

NAPA COUNTYWIDE ACTIVE TRANSPORTATION PLAN TREATMENT TOOLKIT

JANUARY 2025 PUBLIC DRAFT



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INTRODUCTION

The purpose of this Toolkit is to provide best practice guidance to engineers, planners, and community members. This Toolkit introduces bicycle and pedestrian facility treatments, providing an overview, engineering guidance, and additional contextual considerations for each treatment. The Toolkit is not comprehensive nor intended to take the place of design standards prepared by local agencies, Caltrans, or any other entity.

The content in this Toolkit aligns with the following key principles:

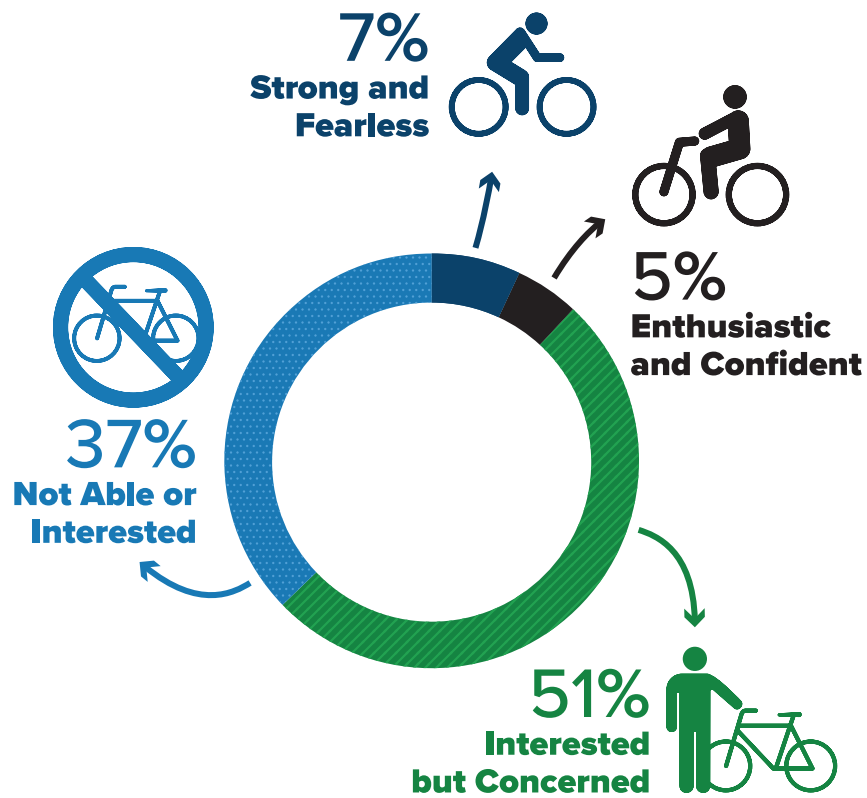
- + The bicycling and walking networks should accommodate people of all ages and abilities.**
- + Bicycle travel on all streets should be safe, continuous, direct, and convenient.**
- + The pedestrian network should not only be safe, but also attractive and dignified, and account for the fact that we are all pedestrians at some point of every trip.**

BICYCLE FACILITIES



1

POTENTIAL BICYCLE USERS



Types of Bicyclists

Many factors contribute to whether people will choose to ride a bicycle for utilitarian trips like commuting to work or school, or running errands. Two of the primary considerations are safety and comfort. Research has found that most of the American population is interested in bicycling for transportation but does not currently do so because they feel unsafe or uncomfortable. In fact, most people in the U.S. have little tolerance for interacting with motor vehicle traffic unless volumes and speeds are very low. This group is referred to as “Interested but Concerned” bicyclists, reflecting both their interest in bicycling for transportation as well as concerns about safety and comfort when interacting with motor vehicle traffic.

Interested but Concerned bicyclists feel safest and most comfortable riding on low-traffic, low-speed streets or on separate paths or other facilities that provide protection or physical separation from fast-moving traffic. Interested but Concerned bicyclists include people of all ages and abilities, including but not limited to disabled users, older adults, and families. The Napa Active Transportation Plan recommends facilities that are comfortable for Interested but Concerned bicyclists, which serves Enthusiastic and Confident bicyclists, as well.

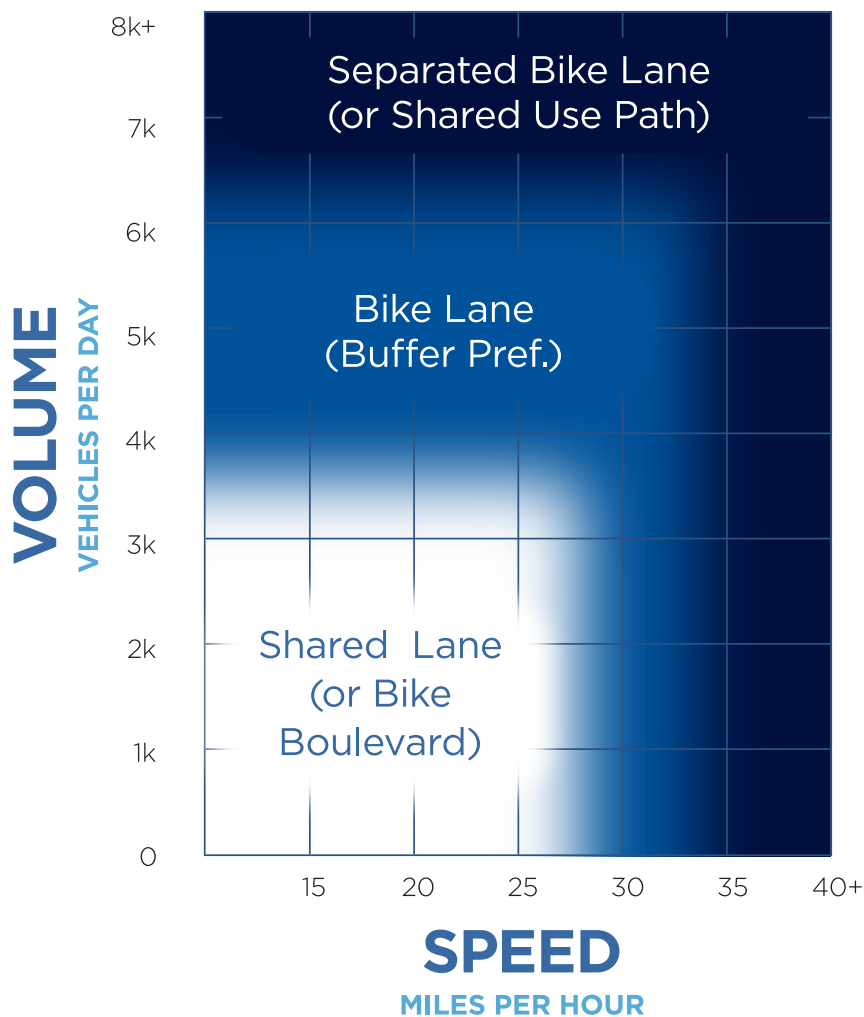
Dill, J. McNeil, N. “Revisiting the Four Types of Cyclists: Findings from a National Survey” Transportation Research Board 95th Annual Meeting, 2016.

BICYCLE FACILITY SELECTION

Designing for Interested but Concerned Bicyclists

Interested but Concerned bicyclists prefer physical separation between the bike lane and vehicle lane as traffic volumes and speeds increase. The bikeway facility selection chart below identifies preferred bikeway facilities for Interested but Concerned bicyclists at different roadway speeds and traffic volumes. Transitions are based on a shift in the 2010 Highway Capacity Manual (HCM 2010) bicycle level of service from A to B (assuming no parking, 12' outside travel lane, 6' bike lane, 8' buffered bike lane), or a C to D transition with on-street parking (8' parking lane). Speed thresholds (which refer to posted speed) are based on bicycle level of traffic stress.

Where the preferred bikeway facility may not be feasible, consider reducing posted speed limit and/or installing traffic calming features to reduce roadway speed or volumes in order match the bicycle facility to road conditions.



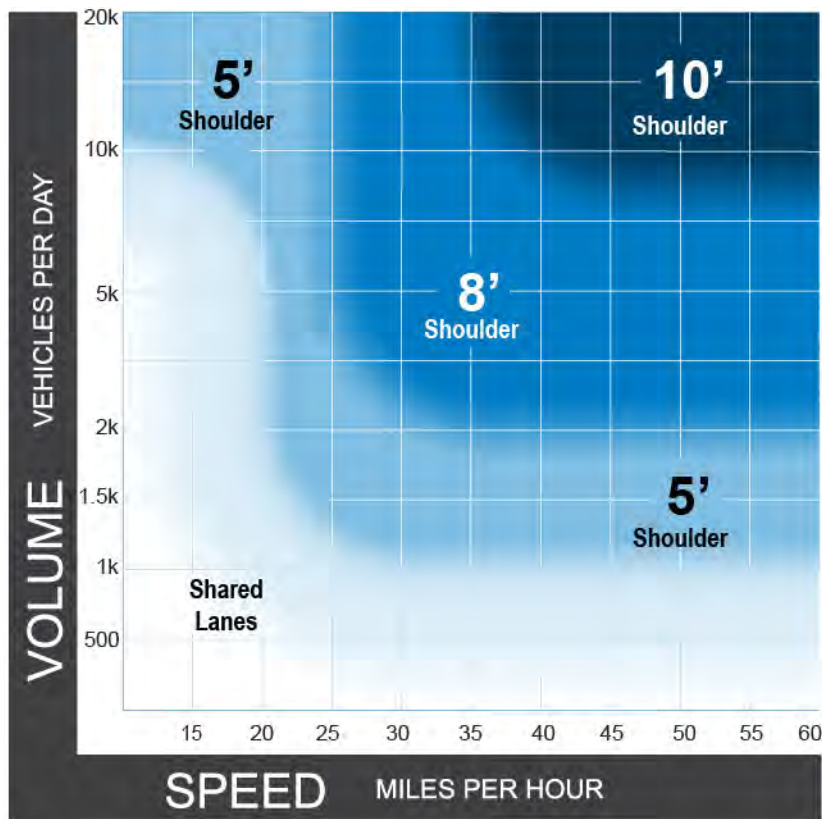
REFERENCES

AASHTO. *Guide for the Development of Bicycle Facilities*. 2024.

BICYCLE FACILITY SELECTION

Shoulder Widths for Rural Roadways

In rural areas, shoulders are often provided instead of more robust bicycle facilities. Shoulder width should be based on traffic volumes and posted speeds in the rural context. For the purposes of determining the appropriate shoulder width, it is assumed that posted speeds are approximately the same as operating speeds. If operating speeds differ from posted speeds, then operating speed should be used instead of posted speed.



Notes

- 1 This chart assumes the project involves reconstruction or retrofit in constrained conditions. For new construction, follow recommended shoulder widths in the AASHTO Green Book.
- 2 A separated shared use pathway is a suitable alternative to providing paved shoulders.
- 3 Chart assumes operating speeds are similar to posted speeds. If they differ, use operating speed rather than posted speed.
- 4 If the percentage of heavy vehicles is greater than 10%, consider providing a wide shoulder or a separated pathway.

Source: AASHTO Guide for the Development of Bicycle Facilities, 5th Edition, 2024

AASHTO. Guide for the Development of Bicycle Facilities. 2024.

SHARED-USE PATHS (CLASS I)



CONSIDERATIONS

- + Shared-use paths are appropriate when an on-street route may be perceived as unsafe due to the speed of the road, the majority of users are recreational or leisure users, or to provide a direct route between points of interest.
- + Shared-use paths typically have a lower design speed for bicyclists than on-street facilities and may not provide appropriate accommodation for more confident bicyclists who desire to travel at greater speeds. In some situations it may be appropriate to provide an on-street bikeway in addition to a shared-use path along the same roadway.
- + Path width should be informed by the number and type of users, and the differences in their speeds. For example, a path used by higher-speed bicyclists and children walking to school may experience conflicts due to the difference in user speeds. Additional user types like roller bladers, skateboarders, and dog walkers can introduce similar conflicts. By widening the path to provide space to accommodate passing, conflicts can be reduced.
- + A path may benefit from the separation of users by user speed, type, or direction. When separating users, consider the path width and paving material preferred by each user.
- + Shared-use paths may present increased conflicts between path users and motor vehicles at intersections and driveway crossings. Conflicts can be reduced by minimizing the number of driveway and street crossings present along a path and otherwise providing high-visibility crossing treatments.
- + Path clearances are an important element in path design and reducing user conflicts. Vertical objects should be set back at least two feet from the edge of the path. Path shoulders may also reduce conflicts by providing space for users who step off the path to rest, allowing users to pass one another, or providing space for viewpoints.
- + **Paths** on grades greater than 3 to 5 percent should be wider to account for higher bicycle speed in the downhill direction and additional space for faster bicyclists to pass slower bicyclists and pedestrians in the uphill direction.
- + On sections with long steep grades, provide periodic sections with a flat grade to permit users to stop and rest.
- + Consider providing amenities such as restrooms, bike racks, and portable water at trailheads, and covered rest stops along the trail to ensure that paths are welcoming to a variety of user types, including families with children and seniors.
- + Consider providing maps and signs to improve wayfinding for users, such as signs that show trail names, connections to nearby trails, and/or nearby destinations.

REFERENCES

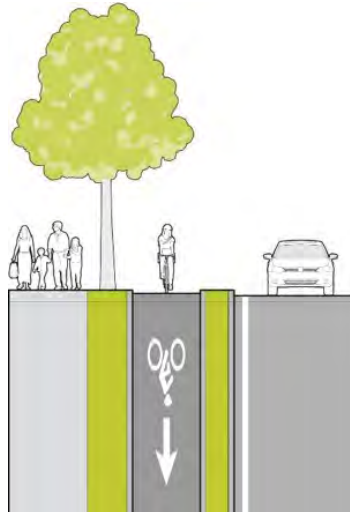
- AASHTO. Guide for the Development of Bicycle Facilities. 2024.*
- Caltrans. Highway Design Manual. 2020.*
- Caltrans. DIB-94: Complete Streets Contextual Design Guidance. 2024.*
- FHWA. Achieving Multimodal Networks. 2016.*

SEPARATED BIKE LANES (CLASS IV)

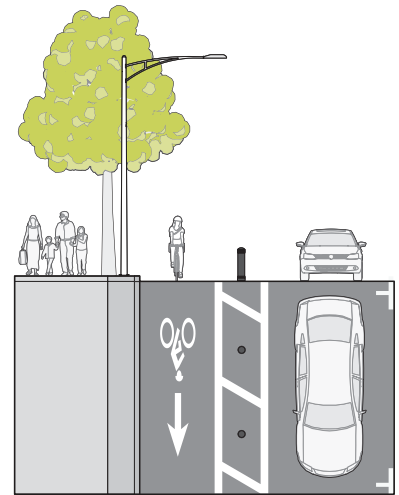
Separated bike lanes are a dedicated bikeway facility type that combines the user experience of a shared-use path with the on-street infrastructure of a conventional bike lane. They are physically separated from motor vehicle traffic and distinct from the sidewalk. Separated bike lanes can be constructed at sidewalk grade, roadway grade, or an intermediate grade between the sidewalk and street. Separated bike lanes can be designed to serve one-way bicyclist traffic or two-way bicyclist traffic.



One-way sidewalk-level separated bike lane



One-way intermediate-level separated bike lane



One-way, street-level separated bike lane with bollards

GUIDANCE

- + Separated bike lanes should be considered on any road with one or more of the following characteristics:
 - + Traffic lanes: 3 lanes or greater
 - + Posted speed limit: 30 mph or more
 - + Traffic: 6,000 vehicles per day or greater
 - + On-Street parking turnover: frequent
 - + Streets that are designated as truck or bus routes
- + One-way separated bike lanes should be 5' wide minimum but widths of 7' are preferred to allow for passing.
- + Buffer width may vary depending on type of vertical separation used, but typically is 3' wide. If adjacent to on-street parking, a minimum 3'-wide buffer is required.

CONSIDERATIONS

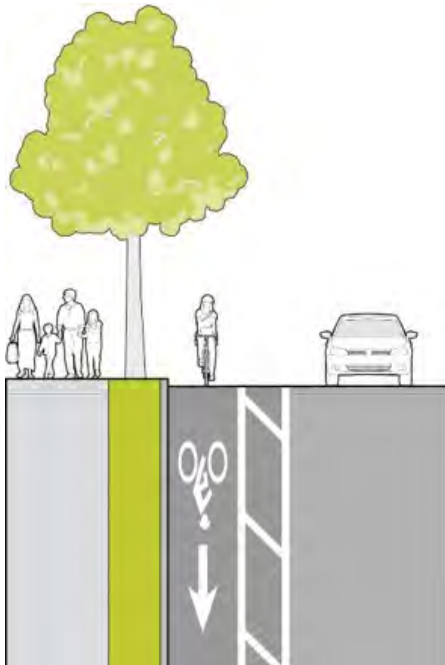
- + Separated bike lanes are preferred over shared-use paths in higher density areas, commercial and mixed-use development, and near major transit stations or locations where pedestrian volumes are anticipated to exceed 200 people per hour on a shared use path.
- + Separated bike lanes are more attractive to a wider range of bicyclists than striped bikeways on higher volume and higher speed roads since they are designed to prevent motor vehicles from driving or waiting in the bikeway. They also provide greater comfort to pedestrians by separating them from bicyclists operating at higher speeds.
- + Choice of one- or two-way facility should be based on connectivity, bicyclist desire lines, roadway configuration, and potential intersection conflicts. Generally, one-way facilities are preferred.
- + The allocation of space can vary from midblock locations to intersection approaches. Providing a larger street buffer at intersections can be achieved by tapering the bike lane toward the sidewalk as it approaches the intersection and narrowing or eliminating the sidewalk buffer.
- + See Driveways section in Chapter 5 for details on how to address driveway crossings.

REFERENCES

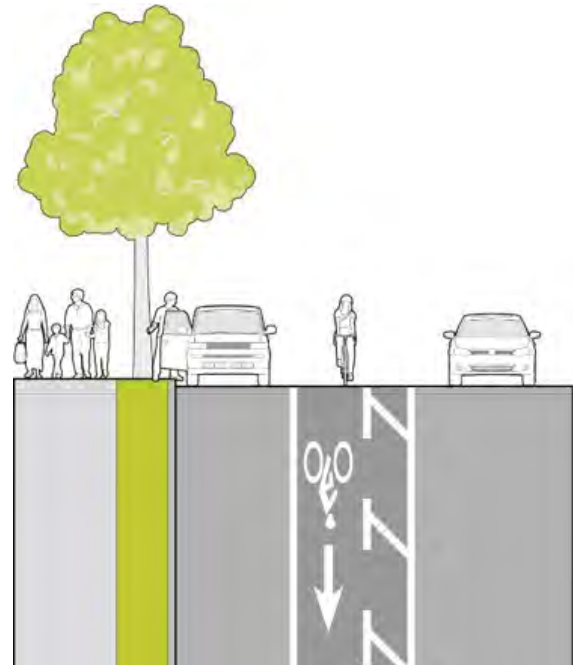
- AASHTO. *Guide for the Development of Bicycle Facilities*. 2024.
- Caltrans. *DIB 89-02: Class IV Bikeway Guidance (Separated Bikeways/Cycle Tracks)*. 2022.
- Caltrans. *DIB-94: Complete Streets Contextual Design Guidance*. 2024.
- FHWA. *Separated Bike Lane Planning and Design Guide*. 2015.
- NACTO. *Urban Bikeway Design Guide*. 2014.

BUFFERED BIKE LANES (CLASS II)

Buffered bike lanes are created by painting a buffer zone between the bike lane and the adjacent travel lane. While buffers are typically used between bike lanes and motor vehicle travel lanes to increase bicyclists' comfort, they can also be provided between bike lanes and parking lanes in locations with high parking turnover to discourage bicyclists from riding too close to parked vehicles.



Buffered bike lane adjacent to a curb



Buffered bike lane adjacent to parking

GUIDANCE

- + Place buffered or unbuffered bike lanes next to travel lane where speeds are 30 mph or slower and when traffic volume are fewer than 6,000 vehicles per day.
- + Bike lanes must be a minimum of 4' wide, excluding gutter pan width, but ideally should be 5-6' wide, plus an 2' minimum (or 3' minimum, if next to parking) painted buffer.

CONSIDERATIONS

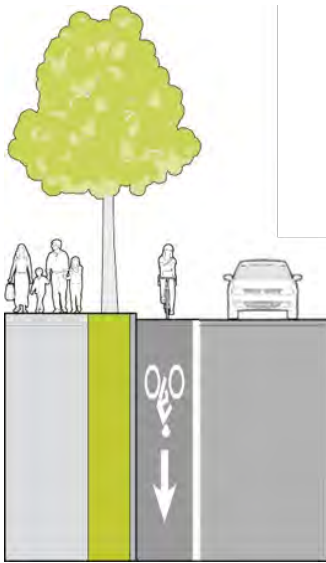
- + Can be used on one-way or two-way streets.
- + Consider placing buffer next to parking lane where there is commercial or metered parking.
- + When 7' of pavement width is available, consider providing a 5-foot bike lane with a 2-foot buffer.
- + Buffered bike lanes allow bicyclists to ride side by side or to pass slower moving bicyclists. A larger buffer and/or bike lane is acceptable in cases where sufficient/excess pavement width is available.
- + Preferable to a conventional bike lanes when used as a contra-flow bike lane on one-way streets.
- + As noted in the Bicycle Facility Selection section earlier in this chapter, where the preferred bikeway facility may not be feasible (such as a street with a posted speed greater than 30 mph and existing Class II bike lanes that cannot accommodate Class IV separated bike lanes), consider reducing the posted speed limit, consistent with state law, and/or installing traffic calming features to reduce roadway speed or volumes in order match the bicycle facility to road conditions. In this example, enhancing the existing bike lanes to Class II buffered bike lanes can be paired with reducing the posted speed limit to 30 mph.

REFERENCES

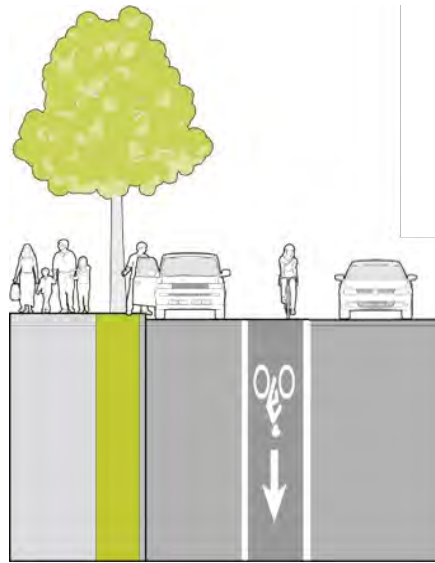
- AASHTO. *Guide for the Development of Bicycle Facilities*. 2024.
- Caltrans. *DIB-94: Complete Streets Contextual Design Guidance*. 2024.
- NACTO. *Urban Bikeway Design Guide*. 2014.

BIKE LANES (CLASS II)

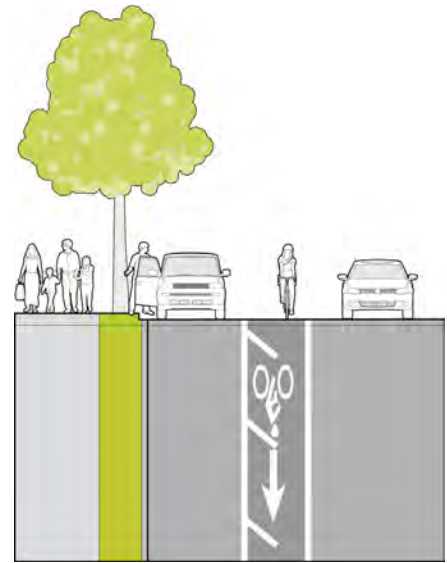
Bike lanes provide an exclusive space for bicyclists in the roadway. Bike lanes are established through the use of lines and symbols on the roadway surface. Bike lanes are for one-way travel and are normally provided in both directions on two-way streets or on one side of a one-way street. Bicyclists are not required to remain in a bike lane when traveling on a street and may leave the bike lane as necessary to make turns, pass other bicyclists, or to properly position themselves for other necessary movements.



Bike lane adjacent to a curb



Bike lane adjacent to parking



Bike lane with door zone marking

GUIDANCE

- + Place bike lanes next to travel lane where speeds are 25 mph or slower and when traffic volume are fewer than 6,000 vehicles per day.
- + Bike lanes must be a minimum of 4' wide, excluding gutter pan width, but ideally should be 5-6' wide. When adjacent to on-street parking, bike lanes should be a minimum of 5' wide.
- + Parking T's or hatch marks can highlight the door zone on constrained corridors with high parking turnover to guide bicyclists away from doors. (See rightmost graphic above.)

CONSIDERATIONS

- + Can be used on one-way or two-way streets.
- + Bike lanes may be enhanced with consistent use of conflict area striping, preferably with green-colored pavement, including right turn lanes & major driveways. More details can be found in the "Bikeway Intersection and Spot Treatments" section.
- + Word/Symbol markings should be applied before & after intersections.
- + Stopping, standing and parking in bike lanes may be problematic in areas of high parking demand and deliveries, especially in commercial areas. Use of sign R7-9 (or R7-9a) and/or red curbs may be used to discourage parking in bike lanes.
- + Wider bike lanes or buffered bike lanes are preferable at locations with high parking turnover.

REFERENCES

- AASHTO. *Guide for the Development of Bicycle Facilities*. 2024.
- Caltrans. *DIB-94: Complete Streets Contextual Design Guidance*. 2024.
- NACTO. *Urban Bikeway Design Guide*. 2014.

BICYCLE BOULEVARD (CLASS III)

Bicycle boulevards are applied on quiet streets, often through residential neighborhoods. These treatments are designed to prioritize bicycle through-travel, while calming motor vehicle traffic and maintaining relatively low motor vehicle volumes. Treatments vary depending on context, but often include elements of traffic calming and measures to discourage cut-through traffic, including traffic diverters, speed attenuators such as speed humps or chicanes, pavement markings, and signs. Bicycle boulevards are also known as neighborhood greenways or neighborhood bikeways, among other locally-preferred terms.



GUIDANCE

- + Bicycle boulevards can generally be considered on any road with one or more of the following characteristics:
 - + Maximum Average Daily Traffic (ADT): 3,000
 - + Preferred ADT: up to 1,000
- + Target speeds for motor vehicle traffic are typically around 20-25 mph; there should be a maximum 15 mph speed differential between bicyclists and vehicles.
- + Bicycle boulevards feature regularly spaced traffic calming treatments to slow vehicles. See "Traffic Calming" section.
- + Refer to State Bill 1216 for new Class III bicycle facility requirements beginning January 1, 2025.

REFERENCES

- AASHTO. Guide for the Development of Bicycle Facilities. 2024.*
- Caltrans. DIB-94: Complete Streets Contextual Design Guidance. 2024.*
- Caltrans. Manual on Uniform Traffic Control Devices. 2014.*
- NACTO. Urban Bikeway Design Guide. 2014.*

CONSIDERATIONS

- + Many cities already have Class III bike routes along neighborhood streets that provide an alternative to traveling on high-volume, high-speed arterials. Applying bicycle boulevard treatments to these routes makes them more suitable for bicyclists of all abilities and can reduce crashes.
- + Stop signs or traffic signals (where possible and allowed by warrant) should be placed along the bicycle boulevard in a way that prioritizes the bicycle movement, minimizing stops and delays for bicyclists whenever possible.
- + Agencies may consider implementing bicycle boulevard treatments on one pilot corridor to measure the impacts and gain community support. The pilot program should include before-and-after crash studies, motor vehicle counts, and bicyclist counts on both the bicycle boulevard and parallel streets. Findings from the pilot program can be used to justify bicycle boulevard treatments on other neighborhood streets.
- + Additional treatments for major street crossings may be needed, such as median refuge islands, rectangular rapid flashing beacons, bicycle signals, or Pedestrian Hybrid Beacons.

URBAN BIKE ROUTES (CLASS III)

Urban bike routes are neighborhood streets where the travel lane is shared between bicyclists and motorists.



GUIDANCE

- + Urban bike routes can generally be considered on any road with one or more of the following characteristics:
 - + Maximum Average Daily Traffic (ADT): 3,000
 - + Preferred ADT: up to 1,000
 - + Posted speed limit of 25 mph or lower
- + Urban bike routes are typically designated with the BIKE ROUTE sign (D11-1), and may additionally include other signs, such as sign R4-11 (shown above, right) and pavement markings, such as sharrows (bike symbol with arrow; shown above, left).
- + Refer to State Bill 1216 for new Class III bicycle facility requirements beginning January 1, 2025.

CONSIDERATIONS

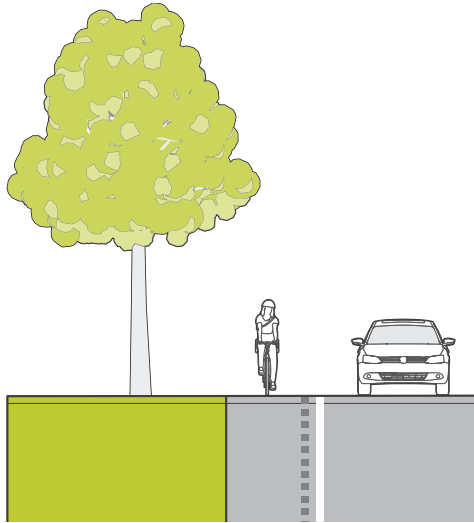
- + The BICYCLE warning sign (W11-1) or BICYCLES MAY USE FULL LANE sign (R4-11) may be used to provide an indication to motorists to expect bicyclists operating within the travel lane. The W11-1 sign may be supplemented with an IN LANE, ON ROAD, or ON ROADWAY plaque. A fluorescent yellow-green background may be used for these sign assemblies.
- + Signs W11-1 or R4-11 should be spaced every 1-2 miles. They should also be placed prior to approaches to curves, hills, or other places with limited sight distances.
- + Use of the SHARE THE ROAD sign (W16-1P) is not recommended as it does not provide a clear message to users.
- + California state law requires motorists to provide at least 3' clearance when passing bicyclists. The Bicycle Passing Clearance sign, R117(CA), may be used to specify this.

REFERENCES

- AASHTO. *Guide for the Development of Bicycle Facilities*. 2024.
- Caltrans. *Manual on Uniform Traffic Control Devices*. 2014.
- FHWA. *Achieving Multimodal Networks: Applying Design Flexibility and Reducing Conflicts*. 2016.

RURAL BICYCLE ROUTES (CLASS III)

Rural bike routes accommodate bicyclists on roadways without dedicated facilities, either on shoulders or by sharing the travel lane with vehicles. This type of facility is applicable in rural areas where dedicated bikeways either will not fit on the street or would not be appropriate given the surrounding context.



Shoulder with edge line rumble strip



GUIDANCE

- + Refer to State Bill 1216 for new Class III bicycle facility requirements beginning January 1, 2025.
- + Where present, shoulder width should be at least 5' if the roadway is curbless and there are no vertical obstructions. If curbs, gutter, or vertical obstructions are present, shoulder width should be 5' minimum exclusive of obstructions. See table on Page 8 for recommended shoulder width based on roadway speed and volume.
- + When posted speed limits or 85th percentile speeds exceed 50 mph and/or if heavy vehicles frequently use the road, shoulders should exceed minimum widths to enhance bicyclist comfort.
- + Edge line rumble strips can provide additional bicyclist protection on paved shoulders. The width of a shoulder with rumble strips should be measured from the rightmost side of the rumble strip. Periodic gaps should be provided to allow bicyclists to move across the strip pattern.

CONSIDERATIONS

- + On roads used by bicyclists that lack shoulders, the BICYCLE warning sign (W11-1) or BICYCLES MAY USE FULL LANE sign (R4-11) may be used. It may be supplemented with an IN LANE, ON ROAD, or ON ROADWAY plaque. A fluorescent yellow-green background may be used for these sign assemblies.
- + Signs W11-1 or R4-11 should be spaced every 1-2 miles. They should also be placed prior to approaches to curves, hills, or other places with limited sight distances.
- + The SHARE THE ROAD sign (W16-1P) is not recommended as it does not provide a clear message to users.
- + For roads that are unable to provide consistent and standard size bikeable shoulders in both directions, provide a wider shoulder on:
 - + The uphill direction on hilly roads to reduce conflicts between slow-moving bicyclists and fast-moving motor vehicles.
 - + The inside of a horizontal curve and/or the downgrade of a vertical curve where sight distance is restricted.
- + In rural areas, paved shoulders may provide space for pedestrians on roadways without sidewalks. In situations where a shoulder is intended for pedestrian use, it must meet Americans with Disabilities Act requirements.

REFERENCES

- AASHTO. *Guide for the Development of Bicycle Facilities*. 2024.
- Caltrans. *Manual on Uniform Traffic Control Devices*. 2014.
- FHWA. *Achieving Multimodal Networks: Applying Design Flexibility and Reducing Conflicts*. 2016.
- FHWA. *Small Town and Rural Multimodal Networks*. 2016.

UNCLASSIFIED BIKE ROUTES

Unclassified bike routes are rural roadways popular with recreational bicyclists that have no dedicated bike facilities and posted speeds of 35 mph or greater. The high posted speed limits preclude these roads from being Rural Bicycle Routes but the considerations below recognize that bicyclists use these roads.



CONSIDERATIONS

- + On roads used by bicyclists that lack shoulders, the BICYCLE warning sign (W11-1) or BICYCLES MAY USE FULL LANE sign (R4-11) may be used. It may be supplemented with an IN LANE, ON ROAD, or ON ROADWAY plaque. A fluorescent yellow-green background may be used for these sign assemblies.
- + Signs W11-1 or R4-11 should be spaced every 1-2 miles. They should also be placed prior to approaches to curves, hills, or other places with limited sight distances.
- + The SHARE THE ROAD sign (W16-1P) is not recommended as it does not provide a clear message to users.
- + California state law requires motorists to provide at least 3' clearance when passing bicyclists. The Bicycle Passing Clearance sign, R117(CA), may be used to specify this.
- + Speed reduction markings, ideally placed upstream of unexpected horizontal curves, may be particularly useful on rural roads with higher volumes of bicyclists. (See Speed Reduction Markings section in Chapter 6 for more information.)
- + Paved shoulders are particularly important for improving comfort and safety for bicyclists on roadways that meet any or all of the following conditions:
 - + Inadequate sight distances for the typical operating speed,
 - + Grades in excess of 5 percent, or
 - + High percentages (> 10 percent) of heavy vehicles.
- + When it is not possible to install paved shoulders on both sides of the roadway, climbing lanes (paved shoulders on one side of the roadway in the uphill direction) provide dedicated space for people to bicycle uphill allowing faster vehicular traffic to pass comfortably.
- + On roadway sections with vertical or horizontal curves that limit sight distance, it can be helpful to provide shoulders over the crest and on the downgrade of a vertical curve or on the inside of a horizontal curve.
- + Refuge areas are paved or unpaved locations adjacent to the roadway where bicyclists may pull over to stop for rest or allow traffic to pass. Refuge areas should have adequate visibility for bicyclists pulling in and out to avoid conflicts with moving traffic. It may also be necessary to restrict parking in refuge areas to ensure that parked vehicles do not inhibit the use of the space by bicyclists or create sight distance obstructions.

REFERENCES

- AASHTO. *Guide for the Development of Bicycle Facilities*. 2024.
- Caltrans. *Manual on Uniform Traffic Control Devices*. 2014.
- FHWA. *Small Town and Rural Multimodal Networks*. 2016.

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BIKEWAY INTERSECTION & SPOT TREATMENTS



2

BIKE BOXES

SINGLE

A bike box provides dedicated space between the crosswalk and vehicle stop line where bicyclists can wait in front of motor vehicles during the red light at signalized intersections. Bike boxes are primarily used to mitigate conflicts between through bicyclists and right-turning motorists and to reduce conflicts between motorists and bicyclists at the beginning of the green signal phase.



GUIDANCE

- + Bike boxes should be a minimum of 10 ft in depth and may be larger depending on anticipated bicyclist volumes.
- + The bike box should connect directly to the approaching bike lane. At least 50 ft of bike lane should be provided on the approach to a bike box so bicyclists will not need to ride between lanes to enter the box. The approaching bike lane, and the bike box, may be colored green.

CONSIDERATIONS

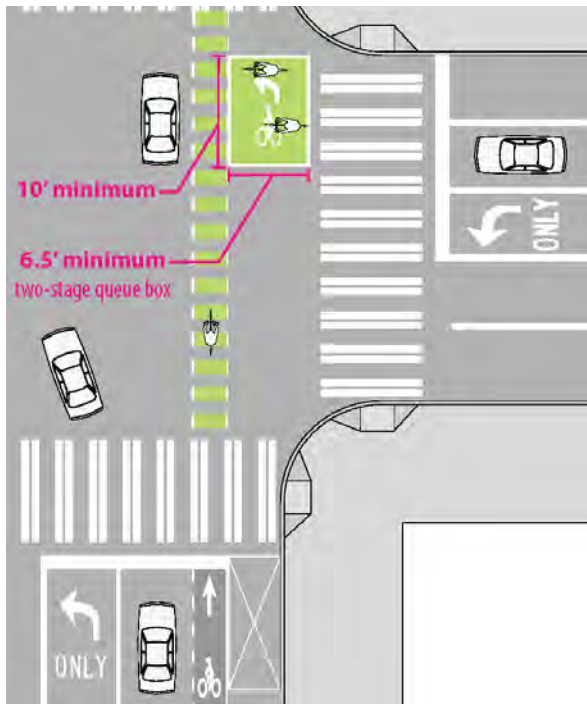
- + Install advance stop bar where crosswalk serves as limit line for existing facilities; also consider pavement marking or signage (such as MUTCD R10-6).
- + Applicable at signalized intersections with high bicycle or motor vehicle volumes, especially those with frequent bicyclist left turns and/or motorist right turns.
- + Recommended where a left turn is required to follow a designated bike route, access a shared-use path, or when the bicycle lane moves to the left side of the street.
- + When a bike box is implemented in front of a vehicle lane that previously allowed right turns on red, the right turn on red movement must be restricted using signage and enforcement once a bike box is installed.
- + A bicycle box should only extend across one travel lane. In limited situations, bike boxes may be used to facilitate left turns for bicycles when there is an unusually heavy left turn volume, such as near the entrance to a popular shared use path, although the preferred treatment for bicyclist left turns is a two-stage bicycle turn box.
- + See Bicycle Signals (Chapter 5) for use of dedicated bike signal or hybrid signal with advance green for bicycles.

REFERENCES

- FHWA. Separated Bike Lane Planning and Design Guide. 2015.*
- Caltrans. Manual on Uniform Traffic Control Devices. 2014.*
- NACTO. Urban Bikeway Design Guide. 2014.*

TWO-STAGE

A two-stage turn box designates a space for bicyclists to wait for traffic to clear before proceeding in a different direction of travel. Two-stage turn queue boxes may be used with any type of bicycle facility. A two-stage turn queue box should be considered where separated bike lanes are continued up to an intersection and a protected intersection is not provided.



GUIDANCE

- + A two-stage bicycle turn box:
 - + Must be located outside of the path of through and turning traffic.
 - + Should be located adjacent to the direct path of bicyclist travel.
 - + Should be located downstream of the crosswalk and downstream of the stop line.
 - + Must include a bicycle symbol oriented in the direction in which the bicyclists enter the box, along with an arrow showing the direction of the turn.
 - + May include green-colored pavement.

CONSIDERATIONS

- + Two stage turn boxes are applicable at locations where a left turn movement is expected by bicyclists.
- + A two-stage bicycle turn box may be used at signalized intersections per FHWA Interim Approval IA-20, though experimental approval from FHWA is required to use this pavement marking at unsignalized intersections.
- + May be used at any signalized intersection but are preferable on high-volume and multilane roads to reduce the need for bicyclist weaving across motor vehicle traffic.
- + Two-stage bicycle turn boxes should be placed in a logical location that aligns with the receiving bicycle facility. They can be placed in front of a through lane, in front of a turn lane, or entirely outside of a motor vehicle lane.
- + Dashed bike lane extension markings may be used to indicate the path of travel across the intersection.
- + A NO RIGHT TURN ON RED sign, R13-A(CA), must be installed where a two-stage turn queuing box is not located outside the path of right-turning traffic to prevent motorists from entering the bicycle queuing area.
- + Passive detection of bicycles in the two-stage bicycle turn box must be provided if detection is required to actuate a traffic signal.

REFERENCES

- AASHTO. *Guide for the Development of Bicycle Facilities*. 2024.
- Caltrans. *Manual on Uniform Traffic Control Devices*. 2014.
- FHWA. *Separated Bike Lane Planning and Design Guide*. 2015.
- NACTO. *Urban Bikeway Design Guide*. 2014.

PROTECTED INTERSECTIONS

Separated bike lanes provide an exclusive travel way for bicyclists alongside roadways that is separate from motor vehicle travel lanes, parking lanes, and sidewalks. Separated bike lane designs at intersections should manage conflicts with turning vehicles and increase visibility for all users.



GUIDANCE

- + Protected intersections have eight key elements, as noted in the above image.

CONSIDERATIONS

- + At major intersections where space is available, protected intersection designs are preferred because they are intuitive and comfortable, provide clear right-of-way assignment, promote predictability of movement, and allow eye contact between motorists, bicyclists, and pedestrians.
- + Where two-way separated bike lanes are installed on one side of the street, the contra-flow direction of bicycle travel introduces an unexpected movement at the intersection and requires more complex signal operations.
- + Corner refuge islands allow the bike lane to be physically separated up to the intersection crossing point where potential conflicts with turning motorists can be controlled more easily. They serve an important purpose in protecting the bicyclist from right-turning motor vehicle traffic.

REFERENCES

- AASHTO. *Guide for the Development of Bicycle Facilities*. 2024.
 FHWA. *Separated Bike Lane Planning and Design Guide*. 2015.
 NACTO. *Urban Bikeway Design Guide*. 2014.

MIXING ZONES

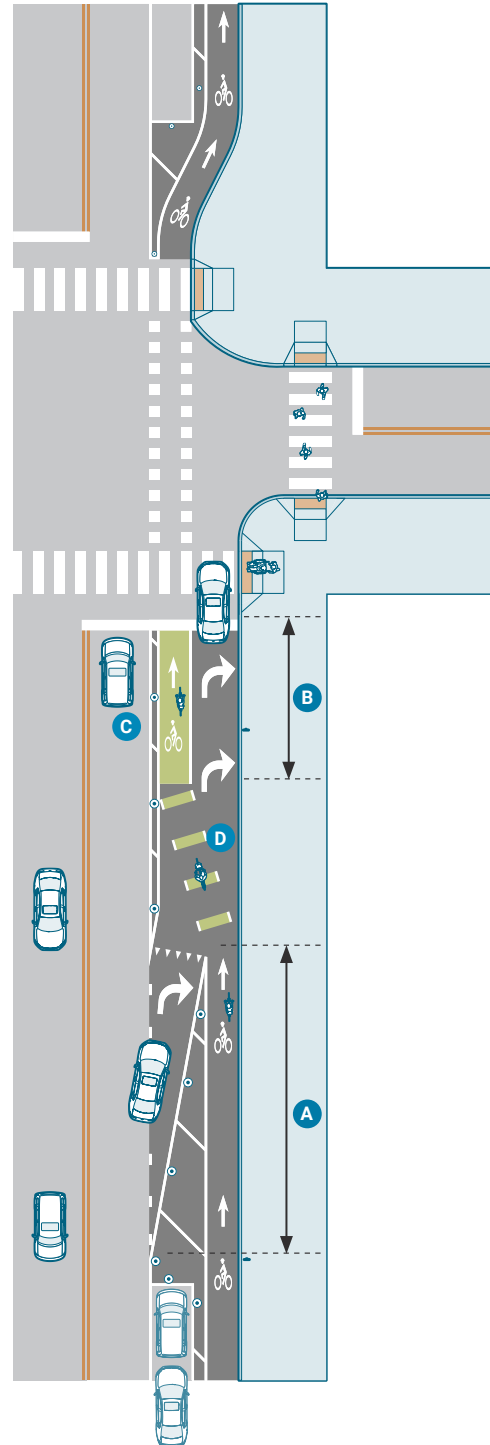
A mixing zone designates space for turning motorists to merge across a separated bike lane at a defined location in advance of an intersection. The mixing zone design limits bicyclists' exposure to motor vehicles by defining a limited merge area for the turning motorist. Mixing zones are compatible only with one-way bike lanes.

GUIDANCE

- A Locate merge points where the entering speeds of motor vehicles will be 20 mph or less by (a) minimizing the length of the merge area and (b) locating the merge point as close as practical to the intersection.
 - B Minimize the length of the storage portion of the turn lane
 - C Provide a buffer and physical separation (e.g. flexible delineator posts) from the adjacent through lane after the merge area, if feasible.
 - D Highlight the conflict area with green surface coloring and dashed bike lane markings, as necessary, or shared lane markings placed on a green box.
- + Provide a BEGIN RIGHT (or LEFT) TURN LANE YIELD TO BIKES sign (R4-4) at the beginning of the merge area.
 - + Restrict parking within the merge area

CONSIDERATIONS

- + At locations where raised separated bike lanes approach the intersection, the bike lane should transition to street elevation at the point where parking terminates.
- + Where posted speeds are 35 mph or higher, or at locations where it is necessary to provide additional storage for queued vehicles, it may be necessary to provide a deceleration/storage lane in advance of the merge point.
- + Protected intersections with phase separation between bicyclists and right-turning motorists are preferable to mixing zones. Mixing zones are generally appropriate as an interim solution or in situations where severe right-of-way constraints make it infeasible to provide a protected intersection.
- + Mixing zones are only appropriate on street segments with one-way separated bike lanes. They are not appropriate for two-way separated bike lanes due to the contra-flow bicycle movement.

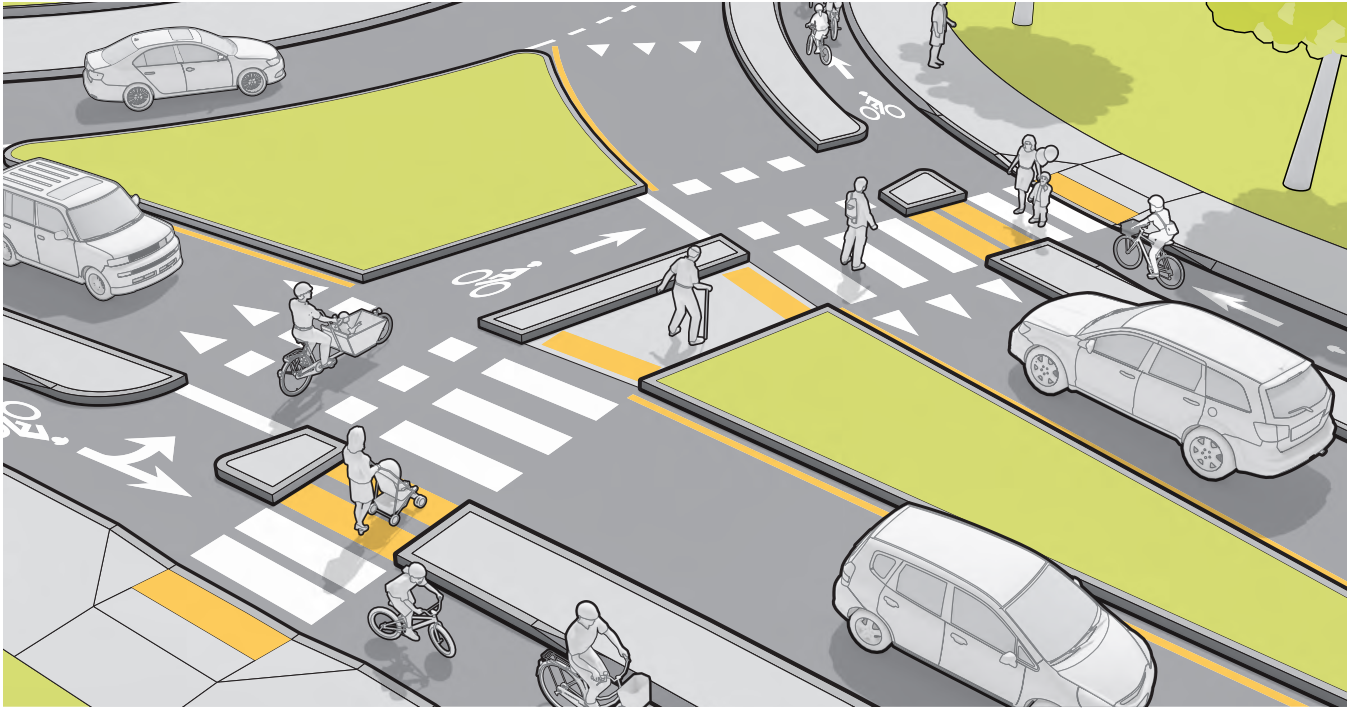


REFERENCES

- Caltrans. *Manual on Uniform Traffic Control Devices*. 2014.
- FHWA. *Separated Bike Lane Planning and Design Guide*. 2015.
- NACTO. *Urban Bikeway Design Guide*. 2014.

SEPARATED BIKE LANES AT ROUNDABOUTS

When separated bike lanes are provided at roundabouts, they should be continuous around the intersection and parallel to the sidewalk. Separated bike lanes should generally follow the contour of the circular intersection.



GUIDANCE

- + Separated bike lanes are applicable at all roundabouts. This treatment reduces conflict and places bicyclists in more predictable and visible positions.
- + Separated bike lanes at roundabout crossings should provide:
 - + Yield control for motorists at the bicycle crossing,
 - + Detectable surface materials to maintain separation between bicyclists and pedestrians; and
 - + Bicycle/pedestrian warning signs (W11-15) at the bicycle and pedestrian crossings.

CONSIDERATIONS

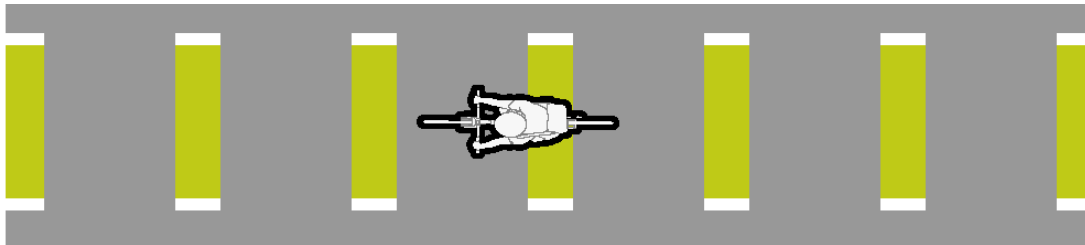
- + It may be advisable to install RRFBs (Rectangular Rapid Flashing Beacons) or apply geometric design changes to support motorist yielding.
- + The bicycle crossing should be immediately adjacent to and parallel with the pedestrian crossing, and both should be at the same elevation.
- + The separated bike lane approach to the bicycle crossing should result in bicyclists arriving at the queuing area at a perpendicular angle to approaching motorists.
- + Consider providing supplemental yield lines at roundabout exits to indicate priority at these crossings.
- + Channelizing islands are preferred to maintain separation between bicyclists and pedestrians, but may be eliminated if different surface materials are used.

REFERENCES

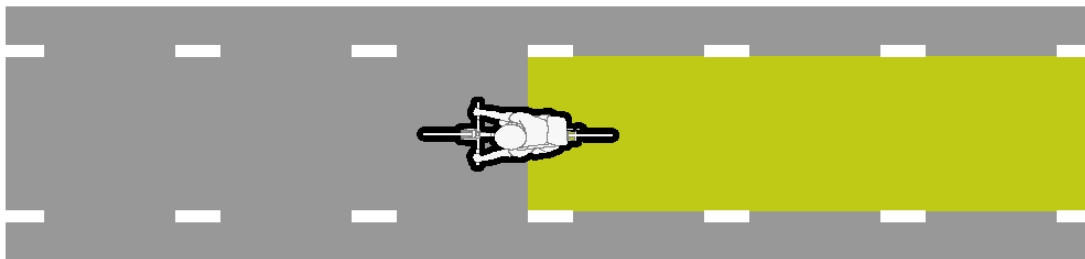
- AASHTO. *Guide for the Development of Bicycle Facilities*. 2024.
- Caltrans. *Manual on Uniform Traffic Control Devices*. 2014.
- U.S. Access Board. *Final Rule on Public Right-of-Way Accessibility Guidelines*, 2023.

BICYCLE LANE EXTENSION MARKINGS

Where a bicycle facility crosses an intersection or higher volume driveway, the delineation of bicycle space through the intersection using dashed line increases the legibility of the bikeway and raises awareness of bicyclists to other roadway users. Bicycle lane extension markings, also called conflict area markings, may be used with any Class II or Class IV bike lane across driveways, through intersections, or in separated bike lane mixing zones. See Protected Intersections graphic for illustration of extension markings at an intersection.



Colored Dash



Colored Conflict Areas

GUIDANCE

- + Dashed white lane lines should conform to the latest edition of the CA MUTCD. These can be used through different types of intersections based on engineering judgment.
- + Green pavement markings may be applied in a solid or dashed pattern within a dashed bicycle lane to indicate conflict areas and where merging maneuvers are permitted, such as across intersections, driveways, and at STOP or YIELD-controlled cross-streets.
- + Green pavement markings shall be placed before the stop bar at the intersection and continue through the intersection. Dashed marking should be aligned with the approaching/receiving bike lane.
- + Green dashed pavement markings are typically 4' by 5'-2" with a 6" white edge.
- + The colored markings should be skid-resistant and retroreflective, made from durable liquid pavement

REFERENCES

AASHTO *Guide for the Development of Bicycle Facilities*. 2024.
Caltrans. *DIB 89-02: Class IV Bikeway Guidance*. 2022.
FHWA Memorandum – *Interim Approval for Optional Use of Green Colored Pavement for Bike Lane*. 2011.

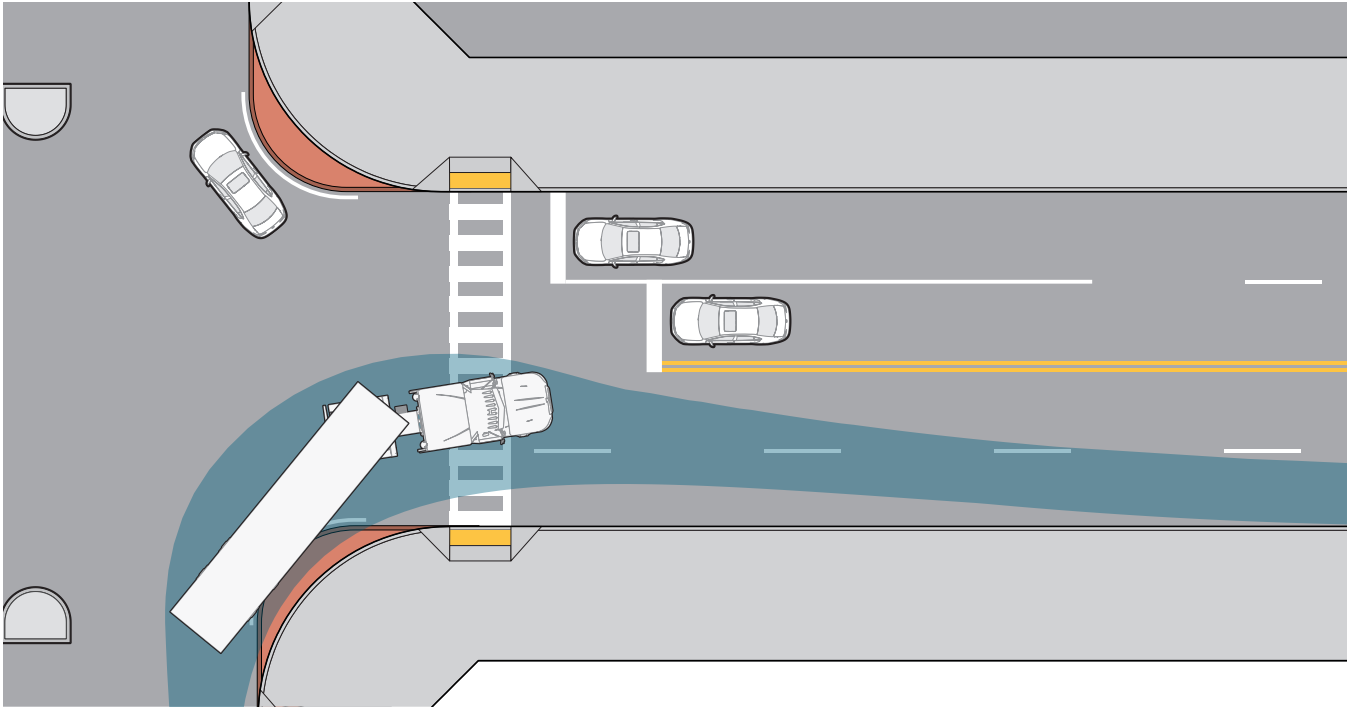
CONSIDERATIONS

- + A variety of pavement marking symbols can enhance intersection treatments to guide bicyclists and warn of potential conflicts.
- + Symbol placement within intersections should consider vehicle wheel paths to minimize maintenance.
- + Driveways with higher volumes may require additional pavement markings and signage.
- + Consideration should be given to using intersection pavement markings as spot treatments or standard intersection treatments. A corridor wide treatment can maintain consistency; however, spot treatments can be used to highlight conflict locations.

FHWA. *Separated Bike Lane Guide*. 2015.
Caltrans. *Manual on Uniform Traffic Control Devices*. 2014.
NACTO. *Urban Bikeway Design Guide*. 2014.

TRUCK APRONS

In locations where large vehicles make occasional turns, designers can consider mountable truck aprons. Mountable truck aprons reduce turning speeds for passenger vehicles, yet accommodate the occasional large vehicle without encroachment or off-tracking into pedestrian waiting areas.



GUIDANCE

- + The mountable surface should be visually distinct from the adjacent travel lane, sidewalk and separated bike lane.
- + The heights of mountable areas and curbs should be no more than 3 inches above the travel lane to accommodate lowboy trailers.
- + Mountable truck aprons have a preferred corner radius of 15'.

CONSIDERATIONS

- + Truck aprons are typically constructed with asphalt or concrete but may also be constructed with pavement markings and bolt-down speed bumps aligned perpendicular to the roadway edge as an interim strategy.
- + Mountable truck aprons are part of the traveled way and should be designed to discourage pedestrian or bicycle refuge.
- + Bicycle stop bars, detectable warning surfaces, traffic signal equipment and other intersection features must be located behind the mountable surface area.
- + While bicyclist and pedestrian safety is negatively impacted by wide crossings, bicyclists and pedestrians are also at risk if the curb radius is too small. Curb radii that are too small for large vehicles to navigate can result in the rear wheels of a truck tracking over queuing areas at the corner. Maintenance problems are also caused when trucks must regularly drive over street corners to make turns.
- + For related information, see Corners and Curb Radii and Curb Extensions sections in Chapter 3.

REFERENCES

AASHTO. *Guide for the Development of Bicycle Facilities*. 2024.
FHWA. *Achieving Multi-modal Networks: Applying Design Flexibility and Reducing Conflicts*. 2016.

AT-GRADE RAILROAD CROSSINGS

Railroad tracks that interface with bicycle facilities can be hazardous. Tracks running along bike facilities create hazards for bicyclists traveling parallel to the tracks as well as when turning across the tracks.



GUIDANCE

- + Railroad crossings should be designed to allow bicyclists to cross at an angle between 60 and 90 degrees to minimize their risk of crashing. This may require wider paved shoulders to accomplish.
- + Provide clear delineation with pavement markings indicating to bicyclists where they should travel to cross railroad tracks at an optimum location.
- + Provide adequate sight lines for approaching bicyclists to see approaching trains at rail crossings.
- + Provide warning signs to alert bicyclists of the crossing ahead.

CONSIDERATIONS

- + Be sure to account for pedestrian needs when designing railroad crossings.
- + Railroad crossings may require supplemental traffic control devices approved by the rail authority; in unique situations, design solutions may include a separate bridge structure to avoid at-grade crossings.
- + Provide, as practicable, the best track surface treatment for bicyclists. Concrete produces the smoothest ride for bicyclists, even under wet conditions. This is preferred to rubber, which can become slippery when wet and degrade over time; asphalt, which can deform or heave over time; and timber, which wears down relatively rapidly and can be slippery when wet.
- + Reduce the flangeway width to minimize the possibility of bicycle wheels getting caught in the opening.
- + Alternative crossing facilities (eg., Class I) may be appropriate (as opposed to shared roadway/shoulder) in locations where higher volumes of bicycle or pedestrian users are expected, or where a history of incidents is present.

REFERENCES

AASHTO. *Guide for the Development of Bicycle Facilities*. 2024.

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PEDESTRIAN FACILITIES & AMENITIES



3

ELEMENTS OF A SIDEWALK

Sidewalks play a critical role in the character, function, enjoyment, and accessibility of neighborhoods, main streets, and other community destinations. In addition to providing space for pedestrians separated from motor vehicles, sidewalks also accommodate street trees and other plantings, stormwater infrastructure, street lights, and bicycle racks. This section defines sidewalk zones and provides considerations for better activating the streetscape to enhance peoples' experiences.

ZONES

Frontage Zone:

The Frontage Zone is the area of sidewalk that immediately abuts buildings along the street. In residential areas, the Frontage Zone may be occupied by front porches, stoops, lawns, or other landscape elements that extend from the front door to the sidewalk edge. The Frontage Zone of commercial properties may include architectural features, outdoor displays, café seating, awnings, signage, etc. Frontage Zones may vary in width from just a few feet to several yards.

Pedestrian Through Zone:

Also known as the "walking zone," the Pedestrian Zone is the portion of the sidewalk space used for active travel. For it to function, it must be kept clear of any obstacles and be wide enough to comfortably accommodate expected pedestrian volumes (as anticipated by density and adjacent land use) including those using mobility assistance devices, pushing strollers, or pulling carts.

Amenity Zone:

The Amenity Zone, or "landscape zone," lies between the curb and the Pedestrian Zone. This area is occupied by fixtures such as street lights, trees, bicycle racks, utility poles, transit shelters, parking meters, signposts, signal boxes, benches, trash and recycling receptacles, and other amenities. In commercial areas, it is typical for this zone to be hardscape pavement, pavers, or tree grates. In residential, or lower intensity areas, it is commonly a planted strip.



Frontage, Pedestrian and Amenity Zones

sufficiently wide enough to accommodate it. Regardless, street furniture should not impede movement in the Pedestrian Zone.

CONSIDERATIONS

- + Where demand is highest, it may be appropriate to re-allocate street width to provide amenities that cannot be accommodated within the existing sidewalk width, such as bicycle parking or outdoor dining. Outdoor dining opportunities contribute to a lively street environment and add economic value by enabling private commercial activity to spill into the public environment of the street.
- + While there are some exceptions, most street furniture installation is installed in the Amenity Zone. For example, bicycle parking may be installed in the frontage zone if it is

- + Seating is most commonly located in the Amenity Zone of the street, but may also be placed in the Frontage Zone. Seating in the Amenity Zone should generally face away from the street and toward the sidewalk or be aligned perpendicular to the curb. Seating in the Frontage Zone should face the street.
- + Stormwater facilities are commonly located in the Amenity Zone.
- + Where demand is highest, it may be appropriate to re-allocate street width to provide amenities that cannot be accommodated within the existing sidewalk width, such as bicycle parking or outdoor dining.

PREFERRED WIDTHS FOR SIDEWALK ZONES

The width of the various sidewalk zones will vary given the street type, the available right-of-way, scale of the adjoining buildings and the intensity and type of uses expected along a particular street segment. A balanced approach for determining the sidewalk width should consider the character of the surrounding area and the anticipated pedestrian activities. For example, is the street lined with retail that encourages window shopping or does it connect a residential neighborhood to a commercial area where pedestrians frequently need to pass one another? Does the scale of the buildings and the character of the street indicate a need for a wider sidewalk?

GRAPHIC UNDER DEVELOPMENT

GUIDANCE

- + Sidewalk width must be a minimum of 4' (not including the curb which is typically 6") and a passing space of minimum 5'x5' is required every 200' or more.

CONSIDERATIONS

- + In locations with constrained rights-of-way, it is possible to provide a narrower Frontage Zone and Pedestrian Zone. Sidewalk width is based on local context, therefore in retrofit locations where development is not occurring and where existing building are anticipated to remain, 5-foot-wide sidewalks may be adequate.
- + Frontage Zones used for sidewalk cafés are a special condition and should generally be no less than 6 feet in width.
- + The provision of tree wells or landscape strip within the Amenity Zone will be based on the existing or planned character of the neighborhood.
- + Sidewalk stormwater facilities (including rain gardens) are generally located in the Amenity Zone and may indicate a need for a wider zone than what is identified in the table above.

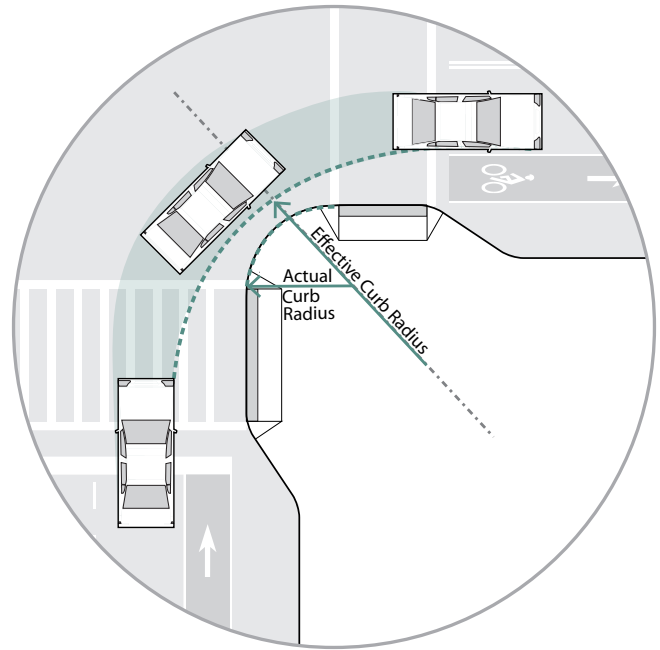
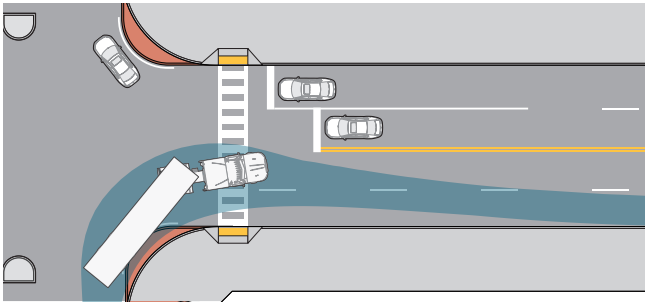
REFERENCES

NACTO. *Urban Street Design Guide*. 2013.

U.S. Access Board. *Final Rule on Public Right-of-Way Accessibility Guidelines*, 2023.

CORNERS AND CURB RADII

Pedestrian safety and comfort is enhanced by smaller curb radii, which shorten crossing distances for pedestrians and reduce vehicle turning speeds. However, streets must accommodate large turning vehicles, including school buses and transit vehicles, which require larger turning radii. One of the most challenging aspects of intersection design is to determine methods of accommodating large vehicles while keeping intersections as compact as possible. This requires engineering judgment, as each intersection is unique in terms of the number of travel lanes, presence of a median, and a number of other features that fundamentally impact corner design.



GUIDANCE

- + Curb radii should be designed to accommodate the intended design vehicle, or the most frequent user of a given street, turning using one approach lane and one receiving lane, as well as the intended control vehicle, or an infrequent larger vehicle, turning using multiple lane spaces.

CONSIDERATIONS

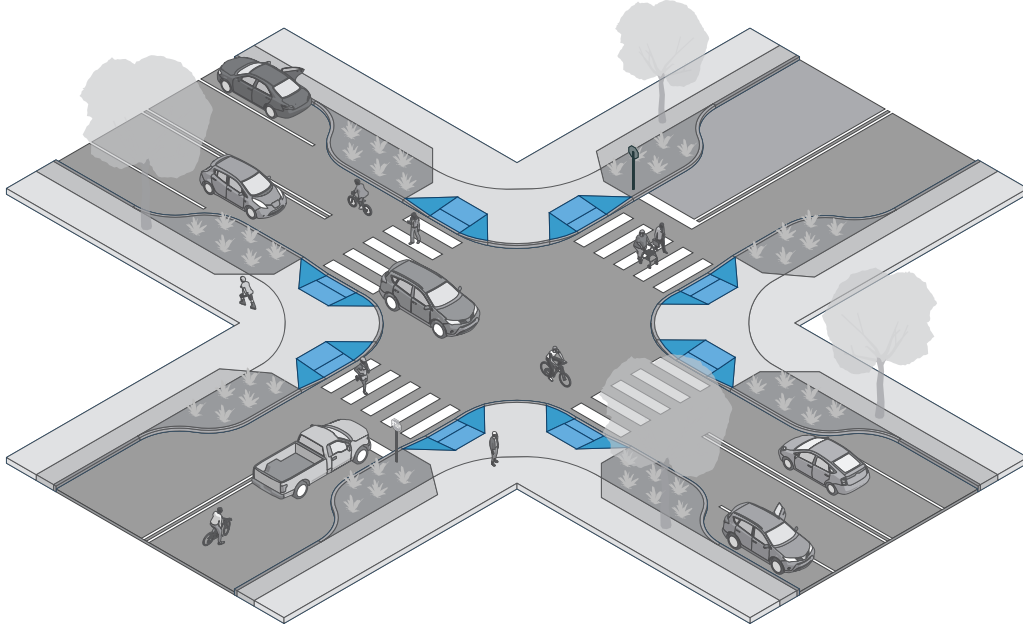
- + The design and control vehicle are context-dependent. Common design vehicles include a DL-27 for local streets, SU-30 for downtown and commercial streets, and BU-40 for designated bus routes. Control vehicles are often larger trucks like a WB-50.
- + At signalized intersections, corner design should assume that a large vehicle will use the entire width of the receiving lanes on the intersecting street.
- + Depending on an agency's encroachment policy, it may be possible to allow a large turning vehicle to encroach on the adjacent travel lane on the departure side (on multi-lane roads) to make the turn.
- + Mountable truck aprons can be implemented to deter design vehicles from making higher-speed turns, while accommodating control vehicles without encroachment or off-tracking into pedestrian areas. Mountable truck aprons should be visually distinct from the adjacent travel lane and sidewalk. (For more information, refer to Truck Aprons section).

REFERENCES

NACTO. *Urban Street Design Guide*. 2013.

CURB RAMPS

The transition for pedestrians from the sidewalk to the street is provided by a curb ramp. The designs of curb ramps are critical for all pedestrians, but particularly for people with disabilities. The ADA Standards require all pedestrian crossings be accessible to people with disabilities by providing curb ramps at intersections and midblock crossings as well as other locations where pedestrians can be expected to enter the street. Curb ramps also benefit people pushing strollers, grocery carts, suitcases, or bicycles.



GUIDANCE

- + Curb ramps are part of the accessible Pedestrian Access Route (PAR) and must be provided at all intersections where pedestrians are permitted and expected to cross the street, i.e., all street corners in California.
- + Separate, perpendicular curb ramps should be provided for each crosswalk at an intersection (as shown in graphic above) rather than a single ramp at a corner for both crosswalks. The separate curb ramps improve orientation for visually impaired pedestrians by directing them toward the correct crosswalk. Blended transitions may be provided instead of perpendicular curb ramps. Diagonal curb ramps are not recommended.

CONSIDERATIONS

- + Curb ramps must meet PROWAG requirements for running slope, cross slope, grade breaks, clear area, side treatments, and detectable warning surfaces.
- + Furnishing zones (the space between the curb and sidewalk) of 7' in width provide just enough space at intersections for curb ramps to gain sufficient elevation to a sidewalk.
- + Consider providing wider curb ramps in areas of high pedestrian volumes and crossing activities.
- + The side of the curb ramp shall be flared when the surface adjacent to the ramp's sides is walkable. However, when the surface adjacent to a ramp is landscaped or otherwise not walkable, the side is not required to be flared, and can be a vertical curb.

REFERENCES

U.S. Access Board. *Final Rule on Public Right-of-Way Accessibility Guidelines, 2023.*

PEDESTRIAN CROSSING TREATMENTS

The following pages describe pedestrian crossing treatments. The table below indicates when each treatment is applicable.

CROSSING TREATMENT	APPLICATION	APPROPRIATE AT...			
		SIGNALIZED INTERSECTIONS	STOP-CONTROLLED INTERSECTIONS	UNCONTROLLED INTERSECTIONS	MID-BLOCK CROSSINGS
HIGH-VISIBILITY CROSSWALK	ALWAYS RECOMMENDED	ALWAYS RECOMMENDED	ALWAYS RECOMMENDED	ALWAYS RECOMMENDED	ALWAYS RECOMMENDED
DIRECTIONAL CURB RAMPS	MANDATORY AT ALL LOCATIONS, PER PROWAG	ALWAYS RECOMMENDED	ALWAYS RECOMMENDED	ALWAYS RECOMMENDED	ALWAYS RECOMMENDED
PEDESTRIAN-SCALE LIGHTING	ALWAYS APPROPRIATE, ESPECIALLY AT AREAS WITH COMMON NIGHTTIME PEDESTRIAN ACTIVITY	ALWAYS RECOMMENDED	ALWAYS RECOMMENDED	ALWAYS RECOMMENDED	ALWAYS RECOMMENDED
DAYLIGHTING	TYPICALLY APPLIED AT CROSSING LOCATIONS WITH ON-STREET PARKING	ALWAYS RECOMMENDED	ALWAYS RECOMMENDED	ALWAYS RECOMMENDED	ALWAYS RECOMMENDED
CROSSING ISLAND (MEDIAN, PEDESTRIAN REFUGE ISLAND)	TYPICALLY APPLIED AT CROSSINGS OF THREE TRAVEL LANES, WITH THE CROSSING ISLAND LOCATED IN THE TWO-WAY LEFT-TURN LANE	SOMETIMES RECOMMENDED	SOMETIMES RECOMMENDED	SOMETIMES RECOMMENDED	SOMETIMES RECOMMENDED
CURB EXTENSIONS (BULB OUTS)	TYPICALLY APPLIED AT CROSSING LOCATIONS WITH ON-STREET PARKING	SOMETIMES RECOMMENDED	SOMETIMES RECOMMENDED	SOMETIMES RECOMMENDED	SOMETIMES RECOMMENDED
RAISED CROSSING	REFER TO TABLE ON FOLLOWING PAGE	N/A	SOMETIMES RECOMMENDED	SOMETIMES RECOMMENDED	SOMETIMES RECOMMENDED
RECTANGULAR RAPID FLASHING BEACON (RRFB)	REFER TO TABLE ON FOLLOWING PAGE	N/A	N/A	SOMETIMES RECOMMENDED	SOMETIMES RECOMMENDED
PEDESTRIAN HYBRID BEACON (PHB)	REFER TO TABLE ON FOLLOWING PAGE	N/A	N/A	SOMETIMES RECOMMENDED	SOMETIMES RECOMMENDED
LEADING PEDESTRIAN INTERVAL (LPI)	MANDATORY AT SIGNALIZED INTERSECTIONS WITH PEDESTRIAN SIGNAL HEADS, PER PROWAG	ALWAYS RECOMMENDED	N/A	N/A	N/A

PEDESTRIAN CROSSING TREATMENTS AT UNCONTROLLED INTERSECTIONS

Treatments for uncontrolled crossings should be selected based on the FHWA Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations (STEP Guide), which recommends appropriate design treatments based on the number of lanes, posted speed limit, and daily traffic volume on a given street.

Pedestrian Crossing Treatments at Uncontrolled Crossings (Application of pedestrian crash countermeasures by roadway feature, FHWA Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations)

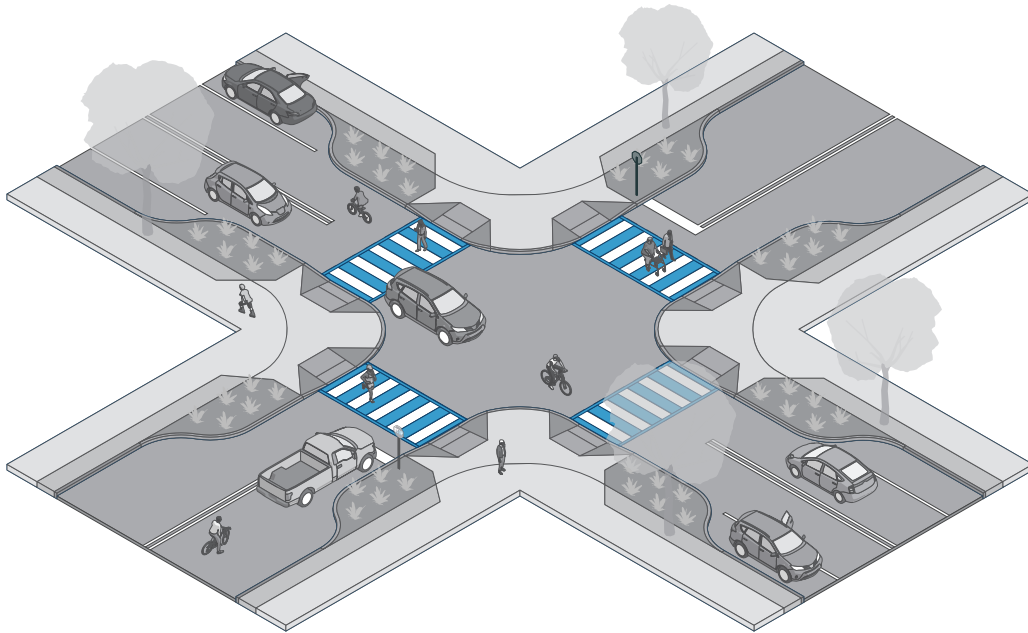
ROADWAY CONFIGURATION	POSTED SPEED LIMIT AND AADT																	
	VEHICLE AADT <9,000			VEHICLE AADT 9,000-15,000			VEHICLE AADT >15,000											
	≤30 MPH	35-40 MPH	45 MPH	≤30 MPH	35-40 MPH	45 MPH	≤30 MPH	35-40 MPH	45 MPH									
2 LANES (1 LANE IN EACH DIRECTION)	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
	4	5	6	7	8	9	4	5	6	7	8	9	4	5	6	7	8	9
	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
3 LANES WITH RAISED MEDIAN (1 LANE IN EACH DIRECTION)	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
	4	5	6	7	8	9	4	5	6	7	8	9	4	5	6	7	8	9
	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
3 LANES W/O RAISED MEDIAN (1 LANE IN EACH DIRECTION WITH A TWO-WAY LEFT-TURN LANE)	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
	4	5	6	7	8	9	4	5	6	7	8	9	4	5	6	7	8	9
	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
4+ LANES WITH RAISED MEDIAN (2 OR MORE LANES IN EACH DIRECTION)	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
	4	5	6	7	8	9	4	5	6	7	8	9	4	5	6	7	8	9
	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
4+ LANES W/O RAISED MEDIAN (2 OR MORE LANES IN EACH DIRECTION)	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
	4	5	6	7	8	9	4	5	6	7	8	9	4	5	6	7	8	9
	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9

Given the set of conditions in a cell,
 # Signifies that the countermeasure is a candidate treatment at a marked uncontrolled crossing location.
 ■ Signifies that the countermeasure should always be considered, but not mandated or required, based upon engineering judgment at a marked uncontrolled crossing location.
 ■ Signifies that crosswalk visibility enhancements should always occur in conjunction with other identified countermeasures.

- 1 High-Visibility Crosswalk Markings, Parking Restrictions on Crosswalk Approach, Adequate Nighttime Lighting Levels, and Crossing Warning Signs
- 2 Raised Crosswalk
- 3 Advance Yield Here To (Stop Here For) Pedestrians Sign and Yield (Stop) Line
- 4 In-Street Pedestrian Crossing Sign (Not Permanent)
- 5 Curb Extension
- 6 Pedestrian Refuge Island
- 7 Rectangular Rapid-Flashing Beacon (RRFB)*
- 8 Road Diet
- 9 Pedestrian Hybrid Beacon (PHB)*
- * PHB and RRFB are not both installed at the same crossing location.

MARKED CROSSWALKS

Legal crosswalks exist at all locations where sidewalks meet the roadway, regardless of whether pavement markings are present. Drivers are legally required to yield to pedestrians at intersections, even when there are no pavement markings. Providing marked crosswalks communicates to drivers that pedestrians may be present, and helps guide pedestrians to locations where they should cross the street. In addition to pavement markings, crosswalks may include signals/beacons, warning signs, and raised platforms.



GUIDANCE

- + Crosswalks should be marked on all legs of signalized intersections, in school zones, and across streets with more than minimal levels of traffic.
- + Marked crosswalks should be oriented perpendicular to streets, minimizing crossing distances and therefore limiting the time that pedestrians are exposed.
- + Marked crosswalks should be at least 10 feet wide or the width of the approaching sidewalk if it is greater. Crosswalks within 600' of school grounds must be painted yellow.
- + Stop lines at stop-controlled and signalized intersection approaches should be striped no less than 4 feet and no more than 30 feet from the edge of marked crosswalks.
- + Yield lines ("shark teeth") at mid-block crossings should be located 20 to 50 feet from the edge of the marked crosswalk.

CONSIDERATIONS

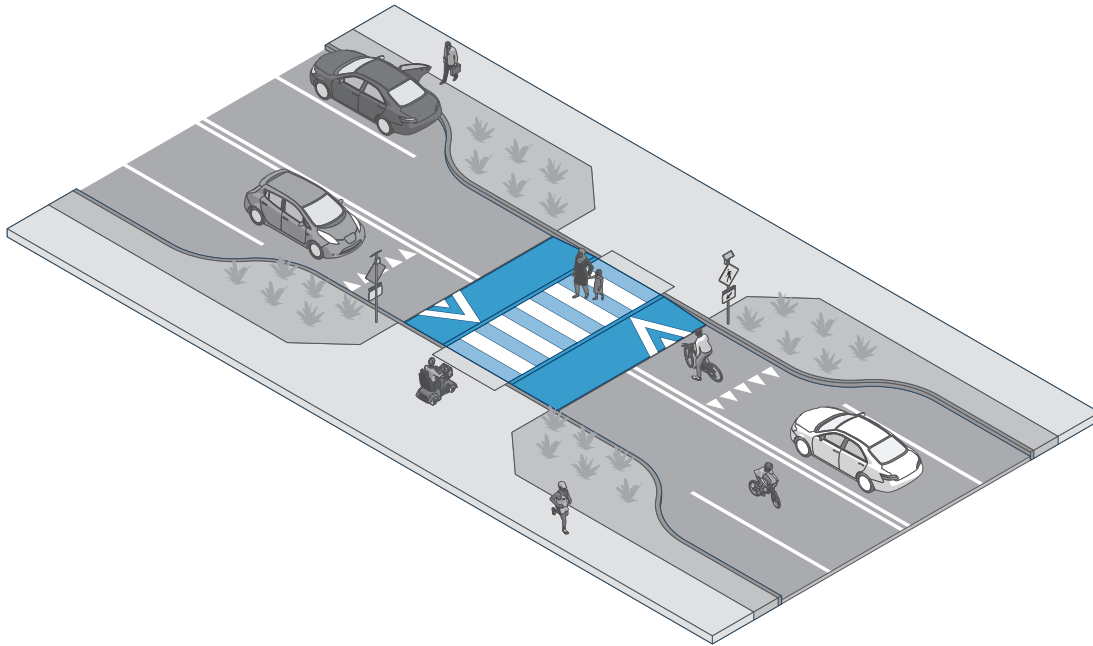
- + There are many different styles of marked crosswalk striping and some are more effective than others. High-visibility crosswalks with striping parallel to the direction of travel for drivers are more visible to drivers, and are recommended in all cases, especially near schools. The graphic above shows continental striping, but other types of high-visibility striping include ladder style, zebra, and triple four.
- + Raised crossings can calm traffic and increase the visibility of pedestrians. (See following section on "Raised Crosswalks" for more details.)
- + In areas of heavy pedestrian volumes (such as transit station areas, school zones, and main streets), marked crosswalks can be up to 25 feet wide.
- + Crosswalks may need to be restriped after pavement work.

REFERENCES

- FHWA. Crosswalk Marking Selection Guide. 2023.*
- FHWA. Manual on Uniform Traffic Control Devices. 2023.*
- NACTO. Urban Street Design Guide. 2013.*
- U.S. Access Board. Final Rule on Public Right-of-Way Accessibility Guidelines, 2023.*

RAISED CROSSWALKS

Raised crosswalks are used for traffic calming and to improve motorist yielding to people walking, rolling and biking at intersections and midblock crossings. In this design, crosswalks are elevated to reduce or eliminate the transition from the sidewalk to the street crossing. Transition aprons on each approach to the raised crossing are marked with pavement markings to alert drivers of the grade change.



GUIDANCE

- + Ensure a raised crosswalk is at least as wide as the connecting sidewalk or path of travel.
- + Provide detectable warning surfaces at the edge of the sidewalk to indicate to pedestrians that they are exiting the sidewalk and entering the street. Ensure that raised crossing meets accessible slope requirements.
- + On-street parking and loading must be restricted 20 feet before the marked crosswalk to provide adequate sight distance between people crossing and people driving.
- + Yield lines (“shark teeth”) should be located 20 to 50 feet from the edge of the crosswalk.
- + Include warning pavement markings for drivers on transition aprons and “Raised Crosswalk” signs at the crossing. Transition aprons should be 5 to 8 percent (relative to the street) on streets, and 5 to 15 percent (relative to the driveway/alley) on driveways and alleys.

CONSIDERATIONS

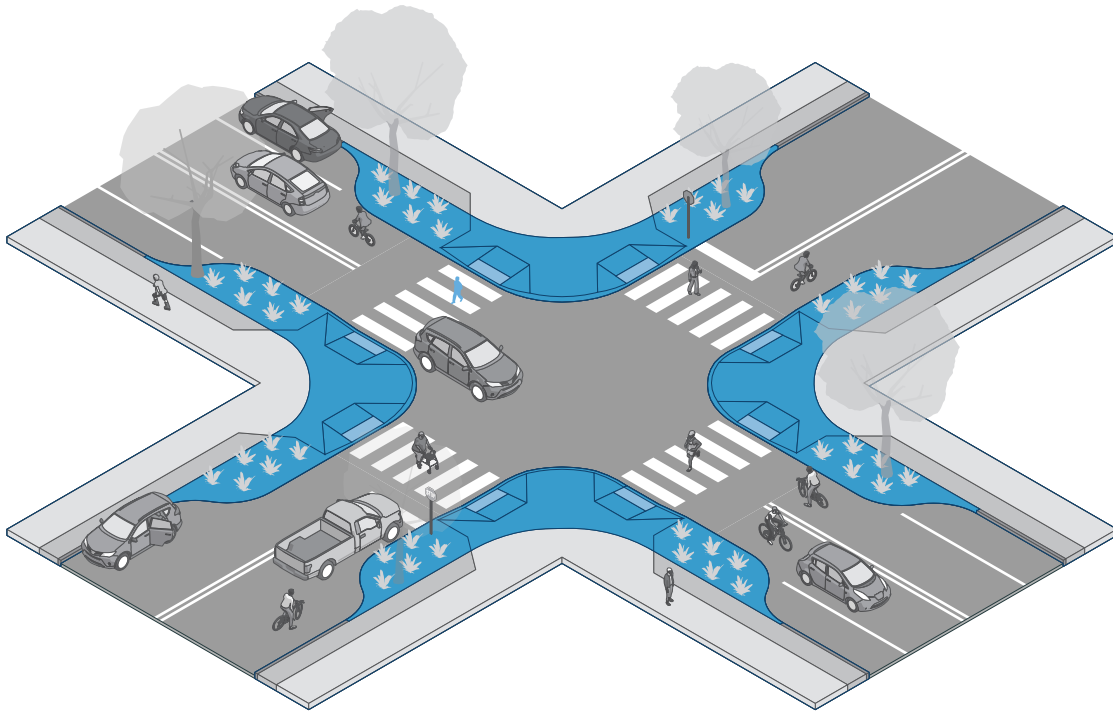
- + Raised crosswalks may be beneficial at:
 - + Unsignalized collector and local street crossings.
 - + Crossings of driveways and alleys.
 - + Crossings of channelized right turn lanes and roundabouts.
 - + Intersections where a large corner radius is required to accommodate large vehicles.
- + Use trail-level and sidewalk-level bikeway crossings and locations where increased visibility, priority or accessibility for people walking, riding bicycles or using dockless mobility vehicles is desired or needed, including school zones.
- + Raised crossings may be used as midblock crossings with the appropriate infrastructure, such as rectangular rapid flashing beacons (RRFBs), pedestrian hybrid beacons (PHB)s, median refuges, warning signage, and other elements as appropriate.
- + Raised crosswalks are not appropriate on streets with steep roadway grades higher than 8%.
- + Ensure that drainage and maintenance needs are accounted for in raised crossing design.

REFERENCES

- AASHTO. *Guide for the Development of Bicycle Facilities*. 2024.
- FHWA. *Manual on Uniform Traffic Control Devices*. 2023.
- U.S. Access Board. *Final Rule on Public Right-of-Way Accessibility Guidelines*, 2023.

CURB EXTENSIONS

Curb extensions, also known as neckdowns, bulb-outs, or bump-outs, are created by extending the sidewalk at corners or mid-block. In addition to shortening crossing distances, curb extensions can be used to change the geometry of intersections resulting in smaller corner radii and slowing turning motor vehicles.



GUIDANCE

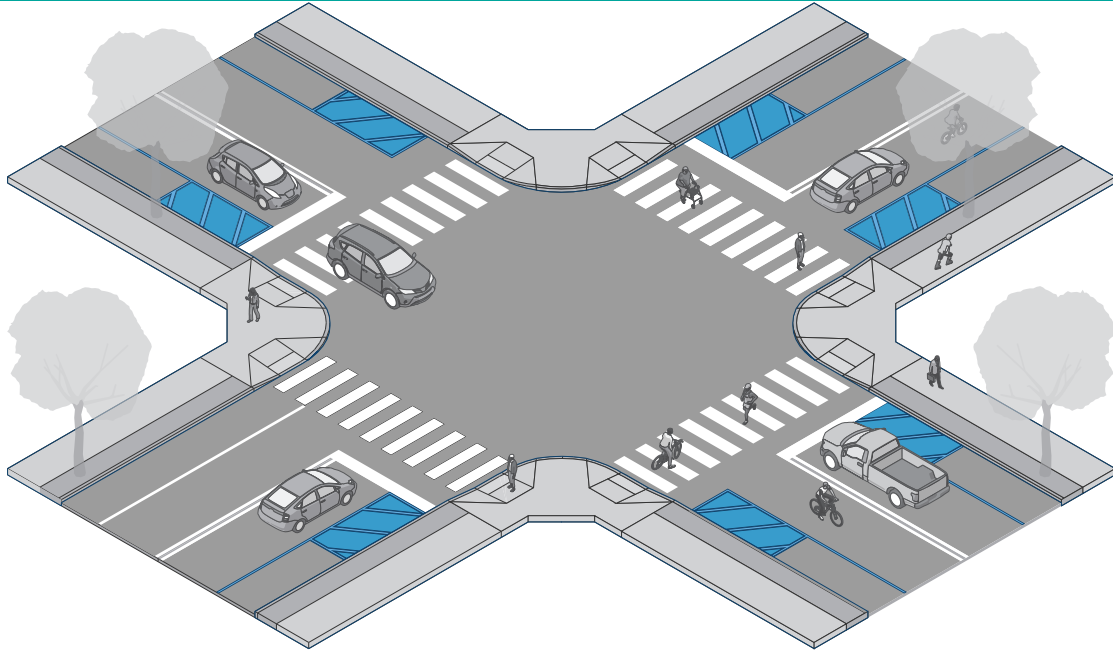
- + Curb extensions should be considered where parking is present or where motor vehicle traffic deflection is provided through other curbside uses such as bicycle share stations or parklets. They cannot be installed where the curbside lane is a vehicle travel lane.
- + Curb extensions are particularly valuable in locations with high volumes of pedestrian traffic, near schools, at unsignalized pedestrian crossings, or where there are demonstrated pedestrian safety issues.

CONSIDERATIONS

- + The turning needs of emergency, transit, and other large vehicles must be considered in curb extension design.
- + Care should be taken to maintain direct routes across intersections by aligning pedestrian desire lines on either side of the sidewalk. Curb extensions often make this possible as they provide extra space for grade transitions.
- + Consider providing a 20' long curb extension to restrict parking within 20' of an intersection to enhance visibility.
- + When curb extensions conflict with turning movements, reducing the width and/or length of the curb extension should be prioritized over elimination.
- + Emergency access is often improved through the use of curb extensions because intersections are kept clear of parked cars.

DAYLIGHTING

Improves visibility at intersections and mid-block crossing locations by removing visual obstructions near the crossing. Daylighting often includes the spot removal of parking spaces, accomplished via red curb, signage, and removal of parking space pavement markings.



GUIDANCE

- + Use at all crossing approaches.
- + Daylighting should be implemented via signage and striping at all crossing approaches (including unmarked crossings) on streets with on-street parking.

CONSIDERATIONS

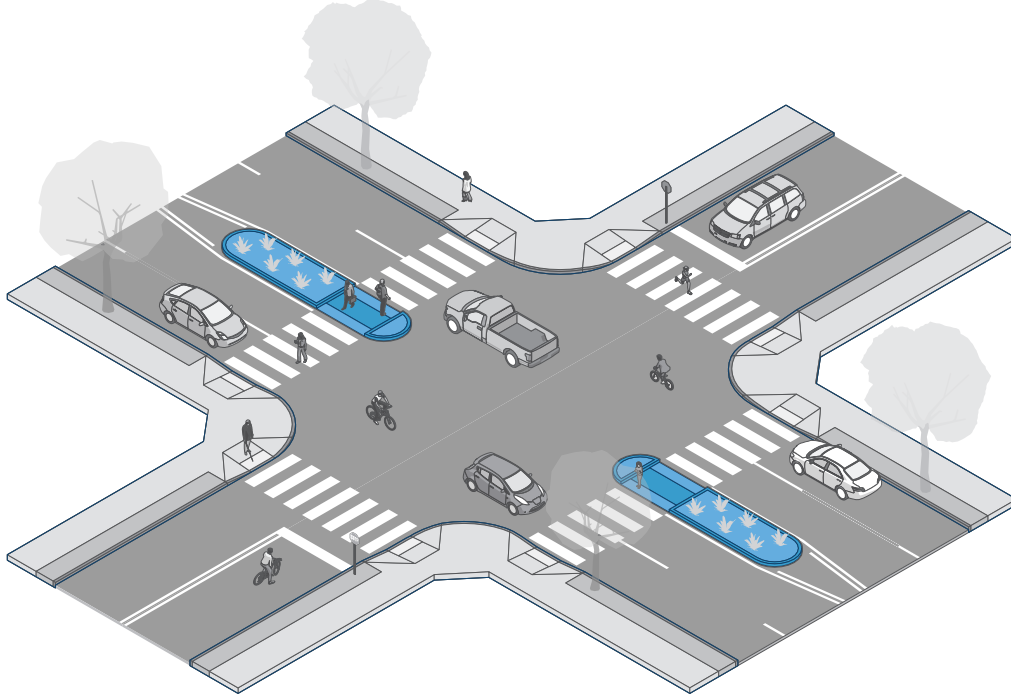
- + California Assembly Bill 413 prohibits the stopping, standing, or parking of a vehicle within 20' of an intersection approach (including any marked or unmarked crosswalk) or within 15' of a crosswalk with a curb extension, effective January 1, 2025. This law applies to all intersections, even where formal daylighting treatments or signs have not been installed.
- + In addition to red-painted curb, the parking-restricted area can be defined using curb extensions, planters, or flexible delineators. Additionally, this space can be repurposed for green infrastructure or bicycle parking.
- + A "No Parking" sign (MUTCD R7 series) can additionally be installed.
- + Enforcement may be necessary to ensure compliance with new restrictions, particularly in residential or commercial areas with high demand for on-street parking.

REFERENCES

- Caltrans. Manual on Uniform Traffic Control Devices. 2014.*
- NACTO. Urban Street Design Guide. 2012.*
- California Vehicle Code § 22500*

CROSSING ISLANDS

Crossing islands are raised islands that provide a pedestrian refuge and allow pedestrians to cross one direction of motor vehicle traffic at a time. They can be located at intersections or mid-block.



GUIDANCE

- + There are two primary types of crossing islands:
 - + The first provides a cut-through of the island, keeping pedestrians at street-grade. These islands must be at least 6' in width in order to integrate detectable warning surfaces and be considered a true pedestrian refuge island.
 - + The second type ramps pedestrians up above street grade and may present challenges to constructing accessible curb ramps unless they are more than 17' wide (accommodating for ramp width and landing area).
- + Crossing islands should always be considered on collector or arterial roadways with moderate-to-high traffic speeds and volumes and multiple lanes, as well as where crossing distances are greater than 50 feet.

REFERENCES

NACTO. *Urban Street Design Guide*. 2013.

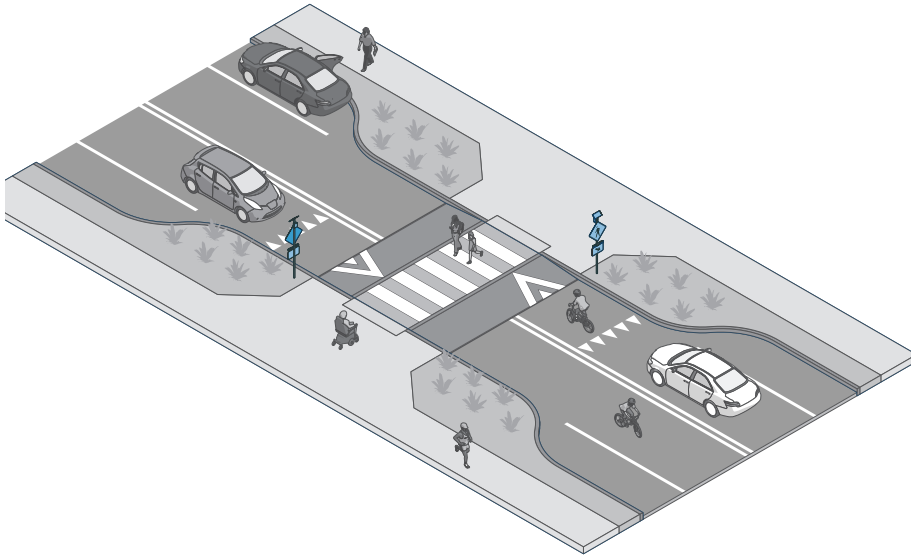
FHWA. *Manual on Uniform Traffic Control Devices*. 2023.

CONSIDERATIONS

- + Crossing islands can be coupled with other traffic calming features, such as partial diverters and curb extensions at mid-block and intersection locations.
- + At mid-block crossings where width is available, islands should be designed with a stagger, or in a "Z" pattern, encouraging pedestrians within the median to face oncoming traffic before crossing.
- + Should a midblock crossing be provided along a multilane arterial, a raised median or crossing island and supplementary traffic control devices are desirable.
- + On a local road with relatively low traffic speeds and volumes, placing a raised median or crossing island might be done for aesthetic considerations or special pedestrian crossing characteristics and volumes.
- + Crossing islands may require widths of 8' or greater in locations where significant pedestrian or bicycle volumes are present/expected, or to accommodate cargo bikes & wheelchairs more effectively.
- + May be implemented as a quick build treatment through use of temporary materials.

RECTANGULAR RAPID FLASHING BEACON

Uncontrolled multi-lane crossings decrease pedestrian visibility and can decrease motor vehicle yielding compliance. Rectangular Rapid Flash Beacons (RRFBs) can be implemented to improve yielding compliance at these locations. RRFBs combine a pedestrian crossing sign with a bright flashing beacon that is activated only when a pedestrian is present.



GUIDANCE

- + RRFBs can be used when a signal is not warranted at an unsignalized crossing. They are not appropriate at intersections with signals or STOP signs.

CONSIDERATIONS

- + RRFBs are considerably less expensive to install than mast arm-mounted signals. They can also be installed with solar power panels to eliminate the need for an external power source.
- + RRFBs should be limited to locations with critical safety concerns, and should not be installed in locations with sight distance constraints that limit the driver's ability to view pedestrians on the approach to the crosswalk.
- + RRFBs should be used in conjunction with advance stop or yield bars and signs.
- + RRFBs are usually implemented at high-volume pedestrian crossings, but may also be considered for priority bicycle route crossings or locations where bike facilities cross roads at mid-block locations.
- + RRFBs may be installed at roundabout crossings.

REFERENCES

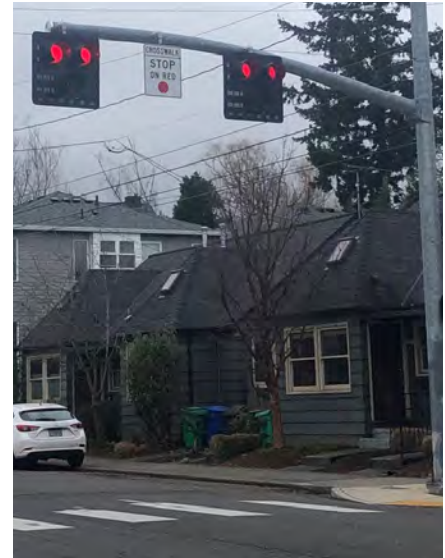
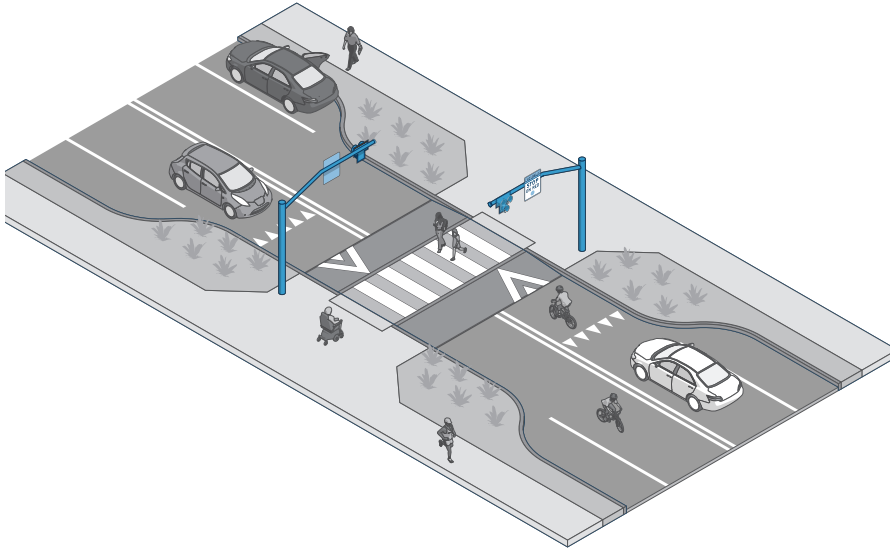
FHWA. *Manual on Uniform Traffic Control Devices*. 2023.

NACTO. *Urban Street Design Guide*. 2013.

Safety Effects of Marked Versus Unmarked Crosswalks at Uncontrolled Locations. 2005.

PEDESTRIAN HYBRID BEACON

Pedestrian hybrid beacons (PHBs), including the High-intensity Activated Crosswalk Beacon (HAWK), are a type of hybrid signal intended to allow pedestrians and bicyclists to stop traffic to cross high-volume arterial streets. This type of signal may be used in lieu of a full signal that meets any of the traffic signal control warrants in the MUTCD.



GUIDANCE

- + This type of device should be considered for all arterial crossings in a bicycle network and for path crossings if other engineering measures are found inadequate to create safe crossings.
- + The MUTCD recommends minimum volumes of 20 pedestrians or bicyclists an hour for major arterial crossings (volumes exceeding 2,000 vehicles/hour).
- + PHBs may also be used at locations which do not meet traffic signal warrants but where assistance is needed for pedestrians or bicyclists to cross a high-volume street.

CONSIDERATIONS

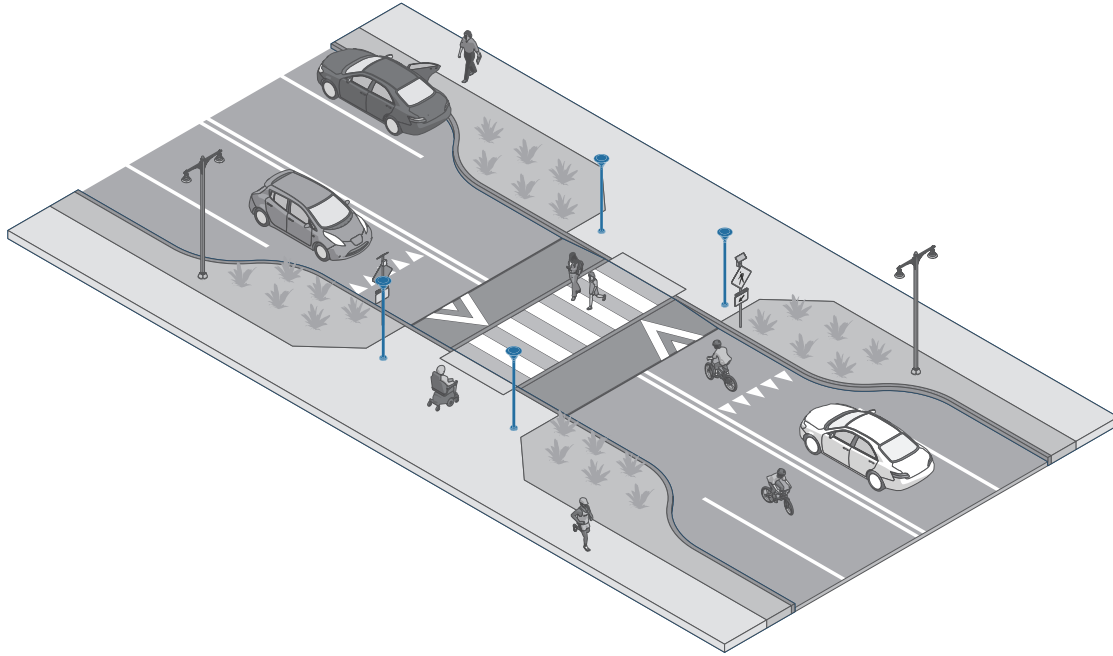
- + While this type of device is intended for pedestrians, it would be beneficial to retrofit it for bicyclists as the City of Portland, Oregon has, using bicycle detection and bicycle signal heads on major cycling networks. Depending upon the detection design, the agency implementing these devices may have the option to provide different clearance intervals for bicyclists and pedestrians. The provision of bicycle signal heads would require permission to experiment from FHWA.

REFERENCES

- FHWA. Manual on Uniform Traffic Control Devices. 2023.*
- NACTO. Urban Street Design Guide. 2013.*
- Safety Effects of Marked Versus Unmarked Crosswalks at Uncontrolled Location. 2005.*

PEDESTRIAN-SCALE LIGHTING

Illuminates sidewalks and crossings at night or low-light conditions using light fixtures that are shorter than roadway-scale light fixtures.



GUIDANCE

Pedestrian-scale lighting should be provided:

- + At controlled and uncontrolled intersections at crossing approaches
- + Along sidewalks, especially along arterials and near schools, parks, commercial and recreation centers

CONSIDERATIONS

- + Lighting should be uniform.
- + Lighting should be provided on crosswalk approaches so pedestrians are lit from the front instead of silhouetted from behind. If a crossing has a crossing island, additional lighting may be provided.
- + Consider energy usage, environmental impacts, and impacts on residential neighborhoods. Also consider applicability of pedestrian-scale lighting to crime reduction efforts such as Crime Prevention through Environmental Design (CPTED).
- + Install lighting to Illuminating Engineering Society and DarkSky standards.

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IMPLEMENTATION STRATEGIES

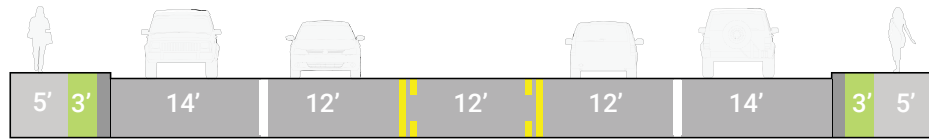


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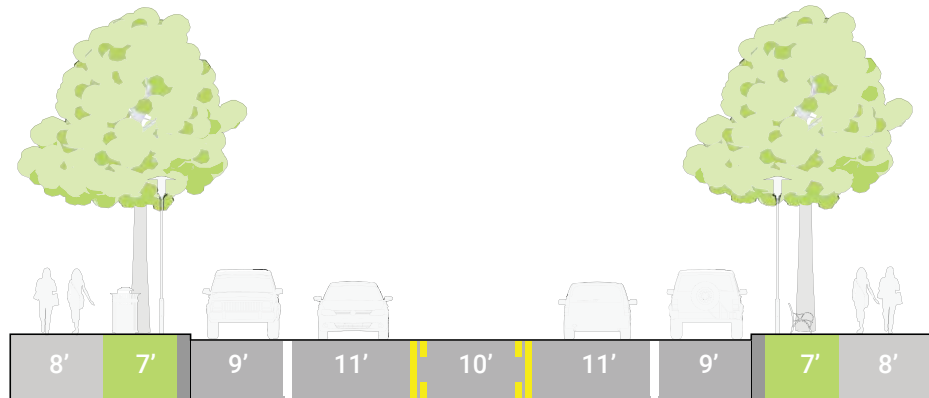
LANE NARROWING

Lane narrowing can improve comfort and safety for vulnerable road users. Narrowing lanes creates space that can be reallocated to other modes, in the form of wider sidewalks, bike lanes, reduced crossing distances, and buffers between cyclists, pedestrians and motor vehicles. Space can also be dedicated to plantings and amenity zones.

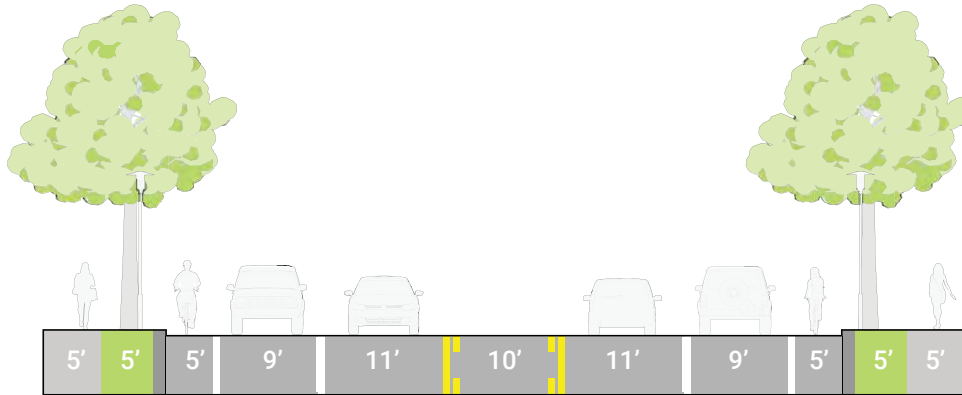
Roadway before narrowing



Narrowing motor vehicle lanes to increase sidewalk and amenity zones



Narrowing motor vehicle lanes to increase amenity zone and add bicycle lanes



GUIDANCE

- + Motor vehicle travel lanes as narrow as 10' are allowed in low-speed environments (45 mph or less) according to the AASHTO Green Book. Caltrans allows lane widths of 10.5' on Caltrans roadways, per DIB-94.
- + 10' travel lanes are not recommended on 4-lane undivided arterial roadways, but may be considered where speeds are 30 mph or less and truck use is low.
- + 11' travel lanes are recommended for transit vehicles per NVTA.

CONSIDERATIONS

- + Narrowing existing motor vehicle lanes may result in enough space to create separated bicycle lanes, widened sidewalks and buffers, or a combination of on-street bike lanes and enhancements to the pedestrian corridor.
- + Narrower lanes can contribute to lower operating speeds along the roadway, which may be appropriate in dense, walkable corridors.

REFERENCES

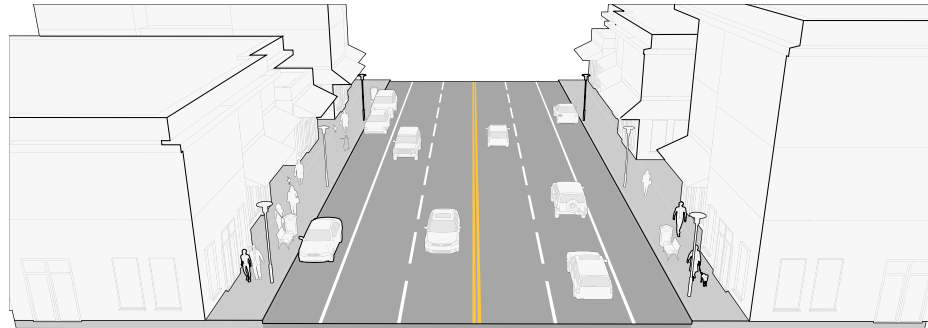
AASHTO. *Green Book*. 2011.

FHWA. *Achieving Multi-modal Networks: Applying Design Flexibility and Reducing Conflicts*. 2016.

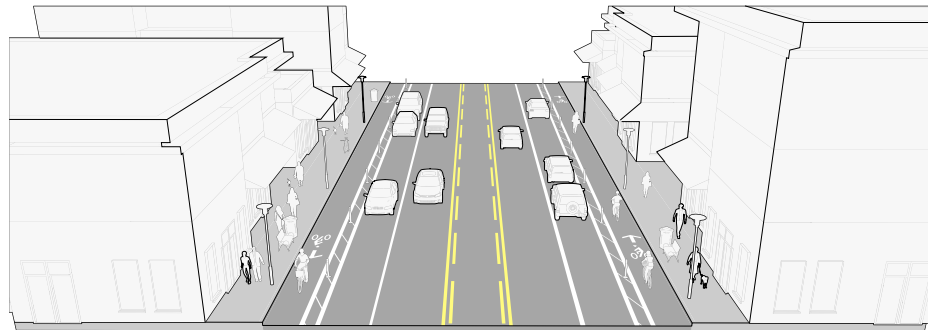
LANE RECONFIGURATION

Lane reconfiguration involves modifying one or more travel lanes to improve the safety performance of a roadway segment and provide space for bicycle lanes, turn lanes, streetscapes, wider sidewalks, and other purposes. Four- to three-lane conversions are most common, however, there are numerous types (e.g., three- to two-lanes, or five- to three-lanes).

Typical 4-lane road with on-street parking



Three-lane road diet (with center two-way left-turn lane), with on-street parking and separated bicycle lanes



GUIDANCE

- + Four-lane streets with volumes less than 15,000 vehicles per day are generally good candidates for four- to three-lane conversions.
- + Four-lane streets with volumes between 15,000 to 20,000 vehicles per day may be good candidates for four- to three-lane conversions. A traffic analysis is needed to determine feasibility.
- + Six-lane streets with volumes less than 35,000 vehicles per day may be good candidates for six- to five-lane (including two-way center turn lane) conversions. A traffic analysis is needed to determine feasibility.

CONSIDERATIONS

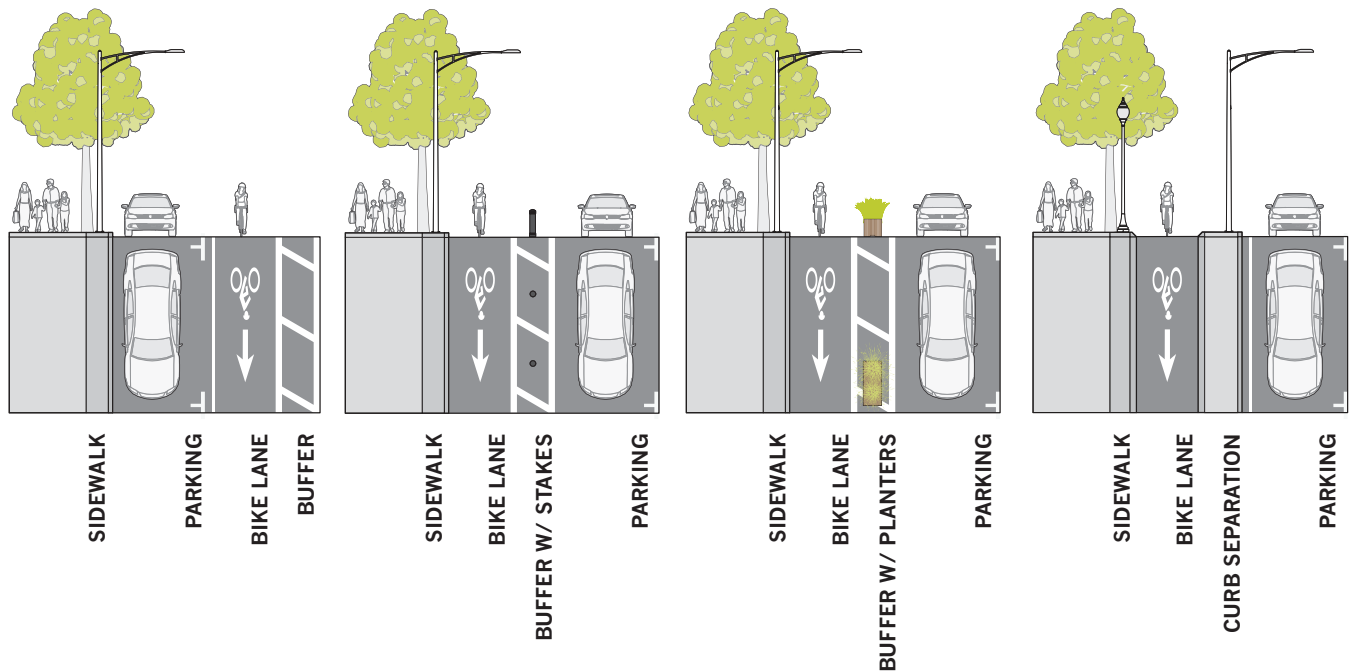
- + Lane reconfiguration is a great tool for reducing collisions and injuries, improving pedestrian crossings and providing designated space for bicyclists. Road diets improve safety as they reduce conflict points and lead to fewer and less severe collisions.
- + Robust public engagement is often required for successful lane reconfiguration projects.

REFERENCES

- AASHTO. *Guide for the Development of Bicycle Facilities*. 2024.
- FHWA *Road Diet Guide*. 2014.
- NACTO *Urban Street Design Guide*. 2013.

QUICK-BUILD

Quick-build projects allow for faster and lower-cost implementation using temporary materials. Many bicycle and pedestrian facilities can be implemented as quick-build projects, including separated bike lanes, curb extensions, mini-roundabouts, and crossing islands. This profile focuses on the quick-build implementation of separated bike lanes, using flex posts and paint to retrofit existing Class II buffered bike lanes. More permanent forms of separation, such as curb-protected bike lanes, cost more and are less flexible once implemented. A phased implementation approach, where quick-build “pilot” projects transition to permanent, protected bike lanes allow for public input and evaluation before investing in a permanent design.



Progression from pilot project to separated bike lane

CONSIDERATIONS

- + Lower-cost retrofits or pilot projects allow for quick implementation, responsiveness to public perception and ongoing evaluation. Separation types for short-term separated bike lane designs often include non-permanent separation, such as flexible delineator posts, planters or parking stops. Pilot projects allow the agency to:
 - + Test the separated bike lane configuration for bicyclists and traffic operations
 - + Evaluate public reaction, design performance, and safety effectiveness
 - + Make changes if necessary
 - + Transition to permanent design
- + Permanent separation designs provide a high level of protection and often have greater potential for placemaking, quality aesthetics, and integration with features such as green stormwater infrastructure. Agencies often implement permanent separation designs by leveraging private development (potentially through developer contribution), major capital construction, and including protected bike lanes in roadway reconstruction designs. Examples of permanent separation materials include rigid bollards, raised medians and grade-protected bike lanes at an intermediate or sidewalk level.

REFERENCES

- FHWA. *DIB-89-02: Separated Bike Lane Planning and Design Guide*. 2015.
- NACTO. *Urban Street Design Guide*. 2013.

MAINTENANCE OF SIDEWALKS AND SHARED-USE PATHS

Maintenance is a crucial component of a well-functioning active transportation network. A timely response to maintenance issues will encourage more people to use the infrastructure and boost confidence in the network.

CONSIDERATIONS

- + Conduct routine inspections of high-volume sidewalks and apply temporary measures to maintain functionality and repair heaving (such as patching, grinding, mudjacking).
- + Shared-use paths should meet a baseline pavement condition index (PCI) of 70 or greater, with 80 or greater preferred. Pavement should also provide enough stability to prevent substantial wear and cracking with regular maintenance vehicle traffic (typically, 6" thick concrete or asphalt).
- + Provide surface repairs such as crack repair, concrete stone replacement, and/or joint sealing as soon as the issue is identified. These problems grow worse over time and can continue to provide opportunity for conflict or injury.
- + Regular sweeping and trash removal of shared-use paths and sidewalks enhance the user experience and minimize opportunities for conflict or injury.
- + Cut back vegetation that is encroaching on paths and sidewalks. Cut back tree roots and/ or install root barriers where appropriate.
- + Inspect signs and markings regularly, replacing and repairing them as soon as possible. Consider upgrading old signs or markings with newer materials, if available.
- + Ensure drainage swales and structures are kept free of silt and debris and are functioning appropriately.
- + For any construction project that may impact an existing sidewalk or shared-use path, an appropriate detour and signage plan should be proposed by the contractor to ensure continuous and safe service.
- + Check, repair, and maintain all lights and lighting systems, particularly underpass lighting.
- + Natural surface paths may need regrading, weeding, or the repair of ruts.



The table below describes the frequency for various shared-use path and bikeway maintenance activities.

Frequency	Maintenance Activity
<div style="text-align: center;"> <p>More Frequently</p> <p>Less Frequently</p> </div>	Tree/brush clearing and mowing
	Repaint or repair trash receptacles, benches, signs, and other amenities, if necessary
	Sign replacement
	Patching/minor regrading/concrete panel replacement
	Planting/pruning/beautification/removing leaves
	Culvert/drainage cleaning and repair
	Surface evaluation/pavement assessment to determine need for patching/regrading/ re-striping
	Repaint or repair trash receptacles, benches, signs, and other amenities, if necessary
	Sealcoat asphalt shared-use paths
	Resurface/regrade/re-stripe shared-use paths
Assess/replace sidewalks and shared-use paths	

MAINTENANCE OF ON-STREET FACILITIES

Maintenance is a crucial component of a well-functioning active transportation network. A timely response to maintenance issues will encourage more people to use the infrastructure and boost confidence in the active transportation network. The considerations below apply to all on-street bicycle facilities, as well as crosswalks.



CONSIDERATIONS

- + Maintenance of bike lanes and crosswalks is the responsibility of the public or private agency that is responsible for maintaining the roadway. This practice may contrast with responsibility for maintaining the adjacent sidewalk, which in some cases will be that of the abutting landowner.
- + Pavement markings may require regular maintenance. Deteriorated bike lane markings, buffers, crosswalks, or sharrows may reduce perceived safety on facility.
- + When roadway pavement condition is assessed, the entire roadway including bicycle facilities and shoulders must be included in the PCI score.
- + The general public, public works staff, and contractors should be trained to place garbage bins in the street buffer zone to avoid obstructing the bike lane. Sidewalk buffers may be used to store bins where street buffers are too narrow.
- + For Class IV separated bikeways: Bike lane widths of 8 feet or more are compatible with smaller sweepers, but responsible parties may have larger and incompatible maintenance fleets. Narrower sweepers (approximately 4 feet to 5 feet minimum operating width) may be required to clear one-way separated bike lanes.
- + For Class IV street-level separated bike lanes without raised medians, debris can collect in the street buffer area between vertical objects and can migrate into the bike lane if not routinely collected.
- + Landscaped areas, including green stormwater infrastructure, can also collect debris and require regular attention.
- + As noted in the previous section, seasonal maintenance activities such as frequent removal of leaves in the fall should be considered.

NACTO. Urban Street Design Guide. 2013.

DESIGNING AN ACTIVE MODES NETWORK



WAYFINDING

Wayfinding helps identify the best routes to destinations, helps bicyclists overcome a barrier of not knowing where to ride, and reminds motorists to anticipate the presence of bicyclists and pedestrians. Wayfinding systems often combine signage and pavement markings to guide bicyclists and pedestrians along preferred routes to destinations across the community, county, or region. Routes may or may not be numbered, named, or color-coded. Signs may also indicate distances or travel time to destinations.



GUIDANCE

- + Basic bicycle route signs consist of a MUTCD-style “Bike Route” sign (D11-1 shown above, right) placed every half mile on a bike route and on the approach to bike routes at decision points.
- + Bike route signs can be supplemented with panels showing destinations, directions, and distances (MUTCD D1 series, shown in photo above, left).
- + Unique numbered or named routes can be designated and can incorporate a route name or agency logos, also shown in photo above, left.
- + Place directional signs on the near side of intersections and confirmation signs on the far side of intersections.

REFERENCES

- AASHTO. *Guide for the Development of Bicycle Facilities*. 2024.
- Caltrans. *Manual on Uniform Traffic Control Devices*. 2014.
- NACTO. *Urban Bikeway Design Guide*. 2014.

CONSIDERATIONS

- + A bicycle wayfinding protocol should coordinate with bicycle route maps and provide three general forms of guidance:
 - + Decision assemblies, which consist of Bike Route identification and optional destination panels, placed at decision points where routes intersect or on the approaches to a designated bike route.
 - + Turn assemblies, which consist of Bike Route panels and arrow plaques, placed where a designated bike route turns from one street to another.
 - + Confirmation assemblies, which consist of Bike Route optional destination panels, placed on the far side of intersections to confirm route choice and the distance (and optionally, time) to destinations.
- + Sign design can be customized to add distinct community branding, but the clarity and accuracy of the information must be the top priority.

PEDESTRIAN SIGNALS

Pedestrian signal heads display the three intervals of the pedestrian phase: (1) The Walk Interval, signified by the WALK indication (or the walking person symbol) alerts pedestrians to begin crossing the street; (2) The Pedestrian Change Interval, signified by the flashing DON'T WALK indication (or the flashing hand symbol accompanied by a countdown display; shown on following page) alerts pedestrians approaching the crosswalk that they should not begin crossing the street; and (3) The Don't Walk Interval, signified by a steady DON'T WALK indication (or the steady upraised hand symbol) alerts pedestrians that they should not cross the street.

CONSIDERATIONS

Intersection geometry and traffic controls should encourage turning vehicles to yield the right-of-way to pedestrians. Traffic movements should be analyzed at intersections in order to utilize non-conflicting phases to implement one or more WALK intervals per cycle.

Signal design should also minimize the time that pedestrians must wait. Requiring pedestrians to wait for extended periods can encourage crossing against the signal. The 2010 Highway Capacity Manual states that pedestrians have an increased likelihood of risk-taking behavior (crossing against the signal) after waiting longer than 30 seconds.

Free-flowing right-turn lanes are discouraged at signalized intersections. Where they are present and unsignalized, the pedestrian signal and pushbutton should be located on the channelization ("pork chop") island. A yield or crosswalk warning sign should then be placed in advance of the crosswalk.

TIMING & ACTIVATION

- + Pedestrian signals should allocate enough time for pedestrians of all abilities to safely cross the roadway. The MUTCD specifies a pedestrian walking speed of 3.5 feet per second to account for an aging population.
- + Countdown pedestrian displays inform pedestrians of the amount of time in seconds that is available to safely cross during the flashing DON'T WALK (or upraised hand) interval. All pedestrian signal heads should contain a countdown display provided with the DON'T WALK (or upraised hand) indication.
- + In areas with higher pedestrian activity, such as near transit stations, Main Streets, and school zones, push button actuators may not be appropriate. People should expect to get a pedestrian cycle at every signal phase, rather than having to push a button to call for a pedestrian phase.

REF.

FHWA. *Manual on Uniform Traffic Control Devices*. 2023.

NACTO. *Urban Street Design Guide*. 2013.

U.S. Access Board. *Final Rule on Public Right-of-Way Accessibility Guidelines*, 2023.

ACCESSIBLE PEDESTRIAN SIGNALS (APS)

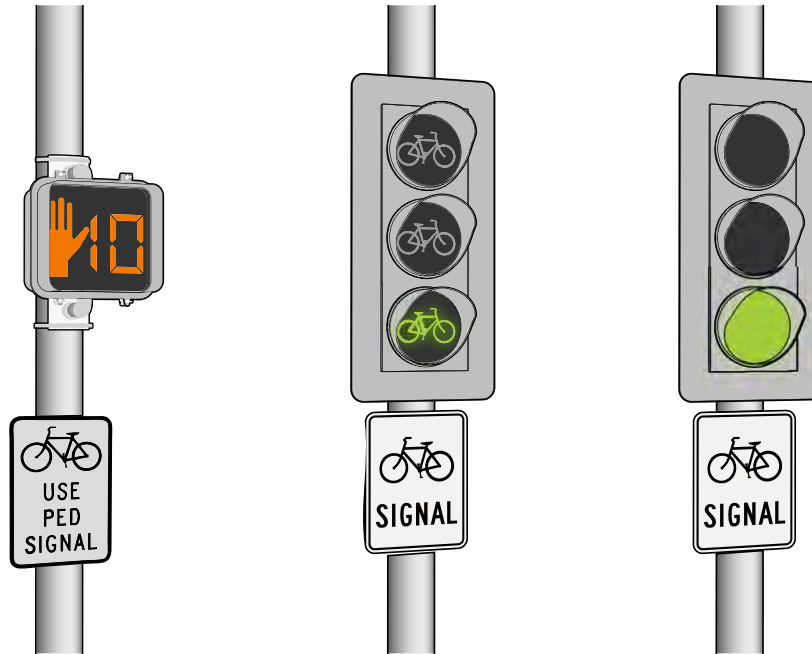
- + Accessible pedestrian signals and accessible detectors are devices that communicate information in non-visual formats about the pedestrian phase to pedestrians with visual and/or hearing disabilities. APS and detectors may include features such as audible tones, speech messages, detectable arrow indications and/or vibrating surfaces.
- + Pushbutton locator tones are used for locating the pedestrian pushbutton needed to actuate the WALK interval. Detectable arrows should be located on pushbuttons to point in the same direction as the crosswalk. At corners of signalized locations where two pushbuttons are present, they should be separated by at least 10'.
- + Audible walk indications should have the same duration as the pedestrian walk indication unless the pedestrian signal rests during the pedestrian phase, in which case the audible indication should be provided in the first seven seconds of the Walk interval.
- + For automatically-called pedestrian phases, pushbuttons can be used to activate accessible pedestrian signal features such as detectable arrow indications and/or speech messages.
- + When new pedestrian signals are installed, APS with pushbuttons are required. For existing pedestrian signals, the APS and pedestrian pushbuttons should be provided when the signal controller and software are altered, or the signal head is replaced.

LEADING PEDESTRIAN INTERVAL (LPI)

- + The Leading Pedestrian Interval initiates the pedestrian WALK indication three to seven seconds before motor vehicles traveling in the same direction are given the green indication. This signal timing technique allows pedestrians to enter the intersection prior to turning vehicles, increasing visibility between all modes.
- + The LPI should be used at intersections with high volumes of pedestrians and conflicting turning vehicles and at locations with a large population of elderly or school children who tend to walk slower.
- + A lagging protected left arrow for vehicles should be provided to accommodate the LPI.

BICYCLE SIGNALS

Bicyclists have unique needs at signalized intersections. Bicycle movements may be controlled by the same indications that control motor vehicle movements, by pedestrian signals, or by bicycle-specific traffic signals. The introduction of separated bike lanes creates situations that may require a leading bicycle interval or protected phases for bicycle traffic, or place bicyclists outside the cone of vision of existing signal equipment. In these situations, provision of signals for bicycle traffic will be required.



GUIDANCE

- + A stationary, or “standing”, cyclist entering the intersection at the beginning of the green indication can typically be accommodated by increasing the minimum green time on an approach per the 2024 AASHTO Guide for the Development of Bicycle Facilities.
- + A moving, or “rolling”, bicyclist approaching the intersection towards the end of the phase can typically be accommodated by increases to the red times (change and clearance intervals) per the 2024 AASHTO Guide for the Development of Bicycle Facilities.
- + Set loop detectors to the highest sensitivity level possible without detecting vehicles in adjacent lanes and field check.

CONSIDERATIONS

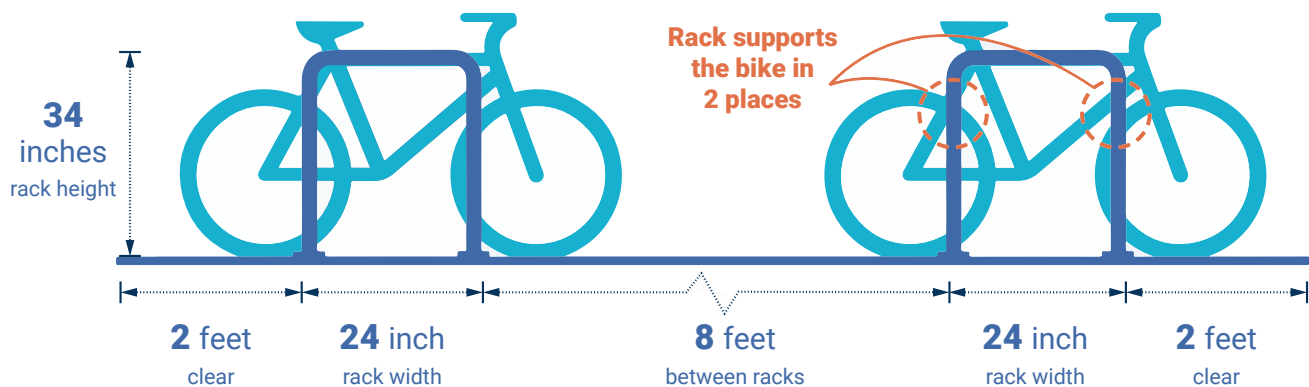
- + Bicycle-specific signals may be appropriate to provide additional guidance or separate phasing for bicyclists per the 2024 AASHTO Guide for the Development of Bicycle Facilities.
- + It may be desirable to install advanced bicycle detection on the intersection approach to extend the phase, or to prompt the phase and allow for continuous bicycle through movements.
- + Video detection, microwave and infrared detection can be an alternate to loop detectors.
- + Another strategy in signal timing is coordinating signals to provide a “green wave” timed to align with the travel speed of bicyclists (often 15 mph) such that bicycles will receive a green indication and not be required to stop. Several cities including Portland, OR and San Francisco, CA have implemented “green waves” for bicycles.

REFERENCES

- AASHTO. *Guide for the Development of Bicycle Facilities*. 2024.
- FHWA. *Manual on Uniform Traffic Control Devices*. 2023.
- NACTO. *Urban Bikeway Design Guide*. 2014.

SHORT-TERM BICYCLE PARKING

Bicycle parking enhances the effectiveness of bicycle networks by providing locations for the secure storage of bicycles during a trip. Sometimes called visitor parking, short-term parking is intended for shorter stays at locations such as shops, recreational facilities, businesses and other institutions. Bicycle parking requires far less space than automobile parking; in fact, 10 bicycles can typically park in the area needed for a single car.



GUIDANCE

- + Bicycle parking consists of a rack that supports the bicycle upright in two places and provides a secure place for locking. Bicycle racks should be permanently affixed to a paved surface. Movable bicycle racks are only appropriate for temporary use, such as at major community gatherings.
- + Bicycle parking facility should not obstruct pedestrian traffic or interfering with the use of the pedestrian areas.
- + Each parked bicycle should be accessible without moving another bicycle.
- + Add 2' from curb face.
- + Add 4' from curb for perpendicular installations.

CONSIDERATIONS

- + Racks should be located in a well lit, high visibility location to reduce potential for theft or vandalism.
- + Bicycle parking should be provided at all publicly accessible buildings, parks, and other destinations, and included in roadway, streetscape, and transit projects, as well as wherever car parking is required.
- + Multiple types of racks exist, but all should adhere to guidance pictured above regarding providing two points of contact for bike frame to prevent bikes from falling.

REFERENCES

- AASHTO. *Guide for the Development of Bicycle Facilities*. 2024.
- APBP. *Bicycle Parking Guidelines, 2nd Ed.* 2010.
- Caltrans. *Manual on Uniform Traffic Control Devices*. 2014.
- NACTO. *Urban Street Design Guide*. 2013.

LONG-TERM BICYCLE PARKING

Long-term bike parking is intended for residents in multi-unit buildings, employees, transit users, and others not attending to their bicycle for longer periods of time (generally several hours or days). Typically used for long-term bicycle parking, bicycle lockers are secure, locked boxes that store a single bicycle.



GUIDANCE

Lockers should be:

- + Clearly marked as a long-term bicycle parking space.
- + Located no lower than the first complete parking level below grade, and no higher than the first complete parking level above grade.
- + Available and accessible to all building tenants during the buildings hours of operation and at all times for residents in residential contexts.
- + Located in a well-lit, visible location near the main entrance or elevators.
- + Separated from vehicle parking by a barrier that minimizes the possibility of a parked bicycle being hit by a car.
- + Securely anchored.
- + Well-maintained and well lit.

REFERENCES

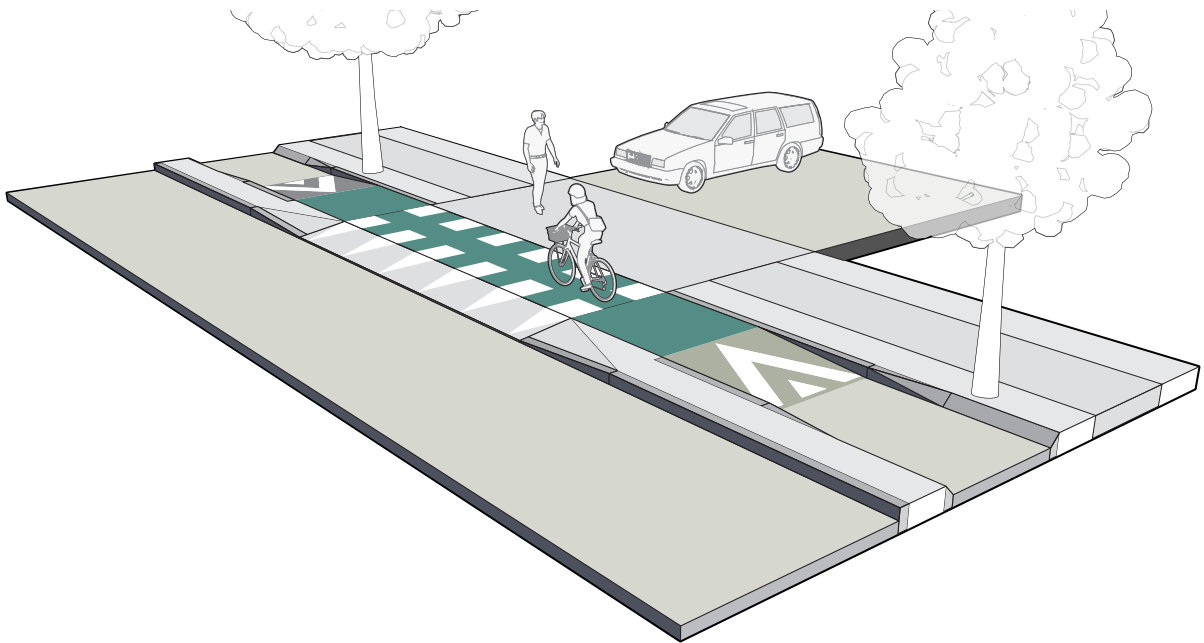
- AASHTO. *Guide for the Development of Bicycle Facilities*. 2024.
- APBP. *Bicycle Parking Guidelines, 2nd Ed*. 2010.
- Caltrans. *Manual on Uniform Traffic Control Devices*. 2014.
- NACTO. *Urban Street Design Guide*. 2013.

CONSIDERATIONS

- + In lieu of lockers, long-term bicycle parking can also be provided indoors. This can be located within businesses or offered as a locked public facility, accessible with the same key card technology as bicycle lockers.
- + Long-term bicycle parking should provide:
 - + Direct or indirect access to the street or sidewalk depending on whether it is located in a parking garage or at street level.
 - + Varying amount of conflict with automobiles depending on whether it is located in a parking garage or at street level.

DRIVEWAYS

Most bicycle and pedestrian facilities will need to cross streets, driveways, or alleys at multiple locations along a corridor. At these locations, the crossings should be designed to 1) delineate a preferred path for people bicycling through the intersection and 2) to encourage driver yielding behavior, where applicable. Bicycle crossings may be supplemented with green pavement, yield lines, and/or regulatory signs.



GUIDANCE

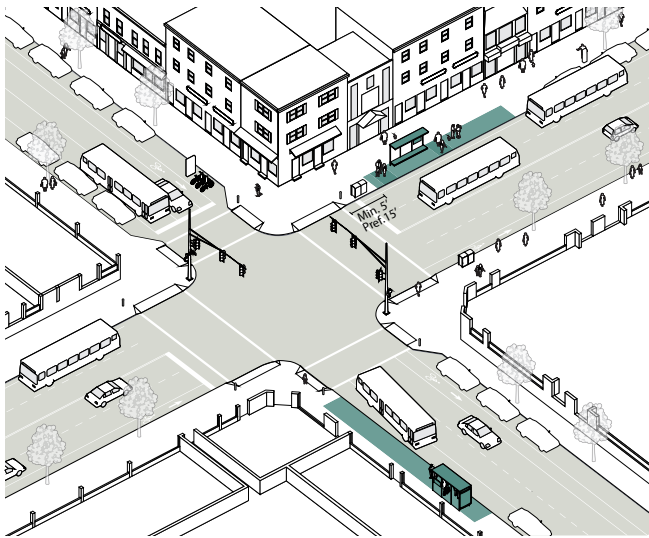
- + The bicycle crossing should be a minimum of 6 feet wide for one-way travel and 10 feet wide for two-way travel, as measured from the outer edge of the elephant's feet. Bicycle lane symbol markings should be avoided in bicycle crossings. Directional arrows are preferred within two-way bicycle crossings. Two-way crossings should also be indicated with warning signage for drivers entering and exiting the driveway.
- + Though the graphic above shows a Class IV Separated Bike Lane, bicycle driveway crossings are also applicable to Class II bicycle facilities.
- + Regardless of whether a driveway crossing is commercial or private, property owners must maintain a "visibility triangle" that ensures adequate sightlines as a motorist exits a driveway. Requirements vary based on jurisdiction.

CONSIDERATIONS

- + Advance stop bars may be used in advance of driveway crossings to alert motorists to bicyclists and pedestrians crossing.
- + Supplemental yield lines ("shark's teeth") may be used in advance of unsignalized crossings at driveways, at signalized intersections where motorists may turn across a bicycle crossing during a concurrent phase, and in advance of bicycle crossings located within roundabouts.
- + Raised bicycle crossings further promote driver yielding behavior by slowing their speed before the crossing and increasing visibility of people bicycling.
- + Dashed green-colored pavement may be used in the bicycle crossing to increase the visibility of the crossing where permitted conflicts occur. Green color may be desirable at crossings where concurrent vehicle crossing movements are allowed and where sightlines are constrained, or where motor vehicle turning speeds exceed 10 mph.
- + Whenever a bicycle lane intersects with a high traffic driveway special treatment should be taken to reduce conflict.
- + Consider installing signage for drivers entering roadway, particularly relevant for commercial driveways (eg: fast food restaurants) where drivers' attention may be challenged.

TRANSIT STOPS

Any marked or signed location where transit vehicles stop and service passenger boarding and alighting is a transit stop. The most basic transit stops have only a pole-mounted “header” sign indicating the transit provider and route(s). High frequency routes and higher volume stops generally have more passenger amenities such as benches, shelters, traveler information, trash receptacles, bicycle parking, and other features.



Landing Zone on Natural Curb Line



Transit Island

GUIDANCE

- + Landing zones should be provided at all doors of the transit vehicle. Buses can vary in length and will have different door configurations. Landing zones should be designed in coordination with all transit providers.

REFERENCES

- AASHTO. *Guide for Geometric Design of Transit Facilities on Highways and Streets*. 2014.
- NACTO. *Urban Street Design Guide*. 2013.
- U.S. Access Board. *Final Rule on Public Right-of-Way Accessibility Guidelines*, 2023.

CONSIDERATIONS

- + All transit stops must be ADA compliant, and should be safe, convenient, well-illuminated, and clearly visible. Transit stops should be connected to the larger pedestrian network with continuous sidewalks, curb ramps, and safe pedestrian crossings. Mid-block stops should provide access to mid-block crosswalks.
- + Transit stops on urban streets are typically located at the natural curb line or on a bus bulb or transit island.
- + Bus bulbs may be considered where additional pedestrian space is needed or to provide an in-lane spot where it is challenging for transit vehicles to reenter traffic. Transit islands are recommended on streets with separated bicycle facilities.
- + Transit stops may be located on the near-side of an intersection before a signal or cross street, on the far-side after a bus has passed through an intersection, or at a mid-block location between intersections.
- + Generally, transit agencies prefer far-side stops since they provide better visibility between transit riders and motor vehicles. Near-side bus stops may be appropriate where traffic flow is lower or where transit riders can more easily transfer without crossing the street. Stops can also be placed mid-block where there are major passenger generators or where space next to an intersection is insufficient.
- + Transit stop locations are determined based on a number of factors including intersection operations, bus routing, curbside conditions, transfer points, intersection geometry and sightlines, consideration of other street users, and major generators or destinations. The location of a transit stop can affect transit travel time, passenger safety, and roadway operations.
- + Seating at or near transit stops can improve passenger comfort, as can shade in the form of street trees or awnings. Seating need not be a unique and dedicated element, but may include leaning rails, planters, ledges, or other street elements.

DRAINAGE AND STORMWATER MANAGEMENT

Providing proper drainage enhances the safety and comfort of all users by reducing water ponding on the street and bike lane surfaces as well as the accumulation of debris. Proper drainage also protects the longevity of the roadway infrastructure and ensures that drainage features are adequate to accommodate state and local requirements to manage stormwater and minimize erosion.



CONSIDERATIONS

- + In urban areas, stormwater may need to be directed toward the sidewalk buffer. In suburban and rural areas, the preferred practice is to direct runoff onto adjacent vegetated areas, where soils and slopes allow for runoff to naturally infiltrate. For uncurbed roadways, the preference is to locate drainage swales between the roadway and separated bike lane or side path, which may require street buffer widths wider than the minimum recommended widths to provide sufficient capacity in the swale.
- + For locations where curbs do not include a gutter, curb inlets located within or adjacent to the bike lane zone should be designed to minimize steep elevation changes or slopes that could cause a bicyclist to crash. If a steep elevation change is provided, it should be designed as a gutter, the steep slope width may not be counted as part of the bike lane, and the area may be demarked with a surface material change and/or a white edge line to guide bicyclists away from the hazard.
- + Drainage grates should be located outside of the bike lane whenever feasible to maintain a comfortable riding surface. When their placement in the bike lane cannot be avoided, drainage grates must be bicycle-compatible, with openings small enough to prevent a bicycle wheel from falling into the slots of the grate or with bar designs which are perpendicular to the path of travel.

- + A hard surface cross slope of 1 percent typically provides adequate conveyance of drainage while meeting accessibility requirements.
- + Rectangular grates should be considered in place of square designs where the grate design can result in bicycle wheels being caught if installed in the wrong direction. Where grates are located within a bicycle facility or adjacent to bicyclists' operating space, the gap between the drainage grate and its frame should be 0.5 in. or less. Another bicycle friendly option is to place the grate entirely within a gutter rather than extending it into the bicycle facility.
- + Grates and other utility covers should remain flush with the pavement surface after a pavement overlay to within 0.25" of the new surface. If this is not possible or practicable, the pavement edge should slope to the drainage grate so it does not have an abrupt edge at the inlet.
- + Pedestrian accessibility guidelines limit openings on ground surfaces, such as grates, to a width of 0.5" or less to prevent wheelchair castors from becoming wedged into the opening. Pedestrian accessibility guidelines also limit vertical deviations in surfaces of more than 0.25". To minimize risks to pedestrians, drainage grates, utility covers, and gutters should not be located within bicycle facilities where pedestrians are traveling unless they meet pedestrian accessibility guidelines.



REFERENCES

AASHTO. *Guide for the Development of Bicycle Facilities*. 2024.

DRAINAGE AND STORMWATER MANAGEMENT



- + Curb extensions can be designed to direct stormwater runoff from bike lanes and adjacent roadways into green infrastructure systems like bioswales or rain gardens, where the water can be filtered and absorbed. These extensions also provide space for permeable surfaces, such as permeable pavement or plantings. Additionally, bulb-outs can improve safety by slowing vehicle speeds and increasing visibility for cyclists and pedestrians.



- + Any infrastructure located in low-lying areas may need special attention due to larger scale drainage and flooding issues. Designers may need to capture excess stormwater to prevent standing water or erosion on a bicycle facility.
- + When stormwater management features such as filtration/infiltration measures or permeable pavements are considered in conjunction with a bike facility project, designers should give special consideration to the location of existing utilities and placement of relocated utilities. Utilities are generally incompatible with stormwater infiltration measures and should be relocated outside of the zone of influence of those facilities.
- + The addition of separated bike lanes to a roadway presents an opportunity to introduce green infrastructure strategies, including continuous treatments (e.g., permeable hardscape surfaces, linear bioretention areas, and linear water quality swales) as well as those that may only be implemented at spot locations (e.g., bioretention areas, bioretention curb extension areas, and tree boxes).
- + Permeable hardscape surfaces for bicycle and pedestrian zones can also reduce stormwater flows.



TRAFFIC CALMING



6

CHICANES AND CHOKERS

Chicanes slow traffic by creating a serpentine travel path by alternating street features from one side of the street to the other. Chokers narrow the road in midblock locations through the application of curb extensions (or on-street parallel parking) on both sides of the street. Chicanes and chokers both can be designed to integrate stormwater drainage catchments, street tree planting, benches, bicycle parking, and other amenities.



GUIDANCE

- + Use chicanes on low-volume, local streets. Use chokers on arterials, collector, and local streets. Engineering judgment should be used to determine when the need is met for each treatment.
- + Chicanes must meet requirements for horizontal tapers per the California MUTCD.
- + Avoid use of chicanes on streets with higher volumes of bus, freight, or emergency service activity. Use mountable curbs to accommodate larger motor vehicles while maintaining tight turn radii to slow people driving.
- + Use vertical elements like plantings in combination with chicanes to warn drivers of traffic pattern.

CONSIDERATIONS

- + Use for stormwater infiltration with bioretention areas or appropriately sized tree filter boxes.
- + Consult with fire department to ensure that designs minimize impacts to emergency services.
- + If needed to maintain existing drainage patterns, consider constructing with a 2' drainage channel between the chicane island and curb.

REFERENCES

- Caltrans. Manual on Uniform Traffic Control Devices. 2014.*
- NACTO. Urban Street Design Guide. 2013.*

SPEED CUSHIONS

Vertical deflection treatments like speed cushions are some of the most effective treatments for slowing motor vehicle speeds. These treatments can reduce higher-speed motor vehicle cut-through traffic on local streets. Speed cushions are similar to speed humps, but include gaps to allow vehicles with wide wheelbases to pass through unimpeded. Speed cushions also provide bicyclists an opportunity to subvert vertical deflection.



GUIDANCE

- + Use on local and shared streets at midblock locations where lower motor vehicle speeds and volumes are desired, such as on bike boulevards.
- + Locate speed cushions periodically along the corridor every 250 to 500 feet to accomplish speed control. Do not locate in front of driveways, close to intersections, or on a sharp curve.

CONSIDERATIONS

- + Unlike speed humps, which extend the entire width of the street, speed cushions are more appropriate for roads with frequent emergency vehicle access. To minimize emergency response delay even further, consider offset speed tables instead, which are speed tables split in half down the street centerline with longitudinal separation between the halves.
- + Speed cushions may be constructed out of asphalt or rubber vertical deflections.
- + Design should consider the ability to withstand the weight of fire apparatus and outriggers.

REFERENCES

- AASHTO. *Guide for the Development of Bicycle Facilities*. 2024.
- FHWA. *Traffic Calming E-Primer*. (N.D.)
- NACTO. *Urban Street Design Guide*. 2013.

SPEED REDUCTION MARKINGS

Speed Reduction Markings (also known as Optical Speed Bars) are transverse pavement markings placed with progressively reduced spacing on both edges of the traveled way to create the perception of increased speed. This illusion encourages drivers to slow down as they pass by the markings.



GUIDANCE

- + Use on collector or local roads with any volume, ideally placed upstream of unexpected horizontal curves.

CONSIDERATIONS

- + Speed reduction markings may be particularly useful on rural roads with higher volumes of bicyclists. (See Chapter 1 for more information on Class III unclassified bike routes.)
- + Durable marking materials, such as thermoplastic, should be used as markings are exposed to increased wear from tires.
- + Do not install on lanes that do not have a longitudinal line (center line, edge line, or lane line) on both sides of the lane.

REFERENCES

- Caltrans. Manual on Uniform Traffic Control Devices. 2014.*
- Caltrans. Traffic Calming Guide. 2023.*
- ITE. Traffic Calming Fact Sheets. (N.D.)*

HARDENED CENTERLINES

Hardened centerlines feature vertical elements such as mountable curb or flex posts that force turning drivers to slow down and keep them from crossing the centerline when making turning movements. They have been shown to reduce motorist-pedestrian conflicts and reduce the speed of left-turning vehicles.



GUIDANCE

Use at:

- + Intersections with a history of collisions involving people walking or rolling and left-turning motor vehicles; or
- + Intersections with high volumes of people walking, rolling, and biking across the street; or
- + Intersections where motor vehicles are frequently turning across double yellow lines at high speeds.
- + Designs can include any combination of plastic curbing, rubber speed bumps, and flex posts, depending on turning radii, lane width, and needs to accommodate large motor vehicle turning movements.
- + Where space allows, install rubber speed bump “nose” extending into the intersection.

CONSIDERATIONS

- + On roadways where trucks and emergency vehicles frequently make turning movements, consider using mountable curbs to allow larger motor vehicles to make turns while slowing smaller motor vehicles.
- + Intersection design including hardened centerlines must consider vehicular turning paths to prevent head-on collisions between opposing left-turning motorists.
- + Can be used in conjunction with turn wedges and at protected intersections

REFERENCES

AASHTO. *Guide for the Development of Bicycle Facilities*. 2024.

TRANSVERSE RUMBLE STRIPS

Transverse rumble strips are raised areas across the surface of an approach lane to produce an audible and tactile warning of the impending intersection.



GUIDANCE

- + Use in combination with Intersection Warning (W2-1 through W2-8), Advance Traffic Control (W3-1 or W3-2), or Pedestrian Crossing (W11-2) signs.

CONSIDERATIONS

- + Noise generated from vehicles traversing the rumble strips can be an issue when residences are in close proximity to the intersection.
- + Can require significant maintenance activities, especially on approaches characterized by high volumes of truck traffic.

REFERENCES

- Caltrans. Manual on Uniform Traffic Control Devices. 2014.*
- ITE. Traffic Calming Fact Sheets. (N.D.)*

TRAFFIC CIRCLES

Traffic circles are circular raised center islands at the intersection of two neighborhood streets installed to slow vehicle approach speeds. Unlike a mini-roundabout, a residential traffic circle is typically characterized by (1) a non-traversable center island, (2) no splitter islands on the intersection approaches, and (3) either yield control or no control.



GUIDANCE

- + Use at intersections in primarily residential areas where daily motor vehicle volumes for all approaching legs of the intersection is less than 15,000 ADT. In particular, these may be used at intersections along bike boulevards.
- + Design the circles to be visible at night with reflective materials and/or ensure adequate street lighting exists.
- + Provide adequate signage (see FHWA MUTCD for details).

CONSIDERATIONS

- + Neighborhood traffic circles are most effective when paired with other traffic calming treatments.
- + Where large vehicles are infrequent, design to allow larger trucks to turn left in front of the circle. Where trucks are frequent, include mountable truck aprons around the outside of the circle to allow large motor vehicles to use the intersection without encouraging high speeds by smaller motor vehicles.
- + If the circle geometry precludes turning movements for larger vehicles, consider turning restrictions if the adjacent street network is adequate.
- + Traffic circles also provide opportunities for plantings, special identifying signage for neighborhoods, or public art. Consider planting native and/or seasonal vegetation in the center of the circles to provide neighborhood beautification, traffic calming elements, and stormwater infiltration.
- + Traffic circles can be constructed as a quick-build project using temporary materials. See the Quick-Build section of Chapter 4 for more details.

REFERENCES

- AASHTO. *Guide for the Development of Bicycle Facilities*. 2024.
- FHWA. *Manual on Uniform Traffic Control Devices*. 2023.
- ITE. *Traffic Calming Fact Sheets*. (N.D.)

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RESOURCES & CITATIONS



7

RESOURCES & CITATIONS

The bicycle and pedestrian facilities and amenities included in this Toolkit are based on the recommendations from the following state and national standards and resources:

American Association of State Highway and Transportation Officials (AASHTO)

Guide for the Development of Bicycle Facilities, 2024

California Department of Transportation (Caltrans)

DIB 82-06: Pedestrian Accessibility Guidelines for Highway Projects, 2017
DIB 89-02: Class IV Bikeway Guidance, 2022
DIB 94: Complete Streets Contextual Design Guidance, 2024
Highway Design Manual, 7th Edition, 2020
Manual on Uniform Traffic Control Devices, Revision 8, 2014

Federal Highway Administration (FHWA)

Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations, 2018
Manual on Uniform Traffic Control Devices, 11th Edition, 2023
Safety Effects of Marked Versus Unmarked Crosswalks at Uncontrolled Locations, 2005
Separated Bike Lane Planning and Design Guide, 2015
Small Town and Rural Multimodal Networks, 2016

Institute of Transportation Engineers (ITE)

Traffic Calming Fact Sheets, (N.D.)

National Association of City Transportation Officials (NACTO)

Urban Street Design Guide, 2013
Transit Street Design Guide, 2017
Urban Bikeway Design Guide, 2014

United States Access Board

Americans with Disabilities Act and Architectural Barriers Act Accessibility Guidelines, 2004
Final Rule on Public Right-of-Way Accessibility Guidelines, 2023

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NAPA COUNTY ACTIVE TRANSPORTATION PLAN TREATMENT TOOLKIT

2024

