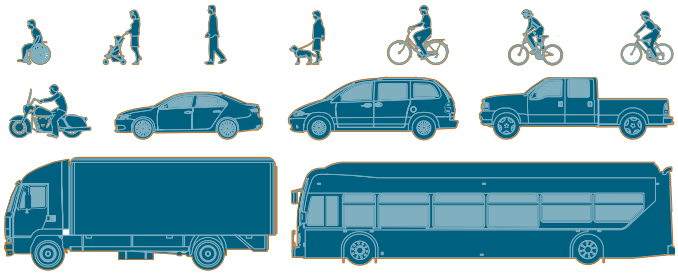
SEPARATED BIKE LANES AT INTERSECTIONS

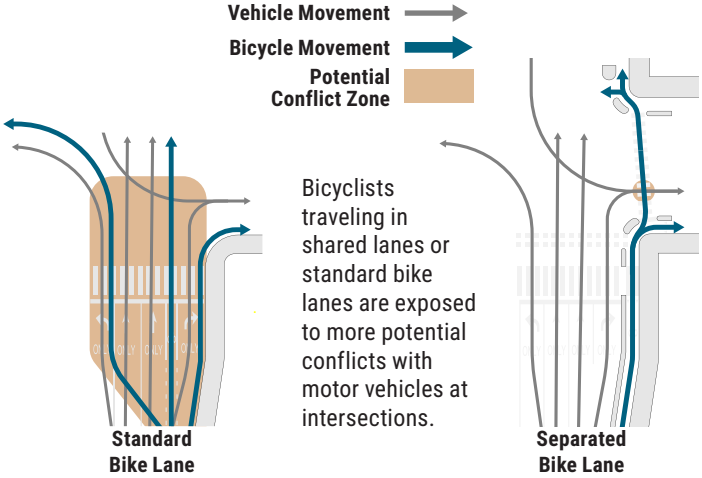
Separated bike lanes reduce stressful interactions between people bicycling and driving by physically separating these users with a horizontal buffer and vertical element. Research shows that they encourage more bicycling, enhance safety for all road users, and are more comfortable for bicyclists and motorists compared to standard bike lanes and shared lanes.

Bicyclists are inherently vulnerable as they have considerably less mass and travel at slower speeds than motorists. This increases the likelihood of serious injury or death in the event of a collision with a motor vehicle. Most conflicts occur at intersections where turning motorists must merge within or turn across a bicyclist's path of travel. Intersection geometry has an influence on the turning speed of a motorist and the approach geometry has an influence on a motorist's merging speed across a bicyclist's path.

At intersections, geometric and signalization strategies for separated bike lanes can reduce conflict areas, clearly communicate the right-of-way for all users, and heighten visibility and lower speeds at crossings. Continuous separated bike lanes along corridors and through intersections serve a primary role in the design of low-stress bicycle networks that appeal to people of all ages and bicycling abilities.

COMMON USERS IN CONFLICT AND CONFLICT ZONES





Bicyclists traveling in shared lanes or standard bike lanes are exposed to more potential conflicts with motor vehicles at intersections.

GUIDING PRINCIPLES TO REDUCE CONFLICTS

SAFETY
Minimize bicyclist exposure to motor vehicles, decrease the speed differential at conflict points, and provide adequate sight distance for all roadway users.

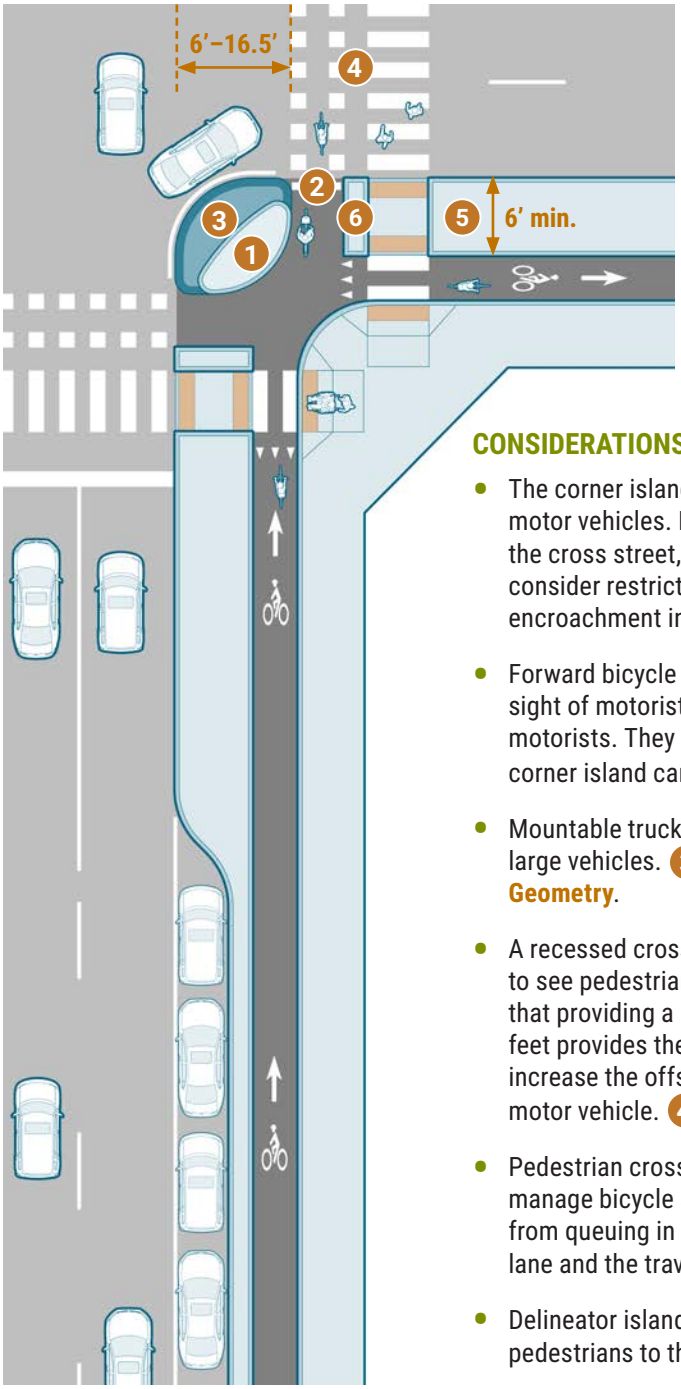
ACCOMMODATION AND COMFORT
Preserve the separated bike lane up to the cross street to create an environment that appeals to bicyclists of all ages and abilities.

COHERENCE
Clearly delineate the path of travel at conflict points.

PREDICTABILITY
Design pavement markings, signs, geometric elements, and signal phasing strategies to encourage predictable behaviors.

CONTEXT-SENSITIVITY
Consider community character and aesthetics when selecting separated bike lane elements.

EXPERIMENTATION
Utilize innovative solutions such as the provision of bicycle signals for protected-phase crossings or truck aprons to slow turning vehicles.



PROTECTED INTERSECTIONS

Protected intersections preserve the separated bike lane up to and through intersections. By maintaining physical separation, they eliminate shared spaces with turning and merging vehicles, limiting bicyclist exposure to a single point where the motorist turns across the bike lane and adjacent pedestrian crossing. The speed of the conflict is controlled through geometric design and sight distance is improved by recessing the crossings. Protected intersections are compatible with one- and two-way separated bike lanes; however, contraflow bicycle movements may require signal-phase separation in some situations.

CONSIDERATIONS

- The corner island protects bicyclists by controlling the speed of right-turning motor vehicles. It also allows the crossing to be located at a narrower part of the cross street, minimizing exposure to turning traffic. (1) Designers should consider restricting right turns on red at protected intersections to reduce vehicle encroachment into the crossings.
- Forward bicycle queuing areas allow stopped bicyclists to wait in direct line of sight of motorists and allow bicyclists to enter the intersection before turning motorists. They should be at least 6 feet long to fit a typical bicycle. Enlarging the corner island can create additional queuing space for bicyclists. (2)
- Mountable truck aprons can be used to slow turning vehicles while accommodating large vehicles. (3) For more information, refer to the design topic on **Intersection Geometry**.
- A recessed crossing creates motor vehicle yielding space and allows motorists to see pedestrians and bicyclists without relying on mirrors. Research shows that providing a bicycle crossing offset from the parallel roadway by 6- to 16.5 feet provides the greatest safety benefit. Enlarging the corner island can further increase the offset to the cross street and create additional yielding space for a motor vehicle. (4) **(Schepers 2011, pp. 853–861)**
- Pedestrian crossing islands reduce crossing distances, allow pedestrians to manage bicycle and motor vehicle conflicts separately, and discourage pedestrians from queuing in the bike lane. They must provide at least 6 feet between the bike lane and the travel lane and include detectable warning surfaces. (5)
- Delineator islands separate bicycle and pedestrian crossings and help guide pedestrians to the crossing island and crosswalk. (6)

SIGHT DISTANCE

For sight distance at intersections and driveways, refer to the **AASHTO Green Book 2011**. Restrict parking and vertical objects near the intersection by at least 20 feet to provide a clear approach area **(FHWA Separated Bike Lane Guide 2015, p. 90)**. Higher design turning speeds require additional clear area for motorists to identify and react to potential conflicts.

SIGNALS

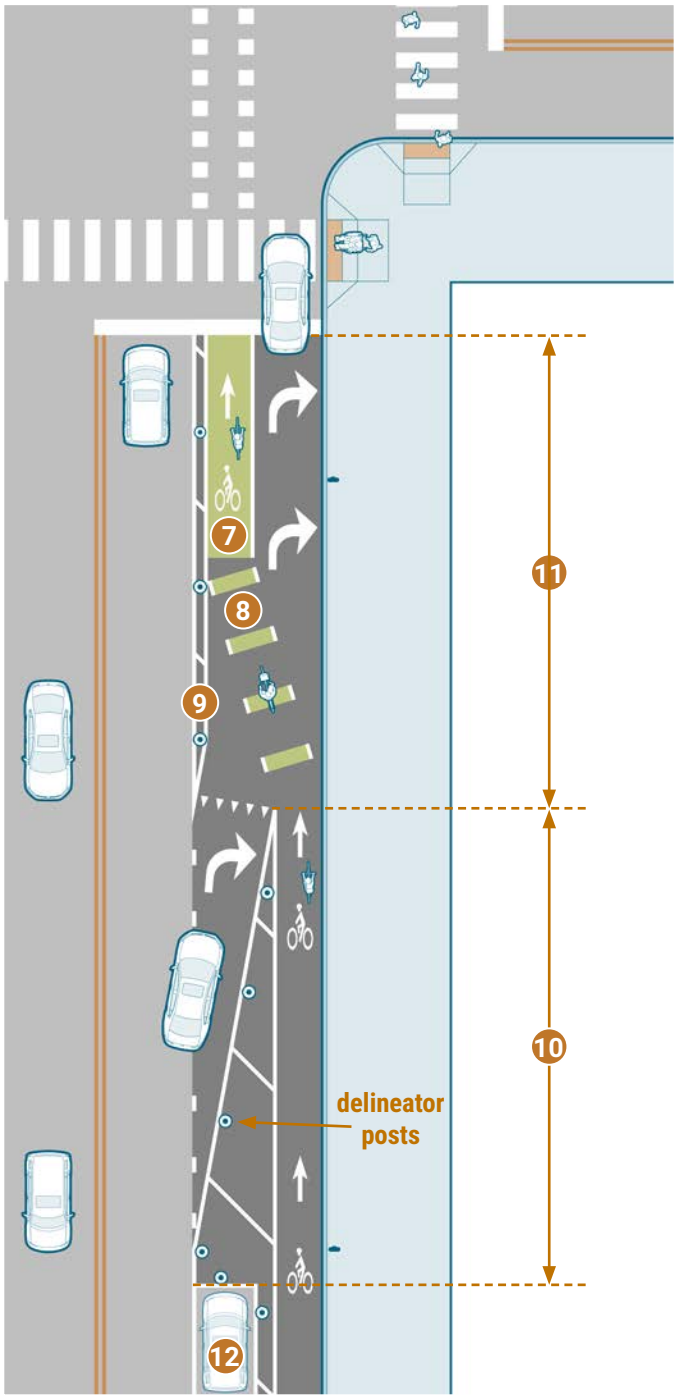
Separated bike lanes are offset from motor vehicle traffic, therefore bicycle signals should be considered to provide consistent, predictable, and easy to understand guidance for bicyclists at signalized locations. Bicycle signals will be necessary at locations where protected or leading bicycle phases are provided. For more information on interval adjustments and signal phasing and coordination, refer to **FHWA Separated Bike Lane Guide 2015, pp. 115–121**.

MIXING ZONES

A mixing zone requires turning motor vehicles to merge into the separated bike lane at a defined location in advance of an intersection. Unlike a standard bike lane where a motorist can merge across at any point, a mixing zone design limits bicyclist exposure to motor vehicles by defining a limited merge area for the turning motor vehicle. They are compatible with one-way separated bike lanes only.

CONSIDERATIONS

- Mixing zones should be limited to constrained locations where maintaining physical separation is infeasible with a maximum of 50–150 turning motor vehicles in the peak hour **(FHWA Separated Bike Lane Guide 2015, p. 107)**. Consider signal separation at constrained locations with higher turning volumes.
- Bike lanes should be continuous through the mixing zone where space permits 7, otherwise shared lane markings should be used.
- Designers should consider a green bike lane or shared lane markings 8 for conflict areas to highlight the conflict point and raise awareness of bicyclists.
- Designers should provide a buffer 9 with a vertical element to separate the turn lane from through lanes, where space permits **(FHWA Separated Bike Lane Guide 2015, p. 83)**.
- Motor vehicle speeds should be reduced at the merge point to 20 mi/h or less through the use of reduced taper lengths. 10
- The length of the mixing zone should be minimized to 60–100 11 feet to maximize comfort for bicyclists and to minimize speed differential with motorists.
- Where parking is present, it may be necessary to restrict some parking in advance of the merge point 12 to increase approach sight distance.



MARKINGS, SIGNS, & MAINTENANCE

Pavement markings and signs can be used to alert motorists of potential conflicts. For more information, refer to the design topic on **Turning Vehicles.**

Providing a safe and rideable surface through all seasons can reduce conflicts by providing an exclusive space for bicyclists year-round. Designers should consider compatibility with maintenance activities and equipment when designing separated bike lanes. For more information see **FHWA Separated Bike Lane Guide 2015, pp. 64–65**.

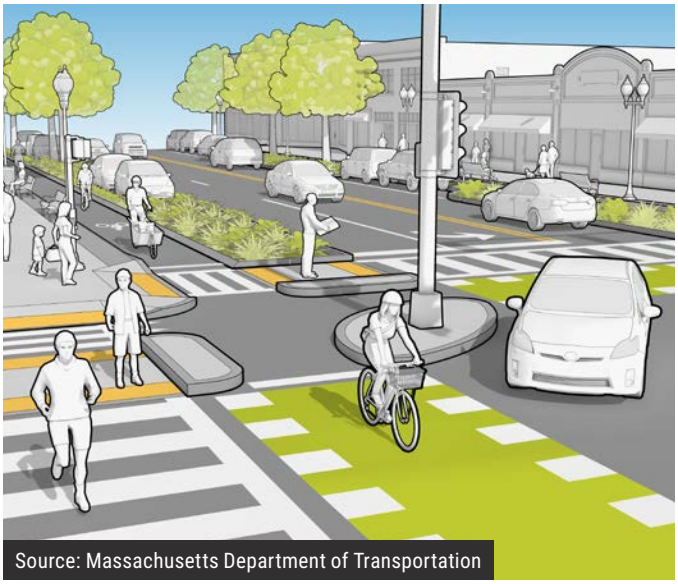
INTERSECTION GEOMETRY

Roadway geometry can assist in reducing conflicts at intersections, especially with separated bike lanes. For more information, refer to the design topic on **Intersection Geometry**.

CASE STUDIES

SEPARATED BIKE LANE PLANNING & DESIGN GUIDE
MASSACHUSETTS

The Massachusetts Department of Transportation (MassDOT) Separated Bike Lane Planning & Design Guide presents strategies and criteria for the planning, design, and maintenance of separated bike lanes. MassDOT recognizes the Guide as a critical tool in support of its Complete Streets approach to project development and its goal to provide healthy transportation options. The Guide provides clarification on when separated bike lanes are appropriate and identifies typical separation strategies and configurations while addressing key design criteria for reducing conflicts between all modes. The document provides design guidance for intersections, signalization, transit stops, loading zones, on-street parking, drainage, stormwater management, and landscaping, among others. Notably, it introduces the first set of guidelines for protected intersections, bringing international best practice to the U.S.



Source: Massachusetts Department of Transportation

PROTECTED INTERSECTION
DAVIS, CA

In August 2015, Davis, CA completed the construction of a new intersection design for bicyclists at Covell Boulevard and J Street. The intersection design, referred to as a protected intersection, created corner islands for bicyclists to maneuver around the intersection with physical separation from motorists. The intersection is reported to be functioning well with the various roadway users able to follow their path without explanation. The design reduced the crossing distances for bicyclists and pedestrians and improved visibility between turning vehicles with bicyclists and pedestrians.

FOR MORE INFORMATION

American Association of State Highway and Transportation Officials. *Guide for the Development of Bicycle Facilities*. 2012.

American Association of State Highway and Transportation Officials. *A Policy on the Geometric Design of Highways and Streets*. 2011.

Federal Highway Administration. *Manual on Uniform Traffic Control Devices*. 2009.

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

Massachusetts Department of Transportation. *Separated Bike Lane Planning & Design Guide*. 2015.

National Association of City Transportation Officials. *Urban Bikeway Design Guide*. 2014.

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

United States Access Board. *Proposed Guidelines for Pedestrian Facilities in the Public Right-of-Way*. 2011.