

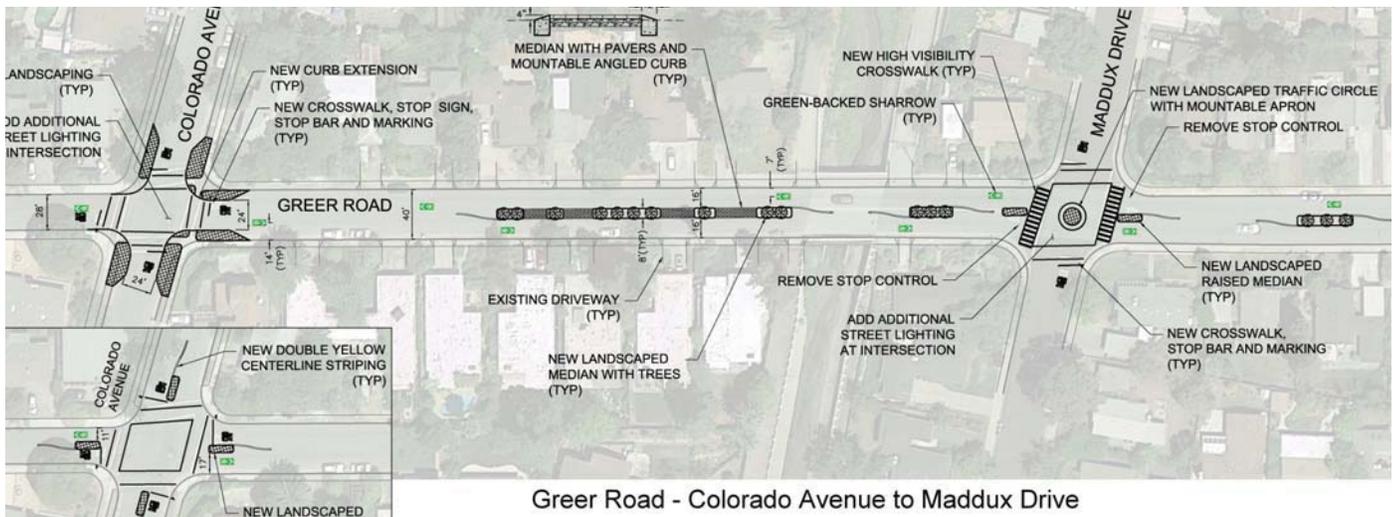
# DESIGN GUIDELINES

- Chapter Contents:
- Bicycle Boulevard
- Pavement Markings and Signage
- Vertical Traffic Calming
- Horizontal Traffic Calming
- Traffic Diversion
- Minor Intersection Treatments
- Major Intersection Treatments
- Offset Intersection Treatments

## INTRODUCTION

These design guidelines are intended to assist the City of Rochester with the design of bicycle boulevards. The following chapter pulls together best practices from public agencies and municipalities nationwide. Within the design guidelines, treatments are covered within a single sheet tabular format relaying important design information and discussion, example photos, schematics (if applicable), and existing summary guidance from current or upcoming draft standards. Existing standards are referenced throughout and should be the first source of information when seeking to implement any of the treatments featured here.

Sample Bicycle Boulevard Plan Set from Palo Alto, CA



Greer Road - Colorado Avenue to Maddux Drive



# BICYCLE BOULEVARD

## DESCRIPTION

Bicycle boulevards are low-volume, low-speed streets modified to enhance bicyclist comfort by using treatments such as signage, pavement markings, traffic calming and/or traffic reduction, and intersection modifications. These treatments allow through movements of bicyclists while discouraging similar through-trips by non-local motorized traffic.

## GUIDANCE

- Signs and pavement markings are the minimum treatments necessary to designate a street as a bicycle boulevard.
- Bicycle boulevards should have a maximum posted speed of 25 mph. Use traffic calming to maintain an 85th percentile speed below 22 mph.
- Implement volume control treatments based on the context of the bicycle boulevard, using engineering judgment. Target motor vehicle volumes range from 1,000 to 3,000 vehicles per day.
- Intersection crossings should be designed to enhance safety and minimize delay for bicyclists.

## DISCUSSION

Bicycle boulevard retrofits to local streets are typically located on streets without existing signalized accommodation at crossings of collector and arterial roadways. Without treatments for bicyclists, these intersections can become major barriers along the bicycle boulevard and compromise safety.

Traffic calming can deter motorists from driving on a street. Anticipate and monitor vehicle volumes on adjacent streets to determine whether traffic calming results in inappropriate volumes. Traffic calming can be implemented on a trial basis.

**Enhanced Crossings** use signals, beacons, and road geometry to increase safety at major intersections.

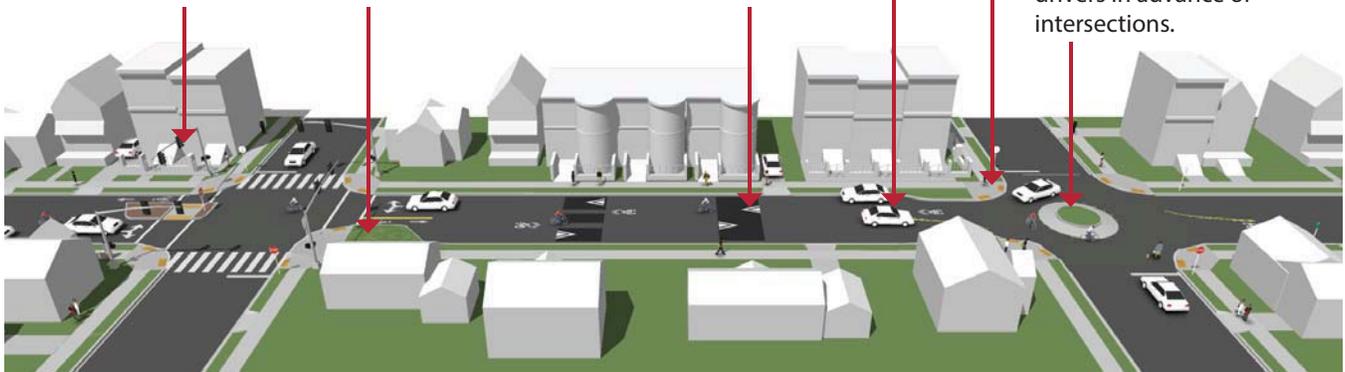
**Partial Closures** and other volume management tools limit the number of cars traveling on the bicycle boulevard.

**Speed Humps** manage driver speed.

**Signs and Pavement Markings** identify the street as a bicycle priority route.

**Curb Extensions** shorten pedestrian crossing distance.

**Mini Traffic Circles** slow drivers in advance of intersections.



## ADDITIONAL REFERENCES AND GUIDELINES

- *Alta Planning + Design and IBPI. Bicycle Boulevard Planning and Design Handbook. 2009.*
- *BikeSafe. Bicycle countermeasure selection system.*
- *Ewing, Reid. Traffic Calming: State of the Practice. 1999.*
- *Ewing, Reid and Brown, Steven. U.S. Traffic Calming Manual. 2009.*

## MATERIALS AND MAINTENANCE

Vegetation should be regularly trimmed to maintain visibility and attractiveness.

## PAVEMENT MARKINGS AND SIGNAGE

### DESCRIPTION

Signs and pavement markings are the minimum treatments necessary to designate a street as a bicycle boulevard. Together, they visibly designate a roadway to both bicyclists and motorists. Signs, and in some cases pavement markings, provide wayfinding to help bicyclists remain on the designated route.

### GUIDANCE

#### PAVEMENT MARKINGS

- Place symbols every 250-800 feet along a linear corridor, as well as after every intersection.
- On narrow streets where a motor vehicle cannot pass a bicyclist within one lane of traffic, place stencils in the center of the travel lane.
- See Marked Shared Roadway guidance for additional information on the use of shared lane markings.
- A bicycle symbol can be placed on a standard road sign, along with distinctive coloration.

#### SIGNS

- Some cities have developed unique logos or colors for wayfinding signs that help brand their Bicycle Boulevards.
- Be consistent in content, design, and intent; colors reserved by the Manual on Uniform Traffic Devices (MUTCD) for regulatory and warning road signs are not recommended.
- Signs can include information about intersecting bikeways and distance/time information to key destinations.



### DISCUSSION

Wayfinding signs displaying destinations, distances, and “riding time” can dispel common misperceptions about time and distance while increasing users’ comfort and accessibility to the bicycle boulevard network. Bicycle Boulevards frequently include offset intersections or ‘jog’ onto another street. Signs and pavement markings can help bicyclists remain on the route. In addition, fewer businesses or services are located along local streets, and signs inform bicyclists of the direction to key destinations, including commercial districts, transit hubs, schools and universities, and other bikeways.

#### ADDITIONAL REFERENCES AND GUIDELINES

- City of Milwaukie. *Milwaukie Bicycle Wayfinding Signage Plan*. 2009.
- City of Oakland. *Design Guidelines for Bicycle Wayfinding Signage*. 2009.
- NACTO. *Urban Bikeway Design Guide*. 2012.

#### MATERIALS AND MAINTENANCE

Pavement markings should be repainted and signs replaced as needed. Wayfinding signs should be regularly updated with new major destinations and bikeways.



# VERTICAL TRAFFIC CALMING

## RAISED CROSSWALKS AND SPEED TABLES/HUMPS

### DESCRIPTION

Vertical speed control measures are composed of slight rises in the pavement, on which motorists and bicyclists must reduce speed to cross.

Motor vehicle speeds affect the frequency at which automobiles pass bicyclists as well as the severity of crashes that can occur. Maintaining motor vehicle speeds closer to those of bicyclists' greatly improves bicyclists' comfort on a street. Slower vehicular speeds also improve motorists' ability to see and react to bicyclists and minimize conflicts at driveways and other turning locations.

Speed humps are rounded raised areas, while speed tables are longer than speed humps and flat-topped. A raised crosswalk is a speed table that is marked and signed for pedestrian crossing. It extends fully across the street and can be longer and higher than a typical speed table. Speed cushions are rounded or flat-topped raised areas across the road that include wheel cut-outs to allow large vehicles to pass unaffected while acting as speed humps to passenger cars.

### GUIDANCE

- For all vertical traffic calming, slopes should not exceed 1:10 or be less steep than 1:25. Tapers should be no greater than 1:6 to reduce the risk of bicyclists losing their balance. The vertical lip should be no more than a 1/4" high.
- Speed humps are raised areas usually placed in a series across both travel lanes. A 14' long hump reduces impacts to emergency vehicles.
- Speed humps can be challenging for bicyclists, gaps can be provided in the center or by the curb for bicyclists and to improve drainage.
- Speed humps can be offset to accommodate emergency vehicles (only recommended with solid yellow center lines to discourage motorists from alternating lanes to avoid the calming element).
- The height of raised crosswalk ends should be the same as the curb height but should not impede drainage.



Speed Hump



Offset Speed Hump



Raised Crosswalk



Temporary Speed Cushion

Speed cushions are divided to allow emergency vehicles to pass unaffected.

## VERTICAL TRAFFIC CALMING (CONTINUED)

- Decorative surface material may be used to call attention to raised crosswalks.

### RAMP SHAPE

- The ramp shapes of vertical traffic calming features are typically either sinusoidal, circular or parabolic, each offering motorists and bicyclists a differing level of comfort and effectiveness in reducing speed:
  - Sinusoidal ramps are most comfortable for motorists and bicyclists but are least effective in reducing traffic speeds and are difficult to construct.
  - Circular ramps offer a moderate comfort level for motorists and are moderately effective in reducing traffic speeds.
  - Parabolic ramps (City of Rochester standard) are least comfortable for motorists and bicyclists but are most effective in reducing traffic speeds.

Sinusoidal



Circular



Parabolic



### DISCUSSION

Emergency vehicle response times should be considered where vertical deflection is used. Because emergency vehicles have a wider wheel base than passenger cars, speed cushions allow them to pass unimpeded while slowing most other traffic. This can also be applied to priority transit routes. Alternatively, speed tables are recommended because they cannot be straddled by a truck, decreasing the risk of bottoming out. Before installing raised crosswalks, designs should be approved by emergency vehicle operators including the fire department.

Traffic calming can also deter motorists from driving on a street. Monitor vehicle volumes on adjacent streets to determine whether traffic calming results in inappropriate volumes. Traffic calming can be implemented on a trial or temporary basis and is more easily accomplished with vertical traffic calming.



This raised crosswalk incorporates curb extensions that facilitate drainage. Source: East Bay Bicycle Coalition

### ADDITIONAL REFERENCES AND GUIDELINES

- AASHTO. *Guide for the Development of Bicycle Facilities*. 2012.
- Alta Planning + Design and IBPI. *Bicycle Boulevard Planning and Design Handbook*. 2009.
- BikeSafe. *Bicycle countermeasure selection system*.
- Ewing, Reid. *Traffic Calming: State of the Practice*. 1999.
- Ewing, Reid and Brown, Steven. *U.S. Traffic Calming Manual*. 2009.
- NACTO. *Urban Street Design Guide*. 2013.
- VTA *Bicycle Technical Guidelines recommend a "speed lump" height of seven cm with a sinusoidal ramp*.
- Institute of Transportation Engineers - <http://www.ite.org/traffic/table.asp>

### MATERIALS AND MAINTENANCE

Traffic calming should be designed to minimize impacts to snowplows. Consider temporary speed humps or cushions on snow emergency routes.

Vegetation should be regularly trimmed to maintain visibility and attractiveness.



## HORIZONTAL TRAFFIC CALMING

### DESCRIPTION

Horizontal traffic calming devices cause drivers to slow down by constricting the roadway space or by requiring careful maneuvering.

Such measures may reduce the design speed of a street, and can be used in conjunction with reduced speed limits to reinforce the expectation of lowered speeds.

### GUIDANCE

- Maintain a minimum clear width of 20 feet (or 28 feet with parking on both sides), with a constricted length of at least 20 feet in the direction of travel.
- Chicanes are a series of raised or delineated curb extensions, edge islands, or parking bays on alternating sides of a street forming an “S”-shaped curb, which reduce vehicle speeds by requiring motorists to shift laterally through narrowed travel lanes.
- Pinchpoints are curb extensions placed on both sides of the street, narrowing the travel lane and encouraging all road users to slow down. When placed at intersections, pinchpoints are known as chokers or neckdowns. They reduce curb radii and further lower motor vehicle speeds.
- Traffic circles are raised or delineated islands placed at intersections that reduce vehicle speeds by narrowing turning radii and the travel lane. Traffic circles can also include a paved apron to accommodate the turning radii of larger vehicles like fire trucks or school buses.



Temporary Curb Extension



Chicane



Choker or Neckdown



Pinchpoint with Bicycle Access

### DISCUSSION

Horizontal speed control measures should not infringe on bicycle space. Where possible, provide a bicycle route outside of the element so bicyclists can avoid having to merge into traffic at a narrow pinch point. This technique can also improve drainage flow and reduce construction and maintenance costs. Traffic calming can also deter motorists from driving on a street. Monitor vehicle volumes on adjacent streets to determine whether traffic calming results in inappropriate volumes. Traffic calming can be implemented on a trial basis.

### ADDITIONAL REFERENCES AND GUIDELINES

- AASHTO. *Guide for the Development of Bicycle Facilities*. 2012.
- Alta Planning + Design and IBPI. *Bicycle Boulevard Planning and Design Handbook*. 2009.
- BikeSafe. *Bicycle countermeasure selection system*.
- Ewing, Reid. *Traffic Calming: State of the Practice*. 1999.
- Ewing, Reid and Brown, Steven. *U.S. Traffic Calming Manual*. 2009.
- NACTO. *Urban Street Design Guide*. 2013.

### MATERIALS AND MAINTENANCE

Traffic calming should be designed to minimize impacts to snowplows. Vegetation should be regularly trimmed to maintain visibility and attractiveness.

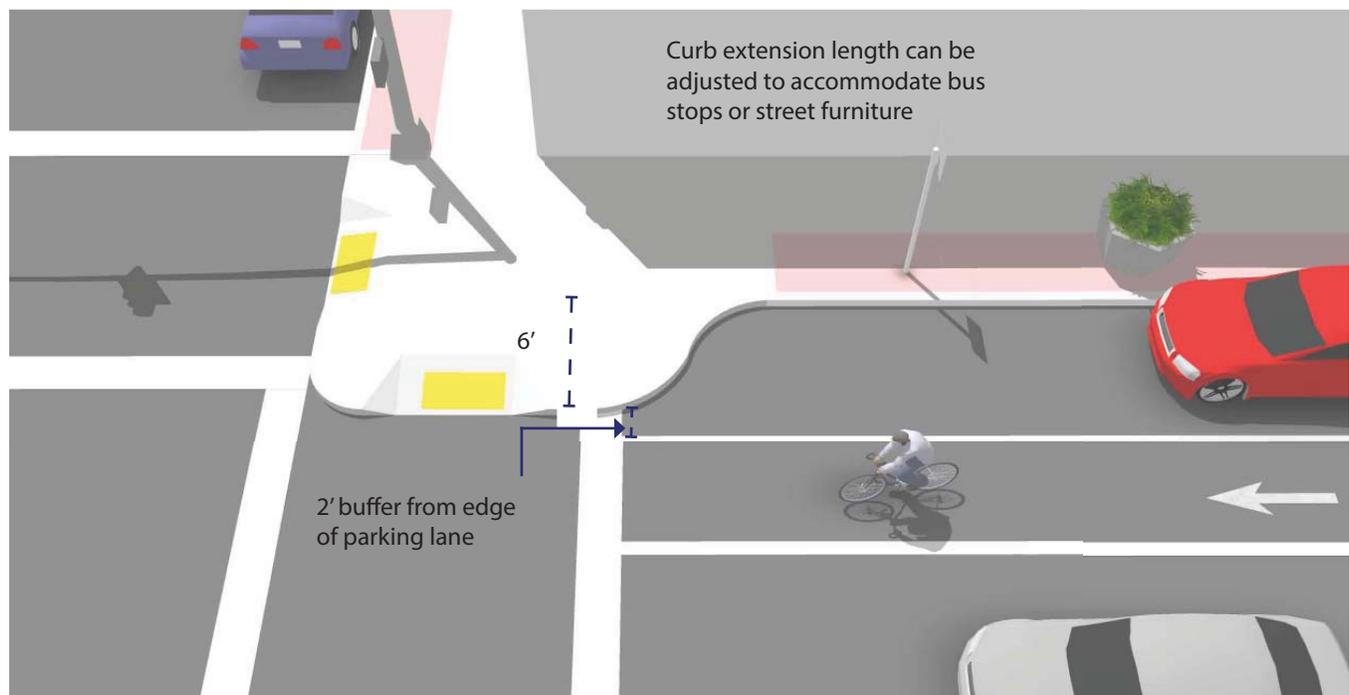
## CURB EXTENSIONS

### DESCRIPTION

Curb extensions minimize pedestrian exposure during crossing by shortening crossing distance and giving pedestrians a better chance to see and be seen before committing to crossing. They may also provide additional space for street furniture and bike parking, and increase sight distance for drivers and pedestrians. They are appropriate for any crosswalk where it is desirable to shorten the crossing distance and there is a parking lane adjacent to the curb. In certain contexts without curb-side parking, small curb extensions are still desirable but need to be carefully designed so as not to negatively impact vehicle operations, especially bicyclists.

### GUIDANCE

- In most cases, the curb extensions should be designed to transition between the extended curb and the running curb in the shortest practicable distance.
- For purposes of efficient street sweeping, the minimum radius for the reverse curves of the transition is 10 ft and the two radii should be balanced to be nearly equal.
- Curb extensions should terminate two feet short of the parking lane to maximize bicyclist safety.



### DISCUSSION

If there is no parking lane, adding curb extensions may be a problem for bicycle travel and truck or bus turning movements. The designer must carefully weigh the impacts to bicycle accessibility and safety. When implemented in areas with parking lanes, curb extensions should be 2 feet shorter than the parking lane. This assists with bicycle travel and allows for easier winter maintenance. Consider installing a vertical object on the curb extensions to guide plows.

### ADDITIONAL REFERENCES

- NACTO. (2013) *Urban Street Design Guide*.
- Ewing & Brown. (2009) *U.S. Traffic Calming Manual*.
- AASHTO. (2004). *Guide for the Planning, Design, and Operation of Pedestrian Facilities*.
- AASHTO. (2004). *A Policy on Geometric Design of Highways and Streets*.

### MATERIALS AND MAINTENANCE

Planted curb extensions may be designed as a bioswale, a vegetated system for stormwater management.



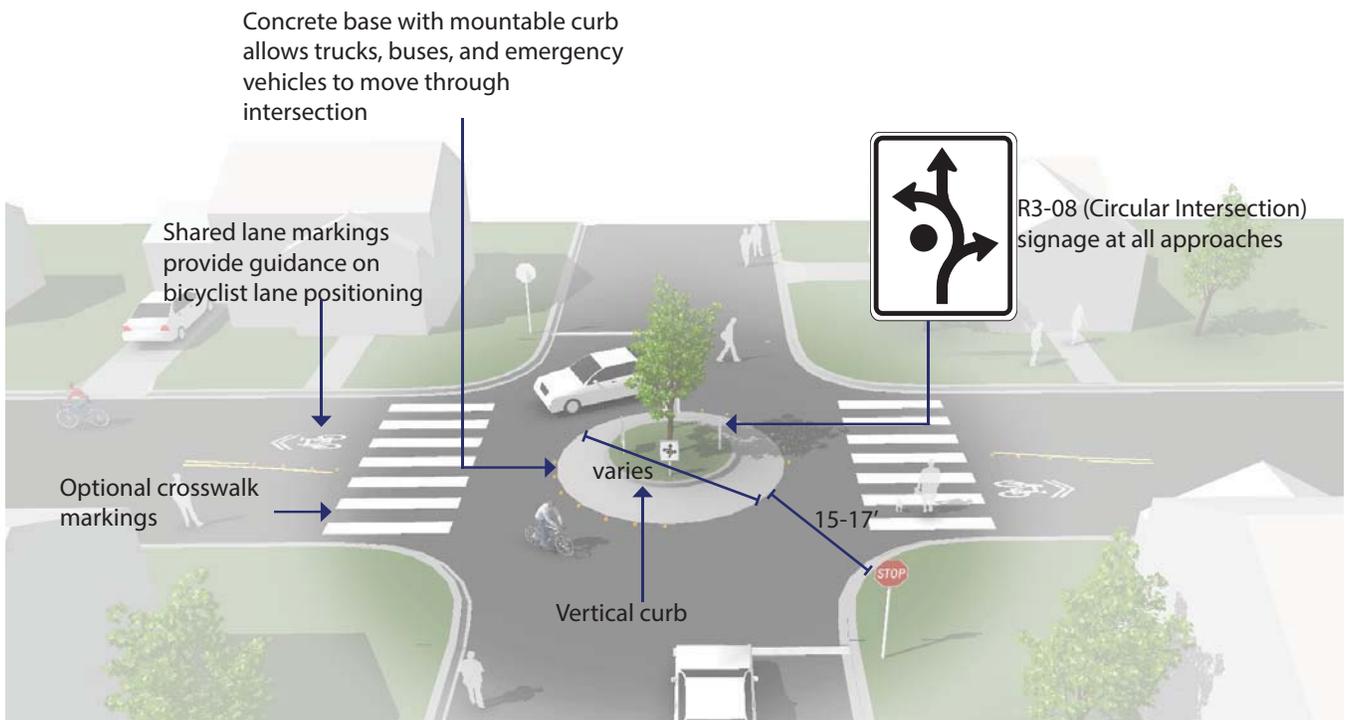
# MINI TRAFFIC CIRCLES

## DESCRIPTION

Mini traffic circles are raised, circular islands placed in the middle of local roadway intersections that control turning movements and help reduce vehicle speeds by forcing slow turns in a predictable manner. Additional benefits include reductions in local air and noise pollution from the removal of stop-and-go traffic, as well as visual and environmental benefits of added landscaping and tree planting opportunities.

## GUIDANCE

- Best suited for low-volume, local streets.
- Design must have low turning radii to reduce vehicular turning speeds, which improves pedestrian and bicyclist safety.
- Install signage and pavement markings to guide motorists, pedestrians, and bicyclists through the allowed turning movements and crossing areas.
- May be Stop- or Yield- controlled.



## DISCUSSION

Work with emergency service providers when considering mini traffic circles. Traffic circles can also include a paved apron to accommodate the turning radii of larger vehicles including fire trucks and school buses where necessary. Temporary mini traffic circles can be constructed using pre-made rubber materials or simply painting a circle in the middle of the intersection. A temporary traffic circle can be used to gauge neighborhood response and the ability for larger vehicles to navigate different diameters.



## ADDITIONAL REFERENCES

- Ewing & Brown. (2009) *U.S. Traffic Calming Manual*.
- NACTO. (2013) *Urban Street Design Guide*.
- FHWA. (2009). *Manual on Uniform Traffic Control Devices*.

## MATERIALS AND MAINTENANCE

Raised concrete planters provide opportunities to integrate landscaping or green stormwater features such as bioswales. Temporary mini traffic circles created with paint and/or removable raised features can be useful in gauging support and finalizing design.

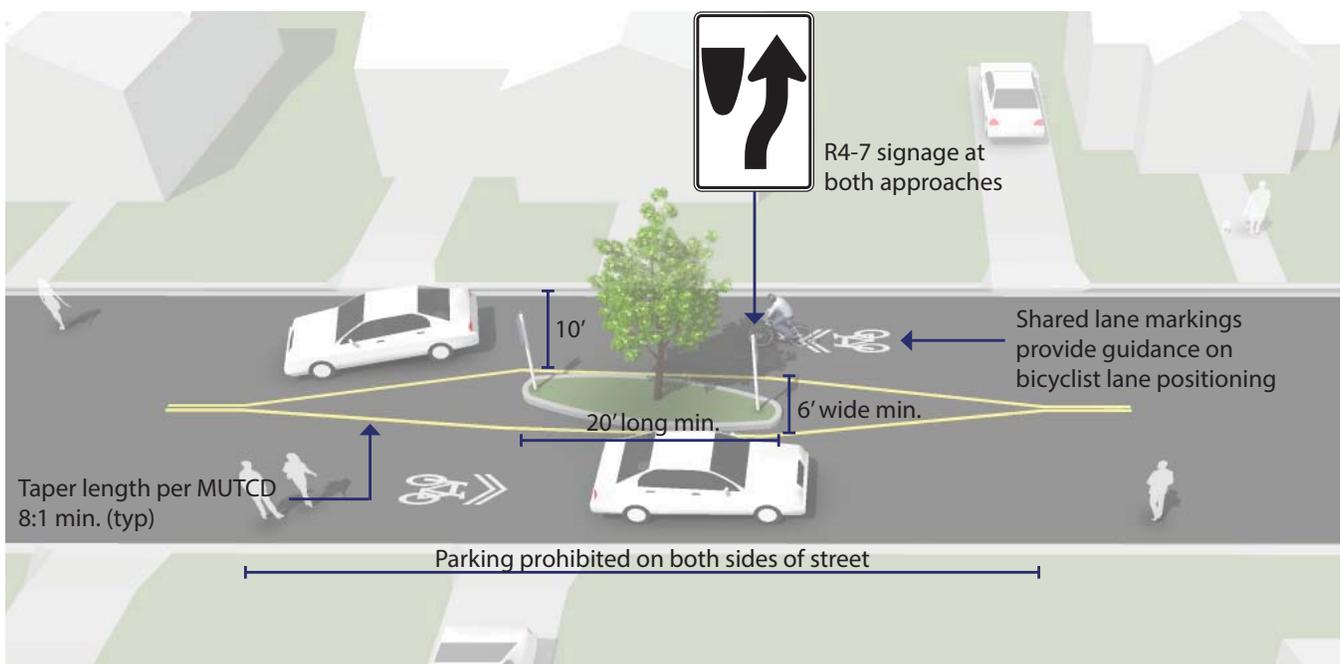
## PLANTED MEDIAN ISLANDS

### DESCRIPTION

Planted median islands are horizontal traffic calming features placed in the center of a street. Planted median islands increase visual interest and narrow the street, encouraging drivers to reduce speeds. They may integrate pedestrian refuge islands and be paired with other traffic calming features such as speed humps or textured paving. Width, length, and the amount of horizontal deflection created will vary based on context.

### GUIDANCE

- Use short median islands on neighborhood streets to slow traffic and indicate that drivers are entering a residential area.
- Long planted medians may be used on multi-lane streets as a visual narrowing technique.
- Median islands can also be configured as diverters at intersections (with pedestrian and bicycle refuges) in situations where volume management is desired.



### ADDITIONAL REFERENCES

- NCDOT. (2012). *Complete Streets Planning and Design Guidelines*.
- NACTO. (2013) *Urban Street Design Guide*.
- Ewing & Brown. (2009) *U.S. Traffic Calming Manual*.

### DISCUSSION

Consider midblock pedestrian refuges where blocks are long and crossing demand is high.

Local plantings can enhance sense of place. Median islands may also incorporate green stormwater infrastructure such as bioswales and flow-through planters.

### MATERIALS AND MAINTENANCE

Hardscaping may be used at narrow points or at pedestrian crossing points. At crossing points, landscaping and tree limbs should be maintained to allow pedestrian and motorist visibility.



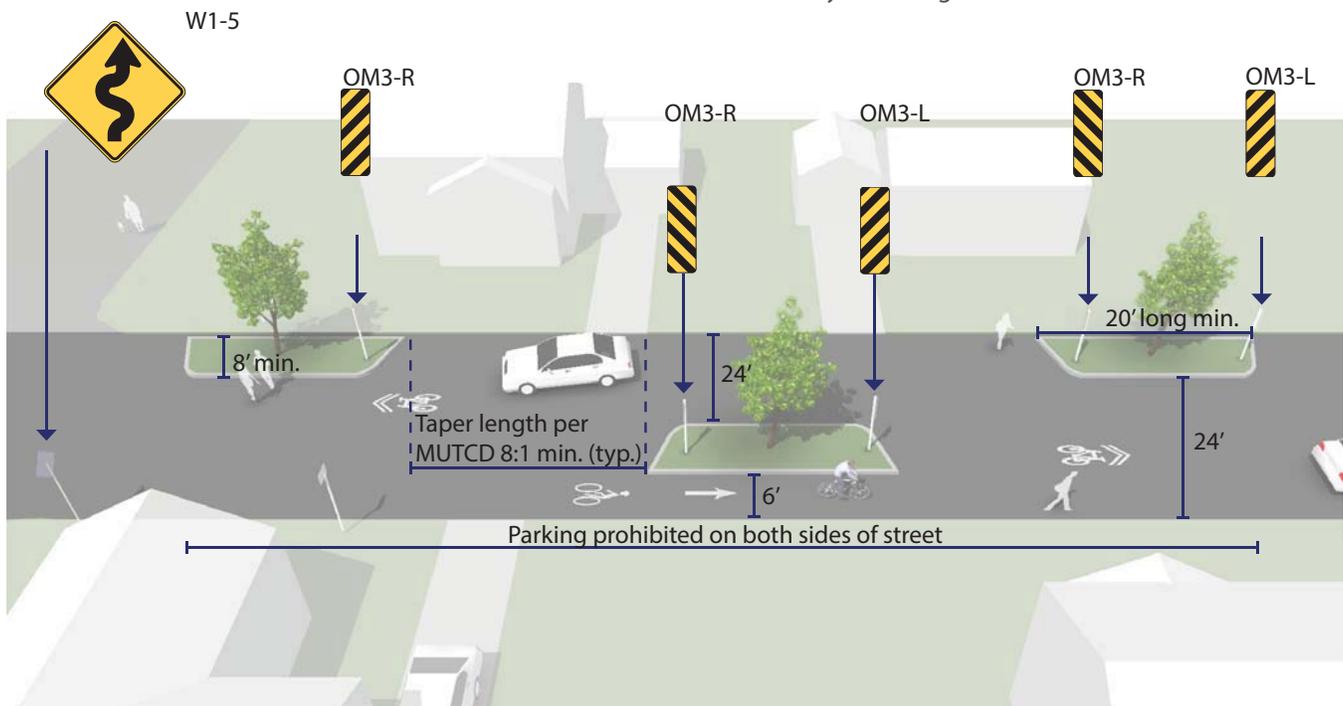
## CHICANES

### DESCRIPTION

Chicanes introduce horizontal deflections in the roadway through the use of alternating curb extensions, edge islands, or parking bays. The intent of chicanes is to slow traffic speeds thereby increasing the comfort of pedestrians and bicyclists. They may also be used to indicate a roadway transition such as from a commercial corridor to a low-speed residential area.

### GUIDANCE

- Use on low traffic residential streets.
- Use a series of at least three curb extensions, islands, or parking bays to effectively slow motorists.
- Narrowing the roadway to one lane with deflection angles of 45 degrees may help prevent “straight line racing.”
- On roadways greater than 37 feet wide, consider leaving a 5-6 foot gap between the curb and Chicane islands on bicycle boulevards to facilitate bicycle through movement.



### DISCUSSION

Chicane design must prevent motorists from being able to maintain their speed by cutting across the centerline, and must ensure that passing motorists do not squeeze cyclists at conflict points. Signage and pavement markings can reinforce the need for motorists and bicyclists to share the road if no exclusive bicycle pathway is provided near curbs. Work with emergency service providers when considering traffic calming or street closures/diverters.

### ADDITIONAL REFERENCES

- NACTO. (2013) *Urban Street Design Guide*.
- Ewing & Brown. (2009) *U.S. Traffic Calming Manual*.
- FHWA. (2009). *Manual on Uniform Traffic Control Devices*.

### MATERIALS AND MAINTENANCE

Raised concrete planters provide opportunities to integrate landscaping or green stormwater features such as bioswales. Temporary chicanes created with paint and/or removable raised features can be useful in gauging support and finalizing design.

## TRAFFIC DIVERSION

### DESCRIPTION

Motor vehicle traffic volumes affect the operation of a bicycle boulevard. Higher vehicle volumes reduce bicyclists' comfort and can result in more conflicts. Implement volume control treatments based on the context of the bicycle boulevard, using engineering judgment. Target motor vehicle volumes range from 1,000 to 3,000 vehicles per day, above which the route should be striped as a bike lane or considered a signed shared roadway.

### GUIDANCE

- Traffic diversion treatments reduce motor vehicle volumes by completely or partially restricting through traffic on a bicycle boulevard.
- Partial closures allow full bicycle passage while restricting vehicle access to one way traffic at that point.
- Diagonal diverters require all motor vehicle traffic to turn.
- Median diverters (see Major Intersection Treatments) restrict through motor vehicle movements while providing a refuge for bicyclists to cross in two stages.
- Street closures create a "T" that blocks motor vehicles from continuing on a bicycle boulevard, while bicycle travel can continue unimpeded. Full closures can accommodate emergency vehicles with the use of mountable curbs (maximum of six inches high).



Partial Closure



Diagonal Diverter



Median Diverter



Full Closure

### DISCUSSION

Bicycle boulevards on streets with volumes higher than 3,000 vehicles per day are not recommended, although a segment of a bicycle boulevard may accommodate more traffic for a short distance if necessary to complete the corridor. Providing additional separation with a bike lane, cycle track or other treatment is recommended where traffic calming or diversion cannot reduce volumes below this threshold.

### ADDITIONAL REFERENCES AND GUIDELINES

- AASHTO. *Guide for the Development of Bicycle Facilities*. 2012.
- Alta Planning + Design and IBPI. *Bicycle Boulevard Planning and Design Handbook*. 2009.
- Ewing, Reid. *Traffic Calming: State of the Practice*. 1999.
- Ewing, Reid and Brown, Steven. *U.S. Traffic Calming Manual*. 2009.
- Oregon Department of Transportation. *Right-In Right-Out Channelization*. 1998.

### MATERIALS AND MAINTENANCE

Depending on the diverter type, these treatments can be challenging to keep clear of snow and debris. Vegetation should be regularly trimmed to maintain visibility and attractiveness.



## MINOR INTERSECTION TREATMENTS

### DESCRIPTION

Treatments at minor roadway intersections are designed to improve the visibility of a bicycle boulevard, raise awareness of motorists on the cross-street that they are likely to encounter bicyclists, and enhance safety for all road users.

### GUIDANCE

- On the bicycle boulevard, the majority of intersections with minor roadways should stop-control cross traffic to minimize bicyclist delay. This will maximize bicycling efficiency.
- Traffic circles are a type of horizontal traffic calming that can be used at minor street intersections. Traffic circles reduce conflict potential and severity while providing traffic calming to the corridor.
- If a stop sign is present on the bicycle boulevard, a second stop bar for bicyclists can be placed closer to the centerline of the cross street than the motorists' stop bar to increase the visibility of bicyclists waiting to cross the street.
- Curb extensions can be used to move bicyclists closer to the centerline to improve visibility and encourage motorists to let them cross.



Stop Signs on Cross-Street



Traffic Circles



Bicycle Forward Stop Bar



Curb Extension

### DISCUSSION

Stop signs increase bicycling time and energy expenditure, frequently leading to non-compliance by bicyclists and motorists, and/or use of other less desirable routes. Bicycle boulevards should have fewer stops or delays than other local streets. A typical bicycle trip of 30 minutes can increase to 40 minutes if there is a STOP sign at every block (*Berkeley Bicycle Boulevard Design Tools and Guidelines*). If several stop signs are turned along a corridor, speeds should be monitored and traffic-calming treatments used to reduce excessive vehicle speeds on the bicycle boulevard.

### ADDITIONAL REFERENCES AND GUIDELINES

- City of Berkeley. *Bicycle Boulevard Design Tools and Guidelines*. 2000.
- City of London Transport for London. *Advanced stop lines (ASLS) background and research studies*.
- Transportation Research Board. *Improving Pedestrian Safety at Unsignalized Crossings*. NCHRP Report # 562. 2006.

### MATERIALS AND MAINTENANCE

Vegetation in traffic circles and curb extensions should be regularly trimmed to maintain visibility and attractiveness. Repaint bicycle stop bars as needed.

## MAJOR INTERSECTION TREATMENTS

### Description

The quality of treatments at major street crossings can significantly affect a bicyclist's choice to use a bicycle boulevard, as opposed to another road that provides a crossing treatment.

### Guidance

- Bike boxes increase bicyclist visibility to motorists and reduce the danger of right "hooks" by providing a space for bicyclists to wait at signalized intersections.
- Median islands provided at uncontrolled intersections of bicycle boulevards and major streets allow bicyclists to cross one direction of traffic at a time as gaps in traffic occur.
- Hybrid beacons, active warning beacons and bicycle signals can facilitate bicyclists crossing a busy street on which cross-traffic does not stop.
- Select treatments based on engineering judgment; see National Cooperative Highway Research Program (NCHRP) Report # 562 *Improving Pedestrian Safety at Unsignalized Crossings* (2006) for guidance on appropriate use of crossing treatments. Treatments are designed to improve visibility and encourage motorists to stop for pedestrians; with engineering judgement many of the same treatments are appropriate for use along bicycle boulevards.



Bike Box



Median Island



Hybrid Beacon (HAWK)



Rectangular Rapid Flash Beacon (RRFB)

### Discussion

Bicycle boulevard retrofits to local streets are typically located on streets without existing signalized accommodation at crossings of collector and arterial roadways. Without treatments for bicyclists, these intersections can become major barriers along the bicycle boulevard and compromise safety.

### Additional References and Guidelines

Transportation Research Board. *Improving Pedestrian Safety at Unsignalized Crossings*. NCHRP Report # 562. 2006.  
 Federal Highway Administration. *Safety Effects of Marked Versus Unmarked Crosswalks at Uncontrolled Locations*. FHWA-RD-04-100. 2004.  
 NACTO. *Urban Bikeway Design Guide*. 2012.

### Materials and Maintenance

Maintain signs, markings, and other treatments and replace as needed. Monitor intersections for bicyclist delay to determine if additional treatments are warranted.



## OFFSET INTERSECTION TREATMENTS

### DESCRIPTION

Offset intersections can be challenging for bicyclists who are required to briefly travel along the busier cross street in order to continue along the bicycle boulevard.

### GUIDANCE

- Appropriate treatments depend on volume of traffic including turning volumes, traffic speeds and the type of bicyclist using the crossing.
- Contraflow bike lanes allow bicyclists to travel against the flow of traffic on a one-way street and can improve bicycle boulevard connectivity.
- Bicycle left-turn lanes can be painted where a bicycle boulevard is offset to the right on a street that has sufficient traffic gaps. Bicyclists cross one direction of traffic and wait in a protected space for a gap in the other direction. The bike turn pockets should be at least 4 feet wide, with a total of 11 feet for both turn pockets and center striping.
- Short bike lanes on the cross street assist with accessing a bicycle boulevard that jogs to the left. Crossing treatments should be provided on both sides to minimize wrong-way riding.
- A cycle track can be provided on one side of a busy street. Bicyclists enter the cycle track from the bicycle boulevard to reach the connecting segment of the bicycle boulevard. This maneuver may be signaled on one side.



Contraflow Bike Lane



Left Turn Bike Lanes



Short Bike Lanes on the Cross Street



Cycle Track Connection

### DISCUSSION

Because bicycle boulevards are located on local streets, the route is often discontinuous. Wayfinding and pavement markings assist bicyclists with remaining on the route.

### ADDITIONAL REFERENCES AND GUIDELINES

- Hendrix, Michael. *Responding to the Challenges of Bicycle Crossings at Offset Intersections. Third Urban Street Symposium. 2007.*
- NACTO. *Urban Bikeway Design Guide. 2012.*

### MATERIALS AND MAINTENANCE

Paint can wear more quickly in high traffic areas or in winter climates. Facilities should be cleared of snow through routine snow removal operations.