Chapter 1520 Roadway Bicycle Facilities

1520.01 General

The Washington State Department of Transportation (WSDOT) encourages and relies upon bicycle use on and interconnecting with its facilities. Bicycle facilities or improvements for bicycle transportation are included in WSDOT's project development and highway programming processes.

This chapter is a guide for designing bicycle transportation facilities within state highway right of way or between the curb lines on city streets designated as state highways. When designing facilities outside of state highway right of way or beyond the curb on city streets designated as state highways, use the local agency's design guidance.

Guidance in this chapter applies to typical situations encountered on state highways and includes options for intersection and interchange design. Unique design challenges are resolved using expertise and guidance from the regional Bicycle Coordinator, or if none exists, the WSDOT headquarters Bicycle Coordinator. Additional concepts to resolve unique bicycle facility design situations can be found in guides referenced (Section 1520.07), but may require additional approvals for signing, pavement markings, or bike facility types not presented within this chapter.

The Region Traffic Engineer is responsible for determining which sections of state highways are inappropriate for bicycle traffic. The State Transportation Operations Engineer, after consultation with the HQ Design and HQ Active Transportation, prohibits bicycling on sections of state highways through the traffic regulation process.

1520.02 Policy (New Section 2023)

WSDOT seeks to provide appropriate bicycle facilities along and across sections of state routes as an integral part of the transportation system. Federal Highway Administration (FHWA) and WSDOT policy is that bicycle facilities be given full consideration in the planning and design of new construction and reconstruction highway projects, except where bicycle use is prohibited. Use a performance-based approach (see next section) to select and design the appropriate solution to address the need to accommodate bicycle uses, including those uses associated with projects that are providing for a Complete Streets facility.

1520.03 Bicycle Facility Selection (Section Rewritten 2023)

Bicycle Level of Traffic Stress (BLTS) can inform facility selection because the ranking system is tied to roadway characteristics and facility types that support the Safe System Approach and a user's willingness to use a given facility. This section provides additional information on facility selection based on the Safe System Approach.

Facilities that reduce driver operating speeds, reduce bicyclist exposure to potential crashes with motor vehicles, increase the predictability of motor vehicle and bicycle interactions, and increase the conspicuity of vulnerable road users decrease the likelihood of a serious injury or fatality crash. See Exhibit 1520-5.

Reduce operating speeds: Measures to reduce operating speeds of roadways (see Section 1103.05(2)). Bike facilities do not necessarily reduce operating speeds, rather different bike facility types are chosen to mitigate for higher speed conditions. Some bicycle facilities such as protected intersections, and protected roundabouts directly influence vehicle turning speeds.

Reduce bicyclist exposure to potential crashes with motor vehicles: Bike facilities generally reduce bicyclist exposure to potential crashes along roadways. Exposure decreases as separation and protective elements increase.

Exposure can also be decreased by reducing the number or length of conflict zones or crossing areas with motor vehicle traffic, or by controlling traffic movements at points of conflict (i.e., signalized control of conflicting movements). Protected intersections and protected roundabouts provide significant reductions in bicyclist exposure at intersections.

Increase predictability of motor vehicle/bicycle interactions: Bike facilities provide a means for increasing the predictability of interactions between motor vehicle and bicycle traffic by providing an identified and recognizable space for bicycle traffic to travel, especially in locations where most cyclists are traveling at a slower speed than motor vehicle traffic. At intersections separated or marked bike facilities help establish both where differing traffic modes can be expected to travel as well as indicating locations where the paths of differing modes cross one another. Signalized intersections with dedicated signal phases for cyclists can further support predictable traffic movements through intersections.

Increase bicyclist conspicuity: Bike facilities do not necessarily make it easier for drivers to see bicyclists. However, bike facilities may increase a driver's attention to the fact that bicyclists may be present and bike facility enhancements such as green paint can accentuate this effect. Raised bike lanes (i.e., bicycle facilities that are vertically separated from the adjacent travelled lane) may directly increase bicyclist conspicuity. Protected intersections and separated bike lanes through roundabouts can directly address bicyclist conspicuity at intersections.

Use the table below to select an appropriate bicycle facility based on the roadway context.

See Section 1510.02(5)(a) for guidance on Pedestrian Level of Traffic Stress (PLTS).

1520.03(1) Speed Considerations (New Section 2023)

While Exhibit 1520-2, Exhibit 1520-3,Exhibit 1520-4, and Exhibit 1520-5 provide ranges of roadway speeds in which different types of bike facilities may be appropriate, it is critical to understand that motor vehicle speed plays a significant role in crash severity between motor vehicles and cyclists. When designing multimodal facilities, a target speed selection within the low-speed design control is encouraged. Safety performance increases as motor vehicle speeds are decreased. See Chapter 1103 for further discussion on target speed and speed management treatments.

1520.03(2) Roadway Bicycle Facilities (Section Rewritten 2023)

There are three general types of dedicated bicycle facilities. See Exhibit 1520-1.

Conventional bike lanes (CBLs) have a paint stripe, signing, and pavement markings to provide a clear indication to bicyclists and drivers about the purpose of the facility. See Exhibit 1520-7.

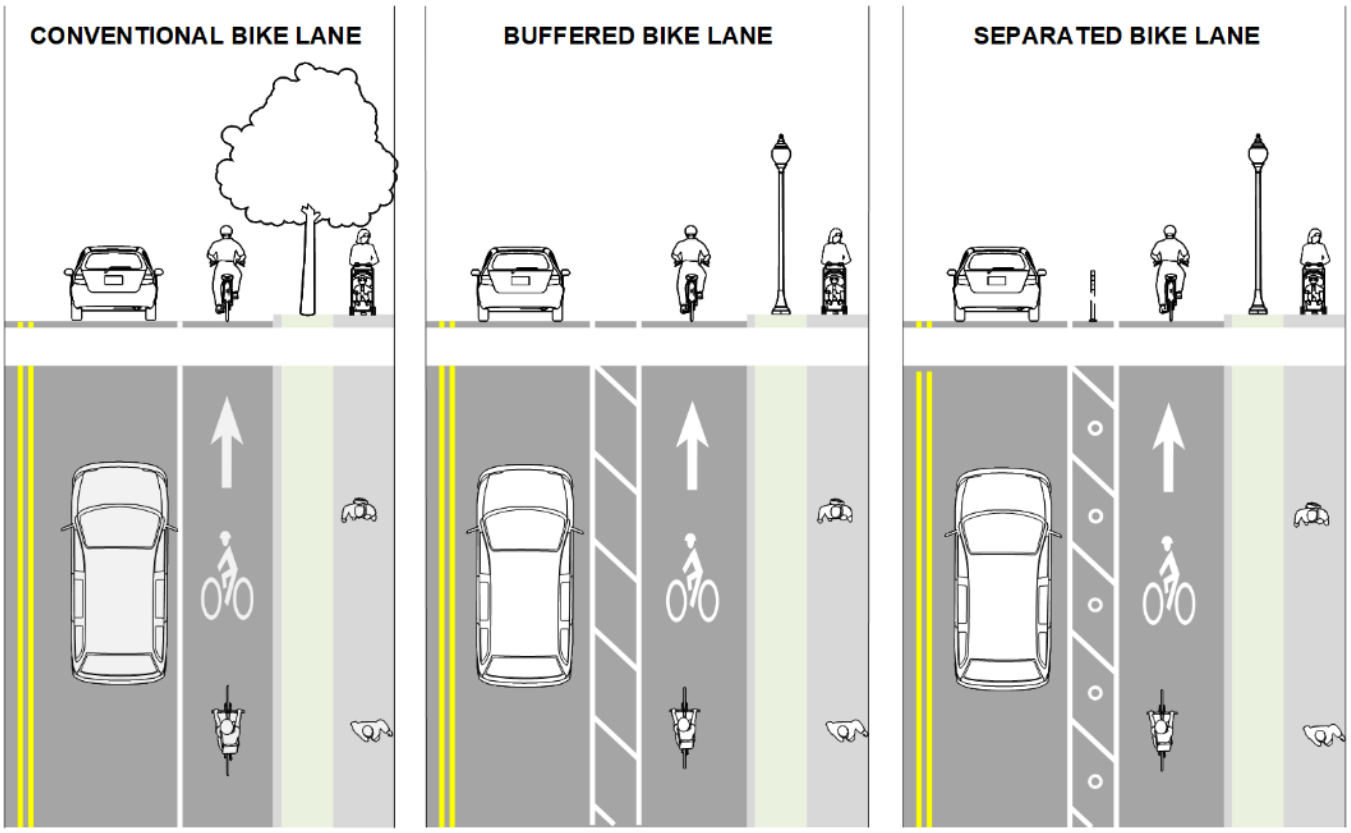
Buffered bike lanes (BBLs) are similar to conventional bike lanes, except they also provide a painted buffer to improve rider comfort and provide the benefit of having greater space between cyclists and motor vehicle traffic. See Exhibit 1520-8.

Separated bike lane (SBLs) also provide a painted buffer, but also include vertical elements to further improve rider comfort and improve the buffer's visibility and the driver's awareness of the buffer. See Exhibit 1520-10.

The width of a bicycle lane with a buffer (BBLs and SBLs) does not include the width of the buffer.

Shared-use paths (see Chapter 1515) are another option for providing physical separation from traffic.

Exhibit 1520-1 Roadway Bicycle Facilities

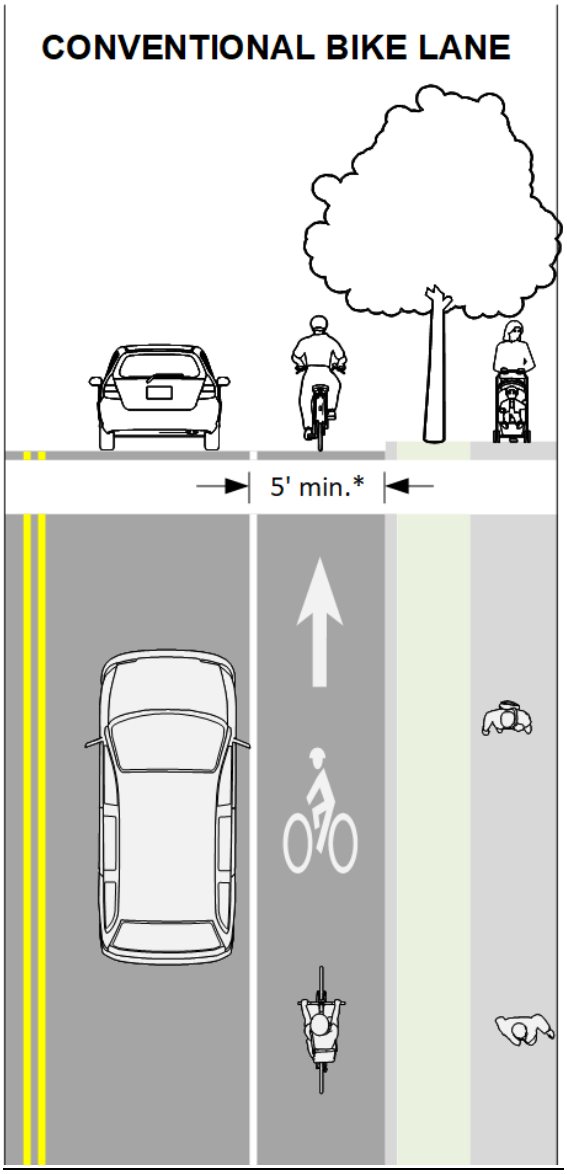


1520.03(2)(a) Conventional Bike Lane

Conventional bike lanes are at grade and adjacent to motor vehicle traffic lane. They are designated by a single solid wide stripe between the motor vehicle lane and bike lane. Additional bike markings (see the *Standard Plans*) in the bike lane and signage are also employed.

The minimum width for a conventional bike lane is 5 feet (not including the gutter pan, where present); the minimum width is 6 feet, not including gutter pan, when the posted speed is > 30 mph and the bike lane is either adjacent to vehicle parking or a sharp pavement drop off, or there is a higher volume of vehicle traffic (> 6,000 vehicles per day or > 5% heavy trucks).

Exhibit 1520-2 Conventional Bike Lane



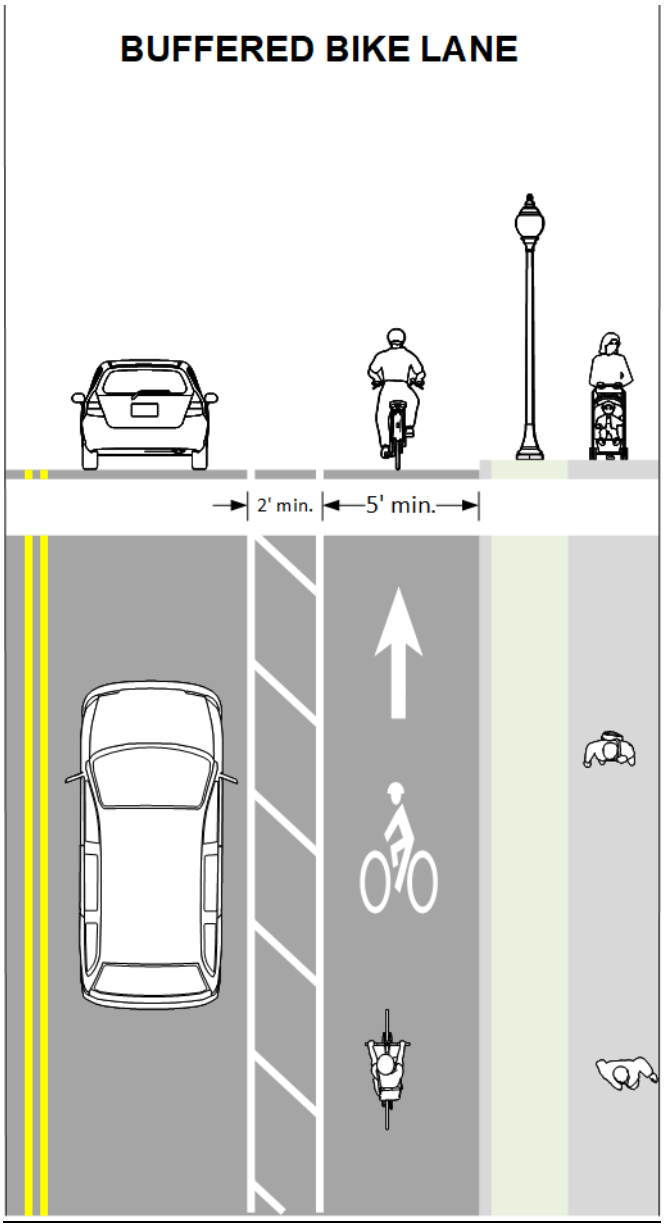
* 6 feet min. when the posted speed is > 30 mph and the bike lane is either adjacent to vehicle parking or a sharp pavement drop off, or when higher than 6,000 vehicles per day or 5% heavy trucks.

1520.03(2)(b) Buffered Bike Lane

As the name suggests, a buffered bike lane is a bike lane with a marked buffer between the bike lane and adjacent motor vehicle traffic. The buffer is typically placed between the bike lane and an active traffic lane but can also be placed between a bike lane and a curbside parking lane. The buffer treatment consists entirely of pavement markings (including RPMs in some cases) with no vertical elements.

Provide a minimum 2-foot buffer strip, and a 5 foot wide minimum bike lane (not including the gutter pan, if present). Widths in excess of the minimum are normally associated with the need to accommodate bicycle passing due to higher volumes, mix of bicycle traffic (i.e., bicyclists with differing levels of aptitude and/or types of bicycles) or steep uphill grade.

Exhibit 1520-3 Buffered Bike Lane



1520.03(2)(c) Separated Bike Lanes

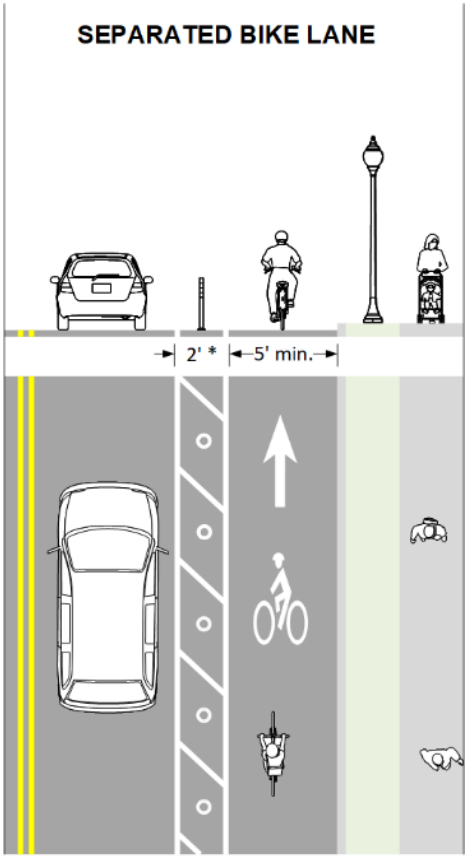
Separated bike lanes include a bike lane and a buffer area that includes a vertical element in addition to the horizontal offset between bike lane and motor vehicle traffic. Bike markings (see the *Standard Plans*) in the bike lane and signage are also employed. For these designs, provide a minimum 5 foot wide bike lane (not including the gutter pan, where present). Widths in excess of the minimum are normally associated with the need to accommodate bicycle passing due to higher volumes, mix of bicycle traffic (i.e., bicyclists with differing levels of aptitude and/or types of bicycles) or steep uphill grade.

Provide a minimum 2 foot wide buffer, or 3 feet wide if the buffer is adjacent to parked cars or includes traffic barrier. By incorporating vertical features into the buffer as described below, BLTS is improved.

Install one of the vertical features available for this purpose in the center of the designated buffer area. Acceptable vertical features include tubular markers, precast or cast in place curb, traffic barrier, vehicle parking, or a curbed planter strip. Other physical separation features may be used; consult with your region Bicycle Coordinator or headquarters Active Transportation Division.

If a curb or traffic barrier is used, review the recommended lateral clearances to vehicle traffic appropriate for the design speed of the roadway in Section 1239.06. Use bike markings in the bike lane and signage as shown in the *Standard Plans*). If curb is used with a street level separated bike lane and without any other vertical elements, paint the curb white and provide guideposts to mark the ends.

Exhibit 1520-4 Separated Bike Lane (tubular markers shown as vertical feature)



* 2 foot minimum. 3 feet minimum if the separation is adjacent to parked cars or has a traffic barrier. Contact HQ Roadside Safety if considering concrete barrier for additional width requirements.

1520.03(2)(d) Bike Boulevard (New Section 2023)

Bike boulevards (also known as Neighborhood Greenways, Bicycle Priority Streets, and other names) can be used on low-speed streets with low vehicle volumes. Bike boulevards are designed to give bicyclists and pedestrians priority. Signs, pavement markings, speed humps, chicanes, diverters, and other tools discourage vehicle through travel and encourage low speeds. Bike boulevards may be used on state highways with ASDE approval; however, it is more likely that bike boulevards will interface with state highways through crossing situations. It is important to consider how to configure an intersection or dedicated bicycle crossing location when intersecting with a bicycle boulevard network (see Section 1520.04(5)).

1520.03(2)(e) Shoulder Use by Bikes (New Section 2023)

Accommodating bicycle use on the shoulder is common on state highways that are not designated as Complete Streets. Shoulder improvements to facilitate bicycle travel include widening the shoulders to a minimum width of 4 feet, removing surface obstacles, and reviewing existing drain grates for compatibility with bicycles. If shoulder rumble strips are present, provide for at least 4 feet of usable shoulder between the rumble strip and the outside edge of shoulder. When barrier is present, provide for at least 5 feet of shoulder between the edge of traveled way (or rumble strip if present) and the face of the traffic barrier.

Note that shoulders wide enough for bicycles are not dedicated bicycle facilities, and bicycle users do not have the same operating privileges as with designated roadway bike facilities. In rural to suburban/urban transition areas consider adding bike facilities, both to encourage speed management of motor vehicle users through the transition and to establish a dedicated special-use lane for cyclists to tie into the local network.

Rumble strips are common on rural highways. and rumble strips and rumble stripes need to be properly installed and maintained (see Section 1600.05(1)) so that the shoulder can be used by bicyclists.

1520.03(3) Design Performance Metric – Level of Traffic Stress (New Section 2023)

The Level of Traffic Stress performance metric applies to Complete Streets projects. When selecting the cross-section layout and dimensions for a Complete Street, first determine the level of traffic stress (LTS) in both the existing and design (final) condition. The design goal is to provide for a BLTS of 1 or 2.

Bicycle Level of Traffic Stress (BLTS) data ranks highway segments from 1 to 4 based on roadway characteristics, with BLTS 1 being deemed suitable for all ages and abilities. BLTS 2 is considered suitable for most bicyclists. BLTS 3 and BLTS 4 represent functional gaps in active transportation networks that present systemic safety issues and likely deter the use of active modes. The data provided in Exhibit 1520-2 - Exhibit 1520-5 provide BLTS (see Section 1520.03(2)(a) i and is not a substitute for detailed investigation of a location when specific investment decisions are being considered. The specific characteristics of locations with the same LTS rankings could vary considerably. It is important to note that a BLTS 1 or 2 location might have additional, unmeasured characteristics that reduce its presumed suitability for active travel (see Section 1520.03(2)(a) ii).

In addition, provide a buffered bike lane or separated bike lane where the existing or proposed posted speed is greater than 30 mph. Separation can be provided by adding a physical barrier such as tubular markers, curb, traffic barrier, or other (see Section 1520.03) or providing a separate facility for pedestrians such as a shared use path.

See Section 1510.02(5)(a) for guidance on Level of Traffic Stress for pedestrians (PLTS).

1520.03(3)(a) Bicycle Level of Traffic Stress (New Section 2023)

Use the following tables to determine the existing Bicycle Level of Traffic Stress (BLTS), and the proposed BLTS for each project alternative under consideration (see Chapter 1104). These tables can also be used to identify potential changes needed to achieve BLTS 1 or 2 for an alternative – including additional bicycle infrastructure, speed reductions, and/or lane reductions. Note that speed referred to in the tables is target speed. For more information about the definitions of bicycle facilities referenced in these tables see Section 1520.05.

Exhibit 1520-5 Bicycle Level of Traffic Stress in mixed traffic (no bicycle facility) (New Exhibit 2023)

BLTS in mixed traffic (no bicycle facility)								
Lanes	AADT	Target Speed						
		≤20	25	30	35	40	45	50+
1 thru lane per direction (or 1 lane one-way street)	0 - 750	1	2	3	4	4	4	4
	751 - 1500	1	2	3	4	4	4	4
	1501 - 3000	2	2	3	4	4	4	4
	> 3000	2	3	3	4	4	4	4
2 thru lanes per direction	0 - 6000	3	3	3	4	4	4	4
	> 6000	3	3	4	4	4	4	4
3+ thru lanes per direction	Any ADT	4	4	4	4	4	4	4

Exhibit 1520-6 Bicycle Level of Traffic Stress for Conventional Bike Lane (paint stripe only) **(New Exhibit 2023)**

Conventional Bike Lanes (5' or greater)								
Lanes	AADT	Target Speed						
		≤20	25	30	35	40	45	50+
1 thru lane per direction (or 1 lane one-way street)	0-750	1	2	2	4	4	4	4
	751-1500	1	2	2	4	4	4	4
	1501-3000	1	2	2	4	4	4	4
	3000+	2	2	2	4	4	4	4
2 thru lanes per direction	0-6000	2	2	3	4	4	4	4
	>6000	3	3	3	4	4	4	4
3+ thru lanes per direction	Any ADT	3	3	4	4	4	4	4

Exhibit 1520-7 Bicycle Level of Traffic Stress for Buffered Bike Lane (painted buffer 2 foot wide or greater) **(New Exhibit 2023)**

Buffered Bike Lanes (minimum 2' buffer / greater than or equal to 7 feet total)								
Lanes	AADT	Target Speed						
		≤20	25	30	35	40	45	50+
1 thru lane per direction (or 1 lane one-way street)	0-750	1	1	2	3	4	4	4
	751-1500	1	1	2	3	4	4	4
	1501-3000	1	1	2	3	4	4	4
	3000+	2	2	2	3	4	4	4
2 thru lanes per direction	0-6000	2	2	2	3	4	4	4
	>6000	2	2	3	3	4	4	4
3+ thru lanes per direction	Any ADT	3	3	3	4	4	4	4

Exhibit 1520-8 Bicycle Level of Traffic Stress for Separated Bike Lane (including buffer 2 foot wide or greater) **(New Exhibit 2023)**

Separated Bicycle Lane								
Lanes	AADT	Target Speed						
		≤20	25	30	35	40	45	50+
1 thru lane per direction (or 1 lane one-way street)	0-750	1	1	1	2	2	2	2
	751-1500	1	1	1	2	2	2	2
	1501-3000	1	1	1	2	2	2	2
	3000+	2	2	2	2	2	2	2
2 thru lanes per direction	0-6000	2	2	2	2	2	2	2
	>6000	2	2	2	2	2	2	2
3+ thru lanes per direction	Any ADT	2	2	2	2	2	2	2

1520.03(3)(b) Refined Bicycle Level of Traffic Stress (New Section 2023)

Once the BLTS for a project alternative is determined per the tables above, examine the additional issues shown in Exhibit 1520-9 below to consider the need to provide design treatments in addition to those described in the BLTS solutions. This refinement is required for the project preferred alternative, but optional at the alternative's formulation and comparison phase, based on an examination of the expectation of the value to the comparison process of the additional detail required to perform the refinement. Most of the issues in the following list do not provide a quantitative basis for examining the existing or proposed (design) condition. Therefore, work with subject matter experts and the project Advisory Team to consider each category listed and determine options for addressing each issue in order to reduce travel stress in the design for bicycles and pedestrians.

The refined BLTS is considered complete when a design approach to addressing the travel stress issues listed below have been determined and documented through a collaborative process, with the intention that those approaches will be incorporated into the design. The designer documents that the BLTS has now been upgraded to the Refined (and final) BLTS for the design.

Exhibit 1520-9 Refined BLTS Criteria (New Exhibit 2023)

Characteristic	Target / Treatment
Operating speeds	Lowest acceptable vehicle travel speed (target speed)
Driveways (especially commercial)	Minimize number of accesses, provide smooth transitions for the PAR
Turn lanes	Only when necessary, seek alternatives
Parking lanes	Prioritize roadside parking as an additional buffer
Crossing distances	Reduce distances using bulbouts and median islands
Crossing barriers (e.g., median channelization)	Minimize the use of traffic barriers
Large (e.g., freight) vehicle traffic	Encourage slower travel speeds and turning movements by minimizing curb radii at intersections.
Minor pinch points (culverts, drain grates, offroad gravel intrusion, etc.)	Minimize
Surface	smooth and free of abrupt changes in vertical elevation
Grade and cross slope	minimized grade and linear distance of slope
Bikeway width	matched to expected volumes, providing shy space from traffic and obstacles.
Roadway width	minimized to reduce crossing distances
Separation	maximized by using shoulders, bike lanes, landscaped buffers, parking
Sight distance	maximized for drivers and pedestrians by using curb extensions and removing obstructions including parking near intersections
Traffic conditions	speeds are managed and lane numbers are minimized
Intersections/crossings	See Section 1310.03
Conflict points	eliminated, reduced, or spread out
Access to adjacent land use	discuss with Active Transportation subject matter expert
Lighting	specifically designed to improve bicyclist vision, with other considerations including bicycle conspicuity to drivers and personal security

1520.04 Intersection Design (New Section 2023)

Provide accommodation for bicycle movement at and through intersections on facilities where bicycles are allowed. See Section 1310.03 for design examples, additional design elements beyond those listed in this chapter, and criteria for determining level of traffic stress, and the appropriate and configurations and dimensions of those elements.

1520.04(1) Intersection Design Treatments

Design intersections for bicycle mobility and safety performance to provide a visible, distinct, predictable, and clearly designated path leading to and through the intersection while managing potential conflicts between all other users and cyclists. This chapter covers options for intersection design for bicyclists while chapters in the 1300 series provide guidance for intersection control type selection and design.

Intersection design in terms of bicycle safety and mobility performance is unique to each location. In every case, provide clear delineation of the bike facility leading up to and through the intersection, as well as segregating or prioritizing movements where appropriate. Although intersection treatments and design methods depicted in this manual are considered state-of-the-practice for WSDOT, certain pavement markings or configurations may not currently appear in the *Manual on Uniform Traffic Control Devices*. In these cases, contact the Region Traffic Engineer for more information about documentation requirements.

1520.04(1)(a) Bike Lane Through Intersection

The approach to intersections needs to balance the bicycle user's safety needs with the mobility needs of other users. Eliminate or minimize conflict areas especially at intersections. If conflict areas exist, use dotted lines to identify the conflict area. Colored pavement markings can be used to further enhance and delineate the conflict area. Exhibit 1520-11 shows different applications of the approach through lane most likely to be encountered.

There are several different ways to delineate bike lanes through the intersection. Dotted lines are the basic treatment that can be supplemented with green pavement markings (see Section 1520.05(1)) to further enhance the bike facility's presence and position within an intersection.

1520.04(2) Intersection Bike Boxes (Section Rewritten 2023)

An intersection bike box is a designated area on the approach to a signalized intersection, between an advance stop line and the intersection stop line, intended to provide bicycles a space in which to wait in front of stopped motor vehicles during the red signal phase so that they are more visible to motorists at the start of the green signal phase, as shown in Exhibit 1520-10. Bike boxes are used at signalized intersections and increase both mobility and safety performance for the bicycle mode. Intersection Bike Boxes are permitted throughout the state of Washington under FHWA approval number IA-18.35. Additional information regarding the use and application of Intersection Bike Boxes is found in FHWA Interim Approval IA-18.

Applying a bike box (see Exhibit 1520-13) assists mobility performance by prioritizing the bicycle movement at an intersection. Positioning bicyclists in the center of the appropriate lane allows them to turn from a location where they are more visible to surrounding traffic, can increase the visibility of stopped bicycle traffic at an intersection, can reduce conflicts between bicycles and motor vehicles, can help mitigate intersection right-turn ("right-hook") conflicts, and can help group bicycles together to clear intersections more quickly. Bike boxes have also been found to prevent cyclist and motor vehicle encroachment into the pedestrian crossing, reducing conflicts with pedestrians at intersections. Bicycle safety performance is improved by increasing the visibility of the cyclist, and by reducing conflicts between motor vehicles making a right turn and the bicycle through movement (also known as "right-hook" conflict).

1520.04(3) Two-Stage Bicycle Turn Boxes

The two-stage bicycle turn box is an area set aside for bicyclists to queue to turn at a signalized intersection outside of the traveled path of motor vehicles and other bicycles. When using a two-stage bicycle turn box to make a left turn, a bicyclist would proceed on a green signal indication to the turn box on the right-hand side of the travel lanes, and then turn left within the turn box and wait for the appropriate signal indication on the cross street to proceed. Two-stage bicycle turn boxes can also be used with a left-side bicycle facility to facilitate bicyclists turning right. In addition to mitigating conflicts inherent in merging across traffic to turn, two-stage bicycle turn boxes reduce conflicts between bicycles and pedestrians and separate queued bicyclists waiting to turn from through bicyclists moving on the green signal.

Two-Stage Bicycle Turn Boxes are permitted throughout the state of Washington under FHWA approval number IA-20.17. Additional information regarding the use and application of Intersection Bike Boxes is found in FHWA Interim Approval IA-20.

Exhibit 1520-13 shows an example of a two-stage left-turn design for bicycle users (two-stage right-turns are available). This design utilizes a rectangular bike box to enable cyclist queueing at the crossroad signal phase. The bicyclist passes partway through the intersection to access the bike box, and then waits for the crossroad next signal phase to eliminate the bicyclist left turn movement. This treatment's best application is at intersections with significant volumes of motor vehicle traffic or large volumes of left-turn cyclists, or when separated or buffered roadway bicycle facilities are used on the segment.

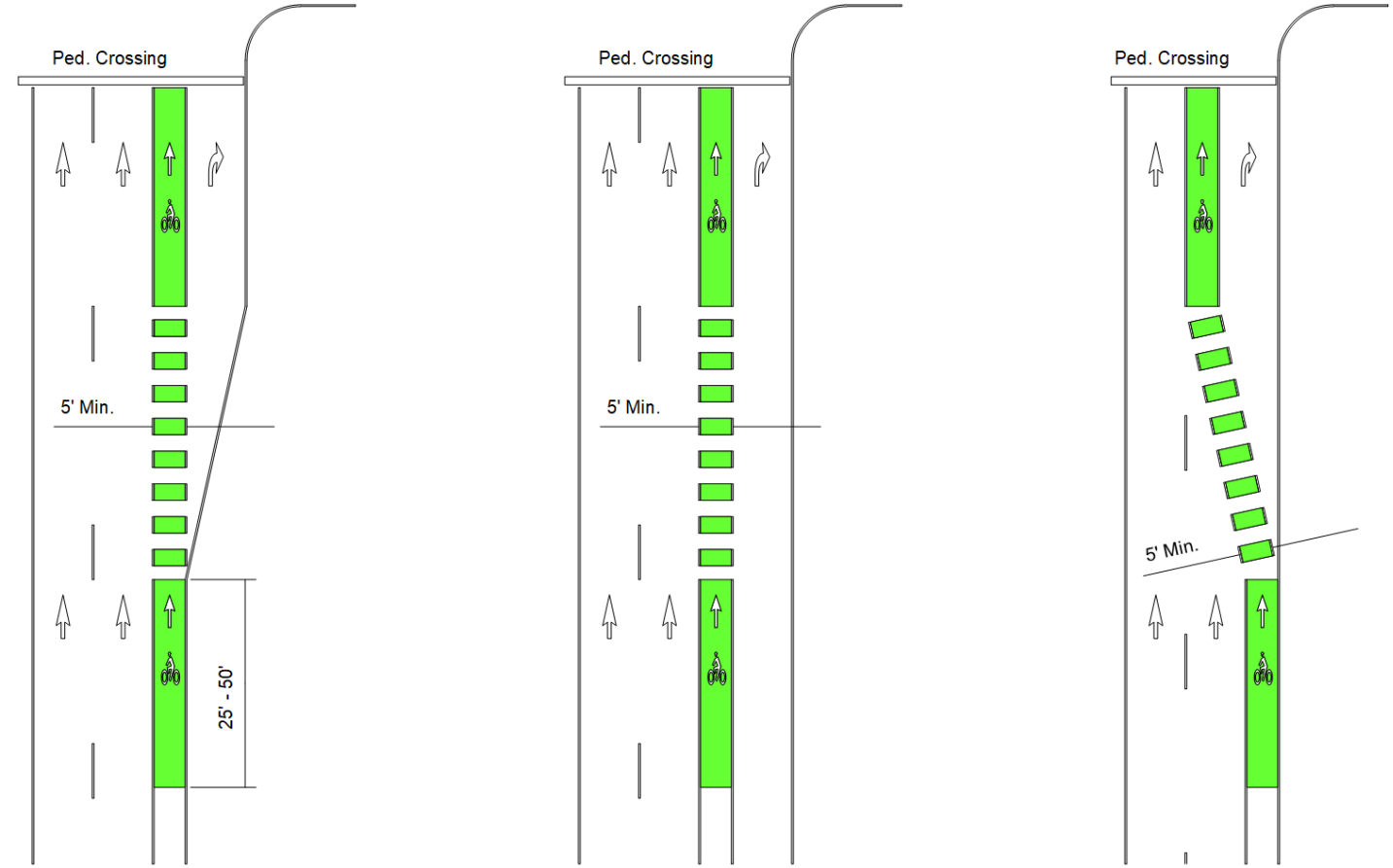
This treatment can increase safety performance by reducing conflicts between cyclists and other users, segregating motor vehicle and bicycle users, and separating turning cyclists from through cyclists.

The position of the queue box is a critical aspect of this intersection design. Depending on the size and configuration of the intersection, it may present a modal performance trade-off between bicycle mobility and safety versus motor vehicle mobility performance. Use turn simulation software to verify the queue box is outside the crossroad left-turn path, or restrict left turns at the crossroad to accommodate the queue box.

The two-stage turn box should be positioned out of the path of travel of conflicting through traffic proceeding through the intersection on a green light, including other bicycle traffic passing through the intersection on the same signal phase as the bicycle traffic that will be using the turn box. Use turn simulation software to verify the turn box is outside the crossroad left-turn path, or restrict left turns at the crossroad to accommodate the turn box. Similarly, right turns from the crossing road may need to be restricted on red lights if the path of the right turn passes over the turn box.

Avoid placing the turn box in a position where it lies between lanes of the crossing street, unless accompanied by a traffic island (e.g., where a right turn lane on the crossing street passes to the right of a traffic island on the approach to the intersection).

Exhibit 1520-10 Approach Through Lanes



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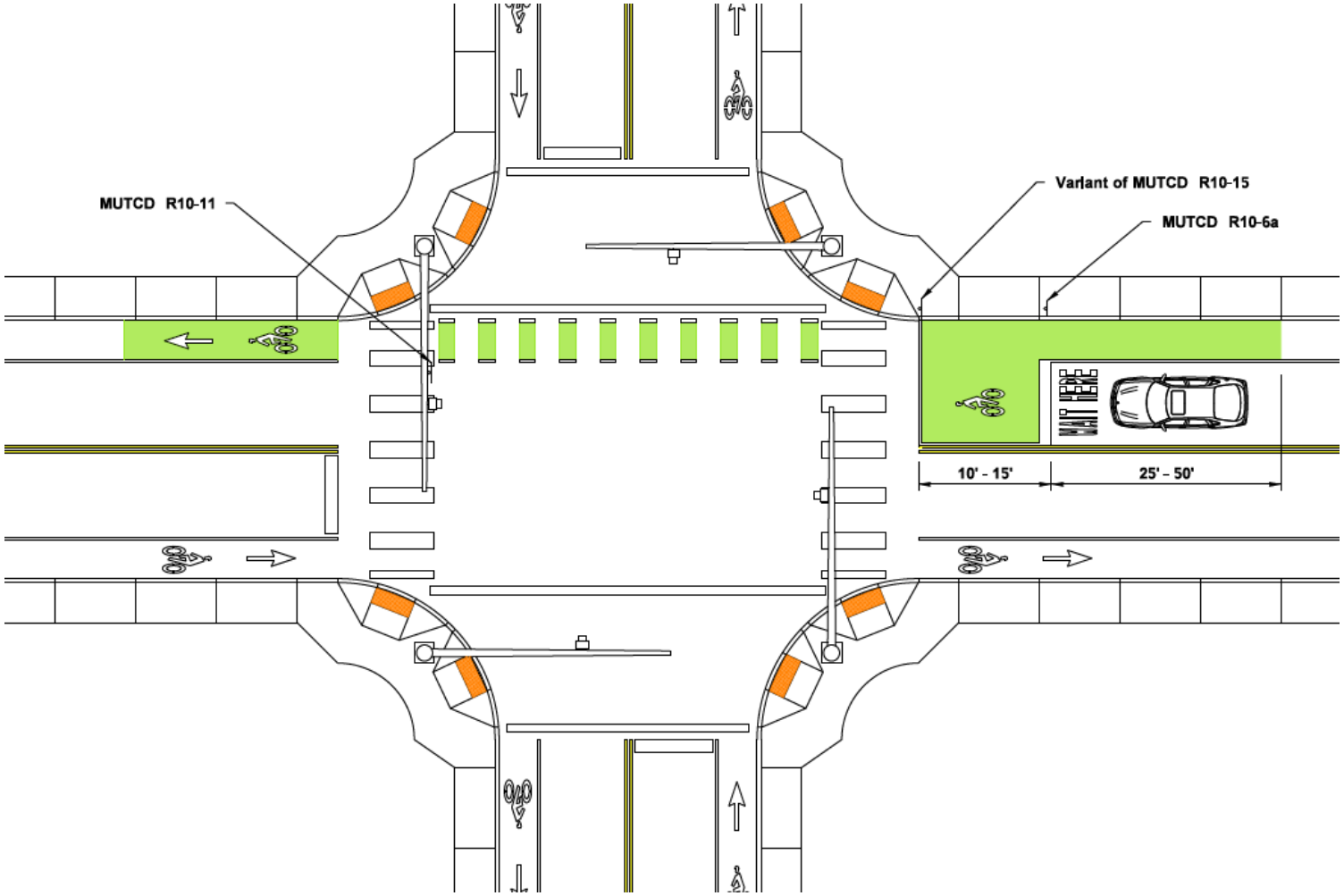
Notes:

- Not to scale and not all dimensions shown.
- See Section 1520.05(1)(a) for criteria when considering the use of green colored pavement markings.
- Consider both the speed of motorized vehicles and bicyclists when determining the length of weave and degree of taper for the bike lane.

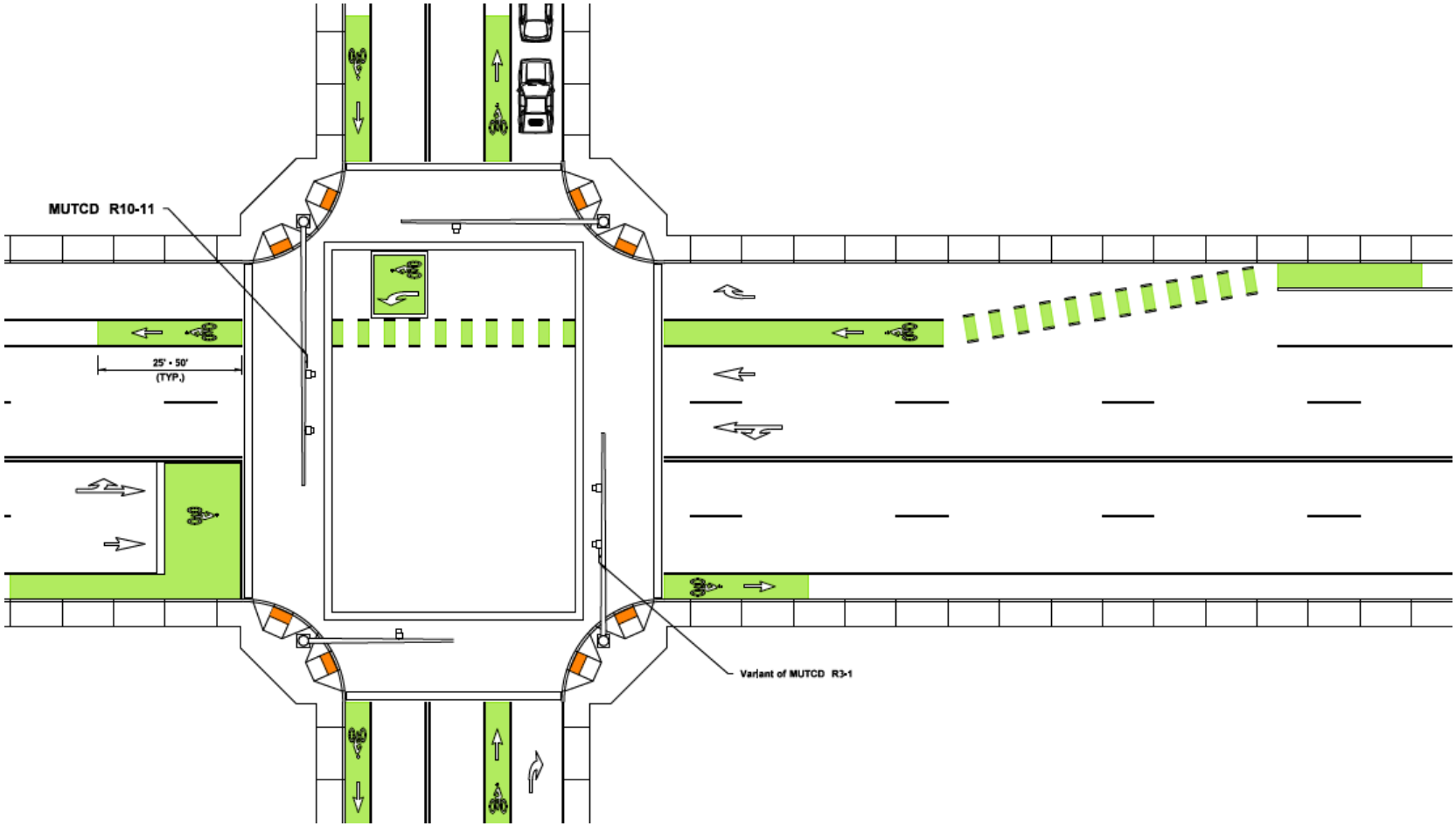
Exhibit 1520-11 Bike Box and Intersection Crossing Markings



Notes:

- This exhibit is intended to illustrate options for bike facilities through intersection areas, and not intended to represent recommended practice for any other features including ADA criteria (See Chapter 1510 for ADA and pedestrian design).
- See Section 1520.05(1)(a) for criteria when considering the use of green colored pavement markings.

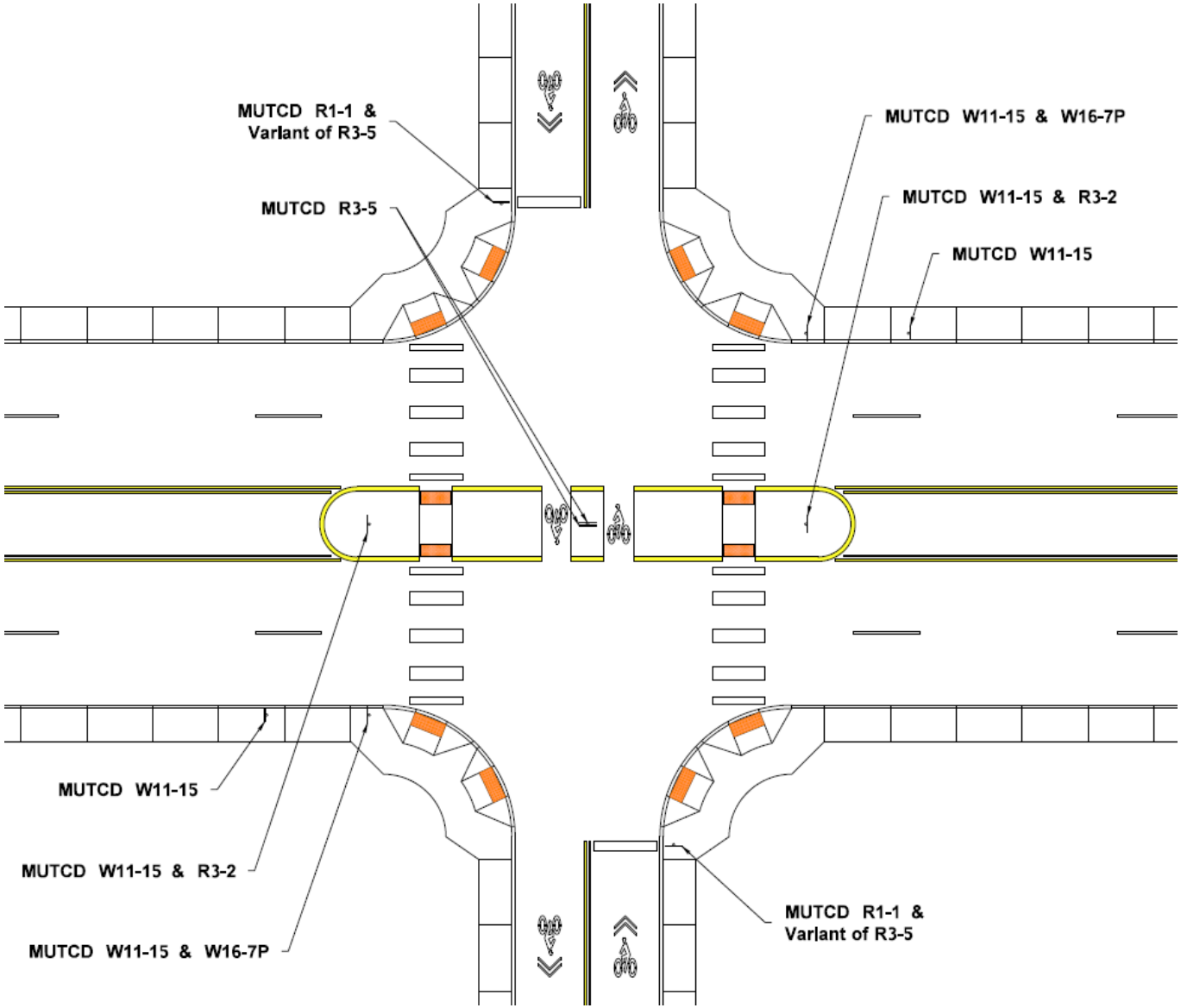
Exhibit 1520-12 Two-Stage Turn Box



Notes:

- This exhibit is intended to illustrate options for bike facilities through intersection areas, and not intended to represent recommended practice for any other features including ADA criteria (See Chapter 1510 for ADA and pedestrian design).
- Consider both the speed of motorized vehicles and bicyclists when determining the length of weave and degree of taper for the bike lane.
- See Section 1520.05(1) for criteria when considering the use of green colored pavement markings.

Exhibit 1520-13 Median Diverter



1520.04(4) Traffic Signals Considerations

Consider bicycle needs and intersection geometry when timing the traffic signal cycle and when selecting the method of detecting the presence of cyclists. Contact the Regional Active Transportation Coordinator and the Region Traffic Engineer for assistance in determining the timing criteria. At a minimum consider safety performance needs, projected bicycle volume, motor vehicle volume, traffic delay, roadway grade and the types of bicyclists using the intersection that may require more time to clear the intersection. Consider the installation of effective loop detectors or other methods of detecting a bicycle within the bike lane (in advance of the intersection) and turn lanes. Select detectors sensitive enough to detect bicycles and use a bike detector symbol to identify detector presence.

Push button actuators may also be used to facilitate movement of bicyclists through a signalized intersection. However, requiring bicyclists to go out of their way to use push button actuators may create motor vehicle driver confusion of the bicyclists intended path through the intersection, as well as inconveniencing the bicyclist. If pushbutton actuators are used, consider their position relative to the bike facility. Pushbutton actuators are more effective when the bike facility is adjacent to the curb (curb extensions at intersections can create this environment). Consider an additional push button actuator for the exclusive use of cyclists when positioning of the actuator is in conflict with ADA design requirements (see Chapter 1510). For additional guidance on signal design, see Chapter 1330.

1520.04(4)(a) Bike Signals

Intersections with separated bike lanes, other complex multimodal intersection treatments or those with a specific baseline need to increase bicycle user safety performance may incorporate a dedicated bike signal head with detection or actuation systems. Bike signal heads further separate modal user movements at intersections, while also allowing for priority to cyclists at intersections. Contact the Region Traffic Engineer for approval for application of this treatment.

At the time of this publication, bike signal faces are subject to requirements of FHWA Interim Approval IA-16.

1520.04(5) Median Diverter

A median diverter prohibits drivers at side street approaches from traveling straight or left at an intersection and drivers on the mainline from turning left while still allowing pedestrian and bicyclists to cross. Median diverters can also provide refuge for pedestrians and bicyclists at a multi-stage crossing. The channelization reduces cut through traffic to create lower vehicular volume facilities and improve pedestrian and bicyclist comfort while also allowing pedestrians and bicyclists to cross one direction of vehicle traffic at a time.

Consider a median diverter when one or more of the following occurs:

- Bike facilities cross a roadway with median restricted left turns.
- Neighborhood greenways
- Used on the cross street.
- There is a performance need to restrict motor vehicle through traffic on a bike route.

Exhibit 1520-13 shows an example of a median diverter designed to accommodate bicyclist through traffic. Design refuge areas between 4 and 5 feet wide (longitudinally with respect to the median), additional width may be needed if high volumes of cyclists exist or are anticipated at the crossing. It is best to provide separate cut-throughs in the median for each direction of bicycle traffic in order to preserve the diverter function of the median.

However, if the bi-directional bicycle movement is accommodated by a single median cut-through, a tubular marker or other treatment may be needed in the center of the cut-through in order to enforce the diverter function of the median.

Consider the types of cyclists and destinations when determining the median refuge length (lateral dimension with respect to the median) to adequately store the bicycle. Consider what locations may need to accommodate the length of a bicycle and trailer. The refuge area is to be in alignment with the approach and receiving lanes of the crossroad. In other situations, the median refuge island may be designed for both pedestrians and bicycle users. When this is the case, design the median refuge predominately for the pedestrian as with midblock crossings (See Chapter 1510), note that additional lateral and longitudinal dimensions will be necessary.

1520.05 Additional Bicycle Design Requirements and Considerations

1520.05(1) Signing and Pavement Markings

Use the MUTCD and the *Standard Plans* for signing and pavement marking criteria. (See Chapter 1020 for additional information on signing and Chapter 1030 for information on pavement markings). Pavement marking and signing options for bicycle facilities are rapidly changing. Situations may exist where unique project concerns may necessitate innovative pavement markings or signage. Consult, as appropriate, the Federal Highway Administration (FHWA) MUTCD website for bicycle facilities for a listing of the current status of bicycle-related pavement markings and treatments:
www.fhwa.dot.gov/environment/bicycle_pedestrian/guidance/mutcd/index.cfm

HQ Transportation Operations Division approval is necessary for traffic control devices not currently approved for use through the MUTCD.

1520.05(1)(a) Green Pavement Marking – Criteria for Consideration

Green-colored pavement markings are a traffic control device that's used as a supplemental treatment for standard striping configurations for bicycle facilities. Green colored pavement markings are used to help mitigate the effects of conflicts between cyclists and other design users, areas where other design users are intended to yield to cyclists, provide corridor or network continuity, and help prevent non-bicycle uses (such as vehicle parking).

The use of green colored pavement for bike lanes is permitted throughout the state of Washington under FHWA approval number IA-14.20. Additional information regarding the use and application of green colored pavement for bike lanes is found in FHWA Interim Approval IA-14.

The below criteria are provided when evaluating the need to apply green colored pavement markings.

1. Existing Bike Facilities – retrofitting an existing facility with green pavement may be considered when two or more of the following apply:
    a. It is the engineering judgment of the Region Traffic Engineer
    b. There is an existing traffic conflict area, such as bike lane crossing a motor vehicle turn lane, and there are one or more observed motor vehicle and bicyclist crashes in the last 5 years.
    c. The bike mode is a modal priority (see Chapter 1103), and there is a baseline or contextual need identified associated with increasing safety performance of the mode.
    d. When a bike route intersects a multilane highway, and the crossing is neither signalized nor a roundabout.

2. Changing of Bike Facility Type –consider green pavement markings when one or more of the following apply:
    a. It is the engineering judgment of the Region Traffic Engineer.
    b. A transition from a separated facility through a functional intersection or interchange area necessitates additional delineation to create a clear, visible, predictable and distinct travel path for bike users, and a bike signal or actuation device is not used.
    c. The facility type change does not substantively alter the configuration of an existing conflict area, and there are one or more observed motor vehicle and bicyclist crashes in the last 5 years at that conflict area.
3. New Bike Facility – Generally, the immediate application of green colored pavement on a new bike facility is discouraged until the need for increased safety performance is demonstrated. This said, consider green colored pavement when two or more of the following conditions exist:
    a. It is the engineering judgment of the Region Traffic Engineer
    b. The bike mode is a modal priority (see Chapter 1103), and there is a baseline or contextual need in which the application of green colored pavement markings is needed to meet the stated modal safety performance target (see Chapter 1101).
    c. The bike facility nodes and/or crossings are within 1 mile of activity centers, such as schools, libraries, colleges, etc.
    d. The bike facility crosses a motor vehicle free right turn to or from an interchange ramp.
    e. The bike facility is a bike route or bike boulevard (for definition, see NACTO's *Urban Bikeway Design Guide*).
    f. The state route is also a city street, and the city policy or municipal code requires green colored pavement markings as their standard.
    g. The bike facility is raised and curb separated, and the city engineer requests green colored pavement markings at either crossings or conflict areas.

1520.05(1)(b) Green Pavement Marking – Configuration

Use green pavement markings to supplement the conventional white bike lane striping as required by the MUTCD and FHWA IA-14. Apply green colored pavement markings in conflict areas where bike lanes cross driveways and intersections. If closely spaced conflict areas exist, it may be appropriate to carry solid green into the next conflict area as determined by the Region Traffic Engineer. Additional configurations or styles exist for the application of green colored pavement and can be used with the approval of HQ Transportation Operations Division. Consider specifically when bike route continuity with a local agency's bike facilities is a concern.

1520.05(2) Drainage Grates and Manhole Covers

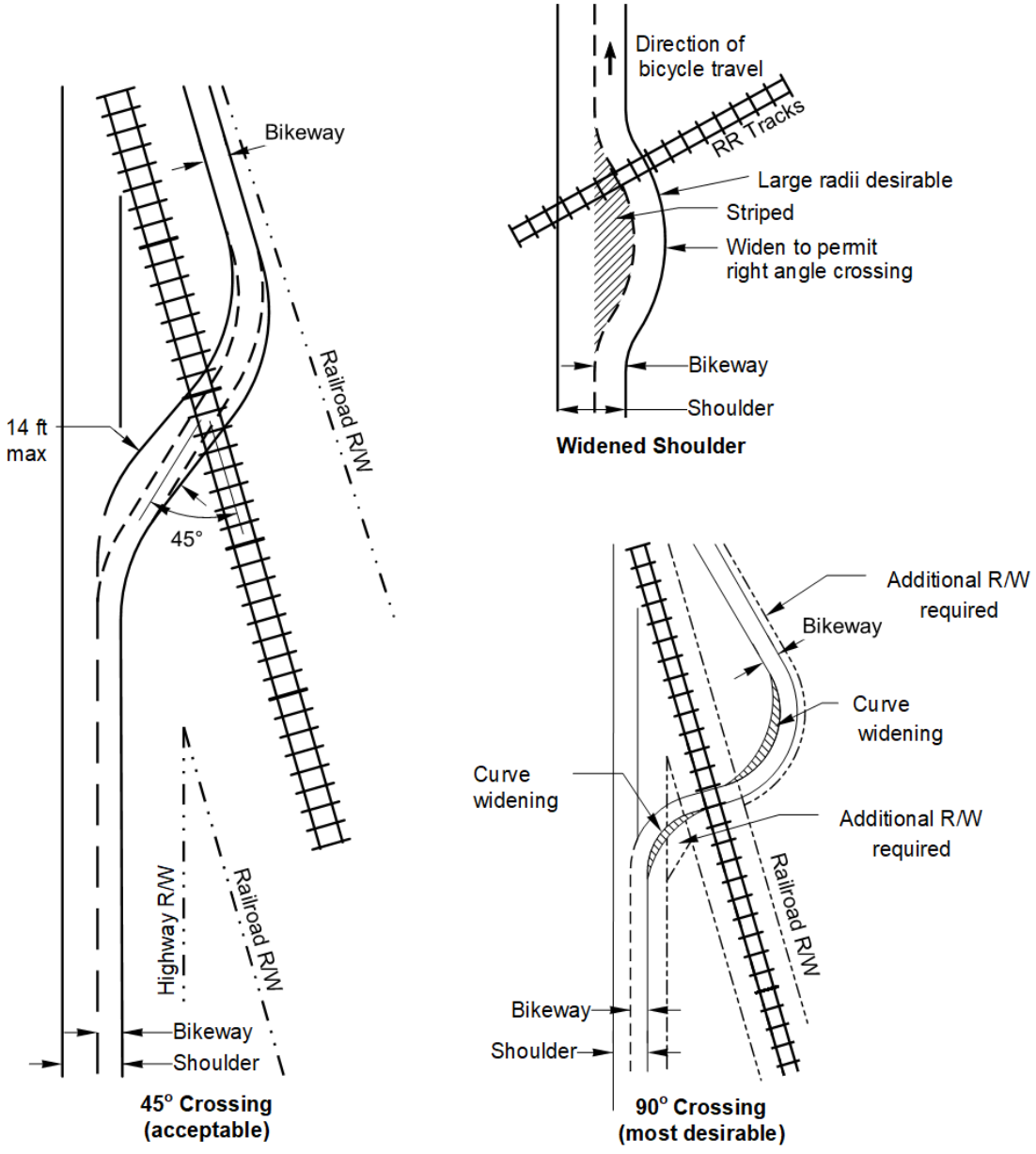
Locate drainage inlet grates and manhole covers to avoid bike lanes. When drainage grates or manhole covers are located in a bike lane, minimize the effect on bicyclists. Consider providing 3 feet of lateral clearance between the edge of a drainage inlet grate and the bike lane stripe, when practicable. Install and maintain grates and manhole covers level with the surface of the bike lane.

Provide drainage inlet grates on bicycle facilities that have openings narrow enough and short enough that bicycle tires will not drop into the grates. Replace existing grates that are not designed for bicycles: a WSDOT vanned grate, herringbone grate, or other grate with an opening 4 inches or less center to center and perpendicular to the direction of travel.

1520.05(3) At-Grade Railroad Crossings

Whenever a bike lane crosses railroad tracks, continue the crossing at least as wide as the bike lane. Use special construction and materials to keep the flangeway depth and width to a minimum. Wherever possible, design the crossing at right angles to the rails. Where a skew is unavoidable, widen the shoulder or bike lane, to permit bicyclists to cross at right angles. Exhibit 1520-14 shows options and details to consider for at-grade railroad crossings.

Exhibit 1520-14 At-Grade Railroad Crossings



Notes:

- Provide additional width at railroad crossings to allow bicyclists to choose their own crossing routes.
- When pedestrians are provided for, design as a shared-use path (see Chapter 1510 and Chapter 1515).

1520.05(4) Barrier, Railing, Fence, or Wall

When the edge of the bike lane is within 5 feet of a vertical object like a barrier, railing, fence, or wall, provide a minimum object height a of 42 inches or more to reduce the potential for bicyclists to fall over the object.

Where bicycle speeds are likely to be high (such as on a downgrade), where high winds are typical (such as on bridges), or where a bicyclist could impact a barrier, railing, fence, or wall at a 25-degree or greater angle (such as on a curve or an angle point in the alignment), a higher 48 in. to 54 in. continuous vertical element may be considered to account for the higher center of gravity of a bicycle rider. If the object is needed for bicycle fall protection because of a vertical drop of 30 inches or greater, or on a bridge the minimum height of the vertical object is 54". If the object is concrete barrier, consider using or converting to single slope barrier to alleviate conflicts with the barrier and bicycle pedal movement that can occur with other barrier designs.

On existing structures, the bridge railing type and height are part of the structure design. Contact the HQ Bridge and Structures Office for additional information. (See Section 1610.07 for further considerations.)

1520.05(5) Transit Considerations

Transit and bicycle facilities can generate unique conflicts because of their typical position within the geometric cross section of the traveled way zone. Where public transport and cycling facilities meet, an integrated design that does not inconvenience either mode is desirable to meet the performance needs of these modes. Consider the following:

- Route the bike lane behind the transit stop location using a raised bike lane or outer separation for that spot location. Ensure the resulting outer separation provided for the transit stop meets the Americans with Disabilities Act (ADA) requirements (see Chapter 1510). Ensure signing and pavement markings are used to alert cyclists and pedestrians of the conflict area created with this design.
- Provide additional delineation in the bike lane to highlight the pedestrian and cyclist conflict, when separated buffered bike lanes and in-lane transit stops are used. Bus loading and other conflict areas will need to meet ADA requirements (see Chapter 1510) and those of the transit agency.
- Where bus operating speeds are low, consider a bus-bicycle shared lane with the transit agency.

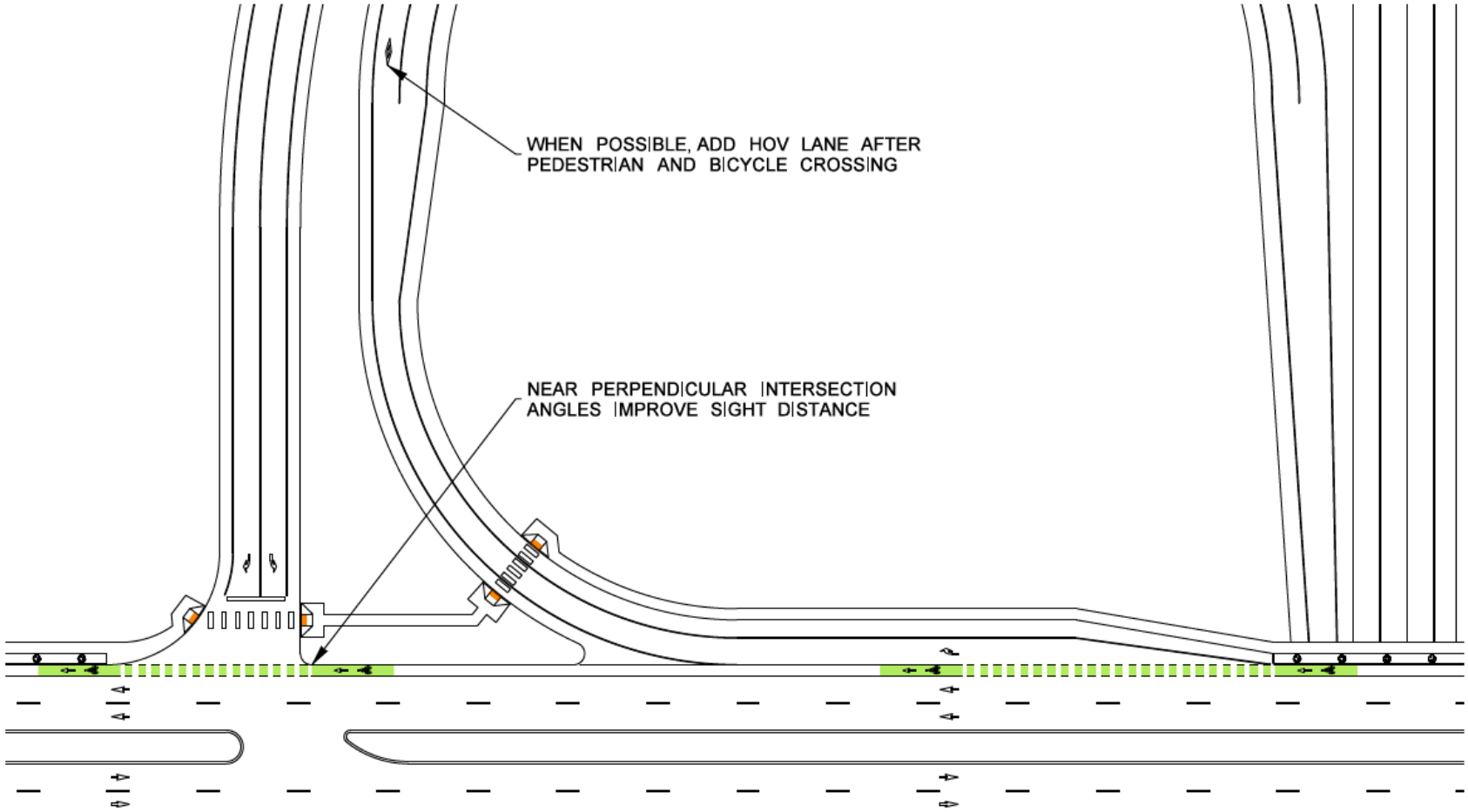
Consider providing bicycle parking facilities near public transportation stops to improve accessibility performance needs.

1520.05(6) Interchange Considerations

Crossing bicycle facilities through an interchange functional area has a greater potential for conflict because of higher travel speeds and lane configurations. Interchange crossings designed in a manner similar to intersection crossings are more compatible to bicyclists. Exhibit 1520-15 through Exhibit 1520-18 illustrate design options for bike facilities design through an interchange functional area. Interchanges can be special environments to evaluate the safety and mobility needs of the bike mode. The specific challenge is often the inclusion of motor vehicle free right turns to or from interchange ramps. The preferred configuration for bicycle safety performance at an interchange will not provide the motor vehicle free right turn and will realign ramps to intersect perpendicular with the crossroad (see off ramp terminal in Exhibit 1520-16).

In some cases, it is possible to align the bike facility to cross an off ramp with a more direct path for the bike crossing (see Exhibit 1520-18). Breaking up the workload for the motor vehicle driver is one advantage of this configuration, similar to pedestrian treatments common in roundabout design. Shortening the crossing distance required for the bicyclist is another advantage with this configuration. Consider the inclusion of Rectangular Rapid Flashing Beacons (RRFB) or a refuge island when there are multiple travel lanes. This configuration may also require additional speed management (see Section 1103.05(2), signing or striping treatments on the ramp.

Exhibit 1520-15 Bike Facility Crossing On- and Off-Ramps

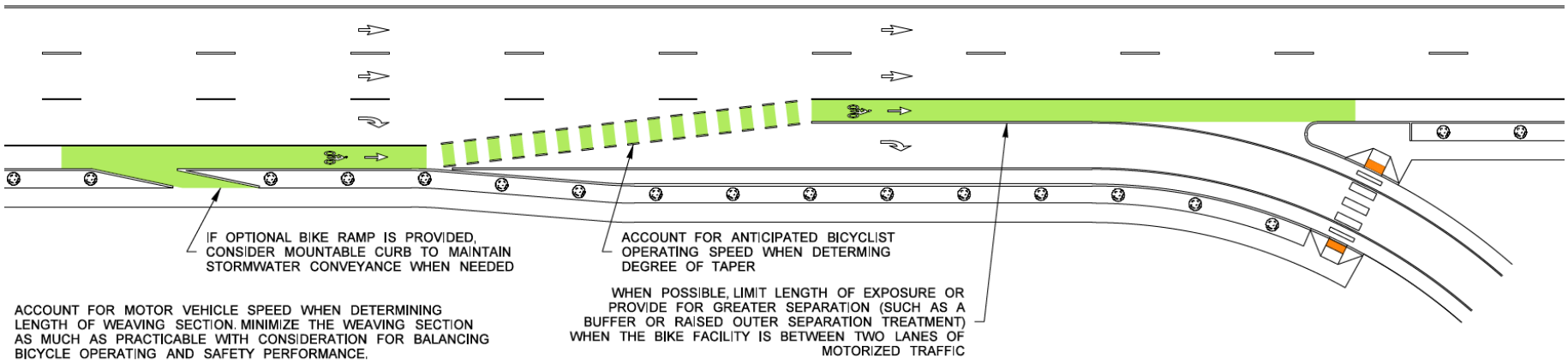


Notes:

Adapted from the Draft Recommended Design Guidelines to Accommodate Pedestrians and Bicycles at Interchanges, ITE, unpublished.

This exhibit is intended to illustrate options for bike facilities through interchange areas, and not intended to represent recommended practice for any other features including ADA criteria (See Chapter 1510 for ADA and pedestrian design).

Exhibit 1520-16 Bicycle Facility Crossing Single-Lane On-Ramp



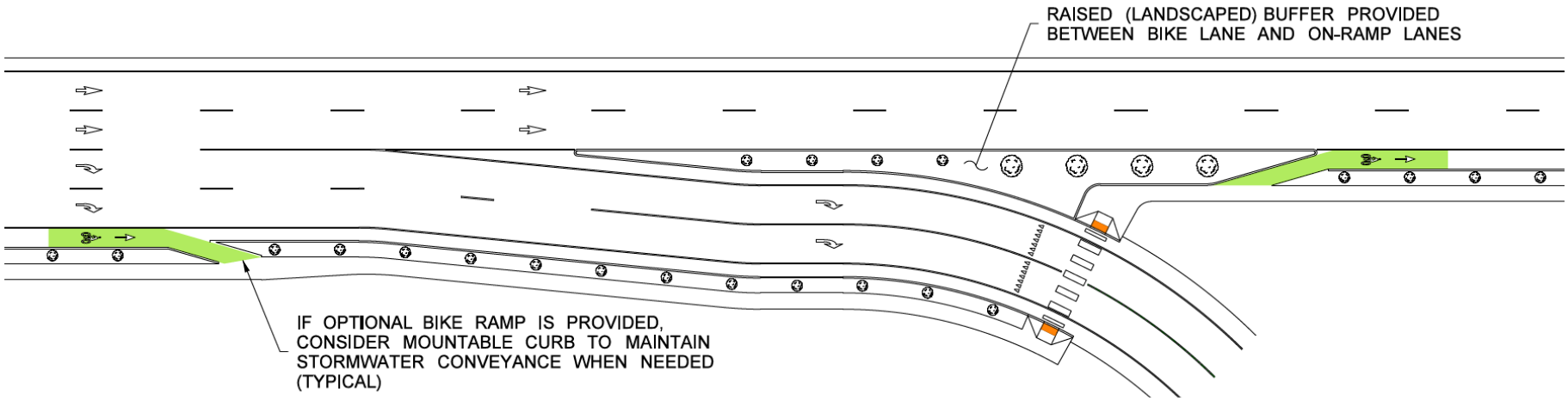
Notes:

Adapted from the Draft Recommended Design Guidelines to Accommodate Pedestrians and Bicycles at Interchanges, ITE, unpublished.

This exhibit is intended to illustrate options for bike facilities through interchange areas, and not intended to represent recommended practice for any other features including ADA criteria (See Chapter 1510 for ADA and pedestrian design).

Consider both the speed of motorized vehicles and bicyclists when determining the length of weave and degree of taper for the bike lane.

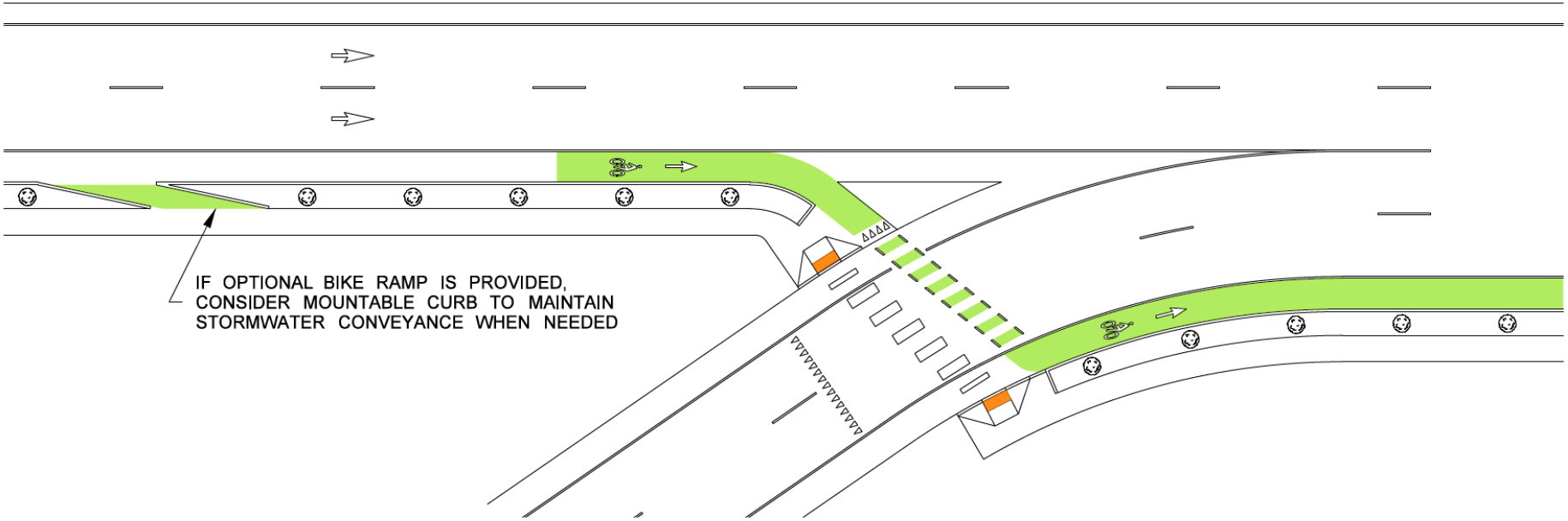
Exhibit 1520-17 Bicycle Facility Crossing Option for Dual Lane On-Ramp Configuration



Notes:

- Adapted from the Draft Recommended Design Guidelines to Accommodate Pedestrians and Bicycles at Interchanges, ITE, unpublished.
- This exhibit is intended to illustrate options for bike facilities through interchange areas, and not intended to represent recommended practice for any other features including ADA criteria (See Chapter 1510 for ADA and pedestrian design).

Exhibit 1520-18 Bicycle Facility Crossing Option for Dual Off-Ramp



Notes:

- Adapted from the Draft Recommended Design Guidelines to Accommodate Pedestrians and Bicycles at Interchanges, ITE, unpublished
- This exhibit is intended to illustrate options for bike facilities through interchange areas, and not intended to represent recommended practice for any other features including ADA criteria (See Chapter 1510 for ADA and pedestrian design).

1520.05(7) Sight Triangles at Intersections and Conflict Areas

The visibility of all users is to be evaluated at intersections. Identifying sight triangles can help determine the optimal configuration of bicycle and pedestrian crossings. See Chapter 1310 for determining sight distance at an intersection, and Chapter 1340 for sight distance at road approaches near midblock crossings. Visibility is impacted by both speed and the configuration of the intersection. There are multiple benefits in multimodal intersection configurations to proactively manage motorized vehicle speeds (see Chapter 1103 for speed reducing traffic calming treatments) at intersection locations, rather than widening the intersection and/or removing elements from the roadside or streetside zone to obtain the needed sight distance. The primary objective at intersections and interchanges is to create a clear, distinct, and predictable travel path for all users through the intersection.

1520.05(8) Maintenance Considerations

Consult with all maintenance jurisdictions for partnering opportunities and clearly understand which jurisdiction will be responsible for specific elements of the bike facility maintenance. Some maintenance jurisdictions may be better equipped to maintain the bike facility than others. Certain bike facilities, like the raised and curb separated, clearly fall within the jurisdictional authority of an incorporated city (see Chapter 1103 and Chapter 1600 for more information). For other facility types it may be more advantageous to discuss the capabilities of each maintenance jurisdiction and develop a maintenance agreement (see Chapter 301).

It is important to obtain information from maintenance regarding the facility type and dimensioning and discuss methods for maintaining the facility. The Maintenance Owner's Manual (See Chapter 301) is suggested to contain frequency, equipment needs and material types necessary for the continual maintenance of facility features, including but not limited to:

- Sweeping
- Snow removal
- Striping and pavement markings
- Signing

1520.06 Documentation

Document the type of bike facility employed or changed in section 5 of the Basis of Design. Dimensions chosen for the facility are documented on design parameter sheets.

1520.07 References

1520.07(1) Federal/State Laws and Codes

Americans with Disabilities Act of 1990 (ADA)

23 Code of Federal Regulations (CFR) Part 652, Pedestrian and Bicycle Accommodations and Projects

Revised Code of Washington (RCW), Chapter 35.75, Streets – Bicycles – Paths

http://apps.leg.wa.gov/rcw/default.aspx?cite=35.75

RCW 46.04, Definitions

http://apps.leg.wa.gov/rcw/default.aspx?cite=46.04

RCW 46.61, Rules of the road

http://apps.leg.wa.gov/rcw/default.aspx?cite=46.61\

RCW 46.61.710, Mopeds, electric-assisted bicycles – General requirements and operation

http://apps.leg.wa.gov/rcw/default.aspx?cite=46.61.710

RCW 47.26.300, Bicycle routes – Legislative declaration

http://apps.leg.wa.gov/rcw/default.aspx?cite=47.26.300

1520.07(2) Supporting Information

Urban Bikeway Design Guide, NACTO, current edition (WSDOT endorsed)

http://nacto.org/publication/urban-bikeway-design-guide/

Guide for the Development of Bicycle Facilities, AASHTO, current edition

https://bookstore.transportation.org/collection_detail.aspx?ID=116

Separated Bike Lane Planning and Design Guide, FHWA, current edition

www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/separated_bikelane_pdg/page00.cfm

Bicycle Parking Guidelines, Association of Pedestrian and Bicycle Professionals, current edition

www.apbp.org/?page=Publications

Manual on Uniform Traffic Control Devices for Streets and Highways, USDOT, FHWA; as adopted and modified by Chapter 468-95 WAC "Manual on uniform traffic control devices for streets and highways" (MUTCD)

www.wsdot.wa.gov/publications/manuals/mutcd.htm

Standard Plans for Road, Bridge, and Municipal Construction (Standard Plans), M 21-01, WSDOT

www.wsdot.wa.gov/publications/manuals/m21-01.htm

Understanding Flexibility in Transportation Design – Washington, WSDOT, 2005

www.wsdot.wa.gov/research/reports/600/638.1.htm

Selecting Roadway Design Treatments to Accommodate Bicycles, USDOT, Federal Highway Administration (FHWA), 1994

NCHRP Report 766: Recommended Bicycle Lane Widths for Various Roadway Characteristics, Transportation Research Board of the National Academies, 2014

http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_766.pdf

NCHRP Report 500 Volume 18: A Guide for Reducing Collisions Involving Bicycles, Transportation Research Board of the National Academies, 2006

http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_500v18.pdf

Four Types of Cyclists?, Dill, Jennifer, and Nathan McNeil, Transportation Research Record: Journal of the Transportation Research Board 2387.1 (2013): 129-138.

Recommended Design Guidelines to Accommodate Pedestrians and Bicycles at Interchanges, ITE, unpublished.

http://ecommerce.ite.org/IMIS/ItemDetail?iProductCode=RP-039

Montgomery County Bicycle Planning Guidance, Montgomery County Department of Transportation, 2014.

www.montgomeryplanning.org/transportation/bikeways/documents/FINALBicyclePlanningGuidance.pdf

Separated Bike Lane Planning and Design Guide, Massachusetts Department of Transportation (MassDOT), 2015

Separated Bike Lane Planning & Design Guide | Mass.gov