



BUS AND BIKE PRIORITY TOOLBOX

A Joint Publication of CDTC and CDTA • Fall 2022

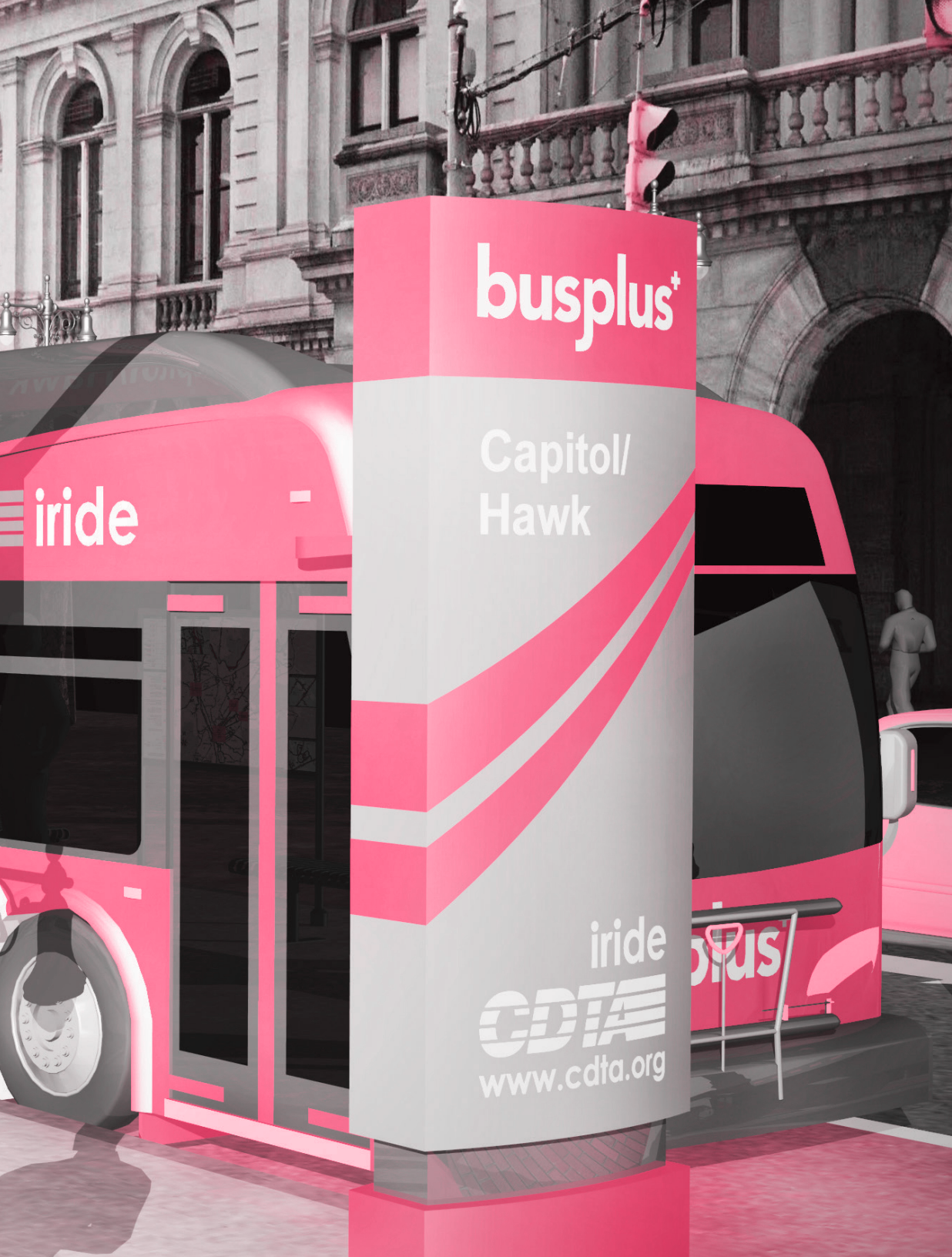


Capitol/Hawk

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10	Crossgates Mall	7	1	Colonie Center	13

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10	Crossgates Mall	7





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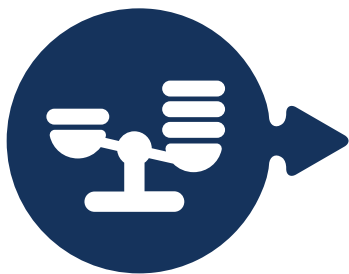
INTRODUCTION

The Capital District Transportation Committee (CDTC) and Capital District Transportation Authority (CDTA) have prepared this toolbox to introduce a variety of bus and bike priority tools that can improve the efficiency, accessibility, and safety of individual bus and bike routes as well as of the bus and bike networks in the Capital District as a whole.

The toolbox provides guidance for community activists, elected representatives, transportation planners, and engineers by showing how bus and bike priority tools can complement other improvements and investments in the Capital District's infrastructure.

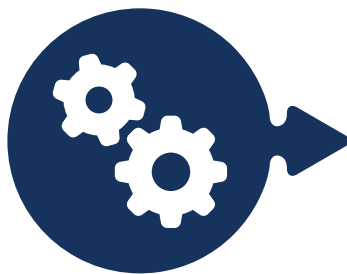
The tools in this toolbox may not be practical in every location; more detailed analysis is often needed to determine where specific tools can and cannot be implemented. Implementation itself requires outreach and engagement to discuss the benefits for pedestrians, cyclists, bus riders, and bus service providers, as well as the potential impacts on vehicular traffic and parking.

By clearly illustrating the tradeoffs between benefits and potential impacts, this toolbox helps communities throughout the Capital District make better-informed decisions about how to prioritize travel for various roadway users in their communities. Each tool's description guides readers through the following process to determine if the tool may be appropriate in their community's context:



Benefits

Which bus or bike priority benefits does the tool offer?



Function

How does the tool work?



Applications

Where does the tool work best?



Cost Considerations

What elements affect how easily the tool can be implemented?



Guidelines

When will the tool fit, and are there other conditions the tool must meet?

BENEFITS AND GUIDELINES

Bus and bike priority benefits vary, and not every benefit applies to every bus or bike priority tool. On the pages that follow, any benefit below that applies to a given bus or bike priority tool is highlighted in blue, while any benefits that don't apply are grayed out.

Similarly, not every roadway can fit every bus or bike priority tool, and some tools may need to meet certain conditions to be effective. On the pages that follow, a guidelines sidebar is provided for each bus and bike priority tool, listing minimum and preferred dimensions, considerations, and approximate costs.



Bus Priority Benefits:



Reduces Travel Time

Reduces the time it takes for the bus to get from one end of the route to the other by speeding up travel.



Reduces Dwell Time

Reduces the time the bus spends at a bus stop waiting for riders to get on, get off, and pay fares.



Reduces Wait Time

Reduces the time the bus spends at an intersection waiting for a green light.



Improves Rider Access

Improves the ease and ability of all riders to get to the bus stop and onto the bus safely and comfortably.



Improves Rider Safety

Improves the safety and comfort of bus riders and other roadway users, including cyclists and drivers.



Bike Priority Benefits:



Reduces Pedestrian Conflicts

Reduces conflicts between pedestrians and cyclists by reducing the number of potential conflict points.



Reduces Vehicle Conflicts

Reduces conflicts between vehicles and cyclists by reducing the number of potential conflict points.



Improves Cyclist Visibility

Improves the visibility of and attention to cyclists among other roadway users, especially drivers.



Improves Cyclist Access

Improves the share of female, young, minority, and novice cyclists, making cycling more accessible to all.



Improves Cyclist Safety

Improves the safety and comfort of cyclists and other roadway users, including bus riders and drivers.



Guidelines:

Space:

- Minimum dimension(s)
- Preferred dimension(s)

Consider:

- List of conditions, thresholds, or other justifications that usually need to be met to implement the tool

Cost:



About the Guidelines

Approximate costs are represented by symbols: \$ indicates a low-cost tool, \$\$ indicates a moderate-cost tool, and \$\$\$ indicates a high-cost tool. Note that these approximate costs are *relative to each other*. Space and considerations information is sourced from the publications in the *References* section.



BUS PRIORITY TOOLS

busplus

South Pearl

iride
data.org

A. CURBSIDE BUS LANE

Curbside bus lanes separate bus traffic from general vehicular traffic and congestion, thereby improving their bus routes' speed and reliability.

Function

These lanes typically repurpose a curbside parking or general travel lane for dedicated bus use. They can be painted or dyed red to distinguish them from the parking and general travel lanes. They can also accommodate cyclists and emergency vehicles, allowing them to reach destinations faster.

Applications

These lanes are justified if the volume of buses on the roadway is a minimum of four buses per hour per direction — six or more buses per hour per direction is the industry standard — and if traffic congestion on the roadway is interfering with bus routes' speed and reliability.

Cost Considerations

The most cost-effective bus lane only requires restriping of existing roadway space; repaving is not typically necessary. Red paint increases the cost, but it is recommended since the paint improves driver compliance.

More costly repaving is recommended in locations with high bus volumes to increase the longevity of the lanes and to reduce maintenance costs. Red-dyed asphalt will last longer than red paint, and red-dyed concrete is even more effective in resisting surface deformation from heavy bus traffic.

Benefits



**Reduces
Travel Time**



**Reduces
Dwell Time**



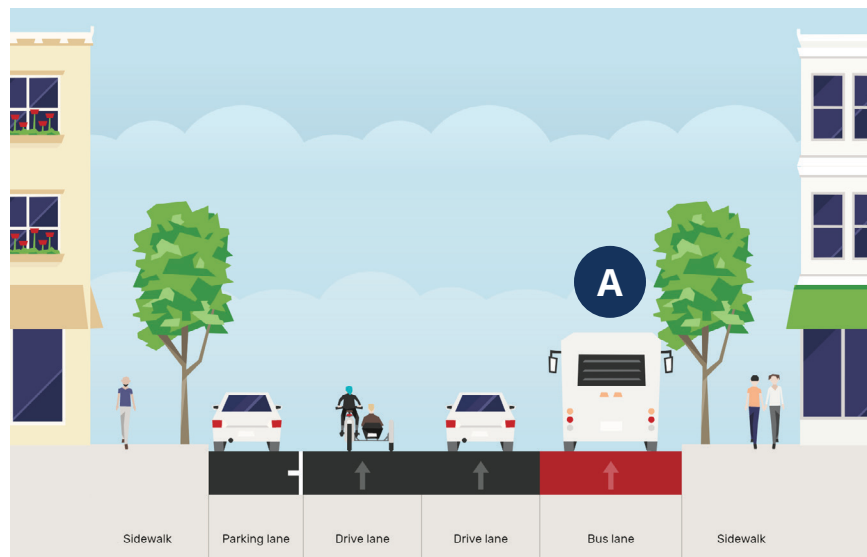
**Reduces
Wait Time**



**Improves
Rider Access**



**Improves
Rider Safety**



Space:

- Minimum width: 11'
- Preferred width: 12'

Consider:

- Bus speed less than 9 mph
- Roadways with 4 or more buses per hour per direction
- Roadways where bus reliability is affected by congestion
- Relatively high passenger throughput

Cost:



Space:

- Minimum width: 11'
- Preferred width: 12'

Consider:

- Bus speed less than 9 mph
- Roadways with 4 or more buses per hour per direction
- Roadways where bus reliability is affected by congestion
- Roadways with demand for curbside parking
- Relatively high passenger throughput

Cost:



B. OFFSET BUS LANE

Offset bus lanes separate bus traffic from general vehicular traffic and congestion, thereby improving their bus routes' speed and reliability.

Function

These lanes typically repurpose a general travel lane adjacent to the parking lane for dedicated bus use. They can be painted or dyed red to distinguish them from the parking and general travel lanes. They can also accommodate cyclists and emergency vehicles, allowing them to reach destinations faster. Buses must pull over to the curb to serve bus stops, but curb extensions or floating bus stops eliminate the need to pull over (see Tools J, K, N, and O).

Applications

In addition to meeting the same volume and congestion justifications as curbside bus lanes, these lanes work best on roadways that have both low general traffic volumes and high demands for curbside parking and access (loading and unloading, deliveries, ridehailing, etc.).

While these lanes preserve curbside parking capacity, vehicles must cross them to park, and they are also vulnerable to illegal parking blockages.

Cost Considerations

The most cost-effective bus lane only requires restriping of existing roadway space; repaving is not typically necessary. Red paint increases the cost, but it is recommended since the paint improves driver compliance.

Benefits



**Reduces
Travel Time**



**Reduces
Dwell Time**



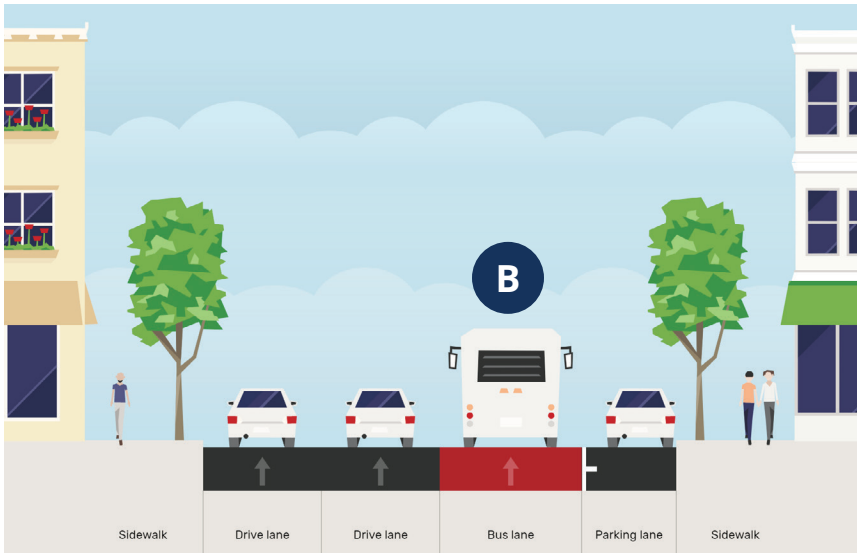
**Reduces
Wait Time**



**Improves
Rider Access**



**Improves
Rider Safety**



C. CONTRAFLOW BUS LANE

On one-way roadways, contraflow bus lanes allow buses to travel in the opposite direction of general traffic, enabling bidirectional bus travel on what otherwise is still a one-way roadway.

Function

Bus operations on one-way couplets are common, but in some cases it may be preferable to consolidate operations onto a single roadway, such as in cases where the couplets are unusually far apart or where they force deviations or other operational obstacles for buses.

Applications

Contraflow bus lanes eliminate the need for riders to walk to different one-way roadways to catch buses traveling in opposite directions, thereby improving rider access. They also improve bus route legibility, since riders are able to see bus stops for both directions on the same roadway.

Cost Considerations

These lanes do not typically require repaving, but restriping, painting, and marking is necessary to alert drivers of the opposing bus travel. Traffic lights may also need to be updated with new signals to accommodate the opposing bus travel and turning movements.

Benefits



**Reduces
Travel Time**



**Reduces
Dwell Time**



**Reduces
Wait Time**



**Improves
Rider Access**



**Improves
Rider Safety**



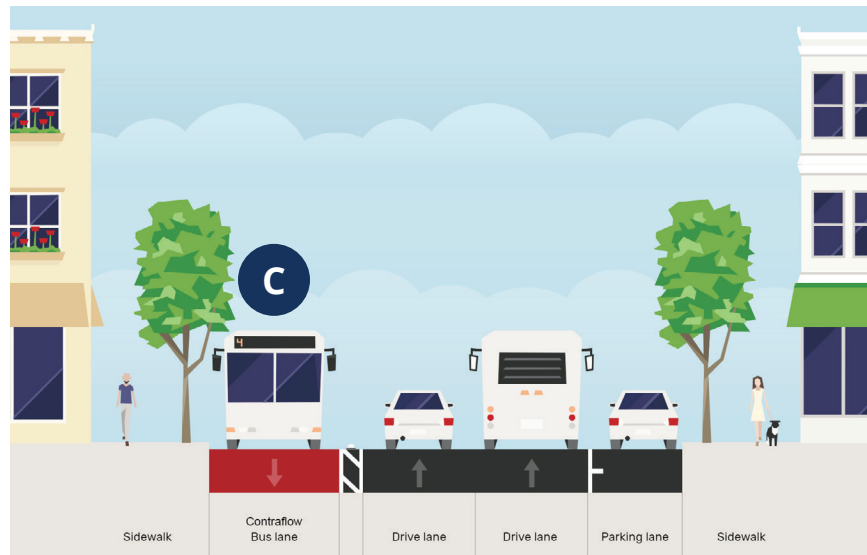
Space:

- Minimum width: 11'
- Preferred width: 12'

Consider:

- Bus speed less than 9 mph
- Roadways with 4 or more buses per hour per direction
- Roadways where bus reliability is affected by congestion
- One-way roadways that require bidirectional bus travel
- Relatively high passenger throughput

Cost:



Space:

- Minimum width: 11'
- Preferred width: 12'

Consider:

- Roadways with high peak bus traffic but fewer than 4 off-peak buses per hour per direction
- Roadways with demand for off-peak curbside parking

Cost:



D. PEAK-ONLY BUS LANE

Peak-only bus lanes temporarily separate bus traffic from general vehicular traffic and congestion, thereby improving their bus routes' speed and reliability during the morning and afternoon rush hours (peaks).

Function

These lanes typically repurpose a curbside parking lane or general travel lane for dedicated bus use, but only during the morning and afternoon rush hours (typically from 6:00 AM to 9:00 AM and again from 3:00 PM to 7:00 PM). Outside these hours, the curbside lane reverts to general travel or parking as needed.

Applications

These lanes are effective in situations where peak bus volumes are high or peak traffic congestion is heavy enough to affect bus speed and reliability, but where off-peak congestion or bus volumes are also not heavy enough to warrant separating buses from general traffic.

While these lanes help preserve off-peak curbside parking, driver compliance is lower than for other bus lanes, and illegal parking is more common.

Cost Considerations

The most cost-effective bus lane only requires restriping of existing roadway space; repaving is not typically necessary. While marking the lane's time restrictions is recommended, red paint is not recommended since the latter should be used to encourage driver compliance with full-time bus lanes.

Benefits



**Reduces
Travel Time**



**Reduces
Dwell Time**



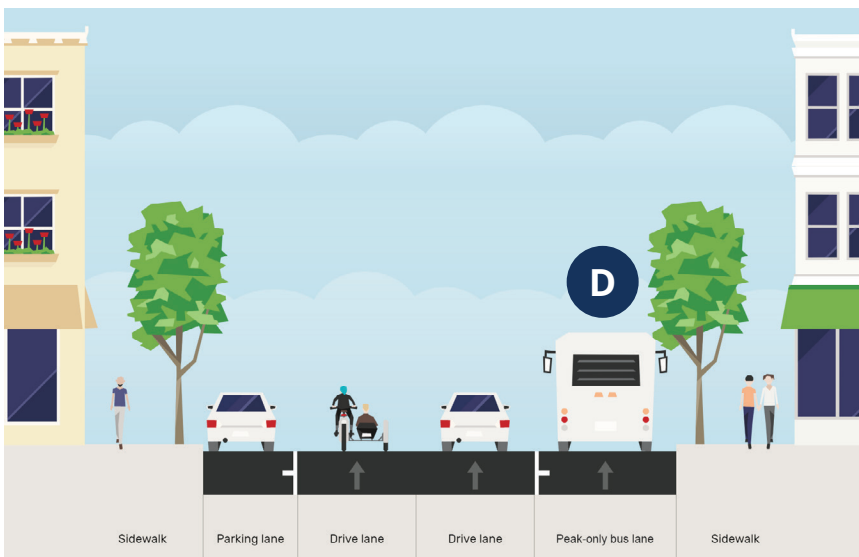
**Reduces
Wait Time**



**Improves
Rider Access**



**Improves
Rider Safety**



E. MEDIAN BUS LANE

Median bus lanes separate bus traffic from general vehicular traffic and congestion by employing a more durable separator than other types of bus lanes, significantly improving their bus routes' speed and reliability.

Function

These lanes typically repurpose the middle of the roadway for dedicated bus use, pushing general travel lanes and parking lanes to the sides of the roadway. They are often painted or dyed red to distinguish them from the parking and general travel lanes, and can also be separated from the latter via raised curbs, raised domes, bollards, or jersey barriers. Riders access median-running buses at either side-boarding or center-boarding median bus stops (see Tools P and Q).

Applications

These lanes offer a highly visible and durable means of separation analogous to dedicated light rail or heavy rail corridors. They are particularly suited for avenues and boulevards, some of which may already have medians left over from the streetcar era that can be converted to median bus lanes.

Cost Considerations

These lanes are costly; they require significant reconstruction of the roadway, even in situations where medians can be reused. They also require pedestrian infrastructure to access the median bus stops and may even require new signals and overpasses/underpasses to separate bus movements from other vehicular turns.

Benefits



**Reduces
Travel Time**



**Reduces
Dwell Time**



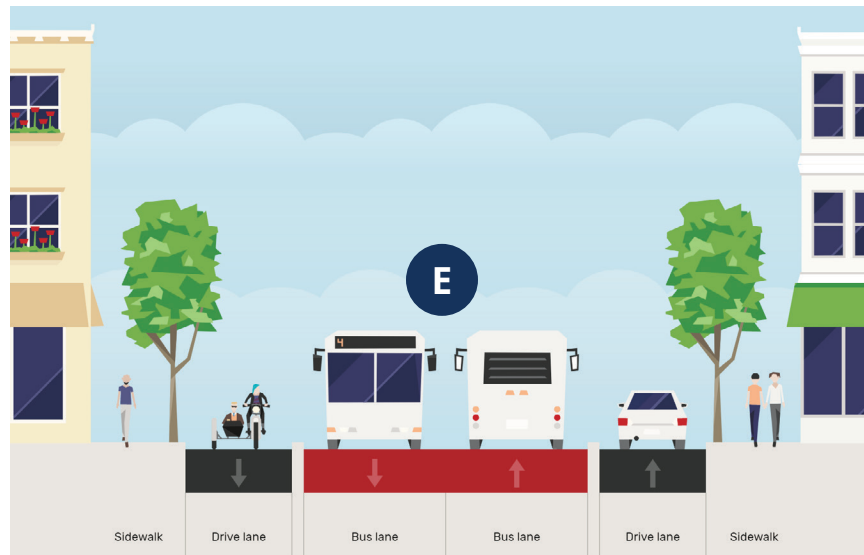
**Reduces
Wait Time**



**Improves
Rider Access**



**Improves
Rider Safety**



Space:

- Minimum width: 22' (11' per direction)
- Preferred width: 26' (13' per direction)

Consider:

- Roadways with 12 or more buses per hour per direction
- Roadways that require separating buses where Tools A, B, C, and D are inadequate
- Relatively high passenger throughput

Cost:



Space:

- Minimum width: 22' (11' per direction)
- Preferred width: 26' (13' per direction)

Consider:

- Roadways with 12 or more buses per hour per direction
- Roadways that require reliable bus corridors similar to rail corridors
- Relatively high passenger throughput

Cost:



F. BUSWAY

Busways offer buses their own dedicated roadway, significantly improving their bus routes' speed and reliability. Busways typically come in two formats: *surface* or *grade-separated*. Riders access busways at either side-boarding or center-boarding bus stops (see Tools P and Q).

Function

Surface busways are common in developed areas where they intersect with cross-streets and often contain sidewalks and/or bike lanes to maintain non-vehicular access to adjacent buildings. These lanes often permit emergency vehicles and off-peak or overnight truck deliveries to adjacent businesses.

Grade-separated busways function similarly to light rail or heavy rail tracks in that they allow only buses to travel on and parallel to them. While emergency vehicles may still be permitted, trucks, pedestrians, and cyclists are not.

Applications

Busways offer a highly visible and durable means of separation analogous to dedicated light rail or heavy rail corridors.

Cost Considerations

These lanes are costly; surface busways require reconstruction of existing roadways and coordinating alternative means of vehicular access to adjacent buildings. In addition to the dedicated roadway itself, grade-separated busways require pedestrian infrastructure to access bus stops and may even require new signals and overpasses/underpasses to separate bus traffic from other vehicular and pedestrian traffic.

Benefits



**Reduces
Travel Time**



**Reduces
Dwell Time**



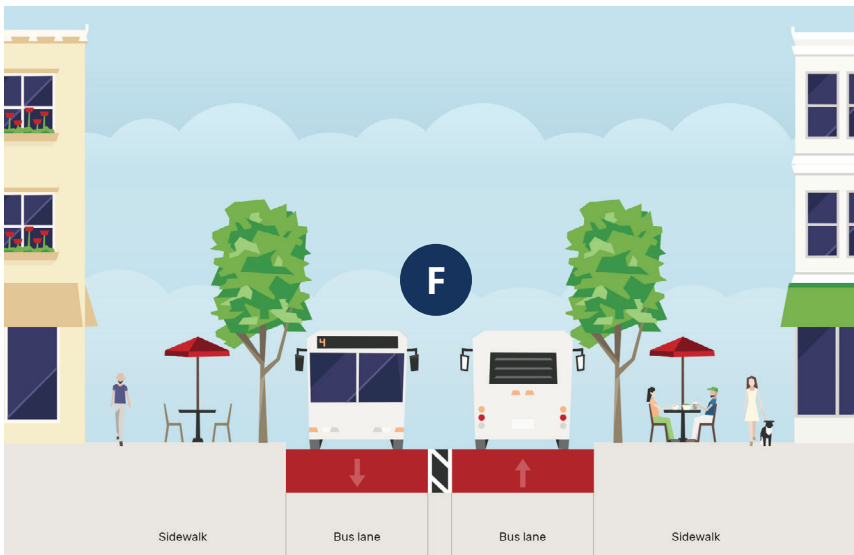
**Reduces
Wait Time**



**Improves
Rider Access**



**Improves
Rider Safety**



G. BUS ON SHOULDER

Bus shoulders separate bus traffic from general vehicular traffic and congestion, thereby improving their bus routes' speed and reliability.

Function

These lanes typically repurpose a boulevard's, highway's, or expressway's shoulder (breakdown lane) for bus use. Vehicle pullovers are still permitted, around which buses must maneuver by merging back into general traffic.

Applications

These lanes are useful on high-speed roadways that are typically congested during peak periods (rush hours), but they can be used during other congested periods too. They are particularly common on highways in and around larger cities, allowing buses to bypass the typically heavy weekday congestion on these highways.

Cost Considerations

While bus shoulders typically only require signage (especially signage at highway exits informing drivers of conflicting bus movements), there are other considerations which can limit their feasibility:

Firstly, roadway shoulders must be wide enough to safely accommodate buses, and many urban highways have narrow or inconsistent shoulders. Secondly, not all roadway shoulders are built to withstand the same amount of vehicular weight as the roadway's general travel lanes. Thirdly, drainage infrastructure may also need to be modified or upgraded.

Benefits



**Reduces
Travel Time**



**Reduces
Dwell Time**



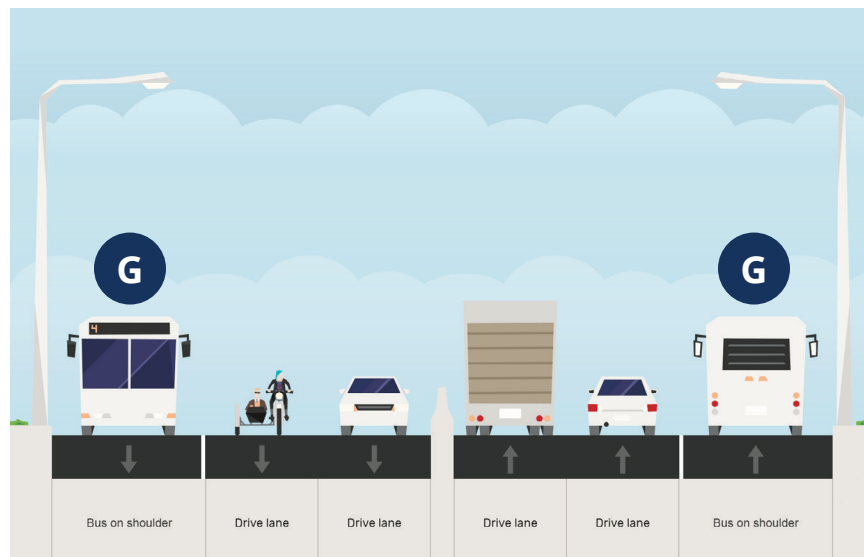
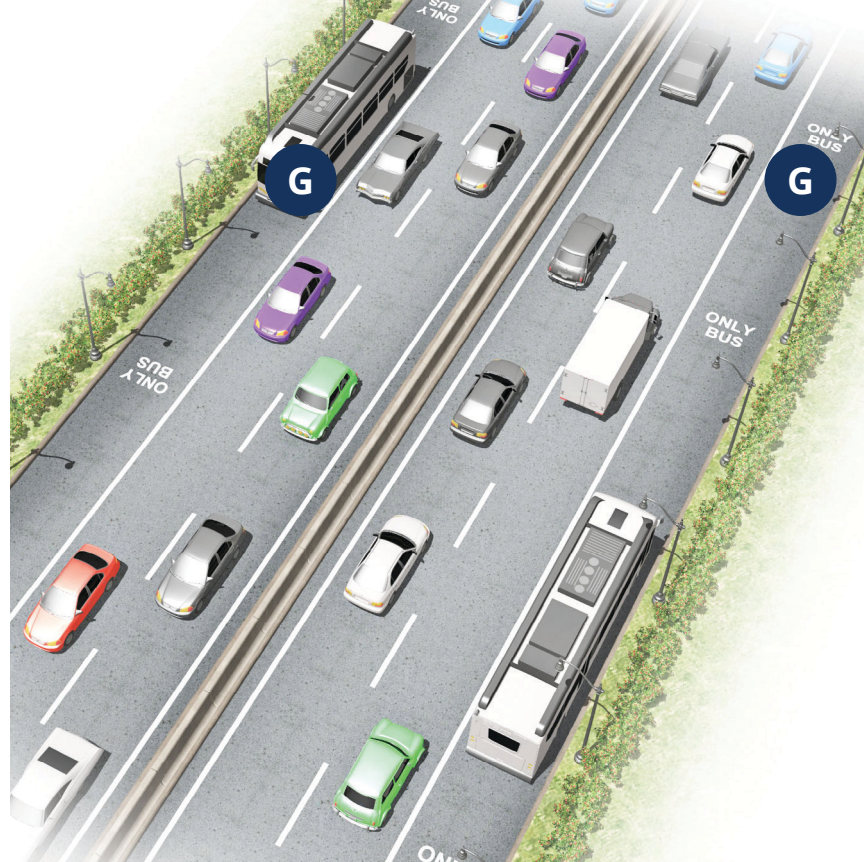
**Reduces
Wait Time**



**Improves
Rider Access**



**Improves
Rider Safety**



Space:

- Minimum width: 11'
- Preferred width: 12'

Consider:

- Pavement thickness of 7" or more to support bus weight
- Roadways where bus reliability is affected by congestion
- Roadways with wide shoulders (see note on pavement thickness above)

Cost:



Space:

- Minimum length: 70' (to fit at least one 40' or 60' bus)
- Minimum rear taper length: 50'

Consider:

- Signalized intersections with long signal cycles
- Congested roadways where bus lanes aren't possible

Cost:



H. QUEUE JUMP

Queue jumps improve bus routes' speed and efficiency by allowing buses to pull ahead of general traffic at intersections with traffic lights.

Function

By pairing a short section of bus lane with a traffic light equipped with a transit signal, a queue jump allows buses to pull alongside general traffic, then proceed through the intersection ahead of the general traffic.

Applications

This tool is useful along roadways with congested intersections where full bus lanes may not be possible. If repeated across multiple intersections along the roadway, the small time savings at each intersection may add up to significant time savings along the entire length of the bus route.

Cost Considerations

Queue jumps are more cost-effective than full bus lanes, but they still require a moderate level of investment. Sections of curbside parking must be removed to allow buses to pull up alongside general traffic, and traffic lights must be replaced or upgraded with transit signals. Queue jumps are typically paired with nearside bus stops since the space for the queue jump can also serve as boarding/alighting space.

Benefits



**Reduces
Travel Time**



**Reduces
Dwell Time**



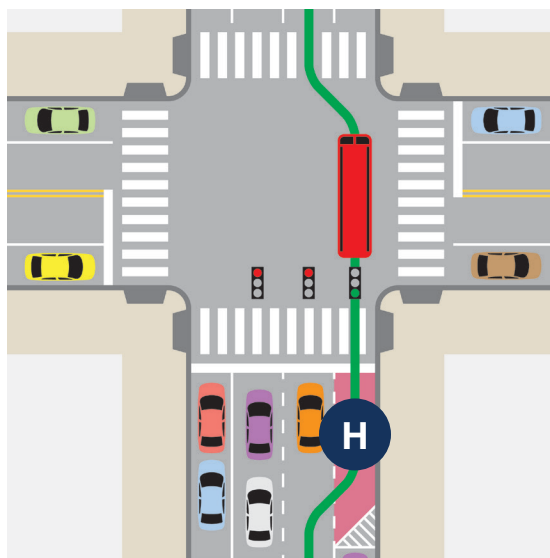
**Reduces
Wait Time**



**Improves
Rider Access**



**Improves
Rider Safety**



I. TRANSIT SIGNAL PRIORITY (TSP)

TSP allows buses to get through intersections faster by modifying the length of red and green traffic lights as buses approach the intersections.

Function

TSP typically works in two ways: if a traffic light about to turn red detects an approaching bus, it can stay green for several seconds longer to allow the bus to pass through the intersection. If an already-red traffic light detects an approaching bus, it can turn green several seconds earlier.

Applications

This tool is useful along roadways with congested intersections, and it can also complement bus lanes. If repeated across multiple intersections along the roadway, the small time savings at each intersection may add up to significant time savings along the entire length of the bus route.

Cost Considerations

TSP requires a moderate level of investment since traffic lights must be replaced or upgraded. Bus fleets also need to be equipped with TSP controllers, so the cost is also affected by the bus fleet size. Finally, TSP requires relocating bus stops from nearside to farside, otherwise, any time savings will be lost by picking up and dropping off riders.

Benefits



**Reduces
Travel Time**



**Reduces
Dwell Time**



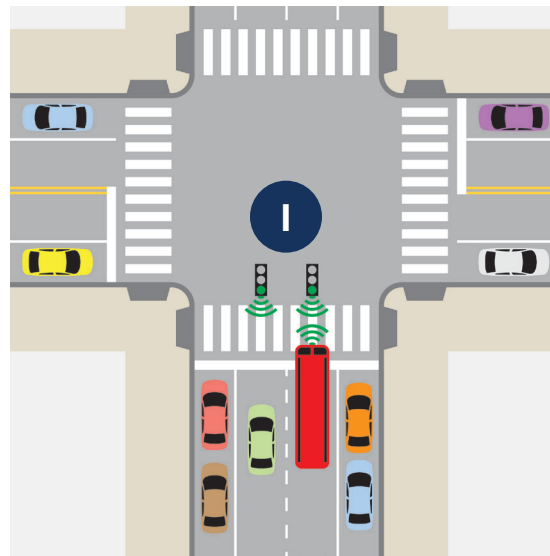
**Reduces
Wait Time**



**Improves
Rider Access**



**Improves
Rider Safety**



Space:

- N/A (placed within existing intersections)

Consider:

- Signalized intersections with long signal cycles
- Signalized intersections with heavy vehicle stacking
- Roadways with long distances between traffic lights

Cost:





BUS STOP TOOLS



J. TEMPORARY CURB EXTENSION

Temporary curb extensions allow buses to serve bus stops faster by picking up and dropping off riders without having to pull over to the curb.

Function

This tool eliminates the need for buses to wait for a break in traffic to merge back from a bus stop and continue traveling. If repeated across multiple bus stops, the small time savings at each bus stop may add up to significant time savings along the entire length of the bus route.

Applications

This tool is useful along roadways that have more than one travel lane in the same direction: if the bus stops in one travel lane to serve a bus stop, vehicles can still use the other travel lane to pass. Curb extensions also improve wheelchair accessibility since bus stops without them may not always have enough space for buses to fully pull over and deploy ramps.

Cost Considerations

Temporary curb extensions are cost-effective: since they are made of heavy rubberized plastic, they can be dropped in place at existing bus stops without any other roadway modifications or restriping. They can serve as “pilot” experiments before committing to more expensive long-term investments.

Benefits



**Reduces
Travel Time**



**Reduces
Dwell Time**



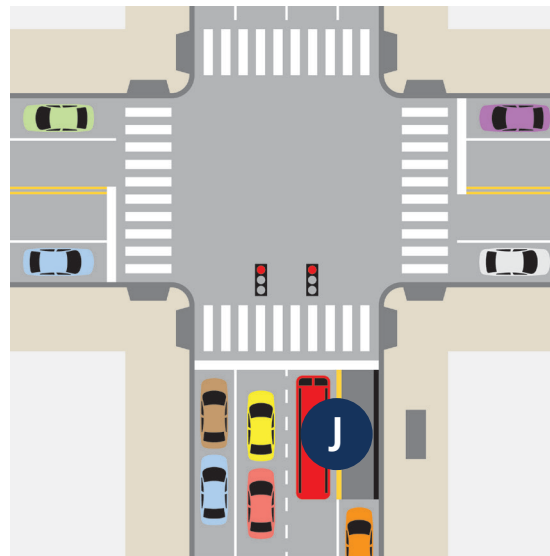
**Reduces
Wait Time**



**Improves
Rider Access**



**Improves
Rider Safety**



Space:

- Minimum length: 42' (fits a 40' bus)
- Preferred length: 62' (fits a 60' bus)

Consider:

- Bus stops with high ridership or with many riders with disabilities
- Roadways with curbside parking to expand into

Cost:



Space:

- Minimum length: 50' (for one 40' bus)
- Preferred length: 140' (for two 60' buses)

Consider:

- Bus stops with high ridership or with many riders with disabilities
- Roadways with curbside parking to expand into

Cost:



K. PERMANENT CURB EXTENSION

Permanent curb extensions allow buses to serve bus stops faster by picking up and dropping off riders without having to pull over to the curb.

Function

Similar to a temporary curb extension, this tool eliminates the need for buses to wait for a break in traffic to merge back from a bus stop and continue traveling. But unlike a temporary curb extension, this tool provides a permanent space for a bus shelter and other bus stop amenities.

Applications

This tool is useful along roadways that have more than one travel lane in the same direction: if the bus stops in one travel lane to serve a bus stop, vehicles can still use the other travel lane to pass. Curb extensions also improve wheelchair accessibility since bus stops without them may not always have enough space for buses to fully pull over and deploy ramps.

Cost Considerations

Permanent curb extensions are significantly more expensive than temporary ones since they require reconstructing curbs and sidewalks, and potentially even relocating storm drain inlets. However, their long-term benefits are greater since they provide permanent waiting, shelter, and amenity space.

Benefits



**Reduces
Travel Time**



**Reduces
Dwell Time**



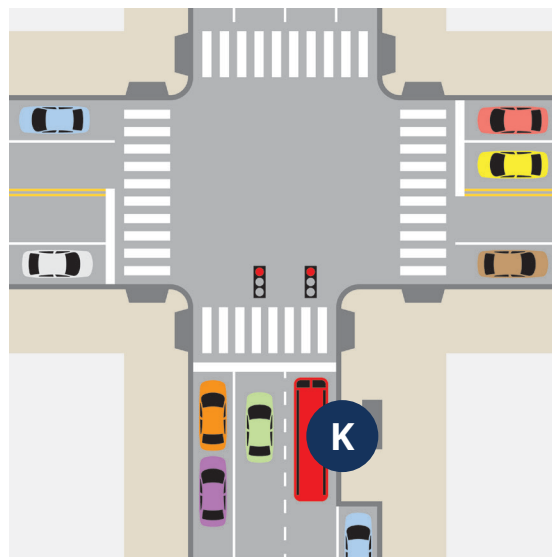
**Reduces
Wait Time**



**Improves
Rider Access**



**Improves
Rider Safety**



L. FARSIDE BUS STOP

Unlike nearside bus stops, farside bus stops allow buses to pick up and drop off riders *after* crossing an intersection. They are becoming common prerequisites for efficient queue jumps and transit signal priority (TSP).

Function

While farside bus stops are vulnerable to blockages from illegally parked vehicles, they are more efficient than nearside bus stops: buses can pass through a traffic light *before* picking up and dropping off riders, and buses can depart the stops without waiting for the lights behind them.

As described earlier, this tool's benefits increase when it is paired with queue jumps or TSP: if repeated across multiple bus stops and intersections, the small time savings at each bus stop and intersection may add up to significant time savings along the entire length of the bus route.

Applications

This tool is best for roadways with wide intersections since buses can block narrow intersections upon stopping, especially if there isn't adequate curbside space for a long bus stop on the far side of the intersection. This tool can be paired with a curb extension (see Tools J and K) to improve rider access and safety.

Cost Considerations

While farside bus stops are not inherently more expensive than nearside stops, any associated queue jumps and TSP can increase their cost. High-volume stops can also benefit from more durable concrete roadway pads.

Benefits



**Reduces
Travel Time**



**Reduces
Dwell Time**



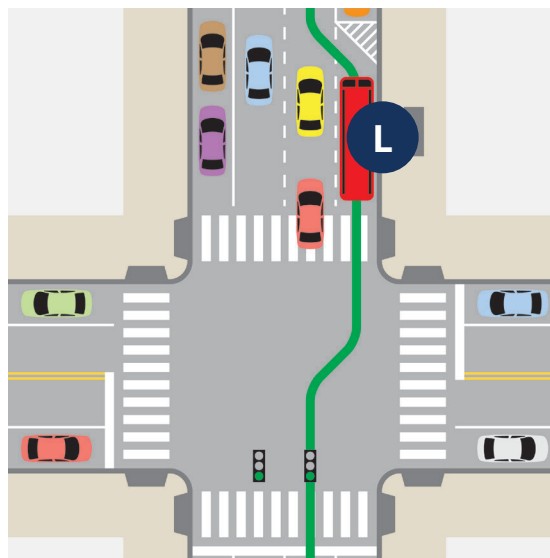
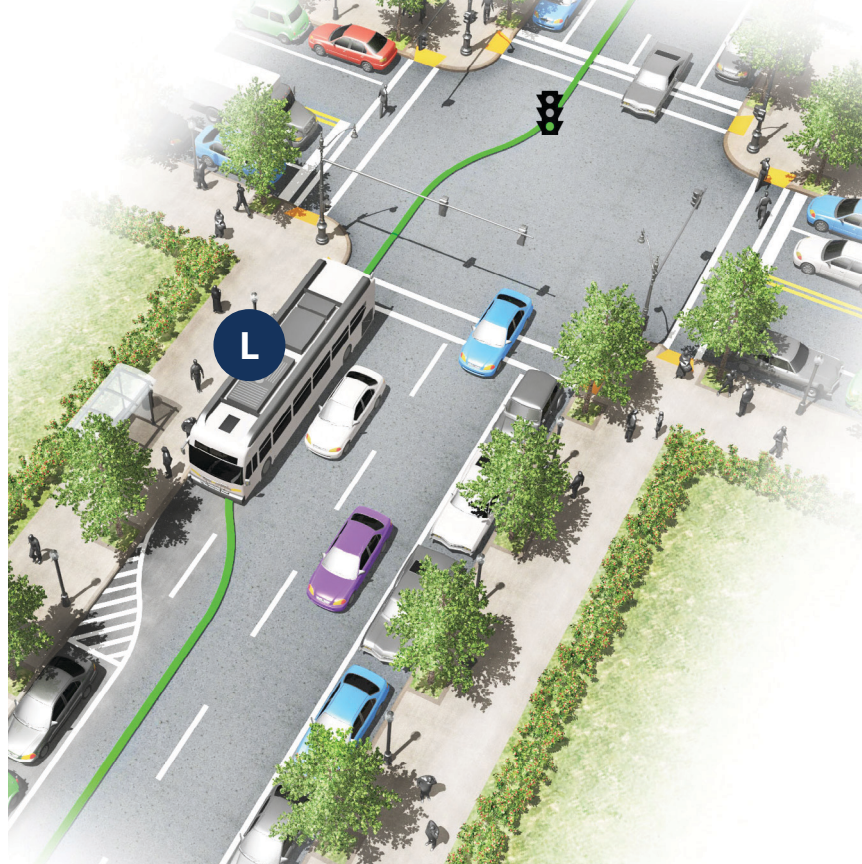
**Reduces
Wait Time**



**Improves
Rider Access**



**Improves
Rider Safety**



Space:

- Minimum length: 70' (to fit at least one 40' or 60' bus)
- Minimum front taper length: 25'

Consider:

- Signalized intersections with long signal cycles
- Transit signal priority or queue jump at preceding intersection

Cost:



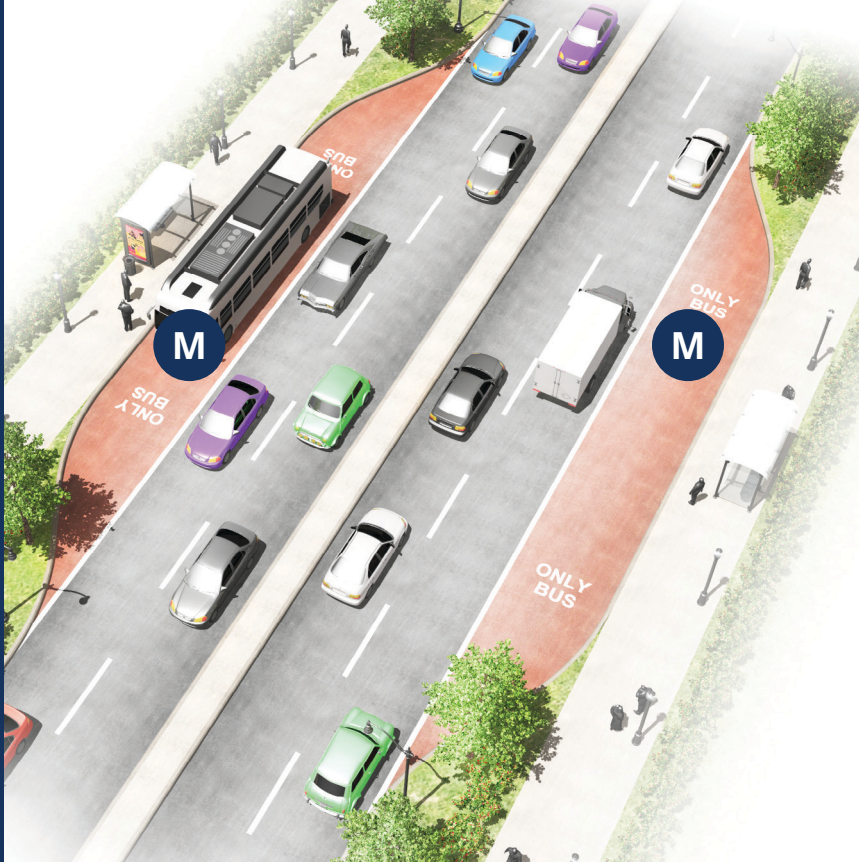
Space:

- Minimum length: 70' (to fit at least one 40' or 60' bus)
- Minimum front taper length: 25'
- Minimum rear taper length: 50'

Consider:

- Bus stops with high ridership or with many riders with disabilities
- Bus stops with layovers

Cost:



M. PULLOUT BUS STOP

Pullout bus stops allow buses to leave the travel lane to pick up and drop off riders. After serving the stop, buses merge back into the travel lane.

Function

Pullout bus stops minimize bus routes' impact to through traffic, but at a cost to dwell and travel times: buses will lose time waiting for a break in traffic to merge back from the bus stop and continue traveling.

Applications

Despite the operational disadvantage above, these stops are useful in locations where better rider access is necessary — for example, at high-ridership stops or stops serving high proportions of riders with disabilities. They are useful at stops where headway-managed buses need to pause and wait to disperse, or where buses need to lay over without impacting through traffic. On corridors with overlapping local and limited-stop buses, they also allow limited-stop buses to pass local buses.

Cost Considerations

The cost for these stops can vary widely depending on the context: in locations where the pullout stop is inset into a curbside parking lane, only signage and marking are typically necessary. Locations where the pullout stop needs to cut into the curbside grass or sidewalk require the more costly reconstruction of curbs, concrete roadway pads, and adjacent sidewalks.

Benefits



Reduces
Travel Time



Reduces
Dwell Time



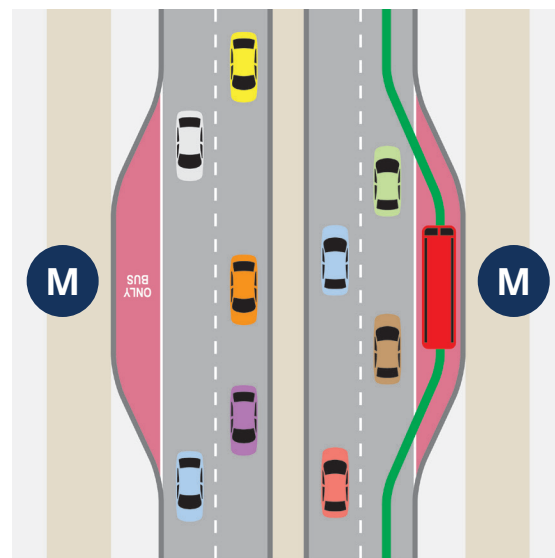
Reduces
Wait Time



Improves
Rider Access



Improves
Rider Safety



N. TEMPORARY FLOATING BUS STOP

Temporary floating bus stops allow buses to pick up and drop off riders without having to pull over into a bike lane and pose a safety risk for cyclists.

Function

By separating the bus stop from the bike lane, this tool improves cyclist safety and provides more space for waiting riders. Since riders still need to cross the bike lane to travel between the bus stop and sidewalk, cyclists must be alert when approaching and passing temporary floating bus stops: the stop's "bump up" pathway is designed to alert cyclists of crossing riders.

Applications

This tool is useful along roadways that have protected or offset bike lanes. A temporary floating bus stop can also effectively serve as a curb extension (see Tools J and K) if it is built out into the parking lane.

Cost Considerations

Temporary floating bus stops are similar to temporary curb extensions: they are made of heavy rubberized plastic, they contain a "bump up" pathway for cyclists, and they can be dropped in place at existing bus stops. They can serve as "pilot" experiments before committing to more expensive permanent floating bus stops (see Tool O).

Benefits



**Reduces
Travel Time**



**Reduces
Dwell Time**



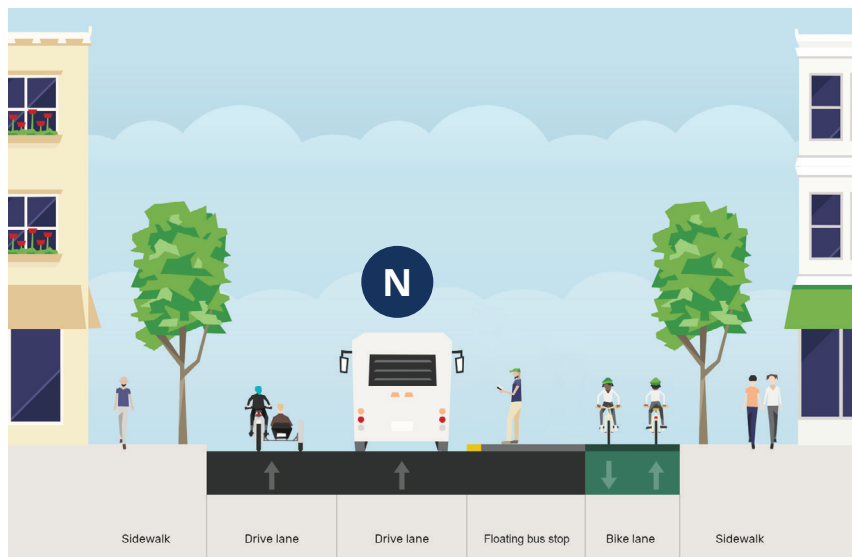
**Reduces
Wait Time**



**Improves
Rider Access**



**Improves
Rider Safety**



Space:

- Minimum length: 42' (fits a 40' bus)
- Preferred length: 62' (fits a 60' bus)

Consider:

- Bus stops adjacent to protected or offset bike lanes
- Roadways with curbside parking to expand into

Cost:



Space:

- Minimum length: 50' (for one 40' bus)
- Preferred length: 140' (for two 60' buses)

Consider:

- Bus stops adjacent to protected or offset bike lanes
- Roadways with curbside parking to expand into

Cost:



O. PERMANENT FLOATING BUS STOP

Permanent floating bus stops allow buses to pick up and drop off riders without having to pull over into a bike lane and pose a safety risk for cyclists.

Function

Similar to a temporary floating bus stop, this tool separates the bus stop from the bike lane, improving cyclist safety but also providing a permanent space for a bus shelter and other bus stop amenities. Since riders still need to cross the bike lane to travel between the bus stop and sidewalk, cyclists must be alert when approaching and passing permanent floating bus stops: signage and surface treatments can help alert cyclists.

Applications

This tool is useful along roadways that have protected or offset bike lanes. A permanent floating bus stop can also effectively serve as a curb extension (see Tools J and K) if it is built out into the parking lane.

Cost Considerations

Permanent floating bus stops are significantly more expensive than temporary ones since they require reconstructing curbs and roadways, and potentially even relocating storm drain inlets. However, their long-term benefits are greater since they provide a firm footing for bus shelters.

Benefits



**Reduces
Travel Time**



**Reduces
Dwell Time**



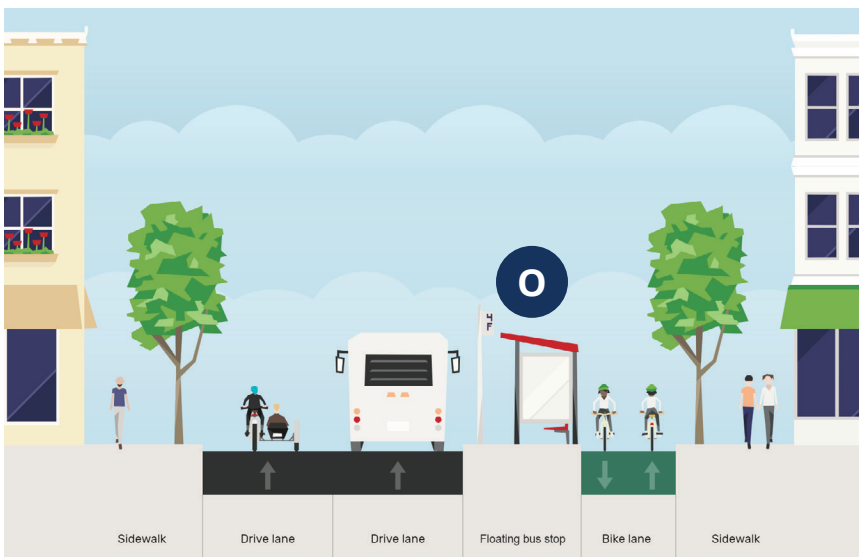
**Reduces
Wait Time**



**Improves
Rider Access**



**Improves
Rider Safety**



P. SIDE-BOARDING MEDIAN BUS STOP

Side-boarding median bus stops allow riders to access bus medians or busways (see Tools E and F) and are positioned on the sides of the bus lanes.

Function

While riders must cross the roadway's general travel lanes to access these stops, they offer dedicated shelter and amenity space for waiting riders separated from any conflicting activities on the nearby sidewalks. These stops also allow buses to pick up and drop off riders without interference from other roadway traffic.

Applications

These stops are needed to access median bus lanes, otherwise, buses would need to leave the median to serve curbside bus stops. By eliminating that need, side-boarding median bus stops reduce bus dwell and travel times.

Cost Considerations

These stops are costly; they require significant reconstruction of the roadway and intersections, even in situations where medians can be reused. Rebuilt intersections require pedestrian infrastructure between the stops and the curbside sidewalks. These stops also require barriers separating them from the surrounding traffic, improving riders' and pedestrians' safety.

Benefits



**Reduces
Travel Time**



**Reduces
Dwell Time**



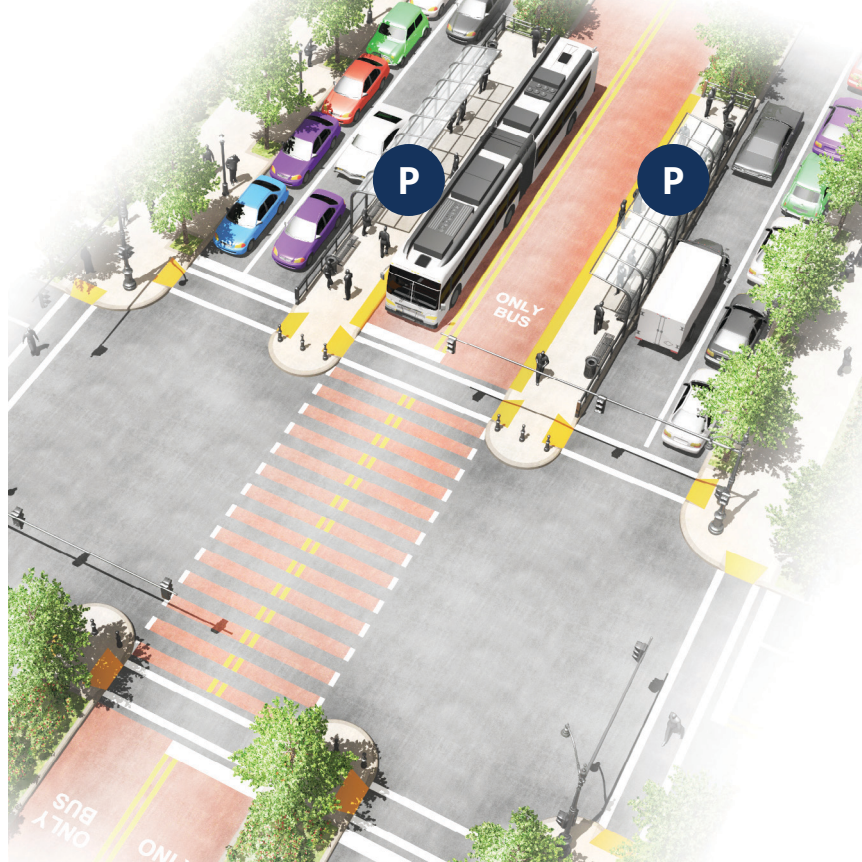
**Reduces
Wait Time**



**Improves
Rider Access**



**Improves
Rider Safety**



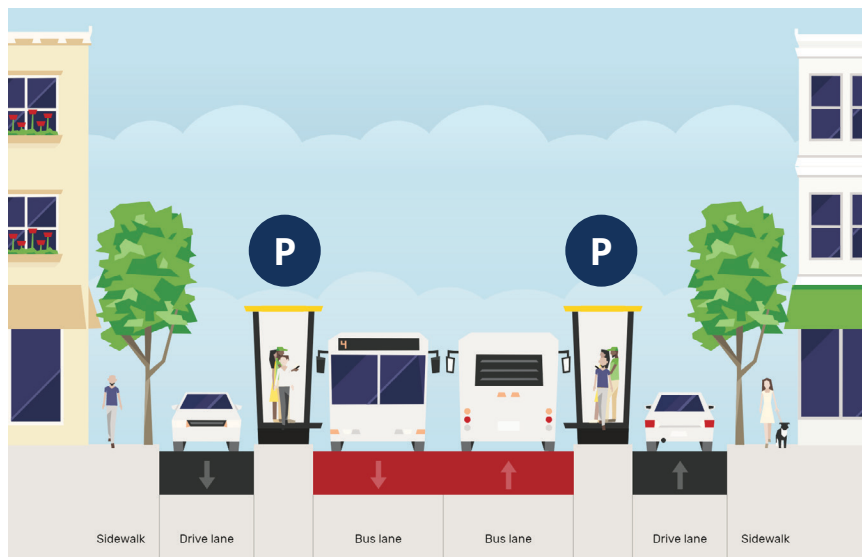
Space:

- Minimum length: 50' (for one 40' bus)
- Preferred length: 140' (for two 60' buses)
- Minimum width: 8' ea. (room for wheelchair boarding)
- Preferred width: 12' ea.

Consider:

- Median bus lanes

Cost:



Space:

- Minimum length: 50' (for one 40' bus)
- Preferred length: 140' (for two 60' buses)
- Minimum width: 8' (room for wheelchair boarding)
- Preferred width: 12'

Consider:

- Median bus lanes

Cost:



Q. CENTER-BOARDING MEDIAN BUS STOP

Center-boarding median bus stops allow riders to access bus medians or busways (see Tools E and F) from the middle of the bus lanes, allowing riders to access buses traveling in both directions from a single platform.

Function

While riders must cross the roadway's general travel and bus lanes to access these stops, they offer dedicated shelter and amenity space for waiting riders separated from any conflicting activities on the nearby sidewalks. These stops also allow buses to pick up and drop off riders without interference from other roadway traffic.

Applications

These stops are needed to access median bus lanes, otherwise, buses would need to leave the median to serve curbside bus stops. By eliminating that need, center-boarding median bus stops reduce bus dwell and travel times.

Cost Considerations

These stops require less construction than side-boarding median bus stops since a shared platform can serve buses in both directions. However, shared platforms require buses with dual-side doors. Offset platforms — one platform on each side of the intersection serving separate directions — can save space and are compatible with buses with standard right-side doors.

Benefits



**Reduces
Travel Time**



**Reduces
Dwell Time**



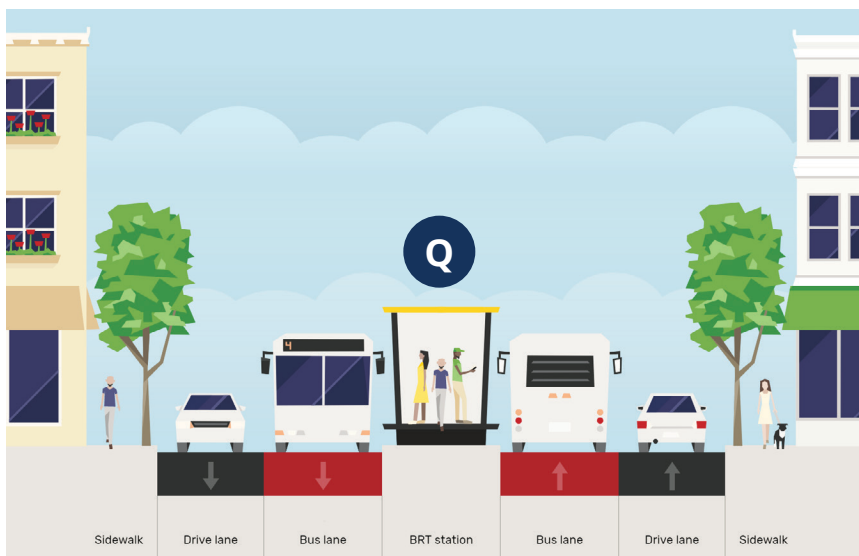
**Reduces
Wait Time**



**Improves
Rider Access**



**Improves
Rider Safety**



R. LEVEL BUS STOP

Level bus stops allow riders to get on and off buses without having to step up or down from the sidewalk, and they reduce the horizontal gap between the curb and the bus doors. The surface height of the raised bus stop matches the surface height of the bus floor, which also makes wheelchair ramp deployment and wheelchair maneuvering easier.

Function

This tool is typically built to a surface height higher than the surrounding sidewalk to accommodate the operation described above.

Due to modern low-floor bus technology, however, these stops do not need to be raised as high as most metro, light rail, or commuter rail platforms: typically only an additional several inches of raised height are needed.

Applications

This tool works best at high-volume bus stops and bus stops that serve high proportions of riders with disabilities. The time it takes for riders to step up and step down from buses contributes to their “dwell time,” so reducing this time can improve a bus route’s speed and efficiency.

Cost Considerations

Raising bus stop surfaces is expensive, especially if sidewalk space is limited. The raised waiting area requires an ADA-compliant ramp and railings, and pouring the raised concrete bed may require relocating posts, grates, utility covers and openings, and other surface obstacles.

Benefits



**Reduces
Travel Time**



**Reduces
Dwell Time**



**Reduces
Wait Time**



**Improves
Rider Access**



**Improves
Rider Safety**



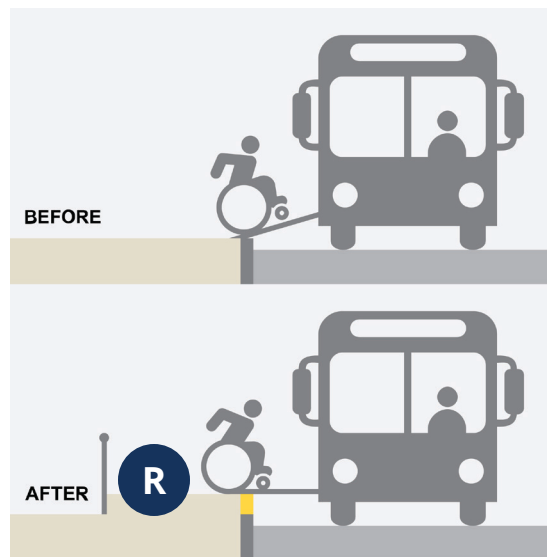
Space:

- Minimum length: 50' (for one 40' bus)
- Preferred length: 140' (for two 60' buses)
- Minimum width: 8' (room for wheelchair boarding)
- Preferred width: 12'

Consider:

- Bus stops with high ridership or with many riders with disabilities

Cost:



Space:

- Minimum ADA-compliant crosswalk width: 4'

Consider:

- Suburban roadways with long distances between intersections, or long urban blocks that impede easy crossing
- Roadways lacking signalized intersection crosswalks

Cost:



S. FLASHING PEDESTRIAN CROSSING

Flashing pedestrian crossings, commonly known as "HAWKS" (High-Intensity Activated Crosswalk Beacons) or "RRFBs" (Rectangular Rapid Flashing Beacons), enable pedestrians to cross roadways in locations lacking conventional signalized intersection crosswalks.

Function

Flashing crossings may contain pedestrian sensors or push buttons that activate flashing lights to alert approaching vehicles of pedestrians. They may also contain raised crosswalks to slow drivers down and refuge medians to encourage pedestrians to cross roadways at right angles for maximum visibility.

Applications

Flashing crossings improve access to bus stops on long city blocks by providing convenient midblock crossing points. They are also useful on suburban roadways that contain few signalized intersection crosswalks. By providing safe crossing points for bus riders, flashing crossings enable *bidirectional* access to bus stops, improving their bus routes' efficiency.

Cost Considerations

Flashing crossings are less expensive than conventional signalized intersection crosswalks, but they still require a moderate amount of investment for any medians, ADA-compliant curb ramps, raised crosswalks, and beacons.

Benefits



Reduces
Travel Time



Reduces
Dwell Time



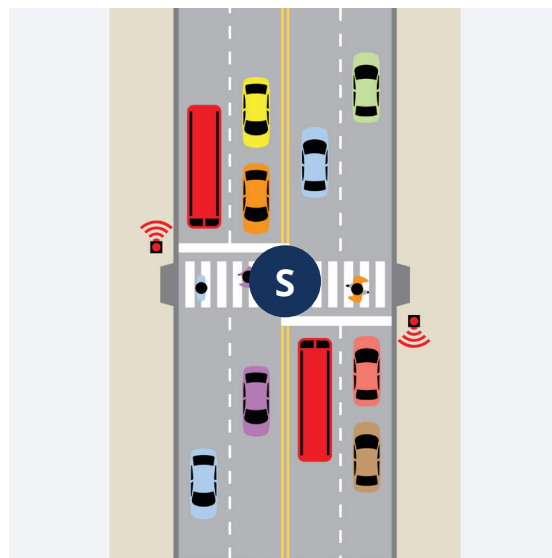
Reduces
Wait Time



Improves
Rider Access



Improves
Rider Safety



T. BUS STOP OPTIMIZATION

Bus stop optimization is the process of adding, removing, or relocating bus stops along a bus route to improve its speed, reliability, and efficiency.

Function

A bus route that stops on every block significantly slows buses down even if the bus stops provide good access for riders. In other locations bus stops may be spaced too far apart, or may be spaced inconsistently, both of which provide poor access for riders. Optimization is the process of re-spacing bus stops consistently while maintaining good access for riders.

Applications

Bus routes that contain closely-spaced stops inherited from streetcar routes, or that have accumulated inconsistent stop spacing from years of piecemeal, ad-hoc stop removals or additions are good candidates for optimization.

Cost Considerations

This tool seldom requires new resources, which are needed only in locations where stops need to be added or moved. However, the resources saved or pulled from discontinued bus stops should be redistributed to the remaining bus stops: optimization is an opportunity to improve the condition of remaining bus stops by adding shelters, benches, and other amenities.

Benefits



**Reduces
Travel Time**



**Reduces
Dwell Time**



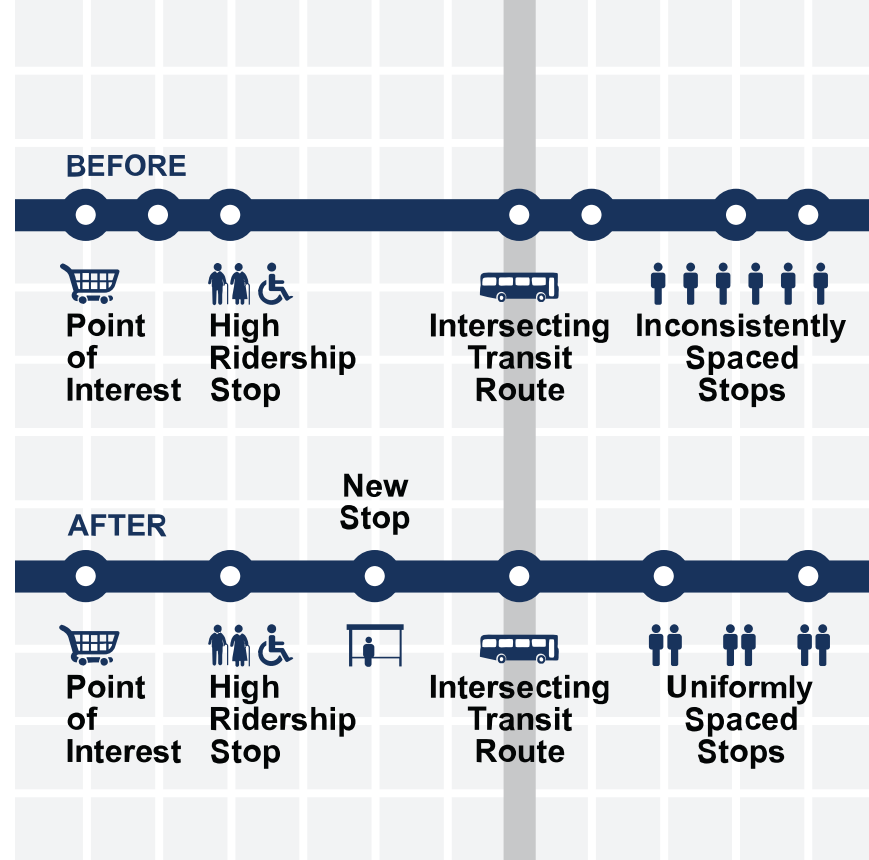
**Reduces
Wait Time**



**Improves
Rider Access**



**Improves
Rider Safety**



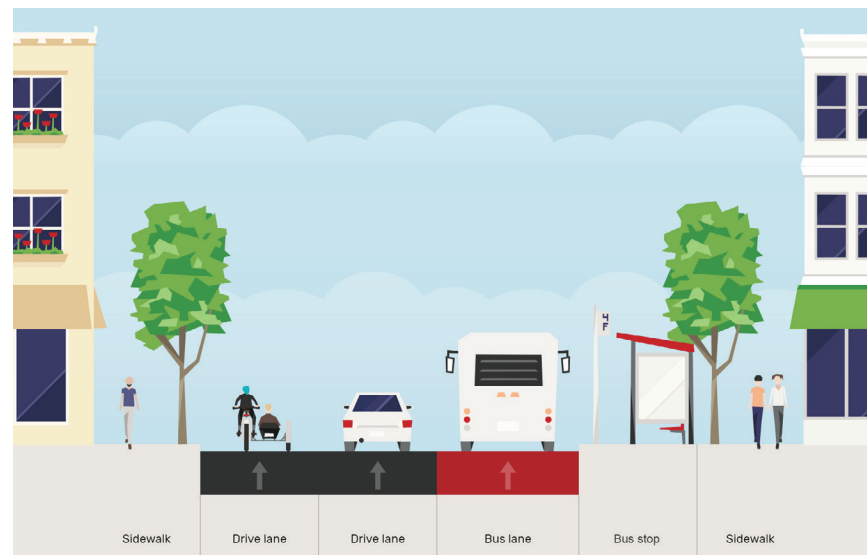
Space:

- N/A (space will vary depending on whether stops are added or removed)

Consider:

- Bus stops spaced only one block apart
- Bus stops spaced too far apart
- Inconsistent bus stop spacing

Cost:





BIKE PRIORITY TOOLS

These tools apply not only to bikes, but also to emerging micromobility technologies such as e-bikes, e-scooters, and other personal mobility devices.

U. CURBSIDE BIKE LANE

Curbside bike lanes improve cyclist safety by allowing them to travel in dedicated lanes separated from moving vehicles.

Function

This tool typically repurposes a roadway's curbside (right side) parking or travel lane for cycling. Curbside bike lanes can be painted green to distinguish them from general travel lanes, and depending on the amount of space allocated, they can be either one-way or two-way.

A curbside bike lane is vulnerable to blockage from illegally parked vehicles (particularly from delivery vehicles), especially if it replaced a curbside parking lane. Raised curbs, raised domes, bollards, or water-filled barricades discourage vehicles from entering or parking in the bike lane and improve cyclist safety and comfort.

Applications

These lanes work best as a network, providing a safe and comfortable environment for cyclists at all experience levels, particularly on higher-speed and higher-volume roadways.

Cost Considerations

These lanes typically only require restriping and painting of existing roadway space, which makes them cost-effective. Repaving is not typically necessary. There are also minor costs for procuring and installing any buffers (raised curbs, raised domes, bollards, or water-filled barricades).

Benefits



**Reduces
Pedestrian
Conflicts**



**Reduces
Vehicle
Conflicts**



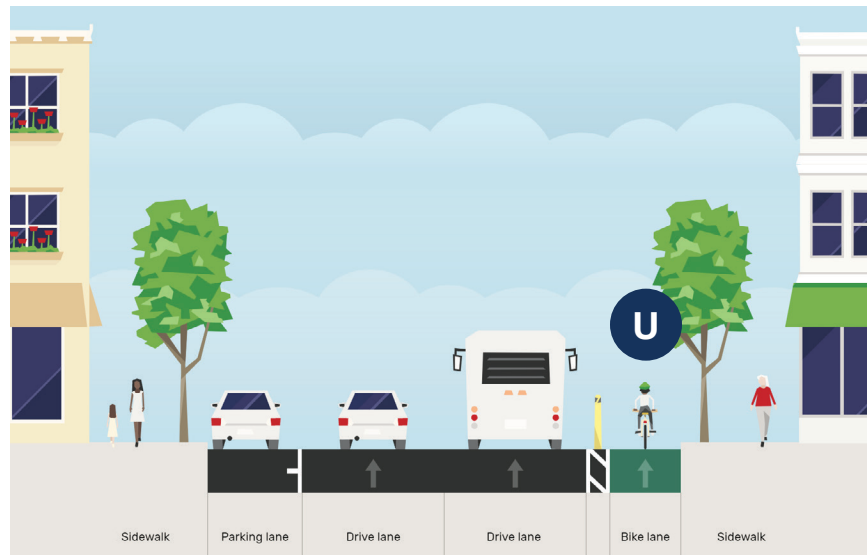
**Improves
Cyclist
Visibility**



**Improves
Cyclist
Access**



**Improves
Cyclist
Safety**



Space:

- Minimum width: 3' to 4'
- Preferred width: 5' to 6'

Consider:

- Roadways with 3,000 or more vehicles per day
- Roadways with speed limits of 25 mph or more
- Roadways with high bus or truck traffic

Cost:



Space:

- Minimum width: 5'
- Preferred width: 6'

Consider:

- Roadways with 3,000 or more vehicles per day
- Roadways with speed limits of 25 mph or more
- Roadways with high bus or truck traffic

Cost:



V. OFFSET BIKE LANE

Offset bike lanes improve cyclist safety by allowing them to travel in dedicated lanes separated from parked and moving vehicles.

Function

These lanes are placed between a roadway's parking and general travel lanes. They can be painted green to distinguish them from the parking and general travel lanes, and they must be of sufficient width to minimize "dooring" from people entering or exiting parked vehicles.

Vehicles must cross these lanes to park, which can pose a safety risk to cyclists from inattentive drivers. Since vehicles must cross these lanes to park, raised curbs, raised domes, bollards, or water-filled barricades typically cannot be deployed, which in turn makes these lanes vulnerable to blockage from illegally parked vehicles, particularly from delivery vehicles.

Applications

These lanes work best as a network, providing a safe and comfortable environment for cyclists at all experience levels, particularly on higher-speed and higher-volume roadways.

Cost Considerations

These lanes typically only require restriping and painting of existing roadway space, which makes them cost-effective. Repaving is not typically necessary.

Benefits



**Reduces
Pedestrian
Conflicts**



**Reduces
Vehicle
Conflicts**



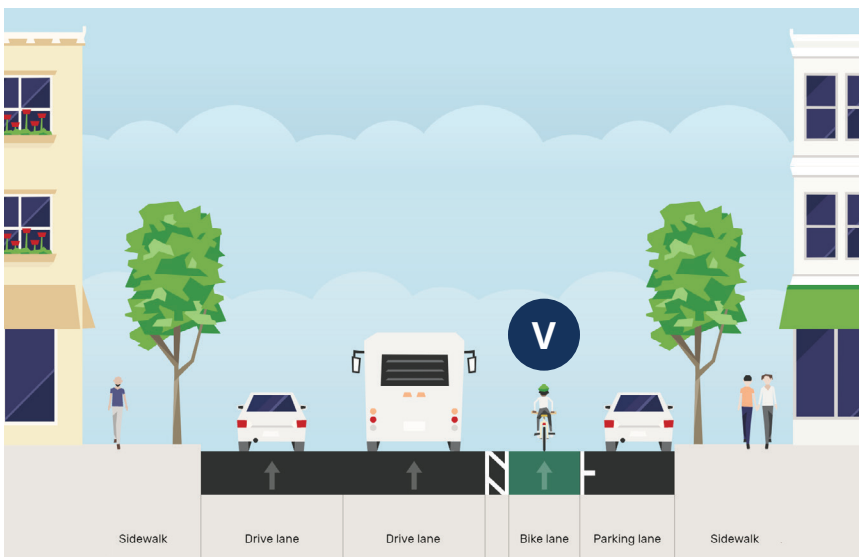
**Improves
Cyclist
Visibility**



**Improves
Cyclist
Access**



**Improves
Cyclist
Safety**



W. PROTECTED BIKE LANE

Protected bike lanes attempt to reduce the cyclist safety risks of offset bike lanes by moving those lanes adjacent to the roadway curb.

Function

Rather than placing the bike lane between a roadway's parking and general travel lanes, protected bike lanes use the parking lane to buffer and protect cyclists from traffic in the general travel lanes. The buffer can be composed of raised curbs, raised domes, bollards, or water-filled barricades.

These lanes can be painted green and can be one-way or two-way depending on the amount of space allocated. Two-way lanes must be wide enough to allow cyclists traveling in opposite directions to safely pass each other.

Applications

These lanes work best on higher-speed roadways on which offset bike lanes are inadequate in reducing cyclists' discomfort with heavy traffic. They are useful in creating connected bike networks and in increasing the cycling mode share, particularly among younger and less experienced cyclists.

Cost Considerations

These lanes require restriping and painting of existing roadway space to indicate the new position of the shifted parking lanes. While repaving is not typically necessary, there are minor costs for procuring and installing any buffers (raised curbs, raised domes, bollards, or water-filled barricades).

Benefits



**Reduces
Pedestrian
Conflicts**



**Reduces
Vehicle
Conflicts**



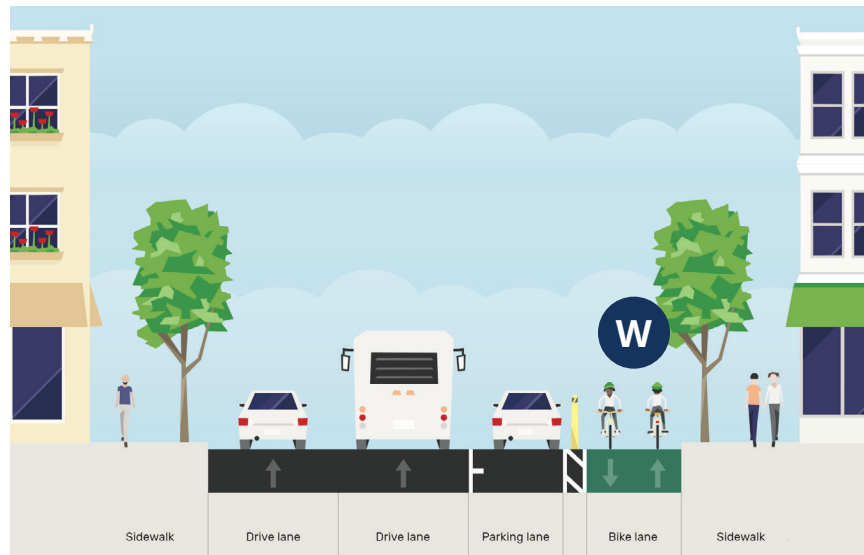
**Improves
Cyclist
Visibility**



**Improves
Cyclist
Access**



**Improves
Cyclist
Safety**



Space:

- Minimum width: 8' (4' per direction)
- Preferred width: 12' (6' per direction)

Consider:

- Roadways with many cyclists
- Roadways with multiple travel lanes, high speeds, high parking turnover, or other stressors for cyclists

Cost:



Space:

- Minimum width: 3' to 4'
- Preferred width: 5' to 6'

Consider:

- Roadways with bus stops
- Roadways with high parking turnover
- Frequent turning vehicles (fewer conflicts with right turns; more visibility for left turns)

Cost:



X. LEFT SIDE BIKE LANE

Left side bike lanes improve cyclist safety by allowing them to travel in dedicated lanes separated from and on the *left side* of moving vehicles, where their visibility among drivers is highest.

Function

By repurposing the leftmost lane of a roadway for cycling, this tool eliminates conflicts between cyclists and parking vehicles in offset bike lanes, as well as conflicts between cyclists and buses in curbside bike lanes, in which buses need to enter the lanes to serve bus stops. Left side bike lanes also position cyclists closer in drivers' sightlines, improving their safety.

Applications

These lanes work best on one-way roadways with significant bus traffic by minimizing conflicts between cyclists, buses, and bus stops. They are also effective on roadways that see a high proportion of left turns: by placing cyclists closer in drivers' sightlines, drivers are more likely to yield to cyclists when making left turns.

Cost Considerations

These lanes typically only require restriping and painting of existing roadway space, which makes them cost-effective. Repaving is not typically necessary. There are also minor costs for procuring and installing any buffers (raised curbs, raised domes, bollards, or water-filled barricades).

Benefits



**Reduces
Pedestrian
Conflicts**



**Reduces
Vehicle
Conflicts**



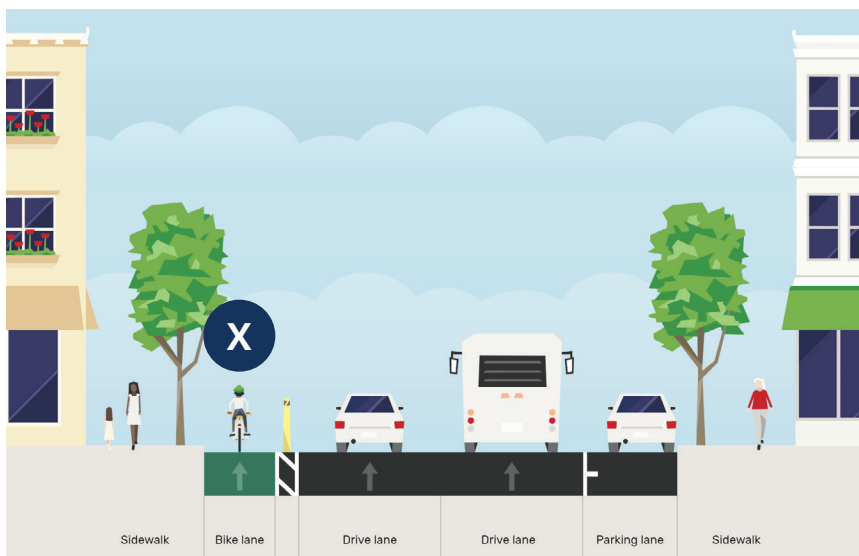
**Improves
Cyclist
Visibility**



**Improves
Cyclist
Access**



**Improves
Cyclist
Safety**



Y. BIKE BOULEVARD

Bike boulevards improve cyclist safety by prioritizing cycling on narrower, quieter roadways with low speed limits, often providing a safer alternative to wider, higher-speed roadways in the area.

Function

Since cyclists and drivers must share the same travel lanes, bike boulevards contain signage and pavement markings called *sharrows* to alert drivers to the presence of cyclists. To slow drivers and improve cyclist safety, traffic calming tools such as narrow lanes, chicanes, intersection diverters, raised crosswalks/intersections, and curb extensions (see Tools J and K) should be applied to the travel lanes.

Applications

Bike boulevards work best on quieter roadways with less than 1,500 vehicles per day, and where prevailing speeds are under 25 mph. Tools U, V, and W are better-suited for busier, faster roadways since cyclists are less comfortable sharing travel lanes with drivers. Not only can a strategic network of bike boulevards help cyclists avoid busier, faster roadways, but bike boulevards also help create quiet neighborhood streets that are more comfortable for children, pets, and other vulnerable groups.

Cost Considerations

While signage and pavement markings (sharrows) are cost-effective, they alone do not improve cyclist safety. The traffic calming tools described above are essential for effective bike boulevards, and their costs can vary widely. For example, it is possible to narrow lanes with simple restriping (cost-effective), or by widening sidewalks to reclaim roadway space (more costly).

Benefits



**Reduces
Pedestrian
Conflicts**



**Reduces
Vehicle
Conflicts**



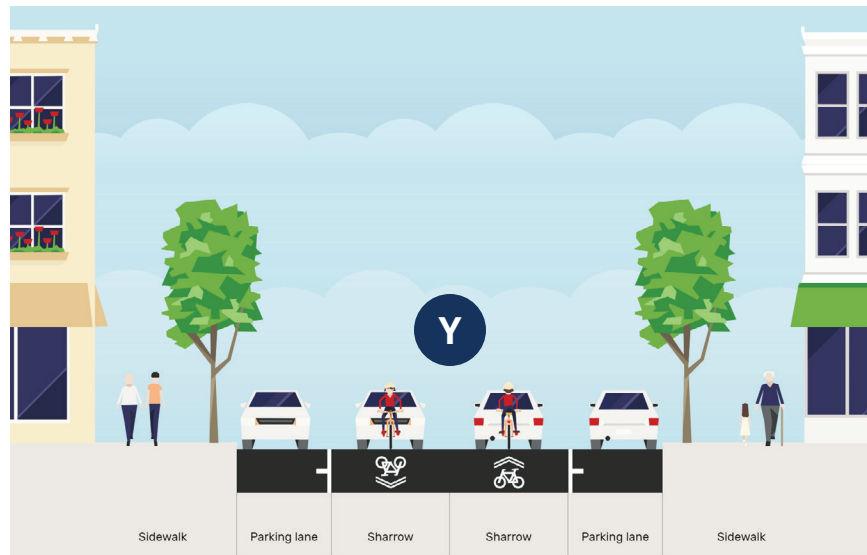
**Improves
Cyclist
Visibility**



**Improves
Cyclist
Access**



**Improves
Cyclist
Safety**



Space:

- Cyclists use a full travel lane marked with sharrows
- Maximum travel lane width of 10' preferred

Consider:

- Roadways with less than 1,500 vehicles per day
- Roadways with prevailing speeds under 25 mph

Cost:



REFERENCES

The information in this toolbox is sourced from a variety of industry publications, primarily from the *Transit Street Design Guide*, *Urban Street Design Guide*, and *Urban Bikeway Design Guide* published by the National Association of City Transportation Officials (NACTO). Additional information on each tool can be found at the links below:

BUS PRIORITY TOOLS

- [Curbside Bus Lane](#)
- [Offset Bus Lane](#)
- [Contraflow Bus Lane](#)
- [Peak-Only Bus Lane](#)
- [Median Bus Lane](#)
- [Busway](#)
- [Bus on Shoulder](#)
- [Queue Jump](#)
- [Transit Signal Priority \(TSP\)](#)

BIKE PRIORITY TOOLS

- [Curbside Bike Lane](#)
- [Offset Bike Lane](#)
- [Protected Bike Lane](#)
- [Left Side Bike Lane](#)
- [Bike Boulevard](#)

BUS STOP TOOLS

- [Temporary Curb Extension](#)
- [Permanent Curb Extension](#)
- [Farside Bus Stop](#)
- [Pullout Bus Stop](#)
- [Temporary Floating Bus Stop](#)
- [Permanent Floating Bus Stop](#)
- [Side-Boarding Median Bus Stop](#)
- [Center-Boarding Median Bus Stop](#)
- [Level Bus Stop](#)
- [Flashing Pedestrian Crossing](#)
- [Bus Stop Optimization](#)

Each NACTO link above has a references section with additional links to research and policy papers, case studies, and transit agency publications with even more detailed information.

This toolkit was prepared for CDTC and CDTA by Foursquare ITP. Section illustrations were prepared with the Streetmix tool.



WELCOME
DOWN
TOWN
ALBANY

STOP

busplus

South Pearl

irida
CDT
NEW LOT 176

905 BUSPLUS
Limited Stop Service

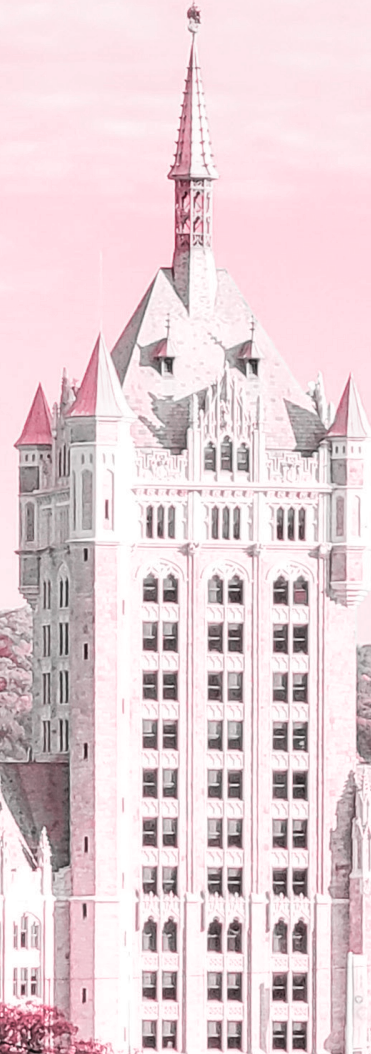
busplus

5605H

01.6217

WELCOME
DOWN
TOWN
ALBANY

FOR
LEASE
458-7113





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