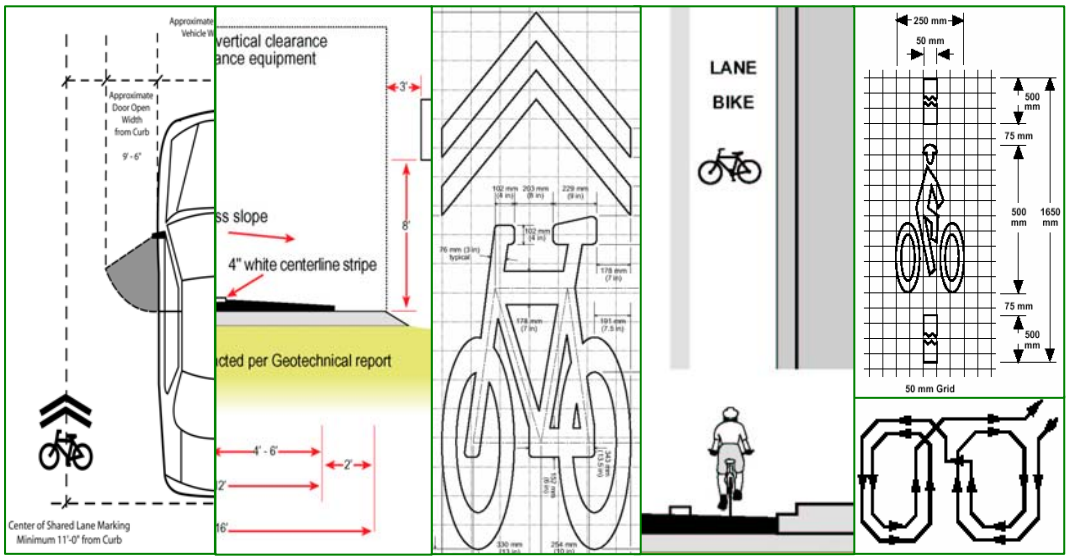
March 2008 – FINAL DRAFT

Supplemental Bikeway Design Guidelines



Prepared for:
Marin County Department of Public Works
Marin County Unincorporated Area
Bicycle and Pedestrian Master Plan

Prepared by:
Alta Transportation Consulting

Supplemental Bikeway Design Guidelines

This reference is provided as a supplement to the 2008 Marin County Unincorporated Area Bicycle and Pedestrian Master Plan. These basic bikeway planning and design requirements are furnished for use in developing the County of Marin bikeway system and support facilities. Where applicable, all recommendations in this appendix meet Caltrans Chapter 1000 "Bikeway Planning and Design" requirements.

Bikeway Facility Classifications

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. For each type of bikeway facility both "Design Requirements" and "Additional Design Recommendations" are provided. Design requirements are those established by Caltrans Chapter 1000 "Bikeway Planning and Design". "Additional Design Recommendations" are provided to assist with design and implementation of facilities and include alternate treatments approved or recommended by not required by Caltrans.

Figure 1 provides an illustration of the three types of bicycle facilities.

Class I Bikeway – Design Requirements

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 2** illustrates a typical cross-section of a Class I multi-use path.

Class I Bikeway - 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 during hours of darkness.
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 – Design requirements

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 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

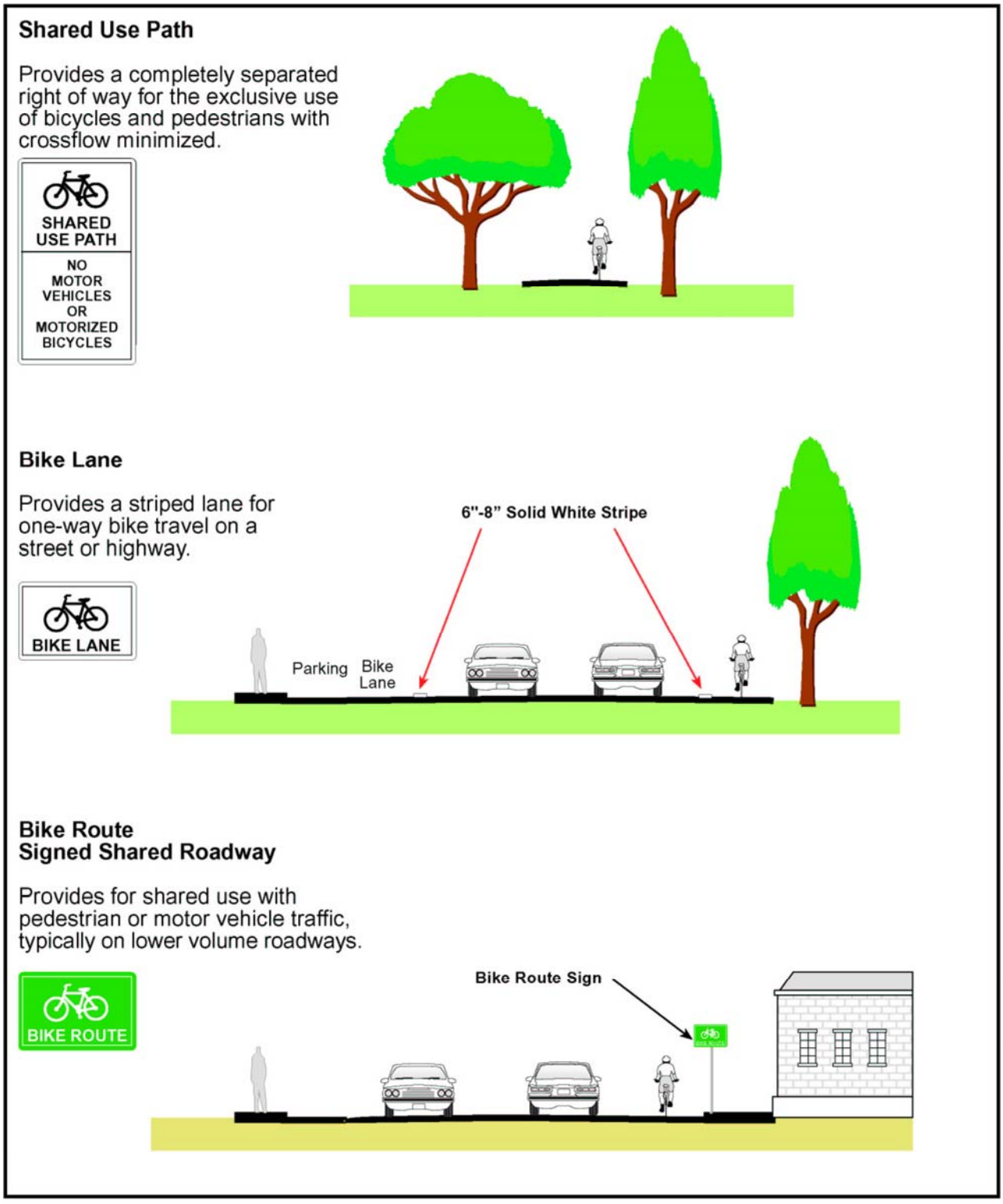


Figure 1 Bicycle Facility Types

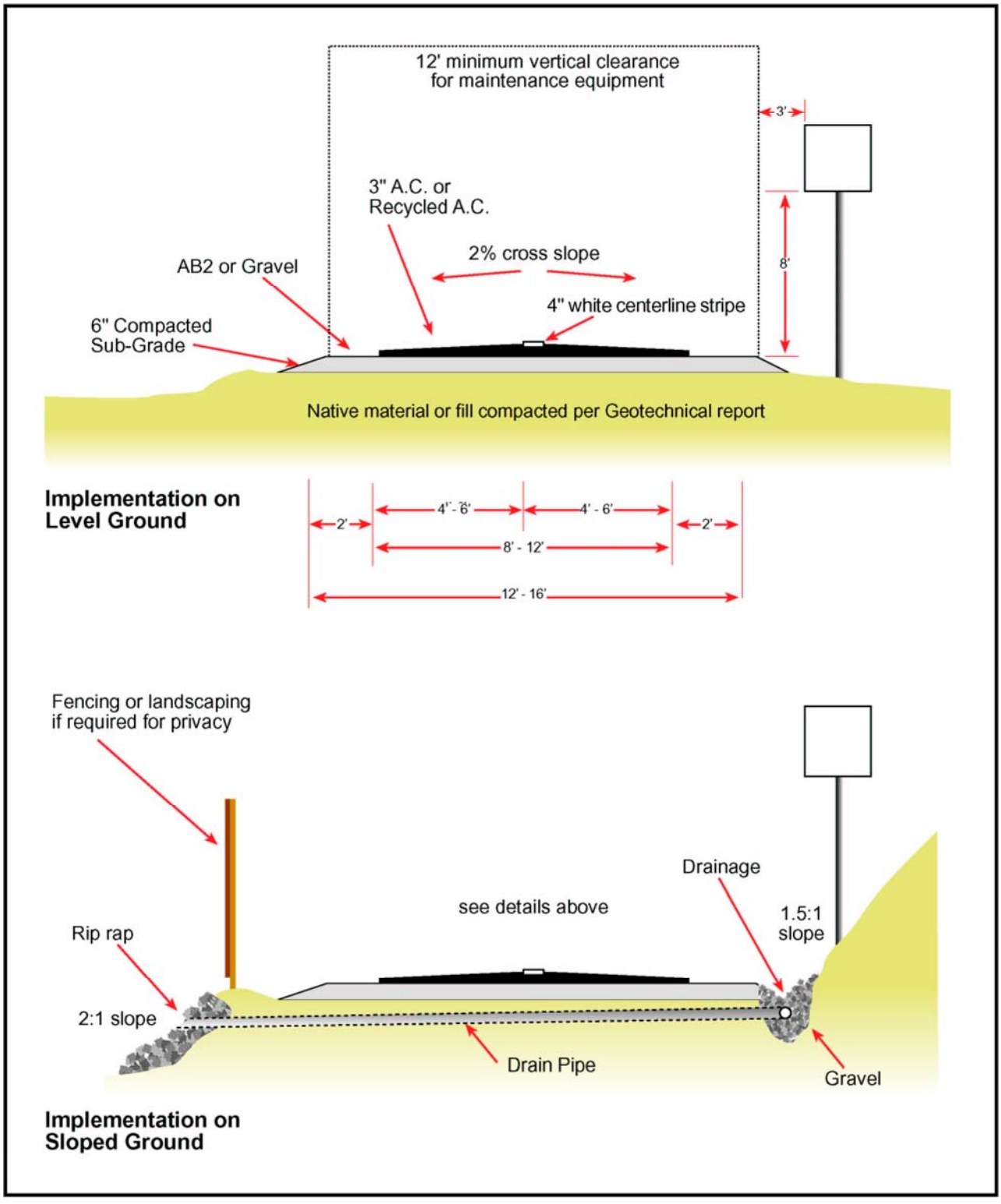


Figure 2 Class I Facility Cross-Section

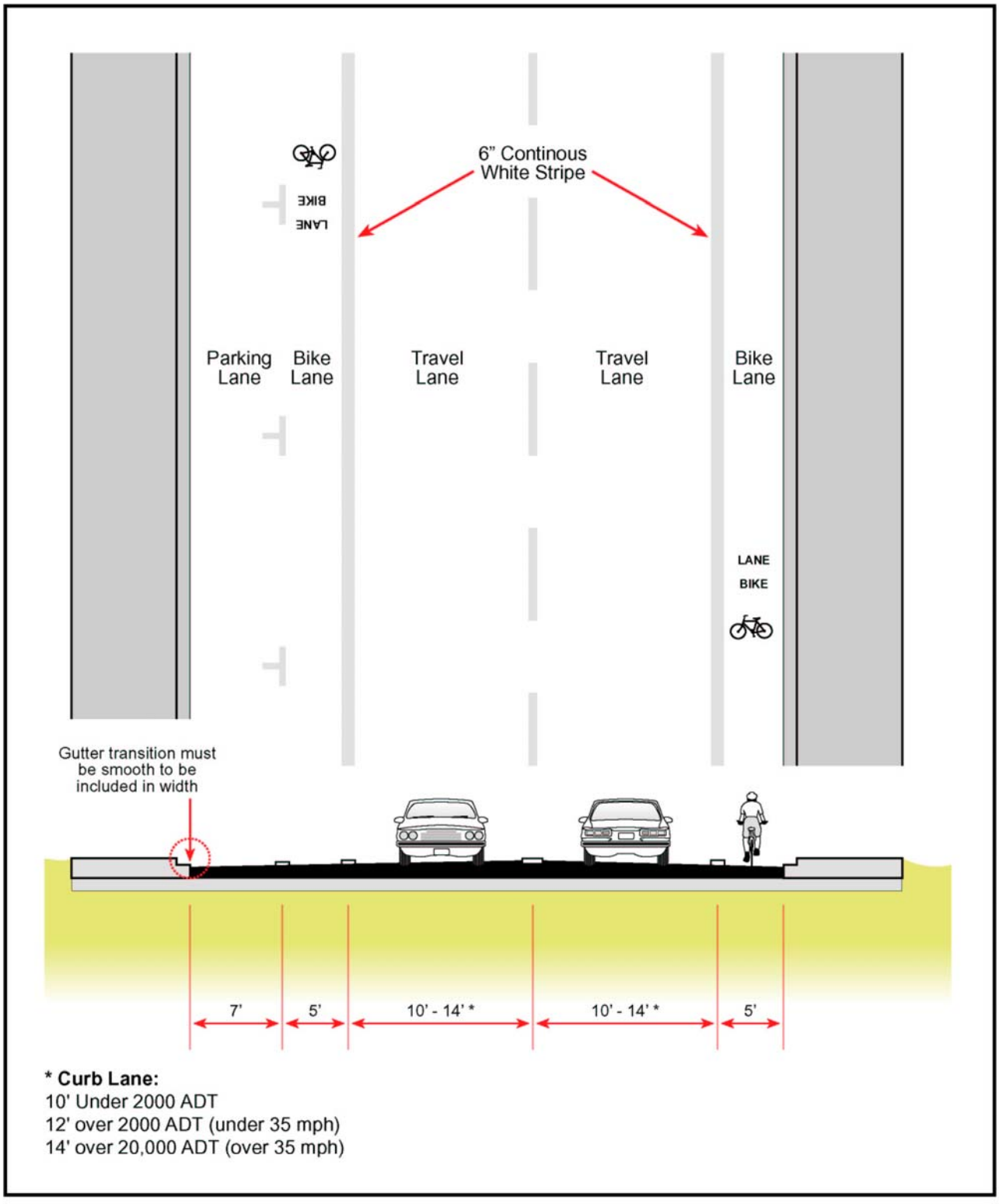


Figure 3 Class II Facility Cross-Section

Class II bikeway - Additional Design Recommendations:

1. Whenever possible, the Department of Public Works should recommend that wider bike lanes beyond the minimum standard be installed.
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.
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 often hazardous to 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.

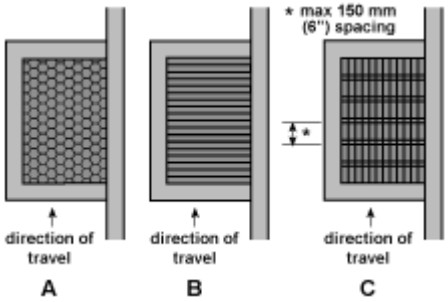


Figure 4 Examples of Bicycle-Friendly Drainage Grates

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.

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. **Figures 5 and 6** are examples of an intersection that provides bike lanes at critical locations at intersections.

Bike Lane Adjacent to Right-Turn Only Lane

Right-turn only lanes present challenges for through-cyclists who must merge to the left to position themselves in the through travel lane. Jurisdictions will sometimes stripe bike lanes on the right-side of right-turn only lanes, which places the through-cyclist in direct conflict with a right-turning vehicle. The appropriate treatment for right-turn only lanes is to either drop the bike lane entirely approaching the right-turn lane, or to place a bike lane pocket between the right-turn lane and the right-most through lane. The design below illustrates a bike lane pocket, with signage indicating that motorists should yield to bicyclists through the merge area.

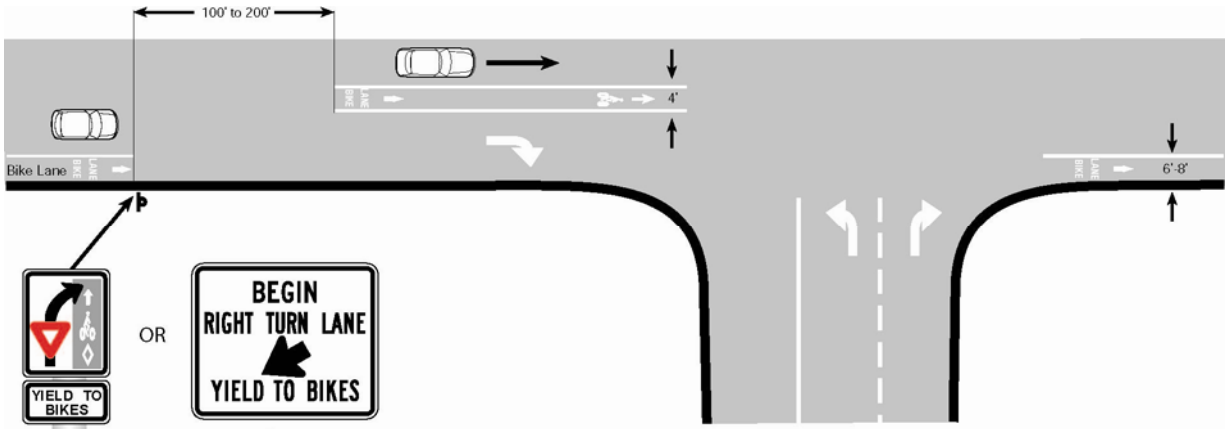


Figure 5 Bike Lane Adjacent to Right-Turn Only Lane

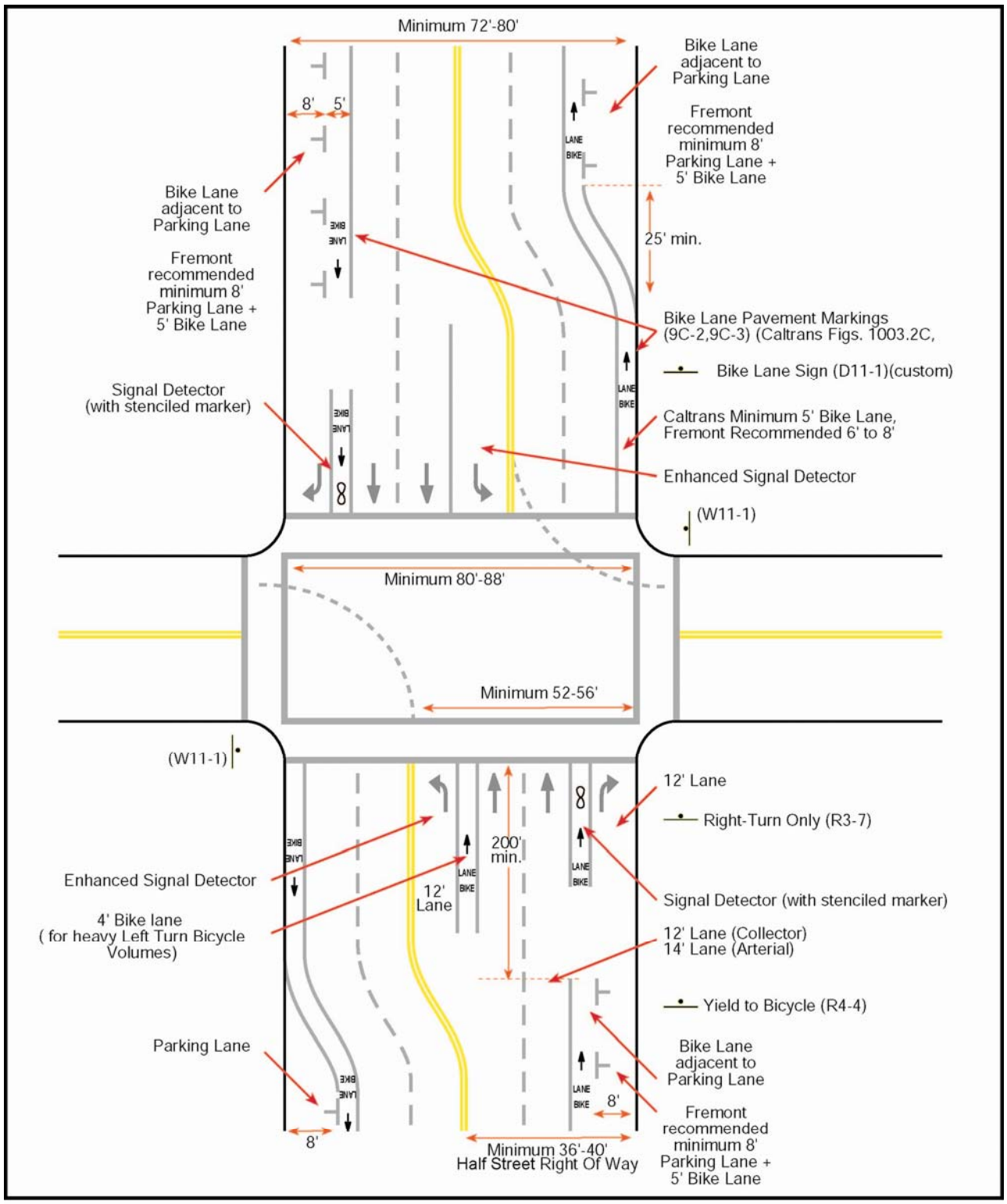


Figure 6 Bike Lanes at Intersection

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.

Class III Bikeway - Additional Design Recommendations

The following recommendations provide additional design options for the existing and proposed Class III routes identified in Marin County's Bicycle Plan. These designs meet Caltrans requirements but are no required as elements of a Class III facility and are provided for information only. No Class III routes are currently designated for these treatments.

Shared Lane Marking

Recently, Shared Lane Marking stencils (also called "Sharrows"), have been introduced for use in California as an additional treatment for Class III facilities. 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. **Figure 7** illustrates recommended on-street Shared Lane Marking stencil placement. The "Chevron" marking design recommended by Caltrans is shown in **Figure 8.** The following pavement markings were adopted for official use by Caltrans on 9/12/2005 as MUTCD 2003 California Supplement Section 9C.103 and Figure 9C-107. Guidance language provided by Caltrans for use of the Shared Lane Marking is as follows:

Section 9C.103 Shared Roadway Bicycle Marking

Option:
The Shared Roadway Bicycle Marking shown in Figure 9C-107 may be used to assist bicyclists with positioning on a shared roadway with on-street parallel parking and to alert road users of the location a bicyclist may occupy within the traveled way.

Standard:
The Shared Roadway Bicycle Marking shall only be used on a roadway which has on-street parallel parking. If used, Shared Roadway Bicycle Markings shall be placed so that the centers of the markings are a minimum of 3.3 m (11 ft) from the curb face or edge of paved shoulder. On State Highways, the Shared Roadway Bicycle Marking shall be used only in urban areas.

Option:
For rural areas, the SHARE THE ROAD (W16-1) plaque may be used in conjunction with the W11-1 bicycle warning sign (see Sections 2C.51 and 9B.18). Information for the

practitioner regarding classification of rural versus urban roadways can be found at the following California Department of Transportation website:
http://www.dot.ca.gov/hq/tsip/hpms/Page1.php

Guidance:
If used, the Shared Roadway Bicycle Marking should be placed immediately after an intersection and spaced at intervals of 75 m (250 ft) thereafter. If used, the Shared Roadway Bicycle Marking should not be placed on roadways with a speed limit at or above 60 km/h, (40 mph).

Option:
Where a Shared Roadway Bicycle Marking is used, the distance from the curb or edge of paved shoulder may be increased beyond 3.3 m (11 ft). The longitudinal spacing of the markings may be increased or reduced as needed for roadway and traffic conditions. Where used, bicycle guide or warning signs may supplement the Shared Roadway Bicycle Marking.

Support:
The Shared Roadway Bicycle Marking is intended to:
* Reduce the chance of bicyclists impacting open doors of parked vehicles on a shared roadway with on-street parallel parking.
* Alert road users within a narrow traveled way of the lateral location where bicyclists ride.
* Be used only on roadways without striped bicycle lanes or shoulders.

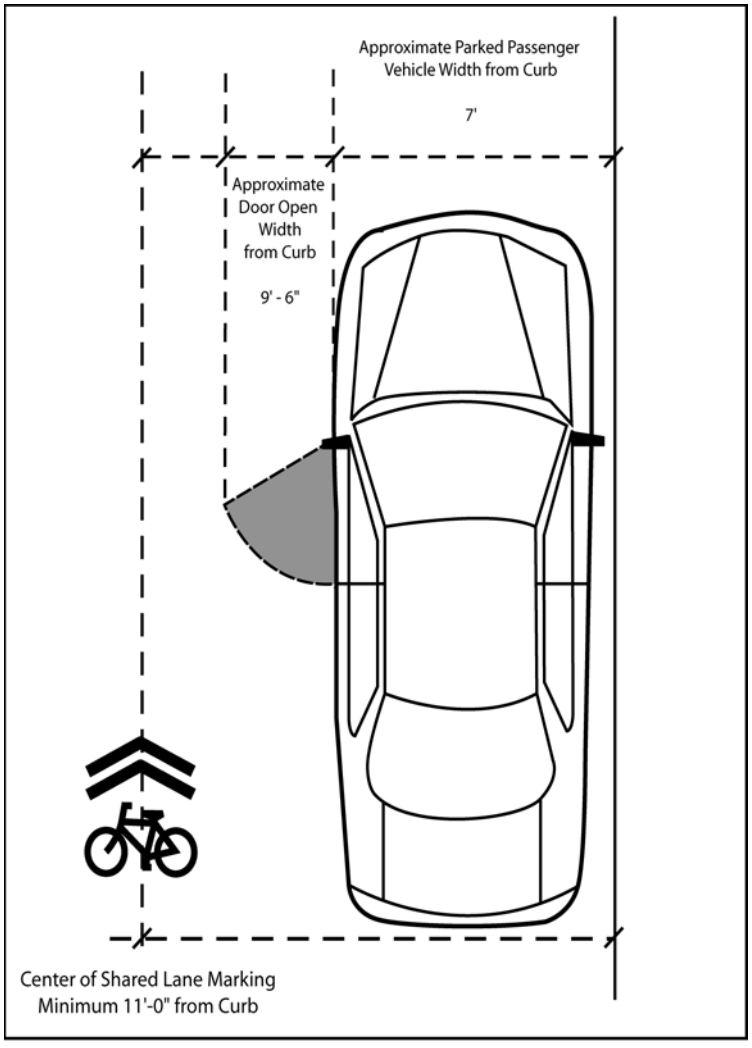


Figure 7 Shared Lane Marking Placement

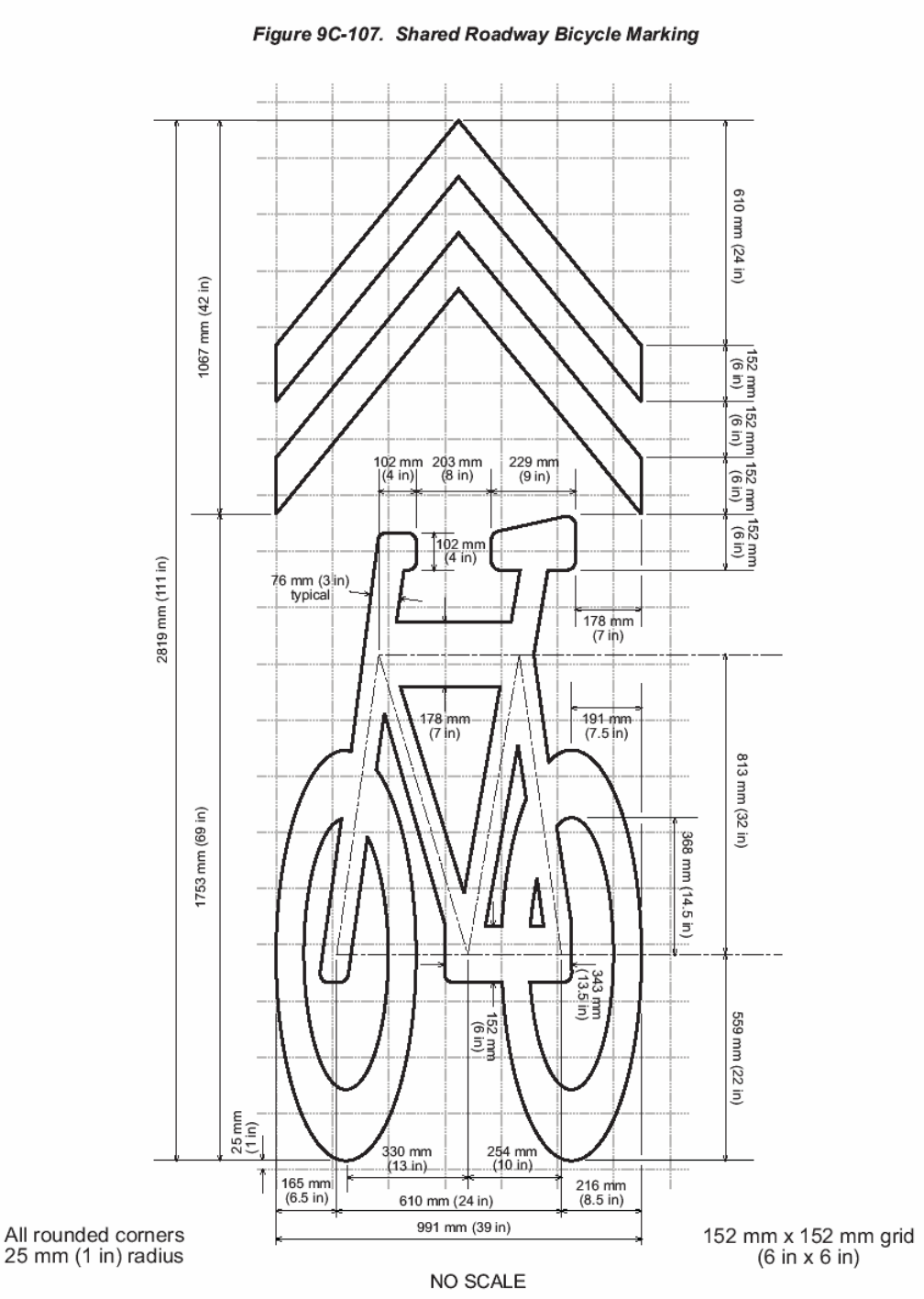


Figure 8 Shared Lane Marking

Bicycle Boulevard

A bicycle boulevard treatment is typically a lower volume street with traffic calming treatments that parallels a higher volume arterial. Traffic calming typically includes a set of improvements to slow traffic and prevent cut-through traffic such as: traffic circles, chokers, and medians. In addition, stop signs favor bicyclists by stopping perpendicular

traffic. Sensor loops activate traffic signals to allow safe crossings of higher volume roadways. The following design considerations apply to a bicycle boulevard:

- Typically used on low volume streets
- Traffic-calmed streets located within 1/4 mile of parallel arterials
- Allows access to key destinations
- Provides safe arterial street crossing for cyclists
- Possible Speed Limit reduction from 25 MPH to 20 MPH

Figure 9 illustrates a typical bicycle boulevard street configuration.
For more information, see the City of Berkeley Bicycle Boulevard *Design Tools and Guidelines* at
http://www.ci.berkeley.ca.us/transportation/Bicycling/BB/Guidelines/linkpag.htm

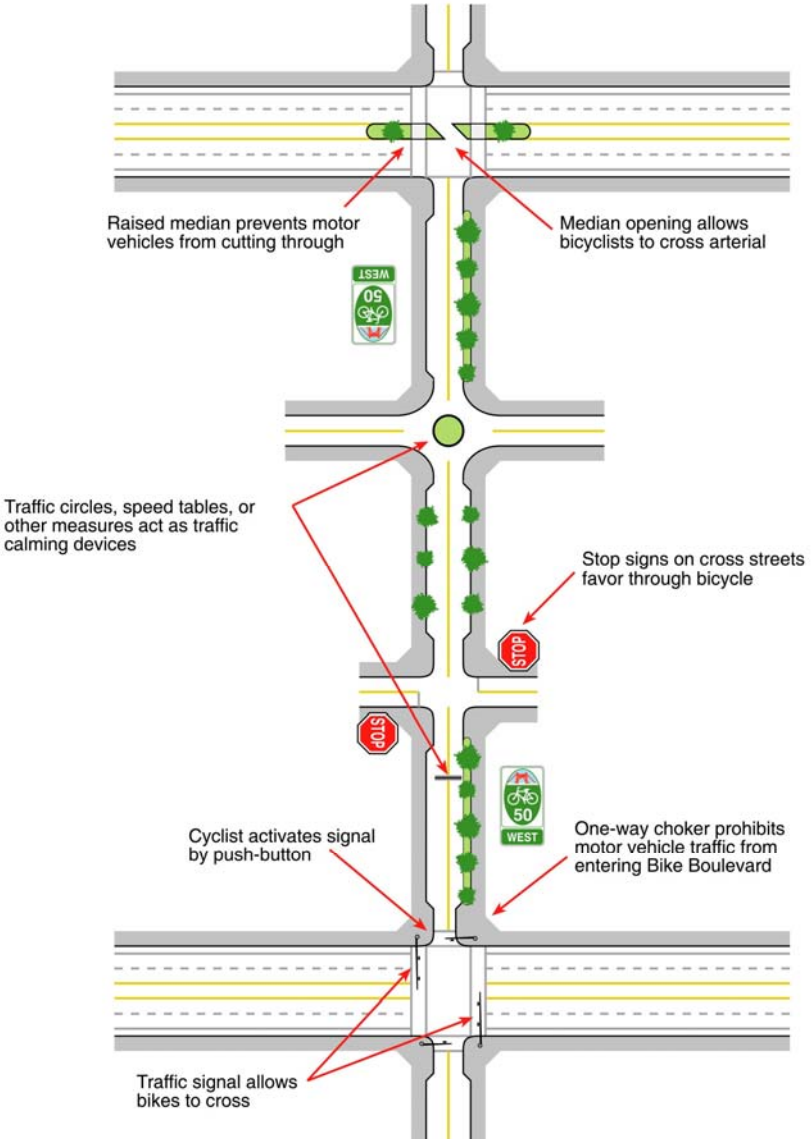


Figure 9 Example Bicycle Boulevard Street Configuration

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 bicycle detection loops should use the Caltrans Standard bicycle detection stencil shown in **Figure 10** to indicate to cyclists where to position themselves over the loop. Two loop detector types appropriate for bicycle detection, Type "C" (quadrupole) and Type "D" (diagonal slashed), are shown in **Figure 11** below. Details of saw cuts and winding patterns for inductive detector loop types appear on Caltrans Standard Detail ES5B. Loop types B (5' square diamond), C (quadrupole), D (diagonal-slashed), Q (figure-8) and modified Type E (circle with a slash) can reliably detect bicycles across their full width. Type D loop is preferred as it has a good, fairly uniform response to bicycles across its area. Types A (6' square) and E (unmodified circle) are not bike-sensitive in their center.

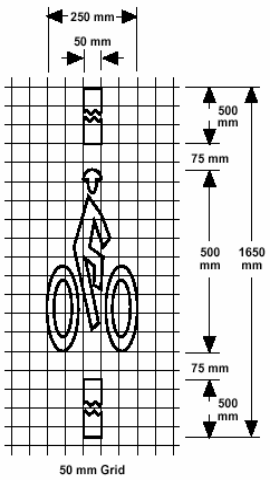
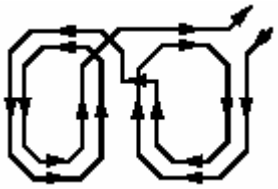
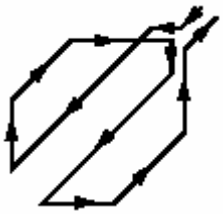


Figure 10 Caltrans Standard Bicycle Detection Marking



Quadrupole Loop – Type "C"
Detects most strongly in center
Sharp cut-off sensitivity
Used in bike lanes



Diagonal Quadrupole Loop – Type "D"
Sensitive over whole area
Sharp cut-off sensitivity
Used in shared lanes

Figure 11 Example Bicycle-Sensitive Loop Detector Types

Bicycle Parking

As more bikeways are constructed and bicycle usage grows, the need for bike parking will increase. Long-term bicycle parking at transit stations and work sites, as well as short-term parking at shopping centers and similar sites, can both 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. Long term parking is very popular and the demand for this service often outpaces the supply.

Bicycle Racks

To date the best set of recommendation for bicycle parking are those developed by the Association of Pedestrian and Bicycle Professionals. Their *Bicycle Parking Guidelines* provide guidance on rack selection and placement. Among the recommendations of the APBP guidelines are:

- The rack element (part of the rack that supports the bike) should keep the bike upright by supporting the frame in two places. For a standard inverted "U" rack, the rack should be oriented so the bicycle is parked parallel to the rack, with the frame resting

against both vertical elements of the "U." The rack should allow one or both wheels to be secured as well as the frame.

- 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, oriented in the parallel direction.
- 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.

It should be noted that the APBP *Bicycle Parking Guidelines* do not recommend use of the wave-style rack, for the reasons that bicycles parked perpendicular to wave racks are only supported on one place and more likely to fall over, and as a result a bicyclist will commonly use a wave rack as if it were a single inverted "U," limiting its capacity.
Table 1 provides basic guidelines on the ideal locations for parking at several key activity centers as well as an optimum number of parking spaces.

Table 1
Recommended Guidelines for Bicycle Parking Locations and Quantities

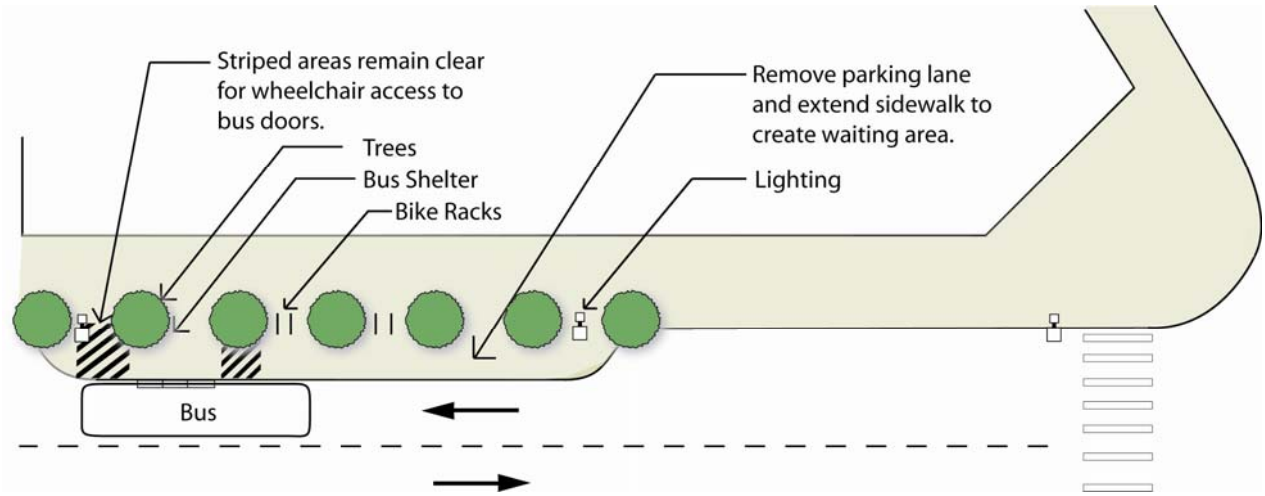
Land Use or Location	Physical Location	Bicycle Capacity
City Park	Adjacent to restrooms, picnic areas, fields, and other attractions	8 bicycles per acre
City Schools	Near school buildings, in area with good visibility	8 bicycles per 40 students
Public Facilities (city hall, libraries, community centers)	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. Attended bicycle parking is typically offered at transit hubs and some special events. For example, the Marin County Bicycle Coalition currently 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 SBC Park in San Francisco.

Bicycle Parking At Bus Stops

Bike parking at transit stops and stations enables bicycling as a regional mode of transportation when combined with a transit trip. When placing bicycle racks at bus stops it is critical to maintain accessibility for persons with disabilities and take care to maintain sufficient clearance for wheelchair access. In cases of limited sidewalk width where right-of-way is not available for widening the sidewalk away from the roadway, curb extensions may be necessary to provide for bicycle parking to ensure safe pedestrian and disabled user access.



Source: Improving Pedestrian Access to Transit: An Advocacy Handbook

Figure 12 Accessible Bus Stop Layout With Bicycle Parking