APPENDIX B

DESIGN & MAINTENANCE STANDARDS

This section provides basic bikeway design and maintenance standards for the development of bicycle facilities. Consistent use of these standards for the development and maintenance of the regional bikeway system will ensure uniformity of the regional system between jurisdictions and for all system users.

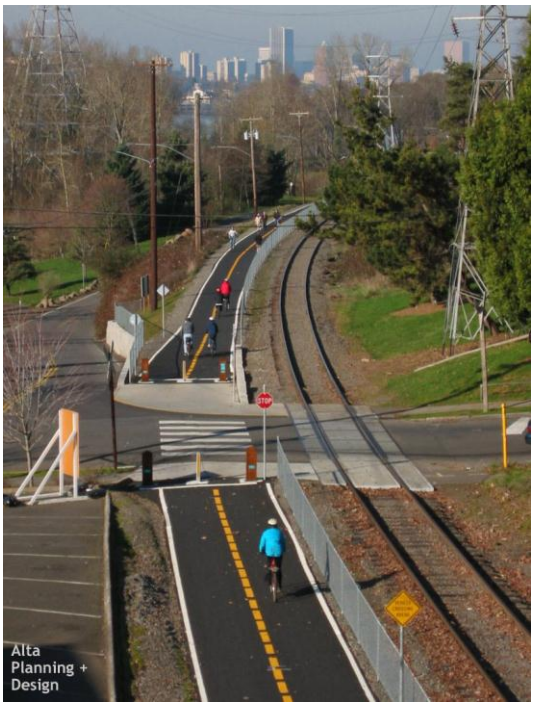
BIKEWAY CLASSIFICATION DESCRIPTIONS

According to Caltrans, the term "bikeway" encompasses all facilities that provide primarily for bicycle travel. Caltrans has defined three types of bikeways in Chapter 1000 of the Highway Design Manual: Class I, Class II, and Class III. Descriptions and general design guidelines are presented below. The sources used for these design recommendations were Caltrans' Highway Design Manual and AASTHTO's Guide for the Development of Bicycle Facilities. **Figure A-1** provides an illustration of the three types of bicycle facilities.

CLASS I BIKEWAY

Typically called a "bike path" or "shared use path," a Class I bikeway provides bicycle travel on a paved right-of-way completely separated from any street or highway. The recommended width of a shared use path is dependent upon anticipated usage:

- 8' (2.4 m) is the minimum width for Class I facilities
- 8' (2.4 m) may be used for short neighborhood connector paths (generally less than one mile in length) due to low anticipated volumes of use
- 10' (3.0 m) is the recommended minimum width for a typical two-way bicycle path
- 12' (3.6 m) is the preferred minimum width if more than 300 users per peak hour are anticipated, and/or if there is heavy mixed bicycle and pedestrian use



A minimum 2' (0.6 m) wide graded area must be provided adjacent to the path to provide clearance from trees, poles, walls, guardrails, etc. On facilities with expected heavy use, a yellow centerline stripe is recommended to separate travel in opposite directions. **Figure A-2** illustrates a typical cross-section of a Class I multi-use path.

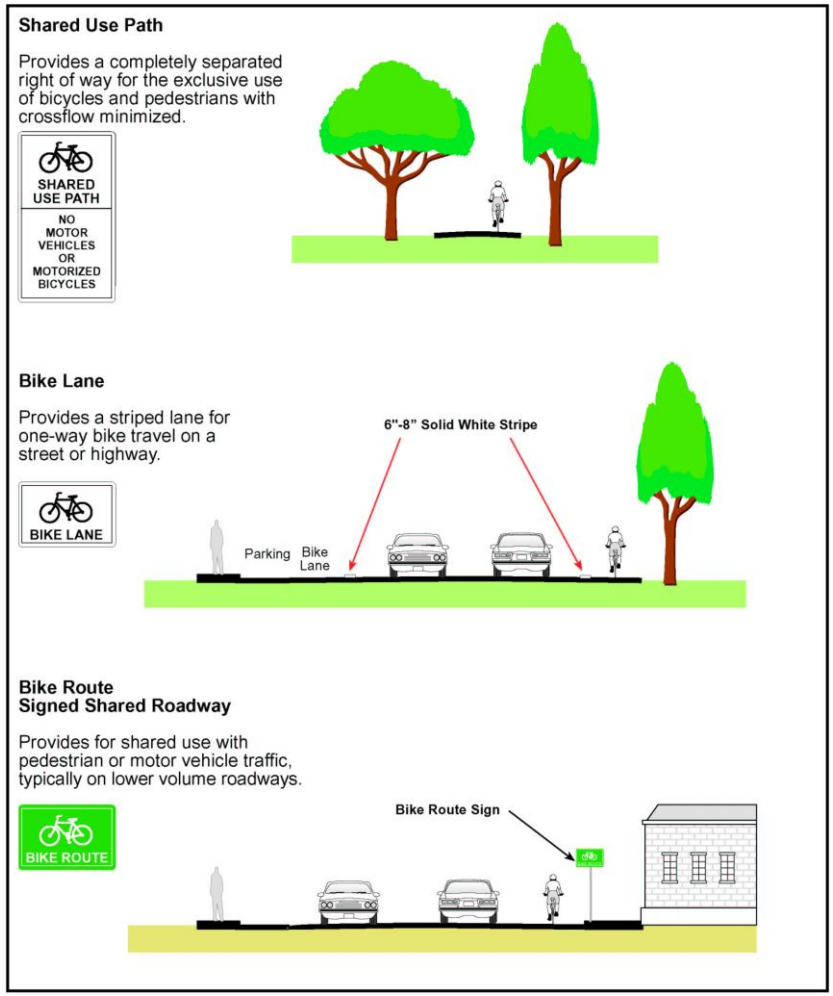


FIGURE A-1 Bicycle Facility Types

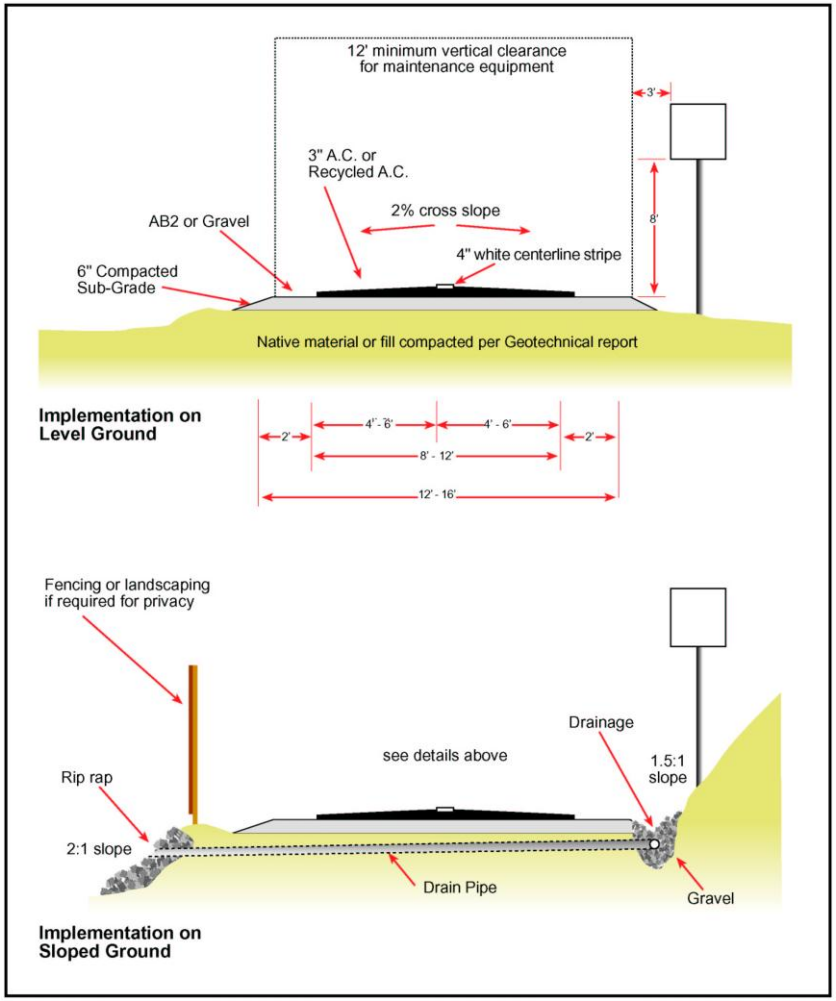


FIGURE A-2 Class I Facility Cross-Section

ADDITIONAL DESIGN RECOMMENDATIONS:

1. Shared use trails and unpaved facilities that serve primarily a recreation rather than a transportation function and will not be funded with federal transportation dollars may not need to be designed to Caltrans standards. However, state and national guidelines have been created with user safety in mind and should be followed as appropriate. Wherever any trail facility intersects with a street, roadway, or railway, standard traffic controls should always be used.
2. Class I bike path crossings of roadways require preliminary design review. Generally speaking, bike paths that cross roadways with average daily trips (ADTs) over 20,000 vehicles will require signalization or grade separation.
3. Landscaping should generally be low water consuming native vegetation and should have the least amount of debris.
4. Lighting should be provided where commuters will use the bike path in the evenings.
5. Barriers at pathway entrances should be clearly marked with reflectors and be ADA accessible (minimum five feet clearance).
6. Bike path construction should take into account impacts of maintenance and emergency vehicles on shoulders and vertical and structural requirements. Paths should be constructed with adequate sub grade compaction to minimize cracking and sinking.
7. All structures should be designed to accommodate appropriate loadings. The width of structures should be the same as the approaching trail width, plus minimum two-foot wide clear areas.
8. Where feasible, provide two-foot wide unpaved shoulders for pedestrians/runners, or a separate tread way.
9. Direct pedestrians to the right side of pathway with signing and/or stenciling.
10. Provide adequate trailhead parking and other facilities such as restrooms and drinking fountains at appropriate locations.

CLASS II BIKEWAY

Often referred to as a "bike lane," a Class II bikeway provides a striped and stenciled lane for one-way travel on either side of a street or highway. **Figure A-3** shows a typical Class II cross-section. To provide bike lanes along corridors where insufficient space is currently available, extra room can be provided by removing a traffic lane, narrowing traffic lanes, or prohibiting parking. The width of the bike lanes vary according to parking and street conditions:

- 4' (1.2 m) minimum if no gutter exists, measured from edge of pavement
- 5' (1.5 m) minimum with normal gutter, measured from curb face; or 3' (0.9 m) measured from the gutter pan seam
- 5' (1.5 m) minimum when parking stalls are marked
- 11' (3.3 m) minimum for a shared bike/parking lane where parking is permitted but not marked on streets without curbs; or 12' (3.6 m) for a shared lane adjacent to a curb face

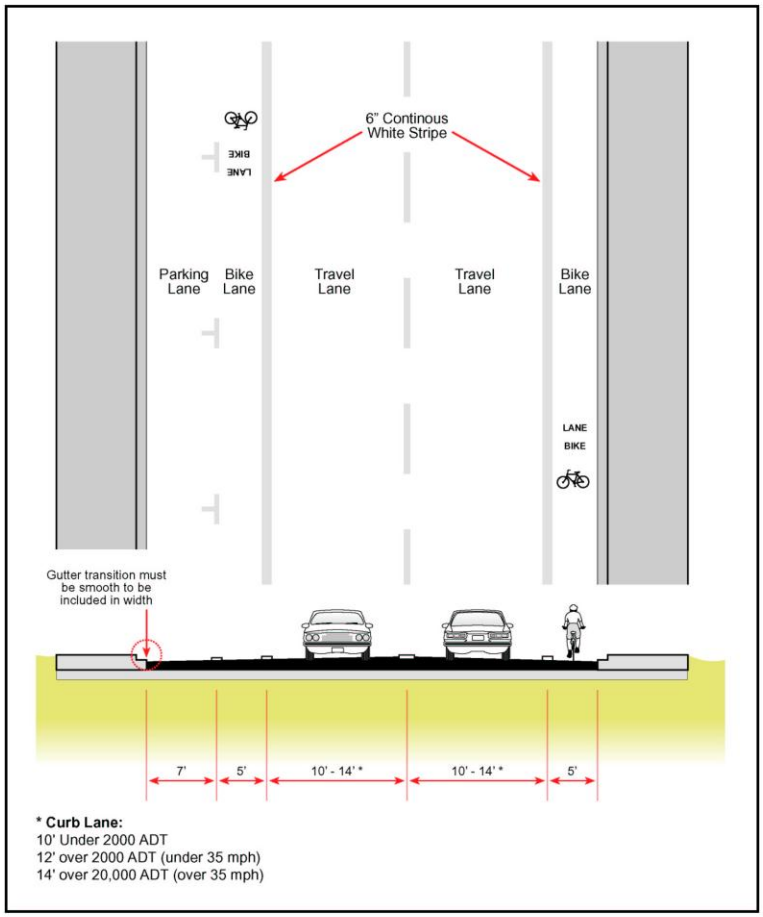


FIGURE A-3 Class II Facility Cross-Section

ADDITIONAL DESIGN RECOMMENDATIONS:

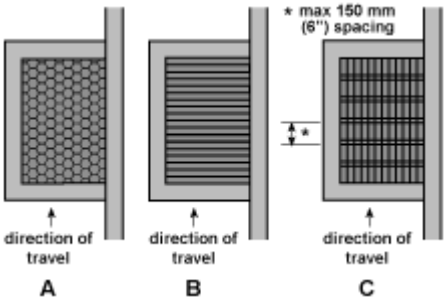
1. Whenever possible, the Department of Public Works should recommend that wider bike lanes beyond the minimum standard be installed to accommodate bicyclists.
2. Intersection and interchange treatment – Caltrans provides recommended intersection treatments in Chapter 1000 including bike lane "pockets" and signal loop detectors. The Department of Public Works should develop a protocol for the application of these recommendations, so that improvements can be funded and made as part of regular improvement projects.
3. Signal loop detectors, which sense bicycles, should be considered for all arterial/ arterial, arterial/collector, and collector/collector intersections. A stencil of a bicycle and the words "Bicycle Loop" should identify the location of the detectors.
4. When loop detectors are installed, traffic signalization should be set to accommodate bicycle speeds.
5. Bicycle-sensitive loop detectors are preferred over a signalized button specifically designed for bicyclists (see discussion of loop detectors, below).
6. Bike lane pockets (min. 4' wide) between right turn lanes and through lanes should be provided wherever available width allows, and right turn volumes exceed 150 motor vehicles/hour.
7. Where bottlenecks preclude continuous bike lanes, they should be linked with Class III route treatments.
8. A bike lane should be delineated from motor vehicle travel lanes with a solid 6" white line, per MUTCD. An 8" line width may be used for added distinction.

This drainage gate, located within a bike lane, forces cyclists to veer into the travel lane to avoid it.

9. Word and symbol pavement stencils should be used to identify bicycle lanes, as per Caltrans and MUTCD specifications.

Installing bike lanes may require more attention to continuous maintenance issues. Bike lanes tend to collect debris as vehicles disperse gravel, trash, and glass fragments from traffic lanes to the edges of the roadway. Striping and stenciling will need periodic replacing.

Poorly designed or placed drainage grates can create a serious hazard for bicyclists. Drainage grates with large slits can catch bicycle tires. Poorly placed drainage grates may also be hazardous, and can cause bicyclists to veer into the auto travel lane. For example, the photo to the right shows a drainage grate, in a bike lane which represents a hazard to bicyclists.



Examples of bicycle friendly drainage grates.

CLASS III BIKEWAY

Generally referred to as a "bike route," a Class III bikeway provides routes through areas not served by Class I or II facilities or to connect discontinuous segments of a bikeway.

Class III facilities can be shared with either motorists on roadways or pedestrians on a sidewalk (not advisable) and is identified only by signing. There are no recommended minimum widths for Class III facilities, but when encouraging bicyclists to travel along selected routes, traffic speed and volume, parking, traffic control devices, and surface quality should be acceptable for bicycle travel. A wide outside traffic lane (14') is preferable to enable cars to safely pass bicyclists without crossing the centerline.

ENHANCED CLASS III (HUMBOLDT COUNTY REGIONAL BICYCLE SYSTEM)

Currently, there are only a few existing Class III routes in the county. In many cases the perception exists that Class III bike routes – simply posting signs – may not be worth the effort, presents a maintenance burden, or that designating roads that are perceived to be dangerous for bicycles as a bike route is a liability. These perceptions need to be dispelled. Often rural roadways, which may be perceived as dangerous routes for bicycles, represent the only viable connection to a destination. An argument can be made that it's not actually the roadway that's dangerous, but the manner in which people drive and interact with cyclists on those roadways that presents the danger. An effective bicycle signing campaign on those roadways that are not feasible candidates for bike lanes should be pursued to alert motorists that bicyclists may be present. There are a number of simple bicycle-friendly augmentations that can provide more bicycle support than a Class III sign alone, but that require less space and./or are less costly than Class II lanes. Ample fog line stripes that provide space between edge of pavement or parked cars

Shared Use Arrow

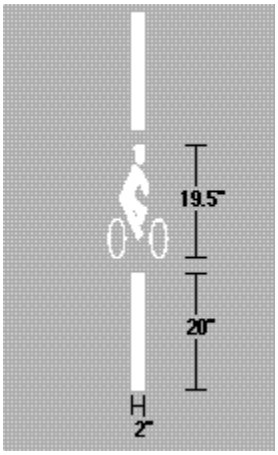
and the travel lane are especially helpful to bicyclists in these situations as they delineate the travel lane from the shoulder – this technique can also help visually constrict the roadway and slow traffic speeds. Other options include additional 'share the road' signage (which can be placed on existing sign posts or in conjunction with bike route signing) and shared use arrows to delineate bicycle routes. These optional treatments may be appropriate for specific segments of the regional bikeway system to further augment some proposed Class III routes.

INTERSECTION CONSIDERATIONS

Intersections represent one of the primary collision points for bicyclists. Generally, the larger the intersection, the more difficult it is for bicyclists to cross. Oncoming vehicles from multiple directions and increased turning movements make it difficult for motorists to see non-motorized travelers.

Most intersections do not provide a designated place for bicyclists. Bike lanes and pavement markings often end before intersections, causing confusion for bicyclists. Loop and other detectors, such as video, often do not detect bicycles.

Bicyclists wanting to make left turns can face quite a challenge. Bicyclists must either choose to behave like motorists by crossing travel lanes and seeking refuge in a left-turn lane, or they act as pedestrians and dismount their bikes, push the pedestrian walk button located on the sidewalk, and then cross the street in the crosswalk. Bicyclists traveling straight also have difficulty maneuvering from the far right lane, across a right turn lane, to a through lane of travel. Furthermore, motorists often do not know which bicyclist movement to expect.



This bicycle loop detector stencil shows bicyclists where to position their bicycle to activate the signal

Changing how intersections operate also can help make them more "friendly" to bicyclists. Improved signal timings for bicyclists, bicycle-activated loop detectors, and camera detection make it easier and safer for cyclists to cross intersections.

Figure A-4 is an example of an intersection that provides bike lanes at critical locations at intersections.

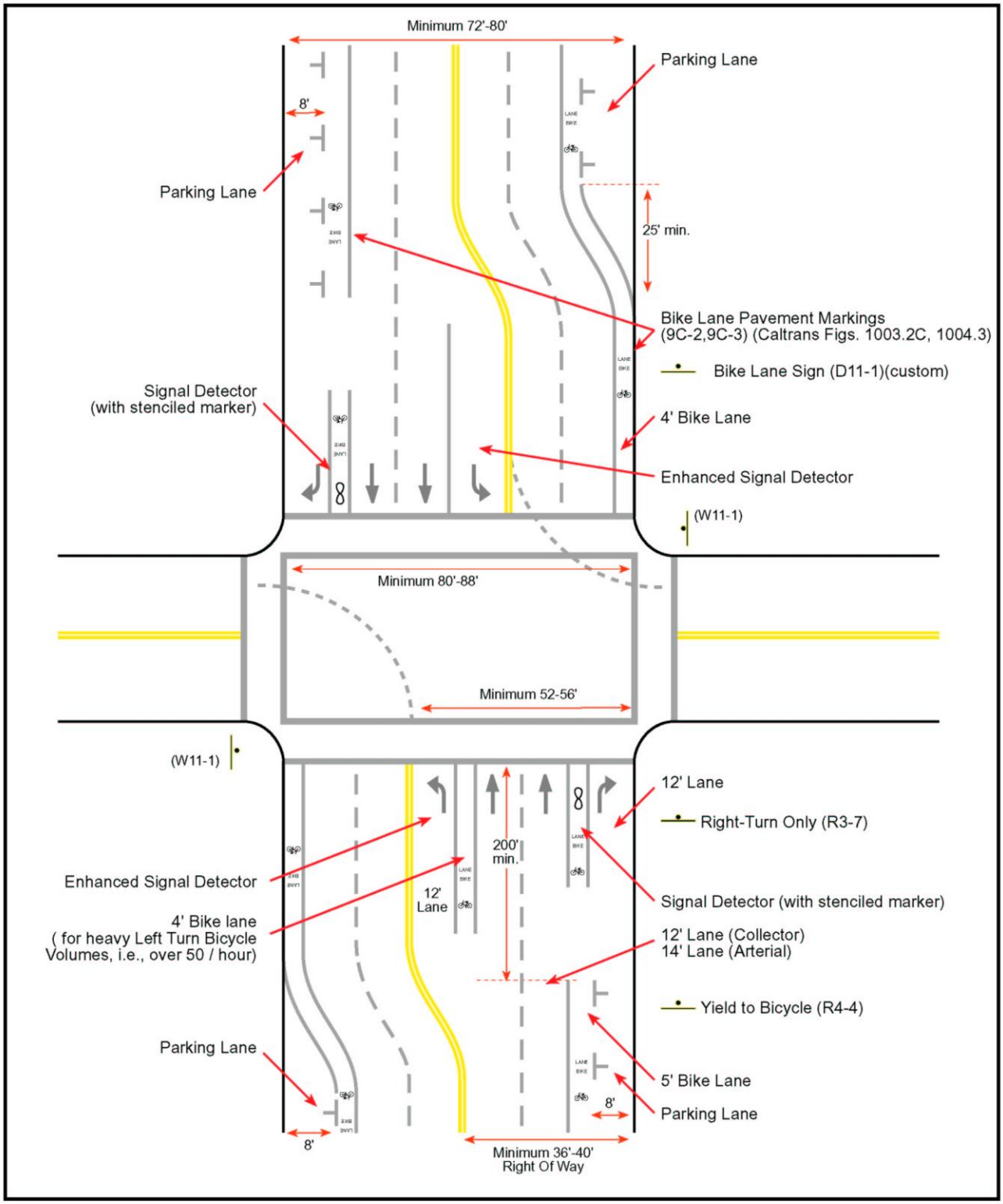
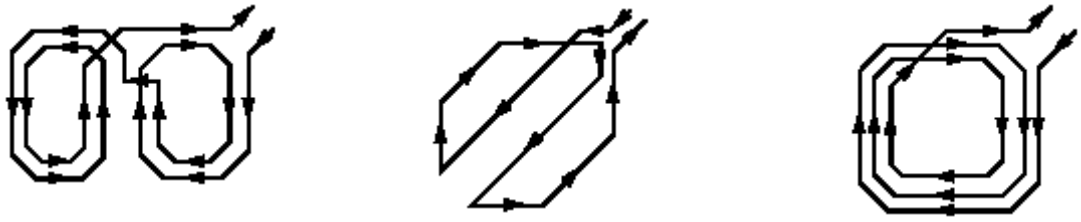


FIGURE A-4 Bike Lanes at Intersection

BICYCLE LOOP DETECTORS

The purpose of bicycle loops is to detect bicyclists waiting at intersections, and to give cyclists extra green time (e.g. five seconds) before the light turns yellow to make it through the light. Current and future loops that are sensitive enough to detect bicycles should have pavement markings to instruct cyclists how to trip them. Common loop detector types are shown in **Figure A-5** below:

Figure A-5
Common Loop Detector Types



Quadrupole Loop	**Diagonal Quadrupole Loop**	**Standard Loop**
Detects most strongly in center	Sensitive over whole area	Detects most strongly over wires
Sharp cut-off sensitivity	Sharp cut-off sensitivity	Gradual cut-off
Used in bike lanes	Used in shared lanes	Used for advanced detection

From: Implementing Bicycle Improvements at the Local Level, FHWA, 1998, page 70.

BIKE BOX

A bike box is a relatively new innovation to improve turning movements for bicyclists without requiring cyclists to merge into traffic to reach the turn lane or use crosswalks as a pedestrian. The bike box is formed by pulling the stop line for vehicles back from the intersection, and adding a stop line for bicyclists immediately behind the crosswalk. When a traffic signal is red, a bicyclist can move into this "box" ahead of the cars to make himself more visible, or to move into a more comfortable position to make a turn. Bike boxes have been used in Cambridge, MA; Eugene, OR; and European cities.

Bike box in Eugene, OR. (Photo: Evaluation of an Innovative Application of the Bike Box, FHWA, 2000.)

UNDERCROSSINGS

There are no proposed bikeway undercrossings recommended for the regional system at this time. **Figure A-6** illustrates basic design standards for undercrossings.

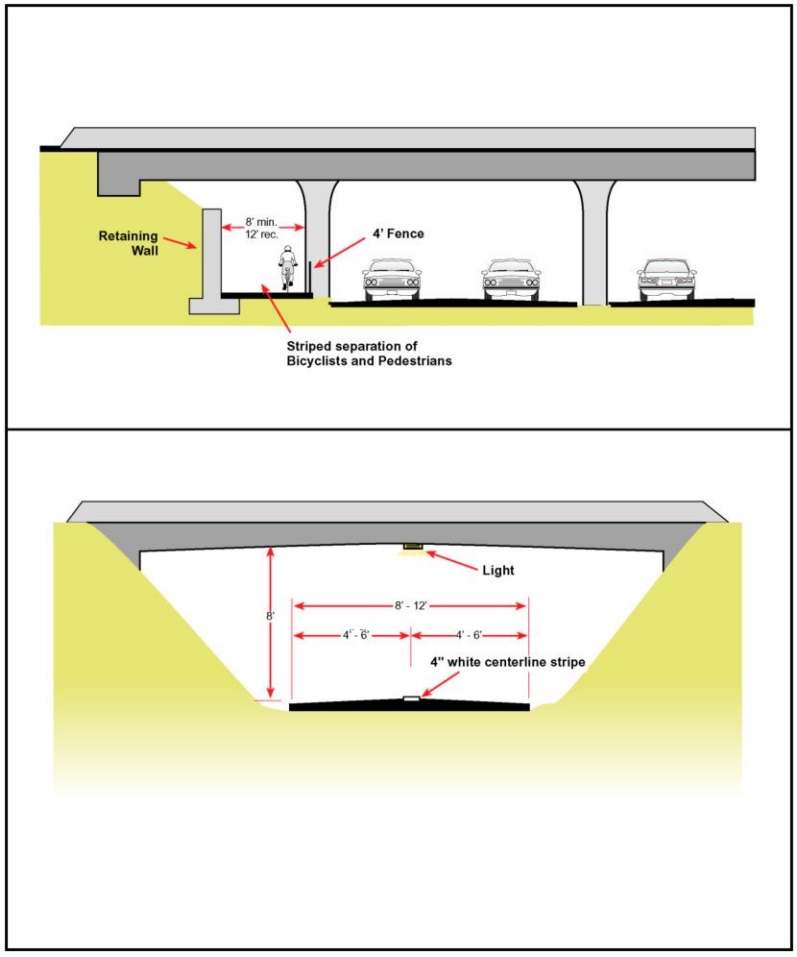


FIGURE A-6 Undercrossing Design Guidelines

Some design considerations with undercrossings:

- Must have adequate lighting and sight distance for safety
- Must have adequate overhead clearance of at least 3.1 m (10 ft)
- Tunnels should be a minimum 4.3 m (14 ft) for several users to pass one another safely; a 3.0 m x 6.0 m (10 ft x 20 ft) arch is the recommended standard
- "Channeling" with fences and walls into the tunnel should be avoided for safety reasons
- May require drainage if the sag point is lower than the surrounding terrain

This undercrossing provides ample vertical and horizontal clearance and a clear sight line through the structure, improving the feeling of safety.

SIGNAGE

Implementing a well-planned and attractive system of signing can greatly enhance bikeway facilities by signaling their presence and location to both motorists and existing and potential bicycle users. By leading people to city bikeways and the safe and efficient transportation they offer to local residents and visitors to the county, effective signage can encourage more people to bicycle.

STANDARD SIGNAGE

All bikeway signing should conform to the signing identified in the Caltrans Traffic Manual and/or the Manual on Uniform Traffic Control Devices (MUTCD). These documents give specific information on the type and location of signing for the primary bike system. A list of bikeway signs from Caltrans and the MUTCD is shown in **Table A-1**. **Figures A-7, A-8, A-9, and A-10** illustrate a number of examples of bikeway signage.

In general, the sizes of signs used on bicycle paths are smaller than those used on roadways. Table 9B-1 of the MUTCD lists minimum sign sizes for both path and roadway bicycle facilities. If the sign applies to drivers and bicyclists, then the larger size used for conventional roads shall apply.

Table A-1. **Recommended Signing and Marking**

Item	Location	Color	Caltrans Designation	MUTCD Designation
No Motor Vehicles	Entrances to trail	B on W	R44A	R5-3
Use Ped Signal / Yield to Peds	At crosswalks; where sidewalks are being used	B on W	N/A	R9-5, R9-6
Bike Lane Ahead: Right Lane Bikes Only	At beginning of bike lanes	B on W	N/A	R3-16, R3-17
STOP, YIELD	At trail intersections with roads	W on R	R1-2	R1-1, R1-2
Bicycle Crossing	For motorists at trail crossings	B on Y	W79	W11-1
Bike Lane	At the far side of all arterial intersections	B on W	R81	D11-1
Hazardous Condition	Slippery or rough pavement	B on Y	W42	W8-10
Turns and Curves	At turns and curves which exceed 20- mph design specifications	B on Y	W1, 2, 3, 4, 5, 6, 14, 56, 57	W1-1, W1-2, W1-4, W1-5, W1-6
Trail Intersections	At trail intersections where no STOP or YIELD required, or sight lines limited	B on Y	W7, 8, 9	W2-1, W2-2, W2-3, W2-4, W2-5
STOP Ahead	Where STOP sign is obscured	B, R on Y	W17	W3-1
Signal Ahead	Where signal is obscured	B, R, G	W41	W3-3
Bikeway Narrows	Where bikeway width narrows or is below 8'	B on Y	W15	W5-4

Item	Location	Color	Caltrans Designation	MUTCD Designation
Downgrade	Where sustained bikeway gradient is above 5%	B on Y	W29	W7-5
Pedestrian Crossing	Where pedestrian walkway crosses trail	B on Y	W54	W11A-2
Restricted Vertical Clearance	Where vertical clearance is less than 8'6"	B on Y	W47	W11A-2
Railroad Crossing	Where trail crosses railway tracks at grade	B on Y	W47	W10-1
Directional Signs	At intersections where access to major destinations is available	W on G	G7, G8	D1-1b(r/l), D1-1-c
Right Lane Must Turn Right; Begin Right Turn Here; Yield to Bikes	Where bike lanes end before intersection	B on W	R18	R3-7, R4-4

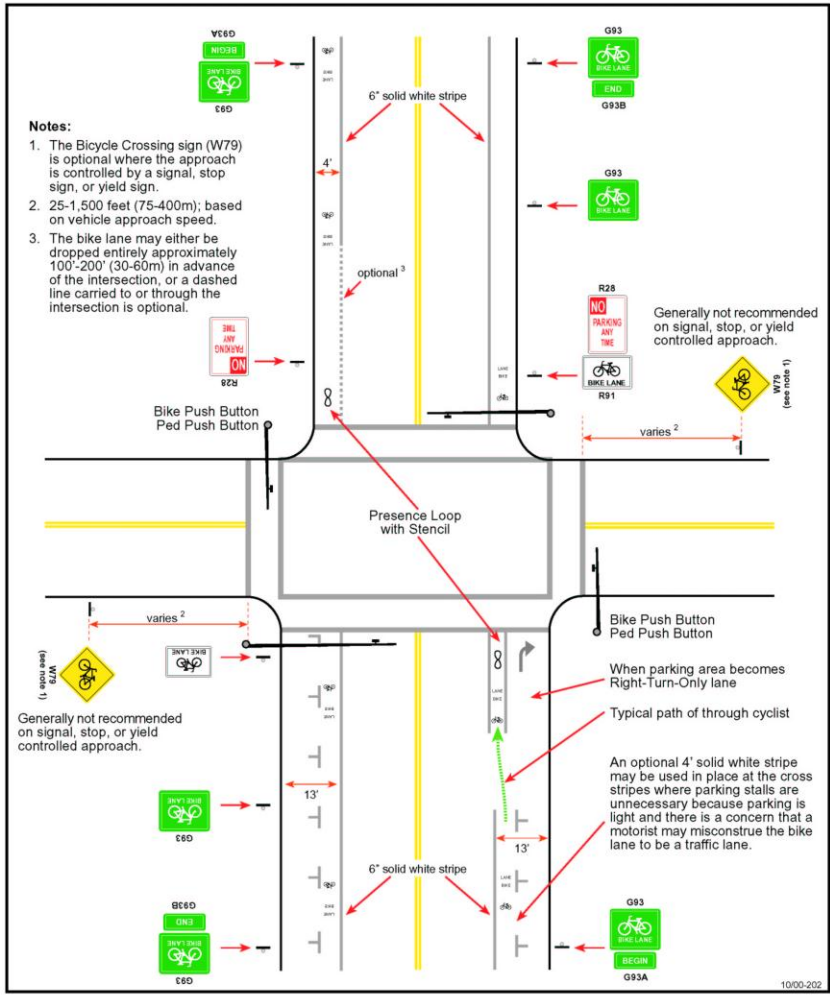
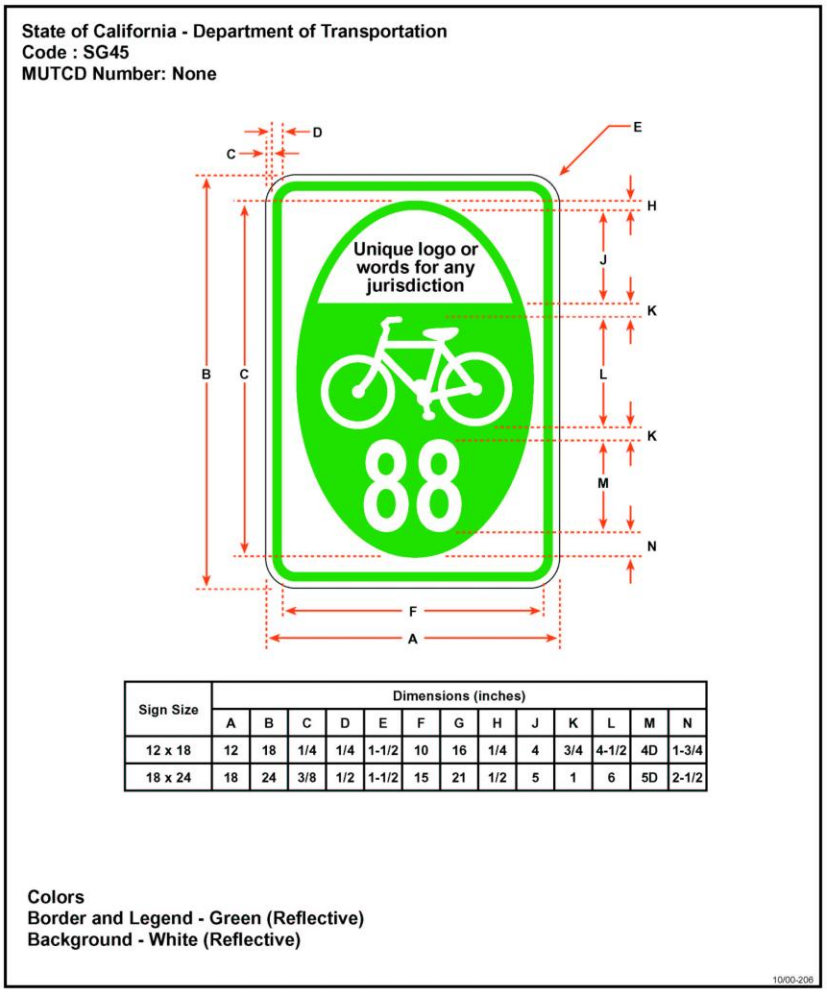


FIGURE A-7 Typical Signing At a Signalized Intersection



Sign Size	Dimensions (inches)												
	A	B	C	D	E	F	G	H	J	K	L	M	N
12 x 18	12	18	1/4	1/4	1-1/2	10	16	1/4	4	3/4	4-1/2	4D	1-3/4
18 x 24	18	24	3/8	1/2	1-1/2	15	21	1/2	5	1	6	5D	2-1/2

FIGURE A-8 Caltrans Customized Bikeway Signs

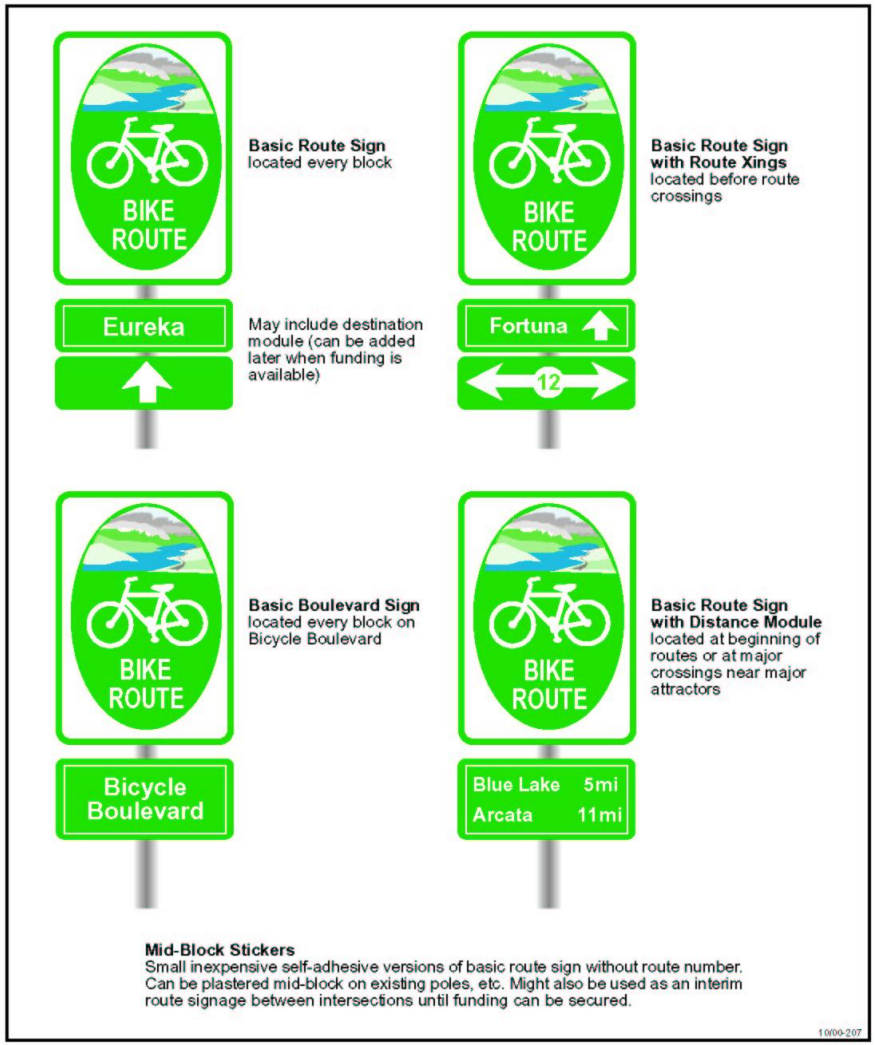


FIGURE A-9 Various Bikeway Informational Signs

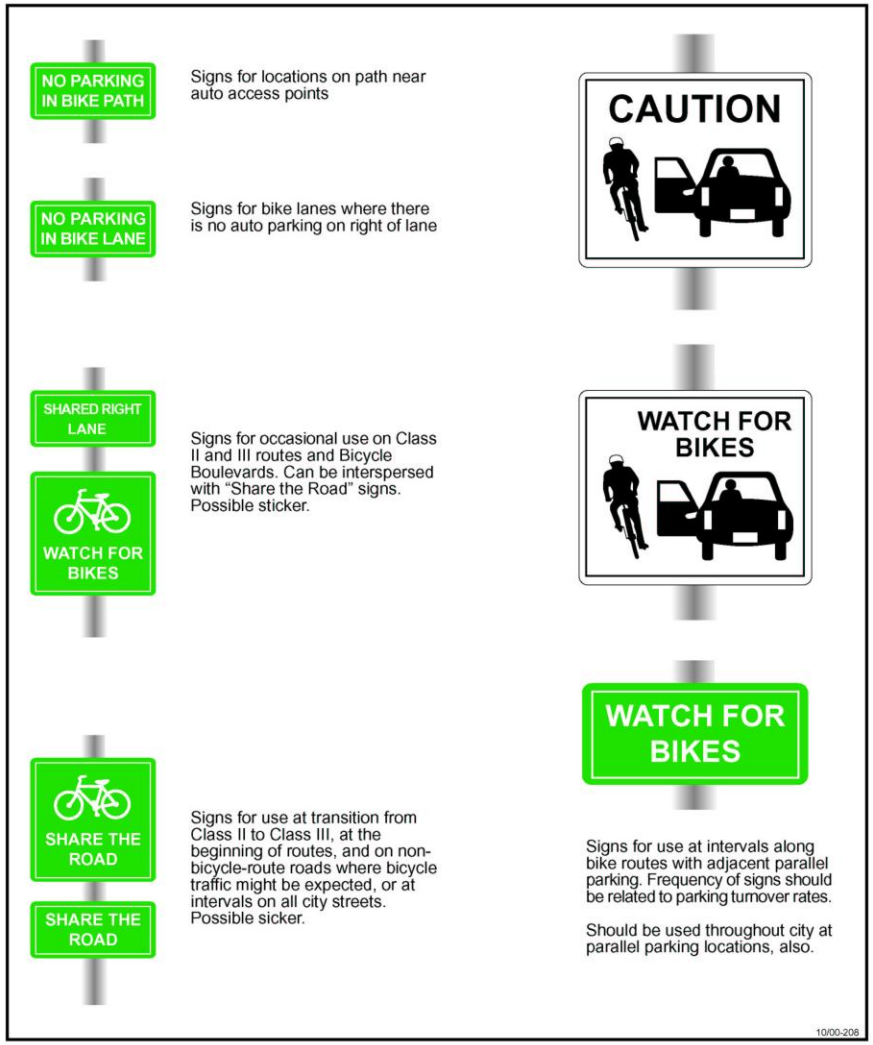


FIGURE A-10 Various On-Street Bikeway Warning Signs

OTHER SIGNAGE

Innovative signing is often developed to increase bicycle awareness and improve visibility. Signs to be installed on public roadways in California must be approved by Caltrans' California Traffic Control Devices Committee. New designs can be utilized on an experimental basis with Caltrans approval.

San Francisco was the first city in California to use the approved customized bike route logo sign. Jurisdictions may choose a graphic of their choice for the upper third portion of the sign and a numbering system, similar to the highway numbering system, can be used in the lower third. Some considerations for the use of directional signage:

- Use signs sparingly, primarily at intersections and junctions with other bicycle routes
- A consistent and recognizable logo, arrows and a destination should be on the sign to clearly direct bicyclists
- Bicycle route signs should be accompanied with destination and direction plaques

The new "Share the Road" sign, adopted by the California Traffic Control Devices Committee in 1999, is designed to advise motorists that bicyclists need to share narrow roadways with motor vehicles. This sign has been installed throughout Marin County.

Interest has been generated over the "Bikes Allowed Use of Full Lane" sign. These words, taken directly from the California Vehicle Code (CVC 21202), remind motorists of the rights of bicyclists on the roadway, Cities may consider using this sign as an experiment as it has not yet been approved by the California Traffic Control Devices Committee.

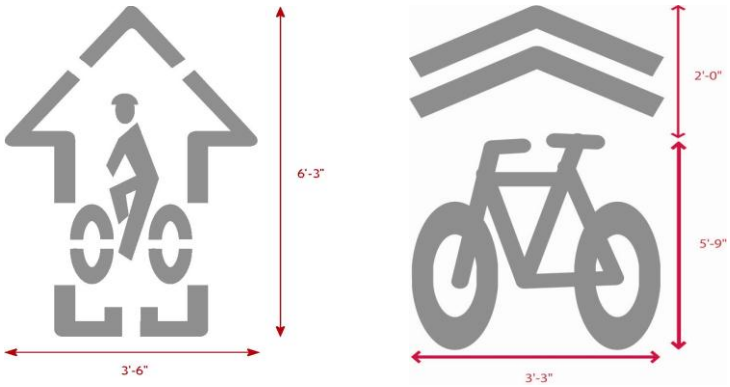
PAVEMENT MARKINGS

The Manual on Uniform Traffic Control Devices (MUTCD) provides guidance for lane delineation, intersection treatments, and general application of pavement wording and symbols for on-road bicycle facilities and off-road paths. In addition to those presented in the MUTCD, the following experimental pavement markings may be considered.

SHARED USE STENCIL

Recently, shared-use pavement stencils, an additional treatment for Class III facilities, have been introduced on city roadways. San Francisco is testing a bicycle stencil for use on Class III facilities where lanes are too narrow for sharing. The stencil can serve a number of purposes, such as making motorists aware of bicycles potentially in their lane, showing bicyclists the direction of travel, and, with proper placement, reminding bicyclists to bike further from parked cars to prevent "dooring" collisions. The City of Denver has effectively used this treatment for several years and the City of San Francisco has recently begun a study of its effectiveness. The two common stencil designs are shown below in **Figure A-11**, and **Figure A-12** illustrates the correct on-street Shared-Use pavement stencil installation.

Figure A-11. Shared-Use Pavement Stencils



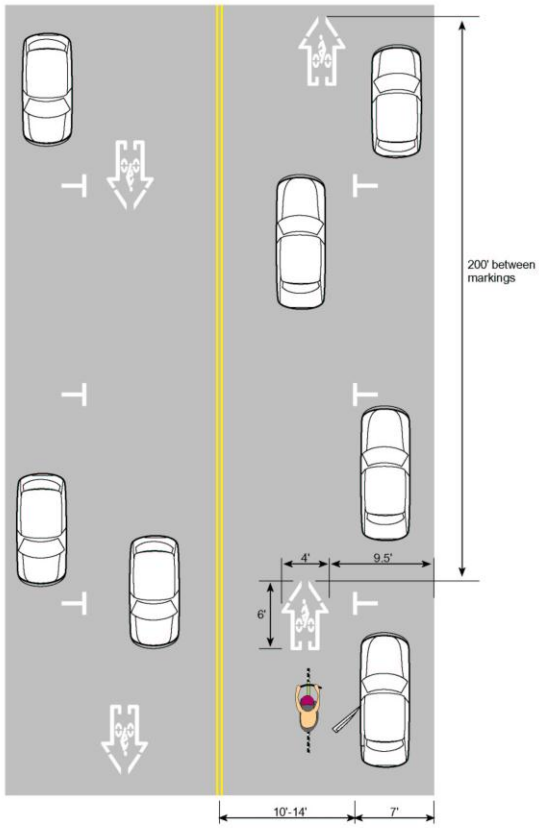


FIGURE A-12 Shared-Use Pavement Stencil Installation

Some considerations with Shared Use pavement arrows:

- Pavement markings should be installed with its centerline 3.7 m (12 ft) from the face of the curb where parking is permitted
- For curb lanes with no room for parking or bicycle lanes, the pavement marking should be placed with the logo's centerline at least 0.9 m (3 ft) from the edge of the ridable surface
- Install logo every 30.5 m – 60.9 m (100 ft - 200 ft)

COMBINED BICYCLE/RIGHT TURN LANE

In this innovative treatment, a standard-width bicycle lane is installed on the left side of the dedicated right-turn lane. A dashed stripe provides the bicycle portion and the right-turn portion of the lane. This installation should be used on roadways where there is not enough room to provide a standard-width bicycle lane and a standard-width dedicated right-turn lane. These facilities are currently used in Eugene, Oregon.

Some considerations for the implementation of combined bicycle/right turn lanes:

- Average vehicle speeds < 48 km/h (30 mi/h)
- Install a sign to instruct motorists and bicyclists how to use the facility
- Stripe and sign bicycle lane pavement markings in the turn lane to position and guide bicyclists in the right-turn lane

The photos above show the operation of a combined bicycle/right turn lane, along with the signage instructing motorists and bicyclists how to properly use the facility.

BICYCLE PARKING

As more bikeways are constructed and bicycle usage grows, the need for bike parking will climb. Long-term bicycle parking at transit stations and work sites, as well as short-term parking at shopping centers and similar sites, both can support bicycling. Bicyclists have a significant need for secure long-term parking because bicycles parked for longer periods are more exposed to weather and theft, although adequate long-term parking rarely meets demand.

BICYCLE RACKS

When choosing bike racks, there are a number of things to keep in mind:

- The rack element (part of the rack that supports the bike) should keep the bike upright by supporting the frame in two places without the bicycle frame touching the rack. The rack should allow one or both wheels to be secured.
- Position racks so there is enough room between adjacent parked bicycles. If it becomes too difficult for a bicyclist to easily lock their bicycle, they may park it elsewhere and the bicycle capacity is lowered. A row of inverted "U" racks should be situated on 30" minimum centers.
- Empty racks should not pose a tripping hazard for visually impaired pedestrians. Position racks out of the walkway's clear zone.

- When possible, racks should be in a lighted, high visibility, covered area protected from the elements. Long-term parking should always be protected

Table A-2 provides basic guidelines on the ideal locations for parking at several key activity centers as well as an optimum number of parking spaces.

Sample bicycle parking ordinance language is provided in **Appendix E** of this Plan, which outlines minimum bicycle parking standards for various land uses. This language can serve as a template for the jurisdictions in Humboldt County who would like to create a bicycle parking ordinance for inclusion in their zoning code.

Table A-2. **Recommended Guidelines for Bicycle Parking Locations and Quantities**

Land Use or Location	Physical Location	Bicycle Capacity
City Park	Adjacent to restrooms, picnic areas, fields, and other attractions	8 bicycles per acre
City Schools	Near office entrance with good visibility	8 bicycles per 40 students
Public Facilities (city hall, libraries, community centers)	Near main entrance with good visibility	8 bicycles per location
Commercial, retail and industrial developments over 10,000 gross square feet	Near main entrance with good visibility	1 bicycle per 15 employees or 8 bicycles per 10,000 gross square feet
Shopping Centers over 10,000 gross square feet	Near main entrance with good visibility	8 bicycles per 10,000 gross square feet
Commercial Districts	Near main entrance with good visibility; not to obstruct auto or pedestrian movement	2 bicycles every 200 feet
Transit Stations	Near platform or security guard	1 bicycle per 30 parking spaces

ATTENDED BICYCLE PARKING FACILITIES

Attended bike parking is analogous to a coat check – your bike is securely stored until you need it in a supervised location. An organization called The Bikestation® Coalition is promoting enhanced attended parking at transit stations.

The Bikestation® concept is now in use in Palo Alto and Berkeley in the Bay Area. Bikestations® offer secured valet bicycle parking near transit centers. What makes Bikestations® distinctive are the other amenities that may be offered at the location – bicycle repair, cafes, showers and changing facilities, bicycle rentals, licensing, etc. Bikestations® become a virtual one-stop-shop for bicycle commuters.

Attended bicycle parking can be offered at some special events. For example, the Marin County Bicycle Coalition sponsors valet parking at many festivals in the county, the Sonoma County Bicycle Coalition sponsors valley parking at the downtown Santa Rosa Farmer's Market, and secured bicycle parking is offered at Pac Bell Park in San Francisco.