APPENDIX F. GUIDANCE FOR RETROFITTING SEATTLE STREETS TO CREATE DEDICATED BICYCLE FACILITIES

The following guidance is to be utilized in conjunction with the City of Seattle Bicycle Master Plan (hereafter referred to as the Master Plan) to assist the Seattle Department of Transportation (SDOT) in the development of a connected bicycle network throughout the City. The Master Plan provides an overall planning and policy framework for future development of bicycle facilities in the City.

The Master Plan recommends a variety of facilities including off-road trails, on-road facilities for low-volume and low-speed neighborhood streets, and on-road facilities for higher-volume and higher-speed streets (Seattle's arterial streets). This guidance addresses the third category, Seattle's arterial streets. The guidance is aimed toward assisting the roadway engineer in determining if adding bicycle lanes are feasible, and providing guidance for retrofitting streets in constrained situations where other types of on-road facilities may be more appropriate. The Master Plan developed specific cross sections for more than 250 miles of arterial roadway segments in the Bicycle Facility Network through a planning-level analysis of Seattle roadways. Detailed descriptions of the bicycle facility types used in these cross sections are in Appendix D. The Master Plan proposes minimum-width configurations that may be permissible depending on roadway characteristics. Implementing some of these facilities will require a change to the existing roadway configuration.

This guidance is provided as a tool to help the designer accomplish the following tasks:

- review the recommended cross section set forth in the Master Plan
- optimize the final proposed cross section dimensions
- develop an optimum cross section for roadway segments not included within the Master Plan
- obtain the necessary City, State, and Federal approvals for the design (as appropriate)

Bicycle Facility Decision-Making Process

Table F-1 illustrates the decision-making process that a designer should follow to develop an optimal bicycle facility recommendation for any arterial roadway in Seattle. This table focuses on selecting the optimal cross section for providing bicycle access, given roadway and traffic characteristics. Intersection considerations are discussed later in this guidance, but are not included in the table. Below is a description of the decision-making process shown in Table F-1.

Target Bicycle Facility Type
Identify a potential cross section for the roadway that includes a bicycle lane (or other target bicycle facility type). This desired roadway cross section would include facilities for all travel modes, as necessary, and would adhere to all relevant guidelines (see Bicycle Facility Design Guidelines discussion).

Analysis
Analyze the roadway to determine feasible cross sections for bicycle facilities, given existing roadway and traffic characteristics. There are two main steps in the analysis phase. First, the designer should consider which elements of the existing roadway could potentially be

modified to provide space for the target bicycle facility. The following questions should be asked:

- Can the existing pavement be widened, or can the curbs be moved?
- Can any existing lanes be removed (consider travel lanes, center-turn lanes, and parking lanes)?
- Can any existing lanes be narrowed?

Second, the designer should consider factors that affect the potential to modify the roadway in any of the three ways listed above. These factors include:

- Roadway capacity
- Traffic volume and speed
- Roadway grade
- On-street parking demand
- On-street parking turnover
- Heavy vehicle traffic (Trucks and Buses)

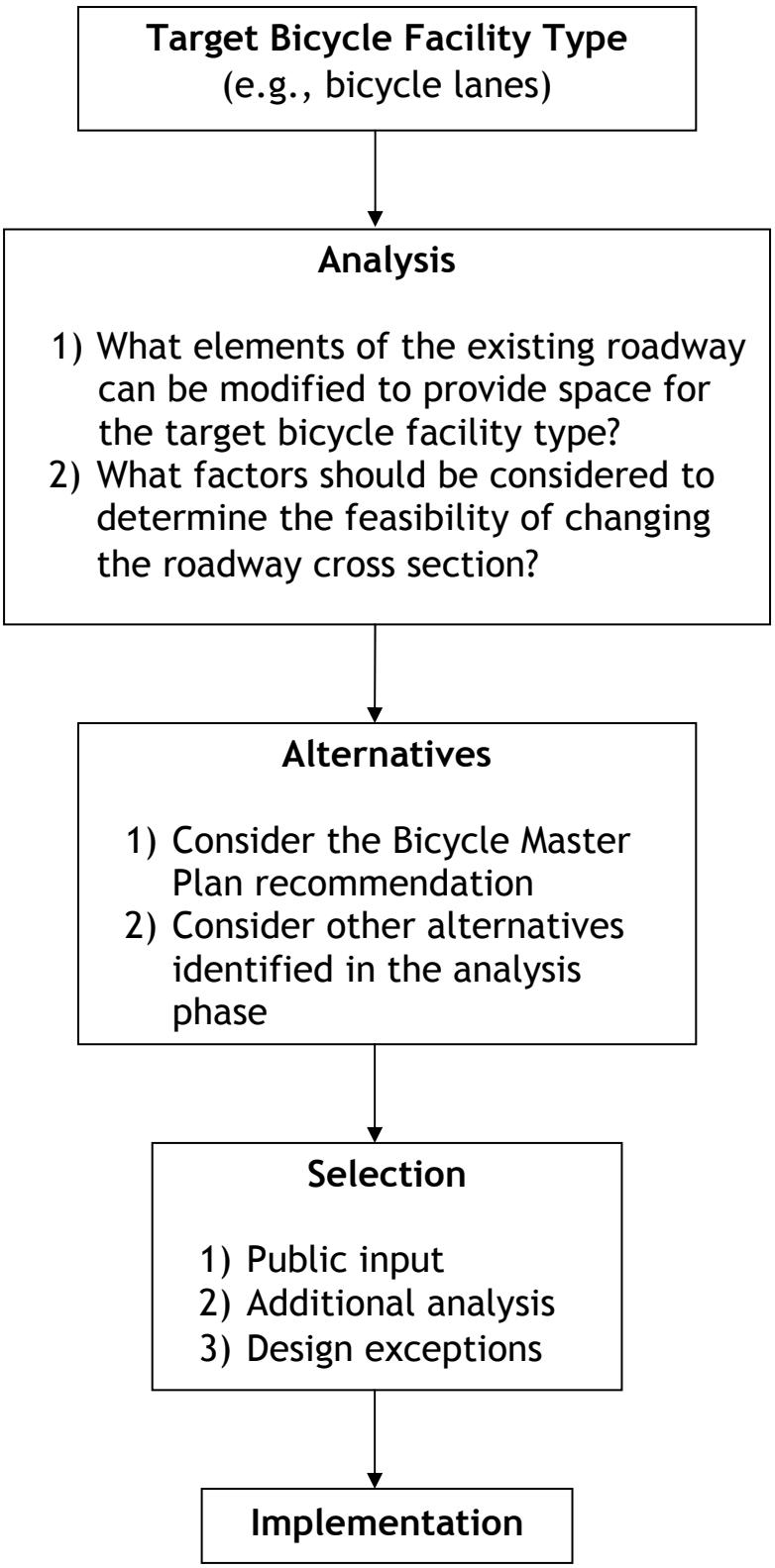
Analysis is critical for selecting an optimal bicycle facility. This phase is discussed in greater detail in the remaining sections of the document.

Alternatives
Identify several alternative cross sections for providing bicycle access in the roadway corridor, based on the recommended bicycle facility in the Master Plan and other options identified during the analysis phase. A bicycle facility recommendation has been developed for more than 250 miles of arterial roadways in Seattle through the Master Plan process. This recommendation is based on a preliminary field assessment of bicycle network connectivity and feasibility, and (where available) should be the first bicycle facility alternative considered for the roadway. However, alternatives identified in the analysis phase should also be considered.

Selection
Obtain public input on several alternative bicycle facility cross sections. Public input may make it necessary to conduct additional analysis. Identification of design exceptions should be made during this phase, if necessary. If design exceptions are not likely to be approved, different alternatives should be chosen.

Implementation
Implement the optimal bicycle facility identified through this decision-making process.

Table F.1. Bicycle Facility Decision-Making Process



Bicycle Facility Design Guidelines

While the goal of this document is to help designers develop roadway designs that meet all of the requirements set forth by city, state, and federal guidance, it is understood that there is a need to allow flexibility to develop safe and efficient roadway designs that serve the widest range of users. This need is acknowledged in both the Washington State Department of Transportation (WSDOT) Design Manual and in the Seattle Right-of-Way Improvement Manual (ROWIM)[1]. Both documents provide a detailed explanation of the required design deviation process[2]. It is likely that design deviations will be required to implement some bicycle facilities.

This guidance is a supplement to national bicycle and roadway facility planning and design guidelines. When using this guidance, the designer is encouraged to consult the following documents:

- AASHTO *Guide for the Development of Bicycle Facilities*, 1999
- *Manual on Uniform Traffic Control Devices, 2003*
- City of Seattle Right-of-way Improvement Manual (ROWIM)
- Washington State City and County Design Standards for the Construction of Urban and Rural Arterials and Collectors
- *A Policy on Geometric Design of Highways and Streets (*Green Book), 2004, AASHTO
- *Standard Plans for Road, Bridge, and Municipal Construction (*Standard Plans*)*, WSDOT, M 21-01
- Washington State Design Manual, WSDOT, M22-01 ***[Comment - Should we also reference: Right-of-Way Manual, WSDOT, M26-01?]***

This guidance is not a design standard, and should not be used as such. Application of this guidance requires the use of engineering judgment when retrofitting Seattle streets to provide optimal bicycle facilities.

Target Bicycle Facility Type

Since geometric and land use conditions vary frequently from location to location, this guidance provides key design considerations for each type of roadway cross section to help identify opportunities to alter elements of the cross section to develop safe and efficient roadway designs that serve the widest range of users. In most situations where the goal is to provide an on-road bicycle facility on an arterial roadway in Seattle, the target facility type is a bicycle lane.

Analysis of Roadway and Traffic Characteristics to Determine Bicycle Facilities

The initial part of the analysis process is to develop a theoretical desired cross section taking into account cross section elements and the design factors mentioned above, and determining if that section will fit within the existing roadway width. If the existing roadway can not accommodate the desired cross section, consideration should be given to roadway widening. When considering potential widening, estimated project costs, and impacts to properties and

[1] WSDOT Design Manual, June 2005, Forward; ROWIM, Section 1.1
[2] WSDOT Design Manual, Chapter 330; ROWIM, Section 2.6

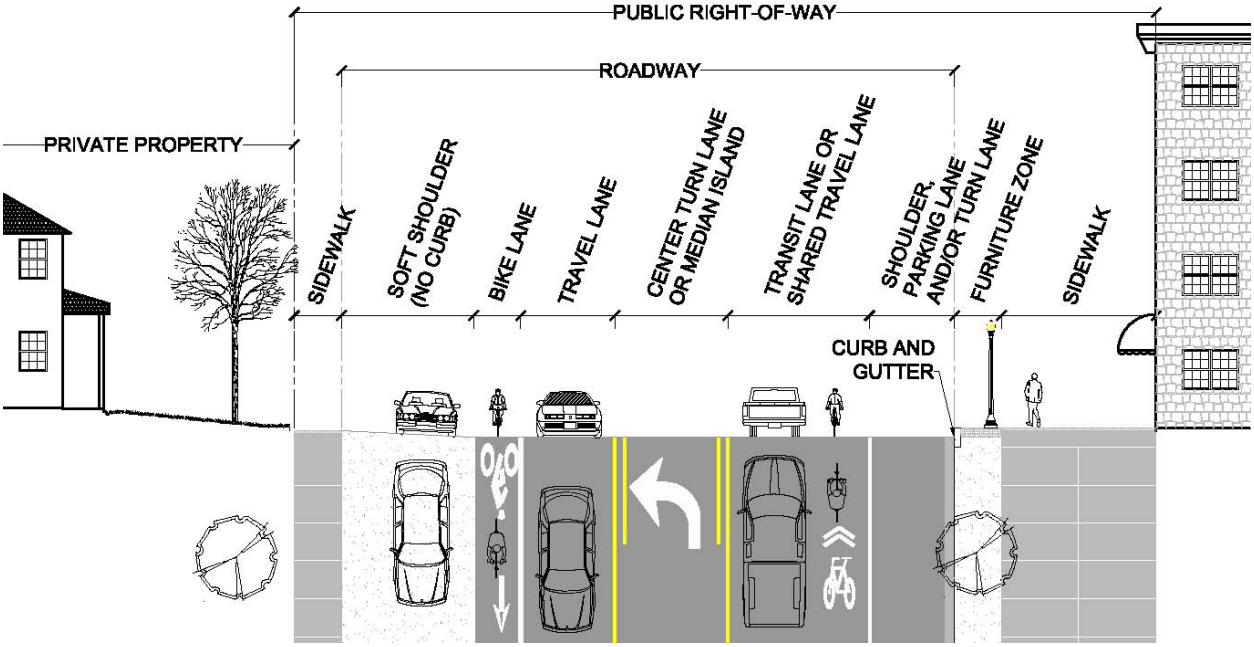
utilities should be evaluated. Careful consideration should also be given to potential impacts to pedestrian facilities. Reductions in sidewalk width below 5' and reductions or elimination of the buffer between the road and a sidewalk are not advisable. In locations with higher pedestrian volumes, sidewalks wider than 5' are needed. In most situations roadway widening is ruled out due to a combination of the above impacts. Therefore, the remainder of this guidance deals with retrofit projects, i.e. projects that are constrained by the existing paved or curb to curb widths.

Analysis is critical for selecting an optimal bicycle facility. As shown in Table F-1, the analysis phase in the bicycle facility decision-making process involves two main steps. First, the designer should consider which elements of the existing roadway could potentially be modified to provide space for bicycle facilities. Second, the designer should consider factors that affect the potential to modify the roadway. The details of these steps are discussed below.

Roadway Cross section Elements

While the discussion focuses on changes that will provide better bicycle access within the roadway, the needs of bicyclists must be balanced with other roadway users within the context of the roadway as a component of Seattle's multi-modal transportation system. Individual roadway cross section elements can either be added or removed or the cross section elements can change dimensions (see Figure F-1, below). These changes must adhere to roadway engineering guidelines. As previously stated, this guidance primarily deals with retrofit projects, therefore cross section elements outside of the existing paved or curb to curb width are not addressed.

Figure F-1. Example Roadway Cross Section Elements



Note: roadways without curb and gutter may have swales or ditch drainage.

Travel Lane
Seattle streets are classified as arterials or non-arterials (neighborhood streets). The non-arterials are generally lower volume roadways with pavement widths varying between 20' and 40'. Centerline striping is not provided on non-arterials and bicycles most commonly share the travel way with motor vehicles.

The following discussion relates to roadways classified as arterials.

Design Criteria:
ROWIM[3]: Through traffic lane - 11 feet
Curb lane - 12 feet
Bus only lane - 12 feet
Wide outside lane (vehicle/bicycle) - 14 feet

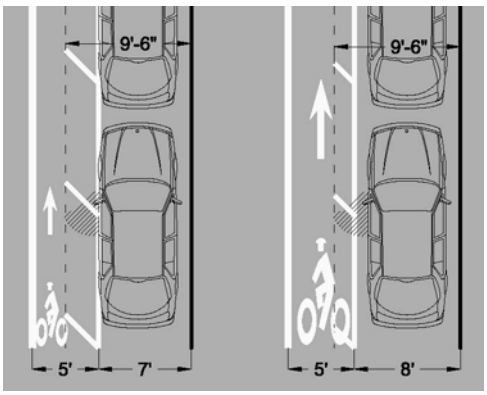
Wash DOT: 11 feet min; varies based upon speed and road classification
AASHTO: 10 feet minimum; 11-12 feet preferred in urban areas[4]

Design Considerations: AASHTO provides flexibility in the establishment of lane width by discussing the merits of reduced lane width for interrupted-flow operating conditions and constrained conditions. AASHTO also states that "local practice and experience regarding lane widths should also be evaluated.[5]" The consideration of narrow travel lanes should also take into account truck and bus volumes.

Bicycle Lane
Design Criteria:
Curb or adjacent to parking:
ROWIM – 5 feet, min.
WSDOT – 5 feet, min.
AASHTO – 5 feet, min.

No curb or parking:
ROWIM – 4 feet, min.
WSDOT – 4 feet, min.
AASHTO – 4 feet, min.

Design Considerations: The minimum width for a bicycle lane adjacent to parking lane is 5'. A bicycle lane adjacent to the edge of the road without a curb may be 4' in width. Bicycle lane stripes are recommended to be 6-inch-wide solid white line. In locations with on-street parking, two stripes should be used to define a bicycle lane: one stripe on the travel-lane side, and one stripe on the parking-lane side of the bicycle lane. These stripes should be dashed in areas where motorists can be expected to merge across the bicycle lane. The design of bicycle lanes wider than 6' should be carefully considered as they can appear to be



Buffered Bicycle Lane

[3] ROWIM - 4.6.2 Design Criteria
[4] AASHTO Green Book, 2004, pg. 472
[5] AASHTO Green Book, 2004, pg. 473

vehicular travel lanes to motorists.

A buffered bicycle lane can encourage bicyclists to ride away from the opening doors of parked vehicles by adding pavement markings to the bike lane. This treatment could be particularly useful to delineate the dooring area where:

- Bicycle lanes are adjacent to 7- or 8-foot parking
- Bicycle lanes adjacent to high turnover parking
- Locations of dooring complaints or crashes

Buffered bicycle lanes may also be considered on steep roadways where higher bicycle speeds can be expected and where more severe dooring crashes can be expected. Buffered bicycle lanes may be accompanied by signs reminding drivers to look for bikes when opening their doors.

Shared Travel Lane [6]

Shared travel lanes are distinctive from travel lanes because they include shared lane markings (SLM) within the travel lane. Shared lane markings are typically applied in constrained locations where bicycle lanes are not feasible.

Design Criteria:

Shared travel lanes follow the same design criteria as travel lanes. A shared travel lane shall be marked by a shared lane marking (from the ROWIM, figure 4-18). If adjacent parking is present, the marking shall be located 12' from the curb for a 10'to 12' travel lane, and 11' from the curb for a travel lane 13' or greater. In locations where the travel lane is adjacent to curb or roadway edge, the center of the marking is placed 4' from the curb or edge.

Design Considerations:

It is desirable to have a shared travel lane be a wide outside lane of 12' to 14'. Shared travel lanes should be considered for the following situations:

- On constrained roadways that are too narrow to stripe bicycle lanes
- To delineate space within a wide outside lane where bicyclist can be expected to ride
- On multi-lane roadways where bicyclists can be expected to travel within the outside lane and motorists should be prepared to change lanes to pass bicyclists
- On roadways where it is important to increase motorist awareness of bicyclists
- On roadways where bicyclists frequently ride the wrong way
- On roadways where bicyclists tend to ride too close to parked cars

Center Turn Lane

Center turn lanes can be utilized to remove turning vehicles from the through travel lanes. This can improve roadway capacity and potentially allow for fewer through travel lanes.

Design Criteria:

AASHTO –10-16 feet[7]

Design Considerations: The width of the center turn lane should be based upon traffic volume. Careful consideration should also be given to the determination

[6] For further discussion on the shared lane marking treatment, read the Share Lane Bicycle Pavement Marking Memorandum located in Appendix N of the Bicycle Master Plan.

[7] AASHTO Green Book, 2004, pg 338

of whether a continuous center turn lane is more advantageous than a dedicated left turn lane. For roadways with lower volume turning movements it may be more beneficial to provide medians or crossing islands and dedicated left turn pockets. AASHTO recommends the use of an 11' width for continuous two-way left turn lanes.

Dedicated Turn Lane
Similar to center turn lanes, dedicated turn lanes can be utilized to remove turning vehicles from the through travel lanes to improve roadway capacity and potentially allow for fewer through travel lanes.

Design Criteria:

ROWIM:	12 feet
Wash DOT:	11 feet min; varies based upon speed and road classification
AASHTO –	9 feet min. (arterial design speed less than 40 mph)[8]

Design Considerations: The width of the turn lane should be based upon traffic volume and speed. Careful consideration should also be given to the determination of the length of the turn lane as it is often necessary to drop bicycle lanes or narrow travel lanes to install a dedicated turn lane. Bicycle lanes should be dropped up to 100' prior to dedicated turn lanes or if bicycle lanes are present, they shall be located to the left of right turn lanes and to the right of left turn lanes.

Parking Area
Design Criteria:

ROWIM:	8 feet[9] minimum 10 feet on a bus route
WSDOT:	8 feet
AASHTO:	7 feet minimum (non-arterial streets primarily accommodating passenger vehicles) 8 feet minimum (arterial) 10-12 feet[10] (for use as possible through lane)

Design Considerations: The use of 7' parking adjacent to bicycle lanes or wide outside lanes in lieu of the 8' minimum may be an option where space is constrained. The addition of a bicycle lane or a wider outside lane alleviates the primary AASHTO concern of sideswiping. Research[11] has found that parked vehicles can be held closer to the curb or edge of the roadway with the use of a 7' striped parking line.

If bus bulbs are installed in the parking area for in-lane bus stops on express routes, they would be infrequent. Bicycle lanes can still be provided on these streets, but woutd be discontinuous at the express bus stop. Appropriate warning signage and markings would be provided for bicyclists and motor vehicle operators at these locations.

Some streets in Seattle have a soft surface area located adjacent to the roadway that allows parking. Soft surface areas where parking is allowed that are narrower than 7' should be widened or parking should be restricted to improve safety along a roadway. If parking is

[8] AASHTO Green Book, 2004, pg 478
[9] This would require a ROWIM policy change to allow for 7-foot parking on all bicycle routes.
[10] AASHTO, pg. 478
[11] Cite Ron Van Houten Research

allowed, an edgeline should be installed to encourage motorists to park off from the roadway. The roadway edgeline stripe is recommended to be 4-inch-wide solid white line. The designer should consider the following options in locations where parked vehicles continue to encroach on the travel way:

- increase the edgeline (parking line) width to 6-inches
- provide parking regulation signs notifying drivers to park off the traveled way
- reconstruct the shoulder with curb and gutter to define parking area

Shoulders

Soft surface shoulders are located adjacent to a number of roadways in Seattle. Soft shoulder areas provide an opportunity for improvements to the roadway cross section, but can create sub-optimal conditions for bicyclists in certain situations.

Design Criteria:

ROWIM: 5 feet (non arterial[12])
WSDOT: 8 feet (parking allowed)
AASHTO: varies

Design Considerations: Shoulders that have a poorly-maintained pavement edge are not desirable for bicyclists operating close to the edge of the roadway (a common practice for bicyclists riding on roadways with narrow travel lanes).
Elimination or reduction of the shoulder may be considered under the following circumstances:

- To provide space for an enhanced bicycle facility (wider travel lane or bicycle lane)
- In locations where there is excess parking capacity
- In locations where the shoulder is greater than 7' in width

If a shoulder is designated as a bicycle lane, it must be at least 4' wide.

Factors that should be Considered when Selecting Bicycle Facilities

Many of the factors previously mentioned (e.g., capacity, traffic volume and speed, on-street parking turnover, heavy truck volumes, etc.) are taken into consideration when determining an optimal cross section for a retrofit project. The relationship between these factors and cross section elements is a key step in the analysis process to determine an optimal cross section. Capacity, speed, volume, heavy vehicles, grades, and parking directly relate to the need for, and dimension of cross section elements. These factors are further discussed below to provide guidance to the designer to achieve increased modal balance within the constrained cross section, and provide the best possible bicycle facility.

Roadway Capacity

Roadway capacity is considered when examining the number and type of vehicular travel lanes. If a reduction in the number of travel lanes is desired, a traffic analysis should be performed to determine if that option is feasible.

Traffic Volume and Speed

Roadways with higher vehicular speed and volumes are less comfortable for cyclists, and are therefore in more need of dedicated bicycle facilities. Excess capacity can also result in

[12] ROWIM- Section 4.6.2

higher traffic speeds. Some roads may benefit from the fewer travel lanes or conversion of travel lanes to turning lanes. Reducing traffic volume and/or speed can also allow for the installation of narrower travel lanes and turn lanes.

Heavy Vehicles

Heavy vehicles (trucks and buses) may require additional operating space on roadways. Additionally, frequent passing of bicyclists by heavy vehicles in a narrow cross section may create conflicts. The AASHTO Guide cites "if substantial truck traffic is anticipated, additional lane width may be desirable."[13] The use of travel lanes below 11' is not recommended on streets with a high percentage of heavy vehicles. This guidance recommends a threshold of 10% of the ADT or greater.

Road Grade

Road grade has the largest affect on bicyclist operating speed. On steep ascents, bicyclists may be slowed to the speeds of pedestrians. On steep descents, bicyclists may exceed motor vehicle speeds. On constrained rights-of-way the designer can accommodate a bicyclist in a narrower cross section by utilizing a climbing bicycle lane in the uphill side of the road. On downhill sections that bicyclist can be directed to share the lane with motorist. This can reduce the total width required for the roadway cross section. Careful consideration should be given to placing bicycle lanes adjacent to parking on portions of roadways with steep descents (See Bicycle Lane discussion).

On-Street Parking Demand

Providing ample on-street parking is often considered an important need by the general public, and efforts to reduce or eliminate it can be met with strong opposition. However, the reduction or elimination of parking should be considered in areas where bicyclists are constrained to riding too close to parked vehicles or where enhanced bicycle facilities are desirable. In locations where there is excess parking capacity, consideration should be given to the following options:

- consolidate parking to one side of road
- remove parking completely where there is no demand or sufficient off street capacity
- remove parking temporarily where there is a need for additional throughput capacity (i.e. - peak hour bike lane, bus lane, and/or travel lane)

On-Street Parking Turnover

High parking turnover can affect the safety of all roadway users. The bicyclist is typically the most vulnerable roadway user because they often ride adjacent to parked vehicles. When riding within the area of an opening door, the bicyclists is in danger of being struck and injured. Existing law[14] requires a motorist to not open a door into moving traffic; nonetheless, the designer should consider this potential hazard in the design process. To reduce the impact of dooring the designer may consider reducing or eliminating parking, providing a buffered bicycle lane or adding dooring warning signs (See Bicycle Lane discussion).

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[13] AASHTO Green Book, 2004, Pg 476

[14] Washington Code §46.61.620. Opening and closing vehicle doors – "No person shall open the door of a motor vehicle on the side adjacent to moving traffic unless and until it is reasonably safe to do so and can be done without interfering with the movement of other traffic, nor shall any person leave a door open on a side of a vehicle available to moving traffic for a period of time longer than necessary to load or unload passengers."

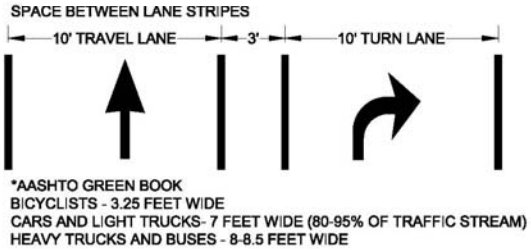
Bicycle Facility Continuity Considerations at Intersections

Continuity of bicycle facilities at intersections takes into consideration the cross section elements and design factors mentioned above. Intersection treatments may vary depending on the approaching cross section. Conversely, bicycle treatments at closely spaced intersections may determine the cross section between nodes. Under ideal circumstances a standard bicycle lane would be accommodated at the approach to an intersection. However, with the frequent need for dedicated turn lanes at intersections, the roadway cross section can become constrained. The following designs offer options for accommodating bicycles in these constrained locations.

Pocket Lane Striping, Berkeley, California

Pocket Lane

Pocket lanes are used when there isn't sufficient space to install a bicycle lane at the approach to an intersection. Pocket lanes provide for a continuous bicycle facility through an intersection. They can encourage motorists to drive more slowly, and maintain a consistent traveling path. The striped pocket lane encourages through-moving bicyclists to stay to the left of right turning vehicles, and the lane enables bicyclists to bypass stopped vehicles. Pocket lanes should be a minimum of 3' in width and should not be marked as bicycle lanes (e.g., should not include the bicycle symbol pavement marking). Pocket lanes are not recommended on roadways with high speeds or high heavy vehicle volumes (10% of ADT or greater). This policy is considered experimental and it is recommended that Seattle conduct additional experimental studies before widespread implementation.



Shared Bicycle/Right Turn Lane

Shared bicycle/right turn lanes are used when there isn't sufficient space to install a bicycle lane at the approach to an intersection. The shared bicycle/right turn lane encourages bicyclists to remain to the left of right turning traffic by striping a dashed bicycle lane through the right turn lane. They maintain the visual continuity of the bicycle lane while still allowing adequate shared space for bicycles and turning vehicles. A shared lane marking may be placed on the left side of a right turn lane to indicate that this space should be shared between through bicyclists and right-turning vehicles in lieu of providing the dashed striping.

Generic Examples of Roadway Cross Sections

The following graphics depict common City of Seattle roadway cross sections. Each of the cross sections is uniquely lettered to correspond to the cross sections recommended in the Master Plan (see Figure F.2. Cross Section Map). The basic cross sections are identified by a single letter. Variations of these basic cross sections are identified with a number following the letter. Each cross section includes additional considerations that should supplement the considerations that have already been discussed earlier in the document.

Figure F.2. Cross Section Map

As previously stated, the cross sections are based on a planning level analysis and that generally ruled out a widening option. Therefore the cross sections are geared toward minimum widths that may be permissible. As projects move toward implementation, the designer is encouraged follow the process outlined above and to utilize the standard reference documents. The designer should also consider the example variations (letter followed by number) when developing cross section alternatives. For example the minimum-width recommendation for roadways with 2 travel lanes, 2 bicycle lanes, and 1 lane of parking is cross section F. As additional variables such as soft shoulder parking or additional road width become available for that cross section, alternative striping patterns are detailed as permutations F-1, and F-2.

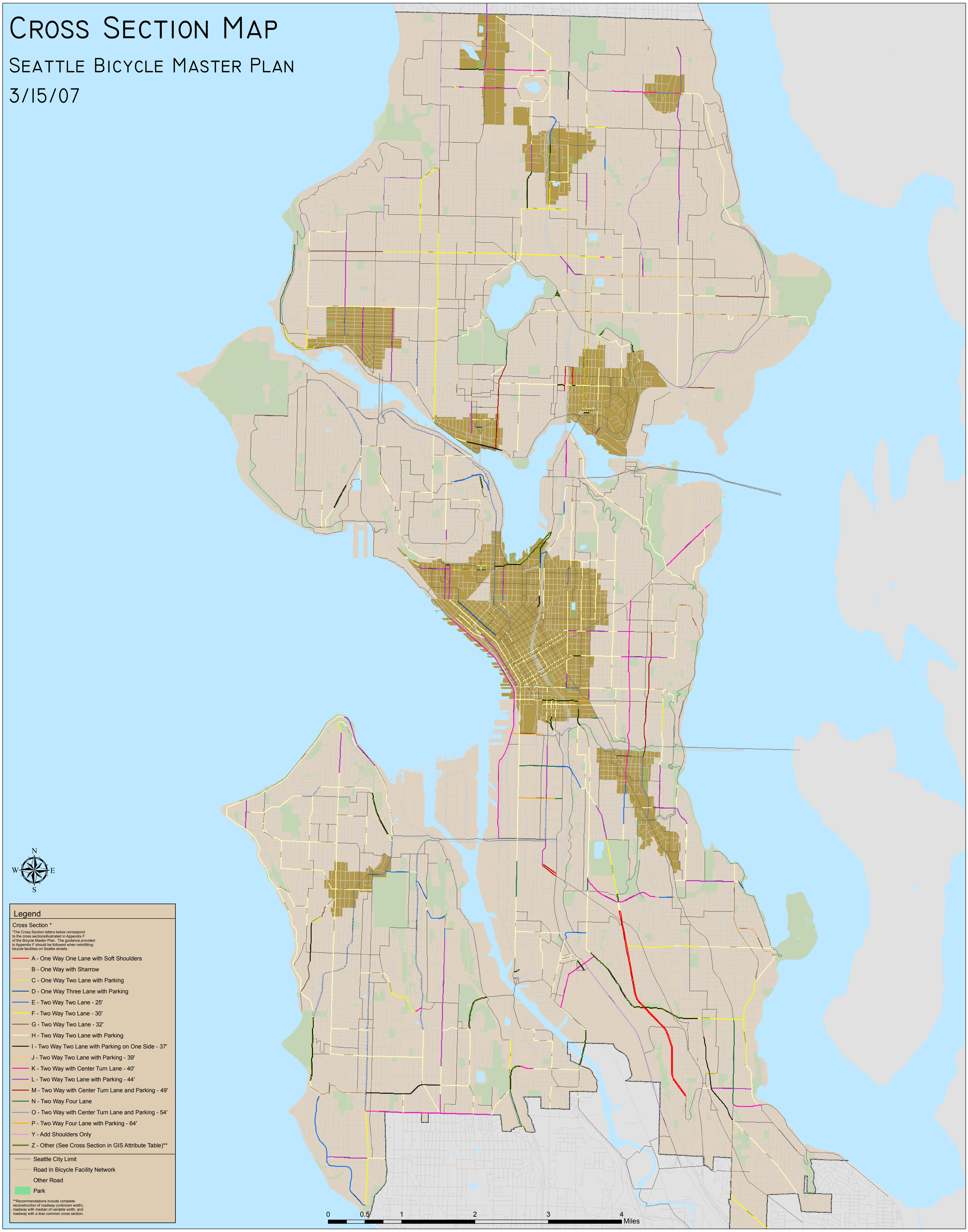
In addition to the design process outlined above, final design will require field confirmation of the following elements to assure a complete understanding of the existing conditions:

- parking
- roadway width
- curb presence and location
- drainage
- bus stop locations and lengths
- any other situation that may affect the implementation of a desired cross section, such as pavement condition, reversible or variable traffic patterns, etc.

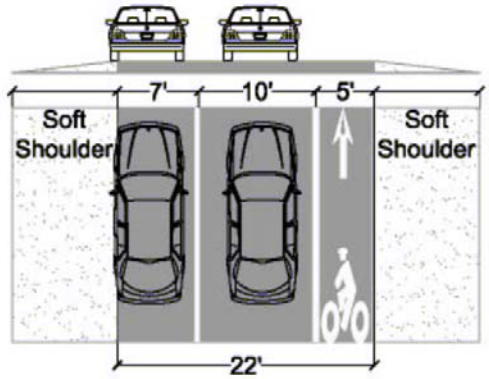
Cross Section Map

Seattle Bicycle Master Plan

3/15/07



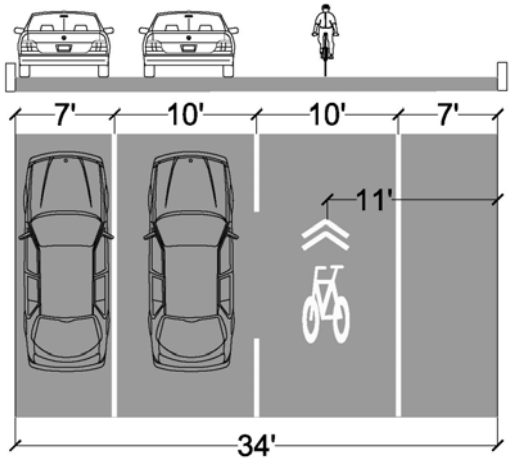
Constrained Cross Sections



A

One Way One Lane with Soft Shoulders – 22'
Additional Considerations

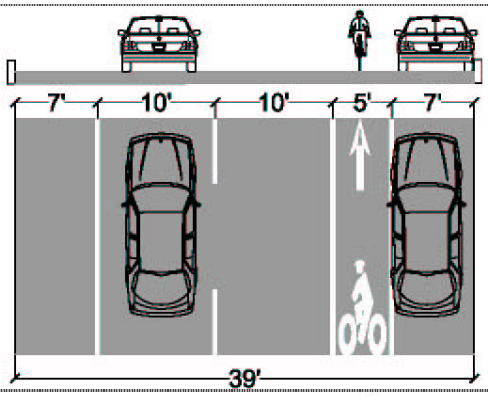
- If parking allowed on shoulder – width of shoulder should equal or exceed 7 feet



B

One Way Two Lane with Parking – 34'
Additional Considerations

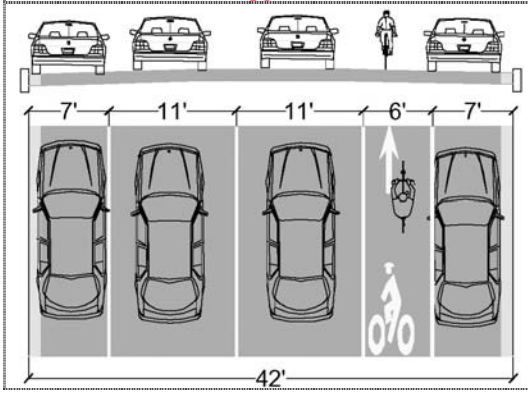
- It may be advisable to place the shared lane marking in the left lane if the predominant flow of bicycle traffic is in the left lane



C

One Way Two Lane with Parking – 39'
Additional Considerations

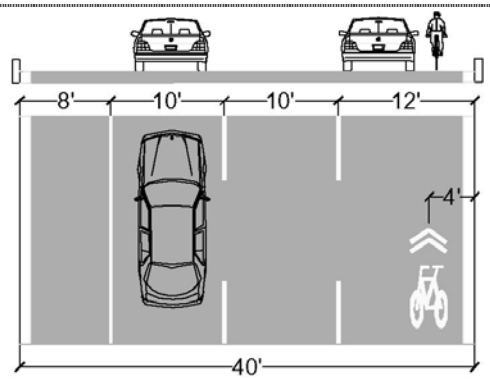
- It may be advisable to utilize a buffered bicycle lane in locations with high parking turnover
- On steep descending grades, it may be more appropriate to utilize a shared travel lane in place of a bicycle lane



C-1

Alternative One Way Two Lane – 42'
Additional Considerations

- It may be advisable to utilize a buffered bicycle lane in locations with high parking turnover
- On steep descending grades, it may be more appropriate to utilize a shared travel lane in place of a bicycle lane

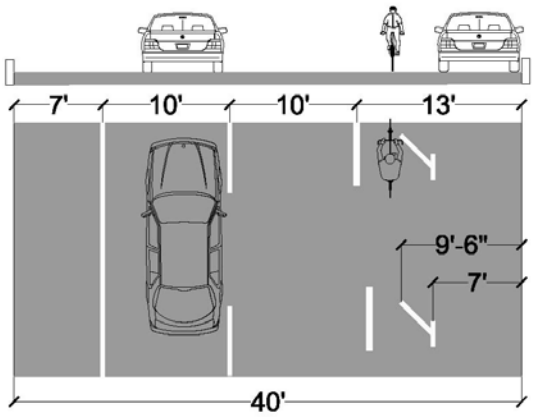


C-2

One Way Three Lane – 40'

Additional Considerations

- If parking allowed in right curb lane, the shared lane marking should not be utilized
- If parking is allowed and restricted – utilize design C-3 instead
- For use of shared lane markings (SLM), see discussion of considerations in this document and in Appendix N

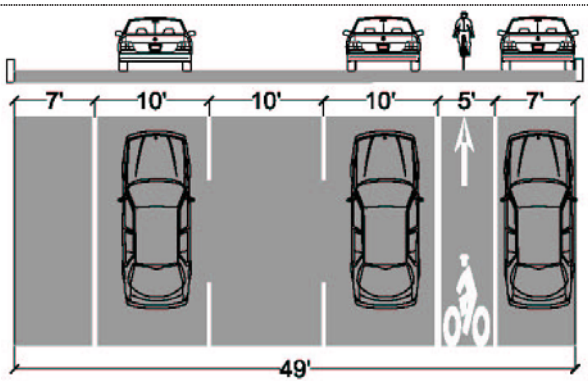


C-3

One Way Two Lane with Peak Hour Restrictions – 40'

Additional Considerations

- This should only be utilized on roadways where parking is restricted in the curb parking lane during rush hour
- The frequency of the tee marking is experimental. It is suggested that the spacing be no more than every 30 feet, with 15 feet as a minimum spacing

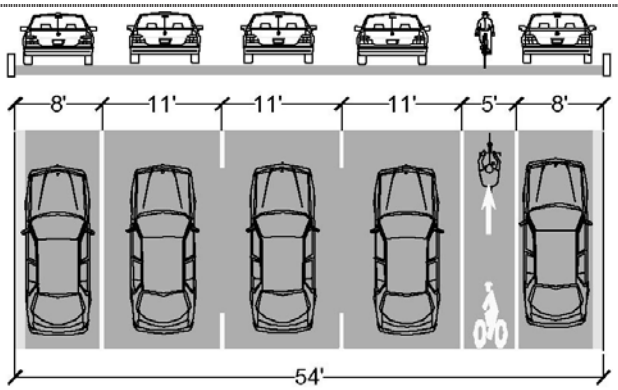


D

One Way Three Lane with Parking – 49'

Additional Considerations

- It may be advisable to utilize a buffered bicycle lane in locations with high parking turnover
- On steep descending grades, it may be more appropriate to utilize a shared travel lane in place of a bicycle lane

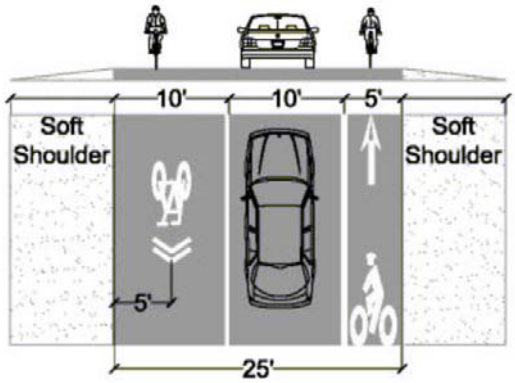


D-1

Alternative One Way Three Lane with Parking – 54'

Additional Considerations

- It may be advisable to utilize a buffered bicycle lane in locations with high parking turnover
- On steep descending grades, it may be more appropriate to utilize a shared travel lane in place of a bicycle lane

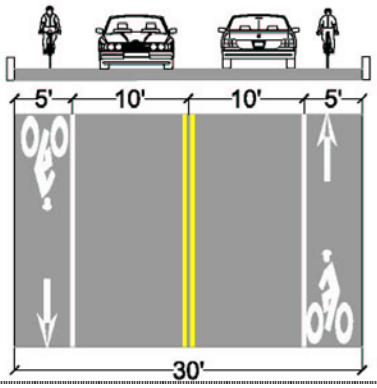


E

Two Way Two Lane – 25'

Additional Considerations

- If parking is allowed on soft shoulder – width of the soft shoulder should equal or exceed 7 feet
- The bicycle lane should be placed on the uphill portion of the roadway
- For use of SLM, see discussion of considerations in this document and in Appendix N
- Equal dimensioned shared lanes are preferred over bicycle lanes on flat sections of roadway (see example E-1)

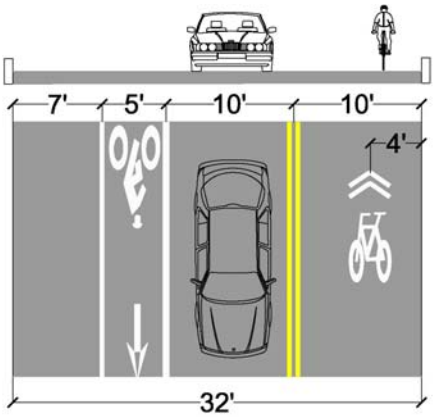


F

Two Way Two Lane – 30'

Additional Considerations

- If the roadway has no curb and parking is allowed on a soft shoulder – width of the soft shoulder should equal or exceed 7 feet

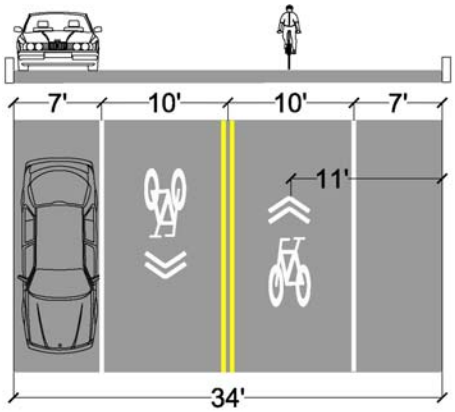


G

Two Way Two Lane with Parking – 32'

Additional Considerations

- It may be advisable to utilize a buffered bicycle lane in locations with high parking turnover
- The bicycle lane adjacent to parking should be placed on the uphill portion of the roadway
- For use of SLM, see discussion of considerations in this document and in Appendix N
- Equal dimensioned shared lanes are preferred over bicycle lanes on flat sections of roadway (see example H-1)

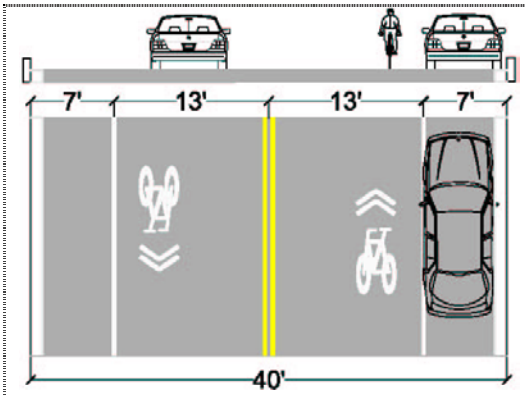


H

Two Way Two Lane with Parking – 34'

Additional Considerations

- Insufficient space to achieve bike lane, use shared lane marking
- For use of SLM, see discussion of considerations in this document and in Appendix N

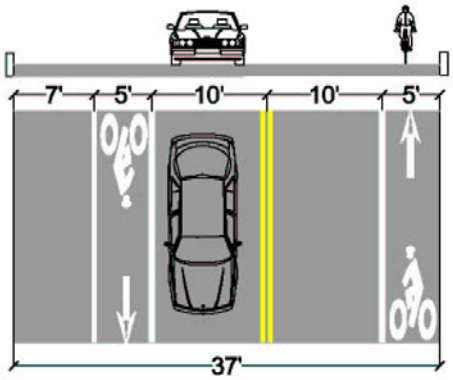


H-1

Two Way Two Lane with Parking – 40'

Additional Considerations

- For use of SLM, see discussion of considerations in this document and in Appendix N
- Climbing lanes are preferred over shared lanes on hilly sections of roadway – see example H
- On flat sections of roadway, this cross section is preferred over climbing lanes (H).

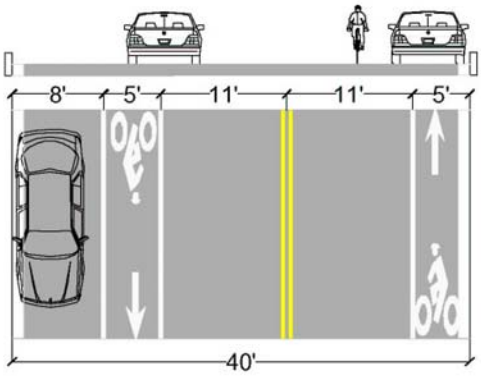


I

Two Way Two Lane with Parking on One Side – 37'

Additional Considerations

- It may be advisable to utilize a buffered bicycle lane in locations with high parking turnover
- The bicycle lane should be placed on the uphill portion of the roadway
- It is preferable to locate parking on the uphill side of the roadway (unless this would cause a significant increase in pedestrian crossings)

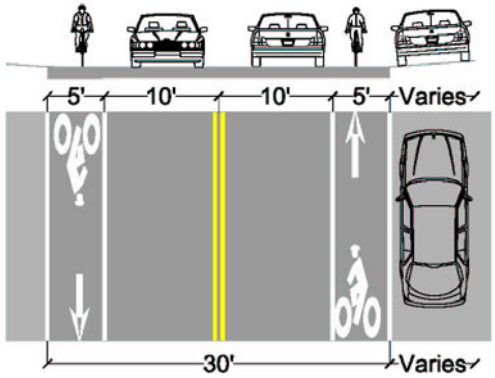


I-1

Two Way Two Lane with Parking on One Side – 40'

Additional Considerations

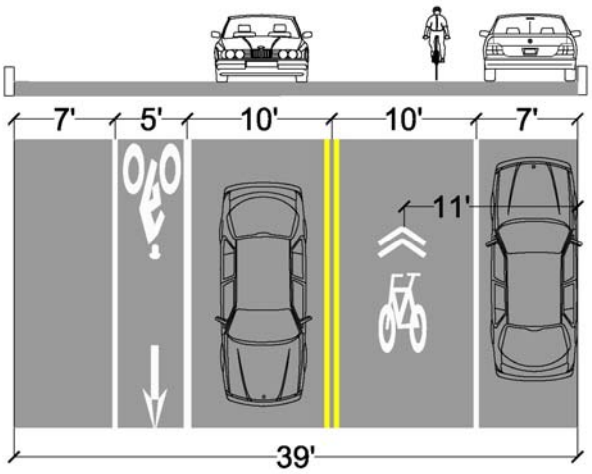
- It may be advisable to utilize a buffered bicycle lane in locations with high parking turnover
- The bicycle lane adjacent to parking should be placed on the uphill portion of the roadway
- If the roadway has no curb and parking is allowed on a soft shoulder – width of the soft shoulder should equal or exceed 7 feet



I-2

Two Way Two Lane with Soft Shoulders
Additional Considerations

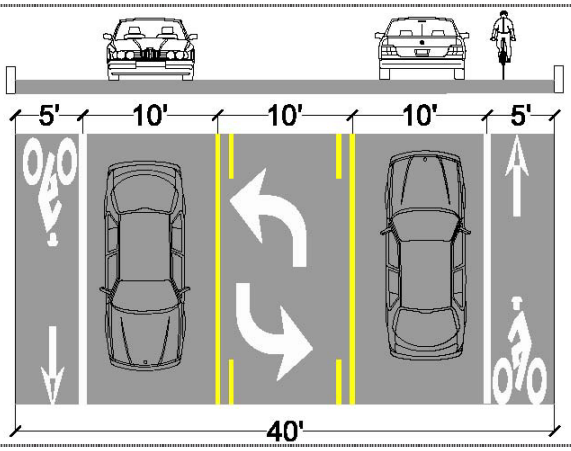
- If parking allowed on shoulder – width of shoulder should equal or exceed 7 feet



J

Two Way Two Lane with Parking – 39'
Additional Considerations

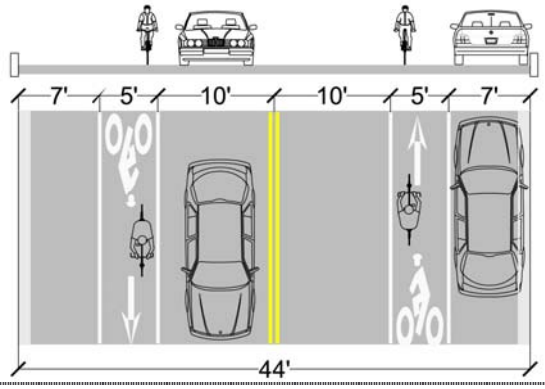
- It may be advisable to utilize a buffered bicycle lane in locations with high parking turnover
- The bicycle lane adjacent to parking should be placed on the uphill portion of the roadway
- For use of SLM, see discussion of considerations in this document and in Appendix N
- Equal dimensioned shared lanes are preferred over bicycle lanes on flat sections of roadway (see example H-1)



K

Two Way with Center Turn Lane – 40'
Additional Considerations

- The use of a 10' center turn lane should be avoided on roadways with high volumes of turning heavy vehicle traffic
- If the roadway has no curb and parking is allowed on a soft shoulder – width of the soft shoulder should equal or exceed 7 feet

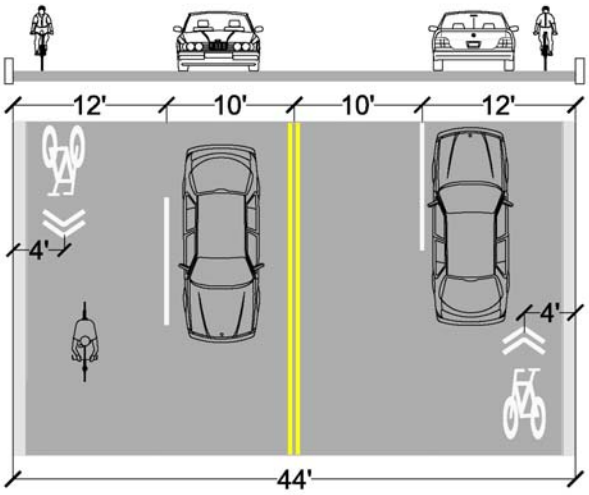


L

Two Way Two Lane with Parking – 44'

Additional Considerations

- It may be advisable to utilize a buffered bicycle lane in locations with high parking turnover
- It may be advisable to utilize a shared travel lane in locations with high parking turnover on steep grades

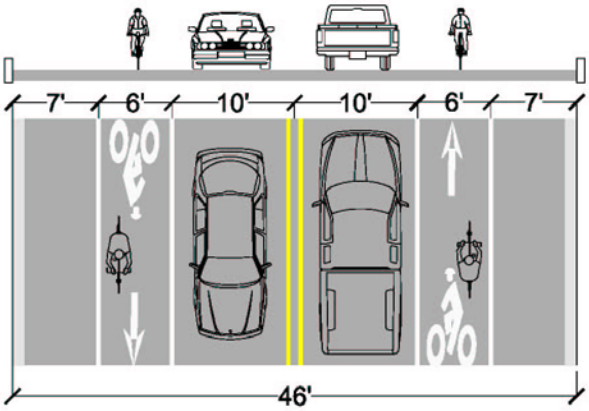


L-1

Two Way Four Lane– 44'

Additional Considerations

- If parking allowed in right curb lane, the shared lane marking should not be utilized
- If parking is allowed and restricted – utilize design C-3 instead
- For use of SLM, see discussion of considerations in this document and in Appendix N

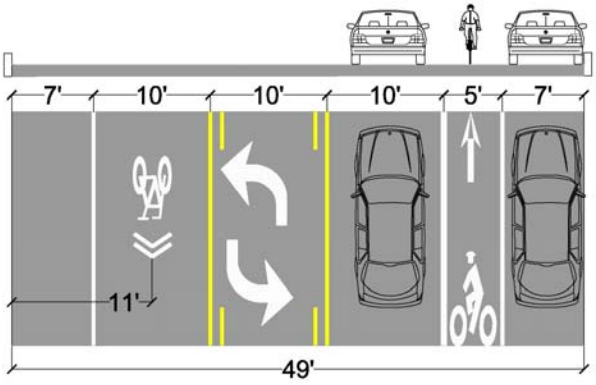


L-2

Two Way Two Lane with Parking – 46'

Additional Considerations

- It may be advisable to utilize a buffered bicycle lane in locations with high parking turnover
- It may be advisable to utilize a shared travel lane in locations with high parking turnover on steep grades
- The narrow travel lanes may be appropriate in locations that require additional traffic calming
- On truck or bus routes, it may be advisable to utilize 11' travel lanes and 5' bicycle lanes

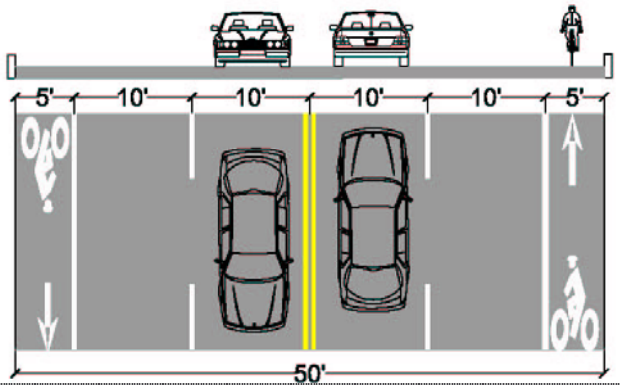


M

Two Way with Center Turn Lane and Parking – 49'

Additional Considerations

- It may be advisable to utilize a buffered bicycle lane in locations with high parking turnover
- The bicycle lane adjacent to parking should be placed on the uphill portion of the roadway
- The use of a 10' center turn lane should be avoided on roadways with high volumes of turning heavy vehicle traffic
- For use of SLM, see discussion of considerations in this document and in Appendix N
- Equal dimensioned shared lanes are preferred over bicycle lanes on flat sections of roadway (see example H-1)

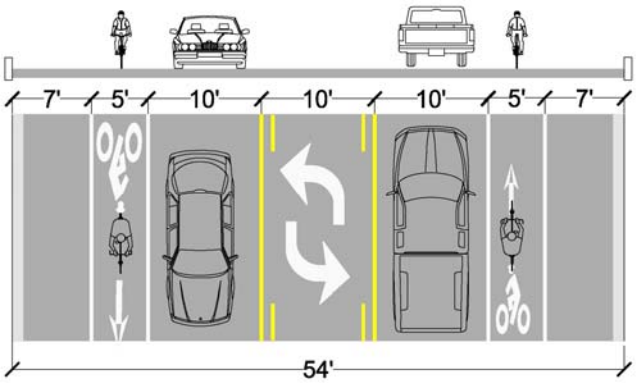


N

Two Way Four Lane

Additional Considerations

- If the roadway has no curb and parking is allowed on a soft shoulder – width of the soft shoulder should equal or exceed 7 feet

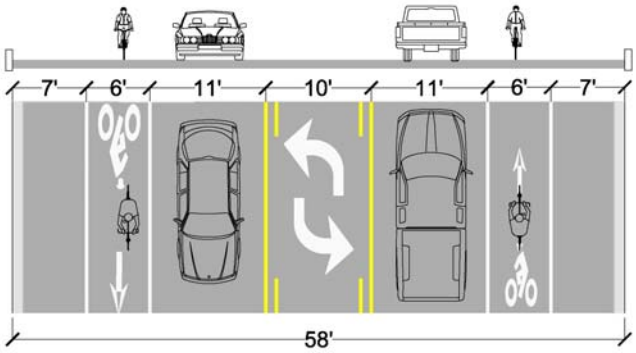


O

Two Way with Center Turn Lane and Parking – 54'

Additional Considerations

- It may be advisable to utilize a buffered bicycle lane in locations with high parking turnover
- It may be advisable to utilize a shared travel lane in locations with high parking turnover on steep grades
- The use of a 10' center turn lane should be avoided on roadways with high volumes of turning heavy vehicle traffic

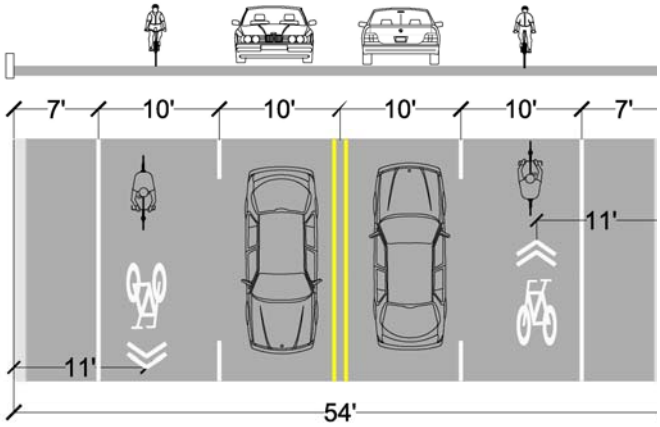


O-1

Two Way with Center Turn Lane and Parking – 58'

Additional Considerations

- It may be advisable to utilize a buffered bicycle lane in locations with high parking turnover
- It may be advisable to utilize a shared travel lane in locations with high parking turnover on steep grades
- The use of a 10' center turn lane should be avoided on roadways with high volumes of turning heavy vehicle traffic

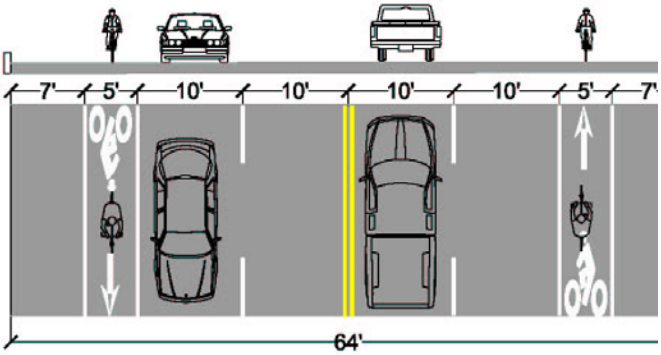


O-2

Two Way Four Lane with Parking – 54'

Additional Considerations

- For use of SLM, see discussion of considerations in this document and in Appendix N



P

Two Way Four Lane with Parking – 64'

Additional Considerations

- It may be advisable to utilize a buffered bicycle lane in locations with high parking turnover
- It may be advisable to utilize a shared travel lane in locations with high parking turnover on steep grades