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1. INTRODUCTION

The City of Pasadena is the seventh most populous city in Los Angeles County and consists of approximately 23 square miles. Residents of Pasadena use many modes of transportation including personal vehicles, transit, bicycling, and walking. This report focuses on the walking mode of travel.

This report documents research aimed at enhancing pedestrian safety in general, though the overall focus of this report is on signalized intersections. Recent data compiled by the City of Pasadena indicates that approximately 70 percent of vehicle-pedestrian collisions resulting in injury or fatality occurred at signalized intersections, over a single year. Several areas in Pasadena such as Old Pasadena, Metro Gold Line Stations, the Rose Bowl, and other districts are known to experience high levels of pedestrian activity on a regular basis.

In the context of enhancing signalized intersections, this report generally notes two types of enhancements, operational and geometric. Operational treatments such as right-turn-on-red restrictions or LED signs that illuminate turn restrictions when pedestrians are detected can help improve pedestrian visibility, driver compliance with traffic control devices, and address some vehicle-pedestrian conflicts.

Geometric treatments at intersections can be used to enhance the pedestrian environment by providing for compact intersection design, median refuge islands, and additional pedestrian accommodations. Other treatments include using signing and striping to alert motorists to the presence of pedestrians at intersections. Examples of education, enforcement, and encouragement are all included as important components to an effective pedestrian safety program.

This report was produced in cooperation with the City of Pasadena. Funding for this program was provided by a grant from the California Office of Traffic Safety, through the National Highway Traffic Safety Administration. The suggestions presented in this report are based on field observations and time spent in the City of Pasadena by the authors. These suggestions, which are based on general knowledge of best practices in pedestrian 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 that may be relevant to the pedestrian safety issues in the City.

This report is divided into seven chapters as described below:

1. **Chapter 1 – Introduction** discusses the purpose and organization of this report.

2. **Chapter 2 – Programs, Policies, and Practices Benchmarking Analysis** reviews the City’s existing practices relating to pedestrians and provides suggestions for potential enhancements.

3. **Chapter 3 – Literature Review and Summary of Best Practices for Pedestrian Treatments at Signalized Intersections** presents a review of research on treatments and strategies for accommodating pedestrians at signalized intersections.

4. **Chapter 4 – Pedestrian Safety Toolbox** presents an array of tools to enhance pedestrian safety at stop-controlled, signalized, and uncontrolled locations, and strategies for providing education, enforcement and encouragement for pedestrians and motorists.

5. **Chapter 5 – Collision History Review and Analysis** provides an analysis of five years of pedestrian-vehicle collision data from the City of Pasadena.

6. **Chapter 6 – Recommendations for Walking Audit Locations** presents potential treatments for five intersections that were visited with City staff and help to serve as prototypical examples for other locations in Pasadena.
7. **Chapter 7 – Next Steps** provides ideas for potential funding sources for recommendations in this report and other activities that can be used to continue promoting pedestrian safety and motorist awareness.
2. PROGRAMS, POLICIES, AND PRACTICES BENCHMARKING ANALYSIS

In this chapter we present a benchmarking analysis of Pasadena’s pedestrian programs, polices, and practices. The benchmarking analysis is based on the two-hour in person interview conducted with City staff on Friday, October 3, 2010, and subsequent review of City documents and resources available online or provided in-person. The results of the benchmarking are first provided in a summary table, followed by a brief discussion and applicable suggestions for each subject area.

PASADENA BENCHMARKING ANALYSIS

A pedestrian safety interview was conducted with City staff to gain an understanding of the existing pedestrian policies, programs, and practices in Pasadena. This interview formed the basis for a benchmarking process that categorized the City’s programs, practices, and policies into three groups:

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

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 may determine where resources and efforts are best placed for meeting local development and infrastructure goals for pedestrians. The results of the benchmarking analysis are provided in Table 1.

The suggestions for potential improvement to the City’s existing programs and policies for each topic described above include the following:

KEY STRENGTHS

(a) Inventory of Sidewalks, Informal Pathways, and Key Pedestrian Opportunity Areas

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

The City has undertaken an inventory of existing informal pathways, sidewalks, and uprooted sidewalks with the intent of updating it every five years. The inventory has been utilized to develop safe routes to school projects and identify potential street treatments and enhancements where facilities are deficient. Sidewalk treatment projects are included in the CIP at a typical funding level of $200,000 per fiscal year.

Suggestion for Potential Improvement

- Complete geo-coding (currently underway) the existing inventory of sidewalks in the City and add informal pathways and key pedestrian opportunity areas.
<table>
<thead>
<tr>
<th>Benchmark Topic</th>
<th>Key Strength</th>
<th>Enhancement</th>
<th>Opportunity</th>
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<td>Transportation Demand Management Programs</td>
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<td>Use of Leading Pedestrian Intervals and Scrambles</td>
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<td>Routine Accommodations/Complete Streets</td>
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(b) Safe-Routes-to-School/Suggested Routes to School

Safe-Routes-to-School 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). Safe-Routes-to-School programs are important both for increasing physical activity (and reducing childhood obesity) and for reducing morning traffic associated with school drop-off. Funding for Safe-Routes-to-School programs and/or projects is available at the state and federal levels.

Pasadena applied for and received Safe-Routes-to-Schools grants in recent years. With awarded grants Pasadena has funded the installation of over 400 school-area signs, in-roadway pavement warning lights, transit access pads, sidewalks, curb ramps, and educational programs. Also, the City has worked with schools on implementing on-site valet pick-up/drop-off at schools.

Pasadena has a City-wide program called Safe Moves that has included bike rodeos and enforcement activities and provides maps of suggested routes to local schools. Pasadena Public Works and Police offer local schools their assistance to improve circulation, pick-up/drop-off, and walkability. The Public Works department provides pamphlets promoting safety and the City has a website with a video and other materials addressing pedestrian safety.

Suggestion for Potential Improvement

- Continue applying for grant funding; apply for non-infrastructure as well as infrastructure projects.

(c) Pedestrian Plan

This type of plan includes a large menu of policy, program, and practice recommendations, as well as site-specific (and prototypical) engineering treatment recommendations. A Pedestrian (or Pedestrian/Bicycle) Plan documents a city’s vision for improving walkability and pedestrian safety; establishes policies, programs, and practices; and outlines the prioritization and budgeting process for project implementation. Pasadena has a Pedestrian Plan that was adopted in 2006. Pasadena also has a Bicycle Master Plan adopted in 2000 with an update anticipated to be complete in 2010.
(d) Transition Plan for Streets and Sidewalks

An Americans with Disability Act (ADA) Transition Plan sets forth the process for bringing public facilities into compliance with ADA regulations. An ADA Transition Plan typically addresses public buildings, sidewalks, ramps, and other pedestrian facilities. An ADA Coordinator is typically responsible for administering a City’s ADA Transition Plan.

Pasadena has an ADA Transition Plan, updated in 2009, that addresses areas of the public right-of-way. The City also has a staff person (Robert Gorski) who acts as part-time ADA Coordinator.

(e) Specific Plans, Redevelopment Areas, and Overlay Zones

Transit-oriented development (TOD) includes mixed-use, walkable areas centered on transit stations and/or along transit corridors. When mixed-use development is convenient to transit service, long-distance travel can be accommodated on buses or trains, while short-distance travel is accommodated by bicycling or walking. TOD in turn has the potential to reduce automobile dependency and usage, and can result in reduced vehicle-miles traveled.

Pasadena has transit-oriented and mixed-use development in the central business district and near Metro Gold Line Stations. Additionally, area plans such as the Central District and Fair Oaks/Orange Grove Specific Plans stress walkability and pedestrian accommodations through a pedestrian network.

Suggestion for Potential Improvement

- Consider TOD, mixed-uses, walkability, bikeability, and pedestrian orientation as a high priority for redevelopment.

(f) Traffic Calming Programs

Traffic calming programs and policies set forth a consensus threshold on neighborhood requests and approvals, as well as standard treatments and criteria.

Traffic calming programs in the City are generally localized efforts governed by the Neighborhood Traffic Management Program (NTMP). When residents are concerned over vehicle speeds, public safety, cut-through traffic, or congestion, they may request the City explore traffic calming options in their neighborhood. Pasadena also has stand-alone Speed Hump Standards. Pasadena includes a variety of traffic calming measures in their NTMP including: half-street closures, chicanes, bulb-outs, traffic circles, signing, and enforcement. Approximately $150,000 (not including staff time) is dedicated in the CIP for NTMP funds.
(g) Economic Vitality

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

The City has three BIDs: Old Pasadena, the Playhouse District, and South Lake Avenue. In addition, the City has a façade improvement program that will contribute up to 50% of façade improvement costs for commercial properties. Pasadena fosters a park-once environment and provides metered parking in areas of high-demand on-street parking. In particular, Pasadena is a national leader in dedicating revenue from parking meters to fund maintenance and streetscape improvements.

Suggestion for Potential Improvement

- Consider establishing additional BIDs in commercial areas of the City and apply funds towards pedestrian-related improvements.

(h) Transportation Demand Management Programs

Transportation Demand Management (TDM) programs encourage multi-modal travel by incentivizing non-auto options. As new development occurs, TDM programs can be expanded, formalized, and strengthened.

Pasadena has a comprehensive TDM program. The Pasadena Transportation Management Association (TMA) is a voluntary, non-profit, City-directed organization aimed at developing and implementing strategies for rideshare programs. Pasadena also has a Trip Reduction Ordinance (TRO) that applies to various uses and existing and proposed land uses, with some exceptions.

Existing TDM efforts by the City and other employers under the TRO include:

- Provision of bicycle and pedestrian amenities
- Private vanpools
- Transit subsidies
- Pay parking for employees
- Alternative work hours
- Capital improvements for transit services

The City has several staff leading these TDM efforts and conducts annual monitoring for large employers in the City.


**Suggestion for Potential Improvement**

- Consider establishing TDM programs for clusters of retail or employment where efforts such as subsidized public transit, eco-passes, shared parking, bicycle sharing, car sharing, and other programs can encourage various modes of transportation.

**(i) Leading Pedestrian Interval and Scrambles**

Leading Pedestrian Intervals (LPI) provide pedestrians with a “head start” signal timing before vehicles on the parallel street are allowed to proceed through an intersection. A 2000 study by the Insurance Institute for Highway Safety found that the LPI reduces conflicts between turning vehicles and pedestrians by enhancing the visibility of the pedestrian in the crosswalk.\(^1\) Pedestrian scrambles provide a pedestrian-only crossing phase, often allowing for diagonal crossings. LPIs and scramble phases are installed in Pasadena.

**Suggestion for Potential Improvement**

- Consider installing additional LPIs in areas of high pedestrian activity throughout Pasadena, providing a right-turn on red restriction as necessary per recent research findings.\(^2\)

- Evaluate the feasibility of installing additional scrambles in commercial districts with high pedestrian volumes.

**(j) Bicycle Parking Requirements**

Bicyclists become pedestrians after parking their bicycles. Safe and convenient bicycle parking is essential for encouraging bicycle travel (especially in-lieu of vehicle travel).

\[\text{Image of bicycle parking facilities}\]

The City has bicycle parking requirements for new development or additions to existing structures exceeding 15,000 square feet. Additionally, Pasadena classifies parking facilities into Class 1 and Class

---


2 parking facilities. Class 1 bicycle parking may include a full enclosed lockable space, an attendant, or a locked structure designated for storing bicycles. Class 2 bicycle parking consists of a rack, stand, or other similar device for securing bicycles. Non-residential structures are required to provide a minimum of four parking spaces while multi-family residential structures are required to provide one space for every six units. Retail uses are required to provide 25% Class 1 parking spaces and 75% Class 2 parking spaces. Multi-family residential structures are required to provide 100% Class 1 spaces, while industrial or office uses are required to provide 75% Class 1 spaces and 25% Class 2 spaces.

**Suggestion for Potential Improvement**

- Consider implementation of “branded” racks for Pasadena (with a unique design or City symbol).
- The Bicycle Parking Guidelines, published by the Association of Pedestrian and Bicycle Professionals (APBP), is a resource for best practices in bicycle parking design (see [http://www.bfbc.org/issues/parking/apbp-bikeparking.pdf](http://www.bfbc.org/issues/parking/apbp-bikeparking.pdf)).

  Additional information on bicycle parking is summarized on [www.bicyclinginfo.org](http://www.bicyclinginfo.org) and [http://www.bicyclinginfo.org/engineering/parking.cfm](http://www.bicyclinginfo.org/engineering/parking.cfm)

**(k) Street Furniture Requirements**

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

Pasadena includes street furniture requirements for the various specific plans; however, a City-wide street furniture ordinance is not in place.

**Suggestion for Potential Improvement**

- Consider establishing a City-wide Street Furniture Ordinance, building off requirements within specific plans, that requires street furniture for high pedestrian activity areas and transit stops.

**(l) Newspaper Rack Ordinance**

Newspaper racks may obstruct walkways and reduce accessibility and pedestrian conspicuity when ordinances are not in place. A Newspaper Rack Ordinance improves the pedestrian realm by reducing clutter and organizing sidewalk zones. A Newspaper Rack Ordinance details size, location, and maintenance requirements.

Pasadena has a Newspaper Rack Ordinance that regulates the appearance and location of newspaper racks.

**(m) Open Space Requirements**

Residents typically rate open space as among a city’s key assets and needs.

The City of Pasadena has open space requirements for various land uses. The Open Space Element of the City’s General Plan emphasizes policies for preserving open space. The Greenspace, Recreation and Parks Master Plan provides policies for preserving the City’s trail system. Pasadena also collects residential impact fees, a portion of which are allocated to maintaining or enhancing existing parks and open space.
(n) Attention to Crossing Barriers

Crossing barriers such as railroads, freeways, and major arterials, may discourage or even prohibit pedestrian access. Additionally, crossing barriers are often associated with vehicle-pedestrian collisions (including severe injuries and fatalities). Identifying and removing barriers, as well as preventing new barriers, is essential for improving walkability and pedestrian safety.

The City does not have a formal policy identifying and addressing barriers in the City, although the City does have barriers such as freeways, on- and off-ramps, and light-rail tracks. The City has a successful track record of dealing with at-grade light-rail crossings through the use of pedestrian barriers and other devices.

Suggestion for Potential Improvement

- Identify and create a GIS inventory of pedestrian barriers.
- Develop policies for reducing the barriers through prioritizing projects and requirements with future development.

(o) Access Management

Access management seeks to limit and consolidate access along major roadways, while promoting a supporting street system and unified access and circulation systems for development. In addition to driveways, access management involves the control of the location, spacing, design, and operation of median openings, interchanges, and street connections. Access management aims to provide efficiency and safety of access operations for all users including motorists and pedestrians.

The Pasadena Department of Transportation developed Draft Policies and Procedures for Driveway Design that provide basic criteria for review of driveway locations. These guidelines discuss municipal code requirements for driveways, call for the minimum number of driveways needed, prohibited driveway locations, and preferred driveway locations based on street classification and proximity to streets and other driveways. These guidelines explicitly state that consideration of pedestrian safety is a basic principle in driveway design.

ENHANCEMENT

(a) ADA Improvements

Compliance with the Americans with Disability Act (ADA) guidelines is important not only to enhance community accessibility, but also to improve walking conditions for all pedestrians.

Pasadena follows Federal ADA guidelines. Curb ramps in Pasadena are primarily diagonal curb ramps due to right-of-way, geometric, and budgetary constraints. Pasadena installs truncated domes for all new crosswalks. Additionally, whenever a project results in the removal, replacement, or resurfacing of a facility, the facility is improved to be consistent with current ADA requirements.
Pasadena also has a policy to address requests for on-street disabled parking that requires an accessible route from the parking spot to the front door of the business or residence.

**Suggestion for Potential Improvement**

- When the right-of-way is available, provide a stated goal of two curb ramps per corner in the Transition Plan.

**(b) Traffic Signals**

The 2009 Federal Manual of Uniform Traffic Control Devices (MUTCD), which is in the process of being adopted by California, requires that all new and retrofitted pedestrian signals heads have countdown indications. Replacing traffic signal bulbs with LED bulbs is also a best practice to increase visibility and improve efficiency.

Virtually all vehicle indications in the city are LED. All pedestrian signals have been outfitted with countdown indications. City specifications require that new pedestrian signals have countdown LED indicators.

The City maintains an inventory of signage in school zones, but does not maintain an inventory of signs, markings, and traffic signals with pedestrian facilities. Pasadena also has an inventory of work orders, many of which result from traffic investigations. Basic problems are typically brought to the attention of City staff via calls, internet requests, and personal visits. Traffic control devices near school areas are monitored before school starts.

**Suggestion for Potential Improvement**

- Develop a proactive monitoring program for traffic control devices.
- Develop a GIS inventory of pedestrian traffic control devices, signs, and markings and include maintenance records in the GIS database.

**(c) Collision History and Collision Reports**

Conducting routine reviews of collision data may enable the identification of trends and inform countermeasure selection.

The Pasadena Police Department immediately reviews pedestrian-vehicle collisions resulting in fatalities or serious injuries utilizing the Crossroads software. Bi-monthly meetings between the Transportation Department and the Police Department may also include review of pedestrian-vehicle collision data. If the City identifies collision trends with applicable engineering solutions, the City may initiate an improvement project.

**Suggestion for Potential Improvement**

- In addition to mapping pedestrian-vehicle collisions with the Crossroads software, consider undertaking a field inventory of collision locations and pedestrian volume counts to enhance comprehensive monitoring. With sufficient pedestrian volume data, the City could prioritize collision locations based on collision rates (i.e., collisions/daily pedestrian 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).

- Conduct an annual review of all pedestrian-vehicle collisions.

(d) Speed Limits and Speed Surveys

As shown in the image below, pedestrian fatality rates increase exponentially with vehicle speed. Thus, reducing vehicle speeds in pedestrian zones may be one of the most important strategies for enhancing pedestrian safety. In Pasadena, speed surveys follow the California Vehicle Code (CVC); City staff conduct surveys every seven years; and independent companies calibrate the speed radar guns. Speed limits signs are typically posted on arterials and collectors, and on residential streets where needed.

![Image of Fatal Injury Rates by Vehicle Speed for Several Pedestrian Age Groups](www.nhtsa.dot.gov/people/injury/research/pub/Image3.gif)

Arterial speed management falls under the purview of Pasadena’s Department of Transportation. Pasadena recently completed a report documenting best practices for arterial speed management for higher speed and volume streets where the strategies found in the NTMP are generally not applicable.
(e) Public Involvement and Feedback Process

Responding to public concerns through public feedback mechanisms represents a more proactive and inclusive approach to pedestrian safety compared to a conventional approach of reacting to pedestrian collisions.

Public involvement and feedback practices in the City include the following:

- Various City departments receive complaints and/or requests for safety improvements on City streets via phone, email, and personal visits.
- Pasadena also has a web-based public feedback system where residents can submit requests to the City. Residents are asked to provide contact information so that the city can reach them, if necessary.
- Traffic investigation process can be initiated through a public request and includes a site visit and other data such as a collision history report.

Suggestion for Potential Improvement

- Consider providing a tracking number for requests made on-line so residents can track their requests electronically.

(f) Pedestrian Safety Program and Walking Audits

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

The Playhouse District recently conducted a walkabout for residents and stakeholders to review the pedestrian environment in this area.

Suggestion for Potential Improvement

- Consider establishing a City-wide pedestrian safety program to include regular walking audits, based on the grant-funded program in
Develop educational campaigns:

- Campaigns may include advertisements on buses and bus shelters, an in-school curriculum, community school courses, public service announcements, and/or brochures, among many other strategies. The Street Smarts program in San José, California, provides a model pedestrian safety education program (see www.getstreetsmarts.org for more information).
- The Bicycle Transportation Alliance has developed a pedestrian safety curriculum for 2nd-3rd graders, which incorporates physical education, health, and social responsibility (refer to www.bta4bikes.org/docs/PedSafetyCurriculumFinal.doc). Other safety curriculum resources are available at: www.saferoutespartnership.org/state/5638/5722.
- Additional pedestrian safety brochures are available at:
  - http://safety.fhwa.dot.gov/media/brochures.htm, and

(g) Design Policies and Development Standards

Design policies and development standards can improve the pedestrian walking experience, encourage walking, enhance economic vitality, and offer funding opportunities for pedestrian improvements. The City has various specific plans that provide ample design and pedestrian considerations, an Urban Forestry Program, and a design review process. Several City design standards address the pedestrian environment, particularly in commercial areas. City staff encourages pedestrian friendly development through internal review in the entitlement process. Additionally, Pasadena is in the process of developing street typologies for classified streets.

Suggestion for Potential Improvement

- Continue consideration of form-based zoning to influence the "look and feel" of neighborhoods throughout the City.

(h) Pedestrian-Oriented Signal and Stop Warrants

Providing all-way stop control (stop signs for every approach) at an intersection improves pedestrian safety by reducing speeds and pedestrian-vehicle conflicts. Best practices include:

- Requiring a crash history of three instead of five collisions based on routine underreporting
- Reducing traffic volume thresholds based on latent demand
- Providing consideration for school children/pedestrians and traffic speeds

Pasadena generally follows MUTCD requirements for signal and stop sign warrants. Pasadena has adopted a residential stop sign warrant.

(i) Pedestrian Volumes

Pedestrian volume data is important for prioritizing projects, developing collision rates, and determining appropriate pedestrian infrastructure. Pasadena does not require that bicycle or pedestrian counts be collected with all manual intersection counts. The City generally collects pedestrian volumes on an ad
hoc basis in response to issues that have been brought to the City’s attention or will require with developments expected to generate significant pedestrian traffic.

**Suggestion for Potential Improvement**

- Consider routinely collecting pedestrian and bicycle volumes by requiring them to be conducted in conjunction with manual intersection counts.
- 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.

**j) Pedestrian/Bicycle Coordinator**

In a sampling of pedestrian-oriented California cities, a full-time pedestrian/bicycle coordinator is typically provided for cities exceeding 100,000 population. Pasadena has a staff member who spends approximately 25% of his time acting as Pedestrian/Bicycle Coordinator.

**Suggestion for Potential Improvement**

- With a population of approximately 150,000, Pasadena may consider employing a full-time Pedestrian/Bicycle Coordinator, in addition to current staff. The Coordinator could be involved in activities such as interdepartmental coordination, grant writing, project management for a Pedestrian Plan update, and staff liaison to a new pedestrian subcommittee.

**k) Formal Advisory Committee**

Advisory committees serve as important sounding boards for new policies, programs, and practices. A citizens’ pedestrian advisory committee is also a key component of proactive public involvement for identifying pedestrian safety issues and opportunities.

The City has an appointed Transportation Advisory Commission (TAC) that reviews pedestrian policies as warranted, through the ad-hoc pedestrian subcommittee that was formed for development of the Pedestrian Plan. Pasadena also forms a Bicycle Plan Advisory Committee for the periodic update to the Bicycle Master Plan.

**Suggestion for Potential Improvement**

- Continue meeting with TAC pedestrian and bicycle subcommittee to address pedestrian needs.

**l) Enforcement**

Enforcement of pedestrian right-of-way laws and speed limits is an important complement to engineering treatments and education programs. The Pasadena Police Department (PPD) has officers that are assigned to the traffic section in Pasadena. They spend approximately twenty percent of their time on pedestrian related issues. Motor officers attend a course specifically focused on pedestrian safety and law enforcement and provide enforcement assistance to schools at their request. Pasadena Police are also involved in special event enforcement activities.
The Department of Transportation and PPD meet monthly to discuss traffic operations and enforcement issues. The PPD has established a radar gun checkout program for community volunteers to monitor residential areas where speeding is a concern. Additionally, the PPD conducts special enforcement activities through the California Office of Traffic Safety (OTS) grants.

**Suggestion for Potential Improvement**

- Continue pursuing OTS funding for special enforcement activities.
- Share police resources with neighboring cities. The Cities of Sunnyvale and Hermosa Beach, California, among others, participate in police sharing with other cities to enhance policy resources for activities such as pedestrian stings.

**(m) Historic Sites**

Historic walking routes, such as the famous Freedom Trail in Boston, encourage walking and enhance economic vitality. Pasadena has several historic sites such as the Blacker House and Castle Green/Hotel Green Apartments. Additionally, Pasadena has a Design and Historic Preservation section within the Planning Division. A review of these documents indicated that pedestrian orientation is not prioritized for historic site planning.

A walking route highlighting Pasadena’s public art is available on the City’s website through the cultural affairs division.

**Suggestion for Potential Improvement**

- Create an historic site/district map and establish and implement a wayfinding program, including signs and maps, to enhance and connect the historic sites.
- Consider developing a walking route oriented toward natural or unique elements in Pasadena, such as historical markers along the Rose Bowl Parade Route.

**(n) General Plan: Pedestrian Nodes**

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

Pasadena’s General Plan does not identify pedestrian nodes but does discuss some pedestrian considerations for high-pedestrian activity areas.
**Suggestion for Potential Improvement**

- Identify pedestrian nodes in future updates to General Plan and provide pedestrian-oriented policies and objectives in these areas.

**(o) Health Agencies**

Involving non-traditional partners such as Emergency Medical Service (EMS) personnel, public health agencies, pediatricians, etc., in the planning or design of pedestrian facilities may create opportunities to be more proactive with pedestrian safety, identify pedestrian safety challenges and education venues, and secure funding. Additionally, under-reporting of pedestrian-vehicle collisions could be a problem that may be partially mitigated by involving the medical community in pedestrian safety planning.3

While health professionals do not have direct participation in the planning or design of pedestrian facilities in Pasadena, development review is coordinated with the Fire Department. In addition, the Department of Public Health was consulted during the development of the Pedestrian Plan and the Bicycle Master Plan.

**Suggestion for Potential Improvement**

- Continue to seek opportunities for technical collaboration and funding with public health and health care professionals.

**(p) Proactive Approach to Institutional Challenges**

Numerous agencies have jurisdiction over components of the Pasadena transportation network, including Metro, Pasadena Unified School District, Los Angeles Community College District (LACCD), and Caltrans. Institutional coordination associated with multiple agencies is necessary because of non-local control of right-of-way and differing policies regarding pedestrian accommodation. For example, Caltrans policies have historically discouraged proposals for bulbouts, wider sidewalks, and other pedestrian-oriented improvements.

Pasadena has encountered institutional obstacles related to pedestrian issues resulting from a lack of collaboration with local community colleges and schools on issues that traverse the school property line into the City’s right-of-way. Other obstacles have arisen attempting to implement bicycle/pedestrian facilities because Caltrans generally denies deviation from their design standards.

**Suggestion for Potential Improvement**

- Recent Context Sensitive Solutions and Routine Accommodations policies within Caltrans (refer to the revised Deputy Directive 64: [www.calbike.org/pdfs/DD-64-R1.pdf](http://www.calbike.org/pdfs/DD-64-R1.pdf)) now require the agency to consider multimodal needs and engage in collaborative community planning. These new
policies may reduce institutional challenges, and the City may work with Caltrans and other agencies to identify new opportunities for joint planning of transportation facilities.

- Consider additional efforts at meeting and coordinating with LACCD on dealing with multi-modal transportation issues.

(q) Neighborhood-sized Schools

Neighborhood-sized schools, as opposed to mega schools on the periphery, are a key ingredient for encouraging walking and bicycling to school. Pasadena may request, but does not require neighborhood-sized schools, as this is under the purview of the local school district. In Pasadena, use of school grounds for night and weekend recreational activity is permitted.

Suggestion for Potential Improvement

- Continue working with the local school districts to maintain neighborhood-sized and oriented schools as part of a Suggested-Routes-to-School policy.

(r) Street Tree Requirements

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

Pasadena has a Tree Protection Ordinance, tree removal list, and Urban Forestry Program that provide guidance on the planting, removal, and maintenance of trees in the public right-of-way. However, a review of these documents and the municipal code did not indicate any requirements for the provisions of street trees with new development or in pedestrian zones.

Suggestion for Potential Improvement

- Consider adopting a Street Tree Ordinance requiring the planting of trees and specifying where and how often street trees could be planted/ replaced. Specification of which types of trees are appropriate can be found in the documents listed above. The ordinance could also allow trees in the parking lane or parking lots, where feasible.

OPPORTUNITY

(a) Crosswalk Installation, Removal, and Enhancement Policy

A formal policy for crosswalk installation, removal, and enhancement provides transparency in decision-making and adopts best practices in pedestrian safety and accommodation. The City utilizes a case-by-case approach to crosswalk installation that includes following the CAMUTCD and Institute of Transportation Engineers best practices. This includes a crosswalk marking threshold of
20 pedestrians per hour for two hours (not necessarily consecutive) and enhanced treatments for crosswalks at locations exceeding 10,000 ADT.

The City does not have a formal crosswalk policy that provides guidance for the installation or removal of crosswalks, or enhancements to the marked crosswalks at un-signalized intersections. Decisions regarding crosswalks are made on a case-by-case basis. Pasadena generally discourages marked crosswalks at uncontrolled locations.

This pedestrian safety study is developing such a policy, which will convert this benchmark to a key strength.

(b) Routine Accommodations/Complete Streets Policy

Routine Accommodations or Complete Streets Policies accommodate all modes of travel and travelers of all ages and abilities. The City does not have a Complete Streets policy but does assess an impact fee for new developments that funds traffic improvements, which can be a key building block for such a policy. The City also addresses pedestrian accommodations through the development review process and has on-going bus priority projects on major corridors. This policy would complement the development of street typologies under way and mentioned above.

Suggestion for Potential Improvement

- To support Complete Streets policies, the City may consider codifying their subdivision and development requirements by establishing a Complete Streets Policy and accommodating all modes in standard cross-sections for collectors and arterials. This policy could include a checklist for use during development application review.

The following jurisdictions have established practices for Complete Streets and Routine Accommodations, including implementation of these policies through multi-modal level of service thresholds, and may serve as models for Pasadena:

- San Francisco, California, Department of Public Health’s Pedestrian Quality Index: [www.sfphes.org/HIA_Tools/PEQI.pdf](http://www.sfphes.org/HIA_Tools/PEQI.pdf)
3. LITERATURE REVIEW AND SUMMARY OF BEST PRACTICES FOR PEDESTRIAN TREATMENTS AT SIGNALIZED INTERSECTIONS

The documents summarized below represent a review of recent literature and an overview of best practice documents for pedestrian safety treatments at signalized intersections. For each document we provide a brief summary of the research and treatments, identify best practices, and discuss major findings from case studies. For brevity, where a best practice is mentioned in a document already summarized in the memo, the strategy is not repeated unless an additional case study is presented.


Alternative Treatments for At-Grade Pedestrian Crossings provides a compilation of pedestrian crossing treatments beyond marked crosswalks. It was initiated after previous research found that marked crosswalks at uncontrolled locations resulted in increased pedestrian collisions. Although a large portion of this report is focused on unsignalized locations, one section of the report is devoted to signalized intersection crossings.

Lalani identifies the following treatments as best practices for enhancing safety at signalized intersections:

- **Leading Pedestrian Signal Intervals** – With this device, a signal modification is made such that the pedestrian walk phase begins three seconds in advance of turning vehicles with permitted left-turn or right-turn movements. The objective is to permit pedestrians to cross several seconds before potentially conflicting motor vehicles receive a green indication. Case studies note the benefits of installing leading pedestrian intervals. In St. Petersburg, FL, Retting et al. (1997) observed a decrease in right-of-way violations when leading pedestrian intervals were installed. In San Francisco, Fleck (2000) noted similar results.

- **Accessible Pedestrian Signals at Signalized Intersections** – These treatments are audible or transmitted tones or speech messages to assist visually impaired pedestrians in identifying when they have the right-of-way at a signalized intersection. The installation of accessible pedestrian signals is a recommended practice of the ADA Accessibility Guidelines (ADAAG). Per the ADAAG, accessible pedestrian signals should be installed at newly signalized intersections with actuated pedestrian signals. The document cites Bentzen et al. (1999), a study that evaluated the ability of visually impaired pedestrians to successfully cross a signalized intersection with and without “Talking Signs,” a type of remote infrared Accessible Pedestrian Signal (APS).
successful crossing was recorded if the pedestrian was able to cross the intersection without conflict or without changing direction. The measures of evaluation were: began crossing during walk interval, began crossing within crosswalk, began crossing facing up curb, ended crossing within crosswalk, and needed no help deciding when to cross. In all five cases, the percentage of successful crossings was higher with the APS than without it.

- **Pedestrian Countdown Signal** – This device displays a countdown of the number of seconds remaining for a pedestrian crossing interval during the flash/don’t walk stage. The document cites Leonard et al. (1999), a study that evaluated countdown-type signals and found that while they did not prevent pedestrians from initiating crossing at the beginning of the flash-don’t walk phase, they did deter some pedestrians from starting to cross with too few seconds left. Additional information on pedestrian countdown signals is included in the following section.

The US Federal Highway Administration (FHWA)’s pedestrian safety guide and countermeasure selection system includes interactive selection tools and matrices, descriptions of countermeasures, and case studies of implemented treatments. The guide notes the factors related to pedestrian crashes, means by which to select treatments, and components for implementation. The guide provides the following case studies related to improving safety at signalized intersections:

- **ADA Curb Ramps** – The City of Austin, Texas worked closely with the US Access Board as ADA guidelines evolved and has continually adapted its designs to create accessible designs for all modes of transportation. This includes the provision of directional curb ramps with truncated domes. The implementation of curb ramps in Austin illustrated that even a simple policy requires a detailed understanding of need, coordination between several stakeholders, and a strong understanding of best practices. The collaborative evaluation of the curb ramps while policy was evolving allowed for the Access Board to also understand the success of new guidelines.

- **Large Intersection Solutions** – In St. Petersburg, FL, wide intersections stalled operations and increased the potential for pedestrian crashes because they required long crossing times (in excess of 30 seconds). The City worked to develop a set of treatments for that could be used to improve pedestrian safety and vehicle operations at large intersections. These treatments were implemented at the intersection of Highway 98 and 74th Avenue. This included providing median refuges, narrowing vehicle travel lanes to reduce speeds, and adding right turn slip lanes to reduce crossing distances. In doing so, the City found that pedestrian safety improved while green time made available to motorists increased. Additionally, the maximum distance that a pedestrian had to cross was reduced by approximately 50 feet.

- **Pedestrian Scramble** – In Beverly Hills, CA, daytime pedestrian activity is very high in the downtown area. Vehicle/pedestrian conflicts occur at many high-pedestrian volume intersections, since large pedestrian flows can block crosswalks to turning traffic for the entire green signal phase. In response to this problem, the City of Beverly Hills modified traffic signals to include a “scramble” phase at eight intersections with high pedestrian volumes. During this phase, no vehicles are in the intersection, so pedestrians can cross diagonally or conventionally. An evaluation of vehicle operations using ICU analysis identified that most intersections continued to operate sufficiently despite the added phase. After nine years of implementation, a before-and-after study was conducted by the City to
evaluate pedestrian safety at the intersections. An overall decrease in vehicle/pedestrian collisions of 66% was realized.

- **Main Street Redesign** – In Hendersonville, NC, pedestrians in the downtown shopping district had a difficult time crossing a wide street with heavy traffic. A group of treatments was applied at intersections: marked crosswalks at all four legs and curb bulbouts at the Main Street legs to shorten crossing distance. With these treatments and mid-block traffic calming, vehicles now travel at 20 miles per hour and crossing is more comfortable for pedestrians. Pedestrian activity in the Main Street area has also increased since the implementation of these treatments.

- **Reduced Curb Radii** – In Bethesda, MD, high vehicle speeds were posing problems for local pedestrians on Leland Street, an arterial roadway. Amongst the countermeasures employed to calm traffic on the street were reducing curb radii from 50 feet to 30 feet. With the redesigned streets, the 85th percentile speed was reduced from 32 mph to 27 mph.

- **Pedestrian Countdown Signals (additional case studies)** – The City of Monterey, CA has a high volume of pedestrian activity. At some busy intersections, pedestrians had large distances to cross and there was confusion and conflicts between pedestrians and motorists. The City decided to test pedestrian countdown signals at signalized intersections to see whether it would improve clarity between pedestrians and motorists. The City chose two intersections for implementation that were equipped with countdown devices. Studies noted that prior to implementation of countdowns, pedestrians would enter the intersection during the flash don’t walk phase, whereas afterwards most pedestrians waited for the next phase once the countdown was less than 10 seconds. Additionally, pedestrians interviewed noted that having the countdown device helped in understanding pedestrian signals. Pedestrian Countdown Signals were also installed in San Francisco, where subsequent studies identified that with countdowns there were fewer pedestrians in the crosswalk once the signal turned red (decrease from 14% to 9%), and the observed vehicle/pedestrian conflicts decreased.
3. **ITE. Toolbox of Countermeasures and Their Potential Effectiveness for Pedestrian Crashes.**

A pedestrian issue brief released by ITE in 2007 reviewed available literature and provided estimates of the crash reduction factor (CRF) for various countermeasures, including countdown pedestrian signals. A CRF of 25 percent was estimated at locations installing countdown pedestrian signals for pedestrian crashes in urban areas with a crash severity of injury or fatal. The CRF is the percentage crash reduction that might be expected following the installation of a countermeasure and are regarded as generic estimates of effectiveness based on prior research.

4. **FHWA. Safety at Signalized Intersections.**

This website provides a one-hour presentation on safety countermeasures for signalized intersections. Many of the countermeasures are relevant to pedestrian safety. In particular, the following countermeasure is recommended to enhance pedestrian safety at signalized intersections:

- **Protected Left-Turn Phasing** – Left turns are the highest-risk movement at an intersection. Providing a protected left-turn phase improves safety and intersection efficiency for all modes.

5. **Metropolitan Transportation Commission (MTC). Pedestrian Safety Toolbox.**
   [http://www.mtc.ca.gov/planning/bicyclespedestrians/safety/overview.htm](http://www.mtc.ca.gov/planning/bicyclespedestrians/safety/overview.htm). As developed by Fehr & Peers (S. Reynolds and M. Ridgway) for MTC.

The Metropolitan Transportation Commission in the San Francisco Bay Area developed a toolbox of strategies for promoting a safe and welcoming environment for bicyclists and pedestrians. The toolbox includes descriptions and implementation of education, engineering, and enforcement treatments and can be sorted by cost, crash type, and target population. Pointers and costs associated with implementation are included within this report. References for further reading and the identification of locations where treatments have been implemented are included in this toolbox. In addition to treatments identified above, this toolbox includes the following countermeasures:

- **Turn Restrictions** – With this tool, signs are placed prohibiting right turns on red (RTOR) at signalized intersections (on one-way streets, this could involve prohibiting left turns on red), all right turns, or all left turns. The restrictions may apply all day or only during certain hours. In addition to signs, a curbed island can be used to restrict left turns from side street approaches onto the street where marked crosswalks are located. This tool is used to reduce the number of turning movements conflicting with pedestrians using the crossing. The City of Philadelphia, PA, New York City, NY, and the City of Atlanta, GA frequently use this tool. Further reading on this tool:


Zador, P., J. Moshman, and L. Marcus, Adoption of Right Turn on Red: Effects on Crashes at Signalized Intersections, Accident Analysis and Prevention 14 (1982), pp.219-234


- **Advance Stop Bars** – With this tool, a stop line is placed in advance of crosswalk to increase pedestrian visibility to vehicles and reduce vehicle encroachment upon the crosswalk. This tool is used to encourage motorists to stop farther away from the marked crosswalk. This tool is used frequently in the City of St. Petersburg, FL and the City of Sacramento, CA. Further reading on this tool:


- **Pedestrian Detection** – For this tool, infrared, microwave, or video detectors are installed at signalized intersections to detect pedestrians. This can be used to increase the length of a pedestrian signal or to actuate a pedestrian phase. While this device is promising, its effectiveness is still under study and it should be consider an experimental device. The tool has been used in Los Angeles, CA. Further reading on this tool:


- **Signal Timing Extensions** – With this tool, the amount of time for pedestrian clearance is increased to allow for slower walk speeds through an intersection. Generally, the extension allows for a pedestrian to cross the intersection while walking at a speed of 2.5-3.5 feet/second instead of the standard 4 feet/second. The timing may be increased with a separate button or a longer button push.

- **Additional Marked Crosswalks** – With this tool, marked crosswalks are applied to all legs of a signalized intersection where crossing is allowed, with a preference for marked crossings across all legs. Marked crosswalks warn motorists to expect pedestrian crossings. At
crosswalks with high pedestrian volumes, near schools, or with skewed crossings, high visibility striping may be appropriate. Further reading on this tool:

- Pedestrian Crossing Study, Final Submittal, Pedestrian Traffic Control Measures, Arctic Slope Consulting Group, Inc.

- Zegeer, C., J. Stuart, and H. Huang, Safety Effects of Marked vs. Unmarked Crosswalks at Uncontrolled Crossing Locations, Federal Highway Administration, Washington, DC, 2001


- **Bus Stop Relocation** – For this tool, transit stops are relocated to the far side of the intersection to allow pedestrians to cross behind the bus and improve driver’s visibility to pedestrians. This practice also improves transit operations.

- **Driveway Treatments/Access Management** – Driveway treatments include narrowing or closing driveways, tightening turning radii, converting driveways to right-in-only or right-out only movements, and providing median dividers on wide driveways. When driveways cross sidewalks, a sidewalk level should be maintained across the driveway of no more than 2 percent sideslope. Large signs and bushes at driveways should be minimized to improve the visibility between motorists and pedestrians. The sidewalk material should be maintained across the driveway as well. This tool reduces pedestrian and motor vehicle conflicts, improves access for people with disabilities, and improves visibility between cars and pedestrians at driveways.

![Image source: www.mrsc.org](https://www.mrsc.org)
• Curb Extension – This tool includes the extension of a curb into the parking lane to reduce the crossing distance for pedestrians and to slow traffic. Curb extensions are used frequently in downtown areas, including in the cities of San Francisco and Philadelphia. Further reading on this tool:


• Pedestrian Refuge Island – A raised island is installed in the roadway’s median to separate opposing traffic. This allows pedestrians to focus on each direction of traffic and provides a resting point should the pedestrian be unable to cross the street in one cycle length. The City of San Luis Obispo, CA has installed pedestrian refuge islands, offering a best practice case study. Further reading on this tool:


• Signs to Prompt Pedestrians – Signs installed at signalized crossings urge pedestrians to wait for the WALK signal. Pavement stencils may also be used. This tool instructs and directs pedestrians to use proper techniques when crossing a street. The City of St. Petersburg, FL uses pedestrian prompt signage.
• Signs to Prompt Motorist Behavior – Motorist-prompting signs communicate variations of the basic message of "Yield to Pedestrians", including "Yield to Pedestrians in Crosswalk", which are sometimes supplemented by signs with strong language, such as “State Law” or “It’s the Law”; and “Turning Traffic Must Yield to Pedestrians.”

• Education and Community Behavior – The MTC Toolbox promotes community activism to help raise the profile of bicycle and pedestrian issues, imbue children with safe bicycling and walking habits, and convince local elected officials to create new bike lanes or improve sidewalks. Strategies include:
  o Neighborhood pace car program
  o Neighborhood watch program
  o School intervention programs
  o Billboards, electronic message boards, brochures, etc.
  o Walk-your-child-to-school day
  o Speed monitoring trailer

• Enforcement – The MTC Toolbox also includes enforcement strategies for enhancing pedestrian safety. Targeted police enforcement supports neighborhood and community goals for improving safety. Enforcement tools can require a significant investment from local agencies. Newer tools like red-light running cameras and radar ‘wagons’ can minimize the amount of staff time required of local law enforcement agencies. Strategies in the toolbox include:
  o Ordinance changes
  o Enhanced police enforcement
  o Pedestrian sting operations
  o Photo enforcement
This document is a technical guide for conducting pedestrian safety assessments. The UC Berkeley Tech Transfer Program has been conducting pedestrian safety assessment as a free service to cities in California since 2008. The objective of the PSAs is to improve pedestrian safety at specific locations, enhance walkability and livability, and create a safe and comfortable pedestrian environment. The guide details a method by which to conduct safety assessments, including involving stakeholders, collecting data, conducting walking audits, and recommending treatments. The guide provides a menu of treatments that may be appropriate to recommend to cities, including engineering, education, enforcement, and encouragement countermeasures. The guide also provides a prompt list of questions, benchmarks, and a toolbox of best practices. The toolbox of best practices was selected based on a comprehensive literature review and recommendations from a panel of experts including academics, practitioners, and state and federal agency officials.

In addition to treatments identified in the documents discussed above, the guide identifies the following engineering countermeasures for signalized intersections and corridors:

- **Road Diet** – This decide includes the reduction in number of travel lanes on a roadway achieved by widening sidewalks or adding bicycle or parking lines. On streets with on-street parking, roadways can be narrowed by converting parallel parking to angled parking.
• Improved Right-Turn Slip-Lane Design – For this tool, a roadway “pork chop” island is designed to channelize right-turn lanes from other travel lanes.

![Image of Improved Right-Turn Slip-Lane Design](image-source: Fehr & Peers)

7. **FHWA’s Pedestrian/Bicycle Information Center**: [http://www.pedbikeinfo.org](http://www.pedbikeinfo.org)

The Pedestrian and Bicycle Information Center (PBIC) is a national clearinghouse for information about health and safety, engineering, advocacy, education, enforcement, access, and pedestrian mobility. They have collected information regarding implementation guidelines and walking solutions, in addition to a compendium of case studies last updated in July 2010. Key studies related to signalized intersections include the following:

• **Comprehensive School-Age Pedestrian Safety Program** – Orange County, FL formed a K-12 curriculum to address pedestrian safety in the area. The safety team is comprised of volunteers from local agencies, with the program being led by the local School Board. Programs such as Walk Your Child to School Day were implemented and curriculum included books, posters, presentations, and videos.

• **Local Media Campaigns** – The City of Toronto created a media campaign to spread their message – “Cross the Street As If Your Life Depends On It, Because It Does,” with posters and safety brochures sent to 900 community agencies and posted in high visibility areas. The cost totaled just over $20,000 and the media launch for the campaign was covered by several newspapers. Over 867,000 viewed the ad shown in movie theaters and media images evaluated were found to educate readers and viewers.

• **Videos** – In Madison, Wisconsin, pedestrian safety enforcement DVDs were created to better train safety officers and the public on how to determine right of way and properly cross at intersections. Despite groups initially reluctant to engage in pedestrian safety training, the DVD proved successful in places where it was shown with a subsequent training book to come.

• **Incentives/Contests** – Many Atlanta residents choose not to walk – even for short trips. In response to this problem, Atlanta’s Downtown Transportation Management Association (TMA) began an education program to increase walking for short trips through a “walk there” challenge. Participants receive a pedometer to track the number of steps they take and
weekly and monthly winners receive prizes. Nearly 2,000 pedometers were distributed during the Walk There! Challenge and was quite successful with elected officials.

8. **FHWA’s National Center for Safe Routes to School:** [http://www.saferoutesinfo.org](http://www.saferoutesinfo.org)

The Safe Routes to School program is intended to enable community leaders, schools, and parents across the US to improve safety and encourage children to walk and bicycle to school. The Federal Highway Administration has developed a Safe Routes to School guide to support the development of SRTS programs. It is based on the tenet that there needs to be implementation of engineering, education, enforcement, and evaluation measures to be fully successful. The guide also identifies various treatments for intersections and things to consider for implementation. Some case studies described include the following:

- **Pedestrian Decoy** – Miami Beach, FL implemented a pedestrian decoy operation in which police acted as plain-clothed pedestrian crossing the street. When motorists did not yield to the police officer, they were pulled over and provided with informational fliers and written and verbal warnings. The operation increased the percentage of motorists yielding to pedestrians with an increase in yielding over a period of more than a year.

- **Traffic Complaint Hotline** – Phoenix, AZ operates a traffic complaint hotline. Residents can call to make complaints regarding traffic violations, and locations with several complaints receive police enforcement. After a period of enforcement, violations and warnings are tallied with additional enforcement scheduled when necessary. Those who call the hotline with complaints receive follow-up from the call center with the results of the enforcement sting.


This document provides agencies conducting Road Safety Audits with a better understanding on the needs of pedestrians through the provision of guidelines and prompt lists. The master prompt list identifies potential issues that should be addressed at all times while the detail prompt list identifies when certain prompts need to be considered. Section B focuses on street crossings and asks questions particularly regarding the visibility of pedestrians, whether traffic controls address needs of all users, and how pedestrians interact with other modes of traffic.


The Victoria Transport Policy Institute identifies best practices for encouraging walking. The VTPI TDM Encyclopedia cites a Cleary and McClintock (2000) paper regarding an employee-based program development. Best practices include: creating a clear, consistent and positive message about non-motorized travel benefits, using promotional campaigns within the overall program, finding opportunities for coordinating with other organizations, and using cycling and walking organizations to help enlist volunteers.


The U.S. Access Board is a federal agency committed to accessible design. This site provides a repository of information regarding ADA accessibility. It identifies research related to pedestrian treatments that are newly required by the ADA, and also provides guidance towards implementation and caveats associated with application of various treatments.
12. **City of Sacramento Pedestrian Safety Guidelines (2003).**


The City of Sacramento has established a set of pedestrian safety guidelines that includes treatments at signalized intersections. The guidelines make note of the use of Leading Pedestrian Intervals, referencing the Institute of Highway Safety study that demonstrated LPIs reducing the number of pedestrian/vehicle conflicts. The City has installed leading pedestrian intervals at four locations.

At signalized intersections with high pedestrian-vehicle conflicts, the City identified the following countermeasures to implement: right turn on red restrictions, reduced corner radii, “watch turning vehicle” and “yield to pedestrian” signage, leading pedestrian intervals and protected left-turn vehicle phases, and animated eye LED signals.

- **Animated Eye LED signals** – This device shows a shifting pair of eyes. They are intended to remind pedestrians to watch for turning vehicles and are installed at locations with high turning movement volumes.

13. **NCHRP Report 616: Multimodal Level of Service Analysis for Urban Streets.**

National Cooperative Highway Research Program (NCHRP) Report 616 is oriented toward public agencies that are responsible for the planning, design, and operation of urban streets. This report includes a method for measuring the performance of an urban street for all of its users including: motorists, transit patrons, bicycle riders, and pedestrians. This document reviews existing literature and models for evaluating the Level of Service (LOS) for the various users of urban streets. Following a discussion of LOS for each mode, the report concludes with an integrated Multimodal LOS Framework for urban streets that reports a single average LOS for the four modes. While this does not relate directly to pedestrian safety, LOS may have an indirect effect on pedestrian safety when infrastructure decisions are made based on automobile LOS only. This may result in wider, higher speed roadways and intersections, with reduced pedestrian LOS and safety.


This report provides candidate measures to be used in the management of vehicular speeds on major streets (major collectors and arterials). Pasadena has a Neighborhood Traffic Management Plan; however, many of the treatments in the Plan are not appropriate for streets with higher speeds and volumes than residential streets. In response, this document suggests a tiered approach for streets exceeding 20,000 vehicles per day and those with less than 20,000 vehicles per day. Measures included in this report include, but are not limited to, roundabouts, road diets, traffic signal techniques, enforcement, and deflection. The selection and applicability of treatments in this report are based on literature reviews and interviews with transportation professionals with expertise in speed management.
With speed directly related to pedestrian injury severity for pedestrian-vehicle collisions, effective speed management can have a significant impact for improving pedestrian safety.

15. *Pasadena Pedestrian Plan (2006).*

The Pasadena Pedestrian Plan is aimed at maintaining and enhancing walkability in the City. This is accomplished by identifying areas with high pedestrian activity, identifying pedestrian-oriented projects, providing design recommendations with pedestrian accommodations, and outlining guidance for the integration of pedestrian treatments into street maintenance, traffic management programs, and the development review process. Additionally, education and enforcement programs are two components of the plan that are aimed at increasing comfort and safety.

This document also discusses the Suggested Routes to School program in Pasadena, funding mechanisms, design guidelines, specific treatments, and implementation for the seven specific plan areas in Pasadena.


The “Downtown Pasadena Walkabout” was held in March of 2008 and included over 120 people. The walkabout was sponsored by the Playhouse District Association and conducted with various stakeholders including residents, business owners, and community members. The walkabouts also included a consultant team focused on urban design and planning. The walkabout was followed-up with a community meeting in August 2008 to present the findings of the walkabout and draft report.

In addition to the walkabout goals and study methodology, this report includes infrastructure and non-infrastructure recommendations for all of downtown and specific districts. The districts in the walkabout include:

- Playhouse District
- Old Pasadena District
- Civic Center/Mid-town District
- South Lake District
- Metro Gold Line Stations

Recommended treatments range from improving sidewalk conditions to slowing speeding drivers to promoting economic vitality and a park-once environment. Finally the report identifies potential funding and implementation mechanisms for the proposed treatments and other local, state, and federal resources that could be used to implement the recommendations provided.
4. PEDESTRIAN SAFETY TOOLBOX

INTRODUCTION

A comprehensive pedestrian safety strategy contains a three-pronged approach including engineering, enforcement, and education programs.

The pedestrian safety toolbox in this document will assist the City of Pasadena in making decisions about where basic crosswalks (two stripes) can be marked; where crosswalks with special treatments, such as high visibility crosswalks, flashing beacons, and other special features, should be employed; and where crosswalks will not be marked due to safety concerns resulting from volume, speed, or sight distance issues.

This document contains a toolbox of elements to improve pedestrian mobility, visibility, and safety. In addition to standard tools, the toolbox includes very promising devices, such as the HAWK/Pedestrian Hybrid Beacon (approved under the 2009 Federal Manual on Uniform Traffic Control Devices, MUTCD) and the Rectangular Rapid Flashing Beacon (approved at the Federal level for experimental use).

Based on research from the National Cooperative Highway Research Program and Federal Highway Administration, among other best practice documents, this toolbox provides guidance about the type of treatments appropriate on various streets and under various conditions. Preferred and enhanced options are provided for signalized locations, stop-controlled locations, and uncontrolled locations. While the strategies in the toolbox reflect best practices and local priorities, the toolbox guidance is not meant to replace engineering judgment. Each situation is unique and pedestrian safety treatments must be selected on a case-by-case basis.

Potential education and enforcement strategies are also included in this toolbox to complement the engineering strategies and provide a comprehensive approach to improving pedestrian safety in Pasadena.

This document is not an official City policy or adopted document. This document is intended to be a tool for City staff to use in evaluating the location of pedestrian treatments.

Funding for this program was provided by a grant from the California Office of Traffic Safety, through the National Highway Traffic Safety Administration.
TREATMENTS AT SIGNALIZED LOCATIONS

This section presents a discussion of preferred and enhanced practices for pedestrian treatments at signalized locations in Pasadena.

Preferred Pedestrian Treatments

The preferred treatments included in the toolbox for signalized intersections should generally be deployed as best practice. These treatments are typically those that are required (i.e., countdown signals required by the 2009 Federal MUTCD) or commonly recommended as best practices (i.e., ADA suggested treatments in Public Rights-of-Way Accessibility Guidance [PROWAG]).

These measures are intended to:

- Improve the visibility of pedestrians to motorists and vice-versa
- Communicate to motorists and pedestrians who has the right-of-way
- Accommodate vulnerable populations such as the disabled, children, and the elderly
- Reduce conflicts between pedestrians and vehicles
- Reduce vehicular speeds at locations with potential pedestrian conflicts

Table 2 presents a description of the preferred pedestrian safety treatments for signalized locations.

<table>
<thead>
<tr>
<th>Type</th>
<th>Measure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Striping</td>
<td>Marked Crosswalk</td>
<td>Marked crosswalks should be installed to provide designated pedestrian crossings at signalized locations, on all feasible approaches. Exceptions for striping crosswalks on all four legs of a signalized intersection may be allowed due to operational and physical considerations.</td>
</tr>
<tr>
<td>Striping</td>
<td>Advance Limit Line</td>
<td>Standard advance limit (white stop) lines are placed four feet in advance of marked crosswalks.</td>
</tr>
</tbody>
</table>
# TABLE 2 – PREFERRED PEDESTRIAN TREATMENTS FOR SIGNALIZED LOCATIONS

<table>
<thead>
<tr>
<th>Type</th>
<th>Measure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signal Treatment</td>
<td>Countdown Signal</td>
<td>Displays a “countdown” of the number of seconds remaining for the pedestrian crossing interval.</td>
</tr>
<tr>
<td></td>
<td><img src="image1" alt="Countdown Signal Image" /></td>
<td></td>
</tr>
<tr>
<td></td>
<td><img src="image2" alt="Image source: www.saferoutesinfo.org" /></td>
<td></td>
</tr>
<tr>
<td>Signal Treatment</td>
<td>Slower Walking Speed</td>
<td>The 2009 Federal MUTCD requires reduction of the pedestrian walking speed from 4.0 feet per second to 3.5 feet per second to reflect average pedestrian walking speeds. The California MUTCD has not yet adopted this change, which is likely to be approved in 2011. The walking speed could be further reduced to accommodate vulnerable populations such as children and the elderly.</td>
</tr>
<tr>
<td></td>
<td><img src="image3" alt="Slower Walking Speed Image" /></td>
<td></td>
</tr>
<tr>
<td></td>
<td><img src="image4" alt="Image source: www.livablestreets.com" /></td>
<td></td>
</tr>
<tr>
<td>Signal Treatment</td>
<td>Peak Hour Pedestrian Recall in High Activity Pedestrian Areas</td>
<td>Peak Hour Pedestrian Recall provides a guaranteed walk phase for each crossing at the signal during peak hours, regardless of whether the pedestrian push button has been activated. This ensures ample time is provided for pedestrian crossings when pedestrians are typically present (even if a pedestrian fails to push the button).</td>
</tr>
<tr>
<td></td>
<td><img src="image5" alt="Peak Hour Pedestrian Recall Image" /></td>
<td></td>
</tr>
<tr>
<td></td>
<td><img src="image6" alt="Image source: www.saferoutesinfo.org" /></td>
<td></td>
</tr>
</tbody>
</table>
## TABLE 2 – PREFERRED PEDESTRIAN TREATMENTS FOR SIGNALIZED LOCATIONS

<table>
<thead>
<tr>
<th>Type</th>
<th>Measure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geometrics/ ADA</td>
<td>Directional Curb Ramp with Truncated Domes and Separated Pedestrian</td>
<td>When right-of-way is available, directional curb ramps are installed two per corner and guide pedestrians into the crosswalk. Truncated domes provide a tactile signal to the visually impaired that they are leaving the sidewalk area. Separated push buttons are placed within five feet of each curb ramp, one per crosswalk. Exceptions for directional curb ramps may be allowed when physical considerations such as existing drainage or required turn radius deem infeasible. Selecting directional curb ramps as a preferred treatment does not call for retrofit of existing curb ramps, rather installation will be done opportunistically in scenarios such as grant funding, development review, new construction, and reconstruction.</td>
</tr>
<tr>
<td>Treatments</td>
<td>Push Buttons (PPB)</td>
<td></td>
</tr>
<tr>
<td>Geometrics</td>
<td>Far-Side Bus Stops</td>
<td>Far-side bus stops allow pedestrians to cross behind the bus, improving pedestrian visibility. Far side bus stops also enhance transit operations by provided a guaranteed merging opportunity for buses. Exceptions for far-side bus stops include considerations for bus routing, sufficient sidewalk area, and conflicts with parking, land uses, or driveways.</td>
</tr>
<tr>
<td>Geometrics</td>
<td>Reduced Turning Radius as Determined by Design Vehicle</td>
<td>The size of the curb radius determines the speed at which approaching vehicles can navigate a turn. Reduced turn radii force approaching vehicles to slow down when turning, while still accommodating emergency vehicles and the largest vehicle expected to typically navigate the intersection (i.e., the design vehicle).</td>
</tr>
</tbody>
</table>

*Image source: City of Pasadena*

*Image source: Fehr & Peers*

*Image source: www.saferoutesinfo.org*
### TABLE 2 – PREFERRED PEDESTRIAN TREATMENTS FOR SIGNALIZED LOCATIONS

<table>
<thead>
<tr>
<th>Type</th>
<th>Measure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geometrics</td>
<td>Removal of Sight Distance Obstructions</td>
<td>If objects impede sight distance, this may result in an unsafe condition where motorists and pedestrians are unable to see each other. Items such as parked cars, signage, landscaping, fencing, and street furniture should be placed in a location that will not obstruct sight distance. Pasadena has a policy requiring a sight distance triangle with legs measuring 25 feet from the property line.</td>
</tr>
<tr>
<td>Geometrics</td>
<td>Driveway Access Management</td>
<td>Access management strategies can reduce the number of driveway crossings pedestrians encounter and result in a wider sidewalk through more efficient allocation of space. Pasadena’s Department of Transportation recently drafted Policies and Procedures and Driveway Design to help address potential conflicts.</td>
</tr>
<tr>
<td>Signage</td>
<td>High-visibility Signs and Markings</td>
<td>High-visibility fluorescent yellow green signs are posted to increase the visibility of a pedestrian crossing.</td>
</tr>
<tr>
<td>Type</td>
<td>Measure</td>
<td>Description</td>
</tr>
<tr>
<td>--------</td>
<td>----------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Signage</td>
<td>Limited Signage/Sign Clutter Evaluation</td>
<td>Road signs and street signs at intersections may distract motorists from the road. Unnecessary signage should be removed and relocated so as to present motorists with only signage relevant to the operation of the intersection.</td>
</tr>
<tr>
<td>Streetscape</td>
<td>Pedestrian-Scale Lighting</td>
<td>Pedestrian-scale lighting improves motorists’ visibility of pedestrians.</td>
</tr>
</tbody>
</table>

*Image source: Fehr & Peers*

*Image source: www.ci.mil.wi.us*
Enhanced Pedestrian Treatments

In addition to the preferred treatments described above, the City of Pasadena’s crosswalk toolbox includes several enhanced treatments. The enhanced pedestrian treatments for signalized locations may not be appropriate at all locations or are countermeasures to address a particular issue at a given location.

Table 3 includes the list of enhanced treatments for signalized locations.

<table>
<thead>
<tr>
<th>Type</th>
<th>Measure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Striping</td>
<td>Ladder or Triple Four</td>
<td>High-visibility markings include a family of crosswalk striping styles such as the “ladder” and the “continental.” High-visibility striping should be provided for crosswalks with heavy pedestrian volumes, with frequent pedestrian-vehicle conflicts (such as with permissive left turns), or at skewed intersections. One style of high-visibility striping should be selected as the City’s preferred style.</td>
</tr>
<tr>
<td>Road Diet</td>
<td>Road Diets</td>
<td>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.</td>
</tr>
<tr>
<td>ADA Treatments</td>
<td>Accessible Pedestrian Signals</td>
<td>Accessible pedestrian signals communicate information about pedestrian crossings in non-visual format such as audible tones, verbal messages, and/or vibrating surfaces, providing access to the pedestrian signals for the visually impaired. Locations for accessible pedestrian signals are coordinated with the Accessibility Disability Commission.</td>
</tr>
<tr>
<td>Type</td>
<td>Measure</td>
<td>Description</td>
</tr>
<tr>
<td>------------------</td>
<td>-------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Signal Treatment</td>
<td>All Red Clearance</td>
<td>Provides a phase (1-2 seconds) where all vehicle indicators hold the red at an intersection.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><img src="http://www.freefoto.com" alt="Image source: http://www.freefoto.com" /></td>
</tr>
<tr>
<td>Signal Treatment</td>
<td>Leading Pedestrian Interval (LPI)</td>
<td>Provides pedestrians with a walk indicator while all vehicle indicators hold the red ball. This allows pedestrians to get a head start crossing the street before vehicles get the green indication.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><img src="http://www.walkinginfo.org" alt="Image source: http://www.walkinginfo.org" /></td>
</tr>
<tr>
<td>Signal Treatment</td>
<td>Scramble Phase</td>
<td>Provides an all red phase for vehicles while providing pedestrians with a walk indication. Pedestrians may cross the street orthogonally or diagonally.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><img src="http://www.streetswiki.wikispaces.com" alt="Image source: www.streetswiki.wikispaces.com" /></td>
</tr>
</tbody>
</table>
### TABLE 3 – ENHANCED PEDESTRIAN TREATMENTS FOR SIGNALIZED LOCATIONS

<table>
<thead>
<tr>
<th>Type</th>
<th>Measure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signal Treatment</td>
<td>Protected Lefts</td>
<td>Protected left turns give vehicles that are turning left an exclusive phase that does not coincide with the pedestrian walk phase. This eliminates the pedestrian-vehicle conflict between permissive lefts and pedestrians in a crosswalk.</td>
</tr>
<tr>
<td></td>
<td><img src="http://safety.fhwa.dot.gov" alt="Protected Lefts Image" /></td>
<td></td>
</tr>
<tr>
<td>Signal Treatment</td>
<td>Flashing Yellow Left Arrow</td>
<td>A flashing yellow left-turn arrow allows permissive left turns and warns motorists of potential conflicts with pedestrians in the crosswalk.</td>
</tr>
<tr>
<td></td>
<td><img src="http://lincoln.ne.gov" alt="Flashing Yellow Left Arrow Image" /></td>
<td></td>
</tr>
<tr>
<td></td>
<td><a href="http://lincoln.ne.gov">Image source: City of Pasadena</a></td>
<td></td>
</tr>
<tr>
<td>Signal Treatment</td>
<td>Full Time Recall/Fixed Time Pedestrian Intervals</td>
<td>Pre-timed signals give pedestrians the walk signal without requiring push button actuation.</td>
</tr>
<tr>
<td></td>
<td><img src="http://lincoln.ne.gov" alt="Full Time Recall/Fixed Time Pedestrian Intervals Image" /></td>
<td></td>
</tr>
<tr>
<td></td>
<td><a href="http://lincoln.ne.gov">Image source: http://lincoln.ne.gov</a></td>
<td></td>
</tr>
</tbody>
</table>
## TABLE 3 – ENHANCED PEDESTRIAN TREATMENTS FOR SIGNALIZED LOCATIONS

<table>
<thead>
<tr>
<th>Type</th>
<th>Measure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signal Treatment</td>
<td>Prohibited Right Turn on Red</td>
<td>Prohibits vehicles from turning right when the signal has a red indication.</td>
</tr>
<tr>
<td></td>
<td>![Image Source: <a href="http://www.luni.net">www.luni.net</a>](Image Source: <a href="http://www.luni.net">www.luni.net</a>)</td>
<td></td>
</tr>
<tr>
<td>Geometrics</td>
<td>Refuge Island</td>
<td>Raised islands are placed in the center of the roadway, separating opposing lanes of traffic with cutouts or ramps for accessibility along the pedestrian path.</td>
</tr>
<tr>
<td></td>
<td>![Image Source: City of Pasadena](Image Source: City of Pasadena)</td>
<td></td>
</tr>
<tr>
<td>Geometrics</td>
<td>Curb Extension/Bus Bulbs/Short Right-Turn Lane Elimination</td>
<td>Also known as a pedestrian bulb-out, this traffic-calming measure is meant to slow traffic and increase driver awareness of pedestrians. It consists of an extension of the curb into the street, making the pedestrian space (sidewalk) wider.</td>
</tr>
<tr>
<td></td>
<td>![Image Source: Fehr &amp; Peers](Image Source: Fehr &amp; Peers)</td>
<td></td>
</tr>
<tr>
<td>Type</td>
<td>Measure</td>
<td>Description</td>
</tr>
<tr>
<td>-------------</td>
<td>-----------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Geometrics</td>
<td>Improved Right-Turn Slip-Lane Design/Pork Chop Redesign</td>
<td>Right-turn slip lanes (aka channelized right-turn lanes) are separated from the rest of the travel lanes by a pork chop-shaped striped or raised median area. This measure separates right-turning traffic and streamlines right turning movements. Improved right-turn slip lanes provide pedestrian crossing islands within the intersection and are designed to optimize the right-turning motorist’s view of the pedestrian and of vehicles to his or her left.</td>
</tr>
<tr>
<td>Image Source: <a href="http://www.tfhrc.gov/">www.tfhrc.gov/</a></td>
<td><img src="image-source" alt="Image Source: Fehr &amp; Peers" /></td>
<td></td>
</tr>
<tr>
<td>Geometrics</td>
<td>Two Stage Crossing</td>
<td>This measure is similar to traditional median refuge islands except that the crosswalk is 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.</td>
</tr>
<tr>
<td>Image Source: <a href="http://www.tfhrc.gov/">www.tfhrc.gov/</a></td>
<td><img src="image-source" alt="Image Source: Fehr &amp; Peers" /></td>
<td></td>
</tr>
</tbody>
</table>
TREATMENTS AT STOP-CONTROLLED LOCATIONS

This section presents best practices for the installation of pedestrian treatments and enhancements at stop-controlled locations.

Preferred Pedestrian Treatments

As with signalized intersections, the preferred treatments included in the toolbox for stop-controlled locations should generally be deployed as standard practice. These treatments are commonly recommended as best practices in pedestrian safety research and literature.

Table 4 includes the list of preferred treatments for stop-controlled locations.

<table>
<thead>
<tr>
<th>Type</th>
<th>Measure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geometrics/ ADA Treatments</td>
<td>Directional Curb Ramp with Truncated Domes</td>
<td>Where right-of-way is available, directional curb ramps are installed at two per corner and guide pedestrians into the crosswalk they would utilize to cross the street. Truncated domes provide a tactile signal to the visually impaired that they are leaving the sidewalk area. Exceptions for directional curb ramps may be allowed when physical considerations such as existing drainage or required turn radius deem infeasible. Selecting directional curb ramps as a preferred treatment does not call for retrofit of existing curb ramps, rather installation will be done opportunistically in scenarios such as grant funding, development review, new construction, and reconstruction.</td>
</tr>
<tr>
<td>Geometrics</td>
<td>Far-Side Bus Stops</td>
<td>Far-side bus stops allow pedestrians to cross behind the bus, improving pedestrian visibility and transit operations. Exceptions for far-side bus stops include considerations for bus routing, sufficient sidewalk area, and conflicts with parking, land uses, or driveways.</td>
</tr>
</tbody>
</table>

Image source: City of Pasadena

Image source: Fehr & Peers
### TABLE 4 – PREFERRED PEDESTRIAN TREATMENTS FOR STOP-CONTROLLED LOCATIONS

<table>
<thead>
<tr>
<th>Type</th>
<th>Measure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geometrics</td>
<td>Reduced Turning Radius as Determined by Design Vehicle</td>
<td>The size of the curb radius determines the speed at which approaching vehicles can navigate a turn. Reduced turn radii force approaching vehicles to slow down when turning, while still efficiently accommodating the largest vehicle commonly expected at the intersection.</td>
</tr>
<tr>
<td>Geometrics</td>
<td>Removal of Sight Distance Obstructions</td>
<td>If objects impede sight distance, it may result in an unsafe condition when motorists and pedestrians are unable to see each other. Items such as parked cars, signage, landscaping, fencing, and street furniture should be placed in a location that will not obstruct sight distance.</td>
</tr>
<tr>
<td>Signage</td>
<td>Limited Signage/Sign Clutter Evaluation</td>
<td>Road signs and street signs at intersections may distract motorists from the road. Unnecessary signage should be removed and relocated to present motorists only with signage relevant to the operation of the intersection.</td>
</tr>
</tbody>
</table>
### Enhanced Pedestrian Treatments

The enhanced pedestrian treatments for stop-controlled locations are intended to provide additional measures that may not be appropriate at all locations or are countermeasures to address a particular issue at a given location.

Table 5 includes the list of enhanced treatments for stop-controlled locations.

<table>
<thead>
<tr>
<th>Type</th>
<th>Measure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Striping</td>
<td><strong>Standard crosswalk for stop-controlled approaches</strong>, Ladder or Triple Four at uncontrolled approaches</td>
<td>High-visibility markings include a family of crosswalk striping styles such as the “ladder” and the “triple-four.”</td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Image Source: www.walkinginfo.org/pedsafe/" /></td>
<td><img src="image" alt="Image Source: Fehr &amp; Peers" /></td>
</tr>
<tr>
<td>Road Diet</td>
<td><strong>Road Diets</strong></td>
<td>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.</td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Image Source: www.tfhrc.gov/" /></td>
<td></td>
</tr>
<tr>
<td>Geometrics</td>
<td><strong>Refuge Island</strong></td>
<td>Raised islands are placed in the center of the roadway, separating opposing lanes of traffic with cutouts or ramps for accessibility along the pedestrian path.</td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Image Source: City of Pasadena" /></td>
<td></td>
</tr>
</tbody>
</table>
### TABLE 5 – ENHANCED PEDESTRIAN TREATMENTS FOR STOP-CONTROLLED LOCATIONS

<table>
<thead>
<tr>
<th>Type</th>
<th>Measure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geometrics</td>
<td>Curb Extension/Bus Bulbs/Short Right-Turn Lane Elimination</td>
<td>Also known as a pedestrian bulb-out, this traffic-calming measure is meant to slow traffic and increase driver awareness of pedestrians. It consists of an extension of the curb into the street, making the pedestrian space (sidewalk) wider.</td>
</tr>
<tr>
<td>Geometrics</td>
<td>Improved Right-Turn Slip-Lane Design/Pork Chop Redesign</td>
<td>Right-turn slip lanes (aka channelized right-turn lanes) are separated from the rest of the travel lanes by a pork chop-shaped striped or raised median area. This measure separates right-turning traffic and streamlines right turning movements. Improved right-turn slip lanes provide pedestrian crossing islands within the intersection and are designed to optimize the right-turning motorist’s view of the pedestrian and of vehicles to his or her left.</td>
</tr>
<tr>
<td>Geometrics</td>
<td>Driveway Access Management</td>
<td>Access management strategies can reduce the number of driveway crossings pedestrians encounter and result in a wider sidewalk through more efficient allocation of space. Pasadena’s Department of Transportation recently drafted Policies and Procedures and Driveway Design to help address potential conflicts.</td>
</tr>
</tbody>
</table>
TABLE 5 – ENHANCED PEDESTRIAN TREATMENTS FOR STOP-CONTROLLED LOCATIONS

<table>
<thead>
<tr>
<th>Type</th>
<th>Measure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Streetscape</td>
<td>Pedestrian-Scale Lighting</td>
<td>Pedestrian-scale lighting improves motorist visibility of pedestrians.</td>
</tr>
</tbody>
</table>

DETERMINING WHERE AND HOW TO MARK UNCONTROLLED CROSSWALKS

The first step in identifying candidate marked crosswalk locations at an uncontrolled crossing (without a stop sign or signal) is to identify the places people would like to walk (pedestrian desire lines), which are affected by local land uses (homes, schools, parks, commercial establishments, etc.) and the location of transit stops. This information forms a basis for identifying pedestrian crossing treatment areas and prioritizing such treatments, thereby creating a convenient, connected, and continuous walking environment.

The second step is identifying the locations safest for people to cross. Of all road users, pedestrians have the highest risk because they are the least protected. National statistics indicate that pedestrians represent 14 percent of all traffic incident fatalities while walking accounts for only three percent of total trips. Pedestrian collisions occur most often when a pedestrian is attempting to cross the street at an intersection or mid-block location.4

Several major studies of pedestrian collision rates at marked and unmarked crosswalks have been conducted. In 2002,

4 Pedestrian Crash Types, A 1990’s Information Guide, FHWA; This paper analyzed 5,076 pedestrian crashes that occurred during the early 1990’s. Crashes were evenly selected from small, medium, and large communities within six states: California, Florida, Maryland, Minnesota, North Carolina, and Utah.
the FHWA published a comprehensive report on the relative safety of marked and unmarked crossings. In 2006, another study was completed that further assists engineers and planners in selecting the right treatment for marked crosswalks based on studies of treatment effectiveness. With these studies as a backdrop, this document presents a variety of treatment options to mitigate safety, visibility, or operational concerns at specific locations.

TREATMENTS AT UNCONTROLLED LOCATIONS

This section presents best practices for the installation of marked crosswalks at uncontrolled intersection and mid-block locations.

When to Install Marked Crosswalks

The following is the recommended practice for providing pedestrian treatments at uncontrolled intersections and mid-block locations. The most common crosswalk of this type will be at intersections where a minor side street is stop controlled and a major street is uncontrolled.

Crossings should be marked where all of the following occur:

- Sufficient demand exists to justify the installation of a crosswalk (see Demand Considerations below)
- The location has sufficient sight distance (as measured by stopping sight distance calculations) and/or sight distance will be improved prior to crosswalk marking
- Safety considerations do not preclude a crosswalk

Demand Considerations

Uncontrolled and mid-block crossings should be identified as a candidate for marking if there is a demonstrated need for a crosswalk. Charts 1 and 2 provide a visual summary of the demand considerations, including suggested threshold values in some cases. Engineering judgment will ultimately be used to select locations appropriate for a marked, uncontrolled crossing.

---


Chart 1. Recommended Selection Process for Uncontrolled and Mid-Block Crosswalk Locations

City Staff receives request for a crosswalk installation or improvement; or

Citizen walkability audits identify a location for crosswalk installation or improvement; or

Citizen surveys identify a key location for crosswalk installation or improvement; or

Severe injury or fatal pedestrian collision occurs

Begin Traffic Investigation process, including staff field visit

Are demand considerations met (see Chart 2)?

NO

This is not a good location for a marked crossing.

YES

Use Pasadena Pedestrian Safety Toolbox and Engineering Judgment to determine treatment options

* A field visit checklist is provided in Appendix A
Chart 2. Feasibility Analysis for Treatments at Uncontrolled Locations

1. **START**
   - 20 pedestrians per hour (in any two hours, not necessarily consecutive) cross at the location
   - YES

2. **Location connects two pedestrian generators such as a school, park, bus stop, or hospital expected to generate pedestrians on a regular basis**
   - NO

3. **Nearest appropriately marked or protected crosswalk is at least 300 feet or more away**
   - NO
   - YES

4. **Low speed (posted or prima facie 25 MPH), two-lane roadway**
   - NO
   - YES

5. **Pedestrians can be easily seen from a feasible stopping sight distance**
   - NO
   - YES

   - **Use Pasadena Pedestrian Toolbox and Engineering Judgment to determine treatment options**
     - feasible

6. **Is it feasible to remove sight distance obstruction or lower speed limit?**
   - infeasible
   - feasible

7. **Direct pedestrians to the nearest marked or protected crosswalk**
   - Direct pedestrians to the nearest marked or protected crosswalk
   - Insufficient need to justify a marked crosswalk

Note: Where no engineering action is recommended in Chart 2, consider applicable education and enforcement efforts.
Considerations for Multi-Lane, High Volume, and/or High Speed Locations

At uncontrolled locations, enhanced treatments beyond striping and signing may be needed for candidate marked crosswalk locations under the following conditions:

- Multi-lane streets (three or more lanes); or
- Two-lane streets with daily traffic volumes (ADT) greater than 12,000; or
- Streets with posted speed limit exceeding 30 miles per hour

Additional funding sources should be identified as needed for these enhancements. Failing to provide an enhanced crosswalk and/or removing a crosswalk should be an option of last resort.

Crosswalk Location and Tool Feasibility Analysis

Charts 1 and 2 describe the overall procedures from the moment City staff receives a request for a new marked crosswalk (or considers removing an existing marked crosswalk) to the installation of the treatment. As described, the first steps to determine the appropriate location and treatment for the crosswalk include a staff field visit (a sample form for this field visit is included in Appendix A).

Treatment Identification

Based on the results of Charts 1 and 2, this Toolbox may be used to identify potential treatments at a candidate crosswalk location. If a candidate uncontrolled location is determined to be appropriate for a marked crossing, the preferred treatments should be provided at the subject location, as appropriate.

Table 6 includes the list of preferred treatments for uncontrolled locations. Unless otherwise noted, these treatments are appropriate for all roadway cross-sections.

---

7 See Appendix A discussion
<table>
<thead>
<tr>
<th>Type</th>
<th>Measure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geometrics/ ADA Treatments</td>
<td>Directional Curb Ramp with Truncated Domes</td>
<td>Where right-of-way is available, directional curb ramps are installed at two per corner and guide pedestrians in to the crosswalk they would utilize to cross the street. Truncated domes provide a tactile signal to the visually impaired that they are leaving the sidewalk area. Exceptions for directional curb ramps may be allowed when physical considerations such as existing drainage or required turn radius deem infeasible. Selecting directional curb ramps as a preferred treatment does not call for retrofit of existing curb ramps, rather installation will be done opportunistically in scenarios such as grant funding, development review, new construction, and reconstruction.</td>
</tr>
<tr>
<td>Striping</td>
<td>High-Visibility Marked Crosswalk</td>
<td>High-visibility markings include a family of crosswalk striping styles such as the “ladder” and the “triple-four.”</td>
</tr>
<tr>
<td>Striping</td>
<td>Advance Yield Limit Line (multi-lane roadways)</td>
<td>Yield limit lines (also referred to as “sharks' teeth”) are placed in advance of marked, uncontrolled crosswalks.</td>
</tr>
<tr>
<td>Type</td>
<td>Measure</td>
<td>Description</td>
</tr>
<tr>
<td>------------</td>
<td>----------------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Road Diet</td>
<td>Road Diet (multi-lane roadways)</td>
<td>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. A road diet is recommended for consideration in all scenarios with four or more lanes of traffic and a daily traffic volume of less than 15,000 vehicles (ADT).</td>
</tr>
<tr>
<td>Streetscape</td>
<td>Pedestrian-Scale Lighting</td>
<td>Pedestrian-scale lighting improves pedestrian visibility.</td>
</tr>
<tr>
<td>Geometrics</td>
<td>Removal of Sight Distance Obstructions</td>
<td>If objects impede sight distance, this may result in an unsafe condition when motorists and pedestrians are unable to see each other. Items such as parked cars, signage, landscaping, fencing, and street furniture should be placed in a location that will not obstruct sight distance.</td>
</tr>
</tbody>
</table>

Image Source: www.tfhrc.gov/ (Road Diet)

Image Source: www.ci.mil.wi.us (Pedestrian-Scale Lighting)

Image Source: Nazir Lalani (Removal of Sight Distance Obstructions)
### TABLE 6 – PREFERRED PEDESTRIAN TREATMENTS FOR UNCONTROLLED LOCATIONS*

<table>
<thead>
<tr>
<th>Type</th>
<th>Measure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geometrics</td>
<td>Refuge Island</td>
<td>Raised islands are placed in the center of the roadway, separating opposing lanes of traffic with cutouts or ramps for accessibility along the pedestrian path. Median refuge islands are recommended where right-of-way allows and conditions warrant.</td>
</tr>
<tr>
<td>Signage</td>
<td>Advanced Warning Signs</td>
<td>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.</td>
</tr>
</tbody>
</table>

*Image Source: City of Pasadena*

Table 7 provides a summary of the enhanced treatments for uncontrolled crosswalks. Enhanced treatments should be selected based on site-specific characteristics and engineering judgment.

Recent research on this topic has found that primary considerations for the provision of marked crossings at uncontrolled locations include traffic volumes, the presence of a median, the number of lanes to be crossed, and posted speed limits. As indicated above, multi-lane locations, and locations that experience high travel volumes and speeds are candidates for enhanced treatments, as research has indicated that for uncontrolled locations the provision of signage and striping may be inadequate.8

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8 In Chapter 3, please see: Zegeer, C., J. Stuart, and H. Huang, Safety Effects of Marked vs. Unmarked Crosswalks at Uncontrolled Crossing Locations, Federal Highway Administration, Washington, DC, 2001
<table>
<thead>
<tr>
<th>Type</th>
<th>Measure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geometrics</td>
<td>Narrow Lanes</td>
<td>Narrow lanes have a calming effect and reduce the distance pedestrians must travel when crossing.</td>
</tr>
<tr>
<td></td>
<td><img src="www.walkinginfo.org/pedsafe/" alt="Image" /></td>
<td></td>
</tr>
<tr>
<td>Geometrics</td>
<td>Curb Extensions</td>
<td>Also known as a pedestrian bulb-out, this traffic-calming measure is meant to slow traffic and increase driver awareness of pedestrians. It consists of an extension of the curb into the street, making the pedestrian space (sidewalk) wider.</td>
</tr>
<tr>
<td></td>
<td>![Image](Fehr &amp; Peers)</td>
<td></td>
</tr>
<tr>
<td>Geometrics</td>
<td>Split Pedestrian Crossover (SPXO)</td>
<td>This measure is similar to traditional median refuge islands; the difference is that the crosswalks in the roadway are staggered such that a pedestrian crosses half the street and then walks toward 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.</td>
</tr>
<tr>
<td></td>
<td><img src="www.tfhrz.gov/" alt="Image" /></td>
<td></td>
</tr>
</tbody>
</table>
### TABLE 7 – ENHANCED PEDESTRIAN TREATMENTS FOR UNCONTROLLED LOCATIONS

<table>
<thead>
<tr>
<th>Type</th>
<th>Measure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geometrics</td>
<td>Raised Crosswalk</td>
<td>A crosswalk with a surface elevated above the travel lanes, attracting drivers' attention, encouraging lower speeds, and improving the visibility of pedestrians.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><img src="https://www.saferoutesinfo.org" alt="Image Source: www.saferoutesinfo.org" /></td>
</tr>
<tr>
<td>Geometrics</td>
<td>Pedestrian Overpass/Underpass</td>
<td>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. The device is recommended only where topography supports its use.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><img src="https://omahamidcenturymodern.blogsome.com" alt="Image source: omahamidcenturymodern.blogsome.com" /></td>
</tr>
<tr>
<td>Signage</td>
<td>In-Street Pedestrian Crossing Signs</td>
<td>This measure involves posting regulatory pedestrian signage on lane edge lines and/or 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.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><img src="https://www.seton.com" alt="Image source: www.seton.com" /></td>
</tr>
</tbody>
</table>
### TABLE 7 – ENHANCED PEDESTRIAN TREATMENTS FOR UNCONTROLLED LOCATIONS

<table>
<thead>
<tr>
<th>Type</th>
<th>Measure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Signage</strong></td>
<td>Crosswalk Flags</td>
<td>Brightly-colored removal flags are placed at crosswalks to increase pedestrian visibility and clearly communicate their desire to cross the street.</td>
</tr>
<tr>
<td><strong>Signal Treatment</strong></td>
<td>In-Roadway Warning Lights</td>
<td>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.</td>
</tr>
<tr>
<td><strong>Signal Treatment</strong></td>
<td>Flashing Beacons</td>
<td>Flashing amber lights are installed on overhead or post-mounted signs, in advance of the crosswalk or at the entrance to the crosswalk.</td>
</tr>
</tbody>
</table>

*Image source: www.walkinginfo.org*  
*Image Source: www.tfhrc.gov/*  
*Image source: tti.tamu.edu*
### TABLE 7 – ENHANCED PEDESTRIAN TREATMENTS FOR UNCONTROLLED LOCATIONS

<table>
<thead>
<tr>
<th>Type</th>
<th>Measure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signal Treatment</td>
<td>Stutter Flash (Rectangular Rapid Flashing Beacon)</td>
<td>The 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. This treatment is not currently approved for use in California, but has provisional approval for use at the Federal level because of recent studies suggesting its effectiveness.</td>
</tr>
<tr>
<td>HAWK/ Pedestrian Hybrid Beacon</td>
<td>HAWK (High Intensity Activated Crosswalks) are pedestrian-actuated signals that are a combination of a beacon flasher and a traffic control signal. When actuated, HAWK displays a yellow (warning) indication followed by a solid red light. During pedestrian clearance, the driver sees a flashing red &quot;wig-wag&quot; pattern until the clearance interval has ended and the signal goes dark. While included in the Federal MUTCD, this treatment is not currently approved for use in California.</td>
<td></td>
</tr>
<tr>
<td>Pedestrian Signal</td>
<td>Conventional traffic control devices with warrants for use based on the MUTCD (a new warrant is provided in the 2009 Federal MUTCD).</td>
<td></td>
</tr>
</tbody>
</table>

*Image source: mutcd.fhwa.dot.gov*  
*Image Source: www.tfhrc.gov/*  
*Image source: City of Pasadena*
Safety effectiveness studies have been conducted for many of the devices in Table 7. Based on these studies, Table 8 provides the conditions under which the enhanced pedestrian treatments for unsignalized intersections should typically be applied. Level 1 represents a minor intervention, appropriate for situations with lower speeds and traffic volumes and high driver yielding rates. Higher levels represent more significant interventions, as may be needed on higher speed or volume roadways, wider roadways, and roadways where motorists are less likely to yield to pedestrians. Treatments may be combined with higher level treatments added to lower level treatments (i.e., flashing beacons with curb extensions).

### TABLE 8 – APPLICATION OF ENHANCED TREATMENTS FOR UNCONTROLLED LOCATIONS

<table>
<thead>
<tr>
<th>Level 1: Basic</th>
<th>Level 2: Low Speeds &lt;= 30 MPH</th>
<th>Level 3: Higher Speeds &gt; 30 MPH</th>
<th>Level 4: Higher Speeds (&gt;30 MPH) and Volumes (12,000 + ADT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Widths</td>
<td>Two to Three Lanes Only</td>
<td>Two to Three Lanes Only</td>
<td>Four or More Lanes Preferred</td>
</tr>
<tr>
<td>Narrow Lanes</td>
<td>In-Street Signs</td>
<td>Raised Crosswalk</td>
<td>Stutter Flash (RRFB)*</td>
</tr>
<tr>
<td>Refuge Island/SPXO</td>
<td>In-pavement Flashers</td>
<td>Overhead/ Post Mounted Flashing Beacons</td>
<td>Pedestrian Hybrid (HAWK) Beacon*</td>
</tr>
<tr>
<td>Curb Extensions</td>
<td>Crossing Flags (with Level 1 treatments)</td>
<td>Under/ Overpass</td>
<td></td>
</tr>
</tbody>
</table>

Notes: * Not currently approved for use in California.

### EDUCATION, ENFORCEMENT AND ENCOURAGEMENT

This section presents best practices for education, encouragement, and enforcement components of pedestrian safety programs.

**Education**

The following is a list of pedestrian safety practices for educating pedestrians and motorists about safe and lawful behavior:

- Website – a city website can contain informational materials relating to pedestrian safety
- Videos – such as public service announcements can be posted to the city’s website
- Community outreach events – events such as Mayor’s night out provide opportunities for pedestrian education
- Pamphlets – informational materials available through the City
- Student group involvement – promote pedestrian safety by involving and educating student groups
- Street/Bus Stop/School Banners – advertisements that can be placed in high activity pedestrian areas
- Yard Signs – communicate roadway conditions to motorists and pedestrians
- Strategic partnerships – partner with groups such as American Association of Retired Persons (AARP) to promote pedestrian safety
- Local media campaigns – involve local media in pedestrian safety campaigns
- Classroom curricula – work with local school districts to develop pedestrian safety curricula for schools
- Structured skills practice – develop a program that trains pedestrians in safe behavior
- Games, coloring books, etc. – fun and educational materials for children

**Enforcement**

The following is a list of pedestrian safety practices for enforcing pedestrian and vehicular right of way laws:

- Officer training courses – provide law enforcement with full understanding of pedestrian laws and safety practices
- Traffic complaint hotline – provides a method for citizens to alert the city when a public facility is of concern, such as inoperable traffic signal
- Community enforcement – provides a mechanism for community members to help enforce traffic laws, such as a radar gun checkout program
- Adult school crossing guards – provides a trained adult to help pedestrians cross the street
- Pedestrian decoys – enforcement activities with a staged pedestrian or motorist, targeting motorists or pedestrians who do not comply with traffic laws
- Partnership with media, stakeholders, and city departments – involve various stakeholders in pedestrian education campaigns and efforts

**Encouragement**

The following is a list of pedestrian safety practices oriented toward encouraging pedestrians and motorists to engage in safe and lawful behavior:

- Wayfinding – signage directing pedestrians to designated routes and destinations
- Walking school buses/Walking Wednesdays – activities organized by schools and/or parents that has students walk to school in groups on selected days
• Community walking audits – community members walk around an area noting positive practices and areas for improvement

• Silver sneaker awards – awards encouraging physical activity among seniors

• Incentives/contests – can be used to reward those who walk or demonstrate safe walking habits

• Peer-to-peer education – educating pedestrians through interaction with peers trained in pedestrian safety
5. COLLISION HISTORY REVIEW AND ANALYSIS

In this chapter we present City-wide vehicle-pedestrian collision data. The data presented includes the frequency of collisions involving pedestrians, the severity of collisions involving pedestrians, and a specific focus on collisions at signalized locations. This data is conveyed through maps and tables. The source for the collision data is the City of Pasadena’s Crossroads database for collisions involving a pedestrian(s) between July 2005 and July 2010.

FIVE YEAR (2005-2010) COLLISION REVIEW AND MAPPING

The five most recent years (July 2005- July 2010) of pedestrian collision data were mapped to illustrate the pedestrian-vehicle collisions throughout the City. The five most recent years of pedestrian-vehicle collisions at signalized intersections were also mapped. This data is useful for identifying the locations with the most vehicle-pedestrian collisions, the locations with pedestrian fatalities, the signalized locations with the most vehicle-pedestrian collisions, and the most common primary collision factors (PCFs) at signalized intersections.9

The pedestrian-vehicle collision data at signalized locations was further reviewed for driver and pedestrian age, time of day, involvement of alcohol, and PCFs to assess potential collision trends. This data is also presented in charts and tables.

Figure 1 displays the frequency of all vehicle-pedestrian collisions in Pasadena and Table 9 provides the “top ten” locations for vehicle-pedestrian collisions city-wide. Figure 2 displays the severity (including fatalities) of all vehicle-pedestrian collisions in Pasadena and Table 10 provides a list of the locations with pedestrian fatalities City-wide. Figure 3 illustrates pedestrian-vehicle collisions at signalized locations in Pasadena and Table 11 includes a list of the “top ten” locations for pedestrian-vehicle collisions at signalized locations. All but three of the locations listed in Table 9 are signalized, thus the list of “top ten” pedestrian-vehicle collisions for signalized locations listed in Table 11 is similar to the “top ten” list of pedestrian-vehicle collisions for all locations in Pasadena in Table 9.

This pedestrian safety field visit considered prototypical locations on many of the high collision corridors in the City, including Lake Avenue, Colorado Boulevard, Orange Grove Boulevard, Mountain Street, Marengo Avenue, and Fair Oaks Avenue.

---

9 Collisions within 25 feet of an intersection were assigned to that intersection.
<table>
<thead>
<tr>
<th>Intersection</th>
<th>Number of Collisions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lake Avenue and Mountain Street</td>
<td>5</td>
</tr>
<tr>
<td>Hill Avenue and Colorado Boulevard</td>
<td>5</td>
</tr>
<tr>
<td>Lake Avenue and Washington Boulevard</td>
<td>4</td>
</tr>
<tr>
<td>Raymond Avenue and Orange Grove Boulevard</td>
<td>4</td>
</tr>
<tr>
<td>Marengo Avenue and Colorado Boulevard</td>
<td>4</td>
</tr>
<tr>
<td>Fair Oaks Avenue and Colorado Boulevard</td>
<td>3</td>
</tr>
<tr>
<td>Lake Avenue and Union Street</td>
<td>3</td>
</tr>
<tr>
<td>Lake Avenue and Colorado Boulevard</td>
<td>3</td>
</tr>
<tr>
<td>Marengo Avenue and Union Street</td>
<td>3</td>
</tr>
<tr>
<td>Lake Avenue and Colorado Boulevard</td>
<td>3</td>
</tr>
<tr>
<td>Lake Avenue and Corson Street</td>
<td>3</td>
</tr>
<tr>
<td>Fair Oaks Avenue and Union Street</td>
<td>3</td>
</tr>
<tr>
<td>Lake Avenue and Maple Street</td>
<td>3</td>
</tr>
<tr>
<td>Green Street and Orange Grove Boulevard</td>
<td>3</td>
</tr>
<tr>
<td>De Lacey Avenue and Union Street</td>
<td>3</td>
</tr>
<tr>
<td>Hudson Avenue and Colorado Boulevard</td>
<td>3</td>
</tr>
<tr>
<td>Lake Avenue and Claremont Street</td>
<td>3</td>
</tr>
<tr>
<td>Marengo Avenue and Villa Street</td>
<td>3</td>
</tr>
<tr>
<td>Fair Oaks Boulevard and Howard St</td>
<td>3</td>
</tr>
<tr>
<td>Garfield Avenue and Walnut Street</td>
<td>3</td>
</tr>
<tr>
<td>Lincoln Avenue and Wyoming</td>
<td>3</td>
</tr>
<tr>
<td>Catalina Avenue and Colorado Boulevard</td>
<td>3</td>
</tr>
<tr>
<td>Catalina and Washington Boulevard</td>
<td>3</td>
</tr>
<tr>
<td>Worcester Avenue and Orange Grove Boulevard</td>
<td>3</td>
</tr>
<tr>
<td>Arroyo Parkway and Fillmore Street</td>
<td>3</td>
</tr>
</tbody>
</table>

Source: City of Pasadena

Notes: This list is based on number of collisions and does not adjust for vehicle or pedestrian volumes (exposure). Collisions occurring 25 feet or closer to an intersection were assigned to the nearest intersection.
RESULTING IN INJURIES AND/OR FATALITIES 2005-2010

FIGURE 2

PASADENA PEDESTRIAN-VEHICLE COLLISIONS

LEGEND
- Fatalities
- Injuries

1 - 2
3
5
7

Fire Station
Library
School
Parks
Goldline Track and Stations

NOT TO SCALE

Febr & Peers
TRANSPORTATION CONSULTANTS
<table>
<thead>
<tr>
<th>Primary Street</th>
<th>Nearest Cross Street</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colorado Boulevard</td>
<td>Fair Oaks Avenue</td>
</tr>
<tr>
<td>Orange Grove Boulevard</td>
<td>Oakland Avenue</td>
</tr>
<tr>
<td>Fair Oaks Avenue</td>
<td>Corson Street</td>
</tr>
<tr>
<td>Colorado Boulevard</td>
<td>El Nido Avenue</td>
</tr>
<tr>
<td>Fair Oaks Avenue</td>
<td>Tremont Street</td>
</tr>
</tbody>
</table>

Source: City of Pasadena and Fehr & Peers
Notes: Collisions occurring 25 feet or closer to an intersection were assigned to the nearest intersection.
PASADENA PEDESTRIAN-VEHICLE COLLISIONS
FREQUENCY AT SIGNALIZED LOCATIONS 2005-2010

FIGURE 3
### TABLE 11 - TOP TEN SIGNALIZED PEDESTRIAN-VEHICLE COLLISION LOCATIONS IN PASADENA 2005-2010

<table>
<thead>
<tr>
<th>Intersection</th>
<th>Number of Collisions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lake Avenue and Mountain Street</td>
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</tr>
<tr>
<td>Hill Avenue and Colorado Boulevard</td>
<td>5</td>
</tr>
<tr>
<td>Lake Avenue and Washington Boulevard</td>
<td>4</td>
</tr>
<tr>
<td>Raymond Avenue and Orange Grove Boulevard</td>
<td>4</td>
</tr>
<tr>
<td>Marengo Avenue and Colorado Boulevard</td>
<td>4</td>
</tr>
<tr>
<td>Fair Oaks Avenue and Colorado Boulevard</td>
<td>3</td>
</tr>
<tr>
<td>Lake Avenue and Union Street</td>
<td>3</td>
</tr>
<tr>
<td>Lake Avenue and Colorado Boulevard</td>
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<td>Marengo Avenue and Union Street</td>
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<td>Lake Avenue and Corson Street</td>
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<td>Green Street and Orange Grove Boulevard</td>
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<td>Hudson Avenue and Colorado Boulevard</td>
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</tr>
<tr>
<td>Fair Oaks Boulevard and Howard St</td>
<td>3</td>
</tr>
<tr>
<td>Lincoln Avenue and Wyoming</td>
<td>3</td>
</tr>
<tr>
<td>Catalina Avenue and Colorado Boulevard</td>
<td>3</td>
</tr>
<tr>
<td>Arroyo Parkway and Fillmore Street</td>
<td>3</td>
</tr>
</tbody>
</table>

Source: City of Pasadena

Notes: This list is based on number of collisions and does not adjust for vehicle or pedestrian volumes (exposure). Collisions occurring 25 feet or closer to an intersection were assigned to the nearest intersection.
REVIEW OF COLLISION DATA AT SIGNALIZED LOCATIONS

With an emphasis on collisions at signalized locations, the City’s collision and associated demographic data was reviewed for relevant trends. Some of the data that was explored includes common PCFs, pedestrian age, time of day, and involvement of alcohol. Approximately 213 collisions involving pedestrians occurred at signalized intersections out of a total of 442 pedestrian-vehicle collisions in Pasadena, indicating just fewer than 50% of the total pedestrian-vehicle collisions occurred at signalized locations.

Table 12 provides a list of the most common PCFs for collisions at signalized locations. The top three PCFs were pedestrian right-of-way violation (vehicle at fault), pedestrian violation (pedestrian at fault), and traffic signals and signs. Among collisions at signalized intersections, these three PCFs accounted for 81% of collisions. With vehicles being at fault at over 60% of pedestrian collisions at signalized intersections, safety campaigns should include education messages for both motorists and pedestrians.

<table>
<thead>
<tr>
<th>PCF</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pedestrian Right-of-Way Violation</td>
<td>57%</td>
</tr>
<tr>
<td>Pedestrian Violation</td>
<td>17%</td>
</tr>
<tr>
<td>Traffic Signals and Signs</td>
<td>7%</td>
</tr>
<tr>
<td>Auto Right-of-Way Violation</td>
<td>5%</td>
</tr>
<tr>
<td>Unsafe Starting or Backing</td>
<td>3%</td>
</tr>
<tr>
<td>Unsafe Speed</td>
<td>2%</td>
</tr>
<tr>
<td>Other Hazardous Movement</td>
<td>2%</td>
</tr>
<tr>
<td>Improper Turning</td>
<td>2%</td>
</tr>
<tr>
<td>Unknown</td>
<td>2%</td>
</tr>
<tr>
<td>Wrong Side of Road</td>
<td>1%</td>
</tr>
<tr>
<td>Driving Under Influence</td>
<td>0.5%</td>
</tr>
<tr>
<td>Improper Passing</td>
<td>0.5%</td>
</tr>
<tr>
<td>Other Improper Driving</td>
<td>0.5%</td>
</tr>
<tr>
<td>Other Than Driver</td>
<td>0.5%</td>
</tr>
</tbody>
</table>

Source: City of Pasadena and Fehr & Peers
Table 13 provides a summary of pedestrian age data for collisions at signalized locations. The ages are grouped in five categories: ages 0-15, ages 15-30, ages 31-45, ages 46-60, and ages 61 and above. Among collisions at signalized intersections, the greatest proportion of collisions involved the groups ages 46-60 with 25%, followed by ages 31-45 and ages 55 and over tied with 23%. Combined, these groups account for 71% of pedestrian collisions at signalized intersections. Pedestrians 16 or older were involved in 92% of pedestrian collisions at signalized intersections, while pedestrians under the age of 15 comprised 8% of pedestrian collisions at signalized location. This indicates education efforts aimed at adults would target the greatest number of people with a propensity to be involved in pedestrian collisions at signalized locations in Pasadena.

<table>
<thead>
<tr>
<th>Age Range</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-15</td>
<td>8%</td>
</tr>
<tr>
<td>16-30</td>
<td>21%</td>
</tr>
<tr>
<td>31-45</td>
<td>23%</td>
</tr>
<tr>
<td>46-60</td>
<td>25%</td>
</tr>
<tr>
<td>61+</td>
<td>23%</td>
</tr>
</tbody>
</table>

Source: City of Pasadena and Fehr & Peers

Table 14 provides a summary of time of day data for collisions at signalized locations. The time of day was grouped into four categories: school/business hours (7:00 AM-4:59 PM), evening hours (5:00 PM-8:59 PM), night hours (9:00 PM-2:59 AM), and morning hours (3:00 AM-6:59 AM). Among collisions at signalized intersections, the greatest proportion of collisions occurred during business hours with 63% of the total, followed by evening hours. Evening and night hours combined for less than 10% of the total collisions at signalized locations.

<table>
<thead>
<tr>
<th>Time of Day</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:00AM-4:59PM</td>
<td>63%</td>
</tr>
<tr>
<td>5:00PM-8:59PM</td>
<td>28%</td>
</tr>
<tr>
<td>9:00PM-2:59AM</td>
<td>8%</td>
</tr>
<tr>
<td>3:00AM-6:59AM</td>
<td>1%</td>
</tr>
</tbody>
</table>

Source: City of Pasadena and Fehr & Peers
Table 15 provides information on the involvement of alcohol for collisions at signalized locations. The PCF “driving under the influence” occurred once among pedestrian collisions at a signalized location. Based on this data, alcohol was involved in 0.5% of collisions at signalized intersections in Pasadena.

<table>
<thead>
<tr>
<th>Alcohol Involved?</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other PCF</td>
<td>99.5%</td>
</tr>
<tr>
<td>PCF for Driving Under the Influence</td>
<td>0.5%</td>
</tr>
</tbody>
</table>

Source: City of Pasadena and Fehr & Peers

In addition to the PCF, age, and time of day data for collisions at signalized intersections, the direction of travel for vehicles was also tabulated. Among these collisions, drivers were proceeding straight approximately 25% of the time and making a left- or right-turn approximately 69% of the time, for a total of 94%. A combination of backing up, changing lanes, slowing/stopping, stopped in road, and “other” comprises the remaining six percent. The high percentage of pedestrian-vehicle collisions occurring while vehicles are turning or proceeding straight indicates a failure to yield to pedestrians at intersections. It should be noted that pedestrian volumes were not available to provide pedestrian crash rates. Pasadena may consider collecting this data as a follow-up to this report.

SUMMARY OF COLLISION REVIEW

From 2005 to 2010 approximately 48% of pedestrian-vehicle collisions in the City of Pasadena occurred at signalized intersections and there were fatalities at five locations. A majority of pedestrian-vehicle collisions were the fault of the motorist, involved adult pedestrians, and occurred during business hours. The data analyzed is inconsistent with the perception that pedestrian education programs should focus on vulnerable populations such as children and the elderly. The collision data for signalized intersections in Pasadena indicates that these two groups are not disproportionately affected by pedestrian-vehicle collisions. Therefore, safety education campaigns may most effectively focus on increasing motorist awareness of pedestrians and on encouraging safer walking behavior by pedestrians of all ages, particularly adults.
6. RECOMMENDATIONS FOR WALKING AUDIT LOCATIONS

WALKING AUDIT RESULTS AND RECOMMENDATIONS

This chapter presents the observations and recommendations made during the walking audit conducted in the City of Pasadena on September 2, 2010. The recommendations are based on best practices and discussions with the participant group regarding local needs and feasibility.

The recommendations in this report are based on limited field observations and general knowledge of best practices in pedestrian design and safety. As this report is conceptual in nature, the City should conduct more detailed studies before finalizing and implementing any physical changes. Conditions may exist in the focus areas that were not observed and are not compatible with recommendations in this report. City staff should conduct further analysis to refine or discard the recommendations in this report if they are contextually inappropriate or do not improve 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 unsafe conditions.

The evaluation team worked with City staff to select five focus areas for the walking audit based on the following criteria:

- The locations were intersections controlled by traffic signals;
- There was a pattern of collisions involving pedestrians from 7/1/05 to 6/30/10;
- There was a high level of pedestrian activity at all five intersections; and
- The intersections were in close proximity to key generators, such as transit, retail, parks, schools and pedestrian-oriented retail businesses.

The focus on signalized intersections arose from a recent study completed by the City that indicated a majority of all pedestrian-related collisions in the City occurred at intersections controlled by traffic signals.

Documents reviewed during the walking audit site visit included signal timing sheets, collision reports, collision diagrams generated by the City’s Crossroads collision database, signal design plans and collision totals for the intersections with the highest frequency of pedestrian collisions.

SELECTION OF FOCUS AREAS

The walking audit focus areas are shown in Figure 4. Five walking intersections were selected for the Pasadena study:

- Walking Audit Site Number 1: Colorado Boulevard at Marengo Avenue
- Walking Audit Site Number 2: Lake Avenue at Mountain Street
Walking Audit Site Number 3: Colorado Boulevard at Fair Oaks Avenue

Walking Audit Site Number 4: Orange Grove Boulevard at Raymond Avenue

Walking Audit Site Number 5: Lake Avenue at Corson Street

The following sections present the key issues identified during the walking audit. Recommendations are presented to respond to the issues at each site. Focus area summary graphics, with a compilation of all recommendations, have been prepared. The graphics are shown in Figures 5 through 9.

Figure 4 - Walking Audit Locations
During the walking audit, the evaluators noted a number of very positive treatments that the City of Pasadena was already implementing to make the street system more oriented to pedestrians in an effort to promote walking as a mode of transportation. Those treatments are discussed here.

- Many bus stops were provided with shelters and benches.
- Street trees were prevalent throughout the City.
- Wheelchair ramps were provided at many intersections.
- Limit lines were striped in advance of marked crosswalks at many of the signalized intersections.
- Countdown pedestrian signal indications were installed at many intersections and the City is in the process of retrofitting all signalized intersections.
- ADA pushbuttons have been retrofitted at a number of intersections, some of which provide locator tones and verbal messages in both English and Spanish.
- A Road Diet (lane reduction treatment) has been implemented on Cordova Street from Lake Avenue to Hill Avenue. The City is working towards implementing a Road Diet on Cordova Street from Arroyo Parkway to Lake Avenue and on Lincoln Avenue from Washington Street to Orange Grove Boulevard.
- Pedestrian-oriented street lighting is provided along some of the major corridors such as Orange Grove Boulevard and Colorado Boulevard.
- Bicycle ramps and racks are provide at the train stations
- A Bicycle Boulevard is planned for Marengo Avenue from Orange Grove Boulevard to Mountain Street.
- Gold Line light rail stations include a number of treatments designed to improve pedestrian awareness of trains approaching on the railroad tracks at station platforms.
- A special type of crosswalk that includes in-pavement flashers that face the pedestrians in the crosswalk (and not drivers approaching the crosswalk) has recently been installed at the intersection of South Arroyo Parkway and Fillmore Street as a pilot project.
- A major project was completed on September 3, 2010, during the walking audit site visit, to improve a heavily used pedestrian walkway in the Rose Bowl area. This project includes redesigning traffic flow at intersections to reduced conflicts and better separation of the pedestrian walkway from the vehicular travel lanes.
Colorado Boulevard at Marengo Avenue

Observations

The intersection of Colorado Boulevard and Marengo Avenue is controlled by a six-phase traffic signal. Protected/permisive left-turn phases are provided for the Colorado Boulevard approaches but not for the Marengo Avenue approaches.

This intersection is located one block away from the Union Boulevard and Marengo Avenue intersection, which is also signalized. The collision pattern primarily involves pedestrians being hit by left- and right-turning vehicles as well as vehicles traveling straight through the intersection. All approaches of the intersection are provided with two through lanes and a left-turn lane.

The following positive characteristics were either observed or discussed with the group:

- Pedestrian push buttons with audible verbal messages in English are provided to assist the visually impaired to cross the street using the pedestrian signals.
- Separate left-turn phases are provided for two of the approaches.
- Marked crosswalks are provided on all legs of the intersection with advance limit lines.
- Curb ramps are provided on all four corners of the intersection.
- Approximately 7,500 vehicles enter the intersection during the highest peak hour, which begins at 5:15 PM.

Possible Safety Treatments

To improve pedestrian safety and mobility at the intersection of Colorado Boulevard and Marengo Avenue, the following treatments are suggested:

Short-Term Operational Treatments

- Consider implementing a Lead Pedestrian Interval (LPI) of at least four seconds to allow pedestrians to establish their right-of-way before drivers receive a green indication to make a conflicting right-turn movement.
- Review the pedestrian clearance intervals to make sure they meet the minimum requirements specified by the CAMUTCD.
• Consider restriping the crosswalk using high visibility markings to emphasize the presence of pedestrians in the crosswalks, especially those crossing Colorado Boulevard because of the uphill grade on the eastbound approach to the intersection.

• Consider implementing an all-red clearance interval of two seconds.

• Consider resynchronizing the Colorado Boulevard/Marengo Avenue intersection with the Marengo Avenue/Union Boulevard intersection so that the vehicular indications turn red at the same time for northbound traffic approaching on Marengo Avenue to avoid displaying conflicting red and green indications at these two closely-spaced intersections.

• Review the vehicle change intervals to make sure they meet the minimum requirements specified by the CAMUTCD.

• Review the intersection safety lighting to determine if the existing luminaries are providing sufficient light to make pedestrians using the crosswalk at night visible to drivers approaching the intersection.

• Consider extending the median on the south of the intersection north to the crosswalk to provide a better refuge area for pedestrians.

Longer-Term Capital Treatments

• Consider implementing the flashing yellow arrow for left-turn phases similar to other signalized intersections in the City of Pasadena.

• Study the Marengo Avenue approaches to determine if separate left-turn phasing should be provided for the northbound and southbound approaches.

Lake Avenue at Mountain Street

Observations

The intersection of Lake Avenue and Mountain Street is controlled by a two-phase traffic signal. Separate left-turn phases are not provided for any of the intersection’s approaches. Transit stops close to the intersection generate significant amounts of pedestrian activity, as do the commercial uses on all four corners of the intersection.

The west leg of the intersection is wider than is needed for the vehicular travel lanes. There is a clear history of southbound drivers turning left on Lake Avenue colliding with pedestrians in the crosswalk marked across the east leg of the intersection. The southbound left-turn movement is heavy even during off-peak hours.
The following positive characteristics were either observed or discussed with the group:

- Crosswalks and countdown pedestrian signals are provided on all four approaches to the intersection.
- Limit lines are striped in advance of the crosswalks to discourage vehicular encroachment into the crosswalk area while stopped at the intersection.
- The transit stop is located on the far side of the intersection in the southbound direction to minimize disruption to traffic on Lake Avenue.
- Curb ramps with ADA-compliant truncated domes are provided all four corners of the intersection.

**Possible Safety Treatments**

To improve pedestrian safety and mobility at the intersection of Lake Avenue and Mountain Street, the following treatments are suggested:

**Short-Term Operational Treatments**

- Consider implementing LPI of at least four seconds to allow pedestrians to establish their right-of-way before drivers receive a green indication to make conflicting right-turn movements.
- Review the pedestrian clearance intervals to make sure they meet the minimum requirements specified by the CAMUTCD.
- Consider increasing the pedestrian walk interval from five seconds to seven seconds.
- Consider implementing Countdown pedestrians signal indications.
- Consider increasing the all-red clearance interval to two seconds.
- If feasible, consider lengthening the bus stop zone on the southwest corner of the intersection to minimize the potential for buses stopping in the middle of intersection and blocking traffic.
- Consider restriping the crosswalk using high visibility markings to emphasize the presence of pedestrians in the crosswalks.
- Review the vehicle change intervals to make sure they meet the minimum requirements specified by the CAMUTCD.
- Review the intersection safety lighting to determine if the existing luminaries are providing sufficient light to make pedestrians using the crosswalk at night visible to drivers approaching the intersection.

**Longer-Term Capital Treatments**

- Consider protected left-turn phases for the Lake Avenue approaches especially in the southbound direction.
- Consider reducing the corner curb radius on the southeast corner of the intersection to make it a more pedestrian-friendly design.
- Consider consolidating the four driveways exiting onto...
the south side of Mountain Street serving the CVS Pharmacy shopping center to make this a more pedestrian-friendly area, reduce the turning movement conflicts, and facilitate the striping of designated left-turn lanes on Mountain Street for traffic turning left into the shopping center.

- Consider reducing the width of the west leg of the intersection (and the length of the crosswalk) by narrowing the north half of Mountain Street on the northwest corner of the intersection.

**Colorado Boulevard at Fair Oaks Avenue**

**Observations**

The intersection of Colorado Boulevard and Fair Oaks Avenue is controlled by a two-phase traffic signal. No separate left-turn phases are provided, and left turns are restricted in the northbound and southbound directions on Fair Oaks Avenue for all vehicular traffic except buses. This left-turn restriction is necessary because there is insufficient width on the Fair Oaks Avenue approaches to provide separate left-turn phases. Blank out “No Left Turn” Symbol signs are displayed during the green interval for traffic traveling on Fair Oaks Avenue to further emphasize to drivers that left turns are not permitted.

Pedestrian activity is extremely heavy at this intersection, which is located in the heart of the central business district. This intersection is also heavily used by various transit providers and is a transfer point between different transit services. The potential for conflicts between pedestrians and turning vehicular traffic is high and was considered a high priority issue for the evaluators. The adjacent signalized intersections incorporate “Scramble” pedestrian phases that permit pedestrians to cross the street diagonally by requiring all vehicle traffic to come to a complete stop. Because of the heavy traffic flows at the Colorado Boulevard and Fair Oaks intersection, this particular modification to the operation of the intersection was not considered feasible.

The following positive characteristics were either observed or discussed with the group:

- Accessible pedestrian push buttons are provided.
- Blank out No Left Turn Symbol signs are displayed during the green interval for traffic traveling on Fair Oaks Avenue to further emphasize to drivers that left turns are not permitted on the northbound and southbound approaches except for buses.
- Marked crosswalks with advance limit lines are provided on all legs of the intersection.
- Curb ramps are provided on all four corners of the intersection.
- The intersection safety lighting as well as lighting emanating from the adjacent commercial business illuminates the crosswalks well and pedestrians are using the crosswalks at night are clearly visible.
- Approximately 3,150 vehicles enter the intersection during the PM peak hour, which begins at 5:00 PM. The mid-day peak hour has very similar volumes and begins at 11:45 AM.
Possible Safety Treatments

To improve pedestrian safety and mobility at the intersection of Colorado Boulevard and Fair Oaks Avenue, the following treatments are suggested:

Short-Term Operational Treatments

- Consider implementing LPI of at least four seconds to allow pedestrians to establish their right-of-way before drivers receive a green indication to make conflicting right-turn movements.
- Review the pedestrian clearance intervals to make sure they meet the minimum requirements specified by the CAMUTCD.
- Consider increasing the Walk pedestrian signal interval from five seconds to seven seconds.
- Consider placing the pedestrian signals in recall during the hours of the day when pedestrian flows are at their heaviest (consider doing this at all signalized intersections in the Central Business District where pedestrian activity is significant throughout the day).
- Consider restriping the crosswalks using high visibility markings to emphasize the presence of pedestrians in the crosswalks.
- Consider implementing an all-red clearance interval of two seconds.
- Evaluate restricting right-turns on red to reduce the conflicts that are occurring between right-turning vehicles and pedestrians in the crosswalks.
- Consider posting additional signs restricting left turns from Fair Oaks Avenue onto Colorado Boulevard on the signal poles located on the northeast and southwest corners of the intersection.
- Review the vehicle change intervals to make sure they meet the minimum requirements specified by the CAMUTCD.
- Work with Metro and Foothill Transit to implement left turn restrictions that apply to transit vehicles for the Fair Oaks Avenue approaches. Currently all vehicles are prohibited from turning left from Fair Oaks Avenue onto Colorado Boulevard.
- Work with vendors to consolidate newspaper racks that clutter the sidewalks to improve pedestrian circulation.

Longer-Term Capital Treatments

- Study the Colorado Boulevard approaches to determine if separate left-turn phasing should be provided, especially for the eastbound approach, which experiences heavy left-turn movements during the noon peak hour.
- Consider removing the right-turn lanes on the Colorado Boulevard approaches, which are not very effective due to their short length. Use this street space to widen the sidewalks (northeast, southeast, and southwest corners), which are frequently crowded with pedestrians.
• Consider constructing streetscape treatments in accordance with the provisions of the applicable Specific Plan.

Orange Grove Boulevard at Raymond Avenue

Observations

The intersection of Orange Grove Boulevard and Raymond Avenue is controlled by a two-phase traffic signal. Separate left-turn phases are not provided for any of the intersection’s approaches.

The intersection is located in a higher density, primarily residential area. Transit stops close to the intersection generate significant amounts of pedestrian activity.

There is a building housing a restaurant fairly close to the southwest corner of the intersection and creates a sight distance obstruction. Mast arm indications are provided for all but the southbound approach to the intersection. The history of pedestrian collision shows that two pedestrians were hit in the crosswalk on the east leg of the intersection by northbound drivers on Raymond Avenue turning right onto Orange Grove Boulevard who said they could not see approaching traffic.

The following positive characteristics were either observed or discussed with the group:

- Marked crosswalks and countdown pedestrian signals are provided on all four approaches to the intersection.
- Limit lines are striped in advance of the crosswalks to discourage vehicular encroachment into the crosswalk area while stopped at the intersection.
- Pedestrian oriented street lighting is provided on the Orange Grove Boulevard approaches.
- Curb ramps with ADA truncated domes are provided on the corners of the intersection.
- Over 100 vehicles per hour turn right on the southbound approach during the two hour periods from 7:00 AM to 9:00 AM and from 4:00 PM to 6:00 PM.

Possible Safety Treatments

To improve pedestrian safety and mobility at the intersection of Orange Grove Boulevard and Raymond Avenue, the following treatments are suggested:

Short-Term Operational Treatments

• Consider implementing LPI of at least four seconds to allow pedestrians to establish their right-of-way before drivers receive a green indication to make conflicting right-turn movements.
• Consider reviewing the pedestrian clearance intervals to make sure they meet the minimum requirements specified by the CAMUTCD.

• Consider providing an all-red clearance interval. None is currently provided.

• Review the vegetation growth at the intersection and request the City’s landscape maintenance crews to trim vegetation as necessary.

• Work with the owner of the building housing the restaurant located on the southwest corner of the intersection to redesign the pedestrian railing running along the north side of the restaurant to reduce its impact to sight distance for northbound drivers on Raymond Avenue turning right onto Orange Grove Boulevard.

• Consider restricting right turns on red for northbound drivers on Raymond Avenue turning right onto Orange Grove Boulevard if the sight distance obstruction caused by the pedestrian railing cannot be removed.

• Consider treatments to Orange Grove Boulevard bike route or designating a parallel bike route.

**Longer-Term Capital Treatments**

• Consider protected left-turn phases for the Orange Grove Boulevard approaches, especially in the eastbound direction.

• Consider reducing the corner curb radius on the northwest corner of the intersection to make it a more pedestrian-friendly design by removing the southbound right-turn lane. Over 100 vehicles turn right during the periods from 7:00 AM to 9:00 AM and from 4:00 PM to 6:00 PM. The City may not feel that removing the right-turn only lane is a viable option.

• Consider constructing a pole with a mast arm and signal on the southwest corner of the intersection facing southbound traffic on Raymond Avenue.

**Lake Avenue at Corson Street**

**Observations**

The intersection of Lake Avenue and Corson Street is controlled by a complex phased traffic signal. A separate left-turn phase is provided for the southbound approach of the intersection on Lake Avenue to turn onto the eastbound SR 210 on ramp and onto Corson Street, which serves as a frontage road to SR 210. The northbound approach does not have a signal phase because the eastbound approach on Corson Street is designated one way and is part of the eastbound off-ramp system for SR 210 at Lake Avenue.

The east leg of the intersection is one-way leaving the Lake Avenue and Corson Street intersection because it is part of the on-ramp system for SR 210 at Lake Avenue and is controlled by ramp metering signals.

Although the intersection is owned by the California Department of Transportation, the City of Pasadena maintains the intersection and maintains the signal timing. There is a Gold Line Light Rail station located
underneath Lake Avenue in the median of SR 210, which generates high levels of pedestrian activity at the Lake Avenue and Corson Street intersection, especially across the east leg. The station is connected to Lake Avenue by a series of stairs and elevators.

There is a narrow, poorly lit pedestrian walkway under Lake Avenue north of the Lake Avenue and Corson Street intersection, which can be used by pedestrians to cross Lake Avenue. Therefore, no crosswalk is provided on the north leg of the Lake Avenue and Corson Street intersection. The pattern of pedestrian collisions primarily involves southbound drivers continuing to turn left even after the left-turn signal has turned red and pedestrians have begun to cross in the crosswalk on the east leg of the intersection.

The following positive characteristics were either observed or discussed with the group:

- Marked crosswalks and countdown pedestrian signals are provided on all approaches to the intersection except the north leg, which is closed but has a pedestrian undercrossing alternate.
- The traffic signal that controls the intersection provides a protected only left-turn phase for southbound traffic that turns across the most heavily used crosswalk.
- Curb ramps with ADA-compliant truncated domes are provided on the corners of the intersection.
- The 12-inch vehicular signal displays are mounted on mast arms and clearly visible to drivers approaching the intersection.
- Approximately 6,500 vehicles enter the intersection during the highest peak hour, which begins at 5:00 PM.

Possible Safety Treatments

To improve pedestrian safety and mobility at the intersection of Lake Avenue and Corson Street, the following treatments are suggested:

Short-Term Operational Treatments

- Consider changing the southbound left-turn phase of the traffic signal that controls the intersection from leading to lagging. This means that the left-turn phase will turn green after the pedestrians have finished crossing the east leg of the intersection and eliminate the current pattern of pedestrian collisions involving drivers running the red arrow signal indication when the left-turn phase has terminated (note: this change will require City staff to review the timing at adjacent intersections and modify the offsets so that north/south traffic on Lake Avenue continues to flow smoothly.)
• Consider installing a no right turn blank out (R3-1 CA) sign, which will turn on only when the pedestrian Walk interval is displayed for pedestrians crossing the east leg of the intersection to eliminate the conflicts occurring when the signal turns green for northbound traffic on Lake Avenue.

• Consider increasing the pedestrian walk interval from five to seven seconds.

• Consider increasing the all-red clearance interval to two seconds.

• Consider restriping the crosswalks using high visibility markings to emphasize the presence of pedestrians in the crosswalks.

• Consider reviewing the vehicle change intervals to make sure they meet the minimum requirements specified by the CAMUTCD.

• Consider installing way finding signs on the Gold Line Platform and sidewalks on Lake Avenue using local landmarks to encourage use of the underpass.

• Consider relocating the pedestrian signal indication on the northeast corner of the intersection to improve visibility to pedestrians.

**Longer-Term Capital Treatments**

• Consider relocating the Metro sign on the northeast corner of the intersection to improve the visibility of pedestrians waiting to cross the east leg of the intersection.

• Consider reducing the corner curb radius on the southeast corner of the intersection to make it a more pedestrian-friendly design.
Overall Comments:
- Consider synchronizing northbound signals with northbound signal at Marengo Avenue and Union Street
- Consider implementing Leading Pedestrian Interval
- Consider implementing an all-red clearance interval
- Consider implementing flashing yellow arrow for left-turn phase similar to other areas
- Review vehicle change intervals
- Review pedestrian clearance intervals
- Review intersection lighting
- Evaluate Marengo Avenue approaches for left-turn phasing

- Consider extending median with thumbnail island on southern leg
- Consider restriping with high-visibility crosswalk markings (sample triple tour shown)
CITY OF PASADENA WALKING AUDIT RECOMMENDATIONS FOR LAKE AVENUE AND MOUNTAIN STREET

FIGURE 6

Overall Comments:
- Consider increasing all-red clearance interval
- Consider narrowing west leg
- Consider lightening southeast corner
- Consider implementing Leading Pedestrian Interval
- Consider restriping with high-visibility crosswalk
- Consider increasing pedestrian walk interval
- Consider实施 countdown pedestrian signals
- Review vehicle change intervals
- Review intersection safety lighting
- Review pedestrian clearance intervals

Consider:
- Evaluating left-turn phase for Lake Ave approaches
- Consider implementing Lead Pedestrian Interval
- Consider restriping with high-visibility crosswalk
- Consider increasing pedestrian walk interval
- Consider implementing countdown pedestrian signals
- Review vehicle change intervals
- Review intersection safety lighting
- Review pedestrian clearance intervals

Consider:
- Adding bulbouts
- Consider adding median turn lane
- Consider consolidating driveways
- Consider narrowing west leg
- Consider lightening southeast corner
- Consider implementing Leading Pedestrian Interval
- Consider restriping with high-visibility crosswalk
- Consider increasing pedestrian walk interval
- Consider implementing countdown pedestrian signals
- Review vehicle change intervals
- Review intersection safety lighting
- Review pedestrian clearance intervals

NOT TO SCALE
CITY OF PASADENA WALKING AUDIT RECOMMENDATIONS FOR COLORADO BOULEVARD AND FAIR OAKS AVENUE

FIGURE 7

Overall Comments:
- Consider left-turn restrictions for transit vehicles
- Consider restricting right-turns on red
- Consider implementing all-red clearance intervals
- Consider Leading Pedestrian Interval
- Consider increasing walk interval from 5 seconds to 7 seconds
- Consider placing pedestrian signals in recall during peak pedestrian hours
- Review pedestrian clearance intervals
- Review vehicle change intervals

Consider removing right-turn lane and add bulbout

Consider consolidating news racks to enlarge pedestrian area

Consider posting additional signs indicating existing left-turn prohibition for vehicles except buses

Consider high-visibility crosswalk and streetscape treatments consistent with specific plan

Evaluate left-turn cheating on Colorado Blvd
Overall Comments:
- Consider improving bike route or designating parallel route to Orange Grove Blvd
- Consider implementing all-red clearance interval
- Consider Leading Pedestrian Interval
- Review pedestrian clearance intervals

- Consider removing southbound right-turn and add bulbout
- Review improving sight distance for northbound right-turning vehicles
- Consider RTOR restriction northbound if sight distance obstruction cannot be removed at southwest corner
- Review vegetation growth and request City landscaping maintenance, as needed

- Consider protected left-turn phasing on Orange Grove Blvd
- Consider installing southbound traffic signal mast arm

Bus Stop

CITY OF PASADENA WALKING AUDIT RECOMMENDATIONS FOR ORANGE GROVE BOULEVARD AND RAYMOND AVENUE
Overall Comments:
- Consider changing southbound left-turns from lead to lag
- Consider increasing all-red clearance interval
- Consider increasing pedestrian walk interval from 5 seconds to 7 seconds
- Consider restriping crosswalks with high-visibility markings
- Review vehicle change intervals
- Consider relocating Metro monument signs farther back to improve visibility of pedestrians
- Consider relocating pedestrian signal indicator to improve visibility to pedestrians
- Consider installing wayfinding signs for transit platform
- Consider installing no right-turn blank out sign activated with north-south pedestrian walk phase
- Consider reducing corner radius and adding bulbout
- Review vehicle change intervals

FIGURE 9
CITY OF PASADENA WALKING AUDIT RECOMMENDATIONS FOR LAKE AVENUE AND CORSON STREET
7. NEXT STEPS

Improving the pedestrian environment requires a multi-faceted approach that targets users of all travel modes in Pasadena. Additionally, the implementation of programs or treatments may be limited by local considerations such as funding, right-of-way, and other modes of travel. This report has documented, specifically with respect to the benchmarking analysis and the review of existing signalized locations in Pasadena, the extent to which local staff is involved with on-going efforts to improve pedestrian safety. Below is a list of potential funding sources or additional activities that can be explored for implementing recommendations in this report or future efforts.

Potential funding sources that can be used for related efforts include:

- Caltrans Transportation Planning Grants
- Los Angeles County Metropolitan Transportation Authority Call for Projects
- State and Federal Safe Routes to Schools Programs
- Proposition 84 Grant Funds
- Office of Traffic Safety (OTS) Grants
- Caltrans Highway Safety Improvement Program (HSIP) Funding

The implementation of specific recommendations or exploration of pedestrian enhancements in this report may be accompanied by:

- Operational analysis of suggested treatments
- Design of suggested treatments
- Additional walking audits, particularly at uncontrolled locations
- Pilot or demonstration projects
- Collection of pedestrian volumes for additional analysis, particularly for rate (exposure)-based collision analysis
APPENDIX A:
FIELD VISIT CHECKLIST
CRITICAL ROADWAY CHARACTERISTICS

Site Distance Issues (circle driver or pedestrian as applicable):

1. Parked cars (driver/ ped)
2. Moving traffic obscures vision during crossing (driver/ ped)
3. Roadway curvature (driver/ ped)
4. Terrain (driver/ ped)
5. Vegetation (driver/ ped)
6. Significant sun glare (driver/ ped)
7. Insufficient building setback (driver/ ped)
8. Moveable roadside items, e.g., street furniture (driver/ ped)
9. Fixed roadside items, e.g., signal control boxes, signs (driver/ ped)
10. Inadequate roadway lighting (driver/ ped)
11. Poor signal visibility (driver/ ped)

Sight distance is generally acceptable if the pedestrian can easily be seen from a distance of 10x the speed limit or 250 feet.

If any of the above issues are circled for the driver or pedestrian, can these issues be mitigated? If no, direct pedestrians to the nearest marked crosswalk (stop field view here) or consider installing a pedestrian signal or grade separation (continue below to collect data for warrant analysis). If yes, make note of mitigation options and continue below.

Mitigation options:

______________________________________________________________________
______________________________________________________________________

GENERAL PEDESTRIAN CHARACTERISTICS

1. Is the crossing along a direct route to a major pedestrian attractor/ generator? Circle: yes/no
2. Peak Hour Pedestrian Volume (total crossing major road): _________________ pedestrians/hour
3. Pedestrian Crossing Distance, curb to curb: _________________ feet
4. Distance to nearest marked crosswalk: _________________ feet. Is the crossing signalized? Circle: yes/no
5. Pedestrian Walking Speed (average): ____________ ft/sec
6. Pedestrian Start-up and End Clearance Time: ____________ sec
7. Existing Pedestrian Signal Timing (crossing major road): ____________ sec
8. Existing Pedestrian Signal Provisions (count down/ push button/ scramble/ other/ none – circle all that apply)
9. Other Existing Pedestrian Accommodations (e.g., signage, crosswalk striping) – list here and include on diagram:
   a. _________________________________________
   b. _________________________________________

**GENERAL VEHICLE/ ROADWAY CHARACTERISTICS**
1. Major Road Traffic Speed (posted/ statutory/ 85th Percentile – circle one): ____________ MPH
2. Major Road Traffic Volume (total of both approaches during peak hour): ____________ vehicles/hour
3. Number of Lanes on Major Road: ____________ and on Minor Road: ____________
4. Typical Motorist Compliance at Pedestrian Crossings in Region: low/ medium/ high (circle one)

**BEHAVIORAL INDICATORS**
Check all that apply:
1. Inadequate ped search (peds enter roadway without searching): _____
2. Inadequate driver search (drivers proceed without searching): _____
3. Aborted crossing (return to curb after both feet in roadway): _____
4. Crossing against light (entry and exit from roadway against signal): _____
5. Small gaps (accepting gaps which require rapid crossings): _____
6. Leaving crosswalk (crossing starts or ends outside of an available crosswalk): _____
7. Crossing in front of a bus: _____
8. Vehicle overtaking (ped crosses in front of stopped traffic – Multiple Threat): _____
9. Running (entry or crossing while running or moving fast): _____
10. Short time exposure (e.g., appearance from behind parked car): _____
11. Retreat (momentary reversal in pedestrian direction of travel): _____

**ADDITIONAL INFORMATION**
Community Characteristics:
1. Population: ________________ people

2. Distance to major transit hub: ________________ feet or miles (circle one)

3. Average age in Census Block: ________________ years versus City-wide average of: ________________ years

Potential Risk Factors:

1. Have pedestrian collisions occurred at this location in the past 5 years? Circle: yes/no
   a. Number of injuries: ________________ people
   b. Number of fatalities: ________________ people

2. Potential or Observed Conflicts (circle observed or potential as applicable):
   a. Pedestrian walks too close to a vehicle – NEAR SIDE OF CROSSING (observed/potential)
   b. Pedestrian walks too close to a vehicle – FAR SIDE (observed/potential)
   c. RIGHT TURN vehicle (on green) too close to pedestrian (observed/potential)
   d. LEFT TURN vehicle too close to pedestrian (observed/potential)
   e. RIGHT TURN ON RED vehicle too close to pedestrian (observed/potential)

3. Other Risk Factors (check all that apply):
   a. Poor crossing surface: _____
   b. Faded roadway striping (e.g. crosswalk striping): _____
   c. High crime area/ personal safety concerns: _____
   d. Bars or package stores near study location: _____
   e. School near study location: _____
   f. Senior facility near study location: _____

Observations or suggestions for appropriate education or enforcement measures based on this field view:
______________________________________________________________________
______________________________________________________________________
______________________________________________________________________
INTERSECTION DIAGRAM

(ATTACH PHOTOGRAPHS TO CHECKLIST)

Adapted from Pedestrian Safety Zone Guide, NHTSA, 