Bicycle and Pedestrian Infrastructure Designs

What should the improvements look like?

Purpose

The following design standards for bicycle and pedestrian infrastructure encompass the range of bicycle and pedestrian needs that currently exist within Tukwila. The designs that follow have been compiled based on a review of federal, state, and local requirements, as well as other sources related to creating bicycle- and pedestrian-friendly environments. The recommended designs are consistent with guidance provided by the State of Washington Department of Transportation (WSDOT) and the U.S. Department of Transportation Federal Highway Administration (FHWA). Design manuals, or guides that were used in the development of the recommendations in this section include WSDOT's Design Manual, the Manual on Uniform Traffic Control Devices (MUTCD, 2003), A Policy on Geometric Design of Highways and Streets (AASHTO, 2004), and the Guide for Development of Bicycle Facilities (AASHTO, 1999).

On any street within Tukwila where transportation improvements are proposed as part of a private or public project, the recommendation is to incorporate Complete Streets principles into the process of design and construction - considering how the improvements will support the safety, convenience, and comfort of pedestrians, bicyclists, and motorized vehicles. This Complete Streets review should also include an analysis of what not to include, such as elimination of shoulders or inclusion of C-curbs that might provide hazards for bicyclists. Generally, the ideal street cross-section in Tukwila that will provide safe and comfortable facilities for pedestrians and bicycles includes bike lanes on all arterials and sidewalks on both sides of the street, with sidewalks separated from the street by a landscape strip. However, it may not be feasible to retrofit all of Tukwila's streets with separated sidewalks and bike lanes. Feasibility and engineering studies, incorporating Complete Streets principles, will help determine what can reasonably be included into a transportation improvement project.

In choosing a design for construction, the recommendation is to use a hierarchy (see section below) to determine which improvements are most suitable. A hierarchical approach means that the designer asks questions on available right-of-way width, traffic volumes and speeds, sight distance, grade, the land uses and conditions to which an improvement will connect, and the most likely users of a route. The designer works through questions in a process of elimination starting with the "best" design for cyclists and pedestrians. Construction of the most preferable infrastructure design in the hierarchy for bicycles and pedestrians should be the City's long-term goal, even if interim improvements are made in the short-term.

Projects with designs that provide improvements in transportation for bicyclists and pedestrians are recommended over those that will provide improvements for just recreation. Transportation oriented design can serve both types of users, can increase overall connectivity of the circulation system, and can be more competitive in grant applications. The "Improvement Options" of the Project sheets contain design guidelines that serve both the commuter and the recreational bicyclists. These design options are

practical recommendations based on existing conditions and the anticipated scope of improvement.

In Tukwila, trails are particularly important facilities for connecting the bicycle and pedestrian network given the city's steep topography and lack of connectivity in the existing street network. The decision for which type of a trail to construct (paved vs. unpaved) is more likely to be based on local site conditions such as topography, available right-of-way, sensitive areas, and surrounding land uses.

Hierarchy

Bicycle Infrastructure Designs

The hierarchy for bike designs is based on the characteristics and needs of different types of bicyclists. When considering which type of design to construct, the specific characteristics of a route, as well as the most likely users of the facility, will need to be assessed. For example, if a particular route is expected to be used heavily and almost exclusively by bicycle commuters, a bike lane may be considered as the appropriate design standard, since these types of users are comfortable riding within the roadway with automobiles. On the other hand, in an area where schoolchildren are expected to be the primary users of a route, a paved multi-use trail separated from automobile traffic may be the best option. For more background on different types and needs of bicyclists, refer to the Needs Analysis in Appendix B.

The hierarchy is shown in order below, with (1) being the highest recommendation in the hierarchy, and (4) being the facility least likely to be recommended. On-street bicycle facilities (bike lanes, paved shoulders, wide curb lanes) need to include signage that identifies them for bicycle use if they are designated bicycle routes.

(1) Bike Lanes
(2) Multi-Use Trails
(3) Paved Shoulders
(4) Wide Curb Lanes

Bike Lanes
Bike lanes are the first option recommended in the list of bicycle design standards in City of Tukwila because it is relatively easy to incorporate them into the existing transportation system and because they are the design standard on which the greatest range of bicyclists are comfortable riding. Bicyclists ranging from expert, commuter riders all the way to beginners, are comfortable riding in bike lanes on streets that have low speeds (at 30 miles per hour or below) and low traffic volumes. Paved shoulders and wide curb lanes are only recommended as temporary facilities within the roadway, until such time as bike lanes can be constructed.

Multi-Use Trails
Many riders feel comfortable riding on multi-use trails because they are separated from automobile traffic. However, these facilities are relatively expensive to construct, since separate right-of-way acquisition is often required and there is not always the room available to construct them in locations where they will link up with the rest of the transportation system. Another critical issue is locating the trail so that driveway

crossings are minimized. Driveway crossings on separated multi use trails are dangerous points of conflict, such as the Green River Trail along Interurban Avenue to the west of the Foster Golf Course. Additionally, the range of users (including pedestrians, dog walkers, rollerbladers, etc.) can pose potential conflicts with bicyclists, since these users all move at different speeds and do not always know/follow the rules of the trail. Multi-use trails are generally the best for recreational trips, allowing bicycle riders time to ride slow. For bicycle commuters, multi-use trails are usually not the preferred option since these trails are often not the most direct route, and are dangerous to ride on at fast speeds.

Paved Shoulders
Paved shoulders are areas of asphalt outside the striped lanes of travel, and are usually not wide enough to be designated (with a painted bike symbol on the pavement and bike lane signage) as bike lanes. While paved shoulders are better than nothing, they are only recommended in this plan as an interim facility until additional right-of-way can be acquired (if needed) to build bike lanes.

Wide Curb Lanes
Wide curb lanes are regular vehicle lanes built for automobile traffic, but made a little wider, with room for automobiles to share the street with bicycles. Wide curb lanes in Tukwila are provided on high-speed, high-traffic streets such as Tukwila International Blvd. and Interurban Ave S. These types of facilities are likely to only be used by the most skilled bicyclists who are comfortable riding in the same lane of traffic with automobiles, and are only recommended in this plan as an interim facility until additional right-of-way can be acquired (if needed) to build bike lanes.

Multi-Use Infrastructure Designs

Multi-use facilities are those infrastructure designs that can be used by both pedestrians and bicyclists. Paved multi-use trails offer the best accommodation for all types of users. However, in areas where there are conditions that include sensitive areas or steep slopes, unpaved trails may be the preferred improvement over paved multi-use trails. While paved shoulders exist in many areas of Tukwila, and can be used as walkways for pedestrians or as a separated space for bicycles within the roadway, paved shoulders are only recommended as temporary improvements. Where there is no other accommodation for pedestrians and/or bicycles, paved shoulders are interim improvements and should be added to the roadway until such time as sidewalks and bike lanes can be constructed. The recommended hierarchy for this type of improvement is:

(1) Paved Multi-Use Trail
(2) Unpaved Multi-Use Trail
(3) Paved Shoulders

Pedestrian Infrastructure Designs

Sidewalks are the recommended infrastructure designs on all streets within Tukwila. Wherever right-of-way width permits or project scope allows, separated sidewalks are

the recommended design, even in residential areas. On all streets with speeds over 30 miles per hour, separated sidewalks should be required in order to provide a buffer between automobile traffic and pedestrians, thereby making the sidewalk more comfortable and pedestrian friendly. The recommended hierarchy for this type of improvement is:

(1) Separated Sidewalk
(2) Attached Sidewalk

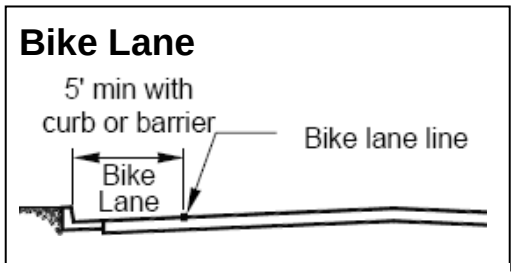
Ancillary Infrastructure Designs

When a path of travel intersects with automobiles, the design of the crossing will favor either the car or the pedestrian. Driveways, intersections, and crosswalks can be designed in different ways to positively or negatively affect the pedestrian experience and safety. Topography also plays an important role and can be dealt with in ways that assist pedestrian and cycling travel.

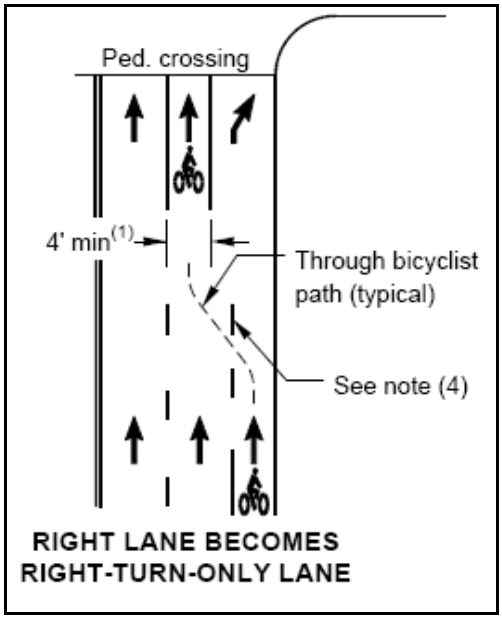
Bicycle Designs – Bike Lanes and Wide Curb Lanes

Bike Lanes

Source: http://www.pedbikeimages.org/



Source: WSDOT Design Manual, Chapter 1020



Source: WSDOT Design Manual, Chapter 1020

Bike lanes are striped lanes for the exclusive use of bicyclists, with pavement markings indicating they are for bicycle use only. A minimum bike lane width of 4' is recommended, excluding any portion of the lane occupied by a gutter or roadway seam. Bike lanes are always one-way facilities, with cyclists traveling in the same direction as motor vehicle traffic. In areas where a bike lane is adjacent to on-street parallel parking, a total of 15 feet measured from the face of the curb to the outer stripe of the bike lane is required to provide an area which is free of the "door zone", the area into which the door of the driver's side of the parked car is expected to swing open. In areas where a bike lane is adjacent to a high barrier, such as a jersey barrier, the bike lane width should be at least 6 feet.

Pros:

- Clearly delineates space within the street for bicyclists
- Encourages bicyclists to ride on the existing system of roads.
- Bike lanes can be integrated into the street network by narrowing and re-striping existing lanes.
- Bike lanes increase the sight distance for automobiles entering or leaving driveways.
- Provide the clearest guidance to all street users about where each user should be located in relation to each other (including automobiles and bicyclists).

Cons:

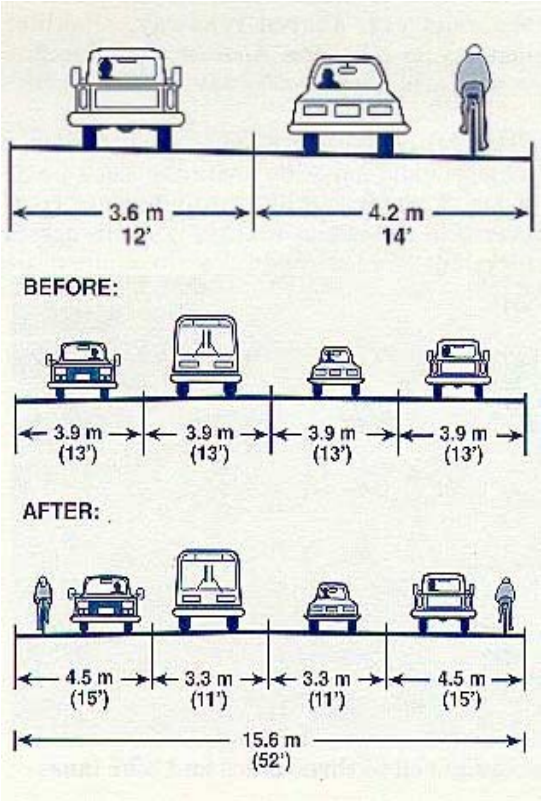
- Care must be taken to ensure pavement markings in intersection areas are not confusing to bicyclists or automobile operators (see figure at left).
- It can be difficult for automobile drivers to see children riding in bike lanes (or on any facility provided within the street).
- Maintenance must be provided on a regular schedule to ensure that debris is removed from the bike lane.
- Additional right-of-way may be required to add bike lanes.

Wide Curb Lanes

Source: http://www.pedbikeimages.org/

Wide curb lanes are outside travel lanes greater than 12 feet in width, and are meant to accommodate both automobiles and bicycles in the same travel lane. Wide curb lanes are usually constructed when a paved shoulder or bike lane is not provided. A width of 14 feet is recommended for a wide curb lane, with more width (15 feet or greater) recommended in areas where bicycles are expected to need extra room, such as steep hill climbs. Wide curb lanes greater than 14 feet are not recommended for continuous stretches of the roadway, since they may encourage the operation of more than one motor vehicle within the lane. Wide curb lanes are not marked for bicycling, except where they are signed as being part of a bike route.

Wide Curb Lane



Source: Oregon Bicycle and Pedestrian Plan

Pros

- Provide room for extra clearance between automobiles and bicyclists than standard 10-to-12 foot lane widths.
- Increase sight distance for automobiles leaving driveways.
- Can be easily integrated with the current street network through re-striping if there is available right-of-way b/w curbs.

Cons

- Can encourage higher automobile speed.
- Wide curb lanes are typically used only by the most experienced bicyclists. Less experienced bicyclists do not perceive them to be as safe as bicycle lanes. (Tracy-Williams Consulting, 1996).
- It can be difficult for automobile drivers to see children riding in wide curb lanes (or on any facility provided within the street).
- Right-of-way acquisition may be needed.

Multi-Use Designs –Trails and Paved Shoulders

Trails

Trails are paved or unpaved areas entirely separated from the street (except at infrequent intersections) dedicated for the exclusive use of nonmotorized travel. Trails can be for pedestrians only, or for use by both pedestrians and bicyclists. Most of the time, trails are constructed where right-of-way is easily acquired or dedicated for nonmotorized use; most often along the edges of waterways and areas where railroad and utility rights-of-way are available. Some types of trails may be constructed in areas where through-streets are not constructed, providing nonmotorized through-connections.

Sidepaths are multi-use trails constructed adjacent to the roadway, and are sometimes constructed as extra-wide sidewalks for use by both pedestrians and bicyclists. The Green River Trail, where it runs adjacent to Interurban Ave S in Tukwila, is an example of a sidepath. Sidepaths are **not recommended** in this plan, because the combination of trail users traveling in two directions, and poor sight distance for automobiles, which makes trail users difficult to see, makes these types of trails dangerous where trails cross driveways or streets. Bike lanes provide a safer facility for bikes than sidepaths, since they provide a one-way facility where bikes are going in the same direction as automobiles and are easier to for automobile drivers to see. Pedestrians on sidewalks travel in two directions, but go at much slower speeds than bicycles, and so their movements are easier for automobiles to predict. The decision to construct a sidepath should be based on a careful evaluation, and should only be considered in areas where there are no intersecting driveways or streets.

Design details are included for multi-use trails, including signage, pavement markings (for paved multi-use trails), and bollard spacing. According to the WSDOT Design Manual, lighting should be installed based on a number of factors. 1. Does the City want to encourage night time use of the facility? Some facilities may have services and uses that people will be using during nighttime hours, such as restaurants and hotels. 2. Is trail use during darkness anticipated? Much commuting occurs during the dark because of the City's northern latitude. 3. What are the costs? 4. Have security problems been reported or anticipated? (Chapter 840 and 1020.6)). Recommended lighting levels for Walkways and Bicycle Trails are located in Figure 840-25 of the WSDOT Design Manual.

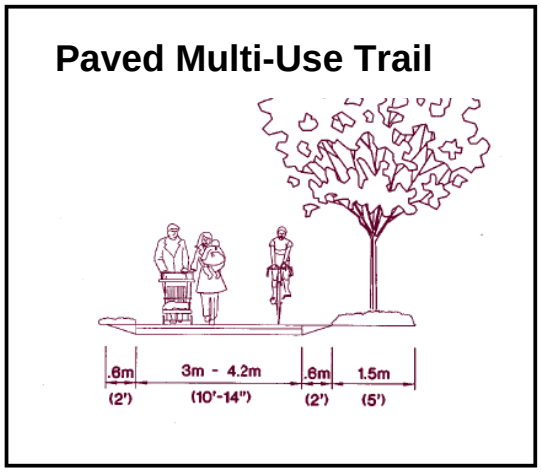
Paved Multi-Use Trails (i.e., Green River Trail, Interurban Trail)

City of Tukwila: Interurban Trail
Source: http://www.pedbikeimages.org/

Paved multi-use trails are for use by both pedestrians and bicyclists. These facilities are usually constructed along waterways such as rivers or lakes, and in utility and railroad corridors where right-of-way may be acquired or dedicated for trail use.

Minimum width: 18 feet (including a 2-foot shoulder on each side of pavement)*

*Higher volumes of bicycle and other fast-moving traffic require greater widths. Extra width should also be provided where sight distance is poor and where there are obstructions within the shoulder.



Source: WSDOT Pedestrian Facilities Guidebook

Pros

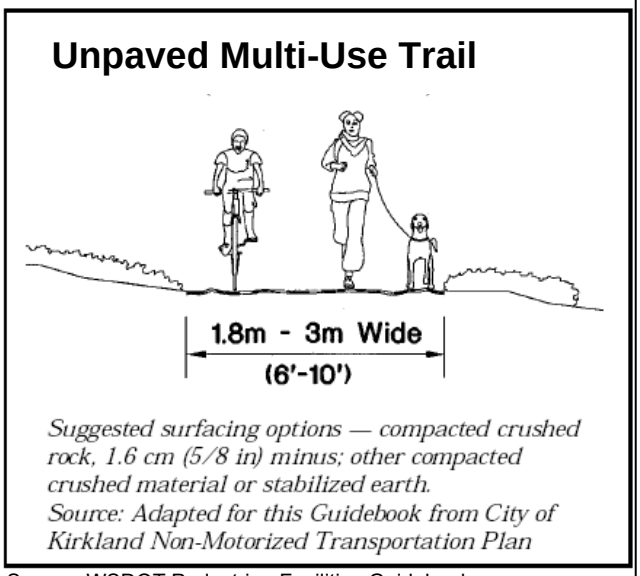
- Facilities are completely separated from automobiles, providing increased safety for bicyclists and pedestrians.
- Can be constructed to preserve view corridors, and to provide public access to environmental amenities and open space.
- Paved trails can provide recreation opportunities to a variety of trail users, including those of varying experience levels and/or disabilities.

Cons

- Multi-use trails do not always provide the most direct routes between destinations, and so are often used more for recreational purposes than for transportation corridors.
- The use of these trails by different user types, and the high speed of bicyclists compared with most pedestrians, requires signage, education, and enforcement to ensure that users practice proper trail etiquette.
- Maintenance must be provided on a regular schedule to ensure that vegetation and debris do not cause unsafe conditions for trail users.
- Right-of-way acquisition may be needed.

Unpaved Multi-Use Trails

http://www.pedbikeimages.org/



Source: WSDOT Pedestrian Facilities Guidebook

Unpaved multi-use trails are for use by both pedestrians and bicyclists. These facilities are usually constructed along waterways such as rivers or lakes, and in street, utility and railroad corridors where right-of-way may be acquired or dedicated for trail use. Unpaved areas can help to preserve the natural character of an area by providing a lower-impact trail design compared with a paved trail.

Minimum width: 6 feet
Optimum width: 8-10 feet

Pros

- Facilities are completely separated from automobiles.
- Can be constructed to preserve view corridors, and to provide public access to environmental amenities and open space.
- Provide natural surfaces for people to walk/run, reducing impact on joints.
- Have the potential to have a lower environmental impact.
- Can provide through-connections where there are dead-end streets or other barriers to nearby destinations.
- Provide recreational opportunities.

Cons

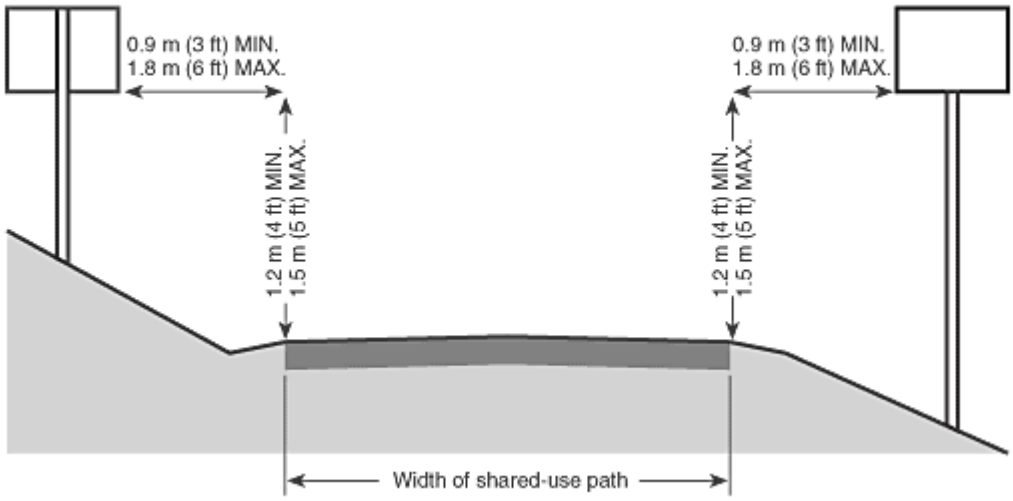
- Use of these trails by different user types, and the high speed of bicyclists compared with most pedestrians, requires signage, education, and enforcement to ensure that users practice proper trail etiquette.
- Maintenance must be provided on a regular schedule to ensure that vegetation and debris do not cause unsafe conditions for trail users, to reduce the threat of crime to both users and property owners, and to ensure that erosion does not wash out the trail.
- Right-of-way acquisition may be needed.

Multi-Use Trail Design Details

Signage, Pavement Markings, and Bollard Spacing

The MUTCD provides guidance on sign placement, determination of who has the right-of-way at trail crossing areas, and centerline striping on multi-use trails. The same types signs (regulatory, directional, and warning signs) are used on trails as those used on roadways. Signage is particularly important in areas where trails cross streets or driveways, to signal to trail users and roadway users alike the presence of a crossing area and the rules (i.e., who has the right-of-way). Also recommended in trail areas are signs that point out areas of interest along the trail, and/or provide information on trail loop routes for walkers. The graphic below from the MUTCD illustrates the distance signs should be placed from the trail, and height of the sign.

Figure 9B-1. Sign Placement on Shared-Use Paths



Source: MUTCD (2003)

According to the MUTCD, “it is sometimes appropriate to give priority to a high-volume shared-use path crossing a low-volume street, or to a regional shared-use path crossing a minor collector street” (MUTCD p. 9B-2). The decision on who is made to stop or yield when a multi-use trail crosses a road should be based on the following considerations:
(A) Relative speeds of shared-use path and roadway users;
(B) Relative volumes of shared-use path and roadway traffic; and
(C) Relative importance of shared use path and roadway.

The City of Seattle is in the process of developing a system to determine who has the right-of-way in areas where regional, multi-use trails cross roadways in Seattle. In some areas, such as where the Burke Gilman Trail crosses lower-traffic streets, the trail user has the right-of-way.

Trail Crossing Warning Signs for Motorists

The type of signs or signals used in trail crossing areas depends on the type of area that a trail will be crossing (arterial, residential, driveway, or alley). On high-traffic-volume streets, such as Henderson Street in Seattle shown below, signals and several warning signs are provided to ensure that trail users are visible to motorists along the roadway. Note the use of curb bulbs used at the Henderson crossing location to help minimize the crossing distance for trail users along this busy arterial street.

Chief Sealth Trail crossing of an arterials street
at S Henderson Street in Seattle

Regulatory and Warning Signs for Trail Users, and Striping and Bollard Placement

Trail crossing of roadway, striping and bollard placement along Chief Sealth Trail in Seattle

Trail crossing of roadway, striping and bollard placement along Interurban Trail in Tukwila

The pictures at left show the regulatory signs that are typically placed along trails at crossing areas, including yield and stop signs. Warning signs are also important on the approach to crossing areas, to warn trail users to slow down and be watchful for automobiles in street- or driveway- crossing areas.

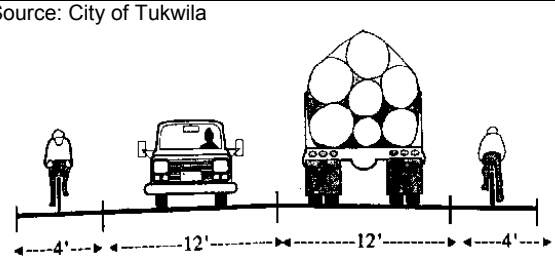
The MUTCD provides guidance on striping lanes on multi-use trails. Striping along multi-use trails is not required, but is recommended on high-traffic trails, or to separate pedestrian from bicycle traffic. Striping is particularly important along trail sections where there is poor sight distance, or where there are obstructions, such as bollards, in the trail. The proper striping around trail obstructions is shown in the picture at top left.

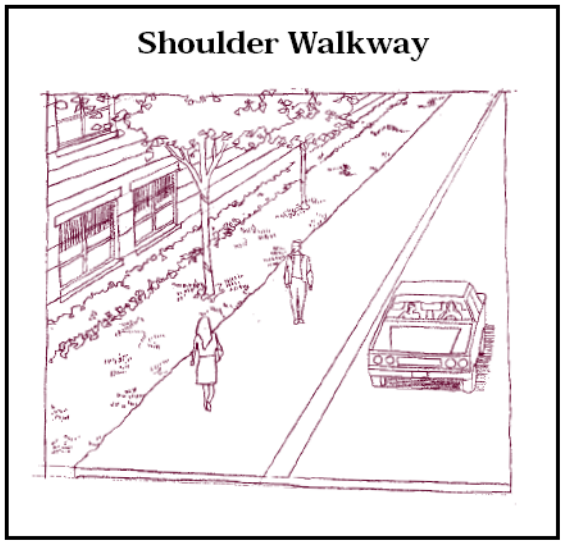
The picture above shows the appropriate use of 3 bollards rather than 4, shown in the picture at bottom. Use of 3 bollards, instead of 4, allows more room in between the bollards (6 feet is the recommended width between bollards), and separates the trail into two lanes rather than 3 lanes of nonmotorized traffic along the trail.

Bollards should always incorporate reflectors or other similar design features to make them more visible during daytime and nighttime hours.

Paved Shoulders

Source: City of Tukwila





Source: WSDOT Pedestrian Facilities Guidebook

Paved shoulders are paved areas adjacent to the outside lane of travel, separated from automobile travel lanes by striping. Paved shoulders are usually meant to provide some extra room for bicyclists and/or pedestrians when the extra right-of-way or improvement funding for bike lanes or sidewalks is not available.

Paved shoulders are recommended as interim improvements when there are no other facilities present. AASHTO says that where no other facilities are provided, any shoulder is better than nothing; however, a paved shoulder width minimum of 4 feet is recommended (see figure at left).

Pros

- Provide room for clearance between motor vehicles and bicyclists and pedestrians.
- Can be easily integrated with the current street network through re-striping if there is available pavement &/or right-of-way.
- Increase sight distance for automobiles leaving driveways.

Cons

- Usually not as wide as bike lanes or sidewalks.
- Paved shoulder areas must be signed and it is difficult to enforce no parking regulations within these areas.
- No curb or other vertical separation is provided between the automobile traffic and pedestrians.
- It can be difficult for automobile drivers to see children riding in the shoulder (or on any facility provided within the street).
- Right-of-way acquisition may be needed.

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Pedestrian Designs – Separated and Attached Sidewalks

Sidewalks

A sidewalk is a walkway that is separated from the roadway with a curb, constructed of a durable, hard and smooth surface, designed for preferential or exclusive use by pedestrians. In areas where the sidewalk is adjacent to the curb, it is called an *attached sidewalk*. In areas where the sidewalk is separated by a landscaping strip or paved area containing street furniture, it is called a *separated sidewalk* (see pictures below).

The minimum recommended width for a sidewalk in any location is 5 feet, which allows two people to walk side by side. In commercial areas, in areas with high levels of pedestrian activity, and on streets where there are high volumes of traffic and high speeds, sidewalk widths should be greater than 5 feet and can range from 6 feet to 15 feet.

A buffer zone of 4 to 6 feet is desirable to separate the sidewalk from the street, and should be provided in all areas when feasible. The width of the buffer zone will vary according to surrounding land uses and anticipated levels of pedestrian activity. In downtown or commercial districts, street furniture, such as pedestrian light fixtures, newspaper boxes and fire hydrants should be provided within the buffer or utility zone. In residential areas, a landscape strip separating the sidewalk from the street is suitable. Additionally, storm drainage features such as drainage swales, can be incorporated within the buffer zone/landscaping strip (see section on Seastreets under Attached Sidewalk design guideline below). Street parking can also provide a buffer separating automobile traffic on the street from pedestrian traffic on sidewalks.

Separated and Attached Sidewalks

Southcenter - separated

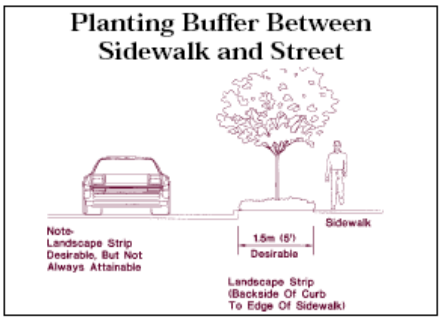
Cascade View - separated

Allentown - attached

Separated Sidewalks

Source: http://www.pedbikeimages.org/

Separated sidewalks are sidewalks separated from the street by a buffer zone. Buffer zones are a minimum of 4 feet in width that contain landscaping, street trees, street furniture, and utilities such as hydrants and street illumination.



Source: WSDOT Pedestrian Facilities Guidebook

Source: WSDOT Pedestrian Facilities Guidebook

Pros

- Reduces the impact of spray on pedestrians from the traffic.
- Provides greater separation between vehicles and pedestrians in case a car jumps the curb or a person falls.
- Allows sidewalk to be constructed at a constant level grade across driveways avoiding dipping at every driveway cut.
- Provides physical separation from traffic.
- Provides space for signs, utilities streets furniture, mailboxes and landscaping street trees.
- Enhances the aesthetic character of the area.
- Provides a space to pile snow.
- Provides pedestrian clearance from side mirrors and overhanging cargo on large vehicles
- Can provide drainage function, separating sidewalks from gutters and storm drains

Source: (WSDOT Pedestrian Facilities Guidebook, http://www.pedestrians.org/tips.htm)

Cons

- Sidewalk must be maintained to provide a smooth travel surface and ensure that debris and other obstructions do not block the sidewalk.
- Landscaping and street furniture must be designed and maintained properly, so as not to hinder visibility and cause security problems.
- Can cause problems for street maintenance vehicles.
- Landscaping must be chosen wisely to prevent the sidewalk from cracking and buckling due to root growth.
- Additional right-of-way acquisition may be needed.

Source: (WSDOT Pedestrian Facilities Guidebook)

Natural Drainage Systems & Separated Sidewalks (SEA Streets)

SEA Streets (SEA = Street Edge Alternatives) is the name of a pilot project completed in north Seattle by Seattle Public Utilities. The aim of the project is to experiment with different street edge improvements that help reduce the amount of impervious surface and introduce natural drainage systems within a residential neighborhood. By placing drainage systems between the roadway and the sidewalk area, SEA Streets represent one form of separated sidewalks. The pictures to the left show before and after conditions associated with the SEA Streets project in north Seattle. The project is located on 2nd Ave NW, between NW 117th and 120th Streets.

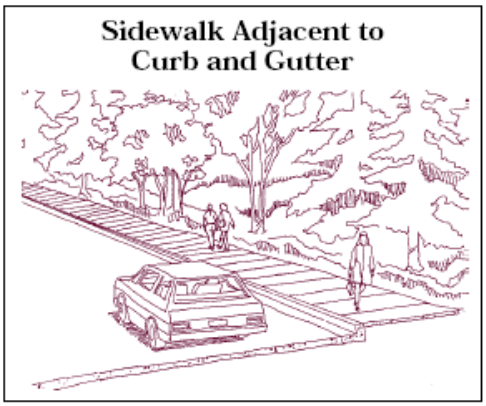
The recently completed High Point project in West Seattle also incorporated natural drainage systems in constructing its new streets, shown in the pictures below.

These features may not be appropriate in all areas of Tukwila – site characteristics such as drainage must be carefully considered for these projects.

High Point Neighborhood, West Seattle:
Natural Drainage Systems & Separated Sidewalks

Attached Sidewalks

City of Tukwila, Tukwila Parkway
Source: City of Tukwila



Source: WSDOT Pedestrian Facilities Guidebook

Attached sidewalks are sidewalks placed directly adjacent to the curb at the edge of the street.

Pros

- Provide a dedicated area for pedestrian travel.
- Can be installed where there is not enough right-of-way to provide buffer areas.
- Curb provides vertical separation from automobile traffic.

Cons

- Must be maintained to provide a smooth travel surface, and ensure that debris and other obstructions do not block the sidewalk.
- No space or physical barriers are provided as a barrier between automobile and pedestrian traffic.
- Care must be taken to ensure that mailboxes, utility poles, and other obstructions are not placed within the 5-foot minimum sidewalk width.
- If not designed correctly, the sidewalk grade will dip at every driveway, creating an inconsistent grade for pedestrians.
- Right-of-way acquisition may be needed.

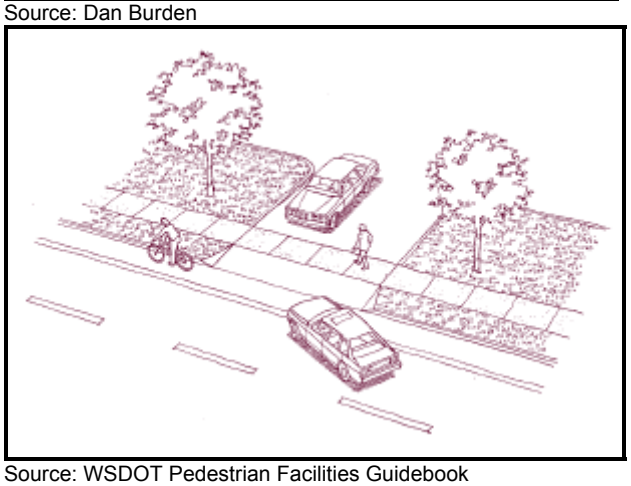
Ancillary Infrastructure Designs

Design standards for bicyclists and pedestrians should include more than just the travel-ways (i.e., bike lanes, sidewalks), Included below are some additional design standards for facilities including driveways and stairs.

Driveways

Source: Dan Burden

Source: Dan Burden



Source: WSDOT Pedestrian Facilities Guidebook

Driveways and intersections are the most common locations for pedestrian-vehicle or bicycle-vehicle accidents. Depending on their design, these areas can also be particularly challenging areas for people with disabilities.

Minimizing the number of driveways along a street and making driveways as narrow as is feasible to reduce the pedestrian crossing distance can help make an area more pedestrian-friendly.

When a driveway must be constructed, the driveway design standard shown below can help make these types of potential conflict points more amenable.

DRIVEWAY DESIGN GUIDELINES

- Ramp up driveway to sidewalk height rather than lowering sidewalk to street grade
- Minimize crossing distance (12' maximum width for one-way traffic; 24' maximum width for two-way traffic)
- Use different pattern and/or material for pedestrian crossing area
- Wide, clearly marked bike lanes provide sight distance for automobiles entering/exiting the driveways
- Landscaping strip:
  - Allows room for driveway apron separate from sidewalk area
  - Provides a buffer between pedestrians on the sidewalk and automobile traffic in the roadway
  - Wide landscaping strip provides greater sight distance for vehicles

Signage

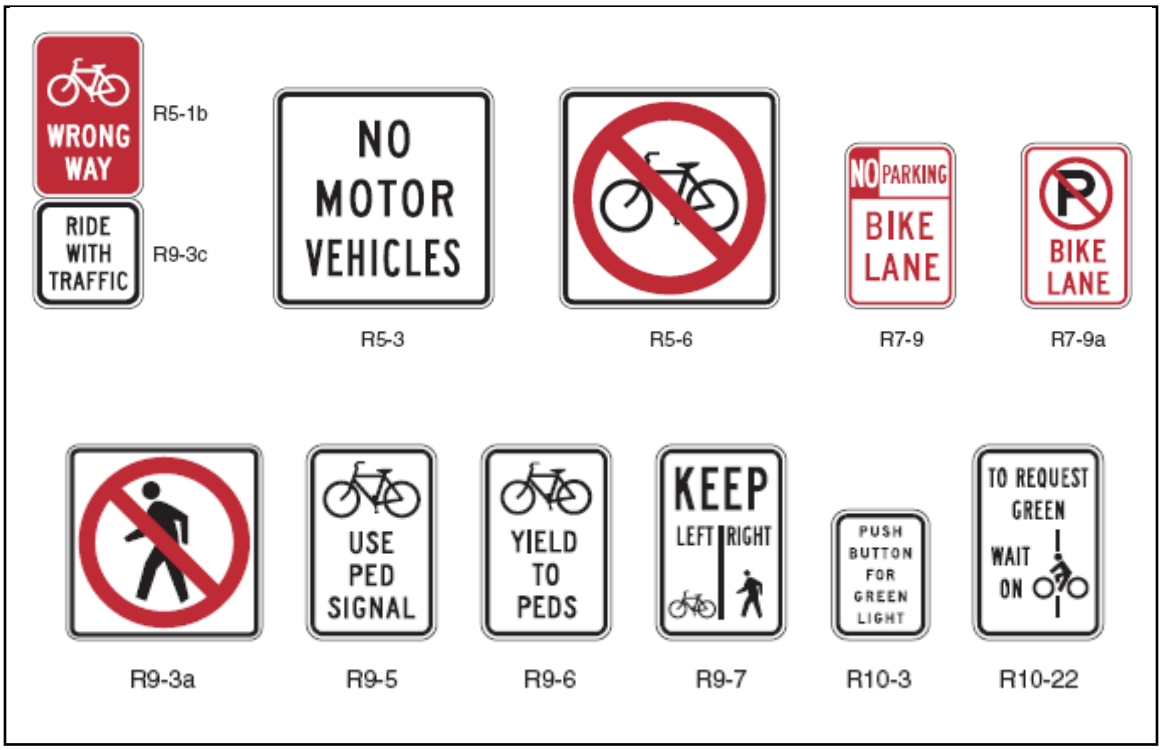
Bicycle facility signage includes pavement markings and posted street signs along streets and trails.

Signage used on bicycle routes, whether on roads or on trails, should convey a range of information, including regulatory information (the rules of the road), route information (distance and direction), and warning information about road/trail conditions.

All signs within the right-of-way must conform to the latest edition of the Manual on Uniform Traffic Control Devices (MUTCD). The most current edition of the MUTCD was adopted in 2003. Part 9 of the MUTCD contains traffic controls for bicycle facilities, including requirements for the size and spacing of signs and pavement markings. Warning signs in Part 2C of the MUTCD can also be used. A variety of samples from different sections of the MUTCD follow.

Many of the signs for bicycle facilities are the same as those for motor vehicles, with the exception of size. Table 9B-1 in the MUTCD is a list of the types of signs that can be installed along bicycle facilities, and their specified sizes. Chapter 2 of the MUTCD contains regulatory and warning signs that should be placed along the road for automobiles, including signs that direct automobiles to “Share the Road” and indicate trail crossing areas. The MUTCD also provides guidance on where these signs should be installed in relation to the trail and/or roadway.

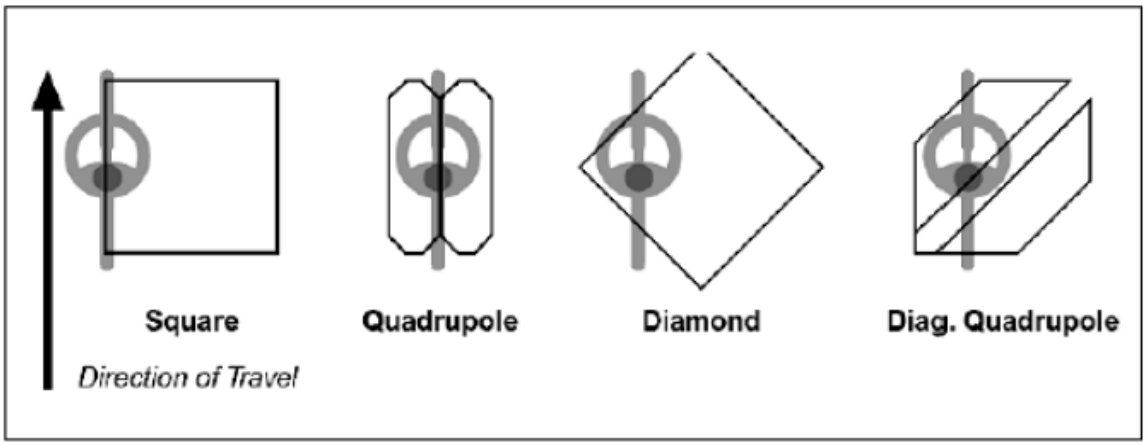
Regulatory Signs for Bicycle Facilities

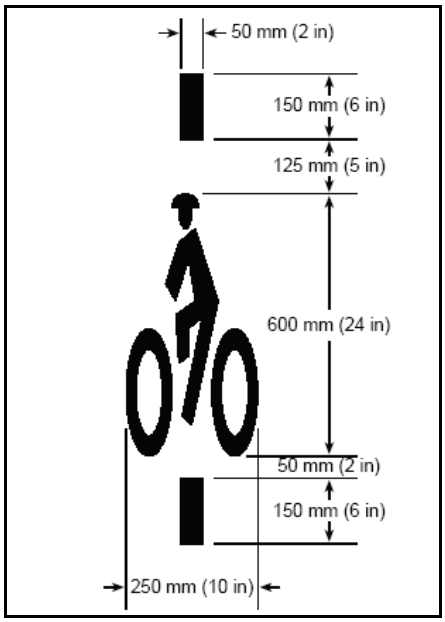


Bicycle Route Signage

Warning Signage

Loop Detectors





The ASSHTO Guide for the Development of Bicycle Facilities notes:

> *"Detection of bicycles at traffic-actuated signals is crucial for bicyclists' safety and for compliance with traffic laws"* (p. 65)

Some types of in-road detectors for automobile traffic can also detect bicycles, including the examples above.

The timing of traffic signals should ensure that bicycles can make it safely through the light in the time provided.

Pavement markings (shown at left) should be incorporated where there are loop detectors that can be activated by bicycles, to help guide bicyclists to where they should position themselves to activate the detector. Detectors should be located in areas at an intersection where bicycles can be expected, including the shoulder and left-turn lanes.

Push buttons for pedestrians and/or bicycles can be used for actuation of a traffic signal in some cases, as long as they are easy to reach and do not require the bicyclist to dismount.

Crossing Areas (Intersections & Mid-Block Crossings)

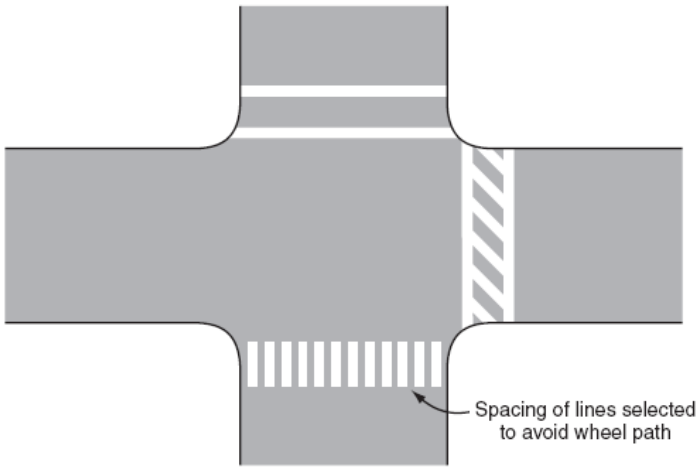
Intersections and other crossing areas are the most common locations for pedestrian-vehicle accidents.

In general, the following considerations should be made when locating and designing a crosswalk:

- The most effective way to prevent serious injuries in these areas, which tend to have high potential for pedestrian-vehicle conflict, is to reduce vehicle speeds.
- Crossing distance should be minimized.
- Crosswalk locations should be convenient for pedestrian access.
- All sides of an intersection should be designed with the idea that pedestrians will be using it as a crossing. However, there may be some sides of an intersection where it makes sense to discourage pedestrians from crossing. An example of this is the intersection of Southcenter Blvd and the 61st Ave S bridge.
- Crosswalks should be used in conjunction with other measures, such as advance warning signs, warning signs, stop bars, median crossing islands and curb extensions (only where there is on-street parking). It is particularly important that additional measures be employed on multi-lane roads with average daily traffic (ADT) above 10,000.
- Marked crosswalks are important for pedestrians who are visually impaired
- Crosswalk markings must be placed to include the ramp so that a wheelchair does not have to leave the marked crosswalk to access the ramp.

Source: (www.walkinginfo.org), WSDOT Pedestrian Facilities Guidebook

Crosswalk Markings



Source: MUTCD, 2003 Edition

Mid-Block Crossings

The Washington State Bicycle Facilities and Pedestrian Walkways Plan (WSDOT 2008) notes that research is currently under way at state and national levels to identify at-grade pedestrian crossings that provide safety improvements to current guidance adopted at the state and national levels. Several design treatments that WSDOT may consider including into WSDOT Guidance and Traffic Operations are the following:

- Zig Zag Approach Restrictions
- Pavement Legends for Pedestrians
- Overhead Warning Signs and Lights
- Pedestrian Railings
- Curb Extensions and Medians
- Lane Reductions
- Setback Crosswalks
- Pedestrian Light Controlled or Pelican Crossing
- Pedestrian User Friendly Intelligent or Puffin Crossing
- Two Can Cross or Toucan Crossing
- Leading Pedestrian Interval
- Advance Stop Lines or Bars
- Scramble Pattern at Signals

Mid-block crossing areas provide additional pedestrian connectivity, especially in areas such as Tukwila's Urban Center, where block sizes are large (greater than 400 feet). However, since these crossing areas are not as common as intersections, and do not typically include a signal; it is more difficult for automobiles to notice them. Mid- block crossings should not be placed indiscriminately. The travel speed of automobiles, the traffic volume, the distance of the proposed mid-block crossing from the nearest signalized intersection, and the location of destinations in relation to existing crossing facilities are important considerations in the decision to construct a new mid-block crossing facility.

Below are several design elements to consider when increasing the safety and visibility of pedestrians in mid-block crossing areas :

- Lighting
- Minimized crossing distance.
- Refuge area.
- Signals.
- Warning signs.
- Angled crossings within median islands.
- Ensure landscaping in median islands does not obscure the view of pedestrians.

Crossing Enhancements

Pedestrian-Actuated Countdown Signals

Pedestrian Push-Buttons

Since crossing areas (both intersections and mid-block crossing areas) are areas where there tend to be high potential for pedestrian-vehicle conflict, the crossing enhancements shown here, and on the pages that follow, are some of the additional features that should be considered during crossing area design.

In-pavement, pedestrian-actuated lighting

Source: City of Kirkland

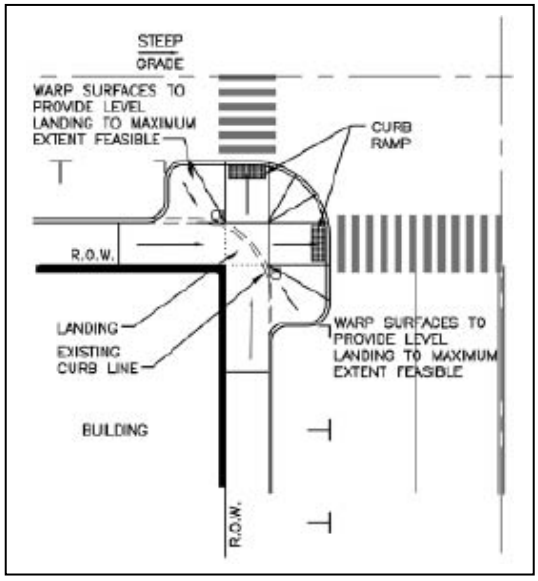
Source: City of Tukwila (Tukwila International Blvd

Crossing Enhancements (continued)

Curb Bulb-Outs

Cascade View, City of Tukwila

Mesa, AZ; Source: www.contextsensitivesolutions.org/

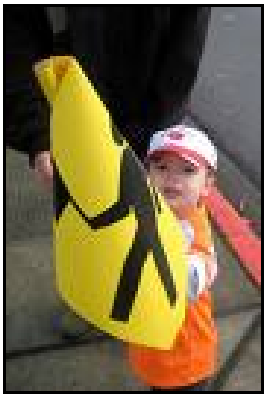


Curb Bulb-Outs serve to reduce the roadway width at intersections and/or mid-block crossing areas, thereby minimizing the crossing distance for pedestrians. They also help to calm traffic, acting to reduce vehicle speeds at pedestrian crossing points. For mid-block crossing areas, the bulbs prevent automobiles from blocking curb ramps, thereby preserving wheelchair access in these areas. Additionally, curb bulb-outs can help to channel pedestrians to pedestrian-activity areas, including pedestrian access points for large sites, potentially discouraging the frequency of jaywalking. Some areas of the bulb do not have to be hardscape, and can be planted with low growing plants (3' height maximum), providing additional green space in urban areas.

- Curb bulb-outs are appropriate where there is on-street parking.
- Curb bulb-outs can be used as a loading area for transit/bus pull-up as they are used in Portland, Oregon.
- On bicycle routes, there is a potential conflict between curb bulb-outs, on-street parking, and bike lanes. In areas with curb bulbs, the bulb-out should not encroach upon the bike lane or pinch down the travel pathway of a cyclist at the right edge. Additionally, as in other areas where there is on-street parking, bike lanes must either be set far enough back from on-street parking to separate bicyclists from the zone in which a car door would swing out.
- Curb bulb-outs should project out into the roadway a maximum distance of 8.5' to 9'.

Crossing Enhancements (continued)

Pedestrian Flags

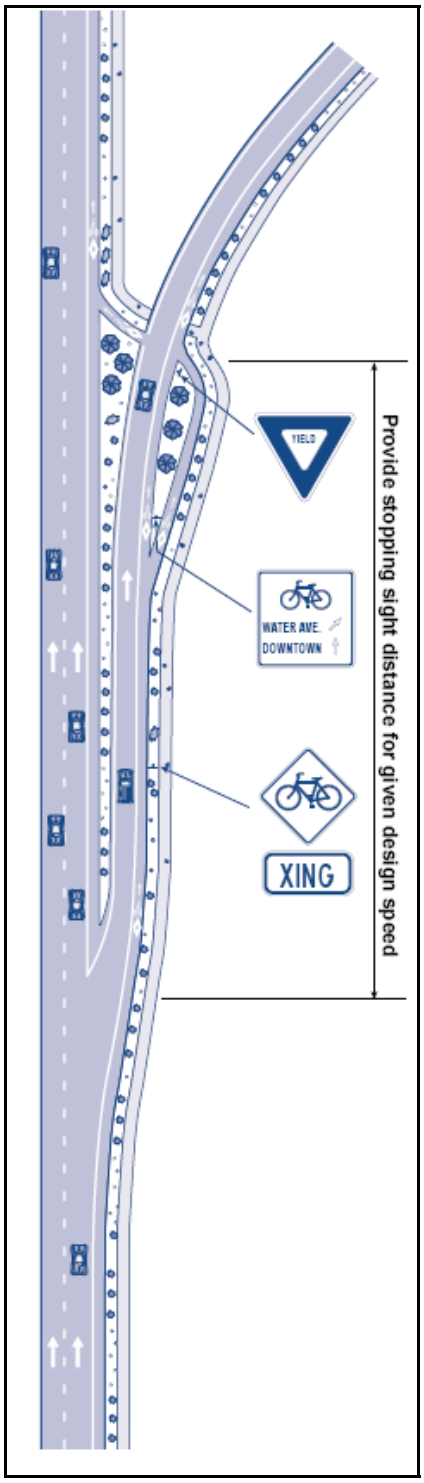


The City of Kirkland, as well as several other cities around the Puget Sound and the U.S. have installed pedestrian flags on either side of crosswalks to make pedestrians more visible. The City of Kirkland has found that when pedestrians use the flags in crossing areas, cars are more likely to stop.

When the program initially started in Kirkland, older people and young children were the pedestrians most likely to use the pedestrian flags. A change to the design of the flags to include the symbol of a pedestrian holding a flag, a change to the flag holders on either side of the crosswalks to make flags easier to grab, and development of a marketing program to increase awareness of the purpose of the pedestrian flags has increased usage of the flags by all user groups. Additionally, businesses and volunteers have partnered with Kirkland to offer incentives for those who make use of the flags and to advertise the program.

Installation of pedestrian flags in Tukwila could help pedestrian visibility at high volume pedestrian and vehicle crossing locations, including the intersection of Tukwila International Blvd and S 144th Street, intersections along Southcenter Parkway, and intersections in school zones.

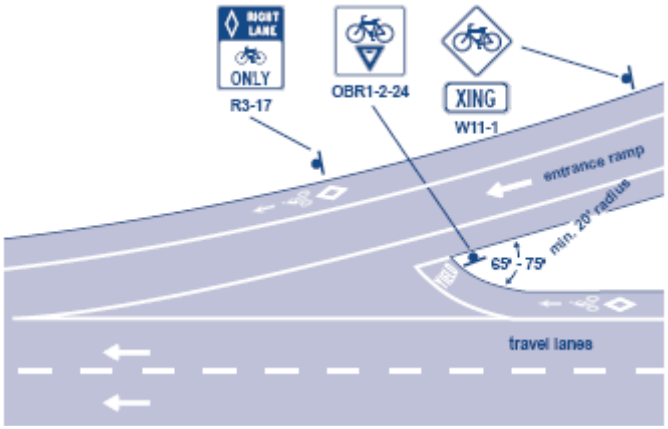
Crossing Areas (Freeway On-ramps and Off-ramps)



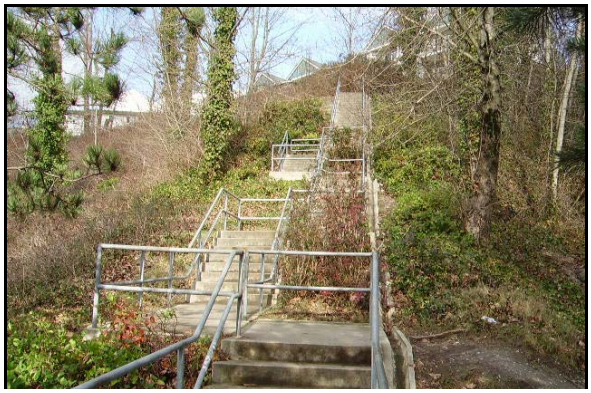
Freeway on and off-ramps are located along several of Tukwila's Bicycle-Friendly Routes, including Boeing Access Rd, Tukwila International Blvd, and Southcenter Blvd. These are dangerous areas for pedestrians and bicyclists, since cars entering or exiting freeways are typically travelling at high speeds, and merging onto the freeway or off the freeway onto arterial streets. Where nonmotorized facilities are located in these areas, it is important to slow automobile speed (through signalization if necessary), and increase visibility of all roadway users. Below are two approaches to the design of bicycle and pedestrian facilities in these areas:

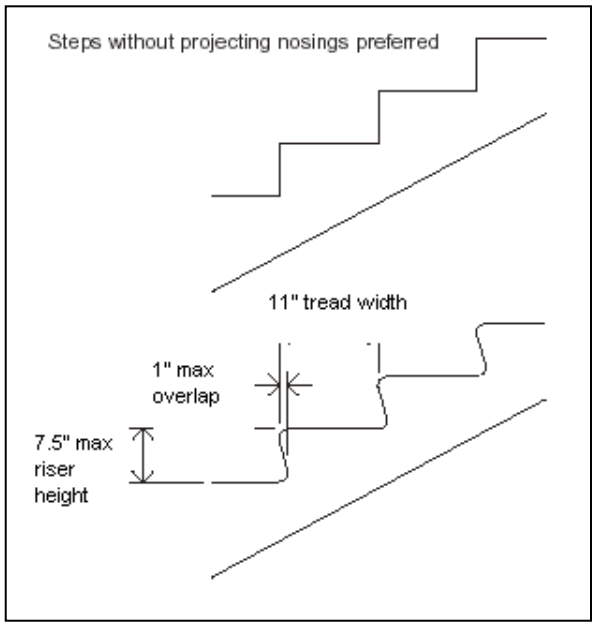
Separated Trail or Bridge:
Completely separate pedestrian and bicycle traffic from automobile traffic. This can be done by routing nonmotorized users completely away from freeway on- and off-ramp areas, or by constructing bridges over or under the freeway facilities. Although costly, these facilities eliminate the conflict.

Jug-Handle Design for At-Grade Crossing (shown at left for on-ramps and below for off-ramps):
Provide an at-grade crossing facility, placed at a right-angle to the off- or on-ramp, to improve the sight distance in these areas for both nonmotorized and motorized users of the roadway. Tukwila uses this model at the Southcenter BL on ramp to I-5 northbound.



Stairs





Source: San Francisco Bicycle Coalition

When slopes exceed 8% (1:12), stairs should be constructed rather than ramps.

- Stairs should be constructed of a firm material such as concrete, asphalt, or metal. However, in trail areas, crushed rock and bark mulch may be considered.
- Minimum stairway width: 5’
- All steps should have uniform riser heights, tread widths and depths.
- Risers and treads should not be designed to form areas that will easily catch the toe of a shoe. See preferred step design at left.
- A 6-foot concrete landing area should be provided for every 12 feet of rise. The maximum slope of the landing area should not exceed a 5% (1:20) grade.
- Handrails must be installed on both sides of the stair, and shall be extended at least 12 inches into any landing area.
- Hand rails should be placed 4” from an adjacent wall surface.
- Risers for outdoor stairways should between 4.5 to 7.5 inches in height.
- Treads should not be less than 11” wide.
- The tread surface should maintain a slip-resistant texture.
- Stairs should be designed with ramps to accommodate bicyclists (see picture at bottom left).

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