DECEMBER 2016

Small Town *and* Rural Multimodal Networks

U.S. Department of Transportation
Federal Highway Administration

1. AGENCY USE ONLY (Leave Blank)	**2. REPORT DATE** December 2016	**3. REPORT TYPE AND DATES COVERED** Final Report
4. TITLE AND SUBTITLE Small Town and Rural Multimodal Networks		**5a. FUNDING NUMBERS** NA
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9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Office of Planning, Environment, and Realty Federal Highway Administration 1200 New Jersey Avenue SE Washington DC 20590		**10. SPONSORING/MONITORING AGENCY REPORT NUMBER** FHWA-HEP-17-024
11. SUPPLEMENTARY NOTES		
12a. DISTRIBUTION/AVAILABILITY STATEMENT This document is available to the public on the FHWA website at: http://www.fhwa.dot.gov/environment/bicycle_pedestrian		**12b. DISTRIBUTION CODE** NA
13. ABSTRACT The *Small Town and Rural Multimodal Networks* report is a resource and idea book intended to help small towns and rural communities support safe, accessible, comfortable, and active travel for people of all ages and abilities. It provides a bridge between existing guidance on bicycle and pedestrian design and rural practice, encourage innovation in the development of safe and appealing networks for bicycling and walking in small towns and rural areas, and show examples of peer communities and project implementation that is appropriate for rural communities.		
14. SUBJECT TERMS Bicycle, bike, pedestrian, safety, networks, activity, rural, small town, multimodal, nonmotorized, planning, bridge, school		**15. NUMBER OF PAGES** 134 **16. PRICE CODE** NA

17. SECURITY CLASSIFICATION OF REPORT Unclassified	**18. SECURITY CLASSIFICATION OF THIS PAGE** Unclassified	**19. SECURITY CLASSIFICATION OF ABSTRACT** Unclassified	**20. LIMITATION OF ABSTRACT** Unlimited

Publication Number: FHWA-HEP-17-024

This document is intended to be a resource for transportation practitioners in small towns and rural communities. It applies existing national design guidelines in a rural setting and highlights small town and rural case studies. It addresses challenges specific to rural areas, recognizes how many rural roadways are operating today, and focuses on opportunities to make incremental improvements despite the geographic, fiscal, and other challenges that many rural communities face.

It provides information on maintaining accessibility and MUTCD compliance, while at the same time encouraging innovation. For example, this document highlights two innovative facility types: Yield Roadways and Advisory Shoulders. Regarding Yield Roadways, this document references AASHTO resources such as the Guidelines for Very Low-volume Local Roads 2001, which includes discussion of Two- Way Single-Lane Roads, and the A Policy on Geometric Design of Highways and Streets, which notes that "on residential streets the level of user inconvenience occasioned by the lack of two moving lanes is remarkably low". It also notes that when faced with two-way traffic in a single lane "opposing conflicting traffic will yield and pause on the parking lane area until there is sufficient width to pass" (2011, p. 5-13). This document notes that Yield Roadways are a common form for low-volume local rural and urban roads, but recognizes that additional research on this facility type will be helpful. It will also be helpful to learn from the experience of states such as Oregon that recommend similar street types in their Oregon Neighborhood Street Design Guidelines.

Similarly, the document notes that as of 2016, an approved Request to Experiment is required to implement Advisory Shoulders. Called "dashed bicycle lanes" in the FHWA experimentation process, at least five such experiments are currently ongoing. Beyond local experimentation, the guidance in this document incorporates lessons learned from installations in the UK, where speed and crash reduction benefits were noted after facility implementation. Refer to FHWA's Bicycle and Pedestrian Program website for the current approval status of these and other treatments before implementation.

By including these facilities in this document, FHWA is fostering innovation and encouraging participation in the formal experimentation process. This will help to ensure that conversations about design flexibility and multimodal networks also address rural conditions and meet the needs of everyone. In doing so, this document is intended to foster an ongoing dialogue about multimodal transportation infrastructure needs in small towns and rural areas.

ACKNOWLEDGEMENTS

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Funding Partners

Funding for this project is provided in part by the Center for Prevention at Blue Cross and Blue Shield of Minnesota

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Special Thanks

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Cover Photo: Diane Banta, National Park Service Rivers, Trails, and Conservation Assistance Program

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CHAPTER 1

Introduction

Allendale, South Carolina–Population 3,264

Introduction

The *Small Town and Rural Multimodal Networks* guide is a design resource and idea book to help small towns and rural communities support safe, accessible, comfortable, and active travel for people of all ages and abilities.

In many small towns and rural communities, active transportation is even more common than it is in urban areas. However, infrastructure to support active transportation is often limited or absent. Many small and rural communities are located on State and county roadways that were built to design standards that favor high-speed motorized traffic, resulting in a system that makes walking and bicycling less safe and uncomfortable. These roadways can be retrofitted and redesigned over time to provide a transportation network that better serves the safety, health, and economic interests of the community.

This guide is a resource for practitioners developing and promoting multimodal networks in small and rural communities. The opportunities for road design highlighted in this document build on a broad range of existing national design guidelines and references. This guide translates existing street design guidance and best practices for bicycle and pedestrian safety and comfort to the rural context, and provides examples of how to interpret and apply these design practices to create safe, accessible, and comfortable multimodal networks.

The guide is intended to:

- Provide a bridge between existing guidance on bicycle and pedestrian design and rural practice.
- Encourage innovation in the development of safe and appealing networks for bicycling and walking in small towns and rural areas.
- Provide examples of peer communities and project implementation that is appropriate for rural communities.

Rushford, Minnesota–Population 1,720

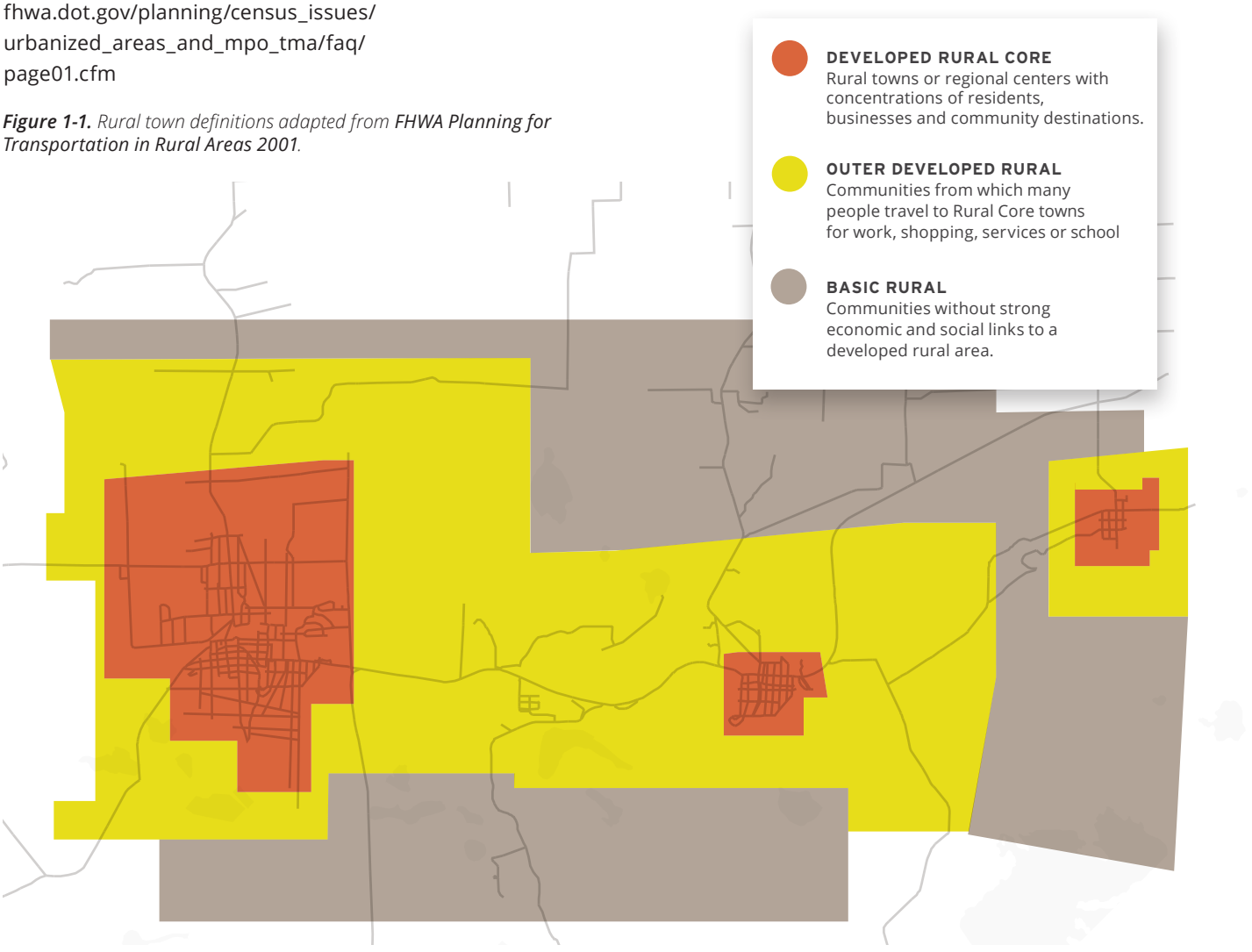
Why a Rural and Small Town Focused Guide?

Rural and small town America is diverse and varied throughout the country. According to the FHWA's Planning for Transportation in Rural Areas, 75 percent of America's 3,000 counties qualify as rural and cover 81 percent of the land area. Approximately 19 percent of the population live in rural areas.

For more information on official designations of urban and rural areas, refer to FHWA's website on Census Urbanized Areas and MPO/TMA Designation, available at https://www.fhwa.dot.gov/planning/census_issues/urbanized_areas_and_mpo_tma/faq/page01.cfm

The field of planning and design for walking and bicycling is advancing rapidly, as more communities across America value incorporating active transportation into their daily lives. Much of the research and analysis of infrastructure design has been focused on larger cities, such as New York City, Portland, and Chicago. This guide is intended to provide design information on bicycle and pedestrian facilities specifically applicable to small towns and rural communities.

Figure 1-1. *Rural town definitions adapted from* ***FHWA Planning for Transportation in Rural Areas 2001****.*



Why a Rural and Small Town Focused Guide?

There is a need and desire to make travel safer and more active in small and rural communities.

While rural places vary considerably in geographic scale and character, there are common issues that prevail:

Longer Non-local Trip Distances

Rural trip distances have been increasing.[i]

Health Disparities

Rural areas have higher rates of physical inactivity and chronic disease than urbanized areas.[ii]

Higher Crash Rates

While only 19 percent of the population lives in rural areas, 58 percent of all fatal crashes and 60 percent of traffic fatalities were recorded in rural regions.[iii]

Income Disparities

Urban households earn 32 percent more in yearly income than rural households.[iv]

Though in many rural communities, residents live long distances from services, most small towns provide a compact center well-suited for walking and bicycling trips.

1 MILE WALK = 20 MINUTES (3 MPH)
1 MILE BIKE RIDE = 6 MINUTES (10 MPH)

Allendale, SC
Population 3,328

Palmer, AK
Population 6,250

Rushford, MN
Population 2,102

Ukiah, CA
Population 15,956

Building a Rural and Small Town Multimodal Network

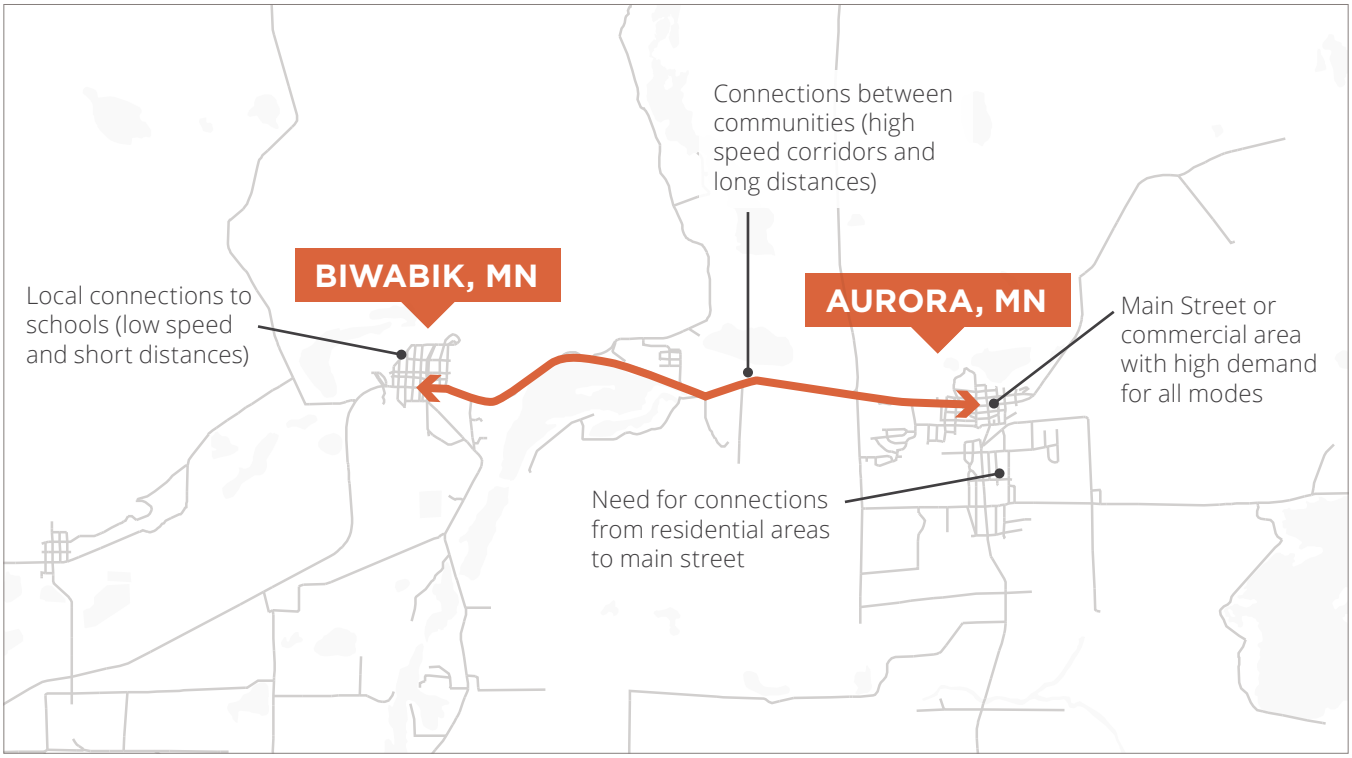
Many communities have invested in good places to walk or ride a bicycle. However, few smaller communities have a complete network that supports people comfortably walking and bicycling throughout the community.

A complete network creates safe, comfortable, and accessible multimodal routes for people walking and bicycling. The network may be comprised of varying facilities that appeal to a range of ages and abilities, such as shared use paths, sidewalks, and bike lanes. These facilities also provide equitable transportation for people of all income levels.

A safe and direct network provides convenient access to key destinations, while minimizing exposure to motor vehicle traffic. In addition to physical safety, user comfort is an important aspect of a multimodal network. Typically, additional separation between motor vehicles and those walking or bicycling, or slowing motor vehicles to walking and bicycling compatible speeds, is desired to create a more comfortable network.

Small and rural towns have great potential for creating viable networks that serve residents and visitors. Common attributes of a small town network include connections between communities that are located along highways and access to retail businesses and schools in a relatively small area within the community core. Communities with strong ties to public lands may also prioritize connections to natural areas, and tribal communities may desire access to ceremonial sites outside of the core.

Figure 2-2. *Network Connections for Rural Communities and Small Towns*



Who Uses the Rural Network?

A walkable and bikeable community is one in which active transportation trips are safe and comfortable for ***people of all ages and abilities.***

All ages *means that children as young as eight can walk and bike independently from their parents. It means that older adults can get around comfortably without a car. Facility needs vary by age, and there is no "one size fits all" solution.*

All abilities *means that people using mobility devices or people with limited vision are not faced with barriers.*

Most small towns across America were established prior to the post-war era, in which most children walked to school and people could navigate their communities without a car. Vehicles served farms and industry but were not necessary to travel the short distances within the community. Over time, as roads were widened and changed to accommodate travel by car, the ability of people to walk and bike diminished.

The rural active transportation network is designed for a range of ages, abilities, incomes, and skill levels. It is designed for people to move independently within their community—such as families walking to the nearby school—and also to experience the landscape between communities, for travel, recreation, or in the context of bicycle tourism.

Practitioners should consider the expected "Design User" of the facility to determine not only physical dimensions, but the characteristics and physical abilities that influence user comfort. Practitioners should design pedestrian and bicycle facilities along roadways, as well as roadway crossings with these factors in mind or they will not be utilized to their full potential.

Current policy is to incorporate safe and convenient walking and bicycling facilities into transportation projects and encourage transportation agencies to go beyond minimum standards to provide safe and convenient facilities for these modes (USDOT Policy Statement on Bicycle and Pedestrian Accommodation Regulations and Recommendations 2010).

The American Association of State Highway and Transportation Officials' (AASHTO) AASHTO Guide for the Development of Bicycle Facilities 2012 discusses bicycle user type in terms of comfort and rider skill level. Adult riders can be classified into two general categories: 1) Experienced and Confident; and 2) Casual and Less Confident. Casual riders are often not comfortable traveling in traffic on busy roads, and prefer low-traffic conditions, or paths separated from busy roads. The AASHTO Bike Guide states the Casual group "includes a majority of the population" (2012, p. 2-5).

In some communities horse drawn buggy accommodations are important and should also be addressed as a part of the transportation planning process.

How to Use this Guide

FACILITIES AND DESIGN CONTEXT

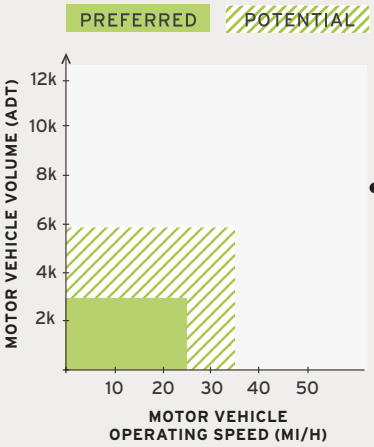
This guide provides design information for a variety of facility types applicable to small town and rural settings.

Within the design chapters, the application context of each facility is identified within the sidebar graphics shown to the right. Refer to the following page for a description of each context area.

EXAMPLE APPLICATION

Speed and Volume

Most appropriate on streets with low to moderate volumes and moderate speed motor vehicles.[iii]



A Speed and Volume

Where is the facility type most appropriate, based on typical speed and volume of motor vehicles?

Network

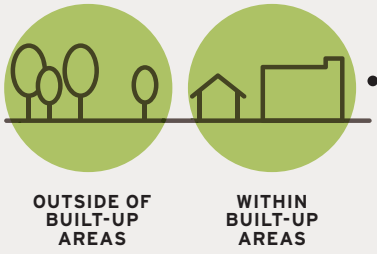
Applies to constrained connections between built-up areas.

B Network

On which part of a roadway network is the facility type likely to be applicable?

Land Use

For use outside, between and within built-up areas with bicycle and pedestrian demand and limited available paved roadway surface.



C Land Use

Is this facility type most appropriate in built up developed rural areas, or less-developed basic rural areas?

How to Use this Guide

A Speed and Volume

Motor vehicle operating speeds and the volumes on a roadway are key considerations in selecting the most appropriate bicycle and pedestrian facilities along a particular roadway. Generally speaking, the greater the speed and volume of motor vehicle traffic, the greater the amount of separation is desired for comfortable biking and walking facilities. Where streets have low volumes and low speeds, the need for separation is less critical, and mixing modes may be appropriate.

The speed and volume chart summarizes how speed and volume affect possible facility options.

- Preferred Application Range: identifies roadway conditions where a facility functions particularly well. This range is intended to set a high bar for facility application.
- Potential Application Range: refers to conditions where the facility type has also been shown to function and may be provide an appropriate context for using the facility.

B Network

The collection of roadways and multimodal facilities in a community creates a network. Networks are interconnected pedestrian and/or bicycle transportation facilities that allow people of all ages and abilities to safely and conveniently get to where they want to go. The network not only connects to destinations within a community, but also creates connections between communities and to external destinations. There are varying levels of comfort associated with roadways within the network, ranging from low-volume, low-speed local streets to high-speed, high-volume arterial roadways. Successful networks also provide equitable access regardless of income level.

C Land Use

Land use describes the manner and intensity in which land is developed or modified from its natural state. Built-up areas, such as commercial districts in a small town, contain a higher density of attractions, destinations, and people, and may support a greater diversity of bicycle and pedestrian amenities. Outside of built-up areas, the land use patterns are much less dense, with more space between destinations.

BENEFITS AND CONSIDERATIONS

For each facility type, the summary lists some key benefits and considerations. In addition to benefits related to transportation, the summary addresses other factors, such as compatibility with a rural aesthetic, and potential environmental impacts caused by road widening.

Creating Networks

Networks are interconnected pedestrian and/or bicycle transportation facilities that allow people of all ages and abilities to safely and conveniently get where they want to go. They provide equitable access for all people.

Developing interconnected networks of bicycling and walking facilities in rural and small town settings can be challenging due to a lack of alternate through roadways and the concentration of motor vehicle traffic on major roads. Planners and engineers must think creatively to establish connected facilities within communities, and consider how all roadway types and independent connections can be used to create access to key locations. A connected network is not developed by a single trail, sidewalk, or bike lane but is comprised of many facilities that support walking and bicycling throughout the community.

The Federal Highway Administration's (FHWA) Case Studies in Delivering Safe, Comfortable and Connected Pedestrian and Bicycle Networks 2016 lists principles of exemplary multimodal network creation. These principles are listed below, and the following images illustrate these concepts in a variety of network scenarios.

Use the facilities shown in this guide to form a cohesive network to allow for uninterrupted travel to destinations. The specific facility type will change in response on the traffic and community context.

COHESION

How connected is the network in terms of its concentration of destinations and routes?

DIRECTNESS

Does the network provide direct and convenient access to destinations?

ACCESSIBILITY

How well does the network accommodate travel for all users, regardless of age , income level, or ability?

ALTERNATIVES

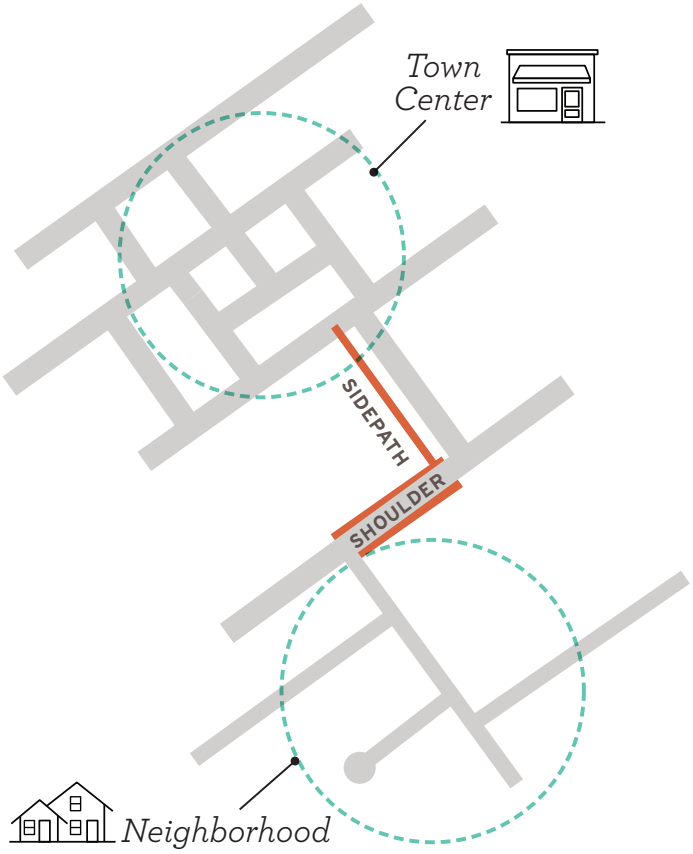
Are there a number of different route choices available within the network?

SAFETY AND SECURITY

Does the network provide routes that minimize risk of injury, danger, and crime?

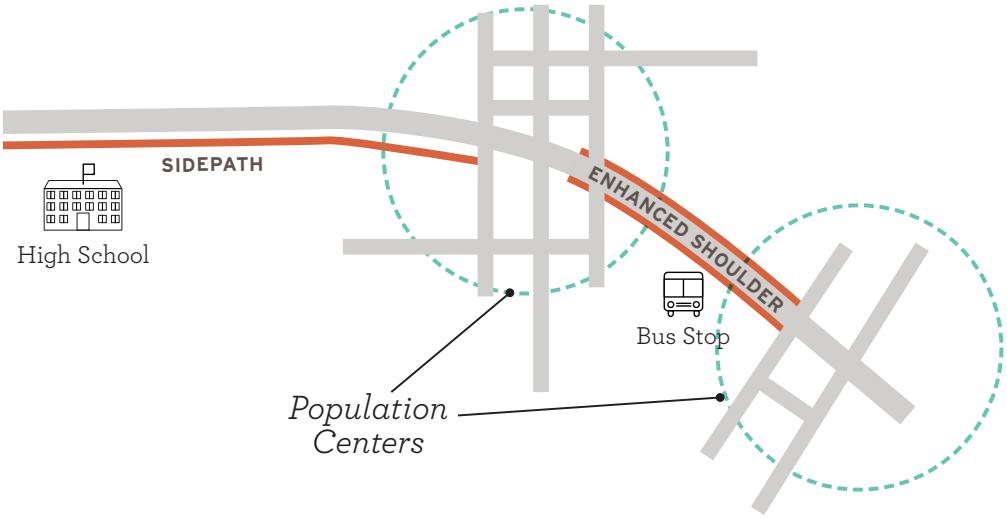
COMFORT

Does the network appeal to a broad range of age and ability levels and is consideration given to user amenities?

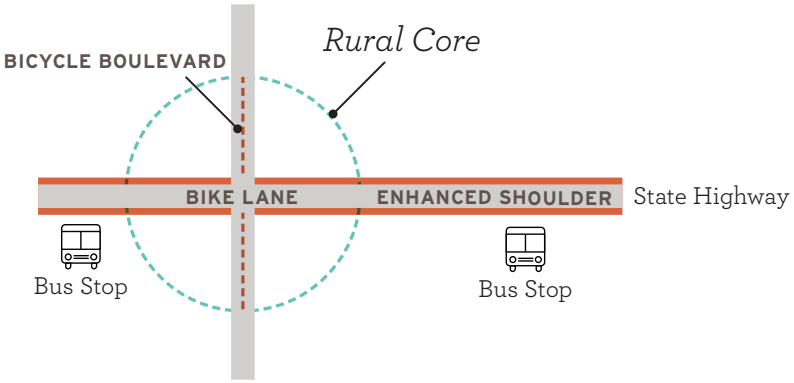


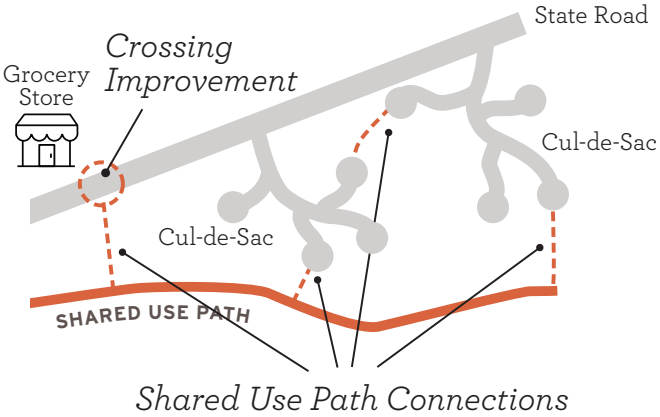
Creating Networks

Connections near schools should provide increased separation of walking and biking facilities that are more appropriate for younger users.

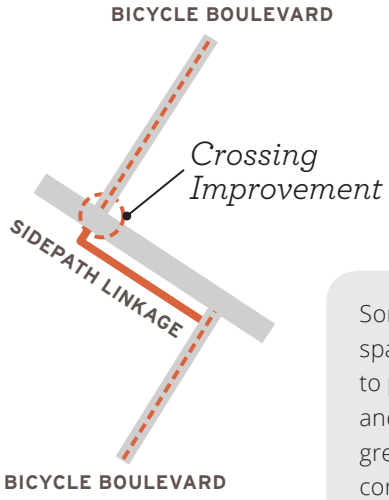


Rural cores should support walking and biking on main commercial corridors and main streets. As the street transitions out of the core area, the facility design that accommodates people walking and biking should change.





Adjacent roadways or shared use paths may complement the transportation function of a primary roadway.



Some facilities may only span short distances to provide connections and fill gaps along a greater network or facility corridor. Transitions between facility types are important and should not be overlooked.

Common Challenges in Small Town and Rural Areas

AGRICULTURAL USES

Small towns and rural areas near agricultural operations need to consider the needs of wide and slow moving special equipment.

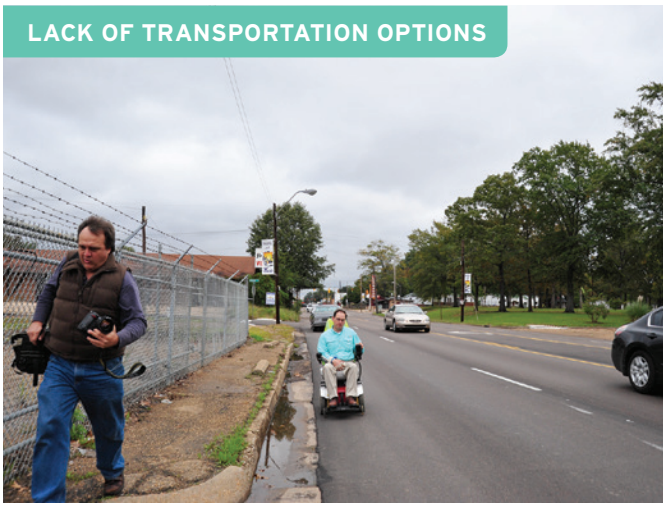
PUBLIC LANDS ACCESS

Many small town and rural communities are located near public lands that serve as popular destinations. Creating comfortable linkages, in effect, extends these public lands into their surrounding communities.

AUTO ORIENTED ROADWAYS

With lower densities and greater distances, many small towns and rural areas have developed in a more auto-oriented fashion than urban areas.

LACK OF TRANSPORTATION OPTIONS



A singular focus on automobile mobility results in a lack of facilities for people walking and bicycling, making travel by these modes difficult and less safe.

Common Challenges in Small Town and Rural Areas

CONSTRAINED TERRAIN

Rural highways often have physical constraints that make the provision of cost-effective facilities for bicycling and walking difficult.

SAFETY

Pedestrian crossings are often not defined and may be difficult to warrant based on low existing use; however, not providing pedestrian crossings makes streets act as barriers that divide communities.

HIGHWAY AS A MAIN STREET

State highways often pass through the heart of small towns and may prioritize through traffic over local access. Some may be wide and over designed, and some may be constrained and hard to change.

CLIMATE AND MAINTENANCE

Winter maintenance is a significant constraint in much of the country. Many small towns and counties do not have adequate resources to pay for special equipment to clear certain types of active transportation facilities.

Reference Guide

Several design resources are referenced frequently throughout this document. The table below includes both the abbreviated title used in this document and full document title..

AASHTO Flexibility Guide 2004	American Association of State Highway and Transportation Officials, *A Guide for Achieving Flexibility in Highway Design*, 2004.
AASHTO Bike Guide 2012	American Association of State Highway and Transportation Officials, *Guide for the Development of Bicycle Facilities*, 2012.
AASHTO Pedestrian Guide 2004	American Association of State Highway and Transportation Officials, *Guide for the Planning, Design, and Operation of Pedestrian Facilities*, 2004.
AASHTO Pedestrian Guide 2017	American Association of State Highway and Transportation Officials, *Guide for the Planning, Design, and Operation of Pedestrian Facilities, 2nd Edition*, 2017.
AASHTO Green Book 2011	American Association of State Highway and Transportation Officials, *A Policy on Geometric Design of Highways and Streets*, 2011.
AASHTO Low Volume Roads 2001	American Association of State Highway and Transportation Officials, *Guidelines for Geometric Design of Very Low-Volume Roads, 1st Edition*, 2001.
AASHTO Low Volume Roads 2017	American Association of State Highway and Transportation Officials, *Guidelines for Geometric Design of Low-Volume Roads, 2nd Edition*, 2017.
FHWA Achieving Multimodal Networks 2016	Federal Highway Administration, *Achieving Multimodal Networks: Applying Design Flexibility and Reducing Conflict*, 2016.
FHWA Resurfacing Guide 2016	Federal Highway Administration, *Incorporating On-Road Bicycle Networks into Resurfacing Projects*, 2016.
FHWA MUTCD 2009	Federal Highway Administration, *Manual on Uniform Traffic Control Devices for Streets and Highways*, 2009.
FHWA Separated Bike Lane Guide 2015	Federal Highway Administration, *Separated Bike Lane Planning and Design Guide*, 2015.
PROWAG 2011	United States Access Board, *Proposed Guidelines for Pedestrian Facilities in the Public Right-of-Way*, 2011. Supplemental Notice of Proposed Rulemaking, *Shared Use Paths*, 2013.
PEDSAFE 2013	Federal Highway Administration. *Pedestrian Safety Guide and Countermeasure Selection System*, 2013.
BIKESAFE 2014	Federal Highway Administration. *Bicycle Safety Guide and Countermeasure Selection System*, 2014.

Accessibility Standards

GUIDELINES FOR PEDESTRIAN FACILITIES IN THE PUBLIC RIGHT-OF-WAY

The U.S. Access Board is the Federal agency responsible for developing and updating accessibility guidelines under the Americans with Disabilities (ADA) of 1990. The Access Board published its *Proposed Guidelines for Pedestrian Facilities in the Public Right-of-Way* (PROWAG) in 2011. At the time of publication of this document, the Board had not issued a final PROWAG rule.

The PROWAG will become an enforceable standard only after the Board publishes a final rule and only after the U.S. Department of Justice (USDOJ) and/or the U.S. Department of Transportation (USDOT) adopt the final guidelines into their respective ADA and Section 504 of the Rehabilitation Act regulations. Until that time, the USDOJ 2010 ADA Standards and the USDOT 2006 ADA and Section 504 Standards provide enforceable standards applicable to the public right-of-way. Where the 2010 ADA Standards or the 2006 ADA and Section 504 Standards do not address a specific issue in the public right-of- way, the Federal Highway Administration encourages public entities to look to the draft PROWAG for best practices. Several jurisdictions have chosen to apply the draft PROWAG as an alternative to, or equivalent facilitation for, the ADA Standards because they provide more specific coverage of accessibility issues in the public-right-of-way. Jurisdictions that have adopted the draft PROWAG as their standard should consistently apply all provisions of the draft PROWAG.

This document cites the draft PROWAG in anticipation of final PROWAG being adopted as the enforceable standard in the near future. Public entities and/or recipients of Federal financial assistance are responsible for complying with the current ADA and Section 504 accessibility standards and/or demonstrating equivalent facilitation.

Frisco, CO–Population 2,782

Leland, North Carolina- Population 16,022

Introduction

FOOTNOTES

i 2009 National Household Travel Survey, Summary of Travel Trends. http://nhts.ornl.gov/2009/pub/stt.pdf

ii http://www.ncbi.nlm.nih.gov/pubmed/16092298

iii NHTSA Traffic Safety Facts. 2013. https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812181

iv Bureau of Labor Statistics. http://www.bls.gov/opub/btn/volume-2/expenditures-of-urban-and-rural-households-in-2011.htm

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Federal Highway Administration. *Case Studies in Delivering Safe, Comfortable and Connected Pedestrian and Bicycle Networks*. 2016.

US Department of Transportation. *United States Department of Transportation Policy Statement on Bicycle and Pedestrian Accommodation Regulations and Recommendations*. 2010.

PHOTO CREDIT

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Page 1-13 (Lack of Transportation Options). Dr. Scott Crawford via Flickr (CC By NC-ND 2.0)

Page 1-14 (Constrained Terrain). Public Domain

Page 1-14 (Safety). Frank Warnock, Bike Delaware

Page 1-14 (Highway as a Main Street). Emmett Anderson via Flickr (CC By NC 2.0)

Page 1-14 (Climate and Maintenance). North Dakota Department of Transportation

Page 1-16. Federal Highway Administration

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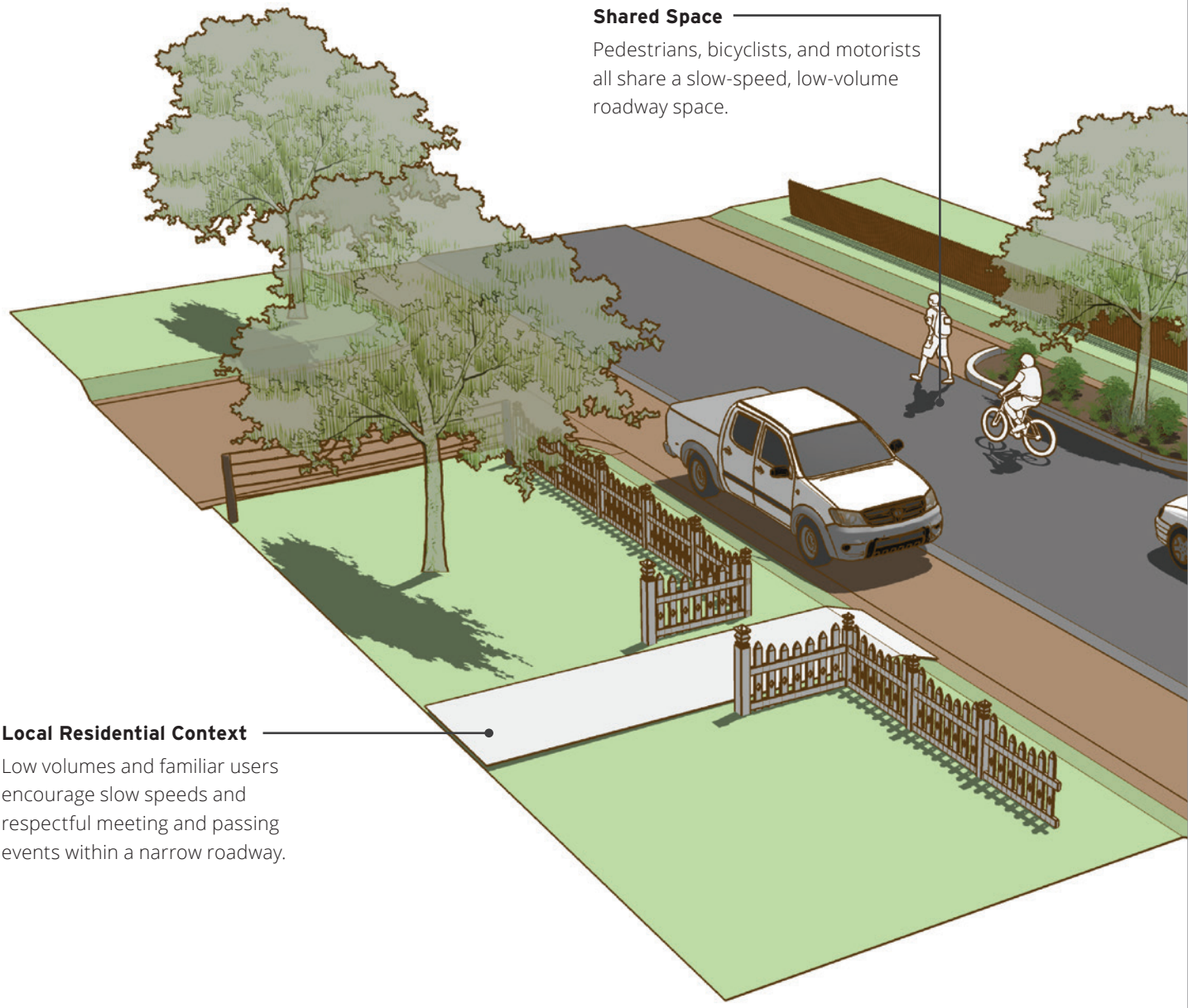
NO PARKING
THIS SIDE
NO PARKING

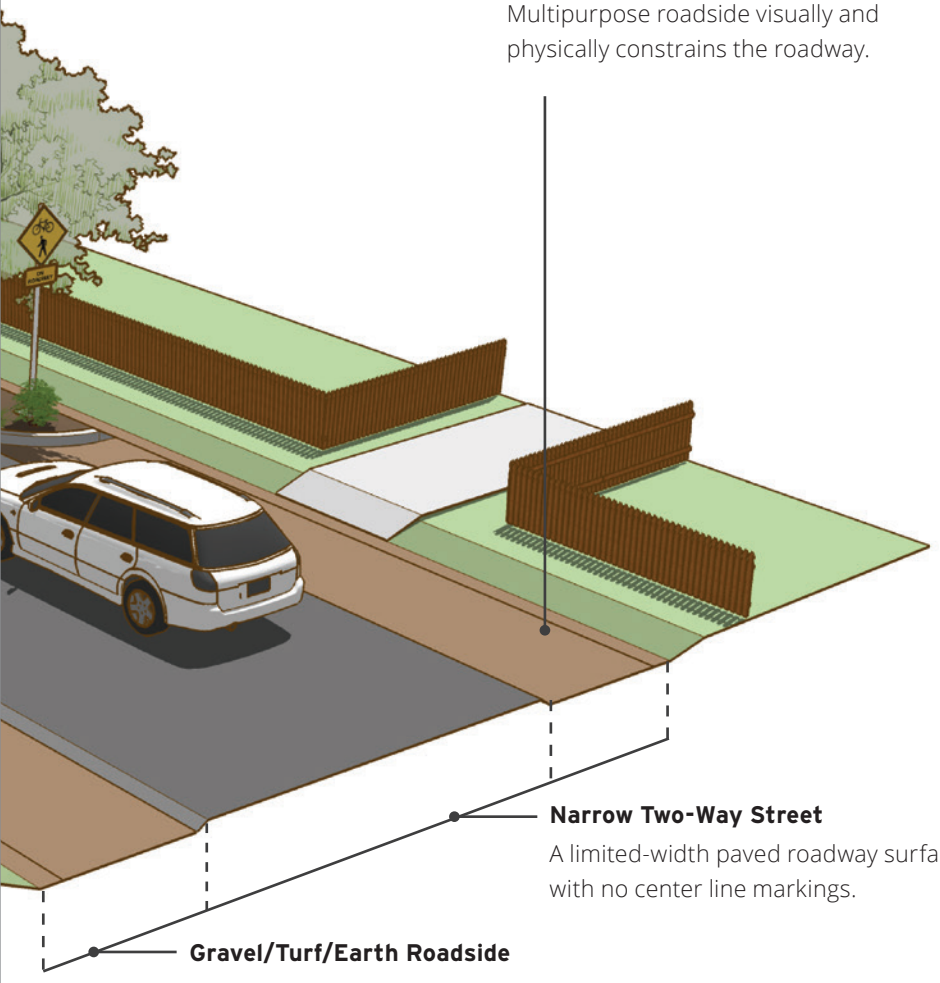
CHAPTER 2

Mixed Traffic Facilities



Yield Roadway

A yield roadway is designed to serve pedestrians, bicyclists, and motor vehicle traffic in the same slow-speed travel area. Yield roadways serve bidirectional motor vehicle traffic without lane markings in the roadway travel area.



Parking/Pull-Out/Furnishings

Multipurpose roadside visually and physically constrains the roadway.

Narrow Two-Way Street

A limited-width paved roadway surface with no center line markings.

Gravel/Turf/Earth Roadside

Limiting paved surfacing encourages natural stormwater management.

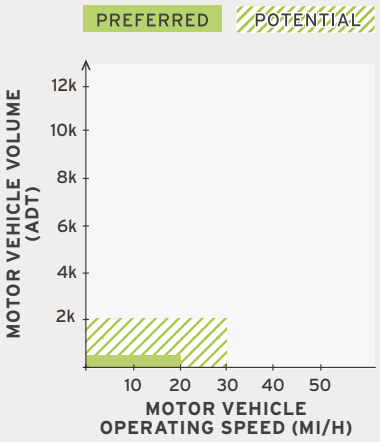
BENEFITS

- Less costly to build and/or maintain than fully paved cross sections.
- Connects local residential areas to destinations on the network.
- Limits impermeable surface area and minimizes stormwater runoff.
- Maintains aesthetic of narrow roads and uncurbed road edges.
- Encourages slow travel speed when narrower than 20 ft (6.0 m).
- Can support a larger tree canopy when located within wide unpaved roadside areas.
- Supports on-street or shoulder parking for property access.
- Low maintenance needs over time.

APPLICATION

Speed and Volume

Appropriate on roads with very low volumes[i] and low speed.

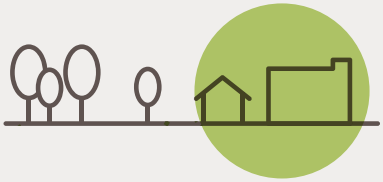


Network

Local residential roadways. Not for through motor vehicle travel.

Land Use

Within built-up areas, particularly near residential land uses where most traffic is familiar with prevailing road conditions.



Yield Roadway

Yield roadways can effectively serve local travel needs, maintain aesthetic preferences, and is a common form for low-volume local rural roads. When operating at very-low volumes and at low speeds, pedestrians and bicyclists are comfortable walking within the travel area of the roadway.[i] Yield roadways are designed with narrow roadway dimensions to prioritize local access and community livability.

For more information on related roadway types, refer to sections on Slow Streets and Shared Streets in *FHWA Achieving Multimodal Networks 2016*.

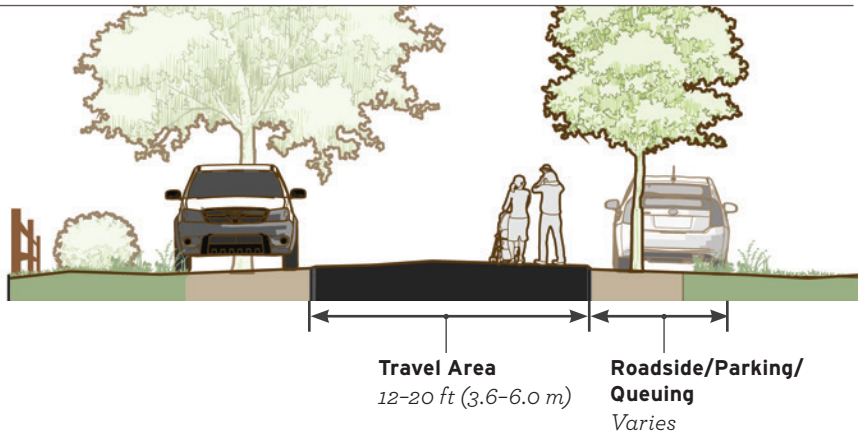


Figure 2-1. *When vehicles travelling in opposite directions meet, the two vehicles may not have enough room to pass within the travel area. One vehicle may need to pull into a parking lane, pull-out, or driveway area to let the other pass.*

GEOMETRIC DESIGN

TWO-WAY TRAVEL LANE

The paved two-way travel lane should be narrow to encourage slow travel speeds and require courtesy yielding when vehicles traveling in opposite directions meet.

- Total traveled way width may vary from 12 ft (3.6 m)–20 ft (6.0 m).[ii]
- Traveled way width below 15 ft (4.5 m) or below function as a two-way single-lane roadway and should follow the guidance of the AASHTO Low Volume Roads 2001.

A When width is 15 ft (4.5 m) or narrower, provide pull-out areas every 200–300 ft to allow for infrequent meeting and passing events between motor vehicles. Pull-out areas may be established in the parking lane or roadside area.[iii]

- Access for emergency vehicles should be provided.[iv] There is no single fire code standard for local roads; however, a range of clear widths for parking and deploying fire department apparatus is between 16–20 ft (5.0–6.0 m). Designers should provide an opening of this width every 200–300 ft (600–91 m).[v]

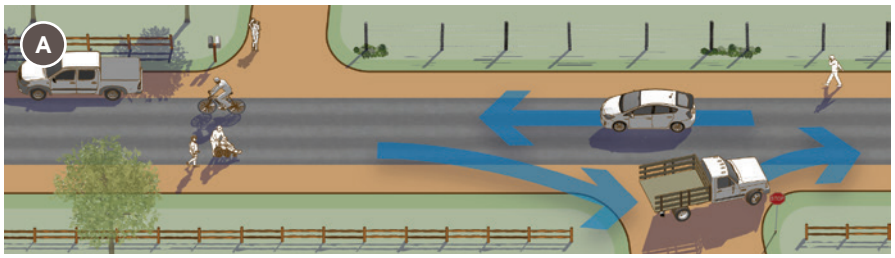


Figure 2-2. *A travel area width of 16–18 ft (4.8–5.5 m) is appropriate for low volumes of two-way traffic and may require slowing when vehicles traveling in opposite directions meet. A travel area of 12–15 ft (3.6–4.5 m) is too narrow for two motor vehicles to pass, and one vehicle may need to pull into a parking lane, pull-out, or driveway area to let the other proceed.*

ROADSIDE

If desired, parking may be located on the paved roadway surface or on gravel or soil shoulders outside of the paved roadway. The parking lane may also serve as a pull-out area while yielding.

- When possible, the parking lane should be constructed with a contrasting material to differentiate the lane from the travel area. Bituminous, crushed stone, gravel, and turf shoulders can be used as contrasting materials to the travel area (AASHTO Green Book 2011, p. 4-13).
- Trees may be planted within the roadside area at regular intervals to visually and physically narrow the corridor, add to the aesthetic environment, and encourage slow speeds.

Yield Roadway

MARKINGS

No markings are necessary to implement a yield roadway.

- Do not mark a center line within the travel area. The single two-way lane introduces helpful traffic friction and ambiguity, contributing to a slow-speed operating environment.[vi]

SIGNS

Use signs to warn road users of the special characteristics of the street. Potential signs include:

- A PEDESTRIAN (W11-2) warning sign with ON ROADWAY legend plaque. See Figure 2-3.[vii]
- Use a Two-Way Traffic warning sign (W6-3) to clarify two-way operation of the road if any confusion exists.

Figure 2-3. *Pair a W11-1, W1-2, or W11-15 warning sign with a custom legend plaque to inform road users that shared use by pedestrians and/or bicyclists might occur.*

INTERSECTIONS

At uncontrolled crossings of local streets, no special treatment is necessary. The additional space within the intersection area offers queuing opportunities when vehicles traveling in opposite directions meet.

- Consider parking prohibitions of 20–50 ft (6.0–15.0 m) in advance of intersections. This is particularly helpful to accommodate large vehicle turning movements.
- Provide adequate stopping sight distance around curves and at uncontrolled intersections. Values of stopping sight distance for two-way single-lane roads should be twice the stopping sight distance for a comparable two-lane road.

Sisters, OR–Population 2,170

IMPLEMENTATION

In rural communities with a disconnected street network, local streets are the only viable connection to a scene of an emergency. Implementing agencies should work closely with emergency response stakeholders.

ACCESSIBILITY

Yield roadways allow motor vehicles, bicyclists, and pedestrians to share the same space. On very low-volume and low-speed streets, pedestrians and bicyclists may be comfortable using the roadway with the occasional vehicle. If this facility is intended for use by pedestrians, it must meet accessibility guidelines for walkways.

CASE STUDY | YIELD ROADWAY

Manzanita, Oregon

PROJECT DESCRIPTION

The residents of Manzanita cherish their small town and have outlined ways to maintain this character. One of the goals identified in the town's Comprehensive Plan is "to maintain and create residential living areas which are safe and convenient, which make a positive contribution to the quality of life, and which are harmonious with the coastal environment." Toward this end they have a network of local streets that create peaceful conditions for people walking, bicycling, and driving.

In addition, there is a recognition that even on collector streets bicycle and pedestrian travel should be safe. The plan states that "Sufficient pavement width should be included on all major streets or roads to accommodate bicycle traffic."

Where a visually or physically separated facility is not provided, speeds will be slowed to create bicycle-friendly conditions. The plan states, "Efforts to reduce speeding on Laneda Avenue should be carried out by the city. This should take the form of maintaining a low speed (20 Mi/h), requesting that the City police and Tillamook County Sheriff's Department maintain a high level of enforcement and installing appropriate warning signs." Efforts such as these enable Manzanita's local streets to be shared roadways where people driving, walking, and biking can all safely share the street.

DETAILS

COMMUNITY CONTEXT

Manzanita is a quiet, peaceful village surrounded by the natural beauty of the Pacific Ocean, Neah-Kah-Nie Mountain, and State and private forests. The Manzanita area is home to 725 full time residents. In the summer the population swells to 2,500 to 3,000.

KEY DESIGN ELEMENTS

The standard City residential street is 20 ft wide paved with asphalt and with a concrete gutter along one side.

ROLE IN THE NETWORK

Manzanita's local streets connect residences with the ocean, parks, and downtown. The ability to use these shared local streets allow people walking or on bikes to access all parts of the community.

FUNDING

The key aspect of this treatment is that it requires funding beyond what is currently used to maintain the local streets. The City maintains the streets that have been brought up to city standards. Graveled streets that have not been brought up to City standards are maintained by the adjacent property owners. There are some roads within the City that are County roads maintained by Tillamook County.

For more information refer to the City of Manzanita website:
http://ci.manzanita.or.us/

Yield Roadway

FOOTNOTES

i Very low-volume local roads are typically used by people who are familiar with the roads. These roads are used by such lowvolumes of traffic that crashes are rare, as vehicles hardly encounter other vehicles. AASHTO defines a very low-volume street as one that is functionally classified as a local road and has 400 cars per day or less **(AASHTO Green Book 2011, p. 5-34)**.

On local streets with less than 400 vehicles per day, no separated pedestrian infrastructure may be necessary **(AASHTO Pedestrian Guide 2004)**.

ii The AASHTO Green Book notes that, on narrow, unlaned roads, "random intermittent parking on both sides of the street usually results in areas where two-way movement can be accommodated" **(2011, p. 4-74)**. Additionally, "The level of user inconvenience occasioned by the lack of two moving lanes is remarkably low in areas where single-family units prevail" **(2011, p. 5-13)**.

iii When two vehicles do encounter one another on a narrow, unlaned street, "opposing conflicting traffic will yield and pause on the parking lane area until there is sufficient width to pass" (**AASHTO Green Book 2011, p. 5-13)**.

iv On the subject of emergency response, the AASHTO Green Book states that a "curb face-to-curb face width of 8 m [26 ft] provides a 3.6-m [12-ft] center travel lane that provides for the passage of fire trucks and two 2.2-m [7-ft] parking lanes" **(2011, p.5-13)**.

v The ***Oregon DOT Neighborhood Street Design Guidelines*** support local street configurations with a clear travel area of 14 ft **(2000, p.20)**. Dan Burden's ***Emergency Response Handbook*** calls for an "operations area for emergency responders every 200–300 ft" **(Burden 2000, p.32)**.

vi The FHWA MUTCD does not recommend center line markings on paved two-way streets that are narrower than 16 ft wide, or operating below 3,000 ADT **(2009, p.349)**.

vi The FHWA MUTCD permits local highway agencies to "develop special word message signs in situations where roadway conditions make it necessary to provide road users with additional regulatory, warning, or guidance information…" These "new word message signs may be used without the need for experimentation." **(2009, p.28)**.

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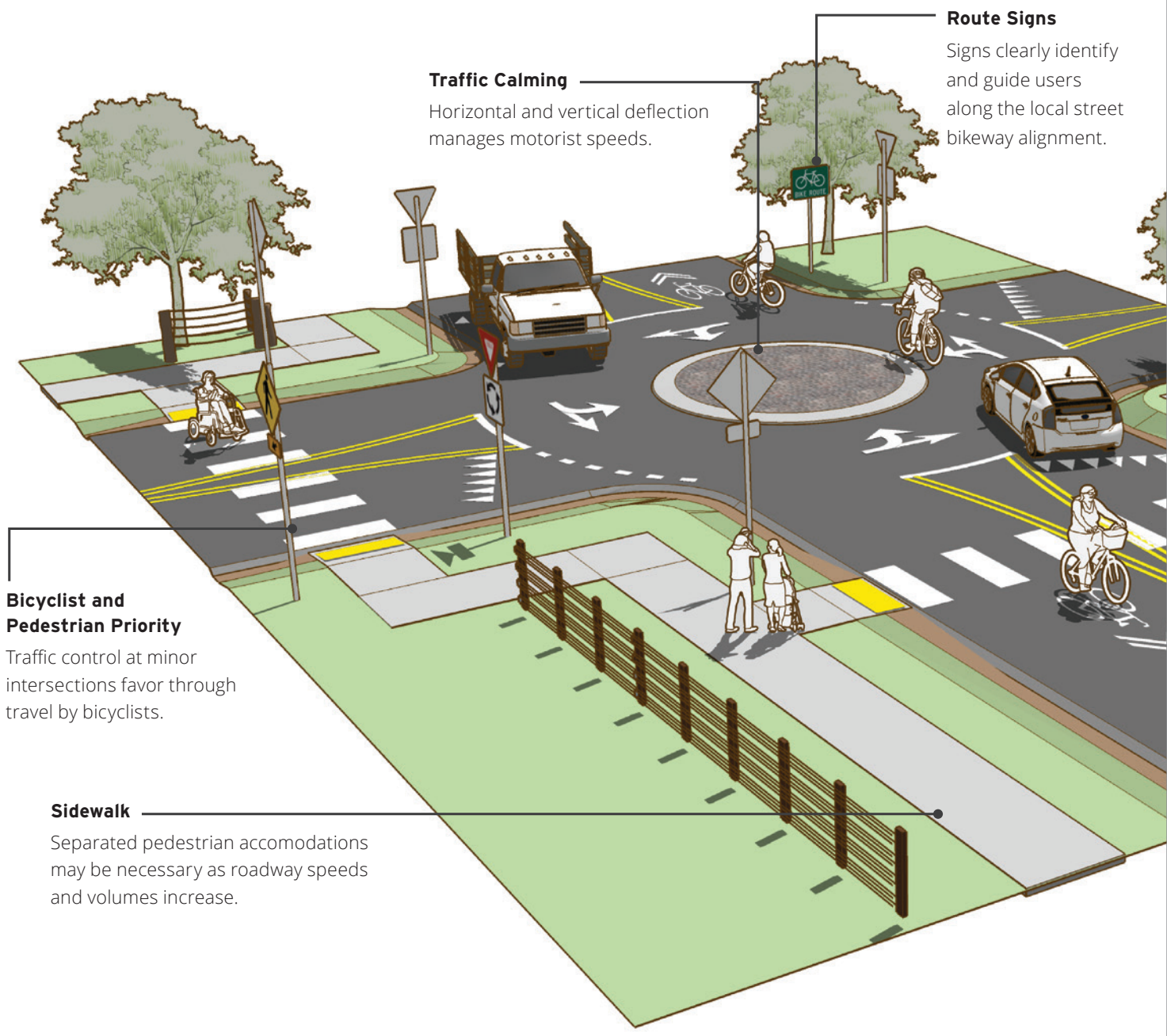
PHOTO CREDIT

Page 2-1. Western Transportation Institute

Page 2-6. Western Transportation Institute

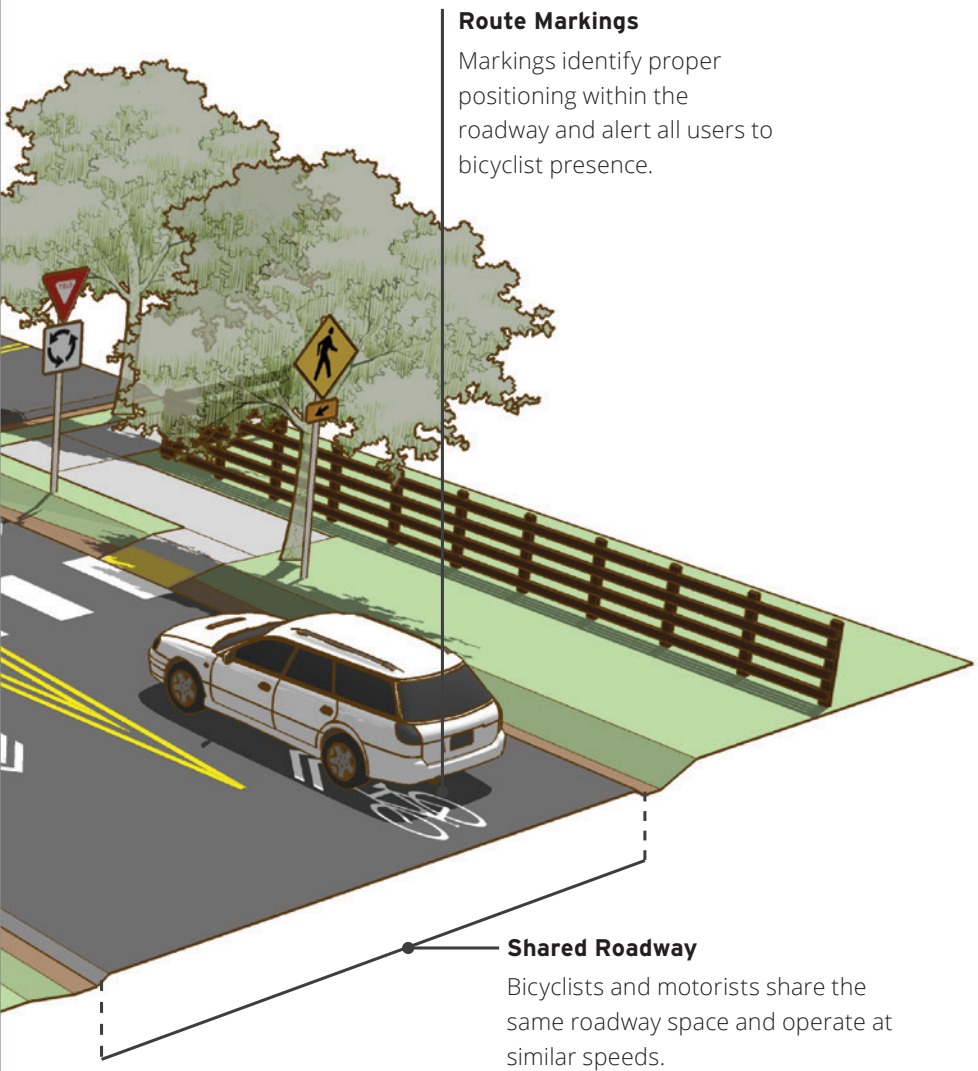
Page 2-7. Alta Planning + Design

Page 2-8. Western Transportation Institute



Bicycle Boulevard

A bicycle boulevard is a low-stress shared roadway bicycle facility, designed to offer priority for bicyclists operating within a roadway shared with motor vehicle traffic.



Route Markings

Markings identify proper positioning within the roadway and alert all users to bicyclist presence.

Shared Roadway

Bicyclists and motorists share the same roadway space and operate at similar speeds.

BENEFITS

- Increases comfort for people bicycling by reducing motor vehicle operating speeds and volumes, if diversion is included.
- Connects local residential roads to commercial corridors and community services such as schools.
- Improves conditions for pedestrians when implemented with sidewalks and enhanced pedestrian crossings.
- May reduce the incidence of serious injuries through reduced travel speeds.
- Improves the quality of life for residents through calmer traffic and safer crossings.
- Less visually impactful than separated facilities.

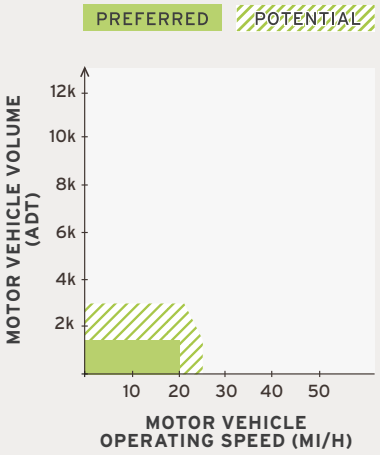
CONSIDERATIONS

- May require additional paved surface to provide sidewalk space for pedestrians.

APPLICATION

Speed and Volume

Appropriate on local streets with low volumes and low speed. Speed and volume management may be necessary to create desired operating conditions.

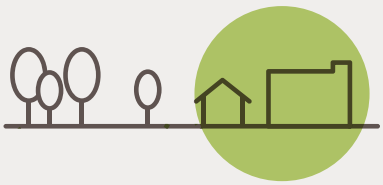


Network

Local residential roadways. Not for through motor vehicle travel.

Land Use

For use inside of built-up areas to connect biking and walking routes in small town street networks.



Bicycle Boulevard

Bicycle boulevards provide a bicycle-priority route designed to offer convenient, low-stress access to local destinations and through neighborhoods. Combinations of access management, traffic calming, and crossing treatments work in concert to enhance the bicycling experience.

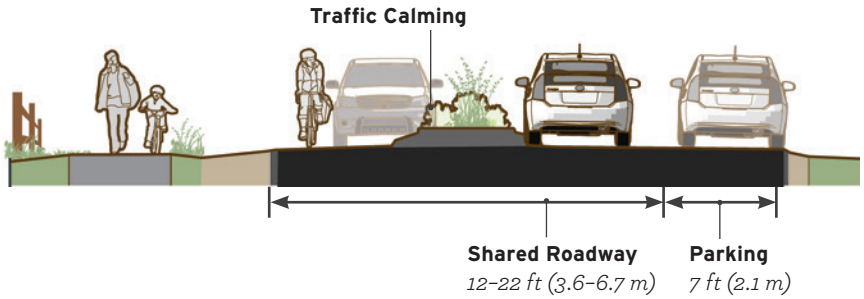


Figure 2-4. *Common elements of a bicycle boulevard*

GEOMETRIC DESIGN

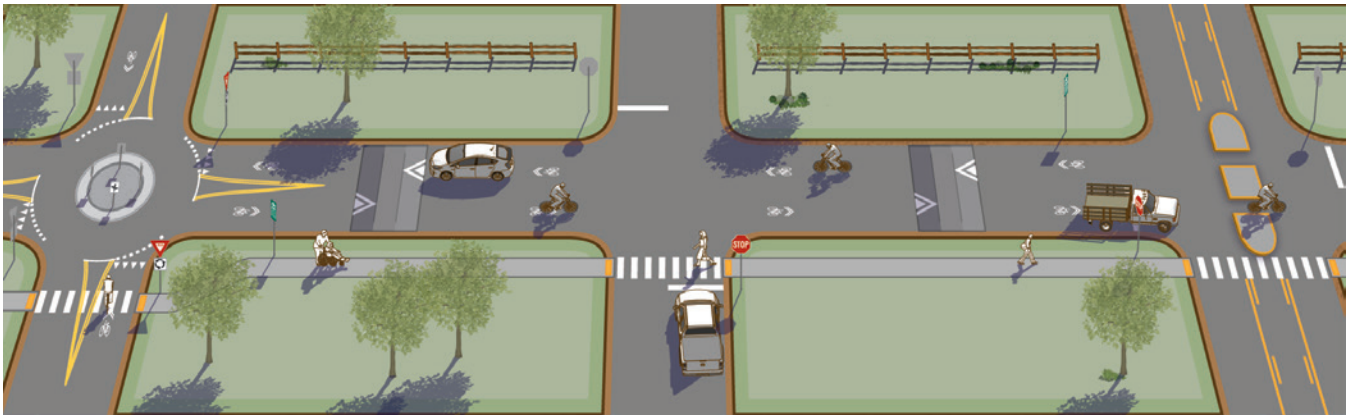


Figure 2-5. *Bicycle boulevards combine road markings, traffic-calming measures, and crossing improvements designed to enhance the comfort and priority of bicyclists traveling along the route.*

The AASHTO Bike Guide describes bicycle boulevards as streets "that have been modified to accommodate through bicycle traffic and minimize motor traffic" (2012, p. 1-2).

Many small town or rural local streets may have existing low-speed and low-volume traffic conditions that are ideal for bicycle boulevard implementation. In cases where speeds and volumes do not meet preferred values, traffic-calming techniques may be used to improve conditions. Even in curvilinear local street networks without cut-through traffic, speeding can be a problem on long, wide streets.

Speed reduction measures can help maintain vehicle speeds below 25 mi/h (40 km/h) and greatly improve bicyclists' comfort on a roadway by reducing the overtaking speed differential between motor vehicles and bicyclists.

For more information on speed reduction measures, refer to the section on Traffic Calming in this guide.

Bicycle Boulevard

MARKINGS

Use markings to encourage motorists to pass bicyclists at a safe distance.

- Do not mark a center line on bicycle boulevard facilities unless it serves as a short channelization device.

Clear identification of the bicycle boulevard is important for road user awareness of the facility.

- Shared lane markings (SLMs) are the standard marking for indicating shared roadway bicycle operations.
- Place SLMs in the center of the travel lane to minimize wear and encourage riding a safe distance from parked cars.

SIGNS

Route wayfinding is critical on bicycle boulevards when located along local routes with circuitous network connections. There are three functional types of wayfinding signs, illustrated in Figure 2-6:

B **Confirmation Signs.** Bike Route Guide (D11-1c) signs indicate to bicyclists that they are on a designated bikeway and make motorists aware of the bicycle route.

C **Turn Signs.** A Bicycle Destination Sign (D1-1) with one or more destinations in a single direction indicates where a bike route turns from one street onto another street.

D **Decision Signs.** Decision sign assemblies are a combination of D11-1c and D1-3a signs used to mark the junction of two or more bikeways and inform bicyclists of the designated bike route to access key destinations.

Ennis, MT–Population 850

B

D11-1c

C

D1-1

D

D11-1c; D1-3a

Figure 2-6. *MUTCD guide signs for bicycle route navigation. The use of the D11-1c sign is preferred over D11-1 whenever practical, as it provides the reader with more useful information regarding the destination or route.*

Bicycle Boulevard

INTERSECTIONS

Comfortable and intuitive intersection accommodations on bicycle boulevards are required to make the route attractive and functional for bicyclists of all ages and abilities. While crossings of local and minor collector streets may be comfortable with minimal modification, most local streets lack appropriate traffic control to safely and comfortably cross large streets. Crossing improvements should safely and comfortably accommodate pedestrians as well as bicyclists.

MINOR INTERSECTION CROSSINGS

Design treatments at minor roadway intersections to offer priority for bicyclists over cross-street traffic.

- Stops or yield signs should be oriented to favor the bicycle boulevard.

MAJOR INTERSECTION CROSSINGS

The quality of treatments at major street crossings significantly affect the utility of a bicycle boulevard route. Design crossing treatments to enhance safety and comfort for crossing users.

Refer to the National Cooperative Highway Research Program's *NCHRP 562 Improving Pedestrian Safety at Unsignalized Crossings Appendix A* for a method to analyze an appropriate crossing treatments for a given roadway context. Evaluate the calculation assuming moderate bicycle and pedestrian activity to reflect the anticipated activity-level at the future enhanced crossing.

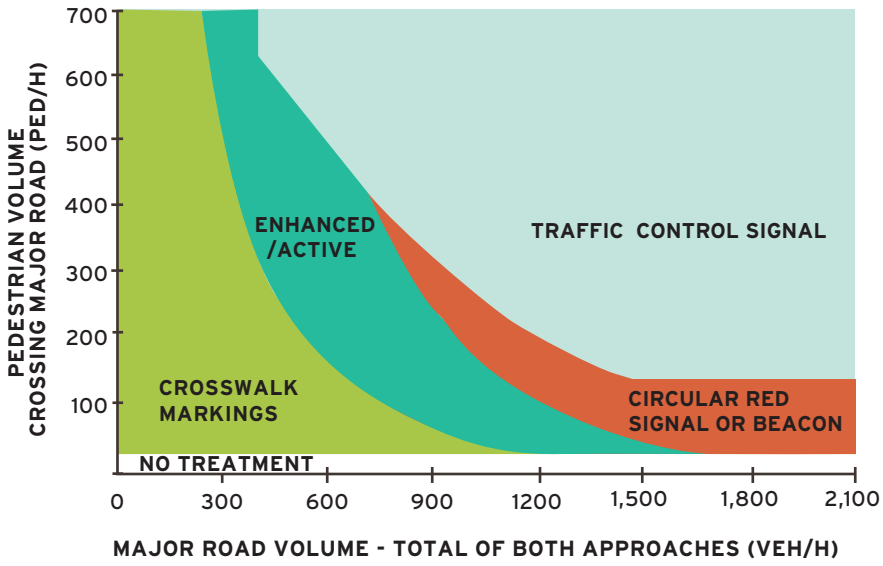


Figure 2-7. *Example Guidelines for Pedestrian Crossing Treatments adapted from NCHRP 562 (Fig. A-5). Calculations assume 34 ft (10.4 m) Pavement,35 mi/h (55 km/h), 3.5 ft/s (1.1 m/s) Walking Speed.*

Figure 2-7 provides an example graph of crossing guidelines following NCHRP 562 methodology. This should only be used when the major-road speed, the pedestrian walking speed, and the crossing distance are matched to the value presented at the top of the graph. For other situations, the reader should use the equations listed in the Appendix A worksheets.

IMPLEMENTATION

Development of bicycle boulevards in rural settings can often be challenging due to a lack of alternate through roadways and the concentration of motor vehicle traffic on arterials. Disconnected road networks may maintain low traffic speeds and discourage through traffic on local roads, but these benefits often sacrifice connectivity.

ACCESSIBILITY

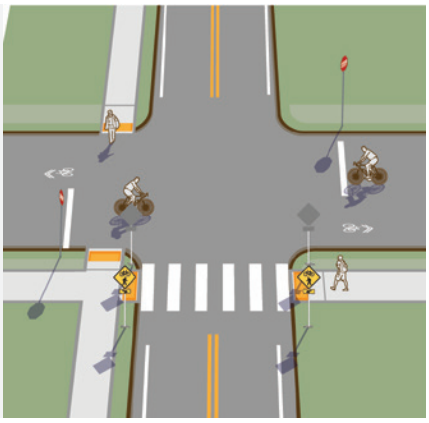
Bicycle boulevards are designed to prioritize use by bicyclists and are not intended for use by pedestrians. On bicycle boulevards, the appropriate pedestrian facility is generally a sidewalk. If the bicycle boulevard is intended to facilitate pedestrian travel within the roadway it must be accessible.

Bicycle Boulevard

CROSSING ENHANCEMENT TOOLS

Crossing enhancements can use a variety of engineering tools to address user comfort, provide additional gap acceptance opportunities, and increase yield to pedestrian rates.

For more information on crossing enhancements for bicycle boulevards, refer to BIKESAFE 2014.



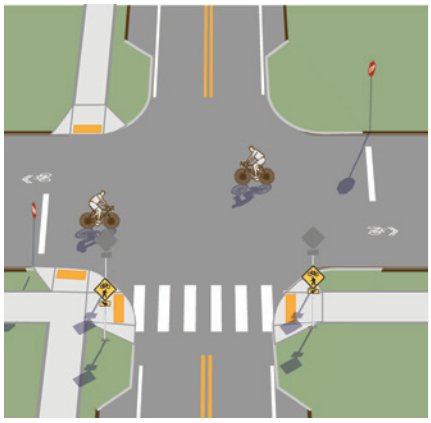


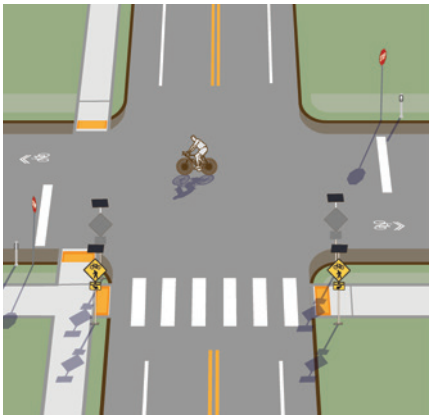
Figure 2-8. *The following images illustrate some potential crossing enhancements for increasing the safety and comfort of bicycle boulevard crossings of other roadways.*

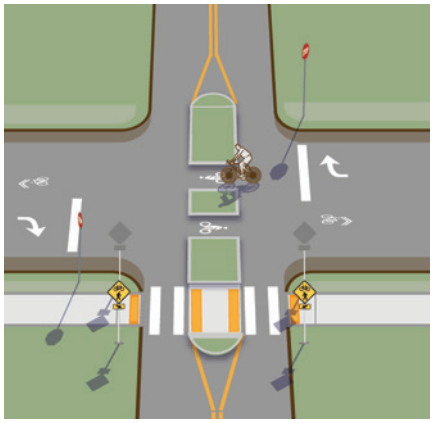
Crosswalk Markings and Crossing Warning Signs

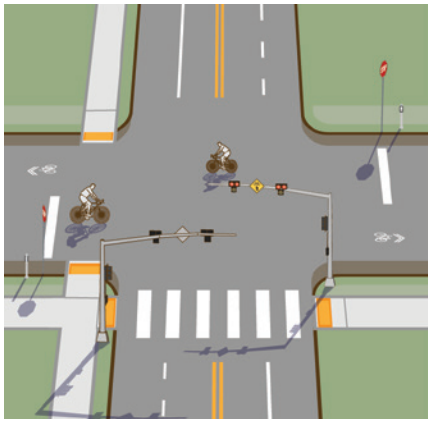
Crosswalk markings and warning signage raise awareness of the crossing by motorists. Use a combined bicycle and pedestrian W11-15 sign to indicate the potential of bicyclists and pedestrians crossing at specific locations.

Curb Extensions

Curb extensions reduce traffic exposure and increase visibility of crossing users. Curb extensions should not be used within shoulders where they interfere with bicycle travel along the major roadway.







Active Warning Beacons

At locations with poor yield-to-pedestrian compliance, install active warning beacons such as rectangular rapid flashing beacons to supplement crossing warning signs and remind motorists of the obligation to yield. Refer to FHWA Interim Approval 11 for more information on the use and application of rectangular rapid flashing beacons.

Median Islands

Divide crossings into multiple stages with a median safety island. This allows crossing bicyclists and/or pedestrians to accept gaps in traffic one direction at a time. Median safety island for bicycle boulevards should be at least 8 ft (2.4 m) deep to accommodate crossing bicyclists.

Median islands are an FHWA Proven Safety Countermeasure.

Pedestrian Hybrid Beacons

At locations with multiple lanes of traffic, high-speed traffic, and/or no opportunity for a median safety island, a full traffic signal or pedestrian hybrid beacon may be effective in creating safe crossing conditions. Pedestrian hybrid beacons are an FHWA Proven Safety Countermeasure. Refer to the FHWA Pedestrian Hybrid Beacon Guide 2014 and MUTCD Chapter 4F for more information.

CASE STUDY | BIKE BOULEVARD

Arcata, California

PROJECT DESCRIPTION

The objective of the Arcata Bicycle Boulevard project was to create a more balanced and multimodal transportation system that provided facilities for walking and biking. Bicycle boulevards play an important role in a bicycle network, by providing a traffic calmed street for bicyclists of all ages and abilities.

The Arcata Bicycle Boulevards were implemented roadways with low traffic volumes (fewer than 2,000 cars per day), which run parallel to high-volume roadways (11th and H Streets). The boulevards connect critical destinations throughout the community, including connecting Aracta High School to downtown Arcata and the Arcata Marsh and Wildlife Sanctuary. The facilities also connect to public transportation at the Arcata Intermodal Transit Facility on 10th Street. The boulevard connects to Q and 11th Streets, where a future pedestrian and bicycle shared use trail is planned along south Q Street, leading toward the Arcata Marsh.

Special attention was given to bicyclists at intersections, where it is important to give bicyclists priority to maintain free-flow travel. Mini traffic circles slow motor vehicle traffic at minor intersections, while allowing bicyclists to continue through the intersection. Traffic calming at intersections also included public art to slow motor vehicle speeds, as seen at the intersection of 10th and I Streets.

A project video can be found at:
https://www.youtube.com/watch?v=-K8j3lKQjGM

DETAILS

COMMUNITY CONTEXT

Arcata is a university town located along Arcata Bay in northern California. The 2010 population was 17,231, with many visitors in the summer.

KEY DESIGN ELEMENTS

Custom wayfinding signs, pavement markings, and landscaped curb extensions, which act as a traffic-calming element, were used in this project. Traffic controls were put in place at intersections to help bicyclists cross major intersections at 10th and K Streets, 11th and I Streets, and 11th and Q Streets. Additional bike parking was also installed along the bike boulevard at popular destinations.

ROLE IN THE NETWORK

Bicycle boulevards were identified as key projects in the *Arcata Pedestrian and Bicycle Master Plan* in 2005 and 2010. This project provides connections between important community destinations, as well as future or planned projects.

FUNDING

In December 2006, the Public Works Department received a Caltrans Bicycle Transportation Account (BTA) grant for $173,612. The grant funded the bicycle boulevard improvements, as well as an intersection study, education and awareness programs, and bicycle parking in downtown Arcata.

For more information refer to:
http://www.cityofarcata.org/298/Arcata-Bicycle-Boulevard

Bicycle Boulevard

San Luis Obispo, CA–Population 45,911

PHOTO CREDIT

Page 2-12. Alta Planning + Design

Page 2-15. City of Arcata

Page 2-16. Adam Fukushima, City of San Luis Obispo

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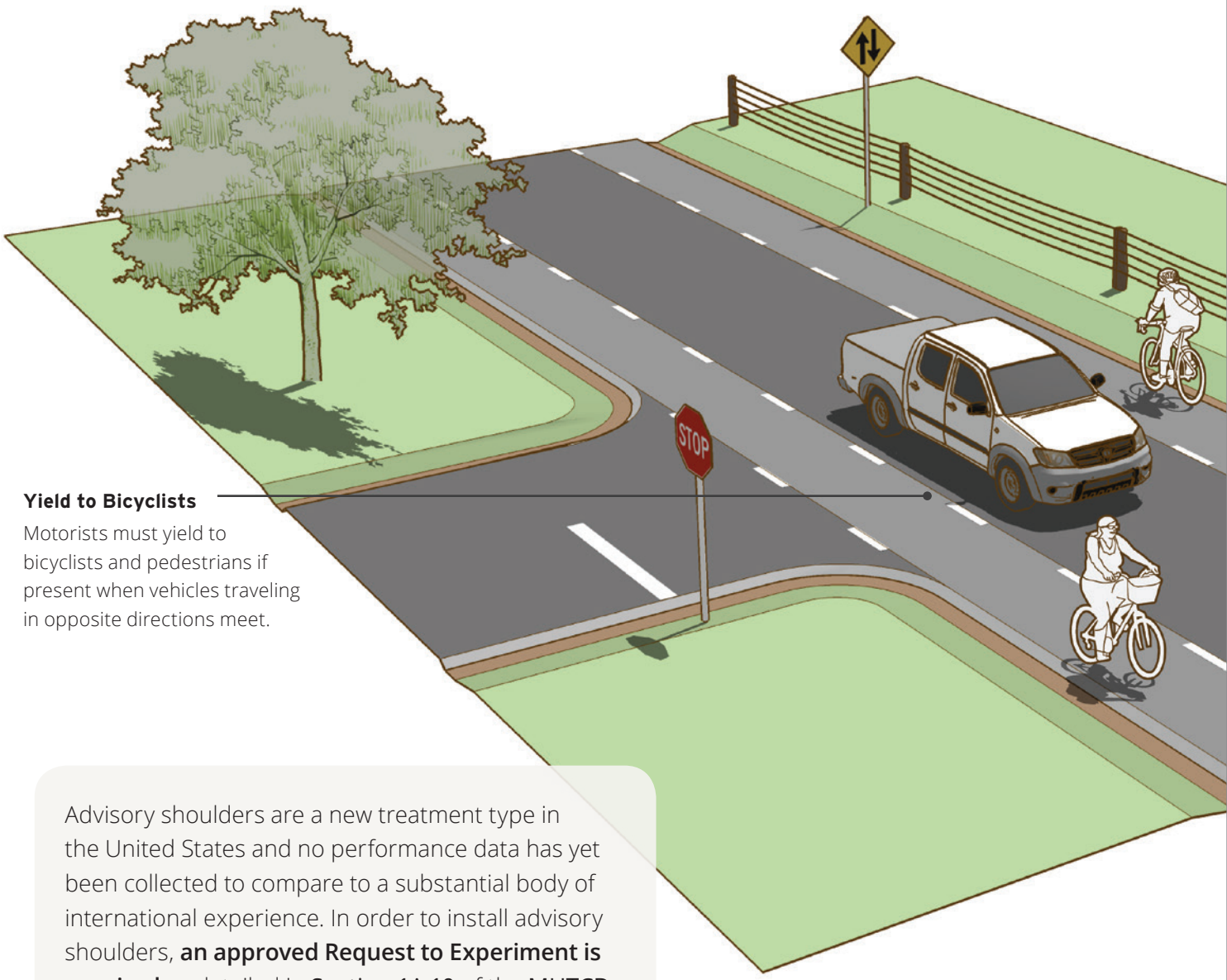


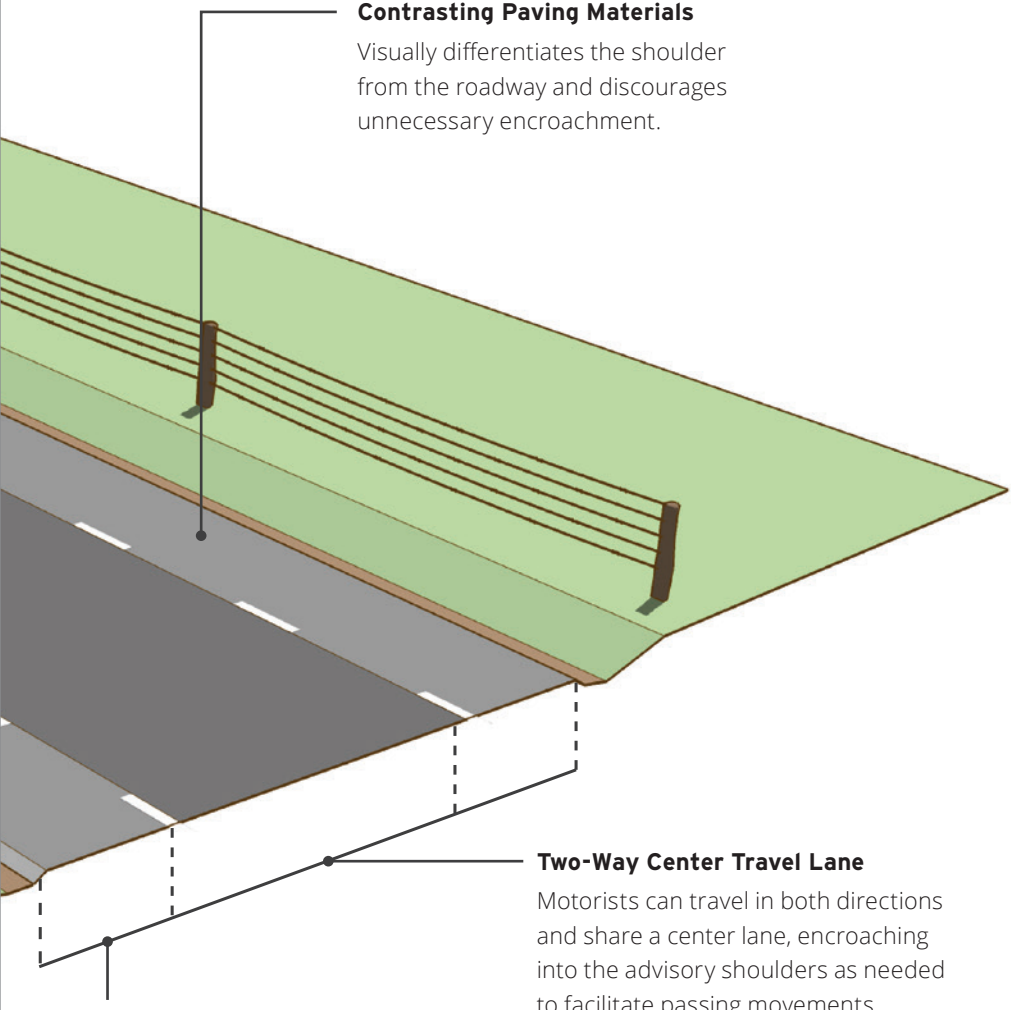
Yield to Bicyclists

Motorists must yield to bicyclists and pedestrians if present when vehicles traveling in opposite directions meet.

Advisory shoulders are a new treatment type in the United States and no performance data has yet been collected to compare to a substantial body of international experience. In order to install advisory shoulders, **an approved Request to Experiment is required** as detailed in Section 1A.10 of the MUTCD. FHWA is also accepting requests for experimentation with a similar treatment called "dashed bicycle lanes."

Advisory Shoulder

Advisory shoulders create usable shoulders for bicyclists on a roadway that is otherwise too narrow to accommodate one. The shoulder is delineated by pavement marking and optional pavement color. Motorists may only enter the shoulder when no bicyclists are present and must overtake these users with caution due to potential oncoming traffic.



Contrasting Paving Materials

Visually differentiates the shoulder from the roadway and discourages unnecessary encroachment.

Two-Way Center Travel Lane

Motorists can travel in both directions and share a center lane, encroaching into the advisory shoulders as needed to facilitate passing movements.

Advisory Shoulder

Prioritizes shared space for bicyclists and occasional pedestrian travel.

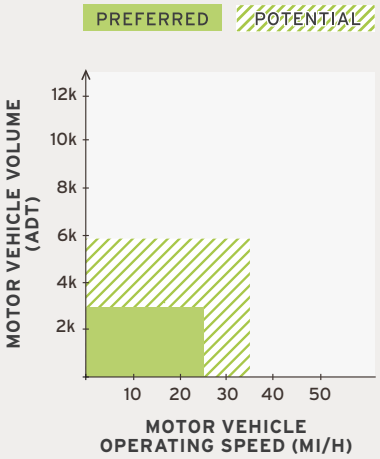
BENEFITS

- Provides a delineated but nonexclusive space available for biking on a roadway otherwise too narrow for dedicated shoulders.
- May reduce some types of crashes due to reduced motor vehicle travel speeds.[i]
- Minimizes potential impacts to visual or natural resources through efficient use of existing space.
- Functions well within a rural and small town traffic and land use context.
- Increases predictability and clarifies desired lateral positioning between people bicycling or walking and people driving in a narrow roadway.
- May function as an interim measure where plans include shoulder widening in the future.
- Supports the natural environment through reduced paved surface requirements.

APPLICATION

Speed and Volume

Most appropriate on streets with low to moderate volumes and moderate speed motor vehicles. [ii]



Network

Applies to constrained connections between built-up areas.

Land Use

For use outside, between, and within built-up areas with bicycle and pedestrian demand and limited available paved roadway surface.

Advisory Shoulder

Roads with advisory shoulders accommodate low to moderate volumes of two-way motor vehicle traffic and provide a prioritized space for bicyclists with little or no widening of the paved roadway surface.

A When vehicles traveling in opposite directions meet, motorists may need to enter the advisory shoulder for clear passage.

An approved Request to Experiment is required to implement Advisory Shoulders, called "dashed bicycle lanes" in the FHWA experimentation process. For more information on the experimentation process, visit http://mutcd.fhwa.dot.gov/condexper.htm.

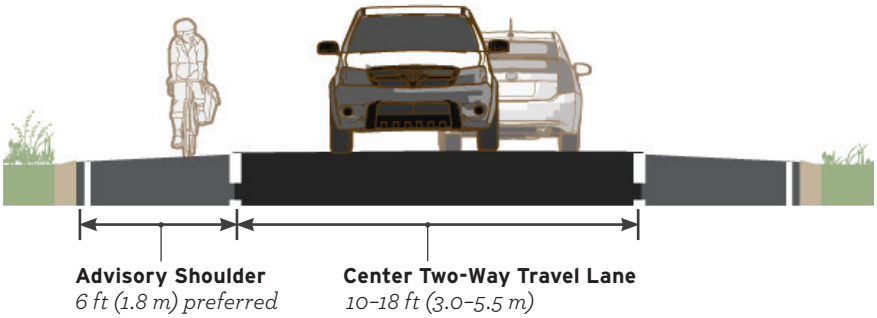


Figure 2-9. *Advisory shoulders clarify positioning and yield priority on roads too narrow to provide exclusive travel space. When pedestrians or bicyclists are present, motorists may need to yield to users present in the advisory shoulder before passing.*

GEOMETRIC DESIGN

Unlike a conventional shoulder, an advisory shoulder is a part of the traveled way, and it is expected that vehicles will regularly encounter meeting or passing situations where driving in the advisory shoulder is necessary and safe, as illustrated in Figure 2-9.

ADVISORY SHOULDER

The advisory shoulder space is a visually distinct area on the edge of the roadway, offering a prioritized space for people to bicycle and walk.

- The preferred width of the advisory shoulder space is 6 ft (2.0 m). Absolute minimum width is 4 ft (1.2 m) when no curb and gutter is present.
- Consider using contrasting paving materials between the advisory shoulder and center travel lane to differentiate the advisory shoulder from the center two-way travel lane in order to minimize unnecessary encroachment and reduce regular straddling of the advisory shoulder striping.

TWO-WAY CENTER TRAVEL LANE

The two-way center travel lane is created from the remaining paved roadway space after the advisory shoulder has been accounted for.

- Preferred two-way center travel lane width is 13.5–16 ft (4.1–4.9 m) although may function with widths of 10–18 ft (3.0–5.5 m). Table 2-2 describes the impacts of various center lane widths on roadway operations.

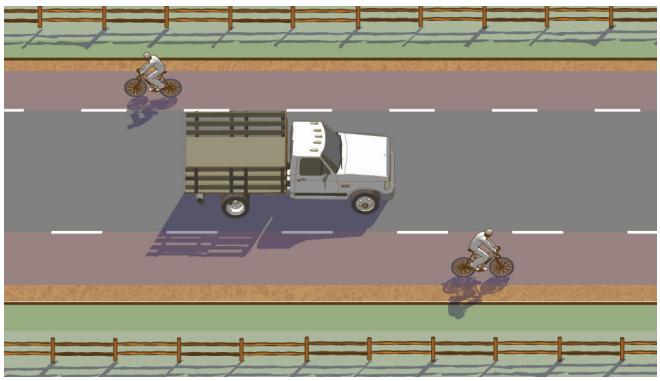


Figure 2-10. *Motorists travel in the center two-way travel lane. When passing a bicyclist, no lane change is necessary.*

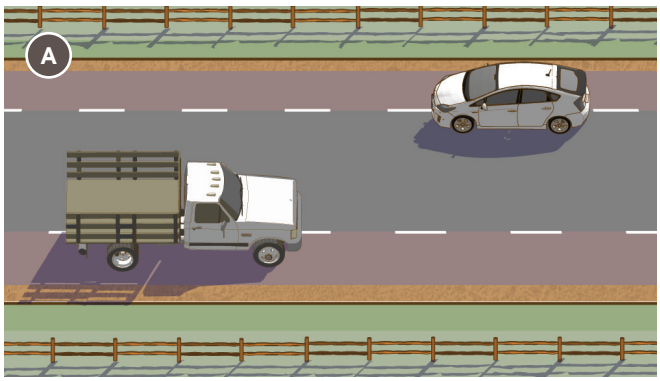


Figure 2-11. *When two motor vehicles meet, motorists may need to encroach into the advisory shoulder space.*

Advisory Shoulder

Table 2-2. *Interactions when vehicles traveling in opposite directions meet by two-way center turn lane width.*

	Two-Way Center Travel Lane Width	Impact on Advisory Shoulder Encroachment When Vehicles Traveling in Opposite Directions Meet
B Practical minimum width	10 ft (3.0 m)	Requires vehicle encroachment into the advisory shoulder space when vehicles traveling in opposite directions meet.
C Preferred minimum width	13.5 ft (4.5 m)	Two passenger cars are physically able to meet each other within the center lane at very low speed. In practice, vehicles will encroach into the advisory shoulder.
Preferred maximum width	16 ft (4.9 m)	Permits two passenger cars to pass within the center lane at modest speeds without encroaching into the advisory shoulder.
D Absolute maximum width	18 ft (5.5 m)	This width is equivalent to two 9 ft (2.7 m) travel lanes and regular encroachment into the advisory shoulder space may not be necessary.

Implementing agencies should be advised that the above dimensional guidance is intended to facilitate implementation on common roadway widths in the U.S. As with most treatments, more overall width is preferable to constrained circumstances.

10 ft (3.0 m) Center Travel Lane | **13.5 ft (4.5 m) Center Travel Lane** | **18 ft (15.5 m) Center Travel Lane**

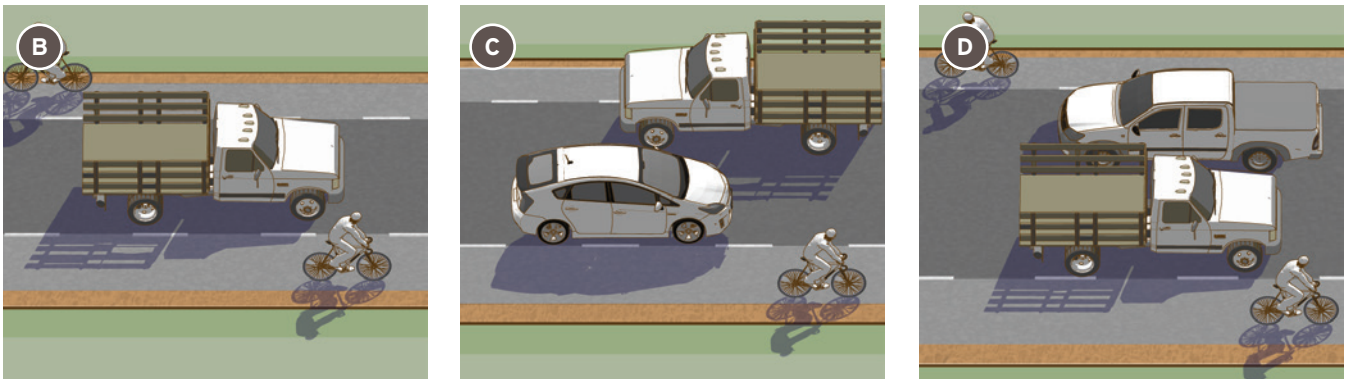


Figure 2-12. *Total roadway width affects the number of road users that can meet and pass simultaneously. Wider roadways allow for more simultaneous interactions and can support higher volumes of motor vehicles.*

MARKINGS

- A broken lane line used to delineate the advisory shoulder should consist of 3 ft (1.0 m) line segments and 6 ft (2.0 m) gaps.[iii]
- Where additional edge definition is desired, stripe a normal solid white edge line in addition to the broken advisory shoulder line.
- In general, do not mark a center line on the roadway. Short sections may be marked with center line pavement markings to separate opposing traffic flows at specific locations, such as around curves, over hills, on approaches to at-grade crossings, and at bridges.

  At these locations, widen the paved roadway surface to provide space for paved bicycle-accessible shoulders and conventional width travel lanes. See Table 2-3 for sight distance requirements.

Table 2-3. *Minimum Passing Sight Distances for No-Passing Zone Markings. Adapted from MUTCD Table 3B-1.*

85th-Percentile or Posted or Statutory Speed Limit	Minimum Passing Sight Distance
25 mi/h	450 ft (137 m)
30 mi/h	500 ft (152 m)
35 mi/h	550 ft (167 m)
40 mi/h	600 ft (182 m)
45 mi/h	700 ft (213 m)
50 mi/h	800 ft (243 m)
55 mi/h	900 ft (274 m)

Advisory Shoulder

SIGNS

Use signs to warn road users of the special characteristics of the street. Potential signs for use with advisory shoulders include:

- As illustrated in **Figure 2-12**. Use an unmodified Two-Way Traffic warning sign (W6-3) to clarify two-way operation of the road.
- Use a NO CENTER LINE warning sign (W8-12) to help clarify the unique striping pattern.
- Use a NO PARKING ON PAVEMENT (R8-1) to discourage parking within the advisory shoulder.

Figure 2-13. *The W6-3 two-Way traffic warning sign can clarify undivided two-way operation of the advisory shoulder configuration.*

An approved Request to Experiment is required to implement Advisory Shoulders, called "dashed bicycle lanes" in the FHWA experimentation process. For more information on the experimentation process, visit **http://mutcd.fhwa.dot.gov/condexper.htm**.

Hanover, NH–Pop 11,250

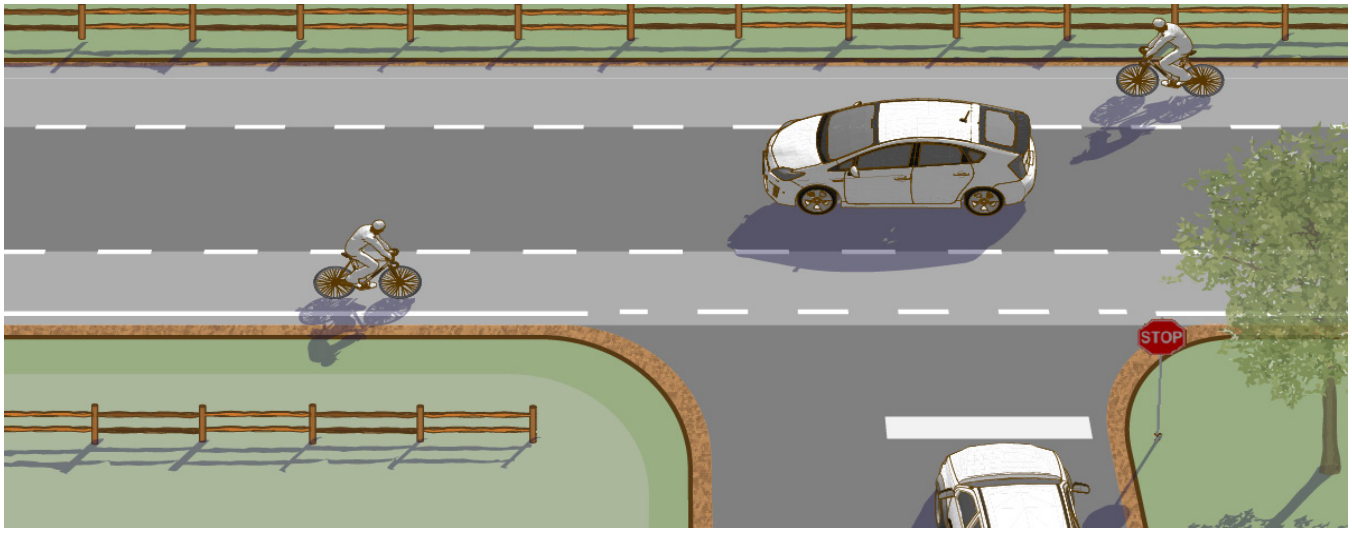


Figure 2-14. *At crossings of minor intersections and driveways, maintain the striping and construction material (if used) of the advisory shoulder.*

Advisory Shoulder

INTERSECTIONS

Advisory shoulder designs work best on road segments without frequent stop or signal controlled intersections that require vehicles to stop within the roadway. The designer should strive to maintain the visual definition of the advisory shoulder through all driveways and street crossings, and provide a conventional shoulder at controlled intersections.

- At minor street crossings, use a dotted line extension on both sides of the advisory shoulder to maintain delineation of the advisory shoulder space (Figure 2-14).
- If contrasting pavement material is used, maintain the material through driveway crossings and minor intersections.
- Where the road is controlled by a stop sign or traffic signal, discontinue the advisory shoulder 50 ft (15 m) in advance of the intersection.
- At these locations, provide a bicycle accessible paved shoulder outside of the travel lanes or design for operation as a shared roadway.

Edina, MN–Population 49,300

IMPLEMENTATION

In order to install advisory shoulders, an approved Request to Experiment is required as detailed in the MUTCD 2009, Sec. 1A.10. FHWA is also accepting requests for experimentation with a similar treatment called "dashed bicycle lanes."[iv]

ACCESSIBILITY

Advisory shoulders as described here are not intended for use by pedestrians. When advisory shoulders are intended for use by pedestrians, they must meet accessibility guidelines.

CASE STUDY | ADVISORY SHOULDERS

Hanover, New Hampshire

PROJECT DESCRIPTION

In 2012, Hanover completed a bicycle and pedestrian planning effort. This plan identified Valley Road as a local bicycle connection in the overall network. In 2013, Hanover completed a Safe Routes to School (SRTS) Plan, which introduced the idea of using advisory shoulders (called advisory bike lanes for this project) on Valley Road. Hanover's Bicycle and Pedestrian Committee (HBPC) advocated to use Valley Road as a pilot project for advisory shoulders. The HBPC surveyed the Valley Road neighbors and built support for a pilot project. While there was some resistance, the neighborhood was generally supportive of the idea. Hanover's Department of Public Works was open to the idea and it was presented to the town select board who approved installation of advisory shoulders unit on Valley Rd. The advisory shoulders were painted on about 400 meters of Valley road in the summer of 2014. In 2016 an evaluation report was produced with traffic counts and results from a follow up survey. Based on the success of the Valley Road advisory shoulders, Hanover is currently evaluating adding advisory shoulders to another important bicycle and pedestrian connection between schools and neighborhoods.

Factors in the success of the advisory shoulders were the leadership of the HBPC, support from the adjacent neighbors, the willingness to pilot them by the Department of Public Works and inclusion of Valley Road and advisory shoulders in both the SRTS and Bicycle and Pedestrian Plans.

DETAILS

COMMUNITY CONTEXT

Hanover, NH, is a town of approximately 11,000 with 8,000 living in the town center. Hanover is home to Dartmouth College with a student population of 6,300. Hanover is located on the Connecticut River and has a dense built-up area surrounded by small suburban neighborhoods that transition quickly to a very rural setting.

KEY DESIGN ELEMENTS

The advisory shoulders project was built on a low-volume, low-speed, residential road. Implementation included pavement markings and signs.

ROLE IN THE NETWORK

Valley Road is a local bicycle connection between neighborhoods with schools, the downtown, and the Dartmouth College campus. Sidewalks were removed due to root damage and were not replaced because the neighborhood preferred the rural look of streets without sidewalks. Advisory shoulders use existing pavement to provide space prioritized for bicycles and pedestrians at very low cost.

FUNDING

The Hanover Bicycle and Pedestrian Plan and the advisory shoulders project were both accomplished with funding from the HBPC, which is funded by a $5 local fee on vehicle registration that was passed by the select board to support alternative transportation and generates approximately $30,000 annually.

For more information, refer to the City of Hanover Public Works Department: http://www.hanovernh.org/public-works

Advisory Shoulder

Bloomington, IN–Population 82,000

FOOTNOTES

i Trials conducted by Transport for London (TfL) show a statistically significant speed reduction effect of 5.4mi/h–8.6 mi/h as a result of removing center line markings on the roadway **(TfL 2014)**.

A four-year study from Wiltshire County (England) showed a 35 percent drop in motor vehicle crashes along 30 mi/h roadways where the center line was removed **(Wiltshire County Council 2014)**.

ii Volume criteria listed here are based on FHWA guidance on center line provision. The **FHWA MUTCD** recommends center lines on roadways with motor vehicle traffic volumes above 3,000 ADT, and requires them on streets above 6,000 ADT **(2009, Sec. 3B.01)**.

Installations in England have functioned well on streets with volumes as high as 10,000 ADT, and an existing installation carries nearly 14,000 ADT according to Department for Transport estimates **(Cardiff Council 2011)**.

iii **FHWA MTUCD** application of broken line markings is to indicate a permissive conditions (Sec. 3A.06). The MUTCD allows use of "dimensions in a similar ratio of line segments to gaps as appropriate for traffic speeds and need for delineation." **(2009, p. 348)**.

iv The FHWA is conducting experimentation with dashed bicycle lane treatments in at least 5 locations across the US. Guidance related to experimentation is available from the FHWA online resource **Bicycle Facilities and the Manual on Uniform Traffic Control Devices 2015.**

WORKS CITED

Cardiff Council. *Cardiff Cycle Design Guide*. 2011.

Federal Highway Administration. *Bicycle Facilities and the Manual on Uniform Traffic Control Devices*. 2015.
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PHOTO CREDIT

Page 2-21. Western Transportation Institute

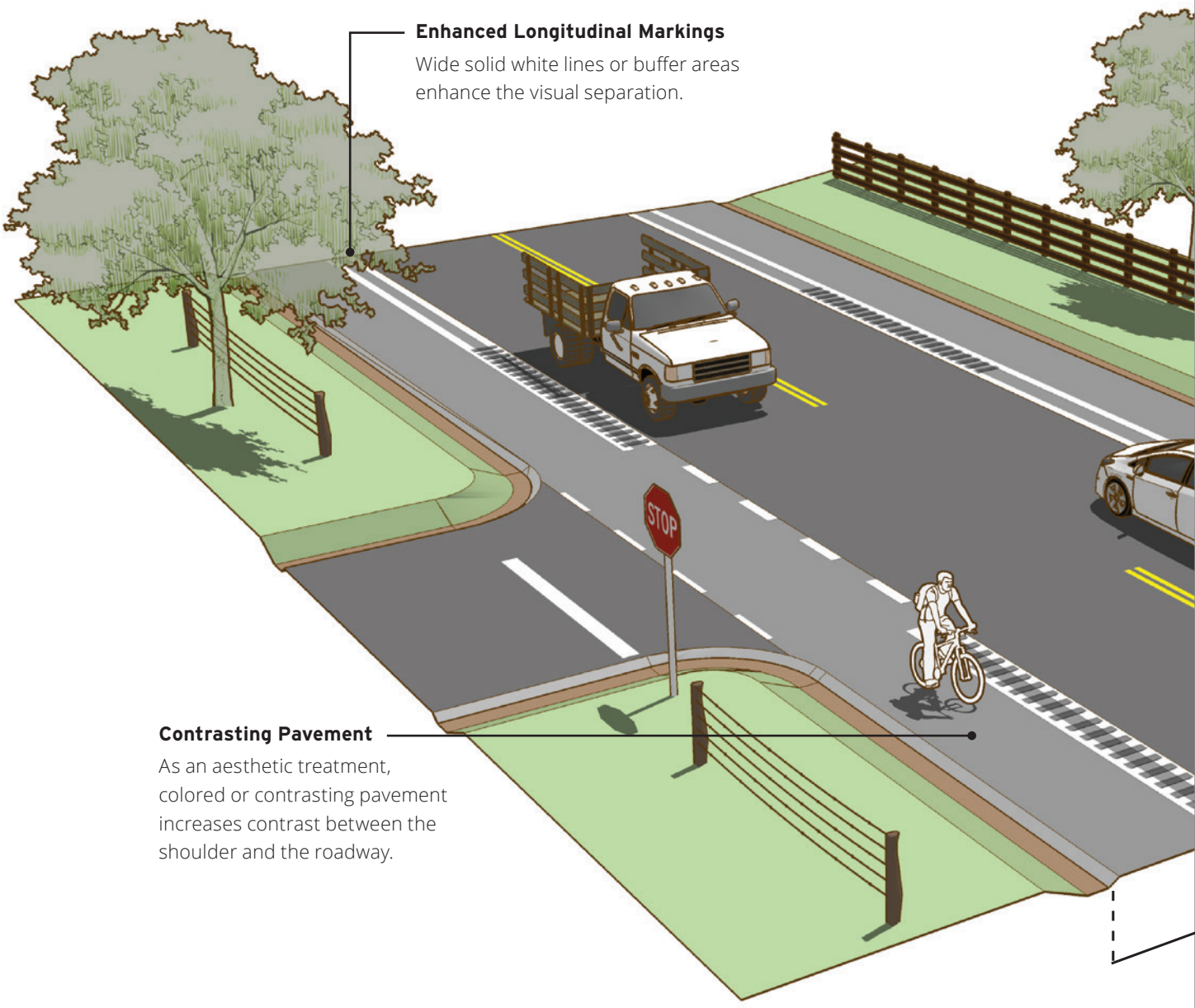
Page 2-22. Alta Planning + Design

Page 2-23. Western Transportation Institute

Page 2-24. City of Bloomington Planning and Transportation Department

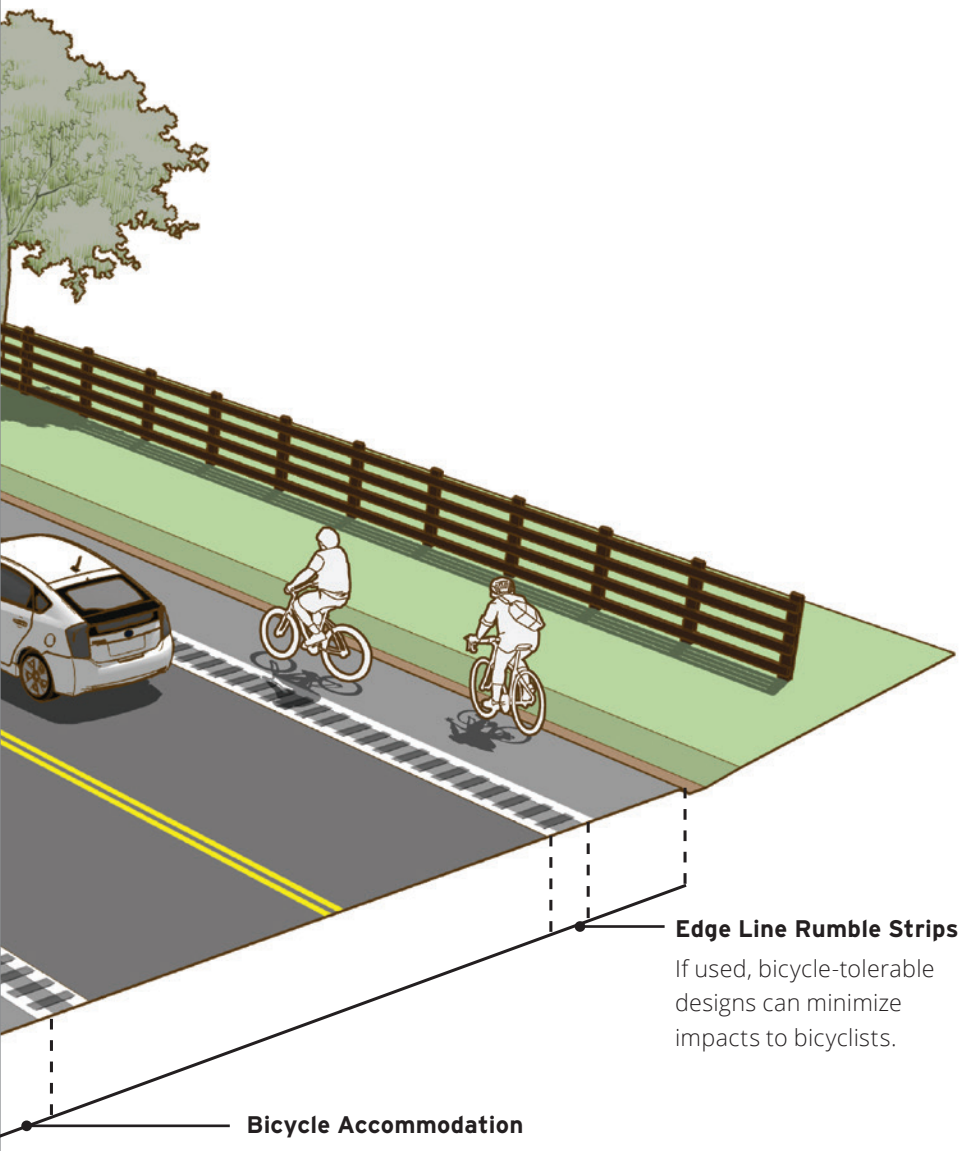
CHAPTER 3

Visually Separated Facilities



Paved Shoulder

Paved shoulders on the edge of roadways can be enhanced to serve as a functional space for bicyclists and pedestrians to travel in the absence of other facilities with more separation.



Edge Line Rumble Strips

If used, bicycle-tolerable designs can minimize impacts to bicyclists.

Bicycle Accommodation

Bicyclists travel in the same direction as the adjacent lane.

BENEFITS

- Improves bicyclist experiences on roadways with higher speeds or traffic volumes.
- Provides a stable surface off the roadway for pedestrians and bicyclists to use when sidewalks are not provided.
- Reduces pedestrian "walking along roadway" crashes.
- Can reduce "bicyclist struck from behind" crashes, which represent a significant portion of rural road crashes.
- Provides advantages for all roadway users, by providing space for bicyclists, pedestrians, and motor vehicles.

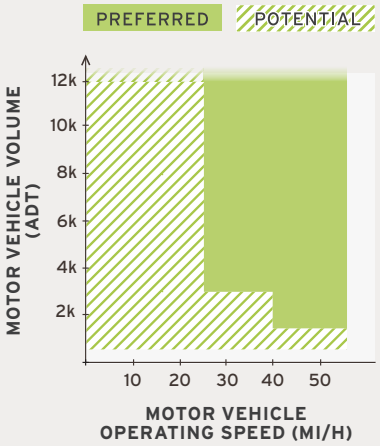
CONSIDERATIONS

- Enhancements with increased levels of striping and signs may interfere with the low-clutter character of a rural environment.
- Requires a wider roadway to provide an accessible shoulder space.

APPLICATION

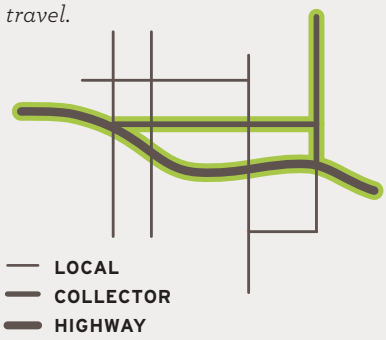
Speed and Volume

Appropriate on roads with moderate to high volumes and speeds and on roadways with a large amount of truck traffic. May function on multilane roads with heavy traffic but fails to provide a low-stress experience in this condition.



Network

Serves long-distance and regional travel.



Land Use

Appropriate outside and within built-up areas, near school zones and transit locations, and where there is expected pedestrian and bicycle activity. Walkable shoulders should be provided along both sides of county roads and highways routinely used by pedestrians.

Paved Shoulder

Shoulders can improve bicyclist comfort and safety when traveling in higher speed and/or volume situations but only when adequate width is provided. If used, locate rumble strips on the edge line or within a buffer area that will not reduce usable space for bicyclists.

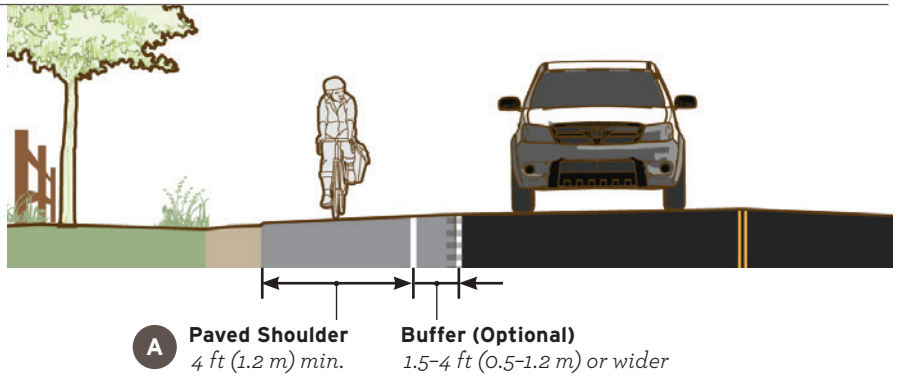


Figure 3-1. *When adequate width is provided, shoulders can serve bicycle trips along roads too busy for comfortable shared roadway travel.*

GEOMETRIC DESIGN

CLEAR PAVED SHOULDER AREA

Any amount of clear paved shoulder width can benefit pedestrians and bicyclists, however, to be fully functional for their use, the paved shoulder area should be wide enough to accommodate the horizontal operating envelope of these users.

A To accommodate bicyclists and pedestrian use of the shoulder, provide a minimum width of 4 ft (1.2 m) adjacent to a road edge or curb, exclusive of any buffer or rumble strip.

- Where possible, provide greater width for added comfort, user passing, and side-by-side riding.[ii]

Table 3-1. *Recommended Minimum Paved Shoulder Widths by Roadway Conditions*[iii]

Functional classification	Volume (AADT)	Speed (Mi/h)	Recommended Minimum Paved Shoulder Width
Minor Collector	up to 1,100	35 (55 km/h)	5 ft (1.5 m)
Major Collector	up to 2,600	45 (70 km/h)	6.5 ft (2.0 m)
Minor Arterial	up to 6,000	55 (90 km/h)	7 ft (2.1 m)
Principal Arterial	up to 8,500	65 (100 km/h)	8 ft (2.4 m)

D'Iberville, MS–Population 10,390

Paved Shoulder

GEOMETRIC DESIGN

RUMBLE STRIPS

Rumble strips are an FHWA Proven Safety Countermeasure for reducing roadway departure crashes. Research has shown that installing rumble strips can reduce severe crashes but may negatively impact bicycle travel if they are poorly constructed.

Additional information on rumble strip design can be found in FHWA Technical Advisory 5040.39 and on the FHWA Rumble Strips and Rumble Stripes Website.

B If rumble strips are desired on bicycle network routes optimize the dimension, design, and placement of rumble strips to be more tolerable to bicyclists.[iv]

- > 12 inch spacing center-to-center
- > 6–8 inches long, perpendicular to roadway
- > 6 inch wide, measured parallel to roadway
- > 3/8 inch deep

- Place rumble strips to overlap with the roadway edgeline, also known as edgeline rumble strips or rumble stripes.[v]
- Provide a bicycle gap pattern to allow access into and out of the shoulder area by bicyclists. The gap pattern consists of a 12 ft (3.3 m) clear gap followed by rumbles, typical 40–60 ft (12.1–18.2 m) (NCHRP Synthesis 490, 2016).

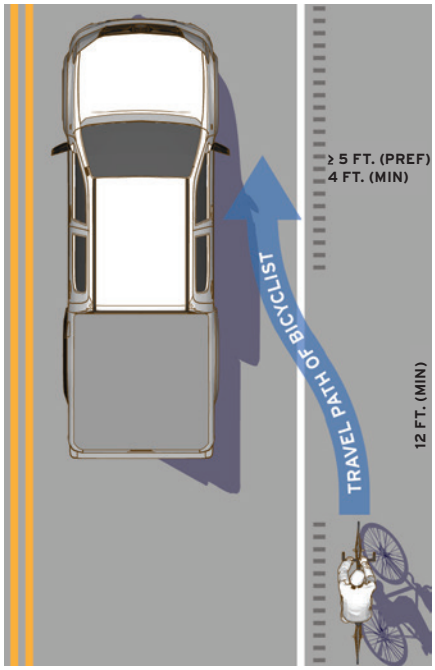


Figure 3-2. *Preferred rumble strip dimensions and placement. Figure from FHWA Achieving Multimodal Networks 2016.*

PAVEMENT CONTRAST AND COLOR

Contrasting or colored pavement materials may be used to differentiate the shoulder from the adjacent travel lanes (AASHTO Green Book 2011, p. 4-13).

- Colored pavement in a paved shoulder is an aesthetic treatment to enhance awareness and is not intended to communicate a regulatory, warning, or guidance message to road users.

Highway 2, Nebraska

Paved Shoulder

MARKINGS

On shoulders designed for bicycle and pedestrian accessibility, the edge should be clearly delineated and defined to discourage unnecessary encroachment by motor vehicles. Options beyond a normal white line include:

- **C** A wide 8 in (200 mm) white line.
- **D** A narrow buffer space–two normal 4 in (100 mm) solid white lines separated by an 18 in (0.45 m) or greater space.
- **E** A wide buffer space–two normal solid white lines, separated by a 4 ft (1.2 m) or greater space and optional crosshatch markings.

Discontinue the edge line at intersections and major driveways. On a bicycle accessible shoulder, additional definition of the shoulder alignment may be desired. In these conditions, consider:

- A dotted white line to extend the edge line through intersections and major driveways.
- A second normal width dotted white line may be used to define the outside edge of the shoulder, defining both sides of the bicycle travel area.

SIGNS

No signs are required on paved shoulders, but signs may be used to identify a road as a bicycle route.

- Bike Route Guide (D11-1c) signs are used to Indicate to bicyclists that they are on a designated bikeway and make motorists aware of the bicycle route.

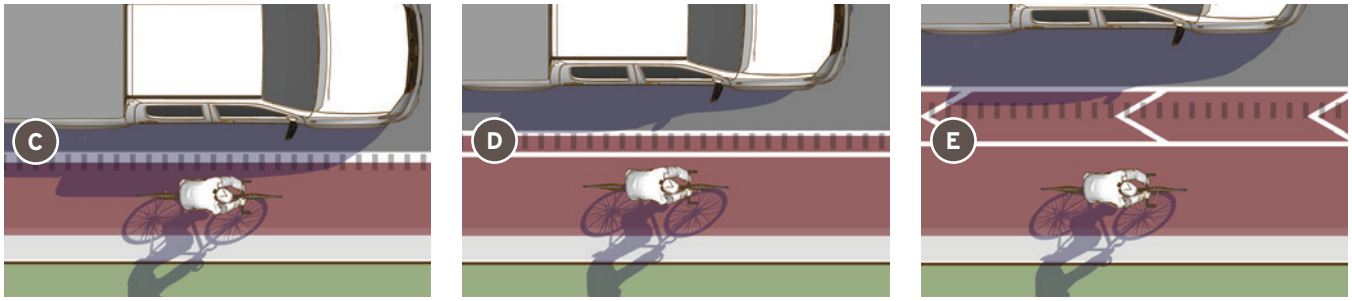


Figure 3-3. *Longitudinal markings along shoulders should be selected in response to shoulder width, and the desire to discourage encroachment by motor vehicles.*

INTERSECTIONS

At intersections, the shoulder area is often narrowed to provide room for or completely replaced by turning, receiving or bypass lanes. It is important to minimize the impacts of these designs to bicyclists using the shoulder for bicycle travel.

AT BYPASS AND TURN LANES

At intersections with heavy left-turn volumes, an auxiliary bypass lane, or center turn lane may be provided for motor vehicles. While this lane may encroach into the shoulder space, 6 ft (1.8 m) of the shoulder should be preserved for bicyclist travel. Absolute minimum width of the shoulder is 4 ft (1.2 m) to maintain bicycle accessibility.

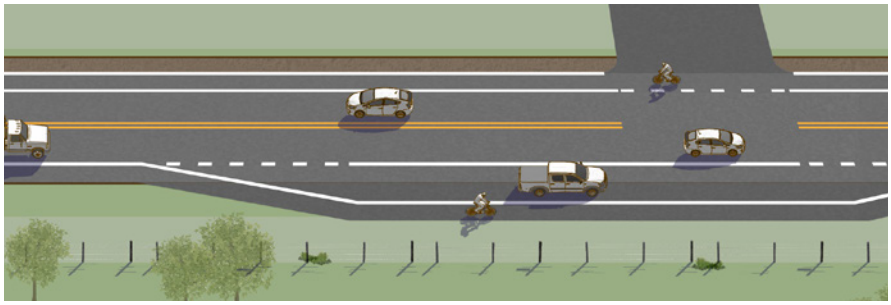


Figure 3-4. *At bypass lanes, widen the roadway to provide a clear shoulder area outside of the travel area. (Based on Figure 4-7 in the* ***AASHTO Bike Guide, 2012****.)*

Paved Shoulder

INTERSECTIONS

Paved shoulders are typically located immediately to the right of right turn lanes. This may lead to right-hook conflicts between through bicyclists and turning vehicles. At intersections with right turn only lanes, bicycle accessible shoulders should be classified as bike lanes or separated bike lanes, and appropriate intersection designs should be used to encourage safe interactions.

CONFIGURE AS AN ON-STREET BIKE LANE

F A right turn lane should be added to the right of the bike lane. Dotted line extensions should be used to define the tapered entrance into the right-turn lane, and signs should direct motorists to yield to bicyclists. For more information, refer to the guidance on bike lanes and **FHWA MUTCD Figure 9C-4**.

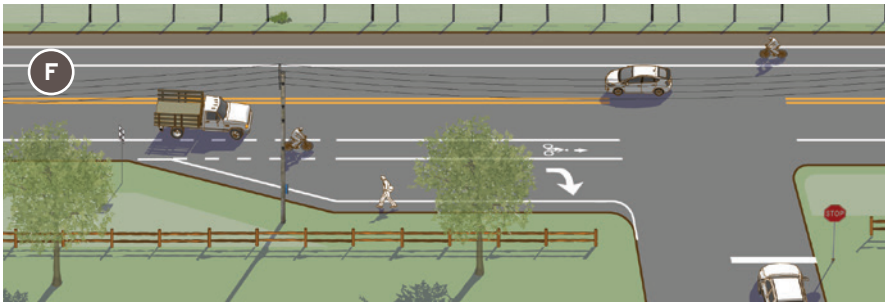


Figure 3-5. *In this scenario, the shoulder is designated as a bike lane and a right turn lane is introduced to the right of the bike lane. Drivers must yield to through bicyclists before entering the turn lane.*

CONFIGURE AS A SEPARATED BIKE LANE OR SHARED USE PATH

G Where a high degree of user comfort is desired, the shoulder may transition into a one-way separated bike lane or shared use path in advance of intersections. Once established, the separated facility may maintain separation up to the crossing. This increased separation provides an opportunity for motorists to slow in advance of the turn and yield to bicyclists. For more information, refer to the guidance on separated bike lanes.

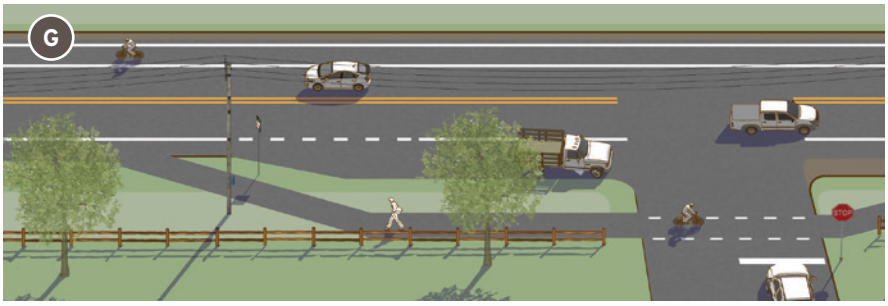


Figure 3-6. *In this scenario, the shoulder is designated as a separated bike lane. Bicyclists are shifted laterally away from the roadway and separated from the travel or turn lanes by an unpaved buffer space.*

IMPLEMENTATION

Include or upgrade shoulders during roadway resurfacing, rehabilitation, and reconstruction in new construction projects. For more information on implementation strategies, refer to the FHWA Resurfacing Guide 2016.

ACCESSIBILITY

When shoulders are intended for use by pedestrians, they must meet accessibility guidelines.

CASE STUDY | PAVED SHOULDER

Capay, California

PROJECT DESCRIPTION

State Route (SR) 16 through the Capay Valley has a wide variety of users including commuters, recreational travelers, freight truck drivers, and farm equipment operators. Capay Valley contains farmland, several small communities, and the Cache Creek Casino Resort. This part of SR 16 is designated as a local Scenic Highway, and is also eligible to become a State Scenic Highway. As SR 16 approaches Interstate 505, the route goes through the unincorporated communities of Esparto and Madison, which are expected to grow in population over the next 20 years from planned development.

The California Department of Transportation (Caltrans) has identified SR 16 corridor safety needs through several studies including a 2012 Transportation Corridor Concept Report (http://www.dot.ca.gov/hq/tpp/corridor-mobility/documents/d_3_docs/SR16_TCCR_FINAL.pdf). The paved shoulders were installed as part of a Caltrans Traffic Calming project within the community of Capay which was completed in December 2011. The enhancements included pigmented and textured shoulders, restriping, improved signage, and architectural, landscaping, and lighting improvements. The improvements along SR 16 have been a partnership effort among Caltrans, Yolo County, the Sacramento Area Council of Governments, a Native American Tribal Government, and the community.

DETAILS

COMMUNITY CONTEXT

Capay is a small, unincorporated community in northern California's Yolo County, with an estimated population of 133. Yolo County's 2010 population was 200,000, including Davis, with a population of 65,000. Yolo County is in the Sacramento Valley and remains largely a rural agricultural region.

KEY DESIGN ELEMENTS

The existing highway through Capay had wide shoulders that were used by people walking and on bikes to access the businesses along SR 16. The paved shoulders were created using pigmented, stamped asphalt which is a relatively inexpensive treatment with low maintenance costs.

ROLE IN THE NETWORK

SR 16 connects the rural communities of Yolo County with Woodland and the I-5 corridor. This road is the only road that connects through the town and is regularly used by people walking and biking. It links homes with local businesses. The enhanced shoulders provide critical accommodation for people walking and biking.

FUNDING

The paved shoulders were installed as part of a Caltrans project.

For more information, refer to California Department of Transportation District 3:
http://www.dot.ca.gov/d3/

Paved Shoulder

FOOTNOTES

i NCHRP Report 600 states that the addition of paved shoulders may improve safety of all roadway users and have been shown to significantly reduce run-off-road crash rates by 80 percent on some rural highways (2012, p. 16-6).

ii The AASHTO Bike Guide states, "Additional shoulder width is also desirable if motor vehicle speeds exceed 50 mi/h (80 km/h); if use by heavy trucks, buses, or recreational vehicles is considerable; or if static obstructions exist at the right side of the roadway" (2012, p.4-7).

iii Functional classification volumes are based on Table 3-6 in FHWA's Highway Functional Classification Concepts, Criteria and Procedures 2013. Desirable shoulder widths based on achieving LOS A using the Bicycle Level of Service Calculator 2007. Calculations assume 1 travel lane per direction; outside lane width of 11 ft.; 2 percent heavy vehicle mix; average pavement quality and no on-street parking.

iv General physical dimensions of rumble strips are based on common designs described in NCHRP Synthesis 490, with bicycle specific enhancements to improve maneuvering by bicyclists identified in *FHWA Technical Advisory on Shoulder and Edge Line Rumble Strips* 2011.

The decision to use adjusted rumble strip dimensions should be made with the understanding that reducing the dimensions can significantly reduce the alerting noise and associated safety effectiveness of the rumble strip for motorists.

v NCHRP Report 641 indicates that there may not be a practical difference in the effectiveness of rumble strips placed on the edge line or 2 ft or more beyond the edge line on two-lane rural roads (2016).

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PHOTO CREDIT

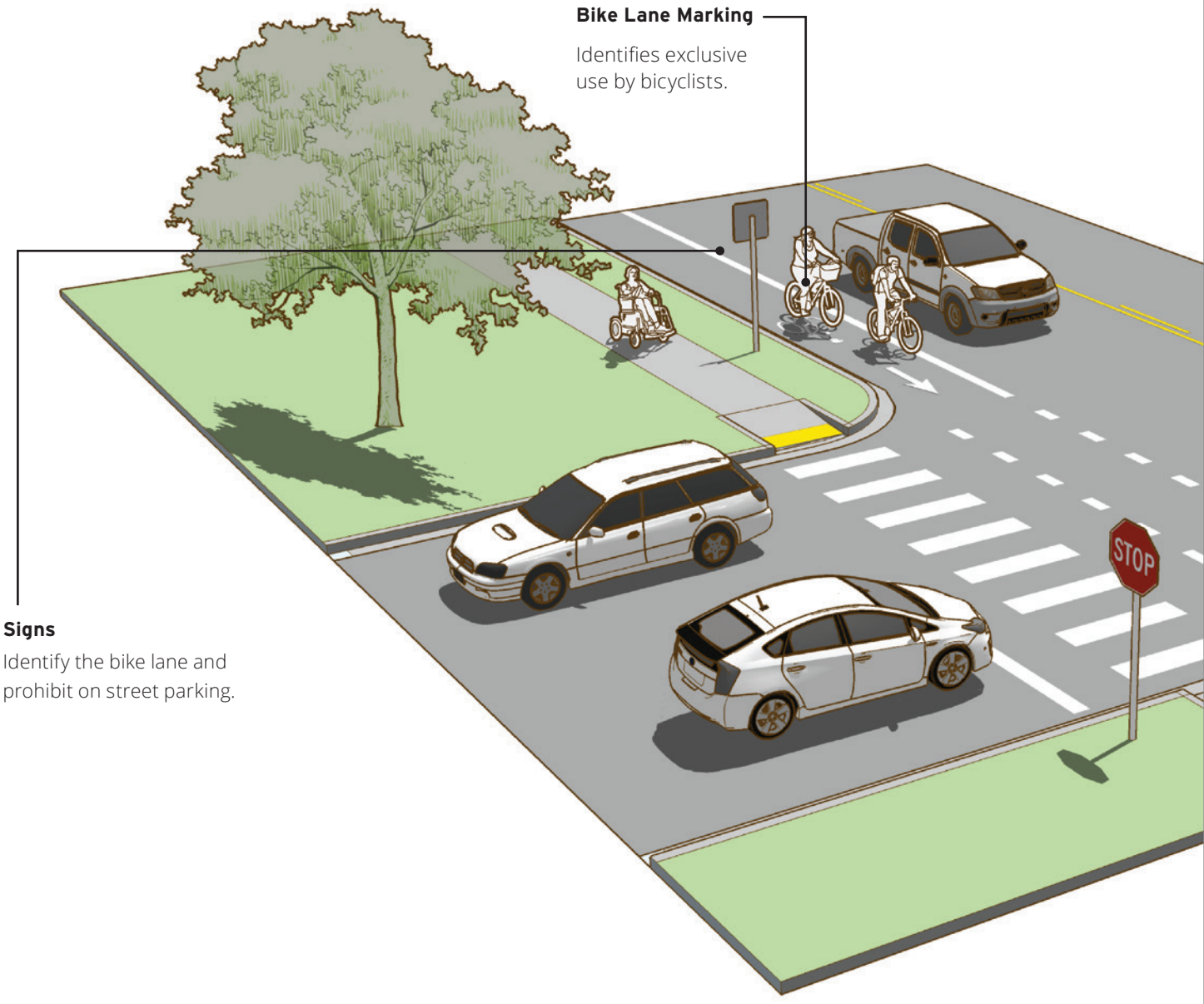
Page 3-1. Western Transportation Institute

Page 3-5. Alta Planning + Design

Page 3-6 Bob Boyce via Ped Bike

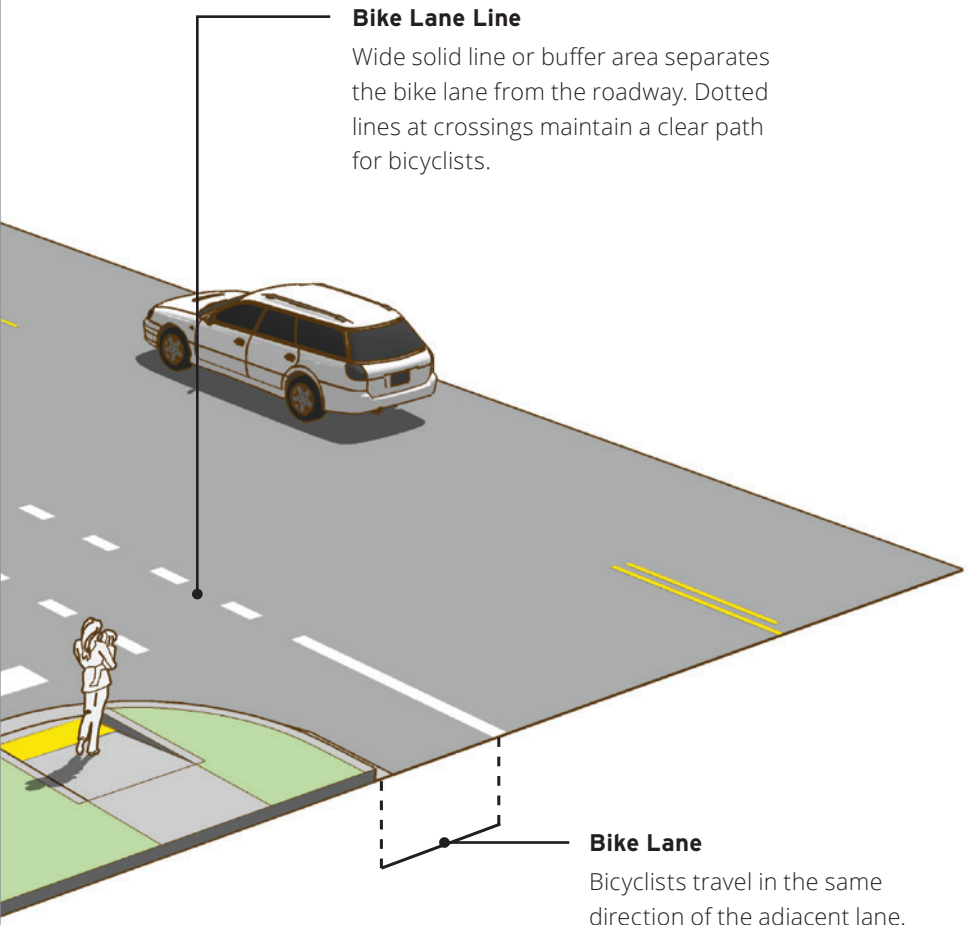
Page 3-9. Alta Planning + Design

Page 3-10. Western Transportation Institute



Bike Lane

Bike lanes designate an exclusive space for bicyclists through the use of pavement markings and optional signs. A bike lane is located directly adjacent to motor vehicle travel lanes and follows the same direction as motor vehicle traffic.



Bike Lane Line

Wide solid line or buffer area separates the bike lane from the roadway. Dotted lines at crossings maintain a clear path for bicyclists.

Bike Lane

Bicyclists travel in the same direction of the adjacent lane.

BENEFITS

- Provides additional separation distance between the sidewalk and motor vehicle travel area, if a sidewalk is present.
- Connects and completes bikeway networks through built-up areas.
- Provides a designated space on the roadway suitable for many skilled bicyclists within built-up areas of small communities.
- Can support school access by bicycle when configured as a wide bike lane on lower-speed, lower-volume streets.
- Provides additional visual cues to drivers that they should expect bicyclists on the roadway. This can be particularly useful when transitioning to a built-up area from a highway context.

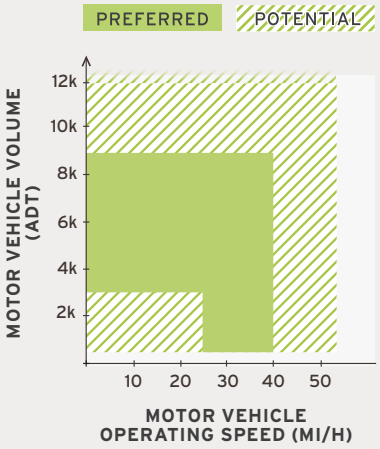
CONSIDERATIONS

- Reflects a more urban visual atmosphere than an unmarked shoulder.

APPLICATION

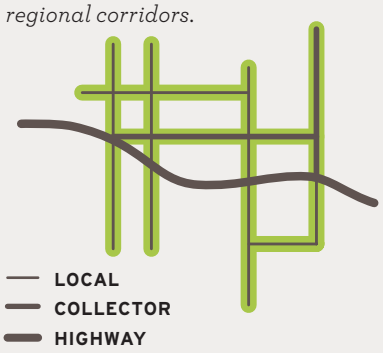
Speed and Volume

Appropriate on streets with moderate volumes and moderate speed. May function on multilane streets with heavy traffic but fails to provide a low-stress experience in this condition, which would appeal to larger numbers of bicyclists.



Network

Serves moderate distance trips connecting local bikeway routes to regional corridors.



Land Use

For use inside or between, built-up areas where increased pedestrian and/or bicycle activity is present or expected.

Bike Lane

Within built-up areas, increased pedestrian activity and curbside uses degrade the experience of nonexclusive bicycling accommodations such as shoulders. Providing a designated bike lane can provide a consistent area for bicyclists to travel outside the path of motor vehicles. When space is available, add a buffer area, distancing the bike lane from the adjacent motor vehicle travel lane.

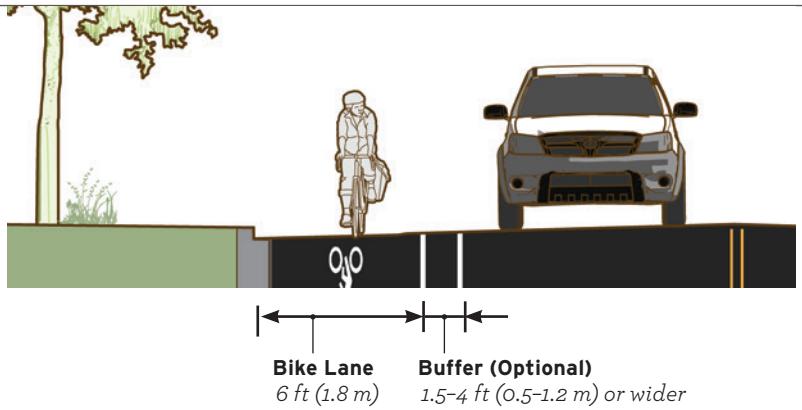


Figure 3-7. *Bike lanes establish an area for exclusive bicycle use outside the path of motor vehicles.*

GEOMETRIC DESIGN

BIKE LANES

Design bike lanes to separate road users and reduce the stress of motor vehicle passing events.

- The preferred minimum width of a bike lane is 6.5 ft (2.0 m) to allow for bicyclists to ride side-by-side or pass each other without leaving the bike lane.
- Absolute minimum bike lane width is 4 ft (1.2 m) when no curb and gutter is present or 5 ft (1.5 m) when adjacent to a curbface, guardrail, other vertical surface or on-street parking stalls (AASHTO Bike Guide 2012).
- Widths 7 ft (2.1 m) or greater may encourage motor vehicle use of bike lane for parking or driving. If extra width is available or desired, configure with a buffer zone to delineate space.

MARKINGS

Mark a bike lane line with a normal solid white line and a standard bike lane symbol marking. Standards and guidance for applying these elements can be found in the MUTCD 2009.

Lane markings should remain solid and not dotted at driveway crossing. The MUTCD does not recognize a driveway as an intersection (MUTCD 2009, AASHTO Bike Guide 2012).

BUFFER ZONE

Bike lanes may be enhanced with a longitudinal marked buffer area for more separation distance. This treatment is appropriate for bike lanes on roadways with high motor vehicle traffic volumes and speed, adjacent to parking lanes, or a high volume of truck or oversized vehicle traffic.[i]

- A minimum width buffer of 1.5 ft (0.5 m) may be bound by two solid lines, without interior markings.

A If the buffer is 4 ft (1.2 m) or wider, mark with diagonal or chevron hatching.

For more information on buffer zone striping and application, refer to NCHRP 766–Recommended Bicycle Lane Widths for Various Roadway Characteristics 2014.

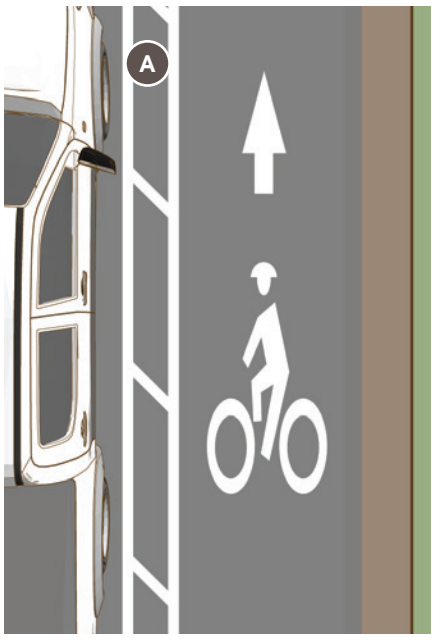


Figure 3-8. *Helmeted bicyclist symbol inside a bike lane with a painted buffer area.*

Bike Lane

SIGNS

An optional bike lane sign may be used to supplement the bike lane pavement markings. Standards and guidance for applying these elements can be found in the FHWA MUTCD.

Figure 3-9. *An optional R3-17 Bike Lane sign may be used to supplement bike lane markings. An R7-9 sign may be used if parked vehicles frequently bock the bike lane.*

INTERSECTIONS

Design strategies for bike lanes at intersections emphasize reducing speeds, minimizing exposure, raising awareness, and communicating right-of-way priority.

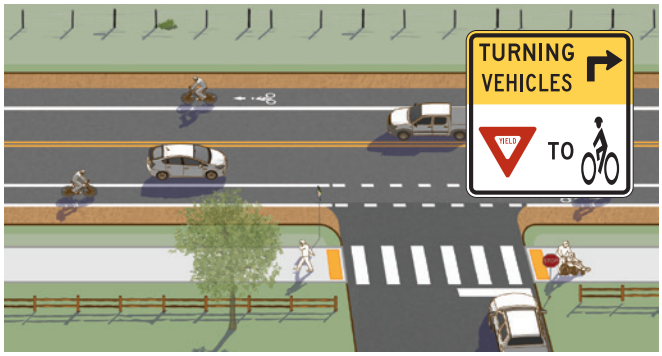
- Under most conditions, bicyclists have priority over turning traffic. Markings and signs should support this priority and remind motorists of the obligation to yield.

B Adjacent to a through-right lane, use a modified R10-15 Turning Vehicles Yield to Bikes sign to clarify user priority.

C Where a right-turn lane is established to the right of a bike lane, R4-4 Begin Right Turn Lane Yield to Bikes sign reminds motorists to yield to bicyclists before entering the lane.

- Where special emphasis is desired, green pavement color may be used within bike lanes and at merging or weaving areas where motor vehicles may cross bike lanes. For more information on the use of color, refer to FHWA Interim Approval 14 2011.

Intersection Crossing Markings



Added Right Turn-Only Lane

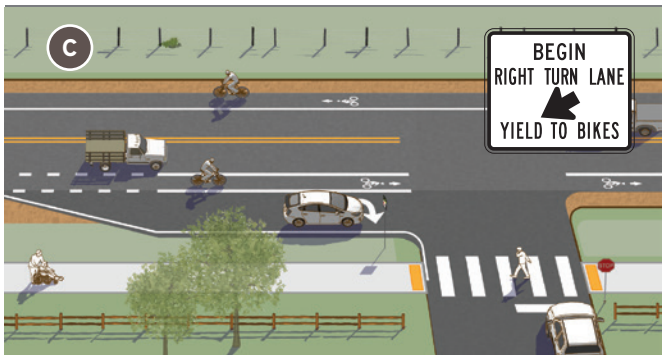


Figure 3-10. *A variety of design treatments exist depending on the roadway configuration, available curb-to-curb width, traffic volumes and desire to provided a dedicated turn lane. All designs should strive to reduce speeds of turning vehicles, remind users of bicycle priority, and clarify user positioning approaching and through the intersection. Common signs at intersections include R4-4 Begin Right Turn Lane Yield to Bikes and a modified R10-15 Turning Vehicles Yield to Bikes sign.*[ii]

IMPLEMENTATION

Include or upgrade shoulders during roadway resurfacing, rehabilitation, and reconstruction and in new construction projects. For more information on implementation strategies, refer to FHWA Resurfacing Guide 2016.

ACCESSIBILITY

Bike lanes are designed for the exclusive use of bicyclists and are not intended for use by pedestrians. For information on appropriate pedestrian facilities, refer to the guidance on Sidewalk orSidepath in this guide.

CASE STUDY | BIKE LANE

Lyndonville, Vermont

PROJECT DESCRIPTION

The Lyndonville planner worked with the Vermont Agency of Transportation (VTrans) during the construction of a large repaving project through Lyndonville to incorporate bike lanes into the project. Bike lanes were incorporated on Main Street, Broad Street, and Center Street. Along Depot Street, shared lane markings are the preferred option given on-street parking. On the Main Street section of the project, the existing roadway had no parking and wide shoulders. This combination allowed VTrans to design painted buffered bike lanes.

The addition of buffered bike lanes to the already under construction paving project was possible through the use of painted buffers. In addition, green paint was added at the bike lane through the intersections to highlight the areas of potential conflict. Because of variable shoulder widths, the painted buffer has a constant width of 2 ft while the bike lane width varies between 5 and 8 ft.

DETAILS

COMMUNITY CONTEXT

Lyndonville, population 1,207, is a village within the town of Lyndon, VT. Located in Vermont's rural Northeast Kingdom, Lyndonville is home to Lyndon State College with approximately 1,400 students. Nearby Burke Mountain offers lift access downhill mountain biking, and Kingdom Trails anchors a growing network of mountain bike trails in the region.

KEY DESIGN ELEMENTS

Painted buffered bike lane with additional pavement markings.

ROLE IN THE NETWORK

The buffered bike lanes on Main Street are part of the network of on-street bike lanes and shared streets that connect the downtown businesses with residential streets and Lyndon State College.

FUNDING

The bike lanes were included as part of the paving project which was funded with 81 percent Federal funds and 19 percent State funds. Being incorporated into a planned and funded paving project meant that the additional costs for the buffered bike lanes were minimal.

For more information, refer to the Vermont Agency of Transportation: http://vtrans.vermont.gov/

Bike Lane

South Lake Tahoe, CA–Population 21,380

FOOTNOTES

i The AASHTO Bike Guide states that "striped buffers may be used to provide increased separation between a bike lane and another adjacent lane that may present conflicts, such as a parking lane with high turnover or a higher speed travel lane" **(2012, p. 4-18)**.

ii The ***FHWA Separated Bike Lane Planning and Design Guide*** recommends the use of a modified R10-15 with a bicycle symbol in place of the pedestrian symbol **(2012, p. 127)**.

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PHOTO CREDIT

Page 3-15. Western Transportation Institute

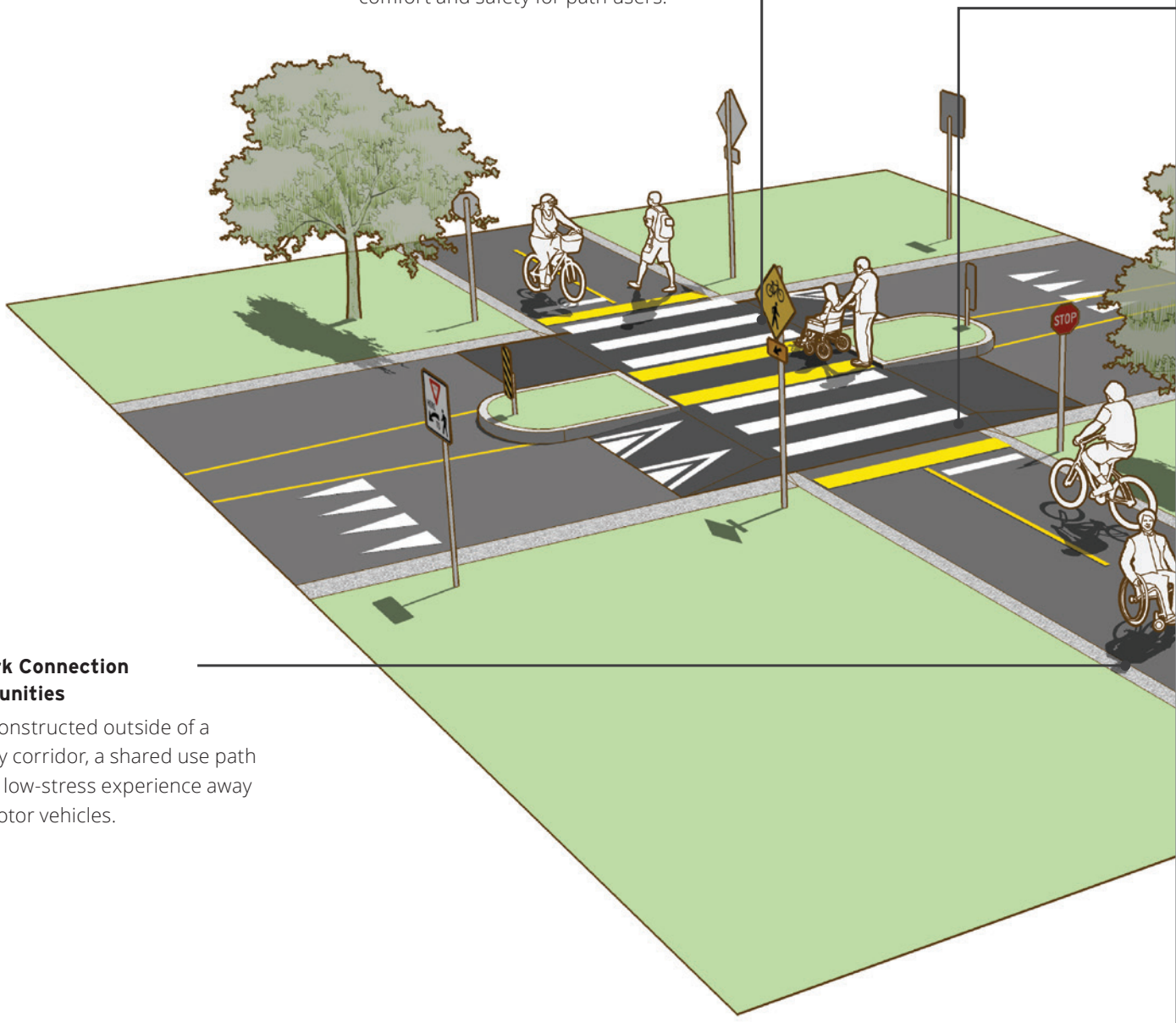
Page 3-16. Tahoe Regional Planning Agency (TRPA)

CHAPTER 4

Physically Separated Facilities

Intersection Crossings

Enhancements such as median crossing islands or raised crossings can increase comfort and safety for path users.



Network Connection Opportunities

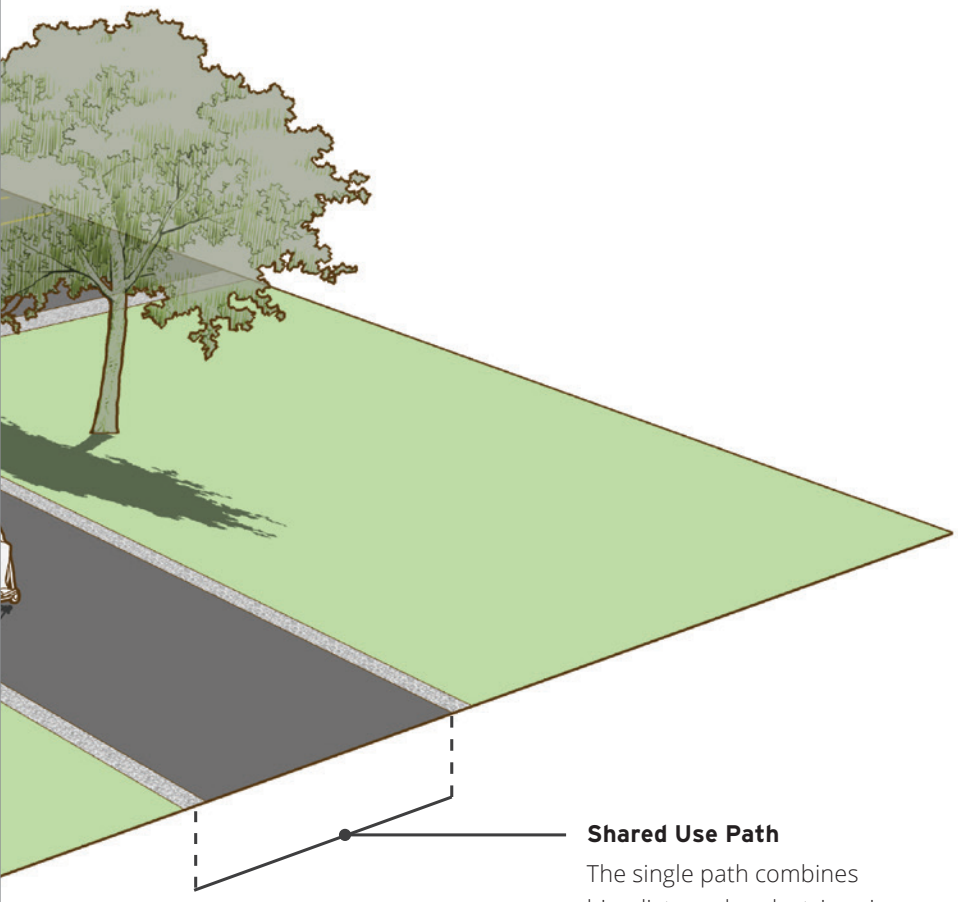
When constructed outside of a roadway corridor, a shared use path offers a low-stress experience away from motor vehicles.

Shared Use Path

A shared use path provides a travel area separate from motorized traffic for bicyclists, pedestrians, skaters, wheelchair users, joggers, and other users. Shared use paths can provide a low-stress experience for a variety of users using the network for transportation or recreation.

Roadway Crossings

Where paths intersect roads, enhancements should improve conditions for path users.



Shared Use Path

The single path combines bicyclists and pedestrians in both directions.

BENEFITS

- Provides a dedicated facility for users of all ages and abilities.
- Provides, in some cases, a short-cut between cities or neighborhoods.
- Provides, in some cases, access to areas that are otherwise served only by limited-access roadways.
- Supports tourism through convenient access to natural areas or as an enjoyable recreational opportunity itself.
- Provides nonmotorized transportation access to natural and recreational areas, which can especially help low-income people obtain access to recreation.
- Paths have a small footprint and can display a distinctly rural character.

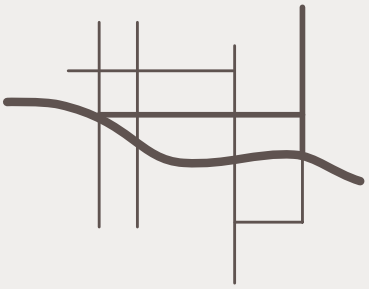
APPLICATION

Speed and Volume

Paths operating in independent corridors are fully separated from traffic. Facility provision is based on opportunity and connectivity rather than roadway context. In some cases, an independent corridor may offer similar connectivity and access to destinations as a nearby roadway.

Network

Serves connections independently of the street network. May function as a network alternative road and highway connections.



Land Use

Generally appropriate outside of built-up areas, and also as a corridor connection within built-up areas.

Shared Use Path

Shared use paths offer network connectivity opportunities beyond that of the roadway network. These facilities are often located in parks, along rivers, beaches, and in greenbelts or utility corridors where there are few conflicts with motorized vehicles. For paths adjacent to roadways, see **Sidepath**.

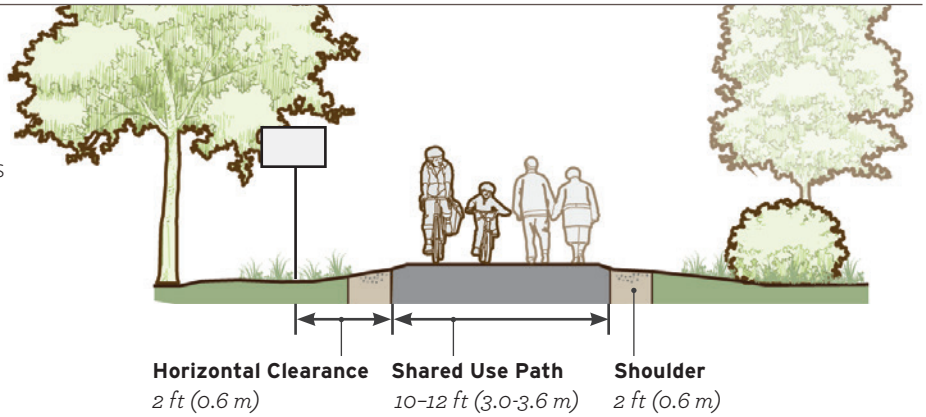


Figure 4-1. *Shared Use Path Dimensions*

Yacolt, WA–Population 1,600

GEOMETRIC DESIGN

WIDTH

The geometric design of shared use paths should support the speed and volume of expected user types.

- 10 ft (3.0 m) width is recommended in most situations and will be adequate for moderate to heavy use.
- A 2 ft (0.6 m) shoulder should be provided on each side of the path, kept clear of vertical elements or obstructions.

Table 4-1. *Pathway Volume and User Mix*[i]

Volume and User Mix	Recommended Minimum Pathway Width
Low volume (less than 50 users in one direction per hour), low mix (75 percent bicyclists, 25 percent pedestrians).	8–10 ft (2.4–3.0 m)
Low volume (less than 50 users in one direction per hour), heavy user mix (50 percent bicyclists, 50 percent pedestrians).	12 ft (3.6 m)
High volume (150 or more users in one direction per hour), low mix (75 percent bicyclists, 25 percent pedestrians).	12–14 ft (3.6–4.2 m)

Shared Use Path

GEOMETRIC DESIGN

- 8 ft (2.4 m) is the minimum allowed for a two-way bicycle path and is only recommended for low traffic situations or for short lengths.
- 12-14 ft (3.6–4.3 m) is recommended for heavy use situations with high concentrations of multiple users.
- Wider paths are useful to accommodate maintenance vehicles; on steep grade to allow for comfortable passing and meeting; and through curves to provide more operating space.

Springdale, AR –Population 75,000

MARKINGS

STRIPING

Under most conditions, center line markings are not necessary, and path users will naturally keep right except to pass.

On shared use paths with heavy peak hour and/or seasonal volumes, the use of a center line stripe may help organize pathway traffic.

- When striping is required, use a 4 inch broken yellow center line stripe with 4 inch solid white edge lines.
- Solid center lines can be provided on tight or blind corners and on the approaches to roadway crossings.
- Mark edge lines on paths expecting evening use.

SIGNS

In a mixed user environment, Yield etiquette signs may be used. An example is shown in Figure 4-2. Many communities have created customized signage to reflect local user groups and conditions.

- Bikes Yield to Peds (R9-6) signs may be used at the entrances of path segments to remind bicyclists of the requirement to yield.

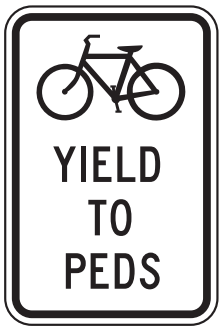


Figure 4-2. *Signs can clarify yielding rules in shared-use environments may be modified based on expected user types.*

Shared Use Path

INTERSECTIONS

Motorists should yield right-of-way to pedestrians within crosswalks. Depending on State or local laws, motorists may also yield to bicyclists within crosswalks.[ii]

Figure 4-3 identifies recommendations related to marked crosswalk installation and enhancement by speed and volume on two-lane streets.

FHWA Safety Effects of Marked Crosswalks at Uncontrolled Locations 2005 recommends crossing enhancements on high-speed and high-volumes roadways where crosswalk markings alone are not a viable safety measure.

For additional information on marked crosswalks, refer to the Enhanced Crossing Treatments section of FHWA Achieving Multimodal Networks 2016 and BIKESAFE 2014.

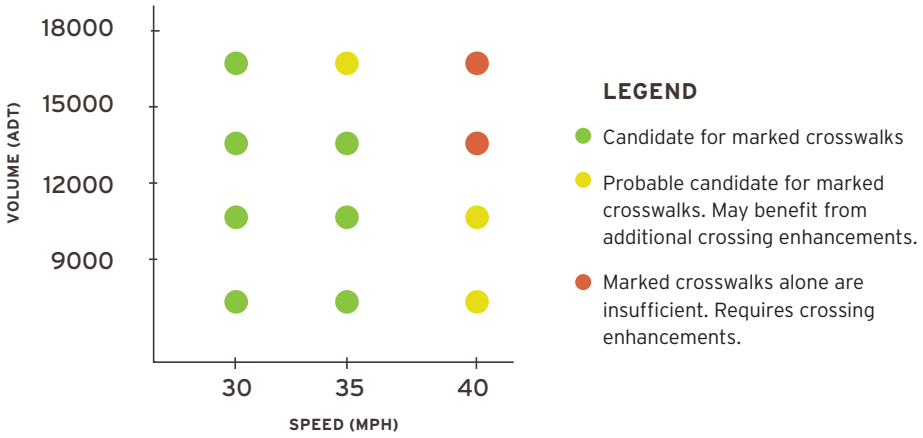


Figure 4-3. *Conditions unsuitable for a marked crosswalk alone are candidates for additional enhancements such as curb extensions, median islands and/or active warning beacons. Chart adapted from* ***FHWA Safety Effects of Marked Crosswalks at Uncontrolled Locations 2005*** *Table 2-11 (data for two-lane roadway at non school crossings).*

Marked Crosswalks

A basic marked shared use path crossing consists of a marked crosswalk, plus signs and other markings to slow or stop traffic.

- Crosswalk markings establish a legal crosswalk at areas away from intersections.
- Crossing sign assemblies and advance crossing sign assemblies using W11-15 and W16-7P signs should be used to warn users of the crossing location.

High-visibility crosswalk markings are the preferred marking type at uncontrolled marked crossings. Transverse lines are "essentially not visible" when viewed from a standard approaching vehicle (ITE 2010).

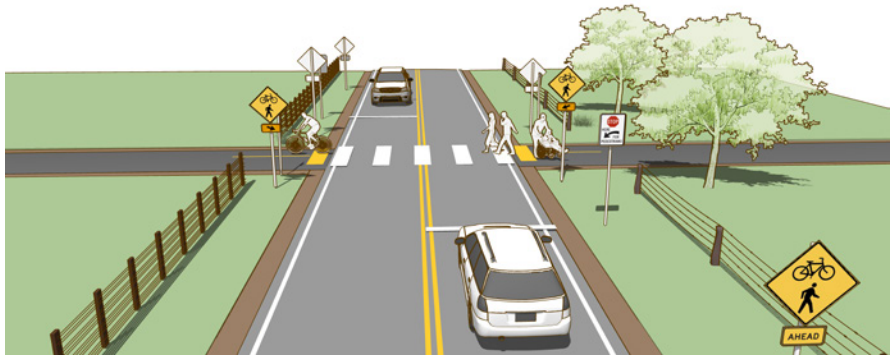


Figure 4-4*. A simple marked crosswalk may be appropriate at crossings with low motor vehicle speeds and volumes.*

Shared Use Path

INTERSECTIONS

MEDIAN ENHANCED CROSSWALKS

Median islands are beneficial on roadways with high volumes and/or high speeds, and on roadways with three or more travel lanes. Median islands particularly benefit people who may travel slower, such as children, older adults, and people with disabilities.

Median islands are an FHWA Proven Safety Countermeasure.

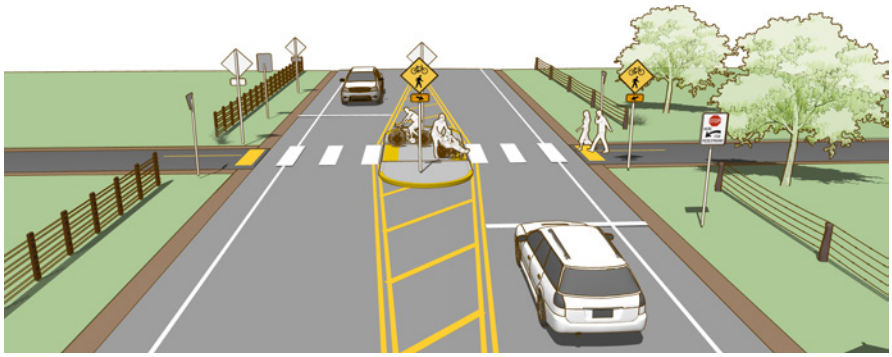


Figure 4-5. *A median safety island should allow path users to cross one lane of traffic at a time. The bicycle waiting area should be at least 8 ft deep to allow for a variety of bicycle types. To promote yielding to bicyclists the median safety island should be designed to require horizontal deflection of the motor vehicle travel lanes.*

ACTIVE ENHANCED CROSSWALKS

Where greater visibility or traffic control is desired, a rectangular rapid flash beacon (RRFB) or pedestrian hybrid beacon (PHB) may be used.

- RRFBs are a yield enhancement device for use at uncontrolled crossings. They may be configured with solar power where it is the most cost-effective option. See FHWA Interim Approval 11 2008 for guidance on the application of RRFBs.
- PHB's provide a red signal indication to drivers, and create yielding rates similar to that of a conventional traffic signal. PHBs are particularly useful on undivided roadways with multiple lanes in any one direction. PHBs are an FHWA Proven Safety Countermeasure. See FHWA Pedestrian Hybrid Beacon Guide 2015 for more information.

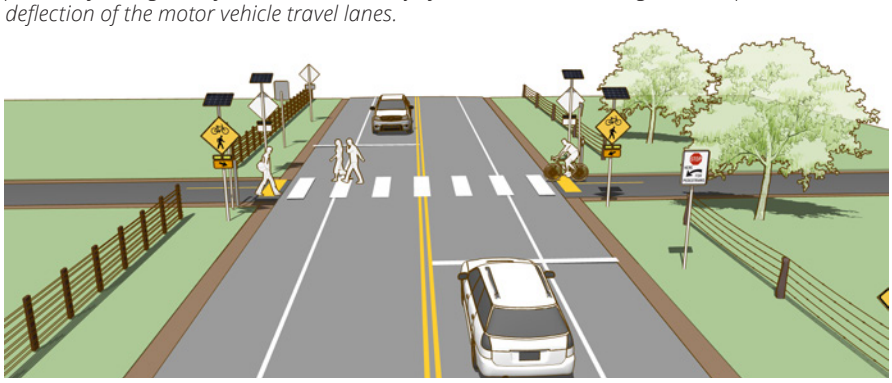


Figure 4-6. *Where yield compliance is low, rectangular rapid flash beacons can be used to draw attention to crossing path users and signal their intent to cross.*

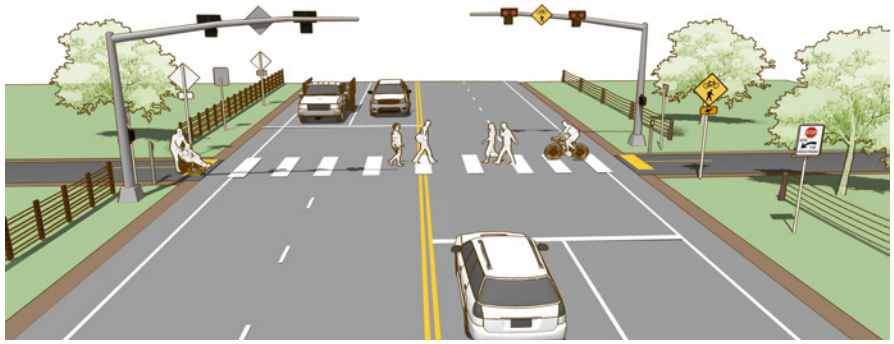


Figure 4-7. *On multilane streets with high volumes and few gaps for crossing, a pedestrian hybrid beacon may be used to increase yielding rates.*

IMPLEMENTATION

Asphalt is the most common surface for shared use paths. The use of concrete for paths has proven to be more durable and significantly reduces maintenance costs over the long term. Saw-cut concrete joints rather than troweled improve the experience for wheeled path users.

ACCESSIBILITY

A shared use path is a separated facility intended for use by pedestrians and must meet accessibility guidelines for walkways and curb transitions. Shared use paths are required to be accessible by all users, including those with mobility devices and vision disabilities.

CASE STUDY | SHARED USE PATH

Pickens and Easley, South Carolina

PROJECT DESCRIPTION

The Pickens "Doodle Line" Railway is a 7.4-mile railroad that previously connected the cities of Pickens and Easley for lumber and other freight travel. As freight and manufacturing in Pickens declined in the late 1990s, the private owner of the railway decided to explore options to sell the ownership rights and promote a rail to trail conversion. The Doodle Trail, a 7.4 mile rails-to-trails partnership between the City of Easley and the City of Pickens opened Memorial Day Weekend 2015.

The shared-use asphalt path provides a vital recreation and transportation corridor for visitors and residents alike, as well as major economic and regional impacts. Residents and governmental leaders saw the economic impacts of the Swamp Rabbit Trail, an over 20-mile rail-trail in neighboring Greenville and wanted to create a similar regional attraction, that also benefited the local community.

The City of Easley and City of Pickens jointly purchased the railway corridor, creating a cooperative partnership between the two cities.

Soon after the trail was completed in Spring 2015, residents of Easley saw the economic development potential of the shared use path and wanted it to extend to their businesses in downtown Easley, approximately 1 mile from the Doodle Trailhead. An extension of the path, from the trailhead to downtown, is currently in the design phase and construction is set to begin in Winter 2016.

DETAILS

COMMUNITY CONTEXT

The City of Easley has a population of 20,300. The City of Pickens, located to the northwest, has a population of 3,150. Both cities are located within Pickens County.

KEY DESIGN ELEMENTS

Fencing, landscaping, and roadway crossings were all designed and constructed to ensure a safe, attractive path between the two communities.

ROLE IN THE NETWORK

The shared use path serves as a transportation and recreation corridor for residents and visitors, and enhances connectivity between the two communities. The City of Pickens developed bike lanes to connect to downtown Pickens. The City of Easley is extending the trail into downtown and has provided bike lanes for alternate connections to Baptist Easley Hospital and cultural amenities.

FUNDING

Both cities used separate General Obligation Hospitality Tax Bonds to fund the acquisition and construction of the trail. The City of Easley is currently using a General Obligation Bond to fund acquisition, design, and construction of the shared use path extension into Downtown. The federally-funded Recreational Trails Program administered through the South Carolina Department of Parks, Recreation, and Tourism funded the extension to Highway 8.

For more information, refer to the City of Easley and the City of Pickens:
http://www.cityofeasley.com/
http://www.cityofpickens.com/

Shared Use Path

FOOTNOTES

i Table calculated based on a target level of service of "B" the FHWA Shared-Use Path Level of Service Calculator 2006.

ii The Uniform Vehicle Code UVC is clear in the priority of pedestrians over motor vehicles in marked or unmarked crosswalks and through driveways.

UVC § 11- 502(a) Pedestrians' right of way in crosswalks: When traffic-control signals are not in place or not in operation, the driver of a vehicle shall yield the right of way, slowing down or stopping if need be to yield to a pedestrian crossing the roadway within a crosswalk.

UVC § 11-509 Pedestrians' right of way on sidewalks: The driver of a vehicle crossing a sidewalk shall yield the right of way to any pedestrian and all other traffic on the sidewalk.

Additionally, bicycles on sidewalks receive the same rights as pedestrians, such as priority over other traffic, and must fulfill the same duties, and shall not "enter the intersection in disregard of approaching traffic" (Sec. 46.2-924)

UVC § 11-1209(c), Bicycles and human powered vehicles on sidewalks: A person propelling a vehicle by human power upon and along a sidewalk, or across a roadway upon and along a crosswalk, shall have all the rights and duties applicable to a pedestrian under the same circumstances.

PHOTO CREDIT

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Page 4-6. Alta Planning + Design

Page 4-9. Alta Planning + Design

Page 4-10. Alta Planning + Design

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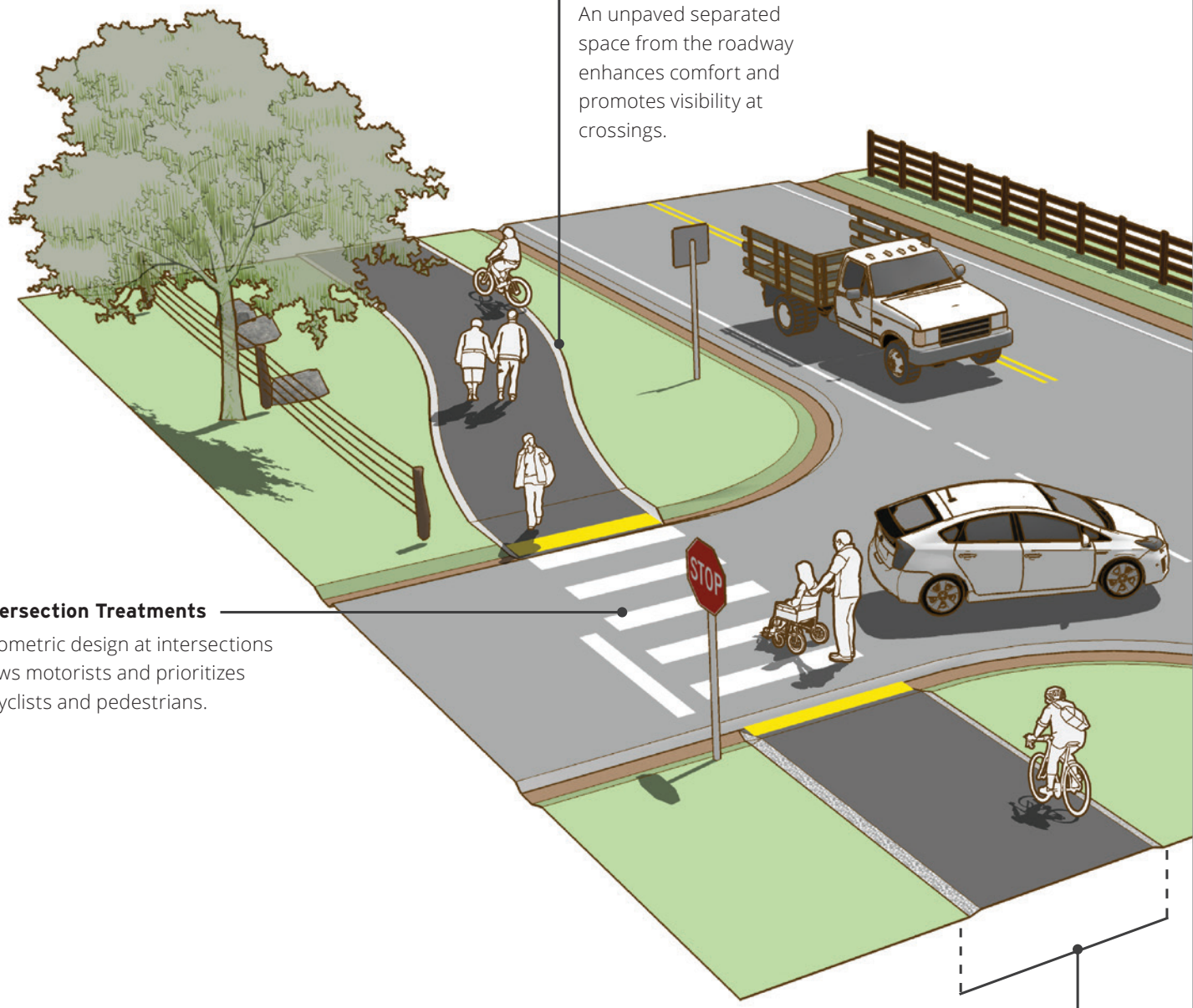
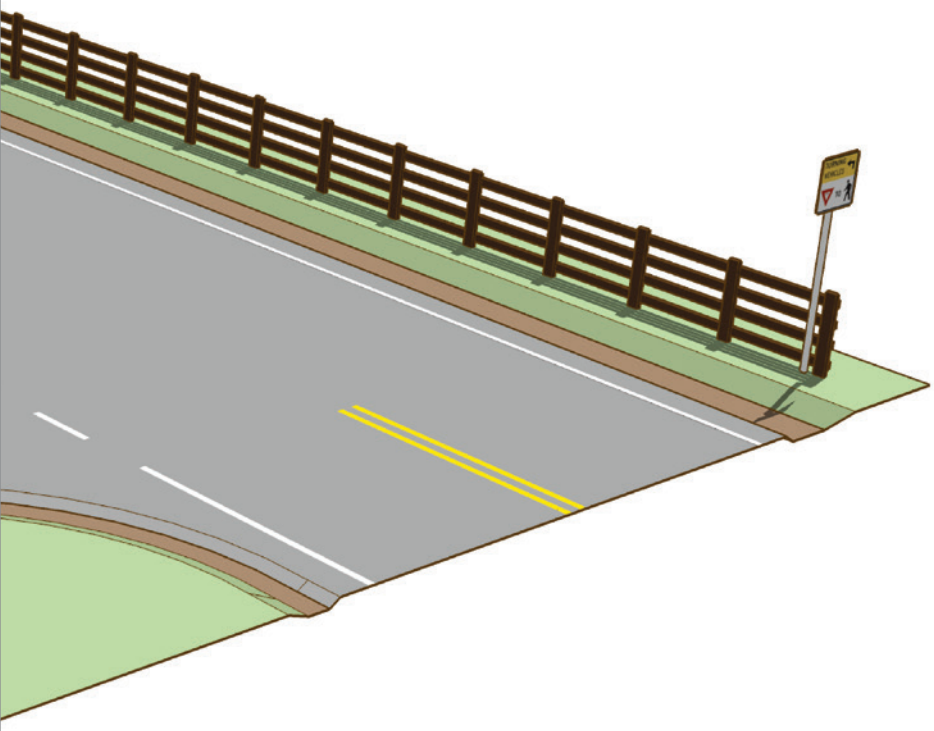


Sidepath

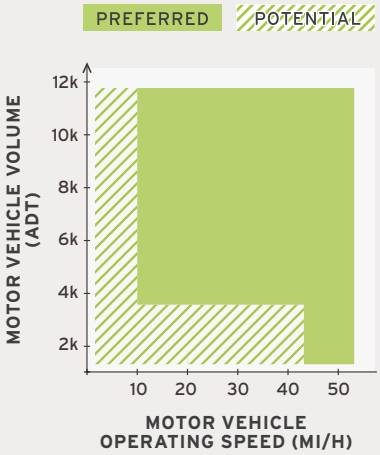
A sidepath is a bidirectional shared use path located immediately adjacent and parallel to a roadway. Sidepaths can offer a high-quality experience for users of all ages and abilities as compared to on-roadway facilities in heavy traffic environments, allow for reduced roadway crossing distances, and maintain rural and small town community character.



APPLICATION

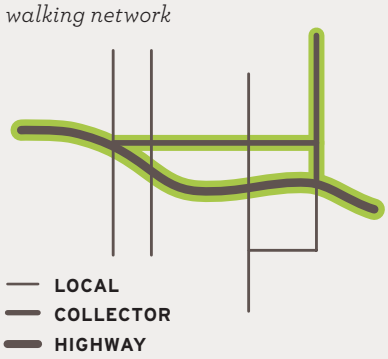
Speed and Volume

For use on roads with high volumes, and moderate-to high-speed motor vehicle traffic.



Network

For use on arterial links on the regional or local biking and walking network



Land Use

For use inside of built-up areas to provide a dedicated space for pedestrians.

BENEFITS

- Completes networks where high-speed roads provide the only corridors available.
- Fills gaps in networks of low-stress local routes such as shared use paths and bicycle boulevards.
- Provides a more appropriate facility for users of all ages and abilities than shoulders or mixed traffic facilities on roads with moderate or high traffic intensity.[i]
- Encourages bicycling and walking in areas where high-volume and high-speed motor vehicle traffic would otherwise discourage it.[ii]
- Maintains rural character through reduced paved roadway width compared to a visually separated facility.[iii]
- Very supportive of rural character when combined with vegetation to visually and physically separate the sidepath from the roadway.

CONSIDERATIONS

- Requires a wide roadside environment to provide for separation and pathway area outside of the adjacent roadway.

Sidepath

Sidepaths offer a low-stress experience for bicyclists and pedestrians on network routes otherwise inhospitable to walking and bicycling due to high-speed or high-volume traffic.

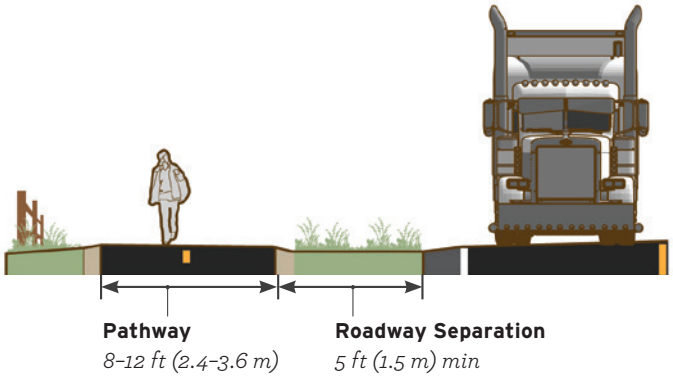


Figure 4-8. *Recommended dimensions for sidepath width and unpaved separation distance.*

GEOMETRIC DESIGN

Widths and design details of sidepath elements may vary in response to the desire for increased user comfort and functionality, the available right-of-way, and the need to preserve natural resources.

PATHWAY

Sidepath width impacts user comfort and path capacity. As user volumes or the mix of modes increases, additional path width is necessary to maintain comfort and functionality.

- Minimum recommended pathway width is 10 ft (3.0 m). In low-volume situations and constrained conditions, the absolute minimum sidepath width is 8 ft (2.4 m)
- Provide a minimum of 2 ft (0.6 m) clearance to signposts or vertical elements.

ROADWAY SEPARATION

Separation from the roadway should be informed by the speed and configuration of the adjacent roadway and by available right-of-way as illustrated in Figure 4-9.

- Preferred minimum separation width is 6.5 ft (2.0 m). Minimum separation distance is 5 ft (1.5 m).
- Separation narrower than 5 ft is not recommended, although may be accommodated with the use of a physical barrier between the sidepath and the roadway. The barrier and end treatments should be crashworthy which may introduce additional complexity if there are frequent driveways and intersections. Refer to the AASHTO Roadside Design Guide 2011 for additional information.

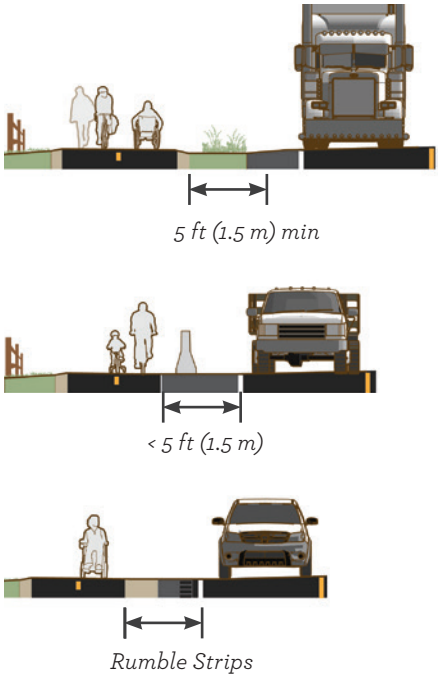


Figure 4-9. *Where a minimum of 5 ft (1.5 m) unpaved separation cannot be provided (top), A physical barrier may be used between the sidepath and the roadway (center). In extremely constrained conditions for short distances, on-roadway rumble strips may be used as a form of separation (bottom).*

- On high-speed roadways, a separation width of 16.5–20 ft (5–6 m) is recommended for proper positioning at crossings and intersections.

Sidepath

GEOMETRIC DESIGN

LANDSCAPING

Trees and landscaping can maintain community character and add value to the experience of using a sidepath. They provide shade for users during hot weather and help to absorb stormwater runoff.

- Provide a 3 ft (0.9 m) horizontal clearance between trees and the pathway to minimize pavement cracking and heaving of the paved surface. Consult a local arborist in the selection and placement of trees.
- When trees are desired within the roadway separation area, consider planting small caliper trees with a maximum diameter of 4 inches (100 mm) to alleviate concerns about fixed objects or visual obstructions between the roadway and the pathway.[iv]

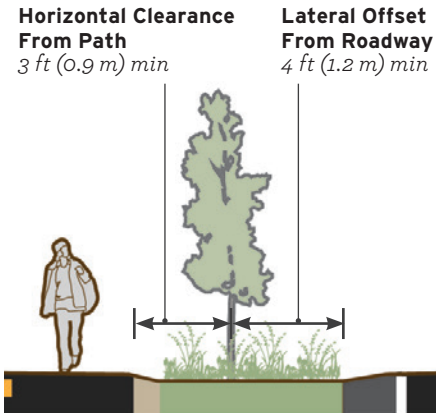


Figure 4-10. *Even small trees can provide an additional feeling of separation between the sidepath and the roadway.*

South Lake Tahoe, CA–Population 21,380

MARKINGS

Sidepaths may include edgelines or centerlines or be unmarked.

- Edge lines should be marked on paths expecting evening use.
- Paths with a high volume of bidirectional traffic should include a centerline. This can help communicate that users should expect traffic in both directions and encourage users to travel on the right and pass on the left (Flink and Searns 1993).

SIGNS

- Shared use paths are bidirectional facilities and signs should be posted for path users traveling in both directions.
- It is important for signs that only apply to the path to not be interpreted as a guidance for roadway travel lanes.

Sidepath

INTERSECTIONS

Operational and safety concerns exist where sidepaths cross driveways and intersections. Refer to section 5.2.2 of the AASHTO Bike Guide 2012 for an identification of potential design issues. Design crossings to promote awareness of conflict points, and facilitate proper yielding of motorists to bicyclists and pedestrians.

DESIGN STRATEGIES

Collision risk increases as the speed and volume of the parallel roadway increase. The AASHTO Bike Guide 2012 lists a variety of design strategies for enhancing sidepath crossings including:

- Reduce the frequency of driveways.
- Design intersections to reduce driver speeds and heighten awareness of path users.
- Encourage low speeds on pathway approaches.
- Maintain visibility for all users.
- Provide clear assignment of right-of-way with signs and markings and elevation change.

DESIGN DETAILS

A Maintain physical separation of the sidepath through the crossing. Sidepath separation distance may vary from 5 ft–24 ft (1.5–7.0 m). Refer to Table 4-2.

- Use small roadway corner radii to enforce slow turning speeds of 20 mi/h or less. On a high-speed roadway, a deceleration lane may be necessary to achieve desired slow turning speeds.

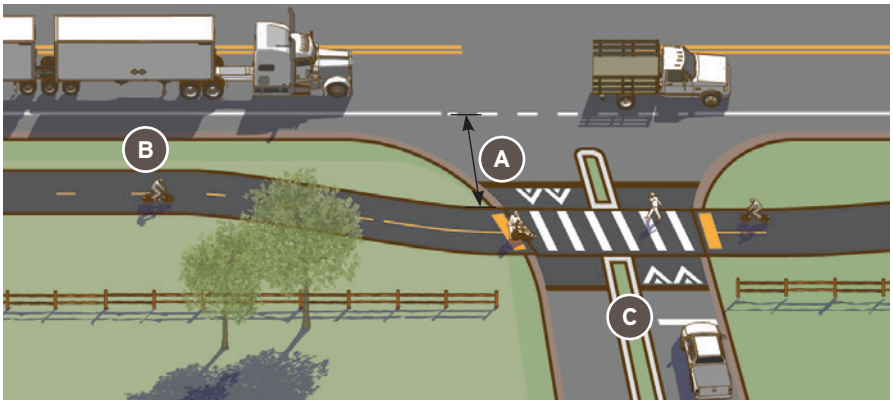


Figure 4-11. *Separation distance should be selected in response to speed and traffic intensity. The pathway may need a shift in horizontal alignment in advance of the crossing to achieve desired separation distance. As speeds on the parallel roadway increase, so does the preference for wider separation distance.*

Table 4-2. *Sidepath Separation Distance at Road Crossings*[vii]

Adjacent Road Speed Limit (Mi/h)	Recommended Sidepath Separation Distance at Crossings
< 25 mi/h	6.5 ft (2.0 m)
35–45 mi/h	6.5–16.5 ft (2.0–5.0 m)
≥ 55 mi/h	16.5–24 ft (5.0–7.0 m)

**Separation distance may vary in response to available right of way, visibility constraints and the provision of a right turn deceleration lane.*

B The roadway and path approaches to an intersection should always provide enough stopping sight distance to obey the established traffic control, and execute a stop before entering the intersection (AASHTO Bike Guide 2012).

- Configure crossings with raised speed table or "dustpan" style driveway geometry to create vertical deflection of turning vehicles. This physically indicates priority of path travel over turning or crossing traffic and helps reduce the risk associated with bidirectional sidepath use.[v]

C Where possible, include raised median island on the cross street to provide additional safety and speed management benefits.

- Use crosswalk markings to indicate the through crossing along the pathway. Continental crosswalk markings are preferred for increased visibility. At low-volume residential driveways, crosswalk markings may be omitted.[vi]
- Use stop or yield line markings in advance of the crossing to discourage encroachment into the crosswalk area.

Sidepath

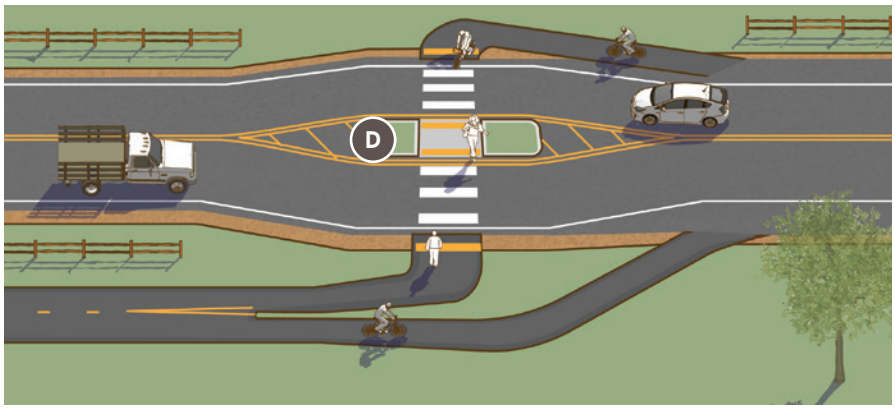


Figure 4-12. *Transition from a sidepath on one side to shoulders on each side of the road.*

Minor Street Crossings

Give sidepaths the same priority as the parallel roadway at all crossings. Attempts to require path users to yield or stop at each cross-street or driveway promote noncompliance and confusion, and are not effective. Geometric design in these cases should promote a high degree of yielding to path users through geometric design.

- Landscaping, barriers, or other visual obstructions should be low to provide unobstructed sight of the crossing from the major street. Both motorists and path users should have a clear and unobstructed view of each other at intersections and driveways.
- Consider using a R10-15 RIGHT TURN YIELD TO PEDESTRIANS at street crossings with right turn interactions.

Connections with On-Street Bikeways

Where a sidepath terminates, it may be necessary for path users to transition to a facility on the opposite side of the road.

D Designs should consider the desire for natural directional flows, and the potential for conflicts with adjacent traffic. Use median islands and horizontal deflection of the roadway travel lanes to slow motor vehicle traffic and offer improved crossing conditions for path users.

ACCESSIBILITY

A sidepath is intended for use by pedestrians and must meet accessibility guidelines for walkways and curb transitions. Sidepaths are required to be accessible by all users, including those with mobility devices and visually-impaired pedestrians.

IMPLEMENTATION

Where sufficient roadway width or right of way is available, designers should consider the simultaneous provision of both sidepaths and bicycle accessible shoulders to serve a diverse range of user types.

CASE STUDY | SIDEPATH

Ennis, Montana

PROJECT DESCRIPTION

The Ennis schools are located in the heart of town, though there were few pedestrian and bicycle facilities connecting to them. In 2010, local nonprofit Madison Byways organized a program to identify safer routes to school.

The project resulted in a network of walking and biking facilities including a sidepath, sidewalks, and bicycle boulevards on residential streets. This network of facilities is called the Mustang Trail, named for the Ennis school mascot.

The central location of the schools means the bike and pedestrian network benefits the entire community, connecting neighborhoods to schools, businesses, and other services.

Critical factors for success included strong leadership by Madison Byways and a collaboration effort that engaged schools, residents, businesses, and public agency representatives. Numerous activities were held to increase awareness of the Mustang Trail, including monthly Farmer's Markets, the 4th of July parade, and annual 5K run/walk.

DETAILS

COMMUNITY CONTEXT

Rural destination community, especially in the summer, with a population of 880 in the town limits and 3,291 within the school district.

KEY DESIGN ELEMENTS

Sidepaths and sidewalks were constructed where previously there were no pedestrian facilities. The sidepath transitions from a concrete path in central Ennis to an asphalt path further west, toward a subdivision.

ROLE IN THE NETWORK

The facilities connect neighborhoods to school and businesses throughout the community. In this small town, residential streets that connect neighborhoods to schools can be shared by people walking, biking, and driving.

FUNDING

Funded by grants from three Federal funding programs: Safe Routes to School (SRTS), Recreational Trails Program (RTP), and allocated through Madison County from the Community Transportation Enhancement Program (CTEP). Local fundraising provided matching funds for the grants.

For more information, refer to the City of Ennis:
http://www.ennismontana.org/

Sidepath

FOOTNOTES

i The AASHTO Bike Guide states that "children often prefer and/or are encouraged to ride on sidepaths because they provide an element of separation from motor vehicles" (2012, p.1-4). Some researchers have found that young riders on sidepaths or sidewalks have a lower crash rate than that of older riders. The researchers speculate that this may be related to lower speeds, group travel or heightened awareness by motor vehicle operators. Wachtel, Alan., Lewiston, Diana, 1994).

ii The AASHTO Bike Guide notes that roadways with high-volume and high-speed motor vehicle traffic "might discourage many bicyclists from riding on the roadway..." (2012, p. 5-10). This idea is supported by the "Four Types of Types of Transportation Cyclists" concept, which estimates 60 percent of the population is interested in riding but concerned about the safety risk of high-speed and high-volume roadways (FHWA Separated Bike Lane Guide, 2015).

iii A visual preference survey in rural Maine found that narrow roads were positively contributing to perceptions of rural character and that it was "somewhat" important to conserve this landscape characteristic. (Walker, A., Ryan, R. 2008.)

iv The AASHTO Green Book does not classify trees that will grow to below 4 inches (100 mm) diameter as a fixed object, and trees of this width may be placed within the clear zone (2011, p. 7-6). Trees should be placed outside of the lateral offset of roadways.

On roadways with a curb and gutter, a minimum lateral offset of 18 inches (0.5 m) should be provided. On facilities without a curb and with a shoulder width less than 1.2 m [4 ft], a minimum lateral offset of 1.2 m [4 ft] from the edge of the traveled way should be provided. (AASHTO Green Book). Trees should be placed carefully as to not cause visual obstructions for turning motorists.

v Researchers have found that raised crossings of sidepaths reduces bicyclist crash risk by 51 percent (Schepers 2011).

vi An FHWA study of crosswalk marking styles find that high-visibility crosswalk markings are the preferred marking type at uncontrolled marked crossings (FHWA, 2013). Other research indicates that simple transverse lines markings are "essentially not visible" when viewed from a standard approaching vehicle (ITE, 2010).

vii This table is based off of statements from the AASHTO Bike Guide and research from the State of Florida, which indicate that separation distance should increase as speeds increase. Values are based on safety research related to roadway separation distances and, design standards from the Dutch CROW Design Manual for Bicycle Traffic 2006.

The AASHTO Bike Guide states that "... in locations where the sidepath parallels a high-speed roadway and crosses a minor road, it is advisable to move the crossing away from the intersection to a mid-block location. By moving the crossing away from the intersection, motorists are able to exit the high-speed roadway first, and then turn their attention to the pathway crossing." (2012, p.5-11). The phrase "mid-block location" may imply a separation distance of at least one car length, 19.5 ft (6.0 m), from the parallel roadway.

Research conducted for the Florida Department of Transportation indicates that, to maximize safety, separation of the sidepath from a roadway should increase as road speeds increase. The Florida data suggest that at lower adjacent road speeds, a smaller separation produces crash rates lower than those of the adjacent road, while that threshold is reached at greater separations for high-speed facilities (Florida Department of Transportation (FDOT). Sidepath Facility Selection and Design. 2005).

Safety research conducted on crash history at separated bike lanes (which function similarly to sidepaths) identify 6.5–16.5 ft (2.0–5.0 m) as the optimal roadway separation distance for safe interactions (Schepers 2011).

The Dutch design manual for bicycle facilities prefers a wide separation of 19.5–23 ft (6.0–7.0 m) for use outside of built-up areas and on roads operating above 35 mi/h (60 km/h) (CROW 2006, p. 231-232).

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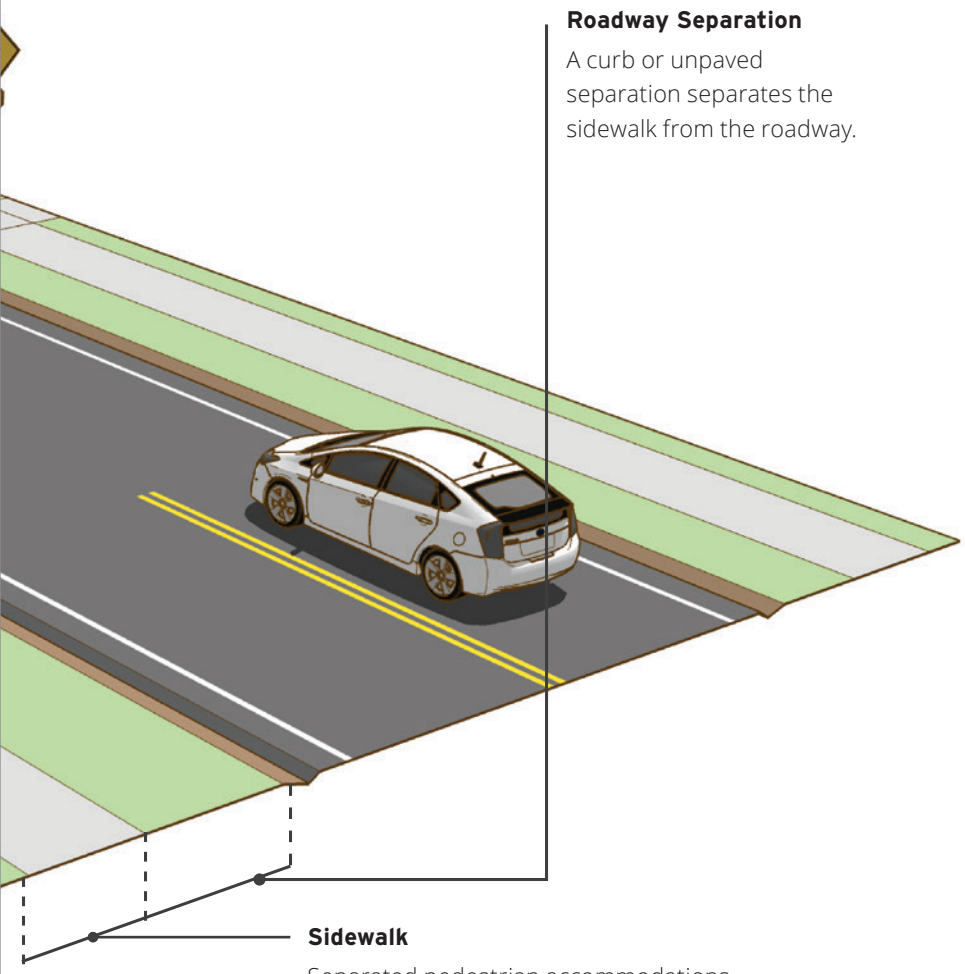
PHOTO CREDIT

Page 4-14. Tahoe Regional Planning Agency

Page 4-17. Western Transportation Institute

Sidewalk

Sidewalks provide dedicated space intended for use by pedestrians that is safe, comfortable, and accessible to all. Sidewalks are physically separated from the roadway by a curb or unpaved buffer space.



Roadway Separation

A curb or unpaved separation separates the sidewalk from the roadway.

Sidewalk

Separated pedestrian accommodations may be necessary as roadway speeds and volumes increase.

BENEFITS

- Provides a dedicated place within the public right-of-way for pedestrians to safely travel and reduces pedestrian collisions in rural areas.
- Reduces "walking along roadway" crashes.
- May notably increase levels of walking in areas with high traffic speeds and/or volumes.[i]

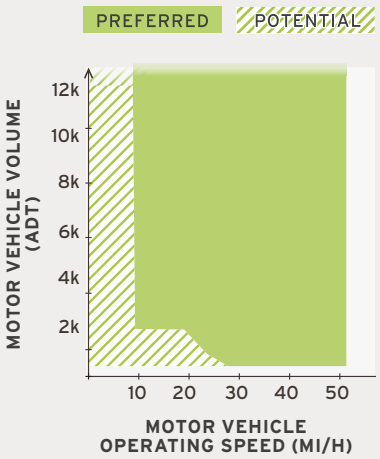
CONSIDERATIONS

- Sidewalks may not support a rural visual character when configured with curb and gutter and no landscaped separation.
- Requires a moderate-width roadside environment to provide for separation and sidewalk area outside of the adjacent roadway.

APPLICATION

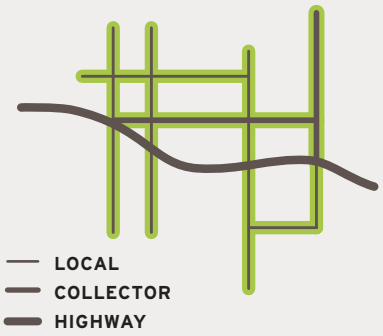
Speed and Volume

Sidewalks are recommended on all but the most low-speed and low-volume roadways.



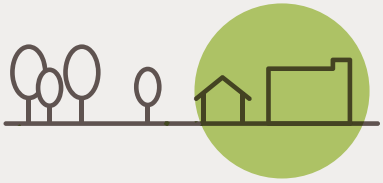
Network

Sidewalks are appropriate on all types of roadways where pedestrian activity is likely.



Land Use

Appropriate inside of built-up areas. May serve short distance travel between built-up areas, e.g., along or near highways in rural areas near pedestrian-generating development, such as neighborhoods, schools, and businesses.



Sidewalk

Sidewalks are desirable to support pedestrian safety and comfort in areas with a mix of land uses and also in areas of the community where the roadway network connections have generally high traffic volumes or speeds.

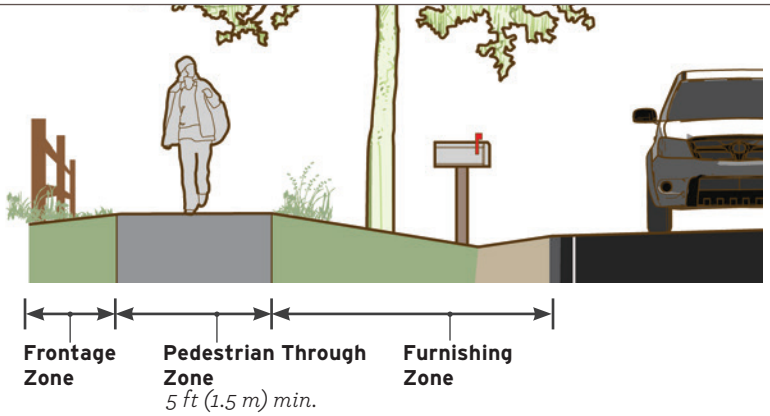


Figure 4-14. *Sidewalks should be physically separated from the roadway by an unpaved buffer separation, barrier or curb edge.*

GEOMETRIC DESIGN

Sidewalks serve multiple important functions and should be designed with three distinct zones to accommodate these uses. Table 4-3 provides recommended and constrained minimum dimensions for a sidewalk elements.

Table 4-3. *Minimum recommended dimensions for sidewalks*

Volume And User Mix	Frontage Zone	Pedestrian Through Zone	Furnishing Zone	Total Width
Constrained Minimum	1 ft (0.3 m)	5 ft (1.2 m)	2 ft (0.6 m)	8 ft (2.4 m)
Recommended Minimum	2 ft (0.6 m)	6 ft (1.5 m)	4 ft (1.2 m)	12 ft (3.6 m)

FRONTAGE ZONE

The frontage zone is a shy zone adjacent to the property line and provides space for people to enter and exit buildings.

- Next to buildings with active ground floor uses, the frontage zone may be widened to 4–6 ft to provide room for door swing, café seating, product display, and window shopping.
- On most sidewalks, a frontage zone of 1–2 ft (0.3–0.6 m) allows for shy distance to fences and building walls. No frontage zone is necessary adjacent to parks or open space.

PEDESTRIAN THROUGH ZONE

The pedestrian through zone is the clear width needed for pedestrian travel activity and should be wide enough for two people to walk side-by-side.

- The pedestrian through zone should be at least 5 ft (1.5 m) wide. This permits side-by-side walking and meets accessibility guidelines for turning and maneuvering.[ii]

FURNISHING ZONE

The furnishing zone is closest to the street and provides space for mailboxes, signs, street lighting, and other utilities. This area serves as snow storage areas in winter climates and protects pedestrians from splash during rain events.

- A furnishing zone of 4–6 ft (1.2–1.8 m) is preferred for comfort and aesthetics. This width allows for trees, benches, and other large furnishing items.[iii]

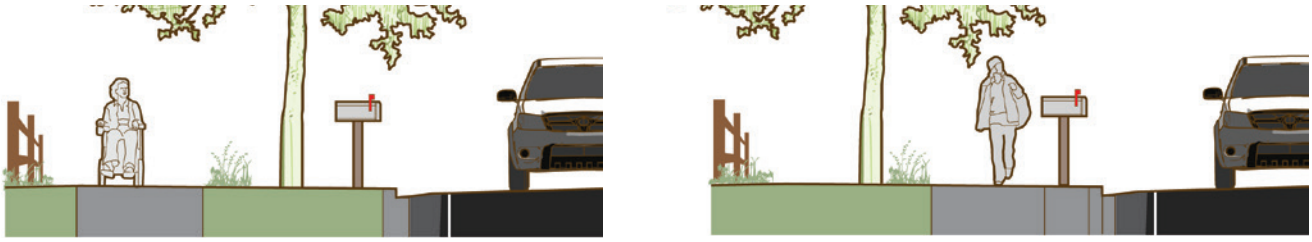


Figure 4-15. *Sidewalks on roads with curbs may feature an unpaved or paved furnishing zone separation (left), or may be constructed with curb & gutter, immediately adjacent to the roadway (right). Offering separation from the roadway is preferred in most areas for user comfort and design flexibility at intersections.*

Sidewalk

INTERSECTIONS

Legal crosswalks often exist at all intersections, whether marked or not. A crosswalk at an intersection is defined as the extension of the sidewalk across the intersection.

UNMARKED CROSSWALKS

Lane markings, stop lines, yield lines, or other traffic control markings should be placed outside of the unmarked crosswalk area. The only way a crosswalk can exist at a midblock location is if it is marked.

MARKED CROSSWALKS

Marked crosswalks are at intersections or midblock crossings based on engineering judgement. They are not to be used indiscriminately. For more information on evaluating locations for crosswalk markings, refer to FHWA Safety Effects of Marked Crosswalks at Uncontrolled Locations 2005.

- The minimum width for a marked crosswalk is 6 ft (1.8 m).
- For improved visibility, the preferred crosswalk marking pattern at uncontrolled and midblock locations is the high-visibility "continental" crosswalk marking. If placed to avoid the wheel track, these markings may last significantly longer than transverse line crosswalks.
- Use of transverse line crosswalk markings should be limited to signalized intersections, or crossings of side streets controlled by stop signs.[iv]
- Minor crossings of local streets may be unmarked.

MARKINGS

No roadway markings are required on sidewalk installation. At intersections, stop lines, yield lines, and crosswalks may be used to clarify pedestrian crosswalk area.

SIGNS

No signs are required on sidewalk installation. Signs may be used to enhance the awareness of crosswalk locations, to remind drivers of the obligation to yield to crossing pedestrians, such as the R10-15 sign shown in Figure 4-16.

Figure 4-16. *R10-15 sign for use at potential right turn conflict locations.*

IMPLEMENTATION

STORMWATER MANAGEMENT

A furnishing zone is often configured as an open ditch for stormwater catchment and infiltration. Ditches can be retrofitted into bioswales or raingardens for filtration and water purification.

CONSTRUCTION MATERIALS

While sidewalks are commonly constructed with concrete, less expensive walkways constructed of asphalt, crushed stone, or other stabilized surfaces may be appropriate. Ensure accessibility and properly maintain all surfaces regularly.

ACCESSIBILITY

A sidewalk is a separated facility intended for use by pedestrians and must meet accessibility guidelines for walkways and curb transitions. Sidewalks are required to be accessible by all users.


Denmark, SC–Population 3,400

CASE STUDY | SIDEWALK

Miles City, Montana

PROJECT DESCRIPTION

The Miles City Active Living Taskforce is an involved group working to encourage residents of Miles City to be more physically active. It was the catalyst for starting a Safe Routes to School (SRTS) program in Miles City. With support from the Montana Department of Transportation's SRTS program, a bicycle and pedestrian safety program was started at Garfield Elementary school. The program is taught by the health enhancement staff and the school resource officer.

The Garfield School sidewalk project was identified through SRTS effort in Miles City and included the installation of approximately 1/2 mile of sidewalk. The northeast portion of Miles City is an area of mostly low income residential development. While most streets in this part of town lack accommodation for bicycles and pedestrians, many children in the area walk or bike to Garfield Elementary. Garfield is the largest of four elementary schools in Miles City with 67 percent of students eligible for free or reduced lunch.

The sidewalks were installed along Lincoln Street, North Lake Avenue, and Riverside Street. This route functions as a collector for a number of neighborhood streets and is the connection to the school. In addition to providing a walking route to the school, the sidewalk project provides access from these neighborhoods to the park along the south side of Lincoln Street.

DETAILS

COMMUNITY CONTEXT

Miles City is located at the confluence of the Tongue and Yellowstone rivers in southeastern Montana. It is the county seat for Custer County with a population of 8,400. Miles City is a medical and financial hub in eastern Montana with a strong agricultural economy.

KEY DESIGN ELEMENTS

Concrete sidewalk was installed behind a gravel shoulder that also serves as parking for the homes and park along Lincoln Street.

ROLE IN THE NETWORK

The sidewalk installed under this project connects the low-speed, low-volume neighborhood streets to a network of existing sidewalks in the area around Garfield School. It provides a critical network link between home, school, and the park.

FUNDING

The project was funded with Federal SRTS funds, as well as Community Transportation Enhancement Program (CTEP) funds and local matching funds from Miles City. While constructed at the same time, funding for the project was applied for in phases and received funding in two different SRTS funding cycles.

For more information, refer to the City of Miles City:
http://milescity-mt.org/

Sidewalk

Altamont, NY–Population 1,609

FOOTNOTES

i The AASHTO Pedestrian Guide states, "even in areas where there may not be an initial demand for pedestrian facilities, walking can almost always be expected to increase when adequate facilities are provided" (2004, p. 54).

"Wherever there is developed frontage along a road or street, there will be people walking for exercise, visiting neighbors, accessing bus stops, or walking for pure enjoyment. Sidewalks or pathways are needed to safely accommodate these activities" (2004, p. 25).

ii Absolute minimum width of an accessible aisle is 4 ft (1.2 m) (PROWAG 2011). This lacks space for comfortable movement and maneuvering, and these conditions should only exist around point obstructions, driveways, and curb ramps.

iii Plant only small caliper trees (4 inch diameter when mature) in 4-foot tree wells.

iv An ITE study of pavement marking patterns at uncontrolled pedestrians crossings found that Transverse lines are "essentially not visible" when viewed from a standard approaching vehicle (ITE Pavement Marking Patterns 2010).

Because of the increased performance of high-visibility markings over transverse lines markings, The 2010 FHWA. Crosswalk Marking Field Visibility Study recommends making continental markings the default for all crosswalks at uncontrolled locations, with exceptions allowing transverse lines where engineering judgment determines that such markings would be adequate, such as a location with low-speed residential streets.

WORKS CITED

American Association of State Highway and Transportation Officials. *Guide for the Planning, Design, and Operation of Pedestrian Facilities*. 2004.

Federal Highway Administration. *Crosswalk Marking Field Visibility Study.* 2010.

Federal Highway Administration. *Safety Effects of Marked Versus Unmarked Crosswalks at Uncontrolled Locations*. 2005.

Institute of Transportation Engineers (ITE) *Technical Committee 109-01. Pavement Marking Patterns Used at Uncontrolled Pedestrian Crossings.* 2010.

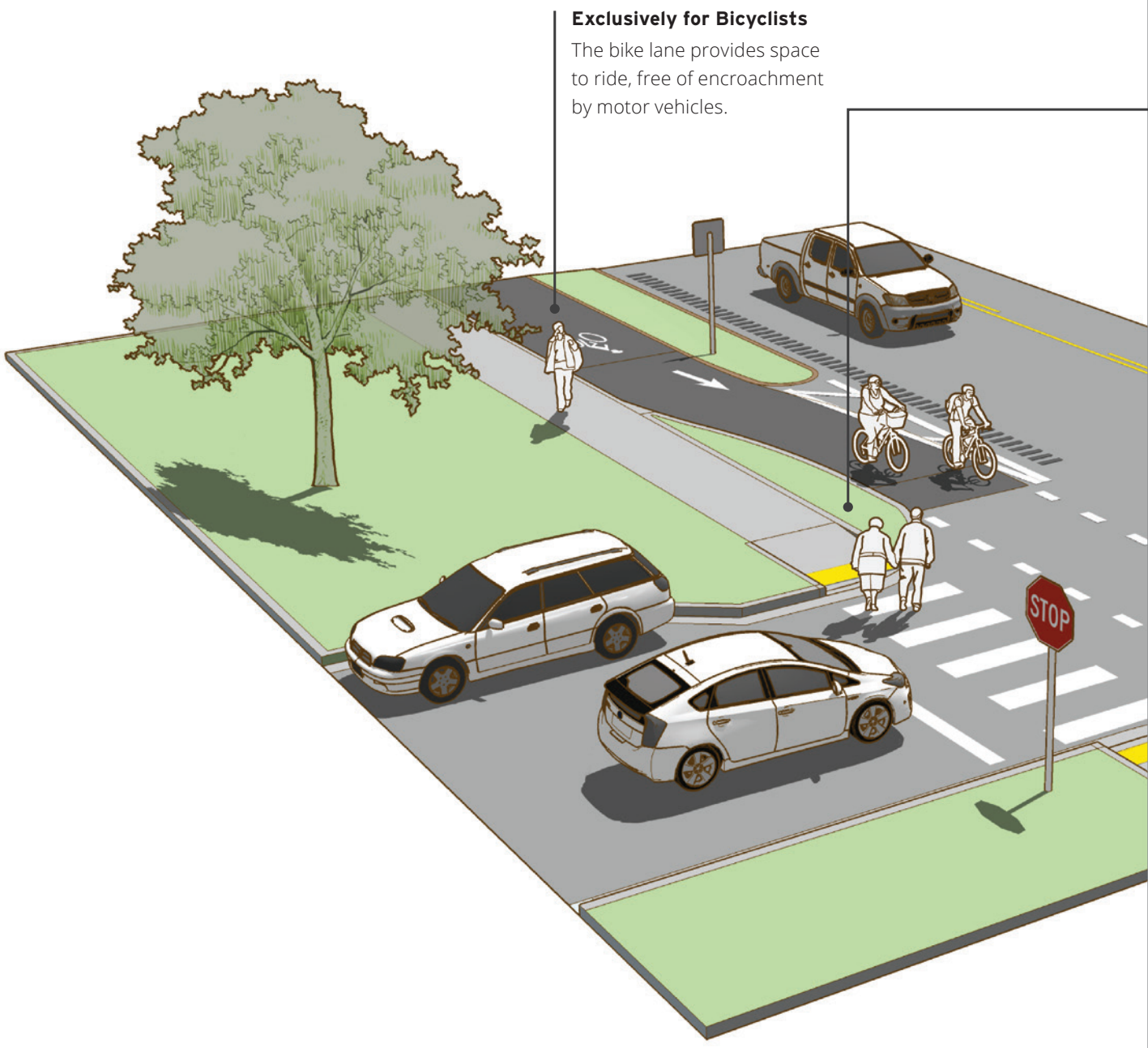
United States Access Board. *Proposed Guidelines for Pedestrian Facilities in the Public Right-of-Way (PROWAG).* 2011.

PHOTO CREDIT

Page 4-22. Alta Planning + Design

Page 4-23. Western Transportation Institute

Page 4-24. Alta Planning + Design

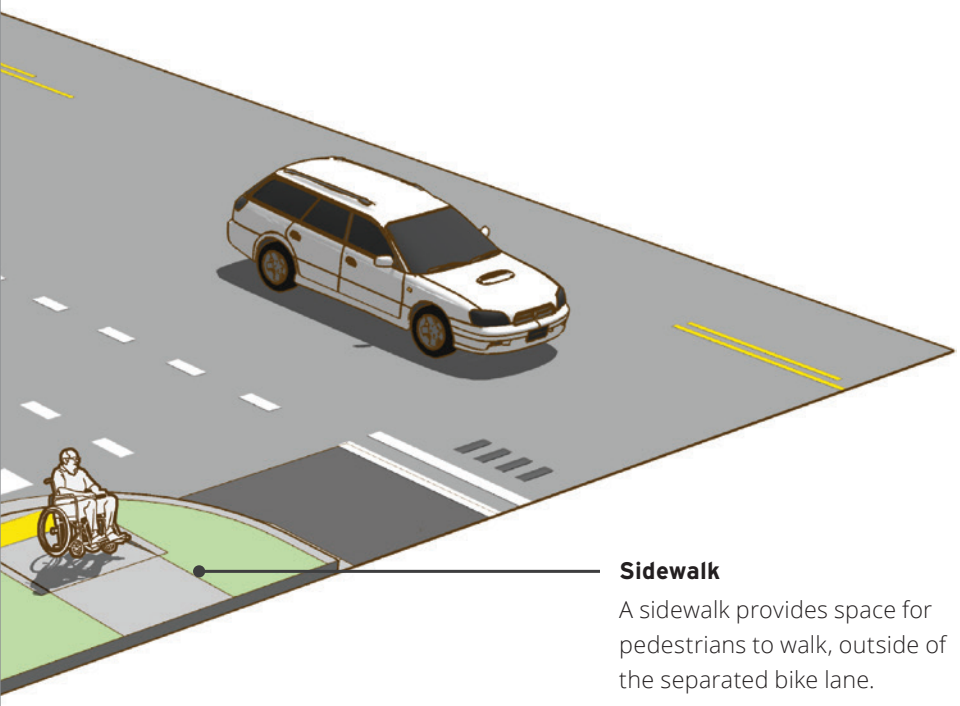


Separated Bike Lane

A separated bike lane is a facility for exclusive use by bicyclists that is located within or directly adjacent to the roadway and is physically separated from motor vehicle traffic with a vertical element.

Pedestrian Separation

The separated bike lane should be distinct from the sidewalks, with contrasting materials, a curb, or other detectable edge.



Sidewalk

A sidewalk provides space for pedestrians to walk, outside of the separated bike lane.

BENEFITS

- Provides a more comfortable experience on high-speed and high-volume roadways than on-road shoulders.
- Separated bike lanes offer bicyclists a similar riding experience to sidepaths but with fewer operational and safety concerns over bidirectional sidepath facilities.
- Offers an increased level of service over sidepaths in areas with high-volumes of pedestrians, when paired with sidewalks.
- Can reduce the incidence of sidewalk riding and potential user conflicts.
- Increases the degree of connectivity over a sidepath, when configured as a one-way directional facility on both sides of the street.

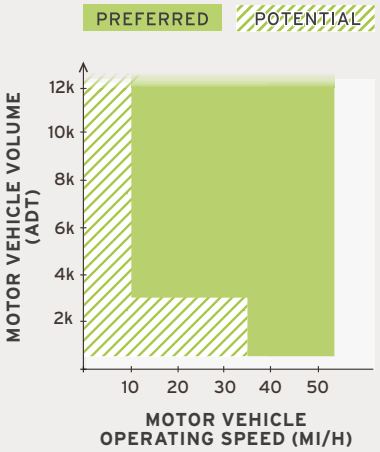
CONSIDERATIONS

- Reflects a more urban visual atmosphere than a sidepath. Use of a wide landscaped buffer may lessen visual impact concerns.
- Requires a wide roadside environment to provide for separation, sidewalks, and bike lane areas.

APPLICATION

Speed and Volume

For use on roads with high motor vehicle volumes, and moderate to high-speed motor vehicle traffic.

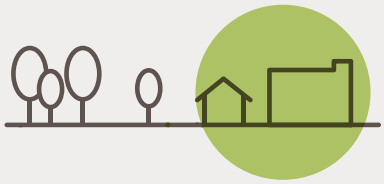


Network

Serves primary connections on major roads through and across communities.

Land Use

For use inside built-up areas where a moderate to high volume of bicyclists and pedestrians is expected.



Separated Bike Lane

DESIGN GUIDANCE

Separated bike lanes can offer a similar experience as sidepaths for bicyclists and pedestrians but with increased functionality and safety where increased numbers of pedestrians and potential conflicts with motor vehicles are present. The guidance in this section focuses on one-way separated bike lanes. For two-way separated bike lanes, refer to the FHWA Separated Bike Lane Planning and Design Guide 2015.

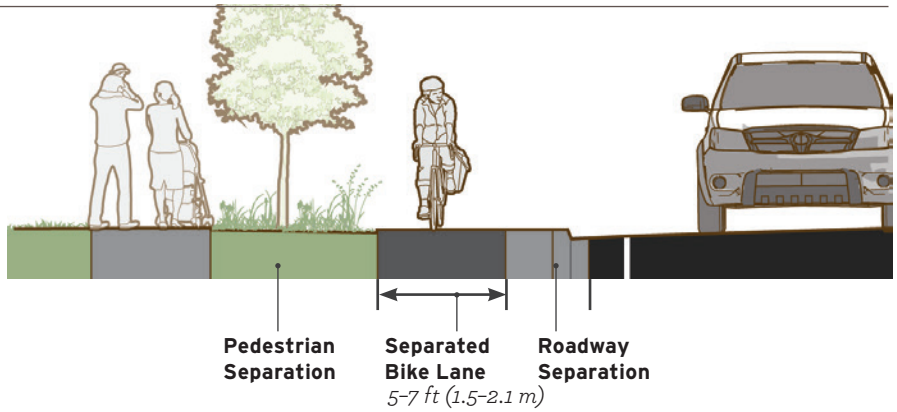


Figure 4-17. *Separated bike lanes are exclusive facilities for bicyclists that are distinct from the sidewalk and physically separated from motor vehicle traffic with a vertical element.*

GEOMETRIC DESIGN

Separated bike lanes are made up of three interrelated zones, illustrated in Figure 4-17.

SEPARATED BIKE LANE

The separated bike lane zone offers a clear operating area for bicyclist travel. Because of the physical separation between the bike lane and the adjacent travel lanes, the design may be more sensitive to debris accumulation, maintenance access, and operating space impacts than conventional on-street bike lanes.

- Preferred minimum width of a one-way separated bike lane is 7 ft (2.1 m). This width allows for side-by-side riding or passing.
- Absolute minimum bike lane width is 5 ft (1.5 m). At this width, bicyclists will not be able to pass slower users until there is a break in the facility and an opportunity to overtake.
- A clear through area of 10 ft (3.0 m) is beneficial for allowing access by snow plows and street sweepers.

Separated Bike Lane

ROADWAY SEPARATION

The roadway separation is the vertical element between the bike lane and the adjacent roadway. Separation width will vary based on separation type.

- A separation width of 3 ft (0.9 m) allows for a variety of separation methods and provides space adjacent to a parking lane to accommodate door swing and passenger unloading.
- A minimum width roadway separation of 1 ft (0.3 m) may be possible with a mountable or vertical curb face.

PEDESTRIAN SEPARATION

Separation from pedestrians is particularly important when a separated bike lane is located immediately adjacent and at the same level as a sidewalk.

- Design and construct separated bike lanes as clearly distinct from the sidewalk. This is accomplished with the use of a curb, separation buffer space, different pavement or other surface treatments, or detectable tactile guidance strips.

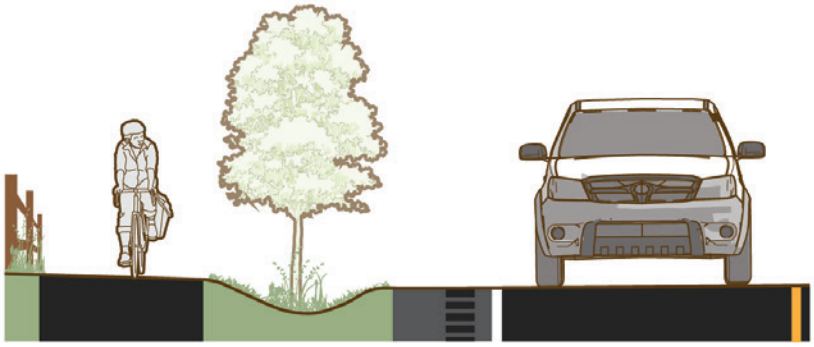


Figure 4-18. *Separated bike lanes may be separated by an unpaved roadway separation, and a vertical element. When configured as directional facilities, separated bike lanes should be provided on both sides of the roadway.*

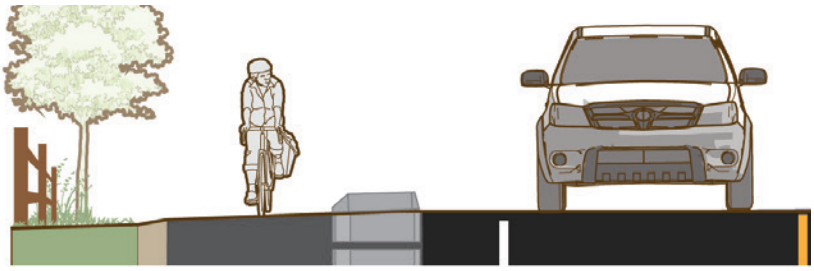


Figure 4-19. *Separated bike lanes may be configured on an existing roadway surface by using a physical barrier such as a curb or median to separate the bikeway from the roadway.*

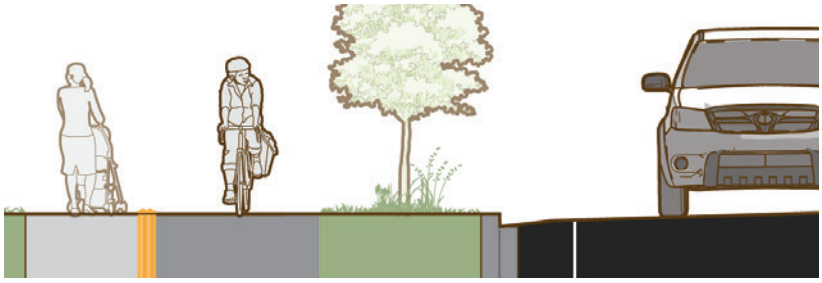


Figure 4-20. *Separation from the sidewalk is valuable for reducing unwanted pedestrian encroachment into the bike lane. The use of physical separation with vertical elements, unpaved separation, or detectable edges may be more effective than visual delineation.*

MARKING

Separated bike lanes use markings to clarify intended users and travel direction.

- Standard Bike Lane symbol markings clarify that the lanes are for the exclusive use of bicyclists.

SIGNING

An optional Bike Lane (R3-17) sign may be used to supplement the bike lane pavement markings. Standards and guidance can be found in the MUTCD 2009.

Guide signs may be used to indicate which users belong on the separate parts of a separated bike lane corridor, as illustrated in Figure 4-21.

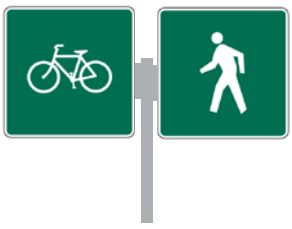


Figure 4-21*. MUTCD signing options for specifying user types and path positioning can be used to indicate which users belong on the separate parts of a separated bike lane corridor (D11-1a, D11-2).*

Separated Bike Lane

INTERSECTIONS

Separated bike lanes may operate similar to sidepaths at intersections, but the one-way directional alignment of the facility allows for additional design treatments and mitigates some of the operational and safety concerns associated with sidepath facilities.

Pedestrians should not travel within the separated bike lane. Accommodate pedestrians on a separate pedestrian facility such as a sidewalk.

Table 4-4 summarizes four approaches to treatments at intersections with separated bike lanes. For details on intersection treatments, refer to the FHWA Separated Bike Lane Guide 2015.

Under all conditions parking, if present, should be prohibited within 20 ft (6.0 m) of the intersection to improve visibility.

Missoula, MT–Population 69,100

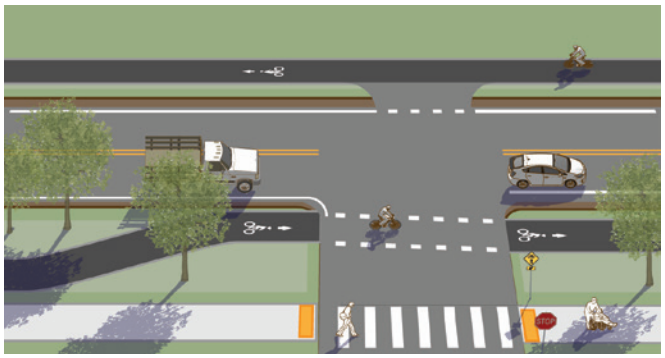
Table 4-4. *Intersection Treatments for Separated Bike Lanes*[i]

Treatment	Advantages	Disadvantages	Design Details
Bend-In Position bicyclists closer to turning vehicles to increase visibility prior to the turn.	Motorists on a side street can see bicycles and vehicles in a similar field of vision. Requires less space than bending out.	Bicyclists may perceive less separation due to proximity of through vehicles.	Align the bike lane immediately adjacent to the roadway, at least 20 ft (6.0 m) in advance of the intersection.
Bend-Out Provide space for right-turning vehicles to yield to bicyclists.	Allows vehicle traffic turning across separated bike lane to queue out of the way of through traffic and before the separated bike lane. Allows a queuing location for bicyclists wanting to turn left. Raised crossing provides traffic calming for automobiles and can also slow bicyclists.	Requires more space than the bend-in approach. Adequate sight distance may be difficult for vehicles approaching on the side street depending on vegetation, grading, and property boundaries.	Position the bike lane 6.5–16.5 ft (2.0–5.0 m) from the adjacent roadway **(Schepers 2011)**.
Mixing Zone Shared turn lane with motor vehicles and bicyclists.	Requires less space. Organize conflicts; reduce right-hook risk by negotiating conflict upstream of the intersection.	Greater traffic stress.	Only appropriate in areas with low speed differentials between bicyclists and motor vehicles.
Protected Signal Phase Separate conflicting movements in time.	Elimination of turn conflict through exclusive bicycle signal phase.	Increased signal cycle length, possibly with increased delay.	May be appropriate at signalized intersections with high turn volumes.

Separated Bike Lane

INTERSECTIONS

Bend In



Bend Out

Mixing Zone

Protected Signal Phase

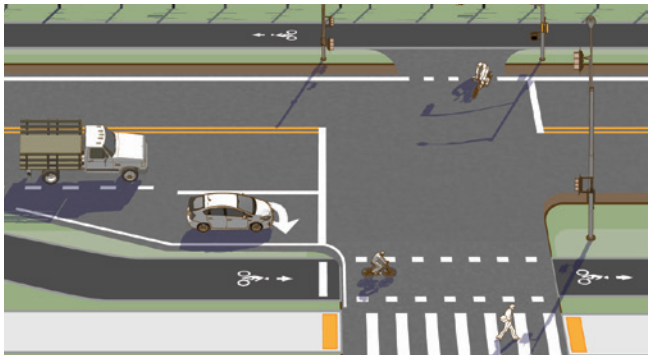


Figure 4-22. *A variety of design treatments exist depending on the roadway configuration, available curb-to-curb width, traffic volumes and desire to provided a dedicated turn lane. All designs should strive to reduce speeds of turning vehicles, remind users of bicycle priority, and clarify user positioning up to and through the intersection.*

IMPLEMENTATION

With new roadway construction a raised separated bike lane can be less expensive to construct than adding an enhanced shoulder by building the separated bike lane to support reduced vehicle load requirements.

On streets with existing curb and gutter, it may be possible to implement a protected bike lane outside of the curb, between the curb and the sidewalk.

Separated bike lanes may be implemented during roadway resurfacing, rehabilitation, and reconstruction or new construction projects. For more information on implementation strategies, see the FHWA Resurfacing Guide 2016.

ACCESSIBILITY

Separated bike lanes are not intended for use by pedestrians. On roadways with separated bike lanes, the appropriate pedestrian facility is a sidewalk.

The design of separated bike lanes must consider driveway conflicts, accessible parking and parking access aisles, transit stop access and egress, and loading zone accommodation (FHWA Separated Bike Lane Guide 2015).

CASE STUDY | SEPARATED BIKE LANE

Connellsville, Pennsylvania

PROJECT DESCRIPTION

The Great Allegheny Passage (GAP) is a long-distance trail network that connects Pittsburgh, PA with Washington, DC. The development of this network has taken grand vision and many years, with the first section of the trail being completed in 1986, and the final piece completed in 2013. The 150-mile trail connects defunct corridors of the four different railways. The Youghiogheny River Trail, as the section of the GAP through Connellsville is known, was constructed in the mid-1990s. During that time, Connellsville decided to route the trail along four blocks of South 3rd Street.

The roadway was widened without the need for additional right of way and the separated bike lane was created. The landscaped buffers are maintained by social groups and clubs in the community.

Because South 3rd Street is the connection of the GAP bike route through Connellsville, a critical aspect of the design is that the bike lane is bidirectional. Additionally, as this is the only section of the Passage that routes on city streets, the bike lane was separated to maintain the rider experience of being separated from motor vehicles. The landscaped buffer maintains this separation and encourages slow-speeds. Where the bike lane crosses West Crawford Avenue (State Route 711), a traffic signal was installed to improve safety at the intersection.

DETAILS

COMMUNITY CONTEXT

Connellsville is a community of approximately 7,000, straddling the Youghiogheny River in western Pennsylvania's Fayette County. Connellsville is located in the heart of coal country and was once a top producer of coke, the fuel for iron smelting furnaces. At one time, five different railways served Connellsville.

KEY DESIGN ELEMENTS

Vertically separated bike lane with curbs and planters providing physical separation.

ROLE IN THE NETWORK

The separated bike lane is the connection of the GAP through Connellsville. Connellsville's *Bicycle Master Plan* builds off of this key element in establishing a broader network that will connect people on bikes from the trail with businesses across the city and Connellsville residents with the GAP.

FUNDING

The South 3rd Street improvements were made through a local project with Federal funding for the signal improvement at West Crawford.

For more information, refer to the Connellsville Redevelopment Authority:
www.connellsvilleredevelopment.org

Separated Bike Lane

FOOTNOTES

i Table contents adapted from Table 3 and Table 4 from the FHWA Separated Bike Lane Guide 2015.

WORKS CITED:

Federal Highway Administration. *Incorporating On-Road Bicycle Networks into Resurfacing Projects*. 2016.

Federal Highway Administration. *Manual on Uniform Traffic Control Devices (MUTCD)*. Department of Transportation. 2009.

Federal Highway Administration. *Separated Bike Lane Planning and Design Guide*. 2015.

Schepers, J.P., et al. *Road factors and bicycle—motor vehicle crashes at unsignalized priority intersections*. Accident Analysis and Prevention. Volume 43, Issue 2, 2011.

PHOTO CREDIT

Page 4-27. Wyoming Pathways

Page 4-29. Federal Highway Administration

Page 4-31. Saara Snow, Adventure Cycling Association

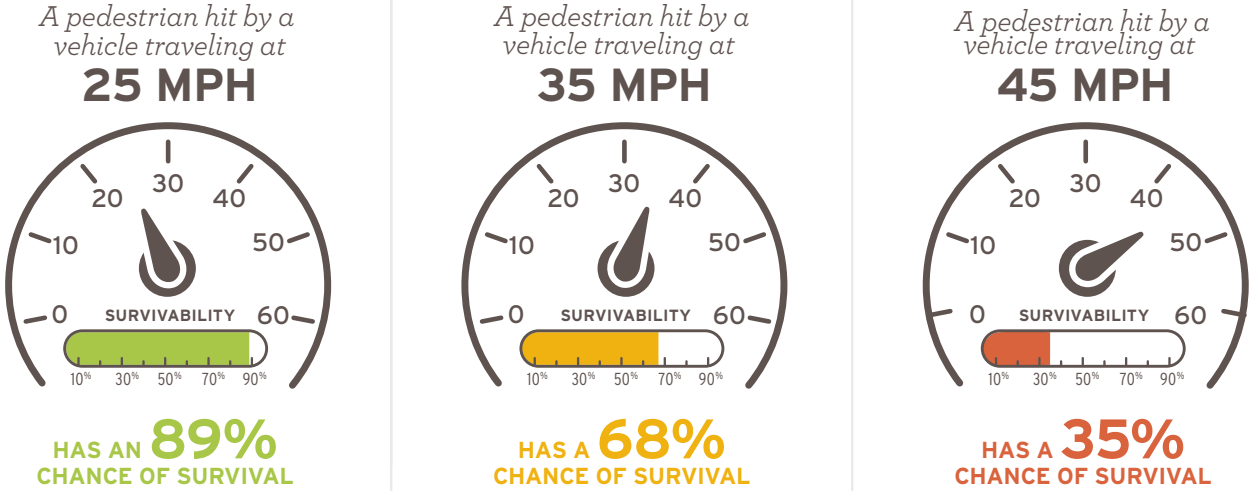
Page 4-32. Alta Planning + Design

Key Network Opportunities

Speed Management

CRITICAL LINKS: SPEED MANAGEMENT

Figure 5-1. *Impact speed and a pedestrian's risk of severe injury or death* ***(Tefft 2011)****.*



The ITE publication Traffic Calming: State of the Practice defines traffic calming as "the combination of mainly physical measures that reduce the negative effects of motor vehicle use, alter driver behavior and improve conditions for nonmotorized street users" (1999, p. 2).

The FHWA Office of Safety Traffic Calming Website note that traffic calming includes physical changes to the roadway, signage, or operation changes and can be thought of as a "silent policeman" enforcing speed limits where no law enforcement is present.

For more information on traffic calming, refer to the FHWA Speed Management Safety Website.

BENEFITS OF REDUCING SPEED

Speeding is a major contributing factor in crashes of all types, and increases severity in the event of a crash. Faster speeds also increase the likelihood of a pedestrian being hit as reaction time and the higher speed of the vehicle increase stopping distance. At higher speeds, motorists are less likely to see and react to a pedestrian and are even less likely to be able to stop in time to avoid hitting one.

APPLICATION

Speed management can play an important part of creating multimodal networks in rural areas. Speed reduction measures are common as part of Bicycle Boulevards to create and enforce desired operating speeds. Speed management can also enhance pedestrian safety in Main Street areas. Refer to the Transitions to Main Streets section in FHWA Achieving Multimodal Networks 2016 for more information on applying traffic calming in advance of built-up areas.

TRAFFIC-CALMING MEASURES

There are three general types of speed reduction measures:

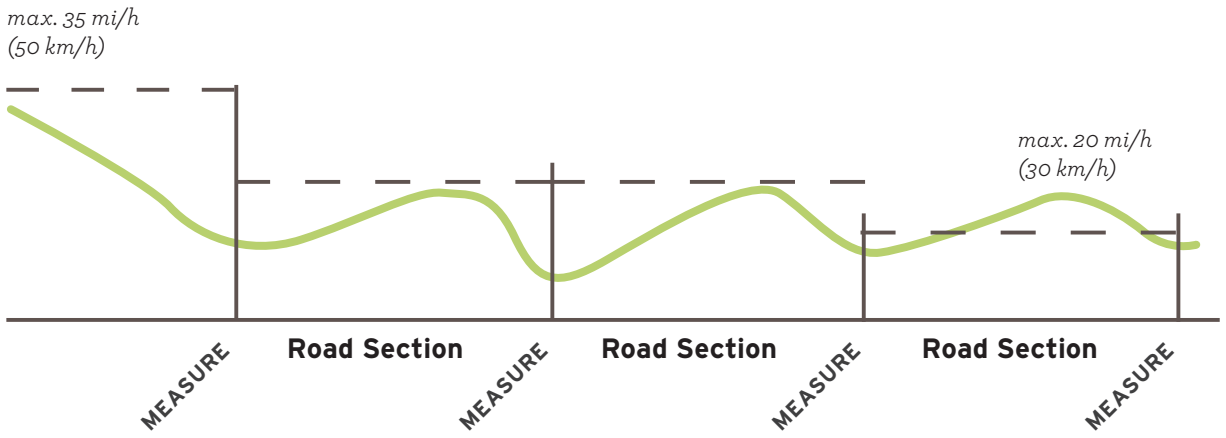
- Physical measures, such as vertical deflections, horizontal shifts, and roadway narrowings, intended to reduce speed and enhance the street environment for nonmotorists.
- Nonphysical measures using signs and markings are intended to raise awareness and reduce speed through visual indications.
- Diversion treatments reduce cut-through traffic by obstructing or otherwise preventing traffic movements in one or more directions.

Due to small community populations and limited roadway connectivity, traffic-calming efforts in small town and rural areas tend to emphasize speed reduction measures rather than volume reduction.

Speed Management

APPLYING SPEED REDUCTION MEASURES

Figure 5-2. *Managing travel behavior through speed management techniques*



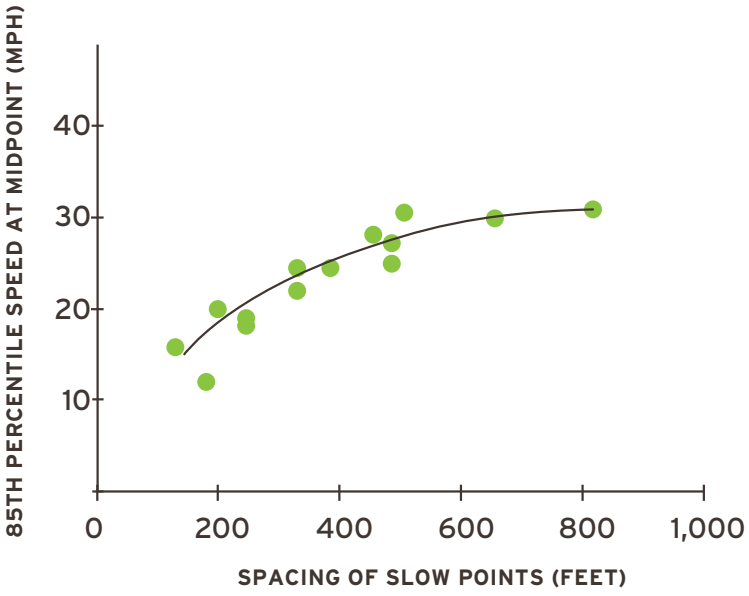
Measures should generally be applied frequently and in concert to create continuous slow conditions along the road. Figure 5-2 illustrates desired speed behavior in managed roadway environments.

Infrequent use of speed reduction measures will fail to effectively manage speed along a roadway corridor. Based on recorded observations displayed in Figure 5-3, slow points should be no more than 300 to 400 ft apart to maintain midpoint speeds of 25 mi/h.

Details on the effectiveness and application of various speed reduction measures can be found in FHWA reference A Desktop Reference of Potential Effectiveness in Reducing Speed 2014. Detailed design drawings for physical traffic-calming measures can be found in U.S. Traffic Calming Manual 2009.

More information on speed management can also be found in BIKESAFE 2014 and PEDSAFE 2013.

Figure 5-3. *Effect of slow point spacing on motor vehicle speed – this figure illustrates measured 85th percentile speeds and spacing of speed reduction measures, as observed in the UK, Australia and Denmark. Adapted from R. Ewing, Best Development Practices, American Planning Association (in cooperation with the Urban Land Institute), Chicago, 1996, p.64.*

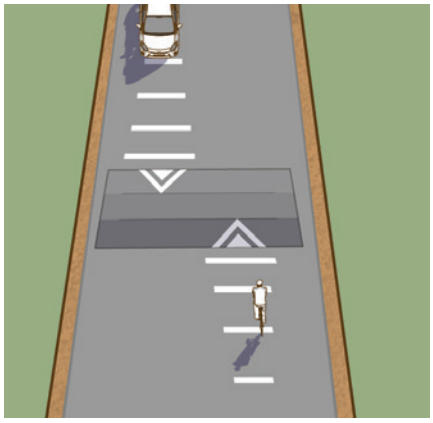


Speed Management

This page presents concepts for speed management in rural settings. See reference materials for contextual guidance in selecting the appropriate measures for implementation.

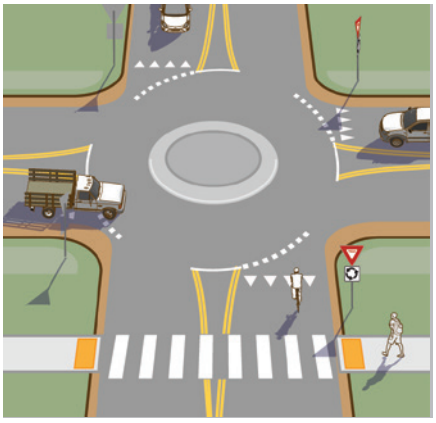
Traffic calming should use a context sensitive approach to roadway modifications. On roadways with no curb and gutter, speed reduction measures constructed with traffic islands to deflect and channelize traffic can be constructed with minimal impacts to drainage and reduce construction and maintenance costs.

Figure 5-4. *The following images illustrate physical speed reduction measures.*



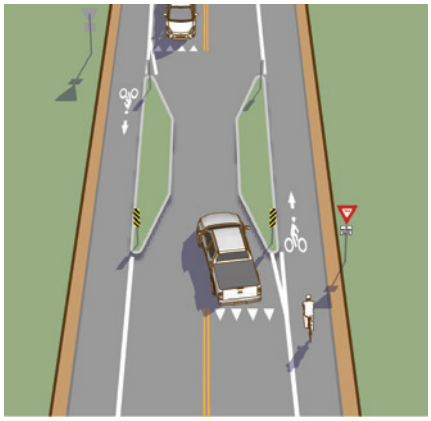
Speed Humps and Speed Tables

Speed humps and tables apply vertical deflection in the roadway that is designed to limit the speed of traffic. The main difference between humps and tables are length and profile. For more information on speed humps refer to the MUTCD 2009.



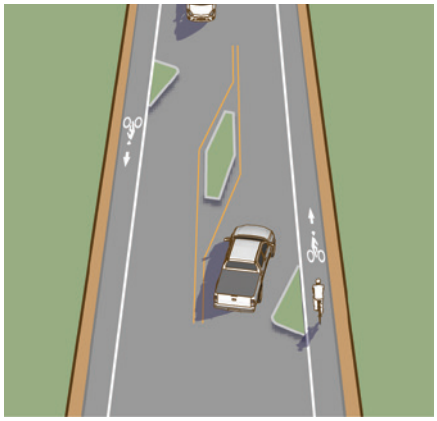
Mini Roundabout

Mini roundabouts are roundabouts with a small footprint and fully traversable central island. For more information on mini roundabouts refer to the MUTCD 2009, and NCHRP 672.



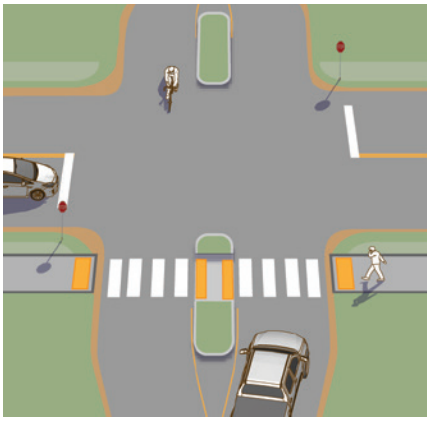
Pinch Point

Pinch points, also called chokers, are curb extensions or edge islands at midblock locations which narrows the road for a short distance, forcing all motorists to merge into a single lane.



Lateral Shift

Lateral shifts are realignments of an otherwise straight travel path. When multiple lateral shifts are applied to form an S-shaped curve it is called a chicane. For traffic calming, the taper lengths may be as much as half of what is suggested in traditional highway engineering.



Median Island

Median island are raised islands located along the centerline of a street that narrow the travel lanes and require deflection of an otherwise straight travel path.

Median islands are an FHWA Proven Safety Countermeasure.

Speed Management

Generally appropriate on higher speed roadways and high-to-low-speed transition areas, nonphysical speed reduction measures use signs and markings to warn, regulate, and influence driver behavior.

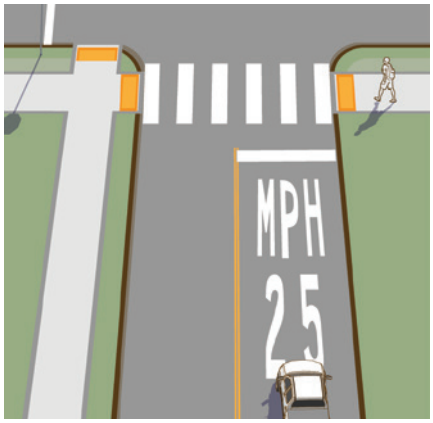


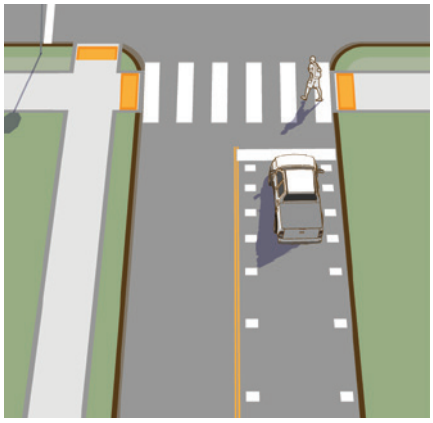
Figure 5-5. *The following images illustrate nonphysical speed reduction measures.*

Speed Feedback Sign

Police departments and transportation agencies use speed feedback signs as educational tools that can enhance enforcement efforts directed at speed compliance. Speed feedback signs educate drivers as to their operating speed, and remind them of the posted speed limit on the roadway.

SLOW or Speed Limit Pavement Legends

Use SLOW or speed limit pavement markings as a supplement to speed-limit signs and reinforce the lawful speed limit.



Speed Reduction Markings

Speed reduction markings are a series of white rectangular markings typically 1 foot wide placed just inside both edges of the lane and spaced progressively closer to create the illusion of traveling faster as well as the impression of narrower lane.

Pedestrian Lane

Pedestrian lanes provide interim or temporary pedestrian accommodation on roadways lacking sidewalks. They are not intended to be an alternative to sidewalks and often will fill short gaps between other higher quality facilities. As part of the planning process, agencies should explore issues and the potential challenges a pedestrian lane may face, including:

- Detectability by people with vision disabilities
- Undesired use by bicyclists
- Accessible cross-slope requirements
- Maintenance strategies, such as sweeping and snow removal

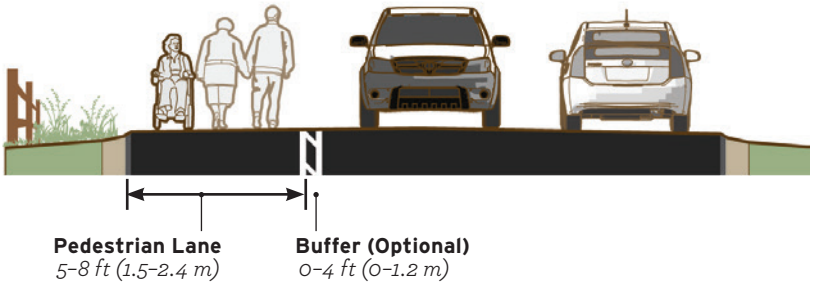


Figure 5-6. *Pedestrian lanes provide an exclusive space for pedestrians to walk outside of the travel area.*

A pedestrian lane is an interim or temporary pedestrian facility that may be appropriate on roads with low to moderate speeds and volumes. A pedestrian lane is a designated space on the roadway for exclusive use of pedestrians. The lane may be on one or both sides of the roadway and can fill gaps between important destinations in a community.

A pedestrian lane may be considered to operate similarly to a sidewalk. Consult State and local vehicle code for implications in a situation where pedestrians are walking along a roadway with no sidewalk or shoulder available.

GEOMETRIC DESIGN

Pedestrian lanes should be designed to support and promote side-by-side walking within the lane. Because of the lack of physical separation, additional width beyond this should be included for added comfort.

- 8 ft (2.4 m) width is preferred
- 5 ft (1.5 m) width is the minimum to allow for side-by-side walking and maneuverability by users of mobility devices.

Pedestrian lanes are intended for use by pedestrians and must meet accessibility guidelines for a pedestrian access route. This includes:

MARKINGS

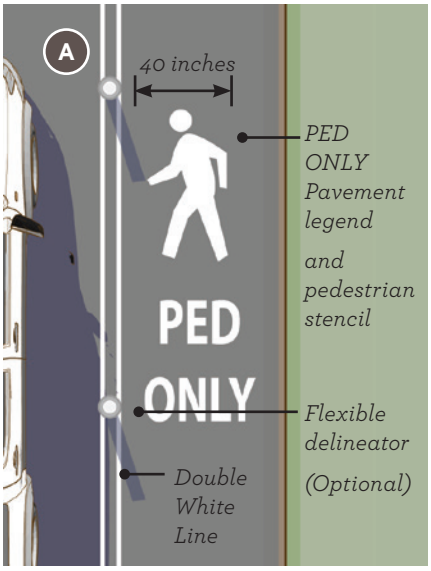


Figure 5-7. *PED ONLY legend marking and/or Pedestrian symbol marking to identify the pedestrian lane to all users.*

- The grade of pedestrian access routes shall not exceed the general grade established for the adjacent street or highway.
- The cross slope of pedestrian access routes shall be 2 percent maximum.
- The surface of pedestrian access routes shall be firm, stable, and slip resistant.

Lane Markings

Separate a pedestrian lane from the adjacent travel lanes with some form of longitudinal marking.[ii]

- Use a double white line for extra emphasis and to discourage motor vehicle encroachment.
- If additional comfort is desired, mark a buffer to increase separation between pedestrians and motor vehicles.

Pedestrian Lane

Legends and Symbols

Mark pedestrian lanes with the appropriate pavement word markings.[iii]

A Use a PED ONLY legend marking to designate exclusive pedestrian use of the lane.

- For additional conspicuity, use a pedestrian symbol to communicate exclusive pedestrian use.
- Markings should be visible to "approaching traffic for all available departures" (MUTCD 2009, p. 415).

Signs

Pedestrian Warning Sign (W11-2) paired with an "ON ROADWAY" legend plaque may be used to indicate to drivers to expect pedestrians within the paved road surface.

R8-1

W11-2

Figure 5-8. *A W11-2 warning sign may be paired with a legend plaque to inform road users that shared use by pedestrians and/or bicyclists might occur.*

INTERSECTIONS

Configure pedestrian lanes with treatments to provide for a safe, clear, and accessible passage at street crossings.

B Define the corner at intersections with a double solid white line to reduce motor vehicle encroachment into the pedestrian areas. Use flexible delineators where a more robust treatment is desired.

- Place stop lines or yield lines outside of the crosswalk area.
- Crosswalks may be marked to clearly delineate the crossing paths of pedestrians.

C Provide detectable warning surfaces advance crosswalks, following accessibility guidelines for blended transitions.

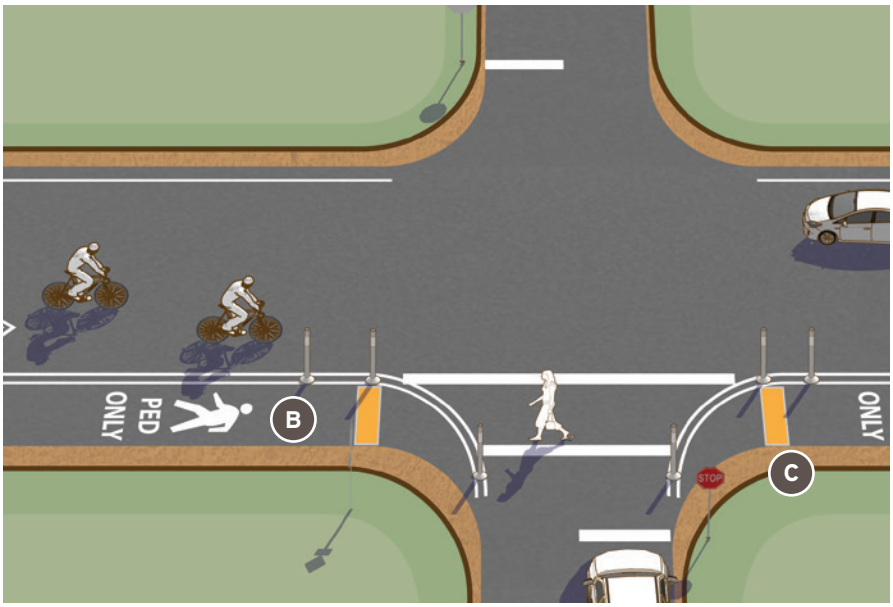


Figure 5-9. *Where clarity of street crossings for persons with vision impairments are a concern, detectable warning strips may be used in advance of the intersection area. This transition can indicate a crosswalk, or a transition out of the pedestrian lane into a shared roadway environment.*

IMPLEMENTATION

Sufficient space to provide a pedestrian lane may already exist or may be created through configuration changes, including removing or consolidating on-street parking, or narrowing of travel lanes. Implementing pedestrian lanes may share some strategies with the implementation of bike lanes. For more information on potential implementation strategies, refer to the FHWA Resurfacing Guide 2016.

ACCESSIBILITY

A pedestrian lane is an on-roadway facility intended for use by pedestrians and must meet accessibility guidelines for walkways. Any deficiencies in meeting ADA guidelines during implementation as a restriping project should be identified in the ADA transition plan and be corrected in the next resurfacing.

Pedestrian lanes are a interim facility, and a full sidewalk construction should be planned for future implementation.

School Connections

Schools are key destinations in communities of all sizes. This is particularly true in small and rural places, where they often play a prominent role in the community as centers of activity for people of all ages and abilities. Since children will be present each day, it is essential to provide separation from motorized traffic, controlled crossings, and wayfinding to and throughout the school campus.

Design for children

When developing facilities for children, increased separation from motorized traffic is preferred. Clearly defined facilities for walking and bicycling should be provided, with vertical and horizontal separation from motor vehicle traffic (AASHTO Pedestrian Guide p. 35). Children have a wide range of skills and abilities when navigating traffic. Walking and bicycling skills can be learned, and development characteristics can change as children mature. The planning and design of routes that serve schools should consider that children tend to react slowly, have a narrow field of vision, have difficulties judging the speed and distance of approaching vehicles, have difficulty concentrating on more than one thing at a time, and have difficulty determining direction of auditory input (AASHTO Bike Guide 2012).

Opportunity for activity

In 1969, almost half of all elementary and middle school students walked or bicycled to school. Today only 13 percent walk or bike.[iii] In rural areas, 12 percent of students on the West Coast and 1.1 percent in the South Atlantic region bike and walk to school.[iv] Lack of physical activity contributes to high rates of unhealthy weight for American children nationwide, but rates are even higher in rural communities where 40 to 50 percent of children are overweight or obese.[v] In fact, rural children are 25 percent more likely to be overweight than urban children.[vi, vii]

Multimodal network

When planning walking and biking infrastructure to for access to school, consider both the school site and bus stop locations. In rural communities, many children will live in locations that are too far to walk or bicycle. Developing walking and bicycles facilities that serve school bus stops or the provision of satellite drop-off locations where children who are bussed can still safely walk a short distance to school.

Centers of community

For many rural communities, schools serve as centers of community life. Safe walking and biking access to schools not only benefits the children and families that are attending the schools but also all community members that attend events and use the school grounds and amenities. It is important to plan on a network scale, balancing new segments of sidewalk, low-stress streets, bike lanes, and crosswalks with filling in gaps and repairing broken stretches.

School location

School siting plays a large role in whether or not students can walk and bike to school. Schools placed further away from residential areas, or sited outside of town along high-speed roadways, create difficult and dangerous routes for students using active transportation. School siting should focus on locating schools near the households they will serve and minimizing required crossings of highways and multilane roads. Properly siting new schools creates more opportunities for cost effective walking and biking facilities as compared to road expansion and increased congestion.

School Connections

St Charles, Minnesota

POPULATION 3,695

St. Charles is located in southeastern Minnesota. In an effort to better connect destinations within the city, the Public Works department painted a network of on-street walk and bike lanes. This nonmotorized network connects the elementary school with the middle and high school and other civic destinations. Where the walk/bike lanes cross an intersection, the lane widths are maintained and are complemented with a crosswalk-style marking.

Arlee, Montana

POPULATION 602

A pathway connecting the north side of Arlee to the schools was completed in 2012. This pathway provides a critical connection that enables students and parents from the neighborhood north of the school to walk and bike to and from school. The pathway connection also provides an additional link from the neighborhood to the businesses in town. The project was funded through the Montana Department of Transportation's Safe Routes to School Program.

Mt Shasta, California

POPULATION 3,292

Completed in 2014, this street reconstruction project eliminated parking from the side of the street opposite the school, removed a midblock crossing, added bike lanes and improved sidewalks. Removal of the parking lane eliminated the practice of students crossing the street to/from their parent's vehicle. The bike lanes and sidewalks provide a comfortable route to and from school as well as completing an important link in this town's bicycle route network. This project was funded with money from the State Transportation Improvement Program.

> *"Rural arterials often provide the only direct connection between populated areas and locations to which the public wishes to travel. Schools, parks, and rural housing developments are usually located to be readily accessible by automobile. However, pedestrians and bicyclists may also wish to travel to the same destination points. Where demands for pedestrian and bicycle travel exist, the designer should consider the needs of pedestrians and bicyclists and provide facilities where appropriate" (AASHTO Green Book p. 10-13).*

School Connections

The preferred facilities near schools should provide as much separation as possible between children and motor vehicles. Facilities such as sidepaths and paved shoulders should also be wider than typical facilities when high-volumes of children are expected to be present. Traffic-calming measures that reduce motor vehicle operating speeds, as well as the volume of motor vehicles near schools, may also be appropriate.

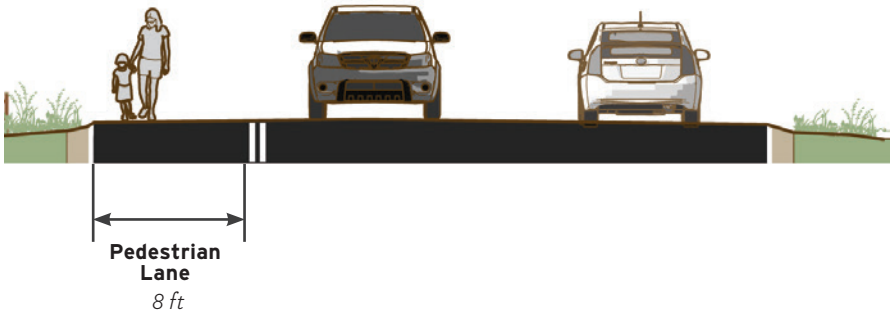
Figure 5-6. *The following images illustrate potential facility designs appropriate for school areas.*

SEPARATION PREFERRED OVER MIXED TRAFFIC

Even in low-speed and low-volume conditions, parents and children may prefer walking in an exclusive pedestrian use space.

For more information, refer to the guidance in this chapter on interim pedestrian lanes.

Before



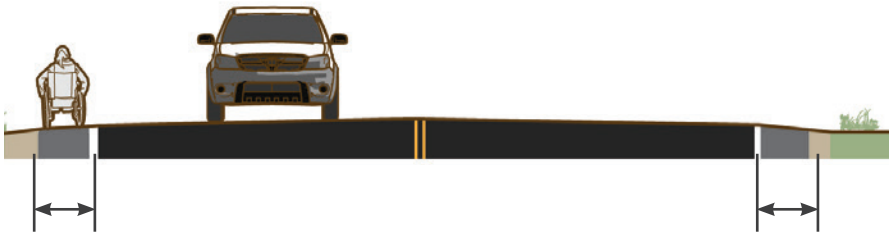
After

School Connections

SIDEWALKS PREFERRED OVER SHOULDERS

Paved shoulders do not offer protection for children walking along the roadway. It may be possible to construct a sidewalk within the same paved roadway area in order to create a safe place to walk.

For more information, refer to the guidance on **sidewalks**.



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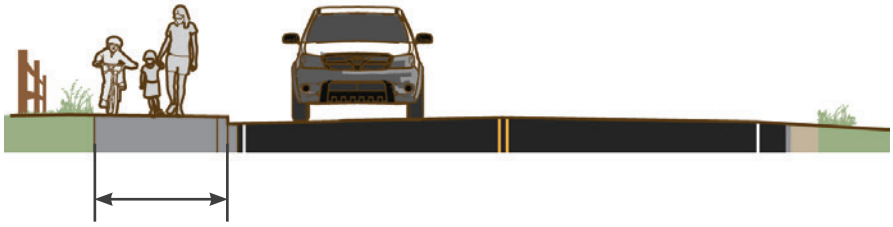


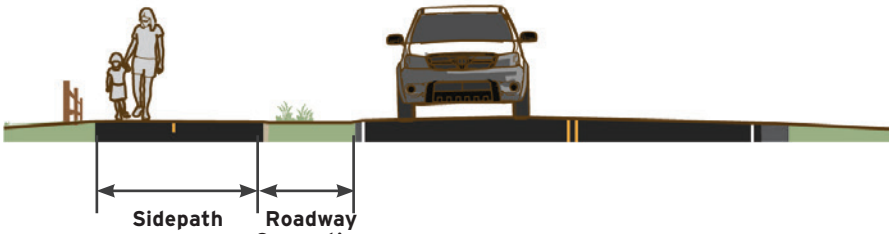
After

SIDEPATHS PREFERRED ON HEAVY TRAFFIC STREETS

On higher speed and volume streets, even wide shoulders may not offer adequate security for children to be comfortable walking to school. A separated path may be a good facility in these conditions.

For more information, refer to the guidance on **sidepaths**.

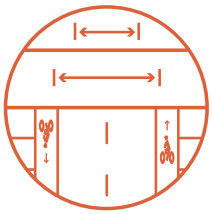
Before



After

Multimodal Main Streets

A traditional "main street" is designed with street-fronting land uses, slow travel speeds, and pedestrian-oriented design features. Running through a built-up, commercial area, a main street may only be a few blocks long and is important for a community's commercial, civic, and sometimes historical identity. These streets are often the most "urban" part of a small town or rural community and may feel similar to commercial areas in larger communities. Main streets are often a small portion of a larger, county road or State-owned highway and may need to balance competing needs and objectives. Many main streets were established prior to the wide spread adoption of motor vehicles. Some have limited width, while others are overly wide. In many cases these main streets have evolved and transformed over their history as transportation priorities and technologies have changed.



Flexible Design

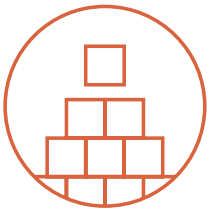
Main streets can be constrained spaces, with more demand for roadway design features than there is typically space to accommodate. Decisions should be informed by local context and reflect the community vision.

Multimodal Design

Multimodal networks provide mobility and access for all users and modes of travel. Main streets become connections between modes, as motorists become pedestrians and pedestrians become transit users.

Placemaking

Main streets can strengthen community identity by creating enhanced aesthetics, spaces for civic activities, and creating conditions to attract and retain business. Successful places foster improved community cohesion and participation in public life.

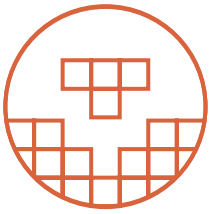


Incrementalism

Small projects can make a big difference. Opportunities such as roadway resurfacing or enhancements associated with individual development projects can be the first step in a gradual transformation.

Environmental Sustainability

Street trees and other vegetation can support a pleasant environment and are a key component of stormwater management strategies. Trees and other vegetation intercept rainfall and can help regulate the flow of stormwater.



Compactness

No one mode or use should dominate the street. Providing compact, well delineated zones for each user of the main street creates a sense of belonging.

Multimodal Main Streets

Imbler, Oregon

POPULATION 305

Located in rural Eastern Oregon, Imbler is bisected by State Highway 82. The highway, which serves as an important freight route for the area, also functions as the town's main street. In 2007, the existing roadway, which included two travel lanes with wide shoulders, was redesigned to add pedestrian and bicycle facilities. Sidewalks and bike lanes were constructed on both sides of the street and pedestrian scale lighting, street trees, and planters were added. Crosswalks were marked at key intersections to connect residents with schools and other destinations.

Los Molinos, California

POPULATION 2,037

Los Molinos has a busy State highway as its main street. The street features high levels of pedestrian and bicyclist use, as well as high-volumes of through vehicular traffic. Prior to reconstruction, vehicle speeds and crash rates were high. Reconstruction of the highway through the downtown corridor added buffered bike lanes, sidewalks, and crosswalk signal treatments. Improvements included stamped colored concrete buffers, in-pavement flashers at crosswalks, islands, lighting, street trees, and speed feedback signs.

Willow Creek, California

POPULATION 1,710

Prior to implementing roadway improvements, Highway 299 in Willow Creek was a four-lane road through downtown that also functioned as the town's main street. Lacking pedestrian and bicycle facilities, people had to walk and bike along the street. By reconfiguring the roadway from four lanes to three lanes (one lane in each direction with a center turn lane), additional space was made available for sidewalks, bike lanes, and landscaping.

Multimodal Main Streets

Galena, IL–Population 3,429

The ITE Walkable Urban Thoroughfares Guide 2010 recommends the following design details for walkable and bikeable commercial main streets:

- **Minimum sidewalk width:** 6 ft (1.8 m)
- **Furnishing zone:** 6 ft (1.8 m)
- **Target travel speed:** 25 mi/h (40 km/h)
- **Number of through lanes:** 2
- **Lane Width:** 10–11 ft (3.0–3.3 m)
- **Parallel On-Street Parking Width:** 7–8 ft (2.1–2.4 m)
- **Bike facility:** 5–6 ft (1.5–1.8 m) min

Hull, IA–Population 2,175

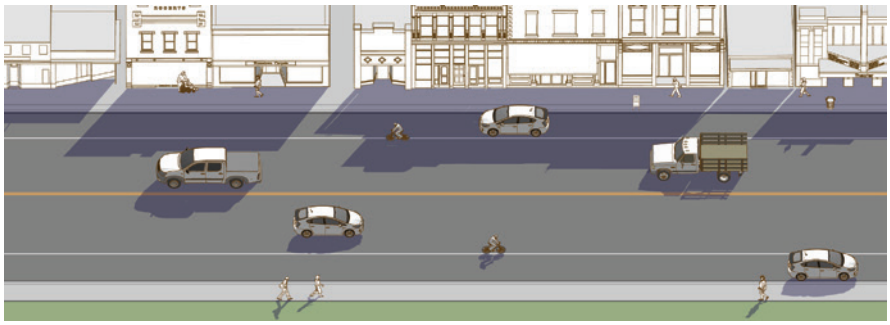
Multimodal Main Streets

TWO-LANE STREET SCENARIOS

Figure 5-7. *The following concepts illustrate potential design options for wide 2-lane main streets.*

EXISTING CONDITIONS TWO-LANE

A typical two-lane main street often has wider than necessary lane widths. Wide lanes encourage higher travel speeds and should be avoided on main streets where lower speeds are desired. By narrowing lanes with excess width, the additional space can be reallocated for other uses.



MEDIAN ISLAND

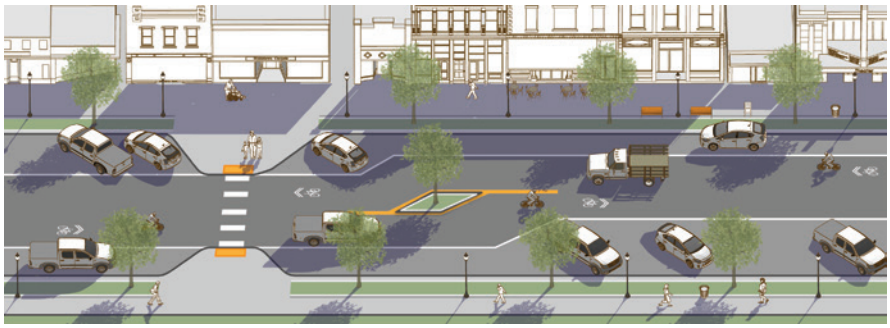
Providing curb extensions and median islands can enhance crossing experience for pedestrians.

For more information, refer to the FHWA Proven Safety Countermeasures on medians and pedestrian crossing islands.

ANGLED PARKING CHICANE

Where through traffic volumes are low, a slow-speed street design may maximize comfort and use by pedestrians and bicyclists.

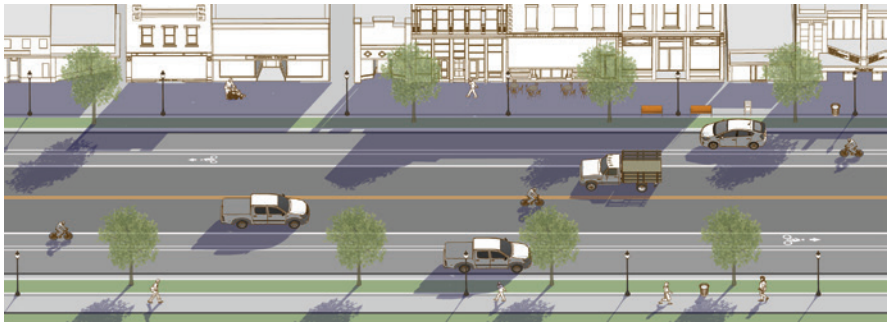
For more information on creating slow-speed conditions, refer to the guidance on Traffic Calming.



BIKE LANE

Narrowing wide travel lanes may provide room to establish on street bike lanes. Pay attention to on street parking by adding a parking side buffer or other mitigation to reduce door zone conflicts.

Refer to the FHWA Resurfacing Guide 2016 for more information.



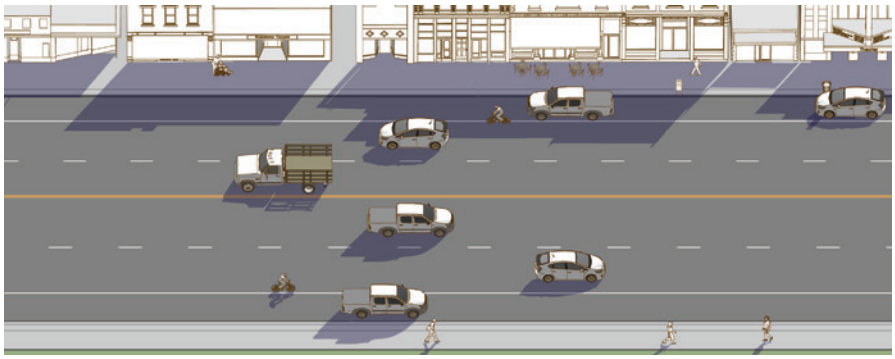
Multimodal Main Streets

FOUR-LANE STREET SCENARIOS

Figure 5-8. *The following concepts illustrate potential design options for main streets with multiple travel lanes in each direction.*

EXISTING CONDITIONS FOUR-LANE

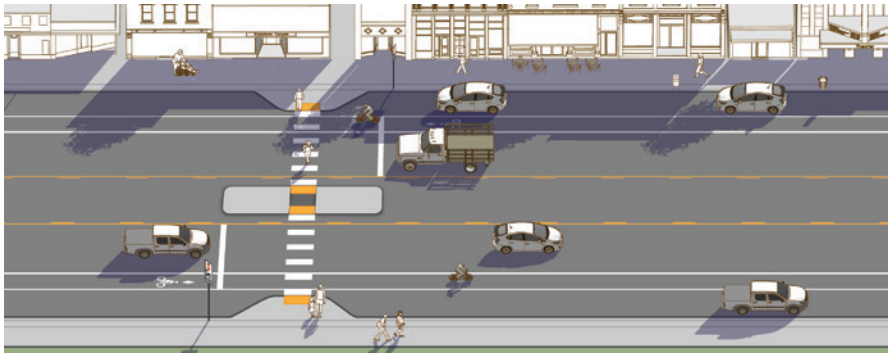
Rural highways are often widened through town centers, providing multiple travel lanes to reduce impediments to through traffic. These configurations may encourage inappropriately high-speed travel and erratic behavior in the vicinity of pedestrian and bicycle activity.



ROAD DIET

A four-lane to three-lane road diet can balance the needs of through travel and local community access, while increasing safety.

Road diets are an FHWA Proven Safety Countermeasure. For more information on road diets, refer to the FHWA Resurfacing Guide 2016 and the FHWA Road Diet Guide 2014.



STREETSCAPE EXPANSION WITH BIKE LANES

Narrowing and consolidating excess space dedicated to motor vehicles can provide room to expand sidewalk areas.

Road diets are an FHWA Proven Safety Countermeasure. For more information on roadway reconfigurations, refer to the FHWA Road Diet Guide 2014. Refer to the ITE Walkable Urban Thoroughfares Guide 2010 for more information on sidewalk configuration.

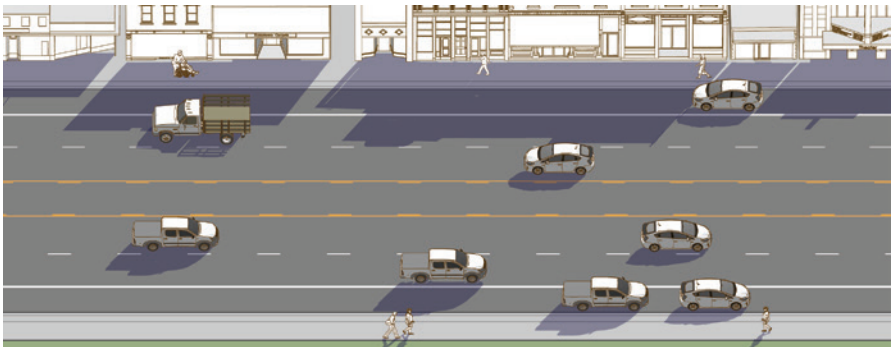
Multimodal Main Streets

FIVE-LANE STREET SCENARIOS

Figure 5-9. *The following concepts illustrate potential design options for under capacity 5-lane main streets.*

EXISTING CONDITIONS: FIVE-LANE

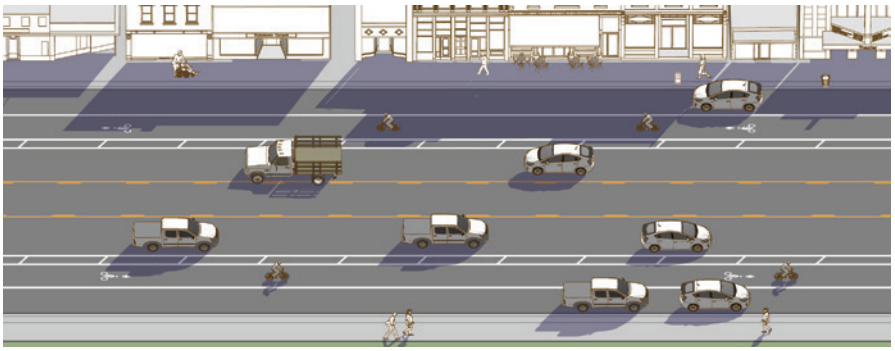
Some small towns have five-lane main streets. This configuration may have arisen from a more intensive highway use that may no longer be relevant due to decline in attractors, or the addition of a bypass over the years. Five-lane main streets with excess capacity represent dramatic opportunities to create high quality experiences for all users.



ROAD DIET WITH BIKE LANES

Where high quality bicycling experience is desired, provide a buffered bike lane.

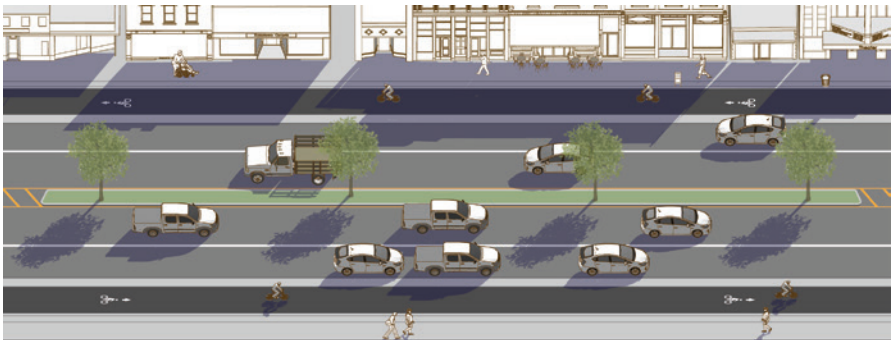
For more information, refer to the guidance on Separated Bike Lanes and the FHWA Separated Bike Lane Planning and Design Guide 2015.



MEDIAN AND SEPARATED BIKE LANES

A continuous center median may take up less space than a center turn lane, providing additional room to establish separated bike lanes and landscaping.

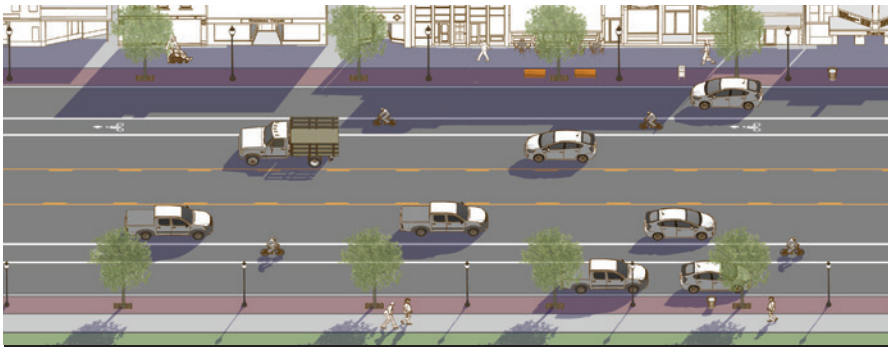
For more information, refer to the FHWA Separated Bike Lane Planning and Design Guide 2015.



STREETSCAPE EXPANSION WITH BIKE LANES

Removing over-capacity lanes creates opportunities for not only bike lanes, but streetscape expansion as well.

Refer to the FHWA Road Diet Guide 2014 for more information on roadway reconfiguration, and the ITE Walkable Urban Thoroughfares Guide 2010 for more information on sidewalk configuration.



Bridges

Bridges are critical connections in any transportation network. Due to the high cost of bridge replacement or upgrades and the various existing and constrained bridge designs that exist, it is not always possible to have continuity in design approaches for multimodal facilities on bridges. It may take decades for older bridges to be replaced with a design that supports walking and bicycling. Rehabilitation existing bridges presents opportunities for reconfiguring bridge decks and structures to better accommodate all the modes that need to use the connection in the network. The overall strategy for accommodating people walking and bicycling on bridges may vary depending on whether the bridge is being reconfigured, retrofitted, or replaced.

REQUIREMENTS

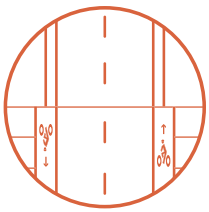
"In any case where a highway bridge deck being replaced or rehabilitated with Federal financial participation is located on a highway on which bicycles are permitted to operate at each end of such bridge, and the Secretary determines that the safe accommodation of bicycles can be provided at reasonable cost as part of such replacement or rehabilitation, then such bridge shall be so replaced or rehabilitated as to provide such safe accommodations" (23 U.S.C. 217(e)). Although this requirement only mentions bicycles, DOT encourages States and local governments to apply this same policy to pedestrian facilities as well.

Separation

Bridges are constrained areas where pedestrians and bicyclists have less flexibility to operate. As such, separation becomes more important than along roadway segments.

Awareness

Signing, marking and active warnings can alert all users to a change in condition or of an active condition needing heightened attention.

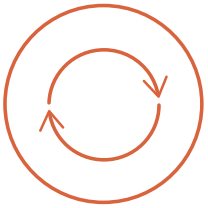


Future Proof

People bicycling and walking should be assumed users of any new or replacement bridge structure. A bridge replacement or rehabilitation project may create an opportunity to provide a new pedestrian and/or bicycle facility that does not necessarily connect to existing facilities. Provide temporary connections from the roadway to the new bridge facilities until the roadway can be permanently upgraded. Providing facilities during construction is less expensive than retrofitting them later.

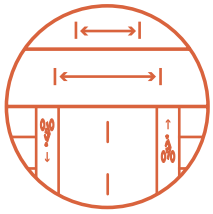
Prioritize

A single major barrier such as a narrow bridge can render an otherwise attractive bikeway or pedestrian route undesirable.



Continuity

Facilities should maintain a consistent alignment across the bridge. Solutions that require users to transition from one side of the road to the other are unlikely to be embraced.



Flexibility

Retrofitting pedestrian and bicycle facilities on bridges presents special challenges because it may be impractical to widen an existing bridge. Evaluate options that can provide space for people walking and/or bicycling without roadway widening.

Bridges

Ferndale, California

POPULATION 1,362

Fernbridge is a historic, two-way vehicle bridge with no shoulder space for bicyclists. The California Department of Transportation added a push button, which bicyclists activate prior to crossing the bridge. The push button activates a flashing beacon notifying motorists that a bicyclist is using the bridge and occupying the vehicle lane. The buttons and beacons are solar powered which reduced installation costs.

Boonville, Missouri

POPULATION 8,370

The Boonslick Bridge, located on State Highway 40, features a sidepath separated from motor vehicle traffic by a concrete barrier. The bridge crosses the Missouri River, connecting Boonville on its southern bank with Franklin (pop 97) and New Franklin (pop 1,100) on its northern bank.

Centerville, California.

POPULATION 362

Constructed at a cost of $369,000, the Clear Creek Bridge provides a cantilevered bridge connection between two trail networks for equestrians, hikers, and mountain bikers as well as providing a secure crossing for commuting bicyclists. This project was a joint effort by Western Shasta Resource Conservation District, the Bureau of Land Management, and Shasta County. The project was funded by the California Natural Resources Agency.

Additional case studies and policy recommendations can be found in **FHWA's Pedestrian and Bicycle Information Center white paper: "Improving Pedestrian and Bicycle Connectivity during Rehabilitation of Existing Bridges" 2016**.

While pedestrian facilities on bridges are more difficult to design due to space limitations, "provisions should always be made to include some type of walking facility as part of vehicular bridges" (AASHTO, Guide for the Planning and Design of Pedestrian Facilities, 2004, p. 63).

Bridges

BRIDGE RECONFIGURATION

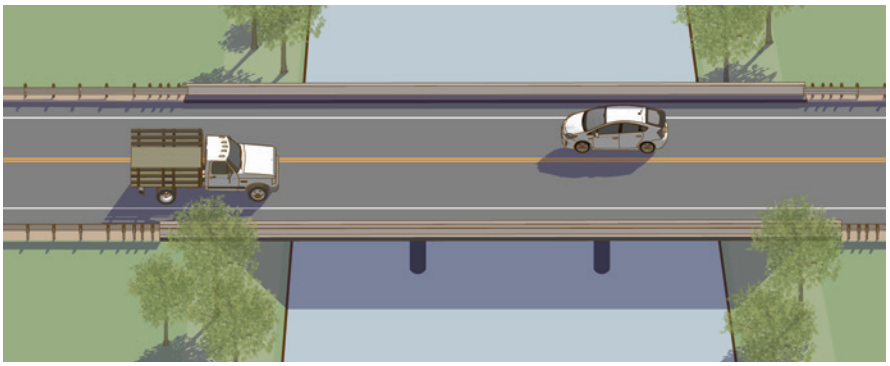
Rehabilitation generally fall into one of two categories, bridges that have some potential for space reconfiguration, and those that are so constrained that there is little to no potential to achieve separated pedestrian and/or bicycle space without widening the bridge.

This sidewalk was installed over the existing bridge deck during a rehabilitation project.

Figure 5-10. *The following concepts illustrate potential design options for retrofitting existing bridges for increased multimodal accommodations.*

EXISTING CONDITIONS

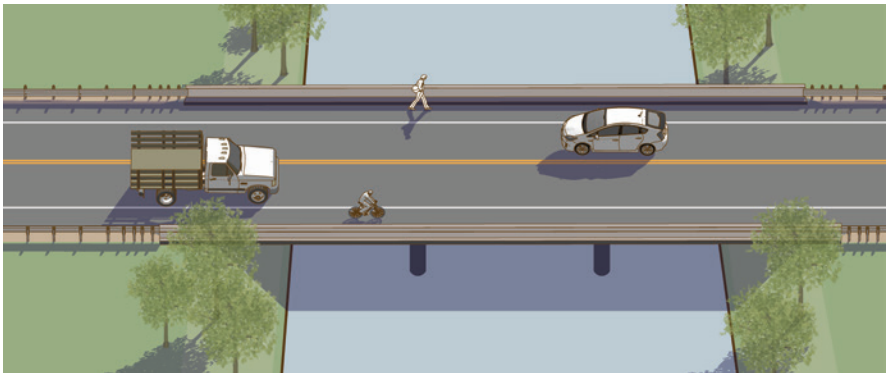
Candidate bridges have travel lanes greater than 11 ft (3.3 m), or some form of existing but substandard pedestrian facility or shoulder space. Many older bridges have narrow, 2 or 3 foot wide curbs where pedestrians may be walking.



Bridges

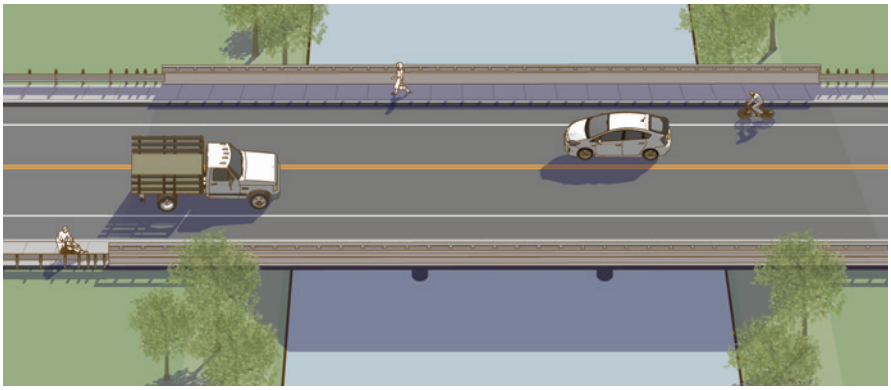
WIDEN SHOULDERS

Remove narrow or substandard sidewalks in favor of widened shoulder space. This may add flexibility and functionality for users. Shoulder space must meet accessibility guidelines if intended for pedestrian use.



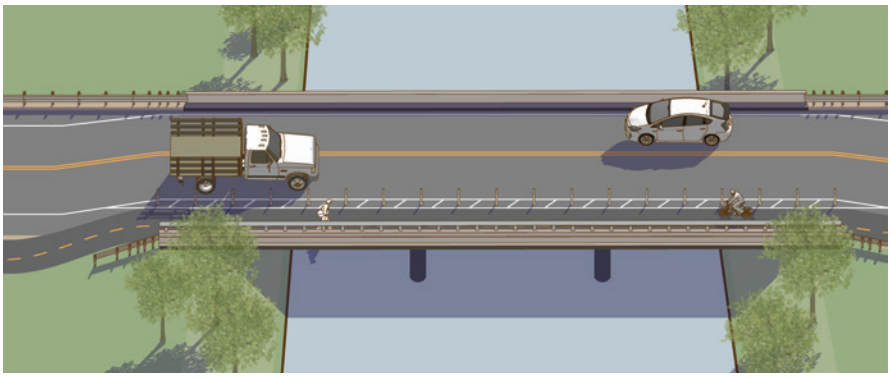
WIDEN SIDEWALKS

Where additional width is available, extend or replace sidewalks into the shoulder, or wide travel lane space to create adequate width. Sidewalks should be 5 ft minimum and be as wide as possible. Ramps at the ends of the bridge facilitate pedestrian and bicycle access.



ON DECK SIDEPATH

Where a sidepath or sidewalk exists that focuses all bicycle and pedestrian traffic on one side of the roadway it may be possible to reduce lane width and shift the travel lanes to create enough space for a shared use path on one side of the bridge deck. Provide a barrier if possible between the travel lanes and the sidepath. Bicyclists riding with traffic on the opposite side of the road from the sidepath may not be able to be accommodated with this scenario without creating a shared lane.



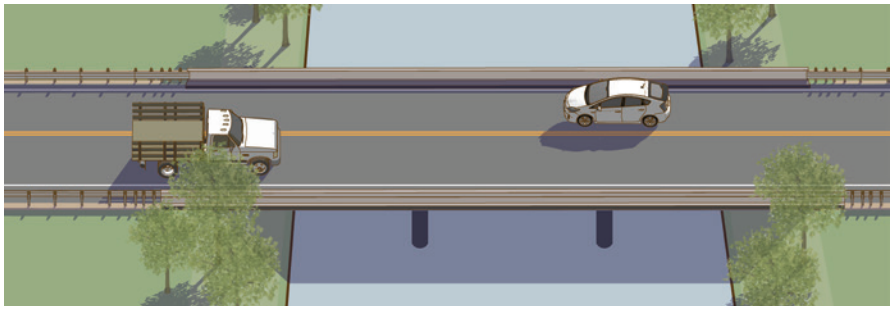
Bridges

CONSTRAINED BRIDGE

Figure 5-11. *The following concepts illustrate potential design options for retrofitting highly constrained bridges.*

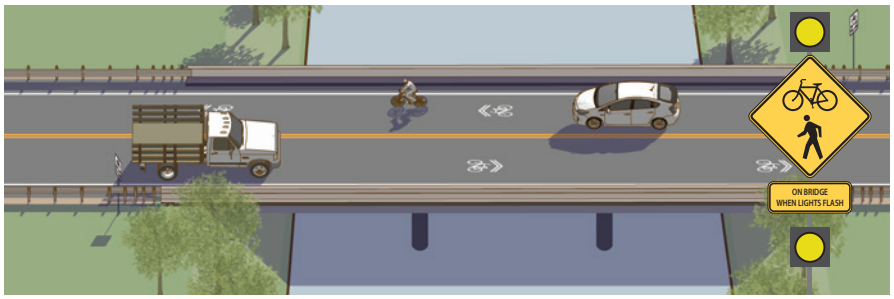
EXISTING CONDITIONS

Some bridges may be so narrow (26 ft or less) as to make any reconfiguration option impossible or too narrow to be of value. Sufficient existing space is only provided for a single travel lane in each direction. No functional sidewalks or shoulders are present.



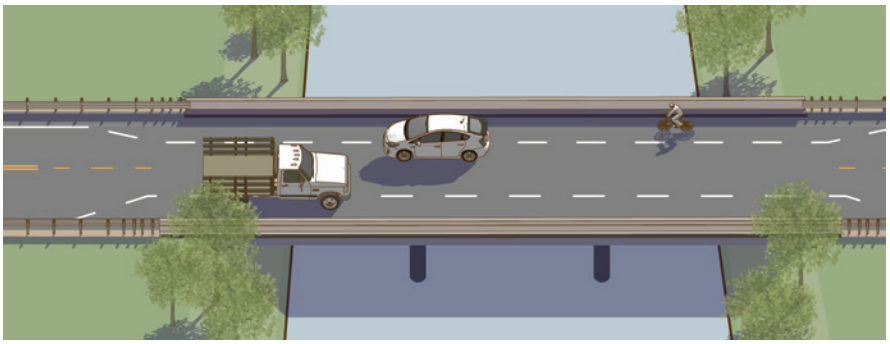
MARKINGS, SIGNS, AND BEACONS

Active warning beacons, R4-11 signs and SLMs may be used to alert bridge users to the likely presence of bicyclists on the roadway. For increased bicyclist comfort, consider reduced or advisory speed limits on the bridge.



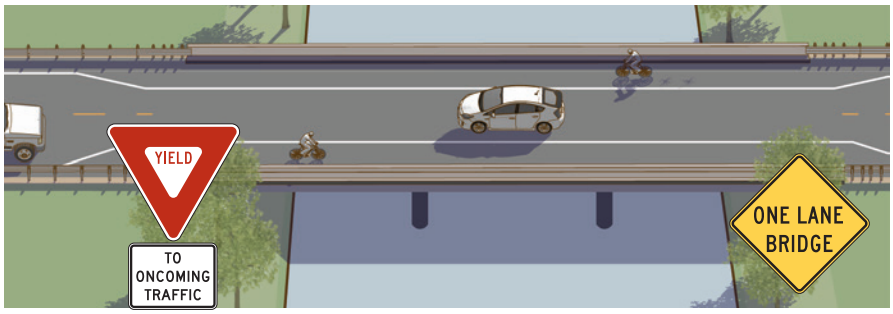
ADVISORY SHOULDERS

Establishing advisory shoulders on the bridge creates dedicated pedestrian and/or bicycle space within the same roadway width. Refer to the guidance on advisory shoulders for additional context.



ONE LANE BRIDGE

Along roadways with low motor vehicle volumes and adequate sight distance, configuring the structure as a one-lane bridge can provide an exclusive separated space for pedestrians and bicyclists. Refer to the FHWA MUTCD section 2C.21.

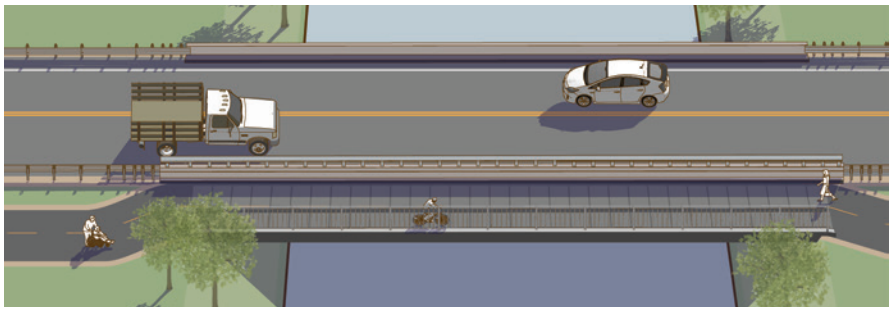


Bridges

CANTILEVERED SIDEPATH

Where other on-deck retrofit strategies are impractical, it may be possible to cantilever a path on one or both sides of the bridge structure.

Refer to the *AASHTO Bike Guide 2012* Section 4.12.3



Cottonwood, CA–Population 3,316

This bridge was reduced to one lane for structural loading reasons; however, this one-lane bridge does offer space for pedestrians to cross the bridge where no space existed.

Farmington, UT–Population 21,599

This bridge, being too narrow to provide dedicated facilities, was given sharrows and "bikes may use full lane" signage in Farmington, UT.

Bridges

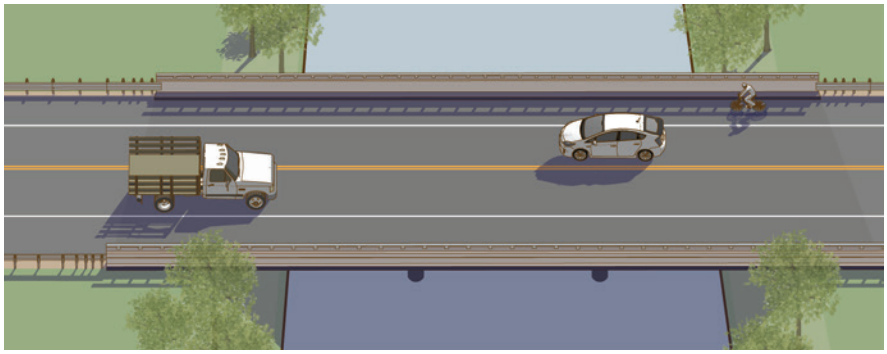
BRIDGE RECONSTRUCTION

New bridges or bridge reconstruction projects offer an opportunity to integrate high-quality and comfortable facilities for people walking and bicycling.

Figure 5-12. *The following concepts illustrate potential design options to consider when reconstructing bridges.*

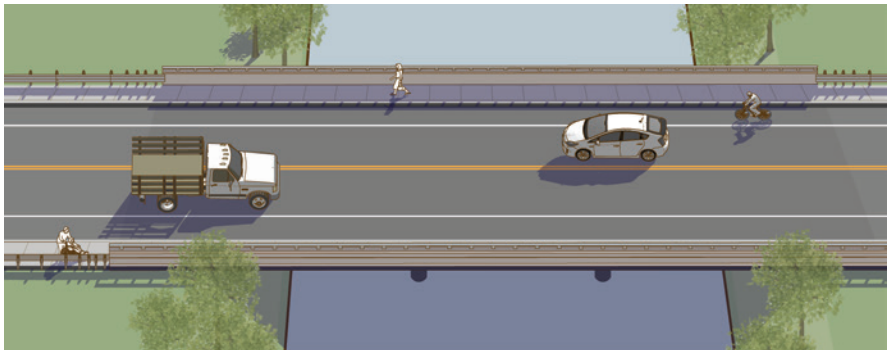
WIDE SHOULDERS

Bridges in areas with little or no pedestrian activity should have wide shoulders maintained across the bridge, even if the roadway is currently lacking them. Wide shoulders should be designed with cross-slopes less than 2 percent if pedestrians are to be accommodated, and 8 ft (2.4 m) is the desirable minimum for comfortable shoulder use by bicyclists and pedestrians. Consider marking the shoulder as a bike lane with buffers if sufficient width is available.



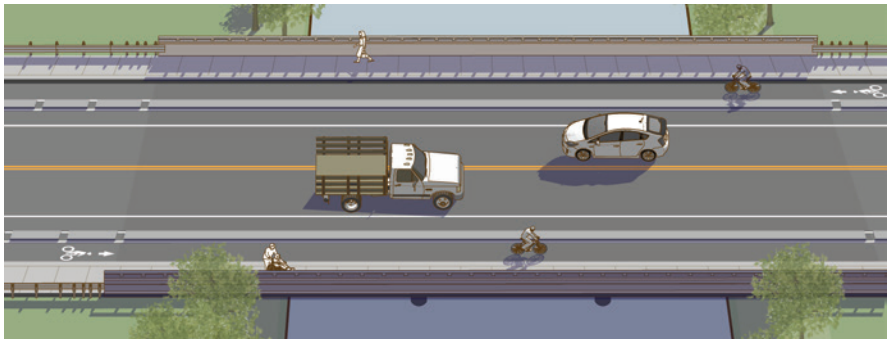
SIDEWALKS AND SHOULDERS

New bridge decks in areas that experience pedestrian use should be given sidewalks with a desired minimum of 6 ft (1.8 m) in width. Shoulders serving bicyclists should follow AASHTO guidance and be 5 ft (1.5 m) in width minimum.



SEPARATED BIKE LANES AND SIDEWALKS

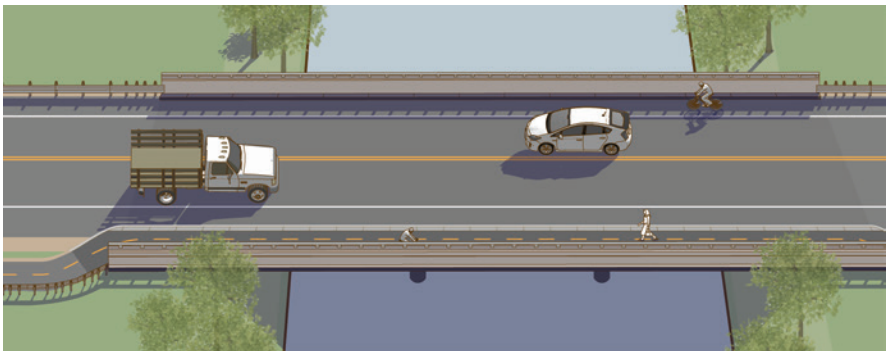
Bridges in built-up areas that experience significant numbers of bicyclists and pedestrians may benefit from separating user types through the use of a separated bike lanes and sidewalks.



Bridges

SHARED USE PATHS

Bridges along roadways with sidepaths, or roadways with planned sidepaths should be designed to maintain continuity. This configuration may also be desirable to provide greater separation from vehicle traffic for people bicycling over the bridge even if there is no sidepath along the corridor. This may be advantageous in built-up areas where bicyclists will have a greater variety of skills and comfort tolerances.



Decorah, IA–Population 8,127

Unincorporated Tehama County, CA–Population 63,463

The Bowman Bridge is a new bridge that integrates wide shoulders with designs from the Nomkaki tribe.

Access to Public Lands

Gateway National Recreation Area

WHAT MAKES PUBLIC LANDS UNIQUE?

Public lands:

- Are often scenic places where people may be more motivated to walk and bike.
- May draw many visitors from other places, creating more support and opportunities for partnerships.
- Offer opportunities for different funding sources, such as the Federal Lands Access Program.

Public lands make up a significant portion of the nation's land area. Federal lands alone make up almost 30 percent of the land in the United States. National parks, forests, wildlife refuges, and the Bureau of Land Management (BLM) lands, State and County parks, and other forms of public lands play important roles in the economies of many rural communities and small towns across America. Improved walking and bicycling access to public lands can also provide opportunities for physical activity in communities. There is increasing interest from public land managers and gateway communities in providing more options for people to access and experience public lands by foot and bike—creating more seamless multimodal transportation networks.

Federal Lands Transportation Program

The Federal Lands Transportation Program (FLTP) was established under the Moving Ahead for Progress in the 21st Century Act (MAP-21) and continued under the Fixing America's Surface Transportation (FAST) Act (23 U.S.C. § 203), to improve transportation facilities for the following Federal Land Management Agency (FLMA) partners:

- National Park Service (NPS)
- Fish and Wildlife Service (FWS)
- USDA Forest Service (USFS)
- Bureau of Land Management (BLM)
- US Army Corps of Engineers (USACE)
- Bureau of Reclamation (BOR), and
- Independent Federal Agencies with natural resource and land management responsibilities (IFAs)

Federal Lands Access Program

The Federal Lands Access Program (FLAP) was established in 23 U.S.C. 204 to improve transportation facilities that provide access to, are adjacent to, or are located within Federal lands. The Access Program supplements State and local resources for public roads, transit systems, and other transportation facilities, with an emphasis on high-use recreation sites and economic generators.

FLAP funded projects have to contain title or maintenance responsibilities vested in a State, county, town, township, tribal, or local government. This requirement leverages partnerships and recognizes the mutual benefit of the projects.

Funds are allocated among the States using a statutory formula based on road mileage, number of bridges, land area, and visitation. Projects are selected by a Programming Decision Committee (PDC) established in each State. The PDCs request project applications through a call for projects. The frequency of the calls is established by the PDCs.

Access to Public Lands

North Moab Recreation Area Alternative Transportation System

Moab, Utah

POPULATION 5,000

This community has evolved from a mining town to a recreation-based economy attracting 2.5 million visitors annually. In 1999, a coalition of public and private agencies initiated the North Moab Recreation Area Alternative Transportation System project in response to congestion and safety concerns due to growing visitation. This project expands the walking and biking network, enabling transportation by nonmotorized modes. The entire project is just under $12 million and has resulted in about 12 miles of shared use paths, a bike and pedestrian bridge over the Colorado River, transit hubs, and 14 miles of wide shoulders. This infrastructure connects Moab to the Colorado River way, Arches National Park, Deadhorse Point State Park, Canyonlands National Park, and popular trailheads and campgrounds on BLM lands.

Moab Canyon Wayfinding

Colorado Riverway Path near Moab

Colorado Riverway Path near Moab

MORE INFORMATION AT:

Partnership Case Study: North Moab Recreation Area Alternative Transportation Project, 2010

http://www.fedlandsinstitute.org/ResourceLibrarySearch/Repository.aspx

North Moab Recreation Area Connections, 2013.

Access to Public Lands

Leelanau County, Michigan

SLEEPING BEAR HERITAGE TRAIL

The Sleeping Bear Heritage Trail will provide a 27-mile nonmotorized multi-use route through the National Park Service Sleeping Bear Dunes National Lakeshore that will connect the Lakeshore's primary visitor destinations with the small gateway communities of Glen Arbor and Empire. The trail will measure 10 ft wide and have 2-foot shoulders, and the surface will alternate between asphalt and smoothly compacted crushed limestone. The Sleeping Bear Heritage Trail was conceived by the Leelanau Scenic Heritage Route (LHRS) Committee, which is made up of representatives from NWMCOG, all the townships, villages, and cities along the Leelanau County portion of M-22, M-204, M-109 that makes up the Heritage Route. Trail development is a partnership between the LSHR Committee, the Michigan Department of Transportation, Sleeping Bear Dunes National Lakeshore, Friends of Sleeping Bear Dunes, and TART Trails. Funding for trail development comes from Federal and State grants, foundations, and individual donations.

Boulder County, Colorado

RURAL ROAD STANDARDS

Boulder County in Colorado has ten incorporated towns and is mostly rural. Forest Service lands in the mountains nearby are popular destinations. The County's paved road standard has been widened from 24 ft to 30 ft for collectors or 32 ft for minor arterials. That allows the County to stripe 11-foot lanes on rural roads, leaving 4 ft or 5 ft for shoulders to be used by all types of users, including people biking and walking. A key to success for Boulder County is emphasizing flexible-use facilities that respond to local context and needs, rather than labeling them as bike facilities or another specific user group. "Multimodal Mobility Transportation facilities shall be designed and constructed so as to maximize the mobility of people, goods, and services by multiple transportation modes, including motorized vehicles, bicycles, pedestrians, and transit." (*Boulder County Multimodal Transportation Standards 2012*).

Three Forks, Montana

HEADWATERS TRAILS SYSTEM

The City of Three Forks is located in Gallatin County and has a population of 1,869 (2010 Census). Two of Three Forks' unique assets are the historic Sacajawea Hotel and the Missouri Headwaters State Park. The former Mayor Gene Townsend and the City of Three Forks have worked over the years to create the Headwaters Trail System to connect to these and other key destinations within the community. Thus far, 8.5 miles of paved shared use path have been built, including two bicycle and pedestrian bridges. Details on how this small town developed an exceptional trail system, including installation of a recycled bridge may be found in the 2012 Montana Complete Streets Toolkit.

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FOOTNOTES

i In the MUTCD, pedestrian lanes may be considered a type of preferential lane. "Preferential lanes are established for one or more of a wide variety of special uses, including but not limited to, high-occupancy vehicle (HOV) lanes, ETC lanes, high-occupancy toll (HOT) lanes, bicycle lanes, bus only lanes, taxi only lanes, and light rail transit only lanes" (2009, p. 415).

ii Section 3B.20 in the MUTCD states that "Word, symbol, and arrow markings on the pavement are used for the purpose of guiding, warning, or regulating traffic" (2009, p. 389). Preferential lane word markings are specifically identified for use, and PED ONLY word markings may qualify.

The MUTCD also states that "Symbol messages are preferable to word messages," although pedestrian markings are not specifically included in the "Standard Highway Signs and Markings" book.

iii The National Center for Safe Routes to School (2011). *How Children Get to School: School Travel Patterns from 1969 to 2009*. Retrieved from http://saferoutesinfo.org/sites/default/files/resources/NHTS_school_travel_report_2011_0.pdf.

iv Active Living Research. *Walking & Biking to School*. http://activelivingresearch.org/sites/default/files/Infographic_WalkBikeToSchool_Regional.pdf.

v Gordon, Serena. *Child Obesity Soaring in Rural America*. U.S. News & World Report. April 9, 2010. Retrieved from http://health.usnews.com/health-news/family-health/childrens-health/articles/2010/04/09/child-obesity-soaring-in-rural-america.

vi Lutfiyya, M.N., et al. *Is rural residency a risk factor for overweight and obesity for U.S. children?* Obesity. 2007. Retrieved from http://onlinelibrary.wiley.com/doi/10.1038/oby.2007.278/epdf.

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Photo by Tom Robertson, Adventure Cycling Association

Planning and Project Development

The Transportation Planning Process

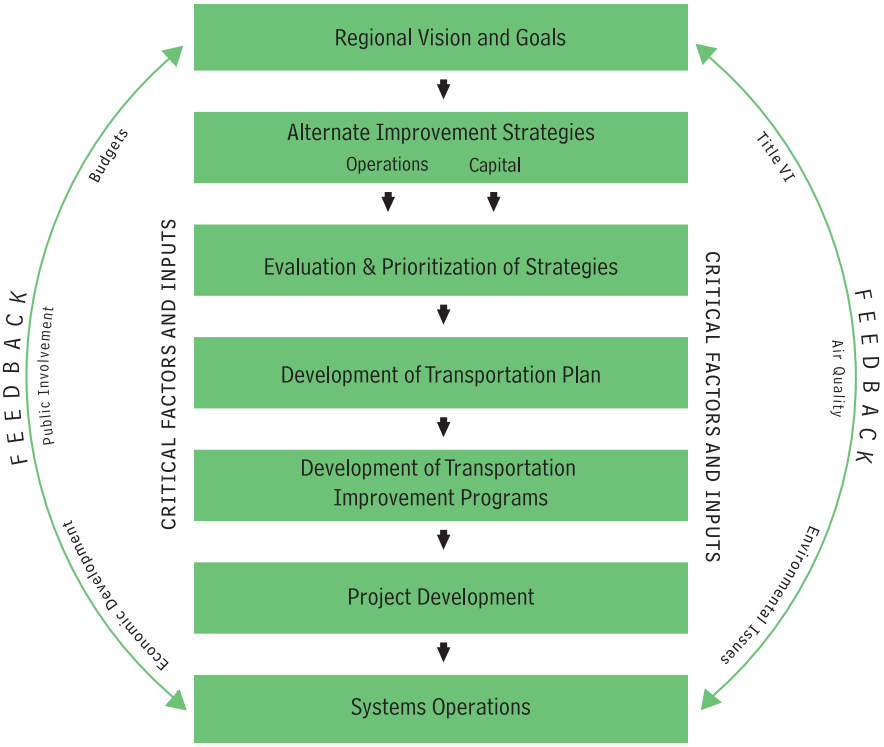
This chapter is intended to ecourage the reader to understand their local, regional, and state process is and what the entry points are for improvements. It is also intended to emphasize the ultimate goal of "mainstreaming" bike and pedestrian planning so that these projects can be systematically and integrally considered alongside motorized enhancements.

Transportation planning is a continuing, cooperative, and comprehensive process that uses a performance-driven approach for decision making. Public agencies that are responsible for the operation, maintenance, and development of transportation systems and facilities work cooperatively to determine long and short-range investments. Public agencies at all scales, from small towns, transit authorities, Metropolitan Planning Organizations (MPOs) to State Departments of Transportation, carry out planning, with active involvement from the traveling public, the business community, community groups, environmental organizations, and freight operators. Figure 6-1 illustrates the development of products and activities within the transportation planning process.

Transportation planning is critical to creating multimodal networks for all users. Jurisdictions employ a system for categorizing roads by function, and the number of vehicles it can accommodate. However, this approach may not always consider the need for active transportation facilities that provide multimodal connections to jobs and essential services. The planning and design of the transportation network should take a comprehensive approach to the various roadway types of arterial, collector, and local roads and associated active transportation facilities that can be implemented with them. The State is required to consult with affected nonmetropolitan local officials to determine projects that may be of regional significance.

This document includes a number of strategies tailored for small town and rural contexts, for consideration during the transportation planning process. The process itself should address local conditions, regional connections, opportunities, and challenges, and consider the needs of the all people in the study area. Gathering demographics of the study area can provide essential information about the travel needs of the community. Nearly one-third of the general population includes residents that are too young or old to drive, are disabled, traditionally underserved, or don't have access to a vehicle. It is critical that transportation planning efforts pay significant attention to these populations and tailor public involvement strategies to involve these groups, even though they may be difficult to reach through traditional public involvement strategies. Flexibility requires consideration of all transportation users; in some unique rural regions user consideration may include safe access for horse-drawn buggies. Other considerations may include providing safe passage for school students, addressing the needs of tourists, and ensuring access for people with disabilities.

Figure 6-1. *The Transportation Planning Process*



Steps in the Transportation Planning Process

- **Engaging** the public and stakeholders to establish shared goals and visions for the community.
- **Monitoring** existing conditions and comparing them against transportation performance goals.
- **Forecasting** future population and employment growth, including assessing projected land uses in the region and identifying major corridors of growth or redevelopment.
- **Identifying** current and projected transportation needs by developing performance measures and targets.
- **Analyzing** various transportation improvement strategies and their related tradeoffs using detailed planning studies.
- **Developing long-range plans and short-range programs** of alternative capital improvement, management, and operational strategies for moving people and goods.
- **Estimating** how recommended improvements to the transportation system will impact achievement of performance goals, as well as impacts on the economy and environmental quality, including air quality.
- **Developing a financial plan** to secure sufficient revenues that cover the costs of implementing strategies and ensure ongoing maintenance and operation.

Within the transportation planning process it is critical to provide a well-vetted strategy for addressing mobility for all users of the transportation system. Performance measures and targets should be identified to track this progress and monitored over time. Connected networks should be defined that service key destinations whether someone is driving, walking, bicycling, or taking transit (if available). Through flexibility in design a variety of ages and abilities should be accommodated.

PLANWORKS: BETTER PLANNING. BETTER PROJECTS.

PlanWorks is a web resource that supports collaborative decision-making in transportation planning and project development. PlanWorks is built around key decision points in long-range planning, programming, corridor planning, and environmental review. PlanWorks suggests when and how to engage cross-disciplinary partners and stakeholder groups. This system can help build consensus throughout these processes. Featured in PlanWorks is an application focused on Bicycles and Pedestrians, available at https://fhwaapps.fhwa.dot.gov/planworks/Application/Show/17.

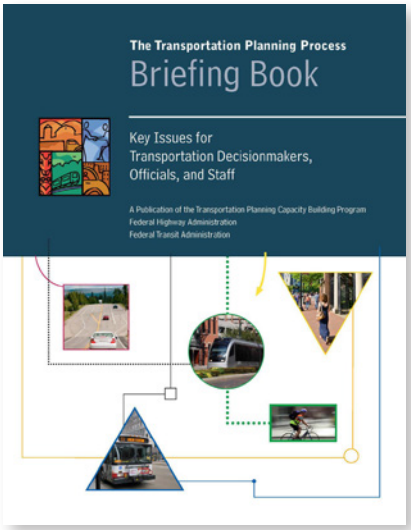


Figure 6-2. *The Transportation Planning Process Briefing Book*

This application is intended to help Metropolitan Planning Organizations, State Departments of Transportation, and other partners fully integrate pedestrian and bicycle planning and design into the formal transportation planning and project development processes. It provides detailed information on how agencies can incorporate multimodal transportation into specific key decisions. It identifies how the user can incorporate information on multimodal transportation into specific key decisions.

Key Products in the Transportation Planning Process

Planning for multimodal small town and rural networks should be integrated into every level of transportation planning. Plans should be as consistent as possible with clear policies to reference local plans before implementing a project. Project descriptions should be detailed enough to glean the full intended roadway configuration and character and not limited to functional classification or lane configuration. The presence of sidewalks, sidepaths, shoulders, or other active transportation facilities should be clearly highlighted. Potentially relevant planning processes include:

- **The Unified Planning Work Program:** The UPWP lists the transportation studies and tasks that MPO staff and member agencies will perform to support the metropolitan transportation planning process. It must identify the funding source for each project, the schedule of activities, and the agency or agencies responsible for each task or study. UPWPs reflect issues and strategic priorities unique to each metropolitan area and will differ by MPO.
- **The Metropolitan Transportation Plan:** In metropolitan areas, the MTP identifies how the region intends to invest in the transportation system. Federal law requires the plan, include both long-range and short-range program strategies or actions that lead to the development of an integrated intermodal transportation system that facilitates the efficient movement of people and goods.
- **Transportation Improvement Program:** MPOs use a TIP to identify transportation projects and strategies they will pursue over the next four years. These projects reflect the investment priorities detailed in the MTP. TIPs list the immediate program of investments that, once implemented, will go toward achieving the performance targets established by the MPO and documented in the MTP. In short, a TIP is a region's means of allocating its transportation resources among the various capital, management, and operating investment needs of the area, based on a clear set of short-term transportation priorities prepared through a performance-driven process. All projects receiving Federal funding must be in the TIP.
- **The Long-Range Statewide Transportation Plan:** State DOTs cooperate with nonmetropolitan area local officials to develop an LRSTP using a performance-driven process based on an agreed upon set of performance measures and targets. Plans are prepared with active engagement with the public and stakeholders and will vary by State. LRSTPs may be either policy-oriented strategic plans, or project–focused investment plans that include lists of recommended projects.
- **Statewide Transportation Improvement Program:** The STIP is similar to the TIP in that it identifies the immediate short-range priorities for transportation investments statewide and must be fiscally constrained. Through an established process, State DOTs work with local officials to identify projects across rural areas, small urban areas called urban clusters (with 2,500 to 49,999 people), and urbanized areas. Projects are selected for the STIP based on adopted procedures and criteria. As noted above, TIPs developed by MPOs must be incorporated, directly or by reference and without change, into the STIP.
- **Public Involvement Process (PIP) and Public Participation Plans (PPP):** States must involve the general public and all other affected constituencies in the essential functions listed above. MPOs and States engage the public and stakeholder communities as they prepare procedures that outline how the public will be advised, engaged, and consulted throughout the planning process. MPOs prepare public participation plans (PPPs), which describe how the MPO involves the public and stakeholder communities in transportation planning. The MPO also must periodically evaluate whether its public involvement process (PIP) is still effective. Similarly, States prepare documented public involvement processes that describe the occasions, procedures, and intended outcomes of public engagement in statewide and nonmetropolitan transportation planning.

What are the Key Products of the Transportation Planning Process?

Federal requirements call for agencies to deliver several key groups of documents as part of the transportation planning process, including (1) *Planning Work Programs*, which include Unified Planning Work Programs (UPWPs) prepared by MPOs and State Planning and Research Work Programs prepared by States; (2) *Transportation Plans*, which include MTPs prepared by MPOs and Long Range Statewide Transportation Plans (LRSTPs) prepared by States; and (3) *Transportation Improvement Programs (TIPs)*, which include Metropolitan TIPs prepared by MPOs and Statewide TIPs prepared by States.

Regional Planning Organizations (RPO) and Regional Transportation Planning Organizations (RTPO) are organizations that identify local transportation needs, conduct planning, assist local governments, and support the statewide transportation planning process in nonmetropolitan regions of a State.

RPOs and RTPOs may carry out the following planning tasks:

- Preparation of a Regional Long-Range Transportation Plan (LRTP)
- Preparation of a Regional Transportation Improvement Program (TIP)
- Coordination of local planning, land use, and economic development
- Provision of technical assistance to local officials
- Participation in national, multi-State, and State policy and planning development processes

Table 6-1. *The key transportation planning products.*

	Who Develops?	Who Approves?	Time Horizon	Content	Update Requirements
UPWP	FHWA/FTA/ MPO	MPO	1 or 2 Years	Planning Studies and Tasks	At Least Once Every 2 Years
MTP	MPO	MPO	20 Years	Future Goals, Strategies, and Projects	Every 5 Years 4 years for nonattainment and maintenance areas
TIP	MPO	MPO/ Governor	4 Years	Transportation Investments	Every 4 Years
LRSTP	State DOT	State DOT	20 Years	Future Goals, Strategies, and Projects	Not Specified
STIP	State DOT	FHWA/ FTA	20 Years	Transportation Investments	Every 4 Years
PIP	State DOT	State DOT	Not Specified	Public Engagement Strategies and Goals, Incorporating Input, Responding to Comments	Periodic Review and Update
PPP	MPO	MPO	Not Specified	Public Engagement Strategies and Goals, Incorporating Input, Responding to Comments	Periodic Review and Update

- Facilitation of a forum for public participation in regional and Statewide planning
- Coordination of plans and programs with neighboring RPOs and RTPOs and Metropolitan Planning Organizations and tribal organizations

Benefits that can be achieved by coordination with RPOs and RTPOs

- Conducting duties that support and enhance the Statewide planning process
- Providing a forum for public participation in nonmetropolitan areas
- Insuring the regional and local input of nonmetropolitan areas
- Fostering coordination of local planning, land use, and economic development plans with transportation plans and programs at the State, regional, and local levels
- Cooperating on the development of the Statewide Transportation Plan
- Consulting on the development of the Statewide Transportation Improvement Program in the non-metropolitan areas of the State

For more information, visit www.planning.dot.gov/focus_rural.asp and www.fhwa.dot.gov/planning/processes/rural

U.S. Department of Transportation

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