BETTER STREETS

CITY OF RICHMOND

PREFACE

Treelined streets offer shade to people, young and old, walking and jogging on the sidewalks, while their friends and neighbors bike on the street, buffered from moving vehicles. Frequent and reliable transit service picks up people, taking them efficiently and comfortably to their jobs, shopping, entertainment, and visiting friends and family. Vehicles use the main streets to connect residents and visitors to entertainment, employment, and cultural resources. Everyone has a choice on how they move safely around the City of Richmond. Our history is reflected in the cobblestones and bricks that create our streets.

This is Richmond's vision. To achieve this vision, Richmond must provide guidance and standards for the design, construction, and maintenance of our City's streets. Richmond's Better Streets sets the standards for our streets, now and in the future.

Richmond City Council established the policy to support a comprehensive, integrated, connected multimodal transportation network that balances access, mobility, health, and safety needs of all users, including persons with disabilities, seniors, children, youth, and families. In support of this policy, the City has developed this Better Streets Manual.

This Better Streets Manual provides guidance for designing, constructing, operating, and maintaining complete streets throughout Richmond, today and in the future. Creating a complete street is a process; there isn't a formula. As transportation technology evolves, so should this manual—periodic reviews of its guidance will be important for Richmond to be on the leading edge of safely and efficiently connecting people and places.

Richmond's streets are changing.

Commitment to the Vision Zero Action Plan's principles and priorities is fundamental to this Better Streets Manual

Starting With a Vision

The Better Streets Manual isn't just about street design—it's about designing streets that support the mobility and safety of all users. Richmond's Vision Zero Action Plan presents a comprehensive set of strategies and actions to address safety on our City's streets, with a goal to eliminate all traffic related fatalities and serious injuries by 2030. Vision Zero is based on five fundamental principles:

1. Traffic deaths and severe injuries are acknowledged to be preventable.
2. Human life and health are prioritized within all aspects of transportation systems.
3. Human error is inevitable and transportation systems should account for this.
4. Safety work should begin with systems-level changes and follow with influencing individual behavior.
5. Speed is recognized and prioritized as the fundamental factor in crash severity.

These principles are supported by six Vision Zero priorities, three of which specifically relate to the design of complete streets:

- Collect, analyze, and use data to identify safety concerns and opportunities for improvement.
- Prioritize actions to provide a safe and equitable transportation system for all users.
- Lead with roadway design that prioritizes safety.

Walking Through the Better Streets Manual

Just like people walk before they can run, this Better Streets Manual starts with policy before moving into design and construction. The manual is divided into three parts:

- **Part 1** - Complete Streets Policy: Provides guidance on creating a complete street. Presents Street Typologies and presents guidance on all street elements within the right-of-way.
- **Part 2** - Geometric Design Guidelines (Right-of-Way Design and Construction Standards Manual): Provides standards for designing and constructing the infrastructure within the right-of-way.
- **Part 3** – Right-of-Way Excavation and Restoration Manual: Provides information on construction of the infrastructure in the right-of-way.

Working Together to Design Complete Streets

This isn't the start of Richmond's commitment to complete streets—the City has many resources that have influenced the information presented in this document or need to be used in conjunction with this document, including:

- Citywide Master Plan – latest version
- Downtown Plan (2009)
- Richmond Bicycle Master Plan (2015)
- Richmond Connects (2013)
- Vision Zero Action Plan (2018)
- Urban Design Guidelines (2006)

- Old & Historic Districts Handbook and Design Review Guidelines (First Edition 2006, updated 2017)
- Pulse Corridor Plan (2017)
- Richmond 300 Master Plan (under development 2018)
- Various Neighborhood Plans

Experts in the transportation industry have compiled standards for the implementation of the elements for complete streets. These standards (current versions) continue to serve as the basis for making good design decisions:

- American Association of State Highway and Transportation Officials (AASHTO) Green Book
- AASHTO Bike Guide
- Virginia Department of Transportation (VDOT) Road Design Manual and other related documents
- Virginia Department of Rail and Public Transportation Multimodal System Design Guideline
- Manual on Uniform Traffic Control Devices (MUTCD)
- United States Access Board Public Right-of-Way Accessibility Guidelines (PROWAG)
- National Association of City Transportation Officials (NACTO) resources, such as the Urban Bikeway Design Guide, Urban Street Design Guide, and Context Sensitive Solutions in Designing Major Urban Thoroughfares for Walkable Communities
- Institute of Traffic Engineers (ITE) Traffic Engineering Handbook, 7th Edition
- Transportation Research Board (TRB) Access Management Manual
- National Cooperative Highway Research Program (NCHRP) Report 672 Roundabouts: An Informational Guide
- Institute of Traffic Engineers (ITE) Designing Walkable Urban Thoroughfares: A Context Sensitive Approach
- Federal Highway Administration (FHWA) Achieving Multimodal Networks
- FHWA Unsignalized Intersection Improvement Guide (UIIG)
- FHWA Highway Safety Manual (HSM)

All improvements in the public right-of-way require the review and approval by the Department of Public Works.

Moving Richmond Forward

Creating streets that balance access, mobility, health, and safety requires collaboration among the City, the citizens, and the designers. Our transportation system is as diverse as Richmond's residents—one solution won't fit everywhere. And transportation isn't the only focus for our road network—the City's rights-of-way make up a significant portion of the public land in Richmond and serve as a significant resource for competing users of the space. Public and private utilities need these corridors to be their lifelines, delivering power, water, sewer, and stormwater to the adjacent land uses.

Use these guidelines to design streets that work for all users—young and old, mobility impaired, drivers, riders, walkers, bikers, utilities, business owners. In doing so, Richmond will be the smart city of the future, leading the region and the Commonwealth of Virginia as to what is possible in creating better streets.

Part 1
Complete Streets Policy

BETTER STREETS
CITY OF RICHMOND

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Part 1: Complete Streets Policy

This Better Streets Manual was prepared by VHB for the City of Richmond.

CHAPTER 1

INTRODUCTION AND VISION

This Better Streets Manual serves as guidance for the design of Richmond's streets. How Richmond defines a complete street is critical to understand when designing improvements to the transportation system. The guiding principles serve as the foundation of the City's definition for a balanced approach to accommodating all users while protecting the most vulnerable—pedestrians and bicyclists.

What are Complete Streets?

Richmond's vision of a complete street is that pedestrians, bicyclists, and transit users equally share the streets with motor vehicle users. Using smart and innovative techniques and technologies, the streets are designed to be safe and comfortable for people of all ages, to be sustainable, and to promote an active, vibrant, healthy community. The streets are easy to cross, walk along, and bicycle through, and also reflect the character of our neighborhoods and our history.

Richmond's streets are its lifelines. They connect people and places—by motor vehicle, frequent and reliable transit service, bicycle, and walking. They also serve as our utility corridors, bringing water and sewer, power, and communication. A complete street respects the needs of all and balances the competing needs for the limited space.

Streets connect our homes, shopping, entertainment, and businesses. Our public streets make up a large portion of the City's land—these public spaces are great opportunities to connect our neighborhoods, enhance our urban design, and improve livability for all citizens.

Establishing the Guiding Principles

This complete streets initiative, guided by Richmond City Council resolution, is to ensure that the design, construction, operation and maintenance of a comprehensive, integrated, connected multimodal transportation network balances the accessibility, mobility, health, and safety needs of all users, including persons with disabilities, seniors, children, youth, and families.

These guiding principles shall be used to inform the design and implementation of Richmond's complete streets policy,:

SAFE
Richmond's streets prioritize the safety of all users, with an emphasis on protection of the most vulnerable users.

GREEN
Richmond's streets are public spaces that integrate green infrastructure to improve street tree health, treat stormwater runoff, and improve overall environmental quality.

ACTIVE
Richmond's streets respect the context of the culture and history of the surrounding land uses and, together with the private property, create active, multifunctional places.

HEALTHY
Richmond's streets are designed to encourage everyone to walk, bicycle, and ride transit because they feel safe and comfortable and support the health and independence of all people.

MULTIMODAL
Richmond's streets are designed for walkers, bicyclists, and transit riders, of all ages and abilities, and motor vehicle drivers. Multimodal designs ensure streets are shared, balancing the needs of everyone.

SMART
Richmond's streets are the backbone of communication infrastructure, providing information to move people efficiently and safely on transit, bike share, and autonomous vehicles, and support Richmond's future transportation systems.

No street in Richmond stands alone

Understanding Richmond's Networks

No street in Richmond stands alone—our streets work together to form the larger transportation network. The goal of this Better Streets Manual isn't that every street equally accommodates every mode of transportation—it's that the network as a whole balances the needs of each mode, allowing each mode appropriate access.

The Richmond Bicycle Master Plan recommends a network of streets that together promote the comfort and safety of bicyclists. It doesn't mean that other streets aren't used by bicyclists for recreation or utilitarian trips. They just don't rise to the same level of investment.

To promote the use of transit, the street network that carries the buses needs to be designed to accommodate and support frequent and timely movement of buses and pedestrian and bicycle access to the bus stops. While streets connected to the transit routes need to support access to the transit service, they do not need to be designed to accommodate buses.

Not all streets present the same level of focus for all modes. This manual provides guidance on how to make good decisions on the best way to balance the priorities of all the modes. When you're starting the design decision process, begin by understanding how the street fits into the various networks—pedestrian, bicycle, motor vehicle, transit, and freight.

Designing Streets for Multiple Users

The process for planning and designing streets must be sensitive to the land use context and to the needs of the various users of the street. With constrained rights-of way, it's important to understand that different users of the street will likely have different expectations of what makes a "good" street. A design that works well for a motorist may or may not work as well for a bicyclist. Even if you could achieve the ideal street for all users, it might not satisfy the expectations of the people who live and work along it, or the needs of the adjacent land uses of the corridor.

So What Are Users' Expectations?

Motorists

Motorists are concerned about congestion and safety. They may expect streets to be widened and signalized intersections to be timed to enhance their travel times. To meet motorists' expectations for safe and efficient travel, ideal conditions would include minimal travel delays, minimal conflicts, and consistently designed facilities. These travel time expectations can be achieved with physical and operational changes such as:

- Adding through lanes or turn lanes to accommodate demand and facilitate access to adjacent parcels
- Providing more green time to the higher traffic volume street
- Constructing grade-separated intersections and roundabouts, which can limit delay and increase capacity
- Building bus pullouts to avoid delays caused by stopped buses

Safety expectations can be met by improvements including:

- Wide travel lanes
- Separate turn lanes
- Medians and other access management tools
- Great sight distances and street lighting
- Clear zones adjacent to the outside travel lane

However, meeting motorists' expectations means considering tradeoffs. While these improvements address vehicle congestion and safety, they may encourage higher speeds, create longer and unprotected pedestrian crossings, and contribute to an uncomfortable environment for bicyclists.

Pedestrians

Pedestrians need a sidewalk and enough time to cross the street—but they want to be comfortable and feel secure. Sidewalks need to connect. Pedestrians want to be able to walk on sidewalks from their home to the playground, to the store, to school, and other important destinations. To support and encourage walking as an attractive and viable travel mode, our streets should include features that pedestrians value, such as:

- Short walking distances
- Sidewalks separated from moving traffic
- Aesthetically pleasing surroundings and amenities
- Safety features including lighting and visibility

Design elements that encourage walking include:

- Width of sidewalks
- Marked crosswalks with signal control
- Continuous sidewalk systems that connect homes to businesses and public spaces
- Minimal number of driveways crossing the sidewalk
- Separation between the sidewalk and the travel lane, such as planting strips, parking lanes, or bicycle lanes
- Refuge islands or curb extensions at intersections
- Signal timings that provide adequate time for pedestrian crossing

The scale of the roadway would dictate the scale of the design elements. Pedestrians with mobility challenges have very specific expectations and require additional design elements to accommodate their disabilities.

Security is also an important consideration, since pedestrians feel more vulnerable than motorists. Street and pedestrian-scale lighting and increased visibility from adjacent land uses can improve that sense of security.

Conflicts can occur between pedestrians and bicyclists; therefore, the proper design of bicycle lanes is important to minimize bicyclists riding on the sidewalks.

Transit

To encourage the use of transit as a viable mode of transportation, the streets need to support both the rider and the driver. Transit drivers want:

- Enough space to operate their vehicles
- Minimal conflicts with traveler and roadside features
- Minimal delays to keep their route operating on time

Design elements that help meet their needs include:

- Wide travel lanes
- Wide corner radii
- Street signs, utility poles, and on-street parking located to maximize clearance for side mirrors
- Adequate merging distances

Transit riders have similar expectations as pedestrians. In addition, they want accessible bus stops that provide comfort and security and are out of the way of people walking along the sidewalk. Bus stops can also provide wayfinding, information, and be a potential space for public art for placemaking.

Bicyclists

Different types of bicyclists have different expectations related to their trips. Experienced bicyclists often feel comfortable biking in the travel lane, while casual bicyclists may prefer traveling in separated, dedicated bicycle lanes. Commuters and bicyclists making utilitarian trips will normally take the shortest, most direct route to their destination, while recreational or less experienced bicyclists may seek out indirect routes to enhance their experience or to avoid high-volume, high-speed streets.

All bicyclists want a well-connected network of bicycle facilities that feel safe. Good signage and visible pavement markings of bicycle lanes are important in meeting the bicyclist's expectations.

Design elements that improve the bicyclists experience include:

- Designated bicycle lanes
- Street lighting for visibility
- Bicycle accommodations at intersections
- Buffers or physical separation from travel lanes and parked cars

At intersections, bicyclists have special types of challenges caused by conflicting movements competing within the right-of-way. They need to be visible to both pedestrians and motorists.

Respecting and Supporting the Adjacent Land Uses

The transportation network supports the land uses. The adjacent land uses are an important consideration when designing the street. They need access to their property, potentially by all modes and want an aesthetically pleasing environment. However, how much access is appropriate and can it be safely accomplished? **The type of land use—residential, commercial, industrial—often determines the expectation and if parcels can be interconnected.** Residential land uses expect low speeds, safe and convenient pedestrian ways, and potentially on-street parking.

Downtown commercial uses depend on their customers walking or biking to their businesses, from parking facilities or transit. Pedestrian-oriented developments depend on wide sidewalks with street furniture and bicycle racks. Industrial land uses expect streets that accommodate larger vehicles.

So How Do You Use This Manual?

The following chapters will provide guidance on all of the street elements to assist in the decision-making process for creating a complete street. Challenges and opportunities are present in designing streets in an established community, like Richmond. The manual will cover the breadth of functions served by the public right-of-way and defines street typologies so that the community member, developer, designers, and city agencies can beginning the process of redefining the use and envisioning the complete street.

Transportation facilities form a system for moving people and goods. Each street needs to be considered as a part of a system—a connection. It is important to understand that connection—is it a critical link in the bicycle mobility system? Is the street a segment used by transit? Is it part of a freight route? The answers to these questions will help the user decide how to accommodate the transportation mode.

The manual is organized as follows:

Street Typologies and Overlays
This chapter will help you to understand how the streets function as a part of the transportation network. Decide on a street typology and check to see if any of the overlays apply before moving into the design of the complete street.

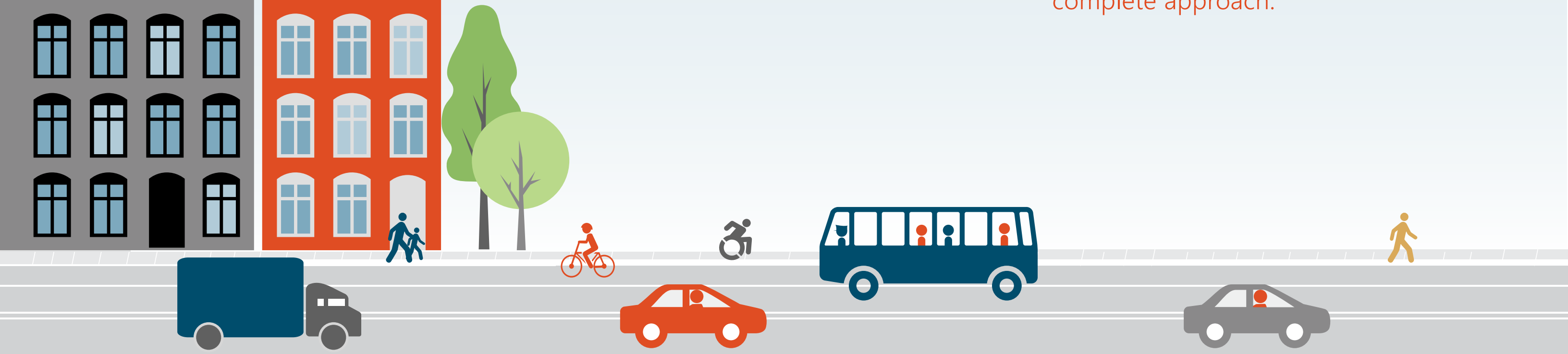
Sidewalk Zones
This chapter presents the design guidelines for the zone behind the curb or street edge. How wide should the sidewalk be? How wide should the buffer zone be based on the need for greenscape? Are there outdoor dining requirements for the frontage zone?

Street Zones
This chapter presents the design guidelines for the area between the curbs or edge of pavement. Should there be a parking lane? How wide should the travel lane be?

Intersections
This chapter presents guidelines for designing intersections. What configuration is best for the volume of motor vehicles, buses, pedestrians, and bicyclists? What is the appropriate geometry based on the street typologies? How are conflicts minimized?

Typologies & Street Elements Integration
This chapter brings it all together. The design of the complete street will come together, taking the guidance provided in the preceding chapters.

In summary, use the information provided in **Part 1** of the manual to prepare the concept for the complete street. **Part 2** will provide the design guidelines and **Part 3** will provide instructions for the construction of the complete street. Together, these documents will help the City reach their goal of providing for pedestrians, bicyclists, transit, and all motor vehicles in a balanced, complete approach.



CHAPTER 2

STREET NETWORK—TYPOLOGIES AND OVERLAYS

Every street is different

Every street is different. So how do planners and engineers make decisions when designing a complete street? Seven unique classifications of streets, or typologies, have been defined and will help designers think about the needs of pedestrians, bicyclists, transit, and motor vehicles. The purpose of this chapter is to assist designers in selecting the appropriate street typology; the following chapters on the Sidewalk Zone and Street Zone will present the design guidelines for each typology.

In addition to the street typology, other land uses or transportation needs may need to be considered. The focus should be on the process for appropriately accommodating the modes and less about the defined design. If a designer is planning improvements to a Neighborhood Connector Street where there is a school, the pedestrian and bicyclist are a higher priority. Several overlays are described in this chapter to provide additional guidance to the designer.

Select the right typology and check to see if any of the overlays apply before designing the complete street.

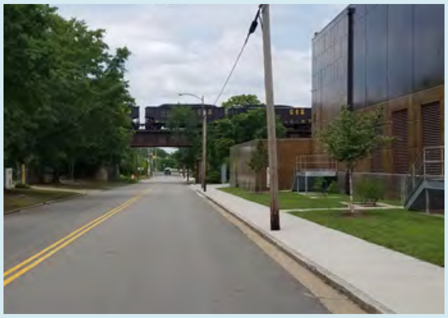
Street Typologies

Using a set of street typologies to classify Richmond's streets will help guide future land development, street design, and streetscape design projects. These seven typologies are not intended to be functional classifications, but they represent the character of the street, uses of the street, and the adjacent land use. Each typology includes guidance in providing for all modes of travel, prioritizing the needs of specific modes based on street and land use overlays. This approach does not mandate the transit and/or bikes must be accommodated on every street—instead, their accommodation will be determined as part of an overall network. With many of Richmond's right-of-ways constrained, tradeoffs must be balanced and should encourage healthy, active transportation options for walking and bicycling.

The first decision is to identify the appropriate street typology for the given roadway. Once decided, this manual will provide for each of the streets the standards and guidance that are aligned with the City's Complete Street Guiding Principles.

Because land use contexts can change throughout the length of a corridor, typologies may change. For example, a corridor may be characterized as a Neighborhood Connector street, but a commercial node along the street may result in a segment being classified as a Mixed-Use Street. Street elements will change, reflecting the street designation and, therefore, it's economic and mobility objectives.

Industrial Streets

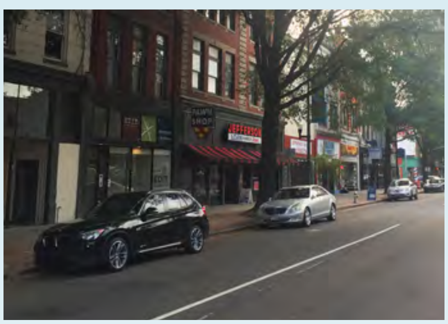


Industrial Streets support manufacturing and commercial businesses and are built to accommodate commercial truck traffic. These streets are typically located away from downtown and residential communities, and connect directly to the regional highway system and other distribution hubs. Industrial Streets often do not have transit or pedestrian or bicycle accommodations.

Examples: North Hopkins Road (west of US 1), Ownby Lane, Commerce Road

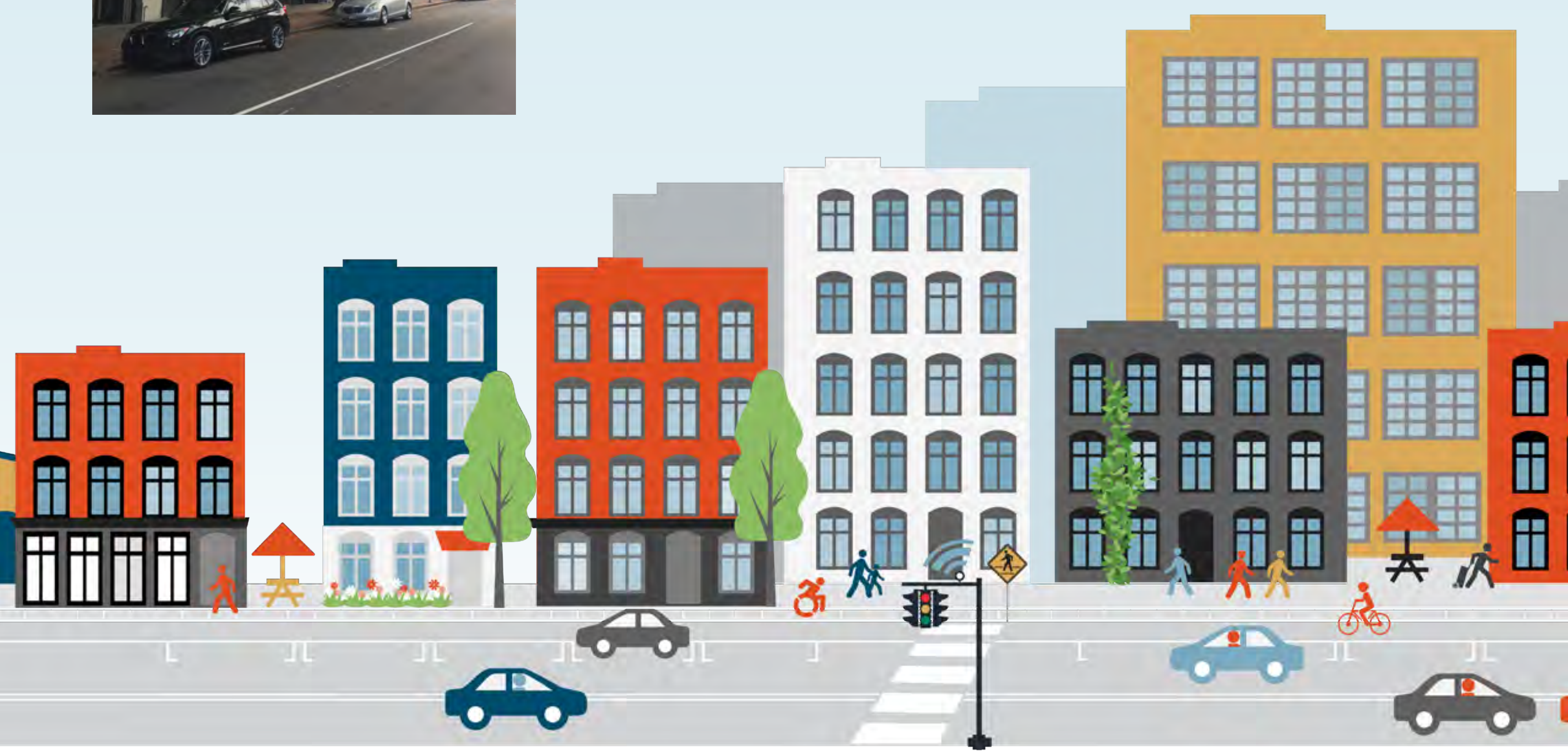
Industrial Streets

Mixed-Use Streets

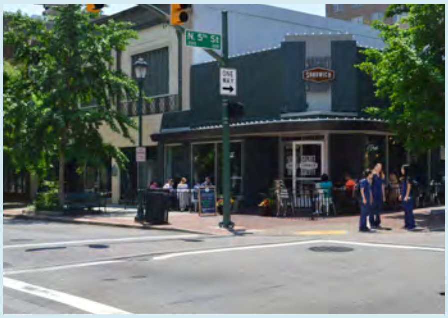


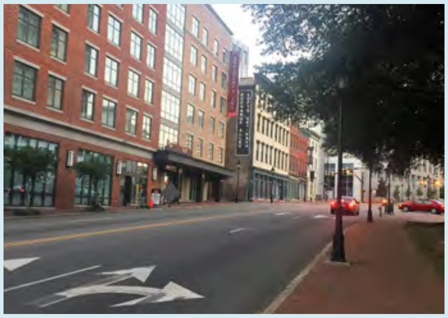
Mixed-Use Streets serve a mix of retail, residential, office, and entertainment uses, in historic or institutional areas of the city. Adjacent buildings are typically two to five stories, and building facades are at the property line. The first floor can be retail or access to multifamily residential. Mixed-Use Streets have high pedestrian volumes and bicycle activity. Streetscape features, such as benches and trash receptacles, are often in the sidewalk zone. The curbside uses prioritize walking, bicycling, transit, and short-term parking access and loading for local shops and restaurants.

Examples: Scott's Addition, Shockoe Bottom, VCU Monroe Park, Carytown, Libbie/Grove, Brookland Parkway



Downtown Streets

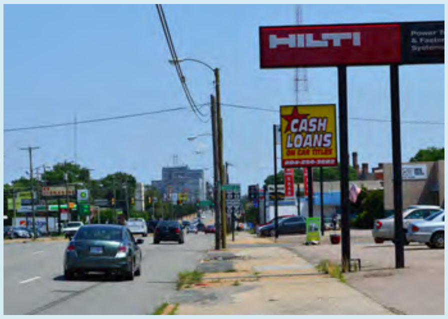




Downtown Streets are located in the core of the city and serve a variety of land uses with a high density. Many are one-way, with sidewalks and on-street parking, and walkable block lengths are usually 300 to 400 feet. Building faces are usually on the property line. The Downtown is a vibrant blend of opportunities to live, work, shop, and play. Downtown Streets support high levels of walking, bicycle, and transit, as well as frequent parking turnover, including loading zones. On-street parking is common along Downtown Streets. Alleys provide access to building deliveries, trash collection, and utility infrastructure. The design of Downtown Streets focuses on providing adequate facilities for all modes—pedestrians, bicyclists, and transit users—with the goal of reducing motor vehicle speeds and creating a more desirable environment for people.

Examples: E. Franklin Street, 7th Street

Commercial Connector Streets



Commercial Connector Streets serve mostly commercial areas with lower-density shopping centers, restaurants, gas stations, entertainment centers, office buildings, and other employment centers. These streets are typically located away from the Downtown area. Commercial Connector Streets are dominated by motor vehicle traffic (cars, transit vehicles, and trucks) and have less pedestrian and bicycle activity and fewer accommodations. Buildings are likely set back from the road and parking is provided on site. These streets are often multilane, serve faster moving traffic, and often provide regional connections. Transit routes exist. Intersections include separate turn lanes for all approaches and are often signalized.

Examples: Midlothian Turnpike, Hull Street, Broad Street (west of Hamilton Street)

Commercial Connector Streets

Neighborhood Connector & Residential Streets

Neighborhood Connector Streets primarily serve residential land uses, with some integrated businesses. They are usually two-way, multilane streets with speed limits over 25 mph. Existing Neighborhood Connector Streets are dominated by motor vehicles, but often have pedestrian and bicycle accommodations. These streets often have bus stops and are key routes in the transit network.

Examples: W. Cary Street, Monument Avenue, Brook Road, Malvern Avenue

Neighborhood Residential Streets serve residential land uses as well as schools, churches, and businesses within residential neighborhoods with lower levels of motor vehicle traffic. Pedestrian and bicycle activity is common along these streets.

Some Neighborhood Residential Streets have sidewalks and offer on-street parking. Typically, these streets are no more than two travel lanes (one in each direction) and are not intended for through traffic.

Examples: Cherokee Road, Grove Avenue, Hawthorne Avenue, Fourqurean Lane

Parkways

Parkways extend through or along parks and natural areas. Parkway design is focused on minimizing impacts to the adjacent natural areas, creating and maintaining the park-like character. Parkways are normally two-lane roads and offer accommodations for bicycles and pedestrians.

Examples: Park Drive, Riverside Drive

Street Overlays

Overlays provide an added modal emphasis to some streets. While all streets will fall into a street typology, a few streets will have multiple land use and street overlays in order to provide additional guidance regarding the functional priority and other design decisions. It is the responsibility of the designer to determine if one or more overlays apply.

Bicycle Network Streets

Bicycle Network Streets are designated in the Richmond Bicycle Master Plan. The plan presents a bicycle network and makes recommendations on the type of bicycle accommodation that should be implemented. Projects will be implemented as part of street repaving, redevelopment, or as stand-alone capital projects. Final decisions about the design and facility type will be made based on additional public input and analysis.

Examples: Bainbridge (Broad Rock to Brander Street), Grove Avenue (Three Chopt Road to Thompson Street)

Transit Streets

A Transit Street emphasizes transit by employing designs that make it safe for transit to operate in mixed traffic. The design of these streets should provide easy access and comfort to transit potential users, including people with disabilities. A Transit Street contains a high level of transit service and/or numerous transit routes. This category is not intended to encompass all streets where transit exists, but instead focuses on the more transit-intensive streets. The Pulse (Bus Rapid Transit) Corridor Plan provided additional guidance on the design and priority of the modes. Current transit routes can be found on the Greater Richmond Transit Company (GRTC) website.

Examples: Nine Mile Road, Jefferson Davis Highway, Forest Hill Avenue

Land Use Areas

Several designated districts and area plans in Richmond will influence the design of the streets. It is important to check the location of streets being designed to see if they should be influenced by the conclusions of previous planning studies or by the district they are located in. City Old and Historic Districts have been designated by the City. These Land Use Areas focus on the preservation of historical or original layout, and materials must comply with design guidelines and policies. Street design should preserve and potentially accentuate the history and identity of these streets. Other designated districts, such as the Riverfront, can be located on the City's Land Use Project Mapper.

School Zones (K-12, Universities)

The higher volume of pedestrians of all ages, school buses, and bicyclists around schools and university campuses influences the design of the accommodations for these modes. Design projects in the vicinity of public and private schools should give preference to pedestrians. The extent of a zone will be dependent on the location of the school within the street network and will extend beyond the property boundaries of the school to include the pedestrian and bicycle influence area of the school as defined by the city Transportation Engineer.

Richmond High Injury Street Network Map

Vision Zero Priorities (High Crash Locations)

The City's Vision Zero Action Plan (available on the City's website) presents a number of maps that show high pedestrian crash locations, the VDOT High Injury Streets Network, and areas with low to high Health Opportunity Indexes (HOI). Complete streets improvements can influence these statistics through engineering countermeasures targeted to the identified crash types. Design decisions on these streets should consider how the improvements can improve transportation safety and can contribute to the improvement of the overall health of residents in areas with the greatest need.

Freight Routes

The movement of freight within the City is important to consider when designing a complete street. The corridors of statewide significance need to be designed to accommodate large trucks, while still considering the needs of the more vulnerable users. National corridors, as defined by the Virginia Office of Intermodal Planning and Investment, include Interstates 95 and 64. These corridors provide access to the City's streets that either serve the industrial uses or to alternative routes through the City based on the vehicle and load requirements (size and weight). Design decisions on these streets should consider the size of these large trucks and their turning movement requirements. VDOT's website identifies designated (STAA) truck routes and restrictions.

Using Street Typologies in Complete Streets

Designing streets is a process of evolution and refinement. Street typologies provide a starting place from which each street can be individually tailored to complement the land uses and activities along it. The typologies do not provide an absolute formula—they provide options for communities to make informed choices as part of a planning or redesign process. They can help set objectives to be advanced and emphasized through street design, reflective of the numerous overlays, and focused on transportation safety.

CHAPTER 3

SIDEWALK ZONES

Character, accessibility, connectivity

The pedestrian is one of the most vulnerable users of the city's streets. A complete street provides a comfortable area that encourages people to walk. The Sidewalk Zone is the space between the edge of the road and the private property which serves as the connection between the adjacent land use and the street. The Sidewalk Zone needs to be wide enough to accommodate an accessible path and provide space for lighting, signage, and street furniture. This policy supports the City's goal to build healthier communities and provide pedestrian-friendly streets. Improving the quality of the pedestrian environment helps to create vibrant public spaces.

How do you create a Sidewalk Zone that is safe, attractive, comfortable, and convenient? Consider the following goals:

- Design the Sidewalk Zone to be accessible by all users
- Design a pedestrian environment that encourages walking, incorporating lighting, street trees, and street furniture
- Meet the needs of the future pedestrian volumes
- Minimize vehicle intrusions across the Pedestrian Travel Zone

Sidewalk Zone Definition

The public Sidewalk Zone is the area in the City's right-of-way located between the property line and curb or edge of the roadway. These areas are specifically designed for pedestrian users and play a critical role in the character, accessibility, and connectivity of City's streets.

Sidewalk Zones are the portions of the street that are designed for pedestrians, but can accommodate other uses such as outdoor dining, stormwater management, landscaping, and utilities. The Sidewalk Zones are comprised of three functional elements:

- **The Frontage Zone**
- **The Pedestrian Travel Zone**
- **The Buffer Zone**

Each of these zones provides a unique function in the overall street operation. The entire Sidewalk Zone shall be graded to ensure that all stormwater flows into collection systems within the public right-of-way.

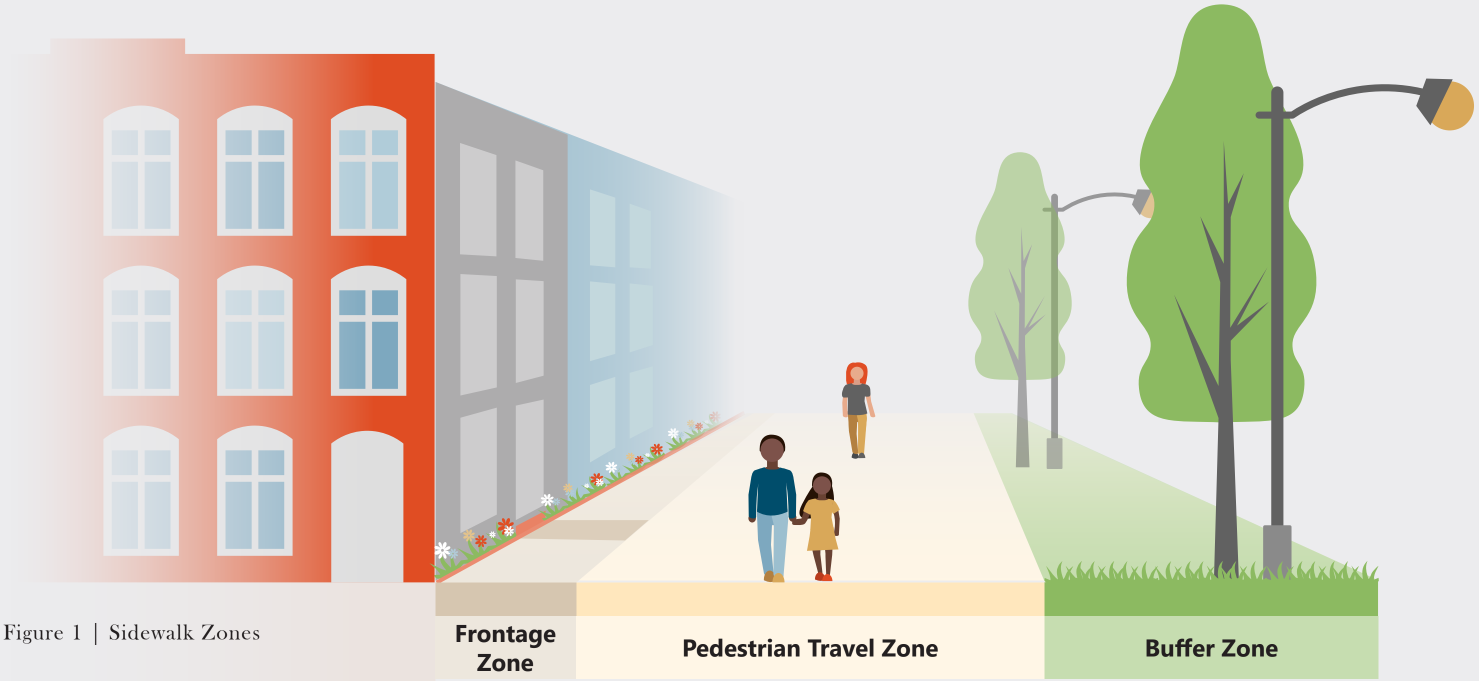


Figure 1 | Sidewalk Zones

Frontage Zone

The Frontage Zone is located between the face of the adjacent building or edge of the private property and the Pedestrian Travel Zone. In locations where buildings are adjacent to the sidewalks, the Frontage Zone serves as a buffer to pedestrians from opening doors and other architectural elements that may encroach into the public right-of-way. In urban areas, the Frontage Zone can also serve as space for outdoor dining, storefront seating, store entrances, displays, and landscaping—as long as these elements do not infringe upon the Pedestrian Travel Zone. The Frontage Zone may vary widely in width. In the areas of encroachments, the minimum width of Frontage Zone should be the width of encroachment plus an additional 1 foot. The maximum width of the Frontage Zone can vary from a few feet to several yards, depending upon the use and context. The Frontage Zone could extend onto private property, creating an extension of the public space for activity. The design of the Frontage Zone on private property is governed by the City's Zoning Ordinance and maintained by private property owners.

Private encroachments in the public right-of-way require approval, based on the policy established by the Department of Public Works. These encroachments range from building thresholds and accessible access structures to outdoor dining. The elements in the Frontage Zone should not protrude into the Pedestrian Travel Zone.

For the outdoor dining, **Table 1** should be used to determine maximum encroachment based on the existing sidewalk zone width. The decision to permit outdoor dining will be subject to a variety of factors including pedestrian volumes, context, and other existing obstructions. Any required barriers to enclose an area for outdoor dining must be included in the encroachment area.

Pedestrian Travel Zone

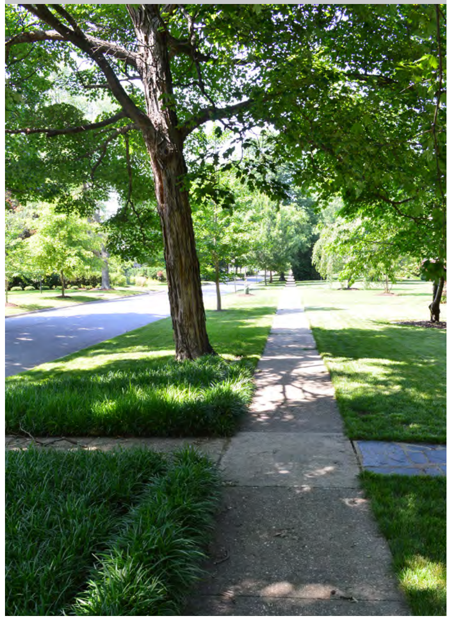
The Pedestrian Travel Zone is a part of the Sidewalk Zone that is specifically reserved and designated for active pedestrian use. This zone must be kept clear and free of any impediments to walking, providing a degree of separation from moving vehicles and/or a populated furniture zone and must be wide enough to comfortably accommodate expected pedestrian volumes regardless of physical ability. At a minimum, the Pedestrian Travel Zone shall meet the ADA (Americans with Disabilities Act) accessibility guidelines. This area should be free of any physical barriers, be well lit, and be clear in all weather conditions. The surface materials should be durable and slip resistant, and should meet sidewalk requirements presented in **Part 2** of this Better Streets Manual.

When selecting materials for the Pedestrian Travel Zone, the designer shall consider the life cycle of the materials and the potential cost of future maintenance. The City standard for sidewalks are concrete and brick. Brick and pavers should be installed in a manner to minimize potential for creating trip hazard (due to heaving, settling, etc.). Any nonstandard material will require the approval of the Urban Design Committee for Location, Character, and Extent. Section 5.8 in **Part 2** of this manual provides more detail on Pedestrian Travel Zone materials and patterns.

The ADA specifies the minimum width, maximum slope, maximum cross slope, and texture for public sidewalks or the Pedestrian Travel Zone. According to the ADA standard, the minimum requirement for the Pedestrian Travel Zone is a 5 feet clear path width without utilities or other obstructions, to accommodate two wheelchairs passing each other.

Sidewalk Zone Width (feet)	Frontage Zone Width (feet)	Pedestrian Travel Zone Width (feet)	Buffer Zone Width (feet)	Outcome
4 to 10	-	-	-	No outdoor dining
11	3	6	2	Outdoor dining may be considered
12	3	6	3	
13	4	6	3	
14	4	6	4	
15	5	6	4	
16	5	6	5	
17	5	7	5	
18	6	7	5	
19	6	7	6	
20	6	8	6	

Table 1 | Dimensions for Outdoor Dining Encroachments



Wider Pedestrian Travel Zones should be considered at locations with:

- High pedestrian volumes
- Street furnishings and/or landscaping
- Transit stops
- Street-level commercial and institutional activity
- Areas with zero building setback
- Tall buildings
- High traffic volumes and/or high speeds

A shared use path can be used instead of a typical sidewalk in the Pedestrian Travel Zone. It allows for two-way, off-street bicycle use and may also be used by pedestrians, skaters, and others, including people with disabilities. Typically, these facilities are found in parks and along roadways or watercourses where there are few conflicts with motorized vehicles. The preferred width is 10 feet of shared-use path for moderate to heavy use and 12 feet for heavy use situations with high concentrations of multiple users. The shared use path should have frequent connections to the street network, and should be a minimum of 8 feet wide in low traffic conditions. The Richmond Bicycle Master Plan provides more information on the design of shared use paths.

Buffer Zone

The Buffer Zone is the area between the back of the curb or edge of pavement and the Pedestrian Travel Zone. It provides separation from moving vehicle traffic. The Buffer Zone also provides space for placement of street elements such as street trees, landscaping, street furniture, street lights, traffic signal poles, signage, hydrants, stormwater elements, bicycle racks, transit stops, trash bins, smart infrastructure (solar panels on recycling and trash bins), parking meters, and utilities. The placement of all elements should be carefully considered so the elements do not encroach on the Pedestrian Travel Zone. Careful consideration should be given to the placement of signs, street trees, light poles, or other objects in the Buffer Zone. These objects can reduce intersection sight lines and impede access to parked cars.

Angle parking shall be offset such that any vehicle overhang onto the Sidewalk Zone doesn’t extend into the clear effective Pedestrian Travel Zone.

The Buffer Zone should be 4 to 6 feet wide. The Buffer Zone width is based on the Street Typology (see page 22).

Greenscape

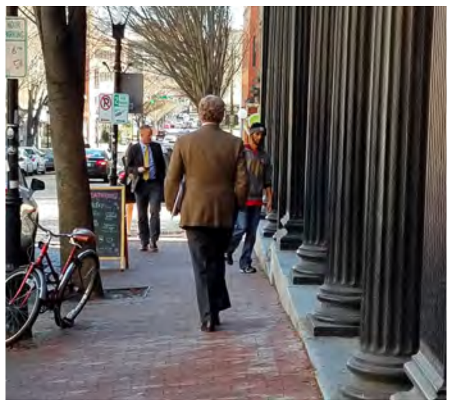
Buffering pedestrians from moving vehicles increases their feeling of comfort and security. Planting strips (street trees and landscaping) are recommended between the curb and the Pedestrian Travel Zone in the Buffer Zone whenever possible. A preferred width of 4 feet or more is desired unless there are right-of-way restrictions.

Trees and planting strips

Street trees and planting strips can help to create suitable buffers between pedestrians and traffic, and also:

- Create aesthetic enhancement to a street
- Help mitigate air pollution
- Allow infiltration of stormwater
- Provide shade and lower temperatures
- Help reduce traffic speeds
- Create a natural barrier between vehicles and pedestrians

Proper maintenance is a key to the success of planted areas and should be considered in the design process. Native non-invasive species should be used. Planting strips should be avoided in the areas with on-street parking and/or high pedestrian volumes and limited width of Pedestrian Travel Zone. In areas where planting strips are allowed, there should be frequent breaks in the strips to allow faster walking speeds and pedestrian passing. The City Arborist must be consulted when planting street trees to determine the appropriate species for the space available.



Stormwater Management

Pedestrian Travel Zones need to be designed such that the stormwater flows across the zone into the drainage conveyance system (gutters or swales) for collection. Buffer Zones can provide a location for stormwater management best management practices (BMPs). The following techniques may be considered:

- **Vegetation swales** are long, shallow, vegetated depressions designed to accept sheet flow runoff. The use of swales allows the reduction of stormwater volume through infiltration as well as the improvement of water quality through vegetative and soil filtration. Vegetative swales often require wider Buffer Zones and are not appropriate in certain Street Typologies.
- **Stormwater planters** to manage stormwater runoff by providing storage and infiltration.

- **Stormwater tree trenches** are a system of trees connected by an underground infiltration structure to manage the incoming runoff. Stormwater runoff flows through a special inlet leading to the stormwater tree trench, which waters the trees and slowly infiltrates through the bottom.
- **Bioretention basins** are landscaped depressions in the Buffer Zone used to slow and the treat stormwater runoff.

Bicycle Parking

With the number of bicyclists in the City ever increasing, bicycle parking has become an important facility that encourages bicycling and helps to make bicycling a more viable transportation for bicycle users. Bicycle parking should be prioritized in high-demand areas. Location of bicycle parking shall not encroach into the pedestrian travel zone and should be coordinated

with the demand for bicycle parking, which could be adjacent to commercial areas, public facilities, and attractions. Bicycle parking should be provided close to common destinations, as bicyclists will seek objects to lock to that are visible and as close to their destination as possible.

Bicycle parking is typically located in the Buffer Zone. Bicycle racks should be placed at least 5 feet from fire hydrants and crosswalks; 4 feet from loading zones, transit stops and benches; and a minimum of 3 feet from parking meters, newspaper racks, mailboxes, light poles, sign poles, and other street furniture. In all cases the length of typical bicycle (70 inches) should be considered. Bicycle racks should be spaced minimum 3 feet (Reference Richmond's Bicycle Master Plan).

Street Furniture

Street furniture plays an important role in making the Sidewalk Zone more attractive for pedestrians by providing a pleasant walking environment, encouraging transit use, providing places to rest, and supporting use of the street as a public space. The following elements are included in the street furniture category: benches, bicycle racks, bus shelters, newsstands, informational signs and kiosks, and waste receptacles.

Utilities

The public right-of-way serves as important corridors for lifeline public and private utilities (those which are essential to community such as water, wastewater, energy, and telecommunications). While most of this infrastructure is underground, some facilities are located above ground. The location of any above-ground infrastructure should be in the Buffer Zone and should not encroach into the Pedestrian Travel Zone.

Lighting

Street lighting increases visibility for vulnerable users like pedestrians and bicyclists. It also improves a pedestrian's sense of personal security and safety. Street lighting enhances the motorist's ability to see pedestrians, which is particularly important at locations with transit service and adjacent to land uses with high pedestrian volumes during evening hours. Lighting levels should be designed for both the Vehicular Travel Zones and the Pedestrian Travel Zones. The City encourages use of state-of-the-art, environmentally friendly, energy-efficient, and effective technology.

The Department of Public Utility approves the design of street lights.

Driveway Design

Driveways across the Sidewalk Zone provide access to businesses, loading areas, and off-street parking areas. Driveways create conflicts between pedestrians and moving vehicles. In order to provide a continuous safe and comfortable walking environment, driveways should be designed to provide a continuous and level pedestrian path across the vehicular path, and to prioritize the pedestrian movement. In areas with alleys or existing entrances, to allow interparcel connectivity and alley service, the developer shall obtain an encroachment permit prior to construction.

For more information on driveway design, refer to **Part 2** *of this Manual.*

Dimensions for Sidewalk Zone

Sidewalk Zone widths will vary based on the Street Typology, the available right-of-way, and the type of adjacent land uses. For example, on a street segment with high pedestrian activity due to adjacent commercial and retail land uses, a wider Pedestrian Travel Zone might be necessary to accommodate existing and future pedestrian demand. On the other hand, a Pedestrian Travel Zone should not be too wide, as it might create a feeling of an empty street, making pedestrians feel lost and out of place.

In constrained rights-of-way, the preferred Sidewalk Zone width may not always be possible; design judgment must be used to achieve safe, functional, and comfortable balance. **Table 2** presents preferred and minimum Sidewalk Zones widths. In the areas with high pedestrian volumes, the Pedestrian Travel Zone should be balanced with other Zones to serve high pedestrian demand.

The Frontage Zone should be maximized to provide space for outdoor dining, but not at the expense of reducing the Pedestrian Travel Zone beyond the preferred width. Also, the Buffer Zone should be maximized where possible beyond the preferred width to provide separation between pedestrians and moving vehicular traffic, but not by reducing the Pedestrian Travel Zone.

Any deviation from the parameters presented in this chapter shall be submitted to the City Transportation Engineer for review and final decision.

	Frontage Zone (feet)	Pedestrian Travel Zone (feet)		Buffer Zone (feet)	
		Preferred	Minimum	Preferred	Minimum
Downtown Streets	1	>8	5	5	2
Commercial Connector Streets	0.5	6	5	6	4
Neighborhood Connector Streets	0.5	>6	5	6	4
Neighborhood Residential Streets	0.5	6	5	4	4
Mixed Use Streets	1	8	5	5	2
Industrial Streets	0.5	5	5	4	4
Parkways	0.5	6	5	4	4

Table 2 | Preferred Width for Sidewalk Zones

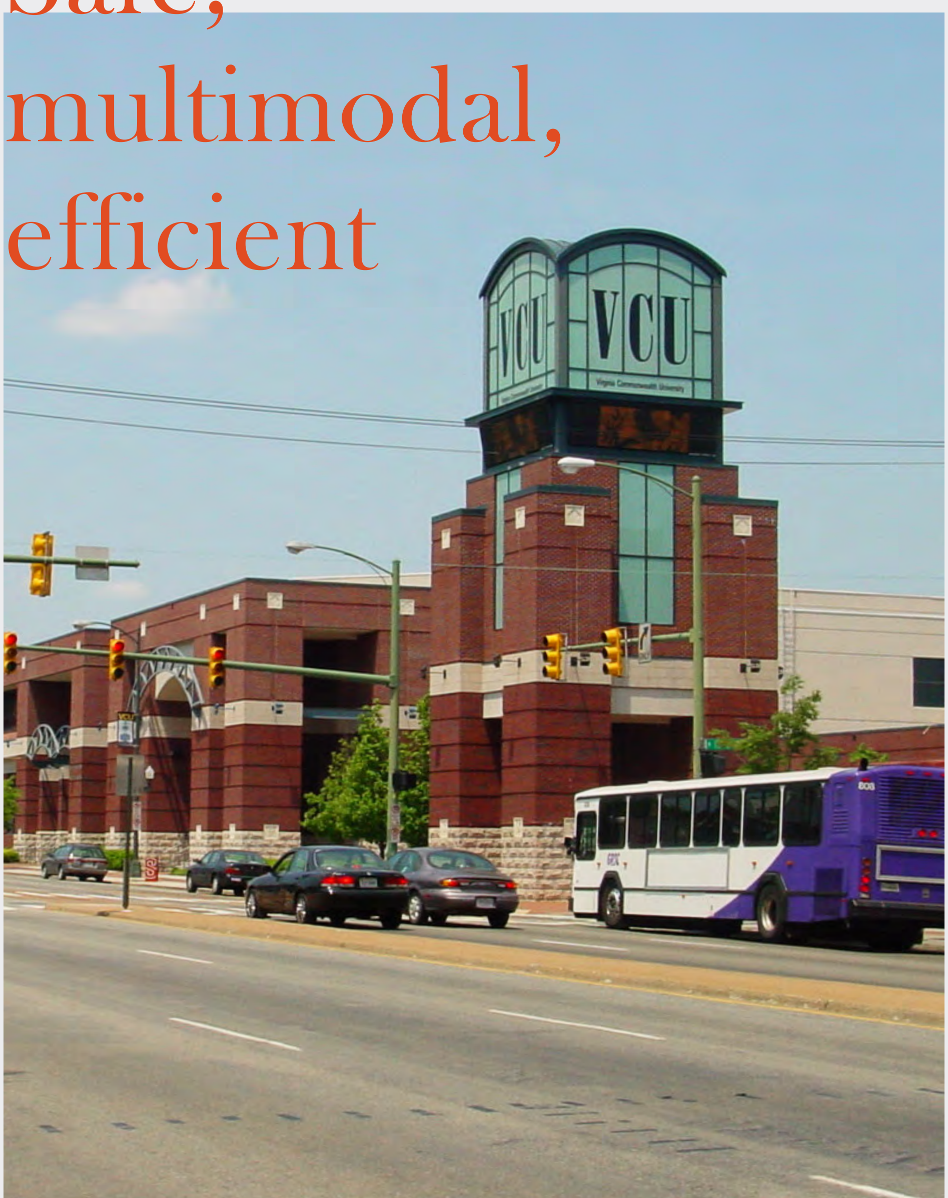
CHAPTER 4

STREET ZONE

The City of Richmond's transportation history dates back to early 17th century when the city served as a port to early colonists. Later, in the 19th century, the City pioneered the first electrically powered street trolley railway system in the country. The roadway and street network has been developing over centuries with transportation mode priorities changing over time. This chapter covers the design of the Street Zone.

The Street Zone is for moving vehicles and parking. Pavement markings, raised medians and islands, and signage designate the allocation of the zone to specific users—bicycles, motorcycles, buses, trucks, and cars. The Street Zone complements adjacent land uses and provides access to those land uses.

Safe, multimodal, efficient



How do you create a Street Zone that is safe, multimodal, and efficient?

Consider the following goals:

Optimize the Street Zone to balance the needs of all transportation modes: bicycles, transit, and motor vehicles

Reduce the number of conflict points for the different transportation modes

Provide safe and convenient accommodations for all transportation modes

Use of **sustainable, long-lasting, and easy to maintain** materials

Provide separation between moving vehicles and vulnerable transportation modes, such as pedestrians and bicyclists, or incorporate design features that accommodate all modes in a shared street concept

Reduce congestion by providing infrastructure for transit, high-occupancy motor vehicles and encourage the use of non-motorized transportation

Maximize technology advances without overlooking low-tech solutions

The Street Zone provides a corridor for underground public and private utilities, which needs to be considered when designing the complete street.

Street Zone Definition

The Street Zone is an area in the City's right-of-way located between two curb faces or edges of pavement. This area is for motor vehicle and bicycle travel, and vehicular parking. As shown in Figure 4-1, the Street Zone consists of two functional elements:

- Vehicle Travel Zone
- Curbside Zone

Each of these zones provides a unique function and plays a critical role in the overall street operation.

Vehicle Travel Zone

The Vehicle Travel Zone is the portion of the street that is reserved for vehicular travel, including transit, motor vehicles, and bicycles, if no other bicycle-specific accommodation is provided. Speed and width are important to consider when designing the Vehicle Travel Zone. Lower speeds promote more equitable use by all transportation modes in urban areas. The Vehicle Travel Zone includes the following elements:

- Turn and travel lanes
- Median/refuge islands
- Transit lanes

The design of turn lanes and travel lanes have a significant impact the operation of the street. While it is important to increase efficiency of movement for motor vehicles, the safety and comfort of vulnerable street users is the priority. Travel lanes should be minimized to maintain the narrowest cross section to support the comfort of all users, and help reduce speeds.

Medians are the center portion of a street that separate opposing traffic. Medians can vary in width and purpose. In urban environments, medians can be used to increase pedestrian safety by creating pedestrian refuge islands, to improve access management, to accommodate turning traffic, and to create a focal landscape point. Medians can also be used in street design to add urban design features, lighting and landscaping. However, medians are not typically used on streets with low traffic volumes and low speeds.

Transit lanes accommodate transit vehicles that are vital to an urban system. When designing urban streets, it is important to ensure that roads traveled by heavy vehicles are designed to accommodate these types of motor vehicles safely alongside other street users. Transit vehicles have different performance characteristics and often require more space for turning and longer stopping distances than cars.

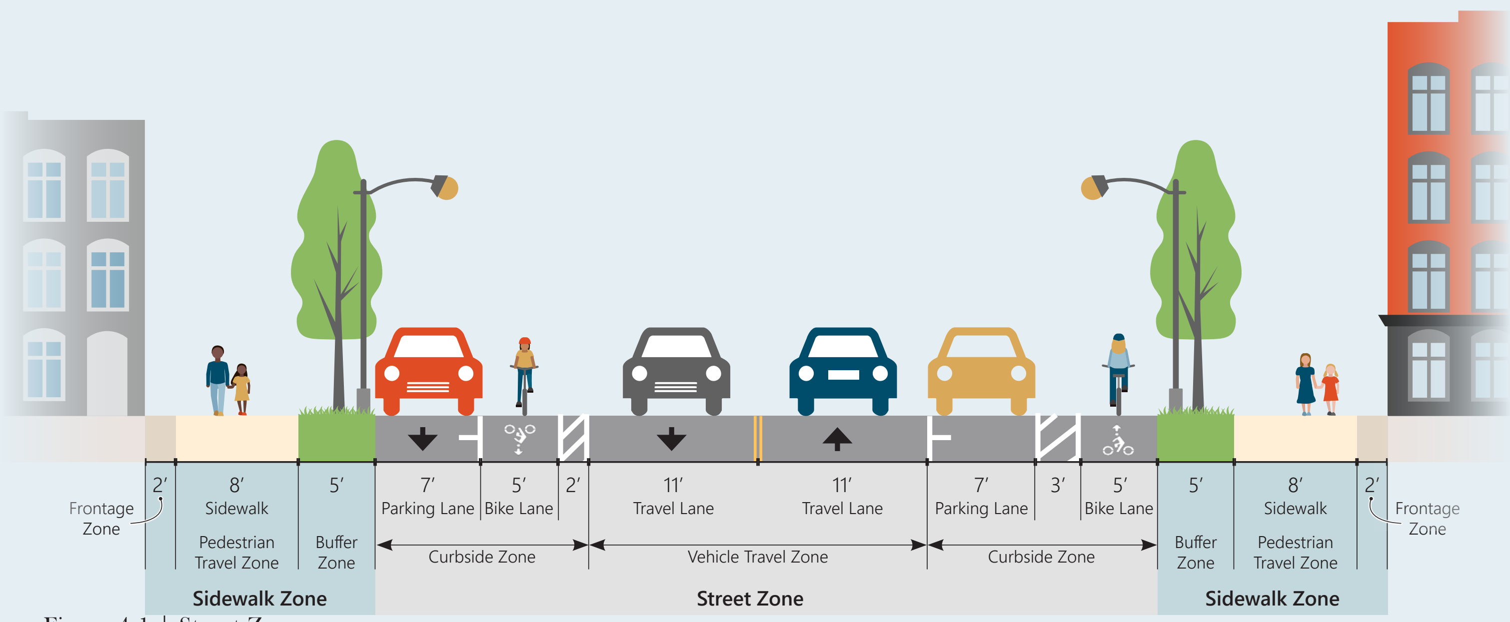


Figure 4-1 | Street Zones

Curbside Zone

The Curbside Zone is a space adjacent to the curb and may accommodate bicycle lanes, parking lanes, loading zones, transit stops, and taxi stands. This zone is in a high demand for competing users due to the recent rise of e-commerce and associated delivery systems; transit network companies (TNC), like Uber and Lyft; and increasing use of bicycles. Determining the best use of the curbside zone requires the consideration of all the users along the corridor. The user's needs of the Curbside Zone users are not uniform and often these users compete for space on the streets. When designing the complete street, these competing needs should be evaluated, comparing the need of the adjacent land use for parking and loading (TNCs, valet, deliveries, taxis) with the use of the lane for transit and bicycle modes.

Bicycle lanes provide an exclusive space for bicyclists in the Curbside Zone. However, motor vehicles may cross bicycle lanes to access parking spaces, driveways, turn lanes, and alleys. Bicycle lanes are usually marked with pavement markings on the roadway surface. They can be adjacent to the curb, adjacent to on-street parking, or physically separated by a vertical element from the adjacent travel lanes (protected bicycle lanes or separated bicycle lanes). Bicyclists are not required to remain in a bicycle lane when traveling and may leave the lane as necessary to make a turn, pass other bicyclists, and properly position themselves for other necessary maneuvers.

Minimum corner clearance at intersections of 20 feet should be maintained in Curbside Zone design. The clearance is important for visibility of motor vehicles, bicycles, and pedestrians entering the intersection from the side street. Street signs may be used to inform drivers to not park within 20 feet of intersection.

Parking lanes are designed to accommodate handicapped parking, parallel parking, back-in angled parking[1], and short-term parking (loading zones, valet). On-street parking is appropriate when the adjacent lands uses (commercial or residential) rely on on-street parking.

Safe Speeds

Pedestrians and bicyclists are the most vulnerable users of the transportation system. Complete streets should operate at speeds that create comfortable and inviting environments for pedestrians and bicyclists. Three terms related to safe speeds are as follows:

- **Target speed** – desired operating speed
- **Operating speed[2]** – speed at which motor vehicles generally operate on that road
- **Design speed** – speed used to determine the geometric features of a new road during design

On-street parking *should be considered to provide the following benefits:*

Increase pedestrian comfort by providing a buffer between pedestrians and moving traffic

Increase bicycle rider comfort by providing a physical separation between moving traffic and a separated bicycle lane

Reduce motor vehicle speeds

1 Municode, Code of the City of Richmond, Virginia, Vol 1 (Sec. 30-710.3:1- Dimensions of parking spaces)
2 AASHTO, A Policy on Geometric Design of the Highways and Streets, 2011

During pedestrian/ vehicle crashes at posted speed limit of 25 mph or less

94%

of pedestrians survive

at posted speed limit of 30 to 35 mph

79%

of pedestrians survive

at posted speed limit of 40 mph or greater

65%

of pedestrians survive

Figure 3 | Survival Rates for Different Posted Speed Limits

Source: 2017 VDOT Pedestrian Crash Assessment: Analysis of Pedestrian Crashes Occurring between 2012-2016

When starting the complete street design, select a target speed first. A target speed is the most desirable speed for motor vehicle operation on a specific street and should be based on the street type and area. When designing new facilities, the design speed should not be more than 5 miles per hour (mph) higher than the target speed and should be equal to the target speed in areas with higher population densities (i.e., Downtown and Mixed-Used Streets). For existing streets, the operating speed might be higher than the target speed and should not be used as the basis for the design.

Operating speeds are fundamentally important to the severity of pedestrian or bicyclist injury as it is directly related to the speed of the motor vehicle during the impact. Drivers in vehicles traveling at lower speeds have more reaction time which helps to prevent crashes.

Traffic calming is defined as the use of certain infrastructures or techniques to slow traffic, especially in residential areas. Traffic calming is not meant to restrict access, rather to slow traffic and make the street safer for all users, particularly the vulnerable users: bicyclists and pedestrians.

For further guidance, refer to the VDOT Traffic Calming Guide for Neighborhood Streets.

On existing streets with excessive operating speeds, the following traffic calming and speed management measures could be considered for certain street typologies to achieve the target speed:

- Curb extensions
- Traffic calming circles
- Splitter islands to narrow the travel way
- Signal timing settings to influence speeds between intersections
- Narrow travel lanes (10 to 11 feet wide)
- Trees in the buffer zone
- On-street parking
- Roadway conversions/ "road diets"
- Speed tables, raised crosswalks, raised intersections
- Gateway treatments

Dimensions for Street Zone

The Street Zone widths will vary based on the available right-of-way and the type of adjacent land uses. For example, on a street with high volumes of heavy vehicle traffic due to adjacent commercial and industrial land uses, a wider Street Zone might be necessary to accommodate existing and future heavy vehicle demand. On the other hand, a Street Zone should not be too wide in urban areas with high pedestrian volumes as drivers are typically inclined to travel at higher speeds with wider lanes, increasing the safety risk for more vulnerable users.

As mentioned earlier, the Street Zone consists of the Vehicular Travel Zone and Curbside Zone. Furthermore, the Vehicular Travel Zone consists of median/refuge islands, transit, travel, and turn lanes. **Table 3** presents preferred and minimum Vehicular Travel Zone widths.

Travel lane width depends on the type of motor vehicles, desired speeds, and road typology. Consideration should be given to providing wider travel lanes along corridors with high traffic volumes of heavy vehicles (greater than 8%). Narrower lane widths are most appropriate on urban streets with constrained right-of-way and higher pedestrian volumes (Downtown, Neighborhood Residential and Mixed Use Streets). The benefits of 10- to 11-foot-wide lanes include:

- Lower speeds
- Fewer, less severe crashes
- Reduced crossing distance for pedestrians
- Reduced footprint of roadway, resulting in more space for active transportation modes

When considering the use of narrower lanes, it is important to recognize that narrow travel lanes also reduce motor vehicle separation from other motor vehicles and from bicyclists. In addition, narrower travel lanes can also create complications for transit buses, trucks, and other large motor vehicles forcing them to infringe on adjacent lanes.

Usage of minimum dimensions for multiple adjacent street design elements should be avoided. Designing a street with the minimum dimensions for adjacent elements may compromise both safety and function. For example, the combined travel lane and on-street parking width on a two-way Downtown Street could be 18 feet minimum (an 11-foot

	Vehicular Travel Zone							
	Median/Refuge Island (feet)		Transit Lanes (feet)		Turn Lanes (feet)		Travel Lanes (feet)	
	PREFERRED	MINIMUM	PREFERRED	MINIMUM	PREFERRED	MINIMUM	PREFERRED	MINIMUM
Downtown Streets	>6	6	11	11	10	10	11	10
Commercial Connector Streets	16	16	11	11	11	11	11	11
Neighborhood Connector Streets	>6	6	11	11	10	10	11	10
Neighborhood Residential Streets	N/A	N/A	11	11	N/A	N/A	11	10
Mixed Use Streets	>6	6	11	11	10	10	11	10
Industrial Streets	N/A	N/A	12	12	11	11	12	11
Parkways	>6	6	11	11	10	10	10	10

Table 3 | Preferred and Minimum Widths for Travel Zone travel lane and a 7-foot parking lane or a 10-foot travel lane and an 8-foot parking lane). Using both minimums (a 10-foot travel lane and a 7-foot parking lane) could compromise the maneuverability in the corridor. One bad parker encroaching in the travel lane would impact the use of the minimum travel lane, potentially creating a bottleneck in the corridor.

Curbside Zone

The Curbside Zone consists of bicycle lanes, on-street parking and loading zones. The type of bicycle facility should be carefully selected and designed based on the guidelines provided in Richmond Bicycle Master Plan. The existing and anticipated bicyclist, pedestrian, and motor vehicle movements should be considered in the overall street design. There are four types of bicycle facilities in the Street Zone currently used in the City of Richmond: shared roadway, bicycle lane, separated bicycle lane, and buffered bicycle lane. There are some street typologies where curbside zones will not formally exist.

The Curbside Zone provides space for motor vehicle on-street parking, which supports adjacent land uses. On-street parking demand is high on Downtown, Neighborhood Residential, and Mixed-Use Streets. On-street parking helps to create a buffer between motor vehicles and vulnerable street users. Along the streets with dedicated bicycle lanes and on-street parking, the width of the parking lane should be minimized in favor of a wider bicycle lane. To accommodate a large volume of bicycle parking, bicycle corrals may be considered in the Curbside Zone. The Curb Zone width can vary based on street typology, adjacent land uses, and transportation mode priorities. Preferred and minimum bicycle lanes and parking lanes widths are presented in **Table 4**.

The Curbside Zone can also provide space for alternative uses as well:

- Food trucks
- Bike Share Station
- Bike Corral/Parklet

Any deviation from the parameters presented in this chapter shall be submitted to the City Transportation Engineer for review and final decision.

	Curbside Zone			
	Bicycle Lanes (feet)		Parking Lanes (feet)	
	PREFERRED	MINIMUM	PREFERRED	MINIMUM
Downtown Streets	>5	5	8	7
Commercial Connector Streets	>5	5	8	8
Neighborhood Connector Streets	>5	5	8	8
Neighborhood Residential Streets	N/A	N/A	7	7
Mixed Use Streets	>5	5	8	7
Industrial Streets	N/A	N/A	8	8
Parkways	>5	5	N/A	N/A

Table 4 | Preferred and Minimum Widths for Curbside Zone


EDGE

CHAPTER 5

INTERSECTIONS

Innovative and creative solutions can be used to reduce conflicts

Intersections

When two or more streets cross, they create an intersection—and an opportunity for conflicts. How do we create an intersection that is safe and convenient for pedestrians, bicycles, and vehicles of varying sizes to navigate through?

People who walk and bike are the most vulnerable roadway users—it is important to prioritize their needs when designing intersections.

Consider street types, identified in the typology chapter, when designing intersections. The key elements will vary in design and configuration depending on the function of the street and role of the intersection in the surrounding area. For example, Downtown and Mixed-Use Streets call for wider sidewalks to support lively pedestrian movement with retail shops and restaurants. Therefore,

Downtown and Mixed-Use Street design criteria take precedence over those corresponding to Neighborhood Connector and Industrial Streets at intersections.

At locations of transition of one street type to another, obvious design features should be used to inform users of the change in typology. For example, in locations where a Neighborhood Connector intersects with a Neighborhood Residential street, users approaching the Neighborhood Residential Street should recognize a lower-speed environment. Enforce this perception of a lower-speed environment with design elements such as raised crosswalks and curb extensions.

Consider the following goals:

Design the intersection to decrease the severity and likelihood of crashes

Create a design that serves all modes and provides a sense of comfort

Create facilities for each mode that are recognizable and consistent

Incorporate and support the natural environment and adjacent land use, such as transit stations, employment centers, and other destinations

Use innovative and creative solutions that can be used to reduce conflicts

Step 1

Determine the Intersection Configuration and Traffic Control

Start by asking the question, "What would be the best approach to managing the traffic on these streets?" Consider pedestrians, motorcycles, bicycles, transit, cars, and trucks. The MUTCD provides standards for controlling traffic with stop signs and traffic signals, the most common solution to designing intersections. However, understanding the volume of all traffic (vehicles, bicycles, pedestrians, transit) will determine the appropriate level of control.

Most of the City's intersections are at grade and controlled by a traffic signal or signs. There are options for innovative intersection designs that could reduce vehicle speeds, increase sight distance, or clearly define vehicle right-of way. Consider alternative intersection designs including:

- **Roundabout (regular and mini)**
- **Innovative intersection**
- **Traffic calming circle**
- **Splitters islands**
- **Raised intersection, speed table**
- **Pedestrian safety curb extensions**

These alternatives may provide an opportunity to improve traffic flow for all modes. For recommendations to improve safety, mobility, and accessibility of unsignalized intersections refer to FHWA Unsignalized Intersection Improvement Guide (UIIG).

Resources to better understand alternative intersection designs are available from FHWA and VDOT.

Signalized/Unsignalized Traffic Control

Intersection control can range from simple stop-controlled intersections with minimum pedestrian accommodations to complex signal controlled intersections, which by 2020 will all be integrated into a centralized Richmond Signal System of 480 intersections. Traffic control devices assign the right-of-way at intersections to specific modes or approaches. The type of control is determined by engineering study predominately based on the following factors:

1. Vehicular, bicycle, and pedestrian traffic volumes on all approaches
2. Number and angle of approaches
3. Approach speeds
4. Sight distance available on each approach
5. Reported crash experience

Chapter 4C of the MUTCD provides information on conditions where use of traffic signals may be warranted; however, satisfaction of a traffic signal warrants shall not in itself require installation of a traffic signal. VDOT and FHWA also provide guidance on intersection control determination, including alternative intersection control treatments like roundabouts and other innovative intersection design concepts.

Roundabout

Modern roundabouts improve safety and provide operational benefits such as shorter delays and queues, better speed management, and an opportunity to improve aesthetics. Roundabouts can be designed to accommodate pedestrians and bicyclists. Roundabouts may also encourage lower vehicular operating speeds and increased yielding behavior from drivers.

The size of the roundabout depends on the volume of traffic and consideration of the street typologies and adjacent land uses.

Alternate Intersection

Three types of alternate intersection design may be considered where applicable:

- Displaced left turn (DLT)
- U-turn intersection
- Restricted crossing U-turn intersection

FHWA provides guidance on the use of these alternate intersections based on geometric depth considerations, operational performance, and the accommodations for pedestrians and bicycles. They would be considered Commercial Connector or Industrial Streets.

Traffic Calming Circles

Neighborhood traffic calming circles, can reduce speeds and crashes in low-volume corridors and are a potential preferred treatment for uncontrolled intersections. They are also good for local streets because they can be used in lieu of stop signs to move vehicles efficiently and moderate vehicular speeds through the intersection, helping to reduce emissions.

Designs should consider the speed of the roadway. Regulatory and/or warning signage may be provided to remind traffic to proceed counterclockwise around the circle.

Figure 4 | Idlewood Ave Roundabout

Step 2

Consider the Design Principles

Regardless of transportation mode, people should feel safe, feel comfortable, and experience minimal delays during their trips. The goal of complete streets is to consider the needs of all users and design new intersections (or retrofit existing intersections) to be efficient, functional, and easy to navigate for all users. The following guidelines discuss intersection design principles and elements as well as different users' needs.

AASHTO and the VDOT Roadway Design Manual provide extensive guidance for intersection design including specific engineering factors, such as horizontal and vertical curves, sight distance, and capacity. The following design principles should be taken into consideration in the intersection design process:

- Safety for all travel modes
- Priority for pedestrians
- Accessibility for pedestrians and transit
- Minimal exposure of pedestrians and bicycles to vehicles
- Safe speeds
- Compact design that still accommodates all modes
- Appropriate traffic control
- Ease of maintenance
- Sustainable practices for stormwater management
- Emission reduction

(Use Part 2 for more design guidance)

Intersection Geometry and Design Guidance

A Policy on Geometric Design of Highways and Streets, most recent edition, commonly referred as the AASHTO Green Book, provides design guidelines for freeways, arterials, collectors, and local roads in both urban and rural locations. The VDOT Roadway Design Manual provides further design guidance and criteria to be used in the design process in Virginia. The geometry of the intersection components is a critical element that sets the basis for how all multimodal travel users interact with each other at intersections.

Corners and Curb Radii

The AASHTO Green Book provides guidance on turn radii at corners for different types of vehicles (large trucks, school buses, etc). Keep in mind that providing greater curb radii for the largest vehicle that might use an intersection can also encourage drivers of smaller vehicles to make turns at higher speeds, which increases safety concerns for pedestrians. A greater radius can increase crossing distances for pedestrians and can leave less space for sidewalks and other uses. A range of curb radii guidelines for each street type is presented in **Table 5.**

A pedestrian crossing gap is defined as the minimum time length of a gap in traffic that allows a single pedestrian or a group of pedestrians to cross a roadway without coming into conflict with passing vehicles.

	CURB RADII RANGE (FEET)
Downtown Streets	5–25
Commercial Connector Streets	25–35
Neighborhood Connector Streets	5–30
Neighborhood Residential Streets	5–30
Mixed Use Streets	5–25
Industrial Streets	25–35
Parkways	5–30

Table 5 | Curb Radii Guidelines

In areas where large vehicles need to be accommodated, consider the following factors to increase the effective curb radius without increasing the actual, physical curb radius:

Cross-street lane width. On streets with heavy bus or truck traffic (greater than 8%), wider lanes (see the Street Zone chapter) may be needed to provide adequate turning space while maintaining a tight corner radius. However, on streets with moderate heavy vehicle traffic (ranging from 4% to 8%), designs that assume the turning vehicles will encroach beyond the travel lane on the receiving street may be acceptable.

Placement of stop bars on non-divided cross-streets. On streets where lighter heavy vehicle traffic volumes (less than 4%) do not create pressure to place vehicle stop lines as close to the intersection as possible, moving the stop line back from the intersection can add cushion space for large vehicles to make right or left turns.

On-street parking or near-side bus stops. Multiple travel lanes as well as space used for buses, bicycle lanes, and on-street parking can help a large vehicle make a wider turn at an intersection, especially when coupled with the ability to bend outside of the immediate lane width on the street receiving the turn movement. The diagram in **Figure 5** illustrates this concept. The curb radius (R1) allows shorter crossing distances for pedestrians, while the effective radius (R2) defines the path that vehicles may follow from one travel lane to another. In this example, on-street parking allows vehicles to navigate a wider path without running over the corner curb.

Curb Extensions

Curb extensions, are created by expanding the sidewalk at intersections. Curb extensions are used to shorten crossing distances and to make pedestrians more visible to drivers. Curb extensions should be considered on all streets where pedestrians' exposure to volumes, speed, and distance in the crosswalk can be minimized, particularly on streets with on-street parking. Consider bicycle accommodations when designing curb extensions at intersections with bicycle lanes.

Drainage should be considered when implementing curb extensions. Stormwater catch basins may need to be relocated. Landscape areas within extensions offer opportunities for landscaping and sustainable stormwater management. Extensions are also good locations for amenities such as bicycle parking, street trees, and trash and recycling receptacles, as long as the requirements for waiting area, clear path, and the landing zone are met.

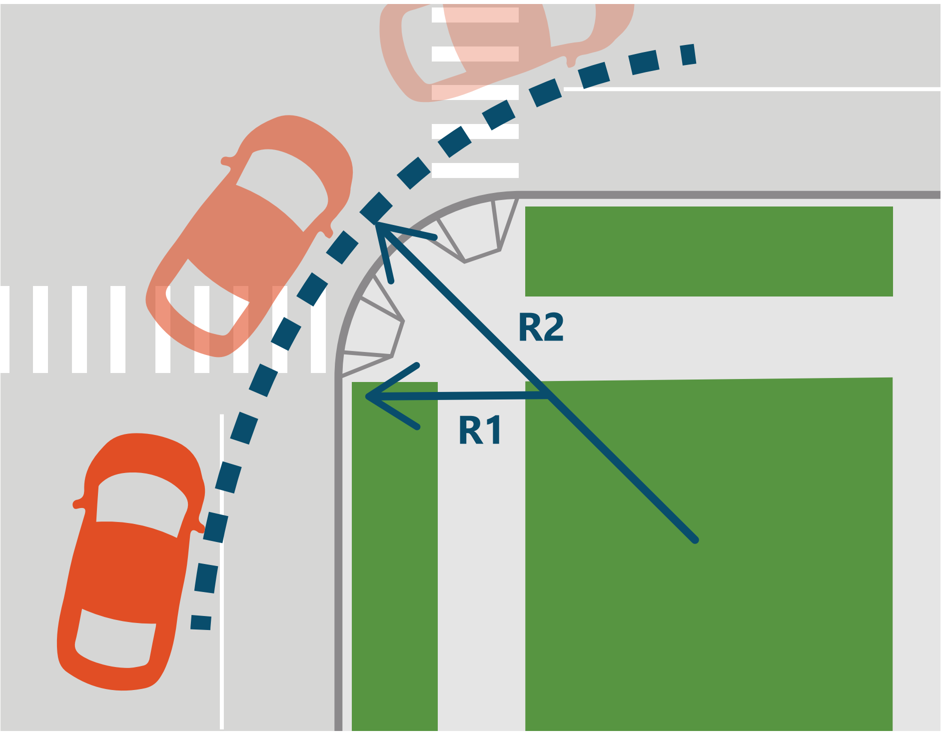


Figure 5 | Physical (R1) and effective (R2) intersection curb radii reduce size.

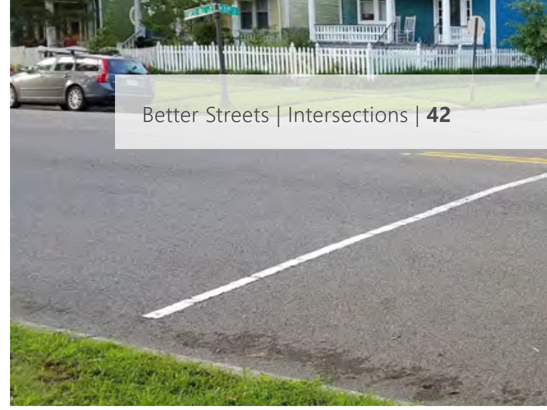
Refuge Islands

Refuge islands are a small section of pavement, protected by raised islands, typically located in the middle of a multilane roadway, where pedestrians can stop before finishing crossing the street. Refuge islands are particularly valuable at unsignalized intersections at multilane roadways, where pedestrians can safely stop and wait to find a gap in traffic allowing for two-stage crossing. Refuge islands should be provided on all streets with three or more lanes, where Average Annual Daily Traffic (AADT) is greater than 12,000 vehicles per day (vpd), or where crossing distance is 60 feet or greater. Refuge islands should be at least 6 feet wide—preferably 8 feet wide to provide adequate refuge for pedestrians with strollers or bicycles—and extend beyond both sides of the crosswalk at intersections.

Network Traffic Signal Control

As it was mentioned earlier, Richmond Signal System incorporates 400 intersections. A platoon is a group of vehicles that can travel very closely together. Signal coordination and shorter signal cycle lengths (no more than 150 second cycle lengths) should be used to platoon traffic. Signals should be spaced in accordance with existing MUTCD guidelines and engineering judgment to enhance access and connectivity throughout the city.

Refer to NCHRP (Signal Timing Manual) document for signal timing.



Designing for the Pedestrian

Pedestrians are the most vulnerable users in the transportation network. Pedestrian safety should be the top priority in intersection design. The following design goals can improve pedestrian crossing safety and comfort at signalized intersections:

- Minimize crossing distance
- Minimize conflicts with turning vehicles
- Provide sufficient signal time to cross the street at signalized intersections

Crosswalks

A pedestrian crosswalk is an area of the roadway for pedestrians to cross the street designated by pavement markings on the surface. Since pedestrians are the most vulnerable road users, the safety of pedestrians should be the most important criterion in the design of crosswalks. Land uses adjacent to the roadway land uses usually provide indication whether the crosswalk is needed and engineering judgment is used to determine where it should be installed. Crosswalks indicate to pedestrians where they should cross the street and inform drivers where to expect pedestrians. Paver crosswalks shall not be used.
There are two types of crossings:

- **Controlled crossings** are found at signalized intersections and locations with pedestrian crossings controlled with pedestrian hybrid beacons, such as High-Intensity Activated crosswalk beacons (HAWK beacons).
- **Uncontrolled crossings** exist at locations where sidewalks or designated walkways intersect a roadway without present traffic control such as a traffic signal or STOP sign. Uncontrolled crossings include non-intersection or midblock crossings.

Crosswalk Design Criteria

When designing crosswalks:

- All crosswalks at signal controlled crossings and other crossing locations deemed appropriate by the City Traffic Engineer should be high visibility block-style pavement markings that avoid the predominant wheel tracking of the major through movements
- All crosswalks at unsignalized crossings should be transverse parallel lines
- The surface, slope, and cross slope of the walking path should meet ADA guidelines unless existing conditions can't be modified to meet standards
- All crosswalks should match the width of the approaching sidewalk, and should not be less than the guidelines provided in **Table 6**
- All corners should have accessible ramps that meet ADA requirements. The ramps should be placed within the crosswalk and offer one ramp per approach, unless otherwise approved by the City Transportation Engineer
- All crosswalks should be 90 degrees or as close as practicable to the crossing travel lanes
- Use of stamped asphalt may be permitted on crosswalks within the intersection if approved by the City Transportation Engineer.
- Transverse parallel line crosswalks may be installed at uncontrolled crossings where adequate gaps are present as determined by an engineering study per the MUTCD
- Advance stop lines and yield lines should be placed ahead of the crosswalk to encourage drivers to stop early enough to reduce conflict with pedestrians and avoid crashes at the crosswalks on multilane roadways. All crosswalks should be at least 1 foot from any conflicting travel lane and 4 feet from any stop line

More detail on crosswalk design, materials, and installation is provided in Part 2 and Part 3 of this manual.

	CROSSWALK WIDTH (FEET)
Downtown Streets	10
Commercial Connector Streets	10
Neighborhood Connector Streets	8
Neighborhood Residential Streets	8
Mixed Use Streets	10
Industrial Streets	8
Parkways	8

Table 6 | Minimum Crosswalk Width Guidelines

Curb Ramps

Curb ramps provide pedestrians a smooth transition from the sidewalk to the street. Appropriately designed curb ramps are critical for providing access across intersections for people with mobility and visual impairments, as well as children riding bicycles or people pushing strollers, grocery carts, or suitcases. Curb ramp designs must meet the requirements of Title II of the Americans with Disabilities Act, which provides detailed standards regarding ramp slope, landing area size, and other design characteristics. Curb ramps should:

- Be aligned with crosswalks. To achieve this, two perpendicular ramps are preferable over a single diagonal ramp.
- Have detectable warning strips that extend the full width of the ramp. As described in the ADA standards, these strips are designed to alert blind or low-vision pedestrians when they are entering a roadway.

Pedestrian Signals

At intersections with signal control, countdown signals shall be provided on all approaches unless the following conditions exist and they are waived by the City Transportation Engineer.

- Geometric constraints
- Operational constraints

Push buttons should be provided on all approaches based upon the safety and operational considerations at a signalized intersection unless waived by the City Transportation Engineer, including:

- In areas with lower population density and lower pedestrian volumes
- on multiple lane roadways with traffic traveling at higher speeds
- In the influence area of a freeway

Push buttons may be required in other areas at the discretion of the City Transportation Engineer.

All push button locations must meet ADA design requirements.

In lieu of push buttons, other approved pedestrian detection technology may be considered.

Gap Wait Times and Distance to Crossing Requirements

A pedestrian crossing gap is defined as the minimum time length of a gap in traffic that allows a single pedestrian or a group of pedestrians to cross a roadway without coming into conflict with passing vehicles. Adequate pedestrian crossing gaps of at least one gap per minute should be provided in the signal timing. The distance to a crossing with a guaranteed gap vary based on street typology and should not be more than the distances shown in **Table 7**.

Accessible Pedestrian Signals

Accessible pedestrian signals (APS) and accessible detectors are devices that communicate information about the pedestrian phase in non-visual formats to pedestrians with visual and/or hearing disabilities. APS shall be installed at intersections where an orientation and mobility specialist has certified that such a device will benefit blind or visually impaired users. APS may be considered at critical signalized intersections located near transit facilities.

	Distance to a Crossing	
	MAXIMUM (FEET)	PREFERRED (FEET)
Downtown Streets	600	300
Commercial Connector Streets	1200	600
Neighborhood Connector Streets	900	400
Neighborhood Residential Streets	900	400
Mixed Use Streets	600	300
Industrial Streets	1200	600
Parkways	1200	600

Table 7 | Distance to a Crossing

Pedestrian Phasing

At signalized intersections, pedestrians should be given ample time to cross the street, protected by the pedestrian signal phase or the pedestrian clearance interval. The pedestrian clearance interval should be calculated at 3.5 feet per second (fps) according to pedestrian walking speed.

All pedestrian clearance intervals should be set to recall on all approaches within the downtown and along the Pulse corridor unless approved by the City Transportation Engineer. At other intersections, the pedestrian clearance interval may be actuated by push button or other detection. If pedestrian actuation is not present or not working, or if there are no pedestrian countdown signals, the equivalent time should be set to recall with each cycle until the additional minimum features are available.

If traffic volumes require less time than the pedestrian walk and clearance interval, then the pedestrian clearance interval may extend through the yellow light or operated with lead pedestrian intervals.

In rare cases, the City Transportation Engineer may approve extending the clearance interval through the red light to keep overall cycle lengths low. This technique may be used at any signalized intersection that is controlling the overall cycle length in a particular signal timing zone.

At intersections that have conflicting concurrent permissive left turns (left turning vehicles from opposite approaches entering the intersection at the same time) or conflicting permissive right turns (right turning vehicles during green light, during which the adjacent pedestrian has a walk signal), the walk phase may be minimized to 7 seconds with the appropriate clearance interval, followed by a steady don't walk phase for the remainder of the phase during the timing period when the conflict occurs. Potential reasons for using this technique includes larger than normal left- or right-turn queues, the left-turn driver dealing with multi-lane threats, and the volume of pedestrians provides reduced gaps for turning vehicles.

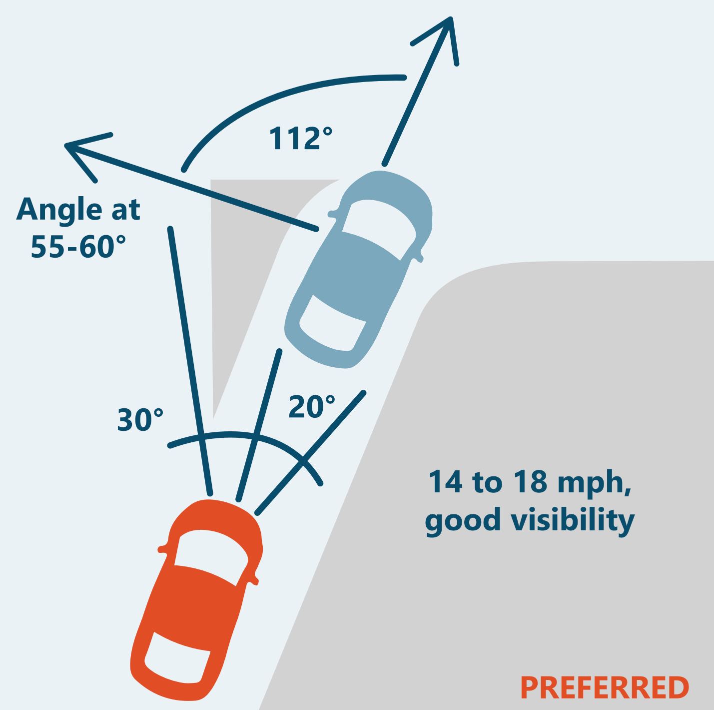


Figure 6 | Channelized Right Turn Lane

At intersections that have few conflicts with concurrent left or right turns, the walk phase should be held to the point required where the remaining time is necessary for a proper pedestrian clearance interval.

Where a pedestrian phase is served at the same time as a conflicting permissive left-turn movement, a leading pedestrian interval (LPI) may be used when it does not significantly degrade the operational performance of the intersection. In limited circumstances, the City Transportation Engineer may approve a timing plan to stop vehicular traffic in all directions.

At intersections that have conflicting concurrent left or right turns, all new signal designs or modifications should have the capability to allow a flashing yellow arrow to be installed, which will create a protected turn-only phase if a walk phase is actuated.

Channelized Right Turn Lanes

Channelized right turn lanes are normally separated from the rest of the intersection by raised barriers usually in the shape of a triangular island. The use of channelized right turns should be restricted in urban areas, such as Downtown and Mixed Use streets. If channelized right turns are utilized, the design must be consistent with the best angle to slow speeds, orient the driver to conflicting vehicle traffic, and minimize pedestrian crossing distance and line of site.

Designing for Bicycles

Bicycle facilities should be carefully selected based on the guidelines provided in Richmond's Bike Master Plan. The existing and anticipated bicyclist, pedestrian, and vehicle movements should be considered in the overall intersection design. It is important to prioritize the goal of reducing potential conflict between bicyclists (and other vulnerable users) and motor vehicles by heightening the level of visibility, denoting clear right-of-way, and facilitating eye contact and awareness with other travel modes. The level of bicycle facility treatments required at intersections depends on the bicycle facility type, whether bicycle facilities are intersecting, the intersecting street typology and land use. To enhance the safety of bicycle users, consider employing design elements including:

- Colored pavement for conflict areas
- Signage
- Medians
- Signal detection
- Pavement markings

Bicycle Lanes Through Intersections

Bicycle lanes designate an exclusive space for bicycle users through the use of pavement marking and signage. The Richmond Bicycle Master Plan (Appendix A) offers many options for the placement and design of bicycle lanes through intersections.

Designers should review the latest approved standards as they continue to be developed for the design of bicycle accommodations.

Signalization

A bicycle signal face may be used under FHWA Interim Approval IA-16 to provide separate control of bicycle movements at signalized intersections and address one or more of the following conditions:

- Bicyclist non-compliance with current traffic control devices
- Provide a leading or lagging bicycle interval
- Continue the bicycle lane on the right-hand side of an exclusive turn lane that would otherwise be in non-compliance with the MUTCD
- Augment the design of a separated counter-flow bicycle facility
- Provide an increased level of safety by facilitating unusual or unexpected bicycle movements through complex intersections, conflict areas, or signal control

Bicycle signal faces shall be actuated with bicycle sensitive loop detectors, video detection, or push buttons. Installation of bicycle signals is recommended at locations with high peak-hour bicycle volumes; locations with high bicycle/vehicle crashes, especially caused by turning movements; at T-intersections with high bicycle movement along the top of the T; where separated bicycle lanes or shared-use paths run parallel to arterial streets; and at the confluence of an off-street shared-use path and a roadway intersection. Bicycle signal phases shall provide protected phases for bicycle movements however concurrent bicycle/vehicle movements can be incorporated via experimental approval from VDOT and FHWA.

Guidance is provided in the FHWA Interim Approval IA-16 memo and in the Richmond Bicycle Master Plan.

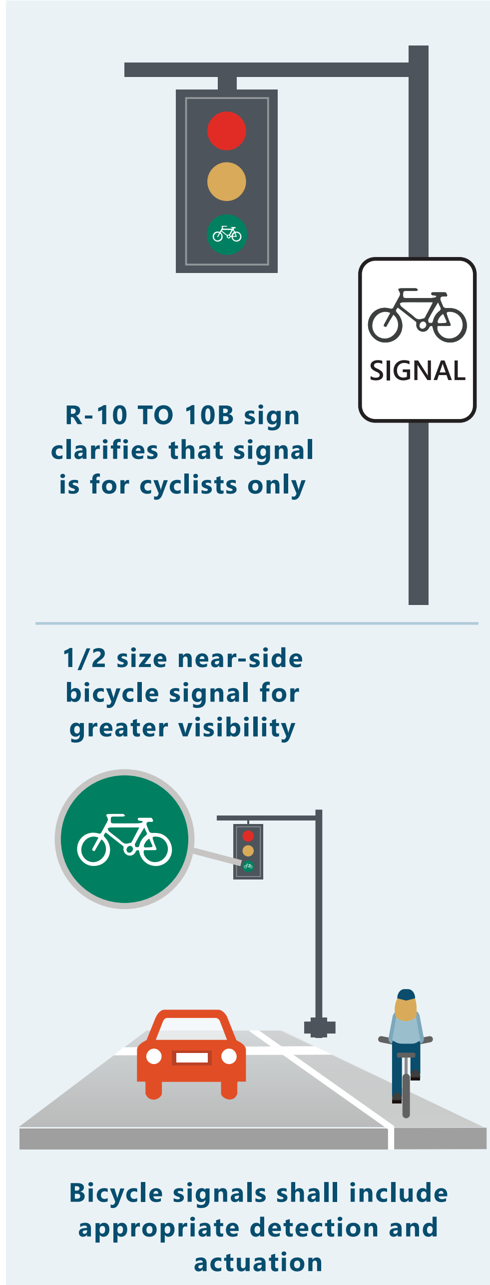


Figure 7 | Bicycle Signal Head and Signage (Source: Richmond Bicycle Master Plan)

Accommodating Left-Turning Bicycles

Bicyclists can always merge into the travel/turning lane with other vehicles; however, roadways with high vehicle volumes can make this maneuver challenging for some bicyclists. An amplified, alternative approach to accommodating left-turning bicyclists at high volume signal-controlled intersections can be achieved through the use of bicycle boxes or two-stage bicycle turn boxes

An intersection bicycle box is a designated area on the approach to a signalized intersection between an advanced motorist stop line and the crosswalk or intersection that provides bicyclists with visible space to wait in front of stopped motorists during the red signal phase. Vehicles must queue behind the white stop line at the rear of the bicycle box. The minimum depth of the bicycle box shall be 10 feet. At least one bicycle symbol shall be placed in the box and a "NO TURN ON RED" R10-11) sign shall be installed on the approach to the box. A STOP HERE ON RED (R10-16 or R10-16a) sign with an EXCEPT BICYCLE PLAQUE should be provided at the advance STOP line to discourage vehicles from entering the bicycle box. At least 50 feet of bicycle lane should be provided on the approach to the box. Where a bicycle box crosses multiple lanes on an approach, countdown pedestrian signals shall be provided for the adjacent crosswalk approach. When considering implementation of the bicycle box, signal operation is impacted by the increased signal clearance times due to longer intersection crossing distances shall be evaluated.

Two-stage bicycle turn boxes offers bicyclists an alternative to make left turns at signalized, multi-lane roadways from the right side. These boxes provide an area for bicyclists to queue to turn at signalized intersections outside of the traveled path of motor vehicles and other bicycles. The minimum depth of the bicycle storage area is 6 feet. Required signing and marking requirements associated with two-stage bicycle turnboxes can be found in the MUTCD Interim Approval for Optional Use of an Intersection Bicycle Box (IA-20) in the Richmond Bicycle Master Plan.

Separated Bicycle Lane (Cycle Tracks)

A separated bicycle lane (SBL), formerly known as cycle tracks, is an exclusive bicycle facility that is located within or directly adjacent to the roadway and this is physically separated from motor vehicle traffic with a horizontal distance and vertical element. Vertical elements can include on-street vehicle parking, barrier, raised curb and medians, rigid bollards, or flexible delineators. SBLs are attractive to a wider range of bicyclists as this type of facility provides higher level of comfort than bicycle lanes, due to the separation from moving vehicles on the roadway. SBLs may be one-way or two-way facilities, and may be at street level, at sidewalk level, or at an intermediate level.

The following principles should be applied to the design of intersections with SBLs:

- Minimize exposure to conflicts;
- Reduce speeds at conflict points
- Communicate right-of-way priority
- Provide adequate sight distance

Additional guidance can be in found in the FHWA Separated Bike Lane Planning & Design Guide.


Source: NACTO

Designing for Transit

Richmond's transit users require safe and accessible access to the frequent transit service. The locations of transit stops at intersections need to be convenient for the pedestrian and bicycle users and support the efficiency of the transit route. It is important to consider the main goals of the transit system:

- To retain and/or improve the reliability of the service
- To retain and maximize efficiency of the service

Most often, transit delays occur at intersections—intersections play an important role in transit system planning and route scheduling. The delay at traffic signals accounts for more than 50 percent of transit delays and at least 10 percent of the overall transit trip. Transit Signal Priority (TSP) is being used for the Pulse Bus Rapid Transit system and will expand in the future to assist in on-time performance of the transit routes.

GRTC is the public transit system that serves every sector of the Richmond region today. A vast majority of the GRTC Transit System stops are located near or at intersections on Richmond streets. GRTC has been collaborating with the City of Richmond to provide better transit connectivity throughout the city.

Transit Stop Location

Determining transit stop location is a critical decision in the planning process, as the location of a bus stop can affect transit travel time, passenger safety, and roadway operations. This decision is made collaboratively between GRTC and DPW. Acceptable locations include:

- Near side of an intersection before a signal, roundabout, or cross street
- Far side of an intersection after a transit vehicle crosses the intersection
- Mid block location between intersections

Transit stop locations are determined based on a number of factors, such as intersection operations, bus routing, curbside conditions, transfer points, intersection geometry and sightlines, consideration of other street users, and major generators or destinations. Transit stops may also be located on curb extensions where on-street parking is present. Mid block locations are the least desirable. Not only do mid-block bus stops require the most amount of curb side space but they also often require mid block pedestrian crossings to ensure safe accommodation of passengers going to or from the stop.

Regardless of location, all transit stops must be ADA compliant, and should be safe, convenient, well lit, and clearly visible. Transit stops should be connected to the larger pedestrian network, with continuous sidewalks, curb ramps, and safe pedestrian crossings, and bicycle networks.

At signalized intersections, far-side placement is generally recommended to permit the bus to pass through the intersection before stopping. This is particularly important where transit signal priority is provided.

Additional advantages of locating stops on the far side of an intersection include:

- Pedestrians are encouraged to cross behind the bus, reducing conflict and bus delay
- Buses are allowed to take advantage of gaps in traffic flow, especially with signal prioritization, rather than needing to be at the front of the queue at an intersection for a near-side stop

- Conflicts between buses and right turning vehicles are minimized and additional right-turn capacity is provided on the near-side of the intersection. This advantage should be weighed carefully at locations where there are heavy turning movements from cross streets

Transit Curb Extensions

Transit curb extensions along the length of a transit stop eliminate the need for transit vehicles to pull in and out of traffic. They reduce crossing distances for pedestrians and provide additional space for street furniture, landscaping, and pedestrian queuing. These areas typically extend the width of the curbside parking space less than 1 to 2 feet to avoid friction with the turn lane.

Curb extensions are only appropriate on streets where on-street parking is present and are effective in enforcing parking restrictions within the stops.

Since curb extensions provide extra passenger queuing space, they are most appropriate at stops with higher passenger volumes. They should be long enough to permit all doors of transit vehicles utilizing the stop to open onto the flat, level surface. If multiple routes with frequent service utilize a stop, curb extensions may need to be long enough to accommodate two or more transit vehicles.

Curb extensions are most effective at reducing travel time if they are utilized throughout a corridor by eliminating the need for transit vehicles to pull in and out of traffic all together. They do not require as much space as curbside stops because the transit vehicle does not need space to pull in and out of the stop; however, they may cause occasional general traffic delay. Since the transit vehicle remains in the travel lane while stopped, extensions can result in traffic delays or unsafe maneuvers by drivers and bicyclists to steer around buses. In most cases, this delay is minor.

Designs should consider the street type, traffic conditions, posted speed, number of travel lanes, and headways of buses. Extensions can interfere with right-turning vehicle movements at near-side intersections. In these cases, they should be designed to self-reinforce provisions precluding traffic from turning right in front of a stopped bus.

On corridors with bicycle facilities, lanes for bicycles should be routed behind the curb extension to remove conflicts between bicycle travel and passenger boarding and alighting activity.

Bus Stop Amenities

Bus shelters, benches, trash cans, and other features at transit stops offer convenience to riders and improve operations, increase ridership, and increase the value of transit to the community. The landing zone or landing pad is the area on the sidewalk where passengers load and unload at bus doors. This area should be free from all obstructions including sign posts and bus stop amenities. The landing zone should be a minimum of 5 feet wide and 8 feet deep.

GRTC has amenities placement guidelines.

Designing for the Vehicle

Moving vehicles normally make up the larger volume of users in an intersection. Intersections are also the location of most vehicular crashes. Although vehicles are the least vulnerable of the modes of transportation, intersections must still be designed to minimize the opportunities for crashes. The number of travel lanes should be determined based on the traffic volumes; however, some congestion is acceptable at peak hours to minimize pedestrian crossing distances. Design the intersection—uncontrolled, controlled, or innovative designs such as a roundabout—by considering all the modes. The characteristics of the area, the typology of the intersecting streets, the volumes of pedestrians, bicycles, buses, and other moving vehicles are all important considerations when designing intersections.


Museums
Newtowne West
Carver
VCU
Monroe Ward
Fan District
Shockoe Bottom
CKOE BOTTOM
WEST

CHAPTER 6

TYPOLOGY AND STREET ELEMENT INTEGRATION

Richmond's communities must be engaged in the conversation

In a perfect world, the designer could just pick the correct typology for the street, check the preferred dimensions for the Sidewalk Zone and Street Zone elements, and create that complete street. Unfortunately, it isn't that simple. The rights-of-ways for the majority of the streets in the City are constrained. Buildings are often right on the property line in the Downtown and Mixed Use Streets. How does the designer decide on what elements are included and the specific dimensions? This chapter will help provide the designer with insight to make good decisions, balancing the needs of all the users.

The information provided in this manual is often presented with preferred and minimum values. Minimum values are intended for use in constrained situations, where it is not practical or feasible to provide the preferred value. Minimum values should not be considered default values.

Accommodating Multimodal Users

Follow the design process to the right to develop the complete street cross section. Although there are corridors where additional right-of-way could be acquired, most project improvements are constrained by the adjacent land uses. Within a constrained right-of-way, the designer must decide how to allocate the limited cross section dimension between the multimodal users.

All streets need to accommodate motor vehicles, understanding the traffic volumes and maneuverability requirements of cars, trucks, emergency vehicles, and buses, to determine the number of travel lanes and the lane width.

Designers should initially consider reducing the number of travel lanes, narrowing existing lanes or adjusting on-street parking. The preferred lane widths should be used but the minimum width could allow the designer to better accommodate pedestrians and bicycles.

Design Process

SELECT
Street Typology

Select the applicable street typology, understanding that there may be more than one typology along a corridor

↓

REVIEW
Overlays

Review the overlays to determine which if any apply; this will help refine the street typology and guide the designer regarding which mode should be given priority within the specific project limits

↓

USE
Guidance Sidewalk Zone, Street Zone, and Intersection Chapters

Use the guidelines presented in the Sidewalk Zone, Street Zone, and Intersection chapters to develop the proposed complete street design

↓

CONSIDER
Neighborhood Context, Sustainability

Consider the context of the neighborhood (opportunities for outdoor dining, building setbacks) and opportunities for sustainable elements (street trees, stormwater management), which could influence the Buffer Zone and Frontage Zone

On-street parking is critical in some corridors and the need is dependent on the adjacent land uses.

- Understand the patterns of the existing on-street parking. Is it time restricted? Are the spaces often occupied? Do you need on-street parking on both sides of the street?
- Consider the location of the parking lane to the rest of the Street Zone. Should the parking lane be a floating lane (bicycle lane at the curb) or adjacent to the curb?
- Think about using the parking lane as travel lanes during peak hour to increase or maintain capacity in corridor with constrained rights-of-way.

The pedestrian is the most vulnerable. The survival rate of pedestrians involved in crashes is directly related to the speed of the vehicle.

- Consider the safety of the pedestrian as the top priority.
- Recognize that pedestrians are young and old, confident walkers and mobility challenged, individuals and families.
- Understand how the street fits into the larger pedestrian network and the opportunities to encourage pedestrian usage when deciding where to place a sidewalk and how wide it should be.

The Pedestrian Travel Zone should accommodate the pedestrian demand in all typologies using the preferred value or greater. The zone must meet accessibility requirements of the ADA. The Buffer Zone is an important separation between vehicles and pedestrians and needs to be wide enough to install sustainability, streetscape and utility elements.

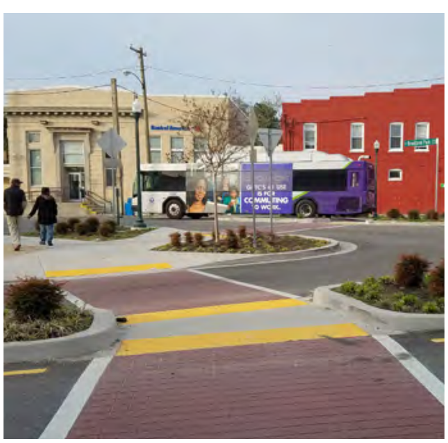
The City's Bicycle Master Plan recommends a citywide bicycle network and gives guidance on the type of facility (bicycle lane, shared use path, etc.).

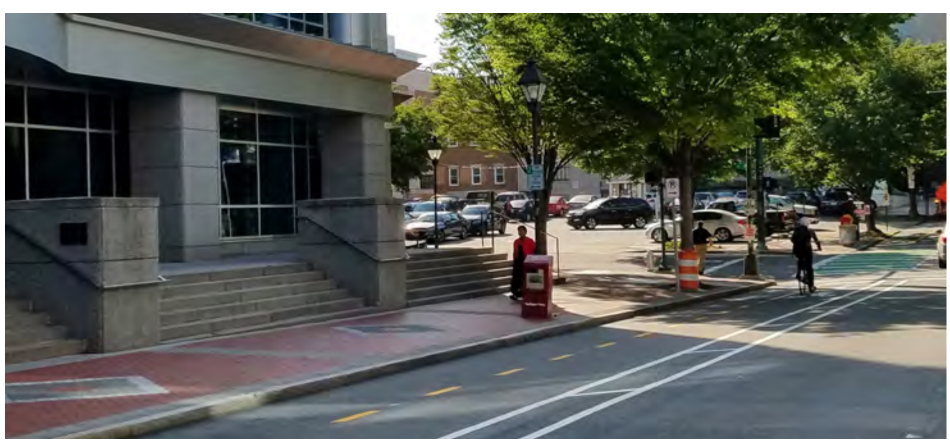
- Review the Richmond Bicycle Master Plan to determine the type of facility (if any) that is appropriate for the corridor.
- Consider the location relative to the bicycle network and the potential for encouraging bicycling.

Not all streets need a marked bicycle facility. Bicyclists can share the travel lane with motor vehicles; however, separate facilities encourage greater use from various age groups and confidence levels.

- Intersections are a primary point of conflict. The safety and mobility of all users is important in the design.
- Understand the typology and traffic volumes of the intersecting streets in the design of the intersection control (signal, stop, yield).
- Consider alternative intersection designs like roundabouts and traffic calming circles.
- Design the intersection to improve the safety for the crossing pedestrian.
- Consider the transit network and accessibility for riders in locating the bus stop and in designing the amenities.

Intersection analysis tools should be used to develop the intersection configuration however, accommodating the more vulnerable users (pedestrians and bicyclists) may take the higher priority over level of service and delay criteria during a peak hour.

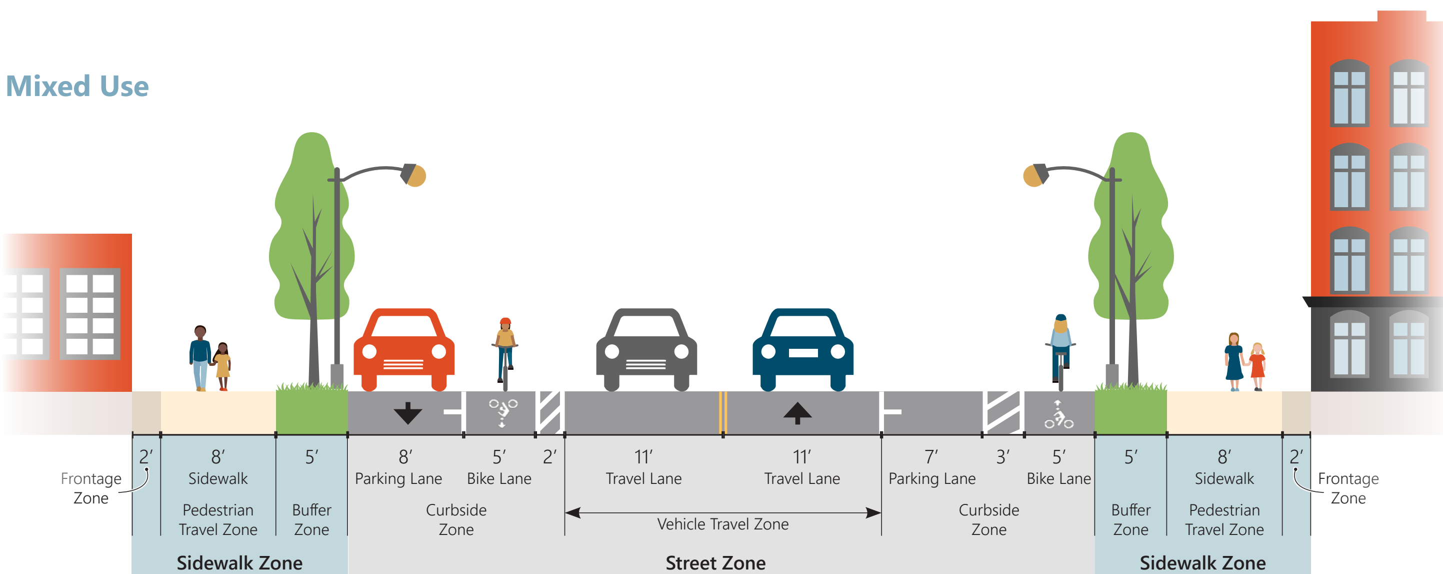




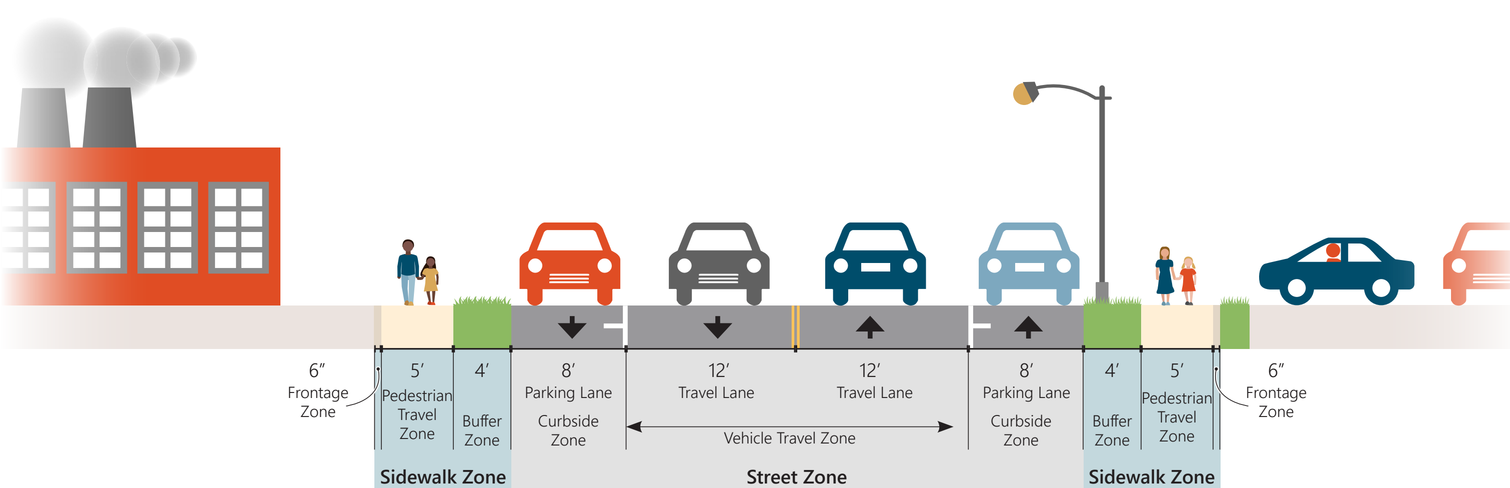
Cross Section Examples

This section presents examples of street cross sections by typology. There are an infinite number of ways to create the complete street; however, these examples provide a place to start. Always consider using the preferred dimensions first. Anything less will require justification and City's Transportation Engineer approval.

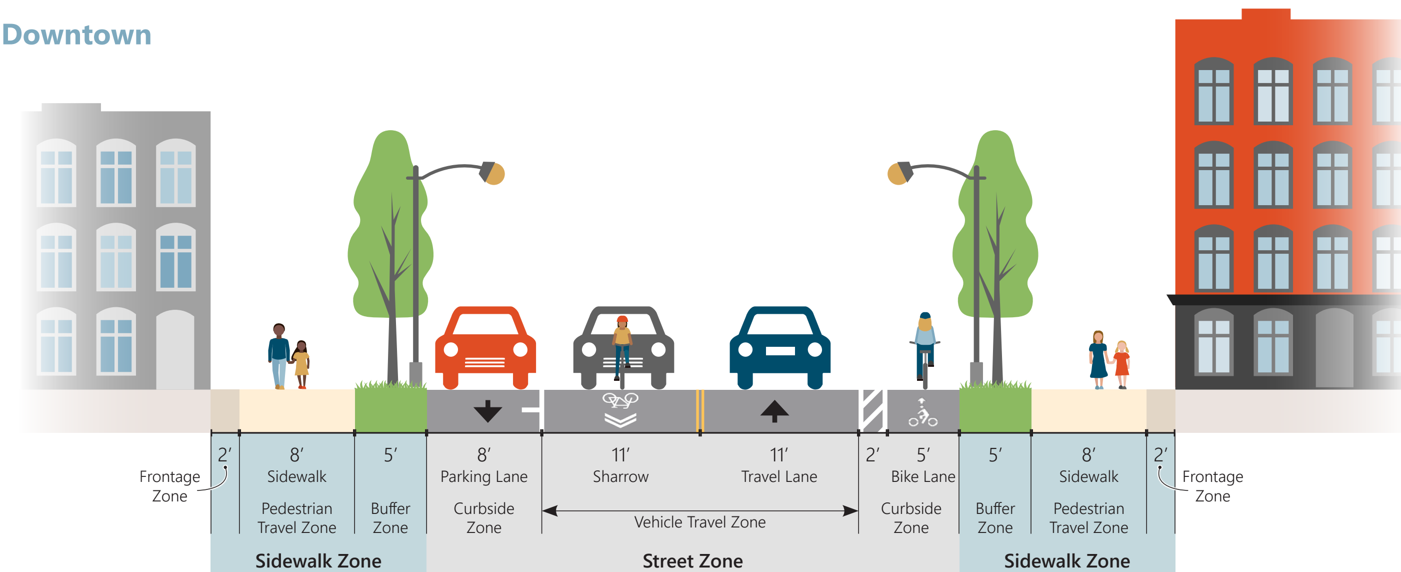
Mixed Use



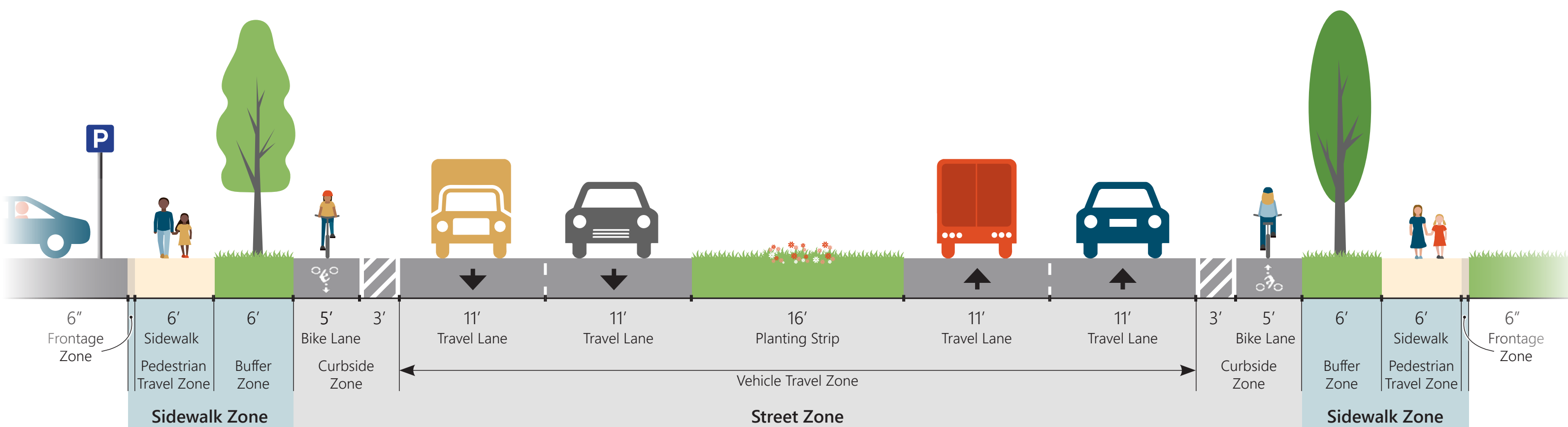
Industrial



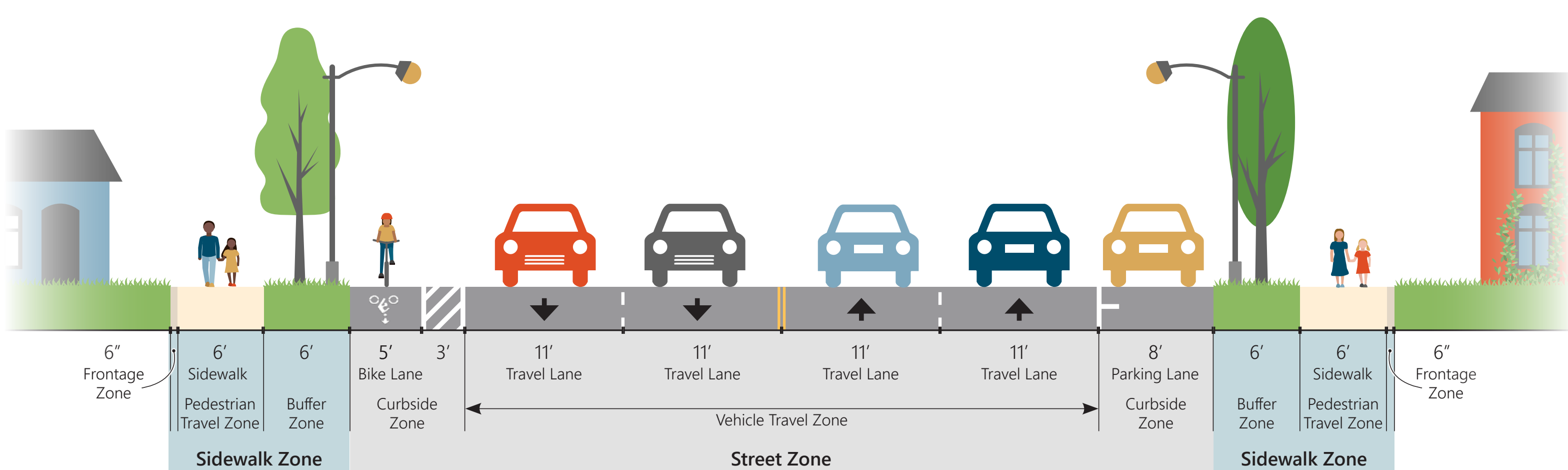
Downtown



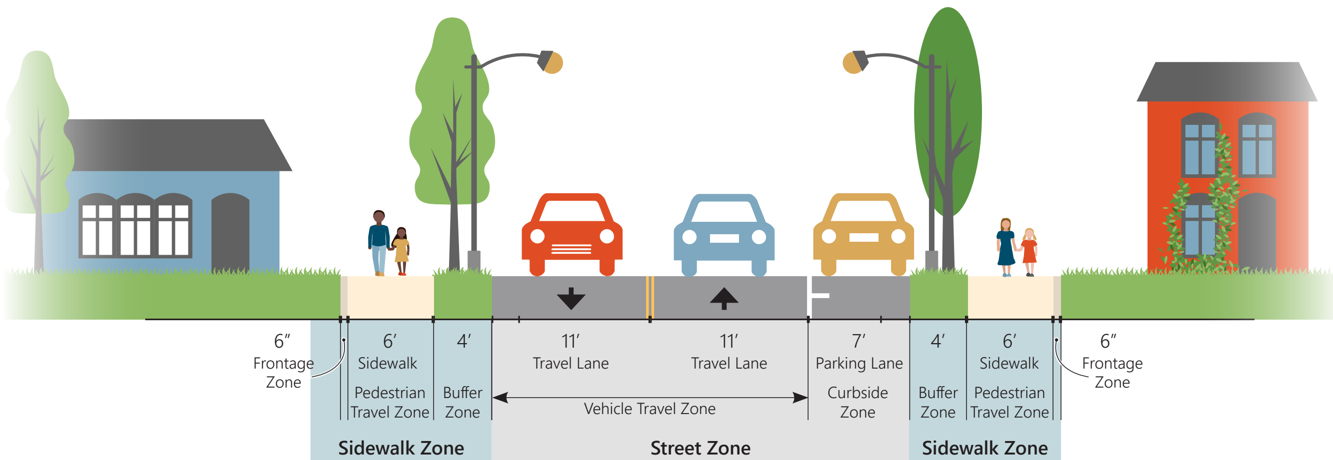
Commercial Connector



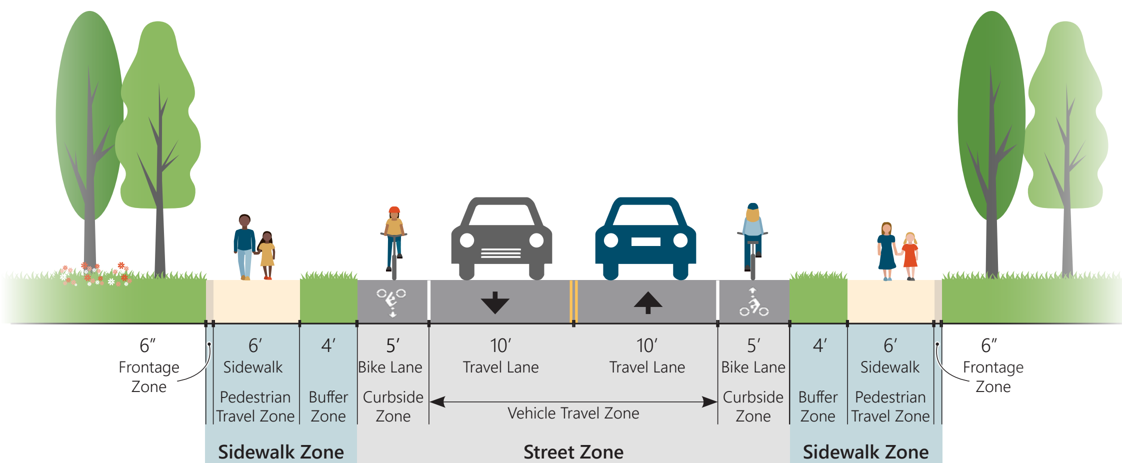
Neighborhood Connector



Neighborhood Residential



Parkway



The public right-of-way must do more than provide travel ways for mobility. Utility systems are the lifelines to our communities. Their location within the right-of-way must be considered. Drainage systems must be designed to remove water from the travel ways for public safety. Appropriate lighting levels for all users, including people who walk and use transit, will dictate the location and system design of the street lights.

Integration

A complete street integrates the type of street and the land uses it serves with the multimodal user needs. Think about how the street relates to the adjacent land uses, how it fits into transportation network, and are there other influences (overlays).

Use the information presented in this manual to design a balanced, complete street.

Use **Part 2** for guidance on the design details for the transportation infrastructure.

Use **Part 3** for guidance on building improvements in the public right-of-way.

Always remember that Richmond's communities must be engaged in the conversation. An open dialogue with residents, business owners, property owners, and all other stakeholders will result in complete street that meets all of the City's guiding principles—safe, multimodal, healthy, green, active, and smart.

It’s a process

CITY OF RICHMOND

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