

BIKEWAY TYPOLOGIES

COMPLETE STREETS WORKSHOP JULY 2014



John Cock, Principal/Planner
Alta Planning + Design





Alta Planning + Design

Creating active communities where bicycling and walking are safe, healthy, fun and normal daily activities



www.altaplanning.com

Attract Residents, Workers, Investment



“Biking is . . .part of our strategy to attract and retain businesses. . .We want young talent to come here and stay..” – Mayor R.T. Ryback



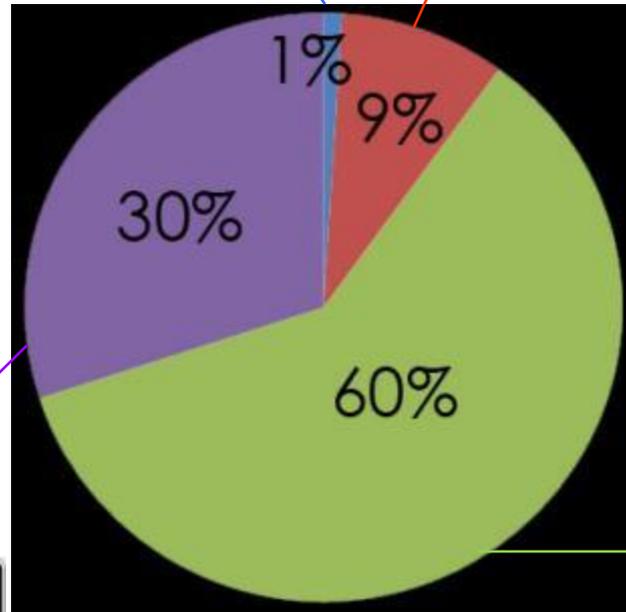
NACTO: Accommodate “interested but concerned”



Strong and fearless



Enthusied and confident



“No way, no how”



Interested but concerned

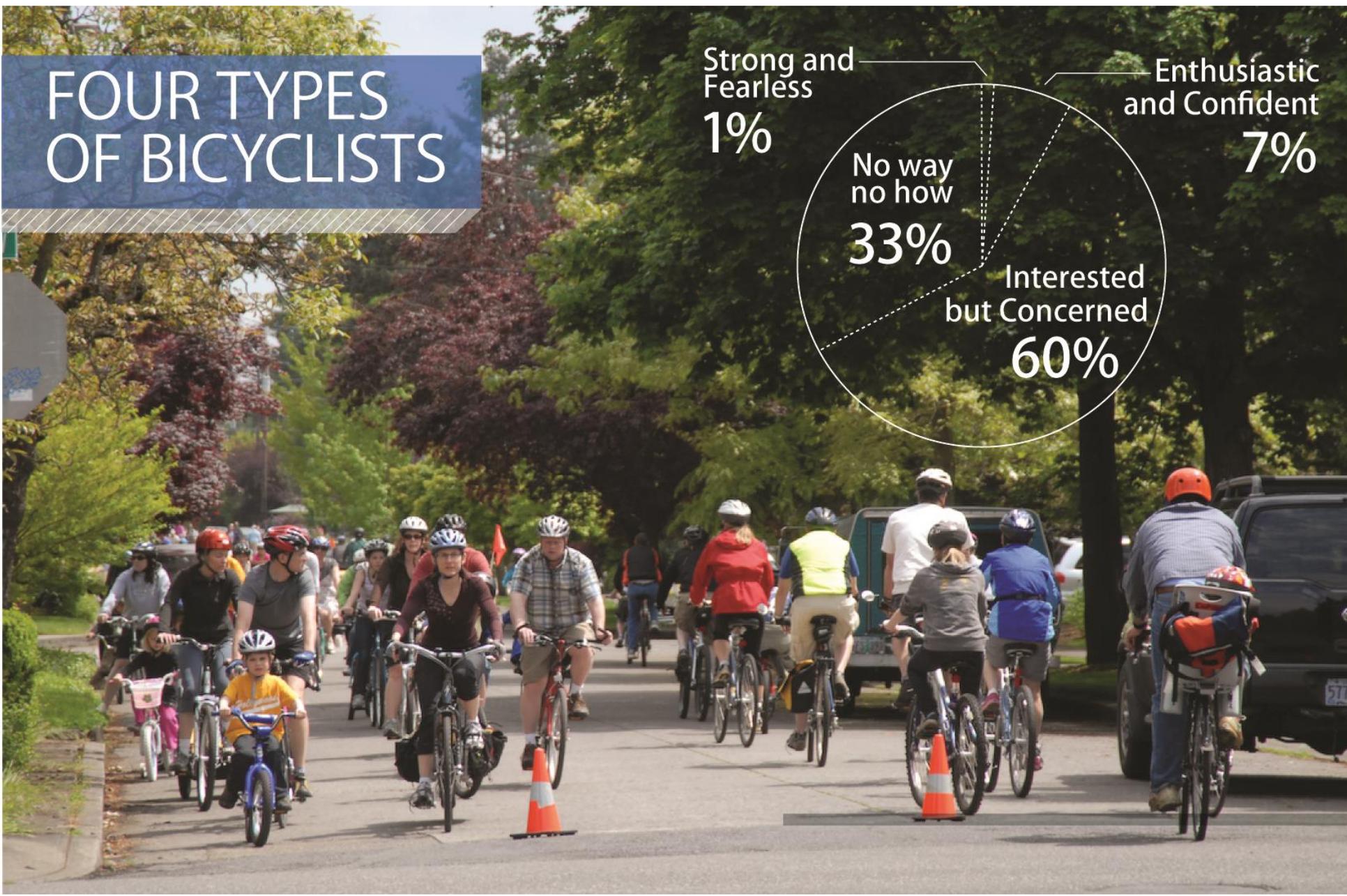
FOUR TYPES OF BICYCLISTS

Strong and Fearless
1%

Enthusiastic and Confident
7%

No way no how
33%

Interested but Concerned
60%

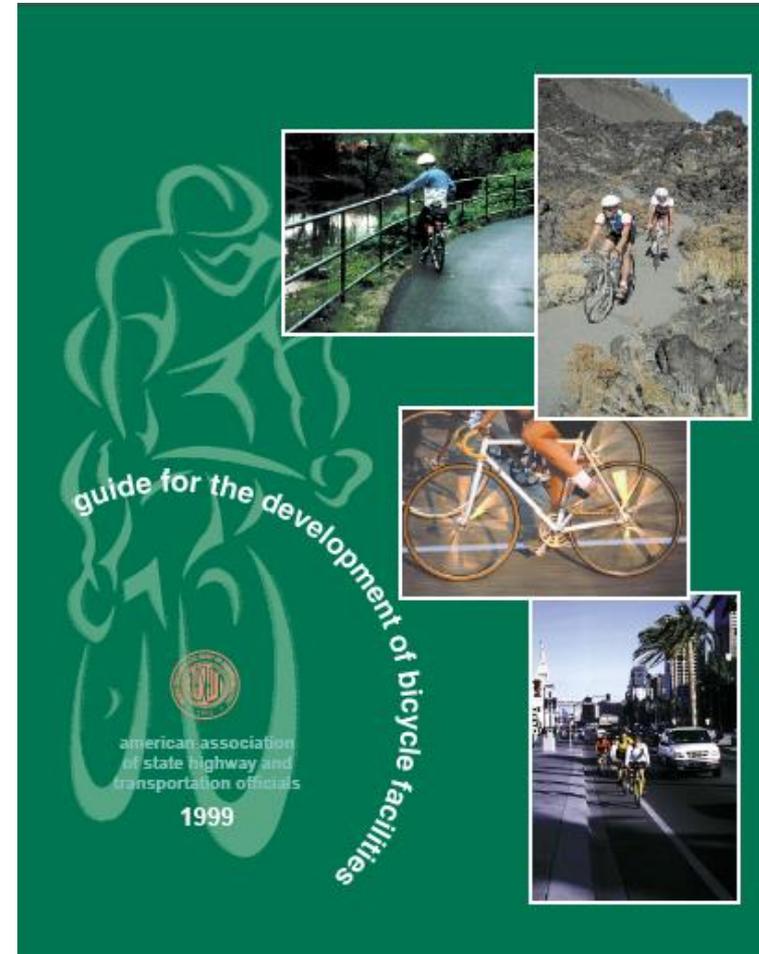
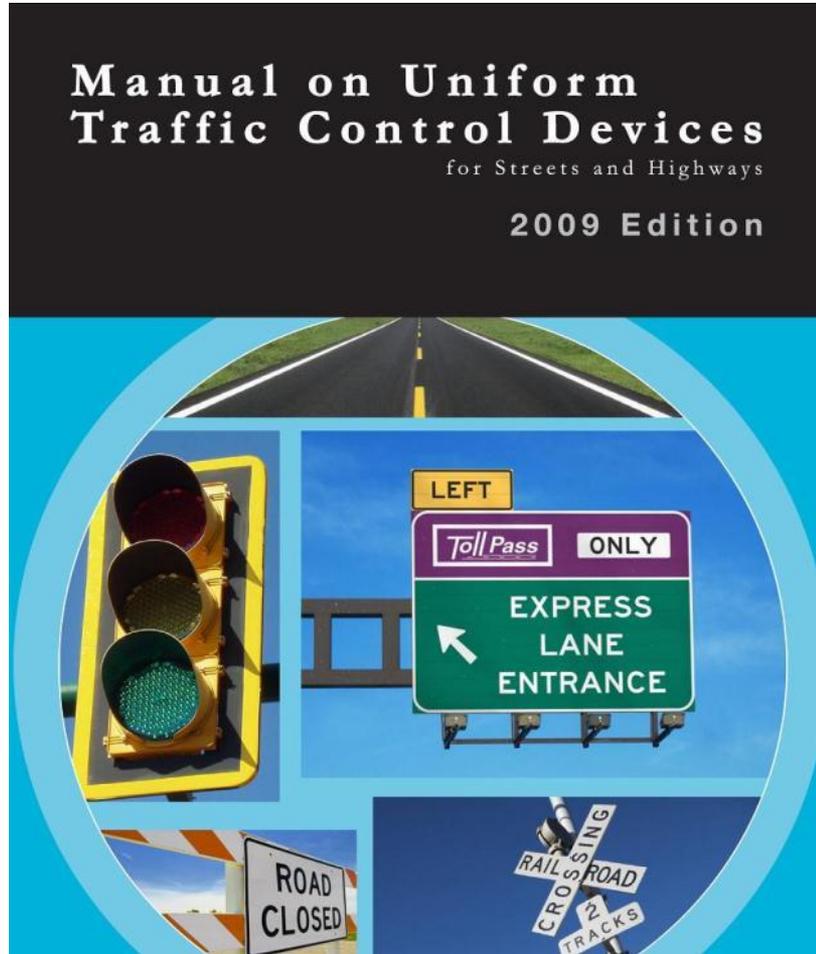




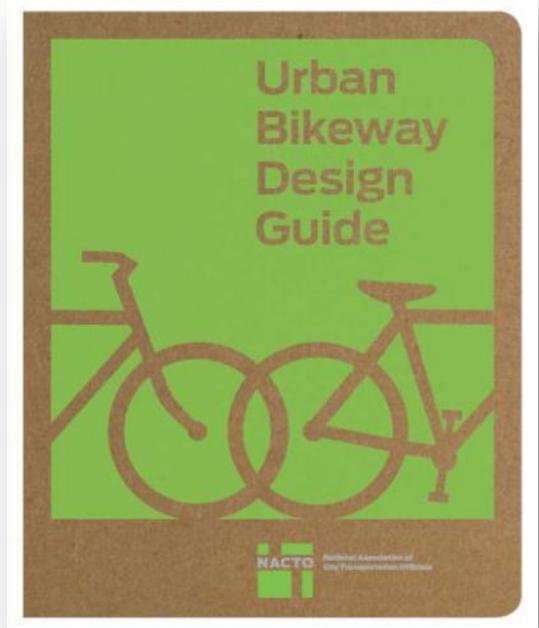
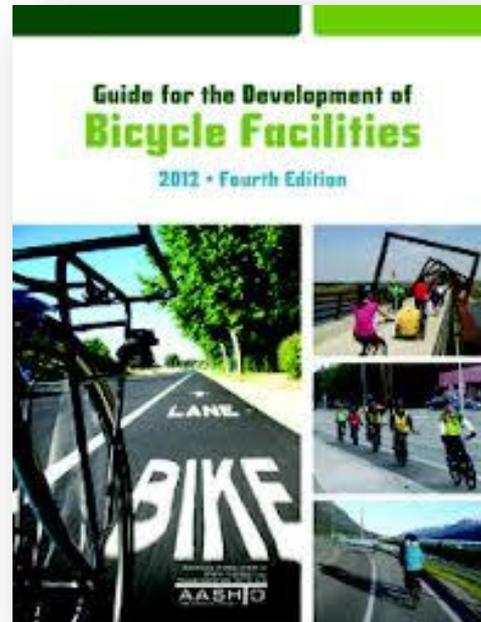
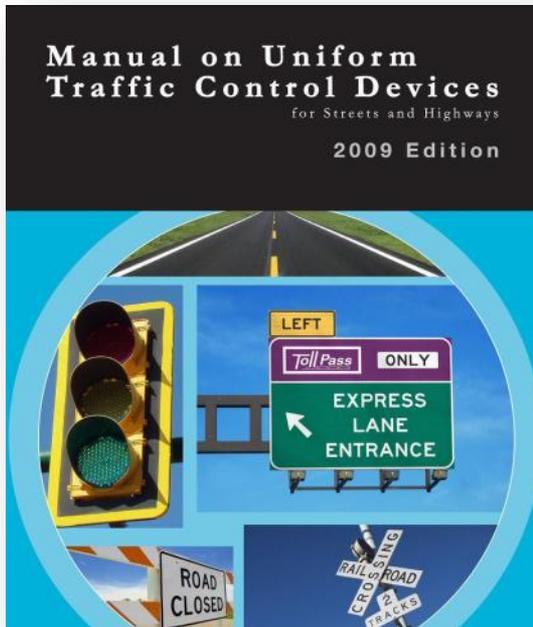




Pre-2011 Bikeway Design Guidance



Post 2011 Bikeway Design Guidance





“This is an extraordinary piece of work that’s long overdue...” *Ray LaHood*

A Collection of 30 Innovative Bikeway Designs



BIKE LANES

- Conventional Bike Lanes
- Left-side Bike Lanes
- Contra-Flow Bike Lanes
- Buffered Bike Lanes

CYCLE TRACKS

- One-way Protected Cycle Tracks
- Raised Cycle Tracks
- Two-way Cycle Tracks

SIGNING & MARKING

- Bike Route Wayfinding Signage and Markings System
- Colored Bike Facilities
- Shared Lane Markings

SIGNALS

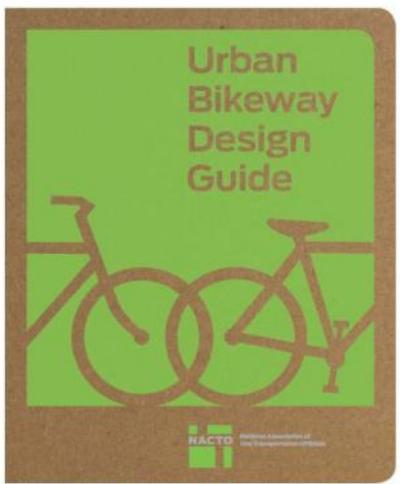
- Bicycle Signal Heads
- Signal Actuation and Detection
- Active Warning Beacon for Bike Route at Unsignalized Intersection
- Hybrid Signal for Bike Route Crossing of Major Street

INTERSECTIONS

- Bike Boxes
- Intersection Crossing Markings
- Two-stage Turn Queue Boxes
- Median Refuge Island
- Through Bike Lanes
- Combined Bike Lane
- Cycle Track Intersection Approach

BICYCLE BOULEVARDS

8 treatments (New for 2012)



U.S. Department
of Transportation
Federal Highway
Administration

Memorandum

SENT BY ELECTRONIC MAIL

GUIDANCE: Bicycle and Pedestrian Facility Design Flexibility Date: August 20, 2013

Gloria M. Shepherd
Associate Administrator for Planning,
Environment and Realty

In Reply Refer To:
HEPH-10

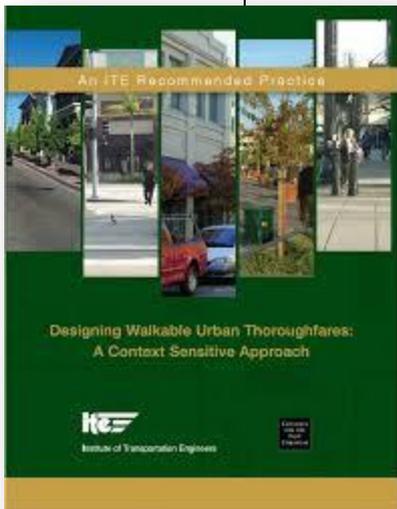
Walter C. (Butch) Waidelich, Jr.
Associate Administrator for Infrastructure

Jeffrey A. Lindley
Associate Administrator for Operations

Tony T. Furst
Associate Administrator for Safety

Division Administrators
Directors of Field Services

This memorandum expresses the Federal Highway Administration's (FHWA) support for taking a flexible approach to bicycle and pedestrian facility design. The American Association of State Highway and Transportation Officials (AASHTO) bicycle and pedestrian design guides are the primary national resources for planning, designing, and operating bicycle and pedestrian facilities. The National Association of City Transportation Officials (NACTO) *Urban Bikeway Design Guide* and the Institute of Transportation Engineers (ITE) *Designing Urban Walkable Thoroughfares* guide builds upon the flexibilities provided in the AASHTO guides, which can help communities plan and design safe and convenient facilities for pedestrian and bicyclists. FHWA supports the use of these resources to further develop nonmotorized transportation networks, particularly in urban areas.





	Manual of Uniform Traffic Control Devices (2009)	Guide for the Development of Bicycle Facilities (2012)	Urban Bikeway Design Guide (2012)	NCDOT Bicycle Facilities & Planning Design Guidelines
Signed Shared Roadway	X	X		X
Marked Shared Roadway	X	X	X	
Bicycle Boulevard		X	X	
Shoulder Bikeway	X	X		X
Bicycle Lane	X	X	X	X
Buffered Bike Lane	-	X	X	
Uphill Bicycle Climbing Lane	-	X	X	
Cycle Tracks	-	Called "one-way sidepath"	X	
Bike Lanes at Right Turn Only Lanes	X	X	X	X
Colored Bike Lanes in Conflict Areas	Interim Approval Granted	X	X	
Combined Bike Lane/Turn Lane	-		X	
Intersection Crossing Markings	X	X	X	
Bicyclists at Single Lane Roundabouts	-	X		
Wayfinding Sign Types	X	X	X	X
Wayfinding Sign Placement	X	X	X	X
Greenways	X	X		X
Shared Use Paths along Roadways	X	Discouraged		Discouraged

How to Select a Bikeway?

- Numerous factors to consider:
 - Roadway function
 - Traffic volume
 - Speed
 - Traffic mix (e.g. truck %)
 - EXPECTED users – skill, age, volume, destinations
 - DESIGN user group
 - Road conditions: space, intersections, parking demand
 - Topography, land uses
 - Bikeway network connectivity/continuity

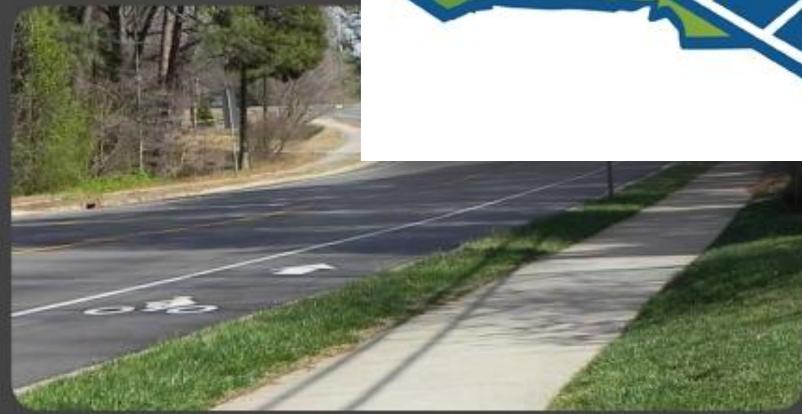


Bicycle Quality of Service

Providing for bicycle quality of service may vary based on context. The surrounding land use, the speed of cars on the street, and the directness of the route connecting destinations are all important factors in identifying the appropriate elements for bicycle facilities. In addition, there are different types of bicyclists with varying levels of expertise. While bicyclists have the legal right to use the traffic lanes, some cyclists will be more comfortable than others riding in mixed traffic. Creating viable transportation options means that a variety of types of facilities should be provided to create a bicycling network. Creating bicycling networks is often an incremental process, and facilities should be provided where appropriate.

Bicycle Lanes

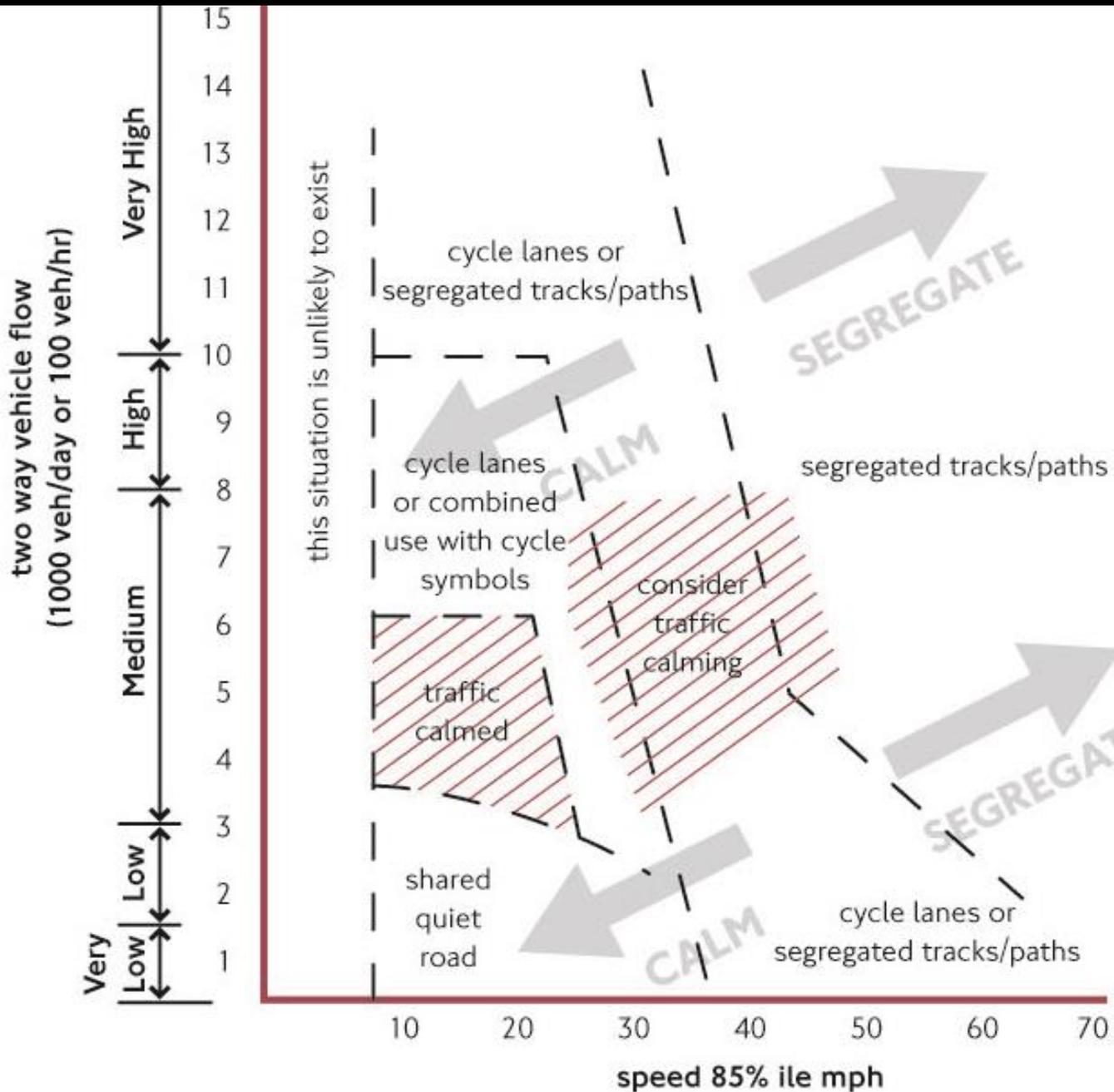
Dedicated bicycle lanes are the preferred option to provide for the greatest variety of cyclists on streets, particularly those streets with higher volumes and speeds. The most recognizable form of a bicycle lane is a striped lane with a painted arrow and cyclist icon. Bicycle lanes are the backbone of a complete bicycle network, as they visually distinguish a bicycle-only travel lane in which a cyclist does not have to maneuver around motor vehicles and vice versa. Bicycle lane widths are typically four feet to six feet of street is not to be considered p lanes are adjacent to on-street minimum width of a bike lane is in excellent condition: it is clear maintain a high quality of service should be re-striped regularly, s clean of debris, and bicycle lan



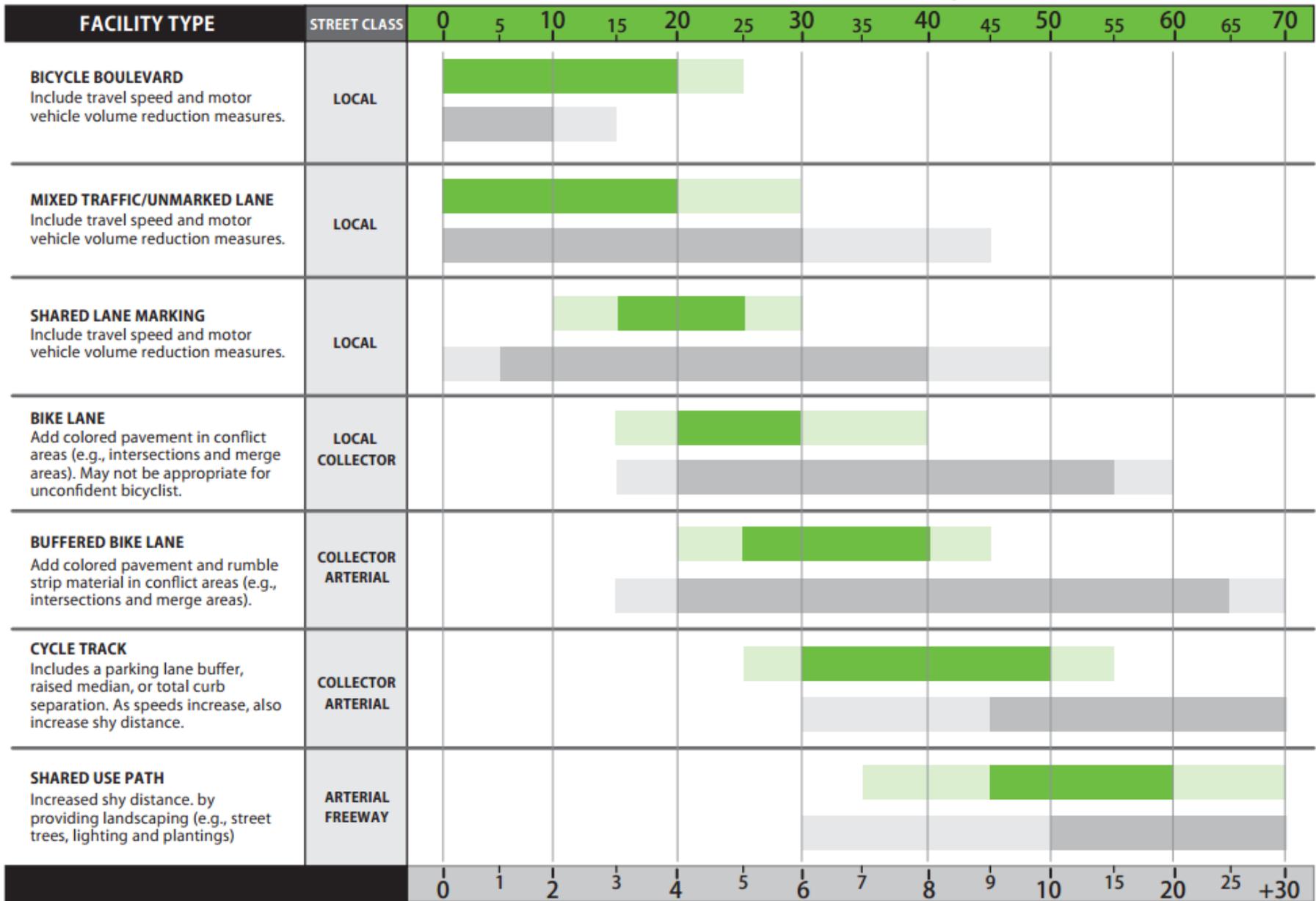
Shared-Lane Markings

In streets where bicycle lanes cannot be accommodated, shared lanes provide an alternative to bicycle lanes. Shared-lane markings are lane markings that indicate a shared-use lane for motorists and cyclists. Shared-lane markings increase a motorist's awareness of the presence of cyclists (by raising the motorists' expectation that they will encounter cyclists), reduce the incidence of wrong-way bicycling, and indicate to both drivers and cyclists the ideal lateral positioning of the cyclist. In the image below is well-maintained a high quality of service in shared-lanes or "Bicycles May Use Full Lane" ment markings should be re-striped





TRAVEL SPEED (mph)



LEGEND	min	SPEED	max
	min	VOLUME	max
ABSOLUTE	DESIRED	ABSOLUTE	

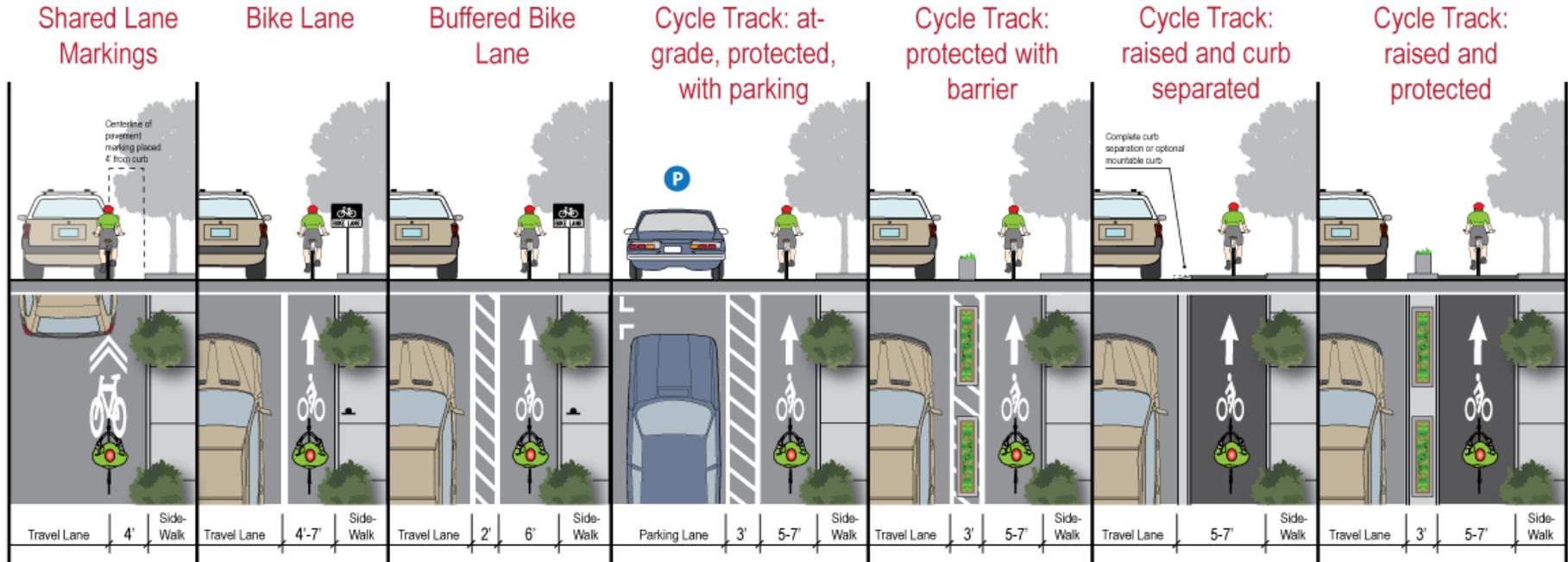
AVERAGE ANNUAL DAILY TRAFFIC (AADT) VOLUME (THOUSANDS)



On-Street Marked Bikeway Continuum

least protected

most protected



- Positions bicyclists in the travel lane
- Alerts motorists to the presence of bicyclists
- Encourages bicyclists to ride an appropriate distance away from the 'door zone' on streets with parking
- Should never be used as a replacement for bicycle lanes

- Exclusive bicycle travel lane increases safety and promotes proper riding
- Reduces possibility that motorists will stray into bicyclists' path
- Visual reminder of bicyclists' right to the road
- 6' width recommended, 4' width in constrained locations
- Bike lanes wider than 7' may encourage vehicle loading in bike lane

- Provides cushion of space to mitigate friction with motor vehicles on streets with frequent or fast motor vehicle traffic
- Allows bicyclists to pass one another or avoid obstacles without encroaching into the travel lane
- Increases motorist shy distance from bicyclists in the bike lane
- Requires additional roadway space and maintenance
- Reduces risk of 'dooring' compared to a bike lane

- Dedicates and protects space for bicyclists and improves perceived comfort and safety
- Reduces risk of 'dooring' compared to a bike lane, and eliminates the risk of a doored cyclist being run over by a motor vehicle
- Low implementation cost through use of existing pavement using parking lane as a barrier
- Use along roadways with high motor vehicle volumes and/or speeds
- Best on streets with parking lanes with a high occupancy rate

- Provides similar benefits as a cycle track with an on-street parking buffer
- Best used on roads with high speeds and long distances between intersections and driveways
- Innovative bicycle-friendly design needed at intersections to reduce conflicts between turning motorists and bicyclists
- Width should never be taken from the pedestrian zone to make room for a cycle track

- Change in level clearly demarcates space for different users and reduces conflicts between bicyclists and pedestrians
- Where bicyclists may enter or leave the cycle track, or where motorists cross at a driveway, the curb should be mountable with a small 45 degree ramp, allowing cyclist turning movements

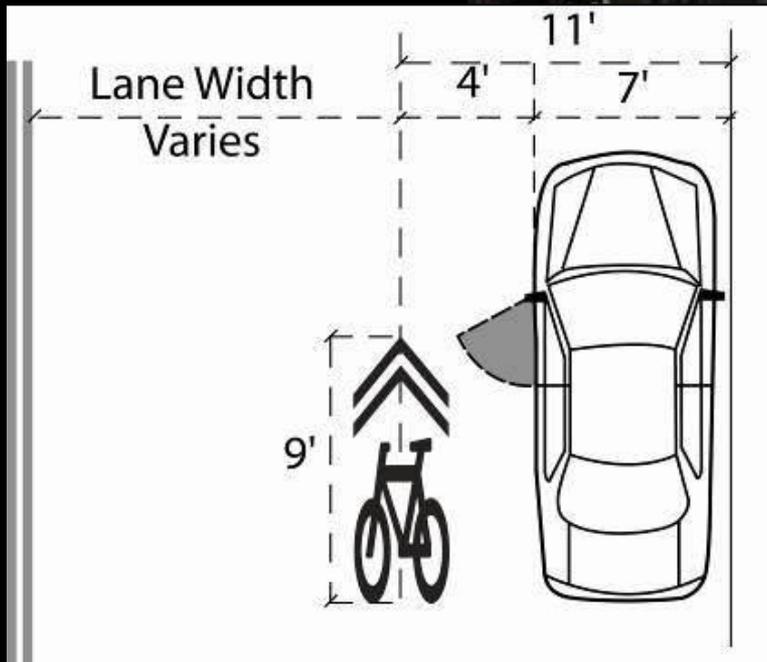
- Cycle track should be two or three inches above street-level, and the sidewalk should be an additional two to three inches above cycle track
- Maintenance of the cycle track requires specialized sweepers
- Where opportunities exist, the buffer zone may be expanded to include bicycle parking

Rural/Suburban Bikeway Continuum



Shared Roadways

- Wide outside lanes
- Shared lane markings
- Bike Boulevards



Shared Lane Marking

- More flexible than traditional signalized intersections for bicycle crossings
- Especially useful for bike boulevard crossings
- Can be used as a wayfinding marking and/or to denote a shared roadway



PORTLAND, OR

Bicycle Boulevards



Design Guidance

Signs and Pavement Markings

2 Where the bicycle boulevard turns or jogs onto another street, signs and/or markings shall be provided to indicate how users can remain on the route.



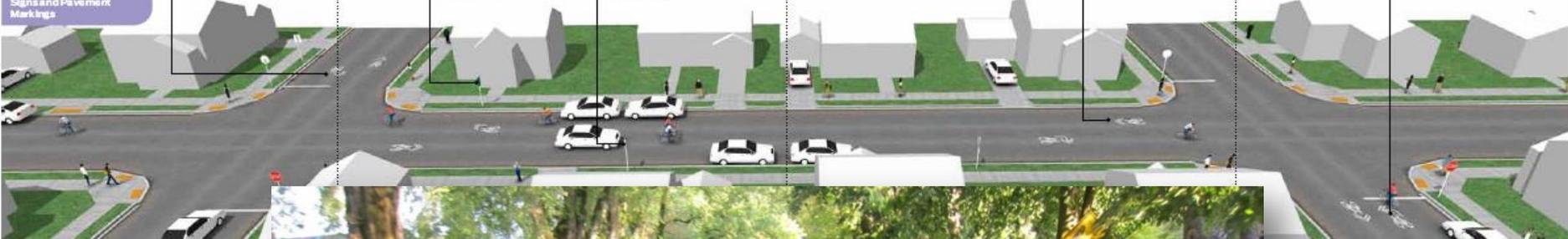
8 Direction and turn signs should include destinations with an arrow and distance and/or bicycling times.



9 Identification/wayfinding signs provide a strong visual identity for the street and designate the corridor as a bicycle route.

10 Either shared lane markings or non-standard markings may be used along bicycle boulevards.

11 The orientation of the chevron marking at offset intersections may be adjusted to direct bicyclists along a continuous route.



Required Features

1 Bicycle wayfinding signage and pavement markings shall be included on bicycle boulevards. Pavement markings and identification/wayfinding signs provide a strong visual identity for the street and designate the corridor as a bicycle route.

have a top line or traffic Drivers have an easier time bicyclists to on roads that do centerline stripes. If vehicles pass each other use full width of the street. If that there is too much traffic street to be a successful boulevard."

2 Where the bicycle boulevard turns or jogs onto another street, signs and/or markings shall be provided to indicate how users can remain on the route.

Recommended Features

4 Pavement markings be large enough to all road users; 12 inches (the standard size lane marking) is the minimum recommended size.

3 Center line stripes (if present) shall be removed or not repainted, except for short sections on intersection approaches that



5 Consider ranking destinations to determine which should be listed on a sign where more than three destinations are nearby.

	Place the closest destination in the top slot.	Bicycling time should assume a typical speed of 10 mph.
→ Main St 0.1 mi		
↑ Industrial Dist 2.5 mi		Stack or abbreviate destination names to accommodate longer destination names before reducing text size.
↑ Waterfront 8.5 mi		At greater distances, list an destination (e.g., downtown and neighborhoods) as a general location.

Consider reserving space for future destinations or bike ways.



Low Stress Bicycle Corridors - Downtown



Bicycle Boulevards – Signing and Marking

Design Guidance

Signs and Pavement Markings



Required Features

- 1 Bicycle wayfinding signs and pavement markings shall be included on bicycle boulevards. Pavement markings and identification/wayfinding provide a strong visual identity to the street and designate the route as a bicycle route.
- 2 Where the bicycle boulevard turns or jogs onto another street, signs and/or markings be provided to indicate how the route can remain on the route.
- 3 Center line stripes (if present) shall be removed or not repainted, except for short sections on intersection approaches.



Position of the sign at offset may be used to direct bicyclists to continuous routes.

Bicycling time should assume a typical speed of 10 mph.

Stack or abbreviate destination names to accommodate longer destination names before reducing text size.

At greater distances, list area destinations (e.g., downtown and neighborhoods) as a general location.

Bicycle Boulevards – Speed Management

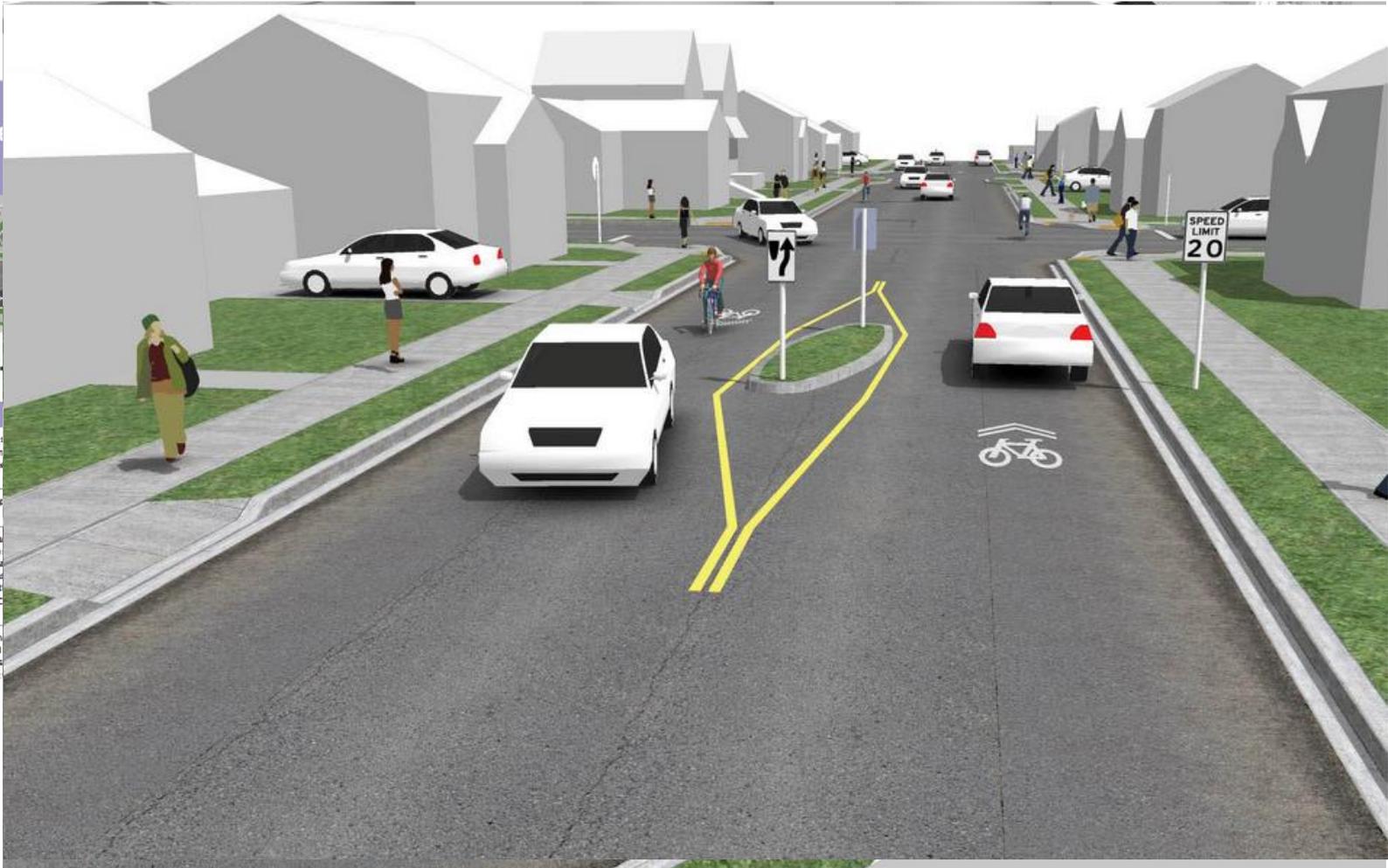
Design Guidance

Speed Management



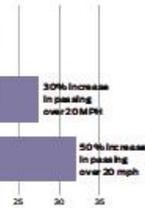
Required Features

- 1 When using horizontal speed management, the minimum clear width of 12 feet travel shall be maintained.
- 2 Speed limits shall comply with local restrictions.
- 3 Speed zones (other than statutory speed limits) shall only be established on the basis of an engineering study that has been performed in accordance with engineering practices (MUTCD 2B.13).
- 3 Speed limits shall be in multiples of 5 mph and shall be located at the points of change from one speed limit to another (MUTCD 2B.13).



Neckdown

cyclist will be this many times



85 percent of ADT 70 percent of ADT 30 percent of ADT 10 percent of ADT

Bicycle Boulevards – Volume Management

Design
Guida

Volume Manag

Required Featu

1 Where emerge
access is provi
absolute minimum
clear space shall be
between bollards or
presence of mounta
flexible or collapsib
restricted lanes may
requirements.

2 Volume manag
treatments sh
bicycle access, eit
4-foot minimum cor
lane or a 5- to 6-foot
between vertical cur



Vehicle
in
10
hall
way

Cyclist will be
this many times



hourly percent of AADT.
separately reported along the
hourly. Cars are traveled along the
necessary. If other. Car volume
are assumed one will act nearly

MEDIAN REFUGE/DIVERTER



NACTO

Intersections
Median Refuge Island and Traffic Diverter

Huntersville, NC73: Bike Cut Through in “Leftover”



Bicycle Boulevards – Major Intersections

Design Guidance

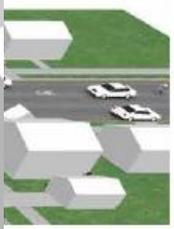
Major Street Crossing

Required Features

- 1 Crossing devices should be considered at any bicycle boulevard crossing of a major street that is not stop-controlled. Treatments should be selected based on the number of lanes, the width of the street, and the desired gap.
- 2 All bascons and signs should be installed with appropriate detection and actuation. For bicycle boulevard crossings, the signal should be set to recall each cycle.



Median refuge area, reduces



Bicycle forward stop bar can reduce the minimum acceptable gap to one second per side of the street.



Median refuge area can cut the acceptable gap needed to cross a major street by 50 percent.



Anne St. Bike Boulevard

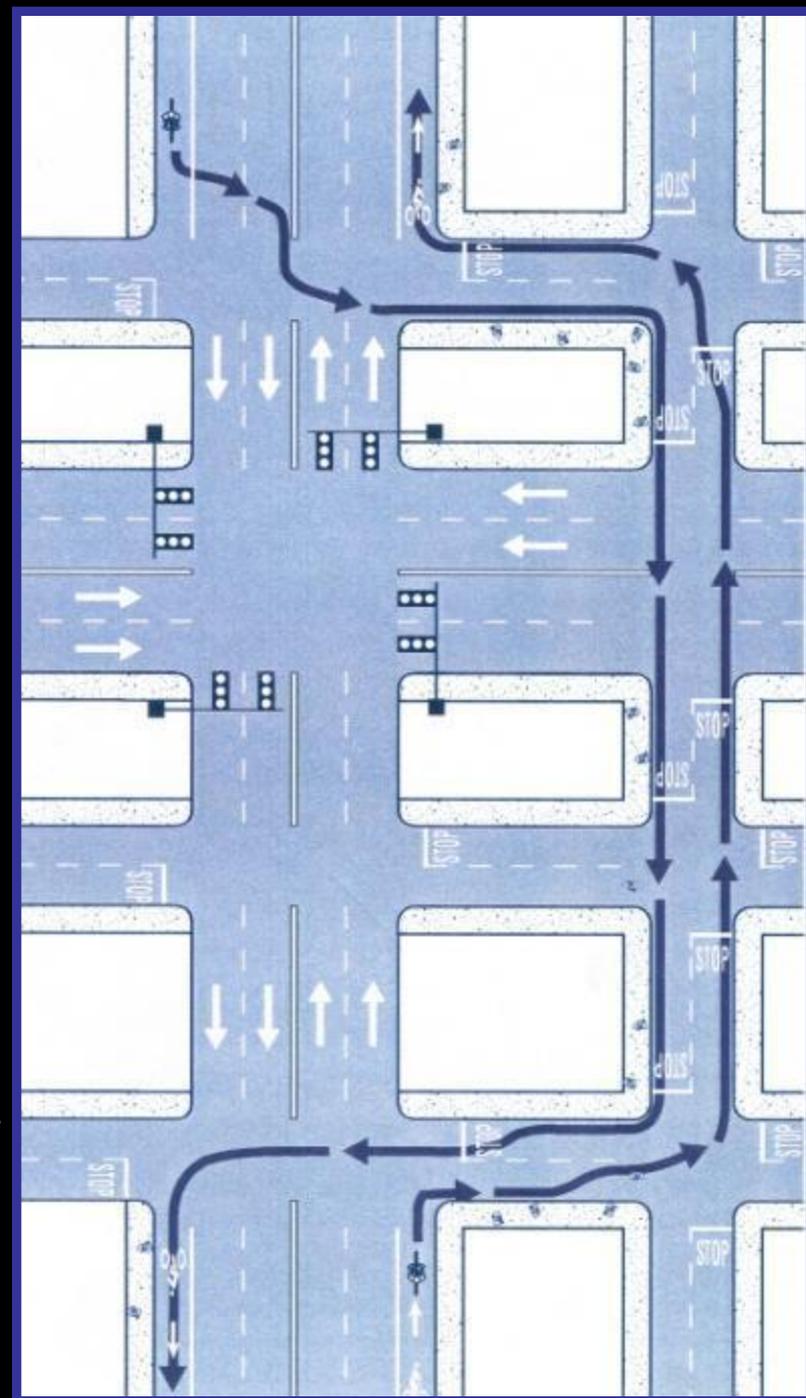




Anne St. Bike Boulevard

Do NOT confuse BB with “Diversionary Bike Routes”

- Thoroughfares are vital, as they offer the most direct routes
- Destinations are often located on thoroughfares
- Without BB treatments, local streets can be slow & discontinuous
- Without BB treatments, arterials can be difficult to cross
- Reentering thoroughfare occurs w/o special treatment
- Some cyclists choose thoroughfares anyway, even without appropriate treatment



BIKE LANES



Bike Lanes

Conventional Bike Lanes



Buffered Bike Lanes



Contra-Flow Bike Lane



Left-Side Bike Lane



Shoulders

- shoulders 3 ft (0.9m) help bicyclists
- any shoulder better than none (AASHTO)



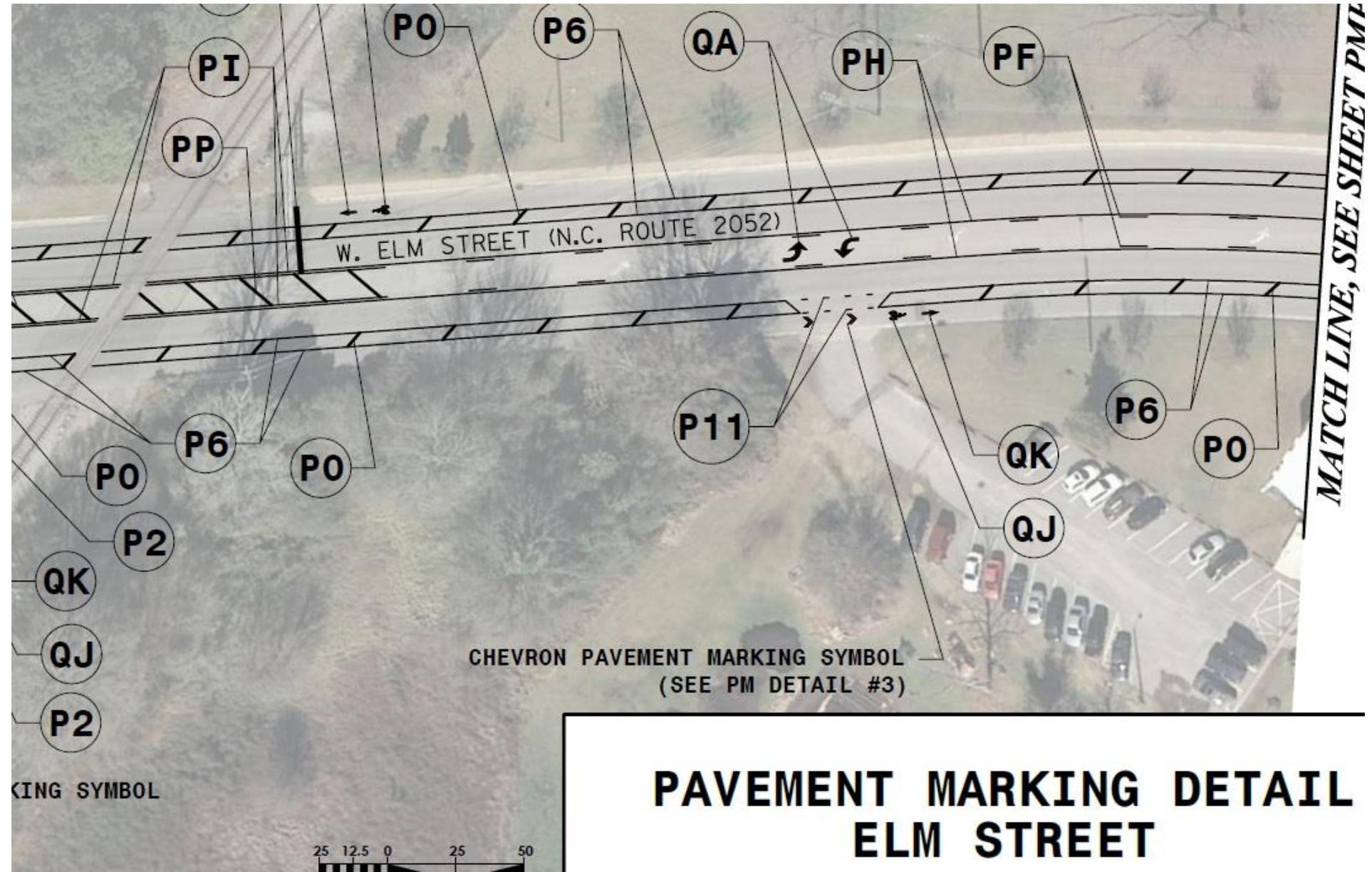
BUFFERED BIKE LANES

- Greater comfort level than conventional bike lane
- Passing zone
- Less effective on streets with loading or double-parking

Charlotte,
Remount Rd



Buffered Bike Lane, Goldsboro, NC



NCHRP

REPORT 766

NATIONAL
COOPERATIVE
HIGHWAY
RESEARCH
PROGRAM

General Conclusions

1. A buffered bike lane provides distinct advantages over simply providing a wider bike lane.
2. Narrowing the width of a bicycle lane reduces the variability of the bicyclists' lateral positions; however, this impact is relatively minor, at least for the bicycle lane widths evaluated in this research.
3. As traffic volume increases, bicyclists move away from vehicles in the travel lane and position themselves closer to parked vehicles or the curb.
4. As truck percentage within the vehicle mix increases, bicyclists move away from vehicles in the travel lane and position themselves closer to parked vehicles or the curb.
5. For streets with on-street parking and where the parking lane width is between 7 and 9 ft and the bike lane width is between 4 and 6 ft, the effective bike lane will likely be less than the physical width of a typical adult bicyclist, and the majority of bicyclists will position themselves outside of the effective bike lane.
6. For streets without on-street parking, as long as the adjacent travel lane is at least 10-ft wide and the bike lane is 4 to 5 ft in width, most bicyclists will position themselves in the effective bike lane, and the effective bike lane will be equivalent to the width of the marked bike lane.



Left-side Bike Lanes – 2012 Edition

Design Guidance

Left-Side Bike Lanes

Required Features

- 1 Design guidance for conventional bike lanes applies to this treatment.
- 2 Left side bike lanes shall only be placed on the left side of one-way streets or two-way median divided streets.

Recommended Features

- 3 Signage should accompany left-side bike lanes to clarify proper use by bicyclists and may be effective in reducing wrong-way riding. Modified MUTCD R3 series signs shown.
- 4 Bicycle through lanes should be provided to the right of vehicle left turn pockets to reduce conflicts at intersections. This is important for through bicyclists as well as left turning bicyclists as left turning vehicles will cross paths with a left turning bicyclist. Additional guidance can be found in through bicycle lanes in this guide.

- 5 Where bicyclist demand is high and street space permits, a buffered bike lane configuration or wider than minimum dimensions should be used to allow bicyclists to pass one another without encroaching upon the adjacent travel lane.
- 6 Intersection treatments such as bike boxes and bike signals, should be considered to assist in the transition from left-side bike lanes to right-side bike lanes.
- 7 A "Yield to Bikes" sign should be post-mounted in advance of and in conjunction with a left turn lane to reinforce that bicyclists have the right-of-way going through the intersection.¹⁴



Optional Features

- 8 Colored pavement may be used along the facility to draw attention to the unique function of the lane, or within conflict areas for increased visibility of bicyclists.



Uphill Bike Lane



Colored Bike Facilities

Commonly applied at

- Intersections
- Driveways
- Conflict Areas
- Along cycle tracks or enhanced facilities



Charlotte, 4th Street

Sidepaths



NC280, Mills River NC



NC280, Mills River NC



CYCLE TRACKS



Cycle Tracks

One-Way Protected Cycle Tracks



Raised Cycle Tracks



Two-way Cycle Tracks



ONE WAY PROTECTED CYCLE TRACK

- Decreases stress, increases comfort on high traffic streets
- Left-side application with bus routes
- Parking lane as protection

One way cycle track
Long Beach, CA



Credit: Bikeable Communities



CHATTANOOGA

RAISED CYCLE TRACK

- Raised to sidewalk-level or intermediate curb
- Capital Reconstruction Project
- Decrease Sidewalk riding



CAMBRIDGE, MA

Russelville, AR



TWO-WAY CYCLE TRACK

Required Features

Bicycle lane word, symbol, and/or arrow markings (MUTCD Figure 9C-3) shall be placed at the beginning of a cycle track and at periodic intervals along the facility to define the bike lane direction and designate that portion of the street for preferential use by bicyclists.

If configured on a one-way street, a "ONE WAY" sign (MUTCD R6-1, R6-2) with "EXCEPT BIKES" plaque shall be posted along the facility and at intersecting streets, alleys, and driveways informing motorists to expect two-way traffic.



A "DO NOT ENTER" sign (MUTCD R5-1) with "EXCEPT BIKES" plaque shall be posted along the facility to only permit use by bicycles.



Intersection traffic controls along the street (e.g., stop signs and traffic signals) shall also be installed and oriented toward bicyclists traveling in the contra-flow direction.

Recommended Features

The desirable two-way cycle track width is 12 feet. Minimum width in constrained locations is 8 feet.²⁴ When protected by a parking lane, 3 feet is the desired width for a parking buffer to allow for passenger loading and to prevent dooring collisions.²⁷

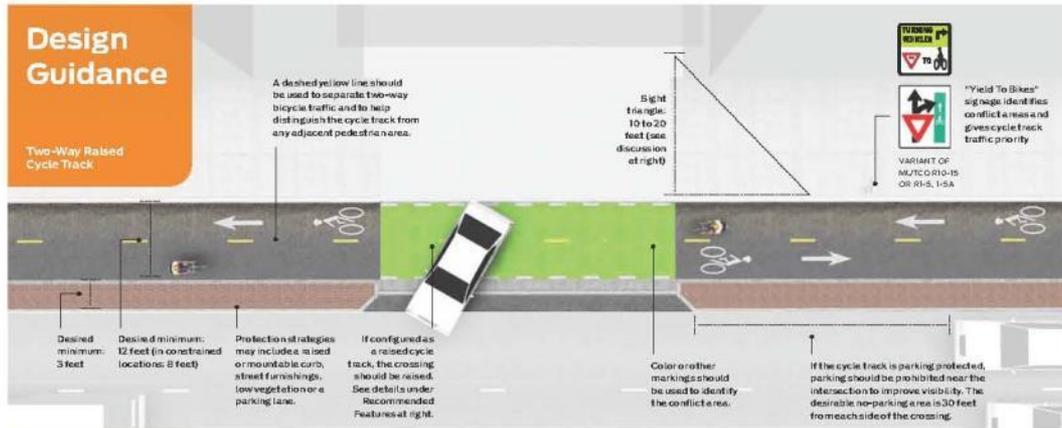
A dashed yellow line should be used to separate two-way bicycle traffic and to help distinguish the cycle track from any adjacent pedestrian area.

Driveways and minor street crossings are a unique challenge to cycle track design. A review of existing facilities and design practice has shown that the following guidance may improve safety at crossings of driveways and minor intersections:

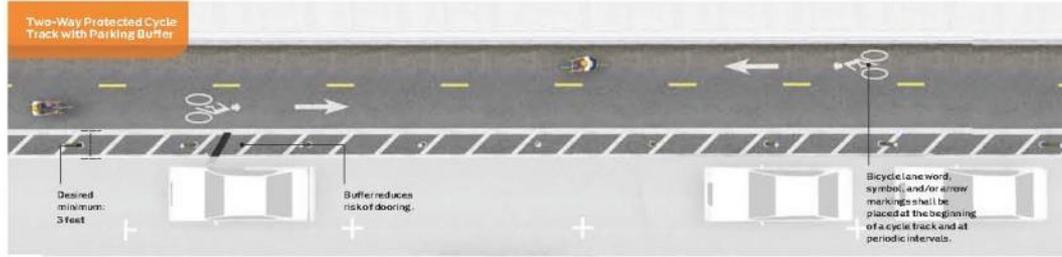
- If the cycle track is parking protected, parking should be prohibited near the intersection to improve visibility. The desirable no-parking area is 30 feet from each side of the crossing.²⁹
- For motor vehicles attempting to cross the cycle track from the side street or driveway, street and sidewalk furnishings and/or other features should accommodate

Design Guidance

Two-Way Raised Cycle Track



Two-Way Protected Cycle Track with Parking Buffer



a sight triangle of 20 feet to the cycle track from minor street crossings, and 10 feet from driveway crossing.

- Color, yield lines, and "Yield to Bikes" signage should be used to identify the conflict area and make it clear that the cycle track has priority over entering and exiting traffic.²⁶

- Motor vehicle traffic crossing the cycle track should be constrained or channeled to make turns at sharp angles to reduce travel speed prior to the crossing.

- If configured as a raised cycle track, the crossing should be raised, in which the sidewalk and cycle track maintain their elevation through the crossing. Sharp inclines on either side from road to sidewalk level serve as a speed hump for motor vehicles.²⁸

Two-stage turn queue boxes should be provided to assist in making turns from the cycle track facility.

Optional Features

Cycle tracks may be shifted more closely to the travel lanes on minor intersection approaches to put bicyclists clearly in the field of view of motorists.³¹

May be configured as a raised cycle track.



TWO-WAY CYCLE TRACK

- “Edge” conditions with few crossings
- Contra-flow movement on one-way street
- Not enough room for one-way cycle track on both sides of the street

NEW YORK, NY



Recent NYC safety data...

9th Avenue Cycle Track:

- Injuries to all street users down 56%
- Injuries to pedestrians down 29%
- Injuries to cyclists down 57%
- Sidewalk riding down 84%

Grand Street Cycle Track:

- Injuries to all street users down 31%
- Reportable crashes down 25%
- Injuries to pedestrians down 21%
- Sidewalk riding down 84%



Pavement Marking Design Project: Gorman Street Cycle Track Concept



New York, NY

4 years

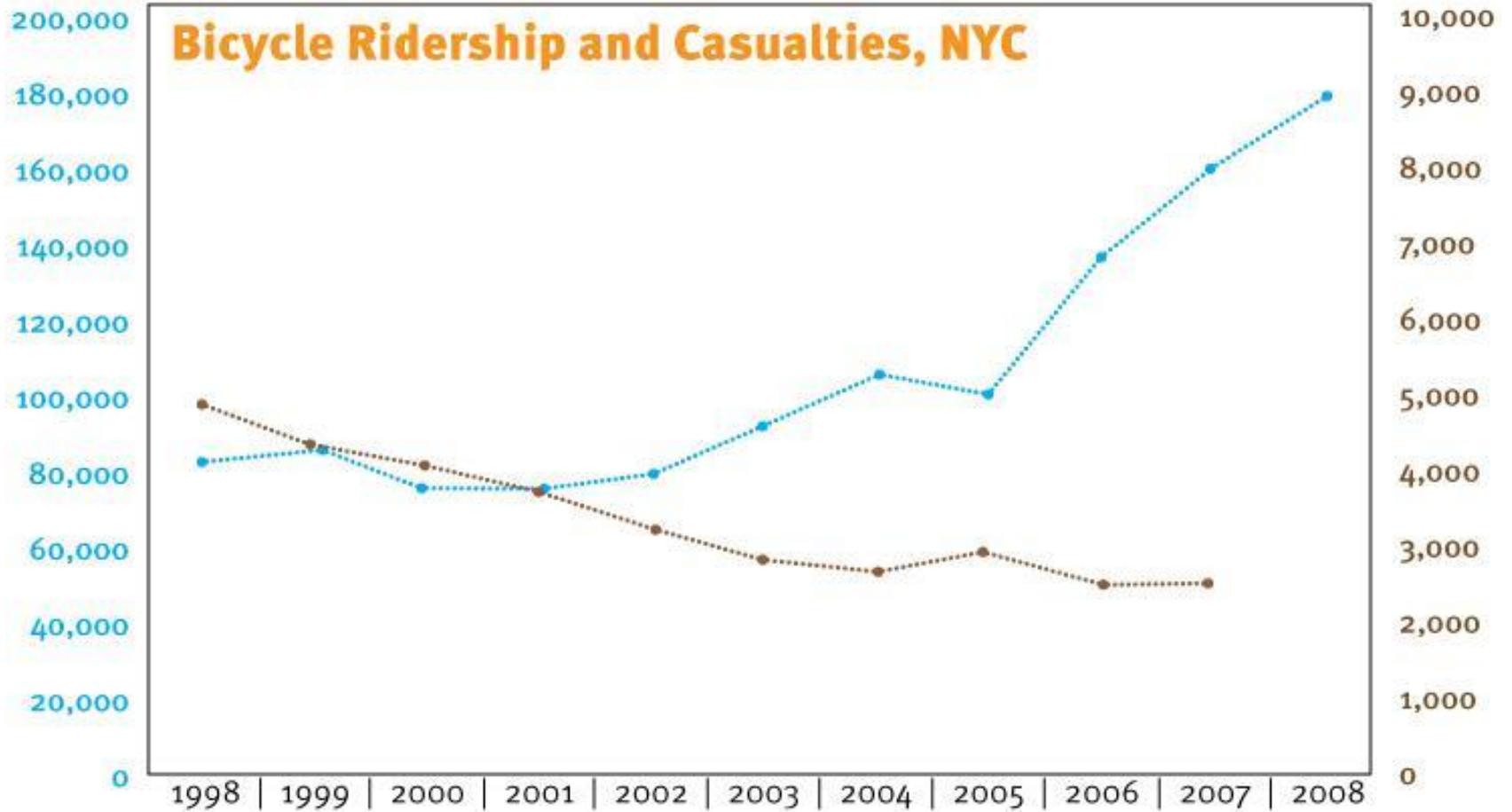
255
bike lane
miles added

45%
growth in
commuter
cycling

72%
decrease in
average risk
of injury

Daily Ridership

Annual Casualties (Injuries and Fatalities)

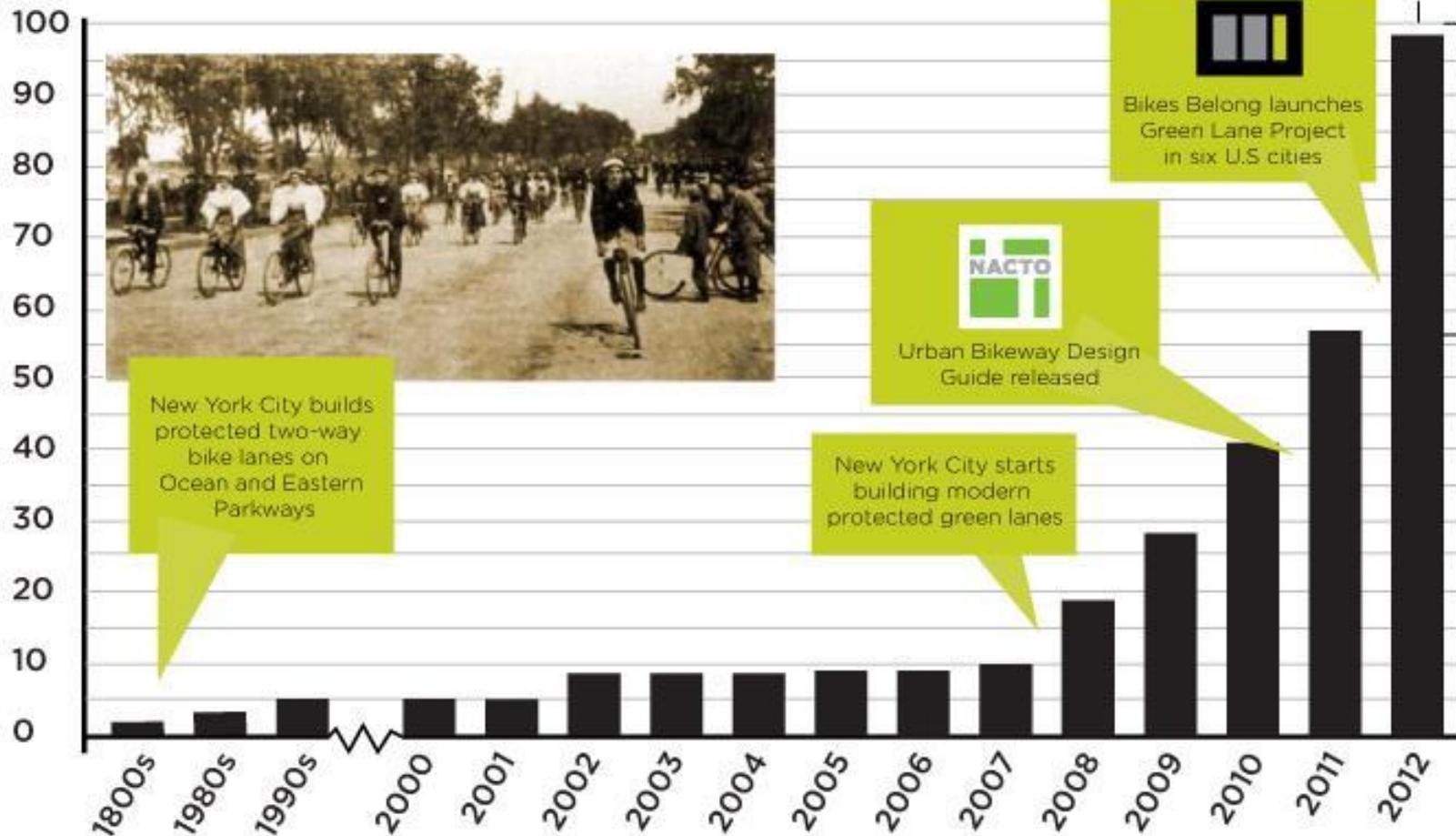


40

green lane PROJECT

New protected green lanes built in 2012

TOTAL PROTECTED LANES



Pavement Reallocation



Overton-Broad Connector Cycle Track – Memphis, TN

Atlanta



PROPOSED IMPROVEMENTS

Looking north at Intersection of Juniper and 7th Streets

Memphis

HERE COMES THE NEIGHBORHOOD

FROM **10 AM** TO **10 PM**

A COMMUNITY EVENT TO **RETHINK** THE STREET, **ACTIVATE** VACANT STOREFRONTS AND **TEST DRIVE** A NEW NEIGHBORHOOD.

MEM FIX

MEMPHIS FLYER
CROFTTOWN ARTS
Memphis Regional Design Center
THE UNIVERSITY OF MEMPHIS
South College of Engineering

MEMPHIS MUSIC
LITTLE ROCK
LRK
Lemmy Bixie Kite

find us on facebook
LIKE US

MOVIE @ 7PM

LIVE MUSIC

BEER FOOD TRUCKS

ARTIST MARKET

POP-UP SHOPS

BIKE LANES

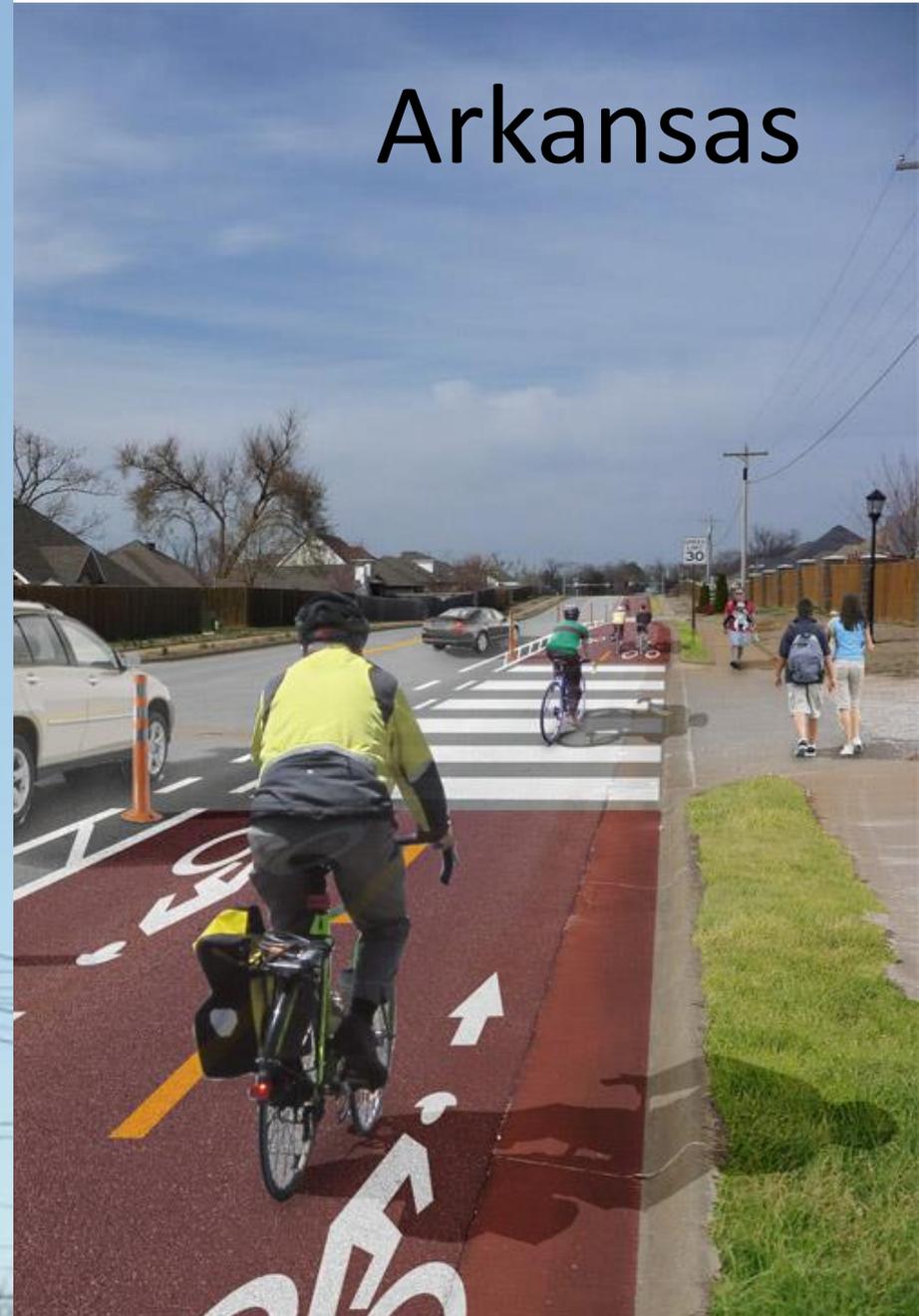
FAMILY FUN

...AND MORE!!

WATKINS STREET
CLEVELAND STREET
PARK AVE
GALLOWAY AVE
OVERTON



Arkansas



Thank You.



John Cock, Principal
johncock@altaplanning.com

704-255-6200

www.altaplanning.com



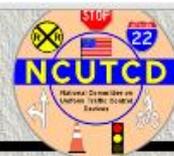


Alta Planning + Design

Creating active communities where bicycling and walking are safe, healthy, fun and normal daily activities



www.altaplanning.com



National Committee on Uniform Traffic Control Devices

Bicycle Technical Committee

Proposals to NCUTCD Sponsors

Spring 2014



Bicycle Box* (Word document, 768K)



Extension of Bike Lanes Through Intersections* (Word document, 1.5MB)



Buffered Bike Lanes* (Word document, 588K)



Contraflow Bicycle Lanes* (Word document, 300K)



"Except Bicycles" Warning Plaque* (Word document, 176K)



Non-Numbered Bicycle Route Signs* (Word document, 368K)



Lane Control Supplemental Plaque (R3-5hP)* (Word document,)



Lane Control Sign (R3-8 Series)* (Word document, 196K)



Turning Vehicles Yield to Bicycles Sign* (Word document, 180K)



Two-Stage Turn Queueing Box* (Word document, 248K)



Wayfinding Signs for Shared-Use Paths* (Word document, 252K)