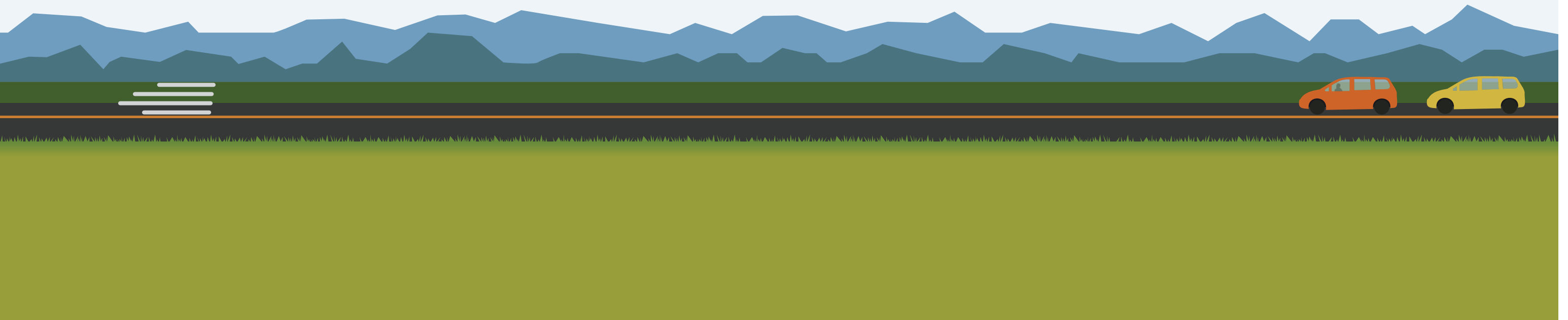


# US 287 BRT Stations Area Toolkit

THAT IS APPLICABLE ELSEWHERE



Made in conjunction with Stakeholder Working Group



SEPTEMBER 2021

**AECOM**



*“This toolkit offers a set of treatments that can be applied at a variety of scales.”*

# INTRODUCTION & PURPOSE OF TOOLKIT

To prepare for ongoing investment in Bus Rapid Transit (BRT), Boulder County has developed this Stations Area Toolkit to provide a menu of options at and around BRT stations and serve as a convenient resource to inspire station design. It was developed in conjunction with the US 287 Stakeholder Working Group. This Toolkit offers a set of treatments that can be applied at a variety of scales throughout Boulder County, from dense urban neighborhoods in Boulder to rural highway service along US 287. BRT stations may range from simple bus stops to full-size stations comparable to rail stations.

The toolkit is not intended to provide specific design guidance but rather create a vision for what great BRT stations in Boulder County could be. The intent is also to **complement local planning and design guidance** and not replace it. Well designed functional stations will help to create great places that further encourage transit use, and station elements can be drawn from this guide as BRT systems are designed.

The toolkit is divided into the following categories:

- BRT Lane Configurations
- Multi-Modal Considerations
- Stations and Stops
- Urban Design

Application of station treatments, benefits, and relative costs, and graphical illustrations are provided for the each of the tools. As stations are designed in Boulder County, this toolkit can be utilized with other local design guidance to identify treatments and amenities that will create great stations.



# DEDICATED BUS LANE

Bus only dedicated lanes that are restricted to general automobile traffic can improve the speed and reliability of bus operations. An exclusive lane can be oriented at the center of a roadway, along the outside adjacent to a curb, or offset from other elements along a roadway.

## Benefits

- Reduces delay due to traffic congestion.
- Helps raise the visibility of high-quality service.
- Curbside and offset bus lanes are subject to encroachment from double parking or deliveries, so enforcement is necessary.

## Toolkit

- 1 Apply **BUS ONLY** markings to the pavement to deter vehicular drivers from using it. Red colored paint will also help emphasize the lane.
- 2 Separate dedicated bus lanes from other traffic using solid single or double white stripes.
- 3 The minimum width of a curbside bus lane is 11 feet, and the minimum width of an offset bus lane is 10 feet.

Source: NACTO. *Dedicated Curbside/Offset Bus Lanes*. [nacto.org/publication/urban-street-design-guide/street-design-elements/transit-streets/dedicated-curbside-offset-bus-lanes](https://nacto.org/publication/urban-street-design-guide/street-design-elements/transit-streets/dedicated-curbside-offset-bus-lanes).



Regional Example:  
15th Street, Denver, CO



# BUSINESS ACCESS & TRANSIT (BAT) LANE

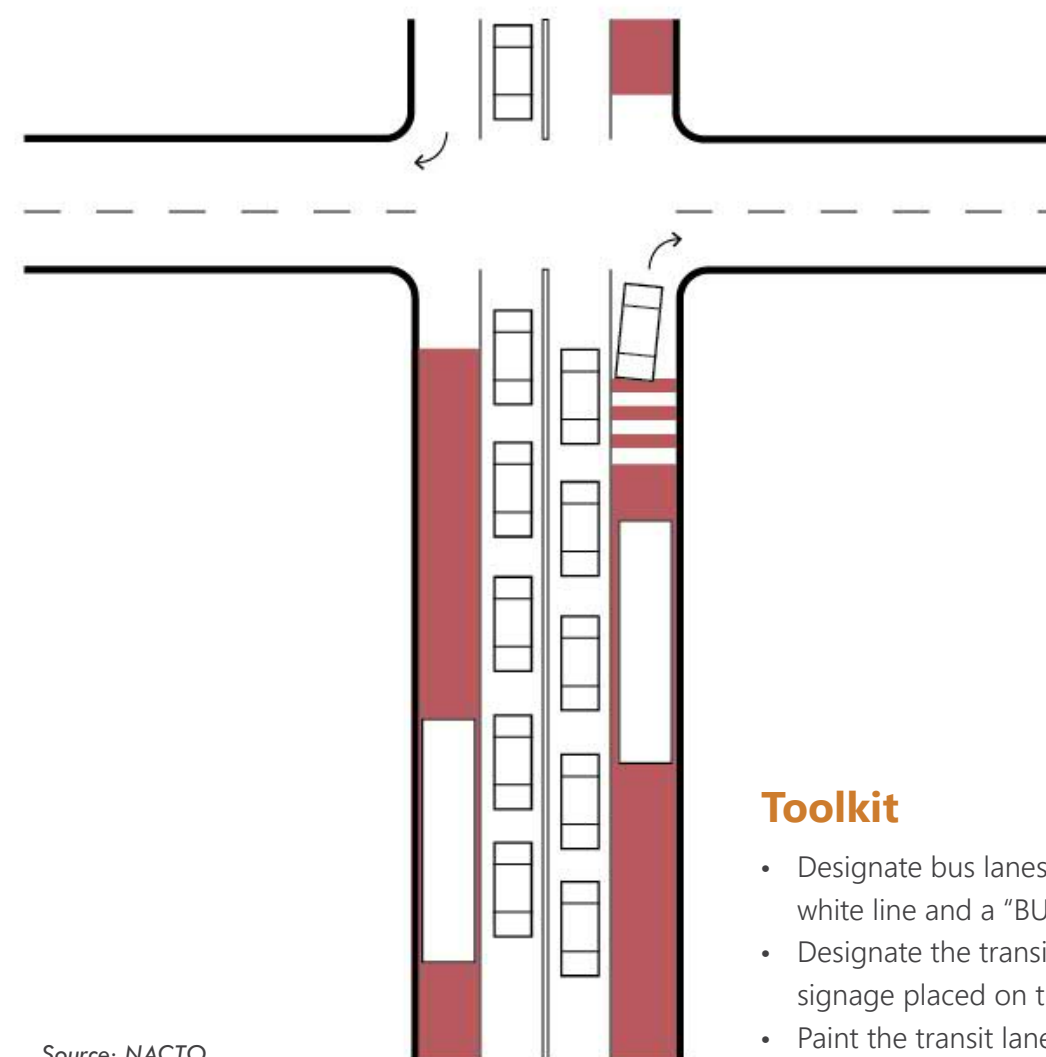
A curbside-running BAT lane is a semi-exclusive transit lane that can be used by general traffic only to make right turns at business driveways and intersections. Station options may include side platforms located midblock or on the near side or far side of an intersection. The design should follow MUTCD guidance for preferential lane markings for segments of BAT lanes where turning movements are permitted and double-line buffer marking where use is prohibited, or no turning accesses exist.

## Application

- Streets with no on-street parking.
- Streets where transit boarding islands do not exist.
- Streets with in-lane sidewalk stops.
- Streets with wide sidewalks and furnishing zones that provide space a buffer between transit and pedestrians.

## Benefits

- Reduces delays caused by interactions with parking or loading vehicles.
- Curbside-running BAT lanes can have flexible uses throughout the day, but fully dedicated transit lanes provide better line of sight.



Source: NACTO

## Toolkit

- Designate bus lanes using a single or double solid white line and a "BUS ONLY" marking.
- Designate the transit lane as restricted using signage placed on the curbside or overhead.
- Paint the transit lane with a red color.
- Increase pedestrian safety and comfort using wider sidewalks that are buffered with plantings or furnishings.

Source: NACTO. *Curbside Transit Lane*. [nacto.org/publication/transit-street-design-guide/transit-lanes-transitways/transit-lanes/curbside-transit-lane](https://nacto.org/publication/transit-street-design-guide/transit-lanes-transitways/transit-lanes/curbside-transit-lane).



Source: Denver Streets Partnership

# INTERSECTION QUEUE JUMP

A queue jump lane provides preference to buses at signalized intersections. This design consists of an additional travel lane on the approach to the intersection that is dedicated to transit or right turning vehicles (and bicycles in some cases). Buses using the queue jump lane receive a head start over other vehicles lined up at the intersection when the light turns green. After passing through the intersection, the bus may merge into the primary lanes of traffic and the queue jump lane ends.

## Application

- At signalized intersections with low or moderately frequent bus routes, especially where transit operates in a right lane with high peak hour volumes but relatively low right turns.
- If applied as a longer transit approach lane, buses may bypass longer queues.
- Queue jumps can be applied at near-side, far-side, or non-stop configurations. At near-side pull-out stops, the bus completes loading before rolling forward onto a loop detector that gives priority.
- At far-side or non-stop locations, the bus receives a priority signal treatment and proceeds either into a far-side stop or ahead of the traffic flow.

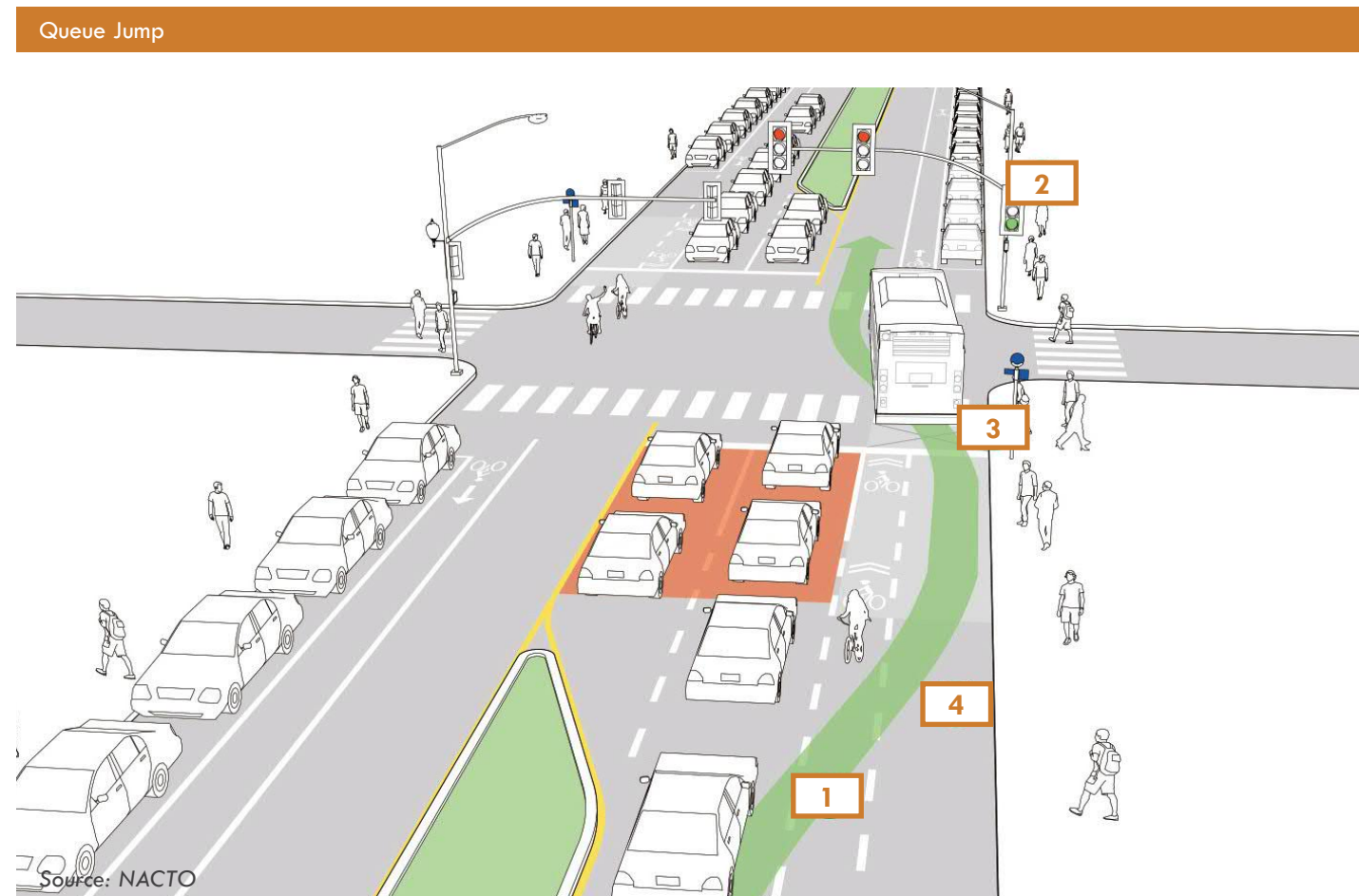
## Benefits

- Improves bus performance by routing vehicles through congested intersections ahead of traffic.

## Toolkit

- 1** Buses must have access to a lane and the ability to reach the front of the queue at the beginning of the signal cycle. Buses receive a head start with an advance green.
  - 2** Separate signals must be used to indicate when transit proceeds and when general traffic proceeds. Transit signals can be a transit specific signal head or visibility-limited green indication, making it visible only to the right-most lane.
  - 3** Where stops are located far-side, a signal phase progresses right-turning vehicles together with through-traveling buses. The queue jump lane must be long enough so buses can effectively bypass the expected length of congestion at the intersection at peak.
  - 4** Where stops are located near-side, right turns are prohibited from happening curbside. The bus pulls into the stop, completes boarding, and then pulls forward onto a loop detector to receive the advance green.
  - 4** The length of a shared head start/right-turn pocket should be long enough to allow storage of right-turning vehicles and allow buses to reach the queue jump during each signal cycle.
- The upper image to the right represents a diagrammatic version of a typical queue jump. The configuration of bike lanes, on-street parking, and the context of the 287 corridor would influence the ultimate design.

Source: Boulder County TMP, FTA





# TRANSIT APERTURE / TRANSIT SIGNAL PRIORITY

## Application

- Useful on BRT routes that often use larger transit vehicles to increase headways and reduce costs on high-capacity routes.
- Most applicable to intersections that have significant queuing or transit route delay due to congestion.
- Corridors that have long signal cycles or long distances between signals are good candidates for these techniques.

## Benefits

- Helps to reduce transit vehicle delay.

## Transit Signal Priority

Transit Signal Priority (TSP) is an operational system installed at signalized roadway intersections to time local traffic signals. The purpose of a TSP system is to reduce regional bus travel times, increase schedule reliability, and reduce bus operating costs. Once



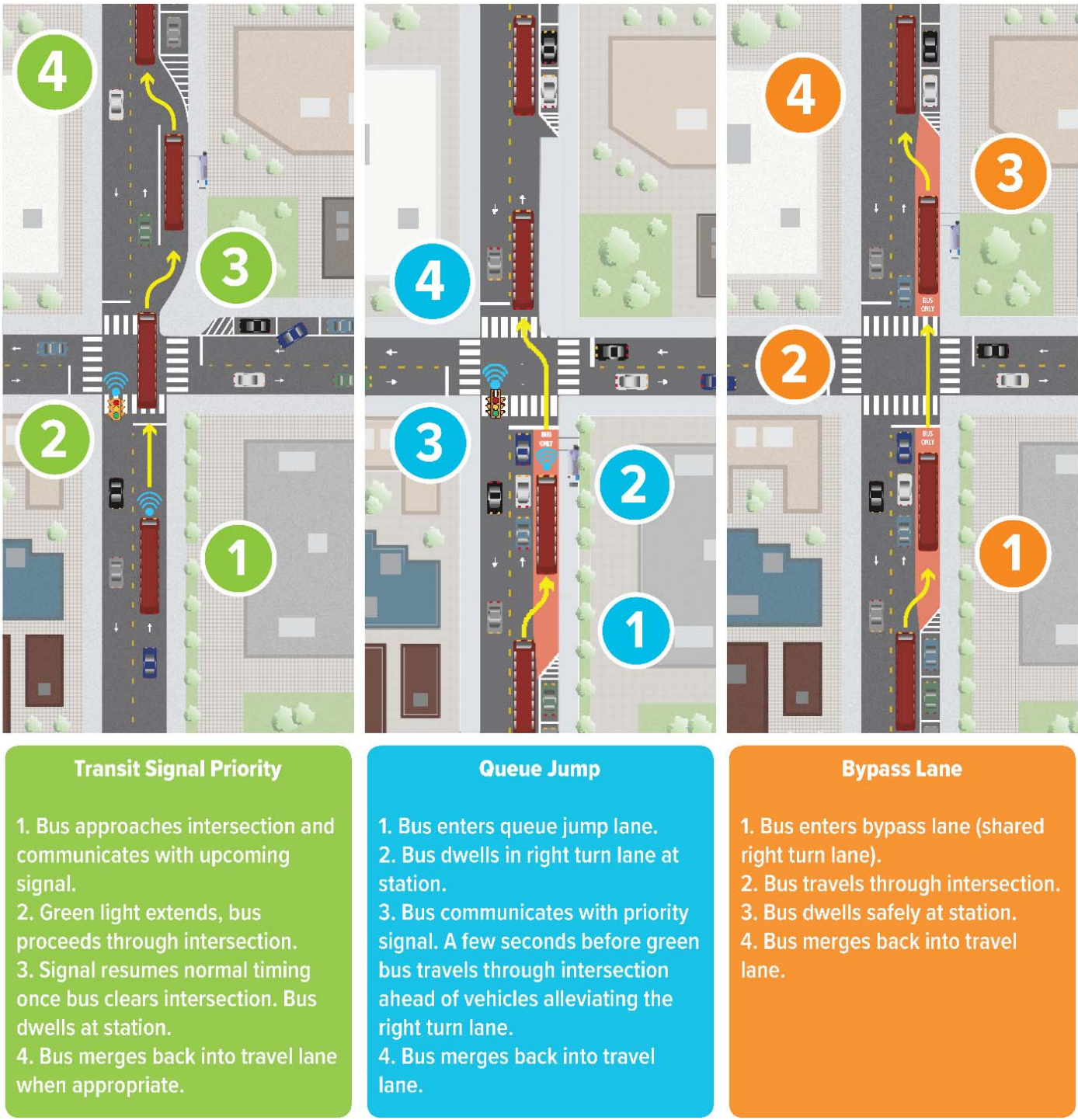
fully implemented, a TSP system can either extend signal green times by a few seconds or bring a green phase sooner every time a bus approaches an equipped intersection. Buses utilizing TSP will emit a unique frequency to intersection traffic signals, triggering a change in the signal phasing and allowing more time for the bus to pass through the intersection. TSP is typically coupled with Automatic Vehicle Location (AVL) so priority requests are only made when the bus is behind schedule. Combined with a queue jump lane, TSP and a bus only lane enable buses to by-pass waiting traffic to get out in front by getting an early green signal.

## Transit Only Aperture

This treatment prohibits or redirects general traffic away from a transit route that continues through an intersection. An exclusive lane at the far side of the intersection is dedicated for transit and/or bicycle use only. Transit-only apertures reduce friction between buses and general traffic, allowing for more efficient travel through congested and/or strategically located intersections.

## Technology

Future technologies may open new opportunities that can be explored as they become applicable.





# BUS ON SHOULDER

The shoulders of freeways and highways can be re-purposed to provide transit-only operating space with very little cost. Buses operating on shoulders can improve bus reliability and travel time by enabling free movement through otherwise congested traffic conditions.

## Key Features

- Creates a transit-only lane with very low capital cost and low impact to other modes.
- Where adequate shoulder is already present, only signage and some restriping may be required. In locations where existing shoulder width is inadequate, some roadway reconstruction will be necessary.

## Application

- High-speed freeways and highways with adequate shoulder width (10 feet or more and built to withstand the weight of a bus).
- Permitted when traffic speed in the general purpose lanes is less than 35 mph - any time of day.
- The bus cannot exceed the speed of general purpose traffic by more than 15 mph, with the maximum speed being 35 mph.



Source: RTD

Local Example:

US-36, Westminster, CO



# SIDE BOARDING ISLAND STOP



Regional Example:  
15th Street, Denver, CO

Source: City and County of Denver

A side boarding island is the preferred configuration when bike lanes are present at bus stations, even in rural and suburban contexts. A bike channel running between the side boarding island and the sidewalk eliminates conflicts between transit vehicles and bikes at stations. This style also reduces dwell times for transit vehicles. Cyclists are required to yield at the crosswalk that allows passengers access to the island.

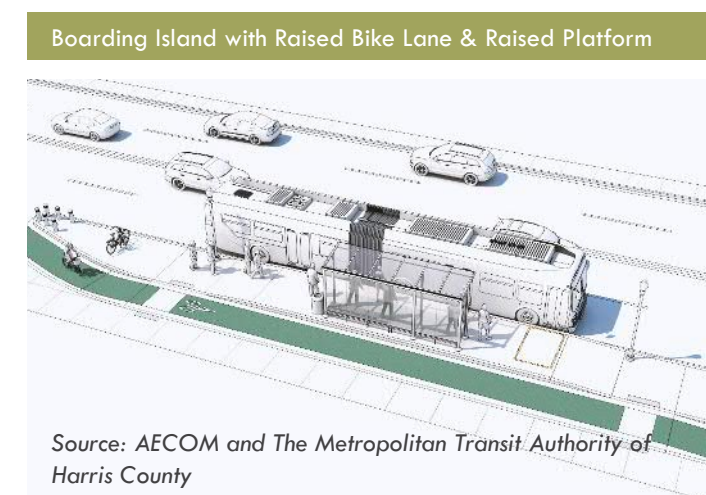
## Application

- Side Boarding Island is best utilized on streets with moderate or high transit frequency, transit ridership, pedestrian volume, or bicycle volume.
- Maintains the flow of bike lanes.

## Benefits

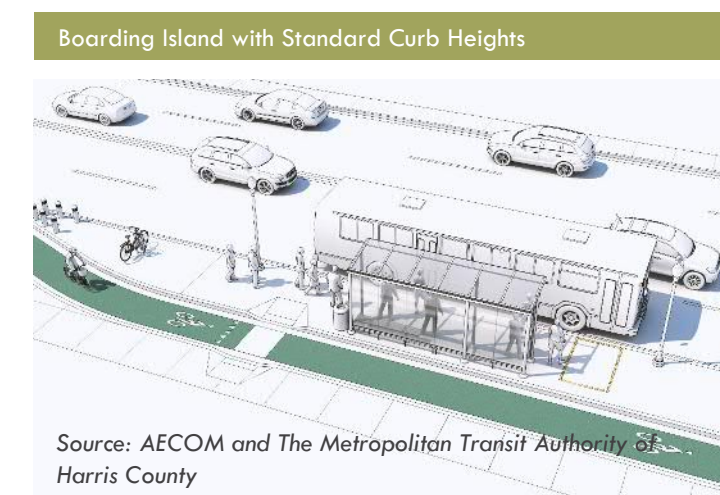
- Reduces dwell times for transit vehicles.
- Minimizes conflicts between buses, bicycles, and pedestrians by providing separate zones for each.
- Provides additional space for transit passengers and transit amenities.
- Improves pedestrian visibility.
- Able to be configured for level boarding or near level boarding.

Source: NACTO. Side Boarding Island Stop. [nacto.org/publication/transit-street-design-guide/stations-stops/stop-configurations/side-boarding-island-stop/](https://nacto.org/publication/transit-street-design-guide/stations-stops/stop-configurations/side-boarding-island-stop/).



Boarding Island with Raised Bike Lane & Raised Platform

Source: AECOM and The Metropolitan Transit Authority of Harris County



Boarding Island with Standard Curb Heights

Source: AECOM and The Metropolitan Transit Authority of Harris County



# DEDICATED BIKE SIGNAL

Multimodal considerations can be improved through the use of dedicated bike signal near transit stops or intersections. This will help reduce conflicts by designating the interaction among pedestrians, cyclists, and transit vehicles.

## Application

- Bicycle routes that present safety challenges and impact transit performance.

## Key Features

- **Bicycle Queuing Space:** An adequate queuing space should be designated for bicycles at intersections. These areas should be clearly marked for bicycles through pavement marking and/or regulatory signage.
- **Bicycle Detection:** Alerts the signal controller of a bicycle crossing. Bicycles can be detected either manually or automatically. Visual indicators, such as in the image on the upper right, can inform bicyclists that they have been detected and can expect a signal when it is time to cross.
- **Bicycle Signal Head:** An electrically powered three-lens signal head that is used in combination with existing vehicular traffic signals. The lenses typically come in green, yellow, and red.

Example:  
Alexandria, VA



Source: Alexandria Times

Bicycle Detection



Source: GGI Road & Traffic

Bicycle Signal Head on Diagonal Highway at 30th Street



Source: City of Boulder Transportation Division, Traffic Signal Practices Manual



# INTERSECTION TREATMENTS

## PEDESTRIAN REFUGE ISLANDS

Crossing wide roads with fast moving traffic can be difficult for pedestrians. Pedestrian refuge islands can help pedestrians to cross more safely by providing a location for pedestrians to safely wait for a gap in traffic so they can finish crossing the road. This allows pedestrians to cross in two stages and deal with shorter crossing distances.

### Benefits

- Reduces pedestrian collisions.
- Allows people to only need to cross one direction of traffic at a time—a reasonably direct pedestrian connection between the transit stop and building entrances on the site.
- Eliminates the need to extend crossing times for those who need extra time.



## RAISED CROSSWALKS

Raised, or otherwise distinguished crossings can enhance visibility and improve pedestrian safety. They can help reduce vehicle speed and also help encourage vehicles to yield to pedestrians. Raised crosswalks can be demarcated with paint or with special paving materials. Raised crosswalks often do not require curb ramps because they are level with the sidewalk.

### Benefits

- Can help improve the vehicle's view of pedestrians.
- Allows pedestrians to cross at-grade with the sidewalk.
- Raised walkway can help reduce vehicle speeds.

Source: FHWA. Raised Crosswalk. [https://safety.fhwa.dot.gov/ped\\_bike/step/docs/TechSheet\\_RaisedCW\\_508compliant.pdf](https://safety.fhwa.dot.gov/ped_bike/step/docs/TechSheet_RaisedCW_508compliant.pdf)



## CONTRA-FLOW BIKE LANES

Contra-flow bike lanes allow bicycles to ride in the opposite direction of vehicle traffic. Contra-flow lanes work best when a buffer separation, or other physical protection is provided for bicyclists, particularly on high volume roadways.

### Benefits

- Contra-flow lanes can help reduce trip distance, reduce out-of-direction travel, and decrease number of intersections encountered for bicyclists.
- Provision of a contra-flow lane can reduce wrong-way riding and sidewalk riding.



## INTERSECTION IMPROVEMENTS

Strategies that improve intersection configurations for bicycle travel include but are not limited to: signal phasing changes, signing changes, and pavement markings to give a cyclist a designated place to be. Signal phasing changes can be adjusted based on different times of the day, day of the week, and integration of right turn or left turn restrictions. Pavement markings and signing changes communicate to motorists, bicyclists, and pedestrians a designated space for each mode, improving safety for all road users to navigate through the intersection. World-class international examples of protected intersection design (such as those seen in the Netherlands) could serve as inspiration for intersection improvements throughout Boulder County.



# FIRST AND FINAL MILE IMPROVEMENTS

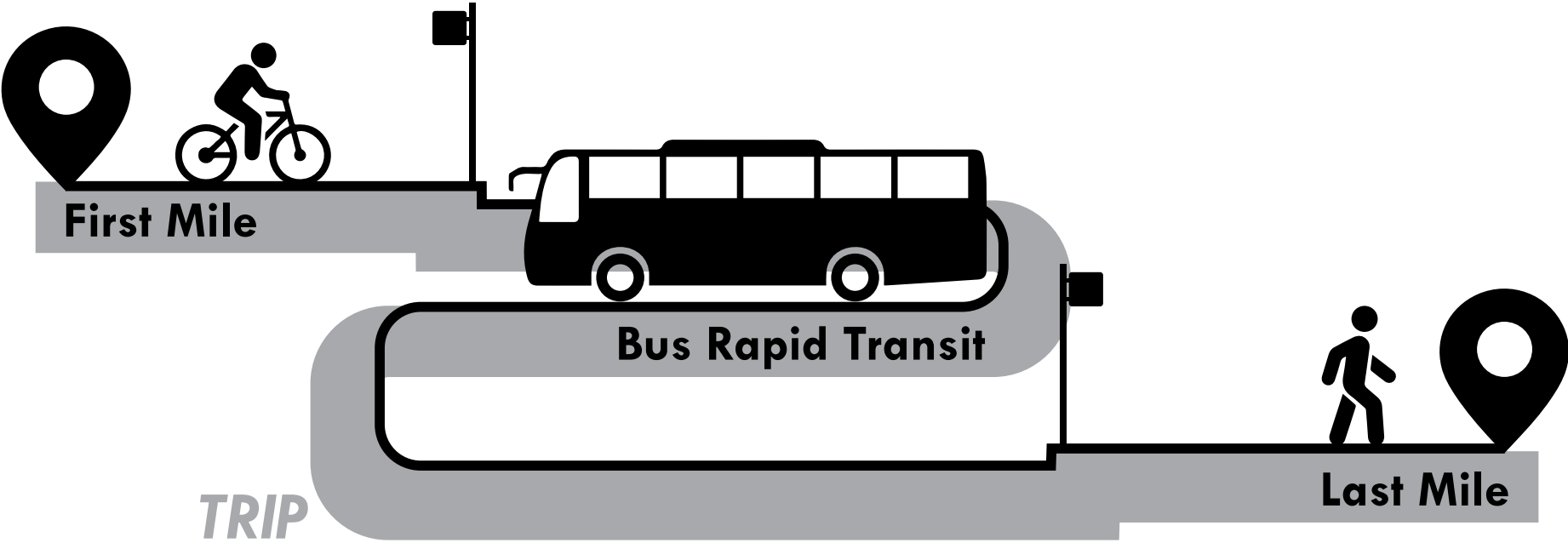
## FIRST AND LAST MILE

Good pedestrian and bicycle infrastructure to and from transit stations enables safe and comfortable connections for people accessing and traveling around transit stops. The following are a few ways to make connections to transit easier:

- Improves modal connections to increase the ability of commuters to use regional transit.
- Reduces travel time delays associated with loading and unloading bicycles.
- Includes additional bike carrying capacity on transit.
- Provides buffered or protected bike lanes where applicable to create comfortable connections.
- Prioritizes bicyclists in conflict areas through the use of green skip paint.
- Create an identity/brand for the route and/or destination through elements like wayfinding, planting, hardscape materials, site furnishings, and art.

Partnerships among local communities, businesses, and neighborhoods are critical to improve first and last mile connections. Many first and last mile destinations are located in areas outside of Boulder County where permissions and collaboration are needed to improve the connections.

The [SH 119 First and Final Mile Study](#) organizes first and final mile recommendations into five categories including bicycle and pedestrian connectivity, wayfinding, transportation demand management, shared parking, and microtransit. All recommendations are intended to increase the quality of travel experience for transit users to and from the stop and while they are waiting at the stop.





# BIKE PARKING

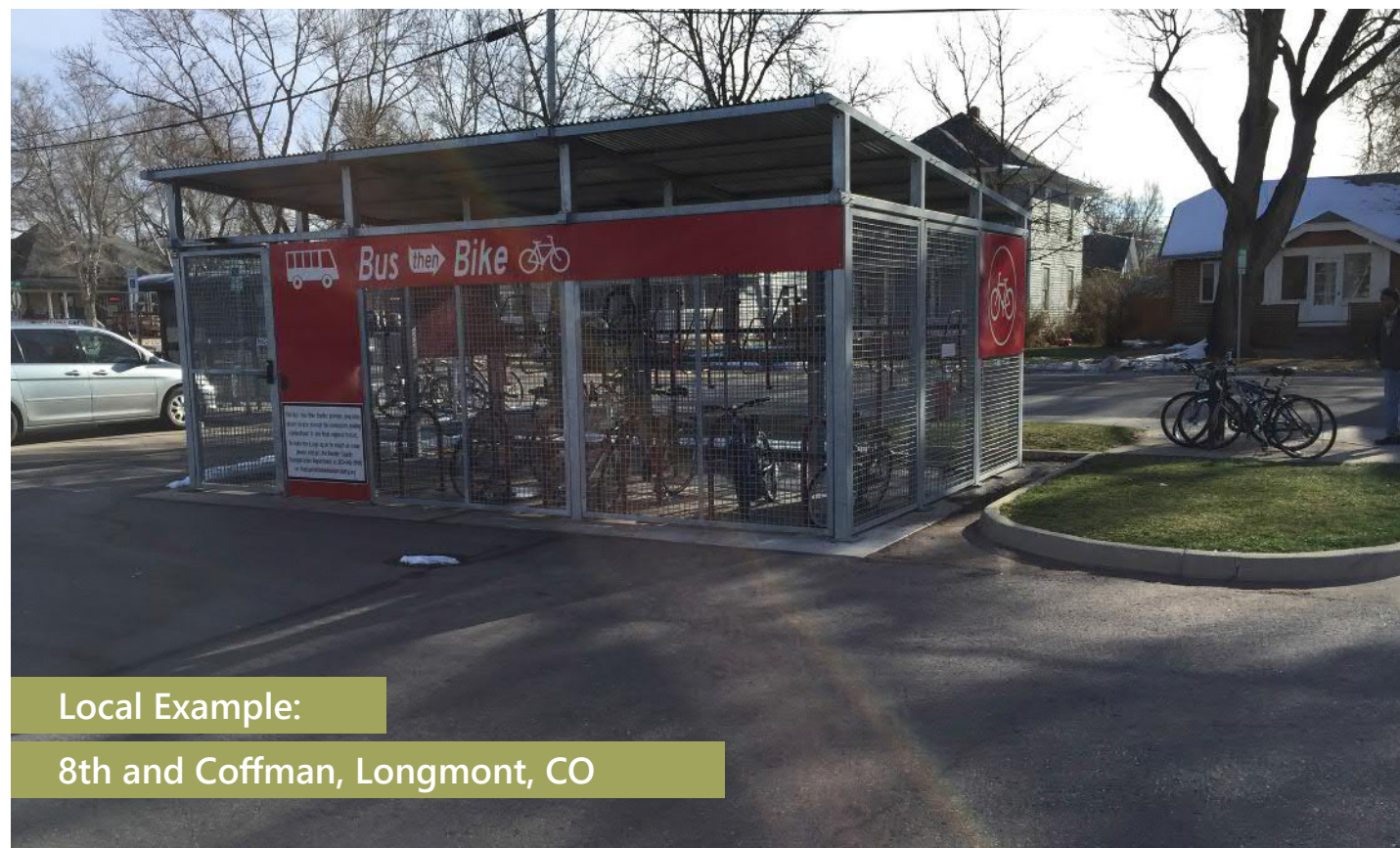
Supplying bike parking at transit stations can expand transit sheds and increase multi-modal access by providing a safe and convenient location to store bikes. This can increase transit ridership by providing an alternative from driving for people to utilize transit who do not live within walking distance. The Association of Pedestrian & Bicycle Professionals offers resources and guidance on how to provide easily used and secure bicycle parking.

## Key Features

- Bike parking type at stations can vary significantly and can offer bike storage that caters to the needs of different riders. For example, stations can offer short-term parking like “Inverted U” bicycle racks, or bike-n-ride shelters, which offer more secure, longer-term bike storage.

## Application

- Short-term parking should be located near the station or use being served.
- If space allows, long-term bicycle parking can offer enhanced security and protection from weather.
- Ensure a clear zone is reserved around bicycle parking so as not to impede transit vehicles or pedestrian circulation.
- Bicycle parking should be located in well-lit and highly visible locations.
- The Boulder County Multimodal Transportation Standards document offers specific guidance on the placement and type of bicycle racks. Other local standards and requirements about bicycle facility placement should be taken into consideration.



Local Example:

8th and Coffman, Longmont, CO



Source: Outdoor Design Group

## Benefits

- Improves multi-modal connectivity at stations.
- Offers convenient, secure bicycle storage to encourage bicycling and bridge first and last mile gaps.



Source: GoStar Group, Inc., South Main Station Apartments



# STATIONS & STOPS

To increase ridership for bus rapid transit, Boulder County is prioritizing the enhancement of bus stop facilities and the accessibility to and from these facilities. These enhancements are designed to minimize dwell time and to create safe, comfortable, and easy to access facilities.

The following criteria could be used to prioritize which stops to improve and the type of improvements to implement:

- Projected daily ridership
- Projected land use
- Public feedback
- Recommendations from municipalities and other agencies
- Stops along transit route
- Existing connections to trail and transit networks
- Safety
- Physical constraints
- Right-of-way needs

Amenities should be placed away from boarding edge of platform and maintain clear walkways within stations. Stations should also remain visually open with clear sightlines. When considering which amenities are appropriate for each station, ongoing maintenance responsibilities should be considered.

## LEANING RAILS

Leaning rails allow passengers to rest while waiting and can also be positioned to help channel pedestrian movements through boarding areas. They typically rise 30-38 inches.



Source: NACTO

## DOCKING GUIDE STRIP

Docking Guide Strips or bumpers provide more precise docking for BRT operators. The bumpers can offer operators more confidence in minimizing the gap between the bus and the platform as the vehicle docks at a station.



## PROTECTION FROM THE ELEMENTS

One of Boulder County’s priorities is to support bus stop facilities that are safe, comfortable, dignified, easy to access, and designed to minimize dwell time. Bus stop enhancements per the Boulder County TMP include benches, concrete pads, shelters, bike racks and route & schedule information. Providing shelters that offer protection from the elements makes waiting for transit much more pleasant for transit patrons in all seasons, but especially during inclement weather.

Physical design elements at stations can help provide both real and perceived protection and separation from the roadway to increase patron comfort.

*Fully enclosed stations provide protection from cars, improved fare zones, improved dwell times, and improved security.*



Source: Leon, Mexico



The following elements can be considered to provide visual and physical protection from vehicles:

- Bollards
- Railing
- Concrete Wall
- Concrete Jersey Barriers
- Planters and Trees
- Full Enclosure

Historic Enclosed Transit “Waiting Area” at Colfax and Broadway, circa 1910s



Source: Bridge Michigan



# STATIONS & STOPS, CONT.

## LIGHTING

Lighting at and around stations and platforms should provide sufficient illumination for security and imparting a sense of safety for patrons. Wherever possible, lighting can also be an artistic element to increase interest and aesthetics. Diffused lighting can be incorporated in some areas to accommodate those with light sensitivity.

- Passenger facilities and stations areas should be illuminated as required to:
- Support wayfinding and system identity by clearly identifying stations, station areas, and entrances.
  - Permit safe and convenient passenger circulation, and reinforce patrons’ perception of a safe environment.
  - Provide a feeling of openness in passenger waiting areas.
  - Support monitoring of stations by law enforcement personnel and surveillance equipment.
  - Accentuate fare collection equipment, emergency cabinets, exit routes, and station amenities.



## ART

Integrating artistic elements at stations can increase the sense of place and aesthetics of transit infrastructure. Art at stations should reflect the culture, history, and geography of the surroundings and pay homage to the cultures and people who lived or live around the station.

‘Plop art’, or art that is not well-integrated into station design should be avoided. Art can be incorporated into bus shelters, benches, building materials, pavement materials, railings/fence, and screen walls. Art integrated as wayfinding can help users navigate the transit system in an intuitive and creative way.



Source: RTD, City of Boulder





# STATIONS & STOPS, CONT.

## ROUTE / SYSTEM MAPS

Route and system maps should be located prominently at stations and be convenient to locate and view. Providing route information that is clear, understandable, and accurate makes it easier for passengers to understand their travel options. Signage for Route and System Maps should be:

- Easy to read and understand.
- Provide useful information.
- Be reasonable to maintain.
- Be unique to the corridor, but also integrated with other existing and future BRT corridors in the region.



Source: NACTO



## WAYFINDING / SIGNAGE

Wayfinding assists in helping patrons locate bus stops as well as other nearby destinations or transit connection locations. Signage that communicates valuable information can enhance the transit stop as a gateway to its surrounding neighborhood or destinations. Station ID, or a unique stop number clearly identified on stop signage helps for orientation, integration with mobile apps, and security at stations.



Consistent appearance of route signage and information makes it easier to find bus stops, especially where stops for opposing travel directions are not located immediately nearby each other. Stop identification signage with route information also helps integrate with mobile apps and finding real time transit information.



## BRANDING

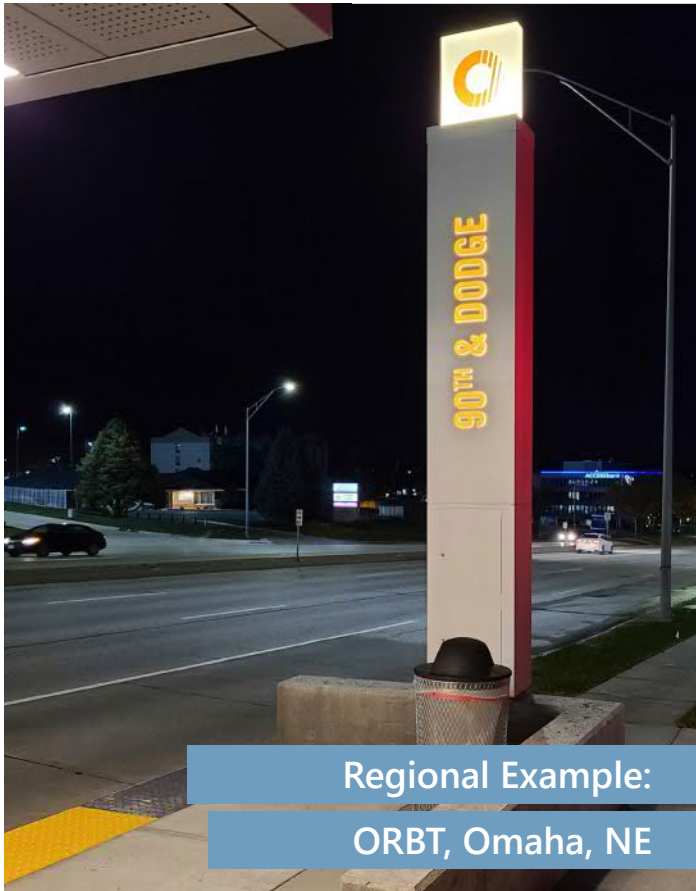
Consistent branding helps with forging a strong identity and reinforces transit rider confidence in navigating transit systems. Branding features encompasses design strategies such as consistent use of color, materials, logo placement, appearance of maps at stations, unique street clocks, distinctive shelter design, amongst many other possible branding distinctions. Branding should be consistent and predictable. Regional or transit agency brand should be consistent, but some distinctions to highlight different services can be emphasized at transit stops if desired.

## CLOCKS

Providing clocks at stations can be useful for patrons without cell phones to know when the next bus will arrive. Clock placement and design can also serve as another station branding element.



Source: Loveland Reporter-Herald



Regional Example:  
ORBT, Omaha, NE





# STOPS & STATION AMENITIES

## STATION SCALE

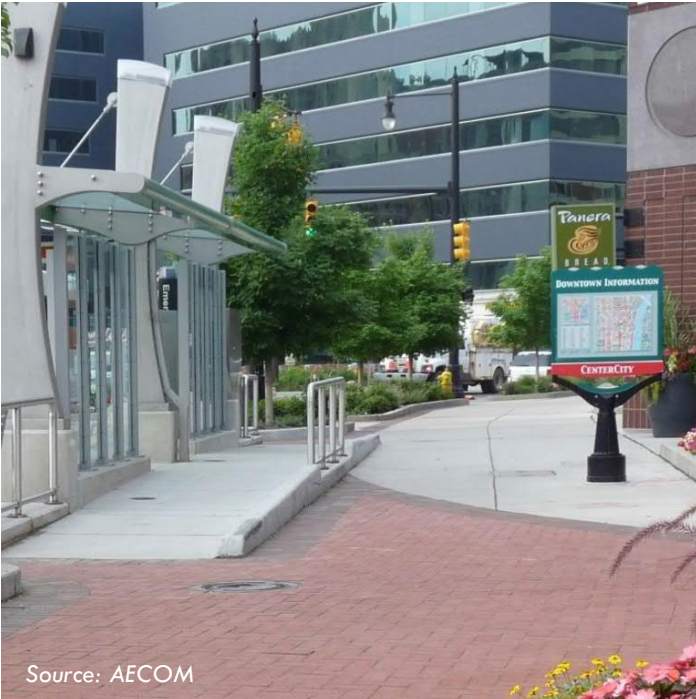
Station scale can be determined by a variety of factors including context, ridership, location, amongst others. BRT stations should have a minimum dimension and then scale up as appropriate, based on the aforementioned factors. The platform length available for boarding and alighting should be determined based on peak-hour boarding with consideration of projected boardings for special events. Platform size should provide comfortable station dimensions that allow free flowing movement, clear space around station amenities and columns, and adequate dimensions to accommodate required ADA dimensions. The desired length of platform should be 60 feet, not including access ramps.

## PATRON CONVENIENCE

Where possible, include drinking fountains or water bottle filling locations near stations. These items increase patron comfort and cater to bicycle commuters who may need water refills before they reach their destination. Vending machines could also be provided where feasible to offer patrons a place to get a drink or snack while they wait for the bus. These amenities may be placed at stations or, depending on station configuration, within other adjacent public spaces (see also 'Outdoor Waiting Plazas').

## PAVING

A variety of hardscaping paving materials can be used in the construction of BRT stops and stations including asphalt, concrete, and pavers. Material selection is typically dependent on the functional requirements of the space (e.g. traffic type, location). Distinctive paving materials enhance the transit streetscape and extends the public space from the sidewalk into the street. Different paving materials or colors, textures, and orientation can be used to identify the different use zones (i.e. pedestrians, cyclists, and BRTs).



The application of different textures, paint, or stickers on the ground at BRT stations can indicate where to wait for the bus. Identifying the location where the door will land improves boarding efficiency so patrons know where to line up.



## PLANTING

Landscape design can be used to enhance the function, safety, and aesthetic of transit stops and stations and integrate the transit area into the surrounding community by complementing the established streetscape or respecting the character of the neighborhoods. A system-wide planting palette that is hardy, low maintenance, non-toxic, suitable for urban environments, and native to Boulder County should be introduced. Any existing trees in good condition should be preserved and maintained when redeveloping a station area.





# STOPS & STATION AMENITIES, CONT.

## ACCESSIBILITY - ADA REQUIREMENTS+

- ADA Requirements at stations include:
- Near-Level Boarding
  - Compliant Lateral Gap
  - Audible Messages
  - Door Indications
  - Fare Collection
  - Ramps (5% to 8.3%) with railings and landings
  - Walkways (<5%)
  - Detectible Warning
  - Adjacent Intersections
  - Universal Design

Detectible or tactile warning treatment can assist visually impaired patrons find the edge of the platform or boarding/door locations. For all patrons, changes in surface treatments can help provide visual cues for where to board, where to wait, and can even assist with pedestrian travel patterns on and around the station platform.

In addition to their safety and functional applications, textured pavers, concrete, and different surface treatments can also add visual interest and improve visual aesthetics of station platforms.

The **Boulder County Transportation Master Plan** advocates for accessible, affordable, and equitable transportation options, ensuring that adequate access to transportation enables those with physical disabilities to lead more independent and self-sufficient lives.



## BLUE LIGHT / EMERGENCY PHONE

Emergency telephones and emergency response buttons can be located within close proximity to all transit facilities. The call boxes can provide a 9-1-1 style service to riders on the platforms.



## WIFI & OUTDOOR CHARGING STATION

WiFi should be considered at stations to supplement cell phone coverage when not available. WiFi/ Smartphone connectivity allows passengers to use their time waiting for the bus for enjoyment or work. Access to the internet can also help people call TNCs and use bicycle/scooter share programs.

Outdoor charging stations should be provided at BRT stops for passengers to charge their low battery mobile devices and to stay connected whether it is for leisure or for work. The stops should be equipped with 4-port USB outlets and wireless charging. Outdoor charging stations should be installed adjacent to a shelter or a bench.





# STOPS & STATION AMENITIES, CONT.

## REAL-TIME ARRIVAL INFORMATION

Real time arrival information at stations helps enhance rider experience and improves predictability by defining the current status of vehicles, including locations and predictive arrival times. This information can be provided via smart phones, but posting real time information on dynamic signs at bus stops can improve real time information to passengers.



## FARE ZONES (PAY TO ENTER)

Paid fare zones are areas reserved for ticketed passengers. Only passengers would be allowed to enter using proof of payment to gain entry. Fare zones can be designed to offer increased amenities and sense of security to passengers while waiting.



## PREPAYMENT

Allowing fare prepayment can streamline the boarding process and improve efficiency. Paired with all-door boarding, advanced payment or prepayment helps to lower dwell time at stations. Prepayment capability also allows for future technology (i.e., digital passes, tap and go fare collection, etc.) Some examples of prepayment technology include:

- Ticket Vending Machine with receipts
- Electronic smart cards
- Cell phone-based apps/mobile payment.

### Ticket Vending Machines

Ticket vending machines allow passengers to purchase single fares, add value to fare cards, or generate proof of payment tickets from passes. Machines typically accept various payment methods, including credit cards, cash, and mobile payment systems. Consider prepaid fare machines that accept cash and return change to ensure equal patron access, even those without a bank account. Machines must be placed at a height between 34 to 38 inches to accommodate users in wheelchairs.



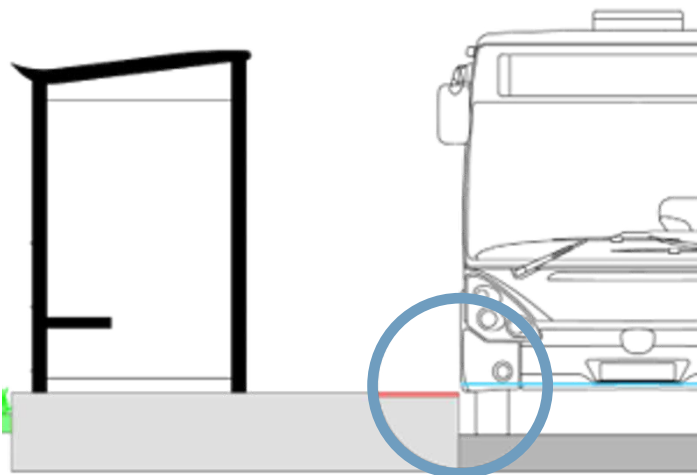


# STATION AREA PLANNING

## LEVEL BOARDING

Platforms should be designed to be a few inches above roadway pavement for near-level boarding. This will be achieved by matching the platform height to the bus, with confidence that the bus floor height will never be lower than the platform. Platforms may be on the side of the road or in the median of the road.

Near-level boarding is an example of universal design. It benefits people with disabilities, parents with baby strollers, and others. Human characteristics considered in universal designs may also include age, gender, stature, race/ethnicity, culture, native language, and learning preference.



Source: AECOM

## Rolling Stock Modification

Rolling Stock refers to transit vehicles and their compatibility with BRT station infrastructure. It is recommended that platform height and transit vehicle type are correlated to minimize required boarding time and preventing delay. Minimizing the gap or distance between coach floor height and platform height facilitates boarding safety for all passengers, but especially those using wheelchairs or other mobility devices. Any horizontal gaps that exist between the vehicle and the station platform can be accommodated with ramps or bridge plates, as shown in the image of the Omaha Rapid Bus Transit vehicle at a station. Boarding position, access to bus bike racks, amongst other factors should be considered in station design.



Source: AECOM



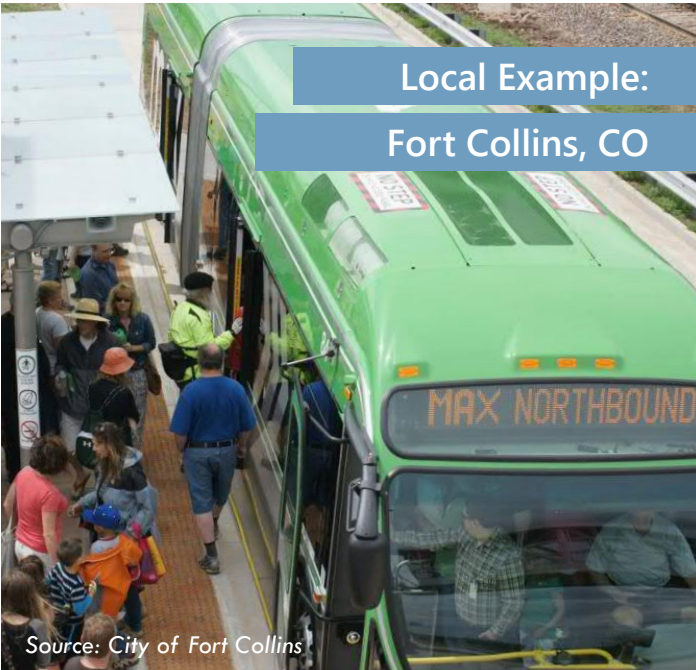
## ALL-DOOR BOARDING

All-door passenger boarding allows riders to board and alight using all doors of a transit vehicle, minimizing passenger queues and delays associated with longer dwell time at busy transit stops.

While it can improve travel time and reliability, all-door boarding also raises fare payment considerations, since bus operators do not automatically serve as fare inspectors as they would with front door-only boarding. All-door boarding is typically paired with advance payment or prepayment solutions. (Refer to page 17 for additional information on Fare Zones and Prepayment.)



Source: Chicago Streets Blog



Source: City of Fort Collins





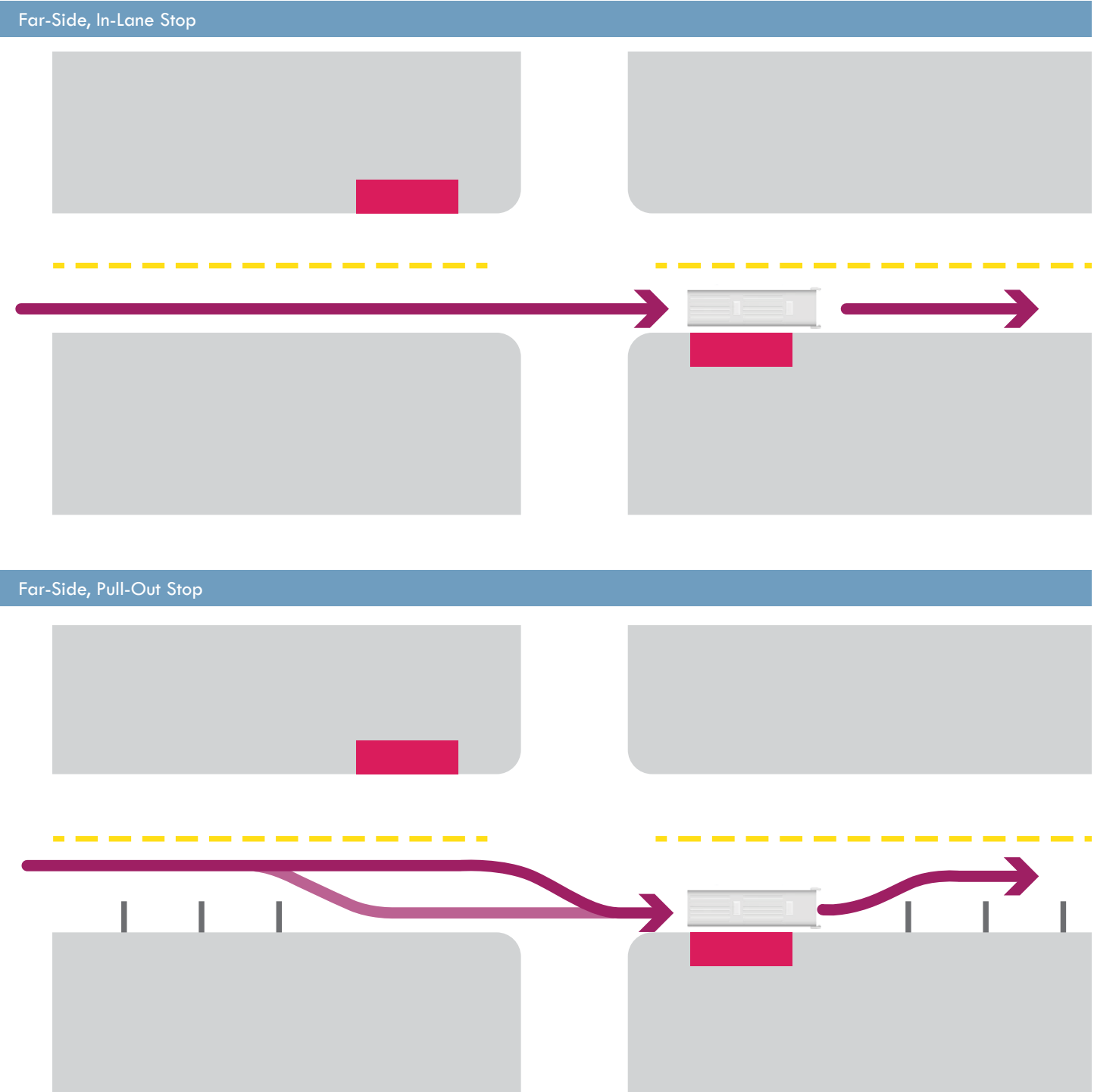
# LOCATING STATIONS

## FAR-SIDE STATION PLACEMENT

The preferred station placement is far-side platforms (after the intersection in the direction of travel).

Benefits to a far-side stop include:

- Reduces conflict with a stopped bus and right-turning vehicles.
- Eliminates sight distance deficiencies from side street approaches to the intersection.
- Transit signal priority can allow buses to approach the stop uninterrupted.
- Buses can easily re-enter traffic at signalized intersections.
- Encourages pedestrians to cross at the rear of the bus and the stopped bus does not obscure pedestrian movements at the station.
- In cases where safety or physical constraints prohibit the adoption of a far side station, near side or midblock stations may be considered.





# CURB EXTENSIONS FOR STATION STOPS

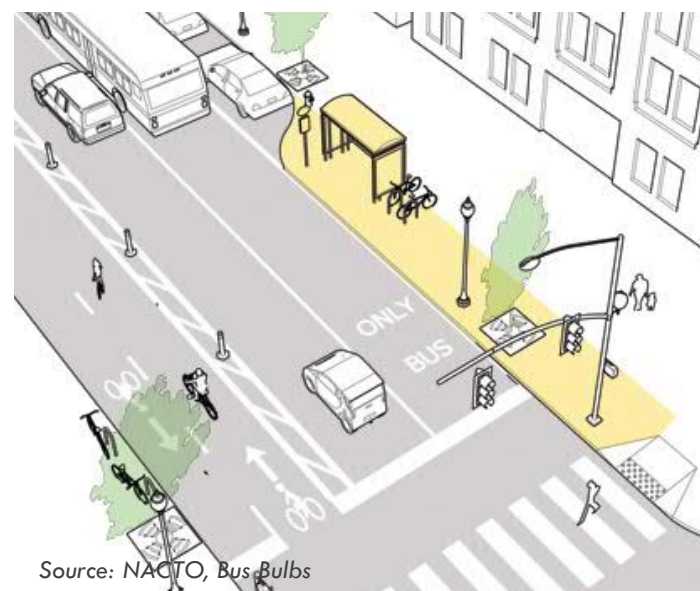
Curb extensions narrow the roadway to provide a larger waiting area for bus stops and to create safer and shorter crossings for pedestrians at intersections. Additionally, the narrow width of the roadway increases the visibility of pedestrians and encourages slower speeds to drivers.

There are different types of curb extensions for different applications. Curb extensions include bus bulbs, gateways, chicanes, and mid-blocks. Bus bulbs are a type of curb extensions that align the bus stops with the on-street parking lane. This enables buses to stop in the travel lane and board passengers. Gateways are a type of curb extensions that adds intersections to transition streets to a slower speed. They are typically introduced at residential streets. Chicanes offset the curb to slow down drivers and to provide more pedestrian space for street furnishings, planting, and other amenities. Mid-blocks are curb extensions added at the center of a block to slow down drives and to create additional space for pedestrians.

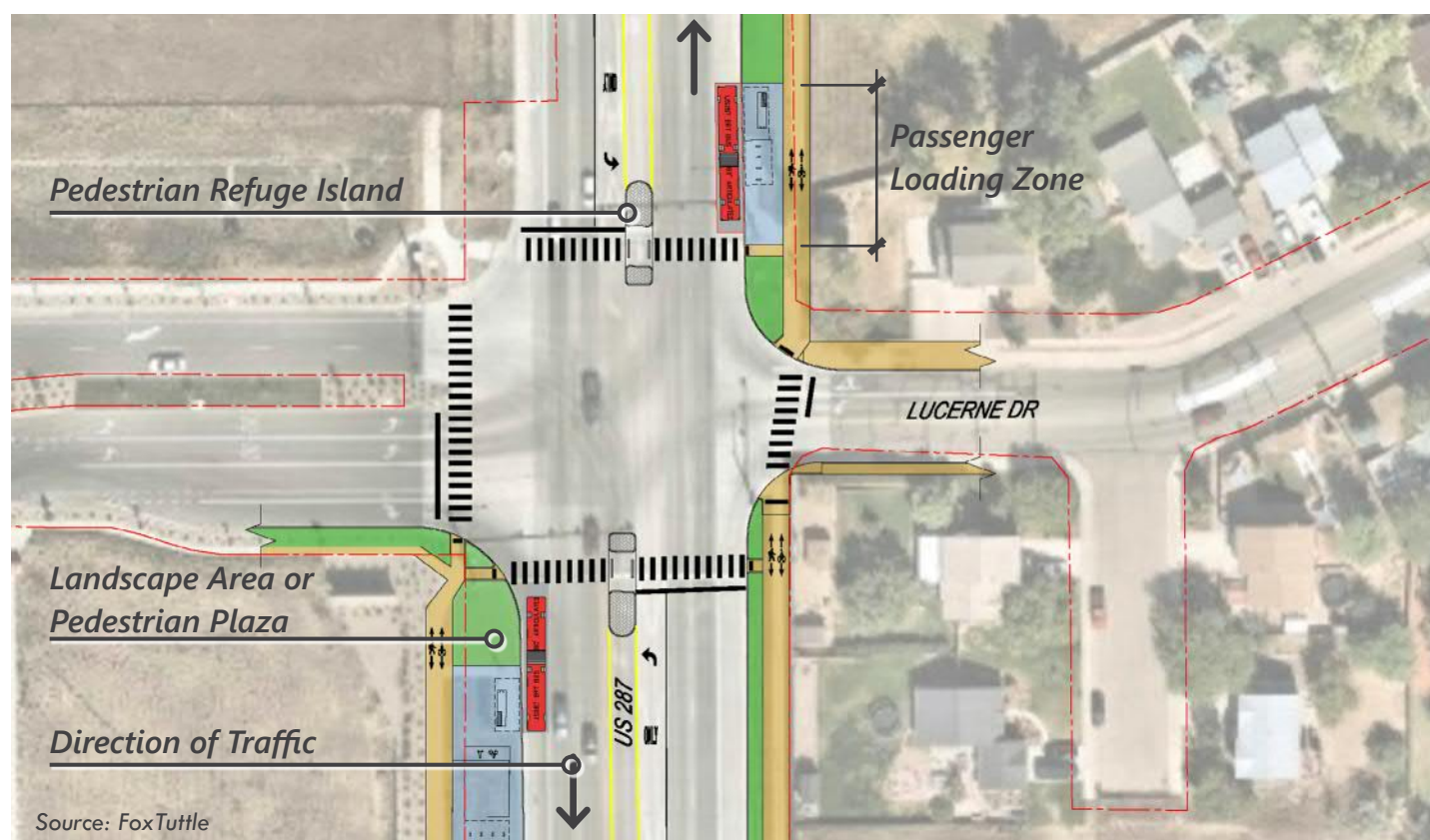
See also 'Intersection Treatments' in the Multi-Modal Considerations section of this document for additional discussion on treatments that can improve pedestrian safety and comfort.

## Benefits

- Increases the visibility of pedestrians.
- Creates safer and shorter crossing distance for pedestrians.
- Prevents drivers from parking on or near crosswalks.
- Encourages slower driving speeds.
- Provides additional space for placemaking, street furnishings, landscaping, and gateways.



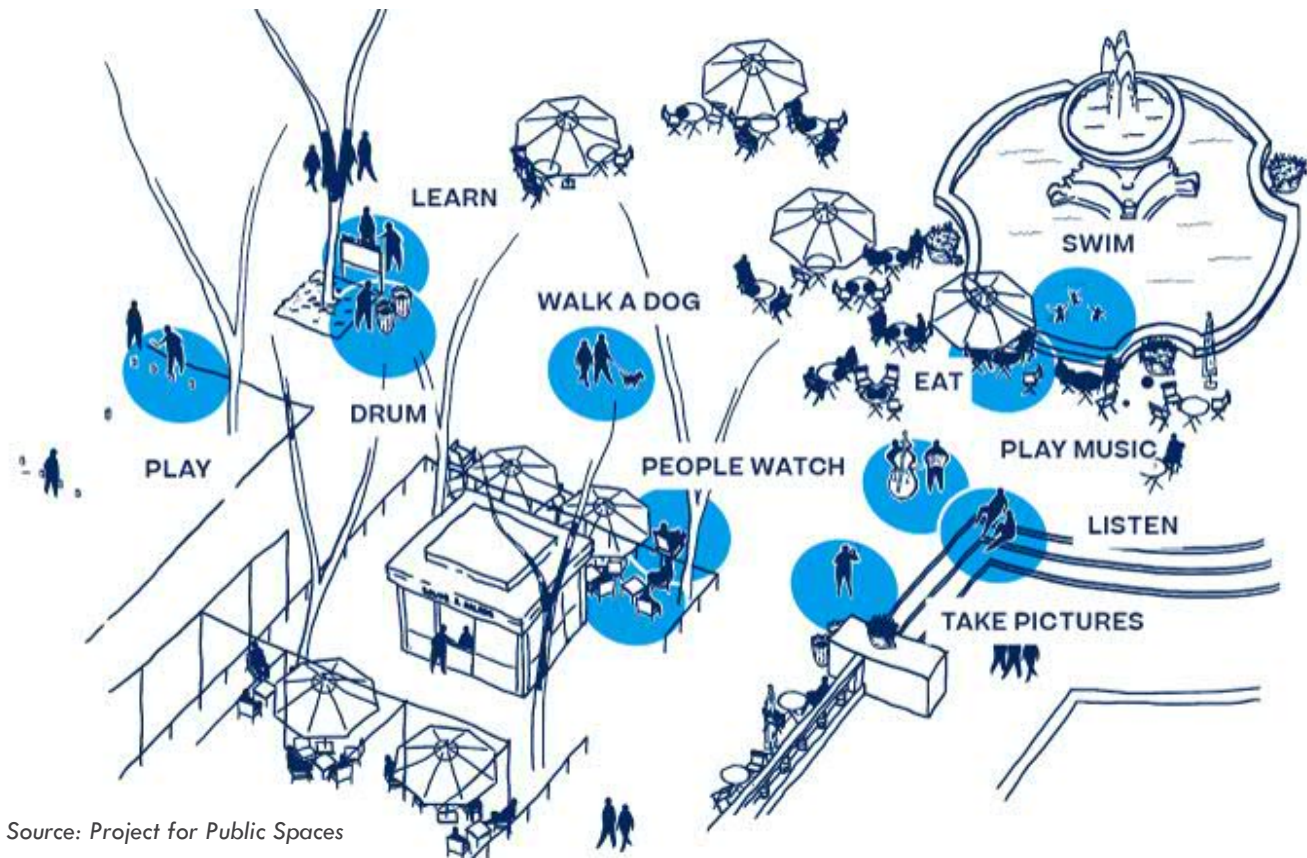
At Grade Crossing at US-287 and Lucerne Dr.





# PLACEMAKING

Project for Public Spaces: Power of 10+ Transform Through Placemaking



Source: Project for Public Spaces

The **Power of 10+** is a concept which posits that places thrive when people have multiple reasons to be there (10+). Some of these reasons may include food, music, places to play, places to sit, culture/history, etc. The tool offers a framework for how to engage residents and other stakeholders to create destinations.

The **Power of 10+** concept may be used within Boulder County to make BRT stations and the spaces around them lively, active community spaces which serve as more than just transit stops. This concept is to create 10 different things for people to do, as a reward for being at the station and to provide a place where people waiting for the bus can enjoy. Larger stations should strive to have 10 or more things to do, medium stations may have 4 to 6, and smaller stations may have 2 to 3 elements.

The following are ways to develop mixed-use hubs surrounding the BRT stations:

- Create active public spaces—plazas should be designed to incorporate elements like public art,

unique paving treatments, decorative landscaping, amongst other design techniques to enliven the public space.

- Extend pedestrian-centric streetscape such as wide sidewalks with tree grates. Trees offer shade and help reduce traffic noise.
- Ensure that land uses surrounding stations are connected to station areas and vice-versa. Safe, welcoming, and facilitated connections help integrate stations into the surrounding context.
- Provide shared parking options, bike share, and other micro-mobility options to provide first and last mile connections.
- Utilize consistent landscaping, materials, colors, streetscaping, signage, and other elements

surrounding BRT stations to establish continuity and provide patrons and pedestrians with visual cues that they are near a station.

- Where applicable, consider incorporating educational or historic signage that can inform patrons waiting for the bus about the surrounding area.
- When feasible, plan proactively so that stations have the physical infrastructure in place to be able to accommodate future opportunities. For example, the appropriate electrical connection could allow a coffee vending cart to locate near a station.
- Offer convenience items such as drinking fountains that increase patron comfort.



Source: The Longmont Leader



# TRANSIT-ORIENTED DEVELOPMENT

Transit-oriented development should be encouraged surrounding transit stations where feasible and where existing and future land use planning is supportive of this type of development. Transit-oriented development, or TOD, is a tool that local communities can implement if aligned with their jurisdiction's land use and development goals.

TOD helps to support the concept of transit-oriented places that offer more than just transit services and become a place where people want to spend time. Placemaking elements such as plazas and other public spaces can help integrate transit stations with adjacent land uses. Development surrounding transit facilities can lead to increased usage from the businesses and residents who live and work around the transit station. The concept of 'eyes on the street' can make transit stations feel safer by having a mix of uses that ensures activity both day and night.

The following are general guidance that could be considered for TOD surrounding transit stations:

- Encourage a full range of land uses and services, particularly those that have active uses on the ground floor.
- Consider inclusion of services that cater to everyday commuter needs within a short walking distance.
- Create multimodal connections from neighborhoods to transit stations.
- Establish clear and convenient pedestrian routes from transit stations to surrounding buildings.
- Activate station areas and spaces surrounding the station with programming and active land use (see Placemaking).
- When feasible, public open spaces that can host community events or other activities can help further integrate the transit station within the community (see Outdoor Waiting Plazas).



## Outdoor Waiting Plazas

Outdoor Waiting Plazas are designed for pedestrians, bicyclists, and transit uses. They become a gathering place full of various amenities, where people can arrange to meet a new client, a colleague, or a friend. Here are some guidelines for designing an outdoor waiting plaza:

- Provide a flexible space to accommodate a variety of public uses during different times of the day, week, and year.
- Provide "comfort" amenities such as bike racks, drinking fountains, recycling and trash receptacles, pedestrian-scale lighting, shade and soft surfaces.
- Provide ample seating and comfort options, such as leaning areas or different areas to wait.
- Include vending machines or places to buy drinks and snacks while passengers wait.
- Include active art and water features.
- Incorporate art into built elements, such as paving, railings, signage, seating or overhead structures.
- Incorporate environmentally friendly features.
- Use high-quality authentic materials.
- Utilize trees and plants to soften the space.
- Provide wayfinding features, such as signage, specialty pavement, and art.
- Incorporate interpretive signage where applicable to increase awareness and educate passengers.
- Design the plaza to appeal and attract a diversity of users from throughout the community.
- Incorporate elements that increase the sense of place.

Source: City of Boulder. *Transit Village Area Plan*. [www-static.boulder.colorado.gov/docs/transit-village-area-plan-1-201304181551.pdf](http://www-static.boulder.colorado.gov/docs/transit-village-area-plan-1-201304181551.pdf), 2010.



# CRIME PREVENTION THROUGH ENVIRONMENTAL DESIGN (CPTED)

Crime Prevention Through Environmental Design, or CPTED, is the practice of using lighting, landscaping, music, and other design elements to improve safety and security.

To the maximum extent possible, CPTED principles should be applied at transit facilities in a way that is conducive to operations without becoming a maintenance or financial burden. According to the American Public Transit Association, CPTED can provide the following benefits:

- Creates a welcoming environment.
- Fosters a sense of physical and social community order.
- Creates a sense of ownership by transit users and employees.
- Maximizes the presence of transit staff and law enforcement figures.
- Minimizes opportunities for out-of-sight activity.
- Manages access to authorized areas and controls access to non-public areas.

## Guidelines

CPTED has five industry strategies as described below:

- **Natural surveillance:** Involves reducing crime by decreasing target opportunities and maximizing visibility.
- **Natural access control:** Denies access to crime and creates a perception of risk for adversaries by channeling people through designated entries and exits.
- **Territoriality:** Notifies users and non-users of the boundaries of the space and creates a psychological deterrent to crime.
- **Activity support:** By encouraging authorized

activities in public spaces, the intended use of the space is understood and criminal acts are discouraged.

- **Maintenance:** Preserves the intended purpose of the space, while the lack of maintenance can be a sign of tolerance for disorder. CPTED maintenance and care standards safeguard the best interests of the community and transit agency.

These strategies can be applied to transit in the following ways:

- **Natural surveillance:** Ensure adequate illumination of all public areas, ensure landscaping does not obscure sight lines, maximize visibility from doors and windows, and utilize surveillance as appropriate.
- **Natural access control:** Use landscaping, architecture, and site design to help distinguish between public and private areas. Clearly delineate where patrons are and are not allowed.
- **Territoriality:** Ensure that there is adequate distinction between restricted and public areas. Well-designed fences, walls, and landscaping can create physical barriers that extend the sphere of influence of the station.
- **Activity Support:** Ensuring that stations are also community facilities can help with safety and surveillance. Lively, active, well-populated places discourage crime.
- **Maintenance:** Maintain cleanliness of all areas, ensure equipment is operating properly, and remove debris and any vandalism. The well-kept appearance of assets, equipment, and facilities can help deter criminal activity.
- **Music:** Although music is not an industry strategy for CPTED, studies have shown that classical music helps to prevent loitering of unwanted users; thus, it creates a safer environment.

Source: APTA, Crime Prevention Through Environmental Design (CPTED) for Transit Facilities. [https://www.apta.com/wp-content/uploads/Standards\\_Documents/APTA-SS-SIS-RP-007-10.pdf](https://www.apta.com/wp-content/uploads/Standards_Documents/APTA-SS-SIS-RP-007-10.pdf)





# STORM WATER MANAGEMENT

Best Management Practices (BMP) to be considered when designing storm water management near stations include:

- Bioretention facilities
- Catch basin/storm drain
- Constructed wetlands
- Dry wells
- Infiltration basins and trenches
- Media filtration
- Porous pavements
- Bioswales
- Wet and dry detention ponds
- Low water and low-maintenance landscaping

Water-tolerant trees should be incorporated into storm water facilities. According to the approved tree list for the Town of Erie, Colorado, the following trees can highly tolerate water: Bald Cypress, European Hornbeam, Norway Maple, and River Birch.

## Benefits

- Improves water quality.
- Reduces flood risks.
- Reduces urban heat island effect.
- Improves air quality.
- Absorbs local carbon emissions.
- Increases biodiversity and habitat.
- Improves public health outcomes.

## Bioretention Planters

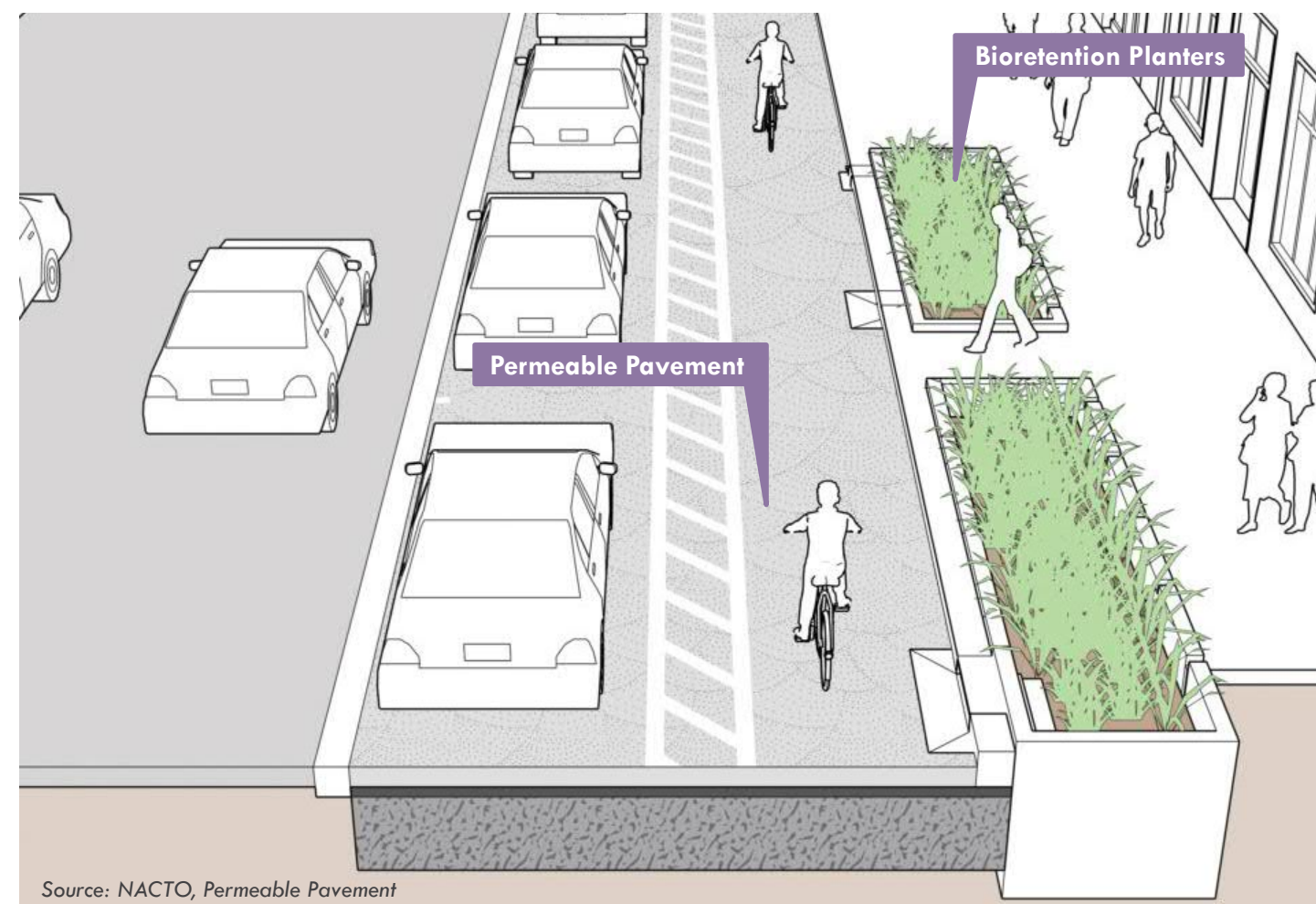
Bioretention planters are stormwater infiltration cells constructed with walled vertical sides, a flat bottom area, and a large surface capacity to capture, treat, and manage stormwater runoff from the street.

Bioretention planters offer greater capacity within the cross-section for stormwater detention and infiltration

than bioretention swales. Planters are highly adaptable to most urban contexts, and can be sized and modified easily to optimize infiltration rate in constrained spaces.

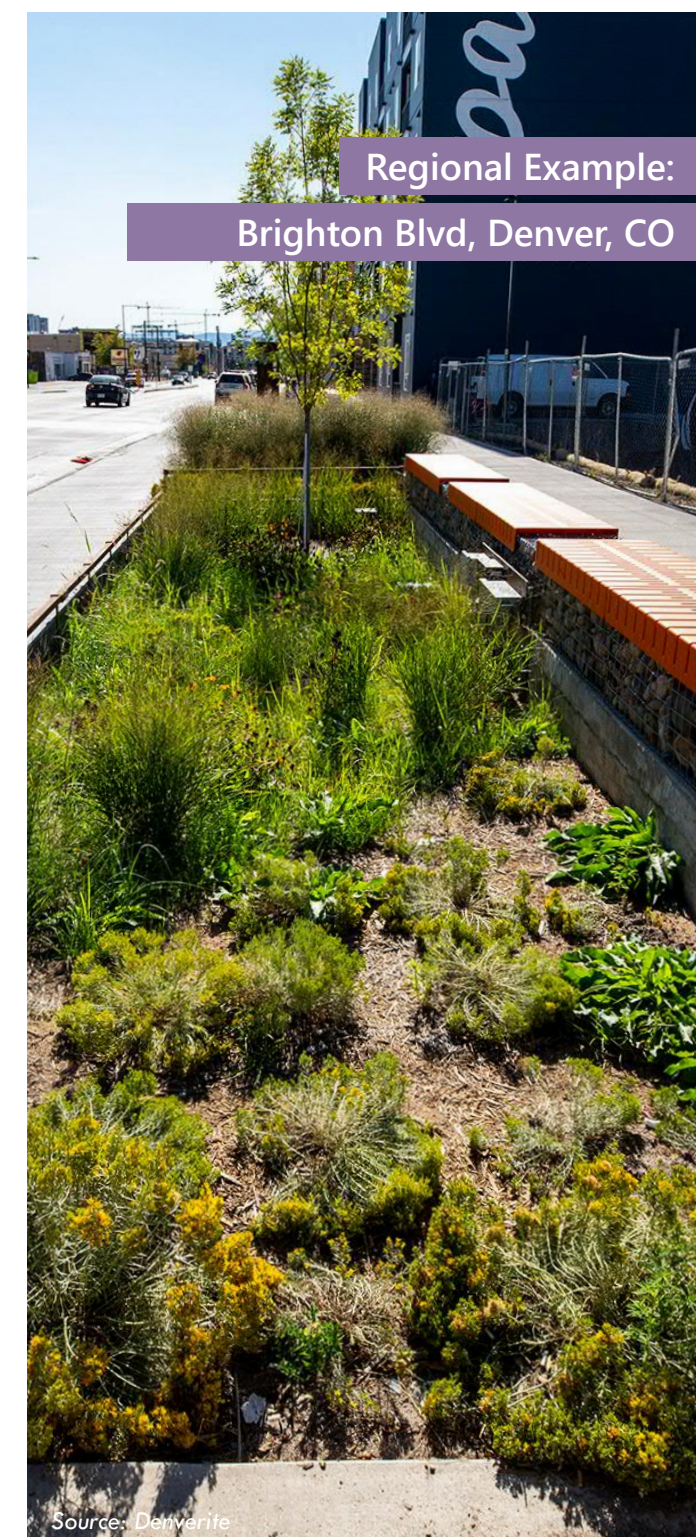
## Bioswales and Rain Gardens

Bioswales or rain gardens are shallow, vegetated, landscaped depressions with sloped sides. They are designed to capture, treat and infiltrate stormwater runoff as it moves downstream. Swales are less expensive to build but use more space for infiltration and conveyance than planters, and can handle low to moderate flows of runoff.



## Permeable Pavement

The high amount of impervious surface cover in cities is a fundamental contributor to urban stormwater challenges. Decreasing the amount of impervious surface cover through the use of permeable pavement materials allows water to infiltrate through streets and sidewalks, reducing runoff.







**AECOM**