Memorandum

To: DEPUTY DIRECTORS
DISTRICT DIRECTORS
DIVISION CHIEFS

Date: January 16, 2024

From:

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Acting Chief
Division of Design

Subject: **DESIGN INFORMATION BULLETIN-94 COMPLETE STREETS: CONTEXTUAL DESIGN GUIDANCE**

Caltrans recognizes the importance of Complete Streets in supporting our mission to provide a safe and reliable transportation network that serves all people and respects the environment. In the 2021 Director's Policy on Complete Streets (DP-37), the California Department of Transportation (Caltrans) committed to the design and development of comfortable, convenient, and connected complete streets facilities for people walking, biking, and taking transit or passenger rail. This Design Information Bulletin (DIB) is issued in accordance with DP-37 and is effective immediately. DIB-94 represents the latest significant step in the implementation of that policy and meets a critical need by providing new flexibility in the design of context-sensitive facilities that serve travelers of all ages and abilities.

No single guidance document can fully capture all the considerations for the diverse climate, topography, and people across California, and so project development teams are encouraged to continue to collaborate with community members and exercise design flexibility and engineering judgement in the development of Complete Streets projects. The Division of Design continues to collaborate on the development of guidance to support livable main streets, traffic calming, and intersection and interchange designs for bicyclists and pedestrians, and designers are encouraged to consult the numerous resources and subject matter experts available to them.

DIB-94 is to be used in conjunction with the Complete Streets Decision Document (CSDD) when making decisions to maximize the use of the public right of way to achieve sustainable and equitable mobility. DIB-94 and the CSDD will help to accomplish the State Highway System Management Plan performance objectives for Complete Streets projects and bicycle and pedestrian facilities.

For projects where the project development process has started, follow the procedures in the Highway Design Manual Index 82.5 "Effective Date for Implementing Revisions to Design Standards."

Project specific applicability and questions should be referred to the Division of Design, Project Delivery Coordinators or the District Design Liaisons. DIB-94 training will commence in the Spring of 2024.

Attachment
DIB-94 Complete Streets: Contextual Design Guidance

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DESIGN INFORMATION BULLETIN NUMBER 94

California Department of Transportation
Division of Design

Complete Streets: Contextual Design Guidance

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1.0 INTRODUCTION

This Design Information Bulletin (DIB) provides guidance for the scoping and design of Complete Streets projects on the State Highway System (SHS).

The DIB identifies best practice and establishes standards for development of Complete Streets facilities to support the design of comfortable and convenient streetscapes by utilizing space-efficient forms of mobility such as people walking, biking, rolling, or accessing transit[1].

Complete Streets are vital community spaces that connect people both within and across communities. This design guidance takes a context-based approach, since the most successful streets respond to the various aspects of their context. Contextual design includes consideration of many factors including, but not limited to, varied user groups, place type, land use, community destinations, topography, community input, and environment.

As defined in Director's Policy 37 "Complete Streets" (DP-37)[2]: "A complete street is a transportation facility that is planned, designed, constructed, operated, and maintained to provide comfortable and convenient mobility, and improve accessibility and connectivity to essential community destinations for all users, regardless of whether they are travelling as pedestrians, bicyclists, public transportation riders, or drivers. Complete streets are especially attuned to the needs of people walking, using assistive mobility devices, rolling, biking, and riding transit. Complete streets also maximize the use of the existing right-of-way by prioritizing space-efficient forms of mobility, such as walking and biking, while also facilitating goods movement in a manner with the least environmental and social impacts. Complete streets shift the focus of transportation planning and project development from vehicle movement as the primary goal to the movement of people and goods."

Beyond being used for transportation, DP-37 also recognizes that streets are valuable community spaces and Complete Streets projects contribute to placemaking and can contribute to business vitality, public health, and community identity. Further, Complete Streets projects should also consider integration with the broader transportation system to support complete networks to serve broader mobility connections.

The California Department of Transportation (Department or Caltrans) published the California Transportation Plan 2050 (CTP 2050) that establishes eight priority goals to guide transportation decision-making including addressing safety, increasing resilience to climate change, equity, quality of life and public health, a vibrant and resilient economy, and enhancing environmental health while maintaining a high-quality transportation system that improves multimodal mobility access to destinations for all users[3]. Caltrans' Complete Streets Action Plan specifically identifies actions that are needed to fully implement the goals of DP-37[4]. For information on how Complete Streets are managed as an asset on the SHS, please refer to the current State Highway System Management Plan[5].

As established in Director's Policy 36 "Road Safety" (DP-36), Caltrans is committed to a safety-first mindset to prioritize the elimination of fatal and serious injury crashes and eliminate disparities in road safety outcomes consistent with the Federal Highway Administration (FHWA) Safe System approach[6].

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[1] See the California Vehicle Code (CVC) Section 231 and Section 467 for definitions of bicyclists and pedestrians.
[2] Director's Policy 37 "Complete Streets" (DP-37)
[3] California Transportation Plan 2050
[4] Complete Streets Action Plan 2022-23
[5] State Highway System Management Plan
[6] Director's Policy 36 "Road Safety" (DP-36), FHWA Safety System Approach

The Safe System approach is organized around six principles: eliminate death and serious injury, humans make mistakes, humans are vulnerable, responsibility is shared, redundancy is crucial, and safety is proactive and reactive[7]. Achieving the DP-36 vision of zero traffic deaths means addressing every aspect of crash risk through the five elements of a Safe System: safer roads, safer speeds, safer people, safer vehicles, and post-crash care. Incorporating particular design elements during project design can help mitigate human mistakes, account for injury tolerances, encourage safer behaviors, and facilitate safe travel for all road users. Complete Streets are an important component of the Safe System approach by accommodating all road users.

In addition to the commitment to the Safe System approach and the ongoing implementation of its principles and elements into Caltrans' project development processes, Caltrans' Performance-Based Decision-Making using the Highway Safety Manual Memorandum establishes guidance on implementing performance-based decision-making on design solutions using the American Association of State Highways and Transportation Officials (AASHTO) Highway Safety Manual (HSM) to reduce the frequency and severity of collisions[8]. The HSM analysis provides a "quantitative performance-based safety analysis that facilitates the Department's safety-first goals and objectives in the decision-making process throughout project development which includes eliminating fatal and serious injury collisions." The HSM policy guidance establishes when the HSM methodologies should be applied, including nonstandard traffic lane or shoulder widths, and roles and responsibilities for staff. For Complete Streets projects, performance-based decision-making can help evaluate the expected changes in safety performance for different design elements and alternatives under consideration for the project.

For guidance on integrating the Safe System approach into a Complete Streets project, consult the District Safety Engineer. For guidance on applying HSM performance-based decision-making into a Complete Streets project, see the "Supplement to the Application of the Highway Safety Manual Methodology for DIB 94 Eligible Projects" [9] and consult District and Headquarters HSM subject matter expert staff.

[7] Director's Policy 36 "Road Safety" (DP-36)
[8] Performance-Based Decision-Making using the Highway Safety Manual Memorandum, 2022. See also the Caltrans Highway Safety Manual webpage for additional information on the policy memorandum and additional HSM-related guidance.
[9] See the Caltrans Highway Safety Manual webpage for additional information.

2.0 USE OF THIS GUIDANCE

2.1 Purpose and Scope

This bulletin was prepared for the Department by the Division of Design for use on the California SHS. This bulletin establishes uniform policies and procedures to carry out the State highway design functions of the Department. It is neither intended as, nor does it establish, a legal standard for these functions. The standards, procedures, and requirements established and discussed herein are for the information and guidance of the officers and employees of the Department. Many of the instructions given herein are subject to amendment as conditions and experience warrant. Special situations may call for deviation from policies and procedures, subject to Division of Design approval, or such other approval as may be specifically provided for in the text of this bulletin. It is not intended that any standard of conduct or duty toward the public shall be created or imposed by the publication of this bulletin. Statements as to the duties and responsibilities of any given classification of officers or employees mentioned herein refer solely to duties or responsibilities owed by these in such classification to their superiors. However, in their official contacts, each employee should recognize the necessity for good relations with the public. This bulletin is not a textbook or a substitute for engineering knowledge, experience, or judgment.

2.2 Identifying Complete Streets Scope

Caltrans projects, in accordance with DP-37 and the Project Development Procedures Manual (PDPM) Appendix FF, record the inclusion of Complete Streets features in projects on the SHS in the Complete Streets Decision Document (CSDD) [10]. The CSDD additionally serves as the scoping document that is used to identify multimodal needs, appropriate Complete Streets improvements, and project scope consistent with the guidance in this DIB. The Caltrans Active Transportation Plans (CAT Plans) [11], Transportation Planning Scoping Information Sheets (TPSIS) [12], the Complete Streets Elements Toolbox [13], and the Main Street, California guide [14] may be used in conjunction with the CSDD, and the guidance contained in this DIB to scope appropriate Complete Streets facilities.

Caltrans' Complete Streets funding is available to achieve Complete Streets goals and features. Design guidance and standards in this DIB or in other Caltrans' publications, e.g., the Highway Design Manual (HDM) or DIB 89 [15], may be used to develop projects to satisfy performance measures and goals for Complete Streets infrastructure.

2.3 Application of Standards and Guidance

This DIB provides design guidance and best practices to incorporate Complete Streets facilities into projects and establishes separate policies, procedures, and standards to be applied in accordance with the HDM Chapter 80 Application of Design Standards. The applicable design standards for a Complete Streets project segment will be either the design standards of this DIB or the design standards in the HDM and DIB 89. This is an opt-in or opt-out concept to accomplish the Complete Streets goals for a project. When this DIB is silent on a subject covered in the HDM or DIB 89, the HDM or DIB 89 will apply. If the design standards of this DIB are used, these design standards will supersede the HDM or DIB 89 standards within a Complete Streets project segment in the State right of way. Note, superseding the

[10] Project Development Procedures Manual (PDPM), Appendix FF.
[11] Caltrans Active Transportation (CAT) Plans
[12] Transportation Planning Scoping Information Sheets (TPSIS)
[13] Complete Streets Elements Toolbox 3.0
[14] Main Street, California
[15] DIB 89 Class IV Bikeway Guidance

HDM standards would also mean superseding the design standards in DIB 79[16], since it is referenced in the HDM. In order to use the design standards of this DIB, the Complete Streets project segment should meet all of the following context criteria:

a. The Complete Streets project segment is located within an Urban Area, Suburban Area, and/or Rural Main Street place type;
b. Posted speed within the Complete Streets project segment does not exceed 45 miles per hour; and,
c. With the implementation of the project, a bicycle, pedestrian, or transit facility will be provided or improved within a Complete Streets project segment according to the CSDD.

Design standards in this DIB are presented as underlined standards, which requires a design standard decision document (DSDD) for noncompliance. Additionally, design decisions for the values in compliance with the underlined standard of this DIB will also require documentation in the project report or project approval document. A direct statement of the decision to opt-in is required if using the design standards of this DIB. After project approval, any change in the design decisions regarding the selected values of the underlined standard should be documented in a Memo to File. This documentation will explain the reasons for the values selected based on the unique characteristics and constraints of the project. Cost should not be the sole reason for the decision. This added discussion will contribute to the purpose and need of the project scope in support of multimodal accommodation based upon engineering judgement.

2.4 Applying Complete Streets Standards to Local Projects

DP-37 calls for the provision of Complete Streets facilities in "… all transportation projects funded or overseen by Caltrans"[17]. For locally or privately funded projects (projects-funded-by-others) on State highway right of way, the project sponsor may work with Caltrans to accomplish the same Complete Streets goals of providing or improving a bicycle, pedestrian, or transit facility. In order to use the standards of this DIB on a Complete Streets project segment, the segment must meet the context criterion (a) and (b) in Section 2.3 and the project report, project approval document, or similar document from the project sponsor must document the reasons why this segment should use the Complete Streets standards of this DIB due to the specific project constraints. Also, a direct statement of the decision to opt-in is required if using the design standards of this DIB. The design standards in the HDM and DIB 89 may be used instead of the design standards of this DIB as described in Section 2.3. Whether the project is using HDM, DIB 89, or the standards of this DIB, the project sponsor is required to document their selected geometric features by using the HSM to conduct a performance-based safety analysis as described in Section 1 of this DIB. For guidance on applying HSM performance-based decision-making using the standards of this DIB, see the "Supplement to the Application of the Highway Safety Manual Methodology for DIB 94 Eligible Projects"[18].

For projects-funded-by-others, maintenance agreements with the local agency may be necessary for the Complete Streets facilities that are constructed within State highway right of way. This coordination should occur early in the project development process. See the PDPM Chapter 13 Article 5 for more

[16] DIB 79 Design Guidance and Standards for Major Pavement Roadway Rehabilitation Projects
[17] Director's Policy 37 "Complete Streets" (DP-37)
[18] See the Caltrans Highway Safety Manual webpage for additional information.

information[19]. The maintenance agreements should be developed after the Project Approval and Environmental Document (PA&ED) phase but finalized before advertising the construction contract.

2.5 Complete Streets Design Team

Complete Streets projects are multifaceted, and their design is an interdisciplinary undertaking that should consider the appropriate balance of transportation needs to arrive at a context sensitive design given the community context and site constraints. A core element of the project development process is a project development team (PDT). The PDT works together to ensure that Complete Streets features are fully coordinated across disciplines, from multimodal facility design to green streets elements. This can include discussing and identifying multimodal safety considerations, maintenance responsibility needs for green streets features incorporated into the project, consideration of truck access needs, stormwater considerations, and integrating input from local agency planning and engineering staff or transit agencies, among others. The team will also develop the project scope in accordance with the asset management requirements of the Department.

See the PDPM Chapters 2 and 8 for more information on PDTs[20].

[19] Project Development Procedures Manual (PDPM), Chapter 13, Article 5.
[20] Project Development Procedures Manual (PDPM), Chapters 2 and 8.

3.0 DESIGN CONTEXTS

Caltrans policies have long considered project context in the development of State highway facilities. To achieve the vision of socially and economically vibrant, thriving, and resilient communities laid out in DP-37, this DIB expands on the idea of context sensitive solutions to identify specific aspects of context that should inform multimodal facility selection and design for Complete Streets.

The context of a transportation project includes community needs and desires, an understanding of community destinations, geography and topography, development and land use, users, and current and expected modal use, as follows:

- Community needs, desires, and destinations are best understood through early and ongoing community engagement and thoughtful site analysis. Site analysis is described in detail in the latest edition of the Main Street, California guide[21]. This engagement and analysis will support the development of the project's purpose and need.
- Geographic and topographic information are readily available, and surveys are often developed through the standard project development procedures. The HDM provides guidance on design of roadways through varied terrain, but the needs of pedestrians and bicyclists should be given special consideration, as their forward movement is physically taxing and opportunities for rest and shelter are of special importance.
- Development and land use patterns can be characterized by descriptions of place type. The various Urban Area, Suburban Area, and Rural Area place types are discussed in Section 3.1. These place types are characterized by common opportunities and challenges for Complete Streets.
- Different place types also correlate with different user profiles and accommodate varied mode share. Successful integration of different modes should consider both the speeds and volumes of different users, with a special emphasis on providing comfortable and convenient facilities for road users who may be underrepresented in the existing roadway environment. This concept of modal priority is discussed in Section 3.2.

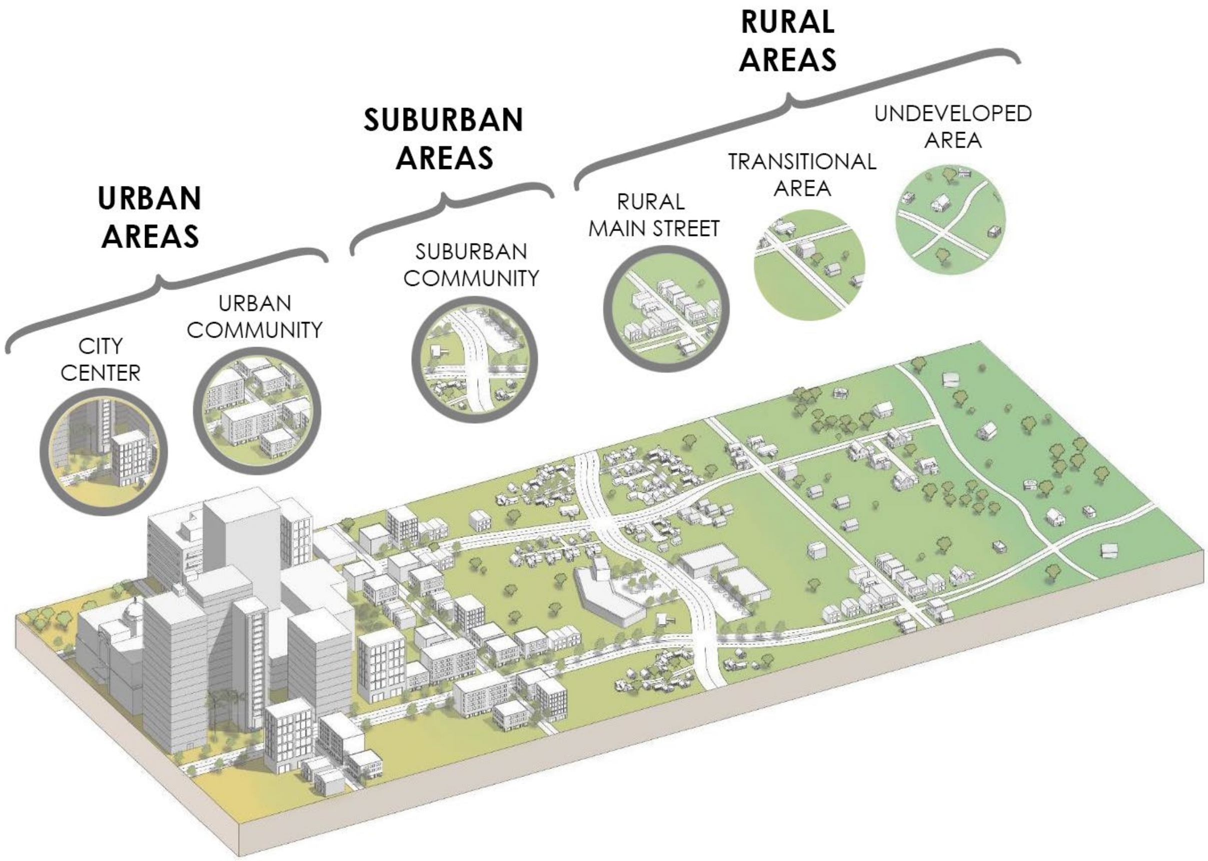
A preliminary understanding of project context is needed to adequately plan and scope a Complete Streets project, but a much more nuanced understanding of the project site is necessary to develop a detailed design. This could be described as identifying project context at the "macro" versus the "micro" scale. Project development procedures have been created to reflect this process. The TPSIS and CSDD are used to identify critical, "macro-scale" information for planning and scoping. Likewise, community engagement and site analysis are critical to the development of context sensitive "micro-scale" project alternatives and detailed project design.

[21] Main Street, California

3.1 Place Types

Place types are used to describe a key component of project context, and provide insight into land use, development density, population, and transportation and mobility options and issues. Definitions of the place types used in this DIB are provided in HDM Topic 81. Figure 3-A depicts these place type development patterns and highlights the Urban Area, Suburban Area, and Rural Main Street place types where the standards in this DIB may be applied.

Figure 3-A - Place Types for Contextual Design Guidance



Place types can help planners and designers to identify common transportation needs, priorities, challenges, and solutions, and may inform discussions with the community. Guidance for developing mobility and transportation options across different place types is available in the Smart Mobility Framework documents and the Main Street, California guide. Opportunities for Complete Streets projects in the different place types are discussed below.

(1) *Urban Areas.* Urban Areas are high-density locations with a full range of land uses, and they can be further broken down into City Centers and Urban Communities.

(a) City Center (Central City, Center City). In City Centers, much of the transportation network has already been built out, but the existing right of way can be optimized to move people and goods most efficiently, while serving as a vital community space. Complete Streets projects in City Centers may focus on:

- Managing the network and increasing person throughput using space efficient modes, such as transit, bicycle, and pedestrian facilities.
- Enhancing connections between modes, for example with Mobility Hubs (places in a community that bring together multiple modes), bicycle or micromobility parking, and pedestrian amenities at transit stops.
- Managing curb space to accommodate transit, deliveries, bicyclists, parking, and loading.
- Developing high quality facilities that improve the comfort of varied users.

Figure 3-B – Example of the City Center place type on US-101 in San Francisco

(b) Urban Communities. In Urban Communities, the public right of way is often constrained and needs to balance different transportation modes and evolving mobility needs. Complete Streets projects in Urban Communities may focus on:

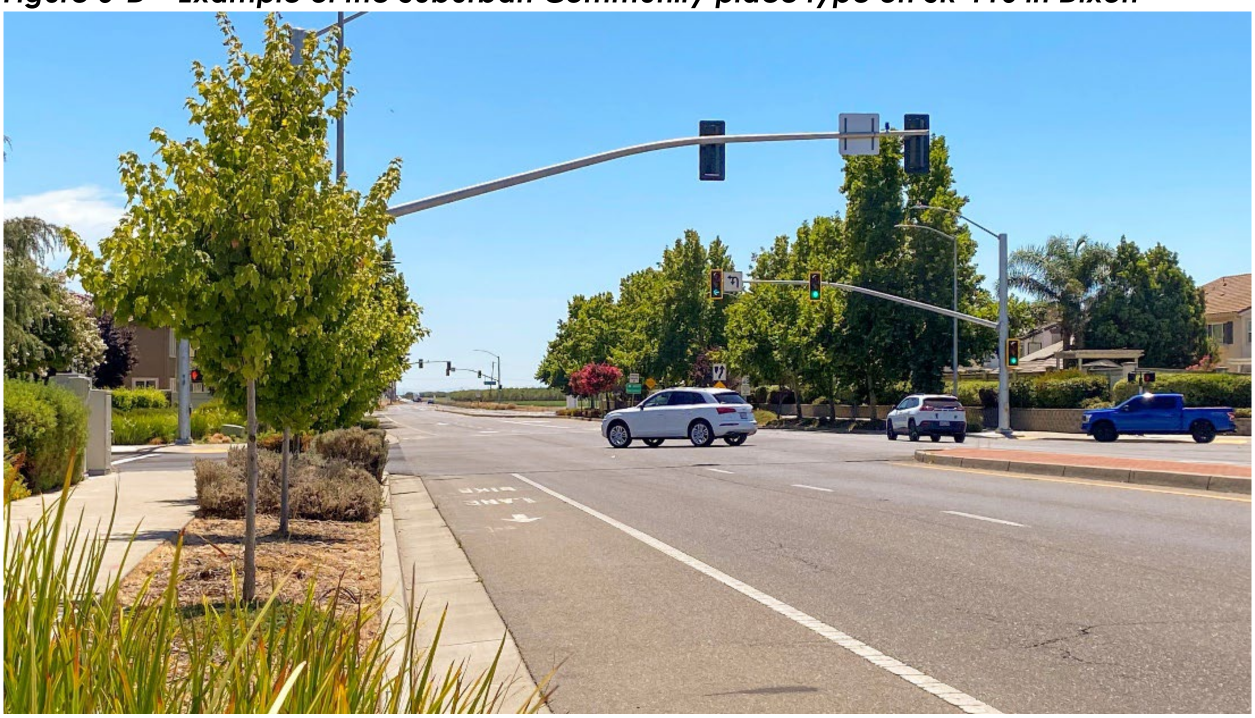
- Balancing the needs of varied users across a constrained roadway cross section, often through road diets or narrowing of vehicle lanes.
- Addressing congestion by improving active transportation, transit, and ride-sharing options.
- Implementing transit, transit-only lanes, or transit-priority features to enhance connections to multiple destinations.
- Developing a bicycle network that closes gaps and provides connections between State and local facilities.
- Enhancing pedestrian facilities to provide sufficient space for users and include landscaping, utilities, shade, furnishings, and marked or enhanced crossings.

Figure 3-C – Example of the Urban Community place type on SR-123 in Albany

(2) *Suburban Areas.* Suburban Areas are prevalent throughout California and their arterial roadways have traditionally been designed to accommodate high volumes of vehicles, and often include sidewalks, but not bicycle facilities. Complete Streets projects in Suburban Area communities may focus on:

- Connections to transit. These projects may include Mobility Hubs, which can provide a connection from Suburban Areas to other urbanized areas, first-mile/last-mile connections between communities and transit service, or transit service improvements, which may include transit stops, transit-only lanes, and transit-priority features.
- Retrofitting existing roadways to support densification, including the reconfiguration of moderate to high speed roads as multimodal corridors, consolidation of curb-cuts, incorporation of traffic calming and landscaping, and expansion of pedestrian facilities.
- Improving the comfort and safety of the multimodal network by adding separated bikeways to arterials, improving narrow sidewalks, closing gaps at ramps to controlled-access facilities, providing furnishings at transit stops, and installing landscaping and street trees.
- Supporting transit and carsharing through park and ride facilities and providing bus stop amenities.

Figure 3-D – Example of the Suburban Community place type on SR-113 in Dixon



(3) *Rural Areas*. The Rural Area place type applies to the low-density areas outside the built-up urban and suburban communities. Rural Areas can be further broken down into Rural Main Streets, Transitional Areas, and Undeveloped Areas. Single occupancy vehicle use is high in Rural Areas, but zero- or low-vehicle ownership households may exist here as well.

a) Rural Main Streets (Rural Towns). State highways in these areas are usually a conventional highway main street through the center of town, where they may be the only main street or one of several. Due to the variable nature of development, projects on Rural Main Street highway segments can be more complicated and costly than similar projects in less-developed rural settings. Complete Streets projects in this place type may include:

- Providing crossings for pedestrians and bicyclists.
- Providing bicycle and pedestrian facilities, whether in the form of sidewalks and bike lanes, or shared use paths.
- Incorporating transit into the highway environment and coordinating with agencies to provide appropriate amenities for transit users.
- Implementing traffic calming measures to achieve operating speeds that are desired by the community and support a walkable and bikeable town center.
- Addressing community desires for an attractive streetscape to support livability.
- Connecting Gateway Communities to nearby scenic resources with transit, shuttles, and multi-use trails. Gateway Communities are visitor-serving places situated near entries to national parks, recreational areas, and other scenic places.

Figure 3-E – Example of the Rural Main Street place type on SR-299 in Weaverville

b) Transitional Areas. State highways through the Transitional Areas between populated Rural Towns and Undeveloped Areas serve both inter-regional traffic and locals seeking to access services. The standards of this DIB do not apply to this place type; nevertheless, projects in these corridors may incorporate Complete Streets features. Traffic calming features may be employed to support the transition from high speed rural highways to low speed main streets and reinforce the lower posted speeds. Projects in Transitional Areas may include features of Complete Streets, such as:

- Providing separation for pedestrians and bicyclists users. Class I bikeways can be an efficient option to provide comfortable access for these users where moderate to high vehicle operating speeds are anticipated.
- Providing a roadway design that supports the reduction of operating speeds and incorporates traffic calming features as vehicles approach the Rural Main Street place type.

Figure 3-F – Example of the Transitional Area place type on SR-116 between Sebastopol and Graton

c) Undeveloped Areas. State highway projects in Undeveloped Areas have traditionally focused on efficient movement of vehicles and freight over long distances, but often the State highway provides the only connection between destinations for non-motorized users as well. The standards of this DIB do not apply to this place type; nevertheless, projects in Undeveloped Areas may incorporate Complete Streets features such as:

- Providing bicycle and pedestrian crossings and connections, including at interchanges and in the vicinity of schools and bus stops.
- Supporting transit, car-share, and ride-share through park-and-ride facilities and bus stop amenities.
- Providing connected access, either on the State highway or on a parallel route, for pedestrians and bicyclists. This may include separated multi use paths or shared shoulders. See discussion of Intercommunity Connectors in Section 3.2.2.

Figure 3-G – Example of the Undeveloped Area place type along SR-29 in Napa County

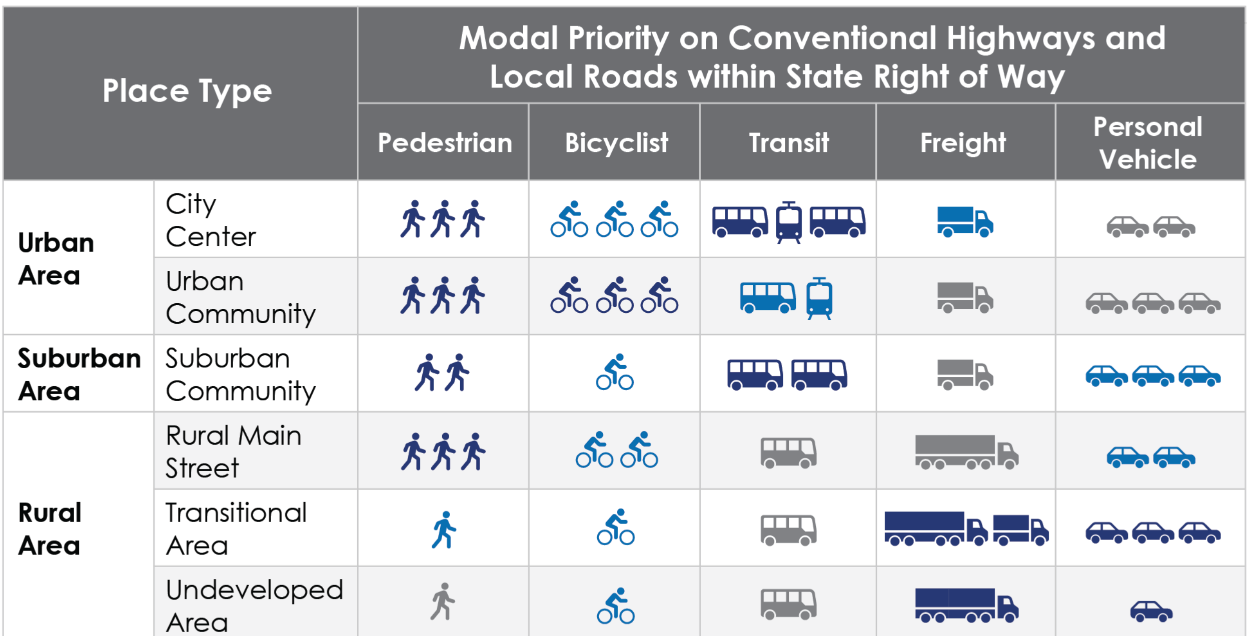
(4) *Special Use Areas and Protected Lands.* These place types generally have a character separate from their surroundings and a specialized land use. The standards of this DIB do not apply to this place type; however, improving bicycle/pedestrian and transit/shuttle infrastructure in these areas can help to minimize environmental impacts.

Figure 3-H – Example of the Special Use Area place type on SR-61 adjacent to the Oakland Airport

3.2 Prioritizing Modes

Caltrans accommodates all modes of transportation in accordance with our Vision, Mission, and Director's Policies. But, for the purpose of this DIB, the Complete Streets modal focus is relative to Complete Streets project segments, which are identified by place types. The place types defined in the previous section can help planners and designers understand the existing and anticipated types of users and intensity of use within a project segment. Furthermore, these generalized place types can be used to facilitate project designs that are in line with agency goals to provide comfortable, convenient, and connected facilities for all users of the SHS. Once the place type and potential users are identified, the existing roadway should be evaluated to determine if it is appropriately integrating those users. Table 3.2 illustrates the relative priority that different transportation modes should be given on the SHS by place type.

Table 3.2 Modal Priority



Place Type		Modal Priority on Conventional Highways and Local Roads within State Right of Way				
		Pedestrian	Bicyclist	Transit	Freight	Personal Vehicle
Urban Area	City Center					
	Urban Community					
Suburban Area	Suburban Community					
Rural Area	Rural Main Street					
	Transitional Area					
	Undeveloped Area					

Note:

Colors in this table indicate relative priority of modes in the given place type.

Number of icons indicate relative number of anticipated users in the place type.

Accommodating all users and modes within the SHS may necessitate trade-offs in the priority of modal improvements, appropriate to the place type. In accordance with DP-37, Complete Streets shift the project focus from vehicle movement to the movement of people and goods. In each place type, the Complete Streets project goal should give the highest priority to the modes indicated in dark blue. Modes in light blue and gray may be given less priority and trade-offs may be needed to best serve priority modes. This prioritization is generalized for conventional highways and local roads within the State right of way but may be adjusted based on local contextual criteria. For example, in an Urban Community the State highway may be used by an important transit line, while parallel local roads provide a comfortable and connected bikeway. These circumstances may lead the project development team, in consultation with the community, to prioritize transit above bicycle infrastructure on a highway segment. The intent of this guidance is to provide a starting point for the allocation of space within the State right of way.

3.2.1 Considering Road User Safety

The safety of pedestrians and bicyclists is a major consideration in setting modal priorities[22]. Bicyclists and pedestrians are two of the road users most susceptible to severe injury and death from crashes, and every traveler is ultimately a pedestrian, as each trip begins and ends on foot or on wheels[23]. Designing for pedestrians and bicyclists can create a roadway that is safer for everyone[24]. Consistent with the Safe System approach, facilities should be designed to "minimize the transfer of kinetic energy through the adoption of design elements that minimize crash speeds and impact angles"[25]. In addition to safety factors that can be quantified through crash data, designers may consider *perceived* safety. Comfortable, low-stress facilities can improve a user's perception of their own safety and accommodate walking, rolling, and biking for a broader range of ages and abilities. Often, when more people bicycle and walk, there is an increase in the safety of these user groups; this effect is commonly referred to as "safety in numbers"[26]. The presence of more pedestrians and bicyclists encourages motorists to look for these road users where they are prevalent. As such, designing for the widest range of users will best accommodate the majority of users[27].

Complete Streets provide connectivity to essential community destinations for all users, regardless of their transportation mode. To maximize the use of existing right of way where space is limited, space-efficient forms of mobility, such as walking, rolling, and biking, should be prioritized while also facilitating goods movement. To strike a balance among the transportation modes that use a specific facility, reallocation of roadway space may be necessary. The following are potential strategies for reallocating roadway space to accommodate bicycle and pedestrian facilities that may be considered[28]:

- Narrowing traffic lanes, including medians/turn lanes, when width is available
- Removing travel or turn lanes
- Removing parking on one or both sides of the street
- Converting angled parking to parallel parking

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[22] Director's Policy 36 "Road Safety" (DP-36)
[23] Transportation Research Board (TRB) NCHRP Research Report 1036: Roadway Cross Section Reallocation, 2022
[24] Marshall, W.E. and N.W. Garrick, Evidence on Why Bike-Friendly Cities Are Safer for All Road Users. *Environmental Practice*, Vol. 13, Issue 1, 2011, pp. 16-27
[25] Director's Policy 36 "Road Safety" (DP-36)
[26] Jacobsen, P. L. Safety in Numbers: More Walkers and Bicyclists, Safer Walking and Bicycling. *Injury Prevention*, Vol. 9, No. 3, 2003, pp. 205–209. Elvik, R. The Non-Linearity of Risk and the Promotion of Environmentally Sustainable Transport. *Accident Analysis and Prevention*, Vol. 41, No. 4, 2009, pp. 849–855. Marques, R. and V. Hernandez-Herrador. On the Effect of Networks of Cycle-Tracks on the Risk of Cycling: The Case of Seville. *Accident Analysis and Prevention,* Vol. 102, 2017, pp. 181-190
[27] Ohio DOT Multimodal Design Guide
[28] Ohio DOT Multimodal Design Guide

3.2.2 Modal Priority in Rural Areas

Rural Areas can be particularly challenging locations to incorporate Complete Streets facilities. Long distances, variable terrain, lower population density, and high vehicle speed may contribute to low volumes of active transportation users, making it difficult to achieve the effect of "safety in numbers" in Rural Areas. These factors also may require distinct design consideration in rural locations. Nevertheless, these areas are often home to equity priority populations and households with limited or no access to a vehicle. For these highway users, Intercommunity Connectors can play an important role. Intercommunity Connectors are segments of the SHS that link small rural communities to each other and to larger or more urban places. Often, they are the only route between destinations. These connectors are the rural highway type most likely to be used by pedestrians and bicyclists due to their function in linking residents to services, and their shorter average length. Along these corridors, consider providing a bicycle and pedestrian facility separate from the roadway and shoulder. Often, this will consist of a Class I bikeway along one side of the highway. Long distance bike routes are also important multimodal facilities that may pass through Rural Areas, where wide shoulders or Class I bikeways may provide the best access.

4.0 VEHICLE SPEEDS

Research has shown that vehicle speeds play a significant role in the safety and comfort of pedestrians and bicyclists. Setting the right speeds is a critical part of implementing the Safe System approach – encouraging drivers to operate at speeds appropriate to the place type. Place type can be used to help identify appropriate speeds for a project segment. For example, Urban Areas would have lower speeds due to the numerous users and types of use (e.g., pedestrian crossings, driveways, street parking) that occur together. There may be additional factors within a project segment or place type that indicate the need for further speed management such as business activity districts, school or senior zones, or crossing locations. This section discusses speeds considered in project design and introduces the concept of proposed operating speeds specific to Urban Areas, Suburban Areas, and Rural Main Streets.

4.1 Proposed Operating Speed

Considerations of speed in highway design have traditionally focused on the development of corridor geometrics to support a set design speed for motorists. However, to address the diversity of users in Urban Area, Suburban Area, and Rural Main Street place types, a proposed operating speed should also be identified. The proposed operating speed, also referred to as target speed, is the speed at which the community expects drivers to operate their vehicles consistent with local goals for streets that support multimodal travel and community livability. The selected proposed operating speed for the roadway may be used to identify various design elements during the planning and project development process. In some cases, taking measures to lower the operating speed can encourage walking, rolling, and biking by improving comfort, while reducing fatalities or serious injuries. Table 4.1 lists the recommended ranges of proposed operating speeds based on place type.

Overall understanding of the relationship between design, posted, operating, and proposed operating speed will provide designers with deeper perspective in considering the trade-offs of design elements that may affect the safety and comfort of all users of the facility, and especially those walking and biking. For definitions of design speed, operating speed, and posted speed, refer to HDM Index 62.8(13). For more information regarding the selection of these speeds, refer to Chapter 100 of the HDM. Whereas the design speed may be higher than the posted speed, to account for those vehicles exceeding the 85th percentile, a proposed operating speed may be lower than the current posted speed.

Determining the proposed operating speed involves communicating with the local community to understand users and preferences, as well as consideration of multimodal activity, adjacent land uses, and mobility choices. The community may also help the PDT identify areas on the corridor that need more attention with regards to speeding and safety. The proposed operating speed should be selected for the entire corridor to encourage a consistent speed profile appropriate for the place type context and discourage sharp acceleration or decelerations by users. The PDT should consult law enforcement agencies, local agencies, local communities, and transit agencies and take into consideration their recommendations. These consultations are critical to learning local perspectives regarding existing and future land use, road user expectation, nonapparent conditions, collision history, and feedback on potential speed changes.

Where the proposed operating speed is lower than the current posted speed, speed management treatments or appropriate geometric design elements may be considered to help achieve the proposed operating speed. Selecting a proposed operating speed without design elements to encourage travel at the slower speed can result in higher than desired operating speeds. While introducing the design elements that are addressed in this DIB may help reduce existing operating speeds, further speed management strategies may also be necessary to consider. Refer to the Caltrans “Traffic Calming Guide” for more information.

Until additional research is conducted on the combined effects of individual speed management treatments, speed management will be an iterative process and a single project may not reduce the speed immediately to the proposed operating speed.

Ultimately, the District/Region will decide what is a reasonable proposed operating speed based on all factors and considerations.

Table 4.1 Ranges of Proposed Operating Speed by Place Type for Conventional Highways in California

Place Type	Proposed Operating Speed Recommended Ranges	Discussion
Urban Area – City Center	25 mph or below	City Centers may include business activity districts with prima facie speed limits of 20 or 25 mph. Condensed right of way may lead to various user types sharing roadway and sidewalk space.
Urban Area – Urban Community	25 – 35 mph	Schools, senior centers, high pedestrian crossing volumes, frequent bus stops, and restricted sight distances are examples of shorter segments that indicate a need for lower operating speeds along a corridor.
Suburban Area	30 – 45 mph	Suburban Areas transitioning to Urban Areas, and spot locations such as schools or community facilities with higher pedestrian usage, may benefit from lower operating speeds.
Rural Main Street	25 – 35 mph	Rural Main Streets may lack the developed infrastructure that provides clearly defined, separated spaces for pedestrians and bicyclists, and thus would require a lower operating speed.

4.2 Place Type Transitions

Transitions will occur between the place types identified in Section 3.1. It may be helpful for communities to work together with the PDT to identify the locations of these transitions. Gateway treatments may help drivers acknowledge the transition. Visual cues that alert drivers to the change in context are important. Speed management and traffic calming measures could be used to achieve the speed reduction from high speed to low speed facilities. Speed management is particularly important for Rural Main Street place types, which may include a rapid transition from a high speed to low speed environment. For rural communities, refer to AASHTO Green Book, Chapter 7.2.19 Speed Transitions Entering Rural Towns for more information[29].

[29] AASHTO A Policy on Geometric Design of Highways and Streets, 7th Edition, 2018

5.0 ROADWAY CROSS SECTION DEVELOPMENT

In Urban Areas, Suburban Areas, and Rural Main Streets, the public right of way is almost always constrained, and designing within constraints necessitates trade-offs. Planners and designers should recognize that every element in a street cross section is an important choice. This section provides flexibility in making those choices to support the design of Complete Streets that serve all users. The underlined standards of this section are reflective of the constrained highway environment.

The project cross section should be developed with consideration of community goals, land use and community destinations, and an understanding of the corridor's role within the transportation network. The place types and modal priorities discussed in Section 3 of this guidance should be evaluated for each project segment. Planners and designers should seek and consider community input with regards to users, destinations, and proposed speed in the corridor. Consideration of whether the project can allow for reconstruction and relocation of curbs, or whether the project is limited to resurfacing and restriping, will influence the cross section design. In some cases, an interim design solution can offer near-term improvements, but wherever possible, project designs should support the ultimate goal of the community. Roadway design and right of way allocation are powerful tools that directly impact safety, equity, climate resiliency, livability, and economic prosperity.

This section provides guidance on best practices for Complete Streets, but it also provides design flexibility in the form of revised standards from the HDM for Complete Streets in Urban Areas, Suburban Areas, and Rural Main Streets. The following sections outline considerations for reducing the width of vehicle traffic lanes and shoulders to provide more comfortable and lower stress facilities for bicyclists and pedestrians. This approach is consistent with the Caltrans' adoption of the Safe System approach. Repurposing vehicle lane space for bicyclists generally leads to increased perceived safety for bicyclists. And while increases in the numbers of bicyclists may lead to an increase in the overall number of crashes involving bicyclists, the number of crashes per bicyclist decreases. For pedestrians, increased sidewalk width and buffer space tend to increase comfort and perceived safety. Additionally, reduced pedestrian crossing lengths— particularly if there are fewer lanes to cross, not just narrower lanes—reduces pedestrian exposure to vehicles and decreases crossing time. Greater perceived and objective safety, as measured by a reduction in crashes, can encourage walking, rolling, and bicycling. In contrast, removing traffic lanes may lead to lower motorist volumes[30]. Thus, the guidance and standards discussed in this section can help achieve the goal of developing comfortable, convenient, and connected facilities on the SHS.

This DIB offers a range of considerations for each design element within different contexts. The ability to select from a range of choices is not indicative of nor encouraging a default selection of either the minimum or the maximum. The range of choice allows for the flexibility to thoughtfully integrate these elements into each project given its unique context. After identifying current and potential users of the facility, the priority and needs of the different classes of users may be ranked. Common community destination routes that currently exist or that are proposed in local plans should be identified. Rather than beginning the design by identifying the minimum required dimensions for each cross section element to piece them together, the practitioner should utilize performance-based decision making tools, such as the HSM guidance and methodologies, to compare and select roadway cross section configuration(s). The Project Guidance for Performance-Based Decision-Making Using Highway Safety Manual Memorandum

[30] TRB NCHRP Research Report 1036: Roadway Cross Section Reallocation, 2022

establishes the guidance for utilizing the HSM guidance and methodologies on projects[31]. The selected roadway configuration(s) should provide a safe environment for all road users while balancing all users' needs.

5.1 Bicycle Facilities

5.1.1 Bicycle Facility Standards

The four types of bikeway classifications used in California:

(a) Class I Bikeway (Bike Path)
(b) Class II Bikeway (Bike Lane and Buffered Bike Lane)
(c) Class III Bikeway (Bike Route)
(d) Class IV Bikeway (Separated Bikeway)

See Chapter 1000 in the HDM and the California Manual on Uniform Traffic Control Devices (CA MUTCD) Part 9 for definitions and additional guidance on bikeways[32]. Refer to DIB 89 for more information on Class IV bikeways[33].

Bicycle facility selection is an important step in creating a connected, convenient, and comfortable bicycle network. In a memorandum issued on June 30, 2020, the Division of Design adopted the FHWA Bikeway Selection Guide (with some textual exclusions) as a resource for supplemental guidance to assist transportation practitioners with making informed decisions about trade-offs relating to the evaluation and selection of bikeway facility types[34]. Below are some of the factors to consider:

- Place type including Urban Areas, Suburban Areas, and Rural Main Streets as discussed in Section 3.1 of this DIB
- Environment including unique climate conditions like snow or heat, topography, landscape
- Equity, community desires, and identity
- Physical constraints including right of way width
- Average daily traffic (ADT), speed, and volume of users
- Maintenance considerations
- Barriers such as railroads and waterways

Maintaining a comfortable, convenient, and connected bicycle facility is the key goal. Designers should adapt the design of the bicycle facility to match changing site conditions throughout each project segment. Design flexibility allows for transition between facility types as designers encounter constraints like pinch points, speed transition zones, bus transit stops, popular destinations, and other unique site conditions.

The facility selection process begins by identifying opportunities to provide the most physical separation for bicyclists. Figure 5-A Recommended Bicycle Facilities should be reviewed and evaluated for the speeds and ADT of the existing route. Tables 5.1.1-5.1.4 will aid in understanding the dimension requirements for each type of bicycle facility. Class I and Class IV bikeway facilities are to be the first considerations for the facility to maximize the benefit of horizontal and vertical separation whenever feasible. If constraints do not allow for those facility types, consider Class II buffered bike lanes then

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[31] Project Guidance for Performance-Based Decision-Making using the Highway Safety Manual Memorandum, 2022
[32] HDM Chapter 1000, CA MUTCD Chapter 9
[33] DIB 89 Class IV Bikeway Guidance
[34] Bikeway Facility Selection Guidance Memorandum, 2020

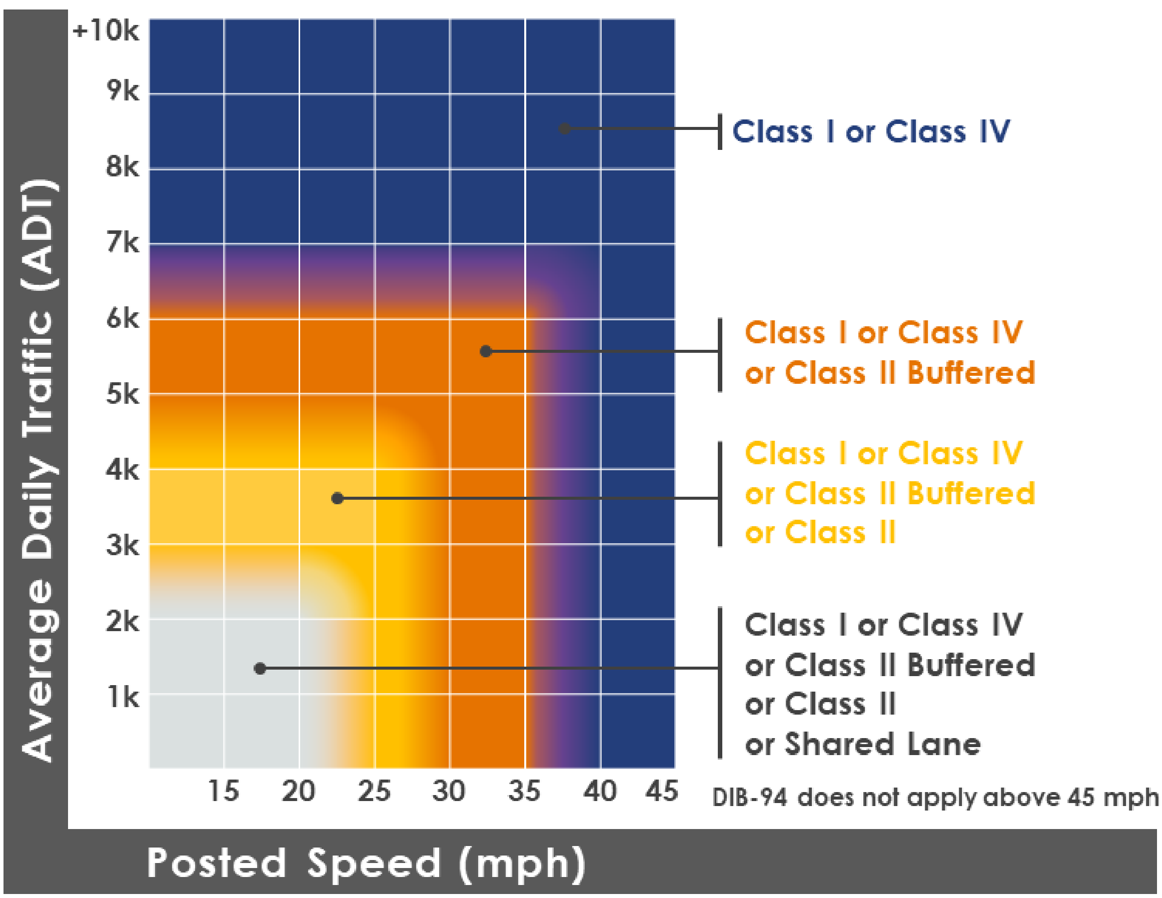
Class II bike lanes in order of priority. The selection of a facility with less vertical or horizontal separation, or the use of a narrower bikeway width, is likely to decrease comfort and functionality, making the bikeway less appealing to some bicyclists. In general, Class III facilities should only be considered for limited distances, as an interim measure, at locations where very low volumes of bicyclists are anticipated, or where the value of providing a constrained facility outweighs the option of providing no facility at all. Once the most appropriate bicycle facility has been identified for each segment of a project, the transitions between any facility changes may be designed. Tables 5.1.1, 5.1.2, 5.1.3, and 5.1.4 provide the recommended ranges for bicycle traveled ways that should be applied to the respective bikeway classifications. Designers should strive to provide a usable traveled way width within these ranges to the maximum extent feasible. The values within the recommended range will be optimal for most locations. The practical maximum value or range should only be considered when bicyclist volumes are high and there are clear benefits. When space is available for a maximum value, there may be other options for the use of that width, such as additional bike lane buffer space or wider sidewalk.

Widths approaching the minimum values should be considered only for short distances and where the benefit of providing a narrow facility outweighs the alternative of no facility at all.

The minimum bikeway width should be as indicated in the underlined text in Tables 5.1.1, 5.1.2, 5.1.3, and 5.1.4.

The following sections provide more details about each bicycle facility type.

Figure 5-A - Recommended Bicycle Facilities for Urban Areas, Suburban Areas, and Rural Main Streets



5.1.2 Class I Bike Path

Figure 5-B - Class I Bike Path

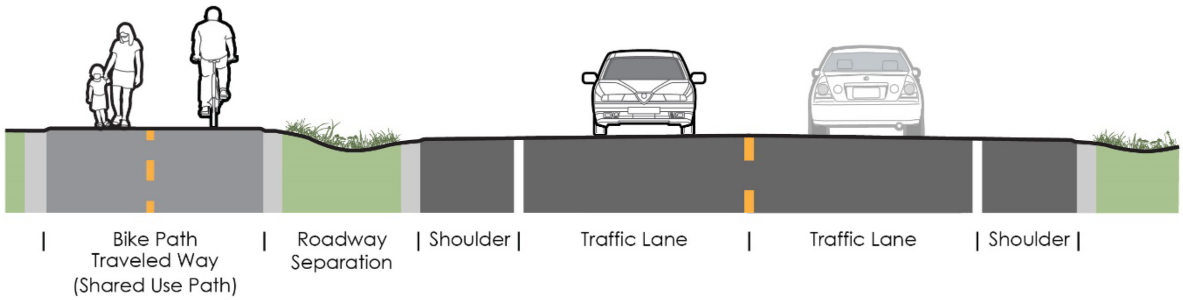


Table 5.1.1 Standard Bicycle Traveled Way Widths (Class I)

Bicycle Facility Placement	Minimum (ft)	Preferred (ft)	Practical Maximum (ft)
One Way	6-7	7	8
Two Way	10-12	10-12	12-15
On structures between railings and in tunnels (one or two way)	10-14	10-14	15
At sidewalk level	12-16	12-16	20

Advantages:

- Class I facilities are shared between pedestrians and bicyclists allowing for a single path to meet the needs of both user groups.
- Class I facilities have wide horizontal separation between vehicles and pedestrians and bicyclists. They are well suited for corridor segments with higher speeds as the separation offers a higher level of comfort for pedestrians and bicyclists.

Considerations for Use:

- Consider if specific pavement markings and striping are necessary. Refer to the CA MUTCD Section 9C.03 for these requirements.
- Designing for Americans with Disabilities Act (ADA) pedestrian accessibility is required. See DIB 82.

In busy areas with a variety of users, a total paved width of 12 to 15 feet plus shoulders is recommended. One-way bike paths in these settings should have a minimum width of 7 feet.

Consideration should be given to how people with different modes will use the Class I bike path. Space should be provided for people to walk or bicycle two-abreast and for faster users to pass lower speed users. The social aspect of walking, rolling, or biking together can create a comfortable and inviting facility for users. Marking a centerline may discourage side by side use. Unmarked paths also allow for peak volumes of directional traffic that fluctuate throughout the day including routes to and from schools or commute routes. However, striping may be preferred when bicycle and pedestrian volumes are higher or when the paved width is wider. In this case, if the path is wide enough to dedicate separate spaces for pedestrians and bicyclists to prevent conflicts, striping may be considered. Figure 5-C shows a Class I facility with a striping configuration that considers pedestrian use.

Figure 5-C - Class I bikeway along I-5 and San Elijo Lagoon in San Diego County

If the Class I bike path is to be added adjacent to an existing roadway with a nonstandard shoulder width, check with Asset Management if there is a plan for future work to widen the shoulder to standard width. If there is future work, place the Class I bike path edge of traveled way at least 5 feet from the future edge of shoulder to accommodate future widening. If no future work is identified and the probability is low for nonstandard shoulder improvements, then place the Class I bike path edge of traveled way at least 5 feet from the existing edge of shoulder.

Within the separation, there is an opportunity to include landscaping elements. When selecting plants, consider maintenance and irrigation needs. Consult with the District Maintenance and Landscape Architect for design and maintainability concepts. Class I bike paths also work when an existing drainage ditch is present adjacent to the roadway. The ditch can be left in place or minimally impacted while serving as part of the required separation.

Class I bike paths are pedestrian facilities and ADA access is required. Please review and comply with DIB 82 Pedestrian Accessibility Guidelines for Highway Projects.

For Roundabout shared use paths see HDM Index 405.10.

<u>The minimum separation between the edge of traveled way of a one-way or a two-way Class I bike path and the edge of traveled way of a parallel road or street should be 5 feet plus roadway standard shoulder width per Section 5.4 of this DIB.</u>

<u>Class I sidewalk level facilities should provide a separation from vehicles as described in guidance for Class IV bikeways at sidewalk level in DIB 89 Section 3.3.</u>

For other geometric design requirements, refer to HDM Index 1003.1 for Class I bike path standards.

Urban Area Contextual Guidance and Considerations

Class I bike paths may not be a feasible option in urban environments due to constrained space. Additionally, separate bicycle and pedestrian facilities are generally more desirable in urban settings because of high volumes of users.

Suburban Area Contextual Guidance and Considerations

Suburban Area place types typically have higher vehicle speeds than Rural Main Streets and Urban Areas. If pedestrian and bicyclist volumes are low to moderate and space allows, Class I bike paths are an option that can serve both pedestrians and bicyclists and may provide a more comfortable user experience.

Rural Main Street Contextual Guidance and Considerations

Class I bike paths should be considered first if the community desires separated facilities for pedestrians and bicyclists and the corridor has the physical space for the separation.

Also, when a rural town wants to preserve its natural character, an unmarked Class I bike path may blend in better with the original environment than the alternative bicycle and pedestrian facilities.

Class I bike paths may be an appropriate choice for developing Transitional Areas between Undeveloped Areas and Rural Main Streets.

5.1.3 Class II Bike Lanes and Class II Buffered Bike Lanes

Figure 5-D - Class II Bike Lane and Class II Buffered Bike Lane

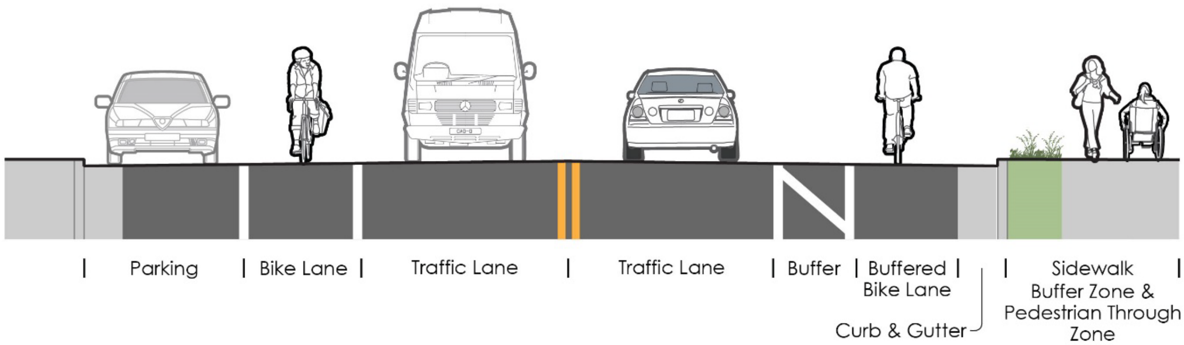


Table 5.1.2 One Way Standard Bicycle Lane Widths* (Class II, Class II Buffered)

Bicycle Facility Placement	Minimum (ft)**	Preferred (ft)	Practical Maximum*** (ft)
Adjacent to edge of pavement	5-7	6-7	8
Adjacent to curb	5-7	6-7	8
Between through lanes and turn lanes	5-7	6-7	8
Adjacent to buffers	4-7	5-7	8
Adjacent to parking	5-7	6-7	8

* Exclusive of the gutter.
** At posted speeds greater than 40 miles per hour, the minimum bike lane width should be at least 6 feet.
*** If the available pavement width is 7-feet or wider, consider providing a 5-foot minimum lane width with 2-foot minimum buffer.

When provided, buffers adjacent to Class II bike lanes should be a minimum of 2-foot width, 2 to 4 feet preferred.

Advantages:

- Class II bike lanes can be implemented more easily within the corridor given their narrower required width compared to Class I or Class IV bikeways while providing exclusive use for bicyclists.
- Class II bike lanes without buffers offer the smallest footprint among the different classes of bicycle facilities.
- Where space may be prioritized for sidewalks or where the community has a strong desire to maintain street parking, Class II bike lanes offer the most flexibility given their reduced bikeway lane width requirements.

Considerations for Use:

- Class II bike lanes are recommended for roadways posted 25 mph and under. Class II bike lanes with buffers are recommended for roadways posted 35 mph and under.
- Where feasible, painted buffers between the traffic lane and bike lane to maximize separation should be provided.
- For corridors where posted speeds are 40 to 45 mph, Class II and Class II buffered bike lanes are not recommended. However, where a separated facility is not feasible, consider a Class II bike lane with a minimum 4-foot buffer.
- Where Class II bike lanes are located adjacent to on-street parking, a buffer between the bicycle lane and the parking lane should be provided. The width of the door zone buffer may vary from 2 to 4 feet.

If Class I bike paths and Class IV separated bikeways cannot be accommodated due to space, cost, or maintainability, Class II buffered bike lanes or Class II bike lanes may be considered. These bike lanes do not require vertical separation and are comprised of striping and pavement markings only, making them less expensive and potentially easier to maintain. An example of a Class II bike lane is shown in Figure 5-E.

Class II bike lanes, with and without buffers, are desirable in constrained environments. When considering these two bicycle facilities, first consider a Class II buffered bike lane to maximize separation. An example of a buffered Class II bike lane is shown in Figure 5-F. If the buffer cannot be accommodated, consider the Class II bike lane. Because Class II bike lanes with buffer and Class IV separated bikeways have similar footprints, consider designing Class II bike lanes with buffer to accommodate potential future upgrade to a Class IV separated bikeway.

One alternative to consider is placing the bicycle traveled way between the on-street parking and the sidewalk. This configuration turns the Class II bike lane into a Class IV separated bikeway with the parked cars providing the required vertical element. However, site constraints like parking removal to provide sight distances from driveways may make this Class IV separated bikeway option undesirable.

If designing Class II bike lanes between on-street parking and vehicular traffic lanes, additional pavement width may be used to provide buffers on both sides of the bicyclists. If space is not available for a marked buffer next to parked cars, consider adding extra width to the bike lane for the bicyclist to avoid open doors. The CA MUTCD provides options for marking the shy space next to parked cars to mitigate for opening doors.

Where driveways are present, especially at locations of higher traffic volumes like those at commercial shopping centers, consider additional pavement markings in the bike lane to highlight these conflict zones.

Urban Area Contextual Guidance and Considerations

When right of way is constrained and on-street parking is not provided, or when priority is given to wider pedestrian sidewalks, a Class II bike lane may be the most feasible option.

Suburban Area Contextual Guidance and Considerations

Vehicle speed is typically higher in suburban area place type locations than other place type locations. If a Class I bike path or Class IV separated bikeway cannot be accommodated, a Class II buffered bike lane offers increased separation. Since space in Suburban Areas is typically not as constrained, provide the widest bike lane width and buffer as is feasible.

Rural Main Street Contextual Guidance and Considerations

In lower speed Rural Main Street place types, Class II buffered bike lanes and Class II bike lanes may be the most feasible dedicated bicycle facility.

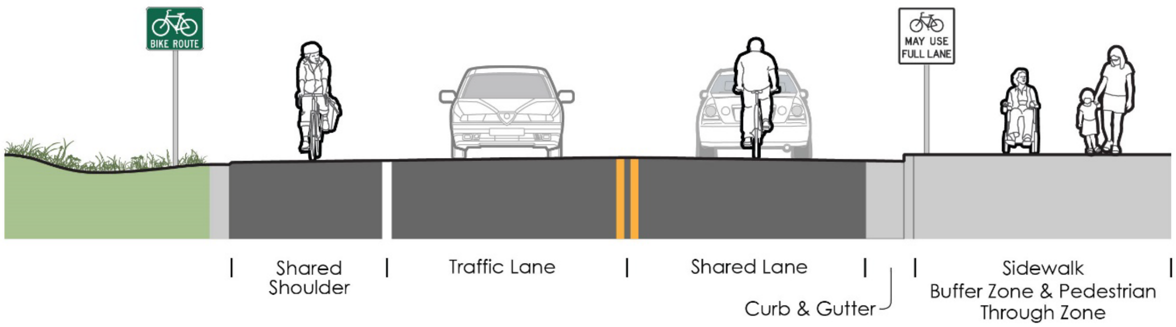
Class II buffered bike lanes are an alternative to Class I bike paths for Transitional Areas between Undeveloped Areas and Rural Main Streets where posted speeds do not exceed 40 mph.

Figure 5-E – Class II bike lane on SR-16 in Esparto

Figure 5-F – Buffered Class II bike lane on SR-135 in Los Alamos.

5.1.4 Class III Bike Route

Figure 5-G - Class III Bike Route (Shared Lanes and Shared Shoulders)



Advantages:

- For Rural Main Streets, Suburban Area, and Urban Area place types, the main purpose of shared lane Class III bike routes is to bridge a short gap between Class I, Class II, or Class IV bikeways for the sake of network connectivity. For Rural Areas not covered by the standards in this DIB, a shared shoulder Class III bike route would typically be a highway shoulder designated and signed for the shared use of motor vehicles and bicyclists. Class III bike routes that are designated shared sidewalks that cannot be constructed as Class I or Class IV bikeways should only be used when there is no feasibility of obtaining the necessary right of way width to construct dedicated bicycle and pedestrian facilities.

Considerations for Use:

- Class III bike routes are not considered a dedicated bicycle facility for the purposes of applying this DIB design standards to a project.
- Class III bike route linear footage does not count towards performance targets for bicycle and pedestrian facilities in the SHSMP.
- Class III bike routes do not offer exclusive use for bicyclists. When bicyclists are required to share a lane with motor vehicles, their comfort and perceived safety will vary widely based on traffic speed and volume. Therefore, shared lanes should only be used in very low speed and volume locations and should be a last resort when there are no other viable alternatives for redistributing space within the cross section.
- Review Figure 5-A for speed and ADT considerations before determining if Class III shared lanes are an appropriate alternative if they are required to provide route connectivity.
- If it is more appropriate for bicyclists to share the sidewalk with pedestrians than to share the lane with motor vehicles, ample signage should be provided to help pedestrians be aware that bicyclists are allowed. Under this condition, evaluate if the sidewalk is wide enough for both pedestrians and bicyclists to comfortably navigate around each other. Within many local agency jurisdictions, bicyclists may legally operate on a sidewalk with pedestrians, and the facility is not necessarily designated as a Class III bike route.
- Unlike Class I, Class II, and Class IV bikeways, the Class III bike route is not a dedicated facility for bicyclists. However, a Class III bike route provides the signage and pavement marking with the goal of bringing extra awareness to drivers that bicyclists are present and sharing the roadway. An example of a Class III bike route in a low speed environment is shown in Figure 5-H.

Refer to HDM Index 1002.1(4) and Index 1003.3 for more details. Also refer to the CA MUTCD Part 9.

Figure 5-H - Class III bike route on SR-29 in Calistoga

Urban Area Contextual Guidance and Considerations

A Class III bike route shared shoulder space will likely not be an option because a Class II bike lane would be the minimum solution for providing a bicycle facility. Sharing the lane or sidewalk would be the last resort when there are no other viable alternatives for redistributing space within the cross section.

Suburban Area Contextual Guidance and Considerations

Generally, a suburban environment would have the space required to put in a minimum Class II bike lane. However, for short gaps along the corridor where the right of way is extremely restrictive and shoulder space may be prioritized for other uses such as on-street parking or bus transit facilities, then a Class III bike route shared lane may be considered.

Rural Main Street Contextual Guidance and Considerations

Class III bike routes are one potential solution to pinch points and gaps between other classes of bicycle facilities where the other facilities will not fit on Rural Main Streets.

In Undeveloped and Transitional Areas that connect to Rural Main Streets, Class III bike routes as shoulders shared with motorists may be considered for the low volume of bicyclists if no other bicycle facility options are feasible. When deciding to designate shared shoulder usage, the width and condition of the shoulder must be evaluated. If standard shoulder widths are provided and the pavement is in good condition sharing the shoulder may be an acceptable option because it will provide the bicyclist with a space that vehicles are not expected to normally travel on.

5.1.5 Class IV Separated Bikeway

Figure 5-I - Class IV Separated Bikeway

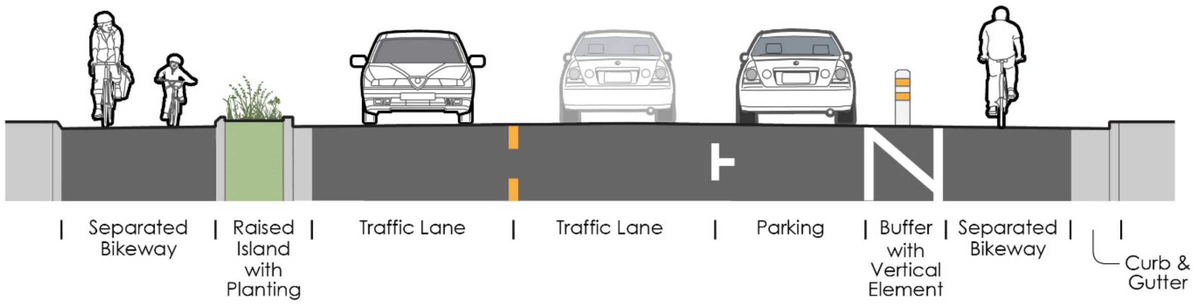


Table 5.1.3 One-Way Standard Bicycle Traveled Way Widths* (Class IV)

Bicycle Facility Placement	Minimum (ft)	Preferred (ft)	Practical Maximum (ft)
Between curbs if a raised island is the separation	6-9	7-9	10
Between curb and buffer	5-8	6-8	9**
Between curb and parking buffer	5-8	6-8	9**
Between edge of pavement and buffer, curb, or parking buffer	4-7	5-7	8**
Between through traffic lane and right turn lane	4-7	5-7	8

* Exclusive of the gutter.
** If additional pavement width is available, consider wider traveled way for high bicycle volumes (above 400 peak hour), or wider buffer or parking separation width for average bicycle volumes (below 400 peak hour).
Note: For horizontal buffer and vertical separation guidance, refer to DIB 89.

Table 5.1.4 Two-Way Standard Bicycle Traveled Way Widths* (Class IV)

Bicycle Facility Placement	Minimum (ft)	Preferred (ft)	Practical Maximum (ft)
Between curbs	10-14	12-14	16
Between curb and buffer	9-12	10-12	14**
Between curb and parking buffer	9-14	10-14	16**
Between edge of pavement and buffer, curb, or parking buffer	8-11	9-11	14**

* Exclusive of the gutter.
** If additional pavement width is available, consider a wider traveled way for high bicycle volumes (above 400 peak hour), or wider buffer or parking separation width for average bicycle volumes (below 400 peak hour).
Note: For horizontal buffer and vertical separation guidance, refer to DIB 89.

Advantages:

- Class IV separated bikeway is suitable for all place types.
- Class IV separated bikeway is the only class of bicycle facility that requires an element of defined vertical separation between bicyclists and vehicles. They are well suited for corridor segments with higher speeds as the vertical separation offers a higher level of comfort for pedestrians and bicyclists.

Consideration for Use:

- Class IV separated bikeway is most appropriate for higher speed and/or higher traffic volume environments.
- A wide range of vertical elements can be selected for the buffered area allowing for customization and contribution to a sense of place.
- Provide a continuous detectable element or vertical separation between bikeway and pedestrian through zone.

Class IV separated bikeways can provide comfortable facilities for all users because of the enhanced separation with a vertical element. Some vertical elements may function as a barrier between the bicyclists and the vehicles, such as the landscape area shown in Figure 5-J, or the sidewalk and buffer shown in Figure 5-K. Other vertical elements, such as the delineators shown in Figure 5-L and the plastic “armadillos” shown in Figure 5-M, serve to bring additional awareness to drivers of the adjacent bikeway. Depending on the project’s context, choosing the appropriate vertical element may require community and maintenance input. Selection of the type of vertical element should be evaluated based on its effectiveness in providing visibility and durability while considering reasonable maintenance needs. Parking separation, as shown in Figure 5-N, may not require the installation of additional vertical elements. Additionally, community involvement should be engaged regarding the visual impact certain types of vertical elements will bring to the landscape. Vertical elements can enhance the visual environment. The District Maintenance Engineer and Landscape Architect should be contacted for support in the design and maintainability of these features. Additionally, green streets elements should be reviewed in Section 8 for consideration as the vertical element.

For more information, refer to DIB 89 and the FHWA Separated Bike Lane Planning and Design Guide.

Urban Area Contextual Guidance and Considerations

Urban environments generally have lower vehicle speeds yet much higher traffic volumes which makes selecting a Class IV separated bikeway very desirable. On-street parking is commonly allowed in Urban Area place types. In these locations, the parking lane may be used as the vertical separator between the traffic lane and bikeway. Selecting vertical elements with more separation will provide a higher level of perceived safety and comfort thereby encouraging bicyclists of all competencies to utilize the bikeway. If a particular Urban Area already has or is expected to have high volumes of pedestrians and/or commuters, providing this type of Class IV separated bikeway may potentially help relieve congested pedestrian traffic.

Suburban Area Contextual Guidance and Considerations

For segments that are longer, uninterrupted by driveways, and do not allow on-street parking, consider selecting vertical elements that provide more visibility to drivers and are more permanent. Also, various combinations of different elements may be explored. When approaching driveways, either the Class IV separated bikeway may be transitioned to a buffered facility without vertical elements or vertical elements that provide sight distances for drivers can be utilized.

Rural Main Street Contextual Guidance and Considerations

For speeds of 35 mph or below and lower traffic volumes, consider flexible vertical delineators or curbs. For sections of similar or higher speeds with higher traffic volumes or truck volumes, consider vertical elements that are taller and more durable.

Figure 5-J – Landscape separates the Class IV separated bikeway from the roadway adjacent to US-101 in Carpinteria

Figure 5-K – A raised Class IV separated bikeway connects to an overcrossing over US-101 in Belmont

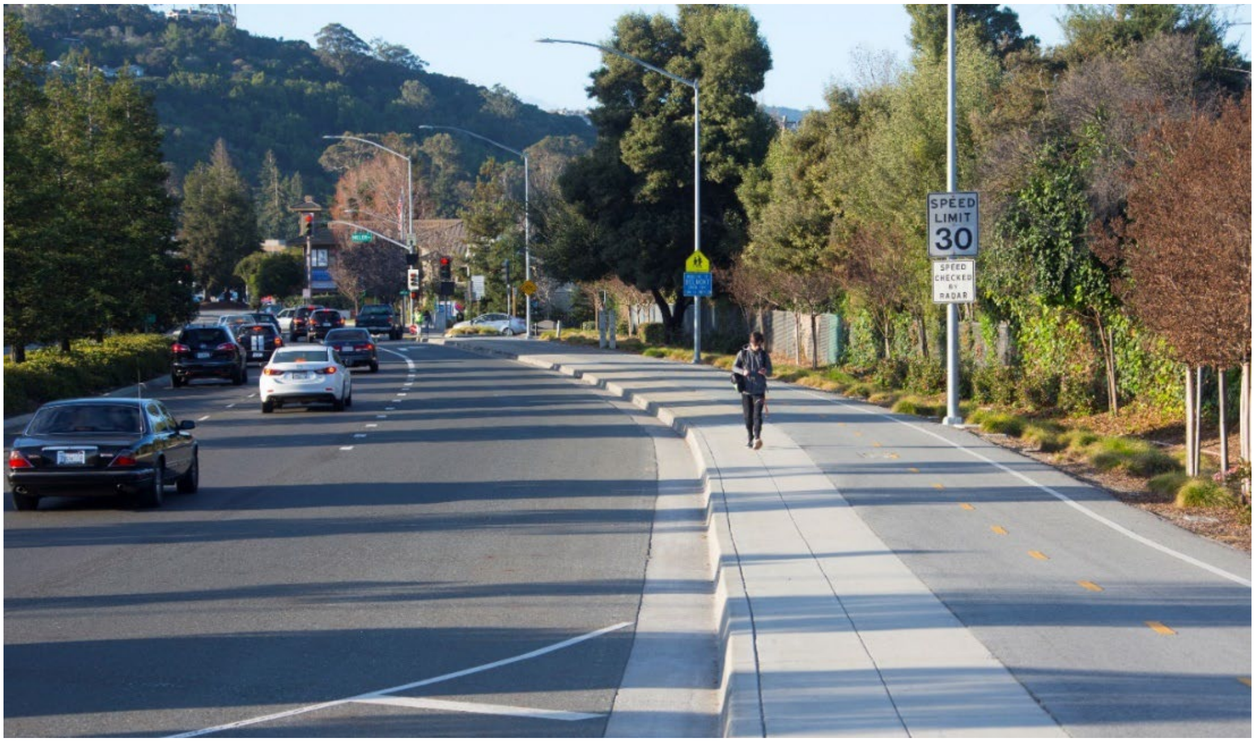


Figure 5-L - Delineators provide vertical separation on a suburban segment of SR-126 in Fillmore

Figure 5-M – Plastic "armadillos" and planters were piloted on SR-150 in Ojai

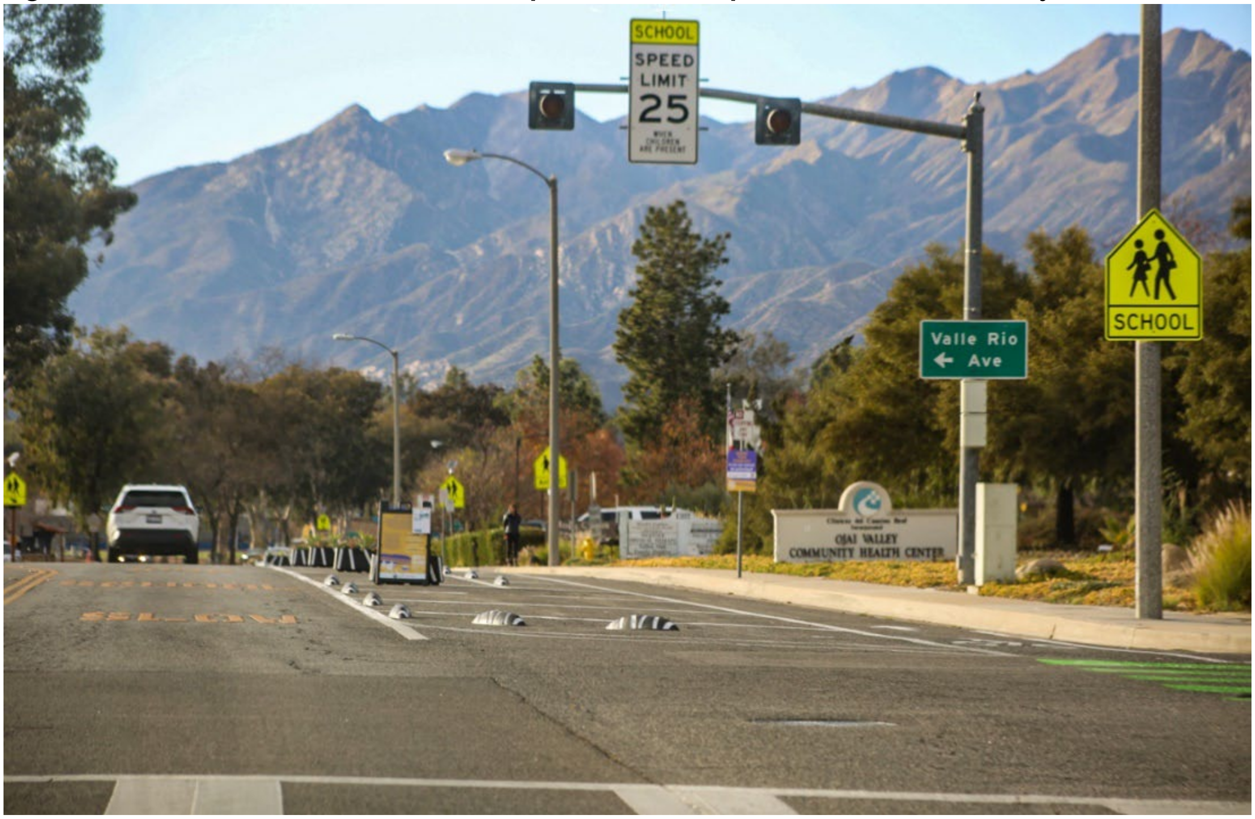


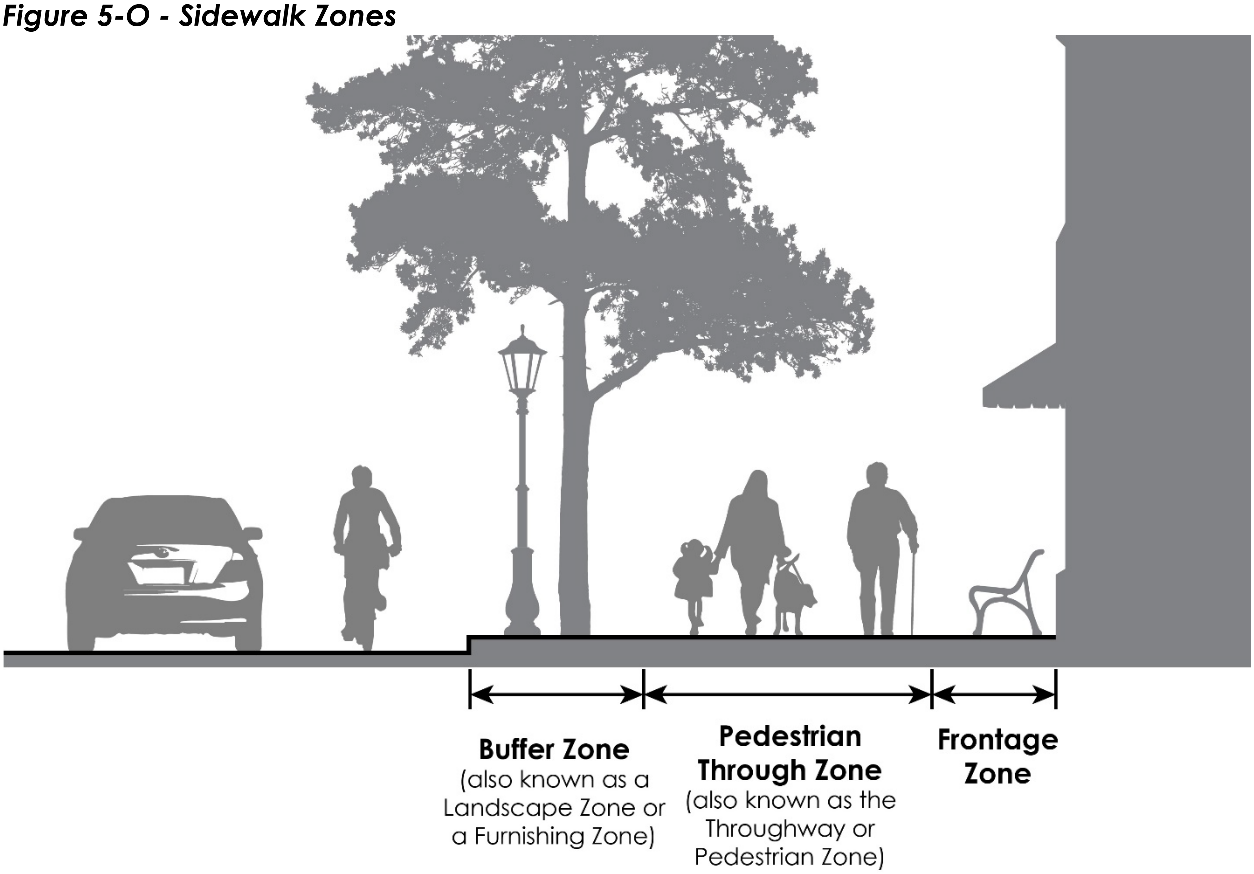
Figure 5-N – Parking-separated Class IV separated bikeway on SR-41 in Atascadero

5.2 Pedestrian Facilities

On the SHS, sidewalks and walkways are designed for the exclusive use of pedestrians. While pedestrians may be permitted access to highway shoulders, these are not required to be designed to meet accessibility standards. Additionally, although many local jurisdictions permit bicyclists to ride on the sidewalk, it would not be considered a bikeway unless designated as such in a bicycle master plan. This section will focus on design considerations for sidewalks in Urban Area, Suburban Area, and Rural Main Street place types. For design and planning purposes, sidewalks may be divided into three general zones, as depicted in Figure 5-O:

1. The buffer zone, described in some guides as the landscape zone or the furnishing zone, provides a buffer between pedestrians and the vehicle traffic on the roadway. It is adjacent to the back of curb and is where utility poles, street lighting, street trees, landscape plantings, and fixed furnishings are typically located. Provision of a wide buffer generally enhances the pedestrian experience and improves perceived safety and livability. Horizontal clearance to all roadside objects should be based on engineering judgement. Refer to HDM Topic 309.
2. The pedestrian through zone, throughway, or pedestrian zone is located behind the buffer zone. This includes the clear width or path of travel required for ADA access, but generally exceeds those minimum requirements. Objects such as utility poles, light posts, and trees should not obstruct the pedestrian through zone. Refer to DIB 82 for pedestrian accessibility guidelines on the SHS.
3. The frontage zone is between the pedestrian through zone and building facades. This area provides space for people to step out of the way, unload deliveries, accommodate fixed furnishings, and operate windows and doors.

Figure 5-O - Sidewalk Zones



While these zones may not be clearly demarcated, and in fact in some cases concrete pavement runs continuously from back of curb to face of building, these zones are conceptually useful to plan for a pedestrian facility that meets all users' needs. An example of a sidewalk exhibiting these three zones is shown in Figure 5-P.

Figure 5-P – Sidewalk buffer, pedestrian through zone, and frontage zone on SR-116 in Sebastopol

The types of uses expected on sidewalks will also vary across place types. Considerations for establishing appropriate sidewalk widths are discussed below.

In Urban Areas, sidewalk space must accommodate a wide variety of users and activities. In older cities these areas can be very constrained.

In Suburban Areas, sidewalks provide critical connectivity for people of all ages and abilities. Suburban Areas vary greatly and may include important commercial or community destinations, as well as residential areas with a lower density of users.

Rural Areas may include Undeveloped Areas, Transitional Areas, and Rural Main Streets (Rural Towns). Rural Main Streets often consist of denser downtown areas combining retail, commercial, and residential uses, and draw visitors from surrounding areas. Corridors in Transitional Areas serve to connect the surrounding residents with their town center and should carefully consider accommodation of pedestrians and bicyclists. Where higher truck volumes are likely, buffer space between pedestrians/bicyclists and the roadway is important to user comfort. Where separate bicycle and pedestrian facilities and roadway buffers are not feasible in Transitional Areas, Class I bikeways or multi use paths may provide a comfortable facility. Refer to Section 5.1.2 of this guidance for recommended Class I bikeway widths.

Sidewalks should be a minimum total width of 8 to 25 feet for the buffer zone, pedestrian through zone, and frontage zone.

The preferred widths for each zone by place type are shown in Table 5.2.1.

Table 5.2.1 Suggested Sidewalk Zone Widths by Place Type

Place Type	Buffer Zone (ft)	Through Zone (ft)	Frontage Zone (ft)
Urban Area – City Center	4-8	6-12	2-4
Urban Area – Urban Community	4-8	6-12	2-4
Suburban Area	2-7	5-8	0-5
Rural Main Street	2-7	5-8	2-5

5.2.1 Buffer, Planting or Furnishing Zone Considerations for Sidewalks

Buffer zones may be paved or unpaved, and provide space for utilities, amenities, and plantings. Landscaping and street trees should be considered in buffer zones, as they contribute to local identity, street character, and provide shade and cooling on corridors where distances between destinations are longer. Along moderate to high speed suburban roadways, buffer zones are particularly important for pedestrian comfort. Inclusion of street trees and/or amenities at bus transit stops would need a wider buffer zone of 6 to 7 feet. In constrained areas with high vehicle volumes and low anticipated pedestrian use, a wider landscaped buffer and narrower paved pedestrian through zone may provide the highest level of comfort.

The following uses and dimensions for buffer space should be considered:

- To accommodate the utilities and signage typical for many Complete Streets projects, a minimum buffer space of 2 feet from the back of curb is typical.
- Streetscape planting:
  - Street trees typically require a buffer width of 6 to 8 feet.
  - Planters providing stormwater treatment typically require 3 to 6 feet of width.
  - Unpaved buffers of less than 3 feet are difficult to maintain and not recommended.
- Paved buffer areas can be used to provide furnishings such as benches, bike parking, and bus transit shelters.
  - Paved buffer zones may utilize various colors, textures, or paving materials to enhance aesthetics and a sense of separation from the roadway.
  - Benches placed parallel to the street typically require 4 to 6 feet of buffer space.
  - Bike parking (bike racks) will typically require a 5 to 6 feet buffer where bicycles are to be parked parallel to the curb. When parked perpendicular to the curb, such as at bike share stations, a wider 7 to 8 feet buffer is typically appropriate.
  - A buffer that is 10 feet wide can accommodate a 4-foot-wide bus shelter placed 6 feet from the curb. Shelters are ideally located in the buffer area, such that a minimum of 5 feet of clear buffer space in front of the shelter and 5 feet of pedestrian through zone behind the shelter are available.
- Buffer space may be used to span grade change, especially at curb ramps and driveways.
  - Curb ramps will typically require a running slope of 7 feet.

    - For pedestrians, the preferred design is to manage grade transitions and driveway ramps in the buffer zone.
- Buffer space may be utilized for a separated bikeway on the sidewalk, or at the transition between the roadway and the sidewalk, per DIB 89.
- Where on-street parking is permitted adjacent to the curb, there should be 3 feet of clear width between objects (furnishings, utility poles, etc.) and the face of curb, to allow access to vehicles.
- Where on-street parking is available adjacent to a landscaped buffer, 1.5 to 2 feet of pavement adjacent to the curb and regular access points across planting areas should be provided.

5.2.2 Pedestrian Through Zone Considerations for Sidewalks

The pedestrian through zone, or the pedestrian zone, provides a continuous accessible pathway clear of fixed objects parallel to the street, and serves the number and variety of pedestrians expected in the corridor. This includes consideration of fluctuating pedestrian volumes in the vicinity of transit, schools, businesses, and entertainment venues. The pedestrian through zone also allows for various users, including those using wheelchairs, strollers, or other mobility devices to comfortably pass one another.

The following uses and dimensions for the pedestrian through zone should be considered:

- In downtown or commercial Urban Areas, the recommended width of the pedestrian through zone is 8 to 12 feet. At point locations, and to accommodate other amenities such as street trees, bike parking, or transit shelters, it may be necessary to reduce the pedestrian through zone to 6 feet in width.
- In Urban Areas which are primarily residential, a continuous clear width of 6 to 8 feet is preferred, which may be reduced to 5 feet at point locations.
- In primarily residential Suburban Areas, where the volume of users is anticipated to be low, a 5- to 6-foot pedestrian through zone may be appropriate.
- Note that on State highways with designated Safe Routes to School and at key locations where high volumes of users are anticipated (such as at tourist destinations) a 10-foot pedestrian through zone may be considered. This wider pedestrian through zone may also be considered in areas where bicyclists are allowed to use the sidewalk, especially if children traveling by bicycle may be anticipated.

5.2.3 Frontage Zone Considerations for Sidewalks

The frontage zone describes the portion of the sidewalk between the pedestrian through zone and the building façade or right of way line. In Urban Areas, the frontage zone may function as an extension of the building, providing space for people to step out of the flow of other pedestrians, to unload deliveries, set out displays, or it may be used for outdoor dining. In Suburban Areas with off-street parking, the frontage zone may be less congested and may provide space for maintenance activities.

In Urban Areas, a frontage zone of 2 to 4 feet in front of a building is generally appropriate, but various site-specific considerations may apply:

- In segments with a high proportion of retail and dining, or where doors open outwards, a 5- to 6-foot frontage zone is recommended.
- In other downtown areas, a 4-foot width is typical.
- In urban residential areas or areas with lower foot traffic, 2 to 4 feet may be appropriate.
- If little pedestrian interaction is expected with the building façade, 2 feet of width should be provided.

- A shy distance of 2 feet between the pedestrian through way and fixed objects or façade elements should be provided.

In Suburban Areas a frontage zone of 2 feet is generally preferred, however, site analysis may indicate areas of high activity where 5 feet of frontage width is appropriate. Where the space adjacent to the sidewalk is expected to remain undeveloped, a 0-foot frontage zone can be considered, however 2 feet of shy distance between the pedestrian through zone and fixed objects should be provided.

In Rural Main Street areas, a frontage zone of 2 to 4 feet is generally appropriate, but various site-specific considerations may apply. See the discussion of the frontage zone in Urban Areas, above, for more detailed recommendations.

5.3 Lane Width

The decision-making process involved with designing a cross section begins with considering if the existing curb location can be moved or the edge of pavement can be widened. This level of extensive construction could have significant right of way, utility and environmental impacts and costs. Often, pavement rehabilitation projects may be constructed more quickly and inexpensively if using the existing curb location and roadway width. In that case, the existing roadway width should be evaluated and possibly reconfigured to free up the space needed to provide facilities that meet the needs of all users such as bike lanes, bus lanes, pedestrian refuge islands, landscaping, and other Complete Streets elements. Reducing existing traffic lane widths, or perhaps narrowing or eliminating a painted median, can be a low-cost method for obtaining additional roadway space to provide for the inclusion of these features. The practice of exercising design flexibility in decision-making is the process of evaluating multimodal accommodations and then using engineering judgement in determining the most appropriate design within those considerations. The guidance and design standards contained in this DIB are intended to assist the engineer and planner to evaluate the possible reallocation of available roadway cross section to provide the necessary space for bicycle and pedestrian facilities within the selected project locations. For more detailed assistance in selecting lane widths, Table 5.3 was developed based on Exhibit 4.8 of the TRB NCHRP Research Report 880[35]. Modifications to the original exhibit were made to accommodate the California Vehicle Code (CVC) requirement discussed in the following paragraph, typical existing roadway environments in California, and other interrelated roadway standards stated in the HDM.

Caltrans is required to follow the CVC which prescribes vehicle width requirements. CVC Section 35100(a) states that the legal width of any vehicle or its load shall not exceed 8.5 feet (102 inches). This width generally accommodates trucks, recreational vehicles, buses, trailers for boats, etc. without the need for an extra-wide transportation permit. Additionally, the CVC Section 35109 specifies that lights, mirrors, or devices may extend up to 10 inches on each side of the vehicle. As such, a minimum lane width of 10.5 feet is required to serve the maximum vehicle width of 122 inches (approximately 10.2 feet) on State facilities. Other considerations include the need for pavement widening as explained in HDM Index 206.2(3) and the need to reduce cross section elements in HDM Index 301.2(3).

Design decisions are to be documented as explained in Section 2.3. Table 5.3 and the considerations as outlined below may be used to help determine the cross section for Complete Streets projects.

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[35] TRB NCHRP Research Report 880: Design Guide for Low-Speed Multimodal Roadways, 2018.

Table 5.3 Suggested Minimum Lane Widths by Place Type and Proposed Operating Speed

Place Type	Lane Type	Suggested Minimum Lane Widths by Proposed Operating Speed					
		20 mph	25 mph	30 mph	35 mph	40 mph	45 mph
Urban Area – City Center	Through	10.5 ft	10.5 ft	10.5 ft	10.5 ft	10.5-11 ft	10.5-11 ft
	L/R Turn	10.5 ft	10.5 ft	10.5 ft	10.5 ft	10.5-11 ft	10.5-11 ft
	TWLTL	10.5 ft	10.5 ft	10.5 ft	10.5 ft	10.5-11 ft	10.5-11 ft
Urban Area – Urban Community	Through	10.5 ft	10.5 ft	10.5 ft	10.5 ft	10.5-11 ft	10.5-11 ft
	L/R Turn	10.5 ft	10.5 ft	10.5 ft	10.5 ft	10.5-11 ft	10.5-11 ft
	TWLTL	10.5 ft	10.5 ft	10.5 ft	10.5 ft	10.5-11 ft	10.5-11 ft
Suburban Area	Through	10.5 ft	10.5 ft	10.5 ft	10.5-11 ft	11-12 ft	11-12 ft
	L/R Turn	10.5 ft	10.5 ft	10.5 ft	10.5-11 ft	11-12 ft	11-12 ft
	TWLTL	10.5 ft	10.5 ft	10.5 ft	10.5-11 ft	10.5-11 ft	11-12 ft
Rural Main Street	Through	10.5 ft	10.5 ft	10.5-11 ft	10.5-11 ft	11-12 ft	11-12 ft
	L/R Turn	10.5 ft	10.5 ft	10.5-11 ft	10.5-11 ft	11-12 ft	11-12 ft
	TWLTL	10.5 ft	10.5 ft	10.5 ft	10.5-11 ft	10.5 ft	10.5 ft

Note: Cells shaded in gray are outside the range of proposed operating speeds recommended in Table 4.1.

Considerations to determine lane widths with Table 5.3:

1. Given a project's place type and available space, evaluate the benefits and limitations of the range of lane widths with respect to all road users of the corridor.
2. In Suburban Area or Rural Main Street place types, the District Truck Access Manager (or District Truck Coordinator) should be consulted to determine if expected truck vehicle activity justifies a wider lane width to accommodate truck turning movements at intersections. When existing lane widths will be reduced coordinate with the District Truck Access Manager to update pilot car maps.
3. On roadways with transit-only lanes or with high volumes of larger design vehicles (e.g., STAA, CA Legal, or 45-Foot Bus and Motorhome), minimum right-hand, transit-only, or left turn lane widths should be 11 feet. See HDM Index 404.4.
4. Take into consideration the adjacent local road geometry to provide consistency while crossing through the State highway right of way, particularly at local road intersections and interchanges.
5. Evaluate the benefits provided by including space for landscaping, wider pedestrian and bicycling facilities, and reducing crossing exposure for people walking, biking, or rolling.

<u>The minimum through, left-turn, and right-turn lane widths should be 10.5 to 12 feet, except this lane width standard does not apply to crossroads (local road or State highway) at interchange locations in the State highway right of way</u>.

A lane width less than 10.5 feet may be used with appropriate documentation of design standard decision document for noncompliance. Engineering judgement may determine that this will operate adequately for a right-turn lane, or through lane in tangent alignment with a shoulder, and with posted speeds less than or equal to 40 miles per hour and AADTT (truck volume) less than 250 per lane. Additionally, the design vehicle will have a direct impact on the design choice. For example, routes that have vehicles pulling trailers (boats, travel trailers, fifth-wheels, stock trailers, etc.), recreation vehicles, buses, or other vehicles at the legal maximum width will be a consideration for not designing a lane width less than 10.5 feet.

The presence of larger vehicles is a factor to consider. High truck activity may indicate the need to consider lanes widths closer to the upper limit of the recommended range. If more than one lane is proposed in each direction, evaluate the lane width requirements with respect to each other. For example, if there are two lanes in one direction, the left-hand (inside) lane may be suitable for 10.5-foot width while the right-hand (outside) lane, more commonly used by trucks, could be designed at 11 or 12 feet wide. This also allows vehicles in the right-hand (outside) lane to shy away from bicyclists or parked cars that may be adjacent to the right-hand lane.

Sometimes a median will be present to the left of the left-hand (inside) traffic lane. If this is the case, drivers will feel comfortable operating toward the left side of the lane where another user is near the right side of the vehicle. When making lane width choices, the inside lane may be narrower to sustain a reasonable level of comfort to pedestrians and bicyclists. Conversely, drivers in the right-hand (outside) lane may have vehicles to their left and possibly bicyclists and/or pedestrians to their right.

The most common scenario within the Rural Main Street place type is that the SHS corridor functions as a main street for the town. A selection toward the higher end of this range may be appropriate for a particular segment if space allows or if there is very little presence of other multimodal modes and vehicles are the predominant mode. The segment at the edge of town where the corridor transitions from an Undeveloped Area to a Transitional Area or Rural Main Street place type is a good candidate for lane widths at the higher end of the range. Lane widths may then be narrowed to the lower end of this range as other modal facilities take priority with the increased presence of pedestrians and bicyclists, or bus transit stops.

In some instances, Rural Main Streets and Suburban Area place types may be suitable candidates for implementing road diets. A road diet is a reconfiguration where the number of existing traffic lanes are reduced to provide space for bicycle and pedestrian facilities. A typical road diet consists of converting four lanes to three lanes – two traffic lanes, one for each direction, and one two-way left-turn lane. Road diets can also benefit from narrower lane widths. In addition to gaining space from the reallocated traffic lane, if the remaining lanes are also concurrently narrowed, the new cross section may allow for the addition of bicycle and pedestrian facilities or enhancing those that exist.

5.4 Shoulder Width

The highway shoulder serves many purposes. For example, it allows additional maneuvering room for motorists and provides emergency parking for immobilized vehicles. This benefit is especially necessary on higher speed, higher volume highways and freeways. In lower speed (45 mph and lower) Urban, Suburban, and Rural Main Street place types, standard shoulders may be a factor that contributes to higher vehicle speeds. Where excessive speeds are a concern, refer to the Traffic Calming Guide. The AASHTO Green Book allows for the provision of shoulders on a discretionary basis when roadway space is utilized for bike lanes, sidewalks, transit lanes, and designated on-street parking.

The considerations for shoulders in these environments are different than for a high speed facility where there may be competing needs for the available cross section right of way. Examples where shoulders may be considered in lower speed Urban Areas, Suburban Areas, and Rural Main Street place types include:

- In a main street setting, the curb, gutter, and shoulder space may be designed only to accommodate necessary drainage flows.
- The provision of on-street parking is considered shoulder width per the HDM. On-Street parking can also operate as a vertical separation for a Class IV separated bikeway when parking is allowed all times of the day.
- In residential areas, shoulder space may need to be provided for temporary use by trash receptacles, leaf piles awaiting pick-up, snow removal storage, etc.
- For projects on evacuation routes, shoulder space may be needed to provide additional room for law enforcement vehicles and related activities. It may also be used as an additional evacuation lane, access lane for emergency vehicles, or space for broken down vehicles to be moved out of the traffic lane(s).

Engineering judgement and design flexibility are to be exercised when determining the need for a shoulder in the Complete Streets environment and the decision to provide a shoulder should be evaluated against other cross section needs to serve place type context.

<u>For right shoulders: The minimum continuous usable paved shoulder width should be 4 feet. In situations where a sidewalk, Class I or Class IV bikeway is provided, the shoulder width of 0 to 4 feet is allowable except the minimum width should be 4 feet at an interchange crossroad (local road or State highway) or adjacent to a barrier or railing.</u>

There are situations where the 4-foot minimum shoulder width standards will be satisfied, although exceeded. These situations are, but not limited to, the following:

i) Where there is a Class II bike lane facility since the bike lane is considered part of the shoulder.

ii) Where a wider shoulder is necessary to accommodate gutter or drainage inlets that are present and to accommodate water spread. See HDM Chapter 830 – Transportation Facility Drainage.

iii) Where the project is on an evacuation route and additional shoulder width is needed to serve evacuating traffic or emergency operations. See DIB 93 “Evacuation Route Design Guidance.”

iv) Where there is on-street parking, since on-street parking is considered part of the shoulder. See the CA MUTCD Section 3B.19 for parking width guidance.

v) Where the shoulder is used by transit vehicles.

Evaluate the potential benefits of repurposing shoulder space to provide or enhance cross section elements that positively impact the community such as providing space for landscaping, wider pedestrian and bicycling facilities, and the benefits of reducing crossing distance for people walking, biking, rolling, or accessing transit. Unique community uses for shoulder area may also be considered in a context sensitive design, as illustrated in Figure 5-Q, where shoulder and vehicle turnout area are used. NCHRP Research Report 1036: Roadway Cross Section Reallocation provides additional guidance for considering how to prioritize and allocate roadway space by considering important aspects, including but not limited to comfort, accessibility, and other community goals that are unique to the context[36].

Overall shoulder width needs to be balanced with all other cross section elements and drainage needs.

Figure 5-Q – A community use of shoulder area on SR-1 in Gualala

[36] TRB NCHRP Research Report 1036: Roadway Cross Section Reallocation (2022)

6.0 CROSSWALKS AND ENHANCED CROSSWALKS

Crosswalk markings provide guidance for pedestrians who are crossing roadways by defining and delineating paths for pedestrians to cross the street and to help alert road users of designated pedestrian crossing points. Crosswalks come in various forms: unmarked crosswalks, marked crosswalks, marked mid-block crosswalks, etc. For the purposes of this DIB, the term “crosswalk” refers to crosswalks marked with two transverse white or yellow (in school areas per CVC 21368) pavement marking lines across a roadway that identify a pedestrian crossing per CA MUTCD Section 3B.18 Crosswalk Markings. “Enhancements” or “enhanced crosswalks” refer to any features supporting crosswalks beyond the two white or yellow pavement marking lines which may include high visibility crosswalk markings. Note that crosswalks may be unmarked at intersections where sidewalk connects to the intersection and pedestrians may cross at unmarked locations using due care per the CVC. This DIB encourages increased visibility of crosswalks to increase driver awareness at crossing locations. See HDM Index 62.4(5) and HDM Index 105.6 for guidance on designing pedestrian crossing facilities at crosswalks.

There are many tools available to support this goal and they can be combined to enhance crosswalks with additional safety and comfort features depending on the site conditions. Crosswalks should be considered where Class I bikeways cross the roadway, since the Class I bikeway is for pedestrians and bicycles. When identifying potential crosswalk users, keep in mind individuals who may have more limited mobility, such as children and seniors. A lack of existing pedestrian crossings at a particular location within the project should not imply a lack of pedestrian crossing demand. Community engagement can help determine if there are pedestrians in the community who would be using a crosswalk if a crosswalk or enhanced crosswalk were provided. The Caltrans Active Transportation (CAT) plans and District planners can also help identify new or enhanced crosswalk locations. The PDT may also consult law enforcement agencies, local agencies, local communities including senior and school communities, and transit agencies and take into consideration their recommendations. Comfortable, convenient, and connected facilities can encourage and empower travelers to take trips on foot or provide more inviting crossings for bicyclists. Providing passage for travelers on foot can connect larger multimodal networks both along State highways and across State highways to adjacent community networks including access to transit and other multimodal opportunities.

Please refer to the HDM Index 105.6 Pedestrian Crossings, CVC Section 275, and CA MUTCD Section 3B.18 Crosswalk Markings for guidance and requirements. See also Caltrans 28 Proven Safety Countermeasures website and the FHWA Guide for Improving Pedestrian Safety at Uncontrolled Crossings Locations for additional guidance for crosswalk enhancements[37].

[37] Caltrans 28 Proven Safety Countermeasures website, FHWA Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations, 2018

6.1 Where to Consider Crosswalks

Crosswalks and enhanced crosswalks should be considered at the locations below where feasible and supported by engineering judgment or an engineering study. The study should consider the number of lanes, the presence or absence of a median, the distance from adjacent signalized intersections, the pedestrian volumes and delays, the vehicular ADT, the posted or statutory speed limit or 85th percentile speed, the geometry of the location, sight distance, the possible consolidation of multiple crossing points, the availability of street lighting, and other appropriate factors (see CA MUTCD Section 3B.18 Crosswalk Markings). Check with the District Pedestrian and Bicyclist Traffic Safety Engineer to verify that the locations for proposed crosswalks or enhanced crosswalks are not already in the Safety Monitoring Program. Potential locations to consider new or enhanced crosswalks include:

- At locations with a roundabout, or traffic signal where engineering judgement indicates crosswalks are needed to delineate pedestrian paths through these intersections[38].
    - See HDM Index 405.10 for guidance related to crosswalks at roundabouts.
- At non-signalized locations where feasible and supported by engineering judgment that have:
    - On or off-ramps that have ADA curb ramps and sidewalks.
    - Bus transit stops: Consider providing a crosswalk or enhanced crosswalk within 50 to 200 feet of a bus transit stop. Preferred placement is behind, or upstream, of the bus transit stop to avoid conflict between pedestrians and transit buses and allow the transit buses to merge with traffic more easily.
    - Community destination(s): Consider providing a crosswalk or enhanced crosswalk within 50 to 200 feet of a community destination where feasible. Examples of community destinations may include shopping areas, dining areas, schools, hospitals, senior centers, places of worship (as shown in Figure 6-A), sports facilities, public parks, beachfront or nature areas, and playgrounds.
    - In Urban Areas consider providing crosswalks or enhanced crosswalks approximately every 250 to 500 feet at intersections that fall between these limits, and/or midblock on long blocks.
    - In Suburban Areas and Rural Main Streets, consider providing crosswalks or enhanced crosswalks every 500 feet where feasible.
- At crossing gaps or needs identified in the District's CAT plans.
- At crossing gaps or needs identified in the future District Roadway Safety Infrastructure Plans.
- At crossing gaps or needs identified in local planning documents.
- At crossing gaps or needs identified by community engagement.
- At locations where bicyclists or pedestrians are present or projected to be present once pedestrian and bike facilities are constructed.

6.2 Approvals

The District Pedestrian and Bicyclist Traffic Safety Engineer provides approval of crosswalk markings or enhancements.

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[38] Refer to (upcoming) Caltrans Intersection Safety and Operations Assessment Process (ISOAP) policy (formerly known as Intersection Control Evaluation (ICE)).

Figure 6-A – Enhanced crosswalks serving a community destination on I-5 Business/ SR-36 in Red Bluff

6.3 Additional Resources

Caltrans California Manual on Uniform Traffic Control Devices (CA MUTCD)

Caltrans Highway Design Manual (HDM)

Caltrans Pedestrian Safety Countermeasure Toolbox

Caltrans Traffic Calming Guidance Memorandum

FHWA Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations, 2018

NACTO Urban Street Design Guide

7.0 BUS TRANSIT

Integration of bus transit within Complete Streets projects supports the efficient movement of people within a limited right of way. Additional forms of transit (e.g., streetcars, light rail, etc.) also support Complete Streets and the efficient movement of people but are not addressed in this DIB. Caltrans does not develop or operate bus transit systems, but where these systems exist, the designer should collaborate with the district transit coordinator and local transit agencies regarding placement of transit loading facilities (bus stops) that meet all users' needs. Consulting with transit operators early and often can help support designs that include information only the transit operator can provide such as the length of buses that serve the stop, the number of buses anticipated to use the stop concurrently, existing operational challenges, future service plans, and bus turning templates. This section highlights current practices for the design of bus stops in a multimodal Complete Streets environment. For additional design guidance, see the resources listed at the end of this section.

7.1 Network Connectivity

Every bus trip begins and ends either on foot or by bicycle, thus it is important that bicyclists and pedestrians have convenient access to bus stops. Routes designed to help people access public transportation are commonly referred to as first-mile/last-mile connections. Many of these connections will be made on local streets, but it is important that the State highway also provides connectivity. Planning for first- and last-mile connections should consider:

- Accessible sidewalks
- Marked or enhanced pedestrian crossings
- Comfortable bicycle facilities[39]
- Short- and long-term bicycle parking
- Access to other modes, such as bike or scooter share, parking, or rideshare

7.2 Bus Stop Configuration

Bus stop configurations are shaped by the operational requirements of the transit vehicles using them and must be developed in conjunction with the transit operator. Bus stops may be in-lane or may allow a bus to maneuver out of the traffic lane for passenger boarding. While stopping in the traffic lane may impact traffic operations, the AASHTO Guide for Geometric Design of Transit Facilities on Highways and Streets notes that, "There are situations where preferential treatment for transit (dedicated lanes, stations, and priority at traffic signals) may be desirable. In those cases, the benefits to transit riders should be balanced with the effects on road traffic. The goal is to minimize overall person delay. The provision of bus transit recognizes that a single bus can carry as many commuters as 40 or 50 personal vehicles and that urban transportation systems should focus on the efficient movement of people and goods, not merely vehicles"[40]. These considerations are particularly relevant to the Complete Streets contexts addressed in this DIB.

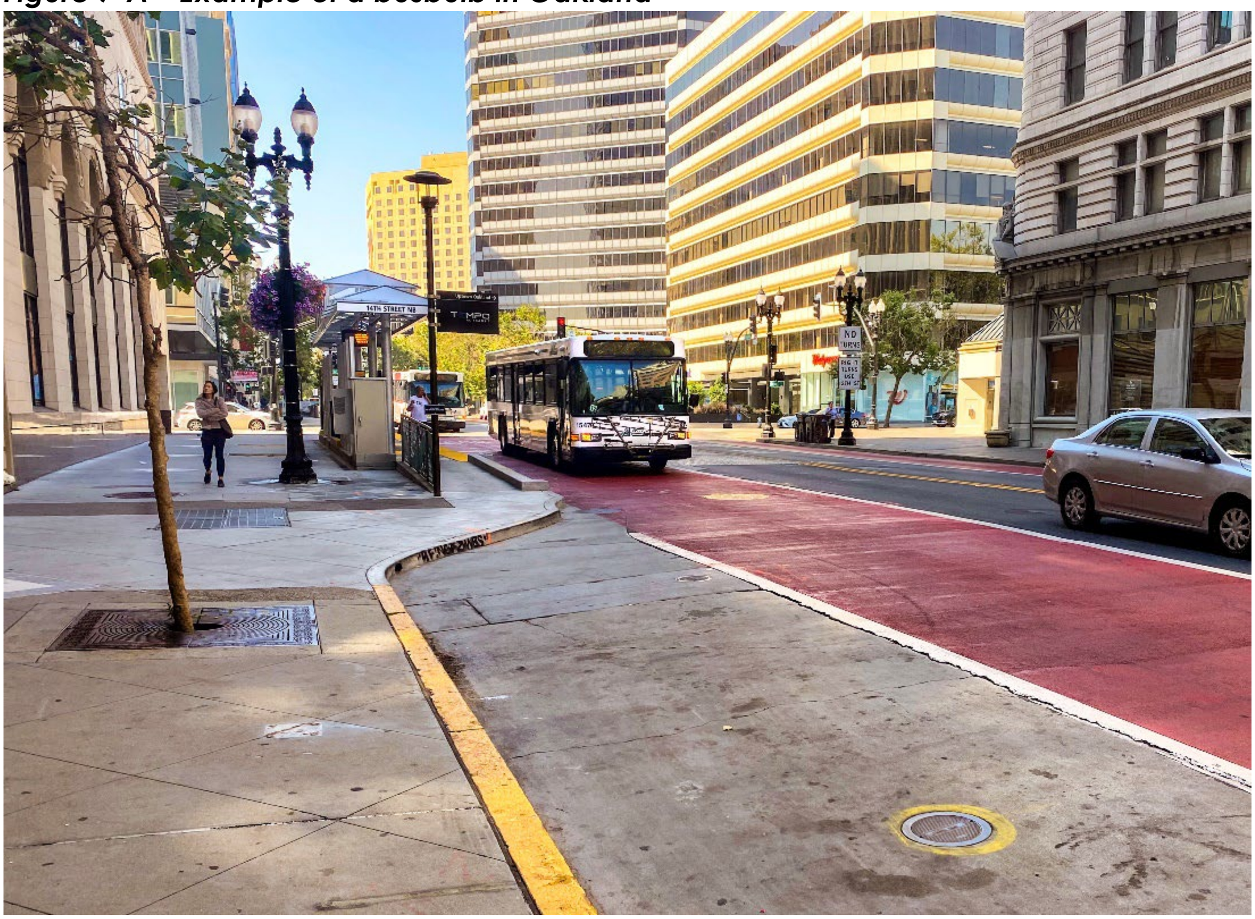
[39] The Federal Transit Administration considers bike facilities within three miles of a public transportation stop eligible for funding due to their "de facto functional relationship."
[40] AASHTO Guide for Geometric Design of Transit Facilities on Highways and Streets, 2014, Section 5.1.

7.2.1 Busbulbs and Busbays

Busbulbs, or curb extensions, as discussed in HDM Index 303.4 and shown in Figure 7-A, may be useful in Urban Areas with frequent bus service, relatively low traffic volumes, low speeds (usually under 40 mph), and where parking is permitted at all times.

According to AASHTO, “Bus bulbs and curb extensions provide additional space for waiting, boarding, and alighting passengers. They better segregate waiting bus passengers from pedestrians walking or rolling along sidewalks, reduce street crossing distances for pedestrians, and provide space for amenities such as shelters and bus benches. They eliminate lateral movement of buses to enter and leave stops, and they eliminate possible delays for buses re-entering a traffic lane. They also can result in more on-street parking than would exist with a conventional bus stop that requires additional space for bus transitions” [41]. Busbays, as discussed in HDM Index 303.4, create a space for buses to pull out of the traffic flow to load and unload passengers. Busbays may be created with an indentation in the curb, as shown in Figure 7-B, or by restricting on-street parking. Busbays are used mainly on suburban roads with speeds greater than 40 mph.

Figure 7-A – Example of a busbulb in Oakland



[41] AASHTO Guide for Geometric Design of Transit Facilities on Highways and Streets, 2014, Section 5.2.

Figure 7-B – A bus bay adjacent to US-101 in Carpinteria

7.3 Reducing Conflicts with Bicyclists

Where both buses and bikeways are present in the same corridor, consideration should be given to minimizing conflicts between buses, bicyclists, and pedestrian passengers. As bus stops and bikeways are both frequently located adjacent to the curb, this is the most common conflict point. There are numerous ways to configure stops, and the designer should employ engineering judgment based upon site analysis to develop an appropriate design. In general, preference should first be given to a design that provides separate spaces for bicyclists to move within their travel way, for buses to stop, and for pedestrians to wait and board bus vehicles. The next-preferred design option would provide a lower degree of separation, integrating pedestrians and bicyclists through the boarding area. The third preference would be to provide a space shared by bicyclists and buses. Examples of each of these configurations are discussed below. It is important to note that these examples do not represent design standards, but rather offer inspiration to the designer to develop a solution appropriate to the project context.

7.3.1 Bus Stop Designs Featuring Separated Spaces

Island platforms, also termed side-boarding islands or floating islands, provide separate spaces for buses to stop (within or outside their traffic lane), for passenger waiting, boarding, and alighting, and for bicyclists to move through a separated bikeway. The bikeway surface may be at roadway level, raised to sidewalk level, or at an intermediate elevation. Design considerations for island platforms are discussed in DIB 89 and the FHWA Separated Bike Lane Planning and Design Guide[42]. Examples of these bus stop designs built by various other agencies are provided as inspiration in the figures below.

[42] DIB 89 Class IV Bikeway Guidance, FHWA Separated Bike Lane Planning and Design Guide, 2018, Section 5, Figures 16 and 17.

Figure 7-C - A Bus boarding island from the FHWA Separated Bike Lane Planning and Design Guide

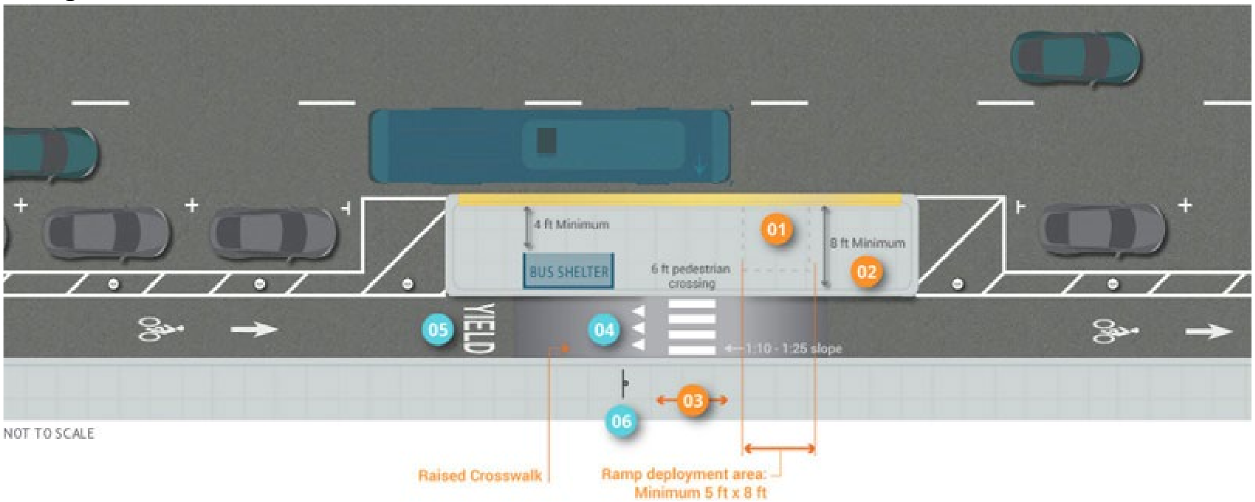


Figure 7-D - Bus boarding island in San Francisco

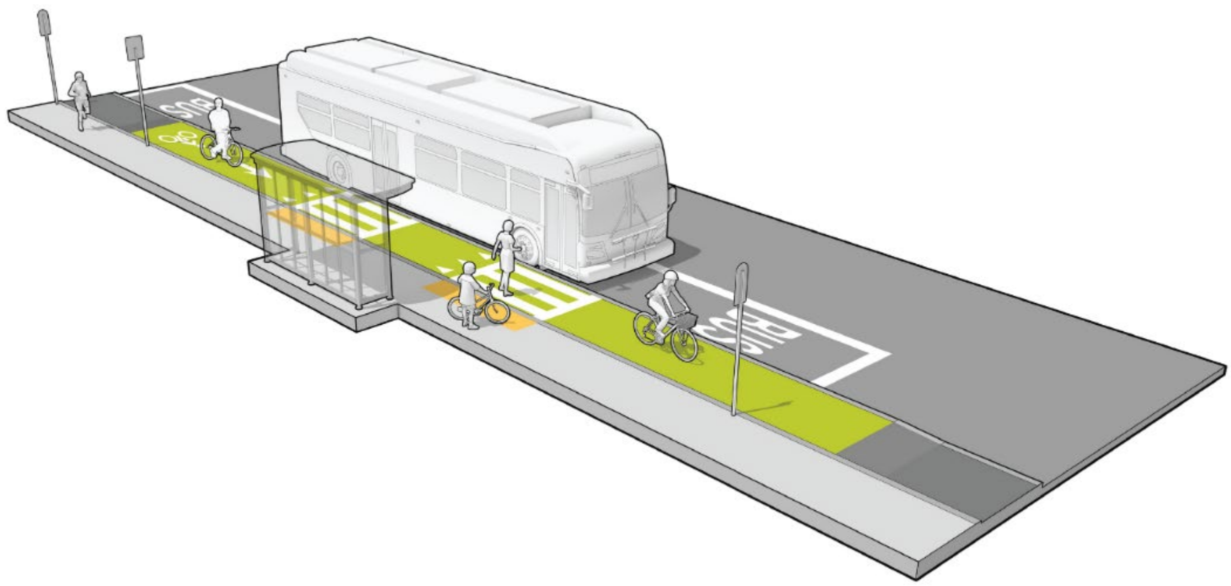
Figure 7-E - Bus boarding island in Oakland

Figure 7-F – Bus boarding island integrated with parking separation in Berkeley

7.3.2 Bus Stop Designs Featuring Integrated Bicycle/Pedestrian Spaces

Where insufficient right of way exists to provide a boarding area separate from the bikeway, an integrated bicycle/pedestrian zone may be developed. The bikeway may be raised to sidewalk level at the bus stop location to allow for passenger boarding and alighting. Bicyclists should yield to crossing pedestrians before entering this conflict zone. The shared space is treated as a crossing and should provide detectable warnings for the visually impaired. Figure 7-G shows this bus stop design from MassDOT below.

Figure 7-G - Diagram of an integrated bicycle/pedestrian zone at a bus stop (MassDOT Separated Bike Lane Guide)



7.3.3 Bus Stop Designs Featuring Shared Bicycle/Bus Spaces

In highly constrained locations or as an interim solution, buses and bicyclists may operate in a shared space at bus stops. The roadway-level mixing zone should be marked to increase awareness between bicyclists and bus operators of possible conflicts. When buses are present at the stop location, bicyclists merge left to pass. The FHWA Separated Bike Lane Planning and Design Guide, adopted by Caltrans in DIB 89, has additional information on when a shared facility, rather than a separated or integrated facility may be appropriate. Additional examples of these bus stop designs from various other agencies are provided as inspiration in the figures below.

Figure 7-H - Diagram of bus stop mixing from the FHWA Separated Bike Lane Planning and Design Guide

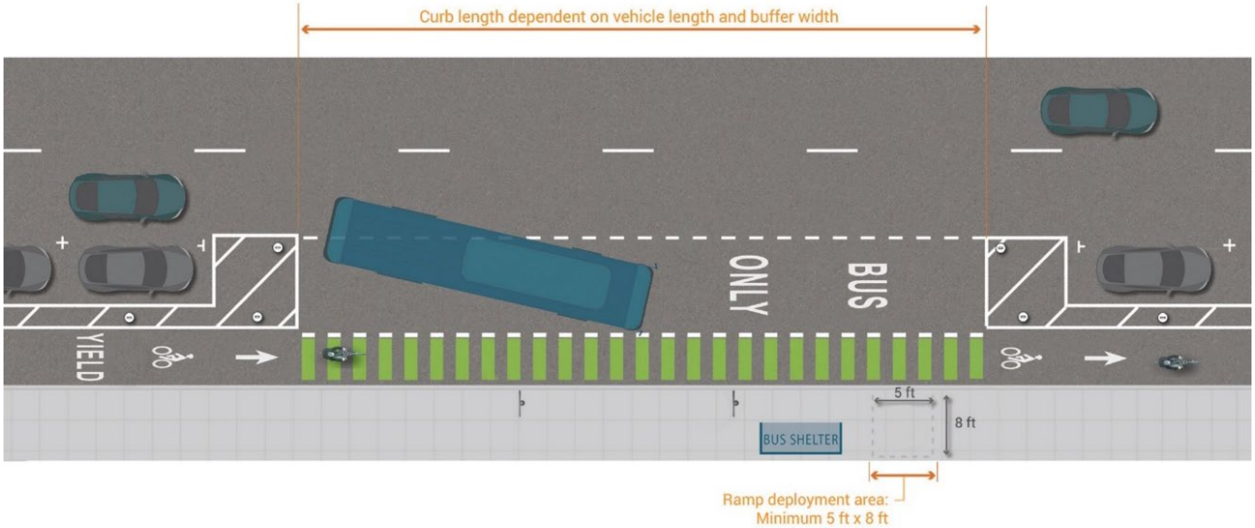


Figure 7-I - Example of bikeway markings at a bus stop and Bus Only lane in San Francisco

Figure 7-J - Conflict zone markings at a bus stop on SR-116 in Sebastopol

Figure 7-K - Bus stop at a Class IV separated bikeway in Hayward

7.4 Additional Resources

AASHTO Guide for Geometric Design of Transit Facilities on Highways and Streets, 2014, Chapter 5: Guidelines for Bus Facilities on Streets and Roadways

Caltrans DIB 82 Pedestrian Accessibility Guidelines for Highway Projects

Caltrans DIB 89 Class IV Bikeway Guidance

Caltrans Highway Design Manual (HDM)

- HDM Index 108.2 Transit Loading Facilities
- HDM Table 302.1 includes shoulder widths for bus stops
- HDM Index 303.4 Curb Extensions discusses Busbulbs and Busbays
- HDM Index 1003.3 Shared Transit and Bikeways

FHWA Separated Bike Lane Planning and Design Guide, 2018

FHWA Improving Safety for Pedestrians and Bicycles Accessing Transit, 2021NACTO Transit Street Design Guide

NACTO Urban Bikeway Design Guide

8.0 GREEN STREETS

Complete Streets incorporate green street concepts where possible to address environmental needs, support livable spaces, and enhance community character. DP-37 recognizes streets as valuable community spaces, and these spaces will best meet the needs of all users when they are designed as green streets. Green streets integrate green infrastructure into the streetscape to improve air and water quality, reduce temperatures, and create beautiful, livable places. This section discusses incorporating green streets features into project design, types of green streets elements, and design considerations.

8.1 What are Green Streets?

Green streets are a system of "green" infrastructure that uses permeable surfaces, tree canopy, and landforms to manage stormwater runoff at its source. At the street scale, green infrastructure refers to stormwater management systems that mimic nature by soaking up, storing, and/or improving the quality of water. These systems employ vegetation, soils, and other drainage design practices to capture, treat, infiltrate, and slow runoff. These can restore some of the natural processes required to manage water and create healthier built environments. For typical Complete Streets projects, green street elements may include street trees, stormwater planters, and planting areas.

8.2 Why Green Streets?

Green streets can provide numerous benefits that are both quantitative and qualitative. These benefits are of particular importance in an Urban, Suburban, or Rural Main Street place type where a variety of non-motorized users are to be expected: "A flooded street is not a complete street. During storm events, people walking, bicycling, and using transit are the first users to encounter barriers and lose access to the street and are the last to regain it. Green street design tools, which integrate stormwater control and management within the right-of-way, are a critical component of complete street design, ensuring the street remains usable and safe for all people during storm events, regardless of mode"[43].

Leveraging Complete Streets projects to develop green infrastructure systems can realize complementary goals, including climate action, economic efficiency, and social equity:

- *Climate action*. Green stormwater infrastructure improves water quality by reducing both the amount of pollution and the volume of runoff entering oceans, rivers, and streams. Managing runoff prior to entering storm sewer systems may help reduce flood potential, and increased infiltration can help recharge groundwater and restore hydrologic systems. The vegetation in these systems contributes to carbon sequestration, reduces fugitive dust and pollution, enhances water quality, and can provide wildlife habitat linkages.
- *Economic efficiency*. Green infrastructure systems are often less costly to install than traditional "gray" infrastructure, and their ability to reduce the load on storm sewers can help extend the service life of existing infrastructure. The landscapes that result from green infrastructure systems contribute to increased property values, reduced heat island effect, and shade from tree canopy can extend pavement life and reduce building energy costs.
- *Social equity.* Green infrastructure systems can realize social equity goals, supported through comprehensive public engagement, to identify improvements, such as street trees, which contribute to vibrant, livable communities while limiting exposure to the burdens noted above. These features can contribute to improvements in mental and physical health through shade and cooling, improved air quality, and beautification.

[43] NACTO Urban Street Stormwater Guide

8.2.1 Regulatory Framework

Additionally, many green streets features are important to achieving compliance with State and Federal regulations. The U.S. Clean Water Act regulates the discharge of pollutants to receiving waters such as oceans, bays, rivers, and lakes. Additional federal regulations under the National Pollutant Discharge Elimination System (NPDES) permit process and U.S Environmental Protection Agency (EPA) control pollutant and stormwater discharges. The California State Water Resources Control Board (SWRCB) serves as the implementing agency for these regulations in California[44]. The Stormwater Quality Handbook: Project Planning and Design Guide (PPDG) provides guidance on the process and procedures for evaluating project scope and site conditions to determine the need for and feasibility of incorporating Best Management Practices (BMPs) into projects within the State right of way[45]. The BMPs for green streets describes strategies that control, prevent, remove, or reduce pollution and minimize potential impacts upon receiving waters.

For additional information on implementing BMPs, the PPDG provides design guidance in support of the Statewide Stormwater Management Plan (SWMP) during the planning and project development process including staff responsibilities, selection of BMPs, and identification and evaluation of stormwater quality issues[46]. To meet the Caltrans stormwater permit requirements, designers should identify and design project features that promote and maximize infiltration including using low impact site design principles and infiltration-type Design Pollution Prevention (DPP) BMPs during site development and design[47].

Figure 8-A – Green street features in Sacramento

[44] [Stormwater Quality Handbook: Project Planning and Design Guide]() (PPDG), Section 1.4.1
[45] [PPDG](), Section 1 Introduction
[46] [Statewide Stormwater Management Plan]()
[47] [PPDG](), Section 5.1 Introduction and Objectives

8.3 Green Streets Elements

Green street designs may include a variety of elements, from street trees and ornamental plantings to engineered stormwater treatment BMPs. While street trees and planted areas may be provided to meet livability and climate goals, BMPs are typically designed to address specific stormwater quality and permit requirements. The following subsections introduce these green street elements and considerations for their inclusion into a project.

Figure 8-B - Green streets may include landscape, street trees, and/or stormwater treatment BMPs

8.3.1 Street Trees

Street trees provide essential and cost-effective infrastructure for climate change resilience and enhancing community livability. Street trees provide environmental benefits by improving air quality, absorbing stormwater and removing pollutants, cooling the air through evapotranspiration, shading roads and buildings in summer, and reducing heat island effects in developed areas. Crucially, trees consume carbon dioxide, the most abundant greenhouse gas contributing to global warming. Street trees also improve conditions for multimodal travelers by providing shade to support active transportation in hot weather and reinforcing traffic calming, making walking, rolling, and biking more inviting. Mature trees sequester more carbon, provide more shade, and weather drought conditions more successfully. Existing street trees should be protected in the project corridor, and then new trees should be established under conditions where they can thrive. The visual and aesthetic beauty provided by trees contributes to a community's sense of place, as seen in Figure 8-C. Including street trees in projects is an equity consideration as underserved communities may have been passed over for street trees in the past or may not have the resources to plant and maintain street trees within their communities. As a result, these communities may disproportionately be excluded from the multiple benefits that trees can bring to a community.

When considering street trees in a project, consult with the District Landscape Architect, Landscape Specialist, and Tree Supervisor. Landscape Architects will consider utility conflicts, sight distance and setback requirements, and prioritize a selection of regionally appropriate shade trees that fit the needs of the project site, local climate, water conditions, and be the appropriate size at maturity.

Refer to HDM Chapter 900 for Tree and Irrigation guidance and standards.

Figure 8-C - Street trees lining US-50/I-80 Business to reinforce the neighborhood sense of place in Sacramento

Protecting Existing Trees

Because it can take many years for a tree to confer maximum climate and aesthetic benefits, preservation of existing mature trees and their root structures should be a top priority in roadway projects. Damage to tree roots through excavation and construction within the trees' dripline is a frequent cause of structural damage and tree mortality. When reconstructing a sidewalk or roadway, consider the following ways to address tree roots and minimize impacts on existing street trees:

- Go around the roots. If there is enough room, the sidewalk can narrow or "meander" to go around the structural roots near the base of the tree.
- Go over the roots. Consider rebuilding the sidewalk like a bridge over the roots. A curb or guard may be needed to avoid creating a drop-off at the edge of the sidewalk. Piers can support the sidewalk from below.
- Go under the roots. Consider excavating out under the roots with an air spade, creating space for the roots to settle into and extend downward. Pea gravel can be used to support the new sidewalk and keep oxygen available to the roots.

While trenching, consider the following ways to address tree roots:

- Use hand tools to dig within the root zone.
- Use micro-trenching to trench under, over, alongside, or through the root zone.
- Consider root pruning in challenging conditions according to Arboricultural Standards to avoid tree removal where possible.

These techniques do not work in every situation, but collaboration between engineers, landscape architects, and arborists can often identify the appropriate opportunities to utilize these solutions.

Adding Street Trees

The best way to grow a successful street tree is to invest in the right soil structure to support street tree growth. Suspended pavement and structural soils both provide a rigid structure to support pavements, while preserving uncompacted areas for roots to grow. Suspended pavement (Figure 8-D) is supported by an underground cage-like structure, which keeps the pavement from settling, but still lets roots grow. Coarse structural soils (Figure 8-E) can be compacted to support pavement, while still retaining the oxygen roots need in the pore spaces between the aggregate.

Consult the District Landscape Architect for additional guidance.

Consult District Maintenance for additional input on maintenance needs.

Figure 8-D – Diagram of a suspended pavement system

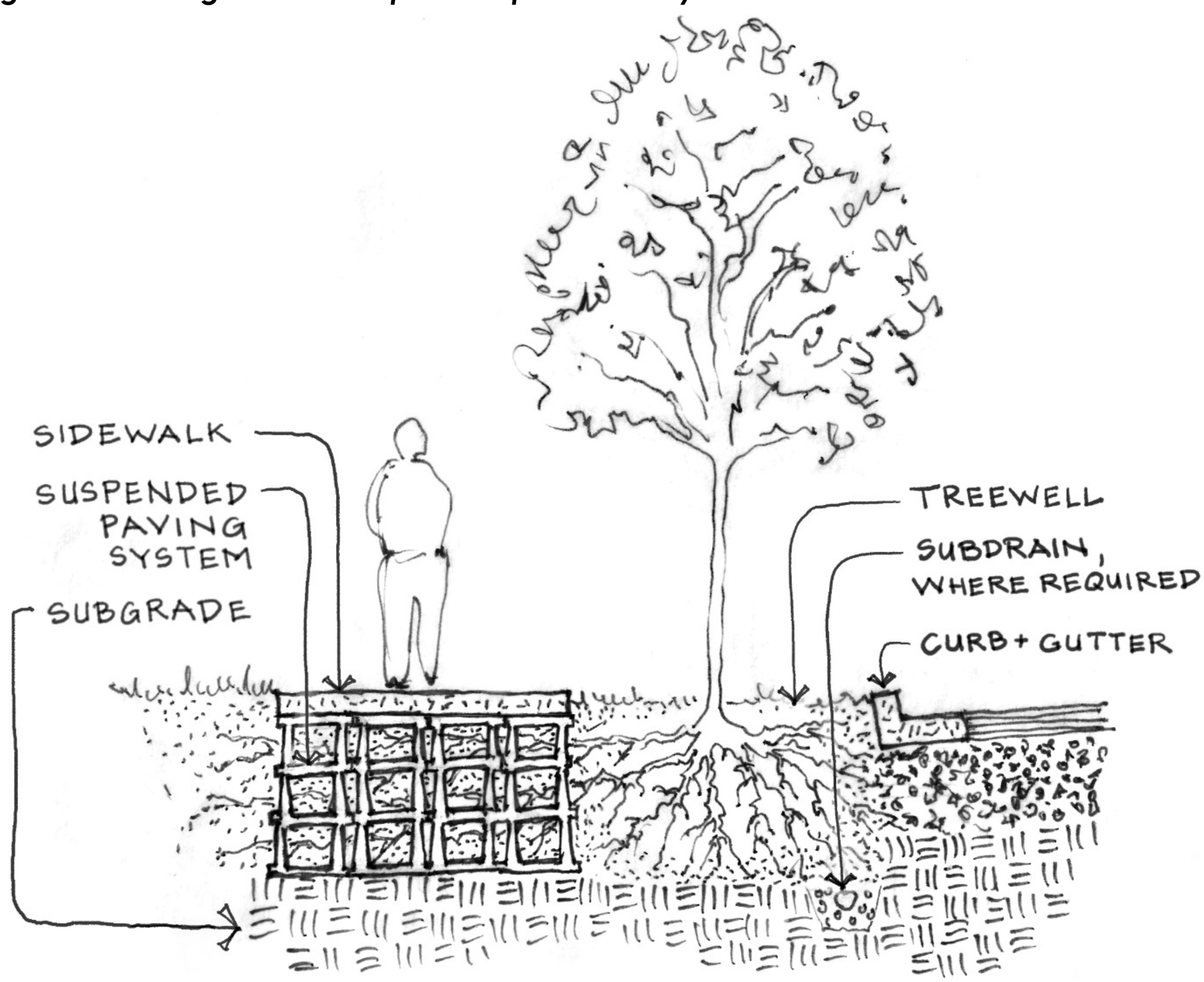
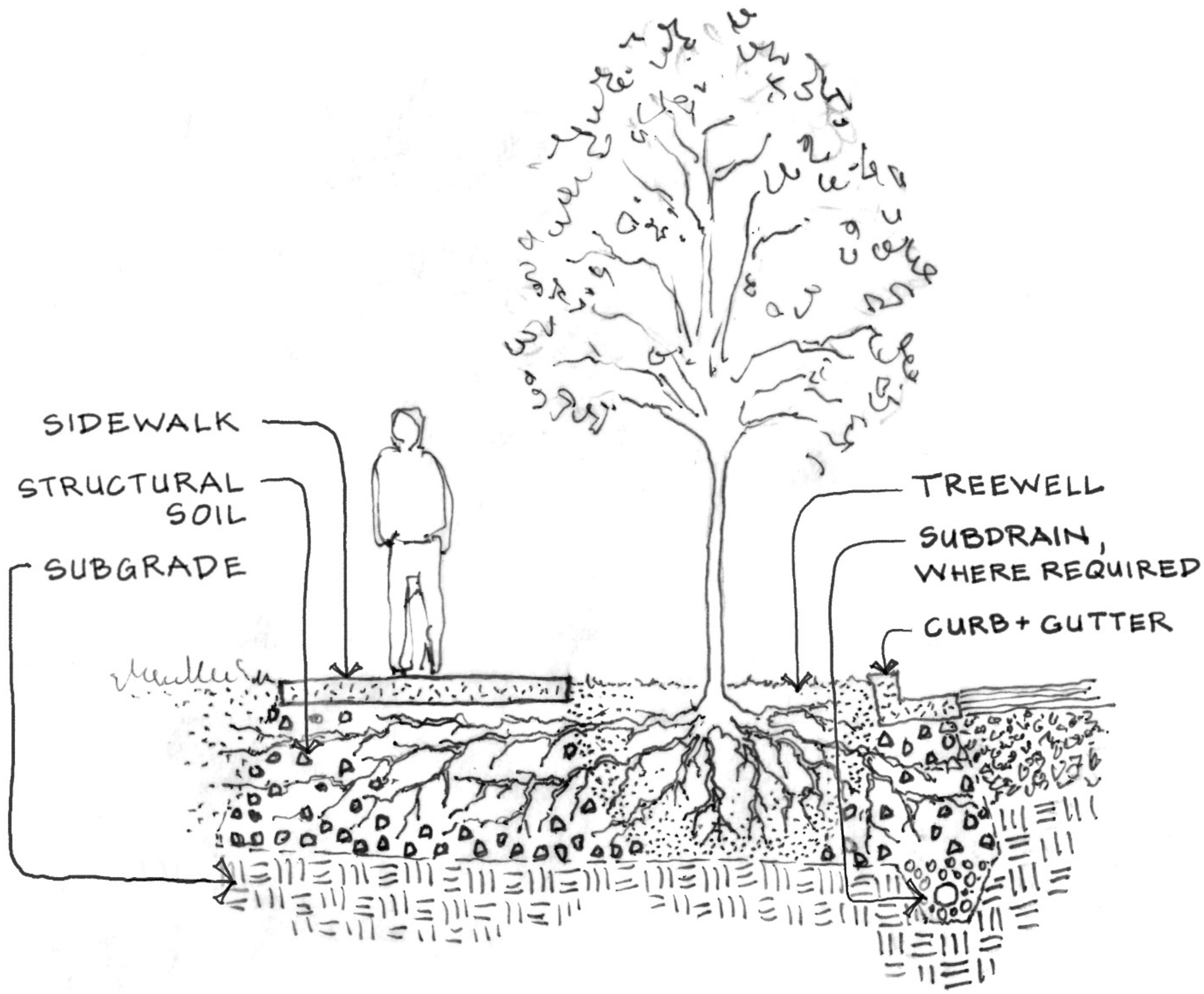


Figure 8-E – Diagram of a structural soil system



Drought and Water Needs

Trees are a valuable environmental resource and maintaining them through drought may be an appropriate use of water. During project development, consider whether existing tree planting areas can be modified to capture stormwater runoff to help water infiltrate into the soil and prolong water availability to tree roots.

When new trees are added as part of the project, pick regionally appropriate tree species that will be drought tolerant once established and consider the type of irrigation necessary to establish new trees. In some locations three to five years of irrigation may be sufficient to establish new trees but in other locations permanent irrigation systems may be necessary.

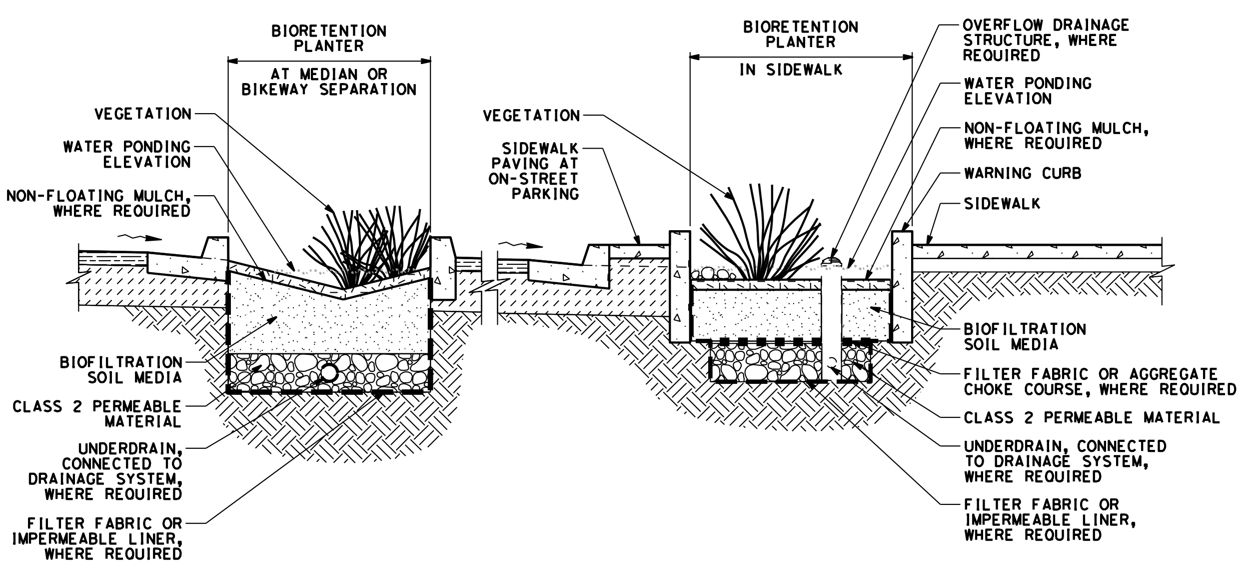
8.3.2 Stormwater Treatment BMPs

As green infrastructure designs have gained popularity, the terminology around these features continues to evolve. Rain gardens, bioswales, bioretention features, and stormwater planters often describe similar features. This DIB uses the term stormwater planter broadly to describe any planting area designed to serve a stormwater management purpose. Other terminology will match that used by the Caltrans Office of Hydraulics and Stormwater Design and the PPDG.

Treatment BMPs (TBMPs) are designed and sized to treat either a certain volume of runoff, a particular flow or rate or runoff, or a particular pollutant of concern. The first priority in TBMP development is to infiltrate runoff from the contributing areas, then treat any excess runoff with a flow-through BMP or other TBMP to achieve compliance. TBMPs are not flood control measures designed for large storm events, but instead are typically designed for the lower volumes or flows of stormwater associated with frequent storms (such as those storm events with a return period of less than two years). The project engineer with the support from the Design Stormwater/NPDES coordinator will determine treatment requirements and appropriate BMP sizing. The PPDG identifies more than a dozen types of Treatment BMPs for application in State highway projects, but only a small subset of these is generally suitable in the constrained site conditions of a Complete Streets design.

A brief overview and examples of the relevant TBMPs are included in this DIB to aid the designer in identifying opportunities for incorporation of these features into their green street design. The relevant Treatment BMPS include Bioretention, Biofiltration, Design Pollution Prevention Infiltration Areas (DPPIAs), Detention Devices, and Pervious Pavement[48]. Examples of each of these TBMPs are shown in Figures 8-F through Figure 8-J.

Figure 8-F – Example Bioretention Treatment BMP



[48] For additional design guidance see the Caltrans Treatment BMP Design Guidance webpage.

Figure 8-G – Example Biofiltration Strip and Swale Treatment BMP

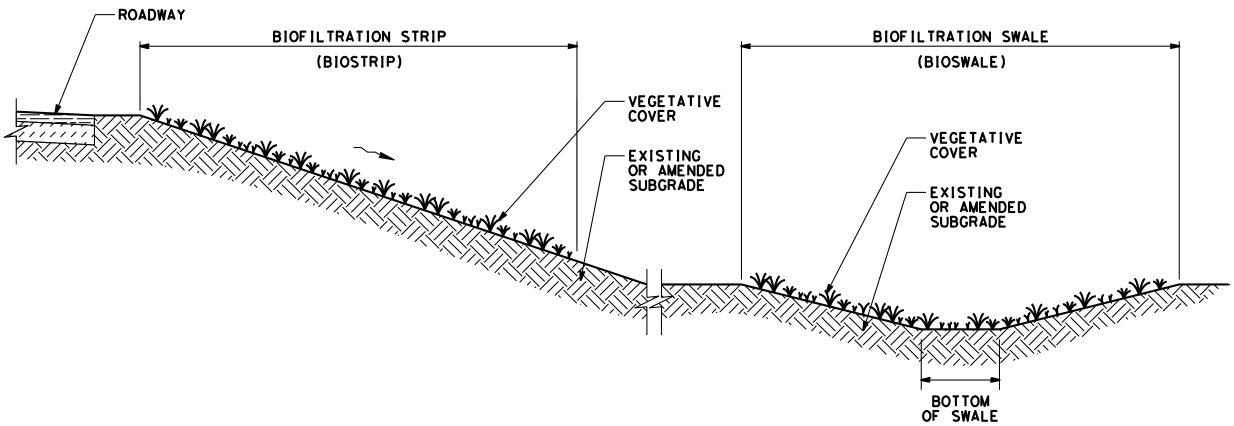


Figure 8-H – Example Design Pollution Prevention Infiltration Area Treatment BMP

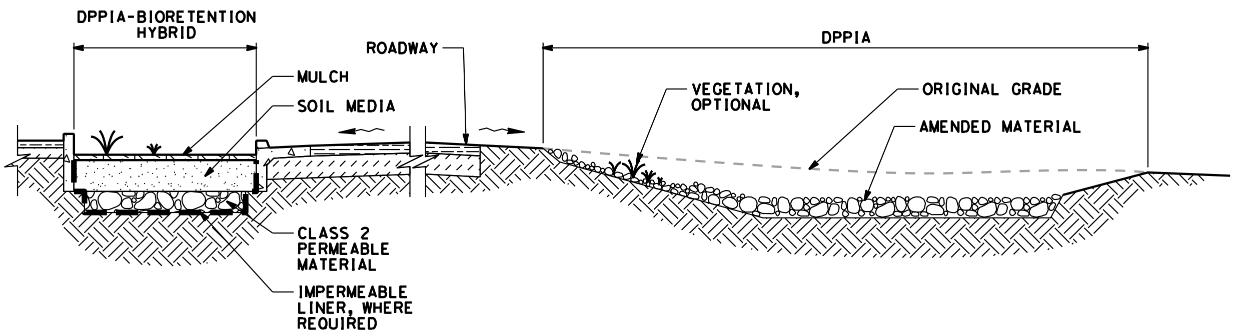


Figure 8-I – Example Detention Basin Treatment BMP

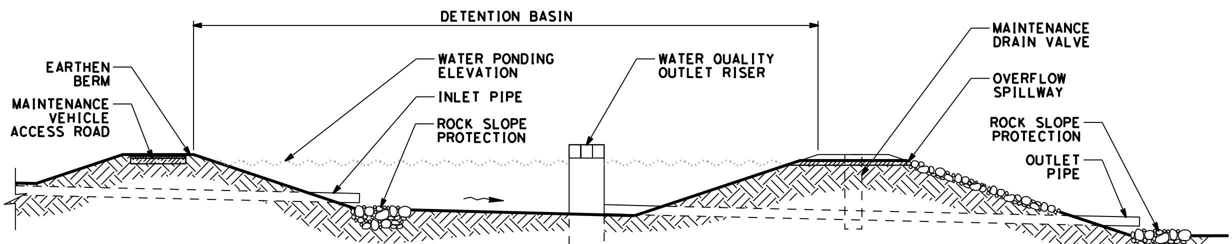
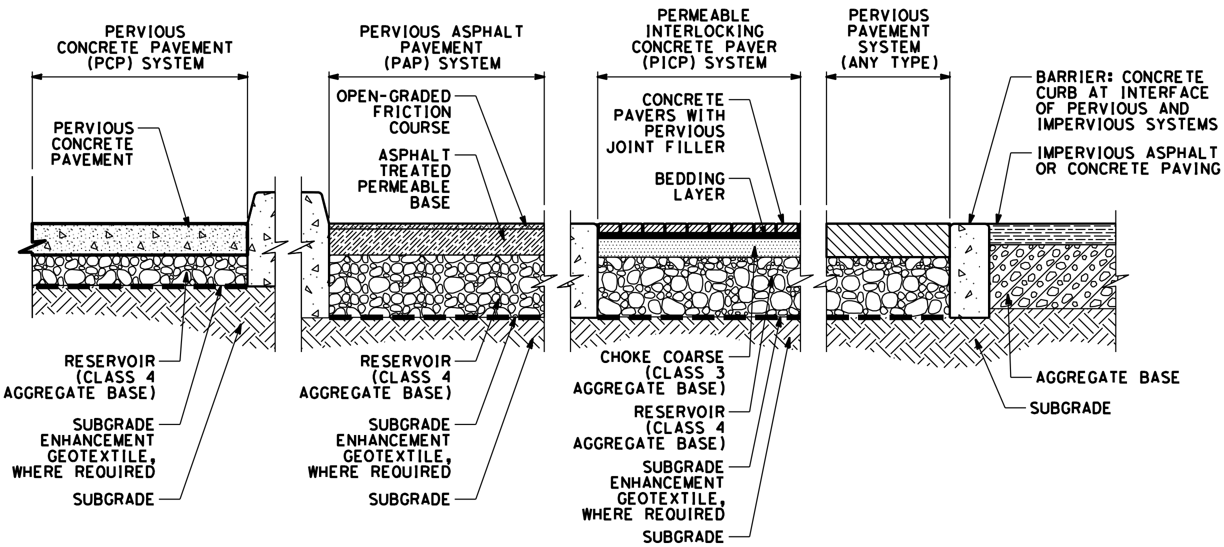


Figure 8-J – Example Pervious Pavement Treatment BMP



Bioretention

Bioretention systems can filter or infiltrate stormwater directly into the soil to recharge streams, lakes, rivers, and underground aquifers, retaining a designated design volume of stormwater on site. In urbanized areas, they are the most common type of BMP in use, and they can help to reduce ambient temperatures and the urban heat island effect, while addressing both water quality and quantity concerns.

In a Complete Streets environment, bioretention features are often designed as linear planting areas that accept runoff from the adjacent roadway surface (Figure 8-K). They may be used to separate bicycle or pedestrian facilities from the roadway, improving the comfort of non-motorized users (Figure 8-L). They can provide additional environmental benefits with the incorporation of native or climate-adapted planting (Figure 8-M), and shade with the incorporation of street trees.

Figure 8-K – Bioretention planters before and after planting on US-101 in Eureka

Figure 8-L – Bioretention features separate modes on SR-123 in El Cerrito

Figure 8-M – Climate-adapted plant material in a median bioretention feature at the Palomar Transit Center in Chula Vista

Bioretention planters typically filter pollutants by allowing stormwater to percolate through an engineered planting media consisting of topsoil, compost, and sand. These planters may reduce both the volume and flow (or rate) of stormwater runoff leaving a site. The fast-draining soil blends typically utilized are underlain with a layer of drainage rock, which provides temporary storage for the stormwater until it infiltrates into the native soil or is transported to a drainage system. Depending on site conditions such as soil permeability and structural requirements, bioretention planters may be designed to convey treated stormwater through an underground permeable pipe, and they may include an impermeable liner to prevent infiltration in place.

Where bioretention planters are located adjacent to a roadway, sidewalk, or bikeway, concrete curbs and stemwalls may be needed to support the pavement section against the uncompacted soils. Where bioretention planters are adjacent to a pedestrian path of travel, the soil elevation and desired ponding depth for stormwater should be considered and curbs or railings may be utilized to address any drop-off concerns for pedestrians (Figure 8-N). The project engineer will typically develop the cross section and sizing of the bioretention feature. The landscape architect should inform pedestrian path of travel, planter design and placement, and develop planting and irrigation design. The project engineer should also review curbs and structural sections, and the hydraulics engineer should review drainage.

Figure 8-N - Warning curbs surround bioretention planters adjacent to on-street parking on SR-123 in El Cerrito

Biofiltration

Biofiltration strips and biofiltration swales are soil-based Low Impact Development (LID) Treatment BMPs capable of treating both water quality flow and volume. They function primarily through the flow of runoff over a sloping vegetated area, where plants aid in removing pollutants such as sediments, metals, oils, and grease through sedimentation, infiltration, and uptake by plants. Biofiltration strips are generally wide grassy areas adjacent to the roadway. Runoff flows over these planted strips. The planted strips should have a slope flatter than 4:1 that extends at least 15 feet beyond the roadway. Biofiltration swales, by contrast, treat a concentrated flow of stormwater moving through a vegetated open channel (Figure 8-O). Both biofiltration strips (sometimes called biostrips) and biofiltration swales (bioswales) are required to maintain 65% vegetated cover to meet treatment and permit requirements (Figure 8-P). As a result, climate considerations and plant selections are critical to their success. In contrast to the engineered soils utilized in bioretention features, biofiltration is typically designed to work with the native soil, incorporating compost and applying seed or installing young plants. Biofiltration strips and swales are most often utilized in a more rural setting without curb and gutter, but there may be opportunities to incorporate biofiltration in suburban and rural main street environments or parking lots.

Figure 8-O - Biofiltration swale along SR-92 near the San Mateo-Hayward Bridge.

Figure 8-P - Biofiltration swale adjacent to I-5 in San Diego

Design Pollution Prevention Infiltration Areas (DPPIAs)

DPPIAs treat stormwater runoff from paved areas by infiltrating the water quality volume to remove pollutants of concern, such as sediments, nutrients, pesticides, metals, and pathogens (Figure 8-Q). These Treatment BMPs are generally designed as relatively flat amended areas that could use Class 2 Aggregate Base, Shoulder Backing, or native material or rock – with or without vegetation (Figure 8-R). They may include a layer of rock material to prevent erosion if velocities warrant or aesthetics dictate a desired finished appearance.

Figure 8-Q – Hybrid DPPIA-Bioretention feature on SR-99 in Live Oak

Figure 8-R – Arid climate DPPIA utilizing aggregates on SR-14 near Santa Clarita

Detention Basins

Detention basins, sometimes also known as detention ponds, are excavated or bermed areas that temporarily detain stormwater runoff to allow sediment and particulates to settle out. Basins may be lined or unlined, depending on subgrade conditions, and are designed to completely drain within 96 hours after a storm event. While this type of treatment may be used in a Complete Streets project, Caltrans design guidance is geared toward large-scale detention basins, often 20 to 50 feet across with depths of 3 to 10 feet. These footprints rarely fit within the roadway right of way in Urban Areas, Suburban Areas, or Rural Main Street place types, but may sometimes be developed through cooperative agreements, as in the example shown in Figure 8-S. The large grassy field serves as a detention basin for storm events, but doubles as a neighborhood park when not inundated.

Figure 8-S – Detention basin adjacent to SR-16 in Esparto

Pervious Pavement

Pervious pavements may be used to reduce site runoff, eliminate standing water, prevent pollutants from entering the stormwater system, and reduce the urban heat island effect. They allow stormwater to filter through voids in the pavement surface into an underlying rock reservoir where it is temporarily stored and infiltrated into the ground below. The surface pavement layer may consist of Pervious Concrete Pavement (PCP), Pervious Asphalt Pavement (PAP) (also known nationally as Porous Asphalt Pavement), or Permeable Interlocking Concrete Pavers (PICP). Regular maintenance of these pavements is critical to preserving their permeability, and typically requires use of specialized vacuum equipment. Currently, pervious pavements within State right of way are considered on a project-by-project basis and are limited to parking lots (Figure 8-T), rest areas, sidewalks, bikeways, and similar areas with very low vehicular use.

Figure 8-T -Pervious concrete pavement at a park and ride lot in Chula Vista

8.4 Site Analysis

Site analysis will inform both the selection and design of green streets features. Considerations for implementation of green streets are discussed below.

Physical and Geotechnical Components

- Available space: Typically, green space is constrained in Urban Areas, Suburban Areas, and Rural Main Street place types. Green street elements may be planned into new facilities or retrofit into portions of existing facilities. Consider green streets elements for the linear separation elements in Class IV bikeways and bulbout areas outside the pedestrian crossing path of travel. Consideration should also be given to planting areas in the buffer zone of the sidewalk including planter strips between the curb and sidewalk, and street tree planting areas.
- Topography: Grades need to accommodate drainage flowing from paved surfaces including roadway, bikeways, and sidewalks into green streets planting areas. Consider existing roadway grading and existing inlet locations before locating green street elements. For new facilities, design grading and green streets facilities in tandem.
- Landscaping: Protect existing vegetation (especially mature trees and sensitive plant species), design irrigation & select adapted plants. Landscape architects should collaborate with engineers to determine bioretention soil mixes and compatible plant material.
- Utilities: Identify and locate existing utility locations (e.g., water, sewer, gas, electric) or future utility plans to avoid conflicts and ensure adequate clearances.
- Infiltration considerations: Consider existing material infiltration rates, soil types, and depth to groundwater before identifying potential stormwater BMP types.
- Flow considerations: Identify existing flow patterns and possible floodplain locations.

Context

- Circulation patterns: Green streets elements should support or enhance rather than obstruct bicycle and pedestrian circulation patterns, pedestrian access points, and loading and unloading zones.
- Plant establishment and maintenance considerations: Plant establishment and long-term maintenance requirements need to be resolved during the design development process.
- Climate considerations Arid and colder climates require additional consideration. Plants may need to tolerate drought and inundation. Permanent irrigation may be necessary for long term success of vegetation. In colder climates snow and deicing agents will impact vegetation.
- Litter abatement considerations: Significant trash generating areas should be identified and trash capture devices should be considered for those sites.
- Other considerations: Archaeological, historic, or cultural resources should be reviewed and considered. Historic districts may have their own design guidelines to guide how to design around eligible resources (e.g., buildings, bridges, monuments, etc.). Areas with historic built environments may pose additional constraints to available space for green street elements.

8.5 Additional Resources

Caltrans Highway Design Manual Chapters 800, 810, and 820

Caltrans Stormwater Quality Handbook Maintenance Staff Guide

Caltrans Stormwater Quality Handbook Project Planning and Design Guide (PPDG)

Caltrans Treatment BMP Design Guidance

City of Portland Green Streets Program

City of Portland Stormwater Management Manual (includes typical details in PDF and DWG format)

City of San Francisco Green Infrastructure Maintenance Guide Book, 2018

City of San Francisco Green Infrastructure Construction Guide Book, 2017

City of San Francisco Stormwater Management Requirements and Design Guidelines (includes vegetation palettes and green infrastructure typical details in PDF and DWG)

City of San José Green Stormwater Infrastructure Maintenance Field Guide, 2019

EPA Green Streets Handbook

MassDOT Separated Bike Lane Planning and Design Guide, Chapter 3

Minnesota Pollution Control Agency Minnesota Stormwater Manual

NACTO Urban Street Stormwater Guide

San Mateo Countywide Water Pollution Prevention Program Green Infrastructure Design Guide, 2020

Santa Clara Valley Urban Runoff Pollution Prevention Program Green Stormwater Infrastructure Handbook, 2019

9.0 COMPLETE STREETS GRAPHIC EXAMPLES BY PLACE TYPE

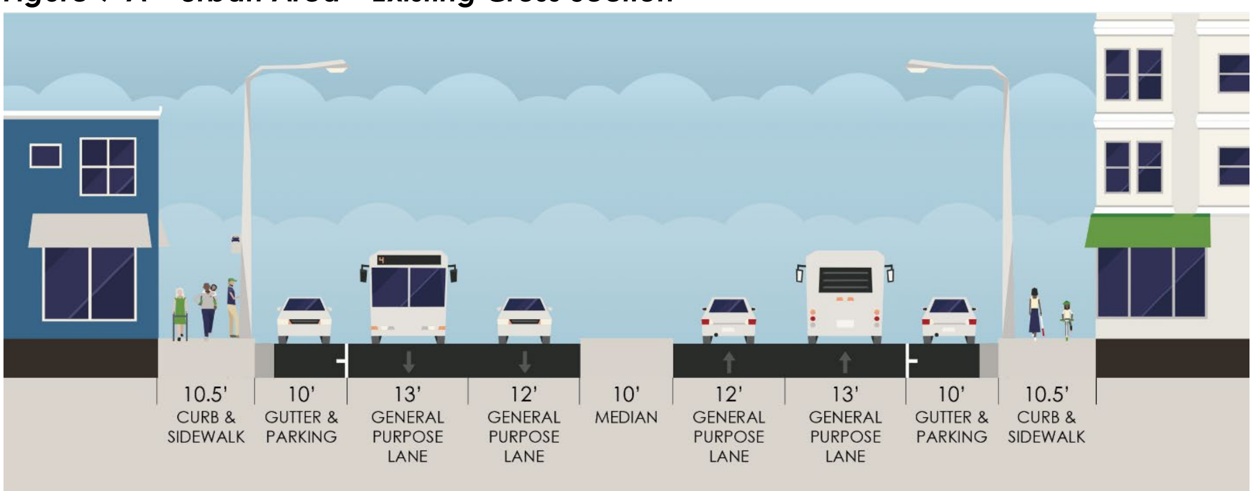
This DIB discusses multiple considerations for the redesign of an existing conventional highway in Urban Area, Suburban Area, and Rural Main Street place types. This section provides examples of how these concepts may be applied to sample roadway cross sections in each place type. The importance of detailed, site-specific project context and community input is stressed throughout the DIB. Dimensions shown in this chapter are provided to illustrate the variety of solutions that are possible using design flexibility and applying design guidance of this DIB. These dimensions and configurations should not be construed as setting standards or defining a preferred design. Rather, these sample cross sections, based on actual Caltrans facilities, should be viewed as inspiration for the project design team.

9.1 Urban Area – Example Cross Sections

Conventional highways in Urban Areas are often challenged with a high density of users, great variety in user types, and a tightly constrained right of way. As discussed in Section 3 of this DIB, highest priority should be placed on space-efficient forms of transportation (walking, rolling, cycling, and transit) in these areas. Existing facilities designed for motor vehicles, particularly shoulders and parking, may be reallocated for bicycle, pedestrian, or transit use. Vehicle lanes may additionally be narrowed, in accordance with the guidance in Section 5, to provide higher quality facilities for pedestrians, bicyclists, and transit users.

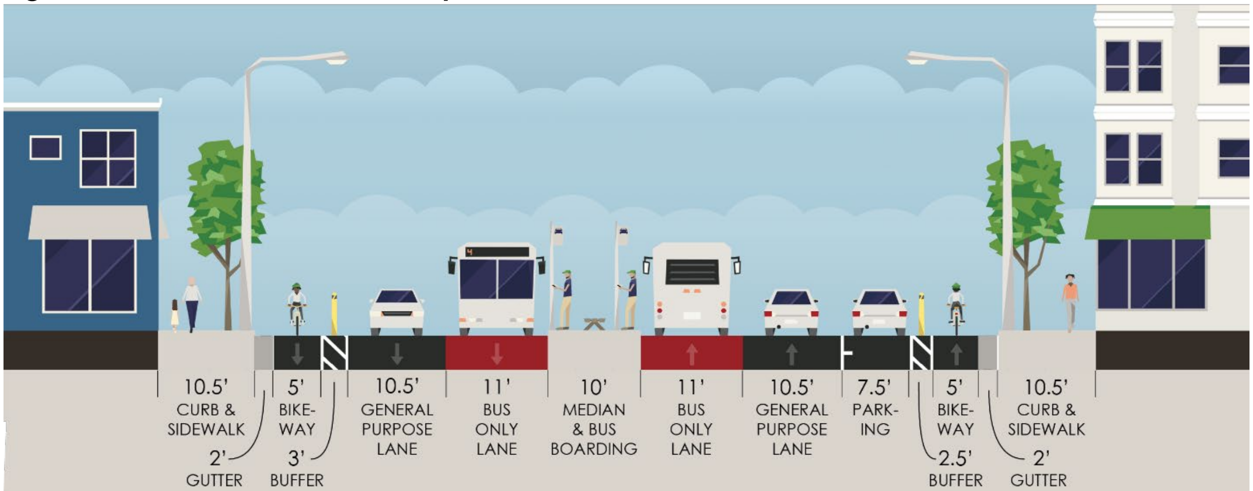
The existing roadway considered in this example includes two traffic lanes in each direction, a raised median, on-street parking, and sidewalks on both sides. See Figure 9-A.

Figure 9-A – Urban Area – Existing Cross Section



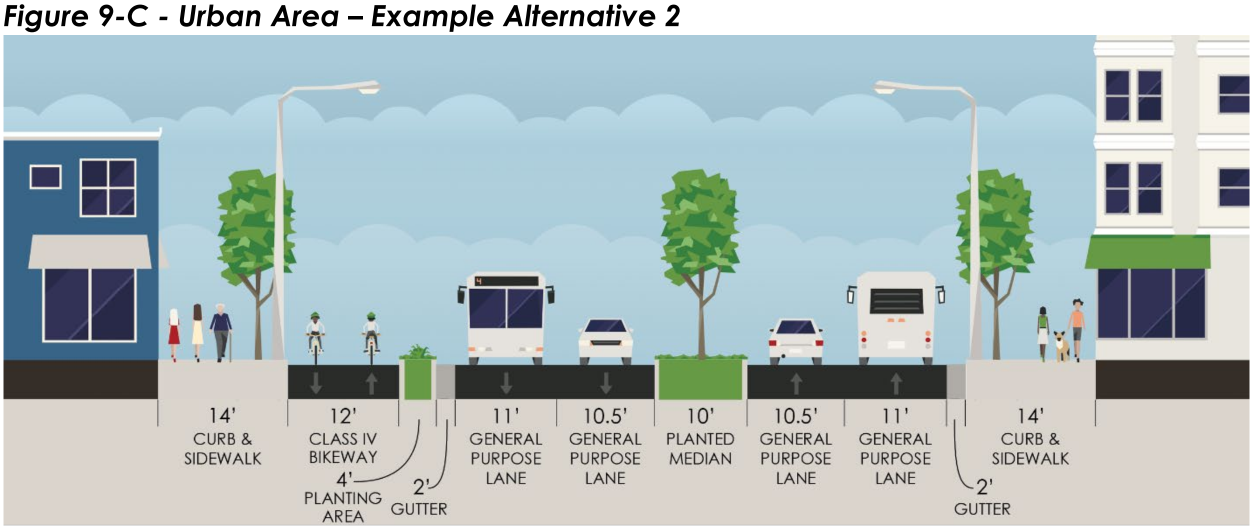
Several modifications can be made to the cross section of this high volume arterial to better accommodate existing bus transit and provide comfortable facilities for bicyclists. See Figure 9-B.

Figure 9-B - Urban Area – Example Alternative 1



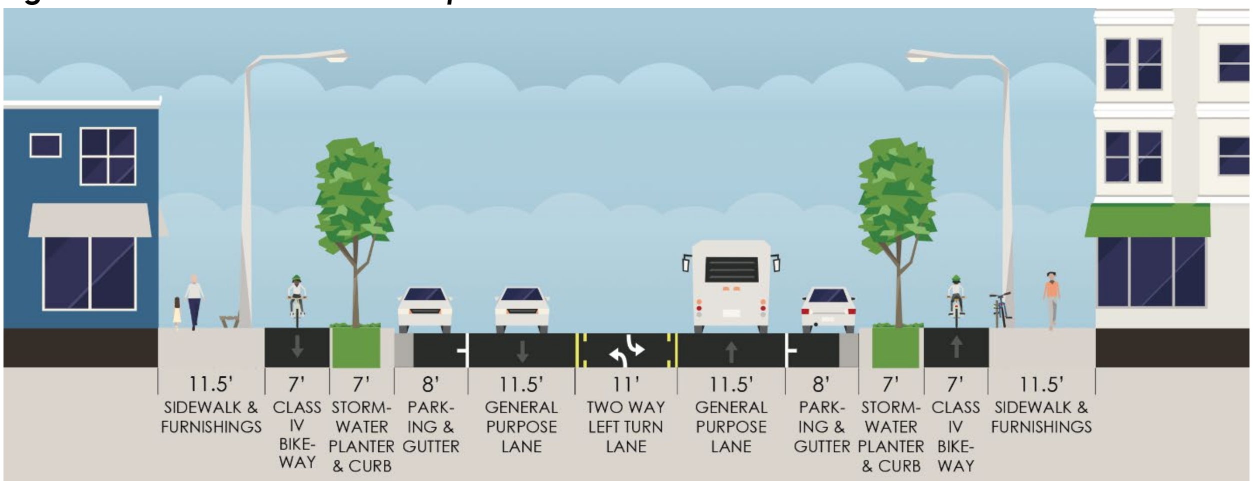
This design adds Class IV separated bikeways, incorporates landscaping in the sidewalk buffer zone, and modifies the raised median to serve as a boarding and waiting area for center-running bus-only lanes, all while preserving the existing curb and gutter. Bus-only lanes may be preferred along corridors that have rapid or express bus service or at spot locations that allow buses to bypass congestion. Locating bus-only lanes to the left of the general-purpose lanes avoids conflicts between buses and bicyclists but necessitates a crossing to allow passengers to reach a bus stop. However, left-side boarding must be coordinated with the transit operator because it necessitates the use of bus vehicles with doors on both sides. The design shown in Alternative 1 also removes parking along one side of the street, narrows the parking lane on the other side of the street, and reduces traffic lane widths to provide the one-way Class IV separated bikeways in each direction. Pedestrian facilities in this design meet the minimum width requirements but may be enhanced with street trees and furnishings.

Figure 9-C - Urban Area – Example Alternative 2



Alternative 2 relocates curb lines to widen sidewalks and create a two-way Class IV separated bikeway along one side of the street. Curb relocation will typically require relocation of utilities, redesign of the existing drainage system and may incorporate stormwater planters at the curb and/or in the median. The right traffic lanes are 11 feet wide to allow for larger vehicles, such as buses, plus a 2-foot gutter accounts for stormwater spread during storm events. Buses would continue to operate in the right lane, but conflicts between buses and bicyclists are avoided through the design of the separated bikeway. Pedestrian and bicyclist interactions would still need to be managed at bus stops (see Section 7). In this example, conflicts between bicyclists and sidewalk users can be mitigated by installing the bikeway at an intermediate level (typically 2 to 3 inches below sidewalk elevation). On-street parking is eliminated in this Alternative, accounting for off-street and side street parking that may be available in the area.

Figure 9-D - Urban Area – Example Alternative 3

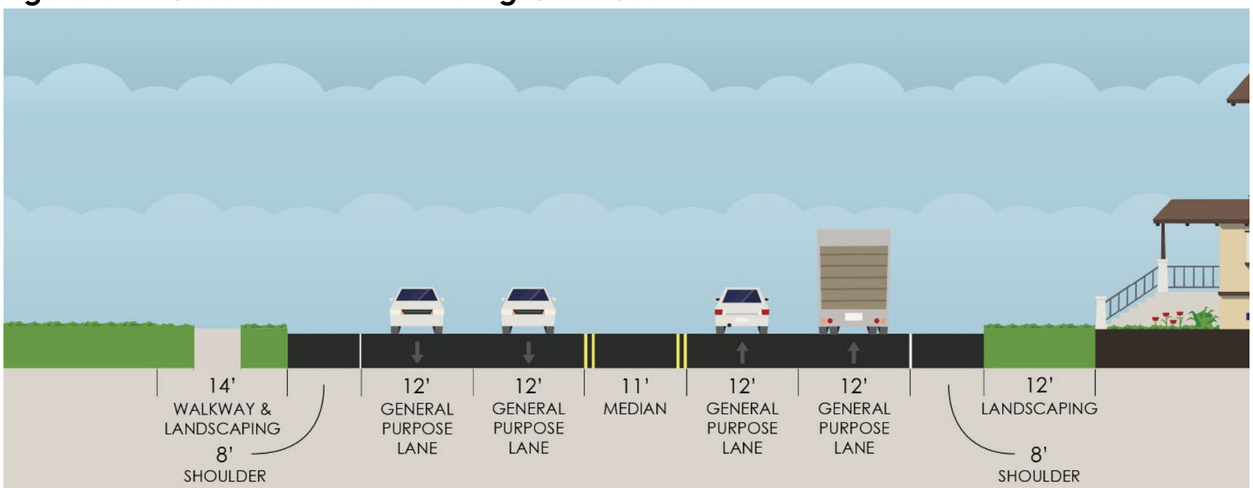


Alternative 3 relocates curb lines to widen sidewalks slightly and create a raised one-way Class IV separated bikeways along each side of the street. Curb relocation will typically require relocation of utilities, redesign of the existing drainage system and in this example incorporates stormwater planters at the curb as a landscaped buffer between the on-street parking and the Class IV bikeways. To allow space for the landscaped buffers, widened sidewalk, and Class IV separated bikeways, one vehicle lane in each direction is removed, and the raised median is replaced with a two-way left turn lane. Reducing vehicle lanes to provide Complete Streets elements requires detailed study to address and balance multimodal needs along the corridor such as transit operations. Vehicle lanes and parking lanes are also narrowed to provide additional space for the enhanced streetscape and Class IV bikeways. Buses would continue to operate in the right lane, but conflicts between buses and bicyclists are avoided through the design of the separated bikeway. Pedestrian and bicyclist interactions would still need to be managed at bus stops (see Section 7). In this example, conflicts between bicyclists and sidewalk users can be mitigated by installing the bikeways at an intermediate level (typically 2 to 3 inches below sidewalk elevation).

9.2 Suburban Area – Example Cross Sections

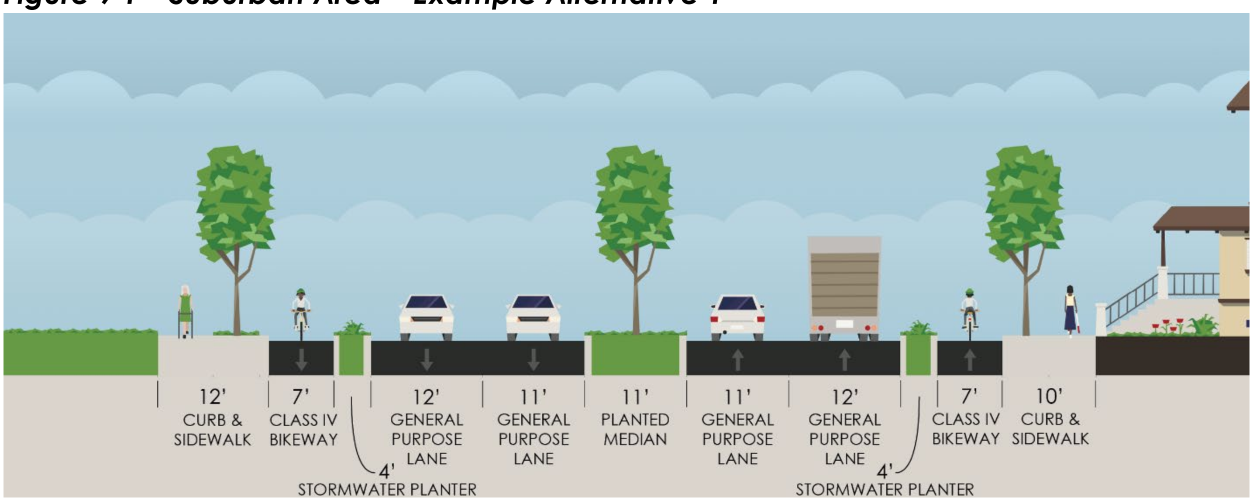
Suburban Area arterials frequently feature wide lanes and shoulders and lack, or have minimal, bicycle and pedestrian facilities. Where bus transit is present, it is important to ensure that adequate facilities are available for pedestrians and bicyclists who may be using the bus. Where higher speeds and volumes of vehicle traffic are present, buffer space and separation are especially valuable to both bicyclists and pedestrians. In the examples below, shoulder space is repurposed, and traffic lane widths are reduced to serve pedestrians and bicyclists on both sides of the street.

Figure 9-E - Suburban Area – Existing Cross Section



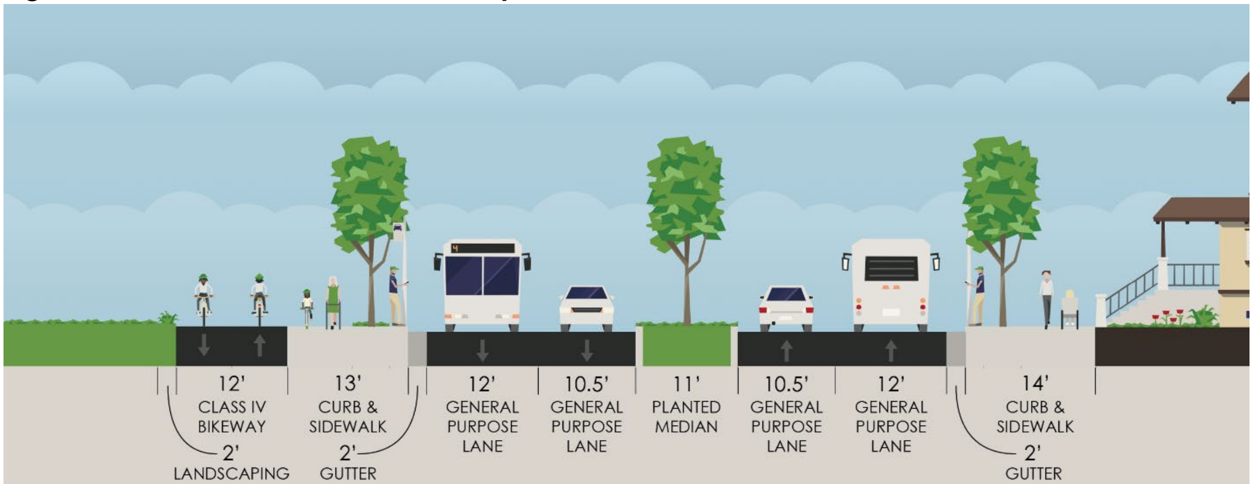
This hypothetical suburban arterial features two traffic lanes in each direction, a median, and shoulders. On one side of the roadway a paved walkway exists within a landscaped area. It may be anticipated that the walkway is currently serving both pedestrians and bicyclists.

Figure 9-F - Suburban Area – Example Alternative 1



In this Alternative, shoulders and some vehicle lane widths are reallocated for bicyclist and pedestrian use. Class IV separated bikeways are provided on both sides of the roadway, with curbed planters providing vertical separation. These planting areas may be designed as stormwater planters, accepting roadway runoff through curb cuts. On the left side of the section, the walkway is reconstructed as a sidewalk behind a wide planted buffer that includes street trees to provide shade. Trees are similarly included in the raised median. At the right side of the roadway, unpaved right of way becomes a sidewalk with street trees behind the bikeway.

Figure 9-G - Suburban Area – Example Alternative 2

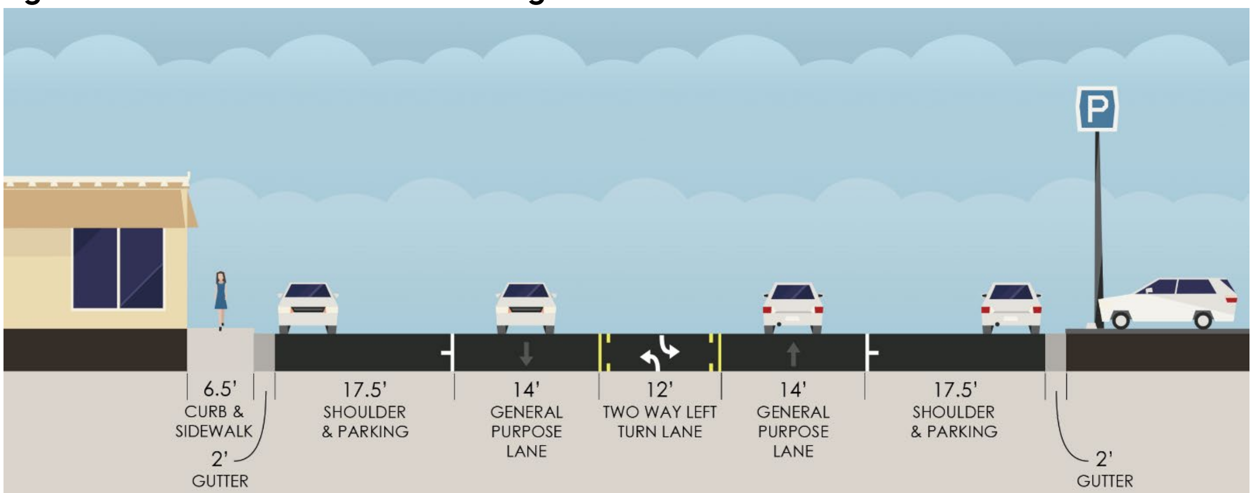


Alternative 2 accommodates a bus route with wider curbside lanes and sidewalks for passengers waiting and loading. Street trees are included on both sides of the roadway and in the median, providing shade and contributing to traffic calming. A two-way Class IV separated bikeway is provided for bicyclists on the left-hand side of the section, which has the benefit of avoiding conflicts with buses and pedestrians at bus stops. This configuration should consider the locations and frequency of intersections and provide convenient crossings for bicyclists to reach destinations on the other side of the roadway. If the locality allows riding bicycles on the sidewalk, it may be anticipated that some bicyclists will use the sidewalk on the other side and sufficient width should be provided.

9.3 Rural Main Street – Example Cross Sections

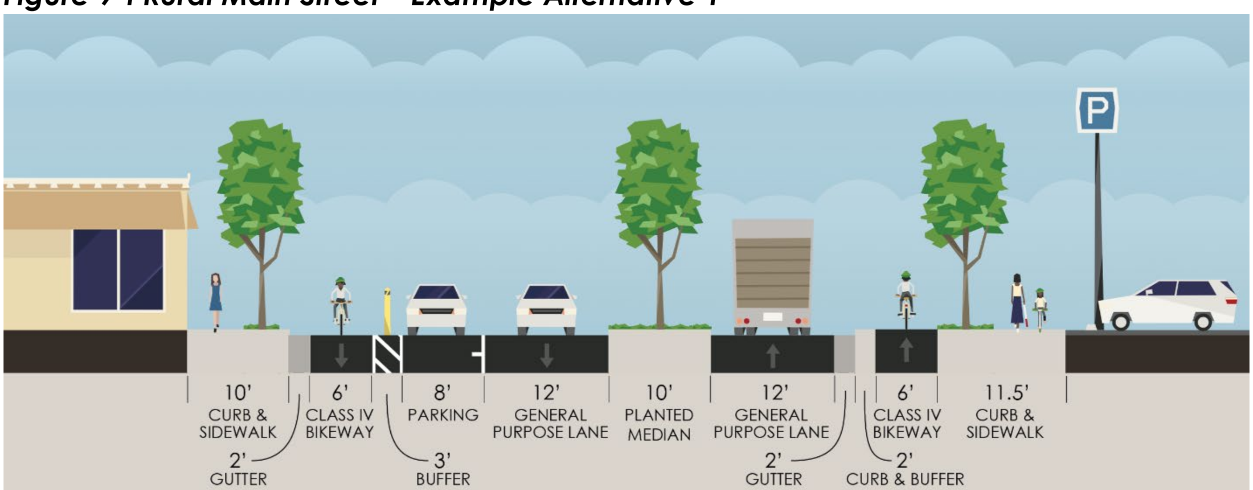
This rural arterial runs through a Main Street setting, but the cross section in its current state prioritizes automobile use through wide traffic lanes and shoulders that are available for parking. Identification of the place type as a Rural Main Street and site analysis of the project segment would both indicate a strong potential for travel by foot or by bicycle if the facilities supported those modes.

Figure 9-H - Rural Main Street – Existing Cross Section



Existing pedestrian facilities are discontinuous, and bicycle facilities are absent. The wide shoulders and parking lanes in this cross section present an opportunity to provide separated facilities for bicycle and pedestrian users. The presence of abundant off-street parking further supports the elimination or reduction of on-street parking in the roadway cross section.

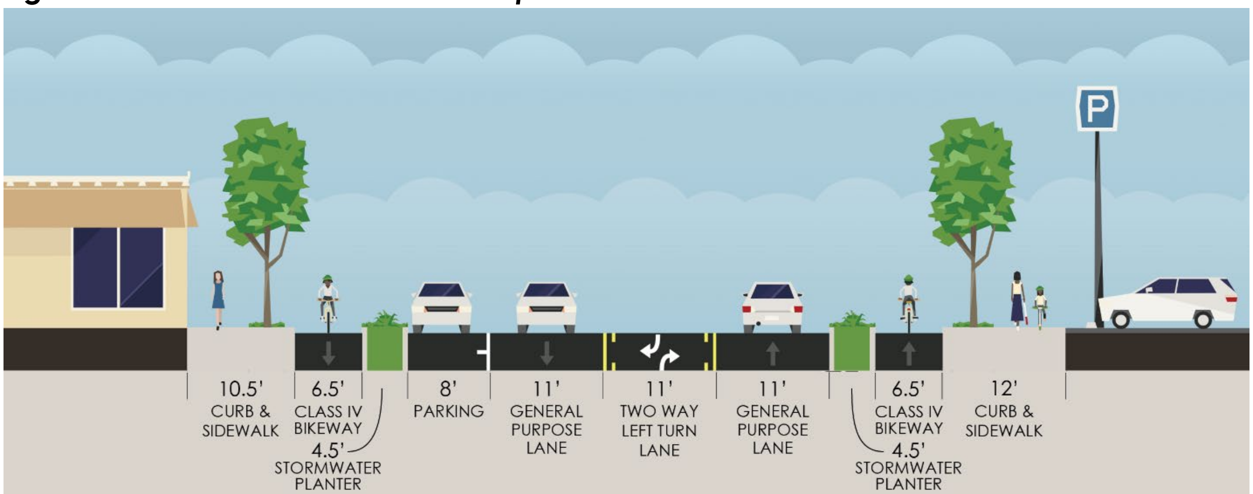
Figure 9-I Rural Main Street – Example Alternative 1



Alternative 1 repurposes shoulder and some lane width to create Class IV separated bikeways on both sides of the road. The design accounts for a route with heavy truck usage with 12-foot traffic lanes. On the right, the bikeway is raised to the sidewalk level with a curb and buffer. The buffer space adjacent to the curb is important for accommodating utilities and shy distance for bicyclists to keep wheels away from curbs and handlebars clear of objects. If pedestrians and bicyclists operate at the same elevation, a continuous detectable element such as a landscape planter should be used to separate pedestrians. On the left side of this cross section, on-street parking is preserved and utilized to provide separation for the

Class IV bikeway. The delineators shown, or any other vertical element, may also aid drivers unfamiliar with this configuration in identifying the correct area for parking. On both sides of the roadway, continuous, widened sidewalks with street trees in the buffer zone create a more comfortable and inviting pedestrian environment. This sidewalk buffer zone may also be used for furnishings such as benches, bike parking racks, or pedestrian scale lighting. The two-way left-turn lane in this alternative is replaced with a 10-foot planted median.

Figure 9-J - Rural Main Street – Example Alternative 2



Alternative 2 maintains a narrowed two-way left-turn lane and narrowed vehicle lanes. One-way Class IV bicycle facilities are provided with stormwater planters separating the bikeway from the parking on the left side of the street and vehicle lane on the right side. Parking is eliminated on the right side of the street given the available off-street parking. This additional space allows for the stormwater planter bikeway separation, as well as widened sidewalks with street trees and buffer space that may be used for furnishings.