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BELLINGHAM

Chapter 4

Chapter 4: Design and Maintenance Guidance

Chapter 4 provides recommended guidance on bicycle facility design and maintenance practices. It includes a discussion of the existing standards that guide street design in Bellingham followed by descriptions of bicycle facility types and intersection treatments that are new or uncommon in the City. Detailed design considerations including design guidance for travel lane widths, corner curb radii and wayfinding are presented in Appendix E.

Public Works Development Guidelines and Improvement Standards

Currently, street design in Bellingham is guided by the *Public Works Development Guidelines and Improvements Standards*, which were adopted in 2001[1]. The guidelines contain provisions for development and improvement of bicycle facilities, including:

- standards
- signs, signals, and markings
- roadway facilities
- bicycle lanes
- bicycle parking

These design guidelines were developed based on the AASHTO Guide for the Development of Bicycle Facilities, the Manual on Uniform Traffic Control Devices (MUTCD), and the Washington State Department of Transportation Design Manual. For local roadways, WSDOT instructs local jurisdictions to use the latest addition of the AASHTO Guide for the Development of Bicycle Facilities.

It is recommended that the existing guidelines and the AASHTO Guide for the Development of Bicycle Facilities should continue to be used in the development of bicycle facilities. Additionally, the National Association of City Transportation Officials (NACTO) Urban Bikeway Design Guide provides guidance based on current best practices used in municipalities. The Federal Highway Administration (FHWA) issued a memorandum in 2013 officially supporting its use. Those documents are not intended to be replaced by the guidance presented here; however, there are instances where additional guidance will be useful in implementing this Plan. This guidance is presented for consideration and possible integration into the Bellingham Public Works Development Guidelines and Improvements Standards. In all cases, the recommendations in this chapter are consistent with current Federal Highway Administration (FHWA) guidance and recommendations.

[1] Bellingham Public Works Development Guidelines and Improvement Standards, Section 4-13.30.

Bicycle Facility Types

Bicycle Boulevards

Definition

A bicycle boulevard is a local street or a series of contiguous street segments that has been designed to function as a through street for bicyclists, while discouraging automobile through-trips. Local access for motor vehicles is maintained. Bicycle boulevards create favorable conditions for bicycling by taking advantage of neighborhood streets and their inherently bicycle- friendly characteristics, including low traffic volumes and vehicle speeds. In addition to traffic calming improvements that discourage automobile trips along bicycle boulevards, it is often necessary to make physical and operational improvements to intersections where bicycle boulevards meet arterial streets.

Applicability and Use

- Bicycle boulevards are typically developed along neighborhood streets and may serve as cross-city routes or as a segment of a bike route that includes other protected facility types (e.g., off-street trails or separated on-street facilities).
- A bicycle boulevard may also be developed as a parallel, alternative to a busier street within the same district, but should generally not be provided in lieu of facilities on the busier street if that street is a more direct route to important destinations.
- Bicycle boulevards can also be used to provide a short connection between a neighborhood and a key destination, such as a school.
- Traffic calming on bicycle boulevards only applies to residential streets; on arterial streets, bicycle boulevards are designated by wayfinding signs or shared lane markings.

Buffered Bike Lanes

Definition

Similar to bike lanes, buffered bike lanes provide an exclusive space for bicyclists, with the addition of a buffer space separating the bicycle lane from the adjacent motor vehicle travel or parking lane.

Applicability and Use

- Provides greater shy distance between motor vehicles and bicyclists.
- Provides space for bicyclists to pass one another without encroaching into the adjacent motor vehicle travel lane.
- Encourages bicyclists to ride outside of the door zone when the buffer is between parked cars and the bike lane.
- Provides a greater space for bicycling without making the bike lane appear so wide that it might be mistaken for a travel lane or a parking lane.
- Appeals to a wider cross-section of existing and potential bicycle users.

Climbing Lanes

Definition

Climbing lanes are bike lanes that are provided only on the uphill side of streets. Bicyclists travelling uphill move significantly slower than adjacent traffic, and therefore benefit from the presence of a separated lane.

Applicability and Use

Climbing lanes may be used on any street with an appreciable grade and insufficient space for bicycle lanes on both sides of the street. Climbing lanes should be strongly considered where the grade is greater than 7.5% or sustained for a length more than 1,000 feet. Climbing lanes are not appropriate on streets where there are short, rolling hills because the lanes would stop and start too often, possibly confusing bicyclists and motorists with the associated lane shifts and transitions. Climbing lanes are beneficial to bicyclists and motorists for the following reasons:

- Allow motorists to safely pass uphill riding bicyclists.
- Provide a dedicated space in the street for bicyclists who may tend towards weaving behavior as they negotiate the hill.
- Improves motorists' line of sight at pedestrian crossings located on the hilltop.

Shared Lane Markings

Definition

From a practical point of view all vehicle travel lanes within a street may be considered shared lanes except where bicycles are prohibited (e.g. limited access freeways). Shared lanes may be unmarked or marked using shared lane markings (sometimes referred to as sharrows).

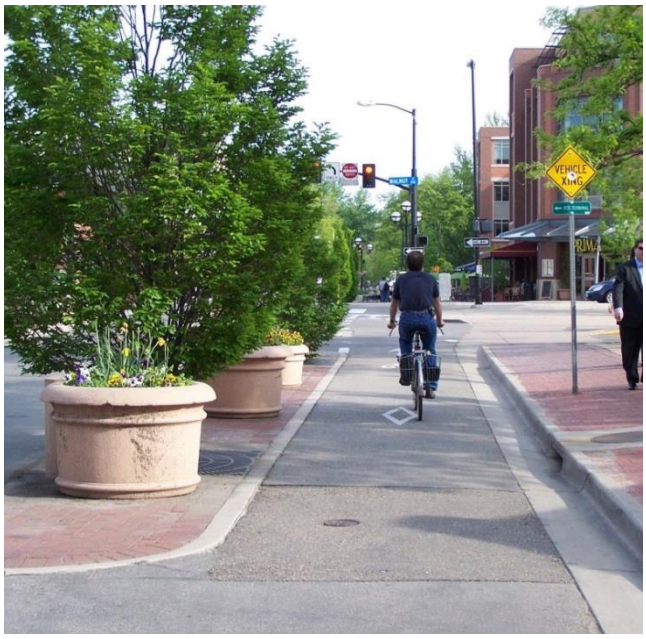
Applicability and Use

Shared lane markings alert motorists of the likely presence and positioning of bicyclists within the travel lane, encourage safe passing of bicyclists, and indicate to bicyclists where to position themselves within the travel lane. Shared lane markings may also be used as a wayfinding tool.

Shared lane markings may be considered in the following situations:

- On arterial streets where space constraints and operations make it unfeasible to provide a dedicated bike facility such as a bike lane or cycle track.
- On arterial street sections where gaps exist between two other bicycle facility types to create an on-street bike network connection.
- On bicycle boulevards as a form of on-street wayfinding.
- On arterial streets with on-street parking, to help position bicyclists to avoid collisions with car doors opening into the travel lane.
- On arterial streets with downhill grades paired with a dedicated uphill climbing lane.

Cycle Tracks



Definition

Cycle tracks have several different forms but share common elements—they provide space that is intended to be exclusively or primarily used for bicycles, and are separated from motor vehicle travel lanes, parking lanes, and sidewalks. Cycle tracks may be one-way or two-way facilities. One-way facilities are also known as Protected Bike Lanes. Cycle tracks are generally located in the roadway, separated from adjacent travel lanes by a buffer, a median, a vertical element such as flexible posts, or a parking lane.

Applicability and Use

By separating bicyclists from motor traffic, cycle tracks can offer a higher level of security than bike lanes and are thus attractive to bicyclists with a wider range of abilities and preferences. Typical applications for cycle tracks include:

- Streets with high bicycle volumes.
- Streets on which bike lanes would cause all but the most skilled bicyclists to feel stress because of factors such as multiple lanes, high traffic volumes, higher speed traffic, high incidence of illegal parking in the bike lane, and high parking turnover.
- Recreational corridors, scenic corridors, or parkways that are part of a regional trail system.

Cycle tracks may be one-way or two-way. In general, one-way cycle tracks should be provided on both sides of a two-way street unless there is a parallel route nearby. Two-way cycle tracks may be appropriate for the following situations:

- Streets with fewer conflicts such as driveways or cross- streets on one side of the street.
- Streets where there is not enough room for a one-way cycle track on both sides of the street.
- One-way streets where contra-flow bicycle travel is desired for connectivity purposes.
- Streets where more destinations are on one side thereby reducing the need to cross the street.
- Streets that intersect with another bicycle facility, such as a cycle track or multi-use trail.

Crossing Treatments

Bike Lanes at Intersections

Definition

Intersections are where most conflicts between bicyclists and motorists occur. Complicated or busy intersections can act as barriers to less confident bicyclists, especially if they are not designed in a way that makes it clear how and where bicyclists and motorists are intended to travel. Design innovations such as green bike lanes, bike boxes, and bicycle signals can make traveling through an intersection more comfortable for all modes.

Applicability and Use

On streets with existing or planned bike lanes, the bike lane pavement markings should continue all the way to the intersection. At intersections without bike lanes, shared lane markings may be used to indicate proper positioning for bicyclists waiting for a green light or passing through the intersection. Green bike lanes are bike lanes that use color to define an area where there is an increased risk of crash between a bicyclists and a motorist. The color helps to improve visibility of the conflict zone. Green bike lanes or a dashed stripe may also be used to direct bicyclists through the intersection. Bike boxes (described in more detail in Appendix D) allow bicyclists to move to the front of the queue, making them more visible and improving their ability to safely execute a left turn or clear an intersection during the green phase.

Right Turns

Right turns are relatively easy for bicyclists, since they typically ride on the right side of the street. Where there is a right-turn only lane, right-turning bicyclists are typically encouraged to merge with right-turning motor vehicles.

Through Movements

Through-moving bicyclists may be vulnerable to right-turning motor vehicles crossing over the bike lane (often referred to as a “right hook” conflict). Where there is no designated right-turn only lane, the bike lane marking should extend to the intersection. Where there is a right-turn-only lane, there are several considerations:

- Where there is adequate width to continue the bike lane marking up to the intersection, the bike lane should be marked to the left of the right-turn only lane. This will enable right-turning motorists to enter the turn lane in advance of the intersection, avoiding last-moment conflicts.

- Where there is not adequate width to continue the bike lane marking up to the intersection, shared lane markings may be incorporated at the left edge of the right-turn lane or in the through lane.

Additional treatments such as green bike lanes and signage may be used to raise both motorists' and bicyclists' awareness of potential conflict points.

Left Turns

A separate bicycle left-turn lane should be provided where there are considerable volumes of left-turning bicyclists, or where a designated or preferred bicycle route turns left. Left-turn lanes may also be appropriate at locations where left turns are allowed for bicyclists but not motorists (e.g. onto a bicycle boulevard or shared use path). A green bike box may be used at a signalized intersection to facilitate bicyclists making left turns, to create space for multiple bicycles to cue (in places where bicycle volumes are high), and to raise awareness that bicyclists may be present.

Roundabouts

Roundabouts provide non-signalized traffic control at intersections. They typically include a one- or two-lane roadway that encircles a central island around which vehicles travel counterclockwise. Continuing bicycle lanes through roundabouts has not been shown to improve safety. Rather, bicycle lanes should terminate in advance of crosswalks at roundabouts, providing sufficient space for bicyclists to merge with motor vehicles. The installation of shared lane markings at the entrance to roundabouts informs bicyclists of proper lane positioning while riding through the roundabout and alerts motorists to expect merging bicyclists. Providing ramps up to the sidewalk allows bicyclists the option of navigating the roundabout as a pedestrian.

Intersection Median Barrier

Definition

Intersection median barriers are raised curbs or islands that extend along a street, preventing vehicles from making U-turns or left turns from cross streets. Intersection median barriers are primarily used as a traffic management technique in places with significant cut-through traffic on neighborhood streets. They are also used in cases where left-turn movements create a safety concern. The median barrier is typically placed on the street with higher traffic volumes. Median barriers can improve safety and convenience for bicyclists and pedestrians when crossing refuges are installed, and are often used in conjunction with bicycle boulevards.

Applicability and Use

Intersection median barriers are a type of traffic diversion and should be used only after a complete traffic analysis. This treatment may be considered in the following locations:

- Where cut-through traffic on a neighborhood street has been observed to be a problem.
- Where analysis of traffic patterns in the area shows that cut-through traffic would not be diverted to a nearby street.
- Where local residents would not have to drive excessive distances to access their homes. Excessive distance may be defined during the planning process, but generally residents should not have to drive more than a quarter mile (total distance) beyond the direct route.
- Where there are bicycle/pedestrian priority routes (i.e. Bicycle Boulevards). Intersection median barriers not only reduce motor vehicle volumes on residential streets, making these streets safer and more comfortable for biking and walking, but also provide an opportunity to enhance crossings of higher volume and speed roadways.
- Where emergency response times are not negatively impacted (see Appendix E).

Rectangular Rapid Flashing Beacons

Definition

A Rectangular Rapid Flashing Beacons (RRFB) is a pedestrian warning signal consisting of yellow LED lights in two rectangular clusters, or beacons, that employ a stutter-flash pattern similar to that used on emergency vehicles. The beacons are often mounted below a standard pedestrian crossing warning sign and above the arrow plaque used to indicate the crossing location. RRFBs are actuated either by a push-button or passive detection.

Applicability and Use

- RRFBs may be used at uncontrolled intersections and mid-block crossings.
- RRFBs should be considered at uncontrolled intersections or at mid-block crossings where additional measures are needed due to high volumes and speeds.
- They should be considered where there are high volumes of pedestrians or bicyclists, a high number of vulnerable pedestrians (e.g. near schools, senior centers), or at off-street path crossings.

HAWK Signal

Definition

"HAWK" stands for High-intensity Activated crossWalK and is also referred to as a pedestrian hybrid beacon. A HAWK signal is a push button-activated pedestrian and bicycle signal that increases pedestrian and bicycle safety at crossings while stopping vehicle traffic only as needed. The following describes how a HAWK signal works:

- The signal will remain dark until a pedestrian activates the walk indication by pushing a button.
- The signal will then turn to a flashing yellow to warn drivers that a pedestrian or bicyclist will begin using the crosswalk.
- The signal will then turn to a steady yellow advising drivers the signal is about to turn red.
- The signal will then turn to a solid red, requiring vehicles to stop at the stop line. The pedestrian or bicyclist will see the walk indication and proceed into the crosswalk.
- Once the walk time is completed, the signal will flash red. This lets the driver know that once they come to a complete stop they may proceed through the intersection if there are no pedestrians or bicyclists in the crosswalk.

Once the walk indication has returned to "Don't Walk", the signal will return to the dark or "off" position until the push button is activated again.

Applicability and Use

HAWK signals may be used at mid-block crossings (including off-street path crossings) and should be considered at crossings where high traffic volumes and speeds make it difficult for pedestrians and bicyclists to cross the street, and where 'warrants' for a conventional signal are not met. HAWK signals provide a protected crossing while allowing vehicles to proceed through a pedestrian/bicycle crossing as soon as it is clear, thus minimizing vehicle delay. HAWK signals may also provide audible information for visually impaired pedestrians.

Bicycle-Activated Signal Push Button

Signals specifically intended for pedestrian and bicycle street crossings such as midblock or HAWK signals may require special activation. Bicycle-activated push buttons are a separate push button located along the curb or location easily accessed by bicyclists. Bicycle activated push buttons allow bicyclists to activate the signal without having to change their course of travel, dismount or detour onto the sidewalk to use a pedestrian pushbutton. This improves convenience, compliance and efficacy of the signal. The disadvantage of push buttons is that they are challenging for bicyclists wanting to make a left turn. The following design considerations should be taken into account:

- Place push button within reach of the curb but with appropriate setbacks to avoid being hit by passing motor vehicles.
- Push buttons work well on streets without parking or where there are parking restrictions at the approach to the intersection.
- Use a large button for easy actuation by bicyclists.
- Placement of the push button assembly and bicycle queuing should take right-turning motor vehicles into consideration.

Bicycle Detection Pavement Markings

Definition

Bicycle detection is used at actuated signals (signals that are user-activated by pavement sensor/loops, video, or push buttons) to alert the signal controller of bicycle crossing demand on a particular approach. Bicycle pavement markings may be used to show where a bicyclist should stop to trigger a demand-actuated signal.

Applicability and Use

For installation of signal detection markings, signal equipment should be investigated first to ensure that it can detect bicycles. When installing roadway markings, consider the following priorities:

- Place detector markings at all new and upgraded signals with loop detectors.
- Systematically adjust sensitivity and add pavement markings at all signals along existing and new bicycle routes.
- Investigate and adjust (if possible) signal sensitivity and add markings at locations requested by the public.

Placement of bicycle detector markings should consider the following:

- The bicycle detector symbol should be placed in the optimum location for the bicycle to actuate the signal.
- The detection zones and markings should be placed within the pathway of bicycles so that they do not have to maneuver into a different position within the lane in order to be detected.
- If bicyclists are expected to use multiple lanes of a roadway (e.g. right and left turn lanes) provide detection and markings in multiple lanes.

Bicycle Parking

Definition

Conveniently located bicycle parking is an important element of a multimodal transportation system because it allows bicyclists to secure their bicycles at their intended destination, whether that is their place of work, a local business or attraction, or a transit station. Bicycle parking may be provided in a variety of forms depending on whether it is for short-term or long-term use (e.g. a brief shopping stop, or an all-day event). Short-term parking may consist of individual or multiple bike racks placed within the furniture or building frontage zones on a sidewalk or, in high-capacity corrals placed within the street itself (where there is a defined motor vehicle parking lane). Long- term parking may consist of racks or an array of racks that may be sheltered and placed in off-street locations such as parking garages/lots or transit station entrances (e.g. cages, sheltered corrals). Long-term parking may be access controlled.

Applicability and Use

- Well-designed and placed bicycle parking promotes a more orderly streetscape, preserves the pedestrian right-of-way and prevents damage to trees and street furniture.
- Bicycle parking should be conveniently placed within close proximity to destinations such as businesses, parks, schools and other community facilities, and major transit stops and stations.
- In general, placing one or two racks at multiple locations along a block face is preferred to grouping all the racks at one location. In order to ensure that there is adequate parking to meet demand, parking utilization should be periodically assessed, and additional parking should be provided where demand is high.
- In areas with high bicycle parking demand and limited sidewalk space, in-street corrals or other high capacity bike rack designs may be considered. This treatment will require a right-of-way permit. Curb extensions may present an opportunity for bicycle rack installation.

Maintenance of Bicycle Facilities

In every context, roadway surfaces deteriorate and debris accumulates over time. If these conditions are not addressed in a timely manner, a high-quality facility may become unusable for bicyclists. Furthermore, surface conditions that are satisfactory for motorists may be hazards for bicyclists. These issues can be easily managed through an effective maintenance program. While the safety of all roadway users is a top priority, a good maintenance program will also help conserve public resources since facilities may need to be replaced or renovated less often.

Funds should be budgeted appropriately so that facilities are sufficiently maintained. The City should seek to establish standards and a regular schedule for inspection and maintenance of facilities. Environmentally-friendly maintenance practices, including removing debris in a timely manner, should be implemented with consideration for stormwater runoff. As bicyclists are often the first to observe facilities that need attention, the City should continue to respond to and document public input regarding maintenance issues. This will help in identifying recurring problems and setting maintenance priorities. Further guidance on roadway maintenance can be found in the AASHTO Guide for Development of Bicycle Facilities.

Pavement Overlays

Overlays provide an excellent opportunity to improve bikeway conditions if executed appropriately. Special caution should be taken to ensure that no seam is left in the roadway space designated for bicyclists (or in areas where bicyclists are expected to ride in the case of shared roads). In addition to ensuring an even and well-marked surface for cyclists, overlays are a practical occasion to consider widening the roadway, especially in areas with planned paved shoulders, such as sections of the Urban Growth Area. Pavement overlays present the opportunity to:

- Create bike lanes and other bicycle facilities
- Install signal sensors that can detect the presence of bicycles
- Consider bigger projects such as road diets

Pavement Marking Maintenance

All markings should be maintained in a legible condition so they can be easily interpreted by all roadway users, including motorists. While newly installed markings are highly visible, they may fade over time, greatly reducing their perceptibility, especially at night. The following strategies apply to pavement marking maintenance:

- Establish routine marking inspections, including assessing visibility at night.
- Markings should be replaced on an as needed basis, with substandard markings being replaced as soon as possible. Markings in high-use areas may need restriping more than once a year.
- Roadways where markings don't follow City design guidelines should be updated to current standards as part of regular maintenance.
- Transitions to county roadways should be evaluated, especially at frequently traveled routes in and out of the city. Coordination with the County may be necessary.
- Consider the cost of using more durable materials such as thermoplastic versus more frequent maintenance of less durable materials such as paint.

Street Sweeping

Streets may feature high-quality bicycle facilities; however, if these facilities are strewn with gravel, sand, or other debris, they become far less safe and attractive to users. As a part of routine maintenance, roadways should be swept to remove any litter. When sweeping vehicle lanes, bicycle lanes or sidewalks, debris should not be swept from one facility to the other. Debris can be removed from roadways with curbs through the use of vehicles that vacuum the debris, while uncurbed roads can be swept. The following recommendations apply to street sweeping:

- All bicycle facilities should be swept routinely. Identifying routes of particular importance will help ensure greater rider comfort. Facilities that may require more frequent sweeping include popular commuter or recreational corridors and roadways that regularly build up debris.
- Establish a sweeping schedule for facilities that anticipates both routine and irregular sweeping needs. Routine sweeping schedules may occur at regular intervals, with greater frequency seasonally. Strategies for inspection and sweeping after unanticipated events should also be established. These events may include flooding, storm events, or vandalism.
- Sweep project area after roadway repairs.
- Continue to update priority routes for street sweeping as new facilities are constructed.
- Reduce the volume of debris on roadways through ordinances that require parties responsible for debris to contain it. Possible requirements include paving gravel and dirt driveway approaches, tarps on trucks loaded with gravel or sand, or clean up after construction operations that leave gravel and dirt on the roadway.

Surface Repairs

Pavement surface condition significantly affects the quality of a bicycle facility, and poor surfaces can deter riders. Defects such as longitudinal cracks or joints, potholes, and root heaves among others can degrade riding conditions considerably. The following recommendations apply to maintaining the surfaces of bicycle facilities:

- Perform routine assessments of roadway surfaces for abnormalities. Make the necessary repairs in a timely manner after observing or receiving comment of any abnormality.

- Correct any pavement edges, seams, or potholes. Keep in mind that bicyclists have a higher level of sensitivity to these surface irregularities during the overlay process.
- In order to avoid leaving an edge or seam on the surface of a bicycle facility, have the overlay encompass the whole roadway surface when possible.
- As funding allows, replace parallel-slatted drain grates with bicycle-safe grates. Prioritize replacements on routes with bicycle facilities. Install bicycle-safe grates on all new projects.
- Use overlays as an opportunity to complete multiple projects at once. Projects that might be completed in conjunction with an overlay include road widening or paving approaches to unimproved road and driveway connections.
- Ensure that surface repairs do not result in seams running longitudinally through bicycle facilities or areas which are anticipated to have high ridership.
- In order to lessen inconvenience to bicyclists and extend the lifecycle of bicycle facilities, carry out preventative maintenance on a consistent basis. Preventative maintenance may include eliminating intrusive tree roots, placing root barriers, selecting paving materials with longer lifecycles, and removing debris from storm drains.

Additional Street Design Resources

The following list provides information on where to find additional bicycle facility and street design guidance. Important design guidance not included above includes bike lanes which can be found in Appendix E, and wayfinding, in Appendix F. Information regarding traffic calming, can be found in PEDSAFE (see below).

- **PEDSAFE** (http://www.walkinginfo.org/pedsafe/)
- **BIKESAFE** (http://www.bicyclinginfo.org/bikesafe/)
- **NACTO Bikeway Design Guide** (http://nacto.org/cities-for-cycling/design-guide/)
- **MUTCD** (http://mutcd.fhwa.dot.gov/)
- **APBP Bicycle Parking Guide** (http://www.apbp.org/?page=publications)
- **AASHTO Guide for the Development of Bicycle Facilities** (https://bookstore.transportation.org/item_details.aspx?ID=1943)