

1 PURPOSE AND POLICY GUIDANCE

The VTA Bicycle Technical Guidelines (BTG) present standards and guidance for planning, designing, operating, retrofitting and maintaining roadways and bikeways. They are intended to improve the quality of bicycle accommodation and to ensure countywide consistency in the design and construction of not only bicycle projects but all roadways. Bicycles are permitted on every roadway in California except as noted in the side bar. Moreover, countywide guidelines are intended to aid Member Agencies in providing a high quality and seamless bicycle network and to facilitate and encourage the use of bicycles as a transportation mode in the County. The BTG apply to projects that are a part of the countywide bicycle network, projects that are funded by the Countywide Bicycle Expenditure Program (BEP) and also to all VTA-funded roadway projects.

The BTG draw from the main state and federal design and uniform traffic control device manuals, as well as policy directives, as indicated in Table 1-1, and are not likely to present an additional burden on agencies. The BTG also highlight best practices used by Member Agencies in order to share information among peers and to foster consistency throughout the County. In the eight years since the first BTG was published, real-world application has yielded better design options as well as has raised more issues to be addressed; thus the BTG refine and expand upon the various options, optimal designs and best practices presented in the 1999 BTG. The BTG should be an invaluable resource for both roadway and bikeway designers.

1.1 ORGANIZATION OF MANUAL

There are four parts to this manual: 1) Introduction and General Guidance; 2) Technical Guidance for Roadways; 3) Technical Guidance for On-Roadway Bike Facilities; and 4) Technical Guidance for Bike-Only Facilities.

Part 1 Introduction and General Guidance

- **Chapter 1: Purpose and Policy Guidance**

This chapter describes the purpose and organization of this document and its relation to other manuals and VTA guidelines.

- **Chapter 2: Bicycle Characteristics**

This chapter presents the dimensions of the bicycle as a vehicle and discusses types of bicyclist skill levels and the facilities that best accommodate them. These physical dimensions are the basis for many of the technical recommendations.

IN THIS CHAPTER:

- 1.1 *Organization of Manual*
- 1.2 *Who Uses These Guidelines?*
- 1.3 *Relation to Other Design Manuals*
- 1.4 *Consistency with Existing Policies*

NOTE

Bicycles are permitted on every roadway in California except freeways where prohibited per California Vehicle Code (CVC) §21960 and toll bridges per CVC §23330. These CVC sections are contained in Appendix A along with pertinent Streets and Highways Code sections.

**Table 1-1
Design Standards and Guidance Manuals for Streets and Bikeways**

Topic	California	National	VTA
Road Design	Caltrans HDM Chapters 000 -900	AASHTO <i>Geometric Design of Highways and Streets</i> AKA "Greenbook"	Bicycle design best practices for each of these topics are in the Bicycle Technical Guidelines
Road and Bikeway Design Element Details	Caltrans Standard Plans	No Federal Manual	
Bikeway Design	Caltrans HDM Primarily Chapters 300, 400 and 1000	AASHTO <i>Guide for the Development of Bicycle Facilities</i>	
Pedestrian/ Bike Bridges	Caltrans HDM Section 208, and Caltrans Bridge Design Specifications	AASHTO <i>Guide Specifications for Design of Pedestrian Bridges</i>	
Signs and Markings	MUTCD - CA	MUTCD	
Signs and Markings on Bikeways	MUTCD - CA Chapter 9	MUTCD Chapter 9	
Policies pertaining to Bicycle Facilities and Design	Caltrans Various Documents including Deputy Directive 64 and Design Bulletins	FHWA Various Documents	
Bike Parking	No statewide Manual	No Federal Manual	
Miscellaneous Best Practices	Professional Journals		

Pedestrian best practices are included in VTA's *Pedestrian Technical Guidelines*.
 CDT best practices are included in VTA's *CDT Manual of Best Practices*.
 HDM: *Highway Design Manual*
 AASHTO: *American Association of State Highway Transportation Officials*
 MUTCD: *Manual of Uniform Traffic Control Devices*
 MUTCD - CA: *California Manual of Uniform Traffic Control Devices*

Part 2 Technical Guidelines for Roadways

Part 2 provides technical guidance for roadways and is divided into four chapters:

- **Chapter 3: Roadway Design Elements**

This chapter includes best practices for lane and cross-section widths, design details for drainage systems and grates, and guidance on reducing surface obstructions, pavement marking materials and signage.

- **Chapter 4: Construction Zones and Maintenance**

This chapter discusses construction zones, design guidance for detour planning and design guidance for bike-friendly roadway maintenance procedures.

- **Chapter 5: Intersections and Interchanges**

This chapter addresses the common conflicts between motorists and bicyclists that occur at intersections due to right- and left-turning vehicles. It also presents the preferred freeway/interchange design and options for striping bike lanes at interchanges.

- **Chapter 6: Signalized Intersections**

This chapter provides a discussion on bike-friendly signal timing and bike-sensitive detection.



Part 3 Technical Guidelines for On-Road Bikeways

- **Chapter 7: Bikeways on Major Rural Roads**

This chapter presents the wide variety of bikeways found on major roadways in both urban and rural settings. It begins with bike lanes in various contexts and address the use of “sharrows”. It discusses shoulders as bikeways and other rural road issues and concludes with cycle-tracks.

- **Chapter 8: Local Roads as Bikeways**

This chapter includes bicycle boulevards and general bike routes, and addresses traffic calming techniques that are compatible with bicycling.



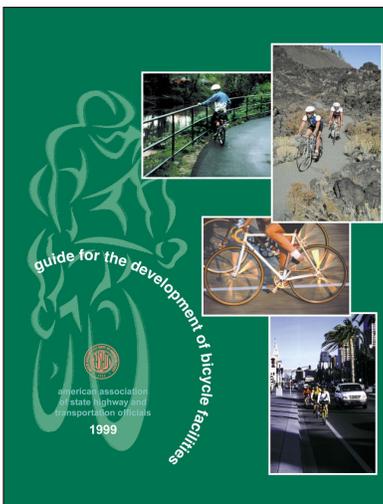
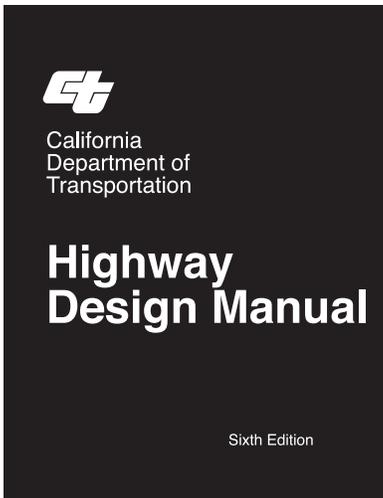
Part 4 Technical Guidelines for Bike-Only Facilities

- **Chapter 9: Bike Paths and Bike Bridges**

This chapter addresses the design elements of bike paths to optimize their use for transportation such as width, the use of bollards and shared use. It also presents guidance for bicycle bridges.

- **Chapter 10: Bicycle Parking**

This chapter describes the recommended types of bicycle storage, placement criteria and quantity for particular locations.



1.2 WHO USES THESE GUIDELINES?

The BTG are for use on all projects in the VTA Capital Improvement Program (CIP) including freeway projects that involve ramps and ramp intersections with surface streets. In particular, the BTG are used by:

- **VTA staff**
 - when screening and scoring projects for inclusion in the Bicycle Expenditure Plan.
 - when designing all roadway and bikeway projects funded through VTA.
 - as the basis for development review comments on proposed projects and mitigation measures.
- **Member Agencies**
 - when designing all bike and roadway projects funded through VTA.
 - as a reference for all other bike and roadway projects.
 - encouraged to adopt the BTG as part of their Bike Master Plans.
- **Developers**
 - to consult the BTG in the pre-design and design phase of their projects.
 - by providing the BTG to their design consultants.
- **Bicycle and Pedestrian Advisory Committee (BPAC) members**
 - when reviewing roadway and bikeway projects.
 - when commenting on development projects in their jurisdictions.

1.3 RELATION TO OTHER DESIGN MANUALS

1.3.1 Relation To State and Federal Design Manuals

The California Department of Transportation (Caltrans) *Highway Design Manual* (HDM), is the primary source for bikeway standards in California. The American Association of State Highway Transportation Officials (AASHTO) *Guide for the Development of Bicycle Facilities* (hereafter referred to as the AASHTO Bike Guide) also presents guidelines to follow when constructing or improving highways and designing and constructing bicycle facilities. It is used by states who do not have their own guidelines and also contains some guidance that is not included in the HDM. Pursuant to SHC 890.6,  HDM provides minimum design criteria for various aspects of bikeways and

 SHC 890.6 “The Department shall establish minimum safety design criteria for the planning and construction of bikeways and roadways where bicycle travel is permitted”. See Appendix A for the full text.

together with the AASHTO Bike Guide also provide some discussion on best practices, as well as practices to avoid. The BTG are intended to supplement these manuals, by providing guidance on when and how to better accommodate the many types of bicyclists. See also page viii and page 1-1. Also, since bicycles are allowed on all roadways, the BTG provide guidance on roadway design elements that affect bicycling. See Section 2.1, 2.2 and 2.3 for discussion of types of bicyclists.

1.3.2 Relation to VTA Documents: Valley Transportation Plan 2030, Pedestrian Technical Guidelines (PTG) and Community Design and Transportation Best Practices Manual (CDT)

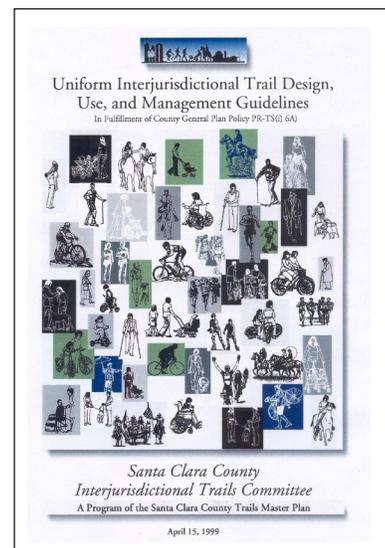
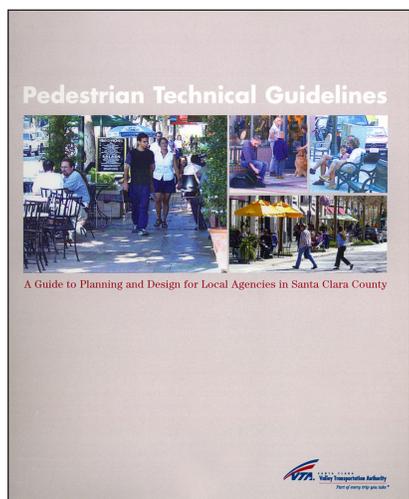
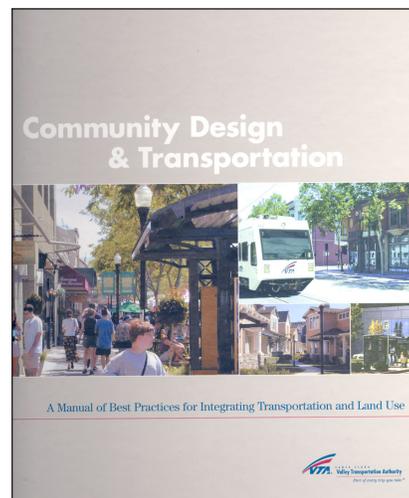
The BTG are the companion document to the VTA Countywide Bicycle Plan (CBP) which is the Bicycle Element of the Valley Transportation Plan (VTP). First published in 1999, the BTG are one of the steps toward the implementation of two policies from the CBP:

- Facilitate and encourage inter-jurisdictional cooperation in the development and implementation of non-motorized projects; and
- Develop a standard checklist of bicycle and pedestrian access guidelines to be used in the planning and programming of all VTA funded transportation projects.

The BTG are one of three technical guidelines authored by VTA. The *Pedestrian Technical Guidelines* (PTG) offer guidance on pedestrian facilities design and the *Community Design and Transportation (CDT) Best Practices Manual* offers guidance on Land Use and Transportation Design and Integration. These three documents complement each other, and the BTG references these documents where appropriate.

1.3.3 Relation to Interjurisdictional Trail Design, Use and Management Guidelines (TDMG)

In 1995, an update of the Countywide Trails Master Plan was adopted by the Santa Clara County Board of Supervisors as an element of the Santa Clara County General Plan. The Countywide Trails Master Plan includes guidelines for Class I Bike Paths and bike routes along rural roads within the unincorporated areas of Santa Clara County. Subsequently on April 15, 1999, the Santa Clara County Parks and Recreation Department, working through an interjurisdictional committee, published the *Uniform Interjurisdictional Trail Design, Use and Management Guidelines*. The BTG complement those found in the 1995 Countywide Trails Master Plan by specifically addressing the design of Class I Bike Paths within the urban areas of the County. Therefore, the BTG will not address Bike Path design, except for a few specific issues regarding bike transportation on bike paths that need elaboration including optimum and constrained rights-of-way, intersection control, and bike bridges and rail heights.



1.4 CONSISTENCY WITH EXISTING POLICIES

The BTG are consistent with recent federal, state and regional policies recognizing that bicycle facilities are an important component of the transportation infrastructure. The most pertinent federal, state and regional policies are as follows:

Federal: US DOT Policy Statement on Integrating Bicycling and Walking into Transportation Infrastructure, March 2000

The Policy Statement was drafted by the U.S. Department of Transportation (DOT) in response to Section 1202 (b) of the Transportation Equity Act for the 21st Century (TEA-21) with the input and assistance of public agencies, professional associations and advocacy groups.

The Policy Statement incorporates three key principles:

1. A policy statement that bicycling and walking facilities will be incorporated into all transportation projects unless exceptional circumstances exist;
2. An approach to achieving this policy that has already worked in State and local agencies; and
3. A series of action items that a public agency, professional association, or advocacy group can take to achieve the overriding goal of improving conditions for bicycling and walking.

**CA Assembly: Concurrent Resolution No. 211
August 20, 2002 (See Appendix A)**

Resolved.. in order to improve the ability of all Californians who choose to walk or bicycle to do so safely and efficiently, the Legislature... hereby encourages all cities and counties to implement the policies of ... DD64 and the US DOT's design guidance document on integrating bicycling and walking when building their transportation infrastructure.

CA State Department of Transportation

**Main Streets: Flexibility in Design & Operations
January 2005**

The California Department of Transportation (Caltrans) recognizes the value of a main street to a community for many reasons such as its scenic or historical value, its service to pedestrians, bicyclists, and public transit, and its access to businesses, residential roads, and other nearby properties. This value does not change when dealing with a main street that also serves as a state highway. When developing highway improvements, planners and designers need to address those community values especially providing access for bicyclists and pedestrians.

Deputy Directive 64-R1 Complete Streets – Integrating the Transportation System

The Department views all transportation improvements as opportunities to improve safety, access, and mobility for all travelers in California and recognizes bicycle, pedestrian, and transit modes as integral elements of the transportation system.

The Department develops integrated multimodal projects in balance with community goals, plans, and values. Addressing the safety and mobility needs of bicyclists, pedestrians, and transit users in all projects, regardless of funding, is implicit in these objectives. Bicycle, pedestrian, and transit travel is facilitated by creating “complete streets” beginning early in system planning and continuing through project delivery and maintenance and operations. Developing a network of “complete streets” requires collaboration among all Department functional units and stakeholders to establish effective partnerships.

The intent of this directive is to ensure that travelers of all ages and abilities can move safely and efficiently along and across a network of “complete streets.”

DIRECTOR’S POLICY

Context Sensitive Solutions Effective Date: 11-29-01

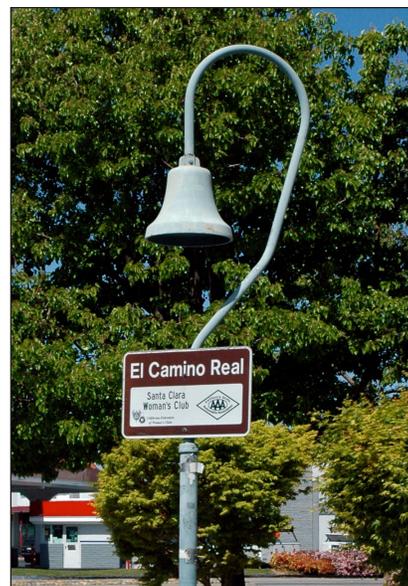
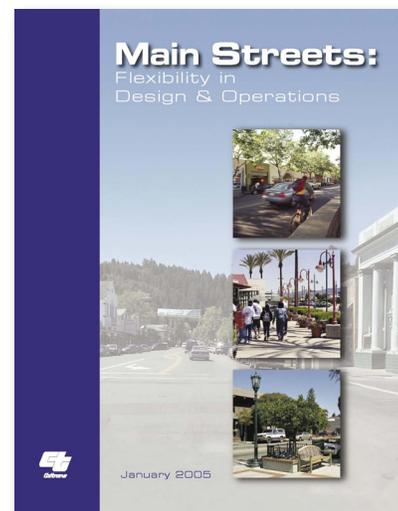
The Department uses “Context Sensitive Solutions” as an approach to plan, design, construct, maintain, and operate its transportation system. These solutions use innovative and inclusive approaches that integrate and balance community, aesthetic, historic, and environmental values with transportation safety, maintenance, and performance goals. Context sensitive solutions are reached through a collaborative, interdisciplinary approach involving all stakeholders. (See Appendix A)

The context of all projects and activities is a key factor in reaching decisions. It is considered for all State transportation and support facilities when defining, developing, and evaluating options. When considering the context, issues such as funding feasibility, maintenance feasibility, traffic demand, impact on alternate routes, impact on safety, and relevant laws, rules, and regulations must be addressed.

Metropolitan Transportation Commission

Transportation 2030 and Routine Accommodation of Bicyclists and Pedestrians in the Bay Area, June 2006

One of the “Calls to Action” included in the Metropolitan Transportation Commission’s (MTC) 2005 Regional Transportation Plan (RTP) calls for full consideration of the needs of non-motorized travelers during project development, design, construction, and rehabilitation. In part, the Call to Action says that “...bicycle facilities and walkways must be



Historic El Camino Real is both a state highway and an urbanized main street. To function as both, it requires context-sensitive design solutions that allow it to safely continue as a major traffic artery through vibrant commercial and residential areas.



considered, where appropriate, in conjunction with all new construction and reconstruction of transportation facilities.”

The Routine Accommodation report makes eleven recommendations for increasing the routine consideration of such facilities in the future. Recommendations include improving review and design strategies to ensure that transportation projects routinely accommodate bicycles and pedestrians. The MTC resolution adopting the Routine Accommodation Policy is contained in Appendix B.



2 BICYCLE CHARACTERISTICS

2.1 DEFINING OPTIMUM, SHOULD AND SHALL

In referencing widths and other measurements, the BTG make frequent use of the word “optimum” to present optimal design guidelines for bikeways and for roadways where bicycles are permitted. In these cases, “optimum” means the best or most favorable condition for a particular roadway or bikeway, from the perspective of the safety and convenience of the typical bicyclist expected to use the facility (see Section 2.2 and 2.3). The purpose of providing optimum as opposed to minimum standards is to set high expectations, build projects to higher design standards, improve the quality of bicycle facilities and encourage bicycling as a transportation mode. (The extent to which “optimum” is provided is in accordance with the resources available.) Similarly, “should” is used where a practice would result in optimum conditions for bicyclists, and “shall” is used to reference a State or Federal mandatory design standard. In some contexts, the design standard refers to the minimum allowable dimension, but larger dimensions are not only permissible but preferable. See sidebar example.

2.2 BICYCLE USER TYPES

The BTG recognizes the varying needs and preferences of the different types of cyclists. There are many ways to categorize the various types of bicyclists, for example, age, skill, trip purpose and even the type of bicycle ridden. These variations affect the type of facility where they ride and ultimately whether they choose to bike at all. For the purposes of the BTG, the types of bicyclists generally fall into five categories based on skill and basic trip purpose, as shown in Table 2-1.

Skill Level	Trip Purpose	
	Transportation	Recreation
Experienced	1. Typically adult	4. Typically adult
Casual	2. Typically adult or teen	5. All ages including families with young children
Novice	3. Novice adult or youth cyclist	

IN THIS CHAPTER:

- 2.1 *Defining Optimum, Should and Shall*
- 2.2 *Bicycle User Types*
- 2.3 *Facility Types and Bicycle Users*
- 2.4 *Operating Space of a Typical Bicyclist*

TECH TIP

Shall vs. Should

Example of use from

HDM §301.2 (1):

The minimum Class II bike lane width shall be 4 feet, except where:

- Adjacent to on-street parking, the minimum bike lane should be 5 feet.
- Posted speeds are greater than 40 miles per hour, the minimum bike lane should be 6 feet.



Many people find biking is a viable option into their 80's.

**Table 2 – 2
Bicyclist Type Versus Facility Type**

		1. Experienced Adult	2. Casual Adult	3. Novice Adult/Youth	4. Experienced Recreational	5. Family Recreational
Roadways						
Expressways		✓				
No Bike Lanes	Bicycle Blvd or < 2000 VPD	✓	✓	✓	✓	✓
	<13' curb lane	✓			✓(low ADT)	
	14' curb lane	✓	✓		✓	
	15'+ curb lane	✓	✓		✓	
Minimum Width	Low ADT	✓	✓	✓	✓	
	Bike Lanes					
	Med ADT	✓	✓		✓	
	High ADT	✓			✓	
Optimal Width	Low ADT	✓	✓	✓	✓	✓
	Bike Lanes					
	Med/High ADT	✓	✓	✓	✓	
Bike Paths/Shared-Use Paths						
8 feet wide			✓	✓		✓
12 feet wide High Ped. Volumes			✓	✓		✓
12 feet wide Low Ped. Volumes		✓	✓	✓	✓	✓
VPD = Vehicles Per Day; ADT = Average Daily Traffic Note: This table attempts to illustrate how bicyclists' preferences tend to manifest themselves and does not imply that all bicyclists fit into one of these categories.						

2.3 FACILITY TYPES AND BICYCLE USERS

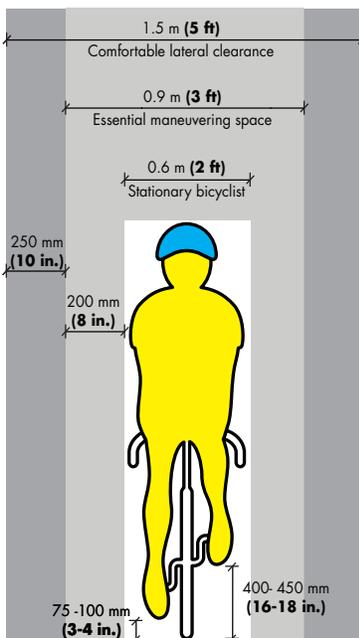
With training, most persons over age 10 can ride safely on most roadways. This does not mean, however, that most persons would choose to do so. This is corroborated by the existing bicycle mode split for work trips in Santa Clara County of less than two percent. The tendency of the five basic types of bicyclists to use roadways and bike paths is presented in Table 2-2. The BTG recommends that in planning bicycle networks, the type of bicyclist expected to use the facility be considered. For example, only experienced cyclists are expected to ride on expressways whereas bike paths typically attract all skill levels and ages. Trip purpose also affects facility choice: the route chosen by a skilled adult rider for a recreational ride will be much different than for a commute trip. To serve the full range of cyclists in a community, a variety of bikeway types should be provided.

2.4 OPERATING SPACE OF A TYPICAL BICYCLIST

Figure 2-1 shows the dimensions and operating space required by a typical bicyclist on a typical bicycle. The width of a stationary bicyclist is approximately 2.0 feet, while a moving bicyclist typically takes up an additional 12 to 16 lateral inches for essential maneuvering space. Added to this is the required clear distance between the bicyclist and other objects and vehicles for a requirement of five feet for comfortable bicycle operation. A bicyclist pulling a trailer requires even more lateral width as shown in Figure 2-2. Figure 2-3 illustrates a two-way bike path which requires ten feet for optimal bicycle accommodation.



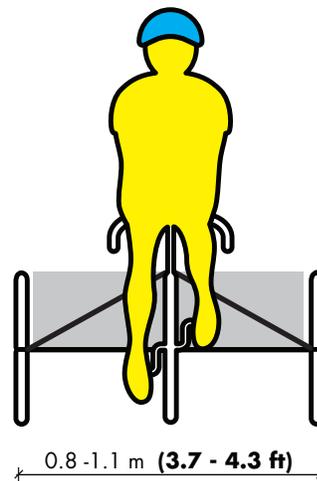
The concrete gutter serves as the comfortable lateral clearance but not essential maneuvering space as defined in Figure 2-1.



Front View

**Figure 2-1:
Bicyclist Essential Operating Space**

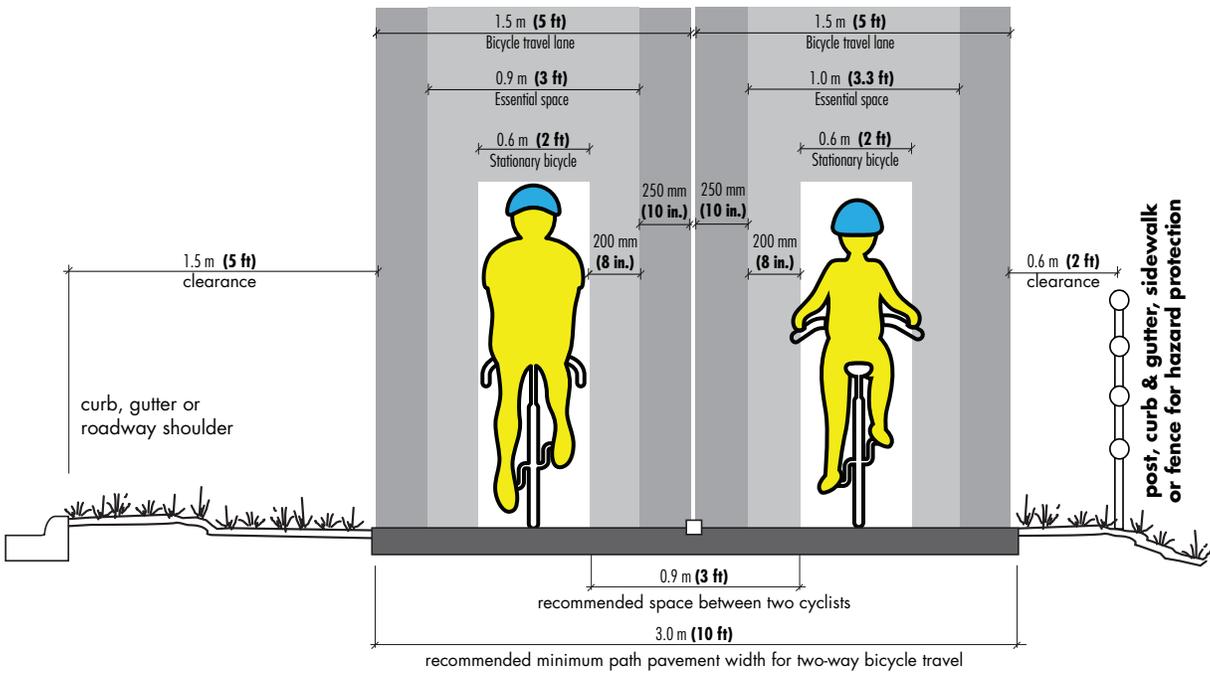
Source: Minnesota Department of Transportation



Front View

**Figure 2-2:
Stationary Bicyclist with Trailer**

Source: Minnesota Department of Transportation



Source: Minnesota Department of Transportation

Figure 2-3:
Bicyclist on Two-Way Path - Essential Operating Space



This cyclist has no margin of error on his right, and would benefit from an edge line on both sides. Although low, the bridge is higher than the minimal required vertical clearance of 8 feet.