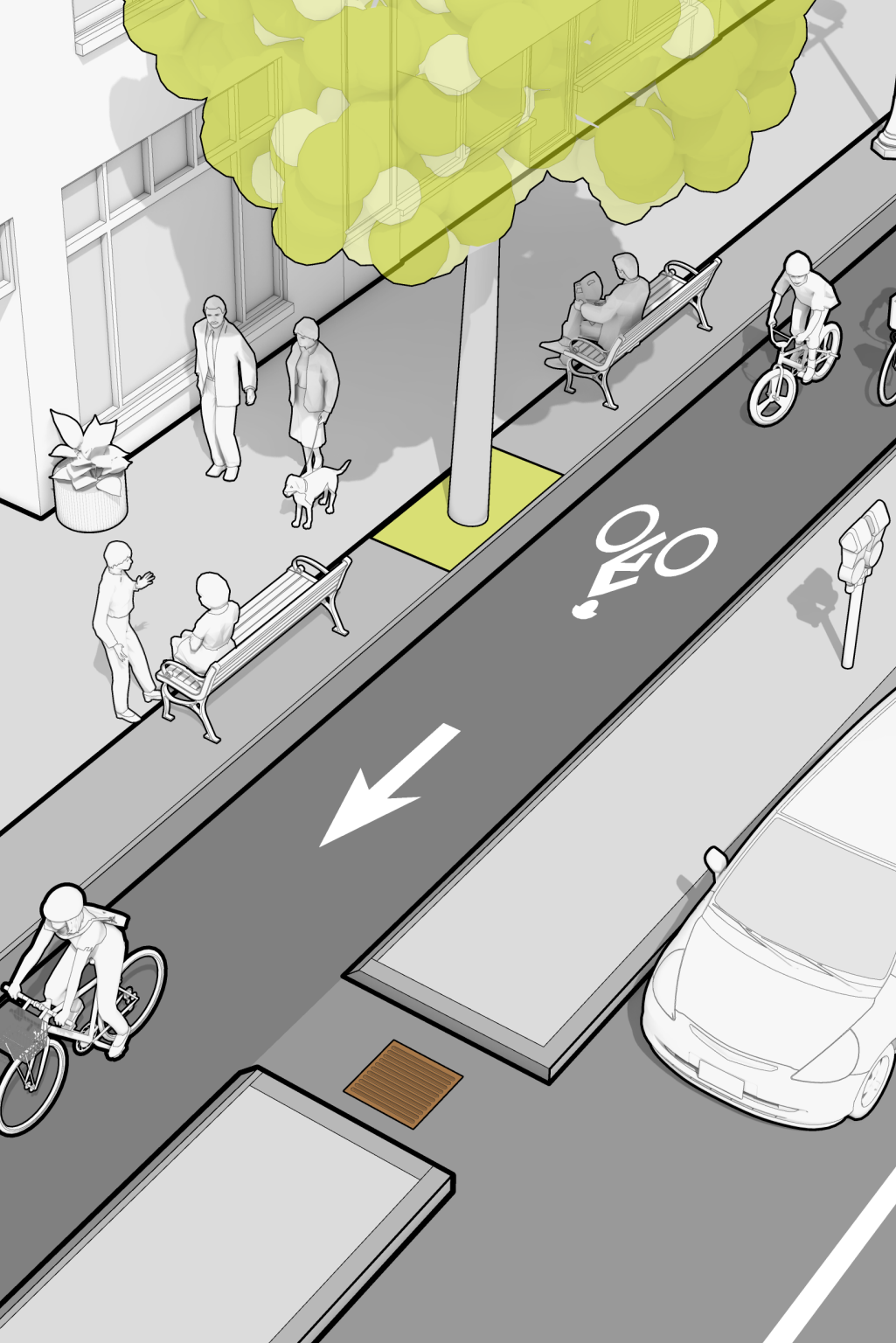


# 1

## OVERVIEW



The Massachusetts Department of Transportation's (MassDOT) **Separated Bike Lane Planning & Design Guide** (the Guide) presents considerations and strategies for the development of separated bike lanes. The Guide provides a framework for determining when separated bike lanes are appropriate and feasible. It presents design guidance for separation strategies, bike lane configuration, and considerations for transit stops, loading zones, utilities, drainage, parking and landscaping. The Guide defines separated bike lane design principles for intersections, introduces intersection design treatments and provides examples of typical intersection configurations. It clarifies when to consider signalization and provides guidance on signal phasing and timing as well as location of signal equipment. The Guide concludes with maintenance strategies, including seasonal operations and maintenance considerations.

## 1.1 SEPARATED BIKE LANE DEFINITION

A separated bike lane is an exclusive space for bicyclists along or within a roadway that is physically separated from motor vehicles and pedestrians by vertical and horizontal elements.

Just as a sidewalk creates a separate space for pedestrians, a separated bike lane creates an exclusive space for people bicycling along or within the roadway. Separated bike lanes include two fundamental elements:

- **Separation from motor vehicles both a) horizontally, with a separated space for bicycling along the street and at intersection crossings, and b) vertically, with a physical object and/or a change in elevation from the street surface.**
- **Separation from pedestrians with a vertical object, a change in elevation or visual delineation. Where separation from motor vehicles is appropriate but volumes of pedestrians and bicyclists are relatively low, a shared use path can be provided.**

Designers have flexibility in determining the type of separation. Depending on the context, separated bike lanes may be designed for one-way or two-way operation and may be constructed at street level, sidewalk level or at an intermediate level between the street and the sidewalk. The method of separation can be achieved with a variety of vertical elements including raised medians, flexible delineator posts, parked vehicles, or by a change in elevation between the bike lane and the roadway.



## 1.2 PURPOSE OF THE GUIDE

This Guide is a supplement to MassDOT's existing bicycle facility design guidance ([Chapters 5 and 6 of the Project Development & Design Guide](#)), providing direction on where to implement and how to design separated bike lanes as part of a safe and comfortable network of bicycle facilities.

### 1.2.1 POLICY CONTEXT

As part of a complete streets approach, MassDOT is committed to providing safe and comfortable travel for residents and visitors who bicycle on the Commonwealth's roads and paths. This commitment was formalized in 2006 with the release of the agency's award-winning context-sensitive design manual, the [Project Development & Design Guide \(PD&DG\)](#). By 2013 MassDOT further refined its complete streets guidance and released the [Healthy Transportation Policy Directive P-13-0001](#), also known as the [GreenDOT policy](#).

**“All MassDOT funded and/or designed projects shall seek to increase and encourage more pedestrian, bicycle and transit trips.”**

*MassDOT Healthy Transportation Policy Directive, September 9, 2013*

A component of the GreenDOT Policy requires that all MassDOT projects be designed and implemented in such a way that all customers have access to safe, comfortable and healthy transportation options including walking, bicycling and transit. This Guide is an important element in MassDOT's efforts to encourage more walking, bicycling and transit trips in the Commonwealth by 2030. Growth in bicycling will also help MassDOT meet its goals of reducing transportation-related greenhouse gas emissions.

Bicycling can also play a role in the Commonwealth's efforts to improve public health. As of 2014, approximately 66 percent of adults and 25 percent of children in Massachusetts were categorized as overweight or obese.<sup>3</sup> The Massachusetts Department of Public Health has launched [Mass in Motion](#), a statewide obesity prevention initiative that promotes better eating habits and increased physical activity. Encouraging more daily bicycle trips can help to reduce rates of chronic diseases and rising health care costs related to physical inactivity.

MassDOT recognizes that implementing separated bike lanes is a critical strategy toward achieving many statewide goals. As stated in the [2014 Healthy Transportation Engineering Directive E-14-006](#), separated bike lanes are an appropriate substitution for other types of accommodation, and if provided, it is

### BICYCLING FOR SHORT TRIPS: THE UNTAPPED POTENTIAL

**Commonwealth residents make 26.5 million trips per day.<sup>1</sup> About half of those trips are less than 4 miles in length<sup>2</sup>—a distance that can, in many cases, be accomplished by bicycle in about the same amount of time as a motor vehicle trip. Safe, comfortable and convenient bicycle facilities make it possible to convert some short trips to bicycling, reducing traffic congestion and improving health.**

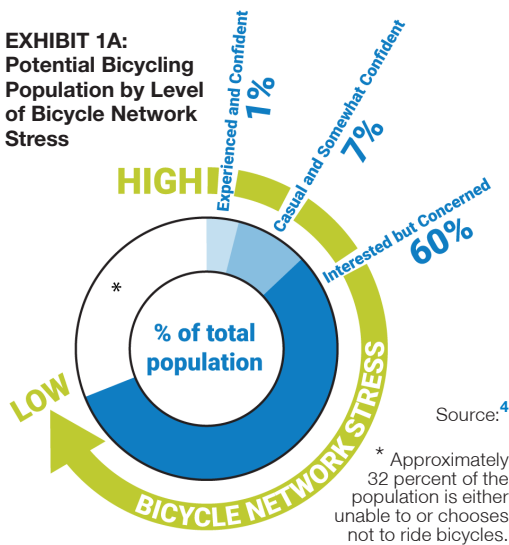
not necessary to provide any additional accommodations (e.g., conventional bike lanes).

Similar policies and guidance are provided at the federal level. The U.S. Department of Transportation (USDOT) is promoting connected and convenient multimodal networks, including high quality bicycle networks that appeal to people of all ages and abilities. As part of this initiative, the Federal Highway Administration released its [Separated Bike Lane Planning and Design Guide \(FHWA Guide\)](#) in May 2015. The FHWA Guide is based on national best practices and provides a series of case studies.

### 1.3 DESIGN USERS

Many people are interested in bicycling for transportation purposes but are dissuaded by stressful interactions with motor vehicles.<sup>4</sup> These “interested but concerned” individuals vary by age and bicycling ability and account for a majority of the general population. While some bicyclists (i.e., the “casual and somewhat confident” or the “experienced and confident”) are more traffic tolerant, they account for a significantly smaller share of the population. By designing for those who are “interested but concerned,” separated bike lanes enhance the quality, safety and comfort of the bicycling environment for all design users. **EXHIBIT 1A** compares design users with their various tolerances for stress caused by interactions with motor vehicles.

**EXHIBIT 1A:**  
Potential Bicycling  
Population by Level  
of Bicycle Network  
Stress



### 1.4 ROLE OF SEPARATED BIKE LANES IN LOW-STRESS NETWORKS

A majority of people have serious safety concerns when bicycling in close proximity to motor vehicles, especially on higher speed, higher volume roadways (e.g., collectors and arterials) or where conflicts with parking, loading and buses are common. Only a small percentage of the population is willing to bicycle in these high-stress environments.<sup>4</sup> Furthermore, research has shown that motorists also experience stress in

conditions where they are sharing lanes or operating in close proximity to bicyclists.<sup>5</sup> Providing some degree of separation between bicyclists and motorists in locations with higher traffic speeds and volumes is therefore an important element in improving perceptions of safety and comfort for both groups.

Bicycling becomes more appealing to a broader segment of the population as the stress of riding a bicycle decreases (see **EXHIBIT 1B**). Bicycle networks can only expect to attract a modest percentage of people without direct and convenient low-stress routes.<sup>4</sup>

Low-stress bicycle networks are comprised of interconnected bicycle facilities that vary by roadway context. Shared lanes and conventional or buffered bike lanes may

**Differences in mass and speed between bicycles and motor vehicles creates hazards and leads to stress for both bicyclists and motorists.**

#### WHAT DOES RESEARCH SAY ABOUT SEPARATED BIKE LANES?

Separated bike lanes have been in use for many years in some European countries, however they are relatively new in the United States. Initial research on their use in North America has shown that:

- Separated bike lanes attract more people to bicycling.<sup>6,7,8</sup>
- Separated bike lanes improve safety for all road users.<sup>9,10,11</sup>
- Motorists and bicyclists prefer separated bike lanes over shared lanes or conventional bike lanes.<sup>5,12,13</sup>
- Women express a preference for separated bike lanes.<sup>14,15,16</sup>

create low-stress environments for most people on low-volume, low-speed streets where curbside conflicts are low. However, on busy streets with higher speeds, physical separation from motor vehicles via separated bike lanes or shared use paths is desirable to maintain a low-stress bicycling environment. Some vulnerable users, such as children and seniors, may only feel comfortable bicycling on physically separated facilities, even in locations with low traffic speeds and volumes.

# Interested but Concerned



## Who are they?

A mother and daughter in Western Mass. who enjoy Saturday rides to the library along the trail that runs near their house. The need to cross a busy road prevents them from riding together to elementary school during the week.

A 45-year-old father of two on the South Coast who was just diagnosed with pre-diabetes. His doctor encouraged him to be more active. He doesn't think he has time to go to the gym, so he's been thinking about commuting to work by bike. As a motorist he feels uncomfortable passing bicyclists, so he isn't sure he'd feel comfortable as a bicyclist sharing the road with cars.

A Boston-area resident who just moved to the US. He's used Hubway bike share a few times to ride home from the train station. He enjoys riding as long as he stays on quiet streets or the sidewalk. He'd like to be able to ride to the grocery store, but there are busy roads and intersections along the way.

# Casual and Somewhat Confident



## Who are they?

A woman on the North Shore who rides her bike downtown every morning to her job at the hospital. She prefers to ride on neighborhood streets, but doesn't mind riding the last few blocks on a busy street since there's a bike lane.

A lower-income Cape resident who rides a bicycle to save money for other household expenses. He's comfortable riding on Main Street without a conventional bike lane because it's a two-lane road and motorists usually don't pass him.

# Experienced and Confident



## Who are they?

A 60-year-old, life-long, daily-commuting bicyclist. He prefers direct routes to his destinations to save time. He is confident riding in mixed traffic and knows to be wary of opening car doors and turning trucks. He enjoys riding on shared use paths, but typically avoids them during congested periods.



LOWER STRESS  
TOLERANCE

HIGHER STRESS  
TOLERANCE

Separated bike lanes minimize conflicts with motor vehicles and heighten visibility between people bicycling and driving at intersections. Pedestrians benefit, too, from reductions in sidewalk riding and, depending on intersection design, shorter crossing distances.

## 1.5 BASIS OF DESIGN GUIDANCE

In developing separated bike lane guidance, MassDOT considered the design strategies from cities, states and countries that have successfully achieved a high percentage of trips by bicycle. While crucial to the overall bicycle network in these locations, separated bike lanes along busy and high speed streets are just one component. Communities with high levels of bicycle use typically provide a network of separated bike lanes, off-road paths, and shared streets where low traffic speeds and volumes enable bicyclists and drivers to coexist comfortably. **Section 2.4** presents a flexible approach to selecting the most appropriate bicycle facility.

This Guide draws upon experience and lessons learned from North American cities that have successfully increased bicycling while reducing crash rates through the implementation of separated bike lanes and other bicycle facilities.

The following guidelines and resources were primary sources for the development of this Guide:

- **National Association of City Transportation Officials Urban Bikeway Design Guide, Second Edition, 2014 (NACTO UBDG)**
- **American Association of State Highway and Transportation Officials Guide for the Development of Bicycle Facilities, Fourth Edition, 2012 (AASHTO Bike Guide)**
- **Massachusetts Project Development & Design Guide, 2006 (PD&DG)**
- **Federal Highway Administration Separated Bike Lane Planning and Design Guide, 2015 (FHWA Guide)**
- **Federal Highway Administration Bicycle and Pedestrian Facility Design Flexibility memorandum, 2013**
- **Dutch Centre for Research and Contract Standardization in Civil and Traffic Engineering (CROW)<sup>17</sup> Design Manual for Bicycle Traffic, 2007 (CROW Manual)**
- **Peer reviewed academic research**

All design guidance conforms to the **2009 Manual of Uniform Traffic Control Devices (MUTCD)** and the **PD&DG**, unless otherwise stated.

Design guidance for other bike facilities—shared lanes, conventional bike lanes, buffered bike lanes and shared use paths—is provided in the **PD&DG, AASHTO Bike Guide, MUTCD, NACTO UBDG** and other local guidance and standards.

## 1.6 USING THIS GUIDE

MassDOT has created the Separated Bike Lane Planning & Design Guide for local officials, planners, designers and other project proponents to supplement the agency's current guidance and reflect recent advancements in bike facility design. The Guide supplements the eight-step project development process as outlined in the **PD&DG**. This eight-step process formalizes the agency's commitment to a multimodal, context sensitive approach to improving and developing the transportation network throughout the Commonwealth. The information in this Guide applies to all projects where separated bike lanes are considered and when:

- **MassDOT is the proponent;**
- **MassDOT is responsible for project funding (state or federal-aid projects); or**
- **MassDOT controls the infrastructure (projects on state highways).**

**EXHIBIT 1C** highlights the relationship between this Guide and the relevant steps of the project development process. This Guide does not provide further considerations for project initiation (Step 3), programming (Step 5), procurement (Step 6) and construction (Step 7) because these processes remain similar with or without separated bike lanes. Project proponents should review Appendix D (Project Evaluation Checklist) and E (Recommended Separated Bike Lane Data Collection Protocol) of the **FHWA Separated Bike Lane Guide** for useful

evaluation measures and data collection methods that support project assessment (Step 8).

This Guide is also intended to be a useful resource for projects without MassDOT involvement, including those that are locally sponsored, funded, and reviewed, or under the jurisdiction of other Massachusetts authorities. Proponents of these projects are encouraged to consider this design guidance to ensure consistent and uniform design elements are used throughout the Commonwealth's bicycle network.

Readers of this Guide will find both recommended and minimum dimensions for separated bike lanes. Roadway designers should strive to incorporate recommended guidance where possible to attract bicyclists of all ages and abilities.

The guidance in this document is based on the premise that roadway design is contextual, and that design flexibility is needed to enhance safety and comfort for all users, particularly vulnerable users. This Guide includes recommended and minimum criteria to provide this flexibility. However, minimum criteria should be reserved for constrained areas only. If a design cannot meet these minimums, a Design Exception Report (DER) shall be prepared to document the site analysis and the reasons for not meeting minimum criteria (see [Section 2.11 of the PD&DG](#)).

See [Section 3.12](#) for design exceptions, Requests for Experimentation, accessibility, and shoulder requirements.

Separated Bike Lane Guide Chapter	Relationship to Project Development Process
1 Overview	Presents an overview of MassDOT and Federal policies and initiatives that create the need for separated bike lanes as part of low-stress bicycle networks. <a href="#">(Step 1: Problem/Need/Opportunity)</a>
2 Planning	Clarifies when separated bike lanes are appropriate and feasible. <a href="#">(Step 2: Planning)</a>
3 General Design	Presents design guidance for horizontal and vertical separation strategies, bike lane configuration, and considerations for utilities, drainage and landscaping. <a href="#">(Step 4: Environmental/Design/ROW Process)</a>
4 Intersection Design	Defines separated bike lane design principles for intersections, introduces intersection design treatments and provides examples of typical intersection configurations. <a href="#">(Step 4: Environmental/Design/ROW Process)</a>
5 Curbside Activity Design	Presents design guidance to reduce conflicts between separated bike lanes and curbside activities such as parking, loading and bus stops. <a href="#">(Step 4: Environmental/Design/ROW Process)</a>
6 Signals	Clarifies when to consider signalization in conjunction with separated bike lanes, and provides guidance on signal phasing and timing as well as location of signal equipment. <a href="#">(Step 4: Environmental/Design/ROW Process)</a>
7 Maintenance	Highlights maintenance and repair strategies for elements of separated bike lanes. Seasonal operations and maintenance are discussed as well, with a particular emphasis on winter maintenance. <a href="#">(Chapter 7 is beyond the scope of the project development process.)</a>

**EXHIBIT 1C: Relationship between the Separated Bike Lane Planning & Design Guide and the Project Development Process**

## 1.7 ENDNOTES

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