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ACTIVE TRANSPORTATION DESIGN GUIDELINES 2021

A Guide for Local Agencies in the Planning, Design, and Maintenance of Bicycle and Pedestrian Facilities

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References and Resources

Federal Highway Administration Bikeway Selection Guide

Federal Highway Administration Separated Bikeway Planning and Design Guide

Minnesota Bicycle Design Guide

NACTO Design Guide

Federal Highway Administration Guide to Incorporating On-Road Bicycle Networks into Resurfacing Projects

Identifying Factors that Determine Bicycle and Pedestrian-Involved Collision Rates that Affect Bicycle and Pedestrian Demand at Multi-Lane Roundabouts
California PATH Research Report
Lindsay S. Arnold, et al.
UCB-ITS-PRR-2010-34

Complete Intersections: A guide to Reconstructing Intersections and Interchanges for Bicyclists and Pedestrians, Caltrans, 2010

Dill, J., McNeil, N. Four Types of Cyclists? Testing a Typology to Better Understand Bicycling Behavior and Potential. 2012

Bicycle Boulevard Planning and Design Handbook

Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations
Report No. FHWA-SA-17-072, 2017

Public Rights of Way Accessibility Guidelines (PROWAG), U.S. Access Board

California Manual on Uniform Traffic Control Devices, 2014, Revision 5

Caltrans Highway Design Manual, Chapter 1000

FHWA Road Diet Informational Guide, Report No. FHWA-SA-14-028, 2014

AASHTO Guide for the Development of Bicycle Facilities, 4th edition

Table of Contents

Chapter 1
Purpose of Guidelines

1.1 Introduction/Context

It is the intent of **Coachella Valley Association of Governments (CVAG)** to develop Active Transportation projects to the highest level of safety and efficiency for the region.

Active Transportation projects are intended to serve users of all ages and abilities. Agencies that utilize CVAG funding for their Active Transportation projects should use this design guidance to develop a project scope and informal corridor analysis that provides a context sensitive solution for the given opportunities and constraints.

The analysis should include all involved agencies to ensure design and facility consistency across multiple jurisdictions. These guidelines incorporate best practices that are being used around the world with a major emphasis on providing greater separation from vehicles, reducing intersection conflicts, and increasing overall safety for vulnerable roadway users.

The design guidance is largely adapted from current national bicycle design guidance and accepted industry practices, including the American Association of Highway

Transportation Officials Guide for the Development of Bicycle Facilities, Federal Highway Administration (FHWA) Separated Bikeway Planning and Design Guide, FHWA Bikeway Selection Guide, The National Association of City Transportation Officials (NACTO) manual, and the current version of the California Manual on Uniform Traffic Control Devices (CAMUTCD). These Design Guidelines are intended to be a living document, with periodic reviews and updates, ensuring representation of best practices and emerging technologies.

1.2 Survey of Active Transportation Standards & Best Practices Used by Member Agencies

Public Works Directors and other staff of member agencies were surveyed by phone interview to determine which references are utilized in the development of Active Transportation projects.

The majority of responses indicated that agencies primarily use the following to make decisions for the placement and implementation of Active Transportation infrastructure:

1. California Manual on Uniform Traffic Control Devices (CAMUTCD).
2. Agency adopted Circulation/Mobility Element.
3. Agency adopted standards for striping details.

1.3 State of the Practice/Facility Inventory

To demonstrate the current State of the Practice for existing bicycle infrastructure within the CVAG region, data for key regional bicycle corridors is provided.

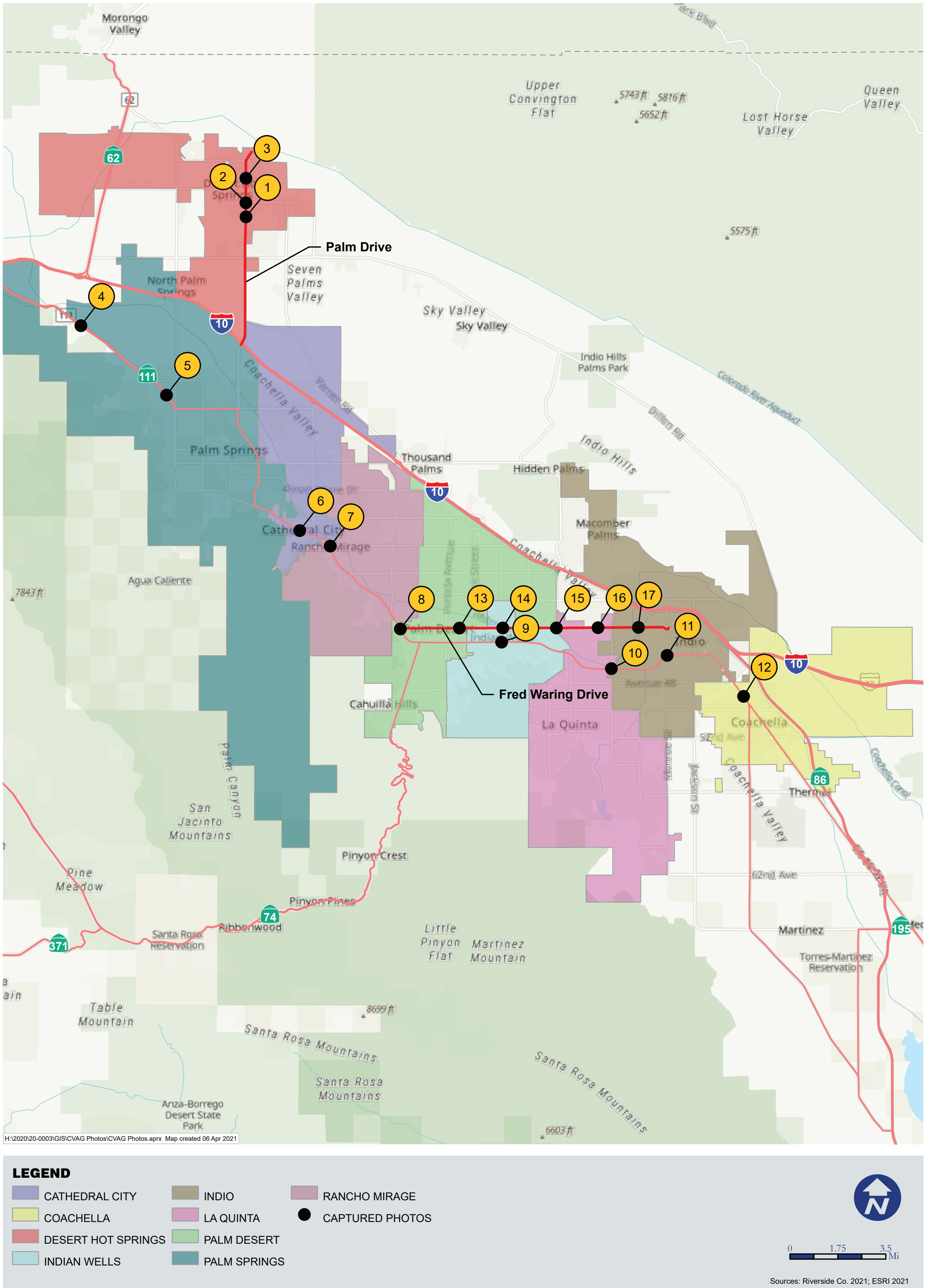
Highway 111, **Fred Waring Drive**, and **Palm Drive** were selected as representative corridors as these roadways pass through the majority of CVAG jurisdictions. Community input indicates a high desirability to have bicycle route continuity and inter-jurisdictional connectivity as part of the Active Transportation strategies.

Highway 111 is the primary commercial corridor through the Coachella Valley. Within Riverside County it spans approximately 65 miles, generally from north to south, extending from Interstate 10 to the Salton Sea.

Fred Waring Drive is an east-west primary arterial roadway that provides access to numerous residential communities. The corridor extends from Highway 111 to Indio Boulevard and is approximately 10 miles in length.

Palm Drive, spanning nearly seven miles, serves as the primary access route for the City of Desert Hot Springs, extending from Interstate 10 to 16th Street.

The most recent available traffic counts (as provided by the Interactive Map on the CVAG website) at locations within the corridors, along with existing speed limits and striping configurations were researched and field reviewed. Current General Plan roadway classifications for each segment are also included in the analysis.



ALBERT A. WEBB ASSOCIATES

Palm Drive – South of Two Bunch Palms Trail

Jurisdiction:
City of Desert Hot Springs

Existing Average Daily Traffic:
14,800 (2017)

Existing Speed Limit:
35 mph

General Plan Designation:
4-Lane Divided Arterial

Existing Striping Configuration:
4-Travel Lanes Sharrow Markings with Bike Route Signs

Palm Drive – South of Hacienda Avenue

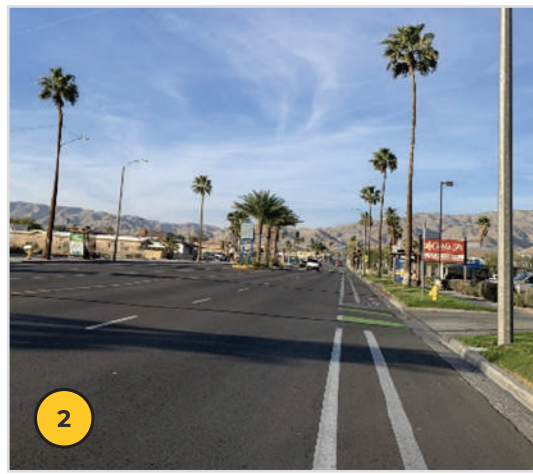
Jurisdiction:
City of Desert Hot Springs

Existing Average Daily Traffic:
28,200 (2017)

Existing Speed Limit:
35 mph

General Plan Designation:
4-Lane Divided Arterial

Existing Striping Configuration:
4-Travel Lanes, Buffered CL 11 Bike Lanes with Green Markings at Conflict Points



Palm Drive – North of 6th Street

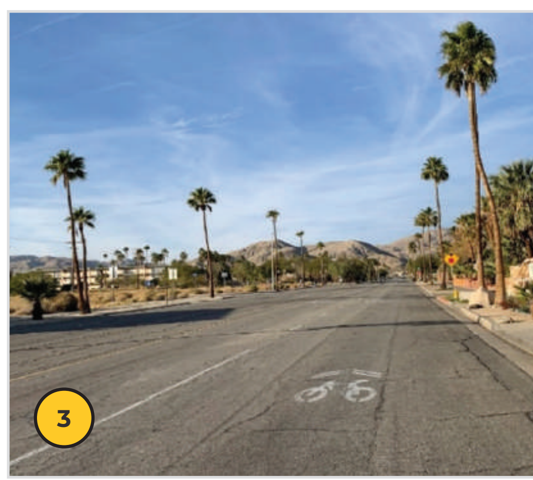
Jurisdiction:
City of Desert Hot Springs

Existing Average Daily Traffic:
14,800 (2017)

Existing Speed Limit:
35 mph

General Plan Designation:
4-Lane Divided Arterial

Existing Striping Configuration:
4-Travel Lanes, Sharrow Markings with Bike Route Signs



(All)
Palm Drive Looking North

Highway 111 – South of Overture Drive

Jurisdiction:

County of Riverside

Existing Average Daily Traffic:

24,000 (Estimated)

Existing Speed Limit:

65 mph

General Plan Designation:

6-Lane Expressway

Existing Striping Configuration:

4-Travel Lanes, No Bikeway Striping/Wide Paved Shoulder with Rumble Stripe

North Palm Canyon Drive – South of West Racquet Club Drive

Jurisdiction:

City of Palm Springs

Existing Average Daily Traffic:

15,800 (2017)

Existing Speed Limit:

45 mph

General Plan Designation:

4-Lane Divided Arterial

Existing Striping Configuration:

4-Travel Lanes, No Bikeway Striping/Markings

East Palm Canyon Drive – West of Cathedral Canyon Drive

Jurisdiction:

City of Cathedral City

Existing Average Daily Traffic:

36,800 (2017)

Existing Speed Limit:

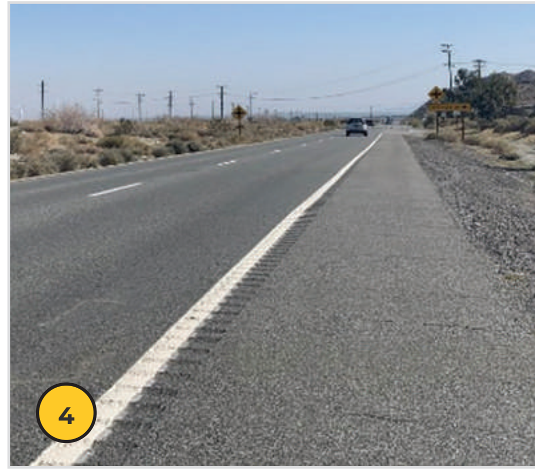
45 mph

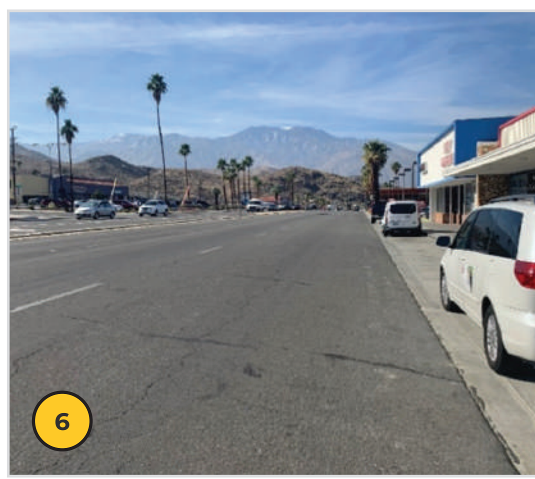
General Plan Designation:

6-Lane Divided Arterial

Existing Striping Configuration:

6-Travel Lanes, No Bikeway Striping/Markings





(Top)
Highway 111 Looking East

(Middle)
North Palm Canyon Drive Looking Southeasterly

(Bottom)
East Palm Canyon Drive Looking Northwest

Highway 111 – South of Frank Sinatra Drive

Jurisdiction:
City of Rancho Mirage

Existing Average Daily Traffic:
39,100 (2017)

Existing Speed Limit:
50 mph

General Plan Designation:
6-Lane Divided Arterial

Existing Striping Configuration:
6-Travel Lanes, No Bikeway Striping or Markings, Sidewalk Path

Highway 111 – North of Fred Waring Drive

Jurisdiction:
City of Palm Desert

Existing Average Daily Traffic:
46,300 (2017)

Existing Speed Limit:
45 mph

General Plan Designation:
6-Lane Divided Arterial

Existing Striping Configuration:
6-Travel Lanes, No Bikeway Striping or Markings

Highway 111 – East of El Dorado Drive

Jurisdiction:
City of Indian Wells

Existing Average Daily Traffic:
43,800 (2017)

Existing Speed Limit:
45 mph

General Plan Designation:
6-Lane Divided Arterial

Existing Striping Configuration:
4-Travel Lanes with Buffered Shoulder Striping, No Bikeway Striping or Markings/Share the Road Signs

(Top)
Highway 111 Looking South

(Middle)
Highway 111 Looking Northwest

(Bottom)
Highway 111 Looking East

Highway 111 – West of Jefferson Street

Jurisdiction:
City of La Quinta

Existing Average Daily Traffic:
42,200 (2017)

Existing Speed Limit:
45 mph

General Plan Designation:
6-Lane Divided Arterial

Existing Striping Configuration:
6-Travel Lanes, No Bikeway Striping or Markings

Highway 111 – East of Monroe Street

Jurisdiction:
City of Indio

Existing Average Daily Traffic:
26,800 (2017)

Existing Speed Limit:
35 mph

General Plan Designation:
6-Lane Divided Arterial

Existing Striping Configuration:
6-Travel Lanes, No Bikeway Striping or Markings

Highway 111 – South of Avenue 49

Jurisdiction:
City of Coachella

Existing Average Daily Traffic:
27,900 (2017)

Existing Speed Limit:
50 mph

General Plan Designation:
6-Lane Divided Arterial

Existing Striping Configuration:
4-Travel Lanes with Striped Paved Shoulders, No Bikeway Striping or Markings

(Top)
Highway 111 Looking East

(Middle)
Highway 111 Looking West

(Bottom)
Highway 111 Looking Northwest

Fred Waring Drive – West of Deep Canyon Road

Jurisdiction:
City of Palm Desert

Existing Average Daily Traffic:
35,400 (2017)

Existing Speed Limit:
45 mph

General Plan Designation:
6-Lane Divided Arterial

Existing Striping Configuration:
6-Travel Lanes with Class II Bike Lanes

Fred Waring Drive – West of El Dorado Drive

Jurisdiction:
City of Indian Wells

Existing Average Daily Traffic:
37,100 (2017)

Existing Speed Limit:
50 mph

General Plan Designation:
6-Lane Divided Arterial

Existing Striping Configuration:
6-Travel Lanes, No Bikeway Striping or Markings

Fred Waring Drive – East of Dune Palms Road

Jurisdiction:
City of La Quinta/Bermuda Dunes

Existing Average Daily Traffic:
25,300 (2017)

Existing Speed Limit:
50 mph

General Plan Designation:
6-Lane Divided Arterial

Existing Striping Configuration:
6-Travel Lanes with Class II Bike Lanes on South Side Only

(Top)
Fred Waring Drive Looking East

(Middle & Bottom)
Fred Waring Drive Looking West

Fred Waring Drive – West of Washington Street

Jurisdiction:

City of La Quinta

Existing Average Daily Traffic:

26,800 (2017)

Existing Speed Limit:

50 mph

General Plan Designation:

6-Lane Divided Arterial

Existing Striping Configuration:

6-Travel Lanes with Class II Bike Lanes

Fred Waring Drive – East of Madison Street

Jurisdiction:

City of Indio

Existing Average Daily Traffic:

21,100 (2017)

Existing Speed Limit:

50 mph

General Plan Designation:

6-Lane Divided Arterial

Existing Striping Configuration:

6-Travel Lanes with Class II Bike Lanes

(Top)
Fred Waring Drive Looking East

(Bottom)
Fred Waring Drive Looking West

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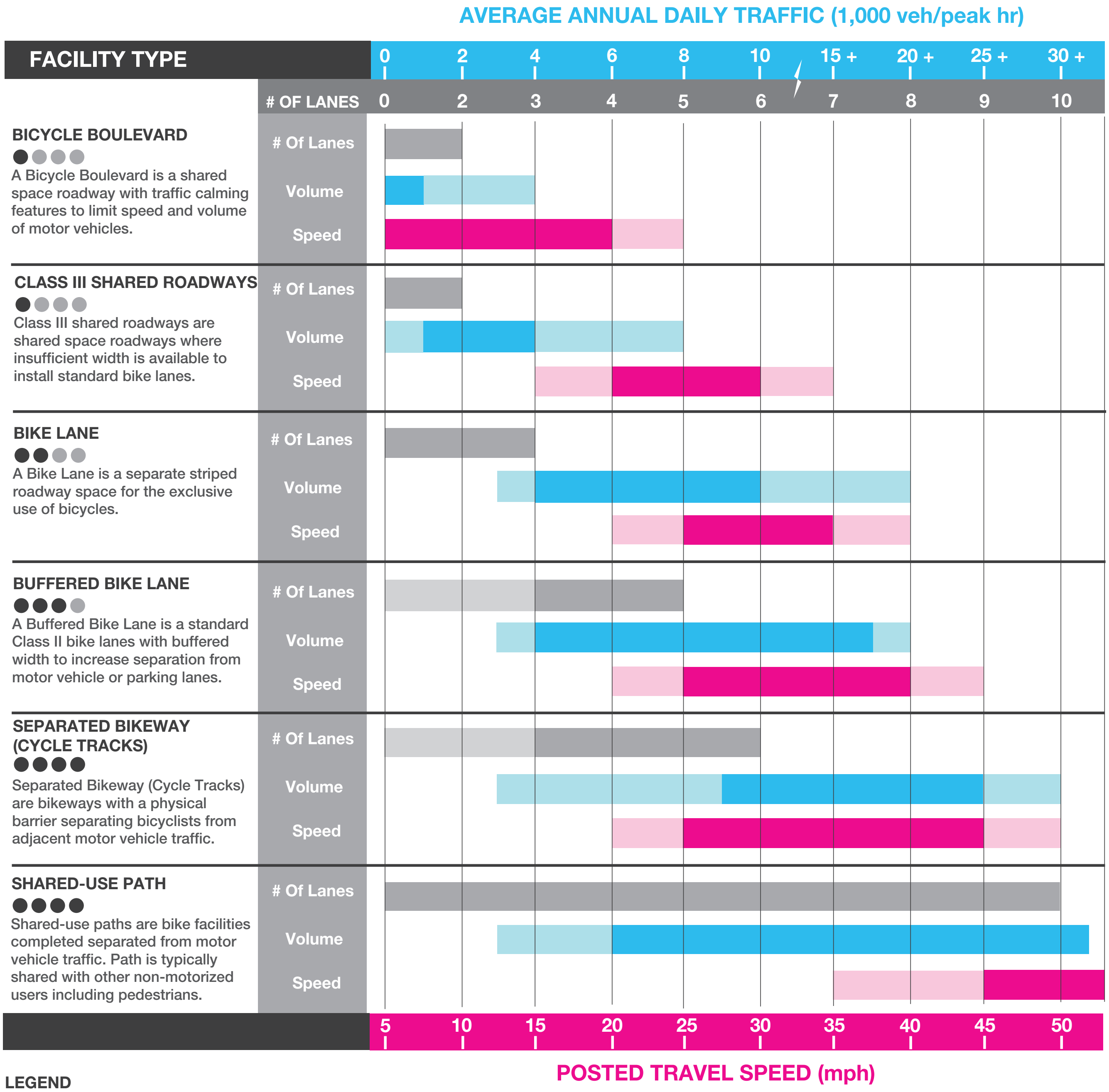
Chapter 2
Design Context

2.1 Facility Selection for Urban Roadways

When selecting a bikeway facility, there are a number of factors that influence bicycle users' comfort and safety. The most significant negative influence on cycling occurs when the speed differential between bicyclists and motor vehicles is high and the roadway carries high traffic volumes. The chart shown below can be used as a starting point to identify a preferred facility. When considering facility type, the designer should review the roadway for the minimum width needed to accommodate motor vehicles considering speed, traffic volumes, number of lanes, and vehicle mix. As a Best Practice, width in excess of this minimum should be allocated to the Active Transportation component of the facility to maximize the separation of motor vehicles and non-motorized vehicles. Increasing separation through buffering and other means enhances comfort and safety for all users.

BICYCLE FACILITY SELECTION CONTEXTUAL GUIDANCE



LEGEND

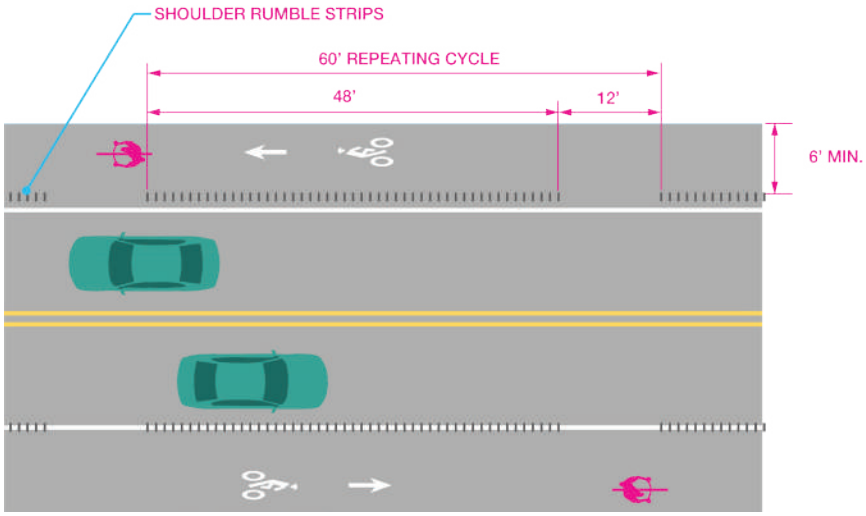
SEPARATION

- ●○○○ Minimal Separation
- ●●○○ Moderate Separation
- ●●●○ Good Separation
- ●●●● High Separation

Min	LANES	Max
Min	VOLUME	Max
Min	SPEED	Max
ACCEPTABLE	DESIRED	ACCEPTABLE

2.2 Shoulder Width on Rural Roadways

Paved Shoulders on the edge of roadways can be enhanced to serve as a functional space for bicyclists and pedestrians to travel in the absence of other facilities with more separation.



Shoulder Rumble Strip

Design Standard

1. On high-speed rural roadways (45 mph or greater), or with Average Daily Volumes more than 6,000 ADT, it is preferable to construct shared use paths for enhanced comfort and safety.

2. On rural roadways, it may not always be feasible to install separated bicycle facilities. With high speeds and increased motor vehicle volumes increase, it can be very uncomfortable for cyclists to share lanes or ride within a narrow-paved shoulder. Comfort level is further decreased with a large percentage of trucks.

3. As rural roadways are often used by long distance recreational and commuter cyclists traveling between populated areas or to work destinations, paved shoulder width is an important element to accommodate these bicyclists.

4. Paved shoulders can be augmented with warning signs indicating the presence of bicyclists to further enhance the bicycle route or upgraded to traditional Class II Bicycle Lanes with appropriate signs / markings..

5. For rural roadways, the minimum paved shoulder width should be 4-FT. As speeds and volumes increase it is preferrable to provide should widths of 6-FT to 8-FT to increase safety and comfort of bicyclists.

6. Shoulders should include bicycle friendly drainage structures, and regularly be reviewed for removal of large debris items. Some agencies use rumble strips to further define the traveled way.

7. Rumble strips should be installed on the edge of the travel way (preferably to the left or under the shoulder stripe) to maximize the available clear pavement width (minimum of 6-FT) for cyclists to ride within and include gaps for riders to cross through.

2.3 Reallocating Roadway Space

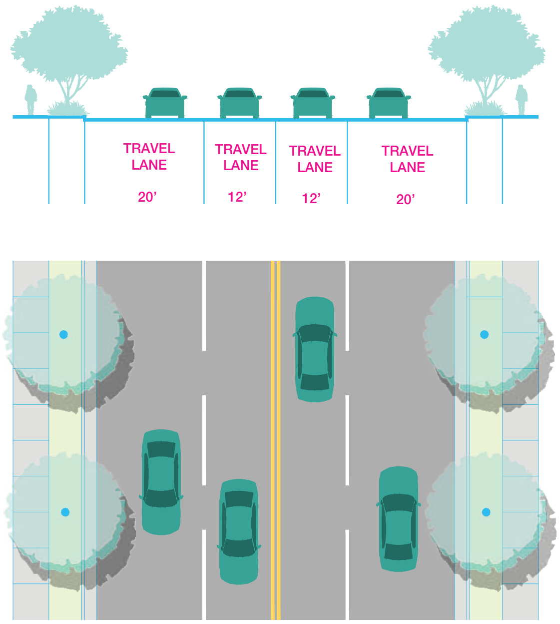
With new roadways, preferred bike facility widths are usually achieved. However, constrained conditions when reconstructing existing roadways often prevent the opportunity to install a desired bike facility or achieve optimum bikeway width. Roadways are often overbuilt for existing and/or future capacity needs and designers should repurpose or reallocate available roadway width when traffic conditions allow.

Narrowing Travel Lanes

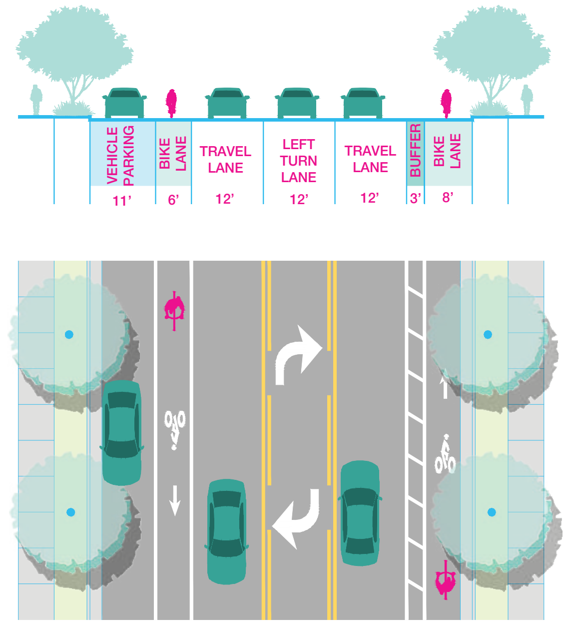
On certain roadways, additional width for bicycle facilities may be achieved by narrowing lane widths across the roadway. Studies have demonstrated that lanes as narrow as 10-FT wide do not reduce roadway capacity or increase crash rates. Narrower lanes often lead to reduced vehicle speeds which can improve the overall safety of the corridor. Lanes next to medians or other raised features, or that serve large vehicles and buses should be no less than 11-FT. Travel lane widths do not have to be equal. Outer lanes, typically used by buses and other large vehicles may be 11-FT, and the remaining lanes can be 10-FT wide.

Road Diets

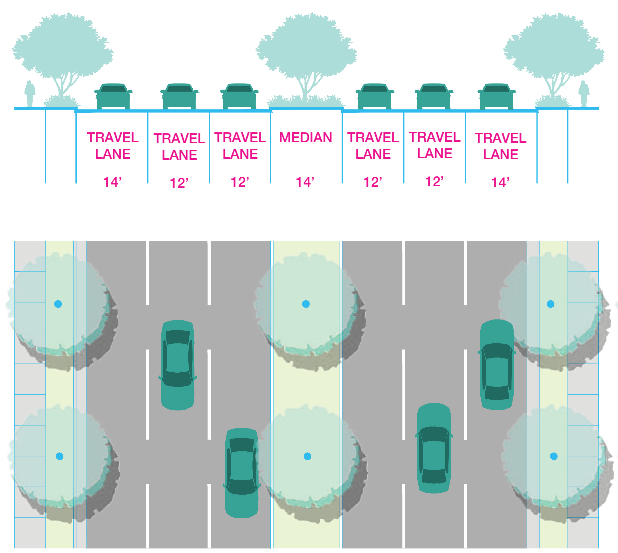
Road diets, also referred to as lane reductions, is a strategy to repurpose the width of an automobile travel lane for use of an active transportation facility. The most common road diet is the conversion of a five lane to three lane roadway. Roadway candidates for this type of conversion usually have less than 15,000 vehicles per day, but with traffic signal modifications and other intersection enhancements, agencies have reported successful projects with roadway volumes up to 20,000 ADT. There are numerous benefits that may be achieved with road diets including reduced roadway speeds, shorter crossing distances for pedestrians, reduced crash rates, opportunity to provide dedicated space for pedestrians and cyclists, additional parking for businesses, parks, and schools, and improved intersection sight distance. If the road diet provides for a dedicated left turn, traffic flow will be enhanced with less weaving and reduction of vehicles stopped in the travel lane to turn. The exhibit below demonstrates typical before and after cross sections for a road diet.



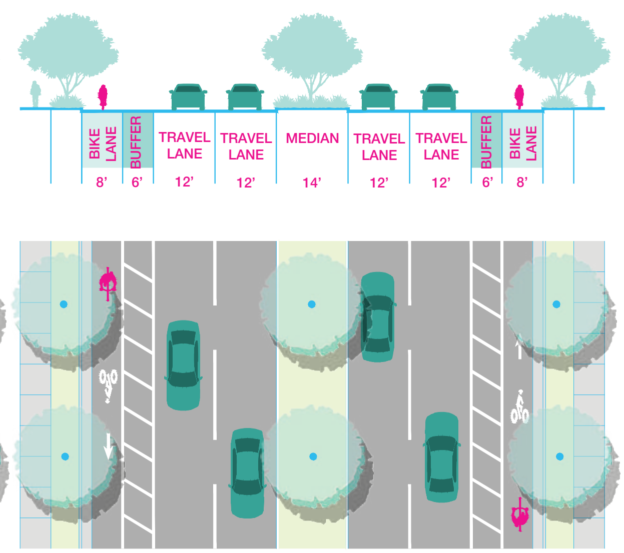
WITHOUT ROAD DIET (4 LANES)



WITH ROAD DIET (REDUCED TO 3 LANES)



WITHOUT ROAD DIET (7 LANES)



WITH ROAD DIET (REDUCED TO 5 LANES)

Reallocating Roadway Space

2.4 Types of Bicyclists

Research has shown there are a variety of categories when describing cyclists that use the bicycle network. Designers should consider all ages and abilities in developing bicycle facilities but maintain design flexibility to accommodate all users. Many agencies focus their efforts on the largest user groups to achieve a higher mode to shift to Active Transportation.

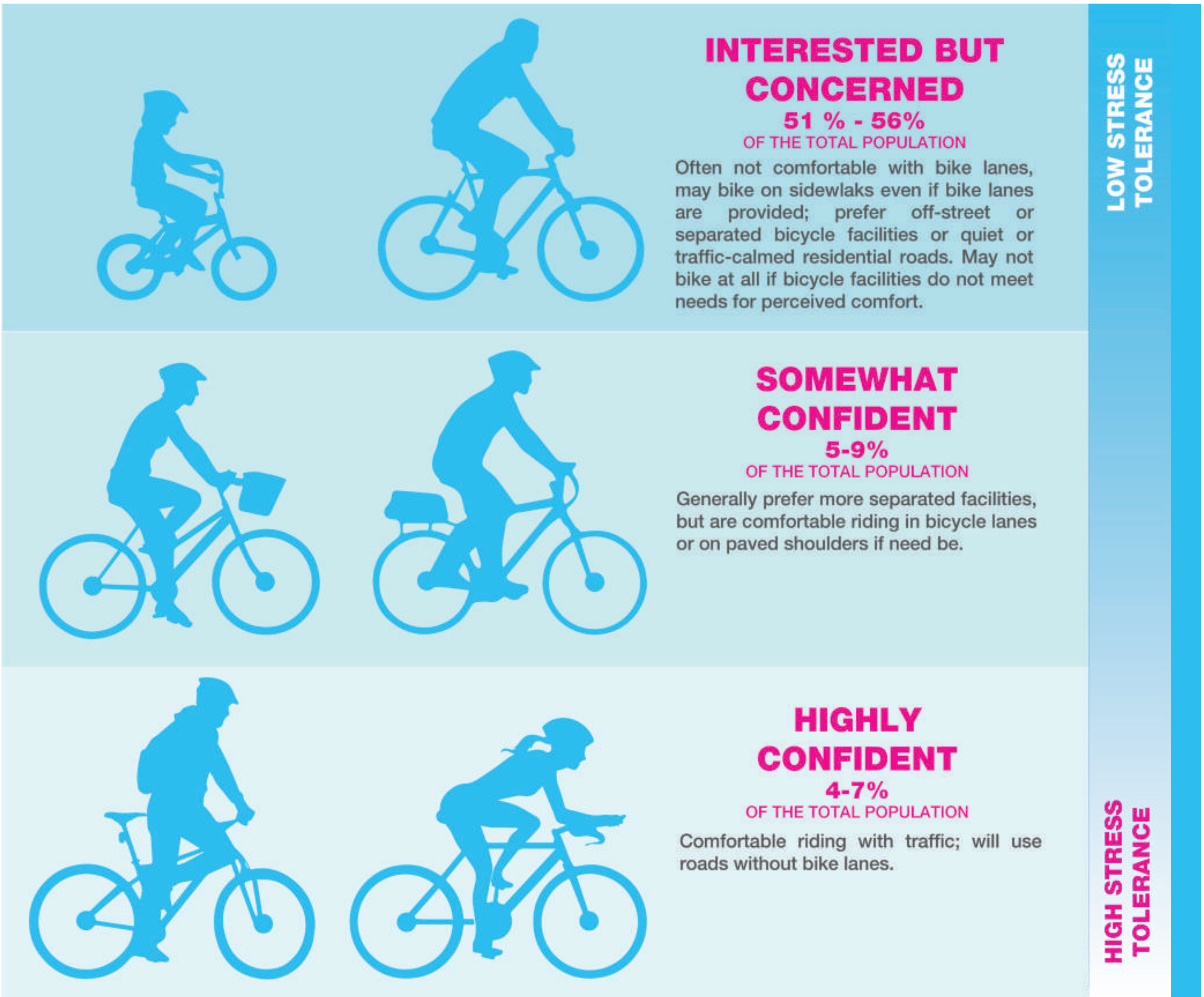
One well-known study conducted in Portland, OR categorized cyclists in four main groups that are described further.

Strong & Fearless
This group of bicyclists, representing approximately 1 percent of the population, will normally ride anywhere regardless of roadway conditions or weather. They ride faster than other user types over varied terrain and prefer direct roadway connections. Motivated by speed and flexibility they will often choose to share the road with vehicles over separated bicycle facilities.

Enthused & Confident
This group of bicyclists, representing approximately 5-10 percent of the population, are generally comfortable riding on all types of bike facilities, but often choose low traffic volume and slower streets or multi-use paths when available. This group, typically commuters and recreational riders, will choose their route, even if it is longer, to take advantage of a preferred facility type.

Interested but, Concerned
This group of bicyclists, representing approximately 60 percent of the population, makes up the majority of people on bikes. They will only ride a bicycle on low traffic streets or separated facilities under the most favorable weather conditions. They want to feel safe, especially when riding with family members. These bicyclists see considerable barriers to the increased use of cycling, primarily because of traffic conditions and other safety issues. There is opportunity for agencies to see a greater modal shift if the bicycle facility design is focused on this group.

No Way, No How
This group, representing the remaining population, do not ride bicycles and consider it unsafe to ride in traffic. People in this group may take up cycling with encouragement and education and some will not ride a bicycle under any circumstances.



SOURCE: *BIKEWAY SELECTION GUIDE,* U.S DEPT. OF TRANSPORTATION

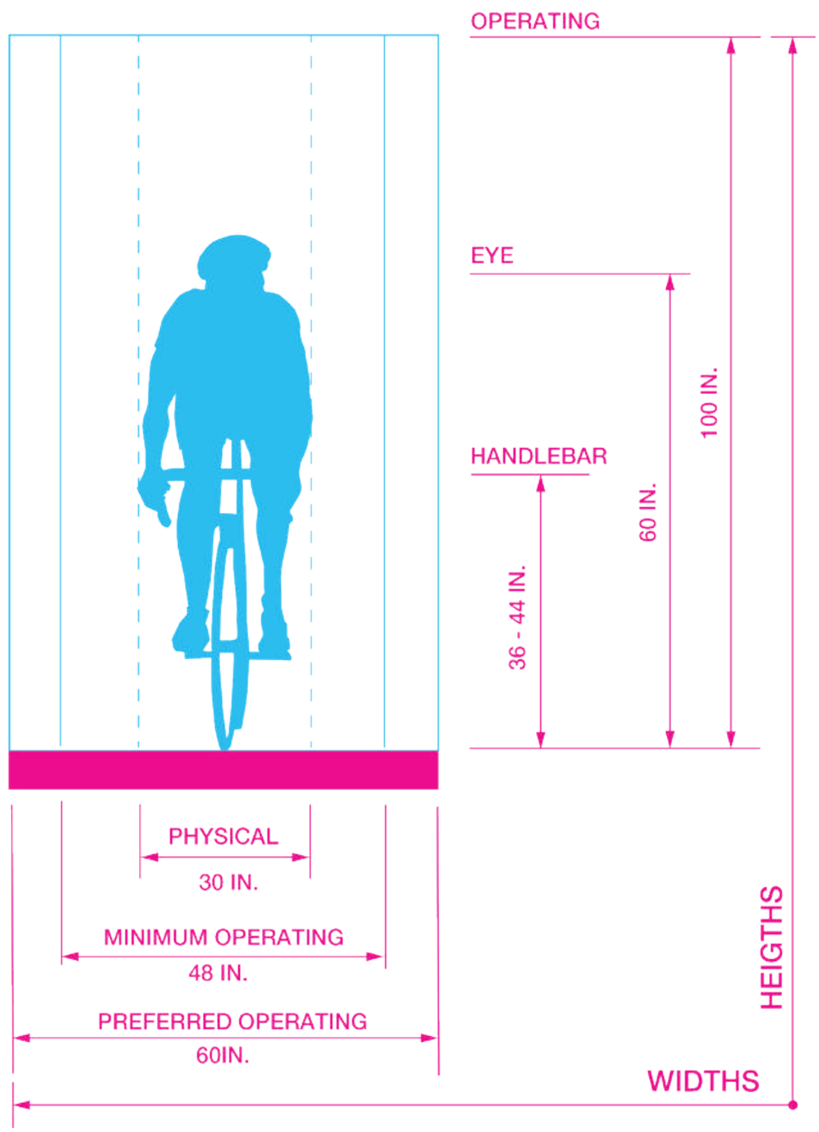
Level of Stress

2.5 Bicycle Operating Space

Operating space is an important factor in the design of a bicycle facility. The minimum operating width for a bicyclist designated in the AASHTO design manual and FHWA guidelines is 4-FT.

An additional 1-FT on either side is added for minor path deviation while riding (see figure to the right). It is important to note, however, that these values should be considered the minimum and the designer should strive to providing as much room as the roadway conditions allow.

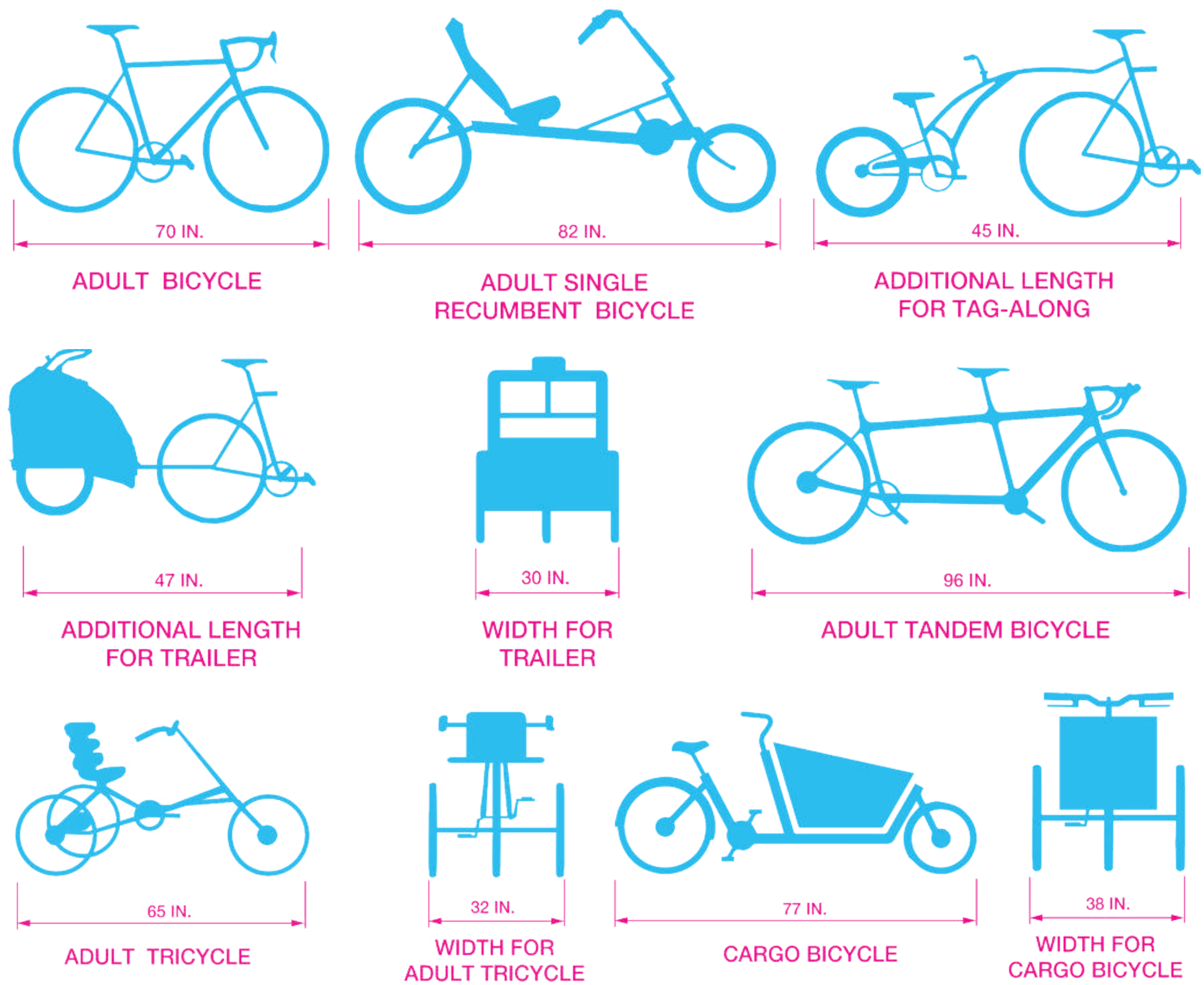
Extra width is desirable to allow cyclists to operate at higher speeds (especially on downhill grades), a higher degree of debris and roadway defect avoidance, and the opportunity to pass slower cyclists. Additionally, extra width allows pairs of cyclists in large groups or parents with children to ride side by side.



2.6 Bicycle Design Vehicle

In addition to standard bicycles, there are many pedal-driven cycles for the designer to consider in the planning of bicycle facilities.

The most common types include adult trikes, tandem and recumbent bicycles, “tagalongs,” and bicycles pulling trailers. Additional operating space may be necessary around turns, near bicycle amenities, and at intersections. The figures shown provide the basic design dimensions for each vehicle type.



2.7 Traffic Control Treatments at Marked Crosswalk Locations

Careful consider should be given in the installation of marked crosswalks at non-signalized locations either at intersections or mid-block. The decision to mark a crosswalk should be accompanied with an engineering study to determine the appropriate crossing treatment. Marking crosswalks alone does not necessarily contribute to enhanced roadway safety especially on multi-lane roadways.

The decision to mark a crosswalk should be based on several factors including adjacent land uses, pedestrian demand, roadway speed and volumes, presence of bus stops, available traffic control (including adult school crossing guards), available street lighting, and collision history.

When factors such as pedestrian demand and collision history are not known or the location is a new crossing, developing countermeasures to address certain risk factors for unsignalized crossings may be more appropriate. This systemic approach helps to address pedestrian crashes before they occur.

The following matrix, based on safety research, best practices, and established national guidelines, can assist the designer in determining the appropriate traffic control treatment based upon traffic speeds, volumes, number of lanes, and roadway classification:

Roadway Configuration	Speed Limit								
	≤30 mph	35 mph	≥40 mph	≤30 mph	35 mph	≥40 mph	≤30 mph	35 mph	≥40 mph
	Vehicle AADT <9,000			Vehicle AADT 9,000–15,000			Vehicle AADT >15,000		
2 lanes*	❶ 2 3 4 5 6	❶ ❸ 5 6 7	❶ ❸ 5 6 ❼	❶ 3 4 5 6	❶ ❸ 5 6 7	❶ ❸ 5 6 ❼	❶ 3 4 5 6 7	❶ ❸ 5 6 7	❶ ❸ 5 6 ❼
3 lanes with raised median*	❶ 2 3 4 5	❶ ❸ 5 7	❶ ❸ 5 ❼	❶ 3 4 5 7	❶ ❸ 5 ❼	❶ ❸ 5 ❼	❶ ❸ 4 5 7	❶ ❸ 5 ❼	❶ ❸ 5 ❼
3 lanes w/o raised median†	❶ 2 3 4 5 6 7	❶ ❸ 5 6 7	❶ ❸ 5 6 ❼	❶ 3 4 5 6 7	❶ ❸ 5 6 ❼	❶ ❸ 5 6 ❼	❶ ❸ 4 5 6 7	❶ ❸ 5 6 ❼	❶ ❸ 5 6 ❼
4+ lanes with raised median‡	❶ ❸ 5	❶ ❸ 5 7	❶ ❸ 5 ❼	❶ ❸ 5 7	❶ ❸ 5 ❼	❶ ❸ 5 ❼	❶ ❸ 5 ❼	❶ ❸ 5 ❼	❶ ❸ 5 ❼
4+ lanes w/o raised median‡	❶ ❸ 5 6 7 8	❶ ❸ 5 ❻ 7 8	❶ ❸ 5 ❻ ❼ 8	❶ ❸ 5 ❻ 7 8	❶ ❸ 5 ❻ ❼ 8	❶ ❸ 5 ❻ ❼ 8	❶ ❸ 5 ❻ ❼ 8	❶ ❸ 5 ❻ ❼ 8	❶ ❸ 5 ❻ ❼ 8

*One lane in each direction †One lane in each direction with two-way left-turn lane ‡Two or more lanes in each direction

Given the set of conditions in a cell,

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

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

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

1 High-visibility crosswalk markings, parking restriction on crosswalk approach, adequate nighttime lighting levels
2 Raised crosswalk
3 Advance Yield Here To (Stop Here For) Pedestrians sign and yield (stop) line
4 In-Street Pedestrian Crossing sign
5 Curb extension
6 Pedestrian refuge island
7 Pedestrian Hybrid Beacon
8 Road Diet

Reference: FHWA Report SA-17-072

2.8 Electric Mobility

Many cyclists are embracing the idea of electric mobility, as it is climate-friendly and efficient. Electric bicycles, or simply E-bikes, enhance mobility for riders of all ages and abilities. E-bikes are very popular and are available in all kinds and sizes. E-bikes are especially useful in areas of hilly terrain, or to substitute for a car when commute distances are further than normal. E-bikes can provide a riding range between 20 and 100 miles depending on battery size, average speed, terrain, and rider weight. There are three different classes of E-bikes. E-bike classes were created to determine how they are used according to local E-bike laws.

Class 1 - Class 1 E-bikes provide assistance only when you pedal and the level of assistance is adjustable based upon individual preference. The Class 1 is distinguished by the assistance being limited up to 20 mph. This bike class can be used in traditional bike lanes, bike paths, roads, and anywhere else you would ride a non-electric bike, in accordance with local ordinances.

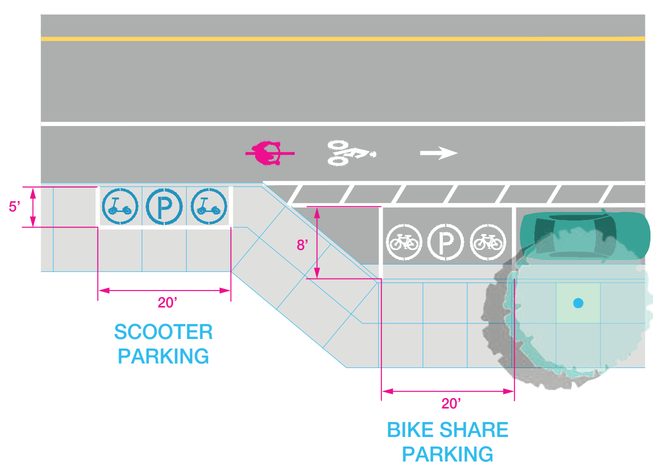
Class 2 - Class 2 E-bikes, similar to Class 1, stop assisting at 20 mph. However, Class 2 E-bikes are normally equipped with a throttle that provides the assistance without pedaling.

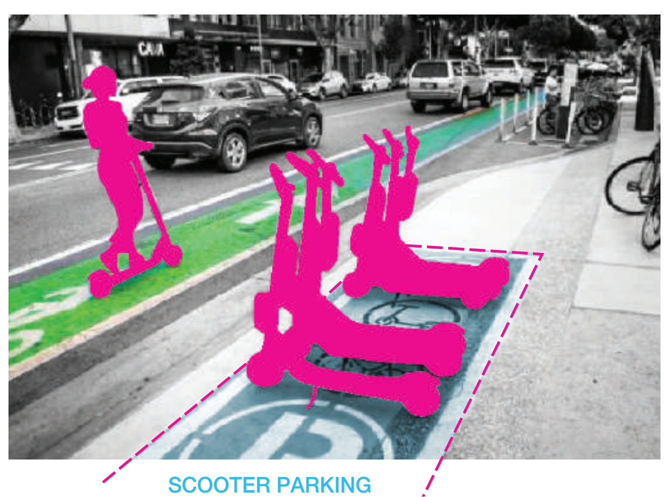
Class 3 - Class 3 E-bikes are equipped with a speedometer and provide assistance up to 28 mph. They can provide assistance through either a throttle (up to 20 mph) or by pedaling. With Class 3 speed capability of 28 mph or more, they are not allowed on traditional multi-use paths.

As E-bikes are commonplace and their use continues to grow, bicycle facilities should be designed to account for higher speeds as allowed in the various classes.

Other forms of electric mobility include the use of golf carts and electric scooters, in accordance with locally adopted plans and ordinances. It is important to consider not only designing the network for these users, but providing amenities including exclusive parking and public charging stations. The ability to recharge will not only increase the acceptance and success of electric mobility, but can boost patronage of restaurants and shopping in areas where this service is provided.

Popular in areas of high tourism are public electric scooter programs. As agencies embrace this mobility option, designated parking spaces are key to encourage the scooters users after completing their trip to park the vehicles so as to maintain clear pedestrian paths and not generate public nuisances. Parking spaces are typically 5-FT wide and 20-FT or longer depending upon expected usage.





2.9 Americans with Disabilities Act (ADA)

The Americans with Disabilities Act (ADA), signed into law on July 26, 1990, requires that individuals with disabilities are entitled to the same access to transportation as everyone else.

This civil rights law assures that a disabled person will have full access to all public facilities - primarily to public transit, public buildings and facilities and along public rights-of-way. Although typically associated with removing barriers to wheelchairs and installing curb access ramps, it is important that the design of all Active Transportation facilities as depicted in these guidelines, take into account the abilities and disabilities of all potential users.

Examples of accessible transportation elements include paths of travel, grades / cross slopes of the facilities, height of buttons, water fountains and other features, and clearances to objects.

For specific compliance details, see www.access-board.gov.

Chapter 3
Roadway Design Elements

3.1 Bicycle Specific Pavement Markings

Guidance for bicycle specific pavement markings for both on and off-street bike facilities is found in **Chapter 9 of the California Manual on Uniform Traffic Control Devices**. Designers should consult this publication for the applicability of available pavement markings, specific sizes, and their installed location within the roadway.

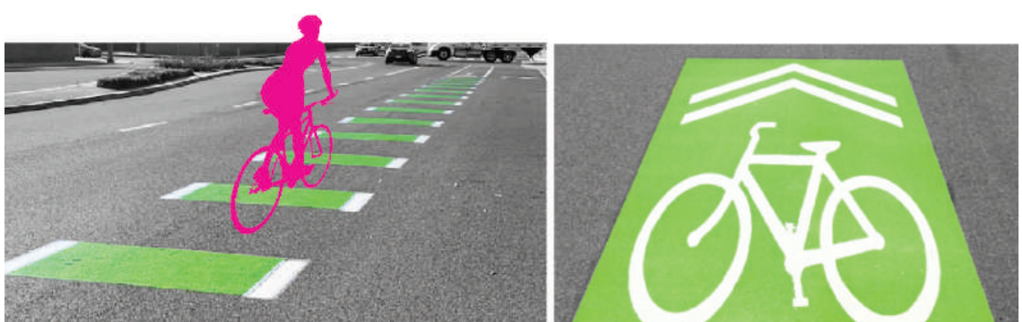
Bicycle Specific Pavement Markings

3.2 Green Colored Pavement Markings

Green colored markings are an optional traffic control device used to designate areas where bicyclists are expected to operate, and locations where bicyclists and motor vehicles have potentially conflicting weaving or crossing movements. The green markings add additional comfort to bicycle facilities and bring greater awareness of the presence of bicycles and where they are likely to be positioned in the traveled way. Green pavement markings, to not reduce their effectiveness, should be used primarily in conflict areas including the beginning of a bike lane, intersection extensions, crossings at driveways, or in two-stage turn queue boxes. To improve the comfort level of cyclists traveling over the markings, the thickness should be no more than 95 mils. The colored surface should be skid resistant and retro reflective. Pre-cut melt in-place markings are recommended as they maintain shape and last 5-7 times longer than traditional painted markings. The green colored surface should meet the daytime and nighttime chromaticity coordinates as specified in the FHWA Interim Approval for Optional Use of Green Colored Pavement for Bike Lanes.

(Left) Supplemental Markings In Conflict Area

(Right) Green Backed Sharrow Marking



3.3 Bicycle Specific Signage

Guidance for bicycle specific signage for on-street bike facilities is found in **Chapter 9 of the California Manual on Uniform Traffic Control Devices**. Designers should consult this publication for the available signing options and their applicability. Agencies should use signs that utilize symbols rather than words whenever possible. Use of symbol signs enhances the processing of the message and improves interpretation by people that speak other languages.

3.4 Bicycle Friendly Drainage Facilities

When roadway drainage is being designed or modified, the safety of cyclists must be considered. Care must be taken to ensure drainage features installed within, or adjacent to bike facilities, are properly designed to enhance bicycle safety.

Catch Basin Without Extended Local Depression

Bicycle-Friendly Drainage Grate

Design Guidance

1. Drainage grates should be bike-friendly. Grates should fit snugly in the outer frame and the inlets of the grates should be small shaped, so that a cyclist's wheel will not be trapped.
2. Consideration should be given to developing a modified standard that keeps the local depression from extending into the bike lane.
3. Nuisance water in cross-gutters pose a significant risk to cyclists as they turn through them. Cross-gutters should be eliminated with new construction and underground piping installed whenever possible. If crossgutters are utilized, the outer edge should align with the upstream gutter pan and not extend into the bike lane. Older style cross-gutters with water channels should be retrofitted. Channels should be filled in as a temporary measure until the new crossgutter is built.
4. Manhole rings, water cans, and utility vaults should be adjusted so they are flush with the surrounding asphalt and constructed of slip resistant materials.

Chapter 4
Bicycle Facility Type

4.1 Bicycle Boulevards

Many local streets, characterized by low existing speeds and volumes, offer the basic elements of a safe bicycling environment. The bicycle network can be further enhanced through bicycle boulevards. Sometimes referred to as Neighborhood Greenways, bicycle boulevards are residential low speed streets that have been enhanced with traffic calming to further improve the safety, comfort, and connectivity for cyclists. Traffic calming elements may include signage, pavement markings, speed and volume reduction strategies, and intersection modifications. Bicycle boulevards are designed to discourage cut-through traffic but give priority to cyclists as through traffic.

Bicycle boulevards achieve community benefit by maintaining low speed limits, reducing motor-vehicle volumes, promoting bicycle free-flow travel by assigning right of way to the bicycle boulevard at intersections, and provide improved traffic control at major arterial intersections. Bicycle boulevards should have distinct markings and signage that promote the facility as a priority route for cycling and to bring further awareness to motorists of bicycle usage.

Bicycle boulevards, used to complement traditional bike lanes, usually are parallel with commercial arterial roadways and provide connectivity to key destinations along the route including schools, parks, transit stops, and neighborhood commercial centers.

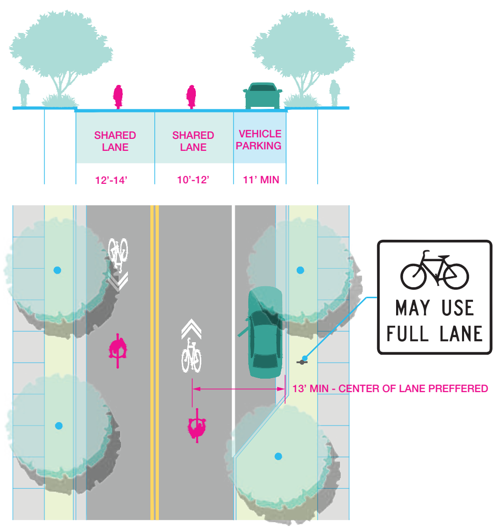
Design Guidance

1. Bicycle boulevards should be limited to roadways with speed limits of 25 mph or less (15 – 20 mph preferred), average daily traffic volumes of less than 3,000 vehicles per day (<1,500 preferred), and a generally continuous route for cyclists.
2. Agencies often brand their bicycle boulevards with unique logos and add them to a series of wayfinding signs throughout the route or include them as a part of the street name signs.
3. Sharrow markings complement the signs and provide further emphasis of increased bicycle usage. Typical sign placement is every 500-FT to 1000-FT with additional locations at key decision points. Sharrows are placed at intervals of 250-FT.
4. Volume reduction strategies may include vehicle diverters, intersection medians, and full road closures.
5. Speed reduction strategies include raised crosswalks/intersections, roundabouts, speed humps/speed tables, and roadway and/or intersection narrowing.
6. Signing includes typical regulatory/warning signs, and optional specialty wayfinding and street name signs.
7. Bicycle boulevards are developed as parallel routes to busy arterials to provide low stress network connections.

4.2 Class III Marked Shared Roadways

Class III bicycle routes can be enhanced with the use of shared lane markings, also known as Sharrows. Sharrows provide positional guidance to bicyclists on roadways that are too narrow to be striped with bicycle lanes and to alert motorists of the location a cyclist may occupy on the roadway.

Shared lane markings are also intended to reduce the chance of a cyclist colliding with an open car door of a vehicle parked on-street, parallel to the roadway.



Marked Sharrow

Typical Sharrow Placement

Design Guidance

1. Sharrows can be augmented with "Bicycles May Use Full Lane" signs (CAMUTCD R4-11) to further enhance the awareness of bicycles operating within the lane.
2. Sharrow placement is typically 13-FT minimum from the curb face with vehicle parking. Consideration should be given to Sharrow placement in the center of the lane to minimalize wear and encourage full lane passing by motor vehicles.
3. Sharrows are normally installed on roadways with speed limits of 35 mph or less.
4. Sharrows may be placed on roadways with speed limits above 35 mph where there is expected bicycle travel and the right-hand lane is too narrow for motor vehicles to pass cyclists, or on downhill roadway sections of sustained grades greater than 5 percent.
5. Sharrows can be enhanced with the use of green background for added visual conspicuity for the markings.

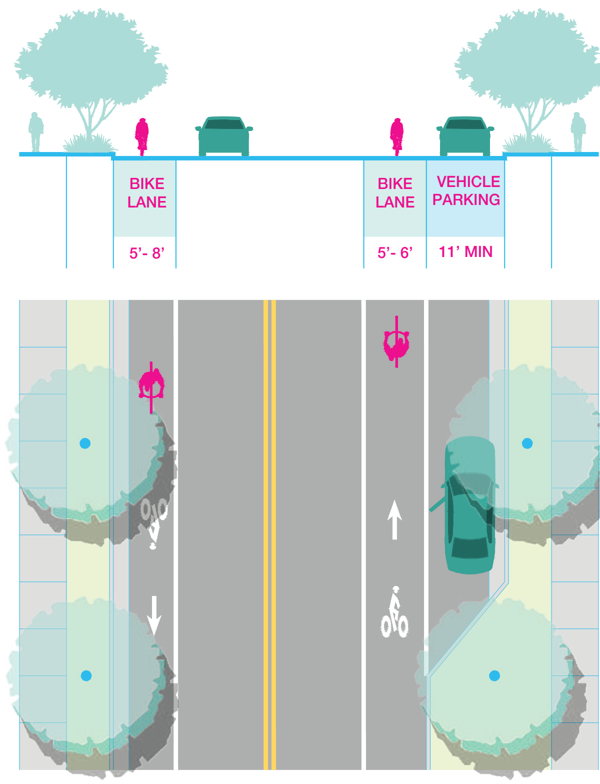
4.3 Class II Bike Lanes

Class II bike lanes provide an exclusive dedicated roadway space for cyclists using striping, pavement markings, and signage.

Bike lanes are typically located adjacent to motor vehicle lanes and bicyclists travel in the same direction. Bike lanes, on a two-way roadway without parking, are located on the right side of the street next to the curb or pavement edge.

Bike lanes, on roadways with parking, are striped between the vehicle lane and the parked vehicle.

Unused Roadway Width Buffered and/or Striped Out



Typical Dimensions of Bike Lanes

Design Guidance

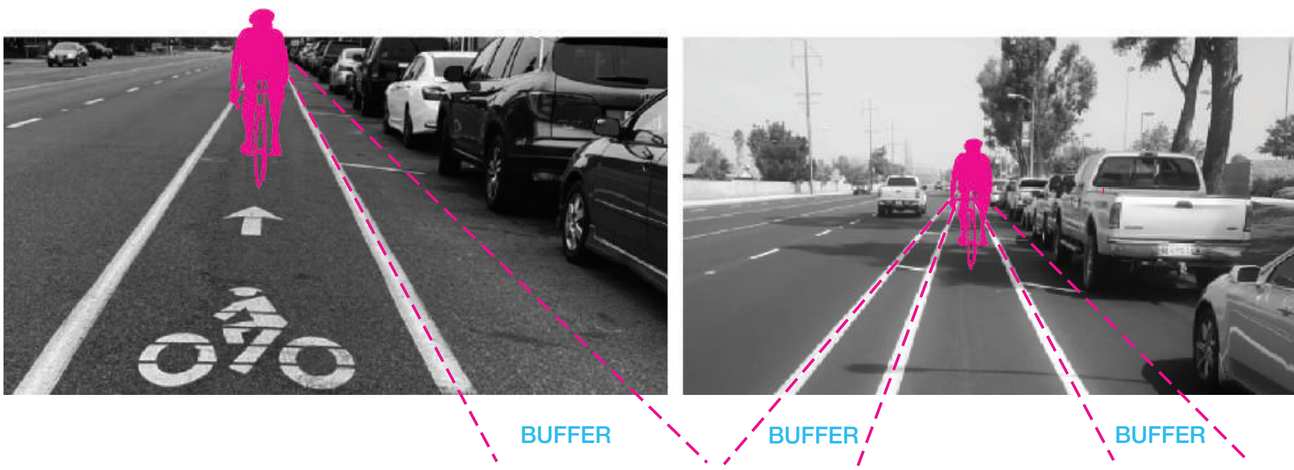
1. Class II bike lanes are used typically with streets with average daily traffic (ADT) of less than 6,000 vehicles and speed limits of less than 40 mph.
2. Minimum width is 5-FT (6-FT to 8-FT preferred for roads with higher speed limits) or extra roadway width available.
3. Consider wider bike lanes where roadway width allows, to afford cyclists side by side riding and increased opportunity to avoid debris without moving out of the lane.
4. Vehicles should not be allowed to park in the bike lanes.

5. If parking is allowed, a minimum of 3-FT of buffering or additional parking lane width should be used to keep cyclists out of the "door zone."
6. Often roadways are overbuilt for existing and/or future capacity needs and a Road Diet may be implemented to reallocate space for bicycle facilities. The FHWA has published a Road Diet Informational Guide to aid in the decision making for implementing Road Diets. Also, additional width may be obtained from narrowing lane widths 10-FT to 11-FT. Research has shown that lanes widths of less than 12-FT do not have a negative impact to roadway safety. The additional width gained can improve safety and comfort for bicycle facilities.
7. On roadways with sustained grades (typically greater than 5 percent), cyclists can often reach speeds of motor vehicles. Consideration may be given to a hybrid combination of bike lane (uphill) and shared roadway (downhill) to provide the cyclist with additional space to maneuver and enhance their visibility within the roadway.
8. Prior to installation, the pavement surface within the bike lane should be reviewed for potholes, cracks, seams, and raised bumps to ensure a smooth riding surface.
9. Existing drainage grates should be replaced with bike friendly versions prior to striping the lanes.
10. Bike lane pavement surface, excluding the gutter pan, should be 4-FT minimum. Using modified local depressions to maintain consistent lane width and remove bumps where asphalt routinely gets pushed up improves the safety and comfort of the bike lane.
11. Include a bicycle lane marking at the beginning of blocks and at regular intervals along the route. For durability, bicycle lane markings should be installed out of the wheel path of turning vehicles. Symbols are preferred over word messages for bike markings.
12. Typical bike lane striping is a 6-inch solid white stripe.
13. As traffic speed and volume increases, consideration should be given to installing buffered or separated bike lanes.
14. Bike lanes should maintain a straight alignment whenever possible. If street width varies along the bicycle corridor, the designer should consider striping out the additional unused roadway area to the right of the bike lane, rather than have the bike lane follow the curb alignment. If the number of lanes is modified, bike lane tapers should be smooth at transitions to reduce abrupt movements by cyclists.
15. If roadway is retrofitted with new bike lanes outside of the regular paving schedule, the old markings/striping should be removed entirely, and the roadway slurry sealed so that the old striping cannot be recognized. "Blacking out" old striping/markings should not be used, as it poses a slippery surface when wet, wears down quickly, and can lead to lane alignment confusion by roadway users when the sun is low in the horizon.
16. Bike lanes should be built for both directions of travel.
17. Refer to the **CAMUTCD Chapter 9** for specific details on bicycle signing and markings.

4.4 Class II Buffered Bike Lanes

Buffered bike lanes allow for increased space between the bike lane and the adjacent travel lane and/or parked cars.

The increased horizontal separation between bicycles and motor vehicles helps to maintain a minimum of 3-FT of passing clearance as required by State Law. Buffered bike lanes increase comfort for both bicyclists and motorists, allow the cyclist to avoid debris without weaving into the adjacent travel lane, and provide opportunity to reduce speeds where excessive pavement exists.



(Left)
Buffered Bike Lane on the Parking Side - Moreno Valley, CA

(Right)
Buffered Bike Lane Between Parked and Moving Vehicles - Moreno Valley, CA

Design Guidance

1. Buffering can be placed between driving lanes and the bike lane, between the bike lane and parked motor vehicles, or both.
2. Buffering is striped with 6-inch white stripes placed a minimum of 2-FT apart.
3. Diagonal cross hatching should be 6-inch white at 45-degree angles, with 30-FT spacing oriented away from the bike lane.
4. 6-inch white Chevrons can be used for cross hatching, with 30-FT spacing.

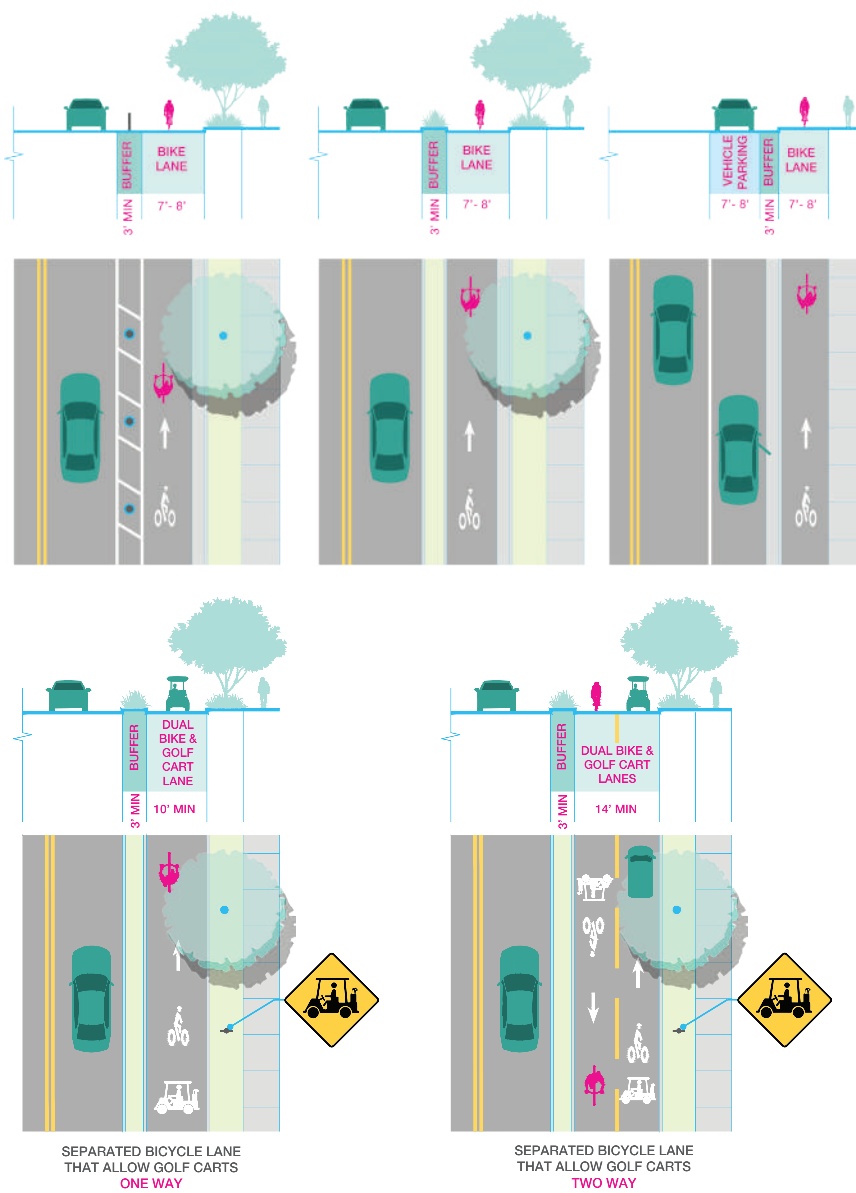
4.5 Separated Bikeways (Cycle Tracks)

A Class IV separated bikeway, also referred to as a Cycle Track, is an exclusive bikeway facility, physically separated from motor vehicle traffic using barriers such as flexible channelizers/buffer striping, raised landscaped medians, or on-street parked vehicles.

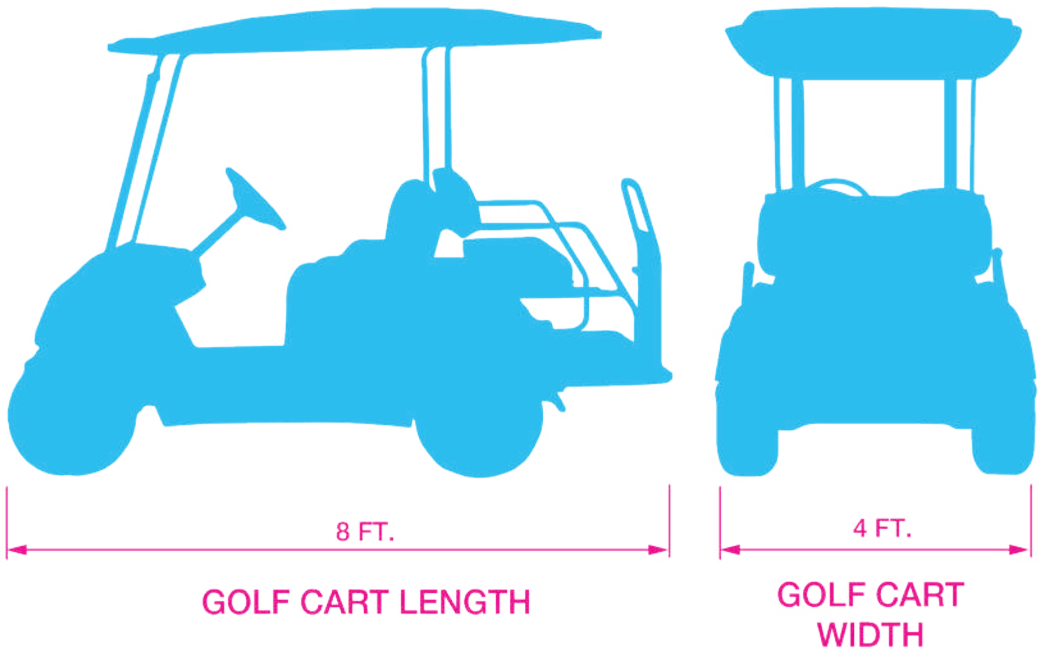
Cycle Tracks may also be raised to the sidewalk level. Cycle Tracks may also be raised to an intermediate level between the roadway and the sidewalk or to the sidewalk level.

Separated bikeways offer more protection from motor vehicle traffic than a standard bike lane and generally provide higher comfort levels for riders of different ages and abilities.

Additionally, pedestrians benefit from this facility type with increased separation from motor vehicles and reduction of bicycles riding on the sidewalk.



Various Cycle Tracks



TWO WAY

SEPARATED BICYCLE LANE
THAT ALLOW GOLF CARTS

Two-way Cycle Track - San Clemente, CA

One-way Parking Protected Cycle Track - San Diego, CA

The recently published FHWA Separated Bikeway Planning and Design Guide is a good resource for feasibility consideration and in-depth design considerations.

Design Guidance

1. Cycle tracks are most effective along streets with minimal intersection and/or driveway crossings.
2. Intersections and driveways should be designed to include signage that alerts motorists of bicyclists crossing from the Cycle Track, and proper sight distance should be provided so that bicyclists and motorists can see each other. The design should include measures to reduce motor vehicle turning speeds across the Cycle Track.
3. For two-way Cycle-tracks, additional signing/markings should be used at conflict points to warn motorists that bicyclists will be approaching from both directions. Two-way Cycle Tracks may be used when most of the destinations are on one side of the street.
4. One-way Cycle Tracks should be built on both sides of the roadway.
5. Intersection treatments are needed to mitigate turning movement conflicts. These include modifying signalized intersections to provide a separate bicycle phase with turning movement restrictions when active, protective islands (protected intersection), Bend-outs, green pavement markings, raised crosswalks, and additional warning signs at unsignalized intersections/driveways. Driveway consolidation is another opportunity to reduce turning movement conflicts.
6. The width of the Cycle Track should consider the opportunity for cyclists to pass or avoid debris, availability of equipment to maintain the facility (primarily special street sweeper), available roadway/buffer width, and expected bicycle volumes. Recommended minimum width is 7-FT for one-way and 12-FT for two-way facilities. If Golf Carts are allowed in the Cycle Track, the width should be increased to 10-FT for one-way and 14-FT for two-way facilities.
7. Cycle Tracks should be designed to the right of transit stops to reduce interactions between bicycles and buses. Crosswalk markings/signing should be added to increase awareness of potential pedestrian crossings.

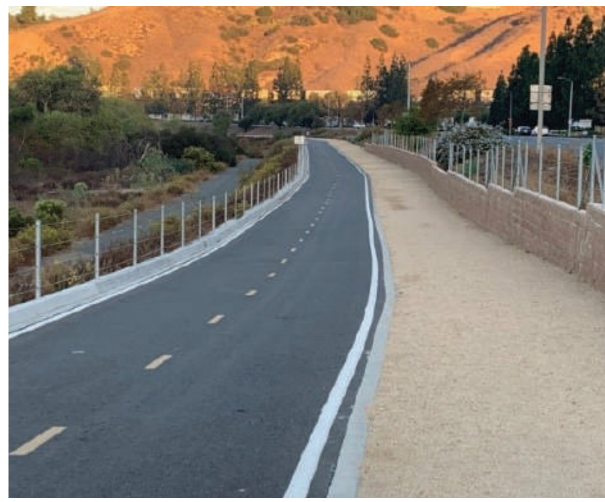
4.6 Class I Shared-Use Path

A shared-use path supports both recreational and transportation uses, such as walking, bicycling, and inline skating.

Shared-use paths are one of the most desirable types of bicycle facilities as they accommodate users of all ages and abilities and are separate from motor vehicle traffic.

Shared-use paths are sought out by large groups of cyclists as they provide a non-stop continuous link to recreational destinations.

Public Art Display - Coronado, CA



Santa Ana Regional Trail - Yorba Linda, CA

Design Guidance

1. The paved width of the path should be 10-FT minimum. A width of 12-FT to 14-FT is preferred for paths that serve as regional commuter routes or where higher pedestrian and bicycle volumes are expected.
2. Minimum design speed for the facility should be 25 mph as multi-use paths users include experienced/commuter cyclists and Class 2 E-bike users, who regularly travel at higher speeds.
3. An additional 2-FT clear zone and/or shoulder should be provided on each side of the paved pathway.
4. As path use grows it may be necessary to separate users to enhance safety and flow. Runners and walkers should be given a separate pathway, usually comprised of different materials. If a separate pathway is used, it should have a minimum width of 6-FT and be constructed adjacent to the paved pathway. A concrete ribbon should be used to define the pathways and to keep loose materials off the paved pathway.
5. Facility design should include paved pull-out areas at regular intervals to perform bicycle maintenance or to provide

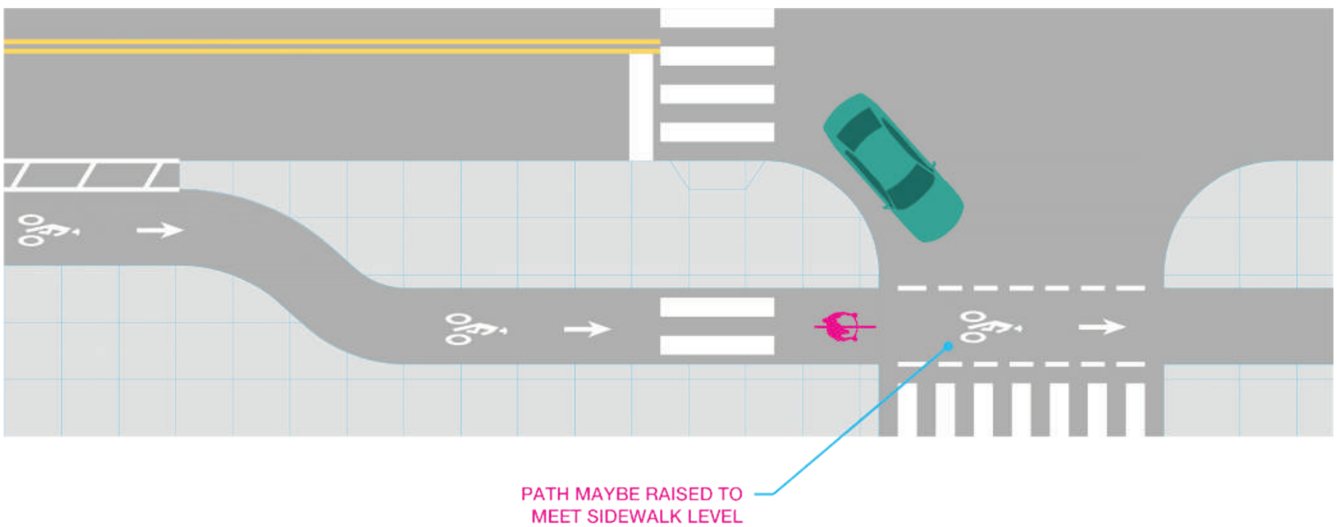
space to rest or relax. Pull-out areas should include shade trees and benches/natural seating opportunities.

6. Paved feeder routes should be provided to parks, schools, community centers, bus stops, train stations, community entrances, and major commercial destinations along the pathway.
7. The design should include access to clean drinking water using water bottle filling stations. Drinking water sites are normally included near restroom facilities to improve access to potable water.
8. Trail head development should include parking, trail identification signage, drinking fountains including a water bottle filling option, restrooms, and informational kiosks. Trail head lighting should be considered to enhance comfort and safety for trail users.
9. Multi-use trails can include interpretive signing at historical or cultural points of interest.
10. Public art displays can add visual interest to the facility.
11. Trail lighting should be considered as many users recreate and/or commute in nighttime conditions.
12. Access points should be wide enough to accommodate the largest expected design vehicle including bikes pulling trailers, recumbent trikes, and other adaptive bicycles. The clear paved path width should be a minimum of 36-inches.
13. Controlling motor vehicle access should be accomplished using regulatory signing, gates, or a center splitting median. Use of bollards for this purpose should be avoided as they pose a collision problem due to limited visibility and profile. If a median island is used, the path width on each side should be ½ the total width of the facility.
14. Overhead clearance should be 8-FT minimum under landscape canopies, underpasses, and tunnels. Where feasible, a vertical clearance of 10-FT is preferred. A minimum of 2-FT of shoulder distance adjacent to each side of the path should be maintained. Paths under structures should be designed to minimize areas available for material storage frequently used by people camping under the structures. Proper drainage under the structures is essential, as these areas will encounter higher cyclist speed and reduced sight distances. Water ponding and debris buildup can pose an unexpected obstruction causing a rider to lose control and crash.
15. As multi-use trails often follow open water courses, fencing should be considered to reduce the possibility of users leaving the path and descending steep embankments or crashing into rocks, trees, or other dense natural landscape features.
16. Lighting for bike paths should be considered, as users often commute during nighttime conditions. Daytime lighting should be provided in underpasses and tunnels. Path lighting levels should be increased at intersections, sag curves, obstacles, and major path direction changes.

Chapter 5
Intersection Treatments

5.1 Bend Out

To set back the bikeway further, the bikeway can be 'bent-out' away from the motor vehicle lanes. This design enhances visibility by raising the angle at which cars cross the bikeway. Increasing the bikeway setback can also provide room for turning cars to wait before making the turn. As it approaches the intersection, the bikeway can be bent away from the motor vehicle lanes and toward the sidewalk.



Design Guidance

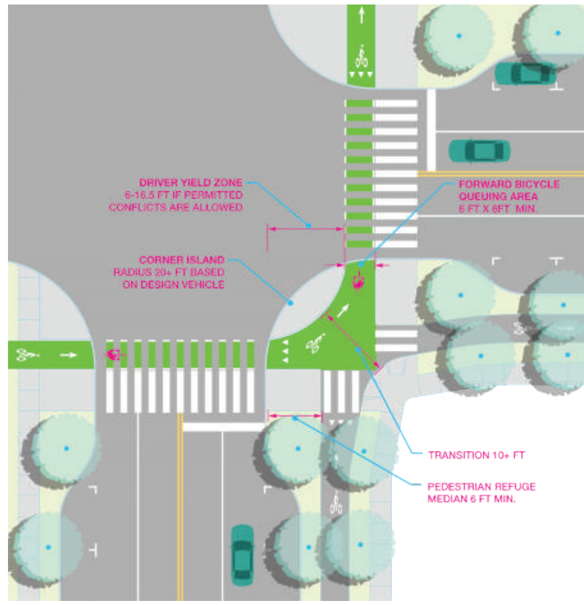
1. Bend-out may be used at driveways and minor street crossings.
2. Design may include a raised crosswalk and reduced turning radii to reduce motor vehicle speeds crossing the bikeway.
3. Path should include additional crosswalk markings/signing to reduce conflicts between cyclists and pedestrians.
4. Offset distances of 6-FT to 8-FT can be used with constrained conditions. However, a car length of 20-FT is preferred to allow vehicles to yield to path users and not block through vehicle traffic on the main roadway.
5. Additional markings/signing is installed before the vehicle crosses the path from the minor roadway to increase motor vehicle yielding for bicycles.
6. Sufficient sight distance should be provided so motorists and bicycles can see each other.
7. Pathway may be raised to sidewalk level prior to crossing the roadway or driveway.

5.2 Protected Intersection

A protected intersection is a design treatment intended to reduce conflicts between cyclists, pedestrians, and motor vehicles. This treatment can be used with Class II Bike Lanes and Cycle Tracks and provides enhanced connectivity at intersections where bicycle facilities cross.

Also known as a setback or offset intersection, the design provides bicycles physical separation from motor vehicles up until the intersection.

The key element to the separation is the use of a raised physical barrier at the corner that improves sight distance for all users, slows the turning speed of motor vehicles, and reduces the intersection crossing distance for cyclists and pedestrians.



Protected intersection

Design Guidance

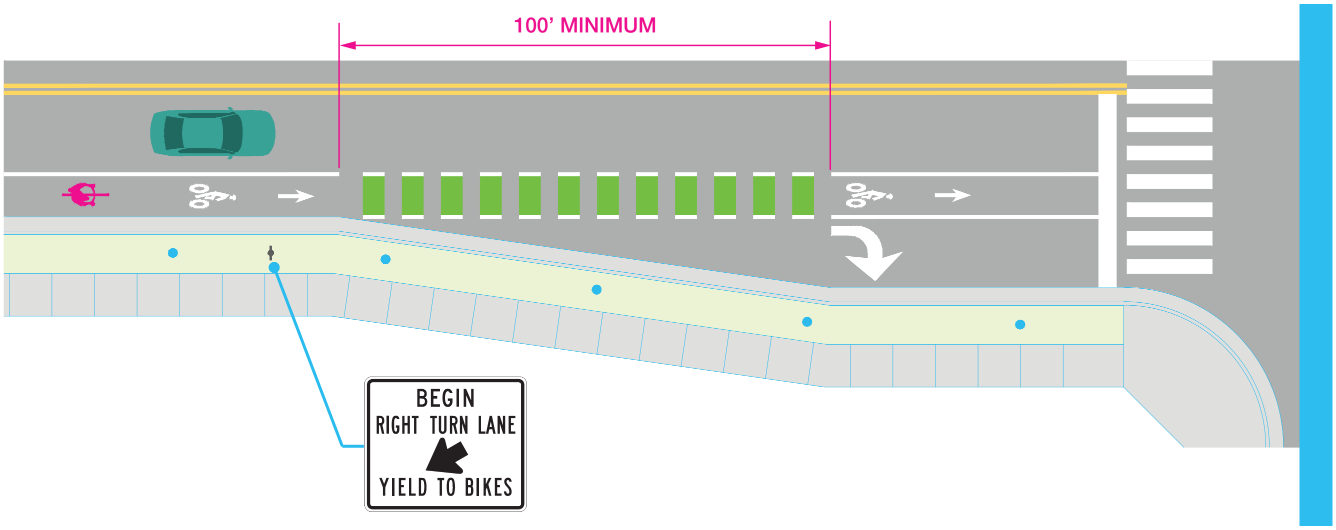
1. The bikeway setback distance typically ranges from 6-FT to 20-FT. If adequate right -of-way is available a setback of 14-FT to 20-FT is preferred. The setback distance improves the sight distance for turning vehicles to see crossing cyclists/pedestrians.
2. The corner island radius should be small enough to encourage slower turning speeds of around 10 mph. This is usually accomplished with a turning radius of 20-FT or less. Corner islands may have a mountable area to accommodate larger design vehicles. Corner islands can be implemented using a raised curb, raised posts, or a combination of channelizing markings/different mountable materials.
3. The bicyclist should have a minimum of 6-FT to 8-FT of waiting area outside the path of the cycle track. Additional width may be added to accommodate bicycles pulling trailers, cargo bikes, or at high bicycle volume intersections.
4. To reduce conflicts between users, bicycles should have intersection crossing markings adjacent and outside of the standard pedestrian crosswalk.
5. Pedestrians should have a minimum separated area of 6-FT to 8-FT in width and include detectable warning surfaces in accordance with ADA requirements. Yield and additional crosswalk markings should be placed where pedestrians cross the cycle track.
6. Curb faces adjacent to the bicycle path should have shallower slopes to reduce pedal strikes and improve maneuverability.
7. If the protected intersection is signalized, then a separate bicycle phase that runs concurrent with non-conflicting motor vehicle movements should be provided.

5.3 Right Turn Only Lanes/Mixing Areas

As cyclists approach intersections, bicycle lanes must transition from a dedicated space to an area that mixes with motor vehicles.

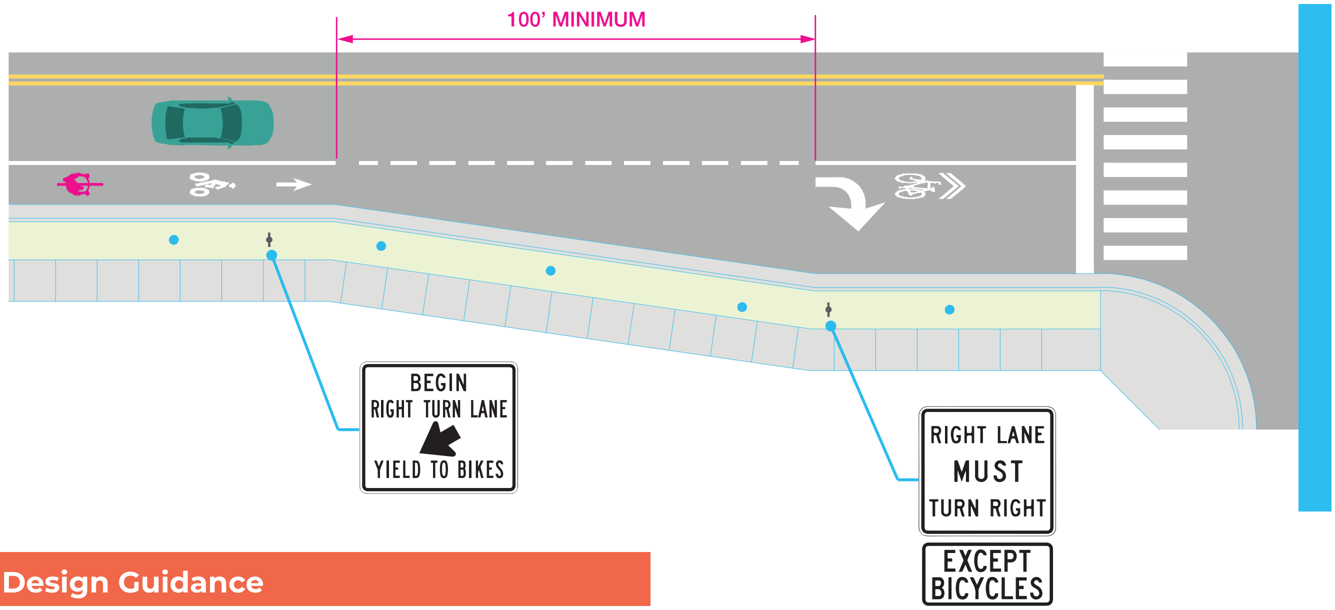
These areas are points of conflict and increase weaving by both vehicle types.

There are several options for the designer to consider, based on geometry, turning movements, available roadway width, and vehicle queuing.



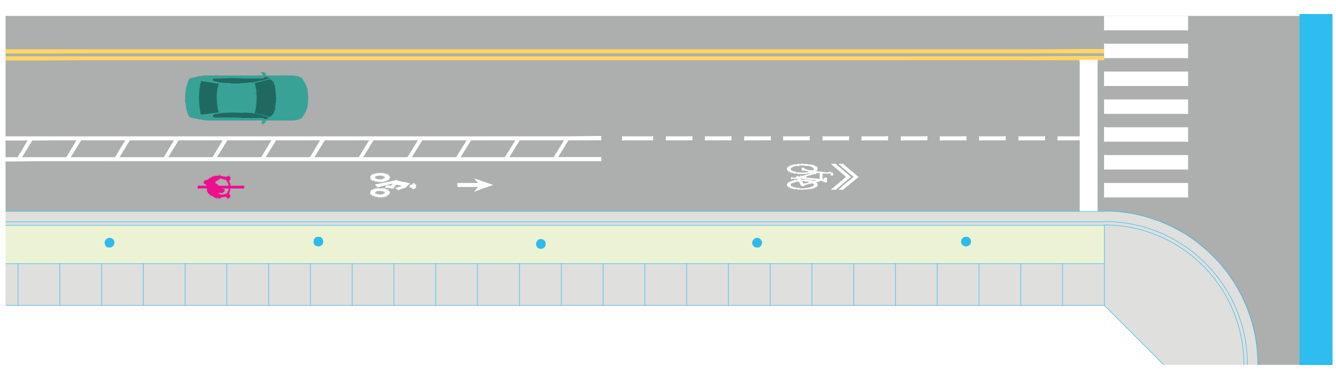
Design Guidance

1. The preferred configuration, as shown in the figure above, is for the cyclist's path to remain straight and motor vehicles to cross their path to access an available right turn lane. This reduces right of way determination between bicycles and motorists.
2. Dashed lines, supplemented with green pavement markings, are used to enhance the visibility of cyclists and indicate to the area of conflict.
3. A "Begin Right Turn Lane Yield to Bikes" sign should be placed at the beginning of the merge area for additional guidance.
4. If the bike lane installed to the left of the right turn lane is longer than 200-FT, consideration should be given to adding extra buffering to increase the separation from adjacent motor vehicle lanes.



Design Guidance

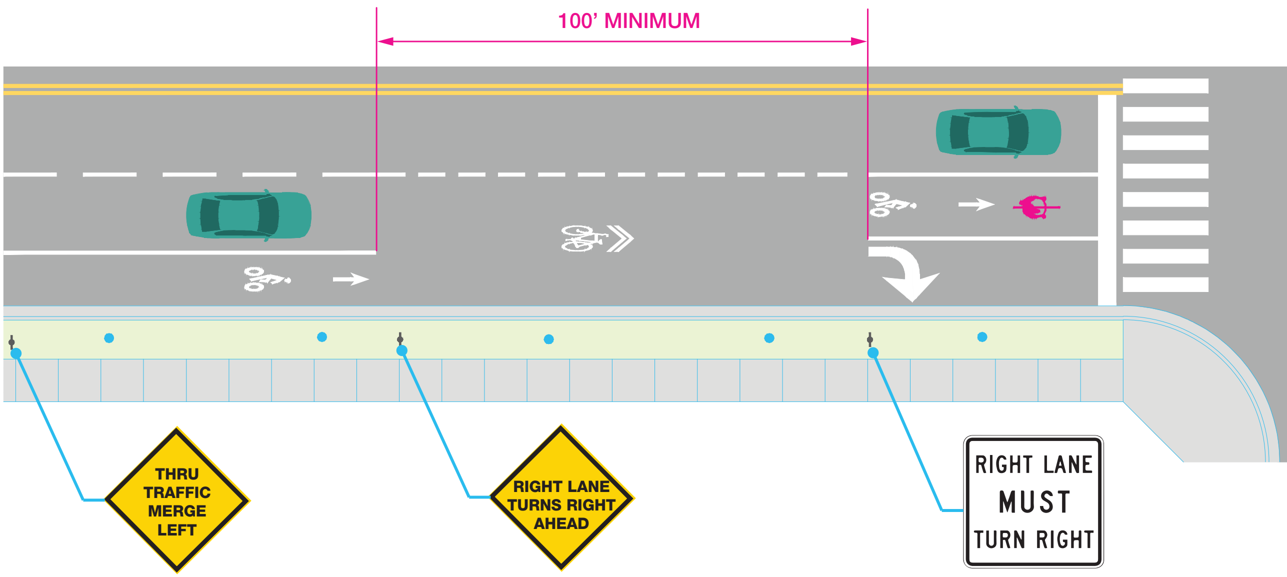
1. In this configuration, the path of the cyclist and the motor vehicle crosses as each gains access to their intended path. Continuing bike lanes should be placed to the left of the right turn only lane.
2. This weaving area is normally a minimum of 100-FT in length.
3. A Sharrow marking may be installed in the middle of the weaving area to further emphasize the shared condition.
4. Standard warning and regulatory signs are used in accordance with the CAMUTCD.



Design Guidance

1. The bike lane terminates prior to the intersection and becomes a shared condition with the travel lanes.
2. The bicyclist may use the through lane, or based on recently enacted law, proceed through the intersection from the right turn only lane.
3. A "Bicycles Exempt" sign can be installed under the "Right Lane Must Turn Right" sign to indicate this lawful movement.
4. Consider additional markings/signing as length of turn lanes increase.

Buffered Bike Lane Merge Area



Additional Signage as Length of Turn Lane Increase

Design Guidance

1. The intersection is without the presence of a dedicated right turn only lane. The bike lane transitions from a separated space to shared condition and motor vehicles are required by law to make their turn close to the curb.
2. The length of this shared space is typically 100-FT to 200-FT based upon approach motor vehicle approach speed.
3. Wider merge areas used in conjunction with buffered bike lanes will encourage motor vehicles to turn closer to the curb, increase single file movements in the merge area, and improve vehicle right-of-way decisions.
4. A Sharrow marking may be used in the merge area to further emphasize the shared condition and assist in positioning the cyclist for maximum visibility.

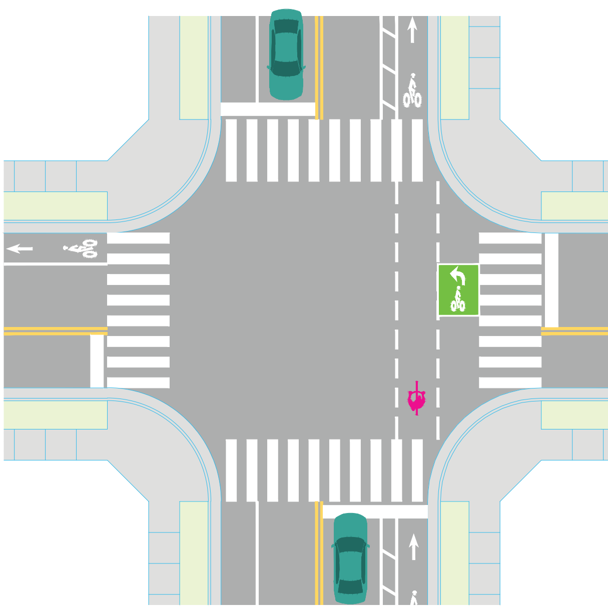
5.4 Two-Stage Left Turn Queue Box

With bicycle facilities on multi-lane high speed corridors, it can be challenging for cyclists to make left turns at intersections due to physical separation, rider ability, or limited gaps in traffic.

Two-stage left turn queue boxes afford the opportunity for bicyclists to make left-turns with increased comfort level at multi-lane signalized intersections through two separate green signal indications.

The cyclist proceeds through the intersection to the far side and then waits for the green light of the next through movement. These two distinct movements can, in certain circumstances, reduce overall delay for the cyclist.

The treatment can also be used at unsignalized intersections to assist in bicycle alignment while crossing an intersection, but it may increase bicycle delay as the cyclist waits for an appropriate gap in traffic.



Typical Placement of Two-Stage Queue Box

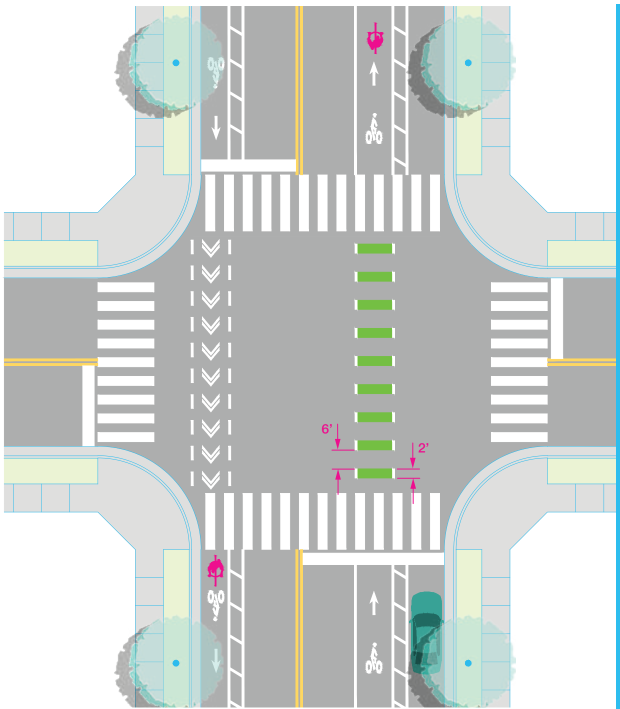
Two-Stage Left Turn Queue Box

Design Guidance

1. Two-stage turn box dimensions are normally 6-FT x 8-FT for proper maneuverability and to allow the use of the box by multiple cyclists.
2. The box should be aligned out of the path of the cyclists and other traffic traveling straight through.
3. The queue box should be outlined with a 4-inch white stripe.
4. The box should be placed to not interfere with pedestrian traffic.
5. Two-stage bicycle turn boxes shall include an appropriately sized bicycle symbol and turn arrow oriented in the direction of entering bicycle traffic.
6. Where the paths of other vehicles turning right on a red signal would cross through the two-stage bicycle turn box, these turns shall be prohibited with the use of a No Turn on Red (R10-11 CAMUTCD) sign. To reduce vehicle delay when no cyclists are present, consideration should be given to the use of specific bicycle detection for the two-stage turn box and LED blank out turn restriction signs.

5.5 Striping/Markings Through Intersections

Bicycle pavement markings through intersections provide positive guidance for bicyclists to maintain a direct path and assist in maintaining separation from adjacent motor vehicles.



Bicycle Pavement Markings Through Intersections

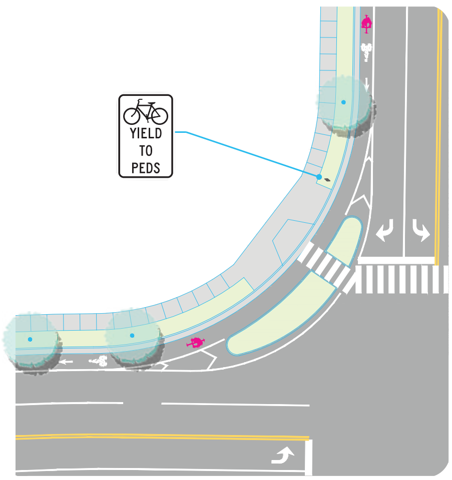
Design Guidance

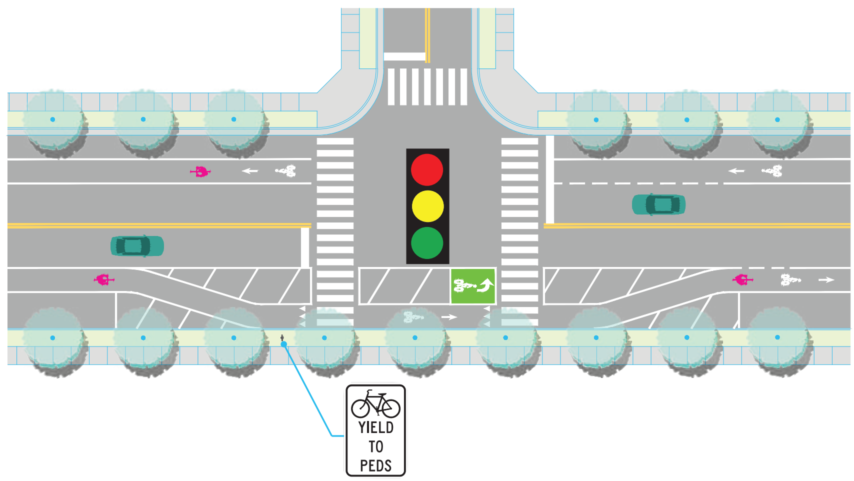
1. Intersection crossing markings may be used where upstream and downstream bicycle facilities are present for continuity through the intersection. They are particularly useful where bicycle positioning is not clear across large and complex intersections.
2. Dashed lines may be installed through intersections and major driveways and should be the same width and aligned with the bike facility. Lines should be white in color, 6-inches wide, 2-FT long, and spaced at 6-FT intervals. Green pavement markings or Chevrons may also be used to add conspicuity. Sharrows should not be used as extension markings through the intersection.
3. Striping and markings should be skid resistant and retro reflectorized.

5.6 Bicycle Bypass Lanes at "T" intersections

People on bicycles benefit from continued momentum when riding. Safety and bicycle flow can be enhanced if cyclists stopping can be reduced.

At "T" intersections with either stop signs or traffic signals, bypass lanes can allow bicycles to move through the intersection, independent of motor vehicles.





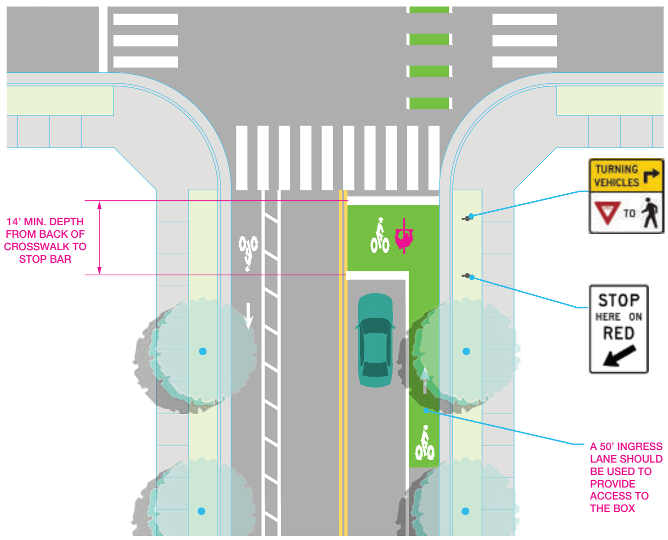
Design Guidance

1. Additional separation may be provided, allowing bicyclists to proceed through the intersection without stopping. Separation should include a physical barrier, so that left-turning vehicles do not conflict with through bicycles
2. Signing should be posting indicating cyclists must yield to pedestrians.
3. Provisions for a separate left-turn area should be provided allowing left turns from the bypass lane.
4. Width of the bypass lane should match the width of the up and downstream bicycle facility.
5. Curvature of the bypass lane should be designed at a design speed of 20-25 miles per hour.
6. This treatment is best suited in areas of light pedestrian traffic.

5.7 Bike Boxes

Bike boxes are used at signalized intersections and provide a designated area located in front of the vehicular stop line. Bike boxes allow cyclists to get in front of queuing traffic during the red phase of the signal, enhancing their visibility and giving them priority in moving through the intersection. Motor vehicles are required to stop at the white stop line at the rear of the box.

Bike boxes are particularly helpful at signalized intersections with high vehicle and/or high bicycle volumes.



Bike Box Treatment

Design Guidance

1. The bike box should have a 14-FT minimum depth from the back of the crosswalk to the white vehicle stop bar.
2. A post mounted "Stop Here on Red" sign, coupled with a "Bicycles Exempt" placard mounted below should be installed at the stop line to improve compliance.
3. A "No Right Turn on Red" sign shall be installed overhead to prevent vehicles from entering the Bike Box.
4. Although optional, green colored pavement is recommended within the box and the approach lane to increase conspicuity of the Bike Box.
5. Access to the box should be provided using an ingress lane (50-FT minimum length).
6. The Bike Box shall contain at least one bicycle symbol per CAMUTCD standard marking requirements.
7. If the Bike Box is provided across multiple lanes of an approach, countdown pedestrian indications shall be provided for the crosswalk across the approach.

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Chapter 6
Driveways

6.1 Driveway Crossings

Driveways provide access to numerous destinations along a corridor and are a source of conflict between bicycles and motor vehicles.

Motorists often misjudge the speed of bicycles or are focused primarily on other conflicting motor vehicles when executing turning movements.

Cyclists are commonly subject to motor vehicle turning conflicts from multiple directions including turning right (right-hook), turning left (left-cross), and pulling out or exiting the driveway. As driveway volume increases, extra steps should be taken to reduce these common conflicts.

Design Guidance

1. For minor driveways, bike striping may be solid, or dashed across the driveway.
2. At major driveways, bike lane striping may be configured like an intersection with dashed mixing areas 100-FT to 200-FT in length.
3. Green conflict and additional bike symbol markings may be added at the driveway to enhance the conspicuity of the bicycle facility. Yield to bicycle signing should be installed in advance of the driveway to augment the green conflict markings.
4. Driveway radii should be constrained to reduce vehicle speeds turning across the facility.
5. Consider converting driveways to right in/out to reduce turning conflicts.
6. Driveways should be consolidated whenever possible, to reduce turning movement conflicts.
7. For separated facilities, the path may be raised to the height of the sidewalk to give right-of-way priority to the cyclist and slow vehicle entry speeds. Bend-outs may be used to enhance the visibility of the cyclists to turning motor vehicles.
8. Sufficient sight distance for exiting vehicles should be provided to maximize visibility of approaching cyclists. Street furniture and landscaping above 30-inches should not be placed within the sight distance triangle.
9. Driveways leading to dirt access roads should be paved for a minimum of 25-FT to reduce rocks and other debris from being thrown into the bike lanes.

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Chapter 7
Pedestrian Infrastructure

7.1 Marked Crosswalks

Marked crosswalks guide pedestrians and alert drivers to a roadway crossing location. Crosswalks can be marked using painted lines or thermoplastic material embedded with reflective glass beads to enhance nighttime visibility.

Marked Crosswalk

Design Guidance

1. The crosswalk should be a minimum of 6-FT in width and align as closely with the intended walking route. Preferred typical crosswalk width is between 10-FT to 12-FT and should be wider to accommodate large crossing groups typically found near schools and commercial and/or job centers. Wider crosswalks allow opposing crossing groups to comfortably pass each other during the crossing movements. Crosswalks are typically white in color unless near a school, where they are marked in yellow.
2. The crosswalk should align with curb access ramps. Curb access ramp should be completely contained within the marked crosswalk.
3. At both signalized and unsignalized locations, crosswalks may be high visibility Continental style. High visibility crosswalks greatly enhance the visibility of the crossing and improve driver yielding behavior. Continental style crosswalks are comprised of 24-inches solid bars marked parallel with the traffic flow and spaced 4-FT on center. Vehicle/pedestrian conflicts can be further reduced with the addition of a 12-inches white advanced stop bar, located 5-FT from the marked crosswalk.
4. The marked crosswalk should have good sight distance for approaching vehicles. Parking, if present, should be restricted a minimum of 25-FT in advance and beyond the marked crosswalk.

7.2 Sidewalk Zones & Widths

Sidewalks provide accessible pedestrian travel and active public space and should be provided on both sides of the roadway. Good walking infrastructure creates a lively and active street. Active streets include amenities such as landscaping, pedestrian scale lighting, wide walking paths, seating, and an abundance of commercial activity/displays. These amenities should be organized and balanced to ensure safe and accessible travel. Sidewalks are defined in a set of five zones as follows:

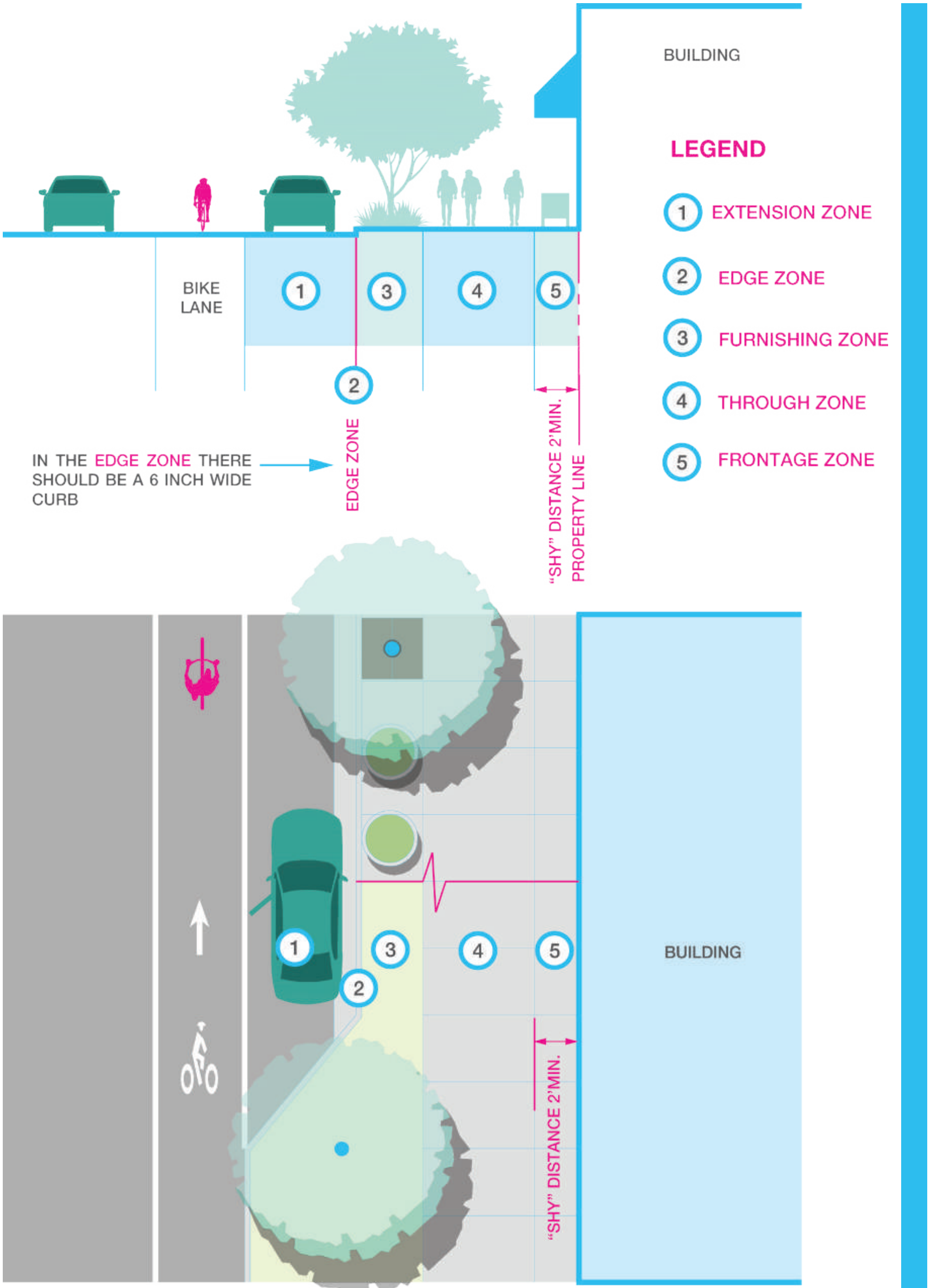
Frontage Zone
The area adjacent to the property line providing a transition between public sidewalk and the adjacent building frontages. The Frontage Zone affords opportunities for commercial seating, window shopping, signs, and landscape planters. Typical width varies between 2-FT and 10-FT.

Through Zone
The portion of the sidewalk designated for pedestrian travel along the street. The zone should be completely clear of impediments. Width should be 4-FT minimum per ADA requirements. Preferred width is 6-FT for passing and maneuverability and should be increased to 10-FT or more to accommodate large pedestrian volumes such as in a downtown environment, near schools, or bus stops. The surface should be smooth and free of grates, underground utility boxes, sign posts and other elements. Clearance to trees and other overhead features should be maintained at 84-inches or greater.

Furnishing Zone
The portion of the sidewalk used for street trees, landscaping, transit stops, streetlights, signal poles, public art, and other street furniture. Typical widths vary between 2-FT and 6-FT to accommodate trees and other landscaping. When possible, additional width should be provided to increase pedestrian comfort with further separation from passing vehicles. Street trees greatly enhance the walkability of sidewalk space. As a best practice, agencies should strive to provide 30 percent or greater shaded sidewalk using water-wise native trees.

Edge Zone
The area used by people getting in and out of vehicles parked at the curbside and is the interface between the roadway and the sidewalk. This is walkable space and should be a minimum of 18-inches wide and should be free of vertical elements such as utility poles, sign posts, trash cans, bike racks, and streetlights.

Extension Zone
The area where pedestrian space may be extended into the width of a parking lane with the use of curb extensions. In downtown of commercial shopping districts, this flexible space can be used for additional seating/parklet development and bicycle corrals.

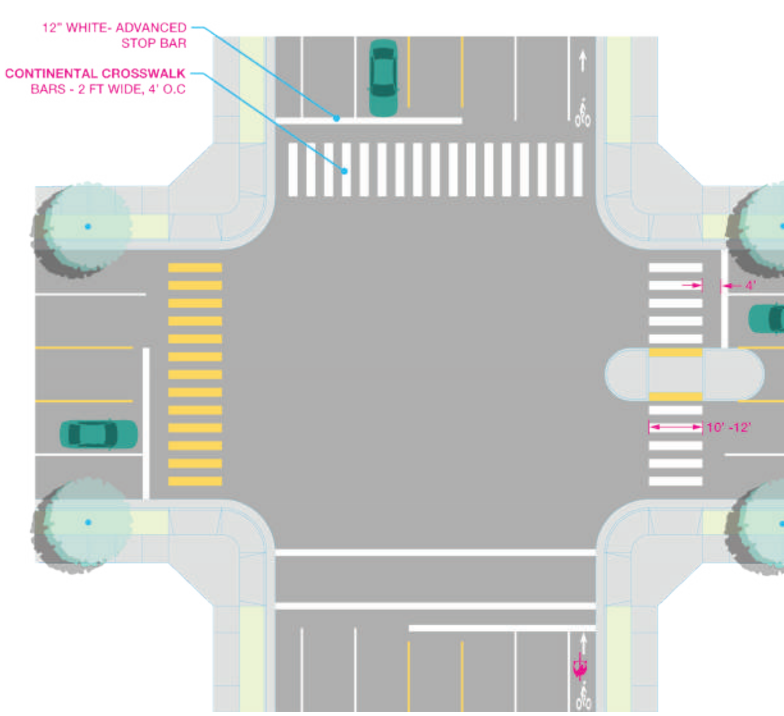


Sidewalk Zones

7.3 Median Refuge Island

Median refuge Islands are generally located at the midpoint of the marked crossing and placed between opposing lanes of traffic.

Median Refuge Islands serve to reduce crossing distances, provide space for signs and other traffic control features, allow pedestrians and bicycles to navigate one direction of traffic at a time, and provide a traffic calming element to the roadway.



Median Refuge Island and Marked Crosswalk

Median Refuge Island

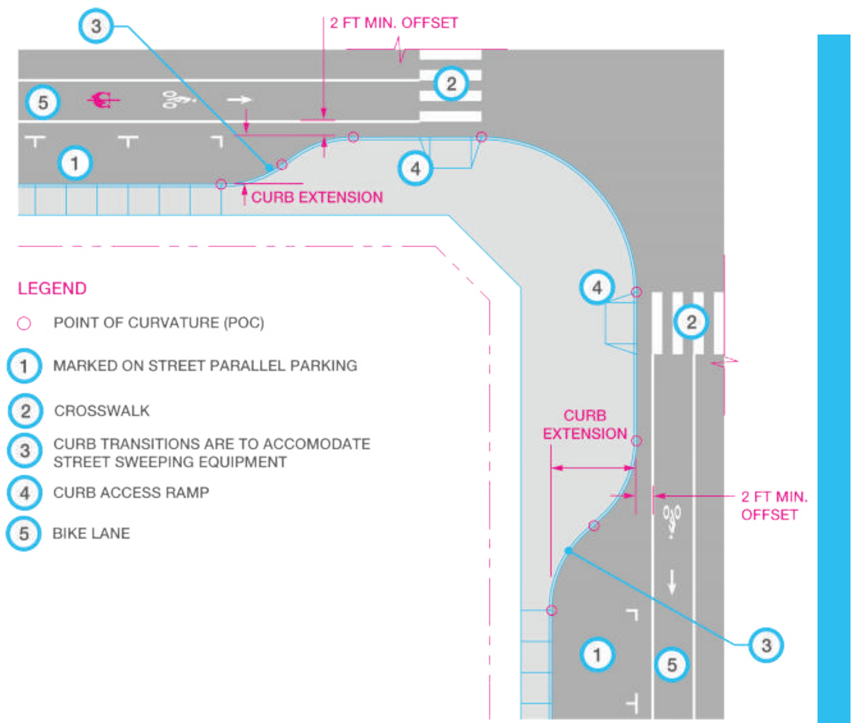
Design Guidance

1. Width of median should be 6-FT minimum. However, median width should be extended to available width of the turn lane to the greatest extent possible. Median width should consider bicyclists with tagalongs and/or trailers.
2. The refuge area should be outlined with roadway striping and raised pavement markers compatible with existing roadway striping in compliance with CAMUTCD requirements.
3. The median area should be supplemented with regulatory and warning signs in compliance with CAMUTCD requirements.
4. The median clear width should be a minimum of 4-FT, but the preferred width is the same as the marked crosswalk.
5. The length of the median refuge should be 20-FT minimum including the crossing area.
6. If used with a raised crosswalk, the median refuge island should be the same height as the crosswalk.

7.4 Curb Extensions (Bulb Outs)

Curb extensions, also referred to as bulb outs, extend the sidewalk or curb line into the street or parking lane, thereby reducing the street width and subsequent pedestrian crossing distance. Curb extensions improve sight distance between the driver and pedestrian and are particularly effective at mid-block crosswalks.

Other advantages include additional space for street furniture, landscaping, and other amenities, reduced incidence of illegal parking across crosswalks, and increased pedestrian corner waiting area. They also provide space to use dual curb access ramps.



Example of a Curb Extension (Bulb Out)

Design Guidance

1. Curb extensions should not extend into the intended path of bicyclists.
2. The turning radius at the corner should be designed to maintain a 10-15 mph vehicle speed.
3. The transition from the curb to the bulb out should include a reverse curve transition of equal radii to facilitate street sweeping and reducing vehicle curb strikes.
4. Curb extension should include curb access ramps with ADA compliant detectable warning surfaces.
5. Curb extensions should not be used on streets without a parking lane. Curb extensions should not decrease outside lane width to less than 11-FT. A practical use for curb extensions are Transit Bulbs. Transit bulbs extend the sidewalk out at transit

stops to improve the overall experience for people using transit. The bulbs provide more space to wait and easier access to the vehicle as it arrives.

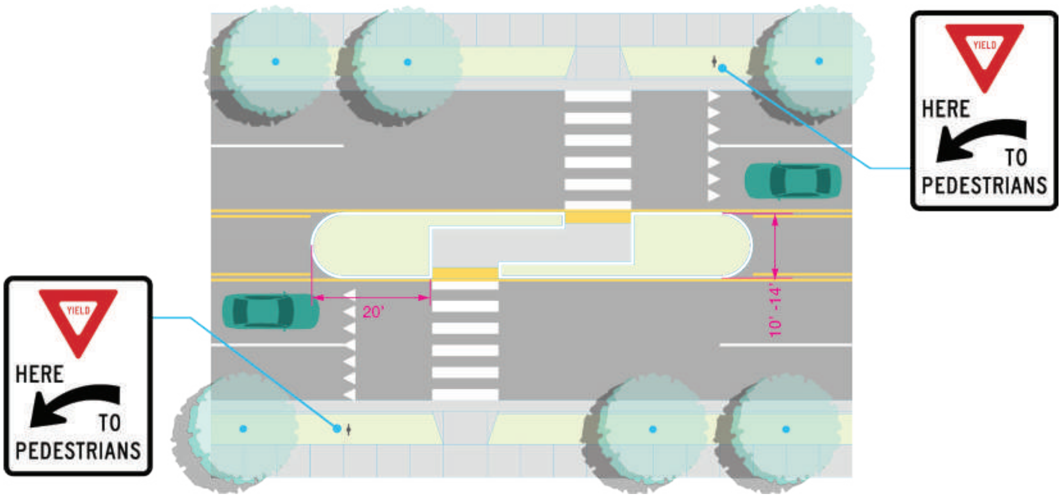
6. Bike lanes should be painted continuously as the bike lane passes the curb extension. The gutter should not extend into the bike lane.
7. Curb extension radii should be designed to balance the needs of all users of the roadway and consider the volume and frequency of each of the users.
8. The design vehicle for the curb return can make the turn within their respective lanes. This design is used for frequent turning movements at the intersection such as buses and small delivery vehicles.
9. Curb return radii may be designed to accommodate larger infrequent vehicles to turn using opposing lanes based upon engineering judgment.

Example of a Curb Extension (Bulb Out)

Example of a Curb Extension (Transit Bulb Out)

7.5 Offset Crosswalks (Z Crossings)

An Offset Crosswalk provides all of the advantages of a median refuge island with the added benefit of directing pedestrians/bicyclists to look toward oncoming traffic before committing to cross the second half of the street.



Offset Crosswalk Example

Design Guidance

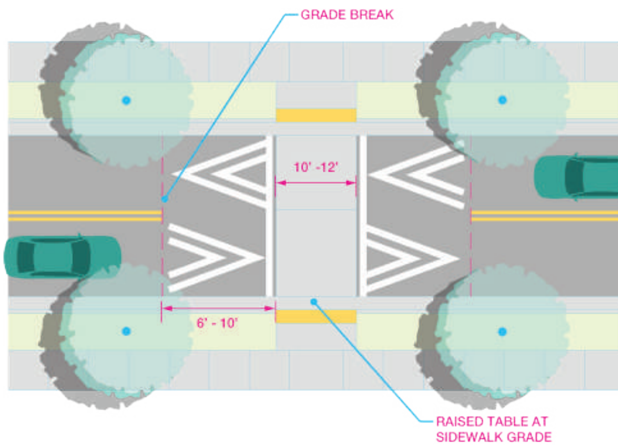
1. The crosswalk offset can be at right angles or skewed depending available median width and existing site conditions.
2. The median width should be a minimum of 10-FT.
3. Design should include a portion of parallel curbing aligned with the crosswalk to redirect pedestrians to cross perpendicular to the roadway.
4. Crossing may include pedestrian scale fencing to further emphasize the intended crossing path.
5. The median clear width should be a minimum of 4-FT, but the preferred width is the same as the crosswalk.
6. Crossing orientation should direct pedestrians to face oncoming traffic briefly to aid in decision when to cross the roadway.
7. If landscaping is used near the crossing, it should be low growth and the plantings should not impede available sight distance.
8. Offset crosswalks can be combined with bulb-outs to further reduce crossing distances.

Offset Crosswalk - Mecca, CA

7.6 Raised Crosswalks

A raised crosswalk or speed table is a higher section of pavement with a marked crosswalk usually at sidewalk grade and spans the entire width of the roadway.

Raised intersections have sloped ramps for the vehicles leading and following the flat raised crosswalk section.



Raised Crosswalk Example

Raised Crosswalk

Design Guidance

1. The raised portion of the crosswalk is installed at the same level as the sidewalk and is typically 10-FT to 15-FT wide allowing both vehicle wheels to be on the table at the same time.
2. Raised crosswalk approach grades are a minimum of 6-FT in length. The raised crosswalk may be constructed with contrasting materials such as concrete or pavers for enhanced visibility of the crosswalk.
3. The crosswalk should be a high visibility type and should be supplemented with regulatory and warning signs in compliance with CAMUTCD requirements.
4. Use of raised crosswalks should be limited to non-emergency/transit routes and low-speed streets.
5. Parking should be restricted (normally 25-FT) on both sides of the crosswalk to maintain sight distance for crossing pedestrians and bicyclists.
6. Impacts to existing drainage patterns must be considered in the design of the raised crosswalk.
7. Truncated domes are installed at the edge of the crosswalk allowing visually impaired pedestrians to detect the crossing.
8. Raised crosswalks can be combined with bulb-outs to further reduce crossing distances.

7.7 Rectangular Rapid Flash Beacons

Rectangular Rapid Flash Beacons (RRFB) can enhance safety by reducing crashes between vehicles and pedestrians at unsignalized intersections and mid-block pedestrian crossings by increasing driver awareness of potential pedestrian conflicts. With solar power and wireless communication, RRFBs offer low-cost benefits to pedestrian crossings that can be rapidly deployed. Studies have demonstrated that RRFBs substantially increase yielding rates at crosswalks, in many cases greater than 90 percent.

RECTANGULAR FLASHING BEACON (RRFB) WITH RAISED MEDIAN REFUGE

Design Guidance

1. The RRFB is dark and activates only upon pedestrian actuation. Pedestrians can manually activate RRFBs with a push-button or passively with photo-sensor bollards.
2. Device is installed in conjunction with a marked crosswalk. High visibility Continental style is the recommended crosswalk type and the color is either white or yellow depending upon proximity to a school. White triangular yield markings are installed in advance of the crosswalk.
3. RRFBs should be installed on both sides of the crosswalk facing each direction of traffic. If a median is present, the RRFBs should also be installed within the median on both sides of the crosswalk.
4. RRFB operation is based upon recommended crossing times for pedestrians and should cease after the pedestrian(s) clear the crosswalk.
5. Parking should be restricted in advance and beyond the crosswalk based upon vehicle approach speeds and sight distance requirements.
6. Installation should include ADA compliant curb access ramps.

7.8 High Intensity Activated Crosswalk/Pedestrian Hybrid Beacons

A High Intensity Activated Crosswalk (HAWK) signal, also known as a Pedestrian Hybrid Beacon (PHB), is a traffic control device designed to help pedestrians safely cross busy or higher-speed roadways at midblock crossings and uncontrolled intersections. This traffic control device is often used at locations that may not meet traditional pedestrian signal warrants. The PHB head consists of two red lenses above a single yellow lens. These lenses remain "dark" until a pedestrian desiring to cross the street pushes the call button to activate the beacon. The signal then initiates a yellow to red interval consisting of steady and flashing lights that directs motorists to slow and come to a stop. The pedestrian signal then displays a walk indication to the pedestrian. Once the pedestrian has crossed the roadway, the hybrid beacon again goes dark.

PEDESTRIAN HYBRID BEACON (PHB) WITH RAISED MEDIAN REFUGE

Design Guidance

1. Two overhead signal indications with three sections (circular yellow centered below two horizontally aligned circular red) are installed facing both directions of the major street.
2. Overhead "Crosswalk Stop on Red" signs (R10-23) are installed to indicate the device is associated with a pedestrian crossing.
3. Device is installed in conjunction with a marked crosswalk. High visibility Continental style is the recommended crosswalk type and the color is either white or yellow depending upon proximity to a school. White stop bars are installed in advance of the crosswalk.
4. The pedestrian signal heads should include countdown timers.
5. The beacon is pedestrian activated. Pedestrian push buttons should be ADA compliant and include countdown instructional signs.
6. Parking is restricted 100-FT in advance and at least 20-FT beyond the marked crosswalk.
7. Chapter 4F of the CAMUTCD provides additional installation details.

Chapter 8
Signalized Intersections

In urban and suburban areas, bicycle facilities routinely go through signalized intersections. It is important to consider the unique operating characteristics of bicyclists in traffic signal timing and design.

8.1 Bicycle Specific Equipment at Traffic Signals

With all new or modified traffic signals, the CAMUTCD requires that bicyclists be detected, unless the traffic signal is permanently placed in recall or a fixed time operation.

Traffic signal detection should be sensitive enough to detect a variety of bicycle types and include all potential movements at the intersection.

Bicycle detection technology should provide enough green time so that bicyclists of all abilities can reach the far side of the intersection past the last conflicting motor vehicle lane (see Chapter 8.2).

Where bicycle loop detectors are not present, cyclists are often forced to wait for a motor vehicle to trigger the signal phase.

Where motor vehicle traffic is light, cyclists will be forced to wait for an acceptable gap and cross against a red signal. Providing bicycle detection at intersections adds benefit to motorcycles and other smaller motorized vehicles that also can go undetected.

Bicycle Detection Marking

Bicycle Push Button

Design Guidance

1. Bicycle detection includes the use of in-ground loops, bicycle push buttons, radar, video, and microwave technology.
2. When implementing new bicycle detection technology, consider using hardware/software that can discriminate between bicycles and motor vehicles. This allows special timing for bicycles when they are present and can be used to adjust the clearance intervals when bicyclists are exposed to conflicting vehicular traffic.
3. If in-ground loops are used for bicycle detection in bike lanes, they should be wired separate from adjacent general-purpose lane traffic loops so sensitivity can be independently adjusted.
4. Consider adding supplemental bike loop markings showing proper lane position for bicyclists to be detected. Bicycle detection may be paired with pole mounted indicators that illuminate when cyclists waiting at an intersection have been detected.
5. A standard bicycle should be used to test and fine tune the bicycle detection after it is installed.
6. For traffic movements without bicycle detection, minimum green times should be set to accommodate bicycle traffic in accordance with the formula in Chapter 8.2.
7. To maximize separation from other conflicting motor vehicles, bicycles may have an independent signal phase and indications per CAMUTCD requirements. Typical installations include right turn on red restrictions when the phase is activated.
8. It is inconvenient for bicyclists to push a pedestrian button to cross a minor roadway. Bicycle push buttons may be installed adjacent to the bike lane, positioned close to the curb. Buttons should be 2-inch ADA compliant versions with bicycle specific signing.
9. Visibility of bicycles is reduced on multi-lane highways and cyclists are especially vulnerable during the traffic signal clearance interval. Consideration should be given to adding protected left-turn phasing on the major roadway to reduce turning movement conflicts.

8.2 Traffic Signal Timing for Bicyclists

Typically, a vehicle-based minimum green time for a signal phase is between 5 and 15 seconds. However, bicyclists accelerate at a slower rate than motor vehicles, and for larger intersections, these minimums may not allow them to cross the intersection prior to release of a conflicting vehicular movement.

The CAMUTCD recommends the following minimum timing guidance to allow bicyclists to cross an intersection: "the sum of the minimum green, plus the yellow change interval, plus any red clearance interval should be sufficient to allow a bicyclist riding a bicycle 6-FT long to clear the last conflicting lane at a speed of 14.7 ft/sec plus an additional effective start-up time of 6 seconds."

Separate Bicycle Indications at Traffic Signal

The following is the general formula and calculated values.

Minimum Green +Y+R >= 6 seconds+(W+6) / 14.7 ft/sec

Y = Length of Yellow Interval (sec)

R = Red Clearance Interval (sec)

W = Distance from Limit Line to Far Side of Last Conflicting Lane (ft)

8.3 Traffic Signal Timing for Pedestrians

Sufficient pedestrian crossing time is crucial for a well-functioning walking environment. The CAMUTCD recommends using a walking speed of 3.5 ft/sec and an initial walk interval of 7 seconds.

In areas where older or disabled pedestrians are expected, it is recommended that the assumed walking speed be reduced to 2.8 ft/sec.

The crossing intersection crossing distance is typically measured from the curb face to the far side of the traveled way.

This distance can be extended to measure from curb-to-curb for enhanced benefit. The yellow and all-red clearance interval can be subtracted from the required total crossing time. The following is the basic formula used:

Pedestrian Clearance Interval (sec) = W / 3.5 ft/sec – Y+R

Y = Length of Yellow Interval (sec)

R = Red Clearance Interval (sec)

W = Measured Crossing Curb-to-curb Width (ft)

8.4 Pedestrian Signal Operations

Leading Pedestrian Intervals

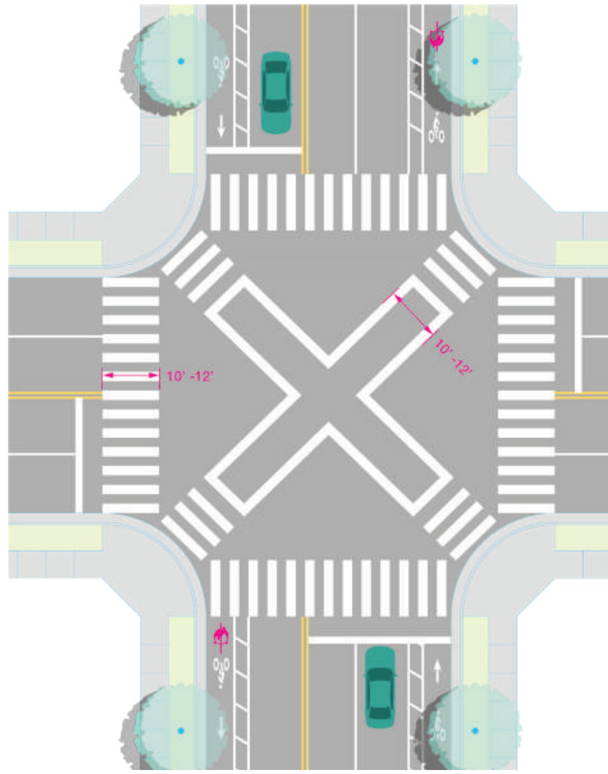
Pedestrians face increased risk when vehicles turn through crosswalks and fail to yield. One opportunity to reduce this conflict is the use of a Leading Pedestrian Interval (LPI). An LPI gives pedestrians a head start when entering the crosswalk by displaying a Walk Indication ahead of the permissive green interval. The LPI increases the visibility of crossing pedestrians and gives them priority within the intersection. LPIs are particularly effective where both pedestrian volumes and turning volumes are high. The duration of the LPI should be at least 3 seconds and may be increased to 7 seconds allowing pedestrians to cross one full lane of traffic.

All-way Walk/Pedestrian Scramble

In areas with very high pedestrian volumes, a pedestrian scramble phase or exclusive pedestrian phase, provides pedestrians with exclusive access to a signalized intersection while vehicular traffic is stopped in all directions. Pedestrians cross in all directions including diagonally. Since pedestrians can cross diagonally, diagonal crosswalks are painted in the roadway, and a sign is installed at the crossing indicating that diagonal crossing is allowed.

Pedestrian Recall

When a pedestrian movement is set in recall operation, pedestrian crossings are assumed to occur on every signal cycle, and the signal should provide sufficient time for pedestrians to complete the crossing. Pedestrian recall enhances pedestrian comfort and convenience over actuated operation. Pedestrian recall operation is most commonly used in urban areas that experience significant pedestrian volumes where crossings occur on most signal cycles. Pedestrian recall can be programmed for certain times of the day if the crossing volumes primarily occur during peak periods. A best practice for the use of pedestrian recall is when pedestrians cross on at least 75 percent of signal cycles for three or more hours per day.



Diagonal Crosswalk

Diagonal Crosswalk

Chapter 9
Roundabouts

9.1 Designing for Bicycles in Roundabouts

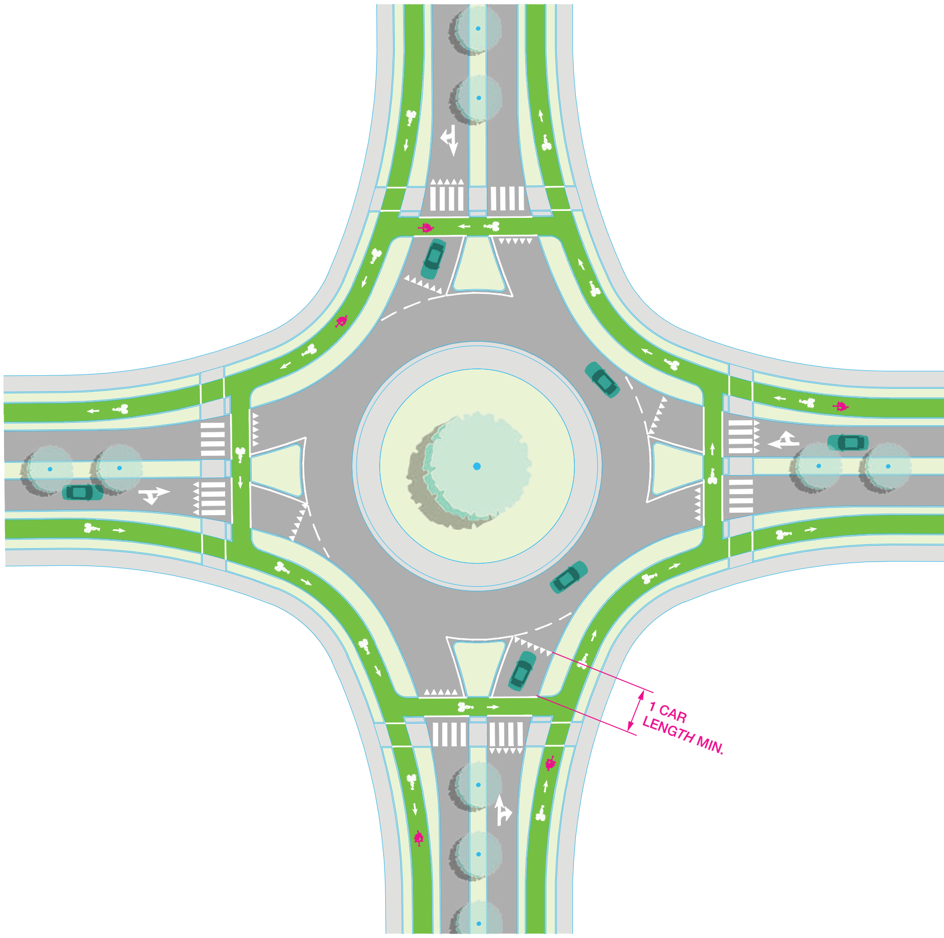
Roundabouts are a safer alternative to traffic signals and all-way stop signs as they eliminate the vehicle conflict points that lead to the most severe types of intersection crashes. However, roundabouts can be intimidating and difficult for bicyclists to navigate.

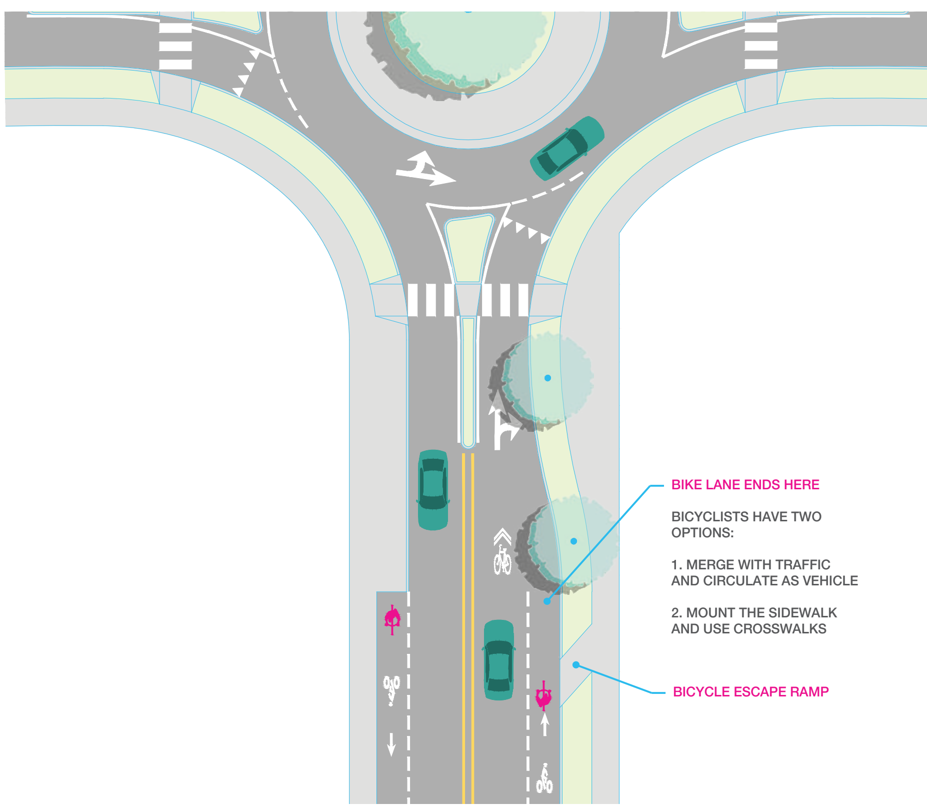
It is important that roundabouts be designed to accommodate bicyclists of all ages and abilities and provide continuity of the bicycle facility within the network.

Design Guidance

1. Utilize single-lane roundabouts when possible to reduce vehicle speeds, multi-threat collision scenarios, the number of conflict points faced by cyclists, and to reduce crossing distances at crosswalks.
2. Provide an alternate bypass facility that circulates around the roundabout allowing bicyclists to exit the roundabout.
3. Reduce the speed of circulating motor vehicles to less than 25 mph (15 mph is preferred). Safety within roundabouts is greatly enhanced when the speed differential between bicycles and motor vehicles is low.
4. Provide Sharrow markings within the roundabout to encourage experienced cyclists to take the lane and encourage single file circulating vehicle movements.
5. Bike lanes should terminate prior to entering the roundabout.
6. Adequate sight distance should be provided at all crossing points. High visibility signing and markings should be used at crosswalks to increase drivers yielding to cyclists.
7. When used with protected facilities, it is preferred that the cyclist path be separate and continuous around the roundabout

Roundabout with Bicycle Path


1 CAR
LENGTH MIN.


BIKE LANE ENDS HERE
BICYCLISTS HAVE TWO OPTIONS:
1. MERGE WITH TRAFFIC AND CIRCULATE AS VEHICLE
2. MOUNT THE SIDEWALK AND USE CROSSWALKS
BICYCLE ESCAPE RAMP

Chapter 10
Construction Zones

10.1 Bicycles in Work Zones

Construction zones pose problems for cyclists as the impacted roadway area is often narrowed, has uneven pavement surfaces, loose construction material, and operating or stored equipment. These conditions should be considered, and the contractor and inspector should take necessary steps to increase the safety of cyclists during the construction.

Bicycle Specific Warning Sign

Construction Plating Installed Within a Bike Lane

Temporary Separated Bicycle Path Behind Barrier

Special Considerations

1. If the roadway is posted with a speed limit of 35 mph or less, and bicycle facilities cannot be maintained, consider augmenting the traffic control plan with "Bicycles May Use Full Lane" signage.
2. If the same condition is on roadways with posted speed limits greater than 35 mph, the traffic control plan should include a signed detour route of comparable quality specific for bicycles.
3. If k-rail is used to define the work zone, the plan should include a temporary bike path through the work zone, separated from adjacent motor vehicles as shown in the images below.
4. If construction plating is used, it should be recessed and flush with the surrounding asphalt, slip resistant, and have no seams between the plates that could trap a bicycle wheel. The plating should be temporarily secured and routinely monitored to ensure no movement due to traffic loading.
5. Special warning signs for bicycles can be used to advise of modified roadway conditions.
6. Maintain a minimum of 5-FT bicycle lane width outside of sandbags, signing, and material storage.
7. Provide transitions for uneven pavement surfaces when possible, especially when construction runs parallel or is angled along the path of the cyclist. If temporary traffic control will require bicyclists to travel over rumble strips for an extended period of time, the pavement indentations should be filled in to provide a smooth riding surface.
8. Consult Part 6 of the CAMUTCD for traffic control elements and bicycle specific signing.

10.2 Pedestrians in Work Zones

When contractors are working on or near a sidewalk or walking path as part of a temporary traffic control (TTC) zone, pedestrians who use that sidewalk or path, including individuals with disabilities, must be accommodated.

When existing pedestrian facilities are disrupted, closed, or relocated in a TTC zone, the temporary facilities shall be consistent with the features present in the existing pedestrian facility.

Special Considerations

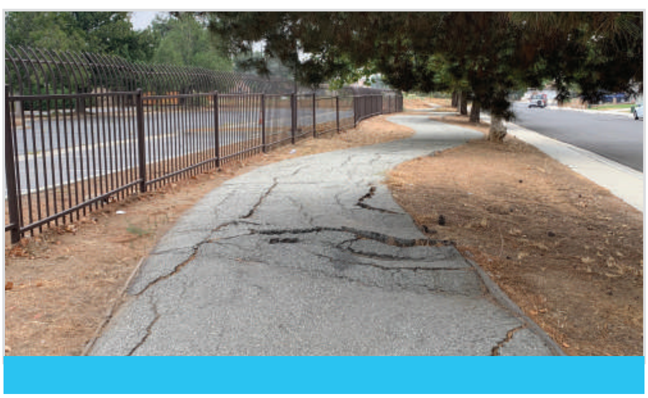
1. Ensure that pedestrians Are protected from trenches and holes adjacent to the side-walk/path. Concrete barriers, plastic channelizing devices, and temporary fencing can be used to guide pedestrians through the work area.
2. Sight distance should be maintained for pedestrians at intersections and crossings. Work vehicles, equipment, and materials should be placed to maintain available sight distance.
3. Access from the sidewalk to existing bus stops should be maintained. If access to the bus stop cannot be maintained, then the stop should be temporarily closed, and direction should be provided indicating alternative bus stops.
4. The existing pedestrian walking path must be clear of mud or dirt, temporary signs, barriers, construction materials, vehicles, and construction equipment. Overhead clearance should be maintained to a minimum of 7-FT. Available width of the path should be a minimum of 4-FT.
5. Often a sidewalk or path cannot be maintained during construction and a pedestrian detour is required. The temporary path should be designated with pedestrian detour signing and channelization well in advance of the work zone.
6. Part 6 of the CAMUTCD should be consulted in the development of pedestrian specific work zone accommodations.

Chapter 11
Maintenance Best Practices

11.1 Pavement Surfaces

Surface condition and pavement smoothness are important to bicyclist comfort and control. Pavement cracks, bumps, and potholes within the roadway create impediments for people on bicycles and will often impact route selection. Poor pavement quality will encourage cyclists to move away from or completely off the facility. This reduces bicyclist predictability by motorists and encourages sharing the lane with motor vehicles. Pavement defects often lead to flat tires, expensive wheel damage, and bicycle crashes.

Proper pavement maintenance is essential for bicycle facilities to maximize their usage and improve safety. Particular attention should be given to areas where pavement meets concrete. These seams are often raised due to AC pushing or damaged due to water splashing from crossgutters. Pavement surfaces that vary more than ⅜-inches should be grinded down or repaved to improve the surface ride-ability. Edges around underground manholes and utility boxes erode creating an uneven surface that can cause a bicyclist to lose control and crash. This becomes increasingly important on downhill grades where speeds increase.



Lifted Asphalt in Bike Path Due to Invasive Tree Roots

Typical best practices are to include bicycle facilities, including off-street trails, in the regular maintenance cycle and budget, make pavement defect repairs a higher priority, and achieve the same pavement quality standard used for motor vehicles. In addition to routine pavement maintenance, agencies should create policies and standards for utility work and other projects so that pavement cuts are backfilled in a manner that returns the roadway to the original pavement condition. Trench repairs should include the entire bike facility width to eliminate uneven surfaces and smooth ride quality. Regular inspection of trench repairs should be conducted to identify any settling of modified asphalt.

Lastly, maintenance of the facility should be considered through the design process. Agencies should include their maintenance staff in the planning and design process for the facility. Often increased or difficult maintenance can be avoided by addressing potential problem areas during construction and consideration of maintenance equipment type and availability.

Whenever possible, bicycle facilities should be installed in conjunction with resurfacing projects. This ensures the new bicycle facilities will be built with a high-quality pavement condition, reduces or eliminates pavement scarring from striping modifications, and achieves quantity of scale as part of the overall striping cost for the roadway.

The Active Transportation staff should be given an opportunity to review the paving locations for potential striping modifications that can modify or incorporate bike facilities into the project.

11.2 Street Sweeping

An integral part of a well-functioning bicycle network is providing for regular maintenance including sweeping of the facilities and removing any debris. Rocks, sand, and other debris are pushed into bike lanes by adjacent vehicle traffic and deposited by adjacent eroding slopes. Routinely, glass bottles are thrown from passing motorists and broken within the bike lanes. Like poor pavement quality, debris and patches of sand can lead to increased flat tires, wheel damage, and increased crashes.

Cyclists will often avoid key bike routes, or simply ride adjacent to them, if they are not regularly swept.

It is a best practice to sweep bike facilities bi-monthly or more often in areas prone to excessive debris or poor drainage.

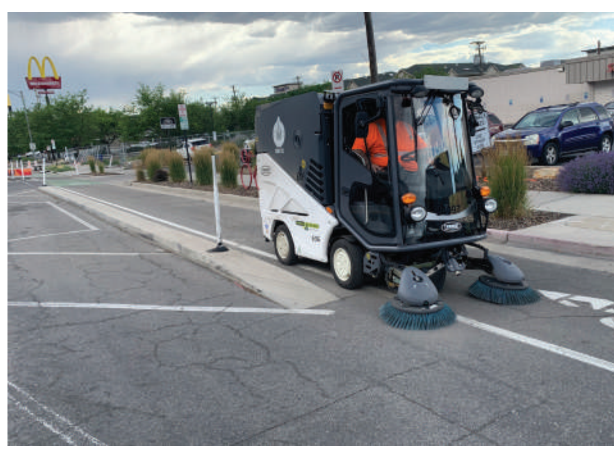
One important aspect of street sweeping that is often overlooked is continuity of the bicycle path through an intersection. Street sweepers, usually for efficiency, turn the corner when they approach an intersection rather than go straight through. This leads to un-swept areas in the intersection, including bike lanes between the regular vehicle lanes and large triangular areas formed by all traffic movements near the corner. These areas, impacted by motor vehicles pushing debris outward, are usually full of nails, glass, tire weights, and rocks. Cyclists are forced to ride through these areas leading to additional distraction and weaving as they avoid the debris.

For protected facilities, constructed width may not allow for traditional street sweepers to maintain the facility. Agencies should consider the purchase of smaller street sweepers to ensure regular maintenance of the bike way. These smaller sweepers are also practical for sweeping sidewalks and other walkways.

Agencies should consider generating exclusive street sweeping schedules for primary bicycle routes to address this issue.

Another consideration of a successful bicycle network is coordinated maintenance responsibilities across multiple jurisdictions. Agencies with small portions of the network should consider contracting with larger adjacent jurisdictions to ensure frequent and complete maintenance of the bicycle facilities.

Triangular Shaped Debris Area with an Intersection



Mini Street Sweeper

11.3 Landscaping/Weed Abatement

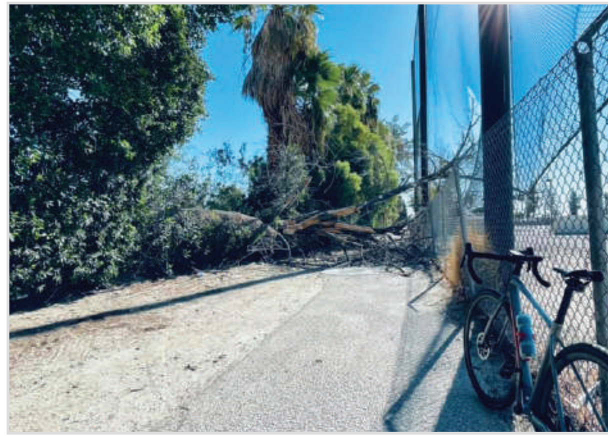
Landscaping can pose on-going maintenance concerns for bike facilities. Bike lanes are often partially or fully blocked by overgrown limbs and bushes. This can generate additional weaving of cyclists in and out of the bike lane, can strike a cyclist as they pass, and catch a handlebar and cause the cyclist to crash.

It is important that landscaping adjacent to bike paths and lanes be trimmed on a regular basis and routinely reviewed for overgrown conditions outside the normal maintenance cycle. Bike facilities should be field reviewed after significant wind events to prioritize removal of any fallen limbs.

Another concern is lifted asphalt due to invasive tree roots. If not addressed early on, lifted asphalt sections can pose a risk for cyclists as they ride over them. This is another area that can be addressed during the design phase of the project through a review by the landscape maintenance staff.

One major concern of cyclists is getting flat tires while riding. This can pose a challenge for a cyclist to repair the tire in areas of high traffic and minimal lighting and can lead to loss of control of the bicycle.

One of the biggest causes of flat tires is Tribulus Terrestris, also known as goat's head or puncturevine. Puncturevine is a summer annual weed and it's commonly found throughout the region. One of the most undesirable traits of puncturevine is the dangerous, sharp seedpods it produces. The small burrs routinely puncture bicycle tires. Puncturevine located near bicycle facilities should be eradicated. Puncturevine plants should be disposed of with normal rubbish and should not be comingled in green waste as the plants will continue to replicate when the seeds are included with mulching.



(Top)
Landscape Debris Blocking Trail

(Bottom)
Tribulus Terrestris - Image Source: UC Weed Science, ANR Blogs

11.4 Recommended Frequency of Maintenance Activities

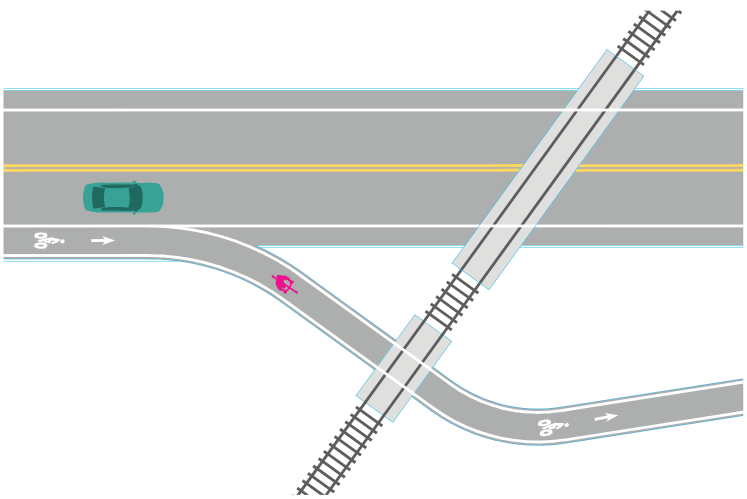
Maintenance Activity	Frequency
Bikeway sweeping	At least 2 times per month
Bikeway / crosswalk pavement inspection	Every 3-6 months; more frequently in areas with construction activity, perpendicular asphalt / concrete joints, and / or areas prone to frequent water runoff / heavy vehicle usage
Overhead tree trimming	Every 1-3 years or as needed to maintain sign visibility and 8 FT clearance over bike way / sidewalk
Shoulder plant trimming / weeds / debris removal	Every 6 months; after significant wind / storm event
Striping of bike lanes	Every 12 months
Sign replacement	Every 5 years; more frequently with south facing signs
Review bike detection operation	Every 30-45 days included with routine traffic signal maintenance
Bikeway pavement slurry seal / replacement	Include with regular pavement maintenance cycles
Temporary facilities / detours with construction	Daily during construction
Pavement markings replacement (including crosswalks)	1-3 years (paint) 3-5 years with thermoplastic; more frequently in areas prone to frequent water runoff
Sidewalk panel replacement due to lifting	When lifted sidewalk is 3/4-inch or greater

Chapter 12
Railroad Considerations

12.1 Bicycle Crossings at Railroad Tracks

Railroad tracks can be a problem for cyclists as they travel over the crossing.

The tracks are often not oriented perpendicular to the roadway, the adjacent asphalt is often raised due to pushing from heavy loads, and the tracks can be slippery in inclement weather.



Bike Lane Designed to Cross Perpendicular to Railroad Crossing

Design Guidance

1. Bike facilities and sidewalks crossing railroad tracks should be designed to cross perpendicular to the tracks.
2. The crossing should be upgraded to include flangeways and concrete/rubber panels, so the crossing is level and flush with the top of the rail.
3. Bike facilities that pass under rail crossings should be protected from falling ballast by fencing or protective netting.
4. Tracks that have been abandoned should be removed or paved over to provide a smooth continuous riding path.
5. Panels used at rail crossings should be flush against each other so that bicycle wheels will not be trapped in the seam.

Bike Lane Designed to Cross Perpendicular to Railroad Crossing

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Chapter 13
Transit Considerations

13.1 Bus Stops

Primary bicycle facilities typically align with major transit routes. Bus stops should be placed and constructed to accommodate bicycles.

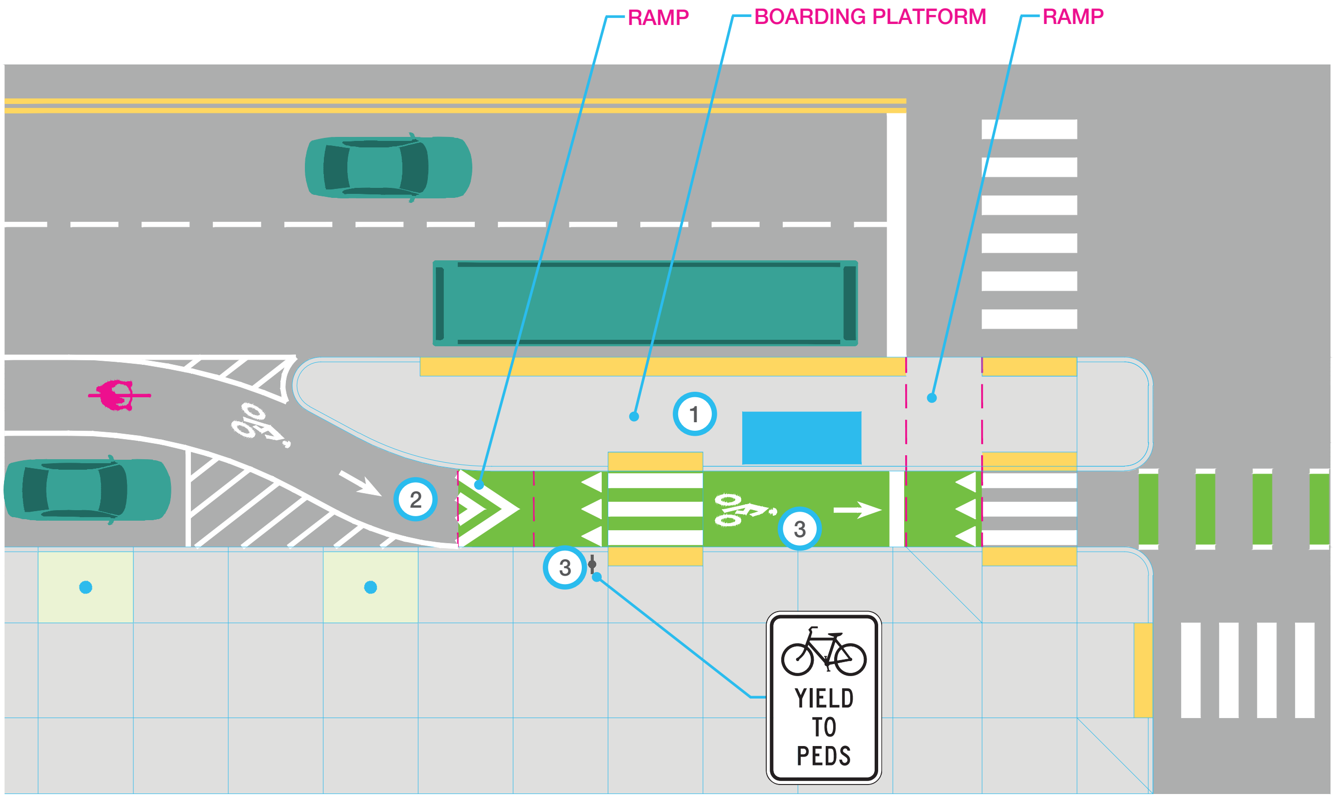
Bicycles are often used to make the "last mile" connections to both home and work and should be included in the design of the transit network.

Design Guidance

1. Bus stops should be located near intersections to reduce mid-block crossings. Far side stops are preferred to improve visibility and operations at the intersections.
2. Modern buses are usually equipped with bicycle racks. Sidewalk should be wider (8-inches minimum) to improve access for pedestrians as bicycles are loaded and unloaded at the front of the bus.
3. Bus stop amenities may include bicycle racks for short-term parking.
4. Class II bike lanes are normally striped to the left of the bus stop. They may be dashed and include green conflict markings to enhance the presence of bicycle traffic to transit operators. An alternative design is a floating bus stop. With this design, the bike facility is routed to the right and separated from the bus waiting area. Floating bus stops reduce conflicts between buses and cyclists. Additional markings and signs should be provided at the pedestrian crossing path for the stop.
5. Separated bikeways should be designed to go to the right of bus stops with additional signing and markings to reduce conflicts between bicycles and entering/existing bus riders.

Conflict Markings at Bus Turnout

6. Major bus stops should include turnouts to allow transit vehicles to alight without blocking the bike lane.
7. Asphalt at bus stops tend to degrade over time due to increased loading from buses. Damaged and sunken asphalt can generate water ponding and create an impediment to bicycle travel. PCC bus pads should be considered to reduce asphalt buckling and/or pushing at the bus stop location.



1 **BOARDING PLATFORM**
MUST AT MINIMUM SPAN FROM THE FRONT DOOR TO THE REAR DOOR, AND MAY BE EXTENDED TO MEET CAPACITY DEMANDS.

2 **BICYCLE LANE**
BEHIND THE FLOATING BOARDING ISLAND CAN BE AT STREET GRADE OR MAY BE RAISED. WHERE THE BIKE LANE CHANGES GRADE, BICYCLE RAMPS SHOULD NOT EXCEED A 1:8 SLOPE. IF RAISED, DELINEATE BIKE AND PEDESTRIAN REALMS USING COLORED PAINT OR PAVING MATERIALS.

3 **MARK PEDESTRIAN CROSSINGS**
THROUGH BIKE LANE. YIELD TEETH AND OTHER MARKINGS AND SIGNS SUCH AS YIELD STENCILS AND BIKES YIELD TO PEDESTRIANS (MUTCD R9-6) SIGNS INFORM BICYCLISTS OF THE REQUIREMENT TO YIELD TO PEDESTRIANS.

Chapter 14
Bicycle Amenities

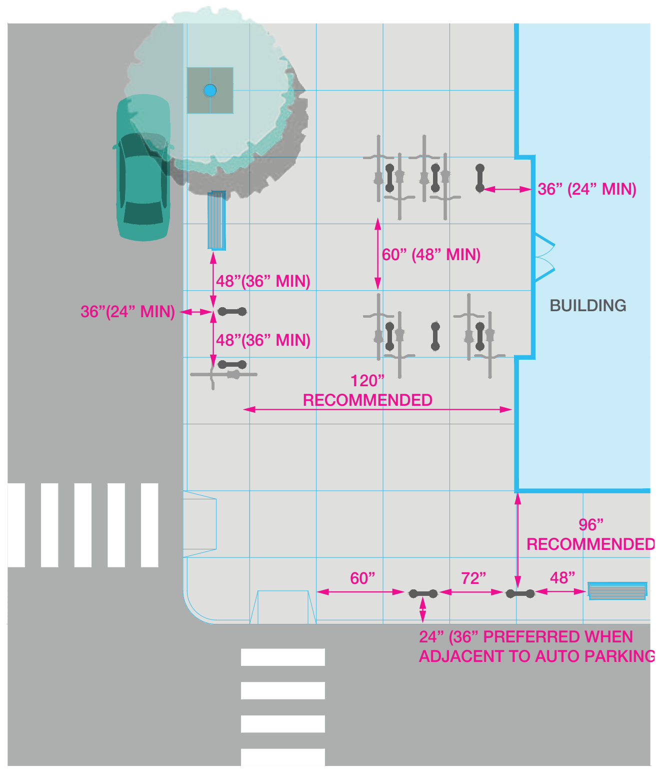
Features of a Bicycle Friendly Community include amenities conveniently located along key bicycle routes and at end of trip destinations. These amenities may include quality bicycle parking, access to showers and lockers, either at worksites or local gyms, repair stations, plentiful access to clean drinking water, and wayfinding signing.

14.1 Short-Term Bicycle Parking

As a bicycle network expands, the need for end of trip amenities increases including bicycle parking. Bicycle parking is categorized as either short-term or long-term. Short-term parking is used at shopping centers and similar land uses and can be installed in conjunction with long-term bicycle parking at train and transit stations, work sites, and schools. Short-term bicycle parking racks provide support for the bicycle and allow for two or more points of contact for typical U-lock security. Bicycle parking facilities should be provided at other public destinations, including government buildings, community centers, and parks. Bicycle parking should be in a safe, secure area and highly visible. Bicycle parking on sidewalks in commercial areas should be provided and may include decorative features to match the adjacent businesses. Temporary bike parking can include E-bike charging stations. Businesses can benefit by offering this amenity to their customers.

Design Guidance

1. Bicycle racks should support the frame in two places which also allows one or both wheels to be secured.
2. Racks should be installed with enough room between adjacent parked bicycles.
3. Racks should be installed in areas of good lighting, as close to the front entrance of the building it is serving, and if possible, in a covered area to provide weather protection.
4. Racks should not impede the path of visually challenged pedestrians and meet all Americans with Disabilities Act (ADA) requirements.
5. Standalone staple or inverted U-shaped racks are preferred.
6. Agencies may consider “decorative” bike racks that highlight adjacent businesses or promote overall bicycle program.



NOTES

1. WHEN INSTALLING SIDEWALK RACKS, MAINTAIN THE PEDESTRIAN THROUGH ZONE. RACKS SHOULD BE PLACED IN LINE WITH EXISTING SIDEWALK OBSTRUCTIONS TO MAINTAIN A CLEAR LINE OF TRAVEL FOR ALL SIDEWALKS USERS.
2. SIDEWALK RACKS ADJACENT TO ON-STREET AUTO PARKING SHOULD BE PLACED BETWEEN PARKING STALLS TO AVOID CONFLICTS WITH OPENING CAR DOORS.

Bicycle Parking - Del Mar Community Center

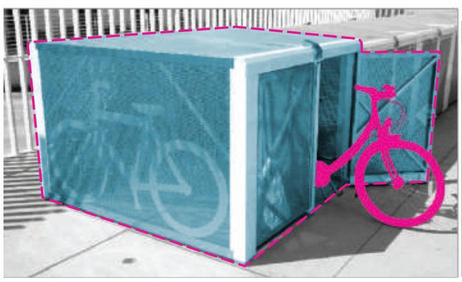
14.2 Long Term Bicycle Parking

Long-term parking is an end of trip amenity that provides for the security of bicycles for extended periods of time. Most long-term parking is accomplished with bike lockers or designated bike rooms located inside a building.

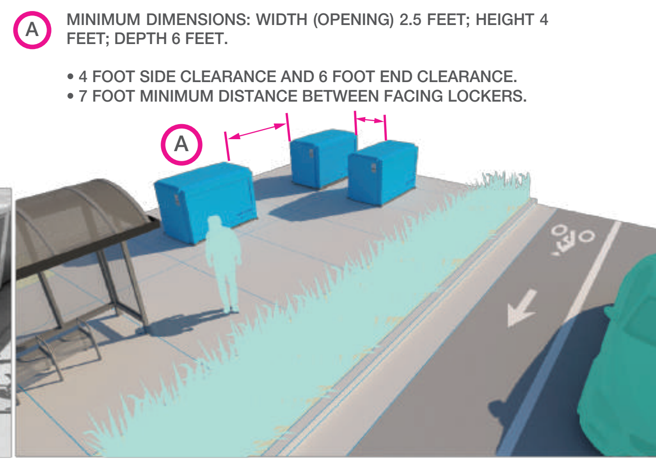
Bicyclists are usually more comfortable storing their bicycles in lockers for long periods because they offer increased security and protection from the weather. Lockers can be accessed with traditional key systems or through subscription services.

Long-term bicycle parking facilities provide a valuable incentive to encourage commuting by bicycle for both students and employees. Long term parking is also used at train and bus stations for storing bicycles used for completing the "last mile" to work or home. Long-term parking is normally installed in well-lit and well-traveled areas.

Long-term parking locations can also be enhanced with bicycle fix it stations, an air pump, and bicycle part vending machines.



BICYCLE LOCKER



BICYCLE LOCKER PLACEMENT

Indoor Bicycle Parking Room

14.3 Bike Corrals

In commercial areas, demand for bicycle parking can often exceed available sidewalk space. To accommodate the additional demand, one design solution is the Bicycle Corral.

Bicycle Corrals are a gathering of bike racks installed in a traditional vehicle parking space. The area of one parking space can provide parking for up to 12 bicycles.

Bike Corrals

Design Guidance

1. Bicycles should have a roadway entry width of 6-FT.
2. Typical dimensions of a Bicycle Corral would be 8-FT wide and 20-FT to 25-FT long.
3. Bicycle parking can be oriented either perpendicular to the curb face or at an angle of 45 or 60 degrees. Racks should be installed 3-FT apart and 30-inches from the curb face.
4. Location of a Bicycle Corral should be as close to an entrance and near multiple commercial destinations such as coffee shops and outdoor cafes.
5. The boundary area for the Bicycle Corral parking should be designated with markings and delineators such as bollards, planters, short metal fencing, or parking bumpers.
6. Bicycle Corrals can be installed in conjunction with a curb extension to provide an enhanced buffer from adjacent street traffic.
7. Bicycle Corrals must be cleaned by hand as a street sweeper will not be able to access the area.
8. A practical application of Bike Corrals is their installation in conjunction with outdoor dining decks/parklets. The Bike Corral substantially expands the parking capability for the restaurant using minimal space.

14.4 Water Bottle Filling Stations

Access to free drinking water is an essential component of any bicycle network. Standard drinking fountains found in public places often lack the flow to quickly fill a typical water bottle or hydration pack bladder.

Agencies are augmenting their parks and other public places by adding water bottle filling stations to work with all types of water bottles and hydration bladders.

These stations provide great community benefit by not only adding improved access to drinking water but also help eliminate plastic bottle waste.

Water Bottle Filing Station Included with Standard Drinking Fountain - CV Link

Design Guidance

1. Water bottle filling stations should be added to trailheads, parks, and other public places along the route.
2. The stations can be stand alone for bottle specific or be combined with regular drinking fountains as a community amenity.
3. Area around the filling station should be concrete and meet standard ADA requirements.

14.5 Wayfinding Signs

Wayfinding signage is an important part of the bicycle network. Implementing a well-planned and attractive system of signage can greatly enhance bikeway facilities.

The opportunity for people on bikes to navigate to key destinations is typically by street names, monuments, and other cues.

Wayfinding signs along key routes typically indicate direction of travel and the distance/travel time to destinations. The use of wayfinding signing helps people on bikes to become familiar with the bicycle network, make decisions on travel time, and decrease anxiety about remaining on course.

Signage can also assist users to navigate toward major bikeways, transit hubs, or other recreational trails. Wayfinding signing can help bicyclists avoid difficult and undesirable road scenarios, like steep terrain, busy intersections, and major highway crossings.

Design Guidance

1. Wayfinding signing may include mile-markers, route identification, key destinations, and informational kiosks. Destinations should be limited to three per pole.
2. Signs should be placed conspicuously along each route providing confirmation to the cyclist that they remain on route.
3. The signage should include turn signs indicating where a bike route turns from one street to another. Sign text should be large enough to be read by passing cyclists, usually with a minimum text height of 2-inch, FHWA 2000 C Series font.
4. The CAMUTCD defines standards for these route network signs.
5. Signs are placed at decision points along bicycle routes typically at key locations leading to and along bicycle routes and at the intersection of two or more bikeways.

Wayfinding Signage

6. Typical sign placement is approximately every ½ mile on off-street facilities and every 500-FT to 1,000-FT along on-street bicycle facilities.
7. Pavement markings can supplement the signing to confirm a bicyclist is on a route.

14.6 Stairway Bicycle Ramps

A bicycle stairway channel, also known as a "runnel," can often been seen at transit stations and other public stairways adjacent to bicycle infrastructure. The ramps are straight and usually adjacent to a stairway on both sides so people can go up and down without having to lift and carry their bikes. These bicycle ramps are particular helpful for E-Bikes which are heavier than traditional bicycles. Independent metal ramps can be installed to provide for additional separation of handlebars and stairway handrails. Although bicycle ramps enhance access, they should not be considered part of a major bike route.

Stair way / Channel

14.7 Bicycle Repair Stations

Bicycle Repair Stations provide an opportunity for riders to make minor adjustments to their bicycle including changing a tire, adjusting brakes and derailleurs, and other repairs. The stations feature an air pump, tools, and a mount so riders can securely hang a bike.

The stations are typically installed in secure parking areas, at trailheads, and other locations of high bicycling activity. Stations should be located with enough area to hang and work on the bike and not impede surrounding pedestrian traffic. The location should be highly visible and include adequate lighting to reduce vandalism and allow repairs to be made during night time conditions.

Bicycle Repair Station

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Chapter 15
Bicycle Friendly Communities

15.1 Bicycle Friendly Communities

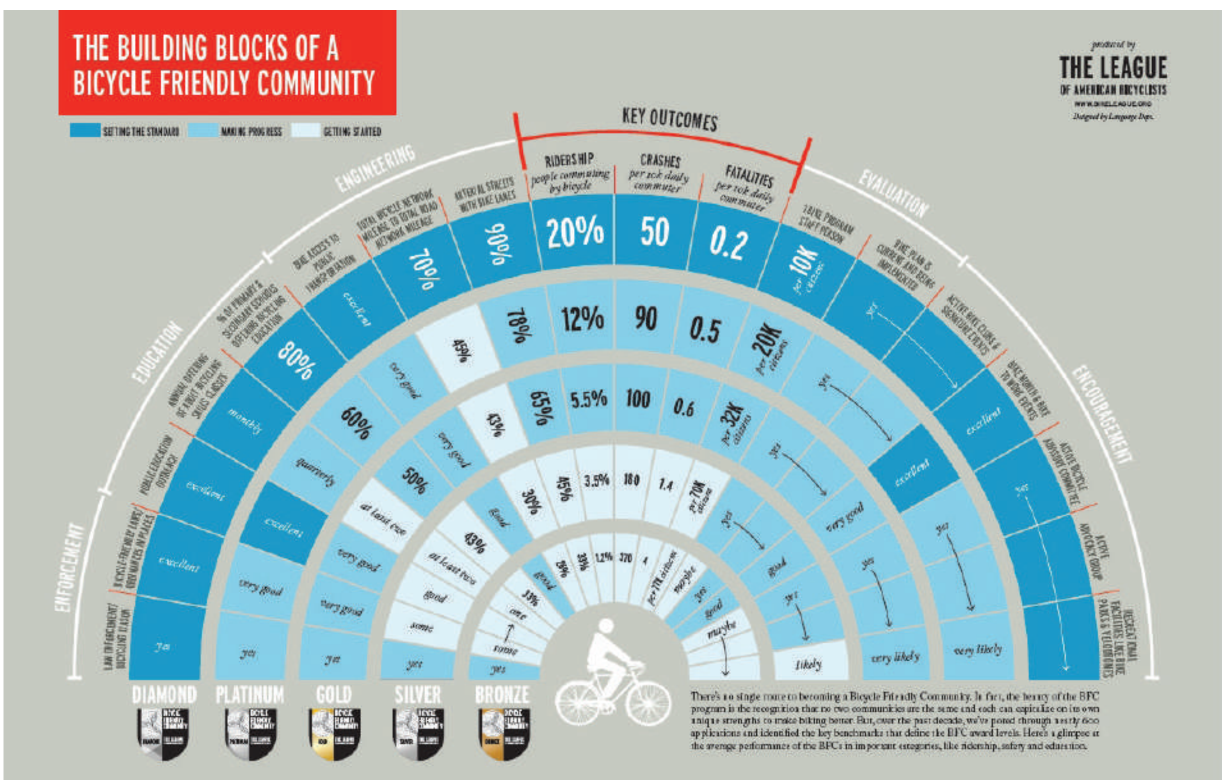
Bicycle Friendly Communities improve public health and air quality, reduce traffic congestion, and improve the quality of life for their residents. The League of American Bicyclists ranks Bicycle Friendly Communities through a self-application process that occurs two times a year. Agencies can use these rankings to judge how they compare in terms of infrastructure and applied best practices.

The rankings consider the **5 "E"'s** (Engineering, Education, Encouragement, Enforcement, and Evaluation/Planning).

Most notable qualities of Bicycle Friendly Communities from an engineering perspective are:

1. Using standards that meet or exceed national guidance.
2. Creating a safe, well-maintained, and connected network.
3. Developing bicycle facilities, including intersections, that best fit the context of the roadway corridor and surrounding community.

The figure below shows the steps that agencies can use to build a Bicycle Friendly Community.



Information graphic on building a Bicycle Friendly Community

More information is available at bikeleague.org/content/communities

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Chapter 16
Example Projects

Crossley Road - Road Diet
City of Palm Springs

Crossley Road is a designated Secondary Highway per the City's General Plan Circulation Element. Typical right of way is 88-FT with a curb-to-curb width of 64-FT. In 2016, as part of the Palm Springs Bicycle Route Plan, the City identified the roadway segment from Ramon Road to 34th Avenue for a potential "Road Diet." The modification provides for one through travel lane in each direction, a two-way left turn lane, parking on both sides, and Buffered Class II Bike Lanes.

Road Diets are usually successful on roads carrying fewer than 15,000 vehicles per day. Road Diets can be implemented successfully on roadways that carry higher volumes. However, further peak hour analysis and impacts to existing intersection traffic control should be reviewed. Existing volumes on Crossley Road are approximately 8,400 ADT and 2035 projected volumes are less than 11,000 ADT. Crossley Road is an ideal candidate for a Road Diet, allowing space reallocation for parking and active transportation uses.

La Quinta Village – Complete Streets Project

City of La Quinta

As part of an Active Transportation Program grant, the City of La Quinta Complete Streets project in the Village and Cove area constructed five roundabouts, buffered bike lanes / golf cart path, high visibility mid-block crossings, and implemented road diets on Calle Tampico, Calle Sinaloa, and Eisenhower Drive.

Per the City's General Plan Circulation Element, the three roadways are designated as Primary Arterials with 108-FT of right-of-way, curb-to-curb width of 78-FT, and a raised center median. Traffic volumes on the roadways averaged between 12,000 to 16,000 ADT. With the higher traffic volumes, the roundabouts provided for continuous traffic flows thereby avoiding traffic signal modifications and intersection widening to maintain Level of Service.

Project cost was approximately $13.5 million and substantially improved safety and mobility for pedestrians, bicyclists, and golf carts traveling to Civic Center Park, Old Town La Quinta, and Benjamin Franklin Elementary School.

Downtown Palm Canyon Drive Corridor Project
City of Palm Springs

This project provided for pedestrian and bicycle safety enhancements at eleven signalized Intersections along the Downtown Palm Canyon Drive Corridor. Palm Canyon Drive is a main commercial corridor and is designated as a Major Thoroughfare (4-Lane divided) with 88-FT of right of way and a curb-to-curb width of 64-FT. Traffic volumes range from 8,000 to 13,000 ADT.

The project provided for curb extensions, Leading Pedestrian Intervals (LPI), protected left-turn signal phasing, green backed shared lane markings (sharrows), countdown timers, Accessible Pedestrian Signals (APS), high visibility Continental style crosswalks, all-way pedestrian scramble crosswalks, and reduced travel lanes.

Th project, at a cost of approximately $2 million, greatly enhanced active transportation safety and mobility throughout the corridor with increased pedestrian visibility at intersections, less vehicle and pedestrian conflicts, shorter pedestrian crossing distances, reduced roadway speeds, enhanced visibility of cyclists, and improved access for visually challenged walkers.