

SOUTH BAY CITIES
COUNCIL OF GOVERNMENTS



Local Travel Network

Best Practices Overview



Overview

- State & Federal Regulation
 - Standards vs. Guidance
 - Regulatory Guidance
 - Modifying Design Standards
- Best Practices & Current Applications
 - Wayfinding & Other Signage
 - Pavement Markings
 - Intersections & Crossings
 - Other Considerations





State & Federal Regulation



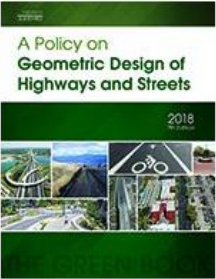
State & Federal Regulation

Standards vs. Guidance

Standards & Guidance Document Hierarchy

Additional References

- NACTO City Limits
- US Traffic Calming Manual
- AB 43 (speed limit setting)
- AB 1938 (speed limit setting)



1. Standards

- CA MUTCD
- Caltrans Highway Design Manual

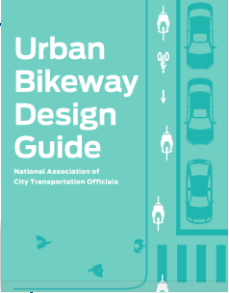


2. Mainstream, traditional geometric guidance

- AASHTO Green Book
- AASHTO Bike Guide

3. Mainstream, innovative guidance

- NACTO Urban Bikeway Design Guide
- NACTO Don't give up at the intersection
- CROW Design Manual for Bicycle Traffic
- FHWA Separated Bike Lane Planning & Design Guide
- MassDOT Separated Bike Lane Planning & Design Guide



4. Local and other guidance

- LA County 2012 Bicycle Master Plan Appx F: Design Guidelines
- South Bay Bicycle Master Plan
- ITE Informational Reports



Definitions

- **Standards** *must* be followed and require documentation when they can't be ("design exceptions")
- **Guidance**
 - There are varying degrees of flexibility for following guidance
 - Guidance may not apply in all situations
 - Usually don't require documentation of design exceptions



Liability

- Public entities may be liable for injuries caused by a dangerous condition of public property
- Adhering to standards provides design immunity
- There are ways to minimize liability
- Alternative: conduct project as an experiment



State & Federal Regulation

Regulatory Guidance

NEV Compliance Documents

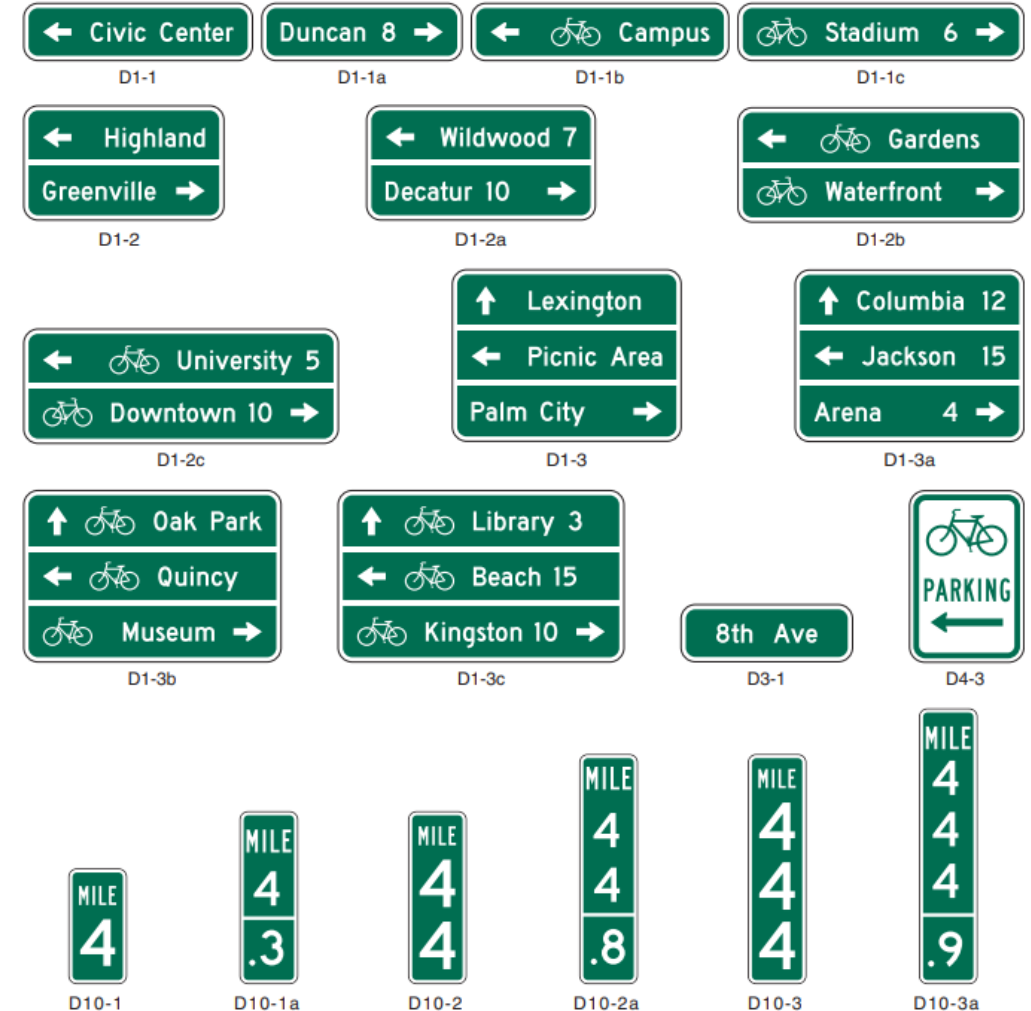
Document	Level	Year Published
National Highway Traffic Safety Administration (NHTSA) Final Ruling on Low-Speed Vehicles	Federal	1998
CA Department of Motor Vehicles (DMV)	State	2000
CA Vehicle Code (CVC) LSV definition and road regulation	State	2006 (definition) 2019 (road regulation)
Caltrans NEV Signage Guidance	State	2017
Slow Speed Network Strategic Plan for The South Bay	Local	2017



MUTCD Wayfinding

- Per the MUTCD, devices should be designed so that:
 - Size, shape, color, composition, lighting or retro-reflection, and contrast draw attention to the devices
 - Message is simple or message combine to produce a clear meaning.
 - Legibility and size combine with placement to permit adequate time for response.
 - Uniformity, size, legibility, and reasonableness of the message combine to command respect.

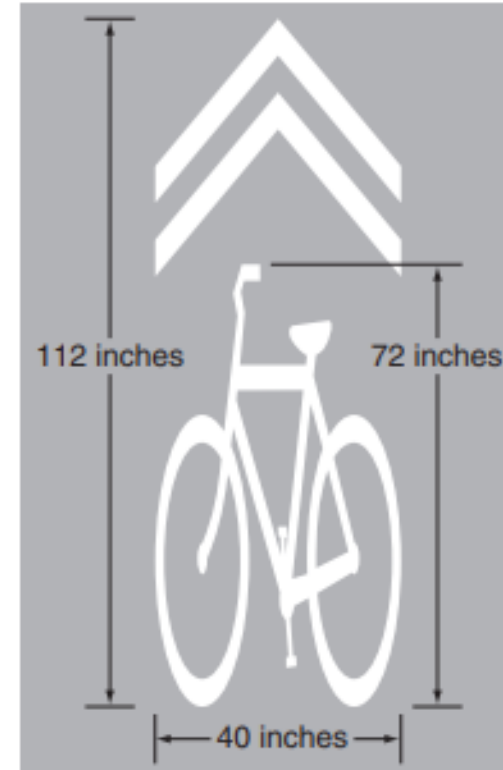
Figure 9B-4. Guide Signs and Plaques for Bicycle Facilities (Sheet 1 of 2)



MUTCD Sharrow Marking

- Per the MUTCD, Shared Lane Marking (Sharrow):
 - Should not be placed on roadways with a speed limit above 35 mph
 - If used on a street without on-street parking that has an outside travel lane that is less than 14 feet wide, the centers of the Shared Lane Markings should be at least 4 feet from the face of the curb, or from the edge of the pavement where there is no curb
 - Shared Lane Marking should be placed immediately after an intersection and spaced at intervals not greater than 250 feet thereafter
 - Shared Lane Markings shall not be used on shoulders or in designated bicycle lanes

Figure 9C-9. Shared Lane Marking



Bicycle Facilities

MUTCD

- Contains all national design, application, and placement, standards for traffic control devices on bicycle facilities
- Use CA MUTCD for state-specific classifications

Highway Design Manual

- Includes criteria for facility selection, design criteria, and treatments
- References MUTCD for signage
- References Caltrans Design Information [Bulletin 89-01](#) for Class IV Bikeway Guidance



Caltrans NEV Sign Specifications

Class III NEV Route



Class III NEV Route



Class II NEV-Bike Lane



Caltrans NEV Sign Specifications

Class II NEV Bike Lane



NEV Parking Spaces



Actuated Traffic Signal Sign



Note: To install with BEGIN and END plaques



State & Federal Regulation

Modifying Design Standards

Experimentations & Interim Approvals

Interim Approval

Allows an agency to request approval for use of a new device or design for which FHWA has issued an Interim Approval. A State can ask FHWA to grant permission for Statewide.

Interim Approvals are treatments that have undergone successful testing and evaluation.



Green Colored Pavement in California had Interim Approval, but is now part of the most recent CA MUTCD

Experimentation

Allows agencies to test a new traffic control device or different application of an existing device for experimentation.

Reduces some, but not all potential liability for use of new non-MUTCD compliant devices.



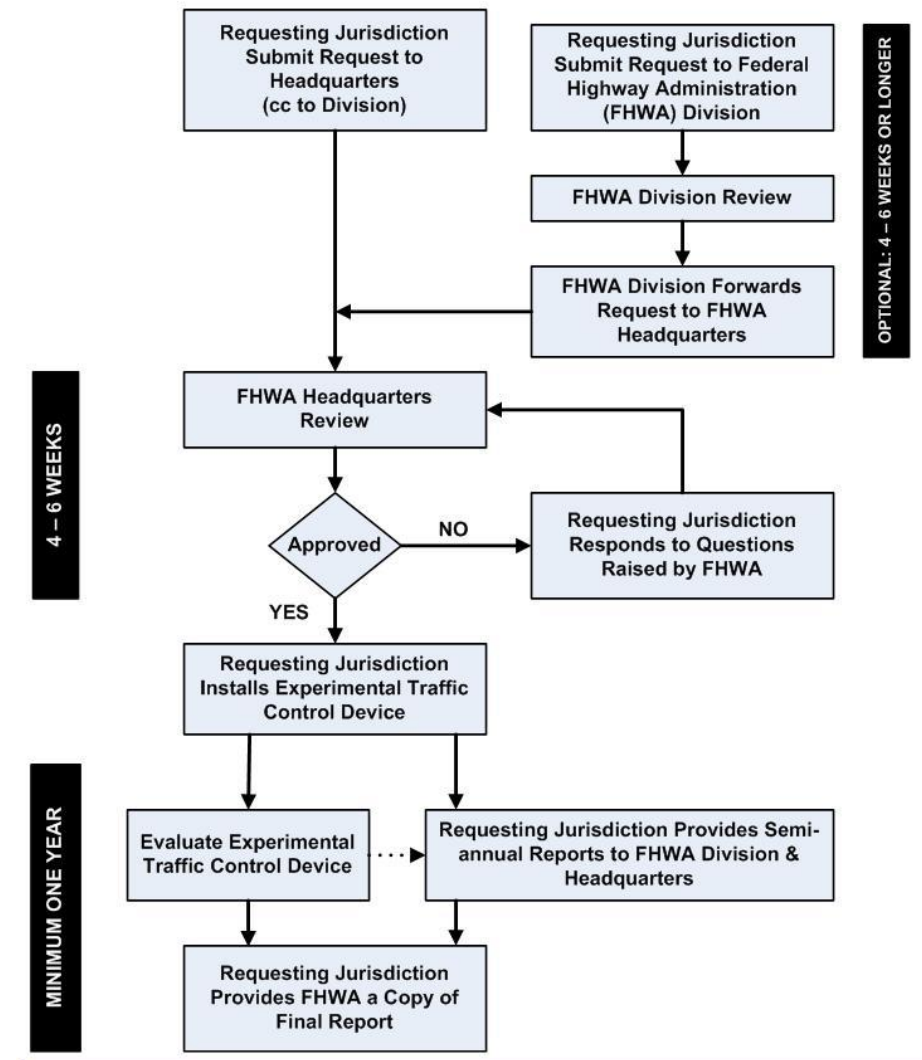
Advisory Bike Lane in Alexandria, VA



Experimental Designs

- Experimental traffic control designs must go through a set procedure outlined in the MUTCD
- The agency must first ask for interim approval from the Federal Highway Administration

OBTAINING EXPERIMENTATION APPROVAL FOR NEW TRAFFIC CONTROL DEVICES





Best Practices



Best Practices

Wayfinding & Other Signage

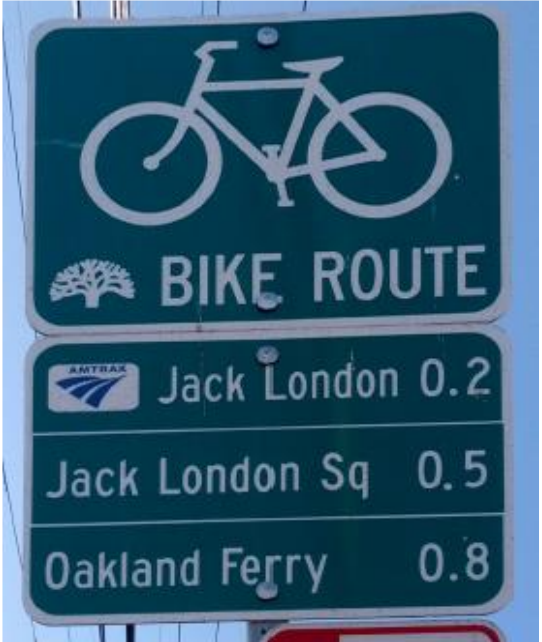
Wayfinding Typologies

Decision



Cupertino, California

Confirmation



Oakland, California

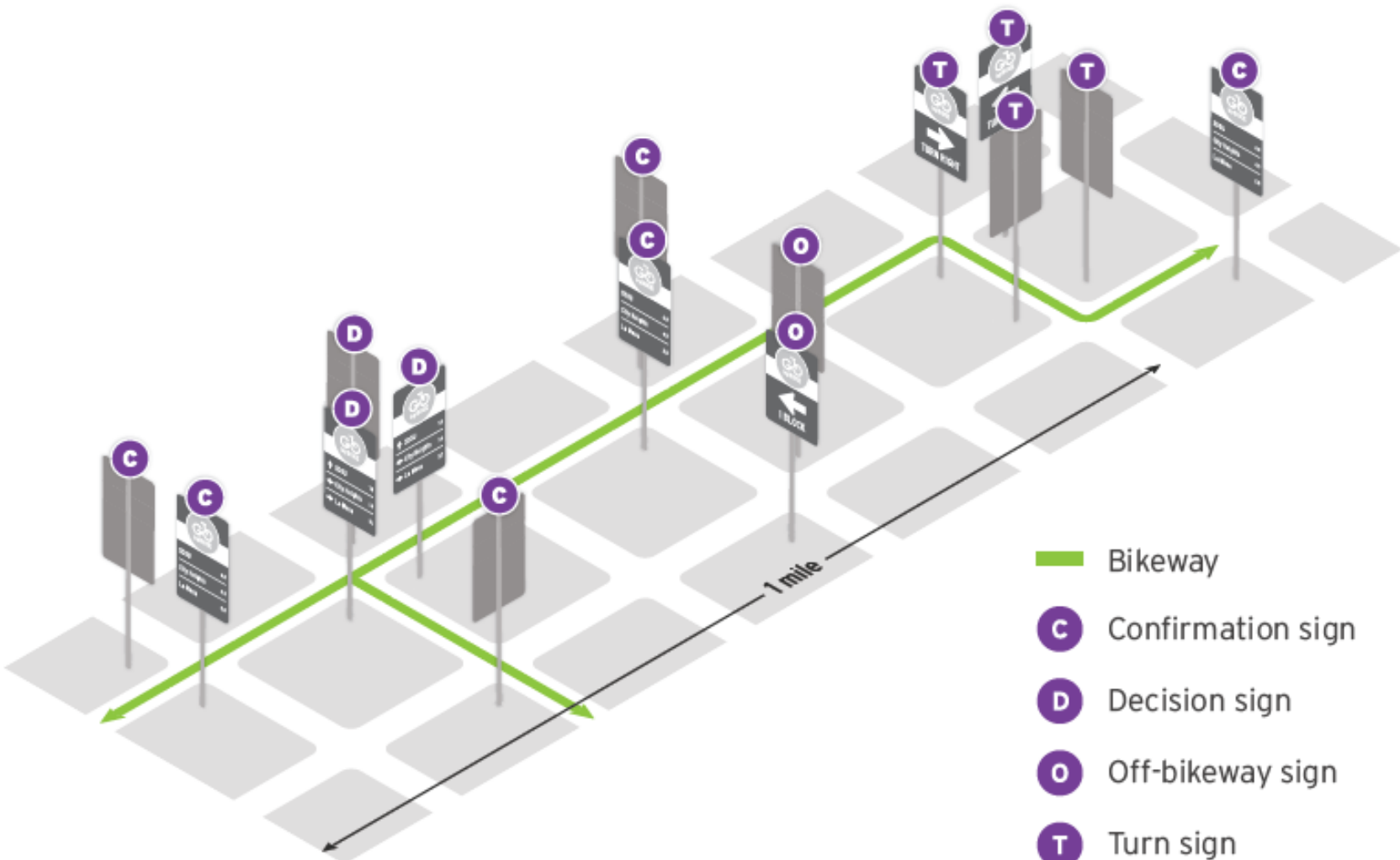
Turn








San Francisco, California



Wayfinding Typologies Placement



-  Bikeway
-  Confirmation sign
-  Decision sign
-  Off-bikeway sign
-  Turn sign

San Diego, California



Other Wayfinding Signage

Street Sign



Oakland, California
(bicycle boulevards)

Yard Sign



Portland, Oregon

Identification Sign



Portland, Oregon



Education and Encouragement

Informative



King County, Washington

Encouraging



Long Beach, California

Unique Application



Sioux City, Iowa



Wayfinding Considerations

Color & Branding

MUTCD allows for custom color variations for community wayfinding, with the expectation of the following colors:

- Red
- Yellow
- Orange

	Decision	Confirmation	Turn	Off-Bikeway											
STANDARD SIGNAGE															
	<table border="1"> <tr><td>↑ SDSU</td><td>1.8</td></tr> <tr><td>← City Heights</td><td>1.6</td></tr> <tr><td>→ La Mesa</td><td>5.1</td></tr> </table>	↑ SDSU	1.8	← City Heights	1.6	→ La Mesa	5.1	<table border="1"> <tr><td>SDSU</td><td>6.8</td></tr> <tr><td>City Heights</td><td>4.5</td></tr> <tr><td>La Mesa</td><td>2.8</td></tr> </table>	SDSU	6.8	City Heights	4.5	La Mesa	2.8	
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→ La Mesa	5.1														
SDSU	6.8														
City Heights	4.5														
La Mesa	2.8														
BRANDED BIKEWAY SIGNAGE*															
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↑ Otay Mesa	6.8														
← Chula Vista	4.5														
→ San Ysidro	2.8														
Santa Fe Depot	6.8														
Petco Park	4.5														
Chula Vista	2.8														

San Diego, California



NEV Signage

Off-Street Facility Sign



Rancho Mission Viejo, California

On-Street Facility Sign



Lincoln, California

- Caltrans standard signs for cities with NEV plan

On-Street Facility Sign



Rancho Mission Viejo, California

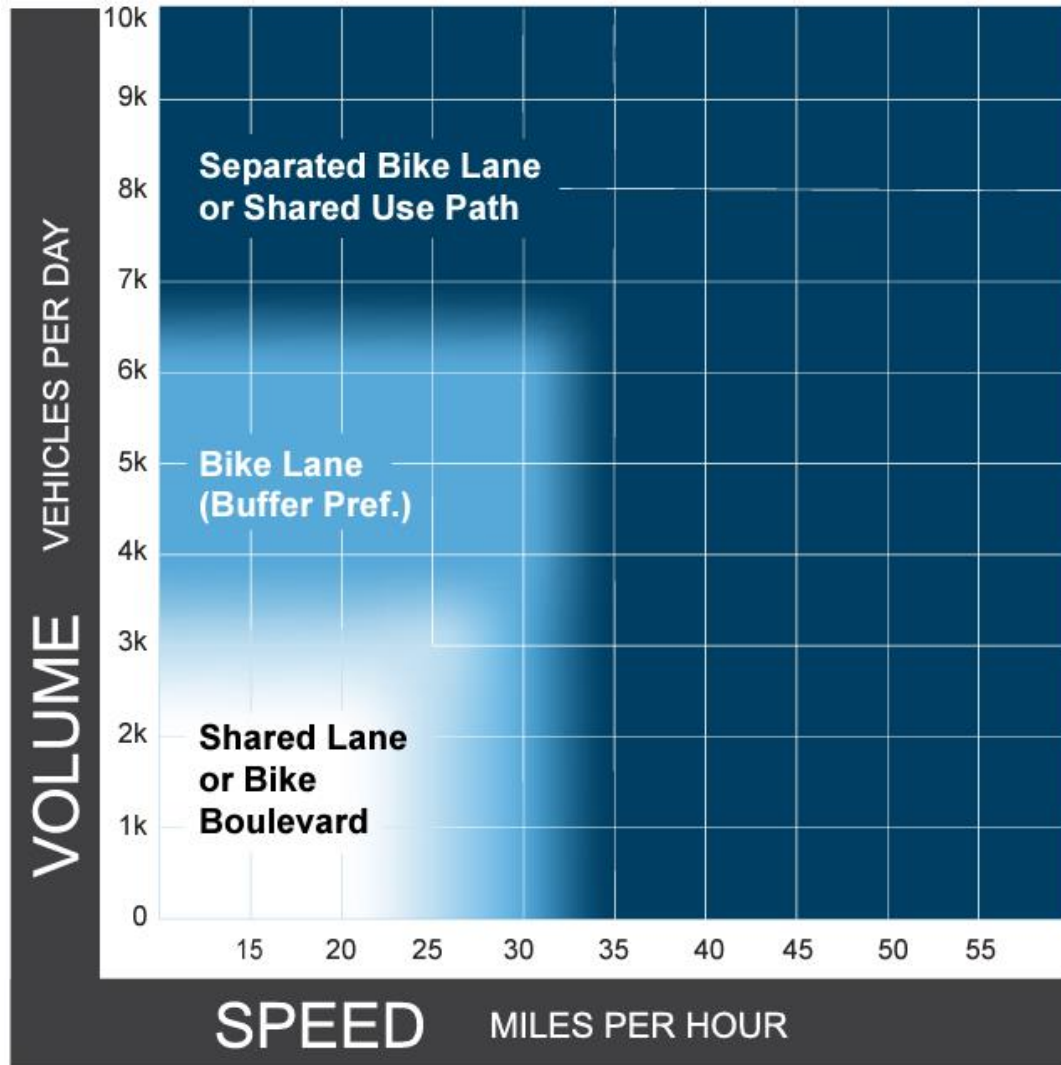
- Caltrans standard signs for cities with NEV plan



Best Practices

Pavement Markings

Facility Selection Guidance



	Shared Lanes	Boulevards	Shoulders	Bike Lanes	One-Way Separated Bike Lanes with Mixing Zones	Separated Bike Lanes and Sidepaths with Protected Intersections
Forgiveness (Safety) - Infrastructure can be designed to accommodate human error						
Relies upon perfect user (driver and bicyclist) behavior to avoid crashes	✓	✓	✓	✓		
Minimal: bicyclists operating in shared space with vehicles	✓					
Moderate: application of traffic calming treatments and lower operating speeds can improve safety		✓				
Moderate: bicyclists operate in separated space from vehicles, however vehicles can encroach into the facility at any location			✓	✓		
Moderate: bicyclists operate in separated space from vehicles except for defined entry point, followed by shared operating space					✓	
High: bicyclists operate in separated space from vehicles except for defined conflict point which can be designed to reduce motorist speed, but contraflow movement from two-way operation can increase risk						✓
Awareness (Visibility) - Awareness improves safety for all users						
Visibility may be restricted by parking necessitating parking restrictions					✓	✓
Visibility is typically unrestricted	✓	✓	✓	✓		
Requires high level of motorists scanning to identify bicyclists approaching from behind or operating beside them	✓	✓	✓	✓		
Requires moderate level of motorists scanning to identify bicyclists approaching or within the conflict point					✓	✓

Source: FHWA Bikeway Selection Guide



Shared Lane Marking (Sharrows)/Class III Facility

Benefits

Bring awareness to presence of bikeway routes for drivers and cyclists

Strengthen connections in a network

Clarify movement and positioning for cyclists

When to Use

Low vehicle volume, low speed street

Where travel speed differential between drivers and cyclists is low

Where combined with bicycle boulevard or similar signage and traffic calming strategies

Other Notes

Green-backed sharrows newly approved by CA MUTCD

Our review *did not* find an NEV sharrow variation in use in CA

Not effective at improving safety, and can have negative impacts when used in the wrong context



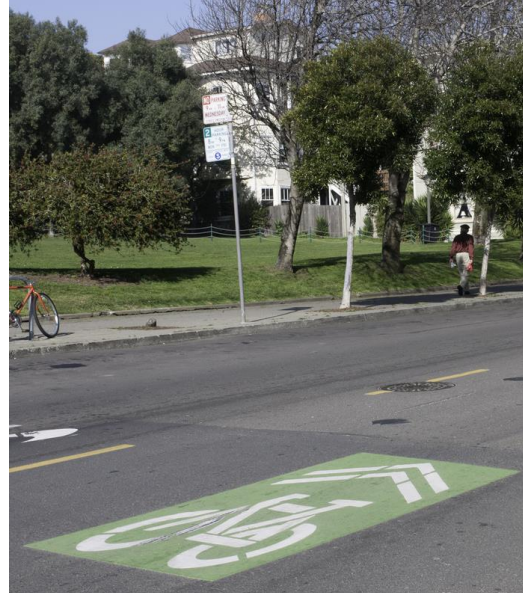
Shared Lane Marking (Sharrows)/Class III Facility

Standard



South Bay, CA

Green-Backed



San Francisco, CA

- Recently added to the CA MUTCD (updated federal MUTCD prohibits green-backed sharrows)
- Used fairly commonly in CA, even before inclusion in CA MUTCD

NEV/Golf Cart



Unknown location, FL

- No evidence found of use in CA
- No documentation found of experimental approval in US
- Would require FHWA/CTCDC approval



Shared Lane Marking (Sharrows)/Class III Facility

Required Features	Recommended Features
<p>Marking</p> <ul style="list-style-type: none">• Bike-and-Chevron “sharrow” illustrated in CAMUTCD <p>Placement</p> <ul style="list-style-type: none">• Shall not be used on shoulders, in designated lanes, or to designate bicycle detection at signalized intersections <p>Use</p> <ul style="list-style-type: none">• NEVs can share a lane with vehicular traffic on roadways with a posted speed limit of 35 mph or less	<p>Placement</p> <ul style="list-style-type: none">• Placed every 50 to 100 feet on busier streets, up to 250 feet or more on low traffic routes.• Preferred placement in the center of travel lane<ul style="list-style-type: none">• Minimum placement 4 feet from curb• Minimum placement 11 feet from the curb face when a parking lane is present <p>Context</p> <ul style="list-style-type: none">• Recommended for <25 mph or slower streets• Not recommended on 35+ mph roads with volumes 3,000+ vehicles per day• Use in combination with traffic calming features (Bicycle Boulevard model)

Sources: CVC, NACTO Urban Bikeway Design Guide, CAMUTCD



Bike Lane or Shared Bike/NEV Class II or IV Facility

Benefits

Provides separated space for bicyclists

Right-of-way priority is clarified for standard vehicle drivers

Separated Class IV facilities provide additional protection via vertical separation element

When to Use

Consider for streets with vehicle volumes 3,000+ and speeds greater than 25 mph

Vertical separation element should be considered for streets above 6,000 vehicles and 30+ mph

Other Notes

Intersections and driveways are important for design interventions to minimize conflicts between standard vehicles and bicycles or NEVs

Buffer can be used to provide more space for NEVs

Shared Class IV bike/golf cart facility recently built in Palm Desert as part of CV Link



Bike Lane or Shared Bike/NEV Class II or IV Facility

Standard Class II



Standard Class II+ (buffered)

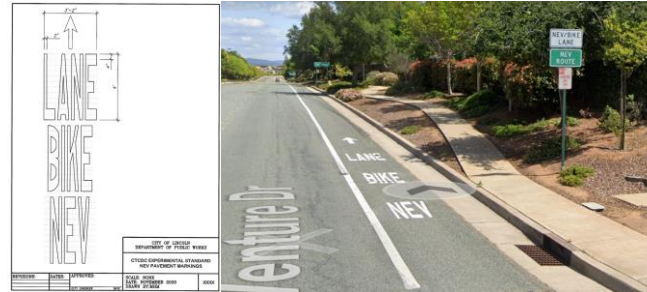


Shared Class IV (separated)



Palm Desert, CA (shared bike/golf cart)

NEV/Golf Cart Markings



Lincoln, CA (experimental approval from CTCDC)



Rancho Mission Viejo, CA



La Quinta, CA

- NEV lane marking used in CA in cities with NEV plans (there are no Caltrans standards, as there are with signs)
- CTCDC and/or FHWA approval may be needed for custom symbols (e.g. image of a NEV rather than letters)

Scooter Markings



UCLA campus, CA



Oakland, CA

- Would require FHWA/CTCDC approval



Bike Lane or Shared Bike/NEV Class II or IV Facility

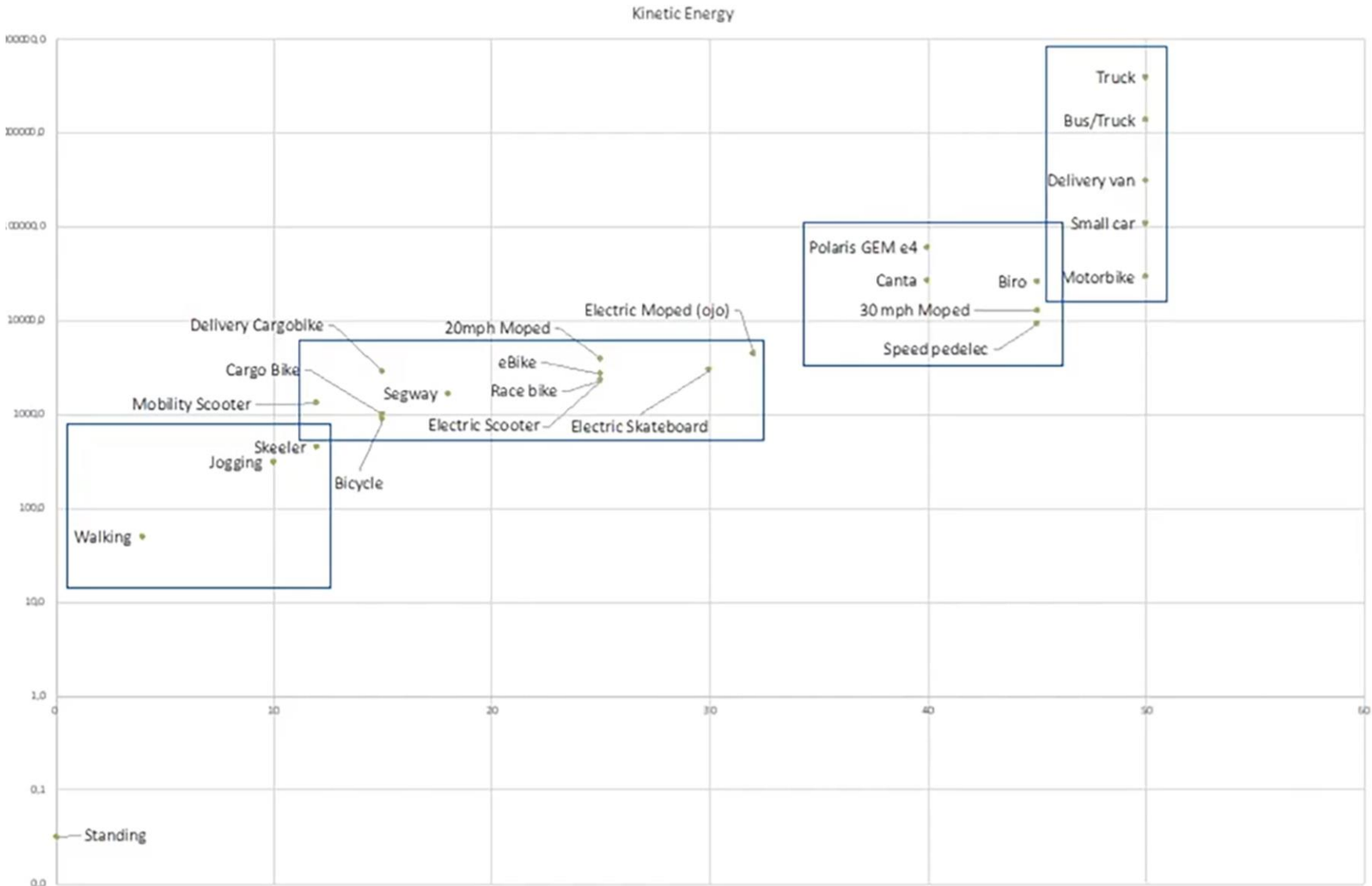
Required Features	Recommended Features
<p>Marking</p> <ul style="list-style-type: none">• Bicycle lane word and/or symbol and arrow markings shall be used to define lane• Solid white lane line marking shall be used to separate motor vehicle travel lane from bike lane <p>Placement</p> <ul style="list-style-type: none">• 6 feet width from curb face• Bike lane next to parking lane shall be at least 5 feet wide, reach from curb face to the edge of the bike lane (including parking lane, bike lane, and optional buffer) is 14.5 feet; absolute minimum reach is 12 feet• A through bike lane should not be positioned to the right of a right turn only lane or to the left of a left turn only lane	<p>Marking</p> <ul style="list-style-type: none">• 4-inch width of solid white line marking when bike lane is placed next to parking• Dashed striping through high traffic merging <p>Design (incl. width)</p> <ul style="list-style-type: none">• Provide wider lane than minimum widths, to accommodate NEVs and provide addl comfort• Gutter seams, drainage inlets, and utility covers should be flush with ground and oriented to prevent conflicts with bicycle tires• Separation should be provided between bike lane striping and parking boundary markings to reduce door zone conflicts• Desired dimensions should be used unless other street elements have been reduced to their minimum

Additional Considerations

- Standards for vertical separation on NEV/Bike Lanes have not been developed
- Markings with unique icons, such as NEVs or E-Scooter require additional review
- Consider incorporating traffic calming treatments
- Emergency Services appreciate early coordination
- E-vehicles and e-vehicle types are being stratified by top speed:
 - E-scooter is 15 mph
 - E-Bike is 20 mph (most)
 - NEV is 25 mph



Additional Considerations – Kinetic Energy by Mode



Best Practices

Intersections & Crossings

Intersection Markings

- Typically applied at:
 - Signalized intersections with wide or complex intersections
 - Along roadways with bike lanes or cycle tracks
 - Across driveways and Stop or Yield-controlled cross streets
- Pavement markings shall be the same color and at least the same width as the line markings they extend (MUTCD Section 3B.08)
- Striping width shall be a min. 6 inches (AASHTO, 1999 Guide for the Development of Bicycle Facilities)



Intersection approach (Milwaukee, WI)



Through the intersection (Seattle, WA)



Considerations for Major Crossings

Goal	Design Consideration
Slow down vehicle speed	<ul style="list-style-type: none">• Bulbouts• Raised intersection• Signal timing and coordination (e.g. Slow Green Wave)• Speed feedback signs
User detection	<ul style="list-style-type: none">• Mode-specific detection
Reduce vehicle volumes	<ul style="list-style-type: none">• Diverters or partial/full closures
Increase visibility	<ul style="list-style-type: none">• Lighting at intersection• Leading Pedestrian Intervals• Signalized intersection control• Intersection crossing markings (e.g. Crossbike marking)• Raised crossing• Bike box for advance stop staging
Reduce conflicts with turning vehicles	<ul style="list-style-type: none">• Bike/NEV facility placed to the left of right-turning vehicles• Mixing/conflict zones markings• Separate signal phases• Restrict right turns on red



Major Crossing Application



Seattle, Washington



Considerations for a Minor Crossing

Goal	Design Consideration
Slow down vehicle speeds	<ul style="list-style-type: none">• Bulbouts• Traffic circle• Speed humps• Chicanes• Median islands
Reduce vehicle volumes	<ul style="list-style-type: none">• Diverters or partial/full closures
Increase visibility	<ul style="list-style-type: none">• Lighting at intersection• Provide clear sightline approaches• Raised crossing• Daylighting (e.g. red curb)



Minor Crossing Application



Seattle, Washington



Best Practices

Low-Speed Network Case Studies

Case Study Overview

- Case studies focus on low-speed networks in the US
- These do not have NEV element, but do focus on neighborhood streets and slow speeds, with goals similar to the LTN
- Berkeley, Portland and Seattle programs have similar core components to the LTN – wayfinding and sharrows across a connected network
- Programs are in cities, but do focus on a multitude of development contexts that have similar patterns to communities in the South Bay
- Cities in case studies are seen as national leaders in speed management strategies, including citywide posted speed reductions
- Berkeley, Seattle and Portland programs are long-running



Slow Streets, Los Angeles



Slow Streets, San Francisco







Healthy Streets, Seattle



Neighborways, Pittsburgh

Recommendations for identifying Slow Streets

Guide Signs (green background, white message)	Warning Signs (yellow background, black message)	Regulatory Signs (white background, black message)	Pavement Markings (typically white)
 		<p>NONE</p> <p>Lobby for State legislation allowing 15 mph speed limits on Slow Streets as is currently allowed for alleys.</p>	

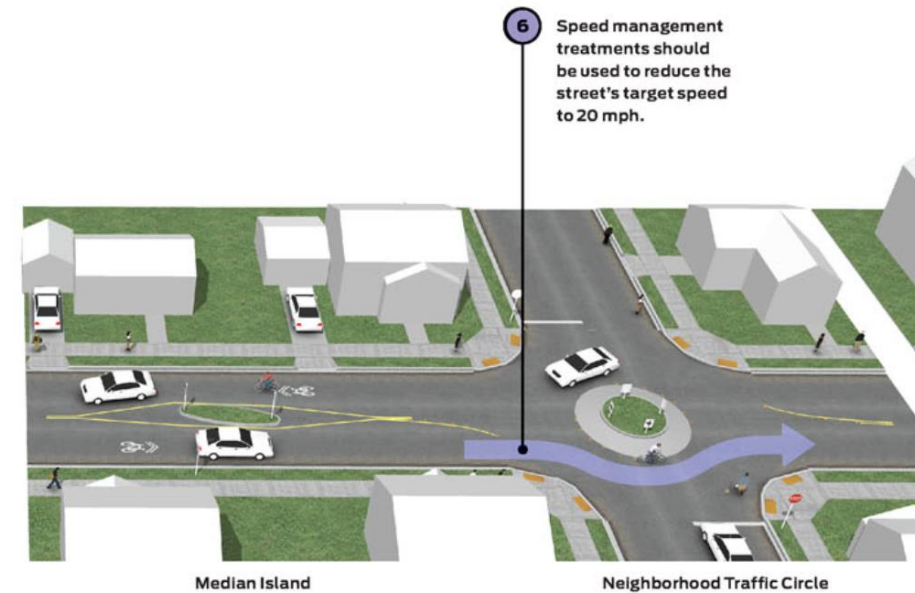
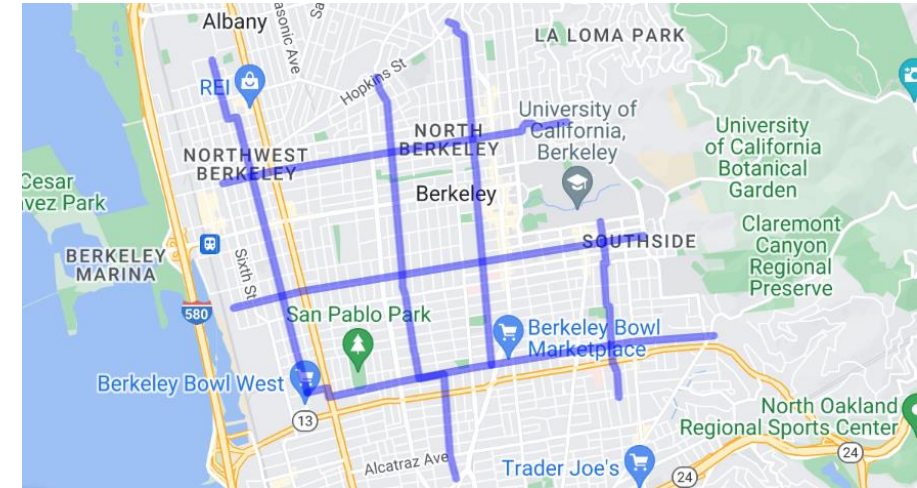
Slow Streets, Oakland



Case Study: Berkeley Bicycle Boulevards

<https://berkeleyca.gov/city-services/getting-around/walking-and-biking/bike-boulevards>

- Berkeley's seven bicycle boulevards are streets that have been identified as optimal routes for cyclists. These streets discourage cut-through vehicle traffic and prioritize through-traffic by bicycle
- Bicycle Boulevards are a network connected streets where bicycle travel is prioritized, which is indicated by signs and pavement markings
- Bicycle Boulevards prioritize speed management and management of low vehicle volumes
- A critical component of Bicycle Boulevards is the use of traffic calming devices, such as:
 - Neighborhood traffic circles
 - Full and partial vehicle traffic diverters
 - Intersection crossing enhancements
 - Low posted speeds
- Comprehensive Bicycle Boulevard guidance is available in the NACTO Urban Bikeway Design Guide:
<https://nacto.org/publication/urban-bikeway-design-guide/bicycle-boulevards>



Case Study: Seattle Neighborhood Greenways

<https://www.seattle.gov/transportation/projects-and-programs/programs/greenways-program>

Interview conducted with Seattle staff to inform LTN Playbook

Program goals:

- Connections to neighborhood destinations, trails Create streets “quiet enough to have a conversation”
- Citywide norm for students to bike and walk to school
- Traffic calming with aim for people to self-organize in the street space (shared streets)

All Neighborhood Greenways have:

- Sharrows, wayfinding signage, 20 mph posted speed, speed humps, side-street stop control

Arterial intersections along Neighborhood Greenways are upgraded to include:

- Marked crosswalk
- Rectangular rapid flashing beacon (RRFB) or pedestrian hybrid beacon (PHB), if no signal
- Bulbouts or median diverters

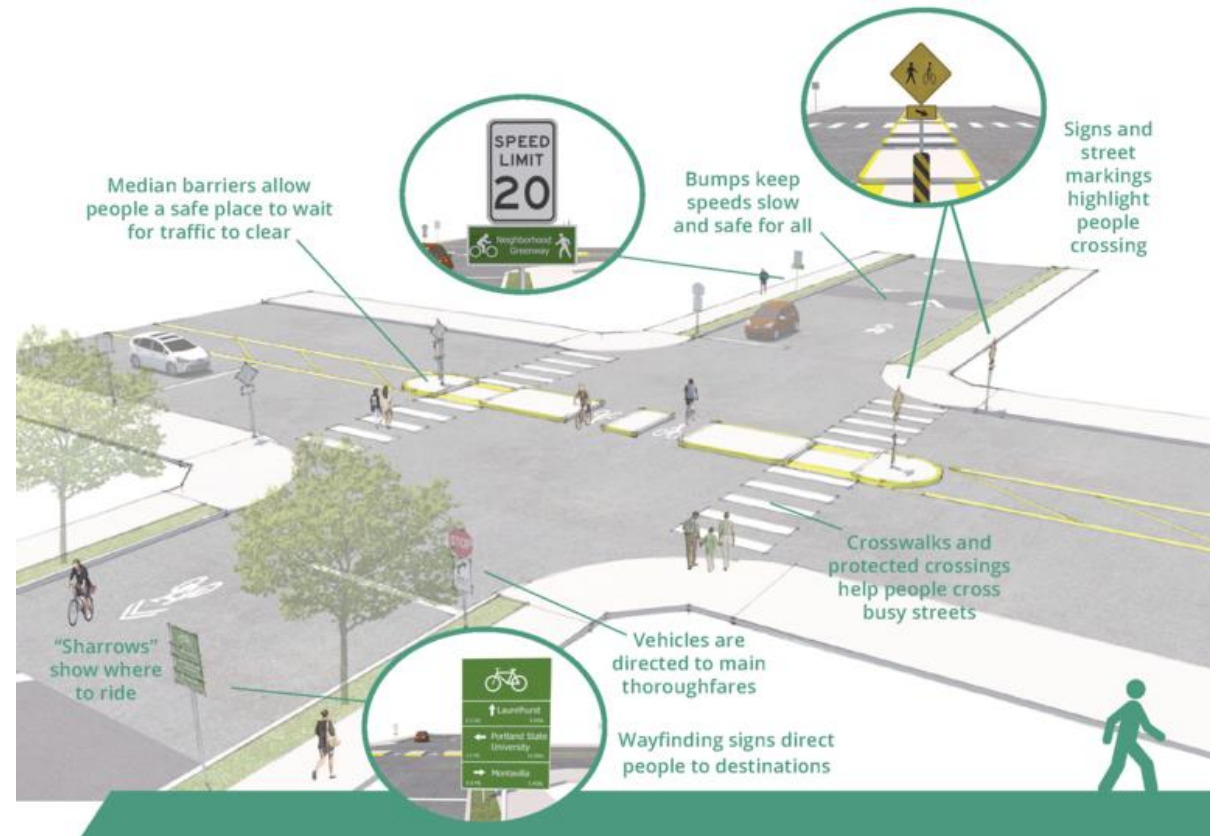


Case Study: Portland Neighborhood Greenways

<https://www.portland.gov/transportation/what-are-neighborhood-greenways>

City of Portland's Neighborhood greenways are quiet and comfortable places for people to walk and bike due to the inclusion of these engineering treatments:

- Speed bumps
- Protected crossings at busy streets
- Traffic diversion
- Wayfinding signs
- Shared Lane Markings



Case Study: Boston Slow Streets

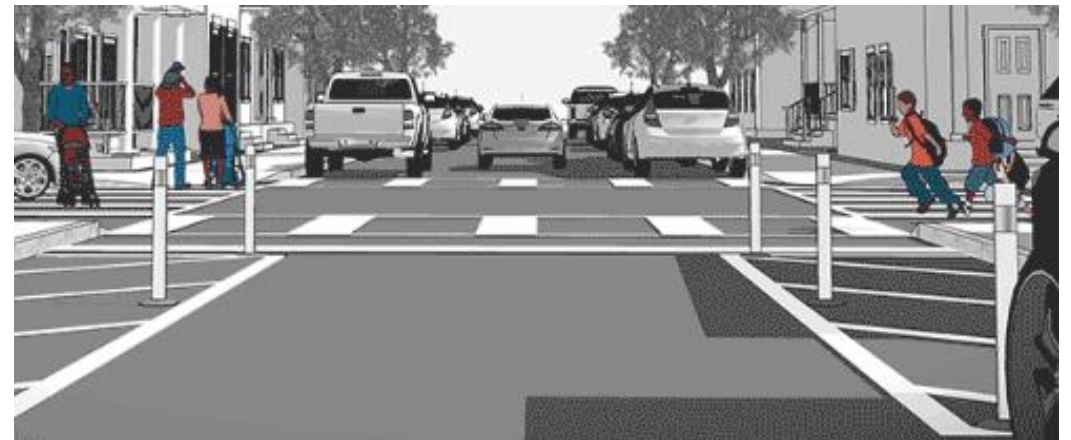
<https://www.boston.gov/departments/transportation/neighborhood-slow-streets>

City of Boston's Neighborhood Slow Streets focuses on improving street safety at the neighborhood scale. Currently the following amenities are being added to the network:

- Clear corners (e.g. red curb)
- Crossing islands
- Curb extension
- Hardened centerline
- In-street "Yield to Pedestrian" signs
- Raised crosswalks and intersections
- Road rightsizing
- T-intersections



Example of Hardened Centerline



Example of Clear Corners

