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Appendix A: Design Guidance

There is no single design manual that comprehensively covers the spectrum of trails and active transportation facilities. Additionally, it is challenging for small cities to have the staff resources to know the intricate details of the many design guides and plans that exist. This leads to project design results that may fall short of desired goals or limits what a city considers when it designs a project. This section summarizes the prevailing state and federal publications that the City of Livingston should use when designing the various trails, bikeways, sidewalks, and street crossing projects.

Project consultants who do general civil engineering work or focus primarily on highway projects may not be aware of the many design manuals they have at their disposal. Incorporating other design manuals helps them design the safest possible project for the people of Livingston, in consideration of many factors and tradeoffs.

Even statewide agencies like MDT do not have a full library of the federally-endorsed design guides that pertain to trails and active transportation projects. While MDT's Roadway Design Manual for pedestrian and bicyclist facilities is pretty solid and reflects many modern design treatments, it does not address every situation within a small city like Livingston.

It is important to note that very few design manuals consist of actual "standards," as there is plenty of flexibility built into how streets are designed. Even the design guide commonly referred to as the AASHTO Green Book (formal title: *A Policy on the Geometric Design of Highways and Streets*) is only guidance and contains no mandated standards.

This is important to understand when retrofitting existing streets to provide safer conditions for people who walk and bike. The Green Book contents are often referred to as "AASHTO standards" and used to imply there is no flexibility contained within it. The opposite is true. For example, there is no AASHTO standard that motor vehicle travel lanes be 12-feet wide (a common design outcome). The AASHTO Green Book states that arterials within cities may have motor vehicle travel lanes ranging from 10-feet wide to 12-feet wide. Additionally, there is not AASHTO standard for motorist level of service, which is oftentimes cited as a requirement to ensure a certain level of motorist convenience and may be used to deny safer conditions for people who walk and bike (e.g. a pedestrian signal for crossing a major street).

Cities and agencies like MDT may take elements of publications like the Green Book and other documents and crate their own policies or design standards. Even within those, there is ample flexibility for engineering judgment to deviate from such policies or standards when local conditions require a unique approach to solve a design problem. When this occurs, engineers should document their reasoning, as the case law pertaining to road design places a higher emphasis on engineers documenting why designs may have deviated from an adopted policy or standards than they on an engineering strictly adhering to a standard.

Most of the Design Guides cited in this Appendix are available for free download. Links are provided.

AASHTO's design guides must be ordered from that organization and are available in both hard copy and PDF format. The City should acquire a copy of these guides and local non-profits may work with the Library to buy them for their reference desk.

Montana Pedestrian and Bicycle Plan

The MDT statewide plan for pedestrians and bicyclists was completed in 2019. While not a formal design guide, the plan serves as a launching point for working with MDT to get pedestrian and bicyclist crossings of Park Street and MDT urban routes within the City. Many of the design guides referenced in this Appendix section are identified as resources in the MDT Pedestrian and Bicyclist Plan.

A key component of the plan is *Goal 1: Reduce pedestrian and bicyclist fatalities and serious injuries in support of Vision Zero*. Supportive statements that help Livingston achieve the goals of the Trails and Active Transportation include:

- Advanced crossing treatments (e.g. RRFBs, PHBs) at unsignalized intersections along major roadways where appropriate.
- Intersection designs such as roundabouts and protected intersections where appropriate.
- Curb extensions, where appropriate, to reduce crossing distance and improve visibility of pedestrians.
- Sidewalk and bike lane widths greater than minimum standards when feasible and appropriate to meet demand.
- Provide boulevards when feasible between sidewalks and the roadway.
- Consider latent demand of pedestrian and bicycle crossings in addition to the number of people willing to cross at an unsafe condition.
- Consider user comfort in design. Treatments that have higher yielding performance or stop traffic will yield a more comfortable crossing.
- Provide appropriate treatments for crossings of major roadways.
- Plow bike lanes and shoulders as part of overall plowing operations.
- Enforce local sidewalk snow removal by property owners.
- Design and construct pedestrian and bicycle facilities to minimize long-term maintenance including locating them outside snow plow debris zones and constructing shared use paths using durable materials.

https://www.mdt.mt.gov/pubinvolve/pedbike/docs/MontanaPedestrianandBicyclePlan_2019.pdf

MDT Road Design Manual: Chapter 7 Multimodal Design Considerations

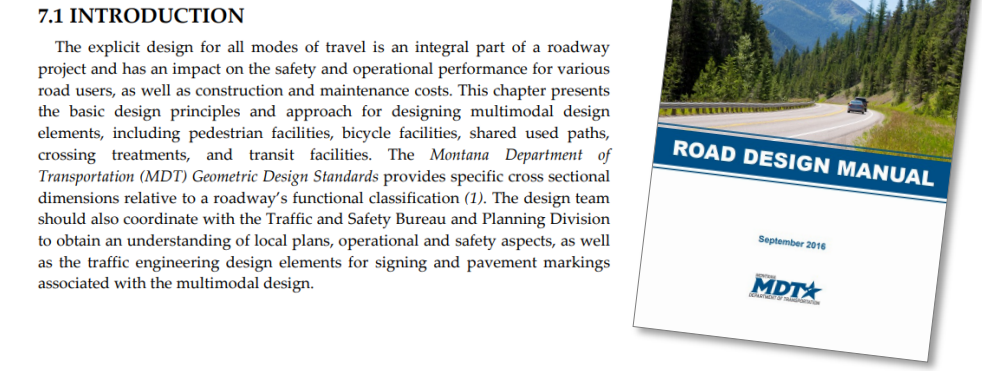
MDT's chapter on multimodal design contains the majority of design considerations of people who walk and bike. It states, "Roadway facilities should be designed and operated to enable safe access for various users, including pedestrians, bicycles, motorists, and transit riders of all ages and abilities.

A fundamental consideration in establishing a multimodal improvement project is an overall vision for the facility tailored toward the specific users, project context, and desired outcome. "

This reflects the process in the Trail and Active Transportation Plan as specific users, context, and desired outcomes, were components of the identification and ranking process.

The chapter contains general descriptions for street treatments for walking and bicycling. It is a good starting point to gain ideas for what treatment may occur along a street and what conditions may point toward a specific treatment.

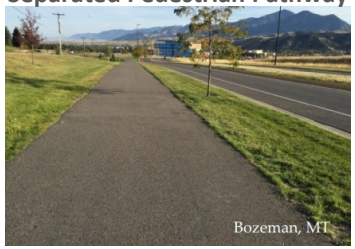
Additionally, the chapter includes references to other federally-endorsed design guides contained in this Appendix. This helps bolster the City's pursuits of funding from federal sources or working with MDT on state-managed routes. They include AASHTO's *Guide for the Planning, Design, and Operation of Pedestrian Facilities* (2004 & 2021) and *Guide for the Development of Bicycle Facilities (2012),* each of which MDT is signatory.



7.1 INTRODUCTION

The explicit design for all modes of travel is an integral part of a roadway project and has an impact on the safety and operational performance for various road users, as well as construction and maintenance costs. This chapter presents the basic design principles and approach for designing multimodal design elements, including pedestrian facilities, bicycle facilities, shared used paths, crossing treatments, and transit facilities. The *Montana Department of Transportation (MDT) Geometric Design Standards* provides specific cross sectional dimensions relative to a roadway's functional classification *(1)*. The design team should also coordinate with the Traffic and Safety Bureau and Planning Division to obtain an understanding of local plans, operational and safety aspects, as well as the traffic engineering design elements for signing and pavement markings associated with the multimodal design.

Separated Pedestrian Pathway

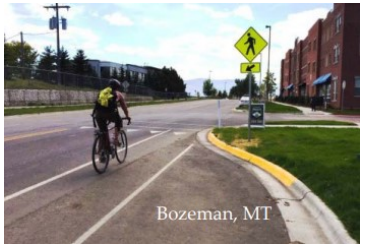


Buffered Bike Lane

Separated Bike Lane

Raised Pedestrian Crossing

Bulbout/Curb Extension



Pedestrian Hybrid Beacon

https://www.mdt.mt.gov/other/webdata/external/cadd/RDM/07-RDM-CH7-Multimodal-Design-Considerations.pdf

MDT Geometric Design Standards

MDT's Geometric Design Standards contain more specific information on the design characteristics of various streets under MDT's authority. The tables shown in this section pertain the most prevalent streets in Livingston.

A major concern within of these design standards is a default to minimum widths for bicyclist and pedestrian facilities. As shown at right under urban minor arterials and urban collectors, a bike lane width is shown as 4 ft. and the footnotes in the MDT document state that this is measured from the face of curb, meaning the typical 12" to 18" gutter pan can be counted in bike lane width even though it is not counted when determining motor vehicle lane width.

Appendix B: Active Transportation Design Gallery has illustrations showing why the gutter must not count when determining bike lane width. See page 25. The reason, supported by the AASHTO Green Book, is there is a seam between the concrete gutter and the asphalt travel lane and that seam poses problems for bicyclist stability.

Design speeds are also dangerously high on these routes, with 35 mph for arterials and 30 mph for collectors in urban settings. Both equate to a high likelihood that a pedestrian or bicyclist will die or be severely injured if hit by a motorist at these speeds.

When working with MDT, through its agreement, to retrofit urban streets within Livingston, the City should be adamant about the need for exceptions to these standards when federal design guidance suggests otherwise.

3.2 Sidewalks

The installation of all new sidewalks will comply with the standards outlined in Exhibit 6. Additional design considerations for pedestrian facilities are provided in Chapter 7 and Chapter 8 of the *RDM*.

Minimum Width [a]	60 inches (for passage) 36 inches (minimum continuous clear width) – ***See additional note below***
Cross Slopes	1V:50H (maximum)
Gradient [b]	5-percent (maximum)
Buffer [c]	18 inches

Note: A minimum sidewalk width of 48 inches is recommended by the AASHTO Guide for Planning, Design and Operation of Pedestrian Facilities (6)

Minimum widths are not recommended. Per FHWA, sidewalks that lack buffers or have building or retaining walls result in a reduced functional width of 18 inches per side where these conditions exist. Design should account for that.

3.5 Urban Minor Arterials [1]

	Design Element		RDM Section	Curbed	Shouldered
Design Control	Design Speed [2]		2.5	35 mph	35 mph
Roadway Elements	Travel Lane Width [3]		5.2	11 ft	
	Minimum Roadway Width		5.2	26 ft [4]	30 ft
	Shoulder Width	Outside	5.2	varies	4 ft
		Inside		N/A	
	Cross Slope	Travel Lane	5.2	2% Typical [5]	2%
		Shoulder		2% Typical [5]	2%
	Minimum Median Width		5.3	Raised: 4 ft [6]	
	TWLTL Width [7]		5.2	11 ft	
	Bicycle Lane Width [8]		5.2	4 ft	
	Parking Lane Width [9]		5.2	10 ft [10]	N/A
Cut Section	Ditch Slope [11]		5.4	4:1	
Alignment Elements [16]	DESIGN SPEED		2.5	35 mph	
	Stopping Sight Distance [12]		2.8	250 ft	
	Intersection Sight Distance [13]		2.8	165 ft	
	Minimum Radius		3.2	371 ft	
	Superelevation Rate [14]		3.3	e_{max} = 4.0%	
	Vertical Curve Length	Crest	See Chapter 4, Section 4.4 of the *RDM*		
		Sag			
	Maximum Grade	Level	4.3	6%	
		Rolling		7%	
		Mountainous		9%	
	Minimum Vertical Clearance [15]		4.5	17.0 ft	

Design speed equated to 50% or higher risk of death for a pedestrian or bicyclist hit at this speed.

4-feet inclusive of gutter does not provide adequate space for a bicyclist to operate next to traffic using a road with a design speed of 35 mph. Bike lane should be 5-feet minimum, exclusive of gutter; wider or buffered, if possible, next to on-street parking. Parking lanes of 8 ft are suitable in most situations.

3.6 Urban Collector Streets [1]

	Design Element		Manual Section	Design Criteria Curbed	Design Criteria Shouldered
Design Control	Design Speed [2]		2.5	30 mph	30 mph
Roadway Elements	Travel Lane Width		5.2	10 ft [3]	
	Shoulder Width	Outside	5.2	0 ft	4 ft [4]
		Inside		N/A	
	Cross Slope	Travel	5.2	2% Typical [5]	2%
		Shoulder		2% Typical [5]	2%
	Minimum Median Width		5.3	Raised: 4 ft [6]	
	TWLTL Width [7]		5.2	11 ft	
	Bicycle Lane Width [8]		5.2	4 ft	
	Parking Lane Width [9]		5.2	8 ft	
Earth Cut Section	Ditch Slope [10]		5.4	4:1	
Alignment Elements [15]	DESIGN SPEED		2.5	30 mph	
	Stopping Sight Distance [11]		2.8	200 ft	
	Intersection Sight Distance [12]		2.8	140 ft	
	Minimum Radius (@ e_{max} = 4%)		3.2	250 ft	
	Spiral Curve Selection		See Chapter 3, Section 3.2		
	Superelevation Rate [13]		3.3	e_{max} = 4.0%	
	Vertical Curve Length	Crest	See Chapter 4, Section 4.4		
		Sag			
	Maximum Grade	Level	4.3	9%	
		Rolling		10%	
		Mt		10%	
	Minimum Vertical Clearance [14]		4.5	16.5'	

Design speed equated to 50% or higher risk of death for a pedestrian or bicyclist hit at this speed.

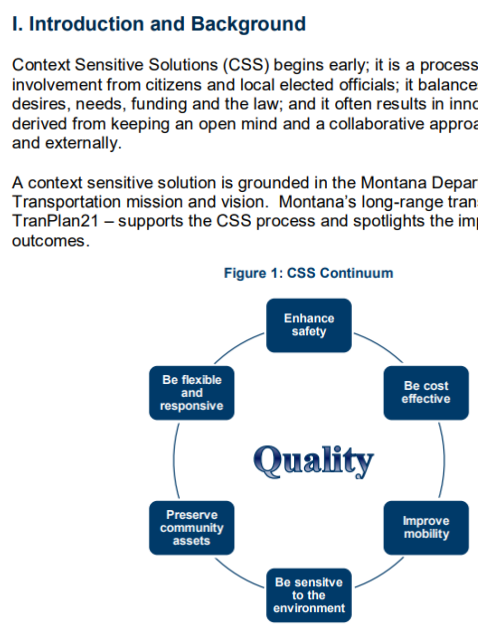
4-feet exclusive of gutter is the minimum preferred width on a street like this, especially in a retrofit. Getting a 5-foot bike lane, exclusive of gutter is preferred, especially when adjacent to on-street parking. Parking lanes of 8 ft are suitable in most instances.

https://www.mdt.mt.gov/other/webdata/external/cadd/RDM/STANDARDS/GEOMETRIC-DESIGN-STANDARDS.pdf

MDT Context Sensitive Solutions Guide

Context Sensitive Solutions (CSS) is a federally-endorsed approach to understanding there is inherent flexibility in road design treatments to align with local interests and the needs of all road users. MDT states that CSS "puts project needs and both agency and community values on a level playing field and considers all trade-offs in decision making based on available funding." MDT's CSS guide includes the following policy statements:

- **Involve local government and citizens.** To help the process get off to the best possible start, include all affected parties (e.g. local government) and those with a partnership interest.
- **Think "outside the box"– innovation is key.** No "cookie cutter" approach is available on exactly how to approach CSS.
- **Listen and keep an open mind.** Be willing to listen to our customers – some of our best solutions come from them. Individuals and communities will have different ideas on what constitutes the ideal context sensitive solution in any given situation.


I. Introduction and Background

Context Sensitive Solutions (CSS) begins early; it is a process needing involvement from citizens and local elected officials; it balances community desires, needs, funding and the law; and it often results in innovative solutions derived from keeping an open mind and a collaborative approach both internally and externally.

A context sensitive solution is grounded in the Montana Department of Transportation mission and vision. Montana's long-range transportation plan – TranPlan21 – supports the CSS process and spotlights the importance of CSS outcomes.

Figure 1: CSS Continuum

https://www.mdt.mt.gov/other/webdata/external/cadd/report_templates_guidance/css_guide.pdf

MDT ADA Transition Plan

MDT's ADA Transition Plan contains several references to federal laws pertaining to ADA compliance. It also contains recommendations that will benefit Livingston in its application of ADA requirements. These include statements on maintaining accessibility during construction and conducting winter maintenance that keeps curb ramps and sidewalks clear of snow plowed from the streets.

MDT's ADA Transition Plan includes an inventory and scoring of curb ramp needs on MDT routes within Livingston. It identifies 142 ramps in need of upgrade on the MDT system within the City, with 106 of these along Park Street. The others are on other urban system routes within Livingston. These ramps are likely to be replaced and upgraded when resurfacing occurs along these routes, as such is required by law. The City should work with MDT to define the safest curb ramp applications that can be applied, especially along Park Street, to avoid diagonal ramps and incorporate design that accounts for future crossings of Park Street.

Method 27 Strive to maintain accessibility during construction.

Method 29 Conduct winter maintenance, coordinate with local jurisdictions, and enforce maintenance agreements.

https://www.mdt.mt.gov/other/webdata/external/civilrights/ADA-TRANSITION-PLAN.pdf

AASHTO A Policy on the Geometric Design of Highways and Streets (2018; 7th Edition)

This document, also called The Green Book, is developed by the national organization that represents all state DOTs. AASHTO (American Association of State Highway and Transportation Officials) has numerous committees tasked with developing this and other design guides. The Green Book is oftentimes mistakenly referred to as "AASHTO standards," which leads to an interpretation by some designers that the values included in it are mandated. The word "shall" is not used in the more than 1,000 pages of The Green Book, meaning nothing in it represents a standard. The preface to this design guide states:

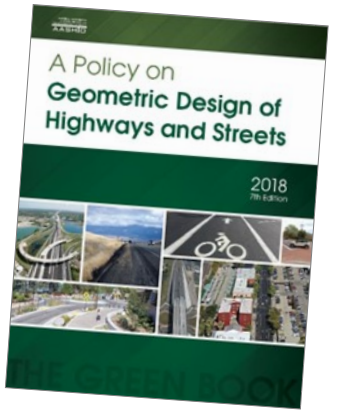
- "Designers should recognize the joint use of transportation corridors by motorists, pedestrians, bicyclists, public transit, and freight vehicles. Designers are encouraged to consider not only vehicular movement, but also the movement of people, distribution of goods, and provision of essential services…This policy is not intended to be a prescriptive design manual that supersedes engineering judgment by the knowledgeable design professional."

One notable element incorporated into this version of the Green Book is the concept of a "target speed" as a method of determining design speed. This is based on Vision Zero concepts for the "self-enforcing road" that recognizes design elements regulate and manage speed greater than enforcement efforts. Instead of using methods like the 85th percentile to determine a speed limit, a target speed approach recognizes that "lower speeds are desirable in walkable, mixed-use urban areas and this desire for lower speeds should influence the selection of the design speed…The target speed is the highest speed at which vehicles should operate…consistent with the level of multimodal activity generated by adjacent land uses, to provide both mobility for motor vehicles and a desirable environment for pedestrians, bicyclists and public transit users. The target speed is intended to be used as the posted speed" (page 2-24).

The Green Book also recognizes that expectations placed upon pedestrians the same as we place on motorists is not a valid approach. Section 2.6.2 General Characteristics of Pedestrians states:

- "Pedestrian actions are less predictable than those of motorists. Many pedestrians will cross roadways when and where they perceive it is safe to do so. Pedestrians tend to walk in a path representing the shortest distance between two points. Therefore, pedestrian crossings at mid-block locations may be appropriate to supplement those at intersections." (page 2-50).

For bicyclists, The Green Book dispels a common myth that the gutter pan of roads is allowed to be counted as part of the bike lane width. A common treatment is to build a bike lane on the asphalt section of the road and then count the width of the concrete gutter pan as additional bike lane width. Page 4-22 of The Green Book states "a gutter of contrasting color and texture should not be considered part of the traveled way."



Price: $310 PDF; $388 hard copy

https://store.transportation.org/item/collectiondetail/180

AASHTO Guide for the Planning, Design, and Operations of Pedestrian Facilities (2004)

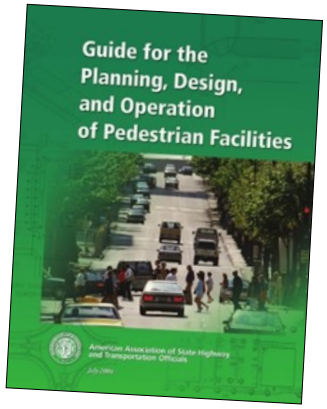
AASTHO's pedestrian guide is referenced more than 30 times in The Green Book and serves as a more detailed reference guide for proper pedestrian accommodations. It has sections on how pedestrians differ from motorist in how they experience the roadway environment:

- Unlike motorists, pedestrians' slower speeds mean that they prefer more, rather than less, detail in their environment…Since pedestrians travel more slowly and are not surrounded by the protective environment of a motor vehicle, their immediate physical environment has a profound effect on their level of comfort.

Some notable elements of the pedestrian guide are sections on pedestrian factors when it comes to the characteristics of pedestrians.

- **Continuity:** Connectivity of the walking environment is just as important for pedestrian as a completely developed roadway network is for motorists.
- **Assumptions:** Assume that pedestrians want and need safe access to all destinations that are accessible to motorists. Additionally, pedestrians will want to have access to destinations not accessible to motorists, such as trails and parks.
- **Generators and Destinations:** All transit stops require that pedestrians be able to cross the street.
- **Frequency:** Pedestrians must be able to cross streets and highways at regular intervals. Unlike motor vehicles, pedestrians cannot be expected to go a quarter mile or more out of their way to take advantage of a controlled intersection.

Regarding vehicle speed and speed management, the AASHTO Pedestrian Guide notes that "absent 24-hour enforcement," reducing travel speeds via enforcement efforts "usually have only a temporary effect." Correspondingly, "if the anticipated 85th percentile speed of vehicular traffic is inconsistent with the anticipated level of pedestrian activity or other factors in the roadway environment, then an effective method to reduce prevailing speeds may be to reduce the roadway design speed and modify the roadway geometrics accordingly."



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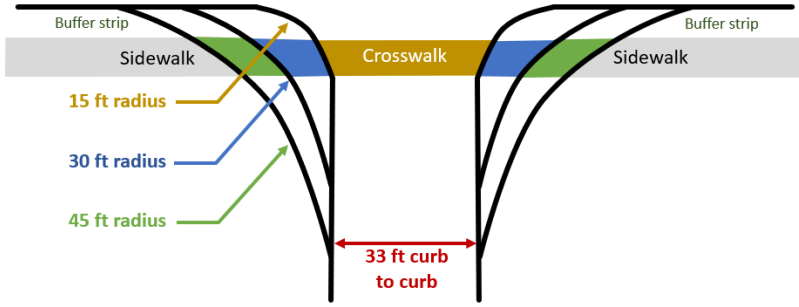


Curb Radius	Crosswalk Distance	Increased Crosswalk Distance*
15 feet	36 feet	3 feet
35 feet	56 feet	23 feet
45 feet	66 feet	33 feet

** Measured along centerline of sidewalk/crosswalk as compared to 33 ft curb-to-curb width.*

Source: AASHTO Guide for the Planning, Design, and Operation of Pedestrian Facilities

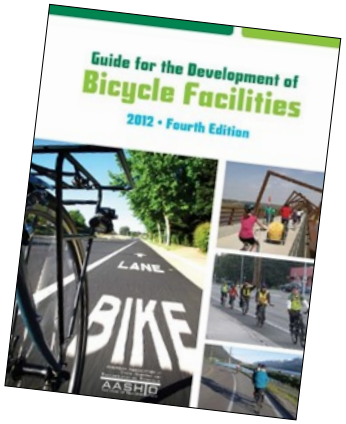
AASHTO Guide for the Development of Bicycle Facilities (2012)

With rapid development of bikeway design guides emerging from NACTO and FHWA, the AASHTO Bike Guide is becoming increasingly outdated. A new edition to the AASHTO bicycle guide is under review and should be published in 2022 to reflect the latest knowledge on this topic. The notable elements of the AASHTO Bike Guide that can be considered pertain to design elements such as separation from vehicle traffic and intersection treatments for shared use pathways. Some other elements of this guide include:

- **Snow clearance:** Many bicyclists ride year-round, especially for utilitarian or commute trips. Snow stored in bike lanes impedes bicycling in winter. The following recommendations apply:
  - On streets with bike lanes and paved shoulders that are used by bicyclists, remove snow from all travel lanes (including bike lanes) and the shoulder, where practical.
  - Do not store snow on sidewalks where it will impede pedestrian traffic.
- **Chipsealing:** Where a chip seal is used on a roadway shared with bicyclists, a fine mix chip seal(3/8 in. or finer) should be used. Where shoulders or bike lanes are wide enough and in good repair, apply the chip seal only to the main traveled way.
- **Work Zones**: At the onset of planning for temporary traffic controls, it should be determined how existing bicycle facilities will be maintained during construction. Accommodation in the work zone may result in the need for the construction of temporary facilities including paved surfaces, structures, signs, and signals.

Pathways. The chapter on shared use pathway design remains relevant and may not always be consulted when agencies lead pathway design simply because they may not know this guide exists. Some notable sections on shared use path design are:

- **Width:** The minimum width for a two-directional shared use path is 10 ft. Wider pathways, 11 to 14 ft, are recommended in locations that are anticipated to serve a high percentage of pedestrians (30% or more of total pathway volume) and higher user volumes (more than 300 total users in the peak hour).
- **Sidepaths:** The minimum recommended distance between a path and the roadway curb (i.e., face of curb) or edge of traveled way (where there is no curb) is 5 ft. Where a paved shoulder is present, the separation distance begins at the outside edge of the shoulder. Thus, a paved shoulder is not included as part of the separation distance. Similarly, a bike lane is not considered part of the separation; however, an unpaved shoulder can be considered part of the separation. Where the separation is less than 5 ft, a physical barrier or railing should be provided between the path and the roadway.
- **Curb Ramps:** The opening of a shared use path at the roadway should be at least the same width as the shared use path itself. If a curb ramp is provided, the ramp should be the full width of the path, not including any side flares. Detectable warnings should be placed across the full width of the ramp.



Price: $162 PDF; $203 hard copy

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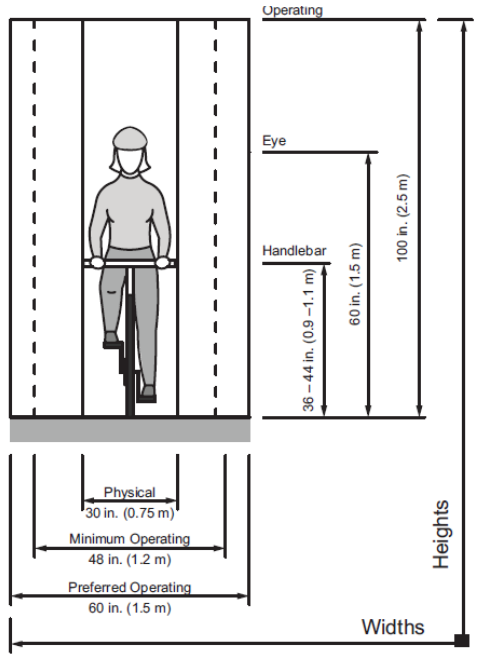


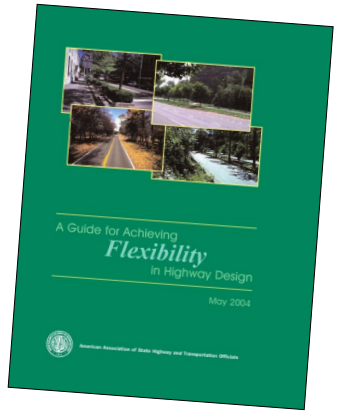
Figure 3-1. Bicyclist Operating Space

AASHTO Achieving Flexibility in Highway Design (2004)

The Flexibility Guide was developed in 2004 as the concept of Context Sensitive Solutions advanced in road design circles. The intent of the flexibility guide was to bolster the already-flexible elements of The Green Book and further highlight how things such motor vehicle lane widths and level of service guidelines were not intended to be sacred design doctrine.

The Flexibility Guide states in section 1.3.3 Intended Use of the AASHTO Green Book that the Green Book "does not prescribe or even favor one value over another," noting that two different states or cities may the same road design features differently, yet "both would be following the AASHTO 'policy.'" The Flexibility Guide also addresses concerns that designers have with concerns over legal liability from what may be perceived as a deviation from The Green Book. Some notable sections include:

- **1.4.5 Level of Service:** Vehicle level of service is oftentimes confused for or advertised as a safety measure, which it is not. The AASHTO Flexibility Guide helps dispel this commonly-held myth, stating "Failure to achieve a level of service indicated [in the Green Book] does not constitute a non-standard design decision…Recognizing the impracticality of constructing a highway or highway network to accommodate all potential future traffic demand…the Green Book includes discussion of the implications of and recommendations for designing for congestion."
- **1.5.2 Design in the Lower Speed Environment:** Context-sensitive solutions for the urban environment often involve creating a safe roadway environment in which the drive is encouraged by the roadway's features and the surrounding area to operate a low speeds.
- **3.6.1 Lane Width:** The normal range of design lane width is between 9 ft and 12 ft. AASHTO Green Book values for lower-speed urban street lane widths are less rigorously derived. Narrower lane widths for urban streets lessen pedestrian crossing distances, enable the provision for on-street parking and transit stops. Lesser widths also tend to encourage lower speeds, an outcome that may be desirable in urban areas. There is less direct evidence of a safety benefit associated with incrementally wider lanes in urban areas, compared with other cross sectional elements.
- **4.9 Importance of Fully Evaluating and Documenting Design Decisions**: In order to reduce exposure to losses due to liability claims, it is essential that the planning and design process be thoroughly documented. It is unfortunately the case that design agencies lose or settle claims not because the staff actions were inappropriate, but because the project files are incomplete or missing key documentation, and staff responsible are no longer available to explain what was done and why.



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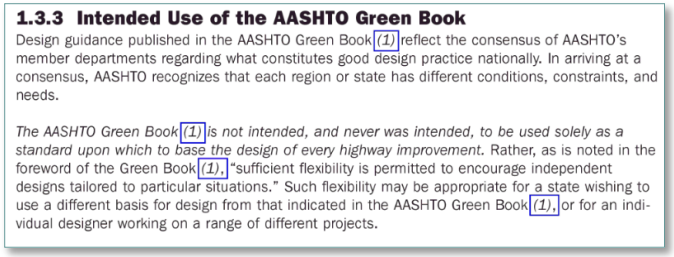
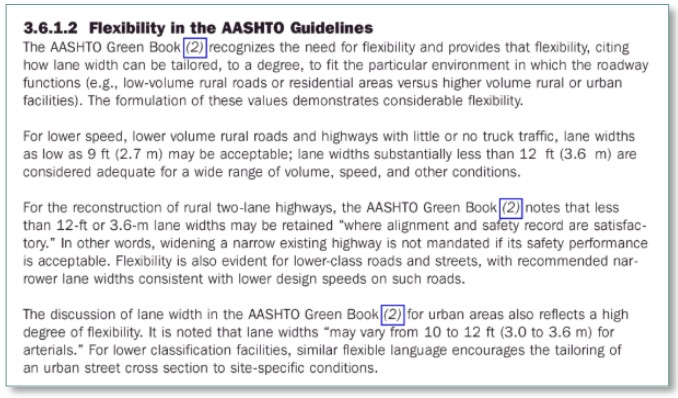


1.3.3 Intended Use of the AASHTO Green Book

Design guidance published in the AASHTO Green Book (1) reflect the consensus of AASHTO's member departments regarding what constitutes good design practice nationally. In arriving at a consensus, AASHTO recognizes that each region or state has different conditions, constraints, and needs.

The AASHTO Green Book (1) is not intended, and never was intended, to be used solely as a standard upon which to base the design of every highway improvement. Rather, as is noted in the foreword of the Green Book (1), "sufficient flexibility is permitted to encourage independent designs tailored to particular situations." Such flexibility may be appropriate for a state wishing to use a different basis for design from that indicated in the AASHTO Green Book (1), or for an individual designer working on a range of different projects.



3.6.1.2 Flexibility in the AASHTO Guidelines

The AASHTO Green Book (2) recognizes the need for flexibility and provides that flexibility, citing how lane width can be tailored, to a degree, to fit the particular environment in which the roadway functions (e.g., low-volume rural roads or residential areas versus higher volume rural or urban facilities). The formulation of these values demonstrates considerable flexibility.

For lower speed, lower volume rural roads and highways with little or no truck traffic, lane widths as low as 9 ft (2.7 m) may be acceptable; lane widths substantially less than 12 ft (3.6 m) are considered adequate for a wide range of volume, speed, and other conditions.

For the reconstruction of rural two-lane highways, the AASHTO Green Book (2) notes that less than 12-ft or 3.6-m lane widths may be retained "where alignment and safety record are satisfactory." In other words, widening a narrow existing highway is not mandated if its safety performance is acceptable. Flexibility is also evident for lower-class roads and streets, with recommended narrower lane widths consistent with lower design speeds on such roads.

The discussion of lane width in the AASHTO Green Book (2) for urban areas also reflects a high degree of flexibility. It is noted that lane widths "may vary from 10 to 12 ft (3.0 to 3.6 m) for arterials." For lower classification facilities, similar flexible language encourages the tailoring of an urban street cross section to site-specific conditions.

FHWA Memo on Bicycle & Pedestrian Design Flexibility (2013)

USDOT passed a 2010 policy on bicycle and pedestrian accommodations that states the organization "encourage transportation agencies to go beyond the minimum requirements, and proactively provide convenient, safe, and context-sensitive facilities that foster increased use by bicyclists and pedestrians of all ages and abilities." To bolster that policy, the 2013 memorandum issued by FHWA provided federal support and justification for agencies to use the AASHTO Guides summarized above, as well as the NACTO guides and ITE guides summarized below, to accomplish this policy directive. FHWA says it "support the use of these resources to further develop nonmotorized transportation networks, particularly in urban areas."

More specifically, this memorandum states:

- "The vast majority of treatments illustrated in the NACTO Guide are either allowed or not precluded by the Manual on Uniform Traffic Control Devices (MUTCD)."
- In its support of the ITE Designing Walkable Urban Thoroughfares: A Context Sensitive Approach, the FHWA memorandum states the "guide is useful in gaining an understanding of the flexibility that is inherent in the AASHTO 'Green Book.'
- FHWA' memorandum summary states the agency "encourages agencies to appropriately use these guides and other resources to help fulfill the aims of the 2010 USDOT Policy Statement."

Memorandum

U.S. Department of Transportation
Federal Highway Administration

PDF Version (1.7 MB)

Subject: Bicycle and Pedestrian Facility Design Flexibility

From:
Gloria M. Shepherd
Associate Administrator for Planning, Environment and Realty

Walter C. (Butch) Waidelich, Jr.
Associate Administrator for Infrastructure

Jeffrey A. Lindley
Associate Administrator for Operations

Tony T. Furst
Associate Administrator for Safety

To:
Division Administrators
Directors of Field Services

Date: August 20, 2013

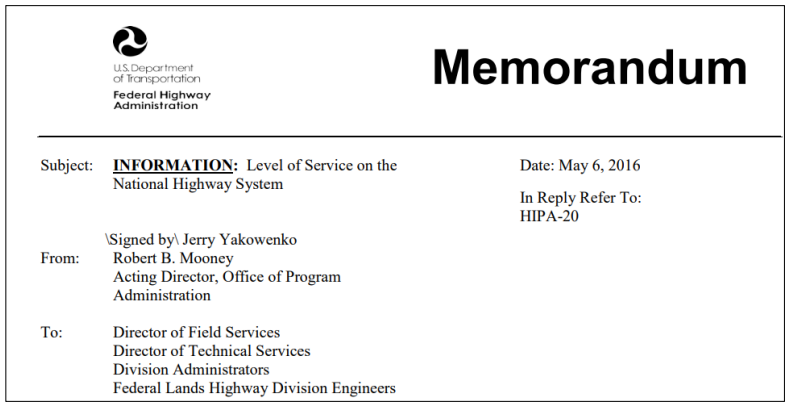
Reply to: HEPH-10

https://www.fhwa.dot.gov/environment/bicycle_pedestrian/guidance/design_flexibility.cfm

FHWA Memo on Level of Service (2016)

In May 2016, FHWA issued a memorandum on Level of Service on the National Highway System. It notes that the Level of Service recommended values in the AASHTO Green Book "are regarded by FHWA as guidance only" and FHWA "does not have regulations or policies that require specific minimum LOS values for projects on the [National Highway System.] FHWA states that while they concur with the LOS guidance, "the recommended LOS values in [The Green Book] may not be reasonably attainable in some situations."

The purpose of the memo was to state that traffic forecasts focused solely on motorist desires are just one factor to consider in the design of projects and that context and other road users need to be considered and not just a secondary consideration after level of service goals for motorists were first accounted for in projects.



U.S. Department of Transportation
Federal Highway Administration

Memorandum

Subject: **INFORMATION:** Level of Service on the National Highway System

Date: May 6, 2016

In Reply Refer To: HIPA-20

From: \Signed by\ Jerry Yakowenko
Robert B. Mooney
Acting Director, Office of Program Administration

To: Director of Field Services
Director of Technical Services
Division Administrators
Federal Lands Highway Division Engineers

https://www.fhwa.dot.gov/design/standards/160506.cfm

FHWA Bikeway Selection Guide (2019)

FHWA's Office of Safety published this new guide in February 2019:

- "This guide focuses on safety, but it also emphasizes the importance of comfort to appeal to a broad spectrum of bicyclists. This will encourage more people to choose to bike and in doing so will help FHWA meet its goal to increase the number of short trips made by bicycling and walking to 30 percent by the year 2025."

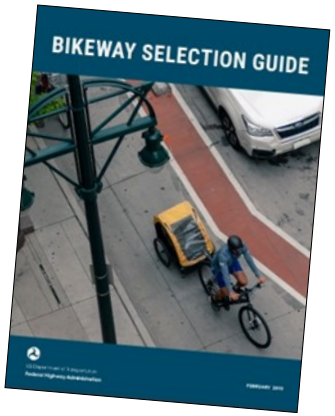
It is intended to be a support tool to help guide design decisions. The Bikeway Selection Guide makes important distinctions from past bicycling infrastructure decisions.

An important component of recognizing the safety needs of bicyclists and incorporating Vision Zero themes into facility design is in Table 2 of the guide under "Forgiveness (Safety)" where it denotes that shared lanes, traditional bike lanes, bikeable shoulders, and bike boulevards rely on "perfect user (driver and bicyclist) behavior to avoid crashes."

Because of that, the safety ratings for these treatments receive only minimal to moderate grades whereas one-way separated bike lanes and separated bike lanes and sidepaths have moderate to high ratings.

The other key component of this guide is Figure 9: Preferred Bikeway Type for Urban, Urban Core, Suburban, and Rural Town Contexts. That figure is shown in the Park Street assessment in this Appendix.

Note that it indicates roadways with 7,000 or more vehicles per day and/or speed limits of 35 mph or higher necessitate separated (protected) bike lanes or shared use pathways.



	Shared Lanes	Boulevards	Shoulders	Bike Lanes	One-Way Separated Bike Lanes with Mixing Zones	Separated Bike Lanes and Sidepaths with Protected Intersections
Functionality (Comfort) - Roads can be categorized by their function						
Lowest at higher vehicle speeds and volumes	✓	✓	✓	✓		
Highest at lower vehicle speeds and volumes	✓	✓	✓	✓		
Moderate to High due to separation from traffic and constrained entry point					✓	
High due to separation from traffic and constrained conflict point						✓
Forgiveness (Safety) - Infrastructure can be designed to accommodate human error						
Relies upon perfect user (driver and bicyclist) behavior to avoid crashes	✓	✓	✓	✓		
Minimal: bicyclists operating in shared space with vehicles	✓					
Moderate: application of traffic calming treatments and lower operating speeds can improve safety		✓				
Moderate: bicyclists operate in separated space from vehicles, however vehicles can encroach into the facility at any location			✓	✓		
Moderate: bicyclists operate in separated space from vehicles except for defined entry point, followed by shared operating space					✓	
High: bicyclists operate in separated space from vehicles except for defined conflict point which can be designed to reduce motorist speed, but contraflow movement from two-way operation can increase risk						✓

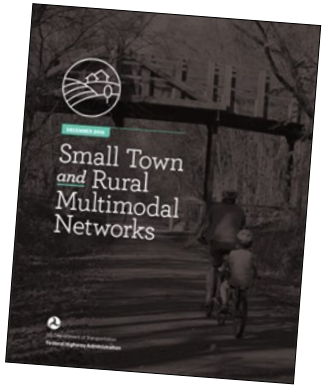
https://safety.fhwa.dot.gov/ped_bike/tools_solve/docs/fhwasa18077.pdf

FHWA Small Town & Rural Multimodal Networks Guide (2017)

The Small Town and Rural Multimodal Networks Guide was released in 2017. Beyond the intent underlying its title, this guide is a useful resource for resource-challenged cities no matter their context. The goal of the guide is to provide a bridge between existing design guidance for bicyclists and pedestrians that identifies lower-cost, but high impact, infrastructure upgrades for the safety of these modes.

The guide recognizes that many residents in small cities reside within just a couple miles of major destinations like downtown, grocery stores, and parks. Trips to these destinations and of these distances can easily be taken by bike or in choosing to walk a slightly longer distance than normal if people feel safe and comfortable doing so.

The guide provides diagrams and speed/volume tables to help designers identify the appropriate context for the various applications in the guide. They range from things like painting pedestrian lanes on streets to lower-cost sidepaths that do not require full scale stormwater management systems. It also includes case studies from various cities to help designers understand how it could be applied in their context.



https://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/small_towns/

FHWA PEDSAFE and BIKESAFE Countermeasures Selection System

These two countermeasures selection systems are easy-to-use online tools to guide practitioners and citizens to the appropriate engineering, education, or enforcement tools to help address a particular concern for the safety of people who walk and bike.

For pedestrians, the tool includes various countermeasures organized by theme:

- Along the Roadway;
- At Crossing Locations;
- Transit;
- Roadway Design;
- Intersection Design;
- Traffic Calming;
- Traffic Management;
- Signals and Signs; and
- Other Measure

For bicyclists, the tool has sections for shared roadways, on-road bike facilities, intersections, and maintenance, and trails, among others.

PEDSAFE

http://www.pedbikesafe.org/pedsafe/

BIKESAFE

http://www.pedbikesafe.org/bikesafe/

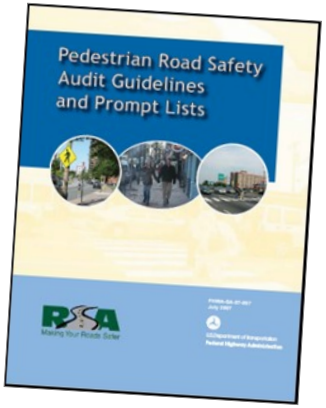
Roadway Classification and Land Use	Sidewalk/Walkway
Rural Highways (< 400 ADT)	Shoulders preferred, with minimum of 0.9 m (3 ft).
Rural Highways (400 to 2,000 ADT)	1.5-m (5-ft) shoulders preferred, minimum of 1.2 m (4 ft) required.
Rural/Suburban Highway (ADT > 2,000 and less than 1 dwelling unit (d.u.) / .4 hectares (ha) [1 d.u. / acre])	Sidewalks or side paths preferred. Minimum of 1.8-m (6-ft) shoulders required.
Suburban Highway (1 to 4 d.u. / .4 ha [1 to 4 d.u. / acre])	Sidewalks on both sides required.
Major Arterial (residential)	Sidewalks on both sides required.
Urban Collector and Minor Arterial (residential)	Sidewalks on both sides required.
Urban Local Street (residential – less than 1 d.u. / .4 ha [1 d.u. / acre])	Sidewalks on both sides preferred. Minimum of 1.5-m (5-ft) shoulders required.
Urban Local Street (residential – 1 to 4 d.u. / .4 ha [1 to 4 d.u. / acre])	Both sides preferred.
Local Street (residential – more than 4 d.u. / .4 ha [4 d.u. / acre])	Sidewalks on both sides required.
All Commerical Urban Streets	Sidewalks on both sides required.
All Streets in Industrial Areas	Sidewalks on both sides preferred. Minimum of 1.5-m (5-ft) shoulders required.

1 acre=0.4 hectares (ha)

FHWA Pedestrian (2007), Bicycle (2012) Road Safety Audit Guidelines & Prompt Lists

FHWA developed these guides to help planners and designers evaluate how projects addressed the needs of pedestrians and bicyclist. (Note, a new combined version of these was released in 2020, but is not as comprehensive and useful). These safety audit guidelines can be used in the planning, design, construction, and post-construction phases and include several prompt lists to be used in the field as projects are evaluated. Some notable elements of the Pedestrian Guidelines include:

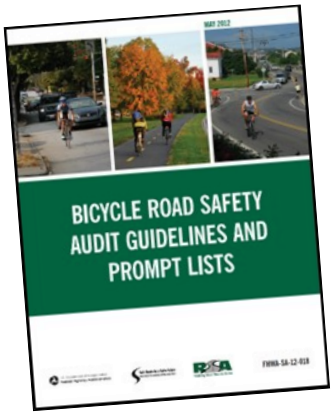
- **Barriers to Walking:** Physical, social and perceptual, and organizational issues may discourage people from walking. Physical barriers consist of unprotected street crossings, lengthy crossings, crossings that are spaced too far apart, interchanges, partial or nonexistent walking paths, poor quality walking surfaces, nonexistent or inappropriate crossing treatments, and high speed traffic.
- **System Connectivity:** All pedestrian facilities should be continuous, consistent, and connected along direct routes to major pedestrian traffic generators. Pedestrians of all ability levels should have continuous pedestrian routes through or around construction areas.
- **Width:** When assessing the width of a sidewalk, the RSA team should consider its usable width. Pedestrians rarely use the foot and a half of the sidewalk closest to the roadway or a building face. The RSA team should also pay attention to "choke points" that narrow the effective sidewalk width (e.g., street furniture, utility poles, etc.).
- **Behavior:** Do pedestrians cross at uncontrolled locations because marked or controlled crossings are dangerous, inconvenient, or not placed appropriately?
- **Buffers:** Often bridges and other sidewalks are designed with only a curb separating pedestrians on the sidewalk from vehicular traffic. This measure alone is often inadequate as the curb does not form an adequate barrier between vehicular and pedestrian traffic. Vehicles traveling at speeds over 25 mph can mount a curb at relatively flat impact angles.



https://rosap.ntl.bts.gov/view/dot/42593/dot_42593_DS1.pdf

Notable elements of the **Bicycle Audit Guidelines** include:

- **Design treatments:** Do accommodations for cyclists conform to the state of practice, guidelines, and relevant standards, or are there more advanced designs that would better support and enhance conditions for cycling? Here is where FHWA provides support for use of NACTO and other modern guides to help influence design.
- **Comfort:** Is the type of cycling accommodation appropriate for the primary or intended users? Bicycle accommodations should match the needs of the intended users. Cyclists, particularly less-experienced cyclists, may prefer greater separation from vehicular traffic, especially as speeds and volumes increase. Particular attention should be given to routes that access schools, parks, and other public spaces that will be frequented by children and families.
- **Continuity:** A network of bicycle-friendly roadways and paths is critical to provide cyclists with continuous and direct access to destinations. Gaps, lack of facilities, or facilities inappropriate for the context may result in indirect routes to destinations and possibly illegal or undesirable behaviors, such as riding against traffic and riding on sidewalks.
- **Vertical clearance:** Bicyclists may change their position on the road or path to maintain comfortable operating space from bridge railings or tunnel walls. Recommended height and shy distance for railings are detailed in the *AASHTO Guide for the Development of Bicycle Facilities*, but many variations may occur, especially at locations where ornamental railings may be used.



https://safety.fhwa.dot.gov/ped_bike/tools_solve/fhwasa12018/

FHWA Designing Sidewalks & Trails for Access (1999 & 2001)

Though more than 20 years old now, this publication helps practitioners understand technical concepts of ADA and illustrates how they are applied to sidewalks and trails. Additionally, since there are few federally-endorsed design guides for trails, this resource provides useful information on how to design them to maximize accessibility and ADA compliance.

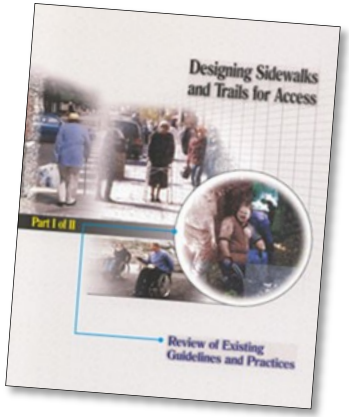
An example is shown at right as it relates to driveway crossings that present cross slope challenges. The guide illustrates common problems and several possible solutions to help designers create an accessible route across the driveway while also account for the transition for drivers from the street to the top of the driveway.

There are similar illustrations on curb ramp design options for constrained areas.

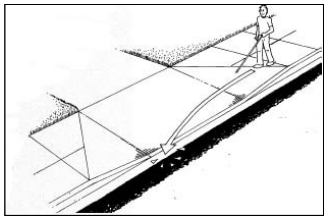
Trails and Pathways. This guide is useful when cities pursue federal grants for trails and may receive pushback or incorrect feedback on ADA compliance in a natural setting.

For example, ADA stipulates that the running slope of a sidewalk shall be no greater than 5%, with exceptions for natural terrain. The same rule does not apply as strictly to shared use pathways but other considerations apply.

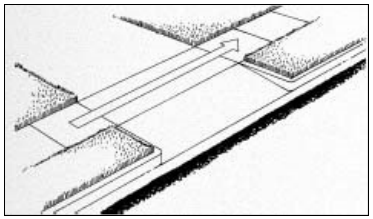
- "If steeper segments are incorporated into the shared-use path, the total running grade that exceeds 8.33 percent should be less than 30 percent of the total trail length. In addition, it is essential that the lengths of the steep sections are minimized and are free of other access barriers. Negotiating a steep grade requires considerable effort. Users should not be required to exert additional energy to simultaneously deal with other factors, such as steep cross slopes and change in vertical levels. When designing maximum grade segments, the following recommendations should be used:
  - 8.3 percent for a maximum of 61.0 m (200 ft);
  - 10 percent for a maximum of 9.14 m (30 ft); and
  - 12.5 percent for a maximum of 3.05 m (10 ft)."



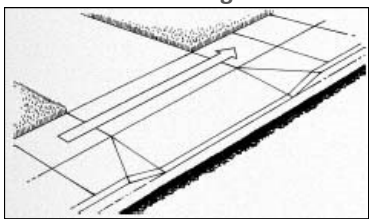
Problematic Design



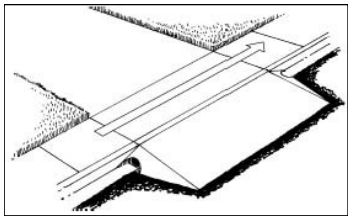
Good Design



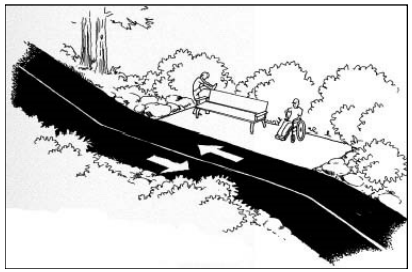
Good Design



Good Design



Shared Use Pathway landing and Rest Area on a steep running slope.



Part 1: https://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/sidewalks/

Part 2: https://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/sidewalk2/contents.cfm

FHWA Manual on Uniform Traffic Control Devices (2009)

This design guide, commonly referred to as MUTCD, provides standards and guidance for engineering of traffic control devices. It is important to note that traffic control devices are narrowly defined as those roadway features that attempt to control traffic. MUTCD includes the standards agencies follow to evaluate whether or not a traffic signal is warranted. They also use MUTCD to guide how to stripe roadways, place signage, and evaluate speed limits.

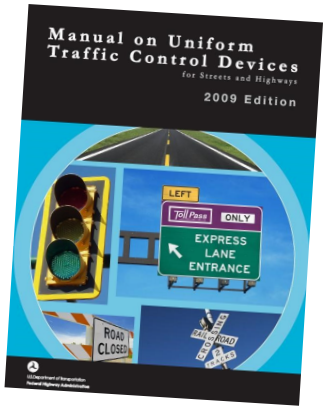
MUTCD is often widely misunderstood and misrepresented by some designers. MUTCD may sometimes be referred to as "MUTCD standards," which is incorrect. While MUTCD does include several standards that are accompanied by "shall" statements, the majority of its contents are guidance or options for engineers to consider. The elements of MUTCD that are labeled as standards and include use of the word "shall" are viewed as compulsory and require substantial documentation and engineering judgment when deviated from.

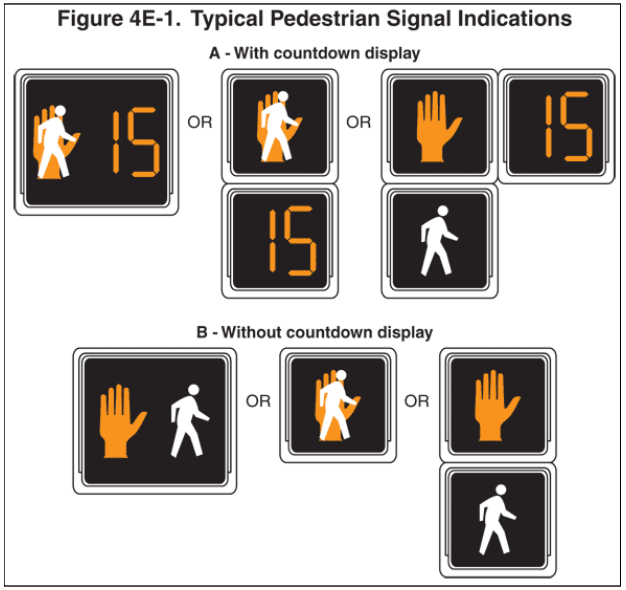
An example of this is the installation of a full, traditional traffic signal for use by pedestrians. In order to justify the signal, MUTCD requires certain "warrants" be met with strict thresholds on how many pedestrians must be crossing in a certain time period to justify the signal. In contrast, a Pedestrian Hybrid Beacon (PHB) is identified when these strict warrants are not met and the determination on whether or not a PHB can be installed is only guidance, leaving more leeway for an engineer to approve it based on other prevailing conditions, such as land uses that generate pedestrian traffic.

In the pedestrian and bicyclist realm, traffic control devices include signage, pedestrian or bicycle signals, crosswalks, school zone treatments, and construction zone practices. Common civil engineering features, such as sidewalks, curb ramps, and protected bike lanes are not considered traffic control devices and, therefore, are not addressed in MUTCD.

The most relevant sections of MUTCD that relate to pedestrians and bicyclists are:

- Section 3B: Pavement and Curb Markings;
- Section 4C.05: Pedestrian Signal Warrants
- Section 4E: Pedestrian Control Features
- Section 4F: Pedestrian Hybrid Beacons
- Sections 6A, 6D, and 6G: Temporary Traffic Controls for Pedestrians, Bicyclists, People with Disabilities (work zones or construction zones)
- Part 7: Traffic Control for School Areas
- Part 9: Traffic Control for Bicycle Facilities

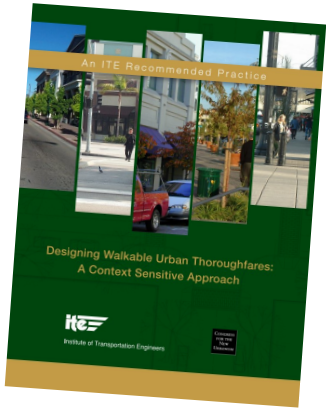




https://mutcd.fhwa.dot.gov/htm/2009r1r2/html_index.htm

ITE Designing Walkable Urban Thoroughfares (2010)

This design guide is sponsored and endorsed by FHWA for use by state and local agencies. It was developed in response to widespread interest for improving both mobility choices and community character aligned with goals for walkable communities. It states that "retail and social transactions have occurred along most urban thoroughfares throughout history. It is only in the 20th century that streets were designed to separate the mobility function from the economic and social functions." The guide cites that it follows the flexibility principles inherent in the AASHTO Green Book, noting that it supplements the Green Book and other AASHTO publications. MDT's Pedestrian and Bicycle Plan cites ITE as having suitable resources to make such design decisions.



A key tenet of this publication is that "walkable thoroughfare design is encapsulated in the phrase 'one size does not fit all,' which means the function of a thoroughfare and its design should complement the context that it serves." Perhaps the most important component of this is how the guide stresses the need to provide frequent spacing of pedestrian crossings on major thoroughfares:

Pedestrian facilities should be spaced so block lengths in less dense areas (suburban or general urban) do not exceed 600 ft (preferably 200 to 400 ft) and relatively direct routes are available. In the densest urban areas (urban centers and urban cores), block length should not exceed 400 ft (preferably 200 to 300 feet) to support higher densities and pedestrian activity.

Conventionally, design speed—the primary design control in the AASHTO Green Book—has been encouraged to be as high as is practical. In this report, design speed is replaced with target speed, which is based on the functional classification, thoroughfare type and context, including whether the ground floor land uses fronting the street are predominantly residential or commercial. Target speed then becomes the primary control for determining the following geometric design values:

- Minimum intersection sight distance;
- Minimum sight distance on horizontal and vertical curves; and
- Horizontal and vertical curvature.

The latest AASHTO Green Book now includes a target speed section that reflects these approaches. ITE notes "the practitioner should be careful not to relate speed to capacity in urban areas, avoiding the perception that a high-capacity street requires a higher target speed."

Table 6.4 Design Parameters for Walkable Urban Thoroughfares

Thoroughfare Design Parameters for Walkable Mixed-Use Areas									
	Suburban (C–3)						General Urban (C–4)		
	Residential			Commercial			Residential		
	Boulevard [1]	Avenue	Street	Boulevard [1]	Avenue	Street	Boulevard [1]	Avenue	Street
Context									
Building Orientation (entrance orientation)	front, side	front, side	front, side	front, side	front, side	front, side	front	front	front
Maximum Setback [2]	20 ft.	20 ft.	20 ft.	5 ft.	5 ft.	5 ft.	15 ft.	15 ft.	15 ft.
Off-Street Parking Access/Location	rear, side	rear, side	rear, side	rear, side	rear, side	rear, side	rear	rear, side	rear, side
Streetside									
Recommended Streetside Width [3]	14.5–16.5 ft.	14.5 ft.	11.5 ft.	16 ft.	16 ft.	15 ft.	16.5-18.5 ft.	14.5 ft.	11.5 ft.
Minimum sidewalk (throughway) width	6 ft.	6 ft.	6 ft.	6 ft.	6 ft.	6 ft.	8 ft.	6 ft.	6 ft.
Pedestrian Buffers (planting strip exclusive of travel way width) [3]	8 ft. planting strip	6–8 ft. planting strip	5 ft. planting strip	7 ft. tree well	6 ft. tree well	6 ft. tree well	8 ft. planting strip	8 ft. planting strip	6 ft. planting strip
Street Lighting	For all thoroughfares in all context zones, intersection safety lighting, basic street lighting, and pedestrian-scaled lighting is recommended. See Chapter 8 (Streetside Design Guidelines) and Chapter 10 (Intersection Design Guidelines).								
Traveled Way									
Target Speed (mph)	25–35	25–30	25	25–35	25–35	25	25–35	25–30	25
Number of Through Lanes [5]	4–6	2–4	2	4–6	2–4	2	4–6	2–4	2
Lane Width [6]	10–11 ft.	10–11 ft.	10–11 ft.	10–12 ft.	10–11 ft.	10–11 ft.	10–11 ft.	10–11 ft.	10–11 ft.
Parallel On-Street Parking Width [7]	7 ft.	7 ft.	7 ft.	8 ft.	7-8 ft.	7-8 ft.	7 ft.	7 ft.	7 ft.
Min. Combined Parking/Bike Lane Width	13 ft.	13 ft.	13 ft.	13 ft.	13 ft.	13 ft.	13 ft.	13 ft.	13 ft.
Horizontal Radius (per AASHTO) [8]	200–510 ft.	200–330 ft.	200 ft.	200–510 ft.	200–510 ft.	200 ft.	200–510 ft.	200–330 ft.	200 ft.
Vertical Alignment	Use AASHTO minimums as a target, but consider combinations of horizontal and vertical per AASHTO Green Book.								
Medians [9]	4–18 ft.	Optional 4–16 ft.	None	4–18 ft.	Optional 4–18 ft.	None	4–18 ft.	Optional 4–16 ft.	None
Bike Lanes (min./preferred width)	5 ft./6 ft.	5 ft./6 ft.	5 ft./6 ft.	5 ft./6 ft.	5 ft./6 ft.	5 ft./6 ft.	5 ft./6 ft.	5 ft. / 6 ft.	5 ft. / 6 ft.
Access Management [10]	Moderate	Low	Low	High	Moderate	Low	Moderate	Low	Low
Typical Traffic Volume Range (ADT) [11]	20,000–35,000	1,500–25,000	500–5,000	20,000–50,000	1,500–35,000	1,000–10,000	10,000–35,000	1,500–20,000	500–5,000
Intersections									
Roundabout [12]	Consider urban single–lane roundabouts at intersections on avenues with less than 20,000 entering vehicles per day, and urban double–lane roundabouts at intersections on boulevards and avenues with less than 40,000 entering vehicles per day.								
Curb Return Radii/Curb Extensions and Other Design Elements	Refer to Chapter 10 (Intersection Design Guidelines)								

https://www.ite.org/pub/?id=e1cff43c%2D2354%2Dd714%2D51d9%2Dd82b39d4dbad

NACTO Urban Bikeway Design Guide & Urban Street Design Guide

The National Association of City Transportation Officials (NACTO) is an association of 84 major North American cities and transit agencies formed to exchange ideas, insights, and practices and cooperatively approach national transportation issues. It is led by licensed engineers, planners, and urban designers. It is referenced extensively in the MDT Pedestrian and Bicycle Plan.

The bikeways proposed in this plan may utilize features of the NACTO bike guide pertaining to bicycle boulevards (see right).

The purpose of the NACTO Design Guides is to provide agencies with state-of-the-practice design concepts that are based on the best and safest bicycling and walking cities in the world and represent a set of combined treatments already present in many AASHTO and MUTCD applications. FHWA has endorsed the NACTO Bike Guide as a reference manual to use in designing safe bicycling infrastructure.

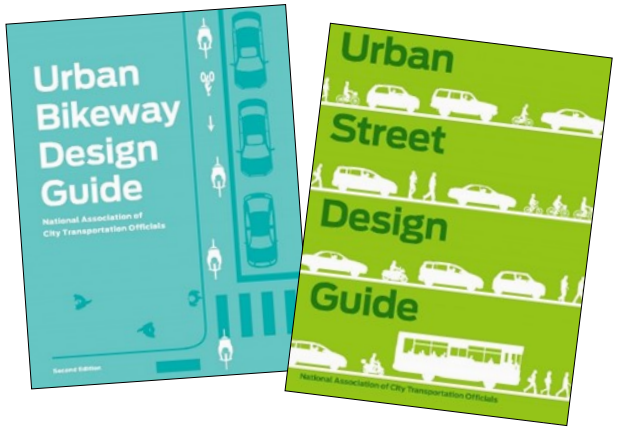
Many small and medium sized cities have officially endorsed NACTO as an acceptable design guide. Nine state DOTs have also endorsed NACTO's guide as acceptable solutions, the closest to Montana being Utah, Oregon, and Washington.

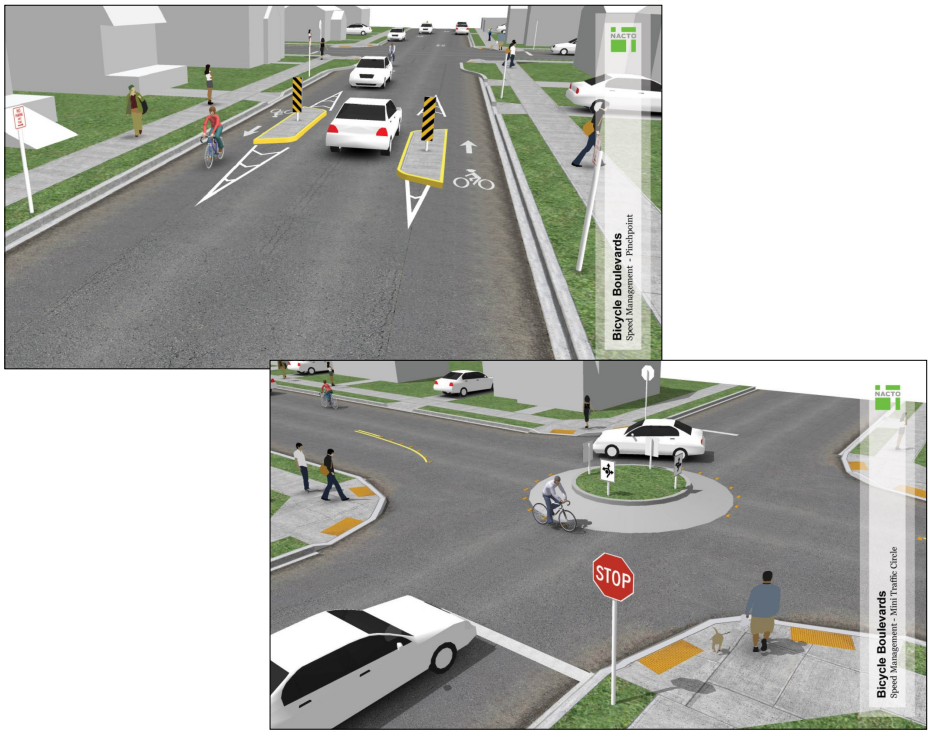
The Urban Bikeway Design Guide includes sections on:

- Cycle tracks;
- Bike lanes;
- Intersection treatments;
- Bicycle signals;
- Bikeway signing and marking;
- Bicycle boulevards; and
- Designing for all ages and abilities.

The Urban Street Design Guide includes sections on:

- Street design elements;
- Interim design strategies;
- Intersections; and
- Design controls.





https://nacto.org/publications/#design-guides-design-guidance

Tactical Urbanist's Guide to Materials and Design

This guidebook identifies proper treatments and materials for tactical urbanism projects, also referred to as "pop-up" or "demonstration" projects. The guide had input from organizations such as NACTO, the Vision Zero Network, and city DOTs from across the United States.

The guide was developed in response to the growing traffic safety crisis in the United States, particularly for pedestrians and bicyclists. The goal of the guide is to help cities "create streets and public spaces that are safe and accessible for everyone." The guide provides materials and design guidance for projects that advance street safety and enhance placemaking for both short– and long-term goals. Using the guide on tactical urbanism efforts helps break down the oftentimes drawn-out process of project development and allows communities to test alternatives with temporary materials before committing to formal application with full-scale design. In some cases, places are finding that semi-permanent materials work just fine and can allow resources to be devoted to other locations that need permanent applications.

The guide includes a listing of the types of temporary treatments that can be applied, many of which are materials common to construction and work zone treatments that contractors use in other street applications.

Cities like Bozeman and Missoula have utilized this guide for their own pop-up or demonstration projects. The bottom right photo is from a statewide effort conducted by the North Dakota Department of Transportation, which illustrates that these treatments are viewed as acceptable by highway agencies. The DOT provided project planning, design, and installation; workshops to guide communities in project selection, planning and design; and creation of project plans outlining design, materials, schedule and roles. A link to the presentation NDDOT provided for AASHTO is below to show examples in communities similar to Livingston.

- https://www.dot.nd.gov/plans/statewide/docs/AASHTO-Presentation-NDDOT-Pop-up-Demonstrations.pdf

http://tacticalurbanismguide.com/

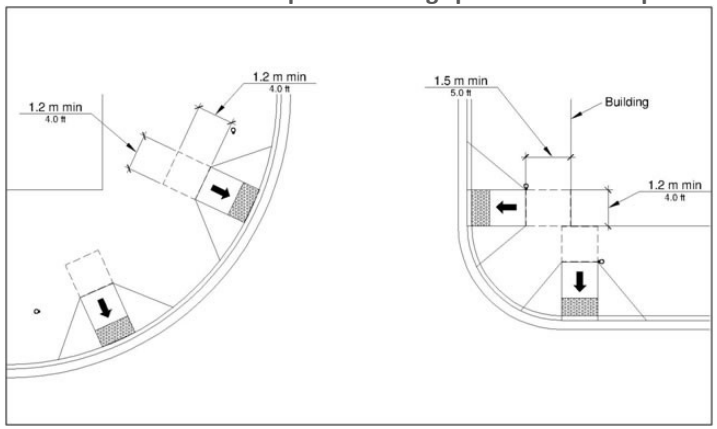
US Access Board Public Right of Way Accessibility Guidelines (PROWAG)

Although PROWAG is yet to be adopted as ADA standards for public right of way, both FHWA and the US Department of Justice have deemed them a best practice for agencies to use in the design of sidewalks, curb ramps, pedestrian push buttons, and other features of walking environment.

It is recommended that Livingston use PROWAG, especially when situations arise where common curb ramp design standards are not appropriate for a given situation. MDT has adopted PROWAG as the foundation for which the design of its accessibility-related improvements are based and PROWAG is referenced extensively in the MDT Pedestrian and Bicycle Plan.

U.S. Access Board
Advancing Full Access and Inclusion for All

PROWAG illustration of compliant turning space at curb ramp landings.



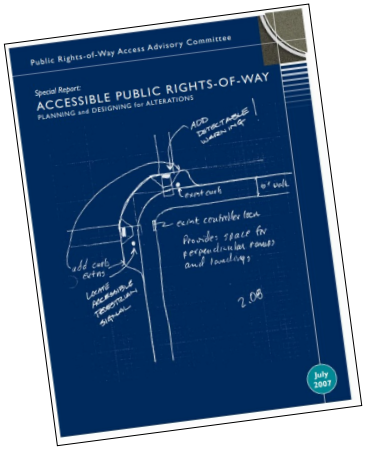
https://www.access-board.gov/prowag/

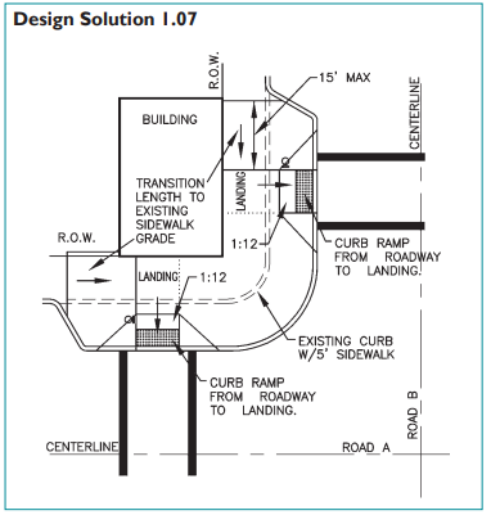
US Access Board Accessible Public Rights-of-Way: Planning and Designing for Alterations (2007)

This publication uses PROWAG and puts its concepts in illustrations to help public agencies address common context issues that may challenge how ADA compliance is achieved.

The guide walks designers through the thought process of how to access a constrained environment, such as a downtown corner with a tight radius, to design for compliance. It includes several design solutions to address various complex situations and shows how the ADA requirements can be met as they relate to curb ramps, landing areas, push button placement, and other pedestrian access route features.

Adopting it by reference in city codes can help guide developers and others to it when they have a challenging situation and the prevailing design standards do not adequately address the situation.





https://www.access-board.gov/files/prowag/planning-and-design-for-alterations.pdf

Appendix B: Trails & Active Transportation Design Gallery

While design manuals provide the technical specifications for active transportation facilities, they don't always provide real-world examples of how they are implemented in places like Livingston. It can be difficult for elected officials and the public to conceptualize some treatments because they may be new or different.

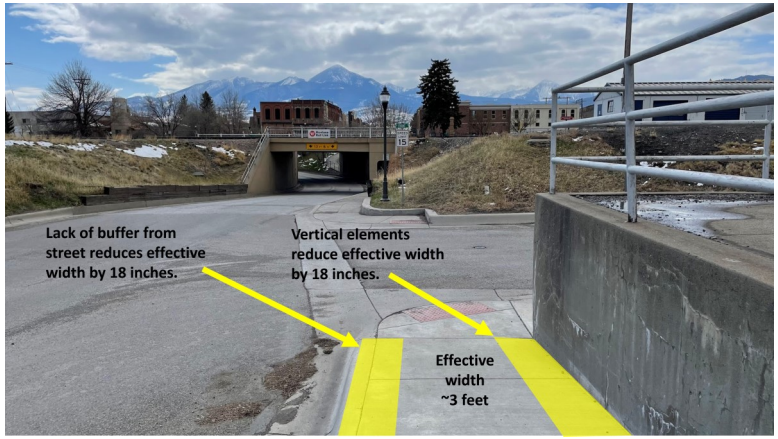
Further, in colder climates there can be resistance from public works officials responsible for programs like snow plowing and street sweeping. Oftentimes, the challenges faced by these operators in navigating things like curb extensions and speed humps has to do with improper design of those features and not the features themselves.

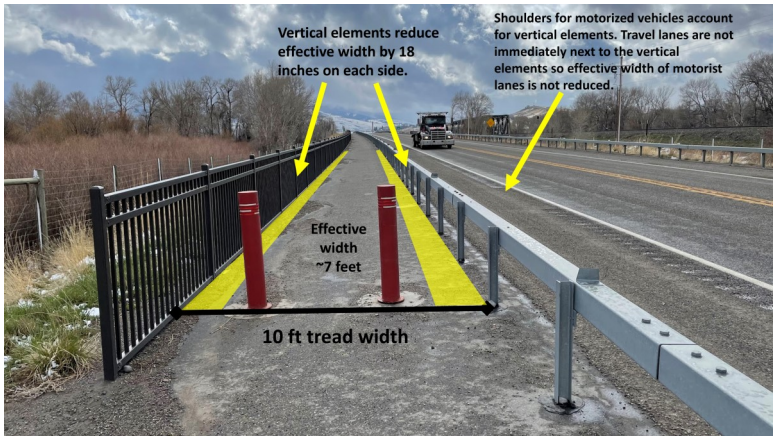
The two-lane streets throughout Livingston offer a prime opportunity to retrofit them with some of these design treatments. Coordination on MDT's urban routes will require their buy-in and this section showcases some known treatments on MDT's routes in other Montana cities.

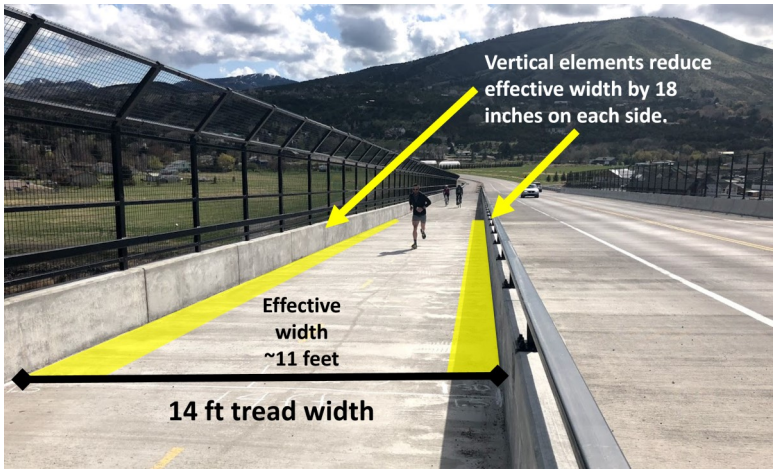
Effective Sidewalk & Pathway Width

The effective width of sidewalks and pathways is reduced 18 inches (per side) when vertical elements such as buildings, retaining walls, and barriers are adjacent to the sidewalk or pathway. This is rarely accounted for in the design of active transportation facilities. The FHWA Office of Safety's research has concluded that sidewalks that lack horizontal buffer from the street also have a reduced effective width of 18 inches. The top image at right shows a sidewalk on Livingston's Main Street that has an effective width of less than 3 feet due to the vertical elements and lack of buffer from the street. This does not allow space for someone in a wheelchair to comfortably pass by another sidewalk user. Sidewalks like this should be at least 7 feet in width with vertical elements and/or lack of buffer.

The diagram below is from the federal Highway Capacity Manual (HCM), which agencies like MDT routinely use in project analysis and design. It illustrates this concept of reduced effective width. The pathway on Highway 89 shows the reduced effective width of the pathway due to vertical barriers (image at right, middle). The presence of a vertical barrier on both sides reduces the pathway width to only 7 feet—a foot less than AASHTO's constrained minimum width for a shared use pathway. Vertical barriers next to the traveled way are not considered clear zone obstructions, per AASHTO. Note that agencies like MDT provide for this reduce effective width in the design of shoulders for motorists; they do not put the travel lane right next to the vertical barrier. The image at the bottom right shows the proper design of a pathway to account for this effective width, accounting for the "shoulder" that is needed for pathway users. The 14-foot tread width of the pathway results in 11 feet of effective width. This is what should be built in future Livingston projects that have vertical elements and lack horizonal buffer from the street.







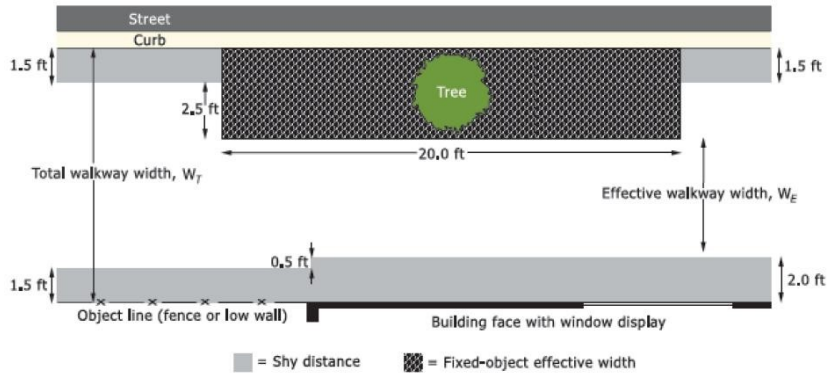


Figure 9: Instructions for calculating effective sidewalk width. Source: HCM Exhibit 17-17.

Shared Use Pathways & Sidepaths

The previous section on effective widths shows how the design of shared use pathways can easily result in a lack of consideration of user needs. The effective width of shared use pathways is crucial to consider given these pathways have the most diverse set of users—from bicyclists to children to people with disabilities.

AASHTO's Guide for the Development of Bicycle Facilities states that 10 -feet is the minimum width of a shared use pathway. Pathways of 8-feet can be used in constrained situations or where pedestrian volumes are expected to be low (e.g. Highway 89 pathway in rural settings).

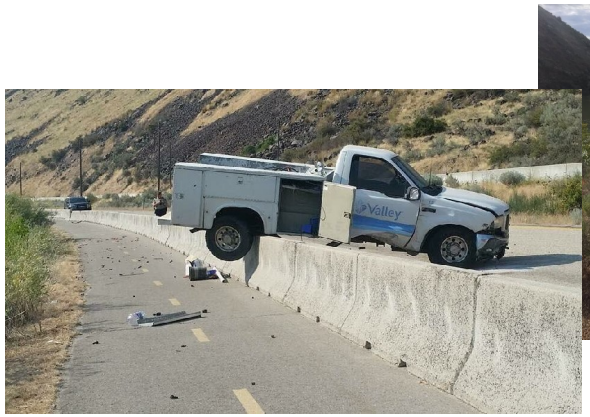
When shared use pathways are not adjacent to roadways, a 10-foot pathway width constitutes 10 feet of effective width unless there are features such as retaining walls adjacent to steep slopes or vertical barriers across bridges.

Shared use pathway do not have to be paved to comply with the Americans with Disabilities Act. A firm and stable surface is required, which usually consists of some type of compacted gravel surface with aggregate of 3/8-inch or less to allow for use by people in wheelchairs.

Much like a rural road has soft shoulders, preparing a 2-ft wide soft shoulder on either side of a paved shared use pathway helps facilitate drainage and prevents the edge of pavement along the pathway from cracking as easily. The 2-ft should also provides a place for joggers who prefer an unpaved surface.

Sidepaths The AASHTO Guide for the Development of Bicycle Facilities has a chapter dedicated to Shared Use Pathways, including when they are adjacent to streets. These are called sidepaths. As noted in the Design Guidance section of this Appendix, sidepaths that lack at least 5-feet of buffer from the top of curbing along a street need a vertical barrier to help separate pathway users from moving vehicles. Curbing provides minimum deflection of vehicles at speeds greater than 25 mph and people using sidepaths are moving in a contraflow direction next to moving traffic.

The shared use pathway bridge on Higgins Avenue in Missoula is a great example of both effective width and high volume use by pedestrians and bicyclists being a key part of its design.



Sidepaths that lack at least 5-feet of horizontal buffer from moving motor vehicle traffic are recommended by AASHTO to have a vertical, longitudinal barrier, to prevent motorized traffic from encroaching on the pathway. Making these barriers crashworthy helps prevent severe injuries to motorists who hit them while protecting pathway users, as shown above in a sidepath along State Highway 21 in Idaho.

A crashworthy longitudinal barrier, such as a jersey rail, is preferred to keep both pathway users from accidentally entering the street and to prevent errant motorists from encroaching on the sidepath.

Some agencies and engineers do not like to use these vertical barriers for fear of them restricting the clear zones they design for errant motorists. AASHTO is clear on this: **Longitudinal barriers like jersey rails are not considered clear zone obstructions**, as they are recommended for use for pedestrian and bicyclist safety in these sidepath and sidewalk setting in AASHTO's *Roadside Design Manual*.

Shared Use Pathway Crossings. Shared use pathway crossings of streets, either at mid-block locations or at intersections, must be designed to be more than an extra wide sidewalk. The width of the pathway needs to be carried through the crossing in terms of both curb ramp and crosswalk width. The images at right from a mid-block pathway crossing in Missoula show several best practices:

- Use of the trail crossing sign to alert motorists that both pedestrians and bicyclists are crossing.
- Curb ramps and crosswalks are the same width as the pathway to help safely facilitate bi-directional use by people who walk and bike, especially those with disabilities.
- Push buttons to activate the RRFB that are placed on the right side of the crossing since pathway users will approach the crossing on the right side.

Other treatments to make pathway crossings safer include raised crosswalks; upgrading of signals to Pedestrian Hybrid Beacons in places with higher volumes; and eliminating movements such as right turn on red and flashing yellow arrows at intersections with pathway crossings.

Missoula's pathway crossing of 6th Ave SW along the Bitterroot Branch Trail has several features for Livingston to emulate in its future pathway crossings of streets. These include adequate width to carry pathway users across the street, as well as properly-placed push buttons for pathway users to activate the signal from buttons placed on the right side of the pathway as they approach the crossing.

Bike Lane Widths

A common mistake in the design and application of bike lanes is counting the gutter pan as part of the bike lane. This is a common mistake that stems from an error in the AASHTO *Guidelines for the Development of Bicycle Facilities*. That guide states that bike lane width is measured from the face of the curb and that 4 feet is the minimum. MDT's design standards repeat this error. It fails to state that the measurement from the face of the curb should exclude the gutter pan. AASHTO's Green Book provides clarification on counting the gutter to measure both bike lanes and motor vehicle lanes:

- "A gutter of contrasting color or texture (black asphalt vs gray concrete) should not be considered part of the traveled way."

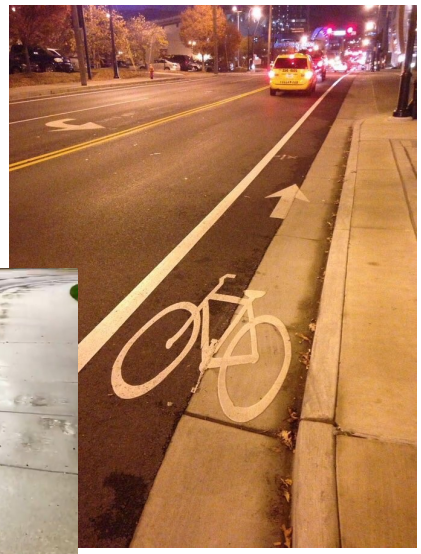
The seam created when asphalt meets a concrete gutter is enough to destabilize a bicyclist, especially one riding on a bike with narrow tires or someone who is a less confident rider. The images at right show other conditions that indicate why the gutter is not usable space for a bicyclist.

While a brand new road may have a flush transition from the gutter to the asphalt travel lane, that condition does not remain for very long. Brand new roads tend to settle and create small vertical offsets at that joint. That joint may also widen over time to create a gap between the asphalt and gutter.

Street maintenance practices like chipseals and overlays create lips at the gutter. Rarely are contractors inspected so closely to ensure a flush joint is preserved when a fresh layer is applied on a resurfacing project. This is when the top layer of asphalt is removed and replaced. Chipseals add height to the asphalt roadway and oftentimes lack smooth lines at the gutter due to difficulties in applying straight lines on the edges when roads are chipsealed.

Further, the gutter is designed into streets for the conveyance of stormwater and is not intended to be a traveled way. During rain events, stormwater is flowing in the gutter. Other road debris, such as leaves and snow collect in the gutter pans.

There are many reasons why the gutter doesn't count as bike lane width. First, the gutter is for stormwater conveyance and is not usable when it rains. Second, gutters are where debris like leaves and snow collect from the road. Finally, the bottom image shows the lip created when a road is resurfaced or chipsealed.



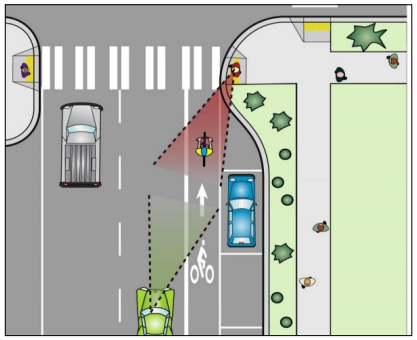
Curb Extensions

Curb extensions, sometimes called "neckdowns," are a crosswalk visibility enhancement use when on-street parking is present. They increase the visibility of pedestrians crossing streets as they are not screen by parked cars. They also reduce pedestrian exposure by limited crossing times.

Places to prioritize curb extensions include busier roadways with high volume pedestrian crossings, school crossings, park crossings, and areas with senior services.

Concerns arise from public works equipment operators and emergency services, which can be mitigated by proper design. The bullets below from FHWA identify some common considerations.

- Curb extensions are only appropriate where there is an on-street parking lane and where transit and bicyclists would be traveling outside the curb edge for the length of the street. They should not extend more than 6 feet from the curb.
- The turning needs of larger vehicles, such as school buses and emergency vehicles, need to be considered in curb extension design, especially at intersections with significant truck or bus traffic. However, speeds should be relatively slow in a pedestrian environment so all vehicles should be traveling at speeds conducive to tight turns.
- Emergency access is often improved using curb extensions if intersections are kept clear of parked cars. Fire engines and other emergency vehicles can climb a curb where they would not be able to move a parked car. At midblock locations, curb extensions can keep fire hydrants clear of parked cars and make them more accessible.



Curb extensions allow drivers and pedestrians to be more visible to each other and reduce crossing distances for pedestrians.

Existing Curb Extensions in Livingston

PEDSAFE—Curb Extensions: http://www.pedbikesafe.org/pedsafe/countermeasures_detail.cfm?CM_NUM=5

Curb Extensions & Street Operations. The abrupt angles created by poorly-designed curb extensions cause challenges for snow plow and street sweeper operators. The top image at right shows this abrupt transition that creates areas where a street sweeper misses debris and a snow plow cannot easily follow the line of the curb.

Designing more curvilinear transitions, along with placing other treatments like cast iron curb edging and reflective delineators assists snow plow operators in identifying the curb line and reducing damage to the curbing.

Other Curb Extension Treatments. Changing the curb line at corner to accommodate curb extensions can change stormwater flows along the curb line. As Livingston reaches a population where it must create a stormwater system, this will provide an opportunity to retrofit corners with curb extensions designed with this in mind.

There are other treatments, shown below, that allow existing stormwater flows to be maintained while achieving similar benefits that come with curb extensions.

Abrupt angles are what impacts plow and sweeper operators as they create corners that are hard to follow with their equipment

Curvilinear transitions create a better edge for street equipment operators to follow.

Mountable curb extensions like this one preserve drainage flows and allow larger vehicles to move over them when turning.

Bozeman uses reflective delineators at curb extensions to help plow operators identify edges when snow is covering the street.

Bridging the gutter to allow water to flow under allows for curb extensions that don't impact drainage. It does require routine checks to avoid clogging with debris.

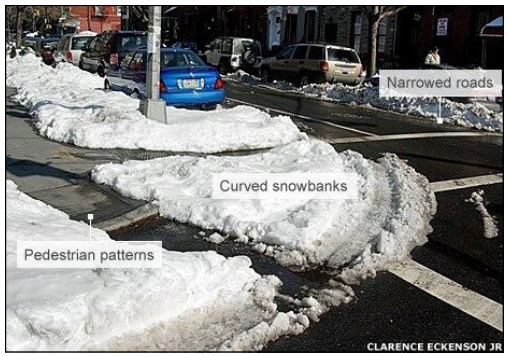
Sandpoint, ID, affixes cast iron edging to curb to help avoid chipping by snow plows.

Temporary Curb Extensions. There are several treatments that can create curb extensions without substantial infrastructure investment. Pop-up projects often use tubular markers to outline curb extensions and some cities use temporary planters and a combination of other treatments to create curb extensions but allow for street features to be moved for winter operations or other reasons.

Piloting curb extensions with temporary materials allows cities to test how narrow they can make a motor vehicle travel lane or how to best design the final curb extension to allow for turning of school buses, emergency vehicles, and trucks.

The images at right show different temporary treatments.

"Sneckdowns." Snowfall reveals the areas at street corners where curb extensions could be installed. The snow creates the neckdown (hence, sneckdown) and illustrates the unused portion of the street that can form the footprint for future curb extensions. The images below show how images can be taken and then lines drawn to show existing curb lines versus the sneckdown the snow created.



Raised Crosswalks

FHWA identifies raised crosswalks as part of a comprehensive pedestrian safety program. Raised crosswalks are ramped speed tables spanning the entire width of the roadway, often placed at midblock crossing locations, but also used at intersections. In their safety publications FHWA states raised crosswalks can reduce pedestrian crashes by 45%.

The crosswalk is demarcated with paint and/or special paving materials. These crosswalks act as traffic-calming measures that allow the pedestrian to cross at grade with the sidewalk. In addition to their use on local and collector streets, raised crosswalks can be installed in campus settings, shopping centers, and pick-up/drop-off zones (e.g., airports, schools, transit centers).

Raised crosswalks are flush with the height of the sidewalk. The crosswalk table is typically at least 10 feet wide and designed to allow the front and rear wheels of a passenger vehicle to be on top of the table at the same time. Detectable warnings (truncated domes) and curb ramps are installed at the street edge for pedestrians with impaired vision.

These may be done in combination with other pedestrian visibility treatments like curb extensions.

The images at right, middle and bottom, are in Bend, Oregon, and Moscow, Idaho—both cities in which there is notable snowfall.

Mid-block raised crosswalk examples showing a bridging of the gutter (top) and in combination with a curb extension (middle).

Raised crosswalk at a T-intersection and in front of a high school.

Raised crosswalks at a shared use pathway crossing of a right turn slip lane.

https://safety.fhwa.dot.gov/ped_bike/step/docs/techSheet_RaisedCW2018.pdf

Curb or Outside Truck Aprons

Sweeping right turn lanes that are commonly referred to as “slip lanes” present challenges for pedestrian safety. They promote high speed turns and drivers are not always looking both ways for people crossing as they try to identify gaps in traffic. Interstate off-ramps are prime locations for these.

One way to narrow these slip lanes and make them safer is to install a truck apron on the outside of the lane. This creates a tighter turning radius for the majority of vehicles while allowing larger vehicles, like trucks and emergency service vehicles, to mount the apron as they would the interior of a roundabout. Examples shown are from US and state highways in Eugene and Bend, Oregon.

Ensuring there is an ADA-compliant pedestrian access route across the apron is important to include in the design. Additional treatments for these areas can be installed of Rectangular Rapid Flashing Beacons at the crossings.

Speed Humps

Speed humps are paved vertical traffic control measures that tend to have the most predictable speed reduction impacts. They can also be used to enhance the pedestrian environment at pedestrian crossings. Speed humps are approximately 3 to 4 in. high at their center, and extend the full width of the street with height tapering near the drain gutter to allow unimpeded bicycle travel. Speed humps should not be confused with the speed “bump” that is often found in mall parking lots.

There are several designs for speed humps. The traditional 12-ft hump has a design speed of 15 to 20 mi/h, 14-ft hump a few mph higher, and a 22-ft table has a design speed of 25 to 30 mi/h. The longer humps are much gentler for larger vehicles.

Speed humps can also be designed with two, 1-ft slots to allow for vehicles with wide wheelbases such as buses and emergency vehicles to pass through them without having to go over the measure. These are typically called speed cushions. These gaps, as shown at right, also allow bicyclists to pass through them.

http://www.pedbikesafe.org/pedsafe/countermeasures_detail.cfm?CM_NUM=35

Rectangular Rapid Flashing Beacons (RRFBs)

RRFBs are a relatively low-cost treatment to raise the visibility of pedestrians at street crossings that do not have other types of traffic controls like traffic signals or stop signs. FHWA data shows RRFBs can reduce pedestrian crashes by 47%. FHWA notes "RRFBs are particularly effective at multilane crossings with speed limits less than 40 mph."

The yellow flashing lights are in a rectangular format below a traditional pedestrian, school zone, or shared use pathway crossing sign. The lights flash when the button is pushed, with LED flashers set at a frequency similar to emergency service vehicles. The studies find that this frequency prompts a yield response from drivers as they are accustomed to reacting to similar flashing from emergency vehicles.

RRFBs can be equipped with solar panels so they don't require a power source. This makes them cheaper and easier to move if their installation doesn't have the desired effect or is upgraded to other treatments.

A frequently overlooked design treatment with RRFBs is putting the pushbutton on the same pole as the signal. While this is more cost-effective, designers must then ensure that the button is ADA-compliant. This means it must be at an appropriate height and reach from a flat landing area at least 4-feet by 4-feet.

If this means the RRFB flasher and sign is placed on the backside of a sidewalk, it may be out of the vision triangle of an approaching motorist. This may require construction of a separate pole, as shown in the trail crossing example at right, which is in Missoula. For pathway crossings, it is important to put the push button on the right side of the crossing since that's where people will be approaching the crossing. Curbside push buttons for bicyclists using the street may also be installed in combination with a typical crosswalk button.

RRFBs currently have interim approval status from FHWA, which means they are not an official part of MUTCD and require special permissions. MDT has obtained this permission and it is applicable for every city in Montana to use.

https://safety.fhwa.dot.gov/ped_bike/step/docs/TechSheet_RRFB_508compliant.pdf

Pedestrian Hybrid Beacons (PHBs)

PHBs area signal type that prompts a stop from motorists. The signal head is comprised of flashing red lights and yellow lights. The yellow lights begin flashing when the signal is activated to alert approaching motorists.

The red lights then activate and are solid when motorists must stop as the pedestrian has the walk signal. Once the countdown phase begins, the red lights begin alternating (called a wig-wag) like a railroad crossing signal. This means a driver can then proceed if after coming to a complete stop and if the crosswalk is clear. This reduces motorist delay when compared to a full traffic signal where the red light would remain through the entire walk and countdown phase of the signal.

FHWA notes PHBs can reduce pedestrian crashes up to 50%. The PHB is often considered for installation at locations where pedestrians need to cross and vehicle speeds or volumes are high, but traffic signal warrants are not met. PHBs are a candidate treatment for roads with three or more lanes that generally have annual average daily traffic (AADT) above 9,000. PHBs should be strongly considered for all midblock and intersection crossings where the roadway speed limits are equal to or greater than 40 miles per hour (mph).

PHBs are typically installed at the side of the road or on mast arms over midblock pedestrian crossings. The mast arms and signal controls increase the cost when compared to a RRFB, however, the image at right-middle shows a PHB application that does not include a mast arm and is cheaper to install.

PHBs may be used with the pedestrian crossing sign, a school crossing, or a combined bicycle and pedestrian (typically a trail crossing) sign. If the crossing is not for a pathway but includes a bikeway, then a curbside side push button is used so bicyclists using the street can activate the PHB.

https://safety.fhwa.dot.gov/ped_bike/step/resources/docs/fhwasa18064.pdf

Traffic Filters & Chicanes

Traffic Filters a traffic diversion technique that reduce traffic volumes on residential neighborhood streets when traffic calming or other measures are in need of additional measures to make a route safer for walking and bicycling. Traffic filters reduces traffic volume by discouraging or preventing traffic from cutting through a neighborhood and restricts access to a street without creating one-way streets. On-street bikeways benefit the most from traffic filters when they are on routes parallel to busier streets as they help divert motorized traffic to other preferred routes.

The prime beneficiaries of traffic diversion are bicyclists, pedestrians, and those who live on the treated streets, but local residents are also most negatively affected by traffic diversion as they may have to deviate from routes they traditional use. Traffic filters consist of islands or other temporary treatments that may allow motor vehicles to proceed in only one direction while allowing bicyclists to pass through an intersection in both directions.

Chicanes are a horizontal traffic control measures used to reduce vehicle speeds on local streets. A secondary benefit of chicanes installation is the ability to add more landscaping to a street. (images at bottom right)

Chicanes create a horizontal diversion of traffic and can be gentler or more restrictive depending on the design. Shifting a travel lane has an effect on speeds as long as the taper is not so gradual that motorists can maintain speeds. For traffic calming, the taper lengths may be as much as half of what is suggested in traditional highway engineering. The taper lengths should reflect the desired speed which should be posted prior to the chicane.

Shifts in travelways can be created by shifting parking from one side to the other (if there is only space for one side of parking) or by building landscaped islands (islands can also effectively supplement the parking shift).

Traffic filters help reduce cut-through traffic on local streets and make conditions safer and more comfortable for people using these streets as bikeways. Traffic may proceed in one direction while bicyclist can operate in both directions through an intersection.

Chicanes create a forced diversion of motor vehicle traffic to help slow speeds (top). They are a combination of street side curb islands and median islands that can include landscaping (right).
Images: PedBikeImages.com/Dan Burden

Mini-Roundabouts & Neighborhood Traffic Circles

Mini-roundabouts and neighborhood traffic circles differ from traditional roundabouts in order to apply them to smaller or existing street sections.

Mini-roundabouts have a circular center island that, unlike regular roundabouts, has a flat, mountable island so larger vehicles can make the turns. The Wallace Street mini-roundabout is part of a full suite of traffic calming or speed management treatments.

Mini-roundabouts may have median islands for pedestrians if right-of-way exists to do so. The example at right from Coralville, Iowa, resembles more of a traditional roundabout with pedestrian islands but with the flat island in the middle.

Neighborhood traffic circles are similar but less formalized than mini-roundabouts. They have similar features but are commonly placed on lower volume residential streets as a traffic calming feature. Missoula recently placed neighborhood traffic circles in their Franklin to the Fort neighborhood using tubular markers and paint. They are raising funds for putting planter boxes in these features.

Mini-roundabouts on Wallace St in Bozeman (left) and Wyoming St in Missoula (below).

Mini-roundabout in Coralville, IA (right) and a neighborhood traffic circle in Lewiston, ID (below).

Missoula's temporary neighborhood traffic circles.

Bicycle Boulevards

Given the limited ability to create dedicated in-street or separated bike lanes in Livingston, the bicycle boulevard treatment is recommended for those routes identified for bikeways.

The main goal of bicycle boulevard treatments is to incorporate design features that manage the speed of vehicles. Both the NACTO *Urban Bikeway Design Guide* and the FHWA *Small Town and Multimodal Networks Guide* contain sections on design for bicycle boulevards.

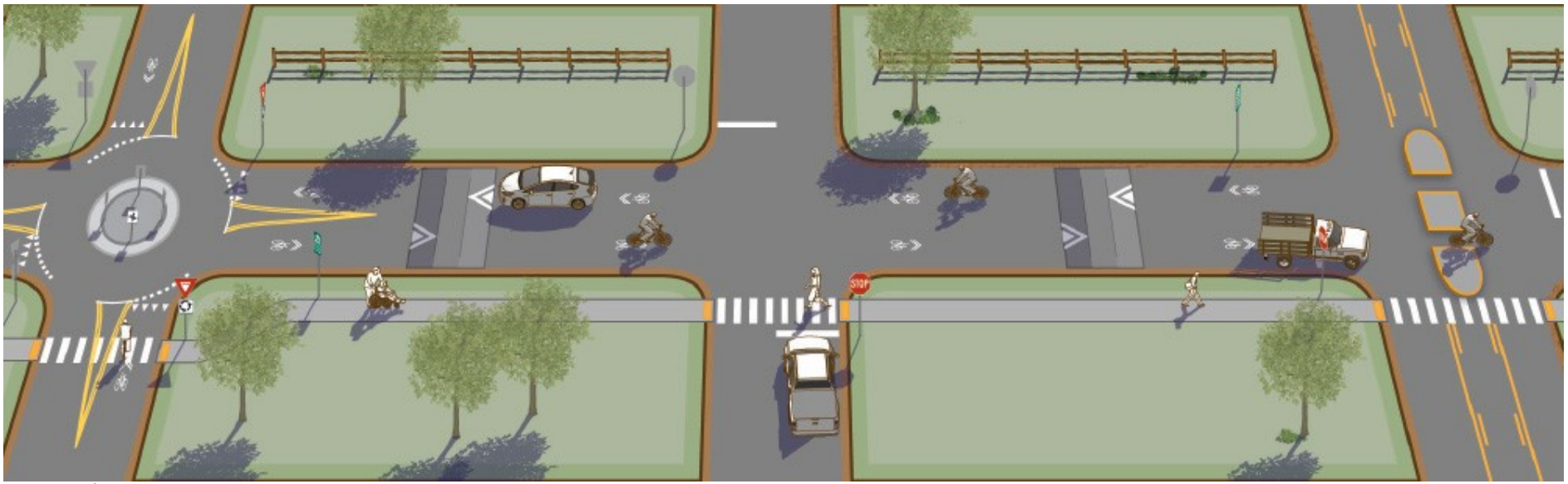
Many of the design features outlined in previous sections can be combined to create bicycle boulevards, which is shown below from the FHWA guide. A combination of curb extensions, chicanes, traffic filters, speed humps, and median islands along a route help keep drivers attentive to these road features and can result in speeds where bicyclists are comfortable sharing the travel lanes.

At major intersections that lack stop signs or traffic signals, treatments such as curbside push buttons for bicyclists to activate RRFBs and PHBs are desired treatments.

At major street crossings with RRFBs or PHBs, place push buttons atop the curb racing the street so bicyclists can activate the signals.

https://nacto.org/publication/urban-bikeway-design-guide/bicycle-boulevards/

https://ruraldesignguide.com/mixed-traffic/bicycle-boulevard



Advisory Shoulders or Advisory Lanes

Advisory shoulders are a tool endorsed by FHWA in its Small Town and Rural Multimodal Networks Guide to 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. Cities must file for experimental use with the state FHWA office in order to apply advisory shoulders on their streets.

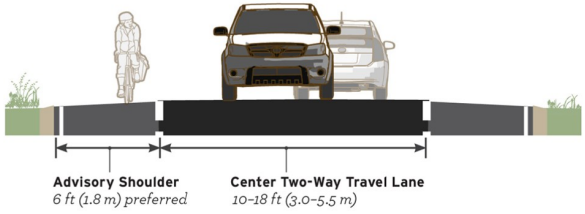
These can be used on low speed, low volume streets intended to become city bikeways. The examples at right show two applications of advisory shoulders:

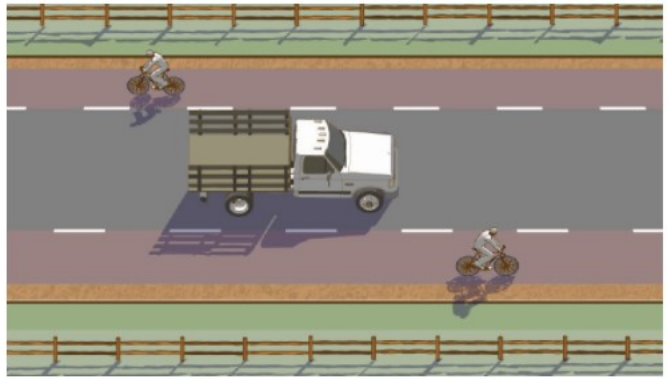
- Top—With on-street parking, which is suitable for residential streets in Livingston.
- Bottom—This was done one in lieu of a dedicated bike lane on a street between a middle school and elementary school. There are no curbs and residential parking is beyond the pavement in this neighborhood.

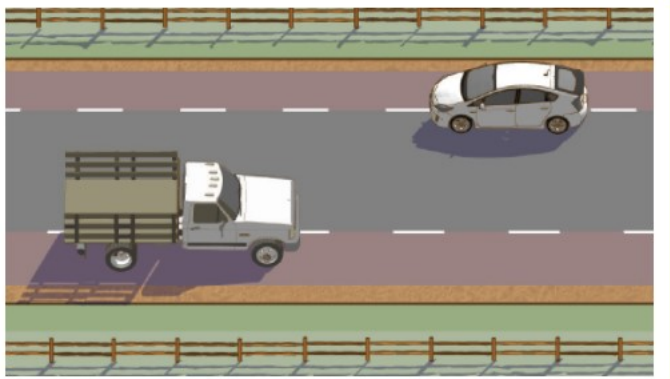
The diagrams below from FHWA show lane width considerations and how vehicles function to use the center drive aisle and merge into the advisory shoulders when another motorist approaches from the opposite direction.

Advisory shoulders can be used on bikeways with on-street parking (right) or without (below).

Motorists use the center drive aisle, and yield to bicyclists in the shoulder as they merge into the shoulder to pass an oncoming driver.







Work Zone Treatments

Pedestrians and bicyclists must be treated with the same care and attention in work zones as motorists. The Manual on Uniform Traffic Control (MUTCD) addresses how pedestrians and bicyclists must be accommodated. Section 6 of MUTCD addresses what are known as Temporary Traffic Controls (TTC), which are the features used in work zones to safely guide all road users through or around a work zone. MUTCD states (emphasis added):

- The needs and control of all road users (motorists, **bicyclists, and pedestrians** within the highway, or on private roads open to public travel, including persons with disabilities **in accordance with the Americans with Disabilities Act** of 1990 through a TTC zone **shall be an essential part of highway construction**, utility work, maintenance operations, and management of incidents.

Pedestrians & ADA Compliance. Providing for the needs of pedestrians, especially those with disabilities, is a key element of work zones that impact sidewalks, curb ramps, crosswalks, and pathways that are alongside streets. MUTCD requires that temporary pedestrian access routes be included when sidewalks and related pedestrian features are closed for construction.

A city, state DOT, or developer, cannot close a sidewalk without designating a detour route or constructing a bypass of the work on-site. The detour route must be comparable in terms of accessibility features as the route that is disturbed. For example, if the route had curb ramps with truncated domes prior to construction, the detour route must also have those features.

The diagram below shows what's known as an "on-site detour" where a corner is disturbed construction and a temporary pedestrian route is erected by closing the adjacent motor vehicle travel lane. The diagram outlines the features of this detour route.

If barricades and channelizing devices do not have bottom edges detectable to people who are blind or vision impaired, they may enter unsafe situations such as open trenches or motor vehicle travel lanes. If routes are not accessible to people using wheelchairs or other mobility devices, they may be forced to use the street and be subject safety threats from moving vehicles.

This is why it is crucial to properly review and permit utility companies, developers, and other contractors who do work in City or MDT right-of-way.

Sample Construction Zone Treatments to Comply with ADA and MUTCD

Construction zone access that is compliant with ADA and MUTCD Section 6 has been an emphasis of the Federal Highway Administration in recent years. The example below shows a temporary ramp, detectible sidewalk barricade, and channelized pedestrian route provided for a curb ramp replacement project on two nearby street corners. Additionally, a parking lane, bike lane, or general purpose travel lane may need to be closed to provide compliant access.

1. Pedestrian detour routes should be thought of the same as roadway detour routes. They should be signed to designate a route comparable to the accessibility features that existed pre-construction.
2. Cane-detectable barricades must be present so they provide a cue to blind or visually-impaired pedestrians that there is a sidewalk closure. Barricades must cover the full tread width of the sidewalk and be no more than 2 inches off the surface.
3. Temporary ramps may be needed to provide access off the curb. Landing areas, cross slope, and running slope requirements are the same as standard ramps.
4. A protected pedestrian access route may be necessary to provide safe, protected movement. Cones and tape or rope between cones is not an accessible barrier. The route must be free of trip hazards and protruding objects.

Bicyclists. Managing bicyclists in work zones has fewer resources than pedestrians and is not subject to ADA requirements unless the work zone impacts a pathway. If a pathway next to a road is impacted, it must be treated as a sidewalk and is required to have the same comparable accessibility measures.

If on-street bikeways that lack dedicated bike lanes are subject to a work zone obstruction or full closure, the bicyclists may be detoured to another comparable route or given the most suitable accommodations on the existing street. Work zone traffic conditions are typically slow enough for bicyclists to share the lanes with motorists.

Safety issues arise when there are abrupt edges in the pavement that can cause a pinch flat for a bicyclist. Grooves in the pavement due to resurfacing can crate unstable conditions for bicyclists using narrow tires.

For routes with bike lanes, a dedicated bike lane should be included through the work zone or work zone conditions created to make the speeds of motorists conducive to a bicyclist sharing the lane. Bike lane closures should be given advance warning so bicyclists can make a decision on how to proceed and bike lanes cannot be blocked by other work zone signage.

Pathways. As noted, pathways adjacent to roadways must be treated like sidewalk and ADA requirements adhered to. If a pathway exists on only one side of a road and there is no sidewalk on the other side, then a full closure of the pathway is not allowed.

Shared use pathways in other settings, such as along rivers or in parks, should be carefully evaluated to determine if a full closure is necessary. Designating and marking a detour route of a pathway can occur through the use of parallel sidewalk routes or dedicating a motor vehicle travel lane to pathway use, using vertical barriers along the route, if the pathway is of high usage.

Providing advance warning of a bike lane closure is proper, but the advance warning sign should not block the bike lane.

Closing a pathway for construction may necessitate a detour route for users, the same as done for motorists when a road is closed. The detour should be similar to the pathway that is closed, in terms of width and safety.

Temporary pathway detours can be constructed by converting existing on-street lanes to a pathway using jersey rails and other types of barricades.

Appendix C: Detailed Project Rankings

The projects identified as part of the Livingston Trails and Active Transportation Plan are generated from the following efforts:

- Previous plans and studies;
- Public input;
- Steering committee input;
- City staff input; and
- Consultant evaluation.

The projects were ranked using a multi-criteria evaluation method with factors generated by the top preferences of the Steering Committee. In May/June 2021, the Steering Committee was asked to determine which factors should be the highest priority when ranking projects.

They are identified in Figure C-1. The ranking factors are divided into two sets for project types—sidewalk/bikeway projects and trail/pathway projects. They were divided into two sets since sidewalk and bikeway projects occur along streets while trail and pathway projects occur primarily in natural areas or separated from streets.

Figure C-1 shows the average score for each proposed factor based on how the Steering Committee weighted each factor in its evaluation. These factors were used to develop a multi-criteria evaluation, based on a 100-point maximum scale, to then rank projects to determine the top tier projects for Livingston.

Once projects were ranked according to these factors, Steering Committee members were asked which projects they felt had intangibles that should be considered in granting up to 5 additional points to the project through the Steering Committee Priority.

The following pages contain the detailed rankings of projects and how points were assigned based on the factors in Figure C-1. The detailed ranking tables for the sidewalks and bikeways projects, and the trail and pathway projects, were combined into the final ranking to determine high, medium, and low priority tiers.

Figure C-1 Project Ranking Factors

Sidewalk/Bikeway Factors	Score
Primary Factors	
Proximity to Schools	5.0
Proximity to Downtown/Other Key Destinations	4.8
Access to Population in Need	4.7
Fills Gap in System	4.7
Proximity to Health & Social Services	4.5
Proximity to Parks/Trails/Natural Areas	4.3
Secondary Factors	
Bus Route & Other Transportation Access	3.8
Potential for New Development to Build	3.7
Access to Food Outlets	3.5
Traffic Exposure	3.3
Steering Committee Priority	3.2
Ease of Implementation	3.0

Trail/Pathway Factors	Score
Primary Factors	
Proximity to Other Parks/Trails/Natural Areas	5.0
Access to Population in Need	4.8
Fills Gap in System	4.8
Environmentally Sensitive Area	4.7
Prox. to Community Assets (Schools,Food,Downtown)	4.5
Secondary Factors	
Ease of Implementation	3.8
Current Property Owner Status (Public/Private)	3.8
Topography & Related Challenges	3.7
Provides Alternative to On-Street Sidewalk/Bikeway	3.7
Steering Committee Priority	3.5
Presence of Existing Parking & Other Amenities	2.8

Figure C-2: Combined Project Rankings, Ordered by Total Points and Tier

	Project Ranking	Project Name	Project Type (SW, SW+BW, BW, P, T)	Length (in Miles)	Recommended Investment	Total Points
						100
Top Tier	1	Gallatin/Bennett, N St to Park	SW+BW	0.6	Add sidewalks on north side, designate bikeway & consider speed mgmt	83
	2	Yellowstone River Trail, north side, Baseball/Softball Complex to Mayor's Landing	P	0.9	Unpaved shared use pathway	78
	2	Lewis/O St Crosstown Bikeway, Park to O St	BW + SW	1.7	Designate bikeway & apply speed management investments	78
	2	Gallatin/C/Chinook, Main to N St	SW+BW	0.8	Rebuild sidewalks, designate bikeway & apply speed management	78
	5	Summit, 7th to Main	SW+BW	0.4	Add sidewalks on one side, acquire land for pathway link	76
	5	5th, Front to Park	SW+BW	0.1	Rebuild sidewalk to pathway width across Railroad	76
	5	Yellowstone River Trail, Mayor's Landing to O Street Connector	P	0.4	Unpaved shared use pathway	76
	5	Yellowstone River Trail, north side, US 89 to Whiskey Creek Road	P	0.6	Unpaved shared use pathway (WWTP)	76
	9	H St, Park to View Vista	BW	0.5	Designate bikeway & apply speed management investments	75
	10	River Dr, 12th to Main/View Vista	SW+BW	0.8	Add sidewalks/walkway on north side, designate bikeway	74
	10	Front, 5th to Starr Road	SW+BW	0.8	Add sidewalks on north side, designate bikeway & consider speed mgmt	74
	12	North Hills Trails, East, Green Acres to Summit/Water Tower	T	1.2	Single track trails	73
Middle Tier	13	12th, River Rd to Park	SW+BW	0.4	Add sidewalks on both sides, designate bikeway & apply speed mgmt	72
	14	E St/Sleeping Giant, Lewis to View Vista	BW	0.5	Designate bikeway & apply speed management investments	71
	14	Yellowstone River Crossing, Meyers Alignment	P	0.1	Bridge over Yellowstone River	71
	16	Park, I St to O St	SW+BW	0.4	Add sidewalks on south side, designate bikeway & consider speed mgmt	69
	17	Lewis, H St to O St, and O St, Lewis to Park	SW+BW	0.6	Add sidewalks on north side east of M, designate bikeway	67
	18	Hwy 89 Pathway, Myers View Trailhead to I-90	P	1.8	Paved shared use pathway	65
	19	Park, Hwy 10 to Geyser	SW	0.6	Add sidewalks on north/west side	60
	20	North Hills Trails, West, Scenic Trail Rd to High Ground Ave	T	0.6	Single track trails	58
	21	Park, 7th to I St	BW	1.3	Designate bikeway & consider speed management investments	56
Bottom Tier	22	7th, Front to Montana	SW+BW	0.3	Add sidewalks on east side, designate bikeway & apply speed mgmt	55
	22	N St, Gallatin to Wineglass	SW	0.2	Add sidewalks on east side	55
	22	Highway 10 Pathway, Park to PFL	P	1.6	Paved shared use pathway	55
	25	5th, Park to Lewis	BW	0.2	Designate bikeway & apply speed management investments	53
	26	View Vista, H St to Mayor's Landing	SW+BW	0.5	Add walkway on north side, designate bikeway & apply speed mgmt	44
	27	Starr, Front to Prairie	SW+BW	0.5	Add/replace sidewalks on east side, designate bikeway	40
	28	Loves, Pronghorn to Park	SW	0.1	Add sidewalk on south side	38
	29	Yellowstone River Trail, South side, Meyers Lane to I-90	P	2.1	Unpaved single track trail (shared use pathway long-term?)	35
	30	Scenic Trail/Prairie Dr, Summit to Starr	BW	0.7	Designate bikeway & apply speed management investments	33
	30	Miles, Gallatin to Maple	SW+BW	0.4	Add sidewalks on one side, designate bikeway & apply speed mgmt	33
	32	Garnier/Old Clyde, Gallatin to City Limit	BW	0.7	Designate bikeway	30

Project Type:
- SW - Sidewalk;
- BW - Bikeway;
- P - Pathway/Double Track;
- T- Trail/Single Track

Figure C-3: Sidewalk and Bikeway Projects Ranking

Project Ranking	Project Name	Project Type (SW, SW+BW, BW)	Length (in Miles)	Recommended Investment	Total Points	Proximity to Schools	Fills Gaps in System	Population in Need	Proximity to Downtown, Health/ Social Services	Proximity to Parks/Natural Areas	Bus Route & Other Transp Access	Traffic Exposure	Access to Food	Ease of Implementation	Steering Committee Priority
					100	15	15	15	15	10	10	5	5	5	5
1	Gallatin/Bennett, N St to Park	SW+BW	0.6	Add sidewalks on north side, designate bikeway & consider speed mgmt	83	15	15	15	5	10	7	5	3	3	5
2	Lewis/O St Crosstown Bikeway, Park to O St	BW	1.7	Designate bikeway & apply speed management investments	78	10	10	10	15	10	10	3	5	5	
2	Gallatin/C/Chinook, Main to N St	SW+BW	0.8	Rebuild sidewalks, designate bikeway & apply speed management	78	5	5	15	15	10	10	5	3	5	5
4	Summit, 7th to Main	SW+BW	0.4	Add sidewalks on one side, acquire land for pathway link	76	15	15	10	10	10	10	5	0	1	
4	5th, Front to Park	SW+BW	0.1	Rebuild sidewalk to pathway width across Railroad	76	15	10	15	5	7	10	5	3	1	5
6	H St, Park to View Vista	BW	0.5	Designate bikeway & apply speed management investments	75	15	5	15	10	7	10	5	5	3	
7	River Dr, 12th to Main/View Vista	SW+BW	0.8	Add sidewalks/walkway on north side, designate bikeway	74	15	15	10	5	10	10	1	3	5	
7	Front, 5th to Starr Road	SW+BW	0.8	Add sidewalks on north side, designate bikeway & consider speed mgmt	74	15	15	10	5	4	7	5	3	5	5
9	12th, River Rd to Park	SW+BW	0.4	Add sidewalks on both sides, designate bikeway & apply speed mgmt	72	10	10	15	10	7	7	3	5	5	
10	E St/Sleeping Giant, Lewis to View Vista	BW	0.5	Designate bikeway & apply speed management investments	71	15	10	15	5	10	7	1	3	5	
11	Park, I St to O St	SW+BW	0.4	Add sidewalks on south side, designate bikeway & consider speed mgmt	69	0	15	10	15	10	10	5	1	3	
12	Lewis, H St to O St, and O St, Lewis to Park	SW+BW	0.6	Add sidewalks on north side east of M, designate bikeway	67	5	10	10	15	4	10	3	5	5	
13	Park, Hwy 10 to Geyser	SW	0.6	Add sidewalks on north/west side	60	10	5	0	15	10	10	5	5	0	
15	7th, Front to Montana	SW+BW	0.3	Add sidewalks on east side, designate bikeway & apply speed mgmt	55	10	10	0	5	7	7	3	3	5	5
17	5th, Park to Lewis	BW	0.2	Designate bikeway & apply speed management investments	53	10	5	0	5	10	10	3	5	5	
14	Park, 7th to I St	BW	1.3	Designate bikeway & consider speed management investments	56	0	0	10	15	10	10	5	3	3	
15	N St, Gallatin to Wineglass	SW	0.2	Add sidewalks on east side	55	0	10	15	0	10	7	3	0	5	5
18	View Vista, H St to Mayor's Landing	SW+BW	0.5	Add walkway on north side, designate bikeway & apply speed mgmt	44	15	10	0	0	10	3	3	0	3	
19	Starr, Front to Prairie	SW+BW	0.5	Add/replace sidewalks on east side, designate bikeway	40	0	15	0	0	10	7	5	0	3	
20	Loves, Pronghorn to Park	SW	0.1	Add sidewalk on south side	38	0	15	0	0	0	10	3	5	5	
21	Scenic Trail/Prairie Dr, Summit to Starr	BW	0.7	Designate bikeway & apply speed management investments	33	0	5	0	0	10	10	3	0	5	
21	Miles, Gallatin to Maple	SW+BW	0.4	Add sidewalks on one side, designate bikeway & apply speed mgmt	33	0	5	15	0	4	3	3	0	3	
23	Garnier/Old Clyde, Gallatin to City Limit	BW	0.7	Designate bikeway	30	0	0	15	0	4	3	3	0	5	

Figure C-4: Sidewalk and Bikeway Factors and Possible Points per Project

Sidewalk & Bikeway Factors	Possible Points
Proximity to Schools: Project will connect a school to neighborhoods and other destinations.	15: Project has direct connection, is only suitable route, or is within ¼-mile of a school. 10: Project is within ¼-mile of a school but has no direct connection. 5: Project is within ½-mile of a school but has no direct connection. 0: Project is beyond ½-mile of a school.
Fills Gap in System: Project will connect to existing facilities by filling the gap between them.	15: Project fills gaps in existing sidewalk or pathway system along a high volume traffic route where no sidewalk exists. 10: Project fills a gap in the system along secondary routes with notable connectivity to destinations/other routes. 5: Project fills a gap in the system along a secondary route with limited connectivity to destinations/other routes. Or along a major route where sidewalks exist only on one side. 0: Project does not address a gap in the system.
Population in Need: Project is within a Census Block Group identified as having socioeconomic needs based on income.	15: Project is within or spans a block group showing median household income less than $40,000. 10: Project is within a block group showing medium household less than $55,000. 0: Project is within a block group with median income greater than $55,000.
Proximity to Downtown, Healthcare, and/or Social Services: Project will connect downtown, healthcare and social services to neighborhoods.	15: Project is a direct connection or is within ¼-mile of downtown or health/social services. 10: Project is within ¼-mile of downtown or health/social services but is not a direct connection. 5: Project is within ½-mile of downtown or health/social services but is not a direct connection. 0: Project is beyond ½-mile
Proximity to Parks or Natural Areas: Project will connect parks, recreation areas or recreational trails to neighborhoods.	10: Project has direct connection or is within ¼-mile of a park or natural/rec area. 7: Project is within ¼-mile of a park or natural/rec area but has no direct connection. 4: Project is within ½-mile of a park or natural/rec area but has no direct connection. 0: Project is beyond ½-mile
Bus Route & Other Transportation Access:	10: Project upgrades sidewalks to streets along existing bus route 7: Project is within ¼-mile of streets along existing bus route. 3: Project is within ½-mile of streets along existing bus route. 0: Project is beyond these limits.
Traffic Exposure: Based on function of the roadway project is along.	5: Project is along a MDT highway route or or MDT urban route 3: Project is along a local street that connects directly to a MDT route 1: Project is along a local street that does not connect to a MDT route.
Access to Food: Project will connect major food outlets to neighborhoods.	5: Project is within 1/4-mile of a major food outlet (grocery store or food pantry) 3: Project is within ½-mile of a major food outlet (grocery store or food pantry) 1: Project is within ¼-mile of a minor food outlet (convenience store) 0: Project is beyond these limits.
Ease of Implementation: Measures the likelihood that project can be easily implemented based on available right-of-way and other constraints.	5: Project has no evident right-of-way constraints or other feasibility issues. 3: Project has limited right-of-way constraints or few other feasibility issues. 1: Project has a right-of-way or feasibility issue but not both. 0: Project has major right-of-way constraints or feasibility issues.
Steering Committee Priority: Points assigned by the steering committee.	Steering committee was asked to identify project where intangibles exist that would justify an additional 5 points for a project.

Figure C-5: Pathways and Trails Projects Ranking

Project Ranking	Project Name	Project Type (T or P)	Length (in Miles)	Recommended Investment	Total Points	Proximity to Parks/Trails/Natural Areas	Fills Gaps in System	Population in Need	Proximity to Downtown, Health/ Social Services	Alt. to On-Street Route	Ease of Implementation	Topography Or Similar challenges	Enviro-Sensitive Area	Existing Parking/ Amenities	Steering Committee Priority
					100	15	15	15	15	10	10	5	5	5	5
1	Yellowstone River Trail, north side, Baseball/Softball Complex to Mayor's Landing	P	0.9	Unpaved shared use pathway	78	15	15	15	10	10	0	5	3	5	
2	Yellowstone River Trail, Mayor's Landing to O Street Connector	P	0.4	Unpaved shared use pathway	76	15	15	15	5	10	5	5	3	3	
2	Yellowstone River Trail, north side, US 89 to Whiskey Creek Road	P	0.6	Unpaved shared use pathway (WWTP)	76	15	10	15	0	10	10	5	3	3	5
4	North Hills Trails, East, Green Acres to Summit/Water Tower	T	1.2	Single track trails	73	10	10	15	5	5	10	3	5	5	5
5	Yellowstone River Crossing, Meyers Alignment	P	0.1	Bridge over Yellowstone River	71	15	15	0	15	10	1	5	5	5	
6	Hwy 89 Pathway, Myers View Trailhead to I-90	P	1.8	Paved shared use pathway	65	15	15	0	10	10	0	5	5	5	
7	North Hills Trails, West, Scenic Trail Rd to High Ground Ave	T	0.6	Single track trails	58	15	10	10	0	5	5	3	5	5	
8	Highway 10 Pathway, Park to PFL	P	1.6	Paved shared use pathway	55	15	15	0	5	10	0	5	5	0	
9	Yellowstone River Trail, South side, Meyers Lane to I-90	P	2.1	Unpaved single track trail (shared use pathway long-term?)	35	15	10	0	0	0	5	0	0	5	

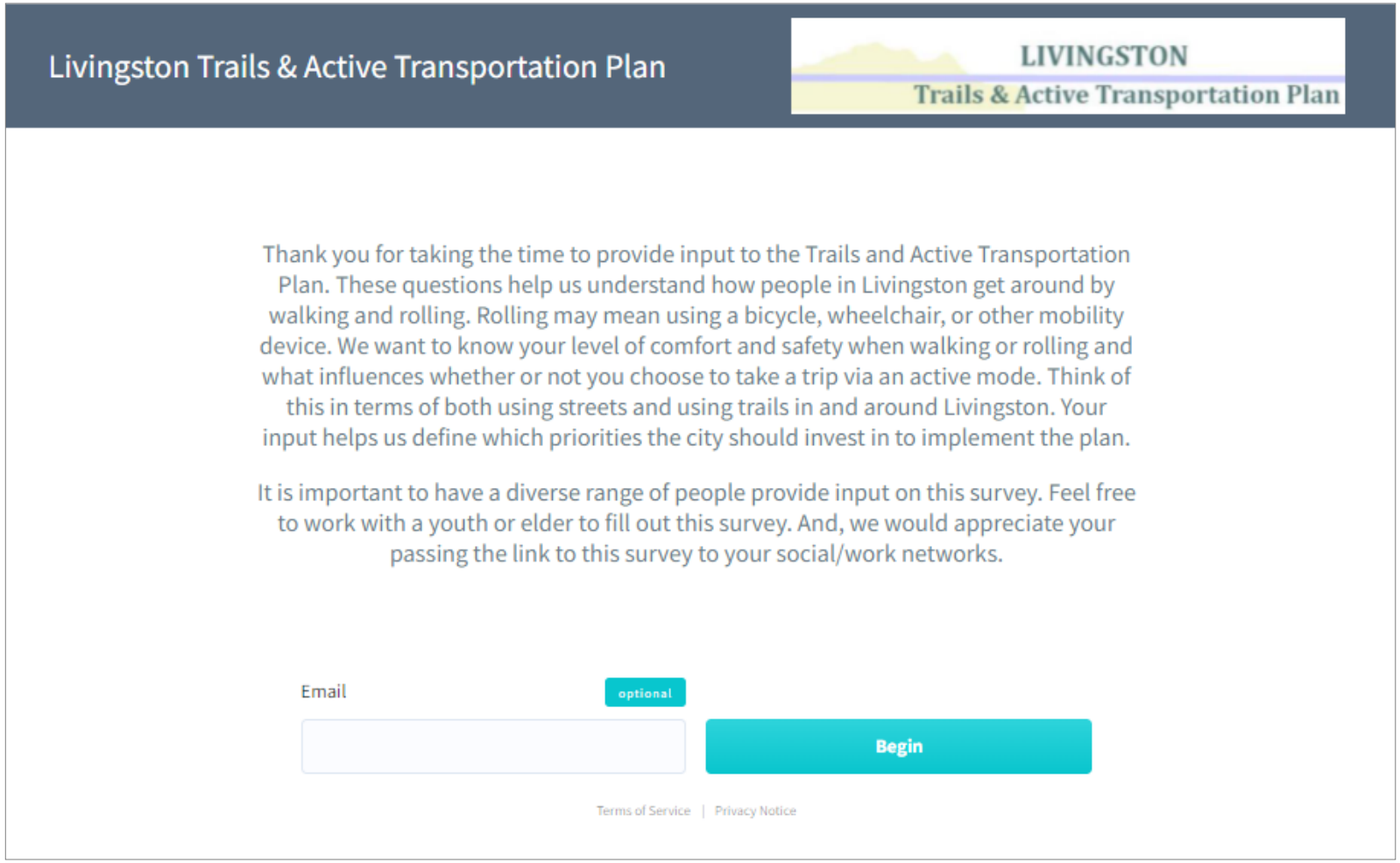
Figure C-6: Pathways and Trails Factors and Possible Points per Project

Trail/Pathway Factors	Possible Points
Property Owner Status	Used as screening criteria. Pathways not already in public ownership or easement not prioritized unless other information suggests it's a possible project.
Proximity to Parks, Trails or Natural Areas: Project will connect parks, recreation areas or recreational trails to neighborhoods.	15: Project has direct connection or is within ¼-mile of a park, existing trail, or natural/rec area. 10: Project is within ¼-mile of a park, existing trail, or natural/rec area but has no direct connection. 5: Project is within ½-mile of a park or natural/rec area but has no direct connection. 0: Project is beyond ½-mile
Population in Need: Project is within a Census Block Group identified as having socioeconomic needs based in income	15: Project is within or spans a block group showing median household income less than $40,000. 10: Project is within a block group showing medium household less than $55,000. 0: Project is within a block group with median income greater than $55,000.
Fills Gap in System: Project will connect to existing facilities by filling the gap between them.	15: Project fills a gap in the existing sidewalk or pathway system along a high volume traffic route. 10: Project fills a gap in the system along secondary routes with notable connectivity to destinations/other routes. 5: Project fills a gap in the system along a secondary route with limited connectivity to destinations/other routes. 0: Project does not address a gap in the system.
Proximity to Community Assets, Schools, Food Outlets, Downtown: Project will connect a community asset to neighborhoods and other destinations.	15: Project has direct connection or is within ¼-mile of multiple assets (school, downtown or food outlet). 10: Project is within ¼-mile of a one asset. 5: Project is within ½-mile of community assets. 0: Project is beyond ½-mile from community assets.
Provides Alternative to On-Street Sidewalk/ Bikeway:	10: Project provides direct alternative to an on-street route that directly serves destinations such as downtown, schools, parks, and other destinations. 5: Project provides direct alternative to an on-street route that indirectly serves destinations. 0: Project does not provide alternative to existing on-street route.
Ease of Implementation: Measures the likelihood that project can be easily implemented based on available right-of-way and other constraints.	10: Project has no evident right-of-way constraints or other feasibility issues. 5: Project has limited right-of-way constraints or few other feasibility issues. 1: Project has a right-of-way or feasibility issue but not both. 0: Project has major right-of-way constraints or feasibility issues.
Topography & Related Challenges	5: No substantial topographical challenges 3: Notable topographical challenges 0: Major topographical challenges
Environmentally sensitive area	5: No known environmental constraints. 3: Possible environmental constraints. 0: Major environmental constraints.
Presence of Existing Parking or Amenities:	5: Project termini have existing parking or other amenities. 3: Parking or amenities nearby. 0: No parking or amenities.
Steering Committee Priority: Points assigned by the steering committee.	Steering committee was asked to identify project where intangibles exist that would justify an additional 5 points for a project.

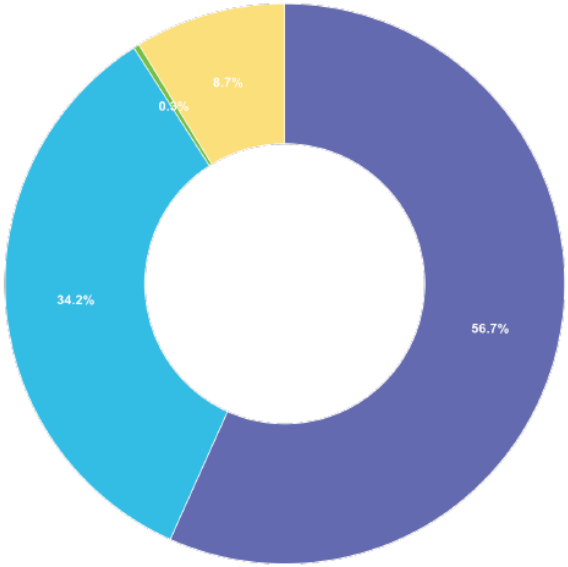
Appendix D: Public Input Survey Results

This sections contains the detailed survey results taken in spring 2021. The survey used SurveyPlanet.com and had 304 responses.

Note: "_archived_" in the response field means either the question was unanswered or there was another error coded by the survey service in the result.



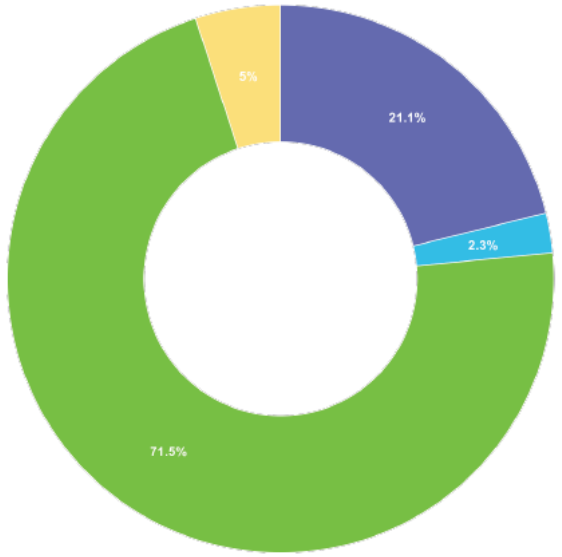
Q1 1\. When you choose to take a trip—for transportation, recreation, or just having fun —-using something other than a motor vehicle, which is the primary mode you use?



Answered: 298 **Unanswered:** 6

Choice	Total
Walk or hike	169
Ride a bicycle	102
Use a wheelchair or other mobility device	1
Other:	26

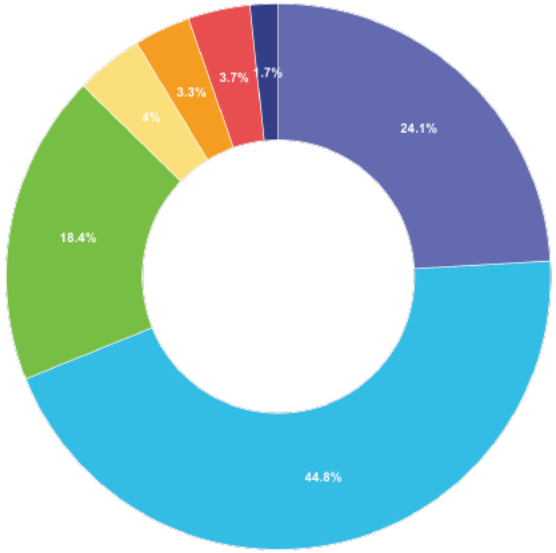
Q2 2\. When deciding whether or not to WALK or ROLL (use a wheelchair or other mobility device) in Livingston, how would you describe your level of interest or confidence in that walk?



Answered: 298 **Unanswered:** 6

Choice	Total
Utilitarian: It's how I get around.	63
Mobility-challenged: I need assistance or have difficulty making those trips.	7
Active: I make that trip at a more rapid pace for health and recreation or I hike	213
Last resort: I only walk if I have to.	15

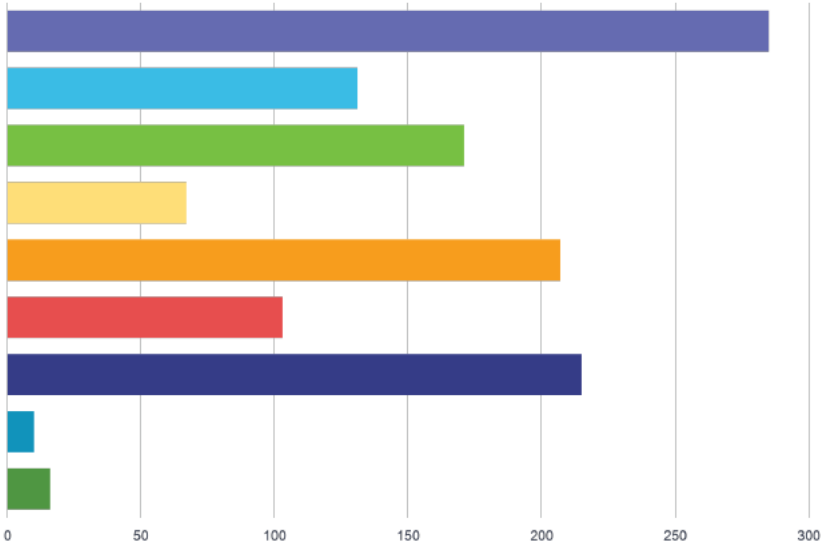
Q3 3\. When deciding whether or not to RIDE A BICYCLE in Livingston, how would you describe your level of interest or confidence in taking that trip?



Answered: 299 **Unanswered:** 5

Choice	Total
Highly confident: I will ride a bicycle in traffic with limited or no bicycle-specific infrastructure (e.g. bike lane)	72
Somewhat Confident: I prefer bicycle-specific infrastructure and trails	134
Interested but Concerned: I prefer to bike on a sidewalk and be far away from traffic	55
Recreation-only: I ride my bicycle on mountain bike trails or other off-street places	12
No Way, No How: I do not bike and/or I am not willing to bicycle even if high-quality bicycling infrastructure is in place	10
I am not able to ride a bicycle.	11
__archived__	5

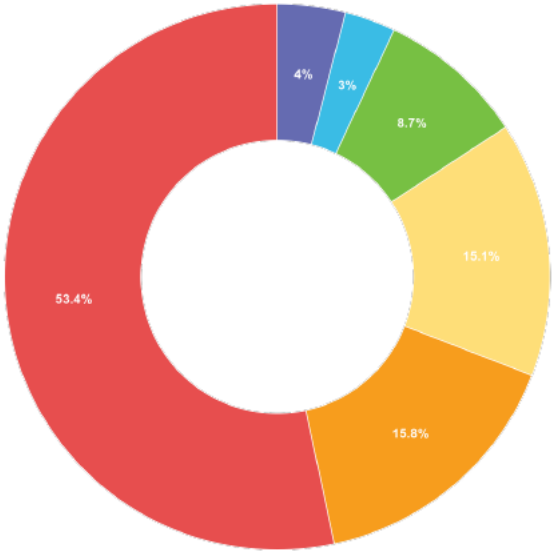
Q4 4\. For what purposes do your walk, roll, or bike in Livingston? Choose all that apply:



Answered: 298 **Unanswered:** 6

Choice	Total
Exercise/Outdoor recreation/Walk the dog	285
Grocery/food shopping	131
Personal business (e.g. pharmacy, post office)	171
Medical appointment	67
Entertainment, visit friends or family	207
Commute to work	103
Mental health (to clear my head)	215
I have not taken a walking/rolling trip in the past month.	10
Other:	16

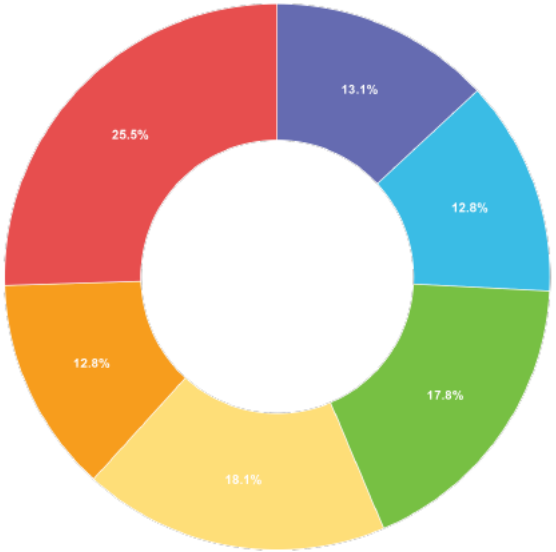
Q5 5\. In an average SUMMER month, how many trips did you make a one-way walking, rolling, or bicycling trip of more than five minutes in Livingston? Include trips along trails in your answer.



Answered: 298 **Unanswered:** 6

Choice	Total
No trips	12
1-2 trips	9
3-6 trips	26
7-10 trips	45
11-19 trips	47
20 trips or more	159

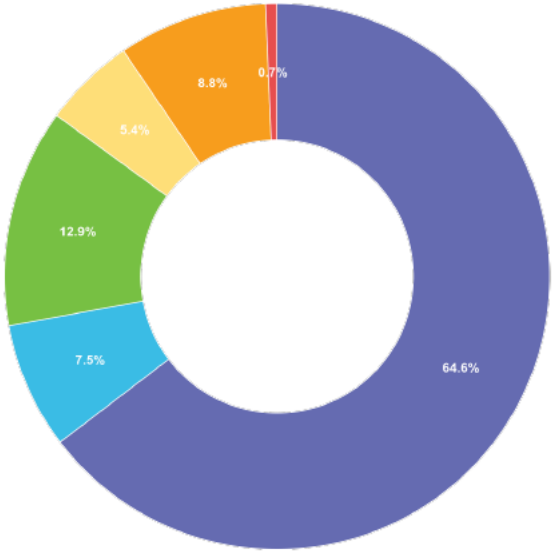
Q6 6\. In an average WINTER month, how many days did you make a one-way walking, rolling, or bicycling trip of more than five minutes in Livingston? Include trips on trails in your answer.



Answered: 298 **Unanswered:** 6

Choice	Total
No trips	39
1-2 trips	38
3-6 trips	53
7-10 trips	54
11-19 trips	38
20 trips or more	76

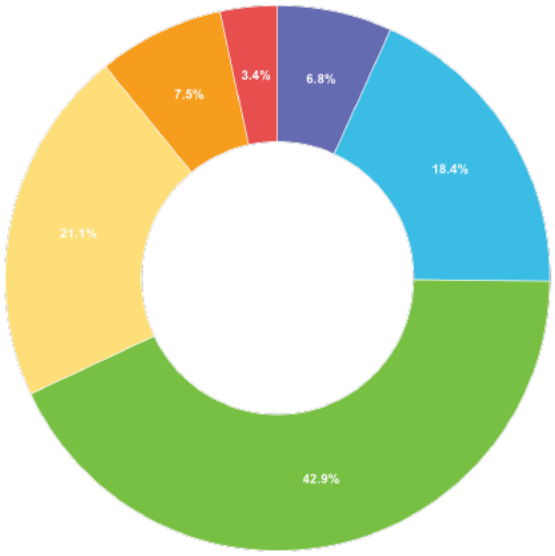
Q7 7\. When do your walking, rolling or bicycling trips typically occur?



Answered: 294 **Unanswered:** 10

Choice	Total
All times of the day and week	190
Weekdays – Morning	22
Weekdays – Afternoon	38
Weekdays – Evening/Overnight	16
Weekends – Daytime	26
Weekends – Nighttime	2

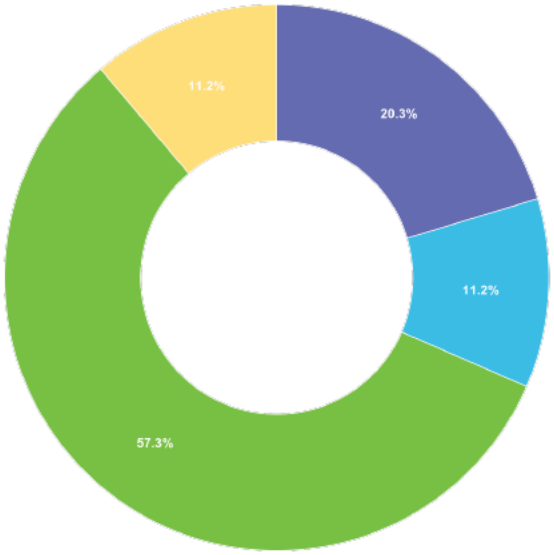
Q8 8\. Generally, how long are your one-way trips when walking, rolling, or bicycling? Include trips along trails, even if for recreation.



Answered: 294 **Unanswered:** 10

Choice	Total
5-10 minutes	20
10-20 minutes	54
20-40 minutes	126
40-60 minutes	62
60-90 minutes	22
Greater than 90 minutes	10

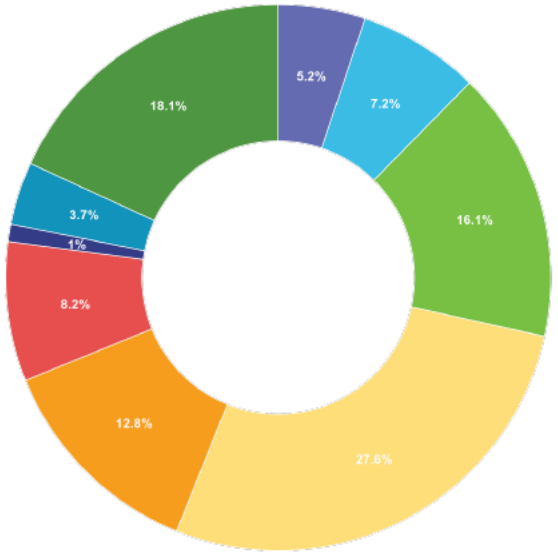
Q9 9\. Compared with pre -COVID-19 pandemic conditions (mid-March 2020), how often are you making walking, rolling or bicycling trips?



Answered: 295 **Unanswered:** 9

Choice	Total
More trips, mostly due to getting outside for recreation	60
More trips, because I have found I enjoy doing it more often	33
About the same number of trips	169
Fewer trips	33

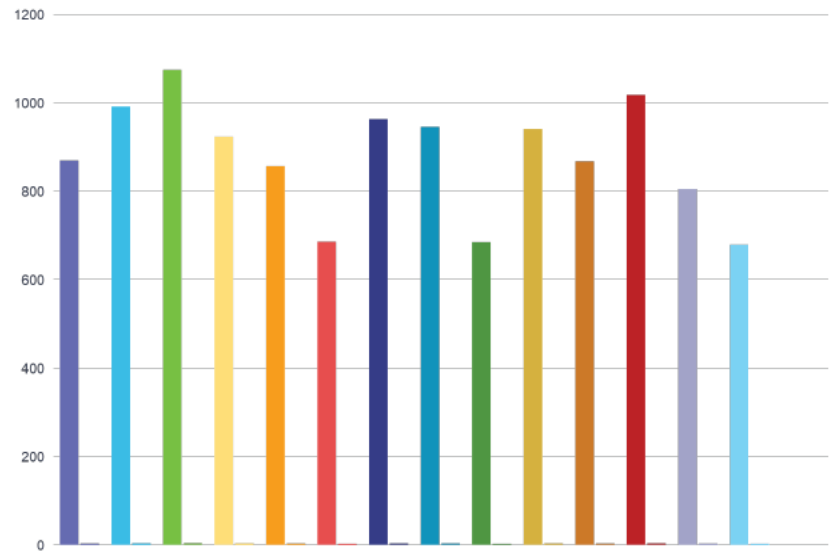
Q10 10\. Why have you NOT taken a walking, rolling or bicycling trip in the past several months? Pick up to 3.



Answered: 264 **Unanswered:** 40

Choice	Total
COVID-19 restrictions or concerns	25
Personal safety concerns	35
Traffic safety or speed concerns	78
Lack of adequate pathways and crossings	134
Barriers are too much to overcome (railroad, highway, waterways)	62
Lack of amenities (such as shopping, school, park) within a comfortable distance	40
Don't like walking or rolling	5
A disability or injury prohibits me from walking or rolling	18
Other:	88

Q11 11\. How satisfied are you with each of the following aspects regarding walking or rolling in Livingston?

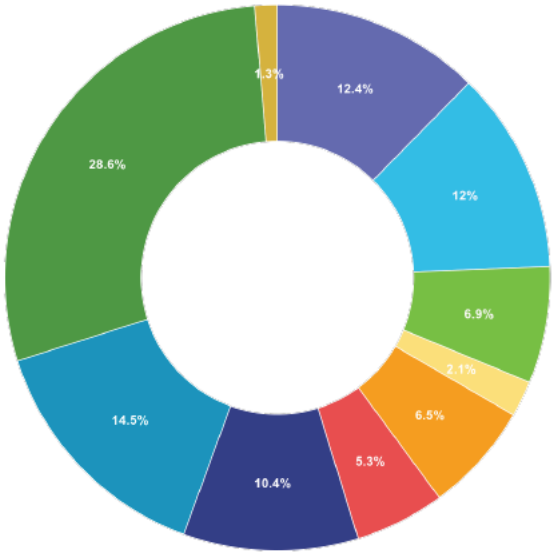


Answered: 293 **Unanswered:** 11

Choice	Score	Average
Speed of moving cars along sidewalks, paths, and streets.	869	2.97
Personal safety while walking or rolling	991	3.38
Shading by trees and buildings	1074	3.67
Amount of sidewalks on your route	923	3.15
Curb ramps on your pedestrian or bicycling route	856	2.92

Choice	Score	Average
Amount of bicycling infrastructure on your ride	685	2.34
Width of sidewalks and pathways	963	3.29
Overhead lighting	945	3.23
Snow and debris removal	684	2.33
Drivers stopping for me when I cross the street	940	3.21
Number of marked crosswalks	867	2.96
Walking or rolling to retail, restaurants, parks, etc.	1017	3.47
Being able to walk or roll to a pathway or trailhead from home	805	2.75
Number of trails in natural settings	679	2.32

Q12 12\. Which measures would make walking or rolling safer for children in Livingston? Choose up to 3.

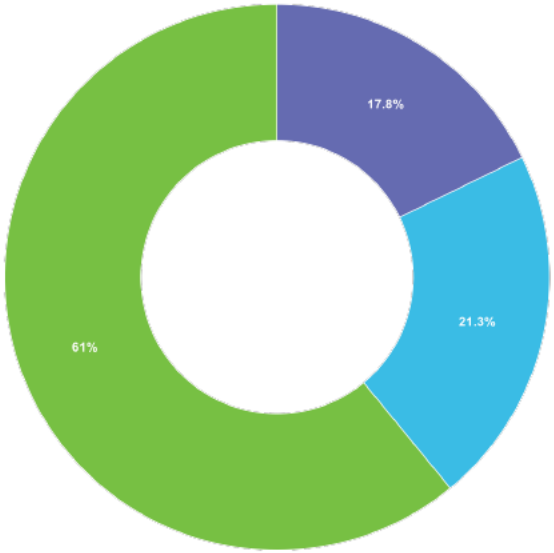


Answered: 288 **Unanswered:** 16

Choice	Total
Safe Routes to School Program	93
Street design to promote slower vehicle speeds near schools and parks	90
More opportunities to walk/roll with other children and parents	52
More crossing guards near schools	16
Safety training at schools	49

Choice	Total
Better enforcement of traffic laws	40
Intersection improvements and narrower crossings	78
Expand sidewalk network	109
Build more pathways and trails separated from traffic	215
__archived__	10

Q13 13\. Have you seen and/or experienced visual, verbal, or physical harassment/ violence when walking or rolling in Livingston? Choose all that apply.



Answered: 294 **Unanswered:** 10

Choice	Total
I have seen harassment/violence toward others when walking/rolling	56
I have experienced harassment/violence when walking/rolling	67
I have not seen or experienced harassment/violence when walking/rolling	192

The following questions had location-specific open responses that were used to identify projects.

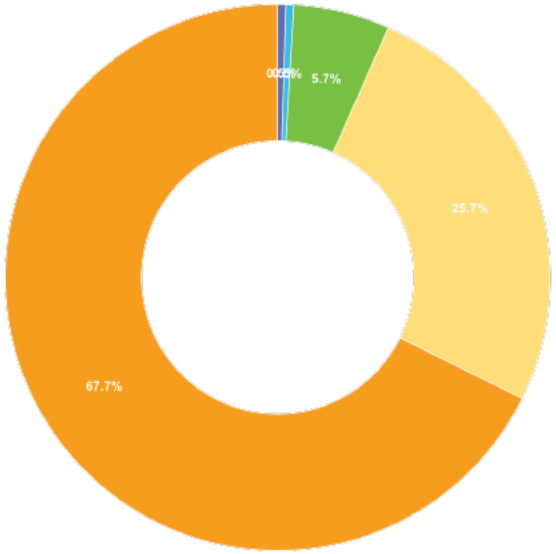
Q14 14\.
Which roadway corridors or intersection are in most need of improvements for walking and rolling?

Q15 15\. Are there specific locations in Livingston with hazards or barriers to walking/ rolling that make it feel unsafe or inconvenient?

Q16 16\. Which natural areas in and around Livingston would be best to plan for additional trails and pathways?

Q17 17\. Which areas or destinations would benefit from additional pathways and trails (not on or next to a street)?

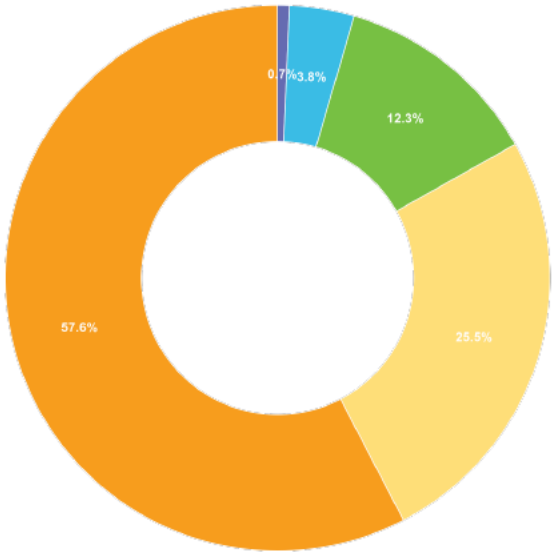
Q18 18\. How do you feel about designing streets and sidewalks to make it safer for walking, rolling, and bicycling even if this means driving slower?



Answered: 285 **Unanswered:** 19 **Average Rating:** 4 - Favor

Choice	Total	Rating
1 - Strongly Oppose	6	6
2 - Oppose	3	6
3 - Don't Know	24	72
4 - Favor	81	324
5 - Strongly Favor	171	855

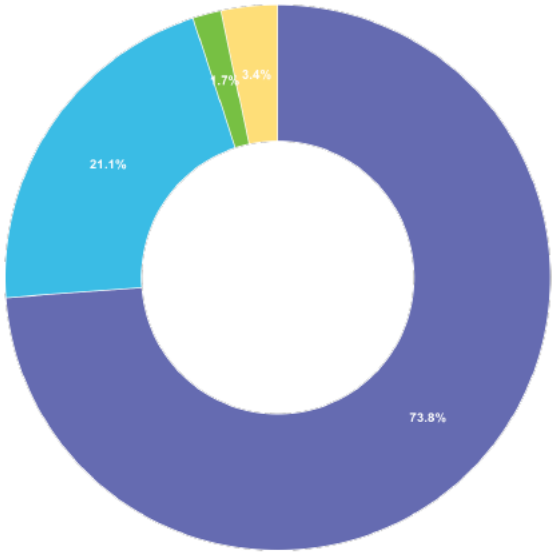
Q19 19\. How do you feel about designing communities so that more stores and other places are within walking or bicycling distance of homes, even if this means building homes closer together?



Answered: 282 **Unanswered:** 22 **Average Rating:** 4 - Favor

Choice	Total	Rating
1 - Strongly Oppose	8	8
2 - Oppose	22	44
3 - Don't Know	47	141
4 - Favor	73	292
5 - Strongly Favor	132	660

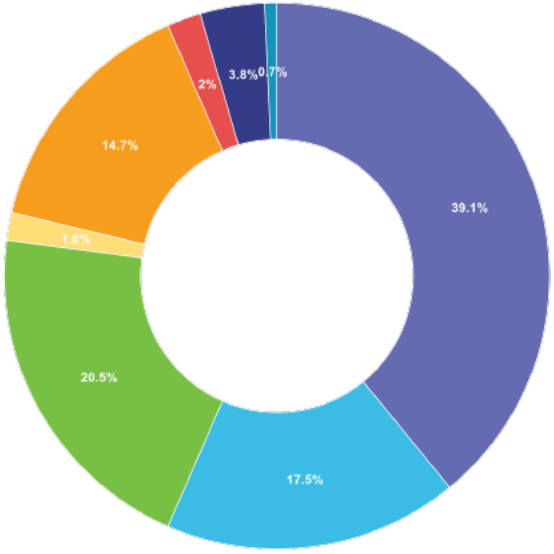
Q20 20\. How would you rate your level of physical activity?



Answered: 298 **Unanswered:** 6

Choice	Total
Frequently active (every day or most days)	220
Sometimes active (some days)	63
Rarely active (hardly ever or never)	5
__archived__	10

Q21 21\. Which investments would most benefit the health and well-being of your household if access via walking, rolling and bicycling were improved? Pick up to 2.

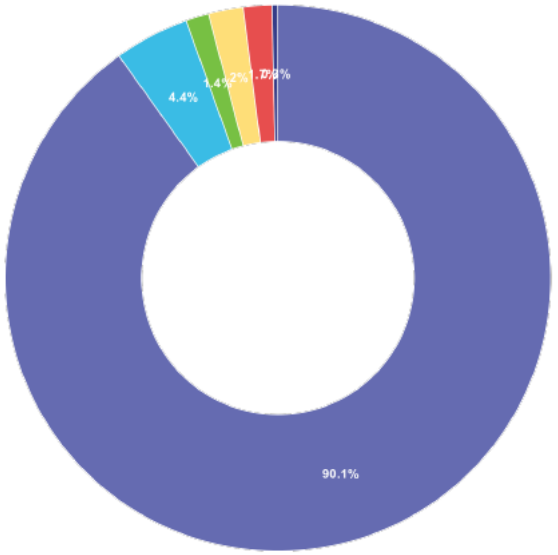


Answered: 292 **Unanswered:** 12

Choice	Total
Accessing outdoor places	215
Fresh, local food	96
A community center within walking distance where I can take classes or recreate	113
Access to healthcare (e.g. doctor's office, urgent care)	9
Places for people of all ages to socialize and interact	81
A spiritual place to worship or meditate	11
Other:	21
__archived__	4

Q22 22\. If you have children, please describe how the answers you provided may be different when walking, rolling or bicycling along compared to doing the same activity with children.

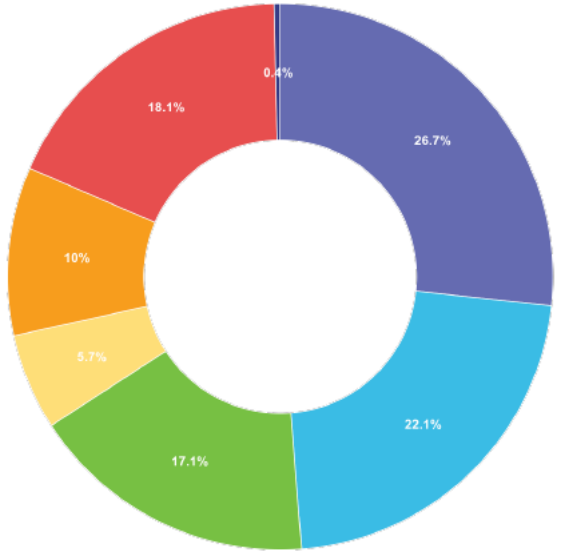
23\. What type of place is your current residence?



Answered: 293 **Unanswered:** 11

Choice	Total
Single-family house (detached house)	264
Townhouse or duplex (attached house)	13
Building with 4 or fewer apartments or condos	4
Building with more than 4 apartments or condos	6
Retirement or senior housing	0
Mobile home/trailer	5
Other (e.g. RV, van):	1

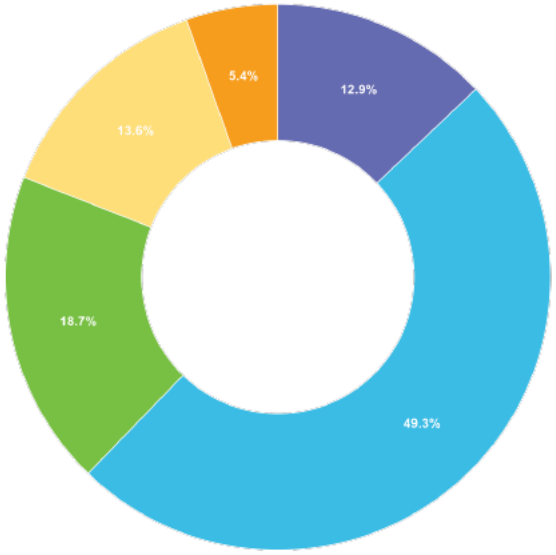
Q24 24\. In which quadrant of Livingston do you live? Knowing this is important for us to understand the barriers you may encounter in reaching other areas of town.



Answered: 281 **Unanswered:** 23

Choice	Total
Southwest	75
Southeast	62
Northwest	48
Northeast	16
Northside Hills	28
Park County, outside the City	51
Outside Park County	1

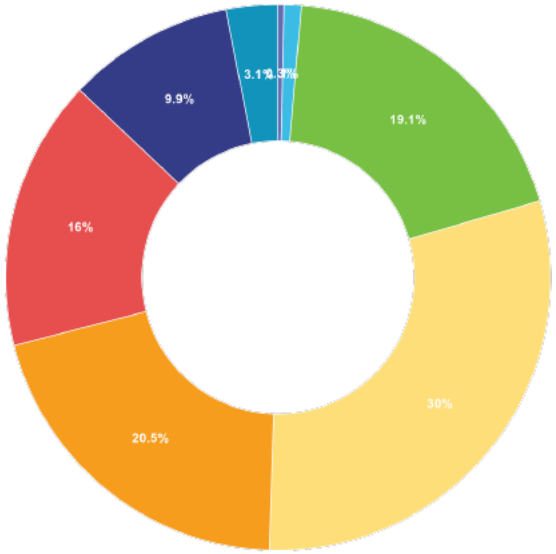
Q25 25\. How many people live in your household?



Answered: 294 **Unanswered:** 10

Choice	Total
1 (I live alone)	38
2	145
3	55
4	40
5 or more people	16

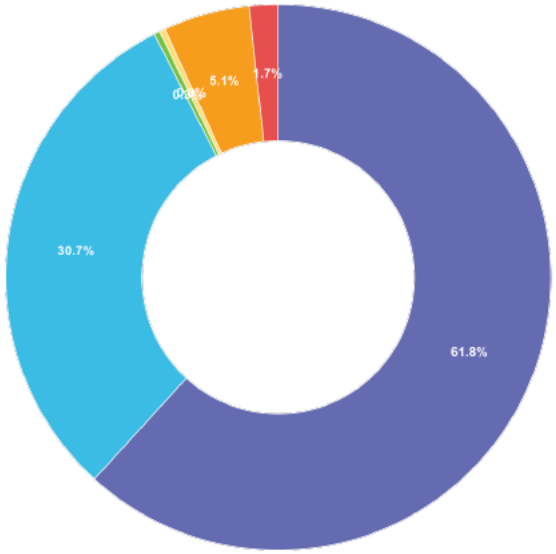
Q26 26\. What is your age?



Answered: 293 **Unanswered:** 11

Choice	Total
Under 18	1
18-24	3
25-34	56
35-44	88
45-54	60
55-64	47
65-74	29
75 or older	9

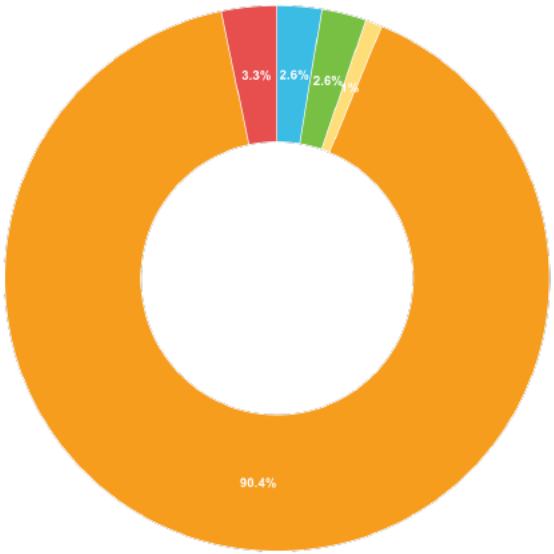
Q27 27\. What is your gender identity?



Answered: 293 **Unanswered:** 11

Choice	Total
Female	181
Male	90
Nonbinary	1
Other	1
Prefer not to answer	15
__archived__	5

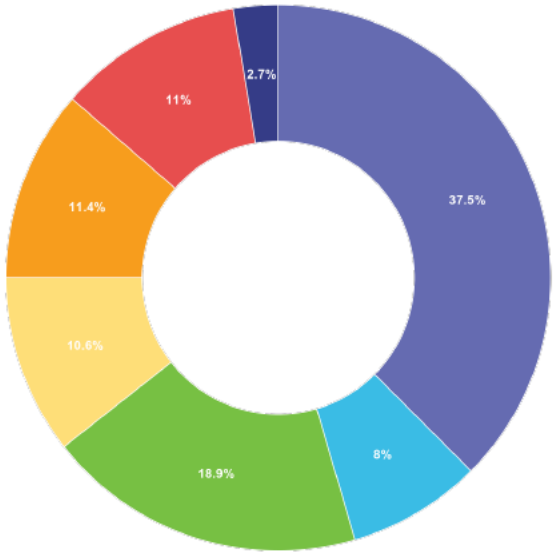
Q28 28\. Do you have a physical condition that limits or prevents you from doing any of the following? Select any that apply.



Answered: 294 **Unanswered:** 10

Choice	Total
Driving a vehicle.	0
Walking or rolling outside the home	8
Riding a bicycle.	8
Using regularly scheduled bus service.	3
No, I do not have a physical conditions that limits these activities.	274
__archived__	10

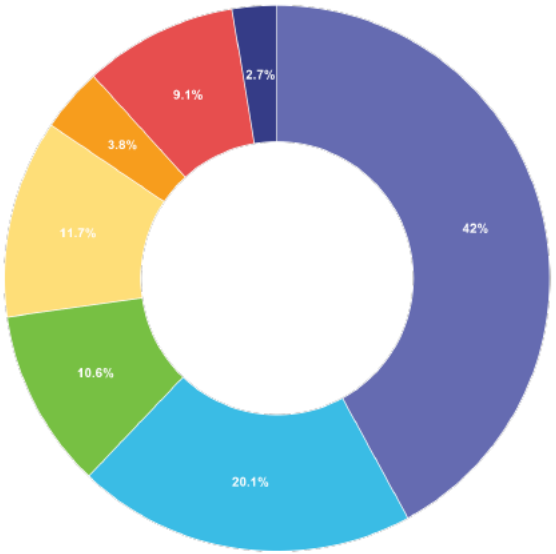
Q29 29\. AS OF TODAY, which of the following best describes your current work location?



Answered: 264 **Unanswered:** 40

	Choice	Total
	Work ONLY at a single location outside of home WITHIN LIVINGSTON	99
	Work ONLY at a single location outside of home and OUTSIDE OF LIVINGSTON	21
	Work ONLY from home or remotely (telework, self-employed)	50
	Work location regularly varies	28
	Telework some days and travel to a work location WITHIN LIVINGSTON for the remainder	30
	Telework some days and travel to a work location OUTSIDE LIVINGSTON for the remainder	29
	Drive or travel for work (driver, sales, deliveries)	7

Q30 30\. BEFORE COVID-19 (mid-March 2020), which of the following best describes your current work location?



Answered: 264 **Unanswered:** 40

	Choice	Total
	Work ONLY at a single location outside of home WITHIN LIVINGSTON	111
	Work ONLY at a single location outside of home and OUTSIDE OF LIVINGSTON	53
	Work ONLY from home or remotely (telework, self-employed)	28
	Work location regularly varies	31
	Telework some days and travel to a work location WITHIN LIVINGSTON for the remainder	10
	Telework some days and travel to a work location OUTSIDE LIVINGSTON for the remainder	24
	Drive or travel for work (driver, sales, deliveries)	7

Appendix E: MDT & Urban Routes in Livingston

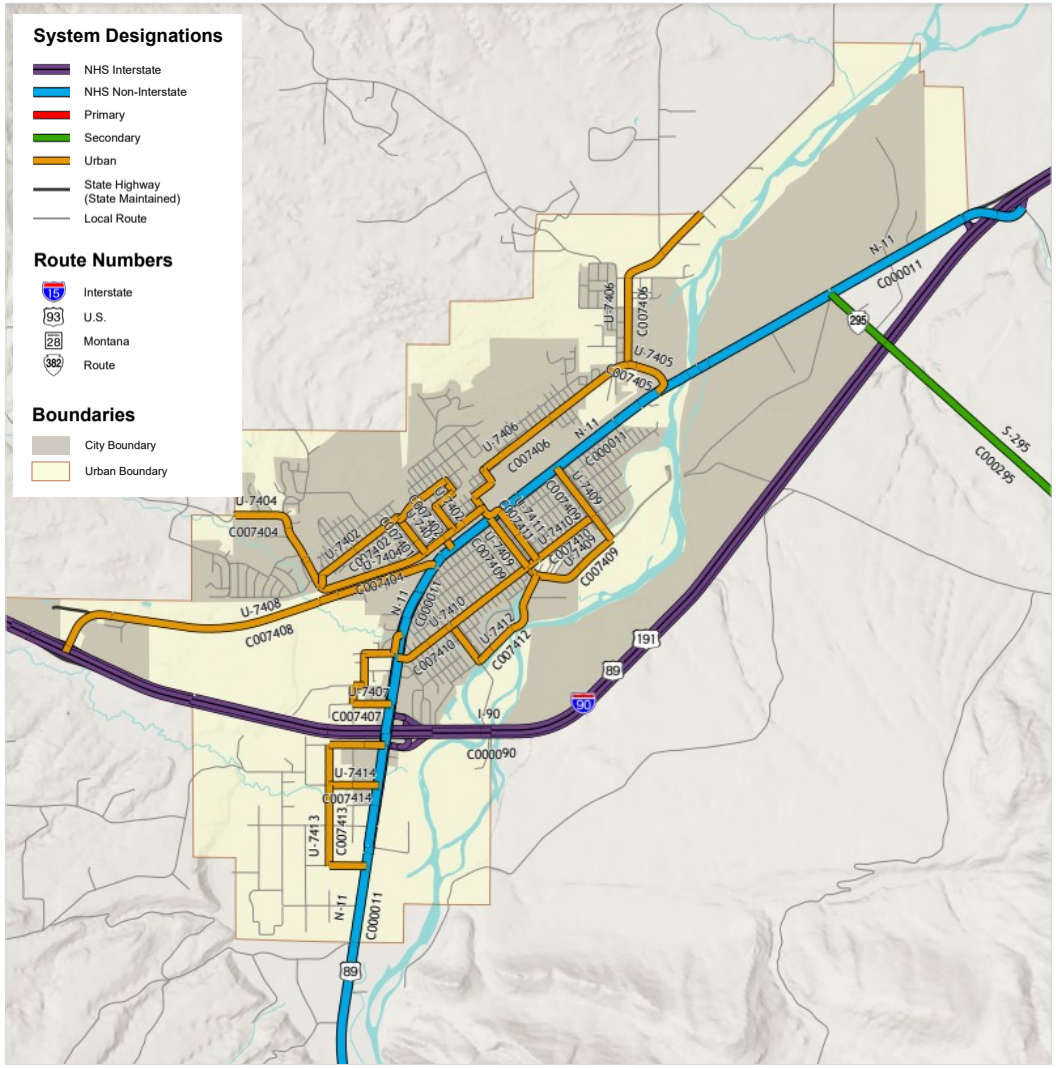
The Montana Department of Transportation controls major routes like Park Street and Highway 10. A significant number of the streets that are identified in the Trails and Active Transportation Plan to become safer for walking and bicycling are designated as urban routes. The color-coded map at right shows the MDT and urban routes in blue and orange. MDT's agreement with the City to manage the urban routes relates to maintenance, as well as physical changes that could be subject to approval of the MDT Commission. This chapter highlights some key considerations on these routes, with a detailed analysis of option for Park Street.

A universal challenge of state DOT's managing routes through cities is that it is sometimes difficult to make the case for safer conditions for people walking and bicycling. This is particularly evident when it comes to things like narrower motor vehicle travel lanes to accommodate bike lanes, installing federally-endorsed speed management treatments like raised crosswalks and curb extensions, and completing sidewalk networks using the state's or federal funds that come to Montana. Livingston has a suballocation of federal funds to address the urban streets under its control, which will help fund the projects recommended on these routes.

Sidewalk gaps remain on long stretches of MDT-controlled Park Street, as well as along urban routes on Gallatin/Bennett/C/Chinook, Front Street, and River Drive. Urban routes identified as top tier bikeway treatments include those listed already, as well as H Street.

City coordination with MDT should highlight the MDT documents summarized in Appendix A to help showcase how the prevailing MDT plans and design guidance, as well as the federally-endorsed design guidance from AASHTO and others supports measures to fill sidewalk gaps, slow traffic speeds, and create safe street crossings on the routes designated as "Urban" in Figure E-1. This is particularly important when MDT is reviewing urban route changes that may or may not have to go before the MDT Commission for approval.

Figure E-1: MDT Urban System Map of Livingston



https://www.mdt.mt.gov/other/WebData/external/Planning/maps/urban/simple_urban/SYSTEMS_LIVINGSTON.PDF

Park Street has additional challenges because it is a US Highway and a designated detour route when I-90 is closed. Given MDT wants to preserve vehicle flow as best as possible, completing the sidewalks on at least one side and making unsignalized crossings safer with RRFB treatments across Park Street improves safety without impacting traffic flows.

Traffic Counts on Major Routes

Figure E-2 shows MDT's traffic counts on major and minor routes in Livingston. Park Street has the highest volumes of any street in Livingston, as would be expected. Both Highway 10 and the 5th Street railroad crossing have volumes in the 5,000s. Highway 10 and 5th Street volumes were relatively stable over the years of data that is available. Park Street volumes show slight increases over the five-year timeframe of the count, with the most notably increases occurring south of I-90. Counts at Loves Lane were 11,700 in 2016 and were shown at nearly 15,000 in 2019.

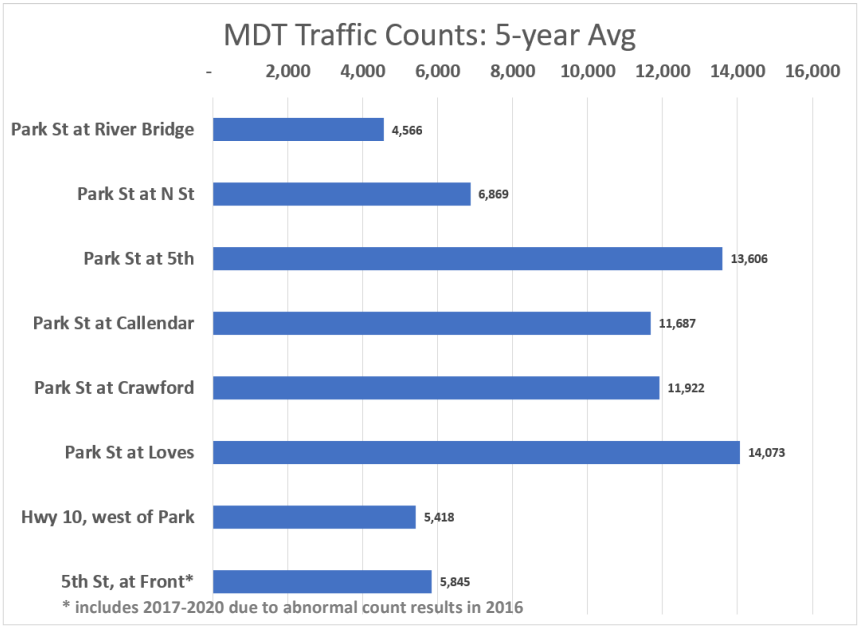
In general, traffic volumes decreased in 2020 due to COVID. Every street in the graphs has between a 7% and 9% drop from 2019 figures to 2020. The fact that these were consistent may indicate MDT performed estimates on these routes instead of conducting actual counts. For example, every secondary street (bottom graph) shows the exact same decrease of 7.0% when comparing 2020 volumes to 2019.

Traffic Volumes and Sidewalks. The Federal Highway Administration (FHWA) denotes that sidewalks are "required" on almost every designated urban route and MDT-controlled street within the City. Figure E-3 on the following page shows how FHWA defines where sidewalks are required and preferred based on street classifications and land uses. The brackets indicate which types of routes in Livingston fall under each category.

This table provides ample support for the City and its partners to ask MDT to complete sidewalk networks on routes like Park Street, recognizing it may be limited to one side due to the railroad right-of-way on the north side.

Traffic Volumes and Bicyclist Facilities. Figure E-4 is from FHWA's Bikeway Selection Guide. It is a matrix of what type of bike facility is justified based on a combination of the traffic volumes and posted speeds on a street. The streets in Figure E-2 are plotted on this matrix for reference.

Figure E-2: MDT Traffic Counts, 5 –year Average (2016-2020)



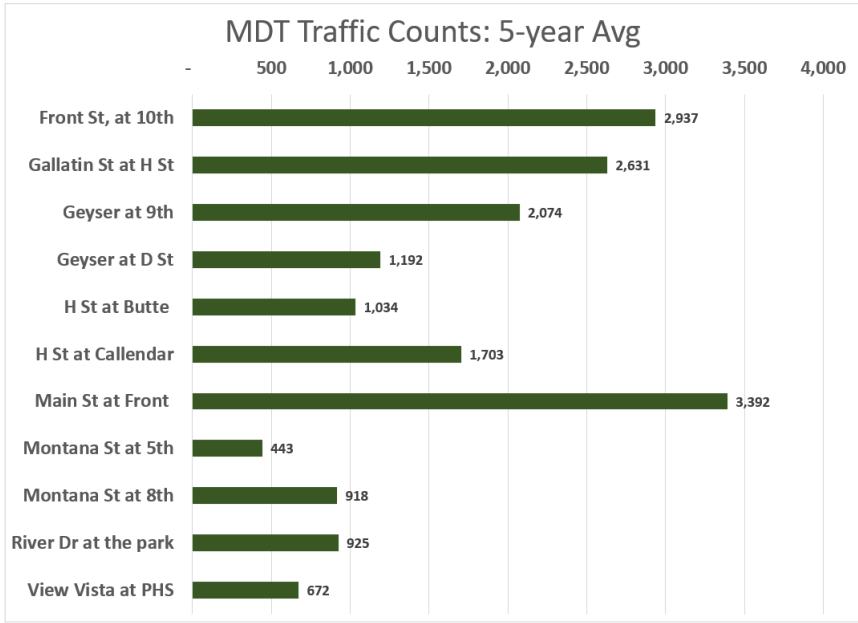


Figure E-3: FHWA Sidewalk Needs by Roadway Classification & Land Use

Roadway Classification and Land Use	Sidewalk/Walkway
Rural Highways (< 400 ADT)	Shoulders preferred, with minimum of 0.9 m (3 ft).
Rural Highways (400 to 2,000 ADT)	1.5-m (5-ft) shoulders preferred, minimum of 1.2 m (4 ft) required.
Rural/Suburban Highway (ADT > 2,000 and less than 1 dwelling unit (d.u.) / .4 hectares (ha) [1 d.u. / acre])	Sidewalks or side paths preferred. Minimum of 1.8-m (6-ft) shoulders required.
Suburban Highway (1 to 4 d.u. / .4 ha [1 to 4 d.u. / acre])	Sidewalks on both sides required.
Major Arterial (residential)	Sidewalks on both sides required.
Urban Collector and Minor Arterial (residential)	Sidewalks on both sides required.
Urban Local Street (residential – less than 1 d.u. / .4 ha [1 d.u. / acre])	Sidewalks on both sides preferred. Minimum of 1.5-m (5-ft) shoulders required.
Urban Local Street (residential – 1 to 4 d.u. / .4 ha [1 to 4 d.u. / acre])	Both sides preferred.
Local Street (residential – more than 4 d.u. / .4 ha [4 d.u. / acre])	Sidewalks on both sides required.
All Commerical Urban Streets	Sidewalks on both sides required.
All Streets in Industrial Areas	Sidewalks on both sides preferred. Minimum of 1.5-m (5-ft) shoulders required.

1 acre=0.4 hectares (ha)

Highways 89 and 10 are in this range.

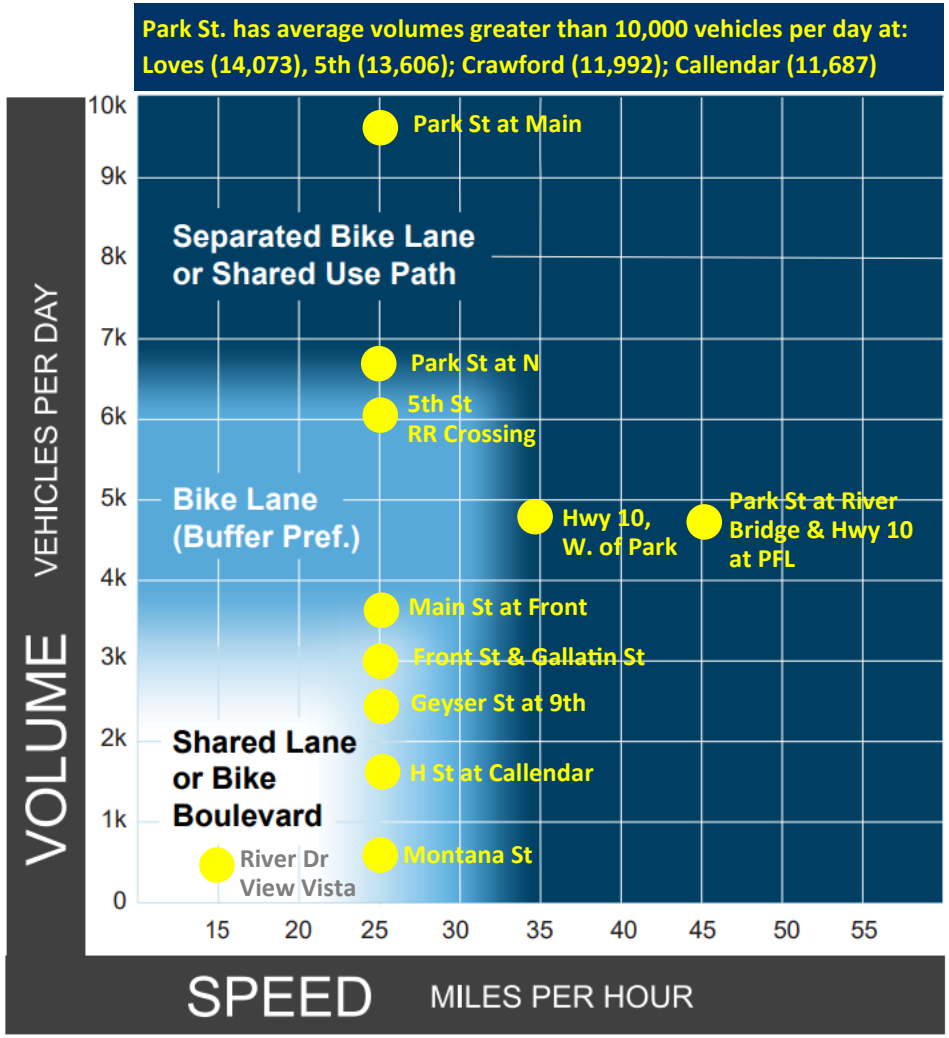
All MDT urban streets in Livingston are in this range.

Local streets managed by the City fall in this range.

Park Street, Downtown Streets

Source: Federal Highway Administration PEDSAFE

Figure E-4: FHWA Bicycle Facility Selection Matrix with MDT Posted Speed & Volume



Source: Federal Highway Administration Bikeway Selection Guide

The volumes on major routes like Park Street and Highway 89 are clearly in the range of needing sidepaths, as this Plan recommends. Highway 10 and 5th Street are borderline for bike lanes with buffer preferred but a separated pathway is more suitable given the railroad constraints. Streets where the preferred facility is infeasible should have speed management features applied for a target speed.

Design Standards

MDT's Geometric Design Standards could be challenging for the City of Livingston to achieve its goals for active transportation, depending on how the state interprets geometric and operational changes that could occur on the urban routes and Park Street. Shown on page 5 of the Appendix, applying these design standards could result in maximum horizontal design dimensions for motorist features of the roadway, including travel lanes and on-street parking, while assigning minimum and suboptimal dimensions for facilities for people who walk and bike. Further, the design speeds of 35 mph for urban arterials and urban collectors are conditions that create deadly consequences for a majority of pedestrians and bicyclists who are hit at those speeds. Fortunately, many of the existing streets in Livingston do not have these maximum motorist elements (11 or 12-ft lanes) and efforts should be made to preserve narrower dimensions while building safer pedestrian and bicyclist routes along them.

The image at right illustrates the research findings on death risk to pedestrians at varying speeds. Figure E-5 also illustrates how higher speeds narrow the driver's field of vision, causing them to focus on a point farther down the road. This results in a driver being unable to see someone approaching a crosswalk or street crossing on a bike.

While streets like Gallatin have posted speed limits of 25 mph, the actual design speed of these routes is higher, which prompts motorists to drive faster. The motor vehicle travel lanes are striped at 12-feet in width, which is wider than MDT's urban street standards recommend. The parking lanes are 7.5-ft in width, which is narrower. Striping the travel lanes to be 11-ft in width (or even 10-ft, which is acceptable per the AASHTO Green Book) would be a first step in helping to narrow the field of vision along this route. Front Street is very similar.

Figure E-5: Speed and Risk to Pedestrians

Speed is especially lethal for vulnerable users like people walking or riding a bicycle. The risk of severe injury or death increases as a driver's field of vision narrows.

Figure E-6: AASHTO Green Book (2018) Section 2.3.6.3 Design Speed—Target Speed

> Lower speeds are desirable for thoroughfares in walkable, mixed-use urban areas and this desire for lower speeds should influence the selection of the design speed. For design of such streets, a target speed should be selected (29). The target speed is the highest speed at which vehicles should operate on a thoroughfare in a specific context, consistent with the level of multimodal activity generated by adjacent land uses, to provide both mobility for motor vehicles and a desirable environment for pedestrians, bicyclists, and public transit users. The target speed is intended to be used as the posted speed limit. In some jurisdictions, the speed limit is established based on measured speeds. In these cases, it is important for the design of the thoroughfare to encourage an actual operating speed that equals the target speed (16, 35).

A simple re-striping, however, will not likely result in the target speed of 25 mph being achieved, which is why this plan recommends other speed management treatments along Gallatin and Front Street, as well as H Street. The AASHTO Green Book includes a segment on designing streets for a Target Speed, shown at right in Figure E-6. It notes that by identifying a target speed and designing for it, the posted speed can be achieved.

Accommodating bike lanes on streets like Gallatin, Front, and H, would require eliminating parking from one or both sides. While this is not always easy in these residential settings, examining the use of on-street parking along these routes may inform future projects. Ultimately, if parking cannot be removed, it bolsters the City's position to consider speed management techniques so the routes operates at a target speed that is safe for bicyclists to share lanes with motorists. The FHWA Bikeway Selection Guide, profiled in Appendix A, includes the matrix shown in Figure E-4 for existing volumes and speed. The City and MDT can plot forecasted volumes and expected posted speeds to determine if the street meets the guidance for shared lanes, bike lanes, or protected lanes.

In some cases, existing conditions may be suitable for shared lanes that are bolstered with other speed management treatments and bikeway striping/signage when the preferred facility is not feasible.

Front Street Assessment

In an ideal world, the railroad right-of-way behind the curb on the south side of Front Street would make a great shared use pathway. Until the railroad is ready to discuss that option, Front Street could be reimagined with an in-street pathway or what is sometimes called a "cycle track." The curb-to-curb width of 38-ft would allow for 7-ft parking lanes, an 11-ft westbound travel lane, a 10-ft eastbound lane, a 1-ft buffer with flexposts, and a 9-foot two-way cycle track. Figure E-7 shows current and possible conditions.

The challenge in working all of these functions into a street of this width is the parking lane, the 10-ft travel lane, and 9-ft cycle track that includes the gutter pan, are all minimum dimensions and could

Exhibit E-7: Reimagining Front Street

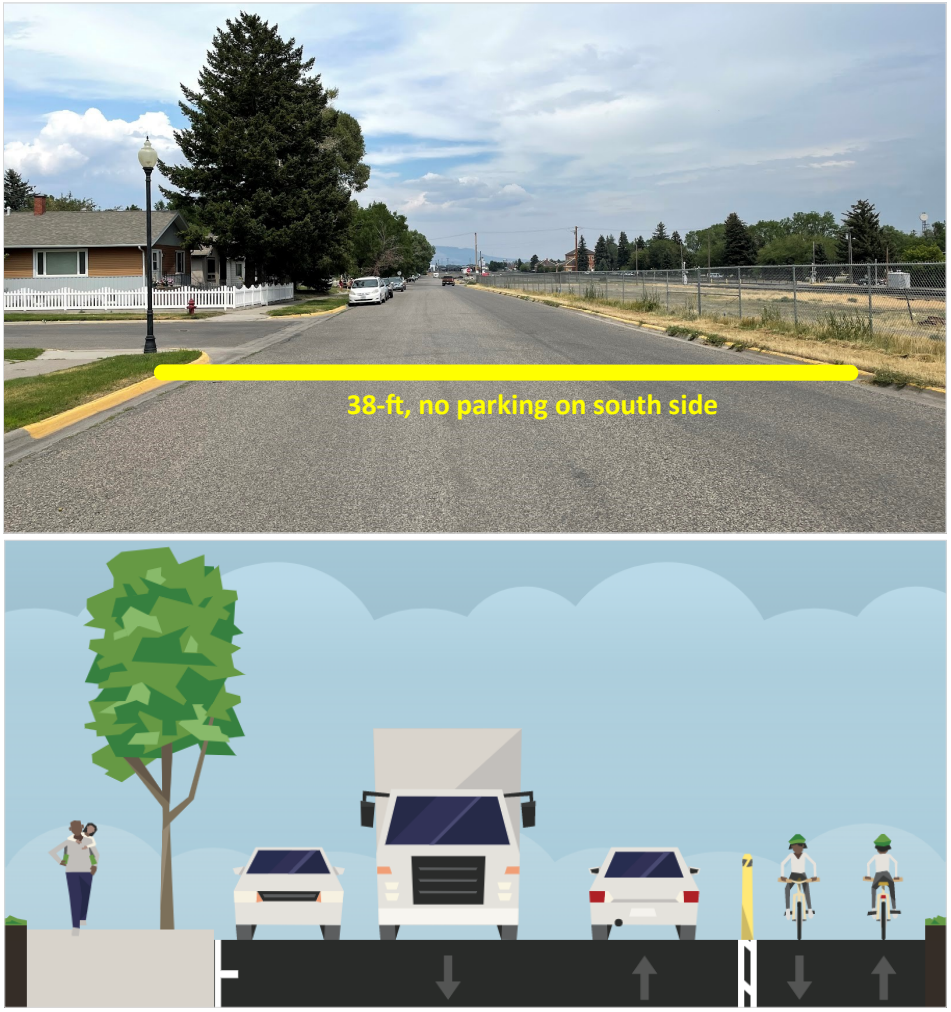


Image: Created with Streetmix

be seen as less than ideal for any road user.

Eliminating parking on the north side would provide enough room to consider other options, but would likely be met with resistance from property owners.

The advantageous part is the existing road does not have any striping and the City could pursue a pilot project to stripe the road with water-based highway marking paint, erect low-costs flexposts in the buffer, and test it during a season.

The water-based paint will wear off quickly if the pilot project is not considered a success or needs to be adjusted for final application. Pre– and post-conditions studies on speed, usage, and other factors should be examined. Special consideration should be given at the intersection with 5th Street to allow for crossing to the sidewalk on the east side of 5th that crosses the tracks.

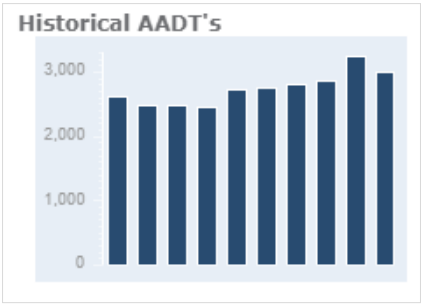
The images at right show the FHWA Bikeway Selection Guide matrix with historical traffic counts from MDT plotted for Front Street and Gallatin Street. Both streets have hovered around 3,000 average annual daily traffic (ADT), or vehicles per day—an average from the past five years. Both are posted for a 25 mph speed limit. When plotting the traffic volumes and speed limit on this matrix, each street sits at the borderline between needing a shared lane or dedicated bike lane.

While Front Street doesn't show the need for a separated bike lane, like shown on the previous page, fitting a bike lane on Front Street in each direction would create more conflict between parked cars and the motor vehicle travel lane. This is due to each lane designation having to be hovering around a minimum width, which can create conflicts with bicyclists having to use a bike lane that is in the door zone of parked cars.

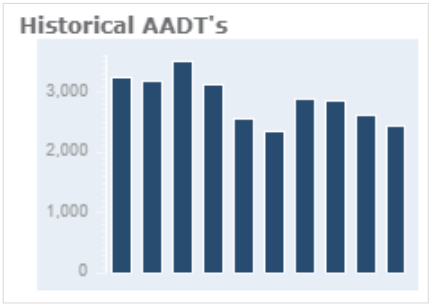
Gallatin Street Assessment

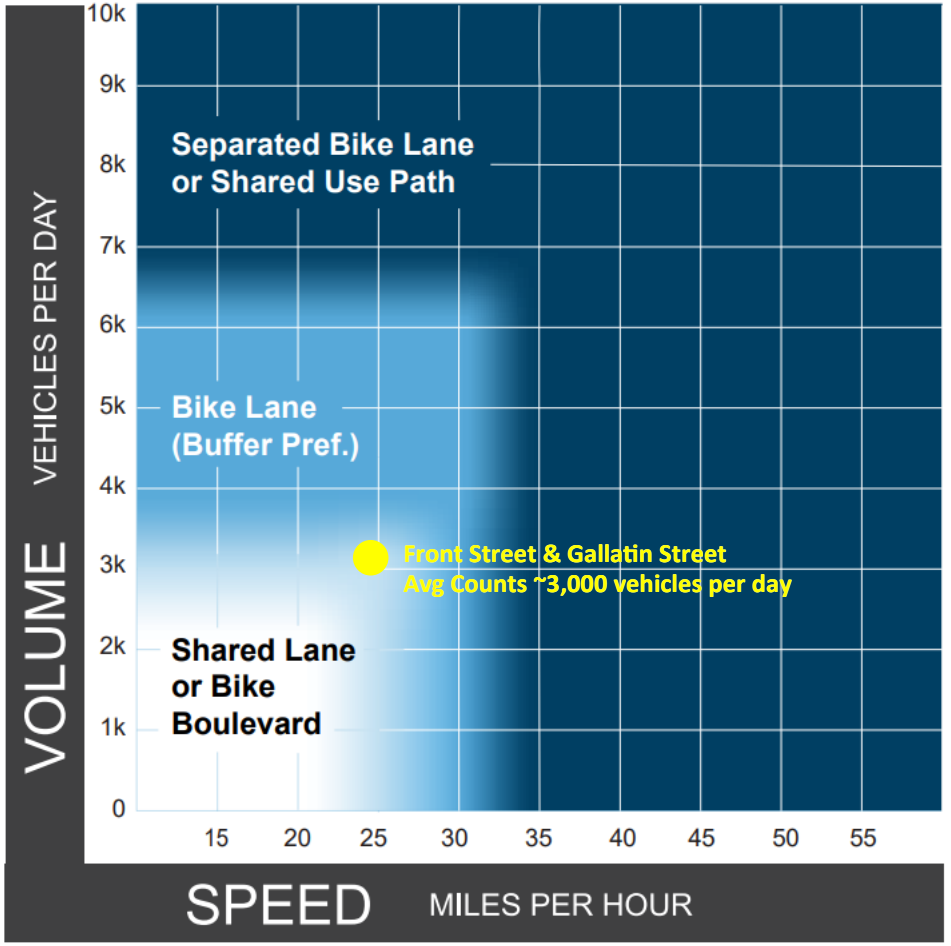
Gallatin Street (and it's other names between Main St and Park St) has similar features as Front Street where there is street curbing. Incorporating a bike lane on this segment is somewhat more chal-

Front Street Traffic Counts



Gallatin Street Traffic Counts





lenging due to more access points on the south side of the street. Incorporating curb extensions, raised crosswalks, and other speed management techniques to self-enforce the 25 mph speed will make people who bike more comfortable using this route.

Sidewalk gaps exist on the north side and should easily be accommodated within existing right-of-way on this route. Where Gallatin turns into Bennett Street, and lacks curbing, presents other challenges to completing a sidewalk connection.

The Plan's recommendations include an expansion of the shoulder on Bennett east of Miles to include an extruded curbing to create a walkway without requiring full-scale drainage upgrades.

Addressing the Bennett St railroad crossing, and providing a safe crossing of Park Street to the O Street Connector pathway, is another challenge that could be remedied with MDT and railroad involvement to construct a pathway underneath the railroad and Highway 89 bridges next to the Yellowstone River. This would require a connection along city property or railroad right-of-way from Bennett, but may be cheaper, safer, and more feasible than building a connection over the railroad tracks.

Given those complexities, having MDT take the lead on such a project might yield more productive results as MDT is more seasoned in dealing with challenges such as railroad right-of-way and bridges.

MDT Overpasses & Interchanges on I-90

Chapter 6: Trails Master Plan includes images that compare existing MDT facilities and others across the United States where shared use pathways have been incorporated into existing interstate right of way and on interstate bridges. There are likely similar scenarios elsewhere in Montana where these partnerships have allowed pathways on interstate right-of-way and FHWA is accepting of these creative approaches.

Other opportunities for hiking trails exist on the underpasses of I-90 at Meyers Lane and Swingley Road. Expanding paved shoulders to create a place for people to walk or allowing natural surface trails or singletrack sidewalks to be erected behind the bridge piers can also be considered.

Bennett Crossing of Railroad Tracks

Swingley Road Underpass of I-90

River Drive Assessment: A Festival Street

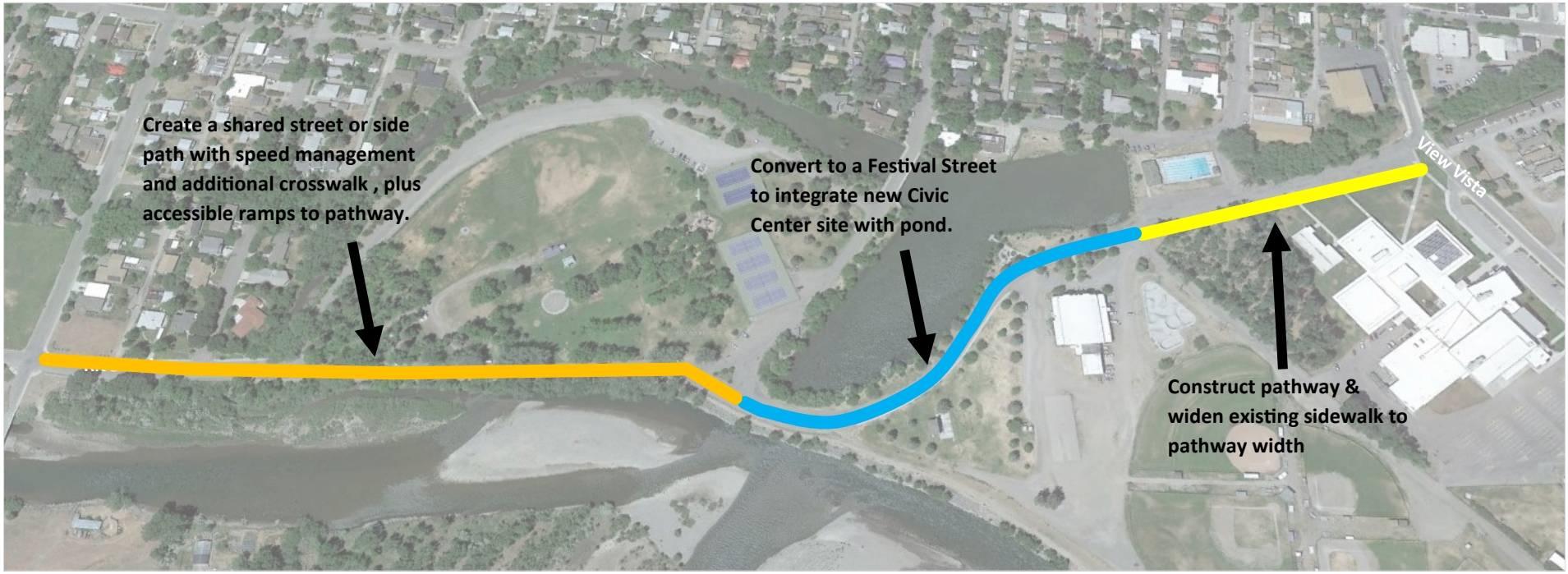
The City should view a redesign of this street in a way reflect the land uses and recreational opportunities around it. Too many other activities occur along River Drive to think of it as only a motor vehicle way, especially with traffic counts under 1,000 vehicles per day.

The concept emerge during the Looking Glass Academy to create a Festival Street in the section between Yellow Stone Street and River Street (blue line below). A reimagining of the street frontage of the new Civil Center complex would integrate the Civil Center's site into a promenade that could extend to the pond and tie these features together. This section is already subject to a temporary street closure when the Farmer's Market is in session.

A raised street section with hydraulic bollards on either end would allow for the street to be closed for more events and serve as an economic, cultural, and recreational engine for the City and County. This section includes only concepts as such a reimagining this street would need to go through a separate visioning session.

On either end of the Festival Street section would be a connecting pathway to link to View Vista to the east and a re-design of the street to 9th Street along the Park Frontage to create a more polished setting that allows for motorists, pedestrians, and bicyclists to use the street. Additional crosswalks from the park to the pathway, along with one or two accessible ramps to access the pathway are desired.

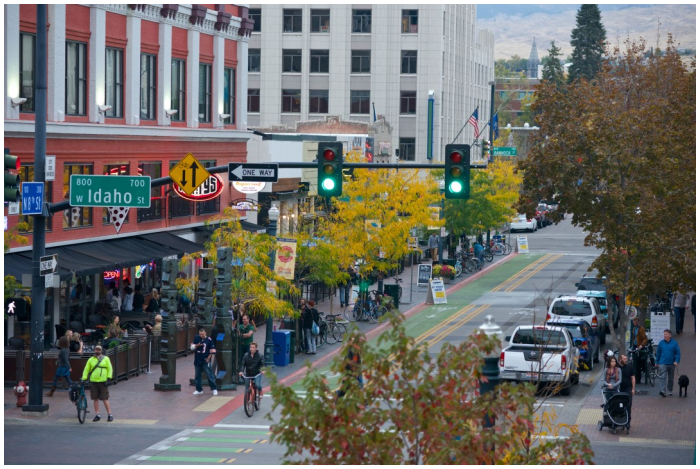
The following page contains images of other Festival Streets or similar applications where streets are integrated with other features around them, shared by all users, and subject to frequent closures for events. Imagine high school dances, outdoor concerts, art shows, beer festivals, and Old West re-enactments occurring on Livingston's Festival Street: River Drive.



River Drive: Livingston, MT

It functions like a festival street on some occasions, with people walking in the road. Closing it to vehicles during these times and integrating the street with its surrounding natural and civil land uses would create a unique space for the people of Livingston.

Boise, ID: 8th Street



Two blocks of 8th Street between Main St and Bannock St are designated as a festival street with hydraulic bollards at the end of each block. Limited curbing allows people to freely move between sidewalks and the street. 8th Street is now being closed to vehicles permanently due to the success of restaurant expansion onto the sidewalks due to COVID-19. Even when open to cars, the street design projects an image that the drivers are guests in this environment.

Image: Capital City Development Corporation

Kirkland, WA: Park Lane

A shared environment for pedestrians and passing vehicles is created by 36,000 square feet of pavers. The surface design promotes walking and biking over driving with its woonerf-style design and 100 percent paver surface, abundant street furniture, and parking hoops for cyclists, as well as multiple art plinths for rotating art exhibits. Local business owners have offered unanimous praise for the new design and reported a surge of new customers as the project came to completion.

Image & Text: American Planning Association

Park Street Assessment

Park Street is the main motor vehicle thoroughfare in Livingston and is managed by MDT. It is designated as a principal arterial and the Interstate 90 Business route. It serves as a detour route when I-90 is closed due to high winds.

These multiple functions are a challenge alone, which are compounded by right-of-way that's constrained by buildings and the railroad's property. In some ways, these constraints have saved Livingston from being bisected by a four– or five-lane arterial through the heart of the city. In other ways, it has prevented the inclusion of dedicated space for bicyclists and limits opportunities for sidewalks on both sides.

The posted speed limit is 25 mph from Yellowstone Street to N Street—a distance of 5,500 feet. The traffic counts obtained from MDT indicate volumes between 7,140 and 13,640 vehicles per day. Sidewalks are continuous along the south side of Park Street in the entire 25 mph zone but do not exist on the north side due to the railroad right-of-way.

The Trails and Active Transportation Plan provides some options for making the corridor safer for pedestrians and bicyclists wishing to travel along or across Park Street. Any changes must be coordinated through MDT.

The options contained in this section are derived from prevailing design guidance endorsed by the Federal Highway Administration (FHWA) and the American Association of State Highway and Transportation Officials (AASHTO). Beyond MDT's jurisdiction, Park Street's status as I-90 Business means FHWA has some oversight and would be a party to any federal funding expended on the corridor. MDT is a member of AASHTO and MDT's Director sits on AASHTO's Board of Directors. MDT is signatory to AASHTO design guides cited in this section.

The first goal for Park Street, given its limitations, should be to first do no harm when it comes to the safety of people walking and bicycling, as well as motorists. What does this mean? It means not raising the speed limit in the existing 25 mph section and not making

Park Street Traffic Characteristics

- 25 mph speed limit between Yellowstone St & N St.
- 2 lanes wide east of 5th St.
- Traffic volumes between 7,140 and 13,640 (2019, MDT)

Image: Google Earth

the general purpose travel lane dimensions wider than their current configuration (12 feet). The parking lanes are 10– and 11-feet wide in the sections that contain curbs. Sidewalks vary in width, but are generally 10-feet wide in the downtown core where there are no landscaped buffers, and 5-feet wide where buffers exist. The 45-foot wide curb-to-curb section of Park Street is shown in the typical section at right with the 10' sidewalk space behind the curb. Note these widths may vary slightly by section due to inconsistencies in striping applications.

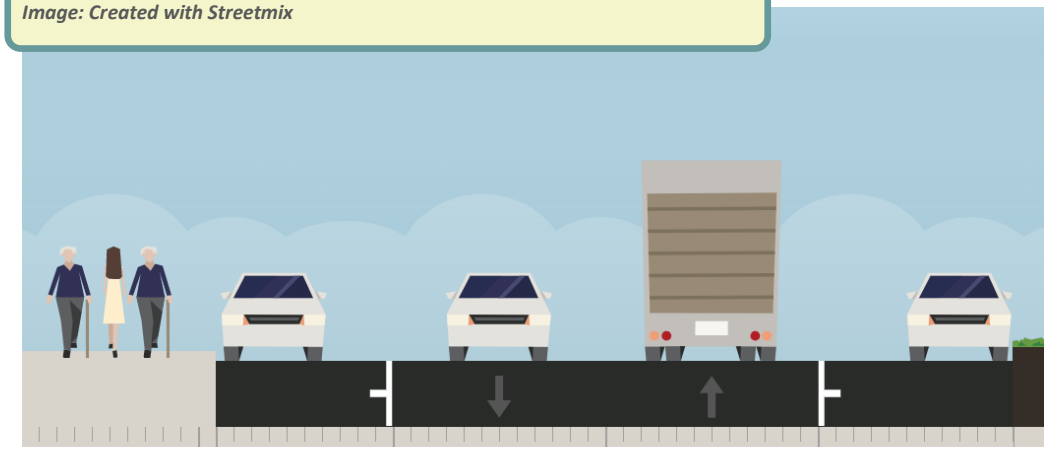
Bike Lanes. Can Park Street be re-striped to include dedicated bicycle lanes? The short answer is: It's complicated.

The image shown on the bottom right uses the same 45-foot section and reconfigures the space for a hypothetical bike lane. In theory, the space is there to provide a 5-foot wide bicycle lane but that's where the justification becomes more difficult. AASHTO's *A Guide for the Development of Bicycle Facilities* guidance on bicycle lane width designates a 5-foot wide bicycle lane as the minimum acceptable width where on-street parking is present. Parking lanes are typically 7-feet to 9-feet in width.

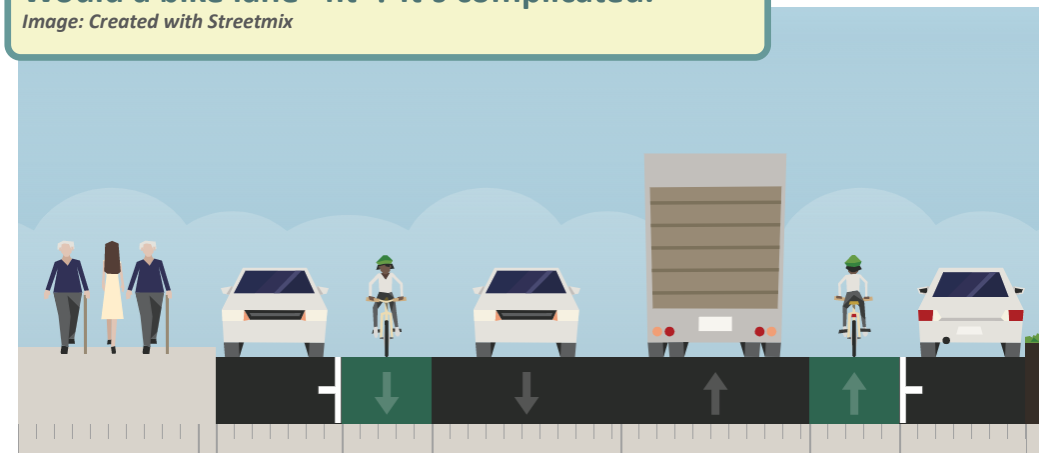
AASHTO's *A Policy on the Geometric Design of Highways and Streets* (aka *The Green Book*) includes guidance for travel lane widths for motor vehicles on a principal arterial like Park Street, which ranges from 10-feet to 12-feet in width. State DOTs like MDT prefer 12-foot lane widths and may be amenable to 11-foot wide lanes in certain situations. This is typically due to the width of trucks. It is compounded by Park Street being a designated I-90 detour route.

Therefore, reconfiguring Park Street to include a minimum width 5-foot wide bike lane requires the minimum width for the parking lane and a near-minimum width for travel lanes, which may not be deemed acceptable by MDT. The centerline striping would be at least one-foot in width and the bike lane striping at least six inches in width for both sides. This leaves little room for error by both the bicyclist and the operator of a large vehicle.

Current Typical Section
Image: Created with Streetmix



Would a bike lane "fit"? It's complicated.
Image: Created with Streetmix



The problem with a 5-foot wide bicycle lane adjacent to a 7-foot wide parking lane is it puts the bicyclist in the door zone of a vehicle—meaning the safety of the bicyclist could be compromised if a driver opens the door into the bike lane as a bicyclist travels by. Dooring crashes can be severe and sometimes fatal. The image at right shows a minimum width parking lane next to a 5-foot wide bicycle lane and the door zone that it creates.

The other option is to prohibit parking on the north side of Park Street. This would provide ample space for a bike lane and a painted buffer, while maintaining a 12-foot travel lane and reducing the parking lane on the south side to 8-feet wide but with a 2-foot wide buffer to keep bicyclists out of the door zone.

In the sections of Park Street that lack curbing on the north side (east of B Street), extruded curbing could be installed or an outside line striped at the edge of pavement with signs to help keep people from parking on the bike lane. The bike lane may be reduced to 4-feet in width in those sections to accommodate the curbing and/or striping.

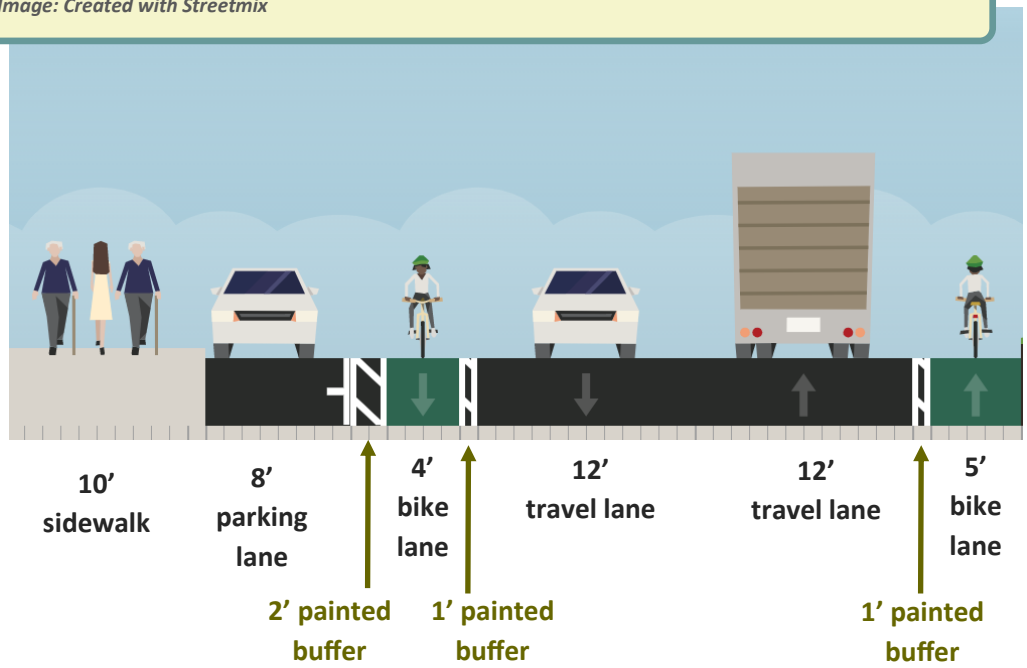
This still creates challenges at the signalized intersection of Park Street and B Street at the railroad underpass. The presence of a center left turn lane, combined with no on-street parking, provides no space for a bicycle lane in its current configuration. Removal of the turn lane would allow the space for a bicycle lane, but may not be seen as desirable due to traffic volumes and queues at the signal. Removal of the turn lane would likely require a "split phase" of the signal where only one direction of travel at a time is given the green light along Park Street.

Design Justification. The engineering justification for removal of parking to allow for a bike lane with a buffer is contained in the FHWA *Bikeway Selection Guide*, which was published by FHWA's Office of Safety in 2019.

The contents of the guide are based on prevailing AASHTO and FHWA design guides and policies, as well as FHWA-endorsed design

Door Zone Bike Lanes
Constrained spaces can create unsafe conditions for bicyclists if parking lanes and bike lanes are configured to minimum widths.

Bike Lane with Buffers & Removal of North Side Parking
Image: Created with Streetmix



guides produced by NACTO and ITE (see Appendix page 11).

The *Bikeway Selection Guide* represents the emerging science and engineering that indicate typical in-street bike lanes that lack separation or protection are viewed as safe by the most confident bicyclists, which represent only 4-7% of the population.

Providing separation from travel lanes—in combination with low motor vehicle speeds—is proven to attract the "interested but concerned" population. This group wants to try to bike more but has fears for safety when asked to ride alongside high-speed traffic. Buffered bike lanes are the next level of treatment when full separation is not possible.

Park Street has a posted speed limit of 25 mph and traffic volumes of approximately 9,400 at Main Street and 7,400 at N Street. When these speed limits and volumes are plotted on the FHWA *Bikeway Selection Guide* matrix, it shows Park Street in the category that would justify full separation.

Given full separation is not practical due to various constraints, the next level of treatment is a bike lane with buffer preferred. The section of Park Street near N Street is closest to this threshold.

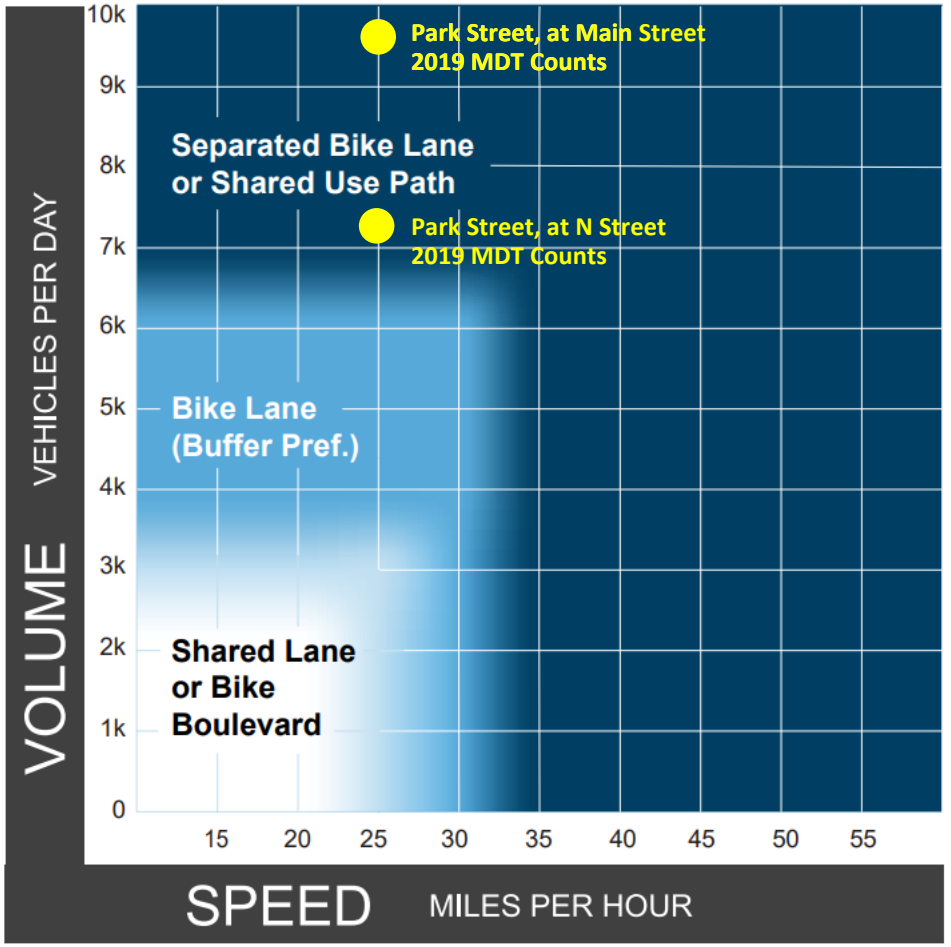
Therefore, this matrix appears to justify, at minimum, consideration of the buffered bike lane. If that treatment proceeds, other efforts should be made by the City and MDT to ensure that the posted and operating speeds of Park Street are maintained at 25 mph.

The existing configuration (a shared lane) is only suitable with traffic volumes below approximately 3,000 vehicles per day and speeds below 25 mph.

Depot Sidewalks. The proposed addition of sidewalks along the north side of Park Street along the Depot frontage (at 2nd Street) would impact the future viability of the Park Street bike lanes if the sidewalk is placed in the existing shoulder on the north side without reconfiguring the road on the south side.

Park Street & Bikeway Selection Guide Matrix

The speed and traffic volumes for Park Street (at its intersection with Main Street) are plotted on the FHWA's *Bikeway Selection Guide* matrix. This shows clear justification for separated treatments instead of an in-street buffered bike lane, however, full separation is not feasible along the current route.



Source: FHWA Bikeway Selection Guide, Preferred Bikeway Type for Urban, Urban Core, Suburban and Rural Town Contexts; https://safety.fhwa.dot.gov/ped_bike/tools_solve/docs/fhwasa18077.pdf

Configuring a bike lane through this section in combination with the addition of sidewalk on the Depot's frontage would require removal of on-street parking on the south side of Park Street. This would likely be between 3rd Street and Main in order to allow for proper tapering of the roadway striping.

The image at right was provided by Steering Committee members to show what MDT is proposing along the Depot frontage. The white area labeled as "new sidewalk" is where current road space would be reconfigured to allow for a sidewalk adjacent to the current stairs that access the street side of the Depot.

Accommodating the sidewalk and future bike lanes would require prohibiting on-street parking in the areas marked with the orange lines (subject to engineering study) and removal of the planned curb extension at 2nd (marked with a circled, red X).

Sidewalks along Depot Frontage of Park St.
The illustration shows a crude mock-up of where the sidewalks and proposed curb extension are planned. The orange lines are added to show where parking would need to be prohibited in order to shift the center line of the road to allow for a future bike lane and the proposed sidewalk on the north side. A curb extension would not be possible at this location if this shift occurred.