Berkeley SafeTREC

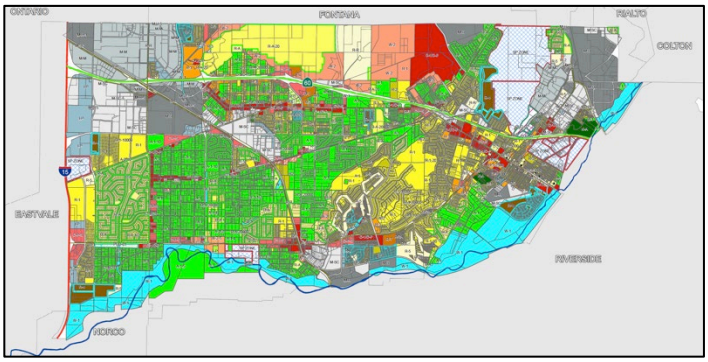
SAFE TRANSPORTATION RESEARCH AND EDUCATION CENTER

PS21033

CITY OF JURUPA VALLEY

COMPLETE STREETS SAFETY ASSESSMENT

Issues, Opportunities, and Suggested Strategies



Assessment Team

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NOVEMBER 2021

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COMPLETE STREETS SAFETY ASSESSMENT

FINAL REPORT

NOVEMBER 2021

ASSESSMENT TEAM

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EXECUTIVE SUMMARY

The City of Jurupa Valley requested that SafeTREC at the University of California, Berkeley conduct a Complete Streets Safety Assessment (CSSA) study for various locations within the City. A team of two safety experts conducted the CSSA. One of the experts visited the City of Jurupa Valley and conducted a walking audit on March 31, 2021. The objectives of the CSSA are to improve pedestrian and bicycle safety and to enhance walkability and accessibility for all pedestrians and bicyclists in Jurupa Valley.

Based on 2018 California Office of Traffic Safety (OTS) data, Jurupa Valley has a population of approximately 106,115 residents, which puts it in Group B, with 58 other California cities in the same population group. Based on the OTS Collision Rankings, Jurupa Valley ranked 25 out of 59 for the number of pedestrian collisions, and 46 out of 59 for the number of bicyclists' collisions (with number 1 being the worst and 59 the best). This ranking is based on a number of weighted factors including population, daily vehicle miles traveled, collision records, collision trends, and others. For more information on OTS rankings, please refer to https://www.ots.ca.gov/media-and-research/crash-rankings-results/

This report is organized into the following chapters:

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

Benchmarking Analysis of Policies, Programs, and Practices

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

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

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

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

Walking Audit Focal Areas

Per City's request, the following six (6) corridors were studied in this assessment:

1. Agate Street: Mission Boulevard – Jurupa Road
2. Etiwanda Avenue: San Sevaine Way – Riverside Drive
3. Mission Boulevard: Roubidoux Boulevard – Crestmore Road
4. Limonite Avenue: Etiwanda Avenue – Ridgeview Avenue
5. 34th Street: Roubidoux Boulevard – Crestmore Road
6. Mission Boulevard: Bellgrave Avenue – Pedley Road

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

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

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

1. INTRODUCTION

1.1. OBJECTIVE OF THE ASSESSMENT

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

1.2. ASSESSMENT APPROACH

The SafeTREC Safety experts conducted a pre-visit telephone interview with City staff on February 23, 2021. One of the SafeTREC experts met with City staff and conducted a walking audit at various locations in Jurupa Valley on March 31, 2021. Positive practices, as well as pedestrian and bicycle safety and accessibility issues were identified at the field audit.

1.3. DISCLOSURES

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

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

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

2. BACKGROUND AND COLLISION HISTORY

The City of Jurupa Valley is located in Riverside County. Per Office of Traffic Safety, as of 2018, with a population of approximately 106,115, it is categorized as one of the 59 cities in Group B, population 100,001 – 250,000 people, as shown in Table 2-1.

Table 2-1: Jurupa Valley Summary Statistics

Year	County	Population	Population Group	Daily Vehicle Miles Traveled (VMT)
2018	Riverside	106,115	B	1,349,673

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

2.1. PEDESTRIAN AND BICYCLIST SAFETY OVERVIEW

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

Victim and collision data for the rankings were acquired from the California Highway Patrol (CHP) Statewide Integrated Traffic Records System (SWITRS), California Department of Transportation (Caltrans), California Department of Justice (DOJ), and the Department of Finance (DOF).

The 2018 OTS safety rankings for Jurupa Valley are shown in Table 2-2. Based on the OTS 2018 statistics, Jurupa Valley ranked 35 out of 59 California cities in Group B, in total fatal and injury collisions (with a ranking of “1” being the worst and “59” the best). It ranked 25 for pedestrian collisions, and 46 for bicyclist collisions.

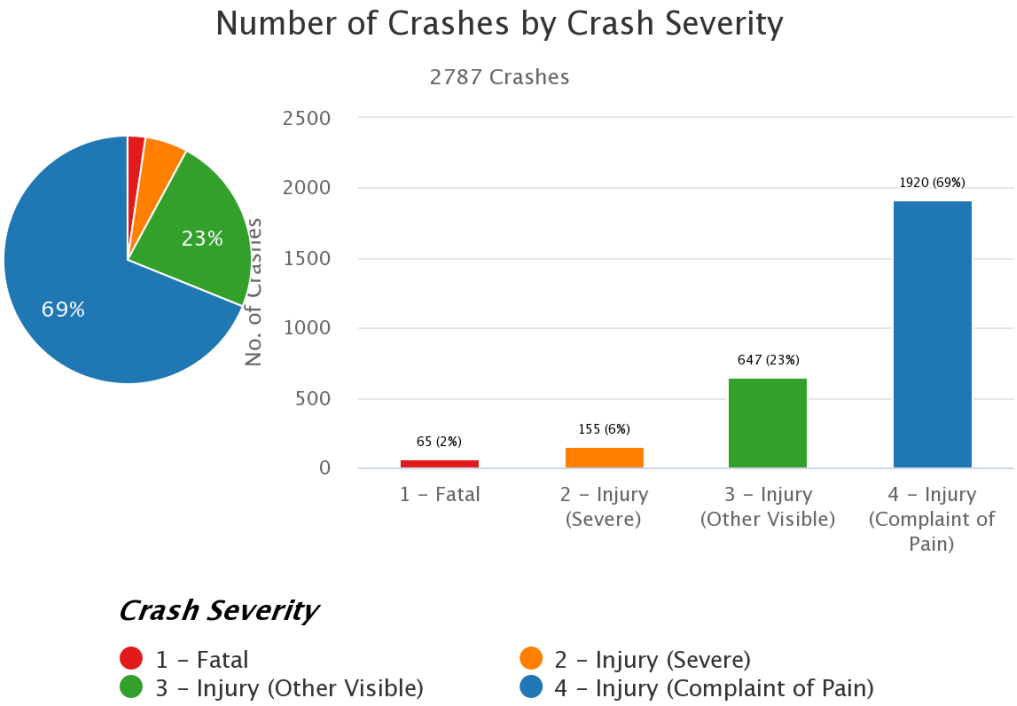
Table 2-2: Jurupa Valley Traffic Collisions and Rankings 2018

Type of Collision	Victims Killed & Injured	OTS Ranking (of 59 cities)
Total Fatal and Injury	504	35
Alcohol Involved	73	15
Motorcycles	26	22
Pedestrians	29	25
Pedestrians < 15	3	33
Pedestrians 65+	2	39
Bicyclists	14	46
Bicyclists < 15	3	33

2.2. PEDESTRIAN AND BICYCLIST COLLISION DATA

The collision data for Jurupa Valley from January 2015 to the end of 2019 was taken from the SafeTREC Transportation Injury Mapping System (TIMS) database. During this five-year period, 2,787 collisions occurred in Jurupa Valley, 65 of which were fatal. There were 118 collisions involving pedestrians and 84 involving bicyclists.

Chart 2.1: Number of Collisions by Collision Severity, Jurupa Valley



Pedestrian Collisions

Within the 5-year period analyzed from TIMS data, 118 collisions involved pedestrians, 21 of which was fatal. Of the 118 collisions, 23 involved pedestrian crossing in crosswalk at an intersection, 2 were crossing in crosswalk, not at intersection, and 50 crossing not in crosswalk. 36 were in road, including shoulder. Most collisions happened on Fridays and Saturdays. The following charts depict this data:

Chart 2.2: Number of Pedestrian Collisions per Day of Week per Time, Jurupa Valley

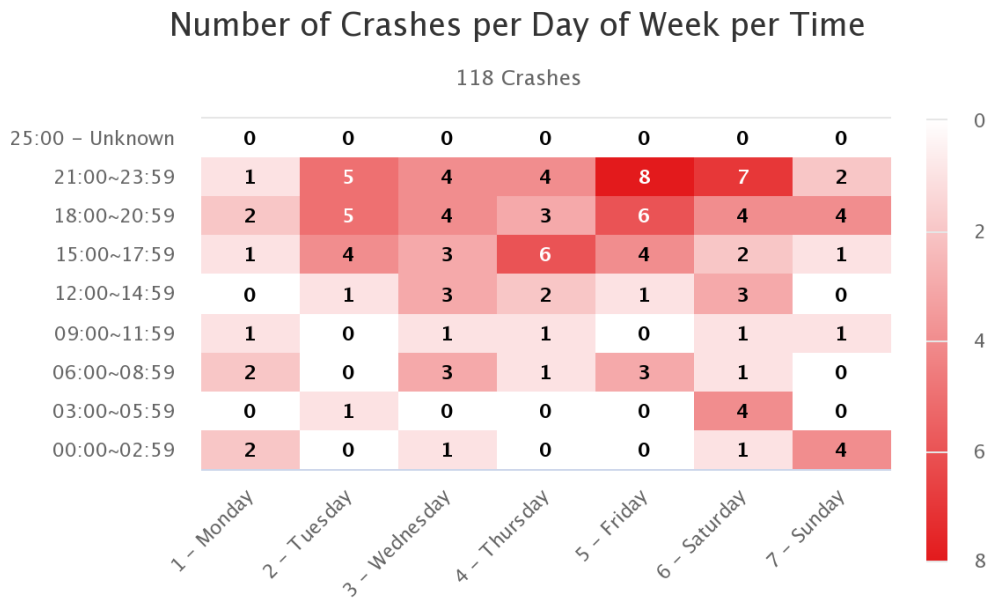
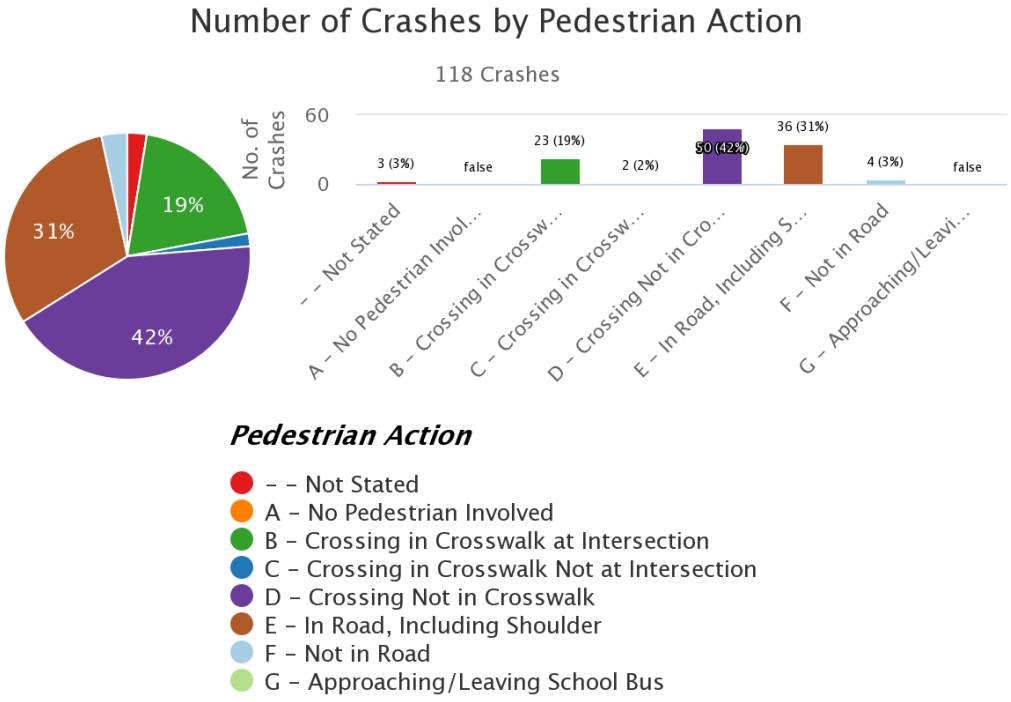


Chart 2.3: Number of Pedestrian Collisions by Pedestrian Action, Jurupa Valley



Bicycle Collisions:

Based on the TIMS data, within the 5-year (2015-2019) period, there were 84 collisions involving bicyclists, 2 of which were fatal and 8 were with severe injury. A total of 21 collisions happened due to the bicyclist riding on the wrong side of road. The highest number of collisions happened on Tuesdays and Saturdays. The following charts depict this data.

Chart 2.4: Number of Bicycle Collisions by Collision Severity, Jurupa Valley

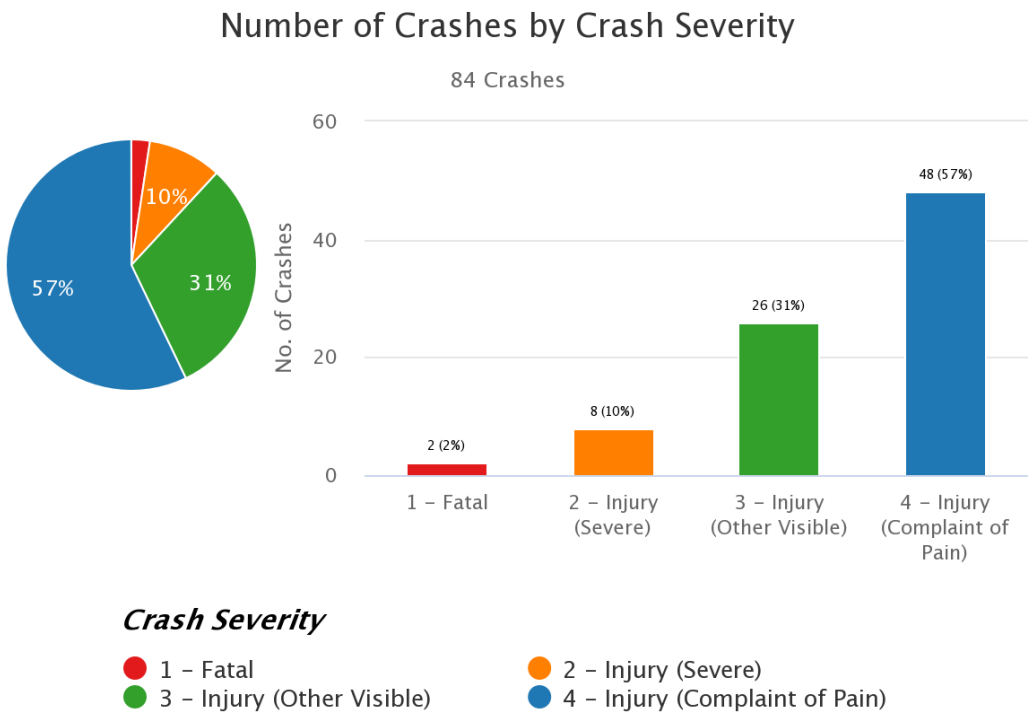


Chart 2.5: Number of Bicycle Collisions per Day of Week per Time, Jurupa Valley

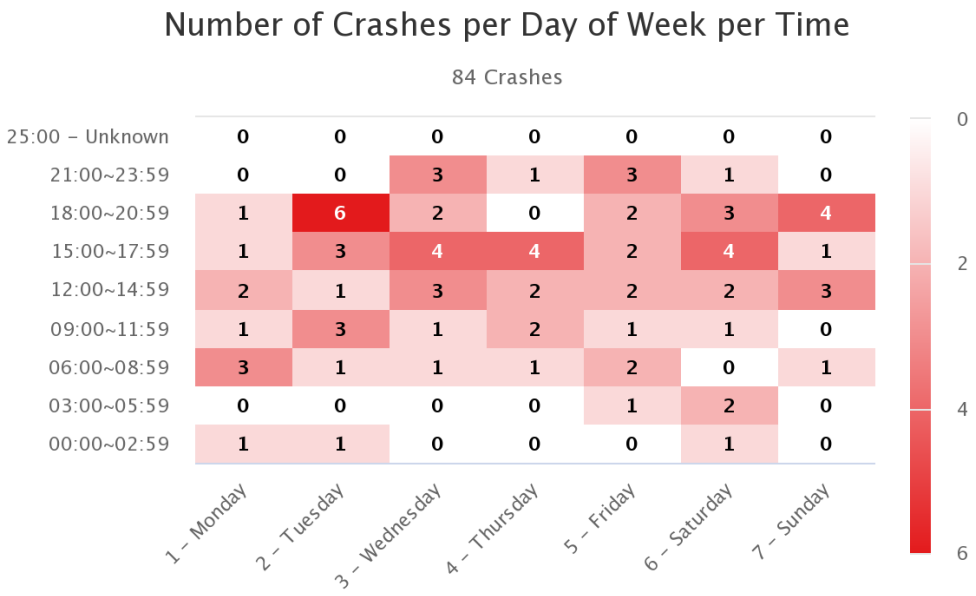
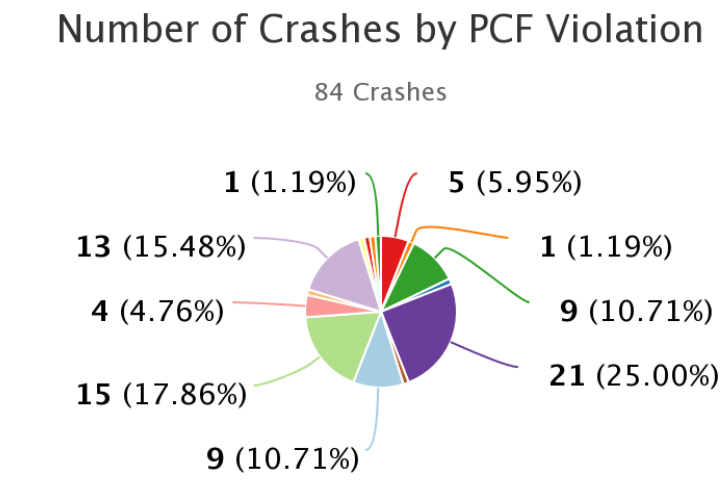


Chart 2.6: Number of Bicycle Collisions by Primary Collision Factor (PCF) Violation, Jurupa Valley



PCF Violation	Count	%
00 - Unknown	5	5.95%
01 - Driving or Bicycling Under the Influence of Alcohol or Drug	1	1.19%
03 - Unsafe Speed	9	10.71%
04 - Following Too Closely	1	1.19%
05 - Wrong Side of Road	21	25.00%
07 - Unsafe Lane Change	1	1.19%
08 - Improper Turning	9	10.71%
09 - Automobile Right of Way	15	17.86%
10 - Pedestrian Right of Way	4	4.76%
11 - Pedestrian Violation	1	1.19%
12 - Traffic Signals and Signs	13	15.48%
14 - Lights	1	1.19%
18 - Other Than Driver (or Pedestrian)	1	1.19%
21 - Unsafe Starting or Backing	1	1.19%
22 - Other Improper Driving	1	1.19%

The type of information provided above was obtained from SafeTREC's TIMS (https://tims.berkeley.edu/) can help the enforcement department in decision making regarding 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 City 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

Prior to the field visit, the CSSA Team conducted an interview with City staff regarding the pedestrian and bicyclist safety policies, programs, and practices on August 3, 2021. The Team also reviewed the City's website and relevant documents. Responses were analyzed with a benchmarking matrix, as shown in Table 3-1, which lists the benchmarking topics that fall under the following categories:

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

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

Table 3-1 lists the benchmarking topics that 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 analysis shares information on current best practices and how the City compares with State best practices. With differing physical, demographic, and institutional characteristics, certain goals or policies may be more appropriate in some jurisdictions than others may. Ultimately, City staff may determine where resources and efforts are best placed for meeting local development and infrastructure goals for pedestrians.

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

Table 3-1: Summary of Programs, Policies, and Practices Benchmarking Analysis for the City of Jurupa Valley

Benchmark Topic	Key Strength	Enhancement	Opportunity
Implementation of Americans with Disabilities Act (ADA) Improvements			
Implementation of Americans with Disabilities Act (ADA) Improvements	**Uses state-of-the-practice (PROWAG) ADA improvements with consistent installation practices**	**Has clear design guidelines but no regular practices for ADA compliance**	**Has minimal design guidelines and practices related to ADA requirements**
ADA Transition Plan for Streets and Sidewalks	Has ADA transition plan in place and an ADA coordinator	Partial or outdated ADA transition plan or an ADA coordinator	No transition plan or ADA coordinator
Policies and Programs			
Pedestrian/Bicycle Coordinator	Has a Coordinator on staff who manages the agency's pedestrian and bicycle programs	Occasionally uses a part-time contract coordinator	Does not have a pedestrian/bicycle coordinator
Formal Advisory Committee	Has a formal, active Transportation Advisory Committee that address bicycle/pedestrian issues	Has an ad-hoc Transportation Advisory Committee. Note: City's Planning Commission may act as Transportation Advisory Committee.	Does not have a Transportation Advisory Committee
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[1]. Considers traffic calming before raising speed limits in pedestrian or bicycle zones	Reviews data only in response to reported concerns or frequent collisions	Reviews speed limits by following CA MUTCD and CA Vehicle Code.
Safe Routes to Schools	Has an ongoing Safe Routes to Schools program and funding for recent projects.	Has obtained funding for recent projects, but has no community-wide Safe Routes to Schools program	Does not have a Safe Routes to Schools program and has not obtained recent funding

[1] https://safety.fhwa.dot.gov/uslimits/

Benchmark Topic	Key Strength	Enhancement	Opportunity
Crosswalk Installation, Removal, and Enhancement Policies	Has a crosswalk policy that reflects best practices for signalized and uncontrolled crosswalk treatments (FHWA Field Guide), including consideration of Pedestrian Hybrid Beacons	Has no policy, but has an established crosswalk installation, removal, and enhancement practice in place	Does not have a policy or set practices for addressing crosswalk installation, removal, or enhancement
Shared Mobility Services	Has curbside management, shared mobility, or micromobility policies (e.g., permitting, enforcement) in place that prioritize pedestrian and bicyclist safety	Has curbside management, shared mobility, or micromobility policies in place, but without a focus on safety	No curbside management, shared mobility, or micromobility policies in place
Funding			
Funding	Has a dedicated annual funding stream for pedestrian and bicycle projects and local grant matches	Depends on grant funding for projects, and is successful in obtaining grants	Only moderately successful in obtaining grant funding or has trouble spending funds when given grants
Data Collection			
Collection of Pedestrian and Bicyclist Volumes	Collects pedestrian and bicyclist volumes routinely with intersection counts and has a GIS database of counts	Collects some pedestrian and bicyclist volumes, but not routinely	Does not collect pedestrian and bicycle volumes
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 some inventories of signs, markings, and signals	Does not have an inventory of signs, markings, and signals

Benchmark Topic	Key Strength	Enhancement	Opportunity
Collision History and Collision Reporting Practices	Employs a data-driven systemic safety or Vision Zero approach to regularly analyze collision data citywide	Reviews data only following fatalities or other high-profile incidents	Does not have set practices for data review
Pedestrian and Bicycle Network Implementation			
Complete Streets Policy	Has a Complete Streets policy that includes all users and modes, affects new construction and maintenance, considers local context, and provides guidance for implementation	Has a Complete Streets policy that is narrow in scope or applies only to public works projects	Does not have a Complete Streets policy
Active Transportation Plans	Has a recently-updated Active Transportation Plan (or similar) with strategic prioritized list of projects that reflects current best practices (e.g., Level of Traffic Stress analysis, inclusion of Class IV protected bicycle facilities)	Has a Pedestrian or Bicycle Master Plan but it may be outdated and/or no recent projects from the Plan have been completed	Does not have a Pedestrian or Bicycle Master Plan
Existing bike network	Includes current best practice features such as separated bikeways, 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

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

Benchmark Topic	Key Strength	Enhancement	Opportunity
Enforcement	Police Department conducts sustained and data-driven enforcement efforts focused on behavior and locations related to most severe bicycle and pedestrian crashes; enforcement activities are designed to consider equity implications	Police Department conducts some enforcement activities related to bicyclist and pedestrian safety	Police Department does not have Traffic Safety Officer(s)

3.1. KEY STRENGTHS

These are areas where the City is exceeding statewide best practices.

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.

The City of Jurupa Valley has clear design guidelines and regular practices for ADA compliance.

Formal Advisory Committee

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

Suggestion for Further Improvement

- Bring all transportation projects to the committee during their monthly meetings to give opportunity for focused complete streets discussion.

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 limits are also critical for complete streets safety. Pedestrian fatality rates increase exponentially with vehicle speed. Thus, controlling vehicle speeds is one of the most important strategies for enhancing pedestrian and bicyclist safety.

The City of Jurupa Valley employs comprehensive practice to proactively review speed limits and considers traffic calming before raising speed limits in pedestrian or bicycle zones.

Suggestions for Further Improvements

- 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 determine whether 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.

Complete Streets Policy

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

Jurupa Valley has practices related to complete streets, such as ADA compliance, the provision of sidewalks, and pedestrian accessibility; however, a formal Complete Streets policy has not been adopted. Jurupa Valley uses their Capital Improvement Program guide to review all transportation projects.

Suggestion for Potential Improvement

- The following jurisdictions have established practices for complete streets, including implementation of these policies through multimodal level of service thresholds, and may serve as models for Jurupa Valley:
    - 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

Design Guidelines and Standards

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

Although the City does not have an active transportation plan, they do consider intersection safety, driver intrusion into bicycle facility and other improvements when designing facilities.

Suggestion for Further Improvement

- Consider adopting national bicycle and pedestrian safety best practices for roadway and facility design guidelines and standards:
  - NACTO Urban Street Design Guide: http://www.nyc.gov/html/dot/downloads/pdf/2012-nacto-urban-street-design-guide.pdf
  - CROW Design Manual for Bicycle Traffic
  - 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
  - AASHTO Guide for the Development of Bicycle Facilities https://nacto.org/wp-content/uploads/2015/04/AASHTO_Bicycle-Facilities-Guide_2012-toc.pdf
  - AASHTO Guide for the Planning, Design, and Operation of Pedestrian Facilities https://transops.s3.amazonaws.com/uploaded_files/Update%20of%20the%20AASHTO%20Guide%20for%20the%20Planning%2C%20Design%2C%20and%20Operation%20of%20Pedestrian%20Facilities.pdf

3.2. ENHANCEMENT AREAS

Funding

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

The City has only been moderately successful in obtaining grant funding.

Suggestion for Further Enhancement

- 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.
- Partner with other agencies and continue applying for grant funding for both infrastructure and non-infrastructure projects.
- Establish a dedicated funding source for pedestrian and bicycle projects.

Collection of Pedestrian and Bicyclist Volumes

The City collects some pedestrian and bicyclist volumes.

Suggestions for Further Enhancement

- Routinely collect pedestrian and bicycle volumes by requiring them to be counted in conjunction with manual intersection turning movement counts. https://mtc.ca.gov/sites/default/files/4_AOC_Tech_Transfer_Seminar_Banner_06032013.pdf
- Geocode pedestrian volume data with GIS software along with other data such as pedestrian control devices and collisions to analyze data for trends or hotspots related to pedestrian safety.

Inventory of Bikeways, Parking, Informal Pathways, and Key Bicycle Opportunity Areas and Inventory of Sidewalks, Informal Pathways, and Key Pedestrian Opportunity Areas

The city maintains an inventory of missing facilities.

- Migrate the inventory of bikeways, bike parking, and future bike improvements into a GIS format for quick mapping and sharing.
- Identify a staff person responsible for maintaining the GIS data set.

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").

The City does not have set practices for data review, although when they have adequate staff, the transportation planner reviews collision data as part of any traffic calming or traffic safety request.

Suggestions for Further Enhancement

- Adopt a data driven systemic safety approach, which would include a systematic approach to identifying, prioritizing, and ultimately implementing safety countermeasure and/or a formal commitment to Vision Zero.
- Work with elected officials and department heads to adopt a Vision Zero policy formally stating the City's commitment to reducing the number of traffic-related fatalities and severe injuries to zero.
- Additionally, with sufficient pedestrian and bicycle volume data, the City could prioritize collision locations based on collision rates (i.e., collisions/daily pedestrian or bicycle volume), a practice that results in a more complete safety needs assessment. Treatments could then be identified for each location and programmatic funding allocated in the City's Capital Improvements Program (CIP).
- Consider utilizing SafeTREC's Transportation Injury Mapping System (TIMS) https://tims.berkeley.edu/. TIMS provides quick, easy and free access to California collision data, the Statewide Integrated Traffic Records System (SWITRS) that has been geo-coded by SafeTREC to make it easy to map out collisions.

3.3. OPPORTUNITY AREAS

These are areas where the City appears not to meet best practices.

ADA Transition Plan for Streets and Sidewalks

ADA Transition plans identify gaps and issues in the City's current ADA infrastructure, prioritize projects for implementation, and set forth the process for bringing public facilities into compliance with ADA regulations. Transition plans typically involve 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.

The City of has no transition plan or ADA coordinator.

Suggestions for Further Enhancement

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

The City does not currently have a Pedestrian or 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.

Safe Routes to Schools Program

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

The City does not have a Safe Routes to Schools program, but has obtained several SRTS grants and has 2 current projects.

Suggestion for Potential Improvement

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

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.

The City does not have curbside management, shared mobility, or micromobility policies in place.

Suggestions for Potential Improvement

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

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

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

Cities have a wide variety of traffic control devices that regulate how bicyclist and pedestrians should use the street and interact safely with drivers. However, some cities do not have inventories how, when, and where these are installed. Creating a database of this information allows the City 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 City to approach safety from a systems perspective and develop projects to close gaps in biking and walking infrastructure over time.

The City of Jurupa Valley does not have an inventory of signs, markings, and signals,

Suggestions for Potential Improvement

- Develop a citywide crosswalk inventory in GIS and maintain it over time. This would allow for a systemic safety approach to enhancing crosswalks, and allow the City to prioritize all crosswalk enhancement projects citywide 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.

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 field observations conducted on March 31, 2021.

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

4.2. FOCAL AREAS

City staff requested reviews of six focal areas:

#	Focal Area	Segment	Issues
1	Agate Street	Mission Boulevard – Jurupa Road	Sidewalks and walkways, crosswalks, traffic calming (speeding), parking (accommodating and organizing)
2	Etiwanda Avenue	San Sevaine Way – Riverside Drive	Crosswalks Pedestrian conflicts with vehicle turning movements
3	Mission Boulevard	Roubidoux Boulevard – Crestmore Road	Crosswalks, bicycle accommodation
4	Limonite Avenue	Etiwanda Avenue – Ridgeview Avenue	Sidewalks, crosswalks
5	34th Street	Roubidoux Boulevard – Crestmore Road	Sidewalks and walkways. Walking to Ina Arbuckle Elementary School. Traffic calming (speeding)
6	Mission Boulevard	Bellgrave Avenue – Pedley Road	Sidewalks, crosswalks

Figure 4-1 locates these focal areas on a map.

Figure 4-1: Map of focal areas

Section 4.3 presents key issues and suggestions identified during the audit that can be applied citywide. Subsequent sections address the six focal areas, with figures that illustrate the suggestions.

4.3. GENERAL CITYWIDE SUGGESTIONS

The following general suggestions for physical enhancements may be appropriate Citywide or in the focal areas. These are discussed in detail below.

Table 4-1: General Suggestions for Physical Enhancements

Pedestrian	Details
Advance Limit Lines	Install 4' in advance of the limit line or first crosswalk line on STOP and signal-controlled approaches, to deter motorists from encroaching into the crosswalk or blocking sightlines to low pedestrians such as wheelchair users.
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.
Crosswalk markings	At uncontrolled crosswalks, incorporate wide longitudinal elements (e.g., "ladder rungs") to enable approaching drivers to recognize the crosswalk earlier.
Leading Ped. Interval	Display WALK phase (typically) 3 seconds before same-direction green indication, so pedestrians can occupy the curb lane.
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.
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.
Directional curb ramps	Provide 2 ramps per corner, aligned with sidewalks, rather than diagonal ramps.
Accessibility	Ensure that signal actuation is ADA compliant, including pushbutton height.
Centerline	Install no-passing (double yellow) centerline 50' back from crosswalk.

Advance Limit (Stop) Lines

On approaches to crosswalks that are controlled by signals or STOP signs, installing an advance limit line a short distance (typically 4 feet) before the crosswalk can remind motorists to stop far enough back that their vehicle's front end does not encroach into the crosswalk. Such encroachment can be a safety issue at multi-lane approaches when the front end of a vehicle waiting 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.*

Corner curb extensions

At intersections with conventional corners and no curb extensions, pedestrians preparing to cross a street typically make their crossing decisions before stepping off the curb, i.e., while on the sidewalk. Due to substantial corner radii at most intersections, this places them over 10 feet outside of the first travel lane they will enter. Corner curb extensions (bulb-outs) enable pedestrians to safely make their decision near the outside travel lane, where they are more visible to approaching motorists and also have a considerably shorter distance to cross. Raised curb extensions also enable crosswalk warning sign assemblies to be installed closer to the travel lanes where they are more visible to motorists. One resource for curb extensions is NACTO's Urban Street Design Guide section: https://nacto.org/publication/urban-street-design-guide/street-design-elements/curb-extensions/

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

"Temporary Traffic Calming Curbs" (Calgary, AB)

Figure 4-2: Segmented floating corner island treatment

Interim curb extensions

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

San Francisco MTA writes:

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

Seattle DOT (SDOT) writes:

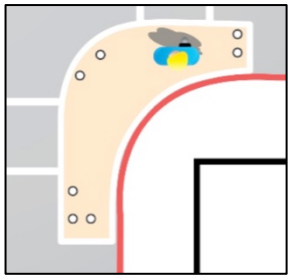
> Interim curb bulbs may be appropriate in locations where there is a safety need and a permanent solution is not feasible in the short term, and/or where there is a planned capital improvement within 5 years. At intersections with curb and gutter, an interim curb bulb can only be done [where] there are existing curb ramps. In some cases, curb bulbs may also be integrated with bioretention to manage storm water runoff from the right-of-way.
>
> https://streetsillustrated.seattle.gov/urban-design/adaptive-design/intersection-treatments/

Crosswalk marking patterns – high visibility and contrast edge

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

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

Los Angeles (Cesar Chavez & St Louis)



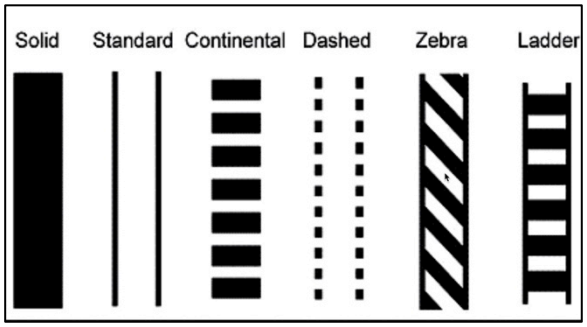
Pasadena Street Design Guide

Los Angeles – Pico & Curson

San Francisco (16th St & Kansas St)

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

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



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

Figure 4-4: Crosswalk marking patterns (FHWA)

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

Table 4-2: Suggested Crosswalk Treatments

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

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

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

Leading Pedestrian Interval

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

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

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

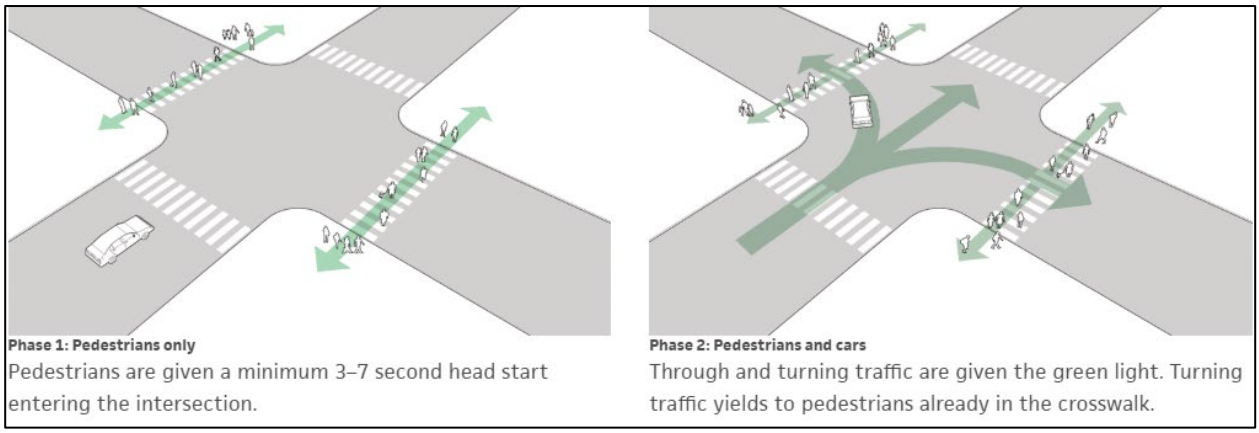


Figure 4-5: Leading Pedestrian Interval phases

Center islands on side streets

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

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

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

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

4.4. FOCAL AREAS

The following sections address the six focal areas (street corridors) listed in Section 4.2.

The evaluator drove the focal areas with city staff on the field visit day. Staff observations and notes appear in each subsection. Because of the Covid-19 pandemic, what was observed may not reflect typical (non-pandemic) peak period operation.

4.4.1. Area #1: Agate Street between Mission Boulevard and Jurupa Road

Existing conditions

Corridor

Agate Street runs north-south for approximately 5,900’ between the CA-60 freeway corridor and 56th Street. Focal area #1 is the 4,100’ segment between Mission Boulevard and Jurupa Road. On this segment Galena Street crosses Agate 2,600’ (1/2 mile) south of Mission.

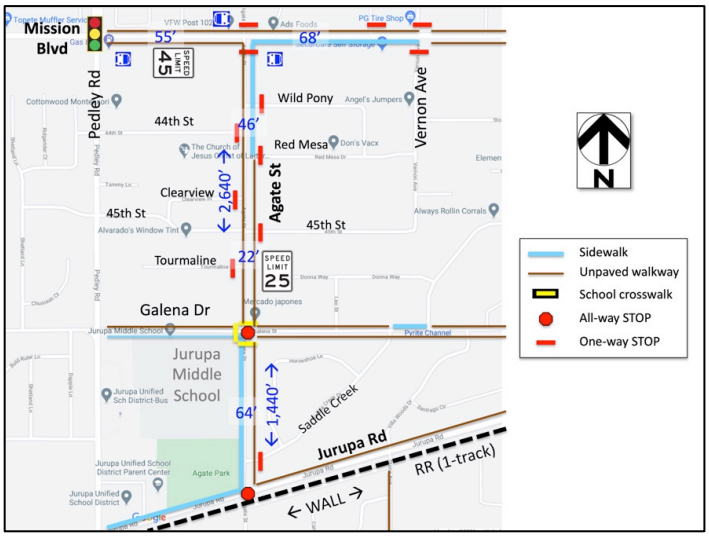


Figure 4-7: Agate Street overview

Land use between Mission and Galena is single-family fronting residential except for a large vacant parcel on the southeast corner at Mission. Between Galena and Jurupa Road the land use on the east side of Agate is also single-family residential, but behind a continuous high backyard wall (access is via Saddle Creek Drive, which intersects Agate from the east approximately 250' north of Jurupa Road).

The superblock bounded by Agate, Galena, Jurupa Road and Pedley Road (which parallels Agate 1/4 mile to the west) contains several public uses:

- Jurupa Middle School (southwest quadrant at Agate / Galena)
- Agate Park (northwest quadrant at Agate / Jurupa Road), including the Jurupa Area Recreation & Park District office on the northwest corner at Jurupa Road
- Jurupa Head Start Program and Jurupa Unified School District Parent Center on Jurupa Road between Agate Park and Pedley Road

Figure 4-7 shows the locations of sidewalks, unpaved walkable areas and marked crosswalks. Because the unpaved frontage is generally between 12' and 18' wide, the entire length of the focal area on both sides is walkable by able bodied pedestrians during the dry season except along a few parcels between Mission and Galena where the frontage is considerably narrower and is obstructed by a parked vehicle or other object.

The wide unpaved areas on the east side of Agate between Jurupa Road and Galena and on the south side of Galena east of Agate are designated as an equestrian / pedestrian trail.

Mission Boulevard intersection and vicinity

Agate's intersection with Mission is a two-way stop (Agate stops). There are no marked crosswalks. Mission is posted 45 MPH and has two travel lanes each way and no center lane. It is 55' wide west of Agate, with a wide unpaved south shoulder used for parking by fronting homes. To the east it is 68', widened toward the south for a parking lane and attached sidewalk. "Far-side" bus stops for Riverside Transit Agency (RTA) Route 49 (Downtown Riverside / Country Village / Fontana) are on both sides of Mission just downstream of Agate.

Making it safer to cross Mission would make it easier for north-side residents to access Jurupa Middle School and Agate Park, and for bus users to make round trips (departing at one bus stop and returning at the one on the other side). City staff said that traffic volume on Mission at this location requires two traffic lanes in each direction, and that future conditions may create the need to install a traffic signal. One potential layout, independent of the installation of a traffic signal, would be four 11' traffic lanes, a 10' left turn lane, and two 7' bike lanes. If the bike lanes were narrowed to 5' at the intersection, 4' "stinger" islands could be provided along the turn lanes, adding some protection for pedestrians halfway across.

Between Mission and Galena

Figure 4-8, facing south between Wild Pony Drive and 44th Street, shows typical conditions north of Galena Street. At this location there is a sidewalk on the east side, which extends to Mission, and a wide unpaved landscape area on the west side. The wide landscape areas are typically not encroached upon by residents extending private front yards — front yard fence and wall setbacks

respect the space — and parking is sporadic so they are usable for walking almost everywhere. There is ample width for future curb, gutter and landscape-buffered sidewalk.

At one residence seen in this figure, a dumpster oriented for pickup from the street obstructed the unpaved area. City staff said it might be for horse waste, as many residents keep horses in backyards. Consideration could be given to designing a standard detail for storing a dumpster behind a pair of gates, oriented toward the street, with a paved access for the service truck.

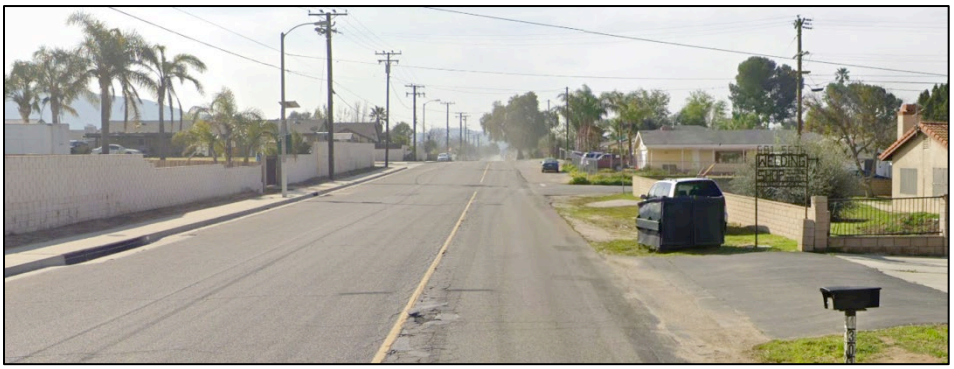


Figure 4-8: Agate facing south between Wild Pony Drive and 44th Street

As shown in Figure 4-9, an alley runs east of Agate behind the house lots that front on the south side of Red Mesa Drive (east side of Agate). North of the alley (left side of figure) the street edge is completed with a sidewalk and parking lane. The tall opaque north fence of the property on the south side of the alley blocks the sight triangle for motorists entering Agate.

Figure 4-9: Alley south of Red Mesa Drive – wood fence blocks sight triangle

The south-side owner could be requested to replace the first 10’ of the wood fence with either pickets low enough for a motorist to see over, or a see-through treatment. Alternatively, installing small islands on both sides of the alley beyond the line of the fence along Agate could make drivers feel more confident about creeping out to make a safe decision.

Galena Street intersection

Agate intersects Galena Street at a four-way stop. The Jurupa Middle School campus occupies the southwest quadrant, with its parking lot and two driveways on Galena near Pedley Road. A paved schoolyard with basketball courts and a large turf playing field occupy the area south of the school buildings along Agate.

There are two-line yellow (school) crosswalks on the north, west and south legs. The northwest corner has no curb and gutter. The northeast corner has a curb but no ramps. The southeast corner has a 45-degree curb ramp (City terminology “Class A”) and a wraparound sidewalk just at the corner. The southwest (school) corner has a 45-degree ramp and buffered sidewalks that extend to Jurupa Road and Pedley Road.

Galena is 52’ wide, with wide outside lanes and left turn lanes approaching Agate, and a center turn lane to the west. Its south side has curb and gutter, with a buffered sidewalk west of Agate (school frontage) and a wide unpaved walkway / equestrian trail to the east along a continuous high backyard wall. The north side has residences fronting the street and a wide shoulder used for parking and presumably also equestrian travel.

The City intends to re-stripe Galena to be more like nearby Pyrite Street, which has bike lanes and a center turn lane.

Between Galena Street and Jurupa Road

Between Galena and Jurupa Road (1,400’), Agate is 64’ wide with a slightly offset dashed centerline (35’ southbound; 29’ northbound) and a continuous sidewalk on the west side that is buffered for 950’ along the school campus and curb-attached to the south along Agate Park. On the east side a 10’ unpaved area between the curb and the continuous backyard wall of the adjacent subdivision is designated as an equestrian / pedestrian trail; it continues east along the south side of Galena.

Parking is allowed along both sides of Agate. The west side serves the school’s playing field and Agate Park / Rick Thompson Arena / Jurupa Community Center just to the south. City staff said that private vehicles with horse trailers park along the east curb when equestrian events are held at the arena and leave the trailers in place during the events.

Jurupa Road intersection

At the south end of the focal area, Agate Street intersects Jurupa Road at a four-way stop. Agate Street’s south leg is a 22’ wide rural road. Jurupa Road intersects at a slight skew because it runs parallel to an adjacent single-track railroad along its south side. The railroad crosses the south leg on a concrete pad. Agate’s southbound approach has a right turn only lane and a through-and-left lane that aligns across the intersection without an offset.

Figure 4-10: Agate Street / Jurupa Road intersection

Both Jurupa Road approaches have a left turn lane and a through-and-right lane. The through lanes have no offset across the intersection.

A free RV dump station is located on a short (1-vehicle) turnout on the north side of Jurupa Road at the southwest corner of Agate Park. Its entrance is approximately 430' west of Agate Street. RVs queue along westbound Jurupa Road in the 19' lane. City staff said that the RV queue sometimes spills back around the corner onto southbound Agate, occupying the southbound right turn only lane.

Analysis

Between Mission Boulevard and Galena Street

North of Galena the key issue is to make the unpaved fronting areas as useful as possible for pedestrians in the short term, and in the medium term to build out a parking lane, curb, gutter and sidewalks. Most of the unpaved frontage is relatively wide — 12' to 18' — so the space accommodates parallel parking with sufficient remaining width along front yard fences and walls for comfortable walking. At the few parcels where the frontage is considerably shallower, location-specific treatments including parking restrictions may be needed for walkway continuity.

Where the unpaved frontage is wide enough for both a comfortable walking area and parallel parking, perpendicular parking could be discouraged or prohibited by signs, with outreach to residents explaining the safety and convenience benefits of a continuous unobstructed walkway for adults, children and families traveling together.

Because of the relatively low traffic volume on this segment, there are probably frequent long gaps in traffic during which pedestrians can cross comfortably. For this reason, sidewalk build-out could perhaps occur on one side initially — perhaps the east side, on which there is existing sidewalk between Mission and Wild Pony Drive.

Galena Street intersection

Even though the Agate / Galena intersection has stop signs on all approaches, pedestrians crossing there are still vulnerable to through and turning traffic, including right turn movements from behind, and to vehicles whose drivers fail to stop. Due to the corner radii, which range between 25' and 35', the crossing distances measured in the middle of each crosswalk are 51' (north leg), 68' (west leg), 78' (south leg), and 66' (east leg, which currently has no crosswalk markings). At a moderate adult walking speed of 3.5 feet per second these equate to exposure times of 14.5, 19.4, 22.3, and 18.9 seconds. Children, and parents pushing strollers or escorting young children, often travel considerably slower.

One way to reduce pedestrian crossing complexity is to provide median refuges, which enable pedestrians to replace a complex two-direction, multiple-conflict crossing decision with two simpler single-direction decisions that can be separated in time. Unfortunately there is often insufficient total width to add them at a conventional intersection, especially one with left turn lanes, or where (as is the case at Galena) future plans include adding bike lanes.

Another option is strongly suggested for consideration by the City. A roundabout with 100' circulatory roadway would fit within the existing corners. Roundabouts provide median refuges in the "splitter" islands on each leg, of great value for pedestrians and probably also helpful for equestrians. Because all traffic circulates counterclockwise, no left turn lanes are needed. Because all approaches operate simultaneously under yield control, right turn lanes are not typically needed. The combination of corner curb extensions and splitter island width typically reduces each half-crossing to about 13' (just 3.7 seconds at 3.5 ft./sec), each only requiring the pedestrian to check in one direction (an easy head-turn) for one approaching vehicle whose speed is limited by the reverse-curving movements required to enter, traverse and exit the roundabout. What the evaluator calls the "coffee-spilling speed" at a 100'-diameter roundabout is typically 15-18 MPH for private cars and small trucks.

A single-lane roundabout can easily replace a busy four-way stop without long queues or delays, while eliminating broadside and head-on collisions. A 100' circulatory roadway of can accommodate all movements by long single-unit trucks, transit and school buses and also moderate-length tractor-trailer configurations, including pickup trucks towing long equestrian trailers. The City would need to confirm compatibility with its selected "design vehicles".

The City may wish to consider the benefits of a roundabout here independently or as part of the transformation of Galena Street. There are at least two relatively nearby examples:

- *Ontario*: East La Avenida Drive (three single-lane roundabouts, at Broadway Avenue, Turner Avenue and Oakville Avenue / New Haven Drive).
- *Riverside County unincorporated area east of Temecula*: Planned "roundabout corridor" on Rancho California Road, a rural collector. Not directly comparable to Agate or Galena; Riverside County staff may be a useful resource.

Between Galena Street and Jurupa Road

On this block the combination of excess width (64') and low traffic volume invites speeding. Even with 8' parking lanes the remaining width is 48' — enough for four traffic lanes.

Installing parking-separated bike lanes and a painted or raised median could absorb the excess width, and would extend bikeway continuity to Jurupa Road when bike lanes are added on Galena. Figure 4-11, drawn with StreetMix.net, shows a cross section with several advantages:

- Floating parking lanes separate bicyclists from traffic, and include 3' door zone buffers.
- The median increases directional separation and (whether painted or raised) would aid pedestrians crossing at Saddle Creek Drive.

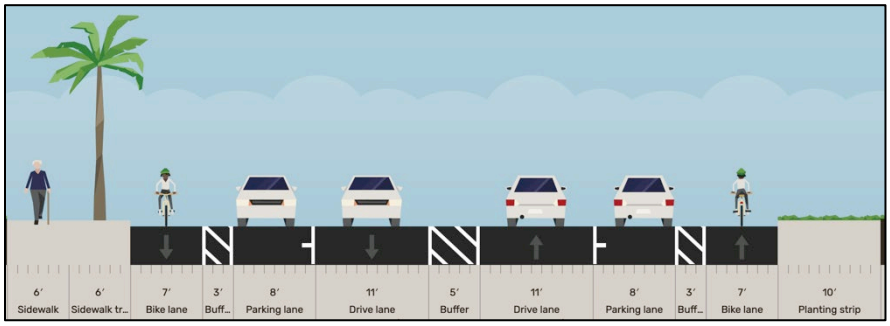


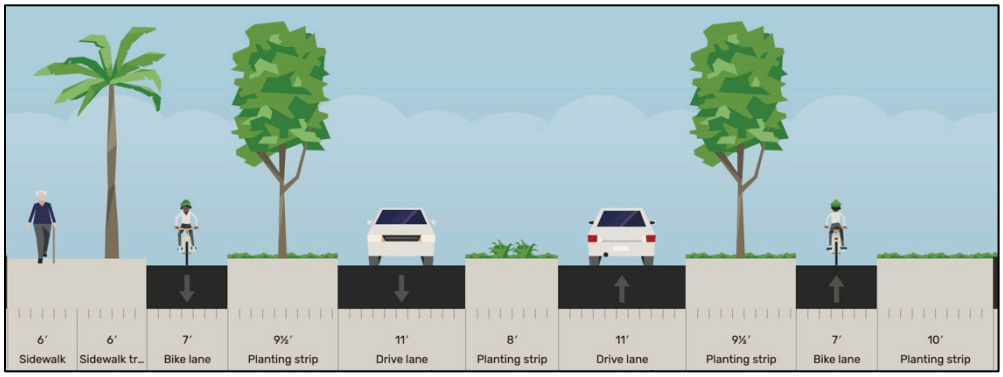
Figure 4-11: Concept for Agate between Galena and Saddle Creek (facing north)

Saddle Creek Drive intersection

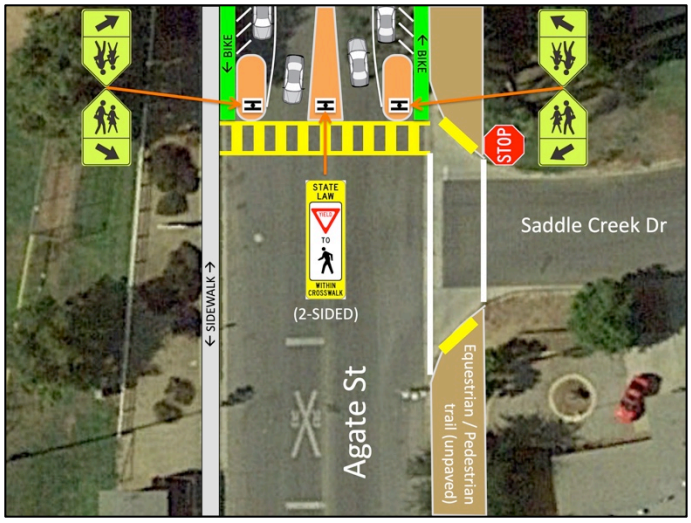
Saddle Creek Drive intersects Agate from the east at a one-way stop approximately 250' north of Jurupa Road. Even though 250' is only about a 1-minute walk, it is likely that pedestrians with origins or destinations on Saddle Creek cross Agate at this intersection rather than incurring 2+ minute round-trip delays by walking to/from Jurupa Road.

At a T-intersection it is usually preferable to enhance the crosswalk on the "left" leg of the T (here, the south leg) because the right leg typically has higher conflict volume due to left turns from the major street (in this case, Agate). However, the pedestrian desire line to/from Saddle Creek is probably toward the north, to the school and to Agate Park's north-side activity centers. For this reason, Figure 4-12 shows a crosswalk on the north leg. Bike lanes are shown in green for emphasis.

The median is widened from Figure 4-11 5' out to 8' to protect persons walking bicycles across the street (6' bike + 1' shy-aways). Two-line crosswalk markings are suggested on Saddle Creek's controlled leg. No suggestion is made for south of Saddle Creek because that segment involves tradeoffs between turn lanes queuing, parking, and potential bike lanes.



a) Cross section



b) Aerial

Figure 4-12: Agate at Saddle Creek Drive – crosswalk concept

Jurupa Road intersection

The suggestions for this intersection are limited to improving pedestrian-vehicle conflicts by installing advance limit lines 4' before each marked crosswalk, to reduce vehicle encroachment. This is a citywide suggestion for stop- and signal-controlled approaches.

Suggestions

Table 4-3: Suggestions for Agate Street Between Mission Boulevard and Jurupa Road

#	Location	Item	Suggestion
1	Mission Boulevard	Facilitating pedestrian crossings	a) With current uncontrolled approaches, consider 11' traffic lanes, 10' left turn lane, and 7' bike lanes away from the intersection. At intersection, transition to 5' bike lanes to fit 4' stinger islands along turn lanes, providing some protection for pedestrians halfway across. b) Ultimately, signalize the intersection
2	Between Mission and Galena	Short term: walkway continuity along unpaved frontage	a) Develop "spot" solutions where the unpaved frontage is not wide enough for a walkway along parallel parking. b) At all locations, prohibit perpendicular parking with regulatory signs ("Park Parallel"), with outreach explaining benefits of a continuous walking area for families. c) Consider speed feedback signs and speed limit markings.
3		Medium term: install sidewalks	Initially, consider extending the east sidewalk to Galena. Ultimately, provide sidewalks on both sides.
4		Traffic calming and safer, more convenient pedestrian crossings	Add physical deflection such as mini-roundabouts and/or speed humps, spaced closely enough to be effective — at least at the "1/3 points" where there are through routes between Pedley and Vernon: a) Between 44th Street and Red Mesa Drive b) At 45th Street
5	Alley on east side south of Red Mesa Drive	North fence of south-side property blocks sight triangle	Have the owner reduce the first segment's height to lower-than-driver's-eye, or replace it with a see-through treatment. Alternatively, install islands beyond the north-south fence line to protect motorists who creep out to get a clear sightline.
6	Galena Street intersection	Traffic control, pedestrian safety	Consider installing a single-lane roundabout. See discussion above, in the "Galena Street intersection" section.
7	Between Galena and Jurupa Road	Bicycle accommodation	Consider parking-separated bike lanes (see Figure 4-11).
8	Saddle Creek Drive intersection	Enhanced crosswalk	Mark and sign a high-visibility crosswalk on the north leg, with islands "capping" the floating parking lanes to the north, and a wide median island to protect persons walking bicycles. Use double-sided signs to maximize motorist awareness.
9	Jurupa Road intersection	Crosswalks	Install advance limit (stop) lines 4' before the marked crosswalks on the southbound and eastbound approaches.

4.4.2. Area #2: Etiwanda Avenue between San Sevaine Way and Riverside Drive

Existing conditions and field observations

Overview

Figure 4-13 shows the focal area, which extends approximately 1,000' along Etiwanda Avenue between San Sevaine Way (north end) and Riverside Drive (south end).

Etiwanda runs north-south across the city, parallel to and approximately 1.5 miles east of I-15. The SR-60 freeway runs east-west in this area. It crosses over Etiwanda approximately 350' north of San Sevaine Way. Its eastbound on-ramp and westbound off-ramp signals are respectively approximately 150' and 600' north of San Sevaine.

Figure 4-13: Etiwanda between SR-60 and Riverside Drive

The large parcel on the south side between Mission and Riverside, vacant in this image, is now occupied by a large Flying-J truck stop.

Continuous attached sidewalks are now present on both sides of Etiwanda through the entire focal area.

Staff said that speeding is not an issue on Etiwanda or its intersections within the focal area.

San Sevaine Way intersection

San Sevaine Way intersects from the east at a one-way stop just south of SR-60 / Mission Boulevard interchange's east ramps. Etiwanda has a raised median at this location, with a southbound left turn pocket; the intersection is otherwise right-in / right-out for San Sevaine. San Sevaine has a right turn lane, a wide painted median, and two entering (eastbound) lanes that enable the southbound left turn and northbound right turn to operate simultaneously. The crosswalk across San Sevaine is not marked.

San Sevaine east of Etiwanda is 64' wide and is currently striped with two lanes in each direction and no center turn lane. Street racing and speed demonstrations are an issue on this segment; loss-of-control crashes have occurred on the curve that begins approximately 3/4 mile east of

Etiwanda. The city plans to re-stripe the street with one lane in each direction and a center turn lane, and to modify the marking alignment near that curve to reduce the likelihood of crashes by speeding motorists.

Mission Boulevard / Van Buren Boulevard intersection

Just south of the San Sevaine intersection, Etiwanda crosses under a two-track railroad. Just south of the railroad embankment is a signalized major intersection with Mission Boulevard (west leg) and / Van Buren Boulevard (east leg). Because Mission / Van Buren and the railroad are skewed northwest-southeast relative to Etiwanda at approximately a 45-degree angle, the northwest and southeast corners are acute-angle and the northeast and southwest corners are oblique-angle.

Staff said that pedestrians use the crosswalks on all four legs. There are single curb ramps on each corner and two-line white crosswalks on all four legs. The skew makes all four crosswalks (and their crossing times) approximately 50% longer than they would be if perpendicular.

Figure 4-14: Etiwanda at Mission / Van Buren – existing conditions

Staff said that a concept is in the works to add a large-radius channelized right turn ("slip") land on the southeast quadrant, i.e., connecting northbound Etiwanda with eastbound Van Buren. This could potentially reduce congestion and signal cycle time by making it easier for large trucks to make the turn without slowing to a crawl.

Providing a crosswalk across such a slip lane would enable pedestrians to resolve the right-turn conflict independently of the conflicts associated with crossing the remaining lanes of the east and south crosswalks. The channelization ("pork chop") island could extend into the intersection, "shadowed" by the eastbound approach's right turn lane, shortening the south and east crosswalks and potentially enabling shorter pedestrian phases.

A right turn channelization island could also be considered for the northwest corner. That corner's alignment is constrained by the railroad embankment so it cannot be reconstructed further from

the center of the intersection. However, it may still be possible to shorten the north and west crosswalks by installing such an island.

Obsolete designs for right turn slip lanes use a single-radius curve whose start and end are tangent to the respective streets. This has the unwanted effect of enabling high speeds at the slip lane crosswalk and at the cross-street merge — which endangers bicyclists approaching from behind on the cross street. That merge also requires a severe head-turn angle, reducing vigilance by motorists who use only their mirrors.

State-of-the-practice slip lane design changes the radius downstream of the crosswalk, which cues approaching motorists to reduce speed and reduces the head-turn angle at the cross street. This is covered in FHWA's Safer Journey Countermeasure #15: Well-Designed Right-Turn Slip Lanes, https://safety.fhwa.dot.gov/saferjourney1/Library/countermeasures/15.htm.

Optionally, the slip lane crosswalk can be raised to force a low-speed approach. The City of Boulder has done this at several major signals near the large University of Colorado campus.

If the slip lane crosswalks are uncontrolled, it is suggested to install high-visibility markings such as a "ladder" pattern.

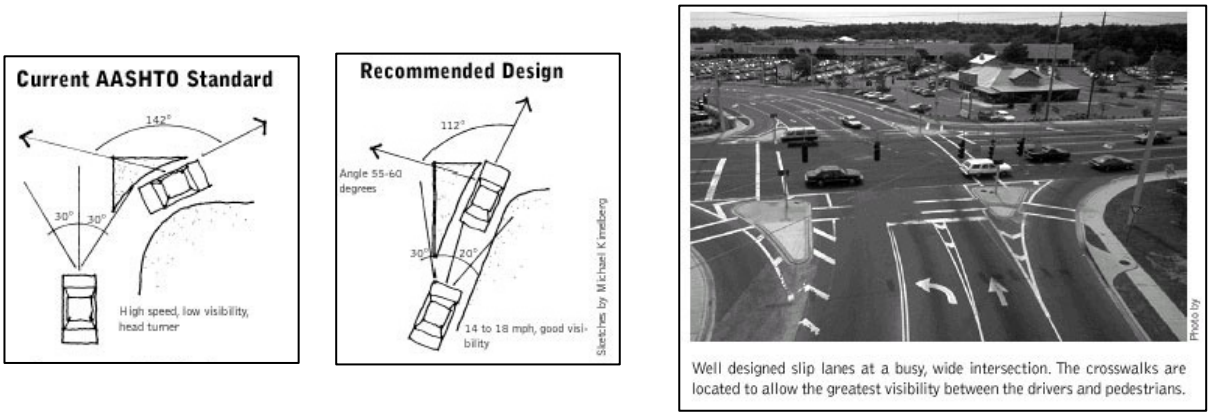


Figure 4-15: FHWA "Well-Designed Right-Turn Slip Lanes" figures

Riverside Drive intersection and vicinity

Riverside Drive intersects Etiwanda from the west at the first signal south of Mission. The east leg is a commercial driveway with no outlet, serving the Farmer Boys restaurant and 7-Eleven both of which have parking for large trucks, respectively behind and beside the buildings. The northwest quadrant is occupied by the large Flying-J truck stop.

There are two-line white crosswalks on the north, west and south legs; the concrete apron of the east driveway serves as a sort of crosswalk marking.

Staff noted the following:

- The intersection's north leg crosswalk is well-used by truckers parked at Flying-J to access the Farmer Boys restaurant and 7-Eleven on the east side.

- The Riverside Drive signal operates split-phase in the east-west direction because both the east and west approaches have a through-and-left option lane.

- There is a heavy left turn movement from eastbound Riverside onto northbound Etiwanda. After turning left from Riverside Drive, much of this traffic stays left and then turns left turn onto Mission to reach SR-60's westbound on-ramp. Traffic queued to make the second left turn onto Mission sometimes spills back into the Riverside intersection, blocking the north crosswalk. To reduce this, the Riverside and Mission / Van Buren signals are coordinated to facilitate the linked left turn movement.

The large Flying-J truck stop that occupies the west side of Etiwanda between Riverside and Mission has a right-in / right-out driveway approximately 330' north of Riverside's north curb. The driveway has a long apron with a crosswalk at the "top" (away from the street) that connects to Etiwanda's attached sidewalk continuing north, and also to the driveway's north-side attached sidewalk into the truck stop. The driveway has no sidewalk on its south side — that quadrant is occupied by the truck stop's passenger-vehicle service station.

Figure 4-16: Flying-J driveway on west side of Etiwanda north of Riverside Drive

Pedestrians originating within the truck stop who intend to patronize the businesses on the east side of the Riverside Drive signal walk along the Flying-J driveway's north sidewalk, cross the driveway at the top of its apron, then continue south along Etiwanda to the Riverside signal. A black iron fence occupies the northwest corner landscape adjacent to the driveway. When viewed from a shallow angle by a southbound motorist preparing to turn right into the Flying-J driveway, the fence's bar spacing could potentially hide such an emerging pedestrian just at the moment that they turn south toward the driveway crosswalk, turning their back on southbound right-turners. In addition, some such pedestrians may cut the corner and walk diagonally toward the driveway's median island, thus hiding them further around the entrance corner.

It is suggested to modify the fence by replacing its right-angle corner (two panels) with a bevel that opens up a sight triangle for entering motorists to see further into the driveway and along its north sidewalk. Also, if the fence does not need to be as tall as the masonry wall along Etiwanda, its height at this corner could be reduced to no more than three feet, further un-obstructing the sight triangle — in the same way as corner landscape without a fence is either maintained below three feet or "limbed up" to no lower than seven feet.

Suggestions

Table 4-4: Suggestions for Etiwanda Between San Sevaine and Riverside

#	Location	Item	Suggestion
1	Mission / Van Buren intersection	Southeast corner	Support staff's concept of adding a large-radius right turn (slip) lane incorporating a marked crosswalk. Incorporate state-of-the-practice slip lane design, including FHWA Safer Journey countermeasure #15, to improve pedestrian safety at the slip lane crosswalk and also the safety of the merge onto Van Buren for eastbound motorists and bicyclists.
2		Northwest corner	Similar to what is envisioned for the southeast corner, consider installing a right turn channelization ("pork chop") island to enable pedestrians to resolve the right turn conflicts independently of the mainline crossings, and to reduce the length of the north and west crosswalks.
3	Riverside Drive intersection	North crosswalk	Consider adding Leading Pedestrian Interval (LPI) phasing, given the high demand for crossing to and from the east-side destinations. Given the high conflict levels due to spillback of the northbound left turn queue approaching Mission, consider also installing high-visibility markings even though this is a controlled crosswalk.
4	Both signals	All approaches	(Citywide suggestion for controlled crosswalk approaches) Install advance limit (stop) lanes four feet upstream of controlled crosswalks, to deter vehicle encroachment and thus reduce the chance that a pedestrian — especially a short or wheelchair-using person — will be hidden from the view of a motorist preparing to turn right on red by a tall vehicle in the adjacent lane.

4.4.3. Area #3: Mission Boulevard between Roubidoux Boulevard and Crestmore Road

Existing conditions

Overview

Figure 4-17 shows the focal area, which extends approximately 3,600' (0.68 mile) along Mission Boulevard between Roubidoux Boulevard (west end) and Crestmore Road (east end). Here Mission runs approximately northwest-southeast, roughly perpendicular to the Santa Ana River (the city limit), which it crosses on a bridge just east of Crestmore.

a) West segment (Roubidoux – Wallace)

b) East segment (Wallace – Santa Ana River)

Figure 4-17: Mission Boulevard between Roubidoux Boulevard and Crestmore Road

Intersection controls and crosswalk markings

There are three traffic signals, at the four-way intersections with Roubidoux, Crestmore, and at Wallace Street. On this segment seven other streets meet Mission at T-intersections, four of which (Packard, Twining, Mintern, Daly) are full-movement; the others (Fort, Mennes, Arora) are right-in / right-out due to Mission's raised median.

Crosswalks across Mission are marked as follows:

Table 4-5: Crosswalk Markings Across Mission Between Roubidoux and Crestmore

Cross street	Junction	Control	Crosswalk markings across Mission
Roubidoux	4-way with angled mainline left turn lanes	Signal	Two-line white, all legs
Twining	Full-movement T (south side)	Uncontrolled	"Ladder" yellow (school),
Wallace	4-way	Signal	Two-line white, west (Mission), north and south (Wallace) legs. East leg unmarked.
Crestmore	4-way	Signal	Two-line white, west (Mission), north and south (Crestmore) legs. East leg unmarked.

The stop-controlled crosswalks at all unsignalized cross streets are all marked with white lines except for two yellow lines (school Mintern and Packard (the first streets east of Twining) and Packard (the first street west of Twining).

Crosswalks across the stop-controlled intersecting streets (listed west to east) are marked as follows:

Table 4-6: Crosswalk Markings Across Side Streets Between Roubidoux and Crestmore

Cross street	Junction	Side	Crosswalk markings
Fort	Right turn in/out	S	2-line white
Packard	Full-movement T	N	2-line yellow (school)
Twining	Full-movement T	S	"Ladder" yellow (school)
Mintern	Full-movement T	N	2-line yellow (school)
Mennes	Right turn in/out	S	2-line white
Arora	Right turn in/out	N	2-line white
Daly	Full-movement T	N	2-line white

Cross section

On this segment Mission has a wide raised landscaped median, with angled left turn lanes at Roubidoux, indented left turn pockets at Wallace, Daly and Crestmore, and a break for left and U-turns at each full-movement T intersection. On each side of the median there are two traffic

lanes and a parking lane. The parking lanes are punctuated by curb extensions at most corners and small mid-block floating islands — both landscaped (one small tree) and hardscape.

Total width (measured on Google Earth, with limited resolution) appeared to be approximately 112’ except near Roubidoux where the median widens for the angled left turn lanes. The cross section element widths appear to be as shown in Figure 4-18.

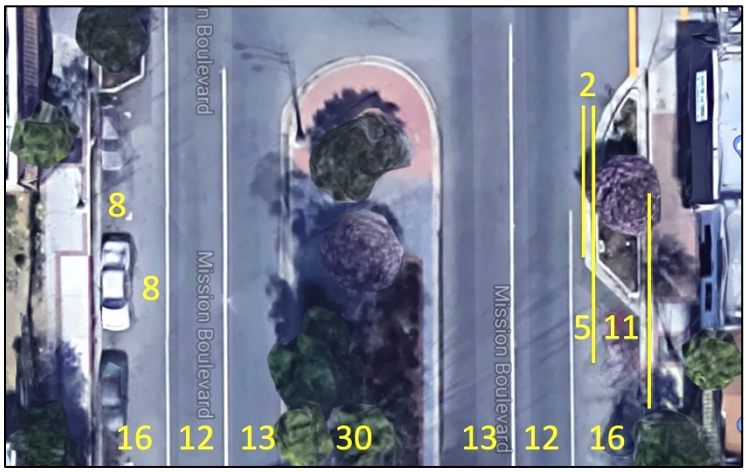


Figure 4-18: Mission Boulevard cross section near Packard Avenue

School crosswalk at Twining Street

The only marked uncontrolled crosswalk in the focal area is the yellow (school) installation on the south leg at the Twining T-intersection, which incorporates a high-visibility “ladder” pattern.

On the north side of Mission these crosswalk markings begin at the curb within the span of the parking lot of a liquor / grocery store. An east-facing SW24-2 (CA) school crosswalk warning sign, combining the “school pentagon” pedestrian symbol sign with the W16-7p Downward Pointing Arrow, is mounted just behind the curb on the west side of the crosswalk. A similar sigh version with a forked arrow (pointing left and right) is mounted on the median.

There is no curb ramp, and this end of the crosswalk does not appear to be accessible. (Although the parking lot’s wide driveway is adjacent — its west wing extends into the crosswalk markings, the apron slope appears to exceed the maximum wheelchair-accessible grade, and there is no detectable warning strip, and a low-vision pedestrian descending the driveway apron would not be properly oriented toward the crosswalk markings.)

Several changes are suggested for this (north) side of the street.

- Modify the liquor store driveway’s west apron (perhaps slightly narrow the driveway) to provide a raised curb across the crosswalk’s full width. Alternatively, install a curb extension and new ADA ramp to the existing sidewalk by modifying the driveway.
- Across the crosswalk width, add a curb extension or a floating island with a gutter bridge. Incorporate a wheelchair-accessible ramp and detectable warning strip.
- Relocate the warning sign assembly onto the curb extension or island

- Install a Yield Line ("shark's teeth") marking upstream of the crosswalk, at the trailing edge of the upstream floating island.
- Install R1-5 Yield Here signs at both sides of the yield line, on the upstream island and median. Pedestrian symbols and arrows should face into the street.
- On the median, install separate 1-sided north- and south-facing warning signs.

Several changes are suggested for the south side of the street (eastbound approach):

- Modify the southeast corner with a full wrap-around extension incorporating a considerably smaller corner radius, extending outward to the fender line of parked vehicles on both streets.
- Relocate the curbside warning sign assembly onto the curb extension.
- Install a Yield Line ("shark's teeth") marking at the start of the return of the west-side floating island upstream of the southwest corner (i.e., near the Poodle Shoppe), flanked by a pair of R1-5 Yield Here To Pedestrians signs as described above.
- Install R1-5 Yield Here To Pedestrians signs at both sides of the yield line, one on the upstream floating island and the other on the median. The left-side sign's pedestrian symbol and arrow should face into the street.
- Consider replacing the left-and-right arrow of the median-mounted crosswalk warning sign with a single arrow pointing toward the street. (There is no safety reason to warn approaching drivers of pedestrians who have already crossed to the median.)

These improvements will:

- Enable pedestrians starting across from the sidewalk to safely wait where they are more visible to approaching drivers
- Improve the conspicuity of the curbside warning signs
- Deter drivers from stopping at the crosswalk where one yielding vehicle could hide a pedestrian about to enter the other lane ("multiple threat" crash mode)

After making these passive improvements, it is suggested to observe motorist yielding behavior with pedestrians present — especially children traveling alone and young children being escorted by parents. If yielding compliance is deemed insufficient, installation of pedestrian-activate Rectangular Rapid Flashing Beacons on the crosswalk warning signs could be considered.

Wallace Street

The east-leg crosswalk at Wallace Street is not marked. A legal crosswalk exists regardless, because Wallace has an east-side sidewalk on both sides of Mission. There does not appear to be a reason to discourage crossing Mission on the east leg — there are no heavy left-turn movements (a frequent reason to consider discouraging crossing the major-street leg intersected by the left turn). It is suggested to mark the crosswalk.

Crestmore Road

The east-leg crosswalk at Crestmore Road is not marked. This may be because (a) there is no sidewalk on the north side of Mission east of Crestmore, i.e., across the Santa Ana River bridge, and (b) Crestmore has no east sidewalk north of Mission.

The northeast parcel is undeveloped. A vehicle-width access-way connects along its south (Mission) perimeter between the Mission intersection's northeast corner and the river's west bank. That connection is currently fenced off with No Trespassing signs at Crestmore.

It is suggested to mark the east crosswalk when a sidewalk is installed on the east side of Crestmore north of Mission or when the aforementioned access-way is opened for public use.

Crosswalks at other intersecting streets

No crosswalk markings are currently installed across Mission at any intersection within the focal area except for the four listed in Table 4-5. However, pedestrian crossing demand exists at these locations — whether the T-intersection is full-movement or right-in / right-out.

For all of these intersections the "detour distance" (round-trip walk to the nearest controlled intersection) is prohibitive. The "Comparable motorist detour" lists the detour distance that a motorist would be asked to travel in the same time interval as the pedestrian detour.

Table 4-7: Pedestrian "Detour Distance" and Time to Nearest Controlled Crossing

Street	Junction	Nearest controlled crosswalk	Round-trip detour	Detour minutes*	Comparable motorist detour**
Fort	Right turn in/out	Roubidoux	970'	4	2.6
Packard	Full-movement T	Roubidoux	1,300'	5+	3.3
Mintern	Full-movement T	Wallace	1,400	5.5	3.6
Mennes	Right turn in/out	Wallace	800	3+	2
Arora	Right turn in/out	Wallace	600'	2.5	1.6
Daly	Full-movement T	Crestmore	1,500'	6	4

* At able-bodied adult walking speed of 4.0 feet/second
** At Mission's posted speed limit of 40 mph (0.67 miles/minute)

It is suggested to consider marking and signing crosswalks on one of the legs of each of these intersections after first prioritizing them based on across-Mission attractors. The strengths of the crossing "desire lines" at each intersection may differ. For example, grocery stores are (or were) directly across Mission at Daly and Arora. Each installation would consist of:

- A walkway through the median, at right-in/out intersections without one
- Curb extensions as needed
- High-visibility (e.g., "ladder") crosswalk markings
- Crosswalk warning signs: 1-sided W11-2 + W16-7p on left and right sides of each approach. Left-side sign: pedestrian and downward-arrow preferably facing into street. Curbside sign on curb extension where available.

- Yield line 20'-40' upstream (or at upstream corner curb return if applicable)
- R1-5 Yield Here To Pedestrian signs at yield lines, both sides, with pedestrian symbols and arrows facing into street
- For locations with uncontrolled approaches, pedestrian-activated Rectangular Rapid Flashing Beacon (RRFB) light bars on the warning sign assemblies, or potentially Pedestrian Hybrid Beacons (PHBs) if RRFBs cannot produce acceptable yielding rates.

Staff mentioned one practical consideration for designating crosswalks at these additional locations — the substantial vertical grade difference across the median, between Mission's two directions. However, it may be possible to address this with a jogged, modestly inclined walkway across the median.

Improving bicycling conditions

Figure 4-18 shows the widths of each cross section element on most of the focal area segment away from Roubidoux. The street does not currently have bike lanes, but the 16' parking lane provides ample lateral separation from the "door zone" on the driver side of parked vehicles.

However, the floating islands that punctuate the parking lane appear to extend to 11' from curb face, leaving only 5' for bicycles to the right of the "shoulder line" that is 16' from curb face. Of that 5', 2' is gutter pan at some islands, leaving only 3' of rideable asphalt.

Figure 4-19: Narrow bicycle travel width along island

Mission's inner (median-side) and outer (parking-side) lanes appear to be 13' and 12' wide, respectively. The posted speed of 40 mph is considered "moderate" for a suburban arterial. Research performed during the first decade of this century showed that using travel lane widths as narrow as 10' on moderate-speed urban and suburban arterials had little or no effect on capacity or crashes (i.e., sideswipes).

> **Relationship of Lane Width to Safety for Urban and Suburban Arterials**
> Ingrid Potts, Douglas Harwood, Karen Richard
> Midwest Research Institute, Kansas City, MO
> Publication: 2007 Transportation Research Board (TRB) Annual Meeting CD-ROM

ABSTRACT: This research investigates the relationship between lane width and safety for roadway segments and intersection approaches on urban and suburban arterials. The research found no general indication that the use of lanes narrower than 3.6 m (12 ft.) on urban and suburban arterials increases crash frequencies. This finding suggests that geometric design policies should provide substantial flexibility for use of lane widths narrower than 3.6 m (12 ft.). Inconsistent results were found which suggested increased crash frequencies with narrower lanes in three specific design situations. Narrower lanes should be used cautiously in these three specific situations unless local experience indicates otherwise.

If Mission's two lanes were narrowed to 12' and 11' respectively, the freed-up 2' could become a traffic-side buffer between the outside lane and the bike-able leftmost portion of the wide parking shoulder, creating a 7' buffered bicycle lane. 11' is ample for transit bus operation.

Improving viability of in-street trees

The streetscape improvements in Mission Boulevard's Roubidoux District segment include street trees in the floating islands and curb extensions that punctuate the parking lane. Shade is welcome in sunny climates, and in-street trees combined with in-sidewalk trees have the potential to create an attractive space for walking and gathering. However, many of the in-street trees did not look healthy.

The evaluator has seen articles and literature describing sub-surface engineering options that can enable growth of a root system while supporting the loads of parked and moving vehicles. One such system is "Silva Cells" product — a plastic/fiberglass structure of columns and beams that support vehicle-loaded pavements (AASHTO H-20 load rating) above un-compacted planting soil, with a high percentage of void space. Another is "Structural Soil", made of 80% crushed rock and 20% loam soil coating the rock, compacted to 95% Proctor Density. The crushed rock has approximately 30% void space, which soil fills while remaining uncompact with the compaction force and transferred paving loads.

The above descriptions are from this website:

https://www.deeproot.com/blog/blog-entries/comparing-silva-cells-and-structural-soil

The evaluator has no experience with either system. However, several decades ago the City of Palo Alto implemented a 4-to-2 lane conversion of its signature "shopping street", University Avenue, that added parking lanes punctuated by capacious in-street tree basins at corners and mid-block. Palo Alto's experience could be a resource for Mission Boulevard and other corridors.

Legacy state route signage

Business Route 60 signs are still present along several segments of Mission Boulevard, despite that state route designation having been removed from all of its length within Jurupa Valley. A drive-through would identify these legacy signs.

Suggestions

Table 4-8: Suggestions for Mission Between Roubidoux and Crestmore

#	Location	Item	Suggestion
1	Twining intersection, south leg crosswalk	Pavement markings, signage and curbside configuration	See detailed list above under topic “School crosswalk at Twining Street”.
2	Wallace Street	East-leg crosswalk	Mark with 2-line white.
3	Additional intersections	Marking and signing crosswalks	Consider installing, prioritizing based on pedestrian attractors across the street. See topic “Crosswalks at other intersecting streets”.
4	Entire focal area	Travel lane widths	Consider narrowing the travel lanes to free up at least 2’ for a traffic-side buffer (buffered bicycle lane). See topic “Improving bicycling conditions”.
5	Entire focal area	Health and viability of in-street trees	Explore sub-surface soils-engineering options. See topic “Improving viability of in-street trees”.
6	Entire corridor	Legacy “Business Route 60” signs	Identify and remove

4.4.4. Area #4: Limonite Avenue between Etiwanda Avenue and Ridgeview Avenue

Existing conditions

Overview

Etiwanda Avenue runs due north-south approximately 1.5 miles east of I-15, which is the City's western limit. Limonite Avenue runs generally east-west through the southern portion of Jurupa Valley, roughly 1 mile north of the Santa Ana River.

Figure 4-20: Limonite Avenue between Etiwanda Avenue and Ridgeview Drive

Etiwanda intersects Limonite at a traffic signal; in this vicinity Limonite runs due east-west. Ridgeview Avenue intersects Limonite at a two-way stop approximately 1,300' east of Etiwanda. Mann Avenue intersects from the south midway between.

Within the focal area Limonite mostly has a five-lane cross section (two lanes each way plus a center lane), with its north edge maintaining a fairly constant alignment, but its south edge setback varies considerably. Along the shopping plaza just west of Etiwanda the south edge has an eastbound right turn lane. Across Etiwanda the setback continues across the corner parcel (Jack-In-The-Box), vanishes across the next two parcels (Mariscos Uruapan restaurant and Truck Country vehicle dealership, resumes across the adjacent parcel (west side of Mann, formerly Culture Cannabis Club), vanishes east of Mann, then reappears east of Ridgeview as a tapered merge lane.

Limonite-Etiwanda intersection

Figure 4-21 shows the current configuration of the Limonite / Etiwanda signal. Both Limonite (east-west) legs have two travel lanes in each direction plus a left turn lane; the west leg also has a right turn only lane. Both legs of Etiwanda (north-south) have five lanes — two travel lanes in each direction plus a left turn lane.

All four legs have sidewalks or an all-weather concrete walking surface on both sides. The northwest quadrant is a large island that channelizes a large-radius right turn slip lane. The area outside the slip lane is unpaved but appears to be dry-season walkable.

There are eastbound and westbound bus stops on Limonite's east leg. Eastbound buses approach Etiwanda in the outside (right turn only) lane, which has an exception sign allowing buses to proceed through. They continue straight ahead across the intersection to the bus stop at Jack-In-The-Box, but must then angle out sharply given the short remaining distance available to merge back into the #2 lane before the south curb shifts left approximately 10' as the setback vanishes. Given Limonite's 50 mph posted speed limit, re-starting from the bus stop could require waiting for the end of the eastbound through phase.

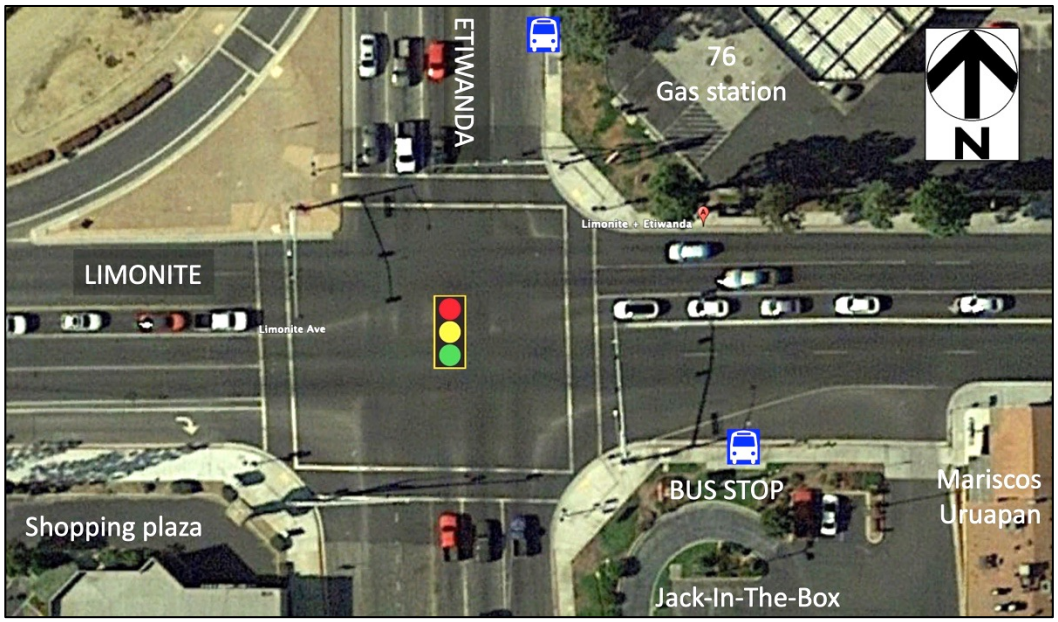


Figure 4-21: Limonite / Etiwanda intersection, existing conditions

Figure 4-22 illustrates a concept for modifying the southwest and southeast corners to reduce pedestrian crossing distances across Limonite. Lane assignment arrows are depicted for clarity, not as suggested additional markings.

Eastbound buses would approach in the outer through lane and continue straight ahead, pulling out of traffic to serve the far-side (downstream) bus stop. They would still need to merge into traffic after the stop, as they do currently.

Removing the eastbound bus through movement from the turn lane makes the unswept space between the eastbound right and through movements available for a segmented right turn channelization island that would substantially reduce the distances and pedestrian phase intervals of the west and south crosswalks. The segmented island would also enable pedestrians to resolve the right turn conflict independently from the mainline conflicts. A signal modification would be needed to add two push button poles on the southwest corner and one on the southeast corner.

The concept incorporates advance limit (stop) lines on all approaches. These are typically installed 4' before the crosswalk. The northbound left turn's limit line keeps in its original position,

out of the westbound left turn sweep. The eastbound left turn and through lanes are extended to the realigned west crosswalk and the northbound through lanes are extended to the realigned south crosswalk.

The south leg's centerline is doubled to deter eastbound through motorists from shortcutting the signal by turning right, making a U-turn, then another right turn. Raised elements could be installed between the two double yellow lines.

Figure 4-22: Limonite / Etiwanda intersection, concept

Sidewalk conditions along the north side of Limonite west of Ridgeview

Sidewalks along many of Jurupa Valley's streets have gaps that are gradually being eliminated by city street projects or when fronting parcels are developed. Figure 4-23 shows the eastward view across the two recently-updated driveways of El Torito Meat Market & Tacos, a popular business on the north side of Limonite opposite Mann Avenue.

Figure 4-23: Limonite north sidewalk across El Torito driveways

Driveway aprons typically have a substantial slope to drain rainwater into the street — too steep for a wheelchair user to keep the chair from steering into the street. Accessible design incorporates gently-sloped “bypasses” behind the aprons. The right side of the figure highlights the aprons in maroon and the accessible route in blue. The yellow areas must remain unparked to enable wheelchair travel. The parking space closest to the street beyond the far driveway obstructs the accessible route and should be eliminated.

The field visit was conducted during the Covid-19 pandemic, so the observed low pedestrian crossing demand may not have reflected non-pandemic conditions. There are significant pedestrian attractors on both sides of Limonite between Etiwanda and Ridgeview:

- Shopping plaza on southwest corner at Etiwanda signal, including Stater Brothers supermarket, Launderland laundromat, three restaurants and a bank. This plaza is reachable safely via the intersection crosswalks

- Mariscos Urupan restaurant, on the south side approximately 200’ east of Etiwanda. This is also close enough to the signal that controlled crosswalks are a reasonable route (200’ is approximately a 1-minute trip at a moderate walking speed of 3.5 feet per second.)

- El Torito Meat Market & Tacos, at Mann Avenue, approximately 650’ (~3-minute walk) from Etiwanda and Ridgeview. This may be a strong attractor for crossing at Mann instead of walking to and from Etiwanda.

- Mary Tyo Trailhead Equestrian Staging Area and “Horse Meets” Park, which occupy the southeast quadrant at Ridgeview — a gateway to many informal trails along the north side of the adjacent Santa Ana River. This may be a strong attractor for horse owners residing north of Limonite (aerial imagery shows backyard horse rings at many homes along streets that intersect from the north, including Ridgeview, Troth and Marlatt).

The controlled crosswalks of the Etiwanda signal can serve trips between north-side origins and the shopping plaza and Mariscos Uruapan restaurant. To reach that signal safely and conveniently year-round, the north sidewalk is a priority for build-out working east from Etiwanda. Completing the sidewalk to Ridgeview will capture many trips, however extending it just 600’ further to Troth would serve all north-side residences because 60th Street extends west to Troth but does not continue through the one block to Ridgeview.

A safe pedestrian crossing of Limonite at Ridgeview would directly connect hundreds of north-side residences east of Etiwanda to the Santa Ana River without the need to detour to Etiwanda and back (at least an 8-minute round-trip).

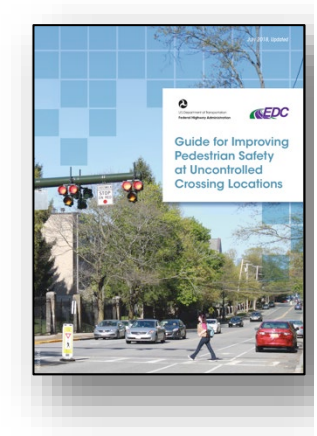
FHWA’s Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations (publication FHWA-SA-17-072) describes suggested treatments based on traffic volume, number of travel lanes, posted speed, and presence of a median refuge. Table 1, “Application of pedestrian crash countermeasures by roadway feature”, reproduced below with markups as Figure 4-24 along with an image of the Guide’s cover, neatly summarizes the guidance and is a great starting point for enhancing any uncontrolled crosswalk. Based on Limonite’s 50 mph posted speed limit, 4 travel lanes, and lack of a raised median, the markups highlight the three identical orange cells in the table’s bottom row. The tree circled, filled-in numbers in those cells urge consideration of three countermeasures:

- 3: Advance stop lines
- 6: Pedestrian refuge island
- 9: Pedestrian Hybrid Beacon (PHB), which stops traffic with an all-red phase

It is suggested that the City evaluate the intersection traffic volumes along with pedestrian and vehicle patterns to determine whether a PHB or a full traffic signal would be preferable.

The circled but not filled-in number specifies another set of countermeasures as a companion to the above three:

- 1: High-visibility crosswalk markings, parking restrictions on crosswalk approach, adequate nighttime lighting levels, and crosswalk warning signs



Roadway Configuration	Posted Speed Limit and AADT								
	Vehicle AADT <9,000			Vehicle AADT 9,000–15,000			Vehicle AADT >15,000		
	≤30 mph	35 mph	≥40 mph	≤30 mph	35 mph	≥40 mph	≤30 mph	35 mph	≥40 mph
2 lanes (1 lane in each direction)	● 2 4 5 6	● 5 6 7 9	○ 5 6 ● 9	● 4 5 6	● 5 6 7 9	○ 5 6 ● 9	● 4 5 6 7 9	○ 5 6 7 9	○ 5 6 ● 9
3 lanes with raised median (1 lane in each direction)	● 2 3 4 5	● ❸ 5 7 9	○ ❸ 5 ● 9	○ 3 4 5 7 9	○ ❸ 5 ● 9	○ ❸ 5 ● 9	○ ❸ 4 5 7 9	○ ❸ 5 ● 9	○ ❸ 5 ● 9
3 lanes w/o raised median (1 lane in each direction with a two-way left-turn lane)	● 2 3 4 5 6 7 9	● ❸ 5 6 7 9	○ ❸ 5 6 ● 9	○ 3 4 5 6 7 9	○ ❸ 5 6 ● 9	○ ❸ 5 6 ● 9	○ ❸ 4 5 6 7 9	○ ❸ 5 6 ● 9	○ ❸ 5 6 ● 9
4+ lanes with raised median (2 or more lanes in each direction)	● ❸ 5 7 8 9	● ❸ 5 7 8 9	○ ❸ 5 8 ● 9	○ ❸ 5 7 8 9	○ ❸ 5 ● 7 8 9	○ ❸ 5 8 ● 9	○ ❸ 5 ● 7 8 9	○ ❸ 5 8 ● 9	○ ❸ 5 8 ● 9
4+ lanes w/o raised median (2 or more lanes in each direction)	● ❸ 5 6 7 8 9	○ ❸ 5 6 7 8 9	○ ❸ 5 6 8 ● 9	○ ❸ 5 6 7 8 9	○ ❸ 5 6 ● 7 8 9	○ ❸ 5 6 8 ● 9	○ ❸ 5 6 ● 7 8 9	○ ❸ 5 6 8 ● 9	○ ❸ 5 6 8 ● 9

Given the set of conditions in a cell,

\# Signifies that the countermeasure is a candidate treatment at a marked uncontrolled crossing location.

● Signifies that the countermeasure should always be considered, but not mandated or required, based upon engineering judgment at a marked uncontrolled crossing location.

○ Signifies that crosswalk visibility enhancements should always occur in conjunction with other identified countermeasures.*

The absence of a number signifies that the countermeasure is generally not an appropriate treatment, but exceptions may be considered following engineering judgment.

○ 1 High-visibility crosswalk markings, parking restrictions on crosswalk approach, adequate nighttime lighting levels, and crossing warning signs
2 Raised crosswalk
● 3 Advance Yield Here To (Stop Here For) Pedestrians sign and yield (stop) line
4 In-Street Pedestrian Crossing sign
5 Curb extension
● 6 Pedestrian refuge island
7 Rectangular Rapid-Flashing Beacon (RRFB)**
8 Road Diet
● 9 Pedestrian Hybrid Beacon (PHB)**

Figure 4-24: FHWA uncontrolled crosswalk countermeasure selection matrix

Two other countermeasures are “candidate treatments” (shown in the table cell but not circled). Neither seems relevant at Ridgeview:

- 5: Curb extension. A curb extension occupies the parking lane, but there are no parking lanes on Limonite at Ridgeview. However the south curb line tapers toward the east, presumably to facilitate acceleration and merging. If this taper was not needed, the south curb could be extended to shorten the south half of the crossing.
- 8: Road diet (i.e., reduction of number of travel lanes). This would only be feasible if Limonite carried substantially lower traffic volume.

Suggestions

Table 4-9: Suggestions for Limonite Between Etiwanda and Ridgeview

#	Location	Item	Suggestion
1	Etiwanda intersection	South curb line east of Etiwanda	Extend north edge to match the curb line to the east (Mariscos Uruapan frontage), extending the corner parcel's north driveway accordingly.
2		Southwest corner	a) Install a (possibly segmented) right turn channelization island, shortening the west and south crosswalks accordingly. b) Install a diagonal crosswalk between the island and the outer curb, with high-visibility markings and possibly a raised crossing surface.
3		Eastbound bus routing	Have eastbound buses approach in the #2 through lane instead of the right turn only lane
4		Northbound approach	Extend the two through lanes to the realigned south crosswalk.
5		All approaches	Install advance limit (stop) lines four feet upstream of the crosswalks.
6	North side east of Etiwanda	Sidewalk	Install continuous sidewalk between Etiwanda and Troth Street (which is reachable from the east via 60th Street).
7	Ridgeview Avenue	Uncontrolled crossing	a) Install a Pedestrian Hybrid Beacon on the east leg, with dual sets of pedestrian call buttons — one at normal height and higher ones usable by equestrians. (The east leg is preferred because of the Santa Ana River open space including the equestrian staging area.) b) Consider also installing a raised median refuge on the east leg, with additional pedestrian call buttons, to further improve crossing safety for slow pedestrians.

4.4.5. Area #5: 34th Street between Roubidoux Boulevard and Crestmore Road

Existing conditions

Figure 4-25 shows the 34th Street focal area and the street network and land use between it and Mission Boulevard. Orange lines are streets; purple lines indicate the school's internal driveway. 34th parallels Mission approximately 1,650' (0.31 mile) to the northeast. It extends approximately 4,900' between Avalon Street and the Santa Ana River corridor. Roubidoux Boulevard intersects at a traffic signal approximately 890' east of Avalon, so the Roubidoux — river segment is approximately 4,000'.

The Riverside County Health System building has been purchased by the City as a Public Works facility, and the northeast corner parcel at Mission / Crestmore has been approved for a mixed-use affordable housing development.

The City does not have formal traffic volume counts for 34th, however staff estimates 1,200-1,500 vehicles per day between Roubidoux and Wallace, and between 1,000 and 1,200 between Wallace and Crestmore. Staff further noted that there is some peaking in the AM and PM peak hour but also at school dismissal time (2:15-2:45 pm).

Intersections and connectivity

There are five intersections on this segment:

Table 4-10: 34th Street Segments East of Roubidoux Boulevard

Street	Segment	Junction	Control	Crosswalk markings
Roubidoux Blvd		4-way	Signal	2-line yellow, all legs
Wallace St	1,900	4-way, 34' offset	All-way stop	None
Daly Ave	770	T (south)	One-way stop	None
Crestmore Rd	700	T (south)	One-way stop	None
Water St	450	T (south)	One-way stop	None

Wallace Street, Daly Street, and Crestmore Road connect between Mission and 34th. Crestmore is closest to the Mission's bridge over the Santa Ana River. Along with 34th it serves as a bypass for out-of-neighborhood motorists who want to avoid Mission and Roubidoux and their major intersection, especially on weekday afternoons and weekends.

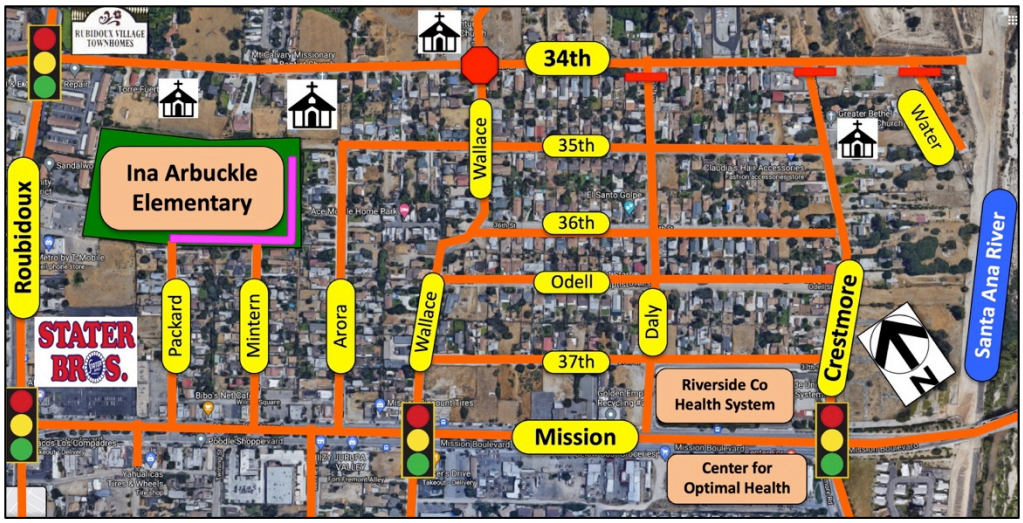


Figure 4-25: 34th Street focal area street network and key destinations

Cross section and land use

The first 270' east of Roubidoux is 60' wide with attached sidewalks and land use characteristic of the Roubidoux corridor — Sandalwood Apartments on the south side and the gated Roubidoux Village Townhomes development on the north side, with driveways respectively 195' and 225' from Roubidoux's east curb.

To the east, 34th's is "rural residential" in character, with a paved width of approximately 22', unpaved shoulders typically 8' - 10', and between 40' and 45' between front fences of fronting homes (Figure 4-26). Most houses have driveways and off-street parking, but some additional vehicles park (mostly parallel) on the shoulders. Parking occupancy observed midday on a weekday was quite low, however off-work demand may be higher as residents return home.

Figure 4-26: 34th Street between Roubidoux and Wallace, facing east

Pedestrian destinations and access

Key pedestrian destinations along or near 34th Street include five churches, listed in west-to-east order: Life Church of God in Christ (both sides of Roubidoux approximately 500' north of 34th),

Torre Fuerte Roubidoux (5530 34th), Mt. Calvary Missionary Baptist (5476 34th), New Century Baptist (5413 34th, northwest corner of Wallace), and Greater Bethel Apostolic Church (3480 Crestmore, approximately 500' south of 34th).

Key pedestrian destinations along Mission east of Roubidoux include Stater Brothers supermarket (at Roubidoux) and the health system facility on the south side between Daly and Crestmore.

The key internal pedestrian destination is Ina Arbuckle Elementary School, whose campus is bounded on the west by the properties fronting Roubidoux, on the north by properties fronting 34th, on the south by the side yards of the northernmost houses that front on Packard and Mintern, and on the east by the back fences of houses fronting Arora Street.

Access from 35th / Arora to Ina Arbuckle Elementary School

Vehicles can access the school from Mission via Packard Avenue and Mintern Street.

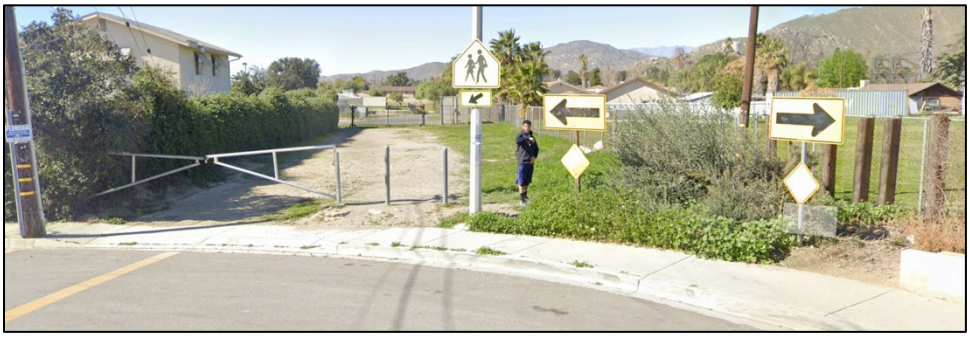
There is school pedestrian access from the west via Arbuckle School Road, a short dead end street on the east side of Roubidoux between the south edge of Sandalwood Apartments and the Roubidoux Community Services District parcel.

The school has pedestrian access from the northeast via the junction of Arora and 35th via a 160' long undeveloped area (Figure 4-27), which the City's public GIS viewer shows is part of the school campus parcel. The school's east fence has a pedestrian gate and double vehicle gates that were locked during the field visit (during the pandemic). The school confirmed that its northeast gate is unlocked during school hours.

Adding approximately 160' of all-weather walkway (essentially a sidewalk) between the sidewalk at Arora / 35th and the school's pedestrian gate would benefit neighborhood residents during the rainy season.

Access between 34th and 35th / Arora

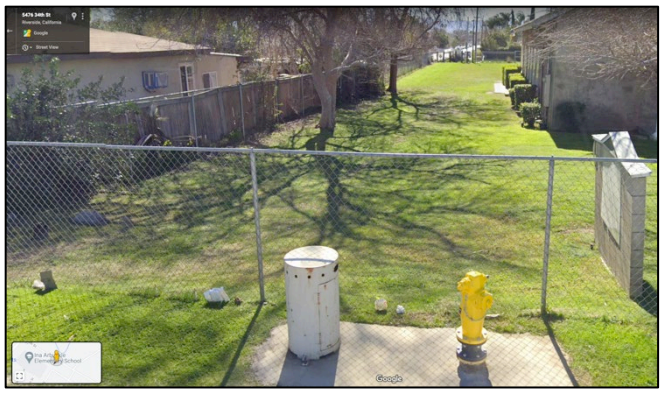
The north edge of the vacant area is the back fence of Mount Calvary Missionary Baptist Church. That fence has a gate near the 35th / Arora corner that was open during field day observations (Figure 4-27(b) and right side of Figure 4-27(a)). Being able to walk through the church parcel between 34th and 35th / Arora is a short but vital link in the neighborhood's pedestrian circulation network because it eliminates the need for residents along 34th west of Wallace to walk to Wallace, along Wallace to 35th, and along 35th to Arora to access the school or continue south to Mission. The round-trip walk between the church parcel and Wallace is approximately 1,250' — 4.75 minutes at a moderate adult speed of 3 mph (264 ft./min). This detour will be incurred twice daily (i.e., almost 10 minutes total) if students are also walked home, and parents escorting youngsters may walk slower than 3 mph.



a) Looking west through vacant parcel toward school from Arora / 35th corner

b) School's northeast gate

c) Mt. Calvary church's south fence gate



d) Church parcel east perimeter, looking south from 34th

Figure 4-27: Ina Arbuckle Elementary School – northeast pedestrian access

This direct access also shortens walking trips to destinations on Mission west of Arora, including the shopping center between Roubidoux and Packard (Stater Brothers supermarket, Pharmacy Express, and a laundromat).

Being able to walk directly between 34th and 35th via the church parcel is also important for safety because it eliminates over 900' of exposure walking along streets without sidewalks — 600' along 34th and 320' along Wallace.

The distance between the east wall of the church and the property's east fence appears to be 30'. Within that space several mature trees are aligned between 6' and 8' from the fence. If the church is comfortable with continuing to allow through pedestrian access, consideration should be given

to preserving access for the neighborhood in perpetuity by negotiating an easement or purchasing a strip of land for a narrow linear park that incorporates the walking route.

Reducing speeds on 34th to improve walkability

City staff said that there is a strong desire for a safe and comfortable walking environment in the neighborhood, especially by parents accompanying children on their way to school and shopping. There are two impediments: vehicle speeding, which endangers and intimidates pedestrians walking along and crossing the street, and the absence of a protected walkway.

Staff said that actual speeds along 34th are 40 mph or greater. The long distance between controlled intersections or turns is a contributing factor (1,900 Roubidoux-Wallace, 1,470 Wallace-Crestmore).

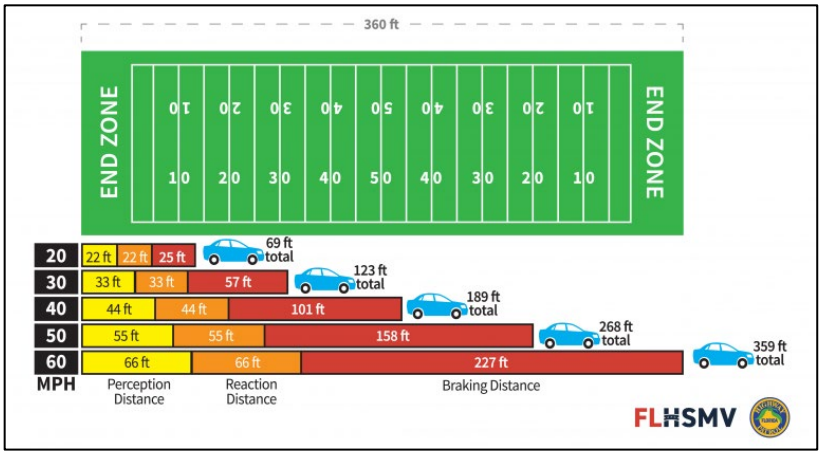
As shown in Figure 4-28, vehicle speed strongly affects stopping distance and pedestrian injury severity because kinetic energy increases as the square of speed — 2x speed, 4x energy. At an impact speed of 40 mph, 5 of 6 pedestrians will die. At an approach speed of 20 mph the stopping distance is so much shorter that the interaction may be a near-miss instead of an impact, and any impact is much less likely to seriously injure or kill.

Especially without a separated pedestrian travelway, limiting vehicle speeds along 34th to pedestrian-compatible levels is key to safety.

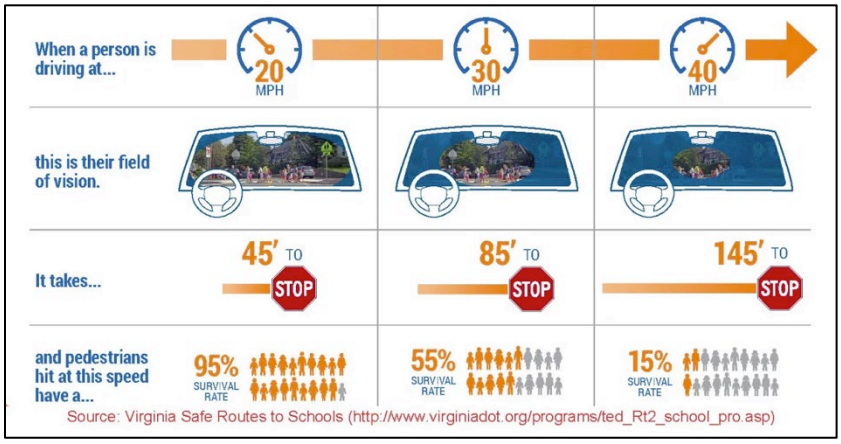
No traffic calming devices are present on 34th Street between the controlled intersections at Roubidoux and Wallace, or between Wallace and Crestmore where most traffic turns. To effectively calm a corridor, devices need to be spaced closely enough that motorists do not regain excessive speed between them. A device's effective behavior-changing distance (upstream and downstream) depends on its type and the vertical or horizontal deflection that it produces.

An evenly-spaced series of two or three speed humps could be effective on the 1/3-mile stretch between Roubidoux and Wallace. If the City chose to install two slow points, one could be approximately 600' west of Wallace, at Mt. Calvary church — the location of the pedestrian through-connection to Arora / 35th. The other could be approximately 600' west, perhaps at a parcel boundary near Torre Fuerte church.

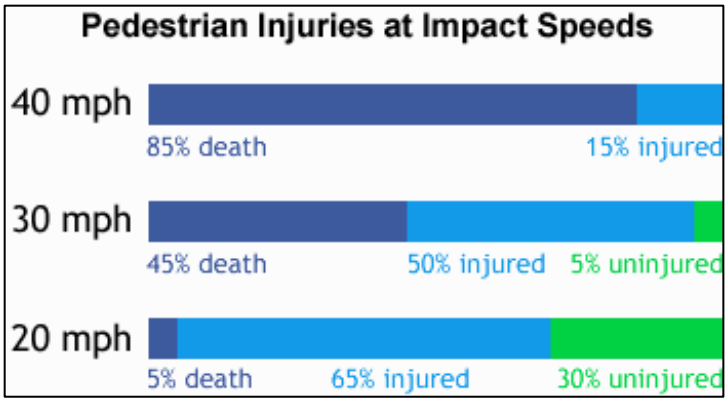
At present Jurupa Valley does not deploy humps. To minimize impact on emergency vehicle response time and transit bus operations, the City may wish to instead consider speed "cushions" (slotted speed humps) instead of speed humps, at least on EMS response routes. These are sets of small speed humps installed across the roadway width, with wheel gaps that wide-axle emergency vehicles and transit buses can use to straddle a hump without raising a wheel. If the gaps are installed properly, ordinary-axle vehicles must raise at least one wheel.



a) Florida Highway Safety and Motor Vehicles



b) Virginia Safe Routes To Schools



c) Saferoutesinfo.org

Figure 4-28: Speed vs. perception / reaction / stopping distance and pedestrian survival

On the 1,470' Wallace — Crestmore segment, the Daly Avenue intersection near the midpoint is a good opportunity for calming. Because of 34th's low volume here, a "neighborhood traffic circle" could work well. These have a small raised (curbed) center island around which most vehicles circulate counterclockwise, but larger trucks and trailer-rigs can make left turns in front of the island because oncoming volume is low. On uncurbed streets like 34th, small roadway-edge islands upstream and downstream may be needed to prevent drivers from avoiding the deflection. Figure 4-29 shows a successful installation at a curbed T-intersection in Sunnyvale, CA. The deflection islands at the "top" of the T (left side) incorporate crosswalk curb ramps.

Canary Drive at Loch Lomond Court, Sunnyvale, CA

Figure 4-29: Neighborhood circle at T-intersection on curbed street – note small islands

It is suggested that the City network with California cities that have positive experience with speed cushions or humps, and also look into neighborhood traffic circles. City staff provided a copy of a June 24, 2021 staff report with images and discussion of a neighborhood traffic circle recently installed in the City of Riverside along Victoria Avenue.

Reid Ewing's classic Traffic Calming: State of the Practice (ITE/FHWA, 1999) discusses device design — including speed hump (but not speed cushions) and neighborhood traffic circles — and effective spacing. Its figure 3.45, Midpoint Speed versus Distance Between Slow Points, is particularly informative. This design guide is downloadable from NACTO's website:

https://nacto.org/wp-content/uploads/2012/06/Ewing-Reid-1999.pdf

The ITE website's Technical Resources area has a Traffic Calming focal area with illustrated application notes (PDFs) for 19 treatments including speed humps:

https://www.ite.org/technical-resources/traffic-calming/traffic-calming-measures/

Minnesota DOT version of FHWA roundabout brochure:

https://www.dot.state.mn.us/stateaid/trafficsafety/roundabout/fhwa-brochure.pdf

Field-installable modular speed cushion kits are useful for pilot tests and permanent installations. This manufacturer's page has a video showing a fire truck using the wheel gaps.

https://trafficlogix.com/speed-cushions

Creating a sidewalk or protected walkway along 34th

Along with limiting vehicle speeds, a walking area along one or both shoulders is needed. It should provide continuous unobstructed travel width and preferably also an all-weather surface. Typically this would be a sidewalk, however the neighborhood has historically valued its rural character (i.e., no sidewalks). But given 34th Street's typically 8' wide shoulders, this means walking unprotected along the street edge and having to walk in the street or squeeze next to a front-yard fence.

A 5' walkway or sidewalk accommodates two adults (2.5' each) walking together or passing in opposite directions. Vehicles are at least 6' wide. The shoulder width, minimum 8', is not sufficient for both parking and a usable walkway. Because parking occupancy appears to be quite low, and because a walkway along the south side is arguably a higher priority than the north side due to destinations (two churches, and the route to the elementary school), it is suggested to implement a walkway on the south side and require that all street parking use the north side.

Because of 34th's low traffic volume, gaps between vehicles will generally be sufficiently frequent and long that crossing the street can be comfortable — especially if speeding is effectively addressed. Using staff's assumption of 1,500 vehicles per day between Roubidoux and Wallace and *doubling* the traffic engineering rule of thumb that 10% of daily traffic is during peak hour, 300 vehicles could be expected during peak hour, which if divided equally gives 150 vehicles per hour each way. Dividing an hour's 3,600 seconds by 150 gives 24 seconds between vehicles in one direction. Though the two hypothetical 24-second gaps in opposite directions will not always coincide to enable crossing immediately, this gives a feeling of how long a pedestrian might need to wait to cross.

Alternative: Edge Lanes (pedestrian-bicycle shoulders)

Because of the street's low traffic volume, another relatively new (to U.S. practice) option may be worth considering — the "Edge Lane Road" (a.k.a. "Advisory Shoulders") treatment described in FHWA's Small Town and Rural Multimodal Networks publication. An Edge Lane Road changes the pavement markings of a typical two-lane low-volume rural-character street with a centerline to a narrower two-way center lane with no centerline, bounded by dashed lines that define paved shoulders for use by pedestrians and bicyclists. The shoulder areas may optionally be visually defined by contrasting pavement.

Motorists driving an Edge Lane Road typically center their vehicle in the two-way center (vehicular) lane until they encounter oncoming traffic, at which point they may encroach into the right shoulder *after yielding to pedestrians and bicyclists in it*. After the oncoming conflict is resolved they return to the center lane.

34th Street's volume is clearly within the "preferred" range on the graph in Figure 4-30, and for pedestrian safety (see Figure 4-28) it will be important to calm speeds to at least the "potential" range if not the "preferred" range.

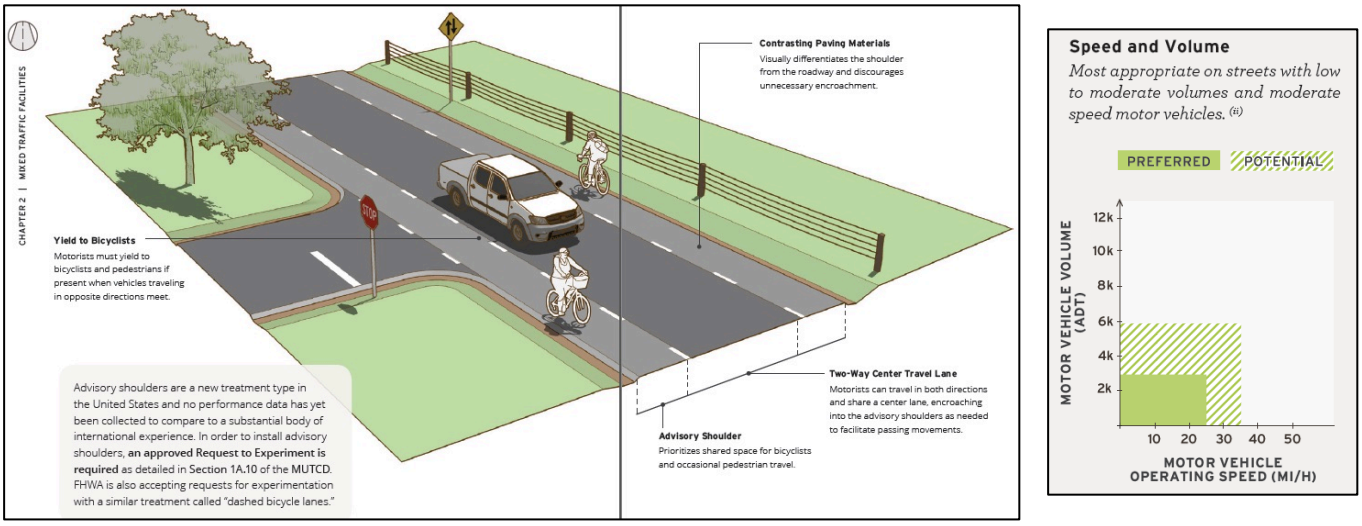


Figure 4-30: Edge Lane Road elements (FHWA Small Town and Rural guide)

Northern European countries have decades of experience with Edge Lane Roads. The are being discussed for U.S. adoption, and pilot tests (under FHWA's Experimentation process) are being rolled out including several in Humboldt County. More information is at these websites:

ruraldesignguide.com/mixed-traffic/advisory-shoulder

www.advisorybikelanes.com

Suggestions

Table 4-11: Suggestions for 34th Street Area Between Roubidoux and Crestmore

#	Location	Item	Suggestion
1	34th Street roadway	Reducing speed to 25 mph range	a) Consider installing traffic calming devices at the one-third points between Roubidoux and Wallace: * East side of Mt. Calvary church (~600' from Wallace) * Near Torre Fuerte Roubidoux (~600 from Roubidoux) Devices could potentially be speed humps, "speed cushions" (slotted speed humps), or one-way slow points.
			b) Consider installing a traffic calming device within or adjacent the Daly Avenue intersection (~700' from both Wallace and Crestmore), such as a speed hump on the east or west leg, or a neighborhood traffic circle — possibly with small deflection islands to prevent "bypassing".
2	34th Street – walkway	Need for assured width given parking along shoulders	Require that all on-street parking use the north shoulder. On the south side between the pavement edge and front yard fence lines, install a standard sidewalk or a walkway protected from traffic with a raised feature such as an intermittent asphalt dike.
3	School pedestrian access from Arora / 35th	Need for all-weather walkway	Add a minimum 8' paved walkway between Arora Street's school crosswalk at 35th Street, and the school's northeast pedestrian gate approximately 160' west.
4	Walkway between 34th and 35th along east edge of Mt. Calvary church yard	Need to preserve access in perpetuity	a) Obtain an access easement, or b) Purchase a strip of land along the fence
5	34th Street and other low-volume rural roadways	Alternative cross section	Look into Edge Lane Roads for potential applicability in Jurupa Valley.

4.4.6. Area #6: Mission Boulevard between Bellegrave Avenue and Pedley Road

Existing conditions

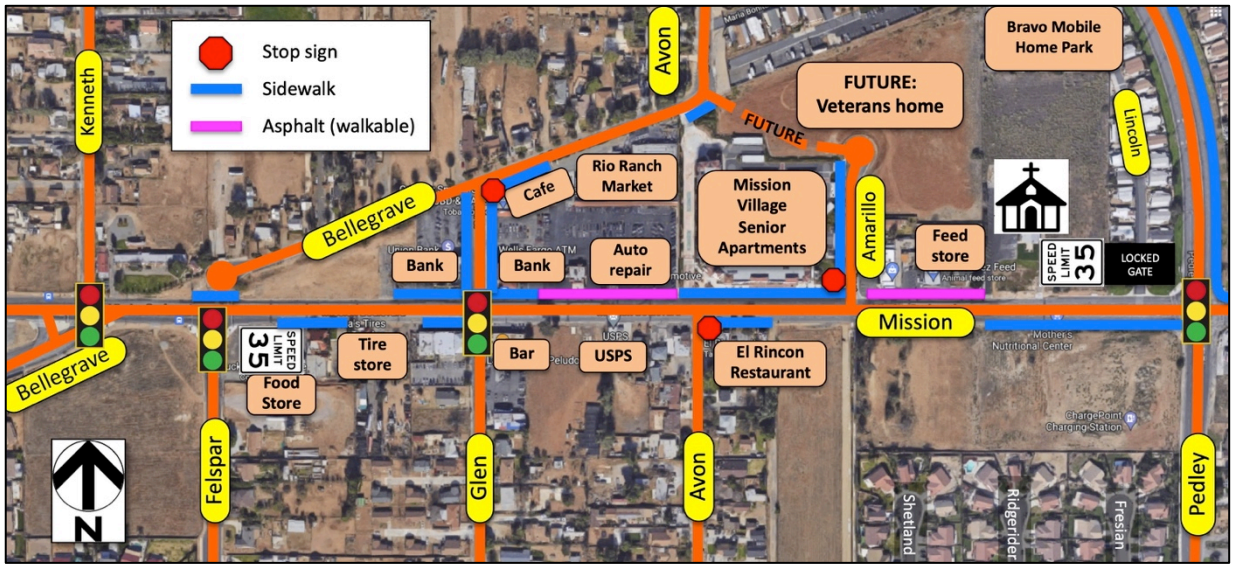


Figure 4-31: Mission Boulevard between Bellgrave Avenue and Pedley Road

The focal area extends approximately 3,000' (0.57 miles) along Mission Boulevard between Bellegrave Avenue and Pedley Street. Mission runs approximately east-west in Jurupa Valley's Glen Avon district. In this area it has five lanes — two in each direction plus a center turn lane. Street width is generally 60'-65' except for a widening for the passenger loading area at Mission Village Senior Apartments (74') and starting 250' west of Pedley (72').

The posted speed limit is 35 mph. There are Riverside Transit bus stops at Bellegrave / Kenneth, Felspar, Glen, Avon and Pedley.

Figure 4-32: Mission Boulevard looking west toward Glen Street

Bellegrave angles west-southwest / east-northeast. It intersects from the south at a signal that marks the focal area's west end. The north leg is Kenneth Way, which runs due north to Ben Nevis Boulevard, the south frontage road of the SR-60 freeway. Bellegrave continues on the north side of Mission after a gap, resuming just north of the Felspar signal at a cul-de-sac with no vehicle

connection to Mission. It continues approximately 1,300' before turning due north just past the gated north driveway of Mission Village Senior Apartments, becoming Avon Street.

Pedley Road intersects at a signal approximately 3,000 east of Bellegrave. It runs due south from Mission; to the north it curves northwest, intersects the east end of Ben Nevis Boulevard, has an interchange with SR-60, and ends at Granite Hill Drive, SR-60's north frontage road.

Three streets intersect Mission from the south between Bellegrave and Pedley, and run due south from Mission: Felspar Street (T signal), Glen Street (4-way signal), and Avon Street (T signal). Glen continues north through a shopping plaza, ending at a stop sign at Bellegrave.

Amarillo Street is the only street that intersects from the north between Glen and Pedley. It is a short stub that serves the east entrance of the Mission Village Senior Apartments. At its north end is a cul-de-sac that will serve a future Veterans Home. City staff said that as part of that development, a short public street would connect Amarillo to the Bellegrave / Avon junction.

Lincoln Avenue parallels Pedley on its west side north of Mission. It is an internal private street of the Bravo Mobile Home Park, which occupies the area bounded on the west and east by Avon and Pedley. Lincoln's south end at Mission is gated and locked; there is currently no private pedestrian entrance at that point.

Francisco Jr. Avenue parallels Pedley on its seat side north of Mission. It is an internal private street of the Bravo Estates Mobile Home Park, which has two sections — one along Pedley and the other on the west side of Agate Street (east of Pedley) near the SR-60 corridor.

Sidewalk conditions

On the north side of Mission, concrete sidewalks are only present across the Felspar intersection, for approximately 150' on either side of the Glen intersection, and for approximately 440' along the Mission Village Senior Apartments frontage.

The Rio Ranch Market shopping plaza frontage, between Glen Street and the Senior Apartments, has continuous walkable asphalt. Street-side objects (hydrant, backflow preventer, telecom cabinet) are set back 5'-6' from the curb — sufficient for an attached walkway that could be made wheelchair with gently sloped "bypasses" behind each driveway apron.

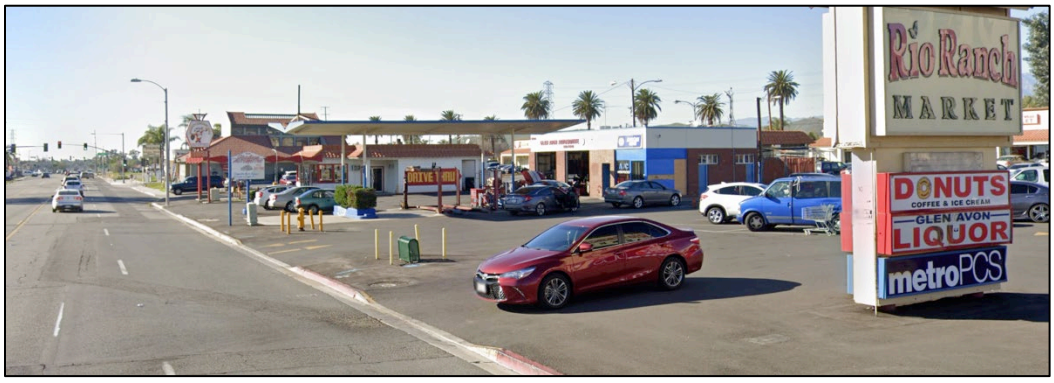


Figure 4-33: Pedestrian conditions along Rio Ranch Market shopping plaza

As shown in Figure 4-34, the shopping plaza has a back-side pedestrian access point approximately 195' east of Glen, via a gap in Bellegrave's south fence (red bollards). The access path splits around and between two large hedge segments that block sightlines. It is suggested to work with the property owner to make this entrance safer and more welcoming — and to extend the adjacent sidewalk to serve it.

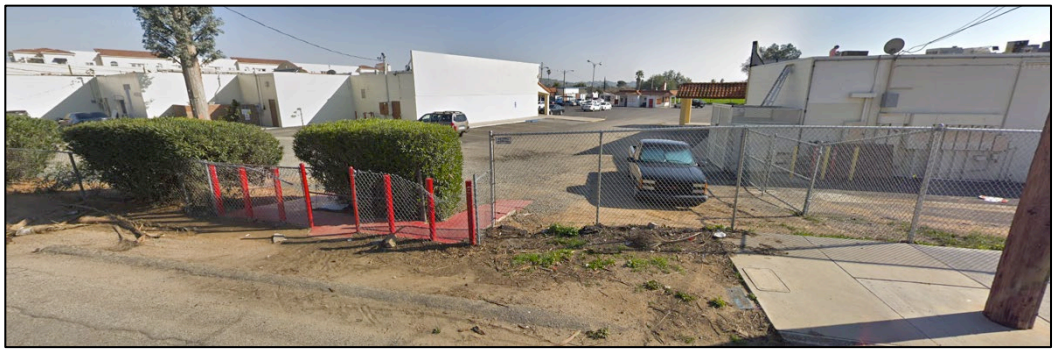


Figure 4-34: Pedestrian access on back side of Rio Ranch Market shopping plaza

East of Amarillo there are several small set-back businesses with varying driveway and front parking conditions. Providing a reasonably protected walkway along this segment would involve parcel-specific design.

Figure 4-35: North-side pedestrian conditions east of Amarillo

On the south side of Mission, sidewalks only exist along two parcels between Felspar and Glen (Lucky 1 Food Store and a small office building, for approximately 200' east of Avon, and as a wide concrete path along the frontage of a large new building on the south side at Pedley.

Analysis

Sidewalk connectivity

The key need within the focal area appears to be connected sidewalks. In Figure 4-31 the blue lines indicate existing sidewalk segments and purple lines indicate continuous asphalt frontage (i.e., existing all-weather walking surface) that could be improved for walking by removing obstacles, providing accessible bypasses at driveway aprons, and physically preventing encroachment by vehicle movements and parking.

Addition of sidewalks or upgrading of existing asphalt frontage is suggested on the following segments. These are not ordered by suggested priority or phasing. It is suggested to use this table as a starting point for a segmented sidewalk improvement plan for this focal area.

Table 4-12: Suggested Segments for Provision of Sidewalks

#	Street	Side	Segment	Existing	Action (Value)
1	Mission	N	Glen - Avon	Asphalt	Remove one unused private pole within 10' of curb. Route walkway behind driveway aprons. Protect from parking with dikes or raised landscape islands. (Continuity / completion, Glen - Amarillo)
2	Mission	S	Felspar - Glen	Sidewalk with gaps	Install sidewalk in gap segments. (Continuity / completion, entire block)
3	Mission	S	Glen – Avon	None	Install sidewalk. (Walkability from Felspar to El Rincon restaurant)
4	Mission	N	Amarillo – 330' E	Asphalt	Reconfigure parking within 10' of curb. Route accessible walkway behind driveway aprons. Protect entire walkway from parking using raised elements. (Improve pedestrian safety around vehicles.)
5	Bellegrave	S	Glen – Avon	Short segment at ends	Complete the sidewalk. (Connect north Avon, including Bravo MHP, to retail.)
6	Mission	N	330' E of Amarillo – Pedley	None	Install sidewalk. (Connect Bravo and Bravo Estates Mobile Home Parks to retail, if they add pedestrian gates at Mission.)
7	Mission	N	Kenneth – Glen	Short segments at Felspar and Glen	Complete the sidewalk. (Connect Kenneth to Mission north-side retail and the north leg of Bellegrave.)
8	Mission	N	Kenneth - Hunter	None	Install sidewalk. (Connect Stanton and Hunter to focal area retail.)

Two locations currently have perpendicular parking accessed by wide driveways — on the south side just east of Glen, and on the north side just east of Amarillo. Because the parking stalls at both locations are set back a sufficient width from the curb, these are not impediments to the installation of walkways or sidewalks. However, as these parcels redevelop or nearby parking opportunities become available off-street or along side streets, it is suggested to remove all perpendicular parking to improve pedestrian safety.

Pedestrian crossing between Glen and Pedley

Residents of Avon Street south of Mission wanting to access the Rio Ranch Market shopping plaza on the north side must either walk approximately 600' to the Glen Street signal (5-minute round trip detour) or cross Mission without protection. There is an existing north-south sidewalk along the east edge of the shopping plaza's parking lot that enables pedestrians on Mission's north sidewalk to walk directly to the supermarket.

Figure 4-36: Rio Ranch Market parking lot east-edge sidewalk

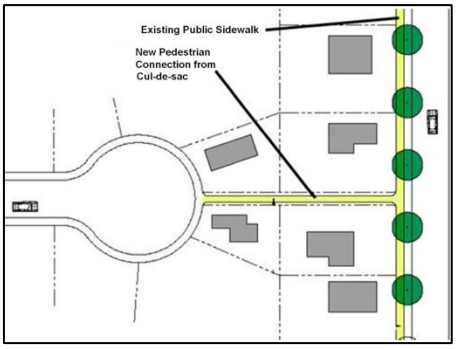
Requiring pedestrian connectivity in developments

As this area and others continue to build out, developments should be required to incorporate the fine-grained pedestrian connectivity needed support active transportation, recreation and public health. Failing to do so locks in the need to drive (or to walk or bike long distances). A subdivision near Pedley illustrates this (Figure 4-37).

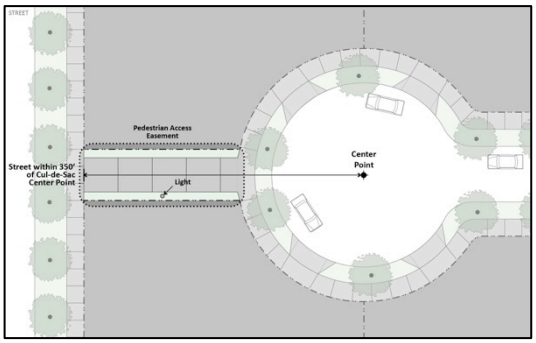
Figure 4-37: Single-family subdivision – missed opportunities for active transportation

Incorporating paths on parcel boundaries (green lines) would have had minimal impact on platting (lot size) that would have been more than offset by enhanced marketable amenity and resale value. This could also have significantly reduced trip generation and traffic congestion from school drop-off / pickup trips.

Here are two municipal code examples and three California implementations, including one in Jurupa Valley.



a) Powhatan County, VA



b) South Elgin, IL

c) Davis, CA

d) Palo Alto, CA

e) Jurupa Valley (Wanamaker / Bishop – Magnum / Brick)

Figure 4-38: Subdivision pedestrian connections

Suggestions

Table 4-13: Suggestions for Mission Between Belgrave and Pedley

#	Location	Item	Suggestion
1	Entire focal area	Sidewalk connectivity	Create a segmented sidewalk improvement plan — see Table 4-12. Prioritize and phase implementation. Along each segment, ensure that the walking route has gently sloped bypasses at each driveway apron, minimize or eliminate perpendicular parking, and ensure that the walking route is protected from vehicle circulation and parking movements, and buffered from the door-opening area beside parked vehicles.
2	Crossing at Amarillo	Need for active device	Consider installing an enhanced crosswalk with pedestrian-activated active features — either Rectangular Rapid Flashing Beacons (RRFBs) or a Pedestrian Hybrid Beacon (PHB).
3	Back-side pedestrian access to Rio Ranch Market shopping plaza, on Bellegrave	Vegetation blocks sightlines	Remove or replace tall bushes
4		Adjacent sidewalk	Extend to the pedestrian access point
5	New developments including residential subdivisions	Pedestrian shortcuts and related connectivity	In the City's Municipal Codes, subdivision design guide, and planning review, require developments to provide fine-grained pedestrian / bicycle connectivity including shortcuts at culs-de-sac and periodically along long blocks, and connections to collector and arterial streets and nearby trails. See Figure 4-37 and associated discussion.

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.
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.

Pedestrian Improvement Measures			
Measure	**Description**	**Benefits**	**Application**
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.
Enhanced Bus Stop Amenities	Adequate bus stop signing, lighting, a bus shelter with seating, trash receptacles, and bicycle parking are desirable features at bus stops.	Increase pedestrian visibility at bus stops and encourage transit ridership.	Appropriate at sites with high patron volumes.

APPENDIX B: GLOSSARY OF BICYCLING IMPROVEMENT MEASURES

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

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

Sharrows	A pavement legend that indicates the location within the travel lane where bicyclists are expected to occupy.	The sharrow encourages cyclists to ride outside of the door zone and studies have shown that sharrows reduce the incidence of cyclists riding on the sidewalk and wrong-way riding.	Two or more lane city streets where the right-most lane is too narrow for a motor vehicle to safely pass a cyclist within the travel lane.
Bike Lanes May Use Full Lane sign (MUTCD R4-11)	Regulatory Sign	Informs motorists and cyclists that cyclists may be travelling in the center of a narrow lane.	Two or more lane city streets where the right-most lane is too narrow for a motor vehicle to safely pass a cyclist within the travel lane.
Share the Road sign (MUTCD W-11/ W16-1p)	Warning sign and placard	Informs motorists to expect cyclists on the roadway.	Two-lane roads particularly in rural areas where shoulders are less than four-feet.
Bike Directional Signs (MUTCD D1 series or similar)	Informational signs indicating place names and arrows, with distances as a recommended option (D1-2C)	Informs bicyclists of the most common destination served by the bike route in question.	Particularly useful to direct cyclists to a facility such as a bike bridge or to use a street to access a major destination that might not otherwise be readily apparent.
D. New infrastructure to improve bicycle connectivity			
Bike Path	A paved pathway for the exclusive use of non-motorized traffic within its own right of way;	Provides additional connectivity and route options that otherwise would not be available to bicyclists.	Wherever a continuous right of way exists, typically found along active or abandoned railroad ROW, shorelines, creeks, and river levees.
Pathway connections	Short pathway segments for non-motorized traffic, for example, that join the ends of two culs-de-sac 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 to	Must meet warrants based on traffic/ pedestrian / bicycle volumes, collision history, and/ or other factors.
Modern Roundabout	A traffic circle combined with splitter island on all approaches and entering traffic must YIELD to traffic within the roundabout; typically designed for traffic speed within the roundabout of between 15 and 23 mph.	Slows traffic on cross street so that cyclists can more easily cross.	Roundabouts are a better alternative than an All-Way Stop signs when the side street volume is approximately 30 % of the total intersection traffic volume and total peak hour volume is less than 2300 vehicles per day.
Hawk Beacon Signal	HAWK (High Intensity Activated Crosswalks) are pedestrian-bicyclist actuated signals that are a combination of a beacon flasher and a traffic control signal. When actuated, HAWK displays a yellow (warning) indication followed by a solid red light. During the cross street phase, the driver sees a flashing red “wig-wag” pattern until the clearance interval has ended and the signal goes dark.	Provides the need gaps in traffic so bicyclists can safely cross the street, can be timed separately for bicycles and pedestrians. Reduces pedestrian-vehicle conflicts and slows traffic speeds	Useful in areas where it is difficult for bicyclists /pedestrians to find gaps in automobile traffic to cross safely, but where normal signal warrants are not satisfied. Appropriate for multilane roadways.
Rectangular Rapid Flashing Beacon (RRFB/Stutter Flash)	A warning sign that also contains rapid flashing LED lamps. The beacon may be push-button activated or activated with pedestrian detection.	Initial studies suggest the stutter flash is very effective as measured by increased driver yielding behavior. Solar panels reduce energy costs associated with the device.	Locations not controlled by any measures listed above. Appropriate for multi-lane roadways.

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

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

APPENDIX C: RESOURCE LIST AND REFERENCES

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

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

Adapted from FHWA Pedestrian Road Safety Audit Guidelines and Prompt Lists

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

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

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APPENDIX D: STREET CONNECTIVITY

Importance of Street Connectivity

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

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

Policies for Street Connectivity

A network of safe, direct, and comfortable routes and facilities: A 2004 PAS report recommends that pedestrian (and bicycle) path connections be every 300 to 500 feet; for motor vehicles, they recommend 500 to 1,000 feet.[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.

[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, Culs-de-sac (or dead-end streets) are discouraged and can be no longer than 200 feet, and have no more than 25 dwelling units.

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

- Intersection density
- Street density
- Average block length
- Link/node ratio
- Connected node ratio = intersections/ (intersections + culs-de-sac)
- 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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