Broward MPO
Metropolitan Planning Organization

BROWARD COMPLETE STREETS MASTER PLAN
Better Streets • Better Communities • Better Broward

Complete Streets Design Guidelines 2.0

Better Streets | Better Communities | Better Broward

prepared by:

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prepared for:

Broward MPO
Metropolitan Planning Organization

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Contents

Acronyms

AASHTO American Association of State Highway and Transportation Officials

ADA American with Disabilities Act

APA American Planning Association

APHA American Public Health Association

ASCE American Society of Civil Engineers

BAT Business Access and Transit Lanes

BRHPC Broward Regional Health Planning Council

BRT Bus Rapid Transit

CDC Centers for Disease Control

CSAC Complete Streets Advisory Committee

CSDG Complete Streets Design Guidelines

CSLIP Complete Streets and Other Localized Initiatives Program

CSMP Complete Streets Master Plan

CTG Community Transportation Grant

EPA Environmental Protection Agency

FDM FDOT Design Manual

FDOT Florida Department of Transportation

FHWA Federal Highway Administration

ITE Institute of Transportation Engineers

LAP Local Agency Program

LPI Leading Pedestrian Interval

LRT Light Rail Transit

LRTP Long Range Transportation Plan

MMLOS Multimodal Level of Service

MMSC Multimodal Scoping Checklist

MPO Metropolitan Planning Organization

NACTO National Association of City Transportation Officials

NHS National Highway System

PAC Project Advisory Committee

PHBs Pedestrian Hybrid Beacons

PD&E Project Development and Environment

ROW Right-of-Way

RRFBs Rectangular Rapid Flashing Beacons

SSS Safe Streets Summit

TIGER Transportation Investment Generating Economic Recovery

TIP Transportation Improvement Program

TOUCH Transforming our Community's Health

TPA Transportation Planning Agency

TPO Transportation Planning Organization

TSP Transit Signal Priority

USDOT U.S. Department of Transportation

Las Olas Boulevard

Photo by Kimley-Horn

1 Introduction

Complete Streets
Design Guidelines 2.0

Context

Complete Streets policies came into being in late 2003 in response to car-centric planning. The term "Complete Streets" was coined by America Bikes, a national coalition promoting bicycling as a means of travel and recreation, as it was developing a new policy initiative with the goal of ensuring the same rights and safe access for all users of streets, including pedestrians, bicyclists, motorists, and transit riders of all ages and abilities.[1]

The first Broward Complete Streets Guidelines was completed in 2012. Since the inception, there has been a spike in public awareness and interest regarding the value of having streetscapes that cater to a variety of transport modes and foster human interaction. A wealth of new information to complement the understanding of what constitutes a Complete Street and the set of measures available to achieve the desired goal has transformed since the starting point of Complete Streets.

What are Complete Streets?

A common definition of Complete Streets refers to the practice of planning, designing, and operating streets so that all transportation modes and users have an equal claim to the right-of-way. Creating a safe and comfortable environment for people of all ages and abilities to freely move in and out of the city is a pinnacle principle for advocates of Complete Streets. Whether residents and visitors choose to travel by means of walking, cycling, public transit or motor vehicles should not inhibit their access to destinations or activities throughout the community.

Building and maintaining the necessary physical infrastructure – such as sidewalks, crosswalks, bicycles lanes, roundabouts, curb extensions, and transit stops – is essential. However, many other design elements must also be considered. Vegetation, lighting, street furniture, lane separation, lane width, parking facilities, accessibility, and connectivity all play an important role in the ultimate success of the network.

Keeping these principles in mind, it is noteworthy to mention that local conditions and demographic trends have a powerful effect on what type of design is appropriate for each specific community. Design elements can take various forms and be adapted to fit the needs and concerns of residents, resulting in a myriad of options for what constitutes a "Complete Street."

[1] ***American Planning Association, Complete Streets Come of Age 2014***

Sidewalk Realm
Source: Complete Streets Master Plan

Why Complete Streets?

Given the relatively recent recognition of the value of Complete Streets, many cities have inherited transportation systems and urban realms vastly dependent on private vehicle travel. Almost uniformly across the globe, the "modern city" is struggling to keep up with the inefficiencies and negative sustainability impacts resulting from car-oriented designs. The repercussions to communities can be thought of in terms of social, economic, and environmental impacts and have lasting effects on the individual, the community, and the planet.

Social

- Social exclusion particularly affecting the most vulnerable groups such as the young, the elderly, disabled, or poor due to limited transportation options.
- Health & wellness deterioration due to a lack of opportunity for necessary daily physical activity and over exposure to greenhouse gas emissions from vehicular traffic.
- Lifeless communities with no sense of cohesion and lack of opportunity for interaction and participation in urban life.

Economic

- Economic hardships to the individual due to the high cost of driving.
- Limited commercial opportunities at neighborhood level, deters small businesses from flourishing.
- Healthcare costs, opportunity cost of lost labor resulting from congestion, cost of energy and fuel overconsumption, and repair costs incurred due to environmental damages. These numbers often circulate in the millions.

Environmental

- Excessive greenhouse gas emissions resulting in higher concentration of pollutants and often resulting in poor air quality.
- Heat-Island Effect heightened due to overuse of concrete pavement. Shaded surfaces may be 20-45°F cooler than unshaded counterparts.[2]
- Expansion of development boundaries which threatens wildlife, protected wetlands, and underwater aquifers.

Complete Streets have a prevailing effect counteracting these negative impacts and generating countless benefits.

[2] ***Using Trees and Vegetation to Reduce Heat Islands, EPA***

Capacity. Complete Streets can improve the efficiency and capacity of existing roads by moving more people in the same amount of space. Complete streets can maintain volume, reduce speeds, and conveniently accommodate bicyclists and pedestrians. Getting more productivity out of the existing road and public transportation system is vital to reducing congestion.

Equity. Complete streets ensure the opportunity for full participation in all activities and benefits for all members of society. People of all ages, abilities, and income levels will have more options when making essential trips such as to work, to school, to the grocery store, or simply for recreational purposes. In face of the usually high costs associated with private vehicle ownership, complete streets open affordable alternative transportation options such as walking, bicycling, and use of public transit for residents and visitors.

Public Health. Complete Streets foster healthier communities. To maintain good health, the World Health Organization recommends that adults engage in at least 150 minutes of moderate exercise throughout the week, while children must accumulate at least 60 minutes daily[3]. The Centers for Disease Control's (CDC) "Active People, Healthy Nation" identifies a strong correlation between planning and investments in infrastructure and an increase in physical activity, counteracting some of the most serious health concerns facing the United States, including obesity, coronary heart disease, diabetes, high blood pressure, cardiorespiratory diseases, and depression. In 2016, over two-thirds of Broward's adults were reported as overweight or obese, while 84% of high-school students were found to not be getting sufficient physical activity[4]. By promoting active transportation, such as walking and bicycling, Complete Streets open an opportunity to integrate moderate exercise into daily routines.

Safety. A 2017 report by the Governors Highway Safety Association found Florida to have the 5th highest rate for pedestrian fatalities in the country[5]. Meanwhile, the rankings do not improve for bicyclists, with the National Highway Traffic Safety Administration declaring Florida as the state with the highest proportion of bicyclist fatalities compared to all other states in the nation[6]. Making these travel choices more convenient and attractive means making them safer and leveling the playing field for the most vulnerable road users.

Sustainability. Sustainable development or "Smart Growth" recognizes "the importance of ensuring that all people should be able to satisfy their basic needs and enjoy a better quality of life, both now and in the future"[7]. It advocates for the resiliency, social, economic, and environmental wellbeing of a city, which is heavily tied to the efficient move of goods and people. The Broward MPO 2035 Long Range Transportation Plan (LRTP) recognizes the need for a shift on investment from car-centric projects to initiatives that promote transit and active transportation. Planning, designing, implementing, and maintaining a safe and convenient network of complete streets is the first – and most decisive- step towards the creation of a sustainable transportation system.

The Time is Right. In recent years, the trend toward Smart Growth has become stronger, louder, and more urgent than at any other point in history. Public and private organizations as well as government agencies across the board are becoming powerful advocates for Smart Growth policies, recognizing the wide range of benefits that sustainable communities yield. Establishing a high-quality transportation system has been documented to bring about economic regeneration, attract talent, investment, and altogether raise the level of competitiveness of communities on a global scale.

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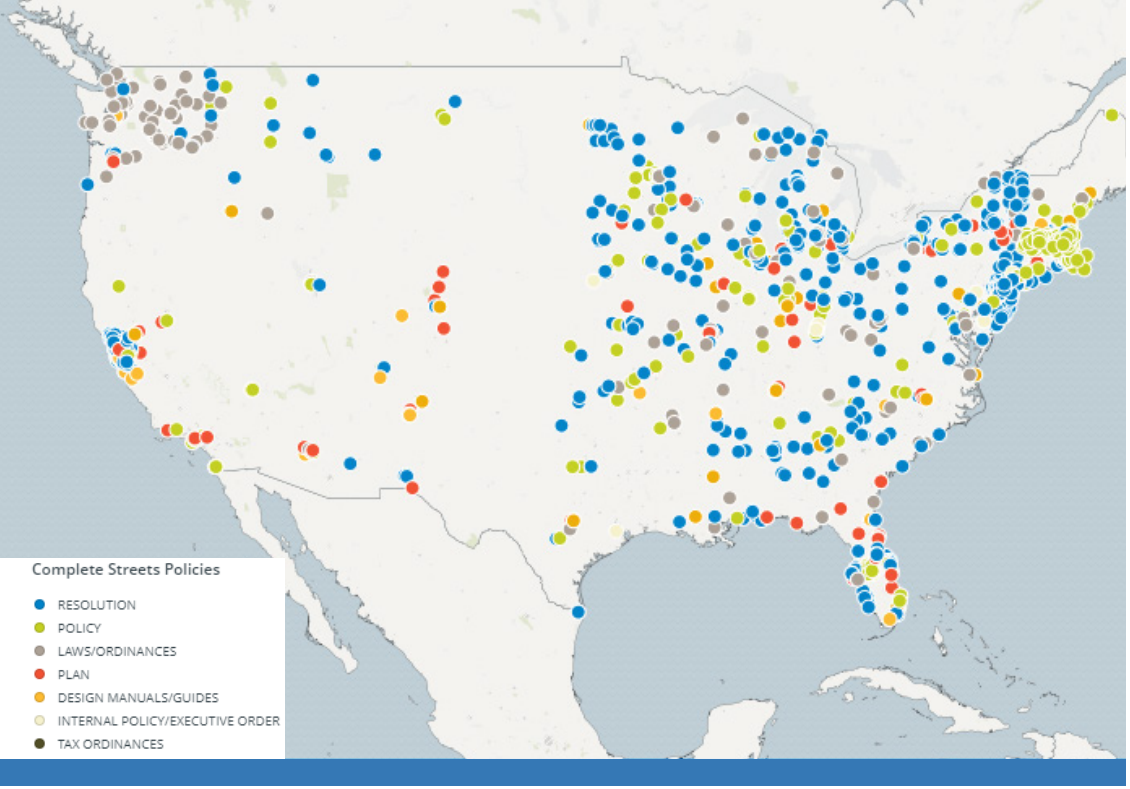
3 ***Physical Activity and Adults, WHO***

4 ***FLHealthCharts***

5 ***Pedestrian Traffic Fatalities by State, 2017 Preliminary Data***

6 ***NHTSA, Bicyclists and other cyclists Traffic Safety Facts, 2015 Data***

7 ***Rees, William E. & Roseland, Mark. 1991. Sustainable Communities: Planning for the 21st Century***



Source: Smart Growth America

Complete Streets tailor and use Smart Growth Principles to make objective-led planning decisions with significant short and long-term impacts. Over 1,400 Complete Streets policies have been passed in the United States to date, including 33 state governments.

Principles for Smart Growth

1. Mix land uses
2. Take advantage of compact design
3. Create a range of housing opportunities and choices
4. Create walkable neighborhoods
5. Foster distinctive, attractive communities with a strong sense of place
6. Preserve open space, farmland, natural beauty, and critical environmental areas
7. Direct development towards existing communities
8. Provide a variety of transportation choices
9. Make development decisions predictable, fair, and cost effective
10. Encourage community and stakeholder collaboration in development decisions[8]

8 ***What is smart growth? Smart Growth America, 2018***

Complete Streets in Broward County

2009

- Broward County, its municipalities, and MPO start advocating and working diligently to adopt Complete Streets policies, design guidelines, and ordinances throughout the county.

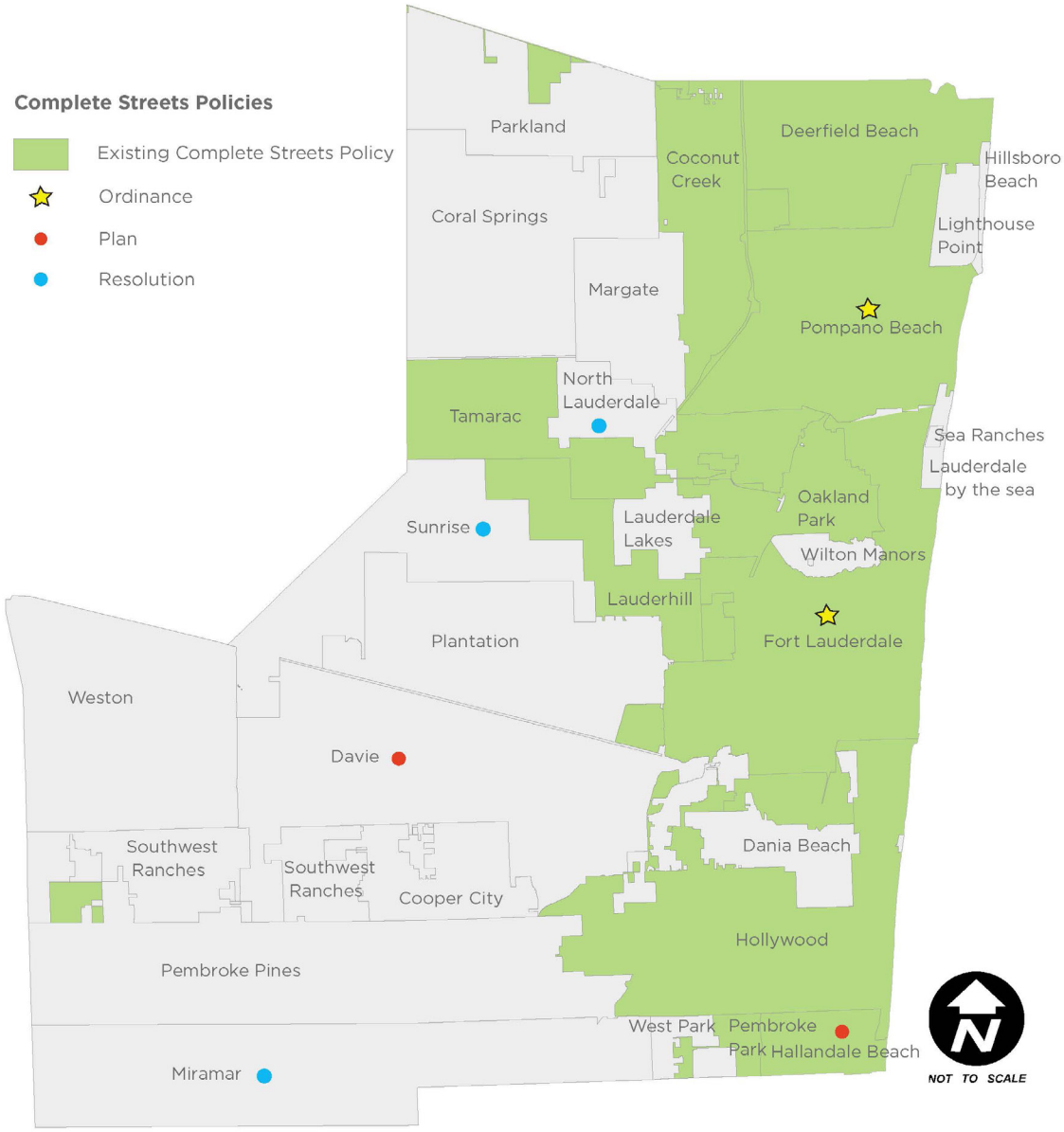
2014

- Broward County Board of County Commissioners adopts Complete Streets policies into the Broward County Comprehensive Plan.
- Several municipalities across the county also adopt policies, ordinances, plans, and resolutions into their own comprehensive plans.

2018

- Broward County voters approve a 30-year, one cent surtax for transportation. Additional surtax revenue generated from the transportation surtax is expected to leverage up to $3 billion from federal, state and other sources. These additional funds will target issues relating to connectivity, traffic congestion, transit services, and improving conditions for alternative modes of transportation such as walking, biking, and skating.

AARP, American Public Health Association (APHA), Safe Routes to School National Partnership, Smart Growth America, Institute of Transportation Engineers (ITE), American Planning Association (APA), and American Society of Civil Engineers (ASCE), **are strong supporters of Complete Streets.**



Complete Streets at the Broward MPO

The Broward Metropolitan Planning Organization (MPO) advocates for safer and healthier streets through a Complete Streets Initiative that encompasses several policies and strategies. The 2012 Complete Streets Design Guidelines provided a reference manual for all municipalities that wished to implement designs oriented to the needs of all road users. Ever since, the MPO has continued its efforts for the enhancement of the urban streetscape of Broward County.

Some of the major initiatives include but are not limited to:

Complete Streets Advisory Committee (CSAC)

Establishment of a standing committee to oversee the needs of pedestrians and cyclists in the County. The committee ensures coordination across departments and agencies to align transportation initiatives and projects for the benefit of active travelers. Professionals of multiple disciplines and backgrounds serve on the advisory committee, which meets regularly and can recommend issues for action or consideration.

Weblink: **http://www.browardmpo.org/index.php/our-committees/complete-streets-advisory-committee**

Complete Streets and other Localized Initiatives Program (CSLIP)

Provides funding for small local transportation projects which improve the safety and mobility for all transportation users in Broward. This competitive grant program can fund projects such as (but not limited to): Complete Streets projects, traffic calming and intersection improvements, ADA upgrades, mobility hubs, bus shelters, bike racks and technology advancements such as transit signal priority and traffic control devices.

Weblink: **http://www.browardmpo.org/index.php/major-functions/complete-streets-localized-initiatives-program**

CSLIP
Broward MPO's Complete Streets and other Localized Initiatives Program

Mobility Program

Serves as the implementation arm of the Complete Streets Initiative and focuses on implementing projects and improvements that provide additional transportation options other than the automobile. These projects fill vital gaps in Broward's bicycle and pedestrian network.

Weblink: **http://www.browardmpo.org/index.php/mobility-program**

Complete Streets Master Plan (CSMP)

Intended to guide future investment in Complete Streets improvements by developing a prioritized list of projects based on technical, data-driven analysis, including access to transit. Projects identified will be based on Complete Streets principles that create safe streets at a human scale. The Complete Streets Master Plan concentrates transportation investments in Bundle Areas of Complete Streets projects which can increase active transportation.

Weblink: **http://www.browardmpo.org/index.php/complete-streets-master-plan**

Walking Audits

High ranked priority corridors from the Complete Streets Master Plan were selected for a Walking Audit. Walking Audits provide an experiential hands-on exercise that evaluates the walking environment, identifies pedestrian (and bicyclist) issues such as safety, access, connectivity, comfort, and convenience and identifies potential alternatives or solutions such as engineering treatments, policy changes, or education and enforcement measures.

Weblink: **http://www.browardmpo.org/index.php/walking-audits**

The Broward MPO's Mobility Projects

August 2019

Brief History of Complete Streets Program

2009

The Broward Metropolitan Planning Organization (MPO) board adopts the 2035 "Transformation" Long Range Transportation Plan (LRTP). This Plan allocates 70% of the projected funding to transportation modes (transit and bicycle/pedestrian) other than the automobile.

2010

Broward MPO, together with the Florida Department of Transportation (FDOT) developed the Broward MPO Mobility Program. The goal of this program is to move active transportation projects from planning to design and ultimately to construction.

2011

Broward Regional Health Planning Council (BRHPC) secures Centers for Disease Control (CDC) Community Transformation Grant (CTG) to create healthy and safe places in Broward by promoting an active lifestyle.

2012

Broward Regional Health Planning Council (BRHPC), Smart Growth Partnerships, and the Health Foundation of South Florida establish a partnership with the Broward MPO to develop the **Broward Complete Streets Guidelines** as part of the CDC CTG Transforming our Community's Health (TOUCH) Grant.

Broward MPO Board endorses the **Broward Complete Streets Guidelines**.

Broward MPO formally establishes the **Complete Streets Advisory Committee (CSAC)** to guide the Broward MPO's Complete Streets Initiative. The Initiative's main intent is to provide the necessary tools and resources for local governments seeking to implement Complete Streets in their respective communities.

The Broward MPO successfully programs approximately $15 million in bicycle/pedestrian improvements in its Transportation Improvement Program (TIP). This initial investment includes multiple projects located in various municipalities throughout the Broward Region.

2013

Broward MPO develops a **Model Complete Streets Policy and Plan Framework** to assist member governments with their Complete Streets efforts.

CSAC selects two **Complete Streets Demonstration projects** – Hollywood Boulevard (Urban Context) in the City of Hollywood and Sunset Strip (Suburban Context) in the City of Sunrise.

The Broward MPO completes its **Multimodal Level of Service tool** to measure the benefits of a more flexible tool than the traditional roadway-based level of service tool. The two demonstration projects are analyzed and evaluated utilizing the Multimodal Level of Service (MMLOS) tool.

City of Deerfield Beach becomes the first city in the State of Florida to adopt Complete Streets Guidelines based on the **Broward Complete Streets Guidelines** developed by the Broward MPO.

2014

Broward MPO hosts the first **Safe Streets Summit (SSS)** in the City of Hollywood to provide training and education to local government staff and elected officials interested in adopting Complete Streets.

The City of Sunrise, in conjunction with the Broward MPO, hosts the inaugural **Let's Go Biking!** Event.

The Broward MPO successfully programs over $100 million in bicycle/pedestrian projects in the region for the next five years.

City of North Lauderdale, City of Coconut Creek, and City of Lauderhill become the first communities in Broward to participate in Walking Audits to help their communities understand the walking and bicycling needs in their area.

2015

The Broward MPO hosts a groundbreaking ceremony to kick off the construction of the initial investment of $15 million in pedestrian and bicycle improvements.

The Broward MPO publishes the **Complete Streets Evaluation Toolkit** to evaluate Complete Streets projects utilizing metrics related to transportation, safety, health, and economic development.

2016

Broward MPO is awarded a **Transportation Investment Generating Economic Recovery (TIGER)** to fund an additional $19 million of Complete Streets projects in Broward.

The City of Dania Beach hosts the Broward MPO's inaugural **Let's Go Walking!** Event.

2017

The Broward MPO breaks ground on two Complete Streets demonstration projects in the City of Hollywood and City of Sunrise.

Broward MPO breaks the $200-million-dollar mark for funded bicycle/pedestrian projects in the 2019 Tentative Work Program.

Broward MPO initiates the development of the Complete Streets Master Plan (CSMP). This effort will guide future investments by creating a prioritized list of projects based on technical, data-driven analysis and community and local partner input.

Broward MPO establishes a Project Advisory Committee (PAC) to guide the development of the **CSMP**.

The Broward MPO develops and publishes the Broward Bike Suitability Map.

The Broward MPO partners with the Palm Beach Transportation Planning Agency (TPA) and the Miami-Dade Transportation Planning Organization (TPO) to host the **4th Annual SSS** in the City of Sunrise.

2018

A ribbon cutting ceremony is held for the Sunset Strip demonstration project in the City of Sunrise.

Broward MPO staff holds meetings with local member governments to review lists of recommendations and provide opportunities for input ensuring the local perspective is included in the **CSMP**.

Broward MPO provides American with Disabilities Act (ADA) Transition Plan training and technical assistance to municipalities.

2019

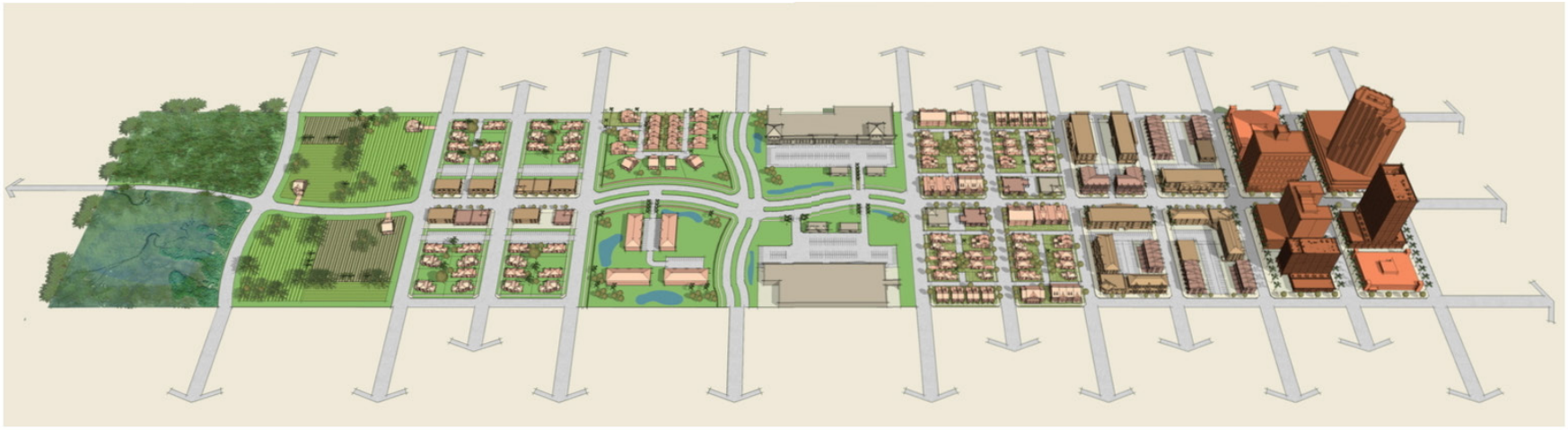
Broward MPO Board adopts the **CSMP.**

Partner Agency Support

Florida Department of Transportation (FDOT)

- 2014 – Adoption of the Complete Streets Policy
- 2015 – Released the Complete Streets Implementation Plan
- 2017 – District Four completed mapping all its state roads for context classification using GIS. District Four has incorporated context classification into its Multimodal Scoping Checklist (MMSC), which is a long-standing district tool used to coordinate with local governments.

The context classification system broadly identifies the various built environments existing in Florida. FDOT's context classification system describes the general characteristics of the land use, development patterns, and roadway connectivity along a roadway, providing cues as to the types of uses and the user groups that will likely utilize the roadway.



C1-Natural
Lands preserved in a natural or wilderness condition, including lands unsuitable for settlement due to natural conditions.

C2-Rural
Sparsely settled lands; may include agricultural land, grassland, woodland, and wetlands.

C2T-Rural Town
Small concentrations of developed areas immediately surrounded by rural and natural areas; includes many historic towns.

C3R-Suburban Residential
Mostly residential uses within large blocks and a disconnected or sparse roadway network.

C3C-Suburban Commercial
Mostly non-residential uses with large building footprints and large parking lots within large blocks and a disconnected or sparse roadway network.

C4-Urban General
Mix of uses set within small blocks with a well-connected roadway network. May extend long distances. The roadway network usually connects to residential neighborhoods immediately along the corridor or behind the uses fronting the roadway.

C5-Urban Center
Mix of uses set within small blocks with a well-connected roadway network. Typically concentrated around a few blocks and identified as part of a civic or economic center of a community, town, or city.

C6-Urban Core
Areas with the highest densities and building heights, and within FDOT classified Large Urbanized Areas (population >1,000,000). Many are regional centers and destinations. Buildings have mixed uses, are built up to the roadway, and are within a well-connected roadway network.

Source: FDOT

Broward County Complete Streets

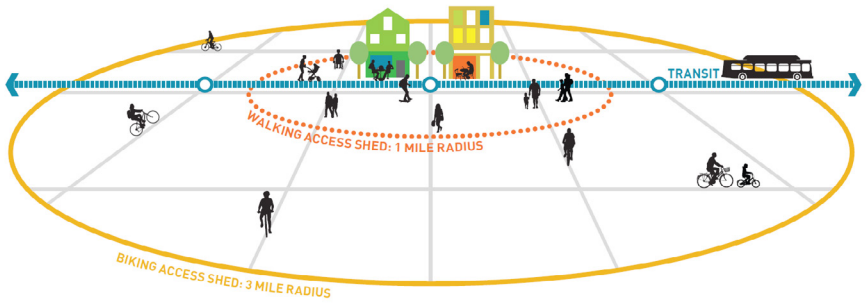
The Broward County Board of County Commissioners adopted Complete Streets policies into the Broward County Comprehensive Plan in June 2014. A number of municipalities have adopted resolutions in support of the concept and are working toward adopting policies into their comprehensive plans.

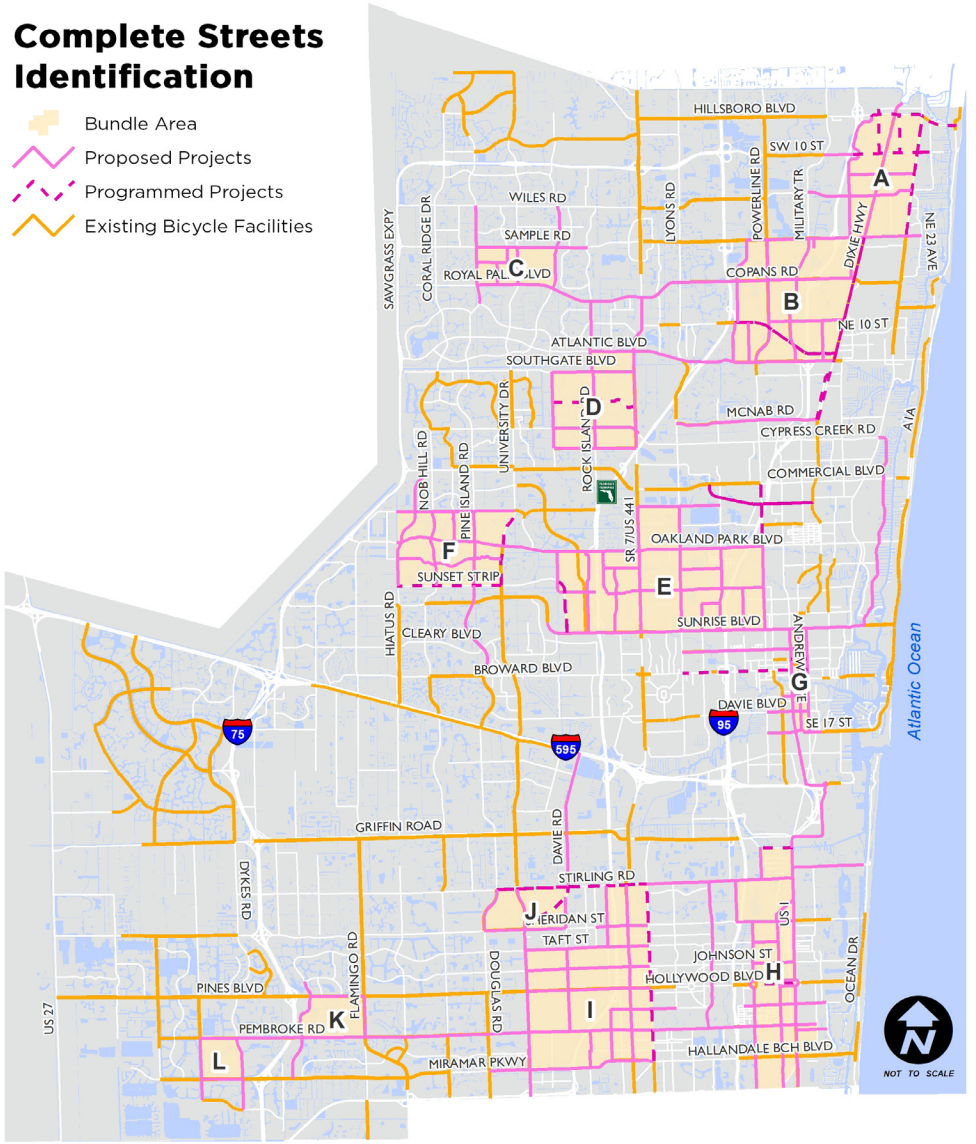
Complete Streets Master Plan (CSMP)

The Complete Streets Master Plan guides future investment in Complete Streets improvements by developing a prioritized list of projects based on technical, data-driven analysis, including access to transit which was adopted by the MPO Board in January 2019. Extensive community engagement strategies were implemented and provided opportunities for transportation partners' input throughout the duration of the CSMP development.

A demand and equity analysis was performed to identify areas of expected walking and biking activity and concentrations of historically vulnerable populations. The demand analysis estimates the cumulative demand representative of where people live, work, shop, plan, learn, and access transit by quantifying factors that generate bicycle and pedestrian movement. The equity analysis considers demographic factors such as age, income, language, race, educational attainment, and commute. Investing in these areas also known as Bundle Areas could help alleviate a broader range of issues; such as access to jobs, education, and healthcare.

Concentrating transportation investments in Bundle Areas of Complete Streets projects can increase active transportation. Typically, many people do not walk farther than a 1-mile radius or bike farther than a 3-mile radius. It is more impactful to build a dense network to help the community become more walkable and bikeable.





Complete Streets Design Guidelines 2.0

Purpose

The purpose of the Broward MPO Complete Streets Design Guidelines 2.0 is to add facility types, techniques, and information that is new since the 2012 Broward Complete Streets Guidelines. It incorporates changes adopted by partner agency policies and standards, including FDOT Context Classification criteria and includes detailed specifications for preferred recommended facilities and design elements, including typical sections.

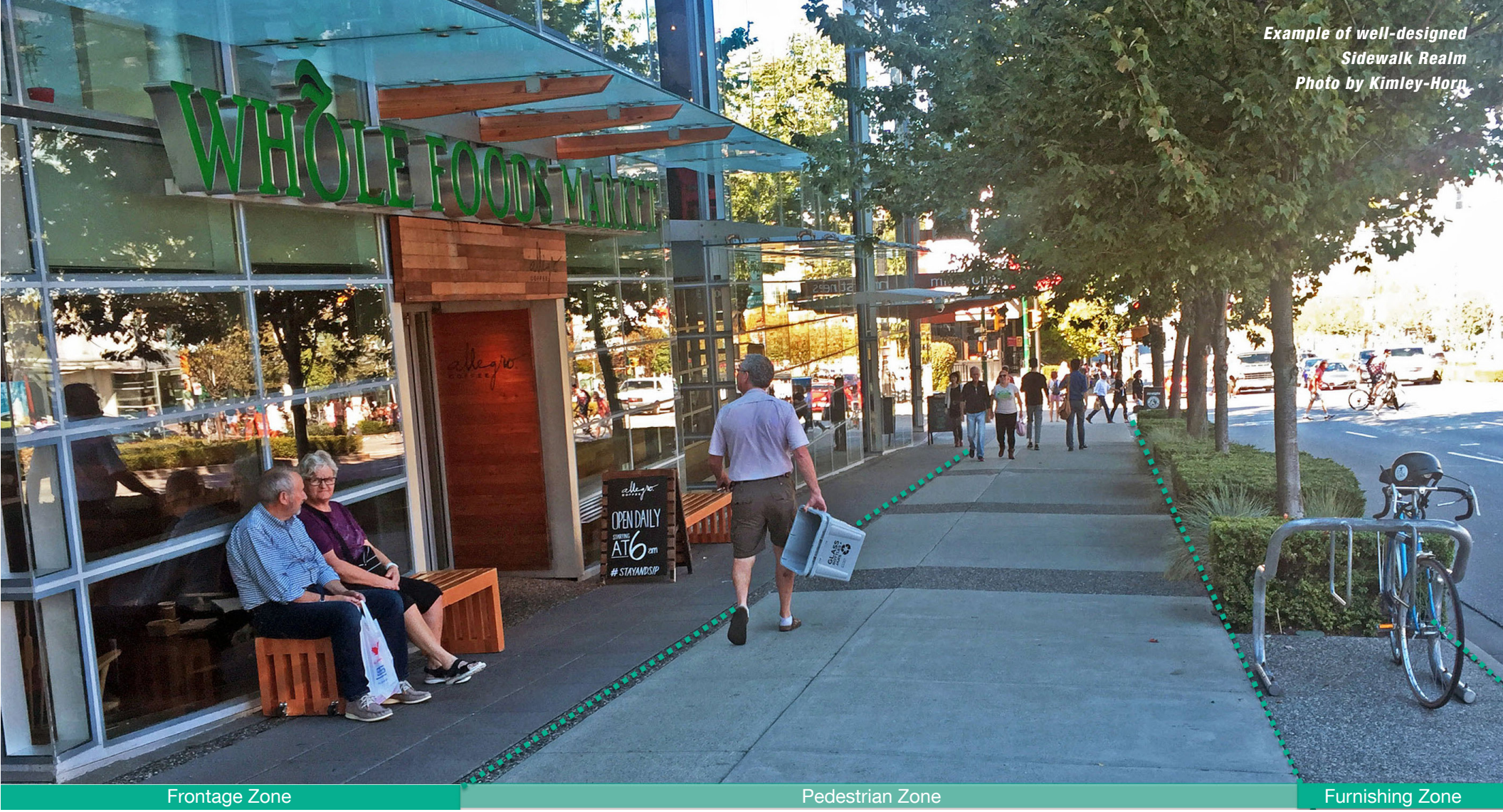
The Design Guidelines 2.0 complements the Complete Streets Master Plan because it provides design guidance for implementing Complete Streets projects.

Bicyclist on street with shade tree canopy

Photo by Kimley-Horn


509

Sidewalk Realm Design 2



Example of well-designed Sidewalk Realm
Photo by Kimley-Horn

The Sidewalk Realm is located between the curb and the property line. Sidewalks are designed primarily to allow safe pedestrian movement separated from moving traffic. This chapter explores three main zone of the Sidewalk Realm: Frontage Zone, Pedestrian Zone, and Furnishing Zone. In addition, design guidelines are analyzed for the following elements:

- Transit Boarding Areas
- Lighting
- Shade
- Green Infrastructure
- Access Management
- Bicycle Facilities
- Micromobility
- End-of-Trip Facilities
- Placemaking

Pedestrian Zone

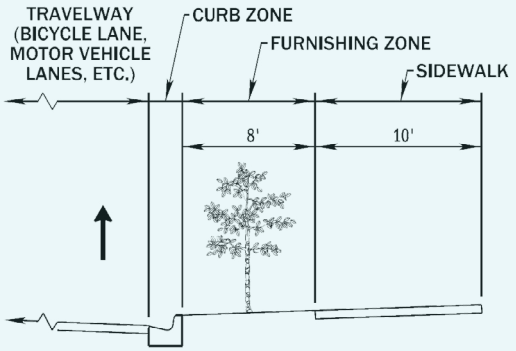
The Pedestrian Zone is the space most associated with the Sidewalk Realm. It consists of a lane designed to exclusively accommodate pedestrian traffic alongside a road. It is usually placed on the outside of the curb at a raised elevation from the adjacent vehicular lanes.

Beyond the basic infrastructure provision often seen in cities, there are numerous design elements that can improve the pedestrian zone to create a friendly, safe, and inviting space. Pedestrians tend to be the most vulnerable road users, making safety an often-cited concern deterring people from choosing walking as a viable transportation option. Lane widths surpassing the constrained 6-foot marking, physical separation from vehicular and bicycle traffic, and enhanced crosswalks can all have a tremendous effect by increasing actual and perceived safety. Removing obstacles and adding amenities can further turn the Pedestrian Zone from a place where people solely travel into a space where people choose to stay and gather.

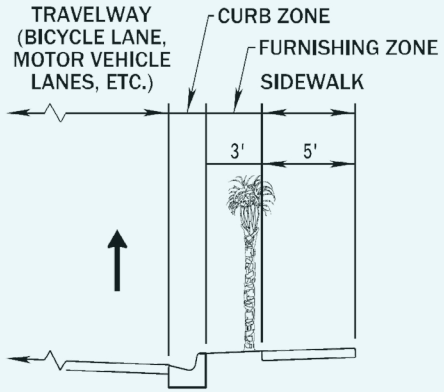
Furnishing Zone

Vegetation is an integral element that can positively shape the built environment of the Sidewalk Realm. Including a Furnishing Zone is one of the first enhancements added to Complete Streets. This space is highly dynamic and can also accommodate other elements of the realm that would become constrictions in the Pedestrian Zone. Street furniture, lighting, signage, litter and recycling bins, utility equipment, stormwater elements, hydrants, bicycle racks, bikeshare stations, public art and parking meters can all be placed.

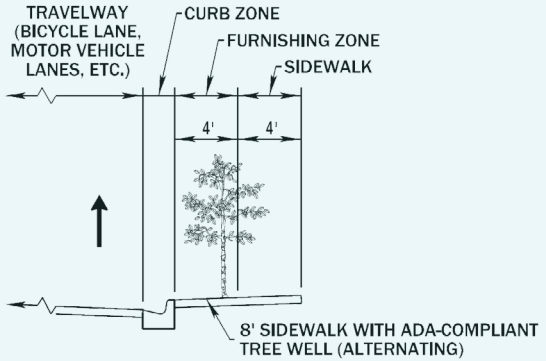
The Furnishing Zone is most often placed between the Pedestrian Zone and the Curb Zone, effectively creating a pleasing primary separation of people on the sidewalk from vehicular traffic. However, the Furnishing Zone can adopt many other layouts tailored to respond to the needs of the location. Occasionally, integration between the Furnishing Zone and Pedestrian Zone is both possible and desirable, as it can create lively public spaces.



FURNISHING ZONE (TARGET)



FURNISHING ZONE (CONSTRAINED)



FURNISHING ZONE (CONSTRAINED)

8' Pedestrian Zone adjacent to 7' Furnishing Zone

Constrained Furnishing Zone within 8' Sidewalk Realm

5' Pedestrian Zone adjacent to 5' Furnishing Zone

Meandering Pedestrian Zone, A1A Greenway

Sidewalk Realm with Frontage & Furnishing Zones

Wide Pedestrian Zone with Furnishing Zone & Frontage Zone

Photos by Kimley-Horn

Frontage Zone in Downtown sidewalk with streetside cafe seating
Photo by Kimley-Horn

Frontage Zone with streetside cafe in residential neighborhood setting
Source: NACTO

Frontage Zone

The Frontage Zone acts as a connector between buildings and the Sidewalk Realm. In the urban core, street cafes can often be found here, inviting foot traffic into the establishments. In general, lower floor facades can create harmony and incite pedestrian activity or deter it. Interesting shop Frontage Zones tend to be narrow and vertical, showcase soft edges, appeal to many senses, have texture and details, and offer a view into the establishments.

In residential areas, the frontage zone is equally notable, as it provides the context for the walk and a transition between the private and public space.

"If the complex is interesting and exciting at eye level, the whole area will be interesting. Therefore, try to make the edge zone inviting and rich in good detail, and save your efforts on the upper floors, which have far less importance both functionally and visually."

Ralph Erskine

Transit Boarding Area

Transit boarding areas offer a space for public transit riders to wait, board, and alight. They are often placed in the Furnishing Zone, near intersections, and in close proximity to the vehicular or transit lanes, but occasionally can also be found in the median. This is the space where the pedestrian and cyclist become transit users and vice versa, therefore creating all possible comfortable conditions for the user transition and easing accessibility for people of all ages and abilities are key ways to encourage multimodal journeys.

Improved transit boarding areas offer street furniture, information screens, and shelters that provide protection from extreme and adverse weather conditions. Ticketing systems can also be placed in Boarding Areas as a way of accelerating the boarding process and reducing transit travel times. Transit boarding areas also play a role welcoming people into streets and neighborhoods, and as such should be clearly visible, marked, and provide wayfinding information.

ADA Requirements for the Boarding and Alighting (B&A) Areas at bus stops include:

- Firm, stable surface
- Minimum clear length of 96 inches (8 feet)
- Minimum clear width of 60 inches (5 feet - measured parallel to the vehicle roadway)
- Connected to streets, sidewalks or pedestrian paths
- The slope of the pad parallel to the roadway be the same as the roadway

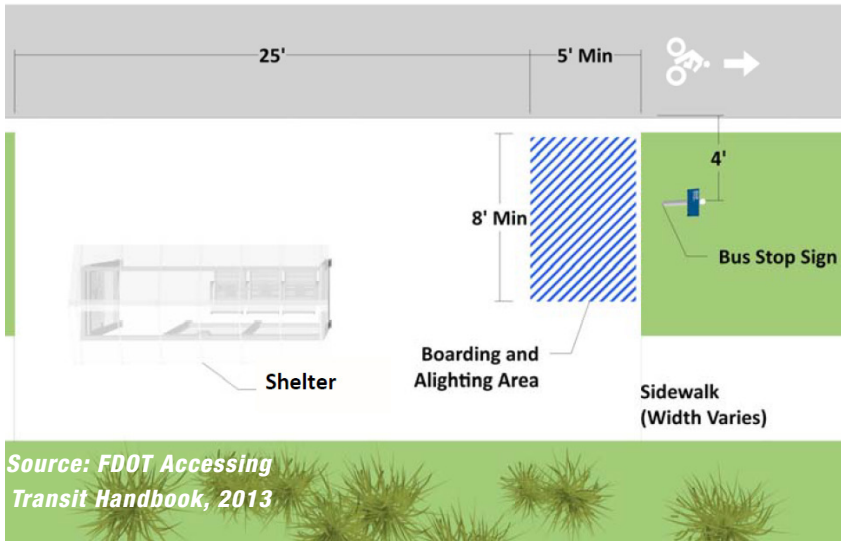
Although a minimum clear width of 5 feet is required, 40 feet is preferred to allow sufficient space for the bus to maneuver. Up to a maximum of 2% slope perpendicular to the roadway is allowed. Moreover, at boarding platforms for buses and rail vehicles, detectable warning surfaces shall be placed at the boarding edge of the platform.

The ability to easily and comfortably access transit can be a powerful indicator of transit ridership. Complete Streets improvements at transit stops and stations, and within the catchment area of transit, are fundamental to the success of any transit system. The design guidelines for these improvements will vary based on transit mode, station size, and community characteristics. Nonetheless, principles of Transit-Oriented Development (TOD) should guide the design of all major transit stations, stops, and mobility hubs.

Downtown Ft. Lauderdale Transit Boarding Area


Sheltered Bus Stop, Lauderdale Lakes

Photos by Kimley-Horn



Source: FDOT Accessing Transit Handbook, 2013

Lighting

Lighting is the main element that defines the nighttime environment, effectively doubling the utility time of infrastructure and street amenities in urban settings. Street lighting in Complete Streets includes pedestrian-scaled lighting in the public right-of-way, in addition to the overhead roadway lighting typically installed for the vehicular lanes.

Well-illuminated streets and public spaces correlate with an increase in actual and perceived safety of the public realm. Guidelines developed for San Francisco recommend minimum luminance of 0.5 fc, which allows pedestrians to "detect obstacles, stay visually oriented, and recognize faces from a distance of 13 feet". Worldwide evidence suggests that lack of proper lighting is a deterrent factor in the use of public transit and participation in active travel, in particular among women.

Pedestrian lighting should be consistent with minimized variance between bright and dark areas across blocks. Nonetheless, there are environmental impacts associated with over illumination - such as energy use and light pollution- that must also be considered when designing street lighting systems. Use of solar technology to power street lighting in appropriate situations is recommended, but its applications remain limited. Some cities are experimenting with adaptive lighting systems and LED lights, which have associated efficiencies in energy-use and costs.

In addition to installation costs, all lighting systems require sustained costs for maintenance and operation. Collecting and maintaining records on actual lighting levels is essential, as nighttime lighting levels can decline sharply over time.

Pedestrian-scaled lighting in urban settings

Photos by Kimley-Horn

Pedestrian-scaled lighting in urban settings

Photos by Kimley-Horn

Shade

Few elements of the built environment have a larger impact on the streetscape - and yield more benefits - than vegetation. Green infrastructure is an integral part of Complete Streets, and should be addressed throughout all phases of project development, including agency coordination, initial design, budgeting, construction, and maintenance.

Integrating native vegetation into roadway design allows for the built infrastructure to merge with the existing ecosystems in a less invasive manner. In addition, the carbon-reducing effect of green infrastructure can lead to statistically significant improvements in air quality, even after accounting for vehicular emissions of greenhouse gases such as CO2, NOx, and ground-level O3. In 2016, exposure to outdoor air pollution was estimated to cause 4.2 million premature deaths worldwide. [1]

Another function of vegetation relates to the regulation of ground temperatures. Exposure to the elements can be a major deterrent keeping people from using public transit, bicycling, or even walking. Shade trees, in specific, can protect against high summer temperatures, direct exposure to UV rays, and can reduce or slow down stormwater by intercepting precipitation. Planting shade trees alongside the roadway creates pleasant and prosperous communities. It encourages physical activity, reduces air and noise pollution, provides a space to commute with nature without need to leave the city, and ultimately leads to an increase in property values.

Recognizing these benefits, many cities have set street canopy goals, and fostered programs with strong performance measures to increase coverage. Quantifying the benefits of shade trees can facilitate policy-making, and extend installation and maintenance costs to developers.

[1] ***Ambient Air Quality and Health, World Health Organization***

Sidewalk Realm lined with shade trees

Photo by Kimley-Horn

Green Infrastructure

Green infrastructure can also be designed to slow, collect, store, infiltrate, and filter stormwater runoff. The most effective of these systems are bioswales.

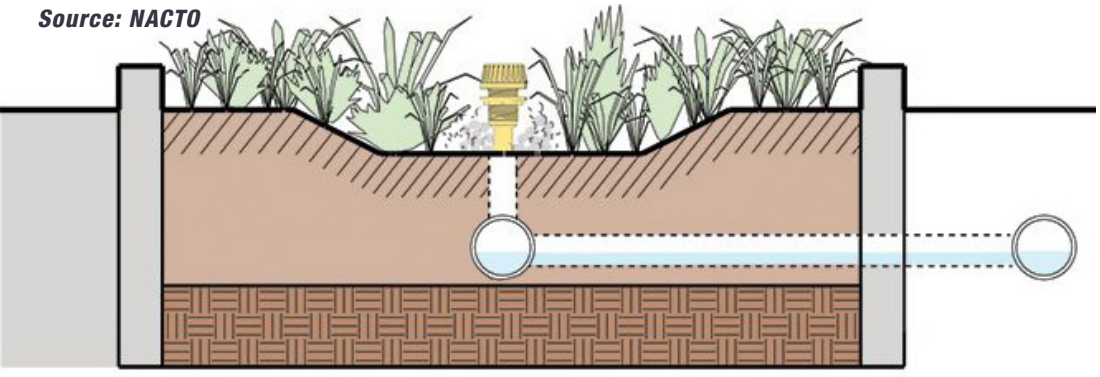
Bioswales are linear landscape depressions, commonly placed along streets, medians, or parking lots for their ability to manage stormwater runoff from impervious areas. The vegetated, shallow areas act as channels that provide treatment and retention.

There are specifications for the type and composition of the soil and vegetation to be used in bioswales to achieve optimized efficiency, as well as for the design of the bioswales themselves. Increased vegetative cover, for example, improves the effectiveness of the system, but the selected plants must be able to withstand heavy watering, require minimum irrigation, and be Florida native plants.

Intermittently spaced curb cuts are recommended where curbs are present, while minimum clearances should be maintained to protect adjacent infrastructure. The design flexibility of bioswales allows them to be used for traffic calming purposes.

Cross-section of a bioswale

Source: NACTO



Bioswales installed at a mid-block crossing

Source: NACTO

Access Management

Access Management relates to the design, implementation, and management of entry and exit points to land parcels from the roadway. The aim of access management measures is to promote efficient traffic flow, provide good ingress and egress to facilities, and enhance safety between vehicular, bicycle, and pedestrian movements.

Driveway Crossings

Driveways are areas of high conflict where motor vehicles must cross over the Sidewalk Realm to ingress or egress the Roadway Realm. ADA requires that all pedestrians, including persons with disabilities, be able to safely use sidewalks with driveway crossings. For this purpose, driveway design must follow specific standards that maintain traffic flow while ensuring the protection of other road users.

Driveways must be designed so that a level path of travel is maintained along the sidewalk corridor before the driveway ramp resumes sloping toward the street. The portion of the driveway that crosses the sidewalk may have, at maximum, a 2% cross slope and be designed with level landings. In commercial driveways with yield or stop control, detectable warning surfaces must be incorporated. Pedestrian right-of-way continues across driveway crossings[2] and signage or pavement markings may be used to inform and reinforce this hierarchy to drivers.

[2] ***Public Rights-of-Way Accessibility Guidelines, US Access Board***

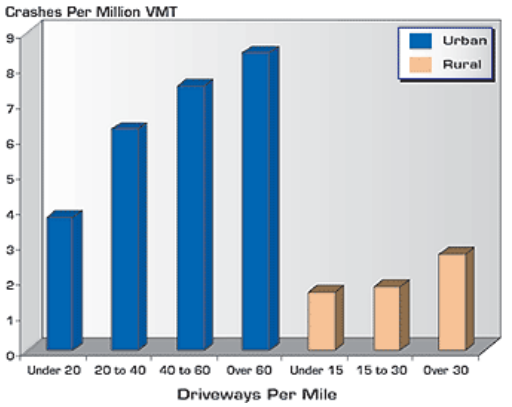
Level path across driveway crossing

Photo by Kimley-Horn

Driveways must also be built in a way that discourages high-speed turns, using small corner radii.

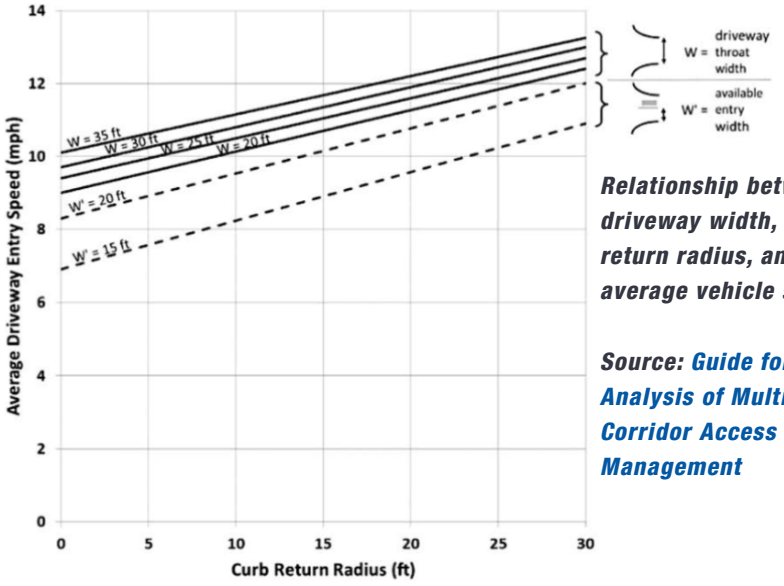
Driveway spacing is another element of Access Management. FHWA specifies that fewer driveways spaced further apart allow for more orderly merging of traffic.[3] This set up also has the potentially to improve pedestrian safety by providing less areas of conflict along the Pedestrian Zone. Driveways are essential for vehicular travel mobility, but their design must ensure that the protection of the pedestrian and vulnerable street users is not compromised. Best practices include:

- Consolidating or eliminating driveways no longer in use, in particular those in noncompliance with ADA requirements
- Regulating maximum driveway width
- Encouraging shared driveways for adjacent developments
- Using raised islands and medians to separate conflicting movements
- Providing adequate turn lanes from driveways



There is a strong linear relationship between number of crashes and number of driveways per mile, as per FHWA research.

Source: FHWA



Relationship between driveway width, curb return radius, and average vehicle speed.

Source: Guide for the Analysis of Multimodal Corridor Access Management

[3] ***Access Management, FHWA***

Raised Separated Bicycle Lane
Source: Complete Streets Master Plan

Bicycle Facilities

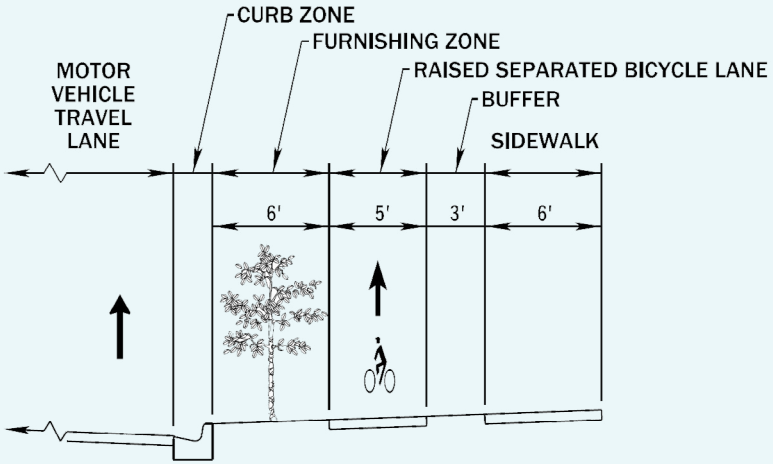
Raised Separated Bicycle Lanes

Raised separated bicycle lanes - also known as raised cycle tracks - effectively transfer the bicycle facilities out of the Roadway Realm and into the Sidewalk Realm. These lanes are placed at an interim elevation between the Roadway Realm and the Pedestrian Zone, or at the same level as the sidewalk.

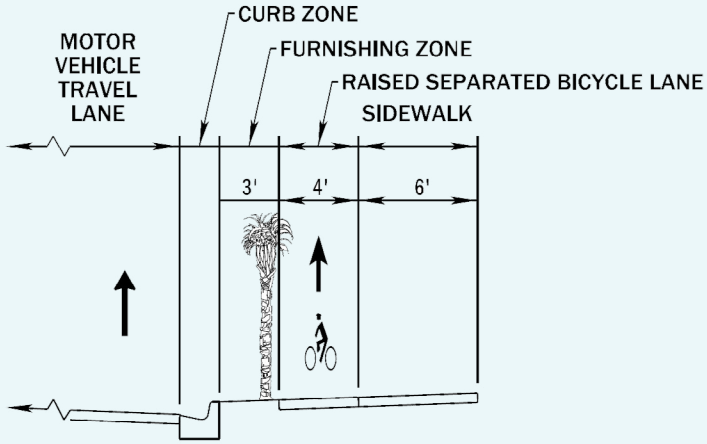
The unrivaled protection from motor vehicles experienced on raised separated bicycle lanes makes them the preferred choice of facility of many bicyclists and planners. Enhanced protection is an undeniable feature of this design. First, the raised surface makes bicyclists more visible to drivers, and meanwhile the leveled separation acts as a barrier keeping vehicles from driving into the bicycle lane. Furnishing space or other buffers can also be incorporated to further separate the motor vehicles, pedestrians, and bicyclists. These lanes are therefore most appropriate in situations or locations where added protection is deemed necessary, such on streets with multiple motor lanes, higher speed limits, or numerous curves.

Noteworthy, these facilities should not be implemented at the expense of the Pedestrian Zone, as pedestrians are likely to cross over to the bicycle lanes if sufficient space is not provided for walking. The target design for this type of facility is a 6-foot Furnishing Zone followed by a 5-foot bicycle lane, a 3-foot buffer, and lastly a 6-foot Pedestrian Zone. If circumstances don't allow for these widths, it is acceptable to reduce the size of the Furnishing Zone and incorporate a 4-foot raised separated bicycle lane adjacent to a 5-foot Pedestrian Zone.

Separated bicycle lanes in the Roadway Realm are discussed in the next chapter.



RAISED SEPARATED BICYCLE LANE (TARGET)



RAISED SEPARATED BICYCLE LANE (CONSTRAINED)

Benefits:

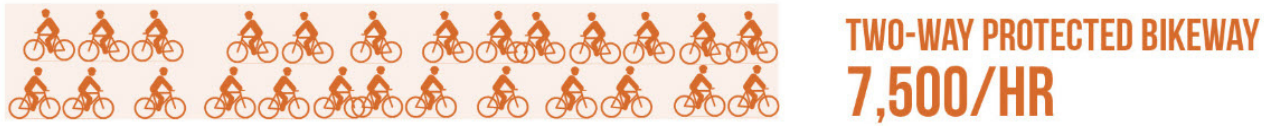
- Greatest degree of separation and protection from motorized traffic, which can encourage cycling
- Novice cyclists are more likely to ride in the bicycle lane, leaving the sidewalk for pedestrians
- Fewest amount of conflict points between bicycle lane and motorized lanes
- Raised separated bicycle lanes receive less wear and tear than travel lanes
- The raised bicycle lane drains towards the centerline, leaving it clear of debris and puddles

Considerations:

- Special maintenance procedures may be needed to allow for regular maintenance like to keep the path clear of debris
- Special consideration to bicycle and pedestrian interactions may be needed to avoid conflicts, and appropriate infrastructure should be considered to alert visually disabled pedestrians of facility changes
- Retrofitting streets with raised bike lanes is costlier, and integration with larger reconstruction projects tends to be preferred due to drainage reconstruction

Two-Way Raised Separated Bicycle Lanes

In certain environments of the Urban Core, where higher volumes of bicycle trips are expected or where there is a desire to increase modal share, Raised separated bicycle lanes can be designed bidirectionally. A 2014 Chinese study measured capacity at 2,500 bikes per hour per meter, which on a 10-foot two-way separated bicycle lane translates into 7,500 people/hr.[4] The directional separation also has an effect on increasing perceived and actual safety, possibly influencing demand for this mode of transport from less confident users.



The capacity of a single 10-foot lane at peak conditions with normal operations.

Source: NACTO

Benefits:

- Provides a safer and more comfortable environment for riders of all comfort levels
- Provides contra-flow movement on one-way streets

Considerations:

- Careful consideration is required at intersections to ensure bicyclists are visible to motorists
- Additional width is needed to accommodate travel in both directions

[4] ***Dan Zhou, et al. Estimating Capacity of Bicycle Path on Urban Roads in Hangzhou, China (2014)***

Two-way raised separated bicycle lane with bus shelter on Furnishing Zone, Minneapolis

Photo by Kimley-Horn

Shared Use Paths

Shared use paths are dedicated spaces where most forms of non-motorized transport share the same lane. Open space or a physical barrier separate these paths from vehicular lanes, providing protection for pedestrians, bicyclists, rollerbladers, skaters, and others. The AASHTO Guide recommends a width of 10-14 feet for shared use paths, although under constrained situations as little as 8-10 feet may be deemed acceptable. [5]

Greenway trails are a type of shared use paths used for either for transportation or recreational purposes. These pathways preserve, enhance, and promote the natural environment as part of the built environment while promoting physical activity and lively communities. The Broward County Greenways Master Plan delineates a regional network of greenways extending for over 370 miles. [6]

[5] ***AASHTO Guide for the Development of Bicycle Facilities (2012)***

[6] ***Broward County Greenways Master Plan***

Flagler Greenway shared use path, Fort Lauderdale

Pompano Beach Airpark shared use path

Photos by Kimley-Horn

Wayfinding in Boulder, CO
Photo by Kimley-Horn

Legible London is the world's largest municipal wayfinding system, with 87% user support
Source: Legible London

Wayfinding

Wayfinding and signage facilitate navigation of the public realm. A comprehensive, intuitive, and consistent wayfinding system enhances the transportation network by directing and educating locals and visitors to the amenities and resources available in the vicinity. It is of particular importance near transit stations and notable destinations, but should not be limited to those areas, as it has been found to have a direct relation to increased walking. Although most cities have some degree of wayfinding, it is not often treated a wholesome, well-coordinated system.

Characteristics of well-designed wayfinding systems include:

- A clear and coordinated system, including transit stop identification, directional signage, and accessibility features
- Consistent, intuitive, predictable, and coherent positioning
- Adequate levels of nighttime lighting and visibility
- Pedestrian-scaled designs, making use of multiple wayfinding elements, including maps, medallions, signs, and non-signage wayfinding such as in-pavement trails and markings
- Inclusive, accessible and compliant with ADA best practices (including the use of tactile signage to assist persons with disabilities)
- Use of color and branding material for easy identification and promotion
- Ongoing maintenance program for durability and removal of vandalism as needed

A wayfinding system can also be used to promote and draw attention to sustainable features and encourage multimodal journeys. While personal trip planning incorporates many of the functions of a wayfinding system, they compliment rather than replace each other. Use of technology allows for display of real-time information updates including travel time to destinations, estimated arrival times for transit, and safety advisory messages.

End-of-Trip Facilities

Providing facilities such as secure bicycle parking, maintenance stations, and changing rooms is important to encourage bicycling for transportation. Bicycle parking facilities can range from racks installed within street rights-of-way to bicycle lockers and storage rooms within transit hubs and other buildings, in which users are granted access through some type of keypad or fob system. Bicycle parking racks within street rights-of-way are sometimes considered short-term parking while bicycle lockers and storage rooms are considered long-term parking suitable for commuters. Bicycle maintenance facilities can range from a fixed maintenance stand with an air hose and a multi-purpose tool to a staffed maintenance room co-located with a bicycle parking station. Changing rooms, showers, and lockers should be provided in employment centers or transit hubs.

Street design measures aimed at creating conditions of comfort and accessibility for active travelers must integrate end-of-trip facilities to provide a comprehensive trip experience. On-street bicycle parking should be accommodated in bicycle parking corrals at street level in downtown districts and urban centers. A bicycle corral is a series of bicycle racks installed in an on-street parking space or near an intersection. On-street bicycle parking may also be provided within the Furnishing Zone of the Sidewalk Realm in urban and suburban areas. Bicycle parking racks may also be accommodated within the Frontage Zone if it does not block doorways, windows, or building access. Bicycle parking should always be provided at bus stops.

On-street bicycle storage room, Boston, MA

Photos by Kimley-Horn

"Post-and-ring" bicycle racks, West Palm Beach

Street level "Inverted U" bicycle corral, Fort Lauderdale

Photos by Kimley-Horn

Bicycle lockers at the Boca Raton Tri-Rail Station

Fixed maintenance stand, Arlington, VA

Bicycle parking racks should firmly support the bicycle (typically two points of contact with the bicycle frame), and make it easy to secure a U-shaped lock to the frame of the bicycle and the rack. Examples of functional bicycle parking rack styles include the "inverted U" rack and the "post-and-ring" rack. Variations on these two styles and artistic designs can be created but should meet the basic functional criteria of firmly supporting the bicycle frame with at least two points of contact and easily securing a conventional U-shaped lock. Rack styles to avoid include wave, spiral, comb (common in schoolyards), bollard, and wheelwell. These rack designs tend to present a variety of real-world problems including lack of proper bicycle frame support, are not intuitive or user-friendly, or are commonly used in a manner inconsistent with good bicycle parking principles. Refer to the Association of Pedestrian and Bicycle Professionals (APBP) Bicycle Parking Guidelines for additional information.

Bicycle thefts are common and lack of secure parking is often cited as a reason people hesitate to ride a bicycle. The same consideration should be given to bicyclists as to motorists, who expect convenient and secure parking at all destinations. Bicycle parking should be in well-lit, secure locations close to the main entrance of a building, no further from the entrance than the closest automobile parking space. Bicycle parking should not interfere with pedestrian movement. Evidence shows that provision of bicycle parking increases bicycle trips, principally in the context of commuting and public transportation access trips.

Some end-of-trip facilities can be incorporated into street design while more robust facilities such as showers and staffed maintenance rooms should be included in building design through land development ordinances.

Micromobility

An increasing number of micromobility options are emerging in urban contexts, a trend exemplified by e-scooter sharing programs across Florida and the US. Most of these initiatives are app-based and characterized by some level of on-demand availability and flexibility in routing and scheduling, typically owned and operated by the private sector. As information communication technology becomes faster and cheaper, the market for these programs is likely to continue to grow.

However, the unrivaled rise in popularity of these micromobility options have caused some concerns regarding safety, regulation, and facility planning. Since few policies exist that dictate standards for the safe integration of these modes, it is imperative for governments and planning agencies to develop strategies to safely integrate these modes. Best practices include:

- Micromobility lanes
- Designated parking zones in non-obtrusive spaces
- Safety messages aimed at users on devices
- Cap the speed of devices within a reasonable margin
- Focus on requiring companies comply with permit obligations
- Cooperation and data sharing between stakeholders

E-scooter provisional parking

Source: Collin Worth

Parklet with art and lightweight street furniture, Toronto

Photos by Kimley-Horn

Placemaking

The Sidewalk Realm is more than a transport lane, it is a place to foster human interaction and wellbeing. As such, it is not enough to create an environment for people to travel through, but rather a place for them to meet, gather, and linger. An endless number of design elements and strategies can be used to create this effect, which planners have denominated "Placemaking".

Incorporating public art exhibitions, music, nighttime illumination, technology, and science in the sidewalk design creates an opportunity for the passersby to interact, admire, and learn from the space. When the sidewalk network is connected through parklets, sidewalk cafes, neighborhood squares, gardens, or plazas the effect is heightened. Concurrently, such elements enrich the character of a community going as far as to impact the local economy.

Countless urban regeneration projects in the U.S. and abroad have demonstrated the added value of designing streets as activated public spaces. In this endeavor policy can be a powerful tool, as evidenced by programs such as the PlaNYC Initiative which among other things succeeded in the planting of over a million new trees throughout New York City.[7]

Creating comfortable and interesting walks with a wide range of destinations and activities along the journey is key to increasing the share of trips generated by this mode of transport, with some studies emphasizing the effect it can have specifically on recreational trips. Special events, such as farmer markets and fairs, can also play an important role promoting lively streets and adding to the range of activities that can take place in the streets. Only by designing dynamic streetscapes suited for multiple uses and users can this powerful effect be unleashed.

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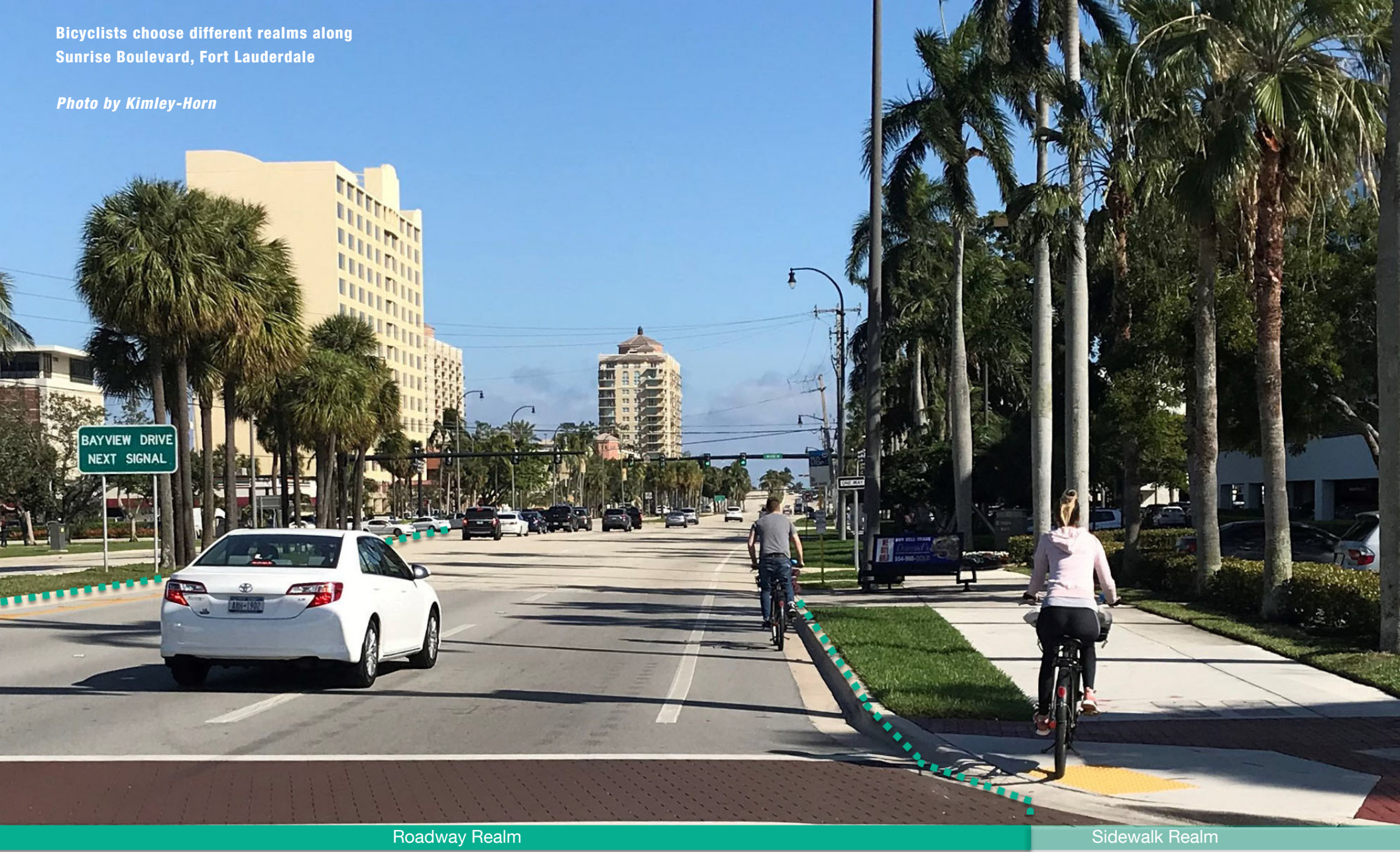
[7] ***PlaNYC, A Greener Greater New York, 2011***

Roadway Realm Design

3



Bicyclists choose different realms along Sunrise Boulevard, Fort Lauderdale

Photo by Kimley-Horn

The Roadway Realm consists of the space where vehicles travel, which is typically located between the curbs of a street right-of-way. This chapter explores the following elements of Roadway Realm design:

- Safe Speeds
- Lane Widths
- Transit Lanes
- Bicycle Facilities
- Traffic Calming
- Curbside Management

Safe Speeds

Streets in the urban context should be designed to operate at speeds that create a safe environment for all users of the roads, motorized and non-motorized. An important element of the FDOT Design Manual (2018) is that it allows for improved flexibility in design speeds on streets in urban communities. Lower speeds are directly correlated with a safer urban environment, particularly for the most vulnerable street users.

Vision Zero

Vision Zero is a multi-national initiative prompting communities to set goals to reduce and ultimately eliminate all traffic fatalities and severe injuries. South Florida is infamous for the alarming numbers of pedestrian and bicyclist fatalities occurring every year, often ranking high in Dangerous by Design's list of most dangerous metro areas. As a response to this public health issue, dozens of cities in the US - including the City of Fort Lauderdale - have declared Vision Zero goals and set clear strategies to achieve those goals. Design speeds can play a pivotal role in this regard, especially since pedestrian fatality rates increase significantly at higher impact speeds. Setting appropriate speed targets to match the context and safety goals of a roadway is critical to achieving Vision Zero goals.

To read City of Fort Lauderdale's Vision Zero Plan visit:
https://www.fortlauderdale.gov/departments/transportation-and-mobility/transportation-division/vision-zero-fort-lauderdale/the-plan

To learn more about becoming a Vision Zero City visit:
https://visionzeronetwork.org/

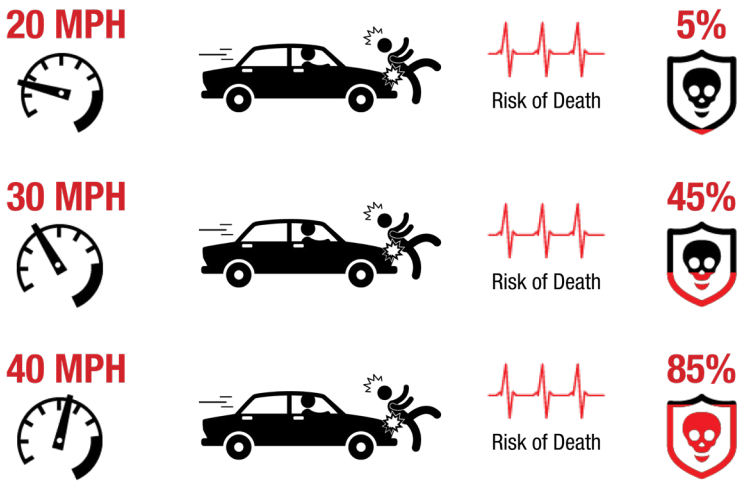
Table 202.3.1 Strategies to Achieve Desired Operating Speed

Context Classification	Design Speed (mph)	Strategies
C1	55-70	Project-specific; see ***FDM 202.4***.
C2	55-70	Project-specific; see ***FDM 202.4***.
C2T	40-45	Roundabout, Lane Narrowing, Horizontal Deflection, Speed Feedback Signs, RRFBs and PHBs
	35	Techniques for 40-45 mph, plus On-street Parking, Street Trees, Short Blocks, Median Islands at Crossings, Road Diet, Bulbouts, Terminated Vista
	30	Techniques for 35-45 mph, plus Chicanes, Median Islands in curved sections, Textured Surface
	≤ 25	Techniques for 30-45 mph, plus Vertical Deflection
C3R, C3C	50-55	Project-specific; see ***FDM 202.4***.
	40-45	Roundabout, Lane Narrowing, Horizontal Deflection, Speed Feedback Signs, RRFB and PHB
	35	Roundabout, Lane Narrowing, Horizontal Deflection, Speed Feedback Signs, Median Islands in crossings, Road Diet, RRFB and Hawk, Terminated Vista
C4	40-45	Roundabout, Lane Narrowing, Horizontal Deflection, Speed Feedback Signs, RRFB and PHB
	35	Techniques for 40-45mph plus On-Street Parking, Street Trees, Short Blocks, Median Islands at Crossings, Bulbouts, Terminated Vista
	30	Techniques for 35-45 mph plus Chicanes, Median Islands in Curve Sections, Textured Surface
C5	35	Roundabout, On-street Parking, Street Trees, Short Blocks, Speed Feedback Signs, Median Islands in Crossings, Road Diet, Bulbouts, RRFB and HAWK, Terminated Vista
	30	Techniques for 35 mph plus Chicanes, Median Island in Curve Sections, Textured Surface
	25	Techniques for 30-35 mph plus Vertical Deflection
C6	30	Roundabout, On-Street Parking, Horizontal Deflection, Street Trees, Median Islands in Curve Sections, Road Diet, Bulbouts, Terminated Vista, Textured Surface
	25	Techniques for 30 mph plus vertical deflection

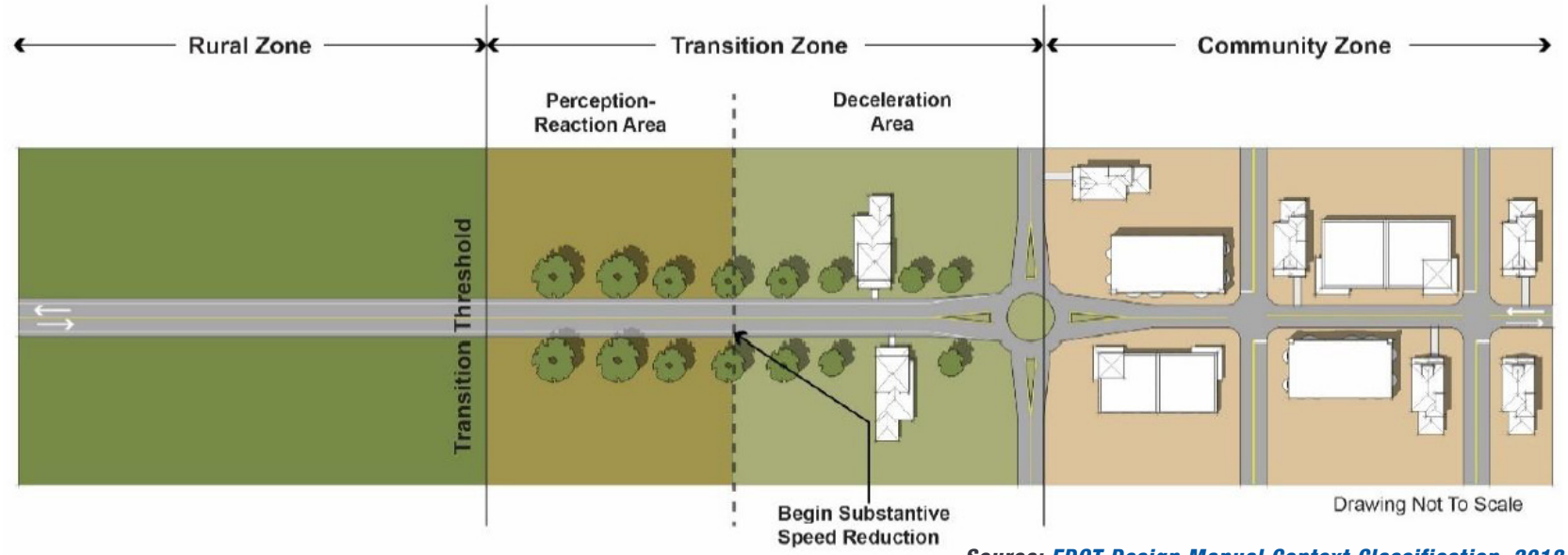
Source: FDOT Design Manual Speed Management, 2018

The 2018 FDOT Design Manual further recommends transitioning zones for speed limits according to the Context Classification System. A good strategy is to design roads so that they feel uncomfortable at speeds higher than the desired operating speed. For existing higher speed roads traffic calming measures can be used. Other design elements, such as lining the roadway with trees, have also been found to reduce operating speeds in urban areas. Special consideration should be given to school zones and its surroundings.

Pedestrian Fatality Rates by Impact Speed



Source: FHWA SA-10-001



Source: FDOT Design Manual Context Classification, 2018

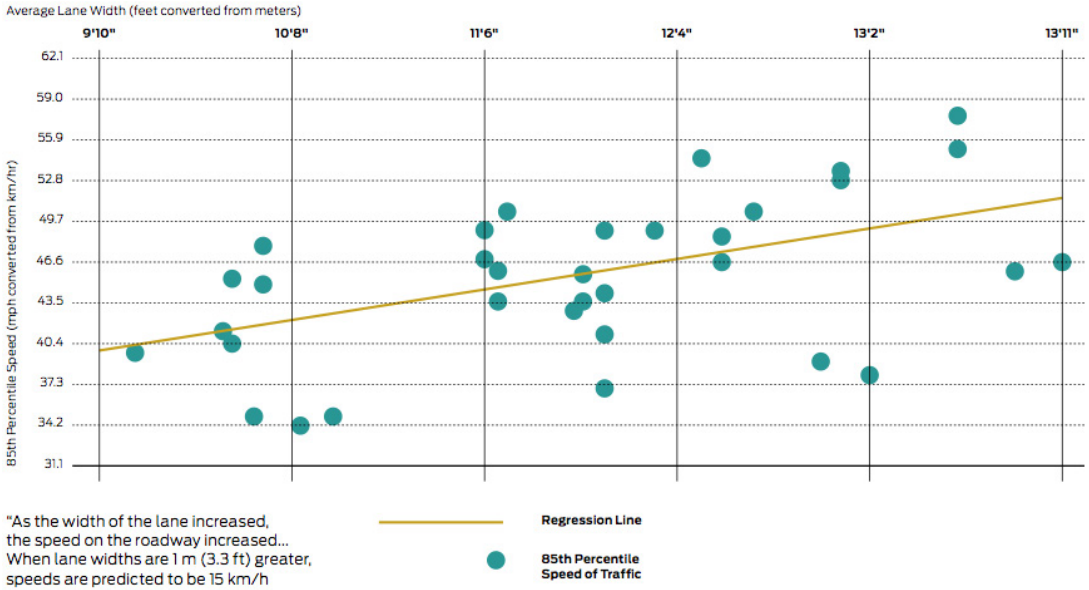
Lane Widths

Until recently, the AASHTO Green Book standard of 12-foot wide through lanes has been the adopted norm in many street designs. However, studies have demonstrated that the wider the lane, the faster vehicles will travel. Since the relationship between higher speeds and chance of survival is so deadly, traffic calming measures usually include road and lane diets, to either repurpose or reduce lane widths where appropriate.

Lane widths in the range of 10 feet to 12 feet show no discernible difference in capacity or increased risk of crashes. All of this suggests that 10 feet may be more fitting for lane widths in the urban context.

Parking lane widths should range from 6.5 feet to 8 feet depending on adjacent street element. Parking lanes adjacent to curb-and-gutter drainage elements should be 6.5 feet wide (exclusive of the gutter pan width) since parked cars can have tires resting on the gutter. Parking lanes not adjacent to curb-and-gutter drainage should be 7 feet wide on local streets and 8 feet wide on collector and arterial streets.

Wider travel lanes are correlated with higher vehicle speeds.



"As the width of the lane increased, the speed on the roadway increased... When lane widths are 1 m (3.3 ft) greater, speeds are predicted to be 15 km/h (9.4 mph) faster."

Chart source: Fitzpatrick, Kay, Paul Carlson, Marcus Brewer, and Mark Wooldridge. 2000. "Design Factors That Affect Driver Speed on Suburban Streets." *Transportation Research Record* 1751: 18–25.

Source: NACTO

Lane Width & Capacity

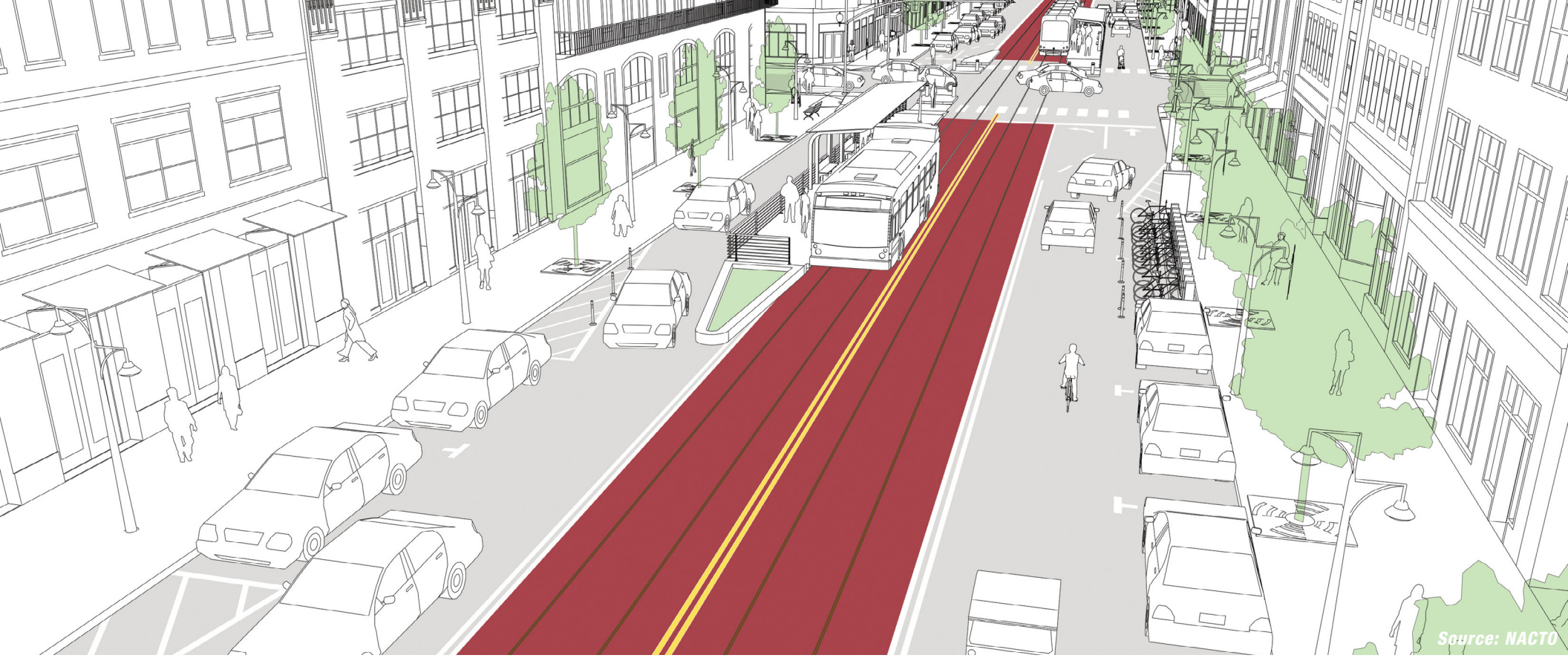
Conserve By Bicycle Program, a 2007 study by the Florida Department of Transportation, found no discernible change in capacity between 12 feet and 10 feet lanes. An analysis is recommended identify roads with excessive capacities to determine the impact on the network of either reducing or eliminating travel or parking lanes.

"The measured saturation flow rates are similar for lane widths between 10 feet and 12 feet. For lane widths below 10 feet, there is a measurable decrease in saturation flow rate. Thus, so long as all other geometric and traffic signalization conditions remain constant, there is no measurable decrease in urban street capacity when through lane widths are narrowed from 12 feet to 10 feet".

John Zegeer, The Influence of Lane Widths on Safety and Capacity

Recommended lane widths based on speed limits

Speed Limit	Lane Width
<=35 mph	10 feet
>40 mph	11 feet
BCT bus routes or designated truck routes in outside lane (regardless of speed limit)	11 feet
Right-turn lane	10 feet (9 feet constrained)
Left-turn lane	10 feet (9 feet constrained)



Transit Lanes

Although transit lanes do not tend to be separated by a physical barrier from other travel lanes, they are intended for the exclusive or semi-exclusive use of transit vehicles. Emergency vehicles may also use these lanes in congested situations. Transit lanes can take many forms and accommodate different modes of public transit based on the context in which they are implemented.

Transit-only lanes are the most common type of transit lanes and are the foundation for more advanced transit infrastructure such as Bus Rapid Transit (BRT) and Light Rail Transit (LRT). Bus-only lanes are typically 11 feet wide but can also be designed as shared bus/bicycle lanes in which case at least 12 feet are recommended. Additional lane width may be considered approaching bus stop areas to improve operations.

Business Access and Transit Lanes (BAT Lanes) are a good solution for urban and suburban conditions where bus frequency is not high enough to warrant exclusive lanes; however, the travel time and reliability benefits of these lanes will serve the transit strategy for the corridor. BAT lanes are expressly reserved for turning vehicles and buses. Bicycles can be permitted to use BAT lanes if a dedicated bicycle lane is not provided on the street. Private motor vehicles can use BAT lanes only to make a right-turn into a driveway or side street. Private motor vehicles turning out of a driveway or side street should turn into the nearest general purpose through lane.

By separating transit from general traffic, time spent in congestion can be significantly reduced – especially at peak hours- and resulting in decreased travel time for public transit users. This can have a powerful effect on the perceived reliability of the service, potentially increasing demand for public transit in busy city zones.

BAT Lane with bicycle shared lane marking

Photo by Kimley-Horn

Bicycle Facilities

Separated Bicycle Lanes

Roadway Realm separated bicycle lanes are found at roadway surface level, inside the curb. These lanes offer a vertical, physical barrier that effectively protects the bicycle lane from motor vehicle traffic. A raised concrete divider measuring 2 feet to 4 feet wide can act as the separator, but other physical elements – such as flexible plastic delineators, parking curbs, planters, or even a parking lane – may also be used.

Conflicts with motor vehicles may still occur at intersections and driveways, and consideration should be given to possible conflict with transit users crossing the bike lane while boarding and alighting a bus. Nonetheless, this facility type provides the most comfortable on-street environment for people who are interested in bicycling more but concerned about riding directly adjacent to traffic. Separated bicycle lanes also eliminate the conflicts with parking or loading vehicles that other bicycle lanes face.

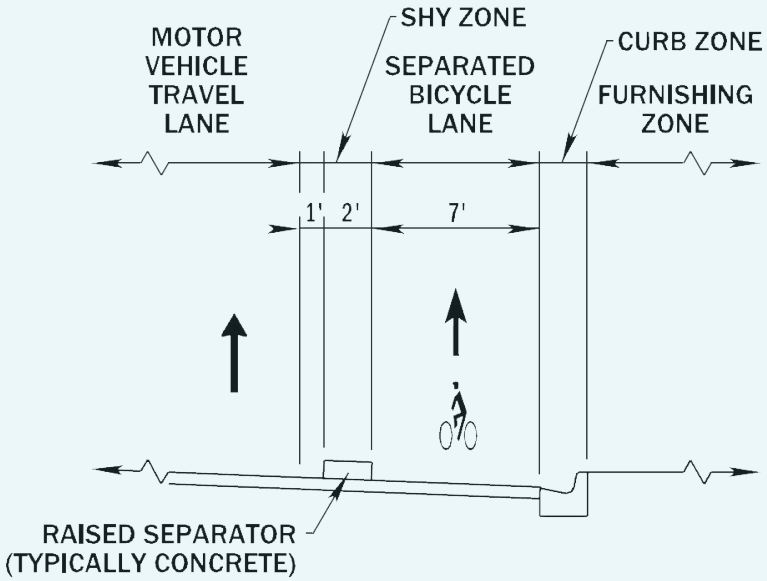
The minimum width for separated bicycle lanes is 5 feet, while the target width is 7 feet to allow comfortable side-by-side riding. In addition, a raised separator must be present. The minimum width of the space within which the raised separator exists is 3 feet. One example is a 2-foot raised concrete divider and a 1-foot shy zone to the adjacent motor vehicle lane. The shy zone is sometimes marked with a lane line edge pavement stripe. Another example is a 3-foot buffer with flexible plastic delineators in the center. Therefore, the minimum width of the combined bicycle lane plus separator is 8 feet and the target width is 10 feet.

Varying physical barriers acting as separators

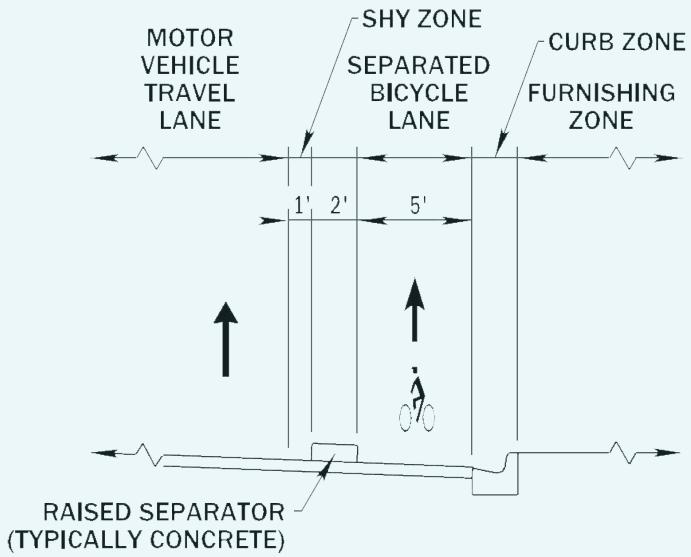
Photos by Kimley-Horn

Accessible bus island adjacent with separated bicycle lane, Seattle, WA

Source: NACTO



SEPARATED BICYCLE LANE (TARGET)



SEPARATED BICYCLE LANE (CONSTRAINED)

Benefits:

- Provides physical protection against encroaching vehicle traffic, increasing safety and comfort
- Low implementation cost by using existing pavement and drainage when space is available
- Reduces conflict with parking cars and parked car doors
- Prevents parked or loading vehicles from blocking the facility

Considerations:

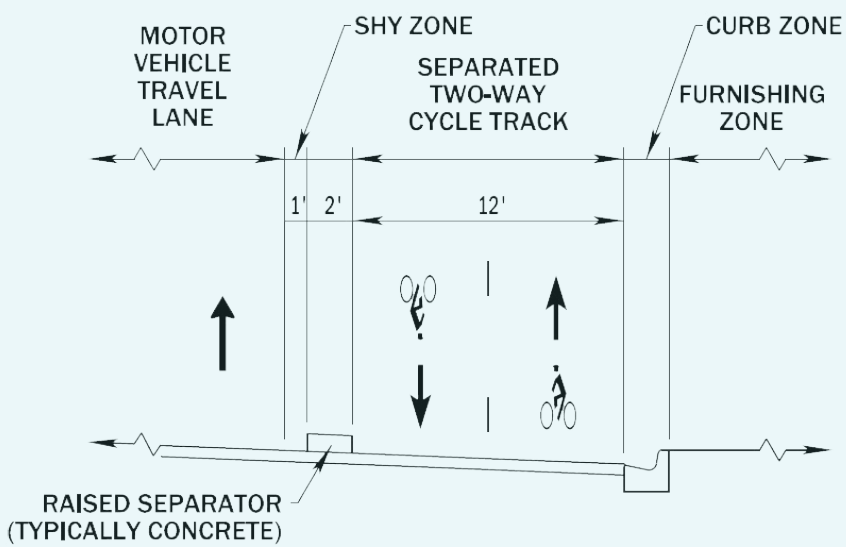
- When a raised concrete divider is used, provide periodic breaks in the raised concrete for open channel drainage flow
- If bus stops are located along a roadway with a separated bicycle lane, provide accessible bus islands between the adjacent travel lane and the separated bicycle lane for passenger loading and unloading to eliminate conflicts with bicyclists and buses; consider raised pedestrian crossings to maintain flush access for bus passengers walking or rolling between the sidewalk and the bus island
- Mid-block curb ramps may be provided near marked accessible parking spaces, or curb ramps may be provided at a consistent interval to provide additional egress points for wheelchair users to gain access to the sidewalk
- Concrete separators may be intermittent on roadways with driveway connections; dash striping or dash skip lines may be used in locations of intermittent breaks on the concrete separators
- Street maintenance vehicles may have difficulties to maintain

Two-Way Separated Bicycle Lanes

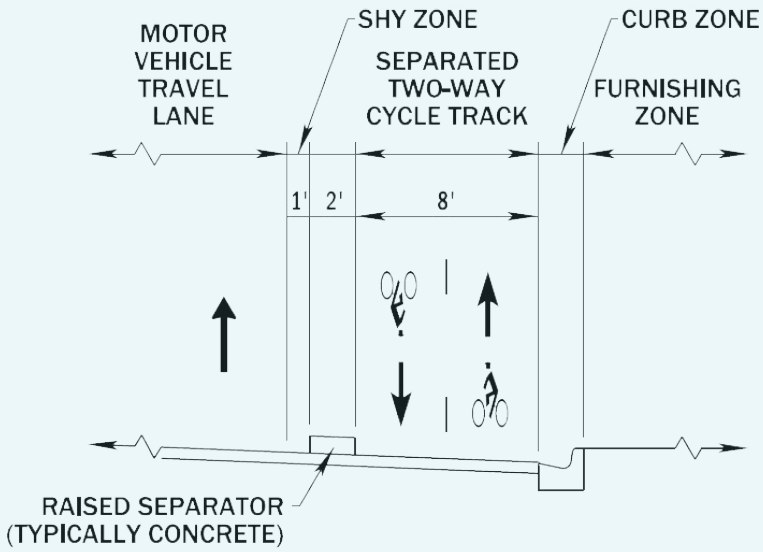
A two-way separated bicycle lane has the added bicycle mobility advantage of allowing travel in both directions on the same side of the road. This arrangement allows for enhanced comfort and safety for users while allowing for the efficiency of riding along a street rather than an off-street path.

Two-way separated bicycle lanes require mitigation for conflicts at intersections, including dedicated bicycle signals as they may be shifted more closely to the travel lanes on minor intersection approaches. They may be preferred in highly urban environments where it is easier to provide bicycle facilities only on specific streets, particularly if those streets are one-way to vehicles.

Target width for two-way separated bicycle lanes 12 feet, but in constrained situations 8 feet may be acceptable.



SEPARATED TWO-WAY CYCLE TRACK (TARGET)



SEPARATED TWO-WAY CYCLE TRACK (CONSTRAINED)

Two-way bicycle lane separated by buffer and plastic delineators

Photo by Kimley-Horn

Two-way bicycle lane with concrete separator and open channel flow drainage

Source: Valerie Nielson, Palm Beach TPA

Benefits:

- The wider overall facility width of two-way cycle tracks may simplify accommodating disabled users
- Increased capacity for areas with high bicycle traffic volume
- All the benefits of separated bicycle lanes also apply to two-way separated bicycle lanes

Considerations:

- A “DO NOT ENTER” sign with “EXCEPT BIKES” plaque should be posted along the facility to only permit use by bicycles
- When provided on the same side of the street as transit stops, an accessible bus island should be provided between the separated bicycle lanes and the adjacent travel lane to reduce bicycle and bus conflicts

Parking Separated Bicycle Lanes

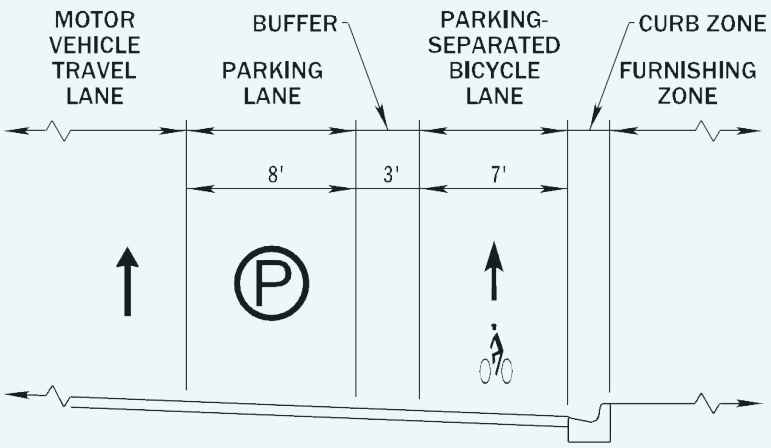
Parking-separated bicycle lanes are a unique type of separated lanes where the vehicle parking lane serves as a buffer between bicycles and motor vehicles. In this case, the parked vehicles provide an additional level of protection for bicyclists further increasing safety and comfort if appropriate buffer width is provided for opening car doors, loading, and unloading. Parking-separated bicycle lanes can be considered in places where on-street parking is necessary. This design is most effective when paired with buffers and physical separators such as flexible plastic delineators or planters.

In this configuration, the minimum width of the parking lane is 8 feet since the parking lane is “floating” not adjacent to the curb-and-gutter. The minimum width of the door zone buffer is 3 feet to reduce the risk of injury to bicyclists from dooring crashes. Therefore, the total minimum combined width of the bicycle lane plus buffer plus parking lane is 16 feet.

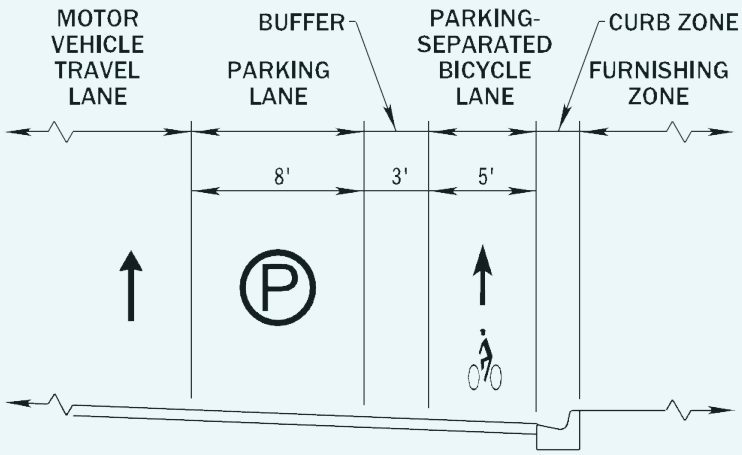
Parking separated bicycle lane with buffer

Parking separated bicycle lane with constrained buffer

Photos by Kimley-Horn



PARKING-SEPARATED BICYCLE LANE (TARGET)



PARKING-SEPARATED BICYCLE LANE (CONSTRAINED)

Benefits:

- Offers a separation and added protection to bicyclists
- Where on-street parking is present, it offers a sensible use of existing resources

Considerations:

- Buffer space is necessary to avoid conflicts with parked vehicles such as opening of vehicle doors
- Special attention should be given to on-street parking accessibility

Contra-Flow Bicycle Lanes

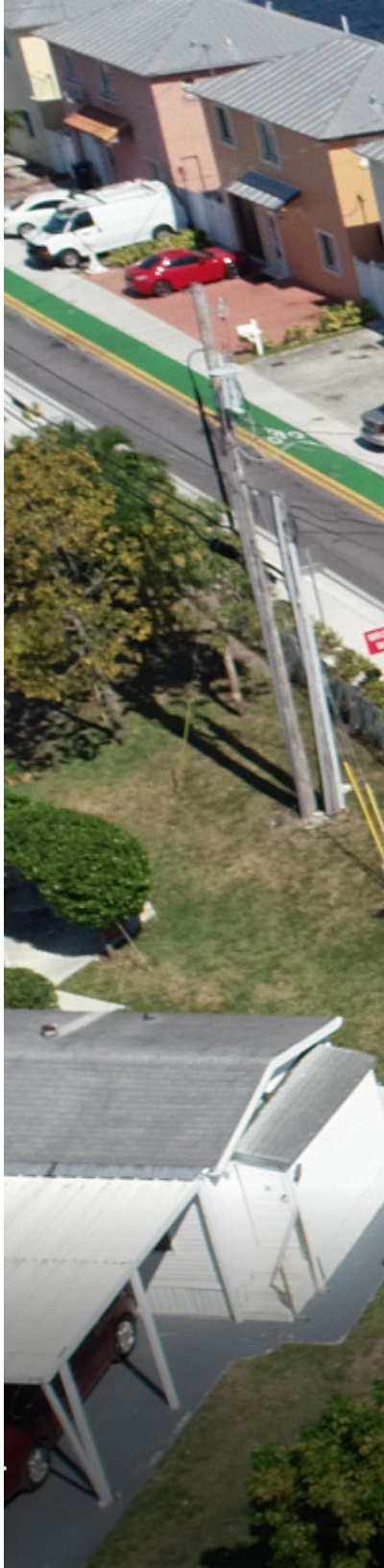
Contra-flow bicycle lanes flow in the opposite direction of vehicular traffic on one-way streets. Unlike motor vehicles, bicyclists can travel in both directions on these streets often creating shortcuts in networks thereby incentivizing bicycle traffic. Contra-flow bicycle lanes work best in residential and local commercial neighborhood areas and are less appropriate along streets with high volumes. Contra-flow bicycle lane width should be a minimum of 5 feet when adjacent to curb and gutter.

Benefits:

- Provides two way traffic for bicyclists on one-way streets
- In addition to the contra-flow bicycle lane, a bicycle lane should also be provided in the direction of motor vehicle traffic; however, a shared lane marking could be utilized on constrained roadways

Considerations:

- Intersection traffic controls along the street (e.g., stop signs, traffic signals, and signage) should also be installed and oriented toward bicyclists traveling in the contra-flow direction to clearly state the flow of traffic



Contra-flow bicycle lane

Source: Town of Medley

Buffered Bicycle Lanes

Buffered bicycle lanes use a striped or painted buffer on the roadway surface as separation between bicyclists and adjacent vehicles. The buffer can also be provided between the bicycle lane and a parking lane to reduce conflicts between bicycles and opening vehicle doors. This space can be temporarily used by faster bicyclists for passing slower users without intruding in the vehicle travel lane. Buffered bicycle lanes increase comfort over conventional bicycle lanes but are subject to conflicts with parking vehicles when a parking lane is present. Special consideration is also necessary at transit stops, pedestrian crossings, and turning points. As no physical separation exists, enforcement and signage are important components of keeping buffered bicycle lanes clear of vehicles.

Bicycle lanes adjacent to buffer space are the current standard for Broward County and FDOT roadways. A total width of 7 feet is recommended for buffered bicycle lanes, with 2-3 feet of that width representing the buffer space.

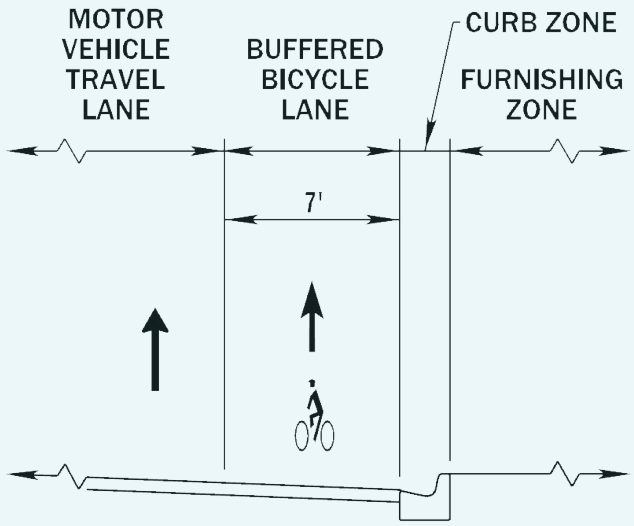
In cases of bicycle lanes adjacent to on-street parking, a door zone buffer of 4 feet in width separating the parking lane from the bicycle lane is required on county roadways.

Broward County Bicycle Pavement Markings & Signs Details (Appendix A) provides detailed drawings for buffered bicycle lane markings.

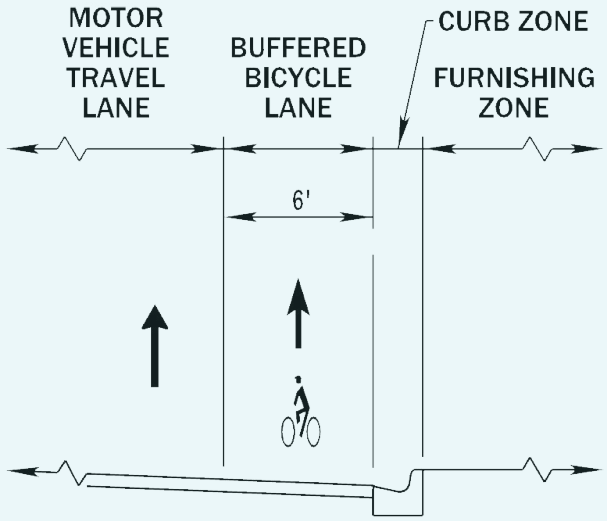
Door zone buffer adjacent to bicycle lane, Sunset Strip

Buffered bicycle lanes provide greater separation from travel lanes

Photos by Kimley-Horn



BUFFERED BICYCLE LANE (TARGET)



BUFFERED BICYCLE LANE (CONSTRAINED)

Benefits:

- Provides greater separation between motor vehicles and bicycles than conventional lanes
- Provides extra space to allow for passing or obstacle avoidance in the bike lane without entering the vehicle travel lanes
- Can provide greater space between bikes and parked cars with a buffer between the parking and bike lanes
- If sufficient space exists through lane width narrowing, no major street reconstruction would be necessary for their installation making it a cost-effective enhancement to conventional lanes

Considerations:

- Signage and enforcement may be required to prevent loading and waiting vehicles from using the space
- As no physical separation exists, markings and color should be considered for driveway intersections to enhance awareness of the potential for bike presence

Conventional Bicycle Lanes

The conventional bicycle lane consists of a striped on-street lane at the edge of the vehicle lanes, flowing in the same direction as motor vehicle traffic. Pavement markings and signage are used to designate the space for the exclusive use of bicyclists (Appendix A). This is the most basic form of a dedicated bicycle facility. This classification provides for more predictable travel patterns than shared lanes, thus increasing actual -as well as perceived- safety for all street users. Bicycle lanes can be placed between vehicle lanes and the curb or, if parking is present, between travel lanes and the parking lane. Conventional bicycle lanes should accommodate space to separate bicycles both from the street gutter and associated debris and from adjacent vehicles. The recommended width for conventional bicycle lanes is 5 feet, with a constrained width of 4 feet.

Conventional bicycle lanes are appropriate for local neighborhood streets with speed limits of 30 mph or less. On collector or arterial roadways, conventional bicycle lanes are only appropriate where space does not exist or cannot reasonably be repurposed to provide separated or buffered bicycle lanes. For example, conventional bicycle lanes should only be provided on a resurfacing project if minimum lane width standards would be violated by providing buffered bicycle lanes.

Appendix A provides Broward's County Bicycle Pavement Markings and Signs Details.

Benefits:

- Provides basic predictability of bicycle travel and positioning for bicyclists, pedestrians, and motorists
- Encourages bicyclists to ride on the traveled way rather than the sidewalk
- Increases the total throughput capacity of the street as compared to a mixed vehicle/bicycle lane

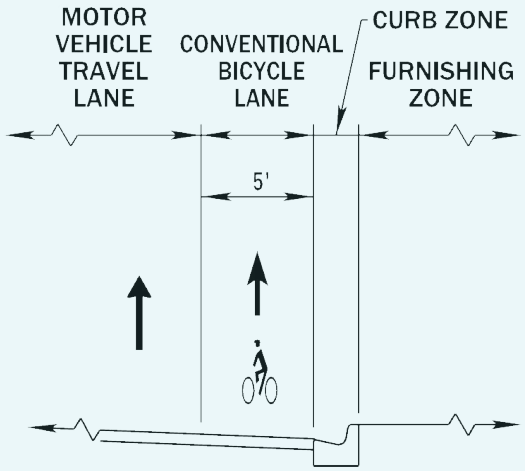
Considerations:

- For bicycle lanes adjacent to a parking lane, provide an edge stripe on the parking lane to keep vehicles from parking partially in the bicycle lane. Providing a wider parking lane can also allow for space to avoid the “dooring” of passing bicyclists.
- Always consider upgrading a conventional bicycle lane to a buffered bicycle lane

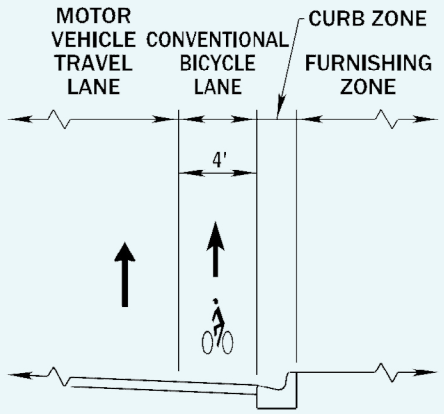
Bicyclists on conventional bicycle lane

Pedicab on conventional bicycle lane

Photos by Kimley-Horn



CONVENTIONAL BICYCLE LANE (TARGET)



CONVENTIONAL BICYCLE LANE (CONSTRAINED)

Shared Lanes

Some streets may have sufficiently low volume and speeds to allow for motor vehicles to share the road with bicycles. In these cases, shared lane pavement markings (also known as sharrows) contribute to the overall safety of cyclists by increasing awareness of drivers.

- Low Stress Networks – streets in a residential neighborhood optimized for road sharing using pavement markings, signage, and traffic calming measures. These streets are low volume, low speed, and often run parallel to arterial roadways.
- Marked shared lanes should not be used on roads with speed limits over 35 mph.
- Shared lane markings can be used on the approach to roundabouts to provide notification of the shared traffic configuration.

Bicyclist on shared neighborhood lane

Photo by Kimley-Horn

Traffic Calming

Traffic calming refers to the set of measures that may be used to reduce motor vehicle speeds and create more pedestrian-friendly streets. Safety concerns tend to be the primary motivation behind deployment of traffic calming measures. These measures can take many forms, including engineering, planning, and policy interventions, and may be appropriate to implement at the facility, corridor, or area-level. The design of a street incontestably reflects its intended users. While a wide, open, and unobstructed design may be appropriate on highways, these elements are not suitable for most streets in an urban or residential context.

Many of the design elements described within these guidelines - such as shade trees, bioswales, raised crossings, medians and reduced curb radii - work effectively for traffic calming purposes. Other toolkit strategies include:

- Vertical deflections - including speed humps, speed tables, and bump-outs - to be placed regularly along a corridor. Slopes are not to exceed 1:10 or be less steep than 1:25.
- Horizontal deflection - including on-street parking, chicanes, bulb-outs, roundabouts, and traffic circles. These features should not interfere with bicycle facilities.
- Different types of pavement treatments
- Radars and electronic speed signs
- Traffic control elements
- Lane narrowing and elimination
- Short blocks (500 ft or less)

FDOT Design Manual (2018) offers a toolkit of traffic calming strategies in accordance with Context Classification.

Notably, while these interventions may be applied independently of each other, evidence indicates that when deployed as a package, results are more favorable. While implementing these design elements on new roadway construction projects will ensure the future of Complete Streets, the most important work lies on retrofitting existing conditions.

More resources for traffic calming include: ***USDOT Traffic Calming, FHWA Speed Management Safety, FHWA, Traffic Calming, ITE, Traffic Calming Measures, NACTO, Speed Management, FDOT, Speed Management***

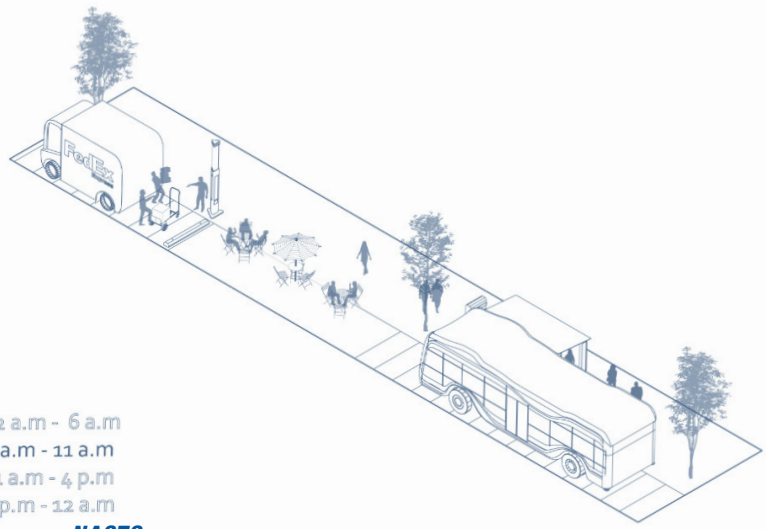
Curb extensions may be used for traffic calming.
Photo by Kimley-Horn

Curbside Management

No other zone in the Roadway Realm would benefit more from flexibility in design than the curbside. Traditionally, the curbside has been an underutilized space, but as travel behavior pattern change to give way to emerging technologies there is an opportunity to increase the functions of this space. A rise in e-commerce, shared mobility, and micromobility options means street design must adapt to changing needs. In addition, schedule flexibility allows this space to serve different functions throughout day and nighttime hours.

Curbside space can be adapted to fit the following functions:

- Pedestrian & crossing infrastructure
- Personal vehicle parking
- Emergency vehicle access
- Public transport/transit infrastructure
- Loading and delivery zones
- Commercial space/mobile vendors
- Bicycle infrastructure
- TNC pick-up/drop-off
- Waste management access
- Repair/maintenance access
- Green space, parklets
- Carshare parking



***Source:* NACTO**

TNC pick-up/drop-off and flexible parking zone

Curbside management, Las Olas Boulevard

Photos by Kimley-Horn

Intersection Design

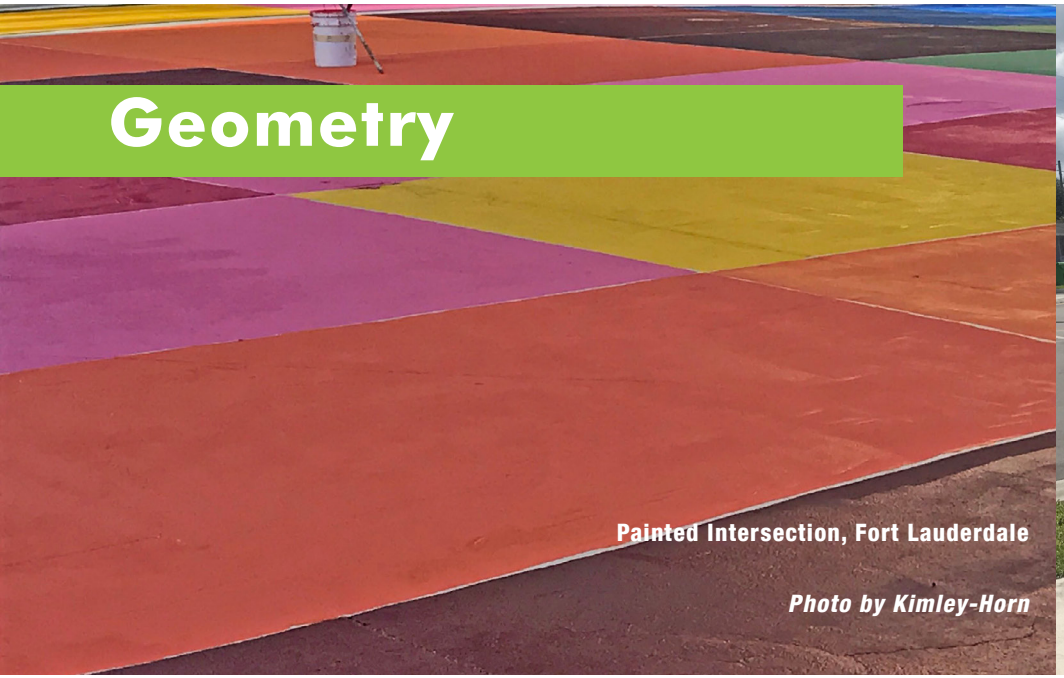
4

Providing bicycle and pedestrian facilities is not enough - an effective network must also incorporate special accommodations to safely cross the Roadway Realm. In most street settings, intersections are the location of the highest conflict zones. Crash data often shows a significant concentration of incidents occurring at crossings, be it among motor vehicles or also involving pedestrians and bicyclists. To address safety concerns, it is essential to design and plan Intersections so that all road users are protected, with emphasis on disadvantaged groups.

The design of an intersection can be a decisive factor in determining whether a space is inviting or intimidating for walking. Street corners can enhance the sense of place of a block by including factors that encourage people to stay and feel comfortable along a street. Some of the elements that may be placed at street corners to make them more attractive include:

- Amenities such as corner groceries, restaurants, cafes, convenience or specialty retail stores (corner buildings should locate their entrances at the corner, rather than mid-block)
- Temporary structures such as mobile mini markets, newsstands, carts, or kiosks promoting local food vendors and inducing walking trips for basic necessities
- Mobility hubs, including bus shelters, bikeshare racks, and information/wayfinding boards
- Art installations, murals, or sculptures that assist with urban recognition and define the character of the neighborhood

Geometry



Painted Intersection, Fort Lauderdale

Photo by Kimley-Horn

Crosswalk through traffic splitter island at roundabout, Sunrise

Photo by Kimley-Horn

Crosswalk Placement and Design

Special Emphasis and Raised Crosswalks

Special emphasis crosswalks enhance visibility by incorporating ladder, zebra, or continental crosswalk markings, and have been shown to improve yielding behavior from motor vehicles. Special emphasis crosswalks consist of 24 inch white longitudinal bars across the roadway spaced on each lane line and in the center of each motor vehicle lane. On the State Highway System, the FDOT Design Manual (2018) specifies that special emphasis crosswalks should be installed at all signalized intersections on all marked legs and at roundabouts, while conventional crosswalks may be used at stop or yield-controlled intersections. Crosswalks at roundabouts should be designed to route pedestrians through the splitter islands, which can serve as a pedestrian refuge, so that one direction of traffic is crossed at a time.

Raised crosswalks further enhance pedestrian comfort and safety by elevating the crossing to or near curb level, doubling as a traffic calming measure. Raised crosswalks are appropriate both at intersection or mid-block locations. ADA accessibility features should be incorporated to alert visually impaired persons of the imminent crossing.

Special emphasis crosswalk with bicycle box, Las Olas Boulevard

Pedestrians on a conventional crosswalk, Lauderhill

Photos by Kimley-Horn

Conventional Crosswalk

The most basic crossing facility is the conventional or standard crosswalk, consisting of two striped markings that enclose the dedicated space for pedestrians to cross the road. The path should allow for directness following the line of pedestrian movement. The conventional crosswalk should be striped as wide or wider than the sidewalk it connects to, so that people coming from both directions can comfortably cross at the same time. Highly visible markings are preferred, as they have been shown to improve yielding from drivers who are more likely to see the pedestrians. Moreover, an advanced stop bar perpendicular to the travel lane should be located at least 4 feet ahead of the crosswalk to alert drivers of the impending crossing. Where necessary, right-turn-on-red restrictions may be issued to avoid conflicts between turning cars and crossing pedestrians.

These crosswalks may be controlled and signalized on arterial and collector roadways. Conventional crosswalks should only be used across controlled approaches – either signalized or stop-controlled – unless additional safety treatments such as a raised crosswalk are also incorporated.

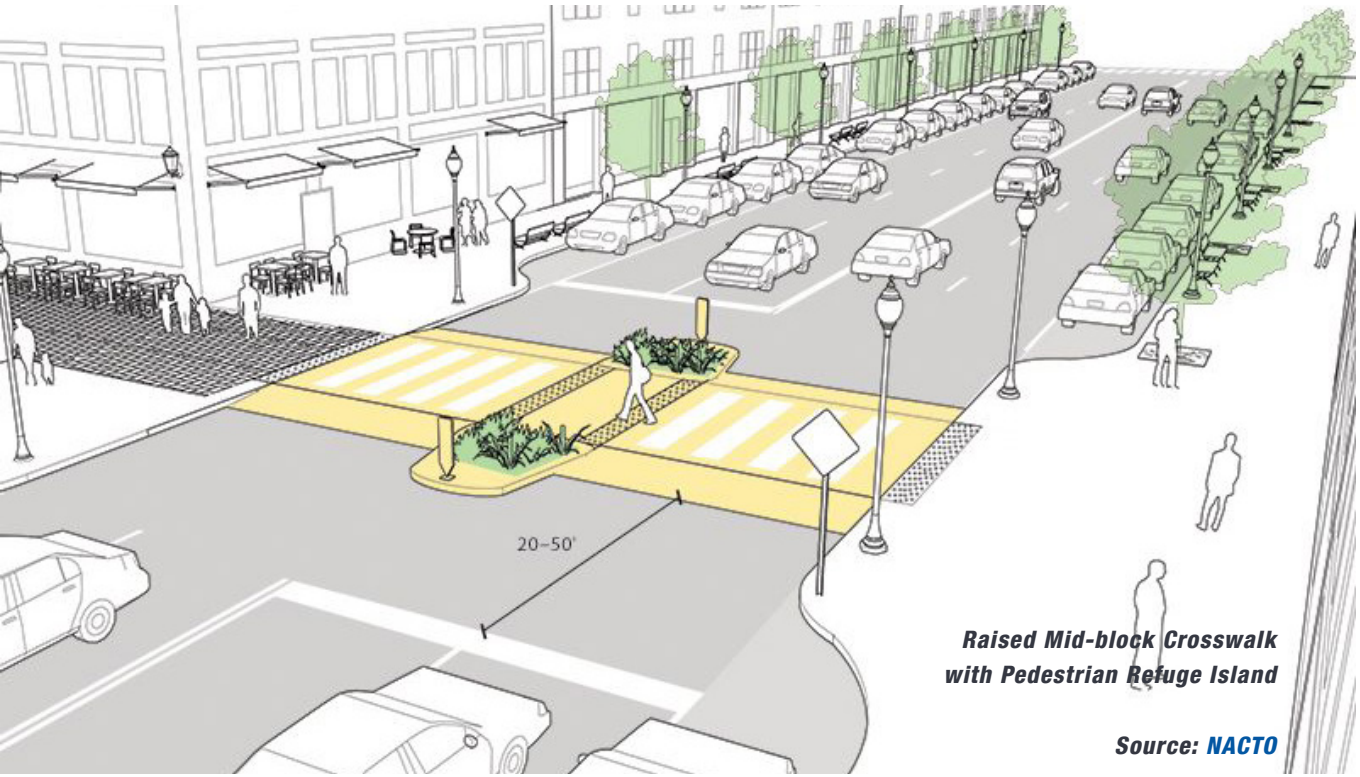
Added features can be used to increase safety, including variations in paving materials including special pavement treatments, decorations, textures, or changes in elevation. Raised crosswalks continue through the intersection at the same level as the sidewalk, defining the space as pedestrian-oriented. This is as much a traffic-calming measure, as a pedestrian enhancement.

Mid-Block Crosswalk

Faced with few opportunities along a long block, pedestrians may be tempted to cross at unmarked, uncontrolled points, creating unexpected conflict points. Data evidence has shown that pedestrian fatalities are more likely to occur at mid-block locations. Well-designed street crossings spaced between intersections provide shortcuts for pedestrians to safely reach their destinations. Signage, pedestrian signalization, pavement markings, special emphasis and raised crosswalks may all be appropriate elements to incorporate at mid-block locations. Moreover, advance stop bars and STOP HERE FOR PEDESTRIANS signs should be used in mid-block crosswalks to alert drivers of the impending crossing. The stop bar for vehicles should be set back 20-50 feet. Crossing signals further emphasize the priority of pedestrians. Flashing beacon crosswalk devices and signalization techniques should be considered for mid-block crosswalks and are discussed in more detail later in this chapter.

Pedestrian crossing on raised mid-block crosswalk, Dixie Highway

Photo by Kimley-Horn



Raised Mid-block Crosswalk with Pedestrian Refuge Island

Source: NACTO

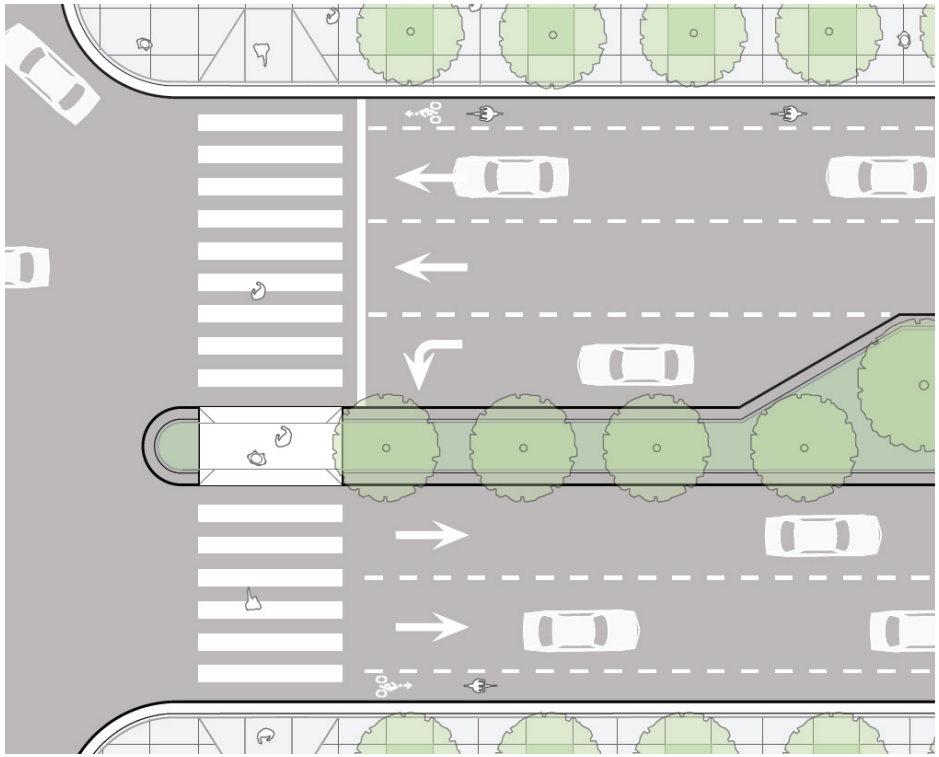
Mid-block crosswalks can enhance the pedestrian experience in situations where destinations, activated public spaces, or pedestrian boulevards are located mid-block, drawing activity from foot traffic.

Examples of nearby institutions where mid-block crosswalks may prove essential to enhance safety include: schools, museums, parks, plazas, waterfronts, courthouses, or airports. Desire lines may be used as an indication of need for a mid-block crosswalk, and existing and forecasted pedestrian traffic volume should be considered.

Pedestrian Refuge Islands (Median)

Pedestrian refuge islands provide a waiting area on the street median for pedestrians, effectively dividing the crossing distance into two shorter segments where pedestrians cross one direction of traffic at a time. They are most appropriate on wide, multilane streets with bidirectional traffic, as they allow people to focus on incoming traffic one direction at a time. Pedestrian refuge islands can also enhance safety at unsignalized crossings and may be used at intersections or mid-block crossings. They may also be placed where safety is a primary concern and high volume of people crossing, such as near schools, transit stations, shopping plazas, or large offices.

A pedestrian refuge island must be designed to be at least 6 feet in length so that it can accommodate wheelchairs, strollers, and bicycles, but a preferred length of 10 feet is recommended to match the width of the crosswalk. In addition, pedestrian refuge islands should have a "nose" extending past the crosswalk to protect waiting people from turning vehicles. The walkway in a pedestrian refuge island should be at the elevation of the crosswalk. Lastly, they may be improved by adding a furnishing zone and stormwater control. This feature is also appropriate at mid-block crossings.



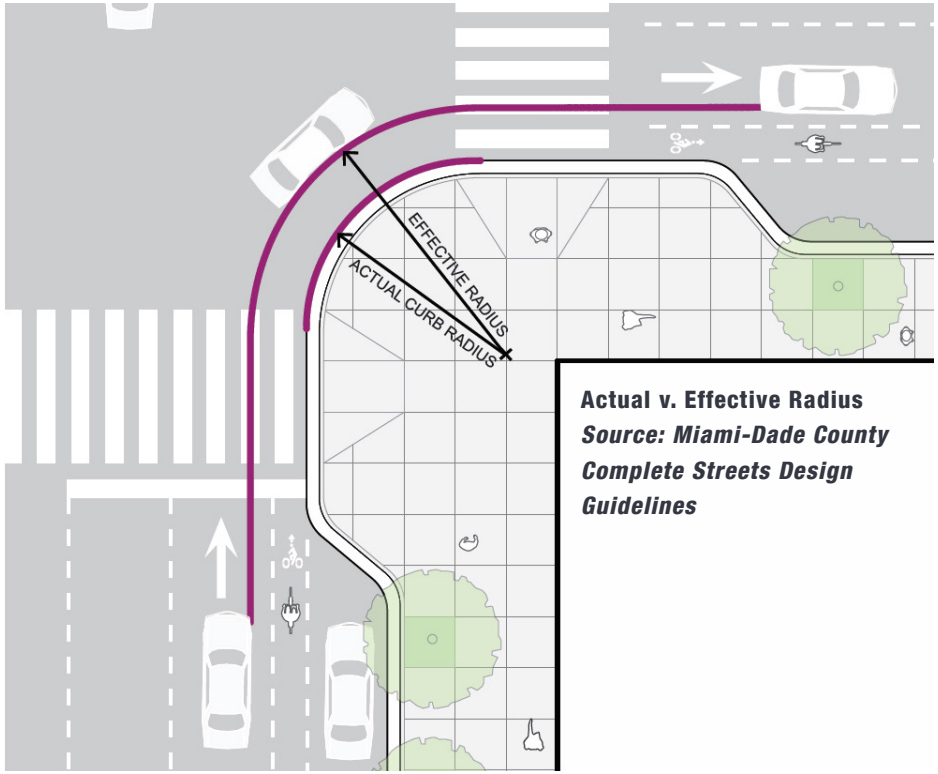
Special Emphasis Crosswalk with Pedestrian Refuge Island
Source: Miami-Dade County Complete Streets Design Guidelines

Pedestrian refuge islands have been demonstrated to decrease the percentage of pedestrian crashes and casualties by 57 – 82 percent in the U.S.

FHWA "Traffic Calming Countermeasures Library" Safer Journey, 2013

Dismounted bicyclists on pedestrian refuge island

Photo by Kimley-Horn



Actual v. Effective Radius
Source: Miami-Dade County Complete Streets Design Guidelines

Curb Radii

The radius of a curb can control the speed at which motor vehicles turn, and determine the total distance a pedestrian must walk to cross the street. Smaller curb radii create a safer environment, since a sharper turn can force motorists to slow down. Additionally, the crossing distance for pedestrians is reduced and the size of waiting areas are increased; both elements enhance the comfort of the pedestrian experience.

Two measurements are used to define curb radii: actual radius and effective radius. The first refers to the curve created by the curb line, while the former refers to the path vehicles follow when turning.

The Florida Greenbook sets a 15 feet minimum curb radii, this measurement may be used as the standard for safety improvement.

In instances where larger vehicles such as trucks or buses need additional space for turning, the effective radius can be increased without affecting the actual radius.

Strategies to resolve any potential conflicts between the needs of pedestrians and motorists include:

- Adding a curb extension - or bulb-out- to reduce the actual distance pedestrians must travel to cross the street
- Curb islands serve a similar function as curb extensions, but with lower installation costs since the curb-and-gutter drainage can remain in place
- Adding a parking lane to expand the effective radius
- Recessing the stop bar on the receiving street
- Use of pavement textures or colors to create a smaller actual curb radius
- Assuming occasional large vehicles will need to complete their turn into a lane other than the curb lane
- In cases where the intersection geometry includes a radius 50’ or larger, consider installing a channelized right turn lane complemented by a pedestrian refuge island

FDOT Context Classification may be used to determine the need to introduce strategies to reduce curb radii in a specific corridors. Tighter curb radii become increasingly more necessary moving from a rural setting toward the urban core, where more pedestrian and bicycle activity is expected.

Curb islands with curb-and-gutter drainage, Stuart FL

Photo by Kimley-Horn

ADA Treatments

The Americans with Disabilities Act (ADA) sets all-inclusive design requirements that ensure access to the built environment for people with disabilities. Complete Streets must adhere to these standards, including:

- Intersections shall be designed so that they do not create barriers to mobility for anyone.
- The pedestrian path must be free of any fixed objects that obstruct the way.
- Provide two ramps at each street corner to direct pedestrians through the crosswalk. A minimum of 4 feet deep by 5 feet wide level landing pad and a detectable warning strip at the street edge must be provided.
- Provide detectable warning surfaces at curb ramps, pedestrian refuge islands, at-grade rail crossings, and transit boarding platforms. Detectable warning surfaces should be 24 inches in the direction of travel and extend the full width of the curb ramp or flush surface.
- Provide visual and audio information, for instance pedestrian push buttons shall have a visible and audible indicator.[1]

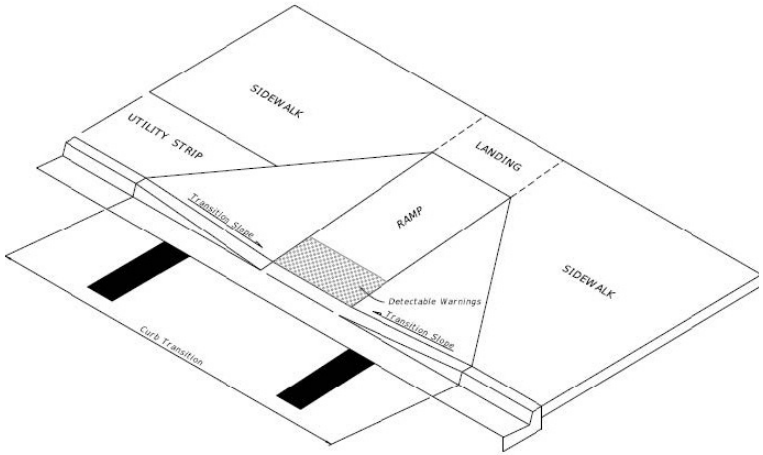
1 ***US Access Board, X02.5 Pedestrian Street Crossings***

Recommended Curb Ramp Dimensions

	Constrained	Target	Maximum
Curb Ramp Width	4'	Width of Pedestrian Walking Zone	Width of Sidewalk Realm
Curb Extension Width	4'	8'	Do not block an existing or potential bicycle lane
Curb Extension Length	Width of Curb Ramp	20'	As needed to improve pedestrian visibility and prohibit parking near intersection
Crossing Refuge Island Width	6'	10'	Width of Median

ADA detectable warning surface at curb ramp

Photo by Kimley-Horn



Curb Ramp
Source: FDOT Design Manual 2018

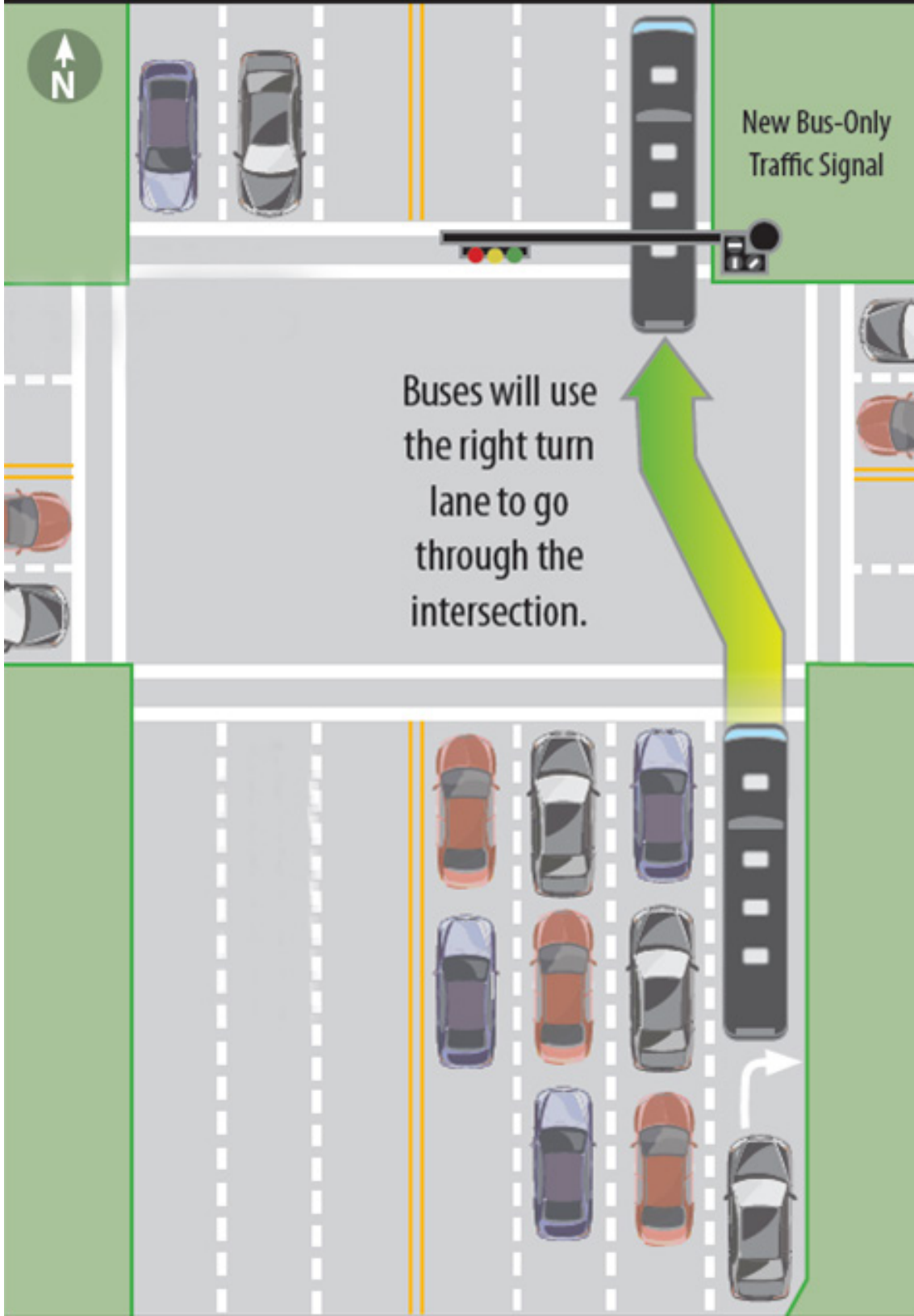
Curb ramp designed to the width of the sidewalk

Source: NACTO

Transit Elements

Bus Queue Jump Lanes

A bus queue jump lane is a special bus preferential treatment that combines a short, dedicated transit lane, or shared right-turn lane, with a special traffic signal phasing that allow buses to jump to the front of the queue during congestion and then proceed through the signalized intersection more efficiently. Bus queue jump lanes are an advanced form of Transit Signal Priority (TSP).



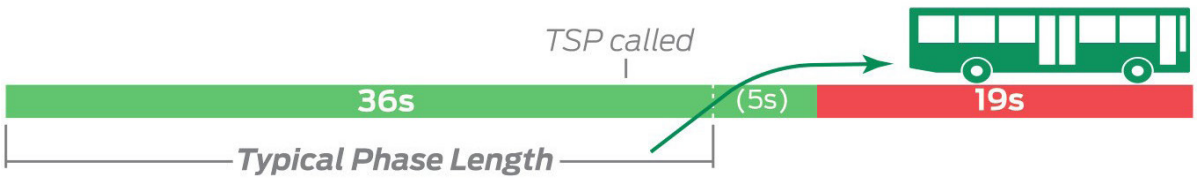
Bus Queue Jump Lane
Source: FDOT

Transit Signal Priority (TSP)

Transit Signal Priority (TSP) involves a set of signal timing strategies that modify the signal timing in favor of transit vehicles and especially those with longer headways. The signal is triggered by an on-board automatic vehicle location (AVL) signal when a bus is determined to be running behind schedule. The TSP picks up the signal and may turn the traffic light green for the upcoming transit vehicle (Early Return to Green), or extend the green (Green Extension) to allow the bus to pass through.

Although Green Extension is the most commonly used form of TSP, alternatives include Green Reallocation, Early Return to Green (Red Truncation), Upstream Green Truncation, Phase Sequence Changes, and Phase Reservicing.

The reductions in travel time are key at increasing reliability in the service and in turn influence demand. As expected, their effects are much more pronounced when implemented in combination with other transit-oriented measures such as dedicated transit lanes.



Source:* *TSP Green Extension, NACTO

"TSP's can significantly improve travel times through heavily signalized corridors, with varying studies reporting a nearing 10% reduction in travel time and up to 50% reductions in delays at some intersections"

NACTO, Transit Street Design Guide

Traffic Control Elements for Crossing Safety

Pedestrian Signals

A Pedestrian Signal shows the right-of-way and number of seconds left for pedestrians to cross the street and should be provided at each leg of an intersection.

The signal may be activated through the push of a button, or passively through pedestrian detection systems. A “WALK” sign or a symbol of a walking person is used to indicate right-of-way for pedestrians.

A Leading Pedestrian Interval (LPI) allows a WALK phase 5 seconds ahead of the concurrent green signal to place pedestrians at a visible spot in the crosswalk to drivers. Phase duration tends to be based on walking speed of 3.5 ft/sec, although 2.8 ft/sec is preferred in certain scenarios, such as in areas with higher rates of senior population. A “DON’T WALK” countdown sign indicates changing signal.

Pedestrians crossing on WALK signal, Fort Lauderdale

Photo by Kimley-Horn

Bicycle Signals

Bicycle signals provide for separate traffic control of the bicycle movement. They are similar to vehicle traffic signals, except it shows a bicycle in green to indicate right-of-way.

Bicycle signals should be used in combination with existing conventional traffic signals or hybrid beacons, and may be further complemented by push buttons, signage, and pavement markings to emphasize right-of-way. Passive activation of bicycle signals is preferred. If the bicycle signal is used to separate through bicycle movements from turning vehicles, then no turn on red shall be required when the bicycle signal is active. As with pedestrian signals, a leading interval is useful in alerting drivers of the impending bicyclist crossing. Moreover, sufficient interval time for crossing must be allowed, and should be determined to accommodate the 15th percentile biking travel speed in correlation with the intersection width.

Bicycle crossing signal

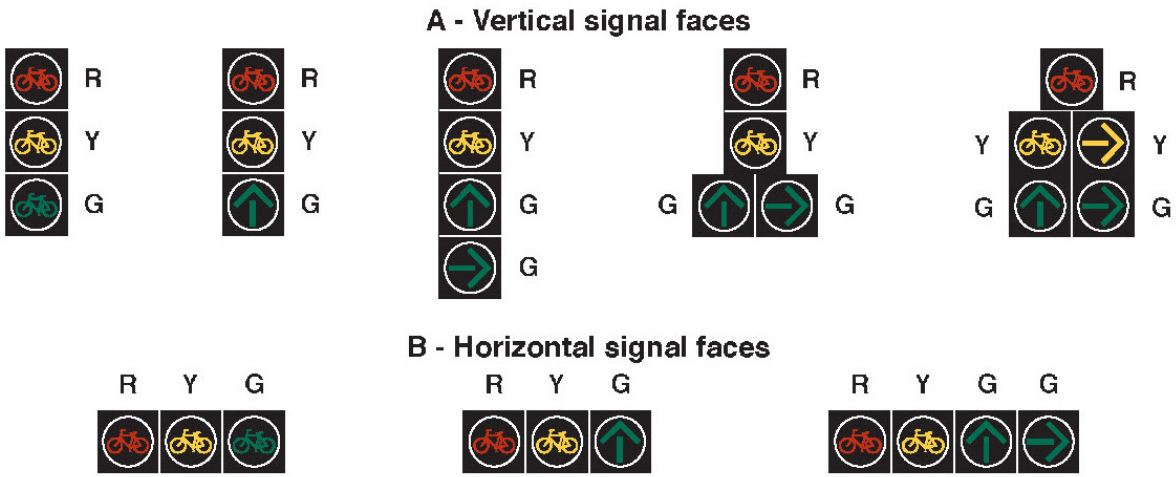
Photo by Kimley-Horn

Installation of bicycle signals is particularly appropriate at conflict zones or where a bicyclist would otherwise not have a signal facing them, as well as in contra-flow and two-way separated bicycle lanes.

Installation has been found to result in increased compliance by bicyclists with the traffic control, and have been shown to reduce bicycle crash rate up to 45% where bicycle volumes simultaneously increase.[2]

2 ***USDOT, FHWA Interim Approval for Optional Use of a Bicycle Signal Face***

Typical Arrangements of Signal Sections in Bicycle Signal Faces



Source: MUTCD IA-16, FHWA

NACTO recommends the total clearance interval (Ci) to be calculated as function of intersection width (W) and typical bicyclist speeds (V), where:

$$C_i = 3 + \frac{W}{V}$$

Source: NACTO

Rectangular Rapid Flashing Beacons (RRFBs)

RRFB's offer a lower cost alternative to pedestrian traffic signals that supplement warning signs at unsignalized intersections or mid-block crosswalks. These solar powered panel units are activated through the pushing of a button or passively through a pedestrian detection system. Flashing warning lights below the sign panel alert drivers of the immediate presence of a pedestrian crossing or requesting to cross the street. They should be used in combination with other measures, including advanced STOP HERE FOR PEDESTRIANS signs. RRFBs are appropriate on lower speed two-lane or multilane roadways of 35 mph or less.

Source: MUTCD IA-21, FHWA

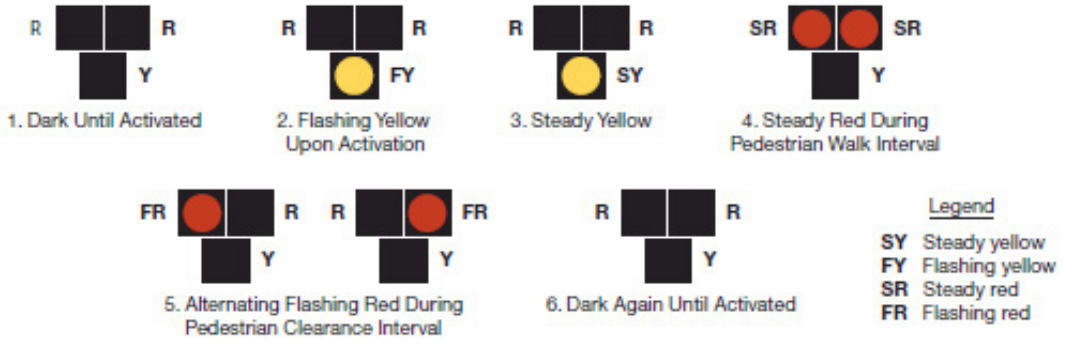
RRFBs at crosswalk and permeable asphalt around tree

Photo by Kimley-Horn

Pedestrian Hybrid Beacons (PHBs)

PHBs are a traffic control device that assigns right-of-way for pedestrians. It consists of two red lenses above a single yellow lens, and it's activated when a pedestrian pushes the call button to cross the street. At that point, the lenses start flashing, alerting drivers of pedestrians crossing the street. Immediately after a WALK sign appears on the pedestrian signal. Once the pedestrian has completed the crossing, all lights turn dark until the call button is pressed again. PHBs are most impactful at mid-block crossings or uncontrolled intersections along higher speed, multilane streets.

Motorist compliance has been shown to exceed 90% at PHBs, and in direct correlation, sites with PHBs have been shown to decrease pedestrian crashes up to 69% and total crashes up to 29%[3]



***Source:* Pedestrian Hybrid Beacon Guide, FHWA**

3 ***USDOT, Federal Highway Administration, Proven Safety Countermeasures***

Keyhole Lane approaching intersection, New York

Continuous Bicycle Lane with Right-Turn Pocket (Keyhole Lane)

Keyhole lanes are bicycle lanes placed between the through lane and the adjacent right turn lane, bus bay, or parking lane. The FDOT Design Manual (2018) calls for 7 feet buffered keyhole lanes on curbed roadways, with a minimum of 5 feet in constrained areas. Keyhole lanes provide continuous bicycle lanes through an intersection approach and eliminate potential right hook conflicts.

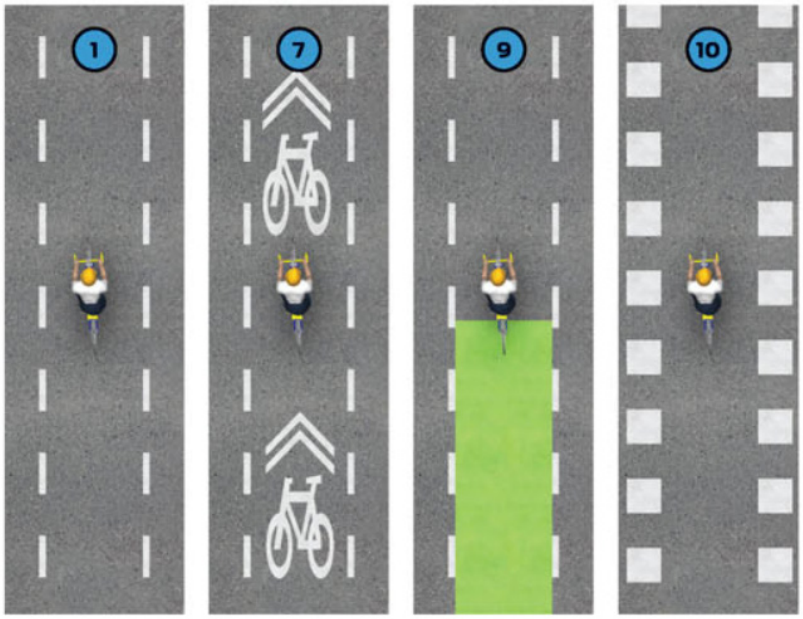
Keyhole Lane

Photos by Kimley-Horn

Pavement Markings through Intersections

Bicyclist safety can be improved through continued pavement markings at the intersection, clearly indicating the intended path for bicyclists to follow across while making drivers aware of bicycle presence. The treatments can vary, and generally consist of stripes, dotted lines, shared lane markings, continued green coloring, or a combination of these measures. In cases of bidirectional bicycle traffic, this should be visibly marked. Specifically, wider and offset intersections are benefited from these pavement treatments.

Bicycle Pavement Marking Standards for Broward County are shown in Appendix A



Intersection Crossing Markings
Source: NACTO

Bicyclist going through marked intersection, Fort Lauderdale

Photo by Kimley-Horn

Bicycle Boxes

Bicycle boxes are chief among safety measures at intersections, as they minimize conflict between bikes turning left across traffic or cars turning right across the bike lane. A delineated green box for bicyclists to wait for a green phase is placed across all lanes just behind the pedestrian crossing and ahead of the motor vehicles. The box should be 10 to 16 feet deep and may be combined with bicycle signals to allow bicyclists to cross ahead of vehicular traffic.

For this setup, the stop line for cars must be set back at least 10 feet from its prior location to provide space and visibility of bicyclists and right-turn-on-red should be restricted as to avoid vehicles from moving into the bicycle box during red phase. Moreover, as per the FHWA, at least 50 feet of bicycle lane should be provided on the approach to a bicycle box to eliminate the need for bicyclists to ride between lanes to reach the bicycle box.[4]

4 ***IA.18: Intersection Bicycle Box, FHWA, 2016***

Bike box at intersection

Photo by Kimley-Horn

"A study in Portland, Oregon found that 77 percent of cyclists felt bicycling through the intersections was safer with bike boxes, and bike boxes reduce motor vehicle encroachment at intersections by almost 20 percent."

Monsere & Dill, 2010

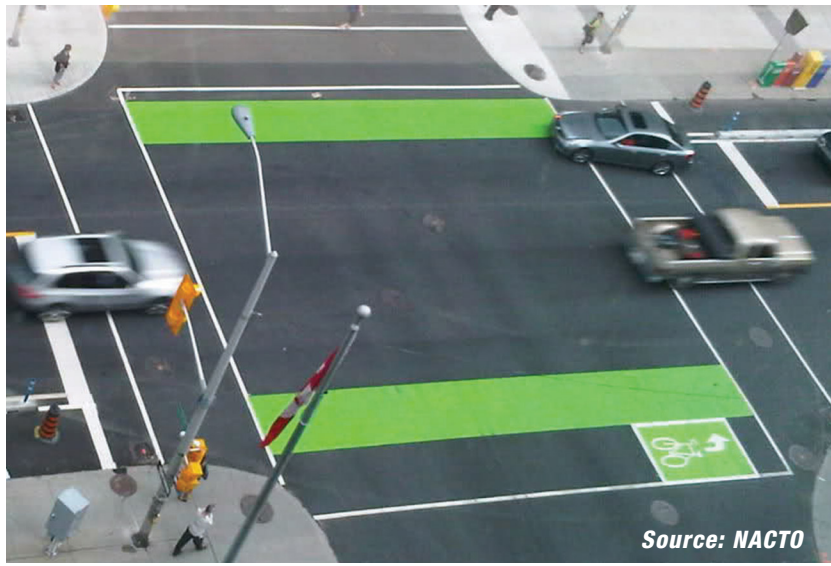
Two-stage left-turn queue box at intersection

Photo by Kimley-Horn

Two-Stage Turn Queue Boxes

Two-stage turn queue boxes are marked areas where bicyclists are anticipated to make two-stage crossings to execute a left turn. It allows bicyclists to complete the turn in two-stages avoiding crossing traffic lanes. On the first stage, the bicyclist moves from the bicycle lane to the bicycle box and completes the turn when allowed by traffic or a traffic signal. Proper bicycle symbol and turn arrow pavement markings must be provided to indicate the directions for bicyclists to follow, wait, and turn. As with bicycle boxes, turn-on-red must be restricted as to avoid vehicles moving into the queue boxes. Moreover, FDOT restricts the installation of bike boxes and two-stage turn queue boxes to signalized intersections only, as to avoid additional conflicts.

Research from the Netherlands, Mexico, and China indicate that two-stage turn queue boxes may be more effective for dealing with left turns than bicycle boxes. However, NACTO Urban Bikeway Design Guide further suggests placing bicyclists in line with a curb or parking area for added protection. A consideration of two-stage turn queue boxes is that it may cause delays for bicyclists, now having to wait for two different green phases.



Source: NACTO

Separated Bicycle Lanes at Intersections

Special consideration must be given to separated bicycle lanes at intersections. Improving visibility is a priority for separated bicycle lanes as well as raised separated bicycle lanes to manage any potential conflicts with turning vehicles. One common solution is to end the protection of the bicycle lane at this point and use special pavement treatments to maintain safety. A bicycle facility must be provided at the intersection to ensure the safe crossing, which may include one or more of the following elements: conventional bicycle lanes, green bicycle lanes, bicycle boxes, two-stage turn queue boxes, and bicycle signals. The NACTO Urban Bikeway Design Guide recommends a width of 6 feet, with an absolute minimum of 4 feet, for transitioning into a non-separated bicycle lane. The transition must be made smooth, clearly marked, and slow bicyclists down using tactile warnings or pavement markings. Moreover, sufficient space must be allowed between the parking lane and intersection (minimum of 20 to 40 feet) and wherever possible the bicycle lanes should be placed behind concrete separators.

Separated bicycle lane at intersection, Chicago

Photo by Kimley-Horn

Implementation 5

Raised Separated Bicycle Lane with Furnishing Zone adjacent to Roadway Realm

Photo by Kimley-Horn

The Broward MPO's Mobility Program serves as the implementation arm of the Complete Streets Initiative. This program focuses on implementing projects and improvements identified in Broward MPO's plans, studies and initiatives that provide additional transportation options other than the automobile. Projects under this program include the construction of bicycle and pedestrian facilities and other Complete Streets supportive infrastructure that complement the goals and vision of the Broward MPO's Complete Streets Program to create safer and healthier streets.

The Broward MPO works closely with its member governments to implement Complete Streets projects. It is known a successful approach promotes flexibility and emphasizes the partnerships between municipalities, community advocates, stakeholders and the development community. Partnerships are key to the success of the Mobility Program.

Broward MPO's vision is: "Our work will have measurable positive impact by ensuring transportation projects are well selected, funded, and delivered." Established requirements have been set to allocate funding and move projects forward to implementation.

Scope of Work

A clearly defined scope of work is crucial to successful implementation of projects. Scope of work should include well-defined limits and identify all elements included as part of the project that can be implemented within the right-of-way (ROW).

Lane Elimination

Retrofitting is an essential component of implementation. Systematic improvements to allow other uses can be achieved through lane elimination projects, where the removal of a travel lane may provide space to implement Complete Streets facilities, features, and measures. On the State Highway System (SHS), a local government entity can submit a request, on behalf of either itself or of a private entity, for the elimination of travel lanes through FDOT's State Review Process. Requirements for lane elimination are to be considered during the Project Development and Environment (PD&E) phase of a project. A Coordination Process is followed for lane eliminations in Broward County, involving all relevant stakeholders. Lane elimination projects on SHS and non-SHS roads must undergo a separate traffic study to determine localized impacts and benefits.

Partner Collaboration

It is expected that local partner governments will work with the appropriate local agencies in developing realistic project scopes. If a partner does not have jurisdictional ownership of the roadway, they will be expected to coordinate with the roadway owner(s) on the proposed improvements to obtain their support. This includes working closely with proper authorities to maintain adequate access on established evacuation routes and adequate outside lane width along transit routes.

Buffered bike lanes on Nob Hill Road from SR-84 to Broward Boulevard

Complete Street demonstration project Sunset Strip from NW 72 Avenue to NW 19 Street

Source: Complete Streets Master Plan

Cost Estimates

It is important to develop a realistic project cost estimate to ensure funding is programmed accordingly. When possible, lane elimination projects should be scoped in coordination with reconstruction or resurfacing projects to provide cost-saving alternatives.

Resolution

Political and community vetting is required to move projects forward and minimize problems/issues during the implementation process.

- Commission Resolution – An executed resolution of support from the Jurisdictional owner is required. This resolution should include the project description, limits, commitment to maintain the project, and an endorsement for FDOT to deliver the project on the agency's behalf.
- Public/Community support – Well-documented community and stakeholder support for each project is required.

Once all the requirements are met, projects will be forwarded to FDOT District IV office for a feasibility review. When the project is determined to be feasible, the project will be considered "program ready" and the Broward MPO will facilitate an "initial" scoping meeting to establish clear roles and responsibilities, verify and/or modify project elements, and provide opportunity for additional local partner input including transit agencies. Coordination with emergency services will begin at this stage of the process to ensure the proposed improvements do not interfere or delay emergency response.

Following the initial scoping meeting, the project will be incorporated into the FDOT Work Program and the Broward MPO's five-year TIP for funding. Typically, FDOT programs the funding for new projects in the fifth year of the five-year work program since the FDOT Work Program and the TIP are fiscally constrained documents. FDOT will design and construct the project on the local government's behalf.

Evacuation Routes

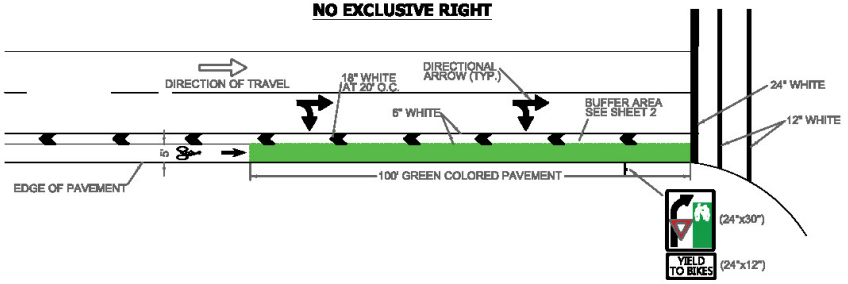
Complete Streets along evacuation routes be designed in a context sensitive manner – with special considerations for treatments that can be adjusted to facilitate a mass evacuation. For example, negative consequences resulting from lane elimination or traffic calming measures on evacuation areas may be avoided by providing demountable alternatives to achieve the desired design configuration, leaving the full required paved roadway width anticipated by the emergency evacuation plan.

Appendix A

Complete Streets
Design Guidelines 2.0

Broward County
Bicycle Pavement Markings & Signs

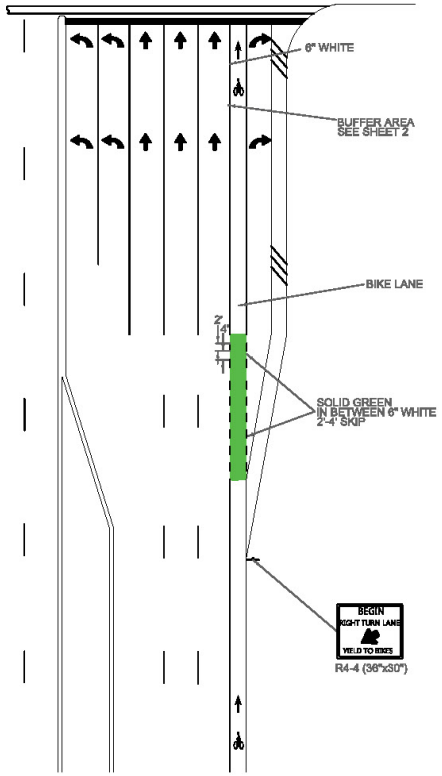
NO EXCLUSIVE RIGHT



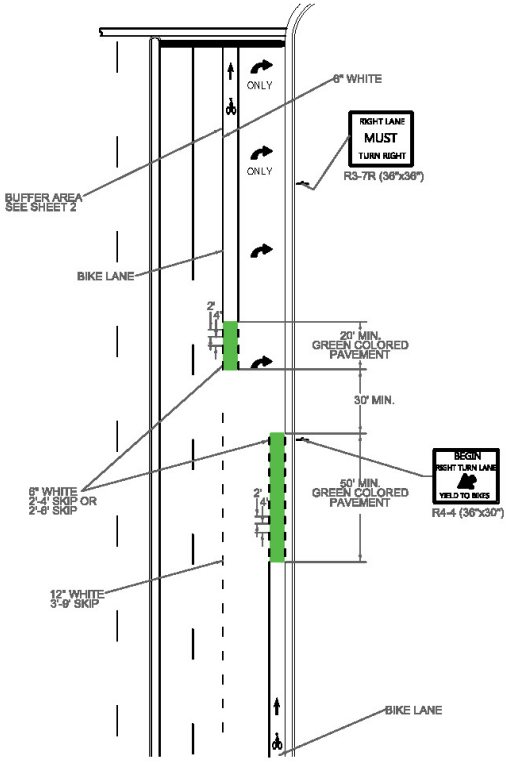
LEGEND

GREEN PATTERNED PAVEMENT

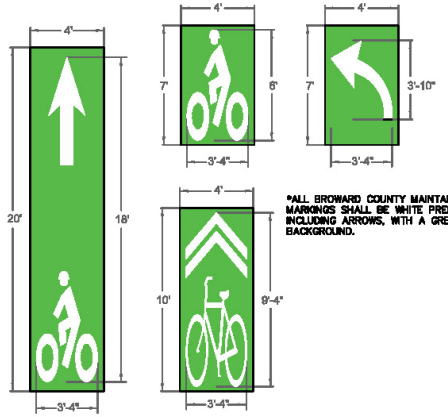
BIKE LANE WITH SEPARATE RIGHT TURN LANE



BIKE LANE WITH RIGHT TURN DROP LANE



BICYCLE PAVEMENT MARKING STANDARDS



*ALL BROWARD COUNTY MAINTAINED WHITE AND GREEN BICYCLE MARKINGS SHALL BE WHITE PREFORMED THERMOPLASTIC SYMBOLS, INCLUDING ARROWS, WITH A GREEN PREFORMED THERMOPLASTIC BACKGROUND.

NOTES

1. THE PREFORMED THERMOPLASTIC MARKINGS SHALL MEET STATE SPECIFICATIONS AND BE APPROVED FOR USE BY THE APPROPRIATE MAINTAINING AGENCY. GREEN AND WHITE PREFORMED THERMOPLASTIC MARKINGS MUST BE ON THE FDOT APL. SPECIFICATION 523 FOR GREEN AND 711 FOR WHITE PREFORMED THERMOPLASTIC MARKINGS.

2. THE SURFACE OF THE PREFORMED THERMOPLASTIC MATERIAL SHALL CONTAIN FACTORY APPLIED NON-SKID MATERIAL WITH A MINIMUM HARDNESS OF 8 (MOHS SCALE). UPON APPLICATION THE MATERIAL SHALL PROVIDE A MINIMUM SKID RESISTANCE VALUE OF 60 BPN WHEN TESTED ACCORDING TO ASTM E 303.

3. THE MATERIAL MUST BE APPLIED AT A MINIMUM THICKNESS OF 90 MILS (2.29 MM) OR 125 MILS (3.15 NUM).

4. THE MATERIAL MUST CONTAIN A MINIMUM OF THIRTY PERCENT (30%) INTERMIXED GRADED GLASS BEADS BY WEIGHT. THE INTERMIXED BEADS SHALL BE CLEAR AND TRANSPARENT. NO MORE THAN TWENTY PERCENT (20%) SHALL CONSIST OF IRREGULAR FUSED SPHEROIDS OR SILICA

5. THE MATERIALS SHALL BE APPLIED USING THE PROPANE TORCH METHOD RECOMMENDED BY THE MANUFACTURER. THE MATERIAL MUST BE APPLIED WITHOUT PREHEATING OF THE PAVEMENT TO A SPECIFIC TEMPERATURE. FOR CONCRETE APPLICATION, A COMPATIBLE PRIMER SEALER MAY BE APPLIED BEFORE APPLICATION TO ASSURE PROPER ADHESION.

REVISIONS	
DATE	DESCRIPTION
07-31-2017	N/A

BROWARD COUNTY FLORIDA

PUBLIC WORKS DEPARTMENT
TRAFFIC ENGINEERING DIVISION

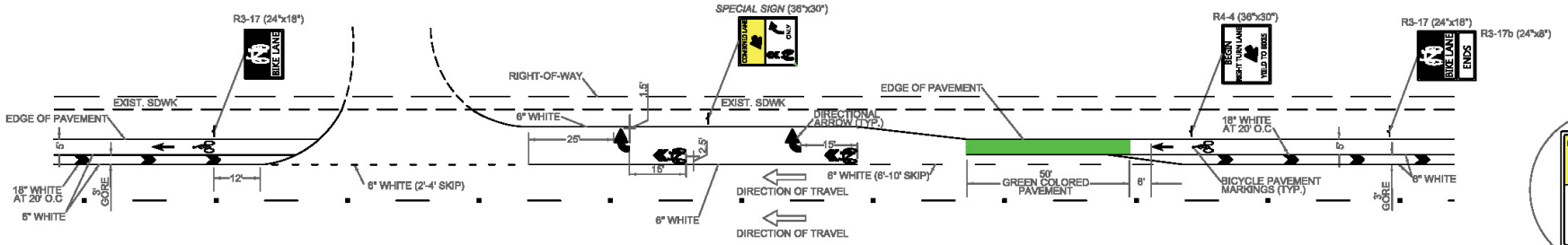
DESIGN BY: CARMELO CARATOZZOLO, P.E.	SCALE: NTS
DRAWN BY: STEPHON RAMOUTAR	
CHECKED BY: ANDREW SEBO, P.E., P.T.O.E	

BICYCLE PAVEMENT MARKINGS AND SIGNS DETAILS

SHEET NO.

1 OF 2

SPECIAL AREA MARKING DETAIL # 1



SPECIAL SIGN DETAIL (36"x30")

SPECIAL AREA MARKING DETAIL #1 NOTES

- USE DETAIL #1 WHEN BIKE LANE CANNOT BE MAINTAINED ADJACENT TO RIGHT TURN LANE.

TYPICAL SECTION: TRANSPORTATION COMPONENTS

Functional Classification	Posted Speed (MPH)	Bicycle Space		On-Street Parallel Parking Requested Through Land Development Code Process for Context Sensitive Corridor Designation	
		Bicycle Lane **	Buffer ***	Door Zone This is in addition to the bicycle space ^^^	Parking Space Measured from curb face ****
Local Streets	30 or less	N/A	N/A	4'	7'
Residential Collector	30 or less	4'–5'^	2'–3'^	4'	7'
Collector & Above	35	4'–5'^	2'–3'^	4'	7'
Collector & Above	40	4'–5'	2'–3'	4'–5'	7'
Minor Arterial	45 or less	4'–5'	2'–3'	4'–5'	7'
Principal Arterial	55 or less	5'–6'	3' or Greater	N/A	N/A

TYPICAL SECTION: TRANSPORTATION COMPONENTS NOTES

1.** A FIVE–FOOT BICYCLE LANE IS THE COUNTY'S TARGET BICYCLE LANE WIDTH

2.*** IF A BUFFER CAN BE INCORPORATED, THREE FEET IS THE TARGET BUFFER WIDTH. A FOUR–FOOT BIKE LANE WITH A THREE–FOOT BUFFER IS PREFERRED TO A FIVE–FOOT BICYCLE LANE WITH A TWO–FOOT BUFFER. IF A BUFFER CANNOT BE PROVIDED, A SOLID DOUBLE 6 INCH WHITE LINE WITH 6 INCH GAP WILL BE USED AS THE BIKE LANE STRIPE. THE BUFFER AREA SHOULD INCLUDE CHEVRON PAVEMENT MARKINGS. SEE BIKE BUFFER LANE OPTIONS.

3.**** IF CURB AND GUTTER DOES NOT EXIST, THE PARKING SPACE WOULD BE EIGHT FEET WIDE MEASURED FROM THE EDGE OF PAVEMENT. PEDESTRIAN AND BICYCLE SPACE TAKES PRIORITY OVER ON–STREET PARKING WHEN RIGHT–OF–WAY IS LIMITED.

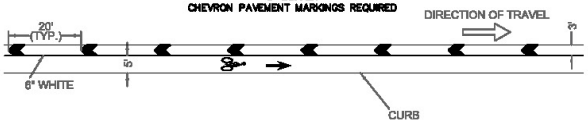
4.^ SLM – SHARED LANE MARKING (FDOT STANDARD INDEX 17347) CAN BE USED ON COLLECTORS AND ABOVE WHEN APPROPRIATE.

5.^^^ WILL CONSIDER A THREE–FOOT DOOR ZONE ON A CASE–BY–CASE BASIS.

BIKE BUFFER LANE - OPTIONS

#1 BIKE BUFFER LANE

3' BUFFER
CHEVRON PAVEMENT MARKINGS REQUIRED

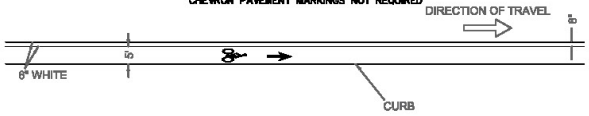


#2 BIKE BUFFER LANE

2' BUFFER
CHEVRON PAVEMENT MARKINGS REQUIRED

#3 BIKE BUFFER LANE

SOLID DOUBLE 6" WHITE LINE BUFFER W/ 6 INCH GAP
CHEVRON PAVEMENT MARKINGS NOT REQUIRED



BIKE BUFFER LANE OPTIONS NOTES

1. OPTION #1 IS DESIRED FIVE FOOT BICYCLE LANE WITH THREE FOOT BUFFER.
2. IF OPTION #1 CANNOT BE ACHIEVED THEN CONSIDER OPTION #2 AND OPTION #3

REVISIONS	
DATE	DESCRIPTION
07-31-2017	N/A

BROWARD COUNTY FLORIDA

PUBLIC WORKS DEPARTMENT
TRAFFIC ENGINEERING DIVISION

DESIGN BY: CARMELO CARATOZZOLO, P.E.	SCALE: NTS
DRAWN BY: STEPHON RAMOUTAR	
CHECKED BY: ANDREW SEBO, P.E., P.T.O.E	

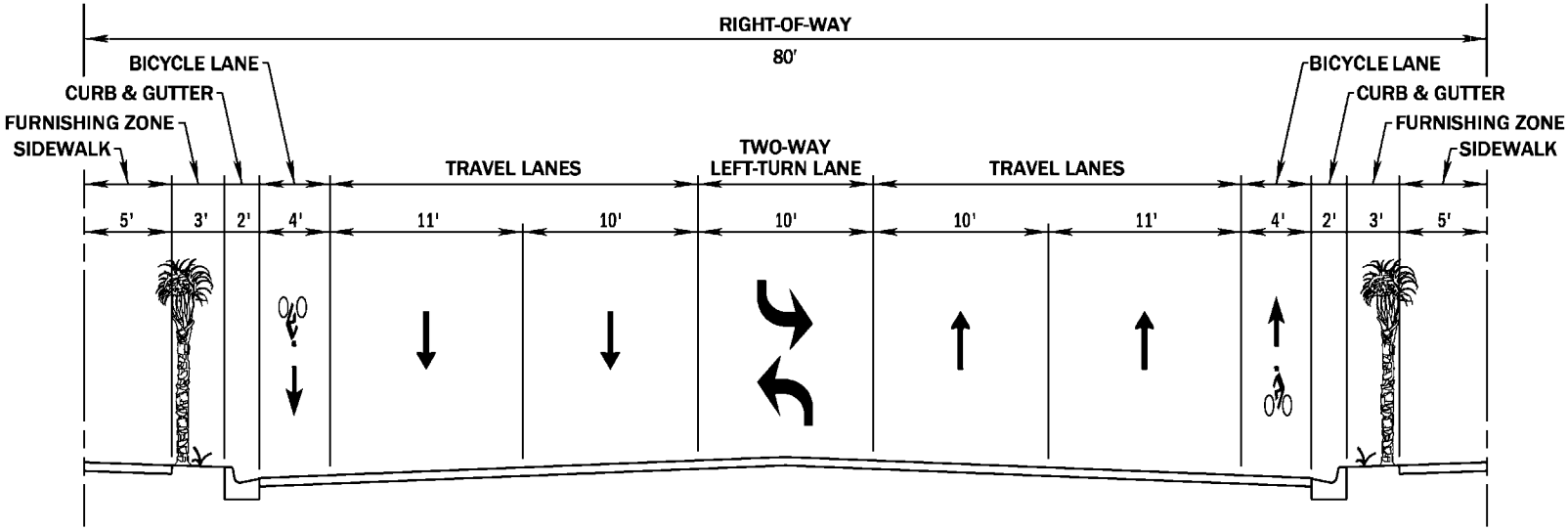
BICYCLE PAVEMENT MARKINGS AND SIGNS DETAILS

SHEET NO.
2 OF 2

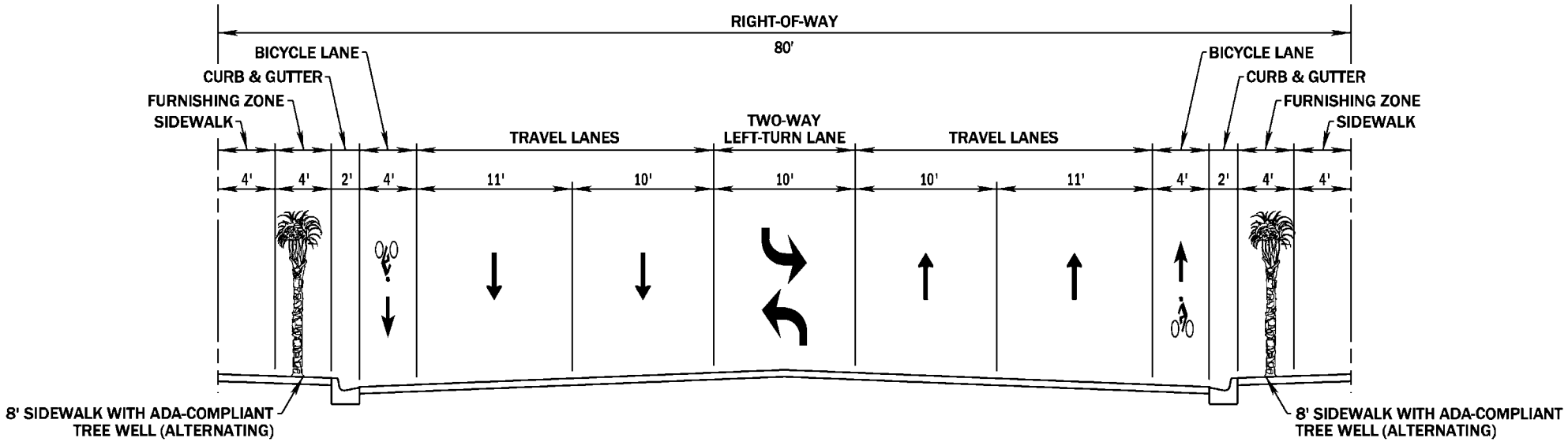
To access the latest Broward County publications on Bicycle Pavement Markings and Signs Details visit: ***Traffic Engineering Division***

Appendix B

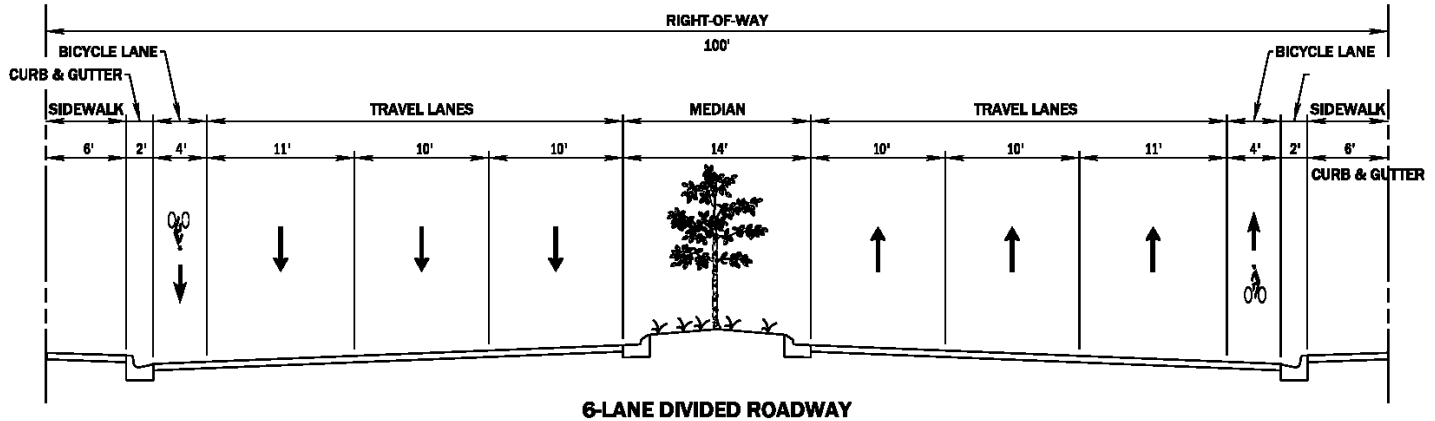
Typical Sections



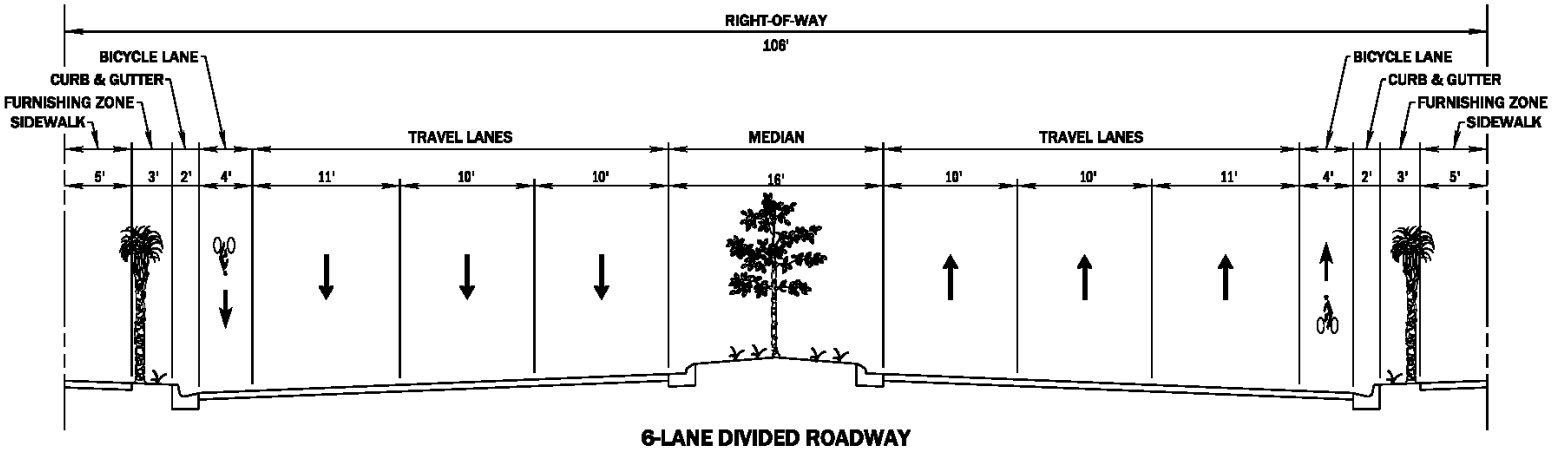
5-LANE UNDIVIDED ROADWAY



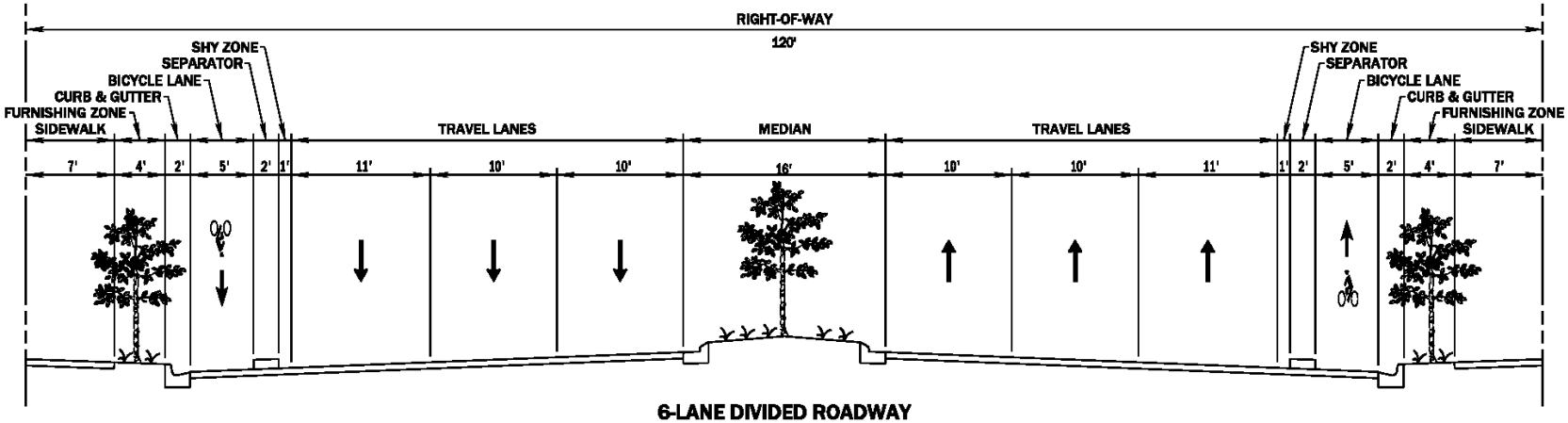
5-LANE UNDIVIDED ROADWAY



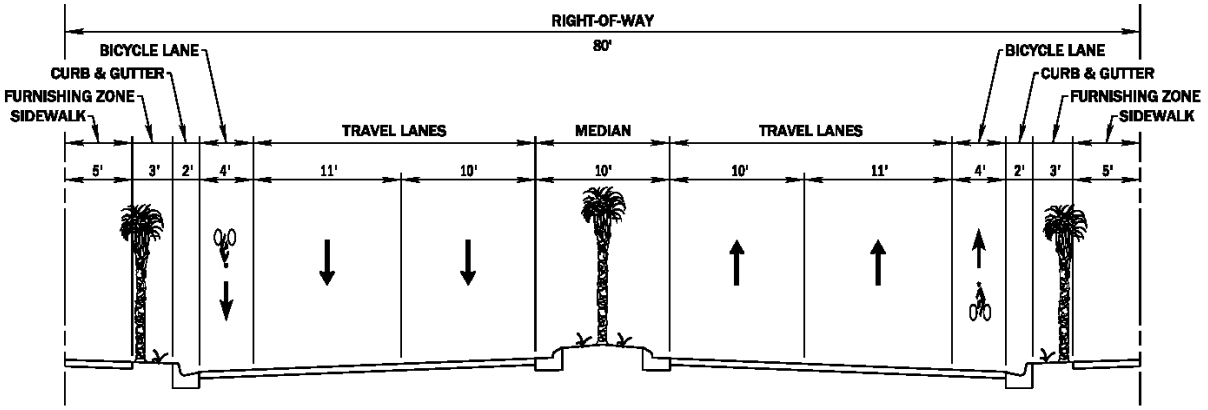
6-LANE DIVIDED ROADWAY



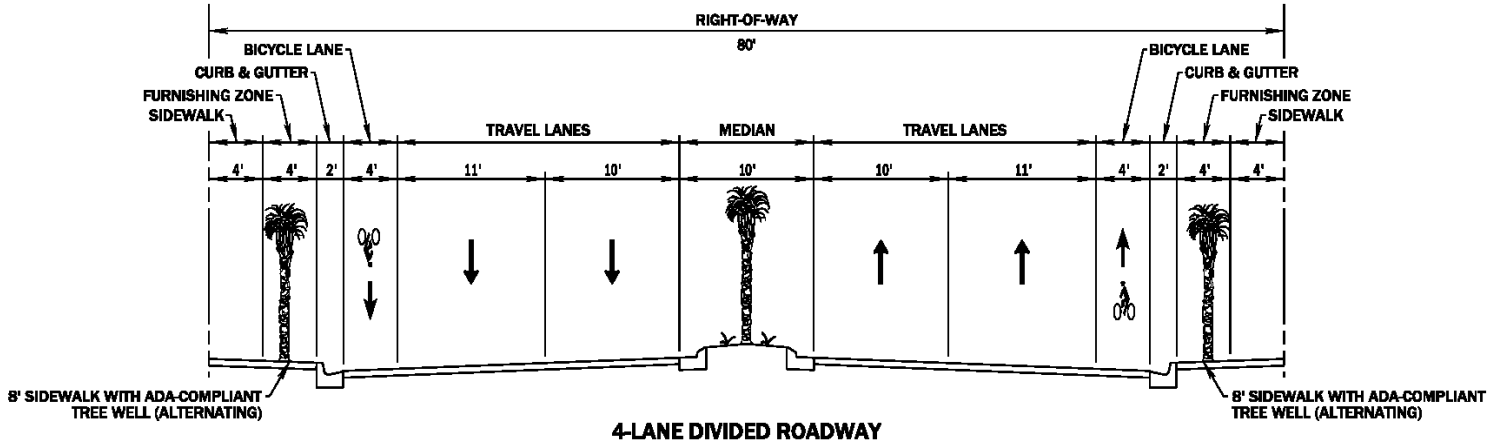
6-LANE DIVIDED ROADWAY



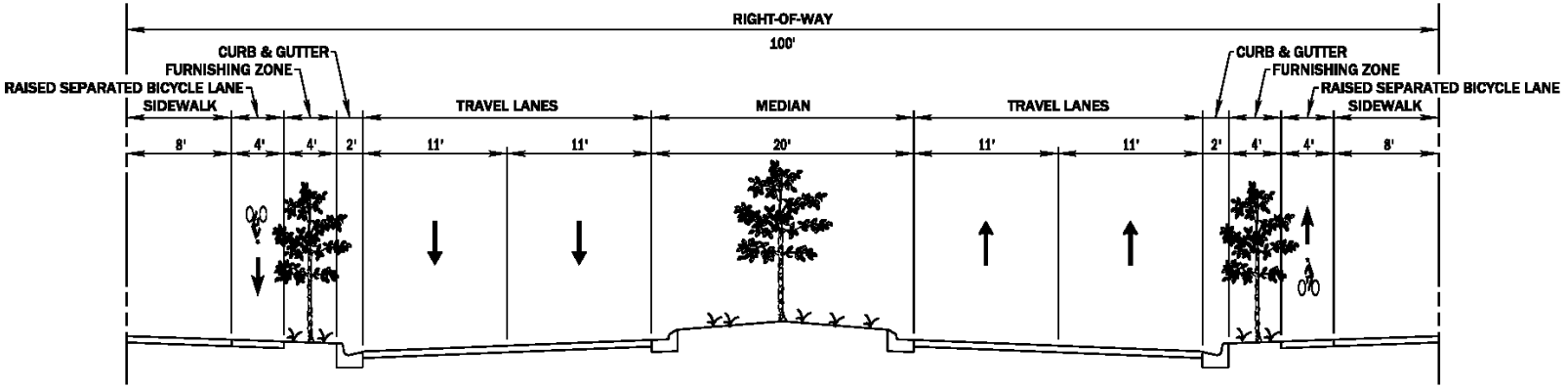
6-LANE DIVIDED ROADWAY



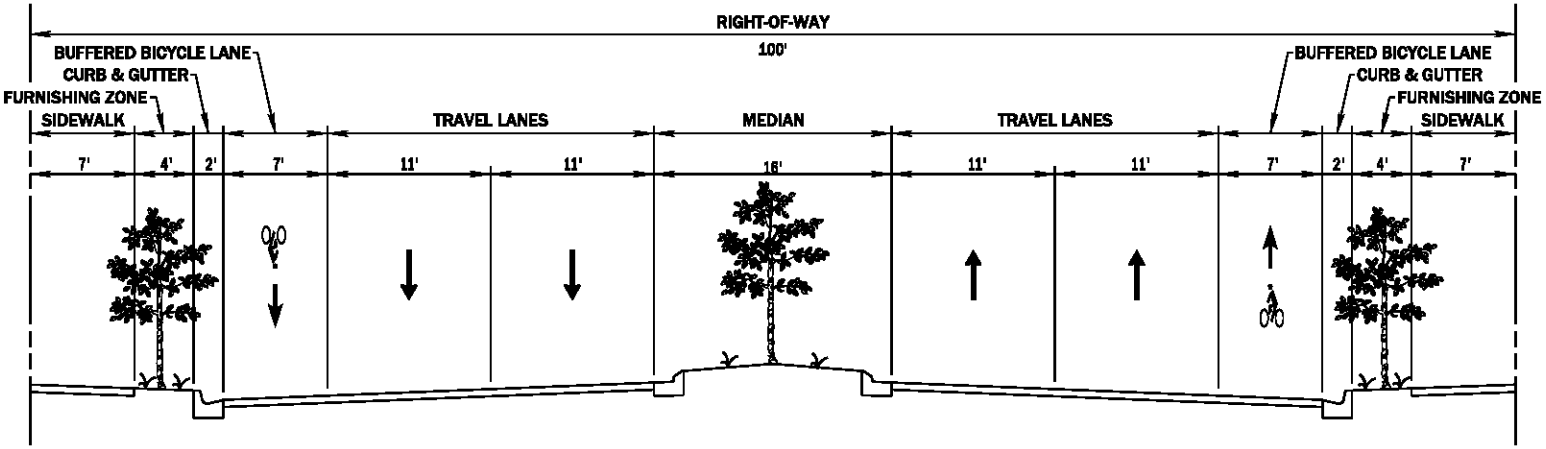
4-LANE DIVIDED ROADWAY



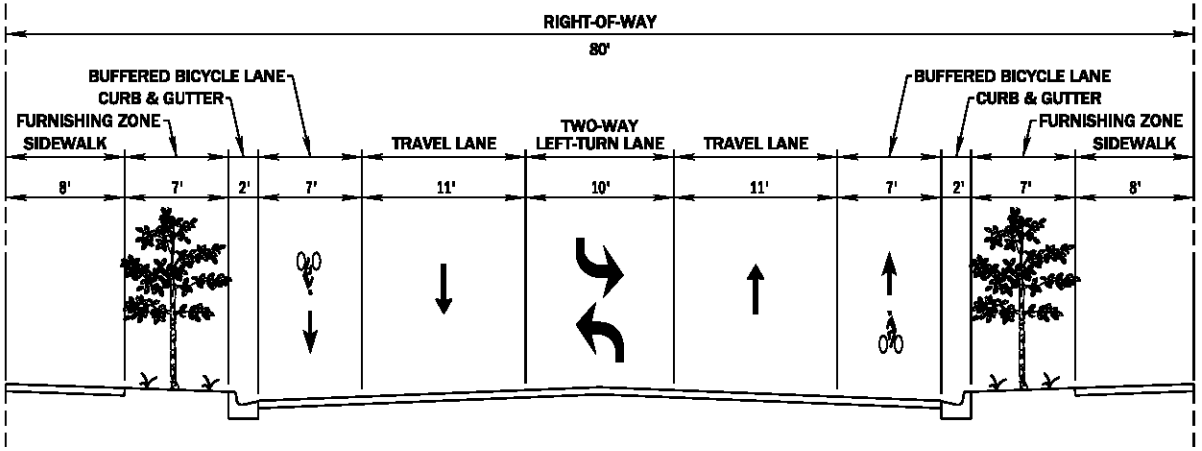
4-LANE DIVIDED ROADWAY



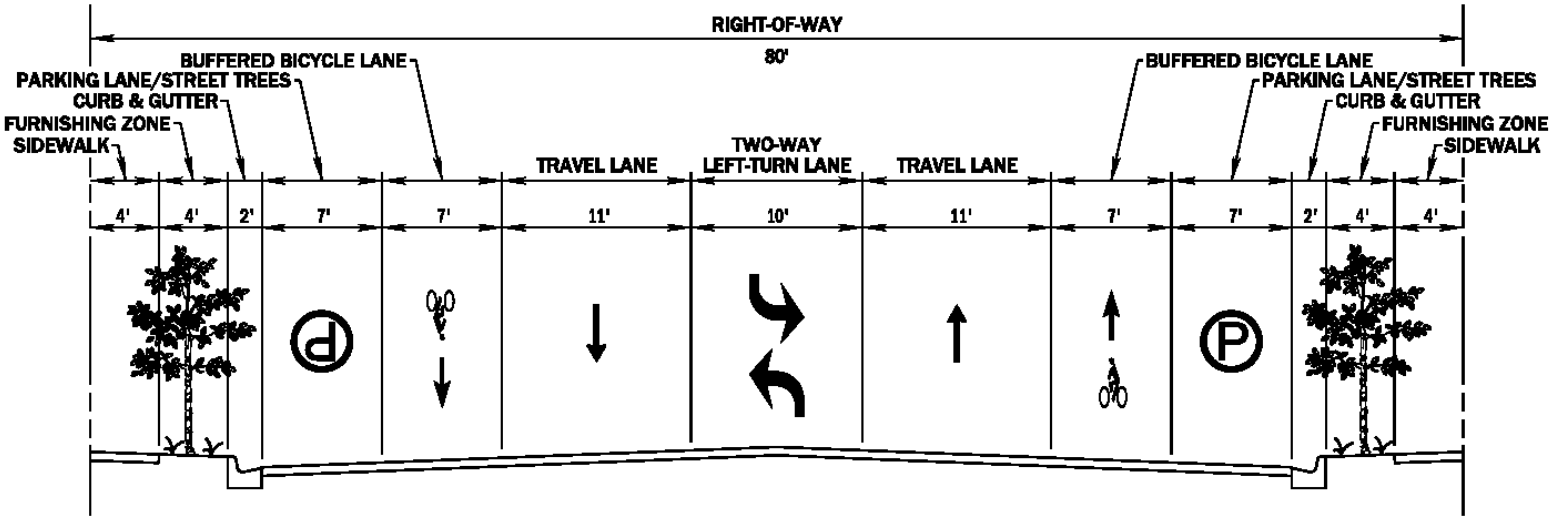
4-LANE DIVIDED ROADWAY
WITH RAISED SEPARATED BICYCLE LANES



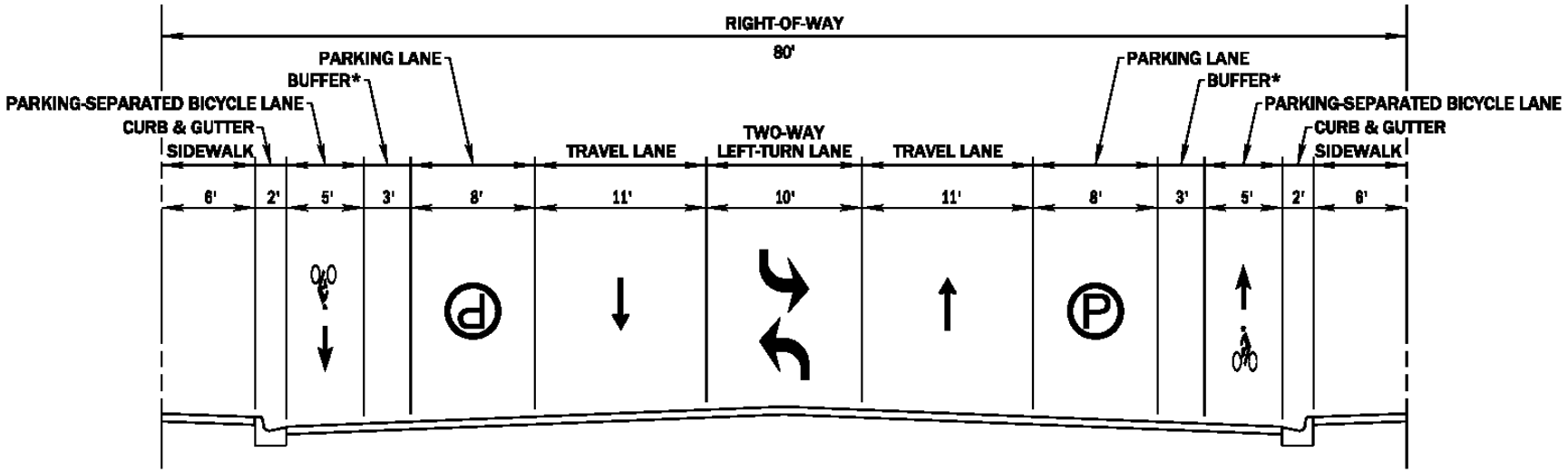
4-LANE DIVIDED ROADWAY
WITH BUFFERED BICYCLE LANES



3-LANE UNDIVIDED ROADWAY

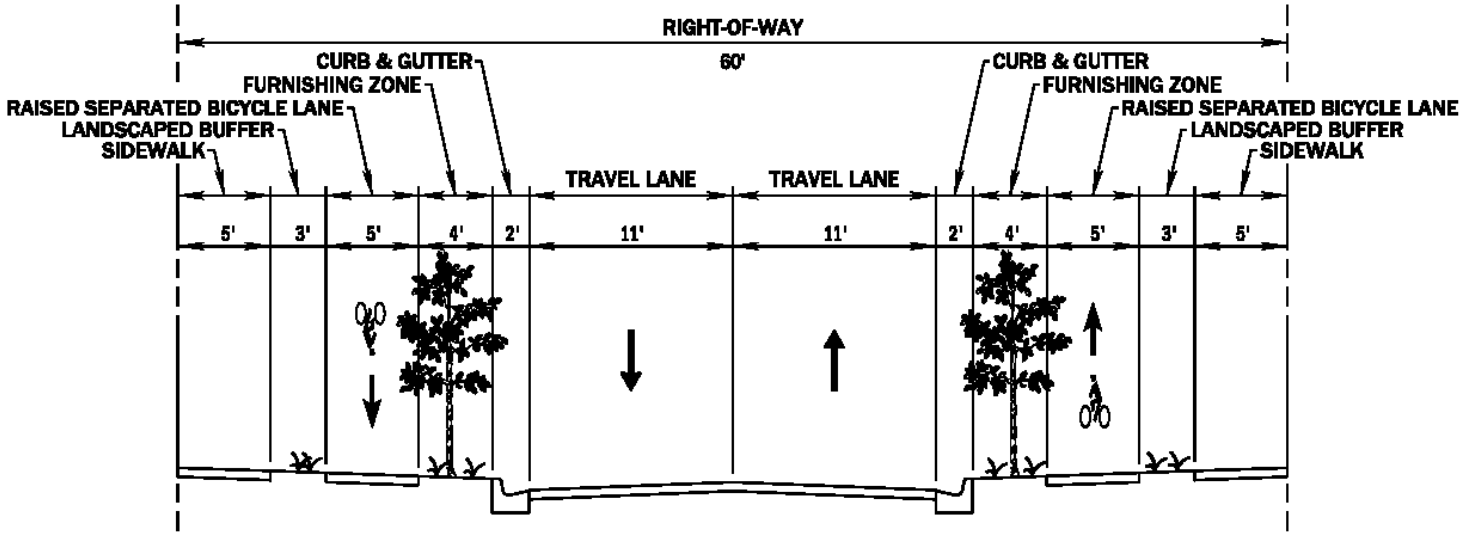


3-LANE UNDIVIDED ROADWAY
WITH ON-STREET PARKING

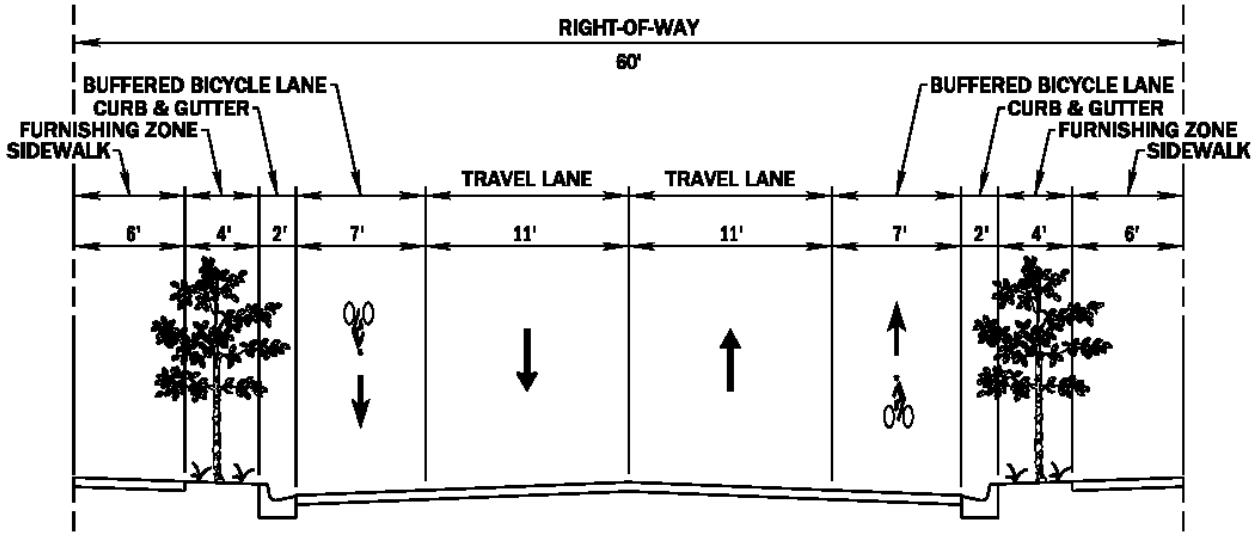


3-LANE UNDIVIDED ROADWAY
WITH PARKING-SEPARATED BICYCLE LANES

*BUFFER MAY INCLUDE ELEMENTS SUCH AS
TUBULAR DELINEATORS, PLANTERS, OR CURBING



2-LANE ROADWAY
WITH RAISED SEPARATED BICYCLE LANES



2-LANE ROADWAY
WITH BUFFERED BICYCLE LANES

Broward MPO
Metropolitan Planning Organization

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