Long Beach Bicycle Master Plan

Appendix A

Bicycle Facility Design Guidelines

APPENDIX TO THE MOBILITY ELEMENT
OF THE GENERAL PLAN
CITY OF LONG BEACH
JANUARY 2017

A

Appendix

Design Guidelines:

Best Practice Design for Bicycle Facilities

GUIDANCE BASIS

The sections that follow serve as an inventory of bicycle design treatments and provide guidelines for their development. These treatments and design guidelines are important because they represent the tools for creating a bicycle-friendly, safe, accessible community. The guidelines are not, however, a substitute for a more thorough evaluation by a landscape architect or engineer upon implementation of facility improvements. The following standards and guidelines are referred to in this guide.

NATIONAL GUIDANCE

The American Association of State Highway and Transportation Officials (AASHTO) **Guide for the Development of Bicycle Facilities (2012)** provides guidance on dimensions, use, and layout of specific bicycle facilities.

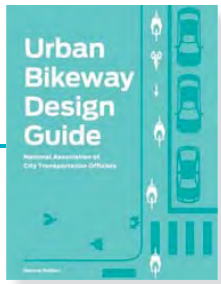
The National Association of City Transportation Officials' (NACTO) **Urban Bikeway Design Guide (2012)** is the newest publication of nationally recognized bikeway design standards, and offers guidance on the current state of the practice designs.

The AASHTO **A Policy on Geometric Design of Highways and Streets (2011)** commonly referred to as the "Green Book," contains the current design research and practices for highway and street geometric design.

IMPACT ON SAFETY AND CRASHES

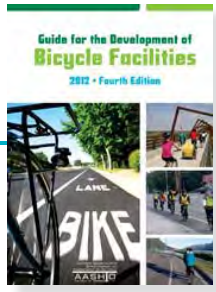
Bicycle facilities can have a significant influence on user safety. The Federal Highway Administration's (FHWA) Crash Modification Factor Clearinghouse (http://www.cmfclearinghouse.org/) is a web-based database of Crash Modification Factors (CMF) to help transportation engineers identify the most appropriate countermeasure for their safety needs. Where available and appropriate, CMFs or similar study results are included for each treatment.

Urban Bikeway Design Guide



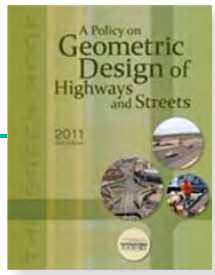
California MUTCD

Guide for the Development of Bicycle Facilities



Complete Intersections

A Policy on Geometric Design



CALIFORNIA GUIDANCE

The California Manual on Uniform Traffic Control Devices (CaMUTCD) (2014) is an amended version of the FHWA MUTCD 2009 edition modified for use in California. While standards presented in the CAMUTCD substantially conform to the FHWA MUTCD, the state of California follows local practices, laws and requirements with regards to signing, striping and other traffic control devices.

The California Highway Design Manual (HDM) (2014) establishes uniform policies and procedures to carry out highway design functions for the California Department of Transportation. The 2012 edition incorporated Complete Streets focused revisions to address the Department Directive 64 R-1.

Complete Intersections: A Guide to Reconstructing Intersections and Interchanges for Bicyclists and Pedestrians (2010) is a reference guide presents information and concepts related to improving conditions for bicyclists and pedestrians at major intersections and interchanges. The guide can be used to inform minor signage and striping changes to intersections, as well as major changes and designs for new intersections.

Main Street, California: A Guide for Improving Community and Transportation Vitality (2013) reflects California's current manuals and policies that improve multimodal access, livability and sustainability within the transportation system. The guide recognizes the overlapping and sometimes competing needs of main streets.

The Caltrans Memo: Design Flexibility in Multimodal Design (2014) encourages flexibility in highway design. The memo stated that "Publications such as the National Association of City Transportation Officials (NACTO) "Urban Street Design Guide" and "Urban Bikeway Design Guide," … are resources that Caltrans and local entities can reference when ma king planning and design decisions on the State highway system and local streets

USER DESIGN DIMENSIONS

Bicyclists, by nature, are much more affected by poor facility design, construction and maintenance practices than motor vehicle drivers. Bicyclists lack the protection from the elements and roadway hazards provided by an automobile's structure and safety features. By understanding the unique characteristics and needs of bicyclists, a facility designer can provide quality facilities and minimize user risk.

Similar to motor vehicles, bicyclists and their bicycles exist in a variety of sizes and configurations. These variations occur in the types of vehicle (such as a conventional bicycle, a recumbent bicycle or a tricycle), and behavioral characteristics (such as the comfort level of the bicyclist). The design of a bikeway should consider reasonably expected bicycle types on the facility and utilize the appropriate dimensions.

The figure to the right illustrates the operating space and physical dimensions of a typical adult bicyclist, which are the basis for typical facility design. Bicyclists require clear space to operate within a facility. This is why the minimum operating width is greater than the physical dimensions of the bicyclist. Bicyclists prefer five feet or more operating width, although four feet may be minimally acceptable.

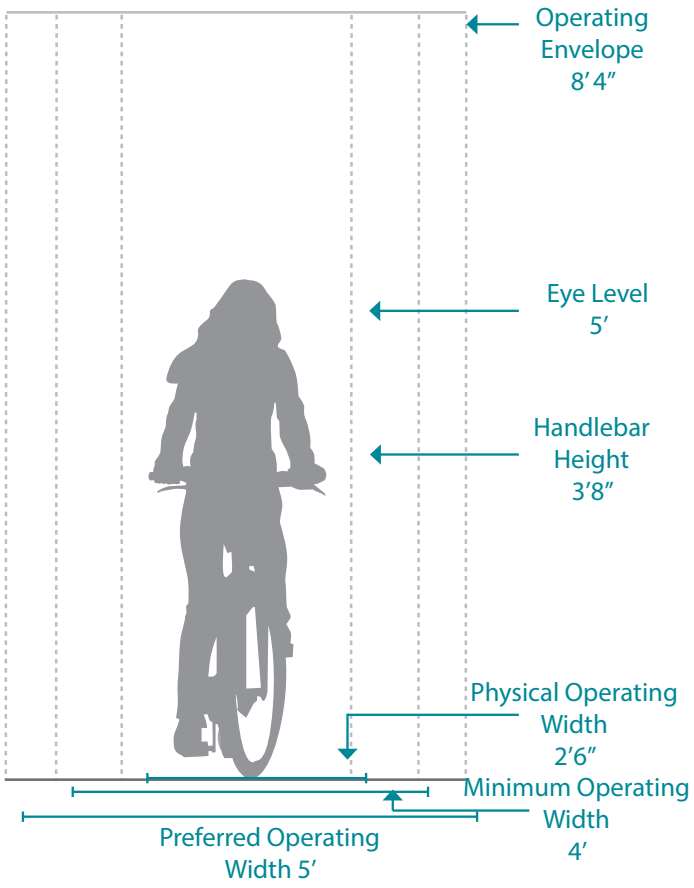
Table A-1: Bicycle as Design Vehicle-Design Speed Expectations

Bicycle Type	Feature	Typical Speed
Upright Adult Bicyclist	Paved level surfacing Crossing intersections Downhill Uphill	8-12 mph* 10 mph 30 mph 5-12 mph
Recumbent Bicyclist	Paved level surfacing	18 mph

*Typical speed for casual riders per AASHTO 2013

DESIGN SPEED EXPECTATIONS

The expected speed that different types of bicyclists can maintain under various conditions also influences the design of facilities such as shared use paths. Table A-1 provides typical bicyclist speeds for a variety of conditions.



Bicycle Rider - Typical Dimensions

FACILITY SELECTION

Selecting the best bikeway facility type for a given roadway can be challenging, due to the range of factors that influence bicycle users' comfort and safety. There is a significant impact on cycling comfort when the speed differential between bicyclists and motor vehicle traffic is high and motor vehicle traffic volumes are high.

FACILITY SELECTION TABLE

As a starting point to identify a preferred facility, the chart below can be used to determine the recommended type of bikeway to be provided in particular roadway speed and volume situations. To use this chart, identify the appropriate daily traffic volume and travel speed on or the existing or proposed roadway, and locate the facility types indicated by those key variables.
Other factors beyond speed and volume which affect facility selection include traffic mix of automobiles and heavy vehicles, the presence of on-street parking, intersection density, surrounding land use, and roadway sight distance. These factors are not included in the facility selection chart below, but should always be considered in the facility selection and design process.

8-TO-80 BIKEWAY

An 8-to-80 bikeway is a low stress facility that people of all ages, from small children to older adults, feel comfortable riding on. Low stress facilities are separated from high speed and/or high volume roadways by physical separation. A bicycle boulevard, with speed and volume management along the route, may be considered an 8-to-80 facility. Likewise, a separated bikeway, which provides physical separation from motor vehicle traffic, is considered a low stress and 8-to-80 facility.

Table A-2: Facility Selection Table

CLASS III: BICYCLE BOULEVARDS

Bicycle boulevards (Class III) are low-volume, low-speed streets modified to enhance bicycling by using treatments such as signage, pavement markings, speed and/or volume reduction, and intersection modifications. These treatments allow through movements of bicyclists while discouraging similar through-trips by non-local motorized traffic.

APPLICATION

- Bicycle boulevards should be developed on streets that improve connectivity to key destinations and provide a direct route for bicyclists.
- Bicycle boulevards parallel to commercial streets improve access for "interested but concerned" bicyclists & complement bike lanes on major roadways.
- Streets are signed at 25 mph or less to improve the bicycling environment and decrease the risk and severity of crashes.
- Traffic volumes are limited to 3,000 vehicles per day (ideally less than 1,500) to minimize passing events and potential conflicts with motor vehicles.
- Use of streets that parallel major streets can discourage non-local motor vehicle traffic without significantly impacting motorists.
- Use of streets where a relatively continuous route for bicyclists exists and/or where treatments can provide wayfinding and improve crossing opportunities at offset intersections.
- Use of streets where bicyclists have right-of-way at intersections or where right-of-way is possible to assign to bicyclists.

DESIGN FEATURES

Pavement Markings

- Place symbols every 250-800 feet along a linear corridor, as well as after every intersection.
- On narrow streets where a motor vehicle cannot pass a bicyclist within one lane of traffic, place stencils in the center of the travel lane.
- A bicycle symbol can be placed on a standard road sign, along with distinctive coloration.

SIGNS

- Some cities have developed unique logos or colors for wayfinding signs that help brand their bicycle boulevards.
- Be consistent in content, design, and intent; colors reserved by the Manual on Uniform Traffic Devices (CAMUTCD) for regulatory and warning road signs are not recommended.
- Signs can include information about intersecting bikeways and distance/time information to key destinations.

FURTHER CONSIDERATION

- Separated bikeways are not generally necessary along bicycle boulevards because roadway design itself creates a comfortable shared environment where people biking and people driving can truly share the road.
- Bicycle boulevards should form a continuous network of streets or off-street facilities that accommodate bicyclists who are less willing to ride on streets with motorized traffic. Most bicycle boulevards are located on residential streets, though they can also be on commercial or industrial streets. Due to the presence of trucks and commercial vehicles, as well as the need to maintain good traffic flow and retain motor vehicle parking, bicycle boulevards on commercial or industrial streets can tolerate higher automobile speeds and volumes than would be desired on neighborhood streets. Vertical traffic calming can minimize impacts to large vehicles and parking.

SAFETY IMPACT

- A study in Berkley, California found that cyclists may be safer riding on side streets than on busy arterials, with collision rates on bicycle boulevards two to eight times lower than on parallel, adjacent arterial routes. The study concluded that properly implemented bicycle boulevards provide a safer alternative to riding on arterial streets (Minikel 2011).

REFERENCES

- *IBPI. Fundamentals of Bicycle Boulevard Planning & Design. 2009. City of Berkeley. Bicycle Boulevard Design Tools and Guidelines. 2000.*
- *City of Emeryville. Bicycle Boulevard Treatments. 2011.*
- *City of Milwaukie. Milwaukie Bicycle Wayfinding Signage Plan. 2009.*
- *City of Oakland. Design Guidelines for Bicycle Wayfinding Signage. 2009.*
- *Minikel, Eric. "Cyclist Safety on Bicycle Boulevards and Parallel Arterial Routes in Berkeley, California." Accident Analysis & Prevention 45 (2011): 241-47. Web. NACTO. Urban Bikeway Design Guide. 2012.*

BICYCLE BOULEVARD VOLUME MANAGEMENT

Volume management measures reduce or discourage thru traffic on bicycle boulevards by physically or operationally reconfiguring corridors and intersections along the route. Lower vehicle volumes increase bicyclists' comfort and reduce the number of potential conflicts.

Implement volume control treatments based on the context of the bicycle boulevard.

APPLICATION

» Bicycle boulevards can bring traffic volumes down to 1,500 cars per day (3,000 cars per day maximum).

» Where traffic calming or diversion cannot reduce volumes below this threshold, provide a bike lane or separated bikeway.

» While volume management methods are designed to restrict motor vehicle access, bicyclist passage should always be allowed.

» Motor vehicle traffic volumes affect the operation of a bicycle boulevard. Higher vehicle volumes reduce bicyclists' comfort and can result in more conflicts.

» Implement volume control treatments based on the context of the bicycle boulevard, using engineering judgment. Target motor vehicle volumes range from 1,000 to 3,000 vehicles per day, above which the route should be striped as a bike lane or considered a signed shared roadway.

DESIGN FEATURES

» There are four main designs that may be used to reduce the volume of motor vehicle traffic on a bicycle boulevard: partial road closure, diagonal diverter, median diverter, and full road closure. Traffic diversion treatments reduce motor vehicle volumes by completely or partially restricting through traffic on a bicycle boulevard.
  - Partial closures allow full bicycle passage while restricting vehicle access to one way traffic at that point.
  - Diagonal diverters require all motor vehicle traffic to turn.
  - Median diverters (see Major Intersection Treatments) restrict through motor vehicle movements while providing a refuge for bicyclists to cross in two stages.
  - Street closures create a "T" that blocks motor vehicles from continuing on a bicycle boulevard, while bicycle travel can continue unimpeded. Full closures can accommodate emergency vehicles with the use of mountable curbs (maximum of six inches high).

FURTHER CONSIDERATIONS

Bicycle boulevards on streets with volumes higher than 3,000 vehicles per day are not recommended, although a segment of a bicycle boulevard may accommodate more traffic for a short distance if necessary to complete the corridor. Providing additional separation with a bike lane, cycle track or other treatment is recommended where traffic calming or diversion cannot reduce volumes below this threshold.

SAFETY IMPACTS

Traffic calmed streets can improve safety through reduced vehicle speeds and less through traffic (Litman 1999). A survey of people living along bicycle boulevards found that the majority of people had positive perceptions of the bicycle boulevard and that it positively impacts home values, quality of life, sense of community, noise, air quality, and convenience for bicyclists (VanZerr 2009).

REFERENCES

» *AASHTO. Guide for the Development of Bicycle Facilities. 2012.*

» *Alta Planning + Design and IBPI. Bicycle Boulevard Planning and Design Handbook. 2009.*

» *Ewing, Reid. Traffic Calming: State of the Practice. 1999.*

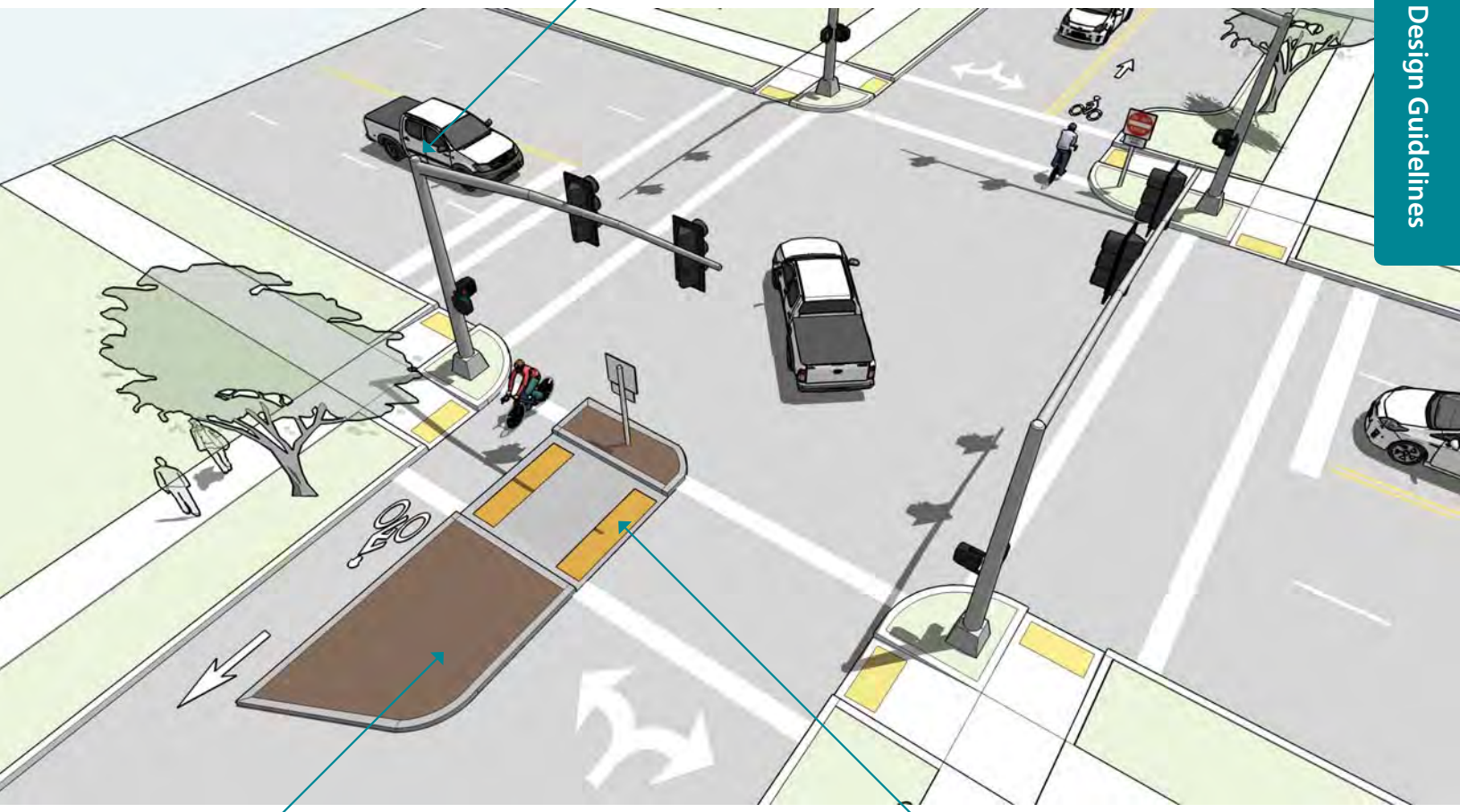
» *Ewing, Reid and Brown, Steven. U.S. Traffic Calming Manual. 2009.*

» *Litman, T. (1999). Traffic Calming Benefits, Costs, and Equity Impacts.*

» *Oregon Department of Transportation. Right-In Right-Out Channelization. 1998.*

» *VanZerr, M. (2009). Resident Perceptions of Bicycle Boulevards: A Portland, Oregon Case Study.*

A traffic signal, paired with access management, reduces the risk of cut through motor vehicle traffic.



Traffic diverters allow for bicyclists to enter but reduce through vehicle traffic.

Median islands create pinchpoint for traffic in the center of the roadway and offers shorter crossing distances for pedestrians when used in tandem with a marked crossing.

BICYCLE BOULEVARD MINOR STREET CROSSINGS

Treatments at minor roadway intersections are designed to improve the visibility of a bicycle boulevard, raise awareness of motorists on the cross-street that they are likely to encounter bicyclists, and enhance safety for all road users.

APPLICATION

Where a bicycle boulevard must cross a minor street.

DESIGN FEATURES

» On the bicycle boulevard, the majority of intersections with minor roadways should stop-control cross traffic to minimize bicyclist delay. This will maximize bicycling efficiency.

» If a stop sign is present on the bicycle boulevard, a second stop bar for bicyclists can be placed closer to the centerline of the cross street than the motorists' stop bar to increase the visibility of bicyclists waiting to cross the street.

» Traffic circles are a type of horizontal traffic calming that can be used at minor street intersections. Traffic circles reduce conflict potential and severity while providing traffic calming to the corridor.

» Curb extensions can be used to move bicyclists closer to the centerline to improve visibility and encourage motorists to let them cross.

FURTHER CONSIDERATIONS

Stop signs increase bicycling time and energy expenditure, frequently leading to non-compliance by bicyclists and motorists, and/or use of other less desirable routes. Bicycle boulevards should have fewer stops or delays than other local streets. A typical bicycle trip of 30 minutes can increase to 40 minutes if there is a STOP sign at every block (Berkeley 2000). If several stop signs are turned along a corridor, speeds should be monitored and traffic-calming treatments used to reduce excessive vehicle speeds on the bicycle boulevard.

SAFETY IMPACTS

If traffic speeds or volumes increase along the bicycle boulevard, speed and/or volume control measures should be implemented to maintain bicyclist comfort and safety along the bicycle boulevard (NACTO 2012).

REFERENCES

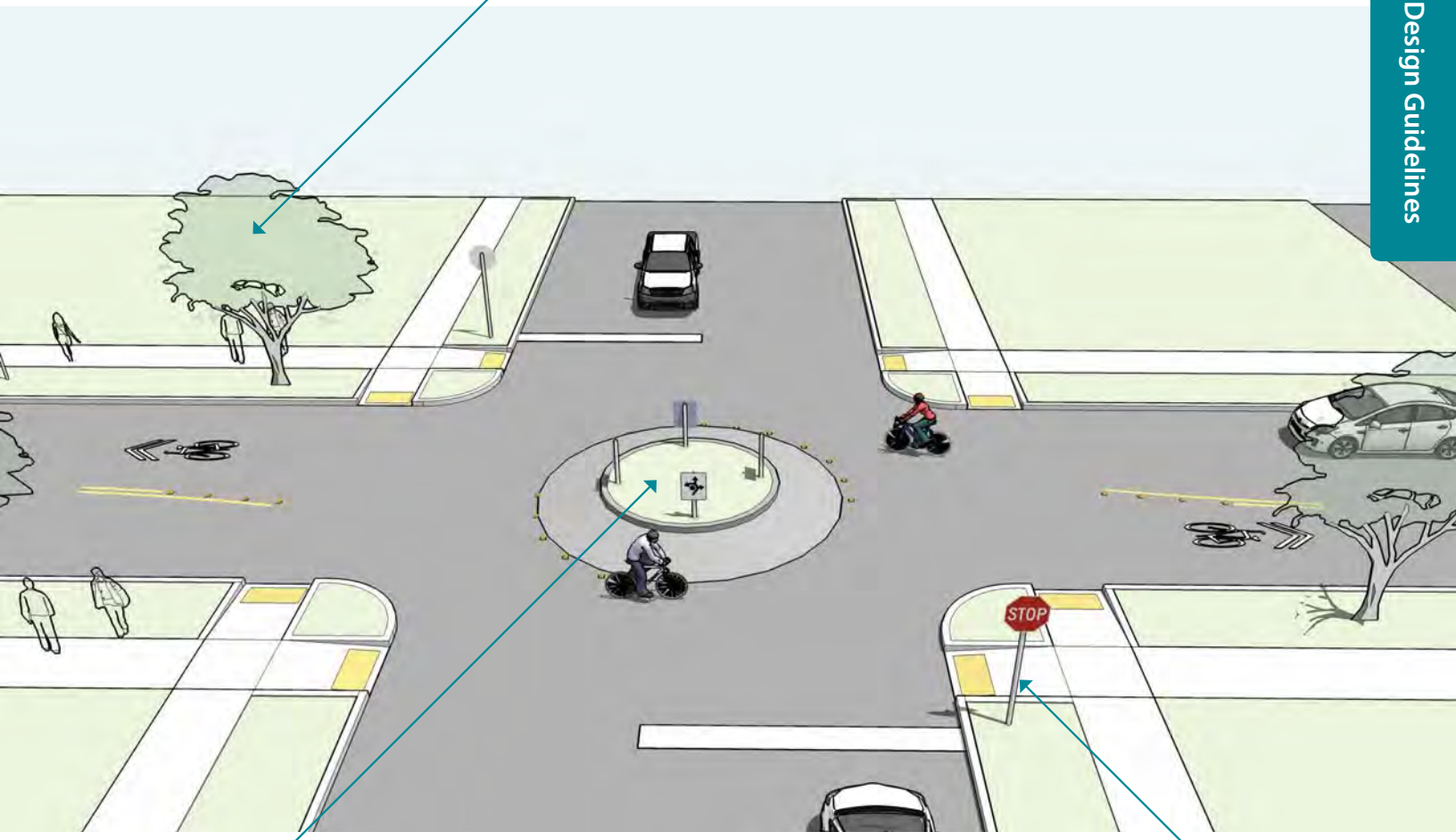
» *City of Berkeley. Bicycle Boulevard Design Tools and Guidelines. 2000.*

» *City of London Transport for London. Advanced stop lines (ASLS) background and research studies.*

» *NACTO. Urban Bikeway Design Guide. 2012.*

» *Transportation Research Board. Improving Pedestrian Safety at Unsignalized Crossings. NCHRP Report # 562. 2006.*

Street trees narrow a driver's visual field and creates a consistent rhythm and canopy along the street, which provides a unified character and facilitates place recognition.



Neighborhood traffic circles reduce speed of traffic at intersections by requiring motorists to move cautiously through conflict points.

Along bike boulevards, stop signs should be located on minor cross streets and not on the bike boulevard route.

BICYCLE BOULEVARD MAJOR STREET CROSSINGS

The quality of treatments at major street crossings can significantly affect a bicyclist's choice to use a bicycle boulevard, as opposed to another road that provides a crossing treatment.

APPLICATION

Where a bicycle boulevard must cross a major street.

DESIGN FEATURES

» Bike boxes increase bicyclist visibility to motorists and reduce the danger of right "hooks", or collisions caused by vehicles making unsafe turns in front of the bicyclist, by providing a space for bicyclists to wait at signalized intersections.

» Median islands provided at uncontrolled intersections of bicycle boulevards and major streets allow bicyclists to cross one direction of traffic at a time as gaps in traffic occur.

» Hybrid beacons, active warning beacons and bicycle signals can facilitate bicyclists crossing a busy street on which cross-traffic does not stop.

» Select treatments based on engineering judgment; see National Cooperative Highway Research Program (NCHRP) Report # 562 Improving Pedestrian Safety at Unsignalized Crossings (2006) for guidance on appropriate use of crossing treatments. Treatments are designed to improve visibility and encourage motorists to stop for pedestrians; with engineering judgement many of the same treatments are appropriate for use along bicycle boulevards.

FURTHER CONSIDERATIONS

» The quality of bicycle boulevards are often compromised by the comfort of the crossings at major streets. Median islands, active warning beacons and hybrid beacons are all potential tools for improving crossing conditions.

» Bicycle boulevard retrofits to local streets are typically located on streets without existing signalized accommodation at crossings of collector and arterial roadways. Without treatments for bicyclists, these intersections can become major barriers along the bicycle boulevard and compromise safety.

SAFETY IMPACTS

Major streets can be barriers along a bicycle boulevard. Improving the crossing experience for cyclists can improve bicyclist safety, and incorporating signalization can improve connectivity and access (NACTO 2012). A median refuge island/area provides space for bicyclists to wait for a gap in traffic and allows for the major street to be crossed in two stages. A median refuge island/area can reduce the gap needed to cross a major street by 50% (NACTO 2012).

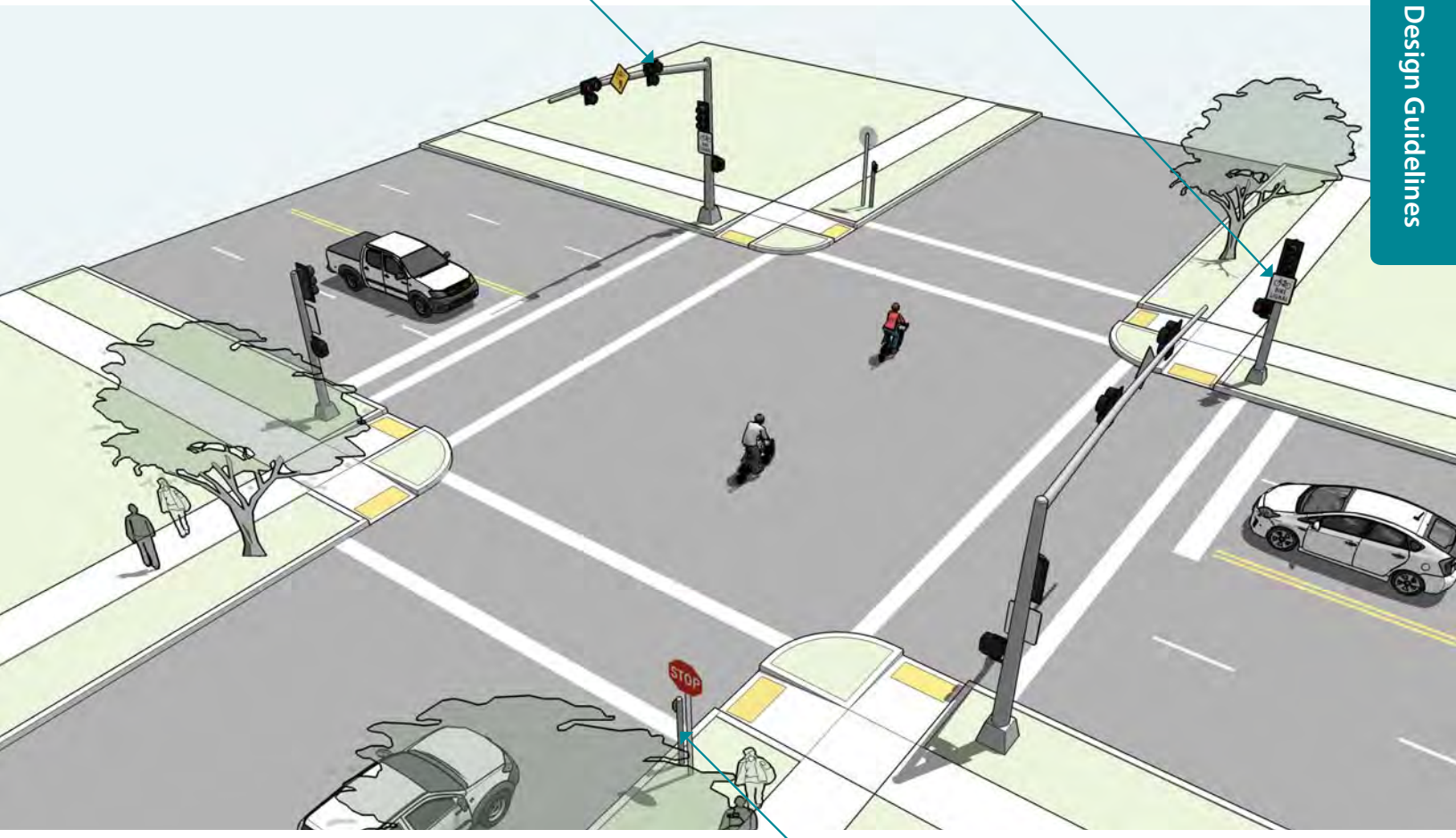
REFERENCES

» *Transportation Research Board. Improving Pedestrian Safety at Unsignalized Crossings. NCHRP Report #562. 2006.*

» *Federal Highway Administration. Safety Effects of Marked Versus Unmarked Crosswalks at Uncontrolled Locations. FHWA-RD-04-100. 2004.*

A hybrid beacon stops traffic on busy arterial streets, providing a protected phase for cyclists to cross the street.

A hybrid beacon may be paired with a bicycle signal had to clarify bicycle movement.



A hybrid beacon and accompanying bike signal are only activated by a cyclist.

CLASS III: MARKED SHARED ROADWAYS

Marked shared roadways (Class III) use shared lane markings, also known as "sharrows", to designate a shared travel lane. Shared lane markings are used to encourage bicycle travel and proper positioning within the lane.

APPLICATION

For use where an on-street bike lane or separated bikeway is preferred, but is not provided.
Most useful on roadways with a speed limit of 30mph or less (NACTO 2012). May be used on streets up to 35 mph.

Work best on streets where traffic signals are timed for a bicycling travel speed of 12 to 15 miles per hour (NACTO 2012). May be used to fill a gap in an otherwise continuous bike path or bike lane.

DESIGN FEATURES

Shared Lane Markings

» Shared lane markings (SLM) should be placed immediately after an intersection (CAMUTCD 9C.07.06) and at intervals of every 50 to 100 feet on busy streets and up to every 250 feet on low traffic bicycle routes (NACTO 2012).

» Place shared lane markings in the center of the travel lane to reduce marking wear and encourage cyclists to occupy the lane outside of the door zone of parked cars.

» Minimum distance from curb is 11 ft from curb face when parking is present, 4 ft from curb face where no parking is present.

Super Sharrow Lanes

FHWA will accept requests to experiment using green-colored pavement as a background for the shared-lane marking as a background conspicuity enhancement. This treatment is known as "Super Sharrow" or "Green Backed Sharrow".

» Green pavement should be constrained to a limited area of 60" x 20" surrounding the shared lane marking (SLM).

Shared Roadway Bicycle Signage

Signs should be used to support the marked shared roadway facility. Appropriate signs include Bike Route (CAMUTCD D11-1) or Bicycles May Use Full Lane (CAMUTCD R4-11) (BMUFL).

» Bicycles may use Full Lane (R4-11) signs may be used to inform road users that bicyclists might occupy the travel lane. This sign may be used with SLMs where travel lanes are too narrow for bicyclists and motor vehicles to operate side by side.

» Bike Route (D11-1) signs may be used with bikeways to inform bicyclists of bicycle route confirmation.

All signs should be applied at intervals frequent enough to keep bicyclists informed of changes in route direction and to remind motorists of the presence of bicyclists. This includes placement at:

» Beginning or end of Bicycle Route.

» After intersections or arterial streets.

» At major changes in direction or at intersections with other bicycle routes.

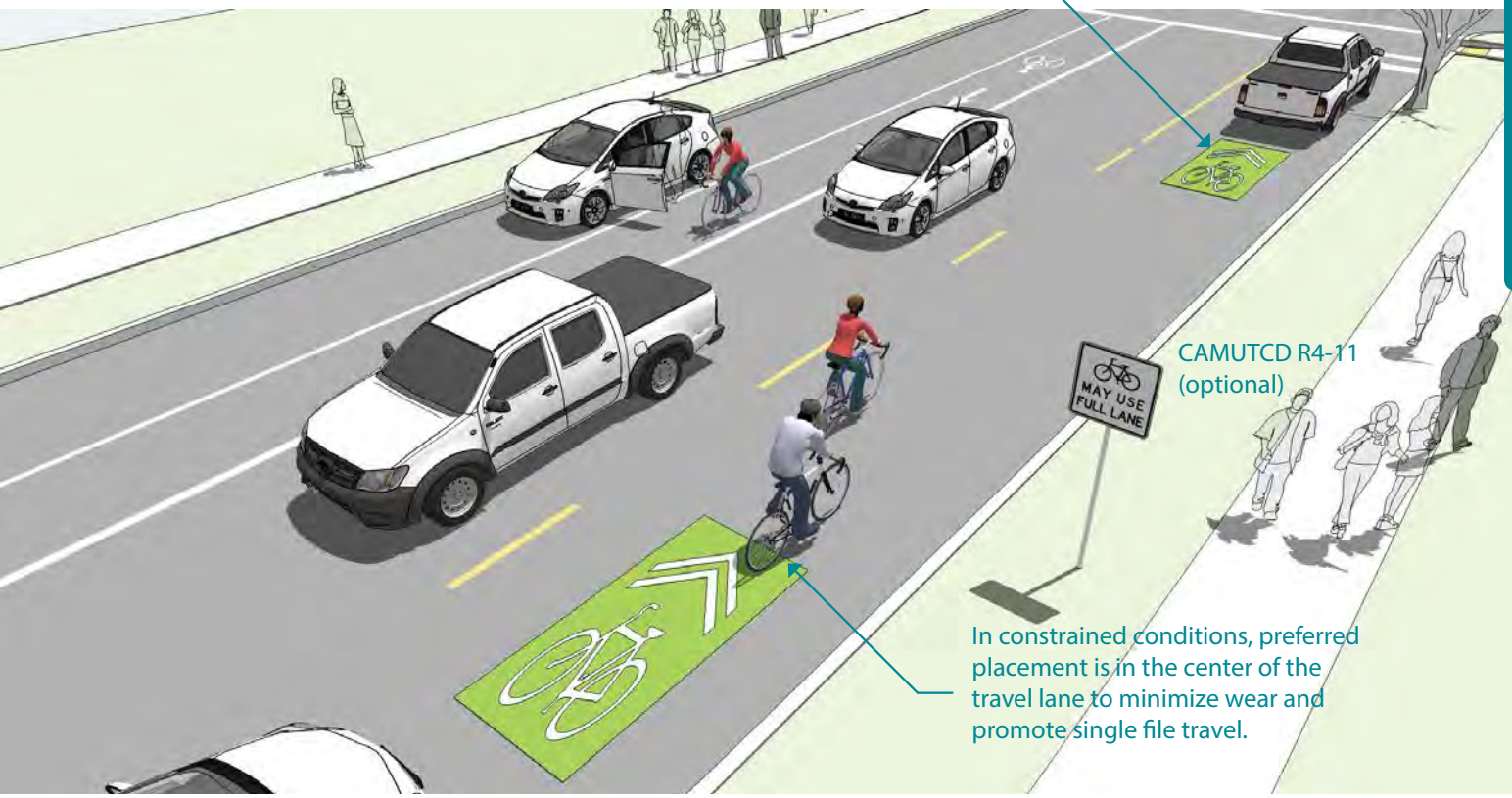
» At intervals not to exceed ½ mile.

FURTHER CONSIDERATIONS

» Shared lane markings may be placed on roadways that have a speed limit above 35 mph, where there is bicycle travel and there is no marked bicycle lane and the right-hand traffic lane is too narrow to allow motor vehicles to safely pass bicyclists. (CAMUTCD 9C.07).

» Shared lane markings on busy streets should be considered an interim measure until more appropriate on-street bike lanes or separated bikeways can be provided.

» The use of green-colored pavement with the shared-lane marking is noncompliant with the Conditions of the Interim Approval for the Optional Use of green-colored Pavement for Bike Lanes (IA-14). Therefore, this treatment is experimental. FHWA will accept requests to experiment using green-colored pavement with the shared-lane marking as a background conspicuity enhancement only. FHWA has discontinued experimentation of using green-colored pavement in a continuous, longitudinal manner in conjunction with the shared-lane marking.



SAFETY IMPACTS

Studies have found that shared lane markings reduce the incidence of wrong-way bicycling in travel lanes by 80% (SF Dept of Parking 2004). The markings have also been found to encourage cyclists to position themselves safely within the travel lane (Center for Transportation 2010).

A study conducted by the City of Austin in 2010 showed that placement of BMUFL signs on multilane streets influenced cyclists to generally ride farther from the curb (an average of .31 feet), and drivers moved further left as they passed bikes after the signs were installed, such that the percentage of motorists who passed within 3 feet (the minimum distance a vehicle can approach a bicyclist as identified by California law) of the bicyclist dropped from 44% to 0%.

REFERENCES

» *AASHTO. Guide for the Development of Bicycle Facilities. 2012.*

» *Center for Transportation Research, the University of Texas at Austin. 2010. Effects of Shared Lane Markings on Bicyclist and Motorist Behavior along Multi-lane Facilities.*

» *Caltrans. California Manual on Uniform Traffic Control Devices. 2014.*

» *FHWA. Interim Approval for the Optional Use of green-colored Pavement for Bike Lanes (IA-14). 2011. The City of Austin. Effects of "Bicycles May Use Full Lane" Signs on Bicyclist and Motorist Behavior along Multi-Lane Facilities. 2010.*

» *FHWA. Bicycle Facilities and the Manual on Uniform Traffic Control: Green-Colored Pavement with the Shared-Lane. Updated 2015.*

» *San Francisco Department of Parking and Traffic. 2004. San Francisco's Shared Lane Pavement Markings; Improving Bicycle Safety.*

» *NACTO. Urban Bikeway Design Guide. 2014.*

CLASS II: BIKE LANES

Bike lanes (Class II) designate an exclusive space for bicyclists through the use of pavement markings and signage. Bike lanes are located directly adjacent to motor vehicle travel lanes and are used in the same direction as motor vehicle traffic. Bike lanes are typically on the right side of the street, between the adjacent travel lane and curb, road edge or parking lane.

APPLICATION

» Streets with moderate volumes ≥ 6,000 ADT (≥ 3,000 preferred).

» Streets with moderate speeds ≥ 25 mph.

» Appropriate for skilled adult riders on most streets.

» May be appropriate for children when configured as 6+ ft wide lanes on lower-speed, lower-volume streets with one lane in each direction.

DESIGN FEATURES

» Mark inside line with 6"stripe. (CAMUTCD 9C.04) Mark 4" parking lane line or "parking Ts".

» Include a bicycle lane marking (CAMUTCD FIGURE 9C-3) at the beginning of blocks and at regular intervals along the route. (CAMUTCD 9C.04)

» 6 foot width preferred adjacent to on-street parking, (5 foot min.) (HDM)

» 5–6 foot preferred adjacent to curb and gutter. (4 foot min.) or 3 feet more than the gutter pan width. (HDM)

FURTHER CONSIDERATIONS

» On high speed streets (posted speed limit ≥ 40 mph) the minimum bike lane should be 6 feet. (HDM 301.2)

» On streets where bicyclists passing each other is to be expected, where high volumes of bicyclists are present, or where added comfort is desired, consider providing extra wide bike lanes up to 7 feet wide, or configure as a buffered bicycle lane.

» It may be desirable to reduce the width of general purpose travel lanes in order to add or widen bicycle lanes. (HDM 301.2 3)

» On multi-lane streets, the most appropriate bicycle facility to provide for user comfort may be buffered bicycle lanes or physically separated bicycle lanes.

SAFETY IMPACTS

Before and after studies of bicycle lane installations show a wide range of crash reduction factors. Some studies show a crash reduction of 35% (CMF ID: 1719) for vehicle/bicycle collisions, while others show a crash increase of 28% (CMF ID: 4659). Due to a lack of bicyclist volume data, these studies did not account for the potential for increased ridership.

REFERENCES

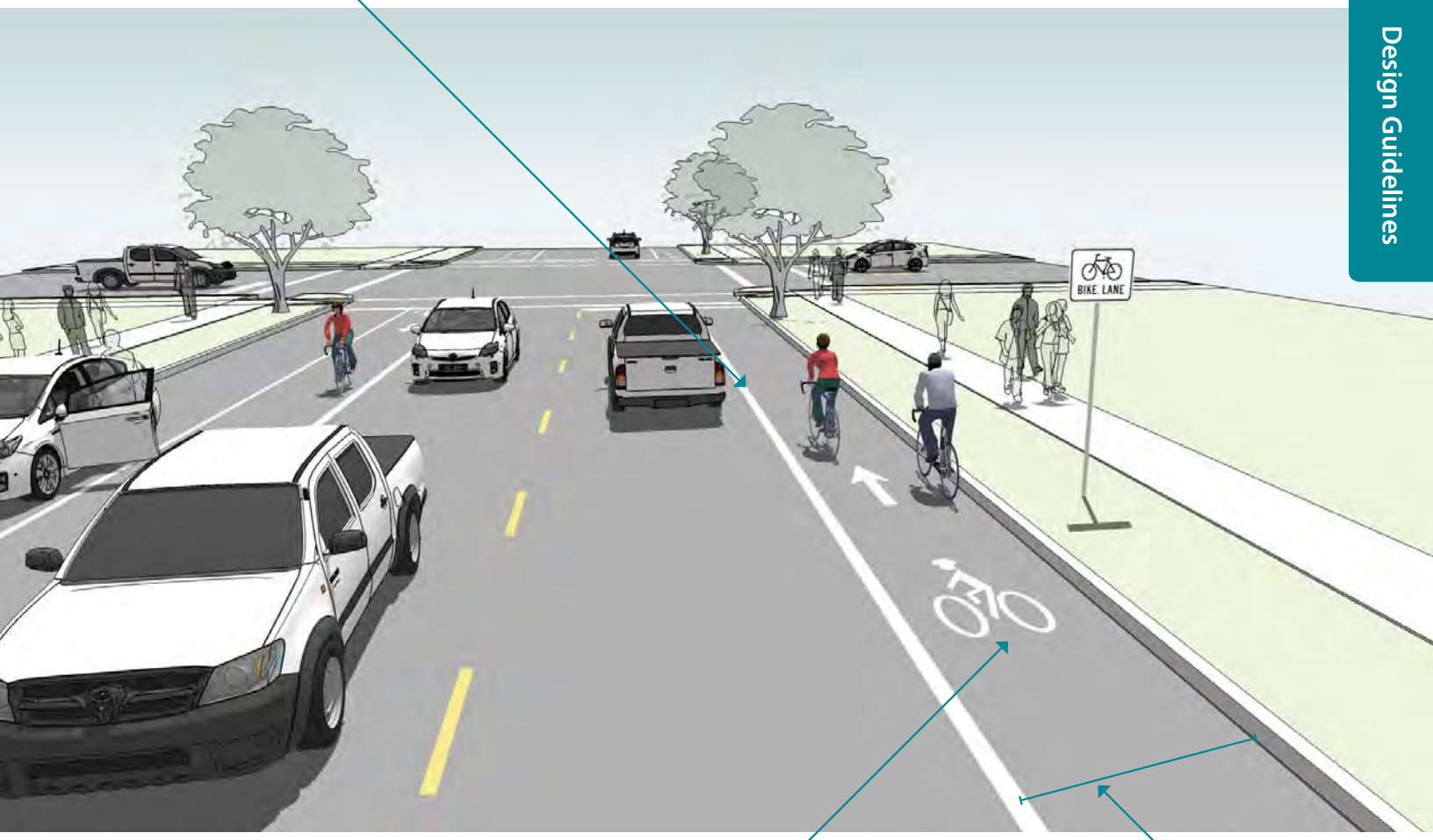
» *AASHTO. Guide for the Development of Bicycle Facilities. 2012.*

» *Crash Modification Factors Clearinghouse (CMF). http://www.cmfclearinghouse.org/*

» *FHWA. Manual on Uniform Traffic Control Devices. 2009.*

» *NACTO. Urban Bikeway Design Guide. 2012.*

Mark inside line with 6" stripe. Mark 4" parking lane line or "Ts"



Include a bicycle lane marking (CAMUTCD Figure 9C-3) at the beginning of blocks and at regular intervals along the route (CAMUTCD 9C.04).

6 ft width preferred adjacent to on-street parking (5 ft min.).

5–6 ft preferred adjacent to curb and gutter (4 ft min.) or 4 ft more than the gutter pan width.

CLASS II: LEFT SIDE BIKE LANES

Left-side bike lanes are conventional bike lanes placed on the left side of one-way streets or two-way median divided streets.

Left-side bike lanes offer advantages on streets with heavy delivery or transit use, frequent parking turnover on the right side or other potential conflicts that could be associated with right-side bicycle lanes.

APPLICATION

» Anywhere a conventional bike lane is being considered.

» On one way streets or two way streets.

» On streets with high parking turnover.

» On streets with a significant number of left turning bicyclists.

DESIGN FEATURES

» Follow guidance for conventional bike lanes.

» Signage should accompany left-side bicycle lanes to clarify proper use by bicyclists to reduce wrong-way riding.

» Bicycle through lanes should be provided to the right of vehicle left turn pockets to reduce conflicts at intersections.

FURTHER CONSIDERATIONS

» Intersection treatments such as turn boxes and bike signals should be considered to assist in the transition from left-side bike lanes to right-side bike lanes.

» Colored pavement, typically green, may be used to draw attention to the left-side bike lane, or to highlight conflict areas for increased visibility of bicyclists.

SAFETY IMPACTS

Cyclists in left-side bike lanes are less likely to experience interactions with car door openings, as right side vehicle doors are less frequently opened. Cyclists riding in left-side bike lanes may be more visible to motorists, as they are on the driver's side. (NACTO 2012).

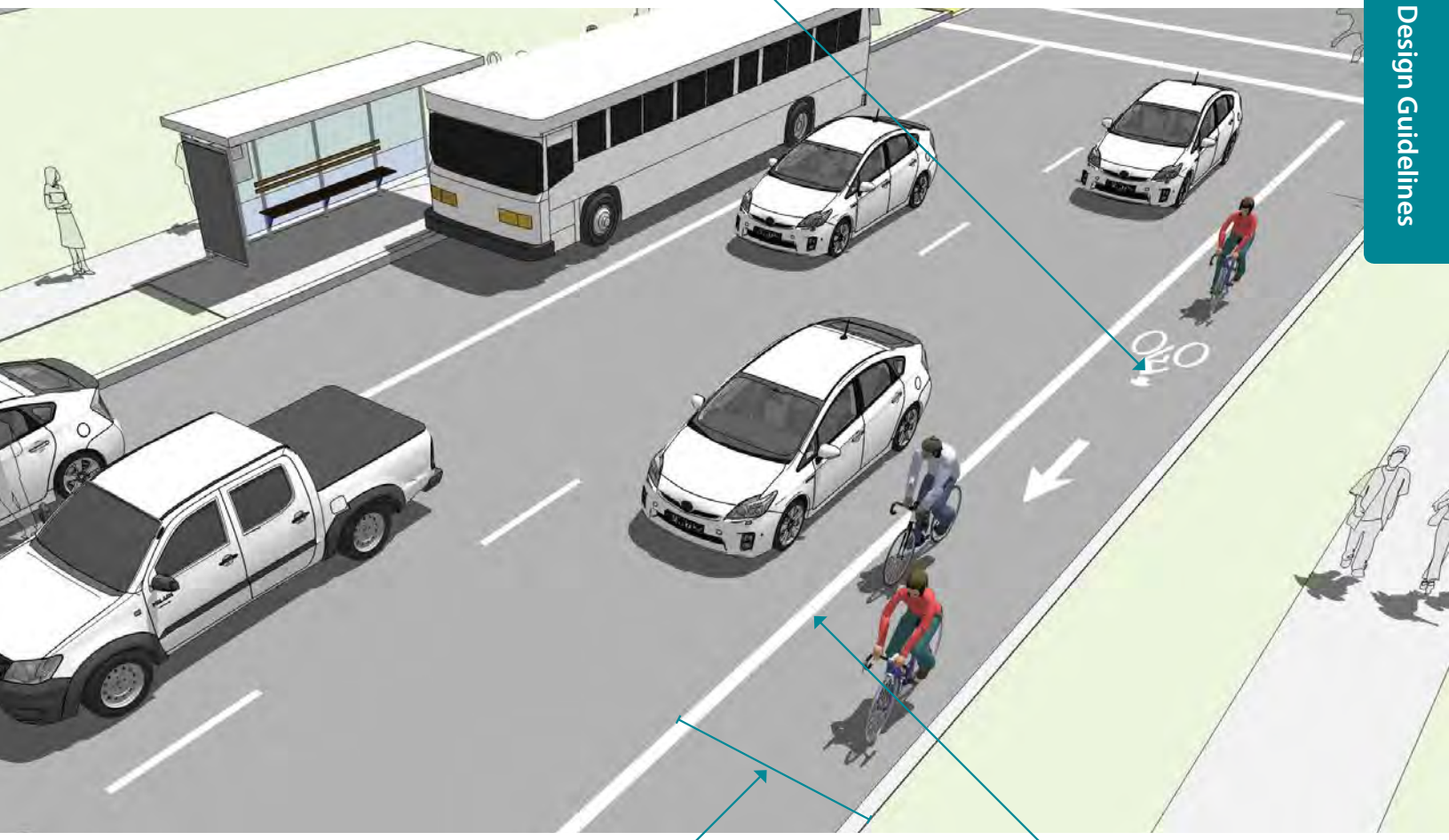
REFERENCES

» *AASHTO. Guide for the Development of Bicycle Facilities. 2012.*

» *FHWA. Manual on Uniform Traffic Control Devices. 2009.*

» *NACTO. Urban Bikeway Design Guide. 2012.*

Include a bicycle lane marking (CAMUTCD Figure 9C-3) at the beginning of blocks and at regular intervals along the route (CAMUTCD 9C.04).



6 ft width preferred adjacent to on-street parking (5 ft min.).

5–6 ft preferred adjacent to curb and gutter (4 ft min.) or 4 ft more than the gutter pan width.

Mark inside line with 6" stripe. Mark 4" parking lane line or "Ts"

CLASS II: BUFFERED BIKE LANES

Buffered bike lanes are conventional bike lanes paired with a designated buffer space, separating the bike lane from the adjacent motor vehicle travel lane and/or parking lane. Buffered bike lanes are designed to increase the space between the bike lane and the travel lane and/or parked cars.

APPLICATION

» Anywhere a conventional bike lane is being considered.

» On streets with high speeds and high volumes or high truck volumes.

» On streets with extra lanes or lane width.

» Appropriate for skilled adult riders on most streets.

DESIGN FEATURES

» The minimum bicycle travel area (not including buffer) is 5 feet wide.

» Buffers should be at least 2 feet wide. If buffer area is 4 feet or wider, white chevron or diagonal markings should be used. (CAMUTCD 9C-104)

» For clarity at driveways or minor street crossings, consider a dotted line.

» There is no standard for whether the buffer is configured on the parking side, the travel side, or a combination of both.

FURTHER CONSIDERATIONS

» Color may be used within the lane to discourage motorists from entering the buffered lane.

» A study of buffered bicycle lanes found that, in order to make the facilities successful, there needs to also be driver education, improved signage and proper pavement markings. (Monsere 2011)

» On multi-lane streets with high vehicles speeds, the most appropriate bicycle facility to provide for user comfort may be a separated bikeway.

» NCHRP Report #766 recommends, when space in limited, installing a buffer space between the parking lane and bicycle lane where on-street parking is permitted rather than between the bicycle lane and vehicle travel lane. (NCHRP 2014)

SAFETY IMPACTS

A before and after study of buffered bicycle lane installation in Portland, OR found an overwhelmingly positive response from bicyclists, with 89% of bicyclists feeling safer riding after installation and 91% expressing that the facility made bicycling easier. (NCHRP 2014)

REFERENCES

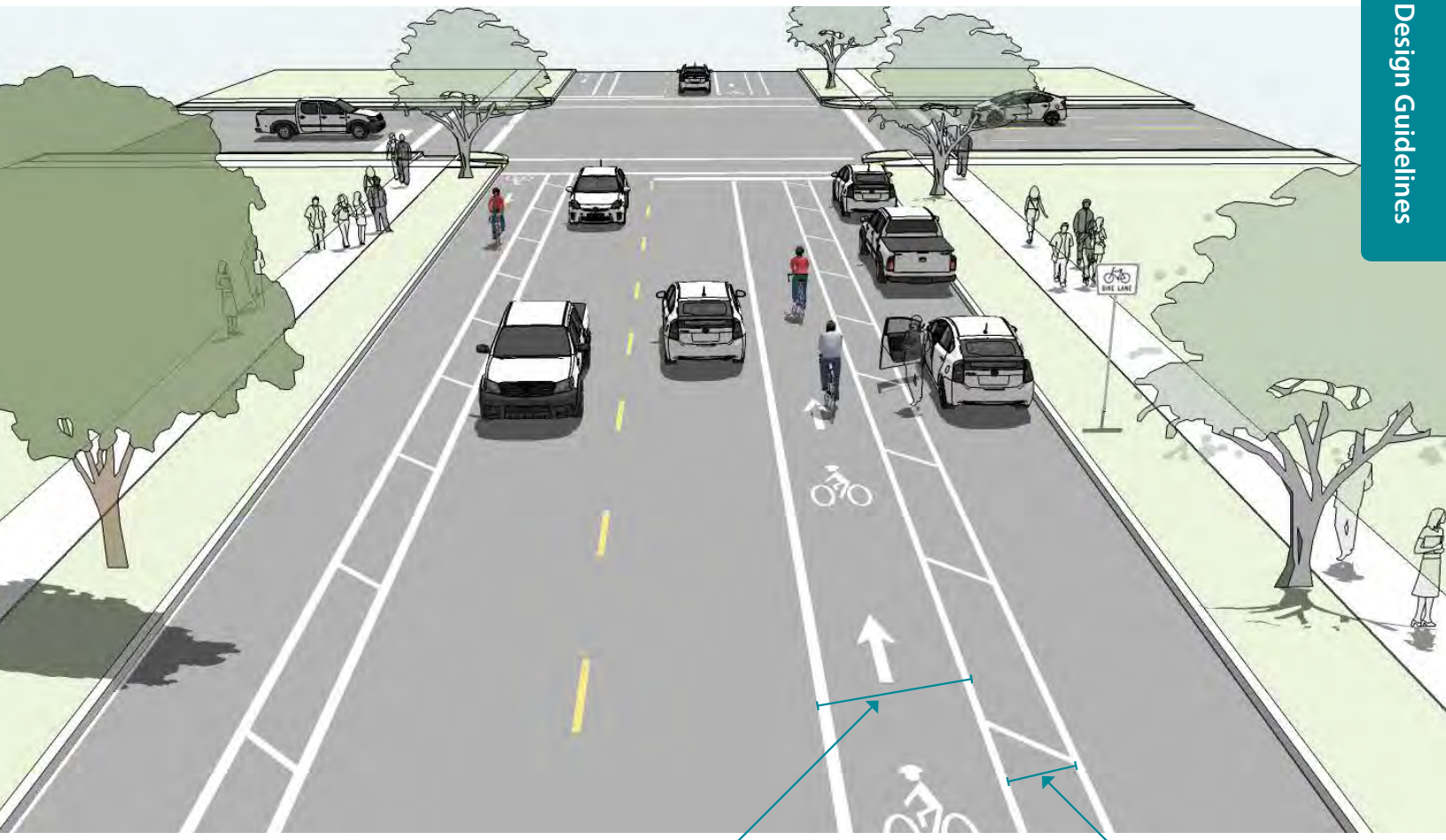
» *AASHTO. Guide for the Development of Bicycle Facilities. 2012.*

» *FHWA. Manual on Uniform Traffic Control Devices. (3D-01). 2009.*

» *Monsere, C.; McNeil, N.; and Dill, J., "Evaluation of Innovative Bicycle Facilities: SW Broadway Cycle Track and SW Stark/Oak Street Buffered Bike Lanes. Final Report" (2011). Urban Studies and Planning Faculty Publications and Presentations.*

» *NACTO. Urban Bikeway Design Guide. 2012.*

» *National Cooperative Highway Research Program. Report #766: Recommended Bicycle Lane Widths for Various Roadway Characteristics. 2014.*



The minimum bicycle travel area (not including buffer) is 5 ft wide.

Buffers should be at least 2 ft wide. If buffer area is 4 ft or wider, white chevron or diagonal markings should be used.

ADVISORY BIKE LANE

Advisory bike lanes (also called dashed bike lanes) provide a bicycle –priority space on a two-lane street too narrow for conventional bike lanes. Similar in appearance to bike lanes, advisory bike lanes are distinct in that they are temporarily shared with motor vehicles during head-on approaching maneuvers and turning movements.

APPLICATION

Advisory bike lanes can be used on roadways where the following conditions exist:

» Narrow two-lane streets where there is insufficient room for conventional bicycle lanes.

» Motor vehicle traffic volumes are low-moderate (1,500-4,500 ADT). May function on streets with up to 6,000 ADT.

DESIGN FEATURES

» No centerline on roadway to promote safe passing distances.

» Bicycle lane delineated with white broken line to permit encroachment when necessary.

» Advisory bicycle lane width of 5 to 7 ft.

» Bicycle lane markings should be used to clarify the designated use of the lane.

» Recommended two-way motor vehicle travel lane width of 16 ft. Some installations have worked with center lane as narrow as 10 ft.

» If a parking lane is present it should be highly utilized or feature frequent curb extensions to clearly define the edge of the travelled way. Parking is prohibited within the advisory bicycle lane.

» Two-Way Traffic warning sign (W6-3) may be used to clarify two-way operation of the road.

FURTHER CONSIDERATIONS

Most appropriate when roadways are straight with few bends, inclines or sightline obstructions. Consider the use of colored pavement within the bicycle priority area to discourage unnecessary encroachment by motorists or parked vehicles.

The following design elements are required by FHWA in a request to experiment with dashed bicycle lanes:

» Bike Lane signs (R3-17). The current CAMUTCD provides that Bike Lane signs for conventional bicycle lanes are optional. An agency can set its own policy on the number, location, spacing, etc. of Bike Lane signs to be used in dashed bicycle lanes.

» Bicycle Lane pavement markings in the dashed bicycle lane are in accordance with Item C of Paragraph 6 in Section 3D.01 in the CAMUTCD.

SAFETY IMPACTS

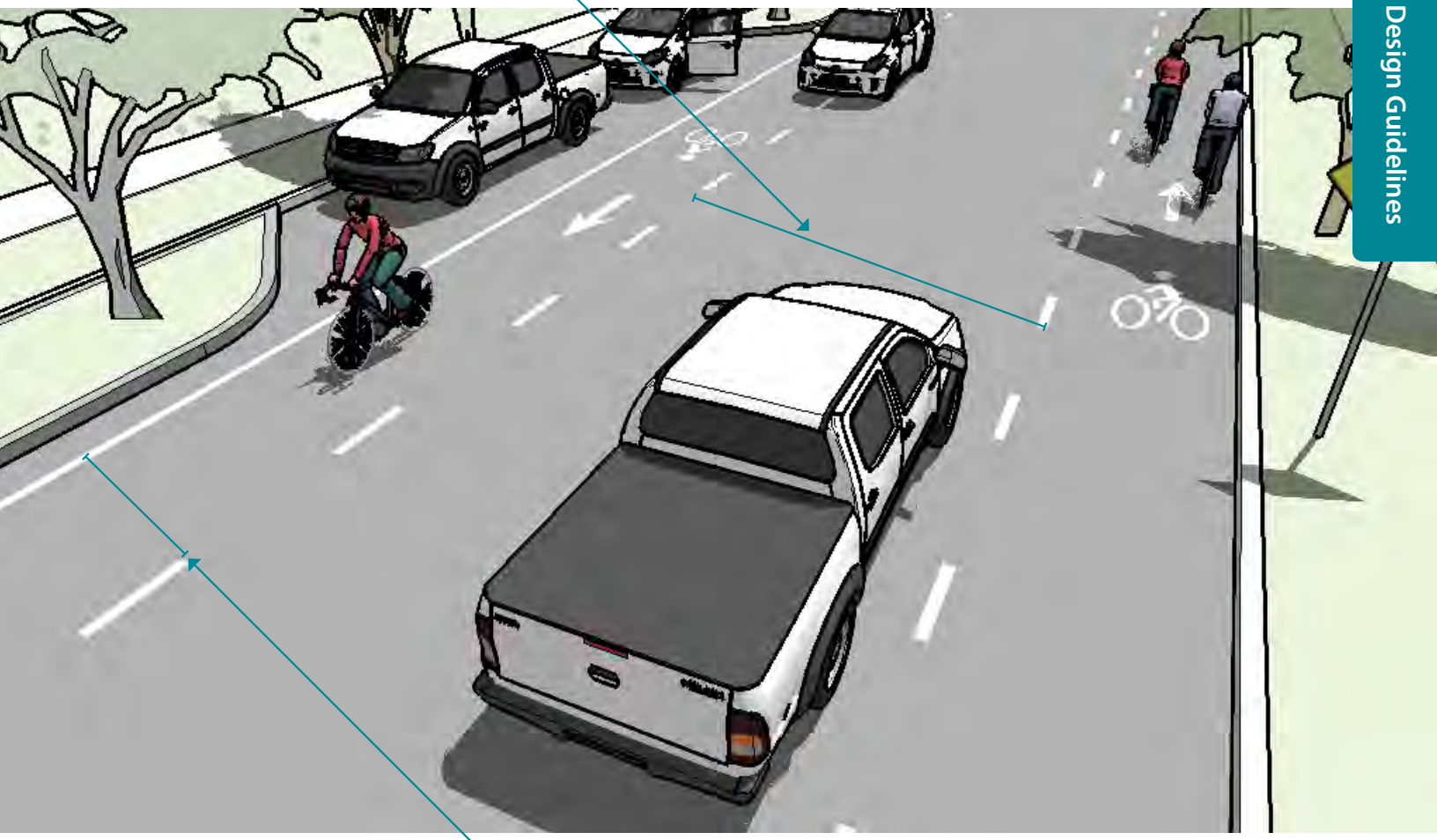
Advisory bike lanes have been found to be beneficial on roadways with low traffic volumes and little to no truck or bus traffic (FHWA 2015).

REFERENCES

» *City of Minneapolis. Request To Experiment. July 2010.*

» *FHWA. (2015). Bicycle Facilities and the MUTCD. https://www.fhwa.dot.gov/environment/bicycle_pedestrian/guidance/mutcd/dashed_bike_lanes.cfm*

The automobile zone should be configured narrowly enough so that two cars cannot pass each other in both directions without crossing the advisory lane line. Minimum 2-way motor vehicle travel lane width of 16 ft.



The minimum bicycle travel area (not including buffer) is 5 ft wide.

GREEN COLORED PAVEMENT ON BIKEWAYS

Green colored pavement is approved for use within on-street bike lanes and separated bikeways to increase awareness of the facility or conflict areas along the facilities. Experimentation is allowed for use as a background enhancement of other bicycle facility markings.

APPLICATION

» Within continuous lengths of bike lanes or separated bikeways.

» As a rectangular background behind the word, symbol, and arrow pavement markings in a bicycle lane or separated bikeway.

» Between dotted line extensions of bike lanes through intersections.

» Between dotted weaving areas across bike lanes in advance of intersections.

» As a background enhancement of non bike lane markings such as shared lane markings or within bike boxes. This last use is experimental.

DESIGN FEATURES

» Where motor vehicle encroachment is prohibited or discouraged, green colored pavement should be applied as a continuous longitudinal manner within the bike lane or separated bikeway facility.

» Where the bike lane or separated bikeway is configured with dotted lines, such as at dotted line extensions through intersections or weaving areas, the pattern of the green colored pavement should be in a manner matching the pattern of the dotted lines; filling in only the areas directly between a pair of dotted line segments (MUTCD Interim Approval IA-14).

FURTHER CONSIDERATIONS

» Application of green colored pavement should be used consistently throughout a city or region.

» Multiple colored pavement application materials exist, including paint, thermoplastic and MMA. These products vary in durability, cost and ease of application. See the NACTO Urban Bikeway Design Guide for more information on pavement materials.

SAFETY IMPACTS

» Evaluations performed in Portland, OR, St. Petersburg, FL and Austin, TX found that significantly more motorists yielded to bicyclists and slowed or stopped before entering the conflict area after the application of the colored pavement when compared with an uncolored treatment. (Hunter 2000)

» A study of solid green painted lanes in NYC indicates that the green paint treatment resulted in fewer instances of drivers encroaching on the bike lane and driving on the bike lane boundary line. (NYCDOT 2011)

REFERENCES

» *AASHTO. Guide for the Development of Bicycle Facilities. 2012.*

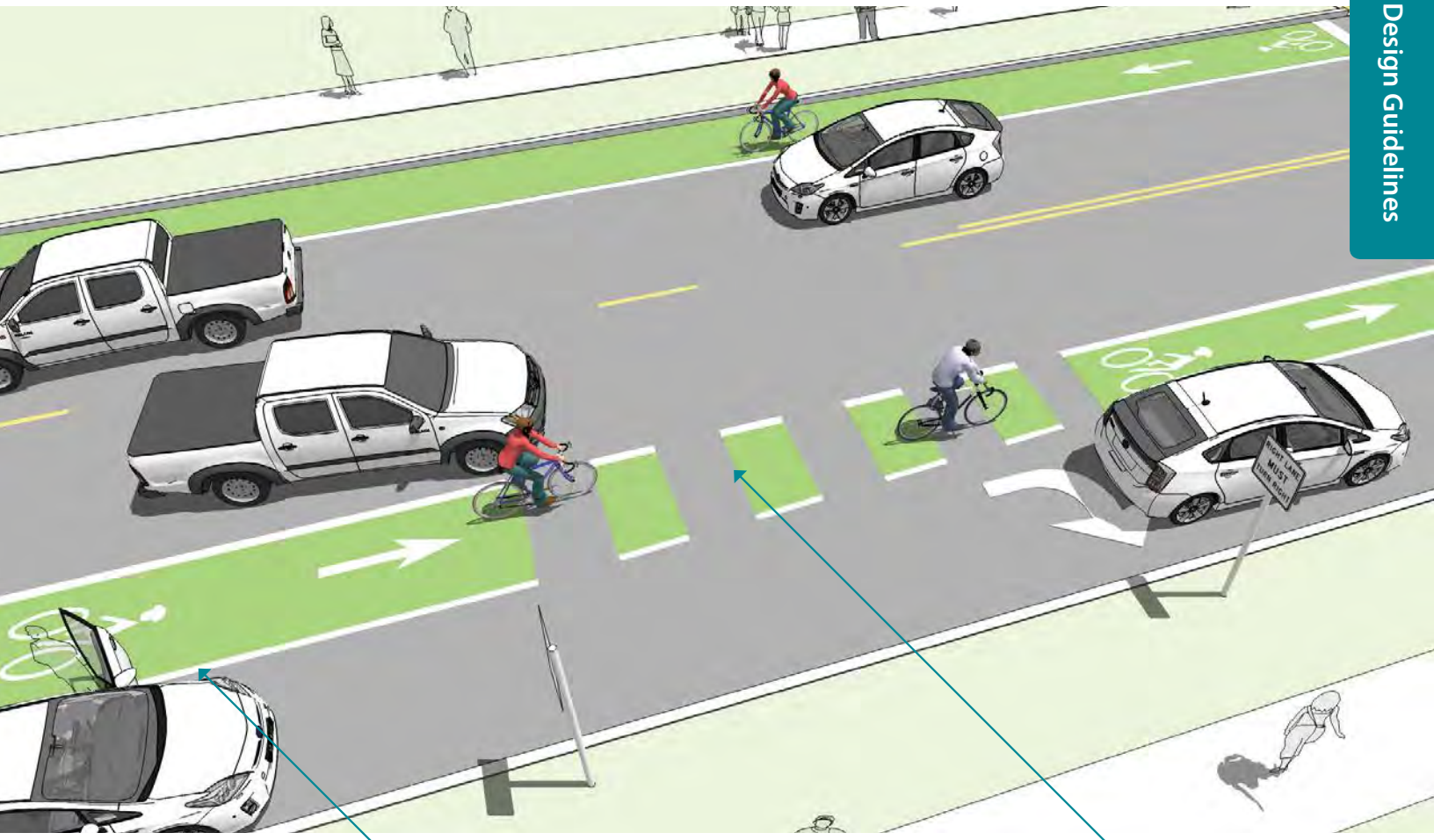
» *FHWA. Manual on Uniform Traffic Control Devices. 2009.*

» *NACTO. Urban Bikeway Design Guide. 2012.*

» *FHWA. Interim Approval for the Optional Use of green-colored Pavement for Bike Lanes (IA-14).*

» *New York City Department of Transportation. Evaluation of Solid Green Bicycle Lanes, to Increase Compliance and Bicycle Safety. (2011).*

» *Hunter, W.W. et al. Evaluation of Blue Bike-Lane Treatment in Portland, Oregon. (2000).*



Typical white bike lanes (solid or dotted 6" stripe) are used to outline the green colored pavement.

In weaving or turning conflict areas, preferred striping is dashed, to match the bicycle lane line extensions.

The colored surface should be skid resistant and retro-reflective (CAMUTCD 9C.02.02).

In exclusive use areas, such as bike boxes, color application should be solid green.

INTERSECTION CROSSING MARKINGS

Bicycle pavement markings through intersections guide bicyclists on a safe and direct path through the intersection and provide a clear boundary between the paths of through bicyclists and vehicles in the adjacent lane.

APPLICATION

» Streets with on-street or buffered bike lanes or separated bikeways.

» At direct paths through intersections.

» Streets with high volumes of adjacent traffic.

» Where potential conflicts exist between through bicyclist and adjacent traffic.

DESIGN FEATURES

» Intersection markings should be the same width and in line with leading bike lane (CAMUTCD 3B.08.01).

» Dotted lines may be placed through intersections or major driveways (CAMUTCD 3B.08.04) and should be a minimum of 6 inches wide and 4 feet long, spaced every 12 feet. (CAMUTCD FIGURE 39A)

» All markings should be white, skid resistant and retro reflective (CAMUTCD 9C.02.02)

» Green pavement markings may also be used (CAMUTCD 3A.05.01).

FURTHER CONSIDERATIONS

The design of intersection crossing markings is an emerging practice area. The National Committee on Uniform Traffic Control Devices has submitted a request to include additional options for bicycle lane extensions through intersections as a part of future MUTCD updates (MUTCD 2014). Their proposal includes the following options for striping elements within the crossing:

» Bicycle lane markings

» Double chevron markings, indicating the direction of travel.

» Green colored pavement.

SAFETY IMPACTS

A study on the safety effects of intersection crossing markings found a reduction in collisions by 10% and injuries by 19% after crossing markings were installed (Jensen 2008).

» A study in Portland, Oregon found that significantly more motorists yielded to bicyclists after the colored pavement had been installed (92% in the after period versus 72% in the before period) (Hunter 2000).

REFERENCES

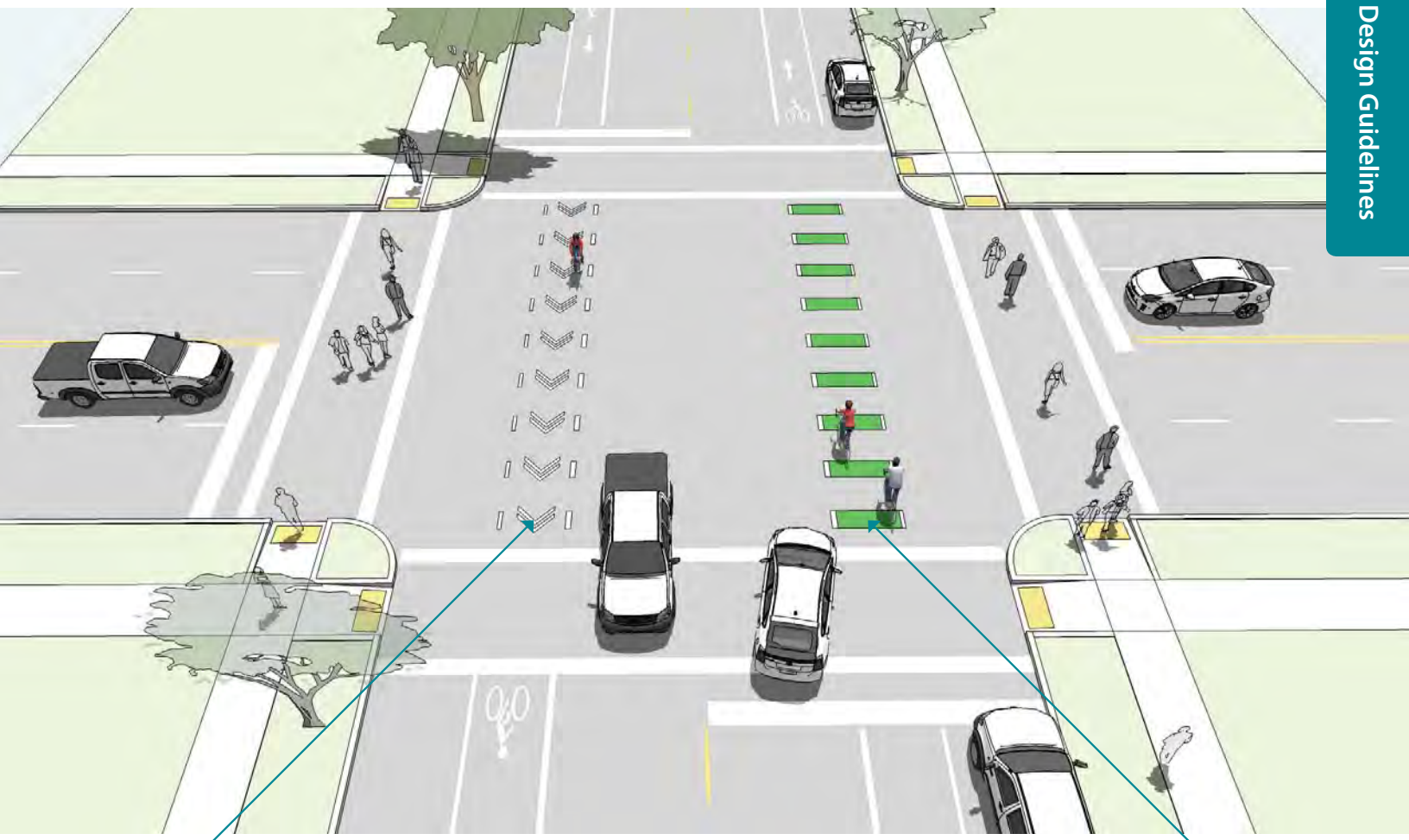
» *California Manual on Uniform Traffic Control Devices (CAMUTCD). 2014. http://www.dot.ca.gov/hq/traffops/engineering/mutcd/*

» *Hunter, W.W. et al. (2000). Evaluation of Blue Bike-Lane Treatment in Portland, Oregon. Transportation Research Record, 1705, 107-115.*

» *Jensen, S.U. (2008). Safety effects of blue cycle crossings: A before-after study. Accident Analysis & Prevention, 40(2), 742-750.*

» *Letter to FHWA from the Bicycle Technical Committee for the MUTCD. Bicycle Lane Extensions through Intersections. June 2014.*

» *Manual on Uniform Traffic Control Devices (MUTCD). 2009.*



Dotted lines should be a minimum of 6 inches wide and 4 ft long, spaced every 12 ft.

Green pavement markings may also be used.

COMBINED BIKE LANE/ TURN LANE

Where there isn't room for an on-street bike lane and turn lane a combined bike lane/turn lane creates a shared lane where bicyclists can ride and turning motor vehicles yield to through traveling bicyclists. The combined bicycle lane/ turn lane places shared lane markings within a right turn only lane.

APPLICATION

» Most appropriate in areas with lower posted speeds (30 MPH or less) and with lower traffic volumes (10,000 ADT or less).

» May not be appropriate for high speed arterials or intersections with long right turn lanes.

» May not be appropriate for intersections with large percentages of right-turning heavy vehicles.

DESIGN FEATURES

» Maximum shared turn lane width is 13 feet; narrower is preferable. (NACTO, 2012)

» Shared Lane Markings should indicate preferred positioning of bicyclists within the combined lane.

» A "RIGHT LANE MUST TURN RIGHT" sign with an "EXCEPT BIKES" plaque may be needed to permit through bicyclists to use a right turn lane.

» Use R4-4 BEGIN RIGHT TURN LANE YIELD TO BIKES signage to indicate that motorists should yield to bicyclists through the conflict area.

FURTHER CONSIDERATIONS

» This treatment is recommended at intersections lacking sufficient space to accommodate both a standard through bike lane and right turn lane.

» Not recommended at intersections with high peak motor vehicle right turn movements.

» Combined bike lane/turn lane creates safety and comfort benefits by negotiating conflicts upstream of the intersection area.

SAFETY IMPACTS

A survey in Eugene, OR found that more than 17% of the surveyed bicyclists using the combined turn lane felt that it was safer than the comparison location with a standard-width right-turn lane, and another 55% felt that the combined-lane site was no different safety-wise than the standard-width location (Hunter 2000).

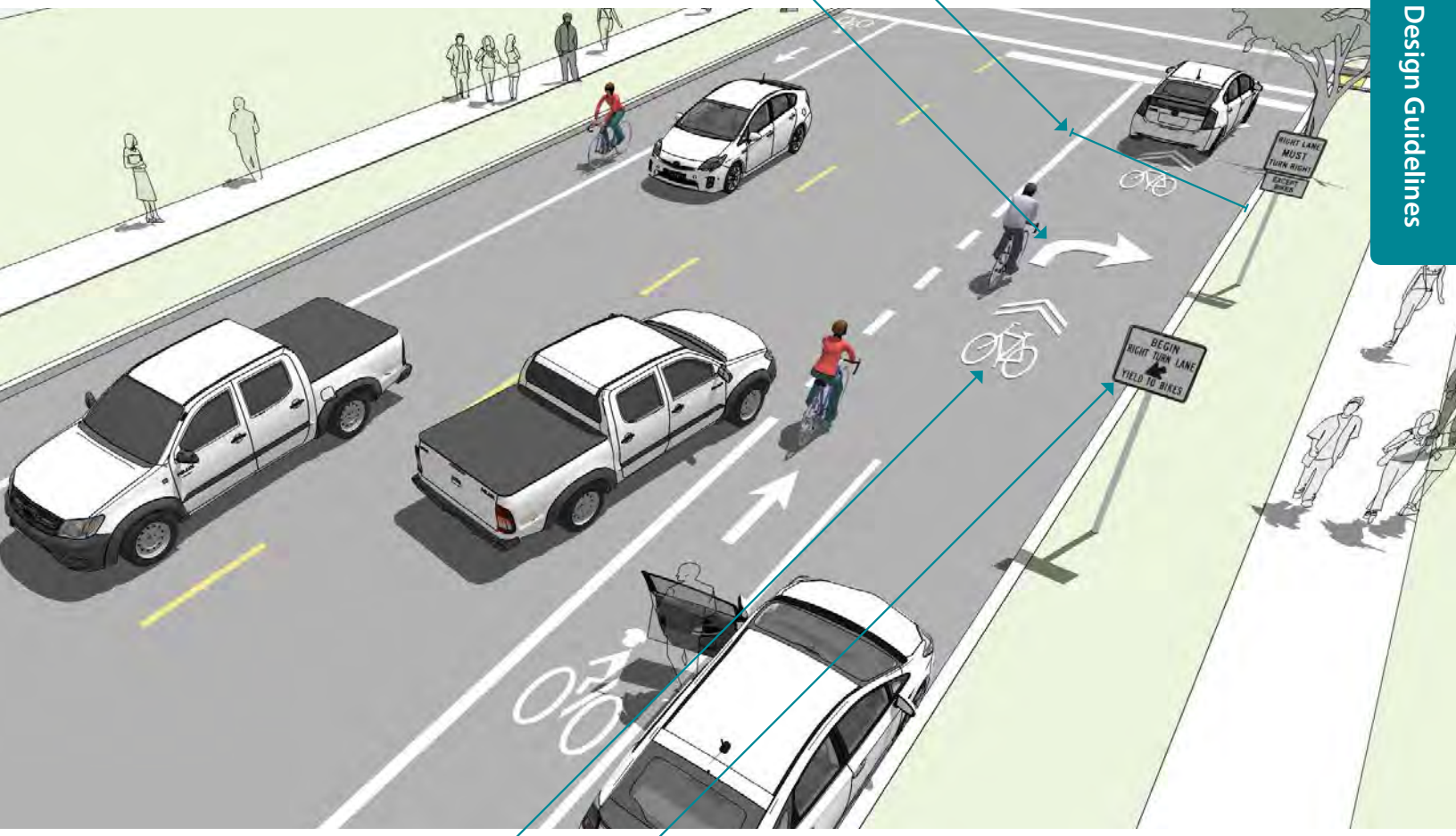
REFERENCES

» *Hunter, W.W. (2000). Evaluation of a Combined Bicycle Lane/Right-Turn Lane in Eugene, Oregon. Publication No. FHWA-RD-00-151, Federal Highway Administration, Washington, DC.*

» *NACTO. Urban Bikeway Design Guide. 2012.*

Maximum shared turn lane width is 13 ft; narrower is preferable (NACTO, 2012).

A "Right Lane Must Turn Right" (CAMUTCD R3-7) sign with an "EXCEPT BIKES" plaque may be needed to permit through bicyclists to use a right turn lane.



Shared Lane Markings should indicate preferred positioning of bicyclists within the combine lane.

Use "Begin Right Turn Lane Yield To Bikes" signage (CAMUTCD R4-4) to indicate that motorists should yield to bicyclists through the conflict area.

BIKE LANES AT ADDED RIGHT TURN LANES

The appropriate treatment at right turn only lanes is to introduce an added turn lane to the outside of the bike lane. The area where people driving must weave across the bike lane should be marked with dotted lines and dotted green pavement to identify the potential conflict areas. Signage should indicate that motorists must yield to bicyclists through the conflict area.

APPLICATION

» Streets with right-turn lanes and right side bike lanes.

» Streets with left-turn lanes and left side bike lanes.

» Design Features

» Mark inside line with 6" stripe.

» Continue existing bike lane width; standard width of 5 to 6 feet (4 feet in constrained locations.)

» Use R4-4 BEGIN RIGHT TURN LANE YIELD TO BIKES signage to indicate that motorists should yield to bicyclists through the conflict area.

» Consider using colored pavement markings in the conflict areas to promote visibility of the dashed weaving area.

FURTHER CONSIDERATIONS

» The bicycle lane maintains a straight path, and drivers must weave across, providing clear right-of-way priority to bicyclists.

» Maintaining a straight bicycle path reinforces the priority of bicyclists over turning cars. Drivers must yield to bicyclists before crossing the bike lane to enter the turn only lane.

» The use of dual right-turn-only lanes should be avoided on streets with bike lanes (AASHTO, 2012). Where there are dual right-turn-only lanes, the bike lane should be placed to the left of both right-turn lanes, in the same manner as where there is just one right-turn-only lane.

» Through lanes that become turn only lanes are difficult for bicyclists to navigate and should be avoided. See the figure below for appropriate striping patterns in this condition.

SAFETY IMPACTS

Studies have shown a 3% decrease in crashes at signalized intersections with exclusive right turn lanes when compared to sharing the roadway with motor vehicles. (CMF ID: 3257)

REFERENCES

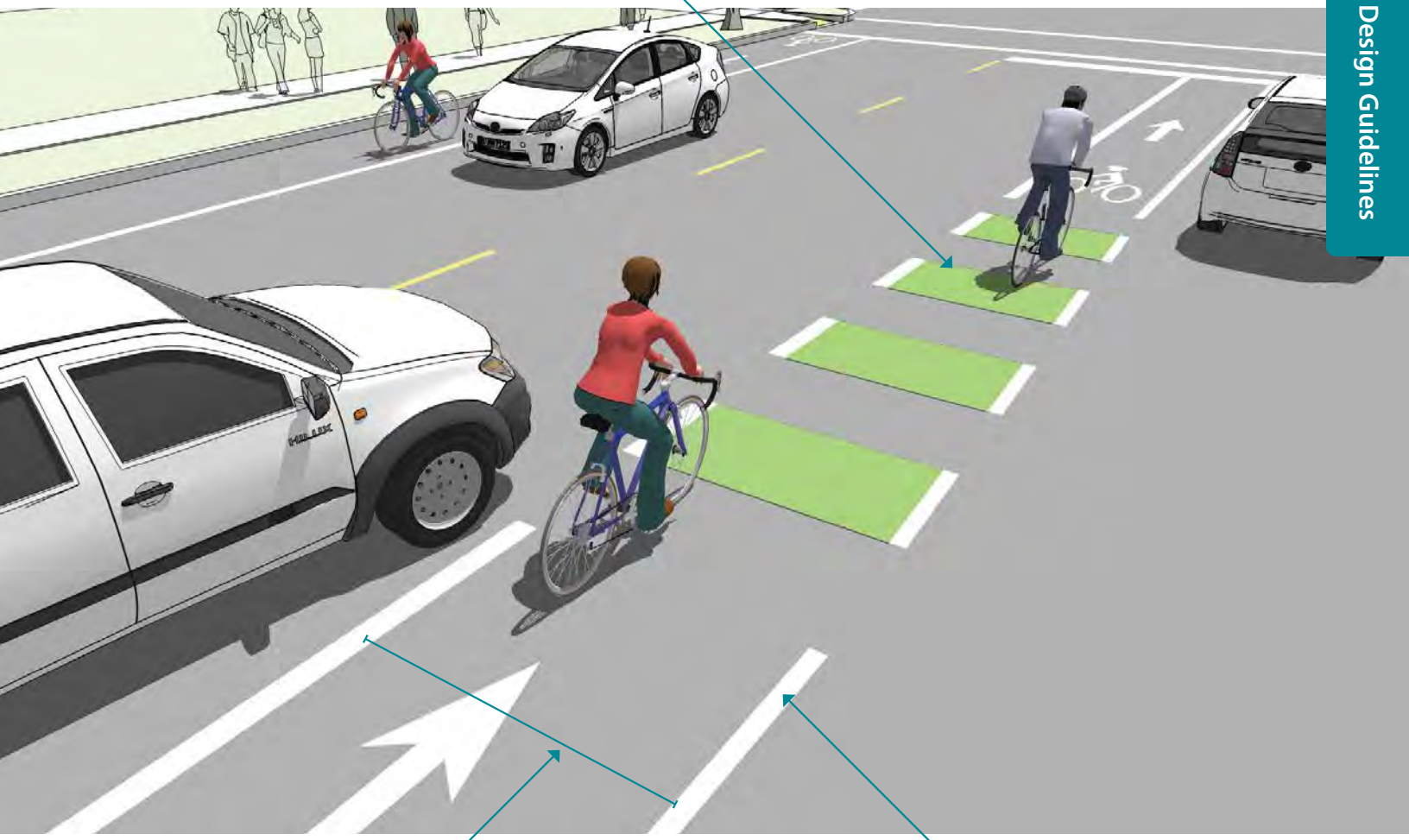
» *AASHTO. Guide for the Development of Bicycle Facilities. 2012.*

» *Crash Modification Factors Clearinghouse. http://www.cmfclearinghouse.org*

» *FHWA. Manual on Uniform Traffic Control Devices. 2009.*

» *NACTO. Urban Bikeway Design Guide. 2012.*

Consider using colored pavement markings in the conflict areas to promote visibility of the dashed weaving area.



Continue existing bike lane width; standard width of 5 to 6 ft (4 ft in constrained locations).

Mark inside line with 6″ stripe.

BIKE BOX

A bike box is a designated area located at the head of a traffic lane at a signalized intersection that provides bicyclists with a safe and visible space to get in front of queuing traffic during the red signal phase. Motor vehicles must queue behind the white stop line at the rear of the bike box. On a green signal, all bicyclists can quickly clear the intersection.

APPLICATION

» At potential areas of conflict between bicyclists and turning vehicles, such as a right or left turn locations.

» At signalized intersections with high bicycle volumes.

» At signalized intersections with high vehicle volumes

DESIGN FEATURES

» 14 foot minimum depth from back of crosswalk to motor vehicle stop bar. (NACTO, 2012)

» A "No Turn on Red" or "No Right Turn on Red" (CAMUTCD R13A) sign shall be installed overhead to prevent vehicles from entering the Bike Box. (Refer to CVC 22101 for the signage) A "Stop Here on Red" (CAMUTCD R10-6) sign should be post mounted at the stop line to reinforce observance of the stop line.

» A 50 foot ingress lane should be used to provide access to the box.

» Use of green colored pavement is optional.

FURTHER CONSIDERATIONS

» This treatment positions bicycles together and on a green signal, all bicyclists can quickly clear the intersection, minimizing conflict and delay to transit or other traffic.

» Pedestrians also benefit from bike boxes, as they experience reduced vehicle encroachment into the crosswalk.

» Bike boxes are currently under experiment in California.

SAFETY IMPACTS

A study of motorist/bicyclist conflicts at bike boxes indicate a 35% decrease in conflicts. (CMF ID: 1718) A study done in Portland in 2010 found that 77% of bicyclists felt bicycling through intersections was safer with the bike boxes (Monsere & Dill 2010).

REFERENCES

» *California Manual on Uniform Traffic Control Devices (CAMUTCD). 2014.*

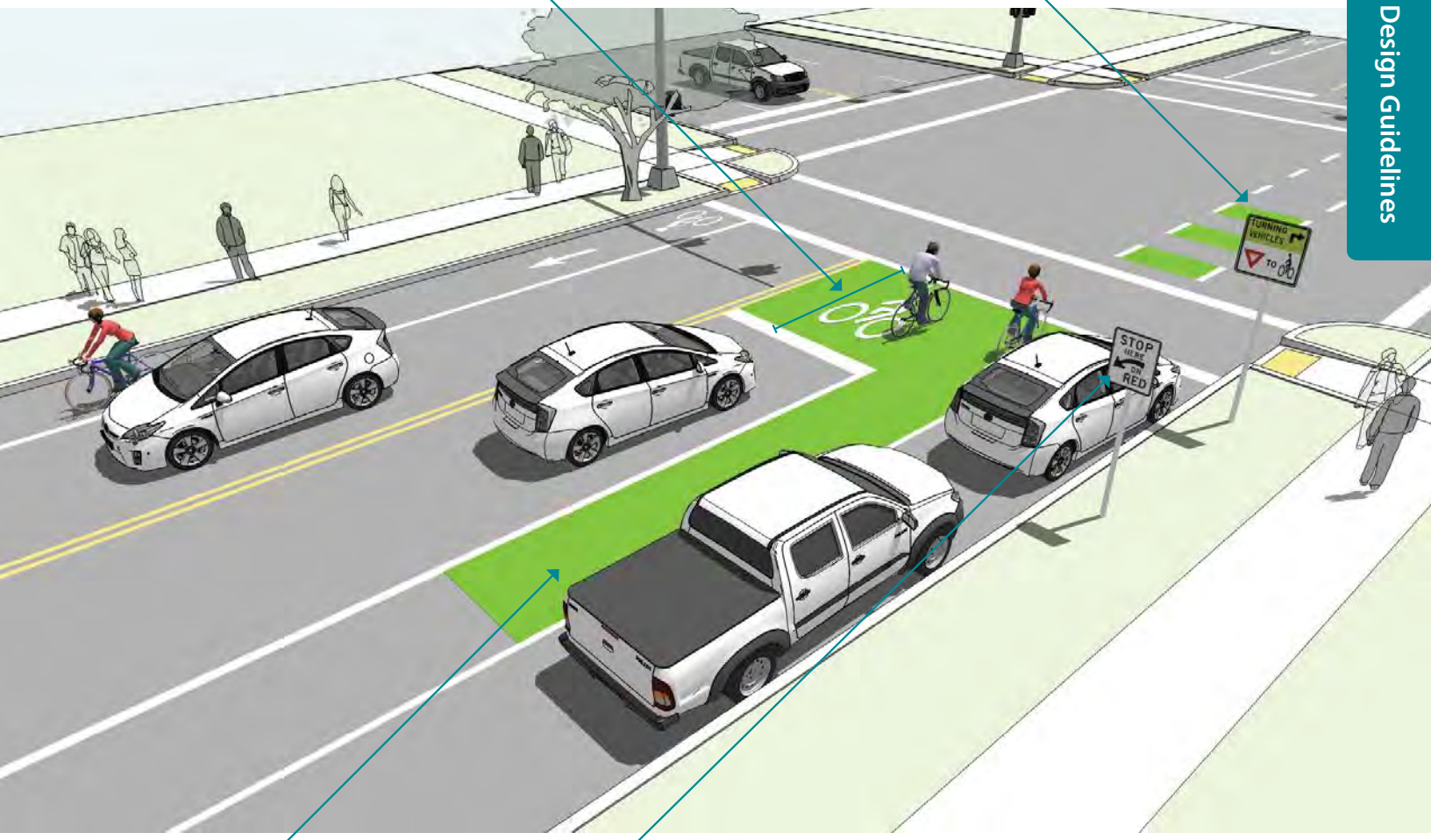
» *Crash Modification Factors Clearinghouse. http://www.cmfclearinghouse.org*

» *Monsere, C. & Dill, J. (2010). Evaluation of Bike Boxes at Signalized Intersections. Final Draft. Oregon Transportation Research and Education Consortium.*

» *NACTO. Urban Bikeway Design Guide. 2012.*

14 ft minimum depth from back of crosswalk to motor vehicle stop bar (NACTO, 2012).

A "Stop Here on Red" (CAMUTCD R10-6) sign should be post mounted at the stop line to reinforce observance of the stop line.



A 50 ft ingress lane should be used to provide access to the box.

Use of green colored pavement is optional.

A "No Turn on Red" (CAMUTCD R10-11) sign shall be installed overhead to prevent vehicles from entering the Bike Box.

CLASS IV: DIRECTIONAL SEPARATED BIKEWAYS

Separated bikeways (Class IV) are exclusive bicycle facilities that are separated from vehicle traffic by a vertical element. Separation is provided through physical barriers between the bike lane and the vehicular travel lane, such as a raised curb, bollards, parking, planter strips or medians.

APPLICATION

» Along streets with high bicycle volumes.

» Along streets with high motor vehicle volumes (9,000-30,000 ADT) and relatively high speeds (30+ mph).

» Along streets with high truck traffic (10% of total ADT).

» In areas of high parking turnover.

» Along streets for which conflicts at intersections can be effectively mitigated using parking lane setbacks, bicycle markings through the intersection, and other signalized intersection treatments.

» Special consideration should be given at transit stops to manage bicycle & pedestrian interactions.

DESIGN FEATURES

» Pavement markings, symbols and/or arrow markings must be placed at the beginning of the separated bikeway and at intervals along the facility. (CAMUTCD 9C.04)

» 7 foot width preferred (5 foot minimum). (HDM 1003.1)

» 3 foot minimum buffer width adjacent to parking. 18 inch minimum adjacent to travel lanes (NACTO, 2012). Channelizing devices should be placed in the buffer area. (CAMUTCD 3H.01)

» If buffer area is 4 feet or wider, white chevron or diagonal markings should be used. (CAMUTCD 9C.04)

FURTHER CONSIDERATIONS

» Separated bikeway buffers and barriers are covered in the CAMUTCD as preferential lane markings (section 3D.01) and channelizing devices (section 3H.01). Curbs may be used as a channeling device, see the section on islands (section 3I.01).

» A retrofit separated bikeway has a relatively low implementation cost compared to road reconstruction by making use of existing pavement and drainage and by using the parking lane as a barrier.

» Gutters, drainage outlets and utility covers should be designed and configured as not to impact bicycle travel.

» Special consideration should be given at transit stops to manage bicycle & pedestrian interactions.

» The implementation cost is low if the project uses existing pavement and drainage, but the cost significantly increases if curb lines need to be moved. A parking lane is the low-cost option for providing a barrier. Other barriers might include concrete medians, bollards, tubular markers, or planters.

SAFETY IMPACTS

A before and after study in Montreal of physically separated bikeways shows that this type of facility can result in a crash reduction of 74% for collisions between bicyclists and vehicles. (CMF ID: 4097) In this study, there was a parking buffer between the bike facility and vehicle travel lanes. Other studies have found a range in crash reductions due to (SBL switches from bikeway to bike lane), from 8% (CMF ID: 4094) to 94% (CMF ID: 4101).

REFERENCES

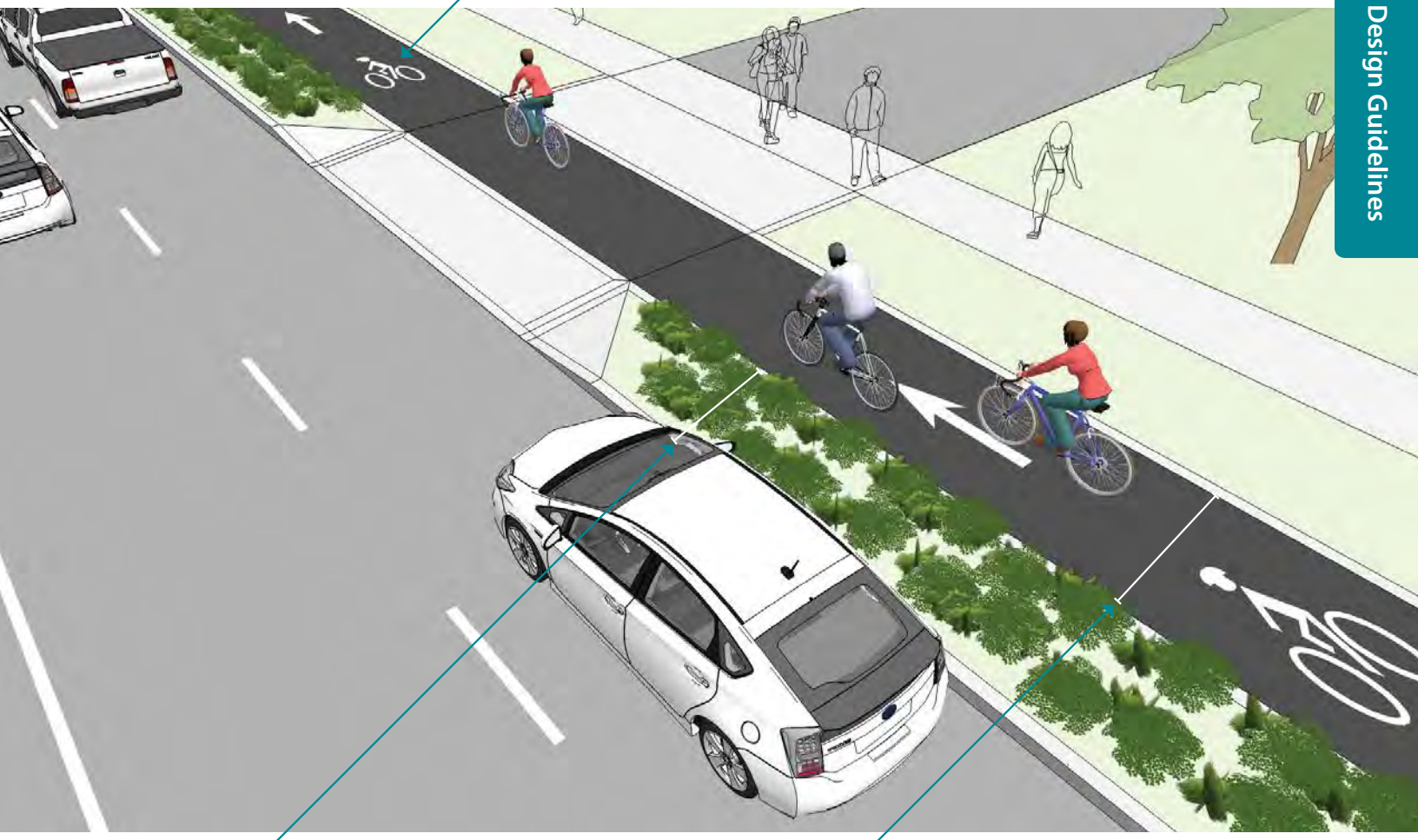
» *California Manual on Uniform Traffic Control Devices (CAMUTCD). 2014.*

» *Crash Modification Factors Clearinghouse. http://www.cmfclearinghouse.org*

» *Federal Highway Administration. Separated Bike Lane Planning and Design Guide. 2015.*

» *NACTO. Urban Bikeway Design Guide. 2012.*

Pavement markings, symbols and/or arrow markings must be placed at the beginning of the separated bike lane and at intervals along the facility (CAMUTCD 9C.04).



3 ft minimum buffer width adjacent to parking. 18 inch minimum adjacent to travel lanes (NACTO, 2012).

Channelizing devices should be placed in the buffer area.

7 ft width preferred (5 ft minimum).

CLASS IV: TWO-WAY SEPARATED BIKEWAYS

Two-way separated bikeways (Class IV) are bicycle facilities that allow bicycle movement in both directions on one side of the road. Two-way separated bikeways share some of the same design characteristics as one-way separated bikeways, but may require additional considerations at driveway and side-street crossings.

APPLICATION

» Along streets with few conflicts such as driveways or cross-streets on one side of the street.

» Along streets where there is not enough room for a one-way separated bikeway on both sides of the street.

» Along one-way streets by incorporating a contraflow lane to create a two-way facility.

» Along streets with high bicycle volumes.

» Along streets where more destinations are on one side thereby reducing the need to cross the street.

» Along streets with high motor vehicle volumes (9,000-30,000 ADT), high truck volumes (10% of total ADT), and relatively high speeds (30+ mph).

DESIGN FEATURES

» 12 foot operating width preferred (10 ft minimum) width for two-way facility. (FHWA 2015)

» In a constrained situation, an 8 foot minimum operating width may be considered. (HDM 1003.1(1))

» Adjacent to on-street parking a 3 foot minimum width channelized buffer or island shall be provided to accommodate opening doors. (NACTO, 2012). (CAMUTCD 3H.01, 3I.01)

» Separation narrower than 5 feet separation may be permitted if a physical barrier separation is present. (AASHTO, 2013)

» Additional signalization and signs may be necessary to manage conflicts.

FURTHER CONSIDERATIONS

» On-street bike lane buffers and barriers are covered in the CAMUTCD as preferential lane markings (section 3D.01) and channelizing devices, including flexible delineators (section 3H.01). Curbs may be used as a channeling device, see the section on islands (section 3I.01).

» A two-way separated bikeway on a one way street should be located on the left side.

» A two-way separated bikeway may be configured at street level or as a raised separated bikeway with vertical separation from the adjacent travel lane.

» Two-way separated bikeways should ideally be placed along streets with long blocks and few driveways or mid-block access points for motor vehicles.

» The implementation cost is low if the project uses existing pavement and drainage, but the cost significantly increases if curb lines need to be moved. A parking lane is the low-cost option for providing a barrier. Other barriers might include concrete medians, bollards, tubular markers, or planters.

SAFETY IMPACTS

A study of bicyclists in two-way separated bikeway found that collision probability decreased by 45% at intersections where the bikeway approach was detected between 2-5 meters from the side of the main road and when bicyclists had crossing priority at intersections. (CMF ID: 3034) Installation of a two-way separated bikeway 0-2 meters from the side of the main road resulted in an increase in collisions at intersections by 3% (CMF ID: 4033).

REFERENCES

» *California Highway Design Manual (HDM).*

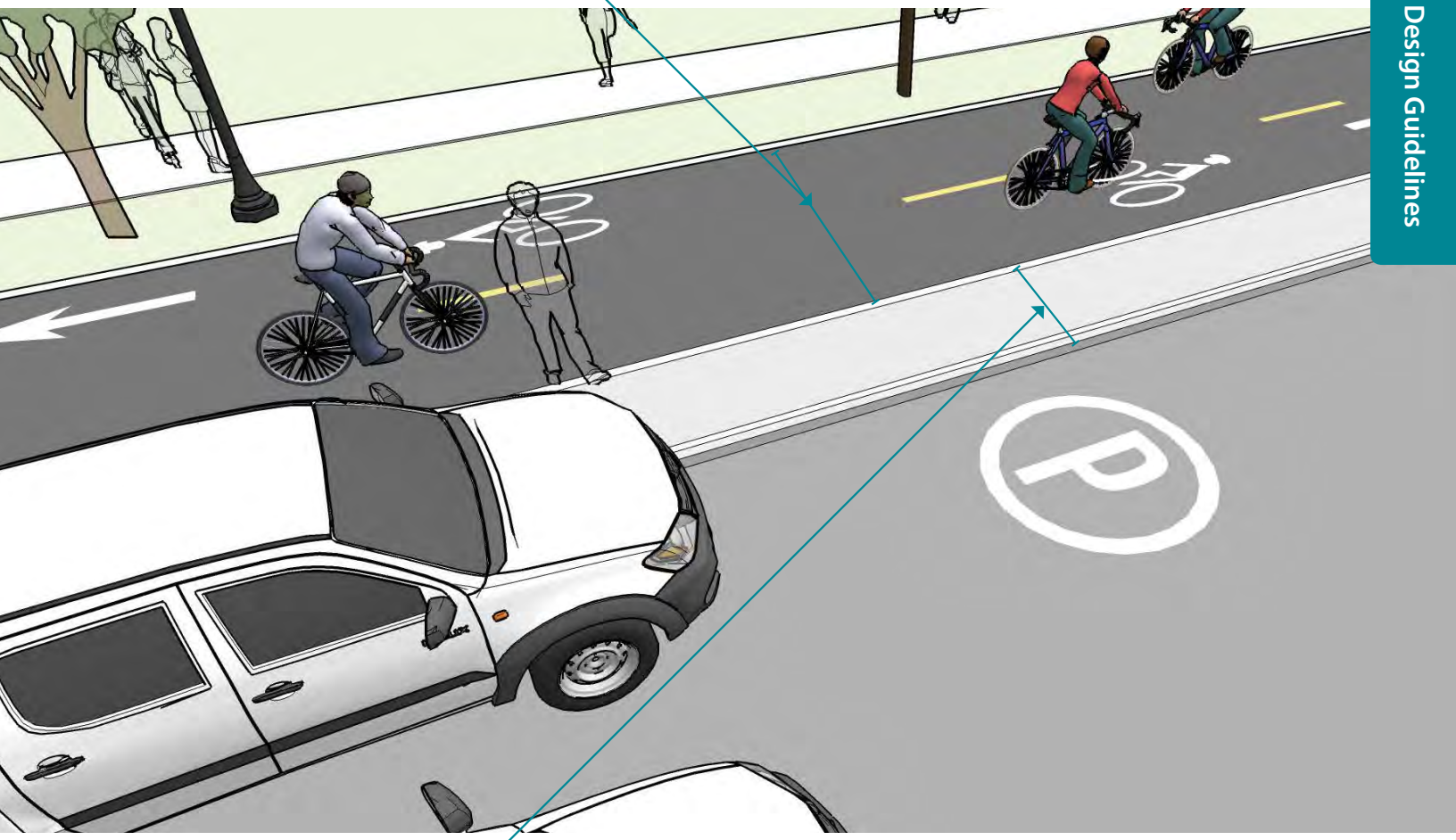
» *California Manual on Uniform Traffic Control Devices (CAMUTCD). 2014.*

» *Crash Modification Factors Clearinghouse. http://www.cmfclearinghouse.org*

» *Federal Highway Administration. Separated Bike Lane Planning and Design Guide. 2015.*

» *NACTO. Urban Bikeway Design Guide. 2012.*

12 ft operating width preferred (10 ft minimum) width for two-way facility. In constrained an 8 ft minimum operating width may be considered.



Adjacent to on-street parking a 3 ft minimum width channelized buffer or island shall be provided to accommodate opening doors (NACTO, 2012) (CAMUTCD 3H.01, 3I.01).

SEPARATED BIKEWAY BARRIER METHODS

Separated bikeways may use a variety of vertical elements to physically separate the bikeway from adjacent travel lanes. Barriers may be robust constructed elements such as curbs, or may be more interim in nature, such as flexible delineator posts.

APPLICATION

Barrier separation methods should be selected in response to available space, desired level of comfort and project cost.

Barrier types appropriate for retrofit projects:

» Parked Cars
» Flexible delineators
» Bollards
» Planters
» Parking stops

Barrier types appropriate for reconstruction projects:

» Curb separation
» Medians
» Landscaped Medians
» Raised separated bikeway with vertical or mountable curb
» Pedestrian Safety Islands

DESIGN FEATURES

» Place curbs or delineator posts as far from the through bikeway space as practicable to maximize effective operating space. Allow for adequate shy distance from vertical elements to maximize useful space.
» When next to parking, allow for 3 feet of space in the buffer space to allow for opening doors and passenger unloading.
» The presence of landscaping in medians, planters, and safety islands increases comfort for users and enhances the streetscape environment.
» In constrained conditions, the barrier type may need to be removable to allow for regular maintenance.

FURTHER CONSIDERATIONS

Other benefits of barrier include:

» Vertical barriers provide comfort for users of all ages and abilities.
» Barriers can define the edge of adjacent parking lanes, minimizing encroachment into the bikeway.
» Barriers can be designed to accommodate maintenance of the separated bikeway.

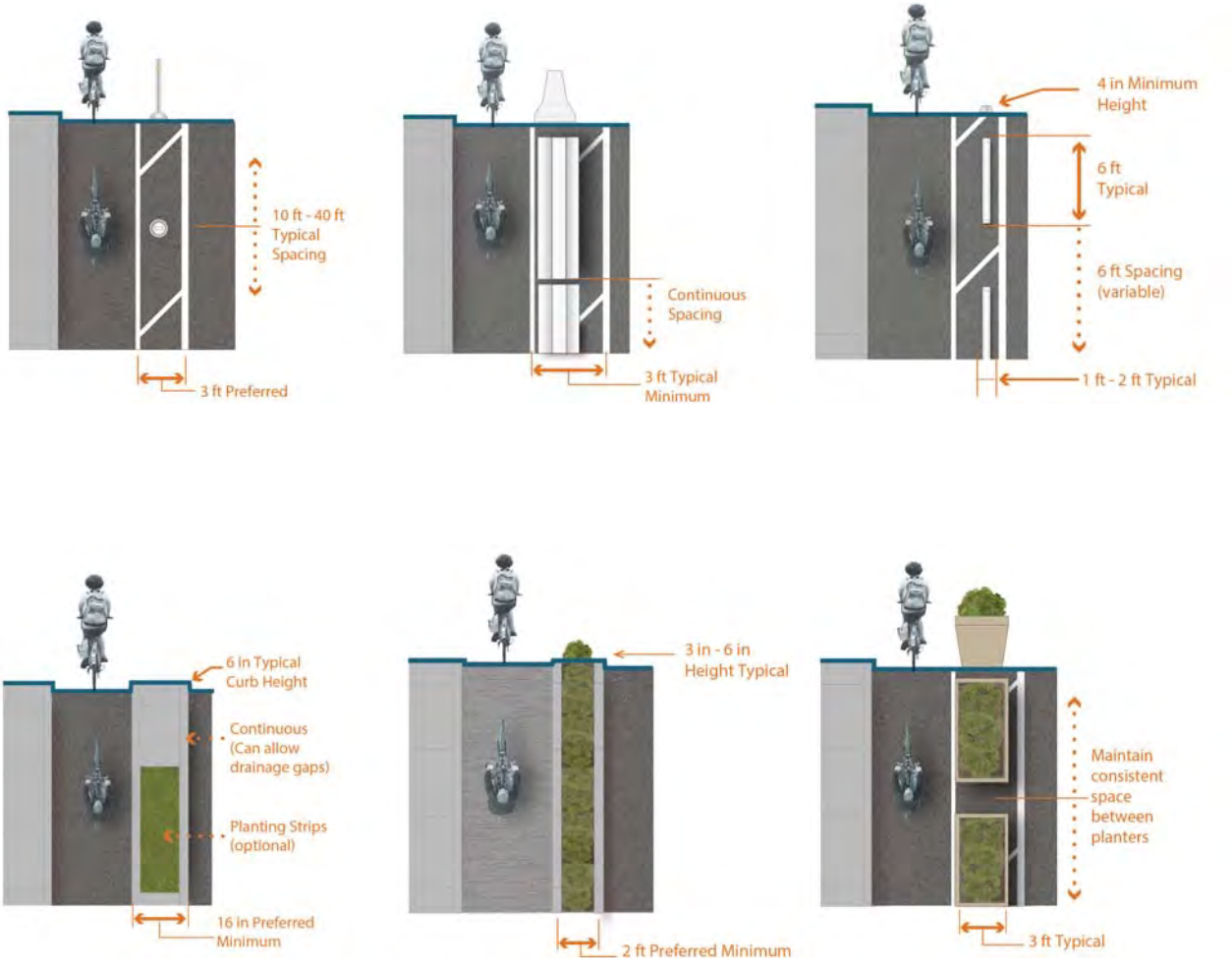
SAFETY IMPACTS

Bicyclists enjoy the greatest level of comfort when buffers provide greater levels of physical separation. Studies show that planters, curbs, and flexible delineator posts provided the greatest sense of comfort, and that any type of buffer shows a considerable increase in self-reported comfort levels over a striped bike lane. (NITC 2014)

REFERENCES

» *Federal Highway Administration. Separated Bike Lane Planning and Design Guide. 2015.*
» *National Institute for Transportation and Communities (NITC). Lessons from the Green Lanes: Evaluating Protected Bike Lanes in the U.S. 2014.*

Separation Methods



SEPARATED BIKEWAYS AT DRIVEWAYS

The added separation provided by separated bikeways creates additional considerations at intersections and driveways when compared to conventional bicycle lanes. Special design guidelines are necessary to preserve sightlines and denote potential conflict areas between modes, especially when motorists turning into or out of driveways may not be expecting bicycle travel opposite to the main flow of traffic.

At driveways and crossings of minor streets, bicyclists should not be expected to stop if the major street traffic does not stop.

APPLICATION

» Along streets with separated bikeways where there are intersections and driveways.

» Higher frequency driveways or crossings may require additional treatments such as conflict markings and signs.

DESIGN FEATURES

» Remove parking to allow for the appropriate clear sight distance before driveways or intersections to improve visibility. The desirable no-parking area is at least 30 feet from each side of the crossing.

» Use colored pavement markings and/or shared line markings through conflict areas at intersections.

» If a raised bike lane is used, the height of the lane should be maintained through the crossing, requiring automobiles to cross over.

» Motor vehicle traffic crossing the bike lane should be constrained or channelized to make turns at sharp angles to reduce travel speed prior to the crossing.

» Driveway crossings may be configured as raised crossings to slow turning cars and assert physical priority of travelling bicyclists.

» Motor vehicle stop bar on cross-streets and driveways is setback from the intersection to ensure that drivers slow down and scan for pedestrians and bicyclists before turning.

FURTHER CONSIDERATIONS

» Removing obstructions and providing clear sight distance at crossings increases visibility of bicyclists.

» Treatments designed to constrain and slow turning motor vehicle traffic will slow drivers to bicycle-compatible travel speeds prior to crossing the separated bike lane.

SAFETY IMPACTS

Raised crossings at driveways and intersections physically indicates priority of path travel over turning or crossing traffic and reduces conflict risk by 51%. (Schepers et al. 2011)

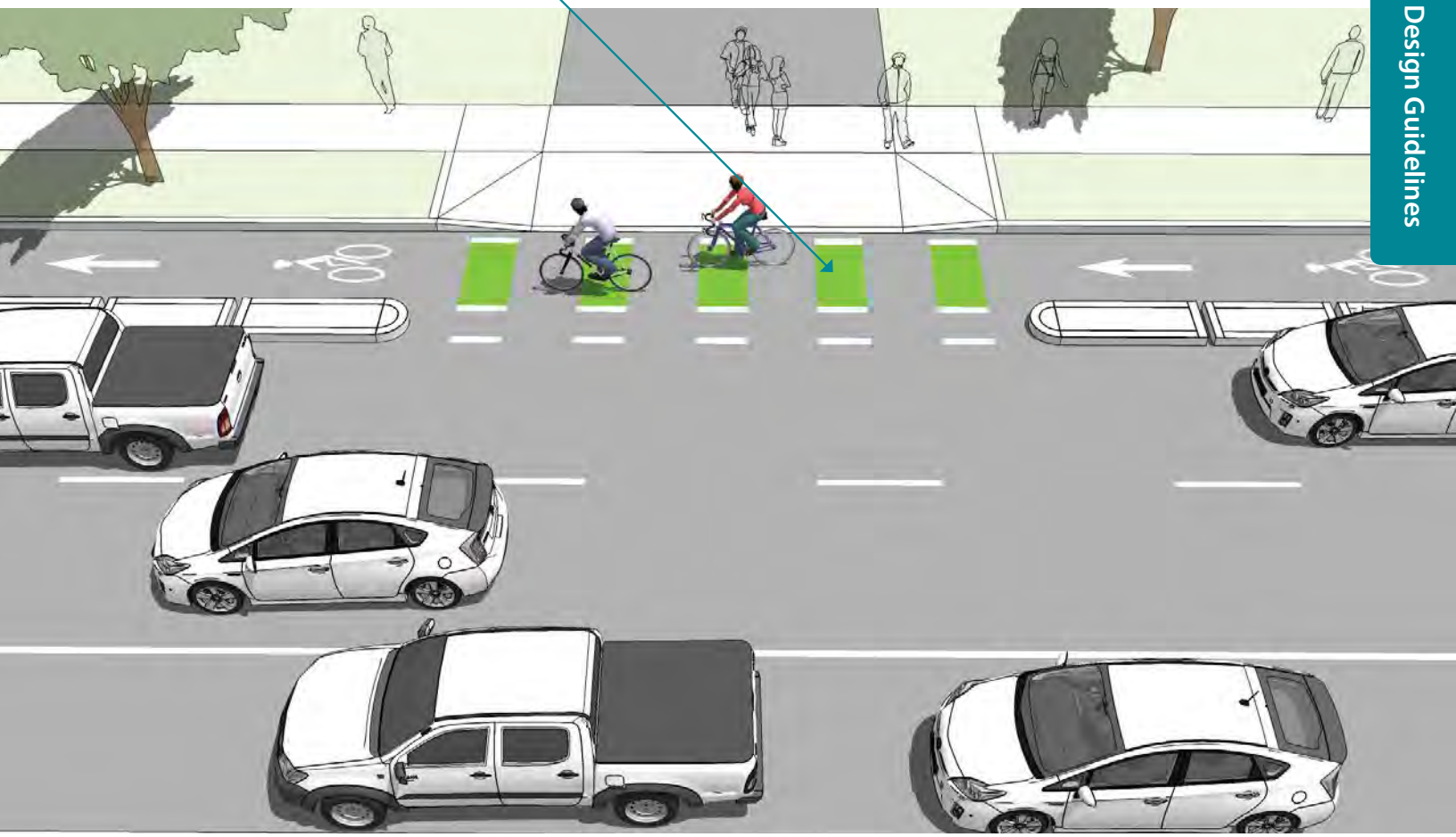
REFERENCES

» *Federal Highway Administration. Separated Bike Lane Planning and Design Guide. 2015.*

» *NACTO. Urban Bikeway Design Guide. 2012.*

» *Schepers et al. Road factors and bicycle—motor vehicle crashes at unsignalized priority intersections. Accident Analysis & Prevention. Volume 43, Issue 2, 2011.*

Use colored pavement markings and/or shared line markings through conflict areas at intersections.



SEPARATED BIKEWAYS AND TRANSIT INTERACTIONS

Where separated bikeways and transit routes overlap, designs of transit stops should mitigate and manage interactions between cyclists, transit vehicles, and boarding and alighting passengers.

APPLICATION

» Streets with moderate to high transit frequency, transit ridership, pedestrian volume, or bicycling volume.

» Routes where bike lanes or separated bikeways and transit operations overlap to maintain bicycle facility continuity, provide separation and minimize conflicts between users.

» Where in-lane transit stops are desired to reduce transit vehicle delay.

DESIGN FEATURES

» The transit platform should be configured between the bikeway and the travel way to remove interactions between transit vehicles and bicyclists. This will generally require the transit vehicle to stop in-lane.

» Clear space for transit loading must be provided at a minimum 5 feet long by 8 feet wide to accommodate wheelchair ramp deployments.

» Transit island platform dimensions must be a minimum of 8 feet wide to accommodate mobility devices. High volume stops should have room for shelters and seating.

» The bus stop island should be a minimum of 8 feet wide, (wider dimensions preferred at stops with higher transit activity) with enough length to serve the average number of vehicles that serve the platform at any given time during peak commute periods.

» At least 5 feet clear width shall be provided between the streetside curb and transit shelter, or the nearest curb ramp across the bicycle lane.

» Raised 6 foot crosswalk across the channelized bicycle lane consolidates the conflict point between passengers and bicyclists. A recommended slope of 1:10 – 1:25 slows down bicycle riders and reinforces pedestrian right-of-way, in addition to signs and yield pavement markings.

FURTHER CONSIDERATIONS

» Transit islands require less drainage modification compared to transit curb extensions.

» Transit islands can incorporate a pedestrian refuge with ADA-compliant ramps to shorten crossing distance where the stop is located adjacent to a crosswalk on the near-side or far-side of an intersection.

» Consider ramping the bikeway up to sidewalk level at this crossing to reduce bicycle speeds and enhance ADA access to the stop.

» Where it is desired to have the transit vehicle move out of the flow of traffic, the bikeway may need to bend around the platform. This lateral shift of the bikeway is determined based on the offset distance and bicycle design speed.

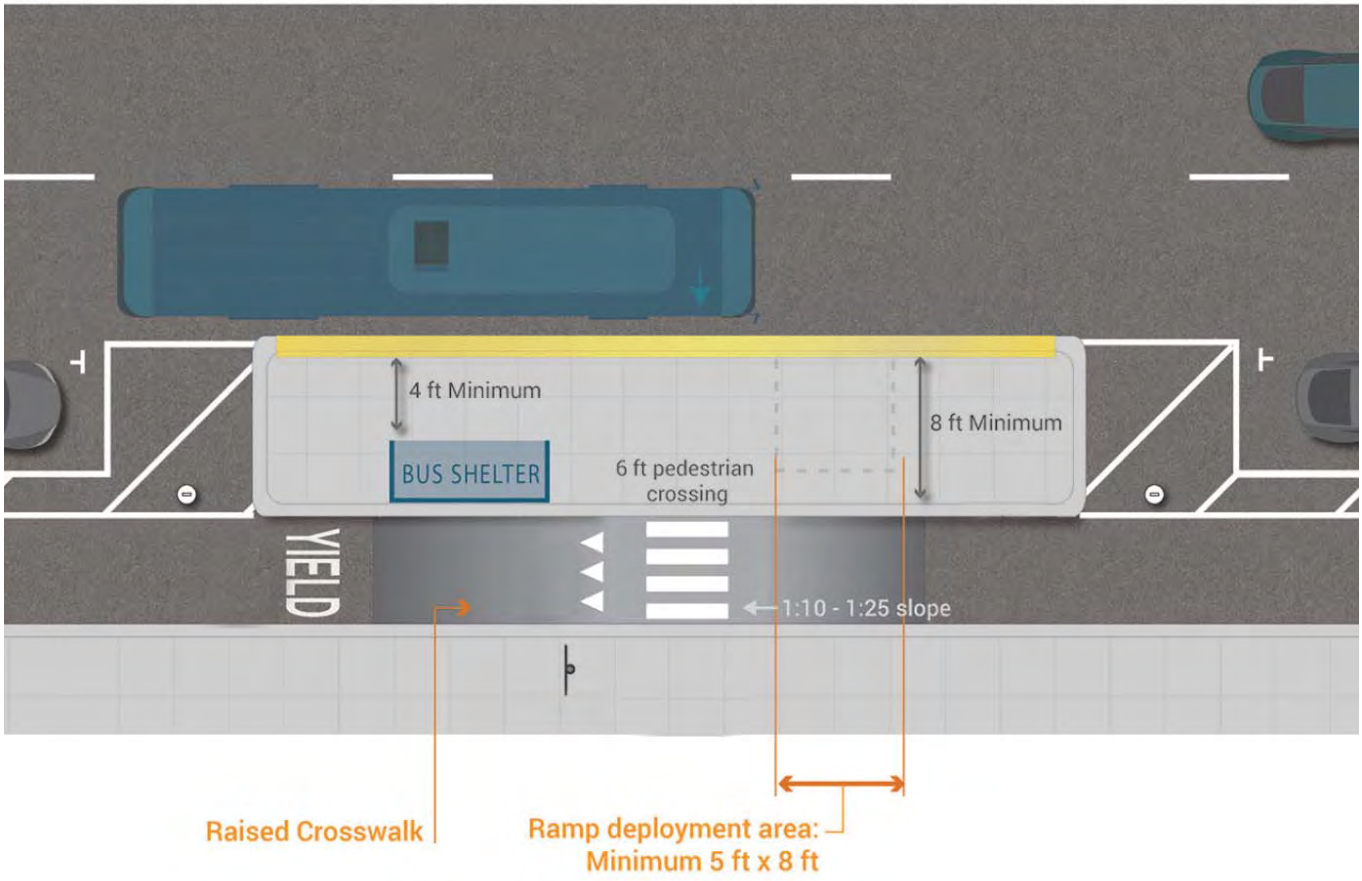
SAFETY IMPACTS

There are no studies on the safety and operations of separated bikeway at transit stops.

REFERENCES

» *FHWA. Separated Bike Lane Planning and Design Guide. 2015.*

» *NACTO. Transit Street Design Guide. 2016.*


4 ft Minimum
8 ft Minimum
BUS SHELTER
6 ft pedestrian crossing
YIELD
1:10 - 1:25 slope
Raised Crosswalk
Ramp deployment area:
Minimum 5 ft x 8 ft

SEPARATED BIKEWAY ACCESSIBILITY AND LOADING

Where separated bicycle lanes are adjacent to accessible on-street parking or freight loading zones, an accessible aisle should be provided to allow for travel from the vehicle to the curb ramp.

APPLICATION

» Streets with on-street parking along the same block face of a separated bikeway.

» Where ADA-accessible spaces are desired, either due to proximity to nearby building entrances, street grades, or other factors.

» Where loading zones are desired along the same side of the street as a separated bikeway due to adjacent commercial users such as retail or hotels, and cannot be relocated to adjacent block faces or alleys.

DESIGN FEATURES

» Accessible spaces should be located adjacent to intersections to simplify access to curb ramps.

» Accessible spaces must be at least 20 feet long and 8 feet wide.

» An accessible 5 foot aisle must be provided on street level between on-street parking and the bicycle facility for the full length of the parking space and must connect to a pedestrian access route. The access aisle shall not encroach on the vehicle travel lane. Front and rear aisles should be at least 3 feet to ease parking.

» To connect between the sidewalk and parking spaces, a crosswalk across the bicycle lane and curb ramp (6 foot minimum width) must be provided.

» Place a YIELD HERE TO PEDESTRIANS (MUTCD R1-5) sign where the bicycle lane crosses the parking access route to clearly establish right-of-way. Yield line pavement marking may be placed prior to the crosswalk.

FURTHER CONSIDERATIONS

» Where the loading zone bends in towards the sidewalk: The separated bikeway may need to shift laterally into the sidewalk to accommodate a required loading or drop-off zone where there is no on-street parking, based on the offset distance and bicycle design speed.

» Maintain an acceptable sidewalk width for clear pedestrian travel where the loading zone bends.

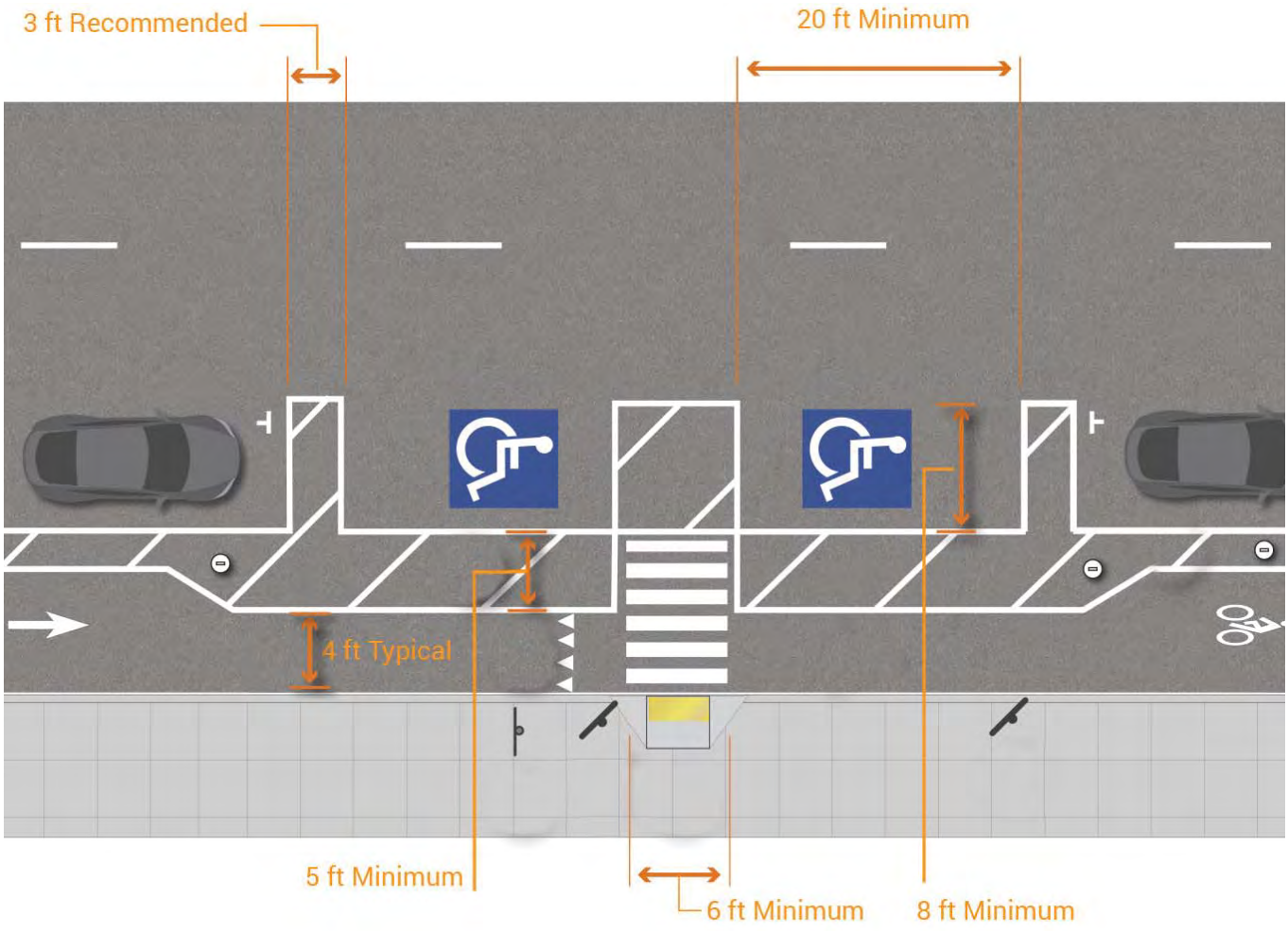
» Where a lateral shift cannot be designed, consider a mixing zone to accommodate loading and drop-off activities with bicycle traffic. This facility would require design treatments to minimize conflict in high-use areas.

SAFETY IMPACTS

There are no studies on the safety and operations of separated bikeway at accessible parking and loading zones.

REFERENCES

» *FHWA. Separated Bike Lane Planning and Design Guide. 2015.*


3 ft Recommended
20 ft Minimum
4 ft Typical
5 ft Minimum
6 ft Minimum
8 ft Minimum

PROTECTED BICYCLE SIGNAL PHASE

Separated bikeway crossings of signalized intersections can be accomplished through the use of a bicycle signal phase which reduces conflicts with motor vehicles by separating bicycle movements from any conflicting motor vehicle movements. Bicycle signals are traditionally three lens signal heads with green, yellow and red bicycle stenciled lenses.

APPLICATION

» Two-way separated bikeways where contraflow bicycle movement or increased conflict points warrant protected operation.

» Bicyclists moving on a green or yellow signal indication in a bicycle signal shall not be in conflict with any simultaneous motor vehicle movement at the signalized location

» Right (or left) turns on red should be prohibited in locations where such operation would conflict with a green bicycle signal indication.

DESIGN FEATURES

» An additional "Bicycle Signal" sign should be installed below the bicycle signal head.

» Designs for bicycles at signalized crossings should allow bicyclists to trigger signals and safely maneuver the crossing.

» On bikeways, signal timing and actuation shall be reviewed and adjusted to consider the needs of bicyclists. (CAMUTCD 9D.02)

FURTHER CONSIDERATIONS

» A bicycle signal should be considered for use only when the volume/collision or volume/geometric warrants have been met. (CAMUTCD 4C.102)

» FHWA has approved bicycle signals for use, if they comply with requirements from F.C. Interaction Approval 16 (I.A. 16).

» Bicyclists typically need more time to travel through an intersection than motor vehicles. Green light times should be determined using the bicycle crossing time for standing bicycles.

» Bicycle detection and actuation systems include user-activated buttons mounted on a pole, loop detectors that trigger a change in the traffic signal when a bicycle is detected and video detection cameras, that use digital image processing to detect a change in the image at a location.

SAFETY IMPACTS

A survey of separated bikeway users in the United States found the 92% of respondents agreed with the statement "I generally feel safe when bicycling through the intersections" when asked about an intersection with a protected bicycle signal phase (NITC, 2014).

REFERENCES

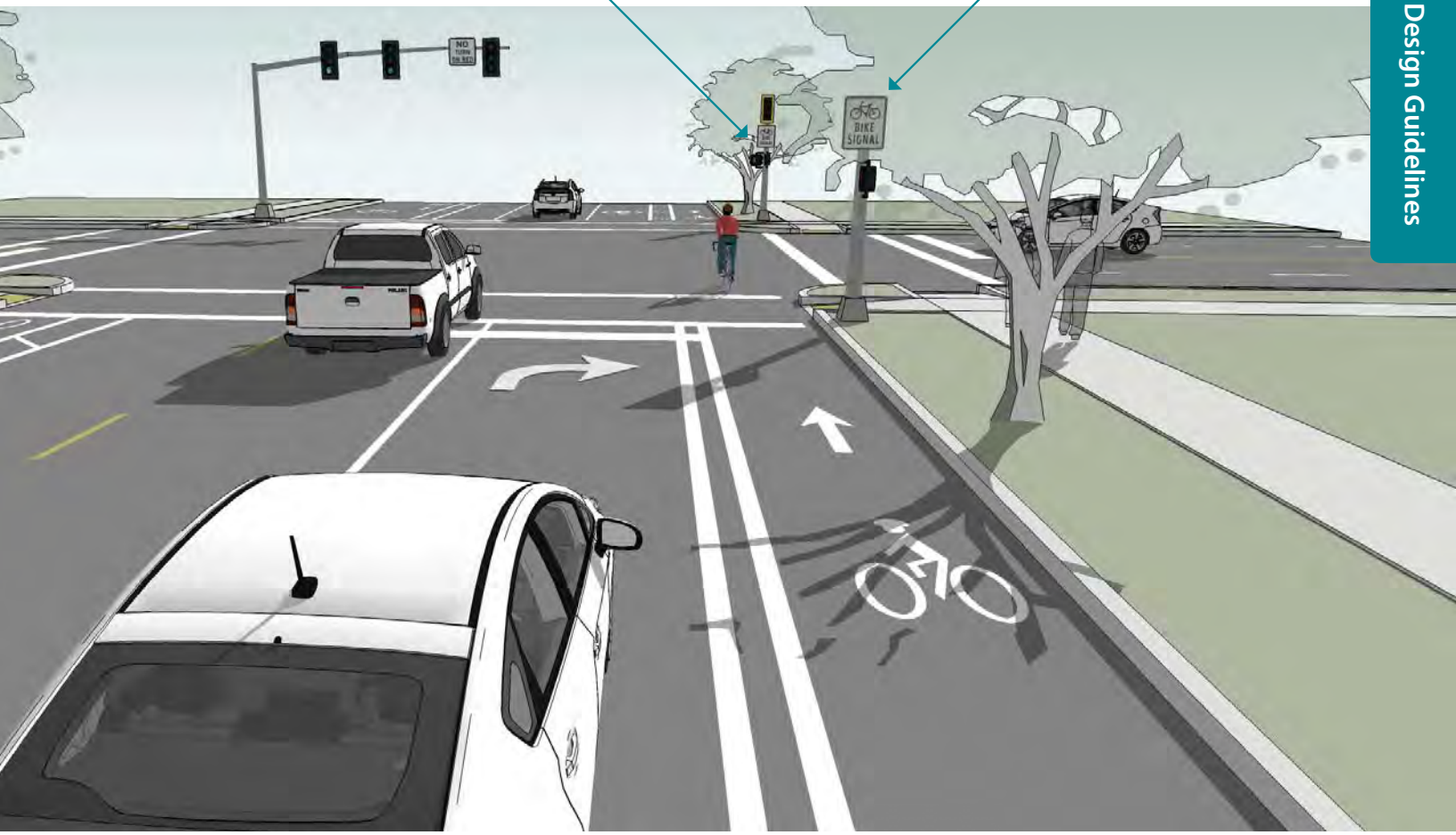
» *FHWA. MUTCD - Interim Approval for Optional Use of a Bicycle Signal Face (IA-16). 2013.*

» *NACTO. Urban Bikeway Design Guide. 2012.*

» *NITC. Lessons from the Green Lanes. 2014.*

An additional "Bicycle Signal" sign should be installed below the bicycle signal head.

Designs for bicycles at signalized crossings should allow bicyclists to trigger signals and safely maneuver the crossing.



MIXING ZONE

A mixing zone creates a shared travel lane where turning motor vehicles yield to through traveling bicyclists. Striping design is intended to slow motor vehicles to bicycle speed, provide regulatory guidance to people driving, and require all users to negotiate conflicts upstream of the intersection.

APPLICATION

» Most appropriate in areas with low to moderate right-turn volumes

» Streets with a right turn lane but not enough width to have a standard width bicycle lane at the intersection.

DESIGN FEATURES

» Use short transition taper dimensions and short storage length to promote slow motor vehicle travel speeds.

» The width of the mixing zone should be 9 feet minimum and 13 feet maximum.

» The transition to the mixing zone should begin 70 feet in advance of the intersection.

» Shared lane markings (CAMUTCD 9C-9) should be used to illustrate the bicyclist's position within the lane.

» A yield line should be used in advance of the intersection.

FURTHER CONSIDERATIONS

» Not recommended at intersections with high peak motor vehicle right turn movements.

» The zone creates safety and comfort benefits by having the mixing zone upstream of the intersection conflict area.

SAFETY IMPACTS

A survey of separated bikeway users in the United States found the 60-80% of respondents agreed with the statement "I generally feel safe when bicycling through the intersections" when asked about intersections with mixing zone approaches (NITC 2014).

REFERENCES

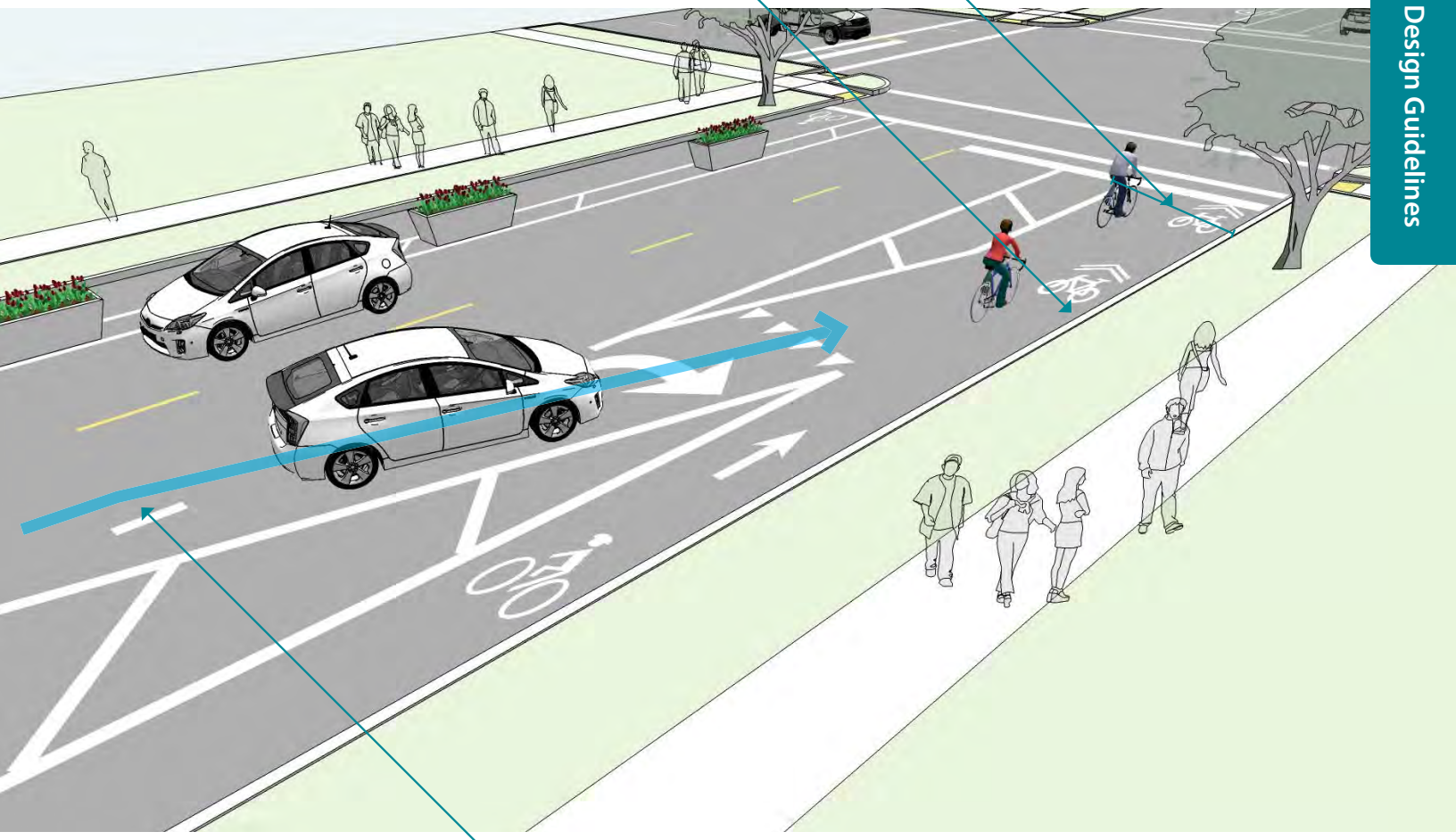
» *California Manual on Uniform Traffic Control Devices (CAMUTCD). 2014.*

» *Federal Highway Administration. Separated Bike Lane Planning and Design Guide. 2015.*

» *NITC. Lessons from the Green Lanes. 2014.*

Shared lane markings (CAMUTCD 9C-9) should be used to illustrate the bicyclist's position within the lane.

The width of the mixing zone should be 9 feet minimum and 13 feet maximum.



Use short transition taper dimensions and short storage length to promote slow motor vehicle travel speeds.

BEND-IN

To increase the visibility of bicyclists for turning motorists, a bend-in intersection approach laterally shifts the separated bikeway immediately adjacent to the turning lane.

APPLICATION

» Bikeways separated by a visually intensive buffer or on-street parking.

» Where it is desirable to create a curb extension at intersections to reduce pedestrian crossing distance.

» Where space is not available to bend-out the bikeway prior to the intersection.

DESIGN FEATURES

» At least 20 feet prior to an intersection, provide between 20 – 40 feet of length to shift the bikeway closer to motor vehicle traffic.

» Where the separated bikeway uses parked cars within the buffer zone, parking must be prohibited at the start of the transition.

» Place a "Turning Vehicles Yield to Bikes" sign (modified MUTCD R10-15) prior to the intersection.

» Provide a narrow buffer with vertical delineators between the travel lane and bikeway to increase comfort for bicycle riders and slow driver turning speed.

FURTHER CONSIDERATIONS

» The design creates an opportunity for a curb extension, to reduce pedestrian crossing distance. This curb extension can also create public space which can be used for bike parking corrals, bikeshare stations, parklets, public art exhibits, and/or stormwater features such as bioswales.

» Can be paired with intersection crossing markings such as green colored pavement to raise awareness of conflict points.

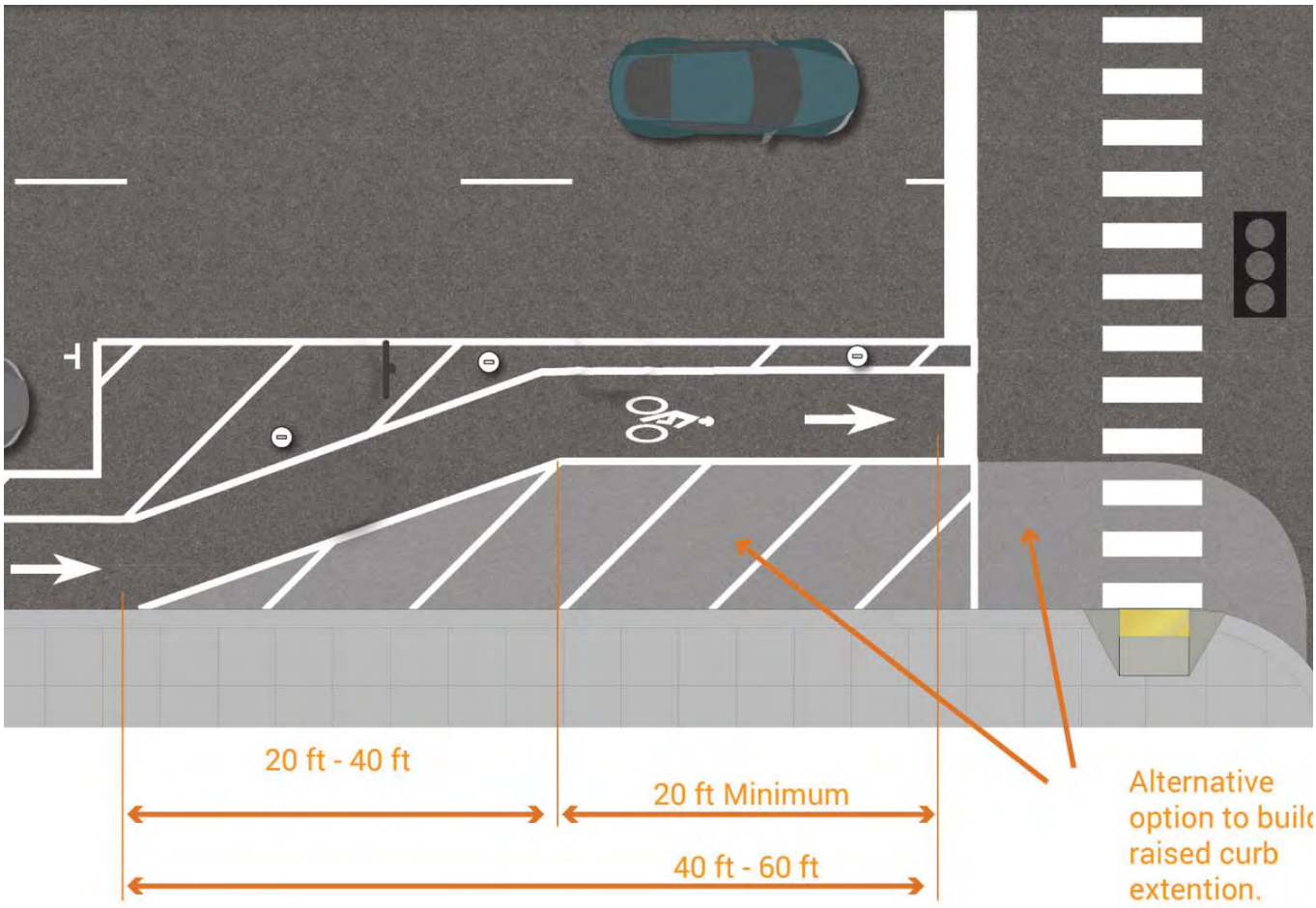
SAFETY IMPACTS

Separated bikeways with "bend-in" approaches create geometry similar to that of conventional on-street bike lanes and should offer a similar safety performance to those designs.

REFERENCES

» *FHWA. Separated Bike Lane Planning and Design Guide. 2015.*

» *NACTO. Urban Bikeway Design Guide. 2012.*


20 ft - 40 ft
20 ft Minimum
40 ft - 60 ft
Alternative
option to build
raised curb
extention.

TWO STAGE TURN BOX

Two-stage turn boxes offer bicyclists a safe way to make turns at multi-lane signalized intersections from a separated bikeway or on-street bike lane.

On separated bikeways, bicyclists are often unable to merge into traffic to turn due to physical separation, making the provision of two-stage turn boxes critical. Design guidance for two-stage turns apply to both bike lanes and separated bikeways.

APPLICATION

» Preferred treatment to assist turning maneuvers on separated bikeways, instead of requiring bicyclists to merge to make a vehicular left turn.

» Required for separated bikeways to assist left turns from a right side facility, or right turns from a left side facility.

» Strongly recommended on streets with 2+ lanes in each direction.

DESIGN FEATURES

» 6' by 8' box dimensions preferred to hold multiple queuing bicyclists and formalize two-stage turn maneuvers. 3' by 6' minimum dimensions can provide adequate storage for a single bicyclist. The box can also be expanded across adjacent travel lanes to increase storage capacity.

» The bicycle box should be outlined with 4 inch white stripes around three edges, leaving the entrance direction "open".

» Green color application may raise conspicuity of the turn box for all users. Bicycle stencil and turn arrow pavement markings shall be used to indicate proper bicycle direction and positioning

» Consider providing a "No Turn on Red" (CAMUTCD R10-11) on the cross street to prevent motor vehicles from entering the turn box.

FURTHER CONSIDERATIONS

Two stage turn boxes may be located within the shadow of an on-street parking lane, separated bikeway buffer area, or between the bicycle lane and the pedestrian crossing. (NACTO 2012)

SAFETY IMPACTS

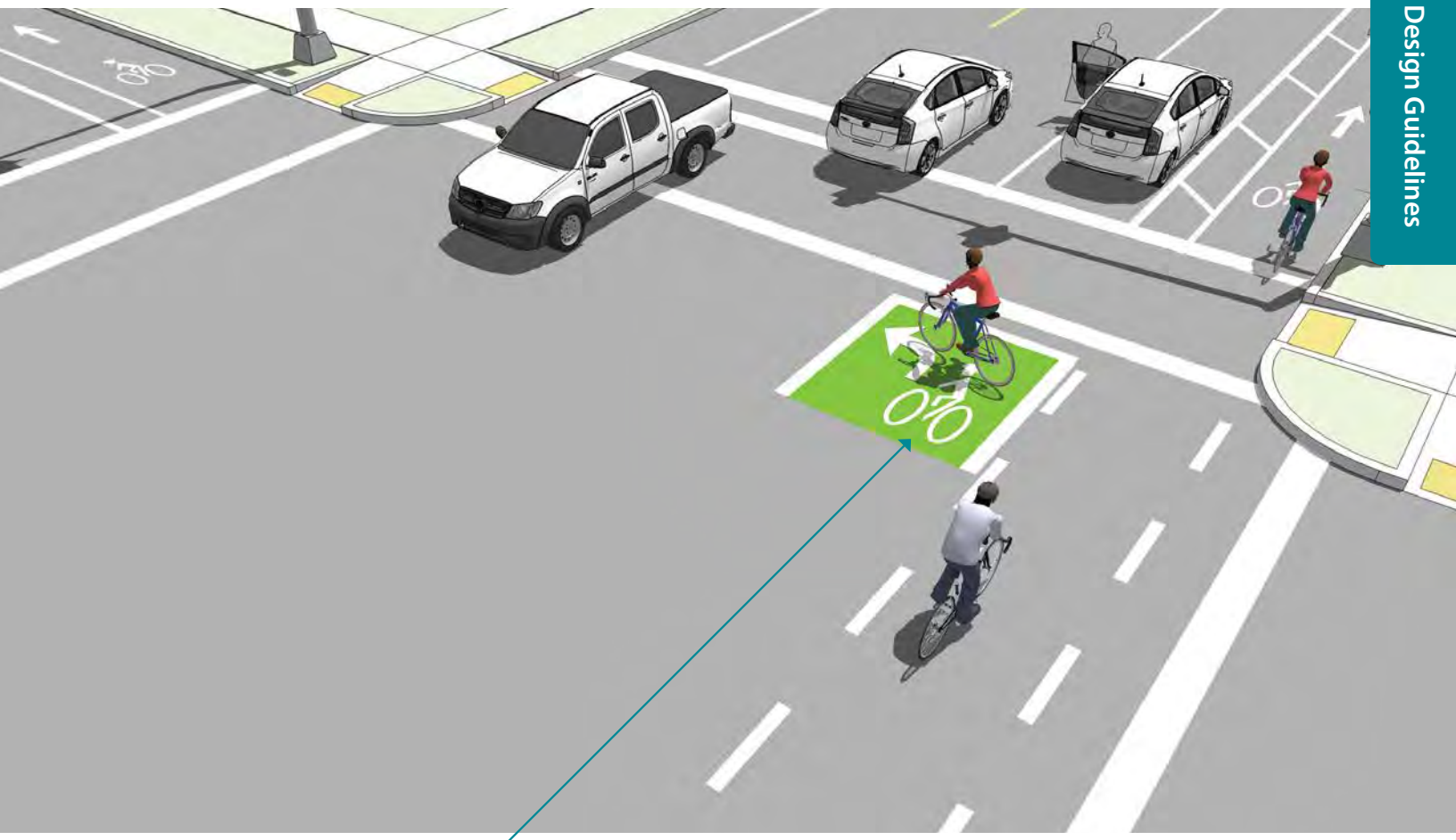
Two stage turn boxes provide a safer way to cross railroad and street car tracks, by providing a safer angle to cross the tracks (Boorse 2011).

REFERENCES

» *Boorse, J., Hill, M., Danaher, A. (2011). General Design and Engineering Principles of Streetcar Transit. ITE Journal, 81(1),38.*

» *FHWA. Separated Bike Lane Planning and Design Guide. 2015.*

» *NACTO. Urban Bikeway Design Guide. 2012.*



Bicycle stencil and turn arrow pavement markings shall be used to indicate proper bicycle direction and positioning. (NACTO, 2012)

CLASS I: SHARED-USE PATHS

A shared-use path can provide a desirable facility, particularly for recreation, and users of all skill levels preferring separation from traffic. A shared-use path allows for two-way, off-street bicycle use and also may be used by pedestrians, skaters, wheelchair users, joggers and other non-motorized users. Shared-use paths should generally provide directional travel opportunities not provided by existing roadways.

APPLICATION

» Commonly established in natural greenway corridors, utility corridors, or along abandoned rail corridors.

» May be established as short accessways through neighborhoods or to connect to cul-de-sacs.

» May be established along roadways as an alternative to on-street riding. This configuration is called a sidepath.

DESIGN FEATURES

» 12' recommended width (14' preferred for heavy use).

» 10' minimum width (8' constrained width for short lengths only).

» Minimum 2' shoulder width on both sides of the path, with an additional foot of lateral clearance as for the installation of signage or other furnishings.

» Frequent access points from the local road network.

» Directional signs to direct users to and from the path.

» A limited number of at-grade crossings with streets or driveways.

» The path terminates where it is easily accessible to and from the street system.

» Path facilities can also include amenities such as lighting, signage, and fencing (where appropriate).

FURTHER CONSIDERATION

» Separated user treads for pedestrians, bicyclists and equestrians when heavy use is expected or a higher level of service is desired.

» The provision of a shared-use path adjacent to a road is not a substitute for the provision of on-road accommodation such as paved shoulders or bike lanes, but may be considered in some locations in addition to on-road bicycle facilities.

» To reduce potential conflicts in some situations, it may be better to place one-way sidepaths on both sides of the street.

SAFETY IMPACT

A wider separation distance between cyclists and motor vehicles has been found to increase safety and decrease crashes between the two users. A before and after study in Montreal of physically separated bikeways shows that this type of facility can result in a crash reduction of 74% for collisions between bicyclists and vehicles. (CMF ID: 4097) A study in Vancouver, BC, and Toronto concluded that the safest bicycle routes were found to be separated bikeways on major streets, local streets with traffic diversion, and shared-use paths. (Teschke 2012)

REFERENCES

» *AASHTO. Guide for the Development of Bicycle Facilities. 2012.*

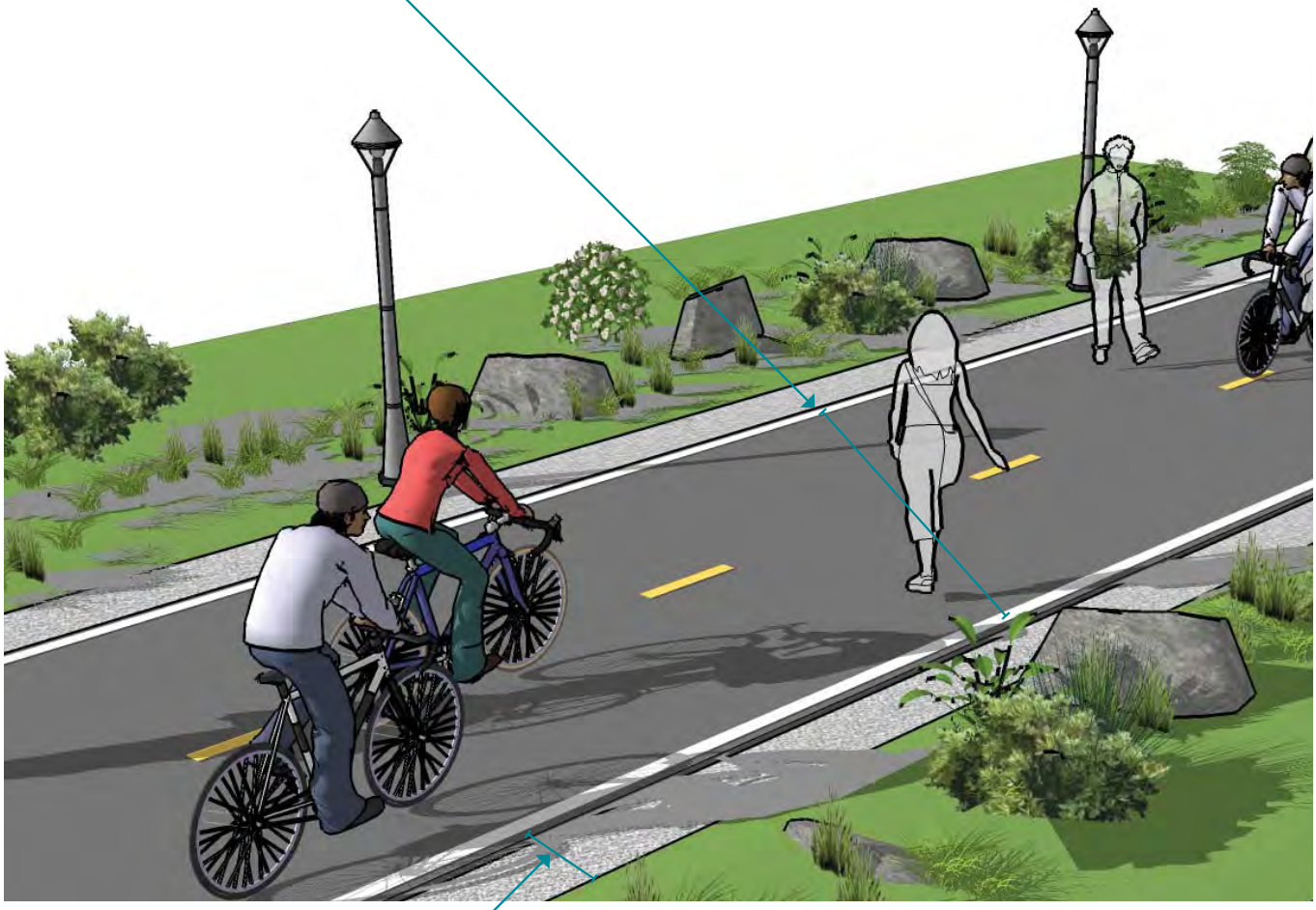
» *FHWA. Manual on Uniform Traffic Control Devices. 2009.*

» *FHWA. Federal Highway Administration University Course on Bicycle and Pedestrian Transportation. Lesson 19: Greenways and Shared Use Paths. 2006.*

» *NACTO. Urban Bikeway Design Guide. See entry on Raised Cycle Tracks. 2012.*

» *Teschke, K. et al. 2012. Route Infrastructure and the Risk of Injuries to Bicyclists, American Journal of Public Health, Volume 102.*

Recommended 10' width to accommodate moderate usage (14' preferred for heavy use). Minimum 8' width for low traffic situations only.



Minimum 2' shoulder width on both sides of the path, with an additional foot of lateral clearance for the installation of signage or other furnishings.

WAYFINDING SIGN TYPES

The ability to navigate through a city is informed by landmarks, natural features and other visual cues. Signs throughout the city should indicate to bicyclists the direction of travel, the locations of destinations and the travel time/distance to those destinations. A bicycle wayfinding system consists of comprehensive signing and/or pavement markings to guide bicyclists to their destinations along preferred bicycle routes.

APPLICATION

» Wayfinding signs will increase users' comfort and accessibility to the bicycle systems.

» Signage can serve both wayfinding and safety purposes including:
- Helping to familiarize users with the bicycle network
- Helping users identify the best routes to destinations
- Helping to address misperceptions about time and distance
- Helping overcome a "barrier to entry" for people who are not frequent bicyclists (e.g., "interested but concerned" bicyclists)

DESIGN FEATURES

» Confirmation signs indicate to bicyclists that they are on a designated bikeway. Make motorists aware of the bicycle route. Can include destinations and distance/time but do not include arrows.

» Turn signs indicate where a bikeway turns from one street onto another street. These can be used with pavement markings and include destinations and arrows.

» Decisions signs indicate the junction of two or more bikeways and inform bicyclists of the designated bike route to access key destinations. These include destinations, arrows and distances. Travel times are optional but recommended.

FURTHER CONSIDERATIONS

» Bicycle wayfinding signs also visually cue motorists that they are driving along a bicycle route and should use caution. Signs are typically placed at key locations leading to and along bicycle routes, including the intersection of multiple routes.

» Too many road signs tend to clutter the right-of-way, and it is recommended that these signs be posted at a level most visible to bicyclists rather than per vehicle signage standards.

» A community-wide bicycle wayfinding signage plan would identify:
- Sign locations
- Sign type – what information should be included and design features
- Destinations to be highlighted on each sign – key destinations for bicyclists
- Approximate distance and travel time to each destination

» Green is the color used for directional guidance and is the most common color of bicycle wayfinding signage in the US, including those in the CAMUTCD.

» Check wayfinding signage along bikeways for signs of vandalism, graffiti, or normal wear and replace signage along the bikeway network as-needed.

SAFETY IMPACTS

There is no evidence that wayfinding signs have any impact on crash reduction or user safety.

REFERENCES

» *AASHTO. Guide for the Development of Bicycle Facilities. 2012.*

» *FHWA. Manual on Uniform Traffic Control Devices. 2009.*

» *NACTO. Urban Bikeway Design Guide. 2012.*

D11-1c

D1-1

D11-1/D1-3a

WAYFINDING SIGN PLACEMENT

Signs are placed at decision points along bicycle routes – typically at the intersection of two or more bikeways and at other key locations leading to and along bicycle routes.

APPLICATION

Confirmation Signs

» Placed every ¼ to ½ mile on off-street facilities and every 2 to 3 blocks along on-street bicycle facilities, unless another type of sign is used (e.g., within 150 ft of a turn or decision sign).

» Should be placed soon after turns to confirm destination(s). Pavement markings can also act as confirmation that a bicyclist is on a preferred route.

Turn Signs

» Near-side of intersections where bike routes turn (e.g., where the street ceases to be a bicycle route or does not go through).

» Pavement markings can also indicate the need to turn to the bicyclist.

Decision Signs

» Near-side of intersections in advance of a junction with another bicycle route.

» Along a route to indicate a nearby destination.

DESIGN FEATURES

» CAMUTCD guidelines should be followed for wayfinding sign placement, which includes mounting height and lateral placement from edge of path or roadway.

» Pavement markings can be used to reinforce routes and directional signage.

FURTHER CONSIDERATIONS

It can be useful to classify a list of destinations for inclusion on the signs based on their relative importance to users throughout the area. A particular destination's ranking in the hierarchy can be used to determine the physical distance from which the locations are signed. For example, primary destinations (such as the downtown area) may be included on signage up to 5 miles away. Secondary destinations (such as a transit station) may be included on signage up to two miles away. Tertiary destinations (such as a park) may be included on signage up to one mile away.

SAFETY IMPACTS

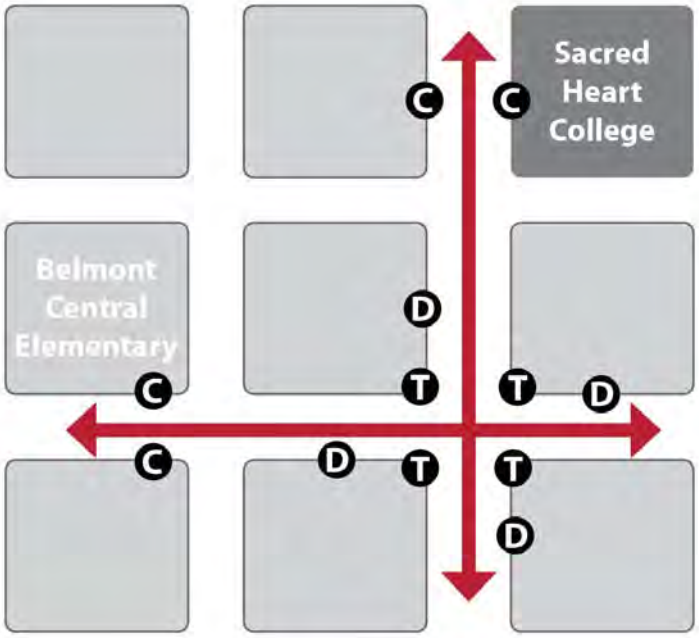
There is no evidence that wayfinding signs have any impact on crash reduction or user safety.

REFERENCES

» *AASHTO. Guide for the Development of Bicycle Facilities. 2012.*

» *FHWA. Manual on Uniform Traffic Control Devices. 2009.*

» *NACTO. Urban Bikeway Design Guide. 2012.*


Sacred Heart College
Belmont Central Elementary
C
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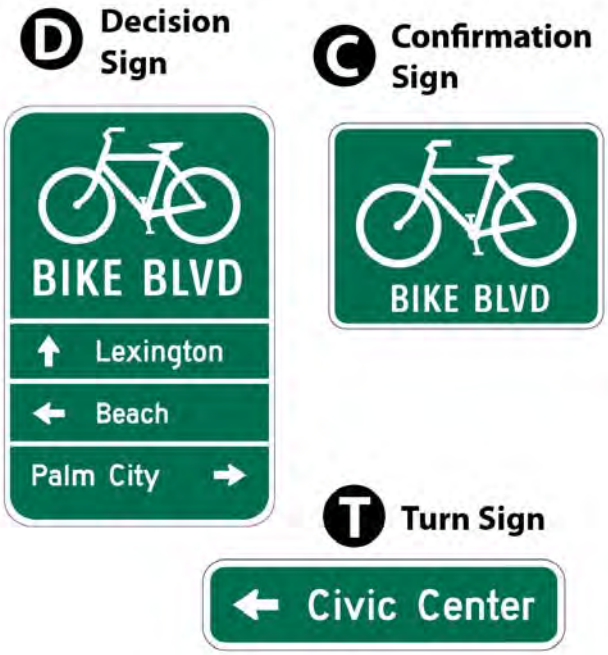

D Decision Sign
C Confirmation Sign
BIKE BLVD
Lexington
Beach
Palm City
BIKE BLVD
T Turn Sign
Civic Center

BICYCLE PARKING - SHORT TERM

Bicyclists expect a safe, convenient place to secure their bicycle when they reach their destination. This may be short-term parking of 2 hours or less, or long-term parking for employees, students, residents, and commuters.

Information on short and long term bike parking has been obtained from the APBP Bicycle Parking Guide, which is updated frequently and is available online at www.apbp.org.

APPLICATION

Bike Racks

» Bike racks provide short-term bicycle parking and is meant to accommodate visitors, customers, and others expected to depart within two hours. It should be an approved standard rack, appropriate location and placement, and weather protection.

Bike Corrals

» On-street bike corrals (also known as on-street bicycle parking) consist of bicycle racks grouped together in a common area within the street traditionally used for automobile parking.

» Bicycle corrals are reserved exclusively for bicycle parking and provide a relatively inexpensive solution to providing high-volume bicycle parking. Bicycle corrals can be implemented by converting one or two on-street motor vehicle parking spaces into on-street bicycle parking.

» Each motor vehicle parking space can be replaced with approximately 6-10 bicycle parking spaces.

DESIGN FEATURES

Bike Racks

2 feet minimum from the curb face to avoid 'dooring.'

» 4 feet between racks to provide maneuvering room.

» Locate close to destinations; 50 feet maximum distance from main building entrance.

» Minimum clear distance of 6 feet should be provided between the bicycle rack and the property line.

Bike Corrals

» Bicyclists should have an entrance width from the roadway of 5-6 feet.

» Can be used with parallel or angled parking.

» Parking stalls adjacent to curb extensions are good candidates for bicycle corrals since the concrete extension serves as delimitation on one side.

FURTHER CONSIDERATIONS

» Where the placement of racks on sidewalks is not possible (due to narrow sidewalk width, sidewalk obstructions, street trees, etc.), bicycle parking can be provided in the street where on-street vehicle parking is allowed in the form of on-street bicycle corrals.

» Some types of bicycle racks may meet design criteria, but are discouraged except in limited situations. This includes undulating "wave" racks, schoolyard racks, and spiral racks. These discouraged racks are illustrated on the following page.

SAFETY IMPACTS

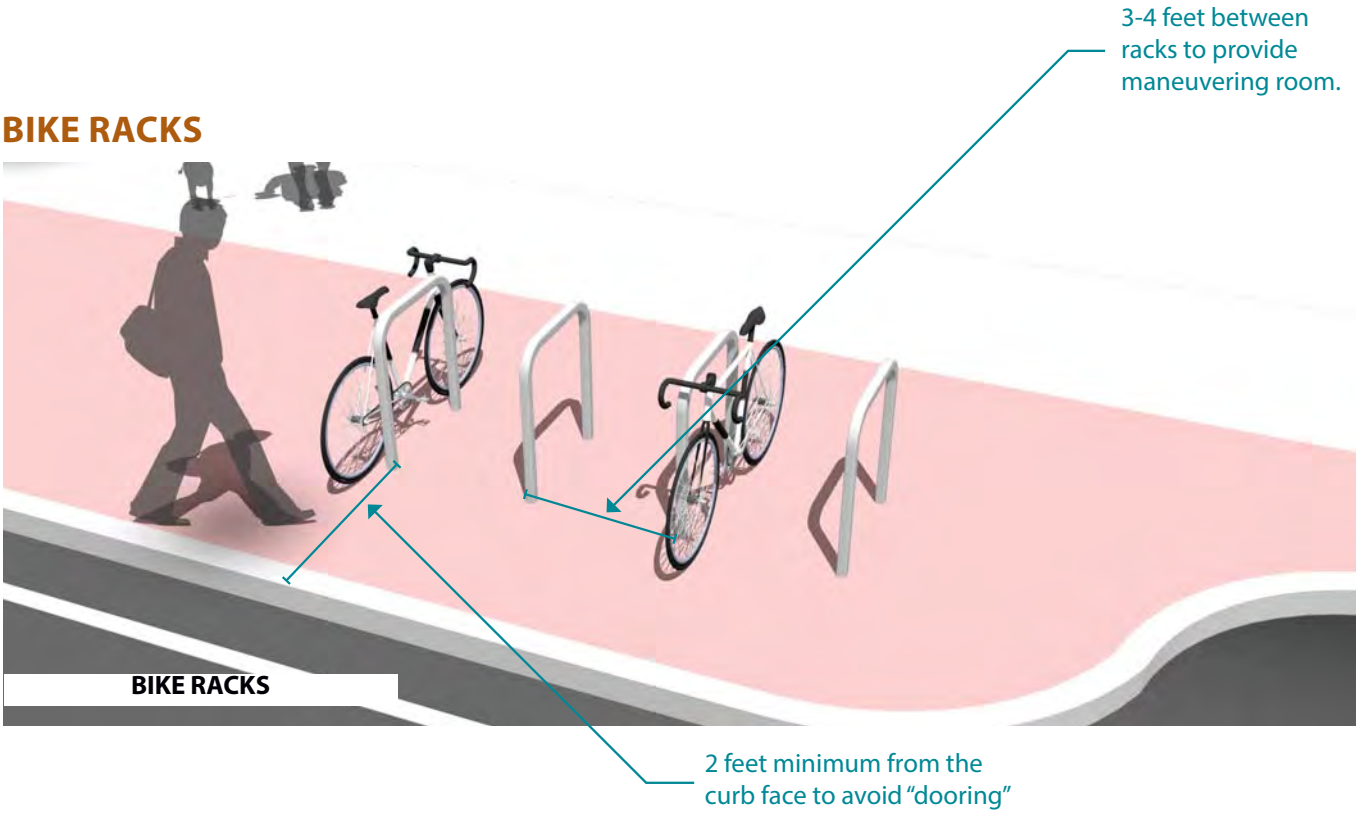
n/a

REFERENCES

» *AASHTO. Guide for the Development of Bicycle Facilities. 2012.*

» *APBP. Bicycle Parking Guide 2015.*

BIKE RACKS



Types of Bike Racks to Use

INVERTED U

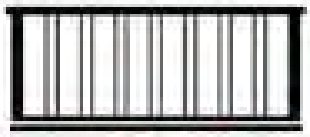
POST & RING

WHEELWELL - SECURE

Racks to Avoid

Because of performance concerns, the APBP Bike Parking Guide recommends **selecting other racks instead of these.**

WAVE



SCHOOLYARD

COATHANGER

WHEELWELL

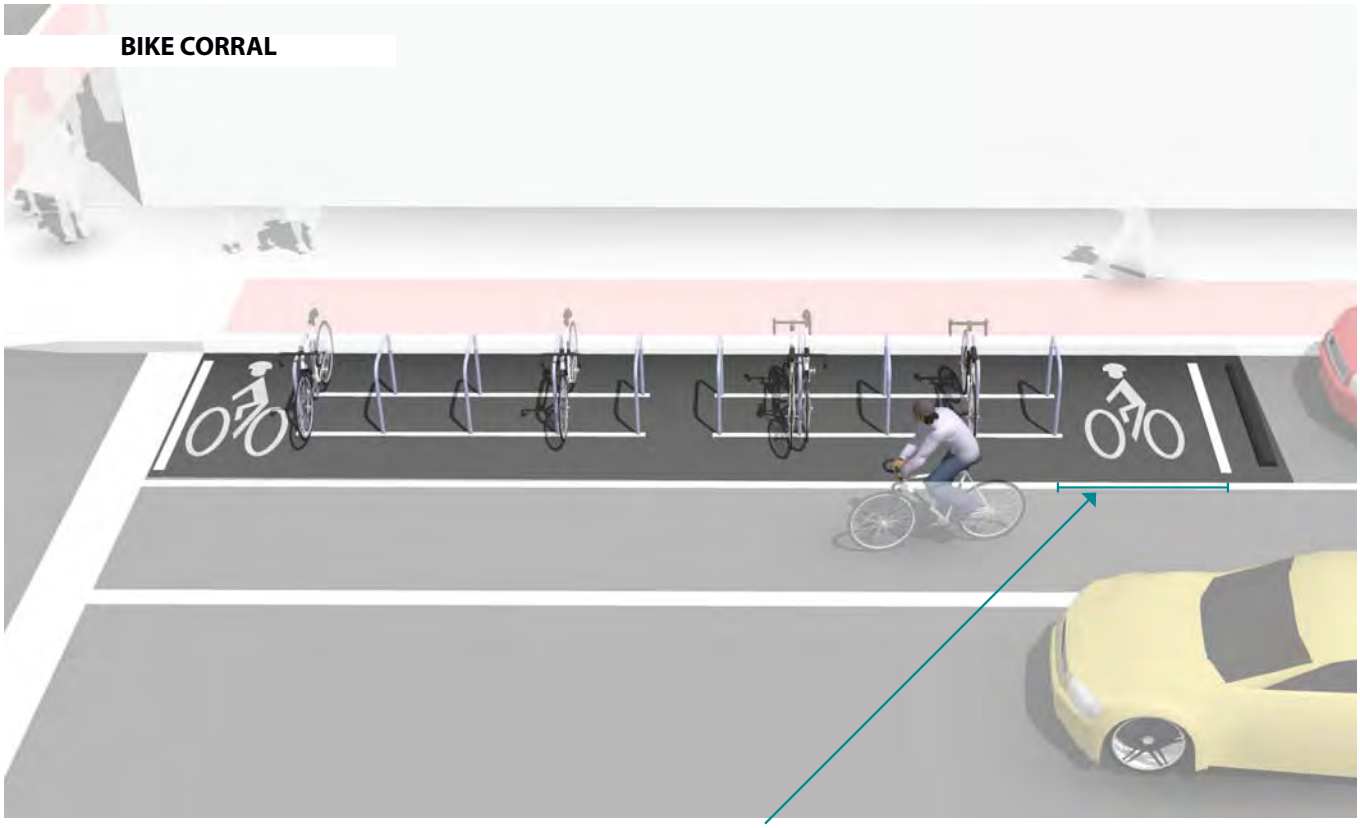
BOLLARD

SPIRAL

BIKE CORRALS

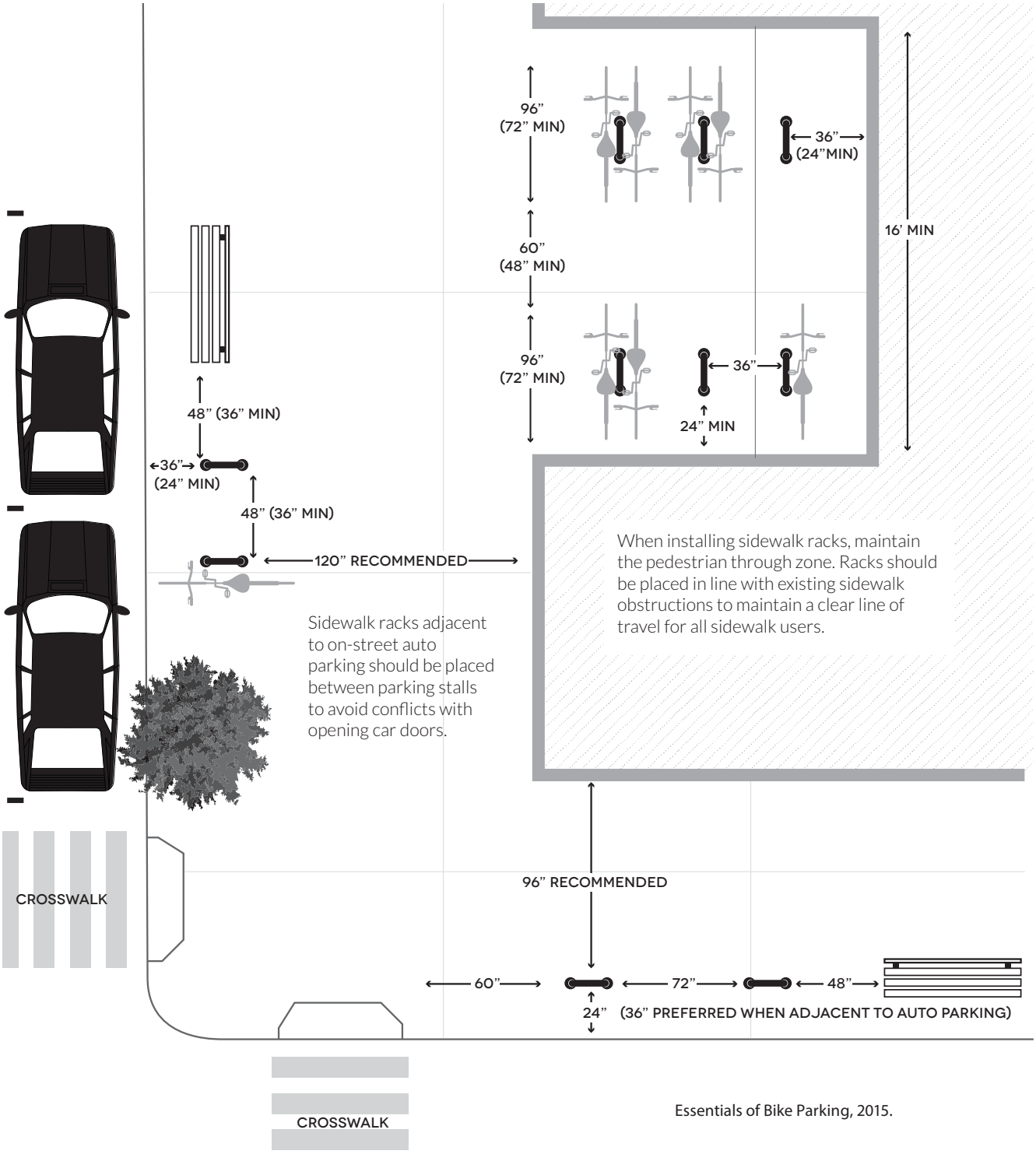
Examples of Bike Corrals

At a minimum, bike corral should accommodate 6-10 bicycles in one motor vehicle parking space.



DETAILED PLACEMENT DIMENSIONS

On-street bike racks may be placed parallel or perpendicular to sidewalks depending on the available space. When bike racks are placed adjacent to walls or fences, users need space to maneuver and position their bicycle. The image below identifies critical dimensions for bike rack placement under multiple conditions.



Essentials of Bike Parking, 2015.

BICYCLE PARKING - LONG TERM

Users of long-term parking generally place high value on security and weather protection. Long-term parking is designed to meet the needs of employees, residents, public transit users, and others with similar needs.

Information on short and long term bike parking has been obtained from the APBP Bicycle Parking Guide, which is updated frequently and is available online at www.apbp.org.

APPLICATION

» At transit stops, bike lockers or a sheltered secure encloser may be appropriate long term solutions.

» On public or private property where secure, long term bike parking is desired.

» Near routine destinations, such as workplaces, universities, hospitals, etc.

DESIGN FEATURES

Bike Lockers

» Minimum dimensions: width (opening) 2.5 feet; height 4 feet; depth 6 feet.

» 4 foot side clearance and 6 foot end clearance. 7 foot minimum distance between facing lockers.

Secure Parking Area

» Closed-circuit television monitoring with secure access for users.

» Double high racks & cargo bike spaces.

» Bike repair station with bench and bike tube and maintenance item vending machine.

» Bike lock "hitching post" – allows people to leave bike locks.

FURTHER CONSIDERATIONS

» As the APBP Bike Parking Guide notes, increasing density without careful attention to user needs can create parking that excludes people because of age, ability, or bicycle type. This may result in people parking bicycles in other less desirable places or choosing not to bike at all.

» To accommodate trailers and long bikes, a portion of the racks should be on the ground and should have an additional 36" of in-line clearance.

SAFETY IMPACTS

n/a

REFERENCES

» *AASHTO. Guide for the Development of Bicycle Facilities. 2012.*

» *APBP. Bicycle Parking Guide 2015.*

LONG TERM BIKE PARKING

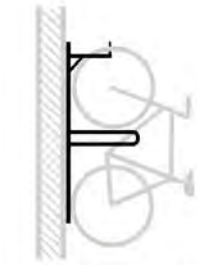
BIKE LOCKERS

SECURE PARKING AREA

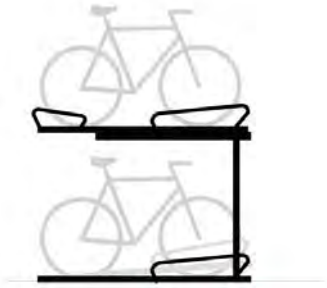
High Density Bike Racks

Racks may be used that increase bike parking density, like the ones below.

SWING ARM SECURE



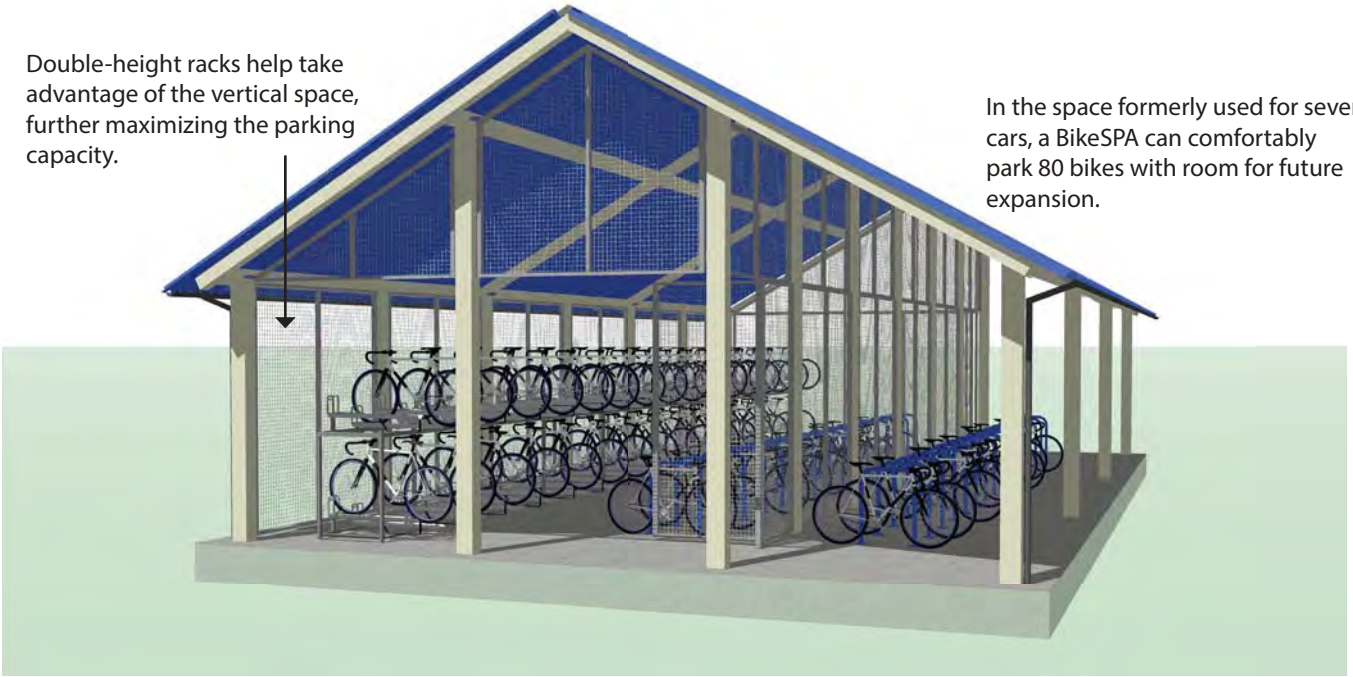
VERTICAL



TWO-TIER

SECURE PARKING AREA DETAILS

Double-height racks help take advantage of the vertical space, further maximizing the parking capacity.



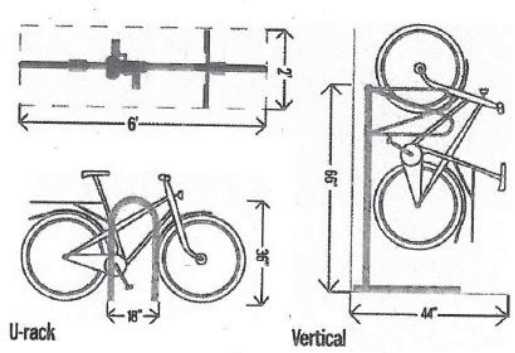
In the space formerly used for seven cars, a BikeSPA can comfortably park 80 bikes with room for future expansion.

BICYCLE PARKING - LONG TERM

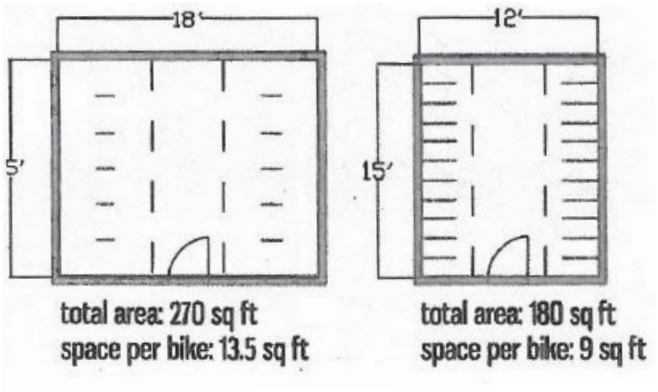
BIKE PARKING ROOMS

Long term bike parking may be available in dedicated rooms in residential and commercial buildings. Bicycle parking can be accommodated in 15 square feet per space or less.

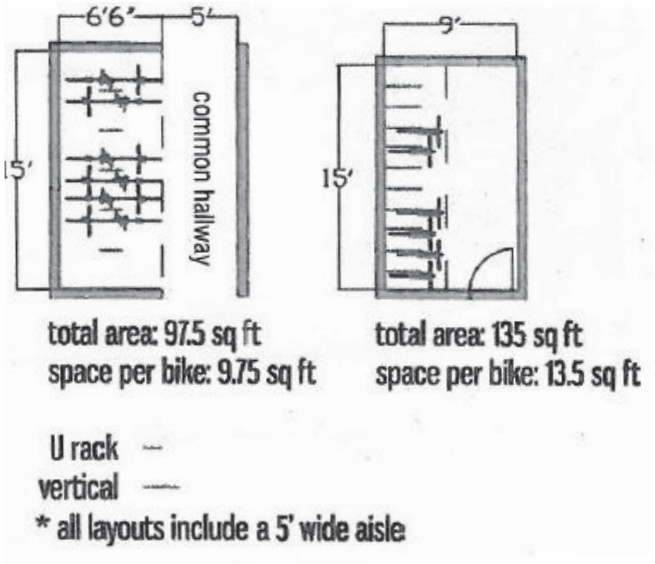
TYPICAL BIKE DIMENSIONS



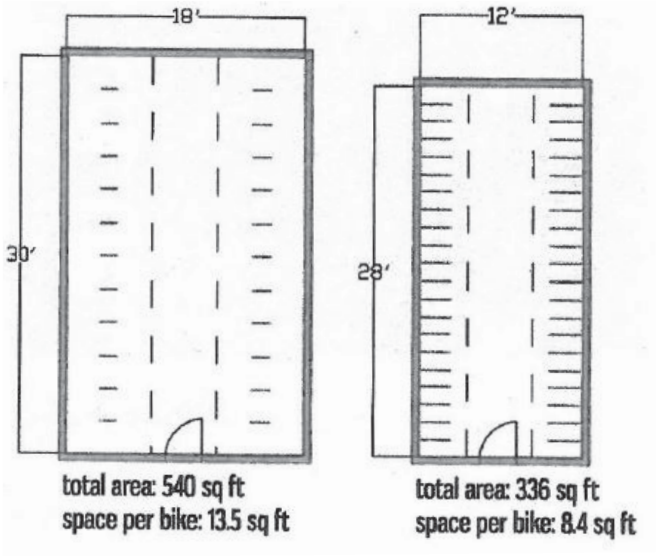
MEDIUM BIKE ROOM - 20 BIKES



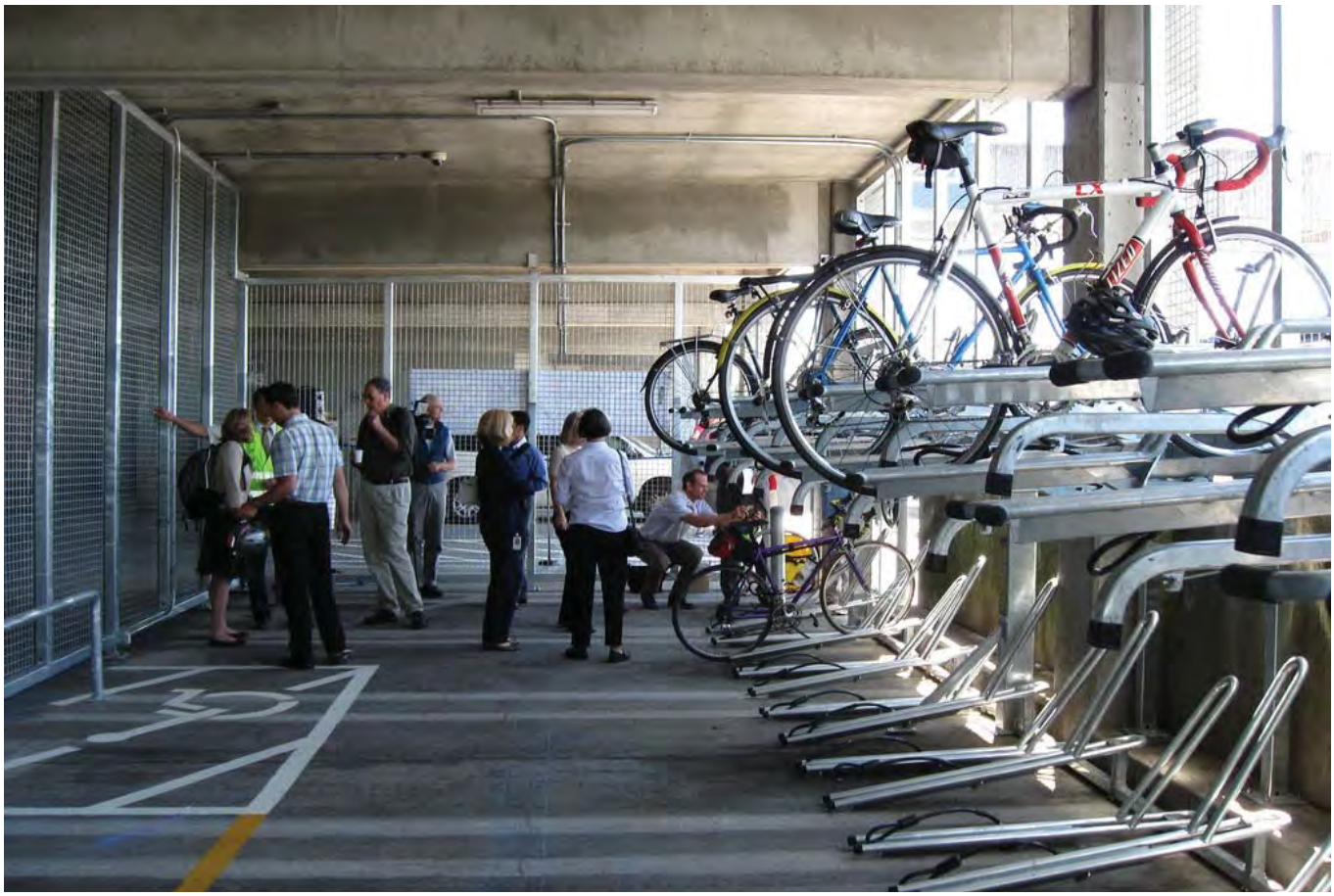
SMALL BIKE ROOM - 10 BIKES



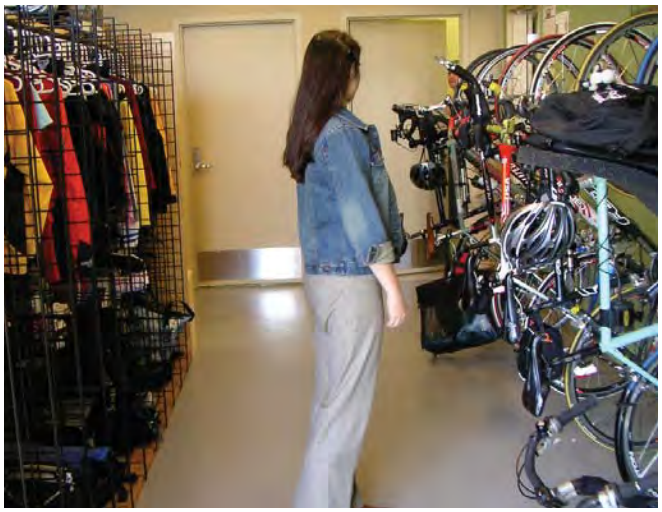
LARGE BIKE ROOM - 40 BIKES



Examples of Bike Parking Rooms



A secured bike parking room located within a parking garage has ample room for maneuvering bikes and provides a safe place for bike storage.



A bike parking room at an office has space for bikes and clothing.

Many types of indoor bike parking is available through a variety of manufacturers.

Long Beach Bicycle Master Plan

Appendix B

Existing Plans and Policies Review

APPENDIX TO THE MOBILITY ELEMENT
OF THE GENERAL PLAN
CITY OF LONG BEACH
JANUARY 2017

Appendix B. Existing Plans and Policy Review

The goal of the Long Beach Bicycle Master Plan is to be consistent with various planning, policy, and regulatory documents. These include the City's own documents, such as the General Plan and Municipal Code. Long Beach also intends to design a bike network that transitions well with bikeways in other jurisdictions. Therefore, the planning context also includes bicycle master plans of neighboring jurisdictions. The Plan should also be consistent with regional plans. The following table summarizes the relevant documents that this Plan has taken into account.

Document	Agency	Year Adopted
CX3 Pedestrian Plan	City of Long Beach	In progress
Southeast Area Specific Plan	City of Long Beach	In progress
Long Beach General Plan Elements	City of Long Beach	In progress
Downtown & TOD Pedestrian Master Plan	City of Long Beach	2016
Vision Zero Long Beach	City of Long Beach	2016
Green TI Plan	City of Long Beach	2015
Livable West Long Beach Plan	City of Long Beach	2015
Long Beach Healthy Communities Policy	City of Long Beach	2014
Sustainable City Action Plan	City of Long Beach	2010
Long Beach Green Building Policy	City of Long Beach	2009
2001 Bicycle Master Plan	City of Long Beach	2001
Bellflower & Paramount Bicycle Master Plan	Cities of Bellflower and Paramount	2016
Carson Master Plan of Bikeways	City of Carson	2013
City of Compton Bicycle Master Plan	City of Compton	2015
City of Los Angeles Mobility Plan 2035	City of Los Angeles	2016
LA Metro Active Transportation Strategic Plan	Metro	2016
Los Angeles County Metro First Last Mile Strategic Plan	Metro	2013
Metro Blue Line Bike and Pedestrian Access Plan	Metro	2011
Metro Bicycle Transportation Strategic Plan	Metro	2006
OCTA Districts 1 and 2 Bikeways Strategy	OCTA	2013
Orange County Transportation Authority (OCTA) Commuter Bikeways Strategic Plan	OCTA	2009
Southern California Association of Governments (SCAG) Regional Transportation Plan (RTP)	SCAG	2016
California State Bicycle & Pedestrian Plan	State of California	In progress
SB 99 - Active Transportation Program Act	State of California	2013
Caltrans Deputy Directive 64 – Complete Streets	State of California	2008
AB 1358 - Complete Streets Act	State of California	2008
SB 375 - California Sustainable Communities Strategy	State of California	2008
AB 32 - California Global Warming Solutions Act	State of California	2006
Policy Statement on Bicycle and Pedestrian Accommodation Regulations and Recommendations	United States Department of Transportation	2010

City Documents

CX3 Pedestrian Plan (In progress)

The City of Long Beach Department of Health and Human Services Healthy Active Long Beach Program, in collaboration with the City's Planning Bureau, Public Works Department, and City Fabrick developed the Communities of Excellence in Nutrition, Physical Activity, and Obesity Prevention (CX3) Pedestrian Plan. Eight neighborhoods were assessed in the Central and Downtown area. One key finding from the assessments was the lack of connectivity within the pedestrian environment as it relates to the design and conditions of public infrastructure. This plan provides the tools for improving active transportation accessibility in the eight neighborhoods, promoting healthier lifestyles.

Southeast Area Specific Plan (In Progress)

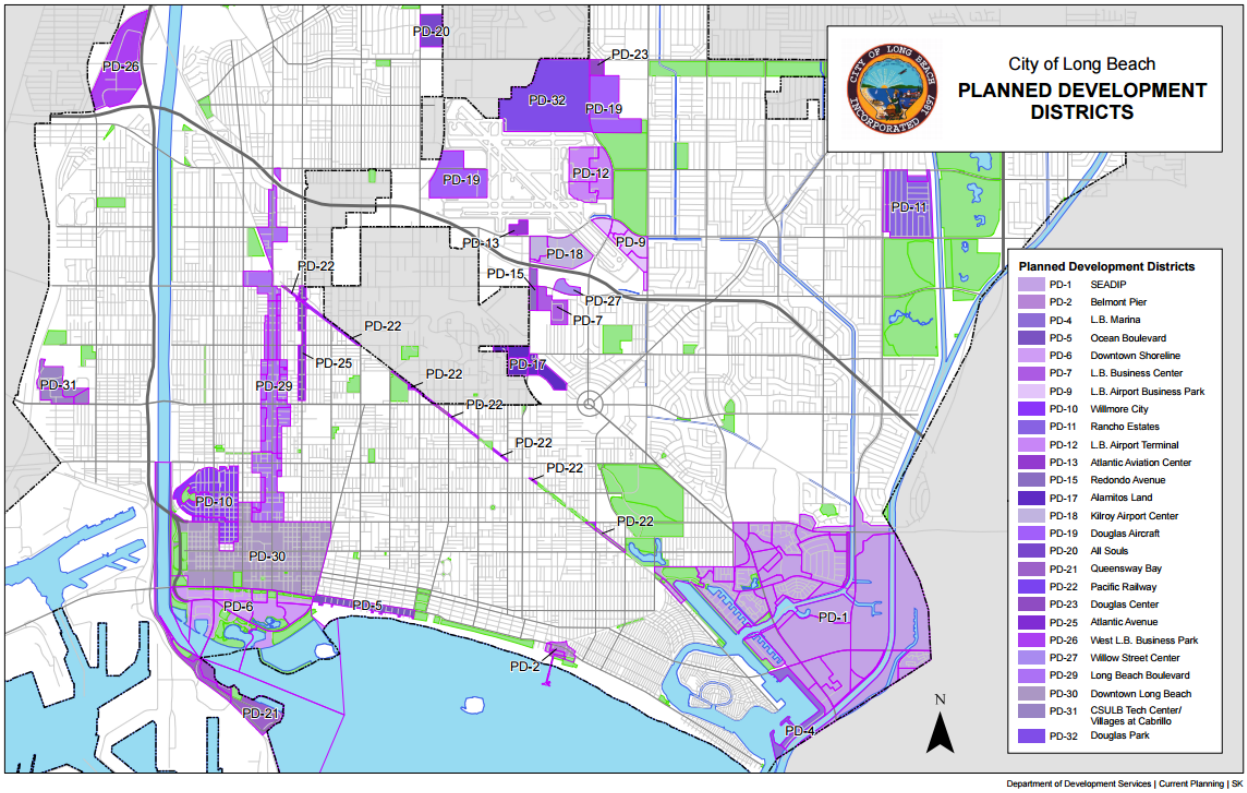
In 2014, Long Beach began the process to develop a specific plan for the Southeast Area. The Southeast Area covers about 1,500 acres and the specific plan takes a fresh look at this area while acknowledging work conducted through previous efforts. The plan maintains valuable natural resources, customizes land uses and development standards, and identifies locations for future development and expanded transportation choices.

General Plan (In progress)

The City's General Plan Land Use Element calls for functional transportation that will maintain or improve the current ability to move people and goods to and from development centers while preserving and protecting residential neighborhoods. Much of the expected new development will be directed to the following areas:

- Downtown
- Downtown Shoreline
- Willmore City
- Long Beach Boulevard
- The Marina
- Areas surrounding the Long Beach Airport
- Long Beach Business Center
- West Long Beach Business Park
- Rancho Estates
- California State University, Long Beach Tech Center
- Atlantic Avenue

This Bicycle Master Plan delineates a network of bikeways that will provide high-priority bikeways to development centers. The following maps illustrate the city's zoning and where new development will concentrate.



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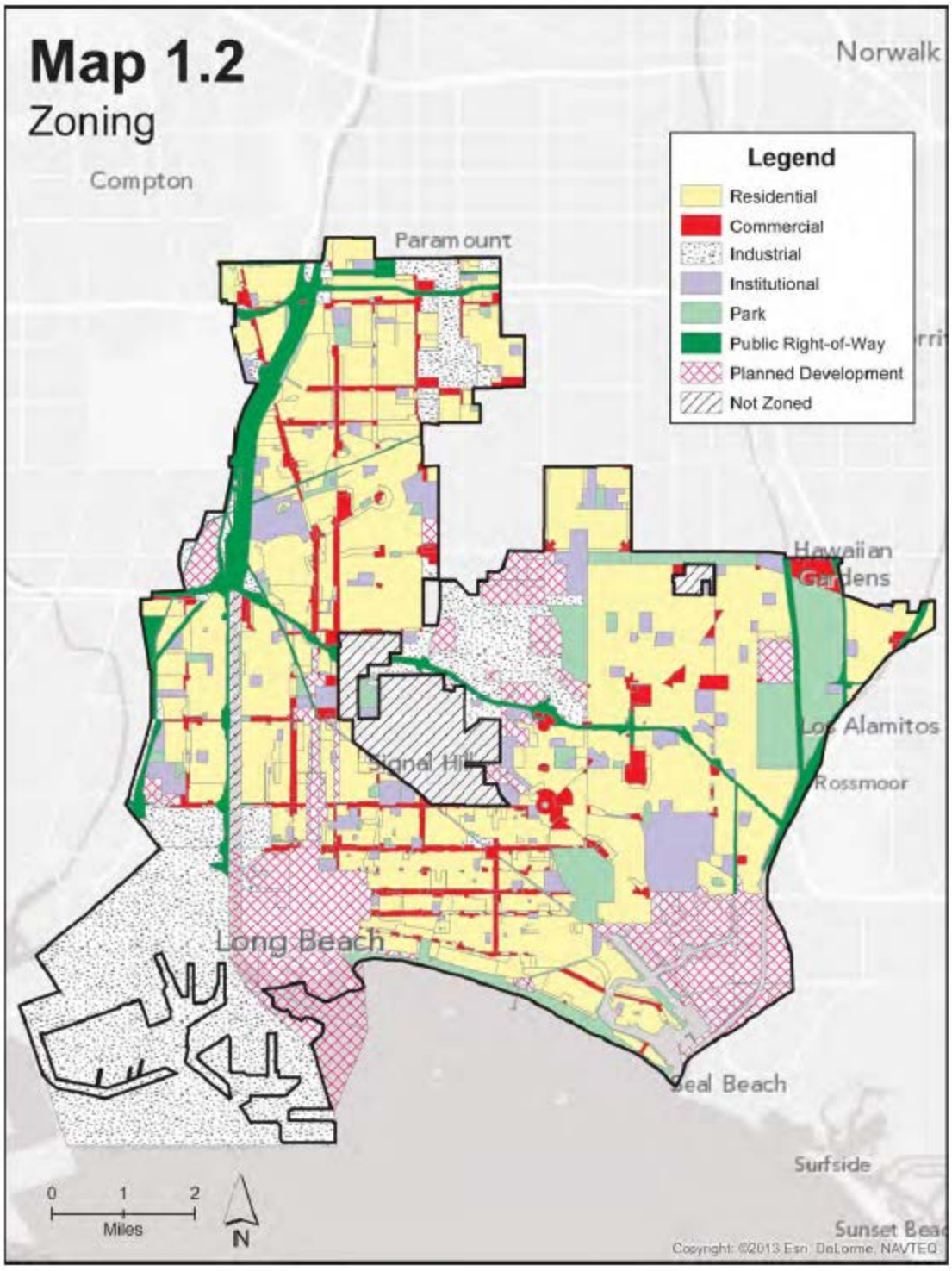


Source: City of Long Beach

The General Plan Mobility Element (adopted in July of 2013) sets forth a vision of a multimodal mobility network that provides options to choose from various forms of convenient transportation. The plans include principles of complete streets, active living and sustainable

community design. The Mobility Element contains provisions for better bicycle access and secure bicycle storage. One section of the Mobility Element specifies various means of planning for active transportation and living. Another reiterates the City's desire to become the most bicycle-friendly city in the United States. A map in the Mobility Element shows the proposed bicycle-priority network. Lastly, it stresses the value of the "5E" (engineering, education, encouragement, enforcement and evaluation) approach to making Long Beach more bicycle-friendly. This Bicycle Master Plan creates the opportunities for reaching the vision and goals in the Mobility Element. Chapter 5 meets the needs for 5E programs. The bikeway system in this Plan contains the bicycle corridors in the Mobility Element.

Downtown & TOD Pedestrian Master Plan (2016)

Downtown & TOD Pedestrian Master Plan was adopted by Long Beach City Council in May 2016. The plan provides a blueprint for achieving a multi-use vision – for streets that provide safe and direct connections to the Metro Blue Line – while, at the same time, reach their potential for enhanced community life, recreational opportunities, and ecological benefits. It identifies high-priority infrastructure investments, policies, funding strategies, and programs that the City of Long Beach can implement over the next 15 years.

Vision Zero Long Beach (2016)

On May 24, 2016, Long Beach City Council approved a staff recommendation to become a Vision Zero city with the goal to eliminate traffic fatalities and serious injuries among all road users by 2026. Vision Zero uses a combination of engineering to slow down vehicles and programs to educate all roadway users in order to achieve this goal.

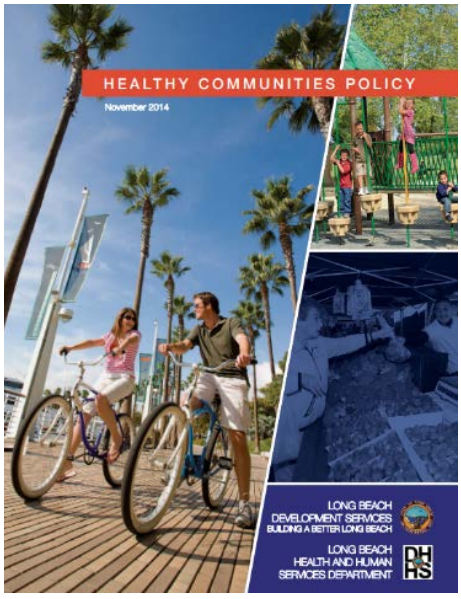
Green TI Plan (2015)

The Green Terminal Island (TI) Transition Plan was completed at the end of 2015. The plan looks at the first/last mile of the Terminal Island Freeway, and includes the community vision, preliminary feasibility study, and design concept aimed at transforming the segment of State Route 103 to a local-serving road, while increasing open space and buffering the West Long Beach neighborhood from air, noise, light, and visual pollution.

Livable West Long Beach Plan (2015)

The Livable West Long Beach Plan presents a comprehensive plan for achieving the community vision for healthy, vibrant, attractive, and safe neighborhoods. The plan synthesized the various City planning efforts proposed in the previous years and presented them to the community for their input. Based on feedback, the plan prioritizes the projects then identifies funding mechanisms for implementation.

Long Beach Healthy Communities Policy (2014)



The Healthy Communities Policy establishes a framework for developing each neighborhood into a healthy, prosperous and livable community. It aims to strengthen links between new trends in land use, mobility, environmental quality, healthy food access, and safe neighborhoods to improvements in community health, through collaboration, engagement and implementation. The policy outlines various goals and objectives surrounding public health including mobility and the objective to, "Expand active transportation infrastructure to encourage physical activity in daily activities." This Bicycle Plan will support the Healthy Communities Policy.

Sustainable City Action Plan (2010)

The Sustainable City Action Plan presents initiatives, goals, and actions in seven different categories that will help Long Beach become a more sustainable city. The categories are buildings and neighborhoods, energy, green economy and lifestyle, transportation, urban nature, waste reduction, and water. One of the goals of the Action Plan in the transportation category is to create a system of at least 200 miles of interconnected bikeways by 2020. One action item in the same category matches a policy in this Plan: Encourage and expand the use of bike valet at local, neighborhood events and festivals.

Long Beach Green Building Policy (2009)

By focusing on municipal buildings, the Green Building Policy demonstrates the city's commitment to environmental, economic, and social stewardship, to cost savings for taxpayers through reduced operating costs, to a healthy work environment for staff and visitors, and to the city's goals of protecting, conserving, and enhancing the region's environmental resources. Through the implementation of Green Building Guidelines, new construction, remodel, and tenant improvement projects will help to set a community standard and model of sustainable building.

2001 Bicycle Master Plan (2001)

This Plan builds upon the 2001 Bicycle Master Plan with additional bikeways, enhanced bikeways and updates to facility and programmatic recommendations.

Bicycle Plans of Neighboring Cities

Cities of Bellflower & Paramount (2015)

The cities of Bellflower and Paramount developed a joint Bike and Trail Master Plan. The Plan proposed bikeways that lead into Long Beach on:

- 70th Street
- Ramona Street
- Vermont Avenue

This Plan includes bikeways that already link or will link with all of these specific bikeways proposed in Bellflower and Paramount.

City of Carson (2013)

The City of Carson Master Plan of Bikeways proposes bikeways that lead into Long Beach on:

- Del Amo Boulevard
- Wardlow Road
- Compton Creek

This Plan includes bikeways that will link with all of these specific bikeways proposed in Carson.

City of Compton (2016)

The City of Compton Bicycle Master Plan proposes bikeways that connect to Long Beach on:

- Greenleaf Boulevard
- Atlantic Avenue
- Long Beach Boulevard
- Artesia Boulevard

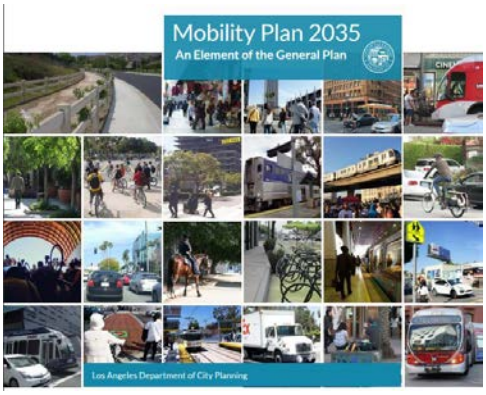
This Plan includes bikeways that will link with all of these specific bikeways proposed in Compton.

City of Los Angeles (2016)

The City of Los Angeles Mobility Plan 2035 proposes bikeways that lead into Long Beach on:

- Pacific Coast Highway
- Anaheim Street
- Vincent Thomas Bridge

This Plan contains bikeways that will link with all of these specific bikeways proposed in Los Angeles.



Regional Plans

Los Angeles Metro Active Transportation Strategic Plan (2016)

The Active Transportation Strategic Plan is Metro's county-wide effort to identify strategies to increase walking, bicycling and transit use in Los Angeles County. The Plan focuses on improving first and last mile access to transit and propose a regional network of active transportation facilities, including shared-use paths and on-street bikeways.

Los Angeles County Metro First Last Mile Strategic Plan (2013)

Los Angeles County Metropolitan Transportation Authority (Metro) is developing a world-class rail system with stations that will be a short distance (three miles or less) from the homes of 7.8 million people, nearly 80 percent of Los Angeles County residents. Over time, this number will continue to grow as cities modify their land-use plans to provide more housing and jobs near stations, consistent with market demand and regional goals for more sustainable communities. The First Last Mile Strategic Plan begin to outline a specific infrastructure improvement strategy designed to facilitate easy, safe, and efficient access to the Metro system for all modes of transportation.

Metro Blue Line Bike and Pedestrian Access Plan (2011)

The Metro Blue Line Bike and Pedestrian Access Plan recommends bikeways to Blue Line stations along with parking at the stations. This Bicycle Master Plan incorporates those recommendations.

Los Angeles County Bicycle Transportation Strategic Plan (2006)

The Los Angeles County Bicycle Transportation Strategic Plan identifies gaps in the regional bikeway network. In Long Beach the Strategic Plan shows the following gaps:

- Connection between the Carson Street Bike Path and Los Angeles River Bike Path
- Connection between the beach bike path and Orange County and the San Gabriel River
- Connection along Willow Street between the Los Angeles River and the San Gabriel River
- Along Ocean Boulevard between the Harbor bike lanes and the terminus of the Los Angeles River

This Bicycle Master Plan proposes to close all of these gaps.

OCTA Districts 1 and 2 Bikeways Strategy (2013)

The Districts 1 and 2 Bikeways Strategy report summarizes the results of a collaborative effort focused on the identification of potential regional bikeways within Orange County's Supervisorial Districts 1 and 2. The Strategy proposes 11 regional bikeway corridors to the east of Long Beach which connect to existing facilities that lead into Long Beach such as Westminster-Hazard and the Pacific Coast Highway.

Orange County Transportation Authority (OCTA) Commuter Bikeways Strategic Plan (2009)

The OCTA Commuter Bikeways Strategic Plan shows two existing or planned bikeways that link with Long Beach bikeways:

- The City of Los Alamitos plans a bikeway along Cerritos Avenue that will connect with a future bike route on Spring Street in Long Beach.
- The City of Seal Beach has bike lanes on Westminster Boulevard that link to the 2nd Street bike lanes in Long Beach.

Southern California Association of Governments (SCAG) Regional Transportation Plan (2016)

The SCAG Regional Transportation Plan includes a commitment to reduce transportation-related emissions to comply with California Senate Bill 375. This Plan will help Long Beach contribute to this goal.

State Plans and Policies

California State Bicycle & Pedestrian Plan (In Progress)

The California State Bicycle and Pedestrian Plan will be a visionary and comprehensive policy plan to promote a multi-modal transportation system that supports active modes of transportation and creates a framework to increase safe bicycling and walking. The plan will contain:

- The vision, goals, and objectives to guide Caltrans active transportation efforts.
- The most promising strategies to achieve the goals and objectives.
- Performance measures and data needs to evaluate success.
- Recommendations for improved Caltrans processes.
- Safety statistics and a safety awareness brochure.
- Investment strategies.

This plan will help Long Beach to work with the local Caltrans office to implement projects on Caltrans right-of-ways.

Senate Bill 99 – Active Transportation Program Act (2013)

SB 99 establishes the Active Transportation Program for the state, in accordance with the federal Moving Ahead for Progress in the 21st Century (MAP-21) legislation, to encourage increased use of active modes of transportation and create a mechanism for distributing federal funds to local and regional efforts. The bill includes the following goals for the Active Transportation Program:

- Increase the proportion of trips accomplished by biking and walking.
- Increase safety and mobility for nonmotorized users.
- Advance the active transportation efforts of regional agencies to achieve greenhouse gas reduction.
- Enhance public health, including reduction of childhood obesity through the use of programs including, but not limited to, projects eligible for Safe Routes to School Program funding.
- Ensure that disadvantaged communities fully share in the benefits of the program.
- Provide a broad spectrum of projects to benefit many types of active transportation users.

Caltrans Deputy Directive 64 – Complete Streets (2008)

In 2001, the California Department of Transportation (Caltrans) adopted Deputy Directive 64, "Accommodating Non-Motorized Travel," which contained a routine accommodation policy. The directive was updated in 2008 as "Complete Streets – Integrating the Transportation System." The new policy includes the following language:

> The Department views all transportation improvements as opportunities to improve safety, access, and mobility for all travelers in California and recognizes bicycle, pedestrian, and transit modes as integral elements of the transportation system.
>
> The Department develops integrated multimodal projects in balance with community goals, plans, and values. Addressing the safety and mobility needs of bicyclists, pedestrians, and transit users in all projects, regardless of funding, is implicit in these objectives. Bicycle, pedestrian and transit travel is facilitated by creating "complete streets" beginning early in system planning and continuing through project delivery and maintenance operations.

The directive establishes Caltrans' own responsibilities under this policy. The responsibilities Caltrans assigns to various staff positions under the policy include the following:

- Ensure bicycle, pedestrian, and transit interests are appropriately represented on interdisciplinary planning and project delivery development teams.
- Ensure bicycle, pedestrian, and transit user needs are addressed and deficiencies identifies during system and corridor planning, project initiation, scoping, and programming.
- Ensure incorporation of bicycle, pedestrian, and transit travel elements in all Department transportation plans and studies.
- Promote land uses that encourage bicycle, pedestrian, and transit travel.
- Research, develop, and implement multimodal performance measures.

Assembly Bill 1358 - Caltrans Complete Streets Act (2008)

"Complete Streets" are designed and operated to enable safe access for all users. This concept allows pedestrians, bicyclists, motorists, and bus riders of all ages and abilities to safely move along and across a complete street. In September 2008, California adopted a new law that requires cities and counties to include complete streets policies as part of their general plans so that roadways are designed to safely accommodate all users, including bicyclists, pedestrians, transit riders, children, older adults, and people with mobility impairments, as well as motorists.

Source Sierra Club

Senate Bill 375 - California Sustainable Communities Strategy (2008)

SB 375 is the first law in the nation that attempts to control greenhouse gas emissions by curbing sprawl. The law requires CARB to develop regional targets for reductions in greenhouse gas emissions from passenger vehicles for 2020 and 2035. Each of the 18 metropolitan planning organizations in California will need to prepare a "sustainable communities strategy" for meeting the emissions reductions target in its region through transportation and land use actions that reduce the number of vehicle miles traveled. SB 375 clearly has the potential to promote walking and bicycling as strategies that reduce vehicle miles traveled. SB 375 establishes per-capita greenhouse gas emission reduction targets of seven percent by the year 2020 and 15 percent by the year 2035, using 2005 levels as the base year.

Assembly Bill 32 - California Global Warming Solutions Act (2006)

The California Global Warming Solutions Act was adopted in 2006 to reduce the state's emissions of greenhouse gases to 1990 levels by 2020 and to 80% below 1990 levels by 2050. The law requires the California Air Resources Board (CARB) to adopt a "scoping plan" indicating how the 2020 target for emission reductions may be achieved from significant greenhouse gas sources through regulations, market mechanisms, and other actions. One of the recommended actions in the CARB scoping plan is to "develop regional greenhouse gas emissions reduction targets for passenger vehicles." The mechanism for developing these targets was established by separate legislation, Senate Bill 375.

Federal Plans and Policies

US DOT Policy Statement on Bicycle and Pedestrian Accommodation Regulations and Recommendations (2010)

The United States Department of Transportation (US DOT) issued this Policy Statement to support and encourage transportation agencies at all levels to establish well-connected walking and bicycling networks. The following Policy Statement and actions are relevant to the Turlock Active Transportation Plan.

Policy Statement

The DOT policy is to incorporate safe and convenient walking and bicycling facilities into transportation projects. Every transportation agency, including DOT, has the responsibility to improve conditions and opportunities for walking and bicycling and to integrate walking and bicycling into their transportation systems. Because of the numerous individual and community benefits that walking and bicycling provide – including health, safety, environmental, transportation, and quality of life – transportation agencies are encouraged to go beyond minimum standards to provide safe and convenient facilities for these modes.

Recommended Actions

The DOT encourages States, local governments, professional associations, community organizations, public transportation agencies, and other government agencies, to adopt similar policy statements on bicycle and pedestrian accommodation as an indication of their commitment to accommodating bicyclists and pedestrians as an integral element of the transportation system. In support of this commitment, transportation agencies and local communities should go beyond minimum design standards and requirements to create safe, attractive, sustainable, accessible, and convenient bicycling and walking networks. Such actions should include:

- Considering walking and bicycling as equals with other transportation modes: The primary goal of a transportation system is to safely and efficiently move people and goods. Walking and bicycling are efficient transportation modes for most short trips and, where convenient intermodal systems exist, these nonmotorized trips can easily be linked with transit to significantly increase trip distance. Because of the benefits they provide, transportation agencies should give the same priority to walking and bicycling as is given to other transportation modes. Walking and bicycling should not be an afterthought in roadway design.
- Ensuring that there are transportation choices for people of all ages and abilities, especially children: Pedestrian and bicycle facilities should meet accessibility requirements and provide safe, convenient, and interconnected transportation networks. For example, children should have safe and convenient options for walking or bicycling to school and parks. People who cannot or prefer not to drive should have safe and efficient transportation choices.
- Going beyond minimum design standards: Transportation agencies are encouraged, when possible, to avoid designing walking and bicycling facilities to the minimum standards. For example, shared-use paths that have been designed to minimum width requirements will need retrofits as more people use them. It is more effective to plan for increased usage than to retrofit an older facility. Planning projects for the long-term should anticipate likely future demand for bicycling and walking facilities and not preclude the provision of future improvements.
- Integrating bicycle and pedestrian accommodation on new, rehabilitated, and limited-access bridges: DOT encourages bicycle and pedestrian accommodation on bridge projects including facilities on limited-access bridges with connections to streets or paths.
- Collecting data on walking and biking trips: The best way to improve transportation networks for any mode is to collect and analyze trip data to optimize investments. Walking and bicycling trip data for many communities are lacking. This data gap can be overcome by establishing routine collection of nonmotorized trip information.

Communities that routinely collect walking and bicycling data are able to track trends and prioritize investments to ensure the success of new facilities. These data are also valuable in linking walking and bicycling with transit.

- Setting mode share targets for walking and bicycling and tracking them over time: A byproduct of improved data collection is that communities can establish targets for increasing the percentage of trips made by walking and bicycling.

Improving nonmotorized facilities during maintenance projects: Many transportation agencies spend most of their transportation funding on maintenance rather than on constructing new facilities. Transportation agencies should find ways to make facility improvements for pedestrians and bicyclists during resurfacing and other maintenance projects.

Corridor Investment Projects

Atlantic Avenue Improvement Project in North Long Beach (2012)

Encompassing the North Village commercial corridor on Atlantic Avenue between 56th Street and 59th Street, the Atlantic Avenue Improvement Project provides design guidelines for landscaping and sidewalk enhancements to bring a new vitality to the area and provide area residents and visitor with a more inviting and stimulating environment. Improvements such as adding new trees, making sidewalk repairs, and repaving the street will help make Atlantic Avenue feel more welcoming for all.

Pine Avenue Improvement Project (2012)

Like the Atlantic Avenue Improvement Project, the Pine Avenue Improvement Project aims to transform the layout and feel of Pine Avenue between Seaside Way and Anaheim Street. Proposed improvements include adding pedestrian lighting, trash cans, and bike racks; repairing sidewalks, and converting several intersections to "pedestrian scrambles," which stop all vehicular traffic and allows pedestrians to cross an intersection in every direction, including diagonally, at the same time. **Figure B-1** shows the finished pedestrian scramble intersection at Pine Street and 1st Street.

Figure B-1: Pedestrian scramble intersection at Pine Avenue & 1st Street in Long Beach

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Long Beach Bicycle Master Plan

Appendix C

Additional Existing Conditions Data

APPENDIX TO THE MOBILITY ELEMENT
OF THE GENERAL PLAN
CITY OF LONG BEACH
JANUARY 2017

Appendix C. Additional Existing Conditions Data

Benefit Impact Analysis

Health Benefits

The implementation of a well-designed, connected bicycle network across Long Beach will encourage a shift from energy-intensive modes of transportation such as cars and trucks to active modes of transportation such as bicycling and walking. The impact analysis model evaluates and quantifies the estimated increase in bicycling trips, the estimated increase in hours of physical activity, and the annual savings resulting from reduced healthcare costs. In order to evaluate these health factors, the project team analyzed readily-available data inputs. The primary inputs into the health component of the impact analysis model come from five-year estimates of commute trip data from the U.S. Census Bureau. Five-year estimates were chosen because they are the most reliable dataset available from the U.S. Census Bureau between the 10-year censuses and because they allow for analysis at the individual census tract level.

Currently, with Long Beach's 1.1 percent bicycle mode share, there are 4,821,000 estimated annual trips by bicycle. Through those trips, the citywide vehicle miles traveled (VMT) is estimated to be reduced by 5,754,000. Additionally, 2,000 people are currently categorized as "active" (residents who meet the CDC, or Centers for Disease Control and Prevention, minimum number of hours of physical activity per day *through bicycling*), and the annual direct and indirect healthcare costs are for those 2,000 active people are reduced by $3,358,000.

Accounting for continued increases in population, employment, and student enrollment rates, should Long Beach achieve a 10 percent bicycle mode share by 2026 (ten years after Plan adoption), annual estimated bike trips will rise to 21,503,000; VMT will be reduced by 24,564,000; there will be 10,000 newly "active" people; and annual healthcare cost savings from those active people will be $14,806,000.

If Long Beach achieves a 20 percent bicycle mode share by 2036, bike trips will rise to 77,968,000, reducing VMT by 97,317,000; there will be 37,000 newly active people, resulting in an annual healthcare cost savings of $53,507,000. These numbers account for an increase in population, employment, and student enrollment rates.

Should Long Beach reach a 30 percent bicycle mode share by 2046, there will be an estimated 179,246,000 bicycle trips annually, leading to a 224,016,000 VMT reduction; 85,000 newly active people, will result in $122,959,000 of healthcare cost savings. Again, these numbers account for an increase in population, employment, and student enrollment rates.

Environmental Benefits

While the causes of physical inactivity and pollution stem from many sources, the implementation of the recommended bicycle projects and policies in Long Beach will contribute to a shift from energy-intensive modes of transportation such as cars and trucks to active modes of transportation such as bicycling and

walking. The impact analysis model evaluates and quantifies the estimated increase in bicycling trips and the annual savings from reduced vehicle emissions. Using the same estimates of VMT reduction calculated in the health benefits analysis, changes in hydrocarbon, particulate matter, nitrous oxides, carbon monoxide, and carbon dioxide were analyzed.

Right now, with the 1.1 percent bicycle mode share, 0.3 metric tons of particulate matter are not being released into the air annually if those riders were driving instead. Also not being released are 5.27 metric tons of nitrous oxide, 0.04 metric tons of sulfur dioxides, 6.89 metric tons of volatile organic compounds (VOCs), and 2,800 metric tons of carbon dioxide (CO_2). This adds up to about $292,000 in savings related to environmental damage or clean-up per year.

Accounting for population, employment, and student enrollment rates rising, should Long Beach achieve a 10 percent bicycle mode share by 2026, Table C-1 shows the reduction in the amount of each pollutant being released into the environment. This leads to a $1,348,000 savings in related environmental damage or clean-up per year.

Table C-1: Estimated Environmental Benefits with a 10 Percent Bicycle Mode Share

Pollutant	Amount Reduced Annually, in Metric Tons
Particulate Matter	1.4
Nitrous Oxides	24.33
Sulfur Dioxides	0.2
VOCs	31.84
CO_2	13,000

If Long Beach achieves a 20 percent bicycle mode share by 2036, Table C-2 shows the resulting reduction in the amount of each pollutant being released into the environment. This leads to a $4,937,000 savings in related environmental damage or clean-up per year. These numbers account for increases in population, employment, and student enrollment.

Table C-2: Estimated Environmental Benefits with a 20 Percent Bicycle Mode Share

Pollutant	Amount Reduced Annually, in Metric Tons
Particulate Matter	5.14
Nitrous Oxides	89.08
Sulfur Dioxides	0.75
VOCs	116.62
CO_2	48,000

Should Long Beach achieve a 30 percent bicycle mode share, Table C-3 shows the resulting reduction in the amount of each pollutant being released into the environment. This would lead to an $11,365,000 savings in related environmental damage or clean-up per year.

Table C-3: Estimated Environmental Benefits with a 30 Percent Bicycle Mode Share

Pollutant	Amount Reduced Annually, in Metric Tons
Particulate Matter	11.82
Nitrous Oxides	205.06
Sulfur Dioxides	1.72
VOCs	268.44
CO_2	111,000

Transportation Benefits

A strong and well-designed bicycle network provides a connection between activity centers and residences. While no money may change hands, real savings can be estimated from the reduced costs associated with congestion, vehicle crashes,

road maintenance, and household vehicle operations. Utilizing the same calculations for estimated increases in annual bicycle and annual VMT reductions used in the health and environmental components, transportation-related cost savings can be calculated. By multiplying the amount of VMT reduced by established multipliers for traffic congestion, vehicle collisions, road maintenance, and vehicle operating costs, monetary values can be assigned to the transportation-related benefits.

Currently, with Long Beach's 1.1 percent bicycle mode share, riding a bicycle contributes to a $3,605,000 annual household transportation cost savings. It also contributes to a $319,000 in traffic congestion cost savings, saves $1,910,000 in costs associated with collisions, and $832,000 in roadway maintenance.

Should Long Beach achieve a 10 percent bicycle mode share by 2026, accounting for population, employment, and student enrollment increases, households could save $16,650,000. Additionally, $1,475,000 would be saved from traffic congestion, $8,823,000 from collision costs, and $3,845,000 from roadway maintenance.

If Long Beach achieves a 20 percent bicycle mode share by 2036, households could save $60,972,000 in transportation costs. Also, $5,403,000 would be saved from traffic congestion, $32,308,000 from collision costs, and $14,079,000 from roadway maintenance. These numbers account for increases in population, employment, and student enrollment.

Should Long Beach reach a 30 percent bicycle mode share, households could save $140,352,000 in transportation costs. $12,437,000 could be saved in traffic congestion costs, $74,374,000 in collision costs, and $32,410,000 in maintenance.

Total Benefits

Currently, with the 1.1 percent bicycle mode share, these health, environmental, and transportation benefits lead to $10,317,000 in savings. A 10 percent mode share by 2026 could lead to $46,947,000 in savings. A 20 percent mode share could lead to a savings of $94,793,000 (with a 3 percent discount rate). A 30 percent mode share by 2046 could lead to $51,745,000 in additional savings (with a seven percent discount rate).