BALTIMORE LINK

BALTIMORELINK TRANSIT PRIORITY TOOLKIT

JUNE 2019

MARYLAND DEPARTMENT OF TRANSPORTATION

MARYLAND TRANSIT ADMINISTRATION

Introduction

The Maryland Department of Transportation Maryland Transit Administration (MDOT MTA) implemented BaltimoreLink in 2017 as a complete overhaul and rebranding for the core transit system serving the greater Baltimore Region. The new system includes a high frequency network of CityLink routes and select LocalLink routes operating with frequencies of 15 minutes or better. The launch of the new system was supported by infrastructure improvements such as new transfer centers, dedicated bus and bike only lanes, and traffic signal priority aimed at improving transit speeds and reliability. The MDOT MTA BaltimoreLink Transit Priority Toolkit identifies physical and technology treatments that can be tactically implemented throughout the BaltimoreLink system to continue supporting the service by addressing bus travel delays, bus reliability and pedestrian and bicyclist safety.

Toolkit Purpose

This Transit Priority Toolkit presents a menu of treatments which may be utilized depending on local conditions. The Toolkit will assist neighborhoods, elected officials, transit planners and transportation engineers to consider how potential transit-prioritizing treatments can compliment local investments in a community's infrastructure.

Toolkit Organization

The Toolkit is organized by five treatment categories:

- **Travel Time Reliability** – The consistency of travel time from day to day and at various times of the day.
- **Travel Delay** – Anything which interferes with bus travel including traffic congestion, crashes, or operational failure. Travel delay is the main source of poor travel time reliability.
- **Stop Delay** – Is associated with passengers boarding or alighting the bus, fare payment and the time it takes for the bus to reenter the travel lane from a bus stop.
- **Signal Delay** – The delay related to stopping at traffic signals.
- **Pedestrian/Bicyclist Safety** – All transit trips begin or end with pedestrian or bicycle access, and any investment in this infrastructure will improve the transit experience.

Treatments may be applied individually or in combination. The Summary Matrix identifies each of the 15 Toolkit treatments.

Toolkit Application

The Toolkit treatments are conceptual and may not be possible in every corridor or location. More detailed analysis is needed to assess which toolkit treatments are likely to be feasible and effective in specific locations. Implementation will require community outreach and stakeholder engagement to discuss the benefits to pedestrians, bicyclists, and transit users, as well as any potential impacts to automobile traffic or parking. With limited right of way, each community must make decisions about how to design for or prioritize the various users of the roadway. This toolkit is intended to help inform those discussions.

Summary Matrix

		CATEGORY ADDRESSED				
	TOOLKIT TREATMENT	TRAVEL TIME RELIABILITY	TRAVEL DELAY	STOP DELAY	SIGNAL DELAY	PEDESTRIAN/ BICYCLIST SAFETY
4	Dedicated Bus Lanes	✓	✓			
5	Business Access and Transit (BAT) Lane	✓	✓			
6	Peak Only Bus Lane	✓	✓			
7	Bus on Shoulder	✓	✓			
8	Transit Only Turns		✓		✓	
9	Intersection Queue Jump	✓	✓		✓	
10	Transit Signal Priority		✓		✓	
11	Far Side Bus Stop		✓	✓	✓	✓
12	Bus Stop Optimization		✓	✓		
13	Bus Stop Accessibility			✓		✓
14	Level Boarding		✓	✓		✓
15	Curb Extension (Bus Bulb)		✓	✓		
16	Floating Bus Stop		✓			✓
17	Left-Side Bike Lane		✓			✓
18	Dedicated Bike Signal			✓		✓

Dedicated Bus Lanes

Dedicated Bus Lanes are designated by signage and pavement markings for exclusive transit use and may be on a separate right-of-way, concurrent with adjacent traffic or contraflow with adjacent traffic. Dedicated bus lanes may also be shared with bicyclists and emergency vehicles.

Treatment Objective:

- Faster travel time
- Improve reliability
- Safer transit movement

Application

- Highly traveled transit routes
- Highly congested corridor segments

Integration Consideration:

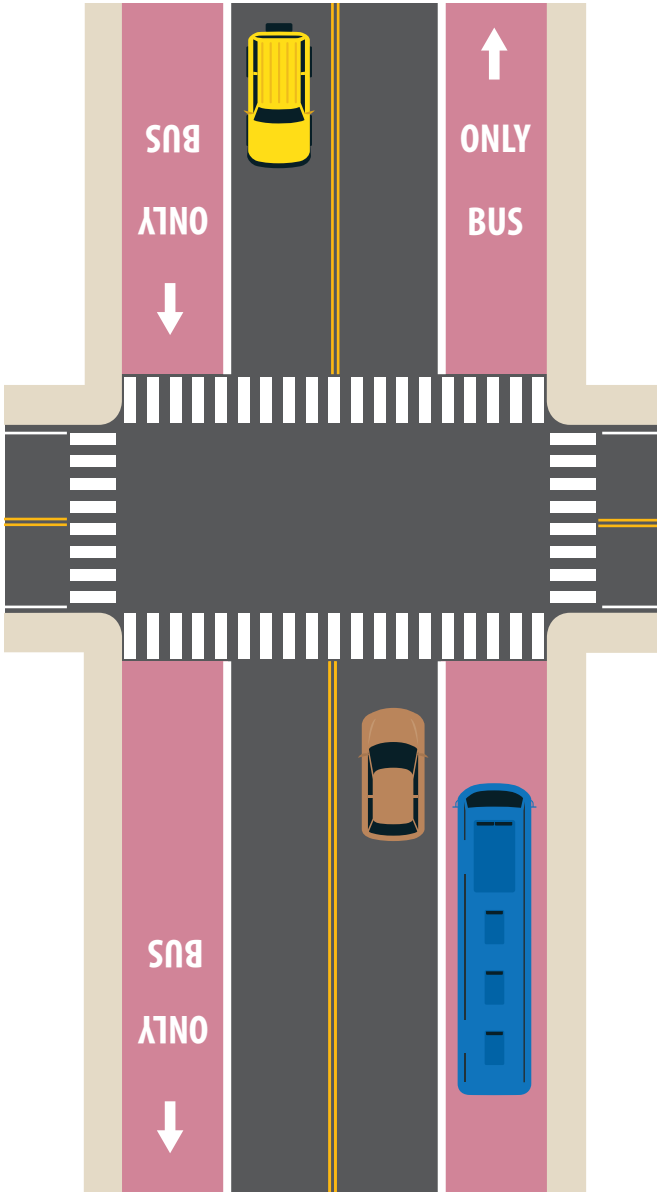
- May require repurposing existing travel lane, parking lane, or additional right of way
- May increase congestion in adjacent vehicle travel lane
- Can be center running, curb side or floating lane
- May allow buses of multiple service providers
- If a dedicated bike lane is not present people riding bikes are allowed in the dedicated bus lanes creating a shared bus and bike zone

Cost Consideration:

- Higher cost projects include additional right of way or physical barriers, lower cost projects can include repurposing existing travel lanes with signage and pavement markings
- Red paint or tinted asphalt if applicable
- Red paint or tinted asphalt is currently being used as an experimental treatment approved by FHWA

Dedicated Bus Lane

Arlington Transit Lane



Business Access and Transit (BAT) Lane

Business Access and Transit Lane is a dedicated bus lane allowing intermittent access for vehicles turning at intersections and vehicular access to driveways.

Treatment Objective:

- Faster travel time
- Improve reliability
- Maintains business and community access

Application:

- Highly congested corridor segments
- Highly traveled transit routes

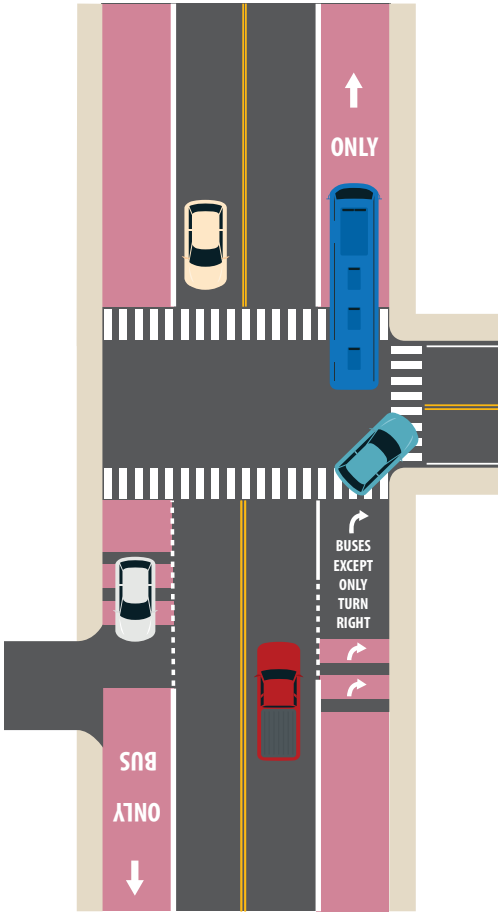
Integration Consideration:

- May require repurposing existing travel lane, parking lane, or additional right of way
- May increase congestion in adjacent vehicle travel lane
- Can be curb side, center or left side running
- Must design to allow intermittent general traffic
- If a dedicated bike lane is not present bicycles may ride in the BAT Lane

Cost Consideration:

- Signage and pavement marking
- Red paint or tinted asphalt if applicable
- Red paint or tinted asphalt is currently being used as an experimental treatment approved by FHWA

Business Access and Transit (BAT) Lane



Peak Only Bus Lane

Peak Only Bus Lanes are used for buses during specified times of the day. During off-peak periods the lane converts to a general travel lane or a parking lane.

Treatment Objective:

- Faster travel time during peak periods
- Allows off peak parking and lane access
- Improves reliability

Application:

- Segments affected by peak period traffic congestion
- Highly traveled transit routes

Integration Consideration:

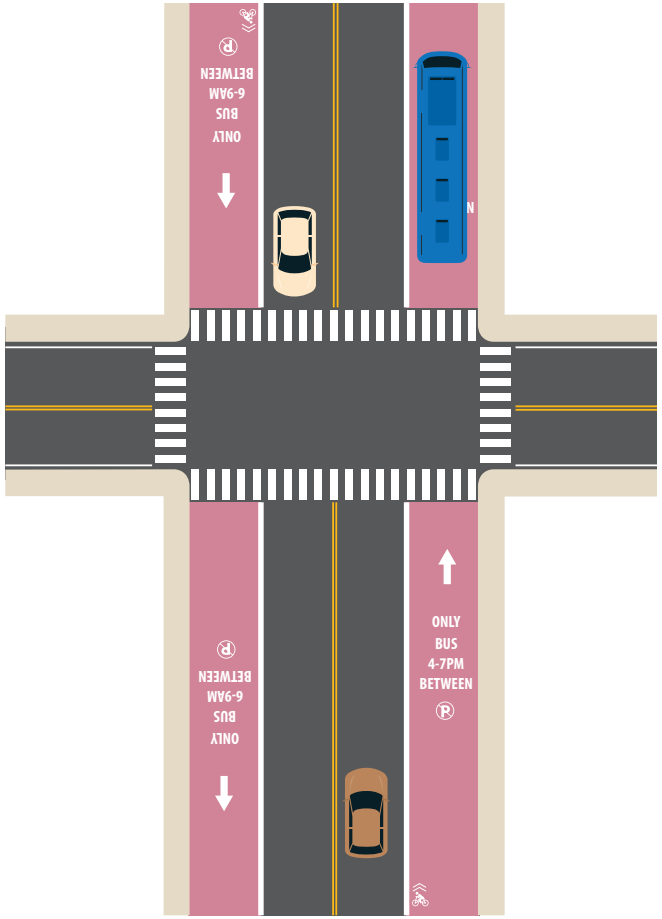
- Typically curbside only
- Requires strict enforcement of no parking times
- Must provide clear signage for other street users

Cost Consideration:

- Signage and pavement markings
- Red paint or tinted asphalt if applicable

Peak Only Bus Lane

Peak Only Bus Lane Sign



Bus on Shoulder

On higher speed, freeways and highways, the shoulder can be used as a *Bus on Shoulder* (BOS) lane. The shoulder is designated as transit only allowing the bus to move through congested corridors without delay.

Treatment Objective:

- Faster travel time
- Improve reliability

Application:

- Transit routes on highways that experience congestion

Integration Consideration:

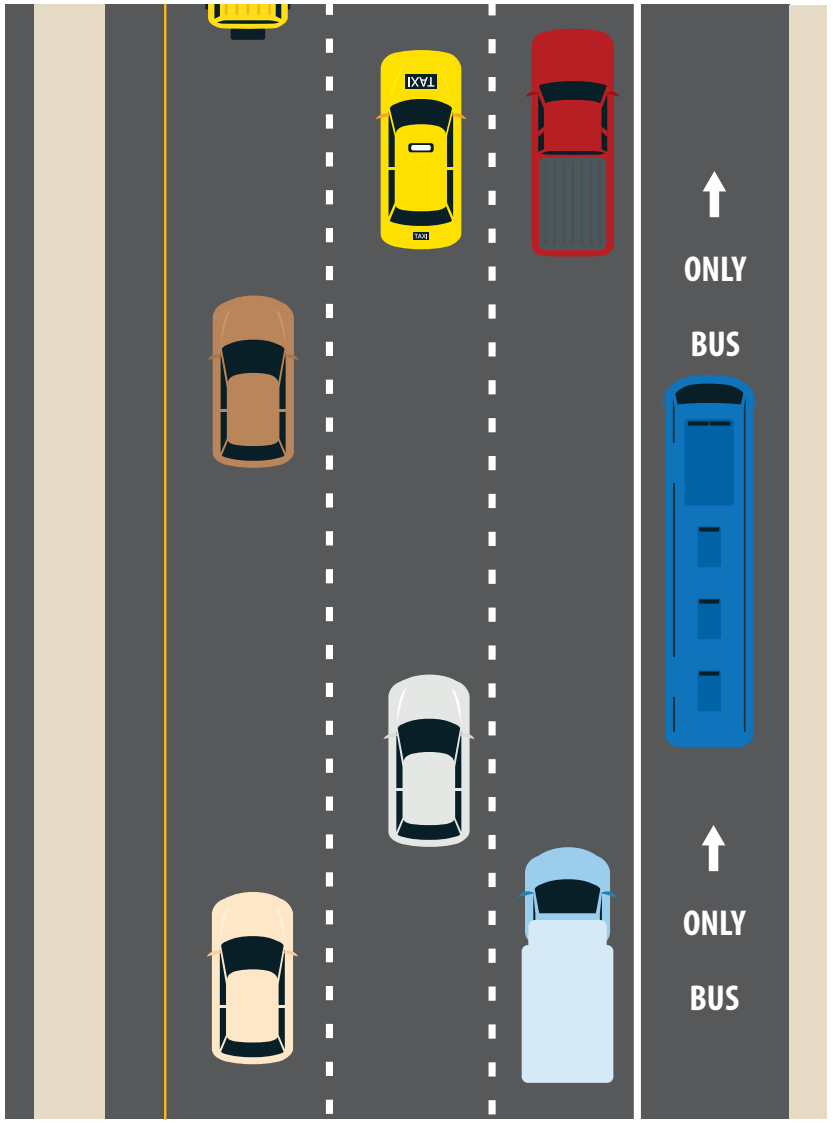
- Requires signage and pavement markings for driver awareness, both vehicular and transit
- Clearly mark turning movements at intersections
- Minimum shoulder width at least 11’
- Shoulder pavement condition
- Straight road geometry desirable
- Bus driver training is necessary
- Can be coupled with transit signal priority
- Evaluate appropriate speed limit for shoulder

Cost Consideration:

- Signage, pavement markings, and expense to maintain shoulder or upgrade paving depth
- Red paint or tinted asphalt if applicable

Bus on Shoulder

Bus on Shoulder



Transit Only Turns

Transit Only Turns restrict or redirect general traffic from proceeding through an intersection, while allowing a transit vehicle to proceed through.

Treatment Objective:

- Efficient movement through congested intersection
- Divert general traffic from proceeding through intersection

Application:

- Intersections where it is beneficial for transit to have the priority
- May also allow for bicycle movements
- May include contra-flow bus and/or bicycle lane
- Can be used for through or turning transit movements

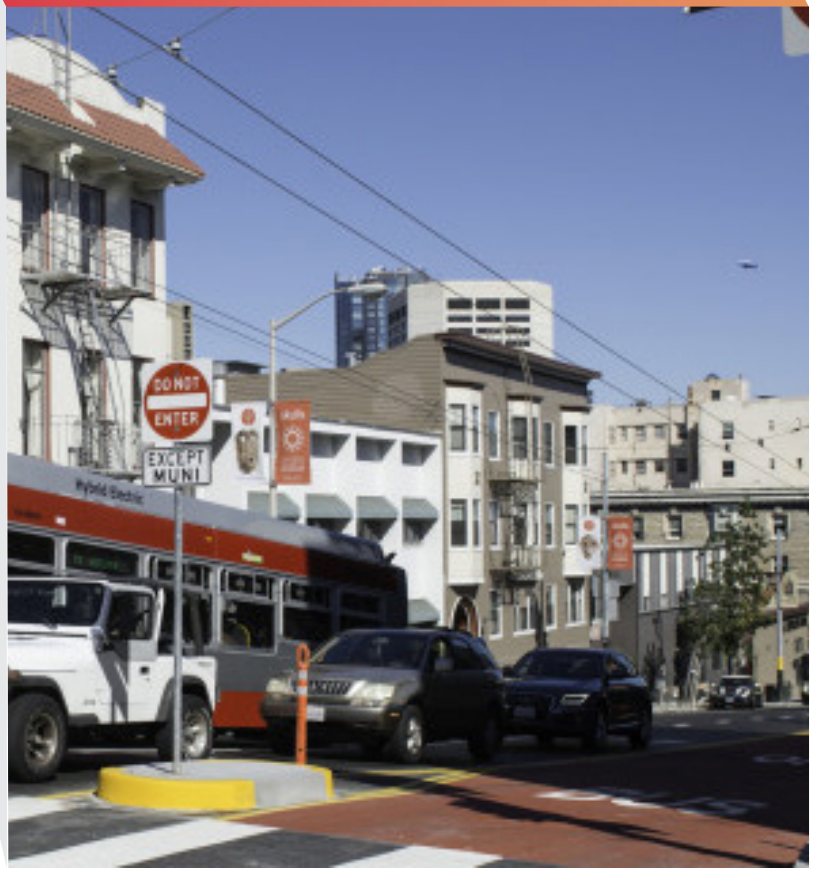
Integration Consideration:

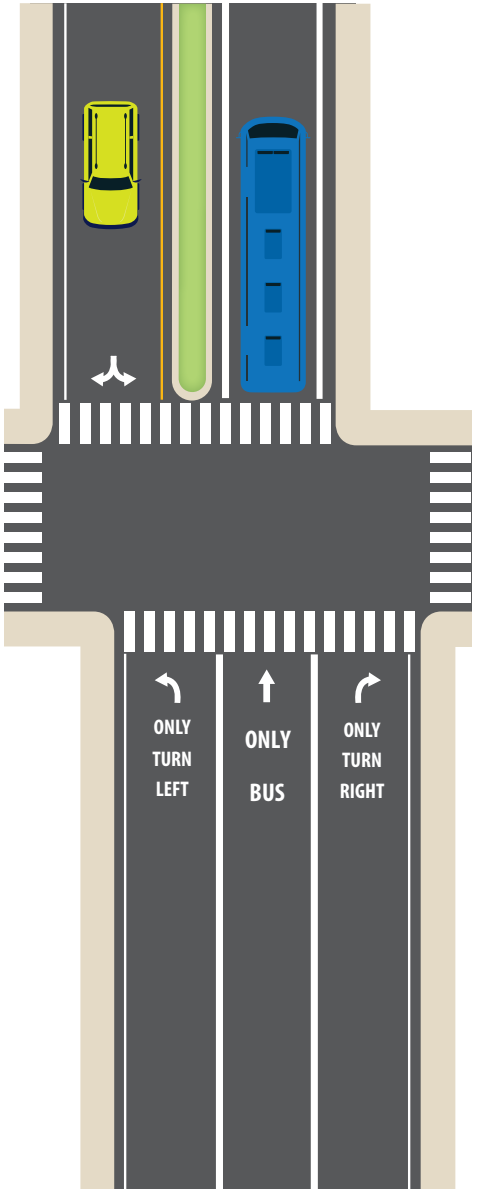
- May use as traffic calming measure
- Enhanced with Transit Signal Priority
- Traffic diversion impact

Cost Consideration:

- Signage and pavement markings
- Traffic signal modification
- Possible roadway modification

Transit Only Turns





Intersection Queue Jump

Intersection Queue Jumps are a short section of transit only lane prior to the intersection. Right turn except bus signage and a bus only traffic signal are typically used to allow buses to jump in front of the queue and proceed through the intersection ahead of the adjacent vehicles. As the bus approaches the intersection it receives a green light, while the general traffic lanes wait at the red light. The gap created on the far side of the intersection allows the bus to merge into the travel lane seamlessly.

Treatment Objective:

- Faster travel time
- Improve reliability

Application:

- Highly congested intersections
- Where general purpose right turn lane can act as queue jump lane for transit vehicles
- Streets where constraints do not allow for a transit only lane or BAT lane

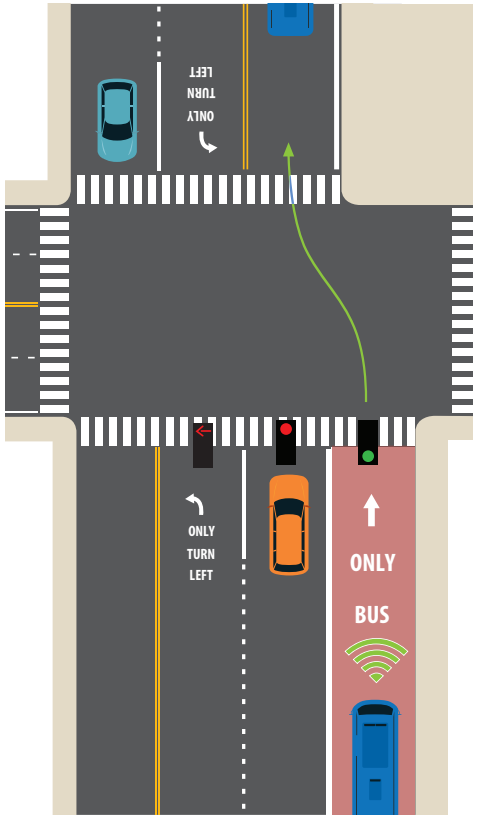
Integration Consideration:

- Consider far side bus stops to complement queue jumps
- Should include transit signal priority
- May create delay for cross street traffic
- May involve parking removal
- Detailed analysis can reveal needed queue jump length

Cost Consideration:

- Signage and pavement markings
- Transit signal priority
- Red paint or tinted asphalt if applicable

Intersection Queue Jump



Transit Signal Priority

Transit Signal Priority uses technology for communication between a traffic signal and an approaching bus to give priority to the approaching transit vehicle. This is typically the addition of a few seconds to a green light, or the reduction of a few seconds to a red light.

Treatment Objective:

- Reduce delay at intersection
- Faster travel time
- Improve reliability

Application:

- Congested intersections
- Intersections with long traffic signal cycles
- Corridors with far distances between signals
- Integration with emergency vehicles
- Corridors with one or two bus routes to avoid signal conflicts

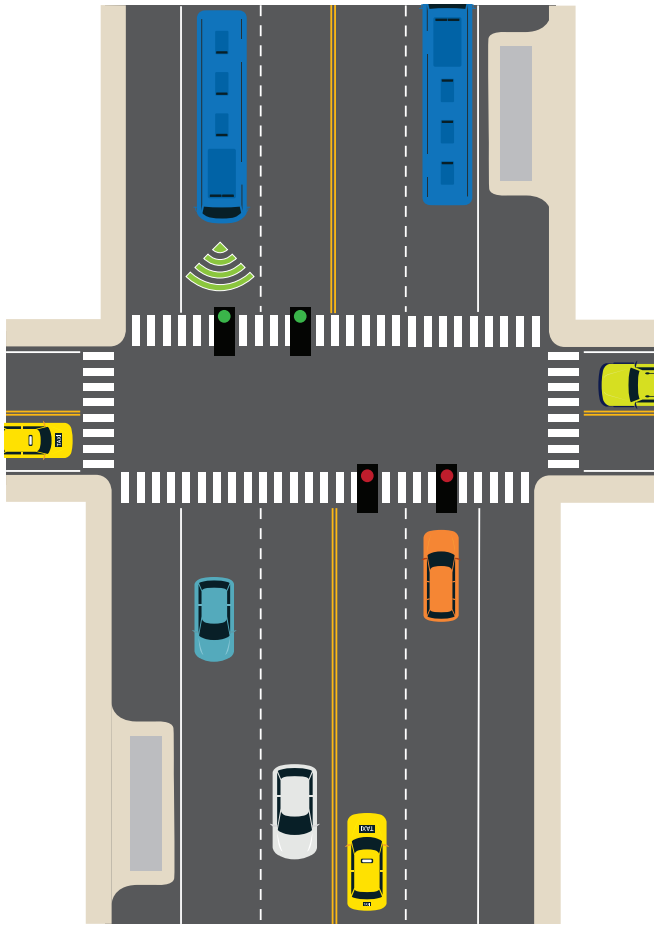
Integration Consideration:

- Works best when paired with other treatments such as Far Side Stops, Dedicated Transit Lanes, or Queue Jumps
- Fewer buses idling at intersections
- May create delay for cross street traffic
- Best suited for non-downtown environments

Cost Consideration:

- Transit Signal Priority integration, including installation and ongoing communications
- Move bus stop to far side

Transit Signal Priority



Far Side Bus Stop

When a bus stop is placed on the far side of an intersection, the bus moves through the intersection then pulls over to the bus stop.

Treatment Objective:

- Reduce stop time
- Increase safety for motorists, pedestrians and cyclists

Application:

- Intersections with long traffic signal cycles
- Most effective when paired with transit signal priority
- Can be paired with bus bulbs
- Encourages pedestrians to cross behind the bus instead of in front of the bus

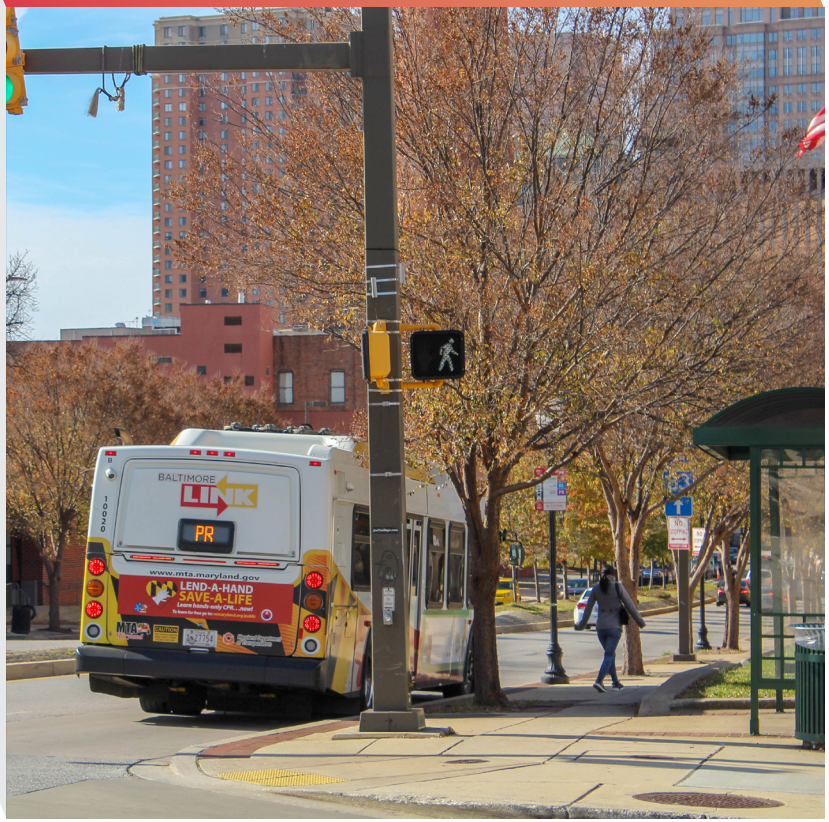
Integration Consideration:

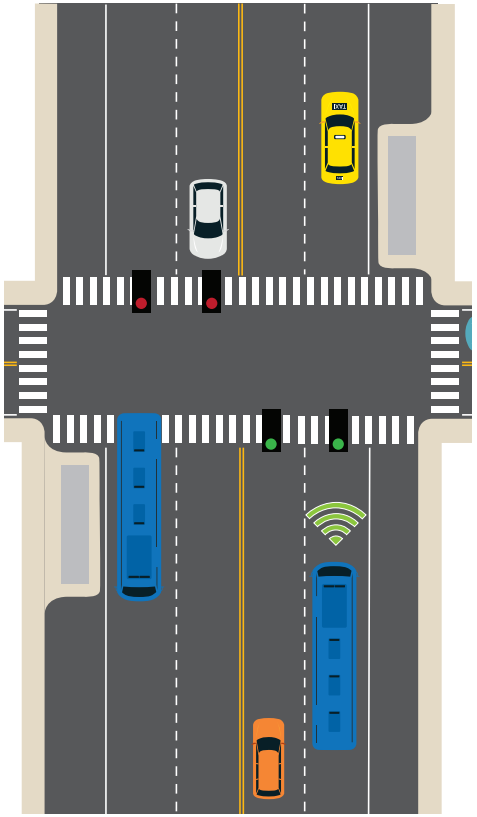
- Contingent on right-of-way available on far side of intersection
- Consider adjacent land use and location of trip generators
- Intersection design and safety
- May add right turn capacity to intersection
- Potential for intersection blockage while bus is stopped
- Design direction provided by MDOT MTA Bus Stop Design Guidelines

Cost Consideration:

- Moving bus stop and amenities to far side of intersection

Far Side Bus Stop





Bus Stop Optimization

Bus Stop Optimization is a process for bus routes with closely spaced or underutilized stops. Targeted stops are relocated or eliminated in order to optimize passenger boarding patterns with transit travel times.

Treatment Objective:

- Ensure bus stop accessibility and safety
- Faster travel time

Application:

- All routes

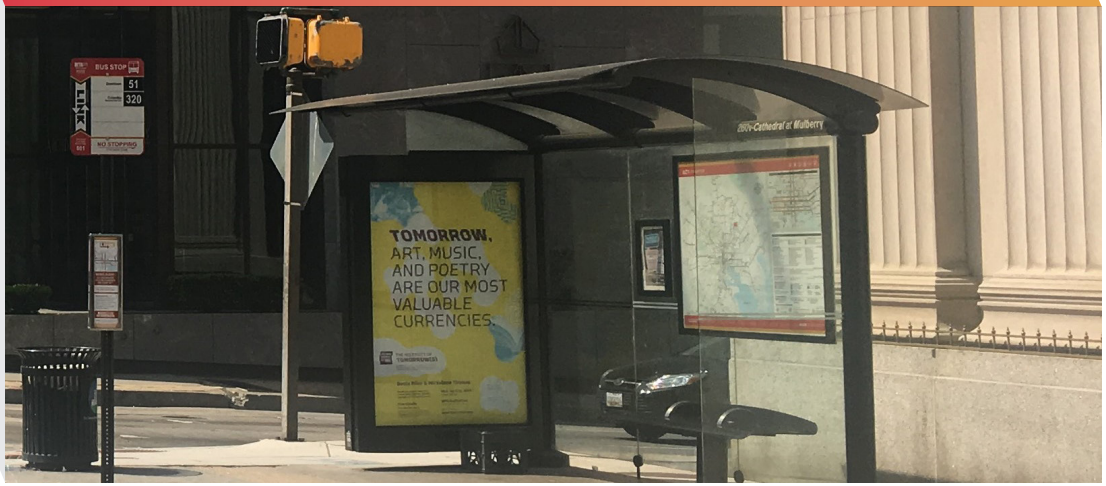
Integration Consideration:

- Public outreach required
- Transfer points, major trip generators, human service facilities, and vulnerable ridership groups including those with mobility challenges must be considered
- Customers may have to walk further to access bus stops
- Consolidating stops to points with better pedestrian infrastructure
- Potential addition of parking spaces
- Design direction provided by MDOT MTA Bus Stop Design Guidelines
- Spacing based on adjoining densities

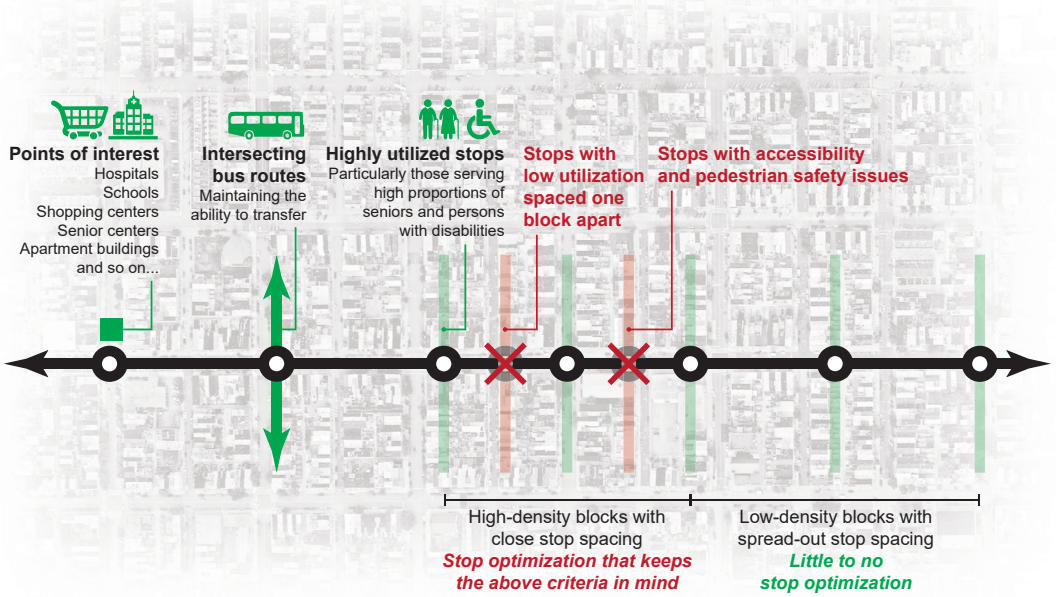
Cost Consideration:

- Removal of bus stop
- Moving bus stop and amenities to new location

BaltimoreLink Bus Stop



Where to Optimize Stops



Bus Stop Accessibility

The bus stop should be accessible to all customers and especially those with physical, emotional or cognitive limitations. All new stops must comply with the Americans with Disabilities Act (ADA) regulations.

Treatment Objective:

- Improve safety, security and accessibility
- Create an inviting pedestrian environment
- Enable limited mobility customers access to fixed route service

Application:

- Any bus stop, urban or suburban

Integration Consideration:

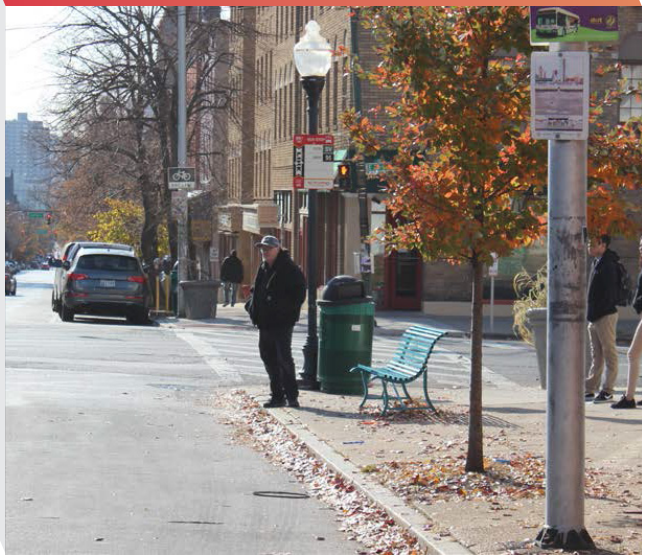
- Location of stop placement, distance from intersection
- Must consider pedestrian connections to surrounding trip generators
- Contingent on right-of-way ownership
- ADA regulations require specific dimensions and slopes

Cost Consideration:

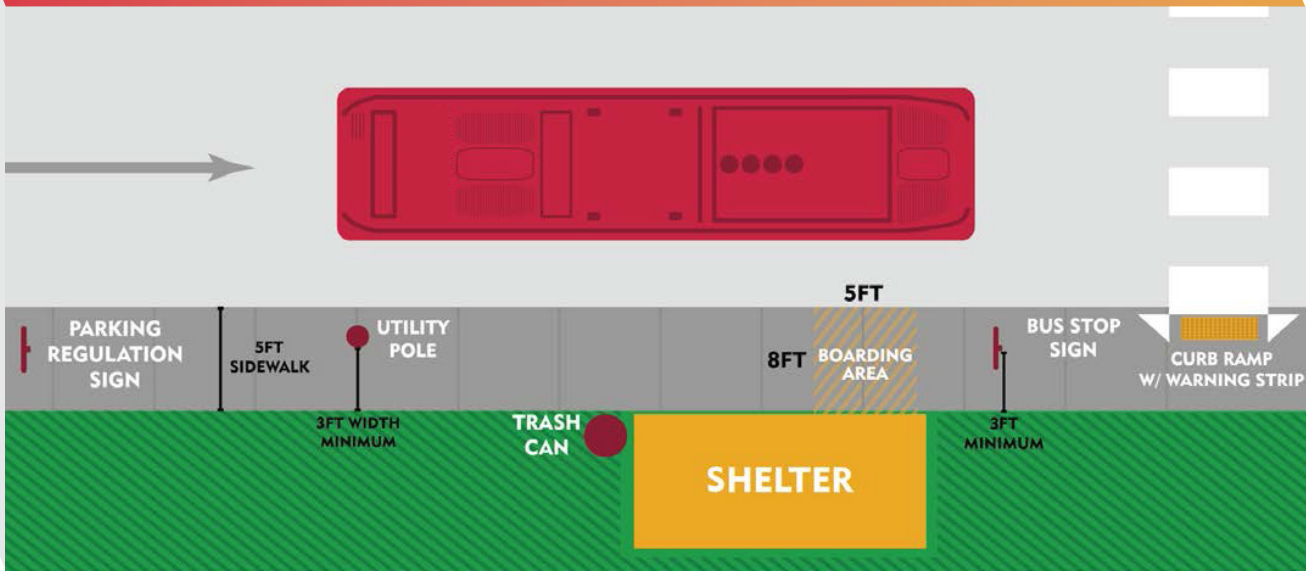
- Boarding and alighting area
- Sidewalk and curb ramp accessible improvements
- Lighting and utility work
- Bus shelters and transit information signs

Inadequate Pedestrian Environment

Ideal Pedestrian Environment



Bus Stop Layout with ADA - Compliant Accessible Path



Level Boarding

With *Level or Near Level Boarding* at stops or stations, the height of the bus platform is raised to minimize the vertical gap between the pavement and the bus floor. This allows patrons to get on and off the bus without steps.

Treatment Objective:

- Reduced dwell time with faster boarding and alighting
- Emphasize bus stop location as separate from pedestrian area

Application:

- High ridership stops
- Accommodate seniors and customers with mobility devices or strollers

Integration Consideration:

- Must rebuild bus boarding area
- Consider adjacent land use
- Contingent on available right-of-way
- Account for ridership profile

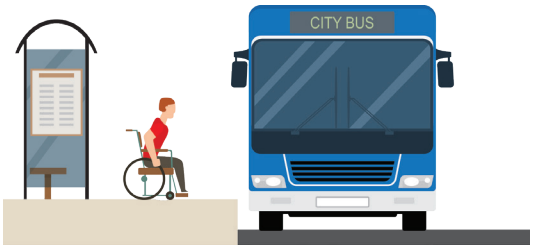
Cost Consideration:

- Modification or rebuild of sidewalk infrastructure
- Right-of-way required
- Potential for stormwater management

Richmond Riverfront BRT

Chicago Loop Link

Level Boarding Wheelchair Access



Curb Extension (Bus Bulb)

Curb Extensions at bus stops or stations are also known as *Bus Bulbs*. The bus stop boarding area "bulbs out" into the travel lane allowing the bus to stop in the travel lane. This may also shorten the crossing distance for pedestrians at intersections.

May be constructed as concrete curb or as a modular curb affixed to the shoulder area.

Treatment Objective:

- Minimize stop time
- Reduce impact on parking

Application:

- Streets where bus struggles to reenter travel lanes
- Retain or add parking space
- Aid with traffic calming and reducing the pedestrian crossing distance
- Bus stops where extra sidewalk space or boarding area is desired

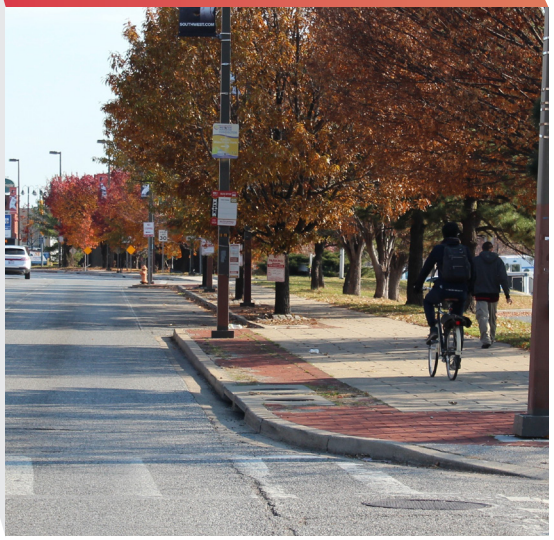
Integration Consideration:

- Bulb area must be long enough to accommodate front and rear doors for the longest buses expected to operate on the route
- Parking and adjacent land uses
- Potential for increased vehicular traffic delay
- Traffic speeds, visibility and safety
- Installed near side or far side of intersection, or mid-block

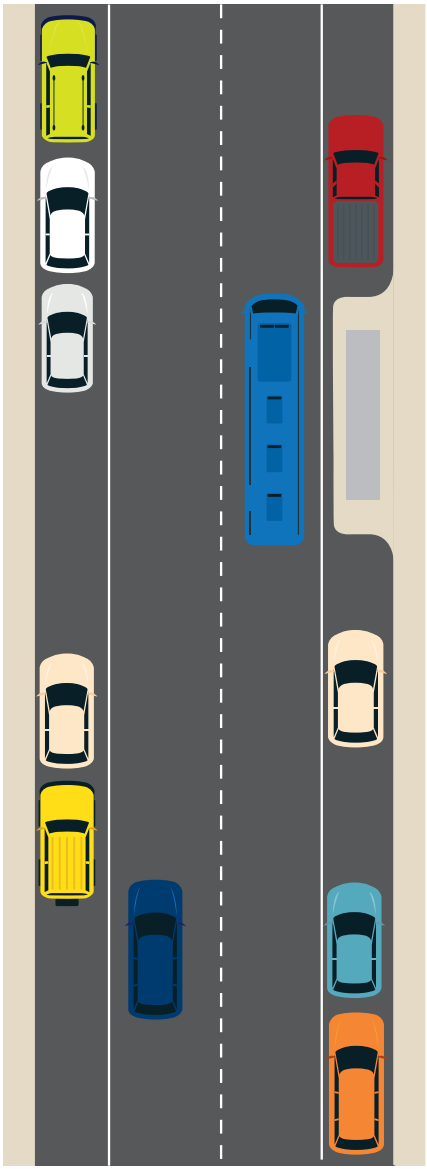
Cost Consideration:

- Extend curb and sidewalk area
- Low-cost options exist that avoid expense of curb alterations
- Stormwater management
- Bus pad

Bus Bulb



Zicla Bus Bulb in New York



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Floating Bus Stop

In this configuration a bike lane wraps around the back side of a bus stop. This configuration can occur with or without the presence of a dedicated transit lane.

Treatment Objective:

- Safely separate cyclists and pedestrians from traffic lane
- Keeps bus in lane, reducing merging out of and into travel lane
- Faster acceleration from bus stop, without merge into traffic lane

Application:

- Segments with separate bike/pedestrian lanes
- Areas with heavy traffic and bike/pedestrian safety concerns

Integration Consideration:

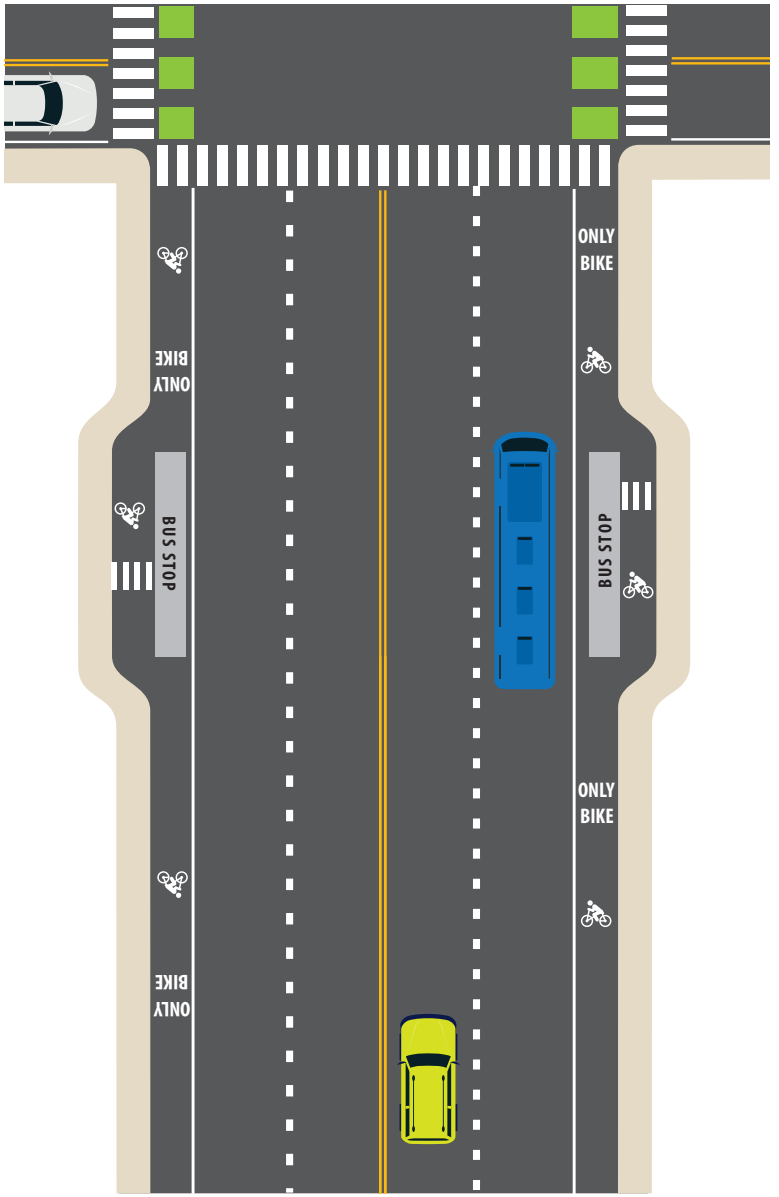
- Organizes multi-modal elements increasing safety
- May require repurposing existing parking or a travel lane

Cost Consideration:

- Right-of-way needed
- Station construction
- Signage and pavement markings
- Low-cost options exist that avoid expense of curb alteration
- Bus pad

Floating Bus Stop

Low Cost Floating Bus Stop with Bike Ramp



Left-Sided Bike Lane (One-Way Street)

A dedicated *Left-Sided Bike Lane* on a one-way street eliminates bus stop boarding conflicts.

Treatment Objective:

- Eliminate the bus and bike conflict on the bus boarding side

Application:

- One-way street with frequent transit
- Streets with a designated bike lane

Integration Consideration:

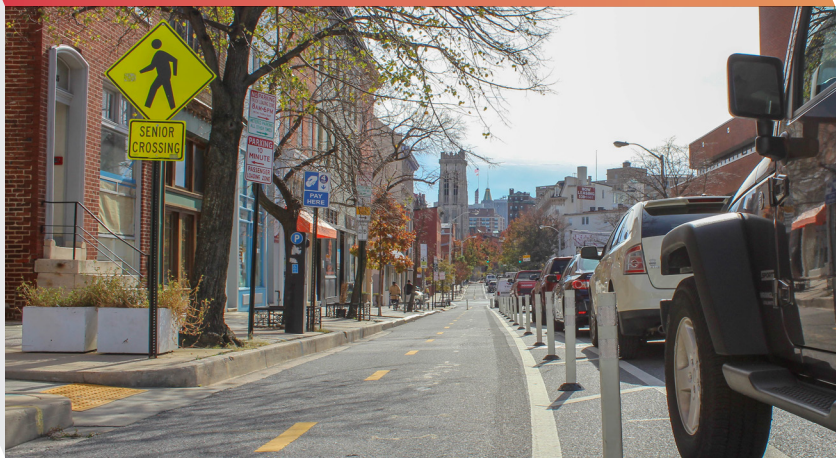
- Left turn volumes
- Bicycle connections

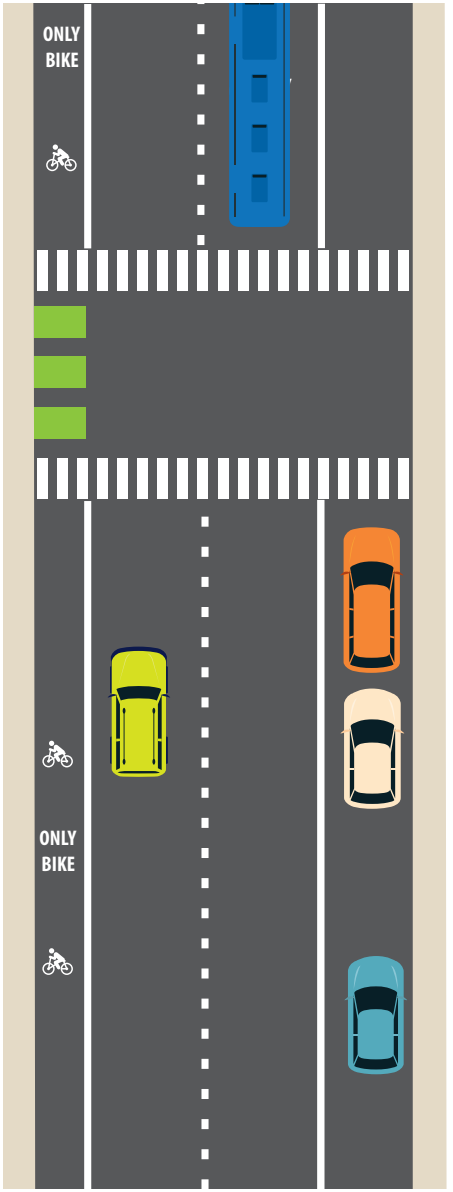
Cost Consideration:

- Signage and pavement marking
- Any flex-posts or other protection for the bike lane

Left-Sided Bike Lane

Left-Sided Bike Lane





Dedicated Bike Signal

A *Dedicated Bike Signal* near busy bus stops or intersections where transit vehicles are turning can help identify and organize transit, bicyclist and pedestrian movements.

Treatment Objective:

- Improve safety for bicyclists
- Reduce turning conflicts at intersection
- Clarify right-of-way at busy intersections

Application:

- Intersections where heavily used bike routes and transit present safety issues

Integration Consideration:

- Adjust timing of traffic signal to include bike signal phase
- Create space for cyclist queuing
- Adding signal time may increase travel delay for transit

Cost Consideration:

- Bicycle signal installation and maintenance
- Signage and pavement markings

Dedicated Bike Signal