AASHTO Bike Guide Webinar Series (Part 2)

Design Principles of High Comfort Bikeways

Jeremy Chrzan Toole Design

AASHTO Bike Guide Webinar Series

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Evolution of Bicycle Infrastructure and the AASHTO Bike Guide

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Design Principles

Webinar 2

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Owner | Multimodal Design Practice Lead
TOOLE DESIGN

July 31, 2025

2012 Guide compared to 2024 Guide

2012 Guide	2024 Guide	Notable Changes of 2024 compared to 2012
Chapter 1. Introduction	1. Introduction	REWRITE with new discussion of design range concept
Chapter 3. Bicycle Operation and Safety	2. Bicycle Operation & Safety	REWRITE of former Chapter 3
Chapter 2. Bicycle Planning	3. Bicycle Planning	REWRITE and NEW CONTENT added to former Chapter 2
	4. Facility Selection	NEW CHAPTER with a few items carried from Chapter 2
	5. Elements of Design	NEW CHAPTER with some content pulled from Chapters 4 and 5
Chapter 5. Design of Shared Use Paths	6. Shared Use Paths	REVISION of Chapter 5
	7. Separated Bike Lanes	NEW CHAPTER with new content
	8. Bicycle Boulevards	NEW CHAPTER with new content
Chapter 4. Design of On-Road Facilities	9. Bike Lanes & Shared Lanes	REVISION of Chapter 4
	10. Traffic Signals and Active Warning Devices	NEW CHAPTER with new content
	11. Roundabouts, Interchanges, and Alternative Intersections	NEW CHAPTER with new content
	12. Rural Area Bikeways	NEW CHAPTER with some content pulled from Chapter 4
	13. Structures	NEW CHAPTER with some content pulled from Chapter 5
	14. Wayfinding	NEW CHAPTER with some content pulled from Chapter 4
Chapter 7. Maintenance and Operations	15. Maintenance & Operations	REVISION of chapter 7
Chapter 6. Bicycle Parking Facilities	16. Parking, Bike Share, & End of Trip Facilities	REVISION of chapter 6

Chapter 5 – Elements of Design

5.5.2. Stopping Sight Distance

Tables provided for:

- Unexpected Conflict, 2.5 second PRT
- Expected Conflict, 1.5 second PRT

Table 5-2: Minimum Bicyclist Stopping Sight Distance vs. Grades for Various Design Speeds—2.5-Second Reaction Time

Stopping Sight Distance (ft) Based on Speed and Grade for a 2.5-Second Perception-Reaction Time											
Speed (mph)	Grade (Positive indicates ascending)										
	–10%	–8%	–6%	–4%	–2%	0	2%	4%	6%	8%	10%
10				65	61	58	55	53	52	51	50
11				74	69	66	63	61	59	57	56
12				84	78	74	71	68	66	64	62
15			130	118	109	102	97	93	89	86	84
18	246	201	174	156	143	134	126	120	115	111	108
20	296	240	207	185	169	157	148	140	134	129	
25	440	353	300	266	241	222	208	196	187		
30	611	486	411	361	325	298	277	260			

Note: Calculations are assumed under wet conditions.

Table 5-3: Minimum Bicyclist Stopping Sight Distance vs. Grades for Various Design Speeds—1.5-Second Reaction Time

Stopping Sight Distance (ft) Based on Speed and Grade for a 1.5-Second Perception-Reaction Time											
Speed (mph)	Grade (Positive indicates ascending)										
	–10%	–8%	–6%	–4%	–2%	0	2%	4%	6%	8%	10%
10%				50	46	43	41	39	37	36	35
11				58	53	49	47	44	43	41	40
12				66	61	56	53	50	48	46	45
15			108	96	87	80	75	71	67	64	62
18	220	175	148	130	117	107	100	94	89	85	81
20	267	211	178	155	139	128	118	111	105	100	
25	403	316	264	229	204	185	171	159	150		
30	567	442	367	317	281	254	233	216			

Note: Calculations are assumed under wet conditions.

5.5.4.1 Sight Distance and Approach Clear Space for Bikeways at Roadway *Intersections*

- **Turning Motorist Yields to (or Stops for) Through Bicyclists**—When a through moving bicyclist arrives or will arrive at the crossing prior to a turning motorist, the motorist must stop or yield to the through bicyclist. For locations where bicyclists are operating on separated bike lanes, sidewalks, and side paths, vertical elements near the intersection, including on-street parking, should be set back sufficiently for the motorist to see the approaching bicyclist and provide sufficient time to slow or stop before the conflict point.
- **Through Bicyclist Yields to (or Stops for) Turning Motorist**—When a turning motorist arrives or will arrive at the crossing prior to a through moving bicyclist, the bicyclist must stop or yield. A variation of this scenario can occur when a bicyclist approaches after a motorist has yielded to other people crossing in the intersection and the crossing is clear for the motorist to proceed. The motorist may begin turning as the bicyclist approaches, requiring the bicyclist to slow and potentially stop while the motorist completes the turning movement.
- **User with Right-of-Way Yields to (or Stops for) Another User**—Sometimes the user who has the right-of-way will yield the right-of-way to another user, such as a pedestrian or bicyclist slowing or stopping if they are concerned that a motorist will not stop, or a motorist slowing or stopping as a courtesy to allow a bicyclist or pedestrian that they see approaching the intersection to cross. The provision of the noted sight distances and approach clear spaces will provide the opportunity for this behavior to occur.

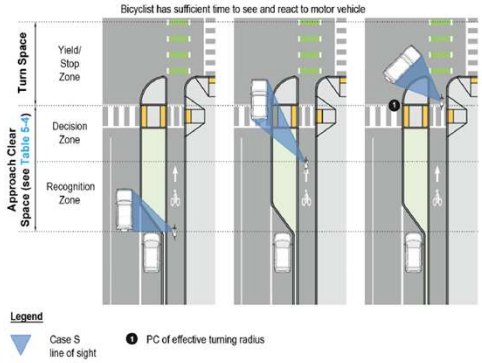


Figure 5-1: Intersection Sight Distance: Case S

5.5.4.1.1 Case S – Right-Turning Motorist Across Separated Bike Lane or Side Path

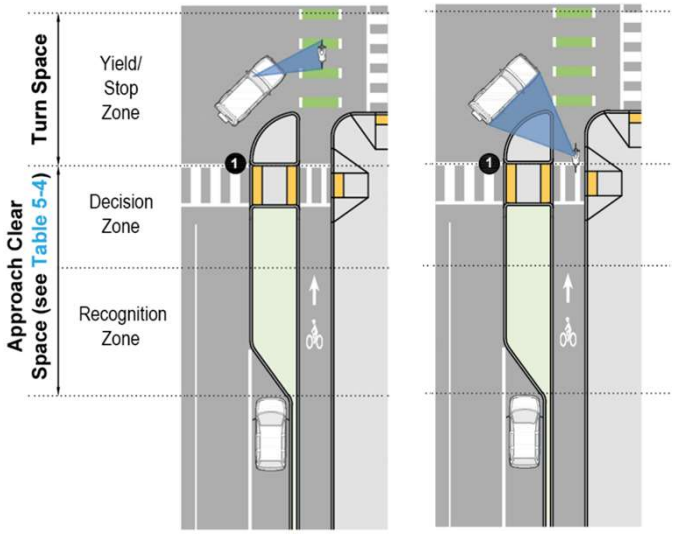
Table 5-4: Recommended Intersection Approach Clear Space by Vehicular Turning Design Speed

Effective Vehicle Turning Radius	Vehicular Turning Speed	Recommended Approach Clear Space
<18 ft	<10 mph[a]	20 ft
18 ft	10 mph	40 ft
25 ft	15 mph	50 ft
30 ft	20 mph	60 ft
>30 ft	25 mph	70 ft

[a] Most low-volume driveways and alleys

legend

line of sight



5.5.4.1.3 Case U1 – Through Motorist Crossing of a Separated Bike Lane or Shared Use Path

- at a minimum the **provision of stopping sight distance for bicyclists should be provided** to allow a bicyclist to slow or stop if a vehicle encroaches into the separated bike lane or side path

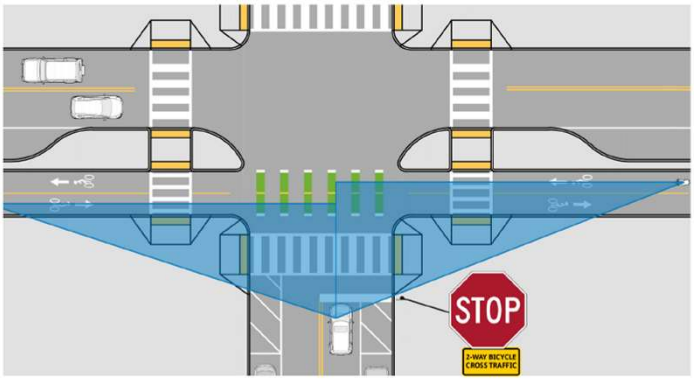
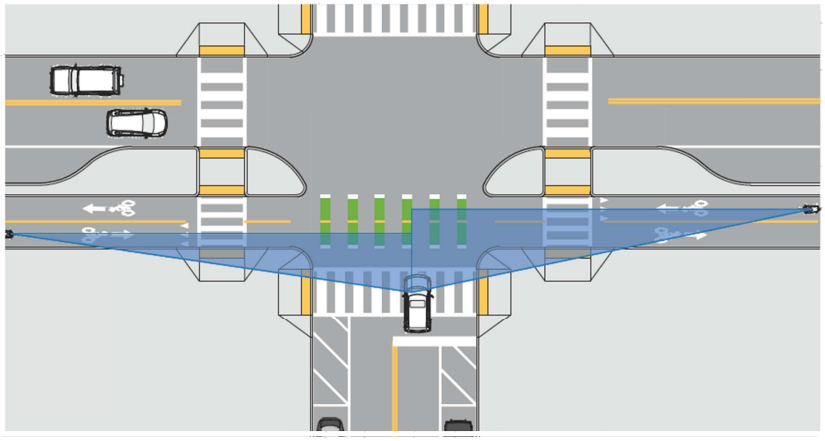


Figure 5-3: Intersection Sight Distance: Case U1

7.9.5 Case U1 – Multistep Variant



Chapter 7 sight distance

- Driver looks for pedestrians, then moves forward
- Driver looks for bicyclists, then moves forward
- Driver looks for other motorists, then proceeds

5.5.4.1.3.3 U3 – Mid-Block Shared Use Path Crossing of an Uncontrolled Roadway

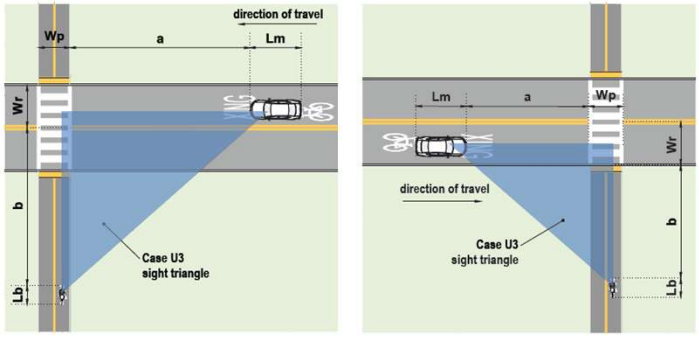


Figure 5-5: Sight Triangle for Uncontrolled Mid-Block Path Crossing of an Uncontrolled Roadway: Case U3

Table 5-8: Length of Path and Roadway Sight Triangle for Uncontrolled Crossings: Case U3

Length of Path and Roadway Sight Triangle (ft) - Case U3						
Bike Speed (mph)	Roadway Speed (mph)					
	15	20	25	30	35	40
10	96 / 58	128 / 59	160 / 63	192 / 68	224 / 74	255 / 81
11	97 / 64	129 / 65	162 / 69	194 / 75	226 / 82	258 / 89
12	98 / 70	131 / 70	164 / 75	197 / 82	230 / 89	262 / 97
15	105 / 87	140 / 88	174 / 94	209 / 102	244 / 111	279 / 122
18	112 / 105	150 / 106	187 / 113	225 / 122	262 / 134	300 / 146
20	118 / 116	157 / 117	197 / 125	236 / 136	275 / 149	315 / 162
25	133 / 145	178 / 147	222 / 156	266 / 170	311 / 186	355 / 203
30	149 / 174	199 / 176	249 / 188	298 / 204	348 / 223	398 / 244

a / b
a = sight distance (ft) along roadway
b = sight distance (ft) along path

Assumptions: Bicycle reaction time = 1.5 seconds
Width of path = 10 ft to 11 ft
Width of road lane = 11 ft to 12 ft
Length of bicycle = 6 ft
Length of motor vehicle = 18 ft
Grade = –2 percent to +2 percent

5.5.4.3 Sight Distance at Horizontal Curves

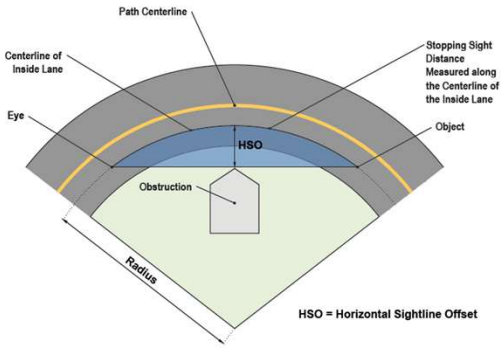


Figure 5-10: Diagram Illustrating Components for Determining Horizontal Sightline Offset

Table 5-11: Horizontal Sightline Offset Look-Up

Minimum Lateral Clearance (Horizontal Sightline Offset or HSO) for Horizontal Curves (ft)														
R (ft)	S = Stopping Sight Distance (ft)													
	40	60	80	100	120	140	160	180	200	220	240	260	280	300
25	7.6	15.9												
50	3.9	8.7	15.2	23.0	31.9	41.5								
75	2.7	5.9	10.4	16.1	22.8	30.4	38.8	47.8	57.4	67.2				
100		4.5	7.9	12.2	17.5	23.5	30.3	37.8	46.0	54.6	63.8	73.3	83.0	92.9
125		3.6	6.3	9.9	14.1	19.1	24.7	31.0	37.9	45.4	53.3	61.7	70.6	79.7
150		3.0	5.3	8.3	11.8	16.0	20.8	26.2	32.1	38.6	45.5	52.9	60.7	69.0
175		2.6	4.6	7.1	10.2	13.8	18.0	22.6	27.8	33.5	39.6	46.1	53.1	60.5
200			4.0	6.2	8.9	12.1	15.8	19.9	24.5	29.5	34.9	40.8	47.0	53.7
225			3.5	5.5	8.0	10.8	14.1	17.8	21.9	26.4	31.3	36.5	42.2	48.2
250			3.2	5.0	7.2	9.7	12.7	16.0	19.7	23.8	28.3	33.1	38.2	43.7
275			2.9	4.5	6.5	8.9	11.6	14.6	18.0	21.7	25.8	30.2	34.9	39.9
300			2.7	4.2	6.0	8.1	10.6	13.4	16.5	19.9	23.7	27.7	32.1	36.7
350				3.6	5.1	7.0	9.1	11.5	14.2	17.1	20.4	23.9	27.6	31.7
400				3.1	4.5	6.1	8.0	10.1	12.4	15.0	17.9	20.9	24.3	27.8
450				2.8	4.0	5.4	7.1	9.0	11.1	13.4	15.9	18.7	21.6	24.8
500				2.5	3.6	4.9	6.4	8.1	10.0	12.1	14.3	16.8	19.5	22.3
600					3.0	4.1	5.3	6.7	8.3	10.1	12.0	14.0	16.3	18.7
700					2.6	3.5	4.6	5.8	7.1	8.6	10.3	12.0	14.0	16.0
800						3.1	4.0	5.1	6.2	7.6	9.0	10.5	12.2	14.0
900						2.7	3.6	4.5	5.6	6.7	8.0	9.4	10.9	12.5
1000							3.2	4.0	5.0	6.0	7.2	8.4	9.8	11.2

Table 5-12: Horizontal Sightline Offset for Horizontal Curves Equation

Horizontal Sight Line Offset for Horizontal Curves Equation

$$HSO = R\left[1 - \cos\left(\frac{28.65S}{R}\right)\right]$$

$$S = \frac{R}{28.65}\left[\cos^{-1}\left(\frac{R - HSO}{R}\right)\right]$$

Where:

S	=	stopping sight distance (ft)
R	=	radius of centerline of lane (ft)
HSO	=	horizontal sightline offset, distance from centerline of lane to obstruction (ft)

Note: Angle is expressed in degrees.

5.8. Intersection Design Objectives

5.8.1. Minimize Exposure to Conflicts

5.8.2. Reduce Speeds at Conflict Points

5.8.3. Communicate Right-of-Way Priority

5.8.4. Providing Adequate Sight Distance

5.8.5. Transitions to Other Facilities

5.8.6. Accommodating Persons with Disabilities

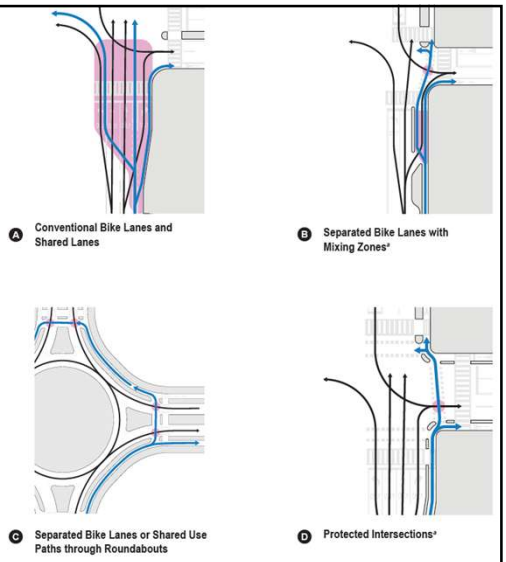


Figure 5-13: Comparison of Bicyclist Exposure to Motor Vehicles at Intersections

5.9.2. Evaluations of Uncontrolled Roadway Approaches to Bicycle Crossings

- 5.9.2.1 Factors That Impact Motorist Yielding Rates
- 5.9.2.2.1 Recommended Crossing Opportunities

Table 5-14: Recommended Minimum Range of Hourly Crossing Opportunities

Major Street Crossings (opportunities per hour)	
Recommended	≥120
Practical Minimum	60 to <120

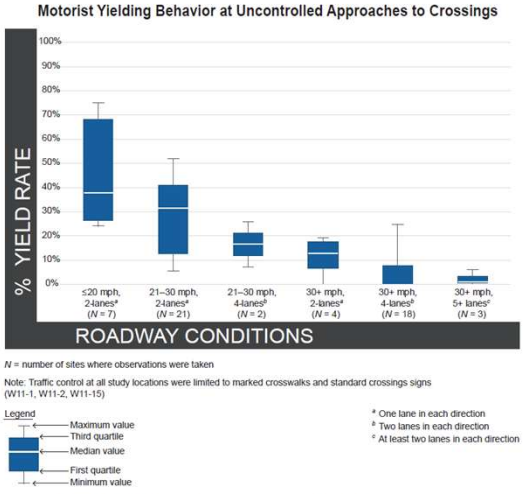


Figure 5-14: Motorist Yielding at Uncontrolled Crossings Based on Roadway Characteristics

5.9.2.3 Apply Countermeasures to Improve Yielding

- Tier 1: Signing & Markings
- Tier 2: RRFB & Geometric Improvements
- Tier 3: PHB, Signal, or Grade Separation

Table 5-15: Uncontrolled Crossing Evaluation

Uncontrolled Crossing Countermeasure Evaluation Table

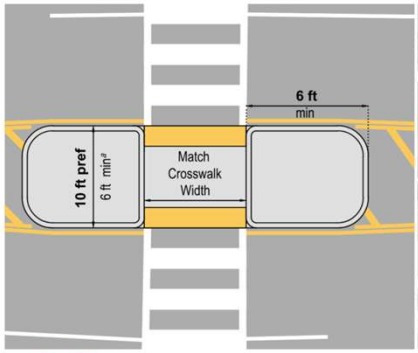
Roadway Type	Vehicle ADT < 9,000			Vehicle ADT 9,000 - 12,000			Vehicle ADT 12,000 - 15,000			Vehicle ADT > 15,000		
Number of Travel Lanes and Median Type	Speed Limit (mph)											
	≤30	35	40≥[a]	≤30	35	40≥[a]	≤30	35	40≥	≤30	35	40≥
2 Lanes[b]	1	1	2	1	1	2	1	1	3	1	2	3
3 Lanes with Raised Median[b]	1	1	2	1	1	2	1	2	3	2	2	3
3 Lanes without Raised Median[b,c]	1	1	2	1	2	2	2	3	3	2	3	3
4 Lanes with Raised Median[c,d]	1	1	2	1	2	2	2	3	3	3	3	3
4+ Lanes without Raised Median	1	2	3	2	2	2	3	3	3	3	3	3

Notes:
[a] Where the speed limit exceeds 40 mph, Tier 3 should be considered.
[b] 1 lane in each direction.
[c] Raised medians must be at least 6 ft wide to serve pedestrians. See Figure 2-4 for different bicycle lengths to serve bicyclists. Where median width is less than these values, review category of 4+ lanes without raised median.
[d] 2 lanes in each direction.

Legend
Tier 1: 1
Tier 2: 2
Tier 3: 3

Section 5.10 – Geometric Design Treatments to Improve Intersection Safety

- **5.10.1 Medians and Pedestrian Refuge Islands; Hardened Centerlines**
- 5.10.2 Curb Extensions
- 5.10.3 Curb Radius
- 5.10.4 Mountable Truck Aprons
- 5.10.5 Raised Crossings
- 5.10.6 Multiple Threat Crossing Treatments
- 5.10.7 Bike Ramps
- 5.10.8 Directional Indicators



[a] See Figure 2-3 for bicycle lengths.

Section 5.10 – Geometric Design Treatments to Improve Intersection Safety

- 5.10.1 Medians and Pedestrian Refuge Islands; Hardened Centerlines
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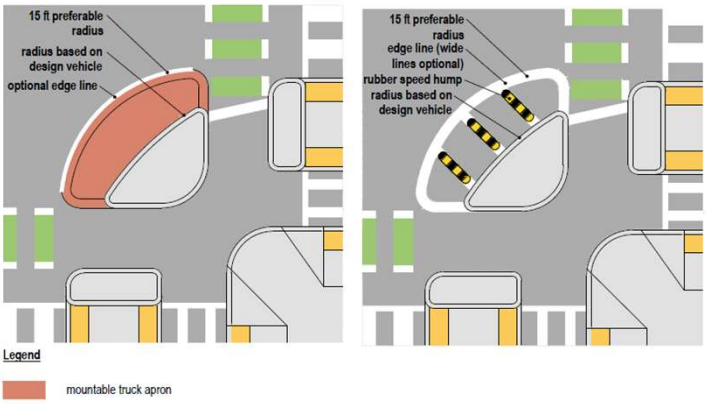

Figure 5-18: Mountable Truck Apron

Curb Radius Decisions vs Design Vehicle

Curb Radius Decisions vs Design Vehicle

Curb Radius Decisions vs Design Vehicle

Section 5.10 – Geometric Design Treatments to Improve Intersection Safety

- 5.10.1 Medians and Pedestrian Refuge Islands; Hardened Centerlines
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- **5.10.8 Directional Indicators**

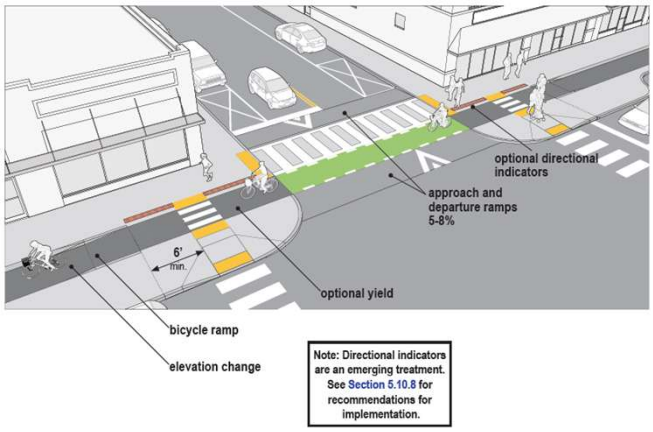


Figure 5-20: Raised Side Street Crossing

Section 5.10 – Geometric Design Treatments to Improve Intersection Safety

5.10.1 Medians and Pedestrian Refuge Islands; Hardened Centerlines

5.10.2 Curb Extensions

5.10.3 Curb Radius

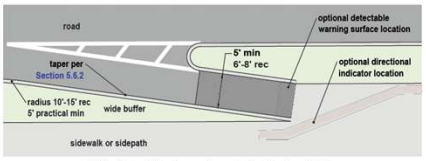
5.10.4 Mountable Truck Aprons

5.10.5 Raised Crossings

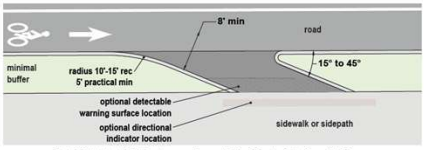
5.10.6 Multiple Threat Crossing Treatments

5.10.7 Bike Ramps

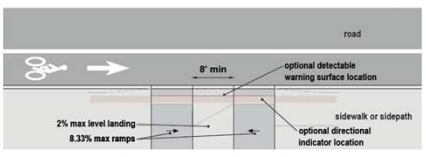
5.10.8 Directional Indicators



Detail 1—Preferred bicycle ramp alignment with wide sidewalk buffer



Detail 2—Lateral shift bicycle ramp alignment with minimal width sidewalk buffer



Detail 3—Parallel bicycle ramp with no sidewalk buffer

Note: All shown locations for detectable warning surfaces and directional indicators are for reference only. See Section 5.10.7 for additional guidance.

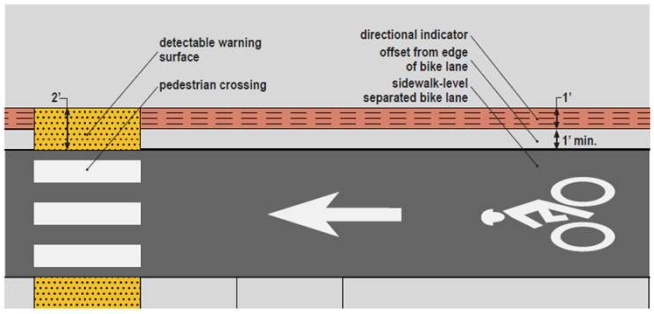
Note: Directional indicators are an emerging treatment. See Section 5.10.8 for recommendations for implementation.

Figure 5-23: Bicycle Ramp Alignments

5.10.8 Directional Indicators

Per ISO 23599 - width of directional indicators (DI) can vary based on use:

- If the DI is perpendicular to the pedestrian path of travel (for example to direct a pedestrian towards a mid-block crossing or transit stop), it must be a minimum width of 2 ft to be detectable.
- If the DI is parallel to the pedestrian path of travel, it can be as narrow as 1 ft.
- At some locations (such as near intersections) pedestrian paths may interact with the DI both parallel and perpendicular, and in these situations the wider width should be used.



Note: Directional indicators are an emerging treatment. See Section 5.10.8 for recommendations for implementation.

Figure 5-24: Sidewalk-Level Separated Bike Lane with Directional Indicator

5.11.5. Turning Vehicles Yield to Pedestrians/Bicyclists Signs

The use of the sign should be limited to the following:

- Crossings where turning motor vehicle volumes exceed 50 vehicles/hour.
- Locations where there is a documented problem with motorists failing to yield.
- Locations with inadequate sight lines and other mitigations are not feasible.
- New installations of left side bicycle lanes or two-way bikeways where counterflow bicycle travel may be unexpected.

A TURNING VEHICLES YIELD TO (or STOP FOR) BICYCLISTS (OR PEDESTRIANS) sign (R10-15 series) that uses a bicycle and pedestrian symbol is an experimental design. Experimental approval from FHWA is required to use this traffic control device (see Figure 5-29). See Section 1.6.1 for guidance on requests to experiment.

Figure 5-29: Turning Vehicles Yield to (or Stop for) Bicyclists Signs

5.12 Pavement Markings

5.12.9. Two-Stage Bicycle Turn Box

5.12.7.2 Bicycle Crossings with Parallel Pedestrian Crossings

Align Bike Crossing Markings with Vehicle Wheel Path and Crosswalk Markings

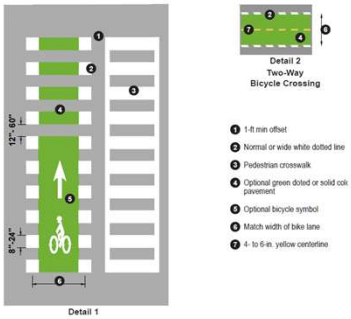


Figure 5-35: Bicycle Crossing Pavement Markings

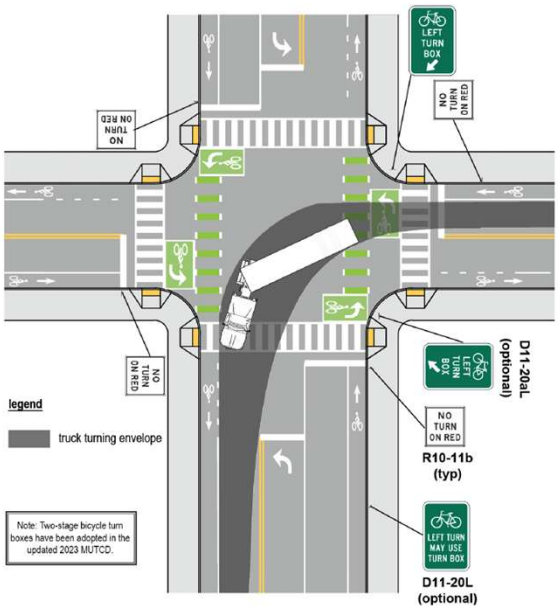


Figure 5-39: Two-Stage Left Turn Box Placement

Chapter 6 – Shared Use Paths

Chapter 6: SUP Width (Two-way)

6.4.3. Recommended Shared Use Path Widths

Table 6-3: Recommended Shared Use Path Widths* to Achieve SUP LOS "C"

Shared Use Path Operating Widths and Operational Lanes*					
SUPLOS "C" Peak Hour Volumes	Recommended Operational Lanes	Practical Minimum	Recommended Lower Limit	Recommended Upper Limit	Practical Maximum
150 to 300	2	8 ft	10 ft	12 ft	13 ft
300 to 500	3	11 ft	12 ft	15 ft	16 ft
500 to >600	4	15 ft	16 ft	20 ft	None

*Typical Mode Split is 55% adult bicyclists, 20% pedestrians, 10% runners, 10% in-line skaters, and 5% child bicyclists

11' wide provides three (3) operational lanes

6.4.2. Shared Use Path Level of Service

Table 6-1: Shared Use Path Operating Conditions Based on Level of Service Criteria

Shared Use Path Level of Service (SUPLOS) and Operating Conditions	
SUPLOS	Peak Operating Conditions
A. Excellent	A significant ability to absorb more users across all modes is available.
B. Good	A moderate ability to absorb more users across all modes is available.
C. Fair	Path is close to functional capacity with minimal ability to absorb more users.
D. Poor	Path is at its functional capacity. Additional users will create operational and safety problems.
E. Very Poor	Path operating beyond its functional capacity resulting in conflicts and people avoiding the path.
F. Failing	Path operating beyond functional capacity resulting in significant conflicts and people avoiding the path.

Table 6-2: Shared Use Path Level of Service Look-Up Table, Typical Mode Split

Shared Use Path Level of Service Look-Up Table, Typical Mode Split*										
Shared Use Path Peak Hour Volume	Shared Use Path Width (ft)									
	8	10	11	12	14	15	16	18	20	≤ 25
50	B	B	B	B	B	A	A	A	A	A
100	D	C	B	B	B	A	A	A	A	A
150	D	C	B	B	B	A	B	A	A	A
200	D	D	C	B	B	A	B	A	A	A
300	E	D	C	C	C	B	B	B	B	A
400	F	E	D	D	C	C	C	B	B	A
500	F	F	D	D	D	C	C	C	C	A
600	F	F	E	E	E	D	D	C	C	A
800	F	F	F	F	F	E	E	E	E	A
1,000	F	F	F	F	F	E	F	F	F	A
≥ 1,200	F	F	F	F	F	F	F	F	F	A

*Assumptions:

1. Mode split is 55 percent adult bicyclists, 20 percent pedestrians, 10 percent runners, 10 percent in-line skaters, and 5 percent child bicyclists.
2. An equal number of trail users travel in each direction (the model uses a 50 percent–50 percent directional split).
3. Trail volume represents the actual number of users counted in the field (the model adjusts this volume based on a peak hour factor of 0.85).
4. Trail has a centerline.

6.4.4. Separation of Pedestrians and Bicyclists

6.4.4.1 Land Use Considerations Where Separation is Desirable

6.4.4.2 Volume Thresholds Where Separation is Desirable

Consider when:

- Level of Service is projected to be at or below level "C."
- Pedestrians anticipated to be 30% or more of the volume

6.4.4.3 Separation Strategies

6.4.4.4 Accessibility Considerations

Figure 6-3: Burke-Gilman Shared Use Path (2008) and Separated Paths (2021), Seattle, WA

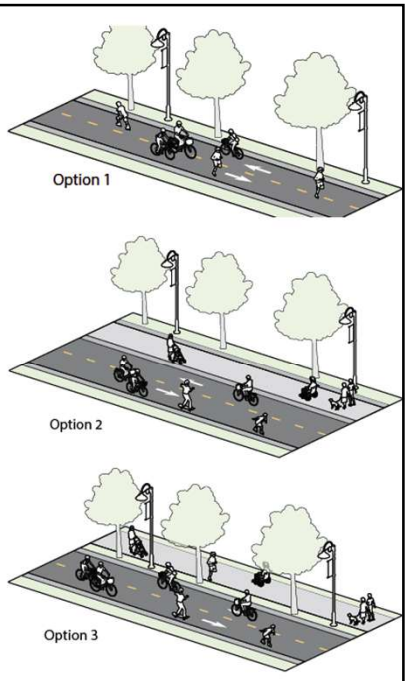


Figure 6-4: Options for Separating Bicyclists and Other Wheeled Users from Pedestrians

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6.3.1. Width and Shy Space Considerations
6.6.3 Horizontal Alignment

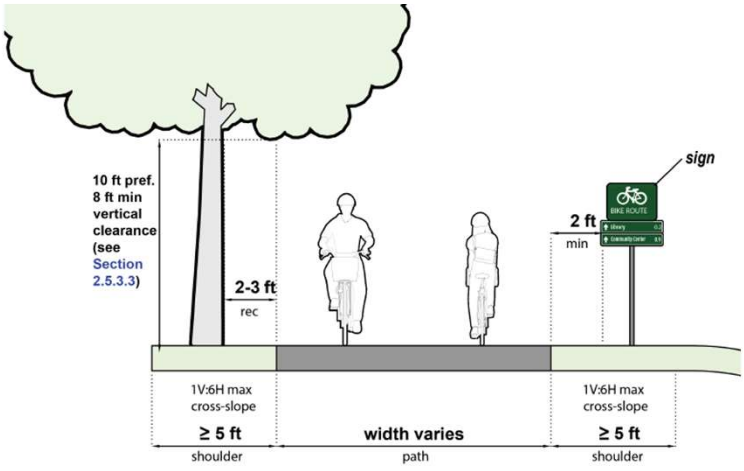

Figure 6-5: Shoulders and Shy Distance on Shared Use Paths

Table 6-5: Minimum Radii for Horizontal Curves at 20-Degree Lean Angles

Design Speed (mph)	Minimum Radii (ft) for Horizontal Curves at 20-Degree Lean Angles
8	12
10	18
12	27
14	36
16	47
18	60
20	74
25	115
30	166

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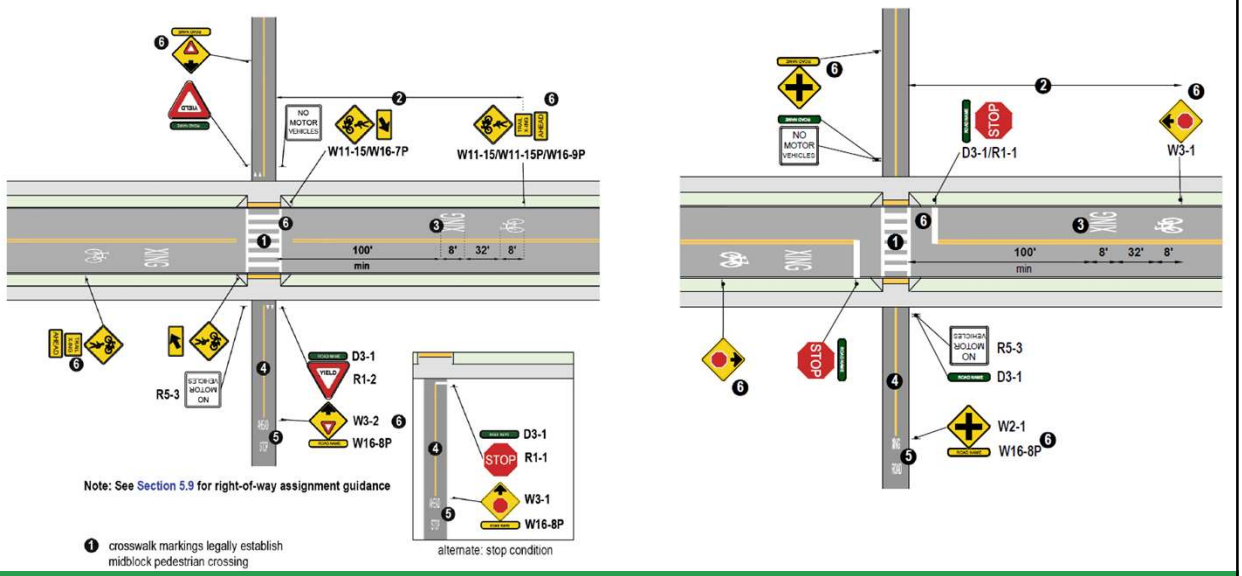
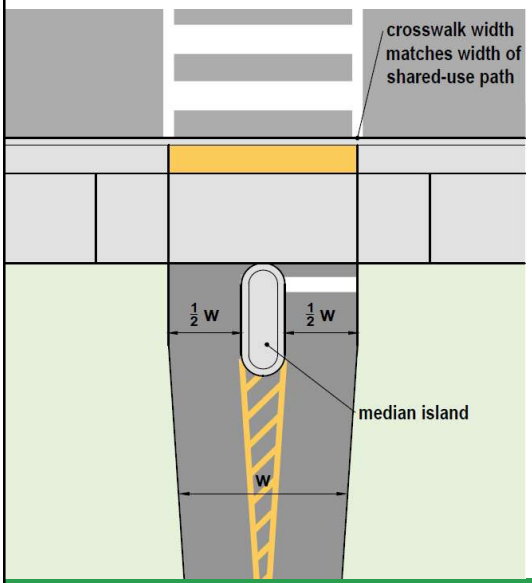
6.7. Shared Use Path Intersections and Transitions



6.7.8 Restricting Motor Vehicles



Bollards are a last resort

- Post No Motor Vehicle signs
- Use different materials
- **Use a center island at approaches**
- Use targeted enforcement
- Consider flex posts before bollards

- Bollards must be retroreflective
- Must include markings to guide users around bollards

Chapter 7 – Separated Bike Lanes and Side Paths

7.2. General Design Considerations

The cross section of a separated bike lane comprises three distinct zones (see Figure 7-1):

1. **Bike lane**—The bike lane is the space in which the bicyclist operates. It is located between the street buffer and the sidewalk buffer.
2. **Street buffer**—The street buffer separates the bike lane or side path from motor vehicle traffic.
3. **Sidewalk buffer**—The sidewalk buffer separates the bike lane from the sidewalk.

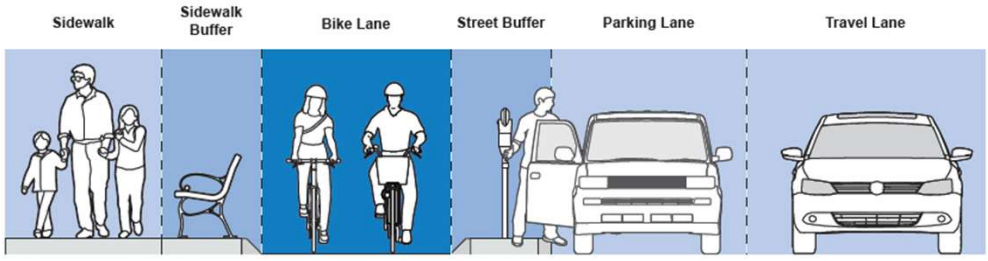


Figure 7-1: Separated Bike Lane Zones

7.2.2 Intermediate-Level Separated Bike Lanes

curb reveal of 2-3 in. below sidewalk elevation is recommended to"

- provide vertical separation to the adjacent sidewalk, and
- provide a detectable edge for pedestrians with vision disabilities

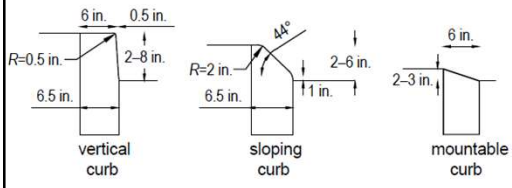
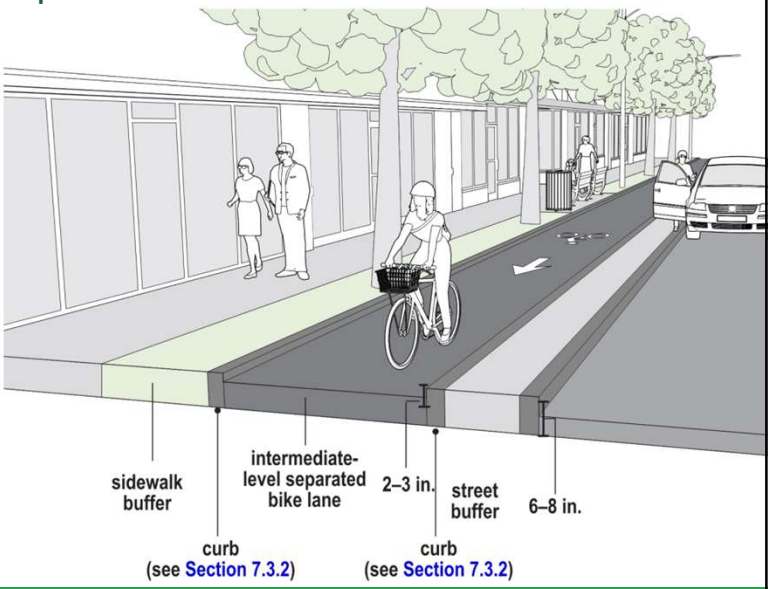
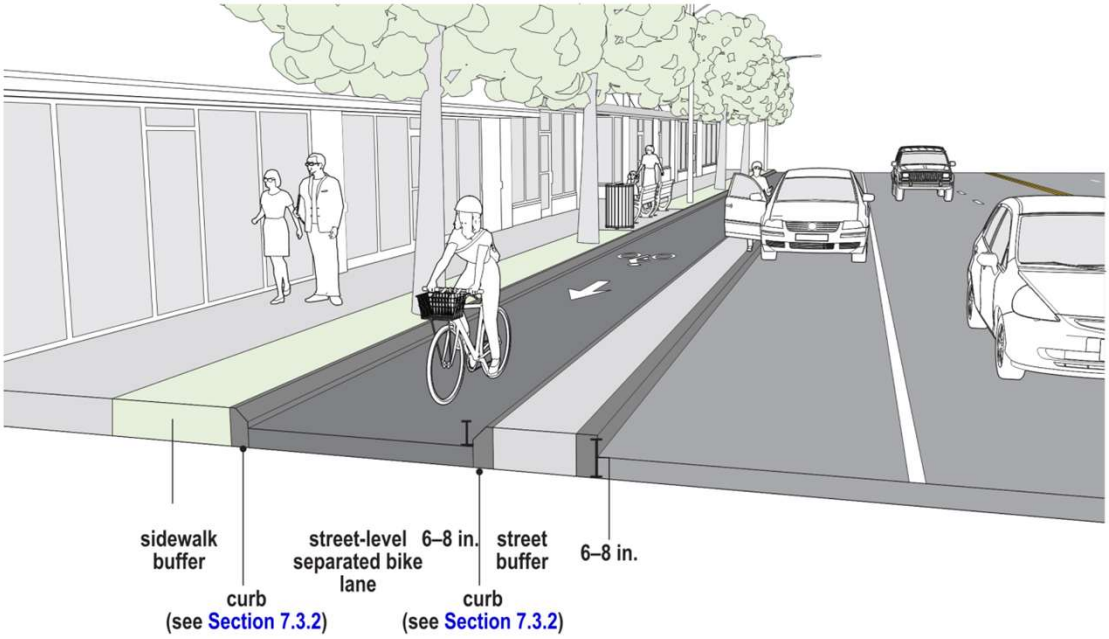


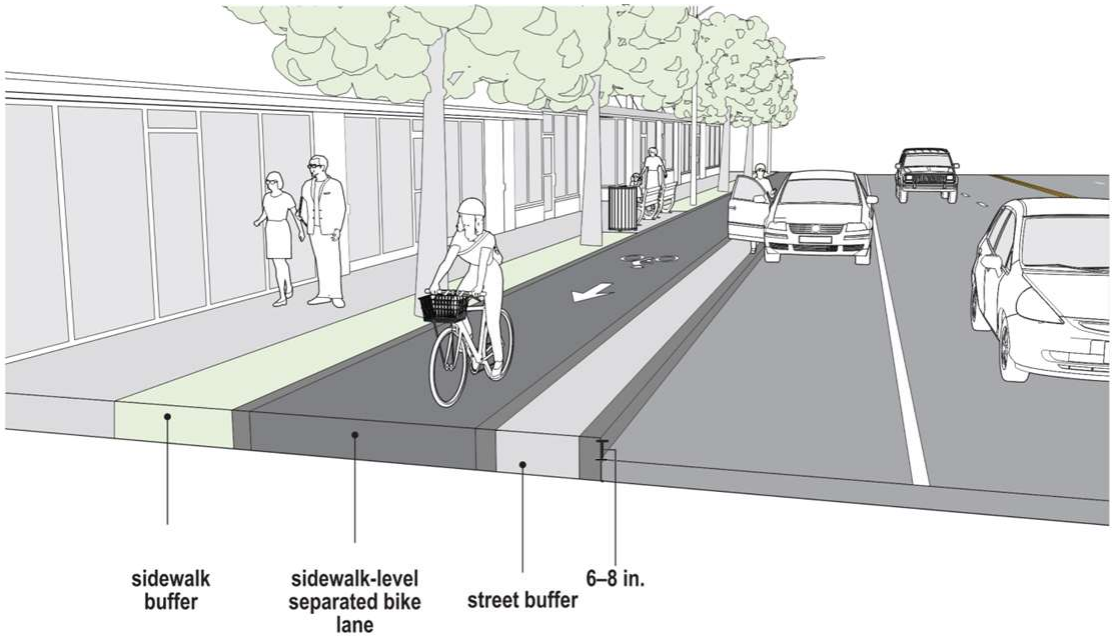
Figure 7-5: Curb Types for Separated Bike Lanes



7.2.2 Street-Level Separated Bike Lanes



7.2.2 Sidewalk-Level Separated Bike Lanes

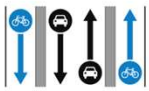


7.2.3 One-Way vs Two-Way
7.2.4 Where to Locate SBL

Corridor-level Planning Considerations	One-way SBL	Counterflow SBL	One-way SBL Plus Counterflow SBL	Two-way SBL
				
Access to Destinations	Limited access to other side of street		Full access to both sides of street	Limited access to other side of street
Network Connectivity	Does not address demand for counterflow bicycling; may result in wrong way riding or sidewalk riding	Requires bicyclists traveling in the direction of traffic to share the lane (may result in wrong way riding or sidewalk riding); counterflow progression through signals may be less efficient	Accommodates two-way bicycle travel, but counterflow progression through signals may be less efficient	
Crash Risk	Lower because pedestrians and turning drivers expect concurrent bicycle traffic	Higher because pedestrians and turning drivers may not expect counterflow bicycle traffic		
Intersection Operations	May use existing signal phases; bike phase may be required depending on volumes	Typically requires additional signal equipment; bike phase may be required depending on volumes		

- One-way on right-side often the easiest option to integrate into existing operations
- Provides intuitive and direct connections with the transportation network
- Consistent with driver expectation since bicyclist operation is in the same direction as motor vehicles

7.2.3 One-Way vs Two-Way
7.2.4 Where to Locate SBL

	One-way SBL Pair	Two-way SBL	Median Two-way SBL
Corridor-level Planning Considerations			
Access to Destinations	Full access to both sides of street	Limited access to other side of street	Limited access to both sides of street
Network Connectivity	Accommodates two-way bicycle travel		
Crash Risk	Lower because pedestrians and turning drivers expect concurrent bicycle traffic	Higher because pedestrians and turning drivers may not expect counterflow bicycle traffic	Higher because pedestrians and turning drivers may not expect counterflow bicycle traffic, but median location may improve visibility and create opportunities to separate conflicts
Intersection Operations	May use existing signal phases; bike phase may be required depending on volumes	Typically requires additional signal equipment; bike phase may be required depending on volumes	

- One-way is not always practical or desirable
- Two-way can save a little space
- Two-way may require additional intersection control and treatments to handle counterflow movement

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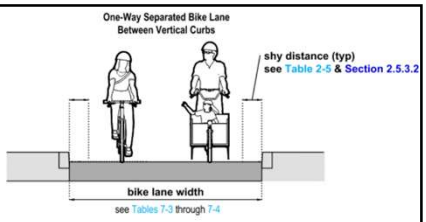
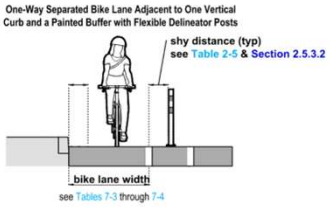
Section 7.3.4 – SBL Width (One-way)

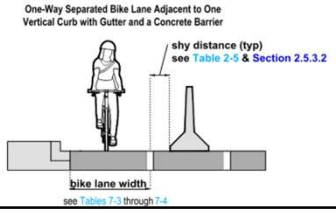
Table 7-3: One-Way Separated Bike Lane Widths Based on Existing or Anticipated Volumes

Peak Hour Directional Bicyclist Volume	One-Way Separated Bike Lane Width (ft) Recommended Values		
	Between Vertical Curbs without Gutter	Adjacent to One Vertical Curb	Between Sloped Curb, at Sidewalk Level, or Adjacent to Curb with Gutter
<150	6.5–8.5	6–8	5.5–7.5
150–750	8.5–10	8–9.5	7.5–9
>750	≥10	≥9.5	≥9
Practical Minimum*	4.5	4	4

*Peak Hour Directional Bicyclist Volume not applicable







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Section 7.3.4 – SBL Width (One-way)

Table 7-3: One-Way Separated Bike Lane Widths Based on Existing or Anticipated Volumes

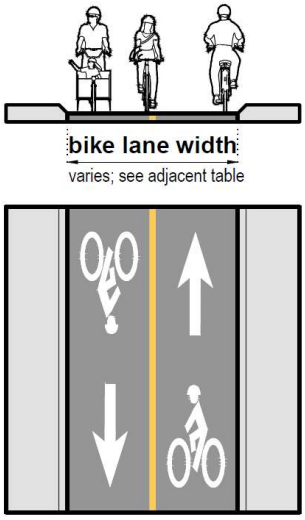
Peak Hour Directional Bicyclist Volume	One-Way Separated Bike Lane Width (ft) Recommended Values		
	Between Vertical Curbs without Gutter	Adjacent to One Vertical Curb	Between Sloped Curb, at Sidewalk Level, or Adjacent to Curb with Gutter
<150	6.5–8.5	6–8	5.5–7.5
150–750	8.5–10	8–9.5	7.5–9
>750	≥10	≥9.5	≥9
Practical Minimum*	4.5	4	4

*Peak Hour Directional Bicyclist Volume not applicable

Low end of width will accommodate occasional passing

Practical Minimum width does not accommodate passing. Only recommend for limited distances.

Section 7.3.4 – SBL Width (Two-way)



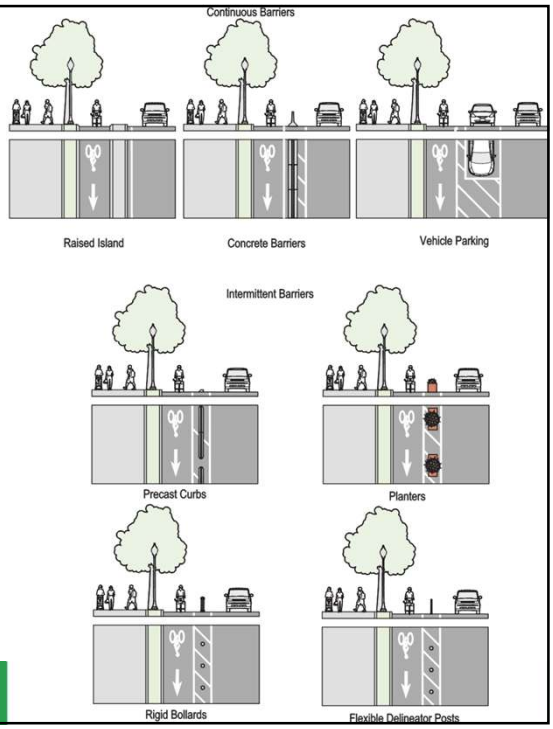
Peak Hour Directional Bicyclist Volume	Two-Way Separated Bike Lane Width (ft) Recommended Values		
	Between Vertical Curbs without Gutter	Adjacent to One Vertical Curb	Between Sloped Curb, at Sidewalk Level, or Adjacent to Curb with Gutter
<150	10–12	9.5–11.5	9–11
150–350	12–16	11.5–15.5	11–15
>350	≥16	≥15.5	≥15
Practical Minimum*	8.5	8	7.5

*Peak Hour Directional Bicyclist Volume not applicable

Section 7. 4 – Street Buffer Zone

Guide covers each of the different buffer treatments including:

- Benefits
- Considerations
- Challenges



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Section 7.5 – Sidewalk Buffer Zone

Use street furniture, landscaping beds, or curb to define the buffer between SBL and sidewalk

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7.7.1. Drainage and Stormwater Management

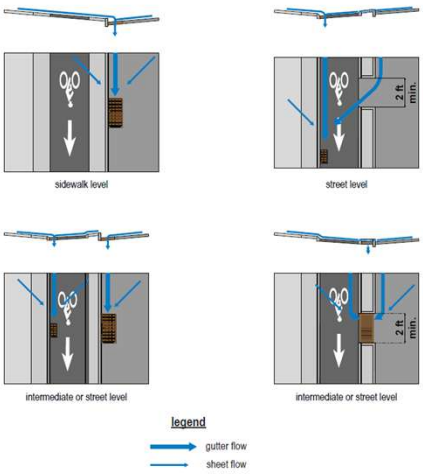


Figure 7-11: Examples of Separated Bike Lane Drainage Options

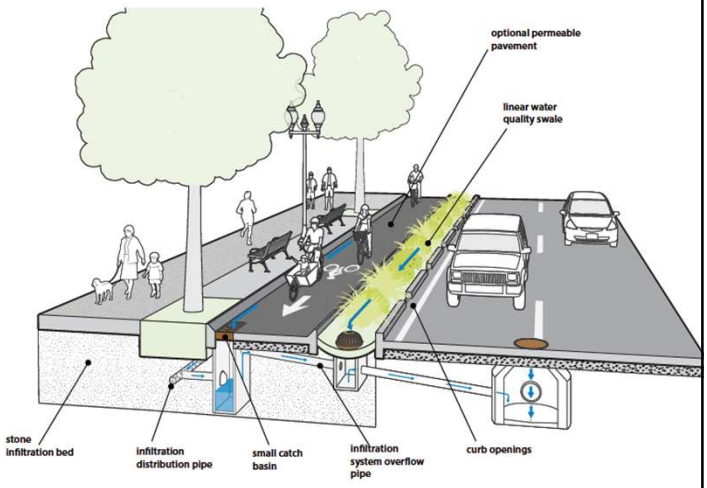


Figure 7-10: Green Stormwater Infrastructure in an Urban Street Context

7.9. Separated Bike Lane and Side Path Intersection Design

- 7.9.1. Minimizing Exposure to Conflicts
- 7.9.2. Reducing Speeds at Conflict Points
- 7.9.3. Transitions between Elevations
- 7.9.4. Right-of-Way Priority
- 7.9.5. Sight Distance
- 7.9.6. Restricting Motor Vehicles

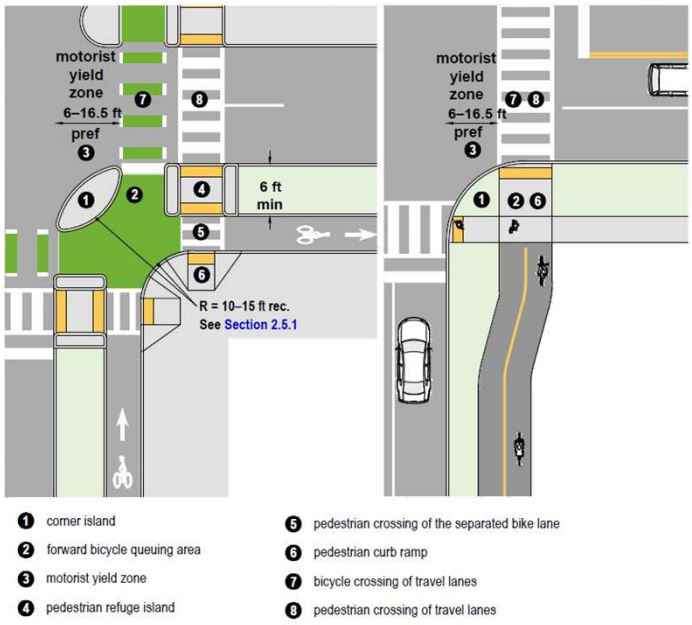
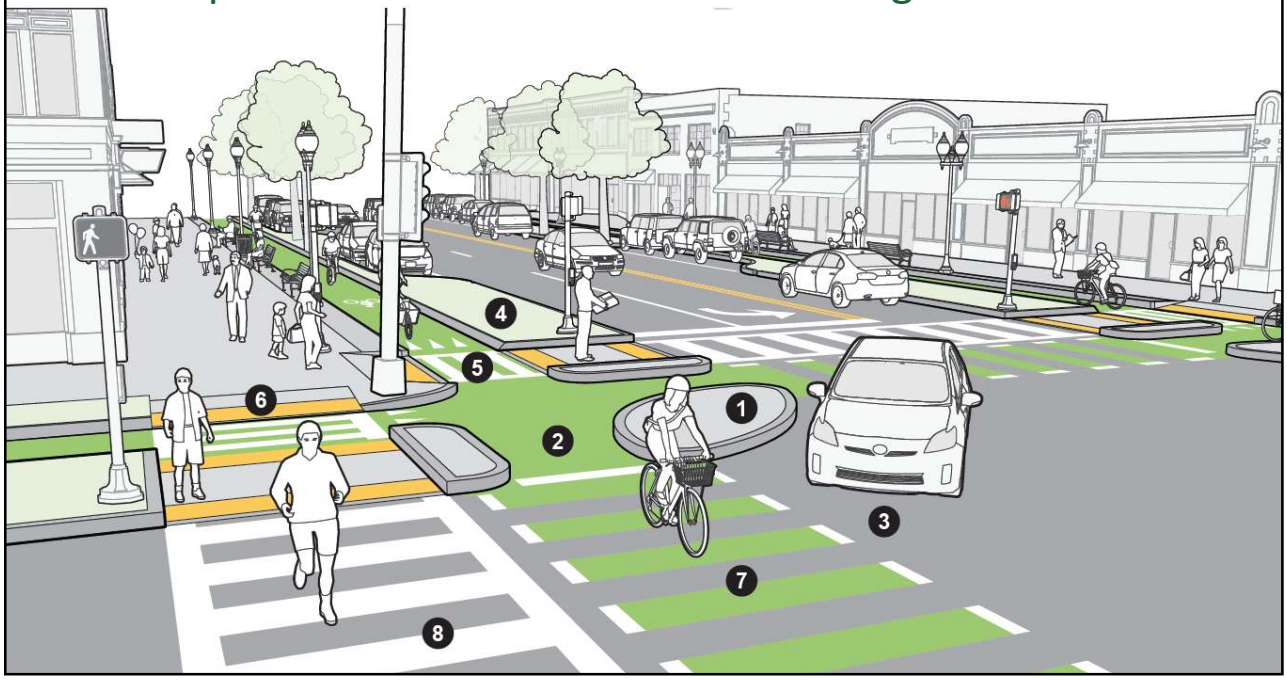
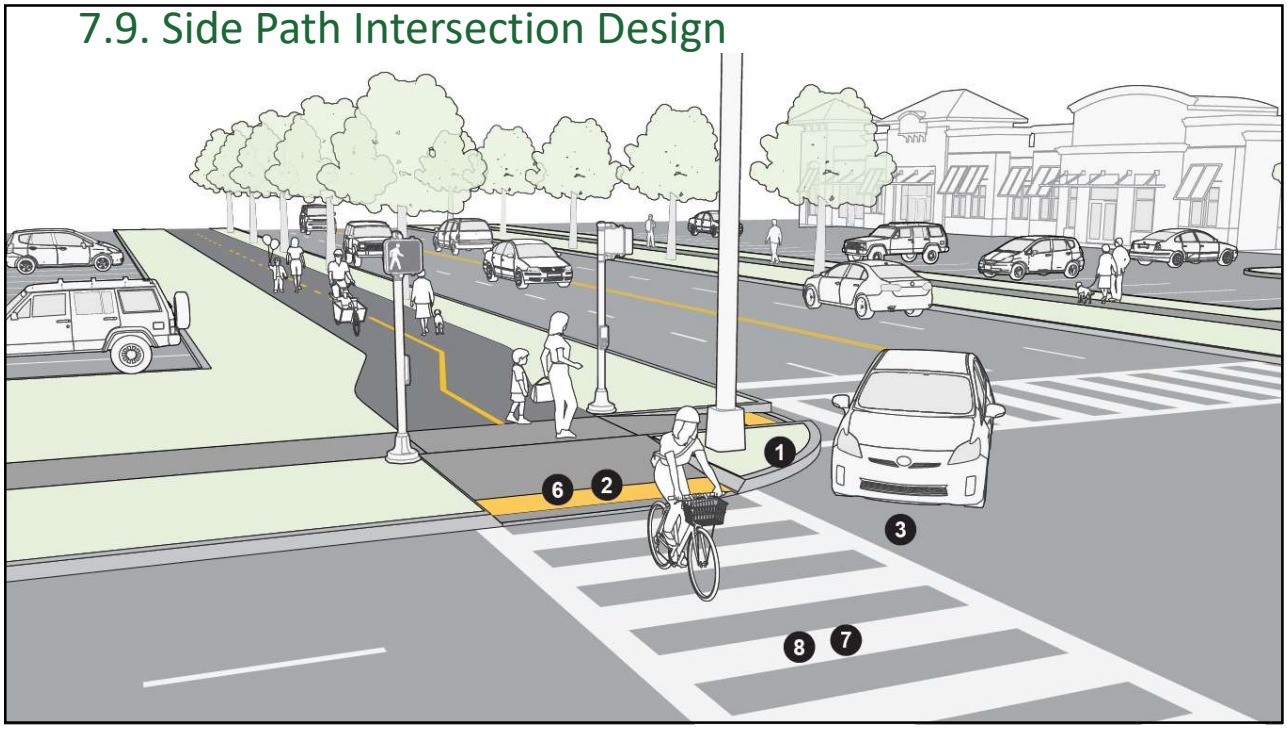


Figure 7-13: Protected Intersection Design for Separated Bike Lanes and Side Paths

7.9. Separated Bike Lane Intersection Design



7.9. Side Path Intersection Design



7.9.7.1 Corner Island

Benefits:

- forward bicycle queuing area
- space for vehicles to wait while
- reduces crossing distances
- reduces motorist turning speeds
- can reduce bicyclist speeds by adding deflection to the bike lane or side path

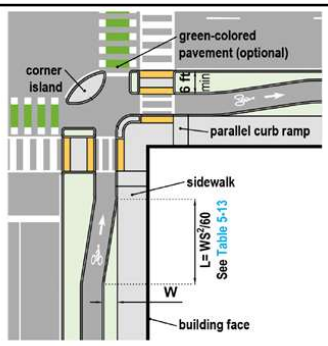


Figure 7-18: Bend-Out Example

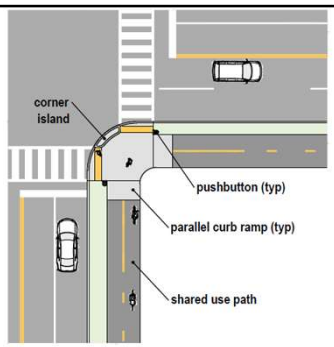


Figure 7-17: Side Path Curb Ramps at Constrained Intersection

Figure 7-15: Corner Island with Flexible Delineator Posts (Source: Carl Sundstrom, PE, Office of Bicycle and Pedestrian Programs, New York City Department of Transportation)

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7.9.9. Intersection Design with Mixing Zones
NOTE: see NCHRP 1125 for selection process

Reduce speeds of motor vehicles entering the merge point to 20 mph or less:

- Minimize the length of the merge area
- Locate the merge point as close as practical to the intersection.
- Minimize the length of the storage portion of the turn lane.
- Provide a buffer and physical separation (e.g., flexible delineator posts) from the adjacent through lane after the merge area, if feasible.
- Highlight the conflict area with a green-colored pavement and dotted bike lane markings, as necessary, or shared lane markings.

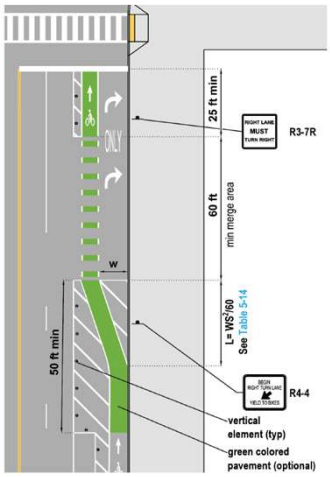

Figure 7-20: Angled Crossing Mixing Zone with Bike Lane

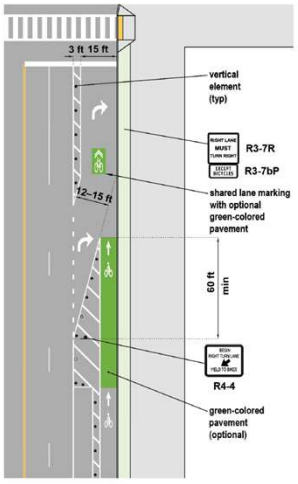

Figure 7-21: Angled Crossing Mixing Zone with Shared Lane

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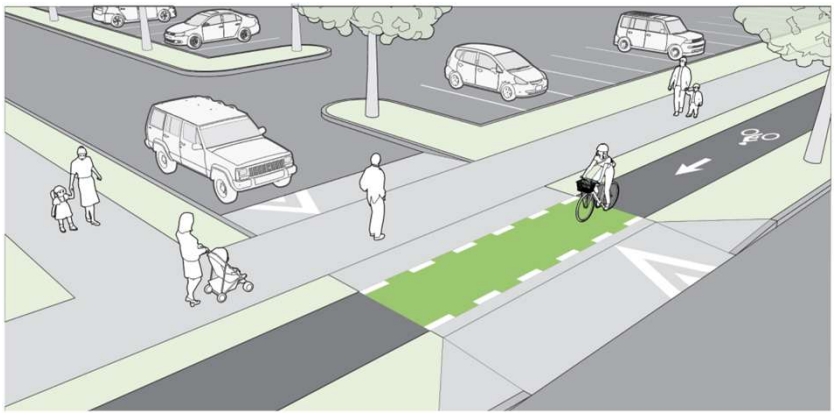
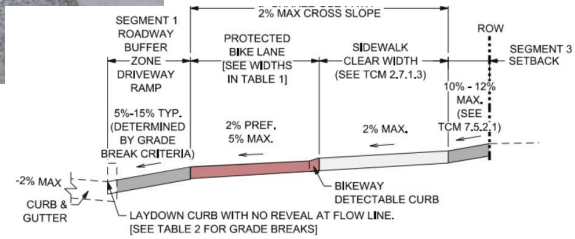
7.9.10 Driveway Crossings

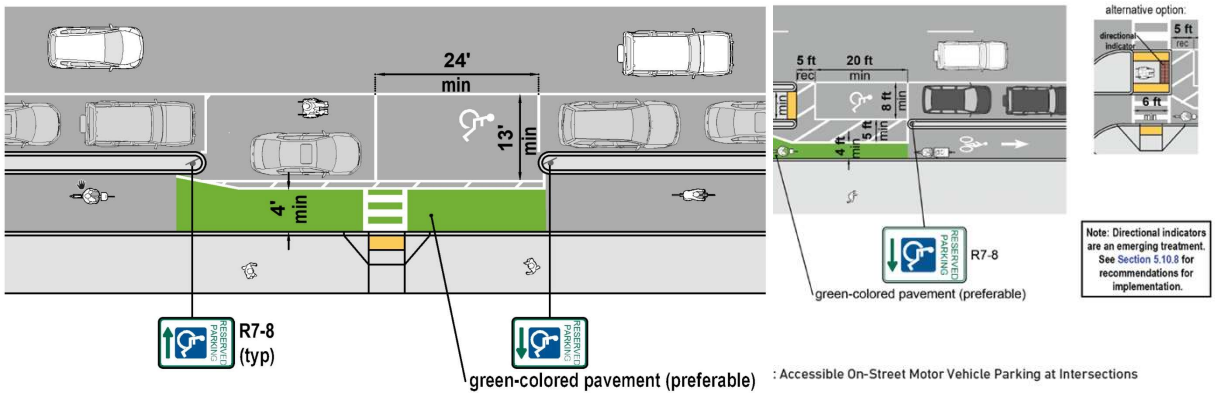
- Low Volume Driveways
- Higher Volume Driveways
- Driveway Frequency



7.9.10 Driveway Crossings



7.9.12.1 Accessible Motor Vehicle Parking



: Accessible On-Street Motor Vehicle Parking at Intersections

7.9.14. Transit Stops

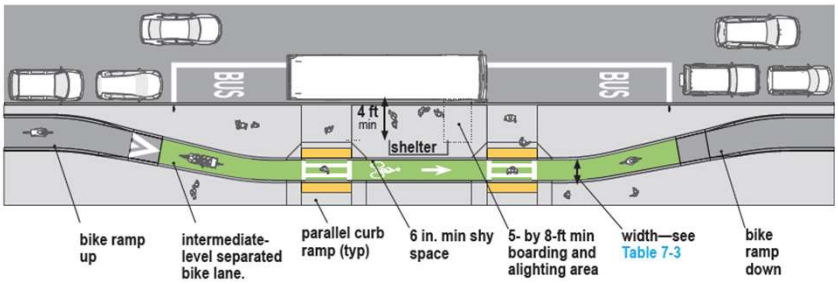
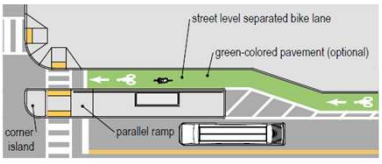
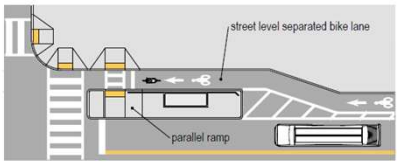


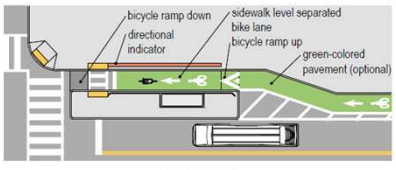
Figure 7-26: Example Configuration: Floating Transit Stop (Mid-Block)



ALTERNATIVE 1



ALTERNATIVE 2

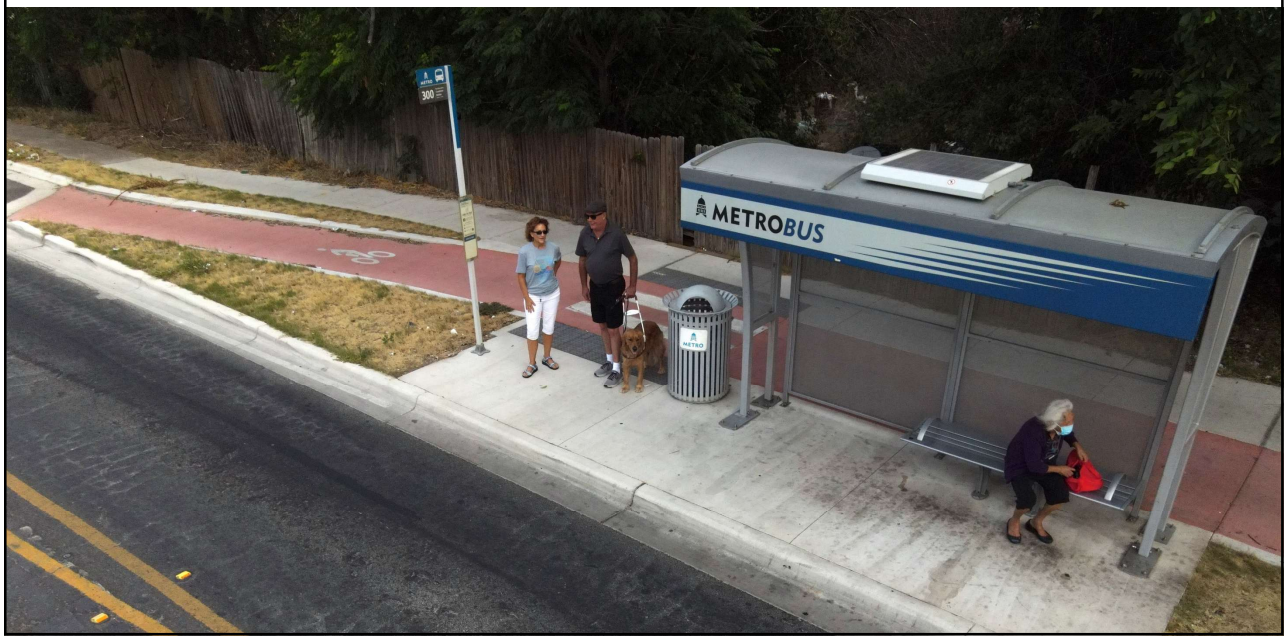


ALTERNATIVE 3

7.9.14. Transit Stops

7.9.14. Transit Stops

7.9.14. Transit Stops



7.10. Transitions between Facilities

- In general, it is preferable for a transition from a separated bike lane to a standard bicycle lane or shared lane to occur on the far side of the intersection.

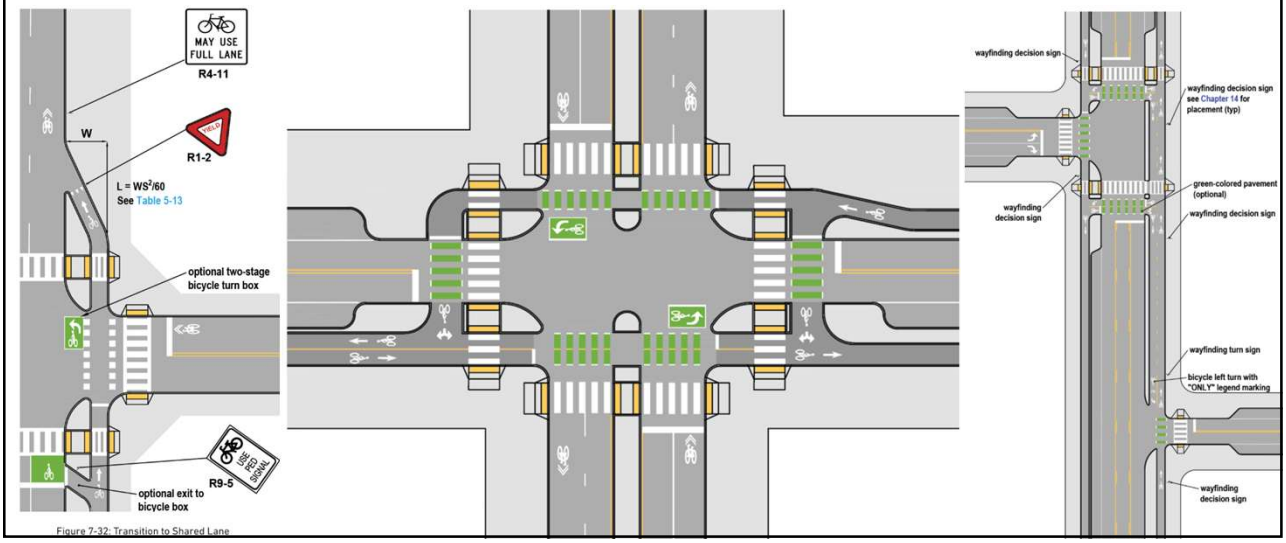


Figure 7-32: Transition to Shared Lane

7.11. Raised Bike Lanes

Table 7-5: Raised Bike Lane Widths

Raised Bike Lane Widths				
Bike Lane Context	Practical Minimum (ft)	Recommended Lower Limit (ft)	Recommended Upper Limit (ft)[2]	Practical Maximum (ft)[2]
Intermediate level or sidewalk level raised bike lane[1]	5	6.5	8	10

[1]Raised bike lane widths are exclusive of the gutter unless the gutter is integrated into the full widths of the bike lane.

[2]Separated bike lane with a street buffer may be preferable to a curb-attached, wide raised bike lane.

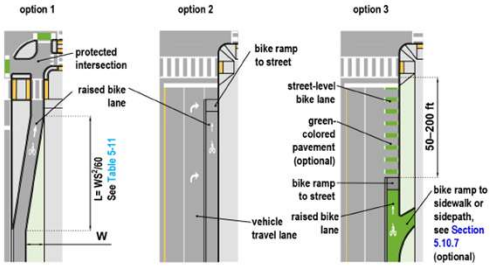


Figure 7-40: Raised Bike Lane Transitions at Intersections

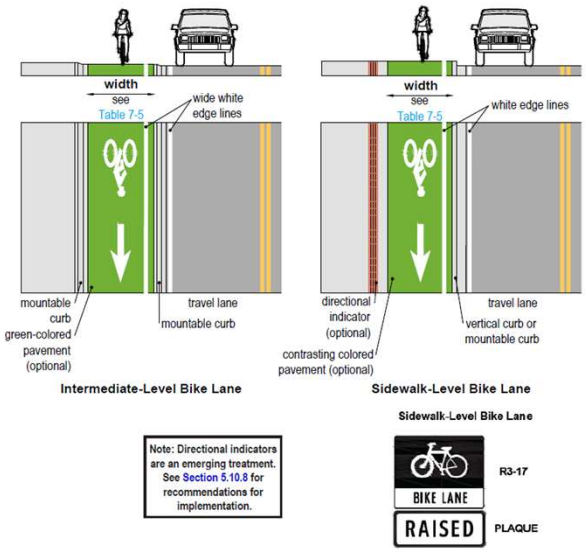


Figure 7-39: Intermediate-Level and Sidewalk-Level Raised Bike Lanes

Chapter 8 – Bicycle Boulevard Planning and Design

8.1 Introduction
8.2 Bicycle Boulevard Principles
8.3 Bicycle Boulevard Minimum Design Elements
8.4 Traffic Calming Strategies (Speed Management)
8.5 Traffic Diversion Strategies (Volume Management)
8.6 Traffic Control for Minor Street Crossings
8.7 Traffic Control for Major Street Crossings

Section 8.2 – Bicycle Boulevard Principles

- Bicycle Boulevards are not just signed bike routes.
- Principles that set them apart from local streets include:
  - 8.2.1. Manage motorized through traffic volumes and speeds
  - 8.2.2. Prioritize right-of-way at local street crossings
  - 8.2.3. Provide safe and convenient crossings at major streets

Minimize Motorized Through Traffic Volumes and Speed Differential			
	Hourly Traffic Volume	Daily Traffic Volume	Speed
Preferred	50 vehicles/hr	1,000 ADT	15 mph
Acceptable	75 vehicles/hr	2,000 ADT	20 mph
Maximum	100 vehicles/hr	3,000 ADT	25 mph

Major Street Crossings (opportunities per hour)	
Preferred	120
Minimum	60

8.4. Traffic Calming Strategies (speed management)

Figure 8-5: Example of a Chicane Treatment on a Two-Way Street Created by a Median and Curb Extensions

Figure 8-6: Example of a Chicane Treatment Created by Alternating Parking from One Side of the Street to the Other

8.5. Traffic Calming Strategies (volume management)

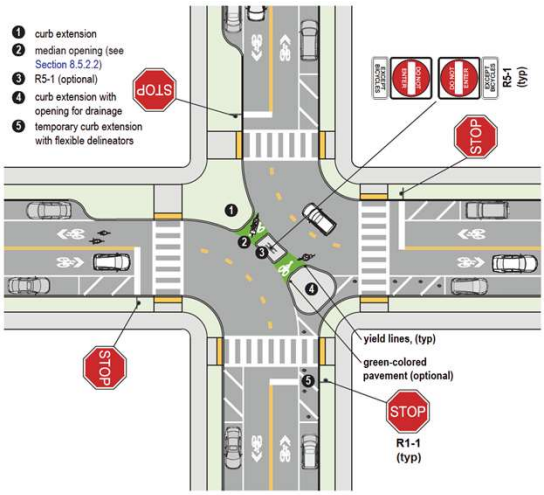


Figure 8-12: Example of a Median Used to Create a Diagonal Diverter at Intersection of Two Local Streets

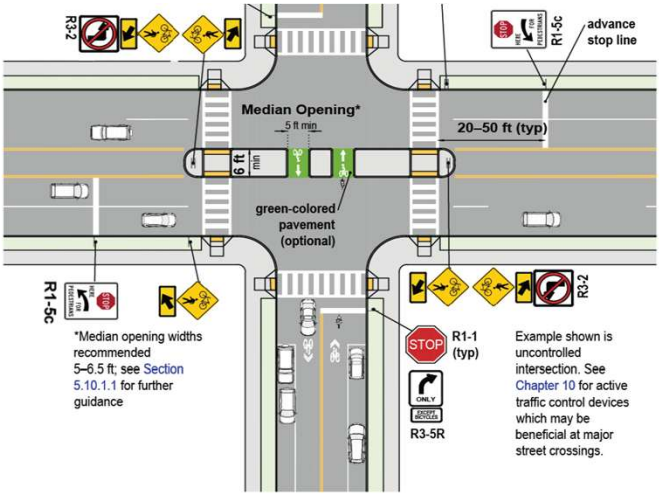
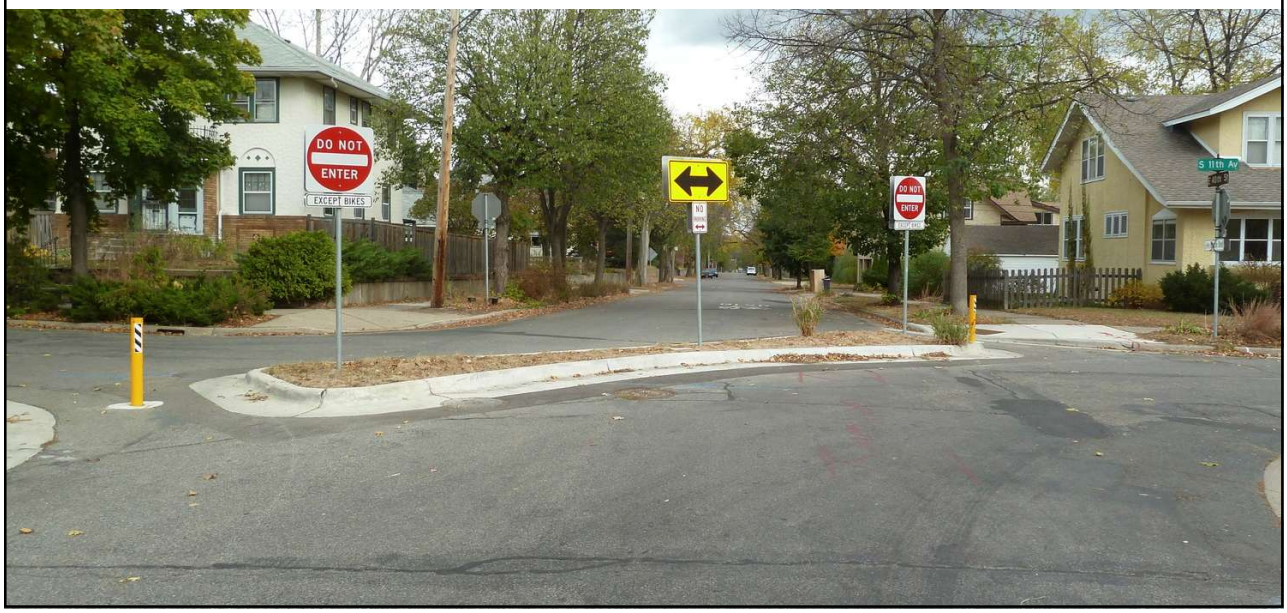


Figure 8-11: Example of a Median Used to Divert Traffic at a Major Street Crossing

8.5. Traffic Calming Strategies (volume management)



8.5. Traffic Calming Strategies (volume management)

Forced Turn

- One-way streets prevent through movements for cars while bikes carry through
- Can maintain two-way traffic for some side streets

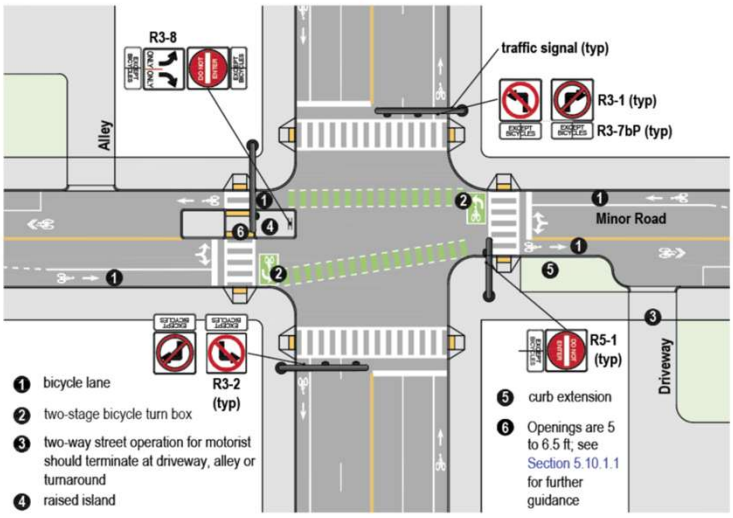
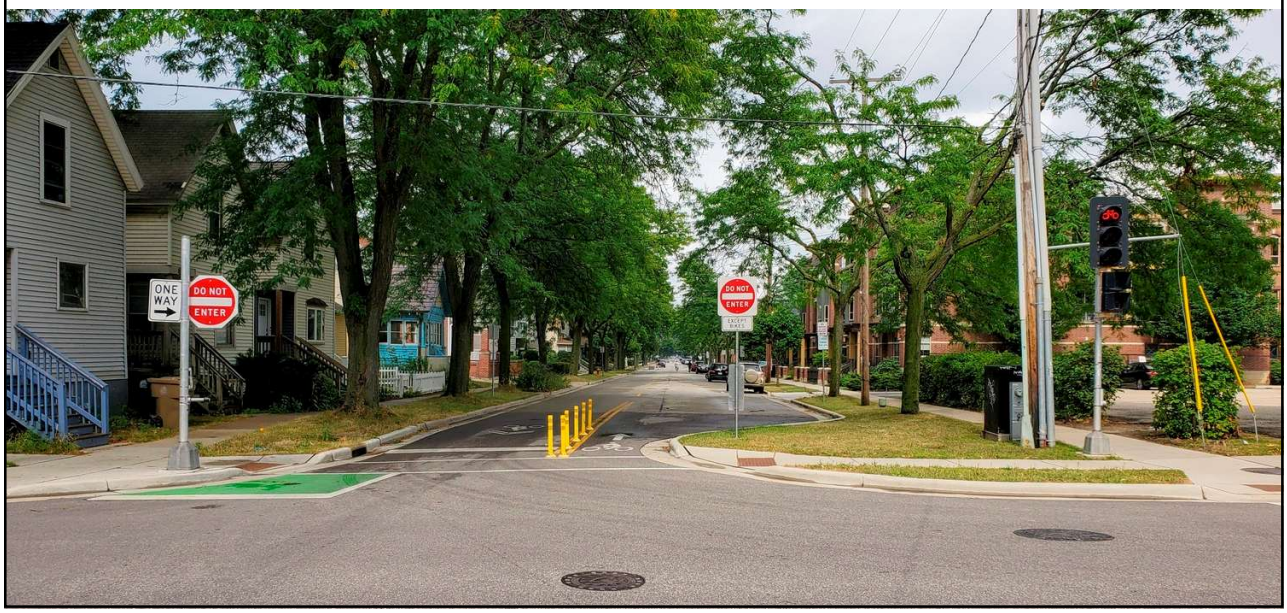


Figure 8-13: Example of a Forced Turn

8.5. Traffic Calming Strategies (volume management)



8.7. Traffic Controls for Major Street Crossings

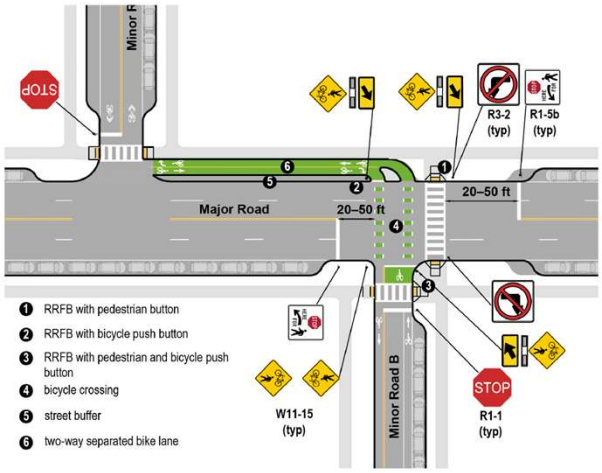


Figure 8-15: Example of Connecting Offset Bicycle Boulevard Segments Using a Two-Way Separated Bike Lane

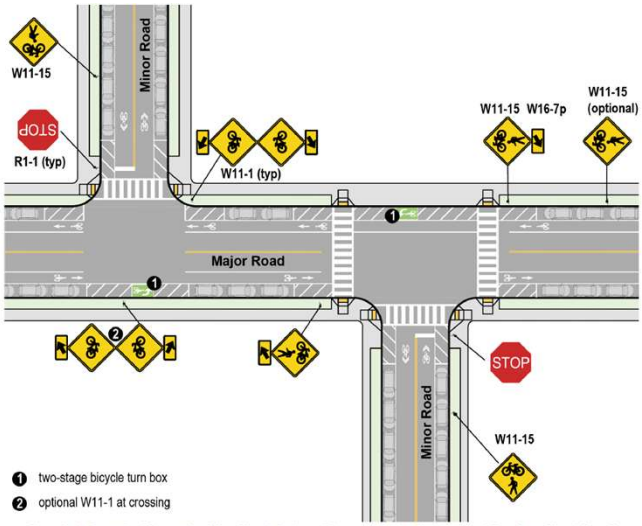


Figure 8-14: Example of Connecting Offset Bicycle Boulevard Segments Using Bike Lanes and Two-Stage Bicycle Turn Boxes

Thank you! Questions?

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TOOLE DESIGN

Discussion

- ⇨ Send us your questions
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