ST. CLAIR COUNTY NONMOTORIZED GUIDELINES

Submitted for consideration to:

MDOT
Michigan Department of Transportation

By:

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and

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Contents

This report is dedicated to the memory of Lucinda J. Means, 1955 – 2005, Executive Director of the League of Michigan Bicycles. Her passion for improving bicycling in Michigan was unwavering and her contributions to make this a better state for all bicyclists unmatched. Her leadership, friendship and joy of bicycling will be missed.

1. Introduction

The Michigan Department of Transportation celebrated its 100th Anniversary this year. In 1905, Michigan established the State Highway Department, the precursor to the Michigan Department of Transportation (MDOT). At that time, Michigan's roads were quagmires that entrapped horse-drawn vehicles, early automobiles and bicycles alike. The League of American Wheelman, and other bicycle clubs around the country, led the effort to improve the country's roads. The President of the League of American Wheelman at the turn of the century was Horatio Earle of Michigan. He organized the first International Good Roads Congress which met in Port Huron, Michigan in 1900. In 1902, Earle co-founded the American Road and Transportation Builders Association. In 1905, Horatio "Good Roads" Earle, became the state's first highway commissioner, heading up Michigan's new State Highway Department. He held that position until 1909 and became known as "the Father of Good Roads." So it is fitting that St. Clair County is once again at the forefront of a movement to improve roads and that MDOT is the organization leading the way.

The goal of the St. Clair County Nonmotorized Plan is to develop an approach to accommodating bicycling, walking and other nonmotorized modes of travel on and across MDOT's trunkline system in St. Clair County. While the focus is on MDOT 's system in St. Clair County, this document has been prepared with the consideration that it may be utilized by other MDOT offices as well as county and local road agencies throughout the state.

This document is intended to bring together and organize a wealth of information on nonmotorized transportation design into a concise guide to address the following issues:

1. How does MDOT (or any other transportation agency) respond to a citizen or non-road agency request for a nonmotorized facility on, adjacent to, or across a roadway under their jurisdiction?

2. What is the most appropriate way to integrate nonmotorized transportation improvements in different types of construction projects?

3. How does the surrounding landscape of a project impact the selection of a particular solution to accommodate nonmotorized travel?

4. How are planned and projected changes to the landscape addressed when implementing facilities that will have an extended lifespan?

5. How does MDOT determine what is a fair share of a project's cost and how do they share expenses with other public and private entities under various circumstances?

6. And last, but not least, what training and available resource should nonmotorized transportation decision makers have?

1.1 Coordination with Previous Reports

This document is best viewed in the context of three other key documents: MDOT's *Southwest Michigan Nonmotorized Investment Plan*; *St. Clair County Master Plan*; and the *St. Clair County 2030 Long-Range Transportation Plan*.

Southwest Michigan Nonmotorized Investment Plan

In 2001 MDOT Southwest Region in collaboration with TY Lin International and Suzan A. Pinsoff & Associates prepared the *Southwest Michigan Nonmotorized Investment Plan*. The plan made recommendations on modifications to MDOT's Project Scoping and Candidate Project Submittal Procedures. The recommendations in that report should be incorporated in MDOT's Metro Region and St. Clair Transportation Service Center's procedures as well. The recommendations within this document are intended to build upon the Southwest Michigan Nonmotorized Investment Plan's recommendations.

The *Southwest Michigan Nonmotorized Investment Plan* details proposed changes to the Project Scoping Checklist to better address nonmotorized projects. The *St. Clair County Nonmotorized Guidelines* (this report) decision support tools are intended to help project planners determine the most appropriate nonmotorized solution early in the project scoping process.

St. Clair County Master Plan

In 2000 the St. Clair County Metropolitan Planning Commission prepared the *St. Clair County Master Plan* which outlined Future Land Uses; Development Districts; Recreation, Open Space and Environment Corridors; Sensitive Environments; Community Centers; and Transportation Improvements that together provide a Vision Based Policy for the long term development of the county. The *St. Clair Nonmotorized Guidelines* (this report) bases the future context scenarios on the recommendations in the St. Clair County Master Plan.

St. Clair County 2030 Long-Range Transportation Plan

In 2004 the St. Clair County Metropolitan Planning Commission in collaboration with URS prepared the *St. Clair County 2030 Long-Range Transportation Plan* with extensive public input. This plan identified and prioritized a number of existing transportation corridors and independent routes for nonmotorized improvements. The exact nature of the proposed nonmotorized improvements was not defined though. The St. Clair Nonmotorized Plan incorporates those corridors into the inventory and provides a basis for selecting the most appropriate facility for those corridors.

The St. Clair County 2030 Long-Range Transportation Plan also recommended allocating 5% of the County's Surface Transportation Apportionment to nonmotorized projects and that this allocation would be further matched by county, local and private sources. The *St. Clair Nonmotorized Guidelines* (this report) outlines funding recommendations that address how to effectively and equitably utilized that 5% allocation.

1.2 Report Overview

The report is divided into eight segments:

Prevailing Nonmotorized Guidelines

This section explores the nonmotorized recommendations within key documents.

Nonmotorized Accommodation Policy

This section offers a model policy.

General Nonmotorized Facility Planning Tool

This section defines eight typical scenarios and the type of nonmotorized facilities that are most appropriate for those scenarios. The approximate location of these scenarios are shown on a map for both existing and projected conditions.

Supplemental Decision Support Tools

This section provides additional decision support tools that help refine the general nonmotorized facility type based on unique conditions.

Recommended Training and Resources

This section outlines the baseline training for staff involved in nonmotorized transportation planning and design as well as recommendations on documents that should be incorporated into agency reference libraries.

Implementation and Funding Guides

These guidelines recommend policies for determining cost sharing for nonmotorized transportation projects.

Supplemental Design Guidelines

These guidelines incorporate current AASHTO, MUTCD and ADA recommendations for typical encountered nonmotorized situations.

2. Prevailing Nonmotorized Guidelines

AASHTO's *A Policy on Geometric Design of Highways and Streets* (The Green Book) is the definitive guideline for its members, the American Association of State Highway and Transportation Officials, of which the Michigan Department of Transportation is a member. MDOT's *Michigan Design Manual* and MDOT's *Local Agency Programs Guidelines for Geometric*s are based on The Green Book and offer clarification on MDOT's interpretation of the document under various situations. Therefore any recommendations that are made in this document should be cognizant of the bicycle and pedestrian recommendations in those documents.

2.1 AASHTO's A Policy on Geometric Design of Highways and Streets

The Green Book makes numerous references to the need to address bicycles and pedestrians in the design of roadways. Most notably in the Forward of AASHTO's *A Policy on Geometric Design of Highways and Streets* the following is stated:

> Emphasis has been placed on the joint use of transportation corridors by pedestrians, cyclists, and the public transit vehicles. Designers should recognize the implications of this sharing of the transportation corridors and are encouraged to consider not only vehicular movement, but also movement of people, distribution of goods, and provision of essential services. A more comprehensive transportation program is thereby emphasized.[1]

When discussing the general characteristics of Design Vehicles it is noted that "the bicycle should also be considered a design vehicle where bicycle use is allowed on a highway."[2] In Michigan that generally means all roads except freeways.

Incorporation via Reference of AASHTO Pedestrian and Bicycle Guides

The AASHTO *Guide for the Planning, Design, and Operation of Pedestrian Facilities* is referenced as a source of additional or further guidance throughout the Green Book a total 18 times.[3]

The AASHTO *Guide for the Development of Bicycle Facilities* is referenced a total of 27 times in the Green Book[4] Beyond referring to the Bike Guide for further or additional guidance the Green Book states the following:

> Provisions for bicycle facilities should be in accordance with the AASHTO *Guide for the Development of Bicycle Facilities*[5]
>
> When bicycle facilities are included as part of the design, refer to AASHTO's *Guide for the Development of Bicycle Facilities*[6]

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[1] AASHTO, *A Policy on Geometric Design of Highways and Streets, Fourth Edition,* Washington D.C. 2001, p. xlii
[2] Ibid., p. 15
[3] Ibid., pp. 96, 98, 99(2), 108, 363, 369, 370, 381, 402(3), 420, 440(2), 445, 490, and 506.
[4] Ibid, pp. 101, 108, 319, 325, 371, 380, 389, 393, 397, 406, 408, 418, 420, 428, 433, 443, 444, 472, 477, 482, 484(2), 500, 506, 583, 732, 743.
[5] Ibid p. 371
[6] Ibid pp. 389, 428 and 437

> Where special facilities for bicycles are desired, they should be in accordance with the AASHTO *Guide for the Development of Bicycle Facilities*[1]
>
> If off-road bicycle facilities are desired, they should be designed as shared-use paths in accordance with the AASHTO *Guide for the Development of Bicycle Facilities*[2]

What is clear by these numerous references is that the AASHTO *Guide for the Planning, Design, and Operation of Pedestrian Facilities* and the AASHTO *Guide for the Development of Bicycle Facilities* are the definitive source of pedestrian and bicycle guidelines from AASHTO's standpoint and that the separate guidelines provide a level of detail and specificity regarding nonmotorized facilities that is not within The Green Book itself.

2.2 MDOT's Michigan Design Manual

Volume 3, Section 12.12 Bicycle Facilities, includes information on Attorney General Options, References, Department "Policy", Agreements and provides design guidance. Section 12.12.04, Nonmotorized Transportation Project Review states:

> For projects that do not have to go through the project development process, the project initiator must consider the feasibility of conveyances for nonmotorized vehicles. Normally all projects with a length of approximately 1 mile or more, including resurfacing projects, should be considered for these facilities.
>
> The merits of a path are considered on the basis of its location, connection to other facilities, and potential for use. Those projects meriting a positive consideration, which includes a recommendation as to type, location, and width of the path, are referred to the Department Bicycle/Pedestrian Coordinator, Bureau of Transportation Planning.

Under Section 12.12.02, Attorney General Opinions, the following is stated "The term "highway" includes facilities for nonmotorized transportation; thus the right of eminent domain applies."

Under Section 12.12.08, Types of Bicycle Facilities, the following is stated:

> Most of the bicycle facilities built in Michigan are of two types: a widened paved shoulder or a separate path.
>
> Separate paths may be one-way, consisting of paths on each side of the road, or two-way, located on one side.
>
> Adding Bike Lanes 4' or wider or, on curbed roadways, widening curb lanes to approximately 14' are design options in urban areas.

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[1] Ibid p.393

[2] AASHTO, *A Policy on Geometric Design of Highways and Streets, Fourth Edition*, Washington D.C. 2001, p. 472

References to AASHTO Guide for the Development of Bicycle Facilities

Section 12.12.09, states "The basis for the design of bicycle facilities is the AASHTO design criteria of the *Guide for the Development of Bicycle Facilities*, Aug. 1991." This publication has been superseded by the AASHTO *Guide for the Development of Bicycle Facilities* published in 1999. This is recognized in an update to the Bridge Design manual where under section 7.01.08 the more recent version is referenced. Nevertheless, the references should be changed to something that more generically lists "the most recent version" or similar such language. It appears that some of the specific design features called out in the section 12.12.09 may not be compliant with the updated 1999 AASHTO Bicycle Guide and should be reviewed and updated or deleted.

Issues Related to Shoulder Width

The Michigan Road Design Manual states under Section 12.12.09E, Design Features of Bicycle Paths the following:

> Part-width paved shoulders that are intended for bicycle use should desirably be 5' wide. The minimum width for shoulder ribbons intended for bicycle use is 4'

This is generally in conformance with the 1999 AASHTO *Guide for the Development of Bicycle Facilities* but the 1999 guide further elaborates:

> It is desirable to increase the width of shoulders where higher bicycle usage is expected. Additional shoulder width is also desirable if motor vehicle speeds exceed 80 km/h (50 mph), or the percentage of trucks, buses and recreational vehicles is high, or if static obstructions exist at the right side of the roadway.
>
> In general, AASHTO's recommendations for shoulder width as described in A Policy on Geometric Design of Highways and Streets (Green Book) are the best guide for bicycles as well, since wider shoulders are recommended on heavily traveled and high-speed roads and those carrying large numbers of trucks. However, in order to be usable by bicycles the shoulder must be paved.[1]

The Green Book indicates that a 6 – 8' shoulder is preferable in low type facilities and 10-12' is preferable for high-type facilities. This seems excessive if the entire width were to be paved. Interestingly enough the Green Book states "For additional information on shoulder widths to accommodate bicycles, see the AASHTO *Guide for the Development of Bicycle Facilities*[2]. In Chapters 5, 6 and 7 of the Green Book that discuss shoulder width for different classes of roadways, the Green Book again references the AASHTO *Guide for the Development of Bicycle Facilities* where bicycle facilities are part of the design. So there does not appear to be clear guidance from AASHTO or MDOT on how wide a shoulder should be if it is intended for bicycle use based on roadway speeds, volumes or percent of truck traffic.

[1] *Guide for the Development of Bicycle Facilities,1999,* Washington D.C. 1999, pp. 16, 17
[2] AASHTO, *A Policy on Geometric Design of Highways and Streets, Fourth Edition,* Washington D.C. 2001, p. 318

Issues Related to Shoulder Cross Slope

In section 6.06.05, Shoulder Slopes, The Michigan Design Manual states that "Standard slope for paved shoulders is 4%. The rationale for the steeper slope on the gravel or earth shoulder is improved drainage over the rougher surface. No shoulders should be graded flatter than 4% except as may be necessary in superelevation." The Green Book states the "Bituminous and concrete-surfaced shoulders should be sloped from 2 to 6 percent…"[1] While the Michigan Design Manuals minimum 4% is within the Green Books parameters the AASHTO *Guide for the Planning, Design, and Operation of Pedestrian Facilities* notes the following:

> Where a shoulder serves as part of a pedestrian access routes, it must meet ADA requirements to the maximum extent feasible. There are many locations where it may not be technically feasible to provide a shoulder with the cross slope of two percent or less that is required for pedestrian access routes.[2]

2.3 MDOT's Local Agency Programs Guidelines for Geometrics

These guidelines are for local agency projects that receive federal or state funds but are not part of the National Highway System. This is a rather concise document and it indicates that for items not addressed in the document either the current Green Book or the Michigan Design Manual apply. The guidelines specifically address Resurfacing, Restoration, and Rehabilitation (3R) projects.

Of issue to bicycle facilities, the Guidelines identifies outside shoulder widths based on ADT for roads with a speed greater than 45 mph. On any roads over 750 current ADT (on two-way roads) a 3' paved outside shoulder is desired. On roads with an ADT greater than 2,000 the total shoulder width is 6' with a 3' paved shoulder desired. This is within 1' of the minimum paved shoulder width to accommodate bicycles according to AASHTO *Guide for the Development of Bicycle Facilities*[3]

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[1] Ibid, p. 320
[2] AASHTO, *Guide for the Planning, Design, and Operation of Pedestrian Facilities, 2004,* Washington D.C. 2001, p. 26.
[3] AASHTO *Guide for the Development of Bicycle Facilities, 1999,* Washington D.C. 1999, p. 22

2.4 Comparison of Shoulder Recommendations

The presence and width of a paved shoulder, or in an Urban setting, a Bike Lane, is critical to bicycle conditions. While the Road Design Manuals guidelines for New Construction and Reconstruction seem to provide an appropriate width of shoulders, the 3R guidelines do not appear to provide even a minimally appropriate shoulder width under some conditions.

Fig. 2.4A MDOT Shoulder Guidelines

Road Design Manual for New Construction / Reconstruction

Rural Arterial: (Non Freeway)

ADT	Under 400	4’	Minimum paved
	400 to 1,500	6’	Minimum paved
	1,500 to 2,000	6’	Minimum paved
	Over 2,000	8’	Minimum paved

Urban Arterials (Non Freeway)
Same Guidelines as Rural Arterials if ROW allows

Rural Collector:

ADT	Under 400	2’	Total	1’-0”	Minimum paved desirable
	400 to 1,500	5’	Total	1’-0”	Minimum paved desirable
	1,500 to 2,000	6’	Total	1’-0”	Minimum paved desirable
	Over 2,000	8’	Total	1’-0”	Minimum paved desirable

Urban Collectors (Non Freeway)
Same Guidelines as Rural Collectors where shoulders are used
(a table that reviewed MDOT Design Elements in comparison with the 2001 Green Book indicated that Urban Collectors should follow the guidelines of Rural Arterials, it is unknown if this in an error or an updated guideline)

Road Design Manual for 3R Projects

Non Freeway with Speeds Greater Than 45 MPH

ADT	Under 750	3’-0”	Gravel		
	750 to 5,000	6’-0”	Total	3’-0”	Minimum paved
	5,000 to 10,000	8’-0”	Total	3’-0”	Minimum paved
	Over 10,000	8’-0”	Total	7’-0”	Minimum paved

Local Agency Programs Guidelines for 3R Projects

Local Agency Programs Guidelines for New Construction / Reconstruction are the same as the Road Design Manual

ADT	Under 750	2’-0”	Gravel		
	750 – 2,000	3’-0”	Total	3’-0”	Paved desired
	Over 2,000	6’-0”	Total	3’-0”	Paved desired

2.5 Conclusions

After reviewing AASHTO's *A Policy on Geometric Design of Highways and Streets*, MDOT's *Michigan Design Manual* and MDOT's *Local Agency Programs Guidelines for Geometric*s with an eye on nonmotorized issues the following observations were made:

- Bicycle and Pedestrians are to be accommodated in Michigan's Highway System and local roadways with the exception of those places where they are specifically forbidden to by law (such as freeways)
- There is nothing in The Michigan Design Manual that appears to be in conflict with the AASHTO *Guide for the Planning, Design, and Operation of Pedestrian Facilities* or the AASHTO *Guide for the Development of Bicycle Facilities*. There are however cases such as with the width of a paved shoulder where the minimum width called out in the Michigan Design Manual is slightly less (1') than what the AASHTO *Guide for the Development of Bicycle Facilities* recommends.
- That the AASHTO *Guide for the Development of Bicycle Facilities* is recognized by MDOT as the prevailing guide for bicycle improvements and that any outdated guidelines in the Design Manual drawn from the previous versions of the AASHTO Bike Guide should not be used for planning facilities.
- That the AASHTO *Guide for the Planning, Design, and Operation of Pedestrian Facilities* while not specifically recognized by MDOT as the prevailing guide for pedestrian improvements is by default the prevailing guide for pedestrian improvements due to its incorporation via reference in the Green Book.
- There is nothing in any of the documents that relates to Equestrian use of the road shoulder. The only mention of horses is in AASHTO's *Guide for the Development of Bicycle Facilities* and that deals specifically with Shared Use Paths.

  > It is usually not desirable to mix horse riding and bicycle traffic on the same shared use path. Bicyclists are often not aware of the need for slower speeds and additional operating space near horses. Horses can be startled easily and may be unpredictable if they perceive approaching bicyclists as a danger. In addition, pavement requirements for bicycle travel are not suitable for horses. For these reasons, a bridle trail separate from the shared use path is recommended to accommodate horses.[1]

  The guidance regarding bicyclists, pedestrians and horses not sharing the same pathways runs contra to the experience the county has had on the Wadhams to Avoca Trail. There is though the issue of horses preferring an aggregate surface rather than a hard surface trail and/or shoulder. This is not addressed anywhere in the existing guidelines. Throughout the country many trail/road intersections, underpasses, and overpasses have been adapted for use by horses.
- There is no clear guidance even in the AASHTO *Guide for the Planning, Design, and Operation of Pedestrian Facilities* of the exact "triggers" which would indicate when a sidewalk is desirable. There is though some general guidance on the width of the sidewalks under various situations.
- There is no guidance that addresses under what circumstances a bicycle facility is desirable nor is there any guidance on how wide a paved shoulder or Bike Lane should be to provide a reasonable level of service to bicycles under various situations.

[1] AASHTO *Guide for the Development of Bicycle Facilities, 1999,* Washington D.C. 1999, p. 58-59

Recommendation for Determining Appropriate Shoulder Width

The most detailed evaluation of appropriate Bike Lane width is the Bicycle Level of Service (BLOS) model developed by Bruce Landis, PE, AICP of Sprinkle Consulting, Inc. for the Florida Department of Transportation as part of their multi-modal Quality/Level of Service Model. It should be noted that this model is fundamentally different than a LOS models used for motor vehicles. This BLOS model is based on data gathered from a wide cross section of users who evaluated numerous real world scenarios. The BLOS score then is a measurement of the perceived safety and comfort of pedestrians and bicyclists. It is the most advanced and statistically reliable model for evaluating the bicycle environment. A similar model was also created for the pedestrian environment. For more information on these models please refer to the Appendix.

3. Recommended Nonmotorized Accommodation Policy

Accompanying any guidelines should be a clear policy that indicates how the guidelines are to be applied. In 1999, the United States Department of Transportation issued a policy statement on integrating bicycling and walking into transportation infrastructure entitled *Design Guidance, Accommodating Bicycle and Pedestrian Travel: A Recommended Approach*. This document indicates the federal government's interpretation on how best to address the nonmotorized transportation requirements of the Transportation Equity Act for the 21st Century. It serves as the best national policy model for accommodating bicycle and pedestrian travel.

3.1 Recommended General Policy Statement

The following draft policy statement is drawn from the United State Department of Transportation's policy statement with minor edits.

1 Bicycle and pedestrian ways shall be established in new construction and reconstruction projects in all urbanized areas unless one or more of three conditions are met:

   a) bicyclists and pedestrians are prohibited by law from using the roadway. In this instance, a greater effort may be necessary to accommodate bicyclists and pedestrians elsewhere within the right of way or within the same transportation corridor.

   b) the cost of establishing bikeways or walkways would be excessively disproportionate to the need or probable use. Excessively disproportionate is defined as exceeding 25% of the cost of the larger transportation project.

   c) where sparsity of population or other factors indicate an absence of need.

2 In rural areas, paved shoulders should be included in all new construction and reconstruction projects on roadways used by more than 1,000 vehicles per day. Paved shoulders have safety and operational advantages for all road users in addition to providing a place for bicyclists and pedestrians to operate.

   a) Rumble strips are not recommended where shoulders are used by bicyclists unless there is a minimum clear path of four feet in which a bicycle may safely operate.

3 Sidewalks, shared use paths, street crossings (including over and undercrossings), pedestrian signals, signs, street furniture, transit stops and facilities, and all connecting pathways shall be designed, constructed, operated and maintained so that all pedestrians, including people with disabilities, can travel safely and independently.

4 The design and development of the transportation infrastructure shall improve conditions for bicycling and walking through the following additional steps:

a) Planning projects for the long-term. Transportation facilities are long-term investments that remain in place for many years. The design and construction of new facilities that meet the criteria in item 1 above should anticipate likely future demand for bicycling and walking facilities and not preclude the provision of future improvements. For example, a bridge that is likely to remain in place for 50 years, might be built with sufficient width for safe bicycle and pedestrian use in anticipation that facilities will be available at either end of the bridge even if that is not currently the case.

b) Addressing the need for bicyclists and pedestrians to cross corridors as well as travel along them. Even here, bicyclists and pedestrians may not commonly travel along a particular corridor that is being improved or constructed, but they will likely need to be able to cross that corridor safely and conveniently. Therefore, the design of intersections and interchanges shall accommodate bicyclists and pedestrians in a manner that is safe, accessible and convenient.

c) Getting exceptions approved at a senior level. Exceptions for the non-inclusion of bikeways and walkways shall be approved by a senior manager and be documented with supporting data that indicates the basis for the decision.

d) Designing facilities to the best currently available standards and guidelines. The design of facilities for bicyclists and pedestrians should follow design guidelines and standards that are commonly used, such as the AASHTO Guide for the Development of Bicycle Facilities, AASHTO’s Guide for the Planning, Design, and Operation of Pedestrian Facilities, AASHTO's A Policy on Geometric Design of Highways and Streets, and the ITE Recommended Practice "Design and Safety of Pedestrian Facilities".

3.2 Recommended Specific Nonmotorized Policies

In addition to the general policies stated in the preceding section, specific policies should also be adopted to clarify certain issues. The following policies are recommended to be adopted by the MDOT:

ROW Acquisition Policy

A Typical 66' wide ROW has the ability to accommodate two lanes of motor vehicle traffic, two Bike Lanes, two Buffer Zones and two Sidewalks. Additional ROW is needed primarily to accommodate additional travel lanes, turn lanes and on street parking for motor vehicles. While the nonmotorized facilities may be located in areas outside a typical 66' wide ROW on a multi-lane roadways, it is the expansion of the roadway itself that causes the need for the additional ROW. Therefore, the cost of additional ROW necessary to maintain room for a multi-modal roadway should be associated with the additional motor vehicle lanes NOT the nonmotorized facilities. No designated nonmotorized funds should be used in the acquisition of additional ROW for a road widening project. Any road widening projects should be accompanied with sufficient ROW to accommodate the recommended nonmotorized facilities.

Level Of Service Policy

Current Level Of Service (LOS) policies and guidelines are focused solely on motorized vehicles. MDOT should review its LOS policies to address all roadway users. The policy should address that when evaluating roadway conversions, a certain reduction in Vehicular Level of Service should be deemed acceptable to accommodate bicycle and pedestrian facilities. The policy should state that a multi-modal approach to roadway engineering is to be employed where the safe movement of all modes is given priority over the capacity of a single mode.

Maintenance Policy

Bike Lanes tend to collect debris faster than motorized travel lanes. The movement of motor vehicle traffic sweeps the road debris into the Bike Lanes. The debris, if not removed in a timely fashion, can accumulate making a paved shoulder or Bike Lane unsuitable for bicycle and/or pedestrian use. Therefore MDOT should establish a system to provide the necessary maintenance to keep Bike Lanes free of debris.

Signal Activation Policy

Bicycles in the roadway need to be able to passively activate signals with the same reliability as motor vehicles. MDOT should provide for the passive detection of bicycles at all actuated signals by adjusting the sensitivity of existing detection loops, the use of Bicycle Detector Pavement Markings, and the upgrading of equipment as necessary.

Performance Evaluation Policy

The criteria with which MDOT staff performances are evaluated should incorporate measurements of nonmotorized transportation. The measurements should be designed so that staff are not penalized if fewer miles of roadway are upgraded or constructed using the new multi-modal roadway design guidelines than would be possible using designs that favor primarily motor vehicles.

Figure 4 A
MDOT Trunklines

4. Landscape Based Guidelines

Context plays a key role in existing AASHTO guidelines. The idea of Functional Classifications (Principal Arterial, Minor Arterial, and Collector) as well as Area Type (Urban and Rural) are pervasive throughout transportation guidelines. AASHTO's *A Policy on Geometric Design of Highways and Streets* defines areas as follows:

> *Urban areas* are those places within boundaries set by the responsible State and local officials having a population of 5,000 or more. Urban areas are further subdivided into *urbanized areas* (population of 50,000 and over) and s*mall urban areas* (population between 5,000 and 50,000). For design purposes, the population forecast for the design year should be used. (For legal definition of urban areas, see Section 101 of Title 23, U.S. Code.)
>
> *Rural areas* are those areas outside the boundaries of urban areas.[1]

In practice though, the areas do not always match these categories. The categories are too broad and do not necessarily reflect current development patterns. The population thresholds are also artificial as they do not address density. A small city or village may have relatively few people living within its boundaries but have a higher population density and a more defined downtown than a township with a larger population. In St. Clair County the cities of Algonac and Marine City are just below the 5,000 cut-off while Clay, Clyde, Fort Gratiot, Ira, Kimball and Port Huron Townships all have more than 5,000 residents. The County's largest city, Port Huron, has around 34,000 residents.

Even traditional urban/rural delineators such as whether a road is curbed or has open drainage are ceasing to reflect the adjacent density of development. Open drainage may be desirable from a water quality standpoint, even in built-up areas.

While any system will fail to capture the diversity of situations on the ground, it is clear is that a better system is called for. Duany Platter-Zyberk & Company, pioneers in Smart Growth and the New Urbanist movements, have compiled much of their best practices into a document called *SmartCode, A Comprehensive Form-Based Planning Ordinance*. This document discussed the concept of a "transect" which is simply a continuum of environments from a natural state to a busy big city downtown. The SmartCode document puts forth guidelines for the built environment for 6 typical environments.

The SmartCode though is a model land development code. It seeks to depict and ideal cross section of land use development patterns based on Smart Growth principals. In reality, we have many development patterns that may not be considered "Smart Growth". The issue is how can transportation infrastructure improve what may be a difficult situation or avoid making the problem more severe.

[1] AASHTO, *A Policy on Geometric Design of Highways and Streets, Fourth Edition*, Washington D.C. 2001, p. 8

Florida DOT also attempts to capture a range of environments within the rural and urban ranges in their Level of Service tables. They further look at their urban roadways as falling into four classes which are based on the spacing of signalized intersections and population.

- Class I, <0.00 to 1.99 signalized intersections per mile.
- Class II, 2.00 to 4.50 signalized intersections per mile.
- Class III, more than 4.5 signalized intersections per mile and not within primary city central business district of an urbanized area with a population of over 750,000.
- Class IV, more than 4.5 signalized intersections per mile and within primary city central business district of an urbanized area with a population of over 750,000.

These Urban sub-categories seem to capture a road's dynamics fairly well. As far as rural areas go there is little distinction. Rural areas though are not homogeneous. There are traditionally sparsely populated and agriculturally focused. But many rural areas have been transformed into places that are in effect very-low density residential areas. There also lies on the edge of most existing communities a "suburban fringe" or transitional zone where new developments are changing the land character from rural to suburban. There are also cross-road developments that are isolated activity centers within predominantly rural landscapes.

It is clear that there is no one-size fits all solution for nonmotorized transportation. What works in an older neighborhood immediately adjacent to downtown is probably not appropriate for a rural residential area. This plan identifies eight typically encountered land use/transportation landscapes and identifies the "default" nonmotorized solution for each landscape.

There is no way to adequately capture the full diversity of landscapes. These areas and proposed solutions should then be seen as a starting point. Additional planning and design tools are included in the following chapters to help address situations where the appropriate solution may not be clear.

4.1 Generalized Landscapes

Eight landscape categories were established. These categories are designed to reflect and blend the classifications systems used by: the County Master Plan: Florida Department of Transportation road classification system; *Smartcode*[1]; and an evaluation of existing conditions within the county.

Rural

- Rural Agricultural
- Rural Residential
- Rural Activity Center

Transition

- Suburban Fringe/Transitional

Urban

- Suburban
- General Urban
- Commercial Center
- Regional Commercial Center

The eight generalized landscape categories are described further on the following pages. It should be noted that there currently are no areas in St. Clair County that would be considered Regional Commercial Center landscapes. Statewide, the downtowns of cities such as Detroit and Grand Rapids would meet this designation. This classification was included so that this document may be adapted to other areas around the state.

[1] Duany, *Smartcode, A Comprehensive Form-Based Planning Ordinance*, Municipal Code Corporation, Tallahassee Florida, 2005. available for download at www.dpz.com

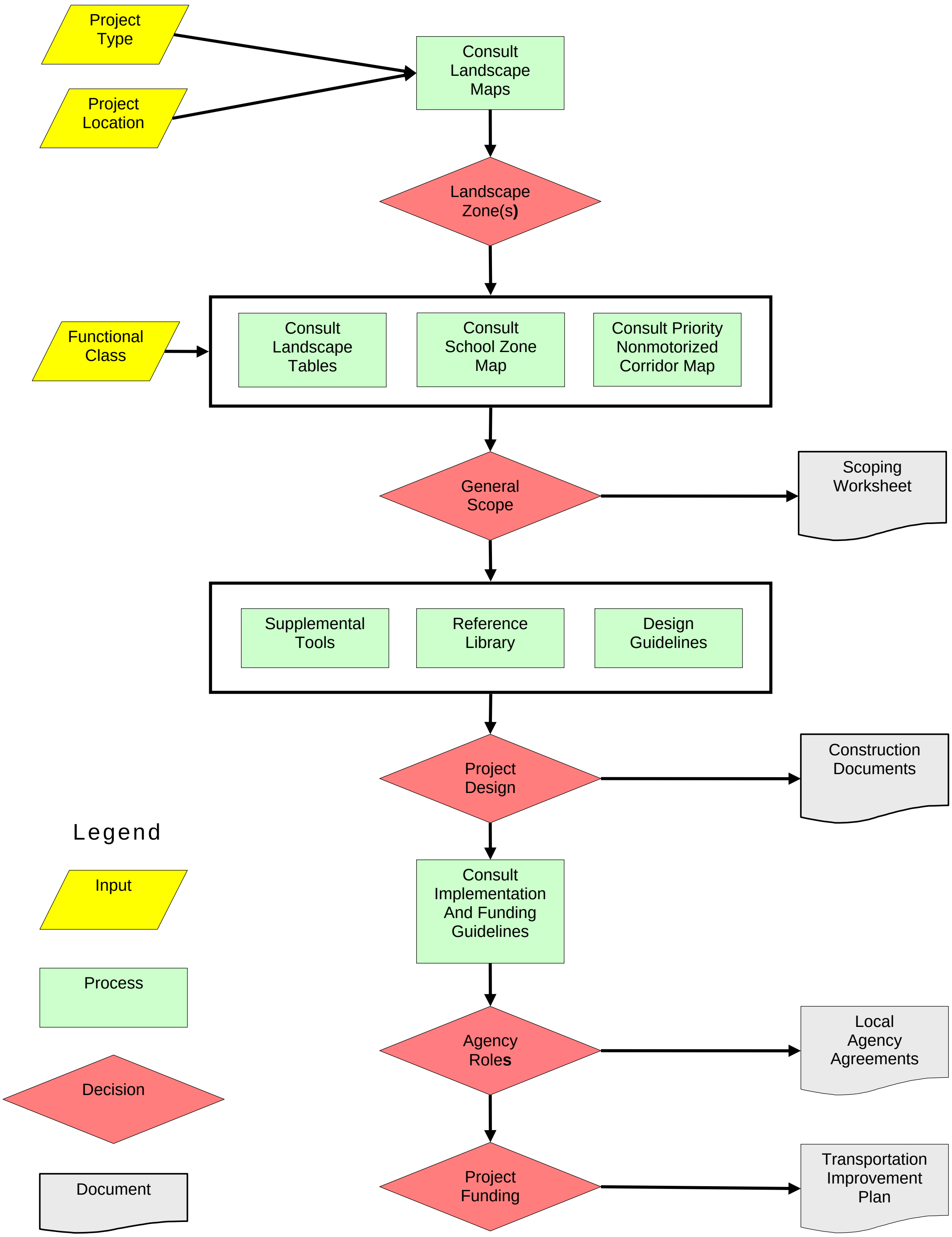
4.2 Using the Landscape Maps, Tables and Supplemental Information

The information in the report goes from general to specific. The maps and tables in this section are the starting points. The following outlines how the report may be used:

1. Determine the general project landscape category(s) by locating the project on the appropriate landscape map. There are two maps. The Long-term Map should be used for New or Reconstruction projects. The Near-term Map should be used for Resurfacing, Restoration and Rehabilitation (3R) projects.
2. Consult the appropriate landscape table. Each table provides an overview of the area. This information may be used to help determine the most appropriate landscape should there be some question. For a variety of situations the most appropriate nonmotorized facility is indicated. Often there is information regarding the AASHTO minimum and the preferred minimums. This information will help in the project scoping phase.
3. Consult the School Zone and Priority Nonmotorized Corridor Maps. They provide supplemental information that may override the guidelines for some landscape areas.
4. As the project is being developed and more information becomes available on the projected speeds and volumes consult *Section 5 –Decision Support Tools*, The reference materials indicated in *Section 6.2 Recommended Reference Library* and *Section 8 – Design Guidelines* to assist in the project design.
5. As the project budget and local agreements are being developed consult *Section 7 – Implementation Funding and Guidelines* for recommendation on appropriate funding sources.

See Fig. 4.2.A. – Process Overview for addition information on how use the material in this report.

Fig. 4.2.A. Process Overview



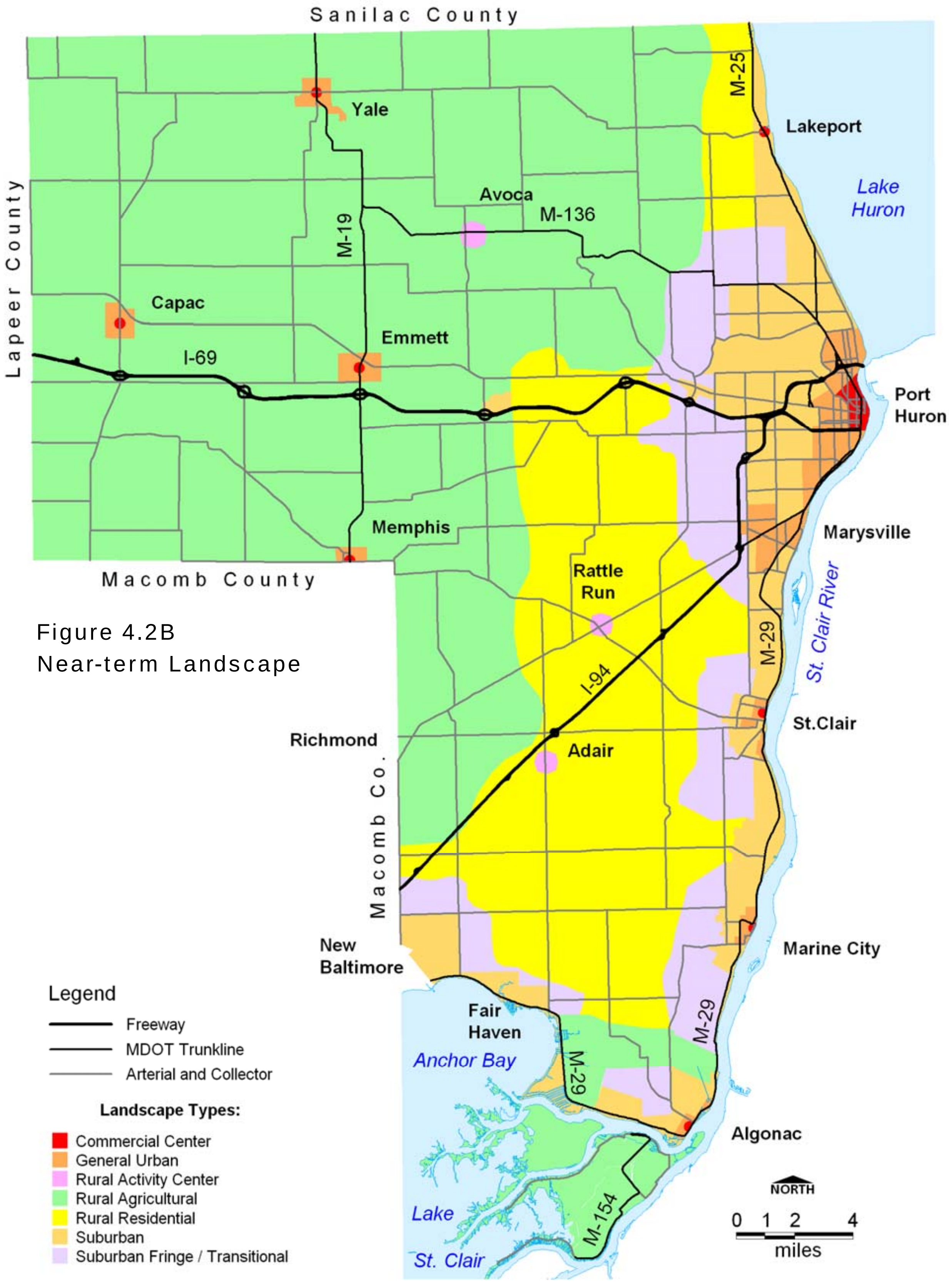


Figure 4.2B
Near-term Landscape

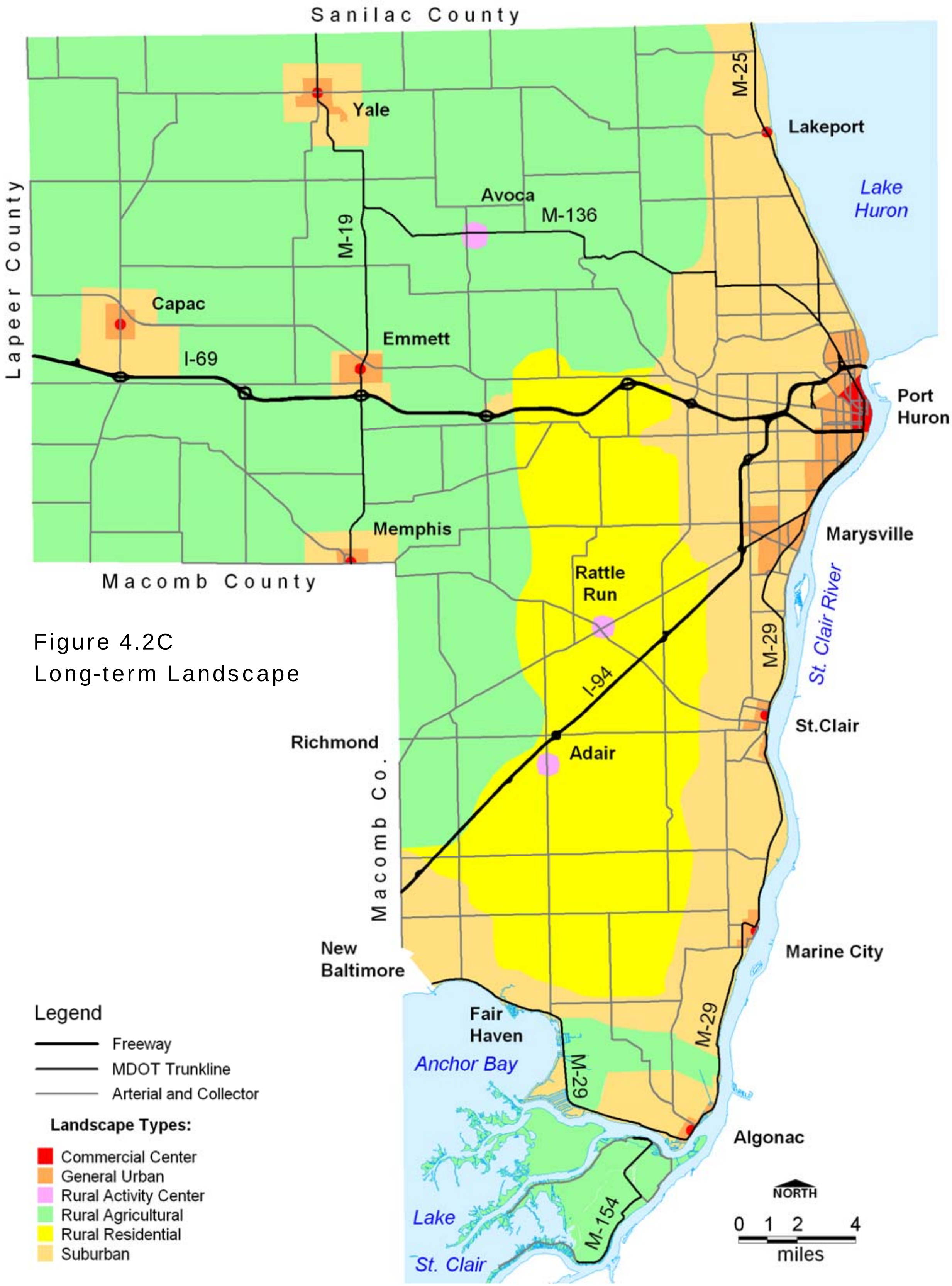


Figure 4.2C
Long-term Landscape

4.3 Rural Agricultural Landscape

A Rural Agricultural Landscape is characterized by farmland, forest and large park or state recreation lands served by high speed, two-lane arterials and collectors. Homesteads are few and far between and there is little pedestrian and bicycle activity on the primary road system. Many of the Minor Arterial and Collector roadways are not even paved. Most bicycle activity is by adult cyclists traveling significant distances.

Typical Planning and Demographics Classifications

County Generalized Master Plans and Zoning Plans Land Uses:	Agriculture and "Rural Residential"; Single Family Residential, Low Density; Recreation, Open and Public Spaces
County Vision Based Policy:	Rural and Agricultural Conservation District; and Open Space Corridors, Environmental Areas, Trails
Housing Density:	0.01 dwelling units per acre
Population Density:	0.025 persons per acre 16 persons per square mile
Job Density:	<1 jobs per acre
Water and/or Sewer System:	None existing or planned
Transit Service:	None, although an express route may pass through the area
Smartcode Transect Equivalent:	T1

Typical Road Conditions and Recommended Nonmotorized Facilities

Signal Spacing;	> 5 miles
FDOT Class Equivalent:	Free Flow
Input Assumptions	12' Lanes, 3% heavy vehicle traffic, rural cross section

	ADT	**Travel Lanes**	**Posted Speed**	**Paved Shoulder Width**	**Buffer Width**	**Sidewalk Width**
Principal Arterial	8,500	2	55 MPH	4.0' AASHTO Min. 4.5' Min. Desired	NA	NA
Minor Arterial	7,000	2	55 MPH	Typically none, pave 4.0' Min. if a Priority Nonmotorized Link	NA	NA
Collector	7,000	2	55 MPH	Typically none, pave 4.0' Min. if a Priority Nonmotorized Link	NA	NA

Typical Nonmotorized Facilities at Signalized Intersections

Generally there will be no sidewalks at a signalized intersection in a Rural Agricultural Landscape

Pedestrian Signals:	N/A
Marked Crosswalks:	N/A
Curb Extensions:	N/A
Crossing islands:	N/A
Bicycle Detection:	If an actuated signal, use Bicycle Detector Pavement Marking in conjunction with R10-22 and adjust detector as necessary.

Typical Nonmotorized Mid-block Cross Corridor Accommodations

Unsignalized Marked Crosswalks:	Only at locations such as trail/road intersections
Crossing Islands:	Not likely necessary, but consider at trail crossings if typical delay for usable gaps exceeds 60 seconds
Mid-block Pedestrian Actuated Signal	Highly unlikely, but consider at trail crossings if a Crossing Island will not reduce pedestrian delay to less than 60 seconds each way and/or there is a documented need to provide an Accessible Route for blind pedestrians

Typical Nonmotorized Facilities on Bridges

Paved Shoulder Width:	Paved Shoulders should be present on a bridge if they are recommended for the approaching roadway. Paved Shoulders should be 5’ min. wide (AASHTO minimum Bike Lane width) or the recommended width of the Paved Shoulder on the approaching roadway, whichever is greater.
Barrier:	N/A
Sidewalk Width:	N/A

Typical Independent ROW Shared-use Pathway

Shared-use Paths in Rural Agricultural areas are generally connecting urban areas and/or recreation areas. Most of the traffic is through traffic. The path may accommodate snowmobiles and/or equestrian uses either on the main pathway or on a separate parallel track.

Width:	10’ AASHTO Minimum, additional width may be desired depending on proximity to urban areas. A separate track for equestrians may be desirable. Provide alternatives to bridges for equestrians, such as an appropriate river fords.
Surface:	Generally crushed fines, although asphalt may be considered desirable depending on the amount and type of use anticipated

Other Nonmotorized Facilities

Some roads may be marked as designated bicycle routes if they connect key destinations or are part of a nationally recognized bicycle route.

4.4 Rural Residential Landscape

A Rural Residential Landscape is characterized by the primary roads being mostly lined with homes on 10 to 20 acre lots interspersed with active Agriculture and fallow fields. Pedestrians and bicycles are to be expected along the roadway.

Typical Planning and Demographics Classifications

County Generalized Master Plans and Zoning Plans Land Uses:	Agriculture and "Rural Residential"
County Vision Based Policy:	Rural Residential District; Residential No Service
Housing Density:	0.1 dwelling units per acre
Population Density:	0.25 persons per acre 160 persons per square mile
Job Density:	<2 jobs per acre
Water and/or Sewer System:	None existing or planned
Transit Service:	None, although an express route may pass through the area
Smartcode Transect Equivalent:	T2

Typical Road Conditions and Recommended Nonmotorized Facilities

Signal Spacing;	> 2 miles
FDOT Class Equivalent:	Free Flow
Input Assumptions	12' Lanes, 3% heavy vehicle traffic, rural cross section

	ADT	**Travel Lanes**	**Posted Speed**	**Paved Shoulder Width**	**Buffer Width**	**Sidewalk Width**
Principal Arterial	8,500	2	55 MPH	4.0' AASHTO Min. 4.5' Min. Desired	NA	NA
Minor Arterial	7,000	2	55 MPH	4.0' AASHTO Min. 4.0' Min. Desired	NA	NA
Collector	7,000	2	55 MPH	4.0' AASHTO Min. 4.0' Min. Desired	NA	NA

Typical Nonmotorized Facilities at Signalized Intersections

Generally there will be no sidewalks at a signalized intersection in a Rural Agricultural Landscape

Pedestrian Signals:	Not likely, but provide where sidewalks exist and within 1 mile of schools.
Marked Crosswalks:	Not likely, but provide where sidewalks exist and within 1 mile of schools.
Curb Extensions:	N/A
Crossing Islands:	N/A
Bicycle Detection:	If an actuated signal, use Bicycle Detector Pavement Marking in conjunction with R10-22 and adjust detector as necessary.

Typical Nonmotorized Mid-block Cross Corridor Accommodations

Unsignalized Marked Crosswalks:	Only at locations such as trail/road intersections.
Crossing Islands:	Not likely necessary, but consider at trail crossings if typical delay for usable gaps exceeds 45 seconds.
Mid-block Pedestrian Actuated Signal	Highly unlikely, but consider at trail crossings if a Crossing Island will not reduce pedestrian delay to less than 45 seconds each way and/or there is a documented need to provide an Accessible Route for blind pedestrians.

Typical Nonmotorized Facilities on Bridges

Paved Shoulder Width:	5’ min. (AASHTO minimum Bike Lane width) or the recommended width of the Paved Shoulder on the approaching roadway, whichever is greater.
Barrier:	A barrier curb between motor vehicle lanes and sidewalk.
Sidewalk Width:	4’ AASHTO Minimum, should be a minimum of 5’ to allow for accessibility depending on bridge length. Width should correspond to sidewalk width on approach or wider to account for the loss of buffer.

Typical Independent ROW Shared-use Pathway

Shared-use Paths in Rural Residential Landscapes may provide dispersed residences with their primary recreational facility as well as a key nonmotorized link to Rural Activity Centers. The path may accommodate snowmobiles and/or equestrian uses either on the main pathway or on a separate parallel track.

Width:	10’ AASHTO Minimum, additional width may be desired depending on proximity to urban areas. A separate track for equestrians may be desirable
Surface:	Generally crushed fines, although asphalt may be considered desirable depending on the amount and type of use anticipated

Other Nonmotorized Facilities

Some roads may be marked as designated bicycle routes if they connect key destinations or are part of a nationally recognized bicycle route.

4.5 Rural Activity Center Landscape

Rural Activity Centers are the historic crossroad hamlets in the county. They are culturally and often historically significant. Rural Activity Centers contrast significantly with their surroundings and are generally quite small. They have considerably more bicycle, pedestrian and equestrian activity than their surroundings. There is a need to distinguish the roadway environment in these areas from the adjacent land uses so that motor vehicle speeds are reduced appropriately for the area.

Typical Planning and Demographics Classifications

County Generalized Master Plans and Zoning Plans Land Uses:	Varies and is inconsistent. Includes Business & Commercial; and Single Family Residential
County Vision Future Land Use:	Primary Cultural Centers; Secondary Cultural Centers
Housing Density:	0.01 Dwelling Units/Acre
Population Density:	0.25 persons per acre 160 persons per square mile
Job Density:	4 jobs per acre
Water and/or Sewer System:	Generally none existing or planned
Transit Service:	None, although an express route may pass through the area
Smartcode Transect Equivalent:	Mix of T3 and T5

Typical Road Conditions and Recommended Nonmotorized Facilities

Signal Spacing;	> 5 miles
FDOT Class Equivalent:	Free Flow
Input Assumptions	12' Lanes, 3% heavy vehicle traffic

	ADT	**Travel Lanes**	**Posted Speed**	**Paved Shoulder Width ***	**Buffer Width**	**Sidewalk Width ****
Principal Arterial	8,500	2	30 to 40 MPH	4.0' AASHTO Min. 4.0' Min. Preferred	5' AASHTO Min. 9' Preferred	5' AASHTO Min. 6' Min. Preferred
Minor Arterial	7,000	2	30 to 35 MPH	4.0' AASHTO Min. 4.0' Min. Preferred	5' AASHTO Min. 9' Preferred	5' AASHTO Min. 6' Min. Preferred
Collector	7,000	2	25 to 30 MPH	4.0' AASHTO Min. 4.0' Min. Preferred	2' AASHTO Min. 6' Preferred	5' AASHTO Min. 6' Min. Preferred

* If curb and gutter add 1'-0".
** Depending on the nature of the commercial activities the Sidewalk width may be wider.

Typical Nonmotorized Facilities at Signalized Intersections

Pedestrian Signals:	Yes, wherever sidewalks are present; pedestrian activated pedestrian signals may be appropriate.
Marked Crosswalks:	Yes, high visibility crosswalks should be used.
Curb Extensions:	Yes, wherever there is on-street parking.
Crossing Islands:	Generally not necessary.
Bicycle Detection:	If an actuated signal, use Bicycle Detector Pavement Marking in conjunction with R10-22 and adjust detector as necessary.

Typical Nonmotorized Mid-block Cross Corridor Accommodations

Unsignalized Marked Crosswalks:	Where spacing between signals exceeds 660', and land use create a demand, crossing at uncontrolled locations should be expected and accommodations provided.
Crossing Islands:	Use with unsignalized crosswalks where there are more than three lanes (including left-turn lanes) or if typical delay for usable gaps exceeds 30 seconds.
Mid-block Pedestrian Actuated Signal	Consider at marked crosswalks if a Crossing Island will not reduce pedestrian delay to less than 30 seconds each way and/or there is a documented need to provide an accessible route for blind pedestrians.

Typical Nonmotorized Facilities on Bridges

Paved Shoulder Width:	5' min. (AASHTO minimum Bike Lane width) or the recommended width of the Paved Shoulder on the approaching roadway, whichever is greater.
Barrier:	A barrier curb between motor vehicle lanes and sidewalk.
Sidewalk Width:	4' AASHTO Minimum, should be a minimum of 5' to allow for accessibility depending on bridge length. Width should correspond to sidewalk width on approach or wider to account for the loss of buffer.

Typical Independent ROW Shared-use Pathway

For long-distance Shared-use Paths, Rural Activity Centers function as service centers for path users. They also serve as a nonmotorized link between the retail and service business and the surrounding low-density residential areas. If the path accommodates snowmobiles and/or equestrian uses the necessary support facilities for those uses should be included within the activity center.

Width:	10' AASHTO Minimum, additional width may be desired depending on proximity to urban areas. A separate track for horses may be desirable.
Surface:	Generally paved, although crushed may be considered due to aesthetic reasons or to discourage uses such as in-line skating or encourage certain uses such as horses.

Other Nonmotorized Facilities

Some roads may be marked as designated bicycle routes if they connect key destinations or are part of a nationally recognized bicycle route.

4.6 Suburban Fringe/Transitional Landscape

Suburban Fringe/Transitional Landscapes are characterized by a mixing of new subdivisions, isolated new strip retail, new schools and agricultural or fallow fields. Fringe/Transitional areas typically lie adjacent to urbanized areas. These areas over the next 5 to 15 years will likely become Suburban. The Fringe/Transitional Landscape may best be described as the foreseeable development zone. The roadway cross sections will generally be rural at the present, but as roads are rebuilt, an urban cross section of curb and gutter may be installed in places or accounted for in ROW acquisition and grading.

Typical Planning and Demographics Classifications

County Generalized Master Plans and Zoning Plans Land Uses:	Agriculture; Rural Residential; Single Family Residential, Low Density
County Vision Future Land Use:	Urban Area
Housing Density:	1 dwelling unit per acre
Population Density:	2.5 persons per acre 1,600 persons per square mile
Job Density:	2.5 jobs per acre
Water and/or Sewer System:	Existing or planned sewer/water service district
Transit Service:	None, although an express route may pass through the area
Smartcode Transect Equivalent:	Approaching T3

Typical Road Conditions and Recommended Nonmotorized Facilities

Signal Spacing;	> 1 miles
FDOT Class Equivalent:	Free Flow
Input Assumptions	12’ Lanes, 3% heavy vehicle traffic, rural cross section

	ADT	**Travel Lanes**	**Posted Speed**	**Paved Shoulder Width***	**Buffer Width****	**Sidewalk Width ****
Principal Arterial	8,500	2	55 MPH	4.0’ AASHTO Min. 4.5’ Min. Desired	Set back sidewalk as necessary to achieve Suburban guidelines accounting for ultimate Urban cross section .	5’ AASHTO Min. 8’ Preferred Min.
Minor Arterial	7,000	2	55 MPH	4.0’ AASHTO Min. 4.0’ Min. Desired		5’ AASHTO Min. 8’ Preferred Min.
Collector	7,000	2	55 MPH	4.0’ AASHTO Min. 4.0’ Min. Desired		5’ AASHTO Min. 6’ Preferred Min.

* If a curb and gutter cross section is used follow Suburban Landscape Guidelines
** Install sidewalks concurrent with development, new road construction or road re-reconstruction. If local agency agreement can not be made for sidewalk installation and maintenance, grade ROW to accommodate future sidewalk installation.

Typical Nonmotorized Facilities at Signalized Intersections

Pedestrian Signals:	Where sidewalks exist, within 1 mile of school, within ½ mile subdivisions
Marked Crosswalks:	Where sidewalks exist, within 1 mile of school, within ½ mile subdivisions
Curb Extensions:	N/A
Crossing Islands:	N/A
Bicycle Detection:	If an actuated signal, use Bicycle Detector Pavement Marking in conjunction with R10-22 and adjust detector as necessary.

Typical Nonmotorized Mid-block Cross Corridor Accommodations

Unsignalized Marked Crosswalks:	Where spacing between signals exceeds 660', and land use create a demand, crossing at uncontrolled locations should be expected and accommodations provided.
Crossing Islands:	Use with unsignalized crosswalks where there are more than three lanes (including left-turn lanes) or if typical delay for usable gaps exceeds 30 seconds.
Mid-block Pedestrian Actuated Signal	Consider at marked crosswalks if a Crossing Island will not reduce pedestrian delay to less than 45 seconds each way and/or there is a documented need to provide an accessible route for blind pedestrians.

Typical Nonmotorized Facilities on Bridges

Because bridges are long-term investments and the character of the landscape is in transition, Bridges should be built to Suburban guidelines

Bike Lane Width:	5' min. (AASHTO minimum Bike Lane width) or the recommended width of the Paved Shoulder or Bike Lane on the approaching roadway, whichever is greater.
Barrier:	A barrier railing between motor vehicle lanes and sidewalk.
Sidewalk Width:	5' Minimum, should correspond to sidewalk width on approach.

Typical Independent ROW Shared-use Pathway

Width:	10' AASHTO Minimum, additional width may be desired depending on proximity to urban areas. A separate track for equestrians may be desirable.
Surface:	Generally paved, although crushed fines may be considered due to aesthetic reasons or to discourage uses such as in-line skating or encourage certain users such as equestrians.

Other Nonmotorized Facilities

Some roads may be marked as designated bicycle routes if they connect key destinations or are part of a nationally recognized bicycle route.

4.7 Suburban Landscape

The Suburban Landscape is characterized by low density residential and business development served by moderately high speed and high volume roadways. Suburban areas include freeway interchange developments.

Typical Planning and Demographics Classifications

County Generalized Master Plans and Zoning Plans Land Uses:	Single Family Residential, High Density; Multi-Family Residential; Business and Commercial; Industrial, Warehouse, & Light Manufacturing
County Vision Future Land Use:	Urban Area
Housing Density:	2 dwelling units per acre
Population Density:	5 persons per acre 3,200 persons per square mile
Job Density:	2 jobs per acre
Water and/or Sewer System:	Yes
Transit Service:	Dial-A-Ride, Non-existent or heavily subsidized scheduled service
Smartcode Transect Equivalent:	T3

Typical Road Conditions and Recommended Nonmotorized Facilities

Signal Spacing;	½ to 1 mile
FDOT Class Equivalent:	Class I
Input Assumptions	11’ Lanes, 3% heavy vehicle traffic

	ADT	**Travel Lanes**	**Posted Speed**	**Bike Lane Width***	**Buffer Width****	**Sidewalk Width**
Principal Arterial	31,000	4	35 to 45 MPH	5.0’ AASHTO Min. 6.5’ Min. Preferred	5’ AASHTO Min. 9’ Preferred	5’ AASHTO Min. 8’ Min. Preferred
Minor Arterial	25,000	4	35 to 45 MPH	5.0’ AASHTO Min. 6.5’ Min. Preferred	5’ AASHTO Min. 9’ Preferred	5’ AASHTO Min. 8’ Min. Preferred
Collector	13,500	2	30 to 40 MPH	5.0’ AASHTO Min. 6.0’ Min. Preferred	2’ AASHTO Min. 6’ Preferred	5’ AASHTO Min. 6’ Min. Preferred

* The Bike Lane Width is measured from the face of curb to the center of the lane marking. It may include the width of the gutter but at least 3’ of the width must be a suitable roadway surface, outside of the gutter and storm drain grate area.

** The Buffer Width may be paved and generally includes street trees, furnishings, light fixtures, signs, etc.

If sidewalks do not already exist; install sidewalks concurrent with development, new road construction or road re-reconstruction. If local agency agreement can not be made for sidewalk installation and maintenance, grade ROW to accommodate future sidewalk installation. If sidewalk exists; evaluate condition of sidewalk and repair/replace as necessary as a part of new road construction, road re-construction and 3R projects.

Typical Nonmotorized Facilities at Signalized Intersections

Pedestrian Signals:	Yes, wherever sidewalks are present; pedestrian activated pedestrian signals may be appropriate. Pedestrian countdown signals should be used where pedestrian crossing distance is greater than 55’.
Marked Crosswalks:	Yes, high visibility crosswalk.
Curb Extensions:	Where on-street parking is present.
Crossing Islands:	Yes, where the number of lanes at an intersection (including turn lanes) is 5 or greater.
Bicycle Detection:	If an actuated signal, use Bicycle Detector Pavement Marking in conjunction with R10-22 and adjust detector as necessary.

Typical Nonmotorized Mid-block Cross Corridor Accommodations

Unsignalized Marked Crosswalks:	Where spacing between signals exceeds 660’, and land use create a demand, crossing at uncontrolled locations should be expected and accommodations provided.
Crossing Islands::	Use with unsignalized crosswalks where there are more than three lanes (including left-turn lanes) or if typical delay for usable gaps exceeds 30 seconds.
Mid-block Pedestrian Actuated Signal	Consider at marked crosswalks if a Crossing Island will not reduce pedestrian delay to less than 45 seconds each way and/or there is a documented need to provide an accessible route for blind pedestrians.

Typical Nonmotorized Facilities on Bridges

Bike Lane Width:	5’ min. (AASHTO minimum Bike Lane width) or the recommended width of the Paved Shoulder on the approaching roadway, whichever is greater.
Barrier:	A barrier railing between motor vehicle lanes and sidewalk.
Sidewalk Width:	5’ Minimum, width should correspond to or be wider than the sidewalk width on approach to account for shy distance from barriers.

Typical Independent ROW Shared-use Pathway

Width:	10’ AASHTO Minimum, 12’ preferred under most circumstances.
Surface:	Generally paved, although crushed may be considered due to aesthetic reasons or to discourage uses such as in-line skating or encourage certain uses such as horses.

Other Nonmotorized Facilities

Some roads may be marked as designated bicycle routes if they connect key destinations or are part of a nationally recognized bicycle route.

4.8 General Urban Landscape

General Urban Landscapes are characterized by moderately compact development typical of inner ring neighborhoods. A mix of commercial and residential land uses are found along the primary roads and the front setbacks are moderate.

Typical Planning and Demographics Classifications

County Generalized Master Plans and Zoning Plans Land Uses:	Industrial, Warehouse, & Light Manufacturing; Business & Commercial; Multi-Family Residential; Single Family Residential, High Density
County Vision Future Land Use:	Urban and General Services District
Housing Density:	4 dwelling units per acre
Population Density:	10 persons per acre 6,400 persons per square mile
Job Density:	4 jobs per acre
Water and/or Sewer System:	Yes
Transit Service:	Yes, approximately 30 minute to 1 hour intervals between buses
Smartcode Transect Equivalent:	T4

Typical Road Conditions and Recommended Nonmotorized Facilities

Signal Spacing;	¼ to ½ Mile
FDOT Class Equivalent:	Class II
Input Assumptions	11’ Lanes, 3% heavy vehicle traffic

	ADT	**Travel Lanes**	**Posted Speed**	**Bike Lane Width***	**Buffer Width****	**Sidewalk Width**
Principal Arterial	23,000	4	30 to 40 MPH	5.0’ AASHTO Min. 6.0’ Min. Preferred	5’ AASHTO Min. 9’ Preferred	5’ AASHTO Min. 8’ Min. Preferred
Minor Arterial	18,000	4	30 to 40 MPH	5.0’ AASHTO Min. 6.0’ Min. Preferred	5’ AASHTO Min. 9’ Preferred	5’ AASHTO Min. 8’ Min. Preferred
Collector	11,500	2	25 to 35 MPH	5.0’ AASHTO Min. 5.5’ Min. Preferred	2’ AASHTO Min. 6’ Preferred	5’ AASHTO Min. 6’ Min. Preferred

* The Bike Lane Width is measured from the face of curb to the center of the lane marking. It may include the width of the gutter but at least 3’ of the width must be a suitable roadway surface, outside of the gutter and storm drain grate area.

** The Buffer Width may be paved and generally includes street trees, furnishings, light fixtures, signs, etc.

If sidewalks do not already exist; install sidewalks concurrent with development, new road construction or road re-reconstruction. If local agency agreement can not be made for sidewalk installation and maintenance, grade ROW to accommodate future sidewalk installation. If sidewalk exists; evaluate condition of sidewalk and repair/replace as necessary as a part of new road construction, road re-construction and 3R projects.

Typical Nonmotorized Facilities at Signalized Intersections

Pedestrian Signals:	Yes, pedestrian phase should be integrated; pedestrian activation should NOT be used; pedestrian countdown signals should be used where pedestrian crossing distance is greater than 55'.
Marked Crosswalks:	Yes, high visibility crosswalks.
Curb Extensions:	Where on-street parking is present.
Crossing Islands:	Yes, where the number of lanes at an intersection (including turn lanes) is 5 or greater.
Bicycle Detection:	If an actuated signal, use Bicycle Detector Pavement Marking in conjunction with R10-22 and adjust detector as necessary.

Typical Nonmotorized Mid-block Cross Corridor Accommodations

Unsignalized Marked Crosswalks:	Where spacing between signals exceeds 660', and land use create a demand, crossing at uncontrolled locations should be expected and accommodations provided.
Crossing Islands:	Use with unsignalized crosswalks where there are more than three lanes (including left-turn lanes) or if typical delay for usable gaps exceeds 30 seconds.
Mid-block Pedestrian Actuated Signal	Consider at marked crosswalks if a Crossing Island will not reduce pedestrian delay to less than 30 seconds each way and/or there is a documented need to provide an accessible route for blind pedestrians.

Typical Nonmotorized Facilities on Bridges

Bike Lane Width:	5' min. (AASHTO minimum Bike Lane width) or the recommended width of the Paved Shoulder on the approaching roadway, whichever is greater.
Barrier:	A barrier railing between motor vehicle lanes and sidewalk.
Sidewalk Width:	5' Minimum, width should correspond to or be wider than the sidewalk width on approach to account for shy distance from barriers.

Typical Independent ROW Shared-use Pathway

Width:	10' AASHTO Minimum, 12' – 14' preferred.
Surface:	Generally asphalt or concrete.

Other Nonmotorized Facilities

Some roads may be marked as designated bicycle routes if they connect key destinations or are part of a nationally recognized bicycle route.

4.9 Commercial Center Landscape

Commercial Centers are the central business districts of towns and cities with a population under 250,000. These are the traditional "downtowns" although the commercial core of some new-urbanist developments would qualify.

Typical Planning and Demographics Classifications

County Generalized Master Plans and Zoning Plans Land Uses:	Business and Commercial; Multi-Family Residential; Public Facilities, Quasi Public
County Vision Future Land Use:	Large Commercial Centers, Commercial Centers
Housing Density:	6 dwelling units per acre
Population Density:	15 persons per acre 9,600 persons per square mile
Water and/or Sewer System:	Yes
Job Density:	6 jobs per acre
Transit Service:	Yes, for communities apart of a metropolitan area with approximately 30 minute intervals between buses. No for smaller towns.
Smartcode Transect Equivalent:	T5

Typical Road Conditions and Recommended Nonmotorized Facilities

Signal Spacing;	<1/4 Mile
FDOT Class Equivalent:	Class III
Input Assumptions	11' Lanes, 3% heavy vehicle traffic

	ADT	**Travel Lanes**	**Posted Speed**	**Bike Lane Width***	**Buffer Width****	**Sidewalk Width**
Principal Arterial	11,000	4	25 to 30 MPH	5.0' AASHTO Min. 6.0' Min. Preferred	5' AASHTO Min. 9' Preferred	5' AASHTO Min. 8-12' Preferred
Minor Arterial	9,000	4	25 to 30 MPH	5.0' AASHTO Min. 6.0' Min. Preferred	5' AASHTO Min. 9' Preferred	5' AASHTO Min. 8-12' Preferred
Collector	5,500	2	25 MPH	5.0' AASHTO Min. 5.5' Min. Preferred	2' AASHTO Min. 6' Preferred	5' AASHTO Min. 6-8' Preferred

* The Bike Lane Width is measured from the face of curb to the center of the lane marking. It may include the width of the gutter but at least 3' of the width must be a suitable roadway surface, outside of the gutter and storm drain area.

* The Buffer Width may be generally paved and include street tree planning, furnishings, light fixtures, signs, etc.

Typical Nonmotorized Facilities at Signalized Intersections

Pedestrian Signals:	Yes, pedestrian phase should be integrated; pedestrian activation should NOT be used; pedestrian countdown signals should be used.
Marked Crosswalks:	Yes, high visibility crosswalks should be used.
Curb Extensions:	Yes, where ever there is on-street parking.
Crossing Islands:	Yes, where the number of lanes at an intersection (including turn lanes) is 5 or greater.
Bicycle Detection:	If an actuated signal, use Bicycle Detector Pavement Marking in conjunction with R10-22 and adjust detector as necessary.

Typical Nonmotorized Mid-block Cross Corridor Accommodations

Unsignalized Marked Crosswalks:	Where spacing between signals exceeds 500', and land use create a demand, crossing at uncontrolled locations should be expected and accommodations provided.
Crossing Islands:	Use with unsignalized crosswalks where there are more than three lanes (including left-turn lanes) or if typical delay for usable gaps exceeds 30 seconds.
Mid-block Pedestrian Actuated Signal	Highly unlikely due to close signal spacing. Consider at high pedestrian volume marked crosswalks if a Crossing Island will not reduce pedestrian delay to less than 30 seconds each way and/or there is a documented need to provide an accessible route for blind pedestrians. Coordinate signal with other signals in the corridor.

Typical Nonmotorized Facilities on Bridges

Bike Lane Width:	5' min. (AASHTO minimum Bike Lane width) or the recommended width of the Paved Shoulder on the approaching roadway, whichever is greater.
Barrier:	A barrier railing between motor vehicle lanes and sidewalk.
Sidewalk Width:	5' Minimum, width should correspond to or be wider than the sidewalk width on approach to account for shy distance from barriers.

Typical Independent ROW Shared-use Pathway

Width:	10' AASHTO Minimum, 14' or wider preferred.
Surface:	Generally asphalt or concrete.

Other Nonmotorized Facilities

Some roads may be marked as designated bicycle routes if they connect key destinations or are part of a nationally recognized bicycle route.

4.10 Regional Commercial Landscape

Regional Commercial Centers are the central business districts of cities with a population over 250,000. They are regional draws and are very intense areas. There currently are no areas in St. Clair that meet this designation. Statewide, places like Detroit and Grand Rapids would meet this designation.

Typical Planning and Demographics Classifications

County Generalized Master Plans and Zoning Plans Land Uses:	N/A
County Vision Future Land Use:	N/A
Housing Density:	12 dwelling units per acre
Population Density:	30 persons per acre 19,200 persons per square mile
Job Density:	>12 jobs per acre
Water and/or Sewer System:	Yes
Transit Service:	Yes, approximately 15 minute intervals between buses
Smartcode Transect Equivalent:	T6

Typical Road Conditions and Recommended Nonmotorized Facilities

Signal Spacing;	< ¼ Mile
FDOT Class Equivalent:	Class IV
Input Assumptions	11' Lanes, 3% heavy vehicle traffic

	ADT	Travel Lanes	Posted Speed	Bike Lane Width	Buffer Width**	Sidewalk Width
Principal Arterial	18,000	6	25 to 30 MPH	5.0' AASHTO Min. 5.0' Min. Preferred	5' AASHTO Min. 9' Preferred	5' AASHTO Min. 12-15' Preferred
Minor Arterial	9,000	4	25 to 30 MPH	5.0' AASHTO Min. 5.0' Min. Preferred	5' AASHTO Min. 9' Preferred	5' AASHTO Min. 8-12' Preferred
Collector	5,000	2	25 MPH	5.0' AASHTO Min. 5.0' Min. Preferred	2' AASHTO Min. 6' Preferred	5' AASHTO Min. 6-8' Preferred

* The Bike Lane Width is measured from the face of curb to the center of the lane marking. It may include the width of the gutter but at least 3' of the width must be a suitable roadway surface, outside of the gutter and storm drain area.

** The Buffer Width may be generally paved and include street tree planning, furnishings, light fixtures, signs, etc.

Typical Nonmotorized Facilities at Signalized Intersections

Pedestrian Signals:	Yes, pedestrian phase should be integrated; pedestrian activation should NOT be used; pedestrian countdown signals should be used.
Marked Crosswalks:	Yes, high visibility crosswalks should be used.
Curb Extensions:	Yes, where ever there is on-street parking.
Crossing Islands:	Yes, where the number of lanes at an intersection (including turn lanes) is 5 or greater.
Bicycle Detection:	If an actuated signal, use Bicycle Detector Pavement Marking in conjunction with R10-22 and adjust detector as necessary.

Typical Nonmotorized Mid-block Cross Corridor Accommodations

Unsignalized Marked Crosswalks:	Where spacing between signals exceeds 400', and land use create a demand, crossing at uncontrolled locations should be expected and accommodations provided.
Crossing Islands::	Use with unsignalized crosswalks where there are more than three lanes (including left-turn lanes) or if typical delay for usable gaps exceeds 30 seconds.
Mid-block Pedestrian Actuated Signal	Highly unlikely due to close signal spacing. Consider at high pedestrian volume marked crosswalks if a Crossing Island will not reduce pedestrian delay to less than 30 seconds each way and/or there is a documented need to provide an accessible route for blind pedestrians. Coordinate signal with other signals in the corridor.

Typical Nonmotorized Facilities on Bridges

Bike Lane Width:	5' min. (AASHTO minimum Bike Lane width) or the recommended width of the Paved Shoulder on the approaching roadway, whichever is greater.
Barrier:	A barrier railing between motor vehicle lanes and sidewalk.
Sidewalk Width:	5' Minimum, width should correspond to or be wider than the sidewalk width on approach to account for shy distance from barriers.

Typical Independent ROW Shared-use Pathway

Width:	10' AASHTO Minimum, 16' or wider preferred.
Surface:	Generally asphalt or concrete.

Other Nonmotorized Facilities

Some roads may be marked as designated bicycle routes if they connect key destinations or are part of a nationally recognized bicycle route.

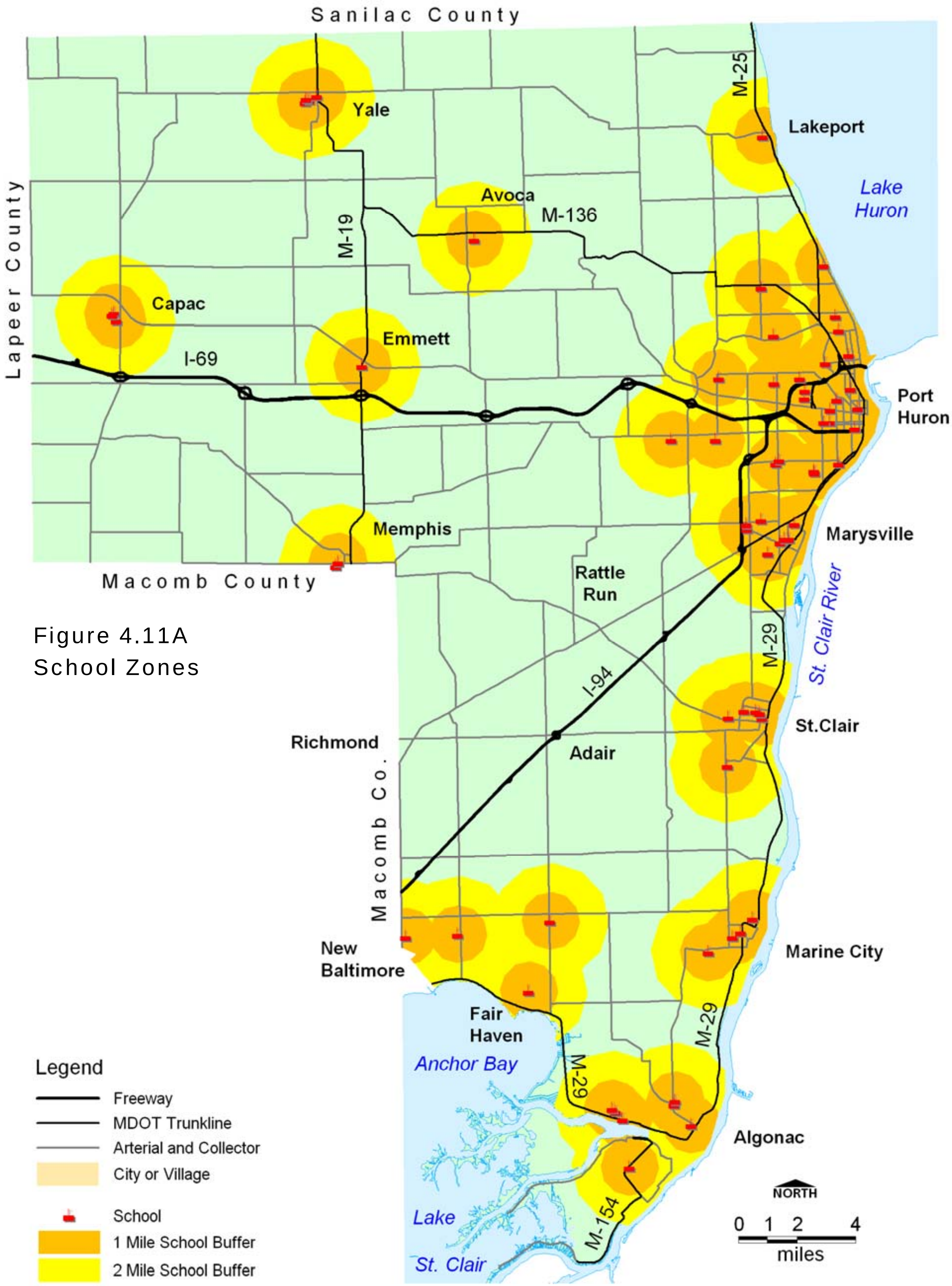


Figure 4.11A
School Zones

4.11 School Zones

Areas within 2 miles of a school require special attention. While school policies vary, students within 1 to 2 miles of a school are typically expected to get themselves to school. If an area within 2 miles of a school zone falls within a Rural Agricultural, Rural Residential or a Suburban Fringe/Transitional Landscape, the guidelines for a Suburban Landscape should be used instead. Improvements to nonmotorized facilities within the School Zone should be given a high priority. When roads are improved in a school zone, the scope of a road project should include nonmotorized facilities appropriate for the ages of the school children who will use the facilities on their way to school.

Every attempt should be made to make sure that safe routes are provided from residential areas within a 2 mile radius of schools. Pedestrian improvements should be the focus of improvements within 1 mile of a school and bicycle improvements within 2 miles of a school.

Safe Routes to School

MDOT should participate in Safe Routes to School programs where roadways under their jurisdiction fall within a two mile radius of the school. Safe Routes to School is a national program funded by National Highway Traffic Safety Administration devoted to identifying the best routes for children to walk to school, based on safe facilities and street crossings. In some areas this has led to on-going efforts to create better routes by building and repairing of sidewalks, hiring crossing guards, and improving crosswalks.

AASHTO's *Guide for the Planning, Design, and Operation of Pedestrian Facilities* lists the following procedures for developing safe routes to school:

- Form and support a safety advisory committee.
- Prepare base maps for the area around the school.
- Inventory existing walking conditions and traffic characteristics- checklists are available from the www.walktoschool.org website for use in auditing a community's walkability.
- Design the walk routes.
- Identify improvement areas.
- Get approval of route maps from all necessary parties.
- Implement improvements.
- Distribute maps and educate students and parents.
- Evaluate the effectiveness of the program.

Safe Routes to School Funding Source

The new federal transportation bill, SAFETEA-LU establishes a funding for a new program called Safe Routes to School (SR2S). The program is targeted to benefit children in Kindergarten through 8^{th} grade. It is estimated that Michigan will receive a total of $19.26 million for this program over five years (2005-2009). The majority of the funds will be for infrastructure related activities that improve the ability of students to walk and bicycle to school. These funds may be used by state, local and regional agencies including private nonprofit organizations.

The manner in which these funds will be made available and how they will be administered is currently under development.

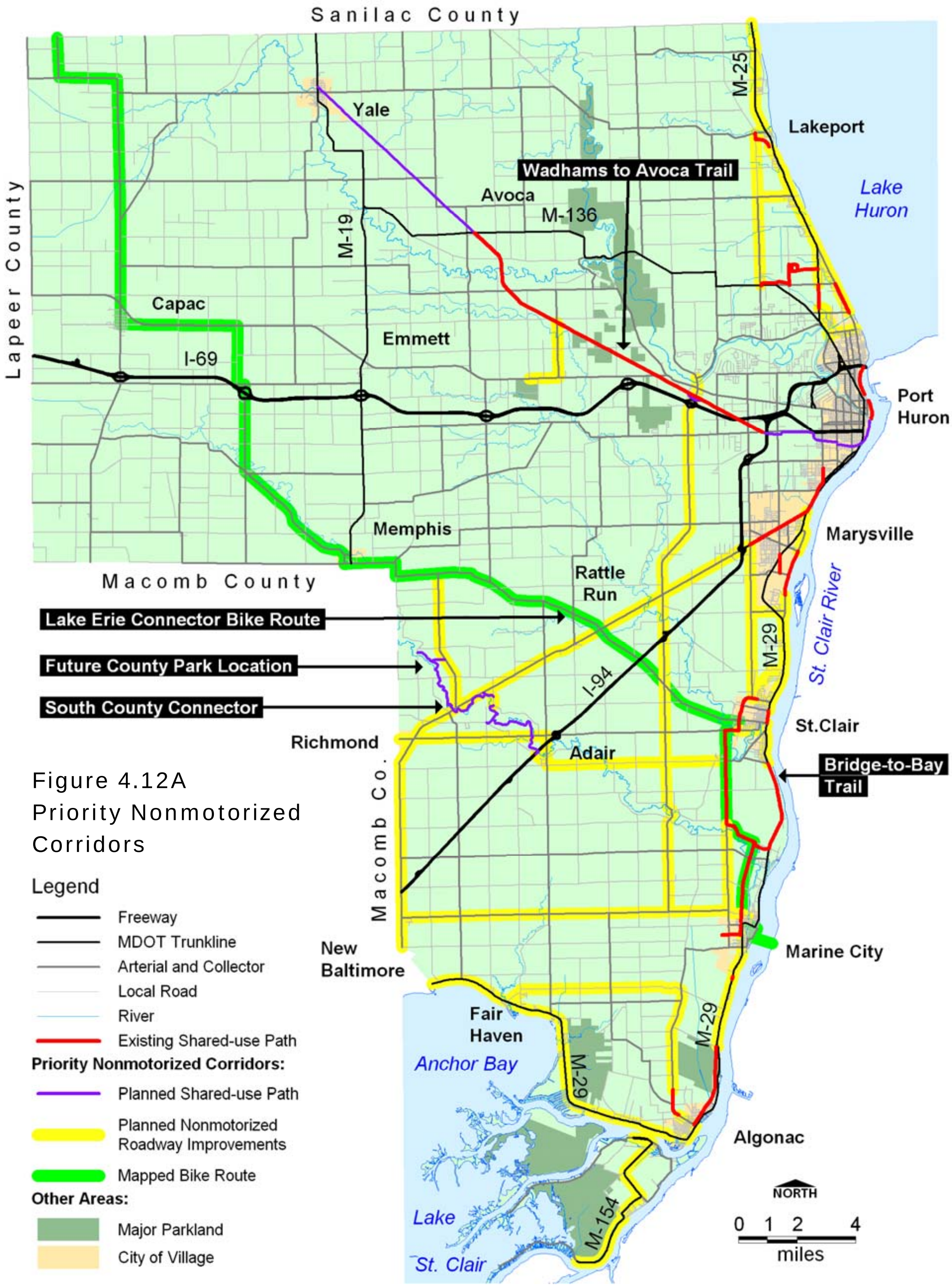


Figure 4.12A
Priority Nonmotorized Corridors

4.12 High Priority Nonmotorized Corridors

High Priority Nonmotorized Corridors are routes for which nonmotorized improvements have already been planned for as well regionally significant bicycle routes. The corridors include planned Shared-use Paths independent from roadways, planned nonmotorized improvements that would added to an existing roadway and mapped bicycle routes.

The purpose for identifying these routes is to highlight corridors and trail/roadway intersection points for which nonmotorized improvements should be added sooner rather than later. Nonmotorized improvements are to be retrofitted to existing roadways whenever possible as part of all roadway resurfacing, restoration and rehabilitation (3R) projects, see Section 7 – Implementation Guidelines. There will be cases though were nonmotorized improvements may not be incorporated without significantly changing the roadway. For most roadways, these improvements would be differed until the road is reconstructed. For High Priority Nonmotorized Corridors, these improvements should be incorporated into the 3R project whenever feasible.

For example, a narrow gravel shouldered rural two-lane road is being going to be resurfaced. The nonmotorized guidelines call for a paved shoulder in this situation but it is deemed not necessary for motorized traffic. Typically the shoulder pavement would be deferred until the roadway is reconstructed. If though the road is identified as a High Priority Nonmotorized Corridor, then paving the shoulder would be incorporated into the 3R project.

The high priority nonmotorized corridors where drawn from the *St. Clair County 2030 Long-Range Transportation Plan*, input from St. Clair County Metropolitan Planning Commission Staff, the Macomb County Trailways Master Plan, Adventure Cycling Association's "Lake Erie Connector" route, the preliminary results of the South County Connector Greenway and the Wadhams-to-Avoca / Bridge-to-Bay Connector studies. The routes were not prioritized as a part of this study. It is anticipated that the high priority nonmotorized corridors will be updated from time to time as studies are completed.

5. Supplemental Tools

The landscape areas can not account for all variations. The unique characteristics of each road as well as physical and ROW restrictions may require the general guidance to be refined.

5.1 Adjustments to Buffer Widths

The buffer plays a key role in the comfort of the pedestrian. Buffers that do not have any physical barriers, such as trees, light poles, etc. do not have the same value as a buffer that does have a vertical physical barriers. On-street parking also provides a key physical barrier between the sidewalk user and moving traffic. Therefore in downtown areas if parking is allowed on only one side of the street, the side without parking should have a greater width buffer than the side with parking.

5.2 Adjustments to Sidewalk Widths

When looking at the sidewalk width is important to address the effective walkway width vs. the total walkway width. The effective walkway width accounts for shy distances and obstructions. More information may be found in AASHTO's *Guide for the Planning, Design, and Operation of Pedestrian Facilities* [1].

5.3 Bicycle Lane Pavement Markings and Signs

In General Urban, Commercial Center and Regional Commercial Center Landscapes, the use of signs to mark Bike Lanes may be undesirable as they add to sign clutter and they are redundant to the pavement markings. As current MMUTCD calls for signs in such cases, MDOT should consider a policy to eliminate the requirement for signs in such situations.

In Rural Agricultural, Rural Residential and Suburban Fringe areas, paved shoulders generally do not need Bike Lane pavement markings and signs. The exception to this is where designated turn lanes are used. In such cases, the lanes should be marked in accordance with the MMUTCD standards for Bike Lanes so that a bicycle traveling on the shoulder is not directed to the right of a designated right-turn lane.

[1] AASHTO, *Guide for the Planning, Design, and Operation of Pedestrian Facilities, 2004,* Washington D.C. 2001, p. 57

5.4 Adjustment to Bike Lane Widths

On Street Parking

When parking is adjacent to a Bike Lane, the parking lane should be 7' wide (total width including gutter) and the Bike Lane width should be a minimum of 5' wide. Additional width for Bike Lane is desirable due to opening doors of parked cars infringing on the Bike Lane width. Bike Lanes wider than 5' should have the door zone cross-hatched to encourage bicyclists to ride a safe distance away from the parked cars.

A 4" stripe should mark the edge of the parking lane to encourage parking as close to the curb as possible. The parking lane should always remain 7'wide to encourage vehicles to park as close to the curb as possible. Any additional room should be allocated toward the Bike Lane first, then to the travel lane adjacent to the Bike Lane.

Speed and Volume

The motor vehicle speeds and volumes shown in the landscape tables are based on typical speeds encountered in those type areas and the upper range of volumes expected while maintaining a LOS of C for motor vehicles. These speeds and especially volumes may not match the existing and project conditions for the roadway. Use Fig. 5.4A Rural Paved Shoulder Sizing Chart and Fig. 5.4B Urban Bike Lane Sizing Chart to adjust the width appropriately based on projected volumes and design speed.

Percent Heavy Vehicles

The percentage of heavy vehicles plays a key role in the comfort of bicyclist using Bike Lanes and paved shoulders. For the Landscape Tables and the Paved Shoulder and Bike Lane Sizing Charts 3% heavy vehicles was used as the default input. For every 1% increase in heavy vehicles approximately 8" to 9" of additional Bike Lane or Paved Shoulder width is required to maintain the same level of service.

Fig. 5.4A Rural Paved Shoulder Sizing Chart

Minimum Paved Shoulder Width Required to Maintain Bike Q/LOS C or Above Rural Cross Section

12' Travel Lanes

No. of Lanes	2	2	2	2	2	2	4	4	4	4	4
Design ADT	<750	1,500	5,000	10,000	15,000	20,000	20,000	25,000	30,000	35,000	40,000
25 mph	0	0	3	3	3.5	3.5	3	3	3.5	3.5	3.5
30 mph	0	0	3	3.5	4	4.5	3.5	4	4	4	4.5
35 mph	0	0	3	4	4.5	5	4	4	4.5	4.5	4.5
40 mph	0	0	3	4	4.5	5	4	4.5	4.5	5	5
45 mph	0	0	4	4.5	5	5	4.5	4.5	5	5	5
50 mph	0	0	4	4.5	5	5.5	5	5	5	5	5.5
55 mph	0	0	4	4.5	5	5.5	5	5.5	5.5	5.5	5.5

11' Travel Lanes

No. of Lanes	2	2	2	2	2	2	4	4	4	4	4
Design ADT	<750	1,500	5,000	10,000	15,000	20,000	20,000	25,000	30,000	35,000	40,000
25 mph	0	0	3	3	4	4	3	3.5	4	4	4
30 mph	0	0	3	4	4.5	5	4	4.5	4.5	4.5	5
35 mph	0	0	3.5	4.5	5	5	4.5	4.5	5	5	5
40 mph	0	0	3.5	4.5	5	5.5	4.5	5	5	5.5	5.5
45 mph	0	0	4	5	5.5	5.5	5	5	5.5	5.5	5.5
50 mph	0	0	4	5	5.5	6	5	5.5	5.5	5.5	6
55 mph	0	0	4.5	5	5.5	6	5	5.5	5.5	6	6

10' Travel Lanes

No. of Lanes	2	2	2	2	2	2	4	4	4	4	4
Design ADT	<750	1,500	5,000	10,000	15,000	20,000	20,000	25,000	30,000	35,000	40,000
25 mph	0	0	3	3.5	4.5	4.5	3.5	4	4.5	4.5	4.5
30 mph	0	0	3.5	4.5	5	5.5	4.5	5	5	5	5.5
35 mph	0	0	4	5	5.5	5.5	5	5	5.5	5.5	5.5
40 mph	0	0	4	5	5.5	6	5	5.5	5.5	6	6
45 mph	0	0	4.5	5.5	6	6	5.5	5.5	6	6	6
50 mph	0	0	4.5	5.5	6	6.5	5.5	6	6	6	6.5
55 mph	0	0	5	5.5	6	6.5	5.5	6	6	6.5	6.5

Inputs 3% Truck Traffic

Fig. 5.4B. Urban Bike Lane Sizing Chart

12' Travel Lanes

No. of Lanes	2	2	2	2	2	2	4	4	4	4	4
Design ADT	<750	1,500	5,000	10,000	15,000	20,000	20,000	25,000	30,000	35,000	40,000
25 mph	0	0	4.5	4.5	5	5	4.5	4.5	5	5	5
30 mph	0	0	4.5	5	5.5	6	5	5.5	5.5	5.5	6
35 mph	0	0	4.5	5.5	6	6.5	5.5	5.5	6	6	6
40 mph	0	0	4.5	5.5	6	6.5	5.5	6	6	6.5	6.5
45 mph	0	0	5.5	6	6.5	6.5	6	6	6.5	6.5	6.5
50 mph	0	0	5.5	6	6.5	7	6.5	6.5	6.5	6.5	7
55 mph	0	0	5.5	6	6.5	7	6.5	7	7	7	7

11' Travel Lanes

No. of Lanes	2	2	2	2	2	2	4	4	4	4	4
Design ADT	<750	1,500	5,000	10,000	15,000	20,000	20,000	25,000	30,000	35,000	40,000
25 mph	0	0	4.5	4.5	5.5	5.5	4.5	5	5.5	5.5	5.5
30 mph	0	0	4.5	5.5	6	6.5	5.5	6	6	6	6.5
35 mph	0	0	5	6	6.5	6.5	6	6	6.5	6.5	6.5
40 mph	0	0	5	6	6.5	7	6	6.5	6.5	7	7
45 mph	0	0	5.5	6.5	7	7	6.5	6.5	7	7	7
50 mph	0	0	5.5	6.5	7	7.5	6.5	7	7	7	7.5
55 mph	0	0	6	6.5	7	7.5	6.5	7	7	7.5	7.5

10' Travel Lanes

No. of Lanes	2	2	2	2	2	2	4	4	4	4	4
Design ADT	<750	1,500	5,000	10,000	15,000	20,000	20,000	25,000	30,000	35,000	40,000
25 mph	0	0	4.5	5	6	6	5	5.5	6	6	6
30 mph	0	0	5	6	6.5	7	6	6.5	6.5	6.5	7
35 mph	0	0	5.5	6.5	7	7	6.5	6.5	7	7	7
40 mph	0	0	5.5	6.5	7	7.5	6.5	7	7	7.5	7.5
45 mph	0	0	6	7	7.5	7.5	7	7	7.5	7.5	7.5
50 mph	0	0	6	6	7.5	8	7	7.5	7.5	7.5	8
55 mph	0	0	6.5	7	7.5	8	7	7.5	7.5	8	8

Inputs 3% Truck Traffic

(yellow) Bike Lanes wider than 7' will likely be used as parking lanes and/or travel lanes

(light blue) The width of the Bike Lane required to maintain a LOS of C is less than AASHTO's minimum Bike Lane width. Whenever possible provide a minimum of 5' wide Bike Lane

5.5 Unsignalized Marked Crosswalks

Unsignalized Mid-block Crosswalks

The majority of pedestrian trips are ¼ mile or less[1], this translates into approximately a five to ten minute walk. Any small forced detour in a pedestrian's path has the potential to cause significant time delays if not shift the trip to another mode (most likely motorized). Pedestrians will seek the most direct route possible and typically are not willing to go far out of their way. Thus, they will often cross the road whether there are crosswalks or not. This results in the increased likelihood of motorists unexpectedly encountering pedestrians crossing mid-block. This is the second most common type of pedestrian/vehicle collision.

A concern with any mid-block crosswalk is providing the pedestrian with a false sense of security. The concern must be weighed against accommodating and encouraging pedestrian travel. If legal pedestrian travel is to be encouraged then well designed, high visibility mid-block crosswalks should be provided at appropriate locations.

Understanding pedestrian routes and common pedestrian destinations will guide the placement of mid-block crosswalks at needed locations. According to AASHTO's *Guide for the Planning, Design, and Operation of Pedestrian Facilities*, there are numerous attributes to consider when determining whether placement of a mid-block crosswalk is appropriate[2]. These include:

- The location is already a source of a substantial number of mid-block crossings.
- Where a new development is anticipated to generate mid-block crossings.
- The land use is such that pedestrians are highly unlikely to cross the street at the next intersection.
- The safety and capacity of adjacent intersections or large turning volumes create a situation where it is difficult to cross the street at the intersection.
- Spacing between adjacent intersections exceeds 200 m [660 ft]. (1/8 of a mile)
- The vehicular capacity of the roadway may not be substantially reduced by the midblock crossing.
- Adequate sight distance is available for both pedestrians and motorists.

Mid-block Crossings of Shared-use Paths

The following issues should also be considered: when a Shared-use Path, such as a rail-trail, intersects a roadway mid-block. Out-of-direction travel should be kept to a minimum. Shared-use Path users will naturally want to cross at the point where they can see the path continuing on the other side of the roadway. If the most direct route presents safety issues, attempts should be made to route the path to the appropriate location well in advance of intersecting the roadway. If the Shared-use Path must parallel the roadway, it should be uninterrupted by driveways and intersections for long distances. For a discussion of Sidewalk Bikeway issues see AASHTO's, *Guide for the Development of Bicycle Facilities*, 1999 pages 20, 22-25 and 58.

[1] AASHTO. *Guide for the Planning, Design, and Operation of Pedestrian Facilities.* 2004, p. 8
[2] Ibid, p. 90

6. Recommended Training and Resources

Nonmotorized transportation is a unique specialization within the transportation field. Typical specializations within transportation, such as planning, signals, safety, geometric design and construction, tend to be focused on one issue and at one scale. Nonmotorized transportation encompasses all of the aforementioned specializations but is focused on particular modes of transportation. Therefore a nonmotorized "specialist" is more accurately described as a generalist who is conversant in a wide range of specializations and is able to work with planning, design and engineering professionals to address nonmotorized issues at a variety of levels.

As nonmotorized transportation planning is an emerging field, there are few formal avenues of study. Most of "experts" in the field have built their knowledge through independent study, specialized national conferences and national peer idea exchange. The professional background includes planners, landscape architects and engineers. Each field brings its own strength and perspective to the field, but all of those fields provide very limited formal education on the subject of nonmotorized transportation.

Perhaps one of the most effective methods of training is first hand experience. Almost all of the professionals who work for MDOT hold a drivers license and are experienced drivers. That experience enriches their work. Their first hand experience as drivers is paired with their professional knowledge to help address situations they encounter at work.

Likewise individuals that have experience commuting as a pedestrian (perhaps as part of a transit trip) or as a bicyclists will in most cases make the most effective staff to address nonmotorized transportation. Walking or bicycling for recreation on nice days on facilities such as local roads and pathways is a completely different experience than year-round commuting where pedestrians and bicyclists interact with motorized vehicles at the busiest times and in all conditions. Book learning can not make up for first hand experience.

The importance of staff training and experience can not be understated. Without knowledgeable staff even the best guidelines may be miss-interpreted and incorrectly applied resulting in ineffective at best and potentially dangerous nonmotorized facilities.

6.1 Recommended Staff Training

Transportation Service Center Staff Training

The Transportation Service Center should have a designated Nonmotorized Transportation Coordinator. This person would be responsible for reviewing all projects to make sure they are in compliance with the applicable guidelines and policies. They will also be responsible for documenting any minor design exceptions and getting the approval for the same from the Region Nonmotorized Transportation Coordinator (or the State Nonmotorized Transportation Coordinator in the absence of a Regional Nonmotorized Coordinator).

TSC Nonmotorized Transportation Coordinator Requirements

This person should ideally be an individual who walks, bikes and/or takes transit for daily transportation trips and has an interest in nonmotorized transportation issues. The recommended requirements for this position are:

1. Completed League of American Bicyclists Effective Cycling Road I Certification. This is to be completed within 1 year.
2. Completed FHWA Independent Course on Pedestrian and Bicycle Transportation. This is to be completed within 1 year.
3. Meets quarterly with the Regional Nonmotorized Coordinator. This requirement anticipates that Region establishes a Nonmotorized Coordinator position. Prior to that time the TSC Nonmotorized Transportation Coordinator should meet with the State Nonmotorized Transportation Coordinator.
4. Beyond the requirements above, the TSC Nonmotorized Coordinator should be encouraged to join the Association of Pedestrian and Bicycle Professionals and MDOT should consider supporting the TSC Nonmotorized Coordinator attending advanced nonmotorized training.

All TSC Staff Training Requirements

The purpose is to introduce the staff to basic nonmotorized issues. At the completion of the overview training staff should understand the basic issues and design requirements.

1. Complete 2 hour Introduction to Bicycle and Pedestrian Issues Seminar.
2. Complete a 2 hour Introduction to Nonmotorized Landscape Sensitive Guidelines Workshop

Regional Office Staff Training

The Regional Office should have a designated Nonmotorized Transportation Coordinator. This person will be responsible for reviewing design exceptions forwarded from the TSC as well as working with staff at the TSC level as necessary to address complicated nonmotorized issues. They will also be responsible for documenting significant design exceptions and getting the approval for the same from the State Nonmotorized Coordinator.

Regional Nonmotorized Transportation Coordinator Requirements

This person should ideally be an individual who walks, bikes and/or takes transit for daily transportation trips and has an interest in nonmotorized transportation issues. The recommended requirements for this position are:

1. Completed League of American Bicyclists Effective Cycling Road I Certification. This is to be completed within one year.
2. Completed FHWA Independent Course on Pedestrian and Bicycle Transportation. This is to be completed within one year.
3. Member of the Association of Pedestrian and Bicycle Professionals.
4. Attends one nonmotorized Training per Year. Training programs would include the Pro-Bike/Pro-Walk Conference held every other year or the Association of Pedestrian and Bicycle Professional's Training Sessions held on alternating years. They should attend their first conference/training session within one year.
5. Meets twice yearly with other Regional Nonmotorized Coordinators. This anticipates that other TSC's also establish a Nonmotorized Coordinator position.

All Regional Staff Training Requirements

The purpose is to introduce the staff to basic nonmotorized issues. At the completion of the overview training staff should understand the basic issues and design requirements.

1. Complete 2 hour Introduction to Bicycle and Pedestrian Issues Seminar.
2. Complete a 2 hour Introduction to Nonmotorized Landscape Sensitive Guidelines Workshop

6.2 Recommended Reference Library

Basic Reference Library for use at the Transportation Service Center Office

- AASHTO, *Policy on Geometric Design of Highways and Streets* (The Green Book)
- MDOT, *MMUTCD 2005 Edition*, (FHWA, *MUTCD, 2003 Edition* with Michigan Supplement)
- AASHTO, *Guide for the Planning, Design, and Operation of Pedestrian Facilities*, 2004
- AASHTO, *Guide for the Development of Bicycle Facilities*, 1999 AASHTO, *Guide for Achieving Flexibility in Highway Design*, 2004
- FHWA, *Designing Sidewalks and Trails for Access, Best Practices Design Guide*, 2001
- US Access Board, Draft Guidelines for Public Rights-of-Way, 2005

Supplemental Reference Materials for use at the Region Office

- ITE, *Innovative Bicycle Treatments, an Informational Report*, 2002
- ITE, *Alternative Treatments for At-Grade Pedestrian Crossings*, 2001
- ITE, *Design and Safety of Pedestrian Facilities*, 1998
- CITE, *Promoting Sustainable Transportation Through Site Design*, 2004
- TRB/NCHRP, *Report 500, Volume 10 – A Guide for Reducing Collisions Involving Pedestrians*, 2004

Supplemental Reference Materials for use at the State Office:

- FHWA, *Safety Effects of Marked vs. Unmarked Crosswalks at Uncontrolled Locations*, 2002
- VELO, *Technical Handbook of Bikeway Design, 2nd Edition*, 2003
- PBIC/City of Chicago, *Bike Lane Design Guide*, 2002
- TRB, *Transportation Research Record No. 1828, Pedestrians and Bicycles 2003*
- ITE, *Transportation Planning Handbook*, Chapter 16: Bicycle and Pedestrian Facilities, 1999
- Oregon Department of Transportation Design Guidelines
- Florida Department of Transportation Design Guidelines

7. Implementation and Funding Guidelines

The guidelines put forth in Section 5, outline AASHTO minimums and desired minimums for a variety of situations. As with all guidelines each project presents challenges related to physical and financial constraints. The following are guidelines on how to implement and fund projects based on the type of project.

Guiding Principals:

- MDOT should always strive to provide the minimum desirable nonmotorized facilities in all projects.
- Where physical constraints exist that make it difficult or impossible to meet the minimum desirable guidelines, a compromise should be made to accommodate all modes rather than provide a higher level of service for only one or two modes.

7.1 New or Reconstruction Projects

The following applies to new or reconstruction projects of the roadway. These projects are long-term investments and should be constructed to accommodate all modes of travel at a high level of service.

Implementation

In-road nonmotorized facilities such as paved shoulders, bike lanes, crossing islands, crosswalks, curb extensions, pedestrian signals, etc. should be included in the scope of work of the project. Nonmotorized facilities outside of the roadway, such as sidewalks or shared-use paths should be included in the scope of work whenever an agreement with the appropriate local agency can me made. If no agreement can be made then the ROW should be graded to accommodate an appropriately sized and located sidewalk in the future. If a sidewalk exists and needs to be relocated or replaced to accommodate roadway construction, it should be replaced based on the desired minimums.

Relevant Guidelines

The facilities installed should meet or exceed the desired minimum guidelines (NOT the AASHTO minimum guidelines). The traffic volumes and speeds that are used to determine the appropriate facilities should be the same that are used in the design of the roadway for motorized traffic.

Funding

The cost of the in-road nonmotorized facilities should be a part of the project budget; no special funds should be sought. The cost of nonmotorized facilities outside of the roadway, such as sidewalks, may or may not be a part of the project cost. Funding for these projects could come from local agencies, Enhancement Funds, or from the not less than 1% of the Michigan Transportation Funds (MTF) that are to be spent on nonmotorized facilities and services as stipulated in Section 10k of Act 51. In the *St. Clair County 2030 Long-Range Transportation Plan*, the county set a target of 5% of their MTF for nonmotorized facilities and services. It is recommended that MDOT consider that same target. MDOT may utilize up to half of the Section 10k allocation for nonmotorized facilities and services on sidewalks.

When a local agency requests nonmotorized facilities that exceed the guidelines within this document, the local agency should be expected to contribute to the cost of the nonmotorized improvements beyond that which MDOT has indicated as an appropriate facility based on these guidelines.

7.2 Resurfacing, Restoration, & Rehabilitation Projects (3R)

3R projects are the most common type of projects. They represent an opportunity to incorporate nonmotorized facilities at minimal costs. They also present an opportunity to add nonmotorized facilities to priority nonmotorized routes by incorporating the nonmotorized improvements into the larger 3R project. This typically results in significant cost savings.

Implementation

Each project should be evaluated to see if the roadway may be retrofitted to accommodate nonmotorized facilities. Examples include narrowing travel lanes to provide Bike Lanes and 4 to 3 lane conversions that incorporate Bike Lanes.

If the route is designated as a high priority nonmotorized corridor, the appropriate nonmotorized facilities should be added to the scope of work.

Relevant Guidelines

Where existing roadways are being retrofitted, AASHTO guidelines should be met at a minimum.

Where new facilities are being added, the facilities should meet or exceed the desired minimum guidelines (NOT the AASHTO minimum guidelines). The traffic volumes and speeds that are used to determine the appropriate facilities should be the same that are used in the design of the roadway for motorized traffic.

Funding

The cost of the in-road nonmotorized facilities that are being retrofitted to the existing roadway should be included the project budget; no special funds should be sought. The cost of new facilities, such as paved shoulders, crossing islands, etc. would generally come from the allocation of not less than 1% of the Michigan Transportation Funds (MTF) that Section 10k of Act 51 stipulates are to be spent on nonmotorized facilities and services. In the *St. Clair County 2030 Long-Range Transportation Plan*, the county set a target of 5% of their MTF for nonmotorized facilities and services. It is recommended that MDOT consider that same target.

The cost of nonmotorized facilities outside of the roadway, such as sidewalks, may or may not be a part of the project cost. MDOT may utilize up to half of the Section 10k allocation for nonmotorized facilities and services on sidewalks. MDOT may also seek funding from local agencies to cover all or part of the sidewalk cost.

When a local agency requests that nonmotorized facilities be constructed such that they cost more than the prescribed minimum, MDOT may enter into an agreement with the local agency such that the local agency contributes the cost of nonmotorized components beyond that which MDOT has indicated as appropriate facility.

7.3 Preventative Maintenance Projects

Many preventative maintenance project involve pavement markings. This provides an opportunity to evaluate the roadway to see if it is a candidate for reconfiguring the lanes so make room for Bike Lanes, paved shoulders.

Implementation

Each project should be evaluated to see if the roadway may be retrofitted to accommodate nonmotorized facilities. Examples include narrowing travel lanes to provide Bike Lanes and 4 to 3 lane conversions that incorporate Bike Lanes.

Relevant Guidelines

Where existing roadways are being retrofitted, AASHTO guidelines should be met at a minimum.

Funding

The cost of the in-road nonmotorized facilities that are being retrofitted to the existing roadway should be a part of the project budget; no special funds should be sought.

When a local agency requests that nonmotorized facilities be constructed such that they cost more than the prescribed minimum, MDOT may enter into an agreement with the local agency such that the local agency contributes the cost of nonmotorized components beyond that which MDOT has indicated as appropriate facility.

7.4 Stand-alone Nonmotorized Projects

Some nonmotorized projects will have no relation to a roadway construction project. These may include a trail crossing, upgrading a crosswalk as part of a safe-routes-to-school program or addressing a safety issue.

Implementation

These projects should be reviewed and prioritized by a subcommittee of the local Metropolitan Planning Organization.

Relevant Guidelines

As these are new facilities, the desired minimums should be met. The traffic volumes and speeds that are used to determine the appropriate facilities should be the same that are used in the design of the roadway for motorized traffic.

Funding

The cost of the stand-alone nonmotorized projects would generally come from the allocation of not less than 1% of the Michigan Transportation Funds (MTF) that Section 10k of Act 51 stipulates are to be spent on nonmotorized facilities and services. In the *St. Clair County 2030 Long-Range Transportation Plan*, the county set a target of 5% of their MTF for nonmotorized facilities and services. It is recommended that MDOT consider that same target.

8. Design Guidelines

These planning and design guidelines should be consulted when planning new facilities or reconstructing or modifying existing facilities. This section includes some background information on pedestrians and bicyclists to support the guidelines.

Topics:

8.1 Understanding Pedestrian Travel

8.2 Understanding Bicycle Travel

8.3 Travel Along Road Corridors

8.3 Travel Across Road Corridors

8.5 Travel on Independent Pathways

8.6 Pedestrian Travel in Commercial Centers

Planning for pedestrian and bicycle travel is significantly different than planning for motor vehicle travel. In measurements of age, uniform education, licensing, physical abilities, and even the speed range on a given facility, pedestrians and bicyclists are tremendously diverse groups as compared to motor vehicle operators. A wide range of abilities must be planned and accommodated for, since there is no such thing as a typical pedestrian or bicyclist.

8.1 Understanding Pedestrian Travel

Trip Types and Distances

Speed and continuity of travel path are key factors that influence the likelihood of a person attempting a trip on foot, versus in the car or on a bike. The average speed for a pedestrian is 3 to 4 mph. This speed varies greatly according to age, trip purpose and fitness level. Pedestrians, like drivers, are significantly affected by the number of traffic signs and signals encountered. The number of traffic signs and signals significantly affect travel time for pedestrians as well as motor vehicles.

Because walking is such a comparatively slow method of transportation, most trips that are taken by pedestrians are limited to short distances. Nationally 44% of trips taken by foot are for personal or family business, with social and recreational trips close behind at 35%. Earning a living only counts for 7% of pedestrian trips. The percentage of people who will choose walking as a form of transportation drops off significantly for trips of over a mile-and-a-half and is negligible for trips over 3 miles. Pedestrians generally take the shortest possible route available, and are not willing to go far out of their way. For example, many pedestrians will make a dash across a busy street if they must walk more than a block to a signalized intersection.

Perhaps the most important factor affecting a pedestrian trip is exposure to motor vehicles and the speed at which the motor vehicles are moving. For both safety and aesthetic reasons, the quality of a pedestrian’s journey is much different when walking along a tree-lined path versus along a busy five-lane road with heavy truck traffic and no vegetation for shade. Also, it is much safer and more pleasant to walk along a street where the speed limit is 25 mph versus a street where the speed limit is 50 mph. Statistics show that a pedestrian’s probability of death if hit by a motor vehicle increases from 15% when the car is going 20 mph to 85% if the car is going 40 mph.

Most likely, for a trip of any length, a pedestrian will need to cross a roadway. Are pedestrian crossing facilities available? Is there a signalized intersection conveniently placed? Do the busy roads have crossing islands? Will the pedestrian have to make a mid-block dash in order to avoid going significantly out of their way? All of these factors influence the quality and safety of a pedestrian’s journey, and may well determine whether or not they will attempt the journey in the first place—or, whether they will attempt that same journey again.

8.2 Understanding Bicycle Travel

One of the most controversial issues in regarding how to accommodate bicyclists within the road right-of-way is whether they are better accommodated in the roadway itself or on a path along side the road. Also, if bicycles are to be accommodated within the roadway, should a portion of the roadway be officially designated for bicycles? When addressing these issues, legal rights, safety, travel efficiency, nationally accepted guidelines and conflicts with pedestrians need to be considered. Prior to discussing these issues, there are a few terms that need to be defined:

Legal Rights

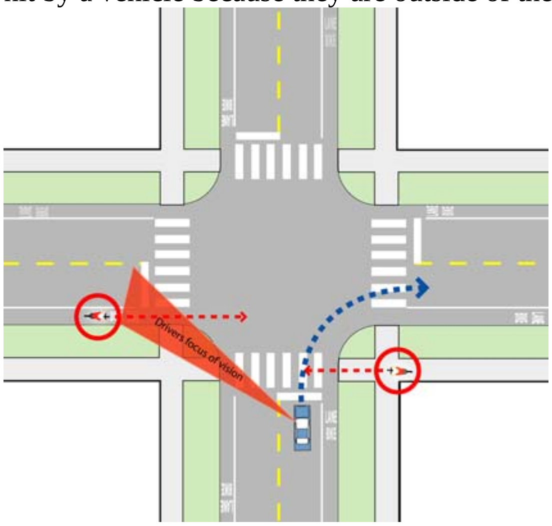
Bicyclists, for the most part, are granted the same rights and subject to the same regulations as motorists. There are some exceptions, such as their use being restricted from freeways, and some special rules regarding their operation, such as riding as close to the right as practical. Through State Law, local agencies have the option to require bicycles to use a path adjacent to the roadway if it has been officially designated for mandatory use. According to state law, if the bicycle rider is less than 16 years old they are required to use an officially designated path.

Safety

While it may seem that bicyclists would be safer on a Sidewalk Bikeway than riding in the roadway, in most cases the inverse is actually true. This is due primarily to the bicycles traveling at a high speed in an area where the drivers of turning vehicles are not looking. This is illustrated in Fig. 2.2A *Bike Lane visibility Vs. Sidewalk Visibility* illustration on the next page. The more frequent and busy the road and driveway intersections are the more chances there are for conflicts.

Fig. 8.2A. Bike Lane Visibility Vs. Sidewalk Visibility

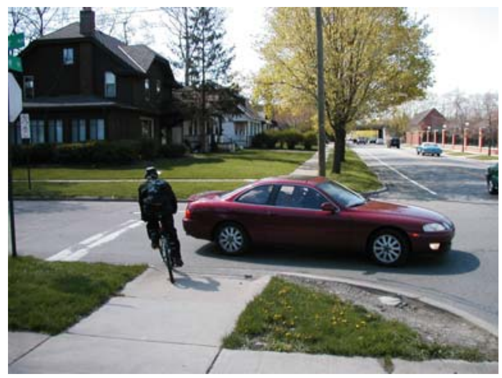
Bicycles traveling the opposite direction of traffic on sidewalks have significantly greater chance of being hit by a vehicle because they are outside of the driver's typical field of view.

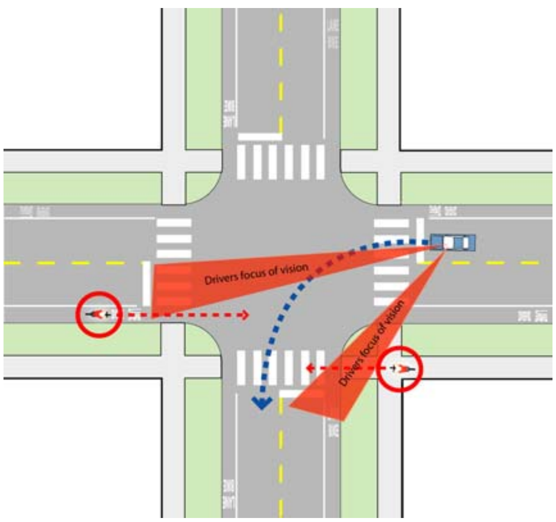


Car turning right

Bicyclist in Bike Lane is in the driver's focus of vision as they scan oncoming traffic and is easily seen.

Bicyclist on Sidewalk Bikeway/Sidewalk is not in the driver's focus of vision and can't easily be seen until just before impact.

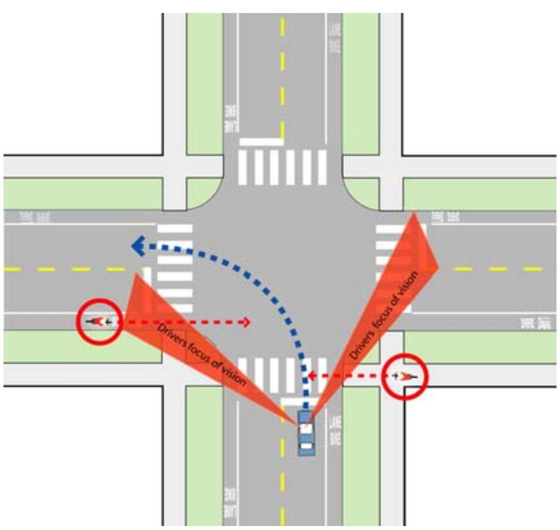




Car turning left

Bicyclist in Bike Lane is in the driver's focus of vision as he/she scans oncoming traffic and is easily seen.

Bicyclist on Sidewalk Bikeway/Sidewalk is not in the driver's focus of vision and can't easily be seen until they are in crosswalk.



Car turning left

Bicyclist in Bike Lane is in the driver's focus of vision and is easily seen.

Bicyclist on Sidewalk Bikeway/Sidewalk is not in the driver's focus until just before impact.

Graphics based on those prepared by Richard Moeur, P.E. for his Good Bicycle Facility Design Presentation available at http://members.aol.com/rcmoeur/

Travel Efficiency

One of the most significant drawbacks to bicycling on sidewalks as opposed to bicycling in the roadway is the loss of right-of-way when traveling along collectors and arterials. When riding in the roadway of a major road, the vehicular traffic on side streets that do not have a traffic light generally yield to the bicyclists on the main road. If riding on a sidewalk, the bicyclist must yield to vehicles in those same side streets. In addition, the cyclist must approach every driveway with caution due to the visibility issues cited in the previous section and the fact that drivers rarely give right-of-way to a bicyclist on sidewalks. As well, the placement of many push-buttons used to trigger walk signals are often inconveniently placed for a cyclist.

It is unclear whether bicyclists have the same legal standing in crosswalks as do pedestrians. It would appear that if a bicyclist wants the same legal standing as a pedestrian, they must dismount their bicycle and walk through the intersection, adding delay to their trip. Even if the bicyclist were to ride through the crosswalk, the placement of many pushbuttons used to trigger walk signals are often inconveniently placed for a cyclist.

Bicyclists are also required by law to yield to all pedestrians when riding on a sidewalk and provide an audible signal of their approach. As the number of pedestrians increase, a bicyclist's progress can be severely impeded and the requirement for audible signal onerous.

The location of sidewalks is often such that when a vehicle on an intersecting driveway or roadway is stopped and waiting for traffic to clear on the through road, their position blocks the sidewalk. This requires difficult and often dangerous maneuvering to circumnavigate the stopped vehicle. As a result of all of the above factors, bicyclists who are using their bike for utilitarian purposes infrequently use sidewalks because they essentially have to yield to all other users in the road corridor.

Pedestrian Conflicts

As the number of bicyclists and pedestrians increase on a shared facility, the number of conflicts increase and pedestrians' comfort decreases. Pedestrians typically travel 2 to 4 miles per hour and bicyclists travel between 8 and 20 miles per hours. The speed difference is significant and the stealthy nature of a bicycle means that pedestrians generally have little to no audible warning of a bicycle approaching from behind. Pedestrians and bicyclists can both be severely injured in bicycle / pedestrian crashes.

AASHTO Guidelines

The American Association of State Highway and Transportation Officials (AASHTO) publishes *A Policy on Geometric Design of Highways and Streets* that is also known as "The Green Book." This set of guidelines is the primary reference for street design used by federal, state, county and local transportation agencies. For guidance on how to accommodate bicycles, The Green Book references AASHTO's *Guide for the Development of Bicycles Facilities*. Federal and most state sources of funding require that bicycle projects conform to these guidelines. AASHTO's guidelines specifically discuss the undesirability of Sidewalks as Shared Use Paths. Sidewalk Bikeways are considered unsatisfactory for the all of the reasons listed above. Only under certain limited circumstances do the AASHTO guidelines call for Sidewalk Bikeways to be considered. On page 20 of the guidelines these circumstances are spelled out as:

a) *To provide bikeway continuity along high speed or heavily traveled roadways having inadequate space for bicyclists, and uninterrupted by driveways and intersections for long distances.*

b) *On long, narrow bridges. In such cases, ramps should be installed at the sidewalk approaches. If approach bikeways are two-way, sidewalk facilities also should be two-way.*

Additional Considerations

Children Riding on Sidewalks – Young children will most likely continue to ride on the sidewalk even if on-road facilities are provided. The risks previously mentioned still hold true, but factors such as unfamiliarity with traffic and the limited depth perception typical of young children should also be considered when choosing the most appropriate facility to use. Also, young children, in general, may be riding at lower speeds than adults.

Transition Points – One of the difficulties in creating a system where bicycle travel is accommodated within a patchwork of on- and off-road facilities is the transition from one facility to the other. The point where the bicyclist leaves the sidewalk to join the roadway is especially difficult at intersections.

Access of Destinations – If a Sidewalk Bikeways are used, consideration should be given to how bicyclists will access destinations on the opposite of the roadway.

Consistent Expectations – One of the overall goals in transportation planning is to improve safety through clear and consistent expectations between road users. Educating bicyclists to ride in different manners from place to place or region to region causes confusion for all of the users.

Redundancy of Facilities – Bicyclists are not restricted from riding in most roadways, nor is it likely that bicyclists will ever be required to ride on a Sidewalk Bikeway given their known safety issues. Therefore, the presence of bicycles in the roadway should be taken as a given. Any off-road facilities that are constructed should be viewed as supplemental to accommodations within the roadway.

Driver and Bicyclist Behavior – There is ample room for improvement to the behavior of bicyclists and motorists alike in the way they currently share (or don't share) the roadway. Community education programs coupled with enforcement programs are the best approach for addressing this issue.

Passing on the Right – In a shared roadway scenario, it is dangerous for a bicyclist to pass a line of cars on the right. Bike lanes have the important advantage of allowing bicyclists to safely pass a line of cars waiting at an intersection. Much like the rewards for carpoolers traveling in a high occupancy vehicle lane, a Bike Lane gives bicyclists preference in moving through congested areas. Bikes can move to the front of an intersection more easily, allowing for better visibility and safer integration among motor vehicles, as well faster travel.

8.3 Travel Along Road Corridors

Our roadway network has been designed primarily to move cars safely, efficiently, and with minimal disruption. This network includes major arterial streets that place cars in multiple lanes moving at high speeds for long distances. These major transportation corridors usually present tremendous challenges when we try to retrofit them with nonmotorized facilities. There are two primary types of nonmotorized movements related to road corridors:

- Travel Along the Road Corridor (Axial Movements) that utilizes sidewalks, shoulders, and bikeways.
- Travel Across the Road Corridor (Cross-corridor Movements) that utilizes intersections, crosswalks, and grade-separated crossings such as bridge overpasses or tunnel underpasses.

Pedestrian travel along road corridors is accommodated by sidewalks or shared-use paths.

Bicycle travel along road corridors is accommodated by Bike Lanes, shared roadways, and shared-use paths. Restricting bicycles to a path along a roadway—while potentially a legal option—is fraught with safety concerns. This diminishes the attractiveness of using a bicycle for transportation.

Multi-Modal Corridor Width Requirements

While primary roads are classified as Principal Arterials, Minor Arterials, and Collectors, there is not in practice a direct relationship between a road's classification and the number of lanes or lane width. Factors such as the available right-of-way, existing infrastructure and context have a significant influence in a road's design.

Multi-Modal Roadway Widths

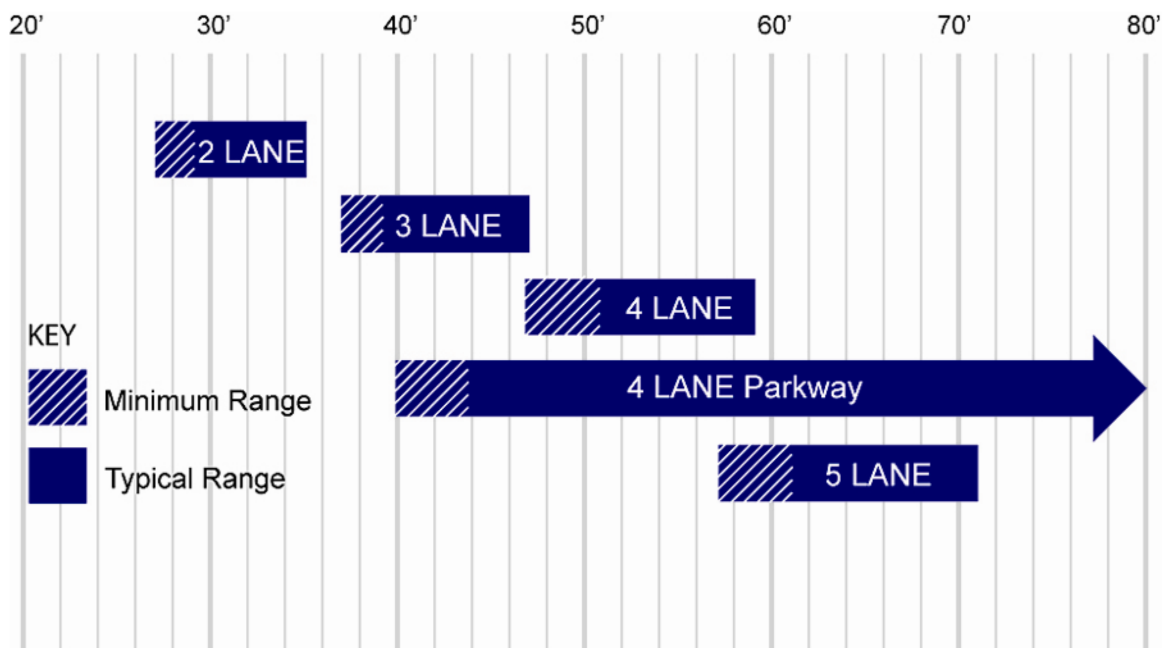
There are various configurations of overall road widths depending on individual lane widths. For instance, a road may have anywhere from ten to twelve foot travel lanes and three-&-one-half to five-&-one-half foot Bike Lanes. Variation in any or all of these widths has an impact on overall road width.

Also affecting roadway widths are:

- Parking – adds approximately seven feet to each side of the road and increases roadway width requirements.
- Speed – wider motor vehicle lanes generally increase speed of motor vehicles. With high speed roads, wider Bike Lanes are desirable to increase the lateral separation between motor vehicles and bicycles.

Fig 2.3E, Multi-Modal Roadway Width Requirements, illustrates the range of widths for typical multi-modal road types. The Minimum Range is based on AASHTO minimum guidelines. The Typical Range begins based on the dimensions in the Scenarios shown for a Collector Road. The upper range is based on the maximum dimensions that would typically be encountered for motor vehicle and Bike Lanes.

Fig 8.3A. Multi-Modal Roadway with Bike Lanes Width Requirements



Multi-modal ROW Widths

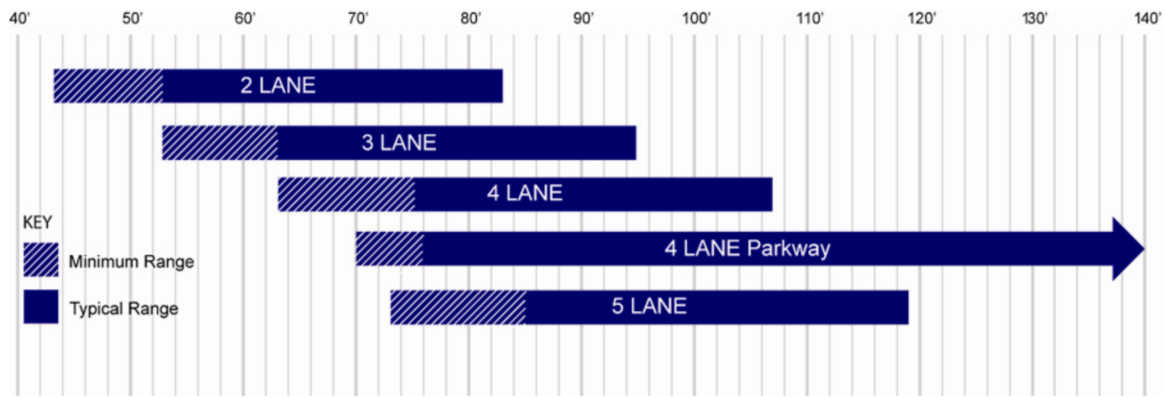
In addition to the road, the ROW contains sidewalks or shared-use paths, the buffer area between the sidewalk and the road and space for a median if any. There is tremendous variation within some variables such as the buffer and the median distance. Also a small portion of a road's ROW may be used for actual road improvements.

Fig 2.3F, Multi-Modal ROW Width Requirements, illustrates the range of widths for typical multi-modal ROWs. If ROW is greater than any of the given scenarios, then all those that fall within that width are feasible. For instance, a ROW of 66' could accommodate a two or three lane road. The two lane road would simply have more opportunities for flexibility than the three lanes. Note that it is not always preferable to go to the maximum allowable ROW width. Bigger is not necessarily better. The best width will depend on contextual circumstances in a given a situation. Special circumstances, however, may make it necessary to make maximum use of the ROW.

Other issues that have a bearing on ROW widths include:

- Parking – parallel on-street parking adds approximately seven feet to each side of the road and increases ROW requirements, though in some circumstances the space would be deducted from the buffer.
- Speed – as noted under Multi-Modal Roadway Widths, higher speeds generally increase the need for a wider road. Higher speeds also make a wider buffer more desirable.

Fig 8.3B. Multi-Modal Right-of-Way Width Requirements



Multi-modal Roadway Design Guidelines

The following pages provide guidance on typically required road width, ROW width and cross section elements for the following typical roadway types:

- Urban Two-lane
- Urban Three-lane
- Urban Four-lane
- Urban Five-lane
- Urban Four-lane Parkway

Fig 8.3C. Urban Two-lane Multi-Modal Roadway Design Guidelines

Typical Roadway Width Range:

27' – Minimum 29' – Minimum Desirable 35' – Upper Range

Typical Right-of-Way Width Range:

51' – Minimum 54' – Minimum Desirable 74' – Upper Range

Sidewalk, Buffer and Bike Lane Width Guidelines:

	Sidewalk Width	**Buffer Width**	**Bike Lane Width**
Collectors	5' AASHTO Minimum 6' Preferred Minimum	2' AASHTO Minimum 6' Preferred Minimum	3.5' AASHTO Minimum 4' Preferred Minimum
Arterials	5' AASHTO Minimum 8' Preferred Minimum	5' AASHTO Minimum 9' Preferred Minimum	3.5' AASHTO Minimum 5' Preferred Minimum

Notes:

- AASHTO guidelines indicate that 4' wide sidewalks may be used if 5' wide passing spaces for wheelchair users are provided at reasonable intervals.
- AASHTO guidelines indicate that curb-attached sidewalks should be a minimum of 6' wide on Collectors and 8 to 10' wide along busy Arterials.
- Bike Lane widths noted are based on the Bike Lane being adjacent to the MDOT's standard 1.5' wide gutter. AASHTO minimum width Bike Lanes are 5' from face of curb to the Bike Lane stripe. The gutter must be flush with the adjacent roadway in order to count the width of the gutter in the overall width of the Bike Lane.
- Bike Lanes over 5.5' may encourage illegal use as parking lanes.

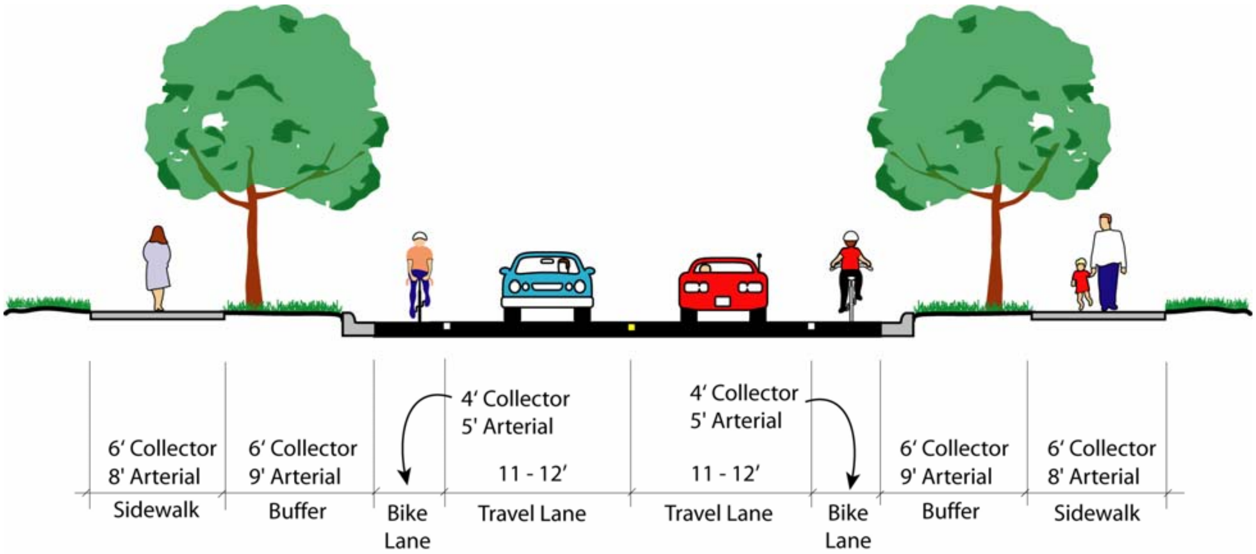
Typical Roadway Cross-Section Guidelines:[1]

Road Width[2]	**27'**	**28'**	**29'**	**30'**	**31'**	**32'**	**33'**	**34'**	**35'**
Bike Lane	3.5'	3.5'	3.5'	4'	4.5'	5'	5.5'	5.5'	5.5'
Travel Lane	10'	10.5'	11'	11'	11'	11'	11'	11.5'	12'
Travel Lane	10'	10.5'	11'	11'	11'	11'	11'	11.5'	12'
Bike Lane	3.5'	3.5'	3.5'	4'	4.5'	5'	5.5'	5.5'	5.5'

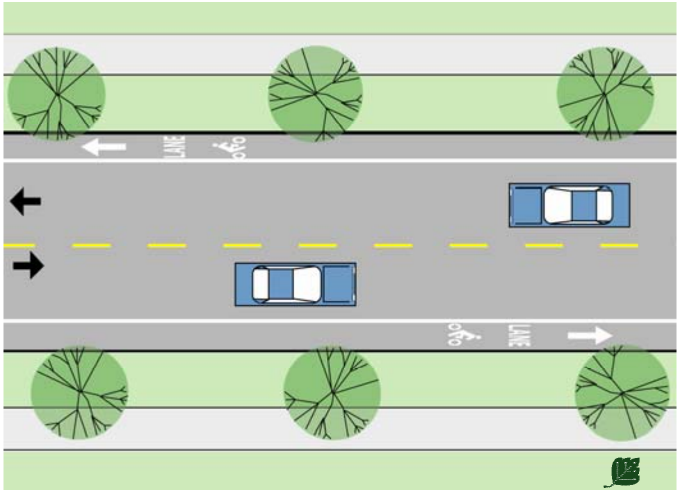
Highlighted cross sections should only be used in specific locations that meet certain conditions for which sub-11' travel lanes are appropriate.

[1] For retrofitting existing streets as well as new street construction or street reconstruction projects
[2] The distance is from edge-of-metal to edge-of-metal and assumes a standard 18" gutter

Urban Two-lane Multimodal Roadway Typical Cross Section



Two-lane Road Typical Plan View



Bike Lanes
On roads with lower speed limits, Bike Lanes may be reduced to the 3.5' minimum (5' total from face of curb). In rural cross sections, the paved shoulder should be a minimum of 4' wide. Bike Lanes over 5.5' may encourage illegal use as parking lanes.

Trees
Tree spacing should be approximately 30' on center. Trees should be placed a minimum 5' back from the face of curb on Arterials and a minimum of 2' back from the face of curb on Collectors. The trees should also be placed a minimum of 2' back from the edge of sidewalk. Tree spacing/alignment should be varied as necessary to permit good visibility at crosswalks and intersections.

Fig 8.3D. Urban Three-lane Multi-modal Roadway Design Guidelines

Typical Roadway Width Range:

37' – Minimum 39' – Minimum Desirable 47' – Upper Range

Typical Right-of-Way Width Range:

53' – Minimum 63' – Minimum Desirable 95' – Upper Range

Sidewalk, Buffer and Bike Lane Width Guidelines:

	Sidewalk Width	**Buffer Width**	**Bike Lane Width**
Collectors	5' AASHTO Minimum 6' Preferred Minimum	2' AASHTO Minimum 6' Preferred Minimum	3.5' AASHTO Minimum 4' Preferred Minimum
Arterials	5' AASHTO Minimum 8' Preferred Minimum	5' AASHTO Minimum 9' Preferred Minimum	3.5' AASHTO Minimum 5' Preferred Minimum

Notes:

- AASHTO guidelines indicate that 4' wide sidewalks may be used if 5' wide passing spaces for wheelchair users are provided at reasonable intervals.
- AASHTO guidelines indicate that curb-attached side walks should be a minimum of 6' wide on Collectors and 8 to 10' wide along busy Arterials.
- Bike Lane widths noted are based on the Bike Lane being adjacent to the MDOT's standard 1.5' wide gutter. AASHTO minimum width Bike Lanes are 5' from face of curb to the Bike Lane stripe. The gutter must be flush with the adjacent roadway in order to count the width of the gutter in the overall width of the Bike Lane.

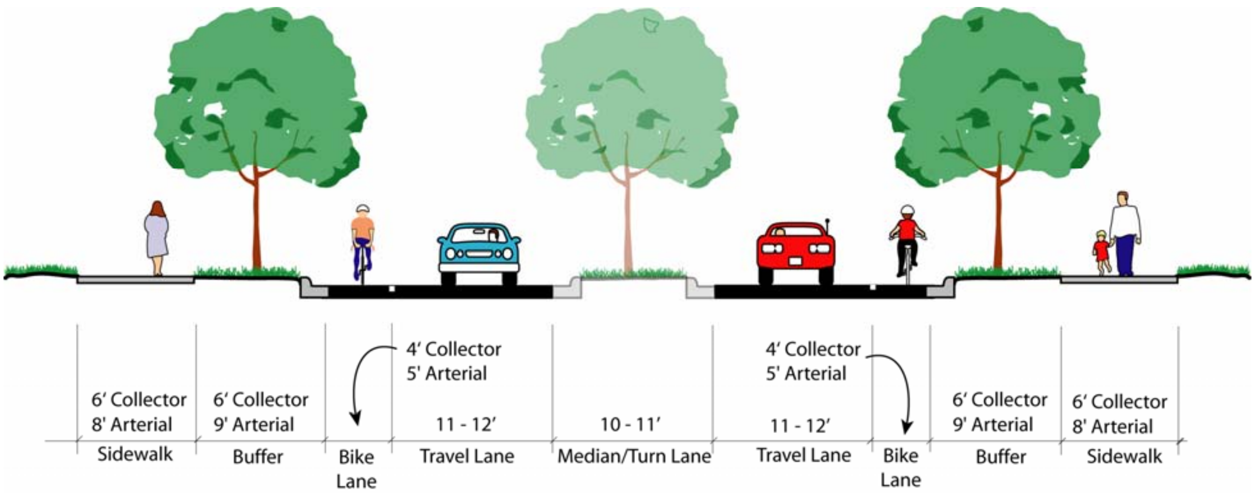
Typical Roadway Cross-Section Guidelines:[1]

Road Width[2]	**37'**	**38'**	**39'**	**40'**	**41'**	**42'**	**43'**	**44'**	**45'**	**46'**	**47'**
Bike Lane	3.5'	3.5'	3.5'	4'	4'	4.5'	5'	5.5'	5.5'	5.5'	5.5'
Travel Lane	10'	10.5'	11'	11'	11'	11'	11'	11'	11.5'	12'	12'
Center Left Turn Lane	10'	10'	10'	10'	11'	11'	11'	11'	11'	11'	12'
Travel Lane	10'	10.5'	11'	11'	11'	11'	11'	11'	11.5'	12'	12'
Bike Lane	3.5'	3.5'	3.5'	4'	4'	4.5'	5'	5.5'	5.5'	5.5'	5.5'

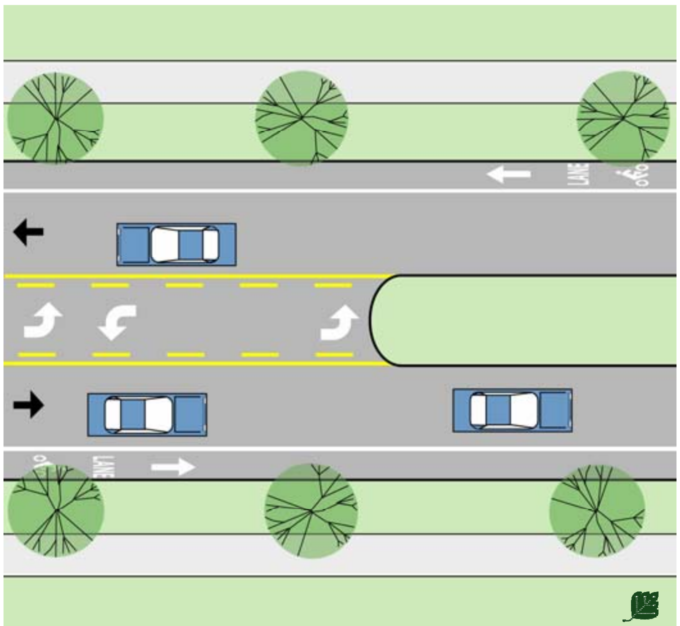
Highlighted cross sections should only be used in specific locations that meet certain conditions for which sub-11' travel lanes are appropriate.

[1] For retrofitting existing streets as well as new street construction or street reconstruction projects
[2] The distance is from edge-of-metal to edge-of-metal and assumes a standard 18" gutter

Urban Three-lane Multi-Modal Roadway Typical Cross Section



Urban Three-lane Multi-Modal Roadway Typical Plan View



Median
A planted median should be incorporated whenever there is no need for a turn lane. The planted median improves the aesthetics of the roadway, reduces the impervious surfaces, can act as an informal crossing island for dispersed mid-block crossings. Medians have also been shown to less expensive to construct and maintain than paving in the long run. The crossing island may also be constructed in a manner that will mitigate storm water run-off.

Bike Lanes
On roads with lower speed limits, Bike Lanes may be reduced to the 3.5' minimum (5' total from face of curb). In rural cross sections the paved shoulder should be a minimum of 4' wide. Bike Lanes over 5.5' may encourage illegal use as parking lanes.

Trees
Tree spacing should be approximately 30' on center. Trees should be placed a minimum 5' back from the face of curb on Arterials and a minim of 2' back from the face of curb on Collectors. The trees should also be placed a minimum of 2' back from the edge of sidewalk. Tree spacing/alignment should be varied as necessary to permit good visibility at crosswalks and intersections.

Fig 8.3E. Urban Four-lane Multi-modal Roadway Design Guidelines

Typical Roadway Width Range:

47' – Minimum   51' – Minimum Desirable   59' – Upper Range

Typical Right-of-Way Width Range:

63' – Minimum   75' – Minimum Desirable   107' – Upper Range

Sidewalk, Buffer and Bike Lane Width Guidelines:

	Sidewalk Width	**Buffer Width**	**Bike Lane Width**
Collectors	5' AASHTO Minimum 6' Preferred Minimum	2' AASHTO Minimum 6' Preferred Minimum	3.5' AASHTO Minimum 4' Preferred Minimum
Arterials	5' AASHTO Minimum 8' Preferred Minimum	5' AASHTO Minimum 9' Preferred Minimum	3.5' AASHTO Minimum 5' Preferred Minimum

Notes:

- AASHTO guidelines indicate that 4' wide sidewalks may be used if 5' wide passing spaces for wheelchair users are provided at reasonable intervals.
- AASHTO guidelines indicate that curb-attached sidewalks should be a minimum of 6' wide on Collectors and 8 to 10' wide along busy Arterials.
- Bike Lane widths noted are based on the Bike Lane being adjacent to the MDOT's standard 1.5' wide gutter. AASHTO minimum width Bike Lanes are 5' from face of curb to the Bike Lane stripe. The gutter must be flush with the adjacent roadway in order to count the width of the gutter in the overall width of the Bike Lane.
- Bike Lanes over 5.5' may encourage illegal use as parking lanes.

Typical Roadway Cross-Section Guidelines:[1]

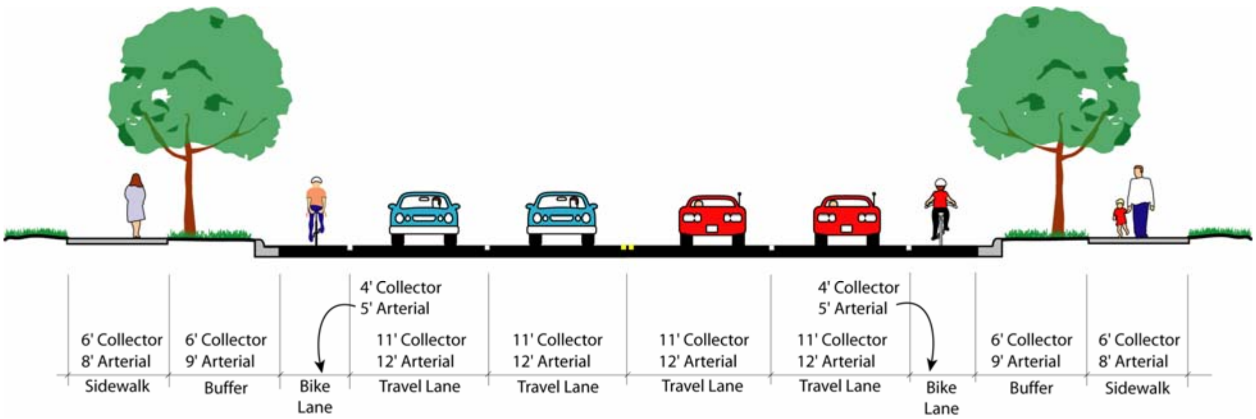
Road Width[2]	**47'**	**48'**	**49'**	**50'**	**51'**	**52'**	**53'**	**54'**	**55'**	**56'**	**57'**	**58'**	**59'**
Bike Lane	3.5'	3.5'	3.5'	3.5'	3.5'	4'	4.5'	5'	5.5'	5.5'	5.5'	5.5'	5.5'
Travel Lane	10'	10.5'	10.5'	11'	11'	11'	11'	11'	11'	11.5'	12'	12'	12'
Travel Lane	10'	10'	10.5'	10.5'	11'	11'	11'	11'	11'	11'	11'	11.5'	12'
Travel Lane	10'	10'	10.5'	10.5'	11'	11'	11'	11'	11'	11'	11'	11.5'	12'
Travel Lane	10'	10.5'	10.5'	11'	11'	11'	11'	11'	11'	11.5'	12'	12'	12'
Bike Lane	3.5'	3.5'	3.5'	3.5'	3.5'	4'	4.5'	5'	5.5'	5.5'	5.5'	5.5'	5.5'

Highlighted cross sections should only be used in specific locations that meet certain conditions for which sub-11' travel lanes are appropriate.

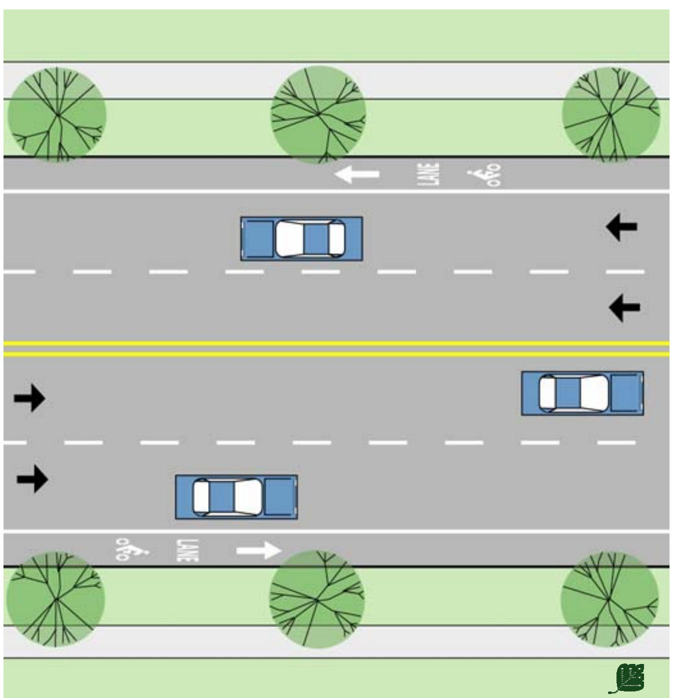
[1] For retrofitting existing streets as well as new street construction or street reconstruction projects

[2] The distance is from edge-of-metal to edge-of-metal and assumes a standard 18" gutter

Urban Four-lane Multi-modal Roadway Typical Cross Section



Urban Four-lane Multi-modal Roadway Typical Plan View



Bike Lanes
On roads with lower speed limits, Bike Lanes may be reduced to the 3.5' minimum (5' total from face of curb). In rural cross sections the paved shoulder should be a minimum of 4' wide. Bike Lanes over 5.5' may encourage illegal use as parking lanes.

Trees
Tree spacing should be approximately 30' on center. Trees should be placed a minimum 5' back from the face of curb on Arterials and a minim of 2' back from the face of curb on Collectors. The trees should also be placed a minim of 2' back from the edge of sidewalk. Tree spacing/alignment should be varied as necessary to permit good visibility at crosswalks and intersections.

Fig 8.3F. Urban Five-lane Multi-modal Roadway Design Guidelines

Typical Roadway Width Range:

57’ – Minimum 61’ – Minimum Desirable 71’ – Upper Range

Typical Right-of-Way Width Range:

73’ – Minimum 85’ – Minimum Desirable 119’ – Upper Range

Sidewalk, Buffer and Bike Lane Width Guidelines:

	Sidewalk Width	**Buffer Width**	**Bike Lane Width**
Collectors	5’ AASHTO Minimum 6’ Preferred Minimum	2’ AASHTO Minimum 6’ Preferred Minimum	3.5’ AASHTO Minimum 4’ Preferred Minimum
Arterials	5’ AASHTO Minimum 8’ Preferred Minimum	5’ AASHTO Minimum 9’ Preferred Minimum	3.5’ AASHTO Minimum 5’ Preferred Minimum

Notes:

- AASHTO guidelines indicate that 4’ wide sidewalks may be used if 5’ wide passing spaces for wheelchair users are provided at reasonable intervals.
- AASHTO guidelines indicate that curb-attached sidewalks should be a minimum of 6’ wide on Collectors and 8 to 10’ wide along busy Arterials.
- Bike Lane widths noted are based on the Bike Lane being adjacent to the MDOT’s standard 1.5’ wide gutter. AASHTO minimum width Bike Lanes are 5’ from face of curb to the Bike Lane stripe. The gutter must be flush with the adjacent roadway in order to count the width of the gutter in the overall width of the Bike Lane.

Five-Lane Road with Bike Lane Cross-Section Guidelines[1]

Road Width[2]	**57’**	**58’**	**59’**	**60’**	**61’**	**62’**	**63’**	**64’**	**65’**	**66’**	**67’**	**68’**	**69’**	**70’**
Bike Lane	3.5’	3.5’	3.5’	3.5’	3.5’	4’	4’	4.5’	5’	5.5’	5.5’	5.5’	5.5’	5.5’
Travel Lane	10’	10.5’	10.5’	11’	11’	11’	11’	11’	11’	11’	11.5	11.5	12	12
Travel Lane	10’	10’	10.5’	10.5’	11’	11’	11’	11’	11’	11’	11’	11.5	12	12
Center Lane	10’	10’	10’	10’	10’	10’	11’	11’	11’	11’	11’	11’	11’	12’
Travel Lane	10’	10’	10.5’	10.5’	11’	11’	11’	11’	11’	11’	11’	11.5	12	12
Travel Lane	10’	10.5’	10.5’	11’	11’	11’	11’	11’	11’	11’	11.5’	11.5	12	12
Bike Lane	3.5’	3.5’	3.5’	3.5’	3.5’	4’	4’	4.5’	5’	5.5’	5.5’	5.5’	5.5’	5.5’

Highlighted cross sections should only be used in specific locations that meet certain conditions for which sub-11’ travel lanes are appropriate.

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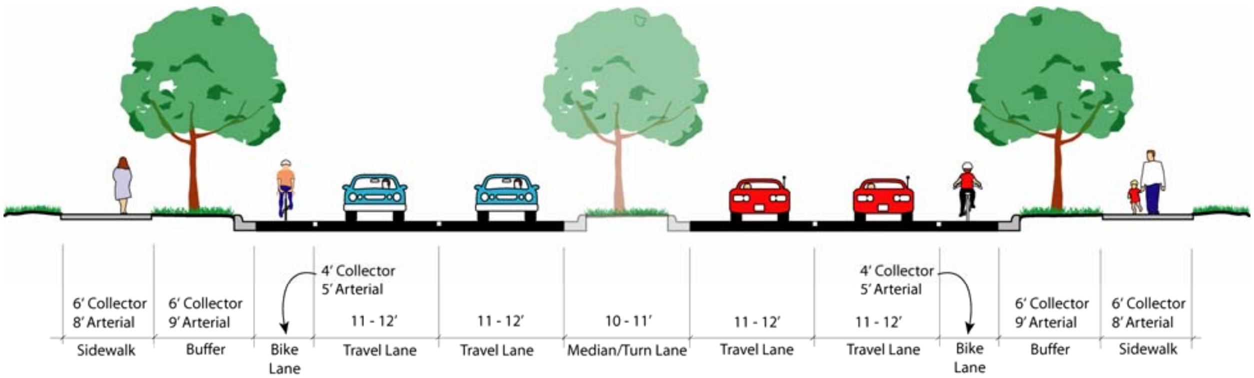
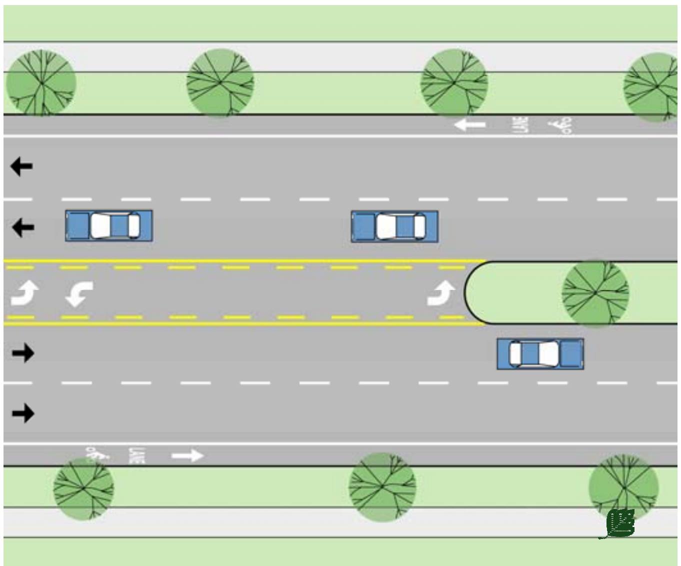
[1] For retrofitting existing streets as well as new street construction or street reconstruction projects

[2] The distance is from edge-of-metal to edge-of-metal and assumes a standard 18” gutter

Five-lane Multi-modal Roadway Typical Cross Section



Five-lane Multi-modal Roadway Typical Plan View



Lane Width
As 5-lane roads are typically higher volume and higher speed facilities, the minimum width indicated should only be considered in extenuating circumstances. Such situations would include areas with numerous driveway and roadway intersections. Where a 5-lane road is a lower speed facility, 57' minimum road width may be considered.

Bike Lanes
On roads with lower speed limits, Bike Lanes may be reduced to the 3.5' minimum (5' total from face of curb). In rural cross sections the paved shoulder should be a minimum of 4' wide. Bike Lanes over 5.5' may encourage illegal use a parking lanes.

Trees
Tree spacing should be approximately 30' on center. Trees should be placed a minimum 5' back from the face of curb on Arterials and a minimum of 2' back from the face of curb on Collectors. The trees should also be placed a minimum of 2' back from the edge of sidewalk. Tree spacing/alignment should be varied as necessary to permit good visibility at crosswalks and intersections.

Median
A planted median should be incorporated whenever there is no need for a turn lane. The planted median improves the aesthetics of the roadway, reduces the impervious surfaces and, can act as an informal crossing island for dispersed mid-block crossings. Medians have also been shown to be less expensive to construct and maintain than paving in the long run. The crossing island may also be constructed in a manner that will mitigate storm water run-off.

Fig 8.3G. Urban Four-lane Parkway Multi-modal Design Guidelines

Typical Roadway Width Range:

47' – Minimum 51' – Minimum Desirable 59' – Upper Range

Typical Right-of-Way Width Range:

63' – Minimum 75' – Minimum Desirable 107' – Upper Range

Sidewalk, Buffer and Bike Lane Width Guidelines:

	Sidewalk Width	**Buffer Width**	**Bike Lane Width**
Collectors	5' AASHTO Minimum 6' Preferred Minimum	2' AASHTO Minimum 6' Preferred Minimum	3.5' AASHTO Minimum 4' Preferred Minimum
Arterials	5' AASHTO Minimum 8' Preferred Minimum	5' AASHTO Minimum 9' Preferred Minimum	3.5' AASHTO Minimum 5' Preferred Minimum

Notes:

- AASHTO guidelines indicate that 4' wide sidewalks may be used if 5' wide passing spaces for wheelchair users are provided at reasonable intervals.
- AASHTO guidelines indicate that curb-attached sidewalks should be a minimum of 6' wide on Collectors and 8 to 10' wide along busy Arterials.
- Bike Lane widths noted are based on the Bike Lane being adjacent to the MDOT's standard 1.5' wide gutter. AASHTO minimum width Bike Lanes are 5' from face of curb to the Bike Lane stripe. The gutter must be flush with the adjacent roadway in order to count the width of the gutter in the overall width of the Bike Lane.
- Bike Lanes over 5.5' may encourage illegal use as parking lanes.

Typical Roadway Cross-Section Guidelines:[1]

Road Width[2]	**47'**	**48'**	**49'**	**50'**	**51'**	**52'**	**53'**	**54'**	**55'**	**56'**	**57'**	**58'**	**59'**
Bike Lane	3.5'	3.5'	3.5'	3.5'	3.5'	4'	4.5'	5'	5.5'	5.5'	5.5'	5.5'	5.5'
Travel Lane	10'	10.5'	10.5'	11'	11'	11'	11'	11'	11'	11.5'	12'	12'	12'
Travel Lane	10'	10'	10.5'	10.5'	11'	11'	11'	11'	11'	11'	11'	11.5'	12'
Travel Lane	10'	10'	10.5'	10.5'	11'	11'	11'	11'	11'	11'	11'	11.5'	12'
Travel Lane	10'	10.5'	10.5'	11'	11'	11'	11'	11'	11'	11.5'	12'	12'	12'
Bike Lane	3.5'	3.5'	3.5'	3.5'	3.5'	4'	4.5'	5'	5.5'	5.5'	5.5'	5.5'	5.5'

Highlighted cross sections should only be used in specific locations that meet certain conditions for which sub-11' travel lanes are appropriate.

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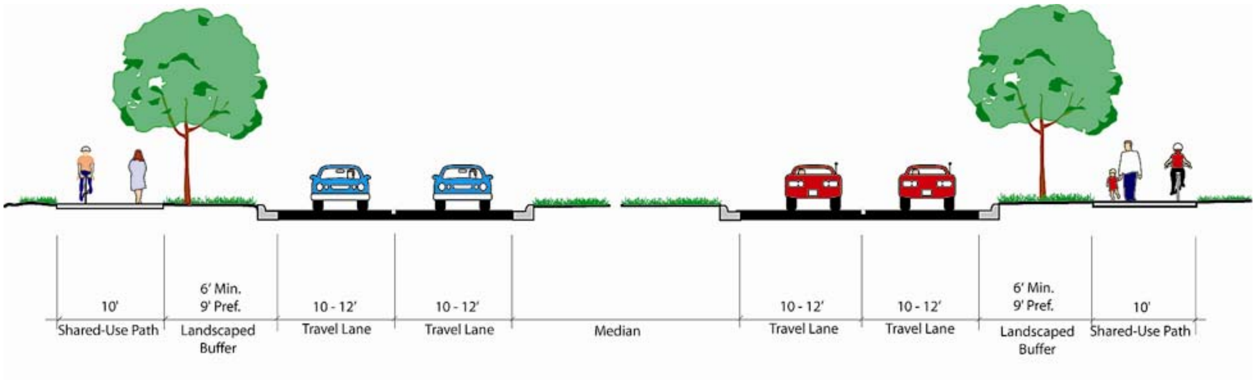
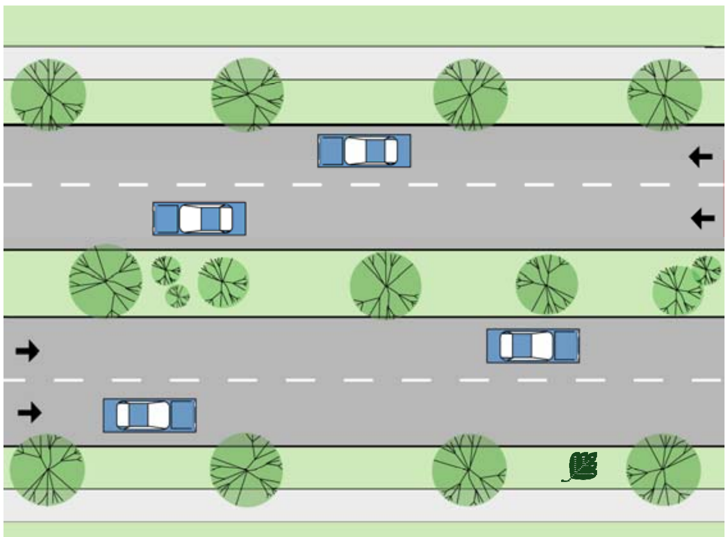
[11] For retrofitting existing streets as well as new street construction or street reconstruction projects

[2] The distance is from edge-of-metal to edge-of-metal and assumes a standard 18" gutter

Urban Four-lane Parkway Multi-modal Typical Cross Section



Urban Four-lane Multi-modal Roadway Typical Plan View



Shared-use Paths
This cross-section may be appropriate for Parkway situations where intersecting roadways and driveways are widely spaced (typically father apart than 1/2 mile) and there is little need to get to destinations on the other side of the road between intersecting roadways and marked mid-block crosswalks.

Care should be taken not to excessively meander the path. Even when on a recreational trip, few bicyclists will travel far out-of-direction unless there is a compelling reason.

The grade of the Shared-use Path should match as close as possible the grade of the road. Excessively steep grades on pathways discourage bicycle travel and may present safety issues. The *AASHTO Guide for the Development of Bicycle Facilities* provides guidelines on the geometric design of Shared-use Paths.

Trees
Tree spacing should be approximately 30' on center. Trees should be placed a minimum 5' back from the face of curb on Arterials and a minim of 2' back from the face of curb on Collectors. The trees should also be placed a minimum of 2' back from the edge of sidewalk. Tree spacing/alignment should be varied as necessary to permit good visibility at crosswalks and intersections.

Median
The planted median improves the aesthetics of the roadway, reduced the impervious surfaces and can act as an informal crossing island for dispersed mid-block crossings. Medians have also been shown to be less expensive to construct and maintain than paving in the long run. The median may also be constructed in a manner to mitigate storm water run-off.

On-Street Parking Guidelines

When adding parking the parking lane should be set at 5.5' (7' total including gutter) and the Bike Lane width should be a minimum of 5' wide. Additional width for Bike Lanes is desirable due to opening doors of parked cars infringing on the Bike Lane width. Bike Lanes wider than 5' should have the door zone cross-hatched to encourage bicyclists to ride a safe distance away from the parked cars.

A 4" stripe should mark the edge of the parking lane to encourage parking as close to the curb as possible. The parking lane should always remain at 5.5'. Any additional room should be allocated toward the Bike Lane first, then to the travel lane adjacent to the Bike Lane.

Multi-modal One-Way Road Design Guidelines

Bike Lanes may be located on either side of a one-way road. For consistency sake, the right hand side should be the default choice. However, there are numerous bus stops with frequent bus service the left hand side of the road may be preferable. If there is on-street parking on one side of the road, the Bike Lane should generally be located on the opposite side of the road than the on-street parking.

Fig. 8.3H Bike Route Guide Signs Design Guidelines

Purpose
Bicycle Route Guide Signs are intended to mark local routes that may not be obvious to users unfamiliar with the area. They are typically on local streets and may utilize pathway connections that link local streets. They are likely to be used by cyclists who are uncomfortable bicycling on the main roads, students bicycling to school or by recreational cyclists.

Directional Signage
The key aspect of a bicycle route is the destination sign that should call out points of interest along the route such as schools, shopping centers or parks (e.g. "To Downtown").

Route Characteristics
Routes signed as a Bike Route should be roads that have a relatively high Quality/Level of Service for bicyclists. The route should not have any known hazards to bicyclists and should be maintained in a manner that is appropriate for bicycle use (e.g. free of potholes, excessively rough surface, debris and puddles).

Where a bicycle route on a local road intersects a busy multi-lane primary road and continues on the other side of the road, a traffic signal or appropriately design mid-block crossing should be provided.

Frequency of Sign Placement
The signs should be placed at every turn, signalized intersection and approximately every ¼ mile along the route.

Fig. H.3I Alternative Bike Route Guide Sign Systems

In 2005, the Chicago Department of Transportation developed a Bike Route signage system that is much more compact and reduces sign clutter. It combines all of the elements of a typical two sign assembly plus it adds distance information into a sign the size of a typical street name sign.

MDOT should evaluate adopting this system as a state standard.

Fig. H.3J Bike Route Signs

Bike Route Signs are used to identify significant state, regional or county routes. St. Clair County has a number of long distance bicycle routes that are a combination of on and off-road bicycle facilities that would fit the criteria. These include the Bridge-to-Bay trail as well as Adventure Cycling Association's "Lake Erie Connector" route.

The route numbers should be identified in related publications such as bicycle and trail maps.

Transitions between Sidewalk Bikeways and Bike Lanes Design Guidelines

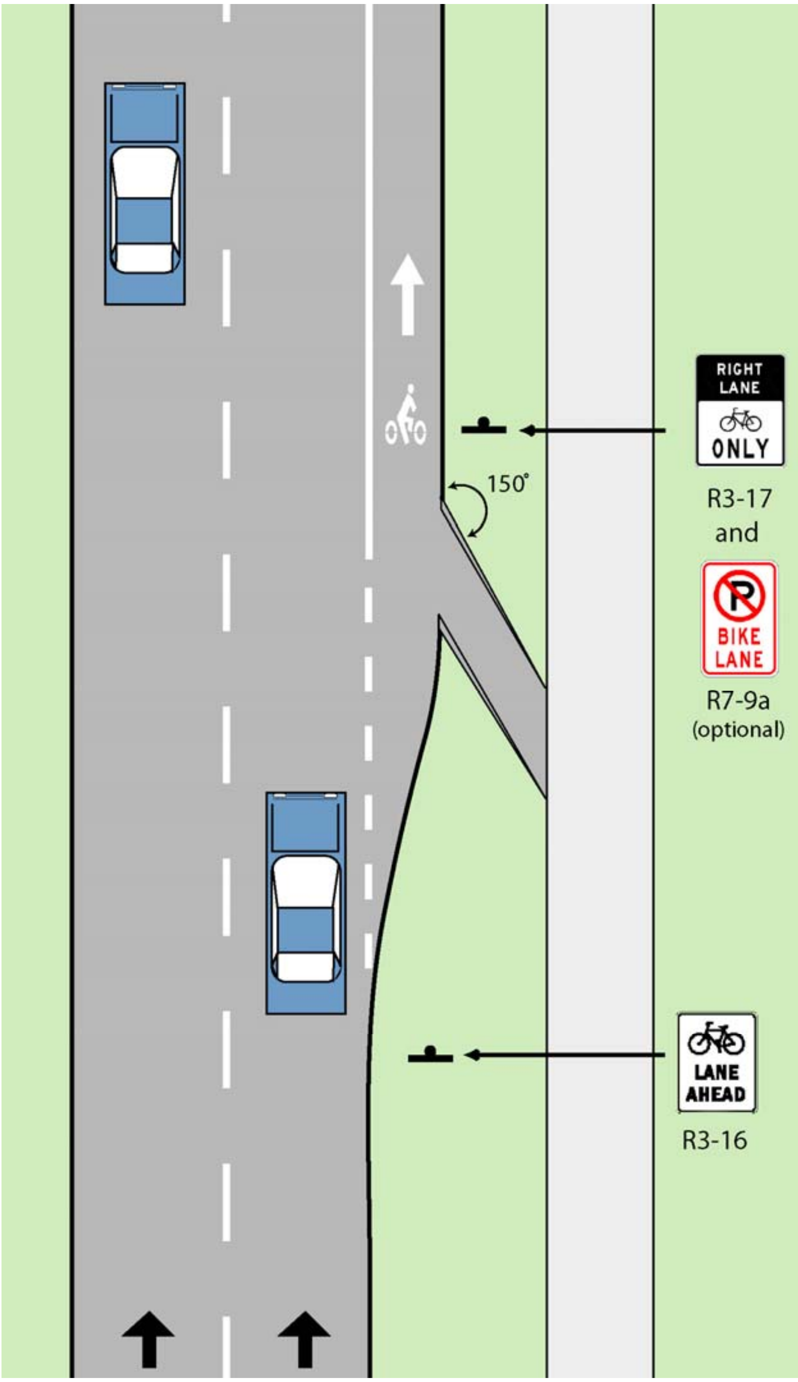
The recommended approach to accommodating bicycles along arterials and collectors is with a bicycle lane. However, there will be places, especially in the near-term, where that may not be possible. This presents a situation where some bicyclists will prefer to continue bicycling in the roadway and others will prefer to leave the roadway and use a sidewalk bikeway. Given the significant variances in bicyclist's abilities, trip purposes, and cycling speeds, forcing all cyclists into a single solution is inappropriate. The solution then is to accommodate both preferences.

The transition points between sidewalk bikeways and bike lanes, presents a number of challenges. This underscores the importance of making the non-motorized system as consistent as possible. When bringing bicyclists into the roadway as shown in Fig 2.3K (next page), the entrance point needs to be protected. Unlike merging points between motor vehicles, the speed differential between bicyclists and motor vehicles may be significant with the potential for hit-from-behind crashes if the merging area is not protected.

When bringing bicycles onto a pathway, there is the potential for conflicts with pedestrians and bicyclists already on the pathway. Trying to segregate bicycles and pedestrians on a single 8' – 10' wide path is not feasible. Each direction for bicycle use requires 4'. Some busy shared-use paths have a dashed yellow line down the center to separate path users by direction of travel. While these tend to work to a degree in busier off-road pathways they are rarely used in sidewalk bikeway situations.

The solution does not differentiate between the sidewalk bikeways that are adjacent to a bike lane from a typical sidewalk. A sign along the pathway can instruct bicyclists to yield to pedestrians per City code. The approach is based on the assumption that the fastest bicyclists will remain in the roadway and share the lane with the motor vehicles rather than leave the roadway and have their travel impeded by pedestrians and driveway crossings.

Fig. 8.3K. Bicycle Entrance Ramp from Sidewalk Bikeway to Bike Lane Design Guideline:



Applications

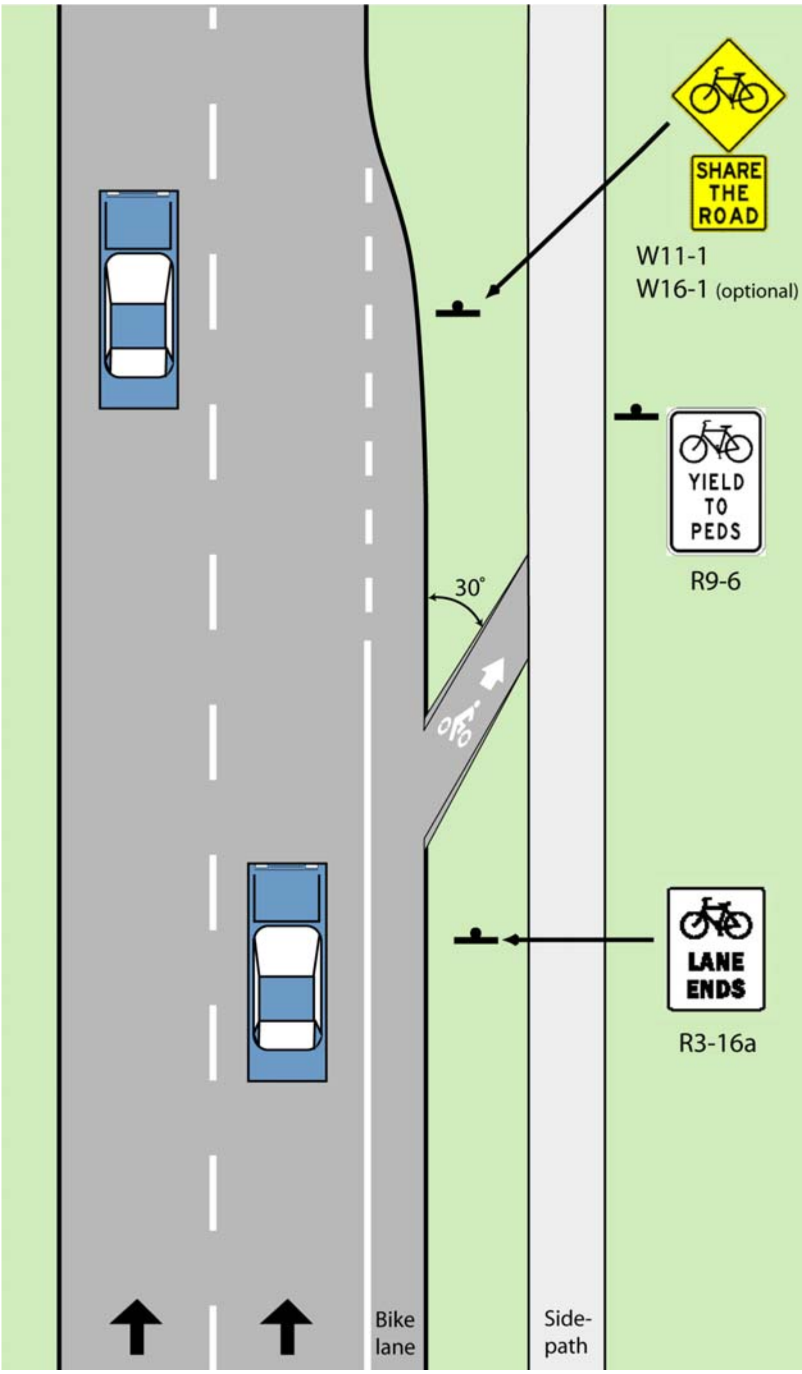
The bike entrance ramp is used to provide easy transition from a Sidewalk Bikeway to a Bike Lane or to allow a bicyclist to enter the roadway to make a turn as a vehicle.

The ramp may be used where a Bike Lane begins or periodically along a Sidewalk Bikeway that parallels a Bike Lane.

Key Elements:

1. Bicyclists have an option to bike either in the Bike Lane or along the Sidewalk Bikeway.
2. The ramp should resemble a curb ramp with flared sides and a flush edge with the road grade.
3. The width of the ramp (not including the flared sides) should be 5’ wide or sized to fit maintenance vehicles designed for sweeping and snow removal.
4. When used at the beginning of a Bike Lane, the road should be widened to accommodate the Bike Lane and protect bikers entering roadway from the Sidewalk Bikeway given the sharp angle of entry. As the road is flared, dashed pavement markings should be used indicate the beginning of the Bike Lane and an area where bikers in the roadway can merge into the Bike Lane.

Fig. 8.3L. Bicycle Exit Ramp from Bike Lane to Sidewalk Bikeway Design Guideline



Applications

The bike exit ramp is used to provide easy transition from a Bike Lane to a Sidewalk Bikeway.

The ramp may be used where a Bike Lane ends or periodically along a Sidewalk Bikeway that parallels a Bike Lane.

Key Elements:

1. Bicyclists have the option of bicycling in the roadway or on a Sidewalk Bikeway.
2. The exit ramp should resemble a curb ramp with flared sides and a flush edge with the road grade.
3. The mouth of the ramp (not including the flared sides) should be 5' wide or sized to fit maintenance vehicles designed for sweeping and snow removal.
4. Where a Bike Lane ends, dashed pavement markings indicate the end of the Bike Lane and an area where bikers are merging back into the roadway. Dashed lines should begin well in advance (150' minimum) of the end of the Bike Lane to ensure adequate warning and a large transition zone.
5. A bike symbol and arrow on the ramp to discourage bicyclists on the Sidewalk Bikeway to enter the roadway going the wrong way.

Designation of Sidewalks as Sidewalk Bikeways

As numerous studies have shown Sidewalk Bikeways to be a more dangerous place to bicycle than in the roadway, MDOT should not designate any Sidewalk Bikeway as a designated bicycle facility. Rather the choice of riding on a sidewalk or in the street should be up to the cyclist based on their experience, comfort level and current conditions. In all cases, the sidewalk/Sidewalk Bikeway should be considered first and foremost for pedestrians. Bicyclists who choose to bicycle on a sidewalk/Sidewalk Bikeway (when permitted by law) must yield to pedestrians. Where an in-road bicycle facility does not exist and the sidewalk/Sidewalk Bikeway is 8’ or wider, the path should be signed for bicyclists to yield to pedestrians.

Modifying Existing Facilities to Incorporate Bike Lanes

The reality of existing road infrastructure must be considered when looking at how Bike Lanes may be added. Waiting for a complete road reconstruction at which time the “ideal” scenario may be applied would result in unnecessary delay in implementing a Bike Lane system. Also, in many cases, existing development, historic districts and natural features dictate that the roadway width will change little if at all even in the long run. Hence, approaches to modifying facilities that work within existing curb lines and with existing storm sewer systems need to be employed.

In some cases, existing travel lanes may be narrowed to accommodate Bike Lanes. In other cases there may be excess road capacity that permits eliminating a lane in order to accommodate Bike Lanes. There may be cases where an alternative road configuration that includes Bike Lanes will work equally as well if not better than the existing conditions for motorists, such as a four to three lane conversion. In most cases though, incorporating Bike Lanes is a compromise between the ideal motorized transportation facility and the ideal bicycle facility in order to establish a true multi-model facility within existing infrastructure limitations. The following guidelines illustrate various techniques for modifying existing facilities in order to incorporate Bike Lanes.

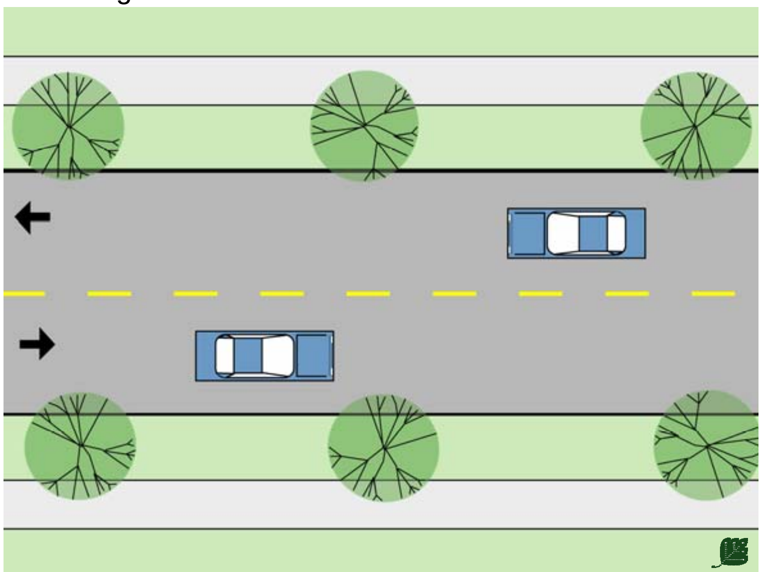
Adding Bike Lanes to High Speed Four and Five-Lane Roads

The narrowing of high speed four and five-lane roads to accommodate Bike Lanes has some specific conversion issues. Given the higher volumes of traffic, higher speeds and higher number of heavy vehicles on many of these roadways, it is desirable to keep the motor vehicle lane widths as close to an 11’ minimum as possible. On some four and five-lane roads, this may mean that it is not possible to accommodate a Bike Lane on both sides of the roadway.

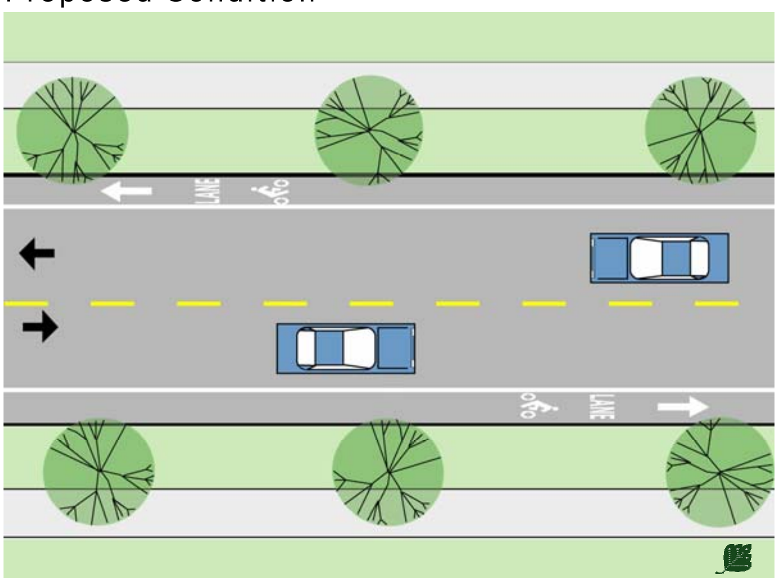
As an interim measure for roads less than 60’, a Bike Lane on one side may be considered in conjunction with a shared lane/side path option on the other side. The Bike Lane should be located on the side with the most driveways and intersecting roads. The other option to consider if there are numerous intersecting roads and driveways on both sides to lower the speed of the roadway so that sub-11’ lanes are more appropriate. This is best accomplished with changes to the physical roadway with such things as planted medians and/or crossing islands. These in combination with the narrow lanes will naturally slow traffic.

Fig. 8.3M. Providing Bike Lanes Through Lane Narrowing Design Guidelines

Existing Conditions



Proposed Condition



Description

The travel lanes are narrowed allowing room for the inclusion of a Bike Lane. The Bike Lane has the additional advantage of providing a buffer between the travel lane and the curb.

AASHTO guidelines specifically discuss narrowing travel lanes in order to accommodate bicycle travel, although there are some situations where narrowing lanes may not be appropriate.

Application

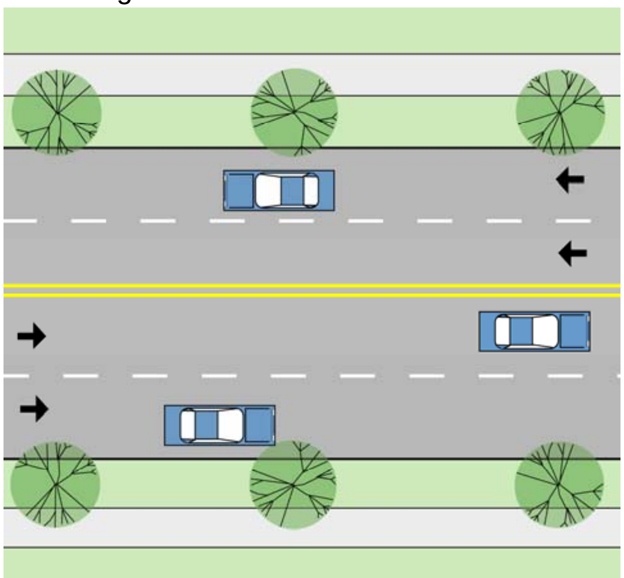
In general, lane narrowing to provide for Bike Lanes may be considered in the following situations:

- 27’ or wider, 2 lane road
- 37’ or wider, 3 lane road (2 lane road with a center turn lane)
- 41’ or wider, 2 lane road with parking on both sides
- 47’ or wider, 4 lane road
- 52’ or wider, 3 lane road with parking on both sides
- 57’ or wider, 5 lane road

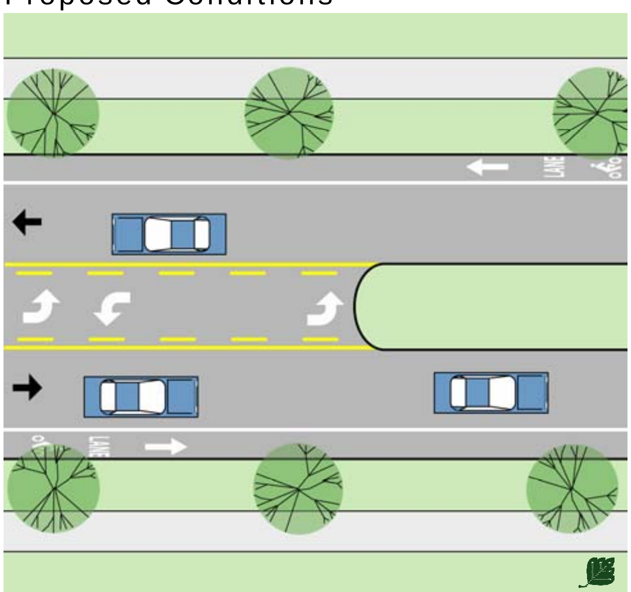
Higher speed roads may require additional width; see notes on multi-modal roadway design guidelines.

Fig. 8.3N. Four-Lane to Three-Lane Road Conversions Design Guidelines

Existing Conditions



Proposed Conditions



Application statistics are referenced from:

Guidelines for the Conversion of Urban Four-lane Undivided Roadways to Three-lane Two-way Left-turn Lane Facilities, April 2001, Sponsored by the Office of Traffic and Safety of the Iowa Department of Transportation, CTRE Management Project 99-54

Description

Four-lane roads present several operational difficulties to motorists. Traffic is often weaving from lane to lane to avoid vehicles that are stopped in the left lane while waiting for a gap in oncoming traffic to make a left turn, or those slowing down in the right lane to make a right turn. The presence of a bicycle in the curb lane also adds to the weaving of traffic if there is not sufficient lane width to pass the bicycle while staying within the lane.

This constant weaving of traffic also makes judging when to enter the road from a driveway or side street difficult as lane positions are changing frequently. This is especially the case for left turns. To address the operational difficulties of 4-lane roadway, the roadway is reconfigured to two through lanes, a center shared left turn lane and/or median and two Bike Lanes.

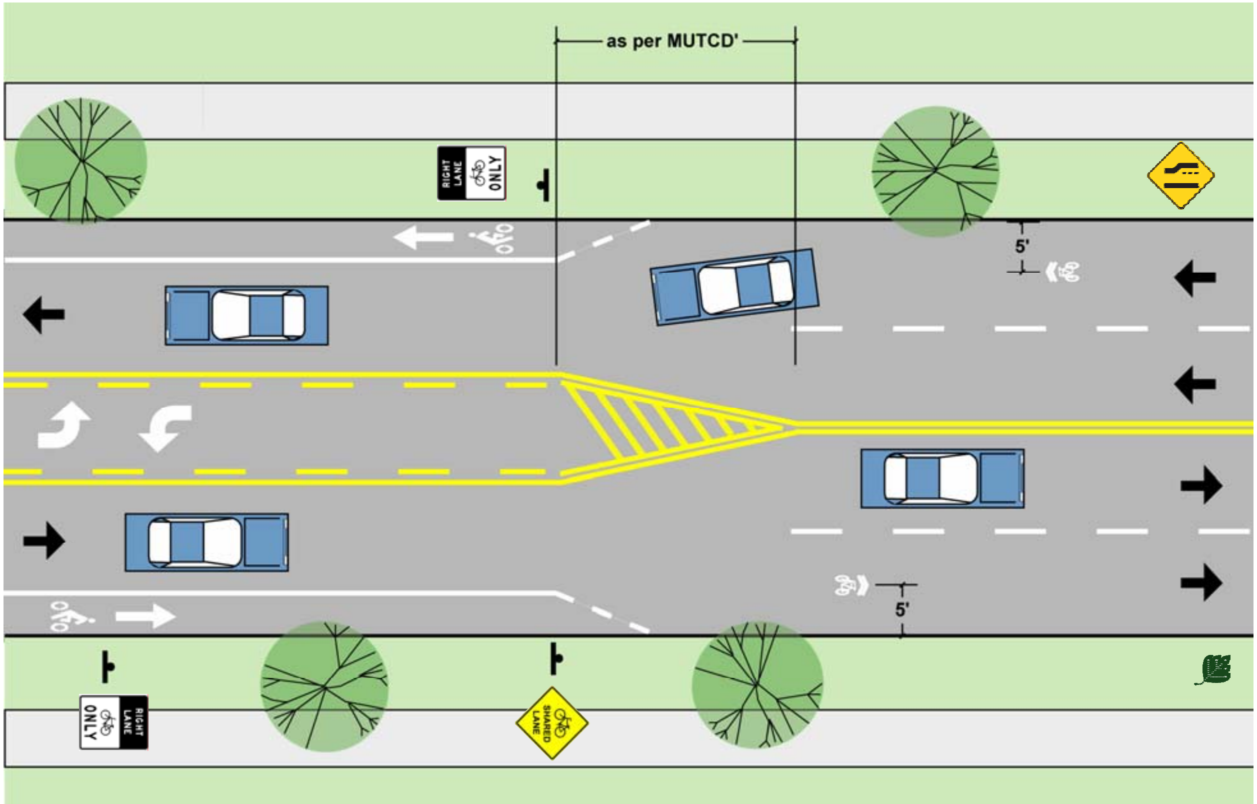
Application

This type of conversion has been used on roadways with up to 24,000 vehicles per day (VPD). Modeling research has shown that in most situations there is no loss in Vehicular Level of Service until about 1,750 vehicles per hour (approximately 17,500 VPD) compared to a four-lane configuration. In addition to a significant improvement in the Bicycle Level of Service, these conversions have been also shown to provide a:

- Reduction of the 85% speed by about 5 MPH
- Dramatic reduction in excessive speeding (60-70%) of vehicles going greater than 5 MPH over the posted speed limit.
- Dramatic reduction in the total number of crashes (17-62%).

Conversions though must be evaluated on a case-by-case basis as numerous factors influence the appropriateness of 4 to 3 lane conversion. Key factors include the frequency of and phasing of traffic signals and how they affect stacking distance as well as the percentage of vehicles making right and left turns.

Fig. 8.3O. Near-term Transition From Three Lanes to Four Lanes at Signals



Description

Where two motor vehicle lanes are needed to accommodate motor vehicle stacking at signalized intersections the Bike Lane may be dropped and replaced with the Shared-Use Arrow.

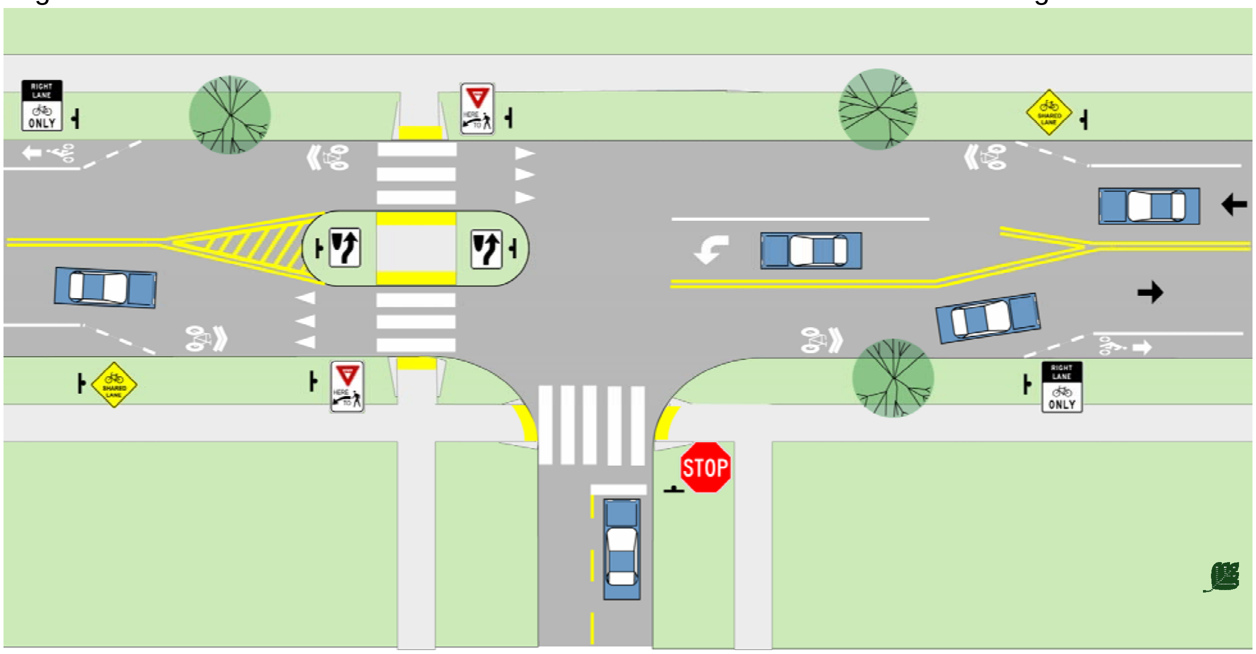
Application

This is an interim approach to accommodating vehicle stacking needs to be used where a Bike Lane is interrupted in the vicinity of a signal. The long-term solution would expand the intersection to accommodate Bike Lanes. The length of the four-lane segment should be minimized.

Three-Lane to Two-Lane Road Conversions

There are cases where a three-lane cross section is used consistently when the need for turn lanes is only intermittent. In these cases a Bike Lane may be added in places where the turn lane is not warranted. The Bike Lane then may be dropped when the turn lane is introduced.

Fig. 8.3P. Near-term Accommodation of Turn Lanes and Crossing islands



Description

Where a designated left-turn lane is warranted and/or a pedestrian crossing island is appropriate, the Bike Lane may be dropped and replaced with the Shared-Use Arrow.

Application

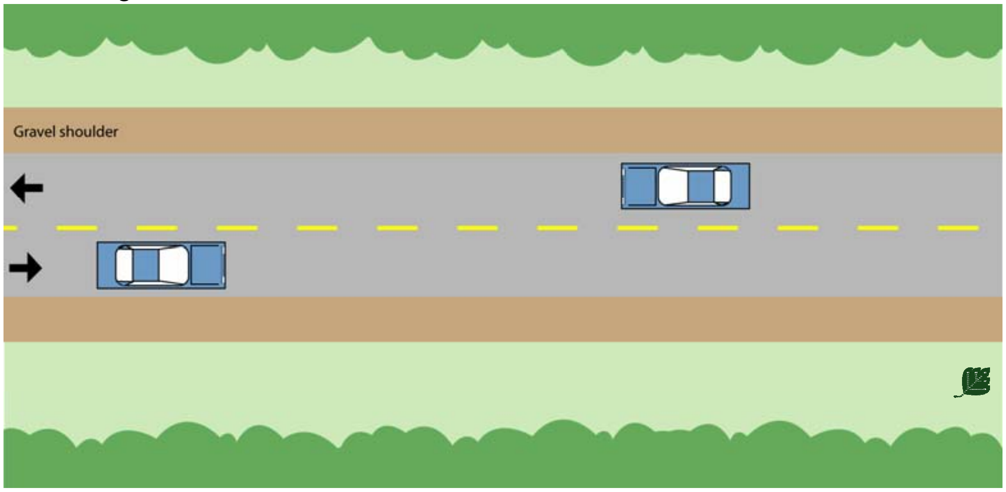
This is an interim approach to accommodating the turn lane and the crossing island. The long-term solution would expand the intersection to accommodate Bike Lanes. The length of the left-turn lane should only be as long as it needs to be to accommodate the conditions of each specific site.

Sub-standard Bike Lanes and Edge Striping Guidelines

There will be places where it will be impossible to reconfigure a roadway to accommodate even the minimum width of Bike Lane as described in AASHTO. In such cases it may be desirable to place a Bike Lane of a slightly narrower width in order to provide continuality of on-road facilities. At an absolute minimum, a Bike Lane next to a standard curb and gutter should have 3' of ridable surface (measured to the centerline of the lane stripe). In a cases where that is not possible and edge stripe may be considered without the standard Bike Lane markings and signs.

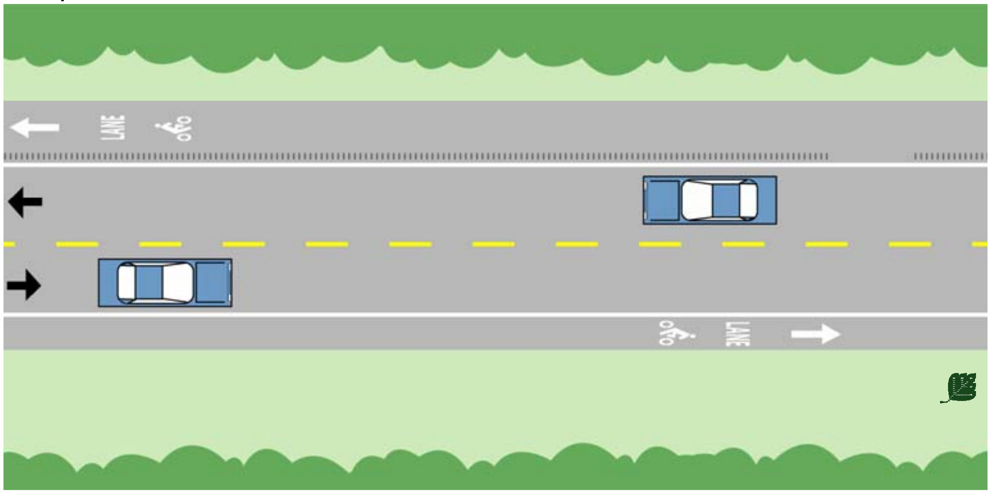
Fig. 8.3Q Paving Shoulders

Existing Conditions



A rural cross-section (no curbs) with gravel or grass shoulder. The existing roadway travel lanes are not of a sufficient width to accommodate Bike Lanes by lane narrowing.

Proposed Conditions



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Description

Paving the shoulder provides a separate bicycle facility and improves roadway conditions from a motor vehicle and maintenance standpoint. The use of rumble strips is discouraged as they may cause a bicyclist to lose control when they leave the Bike Lane to make a turn or to avoid an obstacle. If extenuating circumstances call for the use of rumble strips, breaks should be provided where appropriate to allow for a bicyclest to safely leave the Bike Lane.

8.4 Travel Across Road Corridors

Despite the dangers or inconveniences that exist, at some point in a pedestrian's or bicyclist's journey they will be required to crossing a road. Crossing roadways pose challenges to safe navigation for pedestrians and bicyclists on their journeys. Ways to get across a road (including railroads) include intersections, mid-block crosswalks, bridges and tunnels. All pose unique challenges to pedestrians and bicyclists.

Bicyclists and pedestrians in many cases, cross the road in very different fashions. Bicyclists in the roadway most likely will make left turns just like a vehicle, merging across lanes as necessary. Their restrictions to crossing the road are primarily based on their comfort level of riding with traffic and the volumes, speed and gaps that exist. Some bicyclists, depending on the traffic conditions, choose to make left turns as pedestrians. They leave the roadway and cross the road at a crosswalk.

For pedestrians, and bicyclists who choose to cross the road as a pedestrian, crossing a road can be an intimidating experience. There are often limited safe and legal crossing options. Pedestrians are directed to cross roads at either intersections or at mid-block crosswalks. Each of those options has their own set of issues.

Intersection Issues

While generally, intersections are the safest place for pedestrians and bicyclists to cross the road, there are a number of issues to consider. Intersections are the most common places of conflict for automobiles, bikes and pedestrians. Even at a simple four way stop, there can be up to twelve different possible movements from the cars alone. Add in more lanes of traffic, and it can quickly get overwhelming. In 1999, 46% of nonmotorized (bicycle and pedestrian) crashes in Southeast Michigan were intersection related[1]. However, if designed correctly, intersections can facilitate convenient and safe interactions for all users.

Signalized intersections are the hubs of activity on the roadway and a place with conflicting demands from many different users. For the most part, a roadway's vehicular capacity is determined at signalized intersections. From a pedestrian's standpoint, they often face a sea of left turning vehicles, right turning vehicles, and through traffic from four directions. When crosswalk signals require activation by a push button, pedestrians often ignore them because of their inconvenience. Even when pedestrians push the button, in most cases there is no feedback to the pedestrian that they have indeed activated the signal. Often when the signal phases are long, they will assume that the button is broken and cross the road at an inappropriate time.

Vehicles turning right-on-red also pose dangers to pedestrians. The driver of a vehicle is focused on the traffic to the left, looking for a gap. Frequently drivers do not look right for pedestrians beginning to cross the street before beginning their turn. Another problem occurs in situations where the view of the oncoming traffic is obstructed if the vehicle is behind the stop bar. Often times the driver of the vehicle will advance over the crosswalk to improve their sightline. If they are unable to proceed they completely block the crosswalk with their vehicle. This is a common occurrence especially in the downtown area where right-on-red is permitted even when clear sight lines do not exist from behind the stop bar.

Intersections where the roads meet at odd angles result in wider than typical intersections. When the pedestrian Walk phase is triggered concurrent with Red Ball signal for the cross traffic motorized vehicles are often moving through the far crosswalk at the same time the pedestrian "Walk" phase begins.

[1] Department of State Police Michigan Accident Location Index, 1997-1999.

From a bicyclist standpoint, one of the most frustrating circumstances is not being able to trigger a traffic signal. Many traffic signals in St. Clair County are activated by detector loops placed in the pavement that sense a change in the magnetic field. Depending on how the detectors are adjusted, the position of the bicycle and the nature of the bicycle's frame and wheel, a bicycle may not be able to trigger a signal. As a result, a bicyclist must either leave the turn lane and cross as a pedestrian, ignore the signal, or position themselves forward of the detector into the intersection and wait for a vehicle behind them to trigger the signal.

Unsignalized intersections are also key points where pedestrians and bicyclists want to cross the road corridor. When the crosswalks are left unmarked, pedestrian travel is often discouraged.

The aforementioned issues are addressed throughout the following guidelines. In addition, special attention has been paid to addressing crossings at points other than signalized intersections.

General Crosswalk Design

Marking a crosswalk serves two purposes: (1) it clarifies that a legal crosswalk exists at that location and (2) it tells the pedestrian the best place to cross.[1] Several issues should be considered when designing safe crosswalks, including visibility, telegraphing the pedestrian's intent, minimizing crossing distance, snow obscuring the road surface, and accommodating persons with special needs.

Visibility

Increasing the visibility of all users crossing the road is a key issue for pedestrian safety. The ability of pedestrians to see motorists is equally as important as their own visibility in the roadway. Marked crosswalks should be included only where sight distance is adequate for both pedestrians and motorists. Obstructions in sight lines should be minimized. Visibility can be improved with the following design treatments:

- Wide white ladder crosswalks.
- Stop lines or yield lines that are set back from the crosswalk a sufficient distance to increase visibility from all lanes of traffic.
- Signage directing motorists to yield to the pedestrians.
- Placement of signage that does not obstruct the visibility of the pedestrians.
- Curb extensions (bulb outs), extending the curb out at intersections, also minimize pedestrian crossing distance.
- Removal of low hanging branches and minimal planting between the oncoming vehicles and the sidewalk approaches to the crosswalk such that sight distances are in accordance with AASHTO guidelines.
- Lighting of the crosswalk and the sidewalk approaches.

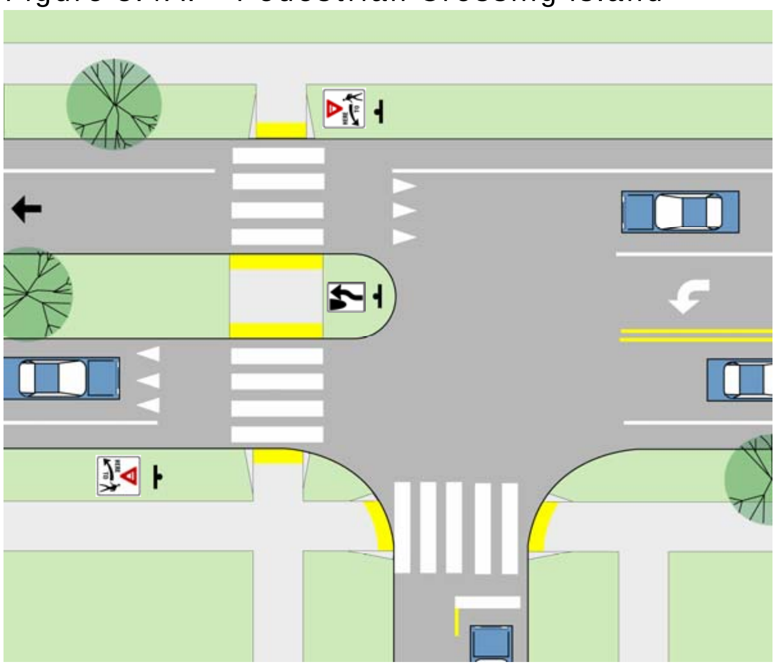
[1] AASHTO. *Guide for the Planning, Design, and Operation of Pedestrian Facilities (Draft).* August 2001.

Understanding the Pedestrian's Intent

Road users should be able to discern if a pedestrian is planning to cross the road so that they may take appropriate measures. If a crosswalk is located where a sidewalk directly abuts the roadway, the road users cannot tell if someone is simply going to walk by the crosswalk or abruptly turn and attempt to cross the street. Also, places where pedestrians may typically congregate, such as bus stops, may cause road users to needlessly stop. To help clarify the pedestrian's intent to cross the road, intersections should incorporate the following features:

- A short stretch of sidewalk perpendicular to the roadway where only pedestrians planning to cross the street would typically stand.
- Placing bus stops past the crosswalk to avoid blocking the crosswalk.
- Distancing the crosswalk from places where pedestrians may congregate adjacent to the roadway without the intent to cross the road.
- Installing curb extensions to reduce the crossing distance for pedestrians and to slow traffic.

Figure 8.4A. Pedestrian Crossing island



Crossing islands

Crossing islands are raised areas that separate lanes of opposing traffic and eliminate the need for pedestrians to cross more than one direction of traffic at a time (see the figure to the left).

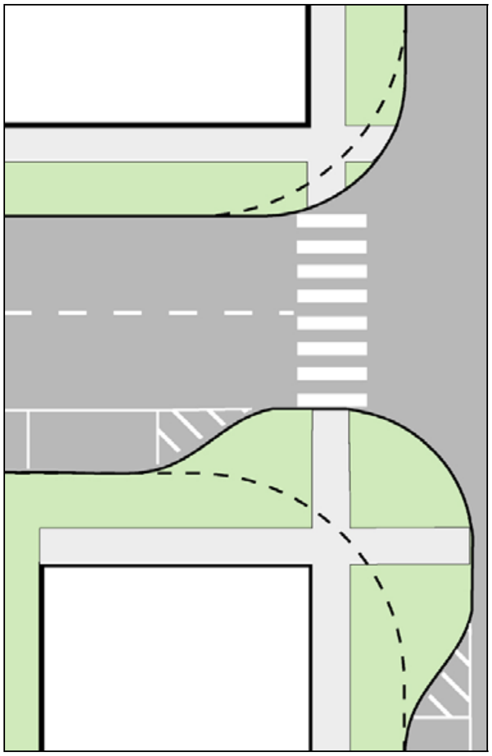
Crossing islands allow the pedestrian to undertake the crossing in two separate stages. This increases their comfort level and opens up many more opportunities to safely cross the road.

Crossing islands increase the visibility of the crosswalk to motorists and reduce pedestrian crossing distances.

Crossing islands should be considered for all unsignalized marked crosswalks that traverse three or more lanes.

Crossing islands should be at least 20' in length. When ever possible, the length of a crossing island should be maximized to increase the visibility of the island.

Fig. 8.4B. Effect of pedestrian curb extensions and smaller curb radii on pedestrian crossing distances



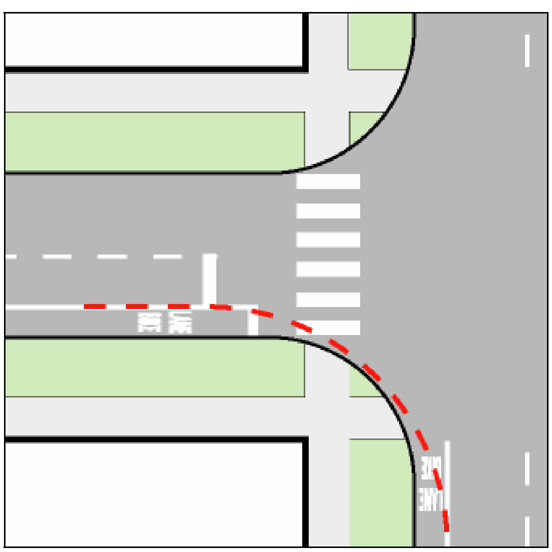
Minimizing Crossing Distances

Minimizing the distance that pedestrians need to cross the street is another critical safety issue. As crossing distances increase, the comfort and safety of a pedestrian decreases. Simple design solutions such as reducing curb radii, and adding curb extensions shorten crosswalk distances as well they reduce the potential for pedestrian-vehicle conflict. Larger corner radii promote higher turning speeds and increase pedestrian crossing distances. See the figure to the left.

In addition to increasing visibility and shortening crossing distances for pedestrians, curb extensions increase the space available for directional curb ramps and prevent parked cars from encroaching on the crosswalk. Curb extensions also serve to make a pedestrian's intent to cross the road known to motorists before they have to step into the roadway. They also provide additional space for pedestrians waiting to cross the street.

For signalized intersections, shorter crosswalks mean more time for the pedestrian "Walk" phase and a shorter clearance interval "Flashing Don't Walk" phase.

Fig 8.4C. Effect of Bike Lanes on Turning Radius



Minimizing Turning Radius When Bike Lanes are Present

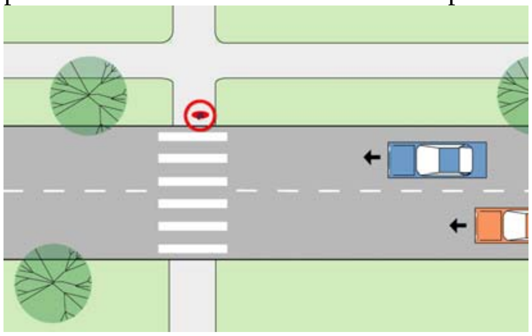
Bike Lanes provide an added advantage of effectively increasing the turning radius for motor vehicles. This is especially the case when both intersecting roads have Bike Lanes, as shown in the figure to the left.

This also applies to driveways. When a sidewalk is close to the road, the curb radius of the intersecting driveways are typically quite small. In these cases, a Bike Lane can significantly improve the ease of entering and exiting the driveway. For example a 5' curb radius adjacent to a 3.5' Bike Lane has an effective turning radius of 10' (including the gutter).

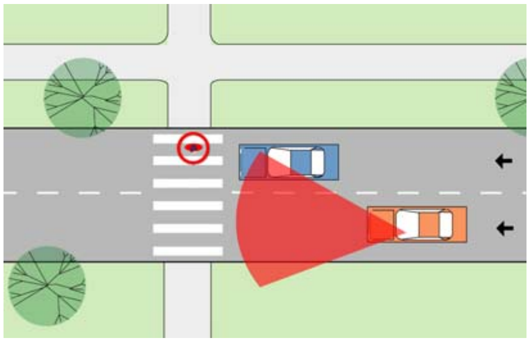
The increased effective turning radius means that motorists are less likely to encroach on adjacent motor vehicle lanes during the turning movements.

Fig. 8.4D. Multiple Threat Crashes

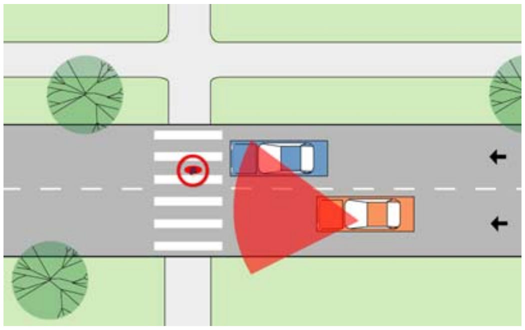
Whenever a crosswalk traverses multiple lanes of traffic traveling in the same direction, there is a potential for what is known as a multiple-threat crash. The crash unfolds as follows:



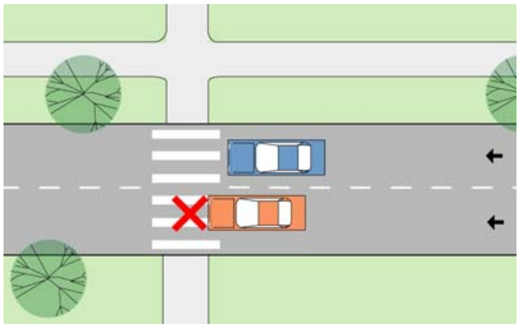
1. The driver in the lane closest to the pedestrian sees the pedestrian approaching the ramp or just entering the roadway and begins to slow down



2. The driver closest to the pedestrian lane stops, yielding the right-of-way to the pedestrian. The car is stopped immediately adjacent to the crosswalk, therefore blocking the sightlines between the pedestrian and the driver of the other car.



3. The driver of the other car fails to see the pedestrian and continues towards the crosswalks without slowing down.



4. The driver of the second car does not see the pedestrian until it is too late to come to a complete stop and hits the pedestrian.

A combination of high visibility crosswalks, yield lines set back from the crosswalk, and crosswalk signage on both sides of the street can help reduce multiple-threat crashes.

Accessibility

Providing accessible options for all users crossing the street is the law. Keeping up-to-date on changing accessibility guidelines is critical to the safety and success of all new intersection and mid-block crosswalk construction. Crosswalk locations that are only identifiable by sight, have blocked sight lines, have short signal timings or signals without accessible information act as barriers of information and barriers to movement for people with visual or mobility impairments. Several treatments of the crosswalk can increase accessibility for impaired users:

- Audible pedestrian signals indicate when the pedestrian signal has changed and the traffic has come to a stop. This prevents a person with a visual impairment from having to discern traffic flow solely through the traffic sounds, which can be difficult at busy intersections and not always reliable.
- Pedestrian activated locator-tone signal buttons placed in a consistent location at every intersection will aid the visually impaired. Even more helpful, passive pedestrian detection technology eliminates the need for push buttons, yet maintains the traffic optimizing advantages of pedestrian activated signals.
- Directional curb ramps guide people with visual impairments to the crosswalk.
- Detectable warning strips at the ends of the crosswalk warn the visually impaired when they are leaving the sidewalk and entering the roadway.
- Median crossing islands should also include detectable warning strips, curb ramps with a level landing or full cut-throughs at road grade for accessibility.
- Pedestrian triggered mid-block control signals aid those with mobility impairments, as well as anyone trying to judge the safest time to cross between gaps in traffic.

Including the options listed above in new crosswalk design makes the pedestrian environment safer for all users. Consistent design treatment of crosswalks will help users of all abilities feel more comfortable and more able to navigate road crossings. Continuity in design will not only allow pedestrians to feel more at ease, but motorists too, will know what to expect and where to be looking for it.

Fig. 8.4E. Countdown Signals

“Walk” Phase

Clearance Interval

“Don’t Walk” Phase

Description

These operate in the same manner as typical pedestrian signals, with one addition. At the onset of the Clearance Interval (flashing "Don't Walk" or red hand), the signal counts down the remaining time until the “Don’t Walk” phase (solid “Don’t Walk” or red hand).

Pedestrians find these very intuitive and they can clear up many misunderstandings as to the purpose or exact meaning of the Clearance Interval. Studies have shown that fewer pedestrians remain in the street at the end of the Clearance Interval with countdown signals than with standard pedestrian signals. These signals have been very well received by pedestrians and have reduced complaints in some communities regarding pedestrian signal timing.

Application

When MDOT should consider using the pedestrian signals with an integrated countdown clock for all new and replacement pedestrian signals. The MDOT should consider adding countdown clocks to existing signals at high pedestrian volume signalized crosswalks.

Fig. 8.4F. Portable Speed and Traffic Detectors

Description

These portable detectors have the ability to perform traffic counts, speed studies and indicate a driver's speed on a LED display. Some models have a strobe light that may be activated when the speed limit is exceeded. They have been shown to reduce speed both before and after studies.

Application

These may be moved into an area where speeding is of concern to residents. The device may be used without displaying the speed to get a baseline speed study and traffic count in an unobtrusive manner. It may then be set to display the speed. Numerous inexpensive mounting plates may be put in place around the County and the detector can be easily and economically moved from place to place. These would be ideal for school zones where speed is a concern.

Fig. 5G. Active Crosswalk Warning Systems

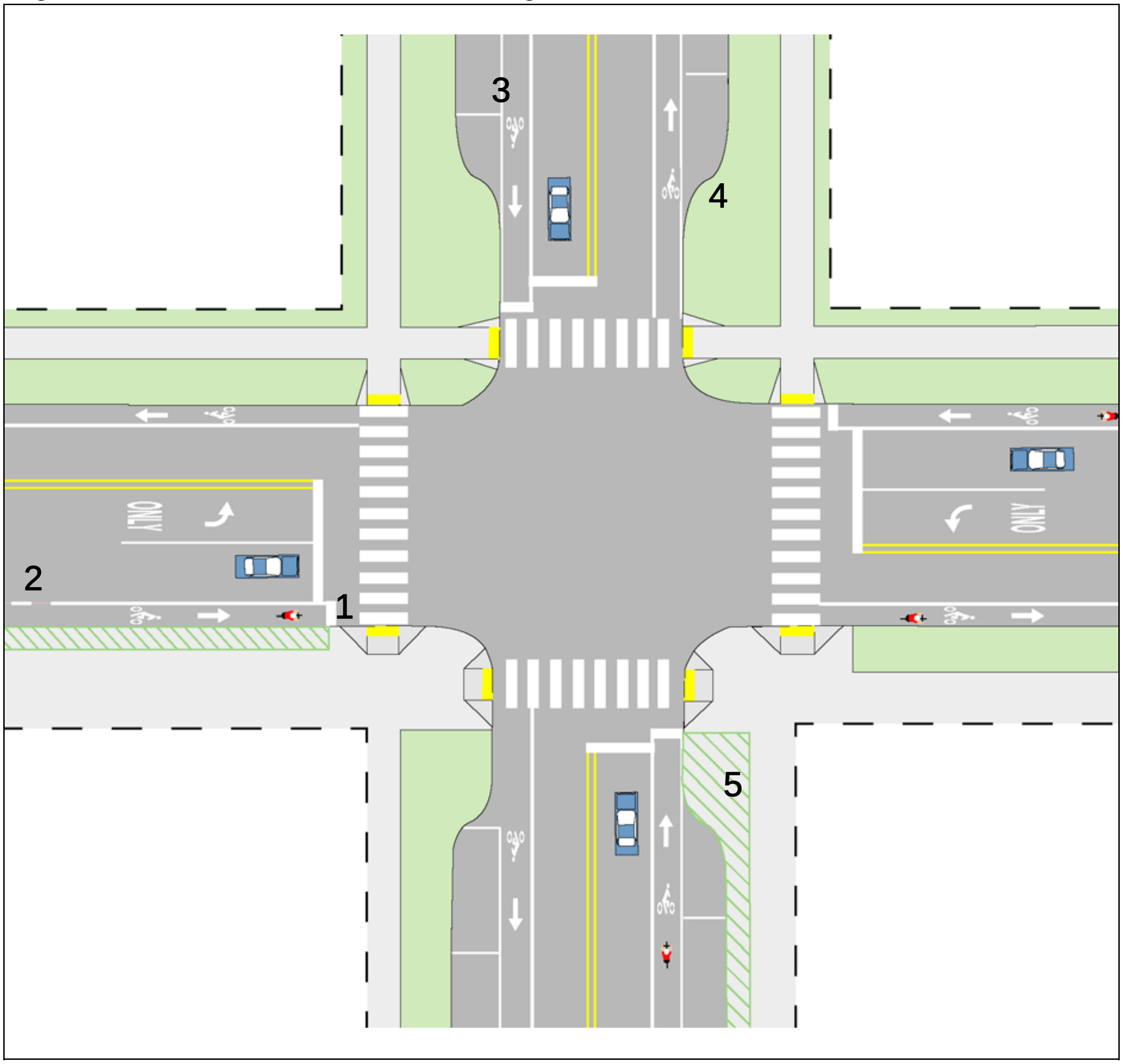
Description

A flashing beacon and/or in-pavement flashing LED's are activated when a pedestrian is present. The signals may be passively activated through a number of methods or activated via a standard push button. The pedestrian approach can also be set to flash a red light with a sign indicating to cross after traffic clears. Various manufacturers have solar powered models with radio controls to activate flashers on advance warning signs and on signs on the opposite side of the street. This significantly reduces the cost of installation and operation.

Application

These flashing signals are best located at pathway and major road intersections, or mid-block crosswalks on major roadways where pedestrian traffic is sporadic. Passive activation works best when there is a lengthily pedestrian approach such as pathway.

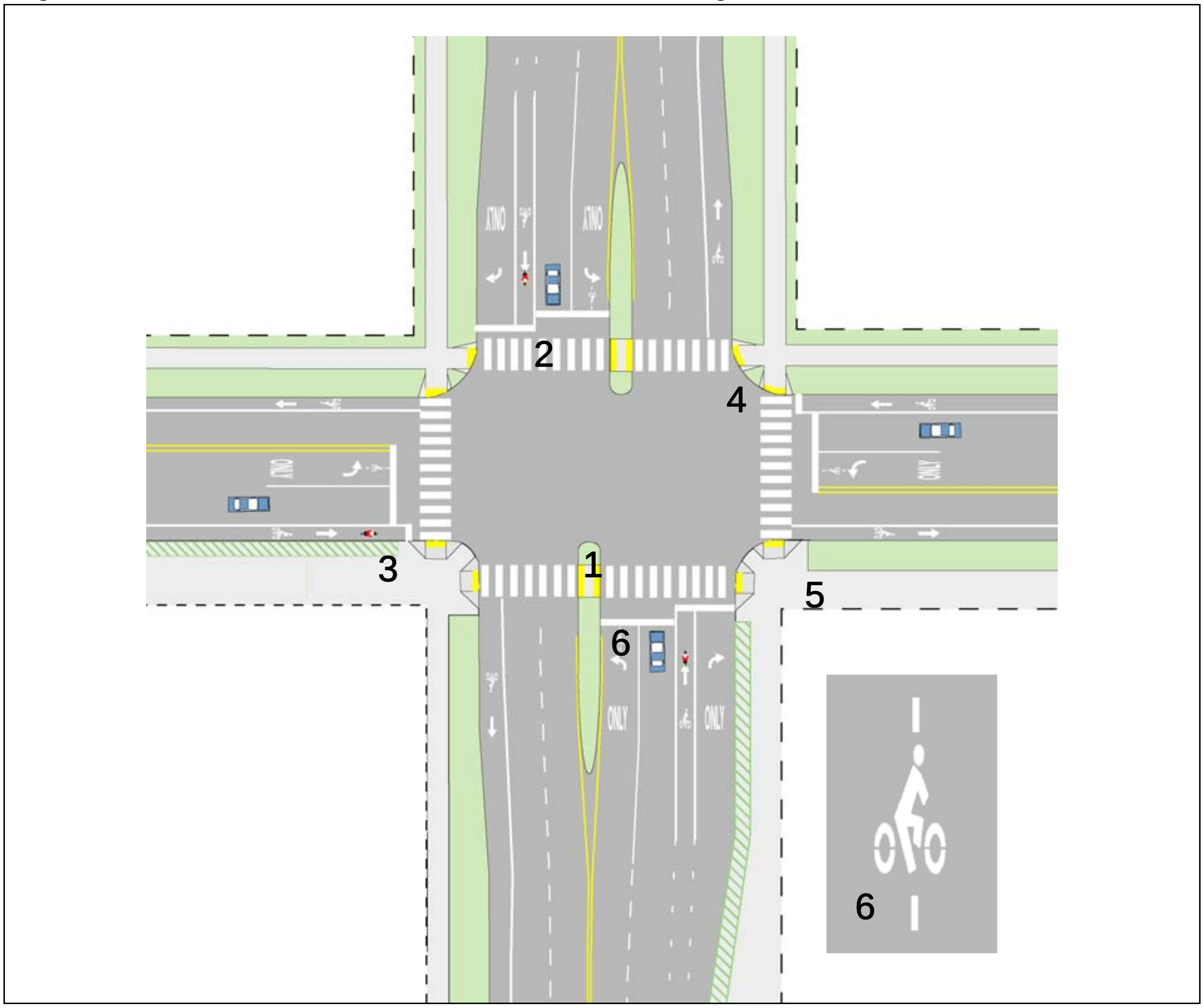
Fig. 8.4H. Urban Intersection Design Guidelines



Key Elements

1. Bike lane striping should stop at the pedestrian crosswalks and resume on the far side of the intersection. Unusual alignments may be aided by extending dashed guidelines through the intersection.
2. Bike lane striping is dashed at the intersection approach to indicate that bikers may be merging with traffic to make a turn.
3. Striping between the parking lane and Bike Lane encourages motorists to park closer to the curb and discourages motorists from using the Bike Lane in combination with an unused parking bay as a travel lane.
4. Pedestrian curb extensions reduce the crossing distance of pedestrians and improve sight distance for both motorists and pedestrians. Curb extensions should be used wherever there is on-street parking.
5. In urban areas, a furniture and street tree zone provides a buffer from the street and improves the pedestrian level of service rating. A sufficiently wide travel way should be clear of any obstructions.

Fig. 8.4I. Multi-lane Urban Intersection Design Guidelines

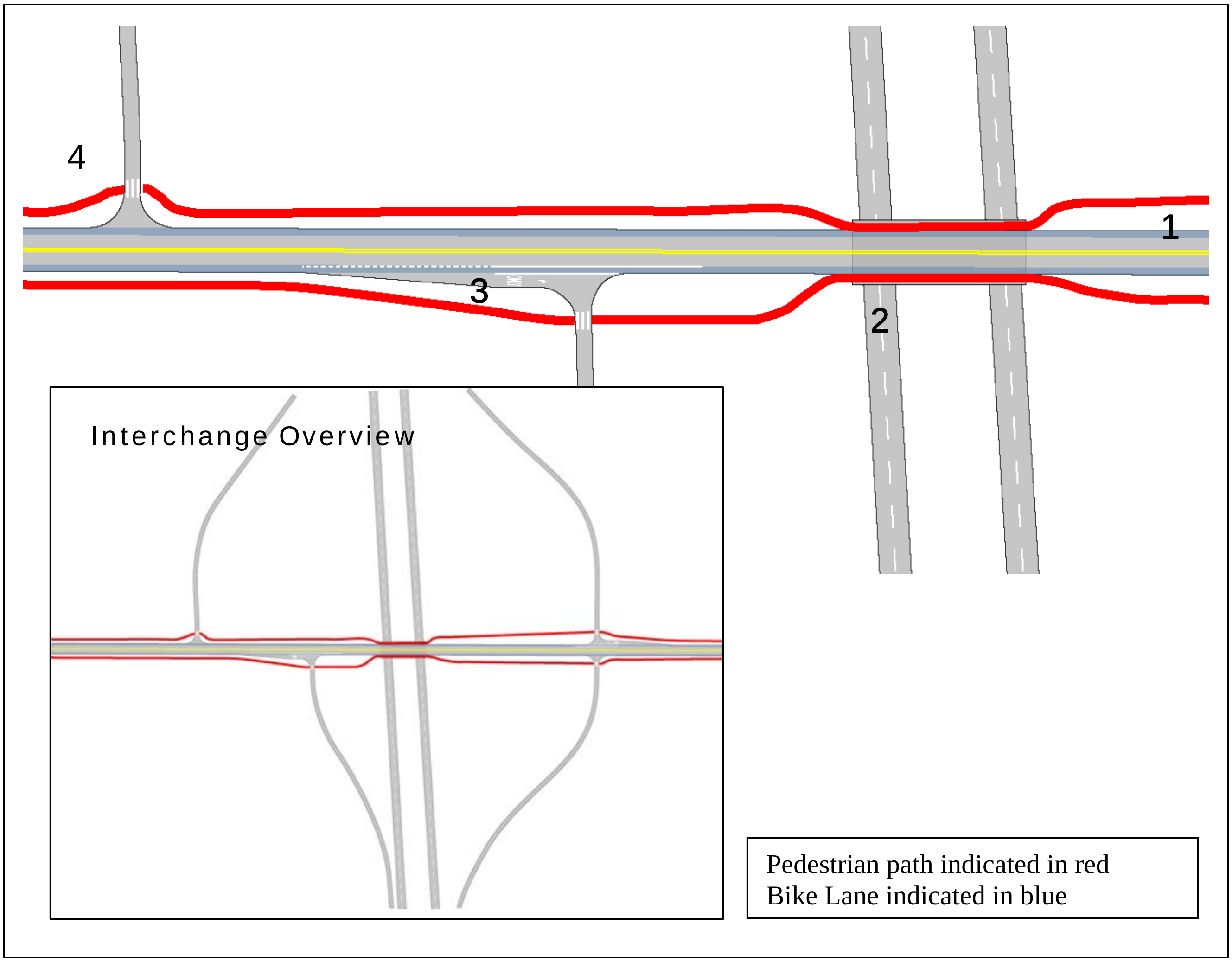


Key Elements

1. Pedestrian crossing islands should be installed at wide, multi-lane streets with high traffic volumes. Curbs, signs, and street hazard markings should delineate the islands.
2. Crosswalks should be a minimum of 10’ wide and clearly marked with a white ladder design to increase visibility and resist tire wear.
3. Bike stop bar is advanced several feet ahead of vehicle stop bar to minimize conflicts of right turning cars with through bike traffic.
4. A small curb radius shortens the pedestrian’s crossing distance and controls traffic speed around corners. Bike lanes provide a significantly larger effective turning radius than the actual curb radius and should be considered in turning radius calculations.
5. Perpendicular ramps should be built 90 degrees to the curb face and should include a detectable warning strip for visually impaired people.
6. Traffic detectors in left turn lanes should be designed to detect bicycles. Detectors should include pavement markings that indicate where bikes can best be detected. Timing of the traffic signal should allow adequate clearance intervals for bikes.

Other intersection features may include Right-On-Red turning restrictions, leading pedestrian interval signal phases, and audible signals for visually impaired users where appropriate.

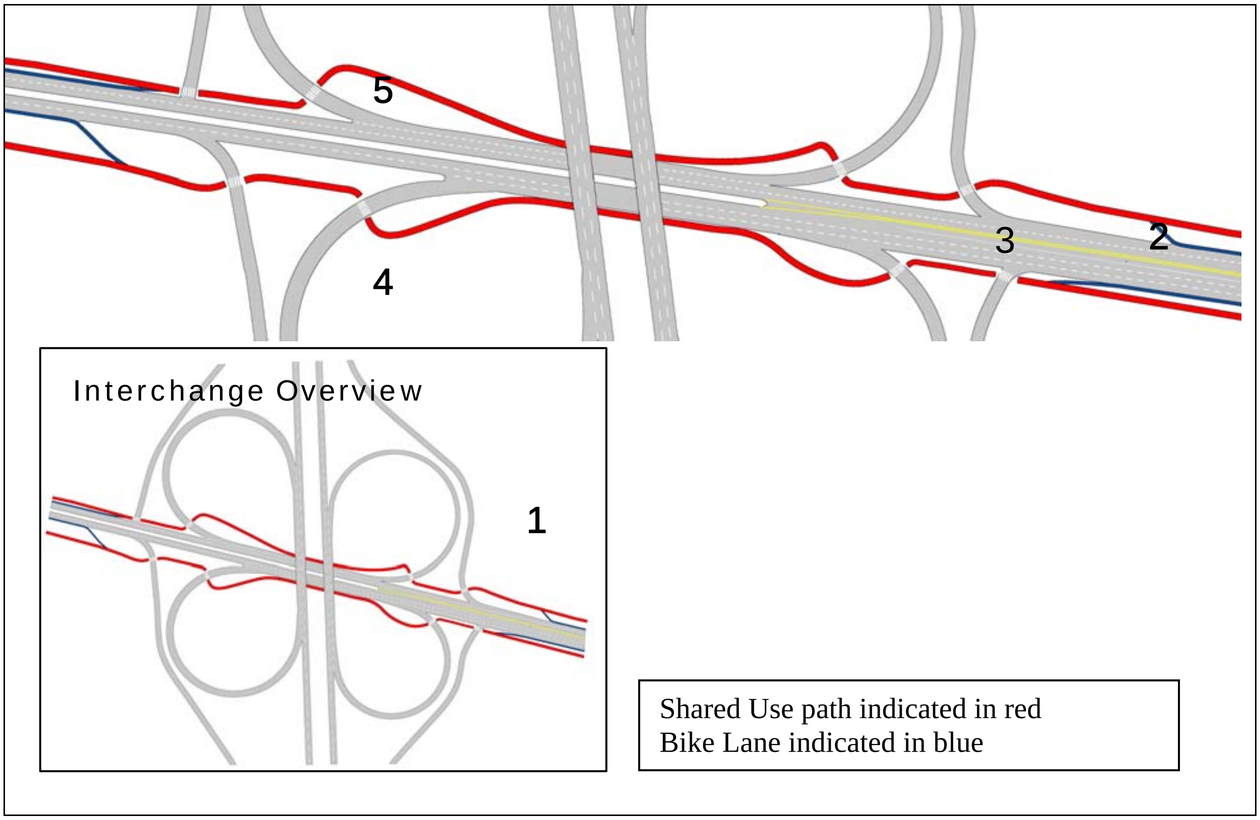
Fig. 8.4J. Urban Overpass Interchange Retro-fit Design Guidelines



Key Elements

1. Bike lanes must be on both sides of road to allow cyclists to ride with traffic.
2. A protective barrier should be provided between the sidewalk and the roadway on the bridge.
3. The through Bike Lane should be to the left of the designated right turn lane onto the entrance ramp.
4. Curb radii of ramps are tightened to narrow pedestrian crossing distances and crosswalks are clearly marked.

Fig. 8.4K. Urban Free-flow Underpass Interchange Retro-fit Design Guidelines



Description

Free-flow ramps pose many dangers to bicyclists and pedestrians. Motor vehicle speeds are high and a lot of merging movements occur in different lanes. When interchanges are reconstructed, ramps should be brought perpendicular to the roadway to reduce speeds at crosswalk locations when ever possible.

Key Elements

1. A Shared-use Path circumnavigating the interchange reduces the conflicts between nonmotorized traffic and merging vehicles.
2. Approaching the intersection, Bike Lanes leave the roadway and merge with the sidewalk to form a Shared Use Path.
3. On-ramp radii are tightened to slow right-turning traffic.
4. Shared-use Path meets all roadways at right angles. The distance that pedestrians and bicyclists must cross at the ramps is minimized. Path crosses ramps in a location with good visibility, where speeds are low, and where the driver is not entirely focused on merging with traffic.
5. Shared-use Path should be at least 10’ wide.

Signal Timing and Turn Restrictions

The length of pedestrian signals are generally determined primarily by the motor vehicle flow with the exception of a few cases where the motor vehicle phase is lengthened to accommodate a long pedestrian clearance interval. Where there is heavy pedestrian flow, such as in the campus area, the flow of pedestrians should be given the same consideration as motor vehicles in setting signal timing.

Where intersection geometry is such that the intersection is wider than typical, motor vehicle clearances should be evaluated to make sure that the pedestrian Walk phase is not started when motor vehicles would be moving through the crosswalk. Also, the motor vehicle clearance time should be set to account for bicycle traffic.

Motorists are prohibited from blocking crosswalks by law. Right turns should be prohibited on where a vehicle cannot see cross street traffic without entering a crosswalk. Where there is significant pedestrian traffic, the signal's pedestrian interval should precede that of the motor vehicles' to prevent right turning vehicles from cutting off pedestrians trying to leave the curb.

Unsignalized Marked Mid-block Crosswalk Signage

Fig. 2.4L. Old Guidelines - 1994 MMUTCD

Pedestrian Warning Sign

W11-2 (W11-1 for Bikes)
30" x 30"

Crosswalk Warning

W11A-2
30" x 30"

Prior to August 15, 2005 in Michigan, Pedestrian Warning (W11-2) signs were used to alert motorists approaching a marked crosswalk with a Crosswalk Warning (W11A-2) located immediately adjacent to the crosswalk. The Crosswalk Warning Sign was distinguished from the Pedestrian Warning sign by the narrow lines at the bottom of the sign representing the crosswalk. Many motorists are unaware of the difference between the two signs. In addition, many motorists do not know what they are required to do when a pedestrian is in the crosswalk. These shortcomings have lead to a new sign in the 2005 MMUTCD.

Fig. 2.4M. Current Best Practices in the 2005 MMUTCD

Pedestrain Warning Sign

W11-2
and
W16-Ahead

R1-5a

R1-5

Crossing Sign

On August 14, 2005 Michigan adopted the 2003 National MUTCD with a Michigan supplement that addresses laws specific to Michigan, this document is referred to as the 2005 MUTCD. The new pedestrian warning signs included in the 2005 MMUTCD address the confusion between the similarity of the existing signs as well as the issue of who yields to whom at the crosswalk. The new crosswalk signs clearly indicate that the motorists are responsible for yielding to pedestrians and where exactly they should do so. They are used in conjunction with a yield line consisting of a row of isosceles triangle pavement markings across approach lanes and pointed towards approaching vehicles. The triangles indicate at what point the yield is intended to be made. See Fig. 2.4N for further discussion of the placement of these pavement markings in conjunction with the R-15a and R1-5 signs.

Fig. 2.4N. Yellow vs. Fluorescent Green Signs

Fluorescent Green should be used for signs within a special zone or for a particular type of crossing such as a school crossing.

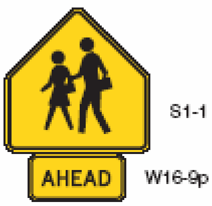
Fig. 2.4O. In-Road Signs

R1-6

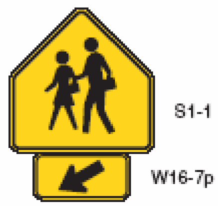
Many communities use Yield to Pedestrian signs placed within the crosswalk that alert motorists of pedestrian crossings and calm traffic in the vicinity of the crosswalk. These in-street crossing signs cannot be used at signalized locations. If the In-Street Pedestrian Crossing sign is placed in the roadway, the sign should comply with the breakaway requirements of AASHTO's guidelines. The in-street sign may be used seasonaly to prevent damage in winter from plowing operations.

Fig. 2.4P. School Crossing Sign Options

Advanced Warning



Crosswalk Warning Options



Non-standard Alternative

In-Street Crosswalk Marking Alternative to Crosswalk Warning Sign

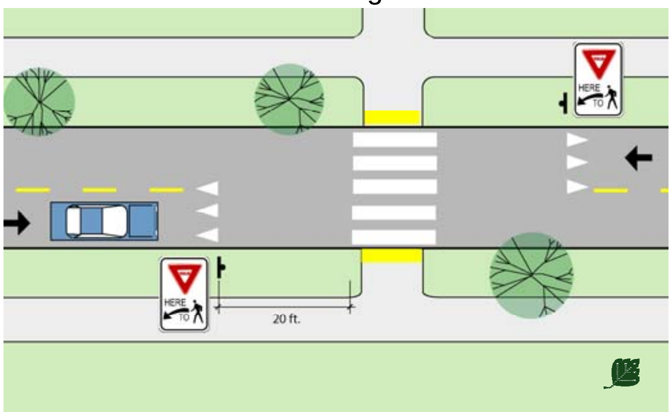
The School Crossing signs are intended to be placed at established crossings that are used by students going to and from school. However, if the crossing is controlled by stop signs, S1-1 should be omitted at the crosswalk location. Only crossings adjacent to schools or on designated routes to school should be signed with S1-1.

If MDOT determines that the "Yield Here to Pedestrian" signs are more effective as traffic control devices than the School Crossing signs, MDOT should consider adding a supplemental plaque (as shown on the Non-standard Alternative Crosswalk Warning Option above) that indicates "Yield to Peds in X-Walk". This would provide a consistent message. Some communities have placed a regulatory plaque (black lettering on a white background) with the same message. Another options indicated in the 2005 MMUTCD is using an in-street Yield to Pedestrians sign.

If the two-sign assembly is used at the Crosswalk it is recommended that the sign be placed slightly behind the crosswalk, so as not to obstruct the views of motorists. A School Advance sign (S1-1) should be used in advanced of every School Crossing sign.

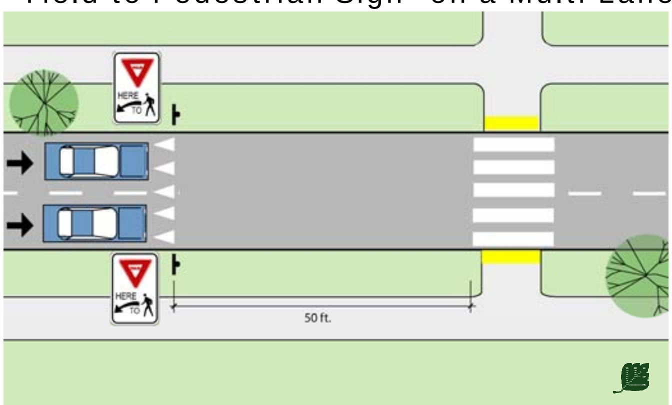
Fig. 8.4Q. Crosswalk Sign and Yield Line Placement

"Yield to Pedestrian Sign" on a One or Two-Lane Road



"Yield Here to Pedestrians" signs and yield line pavement markings should be placed a minimum of 20 ft. in advance of a crosswalk to encourage drivers to stop a greater distance from the crosswalk.

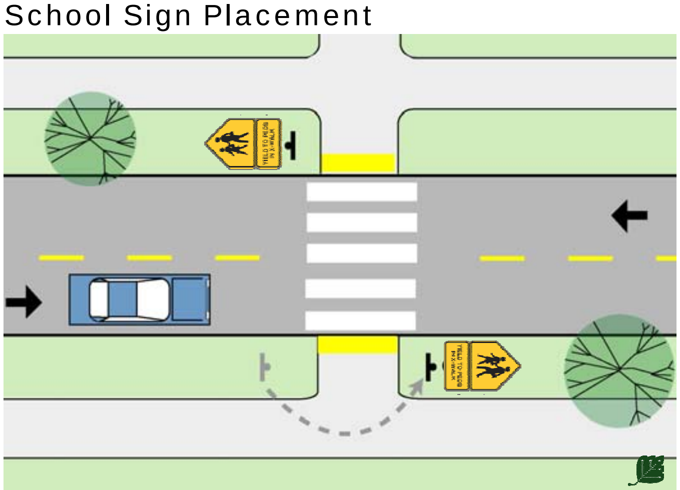
"Yield to Pedestrian Sign" on a Multi-Lane Road



"Yield Here to Pedestrians" signs and yield line pavement markings should be placed further in advance of a crosswalk on multi-lane roads to minimize the risk of a multiple-threat crash (see illustration in this section) and provide improved visibility for motorists in adjacent lanes.

"Yield Here to Pedestrians" signs should be placed on either side of the road to ensure visibility for motorists in both lanes.

School Sign Placement

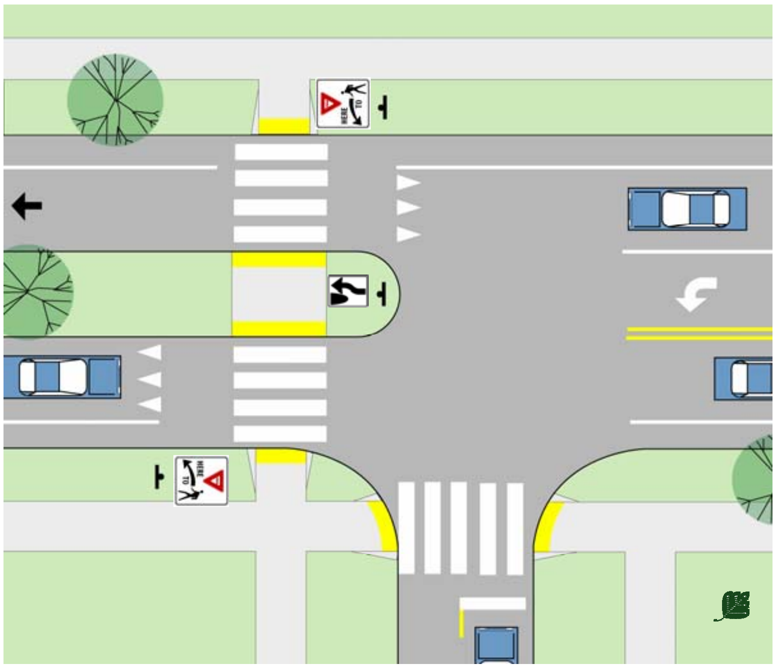


When the S1-1 School Crossing Signs are used with a plaque, consideration should be given to placing the sign behind the crosswalk to improve visibility of crossing pedestrians rather than in front of the crosswalk where the large signs may obstruct motorists' views.

Selected Placement of Crosswalks at Tee intersections Design Guidelines

On some roads it may be desirable to mark only one of the crosswalks at a Tee intersection in order to channel pedestrians to a safer crossing point and to maximize the effectiveness of the crosswalk by not overusing high visibility crosswalks.

Fig. 8.4R. Unsignalized Tee Intersection with Turn Lane Guidelines



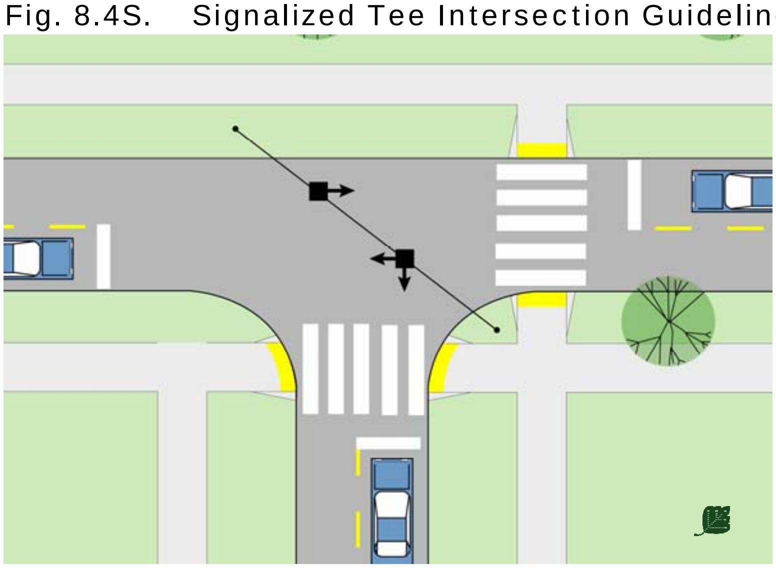
Description

At unsignalized Tee intersections with center turn lanes the marked crosswalk is located to the left of the intersecting street and the turn lane is converted to a pedestrian crossing island. The crossing island should be located such that it requires left turns from the intersecting street to have a fairly tight turning radius, therefore reducing their travel speed.

Curb ramps should be provided at all legal crosswalks, regardless of whether the crosswalk is marked. Driveways should be prohibited in the vicinity of the intersection.

The treatments shown should be used in conjunction with advance warning signs (not shown).

Fig. 8.4S. Signalized Tee Intersection Guidelines

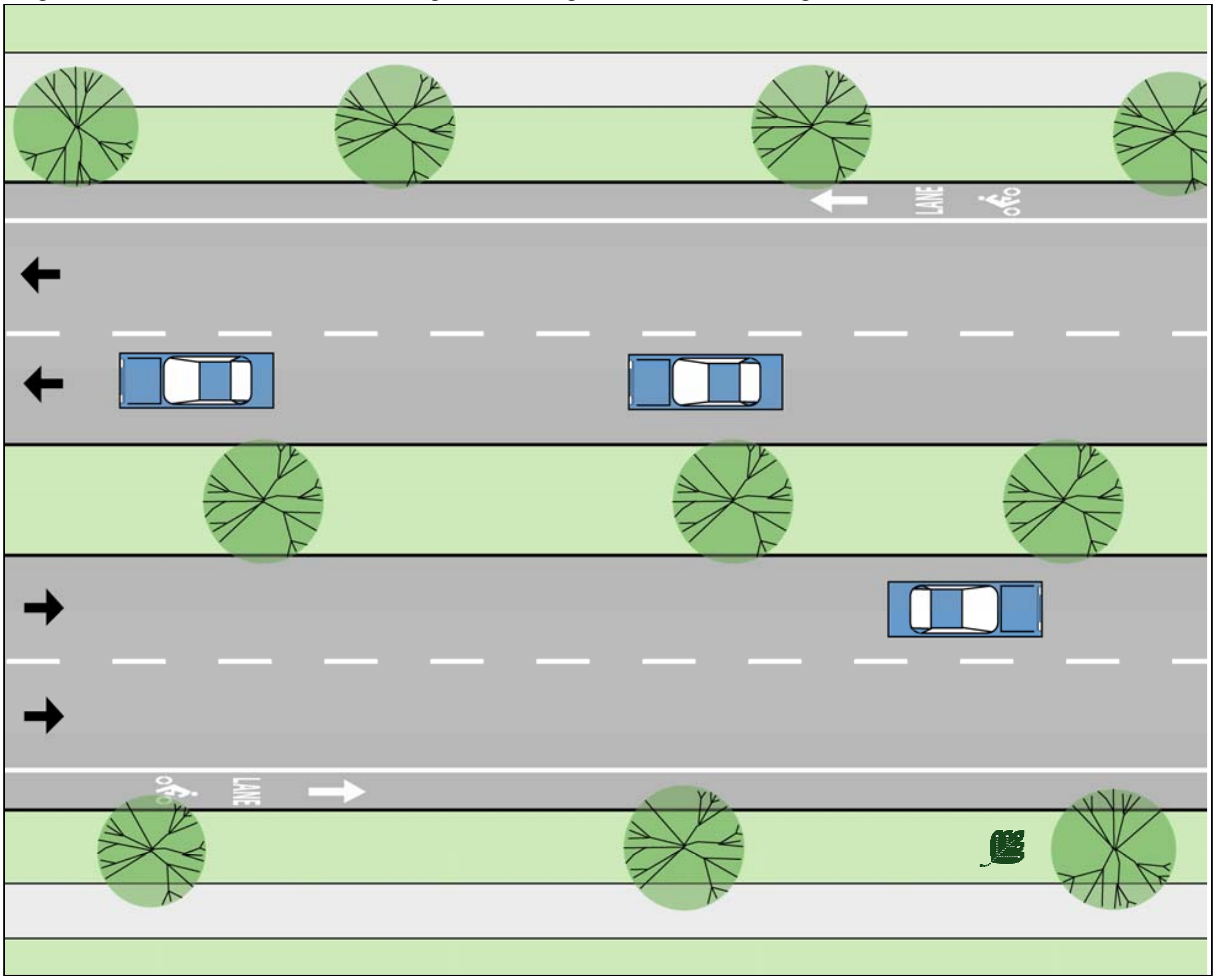


Description

At signalized Tee intersections, the crosswalk to the right of the intersecting street is marked. Left turns at signalized intersections are the most dangerous for pedestrians due to the wider turning radius, the resulting increased travel speed, and the increased distance of the crosswalk from the beginning point of the left turning movement.

There may be individual cases where it is appropriate to have the crosswalk located on the opposite side of the intersection.

Fig. 8.4T. Informal Crossing Utilizing Medians Design Guidelines



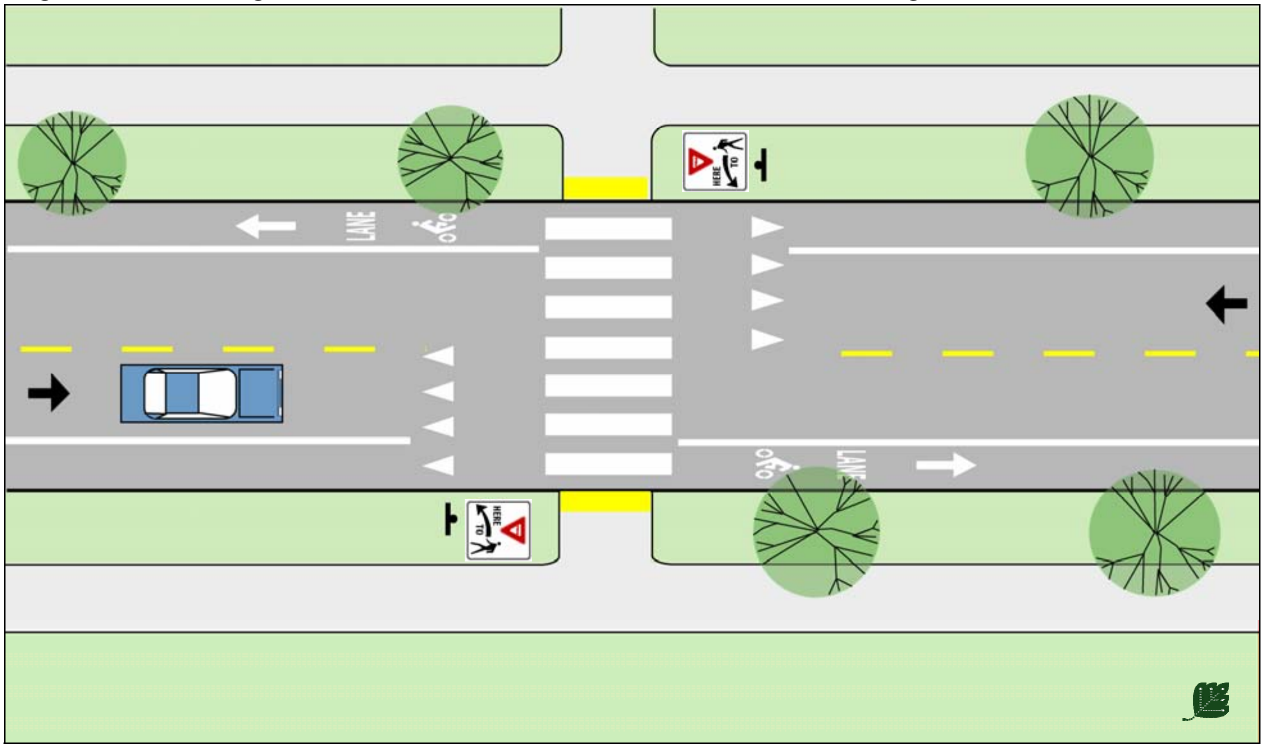
Description
Raised medians may somewhat accommodate dispersed informal crossings by able-bodied adults during periods of low snowfall.

Key Elements
A median with plantings that permits traversing by foot and allows good visibility between the driver and the pedestrian.

Application
On roads of four or more lanes where dispersed crossings are anticipated, where center left-turn lanes are unused, where minimum pavement is desired, and where traffic calming is desired. They may be used where marked crosswalk is being considered as a near-term measure.

Example

Fig. 8.4U. Unsignalized Basic Mid-block Crosswalk Design Guidelines



Description

A mid-block crosswalk for a two-lane road at an unsignalized location without parking. The treatments shown should be used in conjunction with advance warning signs (not shown).

Key Elements:

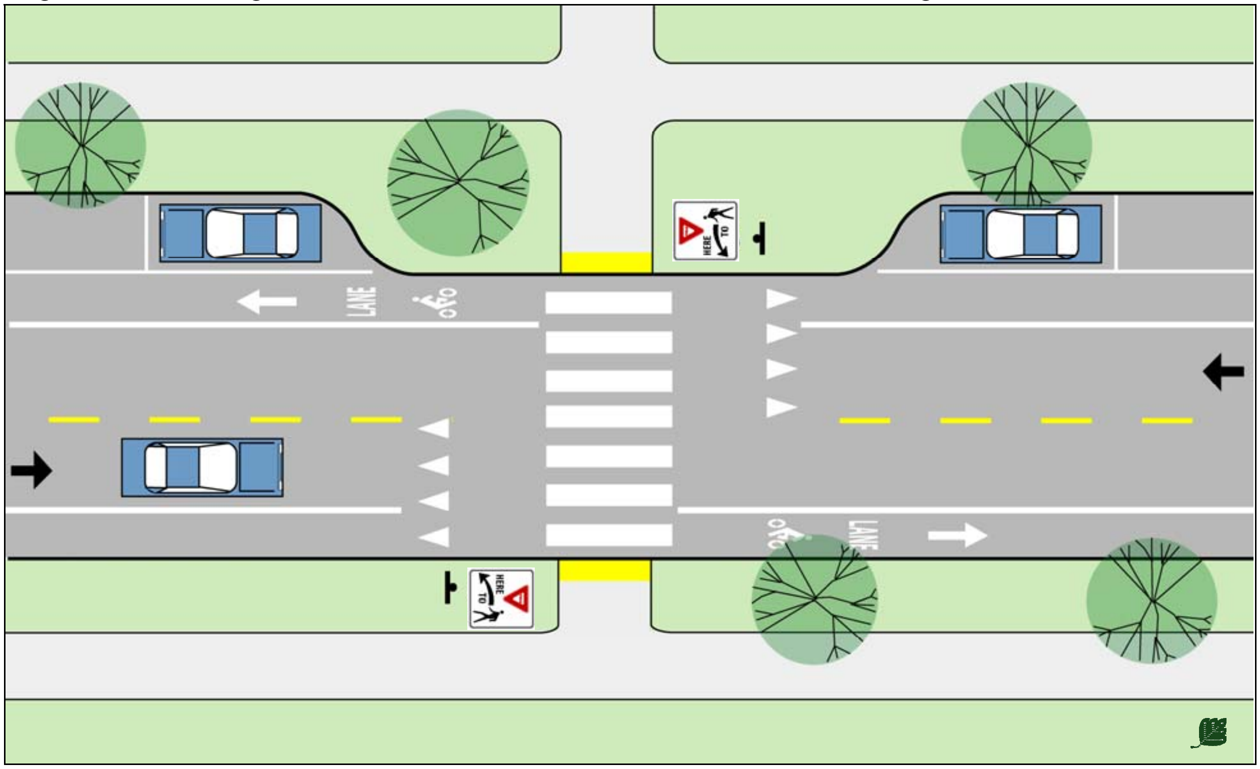
1. The yield markings are set back from the ladder crosswalk to minimize the potential for a multiple threat crash.
2. Where crossing signs other than the R1-5/ R1-5a "Yield Here to Pedestrians" are used, yield lines should be omitted.
3. Sightlines are kept clear of vegetation.
4. A 2' wide detectable warning strip is used at the base of the ramps.

Applications

Generally used on relatively low volume, low speed roads where sufficient gaps in the motorized traffic exist. This crosswalk design should not be used in any situations where there are greater than two travel lanes or when there is on street parking.

Example

Fig. 8.4V. Unsignalized Mid-block Crosswalk With Parking Guidelines



Description

A mid-block crosswalk for a two-lane road at an unsignalized location with parking. The treatments shown should be used in conjunction with advance warning signs (not shown).

Key Elements:

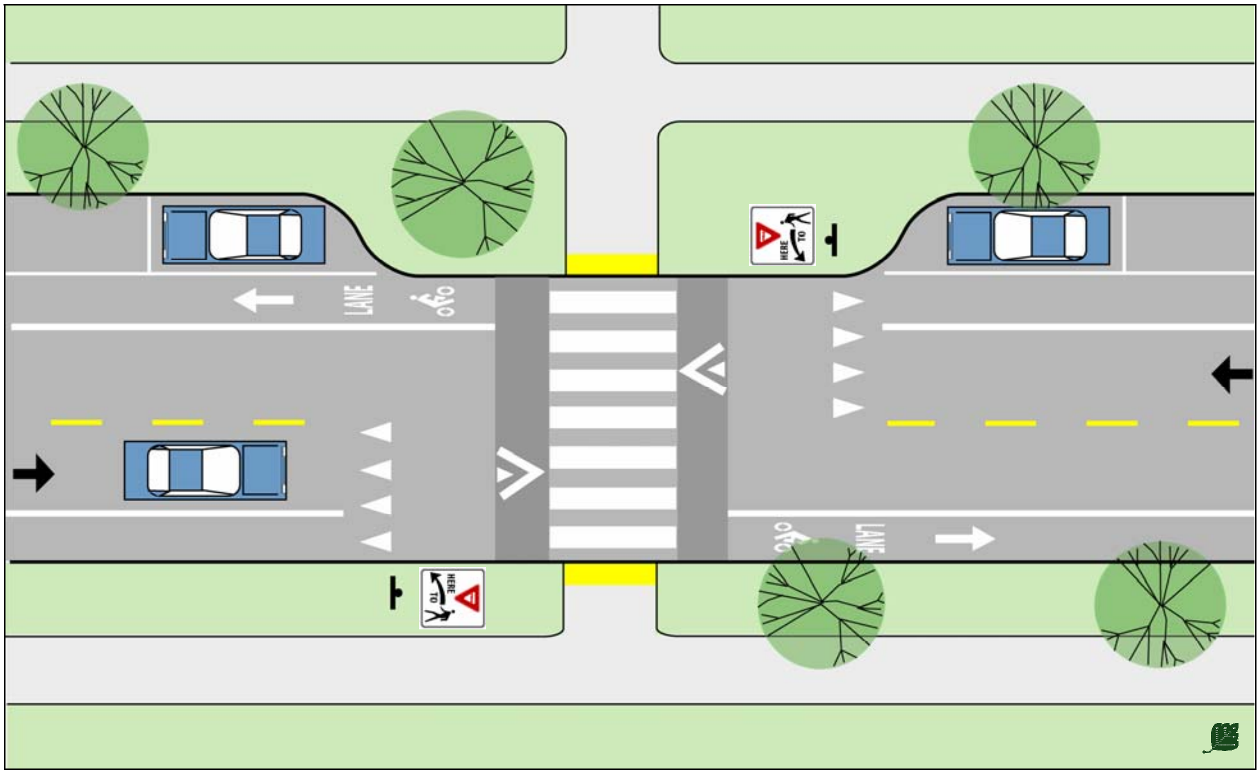
1. See elements listed under Unsignalized Basic Mid-block Crosswalk.
2. A curb extension places the pedestrians waiting to cross the street into the sightlines of oncoming vehicles and eliminates the potential for illegal parking that would obscure views of pedestrians in the crosswalk.

Applications

Generally used on relatively low volume, low speed roads where sufficient gaps in the motorized traffic exist. This crosswalk design should not be used in any situations where there are more than two travel lanes.

Example

Fig. 8.4W Unsignalized Speed Table Mid-block Crosswalk Design Guidelines



Description

A mid-block crosswalk for a two-lane road at an unsignalized location with parking. The treatments shown should be used in conjunction with advance warning signs (not shown).

Key Elements:

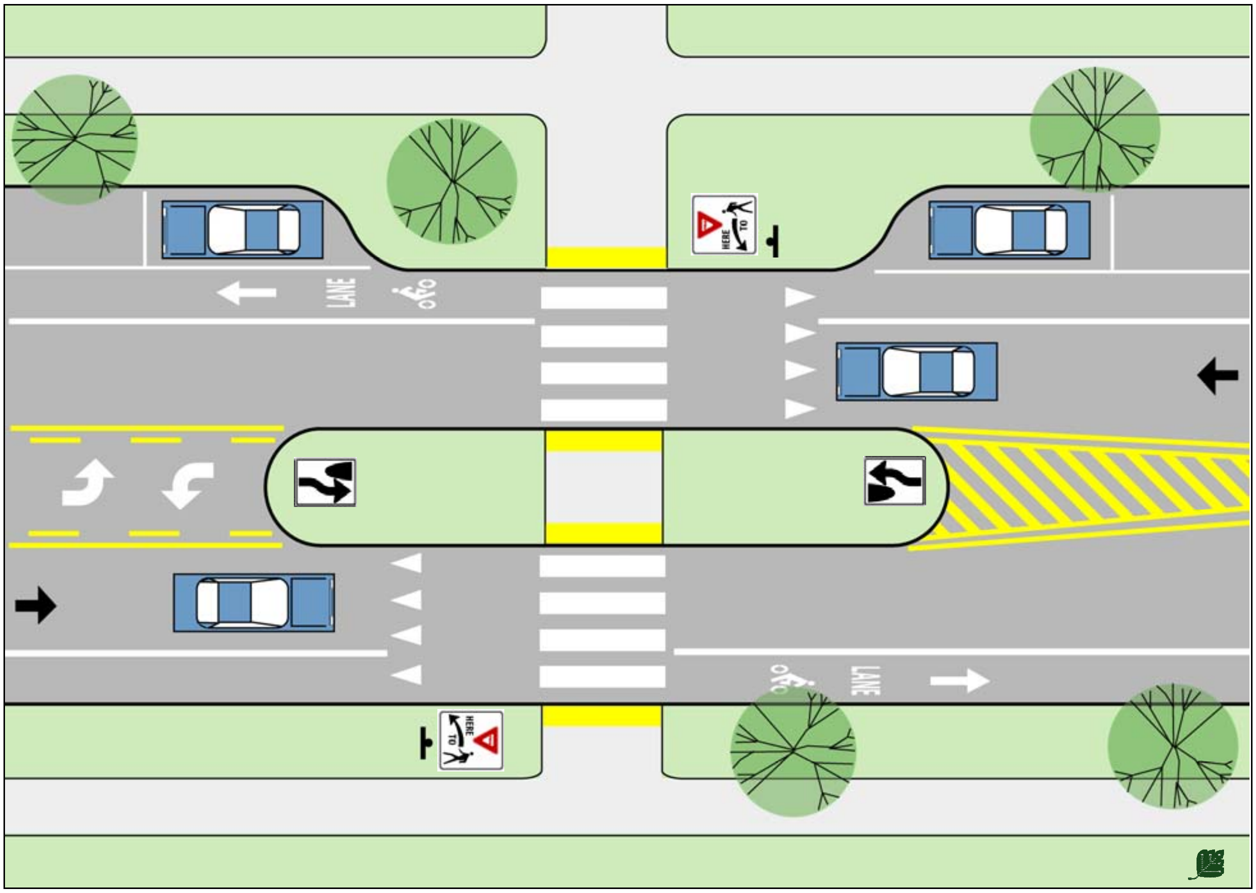
1. See elements listed under Unsignalized Basic Mid-block Crosswalk and Unsignalized Mid-block Crosswalk with Parking.
2. A speed table with 6’ long approach ramps and a 4” high table is placed under the crosswalk to bring travel speeds to approximately 25 MPH.

Applications

Generally used on relatively low volume, low speed roads where sufficient gaps in the motorized traffic exist. This crosswalk design should be used in areas where traffic speeds typically exceed posted speeds. .

Example

Fig. 8.4X. Mid-block Crosswalk with Crossing island Guidelines



Description

A mid-block crosswalk for a two-lane or three-lane road at an unsignalized location with or without parking. The treatments shown should be used in conjunction with advance warning signs (not shown).

Key Elements:

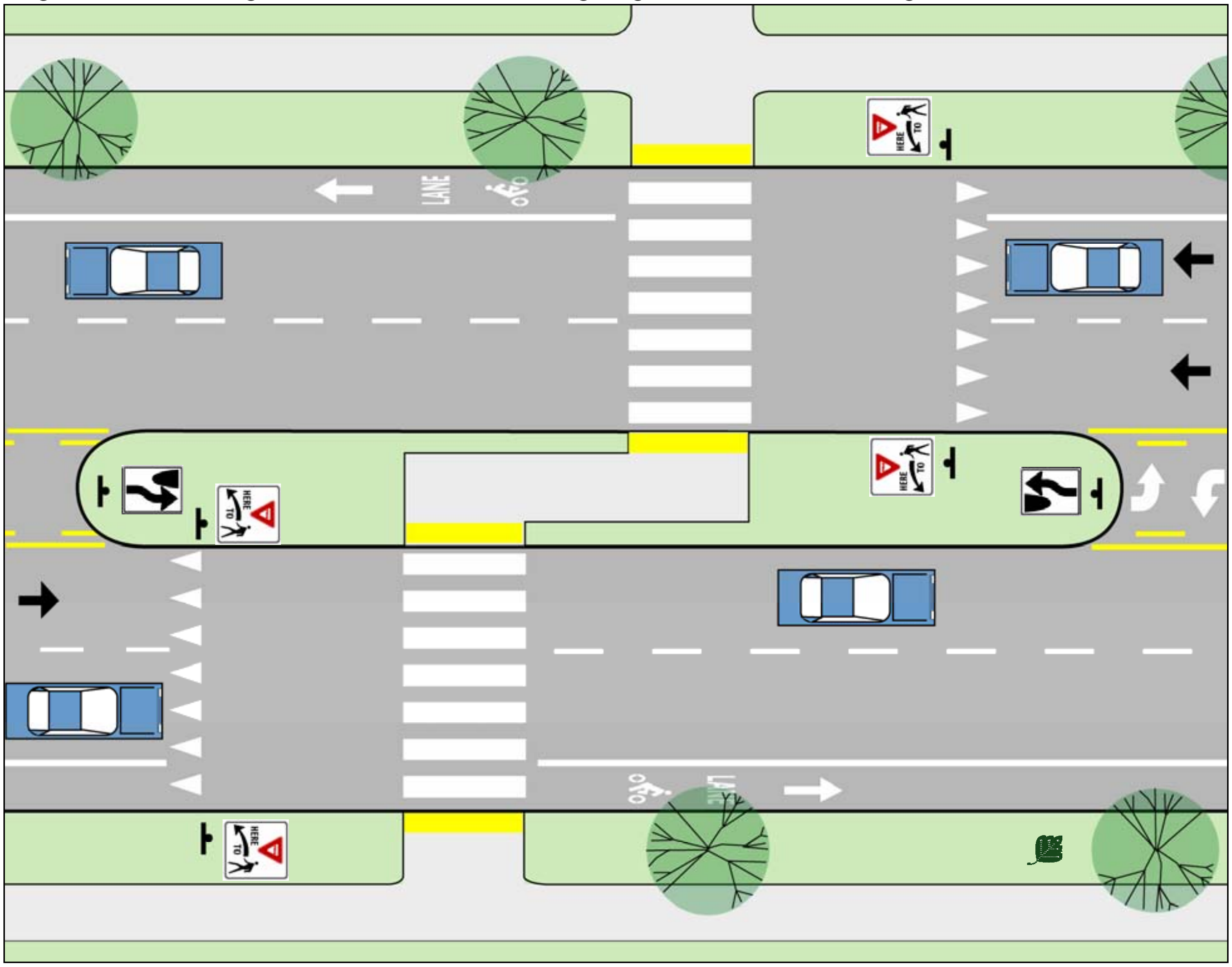
1. See elements listed under Unsignalized Basic Mid-block Crosswalk and Unsignalized Mid-block Crosswalk with Parking.
2. A crossing island is provided to break the crossing into two separate legs. The island has a minimum width of 6’ with 11’ or wider preferred.
3. Planting on crossing islands should be kept low so as not to obstruct visibility.

Applications

Generally used on a higher volume and higher speed road where suitable gaps to cross both directions of traffic in one movement are infrequent.

Example

Fig. 8.4Y. Unsignalized Mid-block Zigzag Crosswalk Design Guidelines



Description

A mid-block crosswalk for a four or more lane road at an unsignalized location without parking.

Application

Generally used on high volume / high-speed multi-lane roads.

Key Elements:

1. See elements listed under Unsignalized Basic Mid-block Crosswalk and Unsignalized Mid-block Crosswalk with Crossing island.
2. The crosswalks are staggered to direct the pedestrian view towards oncoming traffic.
3. Yield markings are set further back to improve pedestrian visibility from both lanes and minimize multiple-threat crashes.
4. Median signs are placed higher than typical so as not to impede sightlines.

Example

Lighting of Crosswalks
All marked crosswalks should be well lighted with overhead lighting. The lighting should also extend to light the extent of any crossing island for the motorists safety.

Marking of Crossing Islands
Crossing islands can present an obstruction in the roadway for motorists. The presence of this obstacle is key to the visibility of the crosswalk even more so than the signage or pavement markings and flush crossing islands have not been shown to have the same safety benefits as raised crossing islands. When the crosswalk is located in a left-turn lane it is located outside of the typically traveled roadway and is a minimum obstruction. When the road flairs around a crossing island it is more of an obstruction for a motorist. To draw attention to the obstruction, typical pavement markings as called for in MMUTCD should be utilized. In addition, reflective material may be added to the sign posts, and reflective flexible bollards may be placed on the ends of the islands to increase the island's visibility at night and during inclement weather.

Roundabouts
In many situations, roundabouts have several advantages over typical intersection design: vehicles move at slower speeds, traffic flows more smoothly, and reduced pavement enhances aesthetics and offers the opportunity for landscaping in the central and splitter islands. There are however, serious drawbacks to roundabouts for those with vision impairments, and two-lane roundabouts are problematic for bicycles in particular. Roundabouts, especially larger ones, can present significant out-of-direction travel for pedestrians. Depending on the nature of the surrounding land uses and the design of the roundabouts, pedestrians may attempt to walk directly across the center of the roundabout.

Because there are no traffic control signals to provide a pedestrian "walk" signal, pedestrians wait for an appropriate gap in traffic and cross. The splitter or diversion islands provides a crossing island the pedestrian, breaking the road crossing into two stages so that they are only dealing with one direction of traffic at a time. This system works quite well for pedestrians without vision difficulties. Studies have shown a reduction in pedestrian crashes for single lane roundabouts and about the same number for multiple lane roundabouts as compared to a traditional signalized intersection. Pedestrians with vision impairments often find roundabouts very intimidating as the audible queues are sometimes insufficient to judge a suitable gap in traffic. Research is currently underway to determine the most appropriate way to accommodate blind and vision impaired pedestrians in roundabouts.

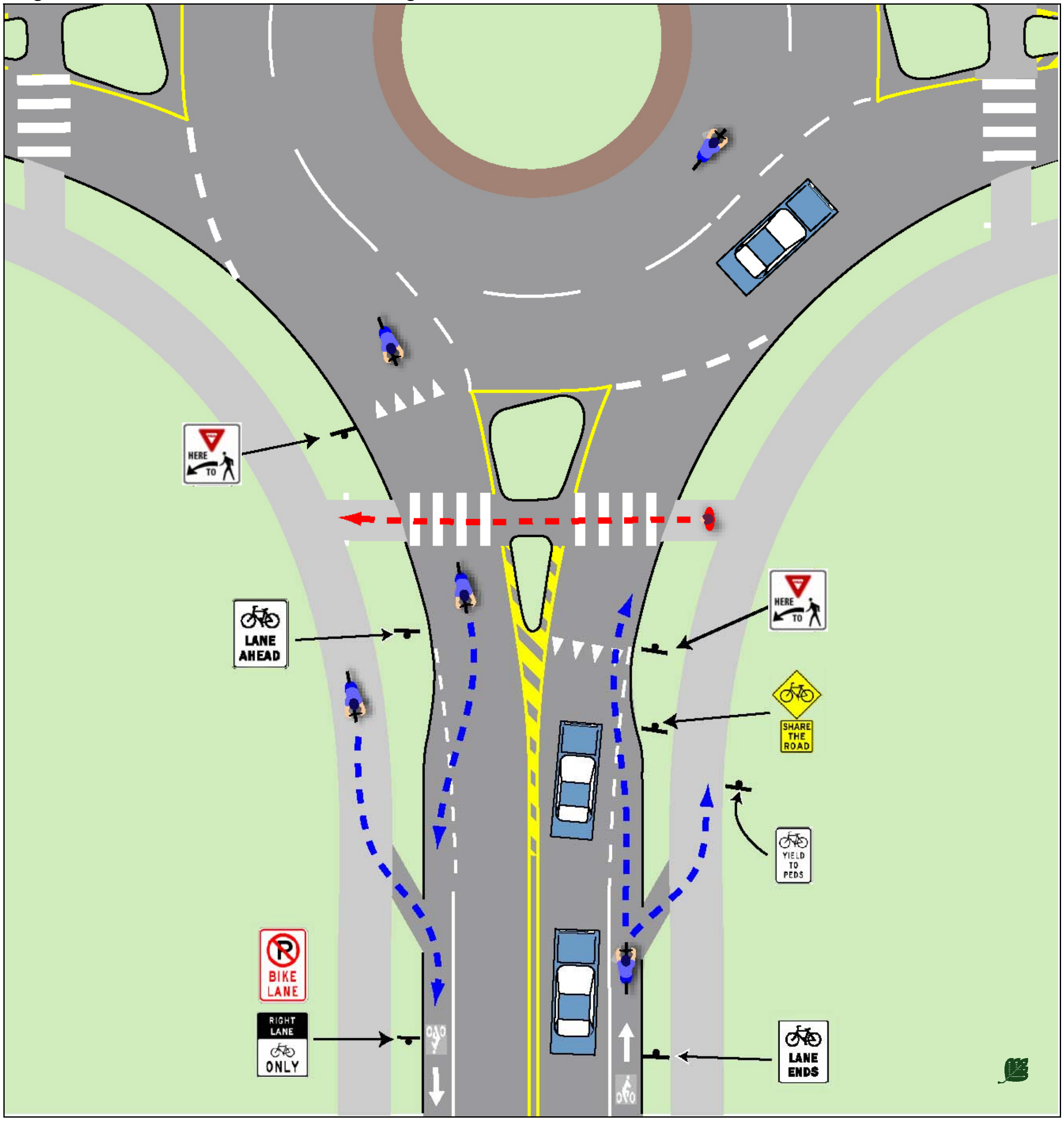
Multi-lane roundabouts are especially problematic for bicyclists. Studies have shown that while single lane roundabouts have about the same number of crashes when compared to traditional signalized intersections, multi-lane roundabouts have significantly more. Because of this, design guidelines recommend allowing bicyclists who are traveling in the roadway approaching the roundabout to exit the roadway prior to the roundabout and navigate the roundabout as a pedestrian would. More confidant bicyclists may remain in the roadway and merge with the motor vehicles.

Design Guidelines:

- Roundabout approaches should include bicycle entrance and exit ramps to give bicyclists the option of biking on a sidewalk bikeway as well as the roadway.
- Roundabouts should include pedestrian crossing islands on all entering roadways.
- The use of roundabouts should be accompanied by an education campaign regarding the issues with blind pedestrians and a motorist responsibly when they see a pedestrian using a white cane.

- The bicycle and pedestrian safety issues should be carefully evaluated for any multiple lane roundabouts.
- The latest research on accommodating blind and vision impaired pedestrians in roundabouts should be consulted before designing and constructing a roundabout.
- Bicycle and pedestrian pavement markings and signs should be regularly evaluated for every roundabout.

Fig. 8.4Z. Nonmotorized Design Considerations for Roundabouts



Signalized Mid-block Crossings

Sometimes signalization is needed at a mid-block crosswalk location to ensure safe crossing. Areas that have many elderly, disabled, or young children crossing between signals are places that warrant special consideration. Signals can also help pedestrians cross at mid-block locations where there are insufficient gaps in traffic to cross safely.

Standard Mid-Block Signalized Pedestrian Crossings

The Michigan Manual of Uniform Traffic Control Devices (MMUTCD) has warrants for installing signalized crosswalks based on pedestrian demand. These include considerations given to the type of pedestrians the signal will serve (young, elderly, and/or persons with physical or visual disabilities). They also recognize that current pedestrian mid-block crossings may be inhibited by the road conditions in combination with the type of pedestrians who would like to cross the road.

With standard mid-block pedestrian signals, when a pedestrian activates the crossing button, a yellow then steady red light is displayed to motorists and then a walk signal is displayed to pedestrians. During the pedestrian clearance interval (flashing don't walk or red hand), the steady red light remains displayed to motorists. After the clearance interval is complete the signal for motor vehicles returns to green and the pedestrian signal returns to a steady don't walk signal. These signalized pedestrian crossings may be coordinated with other signals to minimize the impact the signal has on motorized traffic flow.

When pedestrian activated signals are used, the pedestrian should receive and visual, audible, and tactile response that a signal has been sent to the controller. Otherwise, the pedestrian may assume that the button is not functioning if there is any delay in calling the Walk phase and cross the street during the "Don't Walk" phase.

Other Options

There are also several other types of mid-block signalized crossings that are currently being used on an experimental basis. The following signals, while not meeting current MMUTCD standards, strive to address shortcomings in the standard mid-block signalized pedestrian crossing. Prior to evaluating similar devices, careful analysis would be required. The following are a few of the experimental signals being used around the country:

Mid-Block Signal-Controlled Crossings with Flashing Red

Typically, the signal rests with a green light for motor vehicles. When a pedestrian activates the crossing button, a yellow then steady red light is displayed to motorists and then a walk signal is displayed to pedestrians. During the pedestrian clearance interval (flashing don't walk or red hand), a flashing red light is displayed to motorists who may proceed if the crosswalk is clear. At the conclusion of the pedestrian clearance interval, a steady green signal is displayed to motor vehicles.

The advantage of this signal is that drivers have to stop for pedestrians crossing the road, but may resume travel through the crosswalk as soon as light turns to flashing red and the pedestrian or bicyclist is out of the roadway, rather than waiting for the entire pedestrian clearance phase. This is helpful where many of the crosswalk users clear the crosswalk quickly because they are on a bicycle or typically walk at a brisk pace.

Pelican Crossings (Pedestrian light controlled)
Originally developed in Great Britain, there are a few variations that have been implemented in the United States. Tucson, Arizona has implemented a number of these crossings with the following characteristics. The pedestrian crosses the street in two stages, using a crossing island. For each stage a standard traffic signal rests with a green light for motor vehicles. When a pedestrian activates the signal button, a yellow then steady red light is displayed to motorists approaching the crosswalk and then a walk signal is displayed to pedestrians. After the clearance interval is complete the signal for motor vehicles returns to green and the pedestrian signal returns to a steady "Don't Walk". By splitting the crossing into two stages the signal may be synchronized with signals in either direction along the roadway. Other variations display a flashing yellow signal to motorists during all or a portion of the pedestrian clearance interval. A PUFFIN CROSSING is a variation that uses passive detectors to adjust the clearance interval based on the presence of a pedestrian in the crosswalk.

Toucan Crossing
Toucan Crossings are used at intersections where it is desirable to provide a signalized crossing for bicycles and pedestrians but not for motor vehicles. A typical situation would be where a residential road intersects a primary road and the residents wish to reduce through traffic. The Toucan Crossing uses a standard signal for motor vehicles. Bicyclists and pedestrians who wish to cross the primary road are directed to the center of the minor road where passive sensors trigger the signal. The length of the pedestrian clearance interval is determined by sensors that can detect pedestrians in the crosswalk, thus cutting down on unnecessary delay to motor vehicles when used by bicyclists. Motor vehicles are typically restricted to a right-only turn from the residential roadway onto the primary road.

Hawk Crossing (High-intensity Activated Crosswalk)
The Hawk signal is similar to an emergency beacon in that the signal's purpose is clearly signed adjacent to the signal. The signal is kept dark at its resting state. When a pedestrian activates the crossing button, a flashing yellow signal is displayed to motorists. This is followed by a steady yellow then a solid red at which time the pedestrian is displayed a walk signal. During the clearance interval, the motorists are displayed an alternating flashing red signal. The disadvantage of this signal is that a dark signal indicator for vehicles can often be confusing, and in many states, drivers are required to stop at a darkened signal. Drivers at this signal often remain stopped after it is okay to proceed through the flashing red light.

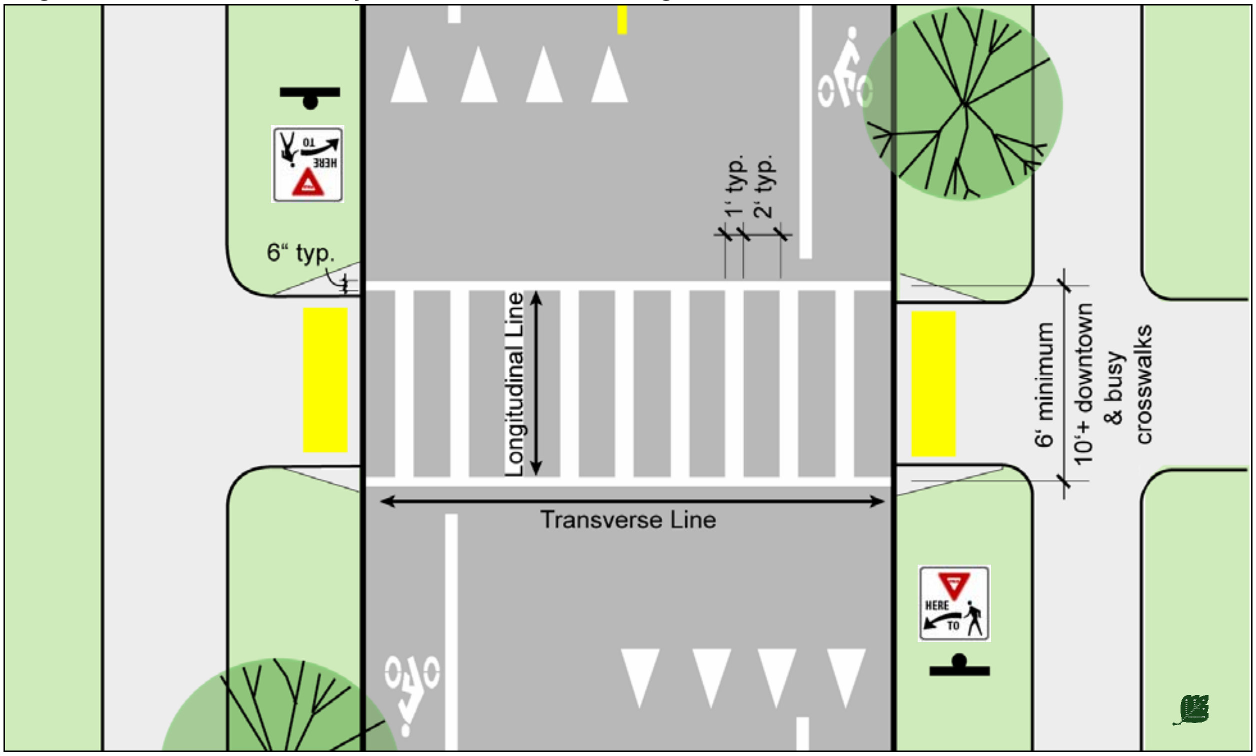
Other Options and Considerations for Experimental Mid-block Signalized Crosswalks
For further information on the types of mid-block signals being used around the country, refer to following report: *Alternative Treatments for At-Grade Pedestrian Crossings*, by Nazir Lalani and the ITE Pedestrian and Bicycle Task Force, Washington, D.C: Institute of Transportation Engineers, 2001.

As is apparent from the descriptions above, numerous features are available for use in a mid-block crosswalk, however none of these have an ideal combination of features. The ideal mid-block signal should incorporate the following:

- **A "hot response" system that immediately activates the signal when the button is pushed.** Often, the delay time for activated signals is so great that many pedestrians assume that the signal is broken and cross prematurely. A "hot response", with its quick activation of signal change, minimizes this problem. At a minimum, the pedestrian should receive some feedback in the form of audible/visual/tactile signal that they have successfully triggered the signal. Many of the newer pedestrian activated buttons have this feature.
- **Automated detection of pedestrians in the crosswalk.** Increasingly, signals are incorporating sensors that use infrared or microwave technology to detect pedestrians in the crosswalk. This technology allows the signals to more accurately reflect when pedestrians leave the crosswalk or ignoring false calls, reducing vehicle delay and minimizing driver frustration. This is an excellent feature where the speed in which typical users cross the road varies dramatically, such as a bicyclist and an elderly pedestrian.
- **Pedestrian yield phase**. Many people crossing at a mid-block signalized crosswalk are likely to feel comfortable enough to cross without activating the signal button. This is desirable to maintain uninterrupted motor vehicle flow as well. The disadvantage of all of the signals mentioned above is that the pedestrian indicators do not accommodate these types of crosswalk users. The signals either indicate that the pedestrian has the right to cross while the vehicle indicator is red, or that the pedestrian should not cross. What is needed is an indicator that informs people that is OK to cross without activating the signal, but that they must yield to motor vehicles. This would essentially be the equivalent of a flashing red signal for pedestrians and bicyclists.

  As the pedestrian yield phase is not a MMUTCD standard the use of such would require a design exception and should be accompanied by a study to determine its effectiveness.

Fig. 8.4AA. Ladder Style Crosswalk Design Guidelines



Description

A combination of Transverse and Longitudinal style crosswalks to improve visibility for motorists and usability for pedestrians with sight impairments.

Key Elements:

1. Longitudinal lines are no more than 1' wide to reduce large areas of thermoplastic markings that may become slippery as they age and become wet.
2. Spacing of the longitudinal lines is no more than 2' to improve the visibility of the crosswalk to motorists.
3. Transverse lines are used to aid pedestrians with sight impairments in finding the edge of the crosswalks (this can be difficult with longitudinal lines alone, especially when spaced far apart).
4. The width of the crosswalk is set such that it can easily accommodate all pedestrians crossing the road.

Application

For all marked mid-block crosswalks across Arterial and Collector streets and signalized crosswalks downtown. Also, on local streets where there is a high potential for conflict between motorists and pedestrians such as crosswalks that serve schools. Locations where pedestrian crossing is sporadic require high visibility as the motorist's expectation for the presence of pedestrians is low.

Example

8.5 Nonmotorized Travel on Independent Pathways

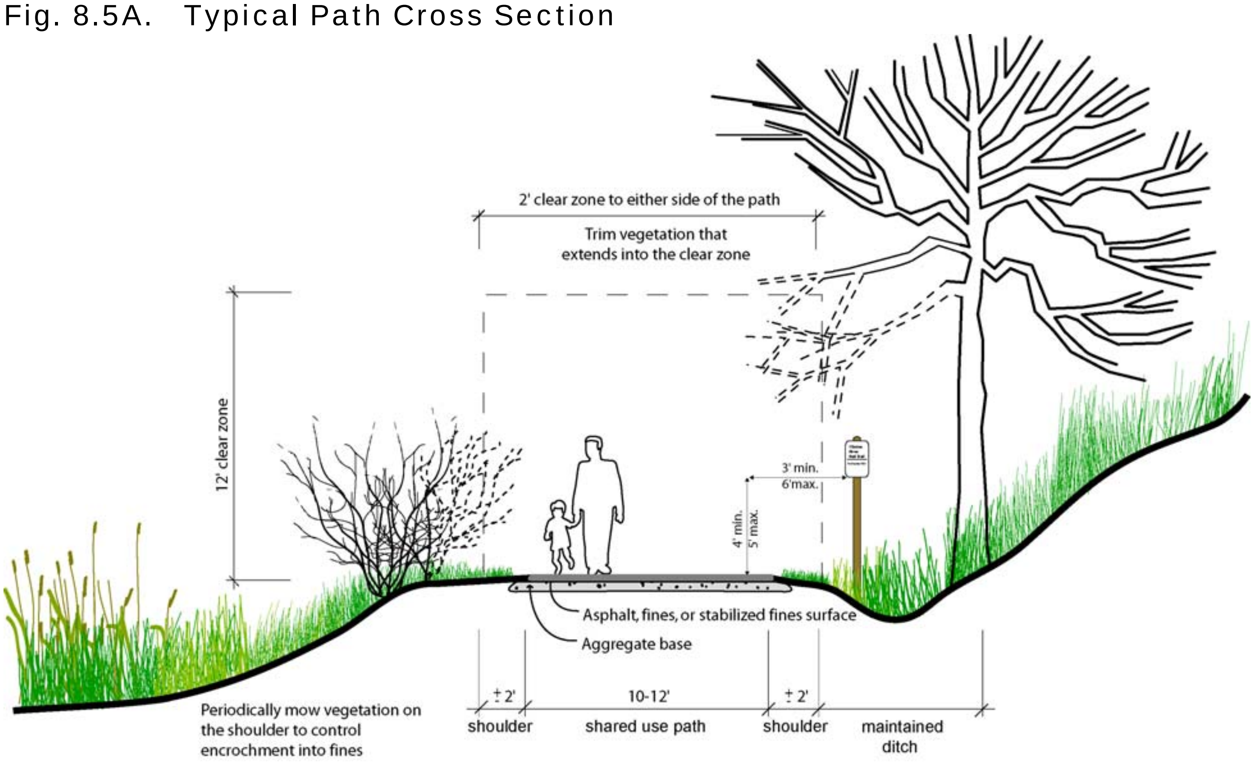
There are many types of Shared-Use pathways, each with unique issues. One type of Shared-Use pathway is the independent pathway that is separate from the road system. Independent pathways include rail-to-trail corridors, paths through parks and other trail systems. Independent pathways can be important and beneficial links to the nonmotorized transportation system provided they have direct connections to the existing network of Bike Lanes and sidewalks. If designed and maintained properly, they can be the "jewels" of a County's nonmotorized transportation system.

Independent pathways should be designed to accommodate shared uses including bikers, walkers, strollers, in-line skaters, and people in wheelchairs. For the safety of all users, the pathway must be built wide enough to accommodate these shared uses. A 10' wide path is the minimum width for a two-way Shared-Use path. The preferred minimum width is 12' in most cases in urban areas.

Trail Cross Section Design Guidelines

Figure 2.5A below illustrates several key points about the design and maintenance of Shared-Use paths:
Whether the surface of the path is asphalt, fines or other material, it should have a solid base and positive drainage as the path may have maintenance vehicles on it at all times of the year.
The vegetation along the trail should be regularly trimmed and mowed to maintain a clear zone around the trail.

Fig. 8.5A. Typical Path Cross Section

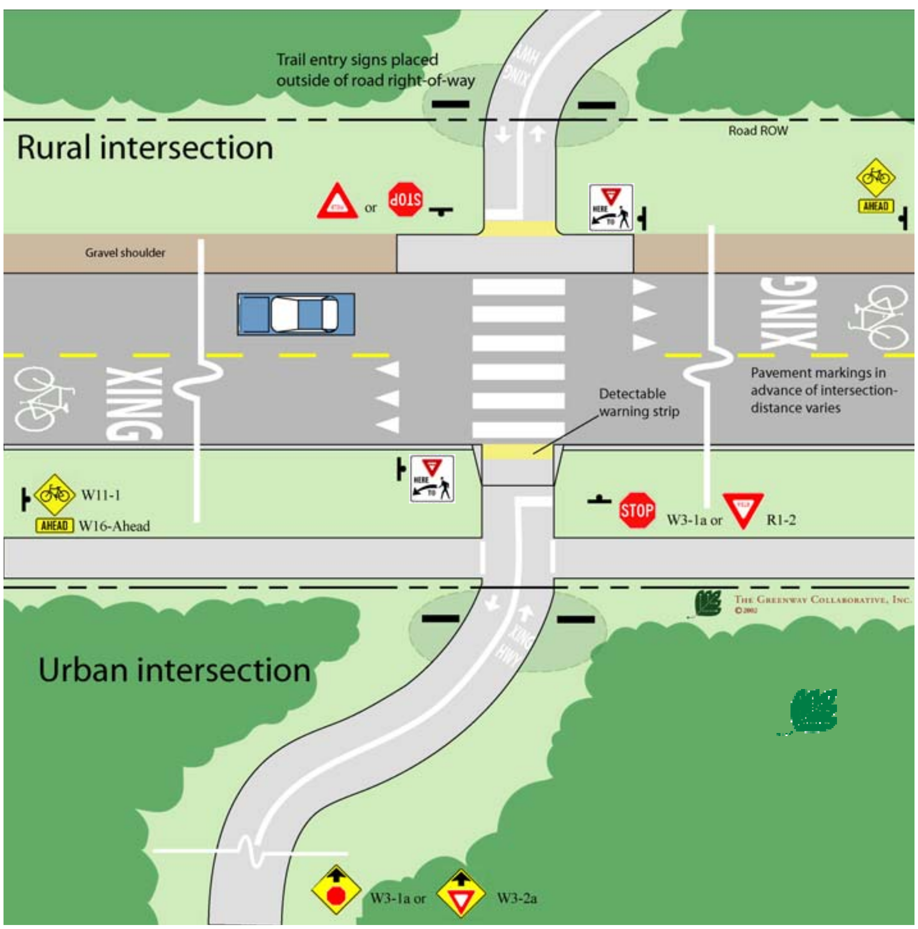


Independent Pathway / Road Intersection Design Guidelines

Independent pathways often intersect roadways at unsignalized mid-block crossings. Many of the design guidelines for a typical mid-block crosswalk apply (See *Section 8.4*, *Travel Across Road Corridors*) but because of the unique nature of independent pathways, several additional safety points must be considered. The following plan illustrates the key points needed for a safe design of the intersection of an independent pathway with a roadway:

- Clear signage that identifies user rights-of-way and notifies both the users of the pathway and the motorists that an intersection is approaching.
- Pavement markings at the beginning of the trail intersection notify users of direction of travel and rights-of-way. Pavement markings further along the trail should be minimized to avoid visual clutter.
- The pathway should meet the roadway at as close to a 90-degree angle as possible for maximum visibility of users.
- Trail signage is set back outside the road right-of-way.
- Regardless of the surfacing material of the trail, asphalt should be used for the portion of the trail that intersects the road. The asphalt increases traction for bicycle users and cuts down on debris from the shoulder of the road accumulating in the pathway. The change in materials can also help to notify trail users of the upcoming intersection. At rural intersections, gravel shoulders should also be paved adjacent to the trail to minimize debris in the stopping zone.

Fig. 8.5B. Typical Pathway/Roadway Intersection



Trail Entrance / Exit Signage Design Guidelines

If designed correctly, trail signage can serve as a pleasing amenity to the trail while providing valuable safety and orientation information to the users of the trail. Key considerations for the design of trail signage include:

- Signs should be placed at the beginning of trail intersections with the roadway to orient the user to his or her location along the trail, the distance to the next intersection crossing, and the rules and regulations of the trail.
- Signs should be a sufficient distance from the shoulder of the trail to prevent obstruction or collisions.
- Signs should be placed to allow access for maintenance vehicles to the trail.

The signs shown below should be considered diagrammatic, illustrating the type of information to be presented and appropriate setbacks. They are not intended as specific design recommendations.

Fig. 8.5C. Trail Entrance Signs

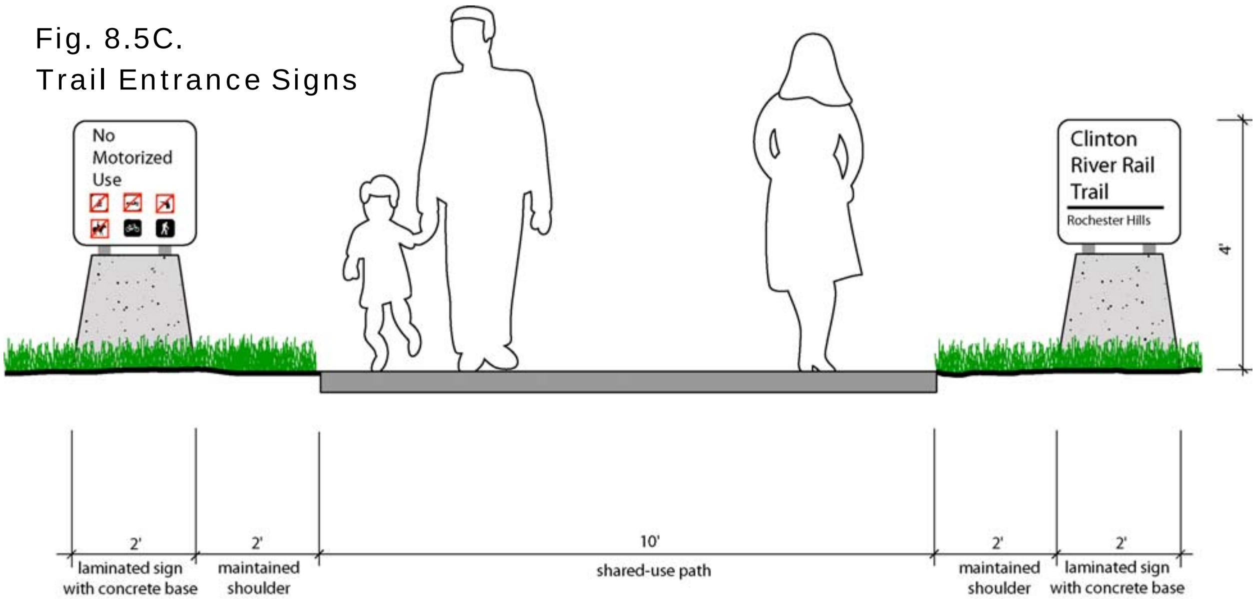
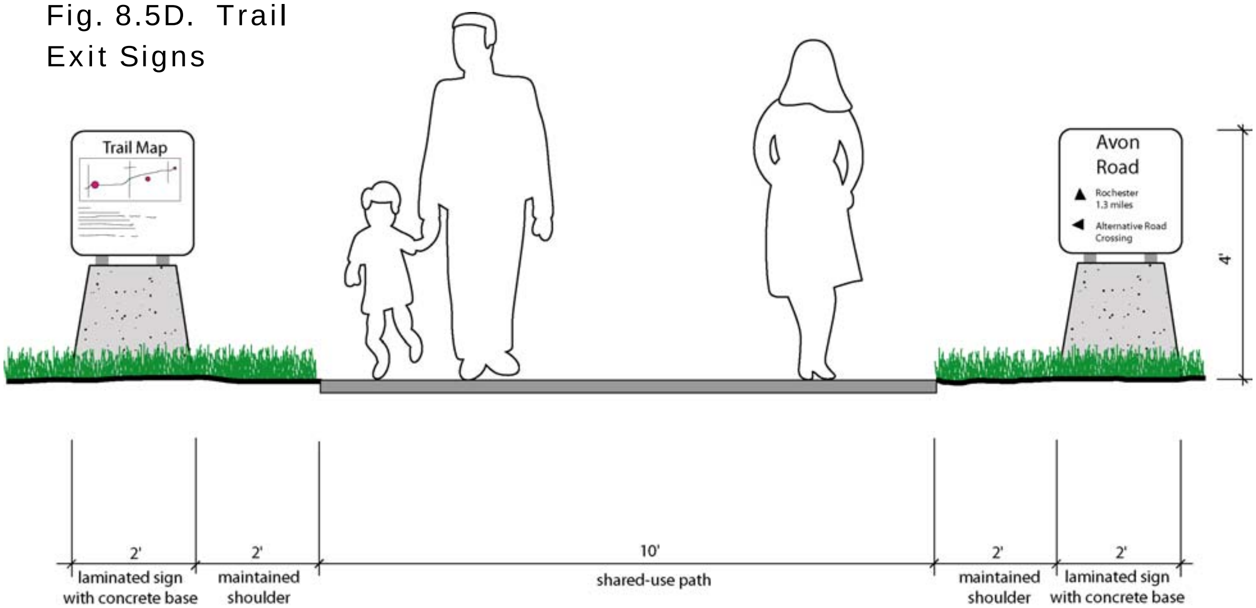


Fig. 8.5D. Trail Exit Signs



Equestrian Path Design Guidelines

Horses are common throughout much of St. Clair County. Shared-use Paths in Rural Agricultural, Rural Residential and Rural Activity Centers landscapes should accommodate equestrian users to the degree possible. Equestrian users should be brought into the design process as there are many design issues that must be considered and only a few are well documented in common trail design guidelines.

It should be noted that there is a large range in horse and rider skills and comfort levels riding with other trail users and with traffic. Also, some riders will be accessing trails from local roads and others will be bringing their horses to the path in a trailer. Recognize that equestrians will wish to access all of the same destinations and amenities as other path users. The following are a few key items regarding equestrians on Shared-use Paths.

- **Surfacing** – use a surface such as crushed fines, if the main pathway is to be a hard surface such as asphalt or concrete provide a parallel 5' wide soft surfaced trail.
- **Signs** – post signs that indicate that horses have the right-of-way as well as signs for other trail users regarding proper etiquette around horses.
- **Staging Areas** – should have specific facilities to accommodate horses including parking for horse trailers (15' x 45), hitching posts, and water.
- **Hitching Posts and Mounting Blocks** – should be provided at all points of interest along the trail.
- **Bridge Alternatives** – provide a place to ford a stream as an alternative to high and/or narrow bridges that may spook horses.
- **Signal Pushbutton Locations** – if pedestrian activated signals are used for crosswalks where horses are present, an additional push button should be located at a height so that a person on horse back could easily reach the button.

8.6 Pedestrian Travel in Commercial Centers

The design of the downtown pedestrian environment has a direct effect on the degree to which people enjoy the walking experience. If designed appropriately, the walking environment serves not only the people who currently walk but also entices those who don't. When considering the appropriate design of a certain location, designers should consider not only existing pedestrian use, but how the design will influence and increase walking in the future.

Additionally, designers must consider the various levels of walking abilities and local, state, and federal accessibility requirements. Although these types of requirements were specifically developed for people with walking challenges, their use will result in pedestrian facilities that benefit all people.

In the downtown area, defined by the boundary of the Downtown Development Authority (DDA), pedestrian accommodation takes on a special importance. Though the following guidelines are intended for the downtown area, many have applicability in other areas of town.

Zones in the Sidewalk Corridor

The Sidewalk Corridor is typically located within the public right-of-way between the curb or roadway edge and the property line. The Sidewalk Corridor contains four distinct zones:

- **Curb Zone**
- **Furnishings Zone**
- **Through Pedestrian Zone**
- **Frontage Zone**

Curb Zone **Furnishings Zone** **Through Pedestrian Zone** **Frontage Zone**

The Curb Zone

The Curb Zone defines the pedestrian area, providing a buffer between the sidewalk and street. This zone usually consists of the width of the curb and may contain space for unloading passengers or freight.

- Curb Zone width should be 18 inches where pedestrian or freight loading is expected and may conflict with obstacles, such as planters, in the Furnishings Zone.
- Curb Zone width along all other streets should be a minimum of six inches.

Curbs prevent water in the street gutters from entering the pedestrian space, discourage vehicles from driving over the pedestrian area, and make it easy to sweep the streets. In addition, the curb helps to define the pedestrian environment within the streetscape, although other designs can be effective for this purpose. At the corner, the curb is an important tactile element for pedestrians who are finding their way with the use of a cane.

On-Street Parking

As noted in Section 2.3 – Travel Along Road Corridors, the presence of on-street parking has a favorable impact on the quality of pedestrian environment. On-street parking increases the lateral separation between pedestrians and moving traffic as well as presenting a substantial buffer between the sidewalk and the street. On-Street Parking also has a traffic calming effect with motorists generally being more cautious looking for opening doors and cars pulling in and out.

Where the buffer zone is limited, on-street parking can compensate for lowered comfort level. Thus, if on-street parking is only allowed on on-side of the street due to road width constraints, the parking should be located on the side with the least buffer, all other factors being equal.

The Furnishings Zone

The Furnishings Zone lies between the Through Pedestrian Zone and Curb Zone. All fixtures and street furniture should be contained in the Furnishings Zone to keep the Through Pedestrian Zone free for walking. This is also the area where people alight from parked cars along the roadway.

Separating pedestrians from travel lanes greatly increases their comfort as they use the Sidewalk Corridor. This buffer function of the Furnishings Zone is especially important on streets where traffic is heavy, yet along many of these streets the existing Sidewalk Corridor is narrow. Where possible, additional width should be given to this zone on streets with traffic speeds over 35 mph.

The furnishing zone is also the area where elements such as signal poles, utility poles, controller boxes, hydrants, signs, parking meters, driveway aprons, grates, and hatch covers are located. Wherever it is wide enough, the Furnishings Zone should include street trees and be paved with tree wells and planting pockets for trees, flowers, and shrubs.

Furnishings Zone Elements

- Trees, planters & landscaping
- Trash & recycling receptacles
- Bicycle racks
- Street lights
- Benches
- Consolidated news racks (advertising racks should be discouraged)
- Clocks
- Public art
- Banners & flags
- Information kiosks
- Fountains
- Wayfinding/signage
- Street Vendors

Planting

Street trees are a highly desirable part of the pedestrian environment, especially large-canopied shade trees. Every effort should be made to provide enough room in the Sidewalk Corridor to accommodate trees in addition to pedestrian travel.

Tree limbs and branches should be trimmed to leave 7' – 6" clear above the level of the sidewalk. Permanent planters usually are not permitted in the right-of-way. Moveable planters may be permitted in the Frontage Zone with a permit from the appropriate agency.

Street Furnishings

Street furnishings can enliven and provide variety to outdoor public spaces. They serve an aesthetic as well as utilitarian function. Proper design and placement of street furnishings reinforces a downtown's design theme. The amount and types of furnishings provided will vary depending on the uses along the street and amount of pedestrian activity.

- On sidewalks of ten feet or greater, the Furnishings Zone width should be a minimum of four feet. A wider zone should be provided in areas with large planters and/or seating areas.
- Street furnishing should create a unified look. The color and appearance of street furnishings should be selected in concert with other design elements (such as special paving), surrounding furnishings, and the area as a whole.
- Street furnishings should be securely anchored to the sidewalk and protected with a graffiti-resistant coating to ensure a long-term quality appearance.
- The design and selection of street furniture should include consideration for the security, safety, comfort, and convenience of the user.
- Street furniture should be grouped together to conserve sidewalk space, provide complementary functions, and maintain a clear width sufficient to accommodate pedestrian flow. A greater number and type of furnishings should be located in high-use pedestrian traffic areas.
- The design and placement of furnishings should accommodate the physically challenged. This includes provision of space adjacent to walkways for wheelchairs and/or strollers.
- Textured paving may be used in the Furnishings Zone for decorative purposes.
- To reduce street clutter, consolidate signage on light poles, and other permanent fixtures, wherever possible.
- Dual-level lighting fixtures, which illuminate the street and sidewalk areas, are recommended on downtown commercial streets.

Street Vendors

Street vendors contribute to the life of downtown and provide inexpensive food to many downtown employees and visitors. When permits are granted to vendors the location should be carefully defined so carts and canopies not interfere with the through pedestrian zone. The use of generators should be strictly regulated or banned as the sound of generators severely degrades the pedestrian experience downtown.

The Through Pedestrian Zone

The Through Pedestrian Zone serves as the sidewalk area dedicated to walking and is located between the Frontage Zone and Furnishings Zone. This zone should be entirely free of permanent and temporary objects.

Width

As a general rule, the zone should be at least 6 feet wide in downtown, with 8-10 feet recommended. A minimum of five feet should be reserved to allow for two people to walk comfortably side by side and meet ADA requirements. The volumes of pedestrian traffic should be evaluated prior to granting sidewalk occupancy permits to make sure there is adequate sidewalk width to accommodate typical pedestrian volumes. An acceptable with would result in a pedestrian having to make only minor adjustments in speed and direction to avoid conflicts with other pedestrians and obstacles.

Alignment

The through pedestrian zone should keep in a straight line for an entire block. Zigzagging alignments to accommodate café tables alternately located against buildings and in the furniture zone reduces the capacity of sidewalk and makes it difficult to transverse for persons with sight and mobility impairments.

Intruding Elements

Driveway aprons should not intrude into the Through Pedestrian Zone. This Zone should be kept clear of any fixtures and/or obstructions. Clearance should be provided in a generally straight path for the convenience of all pedestrians, but especially for the sight-impaired. The Sidewalk surface must be stable, firm, smooth, and slip-resistant, per the ADA.

Constraints in the Sidewalk Corridor

In many downtowns the existing Sidewalk Corridor is too narrow to accommodate the recommended zone widths. Competing needs for space in a constrained Sidewalk Corridor can be resolved in either of two ways: by compromising on the minimum required clearance for some or all of the zone or by increasing the dimensions of the Sidewalk Corridor. The resolution of such conflicts in any given case must be based on considerations of balancing the conflicting uses and adjusting the magnitude of the solution to fit the magnitude of the project.

Widening the Sidewalk Corridor

In some cases, it is possible to increase the dimensions of the Sidewalk Corridor, either through acquisition of right-of-way or public walkway easements, or by reallocation of the overall right-of-way (such as by narrowing travel lanes or reducing the number of lanes). As part of a roadway reconstruction project on a street with a narrow Sidewalk Corridor, the project planners should first analyze the impact of reclaiming a portion of the existing right-of-way. If this proves impractical, the feasibility of acquiring additional right-of-way should be examined. Acquisition should be considered where its cost is reasonable in proportion to the overall project cost.

In the case of infill development, the dedication of public right-of-way or the granting of a public walkway easement to widen the Sidewalk Corridor may be included as a requirement for obtaining a building permit or land use approval.

Grates

All grates within the sidewalk shall be flush with the level of the surrounding sidewalk surface, and shall be located outside the Through Pedestrian Zone. Ventilation grates and tree well grates shall have openings no greater than 13 mm (1/2 in) in width.

Hatch Covers

Hatch covers should be located within the Furnishings Zone. Hatch covers must have a surface texture that is rough, with a slightly raised pattern. The surface should be slip-resistant even when wet. The cover should be flush with the surrounding sidewalk surface.

Surfaces

Walking surfaces shall be firm and stable, resistant to slipping, and allow for ease of passage by people using canes, wheelchairs, or other devices to assist mobility. Sidewalks are generally constructed of Portland cement concrete. Brick or concrete unit pavers may also be used particularly in the Furnishings Zone or around mature trees where sidewalk lifting is a problem.

Frontage Zone

The Frontage Zone is the area between the Through Pedestrian Zone and the property line. This zone allows pedestrians a comfortable "shy" distance from the building fronts, in areas where buildings are at the lot line, or from elements such as fences and hedges on private property.

Where no Furnishings Zone exists, elements that would normally be sited in that zone, such as transit shelters and benches, telephone kiosks, signal and street lighting poles and controller boxes, traffic and parking signs, and utility poles, may occupy the Frontage Zone. In some cases, easements or additional right-of-way may be required to allow for these items. For residential and mixed-use buildings built to the right-of-way line, these elements should not be sited in the Frontage Zone, as they could block access to an existing or future building. Private temporary uses such as sidewalk cafes may occupy the Frontage Zone, so long as the Through Pedestrian Zone is maintained.

Encroachments

Fences and walls, when permitted, must be at least 1 foot behind the back of the sidewalk (or the future sidewalk, if none exists). Encroachments into the right-of-way should not be permitted where the existing sidewalk corridor is less than the recommended width.

Care should be exercised if elements such as standpipe systems for fire safety project into the Frontage Zone from a building face. Standpipes systems should only project a maximum of 1' but not more than 4" if they project in the area between 2'-3" and 6'-8" above the sidewalk, per the ADA.

Adjacent Parking Lots

Where there is no landscaping between parked vehicles and the right-of-way, wheel stops or other means such as walls or fences should be used to prevent parked vehicles from overhanging into the Frontage Zone.

Appendix

A.1 Glossary of Terms

Within this document there are a number of terms that may be unfamiliar to many people. The following is a brief glossary of some of the transportation terms that are found in this document:

AASHTO – American Association of State Highway & Transportation Officials.

Bike Lane – a portion of the roadway designated for bicycle use. Pavement striping and markings sometimes accompanied with signage are used to delineate the lane

Bike Route – is a designation that can be applied to any type of bicycle facility. It is intended as an aid to help bicyclists find their way to a destination where the route is not obvious.

Clear Zones – area free of obstructions around roads and Shared-use Paths, and Walkways.

Crossing Islands – a raised median within a roadway typically set between opposing directions of traffic that permits pedestrians to cross the roadway in two stages. A crossing island may be located at signalized intersections and at unsignalized crosswalks. These are also known as **Refuge Islands.**

Crosswalk – the area of a roadway that connects sidewalks on either side at an intersection of roads (whether marked or not marked) and other locations distinctly indicated for pedestrian crossings by pavement markings.

Curb Extensions – extending the curb out at intersections in order to minimize pedestrian crossing distance, also known as **Bulb-outs.**

Dispersed Crossing – where pedestrians typically cross the road at numerous points along the roadway, rather than at an officially marked crosswalk.

Fines – finely crushed gravel 3/8" or smaller. The fines may be loosely applied or bound together with a stabilizing agent.

E-Bike – a bicycle that is propelled by an electric motor and/or peddling.

Inside Lane – the travel lane adjacent to the center of the road or the Center Turn Lane

Ladder Style Crosswalk – special emphasis crosswalk marking where 1' to 2' wide white pavement markings are placed perpendicular to the direction of a crosswalk to clearly identify crosswalk

Lateral Separation – horizontal distance separating one use from another (pedestrians from cars, for example) or motor vehicles from a fixed obstruction such as a tree

Leading Pedestrian Interval – is a traffic signal phasing approach where the pedestrian "Walk" phase precedes the green light going in the same direction by generally 4 to 5 seconds.

Mid-block Crosswalk – a crosswalk where motorized vehicles are not controlled by a traffic signal or stop sign. At these locations, pedestrians wait for a gap in traffic to cross the street, motorists are required to yield to a pedestrian who is in the crosswalk (but not if the pedestrian is on the side of the road waiting to cross).

MMUTCD – Michigan Manual of Uniform Traffic Control Devices. This document is based on the National Manual of Uniform Traffic Control Devices (MUTCD). It specifics how signs, pavement markings and traffic signals are to be used. The current version is the 2005 MMUTCD, it was adopted on August 15, 2005 and is based on the 2003 National MUTCD.

Mode-share / Mode split – the percent of trips for a particular mode of transportation relative to all trips. A mode-share / mode split may be for a particular type of trip such as home-to-work.

Mode – distinct types of transportation (cars, bicycles and pedestrians are all different modes of travel).

MVC – Michigan Vehicle Code, a state law addressing the operation of motor vehicles and other modes of transportation.

Out-of-Direction Travel – travel in an out-of-the-way, undesirable direction.

Outside Lane – lane closest to the side of the road.

Pedestrian Desire Lines – preferred pedestrian direction of travel.

Roundabouts – yield based circular intersections that permit continuous travel movement.

Shared Roadway – where bicycles and vehicles share the roadway without any portion of the road specifically designated for the bicycle use. Shared Roadways may have certain undesignated accommodations for bicyclists such as wide lanes, paved shoulders, and/or low speeds.

Shared Use Path – a wide pathway that is separate from a roadway by the minimum of an open unpaved space, a barrier or located completely away from a roadway. A Shared Use Path is shared by bicyclists and pedestrians at a minimum. There are numerous sub-types of Shared Use Paths including Sidewalk Bikeways that have unique characteristics and issues.

Shy Distance – the distance that pedestrians, bicyclists and motorists naturally keep between themselves and a vertical obstruction such as a wall or curb.

Sidewalk Bikeways – a specific type of Shared Use Path that parallels a roadway generally within the road right-of-way. This is also known as a **Sidepath**.

Signalized Crosswalk – a crosswalk where motor vehicle and pedestrian movements are controlled by traffic signals. These are most frequently a part of a signalized roadway intersection but a signal may be installed solely to facilitate pedestrians crossings. Signalized crosswalks installed solely for pedestrians must meet MMUTCD warrants.

Speed Table – raised area across the road with a flat top to slow traffic.

Splitter Islands – crossing islands leading up to roundabouts that offer a haven for pedestrians and that guide and slow the flow of traffic.

UTC – Uniform Traffic Code, is a set of laws that can be adopted by municipalities to become local law that address the operation of motor vehicles and other modes of transportation. The UTC is a complementary set of laws to the MVC.

Yield Lines – a row of triangle shaped pavement markings placed on a roadway to signal to vehicles the appropriate place to yield right-of-way. This is a new pavement marking that is used in conjunction with the new “Yield to Pedestrians Here” sign in advance of marked crosswalks.

A.2 Evaluating Quality and Level of Service of Nonmotorized Facilities

Bicycle and Pedestrian Level of Service Models are statistically reliable methods for evaluating the quality and effectiveness of pedestrian and bicycle conditions of a given roadway environment. Various models have been developed over the past decade. The Bicycle and Pedestrian Level of Service Models used for this plan, developed by Bruce Landis, PE, AICP of Sprinkle Consulting, Inc., models bicycle and pedestrian environments based on data gathered from a wide cross section of users who evaluated numerous real world scenarios. Simplified versions of these models have been incorporated in the Florida Department of Transportation's Multi-modal Quality/Level of Service Model, which is the only LOS analysis that FDOT currently accepts. The Quality/Level of Service score is a measurement of the perceived safety and comfort of pedestrians and bicyclists.

It should be noted that the Bicycle Quality/Level of Service model applies only to bicycle environments *within* the roadway. There currently are not any well-researched models for Bicycle Quality/Level of Service for Shared Use Paths. The Pedestrian Quality/Level of Service Model also does not account for the increased conflicts with bicyclists that are likely to occur on a Shared-use Path.

Pedestrian Quality/Level of Service - Key Factors (in order of statistical significance):

1. Presence of a sidewalk
2. Amount of lateral separation between pedestrians and motor vehicles
3. Presence of physical barriers and buffers (including parking) between pedestrians and motor vehicles
4. Motorized vehicle volume
5. Motorized vehicle speed

Bicycle Quality/Level of Service - Key Factors (in order of statistical significance):

1. Presence of Bike Lane or paved shoulder
2. Proximity of bicyclists to motorized vehicles
3. Motorized vehicle volume
4. Motorized vehicle speed
5. Motorized vehicle type (percent truck/commercial traffic)
6. Pavement condition
7. Percent on-street parking

The key factors for both modes are the existence of their own space, how far that space is from the traffic, and the nature of the traffic. The Bicycle and Pedestrian Quality/Level of Service score system has been developed using the same letter grading system with the same connotations as the letter grades used in schools: A being the best and F being the worst.

Because letter-grade Level of Service assessments are typical for vehicular traffic, there may be a desire to compare Vehicular Level of Service to that of Bicycle and/or Pedestrian Level of Service. However, the two evaluation systems are quite different and should not be directly compared. One illustration of the difference is that a Pedestrian Level of Service of "E" is likely the result of there not being any accommodations for a pedestrian. A Vehicular Level of Service "E" is defined as a point along an existing facility in which operations are at or near capacity and are quite unstable.

Providing Multi-modal Road ROW's

There are three typical scenarios for accommodating pedestrians, bicycles and motorists within a road Right-of-Way:

- Sidewalk (for pedestrians) and a Shared Roadway (for bicyclists and motorists)
- Sidewalk (for pedestrians) and a Bike Lane (a separate bike-only lane in the roadway)
- Shared Use Path (for pedestrians and some cyclists) and a Shared Roadway (for other bicyclists and motorists)

The following section looks at these three different scenarios for accommodating bicyclists, pedestrians and motorists. To evaluate each of these scenarios, a generalized cross section was prepared for each scenario along three different classifications of primary roadways: principal arterials, minor arterials, and urban collectors. While there are significant variances among different road classifications, the generalized input used for each covers most roadway situations.

The following table summarizes the input used in this analysis: along the road corridor have been explored using a Quality/Level of Service Analysis to determine which combination is the most beneficial for users

Table A.2A Generalized Road Conditions and Existing AASHTO Guidelines

Criteria		Urban Principle Arterial	Urban Minor Arterial	**Urban Collector**
ADT	Generalized Average Daily Traffic Volumes for Both Directions	30,000	20,000	10,000
Number of Lanes	Generalized Average	4 Total (2 each way)	4 Total (2 each way)	2 Total (1 each way)
Posted Speed	Generalized Average	40 MPH	35 MPH	30 MPH
Sidewalk Width	AASHTO Pedestrian Guidelines	5’ Minimum 6 – 8’ Preferred 10 – 15’in CBD & High Use Areas	5’ Minimum 6 – 8’ Preferred 10 – 15’in CBD & High Use Areas	5’ Minimum
Buffer Width	AASHTO Pedestrian Guidelines (from edge of road to sidewalk)	5’ Minimum 6’ Preferred	5’ Minimum 6’ Preferred	2’ Minimum 4’ Preferred
Bike Lane Width	AASHTO Bicycle Guidelines	3.5’ minimum (5’ total width including gutter)	3.5’ minimum (5’ total width including gutter)	3.5’ minimum (5’ total width including gutter)
Shared Outside Lane	AASHTO Bicycle Guidelines	14’ recommended 15’ maximum	14’ recommended 15’ maximum	14’ recommended 15’ maximum

Notes:

- 4’ minimum walks may be used if 5’ wide passing spaces for wheelchair users are provided at reasonable intervals.
- AASHTO also provides guidelines for curb-attached sidewalks (no buffer is provided between the sidewalk and roadway). The minimum width is 6’, 8 – 10’ is recommended along busy Arterials.
- There are many variables that AASHTO considers that are not articulated in this simplified chart.

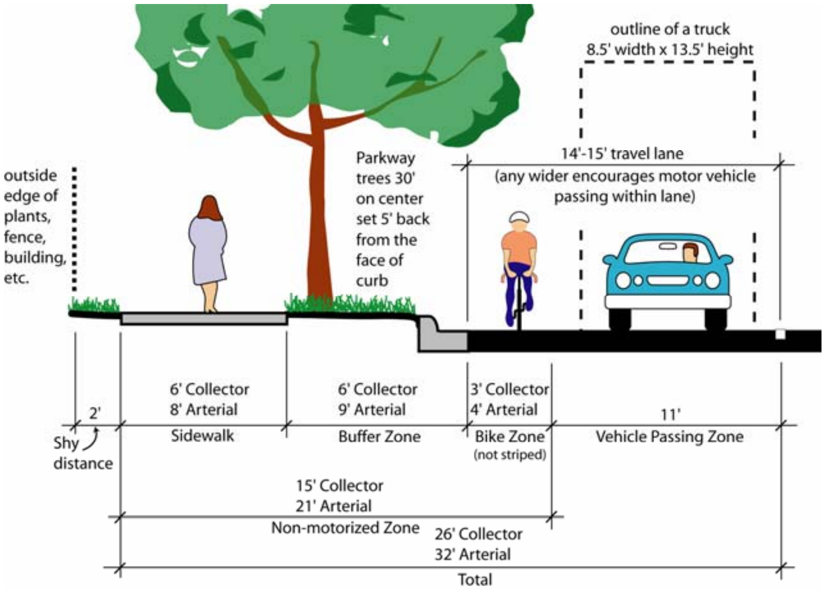
Refining the Scenarios

In comparing the different scenarios, the following design criteria were taken into consideration:

- **Widening the Buffer to Accommodate Trees** – As noted in the *Pedestrian Quality /Level of Service – Key Factors*, the lateral separation of pedestrians from the roadway and the presence of physical barriers such as trees, are the most important factors after the existence of a sidewalk. While trees provide benefits for pedestrian and roadway aesthetics, they are considered hazards to motorists. To minimize vehicular crashes with fixed roadside objects such as trees and light poles, current guidelines recommend placing the fixed objects at least 5' from the face of curb on urban arterials and 2' on collectors. Trees should be setback from the sidewalk at least 2' to allow for root growth and to provide a clear zone for the sidewalk users. To determine the total minimum desirable buffer with for Arterials, 6" is allocated for the width of a new tree trunk and the 18" from the face of curb to the edge of road is included. The result is that the minimum desirable buffer for Arterials is set at 9' wide. For Collectors, 4' is considered the minimum width for a planting strip that could support trees. This results in the total minimum desirable buffer for Collectors being set at 6' wide. As a general rule, the buffer should be as wide as reasonable for the conditions to minimize vehicular crashes with fixed objects, allow optimum planting conditions for trees, and improve the pedestrian environment.
- **Guidelines and Precedents for Narrow Lanes -** AASHTO guidelines note that inside vehicle lanes as narrow as 10' may be used to permit wider outside lanes to accommodate bicycle use.
- **Preserved Capacity with Narrower Lanes -** An 11' vehicular lane with an adjacent Bike Lane operates at near the same capacity as a 12' vehicular lane adjacent to a curb.
- **Narrow Turn Lanes -** AASHTO guidelines note that continuous two-way left-turn lanes may be as narrow as 10'.
- **Vehicle Widths -** A generalized sport utility vehicle is 6'- 4" wide, city buses and trucks are 8'-6" wide.
- **Working Within Existing ROW -** Typical ROW Widths are 66' and 99', which means that the combined width of the sidewalk, buffer zone (space between the road and the sidewalk), Bike Lane (if any), and outside vehicle lane should be no wider than 33' in order to avoid the need for additional ROW. Using inside and continuous two-way left-turn lanes of 11', a four-lane road can be accommodated in 88' and a five-lane road can be accommodated in 99'.
- **Maximizing Bicycle and Pedestrian Level of Service -** Three scenarios were initially designed based on AASHTO guidelines. The scenarios were then refined by adjusting variables within the parameters of AASHTO guidelines such as the sidewalk width, the width of the buffer between the road, sidewalk and tree spacing, the Bike Lane width, and right lane width, all to achieve the most desirable Quality/Level of Service score possible within the typical ROW's.

The following pages include an overview of the three scenarios, their general advantages and disadvantages, and the results of the Quality and Level of Service analyses for the three road classifications.

Fig. A.2B. Scenario A – Sidewalk and Shared Roadway



In this scenario, there are no specifically designated bicycle facilities within the roadway. Bicycles are accommodated through increased right-hand lane width (14' to 15') and reduced traffic speeds. Education and enforcement programs along with signage and potential pavement markings, such as the Shared-use Arrow, are utilized to alert motorists to the bicyclist's presence in the roadway.

Evaluation Results:

Road Classification	**Pedestrian Q/LOS**	**On-road Bike Q/LOS**	**Notes**
Principle Arterial	3.05 = C	4.55 = E	Extremely poor Bicycle Q/LOS
Minor Arterial	2.32 = B	4.23 = D	
Collector	2.47 = B	4.22 = D	Tied for worst Bike Q/LOS w/ scenario C

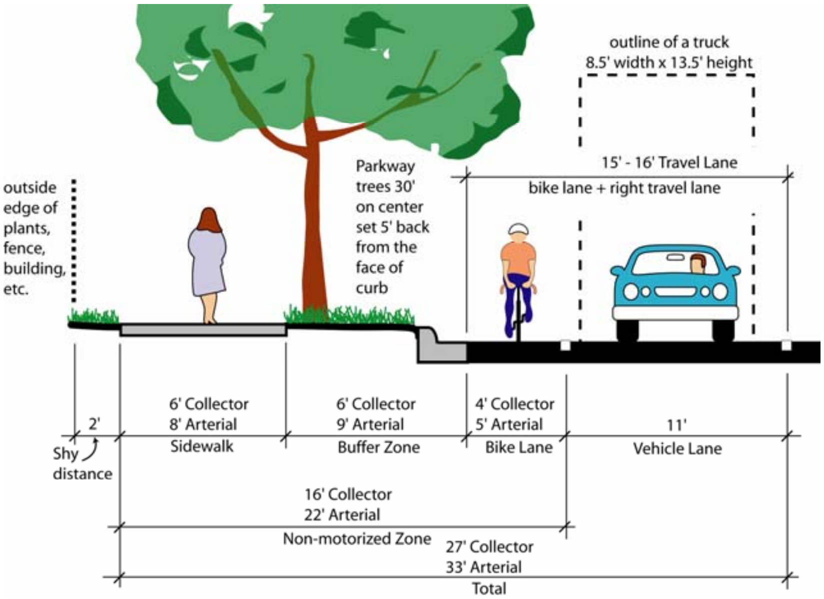
Advantages:

- Simple treatment at intersections
- Considered by some to be the safest way to integrate bicyclists and motorized vehicles
- Wide curb lane vs. Bike Lane studies have shown no significant safety differences in separation distances between the bicyclist and motorist
- Appeals to experienced bicyclists who are often commuters

Disadvantages:

- Unlikely to attract many new cyclists
- May be viewed as a do nothing approach by many
- Many bicyclists will still ride on the sidewalk
- Cars tend to move further to the left and encroach into adjacent travel lanes when passing a cyclist with wide curb lanes than with Bike Lanes
- Wider lanes may encourage higher speeds and may require traffic calming measures

Fig. A.2C. Scenario B – Sidewalk and Bike Lane (Preferred Option)



In this scenario, striped Bike Lanes or designated paved shoulders are provided on all collectors and minor arterials. Principal arterials may have Bike Lanes or widened curb lanes, as determined most prudent for specific situations. The width of the Bike Lanes or shoulders should increase in areas with poor sight lines and/or higher vehicular speeds and volumes.

Evaluation Results:

Road Classifications	Pedestrian Q/LOS	On-road Bike Q/LOS	Notes
Principle Arterial	3.04 = C	3.47 = C	Best Bike Q/LOS, only Scenario with a C rating
Minor Arterial	2.31 = B	3.15 = C	Best Bike Q/LOS, only Scenario with a C rating
Collector	2.46 = B	3.39 = C	Best Bike Q/LOS, only Scenario with a C rating

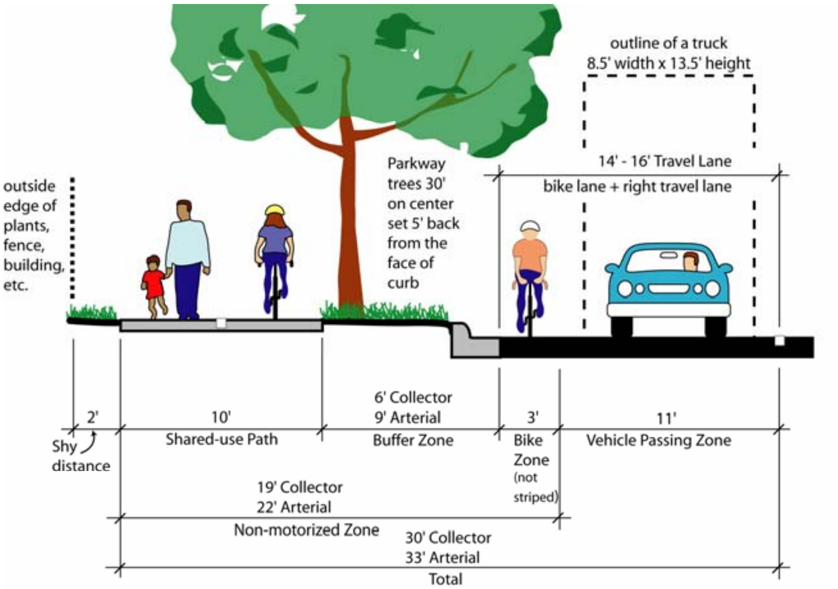
Advantages:

- Highly visible, designated facilities encourage increased bicycle use
- Designated facilities alert motorists of the bicyclist presence in the roadway
- May have a slight traffic calming in some situations
- Concurrent with AASHTO guidelines for most situations
- Motorists are much less likely to encroach into the adjacent lane when passing a bicyclist
- Motorists have less variation in their lane placement

Disadvantages:

- Bike Lanes require supplemental maintenance to be kept free of debris
- Intersections must be designed carefully to minimize conflicts with turning movements
- Presence of lanes may attract less experienced bicyclists to busier roadways
- Some bicyclists will still ride on the sidewalk

Fig. A.2D. Scenario C – Shared-use Path



In this scenario, off-road shared-use paths are provided on principal and minor arterials. Bike Lanes or designated paved shoulders are provided on collectors. Some collectors may also have shared-use paths. Driveways crossing shared use paths are modified to improve bicyclist and pedestrian safety.

Evaluation Scenarios:

Road Classifications	Pedestrian Q/LOS	On-road Bike Q/LOS	Notes
Principle Arterial	3.05 = C	4.69 = E	Worst Bike Q/LOS
Minor Arterial	2.32 = B	4.38 = D	Worst Bike Q/LOS
Collector	2.39 = B	3.89 = D	Tied for worst Bike Q/LOS w/ Scenario A

The analysis does not account for increased conflicts between bikes and pedestrians

Advantages:

- Similar to many of St. Clair County's existing nonmotorized facilities
- Do not have to modify existing roadways
- Facilities separate from busy roads appeal to novice users and those with slower reflexes

Disadvantages:

- Off-road facilities such as sidewalks and pathways are statistically the most dangerous places to bike due to conflicts with motor vehicles at intersections and driveways
- Increased number of conflicts between bicyclists and pedestrians on pathways
- Some bicyclists will still choose the roadway rather than a Shared-use Path.
- Off-road facilities will need to be cleared of snow and have a higher maintenance standard than is currently in place to be considered a transportation facility
- Transition between Shared-use Paths and Bike Lanes are awkward

Scenario Observations

After reviewing the Quality/Level of Service (Q/LOS) analysis and testing alternative inputs for the alternative scenarios, a number of observations were made. These include:

- AASHTO minimum guidelines in many cases do not result in a Q/LOS grade of "C" or better.
- The Sidewalk and Bike Lane scenarios were the only scenarios that consistently achieved a Q/LOS of C or better for bicyclists and pedestrians. The other scenarios consistently had at least one mode rated a Q/LOS of D or worse.
- An 8' wide Bike Lane would be required to achieve a Bicycle Q/LOS higher than C on a typical Principal Arterial due to the traffic volumes and speeds. At that width the Bike Lane may be misinterpreted as a travel lane and would be difficult to fit in most road ROW's.
- A 21' wide buffer would be required to achieve a Pedestrian Q/LOS higher than C on a typical Principal Arterial due to the traffic volumes and speeds. This would be difficult to accommodate in most road ROW's.
- The nonmotorized zone does not vary in width much and all of the scenarios can be accommodated in standard ROW widths.
- While Bike Lanes provide additional buffer space between the vehicular travel way and the sidewalks, the difference in the Q/LOS is not significant.
- The Average Daily Traffic Volume for a 2 Lane Urban Collector would have to be below 3,500 to achieve a Bicycle Q/LOS of C.
- A Bike Lane provides an additional 4 to 5' of lateral separation between fixed objects such as trees and street lights and the motorized travel lanes increasing motorized safety.
- A Bike Lane provides a benefit to trees planted in the buffer by providing an additional 4' to 5' between the canopy of the tree and trucks that may hit the lower branches.

Conclusion

Based on these observations **Scenario B – Sidewalk and Bike Lane** is the preferred alternative for all road classifications under most circumstances. Scenario A – Sidewalks and Shared Roadway may be appropriate for lower volume (<3,500 ADT) and lower speed (<= 30 MPH) Collectors. Scenario C – Shared-use Path may be appropriate for Parkway situations where intersecting roadways and driveways are widely spaced (typically father apart than 1/2 mile). In addition, there should be little need to get to destinations on the other side of the road between intersecting roadways and marked mid-block crosswalks.

Notes on the Application of the Conclusions

It should be noted that traffic volumes and speed, rather than road classifications, should determine whether to use a 4' or 5' wide bike lane. As a general rule, where volumes are expected to be over 25,000 trips per day and/or speeds are posted at 40 MPH or above, a 5' bike lane is preferred. 5' bike lanes are also preferable in situations where the vertical and horizontal curves limit sight lines.

An 8' width for sidewalks along Arterials can generally accommodate cyclists who choose not to use the Bike Lane, without causing excess conflicts for pedestrians in suburban settings.

A.3 Multi-Modal Roadway Typical Cross Sections

The following are cross section options for varying width roadways. Please note that the unique situation of each roadway should be considered in determine the most appropriate solution for any particular roadway.

This format corresponds to the GIS database created for the project. For each road segment the general cross section type called out. For many of the challenging road conversions the road width and specific lane width allocations are called out as well.

Legend:

BL Bike Lane

CBLContra-Flow Bike Lane

CT Center Turn

P Parking (width assumes presence of 1.5' gutter)

1 Lane, 1 Way, 1 Bike Lane

3.5' BL | 10.5' (14' Total)

4' BL | 11' (15' Total)

5' BL | 11' (16' Total)

1 Lane, 1 Way, 1 Contra-Flow Bike Lane:

4' CBL | 10' (14' Total)

5' CBL | 10' (15' Total)

6' CBL | 10' (16' Total)

6' CBL | 11' (17' Total)

7' CBL | 11' (18' Total)

1 Lane, 1 Way, 2 Bike Lanes (1 Contra-Flow Bike Lane):

3.5' CBL | 10' | 3.5' BL (17' Total)

4.5' CBL | 10' | 3.5' BL (18' Total)

5.5' CBL | 10' | 3.5' BL (19' Total)

5.5' CBL | 11' | 3.5' BL (20' Total)

5.5' CBL | 11' | 4.5' BL (21' Total)

6.5' CBL | 11' | 4.5' BL (22' Total)

7.5' CBL | 11' | 4.5' BL (23' Total)

1 Lane, 1 Way, Parking 1 Side, 1 Bike Lane:

3.5’ BL | 10’ | 5.5 P (19’ Total)

3.5’ BL | 11’ | 5.5 P (20’ Total)

4.5’ BL | 11’ | 5.5 P (21’ Total)

5.5’ BL | 11’ | 5.5 P (22’ Total)

5.5’ BL | 12’ | 5.5 P (23’ Total)

5.5’ BL | 13’ | 5.5 P (24’ Total)

1 Lane, 1 Way, Parking 1 Side, 1 Contra-Flow Bike Lane:

3.5’ CBL | 10’ | 5.5 P (19’ Total)

4.5’ CBL | 10’ | 5.5 P (20’ Total)

4.5’ CBL | 11’ | 5.5 P (21’ Total)

5.5’ CBL | 11’ | 5.5 P (22’ Total)

6.5’ CBL | 11’ | 5.5 P (23’ Total)

7.5’ CBL | 11’ | 5.5 P (24’ Total)

1 Lane, 1 Way, Parking 1 Side, 2 Bike Lanes (1 Contra-Flow Bike Lane):

3.5’ CBL | 10’ | 5’ BL | 5.5 P (24’ Total)

3.5’ CBL | 10’ | 6’ BL | 5.5 P (25’ Total) cross hatch door zone

3.5’ CBL | 11’ | 6’ BL | 5.5 P (26’ Total) cross hatch door zone

3.5’ CBL | 11’ | 7’ BL | 5.5 P (27’ Total) cross hatch door zone

4.5’ CBL | 11’ | 7’ BL | 5.5 P (28’ Total) cross hatch door zone

5.5’ CBL | 11’ | 7’ BL | 5.5 P (29’ Total) cross hatch door zone

5.5’ CBL | 11’ | 8’ BL | 5.5 P (30’ Total) cross hatch door zone

1 Lane, 1 Way, Parking 2 Sides, 1 Bike Lane (Same Direction as Motorized Traffic):

5.5 P | 10’ | 5’ BL | 5.5 P (26’ Total)

5.5 P | 11’ | 5’ BL | 5.5 P (27’ Total)

5.5 P | 11’ | 6’ BL | 5.5 P (28’ Total) cross hatch door zone

5.5 P | 11’ | 7’ BL | 5.5 P (29’ Total) cross hatch door zone

5.5 P | 11’ | 8’ BL | 5.5 P (30’ Total) cross hatch door zone

Note Contra-flow Bike Lanes should not be used with parallel parking on both sides of the street. Consider back-in angle parking on one side of the street.

2 Lanes, 1 Way, 1 Bike Lane:

3.5’ BL | 10’ | 10.5’ (24’ Total)

3.5’ BL | 10.5’ | 11’ (25’ Total)

4’ BL | 11’ | 11’ (26’ Total)

5’ BL | 11’ | 11’ (27’ Total)

5.5’ BL | 11’ | 11.5’ (28’ Total)

5.5’ BL | 11.5’ | 12’ (29’ Total)

6’ BL | 12’ | 12’ (30’ Total)

2 Lanes, 1 Way, Parking 1 Side, 1 Bike Lane:

3.5’ BL | 10’ | 10’ | 5.5 P (29’ Total)

3.5’ BL | 10’ | 11’ | 5.5 P (30’ Total)

3.5’ BL | 11 | 11’ | 5.5 P (31’ Total)

4.5’ BL | 11 | 11’ | 5.5 P (32’ Total)

4.5’ BL | 11 | 12’ | 5.5 P (33’ Total)

5.5’ BL | 11 | 12’ | 5.5 P (34’ Total)

5.5’ BL | 11 | 13’ | 5.5 P (35’ Total)

2 Lanes, 1 Way, Parking 2 Sides, 1 Bike Lane:

5.5 P | 5’ BL | 10’ | 10’ | 5.5 P (36’ Total)

5.5 P | 6’ BL | 10’ | 10’ | 5.5’ P (37’ Total) cross hatch door zone

5.5 P | 7’ BL | 10’ | 10’ | 5.5’ P (38’ Total) cross hatch door zone

5.5 P | 6’ BL | 10.5’ | 10.5’ | 5.5’ P (38’ Total) cross hatch door zone

5.5 P | 7’ BL | 10.5’ | 10.5’ | 5.5 P (39’ Total) cross hatch door zone

5.5 P | 6’ BL | 11’ | 11’ | 5.5’ P (39’ Total) cross hatch door zone

5.5 P | 7’ BL | 11’ | 11’ | 5.5 P (40’ Total) cross hatch door zone

5.5 P | 7’ BL | 11’ | 12’ | 5.5 P (41’ Total) cross hatch door zone

5.5 P | 7’ BL | 11’ | 13’ | 5.5 P (42’ Total) cross hatch door zone

5.5 P | 7’ BL | 11’ | 14’ | 5.5 P (43’ Total) cross hatch door zone

5.5 P | 7’ BL | 12’ | 14’ | 5.5 P (44’ Total) cross hatch door zone

5.5 P | 8’ BL | 12’ | 14’ | 5.5 P (45’ Total) cross hatch door zone

2 Lanes, 2 Bike Lanes:

3’ BL | 9’ | 9’ | 3’ BL (24’ Total)

3’ BL | 9.5’ | 9.5’ | 3’ BL (25’ Total)

3.5’ BL | 9.5’ | 9.5’ | 3.5’ BL (26’ Total)

3.5’ BL | 10’ | 10’ | 3.5’ BL (27’ Total)

3.5’ BL | 10.5’ | 10.5’ | 3.5’BL (28’ Total)

3.5’ BL | 11’ | 11’ | 3.5’ BL (29’ Total)

4’ BL | 11’ | 11’ | 4’ BL (30’ Total)

4.5’ BL | 11’ | 11’ | 4.5’ BL (31’ Total)

4.5’ BL | 11.5’ | 11.5’ | 4.5’ BL (32’ Total)

5’ BL | 11’ | 11’ | 5’ BL (32’ Total)

5’ BL | 11.5’ | 11.5’ | 5’ BL (33’ Total)

5’ BL | 12’ | 12’ | 5’ BL (34’ Total)

2 Lanes, Parking 1 Side, 2 Bike Lanes:

3.5’ BL | 10’ | 10’ | 5’ BL | 5.5 P (34’ Total)

3.5’ BL | 10’ | 10’ | 6’ BL | 5.5 P (35’ Total) cross hatch door zone

3.5’ BL | 10.5’ | 10.5’ | 5’ BL | 5.5 P (35’ Total)

3.5’ BL | 10.5’ | 10.5’ | 6’ BL | 5.5 P (36’ Total) cross hatch door zone

3.5’ BL | 11’ | 11’ | 5’ BL | 5.5 P (36’ Total)

3.5’ BL | 10.5’ | 10.5’ | 7’ BL | 5.5 P (37’ Total) cross hatch door zone

3.5’ BL | 11’ | 11’ | 6’ BL | 5.5 P (37’ Total) cross hatch door zone

3.5’ BL | 11’ | 11’ | 7’ BL | 5.5 P (38’ Total) cross hatch door zone

4’ BL | 11’ | 11’ | 7.5’ BL | 5.5 P (39’ Total) cross hatch door zone

4.5’ BL | 11’ | 11’ | 8’ BL | 5.5 P (40’ Total) cross hatch door zone

5.5’ BL | 11’ | 11’ | 8’ BL | 5.5 P (41’ Total) cross hatch door zone

5.5’ BL | 11.5’ | 11.5’ | 8’ BL | 5.5 P (42’ Total) cross hatch door zone

5.5’ BL | 12’ | 12’ | 8’ BL | 5.5 P (43’ Total) cross hatch door zone

2 Lanes, Parking 2 Sides, 2 Bike Lanes:

5.5 P | 5’ BL | 10’ | 10’ | 5’ BL | 5.5 P (41’ Total)

5.5 P | 5.5’ BL | 10’ | 10’ | 5.5’ BL | 5.5 P (42’ Total)

5.5 P | 5’ BL | 10.5’ | 10.5’ | 5’ BL | 5.5 P (42’ Total)

5.5 P | 6’ BL | 10’ | 10’ | 6’ BL | 5.5’ P (43’ Total)

5.5 P | 5.5’ BL | 10.5’ | 10.5’ | 5.5’ BL | 5.5 P (43’ Total)

5.5 P | 6’ BL | 10.5’ | 10.5’ | 6’ BL | 5.5 P (44’ Total)

5.5 P | 5.5’ BL | 11’ | 11’ | 5.5’ BL | 5.5 P (44’ Total)

5.5 P | 6.5’ BL | 10.5’ | 10.5’ | 6.5’ BL | 5.5 P (45’ Total)

5.5 P | 6’ BL | 11’ | 11’ | 6’ BL | 5.5 P (45’ Total)

5.5 P | 7’ BL | 10.5’ | 10.5’ | 7’ BL | 5.5 P (46’ Total)

5.5 P | 6.5’ BL | 11’ | 11’ | 6.5’ BL | 5.5 P (46’ Total)

5.5 P | 7.5’ BL | 10.5’ | 10.5’ | 7.5’ BL | 5.5 P (47’ Total)

5.5 P | 7’ BL | 11’ | 11’ | 7’ BL | 5.5 P (47’ Total)

5.5 P | 7.5’ BL | 11’ | 11’ | 7.5’ BL | 5.5 P (48’ Total)

5.5 P | 8’ BL | 11’ | 11’ | 8’ BL | 5.5 P (49’ Total)

5.5 P | 8’ BL | 11.5’ | 11.5’ | 8’ BL | 5.5 P (50’ Total)

5.5 P | 8’ BL | 12’ | 12’ | 8’ BL | 5.5 P (51’ Total)

3 Lanes, 2 Bike Lanes:

3’ BL | 10’ | 9’ CT | 10’ | 3’ BL (35’ Total)

3.5’ BL | 10’ | 9’ CT | 10’ | 3.5’ BL (36’ Total)

3.5’ BL | 10’ | 10’ CT | 10’ | 3.5’ BL (37’ Total)

3.5’ BL | 10.5’ | 10’ CT | 10.5’ | 3.5’ BL (38’ Total)

3.5’ BL | 11’ | 10’ CT | 11’ | 3.5’ BL (39’ Total)

3.5’ BL | 11’ | 11’ CT | 11’ | 3.5’ BL (40’ Total)

4’ BL | 11’ | 11’ CT | 11’ | 4’ BL (41’ Total)

4.5’ BL | 11’ | 11’ CT | 11’ | 4.5’ BL (42’ Total)

5’ BL | 11’ | 11’ CT | 11’ | 5’ BL (43’ Total)

5.5’ BL | 11’ | 11’ CT | 11’ | 5.5’ BL (44’ Total)

5.5’ BL | 11.5’ | 11’ CT | 11.5’ | 5.5’ BL (45’ Total)

5.5’ BL | 12’ | 11’ CT | 12’ | 5.5’ BL (46’ Total)

5.5’ BL | 12’ | 12’ CT | 12’ | 5.5’ BL (47’ Total)

3 Lanes, Parking 1 Side, 2 Bike Lanes:

3.5’ BL | 10’ | 9’ CT | 10’ | 5’ BL | 5.5 P (43’ Total)

3.5’ BL | 10’ | 10’ CT | 10’ | 5’ BL | 5.5 P (44’ Total)

3.5’ BL | 10.5’ | 10’ CT | 10.5’ | 5’ BL | 5.5 P (45’ Total)

3.5’ BL | 11’ | 10’ CT | 11’ | 5’ BL | 5.5 P (46’ Total)

3.5’ BL | 11’ | 10’ CT | 11’ | 6’ BL | 5.5 P (47’ Total) cross hatch door zone

3.5’ BL | 11’ | 10’ CT | 11’ | 7’ BL | 5.5 P (48’ Total) cross hatch door zone

3.5’ BL | 11’ | 11’ CT | 11’ | 7’ BL | 5.5 P (49’ Total) cross hatch door zone

4.5’ BL | 11’ | 11’ CT | 11’ | 7’ BL | 5.5 P (50’ Total) cross hatch door zone

4 Lanes, 2 Bike Lanes:

3’ BL | 10’ | 10’ | 10’ | 10’ | 3’ BL (46’ Total) Sub AASHTO Bike Lanes

3.5’ BL | 10’ | 10’ | 10’ | 10’ | 3.5’ BL (47’ Total)

3.5’ BL | 10.5’ | 10’ | 10’ | 10.5’ | 3.5’ BL (48’ Total)

3.5’ BL | 10.5’ | 10.5’ | 10.5’ | 10.5’ | 3.5’ BL (49’ Total)

3.5’ BL | 11’ | 10.5’ | 10.5’ | 11’ | 3.5’ BL (50’ Total)

3.5’ BL | 11’ | 11’ | 11’ | 11’ | 3.5’ BL (51’ Total)

4’ BL | 11’ | 11’ | 11’ | 11’ | 4’ BL (52’ Total)

4.5’ BL | 11’ | 11’ | 11’ | 11’ | 4.5’ BL (53’ Total)

5’ BL | 11’ | 11’ | 11’ | 11’ | 5’ BL (54’ Total)

5.5’ BL | 11’ | 11’ | 11’ | 11’ | 5.5’ BL (55’ Total)

5.5’ BL | 11.5’ | 11’ | 11’ | 11.5’ | 5.5’ BL (56’ Total)

5.5’ BL | 12 | 11’ | 11’ | 12 | 5.5’ BL (57’ Total)

5.5’ BL | 12 | 11.5’ | 11.5’ | 12 | 5.5’ BL (58’ Total)

5.5’ BL | 12 | 12’ | 12’ | 12 | 5.5’ BL (58’ Total)

5 Lanes, 2 Bike Lanes

3’ BL | 10’ | 10’ | 9’ CT | 10’ | 10’ | 3’ BL (55’ Total) Sub AASHTO Bike and CT Lanes

3.5’ BL | 10’ | 10’ | 9’ CT | 10’ | 10’ | 3.5’ BL (56’ Total) Sub AASHTO CT Lanes

3.5’ BL | 10’ | 10’ | 10’ CT | 10’ | 10’ | 3.5’ BL (57’ Total)

3.5’ BL | 10.5’ | 10’ | 10’ CT | 10’ | 10.5’ | 3.5’ BL (58’ Total)

3.5’ BL | 10.5’ | 10.5’ | 10’ CT | 10.5’ | 10.5’ | 3.5’ BL (59’ Total)

3.5’ BL | 10.5’ | 11’ | 10’ CT | 10.5’ | 11’ | 3.5’ BL (60’ Total)

3.5’ BL | 11’ | 11’ | 10’ CT | 11’ | 11’ | 3.5’ BL (61’ Total)

4’ BL | 11’ | 11’ | 10’ CT | 11’ | 11’ | 4’ BL (62’ Total)

4’ BL | 11’ | 11’ | 11’ CT | 11’ | 11’ | 4’ BL (63’ Total)

4.5’ BL | 11’ | 11’ | 10’ CT | 11’ | 11’ | 4.5’ BL (63’ Total)

4.5’ BL | 11’ | 11’ | 11’ CT | 11’ | 11’ | 4.5’ BL (64’ Total)

4.5’ BL | 11’ | 11’ | 11’ CT | 11’ | 11’ | 4.5’ BL (64’ Total)

5’ BL | 11’ | 11’ | 11’ CT | 11’ | 11’ | 5’ BL (65’ Total)

5.5’ BL | 11’ | 11’ | 11’ CT | 11’ | 11’ | 5.5’ BL (66’ Total)

5.5’ BL | 11.5’ | 11’ | 11’ CT | 11’ | 11.5’ | 5.5’ BL (67’ Total)

5.5’ BL | 12’ | 11’ | 11’ CT | 11’ | 12’ | 5.5’ BL (68’ Total)

5.5’ BL | 12’ | 11.5’ | 11’ CT | 11.5’ | 12’ | 5.5’ BL (69’ Total)

5.5’ BL | 12’ | 12’ | 11’ CT | 12’ | 12’ | 5.5’ BL (70’ Total)

5.5’ BL | 12’ | 12’ | 12’ CT | 12’ | 12’ | 5.5’ BL (71’ Total)

Legend:

BL Bike Lane

CBL Contra-Flow Bike Lane

CT Center Turn

P Parking (width assumes presence of 1.5’ gutter)

A.4 Differentiating Various Non-motorized Resources

There are numerous resources that are referred to when looking for information on non-motorized planning issues. What makes the search confusing is that there are various publications put out by both public and private organizations that delineate approaches to non-motorized planning and design. While most of the information presented by major non-motorized transportation resources is beneficial and complementary, the degree to which the different sources are accepted by each agency varies.

The existing resources fall into the eight basic categories listed below. They are listed in the order of their significance or degree of authority. This order also generally corresponds to their level of specificity, with the most authoritative documents being more general.

1) **Laws and Spending Bills**—enacted legislation that often prescribes how money should be spent.
2) **Policies**—general legislative or agency directives often tied to funding.
3) **Standards**—design elements that must be adhered to by law or policy directives.
4) **Guidelines**—based on established best practices, supplemented by current research. These generally provide sufficient flexibility to adapt to specific situations.
5) **Standard Plans**—detailed implementation design drawings to particular situations.
6) **Recommended Practices**—not a currently accepted guidelines, but a reflection of best practices employed by some public agencies.
7) **Informational Reports**—scoping documents that review practices employed nationally and internationally regarding specific issues.
8) **Practice**—what actually gets implemented.

A.5 Key Documents Relevant to Non-motorized Transportation

Laws/Spending Bills

ADA – Americans with Disabilities Act

- *ADA Standards for Accessible Design,* rev. 1994

SAFETEA-LU

- *Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users*, enacted August 10, 2005, as Public Law 109-59.

Policies

FHWA – Federal Highway Administration

- *Design Guidance, Accommodating Bicycle and Pedestrian Travel: A Recommended Approach,* 1999

Standards

MMUTCD & MUTCD

- *Michigan Manual of Uniform Traffic Control Devices,* 2005 Edition
- *Manual of Uniform Traffic Control Devices,* 2003 Edition

Guidelines

AASHTO – American Association of State Highway and Transportation Officials

- *Guide for the Planning, Design, and Operation of Pedestrian Facilities,* 2004
- *Guide for the Development of Bicycle Facilities*, 1999
- *A Guide for Achieving Flexibility in Highway Design*, 2004
- *A Policy on Geometric Design of Highways and Streets, 5th Edition — The "Green Book"*, 2004

FHWA

- *Pedestrian Facilities Users Guide: Providing Safety and Mobility,* 2002
- *Safety Effects of Marked vs. Unmarked Crosswalks at Uncontrolled Locations*, 2002
- *Designing Sidewalks and Trails for Access, Best Practices Design Guide*, 2001

Standard Plans

Washington State DOT

- *Design Manual*, 2001

Florida DOT

- *Florida Bicycle Facilities Planning & Design Handbook*, 2002

Recommended Practices

ITE – Institute of Transportation Engineers

- *Transportation Planning Handbook*, Chapter 16: Bicycle and Pedestrian Facilities, 1999
- *Design and Safety of Pedestrian Facilities*, 1998

Informational Reports

ITE

- *Traffic Calming, State of the Practice*, 1999
- *Innovative Bicycle Treatments, an Informational Report*, 2002
- *Alternative Treatments for At-Grade Pedestrian Crossings*, 2001

TRB – Transportation Research Board of the National Academies

- *Transportation Research Record No. 1828, Pedestrians and Bicycles 2003*
- *NCHRP Report 500, Volume 10 – A Guide for Reducing Collisions Involving Pedestrians*

A.6 Existing Educational Resources

A6.1 FHWA COURSE ON BICYCLE AND PEDESTRIAN TRANSPORTATION

Instructor: Independent Study
Website: http://safety.fhwa.dot.gov/pedbike/univcourse/swintro.htm

Course Overview (From the website)
Planning for bicycle and pedestrian travel is a somewhat new field of study, and yet it also involves planning and engineering techniques that have been around for many years. This coursebook provides the reader with current information on pedestrian and bicycle planning and design techniques, as well as practical lessons on how to increase bicycling and walking through land use practices, engineering measures, and a variety of other urban and rural design procedures.

This manual can be used to train future professionals, including planners, engineers, landscape architects, and other designers, in a variety of disciplines. Emphasis is placed on the importance of developing an interdisciplinary team approach to planning and implementing bicycle and pedestrian programs, and of the role played by each profession represented in this course.

This coursebook was developed by the USDOT Federal Highway Administration for use in graduate-level courses in non-motorized transportation planning and design. Several of the lessons address both bicycle and pedestrian issues, while others address one particular aspect of pedestrian or bicycle design.

The coursebook is arranged into three sections:

Introductory Topics
Lessons cover the history of non-motorized transportation, current levels of bicycling and walking, and factors that influence the choice of bicycling or walking.

Lesson 1: The Need for Bicycle and Pedestrian Mobility

Lesson 2: Bicycling and Walking in the United States Today

Planning Section
Lessons cover a wide range of planning issues, including pedestrian and bicycle crash types, how to prepare a local bicycle or pedestrian plan, adapting suburban communities to encourage bicycle and pedestrian travel, traditional neighborhood design, and revising local zoning and subdivision regulations to encourage bicycle and pedestrian-friendly development.

Lesson 3: Bicycle and Pedestrian Planning Overview

Lesson 4: Pedestrian and Bicycle Crash Types

Lesson 5: Adapting Suburban Communities for Bicycle and Pedestrian Travel

Lesson 6: Neo-Traditional Neighborhood Design

Lesson 7: Using Land-Use Regulations to Encourage Non-Motorized Travel

Lesson 8: Tort Liability and Risk Management

Lesson 9: Bicycle and Pedestrian Connections to Transit

Lesson 10: Off-Road Trails

Lesson 11: Traffic Calming

Lesson 12: Pedestrian and Bicycle Facilities in Work Zones

Design Issues

The lessons in this section cover an extensive range of issues in non-motorized transportation design. Traffic calming, pedestrian accommodations at intersections, on-road bicycle facility design and trail design are among the topics addressed, with various levels of detail.

Students are advised to consult standard engineering texts for specific details regarding the analytical basis and methodological techniques for traditional transportation analysis procedures such as transportation modeling, traffic engineering, safety analysis, facility design, and project construction. A variety of sources are cited and included in this document via references. Technical and commentary excerpts were selected from pertinent references for inclusion in this coursebook based on the relevancy of the material to the overall context of pedestrian and bicycle transportation. Some of these references were written from an advocate's perspective and may contain information that is opinion rather than fact. Inclusion of referenced material in this document does not constitute an endorsement of these individual views. Rather, this material has been included for the purpose of presenting diverse and relevant viewpoints with respect to planning and design of pedestrian and bicycle facilities.

Pedestrian Facility Design

Lesson 13: Walkways, Sidewalks and Public Spaces

Lesson 14: Pedestrian Signing and Pavement Markings

Lesson 15: Pedestrian Accommodations at Intersections

Lesson 16: Mid-Block Crossings

Lesson 17: Pedestrians With Disabilities

Bicycle Facility Design

Lesson 18: Shared Roadways

Lesson 19: Bike Lanes

Lesson 20: Restriping Existing Roads With Bike Lanes

Lesson 21: Bicycle Facility Maintenance

Lesson 22: Bicycle Parking and Storage

Lesson 23: European Approaches to Bicycle and Pedestrian Facility Design

Lesson 24: Education, Encouragement, and Enforcement

A6.2 February, 2002 Two-day Course Material

Instructor: Michael Ronkin, of the Oregon Department of Transportation
Website: http://www.dot.state.co.us/BikePed/DesignCourses.htm

Implementation (3 MB)

Bicycle presentation

- Basics of Bikeway Design (50 MB)
- Other design details (11 MB)
- Restriping (20 MB)
- Intersections (12 MB)
- Signing (15 MB)
- Paths 1 (38 MB)
- Paths 2 (43 MB)
- Paths 3 (29 MB)
- Parking (11 MB)
- Advanced Bikeway Design (17 MB)

Pedestrian Presentation

- Designing for peds intro (41 MB)
- What else is does it take (61 MB)
- Sidewalk Basics 1 (57 MB)
- Sidewalk Basics 2 (46 MB)
- ADA (62 MB)
- ADA Standard Drawings (3 MB)
- Crossings 1 (37 MB)
- Crossings 2 (41 MB)
- Intersections 1st half (31 MB)
- Intersections 2nd half (39 MB)
- Inspectors sw & ada workshop (60 MB)

For more information about bicycling and walking in Colorado please contact:

CDOT Bicycle/Pedestrian Program
4201 E. Arkansas Ave. DTD
Denver, CO 80222
303-757-9982
bicycleinfo@dot.state.co.us

A6.3 National Center for Bicycling and Walking

The National Center for Bicycling and Walking has compiled a list of training opportunities available and grouped them by course type. The following information is from their webstie

Website: http://www.bikewalk.org/technical_assistance/training_resources/training_registry.htm

Training Opportunities: Registry

Bicycle

Course: Designing streets for safe bicycle accommodation

Description: 1-day workshop for planners, engineers, on designing bicycle travel space on any kind of street

Instructor: John Ciccarelli

Sponsor: Bicycle Solutions

Arrangements: via contract with sponsoring agencies

Date(s): by arrangement

Location: by arrangement

Cost: varies

Contact: John Ciccarelli (650) 494-9140 info@bicyclesolutions.com

Link: http://www.bicyclesolutions.com/class_accomodation.htm

Course: All about bicycle parking & storage

Description: Image-based seminar on selecting, installing bike racks, lockers, and shared bicycle storage

Instructor: John Ciccarelli

Sponsor: Bicycle Solutions

Arrangements: via contract with sponsoring agencies

Date(s): by arrangement

Location: by arrangement

Cost: varies

Contact: John Ciccarelli (650) 494-9140 info@bicyclesolutions.com

Link: http://www.bicyclesolutions.com/class_ps.htm

Pedestrian

Course: Walkable Community Workshops

Description: Training Courses (one or two-day) on pedestrian, bicycle facilities; traffic calming; healthy street design; walkable communities

Instructor: Dan Burden, and others as required

Sponsor: Walkable Communities, Inc. with local sponsor

Arrangements: via contract with sponsoring agencies

Date(s): by arrangement

Location: by arrangement

Cost: varies

Contact: (386) 454-3304 Walkable@aol.com

Link: N/A

Course: Pedestrian Safety Roadshow

Description: 4-hour workshop helps communities identify and address pedestrian safety concerns.

Instructor: Varies

Sponsor: US Dept. of Transportation with local agencies as arranged

Arrangements: Contact Leverson Boodlal and FHWA and visit website

Date(s): By arrangement

Location: By arrangement

Cost: None

Contact: Leverson Boodlal (202) 366-8044 leverson.boodlal@fhwa.dot.gov

Link: http://safety.fhwa.dot.gov/roadshow/walk/

Combined: Bicycle/Pedestrian

Course: Federal Highway Administration's University Level Bicycle & Pedestrian Course

Description: Graduate or undergraduate level curricula on pedestrian and bicycle planning and design

Instructor: Varies

Sponsor: Intended for use by universities and colleges

Arrangements: Varies

Date(s): Varies

Location: Varies

Cost: Paid for the same way other university courses are

Contact: Carol Tan Esse Carol.Tan.Esse@fhwa.dot.gov or Leverson Boodlal Leverson.Boodlal@fhwa.dot.gov

Link: Brochure from: http://www.walkinginfo.org/pdf/r&d/ucourse.pdf

Course: Bicycle and Pedestrian Issues

Description: 3-hour workshop on impact of bicycle and pedestrian programs.land-use, design and operations, and creative strategies

Instructor: Christopher Hagelin

Sponsor: Center for Urban Transportation Research, Univ. of South Florida

Arrangements: Taught as part of CUTR's 12 - 40 hr. Commuter Choice Certification Program; students can attend without registering for whole program

Date(s): Contact instructor

Location: Contact instructor

Cost: Free for Florida participants

Contact: Christopher Hagelin (813) 974-2997, hagelin@cutr.usf.edu

Link: http:www.cutr.usf.edu or brochure: http://www.cutr.eng.usf.edu/tdm/pdf/Comm_Choice.pdf

Course: Bicycle Facility Design & Pedestrian Facility Design

Description: Courses currently being developed for the National Highway Institute, a division of FHWA

Instructor: To be announced

Sponsor: National Highway Institute

Arrangements: To be announced

Date(s): To be announced

Location: To be announced

Cost: To be announced

Contact: Pat Lees (775) 329-4955 plees@nce.reno.nv.us

Link: http://www.ncenet.com/whatsnew.html

Course: Pedestrian and Bicycle design

Description: 2- and 3-day combined bike and pedestrian courses; 2-day bike or ped courses also available

Instructor: Michael Ronkin

Sponsor: by arrangement (see "Pedestrian Design 101" Oak Park, IL course for example)

Arrangements: by arrangement

Date(s): by arrangement

Location: by arrangement

Cost: varies

Contact: (541) 745-5370 michaelnandrea@attbi.com

Link: N/A

Design

Course: Understanding traffic calming

Description: Image-based presentation for cities, neighborhoods, and civic groups
Instructor: John Ciccarelli
Sponsor: Bicycle Solutions
Arrangements: via contract with sponsoring agencies
Date(s): by arrangement
Location: by arrangement
Cost: varies
Contact: John Ciccarelli (650) 494-9140 info@bicyclesolutions.com
Link: http://www.bicyclesolutions.com/class_calm.htm

Safety

Course: Context Sensitive Solution Training

Description: Teaches practitioners to look "beyond the pavement" to balance mobility needs with community and environment
Instructor: Toni Gold
Sponsor: Project for Public Spaces
Arrangements: Contact course coordinator for dates and course details
Date(s): Contact coordinator
Location: Contact coordinator
Cost: Contact coordinator
Contact: Toni Gold (860) 232-9018 urbanedge@aol.com
Link: http://www.pps.org/CSS/css_training_2002.htm

Training

Course: Professional development/training

Description: Topics include traffic calming, bicycle/pedestrian transportation, roundabouts, crosswalk improvements, ADA improvements
Instructor: Various
Sponsor: RBA Group
Arrangements: via contract with sponsoring agencies
Date(s): by arrangement
Location: by arrangement
Cost: varies
Contact: (973) 898-0300 jmaiorana@rbagroup.com
Link: http://www.rbagroup.com/services/planning/dev_train.html

Course: TrailDART Program

Description: Training topics include trail advocacy, trail development, and TEA-21; (they also sponsor trails conferences)

Instructor: Various

Sponsor: Rails to Trails Conservancy

Arrangements: via contract with sponsoring agencies

Date(s): by arrangement

Location: by arrangement

Cost: varies

Contact: Hugh Morris (202) 331-9696 rtchugh@transact.org

Link: http://www.railtrails.org/whatwedo/building/traildart.asp

A6.4 Safe Routes to School Program

Pedestrian & Bicycle Information Center has put together a Safe Routes to School Program. While the program focuses on school age children, it is addresses many non-motorized transportation issues. The following is from their website.

Website: http://www.pedbikeinfo.org/sr2s/

Communities across the country are looking for ways to make walking and bicycling safe and appealing ways for children to get to school.

Safe Routes to School Programs (SR2S) identify barriers and create action plans that use a combination of strategies such as teaching pedestrian and bicycle safety, building sidewalks, working with law enforcement to slow traffic and initiating walking clubs and contests.

While there is great interest in creating safe routes, identifying the most appropriate strategies can be a challenge. Communities start with different conditions, so the problems, issues and solutions vary. The SR2S National Training Course is designed to help communities create sound programs that are based on community conditions, best practices and responsible use of resources.

This new course, developed by the Pedestrian and Bicycle Information Center (PBIC) in collaboration with SR2S experts from around the country, combines safety, health and transportation issues. It was developed through a partnership of funding from the Federal Highway Administration, the National Highway Traffic Safety Administration, the Centers for Disease Control and Prevention and the Environmental Protection Agency.

Course highlights:

- Designed for community and state-level audiences
- Audience includes transportation engineers, planners, law enforcement officers, school administrators, parents, local advocates, community leaders and state decision makers
- Core content is intermingled with opportunities for discussion, observation and identification of local problems and solutions
- Participants create short- and long-term plans of action for their communities
- One-day and two-day course formats
- Certified instructors bring expertise and experience
- Ongoing technical assistance provided by the PBIC
- On-line resource guide (available summer 2005)

Course agenda includes:

- Setting the context: Safety, health and transportation
- Process for developing and implementing a SR2S program
- Engineering strategies
- Perspectives from local stakeholders
- Walk audit of school campus and surrounding area
- Identifying problems and solutions
- Encouragement and education strategies
- Enforcement strategies
- How communities are making it happen
- Making it happen in your community

Questions or comments can be e-mailed to the PBIC through the web site www.pedbikeinfo.org or through the toll-free phone line: 1-877-925-5245 (877-WALKBIKE)

Pedestrian and Bicycle Information Center
730 Airport Road, Suite 300/Campus Box 3430
Chapel Hill, North Carolina 27599-3430

A.7 Existing Nonmotorized Guidelines

Selected State and City Bike and Pedestrian Web Sites That Contain Guidelines and/or Standard Plans

The following transportation agencies maintain websites that include guidelines and/or standard plans. The guidelines may be in a part of a non-motorized master plan on the website. All of the documents from these websites has been downloaded and is available on the accompanying CD.

ARIZONA
http://www.azbikeped.org/bicycle_and_pedestrian_plan.htm

CALIFORNIA
http://www.dot.ca.gov/

Berkeley
http://www.ci.berkeley.ca.us/transportation/Bicycling/BB/Guidelines/covtoc.htm

San Francisco
http://www.bicycle.sfgov.org/site/uploadedfiles/dpt/bike/Bike_Plan/SF_Design_Guidelines_Feb04.pdf

COLORADO
www.dot.state.co.us/BikePed/

Boulder
http://www.ci.boulder.co.us/publicworks/depts/transportation/master_plan_new/pdfs/TMP_111303_72dpi.pdf

FLORIDA
http://www.dot.state.fl.us/

Ft. Lauderdale
http://ci.ftlaud.fl.us/MasterPlan/111803report/CHAPTER-4.pdf

ILLINOIS

Chicago
http://www.tylin.com/chicago/napbike/pdf/appendix-b.pdf

KENTUCKY
http://transportation.ky.gov/Multimodal/bicycle.asp
http://www.bae.uky.edu/BikeKy/Links/#Federal

MAINE
http://www.maine.gov/mdot/opt/bicycle-transportation.php

MARYLAND
http://www.mdot.state.md.us/

MICHIGAN
http://www.michigan.gov/mdot/

MISSISSIPPI
http://www.mdot.state.ms.us/bicycling/default.htm

NEW YORK
http://www.dot.state.ny.us/pubtrans/bphome.html

NORTH CAROLINA
http://www.ncdot.org/

OHIO
http://www.dot.state.oh.us/bike/

OREGON
http://www.dot.state.co.us/BikePed/

Portland
www.trans.ci.portland.or.us/plans/bicyclemasterplan/default.htm

WASHINGTON STATE
http://www.wsdot.wa.gov/

WISCONSIN
http://www.dot.wisconsin.gov/

Madison & Dane County
http://www.transport2020.net/

TEXAS
Austin
www.ci.austin.tx.us/bicycle/default.htm

Bike and Pedestrian Web Sites - Other Reference Guidelines

AASHTO PowerPoint Presentation Highlighting Geometric Design
http://www.dot.state.oh.us/roadwayengineering/Presentations/Green%20Book%202001%20Highlights.ppt#256,1,AASHTO Policy on Geometric Design of Highways and Streets 2001

bicyclinginfo.org
Exemplary Bicycle & Pedestrian Plans
http://www.bicyclinginfo.org/pp/exemplary.htm

FHWA Bicycle & Pedestrian Program
http://www.fhwa.dot.gov/environment/bikeped/

Notes on Selected States Guidelines and Plans

Washington State
Many references to its own guidelines for specific type of facility design. Repeatedly referenced with descriptive graphics and design details. Very thorough. Recommended Use matrices for specific issues. Referenced by other states' guidelines.

Oregon
Bike / Ped Home Page. Very thorough, but all text driven. No graphics to speak of. Tries to cover the issues found in AASHTO Bike Plan and MUTCD in their own words.

California
Bicycle Guidelines. Separate MUTCD design book. Design details and specific issues. Quite thorough.

Florida
Overall, very well laid out and explained with statistics, studies and good graphic details defining how to create and support a good bike and pedestrian system. Taken steps to develop their own guidelines primarily based on AASHTO and FHWA. Large glossary of terms.

Maryland
DOT has a twenty year plan in place. Carefully delineated strategy and action plan with time frames and funding costs. Strong LOS Inventory process by district. Specific design considerations are deferred to AASHTO and FHWA.

Wisconsin
Very thorough Bicycle Design Guidelines. Descriptions of best and worst practices nicely supported with clear graphics. Pedestrian guide covers issues and concerns extensively, but has very few Pedestrian Design Guidelines.

Georgia
Pedestrian and Streetscape Guide. Deals with very specific needs and issues concerning pedestrians. Has space needs charts and numerous pedestrian specific issues, requirements, statistics, and safety issues. Includes "common characteristics of pedestrian friendly communities." Numerous design details. Particular references to Washington State DOT guidelines and Portland, Oregon Pedestrian Master Plan.

North Carolina
Basically a series of short policy statements online on issues of design, rights, construction, maintenance, and education. There is a more thorough Bicycle facilities and design guideline handbook from 1994.

Arizona
The design and maintenance guidelines included in this Plan are intended to supplement AASHTO guidelines. Some design sketches reference Marin County, California Bike and Ped Plan. Often they get city specific within Arizona. A strong "where the problems / issues are" approach that leaves the actual details for implementation up to interpretation of FHWA, AASHTO and other guidelines. Very language oriented with minimal graphic design tools. Many maps of the state for various descriptions.

Ohio
Ohio references everything out from their website. They point you in the direction of AASHTO, FHWA, MUTCD, and numerous others. There is an older printed guideline from 1988 that may be available. It is actually reasonably thorough.

Colorado
Guide references FHWA, Oregon DOT, and various other, mostly in-state, sources for information. Bike Guidelines has a small section on Pedestrian issues. Excellent graphics. Less about facilities and more about safety. Not much on Design Guidelines.

Kentucky
Basically refers you to U of K Extension Bicycle and Pedestrian Education Program and FHWA Bicycle and Pedestrian Program and from there links you to other organizations.

Michigan
Safety, Maps and Info, Tourist Info, Promotional Organizations in “Bicycling” under Roads and Travel on the MDOT web site. No pedestrian info found.

Notes on Selected Cities Guidelines and Plans

Austin, Texas
Austin has a broad plan for geographic layouts and written guidelines. Delineated with district maps. Goes into detail on specific areas of town. Weak in graphics for design and detail issues.

Berkeley, California
Berkeley looks to be an early (98 - 02) plan that is strong on funding options and areas of town to focus, but weak on specific design and details. Well delineated existing conditions and recommendations.

Boulder, Colorado
Part of the overall Boulder Transportation Master Plan. Overall plan, policies, minimal graphic design & detail examples. Demand Management a high priority. Goes into detail on specific areas of town.

Cambridge, Massachusetts
Much farther along on their pedestrian plan than on their bike plan. Bike plan is referenced out to other guideline sources. Uses graphics from State of Oregon and Portland, Oregon design guidelines. Good bibliography.

Chicago, Illinois
Very defined and well developed bike lane design guidelines.

Denver, Colorado
Much farther along on their pedestrian plan than on their bike plan. Bike plan is referenced out to other guideline sources.

Ft. Lauderdale, Florida
Broad, general information; map with routes

Madison, Wisconsin
An element of the city's Master Plan

Portland, Oregon
Probably the most thorough plan of any out there, including state plans.

San Francisco, California
Graphic Details of bike lane layouts. Very thorough.