at appropriate intervals. On Main Street this would be the beginning of the corridor in each direction, e.g. southbound just beyond Lotz and northbound just past Cordelia.

Speed Limit 25 MPH signs

No speed limit signs are currently posted on Main Street. The prima facie speed limit in a business district is 25 MPH. Speed limit signs could be posted at the entry to the corridor in both directions.

Parking stall markings

Most parallel parking along Main Street has stall markings. Most are Ts with the leg pointing toward the curb. Markings near Morgan Street are crosses with 12-inch street legs. To help motorists locate stalls and to indicate the "door zone" to bicycle users, it is suggested to replace all stall markings with crosses with 24-inch street legs, as is done in Oakland. Figure 4-10 shows

an example. That the rider is centering the bike between the white line and the tip of the street legs of the crosses (the extended legs are a significant visual feature at bicycle speeds).

Figure 4-10: Parking stall crosses with 24-inch street legs (Franklin Street, Oakland)

All-way STOP at Solano Street

The City has received multiple requests for an all-way STOP at Solano Street and Main Street. It is suggested that this option be discussed in light of other suggestions in this section.

Summary of suggestions

TABLE 4-6: SUGGESTIONS FOR MAIN STREET BETWEEN CORDELIA AND LOTZ

#	Item / Issue	Suggestion
1	Raised crosswalks	Consider raising most crosswalks between Morgan and Driftwood, to provide sufficiently frequent vertical deflection to limit vehicle speeds. See Table 4-5. *This is the key traffic calming suggestion.*
2	Corner curb extensions (floating-island bulbouts or "interim" / painted treatments)	Add corner curb extensions at selected crosswalks, to: • Reduce crossing distance • Enable pedestrians to make decisions where they can see and be seen • Open upstream sightlines between pedestrians and drivers • Calm inbound and outbound right turns • Enable mounting warning signs in the street for conspicuity • Enable in-street bike "corrals", reducing need for sidewalk racks
3	Crosswalk warning sign assemblies	Add left-side warning sign assemblies, with the W11-2 signs mirror-imaged to show the pedestrian walking into the street.
4	Crosswalk markings	Add "ladder rungs" longitudinal markings at all uncontrolled crosswalks.
5	Parking markings	Change from tees to parking crosses, with street leg projecting 2 feet
6	All-way STOP at Solano Street	Consider in light of other suggestions in this section

Figure 4-11 illustrates suggestions 1-4 using the Main/Solano intersection as an example. For emphasis both uncontrolled crosswalks are shown with colored fill. The north crosswalk is raised, with speed table markings like those at the Veterans Memorial Building crosswalk.

Both ends of each uncontrolled crosswalk have double-sided warning sign assemblies, installed on curb extensions. The two upstream curb extensions are one parking space long, with space for bike racks.

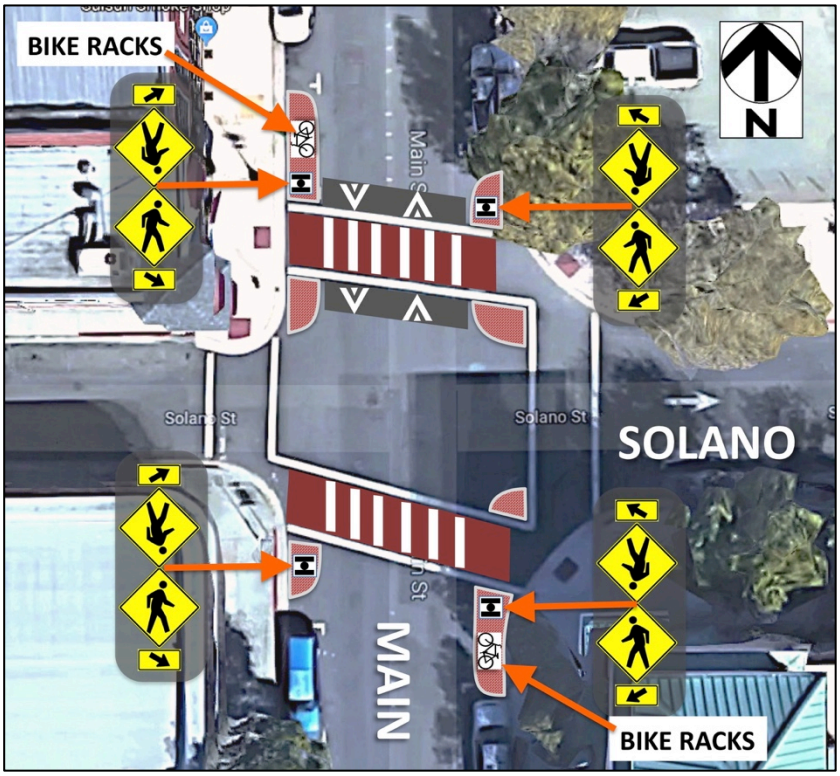


Figure 4-11: Main Street at Solano Street - concept

4.4.2. Area #2: Main Street at train station plaza and commuter parking lot

Existing conditions

As shown in Figure 4-12, Amtrak's Suisun-Fairfield commuter rail station and its plaza occupy the northwest quadrant of the Main Street – Lotz Way intersection. A large commuter parking lot is located on the east side of Main north of Lotz, serving the station.

Along the lot's west edge, at the south end (closest to Lotz) there is a pair of ADA parking stalls with a slash-striped walkway between (blue rectangle) and an ADA ramp at the west end. An iron fence runs north from this ramp, blocking direct access to Main's east sidewalk from the lot. South of the ADA stalls are two more parking stalls that are non-ADA (orange rectangle).

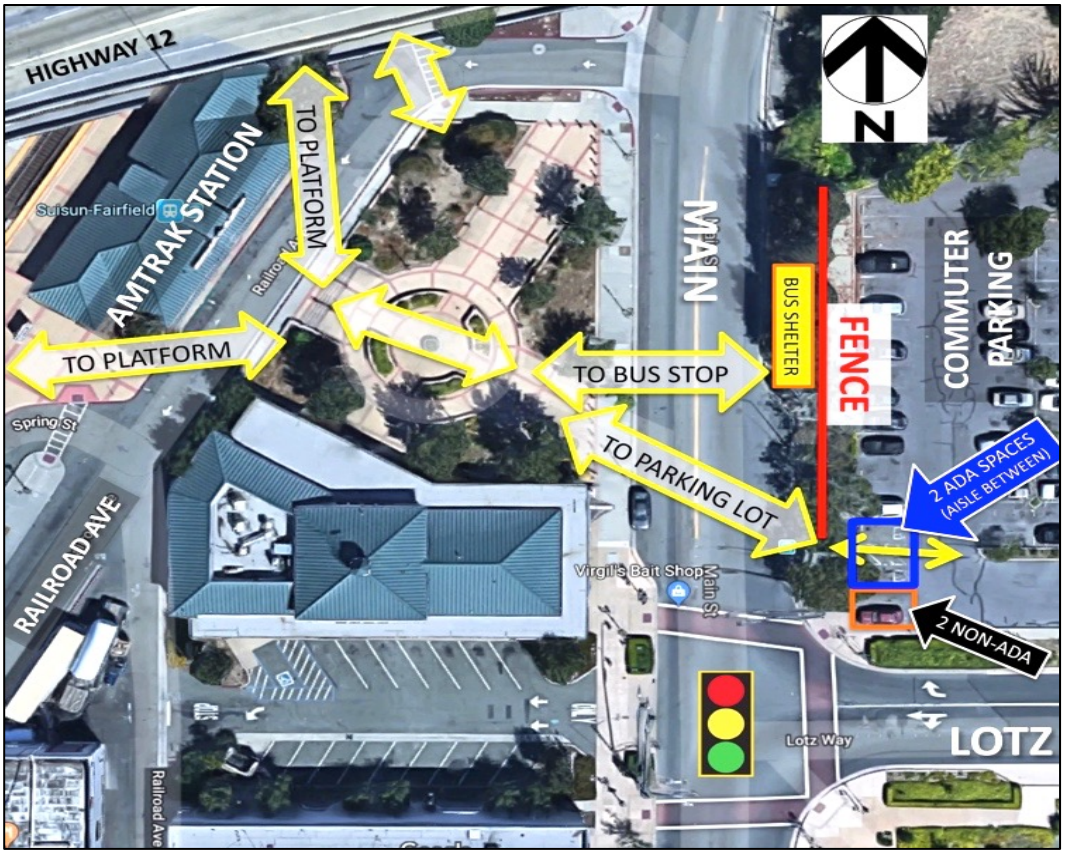


Figure 4-12: Main Street between Amtrak station and parking lot – "desire lines"

Issues and analysis

The City is concerned that some persons cross Main Street north of Lotz; Figure 4-13 shows one example. The station platform is accessible on foot to the north and south of the station building, and the desire lines across Main Street to either end of the station building run through the plaza between Main and Railroad Avenue. The east (parking lot) end of the street-crossing desire line is at the south end of the fence, which is 4 parking stall widths north of the parking lot's southwest corner because there are 2 non-ADA stalls at that corner.

The rail station, adjacent bus stops, and the commuter parking lot comprise a multimodal transit hub served by several bus lines: FAST (Fairfield And Suisun Transit), Greyhound, VineGo (connections to Napa Valley), and the Rio Vista Delta Breeze – a service of the City of Rio Vista. Northbound FAST bus lines 5, 50 and GX stop at the sheltered bus stop on the east side of Main north of Lotz, visible at top left in Figure 4-13.

Persons arriving on Amtrak or at the bus transfer island south of the rail platform may transfer to a northbound bus at the stop on the east side of Main. Those in a hurry may cross Main north of the Lotz intersection to avoid the crosswalk delay, especially if their bus is arriving soon. Some Amtrak commuters who park in the east-side lot may likewise cross north of Lotz because it is faster than walking from or to the crosswalk and waiting for the WALK indication.

Figure 4-13: Pedestrian from station crossing Main north of Lotz, toward bus shelter

Suggestions

If the ADA stall pair (blue rectangle in Figure 4-12) and the adjacent non-ADA pair (orange rectangle) were swapped, the fence could be extended 2 stalls to the south, which could persuade more commuters to use the Lotz signal's north crosswalk. A new curb ramp would need to be installed at the new location of ADA pair's walkway.

Optionally, a raised median could also be added on Main north of Lotz, with a fence to further deter crossing away from the intersection, including by those whose east-side origin and destination is the northbound bus stop. Median fences designed to prevent pedestrian cut-throughs need not be unattractive -- Figure 4-14 shows an example in San Carlos, CA whose barrier feature consists only of stainless steel cables, like a cable railing around a patio deck.

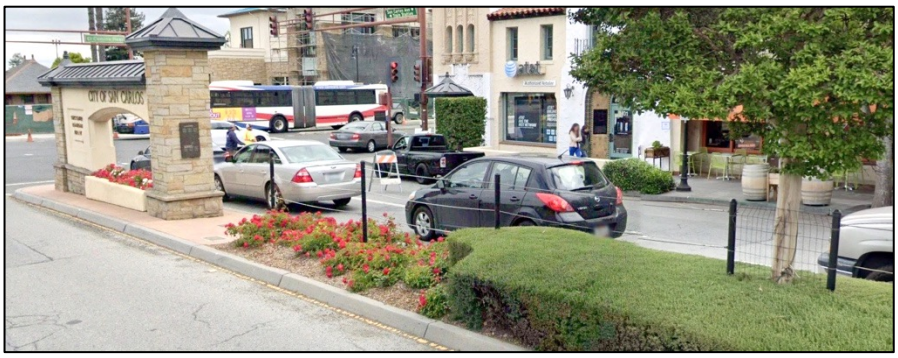


Figure 4-14: Pedestrian crossing barrier fence in raised median (San Carlos CA)

Adding such a raised median north of Lotz would create an opportunity for a downtown gateway sign at the island's north end. *(The San Carlos example's prominent gateway feature is designed to be read from the cross-direction because this is a T intersection with the city's Caltrain station at the top -- all approaching traffic arrives from the cross street, El Camino Real.)*

Table 4-7 summarizes the suggestions.

TABLE 4-7: SUGGESTIONS FOR MAIN STREET NORTH OF LOTZ WAY

#	Item / Issue	Suggestion
1	Location of ADA (disabled persons) parking stalls near SW corner of commuter parking lot	Exchange the locations of the ADA parking stall pair (and its curb ramp) and the two non-ADA stalls immediately south, placing the ADA stalls closer to Lotz.
2	Ornamental iron fence on Main Street's east sidewalk north of Lotz	Extend the parking lot fence southward two parking stall widths, to the new location of the ADA ramp serving the pair of ADA stalls.
3	Middle of Main Street between Lotz and the train station's north driveway	Consider adding a raised median, with a fence to prevent pedestrians from crossing it. Consider adding a "downtown gateway" sign at the north end of the raised median.

Figure 4-15 illustrates the combined concepts.

Figure 4-15: Main Street at Amtrak station and parking lot - concepts

4.4.3. Area #3: Cordelia Street between rail corridor and Main Street

Existing conditions

Cordelia Street, Suisun City's southwestern access, runs east-west from the western city limit at Pennsylvania Avenue, 2,300 feet to the Amtrak / UPRR rail corridor, 1,450 feet (0.28 mile) further to Main Street, and 640 feet further east to Walnut Street, the western edge of Suisun Slough.

From Pennsylvania to just west of West Street, approximately 300 feet east of the tracks, Cordelia is a two-lane rural arterial highway with 12-foot travel lanes and no paved shoulders. At West Street it becomes 40 feet wide with curb and gutter, attached sidewalks, and parallel parking.

There is no stop sign for eastbound traffic until Main Street, though the developed area begins at West Street, 500 feet east of the tracks, where there is also a pair of FAST (Fairfield And Suisun Transit, fasttransit.org) route #5 bus stops.

The westernmost streets that intersect from the south – West Street and Crystal Street -- both end at Suisun Slough just one block (450 feet) south. School Street is the next to the east, with an offset pair of T intersections (south leg west of north leg). School Street's south leg also extends to the slough, which is approximately 1,180 feet (0.23 mile) to the south at that point. The Harbor Breeze and Centennial Arms apartment complexes occupy these south-side blocks between the rural/urban boundary and School Street, where the old town grid begins.

On the north side west of School Street is a vacant parcel bounded by Railroad Avenue, California Street, the north segment of West Street, Morgan Street, and the north segment of School Street. On the north side of Cordelia at Crystal Street a sign says "Property of Fairfield Suisun Unified School District". City staff said that the planned development will connect the north segment of West Street to Cordelia Street.

The vacant parcel on the south side of the street between the railroad and the west-side parcels along West Street is posted "FOR SALE or BUILD TO SUIT", so the future developed edge of the city will be the railroad right of way.

A SPEED LIMIT 25 MPH sign faces eastbound traffic just east of the railroad. No speed limit signs facing westbound traffic were seen between Main and the railroad. However, California Vehicle Code section 22352(b)(1) sets a "prima facie" speed limit of 25 MPH on non-state highways in business and residential districts.

Cordelia west of Main is signed as a Bike Route (Caltrans Class III bikeway), with a D11-1 BIKE ROUTE (bicycle symbol) sign just west of Main Street facing westbound traffic.

Planned conditions

The Waterfront District Specific Plan says that the Circulation Element of the General Plan designates Cordelia between Pennsylvania and Main as a four-lane arterial.

Figure 4-16: Cordelia Street between railroad and Main Street – context

The WDSP's section 4.1.3, Planned Vehicular Circulation Improvements, describes a new collector street parallel and east of the railroad between Cordelia and Spring Street, called the "Old Town Bypass" in the 1999 Specific Plan. This alignment is labeled "Railroad Avenue" in Figure 4-16.

WDSP Figure 4-10, Bicycle and Pedestrian Circulation Network, shows proposed bike lanes on Cordelia Street.

Issues and analysis

There are several issues along this segment of Cordelia Street in its existing condition:

- Crossing the street at the uncontrolled intersection of West Street to access the westbound bus stop
- Crossing the street between West and School Streets to walk across the vacant parcel to the developed area north of Morgan Street
- The need to cue eastbound motorists to obey the posted 25 MPH speed limit east of the tracks, despite there being no controlled intersection until Main, and to decelerate to that posted speed before reaching the bus stops at West Street. This involves resetting the driver's speed expectation from rural highway to urban.
- The need to cue westbound motorists not to accelerate to rural highway speeds until past the tracks.

Lower speeds will make it easier and safer to cross the street and also to make turns into and out of side streets.

West Street is currently the westernmost point where there is a strong reason for pedestrians to cross the street -- to reach the north-side bus stop, and also to traverse the vacant parcel to Morgan Street. Given that the planned north-side development will connect the north and south segments of West Street, its intersection with Cordelia would be a good candidate for a "gateway" feature to cue the behavior change from rural to urban. A physical traffic calming measure with deflection would discourage speeding between it and School Street.

The City does not currently install vertical deflection measures except for raised crosswalks such as the one at the Veterans Memorial Building on Main at Common. A raised crosswalk may not be appropriate at the rural-urban boundary.

Potential horizontal deflection measures that can also serve as visual "gateways" include modern roundabouts, neighborhood traffic circles and non-circular median islands, optionally combined with curbside islands to ensure deflection (i.e. defeat "fast paths" that avoid it).

Without knowing whether and when the "Old Town Bypass" will be implemented, and the specifics of the south (Cordelia) edge of the planned north-side development, this report cannot speculate on which gateway treatment at West Street might be best.

The WDSP shows proposed bike lanes on Cordelia west of Main. If the street was built out at 40 feet curb-to-curb like the segment east of West Street, bike lanes would fit if parallel parking is present on one side, as shown in Figure 4-17.

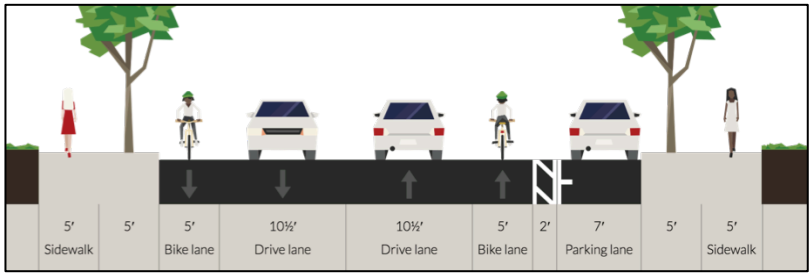


Figure 4-17: 40-foot paved width with bike lanes and one-side parking

At 60 feet of paved width, buffered bike lanes would fit along with a 14-foot median (10' turn lane + 4' stinger islands) that would enable provision of refuges for crossing pedestrians. One concept is shown in Figure 4-18.

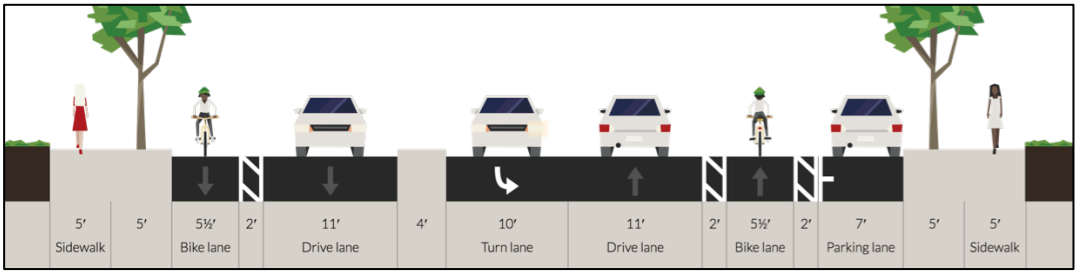


Figure 4-18: 60-foot paved width with buffered bike lanes, one-side parking, center lane

The D11-1 BIKE ROUTE (bicycle symbol) sign, like the one on westbound Cordelia just past Main, does not provide any information as to where the bike route goes or what destinations it serves, and the proximity of those destinations. The current practice is to use the newer D1-series bicycle guide signs that show 1, 2 or 3 destinations with optional distances.

Suggestions

TABLE 4-8: SUGGESTIONS FOR CORDELIA STREET WEST OF MAIN STREET

#	Item / Issue	Suggestion
1	Desire for 25 MPH speeds east of railroad	Consider installing a "gateway" feature at or just west of West Street, incorporating horizontal deflection to limit vehicle speeds.
2	Pedestrian crossing at West Street (bus stops)	Consider marking the uncontrolled east or west crosswalk with a high-visibility ("ladder") treatment and installing double-sided crosswalk warning sign assemblies on both sides of the street.

4.4.4. Area #4: Lotz Way, Main Street – Marina Boulevard

Existing conditions

Lotz Way extends approximately 1/2 mile (2,600) feet from Main Street to Marina Boulevard. Table 4-9 describes its 8 intersections; Table 4-10 summarizes parking, pedestrian, and bicycling conditions along each block.

TABLE 4-9: LOTZ WAY INTERSECTIONS

Intersection	Configuration	Controls	Notes
Main St	4-way (west leg is enter-only parking lot driveway)	Signal	Marked crosswalks on N, E, S legs
Harbor Center / commuter parking lot driveway	4-way	2-way STOP (Harbor Center & driveway)	Marked uncontrolled crosswalk on W leg
Civic Center Blvd	4-way	All-way STOP, SB-WB slip lane	North leg is off- and on-ramps of eastbound Hwy 12. Marked crosswalk on S leg. Uncontrolled SB-EB right turn movement. Large-radius right turn channelization island enables high speed turns toward Main St.
Alder St / Port St	4-way	All-way STOP	Marked crosswalk on S leg.
Marina Center (shopping plaza) driveway	T (north)	1-way STOP (driveway)	Marked uncontrolled crosswalk on W leg

Josiah Way	T (south)	All-way STOP	Pedestrians cross and walk along east edge of shopping plaza to reach walk-through arcade north of Asian Market. Vacant lot to northeast, extends to Hwy 12.
Justice Ave	T (south)	1-way STOP (Justice)	Vacant lot to north, extends to Hwy 12. Marked colored crosswalk on S leg.
Marina Blvd	T (west)	1-way STOP (Lotz)	Grizzly Island Trail on east side of Marina Blvd. Extends 4,900' (north to Highway 12, east to Grizzly Island Road, south to Gray Hawk Lane). *Key low-stress bike-walk access to Downtown Waterfront District*. Vacant lot to northwest, extends to Hwy 12. Marked (2-line) uncontrolled crosswalk on S leg with 1-sided RRFB warning sign assemblies on right side of approaches.

TABLE 4-10: LOTZ WAY BLOCK CONDITIONS

Segment	Length	Land use	Parking	Sidewalks	Bicycling
Main St – Harbor Center	240,	N: Commuter parking lot S: Hotel block	Prohibited	N: buffered S: buffered (parking lane)	Shared lanes
Harbor Center – Civic Center Blvd	320’			S: Mostly attached	
Civic Center Blvd – Alder St / Port St	560’	N: Vacant S: Houses	N: Prohibited S: Some bays	N: attached S: buffered	EB: Shared lane WB: Shared lane or 1-way cycle track (6’ wide, asphalt dike) S: parking bays
Alder St / Port St – Marina Center driveway	220’	N: Retail (back side) S: Houses			
Marina Center driveway – Josiah Way	220’			N: attached S: buffered	
Josiah Way – Justice Ave	440’		Parallel	S: buffered	Shared lanes S side: parking
Justice Ave – Marina Blvd	255’			S: buffered	

Issues and analysis

“Cycle track” on north side

Between Civic Center Boulevard and Josiah Way the northernmost 7’ of pavement is separated from the travel lane by an asphalt dike painted white. This area resembles an informal, undesignated cycle track (on-street separated bikeway), though it currently is blocked (not connected to the travel lane) at Josiah Way and is obstructed by two post-mounted signs facing westbound traffic:

- Midway between Josiah and Marina Center, a W11-2 (pedestrian symbol) + W16-9p (“AHEAD” plaque)
- At the east leg at Marina Center, a W1-5 (Yield Here to Pedestrians) sign

It is worth considering formalizing this facility as a bikeway and extending it to the east and/or west, either as a shared use path (i.e. with pedestrian traffic) or as a cycle track + sidewalk combination (its current cross-section). One consideration is whether it should be designated as a one-way or two-way cycle track.

An east extension to Marina Boulevard would connect Civic Center Boulevard and Marina Center to the Grizzly Island Trail, a shared use path that serves the city’s large eastern residential areas. That Trail directly serves the area east of Sunset and south of Highway 12 by connecting to Anderson Drive. It connects to the areas north of Highway 12 via the signalized crosswalks at Marina Boulevard and Sunset Avenue and the Central County Bikeway along the north side of the highway.

To provide a seamless off-street bikeway in both directions, with a separate sidewalk for pedestrians, it is suggested to continue the existing cycle track + sidewalk layout to Marina Boulevard and designate the bicycle portion as two-way. The reason for not using a shared-use

path cross section between Josiah and Marina Boulevard is that the vacant parcel on the north side is zoned RHD (Residential High Density), which can be expected to generate substantial pedestrian activity.

At the Marina Boulevard intersection there is an existing marked uncontrolled crosswalk on the south leg, with RRFB-enhanced crosswalk warning signs. Whether or not the intersection remains uncontrolled for Marina Boulevard, it is suggested to add a north-leg crosswalk to directly connect the cycle track and north sidewalk to the Trail rather than having users cross the west leg and south leg to reach it. If the Marina Boulevard axis remains uncontrolled, it is suggested to configure that north crosswalk with RRFB signage like the existing south crosswalk.

The existing facility ends on the northeast corner Civic Center Boulevard. That intersection already has a marked crosswalk on its south leg. If one was added on the east leg it would connect users to the hotel block on the southwest corner, which would create an economically significant recreational attractor for hotel guests especially if the hotels provided guest bicycles.

For connecting to the train station, the wide landscaped north and east perimeter of the commuter parking lot between Main Street and Civic Center Boulevard looks promising. Implementing this would require:

- Adding north crosswalks at Civic Center Boulevard. Rather than providing an uncontrolled crosswalk across the southbound right turn slip lane it is suggested to evaluate replacing that geometry with a conventional right turn lane with a small corner radius.
- Adding a crosswalk across Main Street at the train station's north driveway, either uncontrolled and enhanced with RRFBs, or controlled.

There is an existing pedestrian-bicycle bridge across the tracks on the Railroad Avenue axis just north of Highway 12, so connecting the Lotz Way cycle track to the train station would also enable trips to and from the adjacent area of Fairfield.

Facing west at Civic Center Boulevard

Facing west at Marina Center driveway – “cycle track” along north sidewalk

Facing northeast from Marina Center driveway – back (south) side of commercial building

Figure 4-19: Lotz Way - existing conditions

Suggestions

TABLE 4-11: SUGGESTIONS FOR LOTZ WAY GREENWAY CONCEPT

#	Item	Suggestion	Notes
1	Crossing Marina Blvd	Add marked north crosswalk	If uncontrolled, use RRFBs
2	Crossing at Josiah Way	Add marked west crosswalk	
3	Josiah Way axis	Provide spur connections into east side of Marina Center	Avoids having to use Marina Center's main driveway or Alder
4	South (back) side of Marina Center buildings	Opportunity for elevated sidewalk café space	
5	Civic Center Blvd east crosswalk	Add marked crosswalk	To connect with existing south crosswalk to serve hotel block
6	Civic Center Blvd north crosswalk	Add marked crosswalk	Consider replacing large-radius right turn slip lane with a conventional right turn only lane brought to a small-radius corner
7	Main Street at train station north driveway	Add enhanced crosswalk	Connect west end of greenway to train station and City of Fairfield

Figure 4-20 illustrates these suggestions.

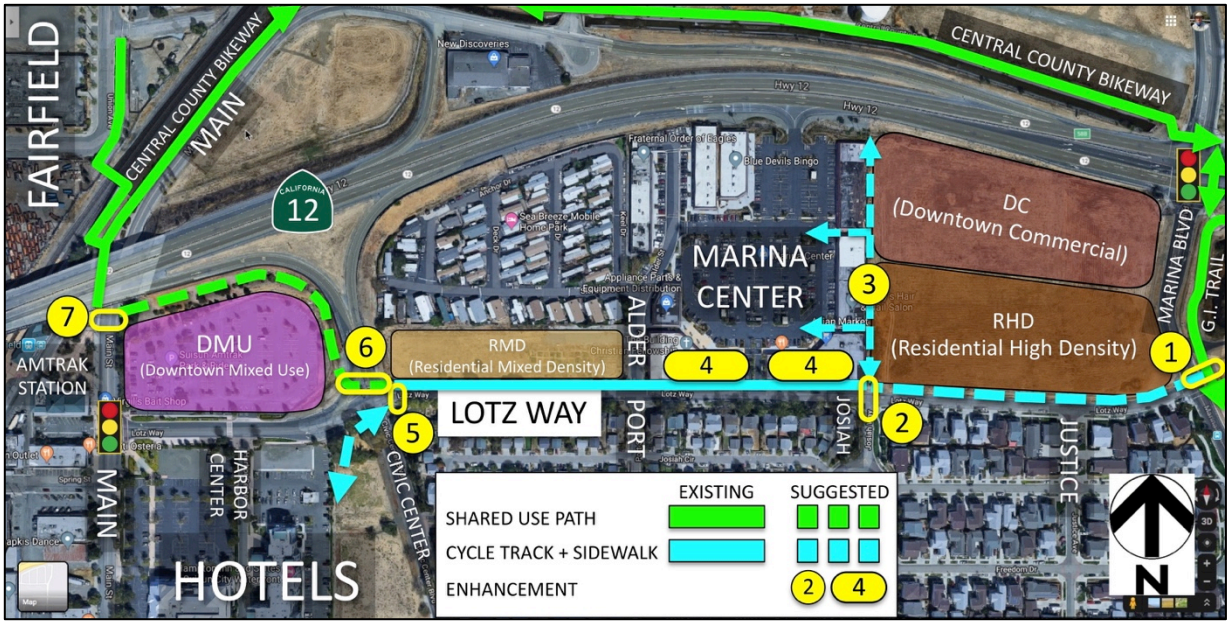


Figure 4-20: Lotz Way greenway concept

4.4.5. Area #5: Marina Boulevard, Highway 12 – Driftwood Drive

Existing conditions

Marina Boulevard runs roughly north-south approximately 4,900 feet (0.9 mile) from Railroad Avenue, on the south side of the Amtrak / UPRR rail corridor, across Highway 12 to Marina Circle on the north side of Suisun Slough. Its first two intersections south of Highway 12 are at Lotz Way (T intersection, 1-way STOP) and Driftwood Drive / Court (4-way STOP). Between Highway 12 and Driftwood the Grizzly Island Trail runs along the east side of the street, ending at a small circular plaza on the northeast corner at Driftwood.

At Driftwood there is a marked school (yellow) crosswalk on the north leg. It has a ladder pattern with 12-inch wide rungs. No other crosswalks are marked at this intersection. Because the traffic control is all-way STOP, all 4 legs have controlled crosswalks.

Southbound at Driftwood: School crosswalk, Grizzly Island Trail terminus (lower left). Bike lanes end.

Figure 4-21: Marina Boulevard between Highway 12 and Driftwood Drive

On the block between Lotz Way and Driftwood the street is 40 feet wide with 5-foot bike lanes and 15-foot travel lanes.

The T intersection with Lotz Way is a 1-way STOP (Lotz stops). There is a marked (2 white line) crosswalk on the south leg, with RRFB-equipped warning sign assemblies on the right side facing both Marina Boulevard approaches. The west end of the crosswalk connects to a wide sidewalk path that runs south to connect to the adjacent residential development's internal streets (Liberty Drive, Victory Way, Freedom Drive) on its way to the northwest corner at Driftwood.

Midway between Highway 12 and Lotz Way the street curves to the left for southbound traffic. At this location there is an advance warning sign assembly consisting of a W11-2 Pedestrian Symbol, RRFB (connected to the device at Lotz Way) and W16-9p AHEAD plaque.

Analysis

At the Lotz Way intersection the uncontrolled crosswalk could be enhanced with wide "ladder rung" markings – a city-wide suggestion for uncontrolled crosswalks. The crosswalk warning sign assemblies could be made double-sided so drivers on both approaches would see signs on the both sides of the street.

Southbound at curve before Lotz Way: Advance RRFB-enhanced warning sign assembly

Southbound at Lotz: 1-sided RRFB warning sign assembly. Bike lanes beyond.

Figure 4-22: Marina Boulevard between Highway 12 and Lotz Way

As noted in the previous section on Lotz Way, a greenway (cycle track + sidewalk) along the north side of Lotz would require adding a north crosswalk at its intersection with Marina Boulevard. If the intersection remained a 1-way STOP the north crosswalk could be configured like the south crosswalk, with RRFB-enhance warning sign assemblies.

At a future resurfacing the block between Lotz and Driftwood could be re-striped with 6-foot bike lanes, 3-foot buffers and 11-foot travel lanes. There is no parking demand on this block because the residential development to the west has ample internal parking and one can park along the north side of Driftwood Court to access the open space to the east.

Although the Grizzly Island Trail provides one way to bicycle between Driftwood or Lotz and Highway 12, to cross the highway to reach the Central County Bikeway or portions of the city further north, many bicycle users may favor the faster and more direct option to ride on the street. Marina Boulevard already has bike lanes between Highway 12 and Railroad Avenue, although in the southbound direction the bike lane ends midway between Buena Vista Avenue and Highway 12 and there is no southbound through bike lane along the right turn only lane at Highway 12.

It is suggested that plans be developed to widen Marina Boulevard between Lotz Way and Buena Vista Avenue to add buffered bike lanes and also through bike lanes along the left sides of the right turn only lanes approaching Highway 12.

Suggestions

TABLE 4-12: SUGGESTIONS FOR MARINA BOULEVARD SOUTH OF HIGHWAY 12

#	Item	Suggestion	Notes
1	North crosswalk at Driftwood	Widen ladder rungs to at least 24”	City-wide suggestion for uncontrolled crosswalks
2	Between Lotz and Driftwood	At next resurfacing consider buffered bike lanes	6’ bike, 3’ buffer, 11’ travel lanes
3	South crosswalk at Lotz Way	a) Add wide “ladder rungs” markings	City-wide suggestion for uncontrolled crosswalks
		b) Make warning sign assemblies double sided	Present signs on both sides of both approaches City-wide suggestion for uncontrolled crosswalks
4	North crosswalk at Lotz Way	If greenway concept is implemented along north side of Lotz Way, install RRFB-enhanced warning sign assemblies and high-visibility pavement markings like south crosswalk	
5	Between Highway 12 and Lotz Way	Develop plans for buffered bike lanes and a northbound through bike lane along the right turn only lane. Implement when the west-side parcel is developed.	Facilitate on-street bicycle trips across Highway 12
6	Between Highway 12 and Buena Vista Avenue	Widen to the west to enable the southbound bike lane to continue to Highway 12, with a through bike lane along the right turn only lane.	Facilitate on-street bicycle trips across Highway 12

Figure 4-20 is a key map of these suggestions.

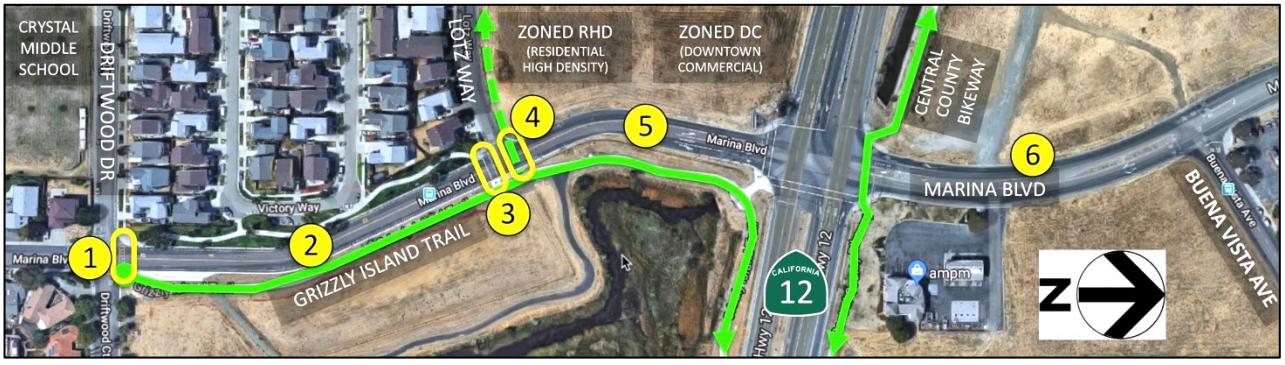


Figure 4-23: Map of suggestions for Marina Boulevard

4.4.6. Area #6: School crosswalks on Whispering Bay Lane

Existing conditions

Crystal Middle School's campus is bounded on the west by Whispering Bay Lane and on the south by the backyard fences of homes on Francisco Drive (Figure 4-24). City staff requested a field review of one existing crosswalk and 2 potential crosswalk locations along Whispering Bay Lane between Driftwood Drive and Francisco Drive, labeled A, B and C in the figure.

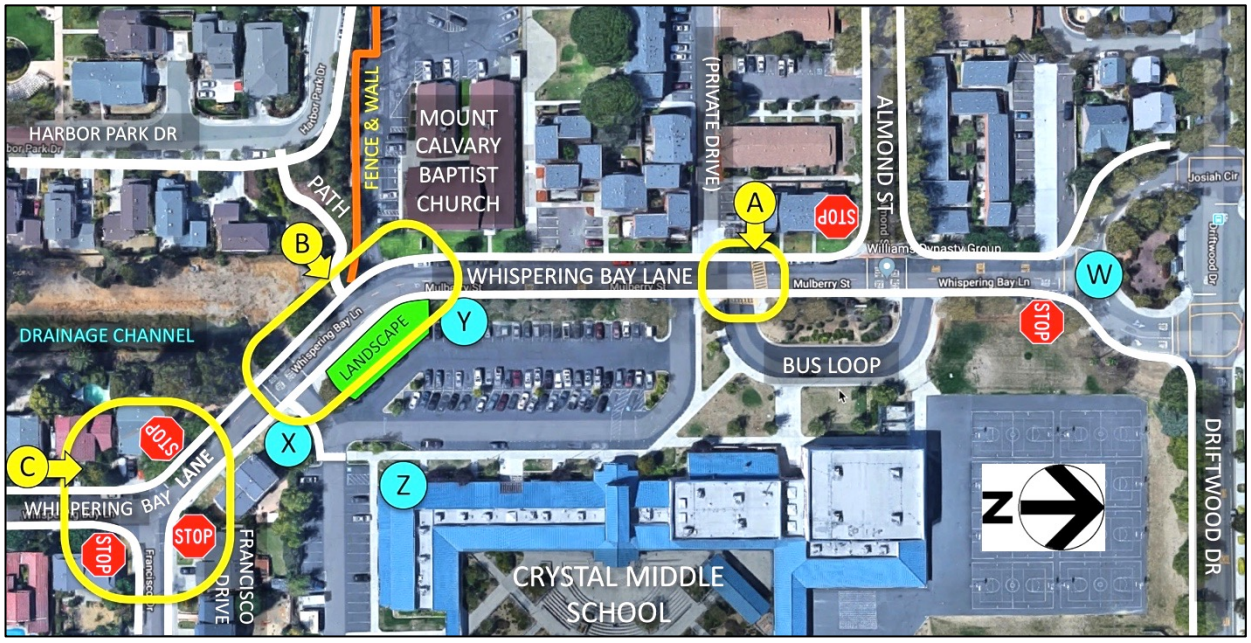


Figure 4-24: Whispering Bay Lane – school crosswalk context

At A there is an existing uncontrolled crosswalk on the north leg of the school bus loop driveway entrance (Figure 4-25). Pedestrians arrive from an apartment complex driveway or from Almond Street. Pedestrians originating from the west side of Josiah Circle can use a controlled crosswalk at the north end of Whispering Bay Lane (W).

On the right side of the both approaches to the uncontrolled crosswalk are sign assemblies consisting of an old-style Caltrans Traffic Manual W66 sign (school pentagon with crosswalk lines) and a W16-7p Downward Pointing Arrow plaque. The one facing northbound traffic is correctly located at the crosswalk. The one facing southbound traffic is mounted atop a R3-2 graphic No Left Turn sign, which detracts from the warning message, and that sign post is not at the crosswalk where the warning assembly may be.

At B, just south of a bend, a path from Harbor Park Drive meets the west sidewalk. The pedestrian desire line is from B to Z, however there is a somewhat impassable landscape area on the school side of the street opposite B, extending around the corner from the driveway at X to the lawn at Y. For safety reasons it is desirable to channelize pedestrians from B so they do not cross the internal parking lot.

Near C is the all-way STOP Y intersection of Whispering Bay Lane and Francisco Drive, which currently has no marked crosswalks. The issue is on which legs to mark crosswalks.

a) Crosswalk locations

b) Southbound warning sign assembly

Figure 4-25: Existing conditions - crosswalks at bus loop driveway entrance

Analysis

Whispering Bay Lane at bus loop entry driveway ("A")

The existing crosswalk across Whispering Bay Lane at the bus loop driveway entrance has its east (school) end on the north side of the bus driveway, which requires pedestrians bound for the school's main entrance to then cross the bus driveway. Both of these crossings have high-visibility yellow (school) crosswalk markings.

To eliminate the need to cross the driveway, it is worth considering removing both sets of yellow markings and instead aligning the crosswalk across Whispering Bay Lane with the bus entry's south corner. Perhaps this was not done because of the west-side catch basin. However, a "floating" curb extension at the catch basin with a gutter bridge can provide the ADA ramp in the street. It can be elongated one car space to the north to keep approach sightlines open.

Path from Harbor Park Drive ("B")

So that persons crossing the street are visible from both approaches, it is suggested to locate the new uncontrolled crosswalk close to the midpoint of the bend. The church driveway is located at the midpoint but the path-sidewalk junction appears to be close enough.

It is suggested that floating curb extensions be added on both sides of the street to prevent parking that would block pedestrian sightlines. High visibility (ladder) markings and warning sign assemblies are appropriate for an uncontrolled crosswalk. The assemblies may be 2-sided but each side may face oncoming traffic, given the bend. If advantageous for conspicuity, one or both assemblies could be located on the curb extensions.

After pedestrians cross the street they will head for their destination, the internal sidewalk at Z. The most direct path is through the landscape between the two trees (bright green in Figure 4-24).

Their destination may actually be the main entrance north of Z, so a desire line passes through Y and across the parking lot. To deter cutting across the landscape and parking lot, it is suggested that a continuous medium-height fence be installed between the two driveways, which it is expected will induce most pedestrians originating at B to walk to the driveway at X.

Intersection of Whispering Bay Lane and Francisco Drive ("C")

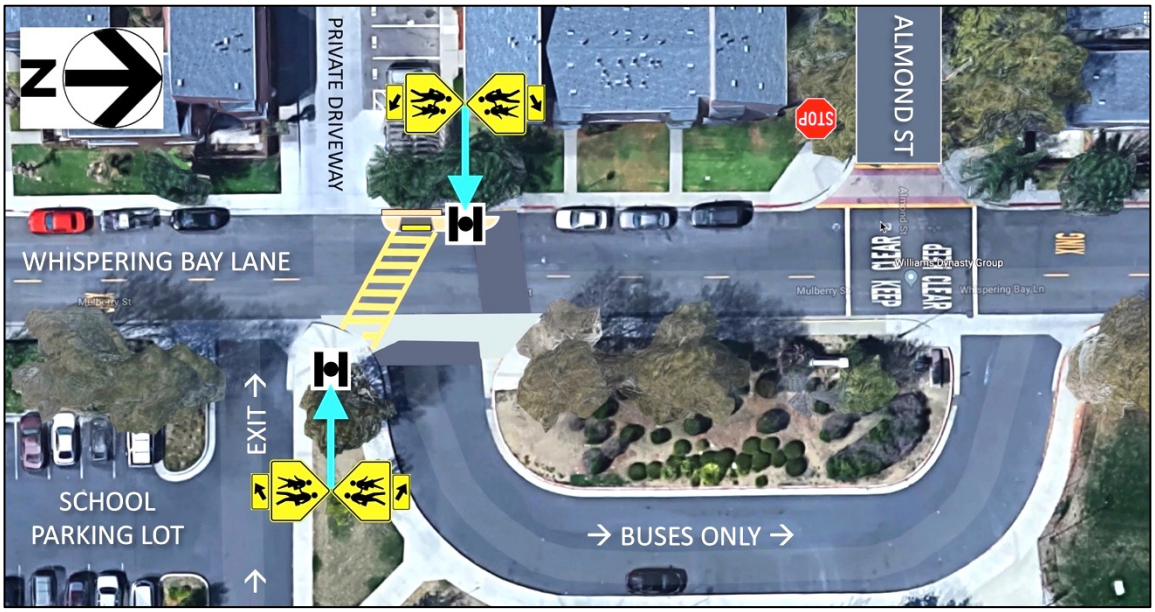
At this intersection, school-bound pedestrians may arrive on either side of the south leg of Whispering Bay Lane and on either side of Francisco Drive. Those arriving on the north sidewalk of Francisco Drive can simply continue to X. Those arriving on Francisco's south sidewalk or the east sidewalk of the south leg of Whispering Bay Lane must cross Francisco, so it is suggested to mark the Francisco leg. Those arriving on the west sidewalk of Whispering Bay Lane must cross Whispering Bay Lane, and may do so north of the junction to avoid having to also cross Francisco, so it is suggested to also mark the northwest leg of Whispering Bay Lane. Because these crosswalks are controlled, two-line yellow markings are sufficient.

Summary of suggestions

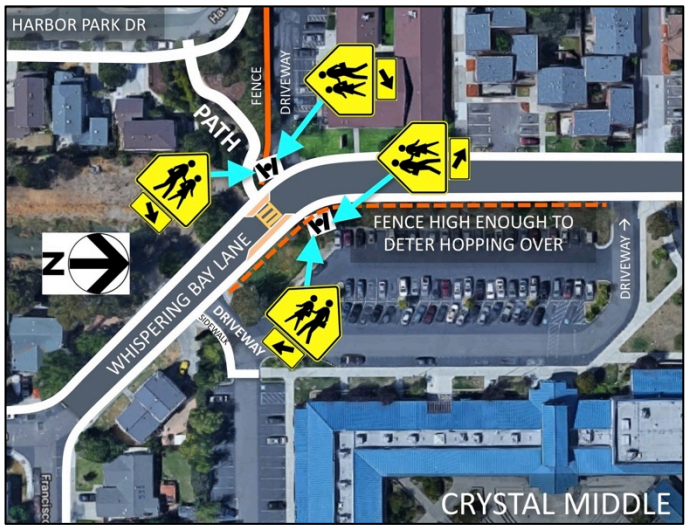
TABLE 4-13: SUGGESTIONS FOR SCHOOL CROSSWALKS ON WHISPERING BAY LANE

#	Item	Issue / Need	Suggestion
Crosswalk at bus loop driveway entrance ("A" vicinity)			
1	Existing uncontrolled crosswalk at north corner of bus entry	Requires pedestrians bound for school's main entrance to also cross the bus driveway	Remove from this location
2	Yellow "crosswalk" markings across bus entry	Not needed if (3) is implemented	Remove
3	Crosswalk aligned with south side of bus loop driveway entrance	Aligns directly with walkway to school's main entrance	Install west floating curb extension with ramp, high visibility markings, 2-sided warning assemblies on both sides.
4	Crosswalk warning signs	Existing sign assemblies are 1-sided and only on right side.	Install double-sided S1-1 + W16-7p on both sides of street, at the crosswalk.
Path from Harbor Park Drive ("B" vicinity)			
5	New uncontrolled crosswalk to serve desire line from path	Locate for best sightlines on both sides of the bend	Locate just south of church driveway. Install ladder markings, and 2-sided warning assemblies on both sides.
6	Desire lines from east sidewalk into school	Channelize pedestrians so they do not cross parking lot	Install fence at back of sidewalk, between the school lot driveways
Intersection of Whispering Bay Lane and Francisco Drive ("C" vicinity)			
7	East (Francisco) leg	Mark 2-line yellow (school) crosswalk	Convey to north sidewalk those pedestrians arriving on Francisco's south sidewalk and east sidewalk of Whispering Bay south leg.
8	Northwest (Whispering Bay Lane) leg	Mark 2-line yellow (school) crosswalk	Convey to north sidewalk those pedestrians arriving on west sidewalk of Whispering Bay Lane's south leg.

Figure 4-26 illustrates the suggestions.



a) At bus driveway



b) At path to Harbor Park Drive

c) At Francisco intersection

Figure 4-26: Suggestions for crosswalks on Whispering Bay Lane

4.4.7. Area #7: Marina Boulevard north of Highway 12

City staff requested input on potential improvements on this segment. Because the urban design for the "triangle parcel" to the west has not been developed, suggestions in this section will mostly address the current (pre-development) condition, though they may inform the future development.

Existing conditions

The street's current width appears to be 64 feet (Google Earth). South of Buena Vista Avenue the cross section is 5 lanes with no parking, with a northbound bike lane that begins just beyond the corner curb return at Highway 12 and a southbound bike lane that is dropped 190' south of Buena Vista where a left turn lane is added to serve the convenience store that occupies the northeast corner at Highway 12.

A short distance north of Buena Vista, one northbound travel lane is dropped and most of its width used for a northbound parking lane. Bike lanes are continuous between Buena Vista and Railroad Avenue (the southbound bike lane begins a short distance south of Railroad Avenue).

Analysis

Marina Boulevard currently has no bike lanes between Highway 12 and Lotz Way (one block south). Another section of this report suggests adding them on that block. Restriping the street's approach and departure from Highway 12 on the north side could support bicycle through movements across Highway 12.

Existing (not to scale)

SB			Median	NB		TOTAL
36				25		
RT	**Thru**	**LT**	**3**	**Travel**	**Travel**	64
12	12	12		12.5	12.5	

Suggested (adds SB bike lane, gives more outside lane width to NB bike movement):

SB				Median	NB		TOTAL
36					25		
RT	**Bike**	**Thru**	**LT**	**3**	**Travel**	**Travel**	64
11	5	10	10		11	14	

North of Buena Vista the southbound travel lanes and the center turn lane appear to be 11.5 feet wide. Consideration could be given to reducing those widths in order to add 2-foot buffers to the bike lanes.

Summary of suggestions

TABLE 4-14: SUGGESTIONS FOR MARINA BOULEVARD NORTH OF HIGHWAY 12

#	Item	Issue	Suggestion
1	Southbound approach to Highway 12	Right turn, through and left turn lanes but no through bike lane	Consider restriping existing 12-12-12 to 11-5 (bike)-10-10.
2	Northbound departure from Highway 12	Two 12.5-foot travel lanes with no bike lane (NB bike lane begins approximately 80' north)	Consider restriping to 11-14 and adding Shared Lane Marking centered 4 feet from curb, to remove "pinch point" for northbound bicyclists
3	Lane widths north of Buena Vista; unbuffered bike lanes	11.5-11-5-11.5 (2 SB travel lanes and center turn lane)	Consider restriping southbound direction to 2 (bike lane buffer), 10.5-11-11.
4	Buffered bike lanes	Insufficient width south of Buena Vista	When triangle parcel is developed, consider widening to the west to produce sufficient total width for 2- or 3-foot bike lane buffers in both directions.

4.4.8. Area #8: Village Drive

Existing conditions

Village Drive, designated a collector street in the City's General Plan, extends 3,500 feet between Railroad Avenue and Highway 12. It runs due north-south except for a slight westward bend at its north (Railroad) end, and is 52 feet wide for its entire length. The lane configuration varies between 3-lane (1 travel lane each way plus a center turn lane) and 2-lane (no center lane). The posted speed limit is 25 MPH.

Between Railroad Avenue and Pintail Drive (1,400 feet) and between Merganser Drive and Highway 12 (1,000 feet) the single-family residential developments on the east side have continuous masonry walls with no driveways or gates (all homes front on internal streets) so there is no parking demand on that side. Heritage Park and the Joseph P. Nelson Community Center occupy the block Between Pintail and Merganzer (1,100 feet).

Village at Railroad, facing south

Village at Buena Vista / Pintail, facing north

Village at Merganzer, facing south

Figure 4-27: Village Drive - existing conditions at key intersections

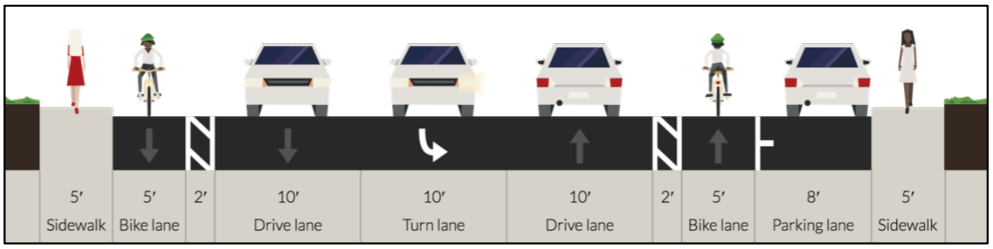
TABLE 4-15: VILLAGE DRIVE: LAND USE AND PARKING DEMAND

			Parcels, access and parking demand	
Segment	**L**	**W**	**W side (single-family)**	**E side**
Railroad – Buena Vista / Pintail	1,400	52	Varies; some walls, some side yards, few driveways	None (Continuous wall)
Buena Vista / Pintail – Merganser	1,100	52	Front driveways (Pintail to Alexander)	Heritage Park Joseph A. Nelson Community Center (off-street parking lot)
Merganser – Hwy 12	1,000	52	Side yards (Alexander – Hwy 12)	None (Continuous wall)

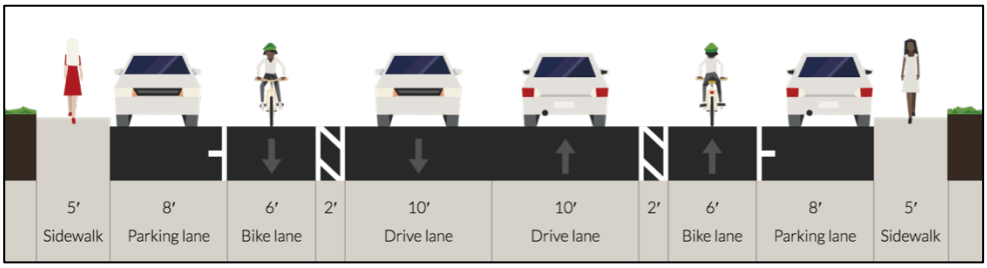
Analysis, issues and opportunities

Buffered bike lanes

At 52 feet, with 1 travel lane in each direction, there is sufficient width to install buffered bike lanes in both directions with parking permitted on both sides. With 1 travel lane in each direction and a center turn lane, parking can still be provided on one side. The following conceptual layouts were made with StreetMix.



Turn lane, parking 1 side



No turn lane, parking 2 sides

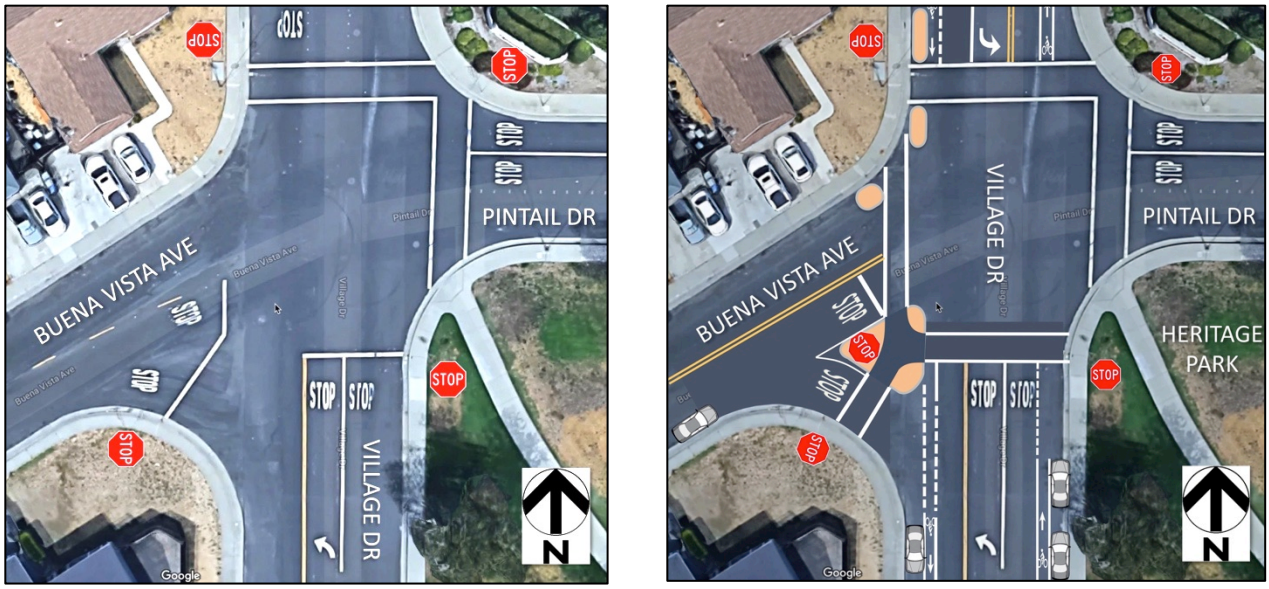
Figure 4-28: Village Drive – conceptual cross sections

Parking is not needed where a continuous wall is present (the entire east side north of Pintail and south of Merganser). Between Pintail and Merganser (Heritage Park and the Community Center) the public facilities share a large parking lot and curbside parking is available on the south side of Pintail along the north edge of the park. If that capacity is sufficient, east-side parking could be removed between Pintail and Merganser and a center turn lane installed. Alternatively a center turn lane could be installed only where needed (northbound approaching Buena Vista / Pintail, southbound approaching Merganser, and optionally southbound approaching one or both of the Community Center parking lot driveways) and east-side parking could be retained elsewhere on the block.

Buena Vista / Pintail intersection

As shown in Figure 4-29(a), at Village Drive's intersection with Buena Vista Avenue and Pintail Drive the west (Buena Vista) leg is angled approximately 33 degrees, making the northwest corner oblique (123 degrees), the southwest corner acute (57 degrees), and the west leg crossing distance 100 feet (vs. the east leg's 57 feet, both measured at the middle of the sidewalk). The Buena Vista approach widens into two waiting positions, one for the through movement onto Pintail and the other for the right turn onto Village.

Exploiting the width of the de facto parking lane along the west curb, several small islands could protect the north end of the west crosswalk, formalize the two eastbound approach movements, and greatly reduce the west crosswalk's unprotected crossing distance. The islands near the curb would leave the gutter open behind them. Figure 4-29(b) shows a concept with bike lanes (buffers are not shown).



a) Existing conditions

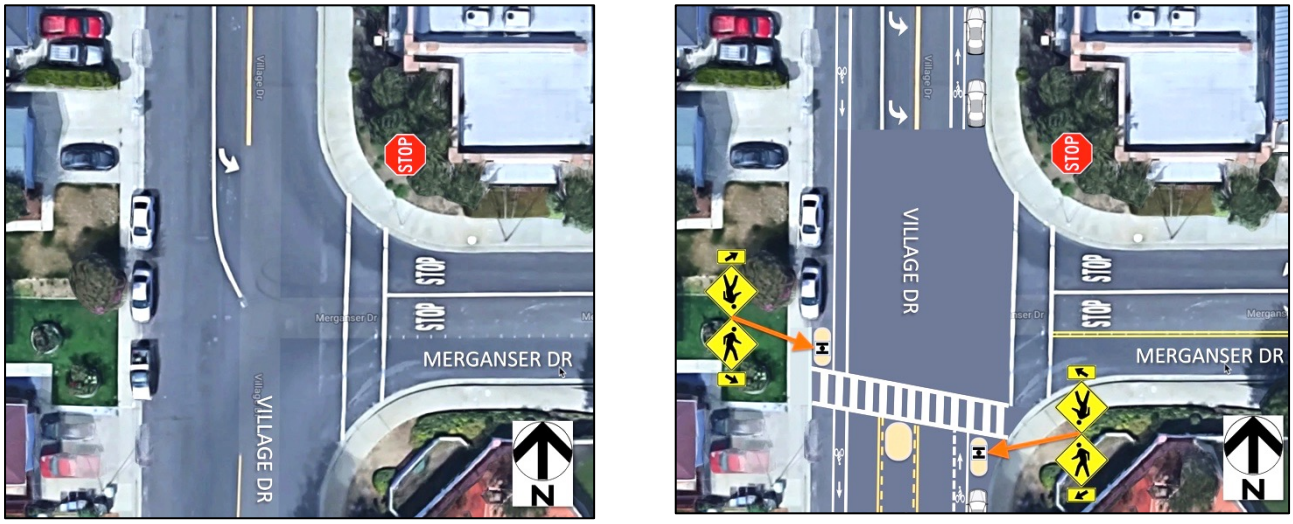
b) Concept (with bike lanes)

Figure 4-29: Village Drive at Buena Vista / Pintail – existing and concept

Merganser Drive intersection

Merganser Drive intersects Village Drive from the east at a T at the south side of the Nelson Community Center as shown in Figure 4-30(a). Merganser has a STOP sign; Village is uncontrolled. The southbound approach has a left turn lane; the Merganser approach has separate left and right turn lanes. South of the T there is no center lane (the travel lanes are extra wide).

Marking and enhancing the south leg crosswalk would increase its safety and convenience. The markings would need to angle slightly relative to Merganser because a house driveway on the west side intersects the prolongation of Merganser's south sidewalk. Because the south leg needs no center turn lane, the width of the north leg's turn lane can be used on the south leg for a raised median refuge. Figure 4-30(b) shows a concept with bike lanes (buffers are not shown).



a) Existing conditions

b) Concept (with bike lanes)

Figure 4-30: Village Drive at Merganser Drive – existing and concept

Support for pedestrians crossing between Buena Vista / Pintail and Merganser intersections

It can be expected that some pedestrians will want to cross Village Drive between Buena Vista / Pintail and Merganser without using the crosswalks at those intersections. Unless done within 500 feet of a controlled intersection, crossing between intersections is legal provided that the pedestrian yields to approaching traffic.

To facilitate such mid-block crossings, it would be useful to add a center turn lane between Buena Vista / Pintail and Merganser. This would provide a place for pedestrians to pause, turn their heads, and check for approaching traffic in the second direction, though a painted center lane is not considered to be a median "refuge". The level of pedestrian protection could be increased by interspersing small raised islands in the long center turn lane to deter driving in it, even if no mid-block crosswalks were marked. A center lane would also facilitate left turns to/from house driveways and the Community Center / Heritage Park parking lot.

If it was deemed desirable to install a mid-block crosswalk between Buena Vista / Pintail and Merganser (marked, signed, and with a raised refuge), it is suggested to locate the crosswalk just north of the Community Center parking lot's north driveway, i.e. is at the midpoint of the long block. The house driveway of #710 is directly opposite that driveway, however a median refuge island could be installed just to the north because a southbound left turn pocket to serve the Community Center driveway is probably not needed. (If necessary, southbound left turns into the driveway could be prohibited with signs; the lot has a second driveway further south.)

Summary of suggestions

TABLE 4-16: SUGGESTIONS FOR VILLAGE DRIVE

#	Item	Issue / Opportunity	Suggestion
1	Buffered bike lanes	Sufficient width is available	Install for full length of street
2	Buena Vista Avenue / Pintail Drive	West (Buena Vista) leg is angled, producing wide crossing distance and a large-radius northwest corners	Install floating curb extensions and a right turn channelization ("pork chop") island.
3		No marked crosswalk on south leg, despite desire line to access Heritage Park	Mark crosswalks between SW corner and pork chop island and between island and SE corner
4	Merganzer Drive T-intersection	Opportunity for median refuge crosswalk on south leg	Install. Angle crosswalk slightly relative to Merganser axis to avoid the house driveway.
5	Mid-block between Pintail and Merganser	Pedestrian crossing support	Install center turn lane, either continuous (if east-side curbside parking is not needed) or intermittently. Consider installing small islands to prevent driving in the center lane and to provide some protection for crossing pedestrians.
6		Optional mid-block crosswalk	Consider installing on the north side of the Community Center parking lot's north driveway.

Figure 4-31 maps these suggestions.

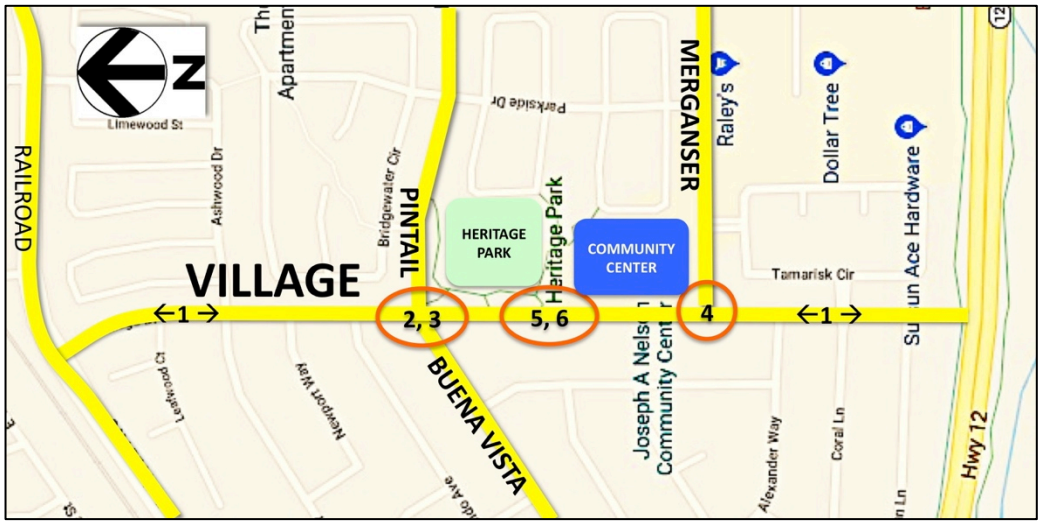


Figure 4-31: Village Drive – map of suggestions

4.4.9. Area #9: Sunset Avenue

Existing conditions

Sunset Avenue runs north-south between Highway 12 and the Amtrak / UPRR rail corridor, continuing north of the railroad into Fairfield and ending at East Tabor Avenue. South of Highway 12 the road becomes Grizzly Island Road, serving 3 blocks of residential development before becoming a rural 2-lane road and then ending at a branch of Suisun Slough.

Close to the rail corridor, Railroad Avenue intersect at T intersections from the west and east, with an 870-foot offset between the west and east junctions.

Canvasback Drive intersects from the east 300 feet south of the west leg of Railroad Avenue. It is important for bicycle connectivity because it continues the Railroad Avenue axis to the east to reach residential areas to the north via Blossom Avenue and Worley Road.

Between the west leg of Railroad Avenue and the commercial area close to Highway 12, Sunset has a 5-lane configuration with bike lanes; the center lane is a fully closed landscaped median except for left turn lanes at Pintail Drive, Merganser Drive, and the shopping center driveway signal midway between Merganser and Highway 12.

The Central County Bikeway, a shared use path, runs along the north side of Highway 12. Bicycle users southbound on Sunset intending to access that path can continue in the rightmost roadway lane to the path crosswalk. However, that lane is narrow and heavily congested with motor vehicles, and having to turn abruptly off the street upon reaching the north crosswalk is awkward. It is preferable to leave the street at the last upstream curb cut and ride the sidewalk to the northwest corner, where one can bicycle west (toward downtown) or turn east and prepare to cross Sunset using the north crosswalk.

No guidance sign currently suggests that sidewalk-based option. The only existing bicycle guide sign near that point is beyond the turn-off opportunity.

Analysis

Opportunity to add bike lane buffers

The widths of each half of the street (median to outside curb) is sufficient to add a buffer to the bike lanes. On the south leg at Canvasback, for example, the southbound paved width is 32 feet, striped as 8 (bike), 12-12 (travel lanes). This could be restriped as 6 (bike), 3 (buffer), 11.5-11.5 or 7 (bike), 3 (buffer), 11-11. A 7-foot bike lane would accommodate disabled vehicles. The existing unbuffered 8-foot bike lane easily accommodates “social cycling” (two-abreast riding) and the buffered configuration would also do so, especially if the bike lane portion was 6 or 7 feet wide.

Bicycle connectivity to/from Canvasback Drive

Because Sunset’s raised median has no openings between Railroad Avenue (west leg) and Pintail Drive, the only bicycle connection between Canvasback Drive and the west leg of Railroad Avenue is Sunset’s east sidewalk, which is narrow where it crosses a drainage ditch just south of the Railroad Avenue west leg signal.

Consideration was given to adding a bicycle-only median opening aligned with Canvasback's south sidewalk, with a southbound bicycle left turn lane, to facilitate bicycle left turns from southbound Sunset and from westbound Canvasback. However, the northbound motor vehicle left turn pocket to Railroad Avenue begins at this point so the bicycle movements across northbound Sunset would be awkward. For this reason it is suggested to widen Sunset's east sidewalk between the northeast corner at Canvasback, and the east side of the Railroad Avenue west-leg signal, to serve a shared use path.

Southbound bicycle guidance to Cross County Bikeway (northwest corner at Highway 12)

On the southbound approach to the northwest corner at Highway 12, it is suggested to add an upstream guide sign informing southbound bicycle users of the option to use the west sidewalk to reach the corner rather than remaining in the rightmost roadway lane, which is right-turn-only and typically congested.

Bicycle through movements across Highway 12

There are currently no through bike lanes on the approaches of Sunset or Grizzly Island Road to Highway 12. Bicycle users southbound on Sunset wishing to cross Highway 12 can either use Lane #2 (through-and-left-turn), which is narrow and typically congested with motor vehicles, or traverse the north and east crosswalks as a pedestrian. Those who use the two crosswalks and wish to continue south on Grizzly Island Boulevard must either re-enter the street from the southeast corner of the Highway 12 intersection or continue as a pedestrian through the south crosswalk – which they would also do if they wish to proceed west on the Grizzly Island Trail along the south side of Highway 12.

Bicycle users northbound on Grizzly Island Road can likewise use northbound Lane #2 (through-only), or can use the east crosswalk and then re-enter the street at the northeast corner.

In the future there may be an opportunity to redesign the Sunset / Grizzly Island Road / Highway 12 intersection. At that time consideration may be given to providing through bike lanes at the right side of the motor vehicle through movements in both directions. On southbound Sunset the through bike lane would be installed between Lane #2 (through-and-left) and Lane #2 (leftmost right-turn-only). On northbound Grizzly Island Road the through bike lane would be installed between Lane #2 (through-only) and Lane #3 (right-turn only).

Summary of suggestions

TABLE 4-17: SUGGESTIONS FOR SUNSET AVENUE

#	Item	Issue	Suggestion
1	Bike lanes	Width is available to add buffers	Install bike lane buffers. Consider 7 (bike), 3 (buffer), 11, 11
2	Connecting the residential areas served by Canvasback Drive to both	No way -- other than the east sidewalk -- for bicycle users to connect between southbound Sunset and both directions of Canvasback, which serves substantial residential areas to the east and northeast.	Widen east sidewalk between NE corner at Canvasback, and the E side of the Railroad Avenue west leg signal.
3			Longer term, consider new shared use path between Railroad Avenue's west leg signal and Bella Vista Drive,

	directions of Sunset		connecting with Blossom Avenue, Worley Road, and Prosperity Road.
4	SB bicycle guidance to Cross County Bikeway	Bike Route sign near NW corner at Highway 12 is beyond where bike user should have moved onto on the sidewalk to avoid right turn conflicts.	Upstream of the NW corner property, sign the suggestion to use the sidewalk to reach the east-west path.
5	Bicycle through movements across Highway 12.	No through bike lanes on the Sunset or Grizzly Island Boulevard approaches. West crosswalk is not marked, probably due heavy SB-WB right turns.	If the Highway 12 intersection is redesigned, widen N and S legs to add 5-foot bike through lanes. Also widen NB departure to enable the NB bike lane to begin at Highway 12.

Figure 4-32 maps these suggestions.

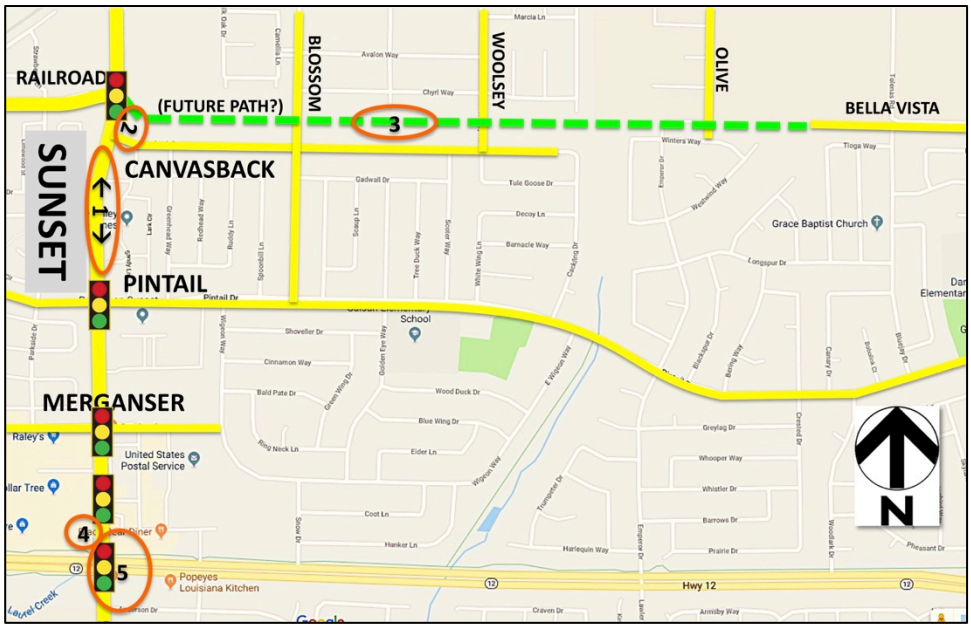


Figure 4-32: Sunset Avenue – map of suggestions

4.4.10. Area #10: "Triangle parcel" west of Marina Boulevard

The City is evaluating development plans for the 30-acre triangular area north of Highway 12 bounded by Main Street, Railroad Avenue, and Marina Boulevard. Development of this parcel would create opportunities to significantly improve pedestrian and bicycle connectivity between the segment of Marina Boulevard north of Highway 12, and the downtown segment of Main Street.

It would be beneficial to consider extending Main Street from its existing north terminus at the Highway 12 westbound ramp to Marina Boulevard. A connection to Buena Vista Avenue would create a cross-town corridor midway between Railroad Avenue and Highway 12.

Pedestrian connectivity

Any development plan for this parcel could be expected to incorporate a fully connected sidewalk network. The west edge of Marina Boulevard would presumably be built out with a sidewalk. If the Heritage Rose Lane intersection remains a T junction for motor traffic, it is suggested to consider providing a median refuge-protected crosswalk there.

Bicycle connectivity

As shown in Figure 4-33, cross-town bicycle trips within the large area of Suisun City north of Highway 12 utilize three corridors depending on their origins and destinations.

- Railroad Avenue serves locations near the railroad, parts of Fairfield reachable via Sunset Avenue's grade crossing, and (via Canvasback Drive) the area east of Sunset between Railroad and Pintail.
- The Central County Bikeway serves locations close to Highway 12 and enables rapid travel to/from north-south connectors (Village, Sunset, Snow, Emperor, Woodlark, Fulmar, Walters).
- Buena Vista and Pintail form a route between the railroad and highway axes.

These three axes come together at the "triangle parcel", shown in yellow. The existing Central County Bikeway (shared use path) runs along the south edge of the development area. It is suggested to prioritize a bicycle and pedestrian connection extending the Railroad Avenue axis westward to where Main Street crosses under Highway 12. This could be accomplished using internal streets within the development, however there may also be an opportunity for a direct shared-use path along the south edge of the railroad right of way that could reduce bicycle travel time between Main Street and the Railroad Avenue / Marina Boulevard intersection.

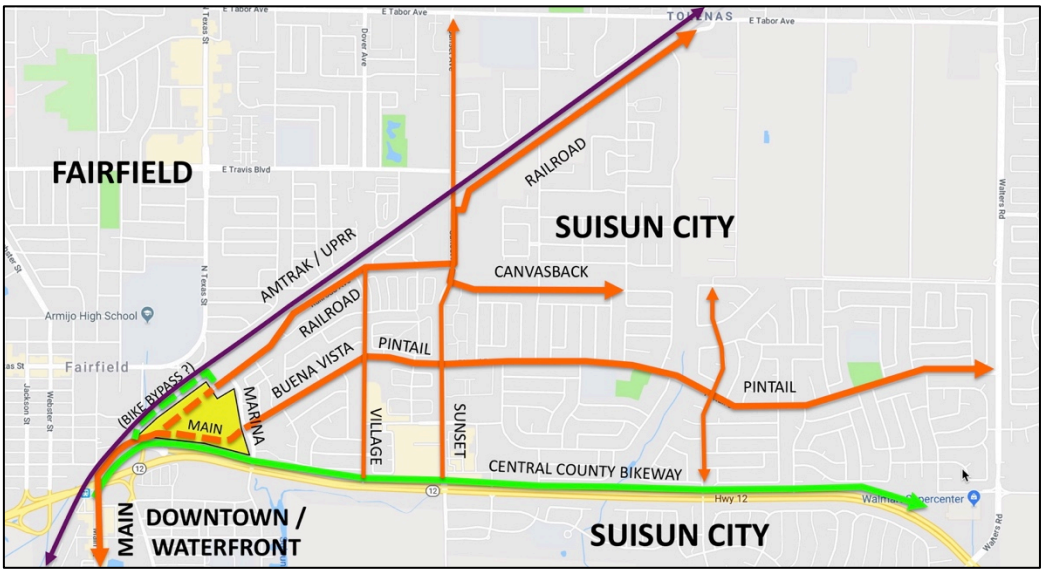


Figure 4-33: Bicycle routes to downtown north of Highway 12

Figure 4-34: Bicycle bypass concept along railroad edge of parcel

Summary of suggestions

TABLE 4-18: SUGGESTIONS FOR "TRIANGLE" DEVELOPMENT SITE

#	Item	Issue	Suggestion
1	Heritage Rose Lane / Marina Boulevard intersection	Direct crossing of Marina Boulevard without having to detour to Railroad Avenue or Buena Vista Avenue.	If this remains an uncontrolled T intersection, consider incorporating a median refuge crosswalk on the south leg.
2	Railroad-corridor bicycle bypass	A way for bicycle users to avoid the delay of riding through the development between the train station and the Marina Boulevard / Railroad Avenue intersection	Evaluate incorporating a shared use path along the development parcel's northwest edge, along the south edge of the railroad corridor.
3	Bicycle guide signage	Orient and direct bicycle users so they can traverse the triangle development without becoming lost, given the turns.	Design and install MUTCD D-series bicycle guide signage.

APPENDIX A: GLOSSARY OF PEDESTRIAN IMPROVEMENT MEASURES

PEDESTRIAN IMPROVEMENT MEASURES			
Measure	**Description**	**Benefits**	**Application**
Traffic Control Countermeasures			
Traffic Signal or All-Way Stop	Conventional traffic control devices with warrants for use based on the Manual on Uniform Control Devices (MUTCD).	Reduces pedestrian-vehicle conflicts and slows traffic speeds.	Must meet warrants based on traffic and pedestrian volumes; however, exceptions are possible based on demonstrated pedestrian safety concerns (collision history).
HAWK Beacon Signal	HAWK (High Intensity Activated Crosswalks) are pedestrian-actuated signals that are a combination of a beacon flasher and a traffic control signal. When actuated, HAWK displays a yellow (warning) indication followed by a solid red light. During pedestrian clearance, the driver sees a flashing red “wig-wag” pattern until the clearance interval has ended and the signal goes dark.	Reduces pedestrian-vehicle conflicts and slows traffic speeds.	Useful in areas where it is difficult for pedestrians to find gaps in automobile traffic to cross safely, but where normal signal warrants are not satisfied. Appropriate for multi-lane roadways.
Overhead Flashing Beacons	Flashing amber lights are installed on overhead signs, in advance of the crosswalk or at the entrance to the crosswalk.	The blinking lights during pedestrian crossing times increase the number of drivers yielding for pedestrians and reduce pedestrian-vehicle conflicts. This measure can also improve conditions on multi-lane roadways.	Best used in places where motorists cannot see a traditional sign due to topography or other barriers.
Stutter Flash	The Overhead Flashing Beacon is enhanced by replacing the traditional slow flashing incandescent lamps with rapid flashing LED lamps. The beacons may be push-button activated or activated with pedestrian detection.	Initial studies suggest the stutter flash is very effective as measured by increased driver yielding behavior. Solar panels reduce energy costs associated with the device.	Appropriate for multi-lane roadways.

PEDESTRIAN IMPROVEMENT MEASURES			
Measure	**Description**	**Benefits**	**Application**
In-Roadway Warning Lights	Both sides of a crosswalk are lined with pavement markers, often containing an amber LED strobe light. The lights may be push-button activated or activated with pedestrian detection.	This measure provides a dynamic visual cue, and is increasingly effective in bad weather.	Best in locations with low bicycle ridership, as the raised markers present a hazard to bicyclists. May not be appropriate in areas with heavy winter weather due to high maintenance costs. May not be appropriate for locations with bright sunlight. The lights may cause confusion when pedestrians fail to activate them and/or when they falsely activate.
High-Visibility Signs and Markings	High-visibility markings include a family of crosswalk striping styles including the “ladder” and the “triple four.” One style, the zebra-style crosswalk pavement markings, were once popular in Europe, but have been phased out because the signal-controlled puffin is more effective (see notes). High-visibility fluorescent yellow green signs are made of the approved fluorescent yellow-green color and posted at crossings to increase the visibility of a pedestrian crossing ahead.	FHWA recently ended its approval process for the experimental use of fluorescent yellow crosswalk markings and found that they had no discernible benefit over white markings.	Beneficial in areas with high pedestrian activity, as near schools, and in areas where travel speeds are high and/or motorist visibility is low.
In-Street Pedestrian Crossing Signs	This measure involves posting regulatory pedestrian signage on lane edge lines and road centerlines. The In-Street Pedestrian Crossing sign may be used to remind road users of laws regarding right of way at an unsignalized pedestrian crossing. The legend STATE LAW may be shown at the top of the sign if applicable. The legends STOP FOR or YIELD TO may be used in conjunction with the appropriate symbol.	This measure is highly visible to motorists and has a positive impact on pedestrian safety at crosswalks.	Mid-block crosswalks, unsignalized intersections, low-speed areas, and two-lane roadways are ideal for this pedestrian treatment. The STOP FOR legend shall only be used in states where the state law specifically requires that a driver must stop for a pedestrian in a crosswalk.

PEDESTRIAN IMPROVEMENT MEASURES			
Measure	**Description**	**Benefits**	**Application**
Pedestrian Crossing Flags	Square flags of various colors, which are mounted on a stick and stored in sign-mounted holders on both side of the street at crossing locations; they are carried by pedestrians while crossing a roadway.	This measure makes pedestrians more visible to motorists.	Appropriate for mid-block and uncontrolled crosswalks with low visibility or poor sight distance.
Advanced Yield Lines	Standard white stop or yield limit lines are placed in advance of marked, uncontrolled crosswalks.	This measure increases the pedestrian's visibility to motorists, reduces the number of vehicles encroaching on the crosswalk, and improves general pedestrian conditions on multi-lane roadways. It is also an affordable option.	Useful in areas where pedestrian visibility is low and in areas with aggressive drivers, as advance limit lines will help prevent drivers from encroaching on the crosswalk. Addresses the multiple-threat collision on multi-lane roads.
Geometric Treatments			
Pedestrian Overpass/ Underpass	This measure consists of a pedestrian-only overpass or underpass over a roadway. It provides complete separation of pedestrians from motor vehicle traffic, normally where no other pedestrian facility is available, and connects off-road trails and paths across major barriers.	Pedestrian overpasses and underpasses allow for the uninterrupted flow of pedestrian movement separate from the vehicle traffic.	Grade separation via this measure is most feasible and appropriate in extreme cases where pedestrians must cross roadways such as freeways and high-speed, high-volume arterials. This measure should be considered a last resort, as it is expensive and visually intrusive.
Road Diet (aka Lane Reduction)	The number of lanes of travel is reduced by widening sidewalks, adding bicycle and parking lanes, and converting parallel parking to angled or perpendicular parking.	This is a good traffic calming and pedestrian safety tool, particularly in areas that would benefit from curb extensions but have infrastructure in the way. This measure also improves pedestrian conditions on multi-lane roadways.	Roadways with surplus roadway capacity (typically multi-lane roadways with less than 15,000 to 17,000 ADT) and high bicycle volumes, and roadways that would benefit from traffic calming measures.

PEDESTRIAN IMPROVEMENT MEASURES			
Measure	**Description**	**Benefits**	**Application**
Median Refuge Island	Raised islands are placed in the center of a roadway, separating opposing lanes of traffic with cutouts for accessibility along the pedestrian path.	This measure allows pedestrians to focus on each direction of traffic separately, and the refuge provides pedestrians with a better view of oncoming traffic as well as allowing drivers to see pedestrians more easily. It can also split up a multi-lane road and act as a supplement to additional pedestrian tools.	Recommended for multi-lane roads wide enough to accommodate an ADA-accessible median.
Staggered Median Refuge Island	This measure is similar to traditional median refuge islands; the only difference is that the crosswalks in the roadway are staggered such that a pedestrian crosses half the street and then must walk towards traffic to reach the second half of the crosswalk. This measure must be designed for accessibility by including rails and truncated domes to direct sight-impaired pedestrians along the path of travel.	Benefits of this tool include an increase in the concentration of pedestrians at a crossing and the provision of better traffic views for pedestrians. Additionally, motorists are better able to see pedestrians as they walk through the staggered refuge.	Best used on multi-lane roads with obstructed pedestrian visibility or with off-set intersections.
Curb Extension	Also known as a pedestrian bulb-out, this traffic-calming measure is meant to slow traffic and increase driver awareness. It consists of an extension of the curb into the street, making the pedestrian space (sidewalk) wider.	Curb extensions narrow the distance that a pedestrian has to cross and increases the sidewalk space on the corners. They also improve emergency vehicle access and make it difficult for drivers to turn illegally.	Due to the high cost of installation, this tool would only be suitable on streets with high pedestrian activity, on-street parking, and infrequent (or no) curb-edge transit service. It is often used in combination with crosswalks or other markings.

PEDESTRIAN IMPROVEMENT MEASURES			
Measure	**Description**	**Benefits**	**Application**
Reduced Curb Radii	The radius of a curb can be reduced to require motorists to make a tighter turn.	Shorter radii narrow the distance that pedestrians have to cross; they also reduce traffic speeds and increase driver awareness (like curb extensions), but are less difficult and expensive to implement.	This measure would be beneficial on streets with high pedestrian activity, on-street parking, and no curb-edge transit service. It is more suitable for wider roadways and roadways with low volumes of heavy truck traffic.
Curb Ramps	Curb ramps are sloped ramps that are constructed at the edge of a curb (normally at intersections) as a transition between the sidewalk and a crosswalk.	Curb ramps provide easy access between the sidewalk and roadway for people using wheelchairs, strollers, walkers, crutches, handcarts, bicycles, and also for pedestrians with mobility impairments who have trouble stepping up and down high curbs.	Curb ramps must be installed at all intersections and mid-block locations where pedestrian crossings exist, as mandated by federal legislation (1973 Rehabilitation Act and 1990 Americans with Disabilities Act). Where feasible, separate curb ramps for each crosswalk at an intersection should be provided rather than having a single ramp at a corner for both crosswalks.
Raised Crosswalk	A crosswalk whose surface is elevated above the travel lanes.	Attracts drivers' attention; encourages lower travel speeds by providing visual and tactile feedback when approaching the crosswalk.	Appropriate for multi-lane roadways, roadways with lower speed limits that are not emergency routes, and roadways with high levels of pedestrian activity, such as near schools, shopping malls, etc.

PEDESTRIAN IMPROVEMENT MEASURES			
Measure	**Description**	**Benefits**	**Application**
Improved Right-Turn Slip-Lane Design	Right-turn slip lanes (aka channelized right-turn lanes) are separated from the rest of the travel lanes by a pork chop-shaped striped area. This measure separates right-turning traffic and streamlines right-turning movements. Improved right-turn slip lanes would provide pedestrian crossing islands within the intersection and be designed to optimize the right-turning motorist's view of the pedestrian and of vehicles to his or her left.	This measure reduces the pedestrian's crossing distance and turning vehicle speeds.	Appropriate for intersections with high volumes of right-turning vehicles.
Chicanes	A chicane is a sequence of tight serpentine curves (usually an S-shape curve) in a roadway, used on city streets to slow cars.	This is a traffic-calming measure that can improve the pedestrian environment and pedestrian safety.	Chicanes can be created on streets with higher volumes, given that the number of through lanes is maintained; they can also be created on higher-volume residential streets to slow traffic. Chicanes may be constructed by alternating parallel or angled parking in combination with curb extensions.
Pedestrian Access and Amenities			
Marked Crosswalk	Marked crosswalks should be installed to provide designated pedestrian crossings at major pedestrian generators, crossings with significant pedestrian volumes (at least 15 per hour), crossings with high vehicle-pedestrian collisions, and other areas based on engineering judgment.	Marked crosswalks provide a designated crossing, which may improve walkability and reduce jaywalking.	Marked crosswalks alone should not be installed on multi-lane roads with more than about 10,000 vehicles/ day. Enhanced crosswalk treatments (as presented in this table) should supplement the marked crosswalk.

PEDESTRIAN IMPROVEMENT MEASURES			
Measure	**Description**	**Benefits**	**Application**
Textured Pavers	Textured pavers come in a variety of materials (for example, concrete, brick, and stone) and can be constructed to create a textured pedestrian surface such as a crosswalk or sidewalk. Crosswalks are constructed with the pavers, or can be made of stamped concrete or asphalt.	Highly visible to motorists, this measure provides a visual and tactile cue to motorists and delineates a separate space for pedestrians, as it provides a different texture to the street for pedestrians and motorists. It also aesthetically enhances the streetscape.	Appropriate for areas with high volumes of pedestrian traffic and roadways with low visibility and/or narrow travel ways, as in the downtown area of towns and small cities.
Anti-Skid Surfacing	Surface treatment is applied to streets to improve skid resistance during wet weather. This is a supplementary tool that can be used to reduce skidding in wet conditions.	Improves driver and pedestrian safety.	Appropriate for multi-lane roadways and roadways with higher posted speed limit and/or high vehicle volumes or collision rates.
Accessibility Upgrades	Treatments such as audible pedestrian signals, accessible push buttons, and truncated domes should be installed at crossings to accommodate disabled pedestrians.	Improves accessibility of pedestrian facilities for all users.	Accessibility upgrades should be provided for all pedestrian facilities following a citywide ADA Transition Plan.

PEDESTRIAN IMPROVEMENT MEASURES			
Measure	**Description**	**Benefits**	**Application**
Pedestrian Countdown Signal	Displays a "countdown" of the number of seconds remaining for the pedestrian crossing interval. In some jurisdictions the countdown includes the walk phase. In other jurisdictions, the countdown is only displayed during the flashing don't walk phase.	Increases pedestrian awareness and allows them the flexibility to know when to speed up if the pedestrian phase is about to expire.	The forthcoming 2009 MUTCD is expected to require all pedestrian signals to incorporated countdown signals within ten years. The signals should be prioritized for areas with pedestrian activity, roadways with high volumes of vehicular traffic, multi-lane roadways, and areas with elderly or disabled persons (who may walk slower than others may).
Transit			
High-Visibility Bus Stop Locations	This measure should include siting bus stops on the far side of intersections, with paved connections to sidewalks where landscape buffers exist.	Provides safe, convenient, and inviting access for transit users; can improve roadway efficiency and driver sight distance.	Appropriate for all bus stops subject to sight distance and right-of-way constraints.
Transit Bulb	Transit bulbs or bus bulbs, also known as nubs, curb extensions, or bus bulges are a section of sidewalk that extends from the curb of a parking lane to the edge of the through lane.	Creates additional space at a bus stop for shelters, benches, and other passenger amenities.	Appropriate at sites with high patron volumes, crowded city sidewalks, and curbside parking.
Enhanced Bus Stop Amenities	Adequate bus stop signing, lighting, a bus shelter with seating, trash receptacles, and bicycle parking are desirable features at bus stops.	Increase pedestrian visibility at bus stops and encourage transit ridership.	Appropriate at sites with high patron volumes.

APPENDIX B: GLOSSARY OF BICYCLING IMPROVEMENT MEASURES

BICYCLING IMPROVEMENT MEASURES			
Measure	**Description**	**Benefits**	**Application**
LINKS /ROADWAY SEGMENTS			
A. Road Design and Operations to Slow Traffic			
Traffic Calming	There are a variety of measures too numerous to list here. See ITE Institute of Transportation Engineers, "Traffic Calming: State of the Practice".	Reduces motor vehicle speeds, which improves safety for all modes and increases bicyclist's comfort.	Urban and suburban settings; suggested for urban major streets with prevailing speeds of 35 mph and higher and for suburban major streets with prevailing speeds 45 mph or higher; and for all local streets with speeds of 30+ mph.
Bicycle Boulevard	A minor street on which traffic control devices are designed and placed to encourage cycling; these include: unwarranted stop signs along bike route are removed; crossing assistance at major arterials is provided (see examples in Nodes-Section E below).	Allows cyclists to maintain their travel speeds, significantly reducing their travel time; provides cyclists with a low volume, low speed street where motorists are aware that it is a bicycle-priority street.	On minor streets with less than 3000 vehicles per day especially useful when Bike Blvd is parallel to and within ¼ mile of a major arterial with many desirable destinations.
Signal Coordination at 15 -25 mph	The signal timing along a corridor is set so that traffic which receives a green light at the first intersection will subsequently receive a green light at all downstream intersections if they travel at the design speed; aka a "green wave."	Encourages motorists to travel at slower speeds, provides a more comfortable experience for cyclists and increases overall traffic safety; also allows cyclists to hit the green lights, so that they can maintain their travel speeds, significantly reducing their travel time.	Urban settings, typically downtown and other areas with relatively short blocks and with traffic signals at every intersection.
Woonerf/Shared Space	A shared space concept where the entire public right of way is available for all modes, often with no sidewalks, and with no lane striping, and little if any signage.	Access for motor vehicles is maintained, unlike a pedestrian zone, but motor vehicle speeds are constrained to 5 mph by design and the presence of other modes. Safety for all modes is improved.	Low volume residential streets where families can gather and children are encouraged to play; also commercial areas with high pedestrian volumes, bicyclists and transit.

B. Road Design to Provide Bicycle Infrastructure			
Bike Lanes	A painted lane for the exclusive use of bicyclists; it is one-way and is 5 feet minimum in width. They can be retrofitted onto an existing street by either a) narrowing existing wide travel lanes; b) removing a parking lane; c) removing a travel lane, or d) widening the roadway. A common method to retrofit bike lanes is described below.	Provides cyclists with their own travel lane so that they can safely pass and be passed by motor vehicles.	Roadways with over 4000 vehicles per day (if less than 4000 vehicles per day see Bicycle Boulevards above).
Road Diet (aka Lane Reduction)	One to two travel lanes are replaced with a bike lane in each direction, and in most cases by also adding left-turn lanes at intersections or a center two-way left-turn lane; variations include widening sidewalks, and replacing parallel parking with angled or perpendicular parking.	Improves traffic safety for all modes by: a) eliminating the double-threat to pedestrians posed by the two or more travel lanes in each direction; b) providing bike lanes for cyclists; c) providing a left-turn pocket for motorists, reducing rear-end collisions and improving visibility to oncoming traffic.	Classic application is a four-lane undivided roadway with less than 15,000 to 17,000 ADT though conversions of four-lane streets may work up to 23,000 ADT. Also applies to three-lane roadways and to 5 or 6-lane undivided roadways
Buffer adjacent to bike lanes	A three to five-foot buffer area is provided on one or both sides of the bike lane.	Right-side buffer (between bike lane and on-street parking): Removes cyclists from the door zone; Left-side (between bike lane and adjacent travel lane): provides greater separation from passing motor vehicle traffic.	This measure is particularly beneficial in the following conditions: Right-side: on streets with parallel on-street parking particularly in cities with a collision history of dooring; Left-side: on streets with traffic with prevailing speeds of 40 mph and higher.
Cycle Tracks	A bikeway within the roadway right of way that is separated from both traffic lanes and the sidewalks by either a parking lane, street furniture, curbs or other physical means.	Reduces sidewalk riding, provides greater separation between motorists and cyclists.	Urban settings with parallel sidewalks and heavy traffic.
C Other Traffic Control Devices			
Except Bicycles placard	A Regulatory sign placard for use with other regulatory signs.	Increases or maintains the access and circulation capabilities of bicyclists.	Used at locations where the restriction in question does not apply to bicyclists, such as No Left Turn or Do Not Enter.

Sharrows	A pavement legend that indicates the location within the travel lane where bicyclists are expected to occupy.	The sharrow encourages cyclists to ride outside of the door zone and studies have shown that sharrows reduce the incidence of cyclists riding on the sidewalk and wrong-way riding.	Two or more lane city streets where the right-most lane is too narrow for a motor vehicle to safely pass a cyclist within the travel lane.
Bike Lanes May Use Full Lane sign (MUTCD R4-11)	Regulatory Sign	Informs motorists and cyclists that cyclists may be travelling in the center of a narrow lane.	Two or more lane city streets where the right-most lane is too narrow for a motor vehicle to safely pass a cyclist within the travel lane.
Share the Road sign (MUTCD W-11/ W16-1p)	Warning sign and placard	Informs motorists to expect cyclists on the roadway.	Two-lane roads particularly in rural areas where shoulders are less than four-feet.
Bike Directional Signs (MUTCD D1 series or similar)	Informational signs indicating place names and arrows, with distances as a recommended option (D1-2C)	Informs bicyclists of the most common destination served by the bike route in question.	Particularly useful to direct cyclists to a facility such as a bike bridge or to use a street to access a major destination that might not otherwise be readily apparent.
D. New infrastructure to improve bicycle connectivity			
Bike Path	A paved pathway for the exclusive use of non-motorized traffic within its own right of way;	Provides additional connectivity and route options that otherwise would not be available to bicyclists.	Wherever a continuous right of way exists, typically found along active or abandoned railroad ROW, shorelines, creeks, and river levees.
Pathway connections	Short pathway segments for non-motorized traffic, for example, that join the ends of two cul-de-sacs or provide other connectivity not provided by road network.	Provides short-cuts for bicyclists that reduce their travel distance and travel time.	Varies by community; suggested at the end of every newly constructed cul-de-sac.
Bicycle Overpass/ Underpass	A bicycle overpass or underpass is a bridge or tunnel built for the exclusive use of non-motorized traffic and is typically built where at-grade crossings cannot be provided such as to cross freeways, rivers, creeks and railroad tracks. They can also be built to cross major arterials where, for example, a bike path must cross a major roadway.	A bike bridge / tunnel complement a local roadway system that is discontinuous due to man-made or natural barriers. They reduce the distance traveled by cyclists, and provide a safer conflict-free crossing, particularly if it is an alternative to a freeway interchange.	Grade separation via this measure is most feasible and appropriate when it would provide direct access to major bicyclist destinations such as a school or college, employment site, major transit station or would reduce the travel distance by one mile or more.

NODES / INTERSECTIONS			
Measure	**Description**	**Benefits**	**Application**
E. Intersection Design For Motor Vehicles			
Reduced Curb Radii	The radius of a curb is reduced to require motorists to make the turn at slower speeds and to make a tighter turn.	Shorter curb radii reduce the speed of turning traffic thereby enabling a more comfortable weave between through cyclists and right-turning motorists.	This measure is suitable for downtown settings, at all cross streets with minor streets, all residential streets and all roadways that are not designated truck routes.
Remove/Control Free Right-Turn Lanes	Where a separate right-turn lane continues as its own lane after the turn, it may be redesigned to eliminate the free turn. A short-term solution is to control the turning movement with a stop sign or signal control and to redesign the island as discussed below.	Improves bicyclist safety since this design forces through cyclists on the cross street to end up in between two lanes of through motor vehicle traffic.	All locations where there are free right-turn lanes except those leading onto freeway on-ramps.
Remove/Redesign Right-Turn Slip-Lane Design	Right-turn slip lanes (aka channelized right-turn lanes) are separated from the rest of the travel lanes by a pork chop-shaped raised island which typically is designed to facilitate fast right turns, and right-turning vehicles are often not subject to the traffic signal or stop sign.	Improves bicyclist safety by slowing right-turning motorists and facilitates the weave between through bicyclists and right-turning motorists.	All locations with a channelized right-turn.
Remove Optional Right-Turn Lane in Combination with a Right-Turn Only Lane	At locations where there is an optional right-turn lane in combination with a right-turn only lane, convert the optional right-turn lane to a through-only lane.	Improves bicyclist safety since cyclists have no way of knowing how to correctly position themselves in the optional (through /right turn) lane.	All locations where there is an optional right-turn lane in combination with a right-turn only lane per HDM 403.6(1) (except on freeways).
Redesign Ramp Termini	Redesign high speed free flow freeway ramps to intersection local streets as standard intersections with signal control.	Improves bicyclist and pedestrian safety on intersections of local streets with freeway ramps.	All freeway interchanges with high speed ramps

F. Intersection Design Treatments - Bicycle -Specific			
Bicycle Signal Detection and Pavement Marking	Provide signal detectors that also detect bicyclists in the rightmost through lane and in left-turn lanes with left-turn phasing. Provide pavement marking to indicate to cyclists where to position themselves in order to activate the detector.	Enables cyclists to be detected when motor vehicles are not present to trigger the needed signal phase. Improves bicyclists' safety.	Per CA MUTCD 4D.105 and CVC 21450.5, all new and modified traffic detection installations must detect bicyclists; All other traffic-actuated signals may be retrofitted to detect bicyclists as soon as feasible.
Bicycle Signal Timing	Provides signal timing to account for the speed of cyclists to cross an intersection.	Improves bicyclists' safety by reducing the probability of a bicyclist being in an intersection when the phase terminates and being hit by traffic that receives the next green phase.	Signal timing that accounts for cyclists is particularly important for cyclists on a minor street approach to a major arterial which crosses a greater distance due to the width of the arterial, hence requiring a longer time interval.
Bicycle Signal Heads	A traffic signal indication in the shape of a bicycle, with full red, yellow green capability.	Improves bicyclist safety by providing a bicycle -only phase, where appropriate, given the geometry and phasing of the particular intersection.	Where intersection geometry is such that a bicycle-only phase is provided and/or bicycle signal heads would improve safety at the intersection. See also CA MUTCD for warrants for bicycle signal heads.
Widen Bike Lane at Intersection Approach	Within the last 200 feet of an intersection, widen the bike lane and narrow the travel; for example from 5 foot bike lane and 12 feet travel lane would become a 7 foot bike lane and 10 foot travel lane.	Improves cyclist safety by encouraging right-turning motorists to enter the bike lane to turn right, (as required by the CVC), which reduces the chance of a right-turn hook collision in which a through cyclist remains to the right of a right-turning motorist.	On roads with bike lanes approaching an intersection without a right-turn only lane and there is noncompliance with right-turning vehicles merging into the bike lane as required by the CVC and UVC.
Bike Lane inside Right-Turn Only Lane ("Combined Bicycle/Right-Turn Lane")	Provide a bike lane line inside and on the left side of a right-turn only lane.	Encourages cyclists to ride on the left side of the right-turn only lane thus reducing the chance of a right hook collision, where a cyclist remains to the right of a right-turning motorist.	On roads with bike lanes approaching an intersection with a right-turn only lane and there is not enough roadway width to provide a bike lane to the left of the right-turn lane.

Bike Boxes	Area between an Advance Stop Line and a marked crosswalk which is designates as the queue space for cyclists to wait for a green light ahead of queued motor vehicle traffic; sometimes painted green.	Primary benefits are to reduce conflicts between bicyclists and right-turning traffic at the onset of the green signal phase, and to reduce vehicle and bicyclist encroachment in a crosswalk during a red signal phase.	Locations where there are at least three cyclists at the beginning of the green phase and moderate to high pedestrian volumes.
Marked Crosswalk with Distinct Marked Area for Bicyclists separate from Pedestrians	A marked crosswalk that has two distinct areas, one for pedestrians and one for bicyclists.	Reduces conflicts between bicyclists and pedestrians by indicating the part of the crosswalk intended for the two different modes.	At a typical intersection, cyclists would not be riding within the crosswalk, so this measure is intended for those few locations where the intersection design is such that bicyclists are tracked into a crosswalk such as at a midblock bike path crossing or possibly a cycle track.
Pedestrian Countdown Signal	Displays a “countdown” of the number of seconds remaining for the pedestrian crossing interval. In some jurisdictions the countdown includes the walk phase. In other jurisdictions, the countdown is only displayed during the flashing don’t walk phase.	While designed for pedestrians, this measure also assists bicyclists in knowing how much time they have to left to cross the intersection.	The 2012 MUTCD requires all pedestrian signals to incorporated countdown signals within ten years
Measure	**Description**	**Benefits**	**Application**
G. Geometric Countermeasures to Assist crossing a Major Street			
Median Refuge Island	A raised island placed in the center of a roadway, separating opposing lanes of traffic, with ramps for cyclists and ADA accessibility	This measure allows bicyclists to cross one direction of traffic at a time; it allows drivers to see bicyclists crossing from the center more easily.	Suggested for multilane roads at uncontrolled crossings where an 8-foot (min.) wide by 15-foot (min.) long median can be provided.
Staggered Refuge Pedestrian Island	This measure is similar to traditional median refuge islands; the only difference is that the crosswalk is staggered such that a pedestrian crosses one direction of traffic street and then must turn to their right facing oncoming to reach the second part of the crosswalk. This measure must be designed for accessibility by including rails and truncated domes to direct sight-impaired pedestrians along the path of travel.	Benefits of this measure include forcing the bicyclists and pedestrians to face the oncoming motorists, increasing their awareness of the impending conflict. Additionally, can improve motorists’ visibility to those persons in the crosswalk.	Best used on multilane roads with obstructed pedestrian visibility or with off-set intersections

Raised Crosswalk/Speed Table	A crosswalk whose surface is elevated above the travel lanes at the same level as the approaching sidewalk. For bicyclists, a typical location would be at a bike path crossing, where the bike path elevation would remain constant while roadway cross traffic would experience a speed-hump type effect.	Attracts drivers' attention to the fact there will be non-motorized users crossing the roadway, and slows traffic by providing a speed-hump effect for motorists approaching the crosswalk.	Appropriate for multi-lane roadways, roadways with lower speed limits that are not emergency routes, and roadways with high levels of pedestrian activity, such as near schools, shopping malls, etc.
Measure	**Description**	**Benefits**	**Application**
H. Traffic Control Countermeasures to Assist Crossing a Major Street			
Traffic Signal or All-Way Stop Sign	Conventional traffic control devices with warrants for use based on the Manual on Uniform Control Devices (MUTCD)	Provides the gap needed in traffic flow so that cyclists can cross the street, reducing bicycle-vehicle conflicts and risk-taking by cyclists to	Must meet warrants based on traffic/ pedestrian / bicycle volumes, collision history, and/ or other factors.
Modern Roundabout	A traffic circle combined with splitter island on all approaches and entering traffic must YIELD to traffic within the roundabout; typically designed for traffic speed within the roundabout of between 15 and 23 mph.	Slows traffic on cross street so that cyclists can more easily cross.	Roundabouts are a better alternative than an All-Way Stop signs when the side street volume is approximately 30 % of the total intersection traffic volume and total peak hour volume is less than 2300 vehicles per day.
Hawk Beacon Signal	HAWK (High Intensity Activated Crosswalks) are pedestrian-bicyclist actuated signals that are a combination of a beacon flasher and a traffic control signal. When actuated, HAWK displays a yellow (warning) indication followed by a solid red light. During the cross street phase, the driver sees a flashing red “wig-wag” pattern until the clearance interval has ended and the signal goes dark.	Provides the need gaps in traffic so bicyclists can safely cross the street, can be timed separately for bicycles and pedestrians. Reduces pedestrian-vehicle conflicts and slows traffic speeds	Useful in areas where it is difficult for bicyclists /pedestrians to find gaps in automobile traffic to cross safely, but where normal signal warrants are not satisfied. Appropriate for multilane roadways.
Rectangular Rapid Flashing Beacon (RRFB/Stutter Flash)	A warning sign that also contains rapid flashing LED lamps. The beacon may be push-button activated or activated with pedestrian detection.	Initial studies suggest the stutter flash is very effective as measured by increased driver yielding behavior. Solar panels reduce energy costs associated with the device.	Locations not controlled by any measures listed above. Appropriate for multi-lane roadways.

In-Roadway Warning Lights	Both sides of a crosswalk are lined with pavement markers, often containing an amber LED strobe light. The lights may be push-button activated or activated with pedestrian detection.	This measure provides a dynamic visual cue of the uncontrolled crosswalk, and is especially effective at night and in bad weather.	Locations not controlled by any measures listed above. Best in locations with low bicycle ridership on the cross street, as the raised markers may present difficulty to bicyclists. May not be appropriate in areas with heavy winter weather due to high maintenance costs. May not be appropriate for locations with bright sunlight.
Bicycle Crossing Sign (MUTCD W11-1) or Trail Crossing sign (MUTCD W11-15/W11-15p)	Warning Sign and placard.	Alerts motorists to a location where bicyclists or bicyclists and pedestrians will be crossing the roadway at an uncontrolled location.	Typical application is at bike path crossing of a roadway. (At a typical pedestrian crosswalk at an intersection, use the Pedestrian warning sign W11-2)
In-Street Pedestrian Crossing Signs (MUTCD R1-6)	This measure involves posting this regulatory sign on road centerlines that read, “YIELD for Pedestrians in crosswalk”. (Depending on state law, the word STOP may replace the word YIELD).	This measure improves the visibility of the crossing to motorists and has a positive impact on pedestrian safety at crosswalks.	Mid-block crosswalks, unsignalized intersections, low-speed areas, and two-lane roadways.
Advanced Yield Lines	Standard white stop or yield limit lines are placed 20-50 feet in advance of marked, uncontrolled crosswalks.	This measure increases the pedestrian’s visibility to motorists, reduces the number of vehicles encroaching on the crosswalk, and improves general pedestrian conditions on multi-lane roadways. It is also an affordable option.	Useful in areas where pedestrian visibility is low and in areas with aggressive drivers, as advance limit lines will help prevent drivers from encroaching on the crosswalk. Addresses the multiple-threat collision on multi-lane roads.
Transit			
Bike Racks on Buses	A rack on the front of the bus that typically holds two or three bicycles.	Increases the trip length distance that a person can make.	Appropriate for all buses; most urban transit agencies have already implemented this measure.
Bikes allowed inside buses when bike rack is full	A policy adopted by a transit agency that allows passengers to bring bicycles inside the bus when the bike rack is full and there is room inside.	Prevents cyclists from needless being left behind to wait for the next bus if the bike rack is full yet there is room inside the bus.	Appropriate for all buses; most urban transit agencies have already implemented this measure.

Folding bikes allowed inside buses	A policy adopted by a transit agency that treats a folding bicycle as luggage, thereby allowing it inside the bus at all times.	Removes cyclists' uncertainty as to whether they will be able to fit their bike either on the bike rack or inside the bus; thus they can reliably plan on being able to catch their intended bus.	Appropriate for all buses; most urban transit agencies have already implemented this measure.

APPENDIX C: RESOURCE LIST AND REFERENCES

RESOURCE LIST AND REFERENCES	
➔ Pedestrian and Bicycle Information Center ("PBIC") http://www.bicyclinginfo.org	Along with walkinginfo.org, a resource site maintained by UNC Highway Safety Research Center (UNC-HSRC)
➔ Pedestrian and Bicycle Crash Analysis Tool ("PBCAT") http://www.walkinginfo.org/facts/pbcat/index.cfm	Crash typing software product intended to assist planners and engineers with improving walking and bicycling safety through the development and analysis of a database containing details of crashes between motor vehicles and pedestrians or bicyclists
➔ FHWA On-Demand Bicycle Safety Training Courses http://www.bicyclinginfo.org/training/ondemand-training.cfm	FHWA University Course on Bicycle and Pedestrian Transportation National Highway Institute Bicycle Facility Design Course Safe Routes to School National Course APBP National Complete Streets Workshops
➔ FHWA University Course on Bicycle and Pedestrian Transportation, Report No. FHWA-HRT-05-085 http://www.tfhrc.gov/safety/pedbike/pubs/05085	A detailed 24-lesson course in planning and design for non-motorized transportation.
➔ FHWA Official Rulings website http://mutcd.fhwa.dot.gov/orsearch.asp	List of FHWA communications regarding experiments, and interpretation of documents (Requests To Experiment / RTEs, response letters, progress reports, final reports, changes).
➔ FHWA Interim Approvals webpage http://mutcd.fhwa.dot.gov/res-interim_approvals.htm	List of all Interim Approvals granted by FHWA. Interim Approvals enable states and local agencies to request approval to use a new device without experimentation before the device is incorporated into a future edition of the MUTCD.
➔ FHWA "Bicycle Facilities and the Manual on Uniform Traffic Control Devices" webpage http://www.fhwa.dot.gov/environment/bicycle_pedestrian/guidance/design_guidance/mutcd_bike.cfm	Status in the 2009 US MUTCD of various bicycle-related signs, markings, signals, and other treatments (e.g. can be implemented, Interim Approval, currently experimental).
➔ FHWA DRAFT Accessibility Guidance for Bicycle and Pedestrian Facilities, Recreational Trails, and Transportation Enhancement Activities (2008) http://www.fhwa.dot.gov/environment/recreational_trails/guidance/accessibility_guidance/guidance_accessibility.cfm	Summary of current accessibility standards, pending standards, guidelines under development, program accessibility, accessibility design criteria for sidewalks, street crossings and shared use paths and trails
➔ FHWA Bollards, Gates and other Barriers (webpage) http://www.fhwa.dot.gov/environment/recreational_trails/guidance/accessibility_guidance/bollards_access.cfm	Current guidance on the hazards of bollards, gates, fences and other barriers to restrict unauthorized use of paths. Alternatives to bollards and gates.
➔ California Traffic Control Devices Committee (CTCDC) http://www.dot.ca.gov/hq/traffops/signtech/newtech/	Committee agendas, minutes, annual reports, experiment status and reports, experimentation guidelines and requests, implementation of FHWA-issued Interim Approvals.
➔ *Caltrans Complete Streets webpage http://www.dot.ca.gov/hq/tpp/offices/ocp/complete_streets.html*	*Complete Intersections guide and other resources*

➔ *Road Safety Audits: Case Studies (FHWA-SA-06-17)* http://safety.fhwa.dot.gov/rsa/rsa_cstudies.htm	
➔ *Bicycle Road Safety Audit Guidelines and Prompt Lists FHWA-SA-12-018* http://safety.fhwa.dot.gov/ped_bike/tools_solve/fhwasa12018/	
➔ *National Center for Safe Routes to School* http://www.saferoutesinfo.org/	*Resources for Infrastructure (engineering, safety, planning, design) and non-infrastructure (education, promotion, outreach) in support of Active Transportation in school commutes*

Adapted from FHWA Pedestrian Road Safety Audit Guidelines and Prompt Lists

RESOURCES FOR EXPERIMENTATION AND INTERIM APPROVALS	
➔ FHWA "Bicycle Facilities and the Manual on Uniform Traffic Control Devices" webpage http://www.fhwa.dot.gov/environment/bicycle_pedestrian/guidance/design_guidance/mutcd_bike.cfm	Status in the 2009 US MUTCD of various bicycle-related signs, markings, signals, and other treatments (e.g. can be implemented, Interim Approval, currently experimental). Start here to determine whether a device requires experimentation.
➔ FHWA Interim Approvals webpage http://mutcd.fhwa.dot.gov/res-interim_approvals.htm	List of all Interim Approvals granted by FHWA. Interim Approvals enable states and local agencies to request approval to use a new device without experimentation before the device is adopted in a future edition of the MUTCD.
➔ FHWA Official Rulings website http://mutcd.fhwa.dot.gov/orsearch.asp	List of FHWA communications regarding experiments, and interpretation of documents (Requests To Experiment / RTEs, response letters, progress reports, final reports, changes).
➔ California Traffic Control Devices Committee (CTCDC) http://www.dot.ca.gov/hq/traffops/signtech/newtech/	Committee agendas, minutes, annual reports, experiment status and reports, experimentation guidelines and requests, implementation of FHWA-issued Interim Approvals.
➔ FHWA (U.S.) Manual on Uniform Traffic Control Devices (MUTCD) (2009), Section 1A.10 http://mutcd.fhwa.dot.gov/ *NOTE: All US MUTCD content appears in-line in the California MUTCD, with California differences shown in blue, and California tables and figures identified with (CA).*	Section 1A10 Interpretations, Experimentations, Changes and Interim Approvals covers the design, application and placement of traffic control devices other than those adopted in the MUTCD. Figure 1A.1 Process for Requesting and Conducting Experimentation for New Traffic Control Devices is a flowchart of the federal (FHWA) process. Figure 1A.2 Process for Incorporating New Traffic Control Devices into the MUTCD is a flowchart of the process after successful experimentation, a research study, or a request from a jurisdiction or interested party
➔ California Manual on Uniform Traffic Control Devices (MUTCD) (2012), Section 1A.10 http://www.dot.ca.gov/hq/traffops/signtech/mutcdsupp/ca_mutcd2012.htm NOTE: All US MUTCD content appears in-line in the California MUTCD	Figure 1A.1 (CA) Process for Requesting and Conducting Experimentation for New Traffic Control Devices in California is a flowchart of the California (CTCDC) process. Figure 1A.101 (CA) Process for the Use of Traffic Control Devices Approved as Interim Approval (IA) by FHWA is a flowchart of additional steps in California before a device granted Interim Approval by FHWA may be used.

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> *From the CROW English website, http://www.crow.nl/English*
>
> *CROW is The Netherlands technology platform for transport, infrastructure and public space. It is a not-for-profit organization in which the government and businesses work together in pursuit of their common interests through the design, construction and management of roads and other traffic and transport facilities. Active in research and in issuing regulations, CROW focuses on distributing knowledge products to all target groups.*

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APPENDIX D: STREET CONNECTIVITY

Importance of Street Connectivity

Providing direct paths for bicyclists and pedestrians via well-connected street networks is important for encouraging bicycling and walking by helping people overcome real and perceived senses of distance.

Street connectivity is also associated with public health benefits. The SMARTRAQ Project analysis in Atlanta, Georgia, found that doubling the current regional average intersection density, from 8.3 to 16.6 intersections per square kilometer was associated with a reduction in average per capita vehicle mileage of about 1.6 percent. Furthermore, the Frank et al. (2006) study of King County, Washington, found that per-household VMT declines with increased street connectivity, all else held constant.

Policies for Street Connectivity

A network of safe, direct, and comfortable routes and facilities: A 2004 PAS report recommends that pedestrian (and bicycle) path connections be every 300 to 500 feet; for motor vehicles, they recommend 500 to 1,000 feet.[1] [2] For new development, such standards can be implemented through ordinances, like those of the regional government of Portland Oregon, Metro, which requires street connectivity in its Regional Transportation Plan and in the development codes and design standards of its constituent local governments.[3]

Measuring Connectivity

The following discussion of measuring street connectivity is provided as a resource and not officially a part of regular BSA processes. However, individuals are certainly encouraged to make such calculations.

Jennifer Dill (2004) presents the following measures of street connectivity:

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[1] Susan Handy, Robert G. Paterson, and Kent Butler, 2004, *Planning for Street Connectivity: Getting from Here to There,* PAS Report #515 (Chicago: APA Planners Press).

[2] For more information on this topic, see American Association of State Highway and Transportation Officials (AASHTO), *AASHTO Guide for the Design of Pedestrian Facilities* (Washington, D.C., AASHTO, 2004); *AASHTO Guide for the Development of Bicycle Facilities* (Washington, D.C., AASHTO, 1999; updated 2009); Institute of Traffic Engineers (ITE), Traffic Calming Guidelines and ITE *Context-Sensitive Solutions in Designing Major Urban Thoroughfares for Walkable Communities*? (Washington, D.C.: ITE, 2006), http://www.ite.org/bookstore/RP036.pdf (accessed September 3, 2008).

[3] The regional government of Portland Oregon, Metro, requires street connectivity in its Regional Transportation Plan and in the development codes and design standards of its constituent local governments as follows: local and arterial streets be spaced no more than 530 feet apart (except where barriers exist), bicycle and pedestrian connections must be made (via pathways or on road right of ways) every 330 feet, Cul de sacs (or dead-end streets) are discouraged and can be no longer than 200 feet, and have no more than 25 dwelling units.

- Intersection density
- Street density
- Average block length
- Link/node ratio
- Connected node ratio = intersections/ (intersections + cul-de-sacs)
- Alpha index = number of actual circuits/ maximum number of circuits

  Where a circuit is a finite, closed path starting and ending at a single node
- Gamma index = number of links in the network/ maximum possible number of links between nodes
- Effective walking area = number of parcels within a one-quarter mile walking distance of a point/ total number of parcels within a one-quarter mile radius of that point
- Route directness = route distance/ straight-line distance for two selected points

Dill suggests that route directness (RD) is perhaps the best connectivity measure to reflect minimizing trip distances, but may be difficult to use in research and policy. However, it may be applied in practice by randomly selecting origin-destination pairs and calculating a sample for the subject area.

Susan Handy, Robert G. Paterson, and Kent Butler, 2004, *Planning for Street Connectivity: Getting from Here to There,* PAS Report #515 (Chicago: APA Planners Press).

For more information on this topic, see American Association of State Highway and Transportation Officials (AASHTO), *AASHTO Guide for the Design of Pedestrian Facilities* (Washington, D.C., AASHTO, 2004); *AASHTO Guide for the Development of Bicycle Facilities* (Washington, D.C., AASHTO, 1999; updated 2009); Institute of Traffic Engineers (ITE), Traffic Calming Guidelines and ITE *Context-Sensitive Solutions in Designing Major Urban Thoroughfares for Walkable Communities*? (Washington, D.C.: ITE, 2006), http://www.ite.org/bookstore/RP036.pdf (accessed September 3, 2008).

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Berkeley SafeTREC

SAFE TRANSPORTATION RESEARCH AND EDUCATION CENTER

(SAFETREC)

UNIVERSITY OF CALIFORNIA, BERKELEY

About the Safe Transportation Research and Education Center (SafeTREC)

Founded in 2000, SafeTREC is part of the University of California, Berkeley, affiliated with the School of Public Health and the Institute of Transportation Studies, with additional partnerships with the Department of City and Regional Planning, Public Policy, and Transportation Engineering. SafeTREC helps the California Office of Traffic Safety (OTS) administer its Community Pedestrian and Bicycle Safety Training workshops and support various safety initiatives from other California agencies, including the California Department of Transportation (Caltrans), by providing programs such as:

- Community Pedestrian and Bicycle Safety Program
- Complete Streets Safety Assessments
- Global Road Safety
- Tribal Road Safety
- Collaborative Sciences Center for Road Safety

SafeTREC's mission is to reduce transportation-related injuries and fatalities through research, education, outreach, and community service.

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