BALTIMORE

COMPLETE STREETS

Brandon M. Scott
Mayor

FINAL | March 2021


HALL

Message from the Mayor

Brandon M. Scott
Mayor

Dear Friends,

Since the Adoption of the Complete Streets Ordinance in 2018, myself and my colleagues have championed equity and progress in our transportation system. This Manual represents change. Change to our priorities on our roadway network: from moving cars through our once vibrant neighborhoods to allowing people to get around their neighborhoods safely on foot, on bike, and on transit.

This Manual establishes our priorities of putting the most vulnerable populations first by adopting a Modal Hierarchy. This hierarchy which prioritizes walking, biking, transit, and freight above automobiles serves as a check on our decisions from project planning and selection to how projects are designed. To serve our existing families and children who walk to school, and to attract future residents to our City, we must prioritize the safe movement of people walking above all else. Walkable communities are vibrant communities.

The Complete Streets Manual prioritizes equity. Baltimore's history in transportation decisions negatively impacted Black and African American Communities. Not only were communities cut apart with high speed roadways to prioritize the movement of cars, but these communities did not receive the same access to the services received by other wealthier neighborhoods throughout the city. This Manual sets forth a process to prioritize projects in historically disinvested areas. It sets forth a process to direct transportation funding to implement more walkable safe streets in areas with the lowest percentages of car ownership.

The Guidance in this manual gets us up to speed with best practices for dense vibrant cities. For too long, we've had practices and policies more in line with suburban areas with a decreased emphasis on serving walking, biking, and transit, and controlling vehicle speeds. The Street Types that were created in this Manual reflect the unique needs of Baltimore's streets. Establishing priorities and design guidelines around Street Type ensures a context and neighborhood sensitive approach to our planning.

Respectfully,

Brandon M. Scott

Brandon M. Scott
Mayor

Acknowledgments

This Manual represents a collaborative effort between City and State agencies, consultant teams, and industry professionals, with oversight from the Complete Streets Advisory Committee. Each section within this Manual was developed based on research of industry best practices by the project team, then crafted with input from Complete Streets working groups and one-on-one sessions with City subject matter experts. The Advisory Committee and working groups met regularly throughout the development of the Manual to review project team recommendations and contribute to the shaping of the Manual to reflect Baltimore's unique culture and communities. The following is a list key participants in the development of the Complete Streets Manual.

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All photographs provided by Wallace Montgomery and Toole Design except where otherwise noted.

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INTRODUCTION

Baltimore commits to a transportation network that is safe, accessible, and efficient for all users of all abilities. This Complete Streets Manual is a document for municipal staff, design professionals, private developers, community groups, and others to reference when planning infrastructure projects in Baltimore. The design standards in this Manual take into account the unique needs of each community and street and apply opportunities for improvements in an equitable manner.

This Introduction chapter includes key components to achieving this transportation network vision:

1. **A Call to Action:** The City Council's mandate for Complete Streets in Baltimore.
2. **How to Use this Manual**: The purpose of this Manual is to provide guidance to anyone planning, designing, implementing, and operating transportation infrastructure projects.
3. **Guiding Principles and Tracking Success**: The guiding principles provide clear direction to transportation designers and City officials for the expected outcomes of Complete Streets transportation projects. Performance measures are included to track the success of transportation projects in meeting the purpose of the Complete Streets Ordinance.
4. **Baltimore's Hierarchy of Modes**: The basis of the Complete Streets Ordinance is to prioritize the safety and accessibility of vulnerable travelers on Baltimore's streets ahead of the mobility of single occupant vehicles. The Citywide Policy Framework addresses the modal priorities and the importance of measuring system performance with regard to safety, accessibility, and mobility metrics.

INTRODUCTION

A Call to Action

On December 6, 2018 Baltimore's Complete Streets Ordinance was signed into law. The Complete Streets Ordinance states:

> *The Department shall construct and operate a comprehensive Complete Streets Transportation System that enables access, mobility, economic development, attractive public spaces, health, and well-being for all people. This Transportation System must be designed and operated in ways that ensure the safety, security, comfort, access, and convenience of all users of the streets. This includes pedestrians, bicyclists, public transit users, emergency responders, transporters of commercial goods, motor vehicles, and freight providers. This transportation system must include integrated networks of connected facilities accommodating all modes of travel.*

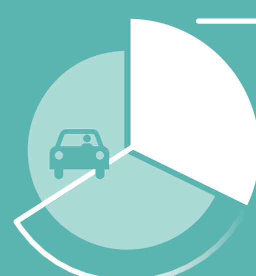
The Complete Streets Ordinance also committed to a more formal equity evaluation for selecting transportation projects. The purpose of this evaluation is to identify projects in places with greater needs for improved transportation services so that transportation investments can be prioritized in these areas. Doing so will provide an equitable distribution of transportation improvements and enhance opportunities for City residents regardless of access to a personal vehicle.

The Complete Streets Ordinance seeks to address disparity in transportation access, while rectifying decisions made that lead to car-oriented roadway design and a neglect of neighborhood needs around transportation.

Baltimore joins other cities throughout the United States and the world in adopting and implementing new Complete Streets design standards. To date, over 1,325 agencies, including Baltimore, have adopted Complete Streets policies. Launched in 2004, the Complete Streets movement represents a paradigm shift from traditional design principles minimizing motor vehicle traffic delay to design principals promoting multimodal opportunities for all users.

Access to Personal Vehicle

The **national average** of households without access to a personal vehicle is **7.4%** in cities similar in size to Baltimore.*



However, the average percentage of **Baltimore** households without access to a personal vehicle is **29%** and as high as **66%** in historically disadvantaged and underserved neighborhoods.†

*Federal Highway Administration. *Summary of Travel Trends 2017 National Household Travel Survey*. 2017.

†Baltimore Neighborhood Indicators Alliance. *Vital Signs 17: Sustainability*. Spring 2019.

How to Use This Manual

Purpose

This Complete Streets Manual is a document for Baltimore residents, municipal staff, design professionals, private developers, community groups, and stakeholders to reference when planning, designing, implementing, and operating infrastructure projects in Baltimore. It is intended to provide transparency and accountability in the planning and project implementation process. The design standards in this Manual focus on the unique needs of each community and street, allowing opportunities for improvements to be applied in an equitable manner.

Framework

The Baltimore Complete Streets guiding principles and modal hierarchy, presented in this Manual's Introduction, serve as the foundation for Complete Streets projects. Complete Streets will be designed to address safety, be accessible, improve mobility, ensure equity, and reflect Baltimore's unique communities, while prioritizing the movement of the streets' most vulnerable users.

Baltimore's ten Street Types, presented in Chapter 2, will also guide design decisions for Complete Streets. Street Types reflect adjacent land uses and character and help designers to choose treatments that preserve community values while making the best use of the limited public right-of-way.

Design Guidance and Best Practices

This Manual formalizes a process for street re-design and presents current best practice guidance and design standards. The information presented in this Manual's Design Guidance chapter, Chapter 3, is not intended to replace existing federal, state, or city laws, rules, or regulations. The guidance has been developed in accordance to the standards presented in other manuals including the Maryland *Manual on Uniform Traffic Control Devices* (MdMUTCD) and publications by the National Association of City Transportation Officials (NACTO), the American Association of State Highway Transportation Officials (AASHTO), the Federal Highway Administration (FHWA), and the National Cooperative Highway Research Program (NCHRP).

The project prioritization processes and project delivery process in Chapter 4 summarize the types of work done by the Baltimore City Department of Transportation and provide goals and required/recommended actions for each part of a design project, including identification, scoping, design, construction, measurement, and maintenance.

Equity in Complete Streets

Equity should be a primary consideration throughout the Complete Streets design process, and projects must be chosen, planned, and implemented in an equitable manner. To accomplish this, project selection should be guided by the project prioritization processes outlined in Chapter 4 of this Manual. To ensure equity is a primary consideration in street design, the project prioritization processes use a data-based equity assessment, described in the Implementation chapter of this Manual, Chapter 4. For Complete Streets projects to be implemented equitably, community engagement must also be actively pursued throughout all phases of the design process. The Equity in Community Engagement Policies section in the Implementation chapter provides guidance for comprehensive and successful community outreach.

Guiding Principles and Tracking Success

Guiding Principles

The following guiding principles provide direction and inform the process of identifying, screening, prioritizing, and implementing transportation projects. Designers and City officials should ensure all transportation projects are guided by and reflect these principles to the greatest extent possible.

System Performance

1. **Address Safety First:** Baltimore streets will be designed with a prioritization to eliminate severe injuries and fatalities.
2. **Be Accessible by Everyone**: Baltimore streets will be accessible by all modes, for people of all ages and abilities.
3. **Improve Mobility**: Baltimore streets will efficiently and reliably move people and goods to, from and around the City.

Community Enhancement

4. **Ensure Equity**: Baltimore streets will reflect equitable opportunities for travel regardless of race, income, age, disability, health, English language proficiency, and vehicular access.
5. **Reflect Baltimore's Unique Communities**: Baltimore streets will exhibit neighborhood values, be sustainable, promote economic vitality, and encourage healthy lifestyles through active transportation.
6. **Be Sustainable**: Baltimore street design methods will align with the City's broader goals of urban sustainability and protecting the environment. Complete Streets designers will utilize best practices in stormwater management, tree placement, streetlighting, public open space, curbspace use, and noise mitigation to minimize the impacts of travel on the environment.

   A fundamental element of this principle is the City's new modal hierarchy, which aligns with the City's Sustainability Plan to emphasize non-automobile/low emissions modes of travel. In the built urban environment, sustainability and density are often intertwined. Increasing the comfort and safety of walking is key to attracting and supporting increased density.

The above guiding principles align directly with the National Society of Professional Engineers Code of Ethics Preamble, which states "Engineering has a direct and vital impact on the quality of life for all people. Accordingly, the services provided by engineers require honesty, impartiality, fairness, and equity, and must be dedicated to the protection of the public health, safety, and welfare."

Performance Measures

Baltimore's Complete Streets Ordinance mandates a yearly report to asses the status of the Complete Streets Transportation System. The report must be made available to the public and be posted on the Transportation Department website. According to the Complete Streets Ordinance, the performance measures to assess the Transportation System will use available data and include the following:

System Performance

1. Crash data year-over-year changes for all modes of travel separately reported by the following categories:
   - All crashes
   - Injury crashes
   - Fatal crashes
2. Transit on-time performance [year-over-year change]
3. Commute times [all modes]

4. Mode share
5. Vehicular travel speed vs posted speed limit on high risk streets

Program Performance

6. Infrastructure data, as defined as amount of transportation infrastructure built, upgraded, replaced, or rehabilitated in the previous 1-year period. Separately reported by the following categories:
   - Infrastructure for walking, biking, and public transit
   - Public space infrastructure
   - Green infrastructure
7. The total amount of infrastructure in the City's overall transportation system. Separately reported by the following categories:
   - Infrastructure for walking, biking, and public transit
   - Public space infrastructure
   - Green infrastructure
8. Inventory of projects as defined as:
   - All ongoing projects in any phase
   - Projected cost of those projects

Economic Development

9. Year-over-year changes in certain economic development data points and conditions: in each of the City's "Main Streets", as part of the Baltimore Main Streets program; and in any other geographical area otherwise designated by the Advisory Committee. Areas defined as Baltimore's active "Main Streets":
   - Belair-Edison
   - East Monument Street
   - Federal Hill
   - Fell's Point
   - Hamilton-Lauraville
   - Highlandtown
   - Pennsylvania Ave
   - Pigtown
   - Waverly

Implementing New Standards

10. Conflicts between local and state or federal standards as defined as:
    - A list of all instances in which the local standards set forth in Article 26 Streets–Subsection 40 Complete Streets or in the Complete Streets Manual were or are planned to be superseded by state or federal standards
    - Citations and causes for the local standard being superseded

Equity Lens

Where applicable, the nine performance measures will be separately reported by geographic subunit (e.g., census tract, traffic analysis zone, or similar) and separately reported by:

(a) Populations that are above and below the median number of persons of color for Baltimore City.

(b) Populations above and below 50% no vehicle access.

(c) Populations with a median income above and below the median household income for Baltimore City.

Baltimore Heritage/Eli Pousson

Guilford Avenue Bridge

Baltimore's Hierarchy of Modes

Citywide Policy Framework

The foundation of this Complete Streets Manual rests on the establishment of a new modal hierarchy framework that prioritizes the safety and accessibility of people as they walk, bicycle, and take transit ahead of single occupant motor vehicles. These travelers are of all ages and abilities and are most vulnerable to severe injuries and fatalities in crashes. This Manual provides Street Types, street design guidance, and other supporting functions that reflect the City's new modal hierarchy. The Complete Streets Ordinance lists performance measures to gauge the City's success in applying this modal hierarchy to new transportation projects.

Baltimore's Modal Hierarchy

The modal hierarchy framework, directed by the Complete Streets Ordinance and supported by this document's guiding principles, informs City decision-making related to funding, project prioritization, transportation planning, street design, traffic operations, maintenance of streets and sidewalks, and enforcement of traffic laws. These impact programs such as capital improvement program projects, sidewalk improvements, street resurfacing, 311 and citizen inquiries, land development, and street and traffic operations. The Project Prioritization and Project Delivery Process sections detail how City decision-making will change to ensure adherence to this framework in these programs.

Baltimore's citywide modal hierarchy—recommended by the Complete Streets Advisory Committee and endorsed by the Baltimore City Department of Transportation—is prioritized as:

1. Walking
2. Cycling / Public Transit / Micromobility
3. Taxi / Commercial Transit / Shared Vehicles
4. Single Occupant Automobiles

While not listed, emergency service providers require special consideration to allow for reasonable and efficient access to destinations in all parts of the City. Similarly, the movement of commercial goods and services will continue to be a high priority for the City, with an understanding that larger vehicles may present challenges within constrained urban environments.

Three of the six guiding principles outlined on page 4 add direction and clarification on the application of the City's modal hierarchy framework:

System Performance

1. Address Safety First

- This principle directs City design engineers to prioritize the safe movement of pedestrians and bicyclists above motor vehicle throughput and delay.

2. Be Accessible by Everyone

- This principle guides City planners and engineers to plan, design, and operate City Streets with all people in mind, ensuring a balanced multimodal approach to the network of streets, individual streets, and intersections. While an individual street within a network may have a modal priority, the design and operation of that street will accommodate all modes of travel. Exceptions convey to the first principle, safety, and thus high-speed movement of people on facilities such as a freeway or heavy rail line will have limited access/crossings.

3. Improve Mobility

- This principle confirms the importance of efficiently moving people and goods throughout the City, but not to the detriment of the safety or accessibility of people traveling via other modes.

Citywide Hierarchy vs. Priority on a Street Section

Baltimore's existing and planned transportation network includes streets with specific modal priorities such as transit priority lanes, light rail, bicycle facilities, truck routes, and freeways with limited access to optimize motor vehicle mobility. Baltimore City's *Bicycle Master Plan* is a good example of a vision for a variety of future bicycle facilities, in some cases becoming a high priority mode for the street but in other cases designating safe connectivity within limited right-of-way.

In highly constrained urban environments, it is not always possible to provide the ideal facilities for all users' needs. For this reason, a comprehensive network approach should allow for flexibility regarding individual streets' modal priorities. The network approach to multimodal transportation ensures movement by all modes of transport along corridors and areas within the City and assigns modal priorities to individual streets.

Baltimore offers modal options through its multimodal network, but there will be City streets that do not have specific accommodations for all modes, such as neighborhood streets that limit truck access, interstate routes that prohibit walking and bicycling, car-free streets, streets without transit routes, or streets without dedicated bicycle facilities.

02

STREET TYPOLOGY

The City of Baltimore's Street Typology is a collection of ten different Street Types that, taken together, form a new vision of how Baltimore's streets can better serve all who use them. Created to consider the adjacent land uses and diverse range of conditions in Baltimore, each Street Type establishes priorities that will guide both future development and current road design projects. Guidance throughout this document will show how different elements of the public realm, such as sidewalks, roadways, intersections, and uses along the curb should function with respect to the Street Types.

STREET TYPES

Street Types represent a new approach to visualizing the purpose of a street in the context of a community, illustrating the best use of the public right-of-way. The City of Baltimore's Street Types reflect adjacent land uses and the envisioned character of the street to guide street design, redesign/retrofit, and capital infrastructure projects. These Street Types provide a vision for, and more specific definition of, the design elements that support Baltimore's Complete Streets policies and respond to the diverse range of conditions throughout the City.

Baltimore Heritage/Eli Pousson

East Madison Street and North Linwood Avenue near Frank C. Bocek Park

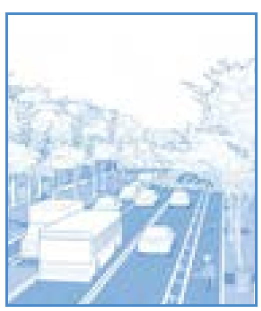
Street Types are intended to supplement the traditional functional classification system of streets, which defines how a street should function to support the movement of people, goods, and services and provide access to property. The traditional roadway functional classification system focuses on the flow of motor vehicle traffic through the street network and assigns a hierarchy according to the character of travel (e.g., arterial, collector, local street). Baltimore's new Street Types provide context-sensitive design features necessary to produce a street network with a modal hierarchy that is responsive to the needs and desires of individual communities. For example, the Street Type that is appropriate in the heart of Downtown is unlikely to also be appropriate for a small neighborhood commercial center, even though the functional classifications of those two streets may be identical.

Associated with each Street Type is a target speed representing the speed appropriate for the function and context of the street. Designers must understand the purpose and importance of the target speed and apply design specifications and treatments to design the street to operate at the target speed.

The Street Type design features reflect the users of the street, prioritizing the use of the space based on

See Downtown Commercial on page 12.

See Downtown Mixed-Use on page 14.



See Urban Village Main on page 16.

See Urban Village Neighborhood on page 18.

See Urban Village Shared on page 19.

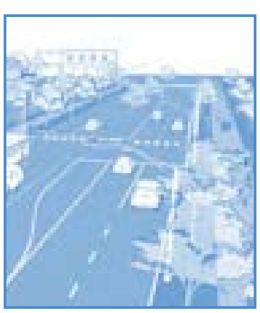
the desired level of pedestrian and bicycle activity, the presence of transit, level of vehicular and truck traffic, and community interaction with the street. For example, Urban Village Main and Industrial Access Street Types possess design features to accommodate the community interaction, but vary greatly based on the different street users. The Parkway Street Type reflects less interaction between the users and the abutting communities, and thus includes design elements to optimize person and vehicular movement.

Street Types may not be continuous along the entire length of a street; a single street may change type as the surrounding land uses or functions of the road change. For example, a street may transition from an Urban Village Neighborhood Street to an Urban Village Main Street, and then back to an Urban Village Neighborhood Street again as it passes through the commercial center of a community.

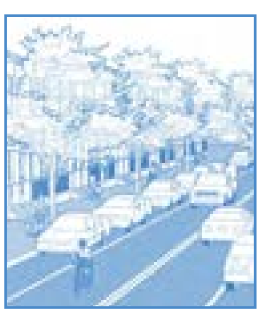
While Street Types portray a desirable vision for how the right-of-way design elements should be allocated, they are intended to be flexible because the context varies greatly throughout the city in terms of land use, types of buildings, landscape, and modal integration. The illustrative renderings provided with each Street Type show only one example of the multiple ways in which the available right-of-way space could be allocated according to that Street Type. Roadway designs and streetscape projects must support Baltimore's economy and local businesses. Designs should balance the movement of freight and motor vehicles with the goal of creating vibrant, lively public spaces that enhance the quality of life for residents and encourage healthy living and active transportation.

Baltimore Heritage/Eli Pousson

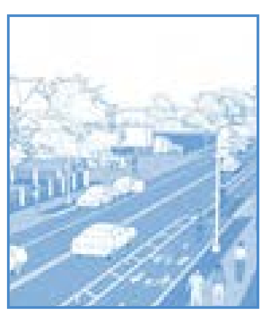
East Pratt Street and South Calvert Street



See Urban Center Connector on page 20.



See Neighborhood Corridor on page 22.



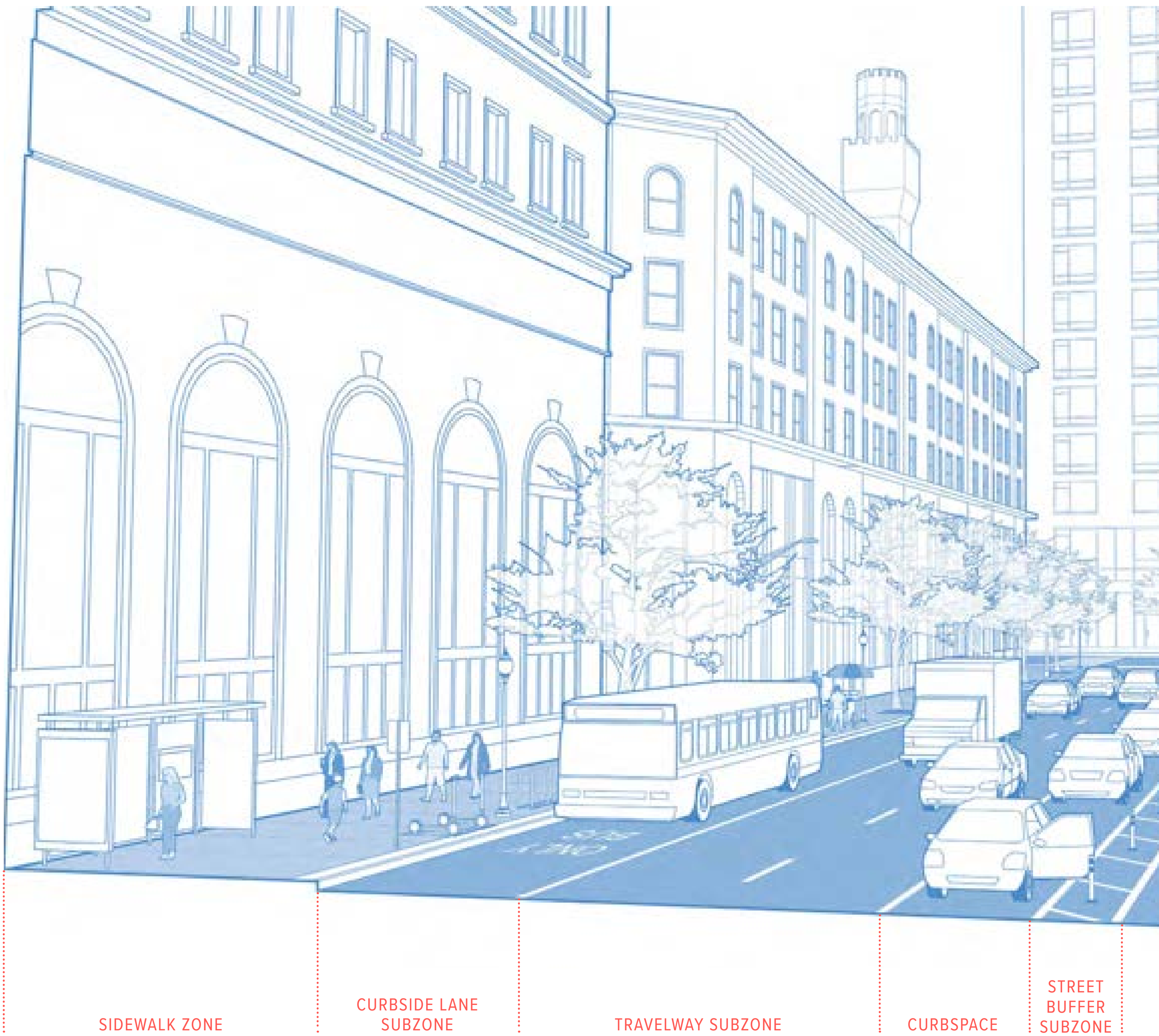
See Industrial Access on page 24.

See Parkway on page 26.

See Boulevard on page 28.

Downtown Commercial

Downtown Commercial Streets have a vibrant streetscape that supports active street-level uses and provides access to downtown businesses, residences, and transit services. Lined primarily with high density commercial uses forming a continuous street wall, these streets require wide sidewalks with limited curb cuts to accommodate high pedestrian volumes and amenities that provide comfortable and attractive public space. These streets support frequent transit in many cases, and therefore on-street parking and loading may be limited to off-peak hours. These functions may be additionally be accommodated by the presence of nearby Downtown Mixed-Use Streets. High demand for space in the right-of-way on Downtown Commercial



and Downtown Mixed-Use Streets often limits green infrastructure options to prioritizing street trees, both retained and new. Despite these limitations, there remains an emphasis on canopy cover to provide optimum benefits compatible with the spatial requirements for other infrastructure. This Street Type should have a target speed of 25 mph. Curb cuts/access points should be limited and reviewed carefully to allow necessary access but minimize conflict points between vulnerable users on sidewalks, bike facilities, and vehicles in travel lanes.

Examples of Downtown Commercial Streets in Baltimore

East Lombard Street in Downtown Baltimore

Light Street in Downtown Baltimore

Downtown Mixed-Use

Downtown Mixed-Use Streets serve a more diverse variety of land uses and are typically smaller in scale than Downtown Commercial Streets. Found in downtown districts such as Mount Vernon and Harbor East, Downtown Mixed-Use Streets support a lively mix of retail, residential, office, and entertainment uses. These streets support high levels of walking and bicycling as well as frequent parking turnover, including loading zones. Downtown Mixed-Use Streets accommodate public spaces, landscaping, and other elements that contribute to a pedestrian-friendly, neighborhood-oriented streetscape. Similar to Downtown Commercial, the high demand for space in the right-of-way limits green infrastructure

options. Transit may also be present. This Street Type should have a target speed ranging from 20-25 mph, depending on the modal priority of the street. Curb cuts/ access points should be limited and reviewed carefully to allow necessary access but minimize conflict points between vulnerable users on sidewalks, bike facilities, and vehicles in travel lanes.

SIDEWALK ZONE

Examples of Downtown Mixed-Use Streets in Baltimore

BCDOT: Street Smart Software

Aliceanna Street in Harbor East

BCDOT: Street Smart Software

North Charles Street in Mount Vernon

BCDOT: Street Smart Software

West Mount Royal Avenue in Midtown

Urban Village Main

Urban Village Main Streets are the spines of Baltimore's urban villages and centers (outside of Downtown), providing residents and workers with daily essentials and visitors a range of services and entertainment. While Urban Village Main Streets must accommodate the movement of people and goods through the Urban Center or Village, the design of these streets encourages slower speeds and clearly communicates that walking, bicycling, micromobility options, and transit access are prioritized. This Street Type should have a target speed of 20 mph.

Examples of Urban Village Main Streets in Baltimore

South Broadway Avenue in Fells Point

West 36th Street in Hampden

Pennsylvania Avenue in Upton

Urban Village Neighborhood

Urban Village Neighborhood Streets play a supporting role to Urban Village Main Streets by serving a variety of land uses, with more emphasis on residential and curbside uses that provide amenity and activation. These streets may also accommodate high turnover parking and loading, as well as other curbside uses. Urban Village Neighborhood Streets may function as a meeting space for the neighborhood by accommodating events such as farmer's markets and festivals. Urban Village Neighborhood Streets also provide a transition to low-volume and low-speed Neighborhood Streets and should communicate this change in street function through the use of signage, traffic calming devices, and lighting. This Street Type should have a target speed ranging from 15–20 mph, depending on the modal priority of the street.

Examples of Urban Village Neighborhood Streets in Baltimore

McCulloh Street in Madison Park

South Montford Street in Canton

Urban Village Shared

A Shared Street is a street that is shared by people using all modes of travel at slow speeds. Curbs are typically removed, and the sidewalk is blended with the roadway in function, if not in appearance. Speeds are slow enough to allow for pedestrians to intermingle with bicycles, micromobility options, motor vehicles, and occasionally transit. Urban Village Shared Streets can support a variety of land uses, including commercial and retail activity, entertainment venues, restaurants, and offices, though in Baltimore, most Urban Village Shared Streets are residential. They are unique spaces where people slow down to enjoy the public realm and where all users must pay close attention to the environment due to the organic movement of people around them. These streets are often surfaced with pavers or other types of decorative surface treatments. Overall, the primary design consideration for Urban Village Shared Streets is maintaining slow vehicular speeds (no more than 15 mph) in order to minimize the potential for conflicts with other street users. This Street Type should have a target speed of 15 mph.

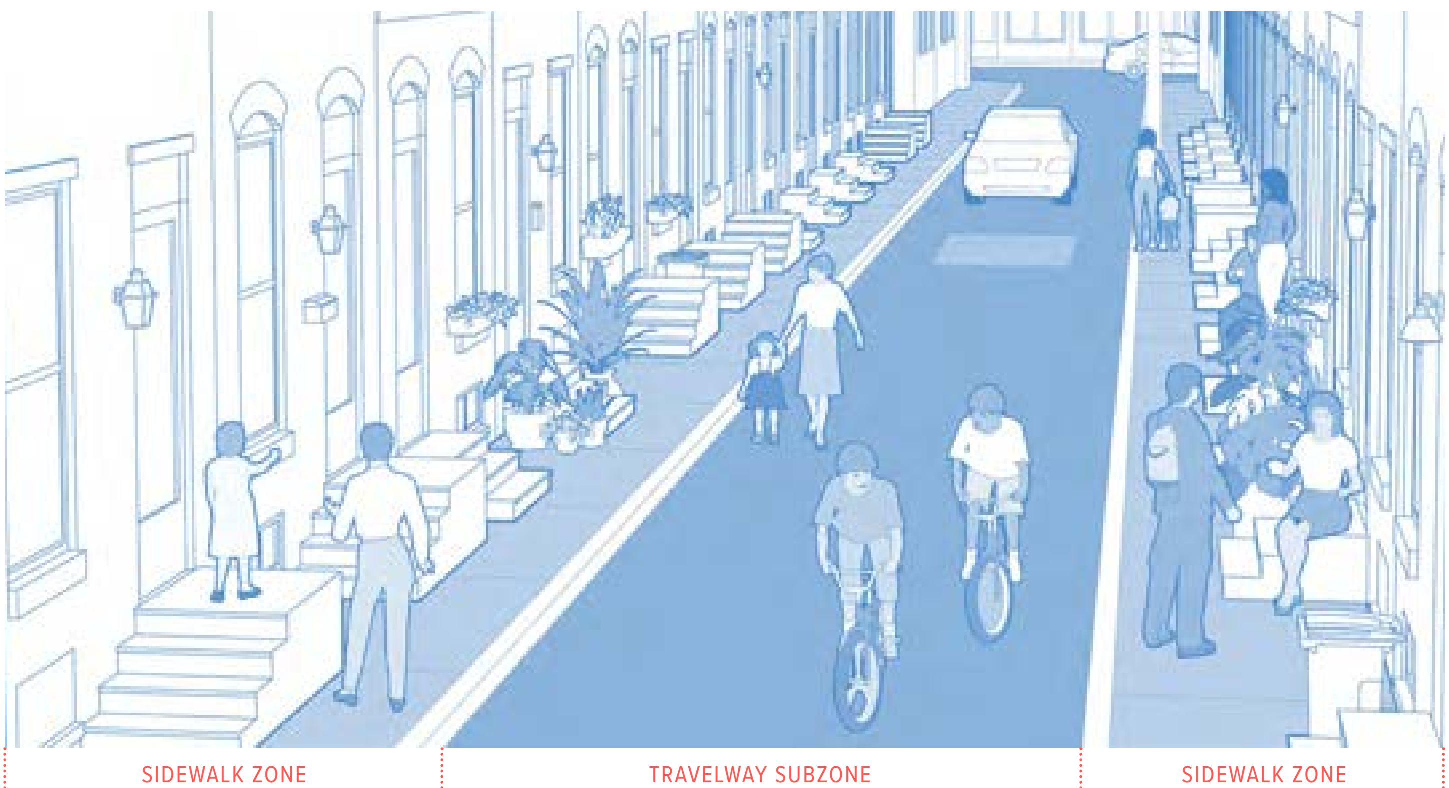
Examples of Urban Village Shared Streets in Baltimore


BCDOT: Street Smart Software

North Bradford Street in Milton-Montford

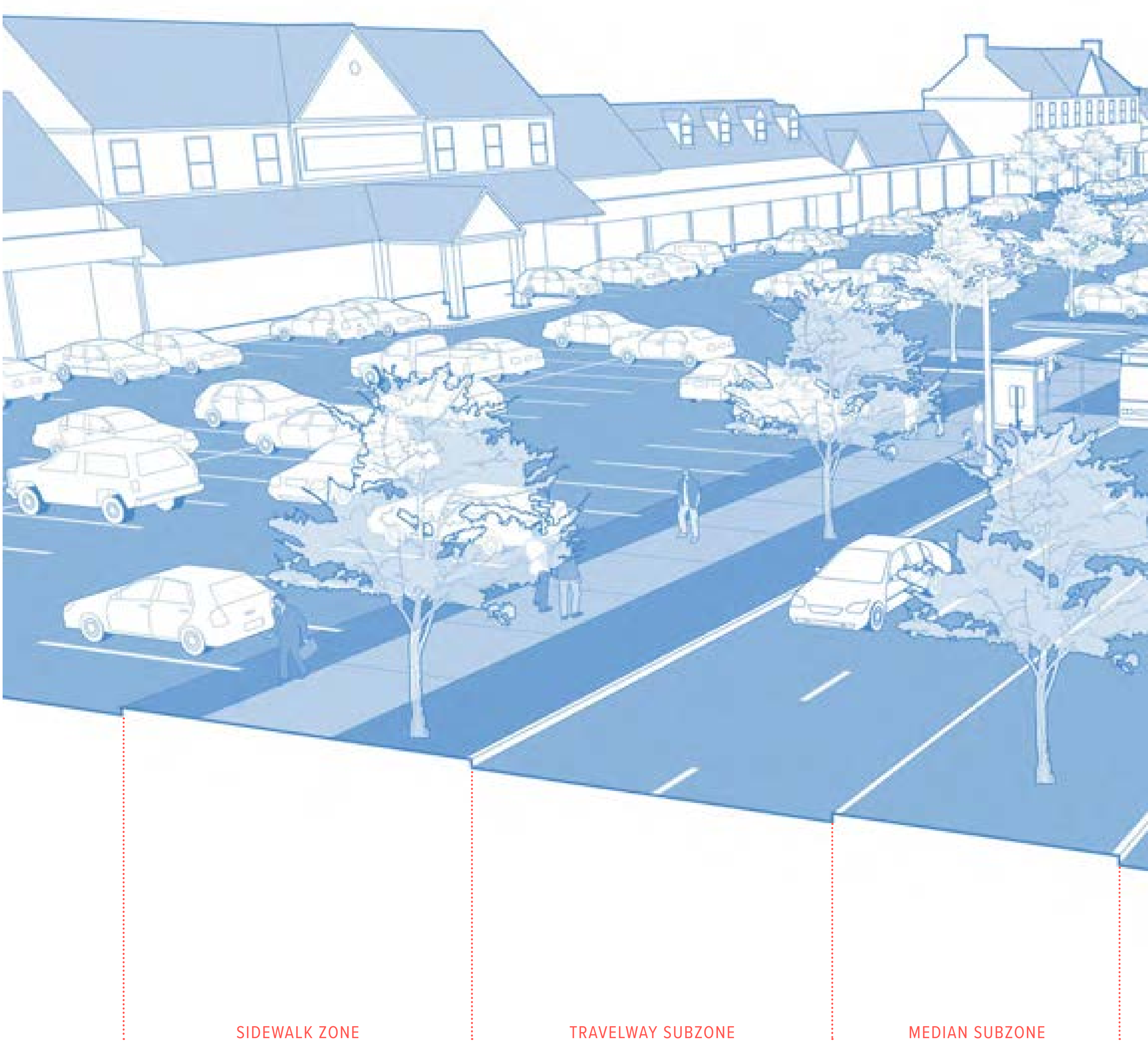

BCDOT: Street Smart Software

Bevan Street in Sharp-Leadenhall

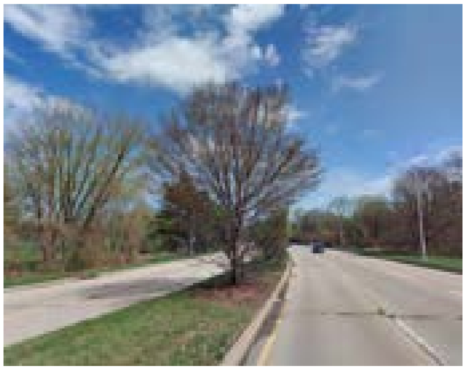


Urban Center Connector

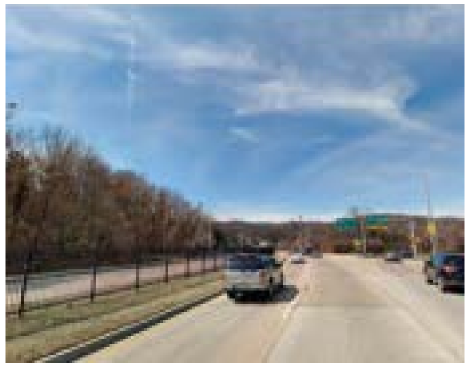
Urban Center Connectors can be streets identified as truck routes, specifically through truck routes, and/or frequent transit routes, where a high level of public and private investment in pedestrian and transit infrastructure is anticipated to support high quality, reliable transit service. Geometric design of Urban Center Connectors must consider the needs of larger vehicles while prioritizing pedestrian safety and providing safer and comfortable bicycle accommodations, where feasible. Signal timing, signal phasing, and other traffic operations should be optimized for the modal priority of the street. This Street Type should have a target speed ranging from 25–35 mph, depending on the modal priority of the street.



Examples of Urban Center Connectors in Baltimore


BCDOT: Street Smart Software

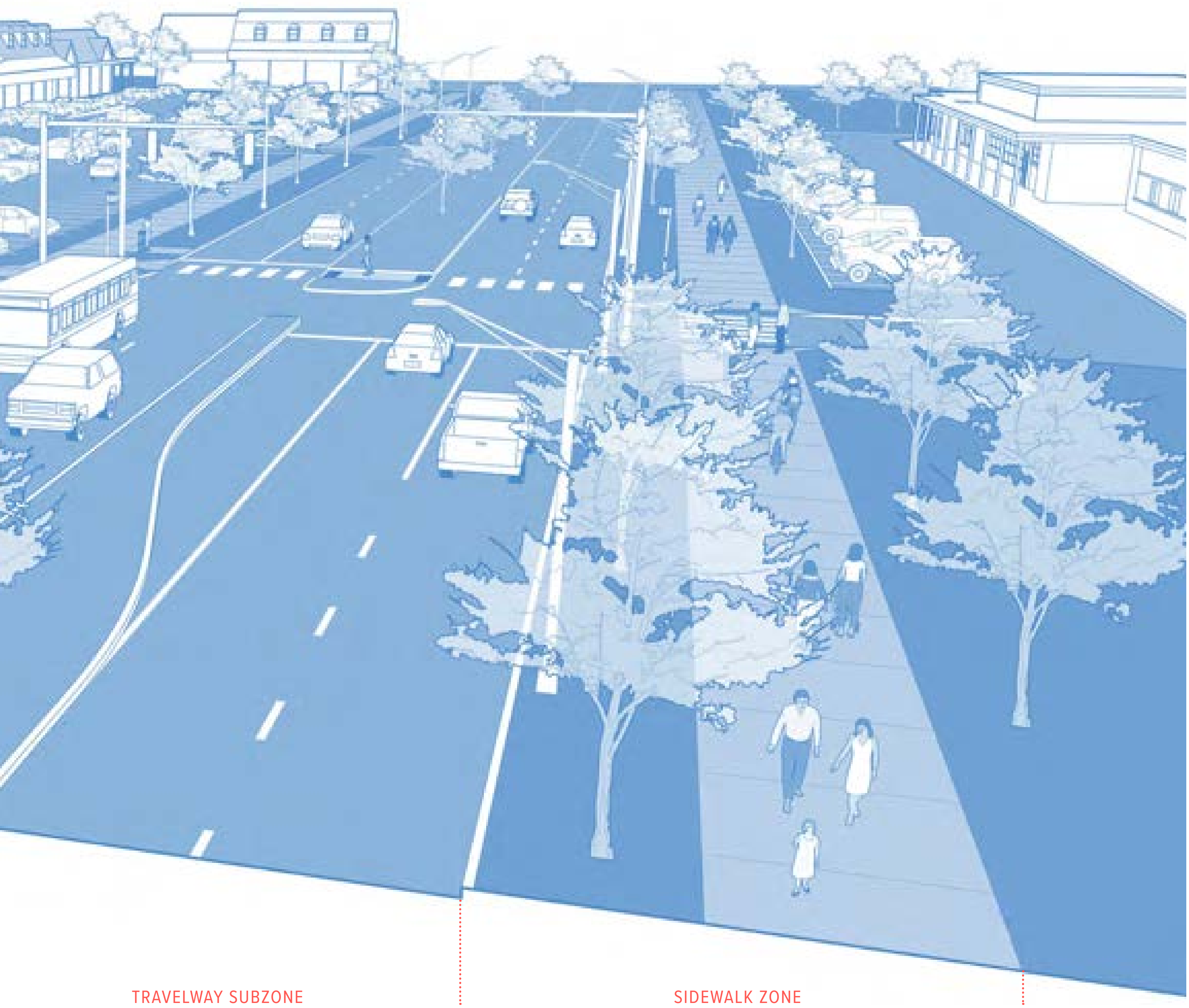
Perring Parkway north of Echodale Avenue


BCDOT: Street Smart Software

West Cold Spring Lane in Coldspring


BCDOT: Street Smart Software

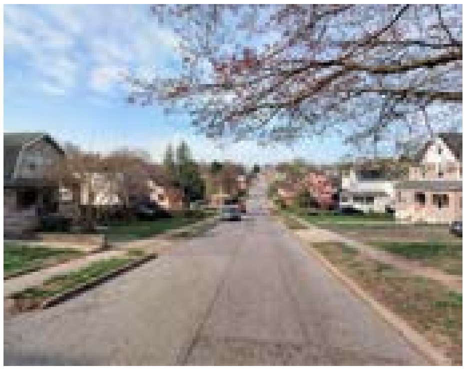
Key Highway



Neighborhood Corridor

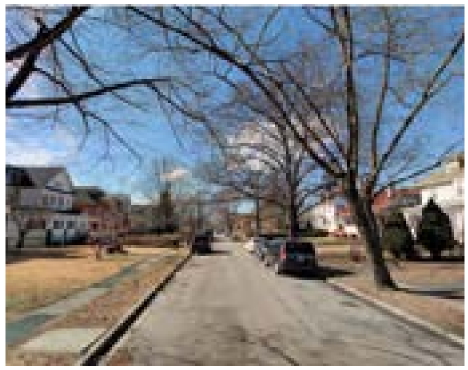
Neighborhood Corridor Streets are adjacent to single family and low-rise residential land uses and play an essential role in moving people between different neighborhoods, Urban Villages, Downtown, and the regional transportation network. This function is balanced with the safety and access needs of those who live in the adjacent neighborhoods. Streets typically allow for single-direction vehicle movement due to the presence of on-street parking and/or traffic calming devices. Neighborhood Corridor Streets are designed to encourage slower traffic speeds and minimize the number of travel lanes in order to enhance pedestrian and bicycle safety. Neighborhood Corridor Streets generally have no or infrequent transit service. This Street Type should have a target speed ranging from 15–20 mph, depending on the modal priority of the street. Curb cuts/access points should be limited and reviewed carefully to allow necessary access but minimize conflict points between vulnerable users on sidewalks, bike facilities, and vehicles in travel lanes.

Examples of Neighborhood Corridor Streets in Baltimore



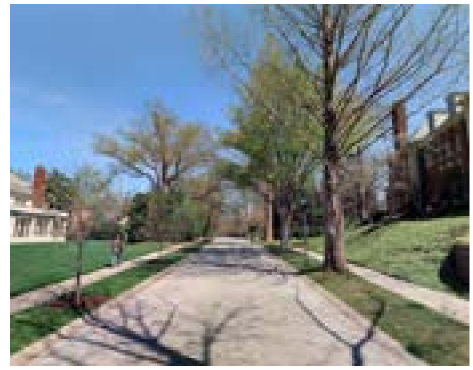
BCDOT: Street Smart Software

Anthony Avenue in Frankford



BCDOT: Street Smart Software

Chatham Road in Dorchester



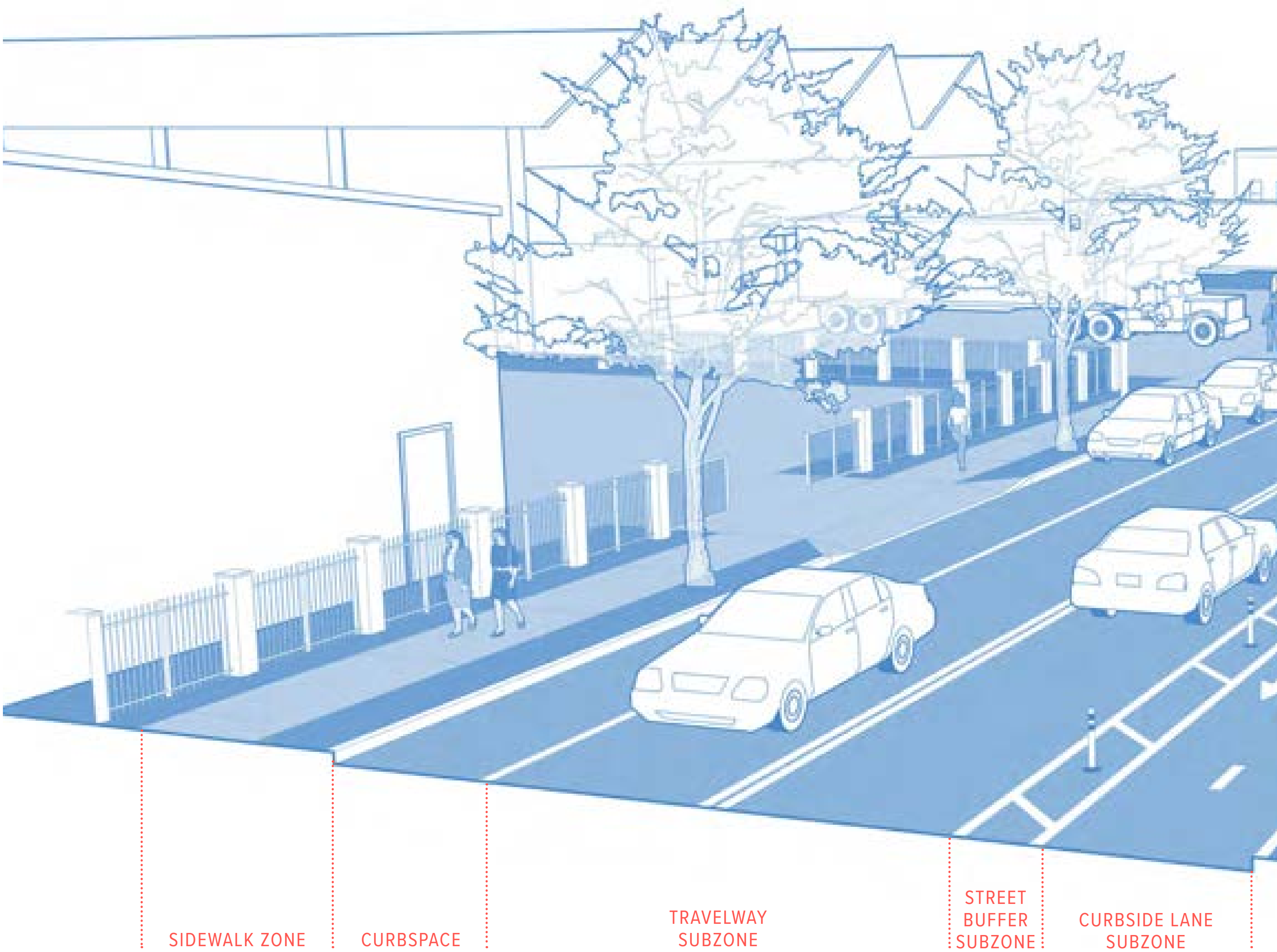
BCDOT: Street Smart Software

East Highfield Road in Guilford

Industrial Access

Industrial Access Streets are adjacent to industrial and manufacturing land uses. They are designed to accommodate large volumes of large vehicles such as single unit trucks, tractor trailers and other delivery vehicles. Industrial Access Streets serve as connections to regional transportation facilities and are designed for large vehicle turning maneuvers into and out of industrial properties. This Street Type may provide opportunities for temporary parking of trucks or staging of equipment or other materials associated with industrial uses. Industrial Access Streets are often located near or linked to freight rail lines serving adjacent properties.

Industrial Access Streets may serve as through-routes to other adjacent land uses and should provide for the safety of all travel modes. Transit, occasionally present on Industrial Access Streets, should have adequate pedestrian connections. If the *Bicycle Master Plan* has recommended a bicycle facility on an Industrial Access Street, parking and other curbspace demands from the adjacent industrial land uses must be taken into consideration. This Street Type should have a target speed ranging from 20–35 mph, depending on the modal priority of the street.



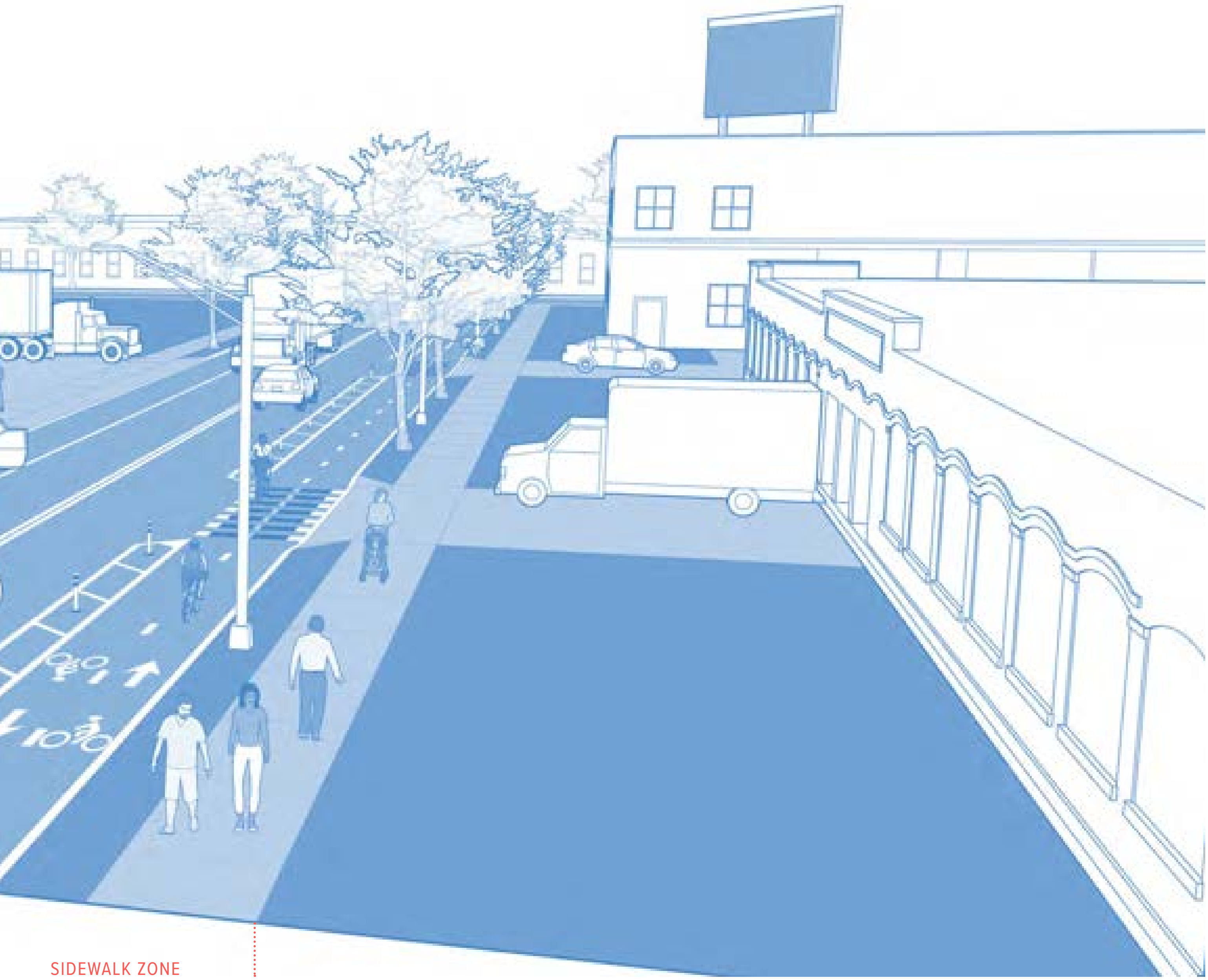
Examples of Industrial Access Streets in Baltimore


BCDOT: Street Smart Software

Erdman Avenue in Pulaski Industrial Area


BCDOT: Street Smart Software

Broening Highway



SIDEWALK ZONE

Parkway

Parkways extend through or along natural areas or large parks where there is a desire to maintain or create a park-like feel to the street. Adjacent land uses can include low-density residential, recreational or institutional facilities, parkland, or natural areas. Elements often include wide planted medians and shared use paths alongside the road instead of sidewalks. Parkway design should focus on minimizing impacts to the adjacent natural areas and maintaining the park-like character. This may be accomplished by using more natural construction materials such as wood or stone, and by installing shared use paths rather than sidewalks, among other strategies. Transit is occasionally present on parkways. This Street Type should have a target speed ranging from 25-35 mph, depending on the modal priority of the street. Curb cuts/ access points should be limited and reviewed carefully to allow necessary access but minimize conflict points between vulnerable users on sidewalks, bike facilities, and vehicles in travel lanes.

Examples of Parkways in Baltimore


BCDOT: Street Smart Software

West Northern Parkway in Pimlico


BCDOT: Street Smart Software

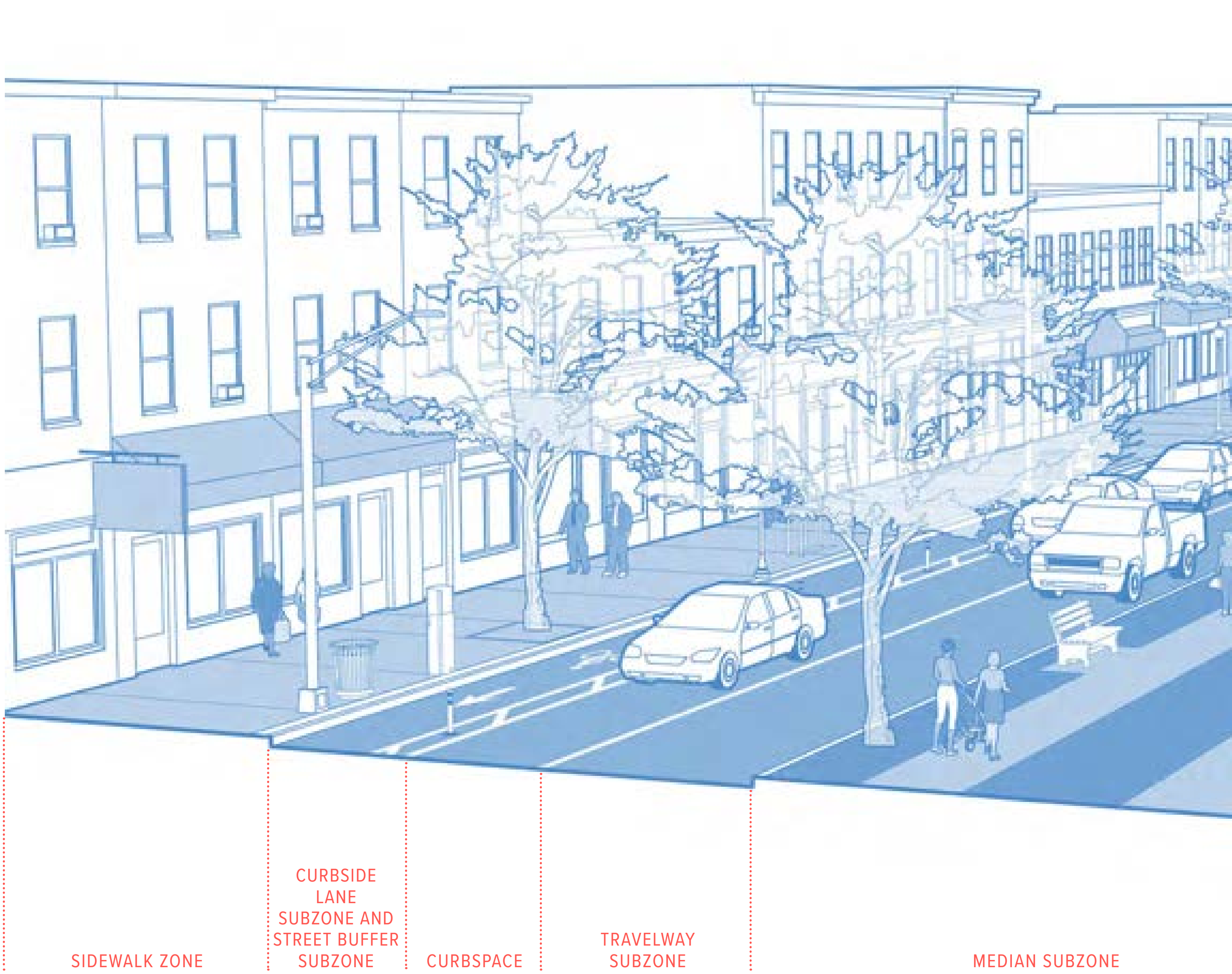
Perring Parkway


BCDOT: Street Smart Software

West University Parkway

Boulevard

Boulevards, like Parkways, are defined by a grand scale and specific urban design characteristics such as wide sidewalks lined with street trees and furnishings. Baltimore has a rich heritage of these streets, which usually have a consistent design for the length of the corridor, often with wide planted medians or curbside landscaping. Boulevards connect important civic and natural places and often feature longer block lengths. Significant, mature tree cover combined with promenades or median malls provide great walking and social spaces. Boulevards have higher-density buildings and more active land uses along both sides of the street than Parkways. Medians may also accommodate light rail or bus rapid transit service. These streets support frequent transit in many cases and therefore, on-street parking and loading may be limited to off-peak hours. This Street Type should have a target speed ranging from 20–25 mph, depending on the modal priority of the street.



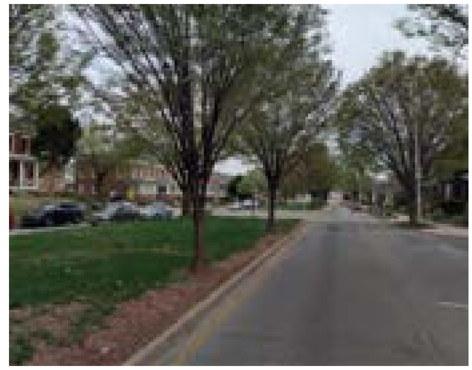
Examples of Boulevards in Baltimore


BCDOT: Street Smart Software

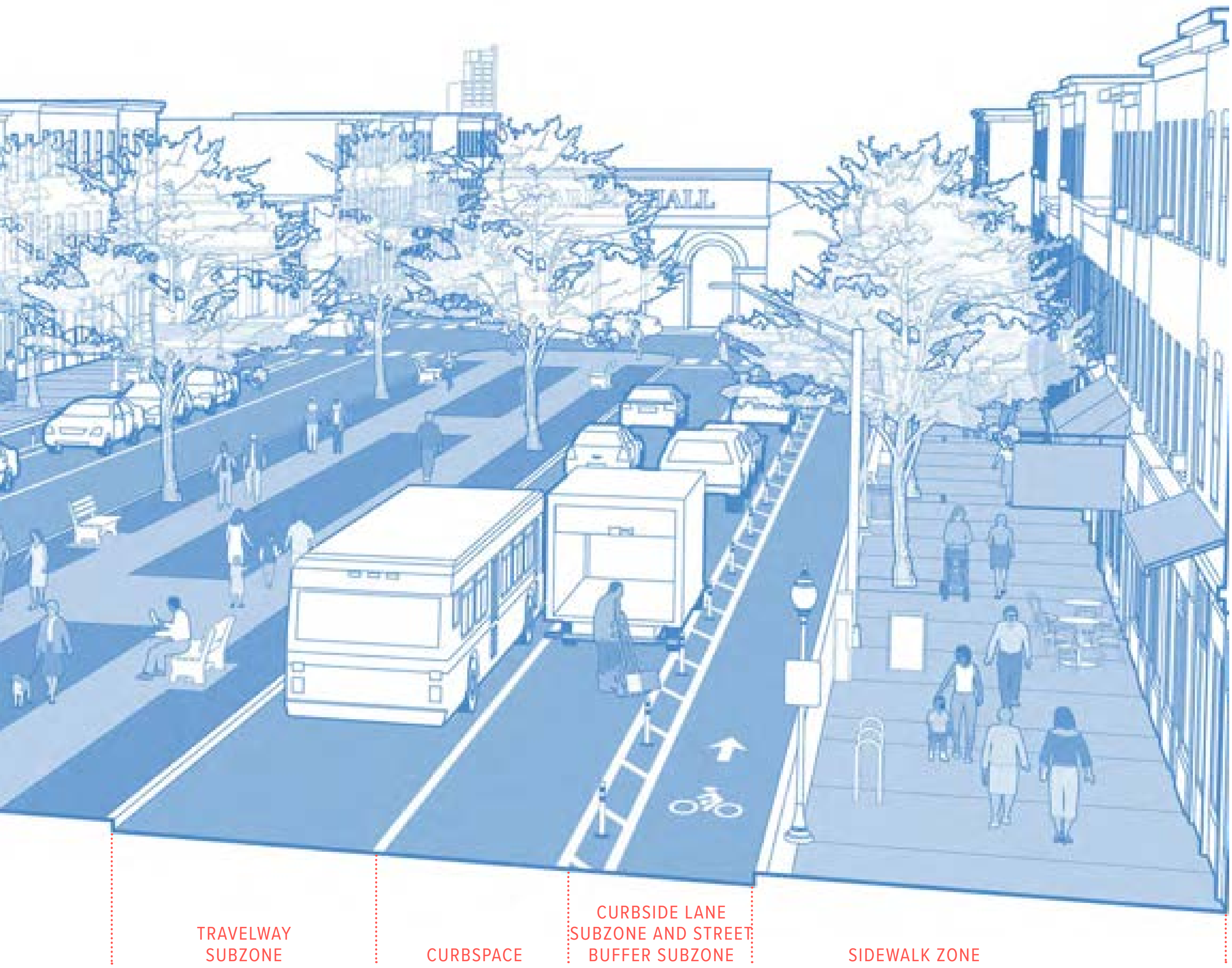
North Broadway in Oliver


BCDOT: Street Smart Software

Roland Avenue in Roland Park


BCDOT: Street Smart Software

East 33rd Street in Waverly



Special Considerations

While the Street Types combine community context with varying transportation functions, City streets often serve areas that necessitate heightened sensitivity to pedestrian, bicycle, and transit activity. Baltimore identifies these areas as "special considerations", and they exist in all land use contexts. Two general categories of special considerations are outlined below: (1) overlays: these are exceptions to the general land use context that require heightened safety treatments; and (2) transition areas: these exist between Street Types and thus warrant attention to the changing environment.

Overlays to the Land Use Contexts

A variety of overlays exist in the City, including school zones walksheds, major transit/mobility hubs, points of interest, college campuses, farmers markets, and community centers.

Major transit/mobility hubs include rail stations, MARC stations, light rail stations, regional bus centers, and other similar hubs. These large- and small-scale hubs in all land use contexts generate pedestrian and micromobility/bicycle trips as well as transfers (transit & shared mobility), and thus need design considerations to maximize safety for all users accessing and egressing the site.

There are many points of interest and community centers in a variety of environments throughout Baltimore. Points of interest such as the Inner Harbor attract tourists, residents, and others traveling primarily by automobile, while community centers attract local neighborhood residents and are often accessed by walking and bicycling.

The best example of an overlay area is a school zone, regarded as the highest priority area for safe street design. Thus, the typical Street Type design standards must include additional treatments and speed management tactics to further control vehicular speed, prioritize pedestrian and bicycle safety, and increase awareness of the school's presence. In general, Baltimore City Public Schools do not provide bus service to children within a one-mile radius from their zoned neighborhood school. This one-mile radius represents a school's walkshed. Ultimately, all streets within a school's walkshed should form a safe and well-connected network for school age children to walk and bike to school, with an emphasis placed on the streets in the immediate vicinity of the school.

Below is a summary of the toolbox for improving school age children's safety and accessibility in Baltimore's school zones:

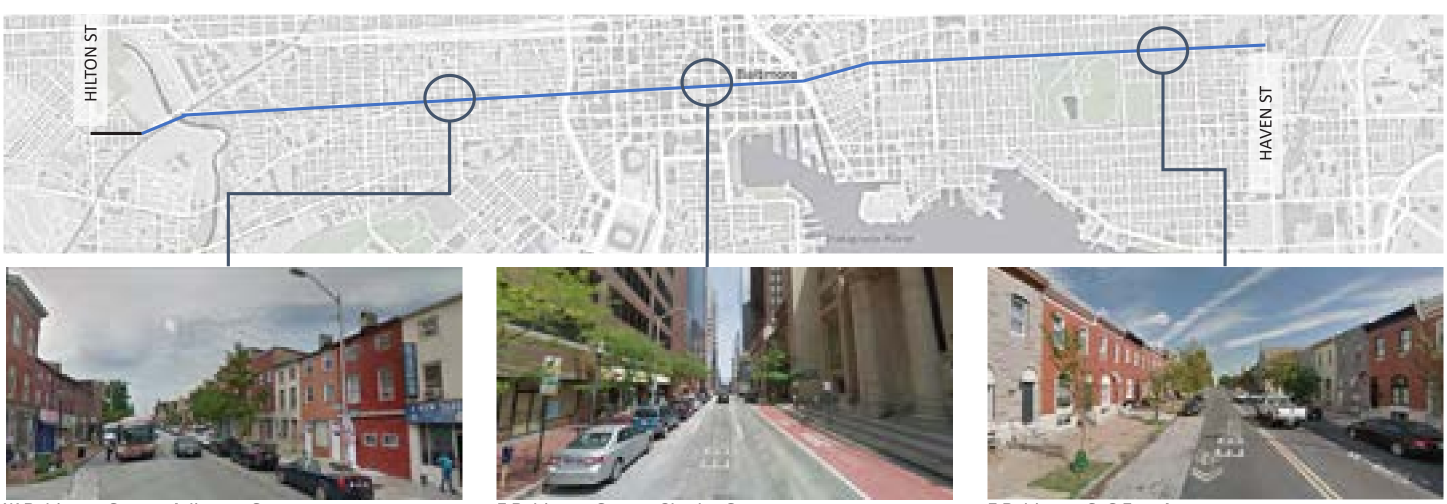
1. Pedestrian Network Enhancements
    a. A well-connected pedestrian network with wide sidewalks and buffers from moving traffic, high visibility crosswalks at intersections, and mid-block crossings that align with desire lines
    b. Intersection treatments to prioritize pedestrian and bicycle safety, accessibility, and mobility
    c. Pedestrian scale streetlighting along pedestrian and bicycle facilities and at intersections to light crosswalks
    d. Special treatments such as pedestrian islands, curb extensions, and raised or textured crosswalks to narrow street crossing distances and manage vehicular speed
2. Bicycle Network Enhancements
    a. Treatments to protect, separate, or buffer cyclists from the travel lane
    b. For Street Types possessing standard bicycle lanes, bicycle facility enhancements such as buffers, physical separation, and off-street options, should be added
3. Speed Management
    a. Apply the lowest recommended speed limit for the road's Street Type.
    b. Use pavement markings to highlight school zone areas and crossings.
    c. Align pedestrian enhancements with speed reduction treatments to control vehicular speed and narrow pedestrian crossings.

4. Site Layout, Parking, and Streets Abutting the School
    a. The design of site layout and parking should focus on reducing pedestrian, bicycle, and motor vehicle conflicts. Safe, direct, and logical pathways should be delineated from pick-up and drop-off areas to the school entrances. Sidewalks abutting the site and on-site of the school should match desire lines
    b. Plaza space should be considered to allow students a place to congregate and socialize.
    c. Drop-off areas should appear as plaza space/pedestrian environments to encourage slow speeds. When feasible, use pavers, scored concrete, bollards, and low height or curbless streets. Trees or green stormwater infrastructure treatments should be incorporated into the drop-off areas to differentiate the area from a typical street with a linear feel.
    d. Curbspace should be prioritized for pickup/drop-off/buses unless an on-street bike network exists on that section of the street.
    e. Bicycle and scooter parking should be provided on-site, near the main entrance to the school.
5. Traffic Control Elements
    a. On higher volume roads, crossings from neighborhood streets to the schools should be controlled with a signal or beacon. On higher volume local roads or collectors, raised crosswalks and/or stop control at primary crossings should be considered.
    b. Strategically apply parking restrictions (with enforcement support) to (1) control pick-up and drop-off areas, (2) provide space for on-street bicycle/micromobility facilities, (3) improve sight distance at pedestrian crossings near the school, and (4) control off-site parking by school students and staff.
    c. Consider supplemental devices such as rectangular rapid flashing beacons (RRFB), reflective strips on signposts, warning signs, pedestrian hybrid beacons (PHB), school area traffic signals, and school crossing guards and safety patrols.

Transition Areas

City streets often traverse varying land use contexts. For example, Baltimore Street (shown below) connects communities and commercial areas. As travelers move from one context to another, the portals from connecting streets to activity centers should include speed management treatments to alert the traveler to the upcoming activity center and align the traveler's prevailing speed with the target speed of the upcoming environment. Transition areas also surround the overlay areas outlined above, as streets enter portions of the community possessing a school or community center.

The speed management guidance may be found in the Intersections, Crossings, and Mid-Block Treatments section.



W Baltimore St near Arlington St | E Baltimore St near Charles St | E Baltimore St S East Ave

The changing street contexts of Baltimore Stree call for different street design approaches.

03

DESIGN GUIDANCE

The Street Types identified in Chapter 2 lay a foundation for designing Complete Streets in Baltimore. They serve as a template for making decisions related to planning, funding, and designing of both City funded and private development projects. Using the guidelines in this Manual to identify Street Type and the corresponding modal priority will help to ensure that land use context is reflected in street design and that all users experience safe, comfortable, and efficient travel.

STREET DESIGN OVERVIEW

The majority of streets in Baltimore serve developed areas with little opportunity to acquire additional right-of-way. Thus, trade-offs must be made to accommodate the priority modes of travel and curb use when space cannot be dedicated for all modes.

This section of the Manual provides a means of clarifying the relative importance of the various zones and subzones with a priority level that will be used to make decisions about the allocation of right-of-way width within a cross section with insufficient space. **Higher priority design elements best align Baltimore's Citywide modal hierarchy with the community and function of the street within the transportation network**.

The public right-of-way often varies along existing streets, challenging the project team to design and implement the typical Street Type cross section. The project team should (1) assess alternative conceptual cross-sections that address the priorities for the range of cross section element widths available, (2) understand the pros and cons of eliminating cross section elements, and (3) identify issues that arise at the transition points. These steps should be done transparently in partnership with the community.

Appendix 1: Baltimore Complete Streets Design Criteria provides a target, or recommended width, and maximum width for each component of the street to optimize space and manage speed. The table also provides a constrained width, which should only be used under special circumstances as approved by the Baltimore City Department of Transportation. Tables of target, maximum, and constrained widths are also provided in each design section.

Table 1 provides recommendations for prioritization based on Street Types and their associated mobility requirements. The numbers represent rankings from 1 to 6 with one (1) being the highest priority and six (6) being the lowest priority. The priority level is intended to guide width choices. The frontage subzone is not included in the priorities, because it is not critical to the safety goals of a Complete Street. As such the target frontage subzone should be met on all streets. Designers should strive to provide the maximum width for high priority elements, and target width for lower priority elements.

Roland Avenue in Hampden

Fawn Street in Little Italy

Baltimore Heritage/Eli Pousson

North Collington Avenue at E Monument Street

Baltimore Heritage/Eli Pousson

Jasper Street in Seton Hill/Mount Vernon

Table 1. Limited Right-of-Way Priorities

	Sidewalk Zone		Roadway Zone			
Street Type	**Pedestrian Subzone**	**Furnishing Subzone**	**Curbspace**	**Curbside Lane Subzone**	**Travelway Subzone**	**Median Subzone**
Downtown Commercial	1	2	3	6	4	5
On Bicycle Network	1	2	4	3	5	6
On Transit Network	1	2	4	3	5	6
On Truck Route	1	2	4	6	3	5
Downtown Mixed-Use	1	2	3	6	4	5
On Bicycle Network	1	2	4	3	5	6
On Transit Network	1	2	3	4	5	6
On Truck Route	1	2	4	6	3	5
Urban Village Main	1	2	3	6	4	5
On Bicycle Network	1	2	4	3	5	6
On Transit Network	1	2	3	5	4	6
On Truck Route	1	2	4	6	3	5
Urban Village Neighborhood	1	2	3	5	4	6
On Bicycle Network	1	2	4	3	5	6
On Transit Network	1	2	3	5	4	6
On Truck Route	N/A	N/A	N/A	N/A	N/A	N/A
Urban Village Shared Street	1	3	4	N/A	2	N/A
On Bicycle Network	1	3	4	N/A	2	N/A
On Transit Network	1	3	4	N/A	2	N/A
On Truck Route	N/A	N/A	N/A	N/A	N/A	N/A

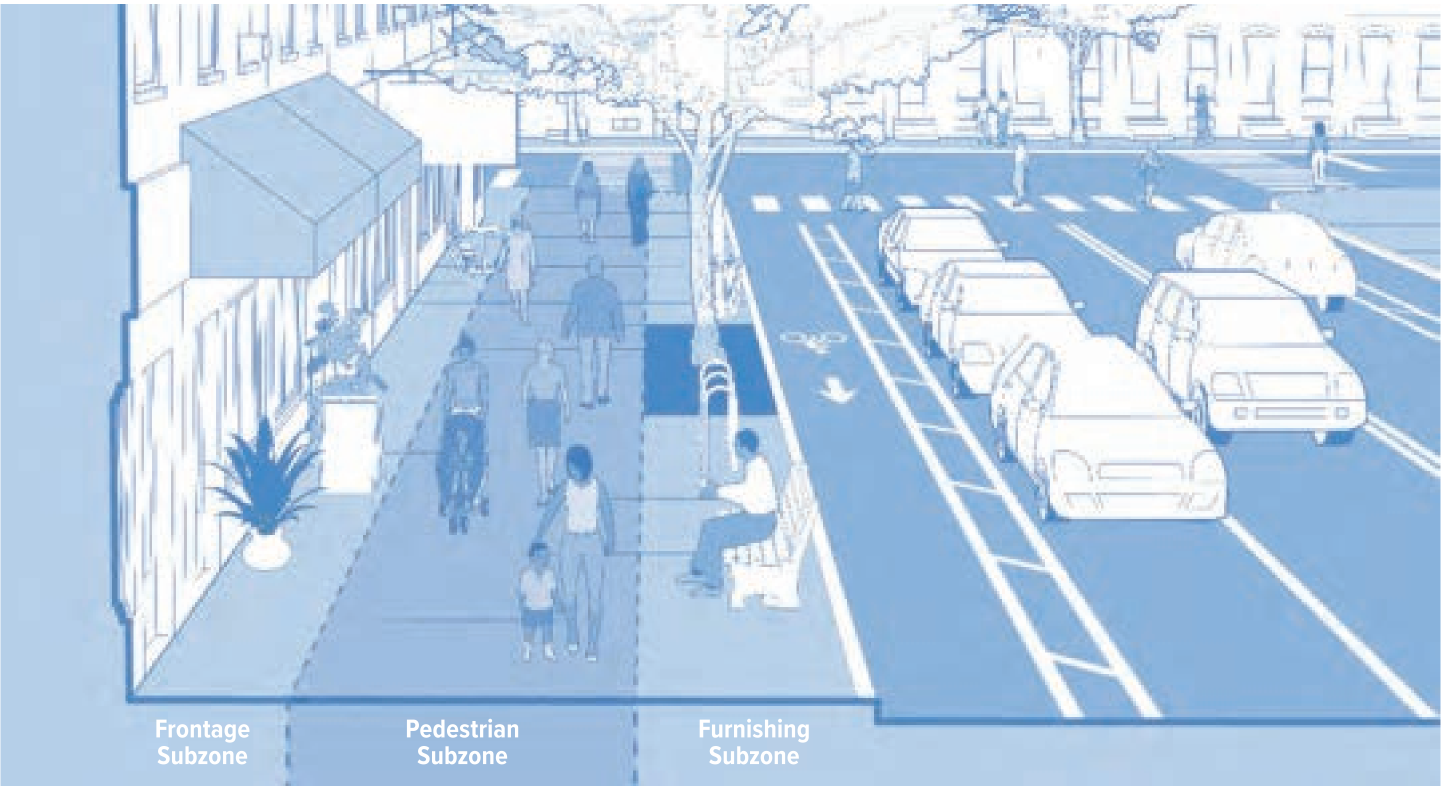
(*table continues next page*)

(*continued from previous page*)

	Sidewalk Zone		Roadway Zone			
Street Type	**Pedestrian Subzone**	**Furnishing Subzone**	**Curbspace**	**Curbside Lane Subzone**	**Travelway Subzone**	**Median Subzone**
Urban Center Connector	1	4	5	6	2	3
On Bicycle Network	1	5	6	2	3	4
On Transit Network	1	4	3	6	2	5
On Truck Route	1	4	5	6	2	3
Neighborhood Corridor	1	2	4	6	3	5
On Bicycle Network	1	2	4	5	3	6
On Transit Network	1	2	4	6	3	5
On Truck Route	N/A	N/A	N/A	N/A	N/A	N/A
Industrial Access	1	5	3	6	2	4
On Bicycle Network	1	5	6	3	2	4
On Transit Network	1	4	3	6	2	5
On Truck Route	1	5	3	6	2	4
Parkway	1	4	5	6	2	3
On Bicycle Network	1	5	6	2	3	4
On Transit Network	1	4	3	6	2	5
On Truck Route	1	4	5	6	2	3
Boulevard	1	2	5	6	3	4
On Bicycle Network	1	2	6	3	4	5
On Transit Network	1	2	3	5	4	6
On Truck Route	1	3	5	6	2	4

(1) If a street has more than one modal priority, the most vulnerable user will be the highest priority.
(2) On Street Types with low priority for the curbspace, curbside lane subzone, or median subzone, these facilities may be eliminated. A high priority indicates that it is desirable to include them.
(3) The target Walking Sidewalk Clear Zone as indicated in Table 2 should be met in all conditions. Constrained widths should only be used under special circumstances as approved by the Baltimore City Department of Transportation.
(4) The bicycle network shall include any future micromobility network.

SIDEWALK ZONE



The sidewalk zone is an integral part of each of Baltimore's unique Street Types, as it reflects community values and provides movement through the public space. This realm functions as a gathering space for residents who use the amenities for economic, social, and leisure activities. The sidewalk zone is split into three sections that include the frontage, pedestrian, and furnishing subzones. Each of these subzones has a unique role in the sidewalk zone and facilitates a Complete Street. Table 2 provides width requirements for each subzone by Street Type. For a complete list of design criteria requirements for a Complete Street, see Appendix 1. This section also includes detailed descriptions of each of the subzones.

Frontage Subzone

The frontage subzone is the portion of the sidewalk zone that is between the right-of-way line (buildings/private property) and the pedestrian subzone. Depending on the Street Type, adjacent land use, and neighborhood density, the look and use of the frontage subzone can vary greatly. The Street Types guide the specifications of the frontage subzone, reflecting the environment and right-of-way. The potential uses for the frontage subzone include sidewalk cafés, store entrances, retail displays, landscaping, bicycle parking, benches, stoops, utility meters, etc.

Design

» Accessible entrances to buildings shall be provided in accordance with City of Baltimore Standards Specification 2006 C (as amended).

» The frontage subzone should not encroach on the pedestrian subzone.

» The frontage subzone may be expanded with modification to the pedestrian subzone to provide for sidewalk cafes.

Table 2. Sidewalk Zone Requirements

		Subzone		
Street Type	**Requirements**	**Frontage**	**Pedestrian (1,2)**	**Furnishing (2)**
Downtown Commercial	Maximum	—	—	—
	Target	2’	12’	7’
	Constrained	0’	8’	4’
Downtown Mixed-Use	Maximum	—	—	—
	Target	2’	10’	7’
	Constrained	0’	8’	4’
Urban Village Main	Maximum	—	—	—
	Target	2’	8’	7’
	Constrained	0’	5’	3.5’
Urban Village Neighborhood	Maximum	—	—	—
	Target	2’	6’	7’
	Constrained	0’	5’	3.5’
Urban Village Shared Street	Maximum	—	—	—
	Target	2’	5’	—
	Constrained	0’	5’	—
Urban Center Connector	Maximum	—	—	—
	Target	2’	5’	7’
	Constrained	0’	5’	3.5’
Neighborhood Corridor	Maximum	—	—	—
	Target	2’	5’	7’
	Constrained	0’	5’	3.5’
Industrial Access	Maximum	—	—	—
	Target	2’	5’	7’
	Constrained	0’	5’	3.5’
Parkway	Maximum	—	—	—
	Target	2’	6’	10’
	Constrained	0’	5’	5’
Boulevard	Maximum	—	—	—
	Target	2’	12’	10’
	Constrained	0’	8’	5’

(1) Sidewalk designed to Baltimore City Standards.
(2) For width requirements of raised separated bike lanes, side paths, and shared use paths refer to Bicycle Facilities.

Pedestrian Subzone

The pedestrian subzone provides pedestrians an accessible route that is continuous, safe, and easily navigable through the street's constrained right-of-way. The pedestrian subzone shall provide pedestrians an intuitive route parallel to city streets with direct connections to crosswalks at intersections that follow the natural path of travel. This route shall be accessible and free from obstructions such as utilities, curbs, street furniture, parked scooters, etc.

Guidance

- Pedestrian volumes should be accounted for when determining the width of the pedestrian subzone.
- For strategies on developing safe pedestrian subzones across intersections, please refer to the Complete Streets Intersection Toolbox.
- Some regions of the world use Tactile Walking Surface Indicators to guide visually impaired individuals through the pedestrian subzone. For additional discussion on Tactile Walking Surface Indicators, refer to Emerging Materials and Treatments.

Design

- Pedestrian subzone width should be in accordance with Table 2 and shall be a minimum of 5' wide.
- Pedestrian subzones should be well lit and designed so that stormwater and runoff flows to the street or to green stormwater infrastructure.
- Pedestrian subzones shall be designed in accordance with City of Baltimore Standards Specification 2006 C (as amended) and the City of Baltimore Americans with Disabilities Act (ADA) Policy, Revised/Updated July 2016.

Furnishing Subzone

The furnishing subzone is the portion of the sidewalk that is between the pedestrian subzone and the curb.

This subzone can consist of a variety of elements including but not limited to:

- Green street components (including street trees, gardens and vegetated areas, and green stormwater infrastructure)
- Streetlights
- Street signs
- Street furniture
- Transit infrastructure/bus shelters and benches
- Bicycle parking and micromobility corrals
- Raised cycle tracks
- Underground utilities
- Signal and lighting controller boxes
- Trash and recycling receptacles
- Parking meters
- Public art

Given the many demands on space in this subzone, the designer should maximize the efficiency of the furnishing subzone without infringing on the pedestrian subzone. The furnishing subzone shall be designed to ensure safe and direct pedestrian access to curbspace activities between the pedestrian subzone and curbspace. The designer should also correlate the needs of the adjacent curbspace, as discussed in the Curbspace Management section, when designing the furnishing subzone.

These guidelines seek to balance the benefits of a healthy greenscape with the realities of limited space and competing needs for utilities placement and maintenance.

Additional guidance on elements within the furnishing subzone are provided as follows:

Green Street Components

The furnishing subzone should accommodate green street components (including street trees, gardens and vegetated spaces, and green stormwater infrastructure) wherever feasible and when cost effective to enhance the experience of multi-modal street users.

Green street components can be used to enhance aesthetics, slow the movement of vehicles and pedestrians, direct movement and define spatial separation of pedestrians, cyclists, and other street uses, and mediate urban heat island effects, while providing an array of environmental benefits. Specific green street components shall be integrated into Complete Streets designs as appropriate within specific locations, considering site constraints, streetscape form and function, feasibility, multi-modal user safety, and visibility. For additional details on green street components, refer to the Green Street Components subsection.

Utilities

Utilities shall be installed per the Baltimore City Department of Public Works and Baltimore City Department of Transportation *Book of Standards*. Consider utility locations and potential complications when locating green street components and furnishings.

Streetlighting

Lighting should be scaled both to the sidewalk zone and for the roadway. Pedestrian lighting can be used alone or in combination with overhead roadway-scale lighting in high activity areas to encourage nighttime use.

Pedestrian lighting can be located on the same pole as roadway lighting to reduce the number of poles within the furnishing subzone. At intersections and midblock crossings, lighting should be provided 10’ in advance of a crosswalk to light the side of the pedestrian facing the approaching vehicle.

Lighting shall be designed in accordance with the Baltimore City Department of Transportation *Specifications for Street Lighting & Conduit Street Lighting and Photometric Design Guide and Street Lighting & Conduit Materials*.

Streetlighting should be integrated into the design of all streets, varying in approach based on the Street Type.

Green stormwater infrastructure on Liberty Heights Avenue.

When designing lighting for streets in Baltimore, the following principles should be followed:

1. Design for safety first: Streetlighting should illuminate travel lanes and sidewalk/path areas along the street and be strategically located at intersections to maximize safety for all users of all abilities. While following City design specifications and spacing standards, attention should be paid to illuminating pedestrian and bicycle crossings as well as balancing pedestrian scale and travel lane lighting along City streets.
2. Be sustainable: Streetlight technology provides an important opportunity to invest in sustainable infrastructure. Lighting fixtures provide the following sustainability benefits:
    a. LED technology reduces operations and maintenance costs.
    b. Fixture selection can address Dark Sky friendly illumination by meeting the recommendations of CIE 126-1997, Guidelines for Minimizing Sky Glow.
    c. LED technology is flexible in illuminating a variety of color temperatures.
3. Style matters: Streetlight fixtures and poles should be compatible with the street's environment and streetscape plan.
4. Deploy smart cities capabilities where appropriate: Some LED fixtures can be programmed to vary the brightness by time of day or community setting. This feature allows for brighter lights for vulnerable user visibility and crime prevention, as well as dimmer lights in residential neighborhoods. Where appropriate, the dimming feature saves operating costs and reduces intrusive light in residential neighborhoods. Programmable lighting should be set so that lights are dimmed or completely extinguished when sufficient daylight is available.
5. Consider maintenance when striving to achieve 1-4 above: LED technology has a longer life than high-pressure sodium illumination, reducing maintenance/replacement needs. Streetlight fixture and pole types should match the community context but be limited in types to manage equipment storage, cost, and availability.
6. Be cost-effective when achieving 1-4 above: LED technology reduces operations and maintenance costs compared to high-pressure sodium illumination.

This streetlighting guidance is consistent with the recommendations in the City's Sustainability Plan.

Transit Zones

The furnishing subzone should provide effective and accessible access to transit stops/shelters/stations, as well as provide space for transit facility amenities.

Transit zones should be designed in accordance with the Maryland Department of Transportation Maryland Transit Administration (MDOT MTA) Bus Stop Design Guide and the Transit Zones subsection of this manual

Bus Bays

Bus bays are used at pull-out bus stops and transfer stations. They provide a space for buses to board and alight passengers or layover outside of the travel lane.

For additional details, see the MDOT MTA *Bus Stop Design Guide* and the Transit Zones subsection.

Bike Racks and Micromobility Corrals

Short-term bike parking or bike racks should typically be sited in the furnishing subzone so that they're visible to people biking and provide convenient bike parking near their destination, without impeding the flow of people in the pedestrian subzone. For details on bike racks and micromobility corrals, please refer to the Micromobility subsection.

Sidewalk-Level Separated Bike Lanes

For details on one-way and two-way sidewalk-level separated bike lanes, please refer to the Bicycle Facilities subsection.

CURBSPACE MANAGEMENT

In recent years, managing curbspace has become one of the most challenging portions of building a Complete Street. The default use of the curbspace has traditionally been for a parking lane. However, multiple competing interests are created by:

- The City's new modal hierarchy
- The advent of shared mobility (i.e., dockless bikes/ scooters and ridehail services such as Uber and Lyft)
- Multimodal curb-running travel lanes
- The desire to improve the livability of communities

These competing demands identify the need for a formal process to prioritize this valuable space. Parking vehicles for extended periods of time is no longer considered the best use of the curbspace on many downtown and commercial Street Types. Additionally, measuring the success of the curbspace is no longer determined by parking revenue, but by the ability to move people and complementing the surrounding community.

This section provides guidance on establishing a curbspace management process and identifies the roles and responsibilities of the City in defining priorities, designing the space, implementing and enforcing the use, and monitoring the success of the program. Adequate curbspace management in a large city requires a program and often a standalone manual be developed; therefore this section sets preliminary steps to best prioritize curbspace in a study area.

The competition for curbspace includes uses such as:

- Private automobiles and residential permit parking
- Accessible parking
- Commercial loading
- Transit
- Taxis
- Food trucks
- Shared mobility
- Ridehailing vehicles
- Bicycles
- Micromobility devices
- Parking corrals for bicycles and micromobility devices
- Carsharing vehicles
- Parklets and cafe seating
- Trees and green streets components

The curbspace can be integrated into the community culture, used to expand abutting activities, or used to improve the safety of vulnerable pedestrians. Prioritizing curbspace to accommodate these demands should be accomplished comprehensively, and the results may be quite different depending on each community's needs and Street Types.

New guidance from the Institute of Transportation Engineers *Curbside Management Practitioner's Guide* outlines the steps to understand the community needs and prioritize curbspace. NACTO has also issued guidance targeting transit benefits: *Curb Appeal: +Curbside Management Strategies for Improving Transit Reliability.*

This Manual recommends the following steps to prioritize curbspace use in a target study area:

1. Seek comprehensive and sector plan guidance from the Baltimore City Department of Transportation, the Baltimore City Department of Planning, MDOT MTA, and the Baltimore City Fire Department:
    a. Understand land use and desired activities
    b. Identify Street Types in the study area
    c. If designated, overlay the modal priorities of streets in the study area:
        i. Curb running bicycle/micromobility facilities
        ii. Transit streets

Competition for curbspace varies by time of day in commercial areas.

Left: ITE's *Curbside Management Practitioner's Guide*; Right: NACTO's *Curb Appeal: Curbside Management Strategies for Improving Transit Reliability.*

iii. Truck routes, delivery patterns, truck restrictions

(Refer to Street Design Overview for further guidance on modal priorities)

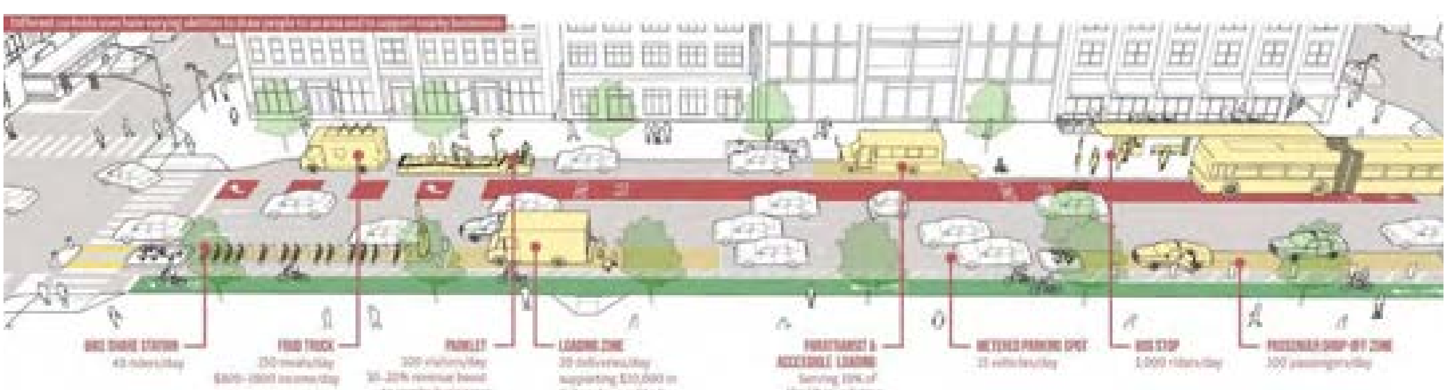
d. Review evacuation and emergency management plans

2. Engage community stakeholders:
    a. Gain insight on area and site-specific demands
    b. Explore equity opportunities and economic development
3. Take a network/subarea study approach, understanding the current and future transportation demands throughout the study area:
    a. Collect existing curbspace designation, including residential permit parking designation, and utilization data
    b. Evaluate spatial relationships to, from and within the study area
4. If not designated by planning documents, consider setting modal priorities by street where appropriate
5. Manage on and off-street parking/docking resources for micromobility and bicycles to meet the area's needs:
    a. On-street along the curb
    b. Off-street in furnishing subzone
    c. Off-street public and private parking
    d. Alleys
6. Set priorities/accommodate needs

The curbspace in many instances acts as the bridge between the pedestrian subzone and the travelway subzone. As such, the curbspace can act as an extension of the furnishing subzone; therefore, the design of the furnishing subzone should be carefully correlated with the needs of the curbspace area to avoid conflict and provide a safe and accessible connection between the two areas. The needs of the curbspace should also be correlated with that of the furnishing subzone in the analysis. Refer to Furnishing Subzone for further details.

The following section recommends the factors to consider when prioritizing and allocating curbspace. The factors align with this Manual's guiding principles, and should balance the City's technical transportation evaluation with the needs expressed by the community.

Dimensions and markings guidance for the referenced elements may be found in Appendix 1.



NACTO

Prioritizing curbspace use should address safety and accessibility needs, as well as be based on an understanding of person movement along the curb.

Prioritizing Curbspace Components

As Baltimore adopts Complete Streets principles and design standards, repurposing the existing right-of-way for the new concepts is challenging due to limited space. Adding progressive elements such as protected bicycle lanes, transit priority lanes, and pedestrian safety treatments competes with existing traditional uses such as on-street parking.

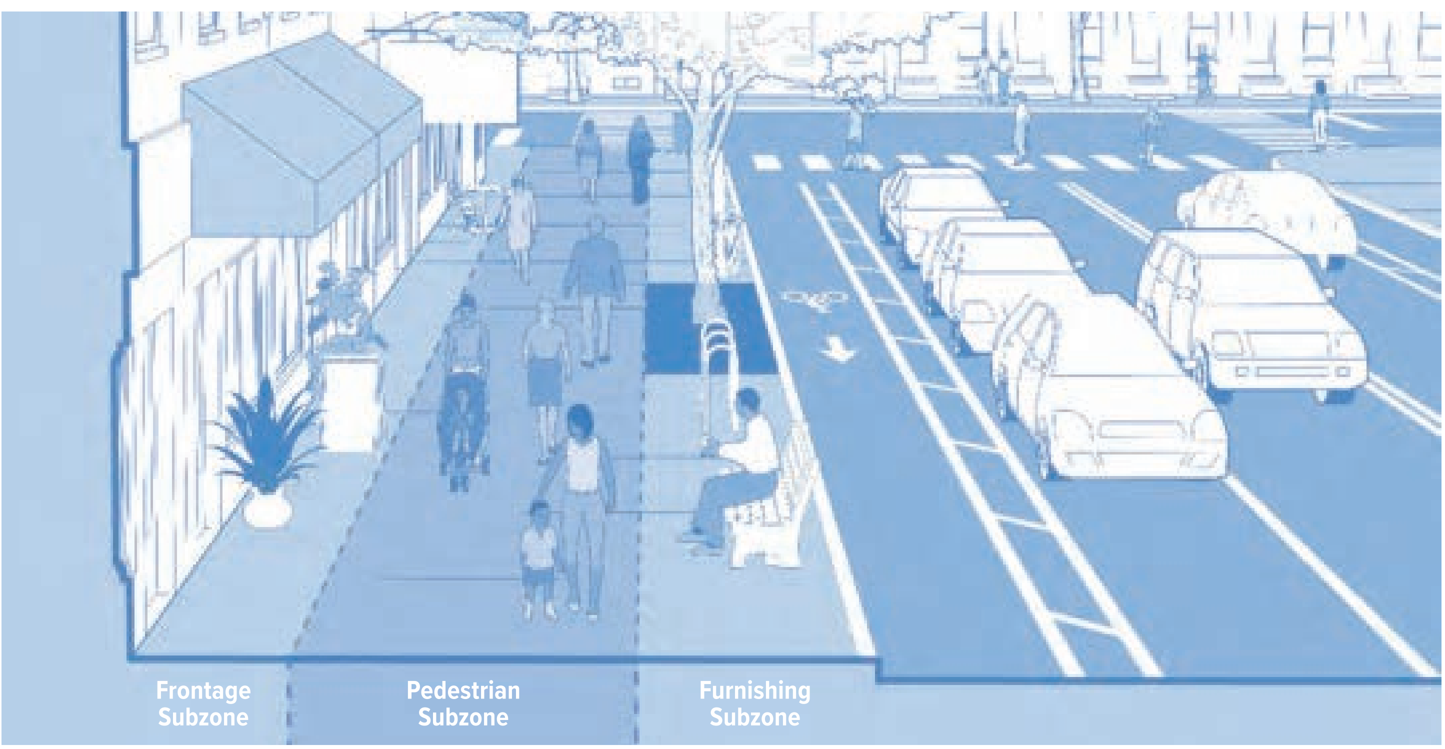
When sufficient space does not exist to implement a Complete Street typical cross section, three elements of the street's cross section should be considered when evaluating curbspace needs:

1. Furnishing Subzone: this area contains transit stop infrastructure, bicycle and micromobility corrals, raised cycle tracks, and parking meters. It may also provide space for vending truck access and outdoor seating.
2. Curbspace: right-of-way reserved for emergency access, docking and parking.

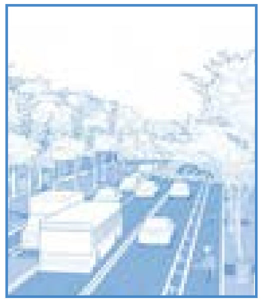
Bicycle lane in the Curbside Lane Subzone on Harford Road.

3. Curbside Lane Subzone (Curb Running Travel Lane): this travel lane can be open for all modes or restricted to priority modes for uses such as bicycle lanes, transit priority lanes (including stations/stops), or off-set parking.

The following table guides the designer in allocating limited right-of-way as it pertains to Complete Streets demands at the curb.







The table prioritizes these three portions of the street right-of-way based on Street Type and modal priority (when designated). When right-of-way is limited, this table aligns the use of the space with the City's priorities, balancing adequate sidewalk space, on-street parking, commercial loading, on-street bicycle/micromobility facilities, and transit priority lanes based on the street's function and purpose in the community.

Each Street Type includes a set of default priorities as well as changes in the priorities when the street has a modal priority and/or specific demands such as commercial loading.

Table 3. Curbside Management Zone Priorities

	The Furnishing Subzone	Curbspace	Curbside Lane Subzone
Downtown Commercial: The default highest priority is the furnishing subzone. Unless the street has a designated modal priority, curbspace is the second priority to provide convenient access for the uses listed on page 44 . If the street has been designated as part of the on-street bike network or transit priority street for bus or LRT, then that use is the highest priority for this space.			
Default	1	2	3
Bicycle Network (Protected)	2	3	1
Transit Priority Network	2	3	1
Truck Route	1	2	3
Commercial Loading	2	1	3
On-street Time Restricted Parking	1	2	3
Downtown Mixed-Use: The default highest priority is the furnishing subzone. Curbspace is the second priority to provide convenient access for the uses listed on page 44 . Given the ground floor street activity in mixed use development, curbspace remains a higher priority than mode-specific on-street uses (exception for LRT).			
Default	1	2	3
Bicycle Network	1	2	3
Transit Network	1	2	3
Commercial Loading	1	2	3
On-street Time Restricted Parking	1	2	3

(*table continues next page*)

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	The Furnishing Subzone	Curbspace	Curbside Lane Subzone
Urban Village Main: The default highest priority is the furnishing subzone. Curbspace is the second priority to provide convenient access for the uses listed on page 44 . With slower travel speeds and multimodal orientation, bicycle and transit activity share the travel lanes.			
Default	2	1	3
Bicycle Network (Protected)	3	2	1
Transit Network	2	1	3
Commercial Loading	2	1	3
On-street Time Restricted Parking	1	2	3
Urban Village Neighborhood: The default highest priority is the furnishing subzone. Curbspace is the second priority given the residential nature of the environment the street serves. On-street parking is an important element of the street, and should be assessed with the understanding of off-street parking availability for residents. With slower travel speeds, bicycle and transit activity share the travel lanes.			
Default	1	2	3
Bicycle Network	1	2	3
Transit Network	1	2	3
Urban Village Shared Street: These streets typically do not possess sufficient right-of-way to have enough space for the sidewalk furnishing subzone, curbspace, or a curbside lane. The narrow streets and very low target speed provide a street environment prioritizing pedestrian and bicycle mobility with limited or no on-street parking. Each of the Urban Village Shared Streets should be assessed individually with the community to ensure safe and convenient travel with no formally designated on-street zones.			
Default	1	2	N/A
Bicycle Network	N/A	N/A	N/A
Transit Network	N/A	N/A	N/A
Commercial Loading	N/A	N/A	N/A
Urban Center Connector: These connectors are designed to accommodate transit, trucks and other vehicular traffic between activity centers. Curbside service is limited generally to transit service, with minimal docking/parking of other vehicles.			
Default	2	3	1
Bicycle Network	2	3	1
Transit Network	2	3	1
Truck Route	2	3	1
Commercial Loading	3	2	1

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	The Furnishing Subzone	Curbspace	Curbside Lane Subzone
Neighborhood Corridor: The default highest priority is the furnishing subzone, providing space for street trees and a buffer from the travel lanes or curbspace. Curbspace is the second priority given the residential nature of the environment the street serves. On-street parking is an important element of the street, and should be assessed with the understanding of off-street parking availability for residents. With slower travel speeds, bicycle and transit activity share the travel lanes.			
Default	1	2	3
Bicycle Network	1	2	3
Transit Network (Limited)	1	2	3
Industrial Access: These streets possess high truck activity and access to the curb for loading and temporary parking. While loading and storage of trucks should primarily occur off of the street, such access is an important element of the street design. While sidewalks remain high priority within the right-of-way, the furnishing subzone portion is a second priority to curbspace.			
Default	2	1	3
Bicycle Network	3	2	1
Transit (Priority) Network	3	2	1
Truck Route	3	1	2
Commercial Loading	2	1	3
Parkway: These streets are designed to accommodate the movement of vehicles (trucks prohibited?) between activity centers. Curbside service is limited generally to transit service, with minimal docking/parking of other vehicles.			
Default	1	3	2
Bicycle Network	2	3	1
Transit Network	2	3	1
Boulevard: The default highest priority is the furnishing subzone, reflecting the City's modal hierarchy. Unless the street has a designated modal priority, curbspace is the second priority to provide convenient access for the uses listed on page 44 .			
Default	1	2	3
Bicycle Network	1	3	2
Transit Network	1	3	2
Commercial Loading	1	2	3

Access for All

Providing fair access to the curb is the greatest challenge of allocating curbspace. The competing demands listed on page 40 overwhelm limited space in activity centers. The highest priority after safety, as reflected in the modal hierarchy, is for people with disabilities. Below are the competing parking/docking demands:

- Accessible parking spaces
- Transit:
    - Stops, shelters and stations
- Passenger vehicles:
    - Ridehailing:
        - passenger loading/unloading zones
        - taxi zones
    - Carsharing parking
    - Time restricted short-term parking
    - Residential permit parking
- Bicycle/micromobility parking:
    - Micromobility corrals—Refer to the Micromobility section for further details.
- Loading zones/commercial vehicle access

Enhance the Community

Another priority for curbspace is creating a space that enhances a community. Creative treatments and uses should be considered along the curb, aligning with the Street Type with an understanding of the level of transportation demand for the limited space. This space can expand vibrant social spaces and improve the environmental health (such as with stormwater management) while beautifying the area. It is recommended to consider these treatments as part of a comprehensive Complete Streets design. Below are examples from NACTO's *Urban Street Design Guide* and *Urban Street Stormwater Guide*.

- Parklets for extending restaurant patios and sidewalk cafes. Refer to Quick-Build Strategies for further details.
- Provisions for vending trucks
- Green infrastructure to enhance aesthetics as well as environmental health via such elements as planted boulevard strips, street trees, planter boxes, rain gardens, and bio-swales. Refer to Green Street Components for further details.

Mobility for People & Goods

The newest curbside management techniques for cities relate to measuring the successful use of curbspace

Measuring mobility along the curb: transit stops and shelters move the most people per linear foot of curb.

from a mobility perspective. The key trade-offs relate to (1) keeping traditional time restricted parking; (2) eliminating parking for curb running multimodal facilities; and (3) expanding multimodal and shared mobility docking uses. The new measure of success, after providing safety and disability accessibility accommodations, assesses the person movement at the curb. Below is an example from NACTO illustrating the quantification of person movement.

Safety

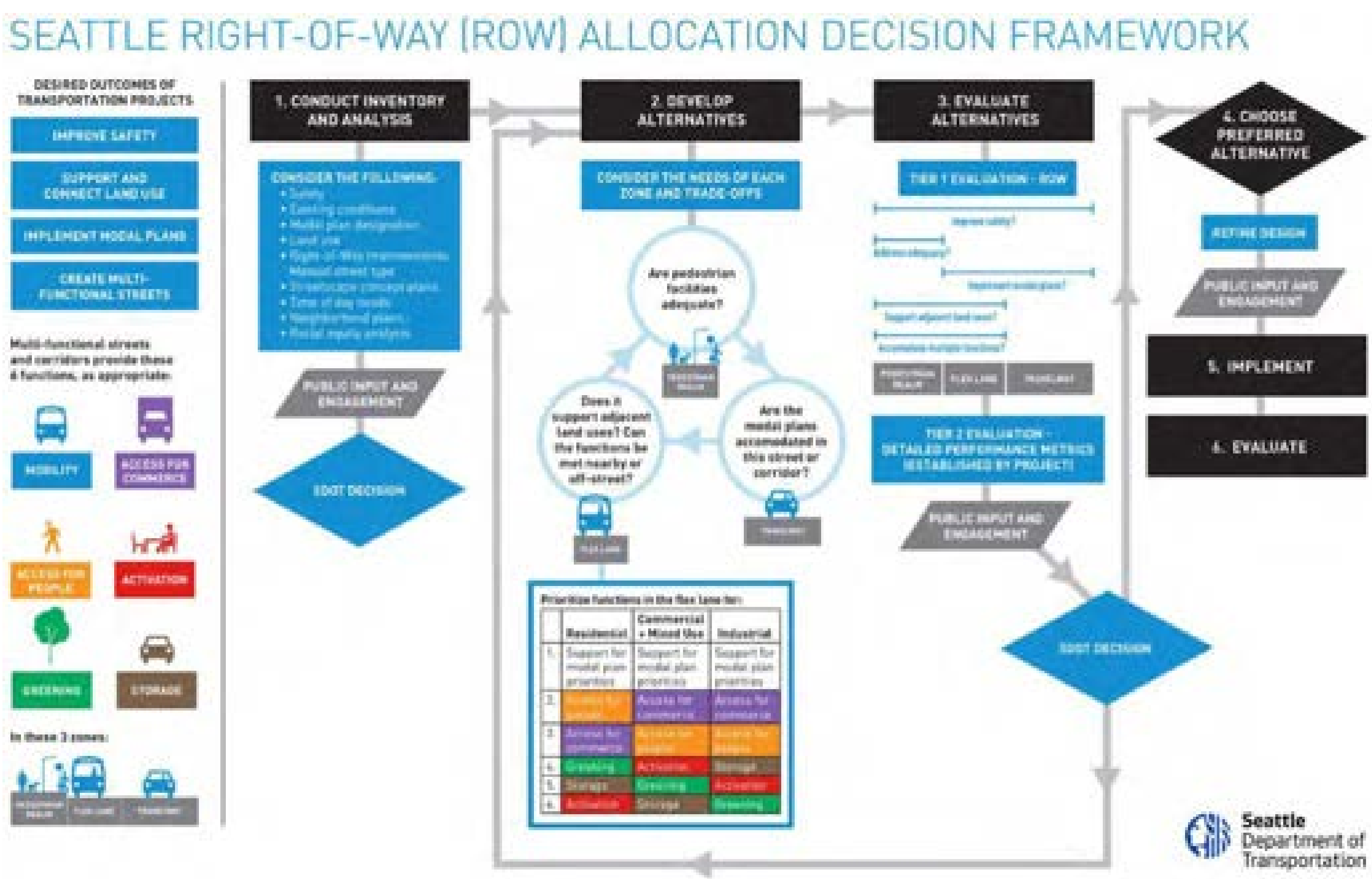
Safety and emergency vehicle access needs to be considered when assigning curbspace. Example components related to safety include:

- 15' buffers on each side of fire hydrants
- Reserved space for fire and rescue access in activity centers
- Parking restrictions setback from intersections and mid-block crossings. Refer to Intersections, Crossings, and Mid-Block Treatments for further details.
- Pedestrian accommodations such as crosswalks, bulb-outs and pedestrian islands

Explore Equity Opportunities and Economic Development

Every aspect of a Complete Streets design should be sensitive to the community's needs, address inequities, and support the local economy. Equity and economic development opportunities should be evaluated during the community stakeholder engagement step of the curbspace prioritization process that is outlined on page 42. Curbside management presents opportunities to address community needs, particularly with regard to improving accessibility of people with disabilities, increasing availability of affordable modes of transportation, providing safe access to schools and for school buses, and helping local businesses needing commercial loading access and on-street parking.

The City of Seattle provides an excellent example of establishing a framework for evaluating curbspace use:



ROADWAY ZONE

The roadway zone is the section of a street that includes the following:

- Curbspace:
  - Can consist of parking lanes, pedestrian bulb-outs, transit bulbs, drop-off zone, protected bike lanes, curbside bike lanes, curbside transit lanes, micromobility corrals, or parklets, etc. See Curbspace Management for further details.
- Curbside Lane Subzone:
  - Can consist of bike lanes, transit lanes, or offset parking lanes.
- Street Buffer Subzone:
  - Typically consists of physical separations between the curbside lane subzone and the travelway subzone.
- Travelway Subzone:
  - Consists of vehicle travel lanes that are used by bicycles, micromobility users, transit, cars, and trucks.
- Median Subzone:
  - Consists of landscaping, median refuge islands, bicycle facilities, trails, and transit facilities.

The roadway zone is used for the movement of bicycles, micromobility users, buses, light rail, cars, and trucks. In addition to the travel lanes for motor vehicles, the roadway may include parking lanes, bike lanes, transit lanes, and medians. The roadway is typically confined by curbs which separate it from the pedestrian realm on the sidewalk. Roads should be designed in accordance with the guidelines in this Manual and the latest versions of the City of Baltimore Standards Specifications and the Baltimore City *Book of Standards*.

The Roadway Zone section of this Manual consists of the following subsections:

- Bicycle Facilities
- Micromobility
- Transit Facilities
- Vehicle Facilities
- Curbside Lane Subzone
- Street Buffer Subzone
- Travelway Subzone
- Median Subzone

North Avenue and Guilford Avenue

Bicycle Facilities

A Complete Streets network includes bicycle infrastructure that allows bicyclists and other micromobility users safe and stress-free transportation throughout the City. The number of micromobility users is expected to grow based on Baltimore City's recent experience with dockless e-scooters (see Micromobility), but for now all facilities will be referred to as "bicycle facilities" in line with national standards. The most recent version of the Baltimore City *Bike Master Plan* and the supplemental Baltimore City *Separated Bike Lane Network* identify the recommended bicycle network for the City.

This Manual further refines the facility type decision process with two resources: (1) NACTO's *Choosing an All*

Table 4. NACTO's Choosing an all Ages & Abilities Bicycle Facility, Modified to be Baltimore-Specific

<table>
<tr><th colspan="4">Roadway Context</th><th rowspan="2">All Ages & Abilities Bicycle Facility</th></tr>
<tr><th>Target Motor Vehicle Speed</th><th>Target Motor Vehicle Volume (Single Direction ADT)</th><th>Motor Vehicle Lanes</th><th>Key Operation Considerations</th></tr>
<tr><td colspan="3">Any</td><td>Any of the following:
• high curbside activity
• high frequency bus service
• high levels of motor vehicle congestion
• high number of turning conflicts</td><td>Separated Bike Lanes or Shared-Use-Path</td></tr>
<tr><td><10 mph</td><td>Less relevant</td><td rowspan="3">No Centerline or single lane one-way</td><td>Pedestrians share the roadway</td><td>Urban Village Shared Street</td></tr>
<tr><td>≤20 mph</td><td>1,000–2,000</td><td rowspan="2"><50 motor vehicles per hour in the peak direction at peak hour</td><td rowspan="2">Bicycle Boulevard, Contra-Flow Bike Lane (1)</td></tr>
<tr><td rowspan="5">≤25 mph</td><td>500–1,500</td></tr>
<tr><td>1,500–3,000</td><td rowspan="3">Single lane each direction or single lane one-way</td><td rowspan="4">Low curbside activity or low congestion pressure</td><td>Traditional or Buffered Bike Lane, Left-Side Bike Lane (1), Buffered Counterflow Bike Lane (1) or Separated Bike Lane</td></tr>
<tr><td>3,000–6,000</td><td>Buffered Bike Lane, or Protected Bike Lane</td></tr>
<tr><td>> 6,000</td><td>Separated Bike Lane</td></tr>
<tr><td>Any</td><td>Multiple lanes per direction</td><td>Separated Bike Lane</td></tr>
<tr><td>>25 mph</td><td rowspan="2">≤6,000</td><td>Single lane each direction</td><td>Low curbside activity or low congestion pressure</td><td>Separated Bike Lane, or reduce speed</td></tr>
<tr><td>>25 mph</td><td>Multiple lanes per direction</td><td>Low curbside activity or low congestion pressure</td><td>Separated Bike Lane, reduce to Single Lane or reduce speed</td></tr>
<tr><td>>25 mph</td><td>>6,000</td><td>Any</td><td>Any</td><td>Separated Bike Lane</td></tr>
<tr><td>High-speed limited access roadways</td><td>Any</td><td>Any</td><td>High pedestrian volume</td><td>Shared-Use-Path with Separated Walkway or Separated Bike Lane</td></tr>
</table>

(1) Facility is not included within NACTO's *Choosing an All Ages & Abilities Bicycle Facility*. Facility is provided as an available option with approval from Baltimore City Department of Transportation.
(2) While an improvement relative to having no bike facility, shared bus-bike lanes should not be considered part of the low stress bicycle network and are not included within NACTO's *Choosing an All Ages & Abilities Bicycle Facility*. Shared transit lanes are currently in use within Baltimore and can be implemented with approval from Baltimore City Department of Transportation and Maryland Transit Authority.

Ages & Abilities Bicycle Facility (modified to fit the needs of Baltimore), and (2) the facility type shown within the street's designated Street Type, shown below.

Standards

The following are summaries of the types of bicycle facilities that can be implemented as part of a Complete Streets network. Designers should also refer to the most recent versions of the AASHTO *Guide to the Development of Bicycle Facilities,* the FHWA *Bikeway Selection Guide* and the NACTO *Urban Bikeway Design Guide* for the latest guidance. The following table provides design criteria for bicycle facilities based on Street Type. For a complete list of design criteria requirements for a Complete Street, see Appendix 1, and for guidance on bicycle signals, see Intersections, Crossings, and Mid-Block Treatments.

Table 5. Bicycle Facility Design Criteria

		Bicycle Facility					
Street Type	Requirements	Shared-Use -Path	Separated Bike Lane (1)	Two-Way Street Separated Bike Lane (2)	Buffered Bike Lane (3)	Traditional Bike Lane	Shared Facility
Downtown Commercial	Maximum	N/A	-	-	8’	N/A	N/A
	Target	N/A	10’	15’	8’	N/A	N/A
	Constrained	N/A	8’	11’	6.5’	N/A	N/A
Downtown Mixed-Use	Maximum	N/A	-	-	8’	7’	N/A
	Target	N/A	10’	15’	8’	6’	N/A
	Constrained	N/A	8’	11’	6.5’	5’	N/A
Urban Village Main	Maximum	N/A	-	-	8’	7’	N/A
	Target	N/A	10’	15’	8’	6’	N/A
	Constrained	N/A	8’	11’	6.5’	5’	N/A
Urban Village Neighborhood	Maximum	N/A	N/A	-	8’	7’	(4)
	Target	N/A	N/A	15’	8’	6’	(4)
	Constrained	N/A	N/A	11’	6.5’	5’	(4)
Urban Village Shared Street	Maximum	N/A	N/A	N/A	N/A	7’	(4)
	Target	N/A	N/A	N/A	N/A	6’	(4)
	Constrained	N/A	N/A	N/A	N/A	5’	(4)

(*table continues next page*)

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		Bicycle Facility					
Street Type	**Requirements**	**Shared-Use -Path**	**Separated Bike Lane (1)**	**Two-Way Street Separated Bike Lane (2)**	**Buffered Bike Lane (3)**	**Traditional Bike Lane**	**Shared Facility**
Urban Center Connector	Maximum	N/A	-	-	8’	N/A	N/A
	Target	N/A	10’	15’	8’	N/A	N/A
	Constrained	N/A	8’	11’	6.5’	N/A	N/A
Neighborhood Corridor	Maximum	N/A	N/A	N/A	8’	7’	(4)
	Target	N/A	N/A	N/A	8’	6’	(4)
	Constrained	N/A	N/A	N/A	6.5’	5’	(4)
Industrial Access	Maximum	-	-	-	8’	7’	N/A
	Target	12’	10’	15’	8’	6’	N/A
	Constrained	10’	8’	11’	6.5’	5’	N/A
Parkway	Maximum	-	-	-	8’	N/A	N/A
	Target	12’	10’	15’	8’	N/A	N/A
	Constrained	10’	8’	11’	6.5’	N/A	N/A
Boulevard	Maximum	-	-	-	8’	7’	N/A
	Target	12’	10’	15’	8’	6’	N/A
	Constrained	10’	8’	11’	6.5’	5’	N/A

(1) Separated bike lane (one-way) width includes 3’ minimum buffer.
(2) Separated bike lane (two-way) width includes 3’ minimum buffer.
(3) Buffered bike lane width includes 1.5’ minimum buffer.
(4) For lane widths of shared lanes, bicycle boulevards, and shared transit lanes refer to the Travelway Subzone section.
(5) Lane widths provided in this table do not include gutter pans. The pavement section in the roadway lane is typically much deeper than the adjoining curb and gutter, and the gutter pan is typically separated by an expansion joint. The added forces on the gutter pan tend to make it “roll”, possibly creating a tripping hazard or vertical separation (bump) at ADA ramps.

General Guidance

Regardless of Street Type or bicycle facility, the design of catch basins is an important safety consideration. A catch basin is an inlet to a storm drain system that typically includes a grate where storm water enters, and a basin to capture sediment, debris, and associated pollutants. Care must be taken to design inlets that are safe for bicycles and scooters with small wheels or narrow tires. The design of the inlet must address the following:

- The grate must meet DPW standards and be bicycle-friendly (not impede tire rotation)
- The slope of the roadway leading to the inlet must not be too severe, and
- The inlet and accompanying concrete box must not extend too far into the bicycle lane

Shared Facilities

Shared facilities are sections of the roadway that bicycles and electric scooters share with vehicles and/or transit. They should be limited to low-speed and low vehicle volume facilities as indicated in Tables 4 and 5 above. Most low-volume roadways with calmed traffic can be considered low stress shared facilities, since it is comfortable to cycle on these roadways. However, there should not be sharrows on the majority of low stress streets. Sharrows should be used sparingly in the City roadway network, with a focus on applications to highlight recommended through-routes for bicyclists, or to designate a roadway as a preferred route between existing low stress streets.

The following types of enhanced shared facilities can be considered:

Shared Lanes

Shared lanes are lanes that bicycles share with motor vehicles. Typically, designated shared lanes are enhanced with pavement markings including sharrows and signs to help reinforce the legitimacy of bicycle traffic on the street and to provide guidance on the recommended route for bicyclists. Designated shared lanes should be designed to meet the following criteria:

Guidance

- Guidance on crossings at major intersections should follow the guidance on serving pedestrians in Intersections, Crossings, and Mid-Block Treatments.
- Shared lane markings shall not be used on shoulders, in designated bike lanes, or to designate bicycle detection at signalized intersections per Maryland *MUTCD* 9C.07 03.
- Sharrow markings should be placed at the beginning and middle of each block, or about every 200' for longer blocks.
- Please refer to Street Type specifications for guidance on selecting sharrow markings or bike lanes.
- Depending on available roadway width and topography, climbing lanes, in which there is a downhill shared lane and an uphill standard bike lane, may be appropriate.

Design

- Shared lanes shall be designed in accordance with the NACTO *Urban Bikeway Design Guide*, the Maryland *MUTCD* and the Baltimore City *Bike Master Plan*.
- Sharrow markings should be painted in accordance with Maryland *MUTCD* 9C-9.
- Sharrows should be placed a minimum of 4' from the edge of the curb, or 12-14' from the edge of the curb if a parking lane is present.
- Sharrows should be placed outside of the door zone of parked vehicles.
- Sharrows can be complemented with the sign "BIKES MAY USE FULL LANE".

Bicycle Boulevards

Bicycle boulevards are roadways that place an emphasis on bicycle and pedestrian access over vehicular access. They are low-traffic, low-speed roadways that often parallel heavier arterial and collector roadways, and can serve as spines in the overall bicycle network. Traffic calming features such as chicanes, bulb-outs, traffic diverters, altering one-way patterns with counterflow bike lanes, speed humps, and mini-roundabouts are often incorporated to help slow moving cars and keep traffic volumes low.

Two of the most effective yet underused treatments on bicycle boulevards in Baltimore City are traffic diverters and altering one-way patterns with counterflow bike lanes. By diverting all motor vehicle traffic at certain intersections, or forcing vehicle turns due to one-way patterns, these simple measures have the potential to create long distance low stress bicycle facilities with minimal cost. In residential areas, community buy-in can often be achieved for these treatments because traffic volumes and traffic speeds are reduced, while neighborhood connectivity by foot and bicycle remains unchanged. Bicycle boulevards should be designed to meet the following criteria:

Guidance

- Bicycle boulevards should be several blocks or more in length to serve as a spine in the overall bicycle network and to accommodate large numbers of bicyclists.
- Traffic calming measures should be employed to help reduce average motorist speed or deter motorists from using the route for through traffic. See the NACTO *Urban Bikeway Design Guide* and the Baltimore City *Bike Master Plan* for traffic calming measures that can be implemented. For traffic calming measures at intersections, see the Complete Streets Intersection Toolbox.
- Traffic signals and other traffic control devices should be used to allow bicyclists opportunity to cross busier streets. Guidance on crossings at major intersections should follow the guidance on serving pedestrians in Intersections, Crossings, and Mid-Block Treatments.
- Two-way stops requiring the bicycle traffic to stop should be minimized. All-way stops are acceptable treatments when sight lines do not allow for safe and comfortable movements from the designated bicycle boulevard.

Design

- Bicycle boulevards should be designed in accordance with the NACTO *Urban Bikeway Design Guide*, the Maryland *MUTCD* and the Baltimore City *Bike Master Plan*.
- Bicycle boulevards can be considered for use in Urban Village Neighborhood and Neighborhood Corridor Street Types. See the design criteria table in Appendix 1 for additional details.
- Refer to Table 4 for bicycle facility selection criteria and Table 5 for width requirements based on Street Type.

Baltimore City Bike Master Plan/Flickr user Payton Chung

Guilford Avenue Bicycle Boulevard

Shared Transit Lanes

While an improvement relative to having no bike facility, shared bus-bike lanes should not be considered part of the low stress bicycle network. See the Transit Facilities subsection of this Manual.

Bike Lanes

A bike lane is a dedicated portion of the roadway for preferential use by bicycles. Bike lanes may also be used by pedal assist electric bicycles (e-bikes) and electric scooters. Bike lanes allow bicyclists and scooter users to ride at their own pace with reduced conflict from motor vehicles. The bike lane is separated from vehicular travel lanes with paint as described in the various configurations below.

Bike lane installation can be completed at the same time as resurfacing or street reconstruction, but also as a retrofit to an existing roadway. When constructed as a retrofit, careful attention should be paid to the condition of the roadway surface. One of the following treatments should be considered for new bike lanes on old asphalt pavement:

- Fog seal
- Seal coat
- Micro-milling and thin overlay
- Mill and pave

Because of the limited or non-existent vehicular travel in bike lanes, low-cost methods for refreshing the roadway surface on these facilities can provide a smoother and safer surface on that portion of the roadway that will not significantly degrade within the usable life of the adjacent asphalt surface. Bike lanes should meet the following criteria:

Guidance

- The bike lane surface should be smooth and slip resistant with a 2% to 4% cross slope. The bike lane should typically be constructed with asphalt or concrete.

Green paint in bike lanes should be limited to conflict points with vehicles at intersections and high-volume driveways.

- Where possible, avoid the placement of utility manholes and inlet grates within the bike lane.
- Wherever possible minimize the width of a parking lane in favor of a larger bike lane.
- Green paint in bike lanes should be limited to conflict points with vehicles at intersections and high-volume driveways. For additional information on the use of green paint, see crosswalk markings in the Complete Streets Intersection Toolbox.

Design

- Bike lanes shall be designed in accordance with the AASHTO *Guide to the Development of Bicycle Facilities,* the NACTO *Urban Bikeway Design Guide*, the Maryland *MUTCD*, and the Baltimore City *Bike Master Plan*.
- Refer to Table 4 for bicycle facility selection criteria and Table 5 for width requirements based on Street Type.
- Bike lanes should be designated with the helmeted bicycle symbol and arrow pavement markings per Maryland *MUTCD* Figure 9C-3.
- For intersection design of bike lanes refer to the Complete Streets Intersection Toolbox.

The following types of bike lanes can be implemented as part of a Complete Street:

Standard Bike Lanes

Standard bike lanes are separated from the vehicular travel lanes with striping, pavement marking symbols, and signage. Standard bike lanes are typically located to the right side of vehicular travel lanes and run in the same direction as traffic. Standard bike lanes should meet the requirements listed on page 53 under Bike Lanes and the following:

Guidance

- If there is not adequate width in the roadway to provide a standard bike lane in each direction, and the road Street Type allows for shared lanes, the designer may consider the use of a standard bike lane going uphill and a shared lane going downhill.
- Designers should consider an alternative to a standard bike lane in areas with high parking turnover and/or frequent bus stops since they can lead to increased conflicts between bike lane users and vehicles.

Baltimore City Bike Master Plan

Bike Lane on Roland Avenue

Design

- When placed adjacent to a parking lane, a 4" wide white line should be placed to separate the standard bike lane from parking. This will discourage cars from encroaching onto the bike lane.

Left-Side Bike Lanes

Left-side bike lanes are placed in the roadway to the left of the vehicle lanes on one-way streets or streets with medians. Left-side bike lanes can help to reduce conflicts between bike lane users and vehicles on streets with high parking turnover, large right-turn volumes, and frequent transit stops. However, there are safety implication of left-side bike lanes since they are not a common facility and can create issues at intersections that are different than what is typically seen by road users. The use of left-side bike lanes should be carefully evaluated before approval. Left-side bike lanes should meet the requirements listed on page 53 under Bike Lanes and the following:

Guidance

- Left-side bike lanes can be used in Street Types where traditional bike lanes are permitted providing that the street is one-way or there is a median, vehicle speeds are under 25 mph, there are not frequent left turns, and the road is not on the freight network.
- Left-side bike lanes should be buffered wherever there is adequate width. Delineators can help to provide additional visual separation between a left-side buffered bike lane and vehicle lane and should be considered in areas without adjacent parking or transit stops.

Design

If a buffer is used, it shall be designed in accordance with Maryland *MUTCD* 3D.01. See Buffered Bike Lanes on page 55 for further details.

Left-side bike lanes should include signs designating that the left lane is for bicycle use only.

Left-Side Bike Lane in New York City

At intersections, the bike lane should not be to the left of a left-turning vehicle lane that is not controlled by a separate traffic signal phase.

Buffered Bike Lanes

Buffered bike lanes function in the same manner as standard bike lanes with the addition of a buffer between the adjacent vehicle lane and/or parking lane. This provides extra protection for users from vehicles and serves as a zone to be avoided by both cars and bikes. Buffered bike lanes should meet the requirements listed on page 53 under Bike Lanes and the following:

Guidance

- Buffered bike lanes should be used instead of a standard bike lane wherever the roadway width permits and on all roads with a speed over 25 mph or on the freight network.
- Wherever possible, minimize the width of a parking lane in favor of a larger buffered bike lane.
- Delineators help to provide additional visual separation between a buffered bike lane and vehicle lane and should be considered in areas without adjacent parking or transit stops. For details on additional buffer treatments refer to Street Buffer Subzone.
- Designers should consider an alternative to a buffered bike lane in areas with high parking turnover and/or frequent bus stops since they can lead to increased conflicts between bicycles and vehicles. In these locations a separated bike lane should be considered.

Design

- The buffer of a bike lane should be comprised of two parallel solid 5” white lines with diagonal hatching if the width of the buffer is under 3’ wide. If 3’ wide or greater, chevrons should be striped in the buffer. Solid white lines on either side of the buffer space indicate where crossing is discouraged but not prohibited.
- When placed adjacent to a parking lane, a 5” wide white line should be placed to separate the bike lane from parking. This will discourage cars from encroaching onto the bike lane.
- The buffer shall be designed in accordance with Maryland *MUTCD* 3D.01.
- The buffer can occur on the outside of the bike lane (adjacent to the travel lane), the inside (adjacent to the parking lane), or both.

Buffered Bike Lane in Portland, OR

Counterflow Bike Lanes

Counterflow bike lanes are bike lanes on one-way streets that allow bicycles to travel in the opposite direction of vehicles. They are typically coupled with a shared lane or bike lane that provides bicycle accommodations in the same direction as vehicle traffic. Counterflow bike lanes should meet the requirements listed on page 53 under Bike Lanes and the following:

Guidance

- Counterflow bike lanes can be used in Urban Village Neighborhoods, Urban Village Shared Streets, and Neighborhood Corridors.
- The widths and design of a counterflow bike lane shall meet the requirements of a standard bike lane.
- Counterflow lanes should not allow for bicycle access in two directions within the counterflow lane itself.
- If adjacent to parking, preference should be for a parking separated curbside bike lane in the counterflow direction. However, counterflow lanes can be placed between a vehicle lane and parking lane on lower volume streets.
- Green paint on counterflow lanes should be considered at all intersections to increase awareness of the counterflow bike lane. Designers should also consider other measures that increase the conspicuity of the bicycle riders (e.g. removing parking, wider lanes, signage, etc.).

Baltimore City Bike Master Plan

Counterflow Bike Lane on Lancaster Street

Design

- The buffer shall be designed in accordance with Maryland *MUTCD* 3D.01.
- Counterflow bike lanes should be separated from opposing traffic with a double yellow line. An additional buffer up to 3’ wide is desirable.
- Signs that note “DO NOT ENTER - EXCEPT BICYCLES” should be posted at intersections and high-volume driveways and at entrances to counterflow bike lanes. W11-1 (bike symbol) signs in conjunction with a W1-7 (double arrow) clip should be used at intersections to warn drivers that bicycles may be traveling in both directions.
- Traffic signals should include phasing or indicators for opposing bicycle traffic, or signs directing bicyclists to use the pedestrian signals to provide direction.

Separated Bike Lanes

A separated bike lane is a bike lane that is a dedicated portion of the roadway for preferential use by bicycles that is physically separated from the vehicle travel lanes. Separated bike lanes allow bicyclists to ride at their own pace with the only conflict with motor vehicles occurring at intersections and driveways. For details on separation elements, refer to Street Buffer Subzone. Separated bike lanes should meet the following criteria:

Guidance

- The separated bike lane should be smooth and slip resistant with a 2% to 4% cross slope. The bike lane should typically be constructed with asphalt or concrete.
- Where possible, avoid the placement of utility manholes and inlet grates within the separated bike lane.
- The following types of buffers may be considered:
  - Curb separated bike lanes are comprised of a bike lane that is at the same elevation as the street with a physical curb separating the bike lane from the vehicle lane or parking lane. Depending on

context, this space may be used as a door zone for the parking lane, or for transit stops, curb ramps, or green stormwater infrastructure.

- » Object separated bike lanes are comprised of a bike lane that is separated from the travel lanes or parking lane by low-cost materials including pinned curbs, planters, bollards, and/or flexible delineators. Flexible delineators are considered an interim solution when more permanent buffers (e.g., curbs) are not immediately feasible, but BCDOT is investigating standards for separated bike lanes to include a permanent option of a physical curb separation with bollards. See Emerging Materials and Treatments for additional information on separation methods.

- » Green paint should be used at conflict points with vehicles at intersections and high-volume driveways. For additional information on the use of green paint, see Crosswalk Markings in the Complete Streets Intersection Toolbox.

Design

- » Separated bike lanes should be designed in accordance with the AASHTO *Guide to the Development of Bicycle Facilities,* the NACTO *Urban Bikeway Design Guide*, the NACTO *Don't Give Up at the Intersection*, the FHWA *Separated Bikeway Planning and Design Guide*, the Maryland *MUTCD*, and the Baltimore City *Bike Master Plan*.
- » Refer to Table 4 for bicycle facility selection criteria and Table 5 for width requirements based on Street Type.

Maryland Avenue Separated Bike Lane

- » Separated bike lane entrances should be designated with the helmeted bicycle symbol and arrows per Maryland *MUTCD* Figure 9C-3. The helmeted bicycle symbol and arrows should also be placed periodically throughout the separated bike lane.
- » A 3' minimum buffer should be provided between parked cars and a one-way separated bike lane and a 5' minimum buffer should be provided between parked cars and a two-way separated bike lane.
- » Refer to the FHWA *Separated Bikeway Planning and Design Guide* for details on designing accessible parking spaces and loading zones adjacent to separated bike lanes.
- » Driver and bicyclist sight distance needs to be analyzed where the separated bike lane crosses intersections and driveways. For further details on this see the Complete Streets Intersection Toolbox. Meeting required sight distance may result in the loss of parking spaces.

The following types of separated bike lanes can be implemented as part of a Complete Street:

Two-Way Separated Bike Lanes

Two-way separated bike lanes are two-way bike lanes that are at street level and are physically separated from vehicle lanes by a variety of methods. This may include a parking separated bike lane where parked vehicles and a buffer space function as the physical separation between the bike lane and vehicle lanes.

Street-Level Separated Bike Lanes

Street-level separated bike lanes are one-way separated bike lanes that are at street level and are physically separated from vehicle lanes. This may include a parking separated bike lane where parked vehicles and a buffer space function as the physical separation between the bike lane and vehicle lanes, or a curbside separated bike lane with a physical barrier or delineator between vehicle lanes and the bike lane.

Sidewalk-Level Separated Bike Lanes

Sidewalk-level separated bike lanes are one-way or two-way separated bike lanes that are above street-grade and contained within the furnishing subzone of the sidewalk. They can be at half-height, as depicted in the Street Buffer Subzone section, or at mid-level height between the roadway surface and sidewalk level, or at sidewalk level. If at half-height, it must be determined if the roadway drainage will overtop the curb and render the lanes unusable. Sidewalk-level separated bike lanes are separate from the pedestrian subzone and are intended to be used primarily by bicycles. Sidewalk-level separated bike lanes should meet the requirements listed under Separated Bike Lanes on page 56 and the following:

Guidance

- A sidewalk-level separated bike lane shall be separated from the roadway with a raised or mountable curb, parking, street furnishing, and/or green stormwater infrastructure. It is preferred to have a landscaped buffer between the roadway and a separated bike lane.

Design

- A minimum 2'-3' buffer should be provided between the sidewalk-level separated bike lane and parked cars.

Seattle Department of Transportation

Sidewalk-Level Bike Lane in Seattle, WA

Shared-Use-Paths

Shared-use-paths are facilities that can accommodate various recreational users such as walkers, runners, rollerbladers, skateboarders, equestrians, bicyclists on both non-motorized bicycles and e-bikes (limited to speeds of 20 mph), electric scooter users (limited to speeds of 15 mph), etc.

Guidance

- The shared-use-path surface should be smooth and slip resistant with a 2% cross slope. The shared-use-path should typically be constructed with asphalt or concrete.
- Where possible, avoid the placement of utility manholes and valve covers within the shared-use-path.
- Green paint should be used at conflict points with vehicles at intersections and high-volume driveways. For additional information on the use of green paint, see Crosswalk Markings in the Complete Streets Intersection Toolbox. Signs at crossings should designate both pedestrian and bicycle crossings.
- A shared-use-path shall be separated from the roadway with a raised or mountable curb, parking, street furnishing, and/or green stormwater infrastructure.
- A shared-use-path should be marked as a multi-purpose trail with signage, decorative pavement markings, or a combination of both.
- A shared-use-path should include a center line to differentiate the direction of traffic.

Design

- Shared-use-paths shall be designed in accordance with the Maryland State Highway Administration *Bicycle Policy and Design Guideline*, the Maryland *MUTCD* and the Baltimore City *Bike Master Plan*.
- Refer to Table 4 for bicycle facility selection criteria and Table 5 for width requirements based on Street Type.
- Shared-use-paths must meet ADA accessibility requirements including slopes, widths, ramps, and detectable warning surfaces.


Baltimore City Bike Master Plan

Shared-Use-Path Along Light Street in the Inner Harbor

The following types of shared-use-paths can be implemented as part of a Complete Street:

Sidepaths

Sidepaths run parallel to roadways, but unlike sidewalks they are not designated for pedestrian use only. Additionally, their vertical alignment can differ from the road in order to provide an optimal alignment for trail users. Sidepaths should meet the requirements listed under Shared-Use-Paths on page 58 and the following:

Guidance

- "The *2012 AASHTO Guide for the Development of Bicycle Facilities, fourth edition*, makes a number of specific statements that recommend against providing shared use paths directly adjacent to the road. Despite this guidance, sidepaths are typically identified on local master plans and are widely used throughout Maryland and in other states. Where no other solution exists, new sidepaths may be constructed and existing ones maintained. However, they must be carefully designed to ensure the safety of all users." Source: Maryland State Highway Administration *Bicycle Policy and Design Guideline*s.

Multi-Use Trails

Multi-use trails are shared-use-paths that run on their own alignment separate from a roadway. Multi-use trails should meet the requirements listed under Shared-Use-Paths on page 58 and the following:

Guidance

- Trails should include wayfinding signage, mile markers, and trail maps. Informational kiosks with trail rules and interpretive and educational information are also desirable.
- Shared-use-paths with heavy pedestrian traffic should be 15' wide or more, or a separate pedestrian sidewalk can be added adjacent to the trail.
- Trails should include adequate lighting for nighttime use where feasible. Trails in more urban areas should include lighting throughout.

Design

- Trails should include a 2' graded shoulder and clear zone on either side of the trail edges.
- When a trail crosses a street at a unsignalized intersection, use the FHWA *Guide for Improving Pedestrian Crossings at Uncontrolled Crossing Locations* to determine the appropriate treatments.
- If the path is not paved, the surface materials used should be suitable for smaller and narrow wheels.
- Trails shall have lighting that meets the requirements of the City of Baltimore Department of Transportation *Specification for Street Lighting & Conduit Street Lighting and Photometric Design Guide* and *Street Lighting & Conduit Material Specifications*.

Micromobility

Micromobility devices are small, electrically propelled vehicles that primarily serve short-distance trips. Micromobility is made possible by the prevalence of smartphones, decreased cost of GPS devices, and advancements in electric motor technology in recent years. Micromobility devices have materialized in Baltimore and across the nation to serve short-distance trips, providing transit patrons, residents, students, tourists, and others a viable option for moving around town.

Micromobility devices take many shapes but are currently most popular in Baltimore as electric scooters. These devices are privately owned, either by the user or deployed by a permitted shared mobility provider. This section discusses how facilities for scooters and other micromobility devices can be considered for Complete Streets designs in order to create safe, comfortable, and effective streets for all road users.

Shared electric scooters were approved for use as a "Dockless Vehicle" pilot program in Baltimore on August 15, 2018, and a permanent permit program was legislated by City Council in May of 2019. Since then, the use of micromobility devices has increased substantially, as illustrated in Figure 1. The shared micromobility devices are dockless, allowing a trip to start from and stop at anywhere within the City. This model has resulted in far more trips and more geographically widespread ridership in Baltimore City than what was seen during the docked bike share system, which operated from 2015 to 2018.

Trip data provided to the City by shared mobility providers shows that the average trip for scooters is around 1-mile in range.

Integration into a Complete Street

Per Baltimore City's ordinance, electric scooters (limited to a top speed of 15 mph) and pedal assist electric bicycles (limited to a top speed of 20 mph) are allowed to ride in the vehicle lanes and within bike facilities. Their use is restricted on sidewalks except where the posted speed limit on a road is 30 mph or greater. Table 6 provides a matrix on preferences for micromobility usage based on Street Type.

Figure 1. Baltimore City Department of Transportation Dockless Vehicle Program Trips

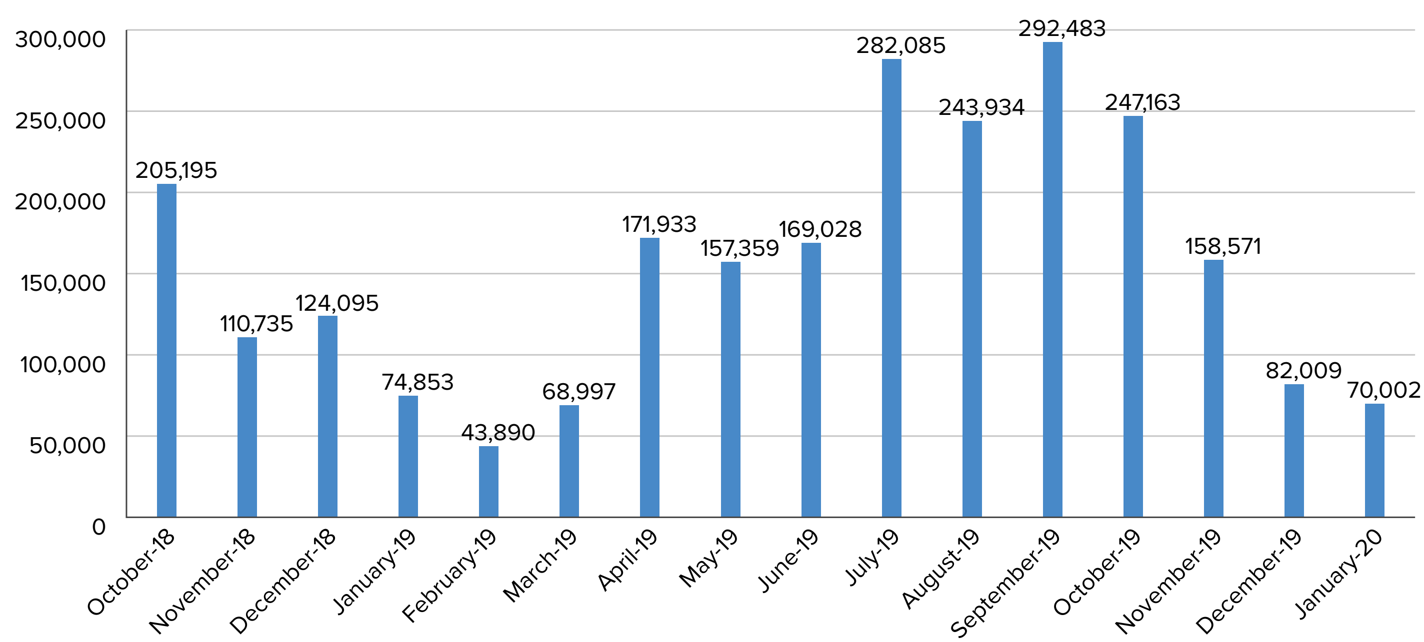


Table 6. Micromobility Usage by Street Type

Usage	Street Type: Downtown Commercial	Downtown Mixed-Use	Urban Village Main	Urban Village Neighborhood	Urban Village Shared Street	Urban Center Connector	Neighborhood Corridor	Industrial Access	Parkway	Boulevard
Ride in bicycle facility, or in vehicle lane if no bicycle facility	X	X	X	X	X		X			
Ride on sidewalk if no bicycle facility (1)						X		X	X	X

(1) Recommended for use on sidewalk if speed limit is 30 mph or greater

Bicycle Facility Optimization for Micromobility

The City prefers that scooters operate within bike facilities when available, and bike facilities should be designed to encourage use by scooters and other micromobility devices. To promote the use of bike facilities, the following should be considered by designers:

- **Enhanced signing and pavement markings**: Many micromobility users are new to using bicycle facilities. As such, it is important to provide clear and concise signage and pavement markings to not only let them know that is preferable for them to ride in bicycle facilities, but to also provide clear guidance on travel operations within the facility.

  Baltimore is monitoring, for future consideration, other cities that have been experimenting with converting bike lanes to what is referred to as a slow lane or mobility lane. In addition to standard bicycle pavement markings, these lanes also include markings for electric scooters. While Baltimore does not plan to imminently change terminology, emerging treatments are being considered for where they may increase safety for users. For additional information on slow lanes, refer to Emerging Materials and Treatments.

- **Facility Design**: Electric scooters have different riding characteristics than bicycles. Designs should consider the differences between vehicles, including turning radii, tire diameter, and braking distance, when designing bicycle facilities.
- **Maintenance**: Since micromobility devices have a smaller wheel sizes than bicycles, micromobility users are more prone to safety issues caused by asphalt in poor condition. As such, the City should strive to minimize the number of large pavement joints, potholes, and utilities within bike lanes. Additionally, when utility work is performed within a bike facility, the entire width of the facility should be repaved. Bike lanes shall also be street swept at regular intervals and have snow removed in a timely manner.
- **Changes in the Bicycle Network**: Given that scooters are primarily used for short trips, the desired routes of users may be different than those of bicyclists. The bicycle network may need to be expanded or adjusted to accommodate and better fit the changing needs of scooter and micromobility users. The trip

data provided to the City by shared mobility providers can prove invaluable for planning and evaluating the bicycle network.

Travelway Optimization for Micromobility

Where there are no bike lanes on a street, scooter riders should still behave like bicyclists by riding on the right side of the lane when safe and practical. Scooters should obey motor vehicle traffic laws and yield to pedestrians. To enhance the use of micromobility within the travelway, the following should be considered by designers:

- **Enhanced signing and pavement markings**: As with bicycle facilities described on page 61, signing and pavement markings should be enhanced for in-lane use to not only let micromobility users know that this is an appropriate place to operate, but to let motorists know that this is a shared facility. See Bicycle Facilities for guidance on shared facilities.
- **Maintenance**: The City should strive to minimize the number of large pavement joints, potholes, and utilities trenches within shared facilities to improve safety and ride quality for micromobility users.

Sidewalk Optimization for Micromobility

On streets where sidewalk riding is permitted, and if there is not enough roadway width to provide on-street bicycle facilities, sidewalks shall be kept free and clear of debris and obstructions. Sidewalk amenities, such as poles or tree pits, should be aligned when possible to leave a clear path of travel for ADA users primarily, but also for micromobility users who are using the sidewalk for safety. Long term maintenance on these sidewalks must also be prioritized to ensure that sidewalk joints and cracks do not pose a safety hazard to users.

For new projects on roads that are posted at 30 mph or greater, designers should incorporate the following design strategies to ensure safe operation for micromobility users and pedestrians:

- If possible, provide on-street bicycle facilities based on the design criteria provided in Bicycle Facilities.
- If on-street facilities cannot be provided, a sidewalk-level separated bike lane or sidepath should be provided. See Bicycle Facilities for further details.
- If a sidewalk-level separated bike lane or sidepath is not feasible, provide sidewalk to the maximum width for the Street Type.
- On all sidewalks and sidepaths, align sidewalk amenities or constructions to leave as straight of a path of travel as possible.

Parking

The shared electric scooters that are permitted in Baltimore are dockless and as many as 2,700 vehicles were deployed daily in 2019. Under the dockless model, users can finish their trip and park them on the sidewalk within the furnishing subzone of the sidewalk zone. A minimum 4’ wide space of the pedestrian subzone in the sidewalk zone shall be kept free and clear of parked scooters for ADA accessibility. Parked scooters should also be kept away from curb ramps, transit stops, and other areas which need to be accessed, like doors or driveways. While geo-fencing can be used to limit speed or parking of shared scooters from larger geographical areas of the City, the technology current is only accurate to within about 25’; thus, GPS-based enforcement of sidewalk riding and parking is not yet possible.

For additional details on bicycle/micromobility parking, refer to Curbspace Micromobility Corrals.

Micromobility Corrals

To encourage micromobility users to park shared scooters correctly and courteously, micromobility corrals can be installed. Unlike docked shared facilities, corrals require very little capital investment, typically consist of signs and markings, and can be deployed in a greater number of locations. To promote the use of corrals, companies are experimenting with incentivizing their use.

The Department of Transportation's permit programming prioritizes corrals in designated permit equity zones, followed by locations near major transit stops. Additionally, corrals should generally be located near points of interest near travel generators such as transit facilities and major activity centers such as community centers, tourist destinations, and other points of interest. The City of Baltimore's Shared Mobility Coordinator has developed a matrix for the selection of areas for corrals in an equitable manner, although owners of private property can also coordinate to install their own micromobility corrals which meet Department of Transportation specifications.

There are two locations for micromobility corrals:

Off-Street: These corrals should be placed entirely within the furnishing subzone and have an ideal width of 6' and a minimum width of 4'. They should include a white border showing the boundary of the corral as well as stencils showing a parking symbol, scooter symbol, and bike symbol. Signs indicating that this is a micromobility parking area can also be provided.

For further details on the furnishing subzone, refer to Furnishing Subzone.

On-Street: These corrals should be placed within the curbside lane subzone and be marked as the width of the parking lane. They should be a minimum of one parking bay (20') in length, though a constrained length of no less than 12' is acceptable.

Pavement markings for the corral shall include a white border showing the boundary of the corral as well as stencils showing a parking symbol, scooter symbol, and bike symbol. The corral can also be bordered by delineator posts and/or raised channelizing systems to further define the space.

For additional details on delineator posts and raised channelizing systems, refer to Emerging Materials and Treatments.

For additional details on the parking lane, refer to Curbspace Management.

On-Street Micromobility Corral

Off-Street Micromobility Corral

Transit Facilities

As part of Baltimore's Complete Streets network, transit services offer efficient accessibility and mobility throughout the City. A Complete Streets design must provide accommodations for transit infrastructure and support reliable transit service to maximize the movement of people.

Buses, light rail, and heavy rail are the three types of transit within the City of Baltimore. Streets with bus and light rail service should be designed to accommodate transit per the MDOT MTA *Bus Stop Design Guide*, the NACTO *Transit Street Design Guide*, and as described in this Manual.

The following subsections focus on on-street transit accommodations that should be considered by Baltimore street designers. Generally speaking, the City endorses all facility types in the NACTO *Transit Street Design Guide*.

For information on transit facilities at signalized intersections, refer to Traffic Signal Operations and Design. For information on the design of intersections within the transit network, refer to Corner Design. The information provided below discusses how to include transit in a Complete Streets network.

Types of Transit Priority Streets

The designated type and needs of a transit street vary depending on Street Type, and reflect the type of transit service provided. For example, design of streets with local bus service will generally follow the design standards detailed in the Street Type chapter of this Manual. However, streets designated as transit priority streets require specifications tailored to the transit mode as well as specific operating characteristics to optimize the movement of the transit service.

When selecting the type of transit street to use, a designer should evaluate the other modal needs of the street. The types of transit streets listed here are those most frequently used in Baltimore. A complete list of transit street types can be found in the current edition of the NACTO *Transit Street Design Guide*.

Enhanced Transit Streets

Transit can be well integrated into many types of urban streets and Street Types throughout Baltimore with streetscape and signal operations enhancements that improve transit operations and create a safer environment for all road users. At a minimum, enhanced transit streets should be applied to any street on which transit operates.

Guidance

- Boarding bulbs (See Transit Stations Stop Types and Locations on page 68) can improve transit reliability, calm traffic with a visually narrow roadway, and support the street as a living space by increasing the size of the pedestrian subzone.
- Transit Signal Priority (TSP) can improve transit operations on streets where there is insufficient width for dedicated transit lanes, but should be applied only on more suburban roads outside of the grid network with increased block spacing and low pedestrian activity.
- Since buses have a wider wheelbase than cars, speed cushions can calm vehicle traffic without adversely affecting transit vehicles.
- Providing designated loading zones reduces the likelihood of double-parking that can impact transit operations.

Transit Streets with Bike Lanes

Within Baltimore, transit routes frequently share roads with bicycle and micromobility routes. Special considerations should be taken with these routes to provide optimal safety and operations for all user groups.

Guidance

- At stops with protected bike lanes, bus stops can be in-lane, which not only improves transit operations but also reduces conflicts between transit and bicycles. At these locations, a boarding island stop or shared separated bike lane stop should be used (See Transit Stations Stop Types and Locations on page 68).

- On one-way streets, if there is not enough room for a protected bike lane, consider the use of left-side bike lanes to minimize conflicts between transit and bicycles. The designer should review safety of the left-side bike lane and determine if any safety mitigation is required.
- If the road has adequate width for a dedicated transit lane but not a separate bike lane, consider the use of a shared bus-bike lane (See Dedicated Transit Lanes). While shared bus-bike lanes are an improvement compared to no bicycle accommodations, they are generally not considered an all-ages bike facility.

Dedicated Transit Lanes

Dedicated transit lanes are sections of the roadway designated exclusively for buses or light rail that improve reliability, especially during peak times. Dedicated transit lanes can be placed within the curbside lanes or median. See Curbside Lane Subzone and Median Subzone for more details. Dedicated transit lanes can be designated as full-time transit facilities or can be converted to other uses during non-peak times. The use of red paint is recommended for marking of full-time dedicated transit lanes.

All dedicated transit lanes should be designed in accordance with NACTO *Transit Street Design Guide* and MTA Guidelines. The following is a list of the types of dedicated transit lanes that can be used within Baltimore City:

Curbside Transit Lanes

A curbside transit lane is a dedicated bus lane that is adjacent to the outside curb. The lane can be implemented on roadways without an adjacent parking lane and may be designated exclusively for transit use or a have a flex-use configuration.

Guidance

- If the road is on the bicycle network, a protected bike lane or left-side bike lane should be considered. If there is insufficient roadway space for a dedicated bicycle facility, a shared bus-bike lane may be considered. See Bicycle Facilities for further details.

Design

- Designate transit lanes by using a single white line to indicate separation from vehicle travel lanes. Additionally, provide red paint on the lane with the text "BUS ONLY" per Maryland *MUTCD* Section 3D.01.
- Signs should be provided per Maryland *MUTCD* Section 2B.20.
- Red paint shall be terracotta or a darker shade of red approved by the Baltimore City Department of Transportation.
- Red paint shall be a methyl methacrylate-based product or red colored asphalt with a red aggregate approved by the Maryland Department of Transportation SHA Office of Materials Technology.

Peak-Only Bus Lanes

A peak-only bus lane is a curbside transit lane that is a transit only facility during peak times, when keeping

Maryland Department of Transportation

Bus Lane with Dark Red Paint on Pratt Street buses on schedule is critical to the effectiveness of the transit system. During off-peak times, this lane can be designated as a parking lane or bike lane.

Guidance

» If the peak-only bus lane permits parking during non-peak hours, clear signage should clearly communicate the prohibited time of parking. Additional enforcement may also be required to clear the lane during peak times.

» Overhead signs are often more effective in communicating the restrictions on the lane during certain times.

Design

» Signs should designate transit lanes with the text "BUS ONLY" and should state the hours when parking is prohibited.

Shared Bus-Bike Lanes

Shared bus-bike lanes are only available for use by buses, bicycles, micromobility users, and turning vehicles. They do not typically provide a high bicycle level of comfort and should only be utilized on streets without appropriate width for separate bicycle facilities and with moderate to low levels of transit frequency. While they are an improvement over having no bike facility, shared bus-bike lanes should not be considered part of the low stress bicycle network.

Shared Bus-Bike Lane on E Fayette Street

Guidance

» Shared bus-bike lanes may be placed adjacent to the curbspace area or adjacent to a curbside lane (parking, loading zones, micromobility corrals, sidewalk and bus stop bulb-outs, etc.).

» Shared bus-bike lanes may be used where operating speeds are 20 mph or less and transit headways are 4 minutes or longer.

Design

» Designate transit lanes by using a single white line to indicate separation from vehicle travel lanes. Additionally, provide red paint on the lane with the text "BIKE BUS ONLY" per Maryland *MUTCD* Section 3D.01.

» Signs should be provided per Maryland *MUTCD* Section 2B.20.

Offset Transit Lanes

An offset transit lane is positioned between vehicle lanes and parking lanes, loading zones, parklets, and other curbside uses. Offset transit lanes can be implemented on streets with in-lane bus stops.

Guidance

» If bicycle facilities are present, consider the use of a buffered bike lane, protected bike lane, or left-side bike lane to reduce conflict points. See Bicycle Facilities for further details.

» Provide bus stop bulbs or floating bus stops, as described in Transit Station Stop Types and Locations.

Design

» See design guidance for Curbside Transit Lane.

Contra-flow Transit Lanes

Contra-flow transit lanes allow transit to operate in the opposite direction on a one-way road. They can be strategically used to shorten travel times for bus routes and provide efficiency in the overall transit service in Baltimore.

Guidance

- Bus stops on contra-flow lanes should be in-lane.
- Contra-flow lanes can be configured with an adjacent one-way or two-way separated bike lane.
- At intersections provide transit-only signals and bicycle signals facing the contra-flow direction. Consider transit operation needs when developing signal timing.
- Particular attention needs to be paid to pedestrian activity and roadway characteristics so that pedestrians intuitively understand that traffic is traveling in both directions.

Design

- A double yellow centerline marking shall separate the contra-flow lane from the rest of the roadway.
- Per Maryland *MUTCD* Section 3B.24, red paint with arrow pavement markings should be used to designate the contra-flow lane. Additionally, per Maryland *MUTCD* Section 2B.20, the text “BUS ONLY” should be provided at all entrances and intersections along the contra-flow lane route.
- Per Maryland *MUTCD* Section 2G.03, provide “DO NOT ENTER” signs with supplemental “BUS ONLY” plaques at intersections.

Rail Lanes, Side-Running

Light rail lines may be placed in the curbside lane and can be adjacent to the curb or offset by a parking lane. Rail paths must be kept clear from all obstructions.

Guidance

- Consider physically separating the transit lane from the travel lanes with rumble strips or curbs.

Design

- Coordination with MTA should commence early in the design process for any improvement on a road that contains a light rail line within its limits.
- Curbside streetcar lanes must be designated using LRT ONLY markings and appropriate signs including LRT Lane per Maryland *MUTCD* R15-4a (*MUTCD* R15-4a), Right Turn Prohibition (R3-1), and No Standing (R7-4).
- Provide 9’ parking spaces if there is a parking lane adjacent to the rail lane. If in an industrial zone, or if there is on-street truck parking, provide an additional 1’ buffer between the rail lane and parking lane. Designers should coordinate these offsets with MTA.
- Explore using the adjacent curb space as a visual and physical buffer from the pedestrian subzone, and identify loading zones and curbside pick-up areas on cross streets.

Center Transit Lanes

Center transit lanes are typically used on major routes with frequent transit use and where traffic congestion will otherwise significantly affect operations. Center transit lanes can be established for bus or light rail use and may be placed in the roadway or in the median subzone.

Guidance

- Consider physically separating the transit lane from the travel lanes with rumble strips or curbs.
- Stations should be built on raised platforms and staggered across signalized intersection as far-side stops.
- Signal operations need to have phasing that avoids conflicts with left-turning vehicles at intersections.

Design

- If placed in the roadway, solid white lines or curbs must be provided along the right side of the transit lane.
- Per Maryland *MUTCD* Section 3B.24, red paint with arrow pavement markings should be used to designate the center transit lane. Additionally, per Maryland *MUTCD* Section 2B.20, the text “BUS ONLY” should be provided at all entrances and intersections along the center transit lane route.
- Per Maryland *MUTCD* Section 2G.03, provide “DO NOT ENTER” signs with a supplemental “BUS ONLY” plaque at intersections.

Transit Station Stop Types and Locations

A transit stop should be placed to complement the type of transit street and to properly interface with the other modal needs of the Complete Street. Depending on the Street Type, the stop may be placed in the furnishing subzone, curbspace, or median subzone. Stops should be placed so that they are easily accessible to people of all ages and abilities. Stops should function as gateways to a community, facilitate ease of movement, and be designed for safety. Stops should also coordinate with bicycle and micromobility corral locations to further enhance mobility of people throughout the City. See Micromobility for further details. Detailed information on the stops including recommended placement locations can be found in the MDOT MTA *Bus Stop Design Guide*. The purpose of this section is to provide an overview on how these stops interface with a Complete Street at an intersection or mid-block.

Pull-Out Stops

At pull-out stops, buses shift out of the travel lane and into the curbspace to board and alight passengers at a stop that is placed in the furnishing subzone. Once all passengers have boarded and alighted, the bus pulls back into the travel lane. Pull-out stops function better for vehicular traffic than for bus operations, as bus operations are typically slowed by the need to wait for a gap to reenter the stream of traffic. Types of pull-out stops include:

Near-Side Pull-Out Stop

At near-side pull-out stops, buses shift out of the travelway prior to an intersection for the stop. After boarding and alighting have occurred, the bus pulls through the intersection and merges back into the travel lane. This configuration benefits vehicle traffic over transit efficiency and should not be the initial choice in the planning and design of a bus stop.

Guidance

- Near-side pull-out stops can create a sight distance issue, since stopped buses can prevent motorists from seeing pedestrians trying to cross the street. To avoid this, near-side pull-out stops should be avoided at unsignalized intersections.
- Near-side pull-out stops should be avoided when bike lanes are present unless the bike lane is a left-side bike lane or protected bike lane.

Design

- Design of near-side pull-out stops should comply with MDOT MTA *Bus Stop Design Guide* Section 2.3.2.

Far-Side Pull-Out Stops

At far-side pull-out stops, buses shift out of the travelway as they go through the intersection to access the stop. After boarding and alighting has occurred, the bus then merges back into the travel lane. This configuration benefits vehicle traffic over transit efficiency. This configuration is safer for pedestrians than a near-side stop since the crosswalk is generally prior to the bus stop.

Guidance

- Far-side pull-out stops should be avoided when bike lanes are present unless the bike lane is a left-side bike lane or protected bike lane.

Design

- Design of far-side pull-out stops should comply with MDOT MTA *Bus Stop Design Guide* Section 2.3.1.

Mid-Block Pull-Out Stops

At mid-block pull-out stops, buses shift out of the travelway to access a stop that is not adjacent to an intersection. This configuration benefits vehicle traffic over transit efficiency. If a mid-block pull-out stop is decided on, there should be a mid-block crosswalk to serve pedestrians.

Guidance

- When configured with a mid-block crosswalk it is recommend that the stop be placed after the crosswalk so stopped buses limit impacts on sight distance.
- Mid-block pull-out stops are the last option that should be considered and should only be used if stops closer to an existing crossing are not feasible. However, if located and signed/signalized properly, mid-block stops do provide some benefits. There are typically fewer lanes to cross and in the case of “long” blocks a HAWK or standard R-Y-G signal that is tied in with the existing interconnected timing system could be used.
- Mid-block pull-out stops only apply at locations where there is a high likelihood of pedestrians not going to an adjacent intersection.

Design

- Design of mid-block pull-out stops should comply with MDOT MTA *Bus Stop Design Guide* Section 2.3.3.

In-Lane Stops

At in-lane stops, buses can make a stop without leaving the travel lane. At these stops, the passengers board and alight from a bus stop that is located within the curbside lane. Since buses do not shift out of the travel lane at stops, their operational delay is minimized. Additionally, since the buses do not need area within the curbside lane to shift over to the stop, additional space can be retained for curbside lane features such as micromobility corrals, parklets, or additional parking.

Guidance

- In-lane bus stops are most appropriate on roads with two or more lanes of travel in each direction, but can also be effective on one or two-lane roads with high traffic volume and longer headways, or low to medium volume and frequent headways. There are three types of in-lane stop configurations:

Near-Side In-Lane Stops

At near-side in-lane stops, buses stop in-lane at a stop that is prior to an intersection. This configuration benefits transit efficiency over motor vehicle efficiency.

Guidance

- Near-side in-lane stops on roadways with two or more lanes in each direction can create a sight distance issue, since stopped buses can prevent motorists from seeing pedestrians trying to cross the street. To avoid this, near-side in-lane stops should be avoided at unsignalized intersections on multi-lane approaches.

Design

- Refer to the following sections in the MDOT MTA *Bus Stop Design Guide* for design of a near-side in-lane stop:

Condition	Stop Configuration	Reference Section
No Curbside Lane	Near-Side In-Lane Stop	2.4.2
Curbside Lane	Near-Side Boarding Bulb Stop	2.5.2
Curbside Lane with Parking and Separated Bike Lane	Boarding Island Stop	2.6
Curbside Lane with Separated Bike Lane (no parking)	Shared Separated Bike Lane Stop	2.7

Far-Side In-Lane Stops

At far-side in-lane stops, buses stop in-lane at a stop that is beyond an intersection. This configuration benefits transit efficiency over motor vehicle efficiency. This configuration is safer for pedestrians than a near-side stop since the crosswalk is generally prior to the bus stop. If bike lanes are present, a boarding island or shared transit separated bike lane stop should be used. See Section 2.6 and 2.7 of the MDOT MTA *Bus Stop Design Guide* for further details.

Design

» Refer to the following sections in the MDOT MTA *Bus Stop Design Guide* for design of a far-side in-lane stop:

Condition	Stop Configuration	Reference Section
No Curbside Lane	Far-Side In-Lane Stop	2.4.1
Curbside Lane	Far-Side Boarding Bulb Stop	2.5.1
Curbside Lane with Parking and Separated Bike Lane	Boarding Island Stop	2.6
Curbside Lane with Separated Bike Lane (no parking)	Shared Separated Bike Lane Stop	2.7

Mid-Block In-Lane Stops

At mid-block in-lane stops, buses stop in-lane at a stop that is between intersections. This configuration benefits transit efficiency over motor vehicle efficiency.

Guidance

» If a mid-block in-lane stop is present, a mid-block crosswalk should be placed prior to the bus stop.

Design

» Refer to the following sections in the MDOT MTA *Bus Stop Design Guide* for design of mid-block in-lane stops:

Condition	Stop Configuration	Reference Section
No Curbside Lane	Mid-Block In-Lane Stop	2.4.3
Curbside Lane	Mid-Block Boarding Bulb Stop	2.5.3
Curbside Lane with Parking and Separated Bike Lane	Boarding Island Stop	2.6
Curbside Lane with Separated Bike Lane (no parking)	Shared Separated Bike Lane Stop	2.7

Vehicle Facilities

While prioritizing the most vulnerable modes in street design and planning, a Complete Streets network will still need to accommodate vehicles for emergency response, transit, and freight. This Manual provides strategies to design Complete Streets to accommodate all types of vehicles while not compromising the safety, comfort, and efficiency of other modes of transportation. The methods of providing vehicle facilities as part of a Complete Street are discussed in greater detail in the following sections and subsections:

» Street Design Overview

» Corner Design

» Curbspace Managementt

» Transit Facilities

» Curbside Lane Subzone

» Travelway Subzone

» Intersections, Crossings, and Mid-Block Treatments

» Emerging Materials and Treatments

» Emerging Trends in Transportation: Challenges and Opportunities

Standards

City streets should be designed for vehicles in accordance with the following standards and guidelines:

» Baltimore City Department of Transportation *Book of Standards*

» Maryland *MUTCD*

» AASHTO *A Policy on Geometric Design of Highways and Streets*

» AASHTO *Roadside Design Guide*

» NACTO *Urban Street Design Guide*

Definitions

Design Vehicles

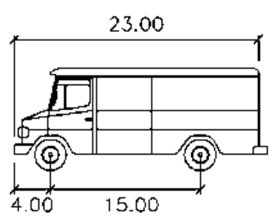
Design vehicles are the least maneuverable vehicles that routinely use a street. They are used by designers to set lane widths, corner radii, median nose design, and slip lane design. Baltimore City Code Art. 26 Subtitle 40 Complete Streets SS 40-27 Design Vehicle defines a design vehicle based on “the most recent edition of the National Association of City Transportation Officials Urban Street Design Guide” and “Transit Street Design Guide” (NACTO *Urban Street Design Guide* and *Transit Street Design Guide*).

Design Vehicle by Street

Design vehicles vary by Street Type, and exceptions should be considered to design for smaller vehicles on specific intersection corners that do not need to accommodate a bus or a truck.

General Design—DL-23

This is a standard delivery vehicle often used for package delivery services to both residential and business locations. The DL-23 shall be the design vehicle on any street that does not accommodate a transit route or a truck route. This is based on the most recent edition of NACTO *Urban Street Design Guide* as specified in Baltimore City Code Art. 26 Subtitle 40 Complete Streets SS 40-27(B).

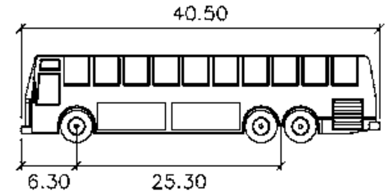


DL−23

		feet
Width	:	8.50
Track	:	8.50
Lock to Lock Time	:	6.0
Steering Angle	:	40.4

Transit Streets Design—BU-40

This is a city bus, which should be the design vehicle along transit routes, and for turning movements at intersections where transit routes change streets. This is based on the most recent edition of NACTO *Urban Street Design Guide* as specified in Baltimore City Code Art. 26 Subtitle 40 Complete Streets SS 40-27(C).



BUS−40

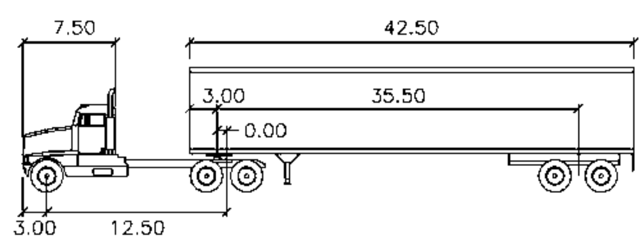
		feet
Width	:	8.50
Track	:	8.50
Lock to Lock Time	:	6.0
Steering Angle	:	41.9

Truck Routes—WB-50

This is a standard sized 5 axle tractor trailer, which should be:

- Design vehicle for intersections connecting non-restricted through truck routes.
- Control vehicle for intersections in which trucks turn to/from local, restricted, or restricted-local truck routes.

This is the based on the most recent edition of NACTO *Urban Street Design Guide* as specified in Baltimore City Code Art. 26 Subtitle 40 Complete Streets SS 40-27(D).

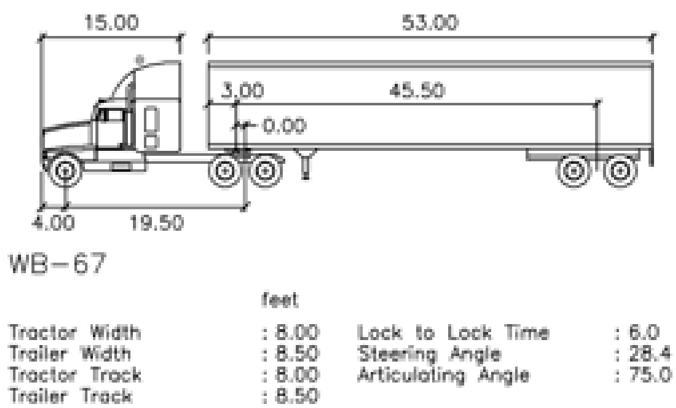


WB−50

	feet		
Tractor Width	: 8.00	Lock to Lock Time	: 6.0
Trailer Width	: 8.50	Steering Angle	: 17.7
Tractor Track	: 8.00	Articulating Angle	: 70.0
Trailer Track	: 8.50		

WB-67

This is the largest tractor trailer that is most appropriate for interstate travel and heavy freight movement. This design vehicle is not appropriate for City streets with the exception of those that travel through industrial areas. To use a WB-67 as a design vehicle, exceptions must be granted through the Department of Transportation's Traffic Engineering and Complete Streets Sections.



As established in Baltimore City Code Art. 26 Subtitle 40 Complete Streets SS 40-27(B) and based on the most recent edition of NACTO *Urban Street Design Guide,* the design vehicle for a street is set by the following criteria:

Route	Route Source	Design Vehicle	Design Vehicle Source
All Non-Truck Routes and Non-Transit Streets	Baltimore City Official Truck Route and MTA Transit Route Map	DL-23	NACTO *Urban Street Design Guide*
Transit Street	MTA Transit Route Map	BU-40	NACTO *Urban Street Design Guide*
Truck Routes	Baltimore City Official Truck Route	WB-50 (1)	NACTO *Urban Street Design Guide*

(1) WB-67 are permitted on Interstates and in Industrial areas.

Control Vehicles

Control vehicles are vehicles that infrequently use a facility but still must be accommodated. Control vehicles can include Emergency Service (EMS), fire engines, moving trucks, and sanitation trucks. On streets with lane widths of 9' (See Travelway Subzone), control vehicles may be required to overhang a travel lane and encroach on adjacent lanes. This can be accommodated by providing low-volume, low-speed roads with good sight distance and should be evaluated by designers of new streets to ensure that there is acceptable width for control vehicles.

At intersections, control vehicles can encroach into the opposing traffic lanes, make multiple-point turns, or have minor encroachment into the street side (providing they avoid impacts to utilities, lights, signal equipment, signs, and the sidewalk zone). For further details, see Corner Design.

Control vehicles to be accommodated in roadway designs are as follows:

» **Emergency Vehicle Response**: Ladder Truck/Fire Engine (per City specifications)

» **Sanitation Truck**: The maneuverability of a sanitation truck is similar enough to a DL-23; therefore, a roadway that accommodates one should adequately serve the other.

Truck Routes

Curbside Lane Subzone

The curbside lane subzone is the section of the roadway that is between the travelway subzone and the curbspace. The size of this space is typically limited due to right-of-way constraints and it is not present on every street. The curbside lane subzone may be directly adjacent to the travelway subzone or it may be buffered by a street buffer subzone. For further details, see Street Buffer Subzone.

The use of the curbside lane subzone is typically defined by the modal priority of the street. Typical uses for the curbside lane include:

- **Bicycle Facilities**: Can be used by micromobility users within the curbside lane and can include standard bike lanes, buffered bike lanes, left-side bike lanes, contra-flow bike lanes, street-level separated bike lanes and two-way street-level separated bike lanes. For further details see Bicycle Facilities.
- **Dedicated Transit Lanes**: Can include a curbside transit lane, peak-only bus lane, offset transit lane, side-running rail lane, and shared bus-bike lane. For further details, see Transit Facilities.

Transit Curbside Lane

Street Buffer Subzone

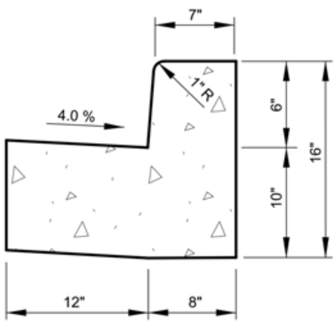
The street buffer subzone is a space that separates vulnerable road users from motor vehicles. The purpose of the street buffer subzone is to maximize the safety and comfort of vulnerable road users by providing a physical separation. This buffer is an important component of a bicycle network that is designed for all ages and abilities as discussed in Bicycle Facilities. The recommended widths for the street buffer subzone are included as part of the bicycle facility widths in Appendix 1: Baltimore Complete Streets Design Criteria. It is important to note that, although an important subzone, the street buffer subzone is not listed in the Limited Right-of-Way Priorities Table on pages 34 and 35 because the table is to assure that modal priority areas are addressed prior to accommodating a buffer between the other subzones.

There are three typical locations where street buffer subzones are used:

- Separation between the travelway and curbside bike lane or transit facility.
- Separation between the curbspace and a separated bicycle facility.
- Separation between the travelway subzone and median bicycle or transit facility.

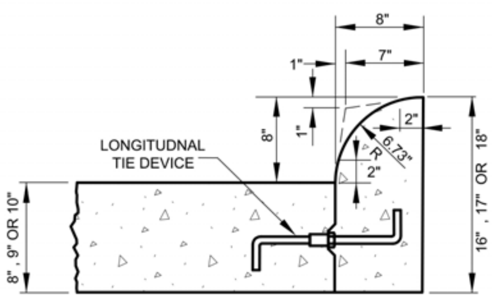
The appropriate street buffer width will vary depending on the degree of separation desired, right-of-way constraints, and type of separation element that is used. The buffer can consist of raised medians with curbs, landscaped medians, parked cars, and other channelizing devices. Materials for the street buffer subzone may vary between permanent installations and quick-build projects, as discussed in Quick-Build Strategies. BCDOT is investigating standards for separated bike lanes to include a permanent option of a physical curb separation with bollards. The various types of materials can be broken into the following categories:

- Medians should be constructed of curb and sidewalk that meet Baltimore City Department of Transportation *Book of Standards*. To reduce the risk of pedal strike, different curbs can be considered to reduce the chance of crashes for bicycles:
  - Standard type A curb or standards type A curb and gutter should be used adjacent to the travelway subzone to act as a barrier.



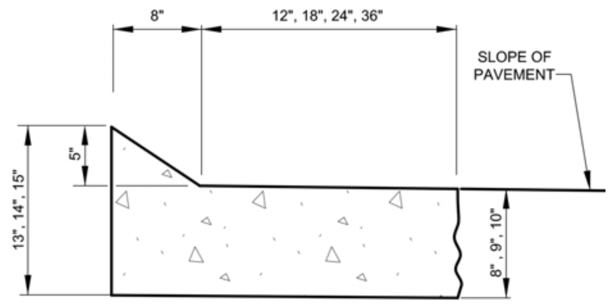
SPECIAL TYPE 'A' COMBINATION CURB AND GUTTER
(12" x 10" PAN)

  - Standard type 'A' modified curb or standard type 'A' modified curb and gutter should be considered for the interior curbs of a separated bike lane. The angle of this type of curb reduces the chance of a pedal striking the curb.



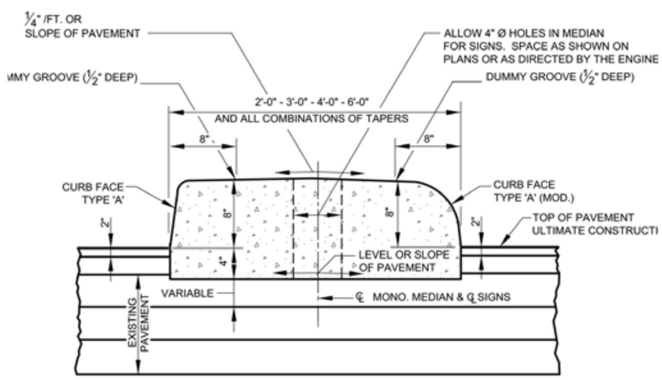
STANDARD TYPE 'A' MODIFIED CURB

- Standard mountable "V" type combination curb and gutter can be considered for the interior curbs of an interim half height sidewalk-level separated bike lane.



STANDARD MOUNTABLE "V" TYPE COMBINATION CURB & GUTTER

- Monolithic concrete medians can be constructed per Baltimore City Department of Transportation *Book of Standards*.



MONOLITHIC CONCRETE MEDIAN
TYPE 'A'
USE WITH FLEXIBLE PAVEMENT

- Green stormwater islands can be used as discussed in Green Street Components.
- Raised channelizing systems, bike rails, and wave delineators may be considered upon approval from Baltimore City Department of Transportation. For further details, see Emerging Materials and Treatments.

Travelway Subzone

The travelway subzone is the portion of the roadway that is primarily used for the movement of motor vehicles. Depending on the Street Type, the travelway subzone may also be frequently used by bicyclists and micromobility users, and may include bicycle facilities such as shared lanes and bicycle boulevards. For further details, see Bicycle Facilities.

Travelway Width

The width of the travelway lanes is established by law and is based on the functional classification in the *Baltimore City Roadway Functional Classification Map* as follows:

1. Local Designated Roads
   Maximum 9' wide lanes
2. Collectors and Arterials
   Maximum 10' wide lanes
3. Transit Streets and Truck Routes
   On a transit street or truck route, one lane in each direction may be up to 11' wide. For further details, see Transit Facilities.

This criteria is reflected in the travel lane widths provided for each Street Type in Appendix 1.

Number of Through Lanes

Consistency in the number of through lanes on a corridor should be a priority to prevent aggressive driving and passing maneuvers. Unless additional lanes can be justified by a significant traffic source or turning movement, the number of through lanes should be kept the same. For example:

» Projects on roadways that transition from 2-through lanes to 4-through lanes to 2- through lanes should be analyzed for conversions to a consistent 2-through lanes.

Lane additions that are justified through a significant traffic generator or turning movement should stay consistent downstream until dropped as high-volume turning movements or other "sinks." If the lane drop does not occur at a high-volume "sink," or turning movement, the lane addition should be considered for removal.

Travelway widths balance narrow lanes for speed control with safely accommodating the movement of transit and trucks.

E Lombard Street at Light Street

Lane Drops

Merging lane drops, or lane drops that occur at low-volume turning movements should be avoided when possible. In the context of an urban environment, lane drops create opportunities for aggressive drivers to speed in order to get ahead of queued traffic before or after an intersection. Consistency in through lanes should be considered. Projects that occur on roadways with existing lane drops should investigate methods of eliminating these conditions by extending the segment in which the number of lanes is reduced.

Lane Drops at Intersections

Existing intersections with safety issues/high crash rates should be prioritized for safety treatments, whether through a quick-build program or longer-term capital improvement projects. Lane drops that occur just prior to or after those intersections should be eliminated, as while they may increase traffic capacity slightly, they can increase the speed differential between lanes and increase the likelihood of aggressive driving, passing, and merging.

Similarly, lane additions for capacity reasons should not occur at or just before an intersection. Removing situations in which this condition exists can help prevent aggressive lane changes/passing and ambiguous right-of-way assignment through intersections where the number of through lanes increases just before an intersection and decreases shortly after.

Traffic Calming within the Travelway

There are several traffic calming elements that can be placed within the travelway subzone on neighborhood and other low-volume streets. These are in addition to intersection and pedestrian crossing traffic calming measures discussed in the Complete Streets Intersection Toolbox. Examples of travelway traffic calming elements include:

Chicanes

Chicanes are offset elements that add lateral shifts to the vehicle travelway. Chicanes require drivers to weave around offsets, which can be outlined with curbs or any vertical barrier element. The spacing of the elements is designated by the Maryland *MUTCD*. The chicanes can provide additional areas for neighborhoods or local officials to place beautification elements. Chicanes can also be used to reduce the space on oversized lanes and can provide some additional curbside parking between the elements.

Guidance

- Chicanes are most appropriate in the following Street Types:
  - Urban Village Shared Street
  - Neighborhood Corridor
- The chicane area should be clearly delineated from surrounding areas.
- Chicanes should be set at 45-degree angles at the maximum.
- Chicanes are typically 5’-7’ from the perpendicular curb line.

Required

- A 1’ buffer should exist between the outside edge of the chicane and the travelway.
- Chicanes shall be outlined with retroreflective pavement marking to visually show the area.
- Minimum ingress length is 15’.
- Minimum egress length is 5’.

Speed Humps, Tables and Cushions

Speed humps and tables are midblock traffic calming devices that raise the entire wheelbase of a vehicle to reduce its speed. Speed cushions are narrower in width and create a vertical deflection for smaller vehicles while allowing wider wheelbase emergency response vehicles to pass through without delay.

Guidance

- Speed humps, tables, and cushions are most appropriate in the following Street Types:
  - Urban Village Neighborhood
  - Urban Village Shared Street
  - Neighborhood Corridor
- Speed humps and tables should not be placed on roads that are primary truck routes on the Baltimore City Official Truck Route Map.
- Emergency vehicle access should be considered when placing a speed hump, and tables should be used near a fire station or along a high-volume emergency response route. In these locations also consider the use of a speed cushion.
- Drainage needs to be considered when placing speed humps and tables, but should not be the sole determining factor in preventing installation of the raised crosswalk.

Design

- For details on speed tables with pedestrian crossing, refer to Raised Crosswalks in the Complete Streets Intersection Toolbox.
- The transition area between the road and the raised crosswalk should be 6’ horizontally for a 6” raised crosswalk. See Maryland *MUTCD*, Figure 3B-30 for further details.
- Pavement markings for raised crosswalks should follow standards in Crosswalk Markings in the Complete Streets Intersection Toolbox as well as the standards in Maryland *MUTCD* Sections 3B.25 and 3B.26. When a raised crosswalk is used at a mid-block crossing, pavement markings should follow Maryland *MUTCD* Figure 3B-17.

Baltimore City Bike Master Plan

Bicycle Friendly Speed Hump

Median Subzone

The median subzone is the section of the roadway that separates two-way streets and can be raised or at roadway level.

Table 7 provides design criteria for the median subzone based on usage and Street Type. For a complete list of design criteria requirements for a Complete Street, see Appendix 1.

Potential uses for the median subzone include:

Flush Median

A flush median is a continuous area located in the middle of the travelway that delineates traffic traveling in opposite directions. Flush medians reduce the travel lane width and can slow traffic.

Guidance

- Surface treatments can be placed to further differentiate the median.
- Vertical elements can be placed along the outside edge of the median.

Required

- Retroreflective markings shall surround the median area.
- Length and width shall depend on the travelway width.
- Ability for emergency vehicles to traverse around the median shall be considered during design.

Pedestrian Safety Islands

Pedestrian safety islands can part of a continuous median or a stand-alone feature. By providing a place to wait mid-crossing, pedestrian safety islands allow pedestrians and bicyclists to navigate one direction of motor vehicle travel at a time. See the Complete Streets Intersection Toolbox for further details.

Landscaping

Traditional landscaping or green stormwater infrastructure can be implemented within a median. All plantings and trees shall be approved by Baltimore City Recreation and Parks' Forestry Division and shall be trees that are included in the Baltimore City Street Tree Species List. See Sustainable Stormwater Management in the Emerging Trends section for further details on implementation of green stormwater management.

Bicycle Facilities

Median bicycle facilities typically consist of one-way sidewalk-level separated bike lanes, two-way sidewalk-level separated bike lanes, or shared-use-paths. See the Bicycle Facilities subsection for further details.

Transit Facilities

Center running transit lanes and boarding islands can be implemented within the median. See Transit Facilities.

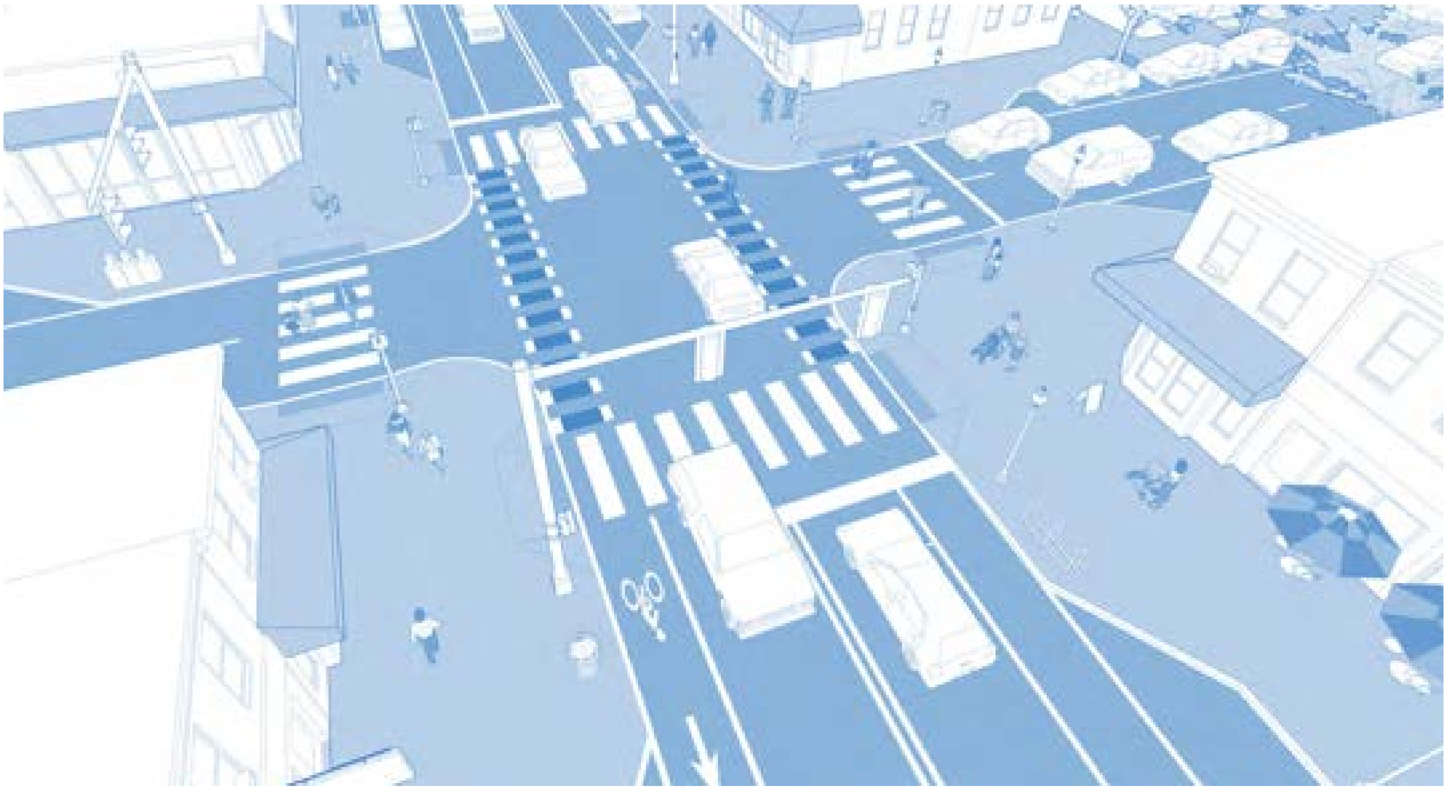
Raised Median with Pedestrian Safety Island

Table 7. Median Subzone Requirements

		Median Use (1)		
Street Type	Requirements	Pedestrian Refuge	Continuous with Landscaping	Continuous without Landscaping
Downtown Commercial	Maximum	-	-	-
	Target	10’	10’	6’
	Constrained	7.33’	6’	2’
Downtown Mixed-Use	Maximum	-	-	-
	Target	10’	10’	6’
	Constrained	7.33’	6’	2’
Urban Village Main	Maximum	-	-	-
	Target	10’	10’	6’
	Constrained	7.33’	6’	2’
Urban Village Neighborhood	Maximum	-	N/A	-
	Target	10’	N/A	6’
	Constrained	7.33’	N/A	2’
Urban Village Shared Street	Maximum	N/A	N/A	N/A
	Target	N/A	N/A	N/A
	Constrained	N/A	N/A	N/A
Urban Center Connector	Maximum	-	-	-
	Target	10’	10’	6’
	Constrained	7.33’	6’	2’
Neighborhood Corridor	Maximum	N/A	N/A	N/A
	Target	N/A	N/A	N/A
	Constrained	N/A	N/A	N/A
Industrial Access	Maximum	-	-	-
	Target	10’	10’	6’
	Constrained	7.33’	6’	2’
Parkway	Maximum	-	-	-
	Target	10’	10’	6’
	Constrained	7.33’	6’	2’
Boulevard	Maximum	-	-	-
	Target	10’	10’	6’
	Constrained	7.33’	6’	2’

(1) For width requirements of median bicycle or transit facilities refer to Bicycle Facilities and Transit Facilities in this Manual.

INTERSECTIONS, CROSSINGS, AND MID-BLOCK TREATMENTS



In cities and urbanized areas intersections, crossings, and mid-block treatments generally represent the highest risk locations within the transportation network. On most roadways, all modes are guided to interact at intersections; therefore, the majority of vehicle to vehicle and vehicle to bike/pedestrian conflicts occur at intersections. Intersections should be designed to maximize the safety of all users of all abilities. The following should be used to assess and address the safety of intersections being designed in Baltimore City:

Pedestrians

Pedestrian safety can be improved on any street by slowing vehicle speeds to align with the Street Type's target speed, shortening pedestrian exposure across the intersection, improving visibility (sight distance and lighting), and providing accessible pedestrian design. This may be achieved by employing the following strategies:

- Select appropriate intersection type
- Reduce the number of through lanes
- Narrow travel lane widths
- Tighten/reduce effective corner radii and minimize the use of free-flowing channelized right turn configurations
- Shorten crossing distances by reducing lane count or constructing bump outs, narrowing travel lanes, and/or reducing effective corner radii
- Implement traffic calming measures
- Provide accessible pedestrian crossings

- Provide accessible pedestrian signals
- Ensure adequate crosswalk lighting
- Implement no right-turn on red restrictions
- Stripe setback stop bars

Pedestrian accessibility and safety can be improved on streets by providing a comfortable and inviting space. This can be accomplished by:

- Maximizing the dedicated space for pedestrians
- Planting trees
- Providing an adequate buffer between moving vehicles and pedestrians

Pedestrians should have convenient crossing opportunities that minimize delays. This can be accomplished by providing:

- Traffic signals at crossings with high traffic volumes (i.e. signalized, stop controlled, beacons, etc.)
- Automatic pedestrian phase for every signal cycle regardless of push button actuation

Curb Extensions Shorten Crossing Distances

Baltimore City Bike Master Plan/ Brian O'Doherty

Complete Streets Improve Pedestrian Safety

- Short signal cycles that minimize wait time for pedestrians. (i.e. shorter cycle lengths)
- Sufficient opportunities to cross the street, including additional crossing opportunities mid-block or at intersections that may currently be uncontrolled
- Crossings at all legs of intersections

Bicyclists and Micromobility Users

Safety on streets can be improved for bicyclists and micromobility users by slowing vehicle speeds, reducing exposure to conflicts, communicating right-of-way, and providing separation between modes. This can be achieved by utilizing the following strategies:

- Select appropriate intersection type
- Reduce lane count
- Narrow vehicle travel lane widths
- Tighten corner radii
- Implement traffic calming measures
- Provide a dedicated and continuous space for bicyclists
- Shorten intersection crossing distance

- Improve sightlines between turning drivers and bicyclists continuing through the intersection
- Ensure that signal design eliminates or minimizes conflicts with other modes of transportation, and provide bicycle signals where appropriate
- Ensure conflict points and approaches to conflicts are adequately illuminated
- Provide appropriate sight lines and intersection geometry to encourage motorist yielding
- Provide separated bicycle facilities

Convenience for bicyclists and micromobility users can be improved at intersections by providing well-maintained and intuitive facilities. This can be accomplished by providing:

- Clear and understandable wayfinding signs designed for all users
- Wayfinding medallions or pavement markings on the pavement in the line of sight of bicyclists
- Signing to clearly communicate right-of-way
- Forward queuing areas and/or bicycle boxes
- High quality pavement that improves ride quality
- Connections to other facilities
- Strategically placed bicycle parking and micromobility corrals

Wayfinding Signs in Baltimore City


Aligning Pedestrian Infrastructure With Transit Stops/Shelters

Bicyclist and micromobility user delays should be minimized with responsive signals that may include the following:

- Bicycle detection
- Bicycle signals (see Bicycle Signal Timing for more details)
- Bicycle phasing (i.e. leading bicycle interval)
- Intuitive crossings

Transit Users

Safety can be improved for transit users by aligning pedestrian and bicycle accommodations with transit facilities, reducing pedestrian exposure, and providing accessible transit stops. This can be achieved by utilizing the following design features and strategies:

- Bus bulbs
- Separated transit facilities
- Far-side bus stops are preferred
- Ensure that stopped transit vehicles do not impede sightlines to crossing pedestrians

Convenience for transit users can be improved by providing mobility hubs and comfortable transit stops.

This can be accomplished by providing:

- Crosswalks adjacent to bus stops
- Adequate wayfinding signs
- Adequate lighting
- Transit shelters and benches
- Level landings aligning with both the front and rear transit doors
- Logical connections to connecting transit services that minimize roadway crossings
- Realtime data on next buses
- Trees and other shade opportunities
- Micromobility hubs with clear and understandable wayfinding signs designed for novice users

Transit user delays should be minimized with responsive traffic signals that may include the following:

- Short signal cycles combined with dedicated transit lanes
- Transit Signal Priority on roads with large block spacing outside of the Central Business District
- Queue jump lanes and/or transit signalization

Vehicle Users

Safety can be improved for vehicle users through traffic calming by slowing vehicular speeds, reducing both opportunity and incentive for aggressive driving, and providing proper traffic control where needed. This can be achieved by employing the following strategies:

- Improve sight lines at intersections, specifically between turning vehicles and through vehicles

On multi-lane roadways:

- Provide dedicated turn lanes for left-turning vehicles at intersections with high left-turn volumes
- Provide traffic signalization or stop control based on sightlines, traffic volumes, and engineering judgment
- Provide consistency in the number of through travel lanes along a corridor

Convenience can be improved for motorists by:

- Minimizing the need to change lanes to continue through along a corridor
- Decreasing signal cycles, especially during off-peak hours, while adequately serving demand
- Utilizing the full grid network by not prioritizing individual corridors in any one direction

Motorist delays shall be minimized with responsive signals that may include the following:

- Coordinated signal timing
- Responsive signal detection outside of the historic grid network in suburbanized areas
- Adaptive signal systems

This section provides recommendations for improving intersections, crossings, and mid-block treatments with the methods above. This can be accomplished by:

- Selecting the appropriate intersection type. See Intersection Types on page 85.
- Optimizing traffic signal operations. See Traffic Signal Operations and Design.
- Designing intersection corners to slow vehicles and shorten pedestrian crossings. See Corner Design.
- Improving safety for all users with the methods presented in the Complete Streets Intersection Toolbox.


East Lombard Street and Calvert Street

Intersection and Street Crossing Control

Intersection and street crossing design should follow modal hierarchy and modal priorities. Well-designed intersection geometry is another vital component to creating a Complete Street that is safe, comfortable, and responsive to all modes of transportation. The context of the intersecting Street Types also needs to be evaluated when designing an intersection or street crossing since intersections and street crossings should be a cohesive part of the community they are within, and not a boundary. This section provides guidance on midblock or unsignalized crossing guidance and a list of both unsignalized and signalized intersection types available for use on Baltimore Streets. All intersection designs must be approved by the Baltimore City Department of Transportation and meet Baltimore City Department of Transportation requirements.

Refer to the other subsections of the intersection portion of this Manual for complete design guidance on intersections, including:

» Optimizing traffic signal operations in Traffic Signal Operations and Design.

» Designing intersection corners to slow vehicles and shorten pedestrian crossings in Corner Design.

» Improving safety for all users with the methods presented in the Complete Streets Intersection Toolbox.

Midblock or Unsignalized Crossing Guidance

Students in Baltimore City Public Schools do not receive bus service within a one-mile radius of their zoned school because a one-mile radius is considered a walkable distance for students beginning at elementary school. Students should be able to safely walk to school. However, this relies on our entire street network being all ages, meaning that all roadways and crossings in residential areas near schools should be considered safe and comfortable enough for an unaccompanied child to navigate.

Previous efforts such as Safe Routes to School programs have attempted to change pedestrian behavior and channelize students to walking routes that are deemed safe. The inherent flaw to this approach is that the most logical route may be ignored because it is not considered safe under existing conditions. For example, a safe route may guide pedestrians on a one block detour to a signalized intersection, adding 700 feet to one's path just to cross a 40-foot-wide roadway. This is not a reasonable accommodation. To adhere to the City's stated modal hierarchy and meet equity goals of serving those who do not have access to vehicles, a primary goal of managing our roadway network is to make all crossings near residential areas and schools all ages.

Engineering judgment and common sense should prevail in determining whether crossings are all ages. The simple question "would I feel safe letting a child cross here by him or herself?" is an adequate litmus test.

For street reconstruction or major capital improvement projects, a comprehensive approach to traffic calming and pedestrian safety should be taken, which can decrease the need for active control at pedestrian crossings. However, safety improvement work is often implemented as a retrofit because the resources are not available to comprehensively reconfigure the function and feel of a street. Under these circumstances, active measures are often the most appropriate treatments for increasing crossing safety in a short period of time at a relatively low expense. The following guidance describes different measures that should be considered to create all age crossings as corridor safety improvements.

Passive Measures

Providing passive measures such as stop signs, pedestrian crossing signs, and striped crosswalks may be appropriate at unsignalized intersections on lower volume roads that operate at their intended target speeds. Passive measures are acceptable crossing treatments on streets that:

- Are classified as local or collector
- Operate at a target speed of <25 mph
- Have Average Daily Traffic of <8,000 vehicles per day
- Are only one lane in each direction

See Intersection Types below for further design guidance.

Active Measures and Raised Crosswalks

Providing active measures such as rectangular rapid flashing beacons or other flashing lights, or raised crosswalks may be appropriate on medium volume roadways that operate at their intended target speeds. Active measures are acceptable crossing treatments on streets that:

- Are classified as a collector or arterial
- Operate at a target speed of <25 mph
- Have Average Daily Traffic of <12,000 vehicles per day
- Are only one lane in each direction

Raised Crosswalk in Washington, D.C.

See Intersection Types below for further design guidance.

Signalized Crossings

High-volume multi-lane roadways that experience higher speeds require special attention to make crossings all ages. Both passive measures and active measures to assist in pedestrian crossings rely on driver compliance in yielding to pedestrians. Because driver behavior differs from city to city, the approach to providing for increased pedestrian safety should adapt to the driver behavior exhibited in each city. In general, signalized crossings including a full-signal, pedestrian signal, or HAWK signal are recommended treatments on streets that:

- Are classified as arterial
- Operate at a speed of >25 mph
- Have Average Daily Traffic of >12,000 vehicles per day
- Are multiple lanes in one direction

See Intersection Types below for further design guidance.

Pedestrian Safety Islands

See the Complete Streets Intersection Toolbox.

While different measures of control may be implemented to improve pedestrian safety at currently unsignalized or mid-block crossings that align with pedestrian desire lines, pedestrian safety islands, combined with passive or active measures, may increase the comfort and safety on a street that experiences higher target speeds.

Intersection Types

Stop Controlled Intersections

Stop controlled intersections are intersections where at least one of the approaches are controlled by a stop sign. At intersections where a minor road intersects a major road, stop signs are typically placed on the minor road. Though not ideal, driver expectation in Baltimore City is that the absence of a stop sign or traffic signal unconditionally provides the driver on that approach the right-of-way. ecause of this, additional attention should be paid to stop sign and/or traffic signal placement at intersections with limited sightlines. All-way stop sign application can be implemented on roadways in which sightlines are limited and minor street volumes and pedestrian volumes are significant enough to warrant a stop sign to assign them equal right-of-way.

Guidance

- Sight distance should be evaluated when identifying the location of a stop sign or evaluating a request for an all-way stop. Inadequate sightlines may warrant an all-way stop or traffic signal.
    - Significant parking elimination or removal of trees/ landscaping features should not be the first solution for an intersection with sightline deficiencies.
- Within the grid network, consistency in all-way stop application should be a significant factor for determining placement of stop signs. If a roadway has multiple all-way stops and two-way stops are the exception, for consistency, it may make sense to install all-way stops at each intersection to better match driver and pedestrian expectations of right-of-way assignment.
- On wide roadways (approximately >35') with stop signs, a left and right side stop sign should be provided.
- On wide roadways, increased visibility to the right side stop sign can be provided by either an in-road stop sign or a stop sign placed in a bump out.
- It is desirable to minimize the number of stop signs on bicycle boulevards. Refer to Bicycle Facilities for further details.
- For details on pedestrian and bicycle enhancements that can be provided at a stop controlled intersection, refer to the Complete Streets Intersection Toolbox.
- For details on transit stops adjacent to stop controlled intersections, refer to Transit Facilities.

Procedure

- Within the City grid network, on roadways with average daily traffic of approximately 5,000 vehicles per day or less, all-way stops can be evaluated according to the following criteria:
    - Calculate total of multiple hours of the major street volume, excluding pedestrians.
    - Calculate total of multiple hours of the minor street volumes, including pedestrians crossing the major street.
    - If the major volume is less than 3 times the minor volume, an all-way stop should be considered.
    - If the major volume is between 3 times and 5 times the minor volume, an all-way stop may be considered given other factors determined by engineering judgment.
    - If the major volume is greater than five times the minor street volume, only special circumstances should warrant an all-way stop.

Standards

- The stop sign shall have a minimum of 4' offset from the crosswalk at the intersection. Refer to the Complete Streets Intersection Toolbox for further details on crosswalks.

Stop Controlled Intersection

- The City of Baltimore's *Specifications for Street Lighting & Conduit* should be referenced to ensure any proposed lighting changes meet the proper requirements.

Options to enhance midblock or unsignalized crossings include:

Mid-Block Crosswalks

Mid-block crosswalks facilitate pedestrian crossings at locations that are not facilitated by crosswalks at nearby intersections. Representative examples that warrant a mid-block crosswalk may include transit stops (bus or light rail), parks, plazas, building entrances, midblock passageways, trails, etc.

Guidance

- The construction of curb extensions is recommended at mid-block crosswalks. Uses for these extensions can include transit stops, micromobility corrals, and green stormwater infrastructure.
- For guidance on the use of crosswalk safety enhancements including high-visibility crosswalk markings, raised crosswalks, advance yield here signs, in-street pedestrian crossing signs, curb extensions, pedestrian refuge islands, rectangular rapid-flashing beacons, road diets, and pedestrian hybrid beacons, refer to the Complete Streets Intersection Toolbox and the FHWA *Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations*.

Standards

- Set stop lines at midblock crossings back 20' to 50'.
- Stripe the crosswalk regardless of the paving pattern, material, or color.
- If curb extensions cannot be constructed, limit parking to at least 20' prior to the crosswalk.
- For lighting design within the crosswalk, refer to NCHRP *Report 672* and the City of Baltimore's *Specifications for Street Lighting & Conduit*.

Raised Intersections

Raised intersections provide a flat raised section of the roadway throughout the intersection. This enhances the pedestrian crossings by slowing approaching vehicles. These intersections are typically placed at the junctures of collector, local, and residential streets that have a high pedestrian crossing demand, and raise both the intersection and the crosswalks on all approaches.

Guidance

- Use at intersections with approach speeds at or less than 35 mph.
- Typically, the raised intersection is level with the adjacent sidewalk.
- Bollards may be used to assist with delineation of the roadway from the surrounding sidewalk. Control vehicle turning movements should be evaluated when placing bollards. The bollards should not be placed as to interfere with pedestrian or bicycle movement at the crossings.
- The flat area of the motorist travelway may be constructed with concrete and can be textured to differentiate it from other sections of the roadway.
- For details on transit stops adjacent to raised intersections, refer to Transit Facilities.

Standards

- Slopes on approaches should not exceed 1:10 or be less steep than 1:25.
- Provide pavement markings and signs on approach to the raised intersection per Maryland *MUTCD* Figures 3B-30 and 3B-31.
- For details on crosswalks through the intersection, refer to Crosswalk Markings in the Complete Streets Intersection Toolbox.
- A 2% cross slope shall be provided in the raised portion of the intersection to ensure adequate drainage.
- The cross slopes of crossing areas of the raised intersection shall comply with ADA guidelines.

» The City of Baltimore's *Specifications for Street Lighting & Conduit* should be referenced to ensure any proposed lighting changes meet the proper requirements.

Mini-Roundabouts / Neighborhood Traffic Circles

Mini-roundabouts (also called neighborhood traffic circles) are circular intersections that use textured and/or raised central islands to circulate traffic in a counter-clockwise direction. This configuration slows vehicles on approach to an intersection since they are required to yield to other vehicles within the intersection. Along with slowing down vehicles, mini-roundabouts can reduce certain types of crashes that are prevalent at traditional intersections, including "T-bone" and "head-on" collisions.

Guidance

» Mini-roundabouts are typically chosen compared to full-size roundabouts with the intention of minimizing/eliminating any work outside of the existing intersection footprint.

» Pedestrian ramps and crosswalks should be placed close to the curb returns at each of the corner quadrants of the roundabout.

» A vertical element should be placed in/on the mini-roundabout to provide drivers awareness of its existence.

» Raised pavement markings or other reflective devices should be placed on the outside of a mini-roundabout to increase nighttime visibility.

» NCHRP *Report 672* recommends an inscribed circle diameter of between 45' to 90' and the use of the SU-30 as a design vehicle. However, a delivery vehicle (DL-23) may be appropriate on residential streets.

» The recommended maximum entry speed for mini-roundabouts is typically 15 mph. (NCHRP *Report 672*).

» Mini-roundabouts can be used as a traffic calming element within a bicycle boulevard. Refer to Bicycle Facilities for further details.

» Mini-roundabouts can be a good opportunity for incorporating green stormwater infrastructure. Refer to Green Street Components for further details..

» Bike lanes should terminate prior to a mini-roundabout. Sharrows should be provided on the approach to the mini-roundabout.

Standards

» Mini-roundabouts should be designed in accordance with Maryland SHA *Roundabout Design Guidelines* and NCHRP *Report 672*.

» Signing and pavement markings at a mini-roundabout should be designed in accordance with the Maryland *MUTCD*.

» Two scenarios to allow for truck turning movements are acceptable:

  » Make the central island traversable so that large turning vehicles can mount it when turning.

  » If the central island is not traversable, trucks or larger vehicles turn left against traffic flow.

» If the splitter island is wider than 6' (7'-4" face of curb to face of curb) then a pedestrian safety island

Vegetated Mini-Roundabout

must be provided. Refer to the Complete Streets Intersection Toolbox and NCHRP *Report 672* for further details.

- For lighting design within a mini-roundabout, refer to NCHRP *Report 672* and the City of Baltimore's *Specifications for Street Lighting & Conduit*.

Roundabouts

In addition to mini-roundabouts, single-lane roundabouts and multi-lane roundabouts are also design options. Some of the differences between the three types include the desirable maximum entry speed, with single-lane roundabouts being between 20 and 25 mph and multi-lane roundabouts being between 25 and 30 mph. Compared with mini-roundabouts, the size of the inscribed circle increases for roundabouts, with single-lane roundabouts having a diameter of 90' to 180'and multi-lane roundabouts having a diameter of 150' to 300'. Rather than the fully traversable island that is characteristically common with mini-roundabouts, the central islands in roundabouts are raised with traversable aprons. Also, the larger roundabouts can service larger volumes of traffic.

Similar to a mini-roundabout, the configuration of a roundabout slows vehicles on approach to an intersection since they are required to yield to other vehicles within the intersection. Along with slowing down vehicles, roundabouts can reduce certain types of crashes that are prevalent at traditional intersections, including "T-bone" and "head-on" collisions.

Guidance

- Given the requirement for drivers to yield to pedestrians, careful selection of roundabouts in urban areas is recommended. Full-size roundabouts are typically better-performing at locations with lower pedestrian volumes.
- The recommended maximum entry speed for single-lane roundabouts is typically 20-25 mph and for multi-lane roundabouts between 25-30 mph. (NCHRP *Report 672*)
- Pedestrian ramps and crosswalks should be placed close to the curb returns at each of the corner quadrants of the roundabout.
- NCHRP *Report 672* recommends a diameter between 90' to 180'for single-lane roundabouts. Single-lane roundabouts should be designed so that a single unit truck can navigate the circulator road in-lane, while a tractor trailer can navigate the roundabout by utilizing the circulatory road and the truck apron. However, if the single-lane roundabout falls on a truck route, the design vehicle can utilize the truck apron.
- NCHRP *Report 672* recommends a diameter between 150' to 300' for multi-lane roundabouts. Multi-lane roundabouts should be designed so that a single unit truck navigates the circulator road in-lane, while a tractor trailer can navigate the roundabout by utilizing the circulatory road and the truck apron. However, if the multi-lane roundabout falls on a truck route, the design vehicle can utilize the truck apron. For details on the design of turning movements through a multi-lane roundabout, including addressing path overlap issues, refer to NCHRP *Report 672*.
- Multi-lane roundabouts present challenges for pedestrians and bicyclists because they must cross

Roundabout with Mountable Apron

two lanes of uncontrolled traffic. Consider the use of rectangular rapid flashing beacons or high-intensity activated crosswalks at pedestrian crossings on multi-lane roundabouts. PROWAG (while not yet approved) will require signalization of all uncontrolled multi-lane crossings. As such, multi-lane roundabouts should generally be avoided. There are designs that could be implemented that provide a refuge island between each lane of moving traffic, but that will increase the intersection footprint.

» Conventional bike lanes must terminate prior to a roundabout per *MUTCD*. A shared-use path or separated bike lane should be provided on the outside of the roundabout. See NCHRP *Report 672* for guidance.

Standards

» Roundabouts shall be designed in accordance with Maryland SHA *Roundabout Design Guidelines* and NCHRP *Report 672*.

» Signing and pavement markings at a roundabout shall be designed in accordance with the Maryland *MUTCD*.

» Crosswalks should be placed approximately 20' upstream of each entrance to allow for a single vehicle to be stopped between the crosswalk and the circulatory road entrance.

» If the splitter island is wider than 6' (7'-4" face of curb to face of curb) then a pedestrian safety island must be provided. Refer to the Complete Streets Intersection Toolbox and NCHRP *Report 672* for further details.

» For lighting design within a roundabout, refer to NCHRP *Report 672* and the City of Baltimore's *Specifications for Street Lighting & Conduit*.

Median Diverters

Median diverters prevent motor vehicles from driving straight through the intersection while allowing bicyclists, micromobility users, and pedestrians to continue through the intersection. They also allow bicyclists, micromobility users, and pedestrians to cross the intersection in two stages.

Guidance

» Median diverters are appropriate on low-volume, primarily residential streets where through traffic is not desired, but pedestrian and bicyclist connectivity is critical.

» Consider the use of green stormwater infrastructure adjacent to the sidewalk and/or bike lane portion of the median diverter.

» In high pedestrian or high bicyclist volume areas consider the use of raised crosswalks.

» Median diverters should be considered along bicycle boulevards to keep motorist volumes low and to provide crossing opportunities for bicyclists along these corridors.

Standards

» If the cut-through is wider than 8' in width, flexible post delineators should be placed in the center of the cut-through to prevent motor vehicles from crossing through.

» The desired width of a median diverter is 8' to 10'. The minimum width of the median diverter is 6' (7'-4" face of curb to face of curb).

» Consult with Baltimore City Department of Transportation to determine the desirable length of the median diverter.

» When installing median diverters in intersections, the turning movements for the designated design and control vehicles need to be modeled and verified.

» The sidewalk ramps in the median shall comply with City of Baltimore Department of Transportation Engineering and Construction Standard No. BC 655.21 or 655.22.

» Vegetated areas within the median diverter should not grow to more than 24" in height at full maturity.

Rectangular Rapid Flashing Beacons (RRFB)

Rectangular Rapid Flashing Beacons (RRFB)

Rectangular rapid flashing beacons are also known as “Light Emitting Diode (LED) Rapid-Flash Systems”, “Stutter Flash”, or “LED Beacons.” They are primarily used to supplement pedestrian warning signs at unsignalized intersections or mid-block crosswalks. RRFBs contain amber lights that use an irregular flashing pattern.

Guidance

- RRFBs are typically used at high pedestrian volume crossings or commonly used bicyclist crossing routes.
- RRFBs are used primarily at mid-block crossings where signals are not used due to preference or warrant, but may be used at slip lanes, roundabouts, or other uncontrolled crossing locations.
- The RRFB can be activated by either push-button or automatic detection of pedestrians.

Standards

- Refer to the FHWA *Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations* for further details on selection criteria of RRFBs.
- RRFBs should be installed according to the conditions of FHWA Interim Approval 21.
- If used with pedestrian safety islands or medians, a secondary RRFB must be used.
- Beacons will be unlit when not in use.
- For lighting design within the crosswalk, refer to Baltimore’s *Specifications for Street Lighting & Conduit.*

High-Intensity Activated crossWalKs (HAWK)

Also known as pedestrian hybrid beacons, HAWK signals are used where a standard traffic signal may not be desired, but active control is still required for pedestrian safety. HAWK beacons control the flow

High-Intensity Activated crossWalK (HAWK)

of traffic with two horizontal red lights over a single yellow light. When pedestrians activate the HAWK beacon, the red signal activates, which signals to traffic to come to a complete stop. The pedestrian signal which accompanies the HAWK beacon then signals to pedestrians that it is safe to cross the roadway.

Guidance

- HAWK beacons are typically used where pedestrian or bicycle facilities intersect major routes.
- If bicycle movements are also expected at the crossings, a bicycle signal head should also be installed along the HAWK signal.
- A standard traffic signal is typically a more appropriate treatment in the context of a city roadway network. HAWK signals should only be used on more suburban type roadways.

Standards

- Refer to Maryland *MUTCD*, Chapter 4F for details on HAWK installation.
- HAWK signal faces are placed in pairs with each beacon facing the vehicular approach directions to the intersection.
- Parking and other obstructions should be evaluated and considered for removal if there are impediments to the sightlines between pedestrians and drivers.
- The Maryland *MUTCD* contains warrant requirements for the use of HAWK signals that should be met to install a hybrid beacon. Warrants may use existing or projected volumes, and may count bicyclists as pedestrians.
- The City of Baltimore's *Specifications for Street Lighting & Conduit* should be referenced to ensure any proposed lighting changes meet the proper requirements.
- For lighting design within the crosswalk, refer to Baltimore's *Specifications for Street Lighting & Conduit*.

Signalized Intersections

Signalized intersections are intersections that contain traffic signals that direct the flow of all street users through the intersection. The warrants and needs for traffic signals are described in Traffic Signal Operations and Design.

Guidance

- The volume of pedestrians and bicyclists through the intersection needs to be considered to determine the pedestrian and bicycle treatments that will be installed at the intersection.
- Consider the location of the intersection in relation to potential conflicts (railroad crossings, schools, etc.) to determine which warrants can be met.

Standards

- Refer to the Maryland *MUTCD* for standards on signalized intersections.
- Pavement markings at signalized intersections shall be designed in accordance with the Maryland *MUTCD*.
- For details on pedestrian and bicycle crossings at signalized intersections, refer to the Complete Streets Intersection Toolbox.
- For lighting design at a signalized intersection, refer to Baltimore's *Specifications for Street Lighting & Conduit*.

Traffic Signal Operations and Design

One of the most important and complicated components of a Complete Streets network is the infrastructure and operations of the traffic signal system. The infrastructure and operations of a traffic signal controls intersection mobility, safety, and accessibility in a variety of impactful ways. Traffic signals are often regulated by specific federal, state, and local guidance. Industry leaders such as NCUTCD (National Committee on Uniform Traffic Control Devices), FHWA, ITE, and NACTO are collaborating on revising guidance, changing from an approach of optimizing vehicular flow to a safety-focused approach based on the modal hierarchy and priorities of a street network.

For the City of Baltimore and this Complete Streets Manual, a progressive approach is defined below to successfully implement a Complete Streets transportation network with integrated signal operations that follow the guiding principles as described in the Introduction chapter.

Traffic signal design and operations should seamlessly integrate into the multimodal transportation network with a focus on the street's:

- Neighborhood character
- Modal priority
- Equity challenges
- Guidance from planning documents

This integration is critically important for the safety, accessibility, and mobility of the City's communities. This policy direction will guide traffic engineers to optimize signals to accomplish the primary objective of prioritizing pedestrians first, per the stated modal hierarchy. Other objectives based on Street Type may include prioritizing bus movements on transit priority streets, moving vehicles along designated parkways and major arterials, controlling vehicle speeds, and optimizing bicycle mobility along streets with cycling infrastructure.

The City encourages progressive site and corridor specific tools to improve safety, accessibility, and mobility by:

- Protecting vulnerable users
- Optimizing person movement instead of vehicle movement
- Providing mode specific infrastructure for transit, bicyclists, and pedestrians

Designing and operating Complete Streets also requires a periodic review of existing traffic control infrastructure to meet these initiatives. This review includes the option of replacing or removing unneeded traffic signals and replacing them with progressive traffic control devices (outlined in this section), or replacing them with all-way stops.

Setting traffic signal timing to reflect the modal priorities of a street is a delicate balancing act. Even small changes to the traffic signal timing and coordination has the ability to positively or negatively affect all modes of travel. Misalignment of the timing or coordination can put pedestrians at an unacceptable level of risk, create an ineffective bicycle/micromobility network, cause transit delays, and/or gridlock vehicles in an entire section of the City. A traffic signal not operating as a seamless part of a Complete Streets network also encourages non-compliance with traffic laws, as people traveling by the various modes become impatient due to extended wait time at the intersection. Therefore, all users, whether they are pedestrians, bicyclists, micromobility users, transit users, or vehicles, should be accommodated at every intersection. This section provides guidance on strategies to achieve desirable operations for all modes of transportation.

Design

- Complete Streets traffic signals shall comply with the following standards:

   - NACTO *Urban Street Design Guide*
   - NACTO *Urban Bikeway Design Guide*
   - NACTO *Transit Street Design Guide*
- The design and implementation of traffic signals should also comply with city, state and federal guidelines in the following:
   - Baltimore City DOT *Book of Standards*
   - Baltimore City DOT *Standard Specifications*
   - Maryland *Manual of Uniform Traffic Control Devices*
   - MDOT SHA Office of Traffic and Safety *Traffic Control Devices Design Manual*
   - AASHTO *Guide to Bicycle Facilities*
   - FHWA-HEP-16-065 *Achieving Multimodal Networks: Applying Design Flexibility and Reducing Conflicts*
   - AASHTO *Guide for the Planning Design, and Operation of Pedestrian Facilities*
   - NCHRP 212 *Signal Timing Manual 2015*

Signalization Principles

This section details overall goals for traffic signal operation in Baltimore City. Each signal and intersection has unique characteristics that may require deviation. However, to create a walkable, safe, and comfortable environment, signal projects should start with the following goals and strategies:

Simple Operations are Better for Pedestrians

Reduce the number of Signal Phases

- Pedestrian expectation is to be able to walk when vehicles traveling in the same direction receive a green signal. 2-phase operation for a signal is ideal for matching pedestrian expectation and reducing pedestrian delay.

Shorten Cycle Lengths

- Shorter cycle lengths result in less delay for pedestrians and less delay for drivers once they are within a grid of closely spaced signals.
- Shorter cycle lengths reduce the availability of gaps in which pedestrians can cross against the signal, encouraging compliance.
- The incentive for all users to violate traffic signals is reduced with shorter cycle lengths because the risk/reward ratio is reduced; i.e., the time savings from running a red light is reduced.

Fixed Time Operation

- Fixed time or pretimed signals improve the predictability of traffic flow and prioritize pedestrian movement.
- Under fixed time operation, pedestrians do not need to press a button to receive a walk signal and are able to cross in any given cycle.
- The pedestrian walk signal plus flashing don't walk signal match the total green time of the corresponding vehicular phase; therefore if a car can go, a pedestrian can go.

Signal Timing

Traffic signal cycle lengths have a significant impact on the opportunities for pedestrians, bicyclists, micromobility users, and transit vehicles to operate safely along a corridor. When long signal cycles are compounded over multiple intersections and on consecutive parallel roadways, these roadways create a barrier that separates destinations within neighborhoods and communities. Longer cycle lengths increase delay times for both pedestrians and drivers attempting to travel against the predominant direction of vehicular flow. Additionally, the longer cycle lengths encourage faster speeds and less compact platoons, making the roadway less safe for pedestrians and bicyclists to cross. This layout can make walking prohibitive, frustrating, and non-inclusive, and discourages walking altogether.

To mitigate this effect, short cycle lengths as detailed in Table 8 should be applied to all roads in the City, especially during off-peak hours. The cycle length should correspond to the crossing distance required for a pedestrian. For example, narrow roadways

Table 8. Desirable Signal Timing Based on Street Type

Street Type	Timing Method	Peak Hours Cycle Length (sec.) (3)	Non-Peak Hours Cycle Length (sec.) (3)	Clearance Intervals	Pedestrian Phases	Coordination	Green Time Allocation
Downtown Commercial	(1)	60-120	60	(4)	(5)	(7)	(8)
Downtown Mixed-Use	(1)	60	40-60	(4)	(5)	(7)	(8)
Urban Village Main	(1)	60	40-60	(4)	(5)	(7)	(8)
Urban Village Neighborhood	(1)	60	40-60	(4)	(5)	(7)	(8)
Urban Village Shared Street	(1)	60	40-60	(4)	(5)	(7)	(8)
Urban Center Connector	(1), (2)	90-120	60-90	(4)	(6)		(9)
Neighborhood Corridor	(1)	60	40-60	(4)	(5)	(7)	(8)
Industrial Access	(1), (2)	90-120	60-90	(4)	(6)		(9)
Parkway	(1), (2)	90-120	60	(4)	(6)		(9)
Boulevard	(1)	60-90	60	(4)	(5)	(7)	(8)

(1) Pretimed (Coordinated where feasible).
(2) Actuated.
(3) Peak hours assumed to be 7AM-9AM and 4PM-6PM. Unique circumstances require exceptions.
(4) Yellow clearance intervals shall be calculated based on the target and posted speed and be kept as short as permitted by law. Red clearance intervals should be based on ITE clearance interval calculation formulas but consider engineering judgment. The goal should be to keep the red clearance interval as short as possible but minimize conflicts resultant from vehicles not clearing the intersection prior to a conflicting phase.
(5) Pedestrian Phase—Urban
- Pedestrian phases shall be recalled every cycle regardless of pedestrian presence.
- Pedestrian walk interval time can be decreased to 4 seconds to allow for a shorter desired cycle length, if this is determined to be adequate based on the characteristics of the crossing and pedestrians utilizing the intersection.
- Minimum pedestrian clearance time calculations shall include the yellow change/buffer interval. The pedestrian change interval may:
  - Include or exceed all of the minimum pedestrian clearance time or
  - Be equal to the minimum pedestrian clearance time minus the buffer interval.
- To obtain the goal of a short cycle length while providing adequate time for crossing, the pedestrian clearance times shall be set on the assumption that the minor approach can receive up to the same amount of green time as the major approach.
- Leading pedestrian intervals should be provided at locations with high turning volumes.
- At actuated signals, rest in Walk operation should be in effect, holding the walk or flashing don't walk for the entire corresponding green signal.

(6) Pedestrian Phase—Suburban/Industrial
- Pedestrian phases should be set to recall during times when pedestrians are expected to be present. Engineering judgment can be used for actuated operation.

(*table continues next page*)

(*table continued from previous page*)

- The pedestrian walk interval can be decreased to 4 seconds to allow for a shorter desired cycle length.
- Minimum pedestrian clearance time calculations shall include the yellow change interval.
- To obtain the goal of a short cycle length while providing adequate time for crossing, the pedestrian change interval shall be set on the assumption that the minor approach can receive up to the same amount of green time as the major approach.

(7) Coordination:
- When progression is desired, offsets/coordination parameters should be set based on the target speed. For the majority of urban roadways, this should be 20 mph.
- Offsets may need to be set differently to consider complex queue interaction.

(8) Green-Time Allocation—Urban
- To obtain the goal of a short cycle length while providing adequate time for crossing, the pedestrian change interval shall be set on the assumption that the minor approach can receive up to the same amount of green time as the major approach.
- The minor approach should receive no less than a 2/3 ratio of the green-time that the major approach receives.

(9) Green-Time Allocation—Suburban/Industrial
- The minor approach should receive no less than a 1/2 ratio of the green-time that the major approach receives.

should have shorter cycle lengths than wide roadways, especially during off-peak times. Strategies should be employed to reduce cycle lengths on wide roadways.

Table 8 provides desirable signal timing operations based on Street Type. Engineers shall use these targets as a guideline when developing signal timing plans. However, deviation on certain corridors may occur with adequate justification.

Signal Coordination

As vehicles travel along a street or arterial, the optimal condition for a driver is minimal delay and stops. Drivers prefer an uninterrupted flow through the intersections. The coordination of signals along the corridor can assist with achieving that goal. Synchronized or coordinated signals allow for the platooning of vehicles. The platoon of vehicles can then travel together through multiple intersections safely and efficiently at a controlled speed. Benefits to platooning include:

- Decreased opportunity and incentive to speed.
- Efficient use of roadway space due to shorter gaps between vehicles in the platoon; but larger continuous gaps due to a decreased incidence of vehicles that seem to be “random arrivals”.
- Less opportunity/incentive for pedestrians to cross the road against the signal.
- More attentive drivers because of the need to control and maintain the distance between one’s vehicle and the vehicle in front of them.

An important aspect for consideration when performing signal coordination is determining what groups of signals need to be coordinated. The length of road, number of intersections, targeted road speed, volume/capacity ratios, and jurisdictional boundaries need to be considered by designers when identifying signal coordination.

In timing a grid network, special attention should be paid to ensuring adjacent corridors are timed with the same cycle lengths to ensure increased opportunity for coordination on multiple approaches.

However, the critical intersection in a network, which is typically represented as an intersection with long minimum pedestrian clearance times or multiple signal phases, will require a higher cycle length to serve all movements. The use of double or half cycling should be employed where possible at intersections with shorter crossings relative to the critical intersection in the network.

In some cases, the cycle length of the critical intersection should be increased if it allows for a shorter half cycle at a large number of other intersections.

Signal coordination can potentially benefit the drivers who are making turning movements that conflict with opposing vehicles traveling along the corridor. Platooning vehicles provide longer continuous gaps between their platoon and the next. These larger gaps are safer for drivers to use to make their turning movements than the gaps provided by low density platoons or random arrivals. Without the gaps between different platoons of vehicles, turning vehicles spend more time waiting for their opportunity to turn or begin using smaller and smaller gaps to make their movement.

Balanced Cycle Lengths and Green-time Allocation

Longer signal cycles and corridor-based timing schemes make large avenues into barriers that separate neighborhoods rather than joining them.

Figures 2 and 3 show a corridor-based signal timing approach with a longer cycle length and a balanced signal timing approach with shorter cycles, respectively. Shorter signal cycles help City streets function as a complete network, rather than as a series of major corridors.

Under the initial conditions shown in figure 2, all users approaching from side streets incur significant delay when crossing the major corridor. The major corridor receives almost four times as much green time (96 seconds) as the minor streets (24 seconds). As a result, motorists avoid minor streets, increasing congestion on main routes. Pedestrians frequently cross the street out of frustration before receiving a walk signal indication.

In the balanced scenario shown in figure 3, the signals are re-timed with 60-second cycle lengths. The amount of green time at each minor intersection is apportioned in a 3:2 ratio (36 seconds for the major street, 24 for the minor). The increased turnover improves pedestrian compliance and decreases congestion on surrounding streets. The shorter wait times and increased ratio of minor to major time also encourages greater utilization of the total available roadway capacity (increased efficiency).

At the time of this Manual release, Baltimore City operates on corridor-based signal timings that run north/south through the majority of Central Baltimore, and east/west through the majority of East and West Baltimore. This approach has historically increased

Figure 2. Corridor-Based Signal Timing with Longer Cycles

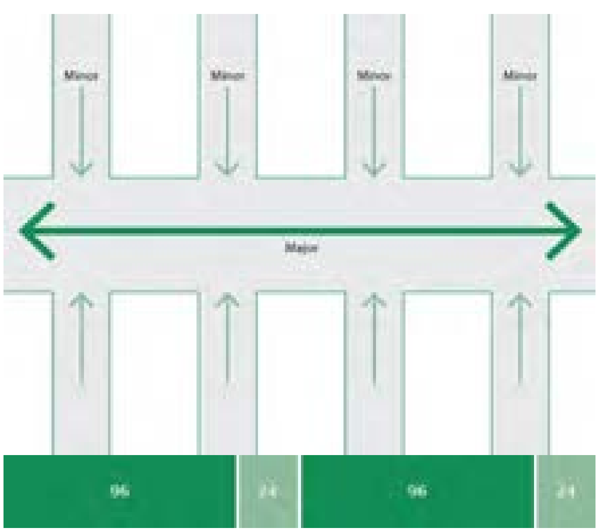
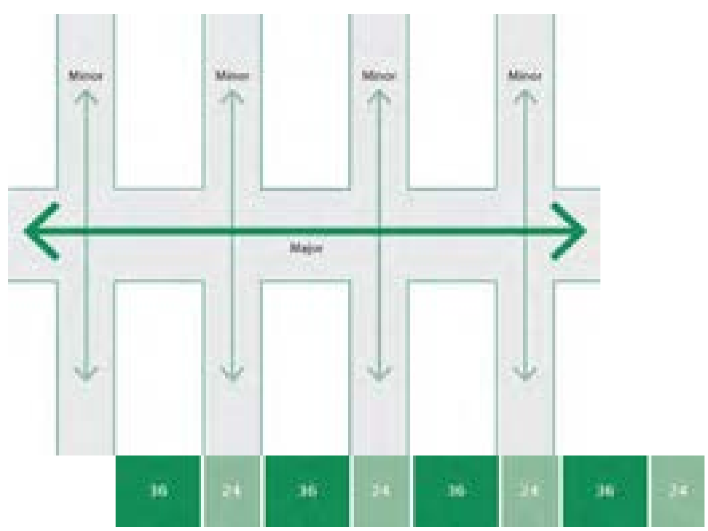


Figure 3. Balanced Signal Timing with Shorter Cycles



speeds through neighborhoods and made travel in opposing directions to the major corridors more difficult by car, foot, or bike.

For example, rather than utilizing available capacity on many of the north/south roads in East Baltimore, signal timings encourage drivers to utilize one of the major east/west corridors as much as possible, and then turn at one of the few major north/south corridors. This approach has decreased the walkability and connectivity of many neighborhoods throughout the City. Additionally, this approach to signal timing has often prioritized the movement of vehicles into and out of the City, rather than encouraging movement within and between City neighborhoods.

Considerations

Short signal cycles reduce overall pedestrian wait times as well as side street delay. Shortening cycle lengths can come at the expense of reducing the amount of time that a pedestrian has to cross the street, and thus attention to minimum clearance time is essential. While long cycle lengths may increase pedestrian non-compliance and risk-taking behavior, short cycle lengths may not always be achieved without resorting to a 2-stage pedestrian crossing. On a roadway with a wide median, a shorter (approximately 60s) cycle that requires a 2-stage pedestrian crossing should be implemented rather than a longer (≥ 120s) cycle serving pedestrians in a single phase. The overall pedestrian delay in a 2-stage crossing will often be similar, while neighborhood connectivity is improved by the increased turnover. Determination of the appropriate cycle length must always be correlated with the pedestrian crossing distance on a given street.

Aligning Signal Timing with the Street's Modal Priority

The signal timing within a Complete Streets network should reflect the role each street has within the network in moving people in a safe and efficient manner.

The introduction of modal priorities on streets should be reflected in the network's signal timing, aligning the street's design priorities with the functionality by time of day. The benefits of such alignment include:

- Transit operations adhering to schedule and performance goals.
- Bicyclists efficiently moving through the City with minimal delays.
- Vehicles traveling at the street's target speed, which optimizes mobility and safety.

Pedestrian Signal Timing

Section 4E.06 (Pedestrian Intervals and Signal Phases) of the Maryland *MUTCD* states, ". . . the pedestrian clearance times should be sufficient to allow a pedestrian crossing in the crosswalk who left the curb or shoulder at the end of the WALKING PERSON (symbolizing WALK) signal indication to travel at a walking speed of 3.5 feet per second to at least the far side of the traveled way or to a median of sufficient width for pedestrians to wait"

This walking speed is also indicated in the Maryland SHA *Bicycle and Pedestrian Design Guidelines*.

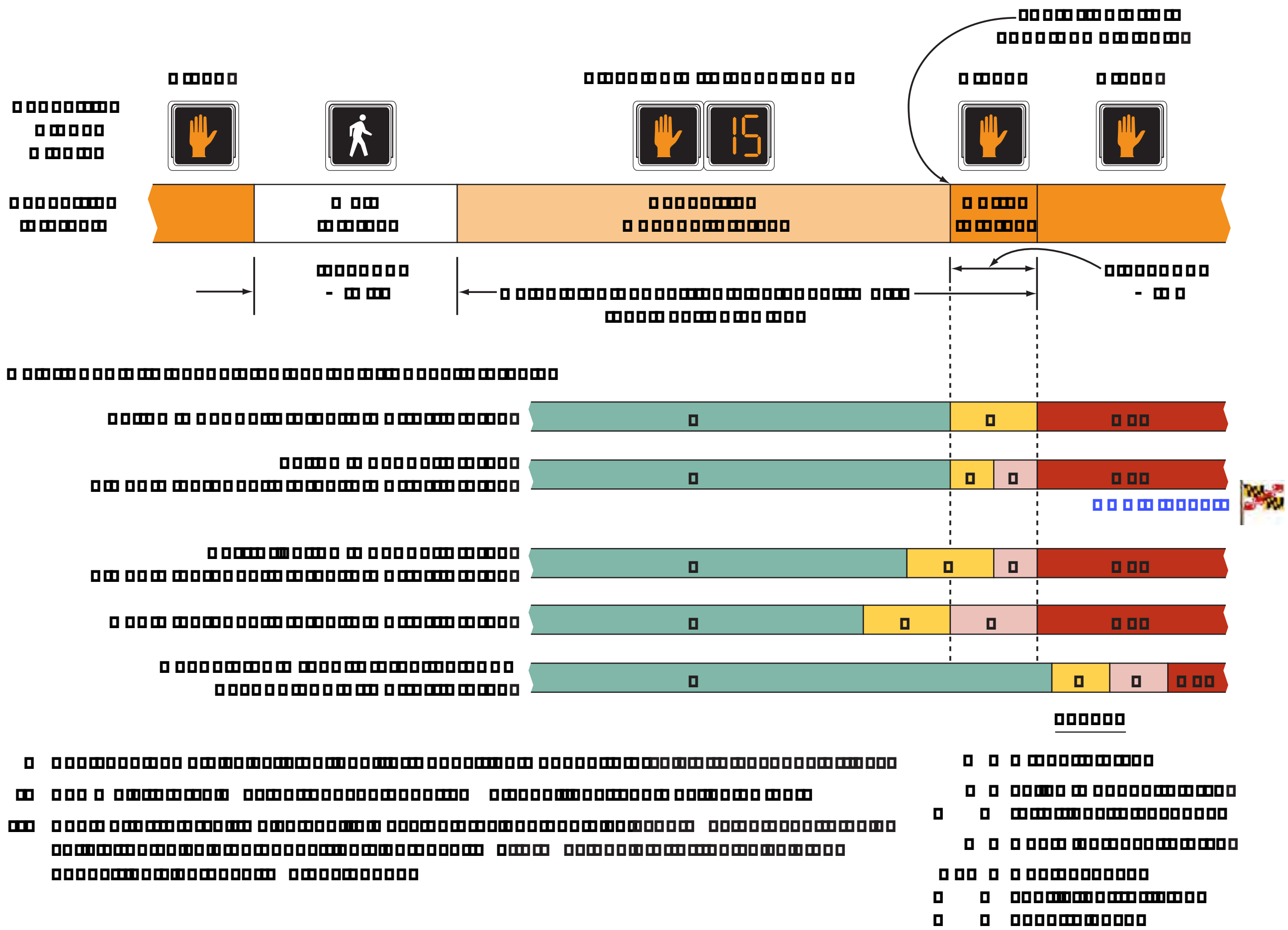
Clearance interval calculations discussed in this section are shown in Figure 4.

Consistent with the goal of keeping signal cycles short, the calculated pedestrian clearance time should include the buffer interval unless there are circumstances that justify increased clearance time.

Accessible Pedestrian Signals (APS)

Section 4E.09 (Accessible Pedestrian Signals and Detectors–General) of the Maryland *MUTCD* states that "along state owned, operated, and maintained roadways and intersections, Accessible Pedestrian Signals and Detectors shall be used at all signalized pedestrian crossings."

Figure 4. Pedestrian Intervals



09 The additional time provided by an extended pushbutton press to satisfy pedestrian clearance time needs may be added to either the walk interval or the pedestrian change interval.

Guidance:

10 *Where pedestrians who walk slower than 3.5 feet per second, or pedestrians who use wheelchairs, routinely use the crosswalk, a walking speed of less than 3.5 feet per second should be considered in determining the pedestrian clearance time.*

11 *Except as provided in Paragraph 12, the walk interval should be at least 7 seconds in length so that pedestrians will have adequate opportunity to leave the curb or shoulder before the pedestrian clearance time begins.*

Option:

12 If pedestrian volumes and characteristics do not require a 7-second walk interval, walk intervals as short as 4 seconds may be used.

Support:

13 The walk interval is intended for pedestrians to start their crossing. The pedestrian clearance time is intended to allow pedestrians who started crossing during the walk interval to complete their crossing. Longer walk intervals are often used when the duration of the vehicular green phase associated with the pedestrian crossing is long enough to allow it.

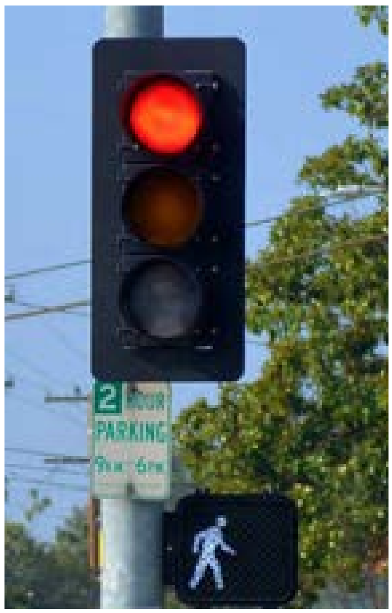
Guidance:

14 *The total of the walk interval and pedestrian clearance time should be sufficient to allow a pedestrian crossing in the crosswalk who left the pedestrian detector (or, if no pedestrian detector is present, a location 6 feet from the face of the curb or from the edge of the pavement) at the beginning of the WALKING PERSON (symbolizing WALK) signal indication to travel at a walking speed of 3 feet per second to the far side of the traveled way being crossed or to the median if a two-stage pedestrian crossing sequence is used. Any additional time that is required to satisfy the conditions of this paragraph should be added to the walk interval.*

Accessible pedestrian signals should be provided for the audible alert and direction that they provide. However, the detection/push button actuation may be unnecessary depending on the function of the traffic signal.

Leading Pedestrian Intervals

Leading pedestrian intervals (LPIs) give pedestrians the opportunity to enter an intersection 3 to 7 seconds before vehicles are given a green indication. They are listed in FHWA's *Proven Safety Countermeasures* and provide a 60% reduction in pedestrian-vehicle crashes at intersections. Additionally, the Maryland *MUTCD* recommends that leading pedestrian intervals be used in conjunction with accessible pedestrian signals. The Maryland *MUTCD* also recommends that the minimum duration of *3* seconds be used and that the interval be timed "to allow pedestrians to cross at least one lane of traffic or, in the case of a larger corner radius, to travel far enough for pedestrians to establish their position ahead of the turning traffic before the turning traffic is released."



Leading Pedestrian Interval

Exclusive Pedestrian Phase

Also known as a "pedestrian scramble," an exclusive pedestrian phase stops all vehicular movements at an intersection in all directions. Pedestrians are then free to cross in all directions. The system is either set to pedestrian recall or actuated by an active push to the pedestrian pushbutton, or passively through an automatic detection system.

The Maryland *MUTCD* dictates that the use of an exclusive signal phase requires the use of a pedestrian signal head in conjunction with vehicular traffic controls. Additionally, the Maryland *MUTCD* also states that if speech walk messages are used at an intersection with an exclusive pedestrian phase, the message should be modeled after the message, "Walk sign is on for all crossings."

Bicycle Signal Timing

Bicycle Clearance Intervals

The typical length of pedestrian clearance intervals is not appropriate for bicyclists. NACTO provides a formula to calculate the total clearance interval for bicyclists that is based on the typical bicyclist speeds as measured in the field, and the intersection width. While field measurements should be used to determine the average speed, AASHTO's forthcoming *Guide for the Development of Bicycle Facilities* sets 12 feet per second (8 miles per hour) as the default speed if field measurements cannot be made.

Leading Bicycle Intervals (LBI)

Similar to an LPI, LBIs allow bicyclists and micromobility users to enter an intersection 3 to 7 seconds before vehicles are given a green indication. LBIs should be accompanied by bicycle signals, as described below.

Bicycle Signals

Bicycle signals should be provided when needed to separate bicycle movements from vehicular or pedestrian movements. Bicycle signals may be installed at signalized intersections to indicate bicycle signal phases and other bicycle-specific timing strategies. In the United States, bicycle signal heads typically use standard three-lens signal heads in green, yellow, and red lenses. They are currently approved for use through *MUTCD*—Interim Approval for Optional Use of a Bicycle Signal Face (IA-16) and should be designed in accordance with the requirements of the interim

Bicycle Signal

Pavement Markings Indicate the Bicycle Signal Detection Location

approval. The following are applicable uses for bicycle signals:

» Where a trail crosses a street
» To split signal phases at intersections where predominant bicycle movement conflicts with main motor vehicle movement during the same green phase
» At intersections where a bicycle facility transitions from a protected bike lane to a bike lane
» On one-way streets with contra-flow bike lanes
» At protected intersections
» To provide a LBI
» At intersections with a high number of bicycles
» At intersections with a high number of bicycle and motor vehicle crashes
» At intersections near schools

Bicycle Detection

Similar to pedestrian detection, the two options available for bicyclists to cross traffic separate from vehicles are either an active push to the pushbutton signal or passively through an automatic detection system. For bicyclists, the preference has been primarily an automatic detection system, as it is easier and safer for the rider. Automatic detection systems include video detection systems that are calibrated to detect bicycles and microwave systems that pick up the heat signatures of bicyclists.

Transit Signal Timing

One of the major causes of delays for transit vehicles is the delay caused when these vehicles are waiting for signals. This signal delay can cause severe interruptions in the schedule and reliability of transit vehicles. NACTO's *Transit Street Design Guide* recommends the use of Transit Signal Priority (TSP). TSP modifies the timing and/or phasing of traffic signals to give priority to transit vehicles as they approach and travel by a signal.

The transit vehicle uses technology to communicate its current position and expected arrival time to the transit signal as it approaches. It can also give detailed information such as passenger load, route number, schedule compliance, etc. to allow the signal to further prioritize the vehicle's arrival.

Modification of the timing and/or phasing of traffic signals should go together with additional infrastructure improvements/changes for Transit Signal Priority to properly work. Transit vehicles and signal heads must be upgraded with the ability to communicate with each other. To optimize the benefits of Transit Signal Priority and increase travel time reliability, it is recommended to provide dedicated lanes (peak or full time) or intersection queue jumps to travel up to and through the intersections.

Transit Signal Priority is not desirable in an urban environment with closely spaced signals for the following reasons:

- Short headways make repeated calls from transit vehicles in different directions difficult to serve.
- Pedestrian signal timing cannot be set to rest in walk. I.e., to allow for certain phases to be shortened, pedestrian movements and clearances must be served first, and then held in “don’t walk.” Pedestrians often ignore the “don’t walk” guidance because the corresponding vehicular movement stays green.
- To provide flexibility in timing changes to serve a transit vehicle, cycles are often longer than ideal for the adjacent land use and Street Type.
- It may be difficult to predict and serve a bus with priority when dwell times at stops may vary significantly with closely spaced bus stops.
- When a dedicated right-of-way or a dedicated lane is provided, a short cycle length is often the best treatment to decrease transit delay because stop delay will be decreased.

Light Rail Timing

Within the limits of Baltimore’s Central Business District, the Light RailLink transports riders traveling along and perpendicular to the passenger vehicles on the City’s streets. As the trains approach several of the ungated intersections on its routes through the City, signals slow and/or stop the trains, causing a high amount of delays. These delays impact both customer experience and satisfaction and add to the operating and fuel costs for the rail line.

While the system currently runs with transit priority, alternative measures to decrease delay should be analyzed. Transit priority may be useful at larger more complex intersections, but its implementation at narrow closely spaced crossings should be discouraged due to the negative side effects of Transit Signal Priority in an urban environment, as discussed above.

While the light rail should not act as a barrier to movement within the grid network, turns across the light

Paul Sableman / Wikimedia Commons

Baltimore Light Rail

rail should be minimized or eliminated where possible as the light rail vehicle is often traveling to the left of, but in the same heading as a vehicle; this violates a driver's expectation, increasing the likelihood of a crash.

Operational Practices (Do's and Do Not's)

Left-Turn Phasing

Roadways with three or more through lanes in each direction should have protected-only signal phasing for any signalized left-turn movements. In general, exclusive/permissive signal phasing should not be implemented on roadways on which the left-turn lane has three or more opposing lanes. The requirements of left-turning drivers to assess both a gap in 3+ lanes of traffic and any conflicting pedestrians in the crosswalk to the left can increase the likelihood of an angle crash or pedestrian-involved crash.

Multiple Turn Lanes

Intersections with turning volumes that are high enough to warrant multiple turn lanes should have signal phases that separate conflicting pedestrian movements from turning vehicles. Strategies should be implemented to eliminate situations at intersections in which multiple turn lanes operate under permissive phasing that conflicts with pedestrians in a crosswalk. To minimize conflict points and potential sightline issues:

» Intersections with multiple turn lanes should be changed to either have single turn lanes or protected-only turn phasing.
» Crosswalk elimination is not an acceptable alternative, as crosswalks should be provided on all legs of an intersection.
» Because protected phasing can increase cycle lengths and shorten pedestrian crossing time, lane reduction and traffic demand management strategies on a multiple block grid should be considered as a first option where feasible.

Right-Turn on Red

In general, right-turn on red should be prohibited at intersections where pedestrian activity could be present, such as in Downtown, Village, Neighborhood, and Boulevard Street Type categories. In conjunction with right-turn on red restrictions, short cycle lengths of ≤ 60s off-peak and ≤ 90s during peak hours are desirable to decrease delay for right-turning vehicles and to reduce the availability of gaps/incentive for a driver to turn right on red.

Left-Turn on Red

The use of left-turn on red at one-way street intersections shall be as approved by the Baltimore City Department of Transportation. The use of left-turn on red shall be carefully evaluated in an effort to minimize conflicts between vehicles and vulnerable road users such as pedestrians, bicyclists, and micromobility users.

School Zone Flashers

Maryland's *MUTCD* allows for the use of a "Reduced School Speed Limit Ahead" sign to inform road users of a reduced speed zone where the speed limit is being reduced by more than 10 mph.

Section 21.803.1 of the Motor Vehicle Law provides for designating school zones and establishing speed limits along segments of a roadway within a 0.5-mile radius of any school by the State Highway Administration or local authorities, and for speed violation penalties within a designated school zone to be doubled.

Section 7B.15 of the Maryland *MUTCD* details the use of the "School Speed Limit Assembly or School Speed Limit" sign where a reduced school speed limit is specified for such areas by statute.

Section 4L.04 of the Maryland *MUTCD* states that "A speed limit sign beacon may be included within the border of a School Speed Limit sign."

Corner Design

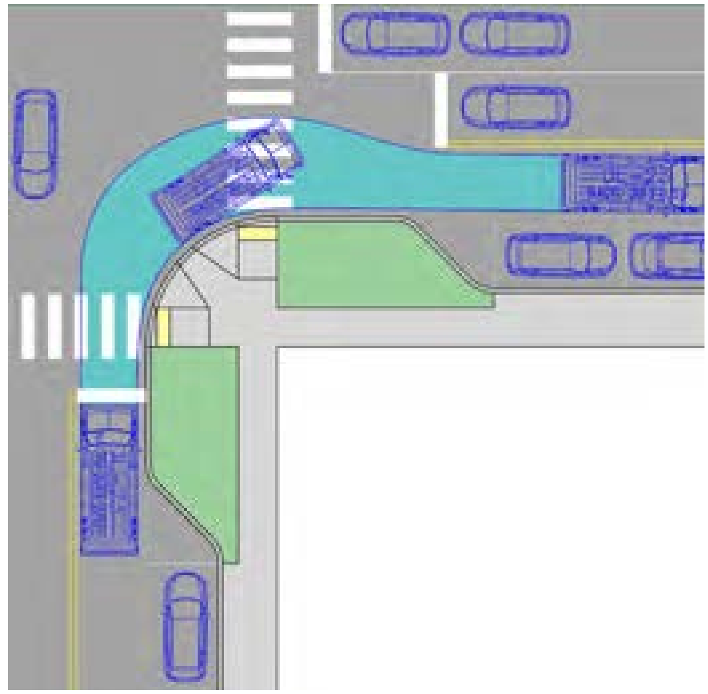
Street corner design directly impacts the safety and comfort of all users. Intersection design and operation must prioritize the safety and comfort of the most vulnerable road users, and as such must be designed to slow vehicle speeds and to provide accessible and intuitive pedestrian crossings that minimize crossing distances. Minimizing crossing distances reduces conflict areas and improves the line of sight between drivers and people walking and biking across intersections. Additionally, when designing corners, a street's modal priorities must be considered, and safe and effective bicycle and transit facilities must be provided on designated streets as detailed in the Bicycle Facilities and Transit Facilities subsections of this Manual.

While slower turns and shorter crossings are the priority, corners should also be designed to provide adequate turning space for the appropriate design and control vehicles. Street Types and the intersecting roadways guide the selection of the appropriate design vehicle for an intersection. This section provides direction for choosing the appropriate design vehicle and designing intersection corners with effective curb radius to accommodate both the design vehicle and control vehicle. A decision-making flow chart, Figure 5 on page 104, outlines this process.

Definitions

Design Vehicle

A design vehicle is a vehicle for which a street is designed to accommodate on a regular basis without great difficulty, interruption to opposing traffic flow, or other operational issues. See Vehicle Facilities for further details.



Effective Curb Radius

Control Vehicle

A control vehicle is the vehicle for which a street is designed to accommodate on a rare/infrequent basis. A control vehicle may utilize multiple lanes, including opposing travel lanes on the origin and destination approaches, to complete a turn. See Vehicle Facilities for further details.

Curb Radius

Curb radius is the actual radius on a physically raised curb, or the radius created by delineators or other vertical elements on a flush curb.

Effective Curb Radius

Effective curb radius forms the curve which vehicles follow when turning, and is increased beyond the actual curb radius when there is on-street parking, bike lanes, and other roadway features which push the starting or ending position of a vehicle away from the curb.

General Guidance

The guidance in Table 9 can be used as a starting point for intersection design/redesign and for quick-build projects. Designers of larger capital projects should reference the flow chart in Figure 5. When comparing the values yielded by Table 9 and Figure 5, the smaller radii should be used for design purposes.

Table 9. Standard Radii for Intersection Design/Redesign and Quick-Build Projects

Street Intersections	Effective Curb Radius
Residential Streets	10 feet
Mixed Use/Commercial (Not Transit/Truck Routes)	15 feet
Transit Streets	20 feet
Local Truck Routes	25 feet
Major Truck Routes	25–30 feet

Strategies and Guidance for Minimizing Curb Radii

Minimizing curb radii slows turning vehicles, improves sightlines, and shortens crossing distances, all of which increase the safety and comfort of vulnerable users at intersections. The following strategies should be employed by designers to ensure curb radii is minimized while still serving the appropriate design and control vehicles:

In General

- Set back stop bars and right-turn on red restrictions should be implemented to minimize curb radii while still accommodating the appropriate design and control vehicles.
- A crawl speed of less than 5 mph should be assumed for turning simulations of large vehicles on truck and transit routes. On smaller streets or access points for deliveries, a “stop and turn full lock” approach should be used in simulation of the control vehicle turn.

Low-Volume Streets

- The control vehicle may swing wide and utilize the entire width of the roadway on the departing and receiving streets.
    - Stop bar placement can be reflective of typical conditions needed for adequate sightlines, even if this interferes with large vehicle turns.

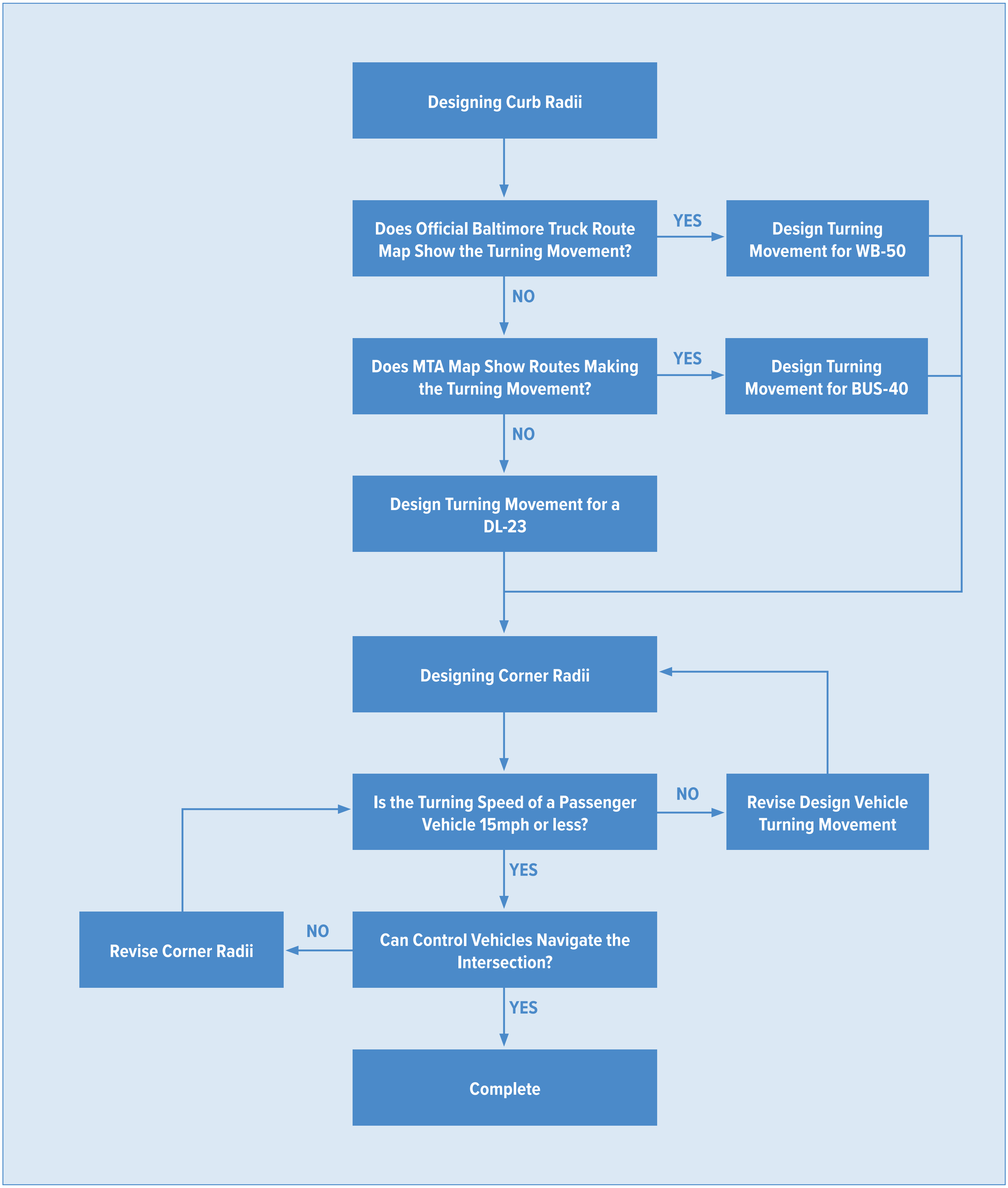
Signalized Intersections

- Buses should be able to turn from the departure lane and may utilize any receiving lane to complete the turn, with attention paid to the needs of adjacent transit infrastructure.
- Trucks may encroach on the lane adjacent to the right-lane from the departure street and turn into any receiving lane on the receiving street, with the swept path utilizing the entire width of the receiving street.

Deviations from Standards

Designers should follow the standards and use the strategies outlined in this section to minimize curb radii; however, the design of corner radii is unique to certain intersections based on the skew of an intersection, required deliveries influencing the control vehicle, or the presence of bicycle or transit facilities. Deviations from the guidance in this Manual shall be approved by the Department of Transportation Traffic Engineering and Complete Streets Sections.

Figure 5. Corner Design Flow Chart



Complete Streets Intersection Toolbox

Intersections and road crossings have the highest crash rates of any part of a street and create circumstances that are challenging and potentially dangerous for vulnerable road users. The higher crash rates are primarily due to conflicts that occur from turning or crossing vehicles as well as speed differentials that exist between moving vehicles and other transportation modes. This section discusses intersection improvements that can be implemented to create Complete Streets that are safe and accessible to all users. The treatment types have been split into categories based on each treatment's primary beneficiary, however most of these treatments are beneficial to all road users.

Please refer to the Intersection and Street Crossing Control section for information on different intersection types and traffic signal operation strategies. Refer to Transit Facilities for treatments that benefit transit operations and safety.

Pedestrian Enhancements

Crossing Placement

Signalized Intersections

Crossings complete with sidewalk ramps and crosswalk markings should be placed at all legs of all signalized intersections.

Unsignalized Intersections

Crossings with sidewalk ramps and crosswalk markings should be placed based on context and adjacent land use. In general, streets through residential and commercial areas should have crossings (unmarked or marked) with sidewalk ramps at all four-leg intersections. T-intersections may not correlate to pedestrian desire lines and may not require sidewalk ramps and pedestrian crossings, but should still be evaluated.

- The need for crosswalk markings is dependent on traffic volume and markings should be placed based on an engineering assessment. I.e., lower volume streets may not require any markings to facilitate safe pedestrian, bike, and vehicle movement.
- On roads with higher traffic volumes (some collectors, all arterials), a minimum of one marked crosswalk across the major street should be placed at each four-leg intersection and at major pedestrian generators, such as bus stops that are not adjacent to signalized intersections.
- On streets through residential and commercial areas, at four-leg intersections, or at bus stops not adjacent to a signalized intersection, pedestrians should not be required to cross more than two lanes of traffic at a time without refuge.
  - Potential treatments include:
    - Pedestrian refuge island/median
    - Lane reduction
- Based on the guidance above, if pedestrian refuge is recommended but cannot be provided, or the roadway is only two lanes but experiences average daily traffic volumes of approximately 10,000 vehicles per day or greater, marked crosswalks are recommended for signalization, which includes:
  - Conventional signal
  - Pedestrian signal
  - Pedestrian hybrid beacon
- Rectangular rapid flashing beacons (RRFBs) are encouraged on mid to high-volume roadways on which a pedestrian is required to cross up to two lanes at a time. However, these should not be considered an adequate substitute for signalization on higher volume multilane (3+) roadways without pedestrian refuge.
- See Traffic Signal Operations and Design. While *MUTCD* traffic volume warrants should be analyzed, meeting volume warrants shall not be the only

deciding criteria for traffic signal placement. Factors to assess the need for signalization of a crossing shall include but not be limited to:

- Engineering judgment
- The safety of people of all ages and abilities in using an unsignalized crossing
- Adjacent or nearby land use
- Consistency in signal placement along a corridor
- Speed control/maintaining platoons
- Sightlines
- Driver behavior in yielding/stopping for pedestrians
- Crash history at the intersection and along the corridor
- Crash history/trends at similar intersections and corridors of similar Street Type, street width, and adjacent land use

Sidewalk Ramps

Guidance

- Wider sidewalk ramps should be provided in areas with higher pedestrian volumes or on shared-use-paths.
- The width of the ramp should match the width of a shared-use path.
- Street lighting should be evaluated at all new or reconstructed sidewalk ramps.
- Non-standard ramps or ramps that do not meet the Baltimore City Engineering and Construction Standards must receive approval from the Baltimore City Department of Transportation prior to construction.

Design

- Sidewalk ramps on opposing sides of the street should line up with each other, unless pedestrian desire lines would recommend alternatively.
- The entire width of the sidewalk ramp must be contained within the crosswalk.
- Sidewalk ramps do not need to be centered within crosswalks. A wider crosswalk that better aligns with pedestrian desire lines may often require off-center sidewalk ramps.
- Sidewalk ramps shall not lead a pedestrian, bicyclist, or other micro-mobility user to a stormwater inlet.
- Sidewalk ramps shall comply with City of Baltimore Department of Transportation Engineering and Construction Standards No. BC 655.11 through 655.22.
- A single ramp should not be used for two crosswalks at the corner of an intersection (except on a shared street). If there are conflicts in the furnishing subzone, such as utilities that prevent the construction of two curb ramps, the following strategies can be implemented:
  - Curb extensions that provide the space for two ramps in front of conflicts can be used. If drainage cannot be reconfigured, consider the use of slot drains to maintain the existing drainage pattern.
  - Interim corner extensions or bump outs that use low-cost materials may also be considered on a case-by-case basis.
    - Interim corner extensions consist of a white thermoplastic edge line and bollards or flexible post delineators (flex posts) to serve a similar

Sidewalk Ramp on a Shared-Use-Path in College Park, MD function to a curb. The use of truffle colored treatment and detectable warning surfaces should also be considered when this treatment is applied. See Quick-Build Strategies for further details.

- Offset/setback pedestrian ramps can also be considered where the crosswalks aren't centered, but rather placed in a normal path that aligns with pedestrian desire lines.

- Detectable warning surfaces shall comply with City of Baltimore Department of Transportation Engineering and Construction Standards No. BC 655.11 through 655.22.

Crosswalk Markings

Crosswalks are pavement markings that facilitate pedestrian and/or bicycle crossings at an intersection.

Guidance

- See Crossing Placement Guidance on page 105.
- Bicycle intersection crosswalk markings should use dotted line extensions of 12" wide lines at 12" spacing and be enhanced with solid green pavement marking.
- Lighting should be evaluated at all new or reconstructed crosswalks.

Liberty Street

Design

- Crosswalk markings shall be the continental style at a minimum 10' width.
- Crosswalk markings shall be a minimum 15' width in the following Street Types:
  - Downtown Commercial
  - Downtown Mixed-Use
  - Urban Village Main
  - Other high pedestrian volume streets
- Crosswalk lines should typically extend to 1' from the extended curb line of the intersecting street.
- Aligning crosswalks with the pedestrian desire lines is critical. Crosswalks of 30' or more can be appropriate to match the pedestrian desire lines when crossings are adjacent to wide sidewalks.
- On wide sidewalks, crosswalks should extend at least to the edge of the building line to match desire lines of pedestrians.
- The stop bar should have a minimum 8' offset from the crosswalk, with a minimum 4' applied only under special circumstances with approval from the Department of Transportation. In special cases a STOP HERE ON RED sign should be deployed to help reinforce the stop bar line.
- For signalized intersections on the transit and truck routes the stop bar may need to be set back up to 20' or more to accommodate turning movements. In these cases, widening the crosswalk to decrease the gap between the crosswalk and the stop bar should be considered to prevent drivers from ignoring the set-back stop bar. See the Corner Design section for additional information on stop bar layout in relationship to corner design.
- All legs of a signalized intersection must have marked crosswalks.
- STOP HERE ON RED (R10-6) sign guidance: The MDSHA *MUTCD* Section 2B.53 states, "The STOP HERE ON RED (R10-6) sign should be used only where the Stop Line is some distance from the intersection

or where violations of the Stop Line are frequent. When the R10-6 sign is used, a stop line on the pavement shall also be used." Staggered stop lines are typically used closer to the intersection to allow vehicles to have better turning sight distance and increased turning radii, and to improve the driver's view of pedestrians.

Engineering judgment should be used in a case by case basis dependent upon the number of approach lanes, the number of lanes utilizing the staggered stop lines, and geometrics of the intersection. If used, R10-6 signs should not be used in a way to confuse the driver.

Curb Extensions

Curb extensions visually and physically narrow the roadway width at intersections or mid-block crossings. This creates a shorter pedestrian crossing and narrower physical lane width that can slow vehicle speeds and improve sight lines between pedestrians and vehicles. The space that is gained can be used to increase the sidewalk furnishing subzone.

Guidance

- Pedestrian curb extensions are appropriate in any Street Type in which the curb extensions do not interfere with the use of the curbspace.
- Drainage should be evaluated for all curb extension installations, but not be a determining factor. Techniques to allow for drainage such as trench drains or "floating" curb extensions should be used when there are special needs for maintaining water flow against an existing curb.
- Installation of curb extensions may require moving fire hydrants to maintain adequate curbside access.
- Curb extensions are ideal locations for in-lane bus stops, known as bus bulbs. See the Transit Facilities section of this chapter for additional guidance.
- The methods of installation include quick-build/nterim techniques or permanent configurations.

Design

- The radii of the curb extension should be designed in coordination with the Corner Design section of this Manual.

Graham Projects/Graham Coreil-Allen

Crossing with Curb Extensions at Margret Brent Elementary School

- The location where the curb transitions to the full width of the roadway shall be a minimum of 10’ from the crosswalk, where feasible.
- The curb extension cannot extend into travel lanes and can encroach only on parking lanes or other non-travel road space.
- See the Transit Facilities section of this chapter for guidance on transit stops on curb extensions.
- See Sidewalk Ramps in the Complete Streets Intersection Toolbox section for guidance on sidewalk ramps.
- Green stormwater infrastructure plantings in curb extensions should not reach more than 24” in height at full maturity.

Pedestrian Safety Islands

Pedestrian safety islands are a raised or protected area in the center of the street at intersections or at mid-block crossings. By providing a place to wait mid-crossing, pedestrian safety islands allow pedestrians and bicyclists to navigate one direction of motor vehicle travel at a time. They also have been shown to reduce pedestrian crashes by up to 56% (FHWA-SA-17-064). Pedestrian safety islands are highly recommended at intersections with higher speeds and volumes that make pedestrian or bicycle crossings prohibitive, or where two or more motor vehicle lanes increase exposure.

Guidance

- Pedestrian safety islands are appropriate as interim or permanent measures in any multi-lane roadway with high traffic volumes.
- Angled pedestrian paths should be constructed at unsignalized mid-block crossings with pedestrian safety islands that are wide enough to accommodate a diagonal cut-through.
- The cut-through should be angled diagonally toward oncoming traffic, directing the attention of pedestrians toward approaching vehicles.
- When installing pedestrian safety islands at intersections, the turning movements for the designated design and control vehicles should be modeled to verify there are no conflicts.
- On streets with center turn lanes, pedestrian safety islands can be used on the side of an intersection that does not have a left-turn movement.
- Appropriate lighting levels should be provided for the pedestrian safety island.
- Consider the use of green stormwater infrastructure or landscaping treatments within the pedestrian safety island.

Design

- The cut-through width should equal the width of the crosswalk on high-volume pedestrian crossings. At lower volume crossings, the cut-through area must be a minimum 5’ wide, while the crosswalk would be striped wider.

Pedestrian Safety Island on Northern Parkway

- The desired width of a pedestrian safety island is 8’ to 10’. The minimum width of a pedestrian safety island is 6’. If bicyclists are to use the pedestrian safety island, the minimum width should be 8’.
- If provided, the sidewalk ramps in the median shall comply with City of Baltimore Department of Transportation Engineering and Construction Standard No. BC 655.21 or 655.22.
- Object markers or other vertical elements are encouraged on or approaching pedestrian safety islands, especially when a lane shift occurs in advance of the island. See Maryland *MUTCD* Figure 2C-13 for further guidance.

Raised Crosswalks

Raised crosswalks use vertical deflection to slow motor vehicles at the crosswalk. Raised crosswalks can improve pedestrian safety due to the following factors:

- Motorists may be more likely to yield to pedestrians at raised crosswalks.
- Pedestrian access is improved because the raised crosswalk brings the height of the crosswalk closer to the sidewalk elevation as opposed to pedestrians having to go down to the road height as with a traditional crosswalk.

Guidance

- Raised crosswalks are most appropriate in the following Street Types:
  - Downtown Mixed-Use
  - Urban Village Main
  - Urban Village Neighborhood
  - Neighborhood Corridor
  - Boulevard
- Raised crosswalks can be used for sidewalks, bike lanes, separated bike lanes, and shared-use paths.
- Raised crosswalks should not be placed on roads that are primary truck routes on the Baltimore City Official Truck Route Map; however, raised crosswalks may still be appropriate on local truck routes.

Raised Crosswalk in Alexandria, VA

- Emergency vehicle access should be considered when placing a raised crosswalk near a fire station or along a high-volume emergency response route.
- Drainage needs to be considered when placing raised crosswalks, but should not be the sole determining factor in preventing installation of the raised crosswalk.
- Material selection for raised crosswalks shall be approved by the Baltimore City Department of Transportation.

Design

- Typical width for a raised crosswalk should be set to 10' and have a maximum cross slope of 2% (1.5% desirable). Wider crosswalks may be appropriate at areas with higher pedestrian volumes, or where adjacent bicycle facilities will cross the raised crosswalk.
- The transition area between the road and the raised crosswalk should be 6' horizontally for a 6" raised crosswalk. See Maryland *MUTCD*, Figure 3B-30 for further details.
- Sidewalk ramps adjacent to raised crosswalks must comply with Baltimore City Department of Transportation's Transportation Engineering and Construction Standard Details. An 8' minimum width should be used for sidewalk ramps.
- Detectable warning surfaces must be included on sidewalk ramps to provide detectable transition between the sidewalk and raised crosswalk.
- Pavement markings for raised crosswalks should follow standards in the Crosswalk Markings section of the Complete Streets Intersection Toolbox as well as Maryland *MUTCD* Section 3B.25 and 3B.26. When a raised crosswalk is used at a mid-block crossing, pavement markings should follow Maryland *MUTCD* Figure 3B-17.

Bicycle Enhancements

Bike Lane Intersection Treatments

Bike lanes at intersections provide bicyclists and other micromobility users facilities that are visually separated with paint from vehicle travel lanes. For additional information on the use of bike lanes, please see the Bicycle Facilities subsection of this Manual. The following section details several options for providing bike lanes at intersections. For additional information and design guidance beyond this Manual, see NACTO's *Don't Give Up at the Intersection*.

Combined Bike Lanes/Turn Lanes

A combined bike lane/turn lane is an area where bicyclists and right-turning motor vehicles merge into one travel lane approaching an intersection. They work best at intersections with lower turning volumes, where on street parking is not provided, or where constrained right-of-way prohibits the width for a dedicated bike lane through the intersection.

Guidance

- Combined bike lane/turn lanes are most appropriate in the following Street Types:
  - Urban Village Main
  - Urban Village Neighborhood

Baltimore City Bike Master Plan/ Flickr user "Luton"

Combined Bike Lane/Turn Lane

    - Neighborhood Corridor Streets
    - Boulevard
- Combined bike lane/turn lanes can be used at intersections with lower turning volumes.
- To achieve a higher bicycle level of comfort and higher ridership of the bicycle facility, separated bicycle facilities should be considered. Refer to Bicycle Facilities for further details.

Design

- Provide a 60' minimum merge area between the end of the bike lane and the right-turn bay.
- Provide a 25' minimum, 50' desirable right-turn bay.
- BEGIN RIGHT TURN LANE and YIELD TO BIKES signs should be located at the beginning of the merge area.
- Sharrow pavement markings should be provided in the merge area and the turn bay.
- Combined bike lane/turn lanes should be designed in accordance with the current editions of the AASHTO *Guide for Development of Bicycle Facilities*, Maryland *MUTCD,* and NACTO *Urban Bikeway Design Guide*.

Through Bike Lanes

Through bike lanes provide a bike lane to the left of right-turn lanes or to the right of left-turn lanes. With this configuration, turning motor vehicles must yield to bicyclists in the bike lane. This configuration only results when dedicated turn lanes begin (lane additions) and is more typical of suburban roadways. The application of dedicated right-turn lanes adjacent to bike lanes should be limited in an urban environment and be used only when a safer option is not feasible.

Guidance

- Through bike lanes are most appropriate in the following Street Types:
    - Urban Center Connector
    - Industrial Access Streets
    - Parkway
    - Boulevard
- The through bike lane should terminate as close to the intersection as possible.
- This treatment can be used in conjunction with bicycle boxes or two-stage bicycle left turn boxes.
- To achieve a higher bicycle level of comfort and higher ridership of the bicycle facility, separated bicycle facilities should be considered. Refer to Bicycle Facilities for further details.

Design

- Provide a 60' minimum merge area for turning vehicles to cross over the bike lane.
- Provide a 25' minimum, 50' desirable bike lane between the merge area and the stop bar.
- BEGIN RIGHT TURN LANE and YIELD TO BIKES signs should be located at the beginning of the merge area.
- See Crosswalk Markings in the Complete Streets Intersection Toolbox for guidance on enhancing the bike lane through the intersection.
- Green paint should be used at a minimum in the merging area as described in the Crosswalk Markings Section.
- Through bike lanes shall comply with Maryland *MUTCD* Figure 9C-4 or 9C-5 and should be designed in accordance with the current editions of the AASHTO *Guide for Development of Bicycle Facilities*, NACTO *Urban Bikeway Design Guide,* and the FHWA *Separated Bike Lane Planning and Design Guide*.

Separated Bike Lane Intersection Treatments

Separated bike lanes at intersections provide bicyclists and other micromobility users facilities that are physically separated from vehicle travel lanes. The separation elements can include curb or other separation elements such as flexible delineators, bollards, wave delineators, raised channelizing systems, etc., as discussed in Emerging Materials and Treatments. Separated bike lanes provide an increased bicycle level of comfort to bicyclists and other micromobility users within a facility. For additional information on separated bike lanes please see the Bicycle Facilities subsection of this Manual. The following section details several options for separated bicycle facilities at intersections. At the time of this writing the design and treatments of separated bike lanes at intersections are rapidly changing. Please check the current editions of AASHTO *Guide for Development of Bicycle Facilities*, FHWA *Separated Bike Lane Planning and Design Guide,* and NACTO *Urban Bikeway Design Guide* for the latest industry standards.

Separated Bike Lane Intersection Approach

Separated Bike Lane Intersection Approaches

Separated bike lane intersection approaches extend the separated bike lane up to the intersection without the use of a mixing zone. They can be installed at signalized intersections with or without dedicated vehicle turn lanes and at intersections without conflicting turning movements.

Guidance

- Separated bike lane intersection approaches are most appropriate in the following Street Types:
  - Downtown Mixed-Use
  - Downtown Commercial
  - Urban Village Main
  - Industrial Access Streets
  - Boulevard
- The separated bike lane should terminate at the vehicle stop lane.
- This treatment can be used in conjunction with two-stage bicycle left turn boxes.
- Signal detection for bicyclists should be provided if the signal is actuated.

Design

- Provide a 1' minimum buffer between the turn lane and the separated bike lane.
- If no dedicated turn lane is present, bicycles may use a pedestrian walk signal. A TURNING VEHICLES YIELD TO BIKES sign should be placed on the mast arm.
- NO TURN ON RED signs shall be installed.
- See Crosswalk Markings in the Complete Streets Intersection Toolbox for guidance on enhancing the bike lane through the intersection.
- Lateral shift transitions should be designed in accordance with the current editions of the AASHTO *Guide for Development of Bicycle Facilities*, FHWA *Separated Bike Lane Planning and Design Guide,* and NACTO *Urban Bikeway Design Guide.*

Mixing Zones

Mixing zones are areas where bicyclists and right-turning motor vehicles merge into one travel lane approaching an intersecting. They work best at intersections with lower turning volumes, where on street parking is not provided, or where constrained right-of-way prohibits the width for a dedicated bike lane through the intersection.

Guidance

- Mixing zones are appropriate in the following Street Types:
  - Downtown Mixed-Use
  - Downtown Commercial
  - Urban Village Main
  - Industrial Access Streets
  - Boulevard
- Mixing zones can be used at intersections with lower turning volumes.

Design

- Provide a 60' minimum merge area between the end of the protected bike lane and the right-turn bay.
- Provide a 25' minimum, 50' desirable right-turn bay.
- BEGIN RIGHT TURN LANE and YIELD TO BIKES signs should be located at the beginning of the merge area.
- Sharrow pavement markings should be provided in the merge area and the turn bay.
- Mixing zones should be designed in accordance with the current editions of the AASHTO *Guide for Development of Bicycle Facilities*, FHWA *Separated Bike Lane Planning and Design Guide,* and NACTO *Urban Bikeway Design Guide*.

Lateral Shift Transitions

Lateral shifts transition bicyclists from a separated bike lane to a traditional bike lane left of the motor vehicle right-turn lane before vehicles can turn right. With this configuration, right-turning motor vehicles must yield to bicyclists in the bike lane. Protected Intersections are preferred over lateral shift transitions since they provide increased safety, comfort, and efficiency. However, lateral shift transitions may be used as an interim solution or if right-of-way is prohibitive.

Guidance

- Lateral shift transitions are appropriate in the following Street Types:
  - Downtown Mixed-Use
  - Downtown Commercial
  - Urban Village Main
  - Industrial Access Streets
  - Boulevard
- The separated bike lane should terminate as close to the intersection as possible.
- This treatment can be used in conjunction with bicycle boxes or two-stage bicycle left turn boxes.

Design

- Provide a 20' minimum taper length for the transition between a protected bike lane and a traditional bike lane.
- Provide a 30' minimum merge area for right-turn vehicles to cross over the bike lane.
- Provide a 25' minimum, 50' desirable bike lane between the merge area and the stop bar.
- BEGIN RIGHT TURN LANE and YIELD TO BIKES signs should be located at the beginning of the merge area.
- See Crosswalk Markings in the Complete Streets Intersection Toolbox for guidance on enhancing the bike lane through the intersection.
- Green paint should be used at a minimum in the merging area as described in the Crosswalk Markings Section.
- Lateral shift transitions should be designed in accordance with the current editions of the AASHTO *Guide for Development of Bicycle Facilities*, FHWA *Separated Bike Lane Planning and Design Guide,* and NACTO *Urban Bikeway Design Guide*.

Protected Intersections

Protected intersections provide a continuous separation of the bicycle, motor vehicle, and pedestrian routes through the intersection. Protected intersections also shorten the bicycle crossing distance through the intersection and give bicyclists a head start in front of motor vehicles on a green phase with signal timing adjustments in place.

Guidance

- Protected intersections are most appropriate in the following Street Types:
  - Downtown Mixed-Use
  - Downtown Commercial
  - Urban Village Main
  - Industrial Access Streets
  - Boulevard
- It is desirable to provide enough space to allow through-moving bicyclists space to pass left-turning bicyclists.
- Bike yield lines are recommended on the approach to the intersection prior to the pedestrian crossing.
- While it is desirable to provide protected crossings on all quadrants of the intersection, if space is limited, or if need is not warranted, traditional bike lane crossings and/or the use of two-stage bicycle left turn boxes may be provided.
- Protected intersections can be used in conjunction with floating bus stops. See the Transit Facilities subsection of this Manual for further information on floating bus stops.

Design

- Corner islands should be designed to accommodate design and control vehicles. See the Corner Design section of this Manual for guidance on corner design. Truck aprons can be implemented on corner islands to help facilitate turning movements for vehicles larger than a passenger car.
- Sight distance between through-moving bicyclists and left or right-turning vehicles needs to be closely

Protected Intersection

evaluated at protected intersections. 40' of clear distance is recommended between the front of the last parking space to the point where bicyclists are exposed to turning vehicles.

- See Crosswalk Markings in the Complete Streets Intersection Toolbox for guidance on enhancing the bike lane through the intersection.
- Protected intersections should be designed in accordance with the current editions of the AASHTO *Guide for Development of Bicycle Facilities*, FHWA *Separated Bike Lane Planning and Design Guide,* and NACTO *Urban Bikeway Design Guide.*

Green Paint

Green paint can be used at conflict points between bicycle and motor vehicle facilities. The use of green paint helps to facilitate the exclusive or preferential use of a portion of the road by bicyclists or micromobility users.

Guidance

- The application of green paint should be limited to high conflict areas as overuse of the color can have diminishing effects on its ability to draw attention to a bicycle facility.
- A methyl methacrylate product with a high frictional coefficient shall be the primary treatment for green bike paint. Alternative products must receive approval from the Department of Transportation.

Bicycle Boxes

Bicycle boxes provide a space in front of the motor vehicle stop bar for bicyclists to queue at a red light. They give bicyclists a head-start in front of vehicles when a traffic signal turns from a red phase to a green phase, which reduces conflicts between bicycles and motor vehicles.

Guidance

- Bicycle boxes are most appropriate in the following Street Types:
  - Downtown Mixed-Use
  - Downtown Commercial
  - Urban Village Main
  - Industrial Access Streets
  - Boulevard

Bicycle Box

- Bicycle boxes should not extend across more than one through lane. For wider intersections with more vehicle lanes, consider the use of a two-stage bicycle left turn box.

Design

- Bicycle boxes should be 10' minimum in depth and be the full width of the bike lane and adjacent general-purpose travel lane.
- Bicycle boxes can extend a maximum of one through lane and one left-turn lane.
- An ingress bike lane of 25' to 50' should be provided prior to the intersection.
- The bicycle box design should follow guidance in the current editions of the AASHTO *Guide for Development of Bicycle Facilities* and NACTO *Urban Bikeway Design Guide*.
- Green paint should be used within the bicycle box and the ingress bike lane.

Two-Stage Bicycle Left Turn Box

Two-stage bicycle left turn boxes improve bicyclist level of comfort through an intersection by reducing potential conflicts between bicyclists and motor vehicles. They allow bicyclists in a bike lane or a separated bike lane that is right of through traffic the ability to make a left turn without having to cross by yielding to adjacent moving through or left-turn motor vehicles. This is achieved by establishing a queuing area to wait to turn at the intersection outside of the traveled path of motor vehicles and other bicycles. Bicyclists proceed across the intersection upon receiving a green signal, or at unsignalized intersections when they are clear.

Guidance

- Two-stage bicycle left turn boxes are appropriate in the following Street Types:
  - Downtown Mixed-Use
  - Downtown Commercial
  - Urban Village Main
  - Industrial Access Streets
  - Boulevard
- Two-stage bicycle left turn boxes can be used at signalized and unsignalized intersections.

Design

- Two-stage bicycle left turn boxes must be placed in a protected area outside of the flow of traffic.
- When implementing a two-stage bicycle left turn box at a signalized intersection in which the bike box is in the path of a conflicting left or right-turning vehicle, NO TURN ON RED signs shall be installed controlling that turning movement.
- Two-stage bicycle left turn boxes should be a minimum of 8' long and 8' wide.
- The two-stage bicycle left turn box design should follow guidance in the latest addition of the AASHTO *Guide for Development of Bicycle Facilities* and NACTO *Urban Bikeway Design Guide*.
- Green paint should be used within the box.

Two-Stage Bicycle Left Turn Queue Box

EMERGING TRENDS

With daily advancements in technology and the continued efforts in the transportation industry to provide safer and more efficient services to meet community and commuter mobility needs, the City of Baltimore must continue to evaluate emerging trends. This evaluation will lead to continued advancements and implementation of best practices. As part of this version of the Complete Streets Manual, several emerging trends have been identified for consideration, with a focus on implementation, methods and materials, safety, sustainability, and mobility.

Implementation

With constrained financial resources to implement capital improvements throughout the entire City in a short period of time, Baltimore and other progressive cities have developed strategies to implement projects and achieve fundamental safety goals by using temporary low-cost materials and pavement markings. These interim strategies, or **Quick-Build Strategies**, can be implemented quickly, are relatively inexpensive, and may be easily modified or removed based on measured data, field observations, and community feedback.

The philosophical shift from prioritizing vehicular throughput to maximizing safety and decreasing traffic related injuries and fatalities has necessitated that cities look at retrofitting existing roadways in a short period of time. Quick-build strategies can be designed and implemented rapidly in order to provide safer conditions for one or more of the three different operating groups: pedestrians, bicyclists and micromobility users, and drivers.

There are typically two phases of a quick-build project: A Pilot Project and the Interim Design Phase.

Methods and Materials

As the different modal needs of City streets continue to evolve, the safety of vulnerable road users should be evaluated regularly. To improve safety and delineate different modes of travel, cities have been applying new **Emerging Materials and Treatments** in their street designs.

While permanent features are designed and constructed to existing Baltimore City Department of Transportation Standards, new emerging materials and construction techniques should be utilized to improve safety and comfort for all modes of travel on City streets in a short period of time.

There are several examples of materials and treatments that can be utilized as part of a quick-build project or permanent treatment in the development of a Complete Street. Examples include colored lanes, additional signing along with pavement makings for emerging modes of travel, separation elements, and delineators. The use of any non-standard material shall be approved by the Baltimore City Department of Transportation prior to implementation.

Safety

One of the primary factors related to safety that many cities are continually addressing is **Speed Management**. Implementing design features to align vehicle speed with the surrounding land use context, modal priority, and street functional classification is critical. There are many existing and new approaches to be considered during the design phase and the development of Complete Streets, with a focus on safety from all user perspectives.

Sustainability

When implementing street elements, a focus of the design should also be on the inclusion of sustainable features and technology. One major consideration for the City of Baltimore is the inclusion of **Green Street Components** given the City's location and relationship with the Chesapeake Bay and surrounding watersheds. Sustainable stormwater management can be implemented into large- and small-scale Complete Streets projects, and should be identified and planned for in the early phases of project development.

Mobility

The City of Baltimore must leverage the development of new technology and diverse transportation options to successfully address changing community development and mobility needs within the City. **Emerging Trends** play a key role to this success and are a key consideration in the development of Complete Streets. A few examples of these trends and technologies include, but are not limited to, micromobility devices, ride-hailing, and autonomous vehicles. These modes provide the City an opportunity to implement a new modal hierarchy, improve street safety, and improve transportation equity.

Quick-Build Strategies

The philosophical shift from prioritizing vehicular throughput to maximizing safety and decreasing traffic related injuries and fatalities has necessitated that cities look at retrofitting existing roadways in a short period of time. Quick-build strategies can be designed and implemented rapidly in order to provide safer conditions for one or more of the three different operating groups: pedestrians, bicyclists and micromobility users, and drivers. Quick-build projects increase safety by accomplishing the following:

- Reducing overall speeds
- Reducing speeds around turns
- Decreasing the amount (time and distance) of exposure that vulnerable modes have to vehicles
- Increasing the separation between modes

With constrained financial resources to implement capital improvements throughout the entire City in a short period of time, Baltimore and other progressive cities have developed strategies to achieve fundamental safety goals by using temporary low-cost materials and pavement markings. These interim strategies can be implemented quickly, are relatively inexpensive, and may be easily modified or removed based on measured data, field observations, and community feedback.

There are typically two phases of a quick-build project: a Pilot Project and the Interim Design Phase. Community engagement should be pursued during both phases, with project sponsors seeking public input to determine ways to improve the street to better suit the modal needs of the users. For additional guidance on quick-build strategies refer to:

- NACTO *Urban Street Design Guide*
- Tactical Urbanist's *Guide to Getting It Done*
- People for Bikes *Quick Builds for Better Streets: A New Project Delivery Model for U.S. Cities*

Quick-build projects typically have the following characteristics:

- Improvements are usually installed within a year of the beginning of the planning phase.
- Changes are evaluated almost immediately after implementation for any possible improvement opportunities.
- Tactics may require modifications to meet the desirable goal.

Bikemore

The Big Jump Project

Applying Low-Cost Materials to Quickly Improve Pedestrian Safety in Baltimore

- The approach enables flexibility in design to overcome challenges to meet a desirable outcome.
- Tactics can be part of larger initiatives such as Vision Zero and bicycle and pedestrian projects.
- Materials should be temporary to allow for change after implementation. See Emerging Materials and Treatments for further details.
- Project designers should evaluate public opinion on potential permanent change.

Liability Concerns

The strategies described in this Manual have the potential to increase safety for users of the roadway when applied appropriately and according to engineering standards, though design, construction, operation, and maintenance of the public right-of-way still hold levels of risk. All parties involved in the development and implementation of a quick-build project need to consider potential safety and liability concerns during all phases of the project. Involved parties should take the following actions to address liability concerns:

- Document the existing conditions at the site and how the proposed treatments may impact them.
- Document the design process for determining proposed treatments, and why a certain treatment was selected. Examples may include community input, maintenance needs, or cost.
- Document and formalize the partnership between project parties.
- Follow national and state design standards.
- Consider obtaining liability insurance.

Quick-Build Designs

Quick-build design is a relatively new trend in the United States and is an evolving field with best practices continually changing. While quick-build strategies follow Complete Streets design principles, the materials used for quick-build projects are typically not permanent. The sections below provide information on currently in-use quick-build materials and potential roadway enhancements, and ideas for uses of reclaimed roadway space.

Quick-Build Materials

Pavement Markings

Pavement markings and colored/painted pavement are temporary measures than can be used to delineate areas of the pavement that vehicles should not traverse under the interim conditions of the quick-build project. The limits of this zone can be increased or decreased based on the performance of the change and feedback that is received. Pavement markings can also be used to adjust lane widths, implement bicycle facilities, and for other safety measures discussed below.

Prior to the installation of any temporary paint or pavement markings, Maryland's *MUTCD* should be

Baltimore City Bike Master Plan/ Flickr user "jacobuptown"

Use of Colored Pavement to Designate a Separated Bike Lane referenced to ensure that all standards are met. Any deviations from the standards would need to be approved by the City of Baltimore Department of Transportation or its representative.

For more details on pavement markings and colored pavement lanes, see Emerging Materials and Treatments.

Enhanced Crosswalk Markings

Enhanced crosswalk markings can be installed for pedestrian or bicyclist use as part of a quick-build project. For details on crosswalk markings, refer to the Complete Streets Intersection Toolbox.

Street Signs

Street signs along with pavement markings are forms of traffic control devices that can be implemented to change the manner in which an intersection or a roadway is used. All signs shall be in accordance with the Maryland *MUTCD*.

Emerging Materials and Trends

Colored pavement lanes, bollards, concrete domes, wave delineators, raised channelizing systems, bike rails, hardened centerline treatments, tactile walking surfaces, and slow lanes have been implemented by other jurisdictions as part of quick-build strategies. For further details on their use, refer to Emerging Materials and Treatments.

Traffic Signal Timing

Changes to traffic signal timing can be made with little capital cost and in short timelines, and results can be quickly assessed. The effects of traffic signal timing changes can be monitored in real time to determine if the desired effect has been met and if the change can become permanent. For additional details on traffic signal timing as part of a Complete Street, see Traffic Signal Operations and Design.

Quick-Build Roadway Enhancements

Travel Lanes

Travel lane configurations and widths can be adjusted as part of a quick-build project. These changes can impact the speed of vehicles on the road and can provide additional space for other modes of travel. For details on widths of travel lanes refer to the Roadway zone section.

Curbspace Management

Pavement markings, colored paint, and/or delineators are potential temporary measures that can be used to delineate areas of the pavement where cars should not park under the interim conditions of the quick-build projects. The limits of the no-parking zone can then be increased or decreased based on the performance of the change and any public feedback that is received. Refer to Curbspace Management for further details.

Curb Extensions

Curb extensions are extensions of the pedestrian area into the intersection that provide shorter pedestrian crossing distances and slow vehicles. They can be applied temporarily using delineators, pavement markings, and/or painted asphalt.

Baltimore is removing underutilized parking spaces for better use along the curb.

Guidance

- Curb extensions can be used to shorten crossing distances and decrease effective turning radii for vehicles.
- Curb extensions can be used to reduce illegal parking near intersections.
- Curb extensions can be used in conjunction with on-street parking.
- For a temporary setup, detectable warning surfaces should be kept at the edge of the existing curb line, and the crosswalk should align with them.
- For details on final installation, see the Complete Streets Intersection Toolbox.

Design

- Curb extensions should be a 20' minimum length measured from the intersecting roadway.
- Curb extensions are typically 1' narrower than the adjacent parking lane.
- Detectable warning surfaces may also be placed in the curb extension.
- For details on setting corner radii, see Corner Design.

Pedestrian Safety Islands

Quick-build pedestrian safety islands are at-grade places for pedestrians to wait mid-crossing at an intersection. For further details on the design of pedestrian safety islands, see the Complete Streets Intersection Toolbox. Pedestrian safety islands can be applied temporarily using bollards, pavement markings, and/or painted asphalt. For a temporary condition, signal timing should be set for a pedestrian to cross the full distance of the roadway crossing in one stage.

Flush Medians

A flush median is a continuous area located in the middle of the travelway that delineates traffic traveling in opposite directions. Flush medians reduce the travel lane width and can slow traffic. For further details refer to the Median Subzone section.

Chicanes

Chicanes are offset elements that add lateral shifts to the vehicle travelway. Chicanes require drivers to weave around offsets, which can be outlined with curbs or any vertical barrier element. For further details refer to the Travelway Subzone section.

Transit Boarding Islands

The location and accessibility of transit boarding islands is an important aspect of a Complete Street. During installation of a quick-build project, the location of transit stops can be adjusted to find the optimal location. Moving of transit stops needs to be coordinated with MTA. For additional details on transit stops, see Transit Facilities.

Consideration should be given to the latest guidance around the accessibility of these platforms to include the potential for railings, detectable warning surfaces, and adequate space for those in wheel chairs to maneuver.

Baltimore City Department of Transportation

Floating Bus Stop on Harford Road

Uses for Reclaimed Space as a Result of a Quick-Build Project

Bicycle Facilities

Bicycle facilities can be added to a Complete Street as part of a quick-build project. These are typically limited to the various types of shared facilities, bike lanes, or protected bike lanes. For further details on the installation of bicycle facilities refer to Bicycle Facilities, as well as the Complete Streets Intersection Toolbox.

Curbspace Micromobility Corrals

Curbspace bicycle and scooter corrals repurpose a single curbspace parking space into a curbspace bicycle parking space or micromobility corral. These spaces can typically fit 8-12 bicycles. The creation of these on-street parking areas provides the opportunity to clear out bicycle parking that is typically placed on the sidewalk. As a result, the sidewalk space becomes available for additional pedestrian movements and/or for local business use. See Micromobility for additional guidance.

Parklets/Stoplets

Also known as street seats or curbside seating, parklets are public spaces that were previously curbside parking spaces. These spaces can be implemented at either road elevation or at the curb/sidewalk elevation. These spaces can be used as public seating, micromobility corrals, or for landscaping. Stoplets follow the same principles as parklets, but are installed for the purpose of allowing buses to load and unload in the travel lane rather than having to pull curbside.

Guidance

- Removal of parklets/stoplets is recommended during winter months.
- Parklets/stoplets are typically made from wood and have planters or other landscaping elements.

Design

- The design of the parklet/stoplet foundation/structure should accommodate drainage against the curb to prevent water pooling.
- A wheel stop or concrete barrier should be placed at a desired distance of 4’ in advance of the parklet/stoplet.
- Vertical elements should be placed along the outside edge of the parklet/stoplet to visually delineate it to drivers.
- The minimum length of a parklet/stoplet is one standard parking space (18’-20’) or 3-4 angled parking spaces.
- The width of a parklet/stoplet should be approximately 1’ less than the striped parking lane, or 7’. Special circumstances may warrant a wider parklet/stoplet, such as when placed adjacent to diagonal parking.

Reclaiming Space to Support Local Businesses in Fells Point

- The parklet/stoplet is to be flush with the curb and sidewalk.
- Parklets/stoplets should be placed and designed per the Transit Station Stop Types and Locations section.

Intersection Murals

Intersection murals provide residents and local artists opportunity to beautify existing intersections using acrylic traffic paint. These murals can add beauty and character to the standard intersection. To assist with slowing vehicle speed, these murals can be paired with several different safety objects.

Guidance

- Murals can be paired with other green infrastructure changes to create a “streetscape-like” environment.
- Murals are best used on low-volume, low-speed intersections.

Design

- Murals cannot encroach on existing crosswalk pavement markings and shall be outside of the travelway.

Pedestrian Plazas

Pedestrian plazas are areas at irregular and underutilized intersections that are converted from “empty space” to pedestrian-use areas. These plazas can provide local businesses and neighborhoods with additional space to provide street furnishings, plantings, seating areas, and other neighborhood improvements.

Guidance

- To further assist with delineating pedestrian plazas from the travelway, surface material treatment should be considered.
- Special signing should be considered to warn drivers of temporary pedestrian plaza structures.
- Pedestrian plaza structures should be movable to assist with local maintenance work.
- Pedestrian plaza structures that are in areas of potential conflict of turning or errant vehicles should be reinforced.

Design

- Pedestrian plazas need to be clearly delineated with vertical elements to prevent encroachment from vehicles.
- Pedestrian plazas should be ADA-compliant even in the interim condition.
- Provide pavement markings that prohibit parking adjacent to the pedestrian plaza area.

Reclaimed curb space for outdoor dining in Fells Point

Fells Point Plaza

Emerging Materials and Treatments

As the different modal needs of city streets continue to evolve, the safety of vulnerable road users should be evaluated regularly. To improve safety and delineate different modes of travel, cities have been implementing new, low-cost materials and treatments in their street design.

While permanent features are designed and constructed to existing Baltimore City Department of Transportation Standards, new emerging materials and construction techniques should be utilized to improve safety and comfort for all modes of travel on City streets in a short period of time.

The materials and treatments listed within this section can be utilized as part of a quick-build project or permanent treatment in the development of a Complete Street. For details on additional quick-build only materials, see Quick-Build Strategies. The use of any non-standard material shall be approved by the Baltimore City Department of Transportation prior to implementation.

Signing and Pavement Markings for New Modes of Travel

Signing and pavement marking guidance needs to be continuously monitored and updated to keep up with emerging modes of transportation (such as micromobility, autonomous vehicles, etc.). Users of these modes may be new to using the facility type, and thus simple and clear signing and pavement markings should be implemented so that users understand the appropriate place to operate the transportation mode. When developing for new modes of travel, designers should refer to:

- Guidance from National Association of City Transportation Officials (NACTO)
- Maryland *MUTCD*
- Guidance from the Institute of Transportation Engineers (ITE)

Emerging trends in signing and pavement markings include:

Colored Pavement Lanes

In recent years the use of colored pavement has become more prominent, particularly in urban areas. Special coloring for specific modes of transportation helps drivers and bicyclists identify restricted lane uses and potential conflicts. Additionally, colored pavement lanes improve traffic law compliance with restrictions. In Baltimore City, red colored pavement lanes have been used to delineate dedicated bus lanes, and green colored pavement lanes have been used to delineate bicycle facilities. These have been constructed in compliance with interim approvals by *MUTCD*.

Bus Lanes

- Colored pavement bus lanes shall be a darker shade of red or “Terracotta” color.
- Surface applied treatments should be a Methyl Methacrylate based product.
- Colored asphalt is acceptable with red aggregate as approved by the Maryland Department of Transportation SHA Office of Materials Technology.
- As materials technology improves and better options may become available, additional products may be considered for approval by Baltimore City Department of Transportation.

Bike Lanes

- On-road colored pavement bike lanes shall be “bike lane green” as specified by FHWA.
- Off-road bike facilities may be any color as approved by the Baltimore City Department of Transportation.
- Surface applied treatments should be a Methyl Methacrylate based product.

In-Road Pedestrian Areas

- In-road painted pedestrian areas should be a truffle or khaki color. If part of a right-of-way art installation, additional colors may be used. See Quick-Build Strategies for further details.
- Surface applied treatments should be a Methyl Methacrylate based product or an epoxy binder with a gravel or colored glass aggregate.
- Other surface applied treatments may be used if they provide enough friction factor and receive approval from the Department of Transportation.

Separation Elements and Vertical Delineators

Separation elements are used to visually or tactilely enhance the separation of modal spaces including pedestrian zones, bikeways, vehicle lanes, and transitways. Vertical delineators provide positive physical control similar to that of a curb, but can be placed in narrow locations that would preclude the placement of a physical curb. The installation of vertical delineators may also be less expensive and labor intensive compared to other methods of separation. For additional details on separation treatments between the travelway and bike lanes see the Street Buffer Subzone section.

Flexible Delineators

Flexible delineators or "flex posts" are vertical delineators that are designed to bend down toward the ground when impacted by vehicle and return to a standing position after being struck. They range in height depending on application and have reflective sheeting for nighttime visibility.

Guidance

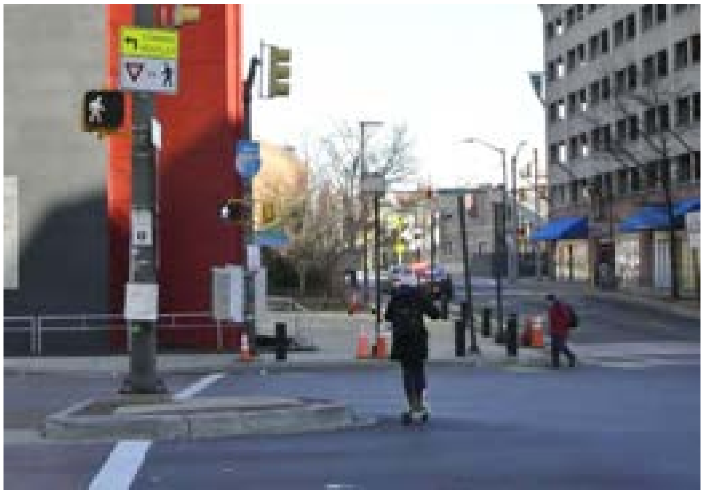
- On surface streets flex posts should be either 28" or 36" depending on the need for visibility by drivers.

Flexible Delineators

  - 28" flex posts are appropriate for long linear applications to prevent drivers from utilizing a space not intended for motor vehicles.
  - 36" flex posts are appropriate near high conflict locations and parking, where additional height will increase visibility.
- Flex posts should be able to withstand multiple impacts from vehicles without failure. Posts made using polyurethane exhibit greater resiliency than those made from other materials and should be the preference. Posts made using polyethylene should not be used due to the lower durability and higher maintenance costs.
- Flex posts may be used for in-road applications anywhere to channelize the movement of any mode. While more permanent solutions are desired, flex posts can be implemented to provide short-term safety improvements at a low cost.

Bollards

Bollards are decorative posts made from steel, concrete, or other materials that are used to separate and control road traffic from other modes. Bollards can be placed as a temporary or permanent measure at a height between 30" to 42". Bollards must be spaced close enough together to prevent vehicle movements between them,



Bollards

with gaps at pedestrian and bicycle crossings. If used as an in-road application, bollards must be retroreflective to be visible at night. Bollards installed permanently are driven or anchored to the ground/roadway/furnishing subzone and are not intended to deflect, but rather stop a vehicle from exiting the roadway.

Planter Barrels and Boxes

Planter barrels and boxes provide an aesthetic benefit to a street and can be implemented as a temporary channelizing device to separate the travelway from pedestrian areas. They are best suited for quick-build projects as they allow for quick adjustments to their configuration.

Concrete Domes

Concrete domes, also called armadillo-style bumps, are higher profile alternatives to rumble strips. There are several styles that have been utilized, and they can be constructed of plastic or concrete. They can be problematic with snow removal.

NACTO

Concrete Domes

Wave Delineators

A newer alternative to the flexible delineator is the wave delineator. They are currently being used to create temporary “pop-up” separated bike lanes. Wave delineators allow officials to temporarily convert a non-protected bike lane into a protected bike lane. Their light-weight nature allows for quick installation and removal for public demonstrations and trials to study how the change to a protected bike lane might affect traffic, parking, and safety.

Saris Infrastructure

Wave Delineator

Raised Channelizing Systems

Raised channelizing systems are modular channelized curbing systems that typically have flexible delineators mounted to the top. Depending on the intended use, the systems can be anchored or unanchored for short-term or long-term configurations. Gaps between the base of the channelizing system and the roadway

Qwick Kurb

Raised Channelizing Systems using Qwick Kurb surface should be provided to allow stormwater to flow underneath. Raised channelizing systems can be used as part of a quick-build project or resurfacing project.

Bike Rails

Bike rails have a similar layout to flexible delineators with the addition of a steel barrier between the posts. The steel rail is placed with a small 2” gap above the pavement so that storm water drainage is not affected. The overall rail height is set at 7” with the installed vertical delineators installed at a total height between 12” to 50”. The modular system can be installed in a temporary or permanent condition as the system is simply anchored to the ground. This system provides both the vertical identification of the posts along with the protection of the steel barrier. Bike rails can be used as part of a quick-build project, resurfacing project, or capital improvement project.

Bike Rail

Rumble Strips

Rumble strips are a low-cost alternative to provide separation without a significant vertical impediment. Rumble strips provide tactile and audible cues to separate transitways. While they are effective in certain aspects, there are drawbacks including: bicyclists and individuals in wheelchairs can have difficultly traveling over the strips, and the low-profile nature of the strips do little to stop vehicles from traveling over them. Additionally, residents and business owners may complain about the noise they generate.

NACTO

The Use of Rumble Strips to Separate Light Rail Transit and Bike Lanes

Hardened Centerline Treatments

Hardened centerline treatments are used to prevent fast left-turning vehicle speeds and enforce overall safe turning behavior. The conception of this treatment arose from the desire to decrease the incidence of pedestrian and bicyclist injuries and fatalities resultant from the failure of drivers to yield while making these turns. Left turns are typically more dangerous than right turns due to:

- The driver’s sightline being blocked by a vehicle’s “A-Pillar” (the metal border on the left side of the windshield)
- Higher turning speeds resulting from a wider turning radius
- Drivers trying to navigate the fastest path through a turn by ignoring and crossing the double yellow line adjacent to either the departure or receiving lane they are turning from/into

Hardened centerline treatments work to minimize or eliminate high-speed aggressive left turns by decreasing the radius of the turning vehicle. Hardened centerline treatments consist of modular curbs (sometimes with vertical delineators) installed along and potentially beyond the centerline of a road close to the intersection or crosswalk. These modular curbs should be installed on the entry and exit movements to prevent vehicles from cutting the corner as they begin and end their turns.

This reduces vehicle speeds and improves sightlines between drivers and pedestrians. Slow turn wedges can also be installed in conjunction with hardened centerlines to further guide vehicles out of conflict zones.

New York City Department of Transportation

Hardened Center Line

Tactile Walking Surface Indicators

Tactile walking surface indicators (also called sidewalk braille) are a system of detectable surface indicators. They consist of a pattern of detectable bumps, cones, or flat-topped bars and are used to guide visually impaired individuals along pedestrian routes and around obstacles. Tactile walking surface indicators can be navigated by walking directly on the partially-raised surface or by maintaining constant contact with the surface.

In the United States, the passing of the Americans with Disabilities Act of 1990 (ADA) ushered in the use of tactile warning surfaces to indicate the boundary between pedestrian and vehicular routes where there is a flush instead of a curbed connection. In 1991, tactile paving surfaces became a requirement at the edge of train platforms and later at the top of stairs and on level landings.

In Europe, Australia, and Asia, tactile walking surface indicators have been used in additional ways. Along shared paths and plazas, tactile paving is used to delineate pedestrian paths from bicycle/vehicular paths. In shared spaces, tactile paving surface indicators guide visually impaired individuals around obstacles such as tables/chairs, trees, artwork, etc.

The United States currently has no definitive guidance on the use of tactile walking surface indicators in ways other than the ones indicated above. The FHWA *Accessible Shared Streets* publication details how best to make shared streets accessible to visually impaired individuals and provides some notes on the use of directional indicators. With no official guidance/requirements in the United States, FHWA references ISO Standard 23599:2012 (since revised to ISO Standard 23599:2019) in terms of the physical requirements of tactile walking surface indicators.

According to the FHWA guide, notable practices for the use of directional indicators include, but are not limited to:

- Directional indicators should have contrasting colors from surrounding surfaces.
- Directional indicators are typically installed in linear fashion (turns or bends require special consideration).
- Impacts on wheelchair users and other mobility-limited individuals should be considered.
- Directional indicators should not be used to define edges between pedestrian and bicycle/vehicular traffic (a buffer should exist).
- Until regulatory requirements exist in the United States, ISO or European standards can be referenced.

The use of tactile walking surface indicators outside of the uses listed in the Americans with Disabilities Act is strictly experimental and may not meet the requirements of future regulation.

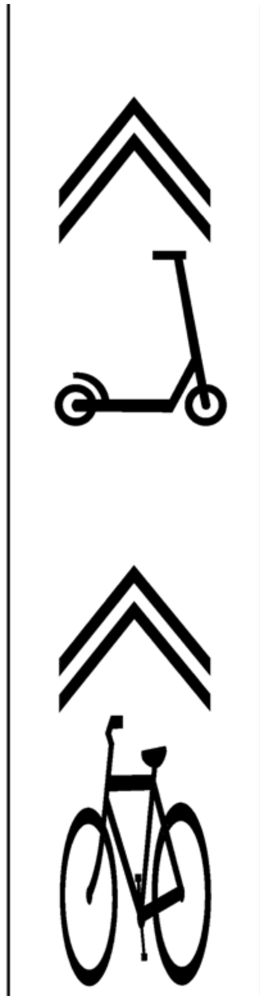
FHWA Accessible Shared Streets

FHWA Accessible Shared Streets

FHWA Accessible Shared Streets

Slow Lanes (Mobility Lanes)

Slow lanes are mixed mobility travel lanes for use by mobility devices traveling between 10 to 15 mph. They are designed to be adaptable and accommodate new modes of micromobility, scooters, and bicycles. Unlike traditional bike lanes, slow lanes also typically include pavement marking stencils for scooters. However, it should be noted that at the time of this writing, the scooter symbol is not provided in the *MUTCD*. Given that the width of these lanes is wide enough to accommodate a vehicle, it may be preferable for slow lanes to be buffered or separated from the roadway. At the time of this Manual publication, Baltimore City has not adopted the use of slow lanes, and micromobility devices are encouraged to use bicycle facilities. See Micromobility for further details.



Slow Lanes are an Emerging Trend in Complete Streets

Advisory Bike Lanes

Advisory bike lanes may be considered on low-volume roadways that are too narrow for standard bike lanes and have traffic volumes between 2,000 ADT and 3,000 ADT with a maximum speed limit of 25 mph. This treatment is currently considered experimental by FHWA and must be approved by Baltimore DOT. If implemented as an experimental treatment, DOT would need to work through MDOT SHA and FHWA to document the reasons for using it over other methods and determine what level of reporting they would need to do after implementation.

Speed Management

Consistent with the City's emphasis on traffic safety, addressing speed management is a fundamental element of Complete Streets. Aligning vehicle speeds with the surrounding land use context, modal priority, and purpose of the street is essential to the success of Complete Streets and safety for the surrounding community.

Excessive vehicular speeds on City streets conflict with safe design and operation of Complete Streets, placing a high severe injury and fatality risk to pedestrians, bicyclists, micromobility users, and transit users. Baltimore City experiences over 30 traffic related fatalities per year, hundreds of serious or incapacitating injuries, and over 5,000 total injuries. Speed management is critical in achieving safe, livable streets.

By Law in the City of Baltimore, the desired speed for a street shall be equal to the target speed and posted speed. The speed limit on a non-highway roadway should not be set according to 85th percentile speeds, but rather it should be set according to the desired speed for that street based on the land use context and modal priority.

Target Speeds by Street Type

Background

Managing vehicular speed on City streets through street design can be accomplished proactively or reactively. Traffic calming treatments are generally applied reactively to a street that has a design speed misaligned with the surrounding environment, street's function, and modal priority. The treatments are deployed to retrofit the street's design to slow vehicles to a desired target speed. Recommended traffic calming treatments/tools are detailed in the Intersections, Crossings, and Mid-block Treatments Section.

Designing to a Target Speed

This Manual's design standards and specifications mandate the alignment of a street's design speed with the desired target speed on all new City transportation projects. Assigning target speeds to Street Types aligns design and target speeds to fit the surrounding community.

The following table identifies target speeds by Street Type that reflect land use context and street functionality. The table also includes subcategories of modal priority per Street Type in order to optimize the balance of safety and mobility. When selecting a target speed for each Street Type, the default target speed should be used on all streets within the pedestrian network. However, the default target speed can be modified depending on the modal priority, as indicated in the table below.

Generally speaking, streets serving residential communities, activity centers, and priority safety/overlay areas such as school zones, possess lower target speeds. Streets connecting communities with less on-street multimodal activity possess higher target speeds. When multiple modal priorities exist on a corridor, the speed that accommodates the most vulnerable of modal priorities should be selected (i.e., bicycle first, transit second, and motor vehicles third). Some streets do not serve pedestrians or cyclists, therefore the target speed can be increased on those streets as indicated in the table.

The target speeds shown below should be incorporated into:

- Street design specifications/geometric decisions
- Speed limit signage
- Traffic calming device spacing (see speed hump spacing table)
- Traffic control device operation
- In a coordinated signal network, the progression speed shall be the target speed or lower based on engineering judgment

Table 10. Target Speeds by Street Type

	Target Design Speed (MPH)
Downtown Commercial	
Base Target Speed. However, if:	25
On Bicycle Network (Separated/Buffered Bike Lanes)	25
On Transit Priority Network	25
On Truck Route	25
Downtown Mixed-use	
Base Target Speed. However, if:	25
On Bicycle Network (Separated/Buffered Bike Lanes)	25
On Bicycle Network (Traditional Bike Lanes)	20
On Transit Priority Network	25
On Truck Route	25
Urban Village Main	
Base Target Speed. However, if:	20
On Bicycle Network (Separated/Buffered Bike Lanes)	20
On Bicycle Network (Traditional Bike Lanes)	20
On Transit Priority Network	20
Urban Village Neighborhood	
Base Target Speed. However, if:	20
On Bicycle Network (Separated/Buffered Bike Lanes)	20
On Bicycle Network (Traditional Bike Lanes)	15

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	Target Design Speed (MPH)
Urban Village Shared Street	
Base Target Speed	15
Urban Center Connector	
Base Target Speed. However, if:	25
On Bicycle Network (Separated/Buffered Bike Lanes)	25
On Transit Priority Network	25
On Truck Route	25
Off of Pedestrian Network	35
Neighborhood Corridor	
Base Target Speed. However, if:	20
On Bicycle Network (Separated/Buffered Bike Lanes)	20
On Bicycle Network (Traditional Bike Lanes)	15
On Transit Priority Network	20
On Single Lane Streets	15
Industrial Access	
Base Target Speed. However, if:	25
On Bicycle Network (Separated/Buffered Bike Lanes)	25
On Bicycle Network (Traditional Bike Lanes)	20
On Transit Priority Network	25
Off of Pedestrian Network	35
Parkway	
Base Target Speed. However, if:	25
On Bicycle Network (Separated/Buffered Bike Lanes)	25
On Transit Priority Network	25
On Truck Route	25
Off of Pedestrian Network	35

	Target Design Speed (MPH)
Boulevard	
Base Target Speed. However, if:	25
On Bicycle Network (Separated/Buffered Bike Lanes)	25
On Bicycle Network (Traditional Bike Lanes)	20
On Transit Priority Network	25
On Truck Route	25
Special Overlay Zones / Transition Areas	
School Zones	15-20
Community Centers / Farmers Markets / Senior Centers	20
Transit Mobility Hubs	25
College Campuses	25
Transition Areas Entering Residential Neighborhoods, Urban Villages, and Downtown	25

An Approach to Managing Vehicular Speeds

The approach below should be followed to manage vehicular speeds on City streets. This approach is most applicable to streets that have not been redesigned to this Manual's new specifications and thus possess design and operational characteristics inconsistent with the community context and modal priority. Overlay zones and transition areas are priority locations for this analysis.

1. **Understand the Community and Purpose of the Street**

   Identify the Street Type that reflects land use context and function of the street. Understand the modal priority and other factors that influence the need for speed management. Examples include:

a. School zones (and time of day arrival/departure)
b. Community centers, playgrounds, and other activity centers
c. Level of pedestrian activity
d. Major transit hubs/stations
e. Transit priority street
f. Bicycle and micromobility priority street

2. **Identify the Target Speeds Associated with the Street Type and Design the Street to Meet the Target Speed**

   Use design elements to manage vehicular speed, applying some or all of the following treatments/ roadway characteristics:

   a. Lane widths/roadway geometry
   b. Signal timing
   c. Speed limit signage
   d. Intersection toolbox treatments
   e. Corner design
   f. Traffic calming measures
   g. Landscaping
   h. Curbspace management

3. **Take a Comprehensive Approach to Implementing and Monitoring City Streets**

   Successfully controlling speeds on Baltimore's streets requires coordination between traffic engineers, planners, community outreach specialists, and the Police as outlined below:

   a. **Evaluate**: Create/maintain a data-driven process to track and compare posted speed limits verses prevailing speeds (85th percentile), and identify high-risk locations on City streets. Assess information by time of day and day of the week. Once established, track the comparison as a performance measure in the Complete Streets Annual Report.
   b. **Engage**: Listen to community members to understand the community perspective and driver behavior.
   c. **Educate**: Partner with the community to increase awareness and support. With communication specialists and the Police, launch education campaigns to emphasize the risks of speeding and the associated penalties.
   d. **Engineer**: Modify the street design and operation using countermeasures listed in Intersection and Street Crossing Control and FHWA's *Speed Management Toolkit*.
   e. **Enforce**: After educating the public, enforce speed limits. Assess the evaluation to understand the speeding challenges such as location, time of day, and street design shortcomings. Focus enforcement based on this evaluation to optimize police resources.
   f. **Equitable**: Be equitable in the allocation of enforcement and engineering resources.

While education and enforcement are components of an implementation process, engineering should be the primary focus for speed management, as real physical changes are the most proven methods of slowing vehicle speeds and increasing safety. Achieving significant speed reduction through education can be extremely difficult, and consistent enforcement is resource intensive.

Speed Management Resources

Institute of Transportation Engineers Speed Management for Safety Resource Hub:
https://www.ite.org/technical-resources/topics/speed-management-for-safety/

Federal Highway Administration:
https://safety.fhwa.dot.gov/speedmgt/

National Association of City Transportation Officials Speed Management Design Guidance:
https://nacto.org/publication/urban-bikeway-design-guide/bicycle-boulevards/speed-management/#design

Green Street Components

Complete Streets should also be green streets. Green streets incorporate trees and plants in a number of ways, including boulevard strips, street trees, planter boxes, rain gardens, and swales. Vegetation in Complete Street design provides multiple benefits including traffic calming, enhanced aesthetics, reduced runoff, and reduction of the heat island effect, which all contribute to added pedestrian comfort, improved environmental health, and increased livability. The multiple benefits of these vegetated functional spaces can be incorporated into large- and small-scale Complete Streets projects and should be identified early in project development.

Green street components can be incorporated within any of the Complete Streets zones and sub-zones as described within this Manual outside of travelways, including within the sidewalk's frontage or furnishing subzones, the curbspace, or within roadway medians or islands.

On streets with low target speeds where the curbspace does not have a lane for bikes, automobiles, transit, etc., nor are there utility conflicts beneath the curbspace, intermittent green street components are encouraged in this zone. I.e., if the curbspace includes parking, loading, bike parking, etc., green street components should be mixed in with the other uses to break up the linear feel of the curb.

This Manual promotes the use of trees and vegetative spaces in Complete Streets projects when feasible. The guidance presented below describes planning and design considerations for green street components as part of Complete Streets projects.

Street Trees

The character and structure of a street is often defined by street trees. Street trees are typically canopy trees, but smaller understory and flowering trees can be used in locations where there are no conflicts with vehicles or pedestrians. They provide fall color, spring blossoms, and a vertical structure and rhythm that enhance the pedestrian realm and create a feeling of enclosure for drivers, which encourages slower speeds. Street trees also contribute to a comfortable pedestrian environment providing valuable shade on hot summer days.

Planter boxes demarking a parklet boundary in the Curbspace Subzone

To create this environment on wider streets, tall trees with overarching canopies should be used; while on smaller narrower streets, medium sized trees can be used to provide a similar effect. Tree spacing is also critical, as the goal is to provide a near seamless tree canopy. Finally, the type of street tree to include in a design depends on available soil volume, canopy cover, and street width.

When determining the placement of street trees, consideration should be given to Street Type and whether gaps should be provided between trees for sightlines at cross streets and pedestrian crossings. On streets with low target speeds, small design vehicles, and traffic signals or all-way stops, trees should be planted up to intersections because of their benefits and the reduced need for long sightlines. However, on higher speed streets with little residential or commercial activity, or at unsignalized intersections on higher speed streets, gaps between trees should be provided for improved sightlines.

Street trees shall be planted as approved by the Baltimore City Recreation and Parks' Forestry Division and shall be trees that are included in the Baltimore City Street Tree Species List.

Planter boxes in the Frontage Subzone

Gardens and Vegetated Areas

Plants add variety and diversity to urban streets. Depending on the Street Type and available space, plants can be incorporated in a number of ways, including:

- Planter boxes
- Conservation landscaping
- Vegatated curb bumpouts and islands
- Median plantings
- Parklets

These can be above-ground containers or at-grade landscaped areas with perennials and shrubs. Use of native species is recommended and use of non-native invasive species is prohibited. Additionally, planted areas can also incorporate site furnishing, such as seating, low walls, and public art. While gardens and plants are typically permanent, they can also be incorporated into quick-build roadway enhancements such as parklets, public space, portable round and linear planters, and seating areas.

Green Stormwater Infrastructure (GSI)

GSI consist of best management practices (BMPs) that collect stormwater runoff for water quality treatment (e.g., filtering to remove pollutants) and/or detaining a portion of the runoff for slow, controlled release that mitigates adverse downstream impacts such as flooding or erosion. Often called Environmental Site Design

(ESD), these micro-scale practices can include but are not limited to:

- Micro-bioretention
- Rain gardens
- Swales

Definitions and design requirements for these micro-scale stormwater practices and additional options which may be incorporated as green street components are defined in the most recent versions of the Maryland Stormwater Design Manual, the Baltimore City DPW Environmental Site Design Standard Details, and the Green Book (Baltimore City Standard Specifications).

Drainage design (e.g., gutter spread along roadways, storm drain and inlet sizing/hydraulic gradient, and general facility design sizing/configuration), structural design (e.g., inlets/manholes, curbs, retaining walls) and related public safety requirements must be in accordance with Baltimore City Department of Transportation requirements and the Baltimore City Book of Standards.

Regulatory and design review for green stormwater infrastructure is required and should be coordinated with Baltimore Department of Public Works (DPW) and Baltimore City Department of Transportation (BCDOT).

Guidance

An evaluation of the location of trees, gardens and vegetated areas, and GSI within the City right-of-way shall consider the following:

Vegetated stormwater curb bumpout

- **Utility conflicts**: Locations that are free of existing underground utilities are preferred, however, in some cases, utilities can be encased or otherwise protected and allowed to pass through or under a planting area. Availability of connections to existing storm drain systems should be evaluated for feasibility of locating GSI facilities.
- **Cost-effectiveness**: While any component of a Complete Street must be considered for cost, for GSI in particular, it is important to consider the cost per impervious drainage area treated to make it cost-justified.
- **Maintenance**: Who is responsible for maintenance of planted areas, and the maintenance schedule and requirements of the vegetation, need to be considered from the start. While street trees tend to require less maintenance than gardens or GSI, watering and pruning will still be needed.
- **Adaptability to site**: Plants selected should be well adapted to site conditions, including soils and compaction, salt exposure, heat and drought, and sun/shade. Appropriate height for visibility and safety should also be considerations.
- **Year-round interest**: Visual interest and wildlife benefits should be considered when selecting plants and trees. Species should be selected that provide various types of sensory interest (visual, aroma, textural, etc.) at different times of the year – (e.g., timing and color of flowers, summer foliage, fall color, and evergreen foliage or stem/branch structure in the winter).
- **Traffic Safety**: Determine if the proposed installation creates any safety issues or reduces visibility to existing or planned traffic control devices.
- **Integration into Complete Street goals**: The installation of green street components should support and enhance the creation of a safe and accessible multi-modal design.

Emerging Trends in Transportation: Challenges and Opportunities

New transportation options are emerging, and existing transportation modes are rapidly changing due to advances in technology and a cultural shift to a shared-mobility mindset. Given the swiftness of these changes, agencies are limited in their ability to provide timely guidance for safely accommodating and regulating these transportation modes.

This section provides guidance for micromobility (addressed in further detail in the Micromobility subsection), ride-hailing services, and autonomous vehicles. At the time of this Manual's publication, industry guidance for these transportation modes is limited and not widely accepted.

Emerging transportation modes provide the City an opportunity to implement a new modal hierarchy, improve street safety (consistent with the Baltimore Vision Zero Initiative), and improve transportation equity. The City must understand the challenges associated with these emerging trends in order to successfully leverage them for positive change. This section identifies emerging trends and provides strategies to address challenges and optimize opportunities. This list is not all inclusive and may change with new technology and market demand, however these strategies should be implemented with all new modes of travel.

Micromobility

The City has approved the use of electric ride-share micromobility devices. As discussed in Micromobility, the preferred location for their operation is within bicycle facilities (see the Bicycle Facilities subsection for more detail). The Micromobility subsection also addresses micromobility corrals, which can be placed within the furnishing subzone or curbspace. The Emerging Materials and Treatments section discusses the potential for using a slow lane for micromobility devices.

Challenges

- Although scooters and other micromobility devices should use the on and off-street bicycle facilities,
  - guidance is limited for novices or tourists new to or unfamiliar with using micromobility on City streets and;
  - many streets do not have bicycle accommodations.

  Therefore, users are left without a clear understanding of where to travel. Depending on the Street Type, sidewalks and street travel lanes vary in the degree to which they provide safe accommodations for these devices.
- Scooters may not have the same maneuverability and braking capabilities of a bicycle, and they also have smaller tires that are less equipped to navigate bumps safely.
- Devices docked in pedestrian zones, shared-use paths, and streets present a hazard to others and are unsightly.
- Deployment of these devices is normally based on forecast demand, limiting access for all users and communities.

Micromobility scooters in Fells Point

Opportunities for Action

- Monitor industry approved signing and markings for micromobility devices and continue to assess wayfinding and advisory signing prospects.
- Partner with Police through Vision Zero initiatives to educate the public and enforce traffic laws.
- Assess methods for the City to manage parking of the dockless devices, including incentivizing the use of micromobility corrals.
- Continue monitoring/documenting service patterns. Engage community interest in an equitable program expansion to support underserved communities.

Ride-Hailing

With the exponential growth in ride-hailing apps and ridesharing programs over the past several years, travelers are benefiting from unregulated accessibility to specific destinations, and can now be picked up and dropped off anywhere. These services are primarily provided by Transportation Network Companies (TNCs).

Challenges

- City curbspace is valuable and there is limited space for TNCs to operate appropriately.
- Other than deploying law enforcement personnel, there is currently no regulation or control over pick-up or drop-off locations.

- This service is normally based on forecast demand, limiting access for all users and communities.

Opportunities for Action

- Assess methods to strategically evaluate curbspace. Evaluate street use and modal priorities when optimizing curbspace area. Investigate opportunities to use technology to regulate TNC pick-up and drop-off locations.
- Continue monitoring/documenting service patterns. Engage community interest in equitable program coverage to support underserved communities.

See Curbspace Management for strategies to optimize the curbspace area.

Autonomous Vehicles (AVs)

Autonomous vehicle technology is rapidly developing, and their deployment may soon become a reality. It is anticipated that ride-hailing and goods delivery will become the first prevalent uses of autonomous vehicles. There are many potential benefits of AV use including:

- Improved safety for all street users
- Greater access to vehicles by a higher percentage of the population
- Reduced need for on-street extended period parking
- Reduced travel lane congestion and improved travel times.

The goal of transportation planning in Baltimore City is to encourage the most efficient modes of travel including walking, biking, and using micromobility and transit. So, while autonomous vehicles potentially bring many benefits, they are still low-occupancy vehicles and should not be prioritized over other transportation modes. The City should adapt to the use of autonomous vehicles while still providing incentives and initiatives for walking, biking, micromobility, and transit use. I.e., the modal hierarchy stated in this Manual remains the same regardless of technological advances in automation.

Challenges

- AVs unlimited access on public streets.
- AV use will likely create a high demand for short-term docking.
- There is industry pressure to integrate the traffic signal/ITS City-owned technology with AVs.
- Identify design/infrastructure changes to the City streets to safely operate AVs to optimize the movement of people, following the modal hierarchy defined in this Manual.
- Identify policies to safely operate AVs, ensuring compliance with the modal hierarchy defined in this Manual.
- Ensure that AVs are accessible in an equitable manner.

Opportunities for Action

- Working through the planning process, identify streets or areas of the City that prohibit AV access.
- As outlined in the Curbspace Management section, establish a prioritization process to manage the anticipated docking demand.
- Coordinate Complete Streets efforts with the Traffic Division as outlined in the Traffic Signal Operations and Design section of this Manual.
- Monitor industry emerging technologies to manage the safe operation of AVs, while ensuring compliance with Complete Streets design standards, modal hierarchy, and curbside management programs.
- Update this Complete Streets Manual to reflect the integration of AVs, starting with policy direction.
- Include in the AV policies an equity assessment to promote accessibility for underserved communities.

04

IMPLEMENTATION

This chapter provides direction on ensuring that the City's programs, processes, and procedures effectively implement the new Complete Streets design standards, and ensuring that transparency and accountability are provided in the project prioritization and delivery processes.

This chapter includes the following policy and procedures direction:

1. **Addressing Equity in Baltimore**: As input into the project prioritization process, assess transportation disparity trends and recommend ways to reverse the trends. Apply an equity assessment tool to identify underserved communities.
2. **Equity in Community Engagement Policies**: When initiating, developing, and delivering a Complete Streets project, engage the public with an equitable approach to race, income, age, and accessibility.
3. **Project Prioritization**: Rank and select the City's transportation and relevant public works infrastructure projects based on a transparent process that balances data-driven safety, accessibility, and mobility metrics with an equity assessment to serve underserved communities.
4. **Project Delivery Process**: From project identification to construction, project delivery checkpoints are identified to ensure City programs adhere to the Complete Streets guiding principles.
5. **Annual Report to Measure Progress**: The City Council's Complete Streets Ordinance requires annual reporting of the City's progress in achieving transportation system performance and economic development goals in an equitable manner.

ADDRESSING EQUITY IN BALTIMORE

Introduction

Per the Complete Streets Ordinance, Baltimore will apply an equity assessment when prioritizing new Complete Streets transportation projects. The Ordinance states that "the equity assessment shall consider transportation disparity trends based on race, gender, sexual orientation, age, disability, ethnicity, national origin, or income and recommend ways to reverse these trends. It shall assess and recommend ways to eliminate structural and institutional discrimination in transportation based on immutable characteristics." This section of the Complete Streets Manual defines transportation equity and provides equity considerations for the City's transportation planning and implementation processes.

To lead change, and as an integral part of the project prioritization process, the City will evaluate how the distribution of City transportation resources impacts historically underserved communities. Baltimore City has inequitably distributed resources and investment among communities for decades. These imbalanced distribution patterns in Baltimore can be traced back to settlement patterns, discriminatory policies, and gentrification, and communities continue to this day to be impacted by the repercussions of these discriminatory policies and practices. Historically underserved communities experience challenges such as decreased traffic safety, urban heat islands, poor air quality, and lower life expectancy.

There are many effects of inequitable transportation resource allocation that fall hardest on vulnerable members of the community including low-income residents, minorities, children, persons with disabilities, and older adults. Typically, these communities have difficult or restricted access to educational and employment resources, own fewer vehicles, have longer commutes and higher transportation costs, and face increased safety risks and disinvestment. For example, Baltimore's Oldtown and Middle East neighborhoods have a median household income of $19,127, well below the average Baltimore household income of $46,641, and 66.2% of those households have no access to a personal vehicle (compared to the Baltimore average of 29% of households that have no access to a personal vehicle).[1] Furthermore, it takes 45 minutes or longer to commute to work for 34.5% of the residents in the predominantly Black Baltimore neighborhoods of Sandtown-Winchester and Harlem Park.[2]

Baltimore recognizes that many communities within the City have a greater reliance on non-automobile transportation infrastructure simply because of the higher cost to own, operate, and maintain a vehicle compared to using transit, walking, and cycling. Identifying and serving these communities with affordable transportation choices is one of the primary reasons why the City has committed to the new modal hierarchy and producing this Complete Streets Manual.

Baltimore's commitment extends beyond establishing the new modal hierarchy and includes a change to the processes used to prioritize transportation investments so that they include an equity asessment. The City has traditionally evaluated transportation investments based on safety, accessibility, asset condition, and mobility

1. 2013–2017 data. Source: Baltimore Neighborhood Indicators Alliance, Jacob France Institute and the University of Baltimore. *Vital Signs 17.* Spring 2019.

2. 96.1% of Sandtown-Winchester and Harlem Park residents are Black or African American, compared to the Baltimore average of 62.3% (2013–2017 data). The average percentage of people who have a work commute of 45 minutes or more in all of Baltimore is 20.8% (2013–2017 data). Source: Baltimore Neighborhood Indicators Alliance, Jacob France Institute and the University of Baltimore. *Vital Signs 17.* Spring 2019.

metrics and considered potential outcomes resulting from investments, such as safety considerations and reducing delays on highly congested roadways. These data-driven processes for each transportation program remain important in prioritizing investments, particularly those pertaining to the “TowardZERO Baltimore” Initiative, and the City’s upcoming commitment to Vision Zero, however they do not provide a comprehensive understanding of the equitable distribution of resources.. Baltimore will continue to employ data-driven processes to prioritize City resources but will now also ensure that an equity assessment is included.

Moving forward, in order to reverse historic inequities related to transportation service and safety, the City of Baltimore will use data related to historically marginalized groups to inform transportation investment decisions.

TowardZERO Baltimore

TowardZERO Baltimore is a long-term initiative to prioritize safety within the City’s multi-modal transportation network.

TowardZERO Baltimore supports the Vision Zero principles of eliminating all traffic fatalities and severe injuries, while increasing safe, healthy, and equitable mobility for all.

More information on the TowardZERO Initiative and Vision Zero can be found at

https://transportation.baltimorecity.gov/towardzero-baltimore
and
https://visionzeronetwork.org.

Defining Equity in Transportation

Definitions of equity can vary in nuance and application. At its most basic level, equity is the quality of being fair and impartial. But when defining equity as it relates to the City, and specifically to Baltimore's transportation system, the definition must be refined.

The Baltimore City Equity in Planning Committee states that "an equitable Baltimore addresses the needs and aspirations of its diverse population and meaningfully engages residents through inclusive and collaborative processes to expand access to power and resources."[3] The Committee promotes the use of an equity assessment that includes structural, procedural, distributional, and transgenerational equity.

Equity Assessment

1. **Structural Equity**: What historic advantages or disadvantages have affected residents in the given community?
2. **Procedural Equity**: How are residents who have been historically excluded from planning processes being authentically included in the planning, implementation, and evaluation of the proposed policy or project?
3. **Distributional Equity**: Does the distribution of civic resources and investment explicitly account for potential racially disparate outcomes?
4. **Transgenerational Equity**: Does the policy or project result in unfair burdens on future generations?

Source: https://planning.baltimorecity.gov/equity-planning-committee#Defining Equity

The Baltimore City Department of Transportation Complete Streets Manual's guiding principles defines an equitable transportation system as one that is safe and accessible, improves mobility for all users regardless of race, income, gender, age, disability, health, English language proficiency, and vehicular access, and reflects neighborhood values and promotes economic vitality.

Historic disparities of an area can automatically impact someone born, raised or living there. The location in which a person lives can limit their access to job opportunities, quality schools, healthy food, green space, healthcare, and social goods. It may also unfairly expose them to external consequences such as poor air and water quality, safety risks, housing barriers, and fewer job opportunities. The systematic disadvantages of one social group compared to another social group leads to inequitable experiences, exposures and outcomes.

Because the impacts of transportation infrastructure can disproportionately and unfairly affect certain populations and communities, it is important to implement transportation decisions equitably. But integrating equity considerations in transportation investments can be complicated because communities may not agree on how best to define "fair" and "equitable" practices and implementation strategies.

Communities often have differing opinions on values, needs, and infrastructure priorities. Those involved in transportation investment decisions may carry conscious or unconscious biases that skew the relationship and perception of equitable disbursement of resources throughout communities. Therefore, it is important to differentiate equal from equitable and to understand that an equitable distribution of resources might not be an equal distribution of resources.

To be equal means to be even or balanced, providing the same exact amount of the same exact "something"

3. https://planning.baltimorecity.gov/equity-planning-committee#Defining Equity

to everyone. To be equitable is to provide everyone the same accessibility, but the ways that accessibility is provided may differ. Equity brings people of differing abilities, financial background, and other social or physical differences to a state where they are afforded the same opportunities. For example, safe, accessible and efficient walking, cycling and transit routes are cornerstones of equitable transportation as they allow residents who don't own, or can't afford, a personal vehicle to access the same educational, employment or recreational opportunities as those who do own a personal vehicle.

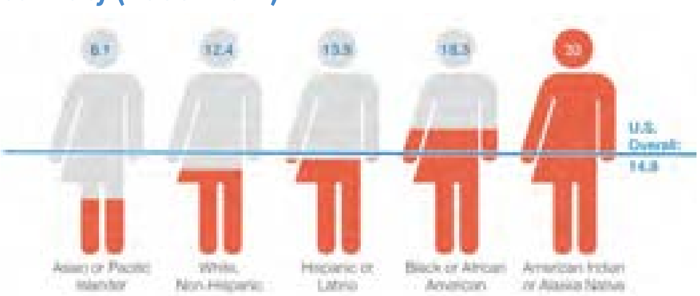
Why is Equitable Transportation Important?

When evaluating and prioritizing potential Complete Streets projects, it is critical to recognize and consider a wide range of perspectives, some which may be divergent or conflicting. This means not simply distributing resources equitably across the City, but identifying the areas with the greatest need for the Deparment of Transportation's attention and resources.

It is important to use a data-driven process to identify, implement, and evaluate equitable practices and procedures when addressing transportation needs. This data-driven process must not unjustly favor one community over another due to an imbalance of power, funds, or other resources embedded into the fiber of communities. To unjustly favor one community over another is to further ingrain inequity in Baltimore.

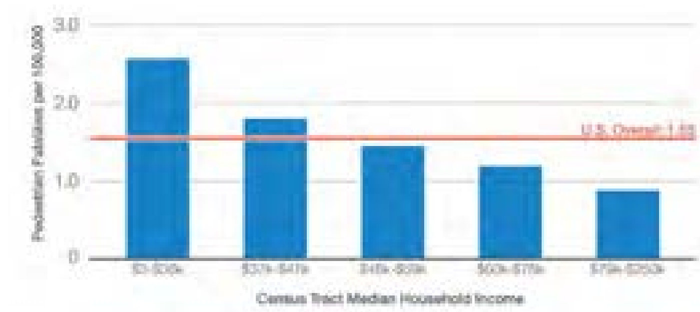
Equity factors including race, income, and car ownership can influence the availability and quality of transportation options, which in turn influences access to amenities such as education, healthcare, food (such as farmers markets and grocery stores), and employment. For example, lower income residents are less likely to be able to afford a personal vehicle, which limits how far, how quickly, and how easily they can travel to a job, in turn limiting their employment options. Individual and community transportation inequalities also result in safety issues. Older adults, Black Americans, and other minority pedestrians in low-income communities have disproportionately higher fatalities in vehicular crashes involving people walking.[4] This is due in part to the history of designing roadways that cut through communities of color and create unsafe pedestrian conditions.

Figure 6. Relative pedestrian danger by race and ethnicity (2008–2017)



Black and Latino pedestrians are more likely to be killed than white pedestrians. (Chart from Smart Growth America and National Complete Streets Coalition. *Dangerous By Design*. 2019.)

Figure 7. Location of Pedestrian Fatalities by Neighborhood Income



"People die while walking at much higher rates in lower-income communities compared to higher-income ones. This is unsurprising, given that low-income communities are significantly less likely than higher income communities to have sidewalks, marked crosswalks, and street design to support safer, slower speeds, also known as traffic calming." (Chart from Smart Growth America and National Complete Streets Coalition. *Dangerous By Design*. 2019.)

4. Smart Growth America and National Complete Streets Coalition. *Dangerous By Design*. 2019.

Baltimore Equity Assessment

Baltimore City Deparment of Transportation recognizes that deep residential engagement along with a data-driven approach based on transportation system performance measures, such as safety, accessibility, and mobility, are needed to identify conditions such as locations with a history of (or potential for) severe and fatal crashes, missing or inaccessible sidewalks, and severe traffic congestion. But, once those conditions are identified, the City must also choose how to prioritize and equitably distribute limited resources to address those conditions. The City will address the inequities outlined above by developing and implementing an equity assessment to ensure fair and equitable distribution of projects in the City.

As part of the data-driven project prioritization process, Complete Streets projects will be evaluated and prioritized utilizing an equity assessment framework, in addition to the standard prioritization schemes based on safety, accessibility, asset condition, and mobility metrics. Potential projects will be analyzed for equity considerations by overlaying the project site with the equity assessment data. This equity assessment data identifies historically underserved areas within Baltimore City according to equity indicators such as race, income and car ownership, and will guide Baltimore City in prioritizing investments in transportation infrastructure to help ensure equitable outcomes across all communities.

On the next page is a map illustrating communities within the City that qualify as historically underserved based on a combination of the following indicators:

a. Race
b. Household Income
c. Household Vehicle Access
d. Rates of Public Transportation Utilization
e. Median Age of Residents

The "Equity Analysis for Baltimore City" map displays the draft composite equity score for each US Census Block Group. The draft composite equity score is the weighted sum of all the individual equity indicators class and rank scores. The preliminary classification and rating approach for each indicator are provided in the 'Proposed Indicator Rank Scoring' table. The individual classification and rating, and the formula for calculating the composite equity score is subject to change based on additional input from the various stakeholders.

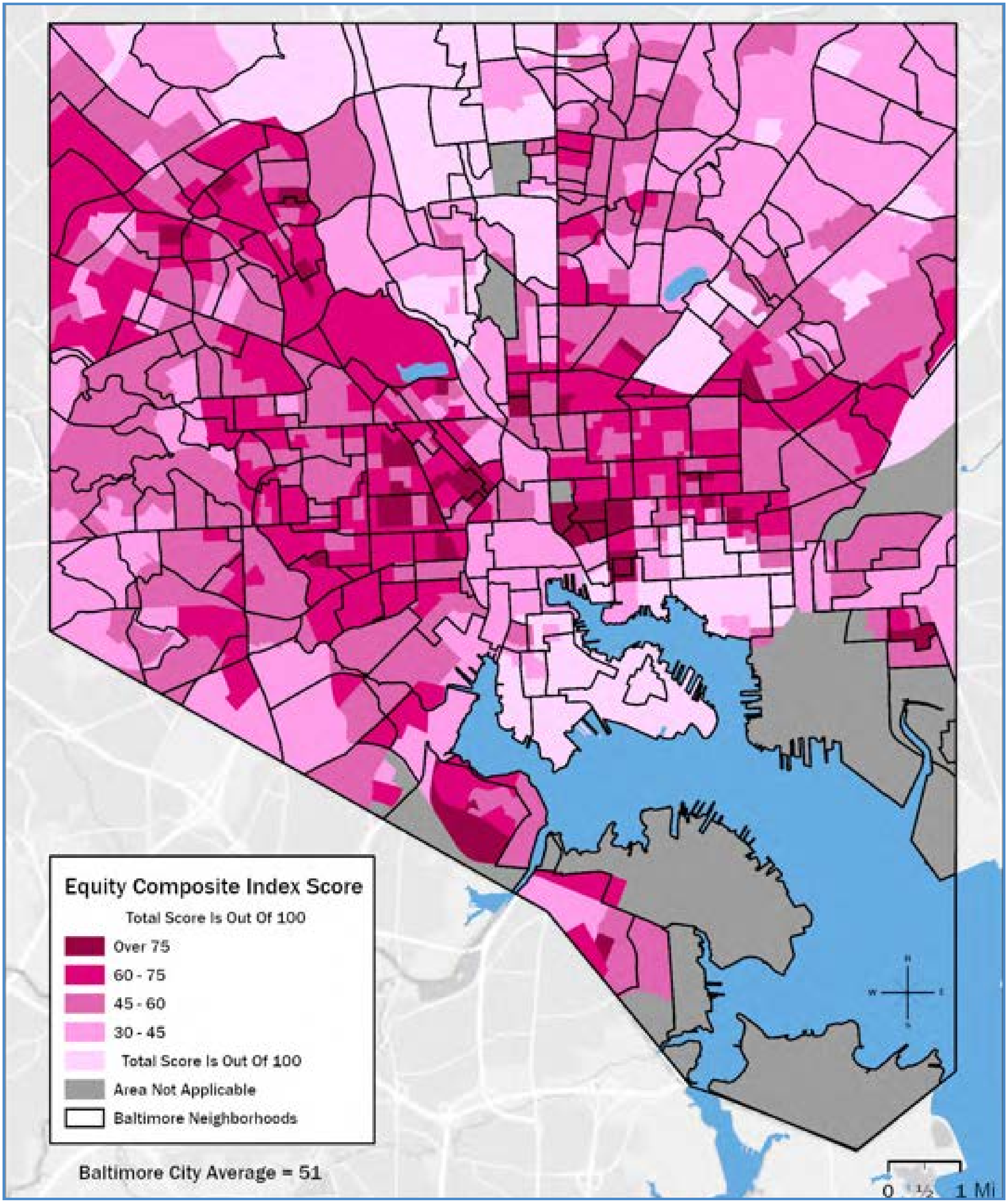
The Baltimore Equity Assessment Process

The equity assessment identifies historically underserved communities by applying the following steps:

1. Identify key indicators of historically underserved communities
2. Acquire and review readily available GIS or tabular data regarding key indicators that facilitates quantification and measurement of equity indicators
3. Select best available data sources for each equity indicator
4. Determine appropriate classification/stratification and rating strategy for each equity indicator dataset
5. Synthesize the individual equity indicators into one GIS dataset by applying the equity scores to develop a composite equity rating for each analytical unit to help prioritize transportation projects (shown on page 157)
6. Engage community groups and stakeholders to validate the data-driven approach used to generate the composite equity ranking

The details of developing each of these steps are documented in Appendix 3.

Figure 8. Equity Analysis for Baltimore City



Example Composite Map of Multiple Equity Indicators for Baltimore Communities, Steps 1–5

EQUITY IN COMMUNITY ENGAGEMENT POLICIES

The City is committed to ensuring that all City communities are included in the development and implementation of Complete Streets improvement projects and commits to an equitable approach to public engagement and education. This section details specific policies related to community engagement that will ensure all affected communities have a voice in Complete Streets improvements, focusing on outreach methods sensitive to factors including, but not limited to, race, gender, culture, income, age, vehicle access, disability, and English language proficiency of populations.

Race/Gender/Culture

Policy

Complete Streets project outreach efforts will be sensitive to race, gender and ethnicity, and will be tailored to the affected community to help achieve comprehensive participation.

Actions

- Consult with key community leaders in the project area who can assist by identifying existing community social networks.
- Partner with faith-based organizations and social service agencies that can provide insight into neighborhood dynamics and offer recommendations on appropriate public meeting forums.
- Ensure that visual aids depict images of diversity and inclusion.

Income

Policy

Complete Streets project outreach efforts will identify communities with socio-economic challenges and customize communication methods and meeting locations to optimize participation and engagement with the project.

Actions

- Host family-friendly meetings in centrally located facilities to minimize transportation and childcare costs.
- Ensure that there are affordable and convenient transportation options to and from meeting locations.
- Design easy to read outreach materials and unambiguous signage.
- Leverage the access to technology to offer community members alternative affordable options to provide input.

Age

Policy

Complete Streets project outreach efforts will engage community members of all ages by customizing communication methods and meeting locations to optimize participation with the project.

Actions

- Contact area senior center/living facilities for guidance on advertising project information and soliciting feedback.
- Contact area PTA's to engage the parents of school-aged children with transportation projects.
- Create audience specific print and electronic communications to attract the attention of all ages

Accessibility

Policy

Complete Streets project outreach efforts will ensure all residents have equal opportunity to participate in the public process regardless of vehicle access, physical disability, or other factors.

Actions

- Hold public meetings in accessible spaces and provide transit information and reasonable accommodations for those with impairments.
- Partner with other agencies to obtain translation services and identify spaces and forums in which immigrant and non-English speakers will be comfortable to engage.
- Schedule meetings at the most opportune time for the majority of community members.

The Complete Streets community engagement policies comprehensively align outreach efforts with the project development and implementation processes, beginning with the initial step of identifying new projects through closeout of construction. Although each project should include a customized outreach plan, the Complete Streets community engagement policies generally apply to the following steps in project development:

1. Project Identification
2. Funding: Budget / CIP
3. Project Initiation
4. Concept Development
5. Pre-final Design
6. Pre-construction

PROJECT PRIORITIZATION

Introduction

The Deparment of Transportation's project prioritization processes include assessments of the following major components:

1. Equity
2. Safety
3. Asset Condition

The Addressing Equity in Baltimore section details the equity indicators recommended for the equity assessment in the project prioritization processes. These indicators represent population factors, recommended in the Complete Streets Ordinance, that can be quantified for such an analysis. This section includes an illustrative spatial analysis of the City for each indicator based on best available information, as well as an example of the process to combine the indicators into one map for application in the prioritization processes. It also provides an example of a method to score the geographic areas 1-5. This equity assessment should be continually reviewed, refined, and applied by the City officials.

Infrastructure projects managed by the Deparment of Transportation that most heavily impact the daily life of residents and visitors to the city are:

1. Sidewalks
2. Roadway Resurfacing
3. Capital Improvement Projects

This section provides guidance on how the Deparment of Transportation will prioritize projects from these three major categories. Following the prioritization of projects, the project delivery process for each project shall be followed per the Project Delivery Process section.

Sidewalks

Baltimore City has 3,600 miles of sidewalks. Historic and current funding levels are not adequate to address all ADA compliance concerns each year, so a data-driven process will guide improvements and repairs based on equity, safety, condition of sidewalks, user needs, and connectivity. Previous sidewalk replacement and repair has been guided through requests routed through the 311 system, but prioritizing work by request does not equitably distribute the work.

Project Prioritization Process

Step 1: Condition Assessment

Conduct a condition assessment for all sidewalks and assign a Sidewalk Condition Score for each sidewalk according to the following scale:

Sidewalk Condition Score	Condition Description
5	Worst condition and must be replaced as soon as possible due to safety concern
4	Poor condition
3	Fair condition
2	Good condition, but not ADA compliant
1	Good condition and ADA compliant

Step 2: Prioritize Safety

All sidewalks with a Sidewalk Condition Score of 5 will be prioritized and repaired regardless of other factors. The 311 system's role in this process will be used primarily to identify immediate safety issues, or sidewalks of the poorest ranking.

Step 3: Identify Sidewalk Needs

Identify sidewalks scored as a 4 on the condition assessment.

Step 4: Apply Equity Assessment

After immediate safety issues are identified, the remaining sidewalk budget will be dedicated to sidewalks with a Sidewalk Condition Score of 4 that are in the two highest-rated equity zones.

Additional Considerations

- The equity assessment is the primary factor in the prioritization process for sidewalk projects, excluding immediate safety needs.
- Baltimore City Code, Article 26 Subtitle 10 defines the maintenance responsibilities for sidewalks adjacent to private properties. It is currently the owner's responsibility to maintain a state of good repair on the sidewalk adjacent to their property.
    - Historic Deparment of Transportation policy splits the cost of sidewalk repair and replacement 50/50 with the adjacent property owner.
    - The Prioritization Process cannot be an equitable process until the City assumes full responsibility for funding sidewalk repairs and replacement. Prioritizing work in disadvantaged areas of the city is equitable; charging the owners of adjacent properties in these areas that did not request the work is not equitable.
- Streetscape projects involving sidewalk work are excluded from this specific project prioritization process.

Resurfacing

The City is responsible for maintenance of over 2,000 miles of roadways. All roadways are assigned a functional classification of:

- Local—lower traffic volume
- Collector—medium traffic volume
- Arterial—high traffic volume

The Deparment of Transportation typically resurfaces all local roads in-house and utilizes contractors for the resurfacing of collector and arterial roadways. The resurfacing of collector and arterial roadways occurs more often because of the increased traffic loads. Collector and arterial roads are also usually wider than local roads.

Roadway resurfacing city-wide has historically been programmed based on requests and a condition assessment, which yields a Pavement Condition Index (PCI) value for each roadway segment. While certain roads can be subjectively chosen for resurfacing, there is a point at which the condition of a road is poor enough that prolonging planned resurfacing could lead to required roadway reconstruction, which involves significant added cost.

Project Prioritization Process

Local Roads

Step 1: Set PCI Threshold

Establish a PCI threshold that triggers mandatory prioritization for roadway resurfacing to avoid future more costly reconstruction.

Step 2: Set PCI Ranking

Establish a PCI ranking to identify and map roadways in poor condition.

Step 3: Apply Equity Assessment

With the available resurfacing budget, apply the equity assessment by prioritizing projects on roadways in poor condition using the following chart as a guide:

Equity Ranking	Percentage of Resurfacing Projects
4–5	55%
2–3	35%
1	10%

Collectors and Arterials

Step 1: Set PCI Threshold

Establish a PCI threshold that triggers mandatory prioritization for roadway resurfacing to avoid future more costly reconstruction.

Step 2: Set PCI Ranking

Establish a PCI ranking to identify and map roadways in poor condition.

Step 3: Apply Weighted Resurfacing Factors

Use the following chart to prioritize resurfacing projects on a weighted scale:

An assessment for each factor should be scored and mapped, with written justification for the score assigned.

Resurfacing Factor	Weighting
Equity	25%
PCI	25%
Traffic Volume	25%
Safety	25%

Additional Considerations

- The equity assessment is the primary factor in the prioritization process of local roads.
- Per the project delivery process, safety improvements and Complete Streets treatments should be considered and implemented when possible during the resurfacing process.

Capital Improvement Projects (CIP)

Project Prioritization Process

Step 1: Evaluate CIP Factors

Evaluate and rank areas and/or projects using the following factors:

CIP Factor	Description	Weighting
Equity	Equity assessment of geographic area	2
Infrastructure Condition	Condition of the current infrastructure	1
Economic Development Potential	Potential economic development resultant from infrastructure investment	1
Safety	How well projects/roadways in the area align with the TowardZERO Baltimore Initiative and have the potential to address safety issues	1
Existing or Planned Work by Other Departments	Potential to leverage/ combine resources from projects being planned or constructed by other departments	1
Transit Dependency and Commute Times	Transit dependency of the population in the geographic area. Consider average commute times and the potential for projects in this area to improve commute times.	1

Step 2: Prioritize Projects

Identify potential projects according to area ranking and evaluate and prioritize them according to the project delivery process, considering factors such as schedule, costs, permits, utilities and right-of-way.

Additional Considerations

- Due to CFR 650, federal requirements require bridge inspections to follow a strict sufficiency rating to identify structures in poor condition and mandate prioritization for improvements; therefore, bridge repair/reconstruction may not follow the outlined prioritization process.
- The CIP prioritization process must be applicable to a wide range of project types and thus should allow for subjectivity when used to identify potential project areas. Furthermore, the CIP prioritization process should be regularly evaluated and modified as program needs and resources change.

PROJECT DELIVERY PROCESS

As outlined in the Mayor's message on page iii, the City is committed to the new modal hierarchy, guiding principles, and design principles detailed in this Manual. This commitment extends to the wide range of projects implemented by the City, by numerous programs. Each of these projects needs to follow the guiding principles, but not all programs require the same types of analysis.

The project delivery matrix in Appendix 2 presents a tool to organize the Complete Streets project delivery process, guiding City project managers, consultants, contractors, and other responsible parties implementing projects within Baltimore. Appendix 2 details the suggested analyses for 40 programs, by project stage, within the project delivery process. Each program should follow these steps, track decisions, and document the actions as outlined in the Summary of Annual Report Requirements and Recommendations section. This process and associated reporting inform the City Council and other City officials as well as external stakeholders as to the progress of implementing the guidance in this Manual.

Applying this Complete Streets project delivery process creates transparency and accountability for each program. Each program should develop a year one transition plan to modify processes and procedures to follow this delivery process.

The project delivery process includes the following steps/checkpoints:

- Stage 1: Project Identification/Funding
    - Goal: Identify/promote Complete Streets in project
- Stage 2: Scoping
    - Goal: Address all needs identified during scoping
- Stage 3: Design
    - Goal: Address all objectives identified during scoping
- Stage 4: Construction
    - Goal: Ensure project is built as designed for Complete Streets
- Stage 5: Measurement
    - Goal: Measure the effectiveness
- Stage 6: Maintenance
    - Goal: Ensure all users are accommodated for lifespan

Stages 1-4 of the project delivery process include close interaction with the public. For every Complete Streets project, public engagement should begin with the identification and funding stage and continue through the construction stage. On the next page is a diagram outlining the type of public outreach efforts recommended throughout the delivery of a Complete Streets project. The Equity in Community Engagement Policies section details the methods to engage the public in the delivery of a Complete Streets project.

Figure 9. Project Delivery Process and Engagement Opportunities

Stage 1	
Project Identification/Funding	Neighborhood, business, and advocacy groups (1) review City proposed projects and (2) recommend projects for consideration by the City, developers, and state.

↓

Stage 2	
Scoping	Communities have input in the planning process regarding (1) the purpose and (2) review analysis.

↓

Stage 3	
Design	Conduct community meetings to (1) select from concept design alternatives and (2) understand right-of-way impacts and design details.

↓

Stage 4	
Construction	The City conducts on-site meetings to discuss the details of the construction (and phases if applicable), and collaborates with community outreach portals for messaging throughout construction.

ANNUAL REPORT TO MEASURE PROGRESS

Summary of Annual Report Requirements and Recommendations

Project Status

The annual report must include:

1. An inventory of all ongoing projects, with the projected cost.
2. A list of all projects and instances in which the local standards set forth in the Ordinance or in the Complete Streets Manual were or are planned to be superseded by state or federal standards, pursuant to § 40-31 of the Ordinance, as well as citations and causes.

Analysis of Geography and Equity Indicators

1. In preparing the annual report, data must be reported by geographic subunit (e.g. census tract, traffic analysis zone, or the like).
2. The annual report must separately report data by race, income, and vehicle access into the following categories:
   a. Populations that are above and below the median number of persons of color for Baltimore City
   b. Populations above and below 50% no vehicle access
   c. Populations with a median income above and below the median household income for Baltimore City

Guiding Principles and Performance Measures, with Recommended Analysis

Guiding Principle: **Safety**
Baltimore streets will be designed to eliminate severe injuries and fatalities.

1. The annual report must include crash data for all modes of travel, separated by all crashes, injury crashes, and fatal crashes, and measured yearly by:
   - The “Maryland Statewide Vehicle Crashes Data” collected by the Maryland State Police
   - The “Fatality Analysis Reporting System” data collected by the National Highway Traffic Safety Administration; or
   - other similar data

   Recommended for the annual report: create a High Injury Network (HIN) based on "Maryland Statewide Vehicle Crashes Data" and City police data.

   - From the HIN, rank City locations for:
     - pedestrian related crashes
     - bicycle related crashes
     - total crashes
   - Balance allocation of resources considering:
     - highest crash locations
     - geographic and neighborhood factors
2. It is recommended the annual report includes information on efforts made to identify and address gaps in prevailing and posted speeds to reduce the risk of severe injury and fatalities.

   Recommended for the annual report: Using the asset management system, add an attribute for street speed limit and 85% speed (from traffic counts). Recommended to include in the annual report:

- Number of streets where prevailing speeds is 5 mph or higher than the posted speed limit
- Number of speed management treatments implemented to Complete Streets Manual standards per fiscal year

3. It is recommended the annual report includes information on how the Complete Streets Manual has been used to redesign pedestrian/bicycle top incident locations as determined by the HIN (i.e. protected crossings, narrow walking distances, and increased crossing visibility). Recommended to include in the annual report:
   - Number of pedestrian/bicycle top incident locations redesigned to Complete Streets Manual standards per fiscal year

Guiding Principle: **Accessibility**
Baltimore streets will be accessible by all modes, for people of all ages and abilities.

The following are recommended for the annual report:

1. Identify and address street design inefficiencies for multimodal use. Recommended to include in the annual report:
   - Miles of roadway designed to Complete Streets Manual standards
2. Identify and address curbspace design inefficiencies for multimodal use. Recommended to include in the annual report:
   - Length of curbspace designed to Complete Streets Manual standards
   - Number of curbspace micromobility corrals, bike racks, and bus/transit stops
3. Identify and address multimodal transportation gaps (i.e.: lack of sidewalks, bike lanes, and protected crossings). Recommended to include in the annual report:
   - Length of multimodal facilities added to eliminate gaps in network, designed to Complete Streets Manual standards
4. Increase ROW use for pedestrians, bicyclists, and transit users (including shared mobility) per identified modal hierarchy. Recommended to include in the annual report:
   - Total feet of new ROW allocated for shared mobility uses
5. Identify and address intersection inefficiencies for shared mobility use. Recommended to include in the annual report:
   - Number of intersections designed to accommodate the modal priority identified
   - Number of intersections redesigned to accommodate multiple shared mobility uses

Guiding Principle: **Economic**
Baltimore streets will reflect neighborhood values and promote economic vitality.

1. The annual report should include information of efforts made to identify “Main Streets”, or streets with significant numbers of retail venues, tourist destinations, or employment centers, and efforts made to ensure multimodal accessibility and mobility on those streets by designing and maintaining them to Complete Streets standards.

- The annual report must measure year-over-year changes in certain economic development data points and conditions in each of the City's "Main Streets", as part of the Baltimore Main Streets program; and in any other geographical area otherwise designated by the Advisory Committee.

2. The annual report should include information on efforts made to identify and address inefficiencies in green infrastructure by improving street tree health and managing stormwater runoff.
    - The annual report must measure the amount of green infrastructure built, upgraded, replaced, or rehabilitated in the previous 1-year period, as well as measure the total amount. Recommended to include in the annual report:
        - Number of street trees replaced, added, and maintained
        - Number of stormwater management treatments implemented to Complete Streets Manual green stormwater infrastructure standards
3. It is recommended the annual report identifies and addresses gaps in the multimodal transportation networks to and from "Main Streets". Recommended to include in the annual report:
    - Number of lane miles and improved connections to and from Main Streets
4. It is recommended the annual report include information on efforts made to move freight efficiently into and throughout the City. Recommended to include in the annual report:
    - Amount of businesses accessible to trucks within a 30-minute travel time from key portals to the City.
        - Apply Baltimore Metropolitan Council (BMC) model

Guiding Principle: **Mobility**
Baltimore streets will efficiently and reliably move people to, from and within the City.

1. The annual report should include information on efforts made to identify and address transit inefficiencies regarding on-time performance, reliability, capacity, comfort, and use.
    - The annual report must measure commute times for all modes of travel, as measured by the travel-time-to-work data reported in the American Communities Survey's "Commuting (Journey to Work)."
    - The annual report must measure year-over-year change in transit on-time performance, as measured by:
        - the performance data collected by the Maryland Transit Administration and published in the Maryland Department of Transportation's Annual Attainment Report; or
        - other similar data collected by the Maryland Transit Administration or the Transportation Department
    - The annual report must measure transit infrastructure upgraded, replaced, or rehabilitated in the previous 1-year period, as well as measure the total amount.
    - It is recommended the annual report addresses improvements to transit travel time on priority transit routes.
    - It is recommended the annual report addresses patronage by traditionally underserved populations.
2. The annual report must measure available modal share, as measured by the means-of-transportation data reported in the American Communities Survey's "Commuting (Journey to Work)."
    - Recommended for the annual report: Formalize the data collection process to include multimodal

counting. Include: traffic volume (ADT, AM & PM peak hour volumes, 85% speed), permanent bicycle counting locations, and transit main-line ridership. Create multimodal screenlines strategically located to monitor person and vehicle movement at priority locations throughout the City. Example:

- http://counters.bikearlington.com/?_ga=2.25599933.1014001043.1558625225-1845187387.1551737125

3. The annual report should include information on efforts made to design streets with a designated bicycle modal priority to safely move bicyclists of all abilities conveniently, comfortably, and efficiently.
   - The annual report must measure bicycle infrastructure (shared use paths, bike lanes, etc.) upgraded, replaced, or rehabilitated in the previous 1-year period, as well as measure the total amount.
   - It is recommended the annual report include usage and commute times for cycle routes (2 measures).
4. The annual report should include information on how streets have been designed with a designated pedestrian modal priority to accommodate users of all ages and abilities.
   - The annual report must measure walking infrastructure upgraded, replaced, or rehabilitated in the previous 1-year period, as well as measure the total amount.

Guiding Principle: **Equity**
Baltimore streets will reflect equal opportunities for travel regardless of race, income, age, gender, disability, health, English language proficiency, and vehicular access.

1. It is recommended the annual report includes information on efforts to identify the most underserved and disadvantaged communities according to geographic subunit, race, income, and vehicle access, and efforts made to ensure project prioritization and implementation in those areas (as outlined in the Addressing Equity in Baltimore Section). Recommended metrics include:
   - Number of implemented treatments, by identified communities
   - Number of streets with a modal priority and hierarchy determination
2. It is recommended the annual report includes information on how transit and shared mobility travel route options have been maximized for underserved populations. Recommended to include in the annual report:
   - Number of new transit routes added or modified to service traditionally underserved populations
   - Number of new ADA compliant improvements constructed to access transit
   - Number of routes subsidized to reduce the cost per trip servicing underserved communities
   - Number of new shared mobility access points (i.e.: roads that accommodate multimodal travel methods, and shared-use paths) that cross the geographical boundary of designated underserved communities
   - Number of new transit hubs within the geographical boundary of designated underserved communities

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APPENDICES

Appendix 1: Baltimore Complete Streets Design Criteria

	Downtown Commercial			Downtown Mixed–Use			Urban Village Main			Urban Village Neighborhood			Urban Village Shared Street			Urban Center Connector			Neighborhood Corridor			Industrial Access			Parkway			Boulevard		
	Target	Maximum	Constrained	Target	Maximum	Constrained	Target	Maximum	Constrained	Target	Maximum	Constrained	Target	Maximum	Constrained	Target	Maximum	Constrained	Target	Maximum	Constrained	Target	Maximum	Constrained	Target	Maximum	Constrained	Target	Maximum	Constrained
Sidewalk Zone																														
Frontage Subzone	2’	–	0’	2’	–	0’	2’	–	0’	2’	–	0’	2’	–	0’	2’	–	0’	2’	–	0’	2’	–	0’	N/A	–	N/A	2’	–	0’
Pedestrian Subzone (1)	12’	–	8’	10’	–	8’	8’	–	5’	6’	–	5’	5’	–	5’	5’	–	5’	5’	–	5’	5’	–	5’	6’	–	5’	12’	–	8’–10’
Shared Use Path	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	12’	–	10’	12’	–	10’	12’	–	10’
Furnishing Subzone	7’	–	4’	7’	–	4’	7’	–	3.5’	7’	–	3.5’	N/A	N/A	N/A	7’	–	3.5’	7’	–	3.5’	7’	–	3.5’	10’	–	5’	10’	–	5’
Curbspace																														
Curb	20”	44”	8”	20”	44”	8”	20”	44”	8”	20”	44”	8”	20”	44”	8”	20”	44”	8”	20”	44”	8”	20”	44”	8”	20”	44”	8”	20”	44”	8”
On–street Parallel Parking (Automobile)	9’	9’	8’	9’	9’	8’	9’	9’	8’	9’	9’	8’	9’	9’	8’	9’	9’	8’	9’	9’	8’	9’	9’	8’	9’	9’	8’	9’	9’	8’
Commercial Loading / High Transit Boarding / Aligning	11’	12’	10’	11’	12’	10’	11’	12’	10’	11’	12’	10’	N/A	N/A	N/A	11’	12’	10’	N/A	N/A	N/A	N/A	N/A	N/A	12’	–	11’	11’	12’	10’
Roadway Zone																														
Curbside Lane Subzone (2)																														
Separated Bike Lane (3)	10’	–	8’	10’	–	8’	10’	–	8’	N/A	N/A	N/A	N/A	N/A	N/A	10’	–	8’	N/A	N/A	N/A	10’	–	8’	10’	–	8’	10’	–	8’
Two–Way Separated Bike Lane (4)	15’	–	11’	15’	–	11’	15’	–	11’	15’	–	11’	N/A	N/A	N/A	15’	–	11’	N/A	N/A	N/A	15’	–	11’	15’	–	11’	15’	–	11’
Buffered Bike Lane (5)	8’	8’	6.5’	8’	8’	6.5’	8’	8’	6.5’	8’	8’	6.5’	N/A	N/A	N/A	8’	8’	6.5’	8’	8’	6.5’	8’	8’	6.5’	8’	8’	6.5’	8’	8’	6.5’
Traditional Bike Lane	N/A	N/A	N/A	6’	7’	5’	6’	7’	5’	6’	7’	5’	6’	7’	5’	N/A	N/A	N/A	6’	7’	5’	6’	7’	5’	N/A	N/A	N/A	6’	7’	5’
Bus Priority Lane / Shared Transit Lane	12’	12’	11’	12’	12’	11’	12’	12’	11’	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	12’	12’	11’
Side Boarding Stop (6)	9’	–	8’	9’	–	8’	9’	–	8’	9’	–	8’	N/A	N/A	N/A	9’	–	8’	9’	–	8’	9’	–	8’	9’	–	8’	9’	–	8’
Travelway Subzone																														
Travel Lane (7)	9’	10’	9’	9’	10’	9’	9’	10’	9’	9’	10’	9’	9’	10’	9’	9’	10’	9’	9’	10’	9’	9’	10’	9’	9’	10’	9’	10’	10’	9’
Transit Lane (8)	11’	11’	11’	11’	11’	11’	11’	11’	11’	11’	11’	11’	11’	11’	11’	11’	11’	11’	11’	11’	11’	11’	11’	11’	11’	11’	11’	11’	11’	11’
Truck Lane (8)	11’	11’	11’	11’	11’	11’	11’	11’	11’	11’	11’	11’	11’	11’	11’	11’	11’	11’	11’	11’	11’	11’	11’	11’	11’	11’	11’	11’	11’	11’
Turn Lanes	11’	12’	10’	11’	12’	10’	11’	12’	10’	11’	12’	10’	N/A	N/A	N/A	11’	12’	10’	N/A	N/A	N/A	11’	12’	10’	11’	12’	10’	11’	12’	10’
Median Subzone																														
Pedestrian refuge	10’	–	7.33’	10’	–	7.33’	10’	–	7.33’	10’	–	7.33’	N/A	N/A	N/A	10’	–	7.33’	N/A	N/A	N/A	10’	–	7.33’	10’	–	7.33’	10’	–	7.33’
Continuous with landscaping	10’	–	6’	10’	–	6’	10’	–	6’	N/A	N/A	N/A	N/A	N/A	N/A	10’	–	6’	N/A	N/A	N/A	10’	–	6’	10’	–	6’	10’	–	6’
Continuous without landscaping	6’	–	2’	6’	–	2’	6’	–	2’	N/A	N/A	N/A	N/A	N/A	N/A	6’	–	2’	N/A	N/A	N/A	6’	–	2’	N/A	N/A	N/A	N/A	N/A	N/A

(1) Sidewalk designed to Baltimore City Standards
(2) Width dimensions include gutter pan width
(3) Separated bike lane width includes 3’ minimum buffer
(4) Two-way separated bike lane width includes 3’ minimum buffer
(5) Buffered bike lane width includes 1.5’ minimum buffer
(6) Boarding island or bulb-out depending on bicycle accommodations
(7) Streets designated on the Baltimore City Roadway Functional Classification Map as a “Collector” or “Arterial” may have travel lane widths up to 10’ wide
(8) On a transit street or truck route, one lane in each direction may be up to 11’ wide

Street Markings

Per the MUTCD, different levels of ADT or roadway characteristics are given for centerlines, edge lines, parking spaces, cross-walks, etc.

Section 3B.01 states, “Center line markings shall be placed on all paved urban arterials and collectors that have a traveled way of 20 feet or more in width and an ADT of 6,000 vehicles per day or greater. Center line markings shall also be placed on all paved two-way streets or highways that have three or more lanes for moving motor vehicle traffic.”

It also gives guidance that, “Center line markings should be placed on paved urban arterials and collectors that have a traveled way of 20 feet or more in width and an ADT of 4,000 vehicles per day or greater.”

Per Section 3B.07, “Edge line markings may be used where edge delineation is desirable to minimize unnecessary driving on paved shoulders or on refuge areas that have lesser structural pavement strength than the adjacent roadway.”

Its reasonable to apply hatching on areas where vehicles are not permitted outside the edge lines.

Appendix 2: Project Delivery Matrix

		Stage 1: Project Identification/ Funding		Stage 2: Scoping																
		Goal: Identify / Promote Complete Streets in Project		Goal: Address All Needs Identified During Scoping																
				Research						Site Visits						Mapping and Analysis				
	Types of Work Done by Baltimore City DOT	Identify Project Initiation	Identify Project Budget	Examine Crash Reports	Examine Relevant Planned/Programmed Roadway Projects	Examine Neighborhood and Modal Plans	Examine Notable Developments In or Near Project	Review Prior Transportation & Traffic Studies	Summarize Prior Public Engagement	Initial Observation	Identify Desire Lines	Building Form and Function	Roadway Form and Function	Relate Crash Data to Field Conditions	Typical Sections	Determine Equity Factor/Weighting	Analyze and Determine Street Type and Target Speed	Generate and Analyze Traffic Volume Map	Generate and Analyze Crash Diagram	Modal Deficiencies and Hierarchy Identification
ATVES	Automated Red Light Camera Program			x										x		x	x		x	
	Automated Speed Camera Program	x		x	x	o	o	x		x			x	x		x	x		x	
Conduit	Conduit Inspection/Repair																			
	Conduit Replacement	x	x	o	o/x	o	o	o	o	x	o	o	o	o	x	o	o	o	o	o
Maintenance	Grass Mowing																			
	Guardrail Installation/Maintenance																			
	Landscaping and Tree Planting				o	o	o					o	o		o	x				
	Pavement Marking Installation (Maintenance)				o	o					o		o			o				
	Pedestrian Light Installation/Repair																			
	Snow Removal		o																	
	Street Light Installation/Repair	x	x	x	x		x			x		x	x	x		x			x	x
	Street Pothole Repair															x				
	Street Repair	x	x							x						x				
	Street Resurfacing (Local)	x	x							x						x				
	Traffic Sign Installation																			
Planning	Freight Projects																			
	Placemaking Activities	x	x	o	o	o	o	o	o	x	x	x	x	x	x	o	x	o	o	x
	Safe Routes to School Study															x				
	Transportation Planning Study	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
ROW	Permits for Special Events in the Right-of-Way																			
	Permits for Work in the Right-of-Way																			
Tec	ADA Curb Ramp Construction/Repair	x	x							x	x									
	Alley Reconstruction/Resurfacing																			
	Bridge Construction/Reconstruction	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	Bridge Inspection																			
	Bridge Repair																			
	Sidewalk Repair									x						x				x
	Sidewalk Replacement	x	x		x	x	x			x	x	o	o		x	x				
	Street Reconstruction	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	Street Resurfacing (Collector, Arterial)	x	x	x	o	o	o	o	o	o	o	o	x	x	x	x	o	o	x	x
	Streetscaping Projects	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Traffic	Pedestrian Safety Improvements	x	x	x	o/x	o/x	o/x	x	o	x	x	o	o	x	x	x	x	o	x	x
	Quick-Build Treatments	x	x	x	x	x	x	x	x	x	x	o	x	x	x	x	o/x	o	o	o/x
	Traffic Calming Study	x	x	x	x	x	x	x	x	x	x	o	o	x	x	x	o/x	o	o/x	x
	Traffic Circulation Study (One-Way/Two-Way Conversions)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	Traffic Signal Design/Reconstruction/New Construction	x	x	x	x	o	o	x	o	x	x	o	x	x	x	x	x	x	x	x
	Traffic Signal Repair																			
	Traffic Signal Timing	x	x	x	o	o	o	o	o	x	o	o	o	x		x	x	x	o	x
	Transit Projects (Dedicated Lanes, TSP)	x	x	o	x	x	x	x	o	x	o	o	x	x	x	x	x	x	o	x
Transit	Bike Facility Planning and Design	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	Shared Mobility Management	x	x													x	o	o	o	o

x = required o = optional __ = N/A

Stage 3: Design													Stage 4: Construction			Stage 5: Measurement		Stage 6: Maintenance		
Goal: Address all Objectives Identified During Scoping													Goal: Ensure Project is Built as Designed for Complete Streets			Goal: Measure the Effectiveness		Goal: Ensure all users are accommodated for lifespan		
Create Design Alternatives				Schematic Design					Obtain Feedback and Approvals				Construction			Measurement		Maintenance		
Summarize Project Information from Scoping	Cross Section Development	Identify Complete Streets Features	Initial Public Engagement	Analyze Crashes and Design for Safer Streets	Apply Street and Intersection Designs and Policies	Create Geometric Layout	Conduct Signal Timing Analysis Related to Modal Priority	Review Intersection Design	Engage Internal Partners	Engage External Agencies	Engage Public Stakeholders	Prepare Preferred Alternative	Communicate Project Objectives to Staff and Contractors	Apply Modal Hierarchy to Maintenance of Traffic Plan	Public Outreach	Safety	Mode share	Identify Maintenance Needs	Establish Program Maintenance and Replacement Cycle	Program Funding for Maintenance
									x		x	x				x				
x	x	x	o	o	o	o	o	o	x	x	o	x	x	x	x			x	x	x
	o					o				o	o				o			o	o	o
														x						
														x						
				x	x	x		x						x		x		x	x	x
													x	x	o					
									x	x	x			x	x			x	x	x
														x						
x	x	o	x	o	x	x	o	x	o	o	x	x	x	x	x	o	o	x	x	o
x	x	x	x	x	x	x	x	x	x	x	x	x						o	o	o
														x	o					
									o	o			o	x	o					
						x		x			x/o		x	x	x					
											x				x					
x	x	x	x	x	x	x	o	x	x	x	x	x	x	x	x	x	o	x	x	x
														o						
														o						
															o					
x	x	o	o	o	x	x		o	o	o	x	x	x	x	x					
x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	o	x	x	x
x	x	x	x	x	x	x	o	x	x	x	x	x	x	x	x	o	o	x	x	x
x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	o	x	x	x
x	x	x	o/x	x	x	x	o	x	o	o	x	x	x	x	x	x	o	x	x	x
o	x	x	o/x	x	x	x	o	x	o	o	x	x	x	x	x	o	o	x	x	x
x	x	x	x	x	x	x	o	o	o	o	x	x	x	x	o	x	o	o	o	o
x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	o			
x	x	x	x	x	x	o	x	x	x	x	x	x	x	x	x	x		x	x	x
					x		x		x		o	o				x				
x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
x	x	x	x	x	x	x	o	x	x	x	x	x	x	x	x	x	x	x	x	x
																	x	x	x	x

x = required   o = optional   __ = N/A

Appendix 3: Equity Assessment

The equity assessment identifies historically underserved communities. The new process applies the following steps:

1. Work with the City and BMC staff to identify key indicators of historically underserved communities

Baltimore's Complete Streets Ordinance cites the following demographic characteristics as possible equity indicators to be considered in the equity assessment:

» Race, gender, sexual orientation, age, disability, ethnicity, national origin, income, and vehicle access

Additional indicators were identified through work efforts led by other City departments and external stakeholders such as the BMC. These indicators include:

» Job access, crime, access to technology, commute times, public health, population density, pedestrian and bicyclist crashes, housing, educational attainment, life expectancy, and environmental factors (such as air quality and climate risk factors including flooding, heat stress, and vulnerability)

While all the equity indicators identified by the Complete Streets Ordinance, other City departmental initiatives, and external stakeholders are important and could be considered when assessing potential projects, the availability of accurate and reliable data with consistent geographic units of analysis may limit Baltimore's ability to fully integrate all of these indicators into an equity assessment. Additionally, many of these identified indicators have substantial overlap between each other and the core characteristics they seek to measure or represent are often derived from the same core source of data, primarily US Census sources.

2. From 1 above, seek data to quantify and measure indicators

With the understanding that numbers cannot fully show the character of a neighborhood, the Complete Streets Subcommittee discussed and chose to prioritize the equity indicators that:

a. Best represent the most pertinent equity issues historically underserved Baltimore communities struggle with;

b. Can be quantified and accurately measured and mapped; and

c. Are most applicable to Baltimore City Complete Streets transportation projects.

The readily available demographic data was then assessed to determine which data sources met these criteria. Additionally, any data source selected for the equity assessment needed to share the following standards to help ensure statistically valid conclusions are drawn from the data:

a. All data must share consistent geographic boundaries

b. Preference is given to primary source data – that is data that is provided by the organization that collected or generated the information set

c. The origins of the data need to be identifiable and the processes used to generate the data need to adhere to industry standards and best practices

d. If the source data is drawn from population samples, the parameters of the sampling or survey process need to be clearly indicated and demonstrate statistical validity

Applying these standards to review the available data, the datasets generated by the United States Census Bureau were found to provide the most appropriate, statistically valid, and geographically consistent data inputs that address the desired community characteristics. These data standards do not preclude the use of data from organizations such as the BMC or the Baltimore Neighborhood Indicators Alliance (BNIA). However, Census data is often the underlying input used by BMC and BNIA to generate their analytical data and these organizations have made determinations as to how they shape the input and output data to best meet their desired use-case and applications. Therefore, preference will be given to use of the raw Census data as it allows Baltimore City to shape the parameters of the data in the way that best serves the City's needs.

3. Select data sources for each equity indicator

For the purpose of illustrating an equity assessment exercise, the Subcommittee identified several viable population indicators for consideration in this Manual's example assessment. The Subcommittee included indicators referenced in the Complete Streets Ordinance and other City equity evaluations. The following equity indicators were selected by Baltimore City Department of Transportation staff in consultation with the Complete Streets Subcommittee members as the base inputs for the equity assessment data based on the availability of quality and reliable data sources:

a. Race

b. Household Income

c. Household Vehicle Access

d. Rates of Public Transportation Utilization

e. Median Age of Residents

The Census block group was selected as the geographic unit of analysis as this is the smallest area that contains all pertinent demographic data and is consistently used across all the data inputs.

4. Determine appropriate classification strategy for equity indicator data and create GIS data

Once the equity indicator datasets are selected, a crucial component of integrating this information into a usable form for the equity assessment involves determining the most appropriate way of displaying and parsing this information. Ultimately, these datasets will be used to create a priority score for each block group that reflects the overall degree of disadvantage experienced by residents of the block groups. Ideally, the final equity dataset would avoid having different block groups ranked with the same equity score. However, considering that Baltimore City has 653 populated block groups, developing a strategy to arrive at 653 unique rankings would inject significant complexity into the analysis used to develop the equity score. Therefore, it is necessary to reduce the complexity of the input data while retaining sufficient precision to clearly depict variation in the levels of disadvantage experienced by residents of each block group. This need requires that the input datasets be classified in logical groupings so that the equity assessment process can assign a related score, or ranking, to each group without overly generalizing the data or providing too much specificity and complexity.

Within a GIS dataset, there are two core elements of each record. One component is the spatial feature that represents the real-world location and extent of any type of feature. In this case, the spatial features are the US Census block group boundaries. The second component in a GIS dataset is what is called the attributes.

Attributes resemble a table of data, where each row is associated with one spatial feature (a block group) and each column contains a value that describes that specific record. In the case of the block groups, an attribute field may contain values representing the median age, population count, or similar demographic values. GIS tools allow the City to group similar records together and display those groups on a map using the same symbols or colors. This data management concept is a type of classification and can be applied for more than just display purposes—in the equity assessment process, the classification of data can address the need to reduce data complexity while retaining valuable data. For example, the median income values for each block group can be used to classify the data in appropriate groups. This means that the number of rankings of block groups for communicating median income can be reduced from 653 to however many groups the City desires to use in its ranking model.

There are many equally valid means of applying classifications to a group of data. The sections below discuss each equity indicator selected for this analysis and propose a classification system that addresses the goals described above. It is important to note that the approaches outlined below are a starting point; further refinement of the data classification and scoring metrics will be performed to address forthcoming input from stakeholders.

Figure 10. Example of Attributes

OBJECTID	Shape	blockgroup	blockgroup_GEOID	Classification Weight Score	Weighted Rank Score	MedAge for calc	Shape_Length	Shape_Area
223	Polygon	223	245101107001	9	5	80	5958.217308	1387252.608314
378	Polygon	378	245102606053	9	5	71	6299.813608	1506414.098932
634	Polygon	634	245102717001	9	5	71	9717.923051	3582732.531115
666	Polygon	666	245102801021	9	5	69	19378.288659	17873867.473455
133	Polygon	133	245100901002	9	5	66	9963.596622	2808955.233354
670	Polygon	670	245102801026	9	5	66	9538.812374	3569524.583189
562	Polygon	562	245102715031	6	4	63	15096.663982	8012723.648801
101	Polygon	101	245100704002	6	4	62	4557.373717	1276287.155744

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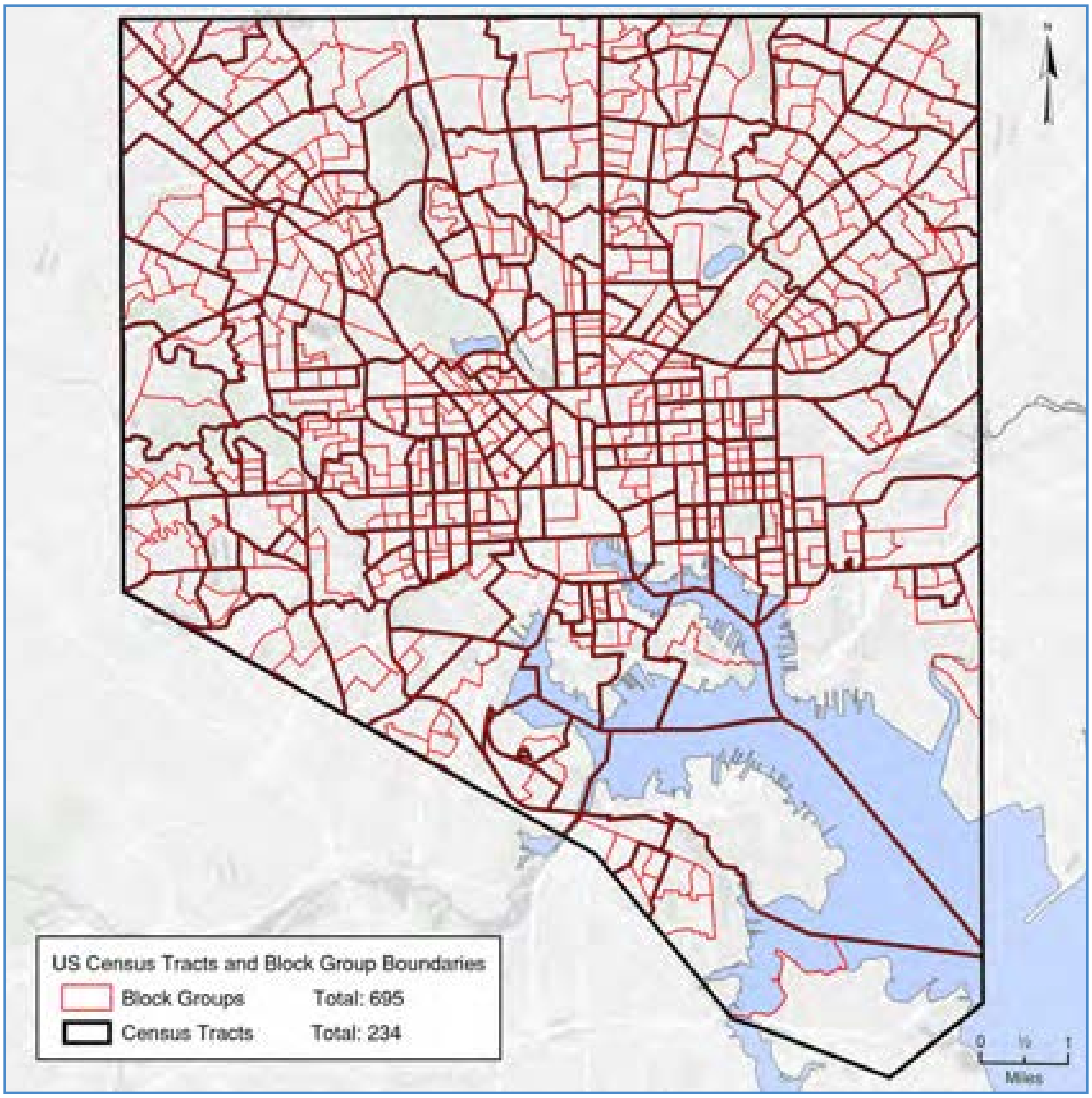
US Census Geographic Sampling Units

For purpose of the Complete Streets equity assessment all data has been derived from the block group geographical sampling level defined by the US Census Bureau. A census block group is a cluster of census blocks having the same first digit of their four-digit identifying numbers within a census tract. Block groups generally contain between 600 and 3,000 people, with an optimum size of 1,500 people. There are about 39 blocks per census block group. Block groups never cross the boundaries of states, counties, or statistically equivalent entities, except for a block group delineated by American Indian tribal authorities. Each census tract contains at least one block group, and block groups are uniquely numbered within the census tract. A block group is the smallest geographical unit for which the census publishes sample data.

Figure 11. US Census Tracts and Block Groups Within Baltimore City



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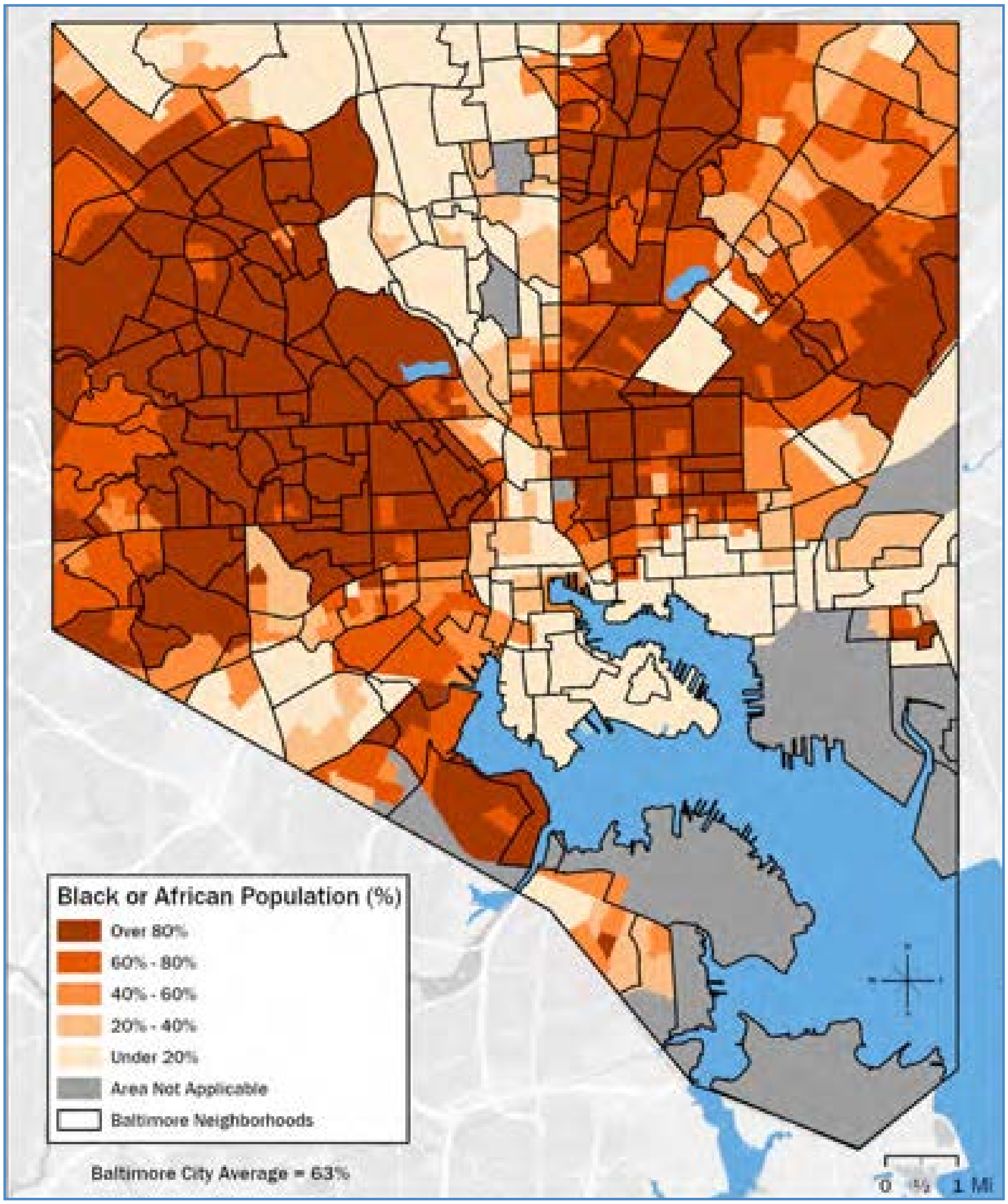
Black Population

This map shows Black and African Americans in Baltimore City, MD as a percentage of the total population per each US Census block group. The US Census defines Black or African American as a person having origins in any of the Black racial groups of Africa and includes people who indicate their race as Black or African American or report entries such as Kenyan, Nigerian, or Haitian. The data used for this map was derived from the American Community Survey (ACS), 2013-2017 5-year estimates, table B02001, and calculated to display the Black and African American average populations. According to the ACS data for 2017, the racial composition of Baltimore was: Black-62.8%, White-30.29%, All other races-6.91%.

Figure 12. Baltimore City's Black and African American Population



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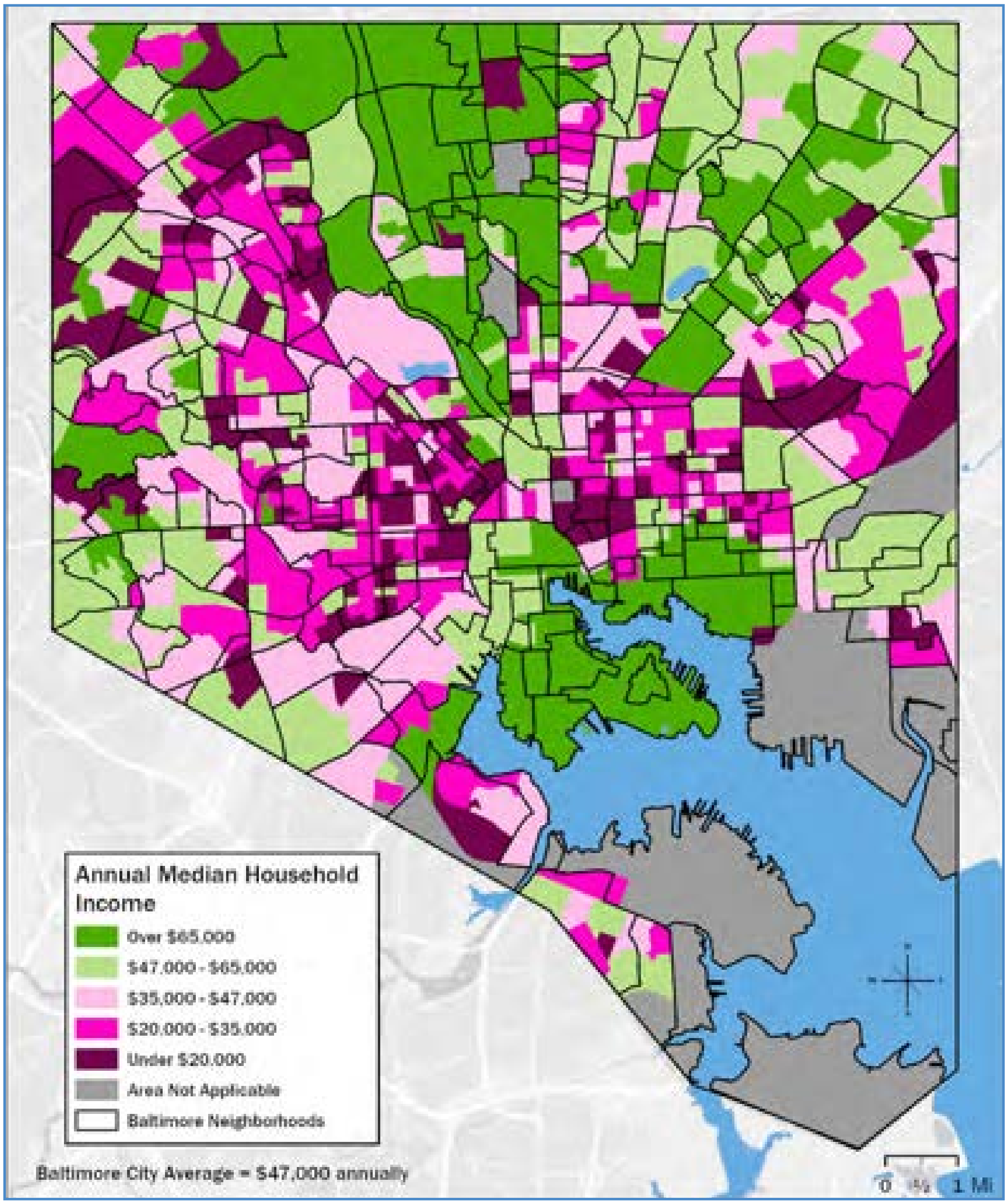
Median Household Income

This map shows the average median household income per US Census block group using data from the ACS 2013-2017 5-year estimates, table B19013. The median divides the income distribution into two equal parts: one-half of the cases falling below the median income and one-half above the median. The median income is based on the distribution of the total number of households and families including those with no income. Median income for households is calculated using linear interpolation, computed based on a standard distribution and then rounded to the nearest whole dollar.

Figure 13. Baltimore City's Median Household Income



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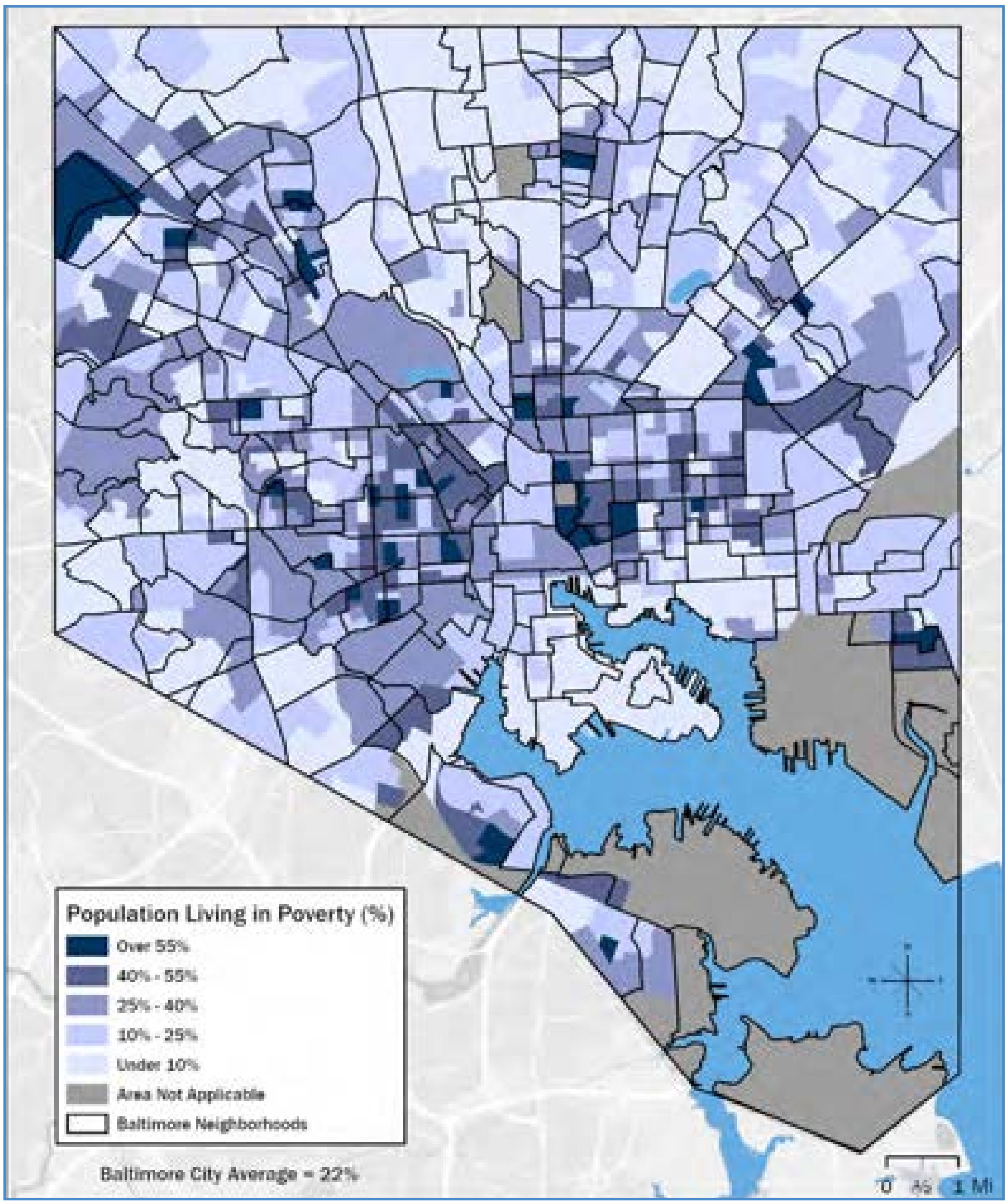
Populations Living Below the Poverty Line

This map shows the poverty status for each US Census block group within Baltimore City as a percentage of the total population for each block group. Note that 22.4% of the population of Baltimore city, MD live below the poverty line, a percentage that is higher than the national average of 13.4%. The US Census Bureau uses a set of money income thresholds that vary by family size and composition to develop a family threshold chart to determine who classifies as impoverished. If a family's total income is less than the family's threshold then that family and every individual in that family are considered living in poverty.

Figure 14. Baltimore City's Population Living in Poverty



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The data for Baltimore City's Population Living in Poverty was derived from the ACS 2013–2017 5-year estimates, table B17025, for populations whom poverty status was determined. Poverty status was determined for all people except institutionalized people, people in military group quarters, people in college dormitories, and unrelated individuals under 15 years old. These groups were excluded from the numerator and denominator when calculating poverty rates.

Figure 15. Family Threshold Chart

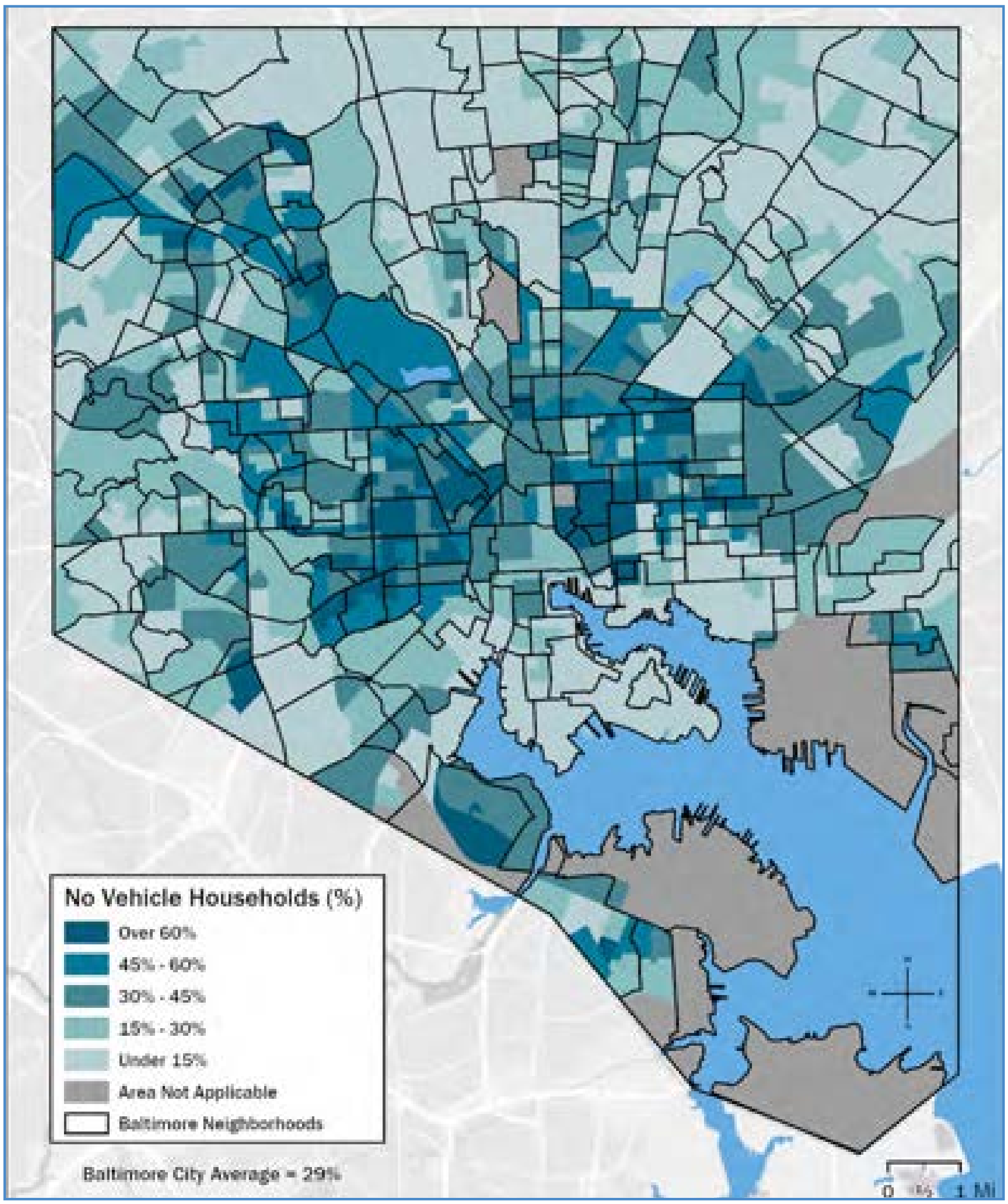
Size of family unit	Related children under 18 years								
	None	One	Two	Three	Four	Five	Six	Seven	Eight or more
One person (unrelated individual):									
Under age 65	13,300								
Aged 65 and older	12,261								
Two people:									
Householder under age 65	17,120	17,622							
Householder aged 65 and older	15,453	17,555							
Three people	19,998	20,578	20,598						
Four people	26,370	26,801	25,926	26,017					
Five people	31,800	32,263	31,275	30,510	30,044				
Six people	36,576	36,721	35,965	35,239	34,161	33,522			
Seven people	42,085	42,348	41,442	40,811	39,635	38,262	36,757		
Eight people	47,069	47,485	46,630	45,881	44,818	43,470	42,066	41,709	
Nine people or more	56,621	56,895	56,139	55,503	54,460	53,025	51,727	51,406	49,426
Source: U.S. Census Bureau									

Data source: U.S. Census Bureau.

Households with No Vehicle Access

This map shows the percentage of households with no vehicle access per each US Census block group. The data on private vehicle access was derived from the ACS 2013-2017 5-year estimate, table B25044, and analyzed at the census block group level for the City of Baltimore. The availability of vehicles data can be used in conjunction with place-of-work and journey-to-work data to provide insight into vehicle travel and to aid in forecasting future travel and its effect on transportation systems.

Figure 16. Baltimore City Households with No Vehicle Access



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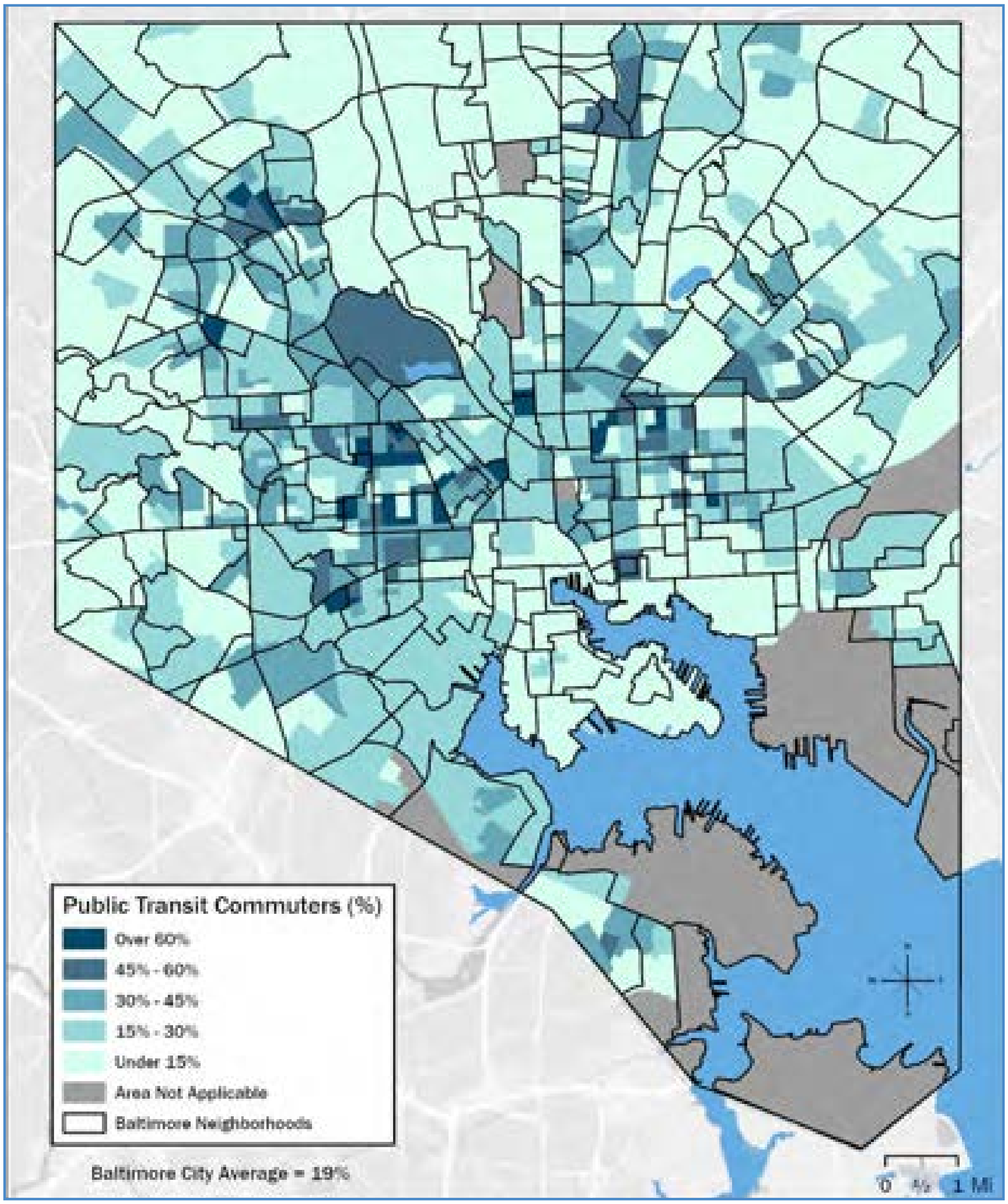
Commuters Using Public Transportation

This map shows the overall percentage of people per US Census block group who use public transportation as their primary mode of transportation. Only 18.6% of people in Baltimore City use public transportation as their primary mode of transportation to work. Public transportation methods include all modes of transit. The data was derived from the ACS 2013-2017 5-year estimates, table B08301, for all workers over the age of 16.

Figure 17. Commuters Using Public Transportation in Baltimore City



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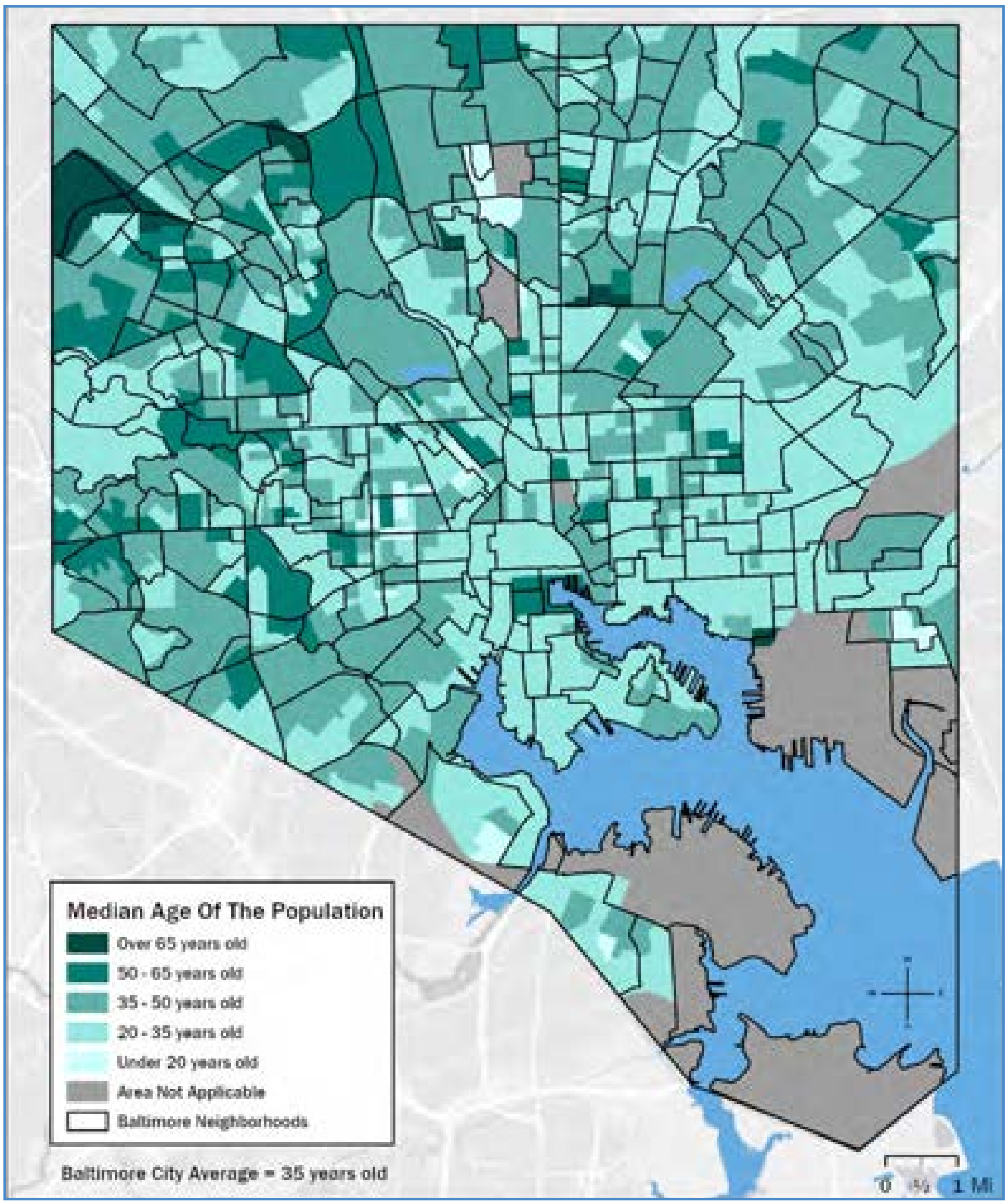
Median Age of The Population

This map shows the average median age of the population per US Census block group using data from the ACS 2013-2017 5-year estimates, table B01002. The median age for Baltimore City, MD is 35 years old. Median age summarizes the age distribution into a single index. Median age is the age that divides a population into two numerically equal groups where half the people are younger than this age, and half are older.

Figure 18. Median Age of Baltimore City's Population



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5. Consolidate the individual equity components into one GIS dataset and apply the resulting equity scores to help prioritize transportation projects

The equity indicators utilized for this assessment are individual components of the final product: one overarching data layer. The compilation of data will provide a data-driven representation of historically underserved areas within Baltimore.

The block group data incorporates a ranking system to ensure the analysis prioritizes areas with the greatest need by assigning them the highest score. Table 11 presents the proposed strategy for classifying and scoring areas based on the racial distribution of residents, using the Black and African American populations as the keystone indicator. Table 12 presents the proposed classification of household income. While the income scoring strategy strives to minimize the priority assigned to wealthier areas by applying scores of zero to higher income areas, the racial scoring system is meant to reflect that even areas with lower than average minority populations still experience disadvantage in transportation infrastructure access and quality. Therefore, only the block groups with the lowest percentage of minorities is assigned a score of zero.

The final composite equity score is developed by taking the assigned individual indicator score, multiplying it by the weighting factor (if any), and then adding each score together.

Table 11. Proposed Race Equity Scoring Approach

Race Classification Break Values	Classified Race Group Score
0 – 10 %	0
11 – 20 %	1
21 – 30 %	2
31 – 40 %	3
41 – 50 %	4
51 – 60 %	5
61 – 70 %	6
71 – 80 %	7
81 – 90 %	8
91+ %	9

Table 12. Proposed Household Income Equity Scoring Approach

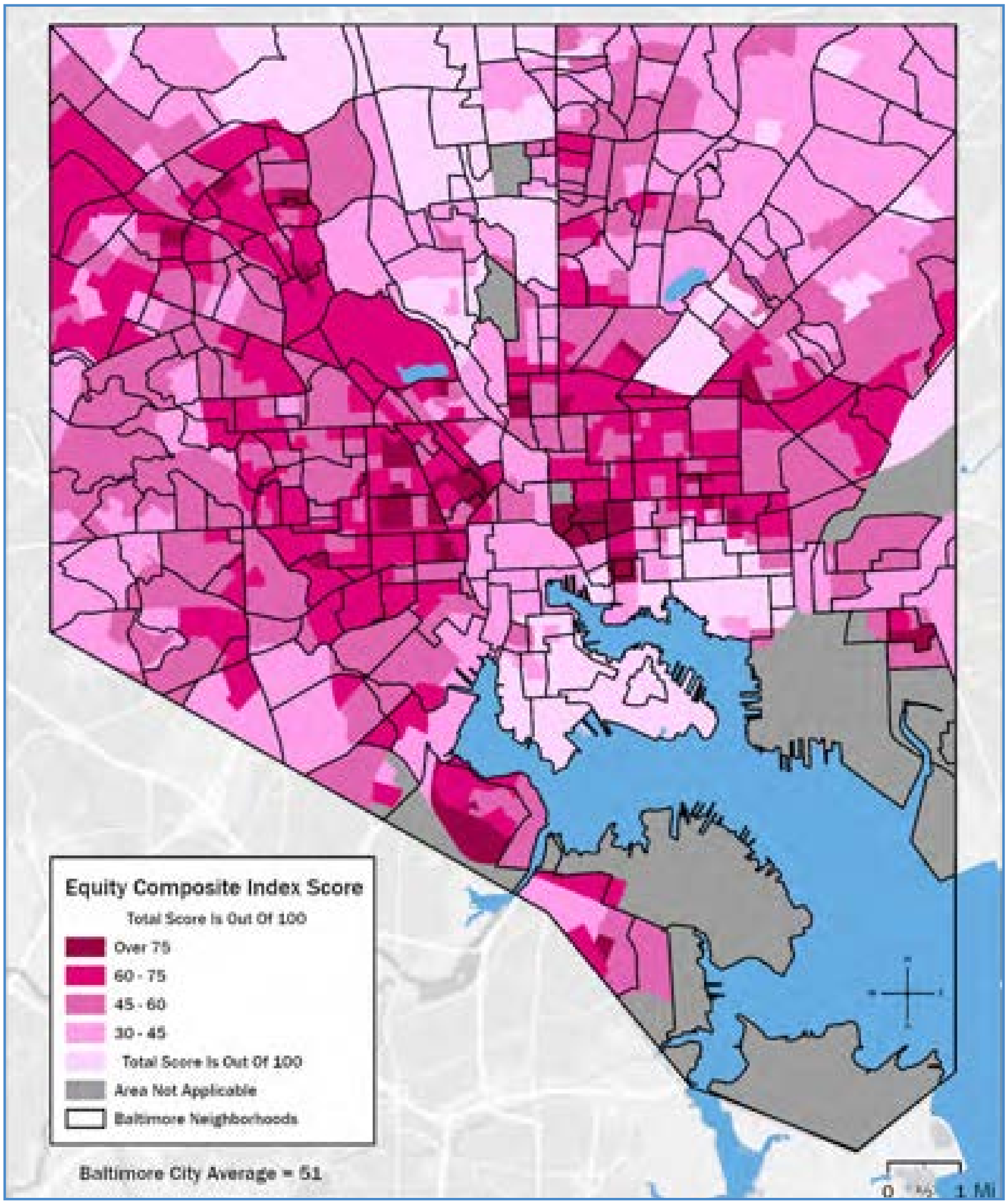
Household Income Classification Break Values	Classified Income Group Score
Less than $10,000	6
$10,000 – $20,000	5
$20,000 – $30,000	4
$30,000 – $40,000	3
$40,000 – $50,000	2
$50,000 – $75,000	1
$75,000 – $100,000	0
$100,000 – $150,000	0
$150,000 – $200,000	0

The overarching data layer is illustrated as the map below. Each individual block group has a calculated composite equity score. Utilizing this equity assessment map and overlaying it with other critical transportation data such as safety, economic development potential, infrastructure condition assessments, and existing or planned work by other departments, the City will be able to systematically prioritize infrastructure investments, as described in greater detail in the Project Prioritization section of Chapter 4.

6. Seek community engagement to validate the data-driven approach

Share and discuss the mapping results with stakeholder groups to gain perspective on the values, opinions, and needs of the communities identified as most historically underserved by the equity assessment. Additionally, provide a recap of community input once the equity assessment is complete.

Figure 19. Equity Analysis for Baltimore City



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