SECTION

5

Design Standards

Design Standards

Pedestrians

Walkers typically walk for exercise and recreation and often for utilitarian reasons such as errands. This is especially true in downtown areas and dense residential/commercial districts. "Evidence indicates that walking among urban residents living in high density districts is far more prevalent than among suburbanites, and that a much higher proportion of short trips (less than one mile) are walked in central business districts than in the suburbs. It should be noted, however, that suburbs and outlying areas often lack sidewalks . . . indications are that the relative convenience of other modes [of transportation] affects reliance on walking."[25]

The strongest impediments to walking as a means of transportation are universally considered to be distance and travel time. Walkers can typically cover three or four miles per hour at a moderate pace,[26] however, evidence indicates that walking trips are predominantly short. Recent studies indicate that 80% of walking trips are less than one mile and 94% are less than two miles.[27] Additionally, data indicates that specific physical aspects of the pedestrian environment affect an individual's choice to walk:

- Sidewalks. Suburban neighborhoods and areas on the fringe of cities frequently lack sidewalks and, as mentioned previously, walking takes place less often in those situations. However, many suburban trips such as shopping for a few groceries, enjoying a restaurant or theater, or a trip to the local bookstore are short enough to be easily manageable on foot. There is evidence, although not comprehensive, that the availability and quality of sidewalks inhibits such uses.

  The standard facility for the universal pedestrian is an ADA standard, contiguous sidewalk system, but a number of populations must be considered. Young children's awareness of sounds and where they come from, as well as their peripheral vision, focus and concentration levels are not fully developed until after the age of eight. Senior citizens typically do not have the sight, speed and reaction time requirements of mobile and alert younger adults. Therefore, facilities must be designed to ensure accessibility and safety for children, seniors and the disabled. If these requirements are met, adequate facilities will be available for any pedestrian.[28]

[25]U.S. Department of Transportation, Federal Highway Administration. "National Bicycling and Walking Study. Case Study Number 1: Reasons Why Bicycling and Walking Are Not Being Used More Extensively as Travel Modes". (Federal Highway Administration Publication Number FHWA-PD-92-041, 1994) 2
[26]Ibid., 12
[27]Ibid., 12
[28]North Central Texas Council of Governments. *Bicycle and Pedestrian Facilities Planning and Design Guidelines*. (Arlington, Texas, 1995) 1-11

- Traffic Signals and Pedestrian Crossings. The absence of traffic signals and striped pedestrian crossings on highly traveled roads is an impediment to pedestrians. When coupled with wide roads and high-speed travel, it can be impossible to safely cross the street, especially for children and older or disabled individuals. These issues are not insignificant—6,000 pedestrians are killed every year in this country (58% are working adults, 23% are age 65 or older, and 19% are children under the age of 19) and 90,000 are injured. These injuries and fatalities result in $20 billion in societal costs.[29]

- Street Lighting. In some neighborhoods, particularly very urban neighborhoods, crime or the perception of potential crime, is a real concern for walkers. Improved lighting is considered one of the most effective ways to reduce these fears.

- Attractive Places to Walk. Walking is a slow or moderately paced activity and it is frequently a solitary one. Therefore, pedestrians have the opportunity to really enjoy their environment. Features which enhance the walker's sensory experience include park trails in scenic situations, historic elements such as architecture and interpretive signs at significant sites, and concentrated activities such as farmers' markets or street fairs have been clearly identified as methods to make walking more popular.

Bicyclists

Distance also has a significant impact on the choice to bicycle rather than use motorized transportation. Therefore, transportation planners assume that the farther one is from a destination, the less likely one is to prefer bicycling and the distance factor has become a common tool to help identify the market for non-motorized transportation. The accepted literature in the field has attempted to quantify average trip lengths; in the late 1970s, the paradigm was that most bicycle trips were less than two miles. In the early 1980s the paradigm was reinforced-studies showed that 90% of work trips taken by bicycle were two miles or less, as were 84% of other utilitarian trips. A 1990 study conducted in Denver found the mean bicycle trip length to be 2.1 miles.[30]

According to the National Bicycling and Walking Study " . . . levels of bicycle commuting in twenty cities were compared across a number of objective physical, environmental, and infrastructural features. The most significant variable appears to be the dominating presence of a university. . . In fact, no other factor correlates so consistently with high levels of bicycle commuting."[31] However, even when excluding college towns, cities with higher rates of bicycle travel to

[29]Federal Highway Administration. "Facts and Figures: National Overview". (Project: AP-18, 1995 statistics)
[30]U.S. Department of Transportation, Federal Highway Administration. "National Bicycling and Walking Study. Case Study Number 1: Reasons Why Bicycling and Walking Are Not Being Used More Extensively as Travel Modes". (Federal Highway Administration Publication Number FHWA-PD-92-041, 1994) 7
[31]U.S. Department of Transportation, Federal Highway Administration. "National Bicycling and Walking Study. Case Study Number 1: Reasons Why Bicycling and Walking Are Not Being Used More Extensively as Travel Modes". (Federal Highway Administration Publication Number FHWA-PD-92-041, 1994) 1

and from schools and workplaces have, on average " . . . 70% more bikeways per roadway mile and six times more bike lanes per arterial mile."[32]

The Federal Highway Administration divides bicyclists into three general categories-**A**, **B** and **C**:

Advanced riders generally use bikes as they would a motor vehicle. These individuals ride for convenience and speed and want direct access to destinations. They are typically comfortable riding with motor vehicle traffic, but they need sufficient operating space to do so.

Basic riders are less confident. They may use their bikes for utilitarian purposes, but prefer to avoid roads with fast and busy motor vehicle traffic unless there is ample roadway width. B riders are most comfortable on greenways, neighborhood streets, and designated facilities such as bike lanes or wide shoulder lanes.

Children may not travel as fast as adults, but still require access to key destinations such as schools and parks. Residential streets with low speed limits linked with greenways and busier streets with defined pavement markings between cars and bikes are most appropriate for these less experienced bicyclists.

Trail Standards

The following standards are adapted from a number of sources including the 1999 *Guide for the Development of Bicycle Facilities* by the American Association of State Highway and Transportation Officials (AASHTO) and various state highway departments' planning and design guidelines for bicycle and pedestrian facilities.

Greenway and trail design criteria have evolved over a period of years and have become relatively standardized due to issues of safety, cost, maintenance and user satisfaction. The American Association of State Highway and Transportation Officials has established pedestrian and bicycle standards that have been widely recognized since the early 1980s. The 1999 AASHTO *Guide for the Development of Bicycle Facilities* was a primary reference throughout this planning process. Additional resources consulted included a variety of state transportation department planning documents, numerous Federal Highway Administration publications, including the *National Bicycling and Walking Study*, and a wealth of engineering and design references related to greenway planning, design and construction. Greenways and trails are extremely diverse. Unlike criteria for other recreational facilities such as playgrounds, ball fields or tennis courts, there is no single, nationally accepted list of design standards to ascribe and adhere to. The individuals in communities who are responsible for greenway implementation must make decisions based on available resources, local issues, safety concerns and community desires. The relevant design material presented in this document is intended to identify the most salient trail design issues in order to facilitate informed decisions by responsible individuals and public agencies.

[32]Ibid., 1

The type of users expected to share a greenway determines the necessary width of multi-use facilities. Width requirements are further impacted by the likelihood that trail users will experience conflicts on portions of planned routes. The minimum width for a moving pedestrian is 2.5 feet. The minimum width for one bicyclist traveling at a normal speed (19 mph) is 3.3 feet. However, the minimum width for two bicyclists traveling at normal speed on a paved area such as a greenway is 9.8 feet. Therefore, the width needed for two opposing bicyclists to pass and share the path with a pedestrian is approximately 12.5 feet. This situation is common on urban pathways with only moderate levels of use—higher use obviously creates more conflicts.[33] Narrower widths may be acceptable if bicycle traffic on the greenway is expected to be low even at peak times, or if pedestrian use is expected to be low even at peak times. Additionally, if the greenway will not be subjected to maintenance vehicle loading conditions that could damage pavement edges and if access by emergency vehicles will not be needed, narrower greenways can be considered. However, widths less than eight feet (the minimum AASHTO standard) for multi-use situations are not recommended, and it should be noted that multi-use recreational trails that are designed to meet AASHTO standard widths ranging from 10 to 12 feet have a greater likelihood of approval for federal funding.

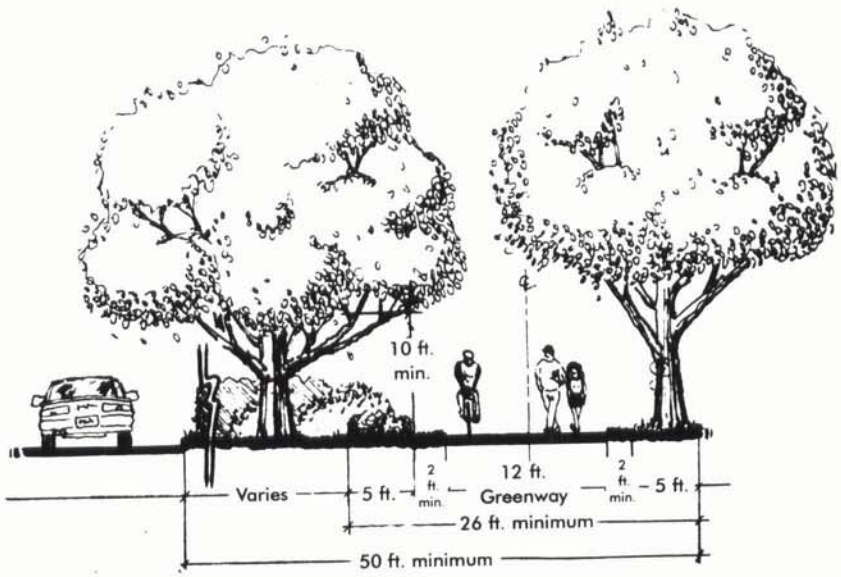


Figure 5.1 - Greenway: Trail physically separated from vehicular traffic by open space or a barrier. Located within the road right-of-way or within an independent right-of-way.

Greenways

Independent multi-use greenways are typically 12' wide to serve a variety of users, including walkers, joggers, runners and bicyclists. In order to ensure safety and access for all users, the trail should be paved with asphalt or concrete, depending upon the location. In areas where jurisdictional wetlands are

[33]North Central Texas Council of Governments. *Bicycle and Pedestrian Facilities Planning and Design Guidelines.* (Arlington, Texas, 1995) 3.8

encountered, the trail should transition to boardwalk. All on-grade trails will require a 2-foot cleared shoulder on both sides of the trail for maneuverability and safety. Consideration should also be given to a painted centerline stripe to control travel direction. Detailed design of the multi-use trails should follow AASHTO standards and criteria in order to accommodate bicycle travel at a maximum speed of 20 mph. The trail should also be designed to support vehicles weighing 6.5 tons at a maximum travel speed of 15 mph.[34] Multi-use trails should be designed to serve all pedestrians, as well as basic, novice and proficient cyclists. See Figure 5.1

Multi-use trails provide access to, and connections between, historic and cultural sites, exceptional natural resources and other points of interest. Multi-use trails may follow roadways, but physical separation is established between motor vehicles and trail uses. Along portions of the trail, changes in elevation are required to conform with existing topography, avoid significant natural features such as rock outcroppings, or compensate for fill materials in floodplains. In these areas of transition, concrete ramped trails with supporting gabion walls should be employed. Trails must not exceed a five percent vertical slope in order to comply with ADA guidelines for accessibility. Any trails that exceed five percent are considered ramps, and must conform to specific ADA requirements relevant to handrails, length of run, landings and other issues. In any event, the maximum vertical slope that can be made accessible for people with disabilities is eight percent.

Bicycle Facilities

It is important to establish a common vocabulary when discussing bicycle facilities. According to AASHTO, Bike Lanes are a portion of a roadway designated by striping, signing and pavement marking for the preferential or exclusive use of bicyclists. Signed Bike Routes are shared roadways designated by signing as preferred routes for bicycle use.[35] Signed bike routes do not include striping or pavement markings.

Bicycle and greenway programs must be responsive to applicable laws and ordinances. Bicycle facilities must not encourage or require bicyclists or pedestrians to operate in a manner inconsistent with the adopted Rules of the Road as outlined in the *Uniform Vehicle Code*. Tennessee's laws clearly state that " . . . bicycles . . . are required to travel on the right hand side of the road with other traffic. Bicycles are not allowed to travel facing traffic, since this is far less safe. They must ride as near to the right hand side of the road as practical, while avoiding road hazards that could cause them to swerve into traffic."[36]

[34]Greenways Incorporated and Lose & Associates, Inc. "Master Plan Summary Report for the Stones River Greenway". (Murfreesboro, TN, 1993) 17

[35]The American Association of State Highway and Transportation Officials. *Guide for the Development of Bicycle Facilities*, (Washington, DC, 1999) 2-3

[36]State of Tennessee Department of Safety. *Tennessee Driver Handbook and Driver License Study Guide.*

Bike Lanes

Bike lanes clearly identify, through pavement markings, the available road space for preferential use by bicyclists. By doing so, they increase bicyclists' confidence that motorists will not stray into the designated bicycle travel lane. Bike lanes should be one-way facilities and carry bike traffic in the same direction as adjacent motor vehicle traffic-wrong-way riding is a major cause of bicycle crashes. On one-way streets, bike lanes should be placed on the right side of the street.

For roadways with no curb and gutter, the minimum width of a bike lane should be four feet. When parking is permitted, the bike lane should be placed between the parked cars and the travel lane and have a minimum width of five feet. If parking is permitted, but the parking area is not striped, parked cars and bicycles should share an area at least 11 feet wide without a curb and 12 feet if adjacent to a curb. If the parking volume is extremely high, consideration should be given to an additional one to two feet of width.

Bike lanes should be distinguished from the motor vehicle travel lane with a six inch-wide, solid white line. If parking is allowed, a second four-inch solid white line can be placed between the parking lane and the bike lane. Raised pavement markings or physical barriers should not be used to divide bike lanes from vehicular lanes. Bike lanes should be provided with adequate drainage to prevent ponding and other hazardous situations. All drainage grates should be bicycle-safe.

Bike lane striping should not be installed across pedestrian crosswalks nor should it continue through street intersections. Bike lane striping should stop at the near side cross street property line and resume at the far side property line. At signalized or stop-controlled intersections with right-turning motor vehicles, the solid striping should be replaced with a broken line (two-foot dots between six-foot spaces) for 50 to 200 feet prior to the intersection. See figure 5.2

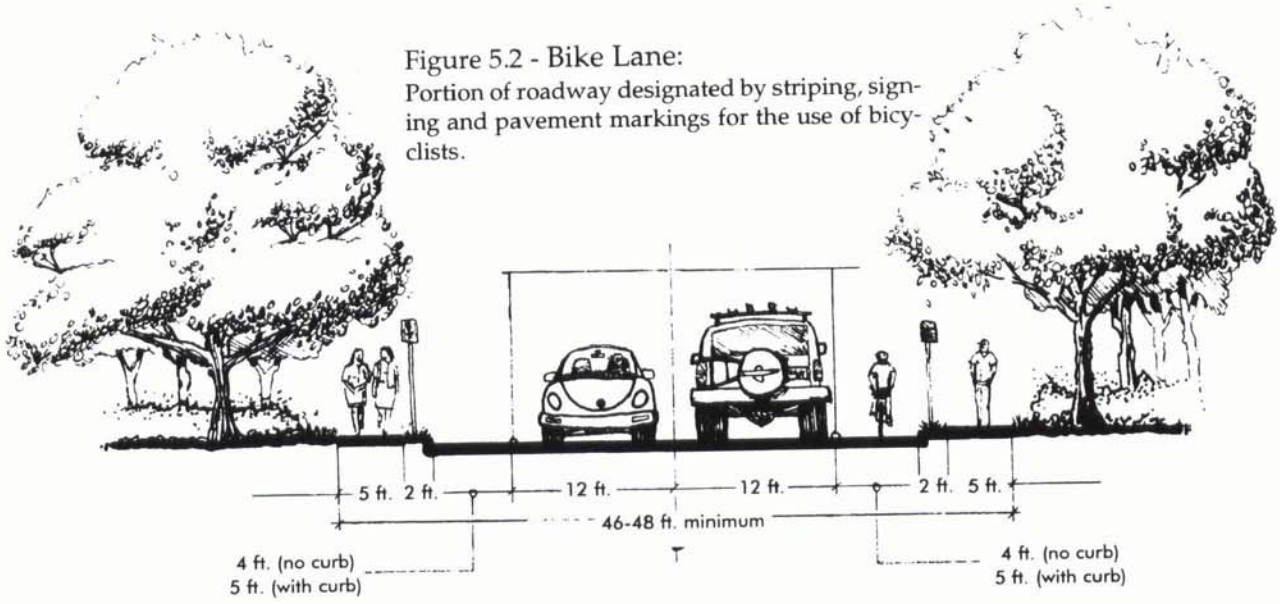


Figure 5.2 - Bike Lane:
Portion of roadway designated by striping, signing and pavement markings for the use of bicyclists.

On-Street Parking

The primary function of streets and roads is to move people from place to place, not to store vehicles. When parking is removed, safety is improved. However, there will certainly be cases where on-street parking cannot be removed. Factors such as the number of businesses and residences and the availability of both on-street and off-street parking must be carefully considered as retrofits are planned. In cases where it is not practical or possible to eliminate on-street parking, a shared lane with parking should be considered.

Bike Routes

"Width is the most critical variable affecting the ability of a roadway to accommodate bicycle traffic. In order for bicycles and motor vehicles to share the use of a roadway without compromising the level of service and safety for either, the facility should provide sufficient paved width to accommodate both modes. This width can be achieved by providing wide outside lanes or paved shoulders."[37] Bicyclists need a minimum width of four feet to ride safely and comfortably. On streets with high speed limits and volume of traffic, five feet is desirable. See figure 5.3

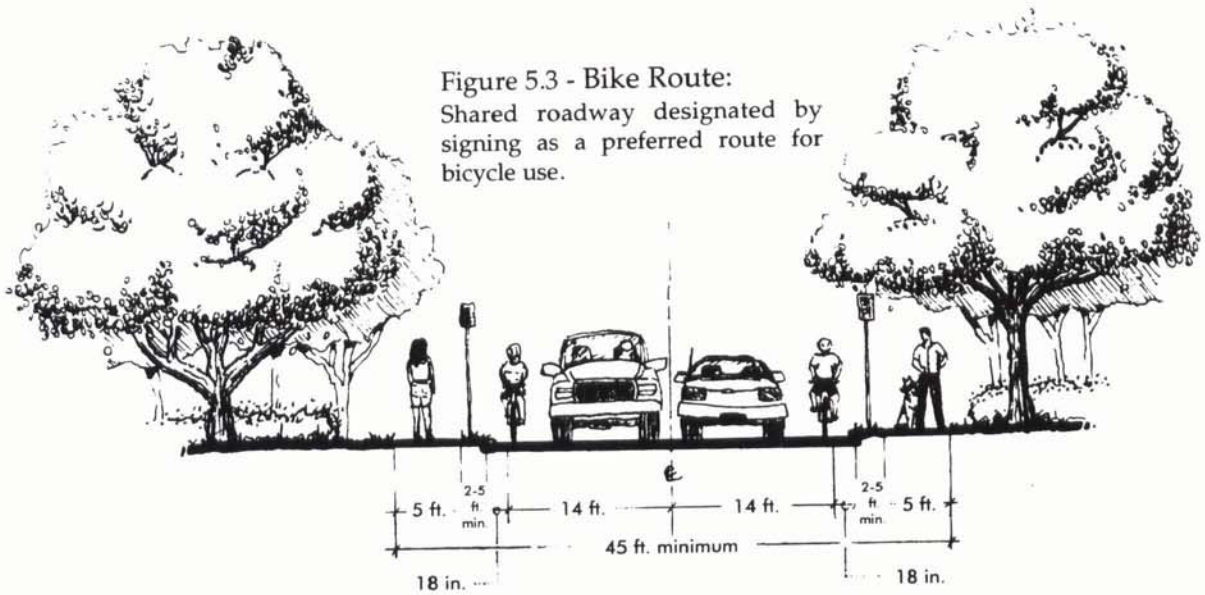


Figure 5.3 - Bike Route:
Shared roadway designated by signing as a preferred route for bicycle use.

Paved Shoulders

Paved shoulders can be the best way to provide for bicyclists in rural settings. As mentioned earlier, four feet is the standard minimum width for bicycle travel. However, bicycles will, to some extent, be used on all roadways where they are not prohibited, so any additional paved shoulder width is beneficial. According to AASHTO " . . . the measurement of usable shoulder width should not include the width of a gutter pan . . . shoulder width of five feet is recommended from the face of guardrails, curbs or other roadside barriers, and additional shoulder width is also desirable if motor vehicle speeds exceed 50 mph."[38]

[35]Ibid., 16
[36]Ibid., 16

Wide Curb Lanes

In some cases, such as urban settings, paved shoulders are not an option. In these cases, wide curb lanes for bicycles are an alternative. In general, 14 feet of usable lane width is the recommended standard for shared use in a wide curb lane. This distance is measured from the joint between the gutter pan and the road. On very steep grades, the curb lane should be widened to 15 feet. However, continuous lengths of curb lanes wider than 14 feet can actually do more harm than good, in that they encourage motor vehicle drivers to treat the space as two lanes.

Bike Route Signage

In all cases where existing streets are to serve as designated bike routes, bicycle route signs should be placed at all areas where new traffic enters the road-the distance between signs should not be greater than two miles. In urban areas, directional arrows should be used at intersections to indicate whether the bicycle route continues through the intersection or turns right or left.[39] Designated bike routes are those that provide continuity to other facilities such as greenways, and are common routes for bicyclists through high demand corridors. Routes that lead to destinations such as schools and parks should be considered as designated bike routes. However, it is important to note that signing of bike routes indicates to cyclists that there are particular advantages to using these routes. Therefore, the responsible agencies must have taken action to ensure that these shared routes are safe and properly maintained-bicyclists should not be encouraged through signing to ride facilities that are not designed to accommodate bicycle travel. AASHTO suggests that the following should be considered prior to signing a route:

- The route should provide through and direct travel in bicycle-demand corridors.
- The route should connect discontinuous segments of greenways, bike lanes or other bike routes.
- Traffic control devices should be adjusted to give greater priority to bicyclists.
- Street parking should be removed or restricted.
- Paving is smooth.
- Regular maintenance is planned.
- Wider curb lanes are provided compared to parallel streets and roads.
- Shoulder and curb lane widths meet minimum width requirements.

Sidewalks

Sidewalks are intended for use by pedestrians. The designated use of sidewalks for bicycle travel should not be encouraged. The width of the sidewalk is irrelevant-wide sidewalks only facilitate higher speed bicycle use and increase the potential for conflicts with motorists at intersections.

"Riding on the sidewalk or in the wrong direction places the cyclist outside the flow of traffic and into positions where they are not visible or not expected. A bicyclist riding at speed on the sidewalk may suddenly appear in an intersection at the moment a motorist on the parallel roadway is turning right into a

[39]Greenways Incorporated and Lose & Associates, Inc. "The City of Murfreesboro Bicycle Plan". (Murfreesboro, January, 1994) 45

side street. In such cases the motorist has the impression that the bicyclist appeared from nowhere . . . a recent study found that bicycling against traffic increases accident risk by 360%, bicycling on the sidewalk increases accident risk by 180%, and bicycling the wrong way on the sidewalk increases accident risk by 430%."[40] Sidewalk bike routes should only be considered on long narrow bridges where no other option exists.

Intersection Design Issues

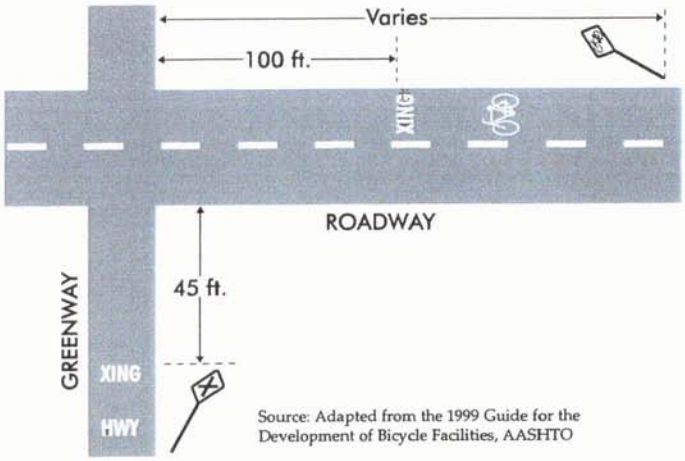
Where off-street, multi-use greenway routes intersect with surface streets; bicyclists and pedestrians must be provided with safe opportunities to enter or exit the greenway, and bollards or other devices should be used to prevent motorized vehicles from entering the greenway. These intersections must also provide safe opportunities for bicyclists and pedestrians to cross or merge with traffic.

In the detailed design phases of greenway development, alternate locations for a trail are typically considered, and locations with the most appropriate intersection conditions should be prioritized. In ideal conditions, greenway crossings of roads should be removed from existing intersections in order to have better control over vehicular movements. When this is not possible, the greenway crossing should be at or adjacent to existing pedestrian crossings.

Greenway-Roadway Intersections

The most critical safety conditions on a greenway generally occur at the intersections of greenways and vehicular roadways. According to the American Association of State Highway and Transportation Officials, there are three basic categories of at-grade greenway/roadway intersections—midblock, adjacent path and complex.

Mid-block crossings should be distinctly removed from existing roadway intersections to clearly separate them from vehicular intersection activity such as merging movements, acceleration/deceleration and preparations to enter turn lanes. The figure below illustrates an acceptable greenway/roadway intersection at midblock.[41]

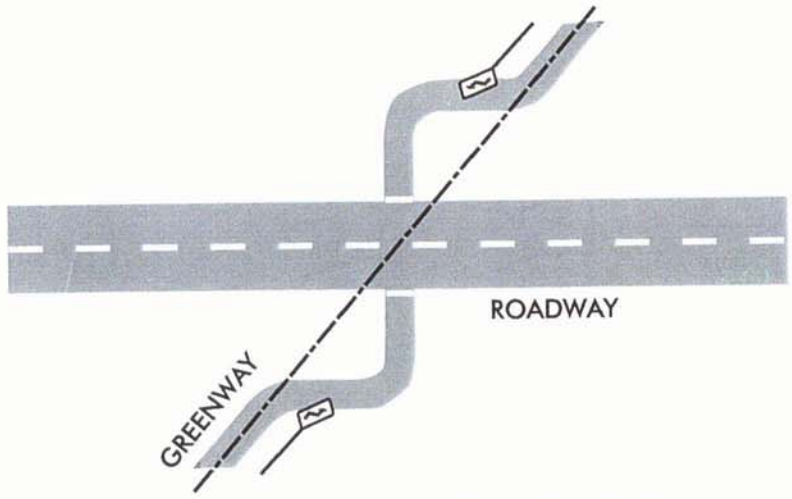


Source: Adapted from the 1999 Guide for the Development of Bicycle Facilities, AASHTO

[40]Paul Schimek. "The Dilemmas of Bicycle Planning" Massachusetts Institute of Technology and the US Department of Transportation, February 13, 1997

[41]The American Association of State Highway and Transportation Officials. *Guide for the Development of Bicycle Facilities*. (Washington, DC, 1999) 47

Where greenways are aligned in such a way that they would not cross the roadway at a 90-degree angle, the configuration below should be used.[42]

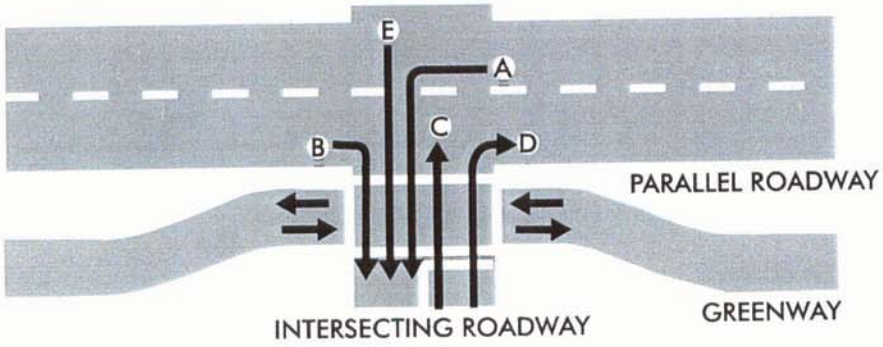


Source: Adapted from the 1999 Guide for the Development of Bicycle Facilities, AASHTO

Adjacent Greenway Crossings

This category of crossing occurs when a greenway crosses a roadway at an existing intersection between two roadways, whether it is a T-intersection such as a driveway, or a four-legged intersection as shown in the illustration below. This type of crossing should be developed as close as possible to the intersection so that both motorists and greenway users recognize each other as intersecting traffic. However, potential conflicts for greenway users will occur with left-turning (A) and right-turning (B) motor vehicles from the parallel roadway, and on the crossed roadway at C, D and E.

To minimize conflicts for type A turning movements, it is advisable to prohibit left turns on a high-volume parallel roadway and high-use greenways. To minimize conflicts for turning movement B, the turning radius should be as small as practical in order to reduce the speed of turning motor vehicles. For turning movements C and D it is advisable to prohibit right turns on red.



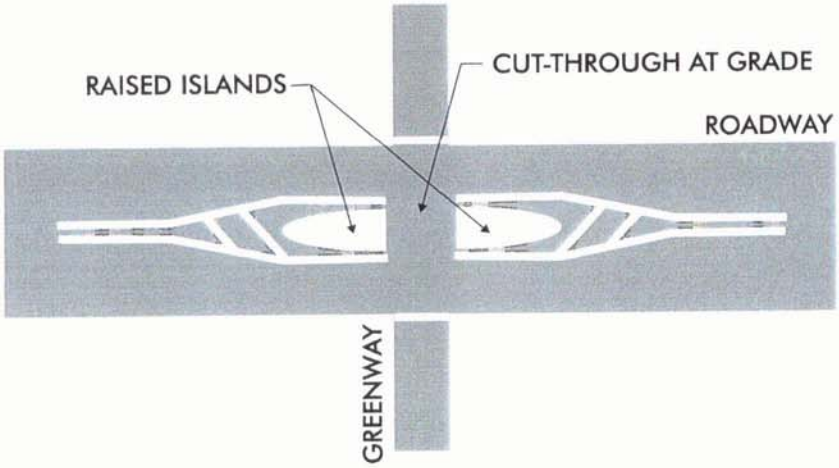
Source: Adapted from the 1999 Guide for the Development of Bicycle Facilities, AASHTO

[42]Ibid., 48

The major roadway in the figure above may be either the parallel or the crossed road. Right-of-way requirements, traffic control devices and separation distance between the road and the greenway will greatly affect this type of intersection-careful attention to these details must occur in the development of construction documents for specific greenway segments.[43]

Complex Intersection Crossings

Complex intersection crossings account for all other greenway/roadway or greenway/driveway intersections. Improvements to complex crossings must be considered on an individual, site-specific basis. The obvious mitigation measures to avoid complex intersection crossings are moving the crossing to an alternate location, installation of a traffic signal, change in signalization timing, or provisions for a refuge island and a two-step crossing for greenway users as shown in the illustration below. The refuge area should be large enough to accommodate groups of users including pedestrians, bicyclists and individuals in wheelchairs. Additionally, adequate space should be provided so that users in the refuge areas do not feel threatened by passing motor vehicles while waiting to finish the crossing.[44]



Source: Adapted from the 1999 Guide for the Development of Bicycle Facilities, AASHTO

Traffic Signals and Stop Signs

Regardless of the type of greenway/roadway intersection, a regulatory traffic control device should be installed at all greenway/roadway intersections-the individual type of control device will vary from case to case.

Under certain circumstances, traffic signals are most appropriate. The Manual of Uniform Traffic Control Devices (MUTCD) developed by the Federal Highway Administration identifies 11 situations that warrant the use of a traffic signal. The MUTCD does not address greenway crossings, but bicycle traffic on a greenway may be functionally classified as vehicular traffic and addressed accordingly. Greenway stop signs should be placed as close to the intended stopping point as possible. Four-way stops at greenway/roadway intersections are not recommended because of frequent confusion about or disregard for right of way rules. Yield signs may be acceptable on low-volume, low-speed

[43]Ibid., 49
[44]Ibid., 52

neighborhood streets. In any event, the designer should ensure that greenway signs are located so that motorists are not confused by them, and that roadway signs are placed so that pedestrians and bicyclists are not confused by them.[45]

Transition Zones
Where greenways terminate at existing roads, the path must be integrated into the existing roadway network. Again, as construction documents are developed, care must be taken to properly design the terminus in order to create a safe merging or diverging situation. The designer should treat each greenway/roadway intersection as a potential point of ingress or egress and the design should consider the movements of greenway users who enter the greenway from the road as well as those who will exit the trail and use the roadway from that point on.[46]

Approach Treatments
Greenway intersections and approaches should be developed on relatively flat areas. The stopping sight distance at intersections must be evaluated and adequate warning signs should be provided to allow bicyclists to stop before reaching the intersection, especially on downgrades. Unpaved greenways should incorporate paved aprons that extend a minimum of 10 feet from paved road surfaces.[47]

Ramp Widths
Ramps for curbs at intersections should be at least the same width as the greenway. Curb cuts and ramps should provide a smooth transition between the greenway and the roadway. A five-foot radius should be considered to facilitate right turns for bicycles.[48]

Bridge Crossings
In some cases, such as stream crossings, bridges may be the only practical treatment-these structures should be designed to serve both pedestrians and non-motorized users. Ideally, the clear width of pedestrian bridges will match the approaching greenway including the recommended minimum two-foot wide cleared area on either side of the trail. Including the cleared area width allows for free space between the users and requisite safety railings and barriers.

When it is necessary to route a trail along an existing vehicular bridge, several alternatives can be considered. The first, if width is limited, is to align " . . . the bicycle path across the bridge on one side. This should be done where the bridge facility will connect to a bicycle path at both ends and sufficient width exists on [one] side of the bridge or can be obtained by widening or restriping lanes."[49] A second alternative is to "provide wide curb lanes over the bridge. This may be advisable where the bicycle path transitions into wide outside lanes at one end of the bridge and sufficient width exists or can be obtained by widening or restriping."[50] The third, and least acceptable alternative is to use

[45]Ibid., 50
[46]Ibid., 51
[47]Ibid., 51
[48]Ibid., 51
[49]North Central Texas Council of Governments. *Bicycle and Pedestrian Facilities Planning and Design Guidelines.* (Arlington, Texas, 1995) 3-32
[50]Ibid., 3-32

existing sidewalks. "This may be advisable where conflicts between bicyclists and pedestrians will not exceed tolerable limits, and the existing sidewalks are adequately wide. Under certain conditions, the bicyclist may be required to dismount and cross the structure as a pedestrian."[51] Retrofitting an existing bridge will present a variety of challenges, and compromises may be required.

Railroad Crossings
Railroad grade crossings should be aligned at a right angle to the rails. The greater the crossing deviates from this angle, the greater the potential for a cyclist's front tire to be trapped in the flangeway, causing loss of control. If the crossing angle is less than 45 degrees, an additional paved shoulder of sufficient width should be provided to permit the cyclist to cross the track at a safer angle. Where this is not possible, and where train speeds are low, commercially available compressible flangeway fillers may be used.[52]

Ancillary Trail Facility Standards

Trailheads
In simple terms, trailheads are trail access points. However, in terms of available facilities, they can be extremely diverse. Trailheads will establish the trail user's first impression of the greenway network, therefore, their detailed design will be critical as construction documents are developed for implementation. Where possible, trailheads will be located in or adjacent to existing or planned parks so that public amenities such as restrooms, telephones, parking, picnic pavilions, playgrounds and general recreation facilities are already available. Frugal use of economic resources does dictates this course. However, economy of means is not the only component of this reasoning. By clustering recreational opportunities, the community will have a greater range of choices to improve their health, quality of life and leisure time.

General Trailhead Criteria
1) Circulation. Adequate, efficient and safe space must be provided for vehicles and pedestrians to maneuver.
2) Parking. Adequate number of spaces for the anticipated level of use of the particular facility including, where appropriate, spaces for RVs, buses, small trailers for boats and canoes, and bicycles.
3) Structures. Again, depending on the anticipated level of use, buildings may be required. Structures may include gazebos, picnic shelters or pavilions, restrooms, maintenance and storage facilities, information booths and kiosks.
4) Emergency telephones.
5) Site furnishings, including benches and trash receptacles.
6) Signs.
7) Fences and lockable security gates.
8) Security lighting.
9) Landscaping.
10) Connector trails to the main trail.
11) River access where appropriate.

[51]Ibid., 3-32
[52]The American Association of State Highway and Transportation Officials. *Guide for the Development of Bicycle Facilities*. (Washington, DC, 1999) 60

Trail Signage

The primary purpose of trail signs is to aid and instruct users of the greenbelt system. Signs fall into three categories: regulatory, warning and guidance. Regulatory signs provide operational requirements, and are used for traffic control. This category includes stop and yield signs, right-of-way signs, speed-limit signs and exclusion signs. They are normally installed where specific regulations apply.

Warning signs function as their name implies-they identify existing or potentially hazardous conditions on or near the trail, and they caution users to reduce speed or dismount a bicycle for safety reasons. They are typically used near intersections, bridges, crossings and tunnels. Warning signs should also be employed to indicate significant grade changes, upcoming traffic control devices and changes in surface conditions.

Guidance signs instruct-they provide trailside information to orient users geographically. The typical "you are here" map is an excellent example of this category of sign. Guidance signs can be both directional and informational. Directional signs point out nearby support facilities and points of interest, such as historic sites and unique natural resources. In this respect, guidance signs are often referred to as interpretive signs.[53]

Trails are transportation corridors, and for that reason, recognizable transportation signs can be adapted for trail use. However, an independent sign "package" that coordinates all greenway-related signage should be developed in succeeding phases of the countywide trail system design. The sign package facilitates several goals-most importantly, it reinforces an overall aesthetic image that incorporates the greenway logo and colors. With consistent application of greenway sign standards, trail users will quickly learn to recognize and comprehend trail components. The trails will be more user-friendly, easier to navigate and safer.

Waysides

Wayside exhibits are built adjacent to trails or at the terminus of a connecting trail. These areas contain interpretive signs that provide information on the natural environment or on cultural and historic points of interest in the vicinity. They also provide small areas where people can sit, relax and enjoy a quiet moment.

Landscaping

Landscaping will be required, not only at trailheads, but virtually all along the trail network. Construction of the greenway will require grubbing and clearing and some loss of existing vegetation. At first, this may seem regrettable, however, it also presents real opportunities for ecological restoration and beautification.

[53]Karen-Lee Ryan, editor. *Trails for the Twenty-First Century: Planning, Design, and Management Manual for Multi-Use Trails.* (Island Press: Washington, D.C., 1993) 122-123

To the extent possible and practicable, native species should be preserved wherever possible as trails are installed. However, invasive exotic species such as privet, honeysuckle and multiflora roses should be removed. Additionally, damaged trees should be examined by certified arborists. Trees in extreme states of decline should be removed, especially if they present safety hazards. Dominant native plants in the areas of disturbance can then be reintroduced and function to provide visual screens, walls, buffers and overhead canopies. The particular environment and intended purpose of landscaping will influence the overall plant palette, and native trees do not have to be used exclusively- some situations will certainly benefit from more ornamental introductions. However, native vegetation should be considered wherever possible, especially in riparian areas where it can protect the environment and stabilize riverbanks. Indigenous plant material will be the most robust and will adapt best to local climate, soils and precipitation.

In most cases, a cleared area should be maintained for five feet on each side of trails. Therefore, new trees and shrubs should be planted at least ten feet from the trail. By maintaining this minimum ten-foot space, visibility will enhance user safety, and tree roots will be less likely to damage trail surfaces. For reasons of security, dense shrub plantings should be avoided adjacent to the trail. Occasional open spaces will also increase security by providing clear routes for people to exit the trail in the event of emergencies.

Canoe Portage

Canoe portage points provide facilities for canoe put-in and take-out. At a minimum, they include a paved access path to natural staging and launching areas. Additionally, a flow gauge should be provided to indicate the degree of safety for canoeing.[54] In some situations, a minimal amount of shotcrete or concrete may be required to improve footing and access within natural rock outcrops. In other situations, a system of large steps or terraces can be constructed of recycled plastic and wood timbers to facilitate put-in and take-out at varying water levels.

Canoe portage points should, wherever possible, take advantage of existing park facilities or proposed trailheads for parking, picnicking, restrooms, and other amenities. In these cases, the launch areas should be as close as possible to the parking lot for convenience, but also be located in such a way as to protect the natural environment. In other situations, portage points may be independent of park facilities and will require dedicated parking. In a few cases, roadway pull-offs with stacking room for two or three users will be adequate. In other cases, more developed parking amenities will be required. Again, the parking should be located as close as possible to launch areas for convenience. However, if parking lots are built too close to shorelines, construction may significantly alter the site environment and contribute to soil erosion.[55]

[54]Greenways Incorporated and Lose & Associates, Inc. "Master Plan Summary Report for the Stones River Greenway". (Murfreesboro, TN, 1993) 18

[55]John Hultsman, Richard L. Cottrell and Wendy Z. Hultsman. *Planning Parks for People*. (Venture Publishing: State College, Pennsylvania, 1998) 73

Maintenance, Safety and Security

Maintenance and related issues require long-term commitment, consistency and enthusiastic public involvement. Regular maintenance ensures trail safety and reduces potential political liability. Additionally, regular maintenance will protect the community's significant investment in the greenbelt system by prolonging the life of trail facilities. According to generally accepted standards, the following tasks should be part of a maintenance schedule:

1) Signs and Traffic Markings for motorists and trail users must be inspected regularly and kept in good condition. Pavement markings must be kept clear and legible.
2) Sight distances, especially those leading to crossings and curves. should not be impaired by vegetation. Trees, shrubs, and tall grass should be trimmed to meet sight-distance requirements based on a 20-mile-per-hour design speed. Adequate clearance must also be maintained overhead and on both sides of trails.
3) Trail surfaces should be patched on a regular basis-patches must be flush with the finish surface of the trail.
4) Trail damage from seasonal washouts and silt or gravel washes must be repaired as soon as possible after they occur. Recurring drainage problems. should be identified and remedied. Culverts, catch basins, and other drainage structures should be cleaned at least once a year.
5) Regular sweeping and cleaning will be required to keep the trail free of debris, including broken glass, loose gravel, leaves, and trash.
6) Structures such as pavilions and restrooms should be inspected annually to ensure they are in good condition. Special attention must be paid to wood foundations and posts to determine if rot or termites are present. At the same time, site furniture and other support facilities should be inspected.
7) Mow trail shoulders and other selected areas on a scheduled basis depending upon season, species and rate of growth.
8) Remove storm-tossed limbs and fallen trees as soon as possible. Inspections should also occur after significant storms to determine if any potential danger exists from tree damage.