Berkeley SafeTREC

SAFE TRANSPORTATION RESEARCH AND EDUCATION CENTER

PS20022

TOWN OF ALTADENA

COMPLETE STREETS SAFETY ASSESSMENT

Issues, Opportunities, and Suggested Strategies

Altadena and San Gabriel Mountains (NASA)

Eaton Canyon Falls

Assessment Team

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November 2020

This report was produced in cooperation with the Town of Altadena Council, Safe Streets Committee. Funding for this program was provided by a grant from the California Office of Traffic Safety, through the National Highway Traffic Safety Administration. Opinions, findings, and conclusions are those of the authors and not necessarily those of the University of California and/or the agencies supporting or contributing to this report.

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COMPLETE STREETS SAFETY ASSESSMENT

FINAL REPORT

NOVEMBER 2020

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EXECUTIVE SUMMARY

The Town of Altadena (Town) Council, Safe Streets Committee requested that SafeTREC at the University of California, Berkeley conduct a Complete Streets Safety Assessment (CSSA) study for various locations within the Town. The Town of Altadena is located in unincorporated area of the Los Angeles County (County). The Los Angeles County Public Works supported this effort and the Altadena Town Council Safe Streets Committee led the community engagement.

A team of two safety experts conducted the CSSA. The objectives of the CSSA are to improve pedestrian and bicycle safety and to enhance walkability and accessibility for all pedestrians and bicyclists in Town of Altadena.

The Town of Altadena is an unincorporated area of Los Angeles County adjacent to Pasadena, and as of the 2010 census, had a population of 42,777 residents. Since the Town of Altadena is in the unincorporated area of the Los Angeles County, the Office of Traffic Safety (OTS) collision rankings do not provide any collision data and ranking for Town of Altadena. The collision data for Town of Altadena from January 2014 to the end of 2018 were obtained from the SafeTREC Transportation Injury Mapping System (TIMS) database. In this five-year period, 47 collisions happened in Altadena involving pedestrians, 8 of which were with severe injuries. Within the same period, there were 37 collisions involving bicyclists, one of which resulted in severe injuries.

This report is organized into the following chapters:

- Chapter 1 is an introduction to the Complete Streets Safety Assessment for the Town of Altadena.
- Chapter 2 presents background information on bicyclist and pedestrian safety in the Town and collision history.
- Chapter 3 presents benchmarking analysis and suggestions for potential improvements.
- Chapter 4 presents observations and suggestions made during conference calls with the Town staff and during online research conducted.

Benchmarking Analysis of Policies, Programs, and Practices

As part of a Complete Streets Safety Assessment, a benchmarking analysis is conducted where the applicant agency is sent a set of questions regarding their pedestrian and bicyclist safety policies, programs, and practices to analyze how the local agency's existing conditions compare with current best practices. Since Town of Altadena is in the unincorporated part of the Los Angeles County, such comparison was not possible. As such an overall discussion was provided. The benchmarking topics fall under the following categories:

- Implementation of Americans with Disabilities Act (ADA) Improvements
- Policies and Programs
- Funding
- Data Collection
- Pedestrian and Bicycle Network Implementation
- Pedestrian and Bicycle Support Programs
- Others

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

Walking Audit Focus Areas

Due to ongoing pandemic and Covid-19 restrictions, the safety experts conducted virtual site visits, utilizing Google Street View and various discussion with the Town Council members.

Per the Town's request, the following five (5) locations were studied in this assessment:

1. Altadena Drive between Lincoln Avenue and Porter Avenue
2. Windsor Avenue between Woodbury Road and Ventura Street
3. Loma Alta Drive between Lincoln Avenue and Lake Avenue
4. Mariposa Street between Fair Oaks Avenue and Lake Avenue
5. Fair Oaks Avenue between Woodbury Road and Loma Alta Drive

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 Town, identify, and prioritize capital improvement projects.

The suggestions offered in this report are based on general knowledge of best practices in pedestrian and bicycle design and safety, are intended to guide Town staff in making decisions for future safety improvement projects in the Town, and they may not incorporate all factors which may be relevant to safety issues in the Town.

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, Town 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 Altadena Town Council Safe Streets Committee requested that the Safe Transportation Research and Education Center (SafeTREC) at University of California, Berkeley conduct a Complete Streets Safety Assessment (CSSA) for the Town. The objective of the CSSA is to improve safety and accessibility for all people walking and biking in the Town of Altadena. This assessment emphasizes safety and mobility issues associated with pedestrians and bicyclists.

1.2. ASSESSMENT APPROACH

The SafeTREC safety experts conducted an initial conference call with the Council members and Los Angeles County Public Works staff on May 21, 2020. Due to ongoing pandemic and Covid-19 restrictions, the safety experts conducted virtual site visits, utilizing Google Street View and various discussion with the Council members. Positive practices, as well as pedestrian and bicycle safety and accessibility issues were identified in the discussion with the Council members.

1.3. ACKNOWLEDGEMENTS

We would like to thank Ms. Dorothy Wong, Council Member, Altadena Town Council Safe Streets Committee, who contributed to the wide range of topics addressed in this report. We also like to thank Los Angeles County, Department of Public Works staff in providing guidance.

1.4. DISCLOSURES

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

The suggestions presented in this report are based on virtual site visits and limited discussions with the Town and County staff. These suggestions, which are based on general knowledge of best practices in pedestrian and bicycle design and safety, are intended to guide Town staff in making decisions for future safety improvement projects, and they may not incorporate all factors, which may be relevant to the pedestrian and bicycle safety issues in the town.

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, Town and County 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

Altadena is an unincorporated area of Los Angeles County adjacent to Pasadena, and as of the 2010 census, has a population of 42,777 residents.

2.1. PEDESTRIAN AND BICYCLISTS SAFETY OVERVIEW

Since Town of Altadena is in the unincorporated area of the Los Angeles County, the Office of Traffic Safety (OTS) collision rankings do not provide any collision data and ranking for Town of Altadena. On the CSSA application received from the Town, the Town Council members described their pedestrian, bicycle, and traffic safety issues:

“Town wide, we have not been able to initiate any real bicycle plan as well safety improvements to advocate for safer complete streets. We have a lack of sidewalks and safe space especially along streets that serve the community for residents to walk to business, transit, library and schools. As well, many in our community would like to have safe space to walk, bike, skate, and scoot to places in our community safely. Now more than ever complete street assessment can help in designing an active transportation and bicycle plan for our community.

“Included is attached letter/map from Waldorf Elementary School on Mariposa as it connects to key business corridors at Fair Oaks to Lake Avenue. Along Mariposa is the Altadena Main Library and Senior Center, Girl Scouts of America Camp and our historic business district. Waldorf Elementary School sits on Mariposa nearest to Fair Oaks. As well, these connecting roads are also our main transit corridor and park.

“Over the years, the speed limits were raised, but the traffic safety has not seen improvement while the collision data seems to show clear safety measures are needed.

“The County of LA has also drafted their Vision Zero Action Plan to support safer streets, so there is much potential to create safe corridors that have yet to come to fruition.”

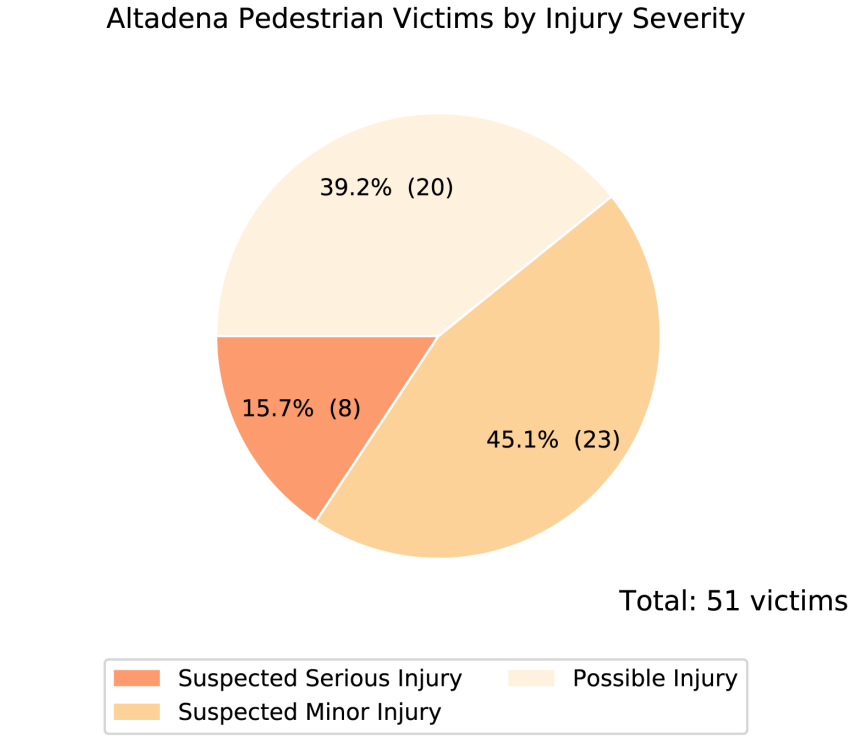
2.2. PEDESTRIAN AND BICYCLE COLLISION DATA

The collision data for Town of Altadena from January 2014 to the end of 2018 were acquired from the SafeTREC Transportation Injury Mapping System (TIMS) database.

Pedestrian Collisions

In this five-year period, 47 collisions happened in Altadena involving pedestrians, 8 of which were with severe injuries. 27 collisions happened when the pedestrian was crossing at a crosswalk at an intersection and 12 happened when the pedestrian was crossing not at a crosswalk. The highest number of collisions happened on Fridays. The following charts depict this data:

Chart 2.1: Number of Pedestrian Victims by Injury Severity, Town of Altadena



Data Source: Statewide Integrated Traffic Record System (SWITRS) 2014-2018; 2017 and 2018 data are provisional as of Mar. 2020

Chart 2.2: Number of Pedestrian Collisions per Day of Week per Time, Town of Altadena

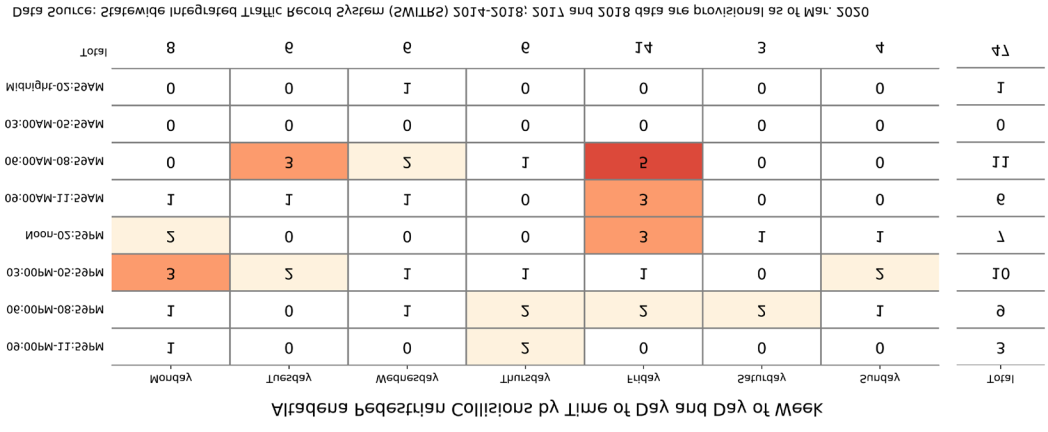
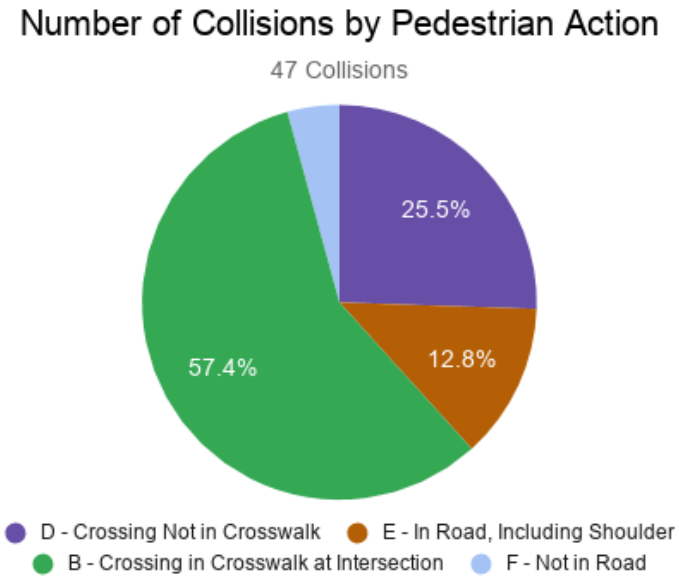


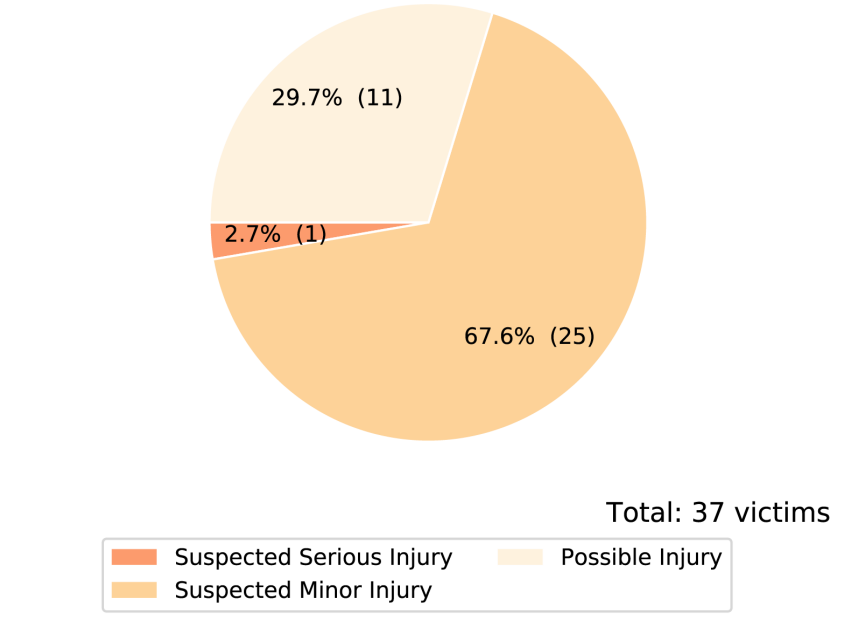
Chart 2.3: Number of Pedestrian Collisions by Pedestrian Action, Town of Altadena



Bicycle Collisions:

Based on the TIMS data, from January 2014 to the end of 2018, there were 37 collisions involving bicyclists, one of which resulted in severe injuries. Nine (9) collisions happened due to the bicyclist's failure to yield right-of-way when making a left turn or U-turn. The highest number of collisions happened on Tuesdays. The following charts depict this data.

Chart 2.4: Number of Bicycle Victims by Injury Severity, Town of Altadena



Data Source: Statewide Integrated Traffic Record System (SWITRS) 2014-2018; 2017 and 2018 data are provisional as of Mar. 2020

Chart 2.5: Number of Bicycle Collisions per Day of Week per Time, Town of Altadena

Altadena Bicycle Collisions by Time of Day and Day of Week

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Total
09:00PM-11:59PM	0	0	1	0	0	0	0	1
06:00PM-08:59PM	1	1	2	1	2	0	0	7
03:00PM-05:59PM	0	4	1	2	0	0	0	7
Noon-02:59PM	1	1	1	0	0	3	0	6
09:00AM-11:59AM	2	1	0	0	1	1	2	7
06:00AM-08:59AM	1	2	3	1	1	0	1	9
03:00AM-05:59AM	0	0	0	0	0	0	0	0
Midnight-02:59AM	0	0	0	0	0	0	0	0
Total	5	9	8	4	4	4	3	37

Data Source: Statewide Integrated Traffic Record System (SWITRS) 2014-2018; 2017 and 2018 data are provisional as of Mar. 2020

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

Altadena Bicycle Collisions by Type of Violation
Total: 37 Collisions

CVC No.	Description	Number of Collisions
21801	Driver failure to yield right-of-way when making a left turn or U-turn	9 (24.3%)
22350	Speeding on the highway / Driving at a dangerously high speed given highway conditions like weather, visibility, traffic, and highway measurements, or driving at a speed that endangers people or property	4 (10.8%)
21650	Failure to drive/ride on right half of the roadway (with some exceptions)	3 (8.1%)
21802	Failure to stop or yield right-of-way at a stop sign	3 (8.1%)
21804	Driver failure to yield right-of-way when entering/crossing a highway	3 (8.1%)
22107	Unsafe turning or moving right or left on a roadway Turning without signaling	3 (8.1%)
21750	Failure to pass safely to the left when passing another vehicle	2 (5.4%)
21800	Failure to yield right-of-way at intersection, including failure to yield to vehicles already in the intersection, on a continuing highway, or on their right side in an intersection, or safely when an intersection is controlled	2 (5.4%)

Data Source: Statewide Integrated Traffic Record System (SWITRS) 2014-2018; 2017 and 2018 data are provisional as of Mar. 2020

The type of information provided above which is obtained from SafeTREC's TIMS (https://tims.berkeley.edu/) can help enforcement agencies 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 sessions 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.

It is suggested that Town staff use this free tool to collect information from their residents for local needs assessments, transportation safety planning efforts, safety programs and project proposals.

3. BENCHMARKING ANALYSIS RESULTS AND SUGGESTIONS

As part of a Complete Streets Safety Assessment, a benchmarking analysis is conducted where the applicant agency is sent a set of questions regarding their pedestrian and bicyclist safety policies, programs, and practices. The benchmarking topics fall under the following categories:

- Implementation of Americans with Disabilities Act (ADA) Improvements
- Policies and Programs
- Funding
- Data Collection
- Pedestrian and Bicycle Network Implementation
- Pedestrian and Bicycle Support Programs
- Others

This benchmarking analysis categorizes the results into three groups:

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

Each topic receives one of those three ratings and is highlighted in blue in the Table 3-1. This analysis shares information on current best practices and how the local agency compares with similar local agencies. With differing physical, demographic, and institutional characteristics, certain goals or policies may be more appropriate in some jurisdictions than others may. Ultimately, the local agency staff may determine where resources and efforts are best placed for meeting local development and infrastructure goals for pedestrians.

The Los Angeles County Department of Public Works staff provided information from County's perspective on the benchmarking questions. Their rating for each item is highlighted in yellow in Table 3-1. Since Town of Altadena is in the unincorporated part of the Los Angeles County, a comparison with other towns in the County was not possible. As such an overall discussion is provided for each item in the following sections. The County of Los Angeles and Town of Altadena may select strategies for implementation based on their local priorities.

Table 3-1: County of Los Angeles Programs, Policies, and Practices: Benchmarking Analysis

Benchmarking 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

Benchmarking Topic	Key Strength	Enhancement	Opportunity
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
Public Involvement and Feedback Process	Creates opportunities for public engagement on walking and biking topics on a regular basis, through a variety of community-specific formats (e.g., venues, times of day, languages)	Has a web-enabled public feedback process (e.g., 311 app) or includes formal public engagement in active transportation on a project-by-project basis	Does not have a formal public involvement or feedback process for bicycle/pedestrian planning or safety
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 communitywide 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

Benchmarking Topic	Key Strength	Enhancement	Opportunity
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
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
Inventory of Sidewalks, Informal Pathways, and Key Pedestrian Opportunity Areas	Maintains an inventory of missing and existing sidewalks in GIS and includes sidewalk projects in the CIP	Maintains an inventory of missing sidewalks, informal pathways, or pedestrian opportunity areas	Does not have an inventory of missing sidewalks, informal pathways, or pedestrian opportunity areas
Pedestrian and Bicycle Traffic Control Audit (Signs, Markings, and Signals)	Maintains an inventory of pedestrian and bicycle signs, markings, and signals in GIS	Has a limited inventory of signs, markings, and signals	Does not have an inventory of signs, markings, and signals
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

Benchmarking Topic	Key Strength	Enhancement	Opportunity
Existing bike network	Includes current best practice features such as cycle tracks, bicycle boulevards, intersection treatments, and/or buffered bike lanes	Includes Class I, II, and III only	Includes only bicycle routes or no designation
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
Bike 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
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 and Stop Sign Warrants	Uses relaxed warrants for traffic signals and/or all-way stops	Uses relaxed warrants for traffic signals or all-way stops	Uses MUTCD Warrants
Sidewalk furniture or other sidewalk zone policies	Design standards require implementation of the sidewalk zone system citywide. Does not allow apron parking or attached (unbuffered) sidewalks anywhere in the city.	Design standards require implementation of the sidewalk zone system in some districts (e.g., CBD, neighborhood commercial, etc.).	There are no design standards requiring implementation of the sidewalk zone system.

Benchmarking Topic	Key Strength	Enhancement	Opportunity
Pedestrian and Bicycle Support Program			
Street Tree Requirements	Has a street tree ordinance that improves pedestrian safety and access	Has a street tree ordinance, but it does not improve pedestrian safety or access	Does not have a street tree ordinance
Bicycling Supportive Amenities and Wayfinding	Bicycle supportive amenities (parking, routing/wayfinding, water fountains, repair stations) are found communitywide	Some bicycle supportive amenities are found in key areas	Bicyclist supportive amenities are not provided in the community
Bicycle Parking Requirements	A bicycle parking ordinance is enforced for all development and a program is in place to install and maintain public bike parking in existing development	A bicycle ordinance for off-street parking is in place but no requirement exists to install parking for existing development	No bike parking ordinance or program in place
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
Others			
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)
Pedestrian Walking Audit Program	Has significant and ongoing programs that include regular walking audits	Has no safety program, but has conducted walking audits sporadically	Does not have a pedestrian safety program and has not conducted a walking audit
Bicycling Safety Audit Program	Has significant and ongoing programs which include bicycling audits	Has some programs and may have conducted a bicycling audit	Does not have bicycling safety audit programs

Benchmarking Topic	Key Strength	Enhancement	Opportunity
General Plan: Provision for Pedestrian and Bicycle Nodes	Pedestrian and bicycle nodes are identified and pedestrian-oriented policies are in place for these nodes	Pedestrian and bicycle nodes are identified, but pedestrian and bicycle accommodations are not	Pedestrian and bicycle nodes are not identified
Bike Ordinances (Sidewalk Riding)	Local ordinances allow for context-specific flexibility in sidewalk riding policies and enforcement (e.g., is there an adjacent bike facility?)	Local ordinance does not include section on sidewalk riding	Ordinances mandate that bikes are not allowed on sidewalks under any circumstances
Transportation Demand Management (TDM) Programs	Has a transit first policy, extensive TDM programs, and enforces parking cash out	Has basic voluntary TDM programs but does not provide reduced fee transit passes	Does not have a TDM program or policy
General Plan: Densities and Mixed Use Zones	Has moderate to high densities in the CBD and mixed-use zones and progressive parking policies, and transportation impact analysis for new development considers multi-modal trade-offs, rather than reliance on LOS	Has moderate densities with separate uses; transportation impact analysis relies on LOS	Has low densities with separate uses; transportation impact analysis relies on LOS
Specific Plans, Overlay Zones, and Other Area Plans	Bicyclist and pedestrian-oriented design, walkability, or placemaking is stressed in the plans	Plans require bicycle and pedestrian accommodations, and placemaking	Plans do not address bicyclist or pedestrian needs or do not exist
Historic Sites	Cultural and historic preservation plans include a wayfinding, bicycle, and walkability focus	Historic areas have been identified, and pedestrian and bicycle access is addressed	No plan is in place, and little consideration is given for pedestrian and bicycle access in historic areas
Economic Vitality	Has several business improvement districts, an established façade improvement program, and progressive downtown parking policies	Has a business improvement district, façade improvement program, or downtown parking policies	Does not have business improvement districts, a façade improvement program, or downtown parking policies
Proactive Approach to Institutional Coordination	Has identified obstacles and has implemented efforts to overcome barriers	Has identified obstacles	Does not have any identified obstacles
Coordination with Schools	Proactive coordination, including school siting for bikeability and walkability, occurs	Reactive coordination, to improve routes to schools, occurs	No coordination with schools regarding bicycle or pedestrian access occurs

Benchmarking Topic	Key Strength	Enhancement	Opportunity
Coordination with Emergency Response	Emergency response is involved in all aspects of bicycle/pedestrian facility planning and design (including pilot testing), and they balance response times with bicyclist/pedestrian safety	Emergency response is involved in some aspects of bicycle/pedestrian facility planning and design	Emergency response is not involved in bicycle/pedestrian facility planning and design
Coordination with Health Agencies	Coordinates regularly with health agencies in the planning of bicycle and pedestrian facilities and/or programs and collection of collision data	Health agencies have programs to promote healthy lifestyles through active transportation	Health agencies are not involved in bicycle/pedestrian safety or active transportation
Coordination with Transit Agencies	Bicycles are accommodated on all transit vehicles with overflow capacity available. There are safe and comfortable routes for biking and walking to transit stops and stations, including on roadways with both frequent bus service and bicycle facilities.	Bicycles are accommodated on buses only, with accommodation limited to rack capacity. Some transit stops and stations safe and comfortable routes for biking and walking access.	Bicycles are not accommodated on transit. There are few bicycle and pedestrian accommodations for accessing transit stops and stations.

Implementation of Americans with Disabilities Act (ADA) Improvements

Implementation of ADA improvements is key to making walking accessible and safe for everyone, regardless of ability or age.

Suggestions for Potential Improvement

- Prioritize areas within the Town 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).
- Consider prioritizing sub-areas within the Town that exhibit greatest pedestrian activity.

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.

Suggestions for Potential Improvement

- Consider reviewing other useful design guidelines and standards:
  - 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/

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.

Suggestions for Potential Improvement

- Expand the County's traffic calming toolbox to include other tools, such as raised crosswalks, raised intersections, chicanes, and traffic diverters.
- Expand the County's practices to include proactive traffic calming measures. The County 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

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

Suggestion for Potential Improvement

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

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.

Suggestion for Potential Improvement

- Develop a town wide crosswalk policy for installation, removal, and enhancement of crosswalks at controlled and uncontrolled intersections. 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

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 into the other work that the County or Town does, including repaving and other routine maintenance of the roadway network.

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.

Collision History and Collision Reporting Practices

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").

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 Town's commitment to reducing the number of traffic-related fatalities and severe injuries to zero.

- Additionally, with sufficient pedestrian and bicycle volume data, the Town 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 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.

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 Plan(s) documents 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.

Suggestion for Potential Improvement

- Implement the "low-hanging-fruit" projects in the ATP and seek grant funding for major projects.

- Pursue additional funding opportunities for programs identified by the Plan.

- Provide regular updates to the Plan, including bicycle and pedestrian facilities and design guidelines that address the needs of bicyclists and pedestrians of all ages and abilities.

Existing bike network

Innovative features such as separated bikeways, bicycle boulevards, and buffered bike lanes can decrease the level of traffic stress experienced by bicyclists, make biking more comfortable, and—in so doing—appeal to a wide range of bicyclists. Level of traffic stress refers to the level of comfort or discomfort a bicyclist might experience. Research conducted by the Mineta Institute in San Jose establishes levels of traffic stress on a scale for 1 to 4 with LTS 1 at the level that most children can tolerate and LTS 4 at the level characterized by "strong and fearless" cyclists (see: http://transweb.sjsu.edu/project/1005.html). A bicycle network that is attractive to the majority of the population would have low stress and high connectivity.

Suggestion for Potential Improvement:

- Identify funding sources and implement the proposed projects identified in ATP.
- Develop design standards for bike boulevards, trails, paths, and landscaping for bicycle network.
- Create a GIS data for existing bike network to identify gaps and opportunities for improvements.

Existing Pedestrian Facilities

The pedestrian facilities include current best practice ADA and safety features such as high visibility crosswalks and advance stop bars, PHBs or RRFBs, bulbouts, etc.

Suggestions 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 Town.
- Identify funding sources for enhancement of sidewalks and crosswalks to include safety features and provide ADA compliance.

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.

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 Crossing Barriers

Crossing barriers—such as railroads, freeways, and major arterials—may discourage or even prohibit bicycle access and are often associated with vehicle-bicycle collisions. Large intersections and interchanges and uncontrolled crossings can often deter 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 bicyclist safety and access.

Suggestion for Potential Improvement:

- Identify and create an inventory of bicycle crossing barriers, along with potential safety countermeasures.
- Identify additional existing “conflict zones” along bikeways—such as large intersection and driveways—and implement enhancements such as green pavement. See Oakland’s

bicycle lane striping guidance for more information on green striping: http://www2.oaklandnet.com/oakca1/groups/pwa/documents/report/oak052468.pdf

- Coordinate with Caltrans to improve bicycle and pedestrian facilities at crossings, interchanges, and intersections with state highways to build out the District 4 Bicycle Master Plan, and 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 bicycle lane design.

- To slow speeds at critical intersections, use smaller corner radii using small design vehicles appropriate for urban areas and update standard to reflect this.

- Review design of slip/channelized right-turn lanes at intersections and implement improvements to slow speed and improve visibility.

- Evaluate upgrades to existing pedestrian and bicycle-only bridges over canals and feasibility of adding more bridges.

Bike Ordinances (Sidewalk Riding)

Suggestion for Potential Improvement:

- Consider an optional helmet ordinance for adults.

- Consider allowing for context-specific flexibility in sidewalk riding policies and enforcement.

General Plan: Densities and Mixed Use Zones

Planning principles contained in a city's General Plan can provide an important policy context for developing bicycle-oriented and walkable areas. Transit-oriented development, higher densities, and mixed uses are important planning tools for pedestrian-oriented areas.

Suggestion for Potential Improvement

- Utilize vehicle miles traveled (VMT) for future transportation impact analysis.

- Ensure the existing and future priority pedestrian areas in the Town, as identified in the ATP, are focus areas in future specific plans and the General Plan update, where varied densities and mixed-uses could accommodate or attract pedestrian activity.

- Consider allowing moderate to high densities in the downtown and mixed-use zones as well progressive parking policies, such as shared parking and demand-based pricing.

- Consider multi-modal trade-offs in the transportation impact analysis for new development, so that the safety and needs of people walking and biking is weighed heavily and vehicular delay is not the primary performance measure.

ADA Transition Plan for Streets and Sidewalks

ADA Transition Plans identify gaps and issues in a city's current ADA infrastructure, prioritize projects for implementation, and set forth the process for bringing public facilities into compliance with ADA regulations. Transition plans typically a range of locations, such as public buildings, sidewalks, ramps, and other pedestrian facilities. Some cities also have ADA Coordinators, who are responsible for administering the Plan and reviewing projects for accessibility considerations.

Suggestion for Potential Improvement

- Prioritize areas within the Town 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).
- Consider prioritizing sub-areas within the Town that exhibit greatest pedestrian activity.
- Expand the ADA Transition Plan to include the public right-of-way, particularly the downtown area, other priority development areas, bus stops, and schools.

Pedestrian/Bicycle Coordinator

A pedestrian/bicycle coordinator provides guidance for pedestrian/bicycle planning efforts and oversees implementation of plans. In a sampling of pedestrian-oriented California cities, a common denominator among cities (with a population over 100,000) is a full-time pedestrian/bicycle coordinator.

Suggestion for Potential Improvement

- Designate a staff member to fill the role of pedestrian/bicycle coordinator to include interdepartmental coordination, grant writing, and staff liaison to local non-profits, advocacy groups, and schools.

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 with a conventional approach of reacting to collisions.

Suggestion for Potential Improvement

- Consider creating an advisor committee and establishing regular scheduled meetings to bring all transportation projects to the general committee to give opportunity for focused complete streets discussion.

Public Involvement and Feedback Process

Having multiple touch points with the community creates transparency and open lines of communication among the County, Town, residents, and businesses. Different kinds of formats and venues for public involvement and feedback allow for broader participation from the community. Consideration of local demographics (e.g., languages spoken) and the easiest formats for people to participate (e.g., online, in person but in the course of their daily activities, or at town-organized meetings) are important for meaningful and productive community dialogue.

Suggestion for Potential Improvement

- Consider providing notices and interpretation in the most commonly spoken languages in the Town.
- As indicated in Section 2.3, consider using Street Story tool, which is a free tool to collect information from their residents for local needs assessments, transportation safety planning efforts, safety programs and project proposals. The Street Story tool (https://streetstory.berkeley.edu/) is developed by UC Berkeley's Safe Transportation Research and Education Center (SafeTREC) with OTS support. It 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. Street Story is publicly accessible. It features a survey where people can record their travel experiences.

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.

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.

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.

Suggestions for Potential Improvement

- Adopt a curb management plan to designate how the Town 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.

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.

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.

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 Town's website for knowledge sharing with the public as well as agencies.

Suggestion for Potential Improvement

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

Inventory of Sidewalks, Informal Pathways, and Key Pedestrian Opportunity Areas

A GIS-based sidewalk inventory enables project identification and prioritization, as well as project coordination with new development, roadway resurfacing, and so on.

Suggestions for Potential Improvement

- Create a town wide inventory of existing and missing sidewalks, informal pathways and key pedestrian opportunity areas in GIS.
- Consider establishing a program to work with property owners to repair damaged sidewalks outside their property. This can be a condition for the sale of the property.
- Geo-code the existing inventory of sidewalks in the Town and add informal pathways and key pedestrian opportunity areas.

Pedestrian and Bicycle Traffic Control Audit (Signs, Markings, and Signals)

Cities have a wide variety of traffic control devices that regulate how bicyclists and pedestrians should use the street and interact safely with drivers. However, some cities do not have inventories of how, when, and where this is installed. Creating a database of this information allows the town to know where infrastructure may be out of date or in needed of updates. For example, countdown signals are important pedestrian safety countermeasure. The California *Manual of Uniform Traffic Control Devices* (CAMUTCD) requires installation of countdown pedestrian signals for all new signals. It also requires installation of bike detection at all actuated signals. Bike detection is a basic building block of the bike network to make sure that bikes can trigger the traffic signal. Inventorying bike detection and countdown signals allows the town to approach safety from a systems perspective and develop projects to close gaps in biking and walking infrastructure over time.

Suggestions for Potential Improvement

- Develop a town wide crosswalk inventory in GIS and maintain it over time. This would allow for a systemic safety approach to enhancing crosswalks, and allow the Town to prioritize all crosswalk enhancement projects town wide for implementation over time and as money is available.
- Ensure that locations with pedestrian desire lines have safe crosswalks. An updated crosswalk policy can help determine the appropriate crossing treatment at uncontrolled locations without marked crosswalks.
- Include maintenance records within the GIS database inventory of signs, markings and signals.
- Develop a proactive monitoring program for ensuring the quality and proper functioning of traffic control devices.

Complete Streets Policy

Complete Streets Policy includes all users and modes, affects new construction and maintenance, considers local context, and provides guidance for implementation. 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.

Suggestion for Potential Improvement

- Consider establishing Complete Streets Policy.
- The following jurisdictions have established practices for complete streets, including implementation of these policies through multimodal level of service thresholds, and may serve as models:

  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

  South Bend, Indiana, Complete Streets Policy:
  https://www.smartgrowthamerica.org/app/legacy/documents/cs/policy/cs-in-south-bend-resolution.pdf

  Town of Ashland, Massachusetts, Complete Streets Policy:
  https://www.smartgrowthamerica.org/app/legacy/documents/cs/policy/cs-ma-ashland-policy.pdf

Bicycle Network Implementation Practices

Some traffic calming measures are implemented in conjunction with bikeway installations. 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. As a safe practice, age 8 to 80 bicyclist considerations need to be applied and/or level of traffic stress be considered

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.

Attention to Pedestrian Crossing Barriers

Crossing barriers—such as railroads, freeways, and major arterials—may discourage or even prohibit pedestrian access and are often associated with collisions. Large intersections and interchanges and uncontrolled crossings can often deter pedestrians 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 safety and access. Crossing barriers also discourage or even prohibit pedestrian access and can create safety challenges for pedestrians. These can be similar to the biking barriers or present additional challenges.

Suggestion for Potential Improvement

- Coordinate with Caltrans to improve bicycle and pedestrian facilities at crossings, interchanges, and intersections with state highways to build out the District 4 Bicycle Master Plan, and 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 bicycle lane design.

- To slow speeds at critical intersections, use smaller corner radii using small design vehicles appropriate for urban areas and update standard to reflect this.

- Review design of slip/channelized right-turn lanes at intersections and implement improvements to slow speed and improve visibility.

- Evaluate upgrades to existing pedestrian and bicycle-only bridges over canals and feasibility of adding more bridges.

- Identify and create an inventory of pedestrian barriers with targeted suggestions for phased improvements.

- Consider pedestrian barriers and needs while conducting bicycle barriers assessment.

Traffic Signal and Stop Sign Warrants

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.

Suggestion for Potential Improvement:

- Consider developing Town-specific signal and stop sign warrants that are pedestrian- and bicycle-friendly.

- Consider installing bicycle detection at signalized intersections.

Sidewalk furniture or other sidewalk zone policies

Street furniture encourages walking by accommodating pedestrians with benches to rest along the route or wait for transit; trash receptacles to maintain a clean environment; street trees for shade, and other facilities. Uniform street furniture requirements also enhance the design of the pedestrian realm and may improve economic vitality.

Suggestion for Potential Improvement

- Adopt a Street Furniture Ordinance to include locations and furniture amenities other than those associated with transit stops, as appropriate.

Street Tree Requirements

Street trees enhance the pedestrian environment by providing shade and a buffer from vehicles, which increase pedestrian safety. Street trees may also enhance property values, especially in residential neighborhoods. However, street trees, when improperly selected, planted, or maintained, may cause damage to adjacent public utilities.

Suggestion for Potential Improvement

- Consider establishing a Street Tree Ordinance to provide guidance on permissible tree types and permitting requirements, also specifying a requirement for new trees plantings associated with development projects.

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.

Suggestion for Potential Improvement:

- Develop a pilot program for bicycle supportive amenities at key locations in the Town, such as schools; include bicycle fix-it stations, water fountains, and similar amenities.

- Create and deploy a bicycle wayfinding strategy town wide.

Bicycle Parking Requirements

Safe and convenient bicycle parking is essential for encouraging bicycle travel (especially in lieu of vehicle travel). Bicycle parking can also facilitate last-mile connections between two modes, such as bicycle parking at a transit station. To be effective, bicycle parking needs to be visible and secure and have enough capacity to accommodate bicycle demand, both long-term and short-term. Long-term and short-term parking can be implemented through a bicycle parking ordinance as that of the City of Oakland (see details at http://www2.oaklandnet.com/Government/o/PWA/o/EC/s/BicycleandPedestrianProgram/OAK024596).

Suggestion for Potential Improvement:

- Implement short-term and long-term, secured bicycle parking at all new development, consistent with the Bicycle and Pedestrian Master Plan and the APBP Bicycle Parking Guidelines, 2nd edition.

- Site bicycle racks to be convenient for bicyclists, out of the way of pedestrians, and with good visibility for security, consistent with the APBP Bicycle Parking Guidelines, 2nd edition.

- Consider implementation of "branded" racks for the Town (with a unique design or Town symbol).

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.

Suggestion for Potential Improvement

- Consider conducting a 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.

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.

Pedestrian Walking Audit Program

Walking audits provide an interactive opportunity to receive feedback from key stakeholders about the study area and to discuss the feasibility of potential solutions. They can be led by Town staff, advocacy groups, neighborhood groups, or consultants.

Suggestion for Potential Improvement

- Include regular walking audits in the Townwide pedestrian safety program, based on the suggestions of this CSSA. This effort may complement other "green" or health-oriented programs within the Town.

Bicycling Safety Audit Program

When City staff and key stakeholders ride along study corridors and experience key route and crossing challenges and best practices, consensus is more readily reached on a vision and action plan for safety enhancements.

Suggestion for Potential Improvement:

- Include regular bicycling audits in the town wide bicycle safety program, based on the suggestions of this CSSA. This effort could complement other sustainability or health-oriented programs within the Town.
- Encourage interdepartmental participation between the County's Planning and Public Works and the Town staff. If possible, encourage Bicycle and Pedestrian Advisory Committee and Town Council members to participate.
- Routinely conduct bicycle safety audits of key corridors throughout the Town, including those with recent improvements, those with heavy bicycle demand, and those with high collision rates.

General Plan: Provision for Pedestrian and Bicycle Nodes

Planning principles contained in a city's General Plan can provide an important policy context for developing pedestrian-oriented, walkable areas. Transit-oriented development, higher densities, and mixed uses are important planning tools for pedestrian-oriented areas.

Suggestion for Potential Improvement

- Identify pedestrian nodes in future updates to the General Plan.
- Create an overlay district for pedestrian priority areas with special pedestrian-oriented guidelines, such as relaxing auto Level of Service standards and prioritizing pedestrian improvements. Prioritize sidewalk improvement and completion projects in these nodes.

Transportation Demand Management (TDM) Programs

TDM programs encourage multimodal travel by incentivizing non-automobile options. As new development occurs, TDM programs can be expanded, formalized, and strengthened.

Suggestions for Potential Improvement

- Consider establishing a TDM Program. As part of a comprehensive TDM program:
- Hire or identify a part-time TDM Coordinator.
- Create a TDM program and accompanying website with separate pages for employees, residents, and visitors.
- Establish a Transportation Management Association (TMA) for key commercial and business areas to coordinate parking, transit, and other TDM strategies and policies.

Specific Plans, Overlay Zones, and Other Area Plans

Suggestion for Potential Improvement

- Emphasize bicyclist and pedestrian-oriented design, walkability, and/or place making in all new specific plans, overlay zones, and other area plans.

Historic Sites

Historic walking routes or bike trails, such as the Freedom Trail in Boston, encourage active transportation and enhance economic vitality.

Suggestion for Potential Improvement

- Consider establishing walking and biking routes showcasing key destinations in the Town's historic district.

Economic Vitality

Improving bicycle and pedestrian safety and walkability can enhance economic vitality. Similarly, enhancing economic vitality through innovative funding options such as Business Improvement Districts (BIDs), parking management, and facade improvement programs can lead to more active areas and encourage walking and bicycling.

Suggestion for Potential Improvement

- Activate the built environment in business areas through BIDs and façade improvement programs.
- Use wayfinding, walking routes, and events to direct pedestrians to commercial areas throughout the Town.
- Install bicycle parking in commercial areas and provide safe, comfortable bike facilities in commercial areas to make in convenient and fun to get to local businesses.

Proactive Approach to Institutional Coordination

Institutional coordination associated with multiple agencies is a critical part of the work of any municipality. Non-local control of right-of-way and differing policies regarding pedestrian and bicyclist accommodation can make the work complex.

Suggestion for Potential Improvement

- Work with school district to identify and implement bicycle and pedestrian safety improvements and programs at each school site.
- Work with transit agencies to improve complete streets safety throughout the Town to provide safe walking and biking routes to transit stops.

Coordination with Schools

Neighborhood-sized schools, as opposed to mega schools on the periphery, are a key ingredient for encouraging walking and bicycling to school. In addition, pedestrian and ADA improvements could be prioritized near schools.

Suggestion for Potential Improvement

- Establish coordination with the local school districts to establish a policy on neighborhood-sized and oriented schools as part of a Safe Routes to School policy.
- Work with the school districts to establish suggested walking routes and address potential barriers to pedestrian or bicycle access.

Coordination with Transit Agencies

Providing safe and comfortable biking and walking routes to transit stops and stations, and the ability to take bicycles on-board transit vehicles increases the likelihood of multi-modal trips.

Suggestion for Potential Improvement:

- Prioritize implementation of safe routes to transit projects around the transit major corridors.
- Work with transit agencies, County, Caltrans, and other relevant partners to improve access and safety to stations and bus stops.
- Consider a monthly or quarterly meeting with transit agency stakeholders to discuss issues in the Town and how to address them.

Coordination with Emergency Response

Emergency response requires special roadway design considerations that sometimes conflict with bicycle and pedestrian treatments. One example is the design of turning radii at intersections. Bicyclists and pedestrians benefit from the reduced vehicle speeds of smaller radii, but larger vehicles, such as fire trucks, have more difficulty performing the turn within the smaller space. These conflicts require consensus building between the Town and the respective departments. Consensus building could include pilot testing of alternative treatments, such as a model traffic circle in an open field.

Suggestion for Potential Improvement:

- Balance the trade-off between traffic calming safety treatments such as roundabouts or partial street closures and longer emergency response times.
- Encourage emergency and transit responders to participate in test runs of roadway designs that are aimed to reduce speed and improve bicycling access.
- Collaborate with schools on projects beyond the school district boundaries.

Coordination with Health Agencies

Involving non-traditional partners such as public health agencies, pediatricians, etc., in the planning or design of pedestrian and bicycle facilities may create opportunities to be more proactive with pedestrian and bicycle safety, identify pedestrian and bicycle safety challenges and education venues, and secure funding. Additionally, under-reporting of pedestrian-vehicle and bicycle-vehicle collisions could be a problem that may be partially mitigated by involving the medical community in pedestrian and bicycle safety planning.[1]

Suggestion for Potential Improvement:

- Consider partnerships with the County Public Health agency and environmental groups to make transportation an element of healthy living and positive health outcomes.

[1] Sciortino, S., Vassar, M., Radetsky, M. and M. Knudson, "San Francisco Pedestrian Injury Surveillance: Mapping, Underreporting, and Injury Severity in Police and Hospital Records," *Accident Analysis and Prevention*, Volume 37, Issue 6, November 2005, Pages 1102-1113

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 field observations. 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 conference call held on May 21, 2020 and during online research conducted in September 2020.

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 remote research by the CSSA evaluator and discussions with Altadena residents. These suggestions are intended to guide Town councilmembers in making decisions for future safety improvement projects in the Town; they may not incorporate all factors relevant to pedestrian and bicycling safety issues in the Town. 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, staff of the Town and the County of Los Angeles 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

#	Focal Area	Local contact notes from conference call
1	Altadena Drive, Lincoln Avenue – Porter Avenue, including Lake Avenue intersection	East-west, 2 schools, 400 students, few sidewalk segments. Width for bike lanes west of Glenrose. Lake intersection identified in Vision Zero; long crossings.
2	Windsor Avenue, Woodbury Road –Ventura Street, especially Figueroa Drive intersection	North-south (Oak Grove - to Mountain View). Difficult on foot or bicycle. Traffic to/from JPL and 210 freeway. Hard to turn into Windsor.
3	Loma Alta Drive corridor, including uncontrolled crosswalk at Loma Alta Park (Sunset Ridge Drive)	Visitor traffic to trailheads. 3 stop signs. Horses, alpacas, peacocks.
4	Mariposa Street, Lake Avenue – Fair Oaks Avenue, including Santa Anita Avenue intersection	East-west. Complete Street opportunity. No sidewalks. Wide. Old drainage culverts. Santa Anita intersection with school and library.
5	Fair Oaks Avenue corridor, including Woodbury Road intersection	North-south. Traffic to/from Pasadena. Overbuilt, high speed, high collision rate in TIMS. Sidewalks lacking except at bus stops. Difficult for older or disabled person wanting to walk or access transit. Need controlled crossings. Crosswalk at Harriet.

Figure 4-1 locates the focal areas on a map of Altadena.

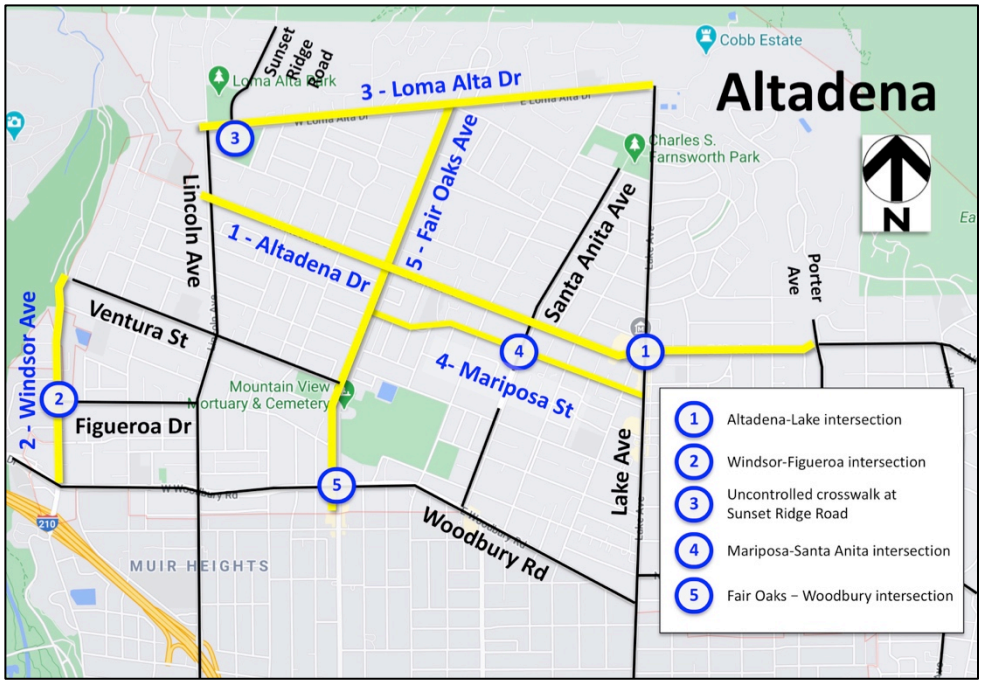


Figure 4-1: Map of focal areas

Section 4.3 presents treatments and suggestions that can be applied townwide. Subsequent sections address the five focal areas, with figures that illustrate the suggestions.

4.3. GENERAL TOWNWIDE SUGGESTIONS

The following best-practice suggestions for crosswalks are appropriate Townwide. Because the treatments discussed below and summarized in Table 4-1 are used in the focal area sections that follow, the reader is encouraged to review this section first.

Table 4-1: Best-Practice Treatments for Crosswalks

Topic	Details
Crosswalk signs and markings	
Crosswalk markings	At uncontrolled crosswalks, incorporate wide longitudinal elements (e.g., "ladder rungs") to enable approaching drivers to recognize the crosswalk earlier.
Centerline	Install no-passing (double yellow) centerline 50' back from crosswalk.
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.)
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.
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.
Yield Lines	Install on multi-lane approaches to uncontrolled crosswalks, 20'-50' before the crosswalk.
Advance Limit Lines	Appropriate for crosswalk approaches controlled by STOP signs, traffic signals, and Pedestrian Hybrid Beacons (PHBs). Install solid white transverse line 4' in advance of the first crosswalk line, Purpose: deter motorists from encroaching into the crosswalk or blocking sightlines to low pedestrians such as wheelchair users.
Raised features relevant to crosswalks	
Corner 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.
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.
Crosswalk operational elements	
Leading Ped. Interval	Display WALK phase (typically) 3 seconds before same-direction green indication, so pedestrians can occupy the curb lane.
Accessibility	Ensure that signal actuation is ADA compliant, including pushbutton height, type (diameter), actuation force, orientation, and location relative to crosswalk and level landing (for wheelchairs).

Crosswalk signs and markings

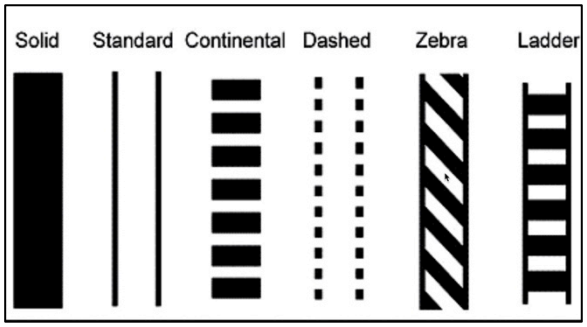
Except as noted, the following sections apply to *uncontrolled* intersection crosswalks, i.e., crosswalks across streets where the approaches are not controlled by STOP signs, traffic signals or Pedestrian Hybrid Beacons (PHBs).

Markings (at and near the crosswalk)

The standard crosswalk-marking scheme at controlled approaches has 2 transverse lines and no fill pattern. Many agencies 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.*

The wide cross stripes in the Continental and Ladder patterns are especially visible because they intercept a wider visual area than thin lines. If the Zebra pattern is used, it is suggested that the angled lines be wide, as shown.



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

Figure 4-2: Crosswalk marking patterns (FHWA)

Low-vision pedestrians (persons who are not completely blind) benefit from a continuous "contrast edge" for guidance when crossing streets, so that they do not wander away from the crosswalk. The Solid, Standard, Zebra and Ladder patterns provide this; the Continental does not. For all crosswalks at uncontrolled approaches that currently use the Continental pattern, it is suggested to add the two solid lines of the Standard pattern to produce the Ladder pattern.

In some jurisdictions "artistic" crosswalks have been 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 concrete strips and the middle of the crosswalk is reduced so the strips

no longer provide an effective contrast edge for low-vision pedestrians. It is suggested that 12-inch transverse lines (white for non-school crosswalks, yellow for school crosswalks) always be incorporated.

To deter passing within or near the crosswalk, it is suggested to mark the double yellow (no passing) centerline 50’ away from the crosswalk (away from the intersection, or in both directions if it is a mid-block crosswalk).

Sign assemblies at the crosswalk

The minimum suggested signage for uncontrolled crosswalks is a single-sided assembly at each end of the crosswalk, facing its approach. A sign assembly is a set of signs and plaques (signs that modify signs), typically arranged vertically, on a single support. For non-school pedestrian contexts the assembly is a W11-2 Pedestrian Symbol above a W16-7p Downward Pointing Arrow plaque. For shared-use path (paved or hard-surface “trail”) crossings a W11-15 (bicycle and pedestrian symbol sign) can replace the W11-2. For school crosswalks a S1-1 School Pentagon replaces the W11-2. In California, the SW24-2 (CA) sign is a single-plate that combines the S1-1 and W16-7p. For more details see California MUTCD Parts 2 (Signs) and 7 (School Areas).

If the crosswalk has pedestrian-activated Rectangular Rapid Flashing Beacon (RRFB) flashing light bars, those are installed between the W11-2, W11-15 or S1-1 sign and the plaque.

Because the W16-7p Downward Pointing Arrow is meant to indicate the actual crossing location so approaching drivers can look for persons crossing, it is important that sign assemblies with this plaque be located at the crosswalk or as close as possible (preferably upstream).

Improving upstream sightlines to street-side signs

An upstream parked vehicle, especially a tall one, may hide a curbside sign. This can be made less likely by prohibiting parking for at least one vehicle length (20’) upstream. Red curb markings are often used for this. A better approach adds a slash-striped area adjacent to the red curb to reinforce the no-parking message. An even better approach physically prevents upstream parking by installing a curb extension or floating island in the space—and that raised feature provides a much more visible mounting location for the warning sign assembly. A simple 5’ diameter island is more than wide enough to protect a crosswalk warning sign assembly in a parking lane, and also works as a simple median refuge where “left-side” signs can be installed.

Left-side sign assemblies at curbside or on median

For increased conspicuity, the curbside sign assemblies can be made double-sided, so approaching traffic also sees a sign assembly on the left side of the approach. This creates what is called a “2-sign” layout (if RRFBs are present, a “2-beacon” layout). Because the three types of crosswalk warning signs each depict one or two walking pedestrians, this evaluator considers it good practice for left-side signs to be mirror-imaged so the pedestrian(s) appear to walk into the approach, not away from it. *MUTCD Section 2A.06 Design of Signs* allows such “mirroring” of symbol signs, however the MUTCD has no separate designation for “right-facing” versions of the W11-2, W11-15 and S1-1, so obtaining them may involve a special order.)

For even more conspicuity, if a raised median wide enough to protect a warning sign assembly is present (4' minimum), left-side assemblies can be installed on it so each approach is "bracketed" on its half-street. This creates a "4-sign" layout (if RRFBs are used, "4-beacon").

Advance signs

If drivers need to be alerted earlier, perhaps because the approach curves, advance signs can be optionally be installed upstream. These use only the warning sign without the downward arrow (or a "XING" plaque, which is no longer current practice). Again, the sign is a W11-2 for non-school crosswalks, W11-15 for a shared-use path crossing, or S1-1 for a school crosswalk. If a median is present, a left-side sign can optionally be installed on it at the same location.

If any warning signs are to be installed for a crosswalk, the warning sign assemblies at the crosswalk should be first priority. Advance warning signs are optional, and should generally not be installed unless the at-crosswalk signs are in place—unless the advance sign's purpose is to raise awareness along a corridor segment independent of a particular crossing location.

On higher-speed approaches to crosswalks whose warning sign assemblies have RRFBs, some agencies have installed RRFBs on advance signs on a case-by-case basis. The advance sign's RRFBs are activated concurrently with those at the crosswalk.

Yield lines and Yield Here signs

Multi-lane approaches to uncontrolled crosswalks involve the risk of "multiple-threat" vehicle-pedestrian collisions, wherein a driver in one lane stops and yields to the pedestrian but their vehicle hides a second approaching vehicle in another lane, whose driver does not realize why the first driver has stopped and does not see or look for the pedestrian—who also does not check the other lane for traffic.

Multiple-threat risk can be reduced by having drivers yield before they reach the crosswalk, because doing so keeps the sight-line open between the pedestrian and the other lane(s). A Yield Line consisting of a row of isosceles triangles indicates the location where drivers are expected to yield. The Yield Line is typically placed between one and two car lengths (20' to 50') upstream, unless the crosswalk is on the far side of an intersection, in which case it is typically placed at the upstream curb return. Parking should be prohibited between the Yield Line and the crosswalk.

A R1-5 Yield Here sign at the Yield Line informs drivers of the legal requirement to yield if a pedestrian is present. It is placed on the right side of the approach. If a raised median is present a second such sign can be installed there. Because the R1-5 depicts a walking pedestrian, this evaluator considers it good practice for left-side signs to be mirror-imaged so the pedestrian is walking into the approach, not away from it.

Advance Limit (Stop) Lines [controlled approaches]

On approaches controlled by STOP signs, traffic signals, and Pedestrian Hybrid Beacons (PHBs), installing an advance limit line a short distance (typically 4 feet) in advance of the crosswalk cues 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 can hide a low pedestrian (child or wheelchair user) approaching across another lane.

MUTCD Section 3B.16 Stop and Yield Lines applies. Guidance Paragraph #10 states:

> *10 If used, stop and yield lines should be placed a minimum of 4 feet in advance of the nearest crosswalk line at controlled intersections, except… at mid-block crosswalks.*

Table 4-2 summarizes 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 Media2-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	

Raised features relevant to crosswalks

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 4-3: 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 4-4). These go by various names such as "Painted Safety Zones" (San Francisco), "Painted Curb Extensions" (Pasadena), "Painted Bulbouts" (Denver) and "Interim curb bulbs" (Seattle).

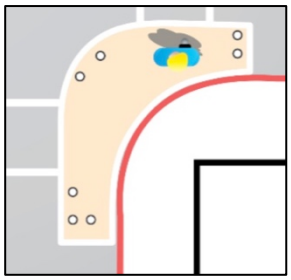
San Francisco MTA writes:

> *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/

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 4-4: Paint-and-delineator curb extensions

Center islands on side streets

Adding center islands behind the crosswalk on a side street can improve safety in several ways:

- Calm right turns from the major street
- Calm left turns from the minor street
- Calm through movements on the side street
- Prevent passing at the crosswalk by impatient motorists
- 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 space within the crosswalk, “shadowed” by the island, for bicycle users approaching on the side street to prepare to cross or enter the major street

Figure 4-5 shows such an island on a 40’ wide residential street in Sunnyvale CA (Canary Drive at Inverness Way). This island is 6’ wide and 20’ long.

Figure 4-5: Median island on residential street (Canary at Inverness, Sunnyvale CA)

Crosswalk operational features

Leading Pedestrian Interval

Leading Pedestrian Interval (LPI) (a.k.a. “Pedestrian Head Start”) 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 Town consider implementing LPI at signals with high pedestrian activity, prohibiting right-turn-on-red as needed per recent research findings.

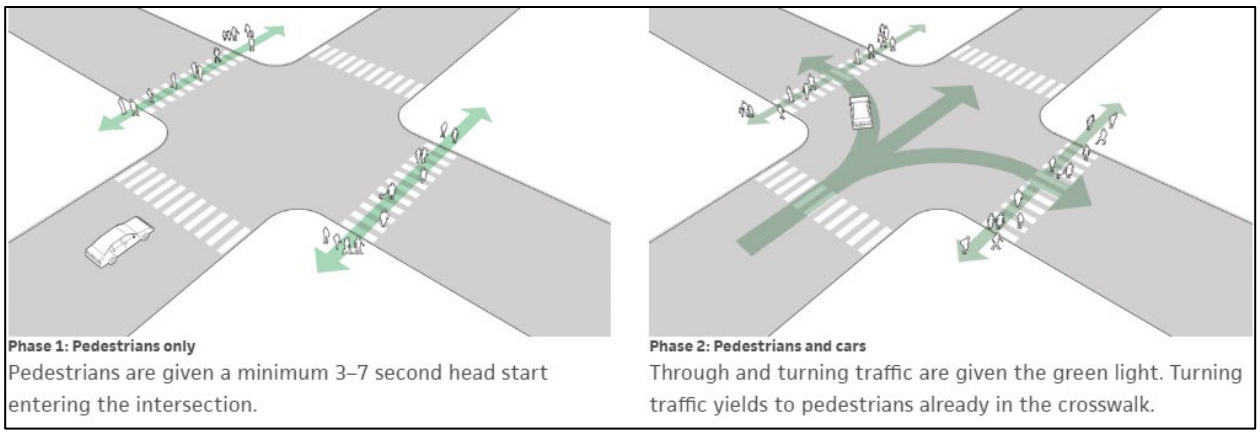


Figure 4-6: Leading Pedestrian Interval phases

Pedestrian pushbutton height, type (diameter), actuation force, orientation and location

Pedestrian pushbuttons that are too high are hard to operate for wheelchair users.

Old-style small pushbuttons require high actuation force and are not operable by severely disabled wheelchair users who do not have the use of their hands and must bump the button with their head or face. These should be replaced with larger buttons (2" is typical) with low actuation force.

Pedestrian pushbuttons should be located close to the crosswalk they serve, and should be oriented so that pedestrians, especially wheelchair users, do not have to travel a considerable distance to and from the button and/or perform an awkward movement with the chair in order to actuate the button.

It is common for buttons to be mounted on signal poles and on large-diameter mast arm poles. However, if those features are not convenient to the served crosswalk it is better to install a separate button post in a convenient location.

Sometimes a button mounted in an awkward location can be made considerably more accessible by adding an extension bracket that positions the button assembly away from the pole or post, and if needed changes its orientation for easier access.

Wheelchair users need the pushbutton to be located within comfortable reach of the "level landing" behind the curb ramp, where they can wait without having to exert force to keep the wheelchair from drifting into the street.

4.4. FOCAL AREAS

The following sections each address one of the five focal areas listed in Section 4.2.

4.4.1. Area #1: Altadena Drive between Lincoln Avenue and Porter Avenue

The Town's request for this focal area was to review markings, signs and locations of crosswalks across 10th Street, particularly uncontrolled crosswalks. The reader is encouraged to first review Section 4.3 because the elements it covers are used in the following discussion.

The following notes for this focal area are from the initial conference call:

2 schools, 400 students, few sidewalk segments.
Width for bike lanes west of Glenrose.
Lake intersection identified in Vision Zero; long crossings.

Existing conditions

Table 4-3 lists segment lengths, widths, sidewalk and parking conditions between Lincoln and Porter. Figure 4-7 maps the segments, sidewalk conditions along the street and on the first blocks at key intersections (blue), and traffic signal locations (red circles).

Table 4-3: Altadena Drive Segments, Lincoln - Porter

				Sidewalk		On-street parking	
#	**West end**	**L**	**W**	**North**	**South**	**North**	**South**
1	Lincoln	1,500	40	1 lot at Olive	Y	Y	Y
2	Olive	1,000	54	1 lot at Glenrose	1 lot at Glenrose	Y	Y
3	Glenrose	1,000	32	N	Y	N	Y
4	Fair Oaks	1,900	28	1 lot at Fair Oaks	Y	N	N
5	Marengo	900	33	N	N	N	N
6	Santa Anita	800	29, 44	N	Y	N	S (44)
7	Santa Rosa	1,300	30-80	E of Catherine	Y	N (off-street)	N (transit)
8	Lake	700	80-64	Y	Y	Y	Y
9	Maiden	1,500	40	Most lots	Few lots	Y	Y
10	Holliston	1,500	28-34	Y	Few	N	Y (some lots)
	Porter						

The street width varies considerably segment-by-segment.

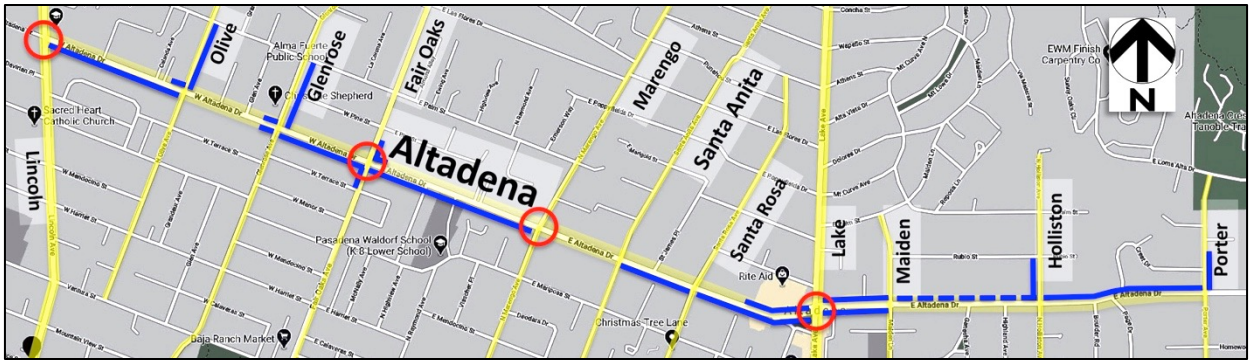


Figure 4-7: Altadena Drive segments, signals and sidewalks

Analysis -- corridor

Sidewalks

The corridor has continuous sidewalks on at least one side of the street except on three segments. On the Olive – Glenrose segment it appears dimensionally feasible to add sidewalks on both sides and also bike lanes. Just adding a sidewalk on the south side would provide connectivity between Lincoln and Marengo.

On the Marengo – Santa Anita segment the existing 33’ width and no-parking condition make it possible to add a 5’ sidewalk on the one side while providing 14’ travel lanes—sufficiently wide for comfortable passing of bicycles. A sidewalk on the south side would connect to the existing south sidewalks west of Marengo and east of Santa Anita.

On the Maiden – Holliston segment most north-side homes have a sidewalk. Continuity could be achieved with some neighborhood cooperation. Completing this block would create connectivity between the Lake Avenue commercial district—including that intersection’s northwest parcel—and Holliston.

Segment	L	W	Options considered (notes)
Olive – Glenrose	1,000	54	a) Add (2) 5’ attached sidewalks: New width 44’: 8’ parking, 5’ bike lanes, 10’ travel lanes b) Add (2) 5’ sidewalks, 1 attached, other with 5’ planting strip: New width 39’: 8’ parking, 11.5’ travel lanes c) Add (2) 5’ sidewalks with 5’ planting strips (10’ per side): New width 34’: 8’ parking, 9’ travel lanes (NO GO)
Marengo – Santa Anita	800	33	Add 5’ sidewalk on south side: New width 28’ (14’ travel lanes). (No existing parking)
Maiden – Holliston	1,500	40	Work with remaining houses on north side to achieve continuity to Porter

Bicycle accommodation

Only on the Olive – Glenrose segment (1,100') and near Lake Avenue is the width sufficient for consideration of bike lanes if parking is not removed.

Between Fair Oaks and Sana Anita the street width is 28' or 33', with no parking, resulting in traffic lanes at least 14' wide—adequate for comfortable passing of bicycles. But on the 40' wide segment between Lincoln and Olive, if two 8' parking width segments are subtracted, the remainder is only 24', i.e., two 12' travel lanes, which are not comfortably shareable.

Nearby parallel streets are available for lower-stress bicycling:

- Lincoln – Lake: Palm & Poppyfields (2 blocks north), Mariposa (2 blocks south)
- Lake – Holliston: Palm (2 blocks north)

Analysis / Lake Avenue intersection

Altadena Drive intersects Lake Avenue at a major signal 1.66 miles from Lincoln. Lake runs due north-south; Altadena angles 15 degrees SW-NE, which lengthens all crosswalks compared with a right-angled intersection. Both streets have two travel lanes in each direction plus a left turn lane. On Altadena Drive the directions are separated by narrow "stinger" islands.

Without being familiar with traffic counts for this intersection, the evaluator wondered whether two westbound through lanes were actually needed on Altadena Drive's east leg, given that:

- Only one westbound lane arrives at Maiden Lane just 700' east
- Homepark Avenue—the only north-side street that contributes traffic west of Maiden—is a dead-end court with only 14 houses
- Some fraction of approaching westbound traffic turns right (north) or left (south)

If the #1 westbound lane remained a through lane but the #2 (outside) lane became right-only onto Lake, an interesting reconfiguration may be possible as illustrated by Figure 4-8. Red lines extend curb lines or lane lines across the intersection or show turning paths. Blue lines show crosswalk realignments.

Island "A" defines a right turn slip lane and makes the corner property's adjacent driveway enter-only. The slip lane enables the north and east crosswalks to be shortened, which reduces pedestrian crossing time and simplifies the pedestrian's task by isolating the right turn conflict. Crossing the slip lane requires only a look in one direction and a few steps, and can be done while the main intersection crosswalks are in "Don't Walk".

In the past, slip lane crosswalks have been seen as pedestrian-unfriendly because of motorists failing to yield. However, incorporating a raised crosswalk to slow turning traffic changes the game. Boulder, CO uses this treatment at major signals near the University of Colorado campus (Figure 4-9). The raised feature is not illustrated in Figure 4-8.

The northeast corner gas station has two south driveways with one parking space between. Exiting drivers wishing to proceed west or south would use the east driveway; the other would become enter-only. The parking space would be eliminated.

With those changes, curb extension “B” could be added because the west leg would not need two lanes for westbound traffic. This would shorten the west crosswalk and calm southbound right turns. To facilitate those turns the bulb-out might not be a full lane width deep.

Curb extension “C” and the no-right-turn restriction would become possible if eastbound traffic bound for southbound Lake was required to use Fontanet Way along the south side of Altadena Triangle Park. That would also remove the right turn conflict at the south crosswalk.

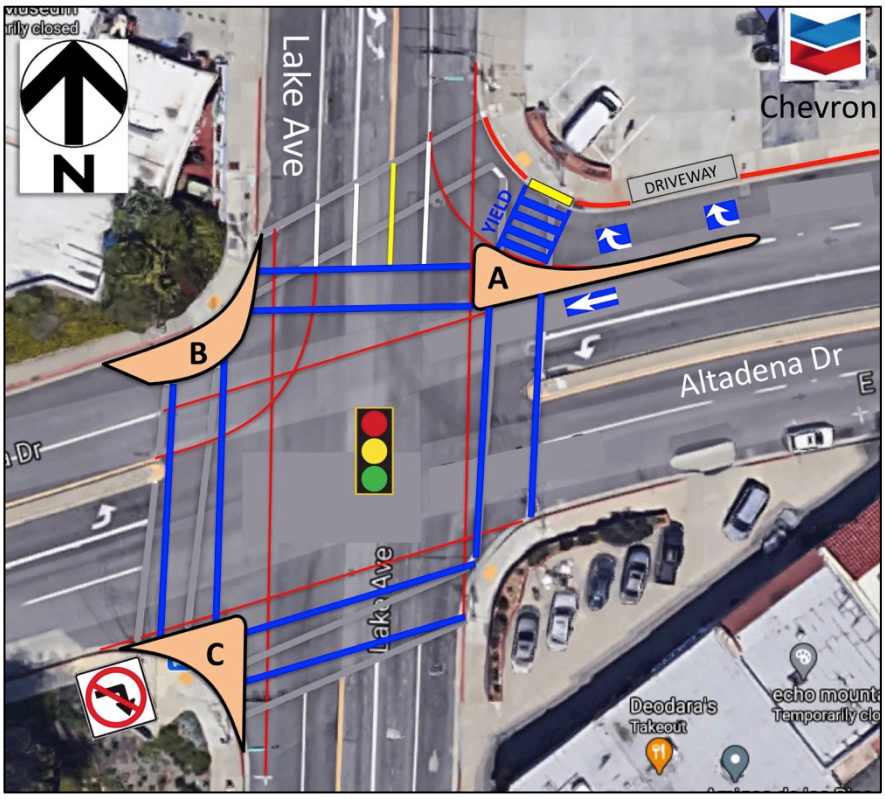


Figure 4-8: Altadena-Lake 1-lane westbound concept

Figure 4-9: Raised crosswalk at right turn slip lane (Boulder, CO)

4.4.2. Area #2: Windsor Avenue between Woodbury Road and Ventura Street

Existing conditions

Windsor Avenue runs north-south near the west side of Altadena between the 210 freeway and Ventura Street. South of the 210 it becomes Arroyo Boulevard. To the west is a residential pocket bounded by Oak Grove Drive, Devils Gate Reservoir and the Caltech Jet Propulsion Laboratory (JPL). To the east is the main body of Altadena.

The Oak Grove – Woodbury Road signal is 500' north of the freeway's north ramp signal. Windsor's northernmost intersection is an all-way STOP with Ventura Street and Explorer Road, at the trailhead parking lot for the reservoir area. There are no other signals or all-way STOPs.

Land use is mostly single-family residential. A Pasadena Water & Power treatment facility occupies the east side just north of Kent; its solar array covers the adjacent Windsor Reservoir.

Residents said travel along and across Windsor was difficult on foot or bicycle. They noted traffic to/from JPL and the 210, and the difficulty of turning onto Windsor from cross streets.

Sidewalks

As shown in Figure 4-10, sidewalks are present on the west side from Oak Grove to opposite the east leg of Vista Laguna Terrace, and on the east side along the Archwood Terrace frontage and from one house lot south of Neldome Street to the north driveway of the power plant opposite Lehigh Street. The figure shows existing sidewalks in blue, with arrows indicating the cross streets that have sidewalks (centered arrow = both sides, offset arrow = one side). Orange segments are key gap-closure opportunities. Yellow highlight indicates areas where enhanced crosswalks are needed.

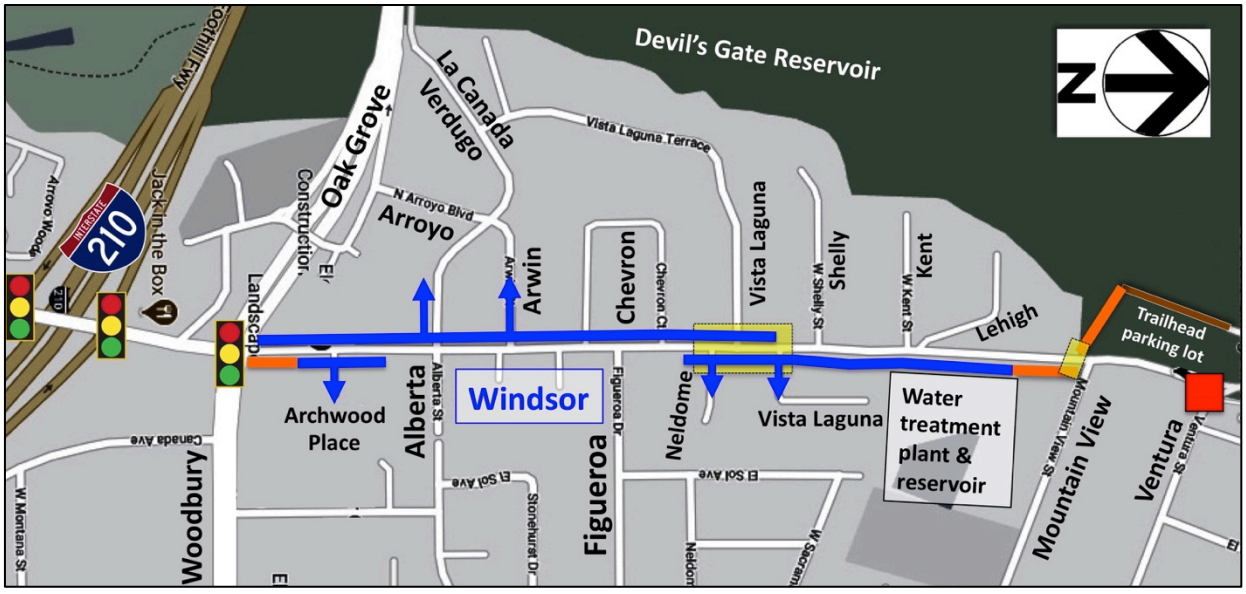


Figure 4-10: Windsor Avenue sidewalk segments, gaps & crossing needs

The street varies in width frequently and substantially as various subdivisions narrow the right of way. Between Oak Grove – Woodbury and Kent, Windsor has a center turn lane and one traffic lane in each direction, and an east-side parking shoulder from Archwood Place (one block north of Woodbury) to just north of Chevron Court.

Analysis

Sidewalks

Even though Windsor does not have continuous sidewalks on both sides for the entire length of the focal area segment (Oak Grove – Woodbury to Ventura), it almost has continuity on at least one side or the other except for a short segment north of the water treatment plant. Three suggested short-term priorities would be to:

- Close the north-end / east-side gap between the water treatment plant and Mountain View, and add an enhanced crosswalk on the south leg at Mountain View to connect to the trailhead parking lot
- Close the south-end / east-side gap between Archwood Place and Woodbury
- Add an enhanced crosswalk where the west and east sidewalks overlap at Vista Laguna

Figure 4-11 shows the context and concept for the first item. In the concept figure blue = existing sidewalk, orange = suggested. Because the suggested crosswalk is uncontrolled, high-visibility markings, Yield Lines, and double-sided warning sign assemblies are shown. If needed, pedestrian-activated Rectangular Rapid Flashing Beacons (RRFBs) could be incorporated.

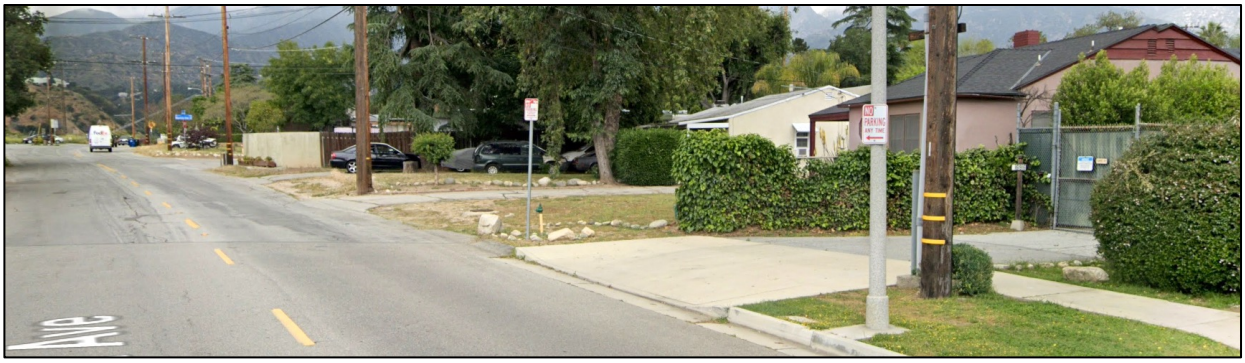
Note the extension of the southeast corner. Mountain View intersects at an angle, and the existing corner is probably set back to facilitate northbound right turns. However, the setback seems excessive for everyday “design vehicles” (trucks that routinely make the turn). There is no need to design for the occasional longer truck (say, a large moving van) because such a vehicle can either wait for Mountain View traffic to clear before using the full street width for a wide turn, or can approach from the east on Mountain View. Extending the corner effectively extends the straight edge of Windsor so the crosswalk can begin at a perpendicular angle.

Also note the one-car parking space for the house next to the treatment plant (below “Windsor”).

Figure 4-12 shows the context for the second item—the missing sidewalk along a vacant parcel between the Archwood Place frontage and the Woodbury intersection, where there are signal-controlled crosswalks. There appears to be ample depth in front of the green fence.

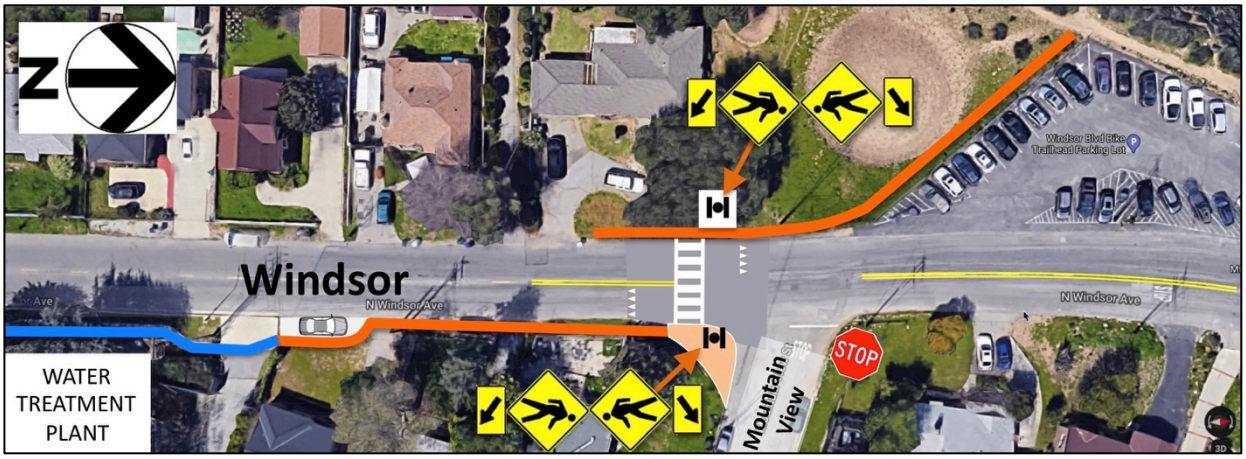
Figure 4-13 shows a concept for the third item—an RRFB-enhanced crosswalk connecting the existing east and west sidewalks between Neldome and the west leg of Vista Laguna Terrace. Island locations minimize effects on right turns out of and left turns into adjacent intersections. The a “dog-leg” refuge enable pedestrians to wait halfway, orients them toward approaching traffic, and reduces traffic delays because only one direction needs to yield at a time.

Note that this preliminary concept does not allow for the possibility of a southbound bike lane. A combined concept is beyond the scope of this report because it might involve shifting the center turn lane eastward.



a) North-end gap between water treatment plant (lower right) and Mountain View

b) Mountain View southeast corner (left side); trailhead parking lot opposite (upper right)



c) Gap closure concept

Figure 4-11: North-end east-side gap closure context and concept

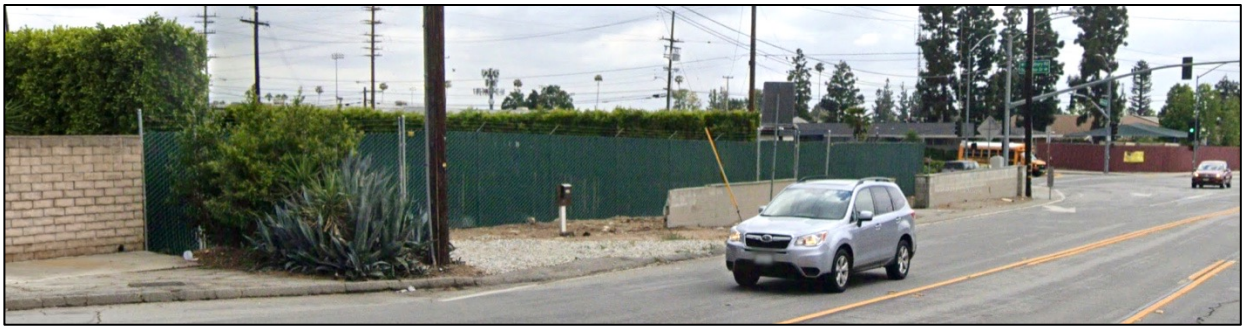


Figure 4-12: South-end east-side gap closure context (Archwood Place—Woodbury)

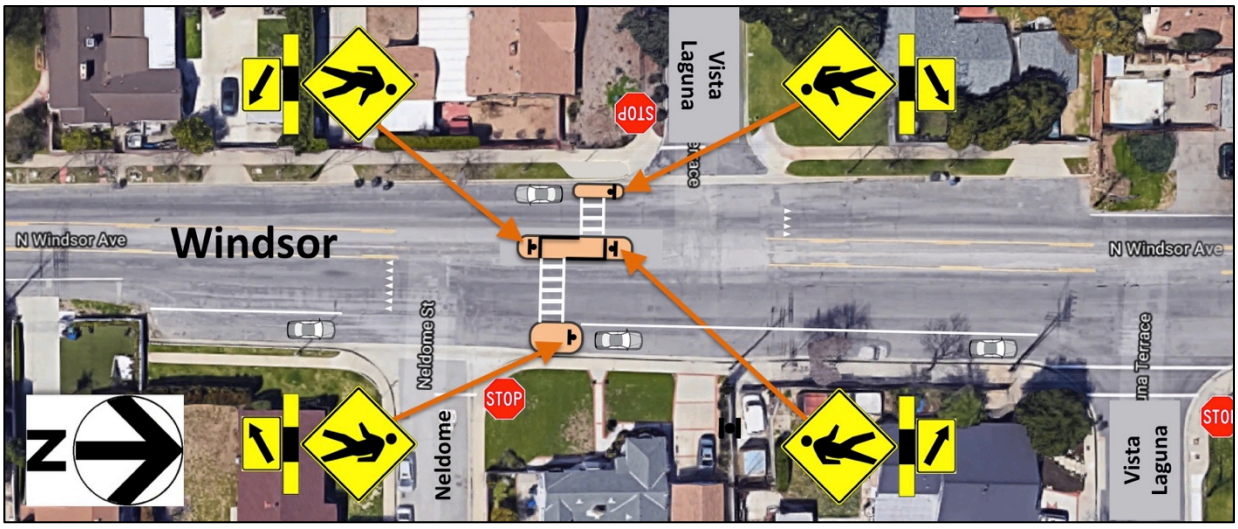


Figure 4-13: Vista Laguna crosswalk concept

Bicycling

The Altadena team requested ideas for improving bicycling on Windsor. Although the street width varies and the center axis shifts, there are essentially five segments with the following available widths for concept purposes:

#	Segment	Length*	Concept width
1	Oak Grove / Woodbury - Alberta (west leg)	665’	56’
2	Alberta (east leg) - 170’ E of Chevron Ct N leg	1062’	42’
3	170’ E of Chevron Ct N leg—S curb of Vista Laguna E leg	360’	56’
4	S curb of Vista Laguna E leg - S end of water facility	600’	56’
5	S end of water facility - N side of Mountain View	690’	34’

As shown in Table 4-4, it appears that bike lanes will fit on segments 1, 3, 4 and 5.

Table 4-4: Windsor Avenue Bike Lane and Buffer Options BY segment

		West						East				
#	Version	Sidewalk	Park	BL	BU	T	CTL	T	BU	BL	Park	Total
1	Existing	Exists	13.5			11	10.5	11			10*	56
	Concept		8	6	2	11	10	11	2	6	0	
2	Existing	Exists				14	10	12			6**	42
3	Existing	Exists	Varies			11	10	27			8	56
	Concept		Varies	6	3	11	10	11	2	6	8	
4	Existing	None				14	10	24			8	56
	Concept	5*		5		11	10	11		6	8	
5	Existing	None	3***			14		17				34
	Concept		3***	4		11		11		5		

* Add 5’ west sidewalk by narrowing curb-curb width to 51’
** East-side parkers straddle the uncurbed edge (2’-3’ of vehicle width off-street)
*** West-side parkers straddle the uncurbed edge (3’ of vehicle width off-street)

In Google Earth segment 1 appears to be 56’ wide, measured from the west curb to the east edge of pavement along the tall hedges south of Alberta. The table lists an existing 10’ east side parking lane in this area (north of the extra-wide area along the Archwood Place subdivision frontage) but that area is signed “No Stopping Any Time” so the Segment 1 concept reuses part of its width for a buffered bike lane that will also informally serve walkers.

Segment 2 is too narrow for bike lanes if the east-side parking and/or the center turn lane are retained. The southbound bicycling condition is a wide (14’) shared outside lane with no parking. 14’ has been shown to be the minimum lane width within which a car or light truck can pass a bicycle without encroaching into the adjacent lane (in this case the center turn lane). In bicycle planning this is called the minimum-width shared lane. (Cars are about 6’ wide; bicycles need a 4’ minimum operating width, and state law requires 3’ clearance when passing a bicycle, for a total of 13’, i.e., 1’ to spare in 14’.)

Segment 2’s northbound bicycling condition is a non-shareable (12’) lane adjacent to sparse parking. Bicyclists can use the parking lane where it is not occupied, but must merge into the traffic lane to ride around parked vehicles. Because parkers tend to align their left fender close to the shoulder stripe, their driver-side door (opening) zone extends approximately 3’ into the 12’ travel lane. Bicyclists aware of the door zone hazard will ride outside of it, “claiming” the lane for their safety. This is uncomfortable for most bicyclists, as is the need to merge repeatedly.

No workable concept for improving bicycling conditions is apparent, so Segment 2 has no concept line in the table.

On Segment 3 the lanes angle toward the east due to projecting parcels at the southeast and northwest ends. Usable width appears to be 56’, not counting the triangular tapered areas. Buffered bike lanes will fit with parking on both sides along most of the taper length.

Segment 4 has sufficient width to add a 5' sidewalk on the west side as well as bike lanes. An east-side sidewalk exists along the water treatment plant's frontage.

On segment 5, shifting the centerline 1' east enables adding an east-side (northbound) bike lane. The 4' west-edge space is 1' wider than what is now used by edge-straddling parkers. Where there are no parked cars, 4' is the minimum acceptable width for an uncurbed bike lane.

Figure 4-14 shows the segments (1 = southernmost, left end) with the conceptual bikeway treatments (green = buffered bike lane, yellow = bike lane, purple = shared lane).

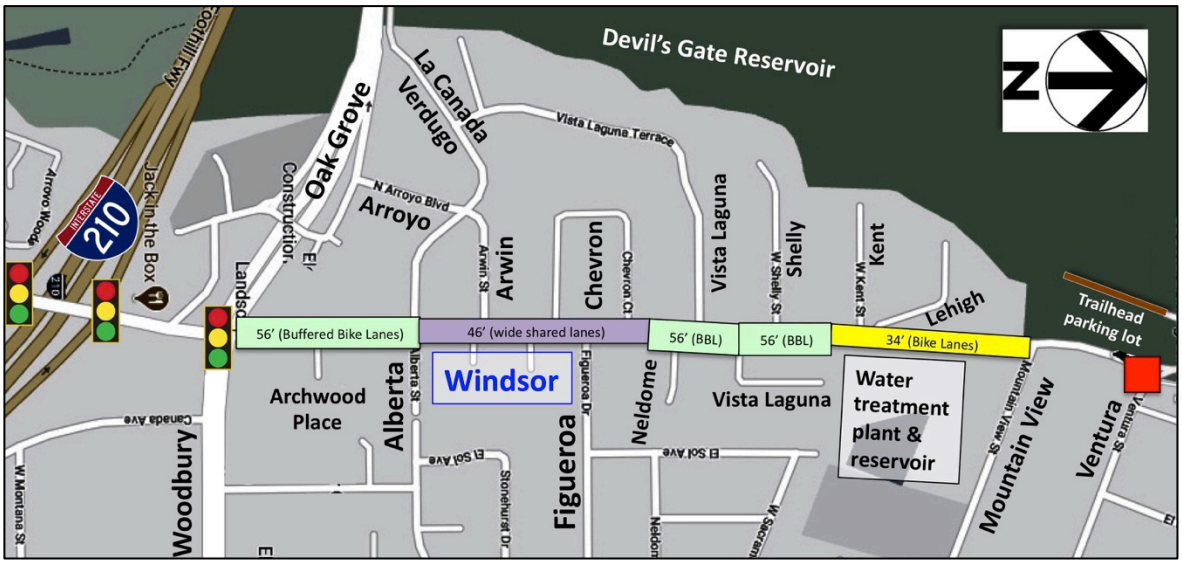


Figure 4-14: Windsor Avenue bikeway concepts by segment

Figueroa intersection

It was also requested to review Windsor's intersection with Figueroa Drive. Figueroa intersects from the east at a STOP-controlled T on Windsor's 42' wide segment, midway between the two T-intersections of Chevron Drive.

The west side of Windsor, opposite Figueroa, has a sidewalk with a planting strip. Figueroa is 40' wide with no curbs or sidewalks. Faded two-line white crosswalk markings are visible on the south leg (the "left" side of the T, on which the center turn lane does not serve a left turn movement). This enables installation of a median refuge.

It is suggested to restore the south-leg crosswalk and construct a sidewalk connection on the west side. The median refuge can be formed using two simple islands—a round one on the south side of the crosswalk and a half-round "thumbnail" on the north side.

The west-side warning sign assembly can be installed in the planting strip. The mid-street assembly will be double-sided. The east-side assembly can be installed on another small island that "caps" the informal parking lane on the northbound approach.

The concept figure also suggests striping Figueroa with 8' shoulders, to define spaces that will be used by walkers and bicyclists as well as for parking.

The area along the east side of Windsor is already used informally for walking. If kept clear it can retain that function until such time as a sidewalk is added.

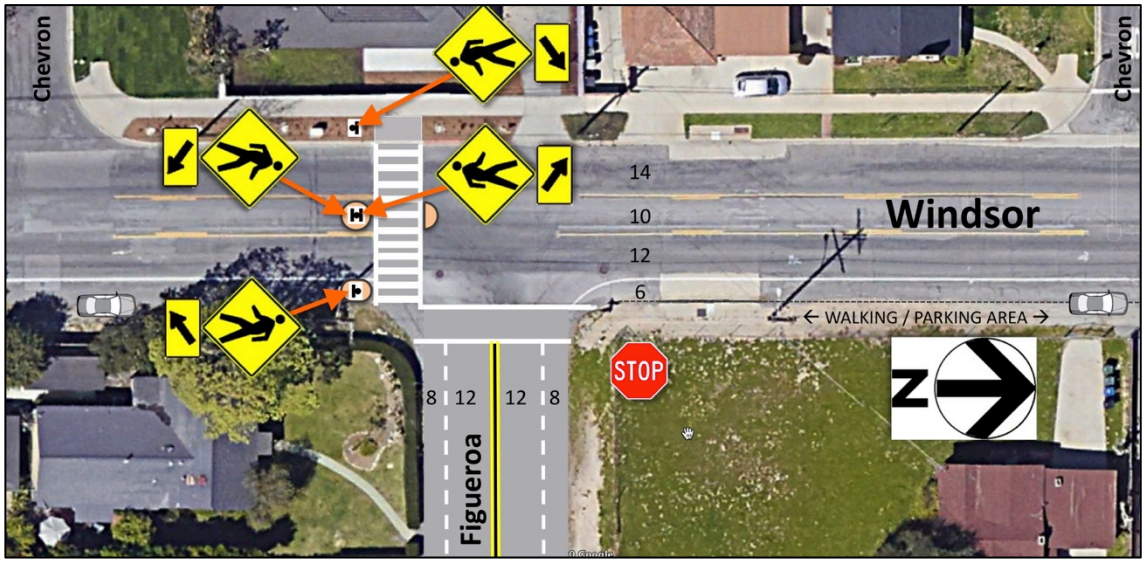


Figure 4-15: Windsor / Figueroa concept

One of the participants on the initial Altadena conference call remarked that it can be difficult to enter Windsor from side streets such as Figueroa. The concept figure does not address this issue directly, however, any treatment that slows vehicle speeds will make it easier for a side-street motorist or bicyclist to obtain a safe gap with which to enter traffic.

4.4.3. Area #3: Loma Alta Drive between Lincoln Avenue and Lake Avenue

Existing conditions

Segments, widths and speed limits

Loma Alta Drive is the northernmost connected east-west street in Altadena. It runs between Lincoln Avenue (west end) and Lake Avenue (east end), a distance of approximately 8,600' (1.64 miles). To the west of its midpoint at Fair Oaks Drive, 4,750 feet east of Lincoln, the street is called West Loma Alta Drive; to the east it is East Loma Alta Drive. Another segment with the latter name, with addresses starting at 1000, continues Rubio Canyon Drive eastward. It is not part of this focal area.

The street is 36' wide between Lincoln and Fair Oaks and between Canon and Lake. Between Fair Oaks and Canon it varies between 30' and 32' with some wider spots.

30 mph speed limit signs are present near Lincoln and east of Fair Oaks.

Land use and destinations

Loma Alta Park occupies the north and south side for the first blocks east of Lincoln Avenue, approximately 450’ to Sunset Ridge Road on the north side and 1,150’ to Dabney Street, which intersects from the south at an angle. The west leg at Sunset Ridge Road has an uncontrolled crosswalk with high-visibility “Continental” markings.

Land use east of Loma Alta Park is single-family residential on both sides, with few exceptions. The nearby Fair Oaks Debris Basin, owned by Los Angeles County Public Works, is located just east of McNally Road. It is one of several catchments in northern Altadena that prevent floods by intercepting sediment washed down from the San Gabriel Mountains during storms.

Canon Boulevard intersects from the north approximately 2,300’ east of Fair Oaks. The campus block on its northeast corner, whose wall says “Loma Alta School,” is also occupied by Pasadena Rosebud Academy and the Oak Knoll Montessori—Loma Alta Campus.

At its east end, Loma Alta turns south and becomes Lake Avenue; the gated driveway of the Cobb Estate forms the east leg. Here the Cobb Estate trailhead provides access to the Altadena Crest Trail and other hiking destinations. Hikers can park along Lake to the south, or to the west along Loma Alta. Lake Avenue near Loma Alta is 56’ wide and has striped parking shoulders, nominally 12’ wide but the west shoulder narrows to 9’ near Loma Alta. Parking is prohibited and marked by a red curb at the corner, and along the closest house lots on both sides of Loma Alta. (Trailhead parking demand is evident in a recent Google aerial image—the north and south curbs are completely parked up east of Monterosa Drive, the first intersection to the west.)

Intersections, traffic controls and marked crosswalks

Table 4-5 lists all intersections along Loma Alta Drive, their controls, and how their crosswalks are marked. Loma Alta has no signals, and only three STOPs east of Lincoln—at Olive, Glenrose and Fair Oaks. There are marked crosswalks only at Sunset Ridge (Loma Alta Park), Glenrose, Canon and Marengo (schools).

Table 4-5: Loma Alta Drive intersections and Marked Crosswalks

Cross street	Junction type	Traffic control*	Marked legs**	Notes
Lincoln Ave	T (E)	**AWS**	None	West end
Sunset Ridge Rd	T (N)	1WS	W (Continental)	430' from Lincoln. Connects north and south parts of Loma Alta Park
Dabney St	T (S) angled	1WS	None	
Thurin Ave	T (S) angled	1WS	None	
N Olive Ave	T (S) angled	**AWS**	None	
Chaney Trail	T (N)	1WS	None	Centerline. Connects to Mt. Lowe Road along summit to the north.
Glenrose Ave	4-way angled	**AWS**	**E (2-line)**	2,350' from Lincoln
Loma View Dr	T (N)	1WS	None	
Fair Oaks Ave / Wapello St	5-way	**AWS**	None	2,400' from Olive Centerline on Fair Oaks S leg
McNally Ave	T (N)	1WS	None	
Unnamed court	T (S)	(1WY)	None	No sign; yield is assumed
Unnamed street	T (N)	(1WY)	None	No sign; yield is assumed
Parkman St	T (S)	1WS	None	
Hollyslope Rd	T (N)	1WS	None	
Alta Pine Dr	T (S)	1WS	None	
Canon Dr	T (N)	**AWS**	**E (2-line yellow)**	2,300' from Fair Oaks
Marengo Ave	T (S) angled	1WS	W (ladder yellow), S (2-line yellow)	680' from Canon
Monterosa Dr	T (N)	1WS	None	
Lake Ave	L (S)	None	None	1,470' from Canon East leg is Cobb Estate driveway (gated). Parking shoulders on Lake

Traffic control: *1WS, 2WS, **AWS** = 1-Way, 2-Way & **All-Way STOP** (**bold = controlled**)*
1WY = 1-way Yield, (1WY) = 1-way no sign (Yield is assumed)
Crosswalk control: *Green = controlled, yellow = uncontrolled*

Crosswalk warning signs

The two uncontrolled crosswalks (yellow cells in Table 4-5) have warning signs.

Table 4-6: Loma Alta Drive Crosswalk Warning Signs

Crosswalk	**Serves**	**At crosswalk** (L=Left, R=Right)	**Advance signs**
Sunset Ridge Rd	Loma Alta Park	EB: W11-2 + W16-7p both sides WB: W11-2 + W16-7p both sides	EB: 225' E (W11-2 + XING) WB: 250' E (W11-2 + XING)
Marengo Ave	Schools	EB: S1-1 + W16-7p, both sides WB, L: S1-1 + W16-7p (2-sided) WB, R: S1-1 + W16-7p, 30' upstream due to overhanging tree	EB: None WB: S1-1 + AHEAD, 490' E

Sidewalk segments

Most of Loma Alta Drive has no sidewalks. The exceptions are mostly at the west end along Loma Alta Park's south and north frontage, and at the east end from near the school campus block at Canon Drive to the Cobb Estate trailhead at Lake Avenue.

Table 4-7: Loma Alta Drive Sidewalk Segments

Side	**Endpoints**	**Length**	**Notes**
West end (Loma Alta Park)			
N	Lincoln – Sunset Ridge	420'	South frontage of north part of Loma Alta Park
S	6 house lots E of Lincoln, to 1 house lot W of Dabney	630'	North frontage of south part of Loma Alta Park
Middle, near Loma View Drive			
N	#107 West - #65/63 West (3 lots)	290'	Attractive treatment for that block's style
East end (school campus block, Cobb Estate trailhead)			
S	4 house lots W of Parkman, to 2 house lots E of Canon	1,000'	Serves school crosswalk at Canon
N	Canon – Lake	1,470	School campus, Cobb Estate trailhead
S	1 house lot W of Marengo, to 1 house lot W of Lake	900'	220' gap (2 house lots) to next south-side segment to the west

Analysis

The key issues for Loma Alta appear to be:

- Enhancing uncontrolled crosswalks at Loma Alta Park (Sunset Ridge) and Marengo
- Strategic sidewalk gap closures
- Making walking along the street more comfortable on segments without sidewalks
- Making crossing the street at other locations safer and more comfortable
- Making bicycling more comfortable

Loma Alta Park crosswalk

The crosswalk at Sunset Ridge Road that connects the north and south parts of Loma Alta Park already has state-of-the-practice crosswalk warning sign assemblies at the intersection.

The advance warning sign assemblies for both approaches have Caltrans Traffic Manual W80 "XING" plates below their W11-2 Pedestrian Symbol signs. The "XING" plate was intended for use only at the crosswalk, not at advance locations, and has been replaced for at-crosswalk applications by the MUTCD W16-7p Downward Pointing Arrow plaque, which strongly indicates the crosswalk location. It is suggested to remove the "XING" plates from both advance signs.

> (Caltrans Traffic Manual, 1996): "The Xing plate (W80) may be used below the standard warning symbol sign such as Bicycle, Pedestrian Crossing, ..., at the point of crossing."

For all uncontrolled crosswalks, whether at intersections or mid-block, it is suggested to use high-visibility markings such as the "ladder" pattern to maximize visibility to motorists from a distance. Two white lines alone do not intercept much visual area as seen by the motorist. In the evaluator's virtual "visit," the markings of this crosswalk differed between Google imagery dates. Google aerial view showed two white lines but StreetView (imagery dated April 2019) showed a "Continental" pattern (i.e., "ladder rungs" without the ladder "uprights") and dark hints of the two removed transverse lines. It was assumed that the Continental pattern is current.

Restoring the long white lines is suggested to aid low-vision pedestrians, who require a "contrast edge" to cross without wandering. See Section 4.3. This is a general suggestion.

Passing should be prohibited at and near the crosswalk. It is suggested to install double yellow centerline for 50' west of the crosswalk and for 50' east of the intersection.

Curb extensions, or small "floating" islands adjacent to the crosswalk that serve the same purpose, can improve crosswalk safety by enabling pedestrians to make their crossing decision at the "fender line" of parked vehicles rather than at the curb. Curb extensions or islands extending to 7' from curb face on both ends of a crosswalk reduce the crossing distance by 14' and reduce exposure time accordingly. Loma Alta is 36' wide at Sunset Ridge Road, so the crossing distance would be reduced by 39%, to 22'.

It is important to prohibit parking for at least one vehicle length upstream of any crosswalk. On the south side at this crosswalk there is currently no red curb or parking prohibition, however, there is a fire hydrant within one vehicle length so parking should be prohibited there regardless. A curb extension or island on the south side could extend upstream (west) to prevent parking.

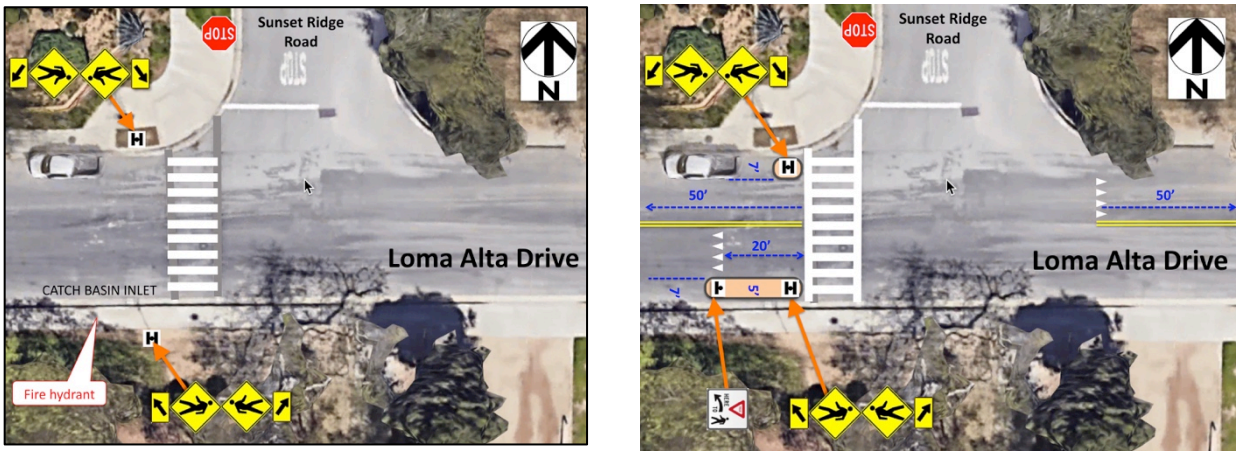
Installing crosswalk signs on curb extensions or on islands in the parking lane makes them more visible to motorists compared with on the sidewalk, and may increase yielding compliance.

It is suggested to add islands on the west side of the crosswalk—a 5' round one at the north end, offset 2' from the curb, and a 5' wide one elongated to the west at the south end, and to mount the warning sign assemblies on the islands close to the crosswalk.

At uncontrolled crosswalks with multi-lane approaches it is suggested to add a Yield Line (isosceles triangles) between 20' and 50' upstream, or across the intersection as applicable. Yield Lines deter the "multiple-threat" crash type, wherein a driver in one lane yields close to the crosswalk, hiding another approaching vehicle whose driver does not understand why the first vehicle has stopped—and whose vehicle is not seen or anticipated by the crossing pedestrian.

Multiple-threat risk is not present at a one-lane approach unless an impatient driver passes the yielding vehicle (see no-passing centerline suggestion above). However, the presence of a Yield Line may improve motorist yielding compliance. It is suggested to install them.

A R1-6 Yield Here to Pedestrians sign, placed at the Yield Line, conveys its legal meaning.



a) Existing b) Concept

Figure 4-16: Crosswalk at Sunset Ridge Road—existing and concept

Marengo Avenue crosswalk

Similar considerations apply to the uncontrolled crosswalk at Marengo, which differs somewhat:

- It is a school crosswalk (yellow rather than white)
- It already has the long transverse lines (i.e., full “ladder” treatment)
- For some reason not apparent, it is angled parallel to Marengo, so a pedestrian’s head is partly turned away from traffic approaching from the left when starting across
- The north-side east-facing sign is east of the crosswalk

The following treatment is suggested. Refer to the preceding section to visualize:

- Determine why the crosswalk is angled. If feasible, replace with perpendicular.
- Install islands on the west side of the crosswalk at the north and south curbs
- Move the crosswalk warning sign assemblies to the islands
- Install double yellow centerline 50’ west of the crosswalk and 50’ east of the intersection
- Add yield lines—eastbound 20’ west of the crosswalk and westbound on the east leg.

Extending sidewalk segments

Installing continuous sidewalk along Loma Alta’s full length would be quite expensive, and for many homes would involve complicated and impactful landscape changes. However, there may be value in implementing certain segments near the west and east ends, listed below.

Table 4-8: Loma Alta Drive Sidewalk Gap Closure Candidates

#	Side	Segment	Length	Access to	Notes
1	S	#710, #716, #724 Loma Alta (4th - 6th houses from Lincoln)	150’	Sunset Ridge Road crosswalk, Loma Alta Park	Sidewalk alignment already unobstructed
2	S	#748, #740, #734 Loma Alta (3 houses closest to Lincoln	150’		3 mature trees, 1 per house. Would need to run in street.
3	S	Dabney westward, 2 house lots (#600, #588)	150’		Alignment unobstructed along corner lot (#588). Landscape at #600 would need major rework.
4	S	2 house lots between Canon and Marengo (#414, #430)	220’	Cobb Estate trailhead	Major landscape rework
5	S	Corner lot (#3383 Lake)	90’		Parking is prohibited; could use street width
6	N	Open space between easternmost house (#589) and Cobb Estate trailhead	<150’		Could grade and construct a retaining wall, or use street width (parking is prohibited)

Improving walking environment where there are no sidewalks

Along most of Loma Alta, sidewalks will probably never be installed. Residents walk along the street edge where cars are parked; fortunately parking occupancy is low on most blocks so pedestrians only infrequently need to walk out around parked cars and interact with motor traffic.

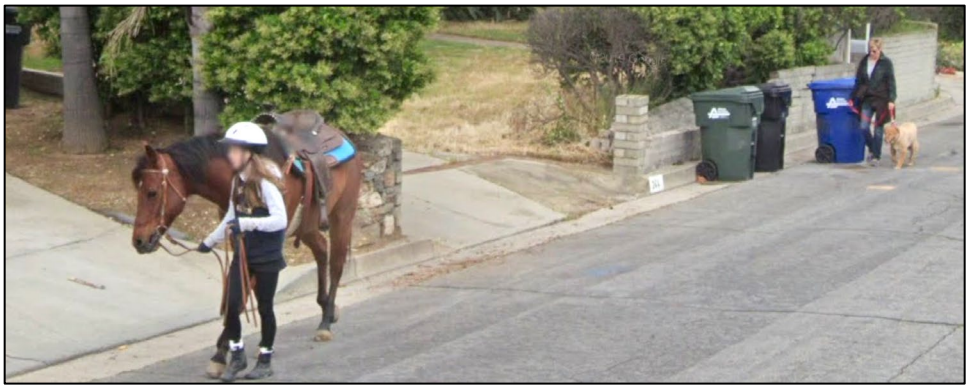


Figure 4-17: Walkers near Olive with horse and dog

Loma Alta is 36’ wide west of Fair Oaks and a bit narrower to the east. On the 36’ segment, consideration could be given to adding shoulder stripes to separate the central vehicular area from edge areas used by pedestrians and also by many bicyclists as well as for parking. An 18’ wide two-way center lane would create 9’ shoulders. Cars and light trucks are about 6’ wide, and if parked 12” from the edge would leave 2’ of shoulder (9’ – 7’) along the vehicular area.

18’ is ample for bidirectional vehicular travel at low to moderate speeds. Centerline would not be installed, to cue reduced speeds by retaining beneficial uncertainty (i.e., positive risk-compensation). Motorists responding to emergency vehicles could encroach into the shoulders.

The sense of protection could be enhanced with periodic placement of narrow islands or planters along the stripe, to prevent driving in the shoulder without impeding driveway access or parking movements. Islands would be sited with resident input to maximize parking usability while serving their protective function.

Optionally, pavement color as shown in Figure 4-18 could further emphasize the "walking / parking shoulders" and visually narrow the street, reinforcing low-speed expectations. Green pavement color has interim approval by FHWA and Caltrans only for bike lanes and certain other bicycle-specific traffic control devices. Its use for a shoulder treatment would be non-standard and would technically require what's called a "Request To Experiment." However, black and shades of gray are not considered traffic control colors, so the visual narrowing could also be accomplished without raising the color issue if the shoulders were noticeably lighter or darker than the center lane.

Figure 4-18: Concept for island-protected "walking / parking shoulders"

Improving crossing of the street at other intersections

As shown in Table 4-5 and Figure 4-19, Loma Alta's controlled intersections are at least 1,100' apart—over four minutes one-way walk at an able-bodied adult walking speed of 4 ft./sec. Clearly, residents already cross between controlled intersections and marked crosswalks.

If the "walking shoulders with islands" treatment was implemented, the crossing distance between the highlighted shoulders would be just 18' because pedestrians would presumably feel more confident waiting to cross at the shoulder stripe / color change or near an island. In addition, motorists are more inclined to yield to a crossing pedestrian when their approach speed is lower, because their stopping distance is shorter, and hopefully the visual treatment would cue lower speeds.

Consideration could be given to marking crosswalks at additional intersections in between the controlled intersections and marked uncontrolled crosswalks listed in Table 4-5, but doing so would not reduce an individual's average "detour" time to acceptable levels.

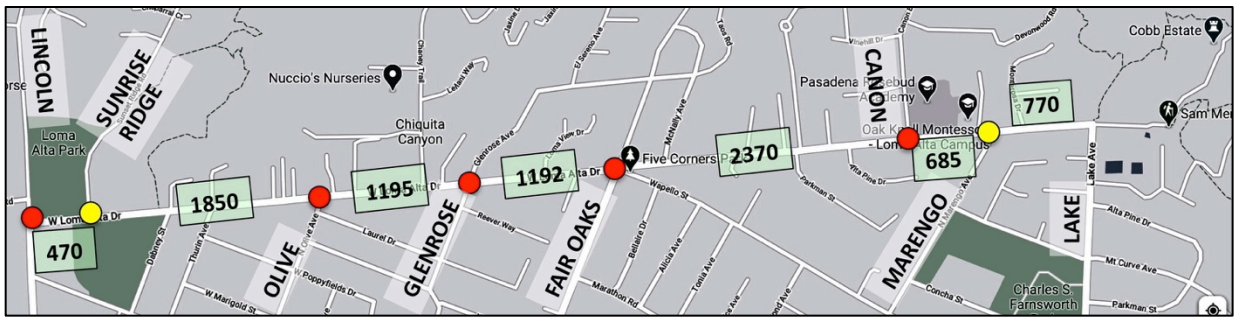


Figure 4-19: Distances between controlled intersections and marked uncontrolled crosswalks

Improving conditions for bicycling

No magic formula for improving bicycling comfort along Loma Alta presents itself.

A 36' street is too narrow to add bike lanes while retaining parking on both sides. Bike lanes are appropriate for streets where the speed difference between motor traffic and bicycle traffic is substantial, which the evaluator assumes is the case at times on Loma Alta. However, another way to make a street more comfortable for bicycling is to reduce motor vehicle speeds, and thus the speed differential, with conventional traffic calming (e.g., speed humps or speed cushions) and/or visual treatments such as colored shoulders that cue motorists to drive more slowly.

Loma Alta has no centerline except for short segments at Lincoln and at the curve onto Lake Avenue. Other than adding other short segments to deter passing at crosswalks, retaining the no-centerline condition along Loma Alta is advisable because centerline—even broken ("passing") centerline—can inhibit motorists from passing bicyclists with comfortable clearance (state law requires 3 feet).

4.4.4. Area #4: Mariposa Street between Fair Oaks Avenue and Lake Avenue

It was requested to review Mariposa Street between Fair Oaks and Lake, including the Santa Anita Avenue intersection.

Existing conditions

Alignment, width, lane assignments

Mariposa Street runs east-west from the western edge of Altadena—west of Casitas Avenue—to Lake Avenue, plus two blocks east of Lake. It parallels Altadena Drive, which are one or two blocks to the north. West and East Mariposa are respectively west and east of Fair Oaks Avenue.

When proceeding east, Mariposa jogs south one house lot at Glenrose and almost all of the way back north at Fair Oaks. East of Fair Oaks it S-curves one block north around the south end of Pasadena Waldorf School (a K-8 school), continuing eastward just one block south of Altadena Drive to its angled intersection with Lake Avenue. It resumes on the east side of Lake a short distance to the north and runs two more blocks east before curving north and merging with Ganesha Avenue to end at Altadena Drive.

For the entire focal area segment, except for the commercial block between El Molino and Lake, the street is 54’ wide. It was formerly a Pacific Electric Red Car Trolley route. Today it has four travel lanes and parking both sides. The inside lanes are 10’ wide so the layout is 17-10-10-17; effectively 7-10-10-10-10-7 though there is no parking stripe. The posted speed is 35 mph; actual speeds are higher. The commercial block east of El Molino is 90’ wide with head-in diagonal parking on both sides.

Sidewalks and crosswalks

A sidewalk is present on the south side for the two westernmost blocks (Fair Oaks—McNally—Highview). Between Marengo and Santa Anita there is a sidewalk on the north side, and on the south side for half the block starting at Marengo. The north sidewalk continues across Santa Rosa to the adjacent bus stop. The south side of the Santa Anita—Santa Rosa block has sidewalk except for the westernmost house lot (250’ frontage). Sidewalk resumes west of El Molino—135’ west on the north side and 350’ west on the south side. The commercial block between El Molino and Lake has sidewalks on both sides.

The only controlled intersections between Fair Oaks and Lake are Santa Rosa and El Molino—all-way STOPs. There are no marked uncontrolled crosswalks at intersections or mid-block.

Transit

L.A. County Metro bus lines 180, 258, 267 and 687 serve various stops along Mariposa.

Traffic volume

The Los Angeles County Public Works database has seven pre-pandemic 24-hour counts for four locations between Fair Oaks and El Molino, five “E/O” (East of) Marengo Avenue, Madison Avenue, or Catherine Road and one “W/O” (West of) Raymond Avenue and Santa Anita Avenue. The highest volume among the six is 3,469 vehicles (east of Madison).

Destinations (west to east)

Pasadena Waldorf School’s K-8 “Lower School” is located on the S-curve between Raymond Avenue, which intersects from the south, and Scripps Place, which intersects from the north. Parents drop off students along the north curb, where there is a sidewalk just along the school frontage. There is also an off-street parking lot.

Figure 4-20: Pasadena Waldorf School, north side between Scripps and Raymond

The Altadena Library and Altadena Senior Center are located on the south side just east of St. James Place, which intersects from the north midway between Santa Anita and Santa Rosa.

During the winter holiday season Santa Rosa Avenue becomes “Christmas Tree Lane,” a destination for driving and strolling.

Los Angeles County Fire Department Station 11 is located on the northeast corner at El Molino. Mariposa is used by fire trucks and EMS vehicles.

Santa Anita Avenue intersection

Santa Anita Avenue intersects Mariposa at a two-way STOP 2,450’ west of Lake Avenue. Santa Anita is 40’ wide, with no sidewalks, no centerline, and parking both sides. There are bus stops east of Santa Anita on the north side just down the block to the east near St. James Place (METRO lines 264, 267, 686 and 687) and on the south side (same routes) near the intersection. The north-side stop has a sidewalk; the south-side stop does not—and it is the one that riders use to access the Altadena Senior Center and Library just east of St. James.

Adding a south-side sidewalk along the frontage of the two residential parcels just east of Santa Anita would connect the south-side bus stop to the Senior Center and Library.

Analysis

If recent-year maximum weekday 24-hour volume is similar to the value noted above, Mariposa is a good candidate for street transformations that would reuse the width of two traffic lanes.

“4-to-3” conversion

One option is a classic “4-to-3” lane reduction (a.k.a. 4-to-3 “road diet”) that retains parking and adds a center turn lane and bike lanes:

Table 4-9: 4-to-3 Conversion Dimensions for Mariposa Street

	Parking	Bike	Travel	Travel	Center	Travel	Travel	Bike	Parking	Total
Existing	7		10	10		10	10		7	54
Bike lanes	7	5		10	10	10		5	7	54

This would improve Mariposa's usability in several important ways:

Table 4-10: Safety and Convenience Advantages of 4-to-3 Conversion

Mode	Maneuver	Existing	4-to-3 conversion	Notes
Pedestrians	Walking	Walk in parking lane Walk out into narrow traffic lane to get around parked cars	Walk in parking lane **Use bike lane to go around parked cars**	The suggested long term goal is still to add sidewalks
	Crossing at uncontrolled locations	2 lanes each way: "multiple threat" risk. No median refuge: must cross entire street in one 4-lane move. Crosswalk warning signs must be on curb	1 lane each way: **no "multiple threat"** Median refuge: **cross 1 direction (1 lane) at a time; can wait halfway** Median can protect mid-street signs	
Bicyclists	Riding	"Claim" outer 10' traffic lane, or ride between parked cars and merge around them.	**Use bike lane** (5' is widest feasible on 54' street with 10' lanes)	3' is "door zone" along parked vehicles
Motorists and bicyclists	Turning left into driveways and cross streets	From inside traffic lane. Traffic behind must change lanes.	**Move into center lane**, wait for gap	Reduces or eliminates "lane changing" crashes
	Turning left out of driveways and cross streets	Obtain gap in 2 lanes on your left. Accelerate across centerline into inside lane	Can **creep out** to bike lane to check. Obtain gap on left in 1 lane and 1 bike lane Can **use center lane before merging**	**Improves driveway usability for residents** (supports property value)
Everyone	Speeding	2 lanes each way: Impatient drivers set the pace	1 lane each way **Prudent drivers set the pace**.	More comfortable bicycling and driveway access

54' turns out to be the absolute minimum width for a 4-to-3 conversion, assuming minimum 10' travel and center lanes, 7' parking lanes, and 12' bike lane + parking combinations. The 12' bike + parking layout is a real improvement over having to ride in a narrow traffic lane, however, 3' of the 5' bike lane would also be the driver-side "door [opening] zone" along parked vehicles. Because of the door zone, the preferable minimum bike + parking width is 14' (7' parking, 3' door, 4' bike) and 15' is even better (5' bike). Although those wider configurations are not feasible on Mariposa, the converted street would still be safer and more convenient for bicycling.

Adding a center lane is a key pedestrian safety improvement because a median refuge transforms a risky two-direction full-street decision into two one-direction half-street decisions, with the option to wait before crossing the other half of the street. Each half-crossing also becomes safer—1 traffic lane and 1 bike lane instead of 2 traffic lanes and "multiple threat" risk (where one motorist yields and their vehicle hides another approaching vehicle that the pedestrian fails to anticipate and who is not anticipated by the second-lane driver).

The bike lanes provide space for vehicles to pull over so an emergency vehicle to pass, and the emergency vehicle can also use the center lane.

For Mariposa there are no real downsides to this 4-to-3 transformation between Fair Oaks and El Molino. It is strongly suggested to consider it.

Roundabouts and "Roundabout Corridors"

One other potential transformation is worth mentioning, though it may not be feasible—a so-called "roundabout corridor" conversion.

A center turn lane on a conventional street serves left turns into cross streets and driveways. This usually involves waiting—sometimes a while—for a safe gap in oncoming traffic. But if the downstream intersection is a roundabout, left turns into cross streets become counterclockwise 3/4 turns, and access to a left-side driveway becomes a quick and convenient U-turn at the roundabout followed by an easy right turn. Both maneuvers can usually be made without delay.

These more-convenient maneuvers are possible only when the roundabout is ahead, i.e., downstream. If the roundabout is the only one nearby, the center turn lane may still be needed to facilitate left turns out of "left side" properties. However, if consecutive intersections along the same street are roundabouts, these advantages apply in both directions between them, and a center turn lane is not needed. On Mariposa's 54' width this would enable a more comfortable parking, bicycling and driving environment, with 8' parking lanes, 6' bike lanes with adequate door zone clearance, 2' buffers between the bike lane and motor traffic, and 11' travel lanes.

Mariposa's straight 3,000' eastern segment has four intersections that could potentially become roundabouts: Marengo, Santa Anita, Santa Rosa and El Molino. 85'-90' diameter circles will fit within each one—a size that can handle left- and U-turns by large single-unit fire and delivery trucks, and probably through movements by longer trucks such as semitrailer moving vans.

However, that inscribed diameter only accounts for the circulatory roadway. An urban roundabout also needs a perimeter sidewalk to connect the crosswalks on each leg. On Mariposa the corner properties would need to be slightly modified to fit in the sidewalk at the corner. Sidewalks would need to extend at least 40' along each block because roundabout crosswalks are one car length out. Parking could resume just beyond the crosswalks.

Further development of this concept is beyond the scope of this report. It is suggested to conduct an initial discussion with an engineering/design firm that specializes in roundabouts.

4.4.5. Area #5: Fair Oaks Avenue between Woodbury Road and Loma Alta Drive

Existing conditions

Fair Oaks Avenue runs north-south between Huntington Drive in South Pasadena and the base of the San Gabriel Mountains north of Loma Alta Drive. Figure 4-21 shows the segments between Woodbury Road and Loma Alta. Sidewalk segments only at bus stops are not shown.

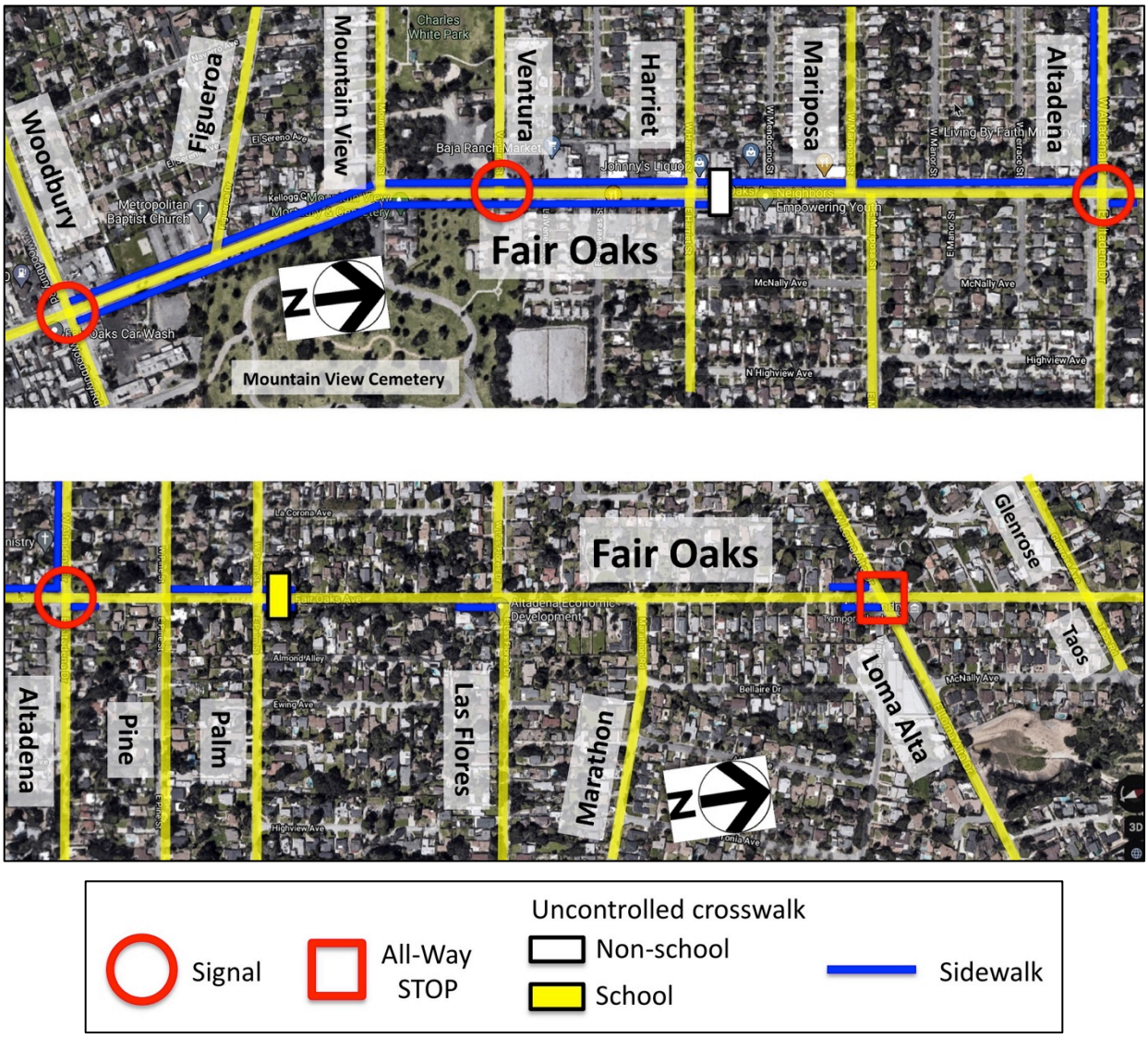


Figure 4-21: Fair Oaks Avenue between Woodbury and Loma Alta

The following notes for this focal area are from the initial conference call:

> *Traffic to/from Pasadena. Sidewalks lacking except at bus stops. Difficult for older or disabled person wanting to walk or access transit. Need controlled crossings. Crosswalk at Harriet. [Woodbury intersection:] Overbuilt, high speed, high collision rate.*

Sidewalks are present on both sides between Woodbury and Harriet, on the north side to Altadena Drive. North of Altadena Drive there are almost no sidewalk segments except at bus stops and some corners.

Los Angeles County Metro's bus route 260 runs the full length of the focal area. The bus stop on the southwest corner at Woodbury offers transfers to several other lines.

Analysis

Especially on the multi-lane southern segments of Fair Oaks, pedestrians would benefit from more controlled crosswalks or pedestrian-activated warnings at uncontrolled crosswalks.

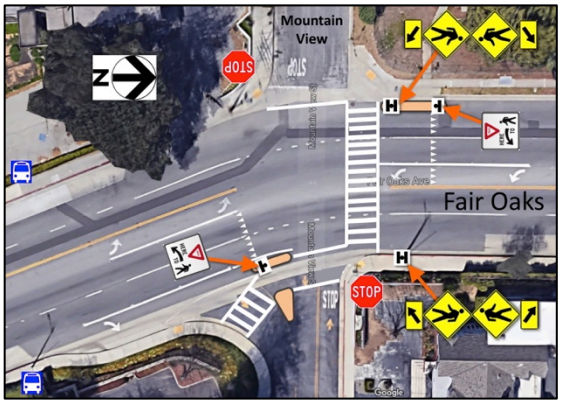
Table 4-11: Suggested Crosswalk Additions on Fair Oaks Avenue

#	Cross street	Leg	W	Next S	Existing*	Suggestion*
	Woodbury (C)					
1	Figueroa	N	74	675	5L, P2	Bulbs, Refuge, HV, 4-RRFB
2	Mountain View	N	72	720	5L, P west, Bus east	HV, islands W side & NB RTOL
3	**Ventura (C)**	N	72	475	5L, Bus2, 2-line	(No change)
4	**Harriet (U)**	N	72	760	5L, P2, HV	Bulbs/PSZs, HV, 2-sign/RRFB
5	W Mariposa	S	76	670	5L, P west, RTOL east	Bulbs, HV, 2-RRFB
6	W Manor	S	58	320	3L, P2	Bulbs, HV, 2-sign
	Altadena (C)			390		
7	Pine	S	31	390	2L, P2	Bulb W, HV, 2-sign
8	**Palm (U)**	N	30	400	2L, P2	Bulbs, HV, 2-sign
9	Las Flores	S	30	1,020	2L, P2	Bulbs, HV, 2-sign
10	Marathon	S	30	485	2L, P2	Bulbs, HV, 2-sign
	Loma Alta (C)			875		

***KEY**

Cross street: **Bold** = existing markings, (C) = controlled, (U) = uncontrolled
Blue = Concept appears in Figure 4-22
Next S = Next crosswalk to the south in this table
2L = 2-lane (1 travel each way, no center turn)
3L = 3-lane (1 travel lane each way + center turn)
5L = 5-lane (2 travel lanes each way + center turn)
P2 = parking both sides, P west/east = one side, Bus = bus stop, Bus2 = both sides,
Bulbs = curb extensions both sides, Bulb W/E = one side, PSZ(s) = Painted Safety Zone(s)
RTOL = Right Turn Only Lane
Refuge = Median refuge (center island, with left-side signs mounted double-sided)
2-sign, 2-RRFB = 2-sided signs at sides (RRFB = with RRFB)
4-sign, 4-RRFB = 1-sided signs at sides, 2-sided signs on median (RRFB = with RRFB)
HV = High-visibility markings and standard warning sign assemblies (all uncontrolled crosswalks)

1) Figueroa

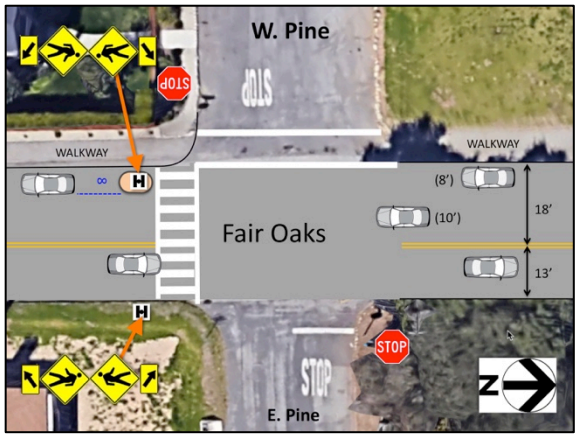


2) Mountain View

3) Harriet

4) Mariposa

5) Manor



6) Pine

Figure 4-22: Crosswalk concepts for various Fair Oaks cross streets

Figueroa

The concept for Figueroa uses the north leg because the center turn lane on that leg is not used for turns. A Painted Safety Zone is wrapped around the west corner and a bulb-out or island installed on the east side. The warning signage uses the 4-beacon RRFB layout. The northbound approach also has a Yield Line and Yield Here sign.

Mountain View

The concept for Mountain View uses the north leg because it is narrower than the south leg and its left turn movement is likely to have lower volume. The west side has a curb extension or island to carry the double-sided warning sign assembly and a Yield Here sign. The east side has no curb extension at the crosswalk because of the geometry of the right turn movement out of the Cemetery. Its double-sided warning sign assembly is at curbside. However, two small islands are added between the eastbound through and northbound right turn movements to partly protect the east crosswalk. Because a median island cannot be installed, the 2-sign (non-RRFB) sign layout is shown; RRFBs could be added if needed.

Harriet

Harriet has an existing marked crosswalk on the north leg. As with Mountain View, a median island cannot be installed because the center turn lane is used for southbound left turns. The concept adds islands on the north side of the crosswalk on both sides of the street, to place the warning sign assemblies in the parking lane with minimal impact on right turn movements. The 2-sign layout is shown; RRFBs could be added if needed.

Mariposa

Fair Oaks narrows to the north and drops a lane in each direction at the offset T intersection of West and East Mariposa. The existing curb ramps are on the south leg. Although the conflict level would be substantially lower on the north leg, the south leg serves the east-side bus stop and Fair Oaks has a sidewalk on the east side south of East Mariposa.

Because the northbound left turn movement crosses the south leg, there is no way to add a median refuge. For this reason only curb extensions are suggested for the south leg. It is suggested to install 2-line markings on the west (STOP-controlled) leg because it is crossed by several vehicle movements and drivers' mental workload may be high because of the lane adds/drops and the offset cross-street through movement (dashed orange line on concept figure—not suggested to be installed).

Because the southbound movement is two-lane, RRFBs are suggested.

Manor

Manor and Terrace Streets cross Fair Oaks at the 1/3 and 2/3 points between Mariposa and Altadena Drive. Manor forms an offset T similar to Mariposa but without the lane adds/drops and bus stop. Terrace is only slightly offset because its west leg is wider.

The south leg is suggested, with curb extensions / islands on the south side of the crosswalk. Because the northbound left turn movement crosses the south leg, there is no way to add a median refuge. For this reason only curb extensions are suggested for the south leg. It is suggested to install 2-line markings on the west (STOP-controlled) leg. No RRFBs are suggested but they could be added later if needed.

Pine

At Pine Street the paved width of Fair Oaks is 31'. The centerline is offset to the east to create 18' west and 13' east sides; the west side allows parking (8') with 10' remaining for vehicle travel.

It is suggested to mark the south leg, and also to add 2-line markings to the controlled west leg because the west-side walkway is present to the north and south. Only one island is suggested, on the west side because it is wider. The east-side sign assembly can be installed off-pavement.

The Palm intersection, one block north, is similar to Pine and could be outfitted similarly. The next intersection to the north, Las Flores, is offset similar to Mason. Marathon Road, the last intersection south of Loma Alta, is a T from the east and could also be outfitted similar to Pine.

Analysis—Woodbury Road intersection

It was also requested to review the Fair Oaks / Woodbury Road intersection.

Fair Oaks intersects Woodbury at a major signal near Altadena's border with Pasadena. Both streets have two travel lanes in each direction and left turn pockets next to narrow "stinger" islands. Woodbury's left turns are single-lane; those from Fair Oaks are two-lane. Woodbury has bike lanes adjacent to on-street parking on both approaches. The westbound bike lane is dropped to fit in a right turn lane. Fair Oaks has bus stops on the north and south legs.

Figure 4-23: Fair Oaks / Woodbury intersection context

In Google Street View all 8 pedestrian buttons appear to be modern larger-diameter low-activation-force types.

No opportunities for major changes are apparent. Suggestions appear in Table 4-12.

Table 4-12: Suggestions for Fair Oaks at Woodbury

#	Location	Issue / Opportunity	Suggestion
Pedestrian			
1	All approaches	Advance limit lines at crosswalks	Install 4' upstream
2	All crosswalks	Leading Pedestrian Interval phase	Consider if right turners on a fresh green are inhibiting same-direction pedestrians from starting across
Bicycling			
3	Bike lanes	Green pavement color	Consider applying to bike lanes, to emphasize bicyclist presence and position
4	WB right turn lane	WB bicycle through movement	a) Install Shared Lane Markings ("Sharrows") interspersed with the arrow markings. Center the sharrows 4' from the lane line. b) Install an upstream R3-7 RIGHT LANE MUST TURN RIGHT sign with a R118 (CA) "EXCEPT [BIKES]" plaque

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	HAWKs (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 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.

Pedestrian Improvement Measures			
Measure	**Description**	**Benefits**	**Application**
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.
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.

Pedestrian Improvement Measures			
Measure	**Description**	**Benefits**	**Application**
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.
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.

Pedestrian Improvement Measures			
Measure	**Description**	**Benefits**	**Application**
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.
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.

Pedestrian Improvement Measures			
Measure	**Description**	**Benefits**	**Application**
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 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.

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 that is typically 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 designated 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 the time remaining 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	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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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.[2] [3] 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.[4]

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:

- Intersection density
- Street density

[2] 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).

[3] 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).

[4] 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.

- 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.

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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