NORTH CAROLINA
Department of Transportation

Multimodal Guidance

Transportation Mobility and Safety Division

July 2024

Connecting people, products and places safely and efficiently with customer focus, accountability and environmental sensitivity to enhance the economy and vitality of North Carolina

Purpose and Content

- This general guidance provides additional information and resources for designers.
- This is not intended to be used as a planning document, or to replace engineering judgement, or as a substitute for other guidance (i.e. Complete Streets methodology, Roadway Design Manual).
- This guidance is an educational resource developed primarily for NCDOT, consultants and local government staff for pavement marking and signing improvements.

Multimodal Guidance Resources

General Guidance	Standards	TEPPL Topics
• Basic overview of facility type and traffic control design elements. • Links to additional resources.	• Standard drawings for pavement markings and signage. • Will be updated as new guidance is released.	• More detailed information about implementation. • Policy and statutory references.

NORTH CAROLINA
Department of Transportation

Guidance for Multimodal Safety Improvements and Traffic Control Devices

Pedestrian Bicycle Transit

Background

This guidance is a reference for local governments and NCDOT Divisions developing plans to implement projects managed by NCDOT or on NCDOT system roads, where the project includes facilities for pedestrians, bicyclists, and bus transit. Consult the Manual on Uniform Traffic Control Devices (MUTCD) for official guidance for traffic control devices. Review the NCDOT Approved Product List for more information about materials that will be considered by NCDOT projects.

This document is not intended for planning-level decisions; designers should consult with the NCDOT Integrated Mobility Division (IMD) to review Complete Streets guidance and assist with initial project planning or scoping decisions. This is not a design standard; designers should consult the Roadway Design Manual and other design resources for additional information about design requirements. Maintenance, operations and network accessibility are additional considerations not included in this document but are important for project decisions.

When To Use This Guide

This guidance provides high level information about multimodal networks (linear features), intersection treatments, and traffic control devices for bicyclists, pedestrians and public transportation buses traveling in the right-of-way. **This guidance directs staff and consultants to relevant Standard Drawings and to other NCDOT resources to inform pavement marking and signing design plans for multimodal facilities.**

This guidance applies *after* projects have been identified in a local or regional transportation plan(s). Network decisions made in plans are based on need, public input, future conditions, and consideration for all modes of travel. Projects led by NCDOT or on NCDOT system roads should be developed consistent with the NCDOT Complete Streets Policy and Complete Streets Project Development Evaluation Methodology.

This guidance is not a substitute for engineering judgment. Each project should be reviewed based on local context and conditions, prior to developing project design. Complete an engineering study as appropriate (see MUTCD for guidance). Consider completing a feasibility review or assessment, such as traffic analysis, for complex configurations.

Consult additional guidance for specific facility design standards and criteria, including but not limited to the following:

- NCDOT Roadway Design Manual (and referenced design guidelines)
- NCDOT Signal Design Section Design Manual
- NCDOT Roadway Standard Drawings (including Bicycle Pavement Marking Guidance)
- FHWA MUTCD (11th edition, published December 2023)

How To Use This Guide

1. Select facilities or features identified in plans for each mode of travel being considered for the roadway or intersection project.
2. Review description of facility type.
3. Review “When to Use” and “When Not to Use” as guidance for facility and feature selection.
4. Consider other feature types that supplement the treatment.
5. Review Frequently Asked Questions (FAQs) for additional information and potential scenarios to be considered.
6. Review other resources listed in “For More Information” for additional design materials.

Pedestrian

Bicycle

Transit

Pedestrian

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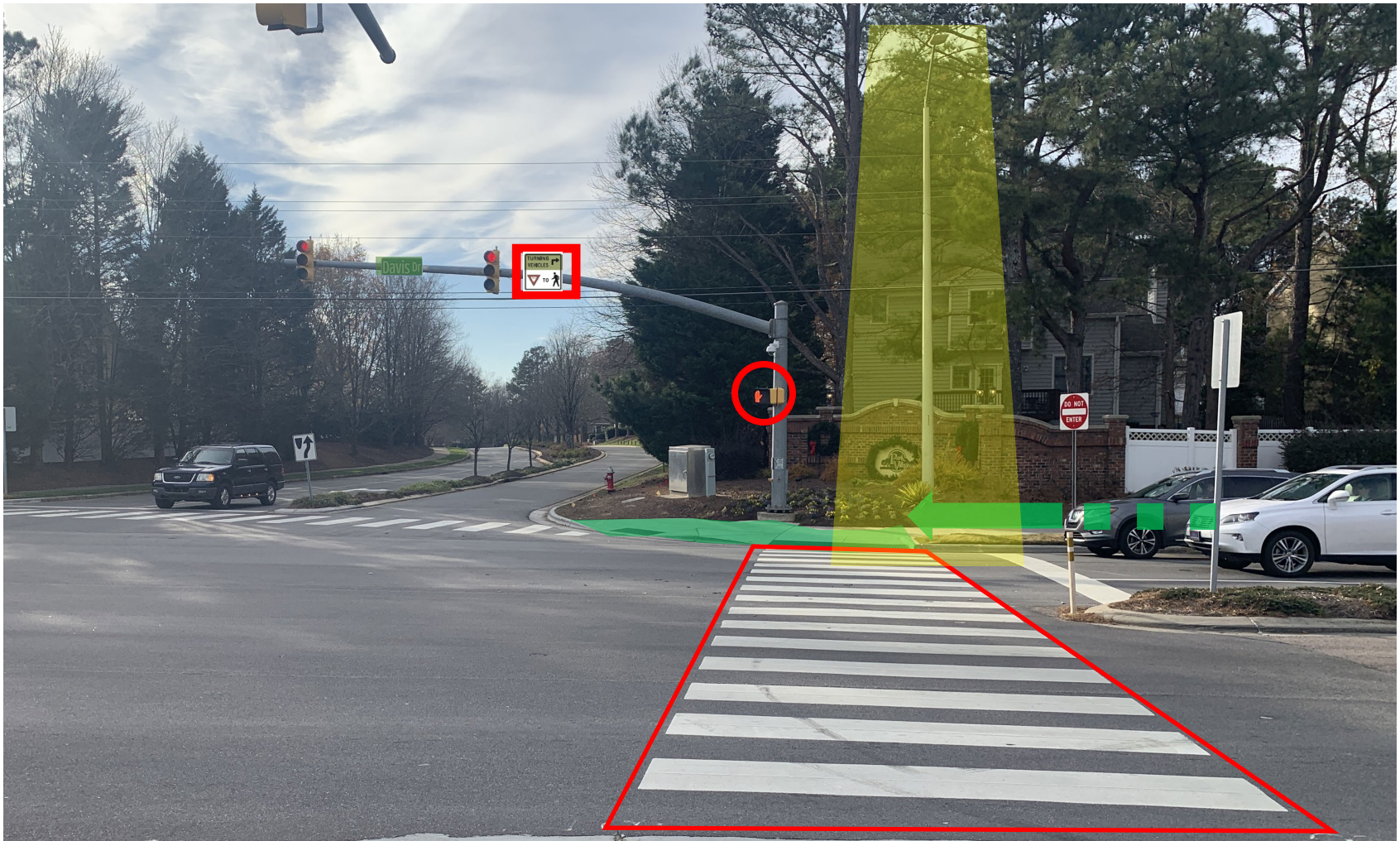
Pedestrian Crossing Features

- Focus of this guidance is on standard pavement markings, signs and traffic control devices associated with pedestrian crossings.
- Additional features, such as curb ramps, sidewalk, and lighting should also be considered as part of the overall pedestrian network.



Public Right-of-Way Accessibility Guidelines (PROWAG)

- U.S. Access Board released this final rule on August 8, 2023.
- "These minimum guidelines will become enforceable once they are adopted, with or without modifications, as mandatory standards under the ADA by the U.S. Department of Justice (DOJ) and the U.S. Department of Transportation (USDOT), or the four federal agencies that set standards for the federal government under the Architectural Barriers Act – the U.S. Postal Service (USPS), General Services Administration (GSA), U.S. Department of Defense (DOD), and U.S. Department of Housing and Urban Development (HUD)." (U.S. Access Board)
- NCDOT continues to follow current ADA standards until PROWAG is adopted.

Pedestrian Crossings

Pedestrian networks are facilities specifically designed and designated for people traveling on foot or using personal mobility devices. Sidewalks and pathways are the most common examples of pedestrian networks. Bicycles may be prohibited from operating on sidewalks, based on local ordinance. Pedestrian crossing treatments are typically selected based on proximity of destinations, vehicle traffic volumes, traffic speed, roadway configuration, existing traffic controls, and expected pedestrian activity. Special consideration must be made for pedestrians who use wheelchairs, have low to no vision, have cognitive or developmental differences, or travel slowly due to age or other reasons. Crossing locations near schools are a specialized type of crossing that may require additional considerations. School-related pedestrian crossings are reviewed following other standards and guidance.

Primary sources for planning and selecting bikeways include the following:

- NCDOT Pedestrian Crossing Guidance
- AASHTO Guide for the Planning, Design and Operation of Pedestrian Facilities
- FHWA MUTCD

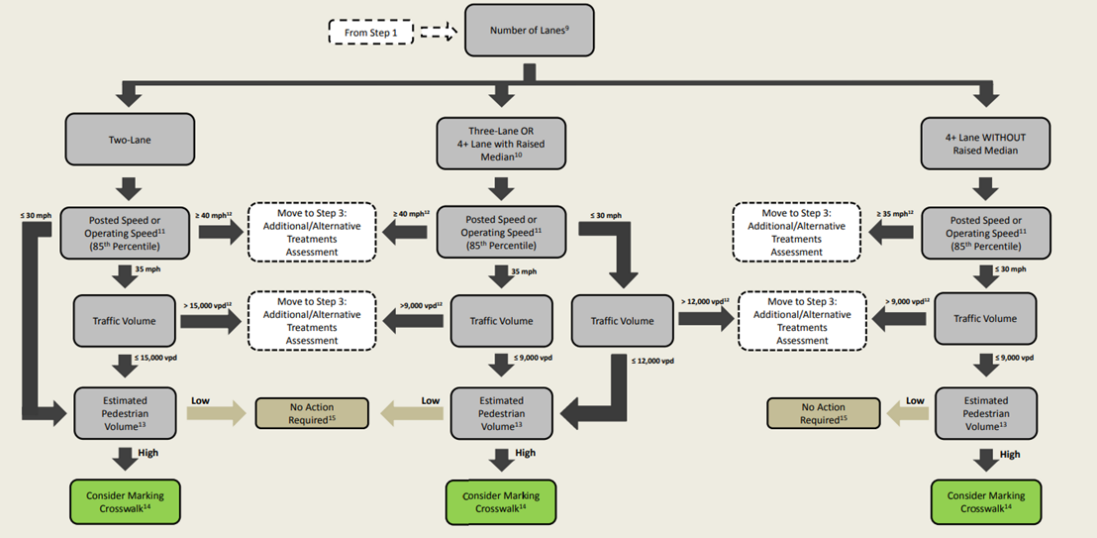


Figure: Flowchart Element for Unsignalized or Midblock Crossing Assessment (NCDOT Pedestrian Crossing Guidance)

Crosswalks (Signalized)

Crosswalks are established at intersections by the convergence of sidewalks or pedestrian access routes. Marking a crosswalk increases awareness and visibility of the crossing for both drivers and pedestrians. Consider maintenance, pedestrian exposure and visibility of the crossings when selecting crosswalk marking patterns. Crosswalks should be designed at least as wide as the approaching sidewalks or paths.

When To Use

- Use high visibility crosswalks to mark crossings at intersections where pedestrian activity is high, with a notable crash history, or where the overall context of the corridor includes high visibility markings.
- Accessible curb ramps are always used in conjunction with marked crosswalks.

When Not To Use

- Consider variations of, or alternatives to, high visibility crosswalks at high traffic intersections, where markings may fade more quickly than the expected lifecycle.

FAQs: Crosswalks (Signalized)

What alternative countermeasures or supplemental features can be considered?

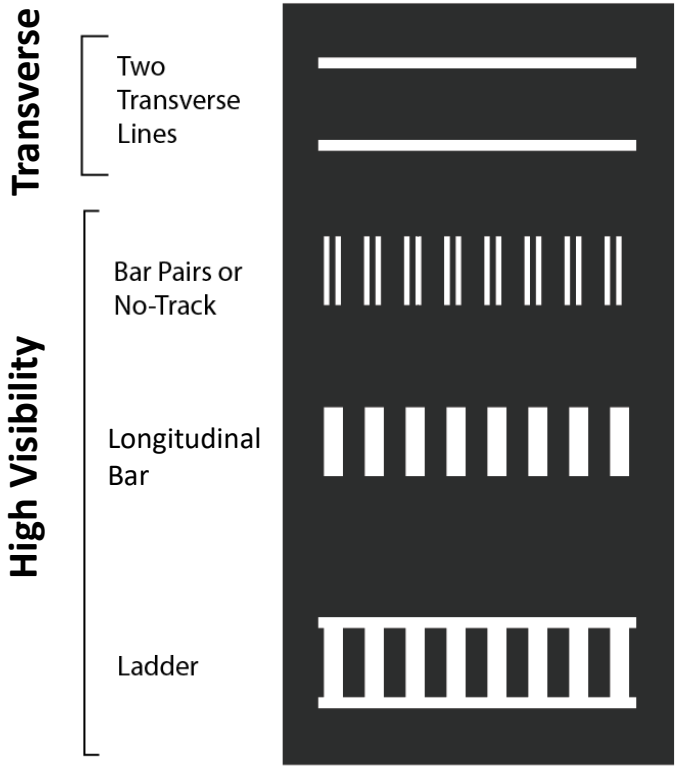
Depending on the characteristics of the intersection, high-visibility crosswalk enhancements can be considered to improve the crosswalk conspicuity. Many other features can be applied at crosswalks, including curb extensions, beacons, signing, etc.

What safety issues are most critical to consider?

Crosswalks should be designed as straight alignments across the intersection. The crosswalk should be placed in the most visible location.

What other design issues or trade-offs should be considered?

The MUTCD requires that crosswalks be a minimum width of 6 feet; except at midblock crosswalks on roads with posted speeds of 40 mph or greater, where the minimum width shall be 8 feet. Decorative crosswalks should not degrade the contrast of the white crosswalk lines and should not detract driver attention from traffic control devices or pedestrians. They should not be implemented in place of high-visibility crosswalks.



For More Information:

- MUTCD Section 3C.03
- FHWA STEP Program
- NCDOT TEPPL Topic # C-54
- Pavement Marking Detail: High Visibility Crosswalks – No Track Marking Guidance

Pedestrian Countdown Signal

Pedestrian countdown signals consist of a standard pedestrian signal head (which shows either a WALKING PERSON or UPRAISED HAND indication) and a display showing a countdown of the remaining crossing time in seconds. Typically, the countdown starts at the beginning of the pedestrian change interval (indicated by the flashing UPRAISED HAND indication).

When To Use

- Consider using at any location with sidewalk and curb ramps on the approach to the intersection.

When Not To Use

- May require additional improvements, such as sidewalk or curb ramps, to support the crossing and the addition of pedestrian countdown signal head.
- Consider alternatives for crossings on slip lanes or channelized lanes, such as separate WALK phase or Yield To signage.
- Consider alternatives at dual turn lane configurations.

FAQs: Pedestrian Countdown Signal

What alternative countermeasures or supplemental features can be considered?
In urban centers with high levels of pedestrian activity, Pedestrian Recall (automatic WALK phase each cycle) may be considered to provide more consistent pedestrian indications.

What safety issues are most critical to consider?
Left turns are typically higher speed movements at signalized intersections. Where in conflict with the WALK phase, protected phasing should be considered.

What other design issues or trade-offs should be considered?
Placement of accessibility features such as push-buttons relative to the crossing should be considered in the design of the signal and for the WALK phase.

For More Information:

- MUTCD Section 4D.02; 4I.01-4
- NCDOT Signal Design Manual (Push Button Placement)

Leading Pedestrian Interval (LPI)

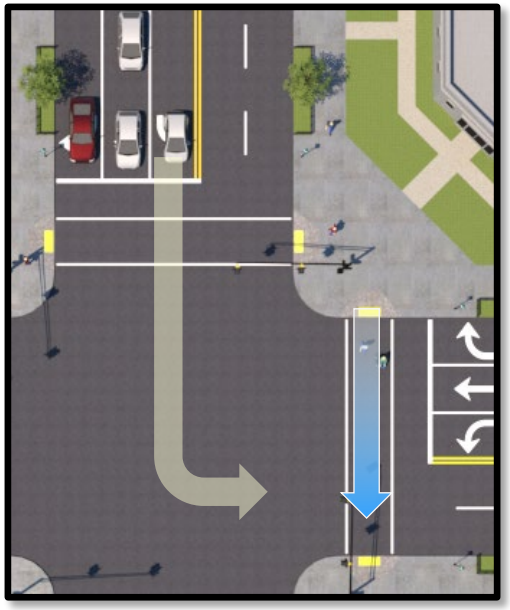
A Leading Pedestrian Interval (LPI) gives pedestrians a typical 3- to 7-second head start entering the crosswalk before vehicles in the parallel direction are given the green signal indication. This allows pedestrians to establish their presence in the crosswalk, improving their visibility to turning drivers.

When To Use

- At all signalized intersections in urban areas where sidewalk, marked crosswalk, and pedestrian signal heads are present.
- To reduce turning movement conflicts where WALK phase is concurrent with permitted turning movements.

When Not To Use

- At interchange off-ramps or other high-speed, high-volume approaches to intersections.
- At intersections with exclusive pedestrian WALK phases.



FAQs: Leading Pedestrian Interval

What alternative countermeasures or supplemental features can be considered?
When pedestrian activity is high, exclusive pedestrian ("Barnes Dance") phases may be considered as a substitute to LPI. Review for including Accessible Pedestrian Signal (APS) with LPI for pedestrians with low to no vision.

What safety issues are most critical to consider?
Intersections with heavy left turns in developed areas or in locations where vulnerable pedestrians, such as young students or older adults, are priority locations for implementing LPI.

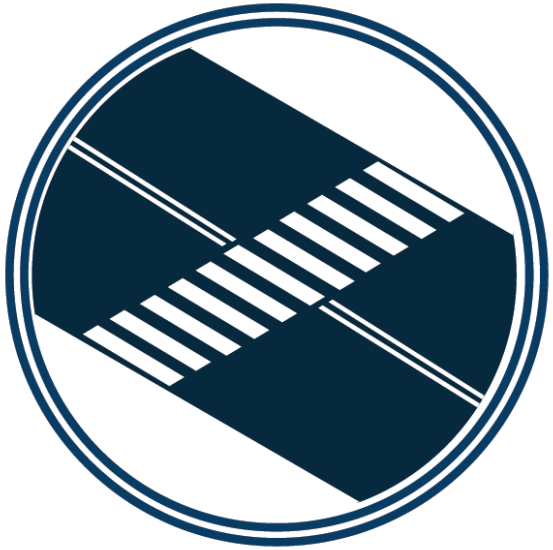
What other design issues or trade-offs should be considered?
LPI may not provide notable safety benefit to pedestrians crossing side street approaches with low turning volumes, especially if using Rest in Walk.

For More Information:

- NCDOT Signal Design Manual
- MUTCD Section 4I.06
- FHWA STEP Program

Crosswalks (Unsignalized)

Uncontrolled crosswalks occur where sidewalks intersect a roadway at a location with no traffic control (e.g., traffic signal or STOP sign). Unsignalized crossings may occur at midblock locations or trail crossings.



When To Use

- High visibility markings should always be used for unsignalized crosswalks.
- Use at crossing locations with higher pedestrian volume and a posted speed less than or equal to 35 mph.

When Not To Use

- Avoid using at locations where no pedestrians are expected to cross or within a short distance of other marked crosswalks.
- Avoid using without other traffic controls or crossing enhancements on roads with more than 12,000 vehicles per day or a posted speed limit of 40 mph or greater.

FAQs: Crosswalks (Unsignalized)

What alternative countermeasures or supplemental features can be considered?
Consider adding supplemental warning signs and/or markings, geometric improvements (refuge island, curb extensions, traffic calming, etc.), or adding a beacon.

What safety issues are most critical to consider?
Marked crosswalks alone may not be sufficient for uncontrolled pedestrian crossing locations along roads with high traffic volumes, high speeds and long distances to controlled crossings.

What other design issues or trade-offs should be considered?
Road user compliance with marked crosswalks depends on traffic volume, speed and distance to other crossings.

For More Information:

- MUTCD Section 3C.02
- NCDOT Pedestrian Crossing Guidance
- FHWA Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations
- Standard Practice for Crosswalks- Mid-Block (Unsignalized) Signing (TEPPL C-36)

Advance Yield

The Yield Here To Pedestrians (R1-5) sign and its variations instruct drivers on where to yield in advance of marked crosswalks at multi-lane, uncontrolled locations. This sign is accompanied by yield line pavement markings that indicate advance yield ("shark's teeth").

Figure: R1-5 sign

When To Use

- Use at multilane, uncontrolled locations with marked crosswalks.
- Consider for lower speed roads (35 mph or less) with limited visibility due to vehicles parked in adjacent parking lanes or where buses stop.

When Not To Use

- Avoid using in advance of crosswalks on an approach to or departure from a controlled intersection or roundabout.
- Consider alternatives or different placement if the R1-5 sign would block the drivers' view of other signing at the crosswalk (e.g., W11-2 sign).

FAQs: Advance Yield

What alternative countermeasures or supplemental features can be considered?

Yield line markings (commonly referred to as “shark’s teeth”) can be used to indicate where drivers should yield in advance of the crosswalk. Pedestrian crossing signs (W11-2) may be used at the crosswalk or in advance in conjunction with the R1-5 sign. Yield markings and signs may be used with refuge islands and/or Rectangular Rapid Flashing Beacons (RRFBs).

What safety issues are most critical to consider?

Advance yield signs and markings are important to consider at multilane crossing locations where a vehicle stopped too close to the crosswalk can block the view of the pedestrian to motorists in the adjacent lane (and vice versa).

What other design issues or trade-offs should be considered?

The sign and yield markings should be placed 20 to 50 feet in advance of the crosswalk, and parking should be prohibited between the sign and the crosswalk. Yield line markings are always accompanied by an R1 series sign.

For More Information:

- MUTCD Section 2B.19 (Yield Here To Signs)
- MUTCD Section 3B.19 (Yield Lines)
- NCDOT Pedestrian Crossing Guidance

In-Street Signs

The In-Street Pedestrian Crossing sign (R1-6) is used to remind road users the pedestrians have the right-of-way at unsignalized or uncontrolled crosswalks. It is placed on the center line, a lane line, edge line or on a median island at the crosswalk location.

When To Use

- Use on 2- or 3-lane roads with speed limits 35 mph or less.
- Prioritize for high-volume crossing locations, to avoid overuse.

When Not To Use

- Do not use at signalized locations, crossings controlled by a pedestrian hybrid beacon, or at STOP or YIELD controlled intersection approaches.
- Do not use at unmarked crossing locations.

FAQs: In Street Signs

What alternative countermeasures or supplemental features can be considered?
The In-Street sign shall be used as a supplement to the pedestrian crossing warning signs (W11-2). Overhead Pedestrian Crossing signs (R1-9) can substitute for the In-Street sign at the crosswalk location.

What safety issues are most critical to consider?
North Carolina is a "Yield State" by law, so the YIELD version of the sign must be used (as opposed to the STOP version used in some other states).

What other design issues or trade-offs should be considered?
The sign shall not be post-mounted or placed on either side of the roadway. The sign should also not be placed in advance of the crosswalk. The sign should be mounted on non-metal breakaway supports.

Figure: R1-6 sign

For More Information:

- MUTCD Section 2B.20
- NCDOT Standard Practice S-75

Refuge Island

A pedestrian refuge island is a median at a pedestrian crossing location to allow pedestrians to find an adequate gap in one direction of traffic at a time.

When To Use

- At intersections or midblock crossing locations on roads with four or more lanes, especially where speed limits are 35 mph or greater or volumes are 9,000 vpd or greater.
- At crossing locations on 2- or 3-lane roads that have high vehicle speeds or volumes.

When Not To Use

- Avoid using at locations where left turns onto side streets are high.

FAQs: Refuge Island

What alternative countermeasures or supplemental features can be considered?
Crosswalk visibility enhancements (markings, signs, lighting, etc.) are often used with refuge island. An offset, changing the direction of the pedestrian's travel in the island, can be used to orient crossing pedestrians to face oncoming traffic. Curb extensions can be used to further shorten the crossing distance.

What safety issues are most critical to consider?
Refuge islands decrease the stress and complexity for crossing pedestrians by allowing them to focus on crossing one direction of traffic at a time.

What other design issues or trade-offs should be considered?
Refuge islands should be designed to allow the anticipated number of pedestrians or bicyclists to stand and wait for a gap in traffic.

For More Information:

- MUTCD Section 3C.12
- Roadway Standard Drawing Notes for Median Island (848.06, sheet 13-13)

Rectangular Rapid Flashing Beacon (RRFB)

Rectangular Rapid Flashing Beacons (RRFBs) are conspicuity enhancements that increase visibility of pedestrians in the crosswalk. The beacons are actuated by pedestrians emitting a flashing pattern toward traffic on both approaches to the crossing. RRFBs may be installed at unsignalized intersections, at roundabout crosswalks, and across free-flow turn lanes separated by a channelized island.

When To Use

- At uncontrolled crossing locations where vehicle speeds are equal to or less than 35 mph.
- At midblock crosswalks where visibility of the crosswalk may be obscured or driver yielding is poor.

When Not To Use

- Do not use at signalized intersections, approaches controlled by a STOP sign or pedestrian hybrid beacon, or uncontrolled intersections with heavy turning movements.
- Avoid using RRFBs at crossings on roadways with speed limits of 40 mph or greater.

Figure: RRFB. Source: FHWA

FAQs: Rectangular Rapid Flashing Beacon

What alternative countermeasures or supplemental features can be considered?
Consider implementing Pedestrian Hybrid Beacon (PHB) or pedestrian signal at crossings with higher traffic speeds or where crossing 4 or more lanes without a median or refuge island.

What safety issues are most critical to consider?
Higher operating speeds (over 35 mph) may impact driver yielding compliance at the crosswalk.

What other design issues or trade-offs should be considered?
Pedestrians and drivers may benefit from education about how RRFBs operate. Visibility of the warning sign and flashing beacon assembly on the approach is an important design consideration for RRFB installation. Consider advance warning signing or advance RRFBs to increase visibility of the crossing.

For More Information:

- NCDOT Pedestrian Crossing Guidance
- MUTCD Section 4L
- FHWA Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations
- NCDOT Signal Resource – RRFB Sign Detail

Pedestrian Hybrid Beacon (PHB)

A Pedestrian Hybrid Beacon (PHB) consists of two red lenses above a single yellow lens. Unlike a traffic signal, the PHB rests in dark until a pedestrian activates it via pushbutton or other form of detection. When activated, the beacon displays a sequence of flashing and solid lights that indicate the pedestrian walk interval and when it is safe for drivers to proceed.

When To Use

- Consider at locations with higher speeds and vehicle volumes, but where traffic signal warrants are not met.
- Review for roads with 3 or more lanes and where traffic volumes exceed 9,000 vpd or the speed limit is 35 mph or higher.

When Not To Use

- Do not use at a location with another beacon or signal type.
- Consider alternatives at intersections, due to limited visibility of the beacon heads by side street traffic.

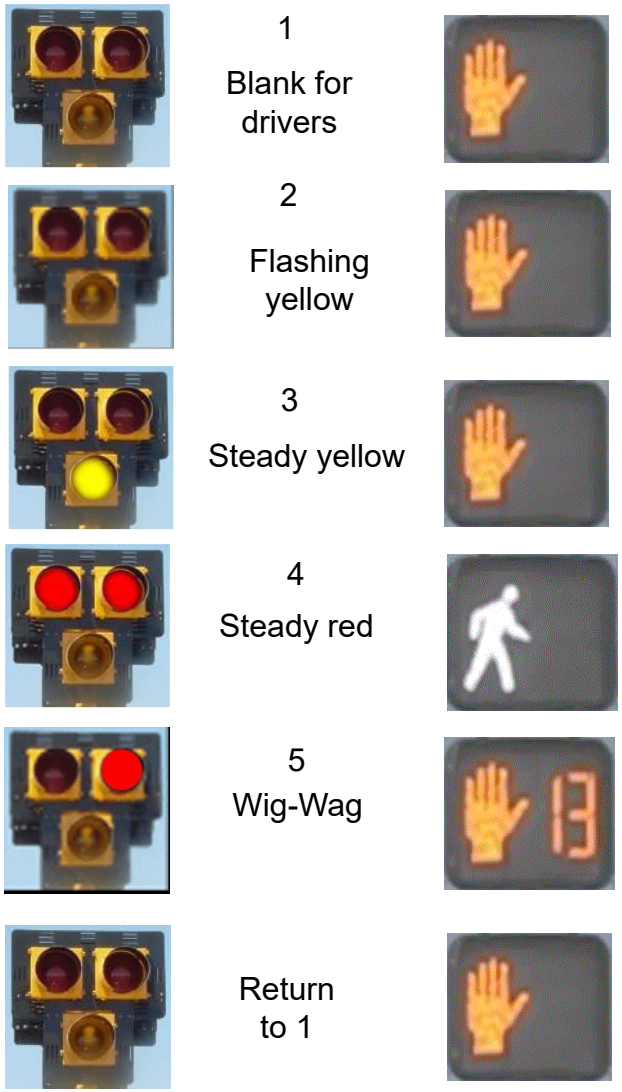


Figure: PHB sequence. Source: FHWA

FAQs: Pedestrian Hybrid Beacons

What alternative countermeasures or supplemental features can be considered?

High visibility crosswalk marking, refuge islands, and advance STOP markings are commonly used in combination with PHBs. Signalized crossings, meeting warrants, may also be considered as an alternative to PHBs. W11-2 warning signs with an AHEAD plaque may be placed in advance of the PHB.

What safety issues are most critical to consider?

PHBs can be a very effective countermeasure at high-speed, multilane crossing locations. Pedestrian crossing volume, vehicle speed and traffic volume, local familiarity with the device are important considerations.

What other design issues or trade-offs should be considered?

If PHBs are not in common use in the community, educational outreach should be conducted in conjunction with implementation of the PHB. Optional signage such as the "Crosswalk-STOP on Red" (R10-23) or "STOP on Steady Red-Yield on Flashing Red after STOP" (R10-23a) may be installed to further communicate driver and pedestrian expectations at the crossing. The steady yellow interval is determined based on engineering practice.

For More Information:

- NCDOT Pedestrian Crossing Guidance
- MUTCD Section 4J, 4F.17
- FHWA Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations

Bicycle

Bikeway Networks


Bike Lane


Buffered Bike Lane


Separated Bike Lane


Shared-Use Path

Other Treatments


Shared Lane Markings


Contraflow Lane ("Counter-Flow")


Climbing Lane


Bicycle Signage

Intersection-Related

Bicycle Box


Two-Stage Turn Box


Bicycle Detection


Bicycle Signals

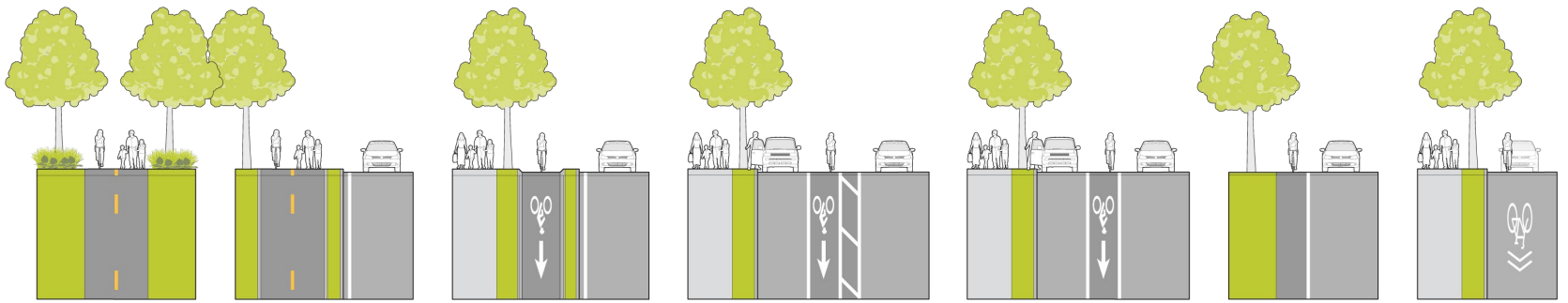

Protected Intersection

Bikeways and Intersection Treatments

Bikeways are networks specifically designed and designated for bicyclists. Roadways where bicyclists travel in shared space with vehicles may be appropriate for some traffic conditions. Facilities can also be designed for bicyclists to share travel space with pedestrians. Bikeway networks and intersection treatments are selected based on the context, vehicle traffic volumes, traffic speed, user needs and expected activity. Right of way or site constraints, public input and unique travel operations may also influence bikeway and intersection treatment selection. This resource does not address traffic laws or expected behaviors. For more information about vehicle and bicyclist operations, see the NCDOT Motorists and Bicyclists: Best Practices for Road Safety

Primary sources for planning and selecting bikeways include the following:

- NCDOT Complete Streets Project Evaluation Methodology
- FHWA Bikeway Selection Guide
- AASHTO Guide for the Development of Bicycle Facilities (2012 current published version)
- FHWA MUTCD (11th edition, published December 2023)



Bikeway Network Types. Source: FHWA Bikeway Selection Guide

Bike Lane

A bike lane is a designated one-way lane on the roadway for use by bicyclists traveling in the same direction as adjacent motor vehicle traffic. Bike lanes are delineated by solid white lane lines and are typically 5 to 7 feet wide, with bicycle symbol markings placed at the beginning of the bike lane and at periodic intervals along the bicycle lane.

When To Use

- Use to provide exclusive space for bicyclists to operate on the roadway.
- Paved shoulders may be repurposed as bike lanes by installing bicycle symbol markings, but bike lanes shall not also be used as a shoulder.

When Not To Use

- Avoid on roadways with high posted speed limits (>= 45 MPH) or high traffic volumes (> 7,000 VPD).*
- Do not use if buffered bicycle lanes or separated bicycle lanes are feasible.
- Do not use bike lane markings in a circular intersection or to the right of a right-turn only lane.

Source: Bikeway Selection Guide (dot.gov)

Click icon for quick access to category

Bike Lane: FAQs

What alternative countermeasures or supplemental features can be considered?

Buffered bike lanes, separated bike lanes, or a shared use path may be preferred if feasible to provide additional separation for bicyclists. Intersection treatments such as bicycle lane extension markings, two-stage turn boxes, and bike boxes should be considered to assist bicyclists with navigating an intersection. Green-colored pavement may be installed for only a portion or the entire length of a bicycle lane. The Bike Lane (R3-17) sign and supplemental plaques shall only be used with marked bike lanes.

What safety issues are most critical to consider?

Bike lanes adjacent to parking should be designed to avoid “door zone” conflicts. Application of green colored pavement at commercial driveways or uncontrolled intersections maybe used to highlight conflict points along the bike lane. If green colored pavement is used, it shall match the pattern of dotted longitudinal lines through an intersection or across driveways.

What other design issues or trade-offs should be considered?

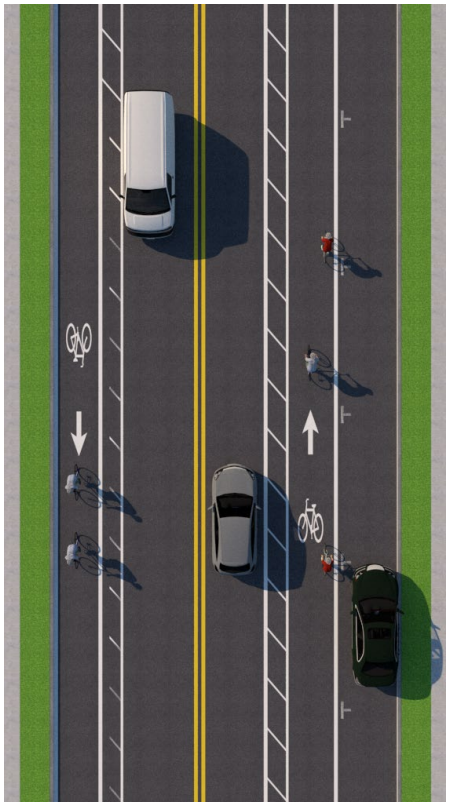
Width of the designated bike lane does not include the gutter pan. Transitions between a bike lane a separated bikeway can be facilitated by a bike ramp in advance of intersections.

For More Information:

- NCDOT Standard Drawings 1205.16
- MUTCD Section 9E.01-.05
- NCDOT Roadway Design Manual 4.15.3
- AASHTO Guide for the Development of Bicycle Facilities
- FHWA Bikeway Selection Guide

Buffered Bike Lane

A buffered bike lane provides horizontal separation between bicyclists and vehicles in the adjacent travel lane and/or parking lane. Buffered bike lanes use solid white edge lines and may also use longitudinal markings (either hatching or chevron markings) depending on the buffer width.



When To Use

- Use to improve the comfort-level of bicyclists traveling along the roadway.
- May be used in place of a separated bicycle lane if there are restrictions on use of vertical elements.

When Not To Use

- Avoid on roadways with high posted speed limits (≥ 45 MPH).
- Do not use if separated bicycle lanes are feasible.

Buffered Bike Lane: FAQs

What alternative countermeasures or supplemental features can be considered?

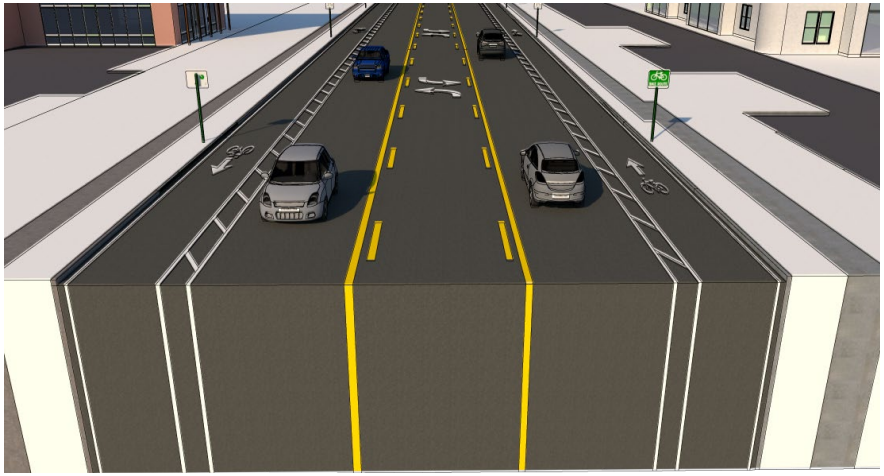
One-way separated bike lanes may be preferred over buffered bicycle lanes on roads with posted speed limit ≥ 35 MPH, or where higher volumes of bicyclists and pedestrians are expected.

What safety issues are most critical to consider?

Include vertical separation on roadways with posted speed limit ≥ 45 MPH, in addition to horizontal separation provided by the buffer.

What other design issues or trade-offs should be considered?

Additional pavement width should be added to the buffer, instead of adding width to a bike lane designed at 5 or 7 feet wide.



For More Information:

- NCDOT Standard Drawings 1205.16
- MUTCD Section 9E.06
- NCDOT Roadway Design Manual, Section 4.15.4
- AASHTO Guide for the Development of Bicycle Facilities
- FHWA Bikeway Selection Guide

Separated Bike Lane

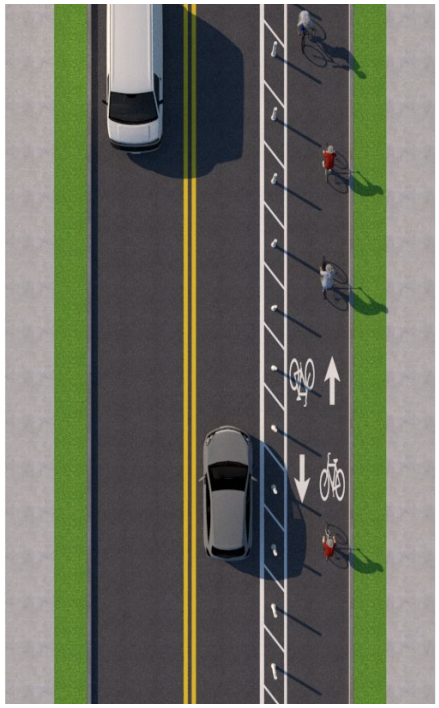
A separated bike lane is either a standard one-way bike lane or a two-way bike lane separated from vehicle traffic with vertical elements. These vertical elements may include tubular markers, parked vehicles, a concrete median, a raised median with curb and gutter, or other vertical material products approved by NCDOT.

When To Use

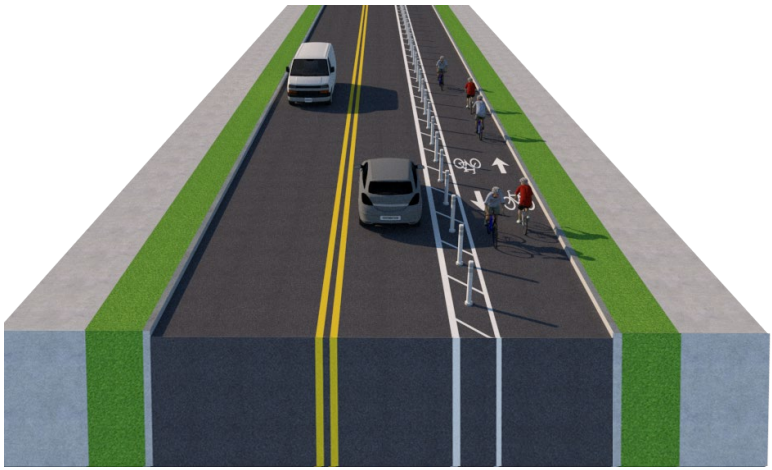
- Use to increase separation between motor vehicles and cyclists on high speed or high traffic roadways.
- Use to augment a buffered bike lane and provide additional separation for bicyclists.

When Not To Use

- Consider alternatives if specialty seasonal maintenance or street-cleaning equipment is not available.
- Consider alternatives where the side of a roadway has a high density of commercial or other high-traffic driveways and uncontrolled intersections.



Separated Bike Lane: FAQs



What alternative countermeasures or supplemental features can be considered?

White tubular markers are a common and cost-effective vertical element, but concrete medians or curbs may provide more protection for cyclists. A shared use path may be preferred over separated bike lanes depending on the surrounding bicycle network.

What safety issues are most critical to consider?

The choice of vertical element is a critical consideration. Tubular markers provide less protection than concrete medians or raised medians with curb and gutter. Refer to the NCDOT Approved Product List for more information about vertical elements. Expectations for driver and bicyclist traffic movements should be clearly marked and signed at complex intersections.

What other design issues or trade-offs should be considered?

When considering bike lane width compared to the horizontal buffer width, one-way bicycle lanes wider than 7’ provide little additional safety benefits. Increased buffer width may be more valuable. Pedestrian access to parked vehicles should be considered where on-street parking is used to separate the bicycle lane from general-purpose lanes.

For More Information:

- NCDOT Standard Drawings 1205.16
- MUTCD Section 9E.07
- NCDOT Roadway Design Manual: 4.15.5
- AASHTO Guide for the Development of Bicycle Facilities
- FHWA Separated Bike Lane Planning and Design Guide
- FHWA Bikeway Selection Guide

Shared-Use Path

A shared-used path is a facility separated from motor vehicle lanes that is intended for both pedestrian and bicyclist use and commonly designed for two-way travel. Typical dimensions vary based on anticipated non-motorist volumes and right-of-way constraints. A shared-used path may also be referred to as a multi-use path, a sidepath (when parallel to a roadway), or, in some cases, a greenway or trail.

When To Use

- Use to increase separation between motor-vehicles and non-motorists.
- Use on roadways with high posted speed limits (≥ 35 MPH) in place of an on-street bicycle facility.
- Use to improve connectivity within the bicycle and pedestrian network.

When Not To Use

- Avoid along routes where sight distance is limited at intersections or where driveway access points are frequent.
- Avoid installing shared-use paths on only one side of the roadway where land uses and destinations are present on both sides and may generate crossing activity.

Shared Use Path: FAQs

What alternative countermeasures or supplemental features can be considered?
Centerline markings may be used to divide travel directions or modes; the width on each side should be enough to accommodate both directions of travel.

What safety issues are most critical to consider?
Shared use paths attract high volumes of bicyclists and pedestrians, and locations where the path crosses the roadway should be carefully reviewed. Conflicts between bicyclists and pedestrians may occur more frequently on shared use paths, especially in situations where the path has a steep grade or limited sight distance. Transitions between shared use paths and other bikeway types can also create confusion without adequate signing, marking and traffic controls.

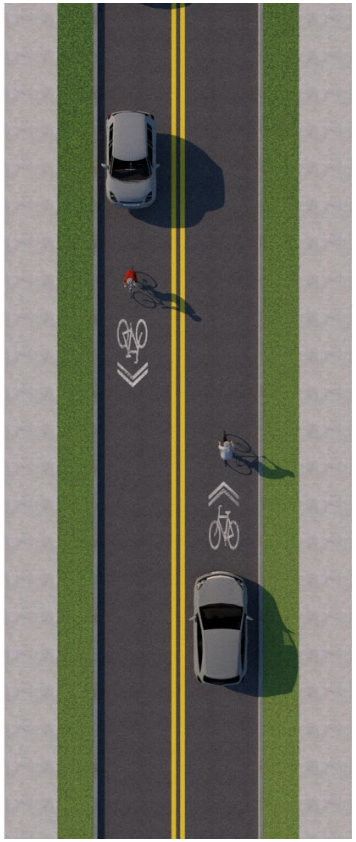
What other design issues or trade-offs should be considered?
Where shared-use paths cross roadways, the width of the crosswalk should be at least as wide as the shared-use path.

For More Information:

- NCDOT Roadway Design Manual 4.14.1.1
- AASHTO Guide for the Development of Bicycle Facilities
- MUTCD Section 9E.13
- FHWA Improving Intersections for Pedestrians and Bicyclists
- FHWA Evaluation of Safety, Design, and Operation of Shared-Use Paths

Shared Lane Marking

A shared lane marking is a pavement marking symbol indicating to motor vehicles and bicyclists that the traveled way (travel lane) is shared by both users.



When To Use

- Typically used to alert road users to the presence of bicycle traffic mixing with motor vehicle traffic.
- Use at locations where bicyclists may transition from a bike lane into the main traveled way.
- Use on one-way streets to decrease wrong-way bicycling.
- Use as a wayfinding element along bicycle routes.

When Not To Use

- Should not use on roadways with posted speed limit >= 40 MPH.
- Avoid using where vehicle volume exceeds 3,000 vehicles per day.
- Do not install on bike lanes, shared-use paths, shoulders, designated extensions of bicycle lanes, two-stage turn boxes, bicycle boxes, or physically separated bikeways.
- Avoid use where light rail transit vehicles also travel.
- Do not use in the circulatory roadway of a roundabout.

Shared Lane Marking: FAQs

What alternative countermeasures or supplemental features can be considered?
If possible, provide a dedicated bicycle facility, such as a bike lane. Additional traffic calming features may be considered on roadways with shared lane markings to maintain lower speeds.

What safety issues are most critical to consider?
Shared lane markings on roadways may not be comfortable for less-confident bicyclists. The volume of heavy vehicles should be considered, as heavy vehicles may have difficulty safely passing bicyclists in a shared lane condition.

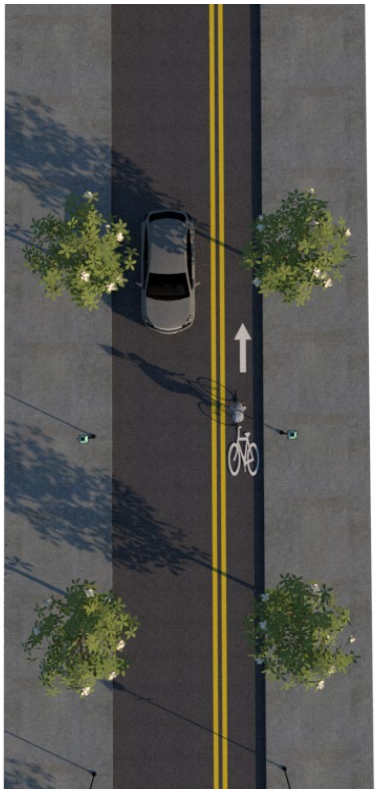
What other design issues or trade-offs should be considered?
While wide lane widths provide additional space for passing, wide lanes may also encourage increased motor vehicle speeds.

For More Information:

- NCDOT Standard Drawings 1205.16
- NCDOT Roadway Design Manual 4.15.1
- MUTCD Section 9E.09
- FHWA Bikeway Selection Guide
- AASHTO Guide for the Development of Bicycle Facilities

Counterflow Bike Lane

A counterflow (or contraflow) bike lane allows bicyclists to ride in the opposite direction of motor vehicle traffic on a one-way street. The counterflow bike lane is separated from the motor vehicle lane(s) using solid double yellow centerline markings or other form of separation.



When To Use

- Use to improve bicyclist connectivity and reduce bicyclist travel time and exposure by allowing two-way travel.
- Use to reduce the occurrence of wrong-way riding and sidewalk riding.
- Use on corridors where alternate routes have high motor vehicle volumes and/or speeds and no bicycle facilities.

When Not To Use

- Avoid if there is not a demonstrated need for two-way bicycle traffic (e.g., pattern of wrong-way riding, lack of alternate routes, etc.).
- Avoid on higher-volume streets or roads with a posted speed limit of 35 mph or greater.

Counterflow Bike Lane: FAQs

What alternative countermeasures or supplemental features can be considered?

Bicycle symbol and arrow markings should be used to clearly delineate the bicycle facility and indicate the direction of travel. The “Except Bikes” plaque (R3-7bP) may be paired with a “One Way” arrow sign (R6-1) or a “Do Not Enter” sign (R5-1) at intersections and driveways. At signalized locations, include a method for actuation and appropriate bicycle signalization to orient bicyclists toward the counter-flow lane.

What safety issues are most critical to consider?

Motorists may not expect to see bicyclists traveling in the opposite direction as motor vehicles. If possible, a bike lane should be provided in the same direction as motor vehicle traffic. If there is not sufficient room, shared lane markings should be used to indicate where bicyclists should operate to travel in the direction of motor vehicle traffic.

What other design issues or trade-offs should be considered?

Restricting right turns on red may help to minimize potential conflicts where cross-street motorists do not expect contraflow bicycle traffic.

For More Information:

- MUTCD Section 9E.08
- NACTO Urban Bikeway Design Guide

Climbing Lane

A climbing lane is a bike lane that is provided only in the uphill direction of the roadway to allow slower-moving bicycle traffic to operate in a dedicated facility. Faster downhill bicycle traffic can operate in a shared lane configuration or other bikeway type.

When To Use

- Use to provide slower-moving cyclists traveling uphill with exclusive space to operate on the roadway.
- Use on roads with steeper grade that do not provide enough width for bike lanes in both directions.

When Not To Use

- Do not use if there is enough roadway width for conventional bicycle lanes in both directions.
- Avoid on roadways with high posted speeds (>= 45 MPH) or high traffic volumes (>7,000 VPD)*. A buffered bicycle lane or separated bicycle lane should be used instead.

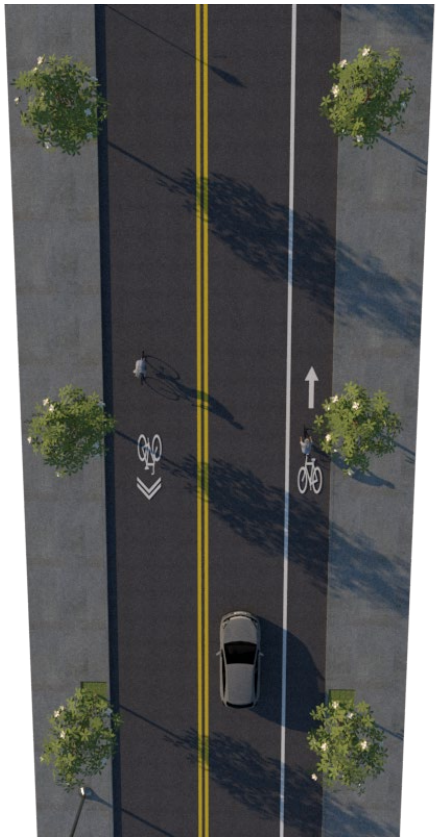
*Source: [Bikeway Selection Guide (dot.gov)]

Climbing Lane : FAQs

What alternative countermeasures or supplemental features can be considered?
Shared-lane markings should be provided in the downhill direction to clearly indicate where downhill-traveling bicyclists should ride. Bicycle symbol markings and arrow markings should be used in the bike lanes to clearly delineate the bicycle facility and indicate the direction of travel.

What safety issues are most critical to consider?
Slower-moving uphill-traveling bicyclists may need more room to maneuver side-to-side. It is important that the climbing lane meets the minimum bike lane width requirements.

What other design issues or trade-offs should be considered?
Appropriate markings should be used to communicate the correct riding position for both uphill and downhill bicyclists to minimize wrong-way riding.



For More Information:

- AASHTO Guide for the Development of Bicycle Facilities

Bicycle Signage

Bicycle warning signage (W11-1) is used to alert the driver to areas where bicyclists may unexpectedly enter the roadway. This may include locations where bicyclists intersect the road or suddenly maneuver into the travel lane.

W11-1 Bicycle Warning Sign

When To Use

- Where bike lanes or other bikeways end and merge with the travel lane.
- Where shoulders or bike lanes narrow, such as at approaches to bridges.
- Where a hazard exists on the side of the roadway, such as on-street parking or a bus stop with frequent service.
- Where a side street or driveway provides egress from a bicycle route, paths, or bikeways.
- Consider adding the W16-1P plaque at locations where bicyclists are likely to enter or ride in the travel lane.

Do Not Use

- The warning sign displaying the message “Share The Road” is no longer included in the MUTCD (2023).
- R4-11 (May Use Full Lane): North Carolina statutes do not clearly permit the R4-11 (May Use Full Lane) sign. General statute § 20-146 discusses specific operating position for vehicles (including bicycles) proceeding at less than the legal maximum speed limit.

Bike Box

A bike box is a designated area placed ahead of a travel lane at a signalized intersection in which bicyclists can position in advance of stopped traffic during a red light. Bike boxes help to prevent conflicts between bicyclists and right-turning vehicles and increase the visibility of bicyclists at intersections by allowing bicyclists to center in the middle, facilitating better left-turn positioning, and giving bicyclists a head start when the signal changes.

When To Use

- Typically installed at signalized intersections with high volumes of both vehicles and bicycles.
- Most appropriate at locations with frequent bicyclist left-turns, motorist right-turns, or where a bicycle lane transitions to the left side of the street.

When Not To Use

- Do not extend a bike box across multiple left turn lanes.
- Do not use if designated bicycle lanes do not approach the intersection.

Bike Box: FAQs

What alternative countermeasures or supplemental design can be considered?

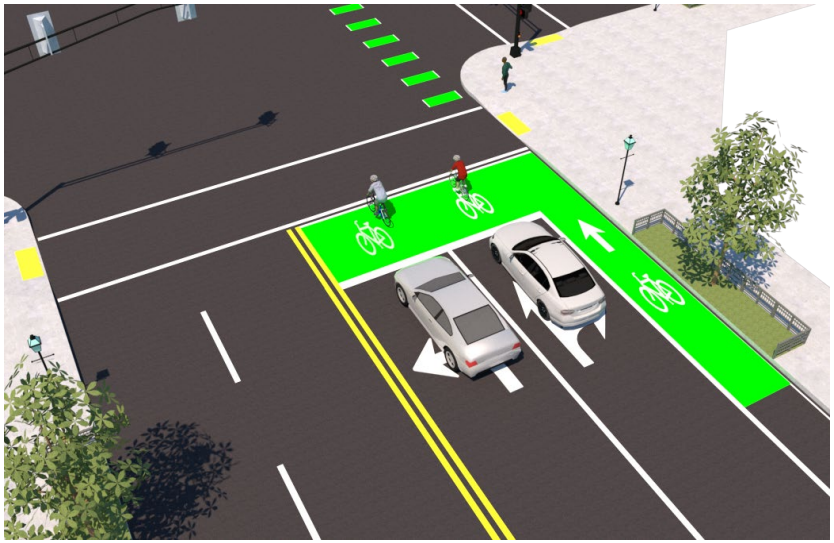
Green colored pavement is optional and may be installed to highlight where bicyclists will queue during a red signal phase. Other treatments such as leading or exclusive signal phases or mandatory turn lanes are alternatives to a bike box.

What safety issues are most critical to consider?

No Turn on Red signs shall be installed at bike box intersections, due to the driver's limited sight distance and to allow bicyclists to approach the box from the bicycle lane. Where the bike box extends across more than one approach lane, countdown pedestrian signals shall be used to display the change interval countdown.

What other design issues or trade-offs should be considered?

If bicycle lanes do not extend across the intersection, the bike box can help bicyclists position to enter the middle of the travel lane. Consider traffic queue storage, as the STOP line is set further back from the crosswalk with a bike box.



For More Information:

- NCDOT Standard Drawings 1205.16
- AASHTO Guide for the Development of Bicycle Facilities
- MUTCD Section 9E.12

Two-Stage Turn Box

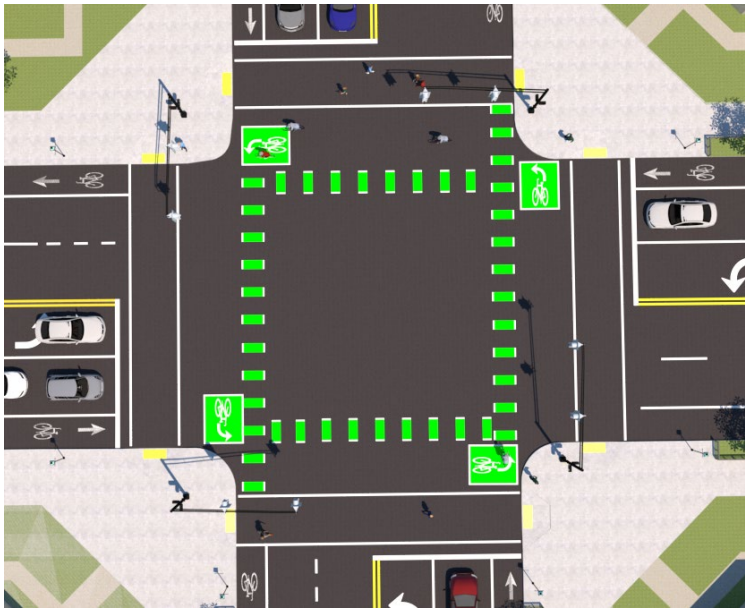
A two-stage turn box is an area set aside for bicyclists to queue for a turn outside the path of travel of motor vehicle and other bicyclists. Bicyclists can use a two-stage turn box to make a turn movement at an intersection without merging into vehicle traffic upstream of the intersection. It is delineated by a white pavement marking box, a turn arrow, and a bicycle symbol, and usually includes green colored pavement. Two-stage turn boxes can be used to facilitate a left turn from a right-hand side bike lane, or a right turn from a left-hand side bike lane.

When To Use

- Use to simplify turn movements for bicyclists.
- Use where there is available space in the intersection for the turn box to be placed outside of other road users' paths.
- Use to minimize bicyclists riding in mixed traffic.
- Typically used at multi-lane signalized intersections.

When Not To Use

- Avoid if there is not sufficient space for the turn box to be placed outside of other road users' paths or crosswalks.



Two-Stage Turn Box: FAQs

What alternative countermeasures or supplemental features can be considered?

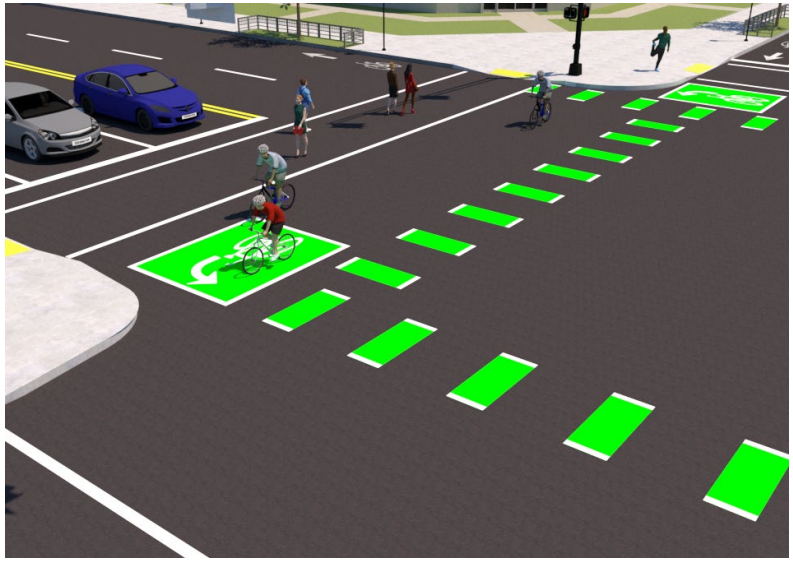
The application of green colored pavement in the turn box is highly recommended to clearly delineate the turn box for all road users.

What safety issues are most critical to consider?

Ensure sufficient space for the turn box outside of other road users' paths is available at the intersection and that the placement does not require bicyclists to conflict with pedestrian crossings.

What other design issues or trade-offs should be considered?

Vehicles are restricted from making right turns on red whenever the turn box is in the motor vehicle's right-turning path.

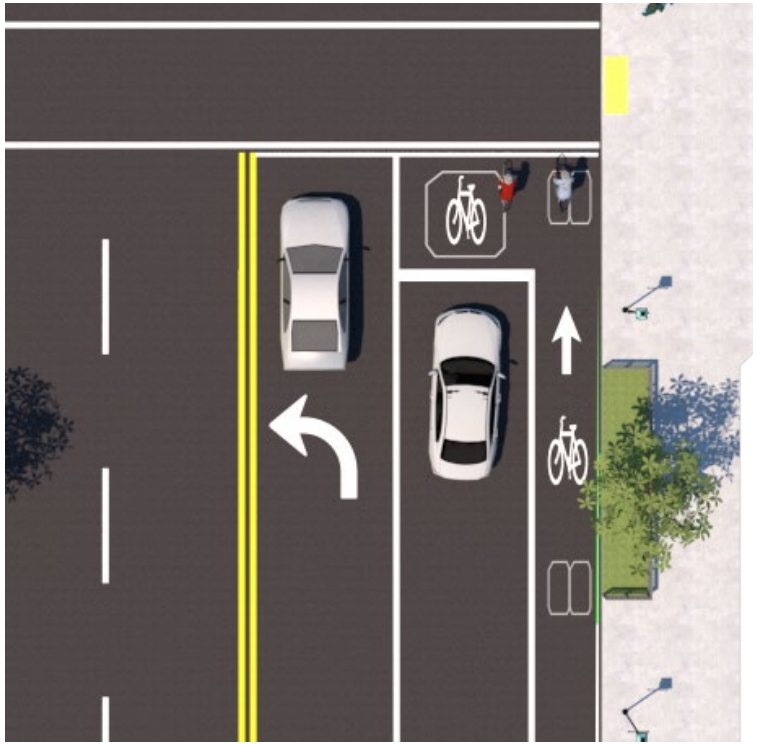


For More Information:

- NCDOT Standard Drawings 1205.16
- MUTCD Section 9E.11
- NACTO Urban Bikeway Design Guide
- FHWA Improving Intersections for Pedestrians and Bicyclists

Bicycle Detection

Bicycle detection is used at actuated traffic signals to alert the traffic signal controller to the presence of a bicyclist. Detection devices may include push-buttons, in-pavement induction loops, video detection, radar detection, or other methods.



When To Use

- Typically used at signalized intersections with high bicyclist volumes and where road user traffic signal actuation is required.
- Typically used at signalized intersections with actuated bicycle signal heads and/or specific traffic signal phasing for bicyclists.

When Not To Use

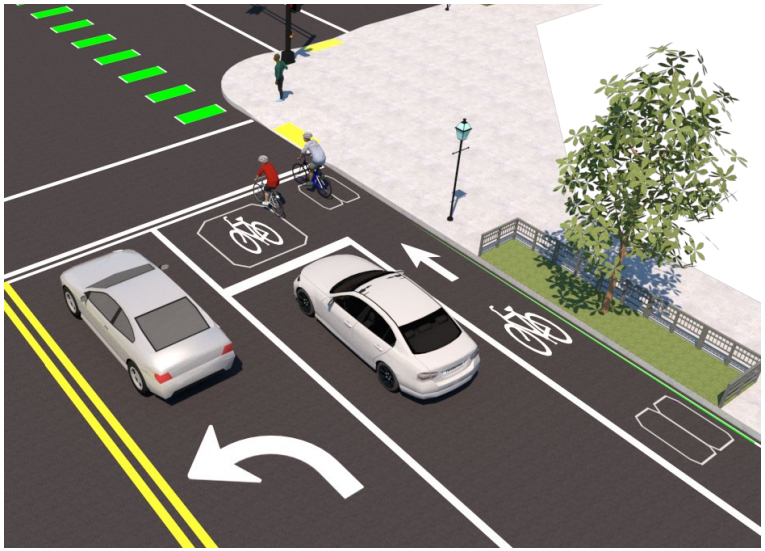
- Avoid at signalized intersections that do not rely on user actuation.

Bicycle Detection: FAQs

What alternative countermeasures or supplemental design can be considered?
The bicycle detector pavement marking can be used to indicate the optimal position for a bicyclist to be detected. A “To Request Green Wait on Bike Symbol” sign (R10-22) can be used to supplement the marking. If push-buttons are used, a “Push Button for Green Light” sign (R10-24, R10-26) may be used.

What safety issues are most critical to consider?
Installing bicycle detection can reduce red light running by bicyclists.

What other design issues or trade-offs should be considered?
Detection systems should be calibrated to make sure that they properly detect bicyclists. If push-buttons are used, the push-buttons should be located so that bicyclists can use them without dismounting or making unnecessary maneuvers.



For More Information:

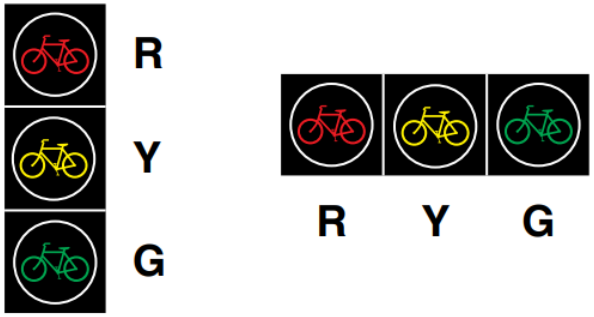
- NCDOT Standard Drawings 1205.16
- AASHTO Guide for the Development of Bicycle Facilities
- MUTCD Section 9E.15

Bicycle Signals

Bicycle signals are traffic signals that apply only to bicyclists. They are used in combination with traditional traffic signals to provide guidance to bicyclists at signalized intersections. Bicycle signal heads typically resemble traditional traffic signal heads but often have specialized lenses with bicycle symbol indications as opposed to the typical ball or arrow indications used on traditional traffic signal heads.

When To Use

- Use to separate bicycle movements at signalized intersections from conflicting movements by other modes.
- Use to provide for a through bicycle lane on the right-hand side of a right-turn lane or for a counter-flow bicycle lane.
- Use to accommodate bicycle-only movements, such as for a contraflow bike lane that would not otherwise have a signal phase.
- Use at intersections or trail crossings where bicycle clearance time is significantly less than pedestrian clearance time.



MUTCD Section 4H.06
Typical Bicycle Signal Face Arrangements

When Not To Use

- Avoid at unsignalized intersections or crossings, or with a hybrid beacon.

Bicycle Signals: FAQs

What alternative countermeasures or supplemental design can be considered?

A bicycle detection system should be in place to actuate the bicycle signal phase (unless the bicycle phase is set to recall). Turns on red should be restricted from any approach that uses a bicycle signal. Install a "Bicycle Signal" sign (R10-40 or 41 series) next to the bicycle signal to clearly communicate to all road users the purpose of that signal head.

What safety issues are most critical to consider?

If the bicycle phase runs concurrent with the parallel pedestrian WALK phase, conflicts between crossing pedestrians and right-turning bicyclists should be considered.

What other design issues or trade-offs should be considered?

Installation of bicycle signals may increase overall delay at the intersection and may result in decreased compliance.

R10-40

(see Section 9B.22)

For More Information:

- NCDOT Standard Drawings 1205.16
- MUTCD Section 9F and 4H
- NACTO Urban Bikeway Design Guide

Protected Intersections

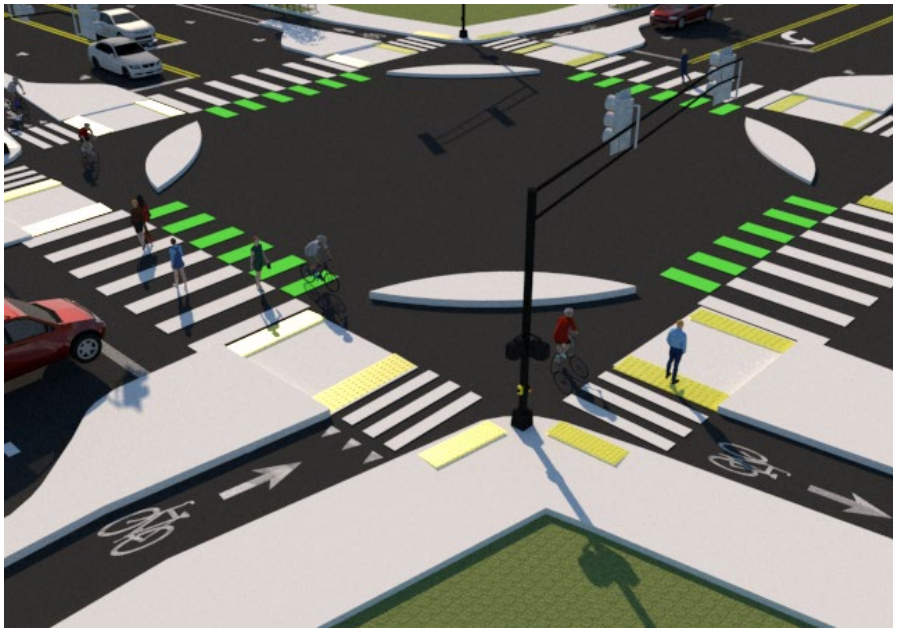
A protected intersection is an intersection that includes treatments designed to continue the separation provided by the bicycle lanes through the intersection. These treatments may include raised corner islands, setbacks, bicycle queueing areas, and pedestrian islands. The protected intersection design allows bicyclists the option to navigate the intersection without merging into mixed traffic.

When To Use

- Use to minimize bicyclists riding in mixed traffic to navigate intersections.
- Use when there are separated or buffered bike lanes on one or more intersection approach.
- Use at multi-lane signalized intersections.

When Not To Use

- Avoid if there are not receiving bikeways on opposite sides of the intersection.
- Consider alternatives where intersection design may result in extended delay for bicyclist travel through the intersection.



Protected Intersections: FAQs

What alternative countermeasures or supplemental design can be considered?

Green colored pavement and bicycle symbol markings is optional and may be installed to highlight conflict points along the bicycle lane and where bicyclists will queue during a red signal phase. Green colored pavement shall not be incorporated into crosswalks. Consider adding bicycle signals where high volumes of bicycling activity is expected.

What safety issues are most critical to consider?

The setback should provide adequate sight distance and visibility for both motorists and bicyclists. Provide a bike yield line and/or “Yield Here to Pedestrian” sign in advance of a crosswalk across the bike lane to avoid conflicts between pedestrians and bicyclists where sidewalks intersect with bike lanes.

What other design issues or trade-offs should be considered?

Vehicles may be permitted to turn right on red. Restrictions may be implemented if a pattern of conflicts between right-turning vehicles and bicyclists or pedestrians is identified.

For More Information:

- FHWA Improving Intersections for Pedestrians and Bicyclists
- NACTO Don’t Give Up At The Intersection

Transit

Bus Lanes

Bus Only Lanes

Bus – Bike Lanes

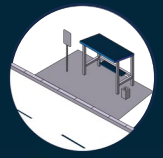
Bus On Shoulder System (BOSS)

Bus Transit Signals

Bus Pull Outs

Bus Stops and Crossings

Floating Bus Stops



Bus Shelter Guidelines

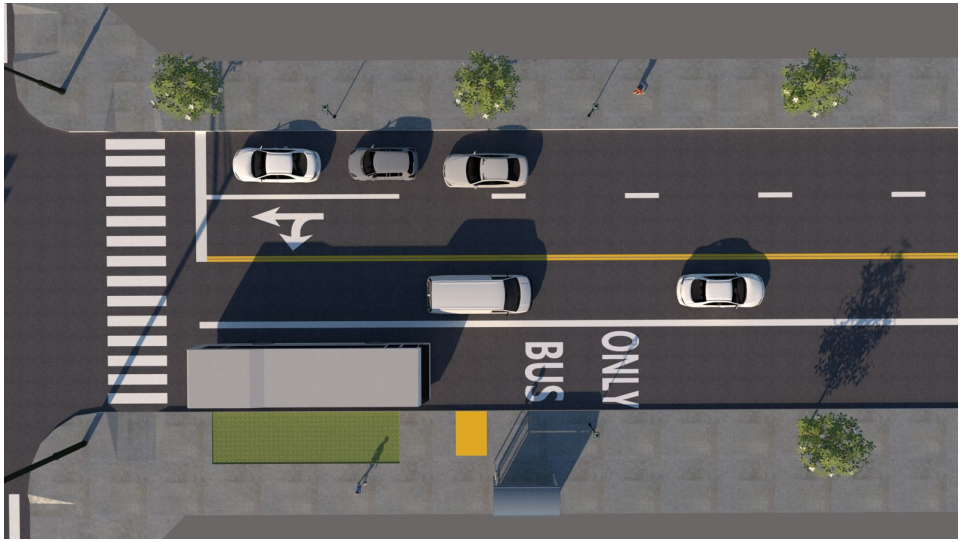
Bus Stops at Pedestrian Crossings

Bus Only Lane

Dedicated bus lanes are applied on routes with heavy bus ridership or where traffic volumes may impact bus operation reliability. Bus only lanes can be located at the curb, in an offset location, or adjacent to a center median. This treatment is often included as part of Bus Rapid Transit (BRT) systems.

When To Use

- To increase public transportation speeds and improve the reliability of travel time for bus routes on roads with high traffic volumes, such as on arterials.
- To reduce impact on traffic operations where bus ridership is high or stops are frequent.



When Not To Use

- Avoid on roadways with high design speeds (≥ 50 MPH) without physical separation.
- Consider alternatives if on-street parking is expected to encroach on the corridor.

Bus Only Lane: FAQs

What alternative countermeasures or supplemental features can be considered?

Bus only lanes should be marked with BUS ONLY pavement markings. Implement additional signal design such as transit signal priority or a leading interval (queue jump) to improve bus operation performance.

What safety issues are most critical to consider?

Consider adding physical separation from traffic on higher speed roadways.

What other design issues or trade-offs should be considered?

Red-colored pavement is a conspicuity enhancement option for transit only lanes. Where red-colored pavement is used, it shall be installed for the full width of the lane. However, red-colored pavement may be applied in a broken pattern (at conflict zones or strategic locations) or along the entire length of a restricted bus lane.

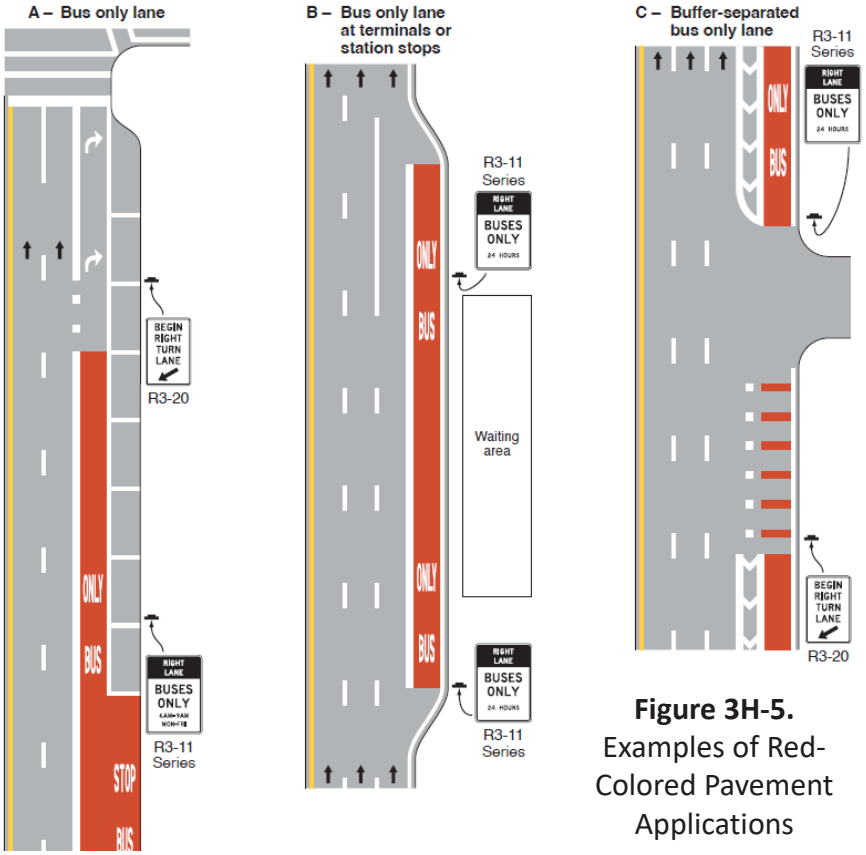


Figure 3H-5. Examples of Red-Colored Pavement Applications

For More Information:

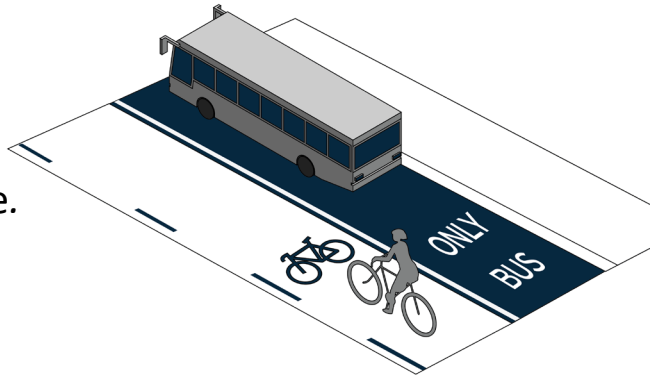
- NCDOT Red Bus Lane Pavement Markings Specifications
- NACTO Transit Street Design Guide
- MUTCD Section 4H.07

Buses and Bike Lanes

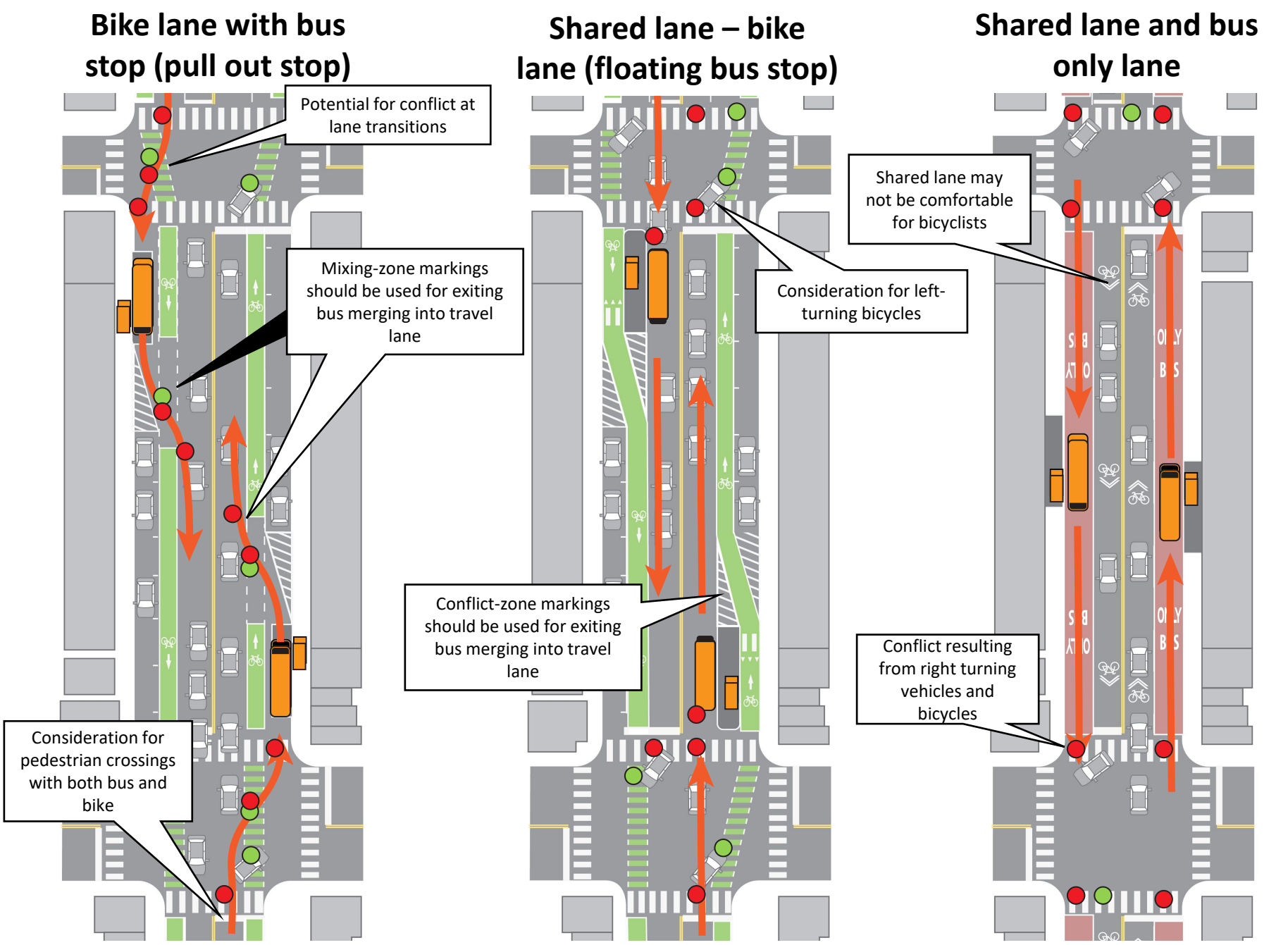
In constrained and urban contexts, demand for bicyclist and bus routes may be high. The unique needs of bus operations and bikeway selection should be considered in early network planning, based on roadway characteristics. Pavement marking and traffic control plans should consider potential conflict points between bicyclists and buses and where pedestrians, bicyclists and buses access bus stops.

Considerations

- Avoid shared (not exclusive) bus-bikeways with frequent bus headways or stops. Combined bicycle and transit facilities, such as shared lanes or bike lanes adjacent to transit stops, can be challenging for bicyclists and transit operators to safely navigate.
- Review mixing zones or transitions between dedicated bicycle lanes, traffic lanes, and bus routes with frequent service. Buses stopping in a bike lane creates a “leap-frog” effect with bicyclists.
- If a curbside bike lane is approaching a bus stop, consider green-colored pavement markings to highlight conflict points where buses may encroach or cross the bike lane to access the stop.



For More Information:
TCRP Report 183



Note: *These figures are for illustrative purposes only. Not to be used for design guidance.*

Bike Conflict Points

Bus Conflict Points

Bus On Shoulder System (BOSS)

Bus On Shoulder Systems (BOSS) allow buses to travel with preferential use on roadways by operating on the shoulder instead of the general-purpose lanes.

When To Use

- Can be restricted to peak traffic congestion hours or when the travel reliability of bus routes are affected.
- On roadways with adequate shoulder width (10 ft minimum, 12 ft preferred) and depth (3 inch minimum, 7 inch preferred) for bus operations.
- When Bus on Shoulder operation fits within a larger strategic framework or project opportunity.

When Not To Use

- Avoid on roadways with frequent shoulder "pinch points" or access point conflicts.

R3-11f

Bus On Shoulder System (BOSS): FAQs

What alternative countermeasures or supplemental features can be considered?

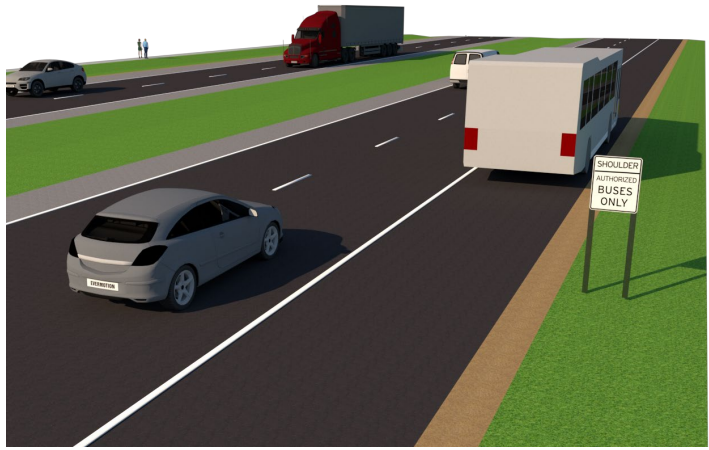
BOSS can be combined with ramp metering to mitigate conflicts at on-ramps. BOSS can feature dynamic signing strategies instead of or in addition to static signing.

What safety issues are most critical to consider?

BOSS can create additional conflict points at freeway on- and off-ramps. Signing and markings should guide vehicle operators to navigate these conflict points. BOSS can prevent the shoulder from being used as a safe pull-off for breakdowns. If possible, periodic pull-outs can be incorporated to provide this opportunity.

What other design issues or trade-offs should be considered?

Sign placement/spreading is key so that vehicle operators can process guidance. Designers should consider the superelevation of the shoulder compared to general-use lanes. Rumble strips should not be placed in the tire path of BOSS vehicles. Coordination with the State Traffic Engineer is required due to BOSS ordinances.



R3-11f sign placed next to Bus on Shoulder

For More Information:

- NCDOT Standard Drawings
- CAMPO BOSS Implementation Blueprint
- MUTCD Section 2G.20-23
- TCRP Report 151

Bus Transit Signals

Transit priority signals are traffic control devices that give transit vehicles priority over other traffic at signalized intersections. These devices can help to reduce transit travel times and improve on-time performance and reliability of transit service benefiting transit riders and agencies. When activated, these signals provide an exclusive phase for transit vehicles to proceed without conflict with other vehicles, bicyclists, and pedestrians.

When To Use

- Where transit vehicles are delayed by passenger vehicle queues at intersections.
- Where exclusive transit lanes or queue jump lanes are provided or where transit vehicles can utilize right-turn lanes as queue jump lanes.

When Not To Use

- Where exclusive queue jump lanes or shared transit lanes are not provided.
- At intersections with high volumes of pedestrians, bicyclists, left-turning vehicles, and emergency vehicles.

(referenced in the MUTCD as Light Rail Transit Signals for use by bus rapid transit movements)

Bus Signal sign may be displayed for clarity

Bus Transit Signals

What alternative countermeasures or supplemental features can be considered?

Queue jump lanes can also be provided as part of a transit signal priority (TSP) solution. A queue jump lane is a dedicated lane adjacent to regular travel lanes at intersections that provides access for transit vehicles to skip the queue and advance to the stop bar at the intersection.

What other design issues or trade-offs should be considered?

TSP modifies the signal timing and phasing in response to the presence of a transit vehicle, differing from preemption. Preemption interrupts typical traffic signal operations to accommodate the presence of dedicated vehicles (such as emergency vehicles and trains at rail crossings). Frequent activity by emergency vehicles or along rail lines may disrupt effectiveness of TSP.

For More Information:

- NCDOT Signal Design Manual
- NACTO Transit Street Design Guide
- MUTCD Section 4F.18

Bus Pull Outs

Curbside pull-out stops are to be used infrequently but may be added where in-lane stops create major impacts to through-traffic. Pull-out stops add more time to bus operations than in-lane stops because buses must exit and merge to re-enter the flow of traffic at the stop.

When To Use

- At route time points or other stops with longer wait times, pull-out stops provide more time for the bus to service passengers.
- Consider bus pull-out stops where routes provide frequent bus service and operate with vehicles operating at speeds 35 mph or greater.
- Consider far-side bus pull-out stops for complex or high traffic intersections.

When Not To Use

- Avoid installing bus pull-out stops where vehicles frequently use curbside space or lanes for legal loading or parking.
- Consider alternatives to bus pull-out stops on roads where removing curbside parking is not feasible.

Bus Pull Outs: FAQs

What alternative countermeasures or supplemental features can be considered?
Queue jumps allow buses to progress from curbside lanes or near-side pull-out stops. Placing bus stops on the far-side of signalized intersections may accomplish a similar benefit as the pull-out stop.

What safety issues are most critical to consider?
Review crash history, bus operations, sight distance conditions on roads with posted speeds 45 mph or greater to determine if in-lane bus stops may increase risk for severe rear-end crashes.

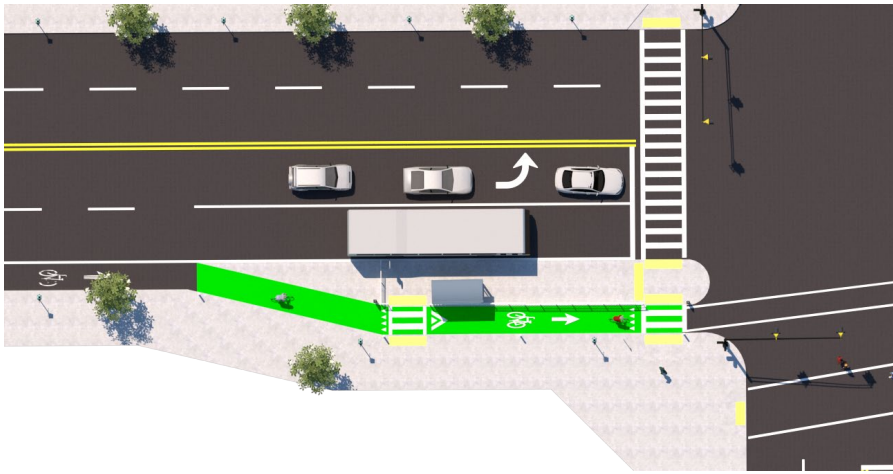
What other design issues or trade-offs should be considered?
The cost of constructing bus pull-out stops requiring additional right-of-way may outweigh the relative benefit to traffic operations. Impacts to overall travel time for bus riders along routes with pull-out stops should also be considered.

For More Information:

- NACTO Transit Street Design Guide
- NACTO Curbside Pull-Out Guidance

Floating Bus Stop

Floating bus stops allow buses to stop in-lane and passengers to wait to board from a raised island, while parallel bike lanes are separated and bent away from the stopping buses to the opposite side of an island.



When To Use

- To maintain or provide separation for bicyclists travelling past the bus stop.
- Where located at an intersection, use where right turn volumes are low or moderate.

When Not To Use

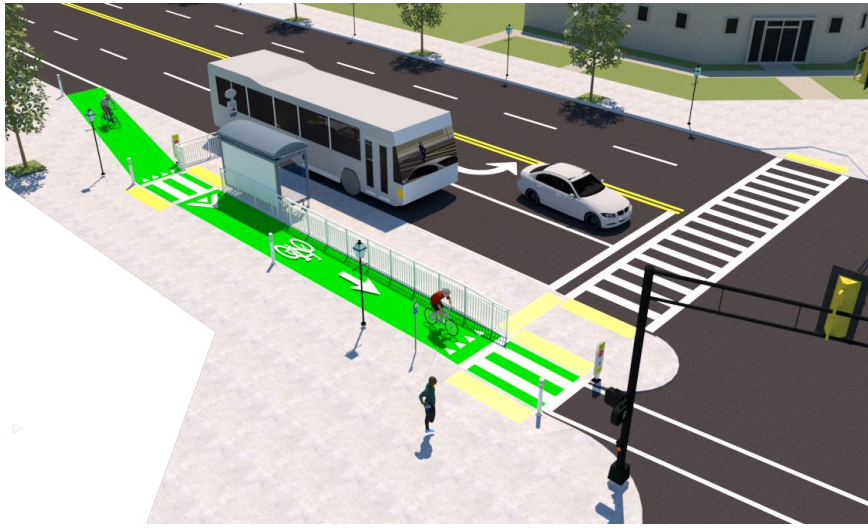
- Consider impacts between vehicle traffic and transit dwell time at stops- especially if stops are used as time-points.
- If passenger transit activity may exceed the capacity of the island.
- If there is not adequate width for the bus pad (8’ minimum).

Floating Bus Stop: FAQs

What alternative countermeasures or supplemental features can be considered?
Tactile warning strips to identify conflicting bikeways. A supplemental braille bus island diagram on sidewalk for visually impaired. Identify bicyclists of pedestrian presence by installing guideposts, 'Yield to Pedestrians' sign, and in bike-lane crosswalk markings.

What safety issues are most critical to consider?
Site the floating bus stop at a controlled intersection or safe location for pedestrian crossings.

What other design issues or trade-offs should be considered?
People with visual impairments can have navigable challenges. While floating bus stops can increase transit and bicyclist efficiency- they produce a conflict point with pedestrians.



For More Information:

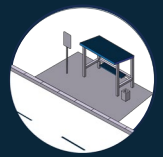
- NACTO Transit Street Design Guide
- FHWA Separated Bike Lane Planning and Design Guide
- Greater Boston Bus Priority Toolkit
- NCDOT Bus Shelter & Bus Stop Guidelines

Bus Stop Shelters

Bus stops including benches or shelters provide seating or shelter for people while waiting on a bus. When placed within NCDOT right of way, these structures must be approved by way of an encroachment agreement.

Considerations

- Place structures behind the sidewalk.
- Prioritize installation of benches or shelters at bus stops with higher transit ridership.
- Where located at an intersection, place bus stops where right turn volumes are low or moderate.



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Initial Contact between Encroaching Party (Municipalities & Transit Authorities) & NCDOT District Engineer's Office

NCDOT District Engineer's Office Agrees with Bus Shelter Site Locations & Designs?

Yes

No

Encroaching Party revises Bus Shelter Site Locations & Designs per NCDOT District Comments and resubmits to District Office

Encroaching Party checks to see if Bus Shelter Structure is on NCDOT Approved Products List (APL) Website

Bus Shelter on NCDOT Approved Products List?

Yes

No

Encroaching Party submits **Bus Shelter Encroachment Package** (Site Location/Design and Bus Shelter Foundation/Connections sealed, signed and dated by NC Licensed Professional Engineer). Also, Encroaching Party submits NCDOT Bus Shelter Structure Approved Products List # with Encroachment Package.

District Engineer's Office Finalizes & Approves Bus Shelter Encroachment Package and issues Encroachment Agreement

Bus Shelter Manufacturer/Vendor submits NCDOT Product Evaluation Program -Bus Shelter Structural Adequacy Document to NCDOT Transportation Value Management

Bus Shelter Manufacturer acquires NCDOT APL status?

Yes

No

Does Encroaching Party want to select Bus Shelter Structure on NCDOT APL List?

No

District Engineer's Office Denies Bus Shelter Encroachment Package

Yes

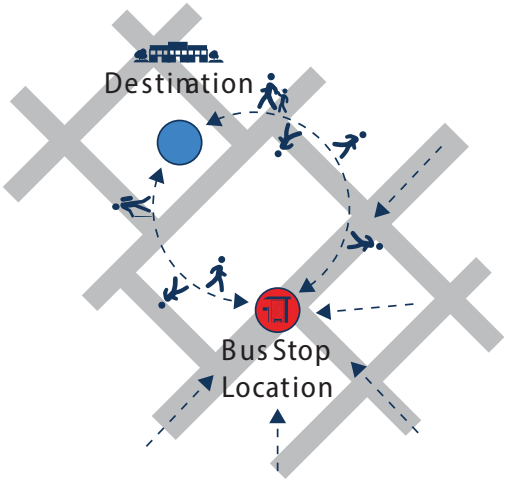
For More Information:

[2017 NCDOT Bus Shelter & Bus Stop Guidelines]

Pedestrian Crossings at Bus Stops

NCDOT project staff should consider the following when coordinating with a transit agency and local government to improve pedestrian crossing safety near bus stops:

- Make safe pedestrian crossing access to a bus stop a priority in the project under review.
- Engage transit agencies, planning organizations, and local governments early in transportation planning processes, project, or studies.
- Look for opportunities to incorporate bus stop and safety improvements into larger corridor or area-wide developments.
- Promote the consistent application of decision-making processes and agreements with respect to bus stops and pedestrian crossings.
- Approach the review of bus stops and pedestrian crossings with input from a multidisciplinary team.



Primary sources for planning and selecting pedestrian crossings at bus stops include the following:

- NCDOT Pedestrian Crossing Guidance
- FHWA MUTCD (11th edition, published December 2023)

Evaluation Criteria

If any of these criteria are *not* met, the NCDOT project staff should consider improvement options detailed below to support safer pedestrian crossing to the bus stop. Engineering judgement should be applied when evaluating the crossing.

- ❑ The bus stop is in proximity to a marked crossing (i.e. <150'-300').
- ❑ There are clear sightlines of the bus stop's marked crossing.
- ❑ The existing marked crossing includes crossing countermeasures that are appropriate for the roadway or intersection context and speed (i.e. overhead lighting, pedestrian signal heads at signalized intersections, visibility enhancements at mid-block locations, etc. as specified by NCDOT guidance).
- ❑ The bus stop and crossing are connected by accessible pedestrian facilities that are appropriate for the context.
- ❑ The bus stop and crossing are positioned to reduce the risk of a near-lane vehicle yielding to a crossing pedestrian and blocking the view of an approaching far-lane vehicle (known as a multiple-threat crash).
- ❑ The bus stop is a sufficient distance to other bus stops serving the same route. Typical minimum bus stop spacing for local bus service is 800' and longer for high-frequency, limited-stop routes.

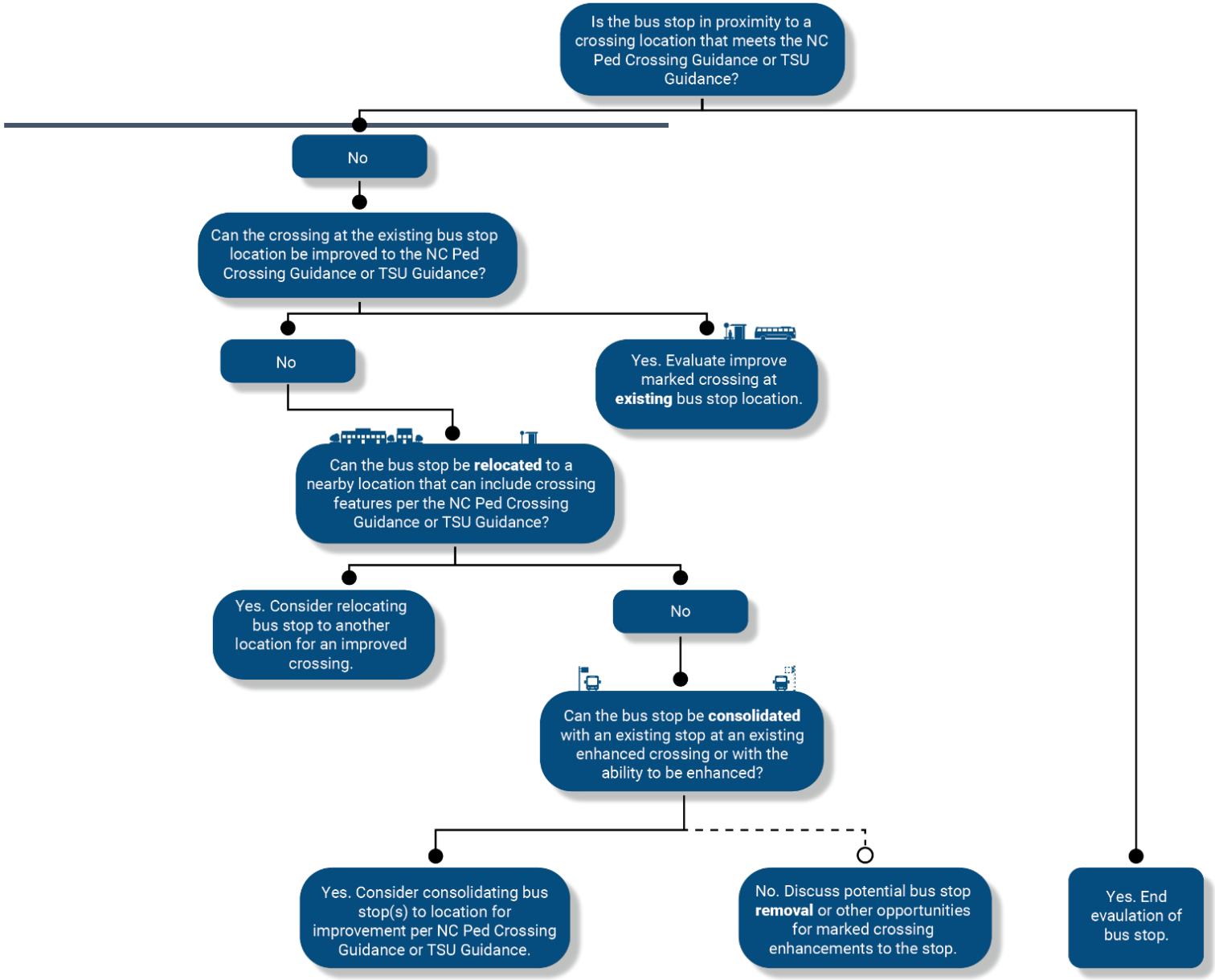
Improvement Options

Improve or formalize the existing crossing location near the bus stop: Recommended where the crossing near the bus stop(s) can be added or improved per the NC Pedestrian Crossing Guidance for uncontrolled locations and TSU/RTE guidance for controlled locations.

Relocate the bus stop to an improved crossing location: Recommended where the bus stop(s) may be repositioned to a crossing location that can be improved per the NC Pedestrian Crossing Guidance for uncontrolled locations and TSU/RTE guidance for controlled locations. Signalized intersection locations are generally preferred to uncontrolled locations. Relocating stops with existing amenities such as shelters and benches will require additional coordination.

Consolidate the bus stop to a location with an improved crossing: Recommended where the stop is in close proximity to another stop that serves the same route and may be combined to a location with an improved crossing.

Removal of the bus stop: This recommendation is not an improvement option, should rarely be made, and it is intended for stops that reduce pedestrian safety; it should occur only after consideration of the other improvements options above and in close coordination with the transit agency, State Traffic Engineer, and Division Engineer.


Is the bus stop in proximity to a crossing location that meets the NC Ped Crossing Guidance or TSU Guidance?
No
Can the crossing at the existing bus stop location be improved to the NC Ped Crossing Guidance or TSU Guidance?
No
Yes. Evaluate improve marked crossing at existing bus stop location.
Can the bus stop be relocated to a nearby location that can include crossing features per the NC Ped Crossing Guidance or TSU Guidance?
Yes. Consider relocating bus stop to another location for an improved crossing.
No
Can the bus stop be consolidated with an existing stop at an existing enhanced crossing or with the ability to be enhanced?
Yes. Consider consolidating bus stop(s) to location for improvement per NC Ped Crossing Guidance or TSU Guidance.
No. Discuss potential bus stop removal or other opportunities for marked crossing enhancements to the stop.
Yes. End evaulation of bus stop.

Common Safety Problems

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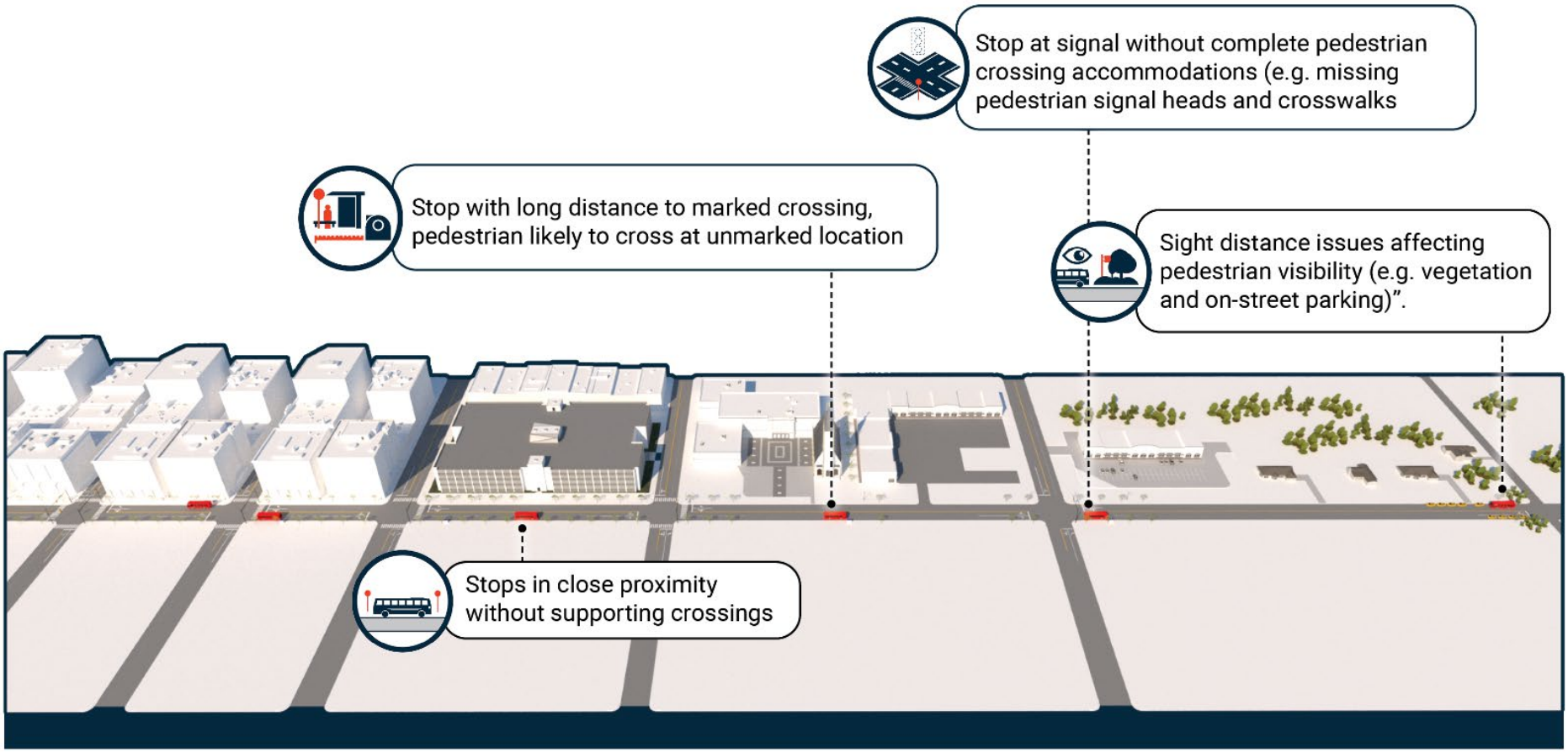
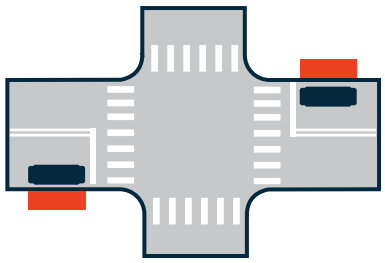
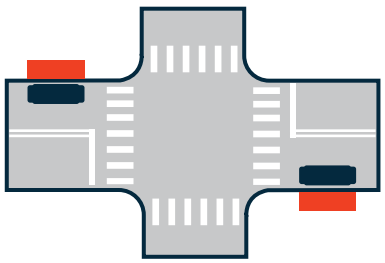
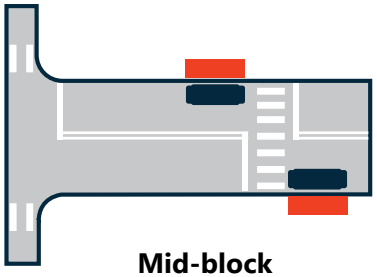




Near-side



Far-side



Mid-block

Far Side vs Near Side?

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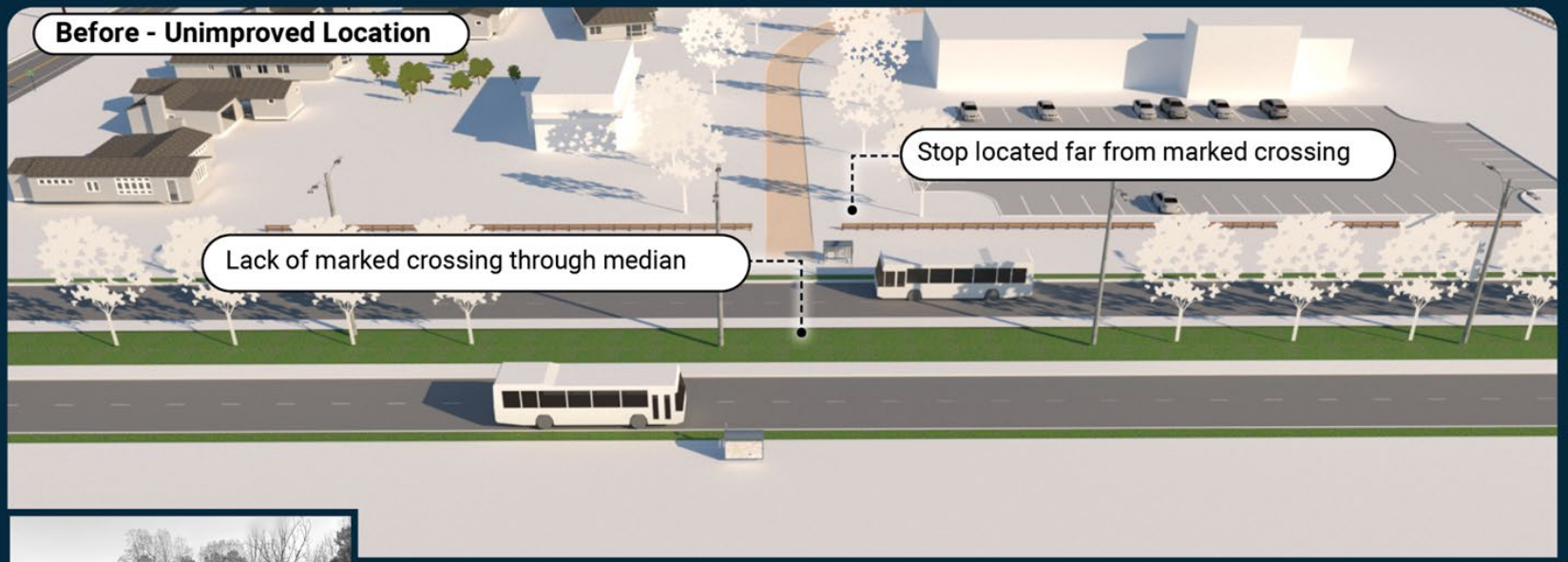
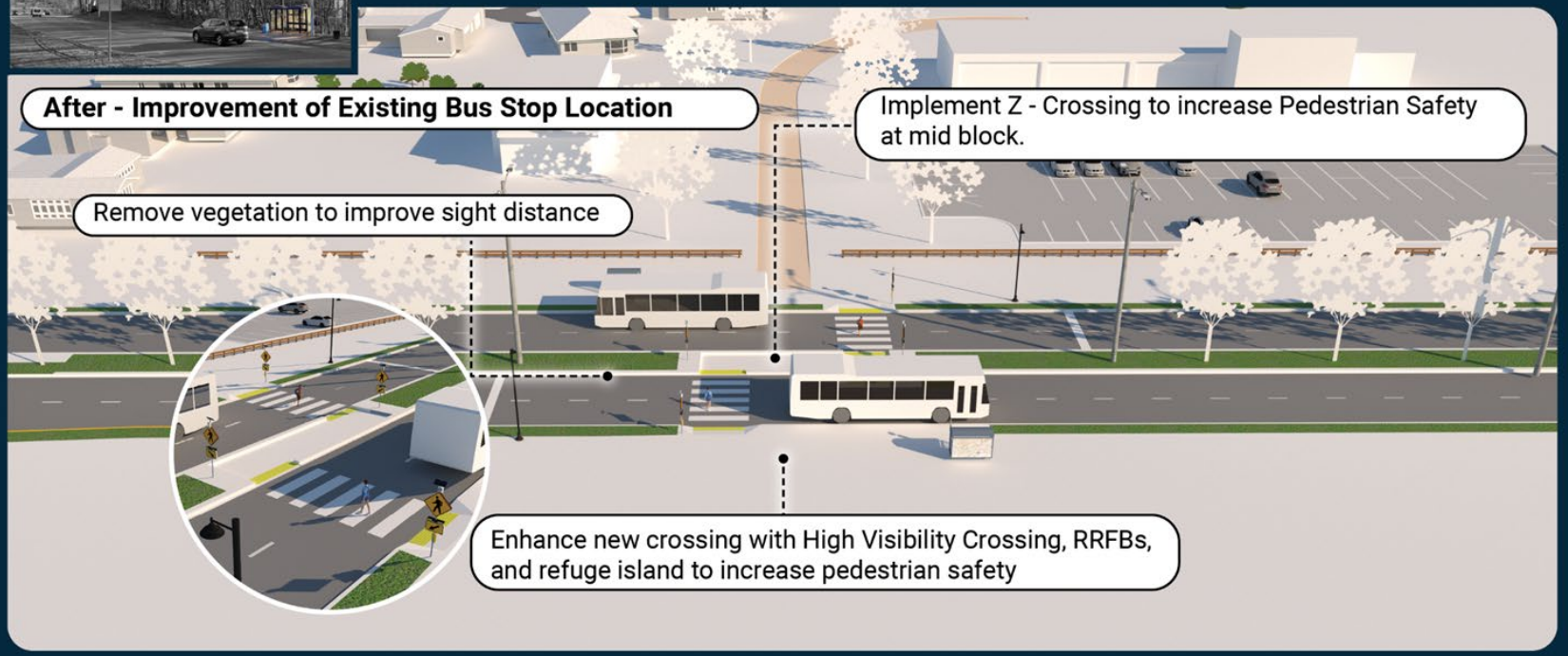
Roadway Context and Countermeasure	Recommended Bus Stop Placement to Crossing Countermeasure	Rationale
Multilane roadway with instantaneous or 'hot' PHB	Before Pedestrian Hybrid Beacon (PHB) and crossing	Upon PHB activation, vehicles will stop, and the pedestrian will cross similar to a near-side signalized intersection.
Multilane roadway with coordinated PHB	After Pedestrian Hybrid Beacon (PHB) and crossing	With a delayed activation, pedestrians may try to cross as vehicles proceed through the dark PHB. Placement after the PHB improves pedestrian visibility to oncoming vehicles before activation.
Multilane roadway with RRFB	After Rectangular Rapid Flashing Beacon (RRFB) and crossing	RRFBs are a conspicuity device, and crossing behind the bus improves pedestrian visibility to oncoming vehicles after RRFB activation.
Two-lane roadway (curb & gutter or no shoulders)	Before countermeasure and crossing	Where the bus stops in-lane and blocks following vehicles from passing around the bus, crossing in front of the bus improves pedestrian visibility to oncoming opposing vehicles.
Two-lane roadway with wide shoulders	After countermeasure and crossing	Where the bus pulls to the shoulder for boarding and alighting, crossing behind the bus improves pedestrian visibility to oncoming/passing vehicles.

Evaluate New or Improve Existing Crossing



Example
Multi-lane roadway Median, Bus stops on both sides of roadway



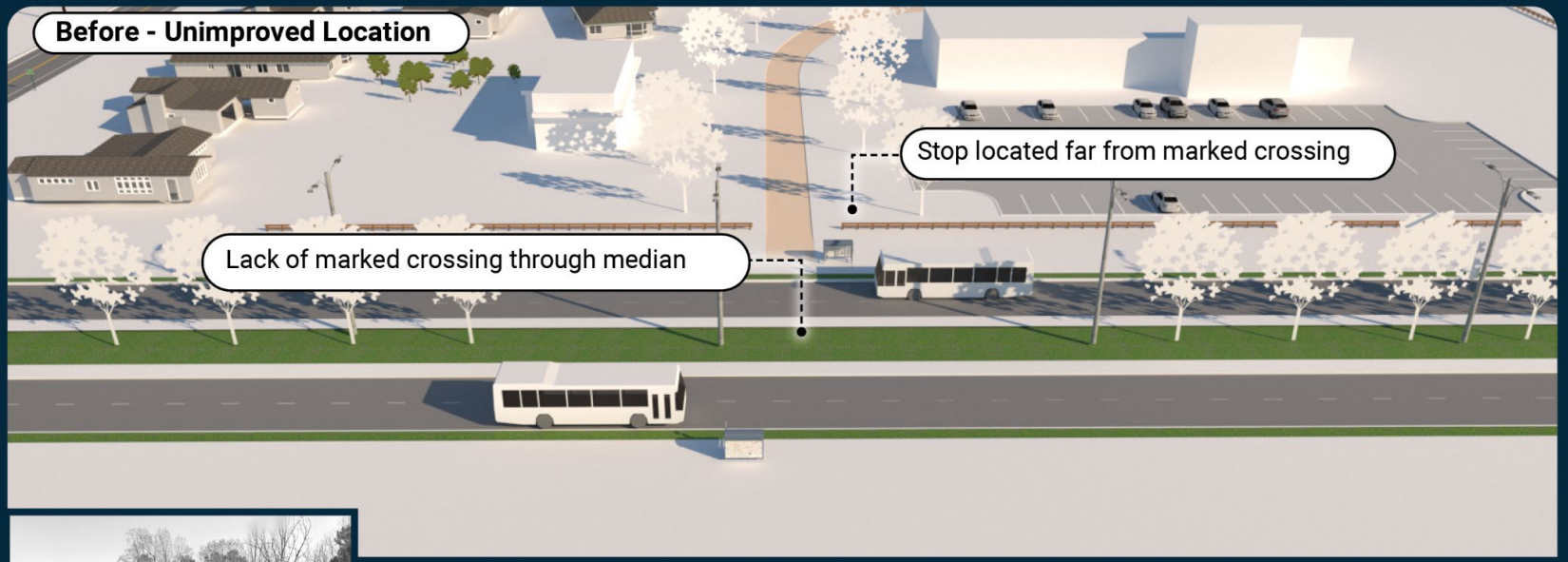
Safety Issues

Distance

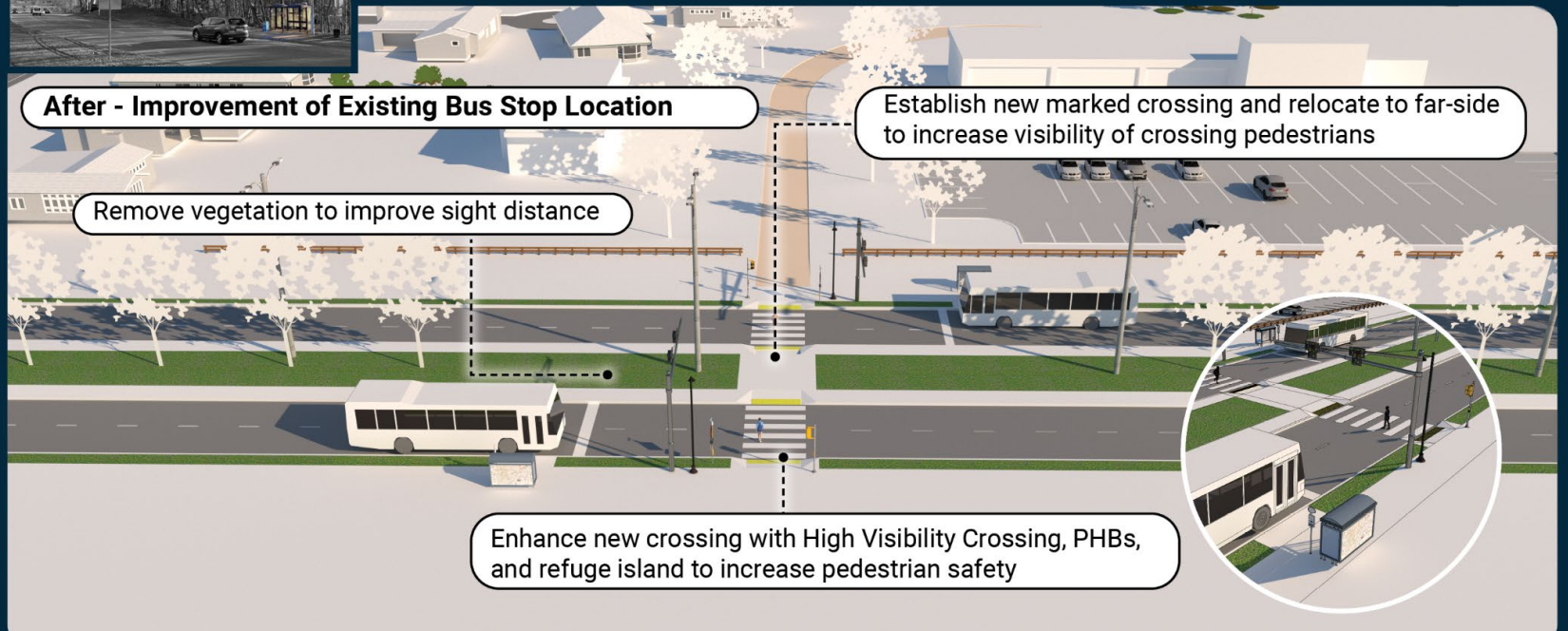
Incomplete Network

Visibility

Evaluate New or Improve Existing Crossing: PHB



Example
Multi-lane roadway Median, Bus stops on both sides of roadway



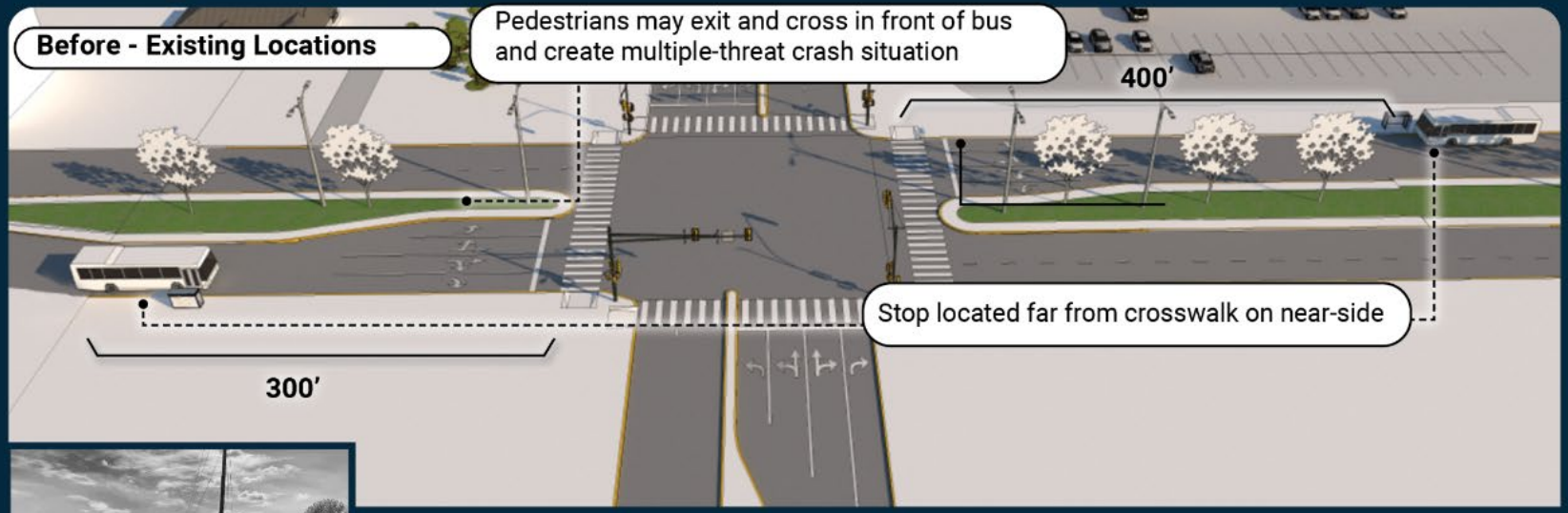
Safety Issues

Distance

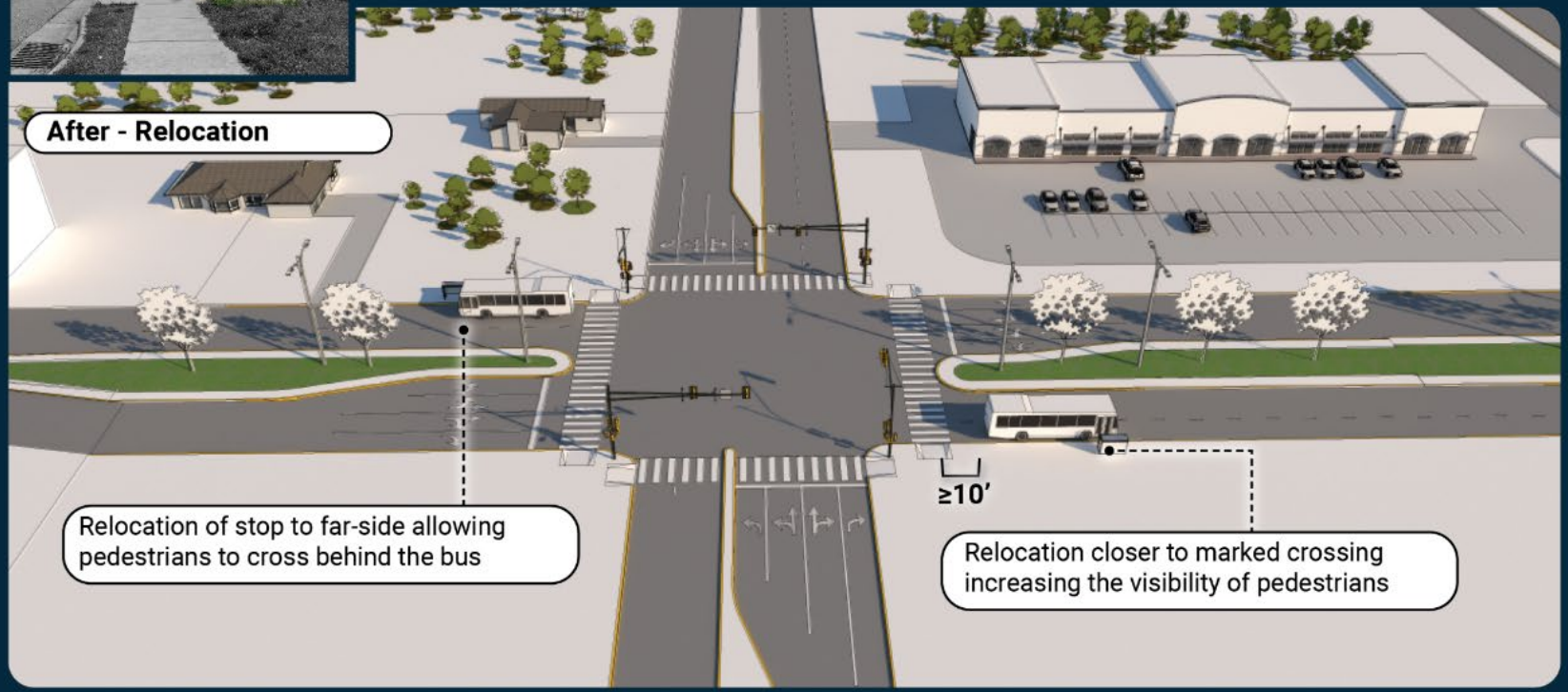
Incomplete Network

Visibility

Relocate Bus Stops



Example
Multi-lane roadway, Stop located in advance of signalized intersection



Safety Issues

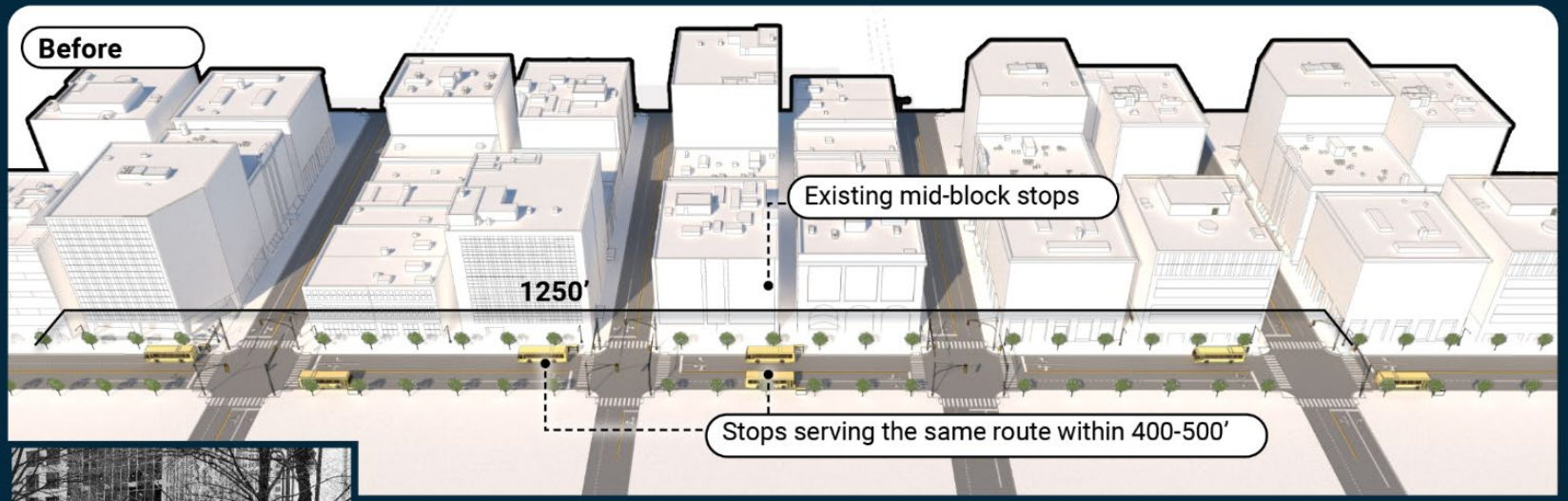
Distance

Incomplete Network

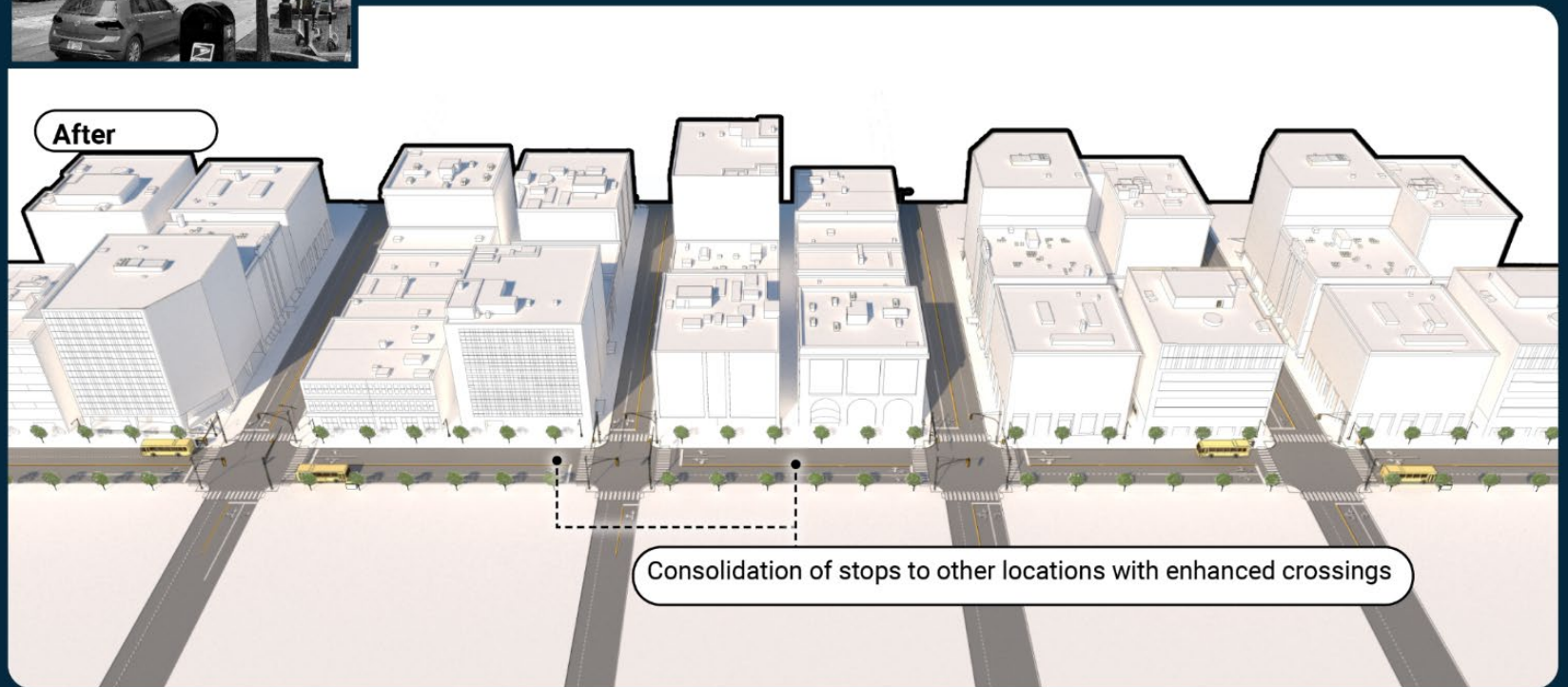
Visibility

Close Proximity

Consolidate Bus Stops



Example
Urban area, Frequent stop locations



Safety Issues

Distance

Incomplete Network

Visibility

Close Proximity

For More Information

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