Greater Boston

Bus Priority Toolkit

Better Bus Project

May 2023

Table of Contents

Chapter 1:

Toolkit Overview

Introduction

The Massachusetts Bay Transportation Authority (MBTA) and its partners are industry leaders for their recent accomplishments in bus priority. Since the launch of the MBTA Transit Priority Group in 2019, the MBTA and its municipal and state partners implemented over 17 miles of bus lanes and activated transit signal priority (TSP) at 85 locations. Transit priority improvements are a key component of the MBTA's Better Bus and Bus Transformation projects, which aim to address the equity gap in transit access, improve accessibility and customer experience, and travel times and encourage more transit use. The MBTA's Bus Network Redesign (BNRD), approved in late 2022, charts a vision for a bus network that serves shifting needs of populations across Greater Boston, including updated routes and new high-frequency service. The purpose of the toolkit is to support state agencies and municipalities expand transit priority across the MBTA region.

The toolkit builds off local and national best practices to provide a clear and consistent approach to planning and implementing transit priority treatments. The toolkit summarizes the lessons learned from recent projects, outlining the benefits and tradeoffs of each treatment with detailed and illustrative implementation considerations. The toolkit guides municipal, state, and MBTA staff through each step of the planning and implementation process to streamline coordination and decision-making and to encourage the consistent application of treatments throughout the region.

Figure 1: MBTA Service Area: Graphic of the municipalities included in the MBTA bus service area at the time of publication.

> "I don't have to be guessing when the bus is coming."
>
> *– Columbus Ave bus rider*

Why Bus Priority?

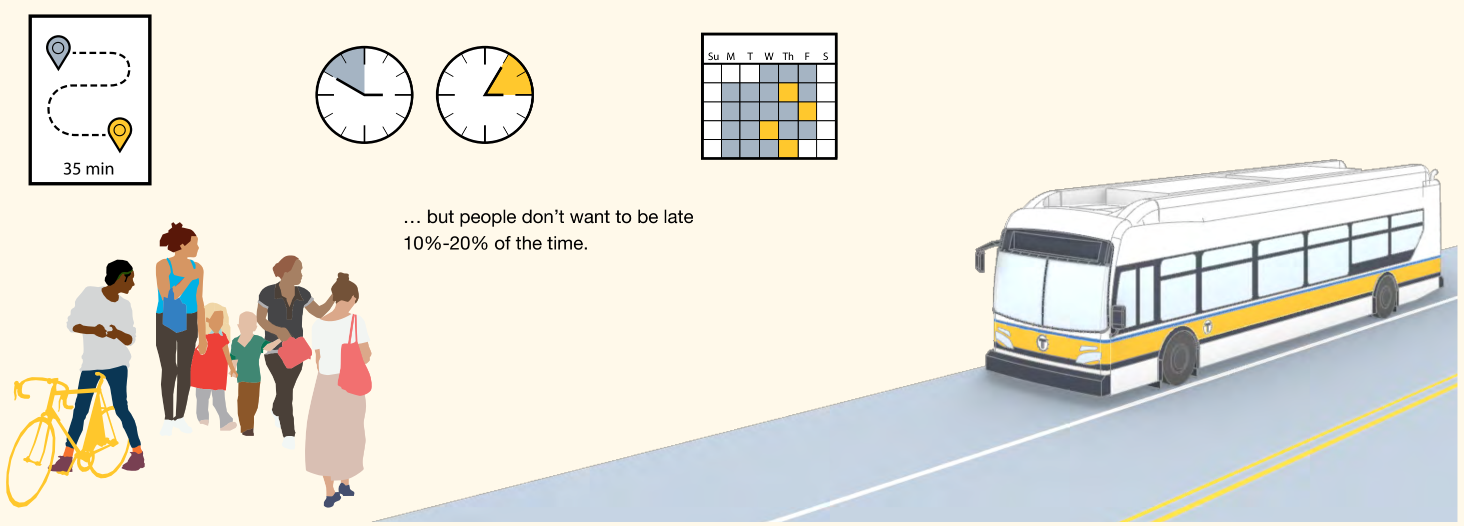
No one likes waiting and wondering if they are going to be late.
Bus travel times can vary, but when those trips take too long, we all feel the consequences.

Schedules are conservative on purpose…

… because people would rather be early than late.

Buses are usually 80%-90% on time…

… but people don't want to be late 10%-20% of the time.

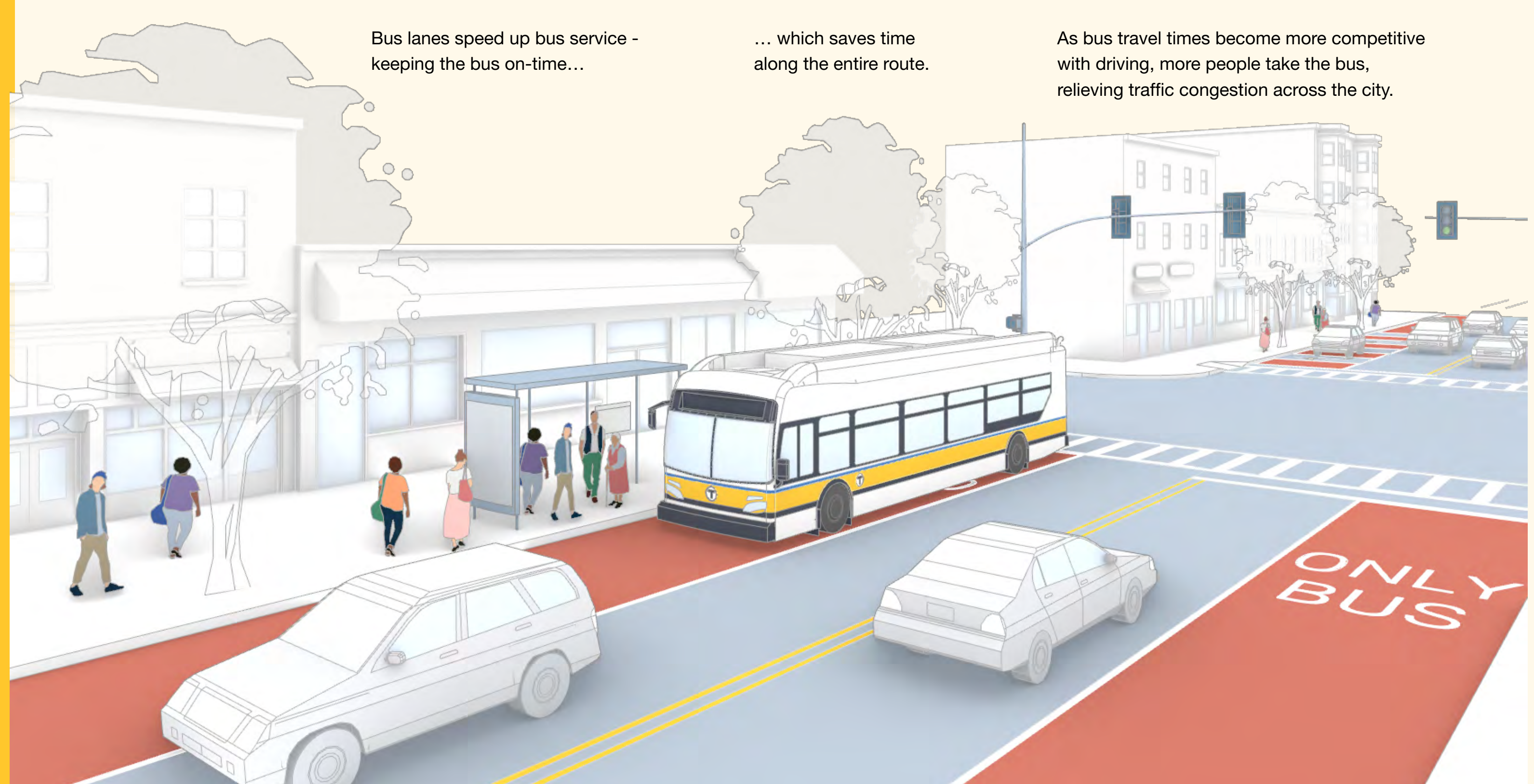


Everyone benefits from bus priority improvements.
Bus priority projects benefit the entire transportation system and everyone who travels through it.

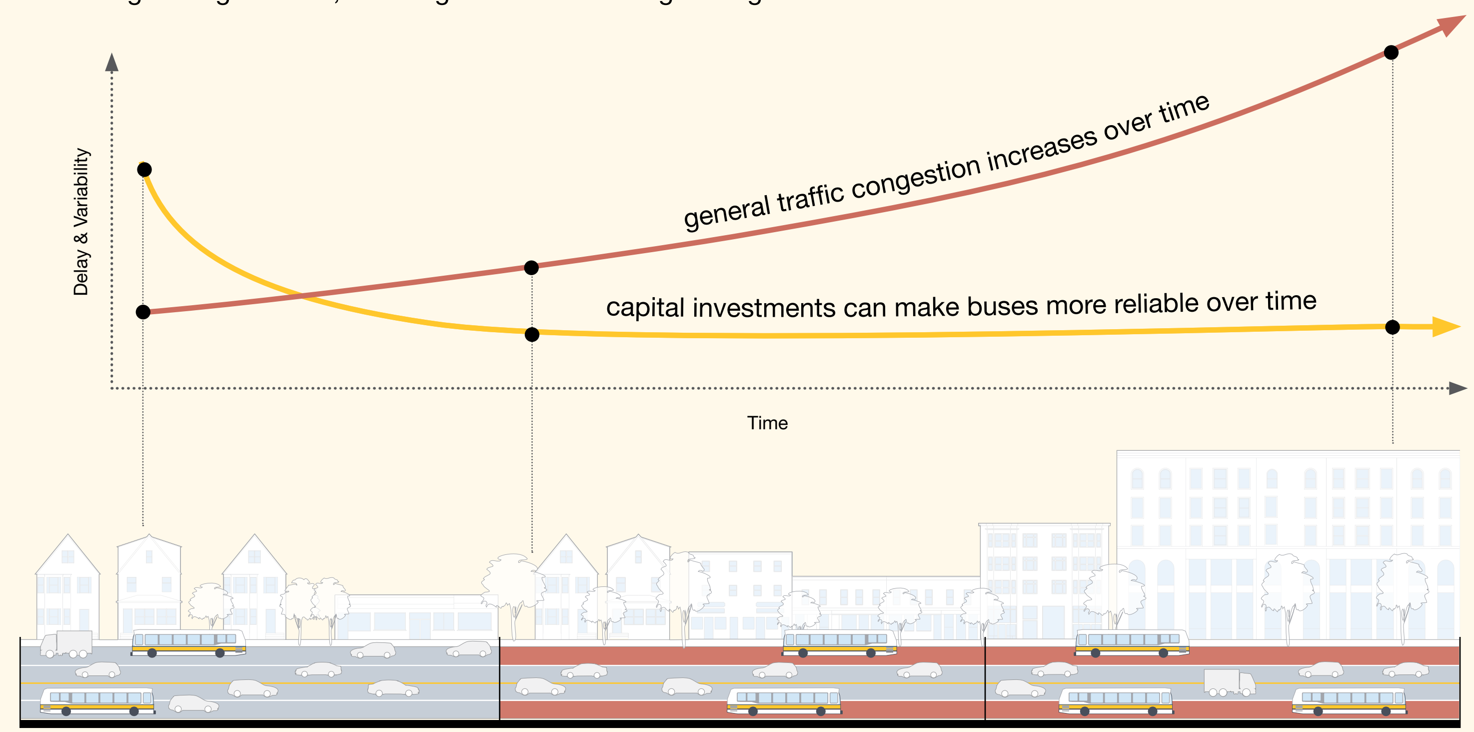
Bus lanes speed up bus service - keeping the bus on-time…

… which saves time along the entire route.

As bus travel times become more competitive with driving, more people take the bus, relieving traffic congestion across the city.



An investment made today will pay off tomorrow.
As our region continues to grow, more trips are made on the roads. Even if these roads are not congested today, over time if transit is not a viable option they will be. Investments in bus priority have long-lasting benefits, ensuring that buses don't get caught in future traffic.



Today

Short-Term Investment

1. **Decreased Travel Times.** Transit priority provides a dedicated space for bus operations, allowing buses to bypass congestion, reducing transit travel times.
2. **Improved Reliability.** With more reliable service riders can be confident their bus will arrive when the schedule says it will.

Long-Term Outcome

3. **Shifting Modes.** If buses are faster and more reliable than other options, they attract more riders and encourage mode shift.
4. **Better Access.** Faster travel times mean you can get to more places within a standard commute time (e.g., jobs within 45 minutes).
5. **Lowered Costs.** Speed and reliability improvements can lead to schedule changes, allowing the MBTA to deliver more service with fewer resources. From the riders perspective, more frequent and reliable service means shorter wait times and fewer consequences for being late.

The Importance of Travel Times and Reliability

Providing fast, reliable, and accessible service is vital to operating an efficient and effective transit system. To make transit a viable and attractive option, transit agencies, municipalities, and state agencies need to collaborate to make improvements to city streets and state roads that improve bus operations and eventually allow transit agencies to enhance service frequency.

For service to be attractive, transit needs to get people where they need to go on time, whether it be work, the grocery store, or healthcare centers, with minimal obstacles. People want to use the fastest, least expensive, most accessible and reliable form of transportation available to them. Faster and more reliable bus service improves the quality of life for todays transit riders and encourages more people to ride transit.

Delayed buses and inconsistent arrival times impact transit schedules and make it difficult for people to depend on transit. People start to buffer time to account for unpredictability when buses are frequently late, or take a different form of transportation altogether. Reducing transit travel times allows the MBTA to offer more efficient and reliable service competitive with other modes of transportation.

Delivering bus speed and reliability improvements requires coordination among MBTA staff, municipalities, and state agencies. This toolkit outlines operational and design treatments proven to deliver more efficient bus service with planning and implementation considerations for the MBTA and partner agencies.

When to Consider Bus Priority Treatments

Bus priority treatments reduce bus travel times, increase reliability, and improve walking and biking paths to transit, which encourages mode shift and transit use, reducing transportation emissions. Municipalities and state agencies can integrate transit priority into a variety of roadway projects, including those with space constraints, frequent delays, and unreliable service.

Municipalities and state agencies should implement bus priority treatments on streets where there are transit delays or where there are other operational conflicts with transit and people walking, biking, rolling, or driving. Repurposing parking or general purpose traffic lanes for transit increases the number of people that can travel on that roadway, and it encourages more transit use as a community grows.

Municipalities and state agencies should coordinate with the MBTA to include transit priority recommendations when updating their community/neighborhood plans, transportations plans, or transit-oriented development plans (TOD). Municipalities and state agencies should also consider transit priority treatments as part of their repaving program or other projects where the roadway is being reconfigured. In addition, municipalities and state agencies can negotiate transit priority treatments in private development plans. The table below lists potential roadway projects and transit priority considerations.

Table 1. Bus Priority Treatment Considerations

Roadway Projects	Transit Priority Treatment Considerations
▶ Regular roadway maintenance or quick-build projects (e.g., restriping, resurfacing)	▶ Dedicated or part-time bus lanes ▶ Bus bulbs ▶ Bus stop accessibility upgrades
▶ Signal infrastructure upgrades and timing changes	▶ Transit signal priority (TSP) ▶ Queue jumps ▶ Leading pedestrian intervals
▶ Intensive street construction	▶ Center-running bus lanes ▶ Median bus platforms ▶ Separated busway ▶ Transit-only street ▶ Fixed guideway ▶ Pedestrian bulb outs and refuge islands ▶ Bus stop accessibility upgrades
▶ Bicycle infrastructure projects	▶ Floating bus stops ▶ Vertical protection (posts, concrete curbing, or parking) ▶ Bike signals and signage

The Project Lifecycle

Implementing bus priority treatments is most effective when the MBTA, local jurisdictions, and other stakeholders follow a common framework. Following this framework allows for consistency among all projects throughout the project lifecycle from project identification to evaluation. This project lifecycle consists of five steps outlined below and in Figure 2 on the following page.

1. **Problem Identification and Diagnosing Travel Time and Reliability Challenges** MBTA staff and municipalities jointly evaluate and monitor existing transit corridors and key performance indicators (KPI's) to assess mobility challenges and needs and identify the causes of transit delays and unreliable service.

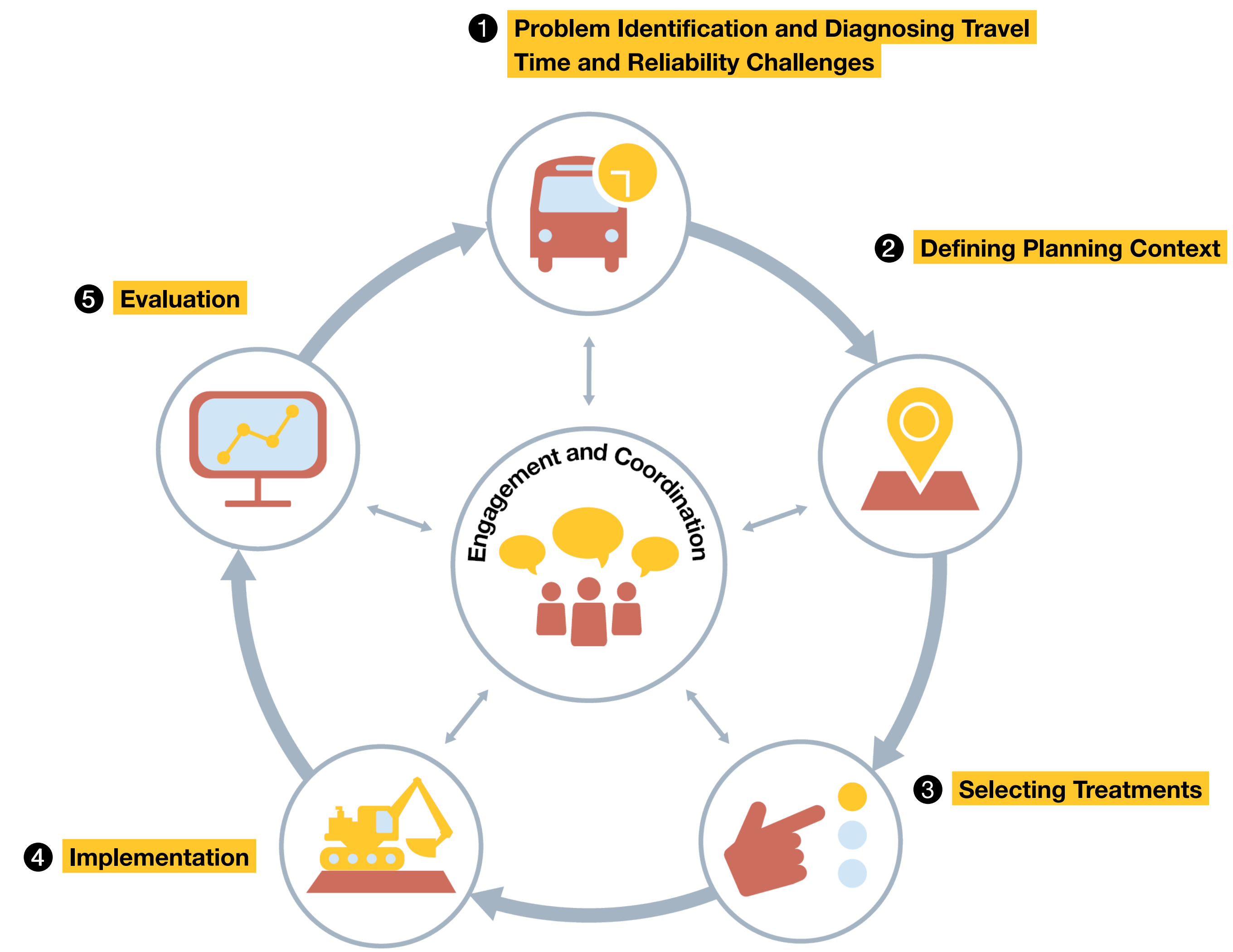
2. **Defining Planning Context** The project lead and MBTA coordinate to define the purpose of the street and develop project goals and objectives consistent with state, regional, and local transportation policy and plans.

3. **Selecting Treatments** The project lead, MBTA, and local decision-makers work jointly to identify potential treatments that would address transit delays and improve overall mobility consistent with project goals and objectives. Treatments are selected with input from local stakeholders and an evaluation criteria.

4. **Implementation** The project lead and MBTA coordinate to establish cost-sharing agreements, construction plans, and traffic and transit reroutes. Construction plans are communicated to adjacent communities for their feedback and awareness.

5. **Evaluation** The project lead and MBTA report out the projects progress against KPI's and use the evaluation criteria to determine if the treatments are achieving their intended objectives. In addition, the project lead should seek feedback from the community on and the evaluation criteria developed jointly use the evaluation criteria developed in beginning project stages to evaluate treatment effectiveness.

Engagement and Coordination: MBTA staff, municipalities, and additional key stakeholders (e.g., advocates, community organizations, elected officials) coordinate and engage with one another throughout the project lifecycle. Who is involved and how is covered in more details in Chapter 6: Planning and Engagement (p. 100).



The Project Lifecycle: This transit priority toolkit was developed to be useful throughout the main steps of the project lifecycle.

Toolkit Audience

This toolkit is primarily designed to help municipalities and MBTA transit staff. However, elected leaders, other public agency staff, transit advocates, and community members should be able to use this document for educational and advocacy purposes.

	MBTA	**State agencies**	**Municipalities**	**Community groups and advocates**	**General public including transit riders**	**Private institutions and business community**	**Elected officials**
About the audience	Develops service plans and route changes, short, medium, and long-term transportation plans, capital plans and budgets, operation and maintenance plans, and in some cases directly manages, designs and implements transit priority projects.	MassDOT, the Department of Conservation and Recreation (DCR), and Massport are responsible for a system of bridges, highways, and roads, that overlap with the MBTA service area.	Primary roadway owner. Addresses community planning and mobility needs and develops funding and planning recommendations. Designs and monitors street projects, coordinates with construction teams, oversees street operations and maintenance activities, and analyzes project viability.	Advocates for safe, reliable, and equitable transit within the community while also sharing information and knowledge within their community and to MBTA and local municipalities.	Community member who lives within the MBTA service area. Intentionally seek perspectives of older adults and people with disabilities.	Local chambers of commerce, Main Street districts, and small business owners.	Influences and approves local development and transportation plans, as well as municipal budgets, and local policy and planning regulations.
How can they use the Bus Priority Toolkit?	Uses toolkit to identify and analyze speed and reliability challenges, and select and implement transit priority treatments—in coordination with municipalities.	Uses the toolkit to better understand how to support transit priority treatments on state-owned rights-of-way (ROW) and in support of state transportation and climate goals.	Uses toolkit to identify the root cause of travel time and reliability challenges, and select transit priority treatments—in coordination with the MBTA.	Uses toolkit to stay informed about the MBTA's approach to transit priority projects and to help advance projects important to their mission forward.	Uses toolkit to stay informed about MBTA decision-making and to prepare for discussions with the local and state agencies about potential projects in the community. Works with local advocates, community groups, and elected officials to advocate for changes.		Uses toolkit to develop projects that address local mobility needs and improve transit speed and reliability—in coordination with municipal staff. Communicates with constituents using toolkit planning and engagement guidance.

In addition, the toolkit is a resource for consultants, nonprofits, and foundations that support the MBTA, local municipalities, and MassDOT on transit priority projects.

Travel Time and Reliability Challenges in Operations and Design

Better bus service requires rethinking street design and the operating environment for buses to reduce transit delays, speed up bus service, and eliminate conflicts with other modes of transportation. Diagnosing transit delay is a key component to improving transit speed and reliability.

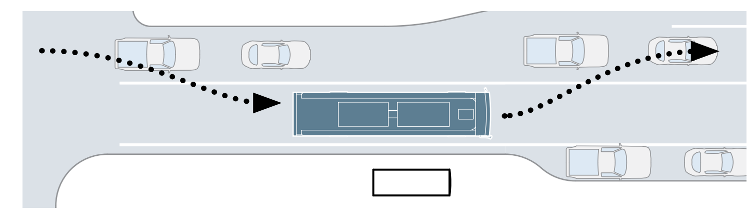
Prior to the pandemic and the expansion of the MBTA bus priority program, buses traveled less than 10 mph during peak periods, and on some routes buses traveled less than 4 or 5 mph—close to the average walking speed. Slow bus service creates a snowballing effect that leads to late buses, crowding, bus bunching, and ultimately leads to frustration and missed appointments for riders. Deteriorating service also disproportionately impacts Black transit riders, who spend on average 64 hours more a year on transit than their white counterparts, according to the Metropolitan Area Planning Council for the Greater Boston Region.

Diagnosing transit delays to select the most effective transit priority treatment is essential to continue to close the equity gap and make bus service more reliable. Transit delays are most commonly due to the following:

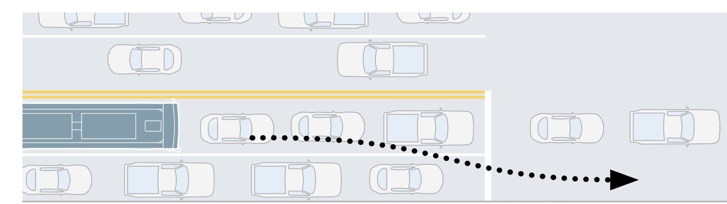
- Congested intersections and streets
- Right and left turn queues
- Heavy curbside loading and unloading activity
- Long boarding times
- Frequent stopping at signals or closely spaced stops
- Traffic signals and double stopping
- Bus stops that are not sufficiently long

While some delays are concentrated during peak-periods, mobility needs and delay type changes throughout the day. It's important for transit agencies and their municipal and state partners to coordinate regularly to review and evaluate data and develop shared solutions.

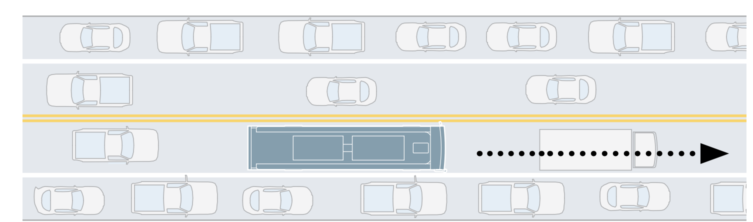
After identifying routes and streets where there are high concentrations of delay it's important to pinpoint exactly where that delay is occurring, whether it be at the intersection, stop, along the length of the street/route, or if it's an alignment issue.



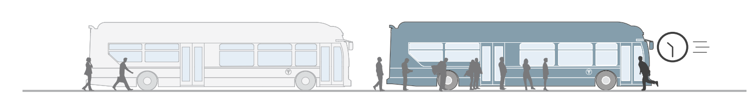
1 **Bus Stops** Delays are caused by the stop location and boarding environment. Treatments should make it easier to access the stop, reduce signal and boarding delays, and provide adequate space and amenities for riders. Bus stops should be long enough so that the ramp deploys to a flat and unobstructed location.



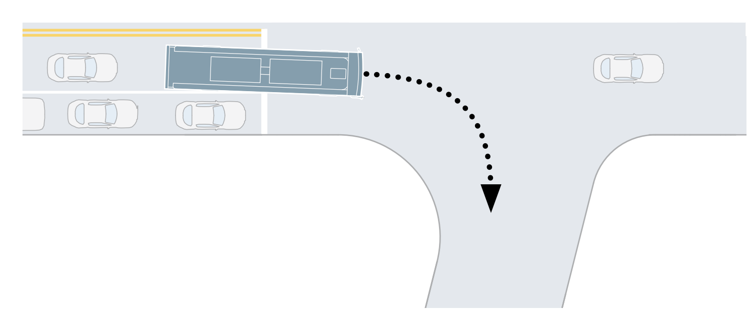
2 **Intersections** Delays are caused by long queues, which is typically due to turning traffic or down or upstream congestion. Treatments should allow buses to bypass slower vehicles and avoid red lights.



3 **Traveling** Delays while traveling are caused by congestion or heavy curbside activity or in many cases both. Treatments should allow buses to bypass traffic and loading/ unloading activities.



4 **Operations** Delays occur when there is a shortage of operators available, a mismatch in scheduling and run times, vehicle failures or safety issues, and deferred maintenance. This can exacerbate speed and reliability issues.



5 **Route Design** Routing decisions influence how often delays occur. Route design factors that most affect bus travel times include route conditions (traffic, walking, and biking environment, and adjacent land use), route length, stop spacing, the number of turns, and the turning radii.

Diagnosing Travel Time and Reliability Challenges

Municipalities can use transit key performance indicators (KPIs) identified as part of the MBTA's Service Delivery Policy (SDP), data from previous studies and municipal plans, and data collected from public outreach to diagnose travel time and reliability challenges. Some key tools and data used to identify where these challenges occur are discussed below and summarized in the table on the next page.

- **Transit data and KPIs** are the most readily available information to monitor performance. Transit data allows planners to analyze trends and compare routes within the MBTA system. Quantitative KPIs, such as ridership, run times, and on-time performance, help identify under-performing routes and prioritize route improvement plans. In addition, qualitative transit data, such as transit rider complaints and on-board survey results, can highlight operational blind spots. Municipalities can also use the MBTA's Plan for Accessible Transit Infrastructure data to prioritize remediating barriers to access at existing bus stops.
- **Municipal plans and previous studies** include collected data that may affect bus travel times such as congestion levels, population density, land uses, and growth projections, which help reveal opportunities for transit priority investments within the service region.
- **Data collection** informs travel time and reliability inquiries. This collection may include personal observations, field work, and outreach that observes operating conditions to assess first-hand experiences, including how transit interacts with people who bike, walk, and drive. In addition, this can include community outreach to evaluate why people do or do not ride transit and their sentiments about the quality of service.

The Bus Network Redesign Transit Priority Plan was developed to show where transit priority will best support the BNRD. Analysis of BNRD service frequency, existing bus and passenger delay, and speed and runtime variability was used to identify corridors where transit priority will help achieve the service and reliability vision for the new network. A Transit Criticality score was given to each segment to help roadway owners prioritize projects more equitably.

Table 2. Data and Tools Used to Diagnose Travel Time and Reliability Challenges

Type of Data or Tool	Qualitative	Quantitative
▶ Transit data and key performance indicators	▶ Customer satisfaction and complaints ▶ On-board survey results (e.g., purpose of trips)	▶ Ridership (e.g., by trip, route, or stop) ▶ Run times (from stop or timepoint level) ▶ Passenger loads ▶ On-time performance ▶ Travel speeds ▶ Revenue hours ▶ Dwell times ▶ Cost per passenger/hour ▶ Bus frequency/headways
▶ Existing municipal plans and previous studies (e.g., environmental impact studies)	▶ Neighborhood design ▶ Roadway types and hierarchy ▶ Right-of-way (ROW) configurations (e.g., lane widths, sidewalk widths, crossing and curb ramp data)	▶ Travel conditions (e.g., traffic congestion, traffic volume) ▶ Current population and projected population growth ▶ Travel flows ▶ Population density
▶ New data collection (e.g., surveys, charettes)	▶ Community survey (e.g., transit use) ▶ Customer Satisfaction survey	▶ Roadway incidents ▶ Bicycle/pedestrian counts

Chapter 2:

Planning Context

Understanding the Planning Context

Understanding the local planning context is essential to transit priority treatment selection and successful project implementation. Evaluating transit performance in a vacuum could lead agencies to implement treatments that fail to address broader community mobility needs and future transportation goals. This chapter outlines how to determine the local planning context and apply toolkit guidance to successfully deliver transit priority projects.

The chapter is split into five sections:

- Purpose and Community Goals
- Street Design and Right-of-way (ROW)
- Neighborhood Context
- Planning for Buses and Bikes
- Street Categories

Unique Characteristics of the MBTA Service Area

Many streets within the MBTA service area have unique characteristics that result in challenging bus operating environments. Examples include constrained ROW's, curvilinear streets, bus-bike interactions, and on-street and angled parking. These unique characteristics are important considerations when making decisions about transit priority.

Many ROWs in the MBTA service area have constrained ROW. In these environments, it is critical to understand and articulate the community benefits of transit priority, such as increasing person-throughput capacity and improving transit reliability.

Curved streets are hard to navigate in a bus. This can exacerbate speed and reliability issues, making bus priority even more important for riders.

Transit corridors often serve many other purposes, such as freight, loading, and biking connections. In these cases, bus priority measures should aim to reduce conflicts and improve safety and efficiency for all modes.

Purpose and Community Goals

The lead agency should coordinate with the MBTA and local stakeholders to determine the purpose of the street, confirm data sources, and develop an engagement strategy. It's important to understand both current and future conditions for freight, transit, walking, and biking. For example, is it a major freight or transit route? Should it include a future protected bike lane? The lead agency should coordinate with local, regional, and state agencies on upcoming projects that intersect or overlap with the project corridor, as well as review relevant transportation plans and policy and planning regulations.

Community engagement is also critical to understanding corridor mobility challenges and needs. The project lead should engage the community early in the project development process to collect feedback on how mobility on the street could improve and the changes the community would like to see. Project goals and objectives should balance community feedback with local, regional, and state transportation goals.

Improving Bus Operations

Improving transit operations through network and schedule changes is another important goal. Transit development plans help identify neighborhoods with greater need for transit priority based on ridership, passenger volumes, travel times, and reliability (both current and projected).

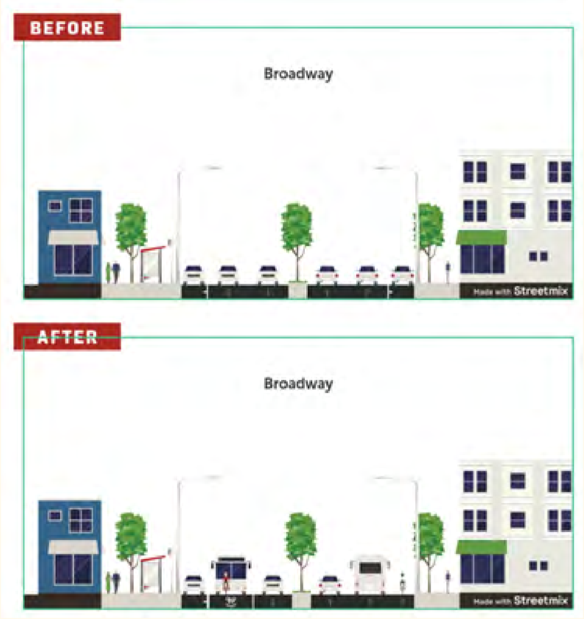
Use the data and tools in Chapter 1 (p. 19) to diagnose travel time and reliability challenges. This will help determine where transit priority will have the greatest impact.

See It in Action: Broadway, City of Somerville (Winter Hill)

In October 2019, the City of Somerville and the MBTA implemented dedicated all-day, bidirectional bus lanes on Broadway between Magoun Square and McGrath Highway. These lanes shortened travel times for bus routes 89 and 101, which connect Somerville with Sullivan Square Station.

The Broadway bus lanes (part of the Winter Hill in Motion multimodal transportation effort) also included bus stop consolidation and better signage, as well as bike and pedestrian improvements. The purpose was to encourage transit, walking, and biking by making these modes more welcoming, efficient, and safe. This aligns with goals in several Somerville plans, such as SomerVision, Climate Forward, and Vision Zero.

After project completion, and in response to pushback from drivers, the MBTA and City of Somerville worked with local businesses and community members to address concerns surrounding curbside access, safety, and parking.



Broadway cross-section before (top) and after (bottom) bus lanes were installed.

Street Design and Right-of-way

Street design and ROW are two key planning considerations when making decisions about transit priority.

Street design is made up of the different elements on a street. These can include, for example, curb extensions, bicycle lanes, sidewalks, speed humps, swales, street trees, travel lanes, and parking spaces. Street design influences how people walking, biking, in buses, and driving vehicles interact with the street and with each other. This affects speeds, pedestrian safety, and person-throughput capacity, not to mention bus delay and reliability.

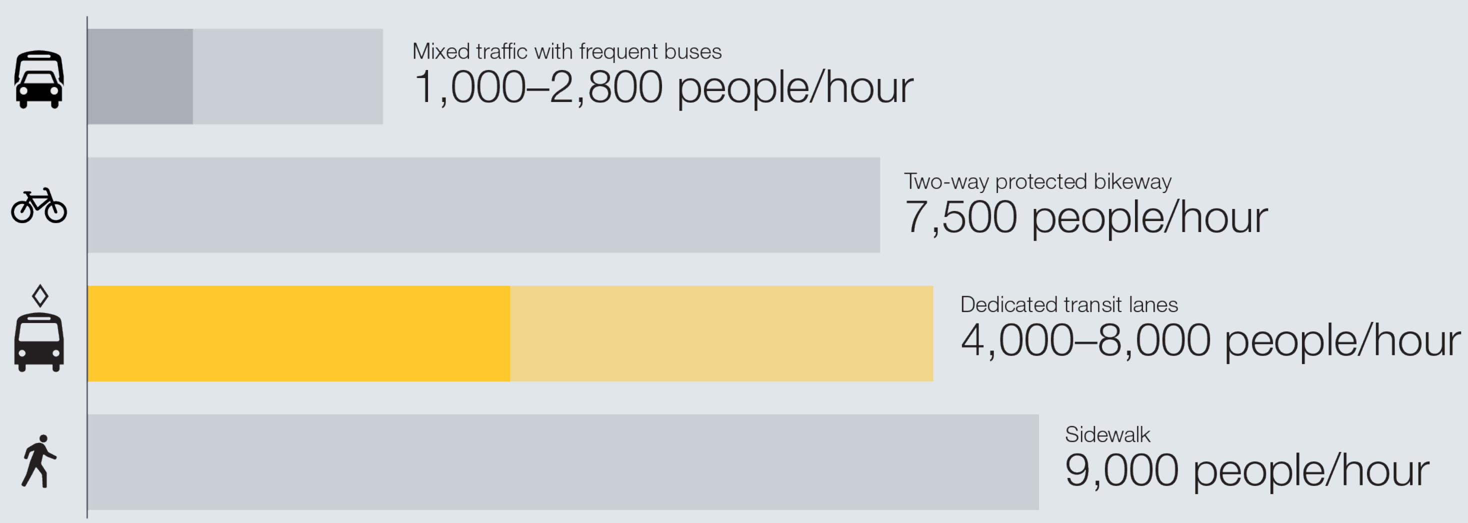
Right-of-way (ROW) is the street and sidewalk space owned and maintained by the local municipality or state agency. Changing the overall ROW available is challenging and requires easements and additional funding. Repurposing space or lanes can improve transit speed and reliability and roadway safety without widening the street and impacting adjacent properties. ROW decisions should account for the neighborhood context and balance the need of different roadway users.

Transit Priority Increases Person-Throughput Capacity

By repurposing space for transit, buses can operate at faster speeds and at a higher frequency. These improvements to transit efficiency increase the number of people that can travel along the corridor, supporting future growth and mode-shift to transit.

How many people can the space of one travel lane serve?

Figure 2: Person-Throughput Capacity



See It in Action: Columbus Ave, City of Boston (Jamaica Plain/Roxbury)

In the Fall of 2021, the City of Boston and the MBTA implemented 0.8 miles of center-running bus lanes on Columbus Ave from Jackson Square to Walnut Ave. The corridor serves the Route 22, one of the MBTA's highest ridership routes, as well as the MBTA Routes 29 and 44.

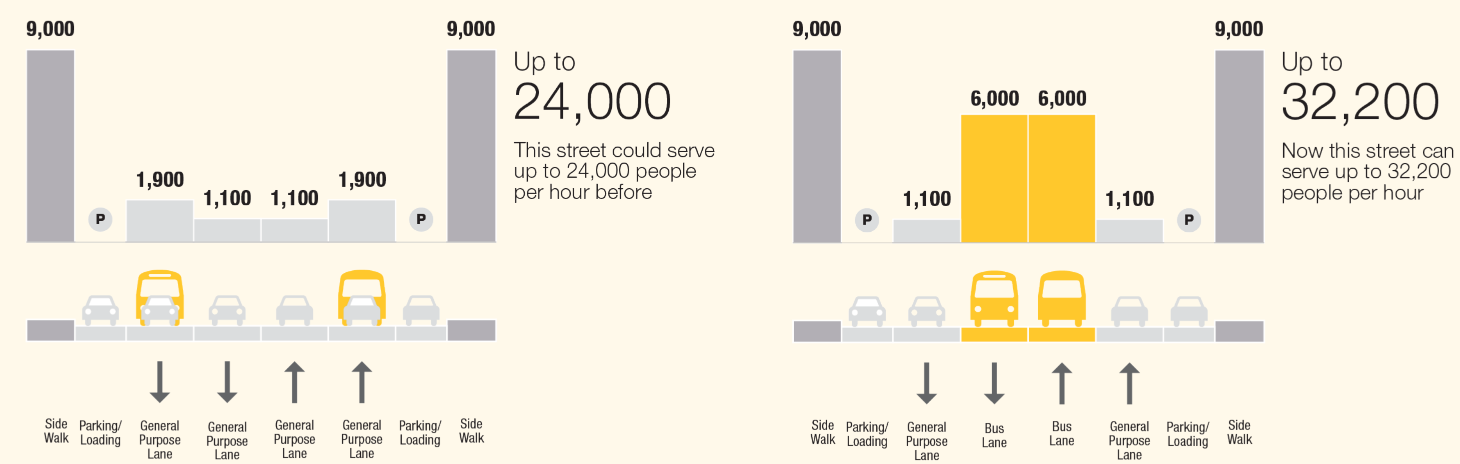
The dedicated bus lanes increased person-throughput capacity on the corridor and reduced delay for riders by 4-7 minutes. The project also improved pedestrian safety, transit access, and overall accessibility.

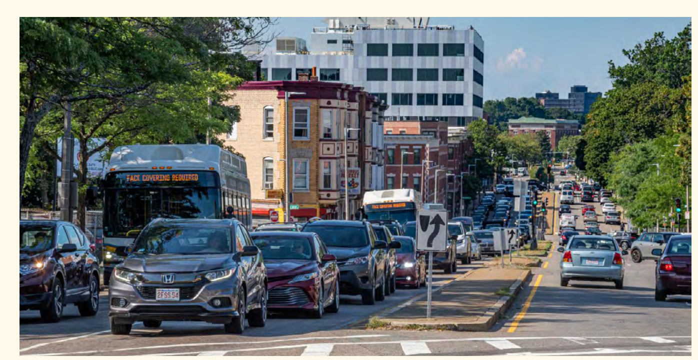
A comparison of September/October 2021 and Winter 2022 data before and after operations began showed that daily bus ridership on Columbus Avenue increased dramatically during this period.

Figure 3: Person-Throughput Capacity Based on Two ROW Configurations

Columbus Ave Without Bus Lanes (Before)

Columbus Ave With Bus Lanes (After)





Columbus Ave before (left) and after (right) dedicated, center-running bus lanes were installed.

Neighborhood Context

Neighborhood context refers to the built environment and transportation network and the policy and planning regulations that govern them. This includes land use, such as residential, commercial, and industrial, as well as the scale of buildings and other factors like bus and bike routes. Downtown areas have a very different neighborhood context than an outlying residential community. The neighborhood context plays a big role in determining project budgets and selecting transit priority treatments.

In addition, neighborhood demographics help identify which communities would benefit the most from more frequent and reliable bus service. Particularly, neighborhoods serving seniors, persons with disabilities and others dependent on bus service. These also include areas where vehicle ownership is low, transit dependency is high, and transit commutes are long. Fixing the equity gap in transit travel times requires prioritizing investments where they're needed most, a critical component of MBTA's implementation plans for the Bus Network Redesign.

See It in Action: North Common St, City of Lynn

In the Spring of 2021, the City of Lynn, MassDOT, and the MBTA implemented Lynn's first bus lane (0.75 miles) along North Common St to make transit faster and more reliable. This effort was the first of many bus priority recommendations in the 2020 Lynn Transit Action Plan.

The neighborhood context was an important planning consideration in the Transit Action Plan. An analysis of neighborhood demographics found that Lynn's Downtown had a high concentration of households without access to cars and households with incomes below the poverty line. Additionally, many of Lynn's environmental justice communities – areas with higher rates of emissions and asthma – are in and around downtown. A key finding of the action plan was a mismatch between transit demand and the quality of transit service. This neighborhood context provided the justification for shared bus/ bike lanes.

Dedicated bus lanes on North Common St in Lynn's downtown.

Planning for Buses and Bikes

Repurposing space for dedicated bus and bike lanes is essential to encouraging more biking and transit use and achieving regional climate goals. Municipalities should coordinate internally and with the MBTA on a decision framework that prioritizes bus operations and biking and manages tradeoffs like slower travel times for general-purpose traffic. Transit priority treatments and bike lanes shouldn't be competing when there is space dedicated for general-purpose traffic or on-street parking that could be reclaimed for more efficient transit and active transportation.

The safest design option for both buses and bikes are separate dedicated bike and bus lanes with vertical protection like parking, concrete curbing or posts, and floating bus stops. Floating bus stops provide all-ages-and-abilities bike lanes, shorten crossing distances for pedestrians, and improve efficiency for buses with in-lane stops. Floating bus stops are the preferred configuration, but on corridors with slower traffic speeds and less frequent bus service, shared bus/ bike lanes provide an option for more confident bicyclists.

More recently, some cities are exploring integrated bus stops with raised bike lanes and a shared condition at the bus boarding area. This maintains the separation between the bike lane and the travel lane on constrained streets, but riders must board and alight in the bike lane. The MBTA prohibits this design because of the safety risk it poses to more vulnerable passengers crossing the bike lane such as older adults and riders who are blind/have low vision and others with disabilities (see Design Directive). Municipalities must collaborate with MBTA and relevant accessibility stakeholder groups to identify the appropriate design solution for bike lanes at bus stops. The MBTA Office of the Chief Engineer may grant a waiver allowing a variation of this treatment on a case-by-case basis.

Most transit priority treatments can coexist with bike lanes, but bus bulbs, particularly on one-way streets can preclude future bike lane implementation. Because bike lanes typically also repurpose parking, bus bulbs can cause bike lanes to abruptly end if they're not reconstructed as floating bus stops. Coordination among bike and transit stakeholder groups is important to ensuring bike infrastructure and transit priority treatments support one another.

Street Categories

Street categories synthesize information about a street's purpose, design, ROW, and neighborhood context, and, in doing so, help to inform transit priority decisions. Categories typically take the form of either street classifications or street types, which are not mutually exclusive.

- **Street classifications** focus on motor vehicle traffic. Arterials have high traffic volumes, collectors medium volumes, and local streets low volumes.
- **Street types** tend to incorporate additional factors, such as other forms of transportation (e.g., walking, bicycling, taking transit) as well as the purpose of the street beyond vehicle movement.

The tables that follow show street classifications and types that are likely to be encountered within the MBTA service area. Street classification categories were created using the NACTO Urban Street Guide and Boston Complete Streets Guide. Street classifications are a critical component of transit priority treatment selection and understanding neighborhood context. By defining the role of the street there are inherent parameters on project priorities that guide project decision-making and coordination and, inform treatment selection and alternatives analysis.

Table 3. Street Categories

Street Type	Street Classification	Description
Downtown Mixed-Use	Arterial or Collector Street	Downtown mixed-use streets support a mix of retail, residential, office, and entertainment uses. This mix creates many of the region's most dynamic public spaces. These streets should support high levels of walking, biking, and transit, as well as frequent parking turnover, including loading zones. Downtown mixed-use streets often feature green space, street furniture, outdoor cafés, plazas, and public art. Downtown mixed-use streets are typically the best candidates for transit-only streets.
Downtown Thoroughfare	Arterial or Collector Street	Downtown thoroughfares prioritize vehicle movement with fast and direct connections from one regional and neighborhood center to the other. Downtown thoroughfares or arterial streets have high traffic volumes and speeds. Because of how busy these streets are across different types of trips and transportation modes, there are often higher rates of conflicts and collisions. To improve safety and encourage more people to walk, bike, and ride, transit municipal and state agencies can repurpose general purpose traffic lanes for other uses like bus and bike lanes.
Transit Corridor	Arterial or Collector Street	Transit corridors support a variety of transit modes including buses and bus rapid transit (BRT), light rail, and streetcars. Transit corridors often overlap with downtown thoroughfares and mixed-use streets. Transit corridors need to provide safe walking, biking, and rolling access to stations and stops. Transit corridors encourage more people to ride transit and spur economic development.

Street Type	Street Classification	Description
Neighborhood Street	Local or Collector Street	Neighborhood streets are often places for recreational activities and leisure. These streets provide safe and inviting places to walk and bike to access neighborhood amenities and schools. Some design elements include stormwater management, curb extensions, traffic calming elements, and bicycle lanes.
Neighborhood Residential	Local or Collector Street	Neighborhood residential streets are used primarily for local trips and are characterized by lower vehicle and pedestrian volumes. These streets typically do not have more than two travel lanes (one in each direction) and are not intended for through-traffic. The design of residential streets focuses on encouraging slow speeds. The emphasis is on pedestrian safety, space for children to play, ample street trees and accessible paths to neighborhood destinations.
Neighborhood Connector	Local or Collector Street	Neighborhood connector streets are through streets that traverse several neighborhoods. Connector streets typically have local transit routes and higher vehicle volumes than residential streets. Depending on characteristics of the street and transit route, neighborhood connectors are often good candidates for offset bus lanes.
Boulevard	Arterial or Collector Street	Boulevards are defined by a grand scale with long block lengths and specific urban design characteristics such as wide sidewalks lined with street trees and furnishings. Boulevards usually have a consistent design for the length of the corridor, often with wide planted medians or green space and they connect important civic and natural places.
Parkway	Arterial or Collector Street	Parkways are typically four lane higher-speed roads, characterized by long, uninterrupted stretches running parallel to open and green spaces. Many parkways have historic elements, including continuous rows of trees and curbing adjacent to parkland. Parkways usually have fewer intersections, which is suitable for motor vehicles, accommodating higher speeds due to the longer distances between signalized intersections. Both Boulevards and Parkways are good candidates for curbside, offset, and center-running bus lanes depending on demand for the curb.
Shared Street	Arterial or Collector Street	Shared streets are shared by people using all modes of transportation at slow speeds. Raised curbs are excluded, and the sidewalk is blended with the roadway. Speeds are slow enough to allow for people who walk to intermingle with bicyclists, motor vehicles, and transit. Shared streets are usually in places where pedestrian activity is high and vehicle volumes are significantly low. Shared streets are designed to significantly reduce traffic speeds using pedestrian volumes and other cues to slow traffic.
Industrial Street	Local, Collector, or Arterial Street	Industrial streets support truck traffic and accommodate the loading and distribution needs of wholesale, construction, commercial, service, and food-processing businesses and are typically also arterials or collectors. Industrial streets need to provide adequate turning radii for trucks at intersections, a primary design consideration. These streets usually feature light pedestrian traffic, but sidewalks and accessible accommodations are still present. Traffic volumes and congestion may be higher on industrial streets compared to more pedestrian-oriented streets.

Chapter 3:

Transit Signal Priority Treatments

Transit Signal Priority Overview

Transit Signal Priority (TSP) gives special treatment to buses at signalized intersections. There are two major techniques for providing TSP—**passive** and **active** treatments. The lead agency must upgrade signals to accessible pedestrian signals (APS).

Passive TSP optimizes signal timings within transit corridors so that the signal progression is set based on the average bus speed instead of the average vehicle speed. Passive TSP does not require any specialized equipment at signalized intersections; it only changes the underlying signal coordination and cycle length to favor bus progression through a corridor. Passive TSP results in transit-friendly corridors often with shorter cycle lengths and signal progression that is based on lower average travel speeds that are reflective of buses serving stops within the corridor. These signal timing treatments can also result in pedestrian benefits by shortening wait times for pedestrians crossing at intersections.

Active TSP detects a bus approaching an intersection and adjusts the signal timing to reduce the amount of time a bus spends waiting at a red light. Delays from traffic signals account for a quarter to a third of overall transit travel times. The objective of active TSP is to improve transit schedule reliability by reducing transit delays at signalized intersections while minimizing the impact to general purpose traffic operations. Active TSP works by detecting buses as they approach a signalized intersection, predicting when the bus will arrive at the intersection, and adjusting the signal timing to reduce the amount of stop delay for the bus at the intersection. TSP helps to provide faster and more reliable transit travel times through a corridor.

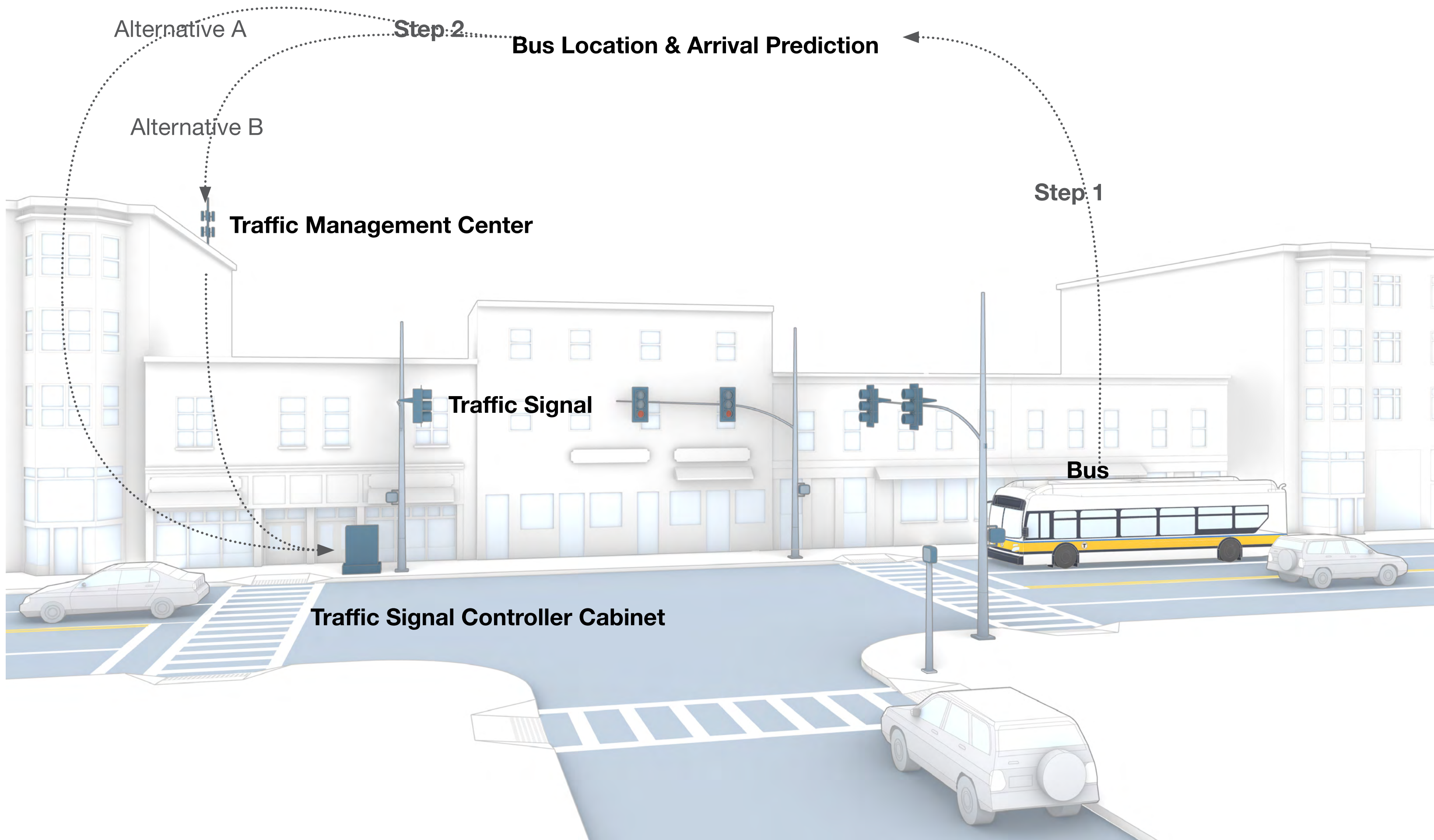
Active TSP Strategies

The figures on the following pages illustrate the five active TSP strategies available for consideration within the MBTA service area. Basic active TSP strategies include green extension and red truncation and can be implemented at any signalized intersection. More advanced TSP strategies include green reallocation, phase insertion and phase reservice. Advanced TSP strategies are typically installed in conjunction with specific bus operations (such as queue jumps) and require more advanced traffic controllers or adaptive signal timing to support the TSP operations. This chapter includes a brief description of each strategy.

How Active TSP Works

The following process outlines how Active TSP works within the MBTA service area:

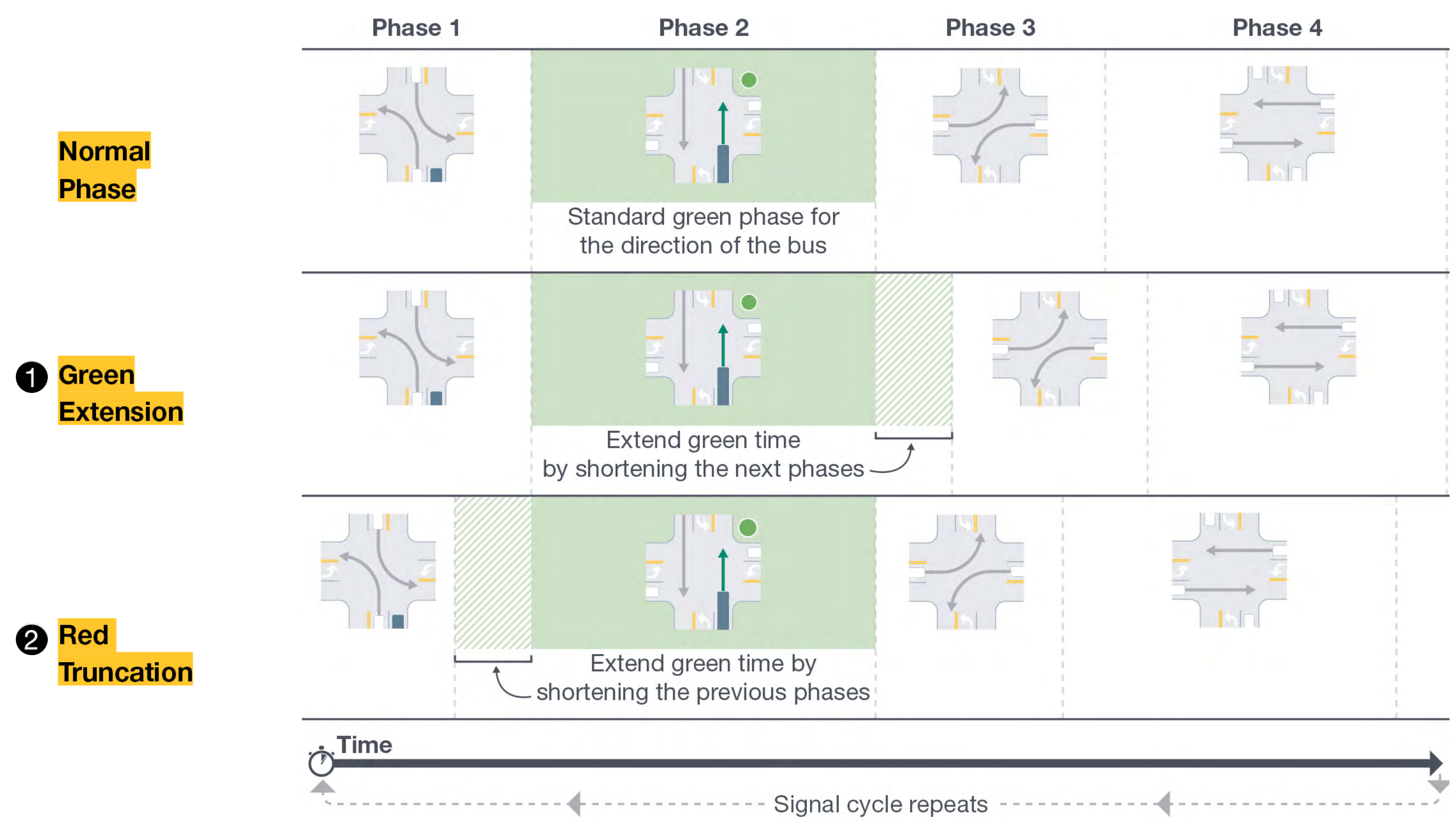
- **Step 1:** The Automatic Vehicle Locator (AVL) on board MBTA buses wirelessly transmits the bus location every 3 to 4 seconds to the MBTA's bus operations control center.
- **Step 2:** The bus location is relayed wirelessly to the transit priority request generator (PRG) in either:
    - **Alternative A:** The traffic signal cabinet where the PRG predicts bus arrival time to the intersection and submits a TSP call to the traffic signal controller within the signal cabinet.
    - **Alternative B:** A centralized traffic management center, where the PRG predicts bus arrival time to the intersection and relays the TSP request to the traffic signal controller via signal interconnect.
- **Step 3:** The traffic signal controller adjusts the signal timing to display a green indication to the bus movement as quickly as possible based on the predicted arrival and TSP strategy programmed for the intersection.



Active TSP Strategies

There are five active TSP strategies that can be implemented within the MBTA service area. A brief description of each strategy is included below.

Figure 4: Basic TSP Strategies



Note: Signal phase diagrams are schematic only to demonstrate the functionality of TSP strategies at a high level. Exact times and phase changes will vary.

Active TSP equipment will maintain minimum pedestrian clearance times at equipped signals. Travel time benefits range based on the amount of time reallocated to the bus phase or increases to the length of the bus phase.

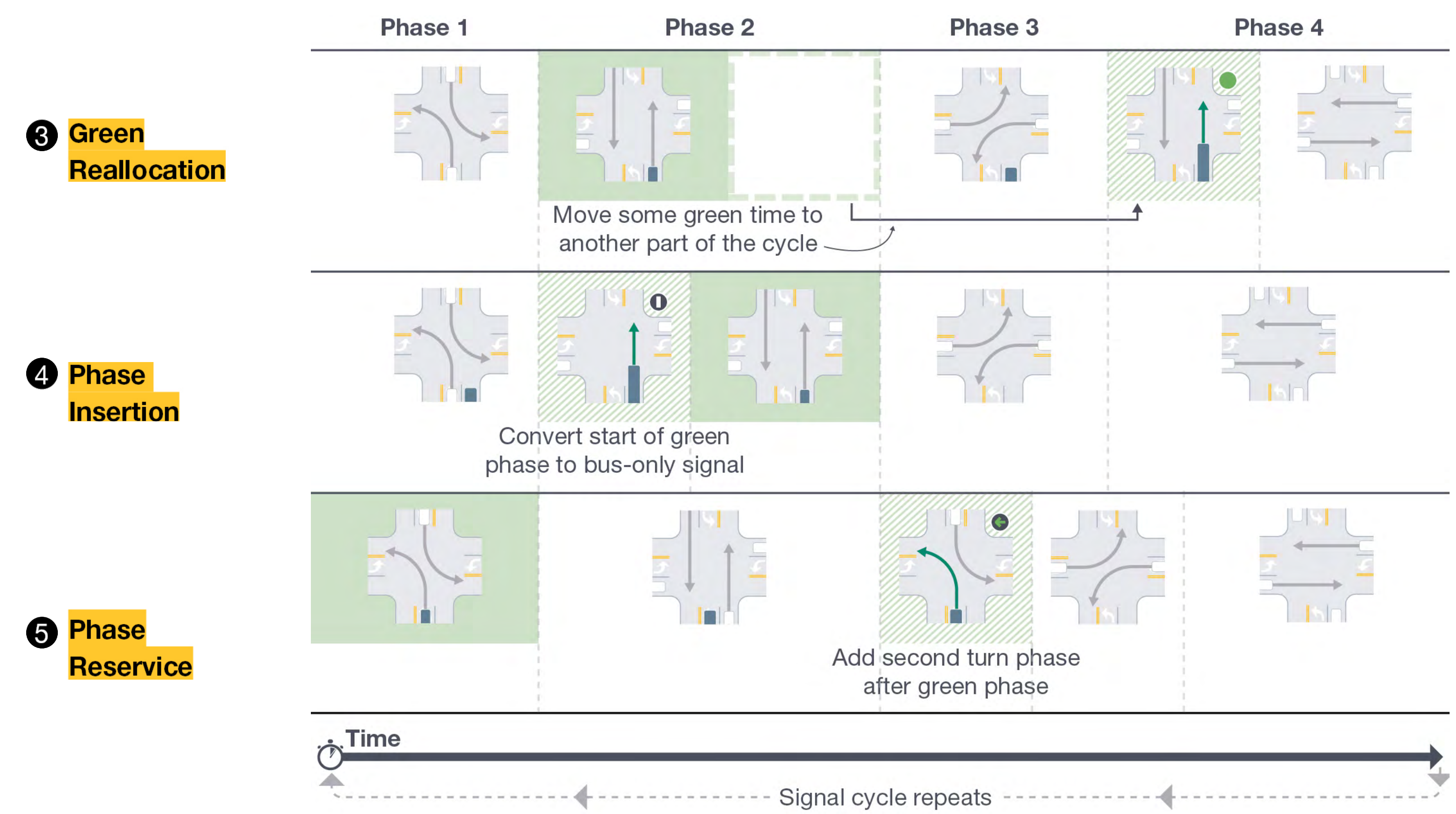
1 Green Extension The signal extends the green time for the bus approaching the intersection, allowing the bus to make it through the intersection without stopping.

- **When to use:** When the predicted bus arrival time is during a transition from green to yellow and red.
- **Impact on delay:** Elimination (bus doesn't stop).
- **Pedestrian considerations:** No impact. TSP operation unnoticeable to most pedestrians.

2 Red Truncation The signal reduces the amount of red time for a bus stopped at an intersection, by shortening the subsequent phase(s) prior to the next green. Also known as early return to green.

- **When to use:** When the predicted bus arrival time is late enough in the cycle that a green extension is not feasible, and the signal is red.
- **Impact on delay:** Reduction (bus stops for less time).
- **Pedestrian considerations:** No impact. TSP operation unnoticeable to most pedestrians.

Figure 5: Advanced TSP Strategies



3 Green Reallocation The signal moves part of the green phase to the time that coincides with the arrival of the bus. This does not affect the total time allocated to cross street traffic.

- **When to use:** If signals have advanced controllers and corridor-based adaptive signal timing.
- **Impact on delay:** Elimination (bus doesn't stop).
- **Pedestrian considerations:** Change in phase sequence may seem unpredictable to pedestrians.

4 Phase Insertion When a bus is detected at the intersection, a special bus-only phase activates before the general-purpose green phase. This enables buses to advance prior to general traffic.

- **When to use:** To support queue jumps through an intersection, or right turns from a center running bus lane, or left turns from a side running bus lane.
- **Impact on delay:** Reduction (bus advances before general traffic).
- **Pedestrian considerations:** Change in phase sequence may seem unpredictable to pedestrians.

5 Phase Reservice The signal can accommodate a green phase for bus movements—typically for left turns, right turns, or queue jumps—at two points within a given cycle, but only activates once per cycle when a bus is present.

- **When to use:** Bus movement has a left or right turn phase or a queue jump.
- **Impact on delay:** Reduction (bus stops for less time).
- **Pedestrian considerations:** Change in phase sequence may seem unpredictable to pedestrians.

Priority versus Preemption

The difference between TSP and signal preemption is that TSP modifies the normal underlying signal operations to better accommodate transit vehicle progression through the corridor, whereas preemption interrupts the normal signal operations for a responding emergency vehicle approaching the intersection. TSP calls are placed to the controller using low priority inputs, whereas emergency vehicle preemption uses high priority inputs to the controller. In the case where the emergency vehicle preemption call is placed after a TSP call has been placed, then the signal would drop the TSP call, interrupt the timing plan, and respond to the preemption call.

TSP Efficacy and Challenges

TSP is most effective and provides the most benefits to transit travel times under the following circumstances:

Flexibility in Signal Timings
TSP is effective when there is flexibility in the signal timings to extend or shorten underlying signal phases, or to add a dedicated transit phase when a bus is detected without shortening other phases below the minimum time needed to serve the pedestrian crossings. For intersections with coordinated signal timings this could mean breaking with coordination for a cycle to serve the TSP request, or increasing the cycle length so phases are not all set to the minimum time to serve pedestrian crossings so that time can be borrowed from other phases to serve the TSP request. For intersections equipped with adaptive signal timing this means having the flexibility to detect and adjust the signal phase sequence to give priority to TSP movements.

Moderate Congestion
TSP works best for intersections with moderate levels of congestion. When congestion levels are high and queue lengths routinely spill back far in advance of the intersection, buses stuck in the queue will not be able to advance to the stop bar to take advantage of the additional time provided by TSP during one cycle. In these conditions, consider providing a dedicated transit lane for buses to bypass the queue.

Newer Technology to Support TSP Operations
The lead agency may need to upgrade traffic signal controllers to support TSP functionality at an intersection. TSP functionality may be impacted by limitations in the controller software and some legacy controller models do not support TSP at all. MBTA has developed specifications that are available on the MBTA Engineering webpage that identify the signal system requirements needed to support TSP operations.

Table 4. Implementation Considerations: Physical Corridors

Questions	Considerations
Is TSP proposed at one or at multiple signalized intersections?	▸ TSP provides a greater bus speed and reliability benefits when installed at multiple signalized intersections along a route or corridor, because of the cumulative reduction in delay.
Is existing or planned dedicated right of way available to buses (i.e., bus lane, part time bus lane, queue jump)?	▸ TSP provides greater benefits in locations where buses can take advantage of dedicated ROW approaching a signalized intersection. ▸ See Dedicated Transit Lane Treatment sheet for more details.
Are there nearside or farside bus stops?	▸ TSP provides greater benefits in locations where buses can stop at the farside of an intersection. ▸ If a stop is nearside of an intersection, look for opportunities to relocate the stop to the farside of the intersection. ▸ See treatment sheets for TSP with farside and TSP with nearside bus stops for more details.
Are there bus-bike interactions?	▸ If a corridor has a separated bike lane, TSP timings will need to consider dedicated bike phases and bike clearance times for phase adjustments. If a shared bus-bike lane is present, bike speed and volume will need to be considered when predicting bus arrival times to the intersection, since a bus with a bike traveling in front of it will be traveling slower as it approaches an intersection. ▸ Consider separate facilities for buses and bicycles if volumes warrant them.

Table 5. Implementation Considerations: Transit Delay

Questions	Considerations
How much delay on average are buses experiencing at each signalized intersection within the proposed project area?	▸ If buses operate through an intersection that routinely has excessive queues that do not clear the intersection during each cycle, there are fewer opportunities to adjust the signal timings to provide TSP benefits and buses will still experience high levels of delay unless other treatments such as dedicated transit right of way are also implemented.

Table 6. Implementation Considerations: Signal Equipment Infrastructure

Questions	Considerations
What existing signal infrastructure is available to support TSP?	▸ Complete a comprehensive field inventory to identify the following: ▸ What type of controller and software versions are currently deployed at intersections? Are the existing traffic signal controllers capable of supporting TSP functionality? ▸ Does the existing signal cabinet have space available to house any additional equipment needed to support TSP? ▸ What are the current signal operations? Are signals operating with coordinated time of day plans, traffic responsive or adaptive operations? ▸ Are cycle lengths set to the minimum time to serve pedestrian crossings with no additional time allocated to any phases? If the lead agency needs to adjust the underlying cyle length, are there additional intersections that will need adjustments to maintain coordinated signal operations? ▸ See MBTA Engineering Directives site for equipment specifications for TSP.

TSP in a Dedicated Lane

TSP for buses operating in dedicated transit lanes provides the greatest benefits to transit travel times and reliability. TSP works best when buses are detected far in advance of the intersection and when predicted travel times from the detection point to the intersection are reliable. When a bus is reliably detected well in advance of an intersection, the lead agency can adjust traffic signal phasing with fewer impacts to other modes and allow buses to pass through without stopping.

Dedicated transit lanes remove general purpose vehicle congestion and queuing between the bus and the intersection. This allows for use of a wider range of detection technologies to detect the bus upstream of the intersection, and results in the most reliable travel time predictions of when the bus will pass through the TSP enabled intersection.

Benefits

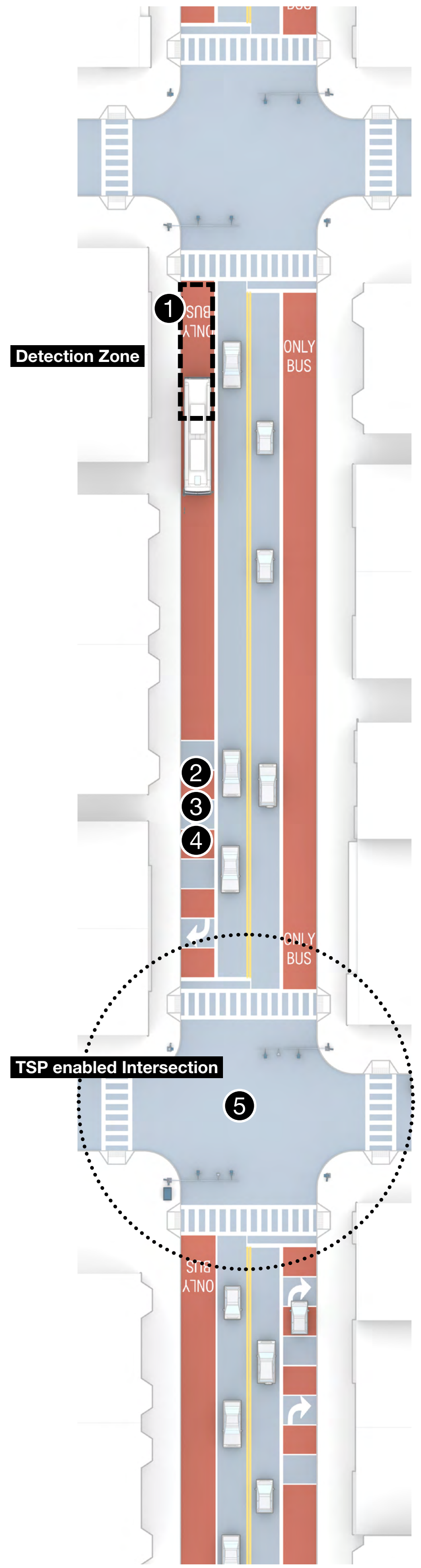
- Provides greatest potential transit signal priority benefit through advanced detection and accurate travel time predictions
- Allows for use of wide range of detection technologies
- Provides transit travel time benefits throughout the whole day

Challenges

- Typically requires removal of an on-street parking lane, conversion of a general-purpose travel lane to a transit lane, or roadway widening to provide a dedicated transit lane.
- Dedicated transit lanes along curb lanes may have locations where right-turning vehicles use the transit lane. High or significantly fluctuating volumes of right-turning vehicles can degrade the accuracy of predicted transit arrival times at the intersections downstream of the right turn location.

Implementation Considerations

1. **Detection Zone** Set detection zone for the bus at the farside of the upstream intersection to the TSP enabled intersection to maximize the amount of time for the controller to respond to the TSP call.
2. **Enforcement** Ensure there is a strategy in place to prevent activities such as illegal parking, standing, or traveling in the bus lane.
3. **Turn Volume** Account for right and left turn volumes, as right-turning vehicles need to cross the bus lane to turn if the bus lane is curbside, and left turns need to cross the bus lane if it is center running.
4. **Traffic Volumes and Queueing** Use dedicated lanes where there are high vehicle volumes and where the bus is often delayed due to vehicle queuing.
5. **TSP Strategies** Can support all TSP strategies including green extension, red truncation, phase insertions (queue jump phases), phase reservice, green reallocation and transit signal optimization (adaptive corridors).



Shared Bus-bike Lanes

- Consider current and future bicycle volumes along the corridor.
- Where possible, accommodate bicyclists separate from the bus lane; otherwise, consider shared bus-bike facilities (such as bus-bike lanes) and additional bike accommodations (such as bike boxes) at intersections.
- Consider grade changes to reduce the speed differential between buses and bikes. Prioritize separate bike lanes for steep uphill segments where possible.
- Consider the volume and frequency of bicycles in the shared lane and how bus speeds may vary from the detection point to the intersection depending on whether leading or following a bicycle.
- Likely will not get the full benefit of accurate bus predictions compared to a dedicated transit lane since bus travel times will vary if a bicyclist is present.

Peak Period Only

- Likely to provide similar benefits to full-time, dedicated bus lanes during peak periods.
- Likely to provide similar benefits to TSP in General Purpose Lane during off-peak periods.

TSP in a Queue Jump Lane

Queue jumps reduce transit delays at intersections by allowing buses to bypass queues at signalized intersections and travel through the intersection ahead of general purpose traffic. Buses can bypass the front of the queue and will get a head start at the beginning of the next signal cycle using a dedicated bus lane or shared turn pocket with low volumes of turning vehicles. A phase insertion strategy may be used to provide a transit-only signal phase when a bus is detected so that the bus can travel through the intersection into receiving general purpose lanes ahead of general traffic.

Benefits

- Provides travel time savings by routing buses around queues at congested intersections ahead of other traffic.
- Provides more reliable travel times in locations where a dedicated transit lane ends and buses merge downstream of the intersection with general purpose traffic.
- Can implement at intersections with a right turn pocket, but not necessarily space for a dedicated bus lane.

Challenges

- Requires a long enough dedicated ROW in advance of an intersection to enable a bus to pass the queues that typically occur at a signalized intersection.
- Requires a dedicated ROW for merging back into the main travel lane.
- Requires upstream bus detection to ensure that a bus isn't going to miss the priority phase and miss the signal.
- Could require dedicated ROW or farside bus stop.

Implementation Considerations

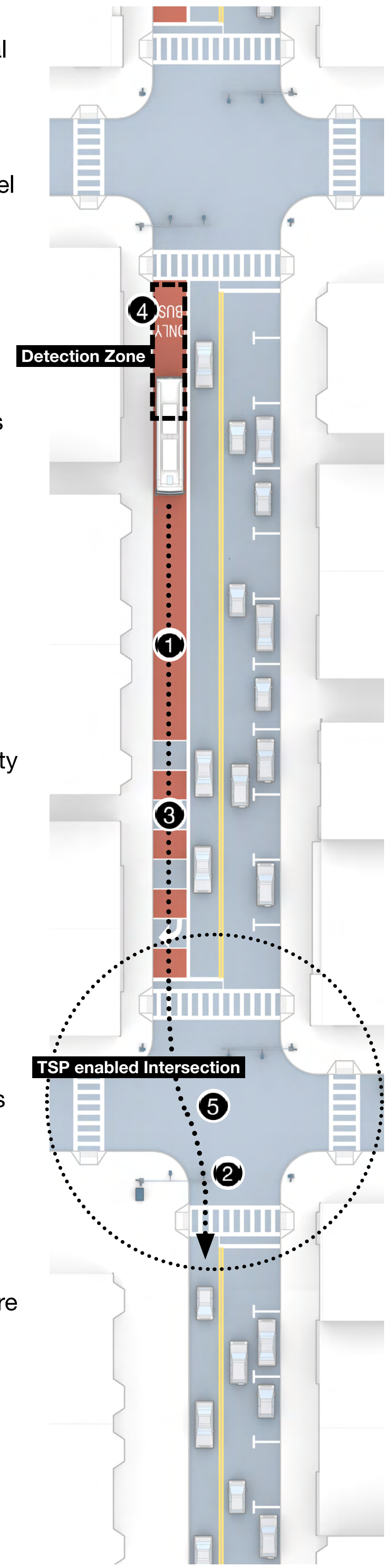
1 **Dedicated Lanes** Implement a dedicated transit, shared bus-bike, or left or right turn lane that is long enough so that a bus can enter the lane from the back of the queue to wait at the stop bar. Ideally, the queue jump lane should be longer than the queue 90% of the time.

2 **Signal Indications** May require a dedicated signal head to indicate when the bus can travel through the intersection ahead of general purpose traffic. The signal head can either be transit specific or optically programmed/louvered, making it visible only to bus operations or to both lanes.

3 **Turn Volume** If the queue jump is from a shared turn lane, the volume of turning vehicles should be low enough to avoid significant queues. The dedicated transit phase will need to be of sufficient length for the bus to clear the intersection before the adjacent through traffic receives a green phase.

4 **Detection Zone** Setting upstream detection zones within the dedicated or shared lane can alert the signal that a transit vehicle is approaching and try to accommodate it. Also, a post intersection detection check out zone can end the transit phase more quickly, reducing the disruption of normal signal operations.

5 **TSP Strategies** Typically implemented with a phase insertion for the dedicated transit signal phase. The lead agency can also combine with a phase reservice to minimize the amount of stop delay for the buses by activating the transit signal phase at more than one point in a cycle.



This page has been left intentionally blank

Mixed Traffic, Farside Stop

Adding TSP to an intersection where buses operate in general purpose traffic lanes with other vehicles can improve transit travel times by reducing stop delays. This treatment works best when buses are detected far in advance of the intersection and when there are reliable, predictable travel times between the detection point and the intersection. This reliability is important, as it means that it's possible to adjust the traffic signal phase with fewer impacts to other modes.

Farside bus stop locations allow buses to receive the greatest potential benefits from TSP. With a farside bus stop, buses are detected detected well in advance of the intersection, the travel time between the detection point and the intersection is not interrupted by a stop location, and buses can pass through the intersection without stopping.

Benefits

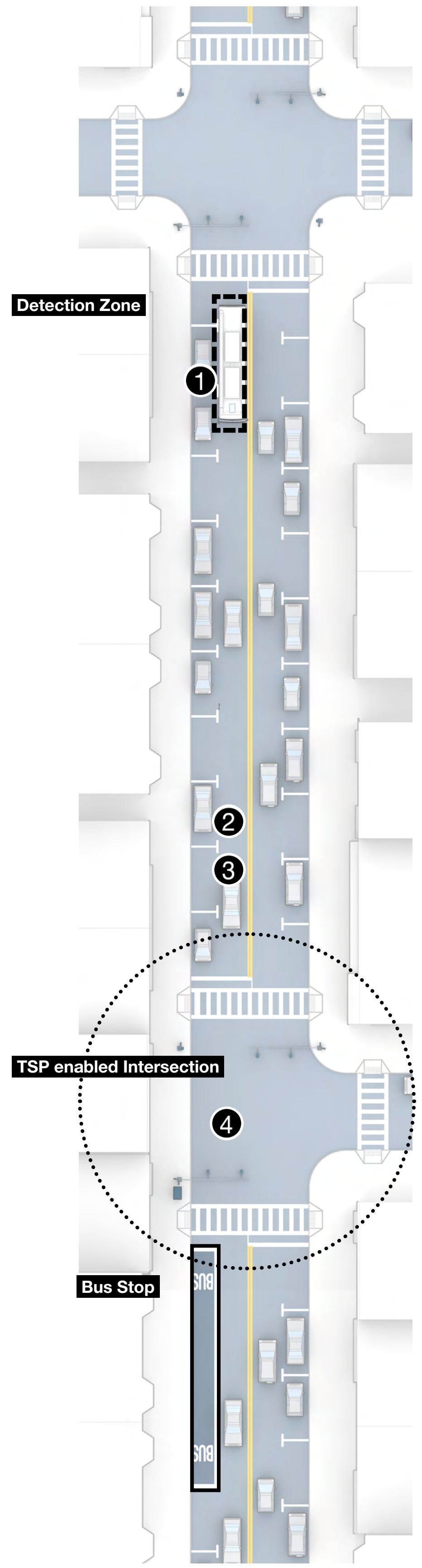
- Provides the greatest potential benefit to transit travel times since the bus stop is not within the detection zone of the TSP intersection
- Possible to implement without changes to roadway channelization
- Maximizes the time allowed for a controller to respond to a TSP call

Challenges

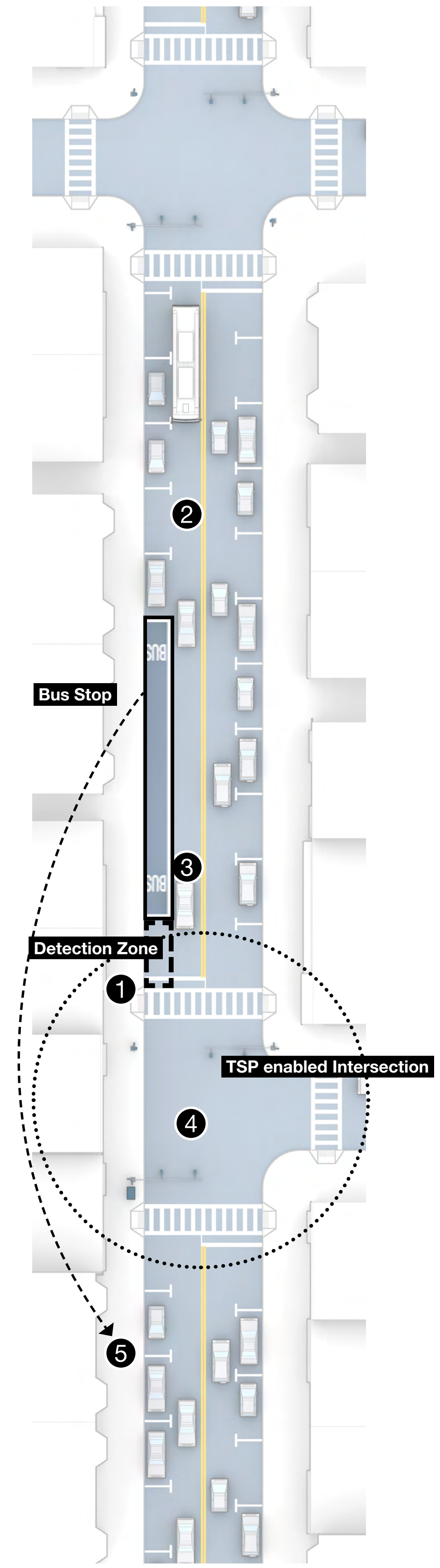
- Accuracy of predicting bus arrivals at the intersection is compromised when there are heavy traffic volumes in the general purpose traffic lane or highly variable traffic conditions throughout the day.

Implementation Considerations

1. **Detection Zone** Set detection zone for the bus at the farside of the upstream intersection to the TSP enabled intersection to maximize the amount of time for the controller to respond to the TSP call.
2. **Traffic Volumes** Heavy traffic volumes in the shared lane with buses will likely impact the ability to accurately predict bus arrivals at the intersection, especially if the traffic volumes are highly variable throughout the day.
3. **Queueing** If queuing in advance of the intersection is excessive, and the intersection regularly experiences cycle failure where upstream queues do not clear the intersection, adding TSP will provide little benefit to transit. Consider providing a dedicated transit lane in these situations so that the bus can bypass queues as it approaches the intersection.
4. **TSP Strategies** Typically implemented with both green extension and red truncation TSP strategies. There is a higher probability of receiving a green extension when there is a longer detection area in advance of the intersection.



Mixed Traffic, Nearside Stop



TSP is possible at intersections with nearside bus stops, but the proximity of the bus stop to the intersection will limit some of the benefits of TSP due to a shorter detection zone. Implementation of TSP at these locations may require additional programming of the traffic signal controller.

Benefits

- Provides low to moderate transit travel time improvements.

Challenges

- Accuracy of predicting bus arrivals at the intersection will be limited based on the shorter detection zone between the bus stop and the intersection.
- With a shorter detection zone, the controller will have limited call reaction time, which may limit the TSP strategies the lead agency can implement.
- May require additional controller programming to delay the TSP request once a bus is detected at the bus stop to account for dwell time.
- May require additional hardware and/or programming of the buses for the API feed to provide "door open/door closed" status ensuring TSP requests are only placed after the bus serves the stop.

Implementation Considerations

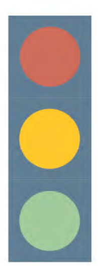
1. **Detection Zone** Set detection zone for the bus just beyond the head of the bus stop in advance of the intersection, or use the bus stop as the detection point with delay timer in the controller, or door open/door closed status in the API feed.
2. **Traffic Volumes** Heavy traffic volumes in the shared lane may cause delays to buses trying to reach the nearside stop and then delay buses clearing the intersection. If right turns are allowed in front of the bus stop, the bus may not be able to pull forward directly after serving the stop, which may further disrupt predictions.
3. **Queueing** If queuing in advance of the intersection is excessive and the intersection regularly experiences cycle failure where upstream queues do not clear the intersection, adding TSP will provide little benefit to transit. Provide a transit lane in these situations.
4. **TSP Strategies** Typically implemented with both green extension and red truncation TSP strategies. Higher probability of receiving a red truncation treatment given short detection zone in advance of the intersection.
5. **Bus Stop Relocation** Having the bus stop close to and on the nearside of the intersection can reduce the benefits of TSP. Therefore, consider relocating the bus stop to the farside of the intersection, or relocate nearside bus stops to mid-block to allow for a longer detection zone in advance of the intersection.

Transit Signal Heads and Phasing

This section provides guidance on the types of signal heads and signal phasing that municipalities can use to support transit operations for typical scenarios. MBTA prefers to use transit signal heads for locations where buses are operating in dedicated ROW, and standard signal heads for locations where the buses operate in general purpose or shared lanes with other vehicles.

The MBTA uses transit signal heads with a horizontal red bar as the red indication, white triangle as the yellow indication and a vertical white bar as the green indication. A standard signal head included in the MUTCD (Manual of Uniform Traffic Control Devices) can include red, yellow, green ball indications or dedicated turn arrow indications. In cases where buses are receiving a phase ahead of adjacent travel lanes, there should be an optically programmable signal head which only is visible from the bus travel lane. Municipalities can use optically programmable signal heads to target visibility of the head to the travel lane to avoid confusion from other drivers trying to advance through the intersection during a dedicated bus phase.

Transit Signal Head

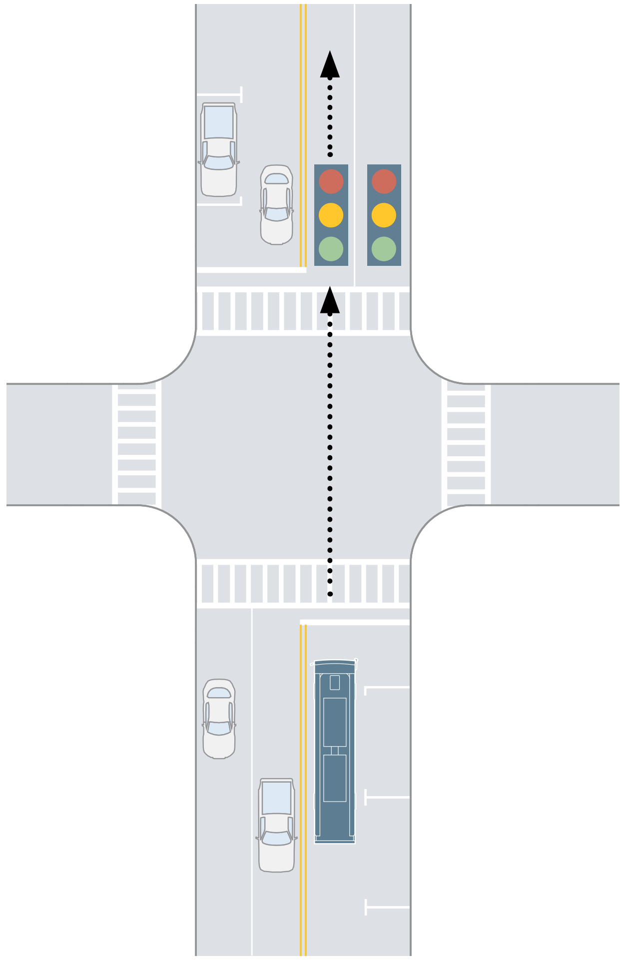


Standard Signal Head

Optically Programmable Signal Head

The MUTCD requires that signalized through movements have a minimum of two primary signal heads for the through movement. In some situations the primary signal heads for the through movements are used for the bus movements at the intersection. For other situations, an additional head is recommended for the bus movement. The following section includes illustrations of eleven scenarios with bus operations at signalized intersections with the guidance on the signal heads for each scenario, unique operational considerations, and complementary Active TSP strategies that municipalities could use for the illustrated conditions.

This page has been left intentionally blank



❶ Bus Operating in Mixed Traffic Traveling through the Intersection

Signal Heads

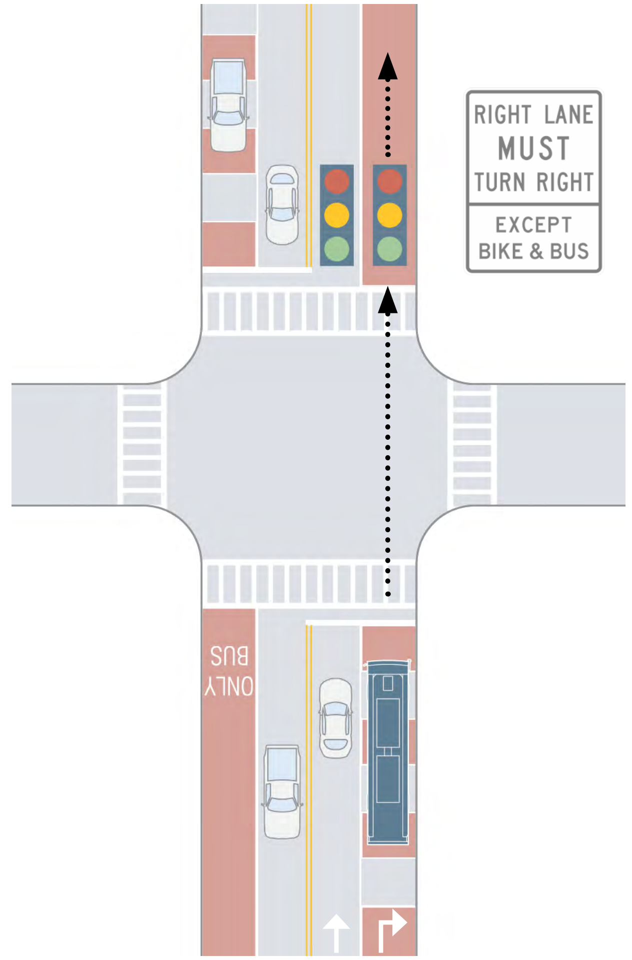
No special signal heads needed for bus movements

Operational Considerations

- No special signal phasing required to support bus operations.
- Mixed traffic operation provides no operational benefit to buses approaching an intersection. The benefits of active TSP strategies are affected by underlying traffic volumes and queue lengths approaching the intersection.

Active TSP Strategies

- Green Extension
- Red Truncation
- Green Reallocation



❷ Bus Operating in a Shared Bus Lane with Right Turns with the Bus Traveling through the Intersection

Signal Heads

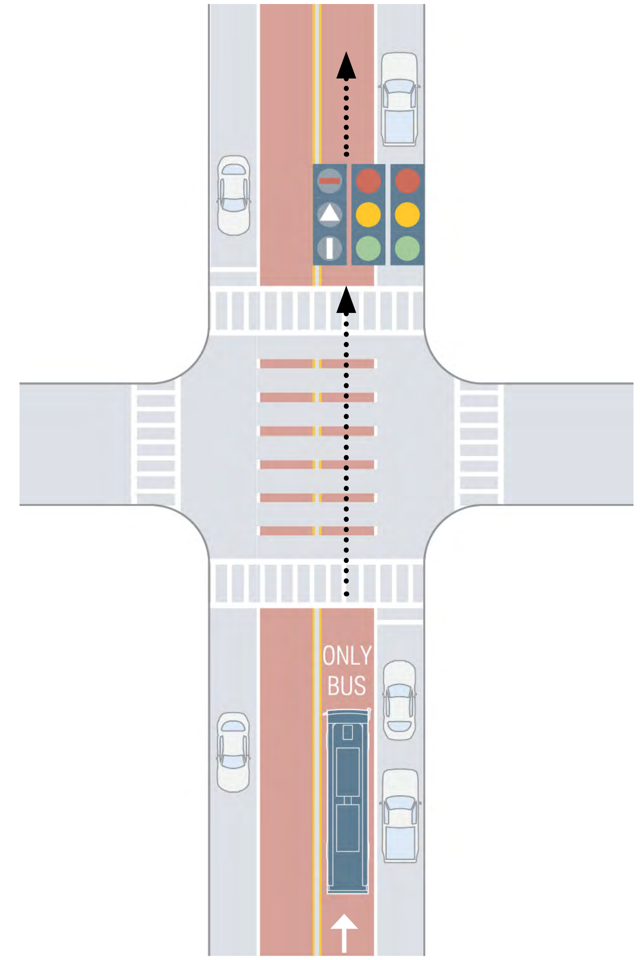
No special signal heads needed for bus movements

Operational Considerations

- No special signal phasing required to support bus operations.
- Include supplemental signing to reinforce shared operations (i.e modified R3-7 sign).
- The operational benefits to buses of shared lanes depends on the volumes of right turning vehicles and pedestrian volumes crossing the intersection. If the volume of right turning vehicles is high and those turning vehicles must yield to a high number of pedestrians crossing the side street, then queues will develop in the shared lane and limit the benefits of the shared lane and active TSP strategies at the intersection.

Active TSP Strategies

- Green Extension
- Red Truncation
- Green Reallocation



❸ Bus Operating in Center-running Bus Lane Traveling through the Intersection

Signal Heads

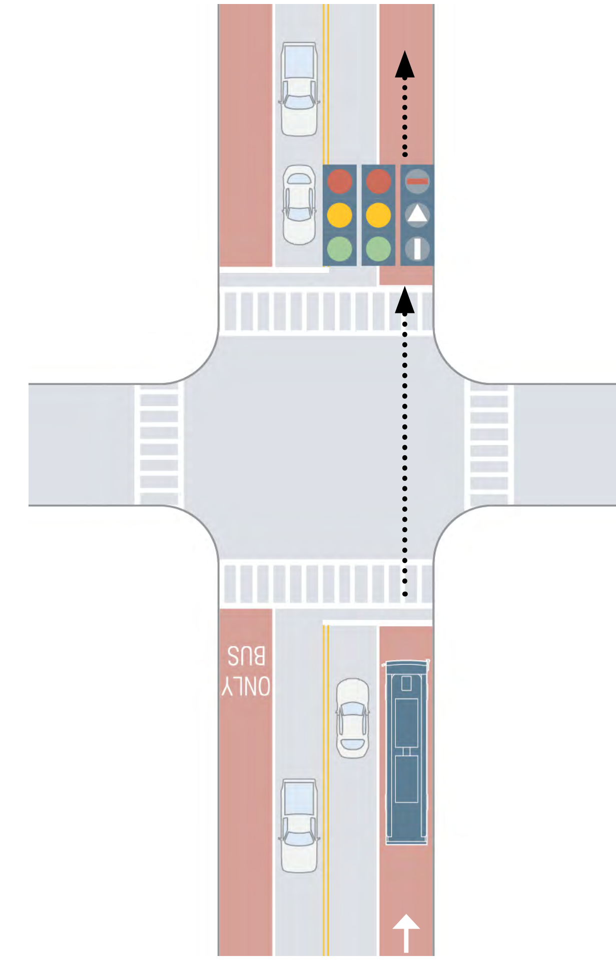
Use dedicated transit signal for bus movements

Operational Considerations

- No special signal phasing required to support bus operations.

Active TSP Strategies

- Green Extension
- Red Truncation
- Green Reallocation



❹ Bus Operating in Curbside Bus Lane Traveling through the Intersection

Signal Heads

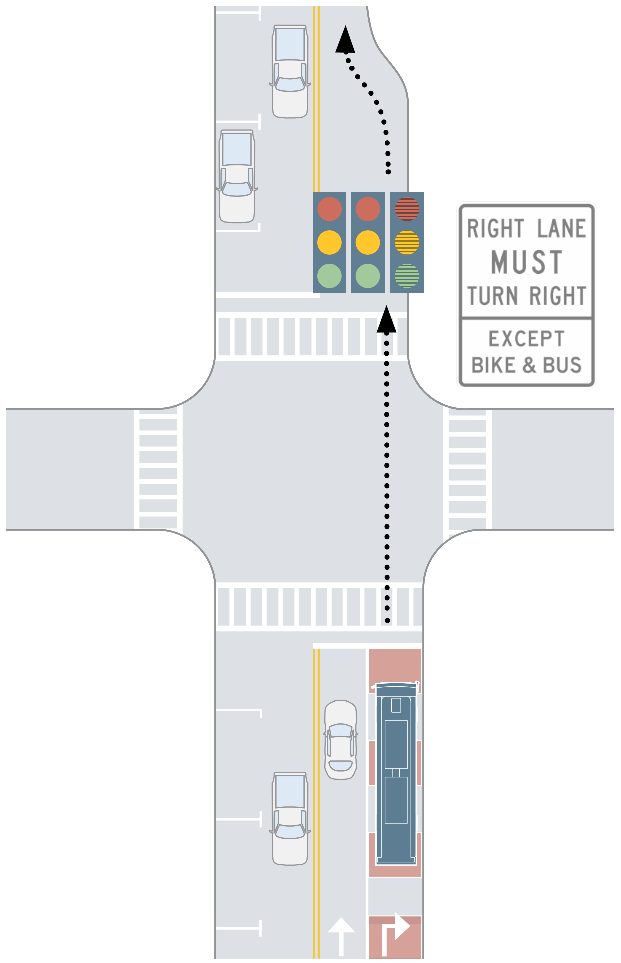
Use dedicated transit signal for bus movements

Operational Considerations

- No special signal phasing required to support bus operations.

Active TSP Strategies

- Green Extension
- Red Truncation
- Green Reallocation



❺ Queue Jump from a Shared Right Turn Lane

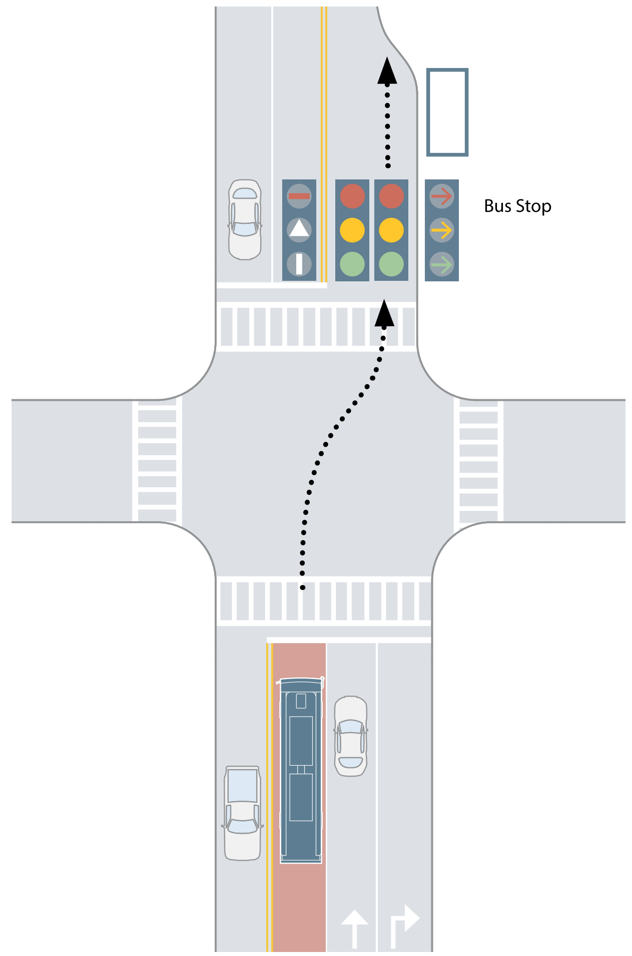
Signal Heads
Use optically programmed signal head for the queue jump lane

Operational Considerations

- Requires a dedicated phase for the queue jump.
- Include supplemental signing to reinforce shared operations (i.e modified R3-7 sign).
- Right turns allowed to make the permissive right turn during the queue jump phase. Best used where right turn volumes and pedestrian crossing volumes are low so that buses are not stuck behind a queue of right turning vehicles yielding to pedestrians.
- Use in locations where a shared bus lane ends and buses need to merge back into mixed traffic.

Active TSP Strategies

- Phase Insertion
- Phase Insertion with Phase Reservice



❻ Queue Jump from a Center-running Bus Lane

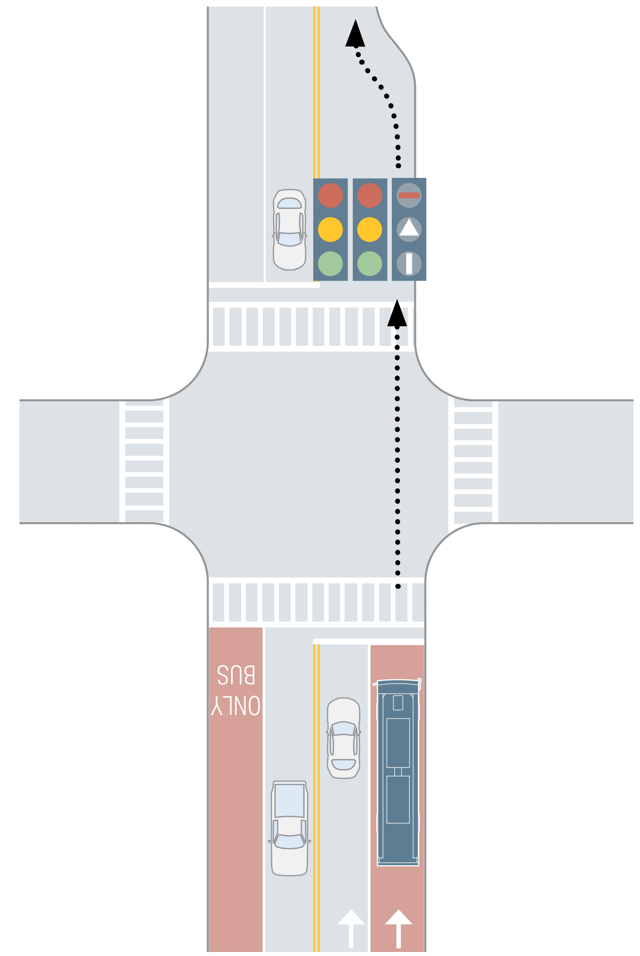
Signal Heads
Use transit signal head for the bus lane

Operational Considerations

- Requires a dedicated phase for the queue jump.
- Use in locations where a dedicated bus lane ends and buses need to merge back into mixed traffic.

Active TSP Strategies

- Phase Insertion
- Phase Insertion with Phase Reservice



❼ Queue Jump from a Curbside Bus Lane

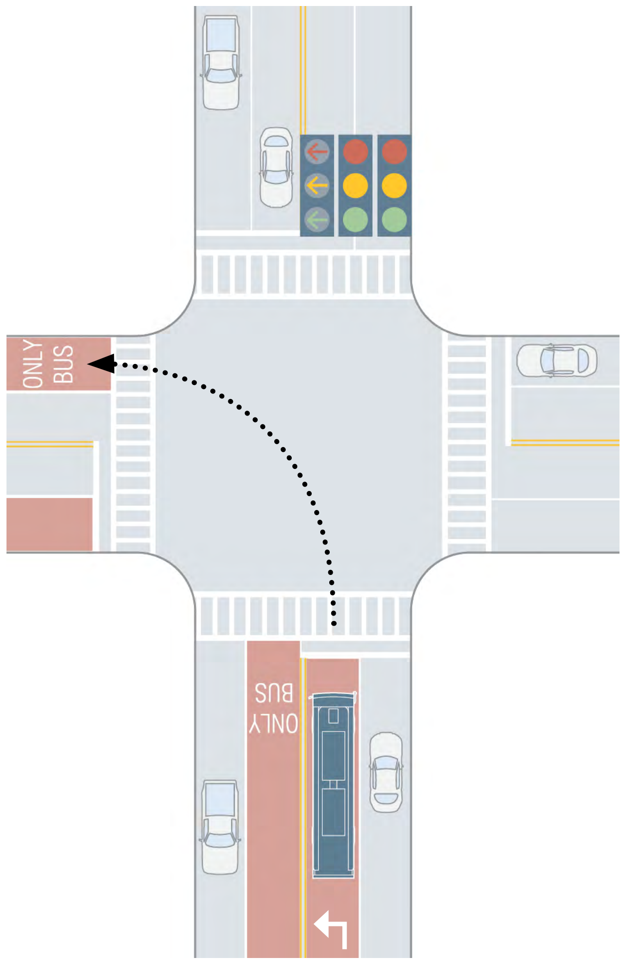
Signal Heads
Use transit signal head for the bus lane

Operational Considerations

- Requires a dedicated phase for the queue jump.
- Use in locations where a dedicated bus lane ends and buses need to merge back into mixed traffic.

Active TSP Strategies

- Phase Insertion
- Phase Insertion with Phase Reservice



8 Bus Left Turn from a Center-running Bus Lane

Signal Heads

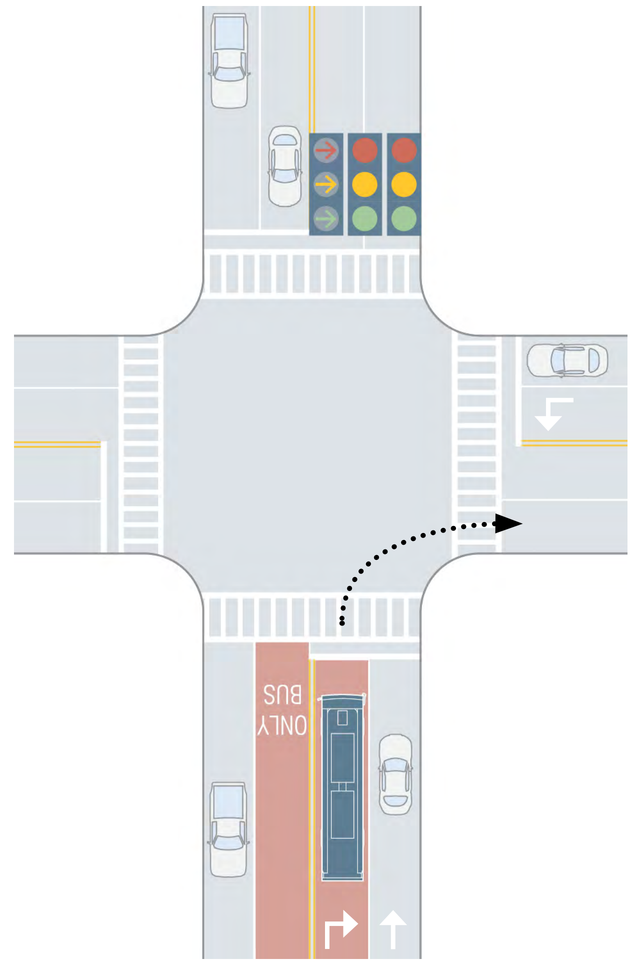
Use standard left turn arrow signal head for the bus lane

Operational Considerations

- Include a standard protected left turn phase for the bus movement.
- Use in locations where the transit route turns from the main road to the cross street.

Active TSP Strategies

- Green Extension
- Red Truncation
- Phase Reservice



9 Bus Right Turn from a Center-running Bus Lane

Signal Heads

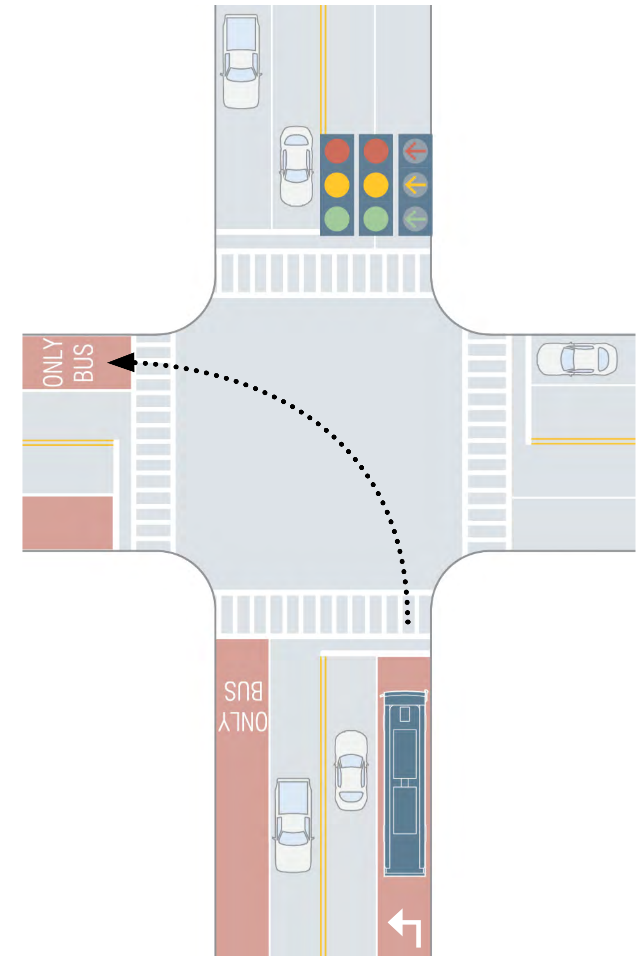
Use standard turn arrow signal head for the bus lane

Operational Considerations

- Requires a dedicated phase for a protected turn isolated from other movements at the intersection.
- Use in locations where the transit route turns and there is significant queuing in the adjacent general purpose lanes that restrict the ability for buses to merge into the right turn lane in advance of the intersection.

Active TSP Strategies

- Phase Insertion
- Phase Insertion with Phase Reservice



10 Bus Left Turn from a Curbside Bus Lane

Signal Heads

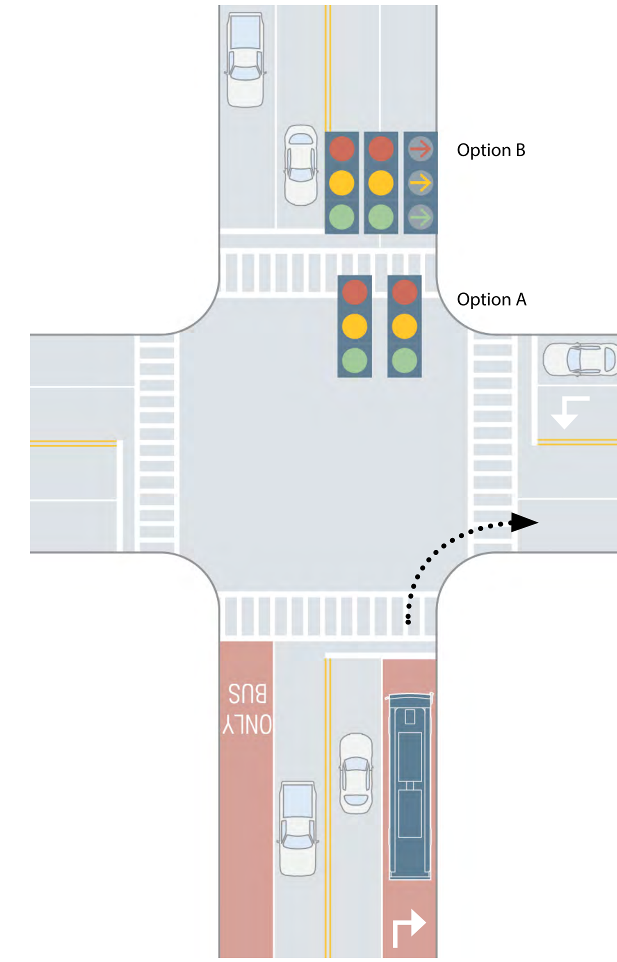
Use standard turn arrow signal head for the bus lane

Operational Considerations

- Requires a dedicated phase for a protected turn isolated from other movements at the intersection.
- Use in locations where the transit route turns and there is significant queuing in the adjacent general purpose traffic lanes that restrict the ability for buses to merge into the right turn lane in advance of the intersection.

Active TSP Strategies

- Phase Insertion
- Phase Insertion with Phase Reservice



11 Bus Right Turn from a Curbside Bus Lane

Signal Heads

Use either standard signal head for the bus lane
Or
Use standard right turn arrow signal head for the bus lane

Operational Considerations

- No special signal phasing required to support bus operations. Can operate as a permissive right turn with buses yielding to pedestrians for locations with moderate to low pedestrian volumes.
- Alternatively provide a protected right turn phase to allow the bus to make the right turn ahead of the pedestrian crossing for locations with high pedestrian volumes.

Active TSP Strategies

- Green Extension
- Red Truncation

  Or
- Phase Insertion

Chapter 4:

Bus Lane Treatments

Introduction to Bus Lanes

Bus lanes are one of the most cost-effective transit priority treatments to improve bus speed and reliability. Bus lanes are typically repurposed general purpose traffic lanes or on-street parking, dedicated for bus-only use designated by signage, red paint, and decals.

The separation of buses from traffic increases bus speeds, reduces travel time variability, and improves schedule adherence resulting in faster, more reliable transit service. Dedicated bus lanes allow buses to bypass traffic and avoid conflicts with other road users. Additionally, bus lanes improve roadway safety by reducing conflicts between buses and other vehicles/modes.

When and Where to Consider Bus Lanes

Bus lanes are most effective on **corridors with:**

- Streets with lanes of traffic or parking that can be repurposed with limited impacts to driveways, bike lanes, and turning traffic where there is curb and sidewalk access
- **Frequent transit delays** where dedicated lanes save riders time and improve reliability, making bus travel more competitive with driving
- **Frequent bus service** and high ridership to maximize speed and reliability benefits
- **Streets with multiple bus routes or planned bus priority projects**

Policy and Planning Considerations

- **Bus lanes help transit agencies get the most out of every operating dollar,** making them an important tool for network redesigns and service changes. Bus lanes support service enhancements by providing dedicated, congestion-free paths along some of the most vital and high ridership routes in the transit network.
- **Bus lanes also support in-fill and new development** by encouraging more people to ride transit and mitigating future congestion. Municipalities should consider promoting bus lanes as part of their development guidelines to ease the financial burden on the city and transit agency to streamline implementation.
- **Taking a network approach to bus and bike lane implementation supports Massachusetts's vision** for safer, more complete streets that promote walking, biking, and riding transit. Bus lanes should complement not preclude bike lanes and vice versa. When possible, municipalities should provide dedicated bus and bike lanes with the understanding that shared lanes are not for all ages and abilities.

Implementation Considerations

Municipalities should consider the following design approaches and strategies to manage bus lane interactions with turning vehicles and other modes.

Frequent and clear signage is required to deter private motorists from entering the bus lane.

Emergency vehicles are always permitted in the bus lane. Other vehicles may be permitted on a case-by-case basis, such as turning vehicles or school buses, these exceptions are typically negotiated between municipalities and the MBTA. The benefits of bus lanes are lessened when the lane is shared with a high-volume of other vehicles.

Provide safe spaces for people biking when implementing bus lanes. Depending on the street context, bike lanes may be separated in the street by paint or posts, raised, or on an adjacent street.

- People biking should be able to use the bus lane when the options above are not available.

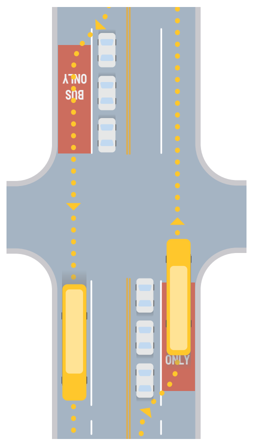
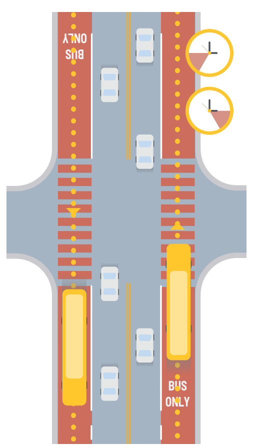
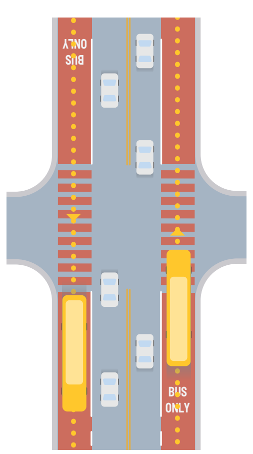
Bus lanes only work well if cars stay out of them. It is important to clearly demarcate bus lanes and craft a strategy for enforcing them. The best enforcement mechanism is road design.

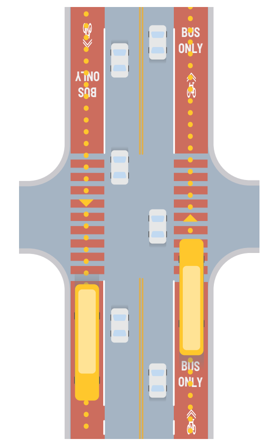
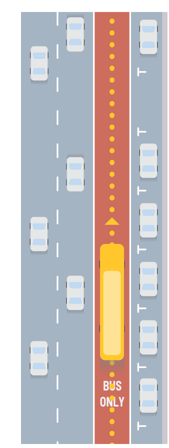
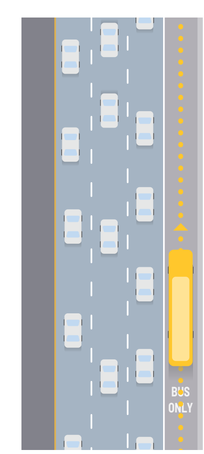
- Center-running and contraflow bus lanes are self-enforcing by design, making it difficult for traffic to use transit-only lanes and reducing the burden of other bus lane enforcement mechanisms.
- For other bus lane and busway designs, physical barriers like posts can provide separation and prevent vehicles from entering. Municipalities should implement self-enforcing design approaches when possible.

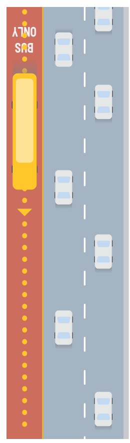
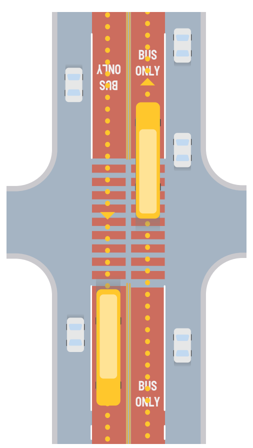
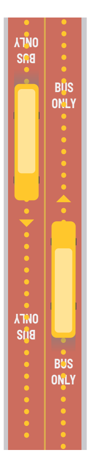
Red paint is widely used to denote bus-only lanes across the United States, typically for 24/7 or all-day bus lanes, but several cities also use red for peak-period bus lanes.

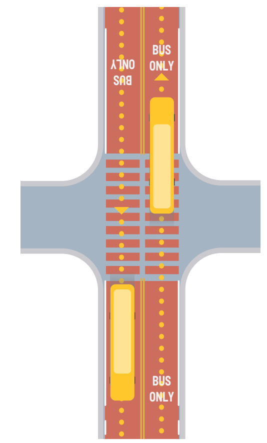
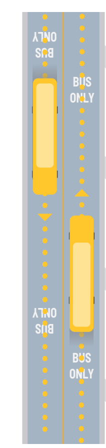
Types of Bus Lanes

Table 7. Bus Lane Types

	Type of Bus Lane and Description	Level of Investment Needed	Right of Way Needed	Level of Transit Priority
	**Short Bus Lane** Short, dedicated transit lanes that exist only on the approach to an intersection	Low: Requires clearly marked lane decals and signage to communicate dedicated transit use	Low: Can be lengthened or reconfigured in any lane to meet needs of a given corridor	Low: Used for spot improvements to allow buses to bypass traffic at specific intersections, with less impact than a full bus lane
	**Part-time Bus Lane** Repurposes general purpose traffic or parking lanes for dedicated bus operations part-time	Low: Requires extra signage and may require new lane markings if existing parking lane is too narrow	Low: Converts general-purpose traffic or parking lanes, typically during peak periods	Low: Allows buses to stop in-lane and bypass congestion during the most congested periods of the day, but illegal parking and loading can cause delays.
	**Curbside Bus Lane** Repurposes general-purpose traffic or parking lanes along the curb for dedicated bus operations	Low: Requires minimal signage, may require new lane markings if existing lane is too narrow	Low: Converts existing curbside lane, either parking or travel lane	Medium: In-lane stops provide additional speed and reliability benefits. Parking lane conversion makes illegal parking and loading possible.

	Type of Bus Lane and Description	Level of Investment Needed	Right of Way Needed	Level of Transit Priority
	**Bus-bike Lane** A shared lane for both buses and people cycling	Low: Requires minimal additional lane markings, like sharrows, or a dashed bike lane	Low: Can be implemented with most types of bus lane configurations	Medium: Improves speed and reliability, but not suitable for corridors with high transit or bike volumes, or fast traffic/ buses
	**Parking Offset Bus Lane** Repurposes a lane of traffic for dedicated bus operations, while preserving on-street parking and loading at the curb	Medium: Requires new lane markings and in-lane stops would require bus bulbs	Medium: Requires ROW for general-purpose traffic, parking, and dedicated bus lane	Medium: In-lane stops provide additional speed and reliability benefits, but illegal use of the lane can cause delays
	**Bus-on-shoulder** Authorizes buses to use the shoulder of an interstate highway or other routes when there is heavy congestion	Low: Requires extra signage and may require relocating or enhancing existing highway elements for safe bus operations; narrow shoulders would require widening	Low: Converts existing shoulder with minor changes to lane markings	Medium: Improves bus speeds and reliability through congested highway segments and state routes

	Type of Bus Lane and Description	Level of Investment Needed	Right of Way Needed	Level of Transit Priority
	**Contraflow Lane** Repurposes a parking or traffic lane for dedicated bus operations that oppose the flow of traffic	●●○ Medium: Requires extra signage and road design to clearly prohibit wrong-way entry and private vehicle use; requires dedicated signals and transit priority	●○○ Low: Converts one lane of traffic or parking for contraflow operations	●●● High: Increases bus speeds with few vehicle conflicts, allows bus travel in both directions along one-way streets reducing the number of turning movements
	**Center-running Bus Lane** Repurposes inner travel lanes for dedicated bus operations	●●● High: Requires median bus platforms, in addition to new dedicated transit signals; likely to impact utilities.	●●● High: Requires a wide cross section for accessible, median bus platforms	●●● High: Provides transit priority consistent with BRT service by eliminating most conflicts between buses and other vehicles
	**Separated Busway** Roadways dedicated exclusively to transit operations with continuous separation from traffic	●●● High: Requires constructing a physical buffer between transit and traffic, may require median bus platforms if a two-way busway	●●● High: Requires a wide cross section to physically separate transitway from general traffic	●●● High: Provides transit priority consistent with center-running lanes

	Type of Bus Lane and Description	Level of Investment Needed	Right of Way Needed	Level of Transit Priority
	**Transit-only Street** Streets dedicated solely to bus operations where all other traffic is prohibited	●●○ Medium: Requires extra signage and road design to clearly prohibit entry, and dedicated signals and transit priority	●●● High: Repurposes entire street for transit and emergency vehicles only	●●● High: Eliminates most conflicts with general-purpose by completely prohibiting traffic
	**Fixed Guideway** Grade separated bridges, tunnels, guideways, or repurposed rail corridors dedicated solely to bus operations	●●● High: Requires construction of new stations and elevators and infrastructure to access the station; may require constructing a separated guideway if not repurposing existing infrastructure	●●● High: Requires right-of-way for elevators and new walkways and bike lanes to access the station	●●● High: Grade separation and greater distances between stop spacing maximize efficiency and eliminate all other modal conflicts.

Short Bus Lane

Short bus lanes—also called transit approach lanes, queue bypass lanes, or queue jump lanes—are segments of traffic lanes dedicated to buses approaching an intersection. Often paired with TSP (see TSP in a Queue Jump Lane), short bus lanes reduce transit delay at intersections by allowing buses to bypass queues and travel through the intersection more quickly.

Benefits

- Improves speed and reliability by allowing buses to bypass general traffic queues. Can use existing stops (if not creating bus stop curb extensions).
- Can implement in areas without space for a longer dedicated lane
- Can lengthen or reconfigure in any lane to meet the needs of a given corridor

Challenges

- Must be long enough to allow buses to bypass queues of through lane and turn lane general purpose traffic
- Enforcement is difficult, as the lane is not typically physically separated, and vehicles are only in the lane for a short time
- Intersections where right turns on red are prohibited may result in longer queues and reduce the benefit of the short bus lane

Complementary Treatments

- Bus Bulbs (p. 90)
- TSP in Queue Jump Plan (p. 40)

Short Bus Lane on Summer Street, Boston.

See It in Action:

An exclusive Short Bus/ Bike Lane was implemented in 2019 on Summer St at South Station for South Boston bus routes bound for Downtown.

1 **Painting Treatment** Short bus lanes should be painted red with “BUS ONLY” or “BUS BIKE ONLY” markings.

2 **Queuing** Ensure short bus lane is long enough for buses to bypass general purpose traffic queues and reach the short bus lane. If queues span multiple intersections along a corridor, consider implementing a dedicated bus lane instead.

3 **Bus-bike Interactions** If the street cannot accommodate a separated bike lane, allow bicycles in the short bus lane with a bike box at the head of the bus lane, if possible.

4 **Enforcement** Ensure there is a strategy in place to prevent illegal driving in short bus lane.

5 **Roadway Type** Short bus lanes are most impactful at approaches to TSP-enabled intersections, intersections where transit vehicles operate in a curbside lane, or at crossings where a right-turn queue jump lane is not viable.

Part-time Bus Lane

Part-time bus lanes are restricted to bus travel only during part of the day, using space otherwise allocated for curbside parking lanes. These lanes typically operate during morning and/or afternoon peak times, when ridership demand is highest, bus service is most frequent, and streets are at their most congested.

Benefits

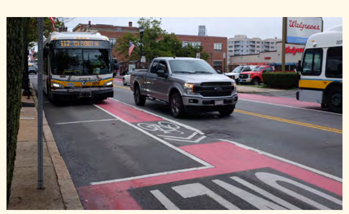
- Maintains general roadway capacity and does not require converting general purpose traffic lanes to transit priority
- Parking lanes are generally curbside, so buses serve existing stops
- Compatible use of ROW—can operate in the morning before businesses open, when on-street parking demand is low
- Can convert from part-time lane to full-time lane as needed

Challenges

- Requires extra signage and education
- Illegal parking and loading cause operational challenges
- Traffic must turn right in the bus lanes
- Only provides bus transit priority for part of the day—with all-day congestion, on-time performance for buses will be better in the peak than in the off-peak

Complementary Treatments

- Transit Signal Priority (p. 31)



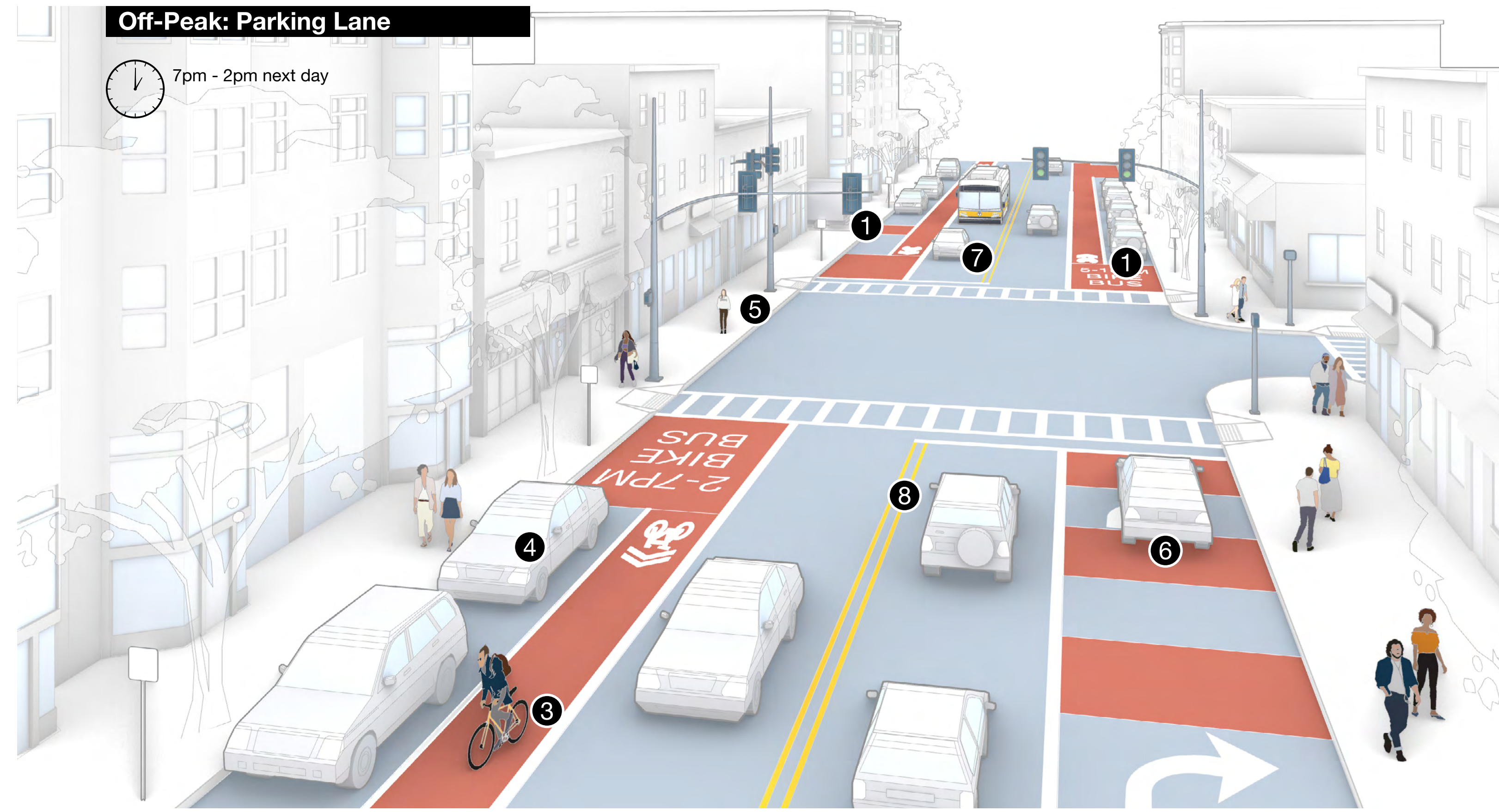
Mid-block

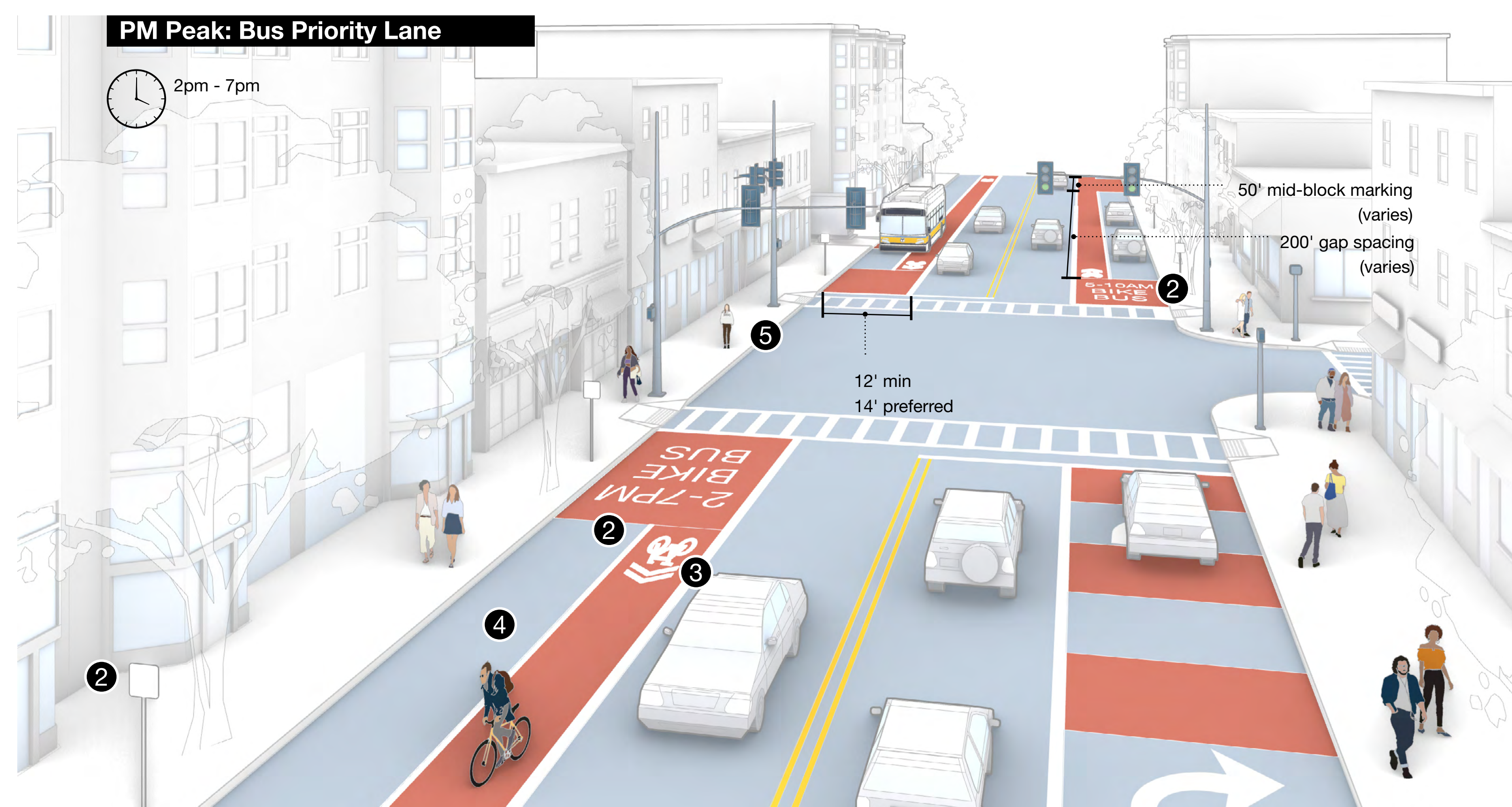
Bus stop

See It in Action

In 2016, the City of Everett piloted a morning peak bus-bike lane on a one mile stretch of Broadway's inbound parking lane. Transit travel times were reduced by 20–30%. With public support, the lane was made permanent and an outbound afternoon peak lane was added.

1. **Curb Access** Consider all the uses (including parking, loading, bike lane) the lane will host and if/how they can be designated to different times of day.
2. **Signage + Painting Treatment** Provide clear and consistent signage regarding when the bus lane is in effect and other shared regulations, such as parking. Apply "BUS ONLY" markings on receiving side of each intersection, more often on longer blocks.
3. **Bus-bike Interactions** Where possible, accommodate bicyclists separate from THE bus lane, potentially through an off-peak curbside bike lane adjacent to parking; otherwise, consider shared bus-bike LANE (P. 66) and additional bike accommodations (such as bike boxes).
4. **Enforcement** Craft a strategy to clear the lane of parked cars before bus only hours and to prevent activities such as illegal parking, standing, or traveling in the bus lane. If the part-time bus lane has electronic parking meters, reprogram them to prohibit parking during the bus lane hours of operation to avoid people being able to pay for parking. Update instructions on traditional parking meters to indicate parking is prohibited while the bus lane is in operation.
5. **Bus Stops** Buses will naturally stop curbside without having to pull in and out of traffic. Curb extensions do not work with this type of bus lane.
6. **Right Turn Volumes** Account for right turn volumes, as right-turning vehicles will need to enter the right lane to turn.
7. **Traffic Volumes + Queueing** Use where there are high vehicle volumes and where the bus is often delayed due to vehicle queuing, especially in peak hours.
8. **Roadway Type** Best used where there is only one travel lane and a parking lane. With more travel lanes, consider other types of full-time bus lanes.





Curbside Bus Lane

Curbside Bus Lanes are bus lanes that run adjacent to the curb and are typically used on routes that experience significant traffic delays. They can be implemented by repurposing a curbside general purpose travel lane or parking lane. This treatment allows buses to stop in-lane to pick up and drop off passengers on the sidewalk, saving time and further improving transit speed and reliability.

Benefits

- Higher visibility and reliability of transit service with full-time dedicated lane
- Maintains existing level of roadway capacity
- Possible to implement on roadways with more limited ROW as compared to other types of bus lanes
- Buses can serve existing stops since the lane abuts the curb
- Cyclists can use the bus lane for a safer option compared to general purpose traffic lanes

Challenges

- Displaces existing curbside parking and loading, which requires modifications to driver behavior and bus lane enforcement to prevent illegal parking or loading
- Requires removal of existing bus bulbs and curb extensions
- Requires wider lane width (11 ft.) than typical parking lane (7 ft.), unless there is a bike lane next to the parking lane
- Right turns must be made within the bus lane or require a dedicated turn-pocket or signal phase
- Municipalities must plow snow that it doesn't block the bus lane or boarding area or have an MOU with MBTA
- Municipalities must keep gutters and drainage clear to avoid rain pooling and splashing onto the sidewalk

Complementary Treatments

- Part-time Bus Lane (p. 62)
- Bus-bike Lane (p. 66)
- Transit Signal Priority (p. 31)

❶ **Curb Access** Plan to relocate any loading or delivery zones or taxi stands to nearby side streets, or restrict delivery hours. Look for opportunities on nearby side streets to add or reconfigure parking, especially handicap spots.

❷ **Signage and Painting Treatment** Apply red paint for entire lane, and bus lane markings on the receiving side of each intersection, as well as intermittently, approximately every 200', on longer blocks. Apply skip stripe markings at intersections or crossings of the bus lane.

❸ **Bus-bike Interactions** Where possible, accommodate bicyclists separate from bus lane. Consider shared bus-bike facility and additional bike accommodations (such as bike boxes) at intersections.

❹ **Enforcement** Ensure there is a strategy in place to limit opportunities of encroaching on the bus lane, such as with turning restrictions or bus specific signals, and clear the bus lane of parked cars to prevent activities such as illegal parking, standing, or traveling in the bus lane.

❺ **Bus Stops** Bus stop curb extensions do not work with this type of bus lane; buses will naturally stop curbside without having to pull in and out of a general purpose travel lane. Ensure there is sufficient sidewalk space for both bus stop passengers waiting to board and pedestrians passing through the stop, as well as any bus stop amenities.

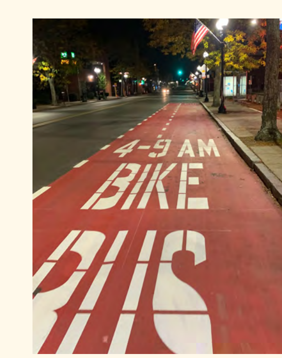
❻ **Right Turn Volumes** Curbside Bus Lanes will need to serve as bus/right turn lanes at intersections, as right-turning vehicles will need to enter the bus lane to turn.

❼ **Traffic Volumes and Queueing** Use where there is a high degree of delay and travel time variability (unreliability) in bus operations, as well as low to moderate curb, street, or driveway conflicts.

❽ **Roadway Type** Best used on roadways with more than two travel lanes; one travel lane with underutilized, limited, or no on-street parking and off-street parking alternatives; or one travel lane with well-utilized parking and a local commitment to prioritize moving people along a corridor.

See It in Action

A Curbside Bus Lane was installed in the City of Revere on Broadway, running southbound between Revere Street and Revere Beach Parkway during AM peak hours. This project has helped improve bus service by reducing congestion delays in a high-traffic area of Revere.



Bus-bike Lane

Bus-bike lanes provide a shared lane for both buses and bicyclists. They can be implemented by re-purposing a curbside general purpose travel lane, parking lane, or a narrow parking lane and adjacent bike lane. This treatment allows both buses and bicyclists to avoid congestion and conflicts from general purpose traffic.

Benefits

- Improves reliability of transit service, which may lead to reduced scheduled run times
- Improves experience for bicyclists as compared to riding in a general purpose travel lane
- Cost effective treatment on streets with constrained right of way unable to accommodate separate bus and bike facilities
- Can be peak period only and revert to parking, or parking and conventional bike lane, in off peak periods

Challenges

- Bicyclists must still share lane with large vehicles
- Biking around buses serving an in-lane stop can be problematic and may lead bicyclists encroaching on general purpose travel lanes; articulated buses are particularly difficult to navigate around
- Not suitable for corridors with very frequent bus service (under 4 minutes), high bicyclist volumes, or high-speed bus service

Complementary Treatments

- Curbside Lane (p. 64)
- Part-time Bus Lane (p. 62)

1 **Headways** Consider current or desired route frequency. Not recommended on roadways with frequent bus service (headways of 4 min. or less).

2 **Bus-bike Interactions** As buses and bikes share a lane, these are not low stress bike facilities.

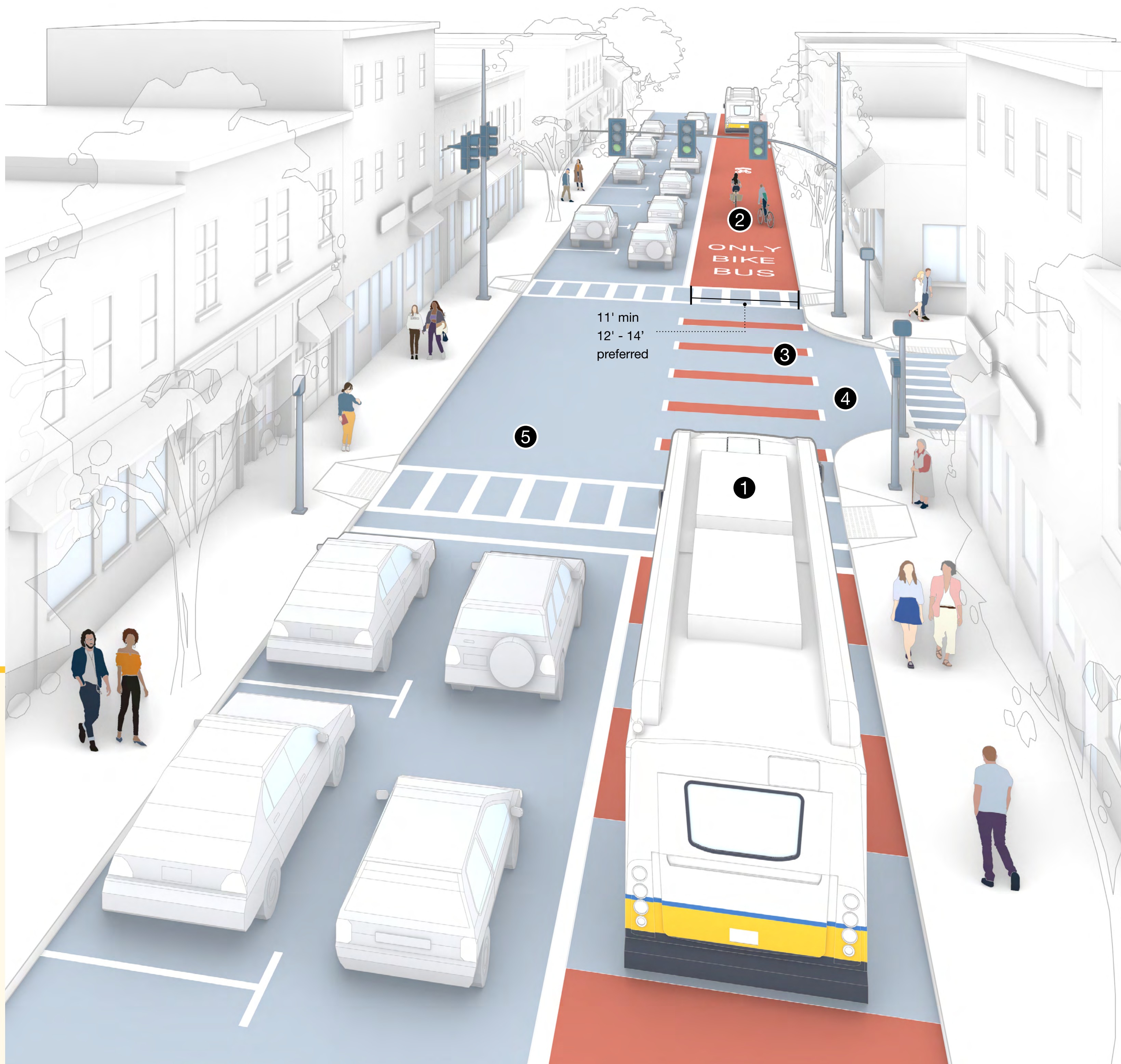
3 **Intersections** Consider installing bike boxes to improve bicyclist visibility and bike signals to provide separation through intersections. Buses would use the general purpose traffic signal(s).

4 **Right Turn Volume** Account for right turn volumes, as right-turning vehicles will need to enter the bus-bike lane to turn. Bus-bike lanes will need to serve as bus-bike-right turn lanes at intersections.

5 **Roadway Type** Bus-bike lanes are best suited for slower roadways with travel speeds of less than 20 mph and where there is only one travel lane and a wide parking lane or parking lane with conventional bike lane, or two travel lanes where one lane is underutilized. Bus-bike lanes are typically implemented because there is not sufficient roadway space for separate facilities. Where space is available, consider installing a bike lane in the direction of uphill travel, where cycling speeds are slower.

See It in Action

In 2020, MBTA and the City of Chelsea implemented an all-day bus-bike lane on Broadway in Downtown Chelsea. At the southern end of the bus-bike lane, a separated bike lane continues south.



Parking Offset Bus Lane

Parking offset bus lanes restrict the use of the outer travel lane(s) to buses only, while preserving on-street parking along the curb. They require at least two travel lanes in each direction of the bus lane.These lanes improve transit speed and reliability and reduce transit travel times by allowing buses to bypass congestion along the corridor.

Benefits

- Maintains parking supply at or near existing levels
- Maintains loading
- Can use existing curbside stops (if not creating bus bulbs)
- Does not require traffic signal changes

Challenges

- Double parking and loading cause operational challenges—enforcement can be difficult
- Buses must pull into the curb, slowing down service, and cannot stop in lane without bus bulbs
- Right turning vehicles must enter or cross the bus lane
- Requires a wider cross-section to preserve the parking lane

Complementary Treatments

- Bus Bulbs (p. 90)
- Transit Signal Priority (p. 31)

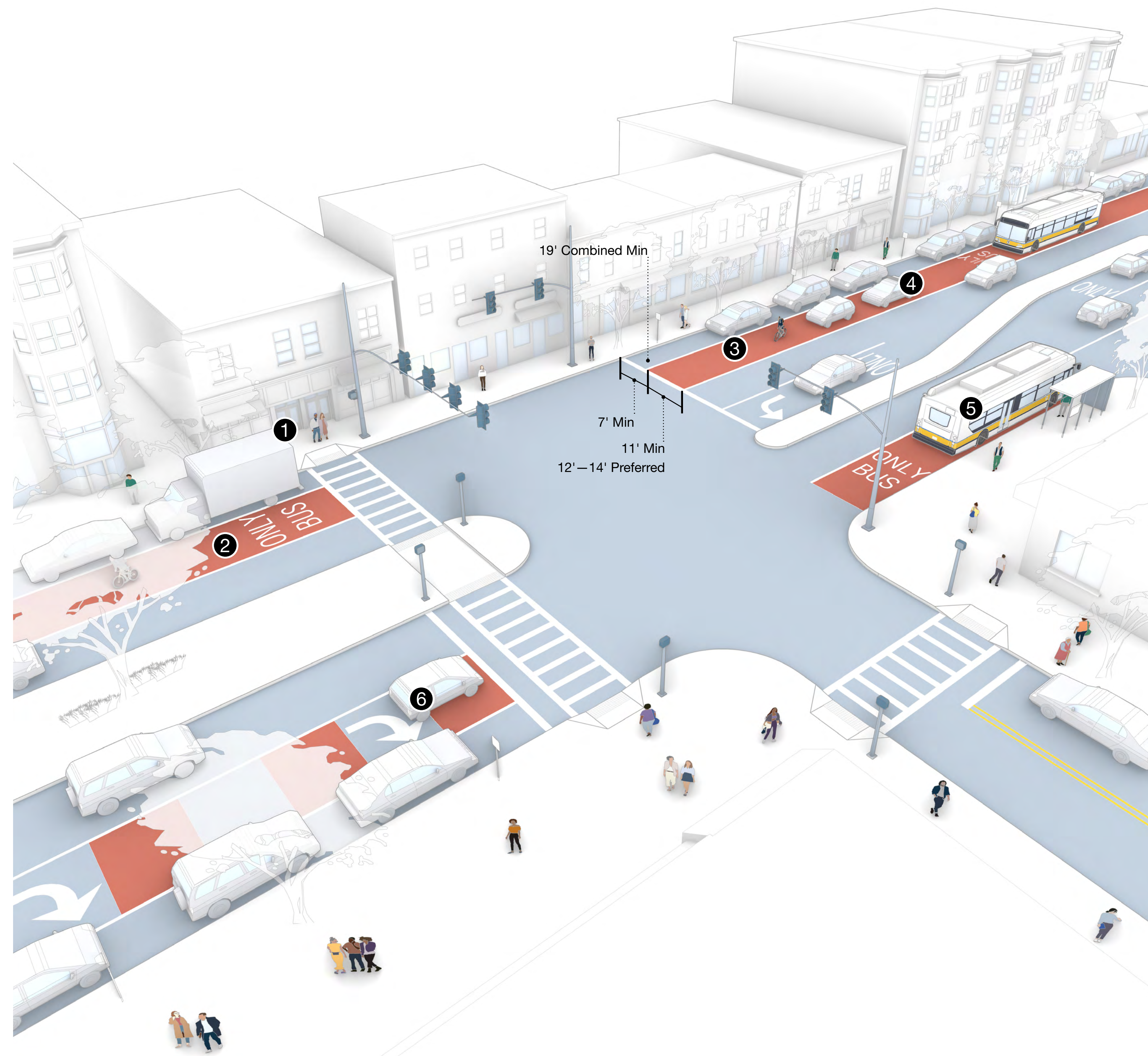
Before

After

See It in Action

In 2019, MBTA and the City of Boston implemented a 0.6-mile parking offset bus and bike lane in both directions on Brighton Ave between Cambridge St and Commonwealth Ave where the MBTA Routes 57 and 66 operate.

1. **Curb Access** Consider how loading activities (such as large vehicles in a narrow parking lane) may encroach on the bus lane, and provide adequate curb access along the corridor.
2. **Painting Treatment** Apply red paint for entire lane with BUS ONLY markings on receiving side of each intersection as well as approximately every 200' on longer blocks.
3. **Bus-bike Interactions** Consider current and future bicycle volumes along the corridor. Where possible, separate bus and bike lanes; otherwise, consider a shared bus-bike lane and additional bike accommodations (such as bike boxes).
4. **Enforcement** Enforce proper use of bus and parking lanes to prevent activities such as double parking and illegal parking or standing. May require more agency-municipal coordination than other bus lanes.
5. **Bus Stops** Bus stop lengths vary based on the stop location and configuration, but must be at least 40'. Bus bulbs require the least amount of curb space while curbside pullout stops require the most. Consider installing bus bulbs, as shown in the image, to reduce curb space and allow buses to stop in lane.
6. **Right Turn Volumes** Account for right turn volumes, as right-turning vehicles will need to enter or cross the bus lane to turn.



Bus-on-shoulder

Bus-on-shoulder operations are when buses are authorized to use the shoulder of an interstate highway or other route when traffic is congested, bypassing slower general purpose travel lanes. This treatment is a relatively low-cost means of improving transit speed and reliability on highways.

Benefits

- Improves bus speeds and reliability through congested segments or periods
- Relatively low capital costs, depending on existing conditions
- High visibility to potential transit users—may encourage mode shift

Challenges

- May require relocating or upgrading rumble strips, stormwater grates and guardrails
- Buses may encroach on general purpose traffic lanes if shoulder is too narrow
- Pinch points, such as bridge abutments, guardrails, etc.
- Emergency use of the shoulder by other vehicles requires buses to merge into general purpose traffic lane
- Left exits and resulting lane shifts
- Monitoring of debris/other obstacles and quick removal
- Snow clearing and surface treatment of the shoulder

I-93 in vicinity of Medford

See It in Action

In Massachusetts, the state's first bus-on-shoulder operations began as a pilot in 2021 on I-93 between the I-95/Rt-128 interchange and Sullivan Square. Bus-on-shoulder are more commonly used in other US metropolitan areas, such as Minneapolis, MN, St. Petersburg, FL, and the Research Triangle area of North Carolina.

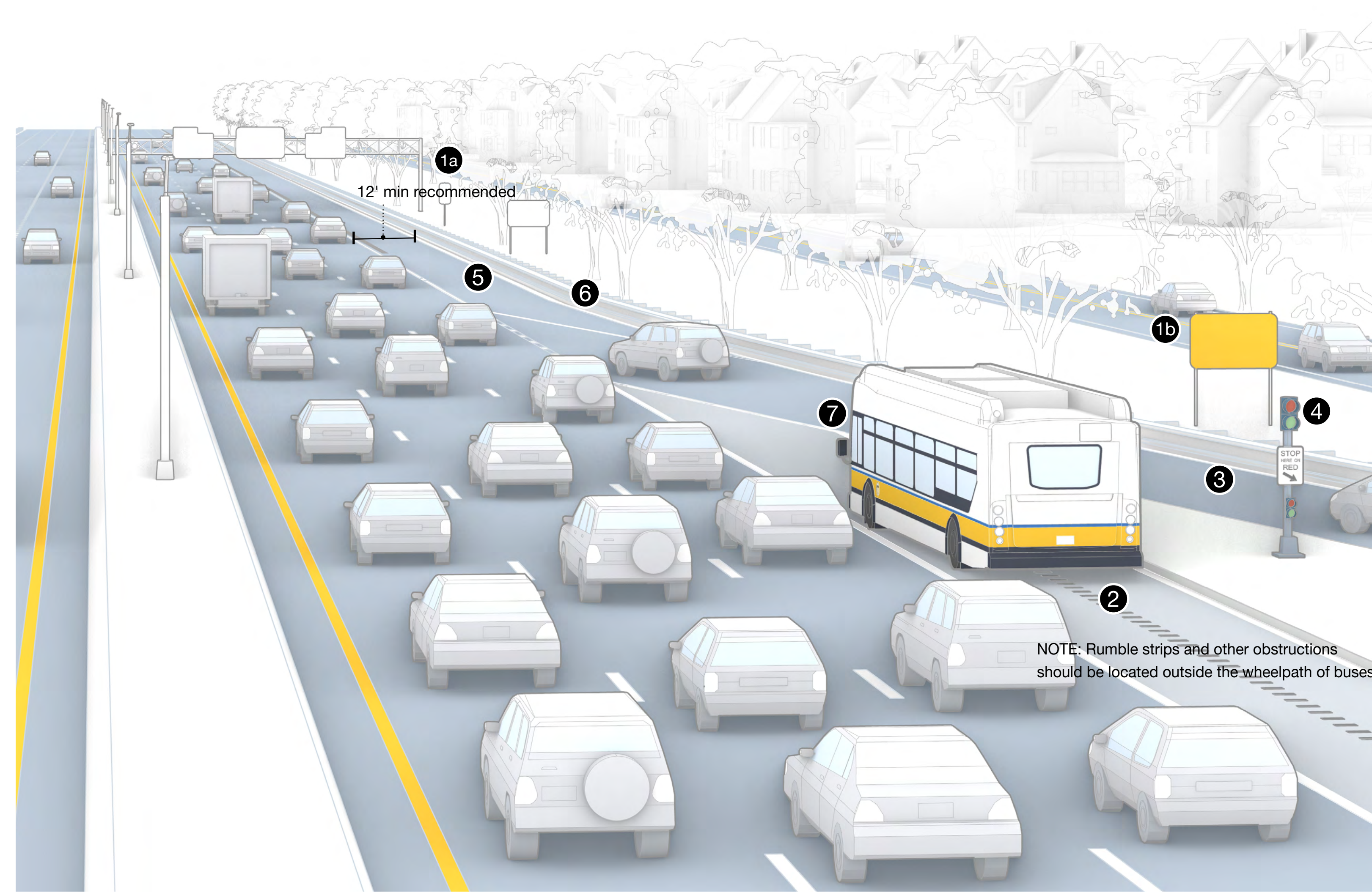
1. **Signs & Striping** Provide signage to prohibit non-transit vehicles from using the shoulder. Signage is also required to alert motorists to the possibility of buses traveling in the shoulder across on and off-ramps. Red paint is not required, but could be used as a spot treatment on a case by case basis to enhance visibility.

2. **Roadway / Guardrail Conditions** Evaluate (1) shoulder width for consistency and identify pinch points, such as at bridges or protruding natural features; (2) roadway shoulder/edge conditions for ability of buses to drive over the surface, including gravel shoulders, edge treatment, or damaged pavement; (3) start of guardrail or impact attenuator to confirm sufficient offset from shoulder.

3. **On/Off-Ramps** Consider bus travel in shoulders through on and off-ramps and the sight lines for vehicles using those ramps. Vehicles merging onto a highway via on-ramps will need additional signage and indication to expect buses traveling in the shoulder. Vehicles exiting the highway will need to be alerted to buses passing on the right at off-ramps.

4. **Signals** Consider use of supportive signal treatments, such as Bus on Shoulder Signals, which are controlling signals installed on on-ramps to notify drivers of approaching buses on the shoulder. If used, a "Ramp Signal Ahead" sign should be installed ahead of the signal to warn drivers.

1a

5. **Education & Enforcement** Only authorized buses can use the shoulder. Extensive outreach, combined with police monitoring when a lane first opens, can build an understanding of proper use of the lane. On highways where peak period travel in the breakdown lane was or is still permitted on other segments, outreach should address that access is no longer permitted in bus-on-shoulder lanes (e.g., via signs). MassDOT permits buses to travel in the shoulder at up to 35 mph. However, MBTA only permits bus operators to travel a maximum 15 mph above the general purpose lane speed, while not exceeding 25 mph. MassDOT has the same 15 mph speed differential restriction.

6. **Maintenance** Repair guardrail if there is any damage that would create a pinch point along the shoulder between the guardrail and bus. Clear catch basins regularly and keep far shoulder edge in sufficient condition to prevent crumbling.

7. **Agency Coordination** When multiple transit operators use the bus-on-shoulder, there should be good communication between the roadway owner and the transit operators to disseminate alerts about lane disruptions and other important messages.

Contraflow Lane

Contraflow lanes are dedicated bus or shared bus-bike lanes that flow against general traffic. A contraflow bus lane operates on one- and two-way streets where one lane is restricted to buses or buses and bikes only; general purpose traffic is prohibited in that lane.

Benefits

- Used strategically to make the bus network more efficient, especially in areas with one-way streets that would require extra turns and route deviations if the bus was going the same direction as traffic
- Buses can run in both directions on one-way streets
- Improves bus speeds by avoiding congestion and parking conflicts, making in-lane, curbside stops
- Also supports contraflow bike lanes

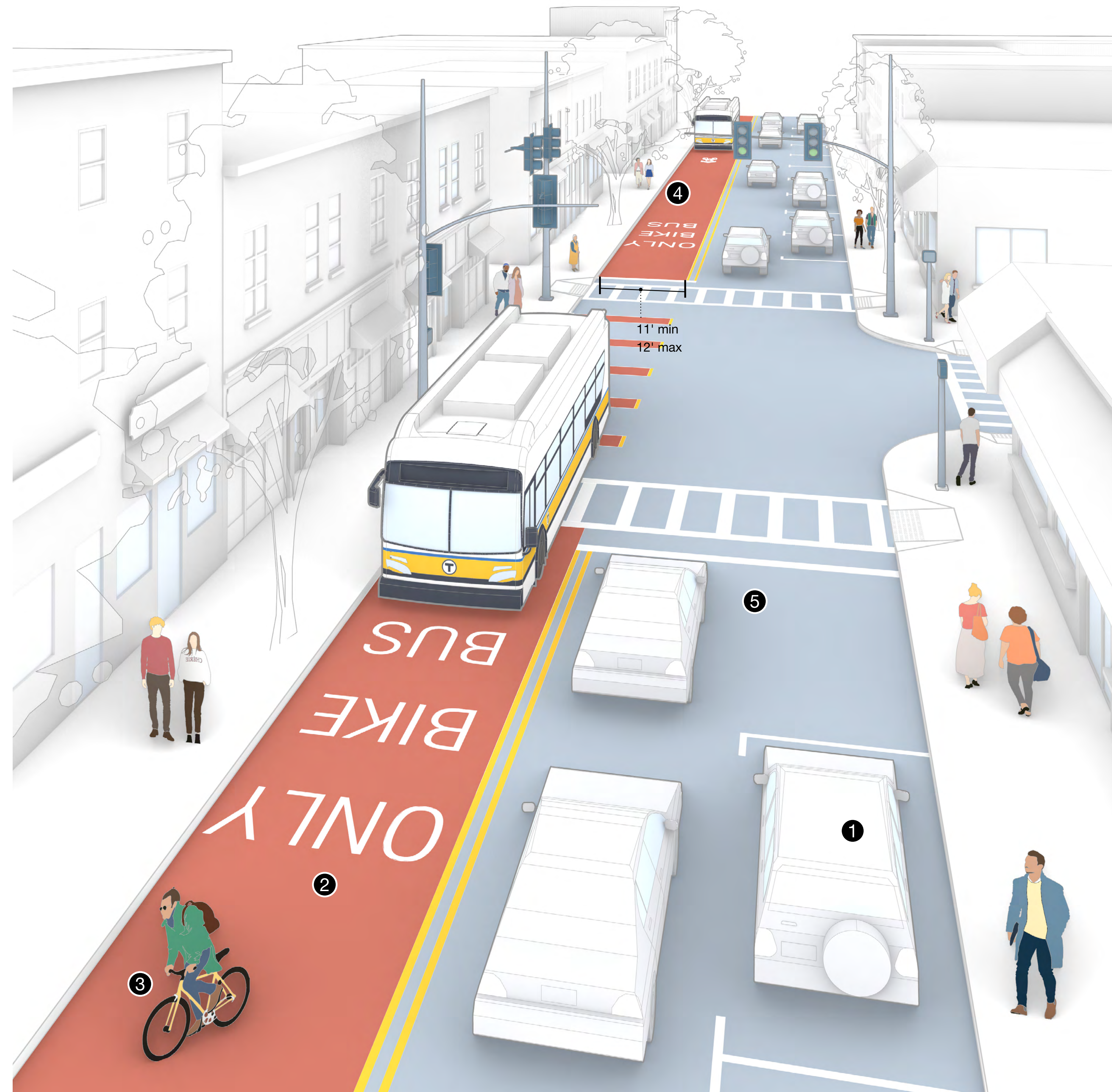
Challenges

- Requires extra signage and road design to clearly prohibit wrong-way entry and private vehicle use, and to aid in pedestrian safety
- May require removing bus or pedestrian bulbs
- Requires traffic signal changes at signalized intersections

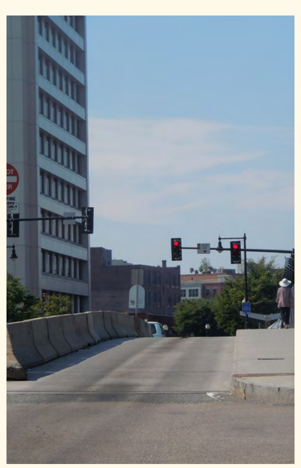
Complementary Treatments

- Transit Signal Priority with or without Queue Jump (p. 40)
- Floating Bus Stops (p. 92)

1. **Curb Access** Relocate parking and loading activities to mixed-traffic side of the street or to adjacent roadways.
2. **Signage and Painting Treatment** Provide clear and consistent signage indicating one-way travel, turn prohibitions, and no entry except for buses (and bikes if applicable). Contraflow lanes should be painted red with “BUS ONLY” or “BUS BIKE ONLY” markings. If there is not a physical separation, a double-yellow center line should be applied to separate the contraflow bus lane from opposing flow of traffic.
3. **Bus-bike Interactions** When possible separate bus and bike lanes. Otherwise, bicyclists should be permitted in the contraflow lane.
4. **Enforcement** Ensure there is a strategy in place to prevent illegal parking, standing, and traveling in the bus lane.
5. **Roadway Type** Municipalities can implement contraflow lanes on a variety of roadway typesNarrow roads may only accommodate one contraflow bus lane and one mixed traffic lane, while wider roads may accommodate bus lanes in both directions.



See It in Action


Washington St, Boston

MBTA Silver Lines 4 and 5 run along a short contraflow lane on the Washington Street bridge over the Massachusetts Turnpike/I-90. There is one southbound bus-only lane, separated by a concrete jersey barrier from northbound traffic, which has two general purpose lanes and one bus-only lane.

Center-running Bus Lane

Center-running bus lanes are dedicated bus lanes that operate in the middle of the roadway, in the same direction as adjacent general purpose traffic lane(s). They are typically implemented on streets that have at least two lanes in each direction. Usually, the leftmost travel lane in each direction is converted to a bus lane. By placing the bus lane away from parking and/or side street traffic, center-running bus lanes reduce conflicts with vehicles and bicycles and significantly improve transit speed and reliability. Center-running bus lanes are often most effective on corridors with a wide cross-section, frequent curb cuts, and/or there is support for a high-quality transit facility.

Benefits

- Reduces bus conflicts with parking, loading, bicycles, vehicle right-turn movements, driveway, and side street egress
- Requires less enforcement, as the bus lane is not curbside, where lane encroachment for stopping, loading and parking, or double parking is typically more prevalent
- When used in conjunction with median bus platforms, provides high level of transit priority—reflective of BRT service, that enhances the public perception of bus service as a high-quality service and passenger experience
- Suports broader multimodal improvements, such as new or enhanced crosswalks, streetscaping, and lighting that also provide traffic calming benefits

Challenges

- Conflict points between through buses and left and u-turning vehicles, and between through vehicles and right-turning buses, requiring transit signals to separate bus and general purpose movements
- Truck and delivery drivers may still attempt to park/load in a center-running bus lane if curb regulations are not updated
- Requires significant construction to relocate bus stops from curbside to median bus platforms; moving stops requires deconstruction of existing eliminated bus platforms and reconstruction of new platforms
- Wider cross-section needed in order to maintain a parking lane
- Higher service frequencies and/or articulated buses may require longer platforms
- Construction may involve extensive utility relocations and drainage improvements as a result of regrading
- Difficult to implement along corridors that are not straight

1 **Intersections** Implement appropriate turning provisions to remove conflicts between buses and turning vehicles, including:

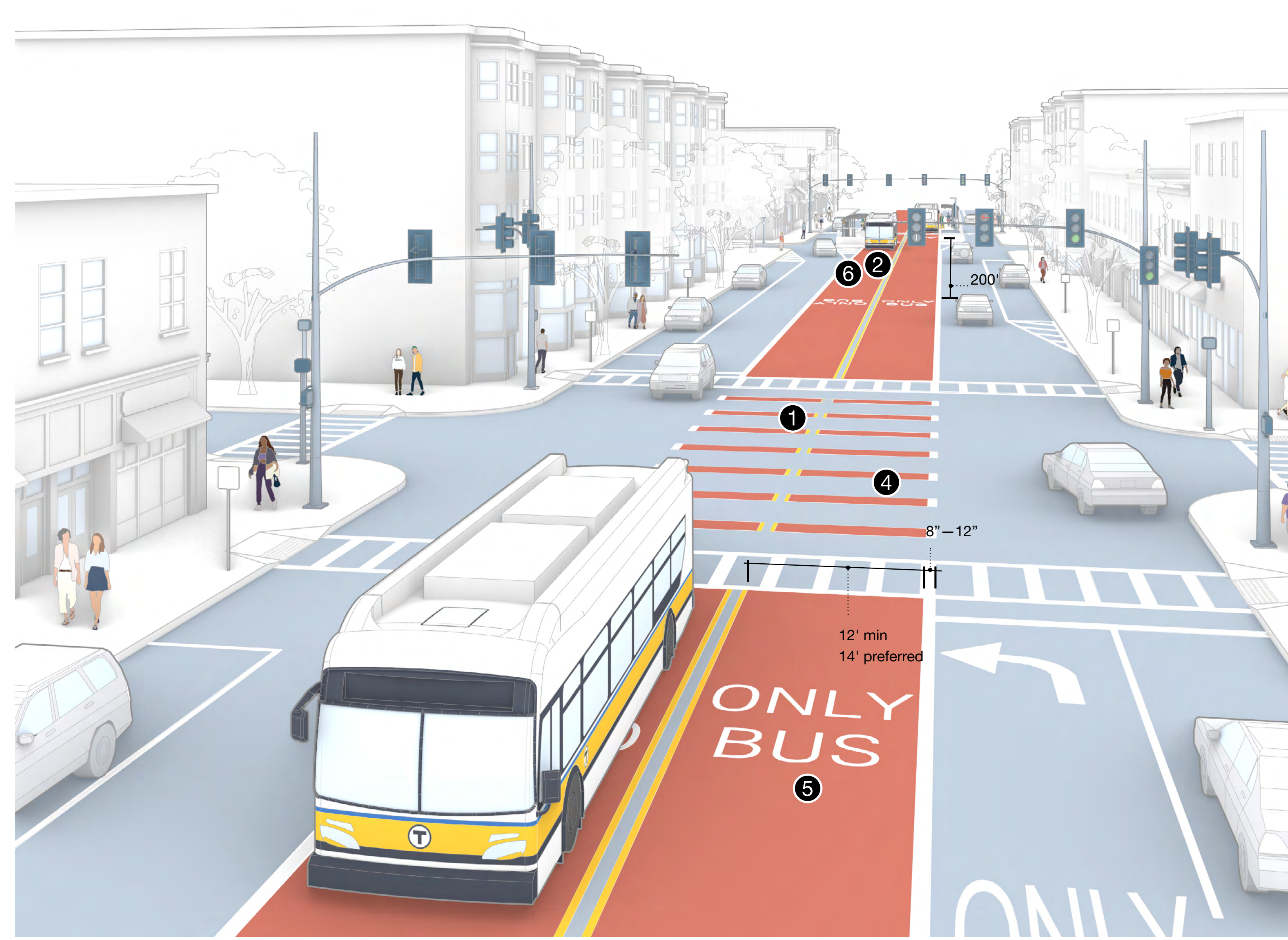
a. Restrict unsignalized left and u-turns for general traffic.
b. Provide dedicated turn signals and transit signals to separate bus movements from general purpose traffic; avoid configurations requiring general purpose traffic to cross over the bus lane.
c. Only use shared center bus lane and left turn lane at start of bus lane, otherwise shared lanes should be avoided.

2 **Platform Length Requirements** Consider current or desired route frequency. More frequent bus service may require longer platforms.

3 **Bus-bike Interactions** Bus-bike conflicts on the right side of the roadway are removed. Center-running lanes are generally not suitable for shared bus-bike lanes due to likely lower comfort level for bicyclists. Bicyclists would have to cross at least one lane of traffic to reach the bus lane/egress and access side streets. Service frequencies and potential conflicts with buses going the opposite direction if trying to pass buses at stops.

4 **Signage + Painting Treatment** Apply red paint for entire lane, and bus lane markings on the receiving side of each intersection, as well as intermittently, approximately every 200', on longer blocks. Solid white lane lines should be used to offset bus lanes from general traffic where physical separation is not present. Apply skip stripe markings at intersections or crossings of the bus lane.

5 **Enforcement** Enforce proper use of bus lane to prevent activities such as illegal use of the lane. Due to their separation from parking and loading areas, center-running bus lanes likely need less intensive enforcement than curbside lanes. Consider the land use of the corridor; commercial uses lacking easy access (short-term) loading zones, may result in loading in the bus lane.



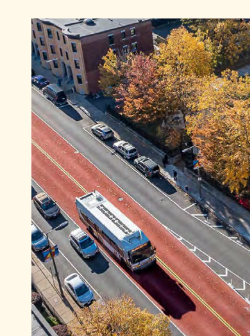
6 **Physical Separation** At lane approaches/egress areas of platforms may warrant vertical deflections to further discourage general vehicle/parking/loading use of gore area. Place the deflections on the outer edge adjacent to travel lane approaching the platform, and on the inner edge adjacent to bus lane approaching and egressing platform, where allowing for service vehicle access. To allow access during a temporary bus lane obstruction and to maintain emergency access, physical separation is discouraged on the right side of the bus lane (except where recurring/problematic turn conflicts may need more visible deterrence).

Complementary Treatments

- Median Bus Boarding Platform (p. 74)
- Transit Signal Priority (p. 31)

See It in Action

Completed in 2021, center-running bus lanes servicing both directions of travel on Boston's Columbus Ave serve MBTA Routes 22, 29, and 44 between Jackson Sq and Walnut St.



Separated Busway

Separated busways are a type of transitway, with street space dedicated exclusively to transit operations, physically separated from general-purpose traffic. They improve bus travel times by allowing buses to bypass traffic and by giving buses priority at the intersection. They are best suited for corridors with high transit volumes to maximize reliability benefits. When implemented along streets with mixed traffic, either on a one or two-way street, separated busways typically run along one side of the street either as bi-directional transit lanes or a single transit lane. Unlike center-running bus lanes, separated busways typically feature vertical separation and buffers along the entire corridor.

Benefits

- Improves bus speed and reliability by eliminating conflicts with parked cars, turning traffic, delivery trucks, bicycles, and general-purpose traffic
- MBTA buses, third party transit operators, and emergency vehicles can use the transitway to bypass traffic
- Physical barriers and enhanced stations create a premium look and feel to bus service that's comparable to rail
- Improves the pedestrian and rider experience by providing separation from vehicle traffic, in addition to refuge islands and other features that shorten crossings

Challenges

- Requires a higher level of capital investment with a longer construction duration compared to bus lanes
- Requires repurposing parking and travel lanes, that could reroute traffic and limit curb access
- Requires a wide cross section to physically separate the transitway and accommodate space for other modes along the corridor
- Requires managing or prohibiting turns across the transitway

Complementary Treatments

- Median Bus Platforms (p. 94)
- Transit Signal Priority in a dedicated lane (p. 38)

1 **Curb Access** Relocate parking and loading activities to the non-busway side of the street, along the median between the transitway and the general-purpose lanes, or to adjacent roadways.

2 **Signage and Painting Treatment** Place signage preventing cars from entering the transitway at every intersection and consider applying red paint for entire transitway with BUS ONLY markings on the receiving side of each intersection.

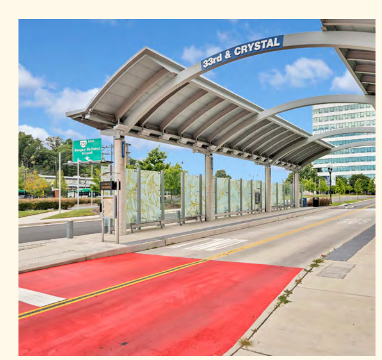
3 **Bus-bike Interactions** Bus and bike facilities should be physically separated or on parallel streets since there is limited space for passing in the busway and high transit volumes.

4 **Signals and Intersections** Separated busways require their own signals with transit signal heads to give the bus priority at the intersection and maintain efficient and reliable bus operations. TSP can extend green lights and truncate red lights as buses approach intersections.

5 **Bus Stops** Where possible, provide premium bus stops with level boarding and off-board fare payment to reduce dwell time at high ridership stops. For two-way busways, bus stops should be along the median between the transitway and the general-purpose lanes.

6 **Pedestrian Crossings** Include refuge islands at intersections between the transitway and general-purpose lanes and allow ample time for pedestrians to cross the full length of the street.

7 **Entering and Exiting** Buses should have a dedicated signal and priority that allow them ample time and space to enter the busway and transition back into the curb lane when the transitway ends.



See It in Action

In Arlington, VA, WMATA's Metroway BRT service runs along the Crystal City Potomac Yard Transitway, which features a separated busway between the 27th St and South Glebe stations. The transitway includes two lanes for buses in both directions along the whole corridor, while the general-purpose lane is either one-way or two-way depending on the segment.

Transit-only Street

Transit-only streets, sometimes referred to as transit malls, are a type of transitway that converts a corridor, curb-to-curb, for exclusive or nearly exclusive use by buses or light rail, prohibiting or restricting general purpose traffic. Transit-only streets typically run through downtown and neighborhood commercial and retail corridors. When paired with other multimodal improvements, transit-only streets can improve access and spur economic growth. Unlike other transitways, transit-only streets provide dedicated transit facilities without physical separation by limiting vehicle access to buses all-day or at certain times of day.

Benefits

- Does not require wide ROW and can support pedestrian and bike improvements to create a vibrant street that promotes economic activity
- Significantly improves bus travel times and reliability in some of the most dense and congested areas
- Reduces conflicts between transit and vehicles, and people and vehicles improving corridor safety

Challenges

- Repurposing general-purpose traffic and parking requires rerouting traffic to other adjacent streets and identifying nearby areas for parking opportunities
- Loading and curb access may be difficult and must be managed for businesses along the corridor with time-of-day restrictions or other access points, like alleys or side streets

Fulton Street, Brooklyn, NY

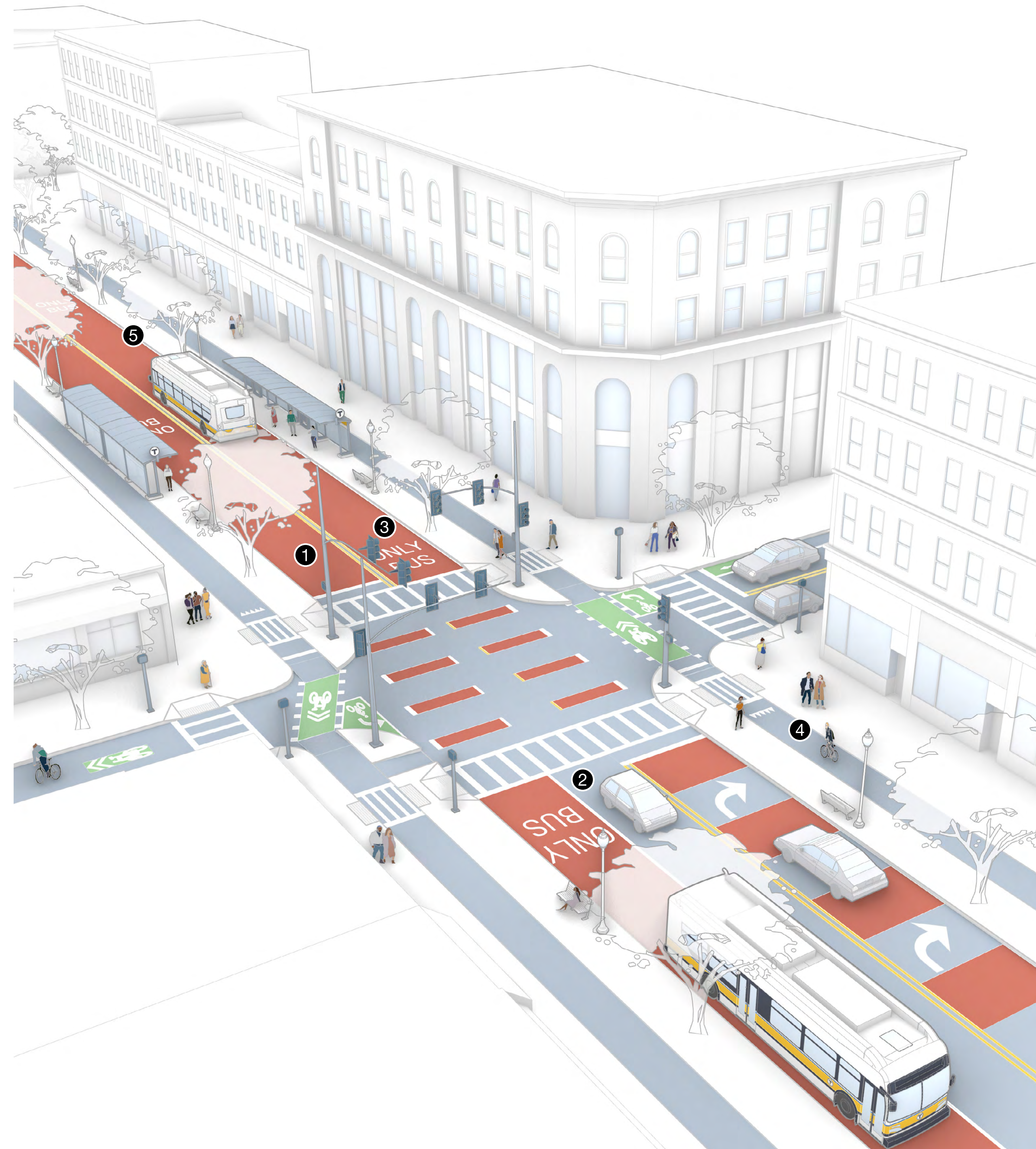
See It in Action

The Fulton Street Busway is a two-lane transit-only street in Downtown Brooklyn, along a dense commercial corridor with high pedestrian and bus volumes. The transit-only street is served by four bus routes carrying approximate 40,000 riders per weekday.

1. **Signage and Painting Treatment** Clear indications that cars should not enter the street are essential, with red painted lanes and visible signage at every intersection.
2. **Street Access** Based on the surrounding street network and loading needs, determine if general-purpose traffic should be prohibited or restricted, such as allowing delivery trucks to load and unload during certain hours.
3. **Enforcement** Enforce proper use of transit-only streets, especially when cars are prohibited from entering, to prevent activities such as blocking or driving in the bus lane.
4. **Pedestrian and Bike Environment** Transit-only streets are likely to have high pedestrian and bike traffic. Sidewalks should be wide enough to accommodate high volumes of pedestrians, and separated bikeways at the sidewalk or street level should be provided to reduce conflicts between pedestrians, bicyclists, and transit riders.
5. **Curb Height & Drainage** Curbless streets encourage activity and maximize the amount of space for transit and people walking and biking. Curbless streets require special landscaping and pavement to support drainage and storm water collection, as well as tactile edges for those with vision impairments. Curbless streets should reserve space outside of the transitway for snow removal.

Complementary Treatments

- Transit Signal Priority (p. 31)



Fixed Guideway

Fixed guideways maximize the efficiency of bus operations by fully separating the busway from the street network. Fixed guideways can be at-grade, elevated, below grade, or tunnels and work for high transit volumes that have limited stops over longer distances. Many fixed guideways are implemented along rail ROW.

Benefits

- Maximizes bus speed and reliability due to limited intersections and conflict points with other modes
- Support new walkways and bikeways can be added along the corridor to increase connectivity and improve safety and comfort for pedestrians and bicyclists
- Expands the transit network to provide faster and often more direct connections to downtown and other neighborhoods centers along the alignment

Challenges

- May require significant capital investment and space to build dedicated guideway and stations
- Requires investments in pedestrian and bike connections to the stations
- Bridges and tunnels may be subject to additional rules and regulations requiring more intense coordination across stakeholder groups, including other jurisdictions, MassDOT, and the Federal Railroad Administration
- Not suited for downtown areas and local stops

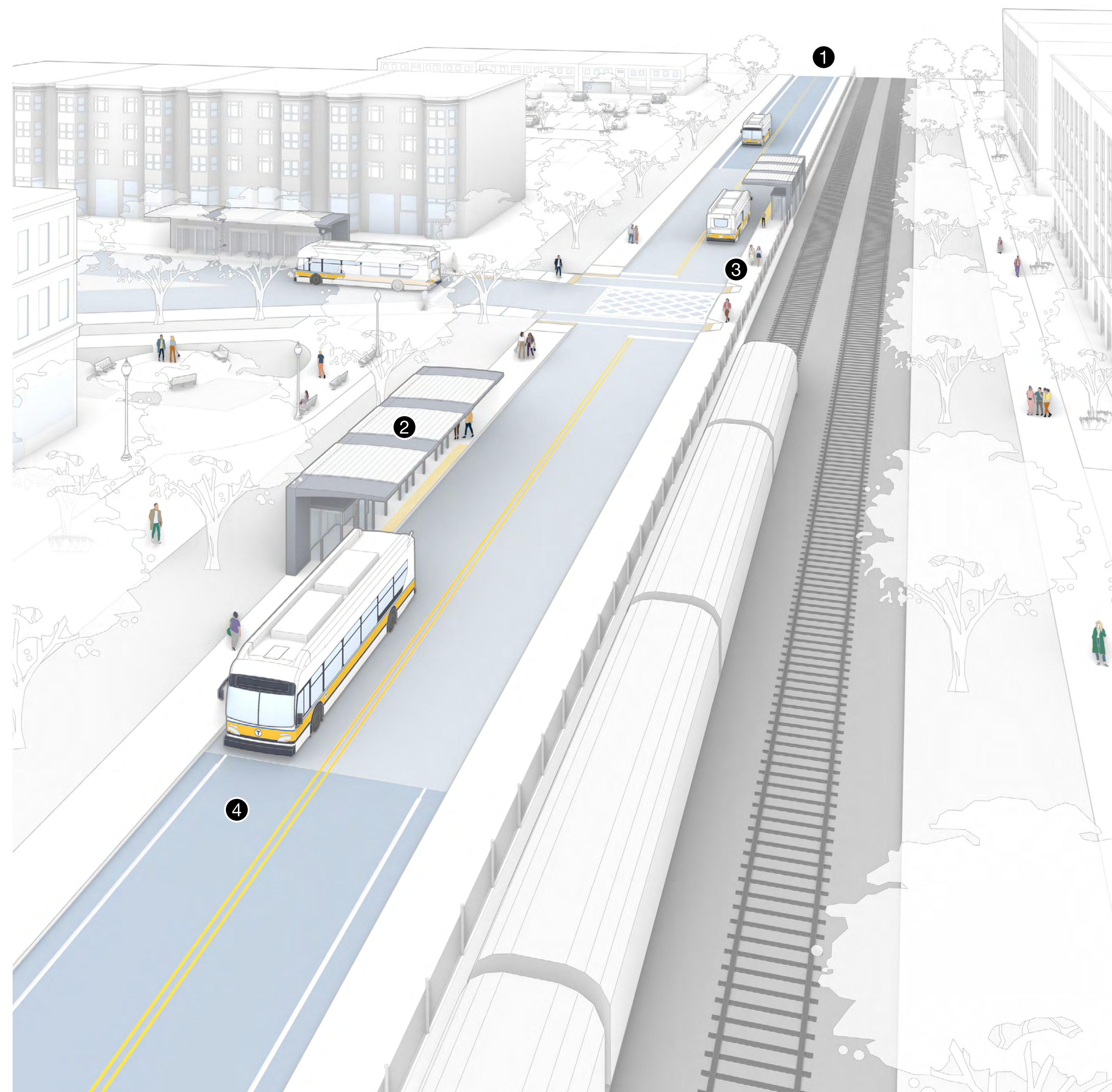
Complementary Treatments

- Transit Signal Priority (p. 31)

See It in Action

In Boston, through Chelsea, Silver Line 3 operates in a fixed guideway adjacent to a rail corridor.

1. **Signage** Post signage at entrances and exits of the fixed guideway to prevent cars from entering.
2. **Station Locations** Consider building premium bus stations at key destinations with a limited stop service to optimize bus speeds. If there is local service consider bypass lanes to allow rapid/express buses to pass local stops.
3. **Station Access** Since a fixed guideway is separate from the street network, provide convenient ADA, pedestrian and bike access to stations, including pedestrian and bike bridges, or elevators if the guideway is not at street-level.
4. **Long-Term Operations** MBTA or MassDOT offices with experience in fixed-guideway and highway operations may be better suited to manage fixed guideways than MBTA bus or other municipalities.



Chapter 5:

Bus Stop Treatments

Bus Stops Overview

Bus stops serve as the gateway to the MBTA system. Everyday, thousands of trips start and end at a bus stop. Safe, accessible, and comfortable bus stops provide a more pleasant experience for riders and improve bus operations, making them a key pillar of the MBTA Better Bus Project. Bus stop treatments reduce bus dwell time, provide more space and separation from pedestrians and bicyclists, and enable in-lane stop access. These improvements help to make buses a more competitive and reliable mode of transportation, further supporting transit priority.

Sources of Delay

Bus priority benefits are lessened by excessive dwell time, when buses spend longer than necessary at bus stops, and frequent stop spacing. Delays at bus stops can occur in the following scenarios:

- **Pulling into a bus stop** Inaccessible boarding areas and insufficient stop lengths make it challenging for operators to reach the curb increasing the boarding time. In addition, if the stop is nearside the bus can experience signal delay if it misses it's green light while passengers are boarding.
- **Passengers boarding and alighting the bus** The volume of passengers at a stop can slow down bus service if there is high ridership and on-board, front-door fare-collection.
- **Exiting and reentering traffic** Buses may need to merge into the parking lane, bike lane, or shoulder to serve a stop and then, after passengers board, find a gap in traffic to reenter. Reentering traffic can be challenging when traffic volumes or traffic speeds are high.
- **Frequent stop spacing** Each bus stop has the potential for merge, signal, and boarding delays. These delays add up and can quickly cause a snowballing effect that results in service that is slow and unreliable. For more guidelines on preferred stop spacing see the MBTA Bus Stop Planning and Design Guide.
- **Stop Accessibility** Inaccessible boarding areas and insufficient stop length can also make it more difficult to board, increasing boarding time.

Implementation Considerations

To reduce dwell time and improve bus speed and reliability, municipalities should consider the following design treatments and approaches:

- **Farside stop placement** MBTA prefers farside stops to take advantage of transit signal priorirty (TSP), reduce signal delay, and allow riders to cross behind the bus.
- **All-door boarding** Can reduce dwell time significantly by eliminating the need for the operator to collect or verify fares. All-door boarding requires off-board fare collection.
- **Bus bulbs and floating bus stops** Allow for in-lane operations in cases where there are not curbside bus lanes. Bus bulbs and floating bus stops eliminate the need to exit and reenter traffic—reducing delays. In addition, they reduce crossing distances, improve visibility, and slow down turning vehicles improving corridor safety. See median boarding platforms (p. 94) for design and implementation considerations.

Bus stops are often modal mixing zones by design. It is important for planners to consider bus stop configurations, sidewalk widths, traffic queuing, curb space demands, and amenity placement when designing bus stops. Below are some design strategies to mitigate common modal conflicts at bus stops:

- **For bus-pedestrian interactions** All bus riders walk or roll to the bus stop at some point in their trip. Safe, accessible, and convenient crossings and sidewalks are key to high-quality transit service. At high-ridership or high pedestrian-traffic stops, it is important to provide adequate space for waiting, boarding, and alighting. Farside stop placement is also typically safer than nearside because people are crossing behind a stopped bus. Floating bus stops and center island bus stops and designs can reduce the risk of pedestrian/bicycle conflicts.
- **For bus-bike interactions** Floating bus stops and median bus platforms maintain a dedicated and protected bike lane at bus stops. On one-way streets, consider configuring the bike lane on the left side of the street, opposite bus stops.
- **For bus-vehicle interactions** In-lane stops and dedicated bus and turn lanes provide dedicated spaces for bus and vehicle operations that reduce lane weaving and conflicts between buses and vehicles. Along busy commercial corridors, consider dedicated loading zones and pick-up drop-off zones to prevent parking and loading in the bus stop.

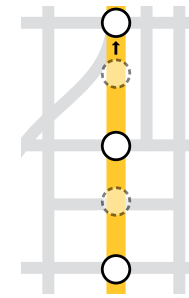
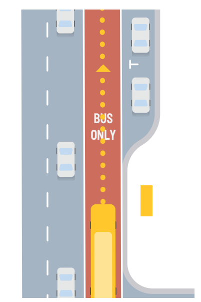
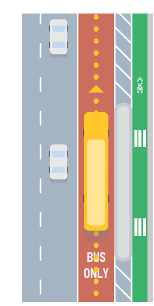
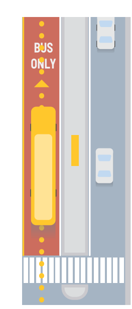
Prioritizing Bus Stop Improvements

Bus stop improvements should be a core component of transit priority projects because of the benefits they provide to the customer experience. Municipalities should consider prioritizing bus stop amenities and bus priority treatments at:

- **High ridership bus stops** with **high volumes of people** boarding or alighting the bus
- All bus stops serving passengers who need **additional time to board** because of mobility impairments, to load groceries, a stroller, or a bike, or at stops serving seniors or persons with disabilities
- **Bus stops with inadequate or inaccessible boarding areas and documented accessibility barriers**
- **Bus stops with insufficient stop length**
- **Along corridors with frequent bus service**
- **Along corridors with** high volumes of people biking
- **Along corridors where bus stops are being consolidated** or relocated
- **Along corridors with planned roadway or development projects**
- In neighborhoods where bus stop improvements **complement local planning goals** for transportation, urban design, and/or activating placemaking

Bus Stop Treatments for Bus Priority

Table 8. Bus Stop Treatments for Bus Priority

Bus Stop Treatment	Level of Investment Needed	Right of Way Needed
 **Bus Stop Relocation and Consolidation** Changes to stop location to reduce signal delay, and changes to stop spacing to increase bus speeds	Medium: Costs vary based on if a bus stop sign is being relocated or if multiple shelters are being relocated	Low: By relocating bus stops farside or removing them cities can regain parking spaces.
 **Bus Bulb** Curb extension reducing crossing distances and allowing buses to stop in-lane	Medium: Requires capital construction and may require relocating passenger amenities	Medium: Extends the curb into the parking lane at stops for in-lane bus operations
 **Floating Bus Stop** Relocates the boarding area to the other side of the bike lanes, allowing buses to stop in-lane and protecting the bike lane from conflicts with vehicles	Medium: Requires capital construction, relocating passenger amenities, and may impact utilities	Medium: Requires repurposing the parking or curbside lane for the bike lane and another travel lane for the new boarding area.
 **Median Bus Platform** Relocate the boarding area and passenger amenities to new boarding platforms along the median; implemented with center-running bus lanes	High: Requires capital construction, reconfiguring the median, relocating passenger amenities, is likely to impact utilities and signal infrastructure	Medium: Repurposes at least one lane of traffic at bus stops for the new boarding area

For more detailed guidelines see the MBTA Bus Stop Planning and Design Guide, which will be updated in 2023.

Bus Stop Relocation and Consolidation

Relocating bus stops can improve transit travel times and reliability by making it easier for buses to pull in and out of stops and travel through intersections. Depending on traffic conditions and the surrounding street design, municipalities can relocate stops at the farside or nearside of the intersection, or mid-block.

Benefits

- May reduce intersection wait time and bus stop dwell time
- May reduce amount of curb space needed at each stop
- May improve travel times, reliability and route efficiency
- May improve stop spacing and locate stops adjacent to land uses with highest ridership
- May enable opportunities to replace curbside "pull out" stops with bus bulbs and in-lane stops

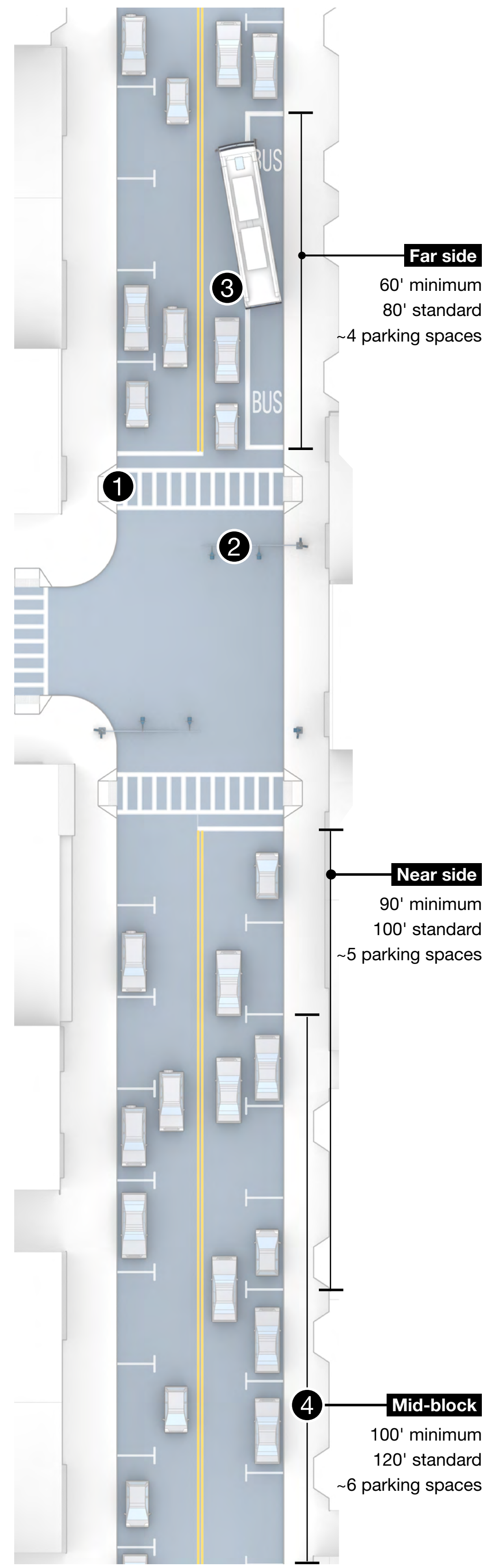
Challenges

- Relocation of stops with benches, shelters, or other amenities may require more capital investment
- Depending on the stop location and configuration there may be impacts to parking, loading, traffic, or pedestrian facilities.
- May face community / abutter resistance
- Increases walking distance between stops

Implementation Considerations

1. **Bus-Pedestrian Interaction** Generally, farside stops are preferred because crosswalks are located behind the bus stop, directing pedestrians to cross behind, rather than in front of a stopped bus.
2. **TSP Integration** Farside stops can typically be integrated with transit priority measures (i.e. queue jump lane and TSP) more easily and effectively.
3. **Traffic Impact** Farside in-lane stops may cause traffic to back up into an intersection. Nearside stops may enable through and right-turn bus movements.
4. **Curb Use Impact** Mid-block stops require the most curb clearance. Curb extensions at stops can be used to minimize parking loss.
5. **Transit Dependent Populations** At housing, social service organizations, and groceries are not recommended candidates.
6. **Stop Spacing and Location** Many riders may have difficulty with increased walking distances. Careful analysis must be conducted to understand and contain increases to required paths. Additionally, the path of travel between the relocated/consolidated stop and its alternate must be reviewed.
7. **Stop Accessibility** Relocated stops and stops adjacent to closed/consolidated stops must meet minimum accessibility standards and must not be less accessible than closed/consolidated stop.

For further detail on stop relocation considerations, consult the MBTA Bus Stop Planning and Design Guide.



Stop lengths assume 40' buses and 20' parking spaces.

This page has been left intentionally blank

Bus Bulbs

Bus bulbs extend the curb of a bus stop to be in line with the bus travel lane, rather than the parking lane, which allows buses to stop in-lane to pick up riders. This treatment saves time and increases transit reliability because buses do not have to merge in and out of traffic when serving a bus stop.

Benefits

- Compatible with both general traffic and dedicated bus lanes
- Reduces dwell time at bus stops
- Taking more room for bus stop and multimodal amenities without taking away sidewalk space
- Shorter bus stop lengths, which preserves more parking because buses do not have to pull into the stop
- Preferred option from accessibility point of view as it separates riders from bicyclists, increases depth of landing pad, and reduces crossing distance

Challenges

- Requires moderate capital investments and potentially drainage modifications due to curb relocation
- Can cause traffic buildup behind buses if there is only a single travel lane
- Precludes implementation of curbside bus lanes
- Precludes implementation of protected bike lanes

Complementary Treatments

- Parking Offset Bus Lanes (p. 68)

Before

After

See it in action

As part of the MassDOT Shared Winter Streets and Spaces Program, the MBTA and the City of Boston installed two bus bulb stops to complement the bus lanes in Roslindale Square.

1 **Curb Access** A typical 40' bus bulb replaces 2–3 standard parking spaces, retaining more parking than a curbside bus stop, which occupies 3–6 spaces depending on placement.

2 **Passenger Amenities** Provides additional space for waiting riders and bus stop amenities, particularly shelters, without encroaching on the original sidewalk area.

3 **Signage and Painting Treatment** Municipalities do not need to strip the roadway because buses are stopping.

4 **Bus Stops** Bus bulbs need to be at least 30' in length for both doors to open on the sidewalk. To not obstruct parking bus bulbs should be 40'. Longer bus bulbs farside provide room for vehicles to queue behind a stopped bus.

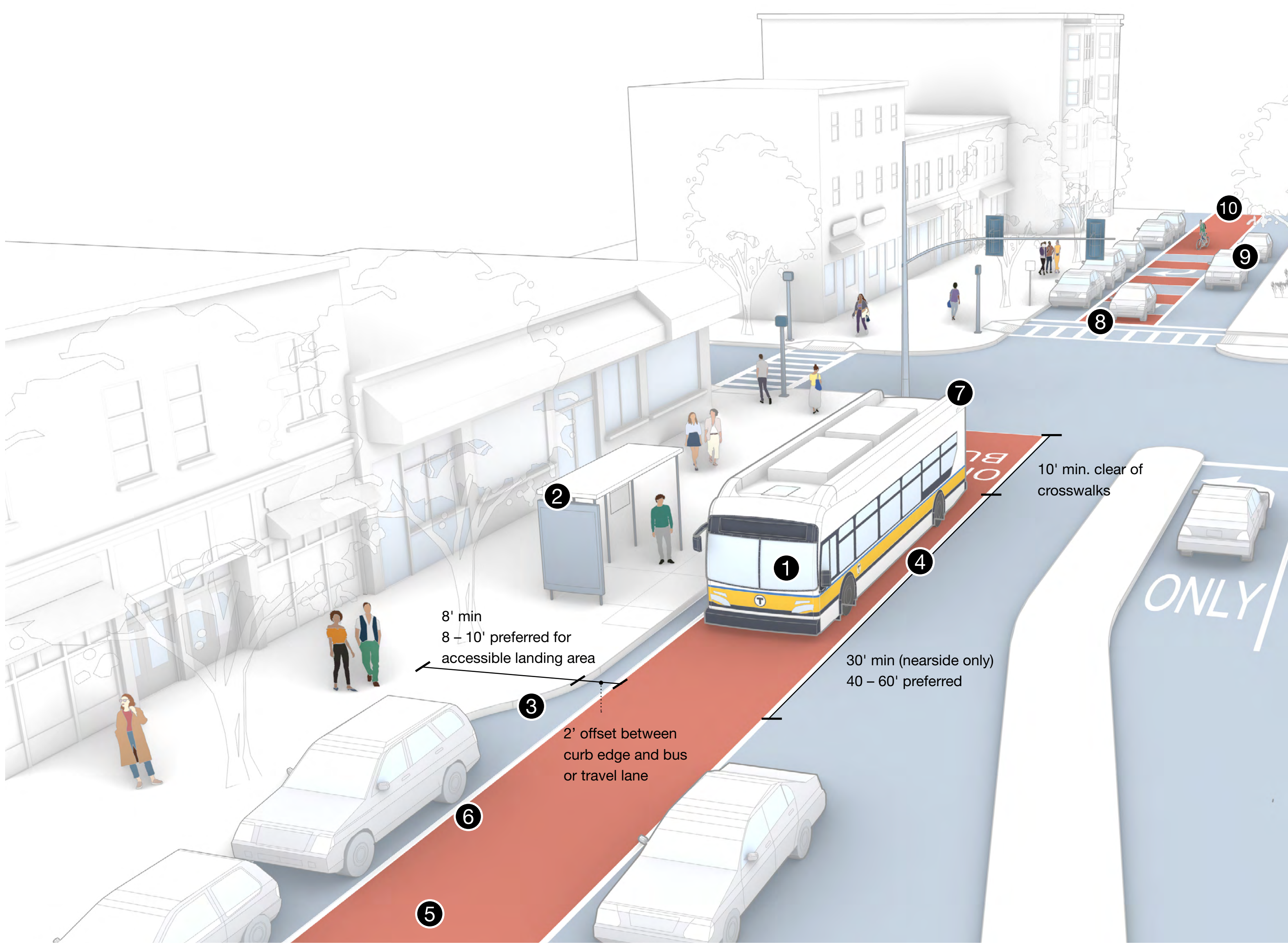
5 **Enforcement** Likely unnecessary as buses will stop in the travel lane.

6 **Bus Lane Compatibility** Incompatible with a part time bus lane that is parking during off-peak hours.

7 **Intersections** Nearside and farside bus bulbs typically include the adjacent pedestrian curb ramp. This reduces the intersection crossing distance for pedestrians.

8 **Right Turn Volumes** Nearside bus bulbs may require right turn restrictions if there is a tight corner radius. The American Association of State Highway Transportation Officials (AASHTO) specifies a 50–55' radius to accommodate urban transit and intercity buses.

9 **Traffic Volumes + Queuing** Consider traffic and queuing impacts with farside bus bulbs, as traffic may back up behind the bus and into the intersection. Also consider traffic volumes and the number of travel lanes in relation to vehicles being able to pass stopped buses.



10 **Bus-Bike Interactions** Integrate protected bike lanes through "floating" bus stops (described on the next page), where the bike lane wraps behind the bus stop at either the street or sidewalk level. Best used where there is high bus frequency, high ridership, and high bicycle volumes. Signage and striping are required for the bike lane. At minimum there should be a bike symbol and yield marks for crossing pedestrians. The bike lane does not need to be painted.

11 **Stop Accessibility** Relocated stops and stops adjacent to closed/consolidated stops must meet minimum accessibility standards and must not be less accessible than closed/consolidated stop.

Floating Bus Stop

Floating bus stops are bus bulbs separated from the sidewalk by bike lanes. This treatment reduces conflicts between buses and cyclists while allowing buses to stop in-lane to pick up and drop off passengers, saving time and further increasing transit speed, reliability, and accessibility.

Benefits

- Enhances overall safety by reducing conflicts between buses and bikes
- Creates more room for passengers and amenities without using existing sidewalk space
- Improves bus speeds by making stops in-lane
- Buses do not have to pull into or out of the stop
- Reduces dwell time at bus stops
- Compatible with both mixed traffic and dedicated bus lanes
- Chicaning effect of bike lanes and raised crosswalks slows bicyclists down as they approach the bus stop

Challenges

- Requires moderate capital investments and may require drainage modifications
- At farside stops on single lane roads, vehicles cannot pass the bus and may queue into the intersection
- Uses more roadway space than a bus bulb because it requires space for the sidewalk, the bike lane, and the bus stop
- Potential conflicts between people crossing to reach the bus stop and cyclists.

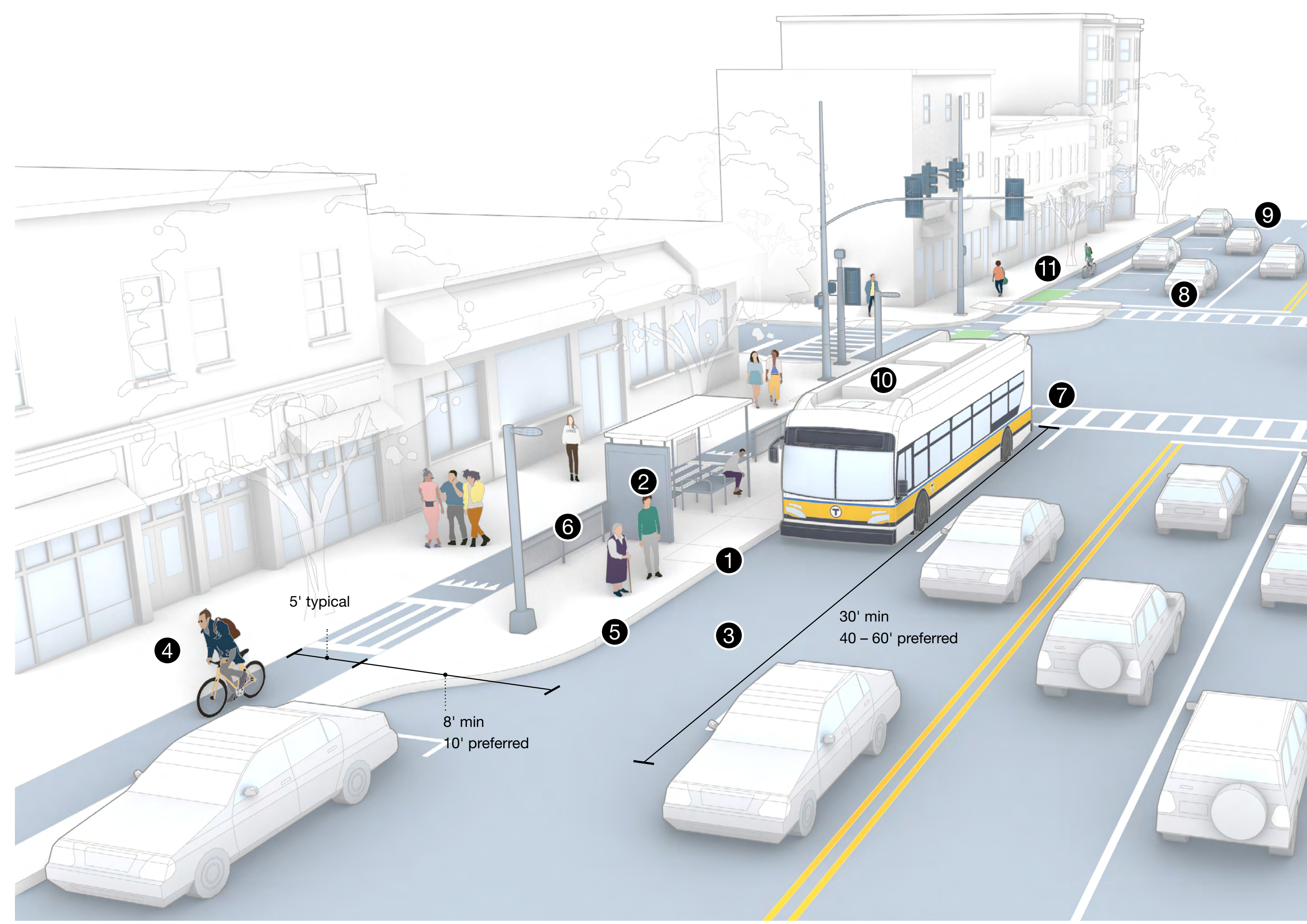
Complementary Treatments

- Parking Offset Bus Lanes (p. 68)

See it in action

Floating bus stops were installed along Commonwealth Ave in Boston's Brighton neighborhood between the Commonwealth Ave Bridge and Packard's Corner.

1. **Curb Access** A typical 40' floating bus stop replaces 2-3 parking spaces, retaining more parking than a curbside bus stop, which occupies 3-6 spaces.
2. **Passenger Amenities** Provides additional space for waiting passengers and bus stop amenities, particularly shelters.
3. **Signs and Striping** Requires effective signage to slow bicyclists and indicate crossings over the bike lane. Does not require pavement marking because buses are stopping in-lane.
4. **Bus-Bike Interactions** Floating bus stops allow for the integration of bike lanes between the passenger waiting area and the sidewalk. Best used where there is high bus frequency and/or high bicycle volumes. Signage and striping are required for the bike lane—at minimum, a bike symbol and yield markings for crossing pedestrians. Bike lane can be at sidewalk or street level. At sidewalk level, paint the bike lane to delineate it from the sidewalk and yield markings (shark's teeth) on the bike lane approach to the crosswalk.
5. **Bus Stops** Floating bus stops must be at least 40'. Farside curb extensions may be longer to provide room for vehicles to queue behind a stopped bus.
6. **Accessibility** MBTA prefers crosswalks at each end of the floating bus stop. At stops with high volumes of pedestrians and bicyclists, fencing and seating should serve as a barrier between the waiting/boarding area and the bike lane.
7. **Intersections** Floating bus stops at intersections are typically extended to include the adjacent pedestrian curb ramp—nearside stops will connect to the ramp at the front of the stop, while farside stops will connect at the rear, reducing the pedestrian crossing distance.



8. **Right Turn Volumes** Nearside floating bus stops may require right turn restrictions. AASHTO specifies a 50- to 55-foot radius to accommodate urban transit and intercity buses.
9. **Traffic Volumes + Queuing** Consider traffic and queuing impacts impacts at farside floating bus stops, as traffic may back up behind the bus and into the intersection. Also consider traffic volumes and the number of travel lanes if vehicles need to be able to pass the bus.
10. **Bus Priority** Compatible with both part-time and full-time parking offset bus lanes when there is an adjacent general purpose traffic lane. Nearside bus stop can serve as a queue jump lane.
11. **Bicyclist Target Speed** The curve of the bike lane around the floating bus stop can slow bicyclists down at pedestrian crossings.

Median Bus Platforms

Median bus platforms are bus stops located in the middle of the roadway, separate from the existing sidewalk. They provide dedicated space for riders to wait for, board, and alight buses operating in a center-running bus lane, or adjacent to a curbside bus lane where the platform physically separates the bus lane and general purpose traffic lanes, such as a right turn lane. Often, they provide near level boarding and enhanced amenities, such as more substantial shelters, wind screens, or other elements. They are typically implemented along corridors that have a wider cross-section, frequent curb-cuts, and/or there is support for bus rapid transit.

Benefits

- Eliminates the need to encroach on private ROW, coordinate with abutting property owners, or occupy curbside sidewalk space for a bus stop, leaving existing sidewalk available for other uses
- Creates a refuge space for pedestrians crossing major roadways at bus stops, improving visibility and safety and reducing the time and distance spent crossing general purpose traffic lanes
- Can provide at or near level boarding, improving accessibility, making boarding and alighting more efficient and pedestrian connections and crossings for emergency egress at each end
- Can provide an overall "traffic calming" effect for the corridor by redirecting general purpose traffic around the median platform; vertical elements placed at the back of the platform create a perceived narrowing of the roadway, elevating the traffic calming effect
- Provides more space for waiting passengers that is not crowded with other streetscape features

Challenges

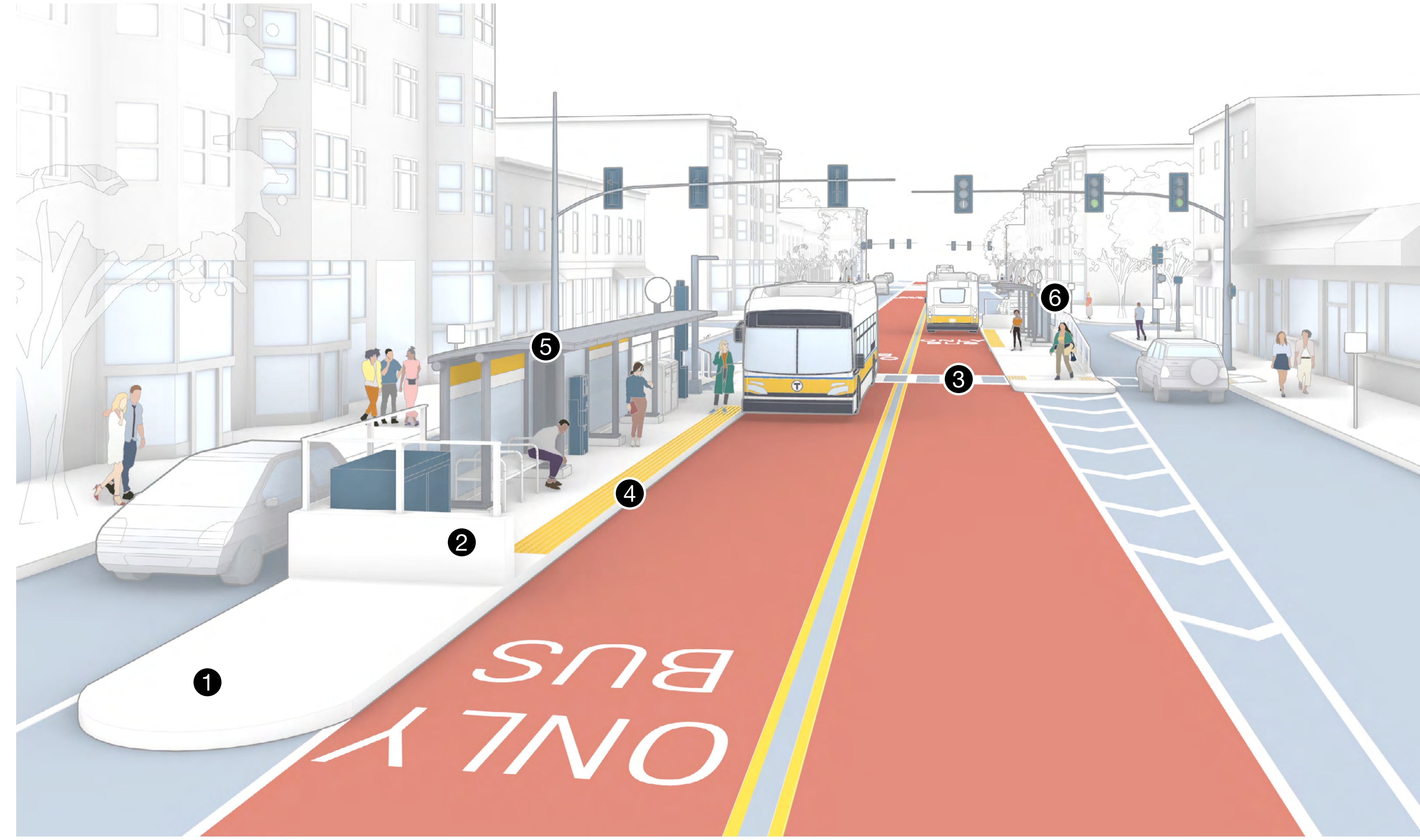
- Requires a wide roadway cross-section; and with a two-way bus facility, one platform in each direction is required to accommodate right-side only door access of the current and planned future bus fleet
- Necessitates wider platforms to accommodate projected ridership; desired elements and amenities may be challenging within the ROW to facilitate the preferred number of buses and width of travel lanes
- Requires longer platforms to accommodate higher frequency service, multiple routes serving the corridor, or articulated buses; it may be difficult to establish crosswalks at either end of the platform
- More complex to design and more costly to build than curbside bus stops, due to location in center of roadway
- Riders must cross traffic to reach bus stops, which may be unfamiliar and or unconventional when compared to typical curbside stops
- Installation will likely require tapered travel lane shifts or removal of existing turn lanes
- Construction may involve extensive utility relocations and drainage improvements to facilitate platforms and any existing median modifications

Complementary Treatments

- Center Running Bus Lane (p. 74)
- Bus Stop Relocation and Consolidation (p. 88)

See it in action

Boston's center-running bus lanes on Columbus Ave include 8 median bus platforms with near-level boarding and enhanced amenities.



❶ Platform Location Determine where in a roadway's cross-section right-side boarding buses can accommodate a median bus platform. Platforms should only be located at signalized intersections, in a constrained ROW. In a constrained ROW, platforms can be off-set immediately before or after the traffic signal. If a corridor with center-running bus lanes cannot accommodate median bus platforms, consider ROW expansion, altering the configuration of the bus lanes. If platforms are located mid-block, as opposed to at an existing intersection, municipalities should evaluate signalizing crossings connecting the platform.

❷ Platform Configuration Determine the length of buses using the stop, as this will affect the design requirements.

❸ Safety Provide crosswalks at each end of longer or double berth platforms, as well as crash protection such as bollards, attenuators, walls or other barriers at the back of the platform to protect passengers from vehicles, and wrap around the tip of the platform if there is no access in that direction. Supplement low-profile barriers at the tip of the platform with a fence or railing to further discourage access. Consider a railing or barrier between the busway and sidewalk connecting the platform and pedestrian refuge area. Railings are required on both sides of the walkway if the sloped walkway or ramp has a grade steeper than 5%. Include a two-foot deep yellow detectable warning panel (federal yellow) along the length of the platform behind the curb on the bus lane side of the platform.

❹ Platform Design Pave the bus lane adjacent to the platform, where buses are accelerating/decelerating, with a heavy duty hot mix asphalt (airport mix) to extend the longevity of the roadway pavement. Platform widths should accommodate projected peak passenger volumes, especially when platforms have a single access point. The platform surface should be heated from and including the landing area of the first bus berth, to the end of and including the clear zone serving the last bus berth to prevent ice and snow accumulation.

5 **Passenger Amenities** Platforms may lack the weather protection offered by buildings and trees at curbside stops and therefore should include shelters with wind screens. Municipalities should consider more substantial shelters than those typically found at curbside stops, such as large-scale, custom-designed and or canopy-style shelters with integrated or standalone pedestrian scale lighting. Other amenities to consider include benches and/or lean rails, digital signage for real-time displays, maps and other information, T-logo lollipop signs, station ID signage with platform bus route direction and destination direction and or wayfinding, emergency call boxes, security cameras, fare vending machines, single standing bike racks, trash cans, bus stop signs etc. Additional platform space may be needed for mechanical/electrical/communications cabinets related to lighting, digital signage, transit signals etc. These shall be placed as far from the passenger waiting space as possible and not interfere with pedestrian paths of travel and passenger-bus operator visibility. The placement of amenities cannot interfere with the ability of a bus to fully deploy its access ramp in the landing area.

6 **Bus Stop Consolidation** Consider whether to consolidate stops when implementing platforms, particularly when used on high-frequency, high-ridership corridors that typically have longer stop spacing, and especially when platforms are designed to accommodate articulated buses, higher frequency service, or multiple routes. Consider the passenger boarding/alighting capacity of the median platform to avoid overcrowding.

7 **Accessibility** Municipalities must coordinate with the MBTA to upgrade intersections, sidewalks, curb ramps, and crossings to be fully accessible. Pedestrian refuges must have detectable warnings for people with low-vision or mobility impairments crossing the street. Platforms must have an 8' by 10' boarding area, clear of amenities, for passengers getting on and off the bus with mobility devices or strollers. Pedestrian signals should allow enough time for people to cross in one trip even if refuges are present. For more details on accessibility requirements, consult the MBTA Bus Stop Planning and Design Guide.

For additional details on passenger amenities, stop spacing, and accessibility requirements,consult the MBTA Bus Stop Planning and Design Guide.

This page has been left intentionally blank

Chapter 6:

Planning and Engagement Process

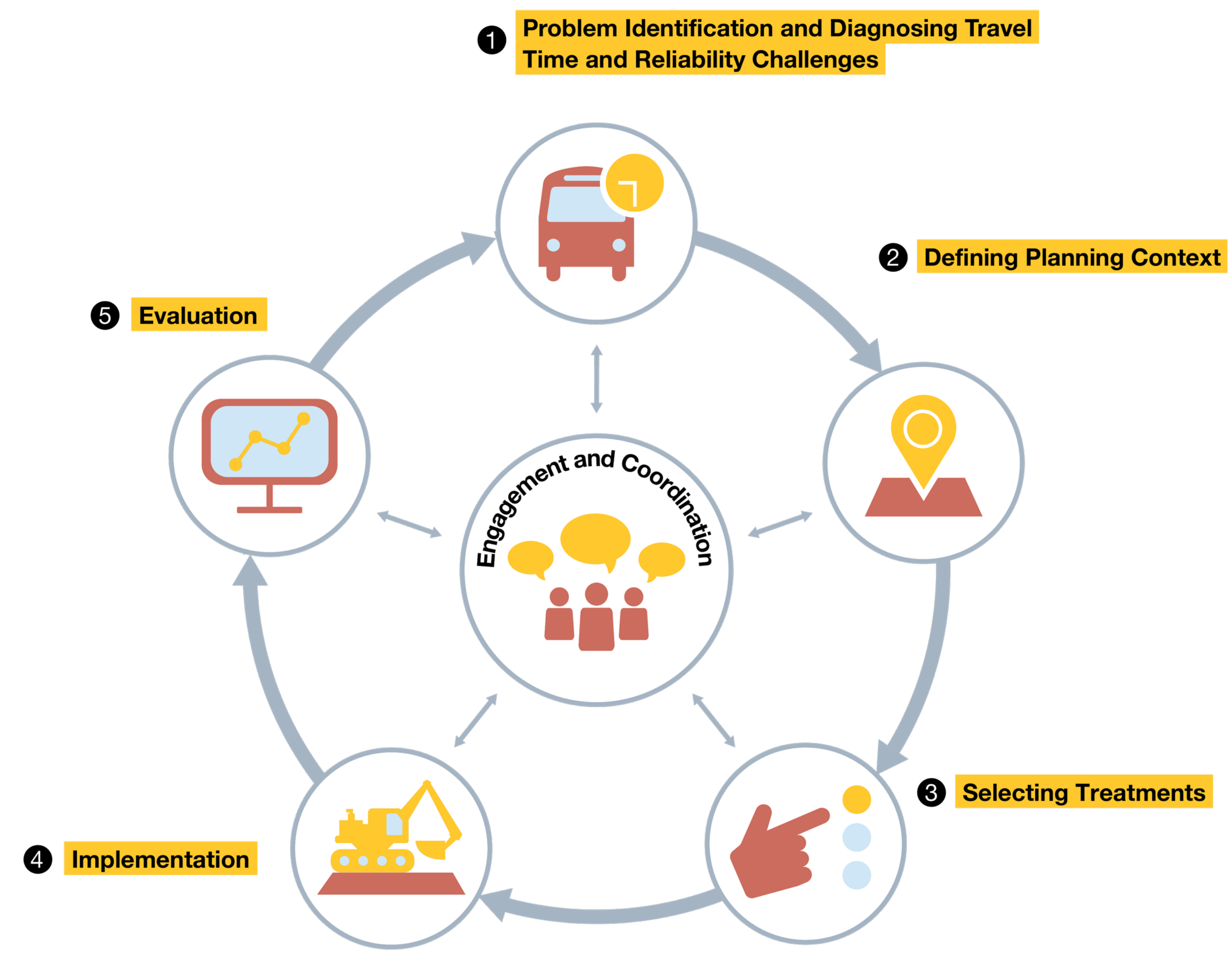
Introduction to the Planning and Engagement Process

Interagency coordination and community engagement are essential to planning and implementing transit priority projects and encouraging more people to ride transit. In Massachusetts there are separate agencies responsible for managing transit service, local transportation policy, and roadway changes. Each agency has an important role to play regardless of if they are the project lead.

There are typically five steps in the project lifecycle for transit priority treatments:

Step 1	Step 2	Step 3	Step 4	Step 5
Problem identification and diagnosing travel time and reliability challenges	Defining planning context	Selecting treatments	Implementation	Evaluation

Coordination and engagement happen throughout the project lifecycle, with each agency and stakeholder group playing a unique role at each step. The following guidance outlines what each step entails, key stakeholders involved, level of engagement, and other considerations, such as funding and project delivery methods. The graphic to the right summarizes the typical steps of the project lifecycle.



Key Stakeholders

The table below summarizes the role of each stakeholder group and outlines how they should coordinate with one another.

	MBTA	State agencies	Municipalities	Community groups and advocates	General public	Private institutions and business community	Elected officials
What is their role?	**Role:** The MBTA is the primary transit provider in the Greater Boston region, but generally does not own the infrastructure that bus service operates on.	**Role:** MassDOT, the Department of Conservation and Recreation (DCR), and Massport are responsible for a system of bridges, highways, and roads, that overlap with MBTA service.	**Role:** Municipalities are the primary roadway owners responsible for the design of streets where transit operates. Municipalities, in partnership with the MBTA, will design and implement transit priority treatments.	**Role:** Transit, health, pedestrian, bicycle, environmental, and disability advocates (such as Councils on Aging, Disability Commissions, etc.) can articulate mobility problems on behalf of their constituencies and help municipalities and the MBTA develop appropriate solutions.	**Role:** Residents and people who ride transit understand the ins and outs of the system and can provide insights on mobility problems and needs beyond what can be found in data.	**Role:** Local chambers of commerce, Main Streets districts, and small business owners are influential project stakeholders because of their networks and political connections.	**Role:** Elected officials are key decision-makers because of their role in funding allocation and project approvals.
How should they coordinate with one-another?	**Coordination:** Coordination with the MBTA throughout the project lifecycle is essential to ensure roadway changes support existing and future transit operations. Municipalities are encouraged to work with the MBTA to integrate transit priority treatments into their street improvement projects.	**Coordination:** The lead agency should coordinate and seek approval from state agencies if a project overlaps with state-owned segments to ensure treatments are consistent with state guidance and regulations.	**Coordination:** The lead agency should consult neighboring municipalities and their constituencies for feedback to ensure transit priority treatments are benefiting transit riders who travel through the project area as well as within it.	**Coordination:** Advocates are important to engage early and often because rider stories can help contextualize and strengthen the case for transit priority treatments. In some cases, advocates may conduct their own outreach to support project development or evaluation.	**Coordination:** It's important to engage the public early and often and to meet people where they are to make it easier for them to share feedback.	**Coordination:** The business community are valuable project champions, engaging them early and often can help mitigate concerns over parking changes and curbside management.	**Coordination:** Elected officials are important stewards of the community and often key project champions. It's vital that they're aware of project benefits, tradeoffs, and potential community concerns. It's important to engage elected officials before making final design decisions.

Step 1: Problem Identification and Diagnosing Travel Time and Reliability Challenges

Public engagement is vital to identifying mobility problems and opportunities for improving walking, biking, and transit conditions. Municipalities should work closely with the MBTA and one another to verify data with community and operator feedback. Data sharing and transparency can support interagency collaboration and build a stronger case for transit priority treatments. Municipalities should coordinate with the MBTA and collectively review transit, equity, and safety data, as well as stakeholder feedback, to identify and prioritize corridors with the greatest need.

When a project enters the project development phase the lead agency should visit the corridor and engage the public to confirm the root causes of mobility problems. Transit priority treatments need to account for what is happening on the street and all the potential sources of transit delays, such as traffic congestion, frequent stop spacing, signal delay, or conflicting/curtailing movements by other road users. By diagnosing what is causing delay the lead agency can develop potential treatment options to improve transit speed and reliability.

Type of Engagement: Collaborate

Engagement with community and advocacy groups, operators, riders, and local businesses is essential to identifying and verifying mobility problems. As first-hand users and observers these stakeholder groups allow roadway owners to see the full picture of what might be slowing down bus service or compromising roadway safety. Deep engagement in the form of collaborative charrettes and workshops is most valuable at this stage because it sets a strong foundation and relationships for subsequent steps in the planning process. Ride-along outings with operations staff and transit advocacy groups are also an effective way to collect feedback and experience mobility problems first-hand.

Key Stakeholders

- Municipalities
- MBTA
- State agencies
- Community and advocacy groups
- The general public, particularly riders

Step 2: Defining Planning Context—Funding and Project Structure

Transit priority improvements need to account for the local roadway context, relevant stakeholder groups, and the role each stakeholder has in project planning, design, and implementation. State agencies or municipalities may be the roadway owner, and responsible for sidewalks and potentially transit shelters, while the MBTA is responsible for transit routes, stop placement, and some stop amenities. Decisions on roadway changes require coordination with municipal transportation and planning staff, and elected officials who are responsible for setting budgets and policy changes.

After clearly outlining mobility problems, municipalities should determine the function and or character of the street. For example, is the street a key part of the transit network, a regional freight connector, or a neighborhood bikeway? Local transportation and master plans for walking, biking, and transit are key resources to determining how a specific street or corridor serves broader mobility needs. After reviewing relevant plans, the roadway owner should coordinate with the MBTA and other municipalities on project funding and structure. This is a critical component of the planning process as budget is often the biggest constraint to implementing and scaling bus priority efforts.

Type of Engagement: Consult

Most of the engagement during this phase is internal and directed towards local and regional agencies to understand relevant plans, upcoming developments, and the purpose of the street or corridor. It is also important to brief elected officials before finalizing the project scope as they can advise on funding, objectives, and potential community concerns. The support of elected officials is extremely valuable and, given their influence on the project, can help streamline planning and implementation. The lead agency should also consult community and advocacy groups to define project objectives and desired outcomes. Attending standing meetings for community and advocacy groups often allows for a more in-depth and productive dialogue compared to open houses.

Key Stakeholders

- Municipalities
- MBTA
- State agencies
- Elected officials
- Community and advocacy groups

Project Structure

Transit priority treatments can be implemented as standalone projects or incorporated into other projects. The latter approach provides implementation efficiencies for outreach, permitting, design, construction, and project management. Repaving, roadway reconstruction, bicycle infrastructure, and sidewalk improvements are the most likely categories of projects that can incorporate transit priority treatments. The roadway owner should proactively engage public works and transportation departments, local and regional planning departments, the MBTA, and state agencies in project scoping.

Municipal and state agencies can add transit priority treatments to existing local, regional, or state Capital and Transportation Improvement Plans (CIP/TIP). The lead agency would need to agree to the change, and the proposing agency may need to identify additional funding and file a formal CIP/TIP amendment. Expansion of an existing project can be difficult if the proposed changes impact schedule, staff resources, or permitting requirements. It is easier to justify integrating transit priority treatments into projects with larger scopes of work (e.g., adding curbside bus lanes along a street being reconstructed with new sidewalks, plantings, signals, and pavement).

Funding Overview

Transit priority projects are almost wholly partnership-based, usually with a municipality or state agency, since MBTA bus service almost exclusively operates on roadway infrastructure that they do not own. Transit agencies typically fund operations and maintenance through a combination of local funding sources, whereas major capital projects are more likely to receive federal funding. Below outlines federal, state, and local funding sources available to support planning and implementing transit priority treatments.

State Funding

The Commonwealth of Massachusetts offers several programs that can fund the implementation of transit priority treatments. These are typically discretionary grants that municipalities can apply for if their project is eligible. Below is a list of funding programs offered by MassDOT.

- The Chapter 90 Program provides annual funding to municipalities for transportation improvements.
- The Complete Streets Funding Program is a multi-step process that provides funding for complete streets improvements on local roads. Eligible projects include transit priority treatments.
- The MassDOT Shared Streets and Spaces Program provides funding to municipalities and public transit authorities for street and plaza improvements that support public health, mobility, and business.

See It in Action: State Funding for North Common Street, City of Lynn

In December 2020, the City of Lynn received $125,000 from MassDOT's Shared Streets and Spaces Program to construct a bus lane on North Common Street. The bus lane was a quick-build project that opened in April 2021. The 2019 Lynn Transit Action Plan included a recommendation for bus priority on this street.

Dedicated bus lanes on North Common St in Lynn's downtown.

Local Funding

With federal and state funds unlikely to fully cover the cost of transit priority treatments, municipalities should prepare to share the costs of the design, installation and/or maintenance of transit priority treatments. Municipalities can fund transit priority treatments out of their local budgets or through special assessments in certain neighborhoods, such as through District Improvement Financing or Tax Increment Financing. Municipalities can also request funding for transit priority treatments through the regional TIP process. Within the MBTA bus service area, the TIP is prepared by the Boston Region Metropolitan Planning Organization (MPO). The Boston Region MPO and Metropolitan Area Planning Council (MAPC) also offer technical assistance grants that can support the implementation of transit priority treatments.

Other Funding Sources

In addition, some non-profit organizations and private institutions fund the implementation of transit priority treatments. Funding from the Barr Foundation was instrumental in creating the MBTA Transit Priority Group, which allowed MBTA to build institutional capacity and become a national leader in bus transit priority implementation. The Barr Foundation also funded bus lanes and other transit priority treatments in Everett, Cambridge, and Arlington, as well as the Bus Priority Toolkit.

Funding Considerations

External funding can come with stipulations and conditions and require additional staff resources to request, spend, monitor, and close out the grant. Below is a partial list of funding considerations for municipalities. Project leads should coordinate with MBTA to streamline the funding process.

- **Application requirements** Level of effort may vary significantly by funding source, with some applications taking weeks or months to prepare, requiring a detailed narrative, charts and graphics, and several forms. Several federal discretionary grant applications also require a Benefit Cost Analysis (BCA), which should be prepared by an economist.
- **Performance measures** Some funding sources may require the recipient to commit to meeting certain performance measures when a project is complete (e.g., bus travel time savings).
- **Reporting** Whether in conjunction with a performance measure requirement, or independently, the awarded recipient is typically required to report data that track the benefit of the transit priority treatments over a defined period of time.
- **Resource requirements** Federal funding, and potentially other sources, require the funding recipient to adhere to certain labor requirements and provisions to use domestically sourced materials for certain components.
- **Future use requirements** Some funding sources may require the recipient to maintain the transit priority treatment for a certain period of time or risk needing to refund some or all of the grant.
- **Future maintenance requirements** It is often easier to identify funding to build a transit priority project than it is to maintain it. As such, it is important to identify maintenance responsibilities and funding early in the design or project development process. Memorandums of Understanding (MOUs) or Construction and Maintenance Agreements (C&Ms) typically document the partnership and roles and responsibilities for each agency.

Step 3: Selecting Treatments

The next step after engaging with stakeholders to diagnose transit delays is to identify potential treatments to improve transit speed and reliability. Transit priority treatments can range from tactical (typically improvements with paint and signs, possibly posts) to completely redesigning the street to change traffic and transit operations and to address accessibility deficiencies.

To develop treatment options, municipalities need to understand what is happening on the street and at the curb, and how much space is available to repurpose for transit or other improvements. Treatment selection also depends on the local transportation network and modal priorities for the corridor. For example, if there are existing and planned bike lanes, the design should improve safety for people who bike. Curbside activity is also important to consider as parking or loading within bus lane decreases speed and reliability benefits.

Transit priority treatments should address mobility problems at both the corridor and intersection-level. For example, short bus lanes and queue jump lanes can help buses pass right-turn queues at congested intersections, whereas full bus lanes offer a corridor-level approach to bypass congestion and increase bus speeds. In cases where there is limited space available, signal and bus stop improvements are cost-effective treatments to improve bus speed and reliability. Complete street redesigns offer the most flexibility in treatment selection, giving agencies the ability to transform the roadway and sidewalk space. These types of projects require deep engagement with the community on their preferred treatments. All relevant stakeholder groups should have the opportunity to provide input on treatment options before the lead agency selects a final design alternative.

Type of Engagement: Consult/Collaborate

Selecting transit priority treatments is one of the most important pieces of the planning process because once a project enters the detailed design phase it can be difficult to make changes. Collaborating with key internal and external stakeholder groups to collect their feedback on treatment options will lead to better project outcomes. Municipalities should consider hosting interactive design workshops with representatives from key agencies involved in defining the local planning context as well as community and advocacy groups. Pop-ups are also a great opportunity to explain benefits and tradeoffs of potential treatments and collect feedback on preferred options. Virtual and public open houses are effective ways to collect feedback from large numbers of people, however, if there are certain stakeholder groups agencies wish to engage, a more targeted approach may be appropriate.

Key Stakeholders

- Municipalities
- MBTA
- State agencies
- Community and advocacy groups
- General public

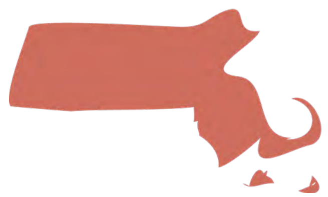
Design Standards

When selecting treatments, the lead agency should consider relevant design standards, guidance, and best practices. The lead agency should verify which standards apply to each location.

Below are the standards and guidelines to consult during the design phase.

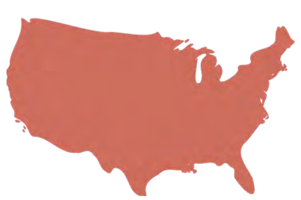
Local

- MBTA Bus Priority Toolkit
- MBTA Bus Stop Planning & Design Guide
- MBTA Design Directives, Standards and Guidelines



State

- MassDOT Bus Lane Standards
- MA Architectural Access Board (MAAB)



Federal

- Americans with Disabilities Act (ADA)
- Title VI
- Manual on Uniform Traffic Control Devices (MUTCD)

National

- National Association of City Transportation Officials (NACTO)
- American Association of State Highway and Transportation Officials (AASHTO)
- Transit Cooperative Research Program (TCRP)

Evaluating Design Impacts and Project Approvals

The roadway owner needs to formally approve the project before implementing transit priority treatments. Approval and coordination processes vary by roadway owner and there are also additional federal, state, or local environmental and historical approval requirements to consider.

- **Municipalities** Depending on agency structure, the local transportation, public works, or planning department will need to approve the project design and issue permits. City/town councils may also need to approve the project and local funding allocation depending on the scale of the project and/or local policies or ordinances.
- **State Agencies** For any project on a state road or right-of-way (ROW), the state agency with jurisdiction over the road must approve the project and issue an access permit.

Environmental and Historical Coordination

The design team should attempt to minimize impacts to environmental and historical resources. This reduces coordination needs, cuts costs, and streamlines project design and implementation. However, environmental and historical impacts are sometimes unavoidable. The lead agency may need to obtain environmental and historical approvals from federal, state, or local agencies depending on the scope, funding source, and location of a project. Examples of potential approvals are listed below.

Potential Local Approvals

- Historic Commission
- Conservation Commission

Potential State Approvals

- MA Historic Commission (MHC)
- MA Environmental Policy Act Agency (MEPA)

Potential Federal Approvals

- National Historic Preservation Act (NHPA)
- National Environmental Policy Act (NEPA)

Abutters

The level of engagement with directly impacted abutters will vary by project depending on the significance of the impacts. Lead agencies should coordinate with abutters when developing design concepts to address their concerns as best as possible. In cases where the footprint for transit priority treatments impacts private property, even temporarily during construction, the lead agency will need a license agreement or easement. Coordination with abutters is critical to successful project implementation; obtaining signed agreements from abutters can delay projects and add costs.

Step 4: Implementation of Treatments

State agencies and local municipalities are typically responsible for the design and implementation of roadway, sidewalk, parking, and bus stop changes. Shared awareness and cooperation are necessary to ensure the road works for everyone throughout implementation. Municipalities will need to coordinate with the MBTA and emergency services if construction involves any partial or full street closures. Municipalities may also need to mitigate traffic impacts through signal timing changes, turn restrictions, or traffic detours.

Type of Engagement: Inform

The lead agency should consult local businesses, and the general public on their construction preferences. For example, do they prefer a low impact construction approach that takes longer to complete, or a faster, high impact construction approach? Mailing notifications to property owners and local businesses along the project corridor may be required depending on the type of construction. For more disruptive construction municipalities should also notify adjacent properties and consider other engagement methods, such as open houses or targeted stakeholder meetings. At this point in the project lifecycle, most of the engagement is focused on informing people of the construction impacts and final project details.

Key Stakeholders

- Municipalities
- MBTA
- Local businesses
- General public

Quick-Build Projects

MBTA has become an industry leader in implementing low-intensity, quick-build transit priority treatments on a short schedule. Quick-build treatments typically use simple, affordable materials like paint, signs and vertical delineators, like flex posts. MBTA uses the quick-build approach to implement curbside, parking off-set and shared bus lanes, as well as transit signal priority (TSP).

Quick-build projects can be temporary pilots or more permanent installations. The length of the pilot depends on the lead agency's objective. Some lead agencies want to demonstrate or test the effectiveness of different transit priority treatments, particularly if there is no local precedence, so they use cones or temporary striping. If the pilot is considered a success, based on the results of the evaluation and public feedback, the demonstration is made permanent with new roadway markings, signage, and other complementary treatments. Other pilots are implemented using semi-permanent materials that, if successful, can remain in place with the municipality only required to make minor refinements to account for any areas of improvement identified in the evaluation.

Delivery Methods

Public sector entities typically choose one of five delivery methods to build transportation projects:

- **Design-Bid-Build (DBB)** This is the traditional construction delivery method, where different entities design and build the treatment. The project is designed by in-house staff or by a consultant. The design plans are then used to procure a contractor to construct the project.
- **Design-Build (DB)** This delivery method features a single design and construction team procured to engineer and build the project, based on a concept design. DB projects can result in schedule efficiencies since the DB team can start construction on some project elements before design is complete. In addition, only one procurement process is needed, whereas a DBB project may need up to two. Although DB projects may reduce the public sector's exposure to some risk, it increases risk for the DB entity, which can result in higher costs to accommodate the additional risk.
- **On-call engineering/construction contracts** These are typically issued on a task-by-task basis to design and build projects. can be completed on a much shorter schedule compared to a full procurement process for each transit priority project.
- **Existing construction contract change orders** These allow agencies to add transit priority treatments to construction projects already under contract. This method is typically only appropriate for low intensity transit priority treatments that fall within the overall scope of work of the existing construction contract and do not impact the overall project schedule.
- **In-house staff** An agency may be able to use internal staff and equipment to design and build the transit priority treatment.

Scheduling Considerations

The project sponsor can anticipate impacts to construction schedules, such as:

- **Construction hours** Some elements of construction may be limited to a brief timeframe, such as overnight for striping and paint application.
- **Traffic diversion/traffic management** Work may need to occur in phases or during off-peak hours to avoid adverse impacts to traffic.
- **Transit impacts** Work may need to occur in phases or with temporary active or inactive facilities to minimize adverse impacts to bus operations or access to bus stops.
- **Weather** Work may need to stop during the winter months or winter moratorium when some municipalities will not issue permits. A severe winter season may delay work to the spring.
- **Procurement** Supply chain shortages may delay the delivery of key components.
- **Utility coordination** Utility companies may not be able to accomplish their work within the schedule anticipated by the project team. In addition, utility companies may conduct unrelated work on newly constructed treatments, which may force the project team to make repairs.

Memorandums of Understanding

The lead agency should consider the durability and long-term maintenance costs when selecting transit priority treatments. Municipalities and the MBTA should sign MOUs or C&Ms outlining operations and maintenance responsibilities before initiating final design. Some of the items to consider incorporating into these agreements are:

- Maintenance responsibilities for pavement markings, red paint, shelters, sidewalks, bus stop amenities, transit signals, lighting, signage, vertical delineators, landscaping, etc.
- Capital improvement responsibilities, if different than the maintenance responsibilities.
- Day-to-day operational responsibilities for trash removal, snow removal, and ice treatment of the bus lane and bus stop.
- The entities and types of vehicles that can use a dedicated bus lane. In addition to buses and authorized transit service vehicles, emergency vehicles, people on bicycles, trucks, school buses, and occupied traditional taxis could utilize a bus lane.

Education and Enforcement

It is important for the lead agency to communicate project changes early and often. Operational changes that impact how people get around may also require a more robust education campaign. For example, with bus lanes, it's important that people driving vehicles are clear where and when they are permitted to enter the bus lane. Education and enforcement campaigns can improve compliance and maximize transit speed and reliability benefits.

MBTA and the roadway owner should confirm that the legal authority to enforce unauthorized use of bus lanes exists. If this authority does not exist, then the state or municipality should adopt an ordinance to grant this authority. The transit agency and roadway owner should then coordinate to identify the most effective enforcement mechanism, such as law enforcement observation, stationary cameras, or cameras on buses. Local police departments should also share data and best practices about how to increase compliance.

An increasing number of transit agencies and municipalities outside of Massachusetts rely on automated enforcement to ensure compliance with bus lane regulations. Automated enforcement is considered a more objective, equitable, and efficient means of enforcement than traditional observation enforcement methods used by local police departments. The use of automated enforcement in Massachusetts will require action by the Massachusetts Legislature.

Step 5: Evaluation

To scale bus priority efforts, municipalities and the MBTA need to comprehensively evaluate and communicate how transit performs before and after implementation. The evaluation process should be transparent, with robust public engagement and metrics that help communicate the full impact of the project and areas for improvement.

The steps to evaluating a transit priority treatment are:

1 → 2 → 3 → 4

1. **Establish metrics and goals.** The project team can report on additional metrics if desired. Suggested metrics include:
   - Bus reliability
   - Bus travel time savings
   - Reductions in bus delay
   - TSP-specific metrics
2. **Identify evaluation tools and procedures**
3. **Develop methods for reporting** for this project and consider ways to use the data to inform future projects
4. **Report on the metrics.**

Type of Engagement: Inform/Consult

The lead agency should engage all relevant stakeholder groups to ensure transit priority treatments are achieving their desired outcomes. It is essential in the first few months following implementation that the lead agency meets regularly with the MBTA. The lead agency typically collects public feedback through online or physical surveys, which the MBTA and community and advocacy groups can help distribute or administer. Community and advocacy groups can also help collect rider testimonials, which are a powerful way to communicate project impacts.

In the first months following project implementation, the lead agency should meet regularly with the MBTA to discuss if transit priority treatments are achieving their desired outcomes. If staff (from either the MBTA or lead agency) discover ineffective treatments or new mobility challenges, they should work together to refine the project. As the regional transit provider, MBTA should be the repository for lessons learned in the Boston region and should be responsible for distributing this information to current and potential transit priority partners.

Key Stakeholders

- MBTA
- Community and advocacy groups
- Local businesses
- General public

Data Collection and Performance Indicators

Municipalities and the MBTA should identify key performance indicators (KPIs) and provide consistent progress reports to the public on transit priority treatments. MBTA typically uses two KPIs to measure bus service:

- **Reliability** as measured by schedule adherence. Reliability is measured at the bus route endpoints and at key timepoints. There are different standards for routes that operate every 15 minutes or less and for routes that operate at greater than 15-minute frequencies.
- **Customer Satisfaction** A panel of MBTA passengers is surveyed monthly and asked to rate four questions on a seven-point scale:
  1. How satisfied are you with the MBTA's communication overall?
  2. How would you rate the MBTA overall?
  3. How would you rate your most recent trip?
  4. How much do you agree with the statement: The MBTA provides reliable public transportation services.

Progress reports should also include rider and community feedback and testimonials, as often perceived travel time savings may be different than actual travel time savings.

Communicating Project Impact

Proactive storytelling that communicates the tangible benefits and impacts of the project helps build support and awareness for transit priority treatments. This also helps prevent opposition to the project from dominating the conversation. Messaging should address travel time savings, reliability enhancements, safety improvements, and project satisfaction and include community and rider testimonials.

Including professional quality before and after photos is one of the most effective ways to communicate the benefits of transit priority treatments. Photos allow people to imagine what it would be like to experience transit in that corridor or a similar one. These photos are valuable for general marketing purposes and to make the case for future bus priority projects. Photos should include infrastructure, buses, and people.

Projects funded by State agencies and/or municipalities must comply with all federal and state rules and regulations, including PROWAG, ADA and MAAB 521 CMR. This is most pertinent where stops are rebuilt, road resurfacing or signal upgrades occur. All bus improvements serving MBTA bus service must also meet Office of the Chief Engineer Design Directives and MBTA Design Guidelines for Access.

See It in Action: Communicating Project Impact on Columbus Ave, City of Boston

For the Columbus Ave center-running bus lane project, MBTA and the City of Boston partnered on a communication plan for messaging key components for the launch of the project, including producing a "how-to-ride" video in English and Spanish, promoting the project in local newspapers, and collaborating with local partners on press releases and press events. This proactive approach to communication helped positively define the project and build support well before the project was completed.

Dedicated, center-running bus lanes on Columbus Ave in Boston.

This page has been left intentionally blank

Acknowledgments

This Toolkit would not be possible without the generous support and cooperation of many of our partners. Thank you to Lisa Jacobson and the Barr Foundation for their continued support of the Bus Priority Program. And to our riders, it is an honor to serve you and we look forward to speeding your bus and bringing you new and better connections across our incredible community.

MBTA
Systemwide Accessibility: Laura Brelsford, Chris Hart, Kathryn Quigley
Office of Customer Experience: Greg Bohner, Joe Pavao
Bus Operations: Sean Mills, Shanel Mercer, Stephen Dane, Jeff O'Gorman, Lynn Anthony, Dane LaiFook, Deanna Davis
Safety: Asia Williams
Customer Experience: Erica Baker, Tom Barton

MassDOT
Violet Wilkins
James Danila
Amitai Lipton
Francisco Lovera

Municipalities and Other Governmental Stakeholders
Arlington: Daniel Amstutz
Boston: Vineet Gupta, Matt Moran, Kirstie Hostetter, Jim Fitzgerald
Brookline: Todd Kirrane (formerly Brookline staff)
Cambridge: Brooke McKenna, Joe Barr (formerly Cambridge staff), Andy Reker
Chelsea: Alex Train
Department of Conservation & Recreation: Jeff Parenti
Everett: Jay Monty
Lynn: Aaron Clausen
Malden: John Alessi (formerly Malden staff)
Medford: Todd Blake
Revere: Julie DeMauro
Somerville: Brad Rawson, Ali Kleyman (formerly Somerville staff)
Quincy: Edward Grennon, Allison Ruel

Project Team

MBTA
Kat Benesh
Wes Edwards
Eric Burkman
Justin Antos
Alex Hallowell
Andrew McFarland
Jay Jackson
Phillip Cherry
Becca Wolfson
Tom Quattromani
Olivia Mobayed
Robert Guptill
Erik Scheier
Ben LeCates

Nelson\Nygaard
Thomas Brennan
Theresa Carr (Project Manager)
Kate Elliott
Gwen Griffin
Evan Mancini
Brendan Rahman
Maria Rocha-Buschel
Yanisa Techagumthorn

McMahon
Sandra Clarey
Randy Fixman
Natalie Raffol

Utile
Cyrus Dahmubed
Kyle Jonasen
Tim Love
Zoe Mueller
Loren Rapport
Avery Robertson
Xiaoran Zhang

Concord Engineering
Meagan Powers