



NORTH CAROLINA
Department of Transportation

Multimodal Guidance: Bicycle Facilities

Transportation Mobility and Safety Division

Original Date: September 2023

Modified Date: February 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 |
|---|---|--|
| <ul style="list-style-type: none">• Basic overview of facility type and traffic control design elements.• Links to additional resources. | <ul style="list-style-type: none">• Standard drawings for pavement markings and signage.• Will be updated as new guidance is released. | <ul style="list-style-type: none">• 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



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



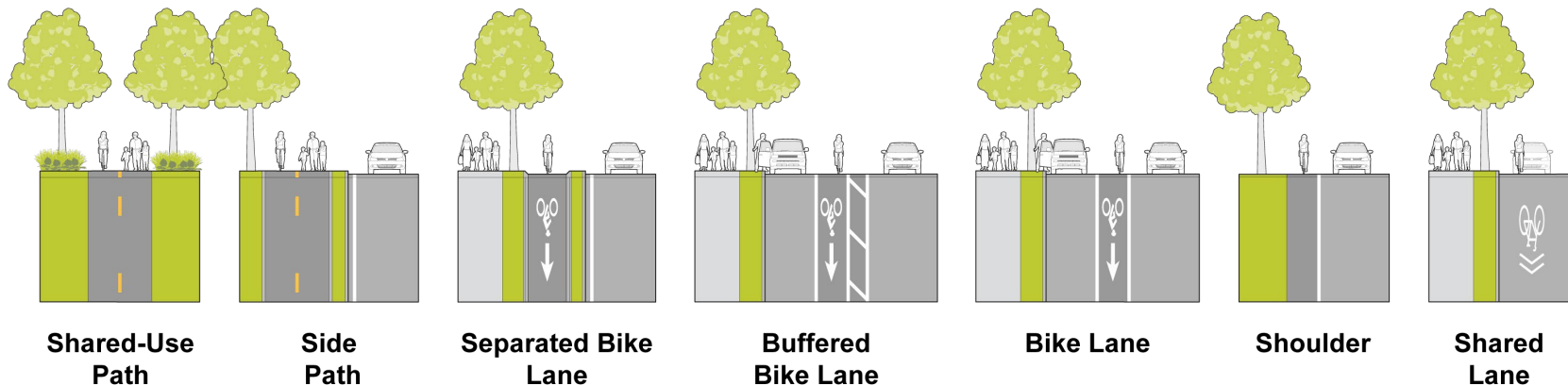
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Bikeways and Intersection Treatments

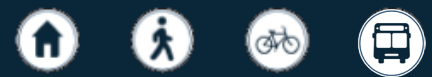
Bikeways are networks specifically designed and designated for bicyclists. Roadways where bicyclists travel in shared space with vehicles may be appropriate for some traffic conditions. Facilities can also be designed for bicyclists to share travel space with pedestrians. Bikeway networks and intersection 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



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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

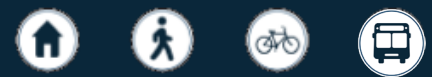
- Use to provide exclusive space for bicyclists to operate on the roadway.
- Paved shoulders may be repurposed as bike lanes by installing bicycle symbol markings, but bike lanes shall not also be used as a shoulder.

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 \(dot.gov\)](https://www.dot.gov/bikeway-selection-guide)





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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](#)



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Buffered Bike Lane

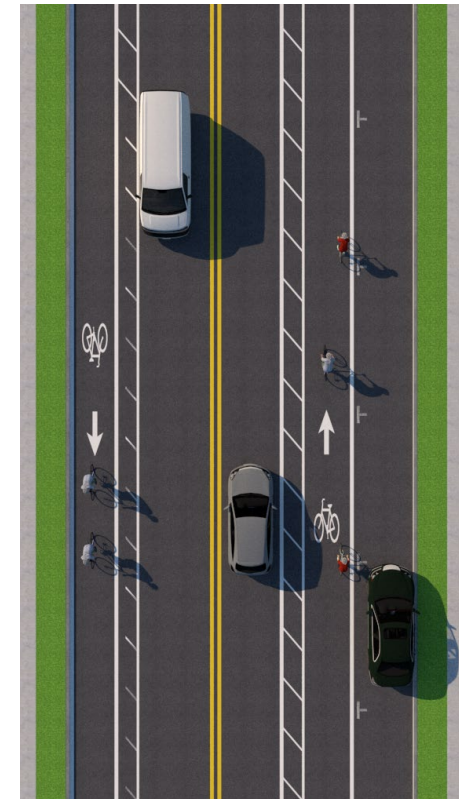
A buffered bike lane provides horizontal separation between bicyclists and vehicles in the adjacent travel lane and/or parking lane. Buffered bike lanes use solid white edge lines and may also use longitudinal markings (either hatching or chevron markings) depending on the buffer width.

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.





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Buffered Bike Lane: FAQs

What alternative countermeasures or supplemental features can be considered?

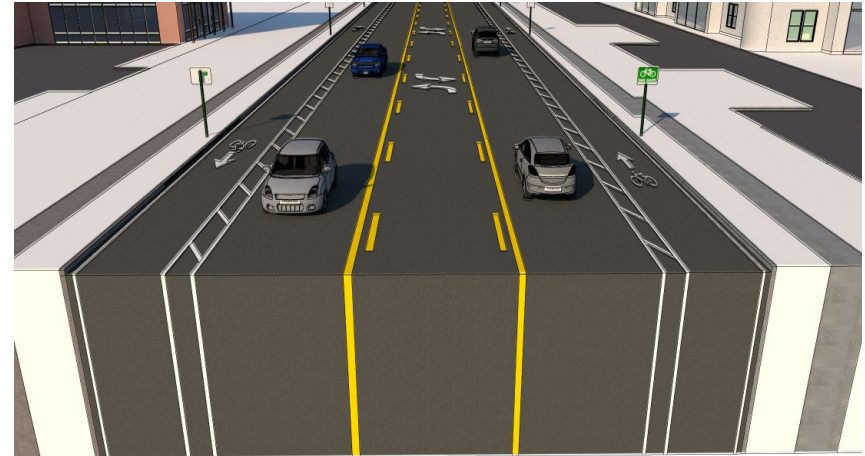
One-way separated bike lanes may be preferred over buffered bicycle lanes on roads with posted speed limit ≥ 35 MPH, or where higher volumes of bicyclists and pedestrians are expected.

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](#)



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Separated Bike Lane

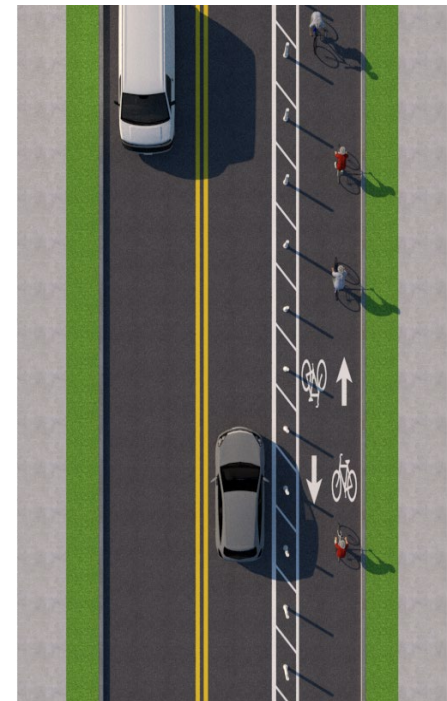
A separated bike lane is either a standard one-way bike lane or a two-way bike lane separated from vehicle traffic with vertical elements. These vertical elements may include tubular markers, parked vehicles, a concrete median, a raised median with curb and gutter, or other vertical material products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

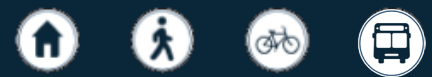
When To Use

- 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.





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Separated Bike Lane: FAQs

What alternative countermeasures or supplemental features can be considered?

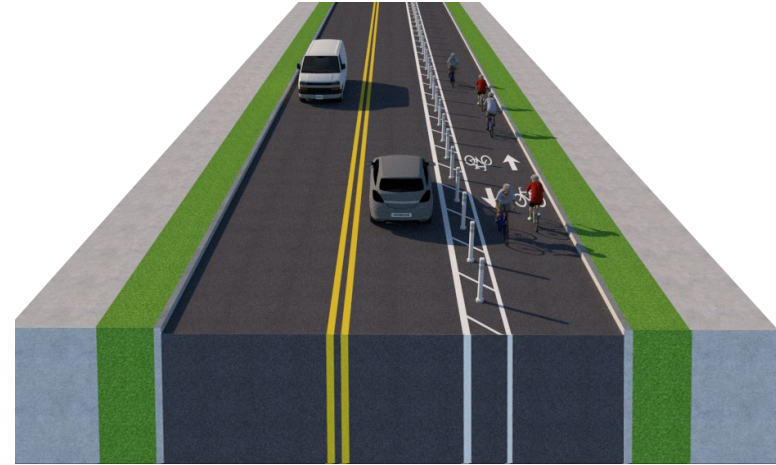
White tubular markers are a common and cost-effective vertical element, but concrete medians or curbs may provide more protection for cyclists. A shared use path may be preferred over separated bike lanes depending on the surrounding bicycle network.

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](#)



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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.





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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](#)



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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.





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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](#)



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Counterflow Bike Lane

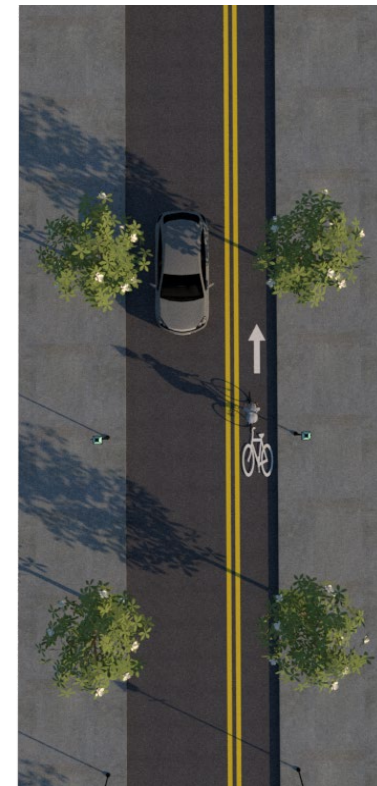
A counterflow (or contraflow) bike lane allows bicyclists to ride in the opposite direction of motor vehicle traffic on a one-way street. The counterflow bike lane is separated from the motor vehicle lane(s) using solid double yellow centerline markings or other form of separation.

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.





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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](#)



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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 \(dot.gov\)](https://www.fhwa.dot.gov/bikeway/bikewayselectionguide/)



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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](#)



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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.

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.



W11-1 Bicycle Warning Sign



W16-1P



W16-1aP



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Bike Box

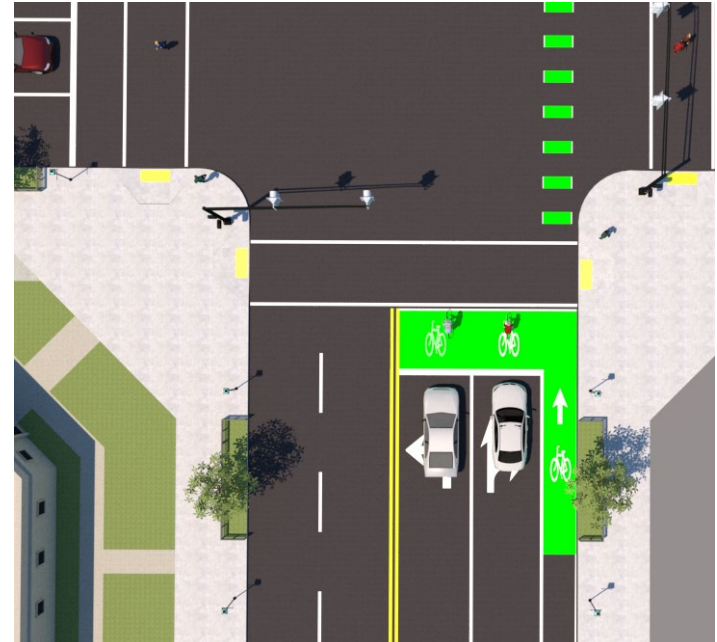
A bike box is a designated area placed ahead of a travel lane at a signalized intersection in which bicyclists can position in advance of stopped traffic during a red light. Bike boxes help to prevent conflicts between bicyclists and right-turning vehicles and increase the visibility of bicyclists at 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.





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Bike Box: FAQs

What alternative countermeasures or supplemental design can be considered?

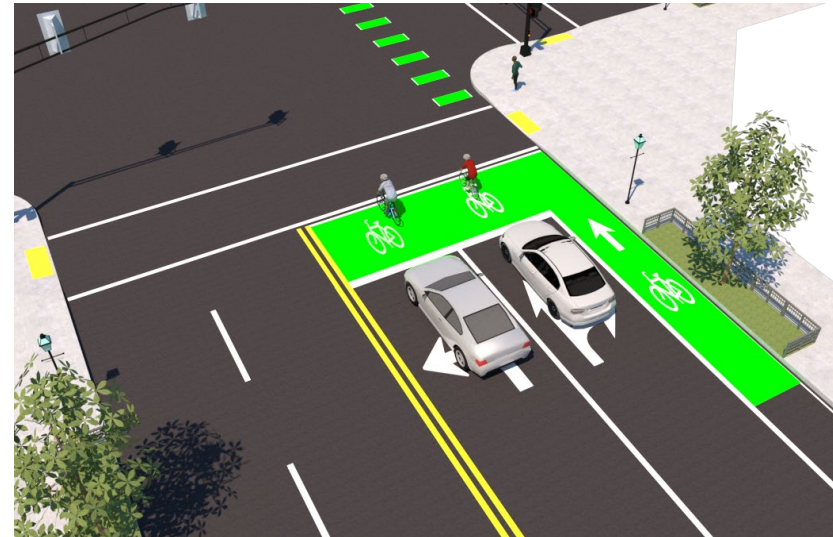
Green colored pavement is optional and may be installed to highlight where bicyclists will queue during a red signal phase. Other treatments such as leading or exclusive signal phases or mandatory turn lanes are alternatives to a bike box.

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](#)



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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.





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Two-Stage Turn Box: FAQs

What alternative countermeasures or supplemental features can be considered?

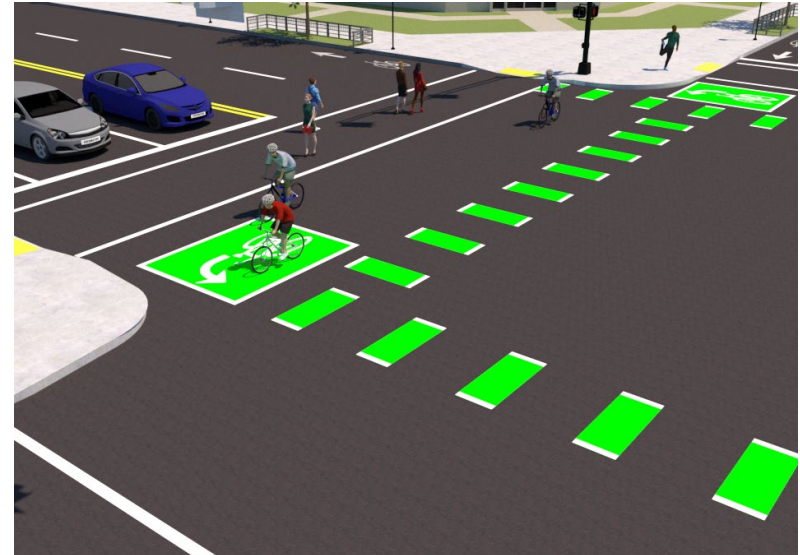
The application of green colored pavement in the turn box is highly recommended to clearly delineate the turn box for all road users.

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 should be restricted from making right turns on red whenever the turn box is in the motor vehicle's right-turning path. Otherwise, right turn on red may be permitted.



For More Information:

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



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Bicycle Detection

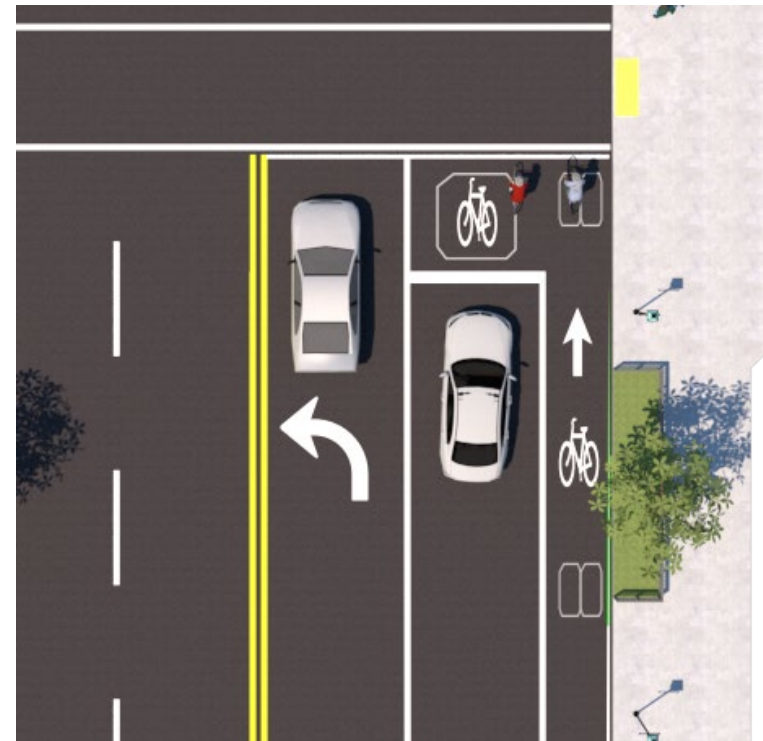
Bicycle detection is used at actuated traffic signals to alert the traffic signal controller to the presence of a bicyclist. Detection devices may include push-buttons, in-pavement induction loops, video detection, radar detection, or other methods.

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.





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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.11](#)



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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.



R

Y

G



R

Y

G

MUTCD Section 4H.06
Typical Bicycle Signal Face
Arrangements

When Not To Use

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



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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

For More Information:

- [NCDOT Standard Drawings 1205.16](#)
- [MUTCD Section 9F](#) and [4H](#)
- [NACTO Urban Bikeway Design Guide](#)



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Protected Intersections

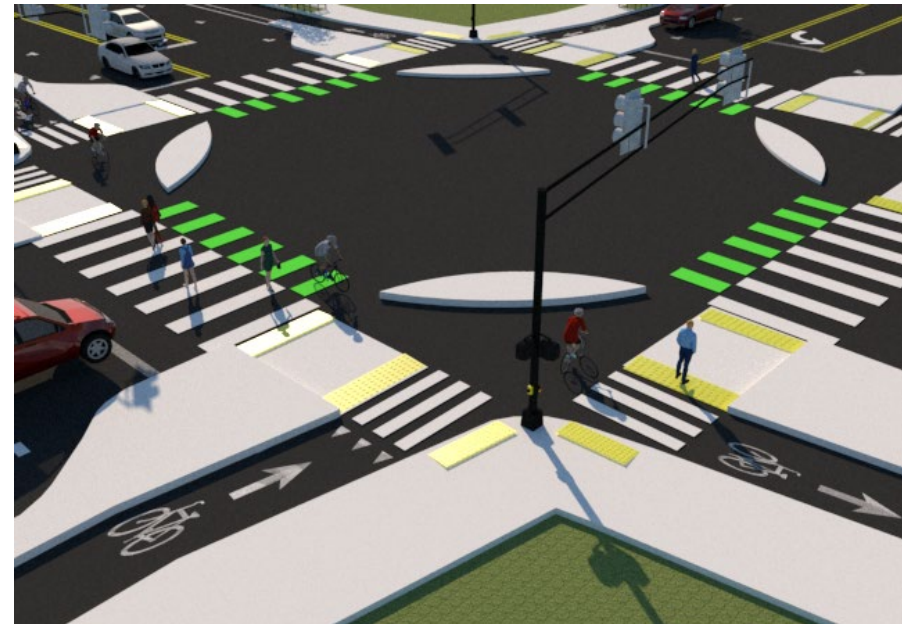
A protected intersection is an intersection that includes treatments designed to continue the separation provided by the bicycle lanes through the intersection. These treatments may include raised corner islands, setbacks, bicycle queueing areas, and pedestrian islands. The protected intersection design 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.





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Protected Intersections: FAQs

What alternative countermeasures or supplemental design can be considered?

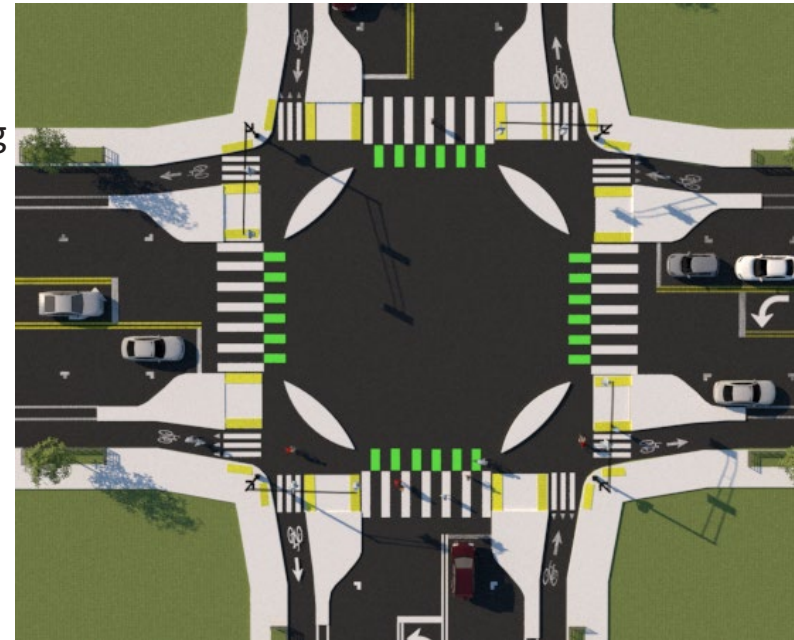
Green colored pavement and bicycle symbol markings is optional and may be installed to highlight conflict points along the bicycle lane and where bicyclists will queue during a red signal phase. Green colored pavement shall not be incorporated into crosswalks. Consider adding bicycle signals where high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

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