Best Practices for Traffic Control at Regional Trail Crossings

A Collaborative Effort of Twin Cities Road and Trail Managing Agencies

Introduction

The Twin Cities region is served by hundreds of miles of trails, used by people of all ages for walking, bicycling, and skating on both recreational and non-recreational trips. The Twin Cities also has many miles of on-street bikeways. This system is built and maintained by a variety of agencies, including the Department of Natural Resources, eleven regional park implementing agencies, seven counties, and hundreds of cities and local park systems. There are plans to add hundreds of additional miles of trails to this system, in addition to expanding the region’s on-street bicycle and pedestrian connections.

In Fall of 2009, Hennepin County staff invited representatives from cities, counties, and stakeholders across metro region to meet on October 29, 2009 to assess the need for a regional collaboration on trail signing practices. At the initial meeting, it was determined that directional wayfinding signage and roadway crossings were the two primary issues for which additional guidance and consistency was needed. Furthermore, it was determined that these two topics were best addressed by creating two separate work groups that would develop guidelines to present to the full group of stakeholders.

The work group charged with trail crossing signage, informally referred to as the Safe Crossings group, identified a lack of consistency in traffic control practices at trail crossings and a lack of understanding by drivers and trail users regarding crosswalk and trail crossing regulations. The Safe Crossings group, composed of representatives from state and local road authorities, park management agencies, and walking/biking advocacy groups in the Twin Cities metro area, sought to create a document which would clarify existing regulations and provide a summary of best practices at trail crossing locations, in order to improve the safety and consistency of trail crossing locations throughout the region.

The types of trail crossing treatments at a given location are, and should be, highly dependent on the type of roadway and on the traffic levels of the roadway and trail, including the type of trail facility and user characteristics. This document is not intended to provide new requirements, nor specific traffic thresholds to trigger particular traffic controls, nor to supersede engineering judgment or the provisions of the Minnesota Manual on Uniform Traffic Control Devices. Rather, it is intended to provide a clarification of state statutes regarding crossing locations, and to provide a set of general principles and options to consider when evaluating traffic control configurations at trail crossings. These principles include maximizing visibility between drivers and trail users, controlling maintenance costs, preserving driver and trail user respect for the signs that are used, and preserving the momentum of bicyclists to maintain the appeal of trail usage.
State Laws Regarding Pedestrian Crossings

Minnesota state law provides legal definitions and responsibilities for crosswalk users which provide the framework for various traffic control configurations. Local ordinances may provide additional regulations but may also be less familiar to motorists and trail users. Crosswalks are narrowly defined in statute to prevent unpredictable interactions and unnecessary braking by vehicles when pedestrians do not intend to cross.

To prevent these unpredictable interactions, mutual responsibilities are placed on drivers, bicyclists, and pedestrians, as outlined in the sections below. Drivers must stop for, and yield to, pedestrians within marked or statutory crosswalks, however pedestrians and bicyclists may only enter crosswalks when it is possible for drivers to safely stop and yield. At locations where crosswalks do not exist, pedestrians must yield to vehicles. Bicyclists may operate as a vehicle within the traffic lanes or as a pedestrian. When a bicyclist is riding on the street as a vehicle, they are subject to the same rights and responsibilities as other drivers. When a bicyclist is crossing a roadway as a pedestrian, they are subject to the same rights and responsibilities as pedestrians.

Some uncertainty exists as to whether a bicycle route or shared use path which does not parallel a roadway should be considered to be roadway which prohibits motor vehicles. This distinction is important in that it affects many of the rules affecting bicycle right-of-way. Regardless of this uncertainty, road authorities should design within the boundaries of state statute, but traffic controls at crossing locations should be clear and readily understandable to drivers, pedestrians, and vehicle operators, most of who are not aware of some of the finer details of Minnesota statutes.

Definition of a Crosswalk
Under state law, crosswalks exist at intersections where sidewalks are present even if the crossing is not marked. However, a crosswalk does not exist at midblock locations unless crosswalk pavement markings are present:


"Crosswalk" means (1) that portion of a roadway ordinarily included with the prolongation or connection of the lateral lines of sidewalks at intersections; (2) any portion of a roadway distinctly indicated for pedestrian crossing by lines or other markings on the surface.

Because a crosswalk is defined as a portion of a roadway, it is also important to note the statutory definition of “roadway”:


"Roadway" means that portion of a highway improved, designed, or ordinarily used for vehicular travel, exclusive of the sidewalk or shoulder. During periods when the commissioner allows the use of dynamic shoulder lanes as defined in subdivision 25, roadway includes that shoulder. In the event a highway includes two or more separate roadways,
the term "roadway" as used herein shall refer to any such roadway separately but not to all such roadways collectively.

The above statute specifically excludes the shoulder or sidewalk from the definition of “roadway”. Because a crosswalk is defined as only a portion of the roadway, a pedestrian would not be considered to be within the crosswalk if they are behind the curb or on the shoulder, even though crosswalk markings may extend onto the shoulder.

While a crosswalk is deemed to exist at intersections by statute, as the prolonged boundaries of sidewalks, the definition of sidewalk does not require that the sidewalk be paved, so long as the area is “intended for the use of pedestrians”. If a roadway shoulder is “intended for the use of pedestrians”, it might be considered to be a sidewalk:

**Statute 169.011, Subd. 75. Sidewalk.**

"Sidewalk" means that portion of a street between the curb lines, or the lateral lines of a roadway, and the adjacent property lines intended for the use of pedestrians.

**Responsibilities of Drivers**

As is consistent with other states based on the Uniform Vehicle Code used nationwide, drivers are required to yield to pedestrians under the conditions set forth below. It is important to note that a pedestrian must be within the “roadway” for this statute to apply. It is not applicable to a pedestrian not within the “roadway” as defined above. A driver must stop to yield to a pedestrian that is within the crosswalk but has not yet entered their lane of traffic, but the driver may proceed once the pedestrian has passed the lane in which the vehicle is traveling.

**Statute 169.21, Subd. 2a. Rights in absence of signal.**

Where traffic-control signals are not in place or in operation, the driver of a vehicle shall stop to yield the right-of-way to a pedestrian crossing the roadway within a marked crosswalk or at an intersection with no marked crosswalk. The driver must remain stopped until the pedestrian has passed the lane in which the vehicle is stopped. …

As noted in the statute listed below, it is unlawful for a driver to pass a stopped vehicle at a crosswalk when a pedestrian is crossing. This provision is intended to prevent “Multiple threat” crashes, where a pedestrian steps out past a stopped vehicle and into an adjacent lane, as illustrated in Figures 4 and 5. But, as discussed later in this document, the approaching driver cannot always determine the reason why vehicles in the adjacent lane have stopped, and may not be able to comply with this provision because the pedestrian may not be visible to the approaching driver. The approaching driver may incorrectly assume that the first driver has slowed or stopped in order to make a turn rather than stopping for a crossing pedestrian. As a result, marked crosswalks alone have been shown to increase the pedestrian crash rate under many conditions, as detailed in Figure 3 and as discussed in more detail later in this document.
Statute 169.21, Subd. 2b. Rights in absence of signal.
When any vehicle is stopped at a marked crosswalk or at an intersection with no marked crosswalk to permit a pedestrian to cross the roadway, the driver of any other vehicle approaching from the rear shall not overtake and pass the stopped vehicle.

Of course, even if a pedestrian fails to obey the law and enters the roadway in an illegal manner, drivers must always use due care to avoid colliding with a pedestrian or bicycle:

Statute 169.21, Subd. 3d. Crossing Between Intersections
...every driver of a vehicle shall (1) exercise due care to avoid colliding with any bicycle or pedestrian upon any roadway and (2) give an audible signal when necessary and exercise proper precaution upon observing any child or any obviously confused or incapacitated person upon a roadway.

Responsibilities of Pedestrians and Bicyclists
State law places several requirements on pedestrians who are crossing or walking along roadways.

Statute 169.21, Subd. 2a. Rights in absence of signal.
... No pedestrian shall suddenly leave a curb or other place of safety and walk or run into the path of a vehicle which is so close that it is impossible for the driver to yield. This provision shall not apply under the conditions as otherwise provided in this subdivision.

Statute 169.21 Subd. 3. Crossing between intersections.
(a) Every pedestrian crossing a roadway at any point other than within a marked crosswalk or at an intersection with no marked crosswalk shall yield the right-of-way to all vehicles upon the roadway. (b) Any pedestrian crossing a roadway at a point where a pedestrian tunnel or overhead pedestrian crossing has been provided shall yield the right-of-way to all vehicles upon the roadway.
(c) Between adjacent intersections at which traffic-control signals are in operation pedestrians shall not cross at any place except in a marked crosswalk.

These requirements also apply to bicyclists using crosswalks as pedestrians. Bicyclists are not required to dismount when using a crosswalk, however the higher approach speeds of bicyclists, as compared to pedestrians, can lead to potential vehicle conflicts when the driver’s available reaction time is reduced. While bicyclists may operate under the rights and responsibilities of pedestrians (unless restricted by local ordinances), bicyclists are also permitted to operate as vehicles when operating within the roadway, subject to the same rights and responsibilities as drivers, as noted in the Statute 169.222.
Statute 169.222, Subd. 1. **Traffic laws apply.**

Every person operating a bicycle shall have all of the rights and duties applicable to the driver of any other vehicle by this chapter, except in respect to those provisions in this chapter relating expressly to bicycles and in respect to those provisions of this chapter which by their nature cannot reasonably be applied to bicycles.

Statute 169.222 Subd. 4f. **Riding on Roadway or Shoulder.**

A person lawfully operating a bicycle on a sidewalk, or across a roadway or shoulder on a crosswalk, shall have all the rights and duties applicable to a pedestrian under the same circumstances.

Riding in the roadway or on the shoulder, in the same direction as traffic, ensures that bicyclists are well-positioned to be visible to drivers on both the mainline and any cross streets. However, riding within the roadway or on the shoulder may not be appropriate for all bicyclist skill levels. Riding in the roadway may also be difficult when vehicles are unable to pass bicyclists due to limited roadway space or high traffic volumes. Riding in the roadway, or on the shoulder, in the opposite direction of traffic is illegal for bicyclists, as it becomes very difficult for other road users to see and react to an approaching bicyclist.

**“Trail Crossing” and Other Warning Signs**

While crosswalks and their associated rules are defined clearly in statute, trail crossings are not defined. Many varieties of trails exist throughout the state, from urban routes heavily used by bicycles to unimproved rural hiking trails. Some trails may be seasonal in nature such as snowmobile or ski trails which are not designed or intended for pedestrian travel. The trail's level of use can also vary, from major state or regional trails to minor trails maintained by homeowner associations. The trail's purpose and level of usage, along with the characteristics of the roadway being crossed, should always be taken into account when choosing the type of traffic controls, if any, to be used at roadway crossings.

A variety of warning signs may be used where roadways approach trail crossing locations, including signs with a pedestrian symbol, a bicycle symbol, a combination of symbols, and a variety of other symbols including horses and snowmobiles. Also available is a word message sign which reads “Trail Crossing”. These signs can be used interchangeably, and, as noted above, there is no Minnesota statutory definition of a trail crossing. Therefore, while these signs may be used, installation of warning signs does not affect rules of right-of-way nor designate a legal crosswalk. However, these signs may be used with or without crosswalk pavement markings or other treatments to advise approaching drivers of a potential hazard. Similarly, the use of crosswalk markings does not necessitate the use of any signs, though signs may help to alert drivers to the potential hazard during inclement weather when pavement markings are not visible. Warning signs for approaching roadway traffic may be placed at the crossing location, in advance of the crossing, or both. The Minnesota Manual on Uniform Traffic Control Devices provides the criteria for the usage and placement of warning signs and pavement markings.
Common Hazards at Trail Crossing Locations

Within state statutes, bicyclists are generally treated as vehicles and expected to ride within the roadway, in the same direction as traffic. However, it has become common practice to construct separated trails away from vehicle traffic for pedestrians, skaters, and recreational and child bicyclists. Although Minnesota statutes provide bicyclists with the same rights and responsibilities as pedestrians when using a crosswalk, bicyclists and pedestrians have very different operating characteristics and capabilities, and the higher speeds of many bicyclists can lead to hazardous situations not readily addressed by state statutes which assume low crossing speeds. Additionally, some crossing locations can present inherently hazardous conditions for both bicyclists and pedestrians if visibility is restricted between drivers and trail users. Recognizing these common hazards can lead to improved design when facilities are constructed and also to the array of traffic control solutions presented later in this document.

Hazards from Turning Vehicles

As noted in the previous section, riding with traffic ensures that bicyclists are well-positioned to be seen by vehicle drivers on both the mainline and any cross streets. For example, a driver who intends to turn right at a stop sign is generally looking to the left for gaps in cross traffic. However, a bicyclist approaching from the right or from the rear, whether on the roadway or a separated pathway, will not be readily seen by a right-turning driver, as shown in Figure 1.

Even when riding in the same direction as adjacent traffic, a bicyclist on a separated bikeway may be difficult to see for some drivers, particularly by drivers making right turns when a bicyclist is approaching from the rear, as shown in Figure 2. When bicyclists ride within the roadway, this conflict is less likely to occur because an approaching bicyclist is better able to observe that a car is turning, and because passing on the right shoulder is illegal for all vehicles, including bicyclists. However, riding in the roadway may not be appropriate for all cycling skill levels, such as young children who have not yet been taught the rules of right-of-way.

**Separated bikeway - Riding in the same direction as adjacent traffic**

![Separated bikeway diagram](image)

**Figure 2**

It has been commonplace for trails to be constructed parallel to roadways to prevent conflicts between high-speed traffic and lower-speed bicyclists, especially children and recreational bicyclists. However, by providing increased separation between motorists and trail users, it becomes more difficult for bicyclists, motorists, and pedestrians to be visible to each other and allow proper yielding when trails cross roadways, regardless of whether the crossing is controlled by a stop sign, signal, or other crosswalk treatment. Therefore, caution should be taken in roadway and trail design and traffic controls to ensure adequate visibility between drivers and bicyclists when approaching potential conflict areas. However, even clear sight lines cannot guarantee that drivers or bicyclists will look rearward before turning, which neither are trained to do.
The Multi-Lane Threat to Trail Users

A 2005 national study \(^1\) by the Federal Highway Administration (FHWA) and the University of North Carolina found that marking crosswalks across uncontrolled approaches provided, at best, no significant safety benefit, and that crosswalk markings substantially degraded pedestrian safety when used across uncontrolled multi-lane approaches. The results of these findings are shown below in Figure 3.

Although drivers are prohibited by statute from passing a stopped vehicle at a crosswalk when a pedestrian is crossing, the approaching driver’s view of a pedestrian can be obscured by the stopped vehicles in the adjacent lane, as shown in Figure 4 and Figure 5. Because of this restricted view, it may not be possible for the approaching driver to comply with the law because the distance necessary to stop the vehicle can be far greater than the distance at which the pedestrian first becomes visible to the driver.

For the purposes of roadway design, engineers typically assume that 2.5 seconds pass before the brakes are first applied, as the driver first recognizes the hazard, makes the decision to stop, and moves their foot onto the brake pedal \(^2\). An additional 86.4 feet, or 3.9 seconds, are needed once the brakes are applied before a 30 mph vehicle comes to a stop, assuming a level surface and wet pavement conditions. Therefore, under these typical assumptions, a pedestrian must be visible to an approaching 30 mph driver when the driver is approximately 200 feet from the crosswalk. At this speed, the driver will need a total of 6.4 seconds in order to apply the brake and bring the vehicle to a stop\(^2\) based on standard assumptions for reaction time and pavement friction.

Even if the driver’s reaction times are exceptional (1.0 seconds), and the pavement is dry allowing for aggressive braking (0.5G or 16.1 ft/s\(^2\)), a driver travelling at 30 mph will still need 3.73 seconds, or 104 feet in order to stop the vehicle from the time a hazard is first observed.

However, because vehicles in adjacent lanes are typically separated by approximately 4 feet, a pedestrian crossing in front of a stopped vehicle, and walking at a typical speed of 4 feet per second, would be visible for as little as 1.0 seconds before stepping into the path of an approaching vehicle in an adjacent lane. For a bicyclist riding in a crosswalk at a modest 12 feet per second (8.1 mph), the bicyclist and approaching driver would be visible to each other for only 0.33 seconds, far below the necessary reaction and braking times for both the driver and the bicyclist. Because available sight distance can be far less than the necessary reaction and braking distance even under ideal conditions, marked crosswalks cannot be relied upon to provide safe pedestrian or bicyclist crossings at uncontrolled multi-lane approaches.

The FHWA study referenced on the previous page contains a table which may be used to identify candidate locations for marked crosswalks at uncontrolled locations, and where marked crosswalks should be avoided unless other effective safety treatments are provided. This table is shown as Figure 6 in this document and is available online at http://www.fhwa.dot.gov/publications/research/safety/04100/04100.pdf.

### Table 11. Recommendations for installing marked crosswalks and other needed pedestrian improvements at uncontrolled locations.*

<table>
<thead>
<tr>
<th>Roadway Type (Number of Travel Lanes and Median Type)</th>
<th>Vehicle ADT ≤ 9,000</th>
<th>Vehicle ADT &gt; 9,000 to 12,000</th>
<th>Vehicle ADT &gt; 12,000 to 15,000</th>
<th>Vehicle ADT &gt; 15,000</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Speed Limit**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>≤ 48.3 km/h (30 mi/h)</td>
<td>56.4 km/h (35 mi/h)</td>
<td>64.4 km/h (40 mi/h)</td>
<td>56.4 km/h (40 mi/h)</td>
</tr>
<tr>
<td>Two lanes</td>
<td>C</td>
<td>C</td>
<td>P</td>
<td>C</td>
</tr>
<tr>
<td>Three lanes</td>
<td>C</td>
<td>C</td>
<td>P</td>
<td>C</td>
</tr>
<tr>
<td>Multilane (four or more lanes) with raised median***</td>
<td>C</td>
<td>C</td>
<td>P</td>
<td>P</td>
</tr>
<tr>
<td>Multilane (four or more lanes) without raised median</td>
<td>C</td>
<td>P</td>
<td>N</td>
<td>P</td>
</tr>
</tbody>
</table>

* These guidelines include intersection and midblock locations with no traffic signals or stop signs on the approach to the crossing. They do not apply to school crossings. A two-way center turn lane is not considered a median. Crosswalks should not be installed at locations that could present an increased safety risk to pedestrians, such as where there is poor sight distance, complex or confusing designs, a substantial volume of heavy trucks, or other dangers, without first providing adequate design features and/or traffic control devices. Adding crosswalks alone will not make crossings safer, nor will they necessarily result in more vehicles stopping for pedestrians. Whether or not marked crosswalks are installed, it is important to consider other pedestrian facility enhancements (e.g., raised median, traffic signal, roadway narrowing, enhanced overhead lighting, traffic calming measures, curb extensions), as needed, to improve the safety of the crossing. These are general recommendations; good engineering judgment should be used in individual cases for deciding where to install crosswalks.

** Where the speed limit exceeds 64.4 km/h (40 mi/h), marked crosswalks alone should not be used at unsignalized locations.

*** The raised median or crossing Island must be at least 1.2 m (4 ft) wide and 1.8 m (6 ft) long to serve adequately as a refuge area for pedestrians, in accordance with MUTCD and American Association of State Highway and Transportation Officials (AASHTO) guidelines.

C = **Candidate sites for marked crosswalks**. Marked crosswalks must be installed carefully and selectively. Before installing new marked crosswalks, an engineering study is needed to determine whether the location is suitable for a marked crosswalk. For an engineering study, a site review may be sufficient at some locations, while a more indepth study of pedestrian volume, vehicle speed, sight distance, vehicle mix, and other factors may be needed at other sites. It is recommended that a minimum utilization of 20 pedestrian crossings per peak hour (or 15 or more elderly and/or child pedestrians) be confirmed at a location before placing a high priority on the installation of a marked crosswalk alone.

P = **Possible increase in pedestrian crash risk may occur if crosswalks are added without other pedestrian facility enhancements**. These locations should be closely monitored and enhanced with other pedestrian crossing improvements, if necessary, before adding a marked crosswalk.

N = **Marked crosswalks alone are insufficient, since pedestrian crash risk may be increased by providing marked crosswalks alone**. Consider using other treatments, such as traffic-calming treatments, traffic signals with pedestrian signals where warranted, or other substantial crossing improvement to improve crossing safety for pedestrians.

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**Figure 6**
Typical Crossing Scenarios

The following pages provide traffic control guidelines for various scenarios under which trails cross roadways and traffic control options which may be used for each. Always consult the Minnesota Manual on Uniform Traffic Control Devices for requirements and recommendations regarding the use of any of the devices shown.

Traffic control devices discussed in the following pages include signs, pavement markings, traffic signals, and pedestrian beacons and are discussed only in the context of at-grade crossing locations. Other potential safety improvements besides traffic control devices are also available, including construction of grade-separated crossings (bridges or tunnels), installation of median refuge islands, and installation of appropriately placed street lighting to improve nighttime visibility.

While marked crosswalks alone have been shown to not improve safety at uncontrolled locations, many other devices and technologies are available for use. However, data is limited regarding the effectiveness of other devices on pedestrian safety, including traffic signals, pedestrian-activated red or yellow beacons, or in-roadway lighting. The implementation of any devices should always consider the available data and desired effect of a particular device. For example, some treatments may increase motorist awareness of the crossing location, but may not increase the number of gaps available to pedestrians or bicyclists who wish to cross. Similarly, a device that improves a motorist awareness of the crossing location, but where pedestrians and bicyclists are not visible to a driver due to obstructed sight lines, may not improve safety. A device which is overused, such as pedestrian crossing signs at a location where pedestrian volume is low, or a trail stop sign at a location where vehicle conflicts are rare, may fail to command the respect of drivers and trail users and therefore decrease the effectiveness of the same devices at other locations where their use may be warranted.

The use of any traffic control device or design treatment at a trail crossing location should always consider the factors specific to the particular crossing location, including approach volumes, approach speeds, available sight lines, the number of lanes, and geometric factors such as curves or hills. Documenting these findings and the reason for a decision to use, or not to use, a particular traffic control device and help to protect a road or trail agency from legal challenges if a crash were to occur.
Midblock Crossings

Midblock crossings, where a trail crosses a roadway away from a street intersection, can be advantageous in that there is no turning traffic and crossing distances are often shorter due to the lack of turn lanes. For drivers, a vehicle stopped at a midblock crossing is a relatively clear indication that a pedestrian is crossing, even if the pedestrian is not visible to the approaching driver, whereas this may not be the case for a vehicle stopped at an intersection. However, midblock locations also typically involve higher vehicle approach speeds.

Pavement markings are required in order for a midblock crossing location to be considered a legal crosswalk. On high-volume roadways, yielding to roadway traffic may result in long waits for pedestrians or bicycles waiting to cross at uncontrolled locations. Marking a crosswalk can increase the number of legally available gaps, and signalization can provide right-of-way to the trail user without requiring the trail user to enter the roadway. Without crosswalk markings, pedestrians and bicyclists at midblock locations are permitted to cross the roadway, but are required to yield to roadway traffic, crossing only when traffic is clear. In many locations, it has been shown that omitting crosswalk markings can substantially improve safety. [1]

To maximize safety at midblock trail crossing locations, the following guidelines should be considered:

1. Refer to the FHWA study table (Figure 6) when considering installation of a marked crosswalk at a midblock or uncontrolled location. The table will provide recommendations for where marked crosswalks at uncontrolled locations should be avoided or supplemented with additional treatments.
2. Stop signs facing trails are likely to be disregarded especially when used unnecessarily. Avoid using stop signs facing trails except where a full and complete stop is absolutely necessary. YIELD signs can effectively assign right-of-way while maintaining bicyclist momentum and respect for stop signs where a full stop is truly needed.
3. Consider pedestrian-activated red beacons or other signal options for multi-lane crossings or where safe gaps in vehicle traffic are insufficient in frequency or duration.
4. Do not use YIELD signs facing the trail if also using crosswalk markings at the same location, as this creates a conflicting message to users. STOP signs, however, may be used with marked crosswalks where necessary to require that bicyclists enter the crosswalk only at low speeds after stopping.
5. Encourage construction of refuge islands in the roadway median so that crossings may be made in two stages. This can be an effective treatment for both two-lane roads and multi-lane roads.
6. At locations where high-volume trails cross low-volume roadways, the roadway may be yield-controlled, or stop controlled if warranted. Under this condition:
   a. If the roadway approach is controlled by STOP or YIELD signs, the crosswalk should be marked, as the purpose for the YIELD or STOP might otherwise not be recognized by drivers and could lead to noncompliance. A sign showing the trail name may also be provided for recognition.
   b. STOP or YIELD signs facing the roadway may be supplemented with “Cross Traffic Does Not Stop” plaques or similar messages.
   c. YIELD signs should not face the trail if the roadway is stop or yield controlled.
   d. STOP signs should not be used facing the trail when the roadway is stop-controlled unless all-way stop control has been determined to be necessary according to an engineering study.
Uncontrolled & Unmarked
Not a legal crosswalk. Trail users must select gaps large enough to avoid conflicts with cross traffic.

Trail Stop Control
Avoid use except where a full stop is necessary for all trail users, usually due to obstructed sight lines. Crosswalk may be marked, check FHWA table.

Stop Ahead or Yield Ahead signs are required only when the stop or yield sign is not visible for a sufficient distance to permit the approaching user to respond to the device. Otherwise, they are optional, but consider ongoing maintenance costs and the creation of an additional fixed object hazard versus the expected benefit.

Crosswalk may be marked, but may degrade safety in some circumstances. Refer to FHWA table.

Warning signs are optional and may be used with or without a marked crosswalk, however pavement markings are required in order to legally designate a crosswalk. Other W11 series warning signs may be substituted. Such warning signs have not been shown to improve safety.

Figure 7
Crossing Uncontrolled Approaches to Intersections

Crossings of uncontrolled intersection approaches pose additional challenges beyond those of midblock crossings. A trail user crossing an uncontrolled intersection approach must be cognizant not only of crossing traffic but also of turning traffic from the other approaches. A driver approaching such a crossing must also be aware of both trail users and other vehicular traffic. If a driver stops at the crosswalk to allow a trail user to cross, other drivers may assume the driver is stopping to make a turn at the intersection and pass the stopped vehicle, while the trail user may not realize that other traffic is approaching. Even in the absence of trail users, marking the uncontrolled approaches of a two-way stop may give the false impression to drivers that the intersection is an all-way stop, increasing the vehicle crash risk.

To maximize safety where a trail crosses an uncontrolled intersection approach, the following guidelines should be considered:

1. Refer to the FHWA study table (Figure 6) when considering installation of a marked crosswalk at any uncontrolled location. The table will provide recommendations for where marked crosswalks at uncontrolled locations should be avoided or supplemented with additional devices such as traffic signals.
2. Stop signs facing trails are likely to be disregarded especially when used unnecessarily. Avoid using stop signs facing trails except where a full and complete stop is absolutely necessary. YIELD signs can effectively assign right-of-way while maintaining bicyclist momentum and respect for stop signs where a full stop is truly needed.
3. Consider installing pedestrian-activated red beacons or other signal options for multi-lane crossings or where safe gaps in vehicle traffic are insufficient in frequency or duration.
4. Do not use YIELD signs facing the trail if also using crosswalk markings at the same location, as this creates a conflicting message to users. STOP signs, however, may be used with marked crosswalks where necessary to require that bicyclists enter the crosswalk only at low speeds after stopping.
5. Encourage construction of refuge islands in the roadway median so that crossings may be made in two stages. This can be an effective treatment for both two-lane roads and multi-lane roads.
Uncontrolled & Unmarked
Considered a legal crosswalk if the crossing is part of the intersection. If the space between the trail and the roadway is excessive, treat as a midblock crossing.

Uncontrolled & Marked
Pavement markings create a legal crosswalk. Trail users must select gaps large enough to allow cross traffic to stop safely. See Note #2.

Trail Yield Control
May be used when the cross traffic is uncontrolled, even if the parallel street is stop controlled. Do not mark crosswalk if using trail yield control.

Trail Stop Control
May be used for consistency with stop signs on parallel street or where a full stop is necessary. Crosswalk may be also marked, check FHWA table.

1. Stop Ahead or Yield Ahead signs are required only when the stop or yield sign is not visible for a sufficient distance to permit the approaching user to respond to the device. Otherwise, they are optional, but consider ongoing maintenance costs and the creation of an additional fixed object hazard versus the expected benefit.

2. Crosswalk markings may cause drivers and trail users to believe that the intersection is an all-way stop. Crosswalk may be marked, but may degrade safety in some circumstances. Refer to FHWA table for markings on uncontrolled approaches.

3. Warning signs are optional and may be used with or without a marked crosswalk. Other W11 series warning signs may be substituted. Such warning signs have not been shown to improve safety.

Figure 8
Crossing Stop-Controlled or Signal-Controlled approaches to Intersections

Trail crossings of stop-controlled intersection approaches typically involve the lowest vehicular speeds, but may still involve multiple lanes or directions of approach. One of the more common hazards at stop-controlled crossings is encroachment into the crosswalk by right-turning vehicles and the failure of drivers to see bicyclists or pedestrians walking in the opposite direction of the adjacent parallel traffic, as shown in Figure 1.

One of the most difficult locations to prevent conflicts is also one of the most common scenarios. When a trail running parallel to a roadway crosses a controlled sidestreet, trail users generally expect to pass without stopping, especially when the minor street has low traffic volumes. However, free-flow operation of the trail can create conflicts with turning vehicles as shown in Figures 1 and 2. Placement of stop or yield signs facing the trail at all such crossings involves a large capital investment and ongoing maintenance liabilities, and also creates an additional safety hazard if the sign itself is struck by a trail user. Yield signs facing the trail can create potential confusion for pedestrians who would otherwise be afforded the legal rights of a crosswalk. Stop signs facing the trail are likely to be disregarded by bicyclists, especially when conflicting traffic is not present, and can encourage disrespect of other more important stop signs.

There is no known effective signage to treat this common scenario. The State of Arizona has adopted an official policy that signs and markings are not to be used on shared use paths that parallel roadways, attached to this document as Figure 9. The practice of other jurisdictions, including some in Minnesota, has been to install signs at all such crossings along particular trail corridors. Although many types of treatments are allowable, some treatments and combinations should be avoided, as noted in the list below and in Figure 8.

To maximize safety where a trail crosses a stop-controlled or signal-controlled intersection approach, the following guidelines should be considered:

1. Crosswalks may be marked and/or stop bars provided. However, neither is required.
2. Do NOT provide ped crossing or trail crossing signs at or in advance of all-way stops or signals, as drivers should always expect a crosswalk at all-way stop or signalized intersections. Additionally, at signalized crossings, the right-of-way is based on the signal indications rather than crosswalk statutes.
3. Stop signs may be provided facing trails, though the vehicular stop sign may also suffice.
4. Geometric treatments may also help to prevent high-speed entries into a crosswalk, particularly where the “Walk” indication is operated on each signal cycle rather than triggered by a pushbutton.
5. Special bicycle traffic signals may be used where justified to prevent conflicts between trail bicyclists and motor vehicles at signalized intersections.
6. Where possible, bicyclists should be accommodated within the roadway design even when parallel pathways are present. Appropriate in-roadway accommodations depend on traffic volumes and speeds, and should always be designed in accordance with the Minnesota Manual on Uniform Traffic Control Devices. In-roadway accommodations may include wide shoulders, shared use of vehicle lanes, or exclusive bike lanes.
1031 SIGNING AND MARKING OF SHARED-USE PATHS

Bicyclists operating on public roadways are recognized in State law as having the same rights and responsibilities as operators of vehicles. Nevertheless, shared-use paths, i.e. separated from motorized vehicular traffic and also used by pedestrians, skaters, joggers, etc., are also frequently used by bicyclists. Such shared-used paths are often placed parallel and adjacent to roadways used by motorized vehicles.

Experience has shown that signing and markings along shared-use paths do not assist adjacent drivers of motorized vehicles in anticipating (and avoiding collisions with) bicyclists when the motorists turns onto an intersecting roadway with which the adjacent shared-use path also intersects. For their part, bicyclists traveling on shared-use paths which parallel public roadways have been observed to take their right-of-way cues not from signs or traffic control devices which may be placed on the shared-use path, but from the traffic movements on the parallel roadway. Bicyclists also tend to ignore STOP signs along shared-use pathways which they perceive to be unnecessary or which conflict with the right-of-way along the parallel roadway.

Moreover, signs and markings placed along shared-use paths are sometimes interpreted as implying that bicyclists are expected to use the path instead of the adjacent roadway. This can lead to harassment of bicyclists who are otherwise safely and legally using the roadway.

It is therefore intended that sidewalks or shared-use paths on State right-of-way parallel and adjacent to roadways shall not be marked or signed for the preferential or exclusive use of bicyclists. This includes the use of centerline markings, BIKE ROUTE signs, STOP or YIELD signs, or similar devices.

R5-3 NO MOTOR VEHICLE signs may be installed at entrances to sidewalks or shared-use paths.

This policy does not apply to shared-use paths on independent alignments that are not parallel and adjacent to roadways and intersect State highways at locations away from roadway intersections, or in locations where the adjacent roadway is a controlled-access freeway where bicyclists have been prohibited in accordance with PGP 1030.

Exceptions to this policy may be made on the recommendation of the District Engineer with the approval of the State Traffic Engineer.


Figure 9
Other Resources

Various sources were used in the development of this document and can provide additional detail and requirements regarding trail design, user characteristics, safety research, and traffic control devices:


“Signing and Marking of Shared Use Paths (Policy Subsection # 1031)”, Arizona Department of Transportation July 2004. 

http://www.richardcmoeur.com/bikestuf.html


http://www.dot.state.mn.us/bike/designmanual.html

Share the Road Minnesota, 
http://www.sharetheroadmn.org/index.html

“How Not to Get Hit By Cars: Important Lessons in Bicycle Safety”  Michael Bluejay. 
http://www.bicyclesafe.com

John Forester, M.S., P.E. 
http://www.johnforester.com

http://www.dot.state.mn.us/trafficeng/publ/mutcd/index.html


http://www.nc-ite.org
## Credits

The following people and agencies contributed their expertise to this set of best practices for trail crossings as part of the Safe Crossings work group.

<table>
<thead>
<tr>
<th>Name</th>
<th>Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joe Gustafson (Editor)</td>
<td>Washington County</td>
</tr>
<tr>
<td>Greta Alquist</td>
<td>Minnesota Department of Transportation</td>
</tr>
<tr>
<td>Lisa Austin</td>
<td>Minnesota Department of Transportation</td>
</tr>
<tr>
<td>Lisa Bender</td>
<td>Hennepin County</td>
</tr>
<tr>
<td>Boe Carlson</td>
<td>Three Rivers Park District</td>
</tr>
<tr>
<td>Brent Christensen</td>
<td>Three Rivers Park District</td>
</tr>
<tr>
<td>Steve Clark</td>
<td>Transit for Livable Communities</td>
</tr>
<tr>
<td>Nik Costello</td>
<td>Washington County</td>
</tr>
<tr>
<td>Marc Culver</td>
<td>City of Maple Grove</td>
</tr>
<tr>
<td>Eric Drager</td>
<td>Hennepin County</td>
</tr>
<tr>
<td>Cris Gears</td>
<td>Three Rivers Park District</td>
</tr>
<tr>
<td>Amy Gurski</td>
<td>Three Rivers Park District</td>
</tr>
<tr>
<td>David Kuebler</td>
<td>City of St. Paul</td>
</tr>
<tr>
<td>Danny McCullough</td>
<td>Three Rivers Park District Police</td>
</tr>
<tr>
<td>Tim Mitchell</td>
<td>Minnesota Department of Transportation</td>
</tr>
<tr>
<td>Shaun Murphy</td>
<td>City of Minneapolis</td>
</tr>
<tr>
<td>Karen Nikolai</td>
<td>Hennepin County</td>
</tr>
<tr>
<td>Tim Plath</td>
<td>City of Eagan</td>
</tr>
<tr>
<td>Margie Dahlof (Walz)</td>
<td>Three Rivers Park District</td>
</tr>
<tr>
<td>John Tripp</td>
<td>Hennepin County</td>
</tr>
<tr>
<td>Ken Wehrle</td>
<td>Ramsey County</td>
</tr>
<tr>
<td>Tony Winiecki</td>
<td>Scott County</td>
</tr>
<tr>
<td>Scott Yonke</td>
<td>Anoka County</td>
</tr>
<tr>
<td>Jody Yungers</td>
<td>Ramsey County</td>
</tr>
</tbody>
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