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Best Practices Synthesis and Guidance in At-Grade Trail-Crossing Treatments

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Research Project
Final Report 2013-23

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At-grade trail crossings have frequently been the sites of bicycle, pedestrian, and snowmobile crashes in Minnesota and throughout the nation. To date, many resources exist for use in the design of trails and intersections, such as the *MnDOT Bikeway Facility Design Manual*, while guidelines of traffic control at roadway-trail crossings are covered in the *MN MUTCD*. Resources on comprehensive guidance for safety treatments at roadway-trail crossings, however, are limited. The goal of this document is to synthesize best practices observed statewide in Minnesota and nationally in order to provide engineers and other transportation professionals with guidance on safety treatment applications at trail crossings. Following discussion of principles of user-friendly trail-crossing designs, this document provides a toolbox of categorized treatments which are widely used in the U.S. with discussion on each treatment. Importantly, a decision tree-based treatment selection methodology is developed for fast look-up and selection of appropriate treatments based on the conditions at a particular trail crossing. These conditions include urban/rural setting of the crossing, number of lanes of the crossed roadway, whether the crossed roadway is divided or undivided, the speed limit and average daily traffic (ADT) of the crossed roadway, and whether the crossing is a midblock or parallel path crossing. Each end node of the decision tree leads to a specific toolbox in table form containing all appropriate treatments for the conditions of the study trail crossing. Final treatments for the study site can be simply chosen from the table, combined with site-specific requirements and engineering judgment.

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Best Practices Synthesis and Guidance in At-Grade Trail-Crossing Treatments

Final Report

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Table of Contents

List of Figures

List of Tables

SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
		NOTE: volumes greater than 1000 L shall be shown in m^3		
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or “metric ton”)	Mg (or “t”)
		TEMPERATURE (exact degrees)		
°F	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	°C
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	$candela/m^2$	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yard	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or “t”)	megagrams (or “metric ton”)	1.103	short tons (2000 lb)	T
		TEMPERATURE (exact degrees)		
°C	Celsius	1.8C+32	Fahrenheit	°F
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	$candela/m^2$	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.

(Revised March 2003)

Executive Summary

Nationwide, bicyclist and pedestrian fatalities combined have represented approximately 13 to 15 percent of traffic fatalities in recent years [1, 2]. Although the number of bicyclist fatalities in Minnesota has been decreasing since 2008, the number of pedestrian fatalities increased by 11 percent between 2010 and 2011 [3]. Based on these facts, the vulnerability of bicyclists and pedestrians is to be considered when designing facilities where non-motorized users interact with motorists. In particular, at-grade trail crossings are one type of location where this interaction is common. According to national statistics, more than 50 percent of all bicycle crashes throughout the country take place at an intersection between a trail and a roadway [4].

In Minnesota, resources exist to be used in the design of trails and intersections such as the *MnDOT Bikeway Facility Design Manual* [4], while guidelines of traffic control at trail crossings are covered in the *Minnesota Manual on Uniform Traffic Control Devices* (*MN MUTCD*) [5]. Resources on comprehensive guidance specifically for safety treatments at existing roadway-trail crossings, however, are limited. In 1996, the Florida Department of Transportation (FDOT) published the *Trail Intersection Design Handbook* [6]. This is one of the most comprehensive publications on the subject to date in the U.S. Considering that the Florida's handbook was developed more than 15 years ago, additional resources and references, which include new technologies and safety treatments for trail crossings, are now available. Also, Minnesota has unique roadway characteristics compared with other states. With these considerations in mind, a guidance handbook for trail-crossing treatments for the State of Minnesota is in need.

In this context, the goal of this document is to synthesize best practices observed statewide in Minnesota, as well as nationally, in order to provide engineers and other transportation professionals with guidance on safety treatment applications at trail crossings. Additionally, establishing treatments for different safety issues associated with various types of trail crossings is another area of focus. Finally, diverse groups of trail users in Minnesota, many of whom travel via alternate modes such as snowmobiles that may not be common in other states, necessitate specific guidelines for trail-crossing treatments that consider the unique needs and characteristics of different groups of trail users.

This document presents a discussion of the needs of diverse trail-user groups based upon matters such as physical and operating characteristics. These user groups include bicyclists, pedestrians, children, the elderly, pedestrians with disabilities, skaters, and snowmobilers. Following the discussion of trail-user groups, overall design considerations taking into account human factors are discussed. The importance of considering trail-user expectation and ensuring consistency between designs is highlighted. Designing for a range of users, with respect to age, ability, and mode of travel, is also a crucial issue discussed [7]. In general, older users of both the trail and roadway will have physical and cognitive characteristics that are held or exceeded by the majority of the population. Thus, in order to accommodate them and in turn the majority of other users in a design, key principles such as applying redundancy, enhancing sight distance, preventing visual clutter, and increasing the size of pavement markings and signage can be applied [8].

The document covers treatments for the two most common types of trail crossings in Minnesota, namely, midblock crossings and parallel path crossings. A midblock crossing occurs where a trail crosses a roadway at a sufficient distance from any nearby intersection such that motorists do not conflict with trail users when completing turning movements [6]. Based on

guidance from the Minnesota Department of Transportation, this “sufficient distance” has been defined as 250 feet (76.2 meters) by this guide. A parallel path crossing occurs where a trail runs longitudinally alongside a roadway (i.e., parallels the roadway) and later travels across another roadway in close proximity to an intersection. Unlike in the case of a midblock crossing where motorists are only able to travel over the crossing via through movements, the configuration of a parallel path crossing allows for turning movements to take place over the crossing. Compared with midblock and parallel path crossings, complex crossings and trail-railway crossings are the other two types of at-grade trail crossings, which are relatively uncommon. These two special types of crossings are briefly discussed. However, they are not covered in the decision-tree that will be discussed later.

Chapters 1 and 2 primarily focus on background material and definitions that are essential to understanding the nature of trail crossings and their users. Beginning in Chapter 3, a wide variety of the state-of-the-practice safety treatments for trail crossings are presented. Specifically, the treatments covered by Chapter 3 include (1) traffic signs, signals, beacons, pavement markings and striping, and other related treatments discussed in the *MN MUTCD* and many other national references; (2) three types of sight distance that are to be provided and maintained at trail crossings; (3) refuge areas in the form of raised islands or medians; (4) methods to control access to a trail including the installation of bollards, lean rails, medians, and the use of discrete curb angles; (5) traffic calming treatments which are primarily intended to help with roadway speed reduction; (6) lighting treatments for trail crossings which can help improve trail and roadway users’ mutual visibility of each other; (7) curb ramps that are necessary for compliance with the Americans with Disabilities Act of 1990 (ADA) [9] and are used to improve access for user groups including pedestrians with disabilities and bicyclists; and finally (8) three alternatives for trail realignment.

Without guidelines specially developed for safety treatment selection for trail crossings, traffic engineers and other transportation professionals would have to consult numerous publications and manuals in order to select proper treatments for application at a given trail crossing. To address this issue, a unique decision tree-based methodology for trail-crossing safety treatment selection was developed. The decision tree-based method facilitates fast identification of all appropriate alternative safety treatments for a specific trail crossing. Traffic engineers and transportation professionals only need to navigate through the decision tree to find an end node based on the combination of basic conditions for the particular study trail crossing. These basic conditions include urban/rural setting of the crossing, number of lanes of the crossed roadway, whether the crossed roadway is divided or undivided, speed limit of the crossed roadway, average daily traffic (ADT) of the crossed roadway, and whether the crossing is a midblock or parallel path crossing. Each end node of the decision tree leads to a specific toolbox in table form containing all appropriate treatments for the conditions of the study trail crossing. Only proper treatments for that specific study trail crossing will be listed in the corresponding treatment table. By using the decision tree, engineers can be given a full list of appropriate treatments by category as long as the basic conditions of the study trail crossing are traced along the decision tree. The engineers can simply choose from the table to recommend final safety treatments, combined with site-specific requirements and engineering judgment. The decision tree focuses on the two primary types of trail crossings, midblock crossings and parallel path crossings. Complex crossings are not covered as treatments for complex crossing are often site-specific and may consist of a combination of treatments provided for both of the primary crossing types.

The decision tree methodology developed with this research enables a fast look-up of appropriate treatments which assures the completeness of alternative treatments, and avoids mistakenly selecting inappropriate treatments. The decision tree also helps ensure consistency among the treatments used at trail crossings throughout Minnesota.

Chapter 1: Introduction

1.1 Background

1.1.1 Safety Issues at Trail Crossings

Nationwide, bicyclist and pedestrian fatalities combined have represented approximately 13 to 15 percent of traffic fatalities in recent years [1, 2]. In Minnesota, 963 bicycle crashes were reported in 2011, resulting in 5 fatalities and 937 injuries. Additionally, 857 pedestrian crashes were reported statewide in 2011 resulting in a total of 40 fatalities and 859 injuries. Approximately 5 percent of pedestrian crashes resulted in a fatality whereas only one-half of one percent of motor vehicle crashes in Minnesota resulted in a fatality, on average. Although the number of bicyclist fatalities in Minnesota has been decreasing since 2008, the number of pedestrian fatalities increased by 11 percent between 2010 and 2011. Further, the numbers of both bicycle and pedestrian crashes increased in 2011 from the 2010 values by 7.2 percent and 6 percent, respectively [3].

Although safety of users is of paramount concern at all locations, the vulnerability of bicyclists and pedestrians is to be considered when designing facilities in which non-motorized users will interact with motorists. The criticality of this issue is expanded in the context of intersections, in particular, at-grade trail crossings. Between 2006 and 2010, nearly 33 percent of pedestrian crashes in Minnesota resulting in a severe injury (i.e., death or incapacitating injury) took place at an intersection [10]. Additionally, more than 50 percent of all bicycle crashes in the U.S. take place at an intersection between a trail and a roadway [4].

The task of crossing a trail-roadway intersection can be extremely challenging for trail users. This task only increases in difficulty as characteristics of the intersection, such as its geometry, become more complex. Issues such as selection of adequate gaps in the traffic stream, scanning the roadway for turning or through-moving vehicles, and perceiving and reacting to other trail users are just a few of many possible components of the crossing task that can create difficulty for the trail user. Environmental considerations at the crossing such as terrain (i.e., grades, pavement condition, etc.) and the presence of access control devices such as bollards or lean rails can also complicate the issue [6].

The high workload often placed on trail users at crossings, as well as drivers approaching or traversing the crossing, can lead to errors in judgment and action by both user groups which can ultimately result in crashes. Common errors include [6]:

- Difficulty with gap selection in turn leading to selection of an inadequate gap;
- Distraction and inattention;
- Neglecting to fully scan one's surroundings and look for hazards that may be outside the immediate field of vision;
- Incorrect expectancy leading to differing conditions than initially planned for and reacted to; and,
- Driver and trail-user impatience.

The array of safety issues at trail crossing requires guidance in proper design and control of trail crossings.

1.1.2 Related Reference and Studies

A number of resources are available to provide guidance for trail crossing design and control, most notably the *MnDOT Bikeway Facility Design Manual* and the *American Association of State Highway and Transportation Officials (AASHTO) Guide for the Development of Bicycle Facilities* [4, 11]. Although both of these resources provide guidance on design of road and trail intersections (see Section 4, "Intersections," of Chapter 5, "Shared-Use Paths," in the *MnDOT Bikeway Facility Design Manual*), they are not particularly comprehensive in addressing treatment recommendations for trail crossings. Furthermore, much discussion about treatment applications is presented in the context of a limited set of scenarios.

A comprehensive guide for design of trail-roadway intersections in the U.S. did not exist until the Florida Department of Transportation (FDOT) published the *Trail Intersection Design Handbook* in 1996. To date, this publication is one of the most comprehensive discussions of road and trail intersection design. In developing the handbook, FDOT conducted field observations at approximately 60 trail-roadway and trail–driveway junctions across the state. The knowledge gained from the observations, as well as an in-depth analysis of the needs of bicyclists, pedestrians with and without disabilities, skaters, children, and the elderly were used to develop the handbook [6].

Additional references are available to provide information on trail-crossing design to a greater extent than the initial references mentioned; however, they are not as comprehensive as Florida's *Trail Intersection Design Handbook*. One such reference is California's *Contra Costa County Trail Design Resource Handbook* [12]. Although not a legal standard, this guide was prepared to supplement the Caltrans *Highway Design Manual* [13] and provides several conceptual trail-crossing designs for scenarios including a trail crossing at a low-volume local street, and a trail crossing at an arterial or collector with median refuge space [12]. Additionally, Chapter 7, "Arterial Roadway Intersections," of the Illinois' *Kane County Bicycle and Pedestrian Plan* contains guidance on necessary considerations in the design of trail-roadway crossings as well as potential safety treatments [14]. The Federal Highway Administration (FHWA) also has published resources on the design of trails and trail crossings. Two publications of note are *Designing Sidewalks and Trails for Access Part II of II: Best Practices Design Guide* and *Innovative Intersection Safety Improvement Strategies and Management Practices: A Domestic Scan* [15, 16]. The former publication provides brief design guidance for different types of trail-crossing configurations while the latter gives innovative practices on intersection treatment for improving conditions for pedestrians and bicyclists.

1.1.3 The Need for Guidance

The lack of comprehensive treatment guidelines and standard procedures for making treatment recommendations for trail crossings requires the development of a guidance handbook specifically for the State of Minnesota. Additionally, treatments for different safety issues associated with each type of trail crossing are another area of focus that served as motivation for this handbook. Finally, a diverse group of trail users in Minnesota, including users of alternate modes (i.e., snowmobile) that may not be used in other states, necessitates specific guidelines for trail-crossing design that consider the unique needs and characteristics of each user and his/her respective mode of travel.

1.2 About the Handbook

This handbook is designed to serve as a supplement to two of the primary design manuals used by the Minnesota Department of Transportation (MnDOT) in trail design, the *MnDOT Road Design Manual* and the *MnDOT Bikeway Facility Design Manual*, as well as the *Minnesota Manual on Uniform Traffic Control Devices* (*MN MUTCD*) [4, 5, 17]. It is focused on providing guidance on design and selection of safety treatments for trail-roadway crossings.

A discussion of the diverse group of trail users and their needs is presented, followed by an outline of principles to aid in the design of user-friendly trail crossings. The four major types of trail crossings are then discussed, as well as high-level concerns associated with each. The handbook then moves into a comprehensive discussion on the types and usage of a variety of treatments for application in the context of at-grade trail crossings.

As previously mentioned, the lack of standardized guidance in design of trail crossings was an issue that necessitated the development of this handbook. Hence, a tree-based selection hierarchy was developed to facilitate a simple, yet comprehensive and standardized, approach to treatment selection at trail crossings. The decision-tree approach presented in the handbook takes into account variables including the setting of the crossing (i.e., urban or rural), the lane configuration of the crossed roadway, whether or not the crossed roadway is divided or undivided, the speed limit of the crossed roadway, and the crossing type (i.e., midblock or parallel path). By following the process outlined in the handbook and navigating the decision tree, designers will be provided with a table presenting a set of treatments applicable to a given crossing scenario.

1.3 Coordination between Highway and Trail Agencies

To increase the probability of project success, coordination between the roadway and trail agencies is essential. Both agencies can make valuable contributions to the project and have complementary knowledge that, when shared with the other agency, can improve the project outcome. Working together, however, can sometimes be difficult as agencies have different resources, differences in rules and governance to which they are subject to, and sometimes competing objectives for land use [18]. That being said, it is important that MnDOT representatives work with trail agencies throughout the course of a project from initial planning through operations and maintenance. For example, in the planning stages, MnDOT traffic engineers may work directly with representatives from the trail agency to assess the impacts adding a new trail crossing, or modifying an existing trail crossing, would have on traffic on the MnDOT managed highway [19]. During the design process, trail agencies may seek guidance from MnDOT on an array of issues, including often omitted topics such as utility coordination for which MnDOT has resources including *Utility Coordination Best Practices* [20]. In the construction phase of a trail project, progress updates and coordination with MnDOT are essential. Finally, it is beneficial for MnDOT and trail agencies to remain in contact after project completion as maintenance to the trail may affect operations on the roadway and vice versa. Through this coordination, both agencies will likely become aware of its benefits, such as improved technical guidance and efficient project delivery, and will be more likely to collaborate in the future [19].

Chapter 2: Design of User-Friendly Trail Crossings

2.1 Needs of Different Trail Users

In the design of trail crossings, the needs of a diverse group of trail users must be evaluated. Bicyclists, pedestrians of all ages, and inline skaters are common groups frequently found on trails. Many of these groups, such as pedestrians, must be given further consideration during the design procedure as users within said group may have differing needs, as would be the case for walkers with strollers, runners, and pedestrians with disabilities. Additionally, certain trails in Minnesota are traveled by different user groups in the winter months, including snowmobilers and cross-country skiers.

2.1.1 Needs of Bicyclists

General dimensions and operating characteristics of bicyclists can be found in the *MnDOT Bikeway Facility Manual* as well as the FHWA report *Characteristics of Emerging Road and Trail Users and Their Safety*, among other sources [4, 21]. Important measures are summarized in the following sections.

2.1.1.1 Operating Space

A stationary bicyclist occupies approximately 2 feet (0.6 meters) (measured between the ends of the handlebars) of lateral space. Bicycle maneuvers increase this envelope to 3 feet (0.9 meters), and "comfortable lateral clearance" is achieved when the bicyclist has at least 5 feet (1.5 meters) of total lateral clearance. In terms of vertical operating space, the design height of a bicyclist is set at 8 feet (2.4 meters) in order to avoid clearance issues at locations such as underpasses. Figure 2.1 highlights key dimensions of a bicyclist's operating space [4].

Bicycles are approximately 5 to 6 feet (1.5 to 1.8 meters) long on average; however, the addition of a trailer can increase the operating length of a bicyclist to between 8.5 and 9.5 feet (2.6 and 2.9 meters). Further, a bicyclist pulling a trailer will occupy more horizontal space when stationary than a bicyclist without a trailer. These considerations could influence the design of a median with storage space for bicyclist and pedestrian refuge and also show the degree of variability between bicyclists and their operating space that is possible. A more comprehensive listing of average dimensions for non-traditional bicycles including hand cycles and recumbent bicycles can be seen in *MnDOT Bikeway Facility Manual* [4].

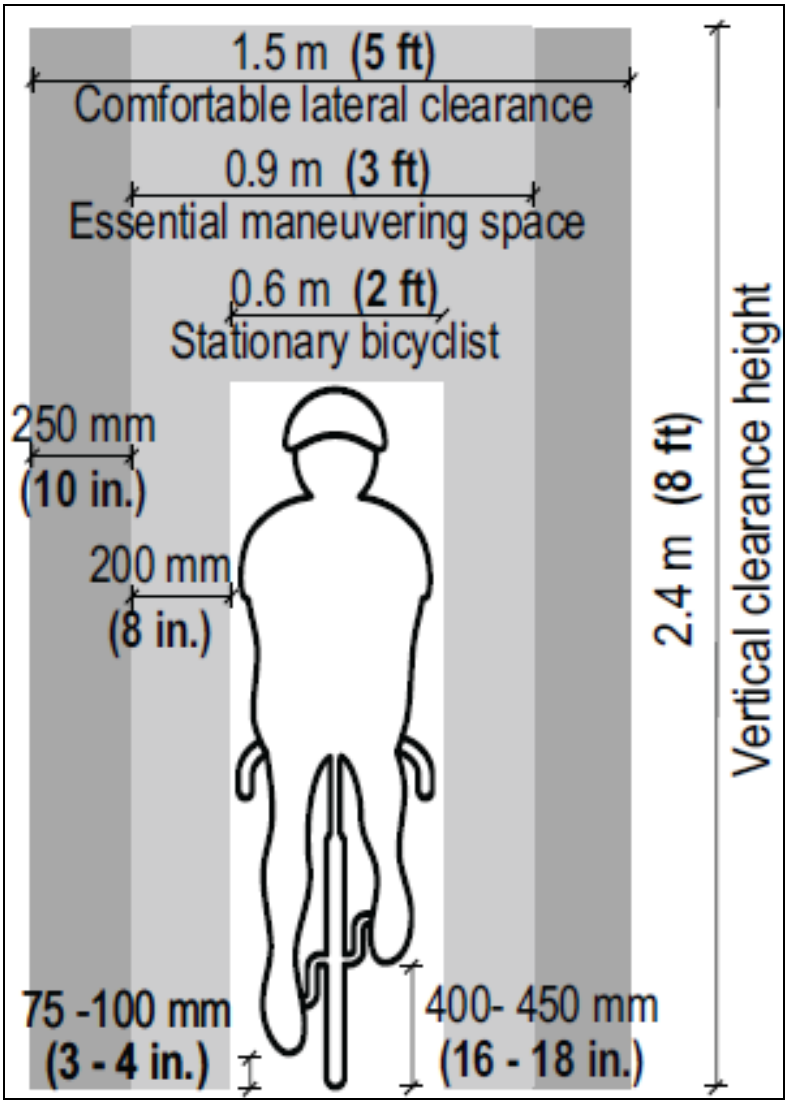


Figure 2.1: Bicyclist Operating Space [4]

2.1.1.2 Stability and Traction

Stability of bicyclists as well as traction between bicycle tires and pavements are two issues of importance in the design of bicycle facilities. Bicycle tires contact the ground with much less surface area than automobile tires making it more difficult to gain sufficient traction and come to a stop. Tires commonly range from 0.8 to 2.4 inches (20.3 to 60.9 millimeters) in width and can contact the ground with as little as 0.12 inches (3.05 millimeters) of tire. Snow and debris on the trail, such as leaves, sand and grass, as well as wet pavements, reduce traction and increase the chances of slipping. Such conditions also necessitate an increased braking distance by bicyclists [4]. Additionally, longitudinal seams in the pavement as small as 0.2 inches (5.1 millimeters) and other imperfections across a paved surface can affect stability and overall control of bicyclists [6].

2.1.1.3 Braking/Deceleration

In order to ensure adequate stopping or decision sight distance is provided for bicyclists at trail crossings, one must examine key parameters associated with their braking and deceleration. In general, sight distances for bicyclists are calculated following the same procedures used to

calculate sight distances for motorists. The following values, as recommended by AASHTO, are to be used in sight distance calculations [4, 11]:

- Perception-reaction time: 2.5 s;
- Coefficient of friction under general braking characteristics: 0.25 (implies a deceleration rate of approximately 8 feet/second^2 or 2.4 meters/second^2);
- Eye height: 4.5 feet (1.4 meters); and,
- Object height: 0.0 feet (0.0 meters).

Braking distances and deceleration rates of bicyclists are subject to a wide degree of variability depending on many factors, including but not limited to, the speed at which the bicyclist is traveling as well as the condition of the pavement. A range of values for braking distances as determined by FHWA as a part of a study for their *Characteristics of Emerging Road and Trail Users and Their Safety* report can be seen in the following [21]:

- Braking Distance
    - Average: 15.7 feet (4.8 meters); and,
    - 85th percentile: 23.0 feet (7.0 meters).
- Deceleration Rate
    - Average: 7.5 feet/second^2 (2.3 meters/second^2); and,
    - 85th percentile: 10.8 feet/second^2 (3.3 meters/second^2).

2.1.1.4 Speed and Acceleration

The speed at which a bicycle travels is highly dependent upon the presence of grades as well as wind. Typical speeds range between 12 and 19 miles per hour (19.3 to 30.6 kilometers per hour) when grades and wind are not present. Bicyclists traveling on a down-grade with a wind at their backs can exceed speeds of 30 miles per hour (48.3 kilometers per hour) [4]. Regardless of the presence of grades, AASHTO advises using a design speed of no less than 20 miles per hour (32.2 kilometers per hour) in the design of multi-use paths. In addition to speed, acceleration can be another important consideration in crossing design, particularly at signalized crossings. In order to determine minimum green time as outlined in the AASHTO *Guide for the Development of Bicycle Facilities*, bicyclists are assumed to accelerate between 1.0 to 3.0 feet/second^2 (0.3 to 0.9 meters/second^2) [11, 21].

2.1.1.5 Visibility

Several factors make bicyclists much more difficult to see for drivers when compared with other motor vehicles. First of all, bicyclists occupy less space than motor vehicles. This issue in conjunction with the placement of bicycle facilities on the outsides of roadways creates conditions that restrict motorists' views of bicyclists as they often reside in the periphery of motorists' field of vision. Additionally, motorists often pay less attention to bicyclists and may fail to notice them as a consequence of only focusing on other motor vehicles in their immediate vicinity. Finally, bicycles can be extremely difficult to see at night and in other dark conditions [6]. Although Minnesota Statute 169.222 Subd. 6 requires bicyclists to use a bicycle light when riding at night, it can be difficult for drivers to see bicyclists when this law is neglected [22].

2.1.2 Needs of General Pedestrians

According to the 6th edition of *A Policy on Geometric Design of Highways and Streets* (also known as the "Green Book") published by AASHTO, the walking speeds of pedestrians are within the range of 2.5 to 6.0 feet/second (0.8 to 1.8 meters/second), on average. AASHTO indicates that elderly pedestrians will typically walk at speeds in the lower end of this spectrum and consequently recommends consideration of a design walking speed of 2.8 feet/second (0.9 meters/second) for facilities located in areas with high populations of elderly people [8].

The 2012 *MN MUTCD* recommends using a walking speed of 3.5 feet/second (1.1. meters/second) for pedestrians in design calculations such as the timing of pedestrian change intervals (Flashing Don't Walk intervals). In cases that a crossing is frequently used by pedestrians who move slower than 3.5 feet/second (1.1 meters/second), such as the elderly, or pedestrians with disabilities, one may consider a design walking speed of less than 3.5 feet/second [5].

Walking speeds have been found to be lower at intersections than at midblock locations and have been found to decrease when density of pedestrians on a given facility increases. Walking speed is further affected by numerous other factors including the presence of steep grades, air temperature, time of day, trip purpose, and the presence of ice and snow on the facilities on which pedestrians travel [8].

2.1.3 Needs of Children

Children are frequent trail users with differing needs than their adult counterparts. One of the most critical differences to be considered in design is the overall decreased ability to judge and accept adequate gaps in a traffic stream exhibited by children, when compared to adults. Other characteristics common in children include the following that were noted in a 1996 FHWA/ National Highway Traffic Safety Administration (NHTSA) publication [23]:

- Reduced peripheral vision;
- Poorer performance in judging speed and distance of traffic;
- Difficulty determining the direction from which a sound is coming;
- Overconfidence;
- Difficulty with reading and understanding the messages relayed by traffic control devices;
- Erratic actions;
- Less established expectations on traffic;
- Trust in and reliance on others for protection; and,
- Reduced comprehension skills for complex situations and scenarios.

2.1.4 Needs of the Elderly and Pedestrians with Disabilities

Over time, physiological changes occur that can lead to declines in one's mental and physical capabilities. In the "Green Book," AASHTO establishes nine "operational deficiencies" that are common among older drivers. These characteristics are not exclusive to drivers and can be generalized as characteristics of older pedestrians or bicyclists as well. Such characteristics include [8]:

- Reduced information processing capabilities;
- Decreased reaction times;
- Difficulty in decision making;

- Reduced visual acuity;
- Hearing loss;
- Difficulty in judging time, speed, and distance;
- Reduced depth perception ability;
- Reduced physical mobility; and,
- Potential side effects associated with prescription drug use.

Changes in the transportation system to support users with disabilities, as well as the elderly, were implemented with the passage of the Americans with Disabilities Act of 1990 (ADA) [24]. ADA was signed into law to prevent discrimination against people with disabilities in a variety of realms including the workplace, government at both the State and local level, public and commercial facilities, transportation, and telecommunications. It has since been amended in 2008 to include a broader definition of the term "disability" [25].

Design requirements and guidelines for items such as curb ramps that are compatible with ADA provisions can be found in sources including the United States Access Board's *Guidelines for Accessible Public Rights-of-Way* (PROWAG), MnDOT's *ADA Project Design Guide*, Chapter 11-3.0 ("Pedestrian Facilities") of the *MnDOT Road Design Manual*, and the *ADA Accessibility Guidelines for Buildings and Facilities* (ADAAG) [17, 26, 27, 28]. When facilities including multi-use paths, sidewalks, and bicycle paths are intended for pedestrian use, they are to comply with the guidelines presented in the ADAAG and PROWAG [4, 26, 28]. According to FHWA, "shared use paths and pedestrian trails that function as trails should meet the accessibility guidelines proposed in the Access Board's *Regulatory Negotiation Committee on Accessibility for Outdoor Developed Areas Final Report* [29, 30]."

Similar to bicyclists and other trail users, maneuvering space guidelines have been established for pedestrians in wheelchairs. A minimum path or walkway width of 5 feet (1.5 meters), free of any obstructions, is desirable. This distance is sufficient to allow two wheelchair users to pass one another or to allow a single wheelchair user to turn around. If 5 feet (1.5 meters) cannot be provided due to right-of-way restrictions, a path or walkway width of 4 feet (1.2 meters) is acceptable for short distances. If this lesser width is used, 5 feet (1.5 meters) wide sections that are at least 5 feet long must be incorporated along the path or walkway at intervals of 200 feet (61.0 meters) [17].

Surface discontinuities caused by use of certain textured and rough materials can be problematic for pedestrians in wheelchairs as well as pedestrians who may use canes or walkers. The discontinuities lead to increased resistance between the wheels on these devices (or the base in the case of a cane) and the ground. The increased resistance in turn leads to vibrations transferred through the device to the user which can be troublesome. Thus, in PROWAG, the Access Board recommends that use of rough or otherwise uneven surfaces be kept to a minimum and it further notes that if they must be used, they should be used at a frequency that minimizes their negative impact on pedestrians [26].

2.1.5 Needs of Skaters

The term "skaters" is a somewhat broad classification of a group composed of inline skaters as shown in Figure 2.2, roller skaters, and skateboarders. These sub-groups do not always exhibit the same operating characteristics as one another, but for design purposes they can be considered as very similar. One such similarity is their increased sensitivity to uneven surfaces and small debris resulting from the small wheel size of skates compared to bicycles or motor vehicles;

common wheel diameter for skates can range from 2.8 to 3.1 inches (71.1 to 78.7 millimeters) [6].

Few studies have been done on specific operating characteristics of skaters; however, the University of Southern Florida published a study on inline skaters in 2000 for the Florida Department of Transportation. This study which collected data on operating speed, operating space, as well as stopping techniques, distances, and widths can help provide a basis for consideration of the needs of skaters in a design. Speeds of skaters recorded ranged from 3 to more than 20 miles per hour (4.8 to 32.2 kilometers per hour), with an average speed of just less than 10 miles per hour (16.1 kilometers per hour). Average lateral clearance or lower/upper sweep width, defined as the lateral distance used by a skater's arms, legs, or any combination thereof, was found to be 4 feet (1.2 meters); overall, clearance values ranged from 2 to more than 6 feet (0.6 to 1.8 meters) [31].

Figure 2.2: Inline Skaters on a Trail

Average stopping distance was found to be 31.5 feet (9.6 meters), while 15th and 85th percentile distances were found to be approximately 15.1 feet (4.6 meters) and 48 feet (14.6 meters), respectively. Stopping width was found to be 4.3 feet (1.3 meters) on average and 81 percent of all skaters observed had a stopping width of 5 feet (1.5 meters) or less [31].

2.1.6 Needs of Snowmobilers

During the winter months, select trails in Minnesota allow access to and usage by snowmobilers. As a result, a new group of design trail users arises in addition to the previously mentioned user groups. When designing for snowmobilers, one of the most important considerations is the speed

that the vehicles are capable of attaining due to its implications on many other parameters, particularly stopping sight distance. In Minnesota, the maximum allowable operating speed for snowmobiles on publicly owned facilities is 50 miles per hour (80.5 kilometers per hour) [32]. According to the International Association of Snowmobile Administrators (IASA), a typical snowmobile has headlights that can illuminate the trail approximately 200 feet (61.0 meters) ahead of the vehicle. When snowmobile operators travel at speeds between 45 and 50 miles per hour (72.4 and 80.5 kilometers per hour), they run the risk of overriding their headlights, a condition that occurs when the required length of stopping sight distance falls outside of the range the snowmobile's headlights are capable of illuminating [33].

Studies on the acceleration and braking characteristics of contemporary snowmobiles are limited. A study conducted by MEA Forensic Engineers and Scientists in Canada did, however, attempt to quantify some of these parameters. In their study, they found that on average, deceleration rates for snowmobiles can be between 0.32 and 0.42g (approximately 10.3 to 13.5 feet/second^2 or 3.1 to 4.1 meters/second^2) [34]. Additionally, a lack of information on the operating space requirements of modern snowmobiles and their users makes it difficult to provide average or ranges of dimensions for parameters such as eye height. It is important to note that many of these parameters, notably eye height and vertical height of the user, can vary depending upon the riding position the snowmobiler assumes; possible positions include, but are not limited to, sitting, standing, and kneeling [33].

2.2 Design Process and Principles

2.2.1 Design Process

Although geometric considerations are extremely important in the design of trails and trail crossings, equally important is the consideration of human factors. This study of human behavior is to be conducted in a predictive context, as well as with respect to existing conditions. In the predictive context, the designer examines human behavior based on research and analysis of tasks to be completed by trail users and drivers, such as control, guidance, and navigation to aid in his or her design. Existing conditions of trails and trail crossings must also be examined in order to determine where, and consequently why, trail-user and driver behavior are different from what was originally planned. Typically, these differences in planned and actual behavior result from a misalignment between the user's actual behavior and what the designer had intended for the user to do. Further, this misalignment is caused by the intended behavior being too difficult for the user to complete given his or her skill set or it being far less convenient than another possible behavior the user deems acceptable.

In the initial phases of design, consideration of driver and trail-user expectation at a trail crossing is an issue of importance for the designer. Consideration of expectation with regards to right-of-way assignment is beneficial as it can help determine sources and types of possible conflicts between trail users and motorists. Additionally, it can help determine other errors resulting from incorrect or unaccounted for driver and trail-user behavior. Finally, the probability that a conflict or error will likely occur, as well as the severity of the potential conflict or error, should be considered.

Common inconsistencies that the designer should attempt to avoid when at all possible include differences in the following [6]:

- Lateral and vertical clearance available to trail users;

- The cross-section/layout of a crossing with respect to things such as lane width or signage and pavement markings (type and placement);
- Right-of-way allocation at a crossing;
- Speed of through or turning motor vehicle traffic that conflicts with trail-crossing maneuvers; and,
- Amount of separation between road and trail users.

Consistency throughout a design is crucial in order to help reinforce driver and trail-user expectancy, which can further aid in the prevention of conflicts or other errors by operators.

2.2.2 Design Principles

From a human factors perspective, a major design principle applicable to trail crossings is to design for the range of users [7]. It is clear that the types and abilities of trail users are quite varied, but some groups may need more accommodation than others. For instance, due to the effects of aging, the elderly exhibit certain "operational deficiencies" as previously discussed. Hence, by considering the elderly as design trail users, one is designing for a set of physical and cognitive characteristics that are held or exceeded by the majority of the population. In the "Green Book", AASHTO further establishes a list of countermeasures to aid older drivers. Countermeasures that do not exclusively apply to motorists and can be in applied in the context of trail users include [8]:

- Examine the feasibility of designing to accommodate physical and cognitive characteristics of older drivers (or trail users) at the 95^{th}- 99^{th} percentile level;
- Enhance sight distance by ensuring obstructions are not within one's field of vision, especially at intersections;
- Increase the amount of walking/crossing time provided for pedestrians;
- Increase the size of pavement markings and signs and make them retro-reflective and/or colored as appropriate;
- Avoid using too many signs to prevent clutter; and,
- Apply redundancy and warn users of upcoming situations in advance.

Other principles outlined in "Designing Pedestrian Friendly Intersections" that are particularly relevant in the context of trail crossings include the following [35]:

- Ensure right-of-way assignment is clearly defined for and assigned to trail users and motorists;
- Use positive guidance at crossings to help define paths to be followed by trail users and pedestrians;
- Reduce conflicts with channelization when applicable;
- If a conflict cannot be avoided, design such that it will occur at a right angle;
- Ensure clear sight triangles and sight distance (stopping, intersection, and decision) are provided at crossings;
- Keep crossing distances as short as possible;
- If a crossing distance is deemed sufficiently long, use a median of ample width to allow for temporary refuge of trail users;

- Eliminate the sources hazards and obstacles; if they cannot be eliminated, increase their conspicuity and provide advance warning;
- Consider roadways as points of trail entrance and egress; design surrounding bicycle and pedestrian facilities, such as on-road bicycle lanes, accordingly;
- Design to ensure adequate light is available at all times, while minimizing glare; and,
- Balance constructability with ease and cost of operations and maintenance.

2.3 Types of Trail Crossings

2.3.1 Midblock Crossings

A midblock crossing occurs where a trail crosses a roadway at a sufficient distance from any nearby intersection such that motorists do not conflict with trail users when completing turning movements [6]. The intersection can exist in one of two configurations: a perpendicular crossing or a skewed crossing. A perpendicular crossing, as seen in Figure 2.3, occurs when the trail and roadway intersect at an angle of 90 degrees, while a skewed crossing occurs when the trail and roadway intersect at an angle other than 90 degrees [36]. Of the two configurations, the perpendicular crossing is preferred. As a result, many skewed crossings are redesigned to achieve an angle of intersection between trail and roadway of 90 degrees. A common conceptual redesign of a skewed crossing, where the trail was initially designed in place of an old railway, can be seen in Figure 2.4. If spatial constraints exist such that a skewed crossing cannot be redesigned as a perpendicular crossing, a maximum angle of intersection between the trail and roadway of 75 degrees may be used. Taking this course of action will lead to an increase in crossing length of 4 percent when compared to a perpendicular crossing [6].

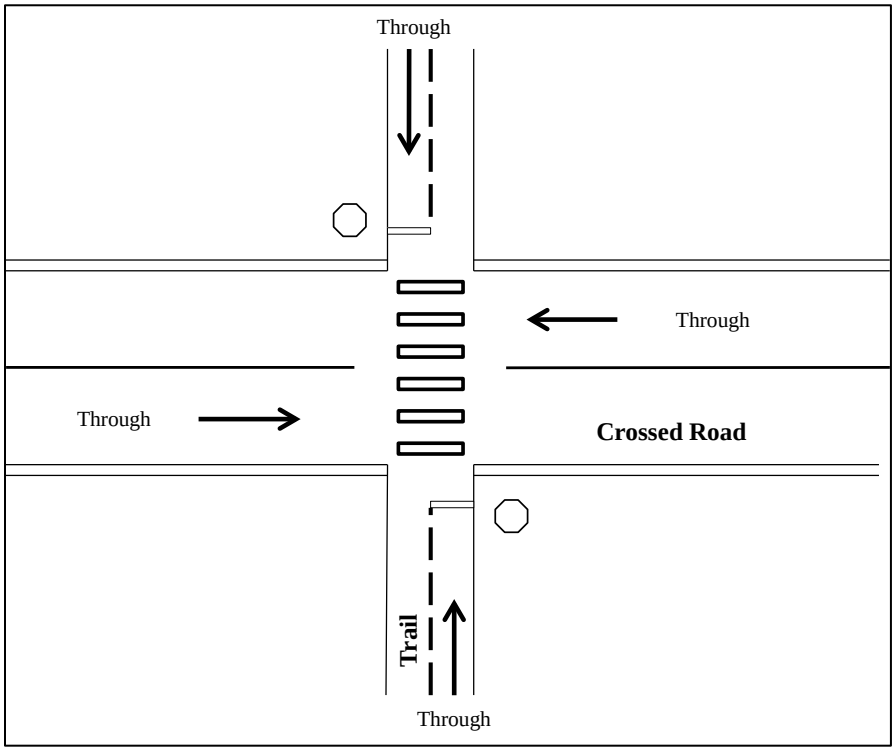


Figure 2.3: Perpendicular Midblock Crossing [6]

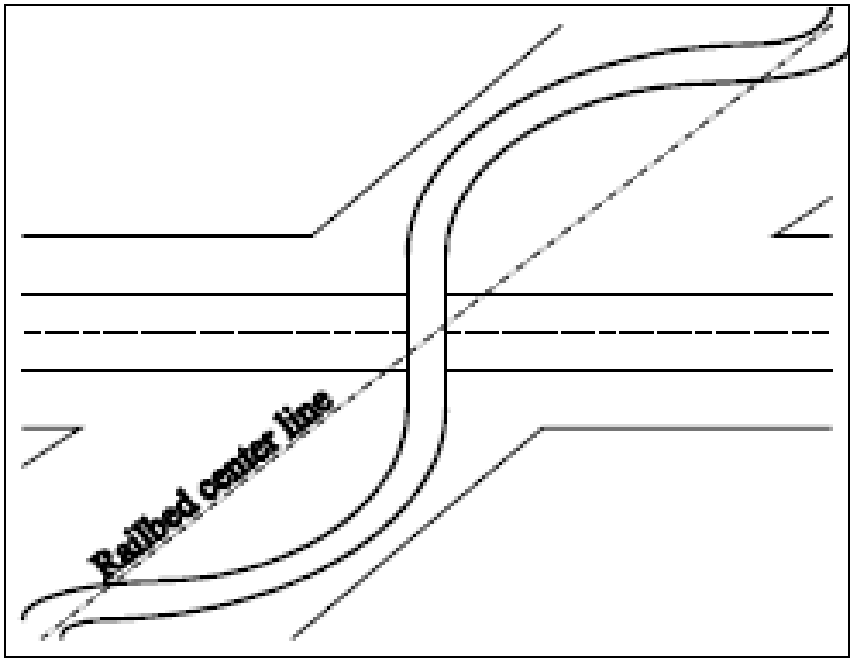


Figure 2.4: Conceptual Redesign of Skewed Crossing [6]

A main criterion in defining a midblock crossing is that it is of sufficient distance from the nearest intersection such that motorist turning movements do not affect the crossing. That is, only through movements by motorists are allowed over the crossing. According to the *MnDOT Bikeway Facility Design Manual*, an at-grade roadway crossing of a trail, that is not at located at an intersection, is recommended to be located "a minimum of 250 feet [76.2 meters] from any roadway intersection [4]." This guide recommends a midblock crossing be defined as being at least 250 feet (76.2 meters) away from the nearest intersection.

2.3.2 Parallel Path Crossings

A parallel path crossing, seen in Figure 2.5, occurs where a trail runs alongside a roadway (i.e., parallels it) and later travels across another roadway in close proximity to an intersection. Unlike in the case of a midblock crossing where motorists are only able to travel over the crossing via through movements, the configuration of a parallel path crossing allows for turning movements to take place over the crossing. As a result, the number of possible conflicts between motorists and trail users is increased. The possible conflicts can initially be classified by the roadway on which the motorist begins his or her maneuver to travel through the intersection. In the case of the parallel roadway, possible conflicts exist between trail users and motorists completing left or right turns onto the crossed road, movements (PL) and (PR) in Figure 2.5, respectively. In the case of the crossed roadway, possible conflicts exist between trail users and motorists completing through movements or right turns over the crossing, movements (CT) or (CR) in Figure 2.5, respectively. The increased number of potential conflicts that can occur at a parallel path crossing, when compared to a midblock crossing, further highlights the necessity of ensuring that sight lines are clear and unobstructed for both motorists and trail users at the crossing [6].

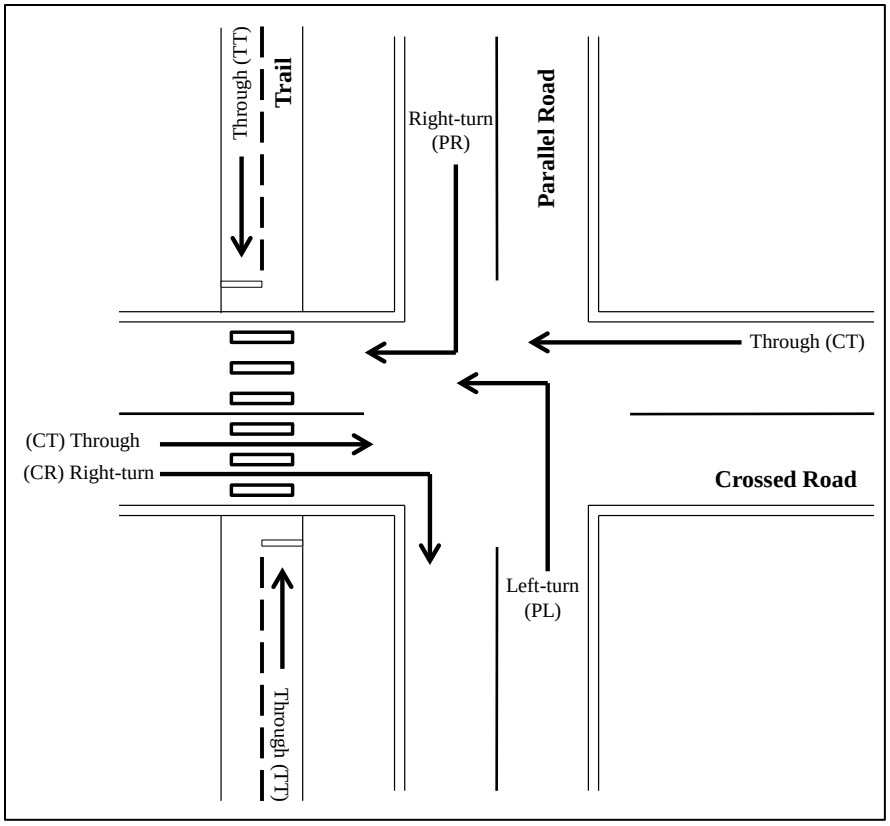


Figure 2.5: Traffic Movements at a Parallel Path Crossing [6]

In the case of a parallel path crossing, the major roadway can travel parallel to or cross the trail. Regardless of the case, issues such as how right-of-way will be assigned, whether or not traffic control devices will be used, if so, what types of devices will be used, and geometric considerations such as how far the crossing is offset from the intersection are critical and must be considered when designing a parallel path crossing. The offset, or separation distance, between the trail and the parallel roadway, has tremendous implications on the operations and safety of the crossing for both motorists and trail users alike. Specifically, the distance can have an effect on the speed at which motor vehicles will approach the trail as well as allow or disallow space for queuing between the trail and parallel roadway. Additionally, the distance has implications on when drivers are able to see the trail, as well as when trail users are able to see approaching drivers. Finally, the offset distance raises concerns with how right-of-way will be assigned at the trail crossing. Further discussion of concerns associated with parallel path crossings, such as those related with turning vehicles at parallel path crossings can be seen in Chapter 3, "Design elements," of the Florida Department of Transportation's *Trail Intersection Design Handbook* [6].

2.3.3 Complex Crossings

Put simply, a complex crossing is a trail crossing that does not fall into either of the aforementioned classifications. Such crossings have no pre-defined configuration and can involve the trail traveling through or in close proximity to an intersection in a variety of manners. In many cases, complex crossings result as a consequence of a trail being near to or crossing an intersection with non-standard geometry (i.e., not a four-leg or "T"-intersection) as seen in

Figure 2.6; for instance, the trail may cross an intersection for which one of the approaches is skewed. As with parallel path crossings, consideration of the conflicts between trail users and motorists, particularly those that would result from turning movements is of utmost importance for the designer. In some cases, the geometry of complex crossings may make the use of a "two-step crossing" desirable. These crossings, which require two separate crossing maneuvers to be made, can be especially useful when trail approaches intersect the roadway at an angle other than 90 degrees and relocation of trail approaches is not feasible or possible. An example of a complex trail crossing making use of a "two-step" or multi-stage crossing can be seen in Figure 2.7; Figure 2.8 shows a picture of this crossing type in Madison, Wisconsin. "Two-step crossing" maneuvers can help simplify the crossing maneuver for the trail users and enhance their safety at the crossing. That being said, trail users may choose not to follow the path used for the staged crossing and simply cross directly from one trail approach to the other since the direct path will be shorter than the "two-step crossing." In many cases, it may be desirable to provide space for refuge of trail users during their crossing. The lack of a "concrete" definition makes examination and design of complex crossings especially difficult. Hence, one must rely on engineering judgment as well as a thorough evaluation of all possible conflicts between motorists and trail users when designing a safe and operationally efficient complex crossing [6].

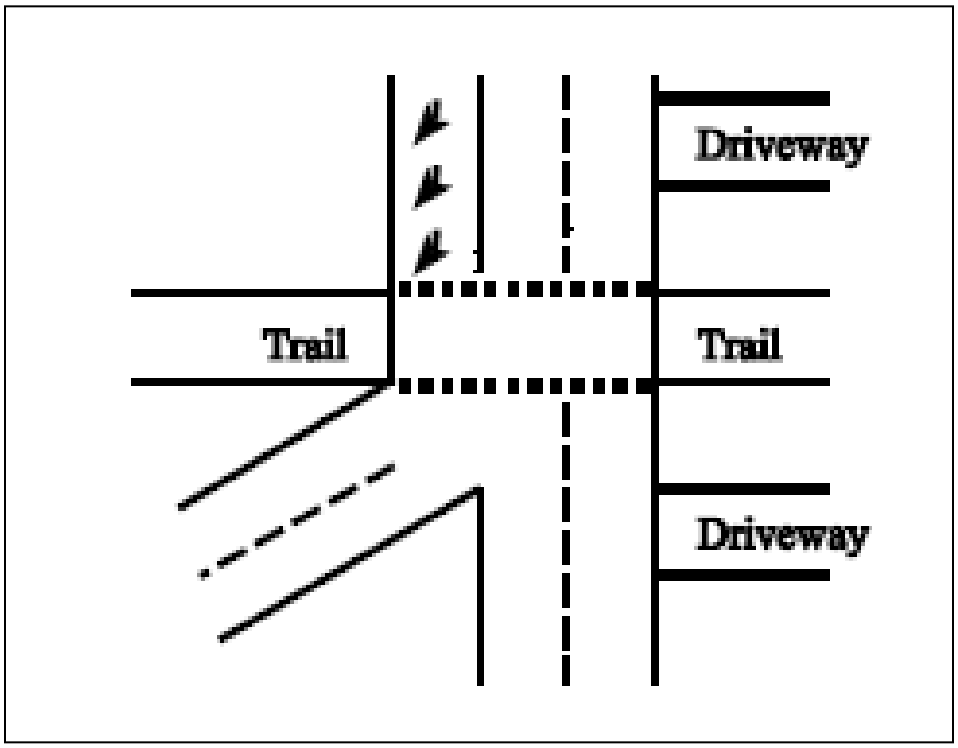


Figure 2.6: Complex Crossing at Intersection with Skewed Approach [6]

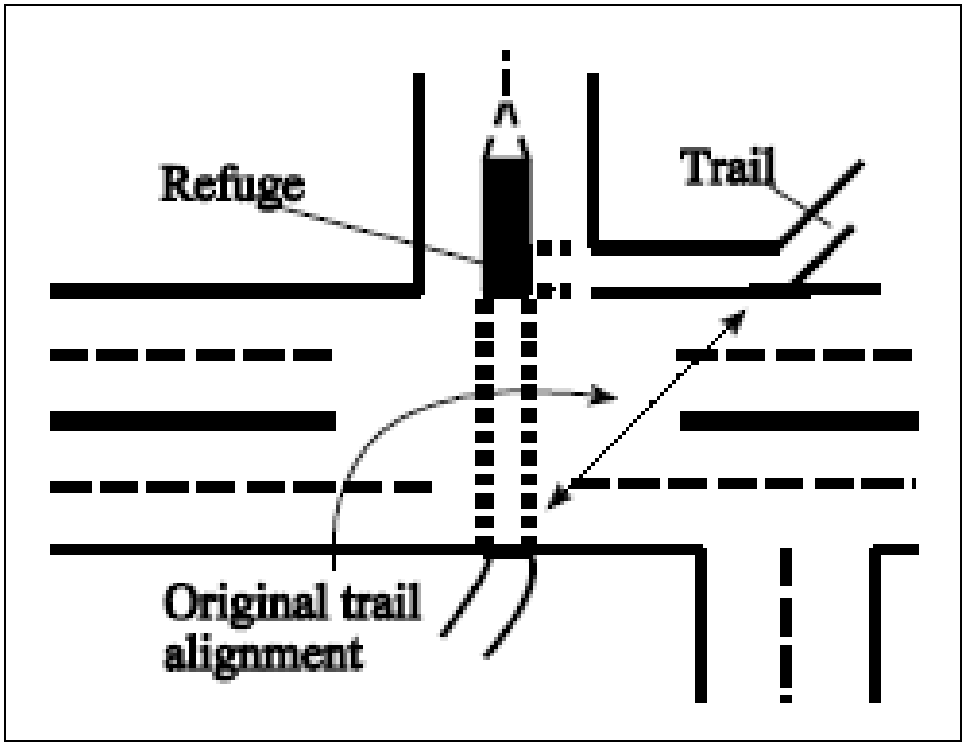


Figure 2.7: Complex Trail Crossing Using Multi-Stage Crossing [6]

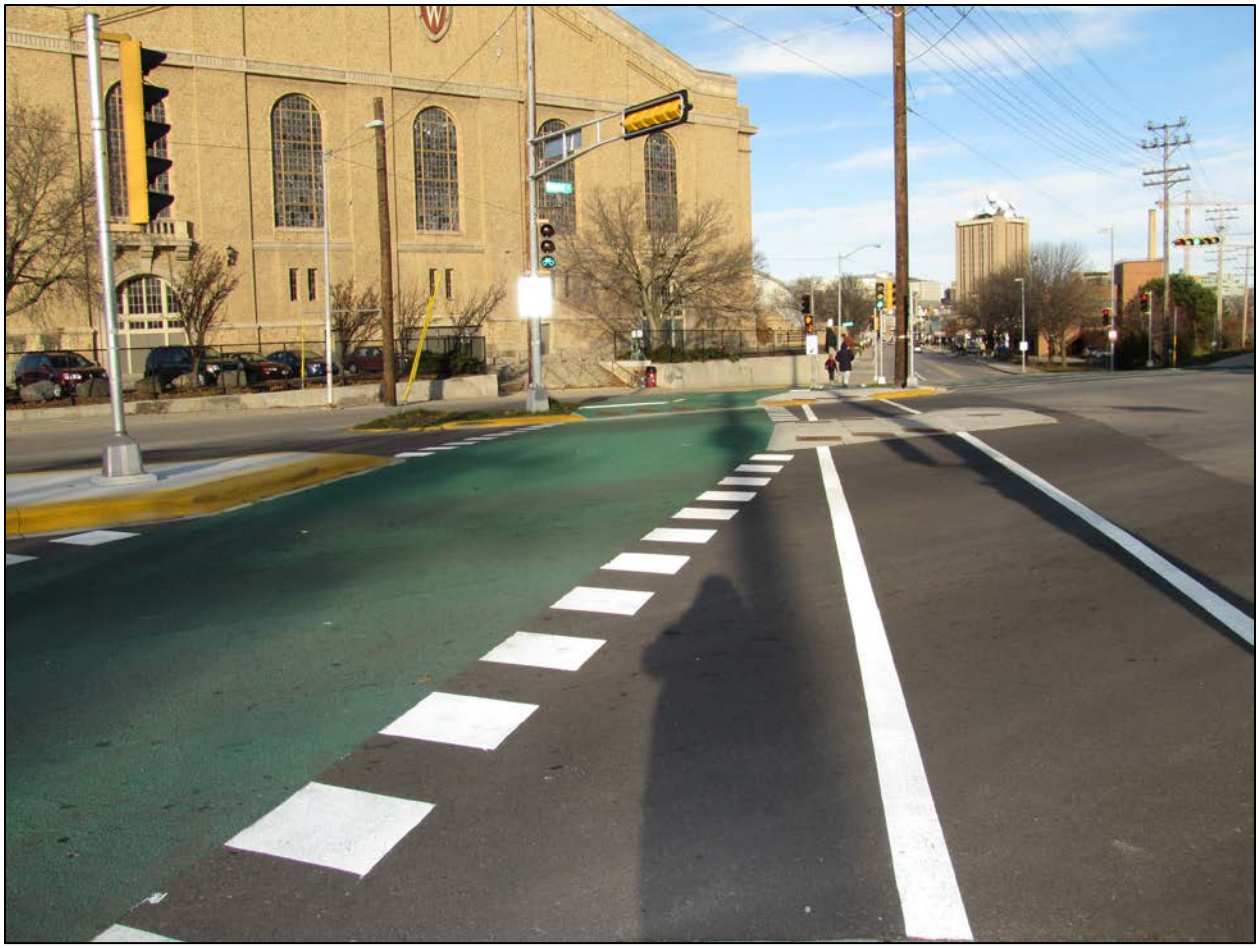


Figure 2.8: Complex Trail Crossing Using Multi-Stage Crossing in Madison, WI

2.3.4 Trail-Railway Crossings

Trail-railway crossings occur where a trail crosses at least one set of at-grade railway tracks. The railway tracks can either be located within or outside of a roadway. This crossing type poses two additional safety concerns not associated with the other types of crossings. First and foremost, potential conflicts between trains and trail users must be addressed due to the severity of the consequences. Additionally, the gap between the rail flangeway and trail surface creates another safety hazard for trail users. This gap is of particular concern for users of non-motorized vehicles along trails, such as bicycles, as it poses a potential falling hazard in the event of a wheel getting stuck in it. When designing a trail-railway crossing, key concerns include the following: alerting trail users of the potential presence of trains, minimizing the negative effects of the flangeway gap, and ensuring sufficient sight distance is provided for trail users as they approach and complete a crossing maneuver [15].

In order to alert visually impaired pedestrians of a trail-railway crossing, detectable warnings in the form of truncated domes must be installed such that the edge of the warning surface closest to the rails is between 6 and 15 feet (1.8 to 4.6 meters) from the centerline of the neatest rail. In this application, the warning surfaces are to be installed in a manner such that the lines of truncated domes are parallel with the direction in which pedestrians in wheelchairs will travel over the crossing [17].

Perpendicular crossings between trails and railways help minimize the chances of a bicyclist's front wheel getting caught in the flangeway and aid in the provision of clear sight lines [4, 15]. If establishing a perpendicular crossing is not possible, one way to solve the problem created by the flangeway gap is to use a filler as shown in Figure 2.9 [15]. Regardless of whether or not a flangeway filler is used, the flangeway gap is not allowed to exceed 3 inches (76.2 millimeters) [17].

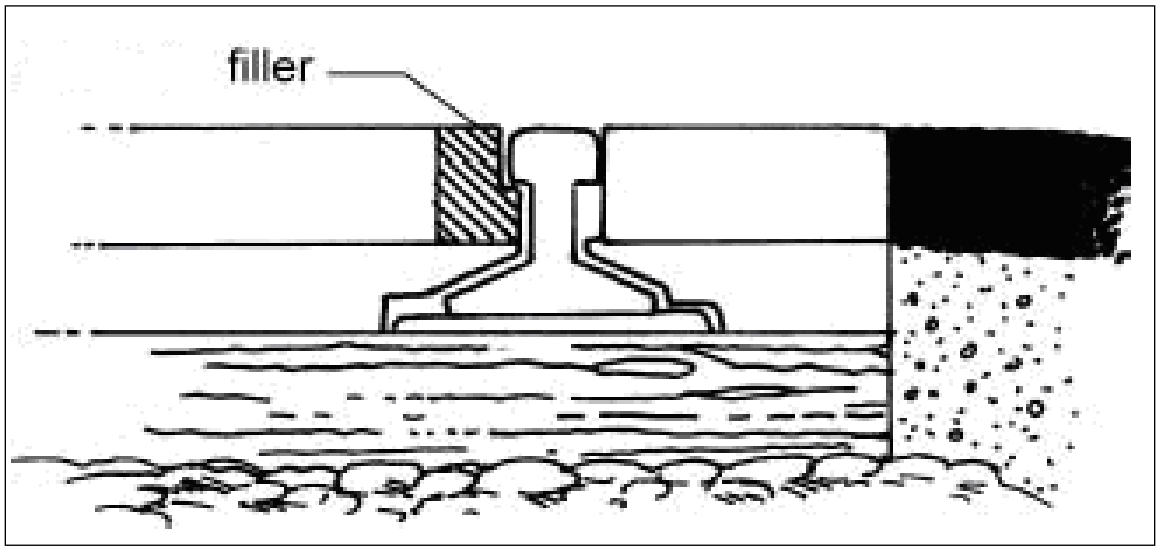


Figure 2.9: Flangeway Filler Used to Eliminate Flangeway Gap [15]

Chapter 3: Alternative Treatments for At-Grade Trail Crossings

3.1 Traffic Signs and Signals

Traffic control devices including traffic signs and signals are typically installed at trail-roadway crossings to assign right-of-way and attempt to minimize/reduce conflicts between movements. Some signs and signals, such as warning signs and flashing yellow beacons, are used as safety treatments to warn roadway and trail users about potential conflicts. All signs, markings and signals used at trail-roadway crossings are covered in the *MN MUTCD* [5]. The *MN MUTCD* follows and is in compliance with the Federal MUTCD. Additionally, guidance and in some cases warrants for when to use a specific traffic control device can also be found in the *MN MUTCD* [5].

3.1.1 Traffic Signs

Traffic signs for trail crossings are comprised of regulatory signs and warning signs [5, 6]. Guide signs may also be used to indicate navigation direction and distance from the crossing. Since guide signs are not critical to the design and safety of the crossing, only regulatory and warning signs are presented in the following sections.

3.1.1.1 Regulatory Signs

Regulatory signs are placed to "inform road users of selected traffic laws or regulations and indicate the applicability of the legal requirements." In the context of trail crossings, they simply help regulate conflicting traffic movements. For trail-crossing applications, regulatory signs found in Chapters 2B., "Regulatory Signs," and Chapter 9B., "Signs," of the *MN MUTCD* include the [5]:

- STOP (R1-1) sign, the YIELD (R1-2) sign;
- Stop Here For Pedestrians (R1-5 series) signs;
- In-Street and Overhead Pedestrian Crossing (R1-6 and R1-9) signs;
- Traffic signal signs for pedestrians (R10-1 through R10-4);
- Push Button to Turn on Warning Lights (R10-25) sign;
- Traffic signal signs for bicycles (R9-5, R10-22, R10-24, and R10-26);
- No Turn on Red (R10-11 series) signs; and,
- NO MOTOR VEHICLES (R5-3) signs.

It is recommended to use a STOP (R1-1) sign at trail crossings where the right-of-way at the crossing is to be assigned to road users. At some crossings, particularly those in rural settings with a high speed limit on the crossed road, STOP signs are sometimes used on the trail approaches to reinforce the message of right-of-way assignment to the road users. Roadway STOP or YIELD (R1-2) signs are only recommended under low speed (< 35 miles per hour or 56.3 kilometers per hour) and low to medium ADT (< 4,999 vehicles per day) conditions [6, 14]. The *MN MUTCD* states "STOP (R1-1) signs shall be installed on shared-use paths [trails] at points where bicyclists are required to stop. Yield (R1-2) signs shall be installed on shared-use paths at points where bicyclists have an adequate view of conflicting traffic as they approach the sign, and where bicyclists are required to yield the right-of-way to that conflicting traffic" [5].

When considering using STOP or YIELD signs at a trail crossing, the *MN MUTCD* asks traffic engineers to consider the following when assigning priority [5]:

- Speed differential between trail and road users;
- Volume differential between trail and road; and,
- Relative importance of shared-use path and roadway.

The last bullet point is an especially important consideration when a high-volume trail intersects with a low-volume roadway. The approaches that receive lower priority should be controlled via the least restrictive method that is appropriate; that is to say a STOP sign should not be used in cases where a YIELD sign is deemed acceptable.

Placement of a trail STOP sign is recommended to be as close to the edge of the crossed road as possible, with a minimum distance of 2 feet (0.6 meters) from the edge of the trail for any part of the sign or its support [5]. Considering that a bicyclist may be inclined forward, lowering the field of vision, signs on the trail approach are typically mounted lower than they may be in other applications, such as on an urban roadway [6]. The *MN MUTCD* requires signs to be mounted at a minimum of 4 feet (1.2 meters) (measured from ground level to the bottom of the sign plate). Besides discussion of placement, the *MN MUTCD* also notes that in some cases, smaller versions of select regulatory signs may be used along a trail. For instance, when a STOP sign is used on a roadway, the minimum size is 30 inches by 30 inches (762.0 millimeters by 762.0 millimeters); when a STOP sign is used on a shared use path, the minimum size is 18 inches by 18 inches (457.2 millimeters by 457.2 millimeters). Further guidance on sign placement and sizing can be found in Chapter 9B, "Signs," of the *MN MUTCD* [5].

A 'Stop Here For Pedestrians' Sign (R1-5 Series) must be used on the crossed roadway when a marked crosswalk crosses multiple lanes on an uncontrolled approach and stop lines are used prior to the marked crosswalk. The R1-6 and R1-9 signs (In-Street and Overhead Pedestrian Crossing signs) serve a similar purpose as the R1-5 series signs except they are to be installed in the roadway or mounted overhead, respectively [5].

Traffic signal signs including CROSS ONLY ON GREEN (symbolic circular green) (R10-1) sign, CROSS ONLY ON (symbolic walk indication) (R10-2) sign, Push Button for WALK Signal (R10-3) series signs, Push Button for Green Light (R10-4) series signs, Bicycle Signal Actuation (R10-22) sign (with the text "TO REQUEST GREEN WAIT ON" and a symbol showing a bicyclist positioned over a detector), and Bicycle Regulatory signs (specifically the R10-24, and R10-26 signs) are recommended to supplement pedestrian or bicyclist pushbuttons in order indicate the existence of the pushbuttons [14]. The USE PED SIGNAL (with bicycle symbol) (R9-5) sign alerts bicyclists that they are to cross the roadway when the pedestrian signal gives them the right-of-way and that they may use a push-button if such a detector unit is present. The R10-24 and R10-26 signs instruct bicyclists to push a button in order to receive a green signal indication and in turn be able to cross the roadway. According to Section 2B.52 of the *MN MUTCD*, "traffic signal signs applicable to pedestrian actuation shall be mounted immediately above or incorporated in pedestrian pushbutton units." Of the aforementioned signs, the R10-1, R10-2, R10-4, R10-24, and R10-26 signs must adhere to this regulation. With respect to placement of the R9-5 and R10-22 signs, the *MN MUTCD* recommends that R9-5 signs be installed near where bicyclists will cross the street and that the R10-22 sign be installed along the side of the trail/roadway next to the detector unit [5].

If in-roadway warning lights, flashing lights, or warning/flashing beacons (such as the RRFB) are used, the 'Push Button To Turn On Warning Lights' Sign (R10-25) can be used to inform users of how to activate the lights. When a High intensity Activated crossWalK (HAWK) pedestrian crossing beacon is used, signs from the 'Push Button for Walk Signal' (R10-3 series) can be used to alert trail users how to activate the signal and receive the WALK indication [5].

In some cases, designers may decide to prohibit right turns during the red interval at a signalized crossing in order to reduce the chances of conflict between motorists and trail users. In these situations, No Turn on Red signs from the R10-11 series can be used to convey this regulation. Applicable signs include:

- NO TURN ON RED (symbolic circular red) (R10-11) sign;
- NO TURN ON RED (R10-11a, R10-11b) sign; and,
- NO TURN ON RED FROM THIS LANE (with down arrow) (R10-11d) sign.

If the R10-11d sign is selected for use, it can be mounted above the center of the lane to which it applies [5].

Trails and multi-use paths are primarily intended for use by non-motorized vehicles (with the exception of snowmobiles on some trails in the winter). Thus, it is desirable to prevent and discourage unauthorized vehicles (typically all motorized vehicles with the exception of emergency and maintenance vehicles) from entering them. The NO MOTOR VEHICLES (R5-3) sign can be mounted at trail entrances to alert unauthorized motorists that, by law, they are not to enter the trail. When used, the sign is to face the roadway such that it is visible to motorists [5].

3.1.1.2 Warning Signs

Warning signs are used to alert trail and road users of potentially unexpected situations. Specific warning signs commonly used at trail crossings include crossing signs for roadway users, advance trail-crossing warning signs for roadway users, and warning signs for trail users.

Advance trail-crossing warning signs are installed on the crossed road in advance of the trail crossing to warn vehicles to expect a trail crossing ahead. Unlike advance trail-crossing warning signs, crossing signs are used immediately adjacent to the trail crossing. If the approach to the intersection is controlled by a signal, STOP sign or YIELD sign, the crossing sign may not be needed [6].

The following warning signs are defined in Chapter 2C., "Warning Signs and Object Markers," of the *MN MUTCD*, and can be used as both crossing warning signs and advance trail-crossing warning signs for roadway users [5]:

- Bicycle Warning (W11-1) sign;
- Pedestrian Crossing (W11-2) sign;
- Combined Bicycle/Pedestrian (W11-15) sign;
- TRAIL CROSSING (W11-15a) sign; and,
- Snowmobile Crossing (W11-6) sign.

The Snowmobile Crossing (W11-6) sign, as seen in Figure 3.1, is sometimes used to alert motorists of a location at which snowmobilers may potentially enter the roadway in order to make a crossing [5]. Traffic engineers also may choose to install Snowmobile Crossing signs if certain geometric conditions such as narrow shoulders or steep sideslopes exist at a trail crossing

in order to make the crossing more conspicuous. However, it is noted in Chapter 6, “Traffic Signs,” of the MnDOT *Traffic Engineering Manual* that if criteria to install a Snowmobile Crossing sign on a multi-use trail are met, that a TRAIL CROSSING (W11-15a) sign must be installed instead. Hence, the Snowmobile Crossing sign would only be used at trail crossings in which the trail is for the exclusive use of snowmobiles only [37]. A selection of additional snowmobile signage, that may be practical on trails with snowmobile usage, can be seen in Appendix A of the *Minnesota Snowmobile Trails Assistance Program: Maintenance and Grooming Manual* (revised 10/19/2009) published by the Minnesota Department of Natural Resources [38].

Figure 3.1: Snowmobile Crossing Sign [5]

The combined Bicycle/Pedestrian (W11-15) sign may be used where the primary trail users are both bicyclists and pedestrians. Such signs exist in both yellow and fluorescent yellow-green colors. A TRAIL X-ING (W11-15P) supplemental plaque may be mounted below the W11-15 sign; both the sign and plaque are shown in Figure 3.2. When the plaque is used, its color should match that of the warning sign it is being used with. The TRAIL CROSSING (W11-15P) sign can be an alternative to the combined Bicycle/Pedestrian sign [5].

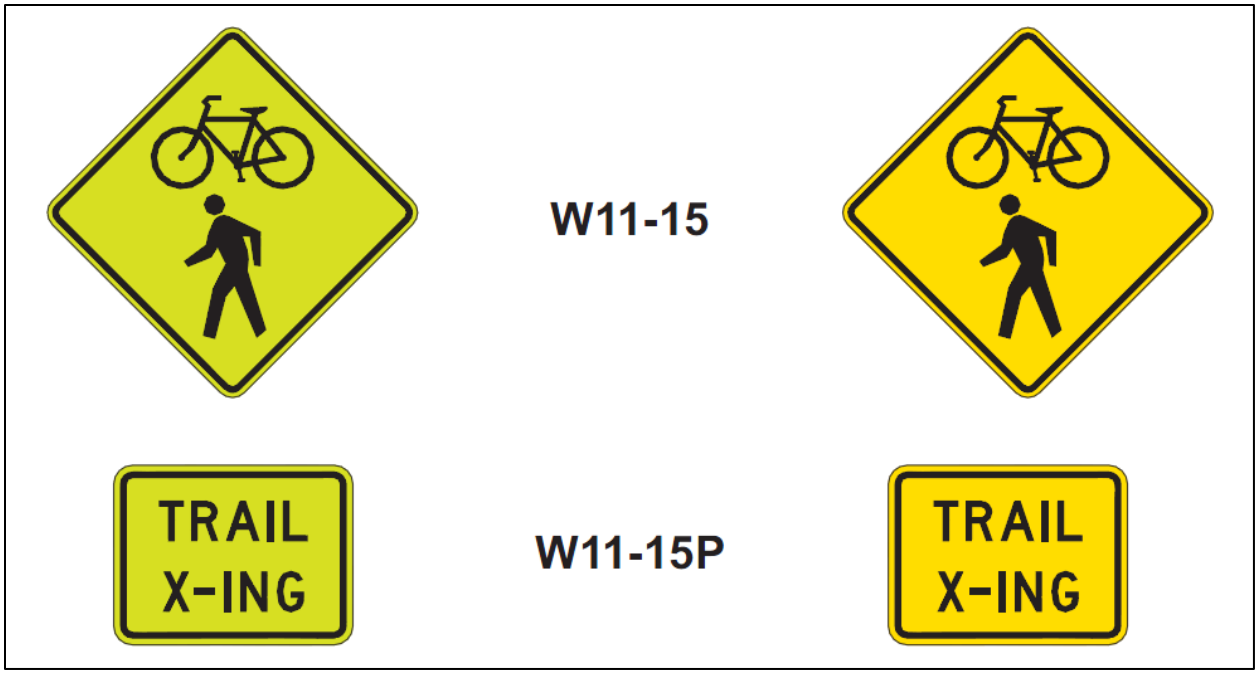


Figure 3.2: Combined Bicycle/Pedestrian Sign with TRAIL X-ING Supplemental Plaque [5]

The *MN MUTCD* recommends that if used as an advance trail-crossing warning sign, a W11-15 or W11-15a sign be supplemented with an AHEAD or XX FEET plaque (Section 2C.53, "Use of Supplemental Warning Plaques," in the *MN MUTCD*) to inform road users that they are approaching a point where crossing activity might occur [5].

It is recommended that the advance trail-crossing warning signs to be placed about 750 feet (228.6 meters) in advance of the crossing location in rural areas where speeds are high, and at a distance of about 250 feet (76.2 meters) in urban residential or business areas, where speeds are low [6, 14]. The *MN MUTCD* gives guidelines for the placement of advance trail-crossing warning signs as specified in the *MN MUTCD*, Table 2C-4, "Guidelines for Advance Placement of Warning Signs" [5].

For warning signs (W11-1, W11-2, W11-6, and W11-15) placed at the location of the crossing point, a diagonal downward pointing arrow (W16-7P) plaque (see Section 2C.50 in the *MN MUTCD*) shall be mounted below the sign, as shown in Figure 3.3 [5].

Figure 3.3: Diagonal Downward Pointing Arrow Combined with Bicycle Crossing Sign [5]

In addition to aforementioned crossing signs, The CROSS TRAFFIC DOES NOT STOP (W4-4P) plaque can be mounted in conjunction with a STOP sign when the engineer determines that people are under the impression or could be easily confused that the intersection in question has an all-way stop control scheme in place. If used, it must be mounted underneath the STOP sign. In addition to the W4-4P plaque, the TRAFFIC FROM LEFT (or RIGHT) DOES NOT STOP (W4-4aP) and ONCOMING TRAFFIC DOES NOT STOP (W4-4bP) plaques can be used to better define conditions that occur when STOP signs exist on all approaches except one [5].

Warning signs for trail users are used to alert trail users of an upcoming intersection. Typical warning sign for trail users include:

- Intersection Warning (W2-1 through W2-5) signs; and,
- Stop Ahead (W3-1) and Yield Ahead (W3-2) signs.

Intersection warning signs are recommended to be used in cases where the visibility of the intersection from the perspective of the trail user, as determined by engineering judgment, is restricted. If the trail crossing is controlled via STOP sign, YIELD sign, or a traffic signal, intersection warning signs are not recommended to be used [5].

Warning signs installed on the trail can sometimes be constructed to a small scale that may be more appropriate for pedestrians and bicyclists and can help reduce visual clutter. For instance, when used on a trail, the minimum size for a Stop Ahead (W3-1) sign is 18” x 18”, whereas the minimum size for a W3-1 sign when used on a roadway is 30” x 30” [5]. Advance warning signs for trail users are recommended to be placed approximately 100 feet (30.5 meters) in advance of the crossing [14].

Despite various types of available warning signs, conservative use of signs is recommended. This sentiment is noted in the *MUTCD* which states, “The use of warning signs should be kept to a minimum as the unnecessary use of warning signs tends to breed disrespect

for all signs". It further elaborates on this point by stating, "Vehicular Traffic Warning signs should be used only at locations where the road user's sight distance is restricted, or the condition, activity, or entering traffic would be unexpected. If the condition or activity is seasonal or temporary, the Vehicular Traffic Warning sign should be removed or covered when the condition or activity does not exist" [5].

3.1.2 Traffic Signals and Warning Lights/Beacons

Traffic signal and warning light/beacon treatments consist of conventional traffic signals, High intensity Activated crossWalK (HAWK) pedestrian crossing beacons, standard yellow flashing beacons, and Rectangular Rapid-Flashing Beacons (RRFBs). Use of these treatments will ultimately depend on how right-of-way is to be assigned between conflicting roadway and trail movements, as well as whether or not warranting criteria are met in the case of signals [5, 39, 40].

3.1.2.1 Traffic Signals

Traffic signals are recommended as a potential safety treatment only at midblock trail crossings [6, 14]. Further, traffic signals are only recommended at midblock trail crossings where the crossed road is a high-speed (> 50 miles per hour or 80.5 kilometers per hour) or high-ADT (> 5, 000 vehicles per day) road [6, 14]. The final recommendation on whether or not to install traffic signals is to be based on the warrant analysis for traffic signals as outlined in the *MN MUTCD*. Although there is not a specific signal warrant for trail crossings, the Minnesota Department of Transportation states that pedestrian signal heads must be used in combination with traffic signals when one or more of the following criteria described in Section 4E.3, "Application of Pedestrian Signal Heads," of the *MN MUTCD* are met [5]:

- An engineering study determines traffic signal installation is justified and the Pedestrian Volume (Warrant 4, Section 4C.5) or School Crossing (Warrant 5, Section 4C.6) warrant is met;
- The signal phase plan includes an exclusive pedestrian phase in which all conflicting vehicular movements are stopped;
- A school crossing exists at a signalized intersection; or,
- The engineer determines that multi-phase vehicular signal indications alone are not sufficient to guide pedestrians in their crossing maneuvers.

All existing signalized intersections are recommended to have pedestrian signal heads [14]. In order to help accommodate pedestrians with disabilities (particularly visual and auditory) at a crossing, accessible pedestrian signals may be used. General usage of accessible pedestrian signals, such as reasons they may be needed, is discussed in Section 4E.9, "Accessible Pedestrian Signals and Detectors – General," in the *MN MUTCD*. Both audible and vibrotactile walk indications are required to be used on accessible pedestrian signals. The *MN MUTCD* notes that use of an audible warning in the form of a rapid 'tick' tone provides clear information to pedestrians that are blind or have other visual impairments. Additionally, it states that vibrotactile indications can help pedestrians who are visually and audibly impaired realize the walk signal is on in loud environments. Pushbuttons for pedestrian signals are recommended to be installed within crossing islands if the roadway width is greater than 80 feet (24.4 meters). When a pedestrian pushbutton is used, signs as described in Section 2B.52, "Traffic Signal Pedestrian and Bicycle Actuation Signs," of the *MN MUTCD* must be mounted next to or on the

pedestrian pushbutton unit [5]. Use of pedestrian pushbuttons is not advised if observed pedestrian levels or fixed-time pedestrian signals cause delay to vehicular traffic [14].

When the pedestrian change interval at an intersection is longer than 7 seconds, the pedestrian signal heads must include a pedestrian change interval countdown display. This display must appear simultaneously with the flashing UPRAISED HAND (i.e., DONT WALK) signal indication [5]. In all cases, if the intersection is signalized, it is crucial to provide oncoming crossing traffic on the crossed road with adequate change and clearance intervals to ensure their clearance of the trail prior to the trail receiving a "WALK" indication [6]. Additionally, when permissive turning maneuvers are allowed to originate from the parallel roadway at a signalized parallel path crossing, traffic engineers may choose to restrict such maneuvers and introduce phases with protected turning movements into the cycles at these signalized intersections. For instance, if a signalized intersection has a dedicated left-turn lane, the engineer may decide to prohibit permissive left turns and enable protected left turns from the parallel roadway while trail users receive a "WALK" or flashing "DON'T WALK" indication. Similarly, if an intersection has a dedicated right-turn lane the engineer may decide to prohibit permissive left turns and enable protected right turns from the parallel roadway while trail users receive a "WALK" or flashing "DON'T WALK" indication [14].

When a pedestrian pushbutton is used at a crossing, it is recommended to be mounted at a height of between 3.5 to 4 feet (1.1 to 1.2 meters) above the trail [5, 6, 14]. This relatively low mounting height makes it possible for bicyclists to reach and activate the signal without the need to dismount. In the case that the trail crosses a divided highway with a median provided for pedestrian and bicyclist refuge, an additional pushbutton may be located in the median to accommodate trail users who had insufficient time to cross the entire roadway [6, 14].

At parallel path trail crossings, despite the fact that signalization can provide for an exclusive pedestrian signal phase, it can create more conflicts and complicate the operation. Therefore, installation of a traffic signal has not been recommended in the existing literature as a safety treatment at a parallel path trail crossing if the intersection is not signalized.

In addition to conventional traffic signals with pedestrian pushbuttons, the use of a High intensity Activated crossWalK (HAWK) pedestrian crossing beacon may be appropriate for select crossing applications [39]. The HAWK Signal was developed to address pedestrian concerns at intersections. Figure 3.4 shows an activated HAWK Signal. The HAWK is activated by a pedestrian, triggering the warning flashing yellow beacon on the roadway. Signage to alert pedestrians how to activate the signal is covered in Section 3.1.1.1, "Regulatory Signs," of this handbook. The indication changes to a solid yellow light, informing drivers to prepare to stop, after a set amount of time. A dual solid red light is then displayed when the pedestrians receive the WALK signal. At the end of the WALK phase, the HAWK Signal displays an alternating flashing red light when pedestrians are shown an upraised hand symbol with a countdown display informing them of the time left to cross. During the alternating flashing red lights, drivers can proceed after coming to a full stop and checking that pedestrians have already crossed their lane of travel [39]. The *MN MUTCD* includes sections about application, design and operations of a pedestrian hybrid beacon, which is similar to the HAWK; these sections are 4F.1 ("Application of Pedestrian Hybrid Beacons"), 4F.2 ("Design of Pedestrian Hybrid Beacons"), and 4F.3 ("Operations of Pedestrian Hybrid Beacons") [5]. A FHWA study has shown that the HAWK Signal is effective in reducing intersection related crashes. Specifically, the reduction in pedestrian crashes was found to be 69 percent [39].

Figure 3.4: HAWK Signal Implemented in Field

3.1.2.2 Warning/Flashing Beacons

Warning beacons that are actuated by pedestrians, bicyclists, or other trail users may be used as a treatment to provide additional warning to vehicles approaching a trail crossing. If warning beacons have more than one signal section, they may be flashed either alternately or simultaneously [5]. The typical warning beacons include the standard over-head or side-mount round flashing beacon and the Rectangular Rapid Flash Beacon (RRFB) [5, 40]. Signage that can be used in conjunction with a beacon, to alert trail users how to activate the beacon, can be found in Section 3.1.1.1, "Regulatory Signs," of this handbook.

Different from the HAWK Signal which requires vehicles to come to a full stop, the standard over-head or side-mount round flashing beacons only use a yellow lens operated in flashing yellow mode to warn drivers of conflict with pedestrians. Figures 3.5 and 3.6 show the over-head and side-mount flashing beacons, respectively. Similar to the HAWK signal, however, the standard flashing beacon can also be activated by pedestrians or other trail users. The *MN MUTCD* includes information on standard flashing beacons in Section 4L.3 ("Warning Beacon"). It is recommended that the flashing beacons be used as emphasis for midblock crosswalks. It is also noted in the *MN MUTCD* that warning beacons that are actuated by pedestrians and bicyclists, via pushbutton, may be used as appropriate to provide additional warning to vehicles approaching a crossing or other location. That being said, warning beacons sometimes operate in an "always-on" mode in which they constantly flash. Activation via pushbutton is not necessary [5].

Figure 3.5: Over-Head Standard Flashing Beacon [41]

Figure 3.6: Side-Mount Standard Flashing Beacons [40]

Rectangular Rapid-Flashing Beacons (RRFBs) are a type of pedestrian crossing warning device which are typically mounted to pedestrian warning signs and similar in operation to emergency flashers on police vehicles. They can be activated via pedestrian pushbuttons discussed in the previous section. Figure 3.7 shows the field implementation of RRFB.

Figure 3.7: Rectangular Rapid-Flashing Beacon

The RRFB is introduced as an alternative to traditional over-head or side-mounted yellow flashing beacons. The LED flasher illuminates in a wig-wag sequence (left and then right). The effect has been described as a "stutter flash effect." FHWA's research project *Effects of Yellow Rectangular Rapid-Flashing Beacons on Yielding at Multilane Uncontrolled Crosswalks* evaluated the RRFB's effectiveness in increasing drivers' yielding to pedestrians on high-volume, multi-lane crosswalks. The results indicated that RRFBs can significantly improve the driver yielding rate to 78.3 percent, while the yielding rate commonly achieved by the standard beacon is only 15.5 percent [40].

FHWA granted an interim approval of RRFBs for optional use in limited circumstances in July 2008. The interim approval allows for the RRFB's usage as a warning beacon to supplement standard pedestrian crossing warning signs and markings at a pedestrian or school crossing and/or where the crosswalk approach is not controlled by a yield sign, stop sign, or traffic-control signal [42].

3.1.3 Markings and Striping

A variety of pavement marking and striping treatments are presented in the *MN MUTCD* [5]. Common treatments include the use of stop lines and word pavement markings as well as crosswalk striping [6].

3.1.3.1 Pavement Markings

Use of pavement markings at crossing locations serves two main functions: to provide trail users with positive guidance at the crossing and to provide information to both trail and road users. When trails are more than 10 feet (3.0 meters) wide and are enough to accommodate two bike lanes [5], a yellow centerline can be used to separate opposing directions of travel on the approach to the crossing and help provide them with guidance as to their position during the crossing in order to mitigate potential conflicts with trail users traveling in the opposing direction. If such a treatment is used, it is recommended that the line extend 150 feet (45.7 meters) back along the approach. In the case that an obstruction is present at the crossing, such as a set of bollards or a lean rail, it is recommended that advance warning striping be used in conjunction with the yellow centerline in order to alert trail users of the potential hazard [6].

In addition to centerline striping, another common treatment for use at trail crossings is application of stop or yield lines (discussed in *MN MUTCD* Section 3B.16, “Stop and Yield Lines”). They are used to define points behind which road and trail users must stop or yield in order to comply with the corresponding traffic control device, a STOP sign or red indication on a traffic signal for a stop line and a YIELD sign for a yield line. If used on trail approaches, it is typically recommended that stop/yield lines be painted within a range of 3 to 6 feet (0.9 to 1.8 meters) from the edge of the intersecting roadway and used in combination with the corresponding regulatory sign (i.e., STOP or YIELD). When stop or yield lines are used at intersections with marked crosswalks, it is recommended that they be placed at least 4 feet (1.2 meters) behind the closest crosswalk line on the roadway [6]. If marked crosswalks are not present, they should be placed where the designer desires vehicles to stop or yield and within a range of 4 to 30 feet (1.2 to 9.1 meters) from the closest edge-line of the intersecting traveled way. In some cases at unsignalized intersections, such as that seen in Figure 3.8, the stop line is set back from the crosswalk in an effort to improve sight lines for both trail users and motorists and increase the chance of having an unobstructed view of each other. When the crossed road is signalized, designers may choose to supplement the stop line by mounting a STOP HERE ON RED (R10-6) sign (covered in *MN MUTCD* Section 2B.53, “Traffic Signal Signs”) in advance of the crosswalk to emphasize the need to stop for trail users in the crosswalk [5].

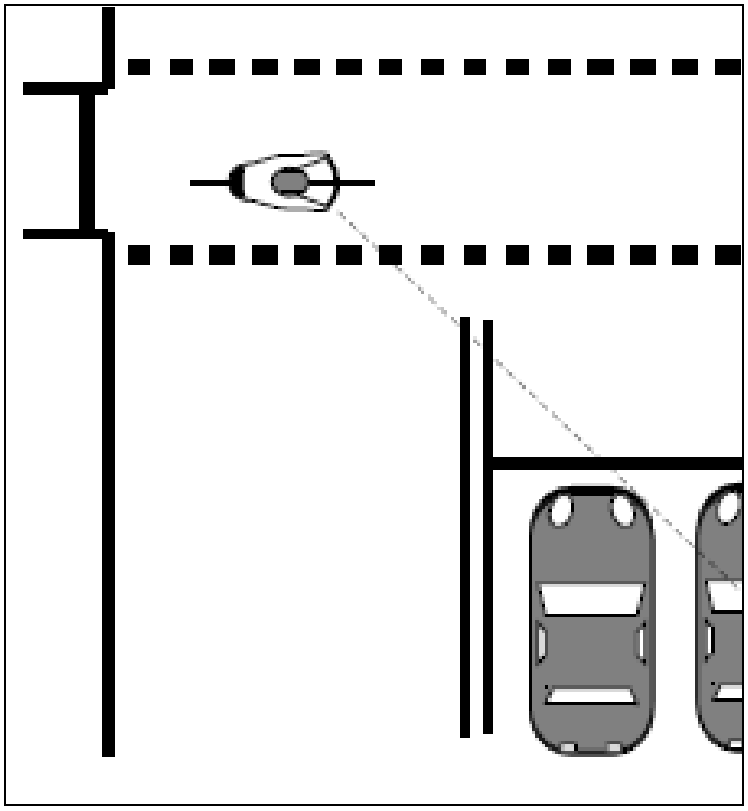


Figure 3.8: Intersection with Stop Line Set Back to Improve Visibility [6]

In some cases, the STOP/YIELD pavement markings covered in *MN MUTCD* Section 3B.20, "Pavement Word, Symbol, and Arrow Markings," can be used together with a STOP sign and stop line or YIELD sign and yield line, respectively, on the trail approach to help strengthen the message delivered to the trail user. It is important to note that if the STOP pavement marking is used, it must be used together with a STOP sign and stop line in accordance with *MN MUTCD* regulation [5]. Use of these additional pavement markings may be especially beneficial for trail crossings since bicyclists are often leaned forward with their heads in a downward position [6]. In addition to using the STOP and YIELD pavement markings on the trail approach, they can also be painted on the crossed roadway. Additional pavement markings that can be used on the crossed road to alert drivers of a stop or yield condition ahead include the STOP AHEAD, YIELD AHEAD, and YIELD AHEAD triangle symbol pavement markings [6, 12]. Neither the YIELD AHEAD or YIELD AHEAD triangle symbols can be used without a corresponding YIELD sign posted [5]. Examples of various pavement markings for application on the crossed road can be seen in Figure 3.9. In addition to the STOP AHEAD and YIELD AHEAD warning pavement markings, the PED XING marking as described in Section 3B.20 of the *MN MUTCD*, "Pavement Word, Symbol, and Arrow Markings" can also be used on the crossed road [5].

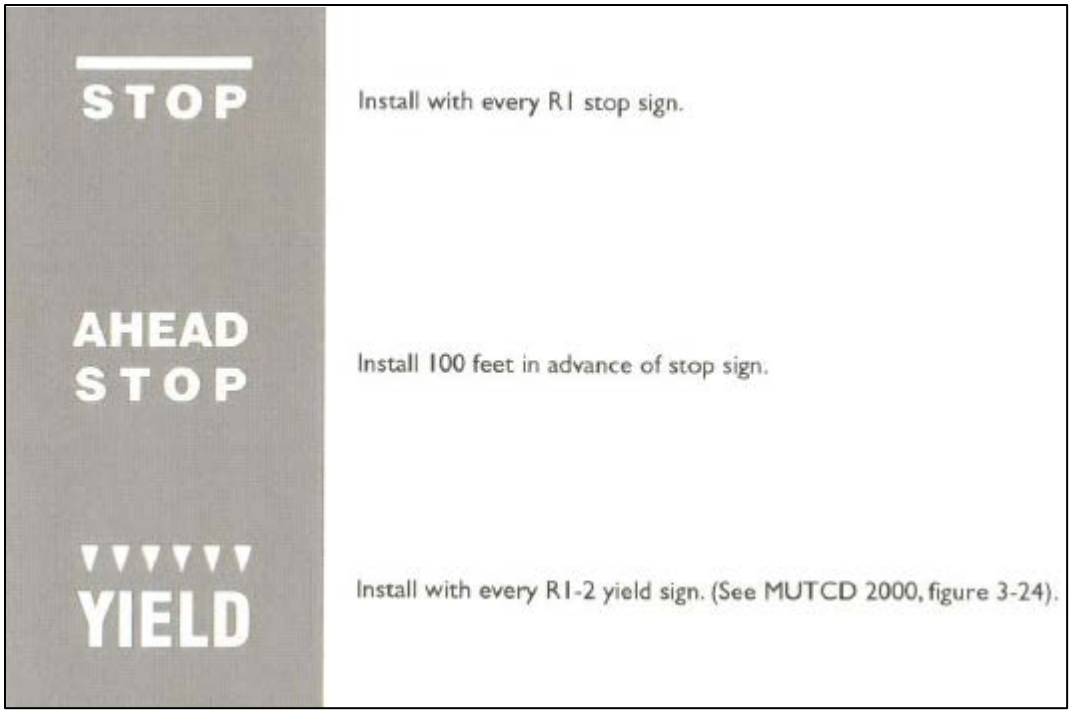


Figure 3.9: Pavement Markings for Application on the Crossed Road [12]

3.1.3.2 Crosswalk Striping

The use of crosswalk markings, covered in Section 3B.18, "Crosswalk Markings," of the *MN MUTCD*, is another potential treatment for use at trail crossings, regardless of whether the intersection is controlled or not. If desired for use at an uncontrolled crossing, the *MN MUTCD* recommends the use of an engineering study in an effort to prevent overuse of crosswalk markings. If an intersection with signal-, STOP-, or YIELD- control already in place is a candidate for crosswalk installation, the *MN MUTCD* notes that crosswalk markings "should be installed where engineering judgment indicates they are needed to direct pedestrians to the proper crossing path(s)." Crosswalk markings can help direct trail users to and along the intended crossing path; also, they can alert motorists of the crossing location as well as of trail users on the crossing. According to the *MN MUTCD*, "new marked crosswalks alone…should not be installed across uncontrolled roadways where the speed limit exceeds 40 mph [64.4 kilometers per hour] and either:

A. The roadway has four or more lanes of travel without a raised median or pedestrian refuge island and an ADT of 12,000 vehicles per day or greater; or,
B. The roadway has four or more lanes of travel with a raised median or pedestrian refuge island and an ADT of 15,000 vehicles per day or greater."

In the aforementioned provisions, the installation of a new marked crosswalk "alone" refers to installing a marked crosswalk when no other treatments are in place (or intended to be installed) that are used to decrease the speeds of road users, decrease the distance pedestrians must travel at a crossing, increase the conspicuity of the crossing from the perspective of drivers, and/or actively warn drivers that pedestrians may be making a crossing maneuver in the area [5].

Numerous styles of crosswalk markings are used today including solid, standard, zebra, and ladder patterns as presented in Figure 3.10. In certain locations in Europe, a dashed pattern is used. The most common styles in the United States, and the styles hence recommended for use, include the solid and ladder patterns. In some locations with high crash rates, the solid pattern is used [6]. Research has shown that the type of pattern used does not have a significant effect on pedestrian crash rates at uncontrolled intersections [43]. It is important to note, however, that high-visibility ladder crosswalk markings (with 1 foot or 0.3 meter wide stripes and 2 foot or 0.6 meter spacing) were determined to be the most recognizable by motorists in an FHWA study conducted in 1988 [30].

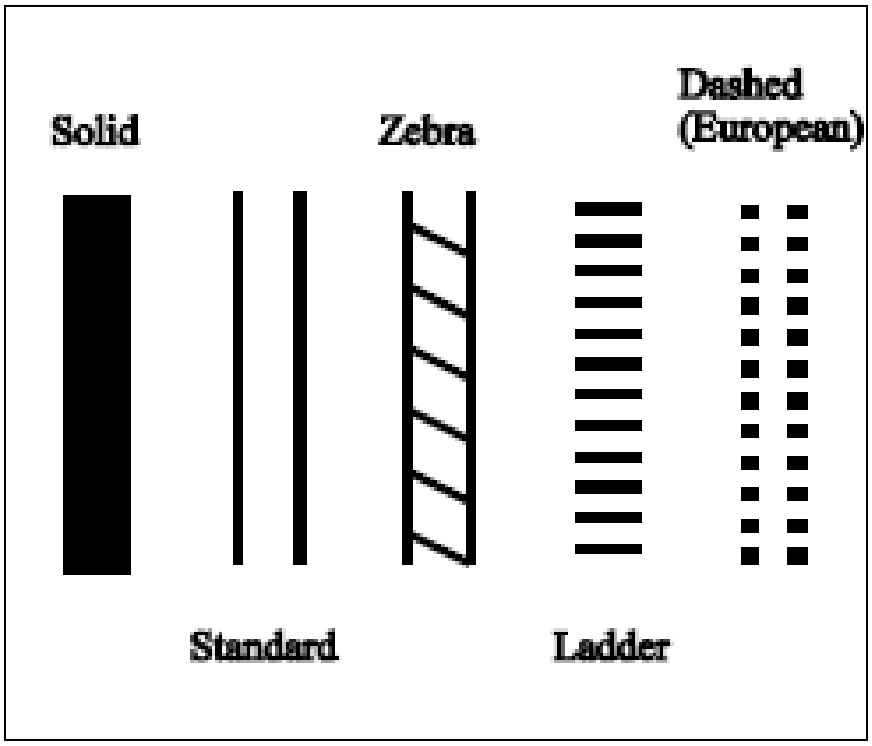


Figure 3.10: Various Crosswalk Marking Patterns [6]

A variety of additional treatments are available for use at locations in which crosswalks are used in addition to traditional striping. In some cases, dotted lines (which are covered in *MN MUTCD* Sections 3A.6, "Functions, Widths and Patterns of Longitudinal Pavement Markings" and 3B.8, "Extensions Through Intersections or Interchanges") within a crosswalk are used to delineate a path for trail users crossing the intersection [5]. They can also be used to create a divided crosswalk in order to provide separation between modes using the trail within a crosswalk as seen in Figure 3.11 [6].

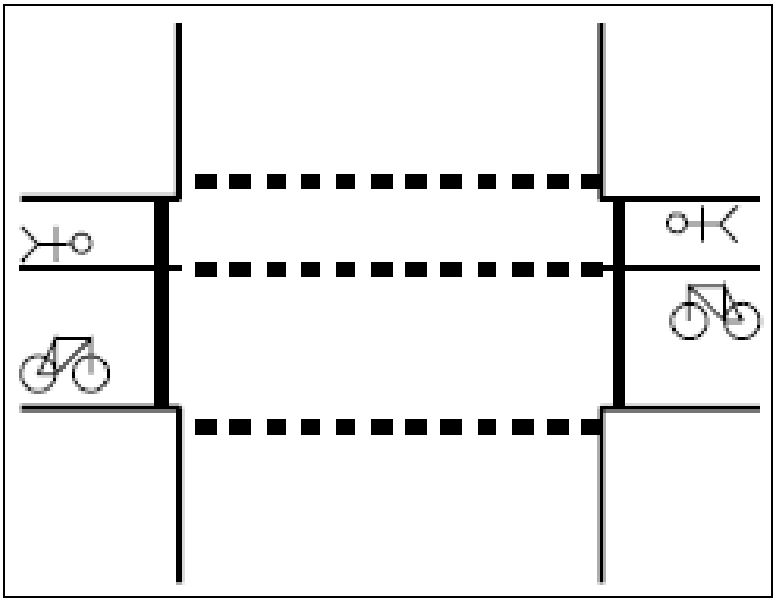


Figure 3.11: Divided Crosswalk Used to Provide Separation between Modes Using the Trail at a Crossing [6]

In low-speed urban settings, designers may sometimes choose to use textured crosswalks in order to increase the conspicuity of the crossing for motorists. The goal is to create a pavement texture in the crosswalk that is different from the rest of the roadway at the intersection. Materials such as bricks, paving stones, or a layer of a different paving material can be used to achieve this effect [14]. Use of these materials in a crosswalk or on a trail, however, does raise additional considerations in terms of safety and comfort of trail users and is thus not recommended. FHWA notes that use of paving materials as a treatment in crosswalks should be limited. When used, these treatments can help alert road users of the function of a space; for example, asphaltic pavements are typically associated with motor vehicle movements and bricks or other alternate pavers can help show a space is to be used by non-motorized users. That being said, alternate paving materials can prove problematic for bicyclists, pedestrians, and wheelchair users to traverse; they can also create difficulty for snow plows. Additionally, traveling over bricks, paving stones, or other alternate paving materials can create unwanted noise that can annoy road users, trail users, and area residents. If these alternate materials are used, FHWA recommends that designers ensure an even surface is provided in the crosswalk that is not slippery. Further, these textured crosswalks should use crosswalk lines in order to enhance their visibility [44]. Ultimately, however, MnDOT recommends that if textured materials are used, that they only be used along the outside of the area over which pedestrians and bicyclists will travel, such as along the edges of a crosswalk [5].

3.1.3.3 Retroreflective and Textural Characteristics of Markings

According to Section 2, "General Principles," of Chapter 9C., "Markings," of the *MN MUTCD*, "markings used on bikeways shall be retroreflectorized." Thus, all markings used on the trail itself are required to be retroreflectorized [5]. It is further recommended that all other pavement markings used at trail crossings be retroreflectorized in order to increase their visibility. Designers should also give consideration to using markings that reduce loss of traction when wet in order to enhance safety. Also, as is the case for their application in travel lanes, markings

selected should be durable and able to stand up against ware. Finally, the designer must also be cognizant of using raised markings, such as those made from thermoplastics, as they are more difficult for trail users to negotiate than for motorists [6].

3.2 Sight Distance

When conducting a safety assessment for a trail crossing, attention needs to be paid to identify whether there are sight distance issues for both trail users and roadway users. There are three types of sight distance which need to be checked: stopping sight distance; intersection sight distance and decision sight distance. A brief explanation of these terms based on their discussion in the AASHTO "Green Book" is seen in the following sub-sections [8]. When any types of sight distance are obstructed, they need to be cleared at the trail crossings. Thus, it is extremely important to not only provide, but also to maintain clear sight triangles and unobstructed sight distances at trail crossings.

3.2.1 Stopping Sight Distance

Stopping sight distance is the distance of roadway ahead that the driver can see. It is composed of the distance traveled during perception-reaction time and the distance traveled from the time the brakes are applied to the time the vehicle comes to a stop. In any given design, the sight distance provided should allow for a driver traveling at or close to the design speed to come to a full stop prior to reaching a fixed object ahead in his or her path. AASHTO defines stopping sight distance (eq. 3-2 in the "Green Book") as follows for the case in which no grade is present [8]:

$$SSD = 1.47Vt + 1.075\frac{V^2}{a} \tag{3.1}$$

Where, the variables are defined as follows:

SSD = stopping sight distance (ft)
V = design speed (mph)
t = brake reaction time (s) (Typically, a value of 2.5 s is used), and,
a = deceleration rate (ft/s^2)

If a grade is present, the following equation to calculate stopping sight distance should be used as defined in the *MnDOT Bikeway Facility Design Manual* [4]:

$$\mathrm{SSD} = \frac{\mathrm{V}^2}{30(\mathrm{f}\pm\mathrm{G})} + 3.67V \tag{3.2}$$

Where, the variables are defined the same as in Equation 3.1 with additional variable defined as follows:

f = coefficient of friction (use 0.25)
G = Grade (ft/ft) (rise/run)

3.2.2 Intersection Sight Distance

For trail crossings, intersection sight distance is the sight distance needed for trail users to complete a crossing maneuver and avoid conflicts with roadway traffic. Intersection sight distance gives a measure of control for trail users' safety. Intersection sight distance for trail crossing is also referred to as crossing sight distance [6].

Crossing sight distance is dependent upon the time required by a trail user to cross the roadway from a full stop and the distance a crossing vehicle, that appears after the trail user has started the crossing maneuver, needs to travel during the time when the trail user is crossing [6]. Figure 3.12 illustrates the crossing sight distance.

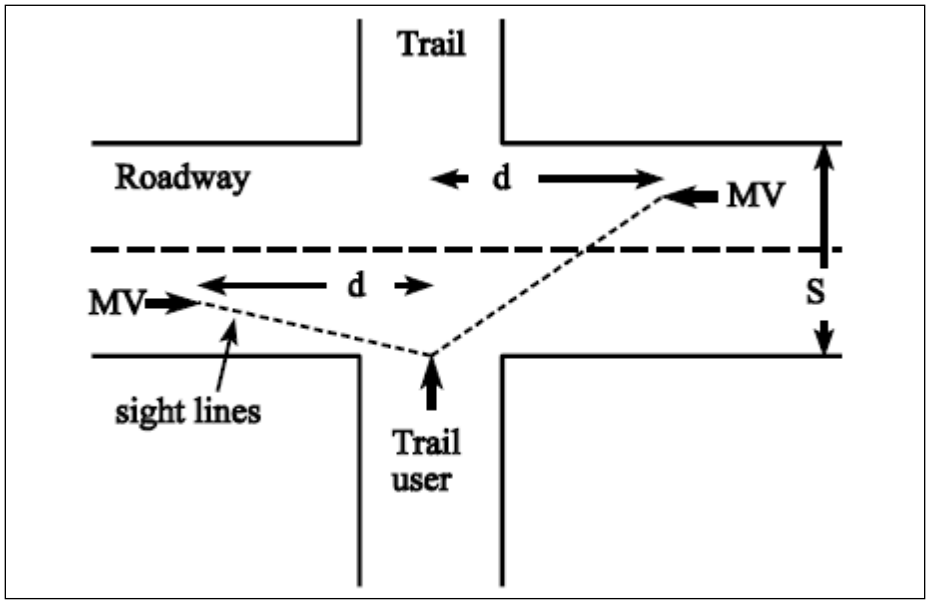


Figure 3.12: Crossing Sight Distance [6]

In Figure 3.12, d represents for the crossing sight distance, which can be computed using the following equation [6, 8]:

$$d = 1.47V(J + t) \quad (3.3)$$

Where,

V = design speed of the crossed road (mph);
J = perception-reaction time (sec) (Typically, 2.5 s is used for road users); and,
t = time required for trail users to accelerate and cross the road (s).

Assuming beginning from a stop, bicycle crossing speed is estimated to be 5.4 feet/second (1.6 meters/second); a 2.5 second perception-reaction time is assumed for perceiving and understanding traffic patterns, making a decision, and beginning to act [14]. Pedestrian crossing speed is estimated to be 3.5 feet/second (1.1 meters/second) according to the *MN MUTCD*, and perception-reaction time is assumed to be 3.0 seconds [5, 6]. These estimated speed values are used when computing t, crossing time required by trail users, in Equation 3.3. Note that when the trail is shared by pedestrian and bicycles, computation should be based on the speed of slower trail users, namely pedestrians [14].

3.2.3 Decision Sight Distance

Decision sight distance is the sight distance drivers need to perceive unexpected or complex situations, recognize the threat or challenge they pose, choose an appropriate speed and path, and in turn react to the threat by starting and completing the necessary maneuvers. It follows the same equation (Equations 3.1 and 3.2) as for stopping sight distance; however, values of decision sight distance are typically greater than those for stopping sight distance, as the T value, in this context being referred to as the pre-maneuver time, is usually larger than the 2.5 seconds perception-reaction time used in computing the stopping sight distance. Decision sight distance provides additional protection beyond the minimum afforded by stopping sight distance [6].

At trail crossings, decision sight distance can also be applied to bicyclists. "Decision sight distance for bicyclists provides clear sight lines that are based on the distances that approaching motor vehicles will travel in the amount of time a bicyclist takes to fully clear the intersection from a 'stop-go' decision point." This concept is illustrated in Figure 3.13 [6].

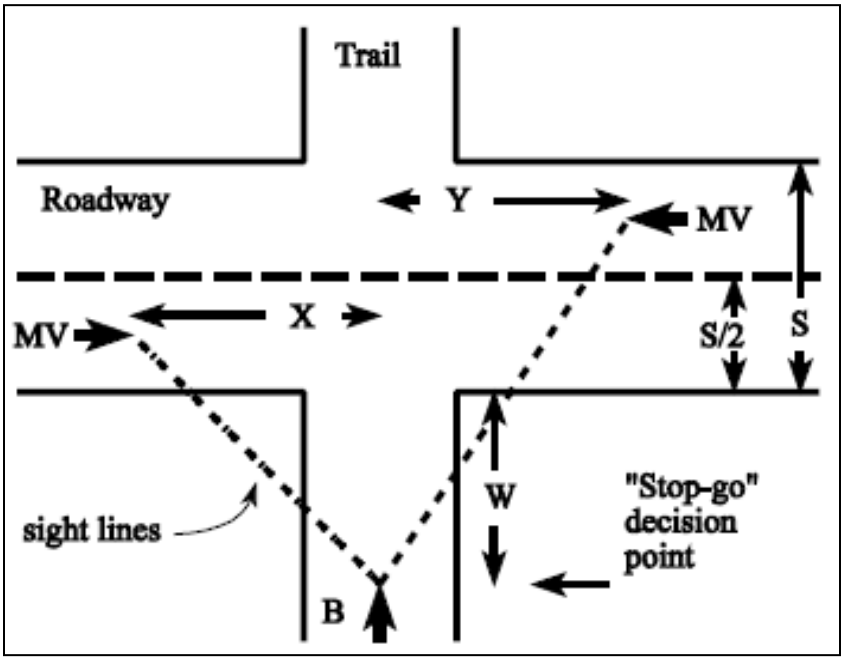


Figure 3.13: Decision Sight Distance [6]

More information about bicyclist's decision sight distance can be found in Chapter 3 of Florida's *Trail Intersection Design Handbook* [6].

3.3 Refuge Areas

Trail users crossing a roadway at midblock or at a parallel path crossing can take refuge within raised islands or medians in the center of the roadway assuming they are sufficiently wide. According to the *MnDOT Bikeway Facility Design Manual*, refuge islands and medians can also help trail users cross fewer lanes at a time and help them better judge potential conflicts [4]. It is also noted in section 3I.6 of the *MN MUTCD*, "Pedestrian Islands and Medians," that the process of gap selection in the case of an unsignalized intersection can be made less complex, as the provision of a place of refuge allows trail users to cross half of the roadway at a time; thus, necessitating a smaller gap [5]. Chapter 11, "Special Designs," of the *MnDOT Road Design*

Manual provides guidance on when pedestrian median islands may be considered for installation in the cases of crossings at both signalized and unsignalized locations. Locations with the following characteristics are candidates for installation of refuge areas [17]:

- Two-way streets wider than 60 feet (18.3 meters) with high traffic volumes, high travel speeds, and high pedestrian volumes;
- Streets with long crossing distances commonly crossed by the elderly, pedestrians with disabilities, and/or children; or,
- Streets where signal timing may not allow pedestrians to complete the full crossing in one walk interval.

Refuge areas can take one of many forms including a median (existing or artificially created) between opposing lanes of traffic, a cut-thru at pavement level of a raised area, a raised island area with curb ramps, or, least desirably, an unprotected painted delineated area at pavement level [6]. According to the *MnDOT Bikeway Facility Design Manual*, refuge islands are recommended to be at least 8 feet (2.4 meters) wide if they are to be used by bicyclists. Further, it is recommended that the island extend outward a minimum of 6.5 feet (2.0 meters) laterally from each side of the cut-through portion [4]. In Chapter 7, "Arterial Roadway Intersections," of the *Kane County Bicycle and Pedestrian Plan*, it is noted that a minimum refuge island size of 50 square feet (4.6 square meters) in urban areas and 70 square feet (6.5 square meters) in rural areas is acceptable. Nevertheless, at least 100 square feet (9.3 square meters) is the preferred minimum area [14].

In order to ensure ADA compliance, raised islands and refuge areas must be cut through level with the street, or have curb ramps on both sides; additionally, a flat area that is a minimum of 4 feet (1.2 meters) long must be provided between the curb ramps [4]. It is noted in PROWAG, that in order to be ADA compliant, a median or pedestrian refuge island must be at least 6 feet (1.8 meters) long (the distance measured between the backs of opposite curb lines) [26]. When a refuge area is at least 6 feet (1.8 meters) long, detectable warnings in the form of truncated domes must be provided at each end of the island in the directions of pedestrian travel. Additionally, if the refuge-area or cut-through is at least 10 feet (3.0 meters) in length, the approaches at each end in the directions of pedestrian travel should serve as ramps that meet at a common elevation in an effort to help with drainage [17, 45]. An example of a refuge island through which a crosswalk travels can be seen in Figure 3.14.

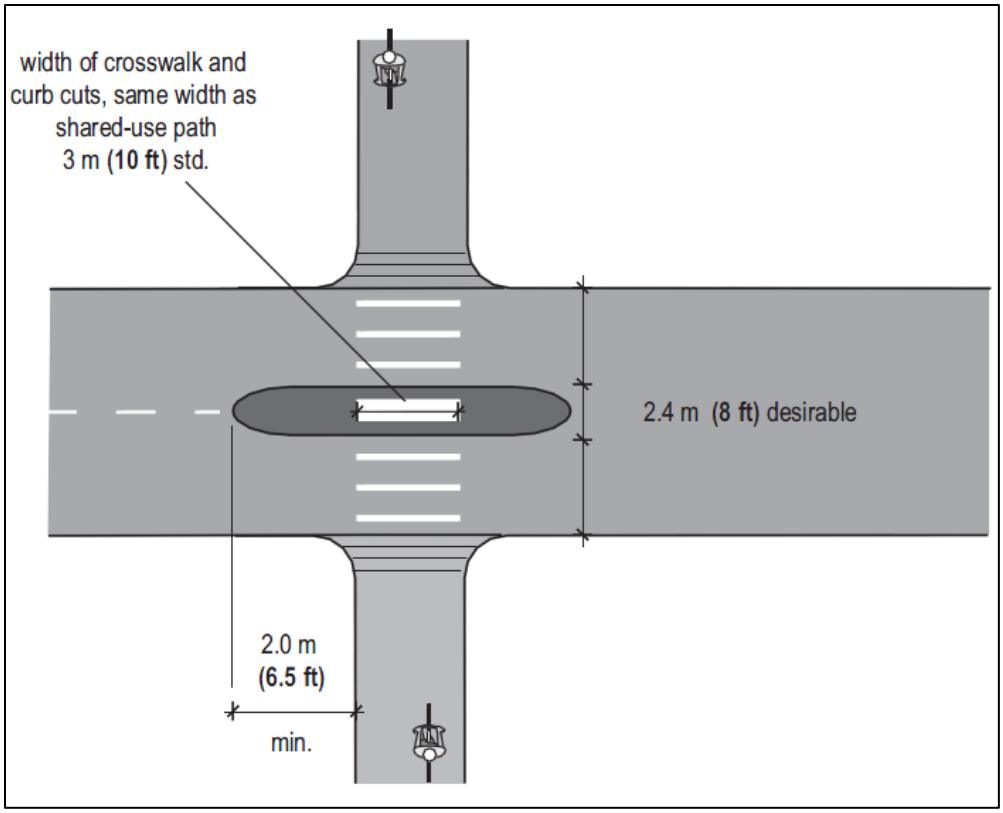


Figure 3.14: Refuge Island through which Crosswalk Travels [4]

The Institute of Transportation Engineers (ITE) further recommends refuge areas to be used on wide roadways (four or more lanes) with high traffic volume and speed or on roadways with insufficient green intervals for safe crossing [45]. Refuge areas are least beneficial for narrow roadways, roadways with substandard width, and roadways with alignments obscuring the island from motorists. [6, 46]. The *MnDOT Bikeway Facility Design Manual* notes that bicyclists can have difficulty when they need to cross more than 3 lanes at a given time [4]. Although not explicitly referenced in the *MnDOT Bikeway Facility Design Manual*, an angled refuge area is also recommended when there is sufficient right-of-way and the trail approaches on each side of the roadway are/can be offset. Use of such a design is beneficial as it orients trail users so that they are facing oncoming traffic as they wait to cross the roadway from the median refuge area. In that case, the median refuge area is recommended to be angled at 75 degrees, as shown in Figure 3.15. A minimum refuge area width of 12 feet (3.7 meters) is recommended for the angled refuge area along with a refuge area center line and STOP or YIELD pavement marking. An alternative recommendation is to provide additional storage area for trail users in the roadway median, as shown in Figure 3.16 [6].

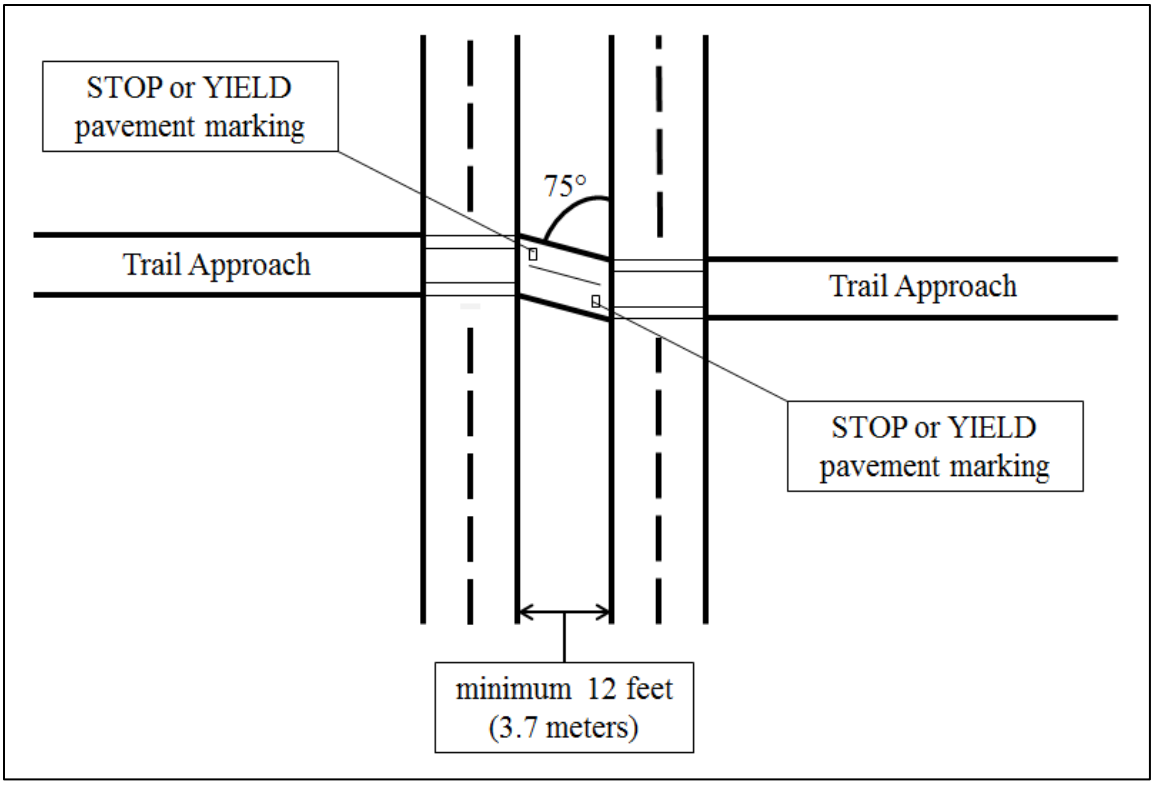


Figure 3.15: Refuge Area Angled by 75 Degrees [6]

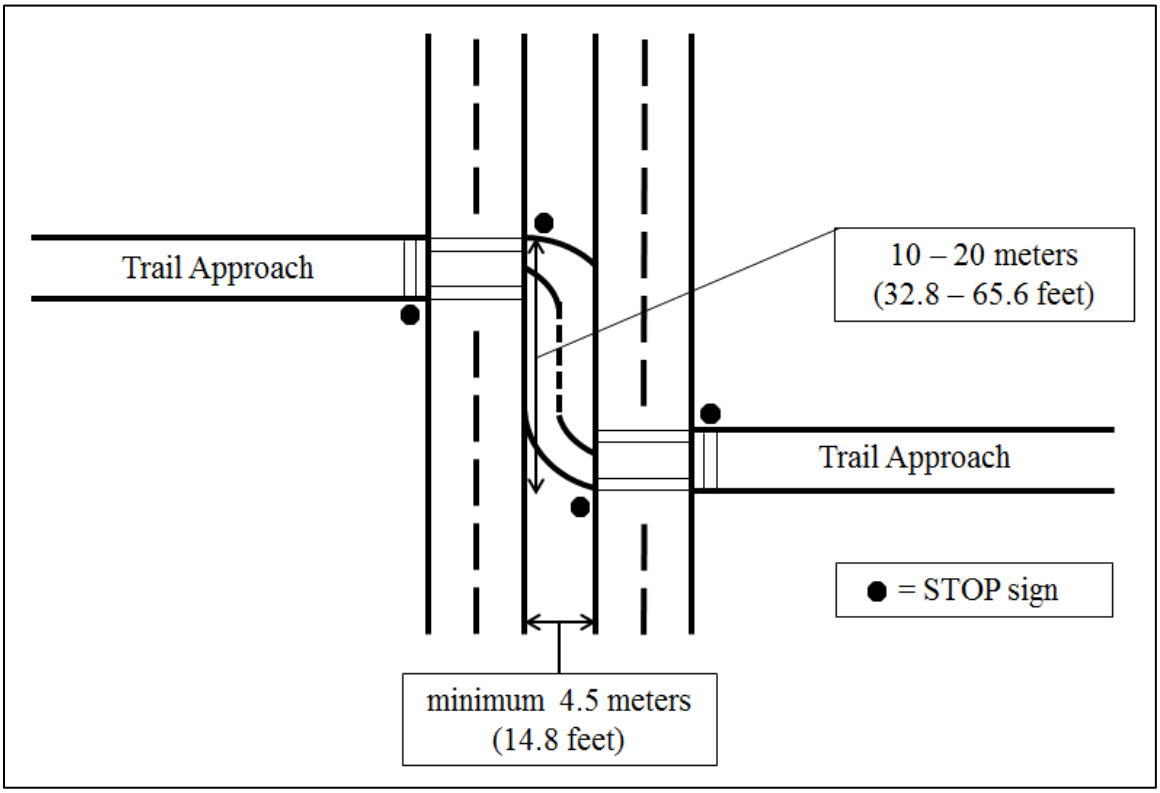


Figure 3.16: Refuge Area with Additional Storage Space [6]

Installation of refuge islands are also recommended as traffic calming treatment for two-lane midblock crossing if the ADT is greater than 2000 vehicles per day. For four-lane midblock crossings, non-protected refuge islands are recommended if the speed limit is less than 35 miles per hour (56.3 kilometers per hour) and ADT is less than 9,999 vehicles per day; and protected refuge islands are recommended if the speed limit is greater than 40 miles per hour (64.4 kilometers per hour) or ADT is greater than 10,000 vehicles per day [6, 14]. Regardless of context, if refuge islands are used, proper design and delineation are essential to ensure not only safety but also to make sure maintenance operations, such as snow plowing of the crossed roadway, are not hindered [6, 46].

In addition to median refuge areas, refuge space for pedestrians and other trail users can be provided on right-turn channelization islands. If used properly, they can reduce the crossing distance for pedestrians, while also benefiting motorists by providing them with easier-to-complete turning maneuvers than would be experienced at a near 90 degree corner. If a pedestrian refuge area is to be provided on a right-turn channelization island, MnDOT recommends the following three principles be adhered to in the design [17]:

- The path in which pedestrians will cross the turn lane should be at an angle of 90 degrees to the turn lane and travel directly across it;
- Mutual visibility between pedestrians and motorists must be provided; and,
- The island should channel vehicles at an angle that promotes low-speed turning maneuvers.

3.4 Access Control

Access control includes a set of treatments used to prevent unauthorized motor vehicle entry onto the trail at trail-roadway crossings. Access control is typically implemented by installing bollards, lean rails, and median on the trail approach, or by altering the curb angle in urban areas.

3.4.1 Bollards

Bollards, also known as barrier posts, are one of the most widely used access control treatments to control motor vehicle access to trails according to the *MnDOT Bikeway Facility Design Manual* [4]. Typically, a bollard is a concrete pole or a swiveling metal pole that collapses to allow maintenance vehicle access to the trail; in some cases, they can also be removable [14, 47]. It is not recommended to place bollards in the travel lane of a bicycle trail as they can cause hazard to bicyclists and divert bicyclists' attention away from traffic [6, 14]. Similarly, they can pose a hazard for snowmobilers; hence, trail operators may want to remove bollards during the winter months at trail crossings for trails that allow snowmobiling [47]. An example of bollards is shown in Figure 3.17.

Figure 3.17: Bollards on Bike Trail [6]

Yellow reflectorized stripes are recommended to be used on bollards separating opposing traffic while white bollards are recommended to be used for other scenarios [6]. Detailed installation guidelines for bollards can be found in *Trails for the Twenty First Century* [47].

3.4.2 Lean Rails

An alternative to the installation of bollards is the usage of a lean rail. A lean rail is a structure approximately 3.6 feet (1.1 meters) high and 8.2 feet (2.5 meters) long that is placed parallel to the trail, as shown in Figure 3.18. Lean rails are not discussed in the *MnDOT Bikeway Facility Design Manual*, yet they serve a similar purpose to bollards and provide and added benefit. A lean rail can be grabbed by bicyclists when they stop at the trail crossing, helping them keep their feet on the pedals. A lean rail can also functions as emergency grab rail for skaters who have difficulty stopping at the trail crossing. Installation guidelines for bollards apply also to lean rails [6]. As was the case for bollards, lean rails can also pose a hazard for snowmobilers. With this in mind, it is recommended that they be removed in the winter months if used on trails that allow snowmobiling.

Figure 3.18: Lean Rail on Shared-Use Path [48]

3.4.3 Medians

Another alternative to restricting unauthorized motor vehicle entry onto the trail is through use of a median on the trail approach near the entrance point, as shown in Figure 3.19. Figure 3.20 shows an example of a median on the trail approach. In the *MnDOT Bikeway Facility Design Manual*, it is noted that "medians can separate and delineate the corridor reserved for bicyclists" [4]. For example, a median could be used to separate trail users traveling in different directions. The median can be landscaped with vegetation [6, 48]. The specification of a possible median area (as defined by FDOT) is: a maximum of 3.3 feet (1.0 meters) wide; a minimum of 6.6 feet (2.0 meters) long, and a minimum of 10 feet (3.0 meters) from the entrance point to the roadway [6].

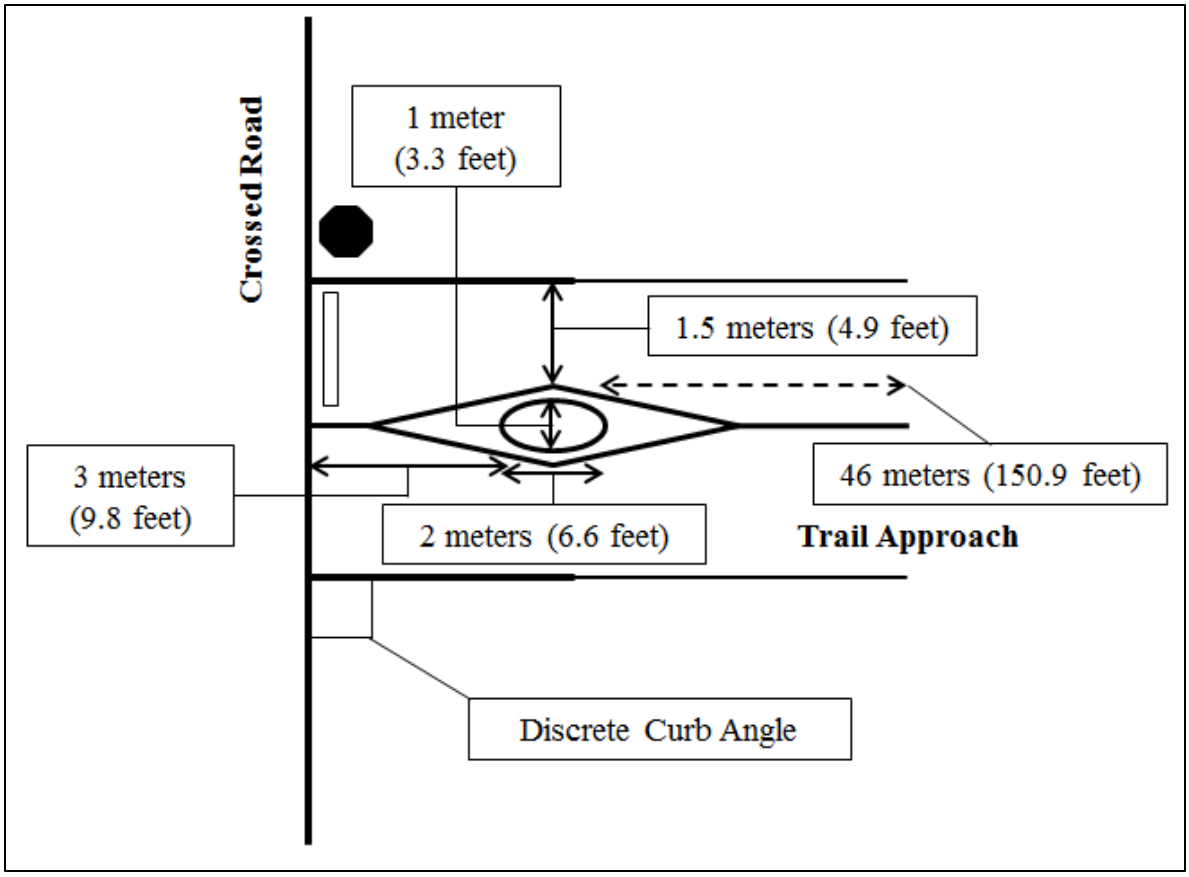


Figure 3.19: Median on Bike Trail with Dimensions as Defined by FDOT [6]

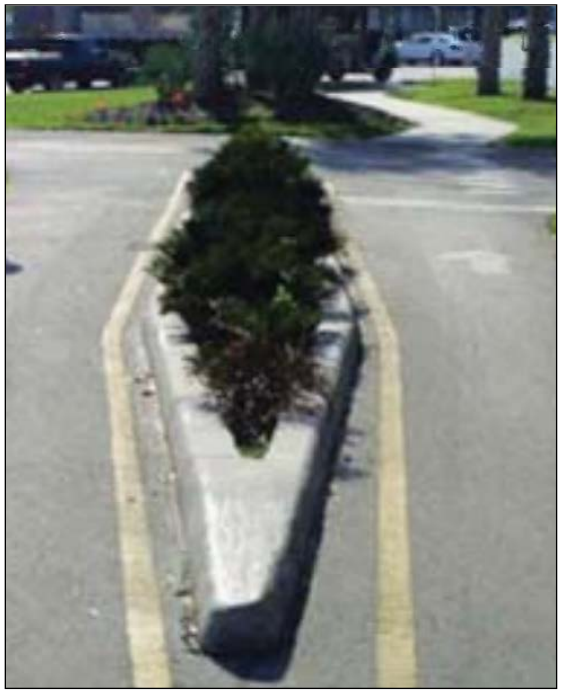


Figure 3.20: Example of Median on Bike Trail [48]

3.4.4 Discrete Curb Angles

The discrete curb angle treatment is reflective of a sharply defined 90 degree curb angle, thus discouraging motor vehicle entry onto trail [6]. With the right angle curb, a motor vehicle has to negotiate a wide turning radius in order to enter the trail. Considering that curbs are only constructed in urban areas, this treatment is only appropriate for urban trail crossings. An example of a discrete curb angle is shown in Figure 3.19.

3.5 Traffic Calming

Traffic calming treatments are typically used at trail crossings to reduce the speed of vehicles on the roadway in order to enhance the safety of the trail users. Although less common than use along a roadway, traffic calming measures are sometimes implemented along a trail to reduce the speeds of trail users as they approach an intersection. The Minnesota Department of Transportation outlines some traffic calming methods in the "A Guide to Establishing Speed Limits in School Zones" section found in the *MN MUTCD* and discusses the concept in the *MnDOT Bikeway Facility Design Manual*; these sections, however, are quite limited in scope [4, 5]. In addition to the information presented in these resources, information on traffic calming methods and projects implemented in Minnesota can be found at mn-traffic-calming.org, a website created and maintained by the Minnesota Local Road Research Board (LRRB). This website contains two main traffic calming resources, the first of which is a database of traffic calming projects implemented in Minnesota to date. Visitors of the site can search the database by traffic calming technique (i.e., use of speed humps, use of raised crosswalk etc.), roadway classification, reason for which the project was implemented, and agency that implemented the project. In many cases, specific data on the project such as the speed limit and ADT of the facility on which it was implemented, as well as measures of effectiveness (i.e., change in speed etc.) and recommendations for future implementations are available. The LRRB website also provides guidelines for collecting data for traffic calming. These guidelines begin by identifying the problem the traffic calming treatment is intended to solve, and then discuss how to collect both qualitative and quantitative data in periods before and after the implementation to determine its effectiveness. Finally, the site contains links to other relevant traffic calming resources from across the state and country [49].

This guide notes some of the best practices in the topic of traffic calming seen in Minnesota as well as around the nation. As a rule-of-thumb for implementation, the Florida Department of Transportation recommends traffic calming treatments at the crossed road if the speed limit of the crossed road is less than 30 miles per hour (48.3 kilometers per hour) and the ADT is less than 2000 vehicles per day. For medium to high ADT on the crossed road (i.e., ADT greater than 2000 vehicles per day), lane narrowing and installation of refuge islands are recommended as alternatives to traffic calming treatments [6]. Detailed information about traffic calming strategies that are appropriate for trail crossings are discussed in following.

3.5.1 Roadway Speed Reduction

According to the FHWA Safety Program, the primary purposes of traffic calming measures are to reduce the speed of motorists and decrease aggressive driving. Implementation of traffic calming measures often involves making physical changes to the roadway itself and can prove to be particularly beneficial for pedestrians and other non-motorized road and trail users [50]. In the case of a multi-lane crossed road with an exclusive right-turn lane, one possible traffic-calming

treatment is to reduce the width of the dedicated turn lane in an effort to reduce the speed of turning vehicles [6]. Another treatment designed to help reduce the speed of turning vehicles involves decreasing the curb corner radius for right-turning vehicles; this treatment is only applicable when there is an exclusive right-turn lane on the parallel roadway [14]. In addition to helping reduce the speed of turning vehicles, using a reduced turning radius can decrease the crossing distance in the roadway for trail users and enhance sight distance for motorists and trail users alike. When considering the possibility of narrowing the curb radius, the designer is advised to ensure that vehicles with large turning radii, such as emergency vehicles, trucks, and buses, will still be accommodated by the new design. Additionally, the designer is recommended to account for the so-called "effective radius" by considering how the reduction would affect operations of bicycle and parking lanes if they are present near the crossing [51].

Another possible treatment that can have similar effects to reducing curb radii is the application of bulb-outs or curb extensions discussed briefly in Chapter 4, "On-Road Bikeways," in the *MnDOT Bikeway Facility Design Manual* [4]. When curb extensions are used at intersections, the implementations are sometimes referred to as 'neckdowns'; when they are used at midblock locations, the implementations may be referred to as 'chokers' [52]. By extending the curb line into the street, the effective width of the roadway is reduced as seen in Figure 3.21 [53]. Curb extensions can be particularly effective in helping reduce the crossing distance for trail users at multi-lane crossings and can further help reduce the speed of turning vehicles and increase visibility for road and trail users [6, 53]. A 2005 study conducted by Oregon State University for the Oregon Department of Transportation found that the use of bulb-outs or curb extensions did lead to a decrease in the average number of vehicles that passed through the crosswalk before a pedestrian could cross the roadway by 33.9 to 42.7 percent depending on the lane; the number of vehicles crossing was measured from the time the pedestrian arrived at the curb [54]. An additional study conducted on an arterial near Washington, D.C. examined the effects of a series of traffic calming implementations including the use of bulb-outs, reduction in curb radii from 50 to 30 feet (15.2 to 9.1 meters), and installation of center islands at select points along the roadway. After the implementation, a 5 mile per hour (8.0 kilometer per hour) decrease in 85th percentile speed, from 32 to 27 miles per hour (51.5 to 43.5 kilometers per hour), was observed. Additionally, the highest observed speed was shown to have decreased by 6 miles per hour (9.7 kilometers per hour) from 44 to 38 miles per hour (70.8 to 61.2 kilometers per hour) [55].

The LRRB's Minnesota Traffic Calming Database (i.e., mn-traffic-calming.org) contained data in the form of changes in the 85th percentile speed prior to and following the implementations of several curb extension projects in Minnesota. One implementation took place in the City of St. Paul at the intersection of Cleveland Avenue and Montreal Avenue in the year 2000. It took place on one side of Cleveland Avenue, a major collector, and a change in 85th percentile speed of 2 miles per hour (3.2 kilometers per hour) from 41 to 39 miles per hour (66.0 to 62.8 kilometers per hour) was observed following the implementation [56]. An application of a choker in the City of Eagan on Ashbury Road (a minor collector) in the year 1999 led to a 4 mile per hour (6.4 kilometer per hour) reduction in observed 85th percentile speed in each direction of travel following the implementation [57].

Figure 3.21: Use of Bulb-outs (Curb Extensions) to Reduce Effective Roadway Width

3.5.2 Speed Humps and Tables

The use of speed humps is another common traffic calming technique that can be used to help reduce the speed of vehicles, particularly in low speed urban settings at midblock crossings [14]. Speed humps are typically composed of asphalt concrete and range in height from 3 to 4 inches (76.2 to 101.6 millimeters), on average, at their center. They are significantly longer than speed bumps found in parking lots; common lengths include 12 and 14 feet (3.7 and 4.3 meters). According to FHWA, the 12 foot hump has a design speed of 15 to 20 miles per hour (24.1 to 32.2 kilometers per hour) and the 14 foot (4.3 meter) hump has a design speed of 25 to 30 miles per hour (40.2 to 48.3 kilometers per hour) [58].

It is generally accepted that the longer the hump, the more comfortable/smooth it is to traverse, particularly for larger vehicles. As a result, sometimes larger speed humps known as speed tables are used; speed tables are commonly 22 feet (6.7 meters) long [58]. In some cases it can be desirable to raise the entire crosswalk as a speed table on the crossed road as seen in Figure 3.22, with a height of 3 to 4.5 inches (76.2 to 114.3 millimeters) at the center of the table. By raising the crosswalk, visibility of trail users making the crossing is increased [15]. The use of speed tables is only recommended when the 85th percentile speed is less than or equal to 25 miles per hour (40.2 kilometers per hour) and ADT is less than 2000 vehicles per day [6, 14].

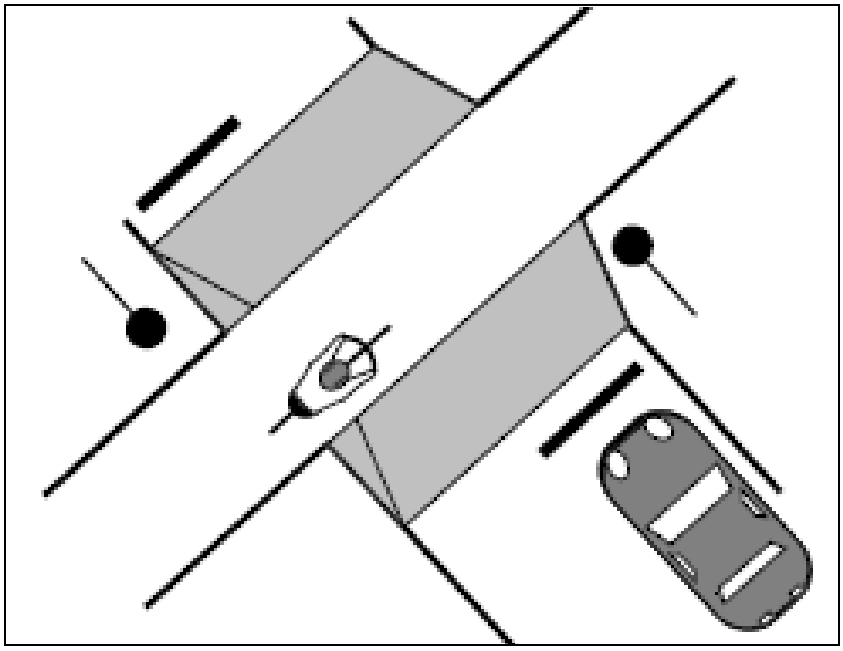


Figure 3.22: Crosswalk Raised as Speed Table [6]

In Minnesota, speed humps and speed tables are not allowed to be installed on County, State, or Federal Highways, State or County Aid roadways, Park Board Roadways, or shared jurisdiction boundaries. Thus, their main area of application is on local roads [59]. The provision of not allowing speed humps and tables on these types of government-funded roadways is described in Minnesota Statute 169.80 ("Size, Weight, Load.") to 169.88 ("Damages; Liability") and 169.14 Subd. 2 ("Speed Limits, Zones; Radar: Speed Limits.") [22].

Studies have been completed to examine the effects of the previously mentioned traffic calming measures on motorist speed. One of the most comprehensive is *Traffic Calming: State of Practice*, published by ITE in 1999. This report compiled data from numerous traffic calming programs around the United States and Canada, including sites in Austin, TX, Bellevue, WA, and Eugene, OR to name a few. In the case of 12 foot speed humps, a 22 percent average decrease in 85th percentile speed was observed across the 179 sites sampled. Applications of 14 foot speed humps showed similar results with an average decrease in 85th percentile speed of 23 percent on average; however, this result was only observed for a sample size of 15 sites. Finally, a survey of 58 sites with 22 foot speed tables found the treatment led to an average decrease in 85th percentile speed of 18 percent on average [60].

In the year 2000, speed humps (the exact size of which was not specified) were installed along Otis Avenue, a local road in the City of St. Paul. Following the installation a 7 mile per hour (11.3 kilometer per hour) decrease in 85th percentile speed was observed (from 35 to 28 miles per hour or 56.3 to 45.1 kilometers per hour) [61]. Similarly, following installation of speed humps along Central Avenue, a local road in St. Paul, a 5 mile per hour (8.0 kilometer per hour) reduction in 85th percentile speed was observed (from 40 to 35 miles per hour or 64.4 to 56.3 kilometers per hour) [62]. No data was provided on the LRRB website on the effectiveness of speed tables in Minnesota.

In the case of parallel path crossings in low speed urban settings, speed humps and tables can sometimes be used; however, they are typically only used to help control the speed of vehicles making a right-turn maneuver that would conflict with trail users in the crossing. One

possible treatment when the crossed road contains a dedicated right-turn lane is to use a speed table in this lane prior to the trail to alert motorists of the crossing ahead [6, 14]. When the parallel roadway has a dedicated right-turn lane, designers may consider using a speed hump in the right-turn path of a vehicle to help decrease speed prior to reaching the crossing, as shown in Figure 3.23, via a treatment known as the "Hague Hill" in the Netherlands [6].

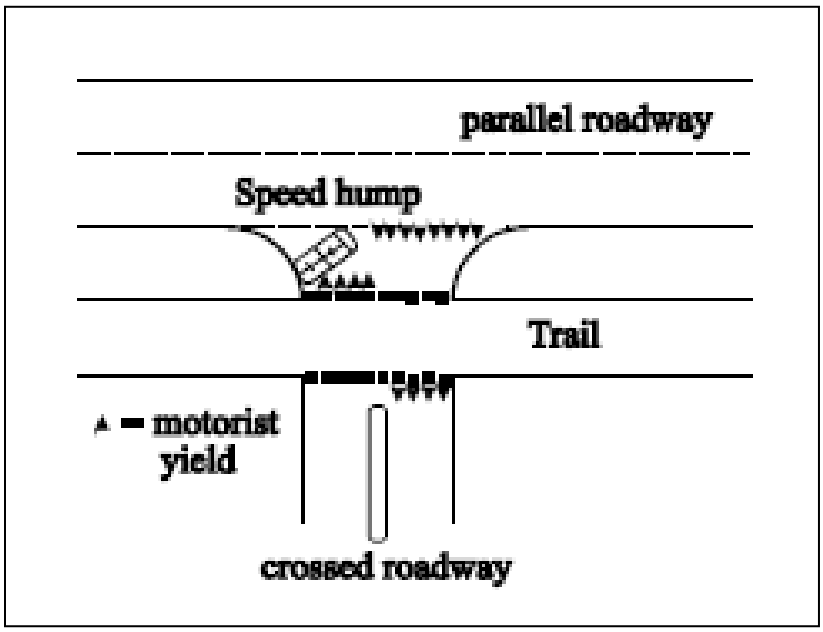


Figure 3.23: Hague Hill Speed Hump [6]

3.5.3 Traffic Calming on the Trail

Although more often used on the roadway, traffic calming techniques can be used to a limited extent along trail approaches to help reduce the speed of trail users as they near an intersection. One application of traffic calming along the trail involves the use of an 18 inch (457.2 millimeter) wide concrete pad, integral to the trail pavement, installed at least 30 feet (9.1 meters) from crossed road [6]. This treatment is primarily intended to alert bicyclists of the upcoming crossing and should not jar them as a speed bump might [47]. It would not be appropriate for installation on a trail with significant volumes of inline skaters as it could pose a tripping hazard [6]. As aforementioned, the Access Board recommends that use of rough or otherwise uneven surfaces be kept to a minimum, and if rough or uneven surfaces must be used, they should be used at a frequency that minimizes their negative impact on pedestrians [26]. Thus, potential applications of the concrete pad along a trail should be given thorough consideration to ensure they would not prove problematic for trail users, particularly those with disabilities.

3.6 Lighting

As a safety treatment for trail crossings, lighting is used to improve both trail users' and roadway users' visibility during non-daylight hours. It is recommended that trail be illuminated for 75 feet (22.9 meters) on either side at a trail crossing; FDOT refines this guidance and recommends that the trail be illuminated at least as brightly as the crossed road for a distance of 82 feet (25.0 meters) on either side of the trail crossing [4, 6]. On an unlit crossed road, transitional lighting is recommended to be provided in order to help motorists adjust to the illumination level [4].

Recommended horizontal and vertical illumination levels for a trail are specified in the *Technical Handbook of Bikeway Design*, though the *MnDOT Bikeway Facility Design Manual* notes that lighting mounted 6 feet (1.8 meters) above the pavement is best for illuminating cyclists and obstructions along a trail [4, 63]. The *MnDOT Roadway Lighting Design Manual* can also be referred to for information on crosswalk lighting design [64]. Finally, providing adequate lighting on both the trail and roadway is important, but so is ensuring safety of the trail and road users by reducing the risk of crashes with light poles. As such, MnDOT reccommends that lateral clearance of at least 3 feet (0.9 meters) be provided between the trail and light poles [4].

3.7 Curb Ramps

Curb ramps, also known as curb cuts, are ramps that cut through curbs or are built up to curb level. They are required at all pedestrian crossings by Title II of the ADA and are primarily intended to help people with disabilities be able to safely travel between the sidewalk at a curb and the roadway upon initiating and completing a roadway crossing [9]. They can also prove beneficial for helping bicyclists easily transition between trail and roadway. Standard plans for the design of various types of curb ramps including perpendicular, parallel, and depressed corner, among others, can be found in the *MnDOT Standard Plans Manual*, specifically in "Standard Plans 5-297.250 Pedestrian Curb Ramp Details" [65].

In 2010, MnDOT published Version 1.0 of *Curb Ramp Guidelines*. This guide contains a collection of best practices to be used along with MnDOT design manuals for the design and installation of curb ramps and is intended for use by designers and inspectors [45]. The guidance presented is in accordance with provisions in PROWAG, other MnDOT design requirements, the Public Rights of Way Accessibility Advisory Committee's (PROWAAC) *Special Report: Accessible Rights-of-Way Planning and Design for Alterations*, and lessons learned from actual curb ramp designs and installation [45, 66]. In use today are three main types of curb ramps: perpendicular, parallel, and blended transition [26, 45]. Perpendicular curb ramps are defined as ramps that have a running slope that is perpendicular to the curb or gutter line. Parallel curb ramps are defined as ramps that have a running slope in the same direction as (i.e., parallel to) the direction of pedestrian travel on the sidewalk. According to PROWAG, both perpendicular and parallel curb ramps have a running slope that is between 1V:20H and 1V:12H. Blended transitions do not fall into either of the aforementioned categories of curb ramps and have a maximum running slope of 1V:20H [26].

Perpendicular curb ramps are common at trail crossings. Key components of a perpendicular curb ramp, seen in Figure 3.24, include the ramp, the approaches, the landing, the flared sides, and a detectable warning surface. The flared sides are used to drop the necessary elevation from the sidewalk to the street level. Transitions between the ramp and the sidewalk and the sidewalk and street are to be level and avoid sudden changes in height [9]. Finally, it is recommended to make the curb ramp as wide as the approaching sidewalk or trail as opposed to as wide as the crosswalk [17, 45].

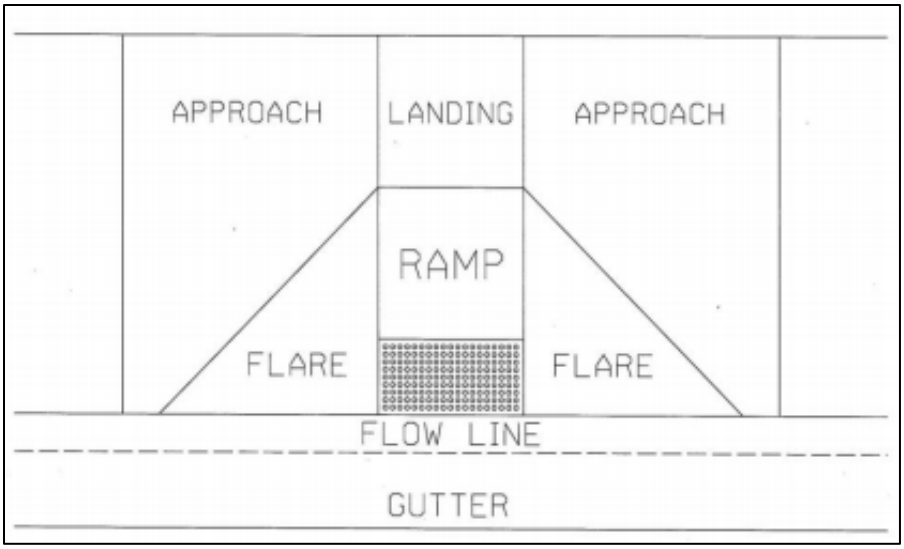


Figure 3.24: Perpendicular Curb Ramp and Corresponding Components [45]

It is required that all curb ramps have detectable warnings in order to alert pedestrians with visual impairments of the crossing [9]. In Minnesota, truncated domes are exclusively used as detectable warning surfaces. Truncated Dome design and placement information is outlined in the MnDOT *Standard Plate Manual* under Standard Plate No. 7038A. When used, detectable warnings must extend at least 2 feet (0.6 meters) in the direction of travel and span the full width of the curb ramp (i.e., within 3 inches or 76.2 millimeters of either side) [67].

3.8 Realignment

In some cases, where right-of-way is available, designers may choose to realign the trail path in a variety of ways; typically, realignment is used to improve sight distance for both trail users and motorists. If at all possible, it is recommended that the trail intersect the crossed roadway at a 90 degree angle. Thus, if a trail intersects the crossed roadway at an angle other than 90 degrees and sufficient right-of-way and funding are available for reconstruction, it is recommended that the trail be realigned such that it intersects the crossed roadway at an angle of 90 degrees as doing so can help can expand the field of view and improve sight lines for trail users and/or motorists [4, 6. If it is not possible to make have the trail intersect the roadway at angle of 90 degrees, an angle of intersection of at least 75 degrees is desirable [6]. Finally, if the trail crossing is a parallel path crossing and permissive left turns are allowed from the parallel roadway, designers may choose to set back the trail path approximately 10 to 30 feet (3.0 - 9.1 meters) from the parallel roadway to allow vehicle stacking space which can help improve motorist recognition of trail users and vice versa [6, 14].

3.9 Summary

This chapter provides information on nine major categories of treatments for at-grade trail crossings including: traffic signs and signals, sight distance, refuge areas, access control, markings and striping, traffic calming, lighting, curb ramps, and alignment. In each category, a wide array of alternative treatments from major resources on the topic of trail crossings is

presented. All treatments referenced are from the most current versions of the related publications. For detailed information on each treatment, key references noted in each section.

Chapter 4: Decision Tree-Based Selection of Trail-Crossing Treatments

4.1 Analysis of the Complexity in Treatment Selection

Given all the alternative treatments, a transportation professional may face a dilemma in choosing appropriate treatments from the many possible alternatives, as not all treatments can be applicable to the combination of specific conditions for the selected trail crossing. If those less desirable or inappropriate treatments can be excluded from the selection process, the complexity of treatment selection can be greatly reduced. Although a lot of treatments are applicable regardless of conditions at the trail crossing (e.g., a yellow centerline could be painted along the trail approach regardless of speed, ADT, and geometry of the crossed road), many other treatments may be appropriate only under certain conditions.

These facts motivate the researchers to study the complexity of treatment selection by exploring the appropriateness for various treatments under diverse speed, volume, urban/rural, geometric and crossing type conditions of trail crossings. Table 4.1 summarizes the results of the complexity study. The table includes a complete list of all alternative treatments with indication of their appropriateness for urban and rural trail crossings, two-lane and multilane crossed roads, high-speed and low-speed crossed roads, high-volume and low-volume crossed roads, and midblock and parallel path crossing types. Moreover, treatments in Table 4.1 are grouped by treatment category, and each treatment is assigned a treatment ID.

The following sections present the analyses that have been done to reveal the complexity of treatment selection and to identify the appropriateness of treatments under various conditions, which are indicated in Table 4.1. Most of these analyses are conducted by reviewing a number of reference documents to find information about the appropriate conditions under which each treatment is suggested to be used. For each treatment listed in the following sections, the references that support the result of the treatment's appropriateness analysis are noted.

4.1.1 Analysis of Urban vs. Rural

According to the AASHTO, urban areas fall into two categories: urbanized areas and small urban areas [8]. The MnDOT *Summary of Functional Classification Guidelines* states that, "The Bureau of the Census defines an area as urban if it is densely populated, and it is not within an urbanized area. Densely populated is defined as a population density greater than 1,000 people per square mile in a core or cores of census blocks with surrounding census blocks of at least 500 people per square mile. An urbanized area is defined as a densely populated area exceeding a population of 50,000." The document further notes that Minnesota has seven urbanized areas including: Duluth/Superior, Fargo/Moorehead, Grand Forks/East Grand Forks, La Crosse/La Crescent, Minneapolis/St. Paul, Rochester, and St. Cloud [68]. In addition to the aforementioned population requirement, this guide imposes a cross-sectional requirement when defining an urban area. Based upon guidance found in the *MnDOT Bikeway Facility Design Manual*, an urban area will have an urban cross section which makes use of curb and gutter for drainage of surface water [4]. A rural area is simply defined as an area that has a rural cross-section that features shoulder and ditch elements and does not meet the population requirements for an urban area [4, 68]. There are a few treatments that are only appropriate for urban trail crossings:

- Lighting (Treatment LT-01) is usually recommended to be provided at urban trail crossings [6], considering light poles are not typically installed in rural areas.
- Certain traffic calming devices such as speed humps (Treatments TC-02 and TC-07), speed tables (Treatments TC-03 and TC-04), and bulb outs (Treatment TC-06) are only recommended for low-speed urban environments due to differences in driver expectancy and general traffic characteristics between urban and rural settings [69].
- The access control treatment of using discrete curb angles to discourage motor vehicle entry onto the trail (Treatment TRAC-05) is only appropriate for urban trail crossing as curbs are typically used in urban areas only [8].
- The HAWK signal (Treatments TSGB-07 and TRSS-09) and RRFB (Treatments TSGB-08 and TRSS-12) are not commonly used on rural roads [70]. Therefore, they are only recommended for urban trail crossings.
- On urban roads, advance trail crossing warning signs (Treatment TSN-02) are recommended to be installed at least 250 feet from the crossing [6, 14].

The following treatments are considered to be only appropriate for trail crossings in rural areas:

- Installation of snowmobile warning sign (Treatment TSN-11) and advance warning sign (Treatment TSN-10) is only recommended for rural trail crossings, considering that snowmobiles are typically allowed on trails in rural areas only.
- On rural roads, advance trail crossing warning signs (Treatment TSN-01) are recommended to be installed at a further distance (at least 750 feet) from the crossing due to the higher speed on the crossed road compared with urban settings [6, 14].

4.1.2 Analysis of Two-lane vs. Multilane

The major difference between two-lane and multilane crossed roads in terms of appropriateness of treatments lies in the difference in the crossing distance for trail users. The longer crossing distance at multilane crossed roads requires more protection for trail users which may be achieved by treatments such as installation of traffic signal or warning beacons and median refuge islands. Specifically, treatments that are appropriate for trail crossings with a two-lane crossed road only are summarized as follows:

- Installation of speed humps (Treatment TC-02) and speed tables (Treatment TC-03) on the crossed road is only recommended for urban, low-speed, two-lane crossed roads at a midblock trail crossing [6], as speed humps are typically installed on roads in residential areas where most roads are two-lane roads.

The following treatments are considered to be only applicable to trail crossings with a multilane crossed road:

- Refuge islands (Treatments RI-01 through RI-03 and TRSS-10) are usually used on wide roadways, i.e., four or more lanes only [6, 46] or three or more lanes only [4], as refuge islands are typically provided to facilitate a two-step crossing at a wide crossed road [17].
- Traffic calming treatments of narrowing the dedicated right-turn lane on the crossed road (Treatment TC-01) and installing speed table on the dedicated right-turn lane on the

crossed road (Treatment TC-04), are obviously only appropriate for multilane crossed road because the dedicated right-turn lane is already the second lane of that direction of the crossed road.

- Bulb outs installed to reduce crossing distance (Treatment TC-06) are only recommended for multilane crossed roads as two-lane roads have shorter crossing distance and do not necessarily need this treatment [14].
- HAWK signals (Treatments TSGB-07 and TRSS-09), yellow flashing beacons (Treatments TSGB-06 and TRSS-11), and RRFBs (Treatments TSGB-08, TRSS-12, TRSS-14) are only recommended for installation at multilane (three or more lanes) crossings [71], as the shorter crossing distance at two-lane crossing should not need these signals and warning beacons to facilitate trail users' crossings, except at school crossing zones.
- Installation of Stop Here for Pedestrians (R1-5) series signs (Treatment TSN-03) is only recommended for multilane crossed roads, as these signs shall be used at an uncontrolled multilane approach only per the MUTCD [5].

4.1.3 Analysis of Divided vs. Undivided

Almost all alternative treatments listed in Table 4.1 can appropriately be applied to trail crossings with a either undivided or divided crossed road. The only exception is the median refuge island related treatments (Treatments RI-01, RI-02, and TRSS-10) are considered to be only appropriate for a divided crossed road. This exception is because extra space for installing the median refuge island is usually available at a divided crossed road only, where a wider median area may be more typically available.

4.1.4 Analysis of High-Speed Crossed Road vs. Low-Speed Crossed Road

The definition of high-speed and low-speed varies slightly for different states. For urban and rural settings, the thresholds that differentiate high and low speeds are also different. According to the literature review, there is not such a speed threshold which is consistent in all the state and federal publications. However, the threshold typically varies in the 30 to 35 mph range for urban crossed roads and in the 40 to 45 mph range for rural crossed roads. In this handbook, 35 mph is used as the threshold to differentiate high and low speed under urban settings, while 45 mph is used as the threshold for rural settings.

Regardless of urban and rural settings, the following treatments are considered to be only applicable to trail crossings with a low-speed crossed road:

- Speed humps (Treatments TC-02 and TC-07), and speed tables (Treatment TC-03 and TC-04) as traffic calming related treatments are only recommended to be implemented only on urban low-speed crossed roads [4, 6, 14].
- Bulb outs (Treatment TC-06) are recommended for installation at low speed unsignalized intersections [14], as they may cause safety issues if used on high speed roads.

The following treatments are considered to be only applicable to trail crossings with a high-speed crossed road:

- Painting the "standard" pattern for the crosswalk (Treatment PMS-06) is only appropriate for high-speed crossed roads [6] as it has less paint compared to other patterns and are not appropriate for busy low-speed roads.
- Refuge islands (Treatments RI-01 through RI-03 and TRSS-10) are only necessitated by high travel speed or high traffic volume on the crossed road [17, 46]. Therefore, refuge islands are recommended only for trail crossings with a high-speed or high-ADT crossed road.

4.1.5 Analysis of High-ADT Crossed Road vs. Low-ADT Crossed Road

The threshold that defines high-ADT and low-ADT is quite consistent in various states' publications. Specifically, the threshold for two-lane roads is about 5,000 vehicles per day (vpd), while the threshold is 9,000-10,000 vpd for four-lane roads [6, 4, 14, 71]. Therefore, in this handbook, 5,000 vpd and 10,000 vpd are used as the thresholds that differentiate high-ADT from low-ADT for two-lane crossed roads and multilane (typically, four-lane) crossed roads, respectively.

The following treatments are considered to be only applicable to trail crossings with a low-ADT crossed road:

- Speed humps (Treatments TC-02), and speed tables (Treatment TC-03 and TC-04) as traffic calming related treatments are only recommended to be implemented only on urban low-ADT crossed roads [6], as they may invite safety issues if installed on high-ADT roads.

The following treatments are considered to be only applicable to trail crossings with a high-speed crossed road:

- Painting the "standard" pattern (has less paint compared to other patterns) for the crosswalk (Treatment PMS-06) is only appropriate for high-ADT crossed roads as recommended by the Florida's *Trail Crossing Design Handbook* [6].
- Refuge islands (Treatments RI-01 through RI-03 and TRSS-10) are only necessitated by high travel speed or high traffic volume on the crossed road [17, 46]. Therefore, refuge islands are recommended only for trail crossings with high-speed or high-ADT crossed road.
- Pedestrian/bicycle signals (Treatment TSGB-01 and TRSS-06) are only recommended for installation at midblock trail crossings with a high-ADT crossed road [6, 71], as low-ADT roads usually do not require signals. The final recommendation should be based on the result of the signal warrant analysis.
- HAWK signals (Treatments TSGB-07 and TRSS-09) are only recommended for installation at midblock trail crossings with a high-ADT crossed road per Association of Pedestrian and Bicycle Professionals [71].
- RRFB and yellow flashing beacon related treatments (Treatments TSGB-06, TSGB-08, TRSS-11, TRSS-12, and TRSS-14) are only recommended for installation at trail crossings with a high-ADT crossed road per Association of Pedestrian and Bicycle Professionals [71].

4.1.6 Analysis of Midblock vs. Parallel Path

In addition to consideration of characteristics of the roadway and environment, special attention must be paid to the type of crossing be examined. Several treatments are applicable to midblock crossings only, where only one movement (i.e., through movement on the crossed road) conflicts with the trail user's movement. These treatments include:

- Raising crosswalks as speed tables on the crossed road (Treatment TC-03) is only appropriate for midblock trail crossings, because the raised crosswalk is close to the roadway-roadway intersection alongside the trail crossing, which may confuse the road users, especially left-turn and right-turn drivers, and invite safety issues.
- Bulb outs (Treatment TC-06) are only recommended for midblock trail crossings, as they may cause potential safety issues for right-turn vehicles on the crossed road at parallel path crossings [14].
- Installation of traffic signals (Treatments TRSS-06 and TSGB-01) or HAWK signals (Treatments TRSS-09 and TSGB-07) is only recommended as a treatment for midblock trail crossings. This is because signalization may complicate the parallel path crossing by inviting red-light running issues which is a significant safety concern for trail users [6, 14].

On the other hand, certain treatments are only appropriate for parallel path trail crossings. Most of these treatments are parallel-road-related or turning-movement-related, which are certainly not applicable to midblock trail crossings. The treatment that are only appropriate for parallel path crossings include:

- Setting back the trail path from the parallel road (Treatment RA-03) to allow vehicle stacking space to reduce the conflict between trail users and the permissive left-turn traffic from the parallel road [6].
- Installing channelizing islands (Treatment RI-03) to split right-turn movements from other traffic on the crossed roadway [6, 4, 46].
- Narrowing the dedicated right-turn lane (Treatment TC-01) on the crossed road, and reducing the turning radius for right-turning vehicles (Treatment TC-05) [6].
- Installing a speed table on the dedicated right-turn lane (Treatment TC-04) [6].
- Installing a speed hump in the path of a vehicle turning right from the parallel road to the crossed road (Treatment TC-07) [6].
- Installing pedestrian/bicycle signal heads on the trail approach (Treatment TRSS-13), in case that the crossed road of the parallel path trail crossing is already signalized [6].
- Prohibiting permissive left turns and enabling protected left turns from the parallel road when trail users receive a "WALK" of flashing "DON'T WALK" indications (Treatment TSGB-02) [6].
- Installing advance trail crossing warning signs on the parallel road (Treatment TSN-06) [6].
- Prohibiting right turn on red by installing R10-11 series signs on the crossed road (Treatment TSN-09) [6].

4.2 Decision Tree-Based Treatment Selection Hierarchy

A decision tree-based method has been developed for traffic engineers and other transportation professionals to help facilitate the identification of appropriate alternative safety treatments for a specific trail crossing. This decision tree enables a fast look-up of appropriate treatments based on the existing conditions of the trail crossing, including urban/rural setting of the crossing, number of lanes and speed limit of the crossed roadway, and whether the crossed roadway is a divided or undivided highway. It further helps ensure consistency among the treatments used at trail crossings throughout the state. Note that the decision tree addresses only two primary types of trail crossings, namely midblock crossings and parallel path crossings. Complex crossings and trail-railway crossings are not covered in this chapter since treatments for complex crossings are most often site-specific. In most cases, treatments for these crossing types consist of a combination of treatments provided for both of the primary crossing types. Figure 4.1 illustrates the decision tree.

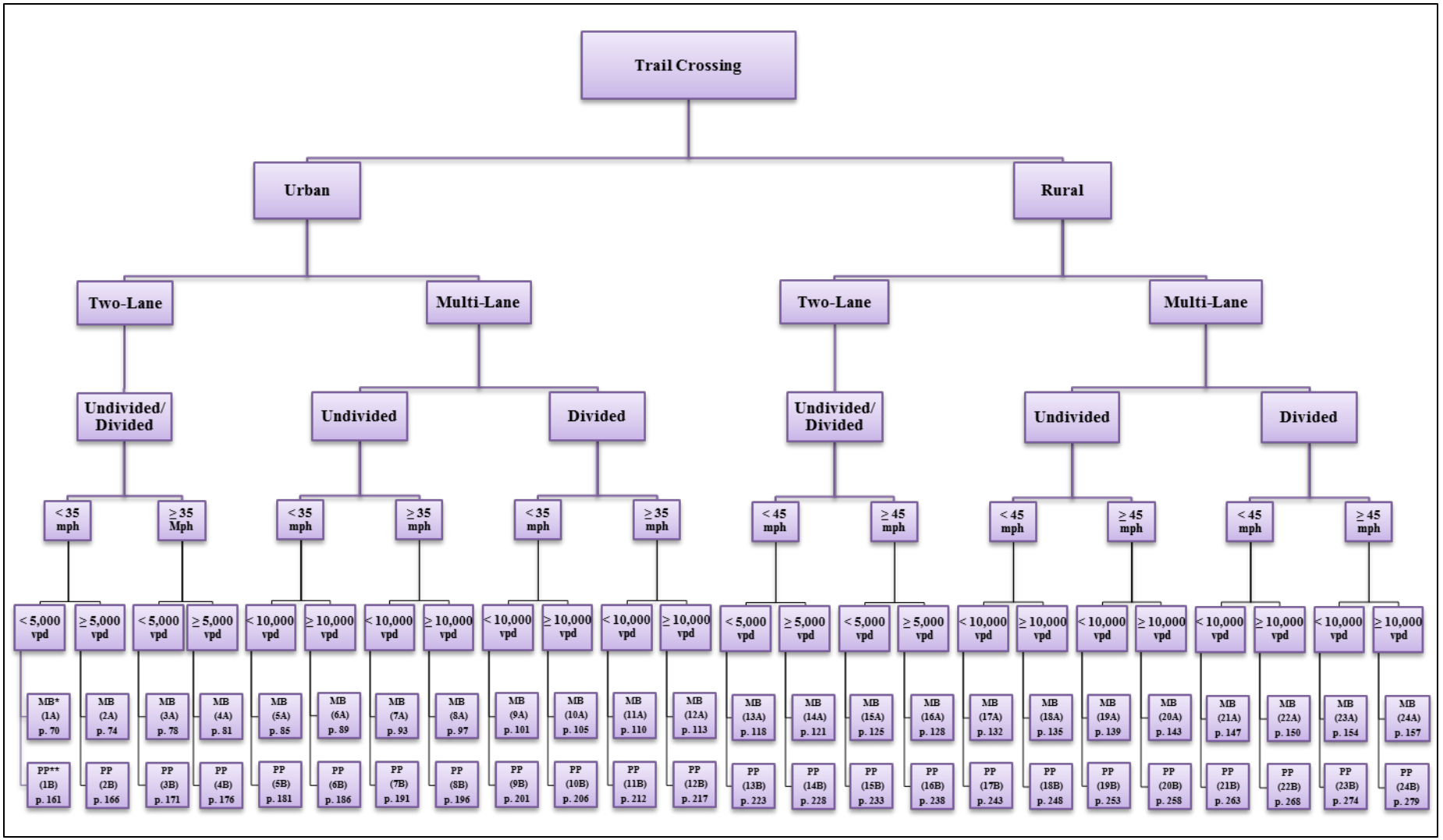
Use of the decision tree requires a simple multiple-step procedure in order to identify the alternative treatments for a given crossing scenario. The information that needs to be gathered before using the decision tree includes the following trail-crossing conditions:

(1) Whether the crossing is in an urban or rural setting (see definition in the preceding section);
(2) Whether the crossed roadway is a two-lane highway or multi-lane highway;
(3) Whether the crossed roadway is a divided highway or undivided highway;
(4) Speed limit of the crossed roadway;
(5) ADT of the crossed roadway; and,
(6) Type of the trail crossing: midblock or parallel path.

Each node of the decision tree corresponds to a condition listed above. The user of the decision tree needs to find an appropriate path to the end node by matching the conditions of the study trail crossing with the corresponding nodes in the decision tree. The final end nodes are either labeled “MB” or “PP”, which represents Midblock Crossing and Parallel Path Crossing, respectively. The content in the parenthesis below the “MB” or “PP” is the number of the table that contains all alternative treatments for the study trail crossing. Forty-eight such tables have been developed to meet the needs of different types of trail crossings. The complete list of treatments, from which a subset of treatments is used to construct each of the forty-eight tables, is seen in a master table (Table 4.1). Each treatment listed in master table has columns indicating the treatment’s appropriateness under various conditions including urban/rural setting, speed, ADT, lane configuration, and trail crossing type. The information of these conditions is provided for fast look-up of appropriate treatments instead of navigating through the decision tree and corresponding treatment tables.

Engineering judgment is always required when using the decision tree as unique conditions and special treatments may lead to conditions not specifically covered in the tree-based methodology. If users are interested in the crash reduction factors (CRFs) for certain treatments in the treatment tables, the user is directed towards a variety of other resources for further information. One of the most comprehensive is the Crash Modification Factors Clearinghouse which is maintained by the University of North Carolina Highway Safety Research Center and funded by FHWA. The website, www.cmfclearinghouse.org, provides a

searchable database with countermeasures to address a wide variety of crash types and severities. Each countermeasure is paired with both as crash modification factor (CMF) and a crash reduction factor, as well as the crash types and severities it may help alleviate, the area type(s) where it has been applied, a study from which the information was gathered, and a rating showing the quality of the study results [72]. CMFs provided in the CMF Clearinghouse can often be used as are those in the *Highway Safety Manual* for safety management and safety prediction processes [72, 73].



***MB denotes the Midblock trail-roadway crossing;**
****PP denotes the Parallel Path trail-roadway crossing; and,**
() denotes the look-up table that contains all alternative treatments for the corresponding type of trail crossing.

Figure 4.1: Decision Tree for Identifying Alternative Trail-Crossing Treatments

Table 4.1 Master List of Trail Crossing Treatments

Treatment Category	Treatment ID[1]	Treatment Description	U/R[2]	Ln[3]	Div[4]	Spd[5]	ADT[6]	Xing Type[7]	Handbook Section
Curb Ramps (CR)	**CR-01**	Install a curb ramp to make the crossing accessible to pedestrians with disabilities and to improve crossing conditions for all trail users. (Note: The curb ramp must have detectable warnings in the form of truncated domes as outlined in MnDOT Standard Plate No. 7038A.)	U/R	2/M	U/D	L/H	L/H	MB/PP	**3.7**
Lighting (LT)	**LT-01**	Provide lighting for the trail-roadway crossing.	U	2/M	U/D	L/H	L/H	MB/PP	**3.6**
Pavement Markings and Striping (PMS)	**PMS-01**	Paint a yellow center line only or use one along with advance warning striping for 150 feet (45.7 meters) along the trail approach from the trail entrance point (Note: applicable only when a bollard, lean rail, or median obstruction is present).	U/R	2/M	U/D	L/H	L/H	MB/PP	**3.1.3.1**
	PMS-02	Paint a stop/yield line to pair with the STOP/YIELD sign or pedestrian/bicycle signal head on the trail at a distance of 3 - 6 feet (0.9 - 1.8 meters) from the crossed road's edge.	U/R	2/M	U/D	L/H	L/H	MB/PP	**3.1.3.1**
	PMS-03	Paint a STOP/YIELD pavement marking on the trail approach.	U/R	2/M	U/D	L/H	L/H	MB/PP	**3.1.3.1**
	PMS-04	Divide the crosswalk to channelize pedestrians and bicyclists and separate their movements.	U/R	2/M	U/D	L/H	L/H	MB/PP	**3.1.3.2**
	PMS-05	Paint a high-visibility crosswalk on the crossed road "ladder" or "zebra" patterns preferable. (Note: The final decision of applying this treatment should be based on engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP, or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	U/R	2/M	U/D	L/H	L/H	MB/PP	**3.1.3.2**
	PMS-06	Paint a high-visibility "standard" pattern crosswalk on the crossed road. (Note: The final decision of applying this treatment should be based on engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or,	U/R	2/M	U/D	H	H	MB/PP	**3.1.3.2**

Treatment Category	Treatment ID[1]	Treatment Description	U/R[2]	Ln[3]	Div[4]	Spd[5]	ADT[6]	Xing Type[7]	Handbook Section
		based on an engineering study, if the crossing is not controlled by signals, STOP, or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)							
	PMS-07	Set back the stop line on the crossed roadway to improve the trail users' and the moving motorists' mutual chance to have an unobstructed view of each other.	U/R	2/M	U/D	L/H	L/H	MB/PP	**3.1.3.1**
	PMS-08	Paint a stop line and install a STOP HERE ON RED (R10-6) sign on the crossed roadway in advance of the trail crosswalk to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	U/R	2/M	U/D	L/H	L/H	MB/PP	**3.1.3.1**
	PMS-09	Paint a STOP AHEAD, YIELD AHEAD, or PED XING advance warning pavement marking on the crossed road.	U/R	2/M	U/D	L/H	L/H	MB/PP	**3.1.3.1**
Realignment (RA)	**RA-01**	Realign the trail path to make a right-angle crossing with the crossed roadway.	U/R	2/M	U/D	L/H	L/H	MB/PP	**3.8**
	RA-02	Realign the trail path such that its angle of intersection with the crossed roadway is ≥ 75 degrees.	U/R	2/M	U/D	L/H	L/H	MB/PP	**3.8**
	RA-03	Set back the trail path approximately 10 to 30 feet (3.0 to 9.1 meters) from the parallel roadway to allow vehicle stacking space (Note: applicable only when permissive left turns from the parallel roadway are allowed).	U/R	2/M	U/D	L/H	L/H	PP	**3.8**
Refuge Islands (RI)	**RI-01**	Install a right-angle median refuge island.	U/R	M	D	H	H	MB/PP	**3.3**
	RI-02	Install a median refuge island angled at 75 degrees with opposite sides of the trail across the roadway being slightly offset and supplementary centerline and STOP or YIELD pavement markings in the refuge area.	U/R	M	D	H	H	MB/PP	**3.3**
	RI-03	Install channelizing islands to split right-turn movements from other traffic on the crossed roadway, narrow the right-turn path, and provide refuge area for trail users to cross the roadway.	U/R	M	U/D	H	H	PP	**3.3**
Sight Distance	**SD-01**	Clear and maintain crossing/stopping sight distance for bicyclists.	U/R	2/M	U/D	L/H	L/H	MB/PP	**3.2.1, 3.2.2**

Treatment Category	Treatment ID[1]	Treatment Description	U/R[2]	Ln[3]	Div[4]	Spd[5]	ADT[6]	Xing Type[7]	Handbook Section
(SD)	**SD-02**	Clear and maintain crossing/stopping sight distance for pedestrians.	U/R	2/M	U/D	L/H	L/H	MB/PP	**3.2.1, 3.2.2**
	SD-03	Clear and maintain stopping/crossing sight distance for motorists.	U/R	2/M	U/D	L/H	L/H	MB/PP	**3.2.1, 3.2.2**
Traffic Calming (TC)	**TC-01**	Narrow the dedicated right-turn lane on the crossed road.	U/R	M	U/D	L/H	L/H	PP	**3.5.1**
	TC-02	Install speed humps on the crossed road (Note: this treatment is not applicable to State Aid roadways and several other types of roadways receiving government funding).	U	2	U/D	L	L	MB/PP	**3.5.2**
	TC-03	Raise the entire crosswalk as a speed table with elevation between 3 inches (76.2 millimeters) and 4.5 inches (114.3 millimeters) and make roadway ramping similar to that of speed humps on the crossed road (Note: this treatment is not applicable to State Aid roadways and several other types of roadways receiving government funding).	U	2	U/D	L	L	MB	**3.5.2**
	TC-04	Install a speed table, on the dedicated right-turn lane of the crossed road, in the path of a vehicle turning right from the crossed road to the parallel roadway (Note: this treatment is not applicable to State Aid roadways and several other types of roadways receiving government funding).	U	M	U/D	L	L	PP	**3.5.2**
	TC-05	Reduce the turning radius for right-turn vehicles.	U/R	2/M	U/D	L/H	L/H	PP	**3.5.1**
	TC-06	Use bulb outs (i.e., curb extensions) to reduce the crossing distance for trail users.	U	M	U/D	L	L/H	MB	**3.5.1**
	TC-07	Install a speed hump in the path of a vehicle turning right from the parallel roadway to the crossed roadway (Note: this treatment is not applicable to State Aid roadways and the several types of roadways receiving government funding).	U	2/M	U/D	L	L/H	PP	**3.5.2**
Trail Access Control (TRAC)	**TRAC-01**	Install a NO MOTOR VEHICLES (R5-3) sign on the trail, facing the roadway, to prevent unauthorized motor vehicles from entering the trail.	U/R	2/M	U/D	L/H	L/H	MB/PP	**3.1.1.1**
	TRAC-02	Install bollards to prevent unauthorized motor vehicles from entering the trail.	U/R	2/M	U/D	L/H	L/H	MB/PP	**3.4.1**

Treatment Category	Treatment ID[1]	Treatment Description	U/R[2]	Ln[3]	Div[4]	Spd[5]	ADT[6]	Xing Type[7]	Handbook Section
	TRAC-03	Install a lean rail parallel to the trail to prevent unauthorized motor vehicles from entering the trail and provide bicyclists with an area in which they can stop without dismounting.	U/R	2/M	U/D	L/H	L/H	MB/PP	**3.4.2**
	TRAC-04	Install a median on the trail to split the trail into two sections and restrict unauthorized motor vehicles from entering the trail.	U/R	2/M	U/D	L/H	L/H	MB/PP	**3.4.3**
	TRAC-05	Use discrete curb angles by providing 90 degree angles and sharply defined curbing of the trail crossing to discourage motor vehicle entry.	U	2/M	U/D	L/H	L/H	MB/PP	**3.4.4**
Trail Signals and Signs (TRSS)	**TRSS-01**	Install a CROSS ONLY ON GREEN (symbolic circular green) (R10-1) sign (Note: applicable only when the pedestrian/bicycle signal is already/ will be installed at the trail crossing).	U/R	2/M	U/D	L/H	L/H	MB/PP	**3.1.1.1**
	TRSS-02	Install a CROSS ONLY ON "WALK" (symbolic walk indication) (R10-2) sign (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	U/R	2/M	U/D	L/H	L/H	MB/PP	**3.1.1.1**
	TRSS-03	Install a sign from the Push Button for Green Light (R10-4) series (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	U/R	2/M	U/D	L/H	L/H	MB/PP	**3.1.1.1**
	TRSS-04	Install a sign from the Push Button for WALK Signal (R10-3) series (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	U/R	2/M	U/D	L/H	L/H	MB/PP	**3.1.1.1**
	TRSS-05	Install a pedestrian/bicyclist pushbutton on the trail 4 - 5 feet (1.2 – 1.5 meters) above the ground such that it is easily accessible for bicyclists to activate the signal without dismounting (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	U/R	2/M	U/D	L/H	L/H	MB/PP	**3.1.2.1**
	TRSS-06	Install pedestrian/bicycle signal on the trail approach (Note: applicable only to sites where a signal is warranted per *MN MUTCD*).	U/R	2/M	U/D	L/H	H	MB	**3.1.2.1**
	TRSS-07	Install an advance warning Stop Ahead (W3-1)/Yield Ahead (W3-2) sign on the trail approach at a distance of approximately 100 feet (30.5 meters) in advance of the crossing.	U/R	2/M	U/D	L/H	L/H	MB/PP	**3.1.1.2**

Treatment Category	Treatment ID[1]	Treatment Description	U/R[2]	Ln[3]	Div[4]	Spd[5]	ADT[6]	Xing Type[7]	Handbook Section
	TRSS-08	Install a STOP (R1-1) or YIELD (R1-2) sign on the trail approach at a minimum of 2 feet (0.6 meters) from the edge of the trail.	U/R	2/M	U/D	L/H	L/H	MB/PP	**3.1.1.1**
	TRSS-09	Install a pushbutton for a HAWK signal on the trail approach (Note: applicable only when the trail crossing is unsignalized); if used, use in conjunction with Treatment TSGB-07.	U	M	U/D	L/H	H	MB	**3.1.2.1**
	TRSS-10	Install a pushbutton at the median refuge island for pedestrians trapped in the refuge area (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	U/R	M	D	H	H	MB/PP	**3.1.2.1**
	TRSS-11	Install a pushbutton for a yellow flashing beacon on the trail approach (Note: applicable only when yellow flashing beacon has been/ will be installed).	U/R	M	U/D	L/H	H	MB/PP	**3.1.2.2**
	TRSS-12	Install a pushbutton for an RRFB on the trail approach (Note: applicable only when RRFB has been/will be installed).	U	M	U/D	L/H	H	MB/PP	**3.1.2.2**
	TRSS-13	Install pedestrian/bicycle signal on the trail approach if the crossed road is already signalized.	U/R	2/M	U/D	L/H	L/H	PP	**3.1.2.1**
	TRSS-14	Install a Push Button to Turn on Warning Lights (R10-25) sign at the crossing to inform trail users of how to activate the flashing beacon or RRFB.	U/R	M	U/D	L/H	H	MB/PP	**3.1.1.1**
Traffic Signal and Beacon (TSGB)	**TSGB-01**	Install traffic signals on the crossed road and trail (Note: only applicable to sites where a signal is warranted per *MN MUTCD*).	U/R	2/M	U/D	L/H	H	MB	**3.1.2.1**
	TSGB-02	Prohibit permissive left turns and enable protected left turns from the parallel roadway while trail users receive a "WALK" or flashing "DON'T WALK" indication (Note: applicable only when the intersection is already signalized and the parallel roadway has a dedicated left-turn lane).	U/R	2/M	U/D	L/H	L/H	PP	**3.1.2.1**
	TSGB-03	Prohibit permissive right turns and enable protected right turns from the parallel roadway while trail users receive a "WALK" or flashing "DON'T WALK" indication (Note: applicable only when the intersection is already signalized and the parallel	U/R	2/M	U/D	L/H	L/H	PP	**3.1.2.1**

Treatment Category	Treatment ID[1]	Treatment Description	U/R[2]	Ln[3]	Div[4]	Spd[5]	ADT[6]	Xing Type[7]	Handbook Section
		roadway has a dedicated right-turn lane).							
	TSGB-04	Provide oncoming crossing traffic on the crossed road with adequate change and clearance intervals to ensure their clearance of the trail prior to the trail receiving a "WALK" indication (Note: applicable only when the intersection is already signalized).	U/R	2/M	U/D	L/H	L/H	PP	**3.1.2.1**
	TSGB-05	Provide an all-red phase on the crossed road to further protect trail users (Note: applicable only when the intersection is already signalized and the crossed road does not have all-red phase).	U/R	2/M	U/D	L/H	L/H	PP	**3.1.2.1**
	TSGB-06	Install a yellow flashing beacon with pedestrian pushbutton at the crosswalk (Note: applicable only when the intersection is unsignalized); if used, the designer may also consider applying Treatment TRSS-11.	U/R	M	U/D	L/H	H	MB/PP	**3.1.2.2**
	TSGB-07	Install a High intensity Activated crossWalK (HAWK) signal (Note: applicable only when the intersection is unsignalized); if used, apply in conjunction with Treatment TRSS-09.	U	M	U/D	L/H	H	MB	**3.1.2.1**
	TSGB-08	Install a Rapid Rectangular Flashing Beacon (RRFB) (Note: applicable only when the intersection is unsignalized); if used, use in conjunction with Treatment TRSS-12.	U	M	U/D	L/H	H	MB/PP	**3.1.2.2**
Traffic Sign (TSN)	**TSN-01**	Install an advance trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at least 750 feet (228.6 meters) from the crossing. A distance plaque may be added beneath the sign.	R	2/M	U/D	L/H	L/H	MB/PP	**3.1.1.2**
	TSN-02	Install an advance trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at least 250 feet (76.2 meters) from the crossing. A distance plaque may be added beneath the sign.	U	2/M	U/D	L/H	L/H	MB/PP	**3.1.1.2**

Treatment Category	Treatment ID[1]	Treatment Description	U/R[2]	Ln[3]	Div[4]	Spd[5]	ADT[6]	Xing Type[7]	Handbook Section
	TSN-03	Install a Stop Here For Pedestrians (R1-5) series sign at the crossing on the crossed road	U/R	M	U/D	L/H	L/H	MB/PP	**3.1.1.1**
	TSN-04	Install a Stop Ahead (W3-1) sign for emphasis on the crossed roadway.	U/R	2/M	U/D	L/H	L/H	MB/PP	**3.1.1.2**
	TSN-05	Install a Yield Ahead (W3-2) sign for emphasis on the crossed roadway.	U/R	2/M	U/D	L/H	L/H	MB/PP	**3.1.1.2**
	TSN-06	Install an advance trail-crossing warning sign, such as the TRAIL CROSSING (W11-15a) sign, on the parallel roadway to warn turning vehicles. A distance plaque may be added beneath the sign.	U/R	2/M	U/D	L/H	L/H	PP	**3.1.1.2**
	TSN-07	Install a trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at the crossing.	U/R	2/M	U/D	L/H	L/H	MB/PP	**3.1.1.2**
	TSN-08	Install a STOP HERE ON RED (R10-6) sign at the trail crosswalk with a painted stop line to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	U/R	2/M	U/D	L/H	L/H	MB/PP	**3.1.1.1**
	TSN-09	Prohibit right turns on red using appropriate signage from the R10-11 series on the crossed roadway to reduce the chance of conflicts with trail users (Note: applicable only when the intersection is already signalized).	U/R	2/M	U/D	L/H	L/H	PP	**3.1.1.1**
	TSN-10	Install an advance trail-crossing warning sign for snowmobiles, i.e., the Snowmobile Crossing (W11-6) sign, on the crossed roadway at least 750 feet (228.6 meters) from the crossing (Note: applicable only on trails for exclusive snowmobile use).	R	2/M	U/D	L/H	L/H	MB/PP	**3.1.1.2**
	TSN-11	Install a snowmobile-crossing warning sign, i.e., the Snowmobile Crossing (W11-6) sign, on the crossed roadway at the trail crossing (Note: applicable only on trails for exclusive snowmobile use).	R	2/M	U/D	L/H	L/H	MB/PP	**3.1.1.2**

Notes:

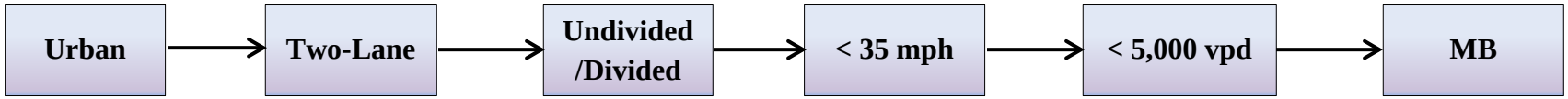
1. Treatments in table are not in any specific order with respect to importance, cost, popularity, ease of implementation etc.

2. “U/R” denotes urban or rural setting of the trail crossing, under which the treatment is applicable. “U” represents urban; “R” represents rural.
3. “Ln” denotes lane configuration of the crossed road, under which the treatment is applicable. “2” represents two-lane crossed road; “M” represents multilane crossed road.
4. “Div” denotes divided crossed road or undivided crossed road, under which the treatment is applicable. “U” represents undivided crossed road; “D” represents divided crossed road.
5. “Spd” denotes speed of the crossed road, under which the treatment is applicable. “L” represents low-speed crossed road; “H” represents high-speed crossed road.
6. “ADT” denotes ADT of the crossed road, under which the treatment is applicable. “L” represents low-ADT crossed road; “H” represents high-ADT crossed road.
7. “Xing Type” denotes type of trail crossing, where the treatment is applicable. “MB” represents midblock trail crossing; “PP” represents parallel trail crossing.

4.2 All Tables of Alternative Trail-Crossing Treatments

This section lists all tables of alternative treatments, which correspond to the table number in the end nodes of the decision tree shown in Figure 4.1.

Table 1A: Alternative Treatments for Urban, Two-Lane, Undivided/Divided, Speed < 35 mph, ADT < 5,000 vpd, Midblock Crossings



		Available Treatments		
		Treatment ID	**Treatment Description**	**Handbook Section**
Treatments for the Crossed Roadway	**Traffic Calming (TC)**	**TC-02**	Install speed humps on the crossed road (Note: this treatment is not applicable to State Aid roadways and several other types of roadways receiving government funding).	**3.5.2**
		TC-03	Raise the entire crosswalk as a speed table with elevation between 3 inches (76.2 millimeters) and 4.5 inches (114.3 millimeters) and make roadway ramping similar to that of speed humps on the crossed road (Note: this treatment is not applicable to State Aid roadways and several other types of roadways receiving government funding).	**3.5.2**
	Traffic Sign (TSN)	**TSN-02**	Install an advance trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at least 250 feet (76.2 meters) from the crossing. A distance plaque may be added beneath the sign.	**3.1.1.2**
		TSN-04	Install a Stop Ahead (W3-1) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-05	Install a Yield Ahead (W3-2) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-07	Install a trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at the crossing.	**3.1.1.2**

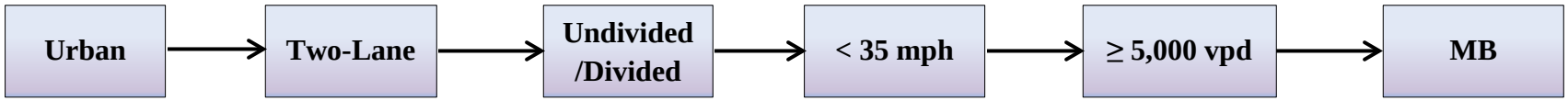
		TSN-08	Install a STOP HERE ON RED (R10-6) sign at the trail crosswalk with a painted stop line to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
	Pavement Markings and Striping (PMS)	**PMS-04**	Divide the crosswalk to channelize pedestrians and bicyclists and separate their movements.	**3.1.3.2**
		PMS-05	Paint a high-visibility crosswalk on the crossed road "ladder" or "zebra" patterns preferable. (Note: The final decision of applying this treatment should be based on engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP, or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	**3.1.3.2**
		PMS-07	Set back the stop line on the crossed roadway to improve the trail users' and the moving motorists' mutual chance to have an unobstructed view of each other.	**3.1.3.1**
		PMS-08	Paint a stop line and install a STOP HERE ON RED (R10-6) sign on the crossed roadway in advance of the trail crosswalk to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.3.1**
		PMS-09	Paint a STOP AHEAD, YIELD AHEAD, or PED XING advance warning pavement marking on the crossed road.	**3.1.3.1**
	Sight Distance (SD)	**SD-03**	Clear and maintain stopping/crossing sight distance for motorists.	**3.2.1, 3.2.2**
Treatments for the Trail	**Pavement Markings and Striping (PMS)**	**PMS-01**	Paint a yellow center line only or use one along with advance warning striping for 150 feet (45.7 meters) along the trail approach from the trail entrance point (Note: applicable only when a bollard, lean rail, or median obstruction is present).	**3.1.3.1**
		PMS-02	Paint a stop/yield line to pair with the STOP/YIELD sign or pedestrian/bicycle signal head on the trail at a distance of 3 - 6 feet (0.9 - 1.8 meters) from the crossed road's edge.	**3.1.3.1**
		PMS-03	Paint a STOP/YIELD pavement marking on the trail approach.	**3.1.3.1**
	Trail Signals and Signs (TRSS)	**TRSS-01**	Install a CROSS ONLY ON GREEN (symbolic circular green) (R10-1) sign (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**

		TRSS-02	Install a CROSS ONLY ON “WALK” (symbolic walk indication) (R10-2) sign (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-03	Install a sign from the Push Button for Green Light (R10-4) series (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-04	Install a sign from the Push Button for WALK Signal (R10-3) series (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-05	Install a pedestrian/bicyclist pushbutton on the trail 4 - 5 feet (1.2 – 1.5 meters) above the ground such that it is easily accessible for bicyclists to activate the signal without dismounting (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.2.1**
		TRSS-07	Install an advance warning Stop Ahead (W3-1)/Yield Ahead (W3-2) sign on the trail approach at a distance of approximately 100 feet (30.5 meters) in advance of the crossing.	**3.1.1.2**
		TRSS-08	Install a STOP (R1-1) or YIELD (R1-2) sign on the trail approach at a minimum of 2 feet (0.6 meters) from the edge of the trail.	**3.1.1.1**
	Trail Access Control (TRAC)	**TRAC-01**	Install a NO MOTOR VEHICLES (R5-3) sign on the trail, facing the roadway, to prevent unauthorized motor vehicles from entering the trail.	**3.1.1.1**
		TRAC-02	Install bollards to prevent unauthorized motor vehicles from entering the trail.	**3.4.1**
		TRAC-03	Install a lean rail parallel to the trail to prevent unauthorized motor vehicles from entering the trail and provide bicyclists with an area in which they can stop without dismounting.	**3.4.2**
		TRAC-04	Install a median on the trail to split the trail into two sections and restrict unauthorized motor vehicles from entering the trail.	**3.4.3**
		TRAC-05	Use discrete curb angles by providing 90 degree angles and sharply defined curbing of the trail crossing to discourage motor vehicle entry.	**3.4.4**
	Lighting (LT)	**LT-01**	Provide lighting for the trail-roadway crossing.	**3.6**

	Curb Ramps (CR)	**CR-01**	Install a curb ramp to make the crossing accessible to pedestrians with disabilities and to improve crossing conditions for all trail users. (Note: The curb ramp must have detectable warnings in the form of truncated domes as outlined in MnDOT Standard Plate No. 7038A.)	**3.7**
	Realignment (RA)	**RA-01**	Realign the trail path to make a right angle crossing with the crossed roadway.	**3.8**
		RA-02	Realign the trail path such that its angle of intersection with the crossed roadway is ≥ 75 degrees.	**3.8**
	Sight Distances (SD)	**SD-01**	Clear and maintain crossing/stopping sight distance for bicyclists.	**3.2.1, 3.2.2**
		SD-02	Clear and maintain crossing/stopping sight distance for pedestrians.	**3.2.1, 3.2.2**

*Note: Treatments in table are not in any specific order with respect to importance, cost, popularity, ease of implementation etc.

Table 2A: Alternative Treatments for Urban, Two-Lane, Undivided/Divided, Speed < 35 mph, ADT ≥ 5,000 vpd, Midblock Crossings



		Available Treatments		
		Treatment ID	**Treatment Description**	**Handbook Section**
Treatments for the Crossed Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-01**	Install traffic signals on the crossed road and trail (Note: only applicable to sites where a signal is warranted per *MN MUTCD*).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-02**	Install an advance trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at least 250 feet (76.2 meters) from the crossing. A distance plaque may be added beneath the sign.	**3.1.1.2**
		TSN-04	Install a Stop Ahead (W3-1) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-05	Install a Yield Ahead (W3-2) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-07	Install a trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at the crossing.	**3.1.1.2**
		TSN-08	Install a STOP HERE ON RED (R10-6) sign at the trail crosswalk with a painted stop line to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
	Pavement Markings and Striping (PMS)	**PMS-04**	Divide the crosswalk to channelize pedestrians and bicyclists and separate their movements.	**3.1.3.2**
		PMS-05	Paint a high-visibility crosswalk on the crossed road “ladder” or “zebra” patterns preferable. (Note: The final decision of applying this treatment should be based on engineering judgment if the crossing is controlled by signals, STOP, or YIELD	**3.1.3.2**

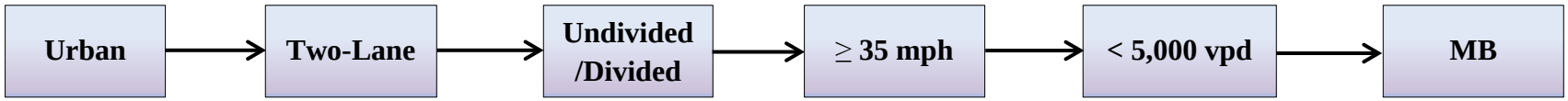
			signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP, or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	
		PMS-07	Set back the stop line on the crossed roadway to improve the trail users' and the moving motorists' mutual chance to have an unobstructed view of each other.	**3.1.3.1**
		PMS-08	Paint a stop line and install a STOP HERE ON RED (R10-6) sign on the crossed roadway in advance of the trail crosswalk to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.3.1**
		PMS-09	Paint a STOP AHEAD, YIELD AHEAD, or PED XING advance warning pavement marking on the crossed road.	**3.1.3.1**
	Sight Distance (SD)	**SD-03**	Clear and maintain stopping/crossing sight distance for motorists.	**3.2.1, 3.2.2**
Treatments for the Trail	**Pavement Markings and Striping (PMS)**	**PMS-01**	Paint a yellow center line only or use one along with advance warning striping for 150 feet (45.7 meters) along the trail approach from the trail entrance point (Note: applicable only when a bollard, lean rail, or median obstruction is present).	**3.1.3.1**
		PMS-02	Paint a stop/yield line to pair with the STOP/YIELD sign or pedestrian/bicycle signal head on the trail at a distance of 3 - 6 feet (0.9 - 1.8 meters) from the crossed road's edge.	**3.1.3.1**
		PMS-03	Paint a STOP/YIELD pavement marking on the trail approach.	**3.1.3.1**
	Trail Signals and Signs (TRSS)	**TRSS-01**	Install a CROSS ONLY ON GREEN (symbolic circular green) (R10-1) sign (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-02	Install a CROSS ONLY ON "WALK" (symbolic walk indication) (R10-2) sign (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-03	Install a sign from the Push Button for Green Light (R10-4) series (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-04	Install a sign from the Push Button for WALK Signal (R10-3) series (Note: applicable only when the pedestrian signal is already/will be installed at the trail	**3.1.1.1**

			crossing).	
		TRSS-05	Install a pedestrian/bicyclist pushbutton on the trail 4 - 5 feet (1.2 – 1.5 meters) above the ground such that it is easily accessible for bicyclists to activate the signal without dismounting (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.2.1**
		TRSS-06	Install pedestrian/bicycle signal on the trail approach (Note: applicable only to sites where a signal is warranted per *MN MUTCD*).	**3.1.2.1**
		TRSS-07	Install an advance warning Stop Ahead (W3-1)/Yield Ahead (W3-2) sign on the trail approach at a distance of approximately 100 feet (30.5 meters) in advance of the crossing.	**3.1.1.2**
		TRSS-08	Install a STOP (R1-1) or YIELD (R1-2) sign on the trail approach at a minimum of 2 feet (0.6 meters) from the edge of the trail.	**3.1.1.1**
	Trail Access Control (TRAC)	**TRAC-01**	Install a NO MOTOR VEHICLES (R5-3) sign on the trail, facing the roadway, to prevent unauthorized motor vehicles from entering the trail.	**3.1.1.1**
		TRAC-02	Install bollards to prevent unauthorized motor vehicles from entering the trail.	**3.4.1**
		TRAC-03	Install a lean rail parallel to the trail to prevent unauthorized motor vehicles from entering the trail and provide bicyclists with an area in which they can stop without dismounting.	**3.4.2**
		TRAC-04	Install a median on the trail to split the trail into two sections and restrict unauthorized motor vehicles from entering the trail.	**3.4.3**
		TRAC-05	Use discrete curb angles by providing 90 degree angles and sharply defined curbing of the trail crossing to discourage motor vehicle entry.	**3.4.4**
	Lighting (LT)	**LT-01**	Provide lighting for the trail-roadway crossing.	**3.6**
	Curb Ramps (CR)	**CR-01**	Install a curb ramp to make the crossing accessible to pedestrians with disabilities and to improve crossing conditions for all trail users. (Note: The curb ramp must have detectable warnings in the form of truncated domes as outlined in MnDOT Standard Plate No. 7038A.)	**3.7**
	Realignment (RA)	**RA-01**	Realign the trail path to make a right angle crossing with the crossed roadway.	**3.8**
		RA-02	Realign the trail path such that its angle of intersection with the crossed roadway is ≥	**3.8**

			75 degrees.	
	Sight Distances (SD)	**SD-01**	Clear and maintain crossing/stopping sight distance for bicyclists.	**3.2.1, 3.2.2**
		SD-02	Clear and maintain crossing/stopping sight distance for pedestrians.	**3.2.1, 3.2.2**

*Note: Treatments in table are not in any specific order with respect to importance, cost, popularity, ease of implementation etc.

Table 3A: Alternative Treatments for Urban, Two-Lane, Undivided/Divided, Speed ≥ 35 mph, ADT < 5,000 vpd Midblock Crossings



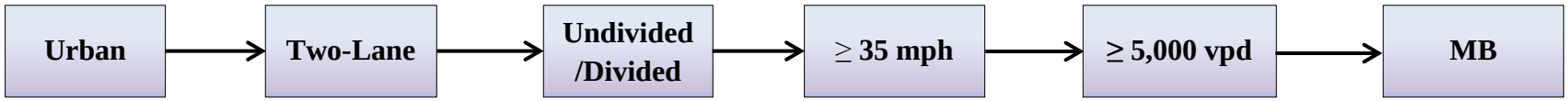
		Available Treatments		
		Treatment ID	**Treatment Description**	**Handbook Section**
Treatments for the Crossed Roadway	**Traffic Sign (TSN)**	**TSN-02**	Install an advance trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at least 250 feet (76.2 meters) from the crossing. A distance plaque may be added beneath the sign.	**3.1.1.2**
		TSN-04	Install a Stop Ahead (W3-1) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-05	Install a Yield Ahead (W3-2) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-07	Install a trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at the crossing.	**3.1.1.2**
		TSN-08	Install a STOP HERE ON RED (R10-6) sign at the trail crosswalk with a painted stop line to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
	Pavement Markings and Striping (PMS)	**PMS-04**	Divide the crosswalk to channelize pedestrians and bicyclists and separate their movements.	**3.1.3.2**
		PMS-05	Paint a high-visibility crosswalk on the crossed road “ladder” or “zebra” patterns preferable. (Note: The final decision of applying this treatment should be based on engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP, or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	**3.1.3.2**

		PMS-07	Set back the stop line on the crossed roadway to improve the trail users' and the moving motorists' mutual chance to have an unobstructed view of each other.	**3.1.3.1**
		PMS-08	Paint a stop line and install a STOP HERE ON RED (R10-6) sign on the crossed roadway in advance of the trail crosswalk to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.3.1**
		PMS-09	Paint a STOP AHEAD, YIELD AHEAD, or PED XING advance warning pavement marking on the crossed road.	**3.1.3.1**
	Sight Distance (SD)	**SD-03**	Clear and maintain stopping/crossing sight distance for motorists.	**3.2.1, 3.2.2**
Treatments for the Trail	**Pavement Markings and Striping (PMS)**	**PMS-01**	Paint a yellow center line only or use one along with advance warning striping for 150 feet (45.7 meters) along the trail approach from the trail entrance point (Note: applicable only when a bollard, lean rail, or median obstruction is present).	**3.1.3.1**
		PMS-02	Paint a stop/yield line to pair with the STOP/YIELD sign or pedestrian/bicycle signal head on the trail at a distance of 3 - 6 feet (0.9 - 1.8 meters) from the crossed road's edge.	**3.1.3.1**
		PMS-03	Paint a STOP/YIELD pavement marking on the trail approach.	**3.1.3.1**
	Trail Signals and Signs (TRSS)	**TRSS-01**	Install a CROSS ONLY ON GREEN (symbolic circular green) (R10-1) sign (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-02	Install a CROSS ONLY ON "WALK" (symbolic walk indication) (R10-2) sign (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-03	Install a sign from the Push Button for Green Light (R10-4) series (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-04	Install a sign from the Push Button for WALK Signal (R10-3) series (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-05	Install a pedestrian/bicyclist pushbutton on the trail 4 - 5 feet (1.2 – 1.5 meters) above the ground such that it is easily accessible for bicyclists to activate the signal without dismounting (Note: applicable only when the pedestrian signal is already/will be	**3.1.2.1**

			installed at the trail crossing).	
		TRSS-07	Install an advance warning Stop Ahead (W3-1)/Yield Ahead (W3-2) sign on the trail approach at a distance of approximately 100 feet (30.5 meters) in advance of the crossing.	**3.1.1.2**
		TRSS-08	Install a STOP (R1-1) or YIELD (R1-2) sign on the trail approach at a minimum of 2 feet (0.6 meters) from the edge of the trail.	**3.1.1.1**
	Trail Access Control (TRAC)	**TRAC-01**	Install a NO MOTOR VEHICLES (R5-3) sign on the trail, facing the roadway, to prevent unauthorized motor vehicles from entering the trail.	**3.1.1.1**
		TRAC-02	Install bollards to prevent unauthorized motor vehicles from entering the trail.	**3.4.1**
		TRAC-03	Install a lean rail parallel to the trail to prevent unauthorized motor vehicles from entering the trail and provide bicyclists with an area in which they can stop without dismounting.	**3.4.2**
		TRAC-04	Install a median on the trail to split the trail into two sections and restrict unauthorized motor vehicles from entering the trail.	**3.4.3**
		TRAC-05	Use discrete curb angles by providing 90 degree angles and sharply defined curbing of the trail crossing to discourage motor vehicle entry.	**3.4.4**
	Lighting (LT)	**LT-01**	Provide lighting for the trail-roadway crossing.	**3.6**
	Curb Ramps (CR)	**CR-01**	Install a curb ramp to make the crossing accessible to pedestrians with disabilities and to improve crossing conditions for all trail users. (Note: The curb ramp must have detectable warnings in the form of truncated domes as outlined in MnDOT Standard Plate No. 7038A.)	**3.7**
	Realignment (RA)	**RA-01**	Realign the trail path to make a right angle crossing with the crossed roadway.	**3.8**
		RA-02	Realign the trail path such that its angle of intersection with the crossed roadway is ≥ 75 degrees.	**3.8**
	Sight Distances (SD)	**SD-01**	Clear and maintain crossing/stopping sight distance for bicyclists.	**3.2.1, 3.2.2**
		SD-02	Clear and maintain crossing/stopping sight distance for pedestrians.	**3.2.1, 3.2.2**

*Note: Treatments in table are not in any specific order with respect to importance, cost, popularity, ease of implementation etc.

Table 4A: Alternative Treatments for Urban, Two-Lane, Undivided/Divided, Speed ≥ 35 mph, ADT ≥ 5,000 vpd, Midblock Crossings



		Available Treatments		
		Treatment ID	**Treatment Description**	**Handbook Section**
Treatments for the Crossed Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-01**	Install traffic signals on the crossed road and trail (Note: only applicable to sites where a signal is warranted per *MN MUTCD*).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-02**	Install an advance trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at least 250 feet (76.2 meters) from the crossing. A distance plaque may be added beneath the sign.	**3.1.1.2**
		TSN-04	Install a Stop Ahead (W3-1) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-05	Install a Yield Ahead (W3-2) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-07	Install a trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at the crossing.	**3.1.1.2**
		TSN-08	Install a STOP HERE ON RED (R10-6) sign at the trail crosswalk with a painted stop line to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
	Pavement Markings and Striping (PMS)	**PMS-04**	Divide the crosswalk to channelize pedestrians and bicyclists and separate their movements.	**3.1.3.2**
		PMS-05	Paint a high-visibility crosswalk on the crossed road “ladder” or “zebra” patterns preferable. (Note: The final decision of applying this treatment should be based on	**3.1.3.2**

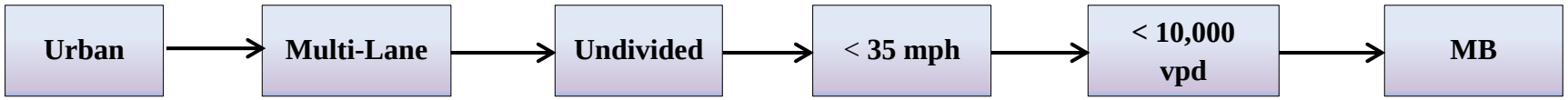
			engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP, or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	
		PMS-06	Paint a high-visibility "standard" pattern crosswalk on the crossed road. (Note: The final decision of applying this treatment should be based on engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP, or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	**3.1.3.2**
		PMS-07	Set back the stop line on the crossed roadway to improve the trail users' and the moving motorists' mutual chance to have an unobstructed view of each other.	**3.1.3.1**
		PMS-08	Paint a stop line and install a STOP HERE ON RED (R10-6) sign on the crossed roadway in advance of the trail crosswalk to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.3.1**
		PMS-09	Paint a STOP AHEAD, YIELD AHEAD, or PED XING advance warning pavement marking on the crossed road.	**3.1.3.1**
	Sight Distance (SD)	**SD-03**	Clear and maintain stopping/crossing sight distance for motorists.	**3.2.1, 3.2.2**
Treatments for the Trail	**Pavement Markings and Striping (PMS)**	**PMS-01**	Paint a yellow center line only or use one along with advance warning striping for 150 feet (45.7 meters) along the trail approach from the trail entrance point (Note: applicable only when a bollard, lean rail, or median obstruction is present).	**3.1.3.1**
		PMS-02	Paint a stop/yield line to pair with the STOP/YIELD sign or pedestrian/bicycle signal head on the trail at a distance of 3 - 6 feet (0.9 - 1.8 meters) from the crossed road's edge.	**3.1.3.1**
		PMS-03	Paint a STOP/YIELD pavement marking on the trail approach.	**3.1.3.1**
	Trail Signals and Signs (TRSS)	**TRSS-01**	Install a CROSS ONLY ON GREEN (symbolic circular green) (R10-1) sign (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-02	Install a CROSS ONLY ON "WALK" (symbolic walk indication) (R10-2) sign	**3.1.1.1**

			(Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	
		TRSS-03	Install a sign from the Push Button for Green Light (R10-4) series (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-04	Install a sign from the Push Button for WALK Signal (R10-3) series (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-05	Install a pedestrian/bicyclist pushbutton on the trail 4 - 5 feet (1.2 – 1.5 meters) above the ground such that it is easily accessible for bicyclists to activate the signal without dismounting (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.2.1**
		TRSS-06	Install pedestrian/bicycle signal on the trail approach (Note: applicable only to sites where a signal is warranted per *MN MUTCD*).	**3.1.2.1**
		TRSS-07	Install an advance warning Stop Ahead (W3-1)/Yield Ahead (W3-2) sign on the trail approach at a distance of approximately 100 feet (30.5 meters) in advance of the crossing.	**3.1.1.2**
		TRSS-08	Install a STOP (R1-1) or YIELD (R1-2) sign on the trail approach at a minimum of 2 feet (0.6 meters) from the edge of the trail.	**3.1.1.1**
	Trail Access Control (TRAC)	**TRAC-01**	Install a NO MOTOR VEHICLES (R5-3) sign on the trail, facing the roadway, to prevent unauthorized motor vehicles from entering the trail.	**3.1.1.1**
		TRAC-02	Install bollards to prevent unauthorized motor vehicles from entering the trail.	**3.4.1**
		TRAC-03	Install a lean rail parallel to the trail to prevent unauthorized motor vehicles from entering the trail and provide bicyclists with an area in which they can stop without dismounting.	**3.4.2**
		TRAC-04	Install a median on the trail to split the trail into two sections and restrict unauthorized motor vehicles from entering the trail.	**3.4.3**
		TRAC-05	Use discrete curb angles by providing 90 degree angles and sharply defined curbing of the trail crossing to discourage motor vehicle entry.	**3.4.4**
	Lighting (LT)	**LT-01**	Provide lighting for the trail-roadway crossing.	**3.6**
	Curb Ramps (CR)	**CR-01**	Install a curb ramp to make the crossing accessible to pedestrians with	**3.7**

			disabilities and to improve crossing conditions for all trail users. (Note: The curb ramp must have detectable warnings in the form of truncated domes as outlined in MnDOT Standard Plate No. 7038A.)	
	Realignment (RA)	**RA-01**	Realign the trail path to make a right angle crossing with the crossed roadway.	**3.8**
		RA-02	Realign the trail path such that its angle of intersection with the crossed roadway is ≥ 75 degrees.	**3.8**
	Sight Distances (SD)	**SD-01**	Clear and maintain crossing/stopping sight distance for bicyclists.	**3.2.1, 3.2.2**
		SD-02	Clear and maintain crossing/stopping sight distance for pedestrians.	**3.2.1, 3.2.2**

*Note: Treatments in table are not in any specific order with respect to importance, cost, popularity, ease of implementation etc.

Table 5A: Alternative Treatments for Urban, Multi-Lane, Undivided, Speed < 35 mph, ADT < 10,000 vpd, Midblock Crossings



		Available Treatments		
		Treatment ID	**Treatment Description**	**Handbook Section**
Treatments for the Crossed Roadway	**Traffic Calming (TC)**	**TC-06**	Use bulb outs (i.e., curb extensions) to reduce the crossing distance for trail users.	**3.5.1**
	Traffic Sign (TSN)	**TSN-02**	Install an advance trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at least 250 feet (76.2 meters) from the crossing. A distance plaque may be added beneath the sign.	**3.1.1.2**
		TSN-03	Install a Stop Here For Pedestrians (R1-5) series sign at the crossing on the crossed road	**3.1.1.1**
		TSN-04	Install a Stop Ahead (W3-1) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-05	Install a Yield Ahead (W3-2) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-07	Install a trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at the crossing.	**3.1.1.2**
		TSN-08	Install a STOP HERE ON RED (R10-6) sign at the trail crosswalk with a painted stop line to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
	Pavement Markings	**PMS-04**	Divide the crosswalk to channelize pedestrians and bicyclists and separate their movements.	**3.1.3.2**

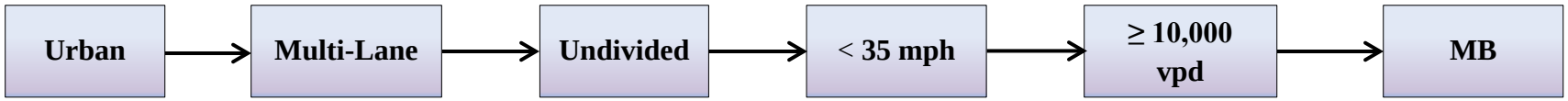
	and Striping (PMS)	**PMS-05**	Paint a high-visibility crosswalk on the crossed road "ladder" or "zebra" patterns preferable. (Note: The final decision of applying this treatment should be based on engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP, or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	**3.1.3.2**
		PMS-07	Set back the stop line on the crossed roadway to improve the trail users' and the moving motorists' mutual chance to have an unobstructed view of each other.	**3.1.3.1**
		PMS-08	Paint a stop line and install a STOP HERE ON RED (R10-6) sign on the crossed roadway in advance of the trail crosswalk to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.3.1**
		PMS-09	Paint a STOP AHEAD, YIELD AHEAD, or PED XING advance warning pavement marking on the crossed road.	**3.1.3.1**
	Sight Distance (SD)	**SD-03**	Clear and maintain stopping/crossing sight distance for motorists.	**3.2.1, 3.2.2**
Treatments for the Trail	**Pavement Markings and Striping (PMS)**	**PMS-01**	Paint a yellow center line only or use one along with advance warning striping for 150 feet (45.7 meters) along the trail approach from the trail entrance point (Note: applicable only when a bollard, lean rail, or median obstruction is present).	**3.1.3.1**
		PMS-02	Paint a stop/yield line to pair with the STOP/YIELD sign or pedestrian/bicycle signal head on the trail at a distance of 3 - 6 feet (0.9 - 1.8 meters) from the crossed road's edge.	**3.1.3.1**
		PMS-03	Paint a STOP/YIELD pavement marking on the trail approach.	**3.1.3.1**
	Trail Signals and Signs (TRSS)	**TRSS-01**	Install a CROSS ONLY ON GREEN (symbolic circular green) (R10-1) sign (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-02	Install a CROSS ONLY ON "WALK" (symbolic walk indication) (R10-2) sign (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-03	Install a sign from the Push Button for Green Light (R10-4) series (Note: applicable	**3.1.1.1**

			only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	
		TRSS-04	Install a sign from the Push Button for WALK Signal (R10-3) series (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-05	Install a pedestrian/bicyclist pushbutton on the trail 4 - 5 feet (1.2 – 1.5 meters) above the ground such that it is easily accessible for bicyclists to activate the signal without dismounting (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.2.1**
		TRSS-07	Install an advance warning Stop Ahead (W3-1)/Yield Ahead (W3-2) sign on the trail approach at a distance of approximately 100 feet (30.5 meters) in advance of the crossing.	**3.1.1.2**
		TRSS-08	Install a STOP (R1-1) or YIELD (R1-2) sign on the trail approach at a minimum of 2 feet (0.6 meters) from the edge of the trail.	**3.1.1.1**
	Trail Access Control (TRAC)	**TRAC-01**	Install a NO MOTOR VEHICLES (R5-3) sign on the trail, facing the roadway, to prevent unauthorized motor vehicles from entering the trail.	**3.1.1.1**
		TRAC-02	Install bollards to prevent unauthorized motor vehicles from entering the trail.	**3.4.1**
		TRAC-03	Install a lean rail parallel to the trail to prevent unauthorized motor vehicles from entering the trail and provide bicyclists with an area in which they can stop without dismounting.	**3.4.2**
		TRAC-04	Install a median on the trail to split the trail into two sections and restrict unauthorized motor vehicles from entering the trail.	**3.4.3**
		TRAC-05	Use discrete curb angles by providing 90 degree angles and sharply defined curbing of the trail crossing to discourage motor vehicle entry.	**3.4.4**
	Lighting (LT)	**LT-01**	Provide lighting for the trail-roadway crossing.	**3.6**
	Curb Ramps (CR)	**CR-01**	Install a curb ramp to make the crossing accessible to pedestrians with disabilities and to improve crossing conditions for all trail users. (Note: The curb ramp must have detectable warnings in the form of truncated domes as outlined in MnDOT Standard Plate No. 7038A.)	**3.7**
	Realignment (RA)	**RA-01**	Realign the trail path to make a right angle crossing with the crossed roadway.	**3.8**

		RA-02	Realign the trail path such that its angle of intersection with the crossed roadway is ≥ 75 degrees.	**3.8**
	Sight Distances (SD)	**SD-01**	Clear and maintain crossing/stopping sight distance for bicyclists.	**3.2.1, 3.2.2**
		SD-02	Clear and maintain crossing/stopping sight distance for pedestrians.	**3.2.1, 3.2.2**

*Note: Treatments in table are not in any specific order with respect to importance, cost, popularity, ease of implementation etc.

Table 6A: Alternative Treatments for Urban, Multi-Lane, Undivided, Speed < 35 mph, ADT ≥ 10,000 vpd, Midblock Crossings



		Available Treatments		
		Treatment ID	**Treatment Description**	**Handbook Section**
Treatments for the Crossed Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-01**	Install traffic signals on the crossed road and trail (Note: only applicable to sites where a signal is warranted per *MN MUTCD*).	**3.1.2.1**
		TSGB-06	Install a yellow flashing beacon with pedestrian pushbutton at the crosswalk (Note: applicable only when the intersection is unsignalized); if used, the designer may also consider applying Treatment TRSS-11.	**3.1.2.2**
		TSGB-07	Install a High intensity Activated crossWalK (HAWK) signal (Note: applicable only when the intersection is unsignalized); if used, apply in conjunction with Treatment TRSS-09.	**3.1.2.1**
		TSGB-08	Install a Rapid Rectangular Flashing Beacon (RRFB) (Note: applicable only when the intersection is unsignalized); if used, use in conjunction with Treatment TRSS-12.	**3.1.2.2**
	Traffic Calming (TC)	**TC-06**	Use bulb outs (i.e., curb extensions) to reduce the crossing distance for trail users.	**3.5.1**
	Traffic Sign (TSN)	**TSN-02**	Install an advance trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at least 250 feet (76.2 meters) from the crossing. A distance plaque may be added beneath the sign.	**3.1.1.2**
		TSN-03	Install a Stop Here For Pedestrians (R1-5) series sign at the crossing on the crossed road	**3.1.1.1**

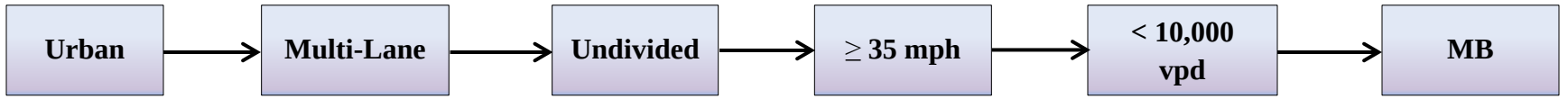
		TSN-04	Install a Stop Ahead (W3-1) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-05	Install a Yield Ahead (W3-2) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-07	Install a trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at the crossing.	**3.1.1.2**
		TSN-08	Install a STOP HERE ON RED (R10-6) sign at the trail crosswalk with a painted stop line to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
	Pavement Markings and Striping (PMS)	**PMS-04**	Divide the crosswalk to channelize pedestrians and bicyclists and separate their movements.	**3.1.3.2**
		PMS-05	Paint a high-visibility crosswalk on the crossed road "ladder" or "zebra" patterns preferable. (Note: The final decision of applying this treatment should be based on engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP, or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	**3.1.3.2**
		PMS-07	Set back the stop line on the crossed roadway to improve the trail users' and the moving motorists' mutual chance to have an unobstructed view of each other.	**3.1.3.1**
		PMS-08	Paint a stop line and install a STOP HERE ON RED (R10-6) sign on the crossed roadway in advance of the trail crosswalk to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.3.1**
		PMS-09	Paint a STOP AHEAD, YIELD AHEAD, or PED XING advance warning pavement marking on the crossed road.	**3.1.3.1**
	Sight Distance (SD)	**SD-03**	Clear and maintain stopping/crossing sight distance for motorists.	**3.2.1, 3.2.2**
Treatments for the Trail	**Pavement Markings and Striping (PMS)**	**PMS-01**	Paint a yellow center line only or use one along with advance warning striping for 150 feet (45.7 meters) along the trail approach from the trail entrance point (Note: applicable only when a bollard, lean rail, or median obstruction is present).	**3.1.3.1**
		PMS-02	Paint a stop/yield line to pair with the STOP/YIELD sign or pedestrian/bicycle signal	**3.1.3.1**

			head on the trail at a distance of 3 - 6 feet (0.9 - 1.8 meters) from the crossed road's edge.	
		PMS-03	Paint a STOP/YIELD pavement marking on the trail approach.	**3.1.3.1**
	Trail Signals and Signs (TRSS)	**TRSS-01**	Install a CROSS ONLY ON GREEN (symbolic circular green) (R10-1) sign (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-02	Install a CROSS ONLY ON "WALK" (symbolic walk indication) (R10-2) sign (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-03	Install a sign from the Push Button for Green Light (R10-4) series (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-04	Install a sign from the Push Button for WALK Signal (R10-3) series (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-05	Install a pedestrian/bicyclist pushbutton on the trail 4 - 5 feet (1.2 – 1.5 meters) above the ground such that it is easily accessible for bicyclists to activate the signal without dismounting (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.2.1**
		TRSS-06	Install pedestrian/bicycle signal on the trail approach (Note: applicable only to sites where a signal is warranted per *MN MUTCD*).	**3.1.2.1**
		TRSS-07	Install an advance warning Stop Ahead (W3-1)/Yield Ahead (W3-2) sign on the trail approach at a distance of approximately 100 feet (30.5 meters) in advance of the crossing.	**3.1.1.2**
		TRSS-08	Install a STOP (R1-1) or YIELD (R1-2) sign on the trail approach at a minimum of 2 feet (0.6 meters) from the edge of the trail.	**3.1.1.1**
		TRSS-09	Install a pushbutton for a HAWK signal on the trail approach (Note: applicable only when the trail crossing is unsignalized); if used, use in conjunction with Treatment TSGB-07.	**3.1.2.1**
		TRSS-11	Install a pushbutton for a yellow flashing beacon on the trail approach (Note: applicable only when yellow flashing beacon has been/ will be installed).	**3.1.2.2**

		TRSS-12	Install a pushbutton for an RRFB on the trail approach (Note: applicable only when RRFB has been/will be installed).	**3.1.2.2**
		TRSS-14	Install a Push Button to Turn on Warning Lights (R10-25) sign at the crossing to inform trail users of how to activate the flashing beacon or RRFB.	**3.1.2.2**
	Trail Access Control (TRAC)	**TRAC-01**	Install a NO MOTOR VEHICLES (R5-3) sign on the trail, facing the roadway, to prevent unauthorized motor vehicles from entering the trail.	**3.1.1.1**
		TRAC-02	Install bollards to prevent unauthorized motor vehicles from entering the trail.	**3.4.1**
		TRAC-03	Install a lean rail parallel to the trail to prevent unauthorized motor vehicles from entering the trail and provide bicyclists with an area in which they can stop without dismounting.	**3.4.2**
		TRAC-04	Install a median on the trail to split the trail into two sections and restrict unauthorized motor vehicles from entering the trail.	**3.4.3**
		TRAC-05	Use discrete curb angles by providing 90 degree angles and sharply defined curbing of the trail crossing to discourage motor vehicle entry.	**3.4.4**
	Lighting (LT)	**LT-01**	Provide lighting for the trail-roadway crossing.	**3.6**
	Curb Ramps (CR)	**CR-01**	Install a curb ramp to make the crossing accessible to pedestrians with disabilities and to improve crossing conditions for all trail users. (Note: The curb ramp must have detectable warnings in the form of truncated domes as outlined in MnDOT Standard Plate No. 7038A.)	**3.7**
	Realignment (RA)	**RA-01**	Realign the trail path to make a right angle crossing with the crossed roadway.	**3.8**
		RA-02	Realign the trail path such that its angle of intersection with the crossed roadway is ≥ 75 degrees.	**3.8**
	Sight Distances (SD)	**SD-01**	Clear and maintain crossing/stopping sight distance for bicyclists.	**3.2.1, 3.2.2**
		SD-02	Clear and maintain crossing/stopping sight distance for pedestrians.	**3.2.1, 3.2.2**

*Note: Treatments in table are not in any specific order with respect to importance, cost, popularity, ease of implementation etc.

Table 7A: Alternative Treatments for Urban, Multi-Lane, Undivided, Speed ≥ 35 mph, ADT < 10,000 vpd, Midblock Crossings



		Available Treatments		
		Treatment ID	**Treatment Description**	**Handbook Section**
Treatments for the Crossed Road	**Traffic Sign (TSN)**	**TSN-02**	Install an advance trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at least 250 feet (76.2 meters) from the crossing. A distance plaque may be added beneath the sign.	**3.1.1.2**
		TSN-03	Install a Stop Here For Pedestrians (R1-5) series sign at the crossing on the crossed road	**3.1.1.1**
		TSN-04	Install a Stop Ahead (W3-1) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-05	Install a Yield Ahead (W3-2) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-07	Install a trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at the crossing.	**3.1.1.2**
		TSN-08	Install a STOP HERE ON RED (R10-6) sign at the trail crosswalk with a painted stop line to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
	Pavement Markings and Striping (PMS)	**PMS-04**	Divide the crosswalk to channelize pedestrians and bicyclists and separate their movements.	**3.1.3.2**
		PMS-05	Paint a high-visibility crosswalk on the crossed road “ladder” or “zebra” patterns preferable. (Note: The final decision of applying this treatment should be based on engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP,	**3.1.3.2**

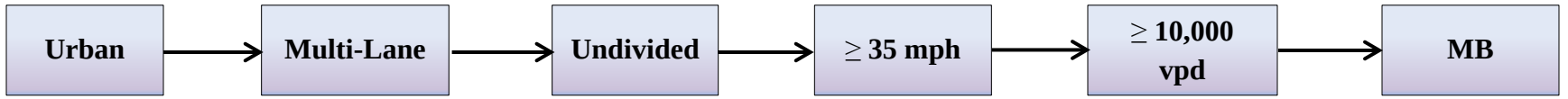
			or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	
		PMS-07	Set back the stop line on the crossed roadway to improve the trail users' and the moving motorists' mutual chance to have an unobstructed view of each other.	**3.1.3.1**
		PMS-08	Paint a stop line and install a STOP HERE ON RED (R10-6) sign on the crossed roadway in advance of the trail crosswalk to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.3.1**
		PMS-09	Paint a STOP AHEAD, YIELD AHEAD, or PED XING advance warning pavement marking on the crossed road.	**3.1.3.1**
	Sight Distance (SD)	**SD-03**	Clear and maintain stopping/crossing sight distance for motorists.	**3.2.1, 3.2.2**
Treatments for the Trail	**Pavement Markings and Striping (PMS)**	**PMS-01**	Paint a yellow center line only or use one along with advance warning striping for 150 feet (45.7 meters) along the trail approach from the trail entrance point (Note: applicable only when a bollard, lean rail, or median obstruction is present).	**3.1.3.1**
		PMS-02	Paint a stop/yield line to pair with the STOP/YIELD sign or pedestrian/bicycle signal head on the trail at a distance of 3 - 6 feet (0.9 - 1.8 meters) from the crossed road's edge.	**3.1.3.1**
		PMS-03	Paint a STOP/YIELD pavement marking on the trail approach.	**3.1.3.1**
	Trail Signals and Signs (TRSS)	**TRSS-01**	Install a CROSS ONLY ON GREEN (symbolic circular green) (R10-1) sign (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-02	Install a CROSS ONLY ON "WALK" (symbolic walk indication) (R10-2) sign (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-03	Install a sign from the Push Button for Green Light (R10-4) series (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-04	Install a sign from the Push Button for WALK Signal (R10-3) series (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**

		TRSS-05	Install a pedestrian/bicyclist pushbutton on the trail 4 - 5 feet (1.2 – 1.5 meters) above the ground such that it is easily accessible for bicyclists to activate the signal without dismounting (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.2.1**
		TRSS-07	Install an advance warning Stop Ahead (W3-1)/Yield Ahead (W3-2) sign on the trail approach at a distance of approximately 100 feet (30.5 meters) in advance of the crossing.	**3.1.1.2**
		TRSS-08	Install a STOP (R1-1) or YIELD (R1-2) sign on the trail approach at a minimum of 2 feet (0.6 meters) from the edge of the trail.	**3.1.1.1**
	Trail Access Control (TRAC)	**TRAC-01**	Install a NO MOTOR VEHICLES (R5-3) sign on the trail, facing the roadway, to prevent unauthorized motor vehicles from entering the trail.	**3.1.1.1**
		TRAC-02	Install bollards to prevent unauthorized motor vehicles from entering the trail.	**3.4.1**
		TRAC-03	Install a lean rail parallel to the trail to prevent unauthorized motor vehicles from entering the trail and provide bicyclists with an area in which they can stop without dismounting.	**3.4.2**
		TRAC-04	Install a median on the trail to split the trail into two sections and restrict unauthorized motor vehicles from entering the trail.	**3.4.3**
		TRAC-05	Use discrete curb angles by providing 90 degree angles and sharply defined curbing of the trail crossing to discourage motor vehicle entry.	**3.4.4**
	Lighting (LT)	**LT-01**	Provide lighting for the trail-roadway crossing.	**3.6**
	Curb Ramps (CR)	**CR-01**	Install a curb ramp to make the crossing accessible to pedestrians with disabilities and to improve crossing conditions for all trail users. (Note: The curb ramp must have detectable warnings in the form of truncated domes as outlined in MnDOT Standard Plate No. 7038A.)	**3.7**
	Realignment (RA)	**RA-01**	Realign the trail path to make a right angle crossing with the crossed roadway.	**3.8**
		RA-02	Realign the trail path such that its angle of intersection with the crossed roadway is ≥ 75 degrees.	**3.8**
	Sight	**SD-01**	Clear and maintain crossing/stopping sight distance for bicyclists.	**3.2.1, 3.2.2**

	Distances (SD)	**SD-02**	Clear and maintain crossing/stopping sight distance for pedestrians.	**3.2.1, 3.2.2**

*Note: Treatments in table are not in any specific order with respect to importance, cost, popularity, ease of implementation etc.

Table 8A: Alternative Treatments for Urban, Multi-Lane, Undivided, Speed ≥ 35 mph, ADT ≥ 10,000 vpd, Midblock Crossings



		Available Treatments		
		Treatment ID	**Treatment Description**	**Handbook Section**
Treatments for the Crossed Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-01**	Install traffic signals on the crossed road and trail (Note: only applicable to sites where a signal is warranted per *MN MUTCD*).	**3.1.2.1**
		TSGB-06	Install a yellow flashing beacon with pedestrian pushbutton at the crosswalk (Note: applicable only when the intersection is unsignalized); if used, the designer may also consider applying Treatment TRSS-11.	**3.1.2.2**
		TSGB-07	Install a High intensity Activated crossWalK (HAWK) signal (Note: applicable only when the intersection is unsignalized); if used, apply in conjunction with Treatment TRSS-09.	**3.1.2.1**
		TSGB-08	Install a Rapid Rectangular Flashing Beacon (RRFB) (Note: applicable only when the intersection is unsignalized); if used, use in conjunction with Treatment TRSS-12.	**3.1.2.2**
	Traffic Sign (TSN)	**TSN-02**	Install an advance trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at least 250 feet (76.2 meters) from the crossing. A distance plaque may be added beneath the sign.	**3.1.1.2**
		TSN-03	Install a Stop Here For Pedestrians (R1-5) series sign at the crossing on the crossed road	**3.1.1.1**
		TSN-04	Install a Stop Ahead (W3-1) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-05	Install a Yield Ahead (W3-2) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-07	Install a trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning	**3.1.1.2**

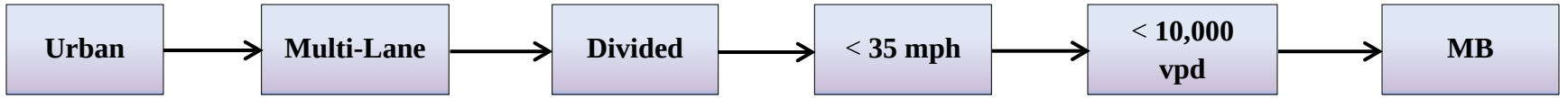
			(W11-15) sign, on the crossed roadway at the crossing.	
		TSN-08	Install a STOP HERE ON RED (R10-6) sign at the trail crosswalk with a painted stop line to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
	Pavement Markings and Striping (PMS)	**PMS-04**	Divide the crosswalk to channelize pedestrians and bicyclists and separate their movements.	**3.1.3.2**
		PMS-05	Paint a high-visibility crosswalk on the crossed road "ladder" or "zebra" patterns preferable. (Note: The final decision of applying this treatment should be based on engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP, or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	**3.1.3.2**
		PMS-06	Paint a high-visibility "standard" pattern crosswalk on the crossed road. (Note: The final decision of applying this treatment should be based on engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP, or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	**3.1.3.2**
		PMS-07	Set back the stop line on the crossed roadway to improve the trail users' and the moving motorists' mutual chance to have an unobstructed view of each other.	**3.1.3.1**
		PMS-08	Paint a stop line and install a STOP HERE ON RED (R10-6) sign on the crossed roadway in advance of the trail crosswalk to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.3.1**
		PMS-09	Paint a STOP AHEAD, YIELD AHEAD, or PED XING advance warning pavement marking on the crossed road.	**3.1.3.1**
	Sight Distance (SD)	**SD-03**	Clear and maintain stopping/crossing sight distance for motorists.	**3.2.1, 3.2.2**
Treatments for the Trail	**Pavement Markings and Striping**	**PMS-01**	Paint a yellow center line only or use one along with advance warning striping for 150 feet (45.7 meters) along the trail approach from the trail entrance point (Note: applicable only when a bollard, lean rail, or median obstruction is present).	**3.1.3.1**

	(PMS)	**PMS-02**	Paint a stop/yield line to pair with the STOP/YIELD sign or pedestrian/bicycle signal head on the trail at a distance of 3 - 6 feet (0.9 - 1.8 meters) from the crossed road's edge.	**3.1.3.1**
		PMS-03	Paint a STOP/YIELD pavement marking on the trail approach.	**3.1.3.1**
	Trail Signals and Signs (TRSS)	**TRSS-01**	Install a CROSS ONLY ON GREEN (symbolic circular green) (R10-1) sign (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-02	Install a CROSS ONLY ON "WALK" (symbolic walk indication) (R10-2) sign (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-03	Install a sign from the Push Button for Green Light (R10-4) series (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-04	Install a sign from the Push Button for WALK Signal (R10-3) series (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-05	Install a pedestrian/bicyclist pushbutton on the trail 4 - 5 feet (1.2 – 1.5 meters) above the ground such that it is easily accessible for bicyclists to activate the signal without dismounting (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.2.1**
		TRSS-06	Install pedestrian/bicycle signal on the trail approach (Note: applicable only to sites where a signal is warranted per *MN MUTCD*).	**3.1.2.1**
		TRSS-07	Install an advance warning Stop Ahead (W3-1)/Yield Ahead (W3-2) sign on the trail approach at a distance of approximately 100 feet (30.5 meters) in advance of the crossing.	**3.1.1.2**
		TRSS-08	Install a STOP (R1-1) or YIELD (R1-2) sign on the trail approach at a minimum of 2 feet (0.6 meters) from the edge of the trail.	**3.1.1.1**
		TRSS-09	Install a pushbutton for a HAWK signal on the trail approach (Note: applicable only when the trail crossing is unsignalized); if used, use in conjunction with Treatment TSGB-07.	**3.1.2.1**
		TRSS-11	Install a pushbutton for a yellow flashing beacon on the trail approach (Note: applicable only when yellow flashing beacon has been/ will be installed).	**3.1.2.2**

		TRSS-12	Install a pushbutton for an RRFB on the trail approach (Note: applicable only when RRFB has been/will be installed).	**3.1.2.2**
		TRSS-14	Install a Push Button to Turn on Warning Lights (R10-25) sign at the crossing to inform trail users of how to activate the flashing beacon or RRFB.	**3.1.2.2**
	Trail Access Control (TRAC)	**TRAC-01**	Install a NO MOTOR VEHICLES (R5-3) sign on the trail, facing the roadway, to prevent unauthorized motor vehicles from entering the trail.	**3.1.1.1**
		TRAC-02	Install bollards to prevent unauthorized motor vehicles from entering the trail.	**3.4.1**
		TRAC-03	Install a lean rail parallel to the trail to prevent unauthorized motor vehicles from entering the trail and provide bicyclists with an area in which they can stop without dismounting.	**3.4.2**
		TRAC-04	Install a median on the trail to split the trail into two sections and restrict unauthorized motor vehicles from entering the trail.	**3.4.3**
		TRAC-05	Use discrete curb angles by providing 90 degree angles and sharply defined curbing of the trail crossing to discourage motor vehicle entry.	**3.4.4**
	Lighting (LT)	**LT-01**	Provide lighting for the trail-roadway crossing.	**3.6**
	Curb Ramps (CR)	**CR-01**	Install a curb ramp to make the crossing accessible to pedestrians with disabilities and to improve crossing conditions for all trail users. (Note: The curb ramp must have detectable warnings in the form of truncated domes as outlined in MnDOT Standard Plate No. 7038A.)	**3.7**
	Realignment (RA)	**RA-01**	Realign the trail path to make a right angle crossing with the crossed roadway.	**3.8**
		RA-02	Realign the trail path such that its angle of intersection with the crossed roadway is ≥ 75 degrees.	**3.8**
	Sight Distances (SD)	**SD-01**	Clear and maintain crossing/stopping sight distance for bicyclists.	**3.2.1, 3.2.2**
		SD-02	Clear and maintain crossing/stopping sight distance for pedestrians.	**3.2.1, 3.2.2**

*Note: Treatments in table are not in any specific order with respect to importance, cost, popularity, ease of implementation etc.

Table 9A: Alternative Treatments for Urban, Multi-Lane, Divided, Speed < 35 mph, ADT < 10,000 vpd, Midblock Crossings



		Available Treatments		
		Treatment ID	**Treatment Description**	**Handbook Section**
Treatments for the Crossed Road	**Traffic Calming (TC)**	**TC-06**	Use bulb outs (i.e., curb extensions) to reduce the crossing distance for trail users.	**3.5.1**
	Traffic Sign (TSN)	**TSN-02**	Install an advance trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at least 250 feet (76.2 meters) from the crossing. A distance plaque may be added beneath the sign.	**3.1.1.2**
		TSN-03	Install a Stop Here For Pedestrians (R1-5) series sign at the crossing on the crossed road	**3.1.1.1**
		TSN-04	Install a Stop Ahead (W3-1) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-05	Install a Yield Ahead (W3-2) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-07	Install a trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at the crossing.	**3.1.1.2**
		TSN-08	Install a STOP HERE ON RED (R10-6) sign at the trail crosswalk with a painted stop line to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
	Pavement Markings and Striping (PMS)	**PMS-04**	Divide the crosswalk to channelize pedestrians and bicyclists and separate their movements.	**3.1.3.2**
		PMS-05	Paint a high-visibility crosswalk on the crossed road “ladder” or “zebra” patterns preferable. (Note: The final decision of applying this treatment should be based on	**3.1.3.2**

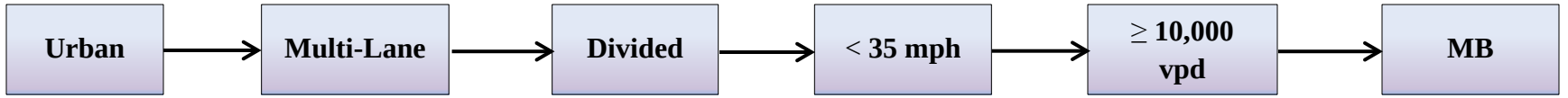
			engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP, or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	
		PMS-07	Set back the stop line on the crossed roadway to improve the trail users' and the moving motorists' mutual chance to have an unobstructed view of each other.	**3.1.3.1**
		PMS-08	Paint a stop line and install a STOP HERE ON RED (R10-6) sign on the crossed roadway in advance of the trail crosswalk to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.3.1**
		PMS-09	Paint a STOP AHEAD, YIELD AHEAD, or PED XING advance warning pavement marking on the crossed road.	**3.1.3.1**
	Sight Distance (SD)	**SD-03**	Clear and maintain stopping/crossing sight distance for motorists.	**3.2.1, 3.2.2**
Treatments for the Trail	**Pavement Markings and Striping (PMS)**	**PMS-01**	Paint a yellow center line only or use one along with advance warning striping for 150 feet (45.7 meters) along the trail approach from the trail entrance point (Note: applicable only when a bollard, lean rail, or median obstruction is present).	**3.1.3.1**
		PMS-02	Paint a stop/yield line to pair with the STOP/YIELD sign or pedestrian/bicycle signal head on the trail at a distance of 3 - 6 feet (0.9 - 1.8 meters) from the crossed road's edge.	**3.1.3.1**
		PMS-03	Paint a STOP/YIELD pavement marking on the trail approach.	**3.1.3.1**
	Trail Signals and Signs (TRSS)	**TRSS-01**	Install a CROSS ONLY ON GREEN (symbolic circular green) (R10-1) sign (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-02	Install a CROSS ONLY ON "WALK" (symbolic walk indication) (R10-2) sign (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-03	Install a sign from the Push Button for Green Light (R10-4) series (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**

		TRSS-04	Install a sign from the Push Button for WALK Signal (R10-3) series (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-05	Install a pedestrian/bicyclist pushbutton on the trail 4 - 5 feet (1.2 – 1.5 meters) above the ground such that it is easily accessible for bicyclists to activate the signal without dismounting (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.2.1**
		TRSS-07	Install an advance warning Stop Ahead (W3-1)/Yield Ahead (W3-2) sign on the trail approach at a distance of approximately 100 feet (30.5 meters) in advance of the crossing.	**3.1.1.2**
		TRSS-08	Install a STOP (R1-1) or YIELD (R1-2) sign on the trail approach at a minimum of 2 feet (0.6 meters) from the edge of the trail.	**3.1.1.1**
	Trail Access Control (TRAC)	**TRAC-01**	Install a NO MOTOR VEHICLES (R5-3) sign on the trail, facing the roadway, to prevent unauthorized motor vehicles from entering the trail.	**3.1.1.1**
		TRAC-02	Install bollards to prevent unauthorized motor vehicles from entering the trail.	**3.4.1**
		TRAC-03	Install a lean rail parallel to the trail to prevent unauthorized motor vehicles from entering the trail and provide bicyclists with an area in which they can stop without dismounting.	**3.4.2**
		TRAC-04	Install a median on the trail to split the trail into two sections and restrict unauthorized motor vehicles from entering the trail.	**3.4.3**
		TRAC-05	Use discrete curb angles by providing 90 degree angles and sharply defined curbing of the trail crossing to discourage motor vehicle entry.	**3.4.4**
	Lighting (LT)	**LT-01**	Provide lighting for the trail-roadway crossing.	**3.6**
	Curb Ramps (CR)	**CR-01**	Install a curb ramp to make the crossing accessible to pedestrians with disabilities and to improve crossing conditions for all trail users. (Note: The curb ramp must have detectable warnings in the form of truncated domes as outlined in MnDOT Standard Plate No. 7038A.)	**3.7**
	Realignment (RA)	**RA-01**	Realign the trail path to make a right angle crossing with the crossed roadway.	**3.8**
		RA-02	Realign the trail path such that its angle of intersection with the crossed roadway is ≥ 75 degrees.	**3.8**

	Sight Distances (SD)	**SD-01**	Clear and maintain crossing/stopping sight distance for bicyclists.	**3.2.1, 3.2.2**
		SD-02	Clear and maintain crossing/stopping sight distance for pedestrians.	**3.2.1, 3.2.2**

*Note: Treatments in table are not in any specific order with respect to importance, cost, popularity, ease of implementation etc.

Table 10A: Alternative Treatments for Urban, Multi-Lane, Divided, Speed < 35 mph, ADT ≥ 10,000 vpd, Midblock Crossings



		Available Treatments		
		Treatment ID	**Treatment Description**	**Handbook Section**
Treatments for the Crossed Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-01**	Install traffic signals on the crossed road and trail (Note: only applicable to sites where a signal is warranted per *MN MUTCD*).	**3.1.2.1**
		TSGB-06	Install a yellow flashing beacon with pedestrian pushbutton at the crosswalk (Note: applicable only when the intersection is unsignalized); if used, the designer may also consider applying Treatment TRSS-11.	**3.1.2.2**
		TSGB-07	Install a High intensity Activated crossWalK (HAWK) signal (Note: applicable only when the intersection is unsignalized); if used, apply in conjunction with Treatment TRSS-09.	**3.1.2.1**
		TSGB-08	Install a Rapid Rectangular Flashing Beacon (RRFB) (Note: applicable only when the intersection is unsignalized); if used, use in conjunction with Treatment TRSS-12.	**3.1.2.2**
	Traffic Calming (TC)	**TC-06**	Use bulb outs (i.e., curb extensions) to reduce the crossing distance for trail users.	**3.5.1**
	Traffic Sign (TSN)	**TSN-02**	Install an advance trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at least 250 feet (76.2 meters) from the crossing. A distance plaque may be added beneath the sign.	**3.1.1.2**
		TSN-03	Install a Stop Here For Pedestrians (R1-5) series sign at the crossing on the crossed road	**3.1.1.1**
		TSN-04	Install a Stop Ahead (W3-1) sign for emphasis on the crossed roadway.	**3.1.1.2**

		TSN-05	Install a Yield Ahead (W3-2) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-07	Install a trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at the crossing.	**3.1.1.2**
		TSN-08	Install a STOP HERE ON RED (R10-6) sign at the trail crosswalk with a painted stop line to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
	Pavement Markings and Striping (PMS)	**PMS-04**	Divide the crosswalk to channelize pedestrians and bicyclists and separate their movements.	**3.1.3.2**
		PMS-05	Paint a high-visibility crosswalk on the crossed road "ladder" or "zebra" patterns preferable. (Note: The final decision of applying this treatment should be based on engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP, or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	**3.1.3.2**
		PMS-07	Set back the stop line on the crossed roadway to improve the trail users' and the moving motorists' mutual chance to have an unobstructed view of each other.	**3.1.3.1**
		PMS-08	Paint a stop line and install a STOP HERE ON RED (R10-6) sign on the crossed roadway in advance of the trail crosswalk to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.3.1**
		PMS-09	Paint a STOP AHEAD, YIELD AHEAD, or PED XING advance warning pavement marking on the crossed road.	**3.1.3.1**
	Refuge Islands (RI)	**RI-01**	Install a right-angle median refuge island (Note: this treatment is applicable when the crossed road has high ADT).	**3.3**
		RI-02	Install a median refuge island angled at 75 degrees with opposite sides of the trail across the roadway being slightly offset and supplementary centerline and STOP or YIELD pavement markings in the refuge area (Note: this treatment is applicable when the crossed road has high ADT).	**3.3**

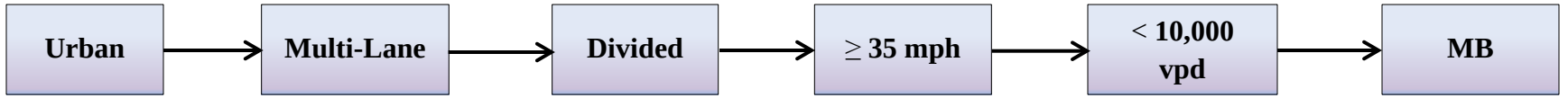
	Sight Distance (SD)	**SD-03**	Clear and maintain stopping/crossing sight distance for motorists.	**3.2.1, 3.2.2**
Treatments for the Trail	**Pavement Markings and Striping (PMS)**	**PMS-01**	Paint a yellow center line only or use one along with advance warning striping for 150 feet (45.7 meters) along the trail approach from the trail entrance point (Note: applicable only when a bollard, lean rail, or median obstruction is present).	**3.1.3.1**
		PMS-02	Paint a stop/yield line to pair with the STOP/YIELD sign or pedestrian/bicycle signal head on the trail at a distance of 3 - 6 feet (0.9 - 1.8 meters) from the crossed road's edge.	**3.1.3.1**
		PMS-03	Paint a STOP/YIELD pavement marking on the trail approach.	**3.1.3.1**
	Trail Signals and Signs (TRSS)	**TRSS-01**	Install a CROSS ONLY ON GREEN (symbolic circular green) (R10-1) sign (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-02	Install a CROSS ONLY ON "WALK" (symbolic walk indication) (R10-2) sign (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-03	Install a sign from the Push Button for Green Light (R10-4) series (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-04	Install a sign from the Push Button for WALK Signal (R10-3) series (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-05	Install a pedestrian/bicyclist pushbutton on the trail 4 - 5 feet (1.2 – 1.5 meters) above the ground such that it is easily accessible for bicyclists to activate the signal without dismounting (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.2.1**
		TRSS-06	Install pedestrian/bicycle signal on the trail approach (Note: applicable only to sites where a signal is warranted per *MN MUTCD*).	**3.1.2.1**
		TRSS-07	Install an advance warning Stop Ahead (W3-1)/Yield Ahead (W3-2) sign on the trail approach at a distance of approximately 100 feet (30.5 meters) in advance of the crossing.	**3.1.1.2**

		TRSS-08	Install a STOP (R1-1) or YIELD (R1-2) sign on the trail approach at a minimum of 2 feet (0.6 meters) from the edge of the trail.	**3.1.1.1**
		TRSS-09	Install a pushbutton for a HAWK signal on the trail approach (Note: applicable only when the trail crossing is unsignalized); if used, use in conjunction with Treatment TSGB-07.	**3.1.2.1**
		TRSS-10	Install a pushbutton at the median refuge island for pedestrians trapped in the refuge area (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.2.1**
		TRSS-11	Install a pushbutton for a yellow flashing beacon on the trail approach (Note: applicable only when yellow flashing beacon has been/ will be installed).	**3.1.2.2**
		TRSS-12	Install a pushbutton for an RRFB on the trail approach (Note: applicable only when RRFB has been/will be installed).	**3.1.2.2**
		TRSS-14	Install a Push Button to Turn on Warning Lights (R10-25) sign at the crossing to inform trail users of how to activate the flashing beacon or RRFB.	**3.1.2.2**
	Trail Access Control (TRAC)	**TRAC-01**	Install a NO MOTOR VEHICLES (R5-3) sign on the trail, facing the roadway, to prevent unauthorized motor vehicles from entering the trail.	**3.1.1.1**
		TRAC-02	Install bollards to prevent unauthorized motor vehicles from entering the trail.	**3.4.1**
		TRAC-03	Install a lean rail parallel to the trail to prevent unauthorized motor vehicles from entering the trail and provide bicyclists with an area in which they can stop without dismounting.	**3.4.2**
		TRAC-04	Install a median on the trail to split the trail into two sections and restrict unauthorized motor vehicles from entering the trail.	**3.4.3**
		TRAC-05	Use discrete curb angles by providing 90 degree angles and sharply defined curbing of the trail crossing to discourage motor vehicle entry.	**3.4.4**
	Lighting (LT)	**LT-01**	Provide lighting for the trail-roadway crossing.	**3.6**
	Curb Ramps (CR)	**CR-01**	Install a curb ramp to make the crossing accessible to pedestrians with disabilities and to improve crossing conditions for all trail users. (Note: The curb ramp must have detectable warnings in the form of truncated domes as outlined in MnDOT Standard Plate No. 7038A.)	**3.7**

	Realignment (RA)	**RA-01**	Realign the trail path to make a right angle crossing with the crossed roadway.	**3.8**
		RA-02	Realign the trail path such that its angle of intersection with the crossed roadway is ≥ 75 degrees.	**3.8**
	Sight Distances (SD)	**SD-01**	Clear and maintain crossing/stopping sight distance for bicyclists.	**3.2.1, 3.2.2**
		SD-02	Clear and maintain crossing/stopping sight distance for pedestrians.	**3.2.1, 3.2.2**

*Note: Treatments in table are not in any specific order with respect to importance, cost, popularity, ease of implementation etc.

Table 11A: Alternative Treatments for Urban, Multi-Lane, Divided, Speed ≥ 35 mph, ADT < 10,000 vpd, Midblock Crossings



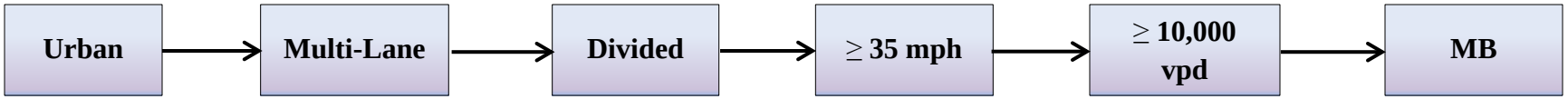
		Available Treatments		
		Treatment ID	**Treatment Description**	**Handbook Section**
Treatments for the Crossed Road	**Traffic Sign (TSN)**	**TSN-02**	Install an advance trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at least 250 feet (76.2 meters) from the crossing. A distance plaque may be added beneath the sign.	**3.1.1.2**
		TSN-03	Install a Stop Here For Pedestrians (R1-5) series sign at the crossing on the crossed road	**3.1.1.1**
		TSN-04	Install a Stop Ahead (W3-1) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-05	Install a Yield Ahead (W3-2) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-07	Install a trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at the crossing.	**3.1.1.2**
		TSN-08	Install a STOP HERE ON RED (R10-6) sign at the trail crosswalk with a painted stop line to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
	Pavement Markings and Striping (PMS)	**PMS-04**	Divide the crosswalk to channelize pedestrians and bicyclists and separate their movements.	**3.1.3.2**
		PMS-05	Paint a high-visibility crosswalk on the crossed road "ladder" or "zebra" patterns preferable. (Note: The final decision of applying this treatment should be based on engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP, or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed	**3.1.3.2**

			restriction detailed in Section 3.1.3.2.)	
		PMS-07	Set back the stop line on the crossed roadway to improve the trail users' and the moving motorists' mutual chance to have an unobstructed view of each other.	**3.1.3.1**
		PMS-08	Paint a stop line and install a STOP HERE ON RED (R10-6) sign on the crossed roadway in advance of the trail crosswalk to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.3.1**
		PMS-09	Paint a STOP AHEAD, YIELD AHEAD, or PED XING advance warning pavement marking on the crossed road.	**3.1.3.1**
	Sight Distance (SD)	**SD-03**	Clear and maintain stopping/crossing sight distance for motorists.	**3.2.1, 3.2.2**
Treatments for the Trail	**Pavement Markings and Striping (PMS)**	**PMS-01**	Paint a yellow center line only or use one along with advance warning striping for 150 feet (45.7 meters) along the trail approach from the trail entrance point (Note: applicable only when a bollard, lean rail, or median obstruction is present).	**3.1.3.1**
		PMS-02	Paint a stop/yield line to pair with the STOP/YIELD sign or pedestrian/bicycle signal head on the trail at a distance of 3 - 6 feet (0.9 - 1.8 meters) from the crossed road's edge.	**3.1.3.1**
		PMS-03	Paint a STOP/YIELD pavement marking on the trail approach.	**3.1.3.1**
	Trail Signals and Signs (TRSS)	**TRSS-01**	Install a CROSS ONLY ON GREEN (symbolic circular green) (R10-1) sign (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-02	Install a CROSS ONLY ON "WALK" (symbolic walk indication) (R10-2) sign (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-03	Install a sign from the Push Button for Green Light (R10-4) series (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-04	Install a sign from the Push Button for WALK Signal (R10-3) series (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-05	Install a pedestrian/bicyclist pushbutton on the trail 4 - 5 feet (1.2 – 1.5 meters) above	**3.1.2.1**

			the ground such that it is easily accessible for bicyclists to activate the signal without dismounting (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	
		TRSS-07	Install an advance warning Stop Ahead (W3-1)/Yield Ahead (W3-2) sign on the trail approach at a distance of approximately 100 feet (30.5 meters) in advance of the crossing.	**3.1.1.2**
		TRSS-08	Install a STOP (R1-1) or YIELD (R1-2) sign on the trail approach at a minimum of 2 feet (0.6 meters) from the edge of the trail.	**3.1.1.1**
	Trail Access Control (TRAC)	**TRAC-01**	Install a NO MOTOR VEHICLES (R5-3) sign on the trail, facing the roadway, to prevent unauthorized motor vehicles from entering the trail.	**3.1.1.1**
		TRAC-02	Install bollards to prevent unauthorized motor vehicles from entering the trail.	**3.4.1**
		TRAC-03	Install a lean rail parallel to the trail to prevent unauthorized motor vehicles from entering the trail and provide bicyclists with an area in which they can stop without dismounting.	**3.4.2**
		TRAC-04	Install a median on the trail to split the trail into two sections and restrict unauthorized motor vehicles from entering the trail.	**3.4.3**
		TRAC-05	Use discrete curb angles by providing 90 degree angles and sharply defined curbing of the trail crossing to discourage motor vehicle entry.	**3.4.4**
	Lighting (LT)	**LT-01**	Provide lighting for the trail-roadway crossing.	**3.6**
	Curb Ramps (CR)	**CR-01**	Install a curb ramp to make the crossing accessible to pedestrians with disabilities and to improve crossing conditions for all trail users. (Note: The curb ramp must have detectable warnings in the form of truncated domes as outlined in MnDOT Standard Plate No. 7038A.)	**3.7**
	Realignment (RA)	**RA-01**	Realign the trail path to make a right angle crossing with the crossed roadway.	**3.8**
		RA-02	Realign the trail path such that its angle of intersection with the crossed roadway is ≥ 75 degrees.	**3.8**
	Sight Distances (SD)	**SD-01**	Clear and maintain crossing/stopping sight distance for bicyclists.	**3.2.1, 3.2.2**
		SD-02	Clear and maintain crossing/stopping sight distance for pedestrians.	**3.2.1, 3.2.2**

*Note: Treatments in table are not in any specific order with respect to importance, cost, popularity, ease of implementation etc.

Table 12A: Alternative Treatments for Urban, Multi-Lane, Divided, Speed ≥ 35 mph, ADT ≥ 10,000 vpd, Midblock Crossings



		Available Treatments		
		Treatment ID	**Treatment Description**	**Handbook Section**
Treatments for the Crossed Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-01**	Install traffic signals on the crossed road and trail (Note: only applicable to sites where a signal is warranted per *MN MUTCD*).	**3.1.2.1**
		TSGB-06	Install a yellow flashing beacon with pedestrian pushbutton at the crosswalk (Note: applicable only when the intersection is unsignalized); if used, the designer may also consider applying Treatment TRSS-11.	**3.1.2.2**
		TSGB-07	Install a High intensity Activated crossWalK (HAWK) signal (Note: applicable only when the intersection is unsignalized); if used, apply in conjunction with Treatment TRSS-09.	**3.1.2.1**
		TSGB-08	Install a Rapid Rectangular Flashing Beacon (RRFB) (Note: applicable only when the intersection is unsignalized); if used, use in conjunction with Treatment TRSS-12.	**3.1.2.2**
	Traffic Sign (TSN)	**TSN-02**	Install an advance trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at least 250 feet (76.2 meters) from the crossing. A distance plaque may be added beneath the sign.	**3.1.1.2**
		TSN-03	Install a Stop Here For Pedestrians (R1-5) series sign at the crossing on the crossed road	**3.1.1.1**
		TSN-04	Install a Stop Ahead (W3-1) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-05	Install a Yield Ahead (W3-2) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-07	Install a trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning	**3.1.1.2**

			(W11-15) sign, on the crossed roadway at the crossing.	
		TSN-08	Install a STOP HERE ON RED (R10-6) sign at the trail crosswalk with a painted stop line to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
	Pavement Markings and Striping (PMS)	**PMS-04**	Divide the crosswalk to channelize pedestrians and bicyclists and separate their movements.	**3.1.3.2**
		PMS-05	Paint a high-visibility crosswalk on the crossed road "ladder" or "zebra" patterns preferable. (Note: The final decision of applying this treatment should be based on engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP, or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	**3.1.3.2**
		PMS-06	Paint a high-visibility "standard" pattern crosswalk on the crossed road. (Note: The final decision of applying this treatment should be based on engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP, or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	**3.1.3.2**
		PMS-07	Set back the stop line on the crossed roadway to improve the trail users' and the moving motorists' mutual chance to have an unobstructed view of each other.	**3.1.3.1**
		PMS-08	Paint a stop line and install a STOP HERE ON RED (R10-6) sign on the crossed roadway in advance of the trail crosswalk to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.3.1**
		PMS-09	Paint a STOP AHEAD, YIELD AHEAD, or PED XING advance warning pavement marking on the crossed road.	**3.1.3.1**
	Refuge Island (RI)	**RI-01**	Install a right-angle median refuge island.	**3.3**
		RI-02	Install a median refuge island angled at 75 degrees with opposite sides of the trail across the roadway being slightly offset and supplementary centerline and STOP or YIELD pavement markings in the refuge area.	**3.3**

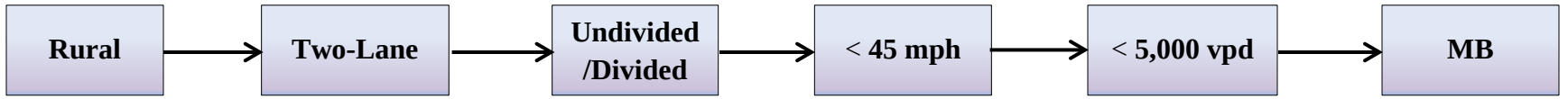
	Sight Distance (SD)	**SD-03**	Clear and maintain stopping/crossing sight distance for motorists.	**3.2.1, 3.2.2**
Treatments for the Trail	**Pavement Markings and Striping (PMS)**	**PMS-01**	Paint a yellow center line only or use one along with advance warning striping for 150 feet (45.7 meters) along the trail approach from the trail entrance point (Note: applicable only when a bollard, lean rail, or median obstruction is present).	**3.1.3.1**
		PMS-02	Paint a stop/yield line to pair with the STOP/YIELD sign or pedestrian/bicycle signal head on the trail at a distance of 3 - 6 feet (0.9 - 1.8 meters) from the crossed road's edge.	**3.1.3.1**
		PMS-03	Paint a STOP/YIELD pavement marking on the trail approach.	**3.1.3.1**
	Trail Signals and Signs (TRSS)	**TRSS-01**	Install a CROSS ONLY ON GREEN (symbolic circular green) (R10-1) sign (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-02	Install a CROSS ONLY ON "WALK" (symbolic walk indication) (R10-2) sign (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-03	Install a sign from the Push Button for Green Light (R10-4) series (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-04	Install a sign from the Push Button for WALK Signal (R10-3) series (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-05	Install a pedestrian/bicyclist pushbutton on the trail 4 - 5 feet (1.2 – 1.5 meters) above the ground such that it is easily accessible for bicyclists to activate the signal without dismounting (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.2.1**
		TRSS-06	Install pedestrian/bicycle signal on the trail approach (Note: applicable only to sites where a signal is warranted per *MN MUTCD*).	**3.1.2.1**
		TRSS-07	Install an advance warning Stop Ahead (W3-1)/Yield Ahead (W3-2) sign on the trail approach at a distance of approximately 100 feet (30.5 meters) in advance of the crossing.	**3.1.1.2**
		TRSS-08	Install a STOP (R1-1) or YIELD (R1-2) sign on the trail approach at a minimum of 2	**3.1.1.1**

			feet (0.6 meters) from the edge of the trail.	
		TRSS-09	Install a pushbutton for a HAWK signal on the trail approach (Note: applicable only when the trail crossing is unsignalized); if used, use in conjunction with Treatment TSGB-07.	**3.1.2.1**
		TRSS-10	Install a pushbutton at the median refuge island for pedestrians trapped in the refuge area (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.2.1**
		TRSS-11	Install a pushbutton for a yellow flashing beacon on the trail approach (Note: applicable only when yellow flashing beacon has been/ will be installed).	**3.1.2.2**
		TRSS-12	Install a pushbutton for an RRFB on the trail approach (Note: applicable only when RRFB has been/will be installed).	**3.1.2.2**
		TRSS-14	Install a Push Button to Turn on Warning Lights (R10-25) sign at the crossing to inform trail users of how to activate the flashing beacon or RRFB.	**3.1.2.2**
	Trail Access Control (TRAC)	**TRAC-01**	Install a NO MOTOR VEHICLES (R5-3) sign on the trail, facing the roadway, to prevent unauthorized motor vehicles from entering the trail.	**3.1.1.1**
		TRAC-02	Install bollards to prevent unauthorized motor vehicles from entering the trail.	**3.4.1**
		TRAC-03	Install a lean rail parallel to the trail to prevent unauthorized motor vehicles from entering the trail and provide bicyclists with an area in which they can stop without dismounting.	**3.4.2**
		TRAC-04	Install a median on the trail to split the trail into two sections and restrict unauthorized motor vehicles from entering the trail.	**3.4.3**
		TRAC-05	Use discrete curb angles by providing 90 degree angles and sharply defined curbing of the trail crossing to discourage motor vehicle entry.	**3.4.4**
	Lighting (LT)	**LT-01**	Provide lighting for the trail-roadway crossing.	**3.6**
	Curb Ramps (CR)	**CR-01**	Install a curb ramp to make the crossing accessible to pedestrians with disabilities and to improve crossing conditions for all trail users. (Note: The curb ramp must have detectable warnings in the form of truncated domes as outlined in MnDOT Standard Plate No. 7038A.)	**3.7**
	Realignment (RA)	**RA-01**	Realign the trail path to make a right angle crossing with the crossed roadway.	**3.8**

		RA-02	Realign the trail path such that its angle of intersection with the crossed roadway is ≥ 75 degrees.	**3.8**
	Sight Distances (SD)	**SD-01**	Clear and maintain crossing/stopping sight distance for bicyclists.	**3.2.1, 3.2.2**
		SD-02	Clear and maintain crossing/stopping sight distance for pedestrians.	**3.2.1, 3.2.2**

*Note: Treatments in table are not in any specific order with respect to importance, cost, popularity, ease of implementation etc.

Table 13A: Alternative Treatments for Rural, Two-Lane, Undivided/Divided, Speed < 45 mph, ADT < 5,000 vpd, Midblock Crossings



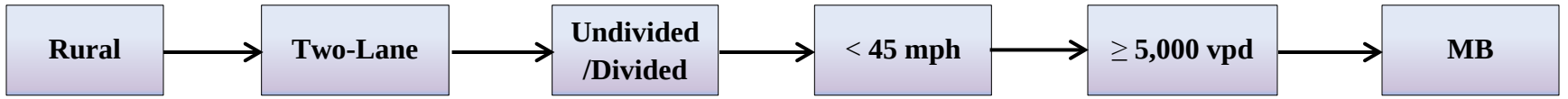
		Available Treatments		
		Treatment ID	**Treatment Description**	**Handbook Section**
Treatments for the Crossed Road	**Traffic Sign (TSN)**	**TSN-01**	Install an advance trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at least 750 feet (228.6 meters) from the crossing. A distance plaque may be added beneath the sign.	**3.1.1.2**
		TSN-04	Install a Stop Ahead (W3-1) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-05	Install a Yield Ahead (W3-2) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-07	Install a trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at the crossing.	**3.1.1.2**
		TSN-08	Install a STOP HERE ON RED (R10-6) sign at the trail crosswalk with a painted stop line to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
		TSN-10	Install an advance trail-crossing warning sign for snowmobiles, i.e., the Snowmobile Crossing (W11-6) sign, on the crossed roadway at least 750 feet (228.6 meters) from the crossing (Note: applicable only on trails for exclusive snowmobile use).	**3.1.1.2**
		TSN-11	Install a snowmobile-crossing warning sign, i.e., the Snowmobile Crossing (W11-6) sign, on the crossed roadway at the trail crossing (Note: applicable only on trails for exclusive snowmobile use).	**3.1.1.2**
	Pavement Markings and Striping	**PMS-04**	Divide the crosswalk to channelize pedestrians and bicyclists and separate their movements.	**3.1.3.2**
		PMS-05	Paint a high-visibility crosswalk on the crossed road “ladder” or “zebra” patterns	**3.1.3.2**

	(PMS)		preferable. (Note: The final decision of applying this treatment should be based on engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP, or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	
		PMS-07	Set back the stop line on the crossed roadway to improve the trail users' and the moving motorists' mutual chance to have an unobstructed view of each other.	**3.1.3.1**
		PMS-08	Paint a stop line and install a STOP HERE ON RED (R10-6) sign on the crossed roadway in advance of the trail crosswalk to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.3.1**
		PMS-09	Paint a STOP AHEAD, YIELD AHEAD, or PED XING advance warning pavement marking on the crossed road.	**3.1.3.1**
	Sight Distance (SD)	**SD-03**	Clear and maintain stopping/crossing sight distance for motorists.	**3.2.1, 3.2.2**
Treatments for the Trail	**Pavement Markings and Striping (PMS)**	**PMS-01**	Paint a yellow center line only or use one along with advance warning striping for 150 feet (45.7 meters) along the trail approach from the trail entrance point (Note: applicable only when a bollard, lean rail, or median obstruction is present).	**3.1.3.1**
		PMS-02	Paint a stop/yield line to pair with the STOP/YIELD sign or pedestrian/bicycle signal head on the trail at a distance of 3 - 6 feet (0.9 - 1.8 meters) from the crossed road's edge.	**3.1.3.1**
		PMS-03	Paint a STOP/YIELD pavement marking on the trail approach.	**3.1.3.1**
	Trail Signals and Signs (TRSS)	**TRSS-01**	Install a CROSS ONLY ON GREEN (symbolic circular green) (R10-1) sign (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-02	Install a CROSS ONLY ON "WALK" (symbolic walk indication) (R10-2) sign (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-03	Install a sign from the Push Button for Green Light (R10-4) series (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**

		TRSS-04	Install a sign from the Push Button for WALK Signal (R10-3) series (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-05	Install a pedestrian/bicyclist pushbutton on the trail 4 - 5 feet (1.2 – 1.5 meters) above the ground such that it is easily accessible for bicyclists to activate the signal without dismounting (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.2.1**
		TRSS-07	Install an advance warning Stop Ahead (W3-1)/Yield Ahead (W3-2) sign on the trail approach at a distance of approximately 100 feet (30.5 meters) in advance of the crossing.	**3.1.1.2**
		TRSS-08	Install a STOP (R1-1) or YIELD (R1-2) sign on the trail approach at a minimum of 2 feet (0.6 meters) from the edge of the trail.	**3.1.1.1**
	Trail Access Control (TRAC)	**TRAC-01**	Install a NO MOTOR VEHICLES (R5-3) sign on the trail, facing the roadway, to prevent unauthorized motor vehicles from entering the trail.	**3.1.1.1**
		TRAC-02	Install bollards to prevent unauthorized motor vehicles from entering the trail.	**3.4.1**
		TRAC-03	Install a lean rail parallel to the trail to prevent unauthorized motor vehicles from entering the trail and provide bicyclists with an area in which they can stop without dismounting.	**3.4.2**
		TRAC-04	Install a median on the trail to split the trail into two sections and restrict unauthorized motor vehicles from entering the trail.	**3.4.3**
	Curb Ramps (CR)	**CR-01**	Install a curb ramp to make the crossing accessible to pedestrians with disabilities and to improve crossing conditions for all trail users. (Note: The curb ramp must have detectable warnings in the form of truncated domes as outlined in MnDOT Standard Plate No. 7038A.)	**3.7**
	Realignment (RA)	**RA-01**	Realign the trail path to make a right angle crossing with the crossed roadway.	**3.8**
		RA-02	Realign the trail path such that its angle of intersection with the crossed roadway is ≥ 75 degrees.	**3.8**
	Sight Distances (SD)	**SD-01**	Clear and maintain crossing/stopping sight distance for bicyclists.	**3.2.1, 3.2.2**
		SD-02	Clear and maintain crossing/stopping sight distance for pedestrians.	**3.2.1, 3.2.2**

*Note: Treatments in table are not in any specific order with respect to importance, cost, popularity, ease of implementation etc.

Table 14A: Alternative Treatments for Rural, Two-Lane, Undivided/Divided, Speed < 45 mph, ADT ≥ 5,000 vpd, Midblock Crossings



		Available Treatments		
		Treatment ID	**Treatment Description**	**Handbook Section**
Treatments for the Crossed Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-01**	Install traffic signals on the crossed road and trail (Note: only applicable to sites where a signal is warranted per *MN MUTCD*).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-01**	Install an advance trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at least 750 feet (228.6 meters) from the crossing. A distance plaque may be added beneath the sign.	**3.1.1.2**
		TSN-04	Install a Stop Ahead (W3-1) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-05	Install a Yield Ahead (W3-2) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-07	Install a trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at the crossing.	**3.1.1.2**
		TSN-08	Install a STOP HERE ON RED (R10-6) sign at the trail crosswalk with a painted stop line to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
		TSN-10	Install an advance trail-crossing warning sign for snowmobiles, i.e., the Snowmobile Crossing (W11-6) sign, on the crossed roadway at least 750 feet (228.6 meters) from the crossing (Note: applicable only on trails for exclusive snowmobile use).	**3.1.1.2**
		TSN-11	Install a snowmobile-crossing warning sign, i.e., the Snowmobile Crossing (W11-6)	**3.1.1.2**

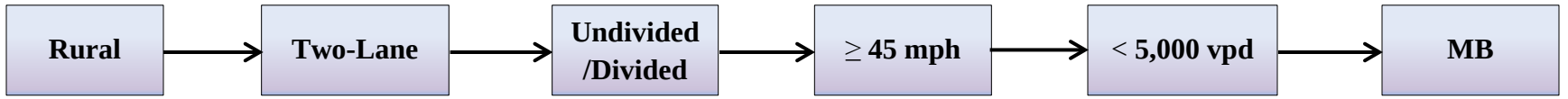
			sign, on the crossed roadway at the trail crossing (Note: applicable only on trails for exclusive snowmobile use).	
	Pavement Markings and Striping (PMS)	**PMS-04**	Divide the crosswalk to channelize pedestrians and bicyclists and separate their movements.	**3.1.3.2**
		PMS-05	Paint a high-visibility crosswalk on the crossed road "ladder" or "zebra" patterns preferable. (Note: The final decision of applying this treatment should be based on engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP, or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	**3.1.3.2**
		PMS-07	Set back the stop line on the crossed roadway to improve the trail users' and the moving motorists' mutual chance to have an unobstructed view of each other.	**3.1.3.1**
		PMS-08	Paint a stop line and install a STOP HERE ON RED (R10-6) sign on the crossed roadway in advance of the trail crosswalk to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.3.1**
		PMS-09	Paint a STOP AHEAD, YIELD AHEAD, or PED XING advance warning pavement marking on the crossed road.	**3.1.3.1**
	Sight Distance (SD)	**SD-03**	Clear and maintain stopping/crossing sight distance for motorists.	**3.2.1, 3.2.2**
Treatments for the Trail	**Pavement Markings and Striping (PMS)**	**PMS-01**	Paint a yellow center line only or use one along with advance warning striping for 150 feet (45.7 meters) along the trail approach from the trail entrance point (Note: applicable only when a bollard, lean rail, or median obstruction is present).	**3.1.3.1**
		PMS-02	Paint a stop/yield line to pair with the STOP/YIELD sign or pedestrian/bicycle signal head on the trail at a distance of 3 - 6 feet (0.9 - 1.8 meters) from the crossed road's edge.	**3.1.3.1**
		PMS-03	Paint a STOP/YIELD pavement marking on the trail approach.	**3.1.3.1**
	Trail Signals and Signs (TRSS)	**TRSS-01**	Install a CROSS ONLY ON GREEN (symbolic circular green) (R10-1) sign (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-02	Install a CROSS ONLY ON "WALK" (symbolic walk indication) (R10-2) sign (Note:	**3.1.1.1**

			applicable only when the pedestrian signal is already/will be installed at the trail crossing).	
		TRSS-03	Install a sign from the Push Button for Green Light (R10-4) series (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-04	Install a sign from the Push Button for WALK Signal (R10-3) series (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-05	Install a pedestrian/bicyclist pushbutton on the trail 4 - 5 feet (1.2 – 1.5 meters) above the ground such that it is easily accessible for bicyclists to activate the signal without dismounting (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.2.1**
		TRSS-06	Install pedestrian/bicycle signal on the trail approach (Note: applicable only to sites where a signal is warranted per *MN MUTCD*).	**3.1.2.1**
		TRSS-07	Install an advance warning Stop Ahead (W3-1)/Yield Ahead (W3-2) sign on the trail approach at a distance of approximately 100 feet (30.5 meters) in advance of the crossing.	**3.1.1.2**
		TRSS-08	Install a STOP (R1-1) or YIELD (R1-2) sign on the trail approach at a minimum of 2 feet (0.6 meters) from the edge of the trail.	**3.1.1.1**
	Trail Access Control (TRAC)	**TRAC-01**	Install a NO MOTOR VEHICLES (R5-3) sign on the trail, facing the roadway, to prevent unauthorized motor vehicles from entering the trail.	**3.1.1.1**
		TRAC-02	Install bollards to prevent unauthorized motor vehicles from entering the trail.	**3.4.1**
		TRAC-03	Install a lean rail parallel to the trail to prevent unauthorized motor vehicles from entering the trail and provide bicyclists with an area in which they can stop without dismounting.	**3.4.2**
		TRAC-04	Install a median on the trail to split the trail into two sections and restrict unauthorized motor vehicles from entering the trail.	**3.4.3**
	Curb Ramps (CR)	**CR-01**	Install a curb ramp to make the crossing accessible to pedestrians with disabilities and to improve crossing conditions for all trail users. (Note: The curb ramp must have detectable warnings in the form of truncated domes as outlined in MnDOT Standard Plate No. 7038A.)	**3.7**

	Realignment (RA)	**RA-01**	Realign the trail path to make a right angle crossing with the crossed roadway.	**3.8**
		RA-02	Realign the trail path such that its angle of intersection with the crossed roadway is ≥ 75 degrees.	**3.8**
	Sight Distances (SD)	**SD-01**	Clear and maintain crossing/stopping sight distance for bicyclists.	**3.2.1, 3.2.2**
		SD-02	Clear and maintain crossing/stopping sight distance for pedestrians.	**3.2.1, 3.2.2**

*Note: Treatments in table are not in any specific order with respect to importance, cost, popularity, ease of implementation etc.

Table 15A: Alternative Treatments for Rural, Two-Lane, Undivided/Divided, Speed ≥ 45 mph, ADT < 5,000 vpd Midblock Crossings



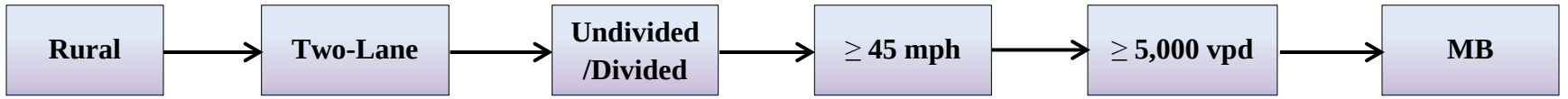
		Available Treatments		
		Treatment ID	**Treatment Description**	**Handbook Section**
Treatments for the Crossed Road	**Traffic Sign (TSN)**	**TSN-01**	Install an advance trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at least 750 feet (228.6 meters) from the crossing. A distance plaque may be added beneath the sign.	**3.1.1.2**
		TSN-04	Install a Stop Ahead (W3-1) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-05	Install a Yield Ahead (W3-2) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-07	Install a trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at the crossing.	**3.1.1.2**
		TSN-08	Install a STOP HERE ON RED (R10-6) sign at the trail crosswalk with a painted stop line to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
		TSN-10	Install an advance trail-crossing warning sign for snowmobiles, i.e., the Snowmobile Crossing (W11-6) sign, on the crossed roadway at least 750 feet (228.6 meters) from the crossing (Note: applicable only on trails for exclusive snowmobile use).	**3.1.1.2**
		TSN-11	Install a snowmobile-crossing warning sign, i.e., the Snowmobile Crossing (W11-6) sign, on the crossed roadway at the trail crossing (Note: applicable only on trails for exclusive snowmobile use).	**3.1.1.2**
	Pavement Markings	**PMS-04**	Divide the crosswalk to channelize pedestrians and bicyclists and separate their movements.	**3.1.3.2**

	and Striping (PMS)	**PMS-05**	Paint a high-visibility crosswalk on the crossed road "ladder" or "zebra" patterns preferable. (Note: The final decision of applying this treatment should be based on engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP, or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	**3.1.3.2**
		PMS-07	Set back the stop line on the crossed roadway to improve the trail users' and the moving motorists' mutual chance to have an unobstructed view of each other.	**3.1.3.1**
		PMS-08	Paint a stop line and install a STOP HERE ON RED (R10-6) sign on the crossed roadway in advance of the trail crosswalk to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.3.1**
		PMS-09	Paint a STOP AHEAD, YIELD AHEAD, or PED XING advance warning pavement marking on the crossed road.	**3.1.3.1**
	Sight Distance (SD)	**SD-03**	Clear and maintain stopping/crossing sight distance for motorists.	**3.2.1, 3.2.2**
Treatments for the Trail	**Pavement Markings and Striping (PMS)**	**PMS-01**	Paint a yellow center line only or use one along with advance warning striping for 150 feet (45.7 meters) along the trail approach from the trail entrance point (Note: applicable only when a bollard, lean rail, or median obstruction is present).	**3.1.3.1**
		PMS-02	Paint a stop/yield line to pair with the STOP/YIELD sign or pedestrian/bicycle signal head on the trail at a distance of 3 - 6 feet (0.9 - 1.8 meters) from the crossed road's edge.	**3.1.3.1**
		PMS-03	Paint a STOP/YIELD pavement marking on the trail approach.	**3.1.3.1**
	Trail Signals and Signs (TRSS)	**TRSS-01**	Install a CROSS ONLY ON GREEN (symbolic circular green) (R10-1) sign (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-02	Install a CROSS ONLY ON "WALK" (symbolic walk indication) (R10-2) sign (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-03	Install a sign from the Push Button for Green Light (R10-4) series (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail	**3.1.1.1**

			crossing).	
		TRSS-04	Install a sign from the Push Button for WALK Signal (R10-3) series (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-05	Install a pedestrian/bicyclist pushbutton on the trail 4 - 5 feet (1.2 – 1.5 meters) above the ground such that it is easily accessible for bicyclists to activate the signal without dismounting (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.2.1**
		TRSS-07	Install an advance warning Stop Ahead (W3-1)/Yield Ahead (W3-2) sign on the trail approach at a distance of approximately 100 feet (30.5 meters) in advance of the crossing.	**3.1.1.2**
		TRSS-08	Install a STOP (R1-1) or YIELD (R1-2) sign on the trail approach at a minimum of 2 feet (0.6 meters) from the edge of the trail.	**3.1.1.1**
	Trail Access Control (TRAC)	**TRAC-01**	Install a NO MOTOR VEHICLES (R5-3) sign on the trail, facing the roadway, to prevent unauthorized motor vehicles from entering the trail.	**3.1.1.1**
		TRAC-02	Install bollards to prevent unauthorized motor vehicles from entering the trail.	**3.4.1**
		TRAC-03	Install a lean rail parallel to the trail to prevent unauthorized motor vehicles from entering the trail and provide bicyclists with an area in which they can stop without dismounting.	**3.4.2**
		TRAC-04	Install a median on the trail to split the trail into two sections and restrict unauthorized motor vehicles from entering the trail.	**3.4.3**
	Curb Ramps (CR)	**CR-01**	Install a curb ramp to make the crossing accessible to pedestrians with disabilities and to improve crossing conditions for all trail users. (Note: The curb ramp must have detectable warnings in the form of truncated domes as outlined in MnDOT Standard Plate No. 7038A.)	**3.7**
	Realignment (RA)	**RA-01**	Realign the trail path to make a right angle crossing with the crossed roadway.	**3.8**
		RA-02	Realign the trail path such that its angle of intersection with the crossed roadway is ≥ 75 degrees.	**3.8**
	Sight Distances (SD)	**SD-01**	Clear and maintain crossing/stopping sight distance for bicyclists.	**3.2.1, 3.2.2**
		SD-02	Clear and maintain crossing/stopping sight distance for pedestrians.	**3.2.1, 3.2.2**

*Note: Treatments in table are not in any specific order with respect to importance, cost, popularity, ease of implementation etc.

Table 16A: Alternative Treatments for Rural, Two-Lane, Undivided/Divided, Speed ≥ 45 mph, ADT ≥ 5,000 vpd, Midblock Crossings



		Available Treatments		
		Treatment ID	**Treatment Description**	**Handbook Section**
Treatments for the Crossed Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-01**	Install traffic signals on the crossed road and trail (Note: only applicable to sites where a signal is warranted per *MN MUTCD*).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-01**	Install an advance trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at least 750 feet (228.6 meters) from the crossing. A distance plaque may be added beneath the sign.	**3.1.1.2**
		TSN-04	Install a Stop Ahead (W3-1) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-05	Install a Yield Ahead (W3-2) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-07	Install a trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at the crossing.	**3.1.1.2**
		TSN-08	Install a STOP HERE ON RED (R10-6) sign at the trail crosswalk with a painted stop line to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
		TSN-10	Install an advance trail-crossing warning sign for snowmobiles, i.e., the Snowmobile Crossing (W11-6) sign, on the crossed roadway at least 750 feet (228.6 meters) from the crossing (Note: applicable only on trails for exclusive snowmobile use).	**3.1.1.2**
		TSN-11	Install a snowmobile-crossing warning sign, i.e., the Snowmobile Crossing (W11-6)	**3.1.1.2**

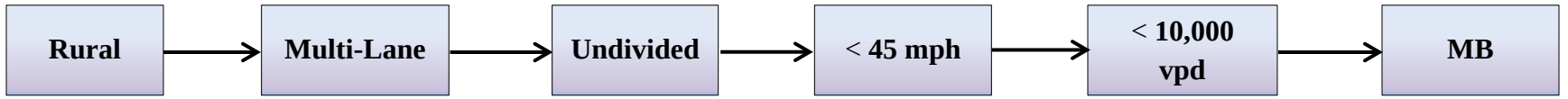
			sign, on the crossed roadway at the trail crossing (Note: applicable only on trails for exclusive snowmobile use).	
	Pavement Markings and Striping (PMS)	**PMS-04**	Divide the crosswalk to channelize pedestrians and bicyclists and separate their movements.	**3.1.3.2**
		PMS-05	Paint a high-visibility crosswalk on the crossed road "ladder" or "zebra" patterns preferable. (Note: The final decision of applying this treatment should be based on engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP, or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	**3.1.3.2**
		PMS-06	Paint a high-visibility "standard" pattern crosswalk on the crossed road. (Note: The final decision of applying this treatment should be based on engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP, or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	**3.1.3.2**
		PMS-07	Set back the stop line on the crossed roadway to improve the trail users' and the moving motorists' mutual chance to have an unobstructed view of each other.	**3.1.3.1**
		PMS-08	Paint a stop line and install a STOP HERE ON RED (R10-6) sign on the crossed roadway in advance of the trail crosswalk to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.3.1**
		PMS-09	Paint a STOP AHEAD, YIELD AHEAD, or PED XING advance warning pavement marking on the crossed road.	**3.1.3.1**
	Sight Distance (SD)	**SD-03**	Clear and maintain stopping/crossing sight distance for motorists.	**3.2.1, 3.2.2**
Treatments	**Pavement Markings and Striping (PMS)**	**PMS-01**	Paint a yellow center line only or use one along with advance warning striping for 150 feet (45.7 meters) along the trail approach from the trail entrance point (Note: applicable only when a bollard, lean rail, or median obstruction is present).	**3.1.3.1**
		PMS-02	Paint a stop/yield line to pair with the STOP/YIELD sign or pedestrian/bicycle signal head on the trail at a distance of 3 - 6 feet (0.9 - 1.8 meters) from the crossed road's	**3.1.3.1**

for the Trail			edge.	
		PMS-03	Paint a STOP/YIELD pavement marking on the trail approach.	**3.1.3.1**
	Trail Signals and Signs (TRSS)	**TRSS-01**	Install a CROSS ONLY ON GREEN (symbolic circular green) (R10-1) sign (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-02	Install a CROSS ONLY ON "WALK" (symbolic walk indication) (R10-2) sign (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-03	Install a sign from the Push Button for Green Light (R10-4) series (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-04	Install a sign from the Push Button for WALK Signal (R10-3) series (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-05	Install a pedestrian/bicyclist pushbutton on the trail 4 - 5 feet (1.2 – 1.5 meters) above the ground such that it is easily accessible for bicyclists to activate the signal without dismounting (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.2.1**
		TRSS-06	Install pedestrian/bicycle signal on the trail approach (Note: applicable only to sites where a signal is warranted per *MN MUTCD*).	**3.1.2.1**
		TRSS-07	Install an advance warning Stop Ahead (W3-1)/Yield Ahead (W3-2) sign on the trail approach at a distance of approximately 100 feet (30.5 meters) in advance of the crossing.	**3.1.1.2**
		TRSS-08	Install a STOP (R1-1) or YIELD (R1-2) sign on the trail approach at a minimum of 2 feet (0.6 meters) from the edge of the trail.	**3.1.1.1**
	Trail Access Control (TRAC)	**TRAC-01**	Install a NO MOTOR VEHICLES (R5-3) sign on the trail, facing the roadway, to prevent unauthorized motor vehicles from entering the trail.	**3.1.1.1**
		TRAC-02	Install bollards to prevent unauthorized motor vehicles from entering the trail.	**3.4.1**
		TRAC-03	Install a lean rail parallel to the trail to prevent unauthorized motor vehicles from entering the trail and provide bicyclists with an area in which they can stop without dismounting.	**3.4.2**
		TRAC-04	Install a median on the trail to split the trail into two sections and restrict unauthorized	**3.4.3**

			motor vehicles from entering the trail.	
	Curb Ramps (CR)	**CR-01**	Install a curb ramp to make the crossing accessible to pedestrians with disabilities and to improve crossing conditions for all trail users. (Note: The curb ramp must have detectable warnings in the form of truncated domes as outlined in MnDOT Standard Plate No. 7038A.)	**3.7**
	Realignment (RA)	**RA-01**	Realign the trail path to make a right angle crossing with the crossed roadway.	**3.8**
		RA-02	Realign the trail path such that its angle of intersection with the crossed roadway is ≥ 75 degrees.	**3.8**
	Sight Distances (SD)	**SD-01**	Clear and maintain crossing/stopping sight distance for bicyclists.	**3.2.1, 3.2.2**
		SD-02	Clear and maintain crossing/stopping sight distance for pedestrians.	**3.2.1, 3.2.2**

*Note: Treatments in table are not in any specific order with respect to importance, cost, popularity, ease of implementation etc.

Table 17A: Alternative Treatments for Rural, Multi-Lane, Undivided, Speed < 45 mph, ADT < 10,000 vpd, Midblock Crossings



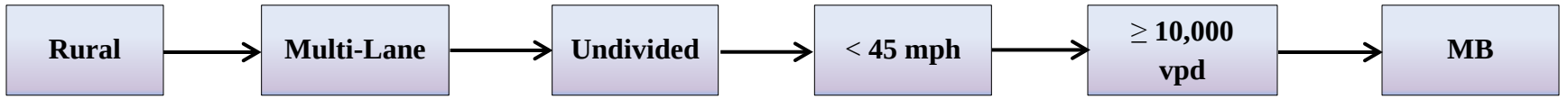
		Available Treatments		
		Treatment ID	**Treatment Description**	**Handbook Section**
Treatments for the Crossed Road	**Traffic Sign (TSN)**	**TSN-01**	Install an advance trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at least 750 feet (228.6 meters) from the crossing. A distance plaque may be added beneath the sign.	**3.1.1.2**
		TSN-03	Install a Stop Here For Pedestrians (R1-5) series sign at the crossing on the crossed road	**3.1.1.1**
		TSN-04	Install a Stop Ahead (W3-1) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-05	Install a Yield Ahead (W3-2) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-07	Install a trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at the crossing.	**3.1.1.2**
		TSN-08	Install a STOP HERE ON RED (R10-6) sign at the trail crosswalk with a painted stop line to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
		TSN-10	Install an advance trail-crossing warning sign for snowmobiles, i.e., the Snowmobile Crossing (W11-6) sign, on the crossed roadway at least 750 feet (228.6 meters) from the crossing (Note: applicable only on trails for exclusive snowmobile use).	**3.1.1.2**
		TSN-11	Install a snowmobile-crossing warning sign, i.e., the Snowmobile Crossing (W11-6) sign, on the crossed roadway at the trail crossing (Note: applicable only on trails for exclusive snowmobile use).	**3.1.1.2**
	Pavement Markings	**PMS-04**	Divide the crosswalk to channelize pedestrians and bicyclists and separate their movements.	**3.1.3.2**

	and Striping (PMS)	**PMS-05**	Paint a high-visibility crosswalk on the crossed road "ladder" or "zebra" patterns preferable. (Note: The final decision of applying this treatment should be based on engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP, or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	**3.1.3.2**
		PMS-07	Set back the stop line on the crossed roadway to improve the trail users' and the moving motorists' mutual chance to have an unobstructed view of each other.	**3.1.3.1**
		PMS-08	Paint a stop line and install a STOP HERE ON RED (R10-6) sign on the crossed roadway in advance of the trail crosswalk to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.3.1**
		PMS-09	Paint a STOP AHEAD, YIELD AHEAD, or PED XING advance warning pavement marking on the crossed road.	**3.1.3.1**
	Sight Distance (SD)	**SD-03**	Clear and maintain stopping/crossing sight distance for motorists.	**3.2.1, 3.2.2**
Treatments for the Trail	**Pavement Markings and Striping (PMS)**	**PMS-01**	Paint a yellow center line only or use one along with advance warning striping for 150 feet (45.7 meters) along the trail approach from the trail entrance point (Note: applicable only when a bollard, lean rail, or median obstruction is present).	**3.1.3.1**
		PMS-02	Paint a stop/yield line to pair with the STOP/YIELD sign or pedestrian/bicycle signal head on the trail at a distance of 3 - 6 feet (0.9 - 1.8 meters) from the crossed road's edge.	**3.1.3.1**
		PMS-03	Paint a STOP/YIELD pavement marking on the trail approach.	**3.1.3.1**
	Trail Signals and Signs (TRSS)	**TRSS-01**	Install a CROSS ONLY ON GREEN (symbolic circular green) (R10-1) sign (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-02	Install a CROSS ONLY ON "WALK" (symbolic walk indication) (R10-2) sign (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-03	Install a sign from the Push Button for Green Light (R10-4) series (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**

		TRSS-04	Install a sign from the Push Button for WALK Signal (R10-3) series (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-05	Install a pedestrian/bicyclist pushbutton on the trail 4 - 5 feet (1.2 – 1.5 meters) above the ground such that it is easily accessible for bicyclists to activate the signal without dismounting (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.2.1**
		TRSS-07	Install an advance warning Stop Ahead (W3-1)/Yield Ahead (W3-2) sign on the trail approach at a distance of approximately 100 feet (30.5 meters) in advance of the crossing.	**3.1.1.2**
		TRSS-08	Install a STOP (R1-1) or YIELD (R1-2) sign on the trail approach at a minimum of 2 feet (0.6 meters) from the edge of the trail.	**3.1.1.1**
	Trail Access Control (TRAC)	**TRAC-01**	Install a NO MOTOR VEHICLES (R5-3) sign on the trail, facing the roadway, to prevent unauthorized motor vehicles from entering the trail.	**3.1.1.1**
		TRAC-02	Install bollards to prevent unauthorized motor vehicles from entering the trail.	**3.4.1**
		TRAC-03	Install a lean rail parallel to the trail to prevent unauthorized motor vehicles from entering the trail and provide bicyclists with an area in which they can stop without dismounting.	**3.4.2**
		TRAC-04	Install a median on the trail to split the trail into two sections and restrict unauthorized motor vehicles from entering the trail.	**3.4.3**
	Curb Ramps (CR)	**CR-01**	Install a curb ramp to make the crossing accessible to pedestrians with disabilities and to improve crossing conditions for all trail users. (Note: The curb ramp must have detectable warnings in the form of truncated domes as outlined in MnDOT Standard Plate No. 7038A.)	**3.7**
	Realignment (RA)	**RA-01**	Realign the trail path to make a right angle crossing with the crossed roadway.	**3.8**
		RA-02	Realign the trail path such that its angle of intersection with the crossed roadway is ≥ 75 degrees.	**3.8**
	Sight Distances (SD)	**SD-01**	Clear and maintain crossing/stopping sight distance for bicyclists.	**3.2.1, 3.2.2**
		SD-02	Clear and maintain crossing/stopping sight distance for pedestrians.	**3.2.1, 3.2.2**

*Note: Treatments in table are not in any specific order with respect to importance, cost, popularity, ease of implementation etc.

Table 18A: Alternative Treatments for Rural, Multi-Lane, Undivided, Speed < 45 mph, ADT ≥ 10,000 vpd, Midblock Crossings



		Available Treatments		
		Treatment ID	**Treatment Description**	**Handbook Section**
Treatments for the Crossed Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-01**	Install traffic signals on the crossed road and trail (Note: only applicable to sites where a signal is warranted per *MN MUTCD*).	**3.1.2.1**
		TSGB-06	Install a yellow flashing beacon with pedestrian pushbutton at the crosswalk (Note: applicable only when the intersection is unsignalized); if used, the designer may also consider applying Treatment TRSS-11.	**3.1.2.2**
	Traffic Sign (TSN)	**TSN-01**	Install an advance trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at least 750 feet (228.6 meters) from the crossing. A distance plaque may be added beneath the sign.	**3.1.1.2**
		TSN-03	Install a Stop Here For Pedestrians (R1-5) series sign at the crossing on the crossed road	**3.1.1.1**
		TSN-04	Install a Stop Ahead (W3-1) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-05	Install a Yield Ahead (W3-2) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-07	Install a trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at the crossing.	**3.1.1.2**
		TSN-08	Install a STOP HERE ON RED (R10-6) sign at the trail crosswalk with a painted stop line to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
		TSN-10	Install an advance trail-crossing warning sign for snowmobiles, i.e., the Snowmobile Crossing (W11-6) sign, on the crossed roadway at least 750 feet (228.6 meters) from the	**3.1.1.2**

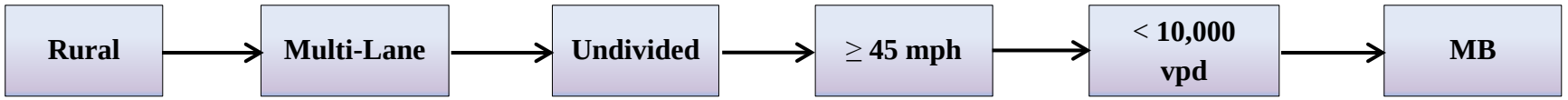
			crossing (Note: applicable only on trails for exclusive snowmobile use).	
		TSN-11	Install a snowmobile-crossing warning sign, i.e., the Snowmobile Crossing (W11-6) sign, on the crossed roadway at the trail crossing (Note: applicable only on trails for exclusive snowmobile use).	**3.1.1.2**
	Pavement Markings and Striping (PMS)	**PMS-04**	Divide the crosswalk to channelize pedestrians and bicyclists and separate their movements.	**3.1.3.2**
		PMS-05	Paint a high-visibility crosswalk on the crossed road "ladder" or "zebra" patterns preferable. (Note: The final decision of applying this treatment should be based on engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP, or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	**3.1.3.2**
		PMS-07	Set back the stop line on the crossed roadway to improve the trail users' and the moving motorists' mutual chance to have an unobstructed view of each other.	**3.1.3.1**
		PMS-08	Paint a stop line and install a STOP HERE ON RED (R10-6) sign on the crossed roadway in advance of the trail crosswalk to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.3.1**
		PMS-09	Paint a STOP AHEAD, YIELD AHEAD, or PED XING advance warning pavement marking on the crossed road.	**3.1.3.1**
	Sight Distance (SD)	**SD-03**	Clear and maintain stopping/crossing sight distance for motorists.	**3.2.1, 3.2.2**
Treatments for the Trail	**Pavement Markings and Striping (PMS)**	**PMS-01**	Paint a yellow center line only or use one along with advance warning striping for 150 feet (45.7 meters) along the trail approach from the trail entrance point (Note: applicable only when a bollard, lean rail, or median obstruction is present).	**3.1.3.1**
		PMS-02	Paint a stop/yield line to pair with the STOP/YIELD sign or pedestrian/bicycle signal head on the trail at a distance of 3 - 6 feet (0.9 - 1.8 meters) from the crossed road's edge.	**3.1.3.1**
		PMS-03	Paint a STOP/YIELD pavement marking on the trail approach.	**3.1.3.1**
	Trail Signals and	**TRSS-01**	Install a CROSS ONLY ON GREEN (symbolic circular green) (R10-1) sign (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail	**3.1.1.1**

	Signs (TRSS)		crossing).	
		TRSS-02	Install a CROSS ONLY ON “WALK” (symbolic walk indication) (R10-2) sign (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-03	Install a sign from the Push Button for Green Light (R10-4) series (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-04	Install a sign from the Push Button for WALK Signal (R10-3) series (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-05	Install a pedestrian/bicyclist pushbutton on the trail 4 - 5 feet (1.2 – 1.5 meters) above the ground such that it is easily accessible for bicyclists to activate the signal without dismounting (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.2.1**
		TRSS-06	Install pedestrian/bicycle signal on the trail approach (Note: applicable only to sites where a signal is warranted per *MN MUTCD*).	**3.1.2.1**
		TRSS-07	Install an advance warning Stop Ahead (W3-1)/Yield Ahead (W3-2) sign on the trail approach at a distance of approximately 100 feet (30.5 meters) in advance of the crossing.	**3.1.1.2**
		TRSS-08	Install a STOP (R1-1) or YIELD (R1-2) sign on the trail approach at a minimum of 2 feet (0.6 meters) from the edge of the trail.	**3.1.1.1**
		TRSS-11	Install a pushbutton for a yellow flashing beacon on the trail approach (Note: applicable only when yellow flashing beacon has been/ will be installed).	**3.1.2.2**
		TRSS-14	Install a Push Button to Turn on Warning Lights (R10-25) sign at the crossing to inform trail users of how to activate the flashing beacon.	**3.1.2.2**
	Trail Access Control (TRAC)	**TRAC-01**	Install a NO MOTOR VEHICLES (R5-3) sign on the trail, facing the roadway, to prevent unauthorized motor vehicles from entering the trail.	**3.1.1.1**
		TRAC-02	Install bollards to prevent unauthorized motor vehicles from entering the trail.	**3.4.1**
		TRAC-03	Install a lean rail parallel to the trail to prevent unauthorized motor vehicles from entering the trail and provide bicyclists with an area in which they can stop without dismounting.	**3.4.2**
		TRAC-04	Install a median on the trail to split the trail into two sections and restrict unauthorized motor vehicles from entering the trail.	**3.4.3**

	Curb Ramps (CR)	**CR-01**	Install a curb ramp to make the crossing accessible to pedestrians with disabilities and to improve crossing conditions for all trail users. (Note: The curb ramp must have detectable warnings in the form of truncated domes as outlined in MnDOT Standard Plate No. 7038A.)	**3.7**
	Realignment (RA)	**RA-01**	Realign the trail path to make a right angle crossing with the crossed roadway.	**3.8**
		RA-02	Realign the trail path such that its angle of intersection with the crossed roadway is ≥ 75 degrees.	**3.8**
	Sight Distances (SD)	**SD-01**	Clear and maintain crossing/stopping sight distance for bicyclists.	**3.2.1, 3.2.2**
		SD-02	Clear and maintain crossing/stopping sight distance for pedestrians.	**3.2.1, 3.2.2**

*Note: Treatments in table are not in any specific order with respect to importance, cost, popularity, ease of implementation etc.

Table 19A: Alternative Treatments for Rural, Multi-Lane, Undivided, Speed ≥ 45 mph, ADT < 10,000 vpd, Midblock Crossings



		Available Treatments		
		Treatment ID	**Treatment Description**	**Handbook Section**
Treatments for the Crossed Road	**Traffic Sign (TSN)**	**TSN-01**	Install an advance trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at least 750 feet (228.6 meters) from the crossing. A distance plaque may be added beneath the sign.	**3.1.1.2**
		TSN-03	Install a Stop Here For Pedestrians (R1-5) series sign at the crossing on the crossed road	**3.1.1.1**
		TSN-04	Install a Stop Ahead (W3-1) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-05	Install a Yield Ahead (W3-2) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-07	Install a trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at the crossing.	**3.1.1.2**
		TSN-08	Install a STOP HERE ON RED (R10-6) sign at the trail crosswalk with a painted stop line to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
		TSN-10	Install an advance trail-crossing warning sign for snowmobiles, i.e., the Snowmobile Crossing (W11-6) sign, on the crossed roadway at least 750 feet (228.6 meters) from the crossing (Note: applicable only on trails for exclusive snowmobile use).	**3.1.1.2**
		TSN-11	Install a snowmobile-crossing warning sign, i.e., the Snowmobile Crossing (W11-6) sign, on the crossed roadway at the trail crossing (Note: applicable only on trails for exclusive snowmobile use).	**3.1.1.2**

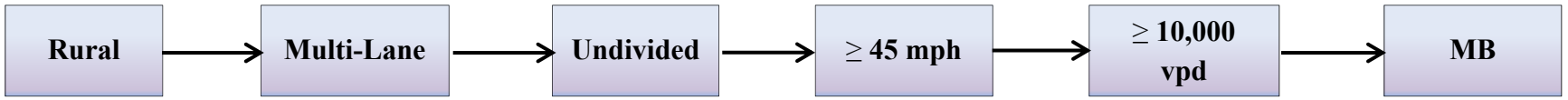
	Pavement Markings and Striping (PMS)	**PMS-04**	Divide the crosswalk to channelize pedestrians and bicyclists and separate their movements.	**3.1.3.2**
		PMS-05	Paint a high-visibility crosswalk on the crossed road "ladder" or "zebra" patterns preferable. (Note: The final decision of applying this treatment should be based on engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP, or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	**3.1.3.2**
		PMS-07	Set back the stop line on the crossed roadway to improve the trail users' and the moving motorists' mutual chance to have an unobstructed view of each other.	**3.1.3.1**
		PMS-08	Paint a stop line and install a STOP HERE ON RED (R10-6) sign on the crossed roadway in advance of the trail crosswalk to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.3.1**
		PMS-09	Paint a STOP AHEAD, YIELD AHEAD, or PED XING advance warning pavement marking on the crossed road.	**3.1.3.1**
	Sight Distance (SD)	**SD-03**	Clear and maintain stopping/crossing sight distance for motorists.	**3.2.1, 3.2.2**
Treatments for the Trail	**Pavement Markings and Striping (PMS)**	**PMS-01**	Paint a yellow center line only or use one along with advance warning striping for 150 feet (45.7 meters) along the trail approach from the trail entrance point (Note: applicable only when a bollard, lean rail, or median obstruction is present).	**3.1.3.1**
		PMS-02	Paint a stop/yield line to pair with the STOP/YIELD sign or pedestrian/bicycle signal head on the trail at a distance of 3 - 6 feet (0.9 - 1.8 meters) from the crossed road's edge.	**3.1.3.1**
		PMS-03	Paint a STOP/YIELD pavement marking on the trail approach.	**3.1.3.1**
	Trail Signals and Signs (TRSS)	**TRSS-01**	Install a CROSS ONLY ON GREEN (symbolic circular green) (R10-1) sign (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-02	Install a CROSS ONLY ON "WALK" (symbolic walk indication) (R10-2) sign (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**

		TRSS-03	Install a sign from the Push Button for Green Light (R10-4) series (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-04	Install a sign from the Push Button for WALK Signal (R10-3) series (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-05	Install a pedestrian/bicyclist pushbutton on the trail 4 - 5 feet (1.2 – 1.5 meters) above the ground such that it is easily accessible for bicyclists to activate the signal without dismounting (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.2.1**
		TRSS-07	Install an advance warning Stop Ahead (W3-1)/Yield Ahead (W3-2) sign on the trail approach at a distance of approximately 100 feet (30.5 meters) in advance of the crossing.	**3.1.1.2**
		TRSS-08	Install a STOP (R1-1) or YIELD (R1-2) sign on the trail approach at a minimum of 2 feet (0.6 meters) from the edge of the trail.	**3.1.1.1**
	Trail Access Control (TRAC)	**TRAC-01**	Install a NO MOTOR VEHICLES (R5-3) sign on the trail, facing the roadway, to prevent unauthorized motor vehicles from entering the trail.	**3.1.1.1**
		TRAC-02	Install bollards to prevent unauthorized motor vehicles from entering the trail.	**3.4.1**
		TRAC-03	Install a lean rail parallel to the trail to prevent unauthorized motor vehicles from entering the trail and provide bicyclists with an area in which they can stop without dismounting.	**3.4.2**
		TRAC-04	Install a median on the trail to split the trail into two sections and restrict unauthorized motor vehicles from entering the trail.	**3.4.3**
	Curb Ramps (CR)	**CR-01**	Install a curb ramp to make the crossing accessible to pedestrians with disabilities and to improve crossing conditions for all trail users. (Note: The curb ramp must have detectable warnings in the form of truncated domes as outlined in MnDOT Standard Plate No. 7038A.)	**3.7**
	Realignment (RA)	**RA-01**	Realign the trail path to make a right angle crossing with the crossed roadway.	**3.8**
		RA-02	Realign the trail path such that its angle of intersection with the crossed roadway is ≥ 75 degrees.	**3.8**
	Sight	**SD-01**	Clear and maintain crossing/stopping sight distance for bicyclists.	**3.2.1, 3.2.2**

	Distances (SD)	**SD-02**	Clear and maintain crossing/stopping sight distance for pedestrians.	**3.2.1, 3.2.2**

*Note: Treatments in table are not in any specific order with respect to importance, cost, popularity, ease of implementation etc.

Table 20A: Alternative Treatments for Rural, Multi-Lane, Undivided, Speed ≥ 45 mph, ADT ≥ 10,000 vpd, Midblock Crossings



		Available Treatments		
		Treatment ID	**Treatment Description**	**Handbook Section**
Treatments for the Crossed Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-01**	Install traffic signals on the crossed road and trail (Note: only applicable to sites where a signal is warranted per *MN MUTCD*).	**3.1.2.1**
		TSGB-06	Install a yellow flashing beacon with pedestrian pushbutton at the crosswalk (Note: applicable only when the intersection is unsignalized); if used, the designer may also consider applying Treatment TRSS-11.	**3.1.2.2**
	Traffic Sign (TSN)	**TSN-01**	Install an advance trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at least 750 feet (228.6 meters) from the crossing. A distance plaque may be added beneath the sign.	**3.1.1.2**
		TSN-03	Install a Stop Here For Pedestrians (R1-5) series sign at the crossing on the crossed road	**3.1.1.1**
		TSN-04	Install a Stop Ahead (W3-1) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-05	Install a Yield Ahead (W3-2) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-07	Install a trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at the crossing.	**3.1.1.2**
		TSN-08	Install a STOP HERE ON RED (R10-6) sign at the trail crosswalk with a painted stop line to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
		TSN-10	Install an advance trail-crossing warning sign for snowmobiles, i.e., the Snowmobile	**3.1.1.2**

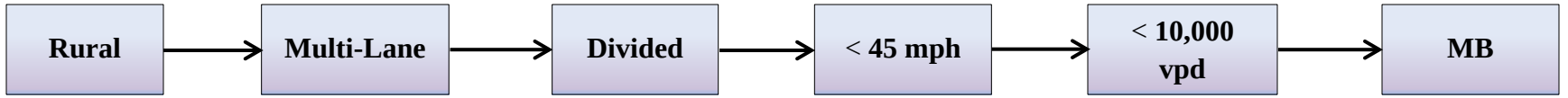
Treatments for the Trail	**and Striping (PMS)**		applicable only when a bollard, lean rail, or median obstruction is present).	
		PMS-02	Paint a stop/yield line to pair with the STOP/YIELD sign or pedestrian/bicycle signal head on the trail at a distance of 3 - 6 feet (0.9 - 1.8 meters) from the crossed road's edge.	**3.1.3.1**
		PMS-03	Paint a STOP/YIELD pavement marking on the trail approach.	**3.1.3.1**
	Trail Signals and Signs (TRSS)	**TRSS-01**	Install a CROSS ONLY ON GREEN (symbolic circular green) (R10-1) sign (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-02	Install a CROSS ONLY ON "WALK" (symbolic walk indication) (R10-2) sign (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-03	Install a sign from the Push Button for Green Light (R10-4) series (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-04	Install a sign from the Push Button for WALK Signal (R10-3) series (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-05	Install a pedestrian/bicyclist pushbutton on the trail 4 - 5 feet (1.2 – 1.5 meters) above the ground such that it is easily accessible for bicyclists to activate the signal without dismounting (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.2.1**
		TRSS-06	Install pedestrian/bicycle signal on the trail approach (Note: applicable only to sites where a signal is warranted per *MN MUTCD*).	**3.1.2.1**
		TRSS-07	Install an advance warning Stop Ahead (W3-1)/Yield Ahead (W3-2) sign on the trail approach at a distance of approximately 100 feet (30.5 meters) in advance of the crossing.	**3.1.1.2**
		TRSS-08	Install a STOP (R1-1) or YIELD (R1-2) sign on the trail approach at a minimum of 2 feet (0.6 meters) from the edge of the trail.	**3.1.1.1**
		TRSS-11	Install a pushbutton for a yellow flashing beacon on the trail approach (Note: applicable only when yellow flashing beacon has been/ will be installed).	**3.1.2.2**
		TRSS-14	Install a Push Button to Turn on Warning Lights (R10-25) sign at the crossing to inform trail users of how to activate the flashing beacon.	**3.1.2.2**

			Crossing (W11-6) sign, on the crossed roadway at least 750 feet (228.6 meters) from the crossing (Note: applicable only on trails for exclusive snowmobile use).	
		TSN-11	Install a snowmobile-crossing warning sign, i.e., the Snowmobile Crossing (W11-6) sign, on the crossed roadway at the trail crossing (Note: applicable only on trails for exclusive snowmobile use).	**3.1.1.2**
	Pavement Markings and Striping (PMS)	**PMS-04**	Divide the crosswalk to channelize pedestrians and bicyclists and separate their movements.	**3.1.3.2**
		PMS-05	Paint a high-visibility crosswalk on the crossed road "ladder" or "zebra" patterns preferable. (Note: The final decision of applying this treatment should be based on engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP, or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	**3.1.3.2**
		PMS-06	Paint a high-visibility "standard" pattern crosswalk on the crossed road. (Note: The final decision of applying this treatment should be based on engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP, or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	**3.1.3.2**
		PMS-07	Set back the stop line on the crossed roadway to improve the trail users' and the moving motorists' mutual chance to have an unobstructed view of each other.	**3.1.3.1**
		PMS-08	Paint a stop line and install a STOP HERE ON RED (R10-6) sign on the crossed roadway in advance of the trail crosswalk to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.3.1**
		PMS-09	Paint a STOP AHEAD, YIELD AHEAD, or PED XING advance warning pavement marking on the crossed road.	**3.1.3.1**
	Sight Distance (SD)	**SD-03**	Clear and maintain stopping/crossing sight distance for motorists.	**3.2.1, 3.2.2**
	Pavement Markings	**PMS-01**	Paint a yellow center line only or use one along with advance warning striping for 150 feet (45.7 meters) along the trail approach from the trail entrance point (Note:	**3.1.3.1**

	Trail Access Control (TRAC)	**TRAC-01**	Install a NO MOTOR VEHICLES (R5-3) sign on the trail, facing the roadway, to prevent unauthorized motor vehicles from entering the trail.	**3.1.1.1**
		TRAC-02	Install bollards to prevent unauthorized motor vehicles from entering the trail.	**3.4.1**
		TRAC-03	Install a lean rail parallel to the trail to prevent unauthorized motor vehicles from entering the trail and provide bicyclists with an area in which they can stop without dismounting.	**3.4.2**
		TRAC-04	Install a median on the trail to split the trail into two sections and restrict unauthorized motor vehicles from entering the trail.	**3.4.3**
	Curb Ramps (CR)	**CR-01**	Install a curb ramp to make the crossing accessible to pedestrians with disabilities and to improve crossing conditions for all trail users. (Note: The curb ramp must have detectable warnings in the form of truncated domes as outlined in MnDOT Standard Plate No. 7038A.)	**3.7**
	Realignment (RA)	**RA-01**	Realign the trail path to make a right angle crossing with the crossed roadway.	**3.8**
		RA-02	Realign the trail path such that its angle of intersection with the crossed roadway is ≥ 75 degrees.	**3.8**
	Sight Distances (SD)	**SD-01**	Clear and maintain crossing/stopping sight distance for bicyclists.	**3.2.1, 3.2.2**
		SD-02	Clear and maintain crossing/stopping sight distance for pedestrians.	**3.2.1, 3.2.2**

*Note: Treatments in table are not in any specific order with respect to importance, cost, popularity, ease of implementation etc.

Table 21A: Alternative Treatments for Rural, Multi-Lane, Divided, Speed < 45 mph, ADT < 10 000 vpd, Midblock Crossings



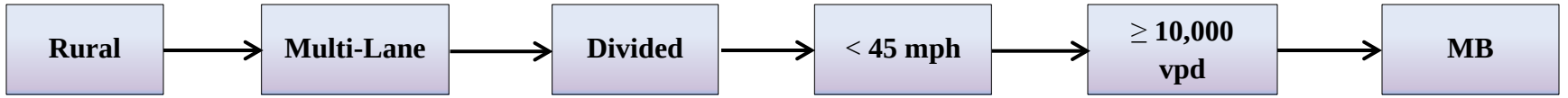
		Available Treatments		
		Treatment ID	**Treatment Description**	**Handbook Section**
Treatments for the Crossed Road	**Traffic Sign (TSN)**	**TSN-01**	Install an advance trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at least 750 feet (228.6 meters) from the crossing. A distance plaque may be added beneath the sign.	**3.1.1.2**
		TSN-03	Install a Stop Here For Pedestrians (R1-5) series sign at the crossing on the crossed road	**3.1.1.1**
		TSN-04	Install a Stop Ahead (W3-1) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-05	Install a Yield Ahead (W3-2) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-07	Install a trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at the crossing.	**3.1.1.2**
		TSN-08	Install a STOP HERE ON RED (R10-6) sign at the trail crosswalk with a painted stop line to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
		TSN-10	Install an advance trail-crossing warning sign for snowmobiles, i.e., the Snowmobile Crossing (W11-6) sign, on the crossed roadway at least 750 feet (228.6 meters) from the crossing (Note: applicable only on trails for exclusive snowmobile use).	**3.1.1.2**
		TSN-11	Install a snowmobile-crossing warning sign, i.e., the Snowmobile Crossing (W11-6) sign, on the crossed roadway at the trail crossing (Note: applicable only on trails for exclusive snowmobile use).	**3.1.1.2**
	Pavement Markings	**PMS-04**	Divide the crosswalk to channelize pedestrians and bicyclists and separate their movements.	**3.1.3.2**

	and Striping (PMS)	**PMS-05**	Paint a high-visibility crosswalk on the crossed road "ladder" or "zebra" patterns preferable. (Note: The final decision of applying this treatment should be based on engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP, or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	**3.1.3.2**
		PMS-07	Set back the stop line on the crossed roadway to improve the trail users' and the moving motorists' mutual chance to have an unobstructed view of each other.	**3.1.3.1**
		PMS-08	Paint a stop line and install a STOP HERE ON RED (R10-6) sign on the crossed roadway in advance of the trail crosswalk to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.3.1**
		PMS-09	Paint a STOP AHEAD, YIELD AHEAD, or PED XING advance warning pavement marking on the crossed road.	**3.1.3.1**
	Sight Distance (SD)	**SD-03**	Clear and maintain stopping/crossing sight distance for motorists.	**3.2.1, 3.2.2**
Treatments for the Trail	**Pavement Markings and Striping (PMS)**	**PMS-01**	Paint a yellow center line only or use one along with advance warning striping for 150 feet (45.7 meters) along the trail approach from the trail entrance point (Note: applicable only when a bollard, lean rail, or median obstruction is present).	**3.1.3.1**
		PMS-02	Paint a stop/yield line to pair with the STOP/YIELD sign or pedestrian/bicycle signal head on the trail at a distance of 3 - 6 feet (0.9 - 1.8 meters) from the crossed road's edge.	**3.1.3.1**
		PMS-03	Paint a STOP/YIELD pavement marking on the trail approach.	**3.1.3.1**
	Trail Signals and Signs (TRSS)	**TRSS-01**	Install a CROSS ONLY ON GREEN (symbolic circular green) (R10-1) sign (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-02	Install a CROSS ONLY ON "WALK" (symbolic walk indication) (R10-2) sign (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-03	Install a sign from the Push Button for Green Light (R10-4) series (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail	**3.1.1.1**

			crossing).	
		TRSS-04	Install a sign from the Push Button for WALK Signal (R10-3) series (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-05	Install a pedestrian/bicyclist pushbutton on the trail 4 - 5 feet (1.2 – 1.5 meters) above the ground such that it is easily accessible for bicyclists to activate the signal without dismounting (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.2.1**
		TRSS-07	Install an advance warning Stop Ahead (W3-1)/Yield Ahead (W3-2) sign on the trail approach at a distance of approximately 100 feet (30.5 meters) in advance of the crossing.	**3.1.1.2**
		TRSS-08	Install a STOP (R1-1) or YIELD (R1-2) sign on the trail approach at a minimum of 2 feet (0.6 meters) from the edge of the trail.	**3.1.1.1**
	Trail Access Control (TRAC)	**TRAC-01**	Install a NO MOTOR VEHICLES (R5-3) sign on the trail, facing the roadway, to prevent unauthorized motor vehicles from entering the trail.	**3.1.1.1**
		TRAC-02	Install bollards to prevent unauthorized motor vehicles from entering the trail.	**3.4.1**
		TRAC-03	Install a lean rail parallel to the trail to prevent unauthorized motor vehicles from entering the trail and provide bicyclists with an area in which they can stop without dismounting.	**3.4.2**
		TRAC-04	Install a median on the trail to split the trail into two sections and restrict unauthorized motor vehicles from entering the trail.	**3.4.3**
	Curb Ramps (CR)	**CR-01**	Install a curb ramp to make the crossing accessible to pedestrians with disabilities and to improve crossing conditions for all trail users. (Note: The curb ramp must have detectable warnings in the form of truncated domes as outlined in MnDOT Standard Plate No. 7038A.)	**3.7**
	Realignment (RA)	**RA-01**	Realign the trail path to make a right angle crossing with the crossed roadway.	**3.8**
		RA-02	Realign the trail path such that its angle of intersection with the crossed roadway is ≥ 75 degrees.	**3.8**
	Sight Distances (SD)	**SD-01**	Clear and maintain crossing/stopping sight distance for bicyclists.	**3.2.1, 3.2.2**
		SD-02	Clear and maintain crossing/stopping sight distance for pedestrians.	**3.2.1, 3.2.2**

*Note: Treatments in table are not in any specific order with respect to importance, cost, popularity, ease of implementation etc.

Table 22A: Alternative Treatments for Rural, Multi-Lane, Divided, Speed < 45 mph, ADT ≥ 10,000, Midblock Crossings



		Available Treatments		
		Treatment ID	**Treatment Description**	**Handbook Section**
Treatments for the Crossed Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-01**	Install traffic signals on the crossed road and trail (Note: only applicable to sites where a signal is warranted per *MN MUTCD*).	**3.1.2.1**
		TSGB-06	Install a yellow flashing beacon with pedestrian pushbutton at the crosswalk (Note: applicable only when the intersection is unsignalized); if used, the designer may also consider applying Treatment TRSS-11.	**3.1.2.2**
	Traffic Sign (TSN)	**TSN-01**	Install an advance trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at least 750 feet (228.6 meters) from the crossing. A distance plaque may be added beneath the sign.	**3.1.1.2**
		TSN-03	Install a Stop Here For Pedestrians (R1-5) series sign at the crossing on the crossed road	**3.1.1.1**
		TSN-04	Install a Stop Ahead (W3-1) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-05	Install a Yield Ahead (W3-2) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-07	Install a trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at the crossing.	**3.1.1.2**
		TSN-08	Install a STOP HERE ON RED (R10-6) sign at the trail crosswalk with a painted stop line to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
		TSN-10	Install an advance trail-crossing warning sign for snowmobiles, i.e., the Snowmobile Crossing (W11-6) sign, on the crossed roadway at least 750 feet (228.6 meters) from	**3.1.1.2**

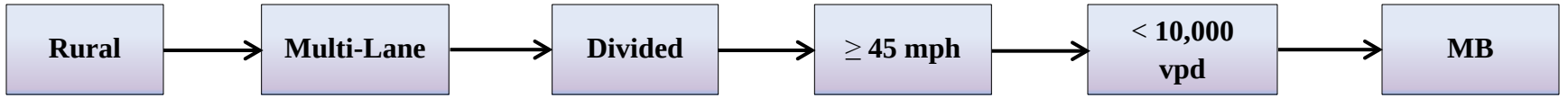
			the crossing (Note: applicable only on trails for exclusive snowmobile use).	
		TSN-11	Install a snowmobile-crossing warning sign, i.e., the Snowmobile Crossing (W11-6) sign, on the crossed roadway at the trail crossing (Note: applicable only on trails for exclusive snowmobile use).	**3.1.1.2**
	Pavement Markings and Striping (PMS)	**PMS-04**	Divide the crosswalk to channelize pedestrians and bicyclists and separate their movements.	**3.1.3.2**
		PMS-05	Paint a high-visibility crosswalk on the crossed road "ladder" or "zebra" patterns preferable. (Note: The final decision of applying this treatment should be based on engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP, or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	**3.1.3.2**
		PMS-07	Set back the stop line on the crossed roadway to improve the trail users' and the moving motorists' mutual chance to have an unobstructed view of each other.	**3.1.3.1**
		PMS-08	Paint a stop line and install a STOP HERE ON RED (R10-6) sign on the crossed roadway in advance of the trail crosswalk to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.3.1**
		PMS-09	Paint a STOP AHEAD, YIELD AHEAD, or PED XING advance warning pavement marking on the crossed road.	**3.1.3.1**
	Refuge Island (RI)	**RI-01**	Install a right-angle median refuge island (Note: this treatment is applicable when the crossed road has high ADT).	**3.3**
		RI-02	Install a median refuge island angled at 75 degrees with opposite sides of the trail across the roadway being slightly offset and supplementary centerline and STOP or YIELD pavement markings in the refuge area (Note: this treatment is applicable when the crossed road has high ADT).	**3.3**
	Sight Distance (SD)	**SD-03**	Clear and maintain stopping/crossing sight distance for motorists.	**3.2.1, 3.2.2**
	Pavement Markings	**PMS-01**	Paint a yellow center line only or use one along with advance warning striping for 150 feet (45.7 meters) along the trail approach from the trail entrance point (Note:	**3.1.3.1**

Treatments for the Trail	**and Striping (PMS)**		applicable only when a bollard, lean rail, or median obstruction is present).	
		PMS-02	Paint a stop/yield line to pair with the STOP/YIELD sign or pedestrian/bicycle signal head on the trail at a distance of 3 - 6 feet (0.9 - 1.8 meters) from the crossed road's edge.	**3.1.3.1**
		PMS-03	Paint a STOP/YIELD pavement marking on the trail approach.	**3.1.3.1**
	Trail Signals and Signs (TRSS)	**TRSS-01**	Install a CROSS ONLY ON GREEN (symbolic circular green) (R10-1) sign (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-02	Install a CROSS ONLY ON "WALK" (symbolic walk indication) (R10-2) sign (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-03	Install a sign from the Push Button for Green Light (R10-4) series (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-04	Install a sign from the Push Button for WALK Signal (R10-3) series (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-05	Install a pedestrian/bicyclist pushbutton on the trail 4 - 5 feet (1.2 – 1.5 meters) above the ground such that it is easily accessible for bicyclists to activate the signal without dismounting (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.2.1**
		TRSS-06	Install pedestrian/bicycle signal on the trail approach (Note: applicable only to sites where a signal is warranted per *MN MUTCD*).	**3.1.2.1**
		TRSS-07	Install an advance warning Stop Ahead (W3-1)/Yield Ahead (W3-2) sign on the trail approach at a distance of approximately 100 feet (30.5 meters) in advance of the crossing.	**3.1.1.2**
		TRSS-08	Install a STOP (R1-1) or YIELD (R1-2) sign on the trail approach at a minimum of 2 feet (0.6 meters) from the edge of the trail.	**3.1.1.1**
		TRSS-10	Install a pushbutton at the median refuge island for pedestrians trapped in the refuge area (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.2.1**
		TRSS-11	Install a pushbutton for a yellow flashing beacon on the trail approach (Note:	**3.1.2.2**

			applicable only when yellow flashing beacon has been/ will be installed).	
		TRSS-14	Install a Push Button to Turn on Warning Lights (R10-25) sign at the crossing to inform trail users of how to activate the flashing beacon or RRFB.	**3.1.2.2**
	Trail Access Control (TRAC)	**TRAC-01**	Install a NO MOTOR VEHICLES (R5-3) sign on the trail, facing the roadway, to prevent unauthorized motor vehicles from entering the trail.	**3.1.1.1**
		TRAC-02	Install bollards to prevent unauthorized motor vehicles from entering the trail.	**3.4.1**
		TRAC-03	Install a lean rail parallel to the trail to prevent unauthorized motor vehicles from entering the trail and provide bicyclists with an area in which they can stop without dismounting.	**3.4.2**
		TRAC-04	Install a median on the trail to split the trail into two sections and restrict unauthorized motor vehicles from entering the trail.	**3.4.3**
	Curb Ramps (CR)	**CR-01**	Install a curb ramp to make the crossing accessible to pedestrians with disabilities and to improve crossing conditions for all trail users. (Note: The curb ramp must have detectable warnings in the form of truncated domes as outlined in MnDOT Standard Plate No. 7038A.)	**3.7**
	Realignment (RA)	**RA-01**	Realign the trail path to make a right angle crossing with the crossed roadway.	**3.8**
		RA-02	Realign the trail path such that its angle of intersection with the crossed roadway is ≥ 75 degrees.	**3.8**
	Sight Distances (SD)	**SD-01**	Clear and maintain crossing/stopping sight distance for bicyclists.	**3.2.1, 3.2.2**
		SD-02	Clear and maintain crossing/stopping sight distance for pedestrians.	**3.2.1, 3.2.2**

*Note: Treatments in table are not in any specific order with respect to importance, cost, popularity, ease of implementation etc.

Table 23A: Alternative Treatments for Rural, Multi-Lane, Divided, Speed ≥ 45 mph, ADT < 10,000 vpd, Midblock Crossings



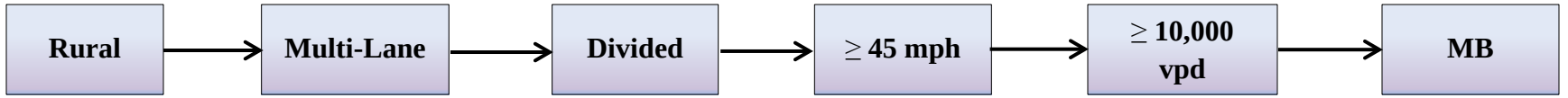
		Available Treatments		
		Treatment ID	**Treatment Description**	**Handbook Section**
Treatments for the Crossed Road	**Traffic Sign (TSN)**	**TSN-01**	Install an advance trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at least 750 feet (228.6 meters) from the crossing. A distance plaque may be added beneath the sign.	**3.1.1.2**
		TSN-03	Install a Stop Here For Pedestrians (R1-5) series sign at the crossing on the crossed road	**3.1.1.1**
		TSN-04	Install a Stop Ahead (W3-1) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-05	Install a Yield Ahead (W3-2) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-07	Install a trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at the crossing.	**3.1.1.2**
		TSN-08	Install a STOP HERE ON RED (R10-6) sign at the trail crosswalk with a painted stop line to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
		TSN-10	Install an advance trail-crossing warning sign for snowmobiles, i.e., the Snowmobile Crossing (W11-6) sign, on the crossed roadway at least 750 feet (228.6 meters) from the crossing (Note: applicable only on trails for exclusive snowmobile use).	**3.1.1.2**
		TSN-11	Install a snowmobile-crossing warning sign, i.e., the Snowmobile Crossing (W11-6) sign, on the crossed roadway at the trail crossing (Note: applicable only on trails for exclusive snowmobile use).	**3.1.1.2**
	Pavement Markings	**PMS-04**	Divide the crosswalk to channelize pedestrians and bicyclists and separate their movements.	**3.1.3.2**

	and Striping (PMS)	**PMS-05**	Paint a high-visibility crosswalk on the crossed road "ladder" or "zebra" patterns preferable. (Note: The final decision of applying this treatment should be based on engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP, or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	**3.1.3.2**
		PMS-07	Set back the stop line on the crossed roadway to improve the trail users' and the moving motorists' mutual chance to have an unobstructed view of each other.	**3.1.3.1**
		PMS-08	Paint a stop line and install a STOP HERE ON RED (R10-6) sign on the crossed roadway in advance of the trail crosswalk to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.3.1**
		PMS-09	Paint a STOP AHEAD, YIELD AHEAD, or PED XING advance warning pavement marking on the crossed road.	**3.1.3.1**
	Sight Distance (SD)	**SD-03**	Clear and maintain stopping/crossing sight distance for motorists.	**3.2.1, 3.2.2**
Treatments for the Trail	**Pavement Markings and Striping (PMS)**	**PMS-01**	Paint a yellow center line only or use one along with advance warning striping for 150 feet (45.7 meters) along the trail approach from the trail entrance point (Note: applicable only when a bollard, lean rail, or median obstruction is present).	**3.1.3.1**
		PMS-02	Paint a stop/yield line to pair with the STOP/YIELD sign or pedestrian/bicycle signal head on the trail at a distance of 3 - 6 feet (0.9 - 1.8 meters) from the crossed road's edge.	**3.1.3.1**
		PMS-03	Paint a STOP/YIELD pavement marking on the trail approach.	**3.1.3.1**
	Trail Signals and Signs (TRSS)	**TRSS-01**	Install a CROSS ONLY ON GREEN (symbolic circular green) (R10-1) sign (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-02	Install a CROSS ONLY ON "WALK" (symbolic walk indication) (R10-2) sign (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-03	Install a sign from the Push Button for Green Light (R10-4) series (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail	**3.1.1.1**

			crossing).	
		TRSS-04	Install a sign from the Push Button for WALK Signal (R10-3) series (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-05	Install a pedestrian/bicyclist pushbutton on the trail 4 - 5 feet (1.2 – 1.5 meters) above the ground such that it is easily accessible for bicyclists to activate the signal without dismounting (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.2.1**
		TRSS-07	Install an advance warning Stop Ahead (W3-1)/Yield Ahead (W3-2) sign on the trail approach at a distance of approximately 100 feet (30.5 meters) in advance of the crossing.	**3.1.1.2**
		TRSS-08	Install a STOP (R1-1) or YIELD (R1-2) sign on the trail approach at a minimum of 2 feet (0.6 meters) from the edge of the trail.	**3.1.1.1**
	Trail Access Control (TRAC)	**TRAC-01**	Install a NO MOTOR VEHICLES (R5-3) sign on the trail, facing the roadway, to prevent unauthorized motor vehicles from entering the trail.	**3.1.1.1**
		TRAC-02	Install bollards to prevent unauthorized motor vehicles from entering the trail.	**3.4.1**
		TRAC-03	Install a lean rail parallel to the trail to prevent unauthorized motor vehicles from entering the trail and provide bicyclists with an area in which they can stop without dismounting.	**3.4.2**
		TRAC-04	Install a median on the trail to split the trail into two sections and restrict unauthorized motor vehicles from entering the trail.	**3.4.3**
	Curb Ramps (CR)	**CR-01**	Install a curb ramp to make the crossing accessible to pedestrians with disabilities and to improve crossing conditions for all trail users. (Note: The curb ramp must have detectable warnings in the form of truncated domes as outlined in MnDOT Standard Plate No. 7038A.)	**3.7**
	Realignment (RA)	**RA-01**	Realign the trail path to make a right angle crossing with the crossed roadway.	**3.8**
		RA-02	Realign the trail path such that its angle of intersection with the crossed roadway is ≥ 75 degrees.	**3.8**
	Sight Distances (SD)	**SD-01**	Clear and maintain crossing/stopping sight distance for bicyclists.	**3.2.1, 3.2.2**
		SD-02	Clear and maintain crossing/stopping sight distance for pedestrians.	**3.2.1, 3.2.2**

*Note: Treatments in table are not in any specific order with respect to importance, cost, popularity, ease of implementation etc.

Table 24A: Alternative Treatments for Rural, Multi-Lane, Divided, Speed ≥ 45 mph, ADT ≥ 10,000, Midblock Crossings



		Available Treatments		
		Treatment ID	**Treatment Description**	**Handbook Section**
Treatments for the Crossed Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-01**	Install traffic signals on the crossed road and trail (Note: only applicable to sites where a signal is warranted per *MN MUTCD*).	**3.1.2.1**
		TSGB-06	Install a yellow flashing beacon with pedestrian pushbutton at the crosswalk (Note: applicable only when the intersection is unsignalized); if used, the designer may also consider applying Treatment TRSS-11.	**3.1.2.2**
	Traffic Sign (TSN)	**TSN-01**	Install an advance trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at least 750 feet (228.6 meters) from the crossing. A distance plaque may be added beneath the sign.	**3.1.1.2**
		TSN-03	Install a Stop Here For Pedestrians (R1-5) series sign at the crossing on the crossed road	**3.1.1.1**
		TSN-04	Install a Stop Ahead (W3-1) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-05	Install a Yield Ahead (W3-2) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-07	Install a trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at the crossing.	**3.1.1.2**
		TSN-08	Install a STOP HERE ON RED (R10-6) sign at the trail crosswalk with a painted stop line to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
		TSN-10	Install an advance trail-crossing warning sign for snowmobiles, i.e., the Snowmobile Crossing (W11-6) sign, on the crossed roadway at least 750 feet (228.6 meters) from	**3.1.1.2**

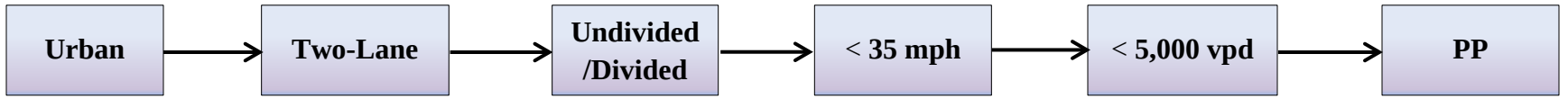
			the crossing (Note: applicable only on trails for exclusive snowmobile use).	
		TSN-11	Install a snowmobile-crossing warning sign, i.e., the Snowmobile Crossing (W11-6) sign, on the crossed roadway at the trail crossing (Note: applicable only on trails for exclusive snowmobile use).	**3.1.1.2**
	Pavement Markings and Striping (PMS)	**PMS-04**	Divide the crosswalk to channelize pedestrians and bicyclists and separate their movements.	**3.1.3.2**
		PMS-05	Paint a high-visibility crosswalk on the crossed road "ladder" or "zebra" patterns preferable. (Note: The final decision of applying this treatment should be based on engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP, or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	**3.1.3.2**
		PMS-06	Paint a high-visibility "standard" pattern crosswalk on the crossed road. (Note: The final decision of applying this treatment should be based on engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP, or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	**3.1.3.2**
		PMS-07	Set back the stop line on the crossed roadway to improve the trail users' and the moving motorists' mutual chance to have an unobstructed view of each other.	**3.1.3.1**
		PMS-08	Paint a stop line and install a STOP HERE ON RED (R10-6) sign on the crossed roadway in advance of the trail crosswalk to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.3.1**
		PMS-09	Paint a STOP AHEAD, YIELD AHEAD, or PED XING advance warning pavement marking on the crossed road.	**3.1.3.1**
	Refuge Islands (RI)	**RI-01**	Install a right-angle median refuge island.	**3.3**
		RI-02	Install a median refuge island angled at 75 degrees with opposite sides of the trail across the roadway being slightly offset and supplementary centerline and STOP or YIELD pavement markings in the refuge area.	**3.3**

	Sight Distance (SD)	**SD-03**	Clear and maintain stopping/crossing sight distance for motorists.	**3.2.1, 3.2.2**
Treatments for the Trail	**Pavement Markings and Striping (PMS)**	**PMS-01**	Paint a yellow center line only or use one along with advance warning striping for 150 feet (45.7 meters) along the trail approach from the trail entrance point (Note: applicable only when a bollard, lean rail, or median obstruction is present).	**3.1.3.1**
		PMS-02	Paint a stop/yield line to pair with the STOP/YIELD sign or pedestrian/bicycle signal head on the trail at a distance of 3 - 6 feet (0.9 - 1.8 meters) from the crossed road's edge.	**3.1.3.1**
		PMS-03	Paint a STOP/YIELD pavement marking on the trail approach.	**3.1.3.1**
	Trail Signals and Signs (TRSS)	**TRSS-01**	Install a CROSS ONLY ON GREEN (symbolic circular green) (R10-1) sign (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-02	Install a CROSS ONLY ON "WALK" (symbolic walk indication) (R10-2) sign (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-03	Install a sign from the Push Button for Green Light (R10-4) series (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-04	Install a sign from the Push Button for WALK Signal (R10-3) series (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-05	Install a pedestrian/bicyclist pushbutton on the trail 4 - 5 feet (1.2 – 1.5 meters) above the ground such that it is easily accessible for bicyclists to activate the signal without dismounting (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.2.1**
		TRSS-06	Install pedestrian/bicycle signal on the trail approach (Note: applicable only to sites where a signal is warranted per *MN MUTCD*).	**3.1.2.1**
		TRSS-07	Install an advance warning Stop Ahead (W3-1)/Yield Ahead (W3-2) sign on the trail approach at a distance of approximately 100 feet (30.5 meters) in advance of the crossing.	**3.1.1.2**
		TRSS-08	Install a STOP (R1-1) or YIELD (R1-2) sign on the trail approach at a minimum of 2	**3.1.1.1**

			feet (0.6 meters) from the edge of the trail.	
		TRSS-10	Install a pushbutton at the median refuge island for pedestrians trapped in the refuge area (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.2.1**
		TRSS-11	Install a pushbutton for a yellow flashing beacon on the trail approach (Note: applicable only when yellow flashing beacon has been/ will be installed).	**3.1.2.2**
		TRSS-14	Install a Push Button to Turn on Warning Lights (R10-25) sign at the crossing to inform trail users of how to activate the flashing beacon or RRFB.	**3.1.2.2**
	Trail Access Control (TRAC)	**TRAC-01**	Install a NO MOTOR VEHICLES (R5-3) sign on the trail, facing the roadway, to prevent unauthorized motor vehicles from entering the trail.	**3.1.1.1**
		TRAC-02	Install bollards to prevent unauthorized motor vehicles from entering the trail.	**3.4.1**
		TRAC-03	Install a lean rail parallel to the trail to prevent unauthorized motor vehicles from entering the trail and provide bicyclists with an area in which they can stop without dismounting.	**3.4.2**
		TRAC-04	Install a median on the trail to split the trail into two sections and restrict unauthorized motor vehicles from entering the trail.	**3.4.3**
	Curb Ramps (CR)	**CR-01**	Install a curb ramp to make the crossing accessible to pedestrians with disabilities and to improve crossing conditions for all trail users. (Note: The curb ramp must have detectable warnings in the form of truncated domes as outlined in MnDOT Standard Plate No. 7038A.)	**3.7**
	Realignment (RA)	**RA-01**	Realign the trail path to make a right angle crossing with the crossed roadway.	**3.8**
		RA-02	Realign the trail path such that its angle of intersection with the crossed roadway is ≥ 75 degrees.	**3.8**
	Sight Distances (SD)	**SD-01**	Clear and maintain crossing/stopping sight distance for bicyclists.	**3.2.1, 3.2.2**
		SD-02	Clear and maintain crossing/stopping sight distance for pedestrians.	**3.2.1, 3.2.2**

*Note: Treatments in table are not in any specific order with respect to importance, cost, popularity, ease of implementation etc.

Table 1B: Alternative Treatments for Urban, Two-Lane, Undivided/Divided, Speed < 35 mph, ADT < 5,000 vpd, Parallel Path Crossings



		Available Treatments		
		Treatment ID	**Treatment Description**	**Handbook Section**
Treatments for Left-turn Traffic on the Parallel Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-02**	Prohibit permissive left turns and enable protected left turns from the parallel roadway while trail users receive a "WALK" or flashing "DON'T WALK" indication (Note: applicable only when the intersection is already signalized and the parallel roadway has a dedicated left-turn lane).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-06**	Install an advance trail-crossing warning sign, such as the TRAIL CROSSING (W11-15a) sign, on the parallel roadway to warn turning vehicles. A distance plaque may be added beneath the sign.	**3.1.1.2**
Treatments for Right-turn Traffic on the Parallel Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-03**	Prohibit permissive right turns and enable protected right turns from the parallel roadway while trail users receive a "WALK" or flashing "DON'T WALK" indication (Note: applicable only when the intersection is already signalized and the parallel roadway has a dedicated right-turn lane).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-06**	Install an advance trail-crossing warning sign, such as the TRAIL CROSSING (W11-15a) sign, on the parallel roadway to warn turning vehicles. A distance plaque may be added beneath the sign.	**3.1.1.2**
	Traffic Calming (TC)	**TC-05**	Reduce the turning radius for right-turn vehicles.	**3.5.1**
		TC-07	Install a speed hump in the path of a vehicle turning right from the parallel roadway to the crossed roadway (Note: this treatment is not applicable to State Aid roadways and several other types of roadways receiving government funding).	**3.5.2**

Treatments for Through Traffic on the Crossed Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-04**	Provide oncoming crossing traffic on the crossed road with adequate change and clearance intervals to ensure their clearance of the trail prior to the trail receiving a "WALK" indication (Note: applicable only when the intersection is already signalized).	**3.1.2.1**
		TSGB-05	Provide an all-red phase on the crossed road to further protect trail users (Note: applicable only when the intersection is already signalized and the crossed road does not have all-red phase).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-02**	Install an advance trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at least 250 feet (76.2 meters) from the crossing. A distance plaque may be added beneath the sign.	**3.1.1.2**
		TSN-04	Install a Stop Ahead (W3-1) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-05	Install a Yield Ahead (W3-2) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-07	Install a trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at the crossing.	**3.1.1.2**
		TSN-08	Install a STOP HERE ON RED (R10-6) sign at the trail crosswalk with a painted stop line to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
	Pavement Markings and Striping (PMS)	**PMS-04**	Divide the crosswalk to channelize pedestrians and bicyclists and separate their movements.	**3.1.3.2**
		PMS-05	Paint a high-visibility crosswalk on the crossed road "ladder" or "zebra" patterns preferable. (Note: The final decision of applying this treatment should be based on engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP, or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	**3.1.3.2**
		PMS-07	Set back the stop line on the crossed roadway to improve the trail users' and the moving motorists' mutual chance to have an unobstructed view of each other.	**3.1.3.1**
		PMS-08	Paint a stop line and install a STOP HERE ON RED (R10-6) sign on the crossed roadway in advance of the trail crosswalk to stop motorists prior to the trail crosswalk	**3.1.3.1**

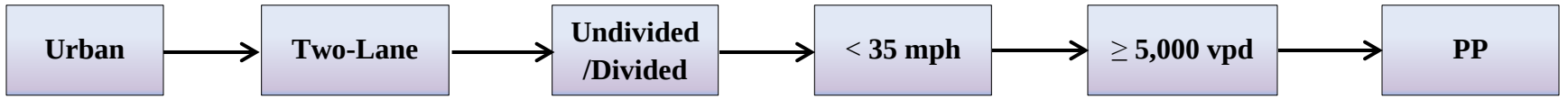
			(Note: applicable only when the intersection is already signalized).	
		PMS-09	Paint a STOP AHEAD, YIELD AHEAD, or PED XING advance warning pavement marking on the crossed road.	**3.1.3.1**
	Traffic Calming (TC)	**TC-02**	Install speed humps on the crossed road (Note: this treatment is not applicable to State Aid roadways and several other types of roadways receiving government funding).	**3.5.2**
	Lighting (LT)	**LT-01**	Provide lighting for the trail-roadway crossing.	**3.6**
	Sight Distance (SD)	**SD-03**	Clear and maintain stopping/crossing sight distance for motorists.	**3.2.1, 3.2.2**
Treatments for Right-turn Traffic on the Crossed Road	**Traffic Sign (TSN)**	**TSN-09**	Prohibit right turns on red using appropriate signage from the R10-11 series on the crossed roadway to reduce the chance of conflicts with trail users (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
Treatments for the Trail	**Pavement Markings and Striping (PMS)**	**PMS-01**	Paint a yellow center line only or use one along with advance warning striping for 150 feet (45.7 meters) along the trail approach from the trail entrance point (Note: applicable only when a bollard, lean rail, or median obstruction is present).	**3.1.3.1**
		PMS-02	Paint a stop/yield line to pair with the STOP/YIELD sign or pedestrian/bicycle signal head on the trail at a distance of 3 - 6 feet (0.9 - 1.8 meters) from the crossed road's edge.	**3.1.3.1**
		PMS-03	Paint a STOP/YIELD pavement marking on the trail approach.	**3.1.3.1**
	Trail Signals and Signs (TRSS)	**TRSS-01**	Install a CROSS ONLY ON GREEN (symbolic circular green) (R10-1) sign (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-02	Install a CROSS ONLY ON "WALK" (symbolic walk indication) (R10-2) sign	**3.1.1.1**

			(Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	
		TRSS-03	Install a sign from the Push Button for Green Light (R10-4) series (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-04	Install a sign from the Push Button for WALK Signal (R10-3) series (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-05	Install a pedestrian/bicyclist pushbutton on the trail 4 - 5 feet (1.2 – 1.5 meters) above the ground such that it is easily accessible for bicyclists to activate the signal without dismounting (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.2.1**
		TRSS-07	Install an advance warning Stop Ahead (W3-1)/Yield Ahead (W3-2) sign on the trail approach at a distance of approximately 100 feet (30.5 meters) in advance of the crossing.	**3.1.1.2**
		TRSS-08	Install a STOP (R1-1) or YIELD (R1-2) sign on the trail approach at a minimum of 2 feet (0.6 meters) from the edge of the trail.	**3.1.1.1**
		TRSS-13	Install pedestrian/bicycle signal on the trail approach if the crossed road is already signalized.	**3.1.2.1**
	Trail Access Control (TRAC)	**TRAC-01**	Install a NO MOTOR VEHICLES (R5-3) sign on the trail, facing the roadway, to prevent unauthorized motor vehicles from entering the trail.	**3.1.1.1**
		TRAC-02	Install bollards to prevent unauthorized motor vehicles from entering the trail.	**3.4.1**
		TRAC-03	Install a lean rail parallel to the trail to prevent unauthorized motor vehicles from entering the trail and provide bicyclists with an area in which they can stop without dismounting.	**3.4.2**
		TRAC-04	Install a median on the trail to split the trail into two sections and restrict unauthorized motor vehicles from entering the trail.	**3.4.3**
		TRAC-05	Use discrete curb angles by providing 90 degree angles and sharply defined curbing of the trail crossing to discourage motor vehicle entry.	**3.4.4**
	Curb Ramps (CR)	**CR-01**	Install a curb ramp to make the crossing accessible to pedestrians with disabilities and to improve crossing conditions for all trail users. (Note: The curb ramp must have detectable warnings in the form of truncated domes as	**3.7**

			outlined in MnDOT Standard Plate No. 7038A.)	
	Realignment (RA)	**RA-01**	Realign the trail path to make a right angle crossing with the crossed roadway.	**3.8**
		RA-02	Realign the trail path such that its angle of intersection with the crossed roadway is ≥ 75 degrees.	**3.8**
		RA-03	Set back the trail path approximately 10 to 30 feet (3.0 to 9.1 meters) from the parallel roadway to allow vehicle stacking space (Note: applicable only when permissive left turns from the parallel roadway are allowed).	**3.8**
	Sight Distances (SD)	**SD-01**	Clear and maintain crossing/stopping sight distance for bicyclists.	**3.2.1, 3.2.2**
		SD-02	Clear and maintain crossing/stopping sight distance for pedestrians.	**3.2.1, 3.2.2**

*Note: Treatments in table are not in any specific order with respect to importance, cost, popularity, ease of implementation etc.

Table 2B: Alternative Treatments for Urban, Two-Lane, Undivided/Divided, Speed < 35 mph, ADT ≥ 5,000 vpd, Parallel Path Crossings



		Available Treatments		
		Treatment ID	**Treatment Description**	**Handbook Section**
Treatments for Left-turn Traffic on the Parallel Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-02**	Prohibit permissive left turns and enable protected left turns from the parallel roadway while trail users receive a "WALK" or flashing "DON'T WALK" indication (Note: applicable only when the intersection is already signalized and the parallel roadway has a dedicated left-turn lane).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-06**	Install an advance trail-crossing warning sign, such as the TRAIL CROSSING (W11-15a) sign, on the parallel roadway to warn turning vehicles. A distance plaque may be added beneath the sign.	**3.1.1.2**
Treatments for Right-turn Traffic on the Parallel Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-03**	Prohibit permissive right turns and enable protected right turns from the parallel roadway while trail users receive a "WALK" or flashing "DON'T WALK" indication (Note: applicable only when the intersection is already signalized and the parallel roadway has a dedicated right-turn lane).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-06**	Install an advance trail-crossing warning sign, such as the TRAIL CROSSING (W11-15a) sign, on the parallel roadway to warn turning vehicles. A distance plaque may be added beneath the sign.	**3.1.1.2**
	Traffic Calming (TC)	**TC-05**	Reduce the turning radius for right-turn vehicles.	**3.5.1**
		TC-07	Install a speed hump in the path of a vehicle turning right from the parallel roadway to the crossed roadway (Note: this treatment is not applicable to State Aid roadways and several other types of roadways receiving government funding).	**3.5.2**

Treatments for Through Traffic on the Crossed Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-04**	Provide oncoming crossing traffic on the crossed road with adequate change and clearance intervals to ensure their clearance of the trail prior to the trail receiving a "WALK" indication (Note: applicable only when the intersection is already signalized).	**3.1.2.1**
		TSGB-05	Provide an all-red phase on the crossed road to further protect trail users (Note: applicable only when the intersection is already signalized and the crossed road does not have all-red phase).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-02**	Install an advance trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at least 250 feet (76.2 meters) from the crossing. A distance plaque may be added beneath the sign.	**3.1.1.2**
		TSN-04	Install a Stop Ahead (W3-1) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-05	Install a Yield Ahead (W3-2) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-07	Install a trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at the crossing.	**3.1.1.2**
		TSN-08	Install a STOP HERE ON RED (R10-6) sign at the trail crosswalk with a painted stop line to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
	Pavement Markings and Striping (PMS)	**PMS-04**	Divide the crosswalk to channelize pedestrians and bicyclists and separate their movements.	**3.1.3.2**
		PMS-05	Paint a high-visibility crosswalk on the crossed road "ladder" or "zebra" patterns preferable. (Note: The final decision of applying this treatment should be based on engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP, or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	**3.1.3.2**
		PMS-07	Set back the stop line on the crossed roadway to improve the trail users' and the moving motorists' mutual chance to have an unobstructed view of each other.	**3.1.3.1**
		PMS-08	Paint a stop line and install a STOP HERE ON RED (R10-6) sign on the crossed roadway in advance of the trail crosswalk to stop motorists prior to the trail crosswalk	**3.1.3.1**

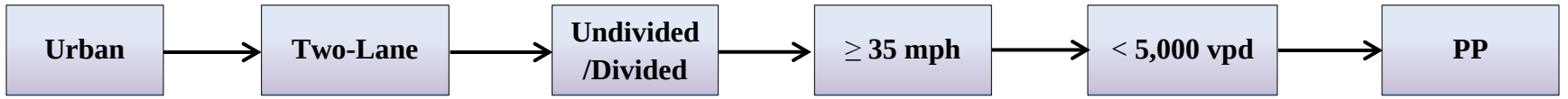
			(Note: applicable only when the intersection is already signalized).	
		PMS-09	Paint a STOP AHEAD, YIELD AHEAD, or PED XING advance warning pavement marking on the crossed road.	**3.1.3.1**
	Lighting (LT)	**LT-01**	Provide lighting for the trail-roadway crossing.	**3.6**
	Sight Distance (SD)	**SD-03**	Clear and maintain stopping/crossing sight distance for motorists.	**3.2.1, 3.2.2**
Treatments for Right-turn Traffic on the Crossed Road	**Traffic Sign (TSN)**	**TSN-09**	Prohibit right turns on red using appropriate signage from the R10-11 series on the crossed roadway to reduce the chance of conflicts with trail users (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
Treatments for the Trail	**Pavement Markings and Striping (PMS)**	**PMS-01**	Paint a yellow center line only or use one along with advance warning striping for 150 feet (45.7 meters) along the trail approach from the trail entrance point (Note: applicable only when a bollard, lean rail, or median obstruction is present).	**3.1.3.1**
		PMS-02	Paint a stop/yield line to pair with the STOP/YIELD sign or pedestrian/bicycle signal head on the trail at a distance of 3 - 6 feet (0.9 - 1.8 meters) from the crossed road's edge.	**3.1.3.1**
		PMS-03	Paint a STOP/YIELD pavement marking on the trail approach.	**3.1.3.1**
	Trail Signals and Signs (TRSS)	**TRSS-01**	Install a CROSS ONLY ON GREEN (symbolic circular green) (R10-1) sign (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-02	Install a CROSS ONLY ON "WALK" (symbolic walk indication) (R10-2) sign (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-03	Install a sign from the Push Button for Green Light (R10-4) series (Note: applicable	**3.1.1.1**

			only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	
		TRSS-04	Install a sign from the Push Button for WALK Signal (R10-3) series (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-05	Install a pedestrian/bicyclist pushbutton on the trail 4 - 5 feet (1.2 – 1.5 meters) above the ground such that it is easily accessible for bicyclists to activate the signal without dismounting (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.2.1**
		TRSS-07	Install an advance warning Stop Ahead (W3-1)/Yield Ahead (W3-2) sign on the trail approach at a distance of approximately 100 feet (30.5 meters) in advance of the crossing.	**3.1.1.2**
		TRSS-08	Install a STOP (R1-1) or YIELD (R1-2) sign on the trail approach at a minimum of 2 feet (0.6 meters) from the edge of the trail.	**3.1.1.1**
		TRSS-13	Install pedestrian/bicycle signal on the trail approach if the crossed road is already signalized.	**3.1.2.1**
	Trail Access Control (TRAC)	**TRAC-01**	Install a NO MOTOR VEHICLES (R5-3) sign on the trail, facing the roadway, to prevent unauthorized motor vehicles from entering the trail.	**3.1.1.1**
		TRAC-02	Install bollards to prevent unauthorized motor vehicles from entering the trail.	**3.4.1**
		TRAC-03	Install a lean rail parallel to the trail to prevent unauthorized motor vehicles from entering the trail and provide bicyclists with an area in which they can stop without dismounting.	**3.4.2**
		TRAC-04	Install a median on the trail to split the trail into two sections and restrict unauthorized motor vehicles from entering the trail.	**3.4.3**
		TRAC-05	Use discrete curb angles by providing 90 degree angles and sharply defined curbing of the trail crossing to discourage motor vehicle entry.	**3.4.4**
	Curb Ramps (CR)	**CR-01**	Install a curb ramp to make the crossing accessible to pedestrians with disabilities and to improve crossing conditions for all trail users. (Note: The curb ramp must have detectable warnings in the form of truncated domes as outlined in MnDOT Standard Plate No. 7038A.)	**3.7**
	Realignment (RA)	**RA-01**	Realign the trail path to make a right angle crossing with the crossed roadway.	**3.8**

		RA-02	Realign the trail path such that its angle of intersection with the crossed roadway is ≥ 75 degrees.	**3.8**
		RA-03	Set back the trail path approximately 10 to 30 feet (3.0 to 9.1 meters) from the parallel roadway to allow vehicle stacking space (Note: applicable only when permissive left turns from the parallel roadway are allowed).	**3.8**
	Sight Distances (SD)	**SD-01**	Clear and maintain crossing/stopping sight distance for bicyclists.	**3.2.1, 3.2.2**
		SD-02	Clear and maintain crossing/stopping sight distance for pedestrians.	**3.2.1, 3.2.2**

*Note: Treatments in table are not in any specific order with respect to importance, cost, popularity, ease of implementation etc.

Table 3B: Alternative Treatments for Urban, Two-Lane, Undivided/Divided, Speed ≥ 35 mph, ADT < 5,000 vpd, Parallel Path Crossings



		Available Treatments		
		Treatment ID	**Treatment Description**	**Handbook Section**
Treatments for Left-turn Traffic on the Parallel Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-02**	Prohibit permissive left turns and enable protected left turns from the parallel roadway while trail users receive a "WALK" or flashing "DON'T WALK" indication (Note: applicable only when the intersection is already signalized and the parallel roadway has a dedicated left-turn lane).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-06**	Install an advance trail-crossing warning sign, such as the TRAIL CROSSING (W11-15a) sign, on the parallel roadway to warn turning vehicles. A distance plaque may be added beneath the sign.	**3.1.1.2**
Treatments for Right-turn Traffic on the Parallel Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-03**	Prohibit permissive right turns and enable protected right turns from the parallel roadway while trail users receive a "WALK" or flashing "DON'T WALK" indication (Note: applicable only when the intersection is already signalized and the parallel roadway has a dedicated right-turn lane).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-06**	Install an advance trail-crossing warning sign, such as the TRAIL CROSSING (W11-15a) sign, on the parallel roadway to warn turning vehicles. A distance plaque may be added beneath the sign.	**3.1.1.2**
	Traffic Calming (TC)	**TC-05**	Reduce the turning radius for right-turn vehicles.	**3.5.1**
Treatments	**Traffic Signal and**	**TSGB-04**	Provide oncoming crossing traffic on the crossed road with adequate change and clearance intervals to ensure their clearance of the trail prior to the trail receiving a	**3.1.2.1**

for Through Traffic on the Crossed Road	**Beacon (TSGB)**		"WALK" indication (Note: applicable only when the intersection is already signalized).	
		TSGB-05	Provide an all-red phase on the crossed road to further protect trail users (Note: applicable only when the intersection is already signalized and the crossed road does not have all-red phase).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-02**	Install an advance trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at least 250 feet (76.2 meters) from the crossing. A distance plaque may be added beneath the sign.	**3.1.1.2**
		TSN-04	Install a Stop Ahead (W3-1) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-05	Install a Yield Ahead (W3-2) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-07	Install a trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at the crossing.	**3.1.1.2**
		TSN-08	Install a STOP HERE ON RED (R10-6) sign at the trail crosswalk with a painted stop line to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
	Pavement Markings and Striping (PMS)	**PMS-04**	Divide the crosswalk to channelize pedestrians and bicyclists and separate their movements.	**3.1.3.2**
		PMS-05	Paint a high-visibility crosswalk on the crossed road "ladder" or "zebra" patterns preferable. (Note: The final decision of applying this treatment should be based on engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP, or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	**3.1.3.2**
		PMS-07	Set back the stop line on the crossed roadway to improve the trail users' and the moving motorists' mutual chance to have an unobstructed view of each other.	**3.1.3.1**
		PMS-08	Paint a stop line and install a STOP HERE ON RED (R10-6) sign on the crossed roadway in advance of the trail crosswalk to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.3.1**

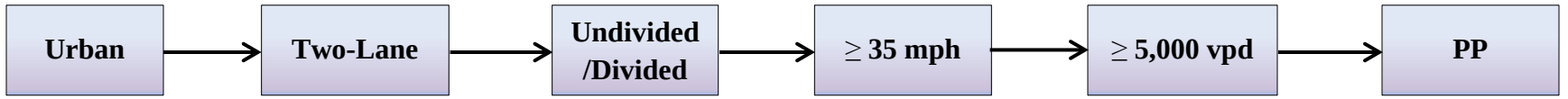
		PMS-09	Paint a STOP AHEAD, YIELD AHEAD, or PED XING advance warning pavement marking on the crossed road.	**3.1.3.1**
	Lighting (LT)	**LT-01**	Provide lighting for the trail-roadway crossing.	**3.6**
	Sight Distance (SD)	**SD-03**	Clear and maintain stopping/crossing sight distance for motorists.	**3.2.1, 3.2.2**
Treatments for Right-turn Traffic on the Crossed Road	**Traffic Sign (TSN)**	**TSN-09**	Prohibit right turns on red using appropriate signage from the R10-11 series on the crossed roadway to reduce the chance of conflicts with trail users (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
Treatments for the Trail	**Pavement Markings and Striping (PMS)**	**PMS-01**	Paint a yellow center line only or use one along with advance warning striping for 150 feet (45.7 meters) along the trail approach from the trail entrance point (Note: applicable only when a bollard, lean rail, or median obstruction is present).	**3.1.3.1**
		PMS-02	Paint a stop/yield line to pair with the STOP/YIELD sign or pedestrian/bicycle signal head on the trail at a distance of 3 - 6 feet (0.9 - 1.8 meters) from the crossed road's edge.	**3.1.3.1**
		PMS-03	Paint a STOP/YIELD pavement marking on the trail approach.	**3.1.3.1**
	Trail Signals and Signs (TRSS)	**TRSS-01**	Install a CROSS ONLY ON GREEN (symbolic circular green) (R10-1) sign (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-02	Install a CROSS ONLY ON "WALK" (symbolic walk indication) (R10-2) sign (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-03	Install a sign from the Push Button for Green Light (R10-4) series (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**

		TRSS-04	Install a sign from the Push Button for WALK Signal (R10-3) series (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-05	Install a pedestrian/bicyclist pushbutton on the trail 4 - 5 feet (1.2 – 1.5 meters) above the ground such that it is easily accessible for bicyclists to activate the signal without dismounting (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.2.1**
		TRSS-07	Install an advance warning Stop Ahead (W3-1)/Yield Ahead (W3-2) sign on the trail approach at a distance of approximately 100 feet (30.5 meters) in advance of the crossing.	**3.1.1.2**
		TRSS-08	Install a STOP (R1-1) or YIELD (R1-2) sign on the trail approach at a minimum of 2 feet (0.6 meters) from the edge of the trail.	**3.1.1.1**
		TRSS-13	Install pedestrian/bicycle signal on the trail approach if the crossed road is already signalized.	**3.1.2.1**
	Trail Access Control (TRAC)	**TRAC-01**	Install a NO MOTOR VEHICLES (R5-3) sign on the trail, facing the roadway, to prevent unauthorized motor vehicles from entering the trail.	**3.1.1.1**
		TRAC-02	Install bollards to prevent unauthorized motor vehicles from entering the trail.	**3.4.1**
		TRAC-03	Install a lean rail parallel to the trail to prevent unauthorized motor vehicles from entering the trail and provide bicyclists with an area in which they can stop without dismounting.	**3.4.2**
		TRAC-04	Install a median on the trail to split the trail into two sections and restrict unauthorized motor vehicles from entering the trail.	**3.4.3**
		TRAC-05	Use discrete curb angles by providing 90 degree angles and sharply defined curbing of the trail crossing to discourage motor vehicle entry.	**3.4.4**
	Curb Ramps (CR)	**CR-01**	Install a curb ramp to make the crossing accessible to pedestrians with disabilities and to improve crossing conditions for all trail users. (Note: The curb ramp must have detectable warnings in the form of truncated domes as outlined in MnDOT Standard Plate No. 7038A.)	**3.7**
	Realignment (RA)	**RA-01**	Realign the trail path to make a right angle crossing with the crossed roadway.	**3.8**
		RA-02	Realign the trail path such that its angle of intersection with the crossed roadway is ≥ 75 degrees.	**3.8**

		RA-03	Set back the trail path approximately 10 to 30 feet (3.0 to 9.1 meters) from the parallel roadway to allow vehicle stacking space (Note: applicable only when permissive left turns from the parallel roadway are allowed).	**3.8**
	Sight Distances (SD)	**SD-01**	Clear and maintain crossing/stopping sight distance for bicyclists.	**3.2.1, 3.2.2**
		SD-02	Clear and maintain crossing/stopping sight distance for pedestrians.	**3.2.1, 3.2.2**

*Note: Treatments in table are not in any specific order with respect to importance, cost, popularity, ease of implementation etc.

Table 4B: Alternative Treatments for Urban, Two-Lane, Undivided/Divided, Speed ≥ 35 mph, ADT ≥ 5,000 vpd, Parallel Path Crossings



		Available Treatments		
		Treatment ID	**Treatment Description**	**Handbook Section**
Treatments for Left-turn Traffic on the Parallel Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-02**	Prohibit permissive left turns and enable protected left turns from the parallel roadway while trail users receive a "WALK" or flashing "DON'T WALK" indication (Note: applicable only when the intersection is already signalized and the parallel roadway has a dedicated left-turn lane).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-06**	Install an advance trail-crossing warning sign, such as the TRAIL CROSSING (W11-15a) sign, on the parallel roadway to warn turning vehicles. A distance plaque may be added beneath the sign.	**3.1.1.2**
Treatments for Right-turn Traffic on the Parallel Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-03**	Prohibit permissive right turns and enable protected right turns from the parallel roadway while trail users receive a "WALK" or flashing "DON'T WALK" indication (Note: applicable only when the intersection is already signalized and the parallel roadway has a dedicated right-turn lane).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-06**	Install an advance trail-crossing warning sign, such as the TRAIL CROSSING (W11-15a) sign, on the parallel roadway to warn turning vehicles. A distance plaque may be added beneath the sign.	**3.1.1.2**
	Traffic Calming (TC)	**TC-05**	Reduce the turning radius for right-turn vehicles.	**3.5.1**
Treatments	**Traffic Signal and**	**TSGB-04**	Provide oncoming crossing traffic on the crossed road with adequate change and clearance intervals to ensure their clearance of the trail prior to the trail receiving a	**3.1.2.1**

for Through Traffic on the Crossed Road	**Beacon (TSGB)**		"WALK" indication (Note: applicable only when the intersection is already signalized).	
		TSGB-05	Provide an all-red phase on the crossed road to further protect trail users (Note: applicable only when the intersection is already signalized and the crossed road does not have all-red phase).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-02**	Install an advance trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at least 250 feet (76.2 meters) from the crossing. A distance plaque may be added beneath the sign.	**3.1.1.2**
		TSN-04	Install a Stop Ahead (W3-1) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-05	Install a Yield Ahead (W3-2) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-07	Install a trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at the crossing.	**3.1.1.2**
		TSN-08	Install a STOP HERE ON RED (R10-6) sign at the trail crosswalk with a painted stop line to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
	Pavement Markings and Striping (PMS)	**PMS-04**	Divide the crosswalk to channelize pedestrians and bicyclists and separate their movements.	**3.1.3.2**
		PMS-05	Paint a high-visibility crosswalk on the crossed road "ladder" or "zebra" patterns preferable. (Note: The final decision of applying this treatment should be based on engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP, or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	**3.1.3.2**
		PMS-06	Paint a high-visibility "standard" pattern crosswalk on the crossed road. (Note: The final decision of applying this treatment should be based on engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP, or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction	**3.1.3.2**

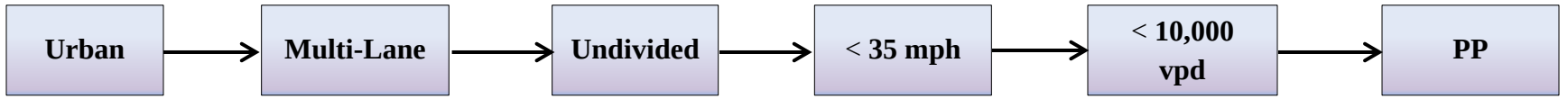
			detailed in Section 3.1.3.2.)	
		PMS-07	Set back the stop line on the crossed roadway to improve the trail users' and the moving motorists' mutual chance to have an unobstructed view of each other.	**3.1.3.1**
		PMS-08	Paint a stop line and install a STOP HERE ON RED (R10-6) sign on the crossed roadway in advance of the trail crosswalk to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.3.1**
		PMS-09	Paint a STOP AHEAD, YIELD AHEAD, or PED XING advance warning pavement marking on the crossed road.	**3.1.3.1**
	Lighting (LT)	**LT-01**	Provide lighting for the trail-roadway crossing.	**3.6**
	Sight Distance (SD)	**SD-03**	Clear and maintain stopping/crossing sight distance for motorists.	**3.2.1, 3.2.2**
Treatments for Right-turn Traffic on the Crossed Road	**Traffic Sign (TSN)**	**TSN-09**	Prohibit right turns on red using appropriate signage from the R10-11 series on the crossed roadway to reduce the chance of conflicts with trail users (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
Treatments for the Trail	**Pavement Markings and Striping (PMS)**	**PMS-01**	Paint a yellow center line only or use one along with advance warning striping for 150 feet (45.7 meters) along the trail approach from the trail entrance point (Note: applicable only when a bollard, lean rail, or median obstruction is present).	**3.1.3.1**
		PMS-02	Paint a stop/yield line to pair with the STOP/YIELD sign or pedestrian/bicycle signal head on the trail at a distance of 3 - 6 feet (0.9 - 1.8 meters) from the crossed road's edge.	**3.1.3.1**
		PMS-03	Paint a STOP/YIELD pavement marking on the trail approach.	**3.1.3.1**
	Trail Signals and Signs	**TRSS-01**	Install a CROSS ONLY ON GREEN (symbolic circular green) (R10-1) sign (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the	**3.1.1.1**

	(TRSS)		trail crossing).	
		TRSS-02	Install a CROSS ONLY ON “WALK” (symbolic walk indication) (R10-2) sign (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-03	Install a sign from the Push Button for Green Light (R10-4) series (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-04	Install a sign from the Push Button for WALK Signal (R10-3) series (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-05	Install a pedestrian/bicyclist pushbutton on the trail 4 - 5 feet (1.2 – 1.5 meters) above the ground such that it is easily accessible for bicyclists to activate the signal without dismounting (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.2.1**
		TRSS-07	Install an advance warning Stop Ahead (W3-1)/Yield Ahead (W3-2) sign on the trail approach at a distance of approximately 100 feet (30.5 meters) in advance of the crossing.	**3.1.1.2**
		TRSS-08	Install a STOP (R1-1) or YIELD (R1-2) sign on the trail approach at a minimum of 2 feet (0.6 meters) from the edge of the trail.	**3.1.1.1**
		TRSS-13	Install pedestrian/bicycle signal on the trail approach if the crossed road is already signalized.	**3.1.2.1**
	Trail Access Control (TRAC)	**TRAC-01**	Install a NO MOTOR VEHICLES (R5-3) sign on the trail, facing the roadway, to prevent unauthorized motor vehicles from entering the trail.	**3.1.1.1**
		TRAC-02	Install bollards to prevent unauthorized motor vehicles from entering the trail.	**3.4.1**
		TRAC-03	Install a lean rail parallel to the trail to prevent unauthorized motor vehicles from entering the trail and provide bicyclists with an area in which they can stop without dismounting.	**3.4.2**
		TRAC-04	Install a median on the trail to split the trail into two sections and restrict unauthorized motor vehicles from entering the trail.	**3.4.3**
		TRAC-05	Use discrete curb angles by providing 90 degree angles and sharply defined curbing of the trail crossing to discourage motor vehicle entry.	**3.4.4**

	Curb Ramps (CR)	**CR-01**	Install a curb ramp to make the crossing accessible to pedestrians with disabilities and to improve crossing conditions for all trail users. (Note: The curb ramp must have detectable warnings in the form of truncated domes as outlined in MnDOT Standard Plate No. 7038A.)	**3.7**
	Realignment (RA)	**RA-01**	Realign the trail path to make a right angle crossing with the crossed roadway.	**3.8**
		RA-02	Realign the trail path such that its angle of intersection with the crossed roadway is ≥ 75 degrees.	**3.8**
		RA-03	Set back the trail path approximately 10 to 30 feet (3.0 to 9.1 meters) from the parallel roadway to allow vehicle stacking space (Note: applicable only when permissive left turns from the parallel roadway are allowed).	**3.8**
	Sight Distances (SD)	**SD-01**	Clear and maintain crossing/stopping sight distance for bicyclists.	**3.2.1, 3.2.2**
		SD-02	Clear and maintain crossing/stopping sight distance for pedestrians.	**3.2.1, 3.2.2**

*Note: Treatments in table are not in any specific order with respect to importance, cost, popularity, ease of implementation etc.

Table 5B: Alternative Treatments for Urban, Multi-Lane, Undivided, Speed < 35 mph, ADT < 10,000 vpd, Parallel Path Crossings



		Available Treatments		
		Treatment ID	**Treatment Description**	**Handbook Section**
Treatments for Left-turn Traffic on the Parallel Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-02**	Prohibit permissive left turns and enable protected left turns from the parallel roadway while trail users receive a "WALK" or flashing "DON'T WALK" indication (Note: applicable only when the intersection is already signalized and the parallel roadway has a dedicated left-turn lane).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-06**	Install an advance trail-crossing warning sign, such as the TRAIL CROSSING (W11-15a) sign, on the parallel roadway to warn turning vehicles. A distance plaque may be added beneath the sign.	**3.1.1.2**
Treatments for Right-turn Traffic on the Parallel Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-03**	Prohibit permissive right turns and enable protected right turns from the parallel roadway while trail users receive a "WALK" or flashing "DON'T WALK" indication (Note: applicable only when the intersection is already signalized and the parallel roadway has a dedicated right-turn lane).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-06**	Install an advance trail-crossing warning sign, such as the TRAIL CROSSING (W11-15a) sign, on the parallel roadway to warn turning vehicles. A distance plaque may be added beneath the sign.	**3.1.1.2**
	Traffic Calming (TC)	**TC-05**	Reduce the turning radius for right-turn vehicles.	**3.5.1**
		TC-07	Install a speed hump in the path of a vehicle turning right from the parallel roadway to the crossed roadway (Note: this treatment is not applicable to State Aid roadways and several other types of roadways receiving government funding).	**3.5.2**

Treatments for Through Traffic on the Crossed Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-04**	Provide oncoming crossing traffic on the crossed road with adequate change and clearance intervals to ensure their clearance of the trail prior to the trail receiving a "WALK" indication (Note: applicable only when the intersection is already signalized).	**3.1.2.1**
		TSGB-05	Provide an all-red phase on the crossed road to further protect trail users (Note: applicable only when the intersection is already signalized and the crossed road does not have all-red phase).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-02**	Install an advance trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at least 250 feet (76.2 meters) from the crossing. A distance plaque may be added beneath the sign.	**3.1.1.2**
		TSN-03	Install a Stop Here For Pedestrians (R1-5) series sign at the crossing on the crossed road	**3.1.1.1**
		TSN-04	Install a Stop Ahead (W3-1) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-05	Install a Yield Ahead (W3-2) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-07	Install a trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at the crossing.	**3.1.1.2**
		TSN-08	Install a STOP HERE ON RED (R10-6) sign at the trail crosswalk with a painted stop line to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
	Pavement Markings and Striping (PMS)	**PMS-04**	Divide the crosswalk to channelize pedestrians and bicyclists and separate their movements.	**3.1.3.2**
		PMS-05	Paint a high-visibility crosswalk on the crossed road "ladder" or "zebra" patterns preferable. (Note: The final decision of applying this treatment should be based on engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP, or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	**3.1.3.2**
		PMS-07	Set back the stop line on the crossed roadway to improve the trail users' and the moving motorists' mutual chance to have an unobstructed view of each other.	**3.1.3.1**

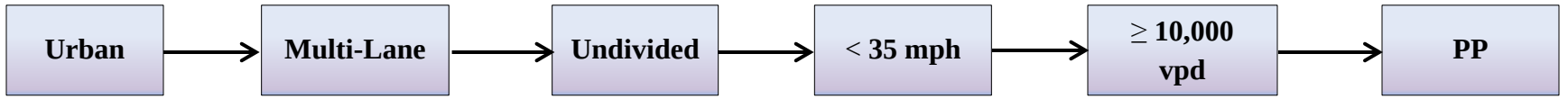
		PMS-08	Paint a stop line and install a STOP HERE ON RED (R10-6) sign on the crossed roadway in advance of the trail crosswalk to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.3.1**
		PMS-09	Paint a STOP AHEAD, YIELD AHEAD, or PED XING advance warning pavement marking on the crossed road.	**3.1.3.1**
	Lighting (LT)	**LT-01**	Provide lighting for the trail-roadway crossing.	**3.6**
	Sight Distance (SD)	**SD-03**	Clear and maintain stopping/crossing sight distance for motorists.	**3.2.1, 3.2.2**
Treatments for Right-turn Traffic on the Crossed Road	**Traffic Sign (TSN)**	**TSN-09**	Prohibit right turns on red using appropriate signage from the R10-11 series on the crossed roadway to reduce the chance of conflicts with trail users (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
	Traffic Calming (TC)	**TC-01**	Narrow the dedicated right-turn lane on the crossed road.	**3.5.1**
		TC-04	Install a speed table, on the dedicated right-turn lane of the crossed road, in the path of a vehicle turning right from the crossed road to the parallel roadway (Note: this treatment is not applicable to State Aid roadways and several other types of roadways receiving government funding).	**3.5.2**
Treatments for the Trail	**Pavement Markings and Striping (PMS)**	**PMS-01**	Paint a yellow center line only or use one along with advance warning striping for 150 feet (45.7 meters) along the trail approach from the trail entrance point (Note: applicable only when a bollard, lean rail, or median obstruction is present).	**3.1.3.1**
		PMS-02	Paint a stop/yield line to pair with the STOP/YIELD sign or pedestrian/bicycle signal head on the trail at a distance of 3 - 6 feet (0.9 - 1.8 meters) from the crossed road's edge.	**3.1.3.1**
		PMS-03	Paint a STOP/YIELD pavement marking on the trail approach.	**3.1.3.1**
	Trail Signals and Signs (TRSS)	**TRSS-01**	Install a CROSS ONLY ON GREEN (symbolic circular green) (R10-1) sign (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**

		TRSS-02	Install a CROSS ONLY ON “WALK” (symbolic walk indication) (R10-2) sign (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-03	Install a sign from the Push Button for Green Light (R10-4) series (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-04	Install a sign from the Push Button for WALK Signal (R10-3) series (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-05	Install a pedestrian/bicyclist pushbutton on the trail 4 - 5 feet (1.2 – 1.5 meters) above the ground such that it is easily accessible for bicyclists to activate the signal without dismounting (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.2.1**
		TRSS-07	Install an advance warning Stop Ahead (W3-1)/Yield Ahead (W3-2) sign on the trail approach at a distance of approximately 100 feet (30.5 meters) in advance of the crossing.	**3.1.1.2**
		TRSS-08	Install a STOP (R1-1) or YIELD (R1-2) sign on the trail approach at a minimum of 2 feet (0.6 meters) from the edge of the trail.	**3.1.1.1**
		TRSS-13	Install pedestrian/bicycle signal on the trail approach if the crossed road is already signalized.	**3.1.2.1**
	Trail Access Control (TRAC)	**TRAC-01**	Install a NO MOTOR VEHICLES (R5-3) sign on the trail, facing the roadway, to prevent unauthorized motor vehicles from entering the trail.	**3.1.1.1**
		TRAC-02	Install bollards to prevent unauthorized motor vehicles from entering the trail.	**3.4.1**
		TRAC-03	Install a lean rail parallel to the trail to prevent unauthorized motor vehicles from entering the trail and provide bicyclists with an area in which they can stop without dismounting.	**3.4.2**
		TRAC-04	Install a median on the trail to split the trail into two sections and restrict unauthorized motor vehicles from entering the trail.	**3.4.3**
		TRAC-05	Use discrete curb angles by providing 90 degree angles and sharply defined curbing of the trail crossing to discourage motor vehicle entry.	**3.4.4**
	Curb Ramps (CR)	**CR-01**	Install a curb ramp to make the crossing accessible to pedestrians with disabilities and to improve crossing conditions for all trail users. (Note: The	**3.7**

			curb ramp must have detectable warnings in the form of truncated domes as outlined in MnDOT Standard Plate No. 7038A.)	
	Realignment (RA)	**RA-01**	Realign the trail path to make a right angle crossing with the crossed roadway.	**3.8**
		RA-02	Realign the trail path such that its angle of intersection with the crossed roadway is ≥ 75 degrees.	**3.8**
		RA-03	Set back the trail path approximately 10 to 30 feet (3.0 to 9.1 meters) from the parallel roadway to allow vehicle stacking space (Note: applicable only when permissive left turns from the parallel roadway are allowed).	**3.8**
	Sight Distances (SD)	**SD-01**	Clear and maintain crossing/stopping sight distance for bicyclists.	**3.2.1, 3.2.2**
		SD-02	Clear and maintain crossing/stopping sight distance for pedestrians.	**3.2.1, 3.2.2**

*Note: Treatments in table are not in any specific order with respect to importance, cost, popularity, ease of implementation etc.

Table 6B: Alternative Treatments for Urban, Multi-Lane, Undivided, Speed < 35 mph, ADT ≥ 10,000 vpd, Parallel Path Crossings



		Available Treatments		
		Treatment ID	**Treatment Description**	**Handbook Section**
Treatments for Left-turn Traffic on the Parallel Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-02**	Prohibit permissive left turns and enable protected left turns from the parallel roadway while trail users receive a "WALK" or flashing "DON'T WALK" indication (Note: applicable only when the intersection is already signalized and the parallel roadway has a dedicated left-turn lane).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-06**	Install an advance trail-crossing warning sign, such as the TRAIL CROSSING (W11-15a) sign, on the parallel roadway to warn turning vehicles. A distance plaque may be added beneath the sign.	**3.1.1.2**
Treatments for Right-turn Traffic on the Parallel Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-03**	Prohibit permissive right turns and enable protected right turns from the parallel roadway while trail users receive a "WALK" or flashing "DON'T WALK" indication (Note: applicable only when the intersection is already signalized and the parallel roadway has a dedicated right-turn lane).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-06**	Install an advance trail-crossing warning sign, such as the TRAIL CROSSING (W11-15a) sign, on the parallel roadway to warn turning vehicles. A distance plaque may be added beneath the sign.	**3.1.1.2**
	Traffic Calming (TC)	**TC-05**	Reduce the turning radius for right-turn vehicles.	**3.5.1**
		TC-07	Install a speed hump in the path of a vehicle turning right from the parallel roadway to the crossed roadway (Note: this treatment is not applicable to State Aid roadways and several other types of roadways receiving government funding).	**3.5.2**

Treatments for Through Traffic on the Crossed Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-04**	Provide oncoming crossing traffic on the crossed road with adequate change and clearance intervals to ensure their clearance of the trail prior to the trail receiving a "WALK" indication (Note: applicable only when the intersection is already signalized).	**3.1.2.1**
		TSGB-05	Provide an all-red phase on the crossed road to further protect trail users (Note: applicable only when the intersection is already signalized and the crossed road does not have all-red phase).	**3.1.2.1**
		TSGB-06	Install a yellow flashing beacon with pedestrian pushbutton at the crosswalk (Note: applicable only when the intersection is unsignalized); if used, the designer may also consider applying Treatment TRSS-11.	**3.1.2.2**
		TSGB-08	Install a Rapid Rectangular Flashing Beacon (RRFB) (Note: applicable only when the intersection is unsignalized); if used, use in conjunction with Treatment TRSS-12.	**3.1.2.2**
	Traffic Sign (TSN)	**TSN-02**	Install an advance trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at least 250 feet (76.2 meters) from the crossing. A distance plaque may be added beneath the sign.	**3.1.1.2**
		TSN-03	Install a Stop Here For Pedestrians (R1-5) series sign at the crossing on the crossed road	**3.1.1.1**
		TSN-04	Install a Stop Ahead (W3-1) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-05	Install a Yield Ahead (W3-2) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-07	Install a trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at the crossing.	**3.1.1.2**
		TSN-08	Install a STOP HERE ON RED (R10-6) sign at the trail crosswalk with a painted stop line to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
	Pavement Markings and Striping (PMS)	**PMS-04**	Divide the crosswalk to channelize pedestrians and bicyclists and separate their movements.	**3.1.3.2**
		PMS-05	Paint a high-visibility crosswalk on the crossed road "ladder" or "zebra" patterns preferable. (Note: The final decision of applying this treatment should be based on engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs;	**3.1.3.2**

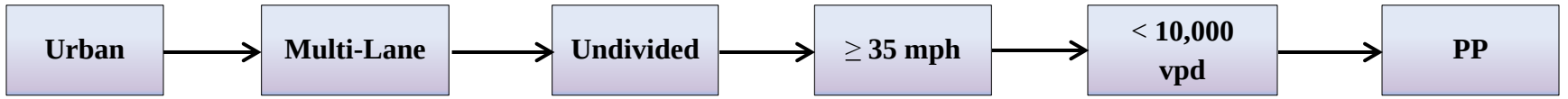
			or, based on an engineering study, if the crossing is not controlled by signals, STOP, or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	
		PMS-07	Set back the stop line on the crossed roadway to improve the trail users' and the moving motorists' mutual chance to have an unobstructed view of each other.	**3.1.3.1**
		PMS-08	Paint a stop line and install a STOP HERE ON RED (R10-6) sign on the crossed roadway in advance of the trail crosswalk to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.3.1**
		PMS-09	Paint a STOP AHEAD, YIELD AHEAD, or PED XING advance warning pavement marking on the crossed road.	**3.1.3.1**
	Lighting (LT)	**LT-01**	Provide lighting for the trail-roadway crossing.	**3.6**
	Sight Distance (SD)	**SD-03**	Clear and maintain stopping/crossing sight distance for motorists.	**3.2.1, 3.2.2**
Treatments for Right-turn Traffic on the Crossed Road	**Traffic Sign (TSN)**	**TSN-09**	Prohibit right turns on red using appropriate signage from the R10-11 series on the crossed roadway to reduce the chance of conflicts with trail users (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
	Traffic Calming (TC)	**TC-01**	Narrow the dedicated right-turn lane on the crossed road.	**3.5.1**
	Refuge Island (RI)	**RI-03**	Install channelizing islands to split right-turn movements from other traffic on the crossed roadway, narrow the right-turn path, and provide refuge area for trail users to cross the roadway (Note: this treatment is applicable when the crossed road has high ADT).	**3.3**
Treatments for the Trail	**Pavement Markings and Striping (PMS)**	**PMS-01**	Paint a yellow center line only or use one along with advance warning striping for 150 feet (45.7 meters) along the trail approach from the trail entrance point (Note: applicable only when a bollard, lean rail, or median obstruction is present).	**3.1.3.1**
		PMS-02	Paint a stop/yield line to pair with the STOP/YIELD sign or pedestrian/bicycle signal head on the trail at a distance of 3 - 6 feet (0.9 - 1.8 meters) from the crossed road's	**3.1.3.1**

			edge.	
		PMS-03	Paint a STOP/YIELD pavement marking on the trail approach.	**3.1.3.1**
	Trail Signals and Signs (TRSS)	**TRSS-01**	Install a CROSS ONLY ON GREEN (symbolic circular green) (R10-1) sign (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-02	Install a CROSS ONLY ON "WALK" (symbolic walk indication) (R10-2) sign (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-03	Install a sign from the Push Button for Green Light (R10-4) series (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-04	Install a sign from the Push Button for WALK Signal (R10-3) series (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-05	Install a pedestrian/bicyclist pushbutton on the trail 4 - 5 feet (1.2 – 1.5 meters) above the ground such that it is easily accessible for bicyclists to activate the signal without dismounting (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.2.1**
		TRSS-07	Install an advance warning Stop Ahead (W3-1)/Yield Ahead (W3-2) sign on the trail approach at a distance of approximately 100 feet (30.5 meters) in advance of the crossing.	**3.1.1.2**
		TRSS-08	Install a STOP (R1-1) or YIELD (R1-2) sign on the trail approach at a minimum of 2 feet (0.6 meters) from the edge of the trail.	**3.1.1.1**
		TRSS-11	Install a pushbutton for a yellow flashing beacon on the trail approach (Note: applicable only when yellow flashing beacon has been/ will be installed).	**3.1.2.2**
		TRSS-12	Install a pushbutton for an RRFB on the trail approach (Note: applicable only when RRFB has been/will be installed).	**3.1.2.2**
		TRSS-13	Install pedestrian/bicycle signal on the trail approach if the crossed road is already signalized.	**3.1.2.1**
		TRSS-14	Install a Push Button to Turn on Warning Lights (R10-25) sign at the crossing to inform trail users of how to activate the flashing beacon or RRFB.	**3.1.2.2**
	Trail Access	**TRAC-01**	Install a NO MOTOR VEHICLES (R5-3) sign on the trail, facing the roadway, to	**3.1.1.1**

	Control (TRAC)		prevent unauthorized motor vehicles from entering the trail.	
		TRAC-02	Install bollards to prevent unauthorized motor vehicles from entering the trail.	**3.4.1**
		TRAC-03	Install a lean rail parallel to the trail to prevent unauthorized motor vehicles from entering the trail and provide bicyclists with an area in which they can stop without dismounting.	**3.4.2**
		TRAC-04	Install a median on the trail to split the trail into two sections and restrict unauthorized motor vehicles from entering the trail.	**3.4.3**
		TRAC-05	Use discrete curb angles by providing 90 degree angles and sharply defined curbing of the trail crossing to discourage motor vehicle entry.	**3.4.4**
	Curb Ramps (CR)	**CR-01**	Install a curb ramp to make the crossing accessible to pedestrians with disabilities and to improve crossing conditions for all trail users. (Note: The curb ramp must have detectable warnings in the form of truncated domes as outlined in MnDOT Standard Plate No. 7038A.)	**3.7**
	Realignment (RA)	**RA-01**	Realign the trail path to make a right angle crossing with the crossed roadway.	**3.8**
		RA-02	Realign the trail path such that its angle of intersection with the crossed roadway is ≥ 75 degrees.	**3.8**
		RA-03	Set back the trail path approximately 10 to 30 feet (3.0 to 9.1 meters) from the parallel roadway to allow vehicle stacking space (Note: applicable only when permissive left turns from the parallel roadway are allowed).	**3.8**
	Sight Distances (SD)	**SD-01**	Clear and maintain crossing/stopping sight distance for bicyclists.	**3.2.1, 3.2.2**
		SD-02	Clear and maintain crossing/stopping sight distance for pedestrians.	**3.2.1, 3.2.2**

*Note: Treatments in table are not in any specific order with respect to importance, cost, popularity, ease of implementation etc.

Table 7B: Alternative Treatments for Urban, Multi-Lane, Undivided, Speed ≥ 35 mph, ADT < 10,000 vpd, Parallel Path Crossings



		Available Treatments		
		Treatment ID	**Treatment Description**	**Handbook Section**
Treatments for Left-turn Traffic on the Parallel Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-02**	Prohibit permissive left turns and enable protected left turns from the parallel roadway while trail users receive a "WALK" or flashing "DON'T WALK" indication (Note: applicable only when the intersection is already signalized and the parallel roadway has a dedicated left-turn lane).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-06**	Install an advance trail-crossing warning sign, such as the TRAIL CROSSING (W11-15a) sign, on the parallel roadway to warn turning vehicles. A distance plaque may be added beneath the sign.	**3.1.1.2**
Treatments for Right-turn Traffic on the Parallel Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-03**	Prohibit permissive right turns and enable protected right turns from the parallel roadway while trail users receive a "WALK" or flashing "DON'T WALK" indication (Note: applicable only when the intersection is already signalized and the parallel roadway has a dedicated right-turn lane).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-06**	Install an advance trail-crossing warning sign, such as the TRAIL CROSSING (W11-15a) sign, on the parallel roadway to warn turning vehicles. A distance plaque may be added beneath the sign.	**3.1.1.2**
	Traffic Calming (TC)	**TC-05**	Reduce the turning radius for right-turn vehicles.	**3.5.1**

Treatments for Through Traffic on the Crossed Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-04**	Provide oncoming crossing traffic on the crossed road with adequate change and clearance intervals to ensure their clearance of the trail prior to the trail receiving a "WALK" indication (Note: applicable only when the intersection is already signalized).	**3.1.2.1**
		TSGB-05	Provide an all-red phase on the crossed road to further protect trail users (Note: applicable only when the intersection is already signalized and the crossed road does not have all-red phase).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-02**	Install an advance trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at least 250 feet (76.2 meters) from the crossing. A distance plaque may be added beneath the sign.	**3.1.1.2**
		TSN-03	Install a Stop Here For Pedestrians (R1-5) series sign at the crossing on the crossed road	**3.1.1.1**
		TSN-04	Install a Stop Ahead (W3-1) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-05	Install a Yield Ahead (W3-2) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-07	Install a trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at the crossing.	**3.1.1.2**
		TSN-08	Install a STOP HERE ON RED (R10-6) sign at the trail crosswalk with a painted stop line to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
	Pavement Markings and Striping (PMS)	**PMS-04**	Divide the crosswalk to channelize pedestrians and bicyclists and separate their movements.	**3.1.3.2**
		PMS-05	Paint a high-visibility crosswalk on the crossed road "ladder" or "zebra" patterns preferable. (Note: The final decision of applying this treatment should be based on engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP, or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	**3.1.3.2**
		PMS-07	Set back the stop line on the crossed roadway to improve the trail users' and the moving motorists' mutual chance to have an unobstructed view of each other.	**3.1.3.1**

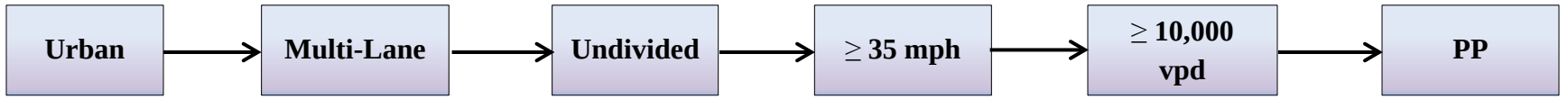
		PMS-08	Paint a stop line and install a STOP HERE ON RED (R10-6) sign on the crossed roadway in advance of the trail crosswalk to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.3.1**
		PMS-09	Paint a STOP AHEAD, YIELD AHEAD, or PED XING advance warning pavement marking on the crossed road.	**3.1.3.1**
	Lighting (LT)	**LT-01**	Provide lighting for the trail-roadway crossing.	**3.6**
	Sight Distance (SD)	**SD-03**	Clear and maintain stopping/crossing sight distance for motorists.	**3.2.1, 3.2.2**
Treatments for Right-turn Traffic on the Crossed Road	**Traffic Sign (TSN)**	**TSN-09**	Prohibit right turns on red using appropriate signage from the R10-11 series on the crossed roadway to reduce the chance of conflicts with trail users (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
	Traffic Calming (TC)	**TC-01**	Narrow the dedicated right-turn lane on the crossed road.	**3.5.1**
Treatments for the Trail	**Pavement Markings and Striping (PMS)**	**PMS-01**	Paint a yellow center line only or use one along with advance warning striping for 150 feet (45.7 meters) along the trail approach from the trail entrance point (Note: applicable only when a bollard, lean rail, or median obstruction is present).	**3.1.3.1**
		PMS-02	Paint a stop/yield line to pair with the STOP/YIELD sign or pedestrian/bicycle signal head on the trail at a distance of 3 - 6 feet (0.9 - 1.8 meters) from the crossed road's edge.	**3.1.3.1**
		PMS-03	Paint a STOP/YIELD pavement marking on the trail approach.	**3.1.3.1**
	Trail Signals and Signs (TRSS)	**TRSS-01**	Install a CROSS ONLY ON GREEN (symbolic circular green) (R10-1) sign (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-02	Install a CROSS ONLY ON "WALK" (symbolic walk indication) (R10-2) sign (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**

		TRSS-03	Install a sign from the Push Button for Green Light (R10-4) series (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-04	Install a sign from the Push Button for WALK Signal (R10-3) series (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-05	Install a pedestrian/bicyclist pushbutton on the trail 4 - 5 feet (1.2 – 1.5 meters) above the ground such that it is easily accessible for bicyclists to activate the signal without dismounting (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.2.1**
		TRSS-07	Install an advance warning Stop Ahead (W3-1)/Yield Ahead (W3-2) sign on the trail approach at a distance of approximately 100 feet (30.5 meters) in advance of the crossing.	**3.1.1.2**
		TRSS-08	Install a STOP (R1-1) or YIELD (R1-2) sign on the trail approach at a minimum of 2 feet (0.6 meters) from the edge of the trail.	**3.1.1.1**
		TRSS-13	Install pedestrian/bicycle signal on the trail approach if the crossed road is already signalized.	**3.1.2.1**
	Trail Access Control (TRAC)	**TRAC-01**	Install a NO MOTOR VEHICLES (R5-3) sign on the trail, facing the roadway, to prevent unauthorized motor vehicles from entering the trail.	**3.1.1.1**
		TRAC-02	Install bollards to prevent unauthorized motor vehicles from entering the trail.	**3.4.1**
		TRAC-03	Install a lean rail parallel to the trail to prevent unauthorized motor vehicles from entering the trail and provide bicyclists with an area in which they can stop without dismounting.	**3.4.2**
		TRAC-04	Install a median on the trail to split the trail into two sections and restrict unauthorized motor vehicles from entering the trail.	**3.4.3**
		TRAC-05	Use discrete curb angles by providing 90 degree angles and sharply defined curbing of the trail crossing to discourage motor vehicle entry.	**3.4.4**
	Curb Ramps (CR)	**CR-01**	Install a curb ramp to make the crossing accessible to pedestrians with disabilities and to improve crossing conditions for all trail users. (Note: The curb ramp must have detectable warnings in the form of truncated domes as outlined in MnDOT Standard Plate No. 7038A.)	**3.7**

	Realignment (RA)	**RA-01**	Realign the trail path to make a right angle crossing with the crossed roadway.	**3.8**
		RA-02	Realign the trail path such that its angle of intersection with the crossed roadway is ≥ 75 degrees.	**3.8**
		RA-03	Set back the trail path approximately 10 to 30 feet (3.0 to 9.1 meters) from the parallel roadway to allow vehicle stacking space (Note: applicable only when permissive left turns from the parallel roadway are allowed).	**3.8**
	Sight Distances (SD)	**SD-01**	Clear and maintain crossing/stopping sight distance for bicyclists.	**3.2.1, 3.2.2**
		SD-02	Clear and maintain crossing/stopping sight distance for pedestrians.	**3.2.1, 3.2.2**

*Note: Treatments in table are not in any specific order with respect to importance, cost, popularity, ease of implementation etc.

Table 8B: Alternative Treatments for Urban, Multi-Lane, Undivided, Speed ≥ 35 mph, ADT ≥ 10,000 vpd, Parallel Path Crossings



		Available Treatments		
		Treatment ID	**Treatment Description**	**Handbook Section**
Treatments for Left-turn Traffic on the Parallel Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-02**	Prohibit permissive left turns and enable protected left turns from the parallel roadway while trail users receive a "WALK" or flashing "DON'T WALK" indication (Note: applicable only when the intersection is already signalized and the parallel roadway has a dedicated left-turn lane).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-06**	Install an advance trail-crossing warning sign, such as the TRAIL CROSSING (W11-15a) sign, on the parallel roadway to warn turning vehicles. A distance plaque may be added beneath the sign.	**3.1.1.2**
Treatments for Right-turn Traffic on the Parallel Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-03**	Prohibit permissive right turns and enable protected right turns from the parallel roadway while trail users receive a "WALK" or flashing "DON'T WALK" indication (Note: applicable only when the intersection is already signalized and the parallel roadway has a dedicated right-turn lane).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-06**	Install an advance trail-crossing warning sign, such as the TRAIL CROSSING (W11-15a) sign, on the parallel roadway to warn turning vehicles. A distance plaque may be added beneath the sign.	**3.1.1.2**
	Traffic Calming (TC)	**TC-05**	Reduce the turning radius for right-turn vehicles.	**3.5.1**
Treatments	**Traffic Signal and Beacon**	**TSGB-04**	Provide oncoming crossing traffic on the crossed road with adequate change and clearance intervals to ensure their clearance of the trail prior to the trail receiving a "WALK" indication (Note: applicable only when the intersection is already	**3.1.2.1**

for Through Traffic on the Crossed Road	**(TSGB)**		signalized).	
		TSGB-05	Provide an all-red phase on the crossed road to further protect trail users (Note: applicable only when the intersection is already signalized and the crossed road does not have all-red phase).	**3.1.2.1**
		TSGB-06	Install a yellow flashing beacon with pedestrian pushbutton at the crosswalk (Note: applicable only when the intersection is unsignalized); if used, the designer may also consider applying Treatment TRSS-11.	**3.1.2.2**
		TSGB-08	Install a Rapid Rectangular Flashing Beacon (RRFB) (Note: applicable only when the intersection is unsignalized); if used, use in conjunction with Treatment TRSS-12.	**3.1.2.2**
	Traffic Sign (TSN)	**TSN-02**	Install an advance trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at least 250 feet (76.2 meters) from the crossing. A distance plaque may be added beneath the sign.	**3.1.1.2**
		TSN-03	Install a Stop Here For Pedestrians (R1-5) series sign at the crossing on the crossed road	**3.1.1.1**
		TSN-04	Install a Stop Ahead (W3-1) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-05	Install a Yield Ahead (W3-2) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-07	Install a trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at the crossing.	**3.1.1.2**
		TSN-08	Install a STOP HERE ON RED (R10-6) sign at the trail crosswalk with a painted stop line to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
	Pavement Markings and Striping (PMS)	**PMS-04**	Divide the crosswalk to channelize pedestrians and bicyclists and separate their movements.	**3.1.3.2**
		PMS-05	Paint a high-visibility crosswalk on the crossed road “ladder” or “zebra” patterns preferable. (Note: The final decision of applying this treatment should be based on engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP,	**3.1.3.2**

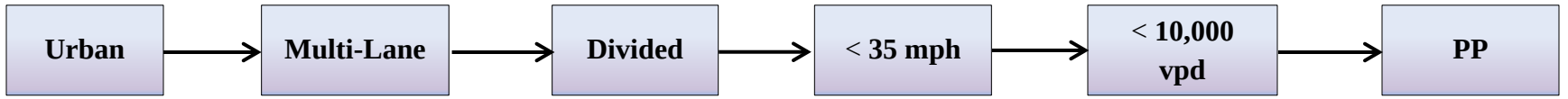
			or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	
		PMS-06	Paint a high-visibility "standard" pattern crosswalk on the crossed road. (Note: The final decision of applying this treatment should be based on engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP, or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	**3.1.3.2**
		PMS-07	Set back the stop line on the crossed roadway to improve the trail users' and the moving motorists' mutual chance to have an unobstructed view of each other.	**3.1.3.1**
		PMS-08	Paint a stop line and install a STOP HERE ON RED (R10-6) sign on the crossed roadway in advance of the trail crosswalk to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.3.1**
		PMS-09	Paint a STOP AHEAD, YIELD AHEAD, or PED XING advance warning pavement marking on the crossed road.	**3.1.3.1**
	Lighting (LT)	**LT-01**	Provide lighting for the trail-roadway crossing.	**3.6**
	Sight Distance (SD)	**SD-03**	Clear and maintain stopping/crossing sight distance for motorists.	**3.2.1, 3.2.2**
Treatments for Right-turn Traffic on the Crossed Road	**Traffic Sign (TSN)**	**TSN-09**	Prohibit right turns on red using appropriate signage from the R10-11 series on the crossed roadway to reduce the chance of conflicts with trail users (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
	Refuge Island (RI)	**RI-03**	Install channelizing islands to split right-turn movements from other traffic on the crossed roadway, narrow the right-turn path, and provide refuge area for trail users to cross the roadway.	**3.3**
	Traffic Calming (TC)	**TC-01**	Narrow the dedicated right-turn lane on the crossed road.	**3.5.1**

Treatments for the Trail	**Pavement Markings and Striping (PMS)**	**PMS-01**	Paint a yellow center line only or use one along with advance warning striping for 150 feet (45.7 meters) along the trail approach from the trail entrance point (Note: applicable only when a bollard, lean rail, or median obstruction is present).	**3.1.3.1**
		PMS-02	Paint a stop/yield line to pair with the STOP/YIELD sign or pedestrian/bicycle signal head on the trail at a distance of 3 - 6 feet (0.9 - 1.8 meters) from the crossed road's edge.	**3.1.3.1**
		PMS-03	Paint a STOP/YIELD pavement marking on the trail approach.	**3.1.3.1**
	Trail Signals and Signs (TRSS)	**TRSS-01**	Install a CROSS ONLY ON GREEN (symbolic circular green) (R10-1) sign (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-02	Install a CROSS ONLY ON "WALK" (symbolic walk indication) (R10-2) sign (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-03	Install a sign from the Push Button for Green Light (R10-4) series (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-04	Install a sign from the Push Button for WALK Signal (R10-3) series (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-05	Install a pedestrian/bicyclist pushbutton on the trail 4 - 5 feet (1.2 – 1.5 meters) above the ground such that it is easily accessible for bicyclists to activate the signal without dismounting (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.2.1**
		TRSS-07	Install an advance warning Stop Ahead (W3-1)/Yield Ahead (W3-2) sign on the trail approach at a distance of approximately 100 feet (30.5 meters) in advance of the crossing.	**3.1.1.2**
		TRSS-08	Install a STOP (R1-1) or YIELD (R1-2) sign on the trail approach at a minimum of 2 feet (0.6 meters) from the edge of the trail.	**3.1.1.1**
		TRSS-11	Install a pushbutton for a yellow flashing beacon on the trail approach (Note: applicable only when yellow flashing beacon has been/ will be installed).	**3.1.2.2**
		TRSS-12	Install a pushbutton for an RRFB on the trail approach (Note: applicable only when RRFB has been/will be installed).	**3.1.2.2**

		TRSS-13	Install pedestrian/bicycle signal on the trail approach if the crossed road is already signalized.	**3.1.2.1**
		TRSS-14	Install a Push Button to Turn on Warning Lights (R10-25) sign at the crossing to inform trail users of how to activate the flashing beacon or RRFB.	**3.1.2.2**
	Trail Access Control (TRAC)	**TRAC-01**	Install a NO MOTOR VEHICLES (R5-3) sign on the trail, facing the roadway, to prevent unauthorized motor vehicles from entering the trail.	**3.1.1.1**
		TRAC-02	Install bollards to prevent unauthorized motor vehicles from entering the trail.	**3.4.1**
		TRAC-03	Install a lean rail parallel to the trail to prevent unauthorized motor vehicles from entering the trail and provide bicyclists with an area in which they can stop without dismounting.	**3.4.2**
		TRAC-04	Install a median on the trail to split the trail into two sections and restrict unauthorized motor vehicles from entering the trail.	**3.4.3**
		TRAC-05	Use discrete curb angles by providing 90 degree angles and sharply defined curbing of the trail crossing to discourage motor vehicle entry.	**3.4.4**
	Curb Ramps (CR)	**CR-01**	Install a curb ramp to make the crossing accessible to pedestrians with disabilities and to improve crossing conditions for all trail users. (Note: The curb ramp must have detectable warnings in the form of truncated domes as outlined in MnDOT Standard Plate No. 7038A.)	**3.7**
	Realignment (RA)	**RA-01**	Realign the trail path to make a right angle crossing with the crossed roadway.	**3.8**
		RA-02	Realign the trail path such that its angle of intersection with the crossed roadway is ≥ 75 degrees.	**3.8**
		RA-03	Set back the trail path approximately 10 to 30 feet (3.0 to 9.1 meters) from the parallel roadway to allow vehicle stacking space (Note: applicable only when permissive left turns from the parallel roadway are allowed).	**3.8**
	Sight Distances (SD)	**SD-01**	Clear and maintain crossing/stopping sight distance for bicyclists.	**3.2.1, 3.2.2**
		SD-02	Clear and maintain crossing/stopping sight distance for pedestrians.	**3.2.1, 3.2.2**

*Note: Treatments in table are not in any specific order with respect to importance, cost, popularity, ease of implementation etc.

Table 9B: Alternative Treatments for Urban, Multi-Lane, Divided, Speed < 35 mph, ADT < 10,000 vpd, Parallel Path Crossings



		Available Treatments		
		Treatment ID	**Treatment Description**	**Handbook Section**
Treatments for Left-turn Traffic on the Parallel Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-02**	Prohibit permissive left turns and enable protected left turns from the parallel roadway while trail users receive a "WALK" or flashing "DON'T WALK" indication (Note: applicable only when the intersection is already signalized and the parallel roadway has a dedicated left-turn lane).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-06**	Install an advance trail-crossing warning sign, such as the TRAIL CROSSING (W11-15a) sign, on the parallel roadway to warn turning vehicles. A distance plaque may be added beneath the sign.	**3.1.1.2**
Treatments for Right-turn Traffic on the Parallel Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-03**	Prohibit permissive right turns and enable protected right turns from the parallel roadway while trail users receive a "WALK" or flashing "DON'T WALK" indication (Note: applicable only when the intersection is already signalized and the parallel roadway has a dedicated right-turn lane).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-06**	Install an advance trail-crossing warning sign, such as the TRAIL CROSSING (W11-15a) sign, on the parallel roadway to warn turning vehicles. A distance plaque may be added beneath the sign.	**3.1.1.2**
	Traffic Calming (TC)	**TC-05**	Reduce the turning radius for right-turn vehicles.	**3.5.1**
		TC-07	Install a speed hump in the path of a vehicle turning right from the parallel roadway to the crossed roadway (Note: this treatment is not applicable to State Aid roadways and several other types of roadways receiving government funding).	**3.5.2**

Treatments for Through Traffic on the Crossed Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-04**	Provide oncoming crossing traffic on the crossed road with adequate change and clearance intervals to ensure their clearance of the trail prior to the trail receiving a "WALK" indication (Note: applicable only when the intersection is already signalized).	**3.1.2.1**
		TSGB-05	Provide an all-red phase on the crossed road to further protect trail users (Note: applicable only when the intersection is already signalized and the crossed road does not have all-red phase).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-02**	Install an advance trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at least 250 feet (76.2 meters) from the crossing. A distance plaque may be added beneath the sign.	**3.1.1.2**
		TSN-03	Install a Stop Here For Pedestrians (R1-5) series sign at the crossing on the crossed road	**3.1.1.1**
		TSN-04	Install a Stop Ahead (W3-1) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-05	Install a Yield Ahead (W3-2) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-07	Install a trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at the crossing.	**3.1.1.2**
		TSN-08	Install a STOP HERE ON RED (R10-6) sign at the trail crosswalk with a painted stop line to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
	Pavement Markings and Striping (PMS)	**PMS-04**	Divide the crosswalk to channelize pedestrians and bicyclists and separate their movements.	**3.1.3.2**
		PMS-05	Paint a high-visibility crosswalk on the crossed road "ladder" or "zebra" patterns preferable. (Note: The final decision of applying this treatment should be based on engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP, or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	**3.1.3.2**
		PMS-07	Set back the stop line on the crossed roadway to improve the trail users' and the moving motorists' mutual chance to have an unobstructed view of each other.	**3.1.3.1**

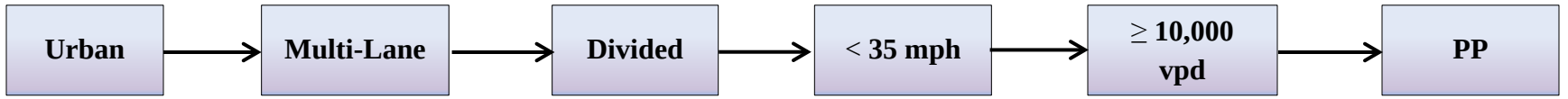
		PMS-08	Paint a stop line and install a STOP HERE ON RED (R10-6) sign on the crossed roadway in advance of the trail crosswalk to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.3.1**
		PMS-09	Paint a STOP AHEAD, YIELD AHEAD, or PED XING advance warning pavement marking on the crossed road.	**3.1.3.1**
	Lighting (LT)	**LT-01**	Provide lighting for the trail-roadway crossing.	**3.6**
	Sight Distance (SD)	**SD-03**	Clear and maintain stopping/crossing sight distance for motorists.	**3.2.1, 3.2.2**
Treatments for Right-turn Traffic on the Crossed Road	**Traffic Sign (TSN)**	**TSN-09**	Prohibit right turns on red using appropriate signage from the R10-11 series on the crossed roadway to reduce the chance of conflicts with trail users (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
	Traffic Calming (TC)	**TC-01**	Narrow the dedicated right-turn lane on the crossed road.	**3.5.1**
		TC-04	Install a speed table, on the dedicated right-turn lane of the crossed road, in the path of a vehicle turning right from the crossed road to the parallel roadway (Note: this treatment is not applicable to State Aid roadways and several other types of roadways receiving government funding).	**3.5.2**
Treatments for the Trail	**Pavement Markings and Striping (PMS)**	**PMS-01**	Paint a yellow center line only or use one along with advance warning striping for 150 feet (45.7 meters) along the trail approach from the trail entrance point (Note: applicable only when a bollard, lean rail, or median obstruction is present).	**3.1.3.1**
		PMS-02	Paint a stop/yield line to pair with the STOP/YIELD sign or pedestrian/bicycle signal head on the trail at a distance of 3 - 6 feet (0.9 - 1.8 meters) from the crossed road's edge.	**3.1.3.1**
		PMS-03	Paint a STOP/YIELD pavement marking on the trail approach.	**3.1.3.1**
	Trail Signals and Signs (TRSS)	**TRSS-01**	Install a CROSS ONLY ON GREEN (symbolic circular green) (R10-1) sign (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**

		TRSS-02	Install a CROSS ONLY ON “WALK” (symbolic walk indication) (R10-2) sign (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-03	Install a sign from the Push Button for Green Light (R10-4) series (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-04	Install a sign from the Push Button for WALK Signal (R10-3) series (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-05	Install a pedestrian/bicyclist pushbutton on the trail 4 - 5 feet (1.2 – 1.5 meters) above the ground such that it is easily accessible for bicyclists to activate the signal without dismounting (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.2.1**
		TRSS-07	Install an advance warning Stop Ahead (W3-1)/Yield Ahead (W3-2) sign on the trail approach at a distance of approximately 100 feet (30.5 meters) in advance of the crossing.	**3.1.1.2**
		TRSS-08	Install a STOP (R1-1) or YIELD (R1-2) sign on the trail approach at a minimum of 2 feet (0.6 meters) from the edge of the trail.	**3.1.1.1**
		TRSS-10	Install a pushbutton at the median refuge island for pedestrians trapped in the refuge area (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.2.1**
		TRSS-13	Install pedestrian/bicycle signal on the trail approach if the crossed road is already signalized.	**3.1.2.1**
	Trail Access Control (TRAC)	**TRAC-01**	Install a NO MOTOR VEHICLES (R5-3) sign on the trail, facing the roadway, to prevent unauthorized motor vehicles from entering the trail.	**3.1.1.1**
		TRAC-02	Install bollards to prevent unauthorized motor vehicles from entering the trail.	**3.4.1**
		TRAC-03	Install a lean rail parallel to the trail to prevent unauthorized motor vehicles from entering the trail and provide bicyclists with an area in which they can stop without dismounting.	**3.4.2**
		TRAC-04	Install a median on the trail to split the trail into two sections and restrict unauthorized motor vehicles from entering the trail.	**3.4.3**
		TRAC-05	Use discrete curb angles by providing 90 degree angles and sharply defined curbing	**3.4.4**

			of the trail crossing to discourage motor vehicle entry.	
	Curb Ramps (CR)	**CR-01**	Install a curb ramp to make the crossing accessible to pedestrians with disabilities and to improve crossing conditions for all trail users. (Note: The curb ramp must have detectable warnings in the form of truncated domes as outlined in MnDOT Standard Plate No. 7038A.)	**3.7**
	Realignment (RA)	**RA-01**	Realign the trail path to make a right angle crossing with the crossed roadway.	**3.8**
		RA-02	Realign the trail path such that its angle of intersection with the crossed roadway is ≥ 75 degrees.	**3.8**
		RA-03	Set back the trail path approximately 10 to 30 feet (3.0 to 9.1 meters) from the parallel roadway to allow vehicle stacking space (Note: applicable only when permissive left turns from the parallel roadway are allowed).	**3.8**
	Sight Distances (SD)	**SD-01**	Clear and maintain crossing/stopping sight distance for bicyclists.	**3.2.1, 3.2.2**
		SD-02	Clear and maintain crossing/stopping sight distance for pedestrians.	**3.2.1, 3.2.2**

*Note: Treatments in table are not in any specific order with respect to importance, cost, popularity, ease of implementation etc.

Table 10B: Alternative Treatments for Urban, Multi-Lane, Divided, Speed < 35 mph, ADT ≥ 10,000 vpd, Parallel Path Crossings



		Available Treatments		
		Treatment ID	**Treatment Description**	**Handbook Section**
Treatments for Left-turn Traffic on the Parallel Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-02**	Prohibit permissive left turns and enable protected left turns from the parallel roadway while trail users receive a "WALK" or flashing "DON'T WALK" indication (Note: applicable only when the intersection is already signalized and the parallel roadway has a dedicated left-turn lane).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-06**	Install an advance trail-crossing warning sign, such as the TRAIL CROSSING (W11-15a) sign, on the parallel roadway to warn turning vehicles. A distance plaque may be added beneath the sign.	**3.1.1.2**
Treatments for Right-turn Traffic on the Parallel Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-03**	Prohibit permissive right turns and enable protected right turns from the parallel roadway while trail users receive a "WALK" or flashing "DON'T WALK" indication (Note: applicable only when the intersection is already signalized and the parallel roadway has a dedicated right-turn lane).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-06**	Install an advance trail-crossing warning sign, such as the TRAIL CROSSING (W11-15a) sign, on the parallel roadway to warn turning vehicles. A distance plaque may be added beneath the sign.	**3.1.1.2**
	Traffic Calming (TC)	**TC-05**	Reduce the turning radius for right-turn vehicles.	**3.5.1**
		TC-07	Install a speed hump in the path of a vehicle turning right from the parallel roadway to the crossed roadway (Note: this treatment is not applicable to State Aid roadways and several other types of roadways receiving government funding).	**3.5.2**

Treatments for Through Traffic on the Crossed Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-04**	Provide oncoming crossing traffic on the crossed road with adequate change and clearance intervals to ensure their clearance of the trail prior to the trail receiving a "WALK" indication (Note: applicable only when the intersection is already signalized).	**3.1.2.1**
		TSGB-05	Provide an all-red phase on the crossed road to further protect trail users (Note: applicable only when the intersection is already signalized and the crossed road does not have all-red phase).	**3.1.2.1**
		TSGB-06	Install a yellow flashing beacon with pedestrian pushbutton at the crosswalk (Note: applicable only when the intersection is unsignalized); if used, the designer may also consider applying Treatment TRSS-11.	**3.1.2.2**
		TSGB-08	Install a Rapid Rectangular Flashing Beacon (RRFB) (Note: applicable only when the intersection is unsignalized); if used, use in conjunction with Treatment TRSS-12.	**3.1.2.2**
	Traffic Sign (TSN)	**TSN-02**	Install an advance trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at least 250 feet (76.2 meters) from the crossing. A distance plaque may be added beneath the sign.	**3.1.1.2**
		TSN-03	Install a Stop Here For Pedestrians (R1-5) series sign at the crossing on the crossed road	**3.1.1.1**
		TSN-04	Install a Stop Ahead (W3-1) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-05	Install a Yield Ahead (W3-2) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-07	Install a trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at the crossing.	**3.1.1.2**
		TSN-08	Install a STOP HERE ON RED (R10-6) sign at the trail crosswalk with a painted stop line to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
	Pavement Markings and Striping (PMS)	**PMS-04**	Divide the crosswalk to channelize pedestrians and bicyclists and separate their movements.	**3.1.3.2**
		PMS-05	Paint a high-visibility crosswalk on the crossed road "ladder" or "zebra" patterns preferable. (Note: The final decision of applying this treatment should be based on engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs;	**3.1.3.2**

			or, based on an engineering study, if the crossing is not controlled by signals, STOP, or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	
		PMS-07	Set back the stop line on the crossed roadway to improve the trail users' and the moving motorists' mutual chance to have an unobstructed view of each other.	**3.1.3.1**
		PMS-08	Paint a stop line and install a STOP HERE ON RED (R10-6) sign on the crossed roadway in advance of the trail crosswalk to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.3.1**
		PMS-09	Paint a STOP AHEAD, YIELD AHEAD, or PED XING advance warning pavement marking on the crossed road.	**3.1.3.1**
	Refuge Island (RI)	**RI-01**	Install a right-angle median refuge island (Note: this treatment is applicable when the crossed road has high ADT).	**3.3**
		RI-02	Install a median refuge island angled at 75 degrees with opposite sides of the trail across the roadway being slightly offset and supplementary centerline and STOP or YIELD pavement markings in the refuge area (Note: this treatment is applicable when the crossed road has high ADT).	**3.3**
	Lighting (LT)	**LT-01**	Provide lighting for the trail-roadway crossing.	**3.6**
	Sight Distance (SD)	**SD-03**	Clear and maintain stopping/crossing sight distance for motorists.	**3.2.1, 3.2.2**
Treatments for Right-turn Traffic on the Crossed	**Traffic Sign (TSN)**	**TSN-09**	Prohibit right turns on red using appropriate signage from the R10-11 series on the crossed roadway to reduce the chance of conflicts with trail users (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
	Traffic Calming (TC)	**TC-01**	Narrow the dedicated right-turn lane on the crossed road.	**3.5.1**

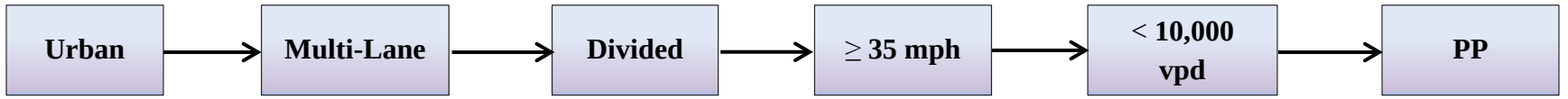
Road	**Refuge Island (RI)**	**RI-03**	Install channelizing islands to split right-turn movements from other traffic on the crossed roadway, narrow the right-turn path, and provide refuge area for trail users to cross the roadway (Note: this treatment is applicable when the crossed road has high ADT).	**3.3**
Treatments for the Trail	**Pavement Markings and Striping (PMS)**	**PMS-01**	Paint a yellow center line only or use one along with advance warning striping for 150 feet (45.7 meters) along the trail approach from the trail entrance point (Note: applicable only when a bollard, lean rail, or median obstruction is present).	**3.1.3.1**
		PMS-02	Paint a stop/yield line to pair with the STOP/YIELD sign or pedestrian/bicycle signal head on the trail at a distance of 3 - 6 feet (0.9 - 1.8 meters) from the crossed road's edge.	**3.1.3.1**
		PMS-03	Paint a STOP/YIELD pavement marking on the trail approach.	**3.1.3.1**
	Trail Signals and Signs (TRSS)	**TRSS-01**	Install a CROSS ONLY ON GREEN (symbolic circular green) (R10-1) sign (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-02	Install a CROSS ONLY ON "WALK" (symbolic walk indication) (R10-2) sign (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-03	Install a sign from the Push Button for Green Light (R10-4) series (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-04	Install a sign from the Push Button for WALK Signal (R10-3) series (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-05	Install a pedestrian/bicyclist pushbutton on the trail 4 - 5 feet (1.2 – 1.5 meters) above the ground such that it is easily accessible for bicyclists to activate the signal without dismounting (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.2.1**
		TRSS-07	Install an advance warning Stop Ahead (W3-1)/Yield Ahead (W3-2) sign on the trail approach at a distance of approximately 100 feet (30.5 meters) in advance of the crossing.	**3.1.1.2**
		TRSS-08	Install a STOP (R1-1) or YIELD (R1-2) sign on the trail approach at a minimum of 2 feet (0.6 meters) from the edge of the trail.	**3.1.1.1**

		TRSS-10	Install a pushbutton at the median refuge island for pedestrians trapped in the refuge area (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.2.1**
		TRSS-11	Install a pushbutton for a yellow flashing beacon on the trail approach (Note: applicable only when yellow flashing beacon has been/ will be installed).	**3.1.2.2**
		TRSS-12	Install a pushbutton for an RRFB on the trail approach (Note: applicable only when RRFB has been/will be installed).	**3.1.2.2**
		TRSS-13	Install pedestrian/bicycle signal on the trail approach if the crossed road is already signalized.	**3.1.2.1**
		TRSS-14	Install a Push Button to Turn on Warning Lights (R10-25) sign at the crossing to inform trail users of how to activate the flashing beacon or RRFB.	**3.1.2.2**
	Trail Access Control (TRAC)	**TRAC-01**	Install a NO MOTOR VEHICLES (R5-3) sign on the trail, facing the roadway, to prevent unauthorized motor vehicles from entering the trail.	**3.1.1.1**
		TRAC-02	Install bollards to prevent unauthorized motor vehicles from entering the trail.	**3.4.1**
		TRAC-03	Install a lean rail parallel to the trail to prevent unauthorized motor vehicles from entering the trail and provide bicyclists with an area in which they can stop without dismounting.	**3.4.2**
		TRAC-04	Install a median on the trail to split the trail into two sections and restrict unauthorized motor vehicles from entering the trail.	**3.4.3**
		TRAC-05	Use discrete curb angles by providing 90 degree angles and sharply defined curbing of the trail crossing to discourage motor vehicle entry.	**3.4.4**
	Curb Ramps (CR)	**CR-01**	Install a curb ramp to make the crossing accessible to pedestrians with disabilities and to improve crossing conditions for all trail users. (Note: The curb ramp must have detectable warnings in the form of truncated domes as outlined in MnDOT Standard Plate No. 7038A.)	**3.7**
	Realignment (RA)	**RA-01**	Realign the trail path to make a right angle crossing with the crossed roadway.	**3.8**
		RA-02	Realign the trail path such that its angle of intersection with the crossed roadway is ≥ 75 degrees.	**3.8**
		RA-03	Set back the trail path approximately 10 to 30 feet (3.0 to 9.1 meters) from the parallel roadway to allow vehicle stacking space (Note: applicable only when permissive left	**3.8**

			turns from the parallel roadway are allowed).	
	Sight Distances (SD)	**SD-01**	Clear and maintain crossing/stopping sight distance for bicyclists.	**3.2.1, 3.2.2**
		SD-02	Clear and maintain crossing/stopping sight distance for pedestrians.	**3.2.1, 3.2.2**

*Note: Treatments in table are not in any specific order with respect to importance, cost, popularity, ease of implementation etc.

Table 11B: Alternative Treatments for Urban, Multi-Lane, Divided, Speed ≥ 35 mph, ADT < 10,000 vpd, Parallel Path Crossings



		Available Treatments		
		Treatment ID	**Treatment Description**	**Handbook Section**
Treatments for Left-turn Traffic on the Parallel Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-02**	Prohibit permissive left turns and enable protected left turns from the parallel roadway while trail users receive a "WALK" or flashing "DON'T WALK" indication (Note: applicable only when the intersection is already signalized and the parallel roadway has a dedicated left-turn lane).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-06**	Install an advance trail-crossing warning sign, such as the TRAIL CROSSING (W11-15a) sign, on the parallel roadway to warn turning vehicles. A distance plaque may be added beneath the sign.	**3.1.1.2**
Treatments for Right-turn Traffic on the Parallel Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-03**	Prohibit permissive right turns and enable protected right turns from the parallel roadway while trail users receive a "WALK" or flashing "DON'T WALK" indication (Note: applicable only when the intersection is already signalized and the parallel roadway has a dedicated right-turn lane).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-06**	Install an advance trail-crossing warning sign, such as the TRAIL CROSSING (W11-15a) sign, on the parallel roadway to warn turning vehicles. A distance plaque may be added beneath the sign.	**3.1.1.2**
	Traffic Calming (TC)	**TC-05**	Reduce the turning radius for right-turn vehicles.	**3.5.1**

Treatments for Through Traffic on the Crossed Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-04**	Provide oncoming crossing traffic on the crossed road with adequate change and clearance intervals to ensure their clearance of the trail prior to the trail receiving a "WALK" indication (Note: applicable only when the intersection is already signalized).	**3.1.2.1**
		TSGB-05	Provide an all-red phase on the crossed road to further protect trail users (Note: applicable only when the intersection is already signalized and the crossed road does not have all-red phase).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-02**	Install an advance trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at least 250 feet (76.2 meters) from the crossing. A distance plaque may be added beneath the sign.	**3.1.1.2**
		TSN-03	Install a Stop Here For Pedestrians (R1-5) series sign at the crossing on the crossed road	**3.1.1.1**
		TSN-04	Install a Stop Ahead (W3-1) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-05	Install a Yield Ahead (W3-2) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-07	Install a trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at the crossing.	**3.1.1.2**
		TSN-08	Install a STOP HERE ON RED (R10-6) sign at the trail crosswalk with a painted stop line to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
	Pavement Markings and Striping (PMS)	**PMS-04**	Divide the crosswalk to channelize pedestrians and bicyclists and separate their movements.	**3.1.3.2**
		PMS-05	Paint a high-visibility crosswalk on the crossed road "ladder" or "zebra" patterns preferable. (Note: The final decision of applying this treatment should be based on engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP, or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	**3.1.3.2**
		PMS-07	Set back the stop line on the crossed roadway to improve the trail users' and the moving motorists' mutual chance to have an unobstructed view of each other.	**3.1.3.1**

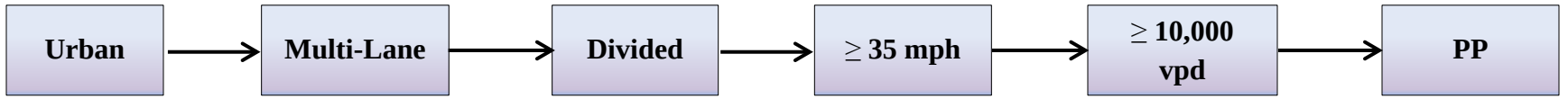
		PMS-08	Paint a stop line and install a STOP HERE ON RED (R10-6) sign on the crossed roadway in advance of the trail crosswalk to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.3.1**
		PMS-09	Paint a STOP AHEAD, YIELD AHEAD, or PED XING advance warning pavement marking on the crossed road.	**3.1.3.1**
	Lighting (LT)	**LT-01**	Provide lighting for the trail-roadway crossing.	**3.6**
	Sight Distance (SD)	**SD-03**	Clear and maintain stopping/crossing sight distance for motorists.	**3.2.1, 3.2.2**
Treatments for Right-turn Traffic on the Crossed Road	**Traffic Sign (TSN)**	**TSN-09**	Prohibit right turns on red using appropriate signage from the R10-11 series on the crossed roadway to reduce the chance of conflicts with trail users (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
	Traffic Calming (TC)	**TC-01**	Narrow the dedicated right-turn lane on the crossed road.	**3.5.1**
Treatments for the Trail	**Pavement Markings and Striping (PMS)**	**PMS-01**	Paint a yellow center line only or use one along with advance warning striping for 150 feet (45.7 meters) along the trail approach from the trail entrance point (Note: applicable only when a bollard, lean rail, or median obstruction is present).	**3.1.3.1**
		PMS-02	Paint a stop/yield line to pair with the STOP/YIELD sign or pedestrian/bicycle signal head on the trail at a distance of 3 - 6 feet (0.9 - 1.8 meters) from the crossed road's edge.	**3.1.3.1**
		PMS-03	Paint a STOP/YIELD pavement marking on the trail approach.	**3.1.3.1**
	Trail Signals and Signs (TRSS)	**TRSS-01**	Install a CROSS ONLY ON GREEN (symbolic circular green) (R10-1) sign (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-02	Install a CROSS ONLY ON "WALK" (symbolic walk indication) (R10-2) sign (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**

		TRSS-03	Install a sign from the Push Button for Green Light (R10-4) series (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-04	Install a sign from the Push Button for WALK Signal (R10-3) series (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-05	Install a pedestrian/bicyclist pushbutton on the trail 4 - 5 feet (1.2 – 1.5 meters) above the ground such that it is easily accessible for bicyclists to activate the signal without dismounting (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.2.1**
		TRSS-07	Install an advance warning Stop Ahead (W3-1)/Yield Ahead (W3-2) sign on the trail approach at a distance of approximately 100 feet (30.5 meters) in advance of the crossing.	**3.1.1.2**
		TRSS-08	Install a STOP (R1-1) or YIELD (R1-2) sign on the trail approach at a minimum of 2 feet (0.6 meters) from the edge of the trail.	**3.1.1.1**
		TRSS-13	Install pedestrian/bicycle signal on the trail approach if the crossed road is already signalized.	**3.1.2.1**
	Trail Access Control (TRAC)	**TRAC-01**	Install a NO MOTOR VEHICLES (R5-3) sign on the trail, facing the roadway, to prevent unauthorized motor vehicles from entering the trail.	**3.1.1.1**
		TRAC-02	Install bollards to prevent unauthorized motor vehicles from entering the trail.	**3.4.1**
		TRAC-03	Install a lean rail parallel to the trail to prevent unauthorized motor vehicles from entering the trail and provide bicyclists with an area in which they can stop without dismounting.	**3.4.2**
		TRAC-04	Install a median on the trail to split the trail into two sections and restrict unauthorized motor vehicles from entering the trail.	**3.4.3**
		TRAC-05	Use discrete curb angles by providing 90 degree angles and sharply defined curbing of the trail crossing to discourage motor vehicle entry.	**3.4.4**
	Curb Ramps (CR)	**CR-01**	Install a curb ramp to make the crossing accessible to pedestrians with disabilities and to improve crossing conditions for all trail users. (Note: The curb ramp must have detectable warnings in the form of truncated domes as outlined in MnDOT Standard Plate No. 7038A.)	**3.7**

	Realignment (RA)	**RA-01**	Realign the trail path to make a right angle crossing with the crossed roadway.	**3.8**
		RA-02	Realign the trail path such that its angle of intersection with the crossed roadway is ≥ 75 degrees.	**3.8**
		RA-03	Set back the trail path approximately 10 to 30 feet (3.0 to 9.1 meters) from the parallel roadway to allow vehicle stacking space (Note: applicable only when permissive left turns from the parallel roadway are allowed).	**3.8**
	Sight Distances (SD)	**SD-01**	Clear and maintain crossing/stopping sight distance for bicyclists.	**3.2.1, 3.2.2**
		SD-02	Clear and maintain crossing/stopping sight distance for pedestrians.	**3.2.1, 3.2.2**

*Note: Treatments in table are not in any specific order with respect to importance, cost, popularity, ease of implementation etc.

Table 12B: Alternative Treatments for Urban, Multi-Lane, Divided, Speed ≥ 35 mph, ADT ≥ 10,000 vpd, Parallel Path Crossings



		Available Treatments		
		Treatment ID	**Treatment Description**	**Handbook Section**
Treatments for Left-turn Traffic on the Parallel Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-02**	Prohibit permissive left turns and enable protected left turns from the parallel roadway while trail users receive a "WALK" or flashing "DON'T WALK" indication (Note: applicable only when the intersection is already signalized and the parallel roadway has a dedicated left-turn lane).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-06**	Install an advance trail-crossing warning sign, such as the TRAIL CROSSING (W11-15a) sign, on the parallel roadway to warn turning vehicles. A distance plaque may be added beneath the sign.	**3.1.1.2**
Treatments for Right-turn Traffic on the Parallel Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-03**	Prohibit permissive right turns and enable protected right turns from the parallel roadway while trail users receive a "WALK" or flashing "DON'T WALK" indication (Note: applicable only when the intersection is already signalized and the parallel roadway has a dedicated right-turn lane).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-06**	Install an advance trail-crossing warning sign, such as the TRAIL CROSSING (W11-15a) sign, on the parallel roadway to warn turning vehicles. A distance plaque may be added beneath the sign.	**3.1.1.2**
	Traffic Calming (TC)	**TC-05**	Reduce the turning radius for right-turn vehicles.	**3.5.1**

Treatments for Through Traffic on the Crossed Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-04**	Provide oncoming crossing traffic on the crossed road with adequate change and clearance intervals to ensure their clearance of the trail prior to the trail receiving a "WALK" indication (Note: applicable only when the intersection is already signalized).	**3.1.2.1**
		TSGB-05	Provide an all-red phase on the crossed road to further protect trail users (Note: applicable only when the intersection is already signalized and the crossed road does not have all-red phase).	**3.1.2.1**
		TSGB-06	Install a yellow flashing beacon with pedestrian pushbutton at the crosswalk (Note: applicable only when the intersection is unsignalized); if used, the designer may also consider applying Treatment TRSS-11.	**3.1.2.2**
		TSGB-08	Install a Rapid Rectangular Flashing Beacon (RRFB) (Note: applicable only when the intersection is unsignalized); if used, use in conjunction with Treatment TRSS-12.	**3.1.2.2**
	Traffic Sign (TSN)	**TSN-02**	Install an advance trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at least 250 feet (76.2 meters) from the crossing. A distance plaque may be added beneath the sign.	**3.1.1.2**
		TSN-03	Install a Stop Here For Pedestrians (R1-5) series sign at the crossing on the crossed road	**3.1.1.1**
		TSN-04	Install a Stop Ahead (W3-1) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-05	Install a Yield Ahead (W3-2) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-07	Install a trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at the crossing.	**3.1.1.2**
		TSN-08	Install a STOP HERE ON RED (R10-6) sign at the trail crosswalk with a painted stop line to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
	Pavement Markings and Striping (PMS)	**PMS-04**	Divide the crosswalk to channelize pedestrians and bicyclists and separate their movements.	**3.1.3.2**
		PMS-05	Paint a high-visibility crosswalk on the crossed road "ladder" or "zebra" patterns preferable. (Note: The final decision of applying this treatment should be based on engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs;	**3.1.3.2**

			or, based on an engineering study, if the crossing is not controlled by signals, STOP, or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	
		PMS-06	Paint a high-visibility "standard" pattern crosswalk on the crossed road. (Note: The final decision of applying this treatment should be based on engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP, or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	**3.1.3.2**
		PMS-07	Set back the stop line on the crossed roadway to improve the trail users' and the moving motorists' mutual chance to have an unobstructed view of each other.	**3.1.3.1**
		PMS-08	Paint a stop line and install a STOP HERE ON RED (R10-6) sign on the crossed roadway in advance of the trail crosswalk to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.3.1**
		PMS-09	Paint a STOP AHEAD, YIELD AHEAD, or PED XING advance warning pavement marking on the crossed road.	**3.1.3.1**
	Refuge Island (RI)	**RI-01**	Install a right-angle median refuge island.	**3.3**
		RI-02	Install a median refuge island angled at 75 degrees with opposite sides of the trail across the roadway being slightly offset and supplementary centerline and STOP or YIELD pavement markings in the refuge area.	**3.3**
	Lighting (LT)	**LT-01**	Provide lighting for the trail-roadway crossing.	**3.6**
	Sight Distance (SD)	**SD-03**	Clear and maintain stopping/crossing sight distance for motorists.	**3.2.1, 3.2.2**
Treatments for Right-turn Traffic on the	**Traffic Sign (TSN)**	**TSN-09**	Prohibit right turns on red using appropriate signage from the R10-11 series on the crossed roadway to reduce the chance of conflicts with trail users (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
	Refuge	**RI-03**	Install channelizing islands to split right-turn movements from other traffic on the	**3.3**

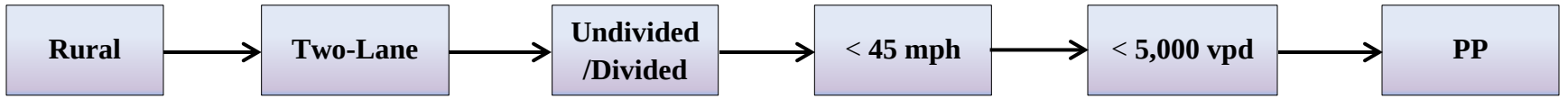
Crossed Road	**Island (RI)**		crossed roadway, narrow the right-turn path, and provide refuge area for trail users to cross the roadway.	
	Traffic Calming (TC)	**TC-01**	Narrow the dedicated right-turn lane on the crossed road.	**3.5.1**
Treatments for the Trail	**Pavement Markings and Striping (PMS)**	**PMS-01**	Paint a yellow center line only or use one along with advance warning striping for 150 feet (45.7 meters) along the trail approach from the trail entrance point (Note: applicable only when a bollard, lean rail, or median obstruction is present).	**3.1.3.1**
		PMS-02	Paint a stop/yield line to pair with the STOP/YIELD sign or pedestrian/bicycle signal head on the trail at a distance of 3 - 6 feet (0.9 - 1.8 meters) from the crossed road's edge.	**3.1.3.1**
		PMS-03	Paint a STOP/YIELD pavement marking on the trail approach.	**3.1.3.1**
	Trail Signals and Signs (TRSS)	**TRSS-01**	Install a CROSS ONLY ON GREEN (symbolic circular green) (R10-1) sign (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-02	Install a CROSS ONLY ON "WALK" (symbolic walk indication) (R10-2) sign (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-03	Install a sign from the Push Button for Green Light (R10-4) series (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-04	Install a sign from the Push Button for WALK Signal (R10-3) series (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-05	Install a pedestrian/bicyclist pushbutton on the trail 4 - 5 feet (1.2 – 1.5 meters) above the ground such that it is easily accessible for bicyclists to activate the signal without dismounting (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.2.1**
		TRSS-07	Install an advance warning Stop Ahead (W3-1)/Yield Ahead (W3-2) sign on the trail approach at a distance of approximately 100 feet (30.5 meters) in advance of the crossing.	**3.1.1.2**
		TRSS-08	Install a STOP (R1-1) or YIELD (R1-2) sign on the trail approach at a minimum of 2	**3.1.1.1**

			feet (0.6 meters) from the edge of the trail.	
		TRSS-10	Install a pushbutton at the median refuge island for pedestrians trapped in the refuge area (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.2.1**
		TRSS-11	Install a pushbutton for a yellow flashing beacon on the trail approach (Note: applicable only when yellow flashing beacon has been/ will be installed).	**3.1.2.2**
		TRSS-12	Install a pushbutton for an RRFB on the trail approach (Note: applicable only when RRFB has been/will be installed).	**3.1.2.2**
		TRSS-13	Install pedestrian/bicycle signal on the trail approach if the crossed road is already signalized.	**3.1.2.1**
		TRSS-14	Install a Push Button to Turn on Warning Lights (R10-25) sign at the crossing to inform trail users of how to activate the flashing beacon or RRFB.	**3.1.2.2**
	Trail Access Control (TRAC)	**TRAC-01**	Install a NO MOTOR VEHICLES (R5-3) sign on the trail, facing the roadway, to prevent unauthorized motor vehicles from entering the trail.	**3.1.1.1**
		TRAC-02	Install bollards to prevent unauthorized motor vehicles from entering the trail.	**3.4.1**
		TRAC-03	Install a lean rail parallel to the trail to prevent unauthorized motor vehicles from entering the trail and provide bicyclists with an area in which they can stop without dismounting.	**3.4.2**
		TRAC-04	Install a median on the trail to split the trail into two sections and restrict unauthorized motor vehicles from entering the trail.	**3.4.3**
		TRAC-05	Use discrete curb angles by providing 90 degree angles and sharply defined curbing of the trail crossing to discourage motor vehicle entry.	**3.4.4**
	Curb Ramps (CR)	**CR-01**	Install a curb ramp to make the crossing accessible to pedestrians with disabilities and to improve crossing conditions for all trail users. (Note: The curb ramp must have detectable warnings in the form of truncated domes as outlined in MnDOT Standard Plate No. 7038A.)	**3.7**
	Realignment (RA)	**RA-01**	Realign the trail path to make a right angle crossing with the crossed roadway.	**3.8**
		RA-02	Realign the trail path such that its angle of intersection with the crossed roadway is ≥ 75 degrees.	**3.8**

		RA-03	Set back the trail path approximately 10 to 30 feet (3.0 to 9.1 meters) from the parallel roadway to allow vehicle stacking space (Note: applicable only when permissive left turns from the parallel roadway are allowed).	**3.8**
	Sight Distances (SD)	**SD-01**	Clear and maintain crossing/stopping sight distance for bicyclists.	**3.2.1, 3.2.2**
		SD-02	Clear and maintain crossing/stopping sight distance for pedestrians.	**3.2.1, 3.2.2**

*Note: Treatments in table are not in any specific order with respect to importance, cost, popularity, ease of implementation etc.

Table 13B: Alternative Treatments for Rural, Two-Lane, Undivided/Divided, Speed < 45 mph, ADT < 5,000 vpd, Parallel Path Crossings



		Available Treatments		
		Treatment ID	**Treatment Description**	**Handbook Section**
Treatments for Left-turn Traffic on the Parallel Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-02**	Prohibit permissive left turns and enable protected left turns from the parallel roadway while trail users receive a "WALK" or flashing "DON'T WALK" indication (Note: applicable only when the intersection is already signalized and the parallel roadway has a dedicated left-turn lane).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-06**	Install an advance trail-crossing warning sign, such as the TRAIL CROSSING (W11-15a) sign, on the parallel roadway to warn turning vehicles. A distance plaque may be added beneath the sign.	**3.1.1.2**
Treatments for Right-turn Traffic on the Parallel Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-03**	Prohibit permissive right turns and enable protected right turns from the parallel roadway while trail users receive a "WALK" or flashing "DON'T WALK" indication (Note: applicable only when the intersection is already signalized and the parallel roadway has a dedicated right-turn lane).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-06**	Install an advance trail-crossing warning sign, such as the TRAIL CROSSING (W11-15a) sign, on the parallel roadway to warn turning vehicles. A distance plaque may be added beneath the sign.	**3.1.1.2**
	Traffic Calming (TC)	**TC-05**	Reduce the turning radius for right-turn vehicles.	**3.5.1**

Treatments for Through Traffic on the Crossed Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-04**	Provide oncoming crossing traffic on the crossed road with adequate change and clearance intervals to ensure their clearance of the trail prior to the trail receiving a "WALK" indication (Note: applicable only when the intersection is already signalized).	**3.1.2.1**
		TSGB-05	Provide an all-red phase on the crossed road to further protect trail users (Note: applicable only when the intersection is already signalized and the crossed road does not have all-red phase).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-01**	Install an advance trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at least 750 feet (228.6 meters) from the crossing. A distance plaque may be added beneath the sign.	**3.1.1.2**
		TSN-04	Install a Stop Ahead (W3-1) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-05	Install a Yield Ahead (W3-2) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-07	Install a trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at the crossing.	**3.1.1.2**
		TSN-08	Install a STOP HERE ON RED (R10-6) sign at the trail crosswalk with a painted stop line to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
		TSN-10	Install an advance trail-crossing warning sign for snowmobiles, i.e., the Snowmobile Crossing (W11-6) sign, on the crossed roadway at least 750 feet (228.6 meters) from the crossing (Note: applicable only on trails for exclusive snowmobile use).	**3.1.1.2**
		TSN-11	Install a snowmobile-crossing warning sign, i.e., the Snowmobile Crossing (W11-6) sign, on the crossed roadway at the trail crossing (Note: applicable only on trails for exclusive snowmobile use).	**3.1.1.2**
	Pavement Markings and Striping (PMS)	**PMS-04**	Divide the crosswalk to channelize pedestrians and bicyclists and separate their movements.	**3.1.3.2**
		PMS-05	Paint a high-visibility crosswalk on the crossed road "ladder" or "zebra" patterns preferable. (Note: The final decision of applying this treatment should be based on engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP,	**3.1.3.2**

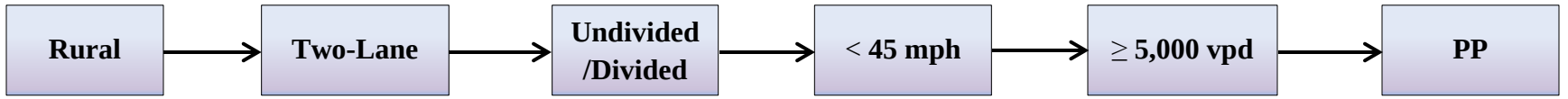
			or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	
		PMS-07	Set back the stop line on the crossed roadway to improve the trail users' and the moving motorists' mutual chance to have an unobstructed view of each other.	**3.1.3.1**
		PMS-08	Paint a stop line and install a STOP HERE ON RED (R10-6) sign on the crossed roadway in advance of the trail crosswalk to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.3.1**
		PMS-09	Paint a STOP AHEAD, YIELD AHEAD, or PED XING advance warning pavement marking on the crossed road.	**3.1.3.1**
	Sight Distance (SD)	**SD-03**	Clear and maintain stopping/crossing sight distance for motorists.	**3.2.1, 3.2.2**
Treatments for Right-turn Traffic on the Crossed Road	**Traffic Sign (TSN)**	**TSN-09**	Prohibit right turns on red using appropriate signage from the R10-11 series on the crossed roadway to reduce the chance of conflicts with trail users (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
Treatments for the Trail	**Pavement Markings and Striping (PMS)**	**PMS-01**	Paint a yellow center line only or use one along with advance warning striping for 150 feet (45.7 meters) along the trail approach from the trail entrance point (Note: applicable only when a bollard, lean rail, or median obstruction is present).	**3.1.3.1**
		PMS-02	Paint a stop/yield line to pair with the STOP/YIELD sign or pedestrian/bicycle signal head on the trail at a distance of 3 - 6 feet (0.9 - 1.8 meters) from the crossed road's edge.	**3.1.3.1**
		PMS-03	Paint a STOP/YIELD pavement marking on the trail approach.	**3.1.3.1**
	Trail Signals and Signs (TRSS)	**TRSS-01**	Install a CROSS ONLY ON GREEN (symbolic circular green) (R10-1) sign (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-02	Install a CROSS ONLY ON "WALK" (symbolic walk indication) (R10-2) sign (Note: applicable only when the pedestrian signal is already/will be installed at the	**3.1.1.1**

			trail crossing).	
		TRSS-03	Install a sign from the Push Button for Green Light (R10-4) series (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-04	Install a sign from the Push Button for WALK Signal (R10-3) series (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-05	Install a pedestrian/bicyclist pushbutton on the trail 4 - 5 feet (1.2 – 1.5 meters) above the ground such that it is easily accessible for bicyclists to activate the signal without dismounting (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.2.1**
		TRSS-07	Install an advance warning Stop Ahead (W3-1)/Yield Ahead (W3-2) sign on the trail approach at a distance of approximately 100 feet (30.5 meters) in advance of the crossing.	**3.1.1.2**
		TRSS-08	Install a STOP (R1-1) or YIELD (R1-2) sign on the trail approach at a minimum of 2 feet (0.6 meters) from the edge of the trail.	**3.1.1.1**
		TRSS-13	Install pedestrian/bicycle signal on the trail approach if the crossed road is already signalized.	**3.1.2.1**
	Trail Access Control (TRAC)	**TRAC-01**	Install a NO MOTOR VEHICLES (R5-3) sign on the trail, facing the roadway, to prevent unauthorized motor vehicles from entering the trail.	**3.1.1.1**
		TRAC-02	Install bollards to prevent unauthorized motor vehicles from entering the trail.	**3.4.1**
		TRAC-03	Install a lean rail parallel to the trail to prevent unauthorized motor vehicles from entering the trail and provide bicyclists with an area in which they can stop without dismounting.	**3.4.2**
		TRAC-04	Install a median on the trail to split the trail into two sections and restrict unauthorized motor vehicles from entering the trail.	**3.4.3**
	Curb Ramps (CR)	**CR-01**	Install a curb ramp to make the crossing accessible to pedestrians with disabilities and to improve crossing conditions for all trail users. (Note: The curb ramp must have detectable warnings in the form of truncated domes as outlined in MnDOT Standard Plate No. 7038A.)	**3.7**
	Realignment (RA)	**RA-01**	Realign the trail path to make a right angle crossing with the crossed roadway.	**3.8**
		RA-02	Realign the trail path such that its angle of intersection with the crossed roadway is ≥	**3.8**

			75 degrees.	
		RA-03	Set back the trail path approximately 10 to 30 feet (3.0 to 9.1 meters) from the parallel roadway to allow vehicle stacking space (Note: applicable only when permissive left turns from the parallel roadway are allowed).	**3.8**
	Sight Distances (SD)	**SD-01**	Clear and maintain crossing/stopping sight distance for bicyclists.	**3.2.1, 3.2.2**
		SD-02	Clear and maintain crossing/stopping sight distance for pedestrians.	**3.2.1, 3.2.2**

*Note: Treatments in table are not in any specific order with respect to importance, cost, popularity, ease of implementation etc.

Table 14B: Alternative Treatments for Rural, Two-Lane, Undivided/Divided, Speed < 45 mph, ADT ≥ 5,000 vpd, Parallel Path Crossings



		Available Treatments		
		Treatment ID	**Treatment Description**	**Handbook Section**
Treatments for Left-turn Traffic on the Parallel Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-02**	Prohibit permissive left turns and enable protected left turns from the parallel roadway while trail users receive a "WALK" or flashing "DON'T WALK" indication (Note: applicable only when the intersection is already signalized and the parallel roadway has a dedicated left-turn lane).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-06**	Install an advance trail-crossing warning sign, such as the TRAIL CROSSING (W11-15a) sign, on the parallel roadway to warn turning vehicles. A distance plaque may be added beneath the sign.	**3.1.1.2**
Treatments for Right-turn Traffic on the Parallel Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-03**	Prohibit permissive right turns and enable protected right turns from the parallel roadway while trail users receive a "WALK" or flashing "DON'T WALK" indication (Note: applicable only when the intersection is already signalized and the parallel roadway has a dedicated right-turn lane).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-06**	Install an advance trail-crossing warning sign, such as the TRAIL CROSSING (W11-15a) sign, on the parallel roadway to warn turning vehicles. A distance plaque may be added beneath the sign.	**3.1.1.2**
	Traffic Calming (TC)	**TC-05**	Reduce the turning radius for right-turn vehicles.	**3.5.1**

Treatments for Through Traffic on the Crossed Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-04**	Provide oncoming crossing traffic on the crossed road with adequate change and clearance intervals to ensure their clearance of the trail prior to the trail receiving a "WALK" indication (Note: applicable only when the intersection is already signalized).	**3.1.2.1**
		TSGB-05	Provide an all-red phase on the crossed road to further protect trail users (Note: applicable only when the intersection is already signalized and the crossed road does not have all-red phase).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-01**	Install an advance trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at least 750 feet (228.6 meters) from the crossing. A distance plaque may be added beneath the sign.	**3.1.1.2**
		TSN-04	Install a Stop Ahead (W3-1) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-05	Install a Yield Ahead (W3-2) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-07	Install a trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at the crossing.	**3.1.1.2**
		TSN-08	Install a STOP HERE ON RED (R10-6) sign at the trail crosswalk with a painted stop line to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
		TSN-10	Install an advance trail-crossing warning sign for snowmobiles, i.e., the Snowmobile Crossing (W11-6) sign, on the crossed roadway at least 750 feet (228.6 meters) from the crossing (Note: applicable only on trails for exclusive snowmobile use).	**3.1.1.2**
		TSN-11	Install a snowmobile-crossing warning sign, i.e., the Snowmobile Crossing (W11-6) sign, on the crossed roadway at the trail crossing (Note: applicable only on trails for exclusive snowmobile use).	**3.1.1.2**
	Pavement Markings and Striping (PMS)	**PMS-04**	Divide the crosswalk to channelize pedestrians and bicyclists and separate their movements.	**3.1.3.2**
		PMS-05	Paint a high-visibility crosswalk on the crossed road "ladder" or "zebra" patterns preferable. (Note: The final decision of applying this treatment should be based on engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP,	**3.1.3.2**

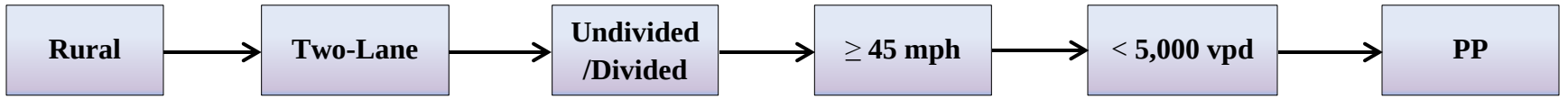
			or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	
		PMS-07	Set back the stop line on the crossed roadway to improve the trail users' and the moving motorists' mutual chance to have an unobstructed view of each other.	**3.1.3.1**
		PMS-08	Paint a stop line and install a STOP HERE ON RED (R10-6) sign on the crossed roadway in advance of the trail crosswalk to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.3.1**
		PMS-09	Paint a STOP AHEAD, YIELD AHEAD, or PED XING advance warning pavement marking on the crossed road.	**3.1.3.1**
	Sight Distance (SD)	**SD-03**	Clear and maintain stopping/crossing sight distance for motorists.	**3.2.1, 3.2.2**
Treatments for Right-turn Traffic on the Crossed Road	**Traffic Sign (TSN)**	**TSN-09**	Prohibit right turns on red using appropriate signage from the R10-11 series on the crossed roadway to reduce the chance of conflicts with trail users (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
Treatments for the Trail	**Pavement Markings and Striping (PMS)**	**PMS-01**	Paint a yellow center line only or use one along with advance warning striping for 150 feet (45.7 meters) along the trail approach from the trail entrance point (Note: applicable only when a bollard, lean rail, or median obstruction is present).	**3.1.3.1**
		PMS-02	Paint a stop/yield line to pair with the STOP/YIELD sign or pedestrian/bicycle signal head on the trail at a distance of 3 - 6 feet (0.9 - 1.8 meters) from the crossed road's edge.	**3.1.3.1**
		PMS-03	Paint a STOP/YIELD pavement marking on the trail approach.	**3.1.3.1**
	Trail Signals and Signs (TRSS)	**TRSS-01**	Install a CROSS ONLY ON GREEN (symbolic circular green) (R10-1) sign (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-02	Install a CROSS ONLY ON "WALK" (symbolic walk indication) (R10-2) sign (Note: applicable only when the pedestrian signal is already/will be installed at the	**3.1.1.1**

			trail crossing).	
		TRSS-03	Install a sign from the Push Button for Green Light (R10-4) series (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-04	Install a sign from the Push Button for WALK Signal (R10-3) series (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-05	Install a pedestrian/bicyclist pushbutton on the trail 4 - 5 feet (1.2 – 1.5 meters) above the ground such that it is easily accessible for bicyclists to activate the signal without dismounting (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.2.1**
		TRSS-07	Install an advance warning Stop Ahead (W3-1)/Yield Ahead (W3-2) sign on the trail approach at a distance of approximately 100 feet (30.5 meters) in advance of the crossing.	**3.1.1.2**
		TRSS-08	Install a STOP (R1-1) or YIELD (R1-2) sign on the trail approach at a minimum of 2 feet (0.6 meters) from the edge of the trail.	**3.1.1.1**
		TRSS-13	Install pedestrian/bicycle signal on the trail approach if the crossed road is already signalized.	**3.1.2.1**
	Trail Access Control (TRAC)	**TRAC-01**	Install a NO MOTOR VEHICLES (R5-3) sign on the trail, facing the roadway, to prevent unauthorized motor vehicles from entering the trail.	**3.1.1.1**
		TRAC-02	Install bollards to prevent unauthorized motor vehicles from entering the trail.	**3.4.1**
		TRAC-03	Install a lean rail parallel to the trail to prevent unauthorized motor vehicles from entering the trail and provide bicyclists with an area in which they can stop without dismounting.	**3.4.2**
		TRAC-04	Install a median on the trail to split the trail into two sections and restrict unauthorized motor vehicles from entering the trail.	**3.4.3**
	Curb Ramps (CR)	**CR-01**	Install a curb ramp to make the crossing accessible to pedestrians with disabilities and to improve crossing conditions for all trail users. (Note: The curb ramp must have detectable warnings in the form of truncated domes as outlined in MnDOT Standard Plate No. 7038A.)	**3.7**
	Realignment (RA)	**RA-01**	Realign the trail path to make a right angle crossing with the crossed roadway.	**3.8**
		RA-02	Realign the trail path such that its angle of intersection with the crossed roadway is ≥	**3.8**

			75 degrees.	
		RA-03	Set back the trail path approximately 10 to 30 feet (3.0 to 9.1 meters) from the parallel roadway to allow vehicle stacking space (Note: applicable only when permissive left turns from the parallel roadway are allowed).	**3.8**
	Sight Distances (SD)	**SD-01**	Clear and maintain crossing/stopping sight distance for bicyclists.	**3.2.1, 3.2.2**
		SD-02	Clear and maintain crossing/stopping sight distance for pedestrians.	**3.2.1, 3.2.2**

*Note: Treatments in table are not in any specific order with respect to importance, cost, popularity, ease of implementation etc.

Table 15B: Alternative Treatments for Rural, Two-Lane, Undivided/Divided, Speed ≥ 45 mph, ADT < 5,000 vpd, Parallel Path Crossings



		Available Treatments		
		Treatment ID	**Treatment Description**	**Handbook Section**
Treatments for Left-turn Traffic on the Parallel Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-02**	Prohibit permissive left turns and enable protected left turns from the parallel roadway while trail users receive a "WALK" or flashing "DON'T WALK" indication (Note: applicable only when the intersection is already signalized and the parallel roadway has a dedicated left-turn lane).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-06**	Install an advance trail-crossing warning sign, such as the TRAIL CROSSING (W11-15a) sign, on the parallel roadway to warn turning vehicles. A distance plaque may be added beneath the sign.	**3.1.1.2**
Treatments for Right-turn Traffic on the Parallel Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-03**	Prohibit permissive right turns and enable protected right turns from the parallel roadway while trail users receive a "WALK" or flashing "DON'T WALK" indication (Note: applicable only when the intersection is already signalized and the parallel roadway has a dedicated right-turn lane).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-06**	Install an advance trail-crossing warning sign, such as the TRAIL CROSSING (W11-15a) sign, on the parallel roadway to warn turning vehicles. A distance plaque may be added beneath the sign.	**3.1.1.2**
	Traffic Calming (TC)	**TC-05**	Reduce the turning radius for right-turn vehicles.	**3.5.1**

Treatments for Through Traffic on the Crossed Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-04**	Provide oncoming crossing traffic on the crossed road with adequate change and clearance intervals to ensure their clearance of the trail prior to the trail receiving a "WALK" indication (Note: applicable only when the intersection is already signalized).	**3.1.2.1**
		TSGB-05	Provide an all-red phase on the crossed road to further protect trail users (Note: applicable only when the intersection is already signalized and the crossed road does not have all-red phase).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-01**	Install an advance trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at least 750 feet (228.6 meters) from the crossing. A distance plaque may be added beneath the sign.	**3.1.1.2**
		TSN-04	Install a Stop Ahead (W3-1) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-05	Install a Yield Ahead (W3-2) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-07	Install a trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at the crossing.	**3.1.1.2**
		TSN-08	Install a STOP HERE ON RED (R10-6) sign at the trail crosswalk with a painted stop line to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
		TSN-10	Install an advance trail-crossing warning sign for snowmobiles, i.e., the Snowmobile Crossing (W11-6) sign, on the crossed roadway at least 750 feet (228.6 meters) from the crossing (Note: applicable only on trails for exclusive snowmobile use).	**3.1.1.2**
		TSN-11	Install a snowmobile-crossing warning sign, i.e., the Snowmobile Crossing (W11-6) sign, on the crossed roadway at the trail crossing (Note: applicable only on trails for exclusive snowmobile use).	**3.1.1.2**
	Pavement Markings and Striping (PMS)	**PMS-04**	Divide the crosswalk to channelize pedestrians and bicyclists and separate their movements.	**3.1.3.2**
		PMS-05	Paint a high-visibility crosswalk on the crossed road "ladder" or "zebra" patterns preferable. (Note: The final decision of applying this treatment should be based on engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP,	**3.1.3.2**

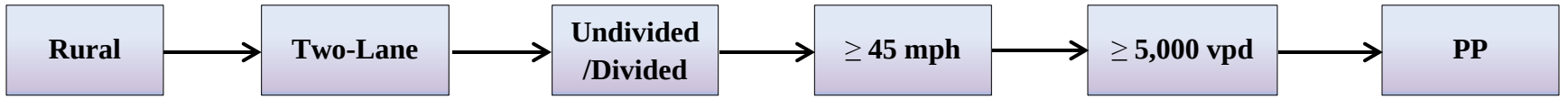
			or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	
		PMS-07	Set back the stop line on the crossed roadway to improve the trail users' and the moving motorists' mutual chance to have an unobstructed view of each other.	**3.1.3.1**
		PMS-08	Paint a stop line and install a STOP HERE ON RED (R10-6) sign on the crossed roadway in advance of the trail crosswalk to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.3.1**
		PMS-09	Paint a STOP AHEAD, YIELD AHEAD, or PED XING advance warning pavement marking on the crossed road.	**3.1.3.1**
	Sight Distance (SD)	**SD-03**	Clear and maintain stopping/crossing sight distance for motorists.	**3.2.1, 3.2.2**
Treatments for Right-turn Traffic on the Crossed Road	**Traffic Sign (TSN)**	**TSN-09**	Prohibit right turns on red using appropriate signage from the R10-11 series on the crossed roadway to reduce the chance of conflicts with trail users (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
Treatments for the Trail	**Pavement Markings and Striping (PMS)**	**PMS-01**	Paint a yellow center line only or use one along with advance warning striping for 150 feet (45.7 meters) along the trail approach from the trail entrance point (Note: applicable only when a bollard, lean rail, or median obstruction is present).	**3.1.3.1**
		PMS-02	Paint a stop/yield line to pair with the STOP/YIELD sign or pedestrian/bicycle signal head on the trail at a distance of 3 - 6 feet (0.9 - 1.8 meters) from the crossed road's edge.	**3.1.3.1**
		PMS-03	Paint a STOP/YIELD pavement marking on the trail approach.	**3.1.3.1**
	Trail Signals and Signs (TRSS)	**TRSS-01**	Install a CROSS ONLY ON GREEN (symbolic circular green) (R10-1) sign (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-02	Install a CROSS ONLY ON "WALK" (symbolic walk indication) (R10-2) sign (Note: applicable only when the pedestrian signal is already/will be installed at the	**3.1.1.1**

			trail crossing).	
		TRSS-03	Install a sign from the Push Button for Green Light (R10-4) series (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-04	Install a sign from the Push Button for WALK Signal (R10-3) series (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-05	Install a pedestrian/bicyclist pushbutton on the trail 4 - 5 feet (1.2 – 1.5 meters) above the ground such that it is easily accessible for bicyclists to activate the signal without dismounting (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.2.1**
		TRSS-07	Install an advance warning Stop Ahead (W3-1)/Yield Ahead (W3-2) sign on the trail approach at a distance of approximately 100 feet (30.5 meters) in advance of the crossing.	**3.1.1.2**
		TRSS-08	Install a STOP (R1-1) or YIELD (R1-2) sign on the trail approach at a minimum of 2 feet (0.6 meters) from the edge of the trail.	**3.1.1.1**
		TRSS-13	Install pedestrian/bicycle signal on the trail approach if the crossed road is already signalized.	**3.1.2.1**
	Trail Access Control (TRAC)	**TRAC-01**	Install a NO MOTOR VEHICLES (R5-3) sign on the trail, facing the roadway, to prevent unauthorized motor vehicles from entering the trail.	**3.1.1.1**
		TRAC-02	Install bollards to prevent unauthorized motor vehicles from entering the trail.	**3.4.1**
		TRAC-03	Install a lean rail parallel to the trail to prevent unauthorized motor vehicles from entering the trail and provide bicyclists with an area in which they can stop without dismounting.	**3.4.2**
		TRAC-04	Install a median on the trail to split the trail into two sections and restrict unauthorized motor vehicles from entering the trail.	**3.4.3**
	Curb Ramps (CR)	**CR-01**	Install a curb ramp to make the crossing accessible to pedestrians with disabilities and to improve crossing conditions for all trail users. (Note: The curb ramp must have detectable warnings in the form of truncated domes as outlined in MnDOT Standard Plate No. 7038A.)	**3.7**
	Realignment (RA)	**RA-01**	Realign the trail path to make a right angle crossing with the crossed roadway.	**3.8**

		RA-02	Realign the trail path such that its angle of intersection with the crossed roadway is ≥ 75 degrees.	**3.8**
		RA-03	Set back the trail path approximately 10 to 30 feet (3.0 to 9.1 meters) from the parallel roadway to allow vehicle stacking space (Note: applicable only when permissive left turns from the parallel roadway are allowed).	**3.8**
	Sight Distances (SD)	**SD-01**	Clear and maintain crossing/stopping sight distance for bicyclists.	**3.2.1, 3.2.2**
		SD-02	Clear and maintain crossing/stopping sight distance for pedestrians.	**3.2.1, 3.2.2**

*Note: Treatments in table are not in any specific order with respect to importance, cost, popularity, ease of implementation etc.

Table 16B: Alternative Treatments for Rural, Two-Lane, Undivided/Divided, Speed ≥ 45 mph, ADT ≥ 5,000 vpd, Parallel Path Crossings



		Available Treatments		
		Treatment ID	**Treatment Description**	**Handbook Section**
Treatments for Left-turn Traffic on the Parallel Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-02**	Prohibit permissive left turns and enable protected left turns from the parallel roadway while trail users receive a "WALK" or flashing "DON'T WALK" indication (Note: applicable only when the intersection is already signalized and the parallel roadway has a dedicated left-turn lane).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-06**	Install an advance trail-crossing warning sign, such as the TRAIL CROSSING (W11-15a) sign, on the parallel roadway to warn turning vehicles. A distance plaque may be added beneath the sign.	**3.1.1.2**
Treatments for Right-turn Traffic on the Parallel Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-03**	Prohibit permissive right turns and enable protected right turns from the parallel roadway while trail users receive a "WALK" or flashing "DON'T WALK" indication (Note: applicable only when the intersection is already signalized and the parallel roadway has a dedicated right-turn lane).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-06**	Install an advance trail-crossing warning sign, such as the TRAIL CROSSING (W11-15a) sign, on the parallel roadway to warn turning vehicles. A distance plaque may be added beneath the sign.	**3.1.1.2**
	Traffic Calming (TC)	**TC-05**	Reduce the turning radius for right-turn vehicles.	**3.5.1**

Treatments for Through Traffic on the Crossed Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-04**	Provide oncoming crossing traffic on the crossed road with adequate change and clearance intervals to ensure their clearance of the trail prior to the trail receiving a "WALK" indication (Note: applicable only when the intersection is already signalized).	**3.1.2.1**
		TSGB-05	Provide an all-red phase on the crossed road to further protect trail users (Note: applicable only when the intersection is already signalized and the crossed road does not have all-red phase).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-01**	Install an advance trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at least 750 feet (228.6 meters) from the crossing. A distance plaque may be added beneath the sign.	**3.1.1.2**
		TSN-04	Install a Stop Ahead (W3-1) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-05	Install a Yield Ahead (W3-2) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-07	Install a trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at the crossing.	**3.1.1.2**
		TSN-08	Install a STOP HERE ON RED (R10-6) sign at the trail crosswalk with a painted stop line to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
		TSN-10	Install an advance trail-crossing warning sign for snowmobiles, i.e., the Snowmobile Crossing (W11-6) sign, on the crossed roadway at least 750 feet (228.6 meters) from the crossing (Note: applicable only on trails for exclusive snowmobile use).	**3.1.1.2**
		TSN-11	Install a snowmobile-crossing warning sign, i.e., the Snowmobile Crossing (W11-6) sign, on the crossed roadway at the trail crossing (Note: applicable only on trails for exclusive snowmobile use).	**3.1.1.2**
	Pavement Markings and Striping (PMS)	**PMS-04**	Divide the crosswalk to channelize pedestrians and bicyclists and separate their movements.	**3.1.3.2**
		PMS-05	Paint a high-visibility crosswalk on the crossed road "ladder" or "zebra" patterns preferable. (Note: The final decision of applying this treatment should be based on engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP,	**3.1.3.2**

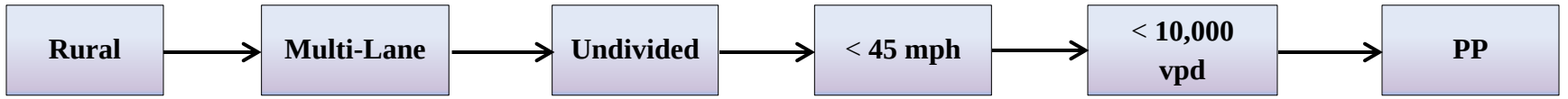
			or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	
		PMS-06	Paint a high-visibility "standard" pattern crosswalk on the crossed road. (Note: The final decision of applying this treatment should be based on engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP, or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	**3.1.3.2**
		PMS-07	Set back the stop line on the crossed roadway to improve the trail users' and the moving motorists' mutual chance to have an unobstructed view of each other.	**3.1.3.1**
		PMS-08	Paint a stop line and install a STOP HERE ON RED (R10-6) sign on the crossed roadway in advance of the trail crosswalk to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.3.1**
		PMS-09	Paint a STOP AHEAD, YIELD AHEAD, or PED XING advance warning pavement marking on the crossed road.	**3.1.3.1**
	Sight Distance (SD)	**SD-03**	Clear and maintain stopping/crossing sight distance for motorists.	**3.2.1, 3.2.2**
Treatments for Right-turn Traffic on the Crossed Road	**Traffic Sign (TSN)**	**TSN-09**	Prohibit right turns on red using appropriate signage from the R10-11 series on the crossed roadway to reduce the chance of conflicts with trail users (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
Treatments for the Trail	**Pavement Markings and Striping (PMS)**	**PMS-01**	Paint a yellow center line only or use one along with advance warning striping for 150 feet (45.7 meters) along the trail approach from the trail entrance point (Note: applicable only when a bollard, lean rail, or median obstruction is present).	**3.1.3.1**
		PMS-02	Paint a stop/yield line to pair with the STOP/YIELD sign or pedestrian/bicycle signal head on the trail at a distance of 3 - 6 feet (0.9 - 1.8 meters) from the crossed road's edge.	**3.1.3.1**

		PMS-03	Paint a STOP/YIELD pavement marking on the trail approach.	**3.1.3.1**
	Trail Signals and Signs (TRSS)	**TRSS-01**	Install a CROSS ONLY ON GREEN (symbolic circular green) (R10-1) sign (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-02	Install a CROSS ONLY ON "WALK" (symbolic walk indication) (R10-2) sign (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-03	Install a sign from the Push Button for Green Light (R10-4) series (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-04	Install a sign from the Push Button for WALK Signal (R10-3) series (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-05	Install a pedestrian/bicyclist pushbutton on the trail 4 - 5 feet (1.2 – 1.5 meters) above the ground such that it is easily accessible for bicyclists to activate the signal without dismounting (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.2.1**
		TRSS-07	Install an advance warning Stop Ahead (W3-1)/Yield Ahead (W3-2) sign on the trail approach at a distance of approximately 100 feet (30.5 meters) in advance of the crossing.	**3.1.1.2**
		TRSS-08	Install a STOP (R1-1) or YIELD (R1-2) sign on the trail approach at a minimum of 2 feet (0.6 meters) from the edge of the trail.	**3.1.1.1**
		TRSS-13	Install pedestrian/bicycle signal on the trail approach if the crossed road is already signalized.	**3.1.2.1**
	Trail Access Control (TRAC)	**TRAC-01**	Install a NO MOTOR VEHICLES (R5-3) sign on the trail, facing the roadway, to prevent unauthorized motor vehicles from entering the trail.	**3.1.1.1**
		TRAC-02	Install bollards to prevent unauthorized motor vehicles from entering the trail.	**3.4.1**
		TRAC-03	Install a lean rail parallel to the trail to prevent unauthorized motor vehicles from entering the trail and provide bicyclists with an area in which they can stop without dismounting.	**3.4.2**
		TRAC-04	Install a median on the trail to split the trail into two sections and restrict unauthorized motor vehicles from entering the trail.	**3.4.3**

	Curb Ramps (CR)	**CR-01**	Install a curb ramp to make the crossing accessible to pedestrians with disabilities and to improve crossing conditions for all trail users. (Note: The curb ramp must have detectable warnings in the form of truncated domes as outlined in MnDOT Standard Plate No. 7038A.)	**3.7**
	Realignment (RA)	**RA-01**	Realign the trail path to make a right angle crossing with the crossed roadway.	**3.8**
		RA-02	Realign the trail path such that its angle of intersection with the crossed roadway is ≥ 75 degrees.	**3.8**
		RA-03	Set back the trail path approximately 10 to 30 feet (3.0 to 9.1 meters) from the parallel roadway to allow vehicle stacking space (Note: applicable only when permissive left turns from the parallel roadway are allowed).	**3.8**
	Sight Distances (SD)	**SD-01**	Clear and maintain crossing/stopping sight distance for bicyclists.	**3.2.1, 3.2.2**
		SD-02	Clear and maintain crossing/stopping sight distance for pedestrians.	**3.2.1, 3.2.2**

*Note: Treatments in table are not in any specific order with respect to importance, cost, popularity, ease of implementation etc.

Table 17B: Alternative Treatments for Rural, Multi-Lane, Undivided, Speed < 45 mph, ADT < 10,000 vpd, Parallel Path Crossings



		Available Treatments		
		Treatment ID	**Treatment Description**	**Handbook Section**
Treatments for Left-turn Traffic on the Parallel Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-02**	Prohibit permissive left turns and enable protected left turns from the parallel roadway while trail users receive a "WALK" or flashing "DON'T WALK" indication (Note: applicable only when the intersection is already signalized and the parallel roadway has a dedicated left-turn lane).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-06**	Install an advance trail-crossing warning sign, such as the TRAIL CROSSING (W11-15a) sign, on the parallel roadway to warn turning vehicles. A distance plaque may be added beneath the sign.	**3.1.1.2**
Treatments for Right-turn Traffic on the Parallel Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-03**	Prohibit permissive right turns and enable protected right turns from the parallel roadway while trail users receive a "WALK" or flashing "DON'T WALK" indication (Note: applicable only when the intersection is already signalized and the parallel roadway has a dedicated right-turn lane).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-06**	Install an advance trail-crossing warning sign, such as the TRAIL CROSSING (W11-15a) sign, on the parallel roadway to warn turning vehicles. A distance plaque may be added beneath the sign.	**3.1.1.2**
	Traffic Calming (TC)	**TC-05**	Reduce the turning radius for right-turn vehicles.	**3.5.1**

Treatments for Through Traffic on the Crossed Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-04**	Provide oncoming crossing traffic on the crossed road with adequate change and clearance intervals to ensure their clearance of the trail prior to the trail receiving a "WALK" indication (Note: applicable only when the intersection is already signalized).	**3.1.2.1**
		TSGB-05	Provide an all-red phase on the crossed road to further protect trail users (Note: applicable only when the intersection is already signalized and the crossed road does not have all-red phase).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-01**	Install an advance trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at least 750 feet (228.6 meters) from the crossing. A distance plaque may be added beneath the sign.	**3.1.1.2**
		TSN-03	Install a Stop Here For Pedestrians (R1-5) series sign at the crossing on the crossed road	**3.1.1.1**
		TSN-04	Install a Stop Ahead (W3-1) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-05	Install a Yield Ahead (W3-2) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-07	Install a trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at the crossing.	**3.1.1.2**
		TSN-08	Install a STOP HERE ON RED (R10-6) sign at the trail crosswalk with a painted stop line to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
		TSN-10	Install an advance trail-crossing warning sign for snowmobiles, i.e., the Snowmobile Crossing (W11-6) sign, on the crossed roadway at least 750 feet (228.6 meters) from the crossing (Note: applicable only on trails for exclusive snowmobile use).	**3.1.1.2**
		TSN-11	Install a snowmobile-crossing warning sign, i.e., the Snowmobile Crossing (W11-6) sign, on the crossed roadway at the trail crossing (Note: applicable only on trails for exclusive snowmobile use).	**3.1.1.2**
	Pavement Markings and Striping (PMS)	**PMS-04**	Divide the crosswalk to channelize pedestrians and bicyclists and separate their movements.	**3.1.3.2**
		PMS-05	Paint a high-visibility crosswalk on the crossed road "ladder" or "zebra" patterns preferable. (Note: The final decision of applying this treatment should be based on	**3.1.3.2**

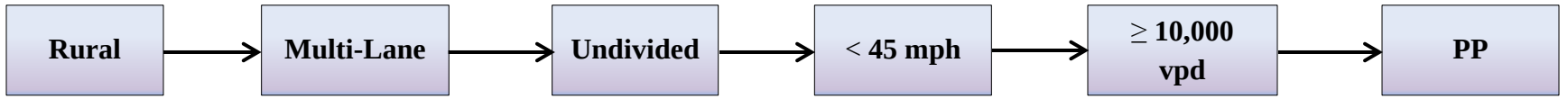
			engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP, or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	
		PMS-07	Set back the stop line on the crossed roadway to improve the trail users' and the moving motorists' mutual chance to have an unobstructed view of each other.	**3.1.3.1**
		PMS-08	Paint a stop line and install a STOP HERE ON RED (R10-6) sign on the crossed roadway in advance of the trail crosswalk to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.3.1**
		PMS-09	Paint a STOP AHEAD, YIELD AHEAD, or PED XING advance warning pavement marking on the crossed road.	**3.1.3.1**
	Sight Distance (SD)	**SD-03**	Clear and maintain stopping/crossing sight distance for motorists.	**3.2.1, 3.2.2**
Treatments for Right-turn Traffic on the Crossed Road	**Traffic Sign (TSN)**	**TSN-09**	Prohibit right turns on red using appropriate signage from the R10-11 series on the crossed roadway to reduce the chance of conflicts with trail users (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
	Traffic Calming (TC)	**TC-01**	Narrow the dedicated right-turn lane on the crossed road.	**3.5.1**
Treatments for the Trail	**Pavement Markings and Striping (PMS)**	**PMS-01**	Paint a yellow center line only or use one along with advance warning striping for 150 feet (45.7 meters) along the trail approach from the trail entrance point (Note: applicable only when a bollard, lean rail, or median obstruction is present).	**3.1.3.1**
		PMS-02	Paint a stop/yield line to pair with the STOP/YIELD sign or pedestrian/bicycle signal head on the trail at a distance of 3 - 6 feet (0.9 - 1.8 meters) from the crossed road's edge.	**3.1.3.1**
		PMS-03	Paint a STOP/YIELD pavement marking on the trail approach.	**3.1.3.1**
	Trail Signals and Signs (TRSS)	**TRSS-01**	Install a CROSS ONLY ON GREEN (symbolic circular green) (R10-1) sign (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**

		TRSS-02	Install a CROSS ONLY ON “WALK” (symbolic walk indication) (R10-2) sign (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-03	Install a sign from the Push Button for Green Light (R10-4) series (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-04	Install a sign from the Push Button for WALK Signal (R10-3) series (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-05	Install a pedestrian/bicyclist pushbutton on the trail 4 - 5 feet (1.2 – 1.5 meters) above the ground such that it is easily accessible for bicyclists to activate the signal without dismounting (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.2.1**
		TRSS-07	Install an advance warning Stop Ahead (W3-1)/Yield Ahead (W3-2) sign on the trail approach at a distance of approximately 100 feet (30.5 meters) in advance of the crossing.	**3.1.1.2**
		TRSS-08	Install a STOP (R1-1) or YIELD (R1-2) sign on the trail approach at a minimum of 2 feet (0.6 meters) from the edge of the trail.	**3.1.1.1**
		TRSS-13	Install pedestrian/bicycle signal on the trail approach if the crossed road is already signalized.	**3.1.2.1**
	Trail Access Control (TRAC)	**TRAC-01**	Install a NO MOTOR VEHICLES (R5-3) sign on the trail, facing the roadway, to prevent unauthorized motor vehicles from entering the trail.	**3.1.1.1**
		TRAC-02	Install bollards to prevent unauthorized motor vehicles from entering the trail.	**3.4.1**
		TRAC-03	Install a lean rail parallel to the trail to prevent unauthorized motor vehicles from entering the trail and provide bicyclists with an area in which they can stop without dismounting.	**3.4.2**
		TRAC-04	Install a median on the trail to split the trail into two sections and restrict unauthorized motor vehicles from entering the trail.	**3.4.3**
	Curb Ramps (CR)	**CR-01**	Install a curb ramp to make the crossing accessible to pedestrians with disabilities and to improve crossing conditions for all trail users. (Note: The curb ramp must have detectable warnings in the form of truncated domes as outlined in MnDOT Standard Plate No. 7038A.)	**3.7**

	Realignment (RA)	**RA-01**	Realign the trail path to make a right angle crossing with the crossed roadway.	**3.8**
		RA-02	Realign the trail path such that its angle of intersection with the crossed roadway is ≥ 75 degrees.	**3.8**
		RA-03	Set back the trail path approximately 10 to 30 feet (3.0 to 9.1 meters) from the parallel roadway to allow vehicle stacking space (Note: applicable only when permissive left turns from the parallel roadway are allowed).	**3.8**
	Sight Distances (SD)	**SD-01**	Clear and maintain crossing/stopping sight distance for bicyclists.	**3.2.1, 3.2.2**
		SD-02	Clear and maintain crossing/stopping sight distance for pedestrians.	**3.2.1, 3.2.2**

*Note: Treatments in table are not in any specific order with respect to importance, cost, popularity, ease of implementation etc.

Table 18B: Alternative Treatments for Rural, Multi-Lane, Undivided, Speed < 45 mph, ADT ≥ 10,000 vpd, Parallel Path Crossings



		Available Treatments		
		Treatment ID	**Treatment Description**	**Handbook Section**
Treatments for Left-turn Traffic on the Parallel Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-02**	Prohibit permissive left turns and enable protected left turns from the parallel roadway while trail users receive a "WALK" or flashing "DON'T WALK" indication (Note: applicable only when the intersection is already signalized and the parallel roadway has a dedicated left-turn lane).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-06**	Install an advance trail-crossing warning sign, such as the TRAIL CROSSING (W11-15a) sign, on the parallel roadway to warn turning vehicles. A distance plaque may be added beneath the sign.	**3.1.1.2**
Treatments for Right-turn Traffic on the Parallel Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-03**	Prohibit permissive right turns and enable protected right turns from the parallel roadway while trail users receive a "WALK" or flashing "DON'T WALK" indication (Note: applicable only when the intersection is already signalized and the parallel roadway has a dedicated right-turn lane).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-06**	Install an advance trail-crossing warning sign, such as the TRAIL CROSSING (W11-15a) sign, on the parallel roadway to warn turning vehicles. A distance plaque may be added beneath the sign.	**3.1.1.2**
	Traffic Calming (TC)	**TC-05**	Reduce the turning radius for right-turn vehicles.	**3.5.1**
	Refuge Island	**RI-03**	Install channelizing islands to split right-turn movements from other traffic on the crossed roadway, narrow the right-turn path, and provide refuge area for trail users to	**3.3**

	(RI)		cross the roadway (Note: this treatment is applicable when the crossed road has high ADT).	
Treatments for Through Traffic on the Crossed Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-04**	Provide oncoming crossing traffic on the crossed road with adequate change and clearance intervals to ensure their clearance of the trail prior to the trail receiving a "WALK" indication (Note: applicable only when the intersection is already signalized).	**3.1.2.1**
		TSGB-05	Provide an all-red phase on the crossed road to further protect trail users (Note: applicable only when the intersection is already signalized and the crossed road does not have all-red phase).	**3.1.2.1**
		TSGB-06	Install a yellow flashing beacon with pedestrian pushbutton at the crosswalk (Note: applicable only when the intersection is unsignalized); if used, the designer may also consider applying Treatment TRSS-11.	**3.1.2.2**
	Traffic Sign (TSN)	**TSN-01**	Install an advance trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at least 750 feet (228.6 meters) from the crossing. A distance plaque may be added beneath the sign.	**3.1.1.2**
		TSN-03	Install a Stop Here For Pedestrians (R1-5) series sign at the crossing on the crossed road	**3.1.1.1**
		TSN-04	Install a Stop Ahead (W3-1) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-05	Install a Yield Ahead (W3-2) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-07	Install a trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at the crossing.	**3.1.1.2**
		TSN-08	Install a STOP HERE ON RED (R10-6) sign at the trail crosswalk with a painted stop line to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
		TSN-10	Install an advance trail-crossing warning sign for snowmobiles, i.e., the Snowmobile Crossing (W11-6) sign, on the crossed roadway at least 750 feet (228.6 meters) from the crossing (Note: applicable only on trails for exclusive snowmobile use).	**3.1.1.2**
		TSN-11	Install a snowmobile-crossing warning sign, i.e., the Snowmobile Crossing (W11-6) sign, on the crossed roadway at the trail crossing (Note: applicable only on trails for	**3.1.1.2**

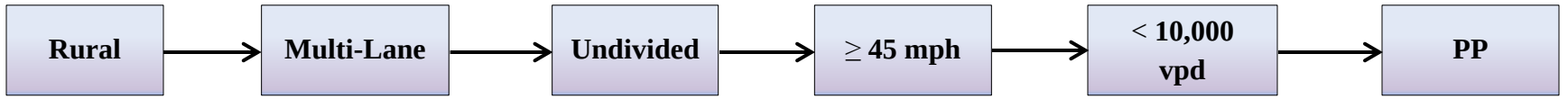
			exclusive snowmobile use).	
	Pavement Markings and Striping (PMS)	**PMS-04**	Divide the crosswalk to channelize pedestrians and bicyclists and separate their movements.	**3.1.3.2**
		PMS-05	Paint a high-visibility crosswalk on the crossed road "ladder" or "zebra" patterns preferable. (Note: The final decision of applying this treatment should be based on engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP, or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	**3.1.3.2**
		PMS-07	Set back the stop line on the crossed roadway to improve the trail users' and the moving motorists' mutual chance to have an unobstructed view of each other.	**3.1.3.1**
		PMS-08	Paint a stop line and install a STOP HERE ON RED (R10-6) sign on the crossed roadway in advance of the trail crosswalk to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.3.1**
		PMS-09	Paint a STOP AHEAD, YIELD AHEAD, or PED XING advance warning pavement marking on the crossed road.	**3.1.3.1**
	Sight Distance (SD)	**SD-03**	Clear and maintain stopping/crossing sight distance for motorists.	**3.2.1, 3.2.2**
Treatments for Right-turn Traffic on the Crossed Road	**Traffic Sign (TSN)**	**TSN-09**	Prohibit right turns on red using appropriate signage from the R10-11 series on the crossed roadway to reduce the chance of conflicts with trail users (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
	Traffic Calming (TC)	**TC-01**	Narrow the dedicated right-turn lane on the crossed road.	**3.5.1**
Treatments for the Trail	**Pavement Markings and Striping (PMS)**	**PMS-01**	Paint a yellow center line only or use one along with advance warning striping for 150 feet (45.7 meters) along the trail approach from the trail entrance point (Note: applicable only when a bollard, lean rail, or median obstruction is present).	**3.1.3.1**
		PMS-02	Paint a stop/yield line to pair with the STOP/YIELD sign or pedestrian/bicycle signal head on the trail at a distance of 3 - 6 feet (0.9 - 1.8 meters) from the crossed road's	**3.1.3.1**

			edge.	
		PMS-03	Paint a STOP/YIELD pavement marking on the trail approach.	**3.1.3.1**
	Trail Signals and Signs (TRSS)	**TRSS-01**	Install a CROSS ONLY ON GREEN (symbolic circular green) (R10-1) sign (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-02	Install a CROSS ONLY ON "WALK" (symbolic walk indication) (R10-2) sign (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-03	Install a sign from the Push Button for Green Light (R10-4) series (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-04	Install a sign from the Push Button for WALK Signal (R10-3) series (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-05	Install a pedestrian/bicyclist pushbutton on the trail 4 - 5 feet (1.2 – 1.5 meters) above the ground such that it is easily accessible for bicyclists to activate the signal without dismounting (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.2.1**
		TRSS-07	Install an advance warning Stop Ahead (W3-1)/Yield Ahead (W3-2) sign on the trail approach at a distance of approximately 100 feet (30.5 meters) in advance of the crossing.	**3.1.1.2**
		TRSS-08	Install a STOP (R1-1) or YIELD (R1-2) sign on the trail approach at a minimum of 2 feet (0.6 meters) from the edge of the trail.	**3.1.1.1**
		TRSS-11	Install a pushbutton for a yellow flashing beacon on the trail approach (Note: applicable only when yellow flashing beacon has been/ will be installed).	**3.1.2.2**
		TRSS-13	Install pedestrian/bicycle signal on the trail approach if the crossed road is already signalized.	**3.1.2.1**
		TRSS-14	Install a Push Button to Turn on Warning Lights (R10-25) sign at the crossing to inform trail users of how to activate the flashing beacon.	**3.1.2.2**
	Trail Access Control (TRAC)	**TRAC-01**	Install a NO MOTOR VEHICLES (R5-3) sign on the trail, facing the roadway, to prevent unauthorized motor vehicles from entering the trail.	**3.1.1.1**
		TRAC-02	Install bollards to prevent unauthorized motor vehicles from entering the trail.	**3.4.1**

		TRAC-03	Install a lean rail parallel to the trail to prevent unauthorized motor vehicles from entering the trail and provide bicyclists with an area in which they can stop without dismounting.	**3.4.2**
		TRAC-04	Install a median on the trail to split the trail into two sections and restrict unauthorized motor vehicles from entering the trail.	**3.4.3**
	Curb Ramps (CR)	**CR-01**	Install a curb ramp to make the crossing accessible to pedestrians with disabilities and to improve crossing conditions for all trail users. (Note: The curb ramp must have detectable warnings in the form of truncated domes as outlined in MnDOT Standard Plate No. 7038A.)	**3.7**
	Realignment (RA)	**RA-01**	Realign the trail path to make a right angle crossing with the crossed roadway.	**3.8**
		RA-02	Realign the trail path such that its angle of intersection with the crossed roadway is ≥ 75 degrees.	**3.8**
		RA-03	Set back the trail path approximately 10 to 30 feet (3.0 to 9.1 meters) from the parallel roadway to allow vehicle stacking space (Note: applicable only when permissive left turns from the parallel roadway are allowed).	**3.8**
	Sight Distances (SD)	**SD-01**	Clear and maintain crossing/stopping sight distance for bicyclists.	**3.2.1, 3.2.2**
		SD-02	Clear and maintain crossing/stopping sight distance for pedestrians.	**3.2.1, 3.2.2**

*Note: Treatments in table are not in any specific order with respect to importance, cost, popularity, ease of implementation etc.

Table 19B: Alternative Treatments for Rural, Multi-Lane, Undivided, Speed ≥ 45 mph, ADT < 10,000 vpd, Parallel Path Crossings



		Available Treatments		
		Treatment ID	**Treatment Description**	**Handbook Section**
Treatments for Left-turn Traffic on the Parallel Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-02**	Prohibit permissive left turns and enable protected left turns from the parallel roadway while trail users receive a "WALK" or flashing "DON'T WALK" indication (Note: applicable only when the intersection is already signalized and the parallel roadway has a dedicated left-turn lane).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-06**	Install an advance trail-crossing warning sign, such as the TRAIL CROSSING (W11-15a) sign, on the parallel roadway to warn turning vehicles. A distance plaque may be added beneath the sign.	**3.1.1.2**
Treatments for Right-turn Traffic on the Parallel Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-03**	Prohibit permissive right turns and enable protected right turns from the parallel roadway while trail users receive a "WALK" or flashing "DON'T WALK" indication (Note: applicable only when the intersection is already signalized and the parallel roadway has a dedicated right-turn lane).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-06**	Install an advance trail-crossing warning sign, such as the TRAIL CROSSING (W11-15a) sign, on the parallel roadway to warn turning vehicles. A distance plaque may be added beneath the sign.	**3.1.1.2**
	Traffic Calming (TC)	**TC-05**	Reduce the turning radius for right-turn vehicles.	**3.5.1**
	Traffic Signal and	**TSGB-04**	Provide oncoming crossing traffic on the crossed road with adequate change and clearance intervals to ensure their clearance of the trail prior to the trail receiving a	**3.1.2.1**

Treatments for Through Traffic on the Crossed Road	**Beacon (TSGB)**		"WALK" indication (Note: applicable only when the intersection is already signalized).	
		TSGB-05	Provide an all-red phase on the crossed road to further protect trail users (Note: applicable only when the intersection is already signalized and the crossed road does not have all-red phase).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-01**	Install an advance trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at least 750 feet (228.6 meters) from the crossing. A distance plaque may be added beneath the sign.	**3.1.1.2**
		TSN-03	Install a Stop Here For Pedestrians (R1-5) series sign at the crossing on the crossed road	**3.1.1.1**
		TSN-04	Install a Stop Ahead (W3-1) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-05	Install a Yield Ahead (W3-2) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-07	Install a trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at the crossing.	**3.1.1.2**
		TSN-08	Install a STOP HERE ON RED (R10-6) sign at the trail crosswalk with a painted stop line to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
		TSN-10	Install an advance trail-crossing warning sign for snowmobiles, i.e., the Snowmobile Crossing (W11-6) sign, on the crossed roadway at least 750 feet (228.6 meters) from the crossing (Note: applicable only on trails for exclusive snowmobile use).	**3.1.1.2**
		TSN-11	Install a snowmobile-crossing warning sign, i.e., the Snowmobile Crossing (W11-6) sign, on the crossed roadway at the trail crossing (Note: applicable only on trails for exclusive snowmobile use).	**3.1.1.2**
	Pavement Markings and Striping (PMS)	**PMS-04**	Divide the crosswalk to channelize pedestrians and bicyclists and separate their movements.	**3.1.3.2**
		PMS-05	Paint a high-visibility crosswalk on the crossed road "ladder" or "zebra" patterns preferable. (Note: The final decision of applying this treatment should be based on engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP,	**3.1.3.2**

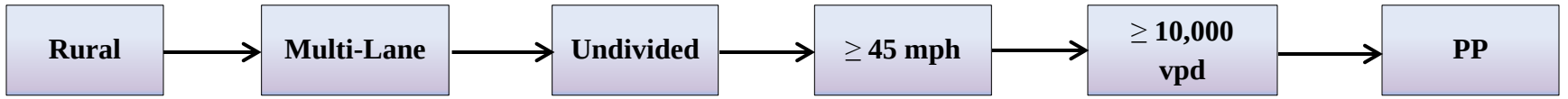
			or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	
		PMS-07	Set back the stop line on the crossed roadway to improve the trail users' and the moving motorists' mutual chance to have an unobstructed view of each other.	**3.1.3.1**
		PMS-08	Paint a stop line and install a STOP HERE ON RED (R10-6) sign on the crossed roadway in advance of the trail crosswalk to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.3.1**
		PMS-09	Paint a STOP AHEAD, YIELD AHEAD, or PED XING advance warning pavement marking on the crossed road.	**3.1.3.1**
	Sight Distance (SD)	**SD-03**	Clear and maintain stopping/crossing sight distance for motorists.	**3.2.1, 3.2.2**
Treatments for Right-turn Traffic on the Crossed Road	**Traffic Sign (TSN)**	**TSN-09**	Prohibit right turns on red using appropriate signage from the R10-11 series on the crossed roadway to reduce the chance of conflicts with trail users (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
	Traffic Calming (TC)	**TC-01**	Narrow the dedicated right-turn lane on the crossed road.	**3.5.1**
Treatments for the Trail	**Pavement Markings and Striping (PMS)**	**PMS-01**	Paint a yellow center line only or use one along with advance warning striping for 150 feet (45.7 meters) along the trail approach from the trail entrance point (Note: applicable only when a bollard, lean rail, or median obstruction is present).	**3.1.3.1**
		PMS-02	Paint a stop/yield line to pair with the STOP/YIELD sign or pedestrian/bicycle signal head on the trail at a distance of 3 - 6 feet (0.9 - 1.8 meters) from the crossed road's edge.	**3.1.3.1**
		PMS-03	Paint a STOP/YIELD pavement marking on the trail approach.	**3.1.3.1**
	Trail Signals and Signs (TRSS)	**TRSS-01**	Install a CROSS ONLY ON GREEN (symbolic circular green) (R10-1) sign (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-02	Install a CROSS ONLY ON "WALK" (symbolic walk indication) (R10-2) sign (Note: applicable only when the pedestrian signal is already/will be installed at the	**3.1.1.1**

			trail crossing).	
		TRSS-03	Install a sign from the Push Button for Green Light (R10-4) series (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-04	Install a sign from the Push Button for WALK Signal (R10-3) series (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-05	Install a pedestrian/bicyclist pushbutton on the trail 4 - 5 feet (1.2 – 1.5 meters) above the ground such that it is easily accessible for bicyclists to activate the signal without dismounting (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.2.1**
		TRSS-07	Install an advance warning Stop Ahead (W3-1)/Yield Ahead (W3-2) sign on the trail approach at a distance of approximately 100 feet (30.5 meters) in advance of the crossing.	**3.1.1.2**
		TRSS-08	Install a STOP (R1-1) or YIELD (R1-2) sign on the trail approach at a minimum of 2 feet (0.6 meters) from the edge of the trail.	**3.1.1.1**
		TRSS-13	Install pedestrian/bicycle signal on the trail approach if the crossed road is already signalized.	**3.1.2.1**
	Trail Access Control (TRAC)	**TRAC-01**	Install a NO MOTOR VEHICLES (R5-3) sign on the trail, facing the roadway, to prevent unauthorized motor vehicles from entering the trail.	**3.1.1.1**
		TRAC-02	Install bollards to prevent unauthorized motor vehicles from entering the trail.	**3.4.1**
		TRAC-03	Install a lean rail parallel to the trail to prevent unauthorized motor vehicles from entering the trail and provide bicyclists with an area in which they can stop without dismounting.	**3.4.2**
		TRAC-04	Install a median on the trail to split the trail into two sections and restrict unauthorized motor vehicles from entering the trail.	**3.4.3**
	Curb Ramps (CR)	**CR-01**	Install a curb ramp to make the crossing accessible to pedestrians with disabilities and to improve crossing conditions for all trail users. (Note: The curb ramp must have detectable warnings in the form of truncated domes as outlined in MnDOT Standard Plate No. 7038A.)	**3.7**
	Realignment (RA)	**RA-01**	Realign the trail path to make a right angle crossing with the crossed roadway.	**3.8**

		RA-02	Realign the trail path such that its angle of intersection with the crossed roadway is ≥ 75 degrees.	**3.8**
		RA-03	Set back the trail path approximately 10 to 30 feet (3.0 to 9.1 meters) from the parallel roadway to allow vehicle stacking space (Note: applicable only when permissive left turns from the parallel roadway are allowed).	**3.8**
	Sight Distances (SD)	**SD-01**	Clear and maintain crossing/stopping sight distance for bicyclists.	**3.2.1, 3.2.2**
		SD-02	Clear and maintain crossing/stopping sight distance for pedestrians.	**3.2.1, 3.2.2**

*Note: Treatments in table are not in any specific order with respect to importance, cost, popularity, ease of implementation etc.

Table 20B: Alternative Treatments for Rural, Multi-Lane, Undivided, Speed ≥ 45 mph, ADT ≥ 10,000 vpd, Parallel Path Crossings



		Available Treatments		
		Treatment ID	**Treatment Description**	**Handbook Section**
Treatments for Left-turn Traffic on the Parallel Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-02**	Prohibit permissive left turns and enable protected left turns from the parallel roadway while trail users receive a "WALK" or flashing "DON'T WALK" indication (Note: applicable only when the intersection is already signalized and the parallel roadway has a dedicated left-turn lane).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-06**	Install an advance trail-crossing warning sign, such as the TRAIL CROSSING (W11-15a) sign, on the parallel roadway to warn turning vehicles. A distance plaque may be added beneath the sign.	**3.1.1.2**
Treatments for Right-turn Traffic on the Parallel Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-03**	Prohibit permissive right turns and enable protected right turns from the parallel roadway while trail users receive a "WALK" or flashing "DON'T WALK" indication (Note: applicable only when the intersection is already signalized and the parallel roadway has a dedicated right-turn lane).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-06**	Install an advance trail-crossing warning sign, such as the TRAIL CROSSING (W11-15a) sign, on the parallel roadway to warn turning vehicles. A distance plaque may be added beneath the sign.	**3.1.1.2**
	Traffic Calming (TC)	**TC-05**	Reduce the turning radius for right-turn vehicles.	**3.5.1**
	Traffic Signal and	**TSGB-04**	Provide oncoming crossing traffic on the crossed road with adequate change and clearance intervals to ensure their clearance of the trail prior to the trail receiving a	**3.1.2.1**

Treatments for Through Traffic on the Crossed Road	**Beacon (TSGB)**		"WALK" indication (Note: applicable only when the intersection is already signalized).	
		TSGB-05	Provide an all-red phase on the crossed road to further protect trail users (Note: applicable only when the intersection is already signalized and the crossed road does not have all-red phase).	**3.1.2.1**
		TSGB-06	Install a yellow flashing beacon with pedestrian pushbutton at the crosswalk (Note: applicable only when the intersection is unsignalized); if used, the designer may also consider applying Treatment TRSS-11.	**3.1.2.2**
	Traffic Sign (TSN)	**TSN-01**	Install an advance trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at least 750 feet (228.6 meters) from the crossing. A distance plaque may be added beneath the sign.	**3.1.1.2**
		TSN-03	Install a Stop Here For Pedestrians (R1-5) series sign at the crossing on the crossed road	**3.1.1.1**
		TSN-04	Install a Stop Ahead (W3-1) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-05	Install a Yield Ahead (W3-2) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-07	Install a trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at the crossing.	**3.1.1.2**
		TSN-08	Install a STOP HERE ON RED (R10-6) sign at the trail crosswalk with a painted stop line to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
		TSN-10	Install an advance trail-crossing warning sign for snowmobiles, i.e., the Snowmobile Crossing (W11-6) sign, on the crossed roadway at least 750 feet (228.6 meters) from the crossing (Note: applicable only on trails for exclusive snowmobile use).	**3.1.1.2**
		TSN-11	Install a snowmobile-crossing warning sign, i.e., the Snowmobile Crossing (W11-6) sign, on the crossed roadway at the trail crossing (Note: applicable only on trails for exclusive snowmobile use).	**3.1.1.2**
	Pavement Markings	**PMS-04**	Divide the crosswalk to channelize pedestrians and bicyclists and separate their movements.	**3.1.3.2**

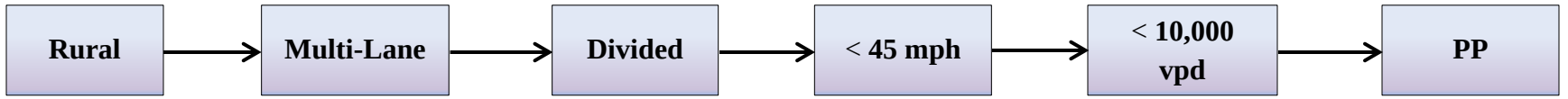
	and Striping (PMS)	**PMS-05**	Paint a high-visibility crosswalk on the crossed road "ladder" or "zebra" patterns preferable. (Note: The final decision of applying this treatment should be based on engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP, or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	**3.1.3.2**
		PMS-06	Paint a high-visibility "standard" pattern crosswalk on the crossed road. (Note: The final decision of applying this treatment should be based on engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP, or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	**3.1.3.2**
		PMS-07	Set back the stop line on the crossed roadway to improve the trail users' and the moving motorists' mutual chance to have an unobstructed view of each other.	**3.1.3.1**
		PMS-08	Paint a stop line and install a STOP HERE ON RED (R10-6) sign on the crossed roadway in advance of the trail crosswalk to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.3.1**
		PMS-09	Paint a STOP AHEAD, YIELD AHEAD, or PED XING advance warning pavement marking on the crossed road.	**3.1.3.1**
	Sight Distance (SD)	**SD-03**	Clear and maintain stopping/crossing sight distance for motorists.	**3.2.1, 3.2.2**
Treatments for Right-turn Traffic on the Crossed	**Traffic Sign (TSN)**	**TSN-09**	Prohibit right turns on red using appropriate signage from the R10-11 series on the crossed roadway to reduce the chance of conflicts with trail users (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
	Traffic Calming (TC)	**TC-01**	Narrow the dedicated right-turn lane on the crossed road.	**3.5.1**

Road	**Refuge Island (RI)**	**RI-03**	Install channelizing islands to split right-turn movements from other traffic on the crossed roadway, narrow the right-turn path, and provide refuge area for trail users to cross the roadway.	**3.3**
Treatments for the Trail	**Pavement Markings and Striping (PMS)**	**PMS-01**	Paint a yellow center line only or use one along with advance warning striping for 150 feet (45.7 meters) along the trail approach from the trail entrance point (Note: applicable only when a bollard, lean rail, or median obstruction is present).	**3.1.3.1**
		PMS-02	Paint a stop/yield line to pair with the STOP/YIELD sign or pedestrian/bicycle signal head on the trail at a distance of 3 - 6 feet (0.9 - 1.8 meters) from the crossed road's edge.	**3.1.3.1**
		PMS-03	Paint a STOP/YIELD pavement marking on the trail approach.	**3.1.3.1**
	Trail Signals and Signs (TRSS)	**TRSS-01**	Install a CROSS ONLY ON GREEN (symbolic circular green) (R10-1) sign (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-02	Install a CROSS ONLY ON "WALK" (symbolic walk indication) (R10-2) sign (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-03	Install a sign from the Push Button for Green Light (R10-4) series (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-04	Install a sign from the Push Button for WALK Signal (R10-3) series (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-05	Install a pedestrian/bicyclist pushbutton on the trail 4 - 5 feet (1.2 – 1.5 meters) above the ground such that it is easily accessible for bicyclists to activate the signal without dismounting (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.2.1**
		TRSS-07	Install an advance warning Stop Ahead (W3-1)/Yield Ahead (W3-2) sign on the trail approach at a distance of approximately 100 feet (30.5 meters) in advance of the crossing.	**3.1.1.2**
		TRSS-08	Install a STOP (R1-1) or YIELD (R1-2) sign on the trail approach at a minimum of 2 feet (0.6 meters) from the edge of the trail.	**3.1.1.1**

		TRSS-11	Install a pushbutton for a yellow flashing beacon on the trail approach (Note: applicable only when yellow flashing beacon has been/ will be installed).	**3.1.2.2**
		TRSS-13	Install pedestrian/bicycle signal on the trail approach if the crossed road is already signalized.	**3.1.2.1**
		TRSS-14	Install a Push Button to Turn on Warning Lights (R10-25) sign at the crossing to inform trail users of how to activate the flashing beacon.	**3.1.2.2**
	Trail Access Control (TRAC)	**TRAC-01**	Install a NO MOTOR VEHICLES (R5-3) sign on the trail, facing the roadway, to prevent unauthorized motor vehicles from entering the trail.	**3.1.1.1**
		TRAC-02	Install bollards to prevent unauthorized motor vehicles from entering the trail.	**3.4.1**
		TRAC-03	Install a lean rail parallel to the trail to prevent unauthorized motor vehicles from entering the trail and provide bicyclists with an area in which they can stop without dismounting.	**3.4.2**
		TRAC-04	Install a median on the trail to split the trail into two sections and restrict unauthorized motor vehicles from entering the trail.	**3.4.3**
	Curb Ramps (CR)	**CR-01**	Install a curb ramp to make the crossing accessible to pedestrians with disabilities and to improve crossing conditions for all trail users. (Note: The curb ramp must have detectable warnings in the form of truncated domes as outlined in MnDOT Standard Plate No. 7038A.)	**3.7**
	Realignment (RA)	**RA-01**	Realign the trail path to make a right angle crossing with the crossed roadway.	**3.8**
		RA-02	Realign the trail path such that its angle of intersection with the crossed roadway is ≥ 75 degrees.	**3.8**
		RA-03	Set back the trail path approximately 10 to 30 feet (3.0 to 9.1 meters) from the parallel roadway to allow vehicle stacking space (Note: applicable only when permissive left turns from the parallel roadway are allowed).	**3.8**
	Sight Distances (SD)	**SD-01**	Clear and maintain crossing/stopping sight distance for bicyclists.	**3.2.1, 3.2.2**
		SD-02	Clear and maintain crossing/stopping sight distance for pedestrians.	**3.2.1, 3.2.2**

*Note: Treatments in table are not in any specific order with respect to importance, cost, popularity, ease of implementation etc.

Table 21B: Alternative Treatments for Rural, Multi-Lane, Divided, Speed < 45 mph, ADT < 10,000 vpd, Parallel Path Crossings



		Available Treatments		
		Treatment ID	**Treatment Description**	**Handbook Section**
Treatments for Left-turn Traffic on the Parallel Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-02**	Prohibit permissive left turns and enable protected left turns from the parallel roadway while trail users receive a "WALK" or flashing "DON'T WALK" indication (Note: applicable only when the intersection is already signalized and the parallel roadway has a dedicated left-turn lane).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-06**	Install an advance trail-crossing warning sign, such as the TRAIL CROSSING (W11-15a) sign, on the parallel roadway to warn turning vehicles. A distance plaque may be added beneath the sign.	**3.1.1.2**
Treatments for Right-turn Traffic on the Parallel Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-03**	Prohibit permissive right turns and enable protected right turns from the parallel roadway while trail users receive a "WALK" or flashing "DON'T WALK" indication (Note: applicable only when the intersection is already signalized and the parallel roadway has a dedicated right-turn lane).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-06**	Install an advance trail-crossing warning sign, such as the TRAIL CROSSING (W11-15a) sign, on the parallel roadway to warn turning vehicles. A distance plaque may be added beneath the sign.	**3.1.1.2**
	Traffic Calming (TC)	**TC-05**	Reduce the turning radius for right-turn vehicles.	**3.5.1**

Treatments for Through Traffic on the Crossed Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-04**	Provide oncoming crossing traffic on the crossed road with adequate change and clearance intervals to ensure their clearance of the trail prior to the trail receiving a "WALK" indication (Note: applicable only when the intersection is already signalized).	**3.1.2.1**
		TSGB-05	Provide an all-red phase on the crossed road to further protect trail users (Note: applicable only when the intersection is already signalized and the crossed road does not have all-red phase).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-01**	Install an advance trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at least 750 feet (228.6 meters) from the crossing. A distance plaque may be added beneath the sign.	**3.1.1.2**
		TSN-03	Install a Stop Here For Pedestrians (R1-5) series sign at the crossing on the crossed road	**3.1.1.1**
		TSN-04	Install a Stop Ahead (W3-1) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-05	Install a Yield Ahead (W3-2) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-07	Install a trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at the crossing.	**3.1.1.2**
		TSN-08	Install a STOP HERE ON RED (R10-6) sign at the trail crosswalk with a painted stop line to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
		TSN-10	Install an advance trail-crossing warning sign for snowmobiles, i.e., the Snowmobile Crossing (W11-6) sign, on the crossed roadway at least 750 feet (228.6 meters) from the crossing (Note: applicable only on trails for exclusive snowmobile use).	**3.1.1.2**
		TSN-11	Install a snowmobile-crossing warning sign, i.e., the Snowmobile Crossing (W11-6) sign, on the crossed roadway at the trail crossing (Note: applicable only on trails for exclusive snowmobile use).	**3.1.1.2**
	Pavement Markings and Striping (PMS)	**PMS-04**	Divide the crosswalk to channelize pedestrians and bicyclists and separate their movements.	**3.1.3.2**
		PMS-05	Paint a high-visibility crosswalk on the crossed road "ladder" or "zebra" patterns preferable. (Note: The final decision of applying this treatment should be based on	**3.1.3.2**

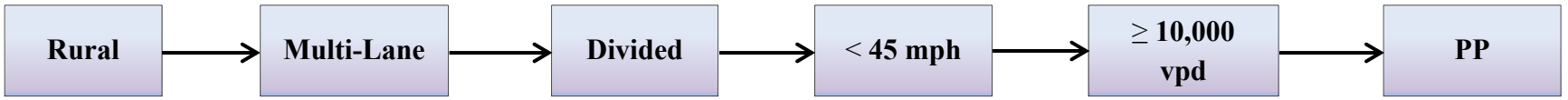
			engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP, or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	
		PMS-07	Set back the stop line on the crossed roadway to improve the trail users' and the moving motorists' mutual chance to have an unobstructed view of each other.	**3.1.3.1**
		PMS-08	Paint a stop line and install a STOP HERE ON RED (R10-6) sign on the crossed roadway in advance of the trail crosswalk to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.3.1**
		PMS-09	Paint a STOP AHEAD, YIELD AHEAD, or PED XING advance warning pavement marking on the crossed road.	**3.1.3.1**
	Sight Distance (SD)	**SD-03**	Clear and maintain stopping/crossing sight distance for motorists.	**3.2.1, 3.2.2**
Treatments for Right-turn Traffic on the Crossed Road	**Traffic Sign (TSN)**	**TSN-09**	Prohibit right turns on red using appropriate signage from the R10-11 series on the crossed roadway to reduce the chance of conflicts with trail users (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
	Traffic Calming (TC)	**TC-01**	Narrow the dedicated right-turn lane on the crossed road.	**3.5.1**
Treatments for the Trail	**Pavement Markings and Striping (PMS)**	**PMS-01**	Paint a yellow center line only or use one along with advance warning striping for 150 feet (45.7 meters) along the trail approach from the trail entrance point (Note: applicable only when a bollard, lean rail, or median obstruction is present).	**3.1.3.1**
		PMS-02	Paint a stop/yield line to pair with the STOP/YIELD sign or pedestrian/bicycle signal head on the trail at a distance of 3 - 6 feet (0.9 - 1.8 meters) from the crossed road's edge.	**3.1.3.1**
		PMS-03	Paint a STOP/YIELD pavement marking on the trail approach.	**3.1.3.1**
	Trail Signals and Signs (TRSS)	**TRSS-01**	Install a CROSS ONLY ON GREEN (symbolic circular green) (R10-1) sign (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**

		TRSS-02	Install a CROSS ONLY ON “WALK” (symbolic walk indication) (R10-2) sign (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-03	Install a sign from the Push Button for Green Light (R10-4) series (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-04	Install a sign from the Push Button for WALK Signal (R10-3) series (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-05	Install a pedestrian/bicyclist pushbutton on the trail 4 - 5 feet (1.2 – 1.5 meters) above the ground such that it is easily accessible for bicyclists to activate the signal without dismounting (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.2.1**
		TRSS-07	Install an advance warning Stop Ahead (W3-1)/Yield Ahead (W3-2) sign on the trail approach at a distance of approximately 100 feet (30.5 meters) in advance of the crossing.	**3.1.1.2**
		TRSS-08	Install a STOP (R1-1) or YIELD (R1-2) sign on the trail approach at a minimum of 2 feet (0.6 meters) from the edge of the trail.	**3.1.1.1**
		TRSS-13	Install pedestrian/bicycle signal on the trail approach if the crossed road is already signalized.	**3.1.2.1**
	Trail Access Control (TRAC)	**TRAC-01**	Install a NO MOTOR VEHICLES (R5-3) sign on the trail, facing the roadway, to prevent unauthorized motor vehicles from entering the trail.	**3.1.1.1**
		TRAC-02	Install bollards to prevent unauthorized motor vehicles from entering the trail.	**3.4.1**
		TRAC-03	Install a lean rail parallel to the trail to prevent unauthorized motor vehicles from entering the trail and provide bicyclists with an area in which they can stop without dismounting.	**3.4.2**
		TRAC-04	Install a median on the trail to split the trail into two sections and restrict unauthorized motor vehicles from entering the trail.	**3.4.3**
	Curb Ramps (CR)	**CR-01**	Install a curb ramp to make the crossing accessible to pedestrians with disabilities and to improve crossing conditions for all trail users. (Note: The curb ramp must have detectable warnings in the form of truncated domes as outlined in MnDOT Standard Plate No. 7038A.)	**3.7**

	Realignment (RA)	**RA-01**	Realign the trail path to make a right angle crossing with the crossed roadway.	**3.8**
		RA-02	Realign the trail path such that its angle of intersection with the crossed roadway is ≥ 75 degrees.	**3.8**
		RA-03	Set back the trail path approximately 10 to 30 feet (3.0 to 9.1 meters) from the parallel roadway to allow vehicle stacking space (Note: applicable only when permissive left turns from the parallel roadway are allowed).	**3.8**
	Sight Distances (SD)	**SD-01**	Clear and maintain crossing/stopping sight distance for bicyclists.	**3.2.1, 3.2.2**
		SD-02	Clear and maintain crossing/stopping sight distance for pedestrians.	**3.2.1, 3.2.2**

*Note: Treatments in table are not in any specific order with respect to importance, cost, popularity, ease of implementation etc.

Table 22B: Alternative Treatments for Rural, Multi-Lane, Divided, Speed < 45 mph, ADT ≥ 10,000 vpd, Parallel Path Crossings



		Available Treatments		
		Treatment ID	**Treatment Description**	**Handbook Section**
Treatments for Left-turn Traffic on the Parallel Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-02**	Prohibit permissive left turns and enable protected left turns from the parallel roadway while trail users receive a "WALK" or flashing "DON'T WALK" indication (Note: applicable only when the intersection is already signalized and the parallel roadway has a dedicated left-turn lane).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-06**	Install an advance trail-crossing warning sign, such as the TRAIL CROSSING (W11-15a) sign, on the parallel roadway to warn turning vehicles. A distance plaque may be added beneath the sign.	**3.1.1.2**
Treatments for Right-turn Traffic on the Parallel Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-03**	Prohibit permissive right turns and enable protected right turns from the parallel roadway while trail users receive a "WALK" or flashing "DON'T WALK" indication (Note: applicable only when the intersection is already signalized and the parallel roadway has a dedicated right-turn lane).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-06**	Install an advance trail-crossing warning sign, such as the TRAIL CROSSING (W11-15a) sign, on the parallel roadway to warn turning vehicles. A distance plaque may be added beneath the sign.	**3.1.1.2**
	Traffic Calming (TC)	**TC-05**	Reduce the turning radius for right-turn vehicles.	**3.5.1**

Treatments for Through Traffic on the Crossed Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-04**	Provide oncoming crossing traffic on the crossed road with adequate change and clearance intervals to ensure their clearance of the trail prior to the trail receiving a "WALK" indication (Note: applicable only when the intersection is already signalized).	**3.1.2.1**
		TSGB-05	Provide an all-red phase on the crossed road to further protect trail users (Note: applicable only when the intersection is already signalized and the crossed road does not have all-red phase).	**3.1.2.1**
		TSGB-06	Install a yellow flashing beacon with pedestrian pushbutton at the crosswalk (Note: applicable only when the intersection is unsignalized); if used, the designer may also consider applying Treatment TRSS-11.	**3.1.2.2**
	Traffic Sign (TSN)	**TSN-01**	Install an advance trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at least 750 feet (228.6 meters) from the crossing. A distance plaque may be added beneath the sign.	**3.1.1.2**
		TSN-03	Install a Stop Here For Pedestrians (R1-5) series sign at the crossing on the crossed road	**3.1.1.1**
		TSN-04	Install a Stop Ahead (W3-1) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-05	Install a Yield Ahead (W3-2) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-07	Install a trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at the crossing.	**3.1.1.2**
		TSN-08	Install a STOP HERE ON RED (R10-6) sign at the trail crosswalk with a painted stop line to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
		TSN-10	Install an advance trail-crossing warning sign for snowmobiles, i.e., the Snowmobile Crossing (W11-6) sign, on the crossed roadway at least 750 feet (228.6 meters) from the crossing (Note: applicable only on trails for exclusive snowmobile use).	**3.1.1.2**
		TSN-11	Install a snowmobile-crossing warning sign, i.e., the Snowmobile Crossing (W11-6) sign, on the crossed roadway at the trail crossing (Note: applicable only on trails for exclusive snowmobile use).	**3.1.1.2**

	Refuge Island (RI)	**RI-01**	Install a right-angle median refuge island (Note: this treatment is applicable when the crossed road has high ADT).	**3.3**
		RI-02	Install a median refuge island angled at 75 degrees with opposite sides of the trail across the roadway being slightly offset, and supplementary centerline and STOP or YIELD pavement markings in the refuge area (Note: this treatment is applicable when the crossed road has high ADT).	**3.3**
	Pavement Markings and Striping (PMS)	**PMS-04**	Divide the crosswalk to channelize pedestrians and bicyclists and separate their movements.	**3.1.3.2**
		PMS-05	Paint a high-visibility crosswalk on the crossed road "ladder" or "zebra" patterns preferable. (Note: The final decision of applying this treatment should be based on engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP, or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	**3.1.3.2**
		PMS-07	Set back the stop line on the crossed roadway to improve the trail users' and the moving motorists' mutual chance to have an unobstructed view of each other.	**3.1.3.1**
		PMS-08	Paint a stop line and install a STOP HERE ON RED (R10-6) sign on the crossed roadway in advance of the trail crosswalk to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.3.1**
		PMS-09	Paint a STOP AHEAD, YIELD AHEAD, or PED XING advance warning pavement marking on the crossed road.	**3.1.3.1**
	Sight Distance (SD)	**SD-03**	Clear and maintain stopping/crossing sight distance for motorists.	**3.2.1, 3.2.2**
Treatments for Right-turn	**Traffic Sign (TSN)**	**TSN-09**	Prohibit right turns on red using appropriate signage from the R10-11 series on the crossed roadway to reduce the chance of conflicts with trail users (Note: applicable only when the intersection is already signalized).	**3.1.1.1**

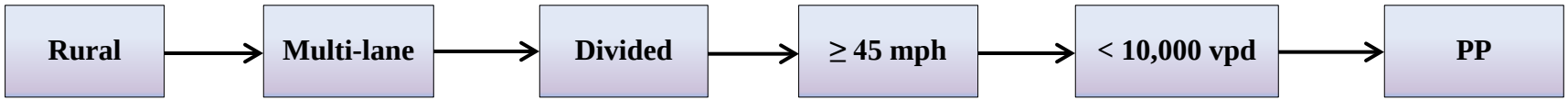
Traffic on the Crossed Road	**Refuge Island (RI)**	**RI-03**	Install channelizing islands to split right-turn movements from other traffic on the crossed roadway, narrow the right-turn path, and provide refuge area for trail users to cross the roadway (Note: this treatment is applicable when the crossed road has high ADT).	**3.3**
	Traffic Calming (TC)	**TC-01**	Narrow the dedicated right-turn lane on the crossed road.	**3.5.1**
Treatments for the Trail	**Pavement Markings and Striping (PMS)**	**PMS-01**	Paint a yellow center line only or use one along with advance warning striping for 150 feet (45.7 meters) along the trail approach from the trail entrance point (Note: applicable only when a bollard, lean rail, or median obstruction is present).	**3.1.3.1**
		PMS-02	Paint a stop/yield line to pair with the STOP/YIELD sign or pedestrian/bicycle signal head on the trail at a distance of 3 - 6 feet (0.9 - 1.8 meters) from the crossed road's edge.	**3.1.3.1**
		PMS-03	Paint a STOP/YIELD pavement marking on the trail approach.	**3.1.3.1**
	Trail Signals and Signs (TRSS)	**TRSS-01**	Install a CROSS ONLY ON GREEN (symbolic circular green) (R10-1) sign (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-02	Install a CROSS ONLY ON "WALK" (symbolic walk indication) (R10-2) sign (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-03	Install a sign from the Push Button for Green Light (R10-4) series (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-04	Install a sign from the Push Button for WALK Signal (R10-3) series (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-05	Install a pedestrian/bicyclist pushbutton on the trail 4 - 5 feet (1.2 – 1.5 meters) above the ground such that it is easily accessible for bicyclists to activate the signal without dismounting (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.2.1**
		TRSS-07	Install an advance warning Stop Ahead (W3-1)/Yield Ahead (W3-2) sign on the trail	**3.1.1.2**

			approach at a distance of approximately 100 feet (30.5 meters) in advance of the crossing.	
		TRSS-08	Install a STOP (R1-1) or YIELD (R1-2) sign on the trail approach at a minimum of 2 feet (0.6 meters) from the edge of the trail.	**3.1.1.1**
		TRSS-10	Install a pushbutton at the median refuge island for pedestrians trapped in the refuge area (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.2.1**
		TRSS-11	Install a pushbutton for a yellow flashing beacon on the trail approach (Note: applicable only when yellow flashing beacon has been/ will be installed).	**3.1.2.2**
		TRSS-13	Install pedestrian/bicycle signal on the trail approach if the crossed road is already signalized.	**3.1.2.1**
		TRSS-14	Install a Push Button to Turn on Warning Lights (R10-25) sign at the crossing to inform trail users of how to activate the flashing beacon.	**3.1.2.2**
	Trail Access Control (TRAC)	**TRAC-01**	Install a NO MOTOR VEHICLES (R5-3) sign on the trail, facing the roadway, to prevent unauthorized motor vehicles from entering the trail.	**3.1.1.1**
		TRAC-02	Install bollards to prevent unauthorized motor vehicles from entering the trail.	**3.4.1**
		TRAC-03	Install a lean rail parallel to the trail to prevent unauthorized motor vehicles from entering the trail and provide bicyclists with an area in which they can stop without dismounting.	**3.4.2**
		TRAC-04	Install a median on the trail to split the trail into two sections and restrict unauthorized motor vehicles from entering the trail.	**3.4.3**
	Curb Ramps (CR)	**CR-01**	Install a curb ramp to make the crossing accessible to pedestrians with disabilities and to improve crossing conditions for all trail users. (Note: The curb ramp must have detectable warnings in the form of truncated domes as outlined in MnDOT Standard Plate No. 7038A.)	**3.7**
	Realignment (RA)	**RA-01**	Realign the trail path to make a right angle crossing with the crossed roadway.	**3.8**
		RA-02	Realign the trail path such that its angle of intersection with the crossed roadway is ≥ 75 degrees.	**3.8**
		RA-03	Set back the trail path approximately 10 to 30 feet (3.0 to 9.1 meters) from the parallel roadway to allow vehicle stacking space (Note: applicable only when permissive left	**3.8**

			turns from the parallel roadway are allowed).	
	Sight Distances (SD)	**SD-01**	Clear and maintain crossing/stopping sight distance for bicyclists.	**3.2.1, 3.2.2**
		SD-02	Clear and maintain crossing/stopping sight distance for pedestrians.	**3.2.1, 3.2.2**

*Note: Treatments in table are not in any specific order with respect to importance, cost, popularity, ease of implementation etc.

Table 23B: Alternative Treatments for Rural, Multi-Lane, Divided, Speed ≥ 45 mph, ADT < 10,000 vpd Parallel Path Crossings



		Available Treatments		
		Treatment ID	**Treatment Description**	**Handbook Section**
Treatments for Left-turn Traffic on the Parallel Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-02**	Prohibit permissive left turns and enable protected left turns from the parallel roadway while trail users receive a "WALK" or flashing "DON'T WALK" indication (Note: applicable only when the intersection is already signalized and the parallel roadway has a dedicated left-turn lane).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-06**	Install an advance trail-crossing warning sign, such as the TRAIL CROSSING (W11-15a) sign, on the parallel roadway to warn turning vehicles. A distance plaque may be added beneath the sign.	**3.1.1.2**
Treatments for Right-turn Traffic on the Parallel Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-03**	Prohibit permissive right turns and enable protected right turns from the parallel roadway while trail users receive a "WALK" or flashing "DON'T WALK" indication (Note: applicable only when the intersection is already signalized and the parallel roadway has a dedicated right-turn lane).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-06**	Install an advance trail-crossing warning sign, such as the TRAIL CROSSING (W11-15a) sign, on the parallel roadway to warn turning vehicles. A distance plaque may be added beneath the sign.	**3.1.1.2**
	Traffic Calming (TC)	**TC-05**	Reduce the turning radius for right-turn vehicles.	**3.5.1**

Treatments for Through Traffic on the Crossed Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-04**	Provide oncoming crossing traffic on the crossed road with adequate change and clearance intervals to ensure their clearance of the trail prior to the trail receiving a "WALK" indication (Note: applicable only when the intersection is already signalized).	**3.1.2.1**
		TSGB-05	Provide an all-red phase on the crossed road to further protect trail users (Note: applicable only when the intersection is already signalized and the crossed road does not have all-red phase).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-01**	Install an advance trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at least 750 feet (228.6 meters) from the crossing. A distance plaque may be added beneath the sign.	**3.1.1.2**
		TSN-03	Install a Stop Here For Pedestrians (R1-5) series sign at the crossing on the crossed road	**3.1.1.1**
		TSN-04	Install a Stop Ahead (W3-1) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-05	Install a Yield Ahead (W3-2) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-07	Install a trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at the crossing.	**3.1.1.2**
		TSN-08	Install a STOP HERE ON RED (R10-6) sign at the trail crosswalk with a painted stop line to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
		TSN-10	Install an advance trail-crossing warning sign for snowmobiles, i.e., the Snowmobile Crossing (W11-6) sign, on the crossed roadway at least 750 feet (228.6 meters) from the crossing (Note: applicable only on trails for exclusive snowmobile use).	**3.1.1.2**
		TSN-11	Install a snowmobile-crossing warning sign, i.e., the Snowmobile Crossing (W11-6) sign, on the crossed roadway at the trail crossing (Note: applicable only on trails for exclusive snowmobile use).	**3.1.1.2**
	Pavement Markings and Striping (PMS)	**PMS-04**	Divide the crosswalk to channelize pedestrians and bicyclists and separate their movements.	**3.1.3.2**
		PMS-05	Paint a high-visibility crosswalk on the crossed road "ladder" or "zebra" patterns preferable. (Note: The final decision of applying this treatment should be based on	**3.1.3.2**

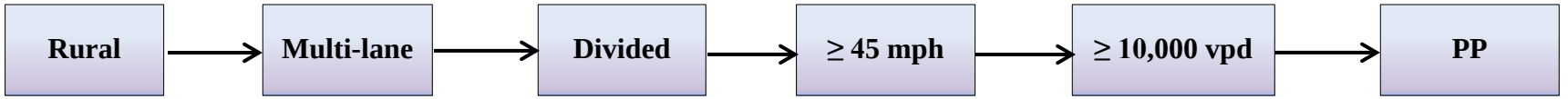
			engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP, or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	
		PMS-07	Set back the stop line on the crossed roadway to improve the trail users' and the moving motorists' mutual chance to have an unobstructed view of each other.	**3.1.3.1**
		PMS-08	Paint a stop line and install a STOP HERE ON RED (R10-6) sign on the crossed roadway in advance of the trail crosswalk to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.3.1**
		PMS-09	Paint a STOP AHEAD, YIELD AHEAD, or PED XING advance warning pavement marking on the crossed road.	**3.1.3.1**
	Sight Distance (SD)	**SD-03**	Clear and maintain stopping/crossing sight distance for motorists.	**3.2.1, 3.2.2**
Treatments for Right-turn Traffic on the Crossed Road	**Traffic Sign (TSN)**	**TSN-09**	Prohibit right turns on red using appropriate signage from the R10-11 series on the crossed roadway to reduce the chance of conflicts with trail users (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
	Traffic Calming (TC)	**TC-01**	Narrow the dedicated right-turn lane on the crossed road.	**3.5.1**
	Refuge Island (RI)	**RI-03**	Install channelizing islands to split right-turn movements from other traffic on the crossed roadway, narrow the right-turn path, and provide refuge area for trail users to cross the roadway.	**3.3**
Treatments for the Trail	**Pavement Markings and Striping (PMS)**	**PMS-01**	Paint a yellow center line only or use one along with advance warning striping for 150 feet (45.7 meters) along the trail approach from the trail entrance point (Note: applicable only when a bollard, lean rail, or median obstruction is present).	**3.1.3.1**
		PMS-02	Paint a stop/yield line to pair with the STOP/YIELD sign or pedestrian/bicycle signal head on the trail at a distance of 3 - 6 feet (0.9 - 1.8 meters) from the crossed road's edge.	**3.1.3.1**
		PMS-03	Paint a STOP/YIELD pavement marking on the trail approach.	**3.1.3.1**

	Trail Signals and Signs (TRSS)	**TRSS-01**	Install a CROSS ONLY ON GREEN (symbolic circular green) (R10-1) sign (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-02	Install a CROSS ONLY ON "WALK" (symbolic walk indication) (R10-2) sign (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-03	Install a sign from the Push Button for Green Light (R10-4) series (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-04	Install a sign from the Push Button for WALK Signal (R10-3) series (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-05	Install a pedestrian/bicyclist pushbutton on the trail 4 - 5 feet (1.2 – 1.5 meters) above the ground such that it is easily accessible for bicyclists to activate the signal without dismounting (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.2.1**
		TRSS-07	Install an advance warning Stop Ahead (W3-1)/Yield Ahead (W3-2) sign on the trail approach at a distance of approximately 100 feet (30.5 meters) in advance of the crossing.	**3.1.1.2**
		TRSS-08	Install a STOP (R1-1) or YIELD (R1-2) sign on the trail approach at a minimum of 2 feet (0.6 meters) from the edge of the trail.	**3.1.1.1**
		TRSS-13	Install pedestrian/bicycle signal on the trail approach if the crossed road is already signalized.	**3.1.2.1**
	Trail Access Control (TRAC)	**TRAC-01**	Install a NO MOTOR VEHICLES (R5-3) sign on the trail, facing the roadway, to prevent unauthorized motor vehicles from entering the trail.	**3.1.1.1**
		TRAC-02	Install bollards to prevent unauthorized motor vehicles from entering the trail.	**3.4.1**
		TRAC-03	Install a lean rail parallel to the trail to prevent unauthorized motor vehicles from entering the trail and provide bicyclists with an area in which they can stop without dismounting.	**3.4.2**
		TRAC-04	Install a median on the trail to split the trail into two sections and restrict unauthorized motor vehicles from entering the trail.	**3.4.3**

	Curb Ramps (CR)	**CR-01**	Install a curb ramp to make the crossing accessible to pedestrians with disabilities and to improve crossing conditions for all trail users. (Note: The curb ramp must have detectable warnings in the form of truncated domes as outlined in MnDOT Standard Plate No. 7038A.)	**3.7**
	Realignment (RA)	**RA-01**	Realign the trail path to make a right angle crossing with the crossed roadway.	**3.8**
		RA-02	Realign the trail path such that its angle of intersection with the crossed roadway is ≥ 75 degrees.	**3.8**
		RA-03	Set back the trail path approximately 10 to 30 feet (3.0 to 9.1 meters) from the parallel roadway to allow vehicle stacking space (Note: applicable only when permissive left turns from the parallel roadway are allowed).	**3.8**
	Sight Distances (SD)	**SD-01**	Clear and maintain crossing/stopping sight distance for bicyclists.	**3.2.1, 3.2.2**
		SD-02	Clear and maintain crossing/stopping sight distance for pedestrians.	**3.2.1, 3.2.2**

*Note: Treatments in table are not in any specific order with respect to importance, cost, popularity, ease of implementation etc.

Table 24B: Alternative Treatments for Rural, Multi-lane, Divided, Speed ≥ 45 mph, ≥ 10,000 vpd, Parallel Path Crossings



		Available Treatments		
		Treatment ID	**Treatment Description**	**Handbook Section**
Treatments for Left-turn Traffic on the Parallel Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-02**	Prohibit permissive left turns and enable protected left turns from the parallel roadway while trail users receive a "WALK" or flashing "DON'T WALK" indication (Note: applicable only when the intersection is already signalized and the parallel roadway has a dedicated left-turn lane).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-06**	Install an advance trail-crossing warning sign, such as the TRAIL CROSSING (W11-15a) sign, on the parallel roadway to warn turning vehicles. A distance plaque may be added beneath the sign.	**3.1.1.2**
Treatments for Right-turn Traffic on the Parallel Road	**Traffic Signal and Beacon (TSGB)**	**TSGB-03**	Prohibit permissive right turns and enable protected right turns from the parallel roadway while trail users receive a "WALK" or flashing "DON'T WALK" indication (Note: applicable only when the intersection is already signalized and the parallel roadway has a dedicated right-turn lane).	**3.1.2.1**
	Traffic Sign (TSN)	**TSN-06**	Install an advance trail-crossing warning sign, such as the TRAIL CROSSING (W11-15a) sign, on the parallel roadway to warn turning vehicles. A distance plaque may be added beneath the sign.	**3.1.1.2**
	Traffic Calming (TC)	**TC-05**	Reduce the turning radius for right-turn vehicles.	**3.5.1**
Treatments	**Traffic Signal and Beacon**	**TSGB-04**	Provide oncoming crossing traffic on the crossed road with adequate change and clearance intervals to ensure their clearance of the trail prior to the trail receiving a "WALK" indication (Note: applicable only when the intersection is already	**3.1.2.1**

for Through Traffic on the Crossed Road	**(TSGB)**		signalized).	
		TSGB-05	Provide an all-red phase on the crossed road to further protect trail users (Note: applicable only when the intersection is already signalized and the crossed road does not have all-red phase).	**3.1.2.1**
		TSGB-06	Install a yellow flashing beacon with pedestrian pushbutton at the crosswalk (Note: applicable only when the intersection is unsignalized); if used, the designer may also consider applying Treatment TRSS-11.	**3.1.2.2**
	Traffic Sign (TSN)	**TSN-01**	Install an advance trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at least 750 feet (228.6 meters) from the crossing. A distance plaque may be added beneath the sign.	**3.1.1.2**
		TSN-03	Install a Stop Here For Pedestrians (R1-5) series sign at the crossing on the crossed road	**3.1.1.1**
		TSN-04	Install a Stop Ahead (W3-1) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-05	Install a Yield Ahead (W3-2) sign for emphasis on the crossed roadway.	**3.1.1.2**
		TSN-07	Install a trail-crossing warning sign such as the Bicycle Warning (W11-1) sign, the Pedestrian Crossing (W11-2) sign, or the Combined Bicycle/Pedestrian Warning (W11-15) sign, on the crossed roadway at the crossing.	**3.1.1.2**
		TSN-08	Install a STOP HERE ON RED (R10-6) sign at the trail crosswalk with a painted stop line to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
		TSN-10	Install an advance trail-crossing warning sign for snowmobiles, i.e., the Snowmobile Crossing (W11-6) sign, on the crossed roadway at least 750 feet (228.6 meters) from the crossing (Note: applicable only on trails for exclusive snowmobile use).	**3.1.1.2**
		TSN-11	Install a snowmobile-crossing warning sign, i.e., the Snowmobile Crossing (W11-6) sign, on the crossed roadway at the trail crossing (Note: applicable only on trails for exclusive snowmobile use).	**3.1.1.2**
	Refuge Island (RI)	**RI-01**	Install a right-angle median refuge island.	**3.3**
		RI-02	Install a median refuge island angled at 75 degrees with opposite sides of the trail across the roadway being slightly offset and supplementary centerline and STOP or	**3.3**

			YIELD pavement markings in the refuge area.	
	Pavement Markings and Striping (PMS)	**PMS-04**	Divide the crosswalk to channelize pedestrians and bicyclists and separate their movements.	**3.1.3.2**
		PMS-05	Paint a high-visibility crosswalk on the crossed road "ladder" or "zebra" patterns preferable. (Note: The final decision of applying this treatment should be based on engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP, or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	**3.1.3.2**
		PMS-06	Paint a high-visibility "standard" pattern crosswalk on the crossed road. (Note: The final decision of applying this treatment should be based on engineering judgment if the crossing is controlled by signals, STOP, or YIELD signs; or, based on an engineering study, if the crossing is not controlled by signals, STOP, or YIELD signs.) (Note 2: For multi-lane roadways, this recommendation has a speed restriction detailed in Section 3.1.3.2.)	**3.1.3.2**
		PMS-07	Set back the stop line on the crossed roadway to improve the trail users' and the moving motorists' mutual chance to have an unobstructed view of each other.	**3.1.3.1**
		PMS-08	Paint a stop line and install a STOP HERE ON RED (R10-6) sign on the crossed roadway in advance of the trail crosswalk to stop motorists prior to the trail crosswalk (Note: applicable only when the intersection is already signalized).	**3.1.3.1**
		PMS-09	Paint a STOP AHEAD, YIELD AHEAD, or PED XING advance warning pavement marking on the crossed road.	**3.1.3.1**
	Sight Distance (SD)	**SD-03**	Clear and maintain stopping/crossing sight distance for motorists.	**3.2.1, 3.2.2**
Treatments for Right-turn Traffic on the	**Traffic Sign (TSN)**	**TSN-09**	Prohibit right turns on red using appropriate signage from the R10-11 series on the crossed roadway to reduce the chance of conflicts with trail users (Note: applicable only when the intersection is already signalized).	**3.1.1.1**
	Traffic Calming	**TC-01**	Narrow the dedicated right-turn lane on the crossed road.	**3.5.1**

Crossed Road	**(TC)**			
	Refuge Island (RI)	**RI-03**	Install channelizing islands to split right-turn movements from other traffic on the crossed roadway, narrow the right-turn path, and provide refuge area for trail users to cross the roadway.	**3.3**
Treatments for the Trail	**Pavement Markings and Striping (PMS)**	**PMS-01**	Paint a yellow center line only or use one along with advance warning striping for 150 feet (45.7 meters) along the trail approach from the trail entrance point (Note: applicable only when a bollard, lean rail, or median obstruction is present).	**3.1.3.1**
		PMS-02	Paint a stop/yield line to pair with the STOP/YIELD sign or pedestrian/bicycle signal head on the trail at a distance of 3 - 6 feet (0.9 - 1.8 meters) from the crossed road's edge.	**3.1.3.1**
		PMS-03	Paint a STOP/YIELD pavement marking on the trail approach.	**3.1.3.1**
	Trail Signals and Signs (TRSS)	**TRSS-01**	Install a CROSS ONLY ON GREEN (symbolic circular green) (R10-1) sign (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-02	Install a CROSS ONLY ON "WALK" (symbolic walk indication) (R10-2) sign (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-03	Install a sign from the Push Button for Green Light (R10-4) series (Note: applicable only when the pedestrian/bicycle signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-04	Install a sign from the Push Button for WALK Signal (R10-3) series (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.1.1**
		TRSS-05	Install a pedestrian/bicyclist pushbutton on the trail 4 - 5 feet (1.2 – 1.5 meters) above the ground such that it is easily accessible for bicyclists to activate the signal without dismounting (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.2.1**
		TRSS-07	Install an advance warning Stop Ahead (W3-1)/Yield Ahead (W3-2) sign on the trail approach at a distance of approximately 100 feet (30.5 meters) in advance of the crossing.	**3.1.1.2**
		TRSS-08	Install a STOP (R1-1) or YIELD (R1-2) sign on the trail approach at a minimum of 2	**3.1.1.1**

			feet (0.6 meters) from the edge of the trail.	
		TRSS-10	Install a pushbutton at the median refuge island for pedestrians trapped in the refuge area (Note: applicable only when the pedestrian signal is already/will be installed at the trail crossing).	**3.1.2.1**
		TRSS-11	Install a pushbutton for a yellow flashing beacon on the trail approach (Note: applicable only when yellow flashing beacon has been/ will be installed).	**3.1.2.2**
		TRSS-13	Install pedestrian/bicycle signal on the trail approach if the crossed road is already signalized.	**3.1.2.1**
		TRSS-14	Install a Push Button to Turn on Warning Lights (R10-25) sign at the crossing to inform trail users of how to activate the flashing beacon.	**3.1.2.2**
	Trail Access Control (TRAC)	**TRAC-01**	Install a NO MOTOR VEHICLES (R5-3) sign on the trail, facing the roadway, to prevent unauthorized motor vehicles from entering the trail.	**3.1.1.1**
		TRAC-02	Install bollards to prevent unauthorized motor vehicles from entering the trail.	**3.4.1**
		TRAC-03	Install a lean rail parallel to the trail to prevent unauthorized motor vehicles from entering the trail and provide bicyclists with an area in which they can stop without dismounting.	**3.4.2**
		TRAC-04	Install a median on the trail to split the trail into two sections and restrict unauthorized motor vehicles from entering the trail.	**3.4.3**
	Curb Ramps (CR)	**CR-01**	Install a curb ramp to make the crossing accessible to pedestrians with disabilities and to improve crossing conditions for all trail users. (Note: The curb ramp must have detectable warnings in the form of truncated domes as outlined in MnDOT Standard Plate No. 7038A.)	**3.7**
	Realignment (RA)	**RA-01**	Realign the trail path to make a right angle crossing with the crossed roadway.	**3.8**
		RA-02	Realign the trail path such that its angle of intersection with the crossed roadway is ≥ 75 degrees.	**3.8**
		RA-03	Set back the trail path approximately 10 to 30 feet (3.0 to 9.1 meters) from the parallel roadway to allow vehicle stacking space (Note: applicable only when permissive left turns from the parallel roadway are allowed).	**3.8**
	Sight	**SD-01**	Clear and maintain crossing/stopping sight distance for bicyclists.	**3.2.1, 3.2.2**

	Distances (SD)	**SD-02**	Clear and maintain crossing/stopping sight distance for pedestrians.	**3.2.1, 3.2.2**

*Note: Treatments in table are not in any specific order with respect to importance, cost, popularity, ease of implementation etc.

4.3 Explanation of Treatment Tables

This section briefly explains and describes what treatments are included in the treatment tables for midblock crossings and parallel path crossings.

Treatments for midblock crossings are specified to two different groups by traffic movement, namely, Treatment Group 1: Treatments for the crossed road; and, Treatment Group 2, Treatments for the trail approach. Treatments for the crossed road can be categorized into different groups by the involved traffic control strategy. These groups include Traffic Signal and Beacon (TSGB), Traffic Sign (TSN), Pavement Markings and Striping (PMS), Refuge Island (RI), Traffic Calming (TC), and Sight Distance (SD).

Parallel path trail crossings are more complicated compared to midblock crossings due to the involvement of five vehicular movements that conflict with movements of trail users. These movements include left-turn movements on the parallel road, right-turn movements on the parallel road, through movements on the crossed road, and right-turn movements on the crossed road, and are shown in Figure 2.5 as Movement PL, Movement PR, Movement CT, and Movement CR, respectively. Section 2.3.2 has briefly discussed the conflicts between different vehicular movements and trail users' movements.

For treatment tables for parallel path trail crossings, treatments are grouped into five treatment groups by movement, including:

- Treatment Group 1: Treatments for Left-turn Movement on the Parallel Road
- Treatment Group 2: Treatments for Right-turn Movement on the Parallel Road
- Treatment Group 3: Treatments for Through Movement on the Crossed Road
- Treatment Group 4: Treatments for Right-turn Movement on the Crossed Road
- Treatment Group 5: Treatments for the Trail Approach

Chapter 5: Conclusions

The decision tree-based method for treatment selection assistance developed in this research aims at simplifying the safety treatment selection procedure faced by transportation professionals during their decision-making process. Each end node of the decision tree corresponds to a customized toolbox containing exclusively appropriate treatments for the combination of six fundamental conditions (i.e., urban/rural, lane configuration, lane division, speed, volume, and crossing type) of the study trail crossing. Transportation professionals can confidently use the identified toolbox for a selected study trail crossing as the filtered treatment selection methodology to identify final treatment recommendations. In conclusion, benefits of using the decision tree-based method can be reflected by the following aspects:

- **Comprehensive**: The most state-of-the-practice alternative treatments which are distributed in different reference documents are covered in a single master toolbox based on the synthesis completed in this research.
- **Simple and Efficient**: Use of the decision tree requires simply navigating through the decision tree node by node by matching the six general conditions of the study trail crossing to the corresponding tree nodes before the certain treatment toolbox for the specific trail crossing is located. Using the toolbox with filtered treatments is expected to significantly improve the transportation professional's efficiency in making treatment recommendations.
- **Effective**: Both the decision tree and toolboxes are developed after the selection complexity has been revealed and solved by excluding inappropriate alternative treatments from entire selection pool.
- **User-friendly**: Toolboxes are scientifically organized by grouping treatments by traffic movements, which can facilitate transportation professionals to fast locate the alternative treatments for a specific targeting movement for treatment recommendation. Within each treatment group, the treatments are further categorized by the treatment's category to further assists users in locating certain treatments.

It is noted that treatments in the identified toolbox are filtered alternative treatments which fit the study trail crossing based on the combination of the trail crossing's various conditions, rather than the final recommendations to be implemented. Engineering studies and judgment are required to make final recommendations by selecting certain treatments from the filtered toolbox.

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