APPENDIX E: BICYCLE FACILITY DESCRIPTIONS

This appendix provides general descriptions of the types of bicycle facilities recommended for the Seattle Bicycle Facility Network. There are two main categories of facilities: facilities for network segments and facilities for roadway crossings. Additional design details for these facilities are provided in Appendix F and Appendix H.

Types of Facilities for Network Segments

The Bicycle Facility Network includes a variety of on- and off-road bicycle facilities. On-road bicycle facilities serve several purposes, including designating roadway space for bicyclists, channelizing motor vehicles and bicyclists, making bicyclist movements more predictable, indicating the proper direction for bicyclists to travel on the roadway, and indicating the optimal location on the street for riding at mid-block locations and when approaching intersections. Off-road bicycle facilities, including multi-purpose trails and sidepaths, provide a space for bicyclists to be physically separated from roadway traffic. The specific types of facilities that are recommended on each segment of the network depend on a wide range of factors, including:

- Surrounding land uses and connectivity to destinations
- Existing right-of-way space
- Number of travel lanes
- Travel lane width
- Traffic volume
- Traffic speed
- Traffic composition (presence of buses and large trucks)
- Presence of on-street parking
- Pedestrian activity

Bicycle facilities are recommended for segments in the Network are described below. Additional detail is provided in Appendix F: Guidance for Retrofitting Seattle Streets to Create Dedicated Bicycle Facilities and Appendix H: Roadway Crossing Design for Bicycles.

<u>Bicycle Lanes</u>
A bicycle lane is a portion of the roadway that has been designated by striping, signing, and pavement markings for the preferential use of bicyclists. The minimum width for a bicycle lane next to parked cars is five feet (four feet if next to a curb). Bicycle lanes include a bicycle pavement marking with an arrow to indicate that bicyclists should ride in the same direction as adjacent motor vehicle traffic. These facilities are recommended for arterial roadways in Seattle. Bicycle lanes provide the following benefits:

- Increase the comfort of bicyclists on roadways
- Increase the amount of lateral separation between motor vehicles and bicycles
- Indicate the most appropriate location to ride on the roadway with respect to moving traffic and parked cars, both at mid-block and approaching intersections
- Increase the capacity of roadways that carry mixed bicycle and motor vehicle traffic
- Make bicyclist and motorist movements more predictable
- Make drivers more aware of bicyclists while driving and when opening doors from an on-street parking space

When on-street parking exists, bicycle lanes should be designed so that bicyclists are encouraged to ride far enough away from parked cars so that they are not at risk of being struck by opening doors. Further, bicycle lanes should not be placed between parked cars and the curb, for the following reasons:

- Motor vehicles entering the arterial roadway from a side street must cross through the bicycle pathway to view arterial roadway traffic around the parked cars. This takes driver attention away from bicyclists and blocks the bicycle pathway.
- To make a left turn, bicyclists must merge into the travel lanes from behind a line of parked cars, creating a situation with poor sight lines between motorists and bicyclists. If parking is fully-utilized, this may not even be possible.
- Motor vehicle passengers are not accustomed to looking for bicyclists when they open their doors on the right side of the vehicle.
- If the facility is a two-way bicycle pathway, bicyclists are encouraged to ride in the opposite direction of adjacent motor vehicle traffic, making them vulnerable to motor vehicle drivers who only look to their left when turning right from a side street.
- Roadway space is not used efficiently. Roadways with on-street parking require some space for car doors to open safely. This space is needed along both sides of the road on the driver's side of parked cars. When one line of cars is moved away from the curb to make room for the bicycle facility, several feet of shy distance are needed on both sides of that line of parked cars, rather than just on the drivers side. Overall, more roadway space is needed for car doors to open, so less space can be used for other purposes.

Shared Lane Pavement Markings

Shared lane pavement markings (or "sharrows") are bicycle symbols that are placed in the roadway lane. Unlike bicycle lanes, they do not designate a particular part of the roadway for the use of bicyclists. The bicycle symbols used in shared lane pavement markings include chevrons pointing in the direction motor vehicle traffic to indicate that bicyclists should also ride in this direction. Shared lane pavement markings have the following benefits:

- Provide a visible cue to bicyclists and motorists that bicycles are to be expected and welcomed on the roadway
- Indicate the most appropriate location to ride on the roadway with respect to moving traffic and parked cars
- Can be used on roadways where there is not enough space for standard four- or five-foot-wide bicycle lanes
- Connect gaps between other bicycle facilities, such as a narrow section of roadway between road sections with bicycle lanes

Climbing Lanes

Climbing lanes are a hybrid bicycle facility that include a five-foot bicycle lane on one side of the roadway (typically in the uphill direction) and a shared lane pavement marking on the other side of the roadway. This allows slower-moving, uphill bicyclists to have a designated bicycle lane space and allows motor vehicles to pass more easily. It also allows faster-moving, downhill bicyclists to have a shared-lane pavement marking, which helps make motorists be aware that the faster-moving bicyclists are more likely to move away from parked cars and merge into the travel lane. The bicycle lane and shared lane pavement markings also indicate the proper direction for bicyclists to travel on either side of the street. This type of facility is particularly useful in Seattle because of its topography and because it can be used on streets where there is not enough space for standard four to five-foot-wide bicycle lanes on both sides.

Bicycle Boulevards

Bicycle boulevards are non-arterial streets that are designed to allow bicyclists to travel at a consistent, comfortable speed along non-arterial roadways and to cross arterials conveniently and safely. This is achieved by introducing treatments that slow or divert motorists while allowing bicyclists to travel along the bicycle boulevard with minimal stopping. Traffic calming and traffic management treatments such as traffic circles, chicanes, and diverters are used to prevent motor vehicles from speeding and using the bicycle boulevard as a cut-through. Quick-response traffic signals, median islands, or other crossing treatments are provided to facilitate bicycle crossings of arterial roadways. Bicycle bouelvards are marked with a bicycle pavement symbol and the words "BIKE BLVD".

CALL-OUT BOX: "Streets with a series of traffic calming features work well as bike routes. Cars have to slow down to bicycle speed."

Multi-Purpose Trails

Multi-purpose trails (also referred to as shared-use paths) are an important component of Seattle's bicycle transportation system. These facilities can provide a high-quality bicycling experience because they are separated from motor vehicle traffic and often provide an opportunity for extended landscaping and territorial views of the City. Multi-purpose trails can be paved and should be a minimum of ten feet wide. Minimum width may be reduced to eight feet were physical or right-of-way constraints are severe. Trail widths of 12-, 14-, and even 16-feet are appropriate in high-use urban situations.

Shared Roadways

Shared roadways are regular streets without any designated bicycle facilities. Many non-arterial roadways with low traffic volumes and low speeds are already excellent places for bicyclists to ride because they are quiet streets. Roadway striping and markings do not need to be provided to make them comfortable for most bicyclists to use. Many of Seattle's arterial streets are also currently shared roadways, but appropriate facilities described above should be added to the arterials to make them more comfortable for bicycling.

Other Bicycle Facilities

Other bicycle facilities recommended for the Bicycle Facility Network include paved shoulders, wide outside lanes, shared bus/bike lanes, and bus/bike-only roadways.

Paved shoulders provide space on the outside of the roadway for bicycle and pedestrian use[1]. There is no minimum width for paved shoulders, however a width of at least 4 feet is preferred. On some undeveloped roadways (many of which are in the far northern and southern parts of Seattle), paved shoulders can be provided to make important bicycle connections. In some locations, reconstructing the roadway with shoulders can also include pavement for an on-street parking lane or parking pockets. Paved shoulders also improve safety for motor vehicles and prevent pavement damage to the travel lanes.

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In locations where it is not feasible to add pavement at the edge of a roadway to create a paved shoulder, the City may consider experimenting with striping a dashed shoulder to identify the space where motorists should be prepared to see pedestrians and bicyclists. This treatment can be combined with traffic calming devices such as chicanes to encourage slower vehicular speeds. Motorists would share a 14'-18' center shared lane (typical on neighborhood streets with parking on both sides) while a 3'-5' shoulder on the edges would allow for motorist to pull aside to pass. This treatment would be appropriate for lower volume roadways that do not allow parking on or near the shoulder and do not have sidewalks for pedestrians.

Wide outside travel lanes are typically designed to be 13- to 15-feet wide. This width allows more separation between bicyclists and motor vehicles than more typical 10- to 12-foot wide travel lanes. Wide outside travel lanes on arterial roadways are generally acceptable for experienced cyclists, but the City does not encourage less-experienced bicyclists to use this type of facility. These travel lanes do not provide the benefit of having a striped area that is exclusively for the use of bicyclists, a feature that bicyclists with all levels of riding experience have reported as desirable. Wide outside lanes also do not have markings to indicate where bicyclists should be positioned when passing through an intersection with a right-turn lane.

Bus/Bike Only Roadways
Shared Bus/Bike Lanes

Due to limited opportunities and other considerations, this Plan recommends considering use of sidewalk facilities for bicycling in a limited number of specific locations. Special attention will be required in the design process to ensure user safety on sidewalks and sidepaths.

Sidewalks may be useful for bicycling for a number of reasons:

- Bicycle access is needed but bicycle volumes and/or pedestrian volumes are expected to be low.
- Right-of-way or traffic safety (high speeds, high volumes, lots of trucks) issues suggest that sidewalk use may be the only option or even preferred, especially if bicyclists are traveling up a steep hill. However, bicyclists should not travel faster than the speed of a typical jogger (5 to 10 miles per hour) if they use sidewalks.
- They can be designed to accommodate separated, one-way bicycling on each side of the road so that bicyclists can safely and easily transition to and from the road at each end of the segment. Sidewalk bike routes should not result in bicyclists riding opposed to motor vehicle traffic when they re-enter the street.

Sidepaths are essentially trails that are located on the side of a roadway. However, sidepaths are often located only on one side of a road and are intended to provide two-way bicycle and pedestrian travel. Sometimes this type of facility is the only option or is the safest option. Sidepaths can function well if some of the following key design features can be achieved:

- Sufficient width is available to build a facility with at least a five-foot buffer between the outside travel lane and edge of pathway (3'6" barrier also acceptable).
- The path can be located in an area where conflicts with crossing roadways (which may or may not be signalized) can be minimized. Paths work particularly well where they are parallel to expressways and railroad rights-of-way because they are limited access in nature.
- Crossings of free flow ramps can be avoided, minimized or made sufficiently safe.

One type of facility that is not recommended in this Plan is a bicycle lane or path at the edge of an arterial roadway between parked cars and the curb. Several reasons for discouraging the use of this type of facility are provided under the description of bicycle lanes.

Further Study Required

There are a number of roadways that have poor conditions for bicycling, but do not have straightforward opportunities to stripe narrower lanes, remove lanes, add shoulders, or make other physical improvements due to right-of-way constraints and traffic volumes. Some of these roadways represent critical connections between major destinations in the Bicycle Facility Network. In order to make recommendations on how to make these roadways better for bicyclists, the City will need to conduct additional, detailed studies that are beyond the scope of this Plan.

Transitions Between Different Bicycle Facility Types

Due to existing roadway conditions, surrounding land uses, available right-of-way, and other characteristics, it is often necessary to use different bicycle facilities to provide bicycle access within the same bikeway corridor. It is important for the City of Seattle to provide safe transitions between different facilities (such as adding shared lane pavement markings and "SHARE THE ROAD WITH BICYCLES" signs when transitioning from a bicycle lane to a shared roadway). These transitions can be made safer and more understandable for bicyclists and motorists with appropriate treatments, such as spot directional signs, warning signs, pavement markings, curb cuts, etc. Transitions should be provided as a part of the bicycle facility design process.

Types of Facilities for Network Roadway Crossings

Roadway crossings are critical to the safety and convenience of the Bicycle Facility Network. Seattle has a number of multi-lane streets that carry high-speed, high-volume traffic, such as Aurora Avenue N and Rainier Avenue S. Many other arterial streets are also challenging to cross, particularly during peak travel periods. In order to make it possible for bicyclists to travel throughout the City, there must be safe places to cross these major streets. The section below describes the types of treatments that are recommended to help bicyclists cross these roadways. Selection of the appropriate roadway crossing treatment depends on a number of factors:

- Roadway width
- Motor vehicle traffic volumes
- Travel speed
- Sight-distance
- On-street parking
- Presence of traffic signals at the intersection or at nearby intersections
- Location on a signed bicycle route or bicycle boulevard

Roadway crossing facilities recommended for the Network are described below. Additional detail is provided in Appendix F: Guidance for Retrofitting Seattle Streets to Create Dedicated Bicycle Facilities and Appendix H: Roadway Crossing Design for Bicycles.

An appropriate combination of physical improvements is recommended for each crossing location. The types of physical improvements that are recommended are described below. There are four general categories of improvements:

1) Traffic signals
2) Geometric improvements
3) Signs
4) Paint

Full Traffic Signals

Full traffic signals allow bicyclists to cross arterial streets without needing to select an appropriate gap in moving traffic. Traffic signals make it easier to cross the street, though it is important to make bicyclists aware of potential conflicts with turning vehicles and make improvements to reduce these conflicts.

Considerations:

Must meet MUTCD warrants
Roadway approach volumes (all directions)
Sight distance
Crash history

Pedestrian Crossing Signals

Pedestrian crossing signals to allow pedestrians to stop traffic to cross arterial streets at key locations. These signals are beneficial for bicycle crossings. However, because they are oriented for pedestrians, the signals are provided on only one side of the non-arterial roadway, and the push-buttons for actuating the signal are adjacent to the sidewalk, out of reach of bicyclists in the roadway (see section below for recommended improvements to these signals).

In order to improve bicycle access, SDOT has established a policy to provide signals and crosswalks on both sides of non-arterial roadways at intersections with pedestrian crossing signals. The policy also restricts motorist movements at these intersections to left- and right-turns only to prevent cut-through traffic.

Considerations

Must meet SDOT director's rule 04-01.
Non-arterial street volume
Gaps in arterial traffic
Sight distance
Crash history

Curb Extensions

Curb extensions shorten bicycle and pedestrians crossing distance (exposure time) and increase the visibility of non-motorized users at roadway crossings. By narrowing the curb-to-curb width of a roadway, curb extensions may also help reduce motor vehicle speeds and improve bicyclist and pedestrian safety. Curb extensions are only appropriate for locations that have on-street parking.

Considerations:

Curb radius determined by turning design vehicle
Parking must be allowed full time on arterial
Sight distance
Utilize where arterial turn pockets are required and median can not be provided

Curb radius reduction

Wide curb radii allow motorists to make high-speed turning movements. Reducing the curb radii at the corners of an intersection helps to slow turning vehicles, improves sight distance between bicyclists and motorists, and shortens the crossing distance for bicyclists and pedestrians. The choice of a curb radius is dependent on the design vehicle and speed; and whether the street is a local residential street, a neighborhood collector, or a major arterial. This requires a separate calculation to determine the appropriate radius for each corner of an intersection.

Median Islands

Median islands (or crossing islands) allow bicyclists and pedestrians to cross one direction of motor vehicle traffic at a time. Arterial roadway intersections that have low demand for left-turn movements can be potential candidates for adding median islands. Median islands can be constructed on these roadways by using the available center turn lane area or by removing parking from one side of the street and shifting the travel lanes. Median islands are likely to be a medium-term improvement on roadways where significant channelization changes are needed to provide enough space for the median island.

Considerations:

Parking must be allowed full time on arterial
Taper full width of parking
Left turn volume limited will be limited on the arterial roadway–-left-turning cars must wait in the middle of the intersection between medians
Full closure of the median (rather than islands) prohibits left turns from the arterial street and through-movements on the non-arterial street

Arterial Speed Management

Traffic speeds on arterial streets can be managed by alternating the location of on-street parking from one side of the street to the other in different blocks and adding median islands at roadway crossings. Slower speeds improve conditions for walking and bicycling along the roadway and make it safer and easier for pedestrians and bicyclists to cross the roadway.

Considerations:

Arterial must only have 2 lanes of traffic
To create a shift in travel lanes, the arterial may have parking on one side of road that alternates sides or parking that alternates between parallel and back-in angle parking on a block-by-block basis
Parking must be allowed full time on one side of road

Other potential forms of arterial speed management include parking management, road diets, lane narrowing, signage, medians, and speed cushions.

Overpasses and Underpasses

Overpasses and underpasses separate bicycle and pedestrian traffic from vehicular traffic, allowing bicyclists and pedestrians to cross freeways, busy streets and railroad tracks without potential conflicts. They can also be used to cross ravines, canals and streams. However, they should be used with great caution: they are expensive to construct; underpasses are prone to security concerns due to low visibility; and the inconvenience of out-of-distance travel is high, up to 1000 feet or more, because of the need to provide accessible ramps, pedestrians will not walk this extra distance and cross at-grade. To be effective, there often has to be a self-enforcing feature that requires the bicyclists or pedestrian to use the bridge, such as topography, or fencing. Consequently, they should be reserved for locations where there is a high demand for bicycle and pedestrian crossings and there are no other more attractive options. Adequate width (for users to pass each other comfortably), lighting, and surveillance should also be provided to increase security of these crossings.

Bike Box at Intersection

Bike boxes are installed to allow bicyclists to move in front of cars waiting at an intersection to increase their visibility and reduce conflicts with turning vehicles. They are typically used at intersections where bicyclists need to turn left and/or many vehicles turn right. During a red signal phase, bicyclists are able to better position themselves for a left turn by moving left across the bike box.

High-visibility pedestrian/bicycle crossing warning signs

High-visibility bicycle and pedestrian pedestrian warning signs are recommended at trail crossings in Seattle. These signs can increase driver awareness of pedestrians and bicyclists, especially at mid-block locations where pedestrians and bicyclists may not be expected. These signs will be most effective when combined with other treatments, such as marked crosswalks, curb extensions, median islands, etc. Signs should be used judiciously—too many signs can cause visual clutter and lead to non-compliance. See Appendix H for additional guidance on right-of-way assignment and appropriate crossing treatments.

Sight-distance improvements

Sight-distance obstructions can increase the risk of bicyclist being struck by vehicles at roadway crossings. Several of the locations recommended for bicycle crossing improvements in Seattle have on-street parking, landscaping, light poles, bus stop shelters, and other features obstructing the line of sight between drivers and bicyclists. While these features can make a street more attractive and serve other valuable functions, they should be placed in locations that do not obscure drivers' views of bicyclists. The City should continue to make sight distance improvements through its Spot Maintenance Program.

Note that parking is already restricted within 30 feet of intersections and within 20 feet of a midblock crosswalk on arterial streets. However, consideration should be given to painting curbs red to designate these no-parking areas near intersections. Enforcement of this law should be improved on arterial roadways with bicycle lanes and at intersections where signed bicycle routes cross arterial roadways.

CALL-OUT BOX: "Please consider restricting street parking near intersections with heavily-traveled bike routes. Having good sight lines is critical to the safety of cyclists…"#