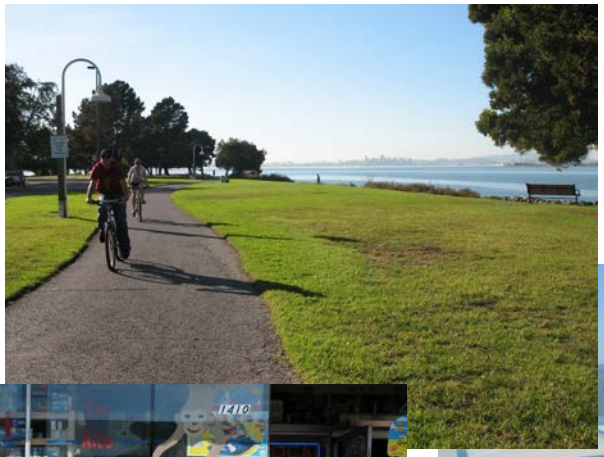
City of Alameda

Bicycle Facility Design Standards



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I. INTRODUCTION

Purpose of the Bicycle Facility Design Standards

> *To provide Alameda residents and visitors the choice of traveling to their destinations by bicycle by providing new and improved and well-maintained transportation facilities that conveniently and efficiently accommodate bicyclists of all abilities, for all types of trips, throughout the City and to neighboring jurisdictions in a suitable environment.*

The City of Alameda *Bicycle Facility Design Standards* were developed to clarify and facilitate the implementation of consistent bicycle-related infrastructure and to ensure the appropriate design of projects that impact bicycle use and access in the City of Alameda. The goal of the *Design Standards* is to ensure that design treatments and transportation projects support the City of Alameda General Plan transportation policy to de-emphasize the automobile and to facilitate the implementation of the multimodal policies of the General Plan's Transportation Element and the City's Bicycle Master Plan.

Preparation and Context of the Bicycle Facility Design Standards

The City of Alameda *Bicycle Facility Design Standards* were developed to provide direction and clarity to City staff, developers, and the public regarding the implementation of bikeways and bicycle parking facilities in Alameda. While the Bicycle Master Plan identifies the locations and types of bicycle facilities to be established in Alameda, the design standards provide specific details regarding how those facilities are to be constructed. These standards are intended to supplement Chapter 1000 of the Caltrans *Highway Design Manual* (HDM) and the *California Manual on Uniform Traffic Control Devices* (CA MUTCD). The HDM provides statewide design standards for bikeways and bikeway-to-street relationships, while the CA MUTCD includes standards and guidance regarding the application of facilities related to bicycling, including traffic controls, signage, and striping. These *Bicycle Facility Design Standards* were developed to address local implementation issues not addressed by the HDM, and for situations in which the City of Alameda may choose to provide facilities designed to a stricter level than what is identified in the *Highway Design Manual*. This document establishes the standard for the design of all future bicycle facilities in Alameda; in situations where significant obstacles exist to implementing a facility in accordance with these design standards, an alternative design may be considered with input from the public, as described below.

In addition to the HDM and CA MUTCD, the *Guide to the Development of Bicycle Facilities* prepared by the American Association of State Highway Transportation Officials (AASHTO) and the Association of Pedestrian and Bicycle Professionals' (APBP) *Bicycle Parking Guidelines (2nd edition)* were also consulted in developing these standards.

These standards include the following three components:

1) Design characteristics, signing, and striping of bikeways, including the design characteristics of shoreline bicycle facilities.
2) Design and location of bike parking.
3) Design and placement of wayfinding signage.

Providing bicycle-specific facilities (signs and pavement markings, paths, routes, parking racks, etc.) is an important means of providing bicyclists safe and efficient travel throughout Alameda. The facilities covered by these standards are only part of the solution for safe cycling, however, and the City of Alameda will continue to support education and enforcement efforts to maximize the safety for all transportation users.

Using the Standards to Inform Design Decisions

The *Bicycle Facility Design Standards* will be applied in accordance with City policies, and based on objective assessments of physical and operational constraints. In the case where engineering analysis or staff judgment identifies a conflict or issue, an exception will be requested, as described below.

In particular, the application of the standards will rely on policies from the Transportation Element of the Alameda General Plan, which was extensively updated in 2009 to better accommodate the needs of all transportation modes. A major component of the Transportation Element is the City's street functional classification system, which identifies preferred modes for streets throughout Alameda. This street functional classification system is more detailed than previous arterial/collector/local street designations, as it considers the land uses adjacent to the street and the specific transportation needs of the adjacent land uses.

In certain circumstances, this multimodal classification system has identified multiple preferred transportation modes for a street. For example, a street that has been designated as both a bicycle priority and a transit priority may be unable to completely address the operational needs for both bicyclists and transit, since buses must stop to load and unload passengers; it may need to disrupt the flow of bicyclists along the street. For this purpose, the City will use its Thresholds of Significance criteria to determine the appropriate course of action.

In addition, since most of Alameda's streets are built out within a fixed right-of-way, widening a facility for one mode may require the narrowing of the facility for another mode. This may necessitate changes to the number and widths of travel lanes to better accommodate appropriate bikeway design. If such a change in capacity would trigger an environmental review, the City would use its Thresholds of Significance criteria to determine the appropriate course of action.

Exceptions may be made in applying these standards in the following circumstances:

- There is insufficient physical space to accommodate the standard design.
- The standard design is determined to be financially infeasible.
- The facility is not identified in the Bicycle Master Plan.
- Other overriding considerations.

The Planning Board will have the authority to approve an exception in the case of a land development project, while the Transportation Commission will have this authority in the case of a capital improvement project.

Bikeway Standards Implementation

During the design of capital improvement projects that include improvements to existing or construction of new bicycle facilities, the Public Works Department will hold a public meeting to elicit input from the public. City staff will consider recommendations and comments in completing the final project design that will go to the City Council for approval. In the event that staff identifies unanticipated constraints during final design, resulting in a recommended modification to bicycle facilities included in the project, the revised design will be brought back to the public for review prior to construction.

II. BIKEWAY DESIGN

This section provides recommended design characteristics for each bikeway type. Caltrans' minimum design standards will serve as the City of Alameda's minimum standards. However, as indicated in Table 1 on page 15, the City (as well as Caltrans) recommends adhering to a stricter standard where feasible, particularly at locations where usage is anticipated to be heavy. Figure 1 illustrates the three types of bikeways, as defined in the *Highway Design Manual.*

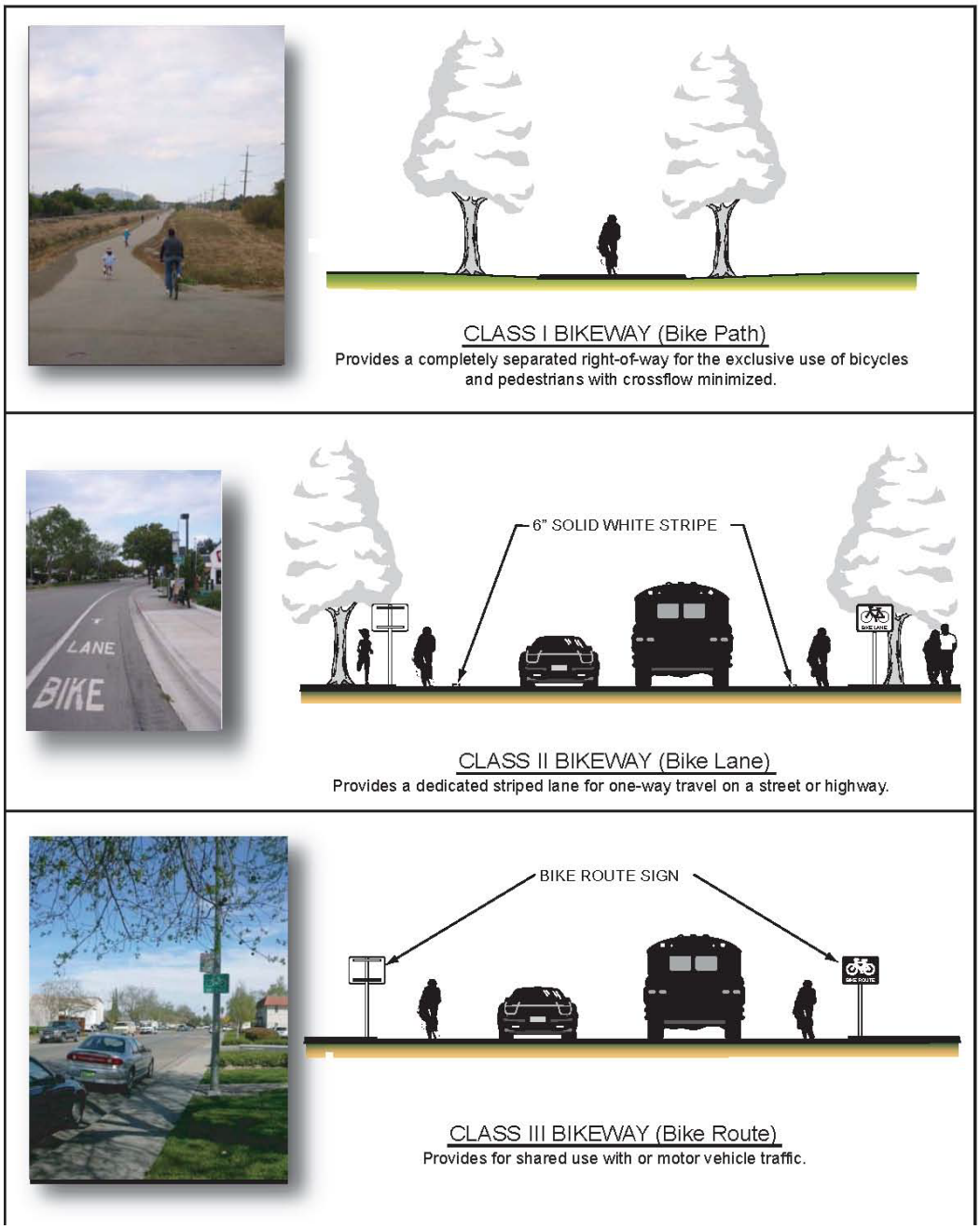

Figure 1. Illustration of Class I, II, and III bikeways. (*source: Fehr and Peers*)

Class I Bikeways

Class I bikeways, also called bike paths or shared use paths, are completely separated from streets by a buffer area or barrier. While bike paths generally serve recreational users, depending on the location, they may also be desirable commuter routes. To minimize conflicts between bicyclists and drivers, bike paths should generally be located in corridors where there is minimal motor vehicle cross traffic. In general, a bike path with multiple street crossings or commercial driveways should be avoided. In addition, the project design should account for the operational requirements of preferred transportation modes identified for that corridor, per the Transportation Element of the General Plan.

Design Characteristics

The City of Alameda's recommended paved width for a two-way bicycle path is ten feet. For the Cross Alameda Trail, Bay Trail or other waterfront trails, the paved path width should be 12-14 feet. (Table 1) Other design features of bike paths include:

- *Graded area/clearance from obstructions:* Paths are to be designed with a graded recovery area adjacent to the path. (Figure 2) They also must provide users with clearance from obstructions such as signs. For Alameda, it is preferred that paths include a three-foot graded area, which is sufficient for both purposes. Trees may be planted adjacent to paths with sufficient clearance, but appropriate trees should be selected in accordance with the City's Master Tree Plan to minimize future maintenance costs associated with damage caused by tree roots.
- *Jogging path:* For the Cross Alameda Trail, Bay Trail or other waterfront trails, the graded area on one side should be widened to four feet to serve as a jogging path, if sufficient right-of-way is available. Along heavily-used paths where such facilities are not provided, runners frequently establish an informal place to run adjacent to the pavement. This can cause the development of ruts, which will ultimately compromise the structural integrity of the path and lead to increased maintenance costs. When provided, jogging paths should be placed on the side with the best view, such as adjacent to the waterfront or other vista.
- *Centerline:* A yellow centerline stripe may be used to separate opposite directions of travel, particularly at curves or other locations where sight lines may be limited.

Figure 2. Path designed to include sufficient adjacent graded area and clearance from obstructions (*source: www.pedbikeimages.org/Reuben E. Moore*)

Sidewalks and meandering paths are usually not appropriate to serve as bike paths, as they are primarily intended to serve pedestrians, generally do not meet Caltrans' design standards, and do not minimize motor vehicle cross flows. Because they are context-dependent, appropriate location of paths adjacent to streets must be evaluated on a case-by-case basis. Where a shared use path is constructed parallel and adjacent to a street, there should be a buffer area between the path and the street at least three feet wide with a physical barrier or five feet wide without a physical barrier. A parking lane or sidewalk may be considered as part of the buffer area between a bikeway and travel way, however, the path should be located a minimum of three feet from an adjacent parking lane to avoid potential conflicts with passenger-side doors. The AASHTO bike guide provides a more extensive description of potential concerns to be considered when constructing paths adjacent to streets.[1]

Materials

Asphalt or Portland cement concrete should be used for bike paths, although for paths located in environmentally-sensitive areas where high groundwater is not a concern, a more permeable material may be recommended. The material selected for jogging paths should help minimize impact for runners, should be permeable to minimize stormwater runoff, and should meet site constraints, maintenance needs and resources.

[1] *Guide to the Development of Bicycle Facilities,* American Association of State Highway Transportation Officials, 1999, pp. 33-35.

Bicycle Path Structures

Bridges may be required on bike paths when crossing drainage channels, streets, or other obstacles. Crossings can utilize prefabricated bridges made from self-weathering steel with wood decks. Bridges shall be designed to meet ADA accessibility, and openings between railings and railing height should meet current state requirements.

Signage

Generally, the City of Alameda will use signage on bike paths that conforms to the CA MUTCD. Unique sign designs, such as the standard Bay Trail signs used throughout the region, can also be developed for major trails as desired to help develop an identity for a particular trail corridor.

Multimodal Considerations

With the appropriate design, off-street corridors can be designed for multimodal use, meeting the needs of bicyclists, pedestrians, and transit vehicles. Over the past several decades, many communities across the U.S. have converted former railroad corridors to multi-use paths. However, more recently, there has been a growing recognition of the value of rail corridors, and there is a growing trend to design the corridors to potentially serve multiple modes in the future. If sufficient right-of-way is available, and appropriate design features are used, bike paths and rail or bus rapid transit service can coexist adjacent to one another. Figure 3 demonstrates an example from Minneapolis in which a trail was constructed within a former railroad right-of-way while preserving sufficient space for potential future transit service adjacent to it.

Figure 3. Bike path constructed in a former railroad right-of-way in Minneapolis, MN, where a portion of the right-of-way was reserved for potential future rail use.

Bike Path Crossings

There are several important factors that must be considered in designing crossings of bike paths and streets. Some design treatments differ depending on whether the path is located immediately adjacent to a street and is operationally part of a street-to-street intersection, or if it is at a mid-block location.

Some design issues apply to both types of crossings:

- Traffic analysis should be conducted to determine the need for traffic control devices.
- Crossings must be designed to meet accessibility needs in accordance with ADA guidelines. This includes designing curb ramps to be at least the same width as the approaching bike path.
- Curb cuts and ramps should provide a smooth transition between the shared use path and the street.
- Cross drains or other designs should be employed as needed to prevent water from accumulating at the base of the ramp.
- For path crossings with actuated traffic signals, separate detection systems should be provided for bicyclists and pedestrians. Typically actuated traffic signals include push-buttons for pedestrians, which may not be convenient for bicyclists. By using in-ground loop detectors or other comparable technology, bicyclists can activate the signal without having to dismount.

Issues Unique to Mid-Block Path Crossings

Mid-block path crossings may be considered for selected locations, depending on the location of the path corridor, and the operational characteristics of the crossing. While mid-block crossings are less common, and therefore less expected by drivers, the lack of turning vehicles means that traffic interactions are somewhat less complex than those at street intersections.

- Mid-block crossings of streets should be located outside of the operational area of the nearest intersection. Intersections of two streets require motorists to react to numerous variables, such as turning vehicles, merging movements or acceleration/deceleration, so the isolation of a mid-block path crossing enhances the ability of drivers to focus their attention on path users.

- Refuge islands may be an effective treatment at uncontrolled mid-block crossings. This treatment should be considered where sufficient right-of-way is available, especially at locations where the motor vehicle traffic is not controlled, or where there are high vehicle volumes or speeds. By providing an area where bicyclists can stop in the middle of a crossing, refuge areas enable path users to focus on one direction of oncoming

vehicle traffic at a time. The refuge area should be large enough to accommodate platoons of users, such as groups of pedestrians or bicyclists, individual tandem bicycles, or people with strollers. The area may be designed with the storage aligned across the island or longitudinally. Refuge areas should be a minimum of 10 feet deep to enable path users to feel protected from passing vehicular traffic. The impact of proposed refuge islands on other transportation modes and traffic operations should be assessed as part of the project design process.

- To provide visibility for drivers and path users at an intersection, the crossing should be as close to 90 degrees as possible. For mid-block crossings – which may be constructed along former railroad lines or other rights-of-way that do not intersect streets at 90 degrees – this may require a realignment of the path as it approaches the crossing, as illustrated in Figure 4.

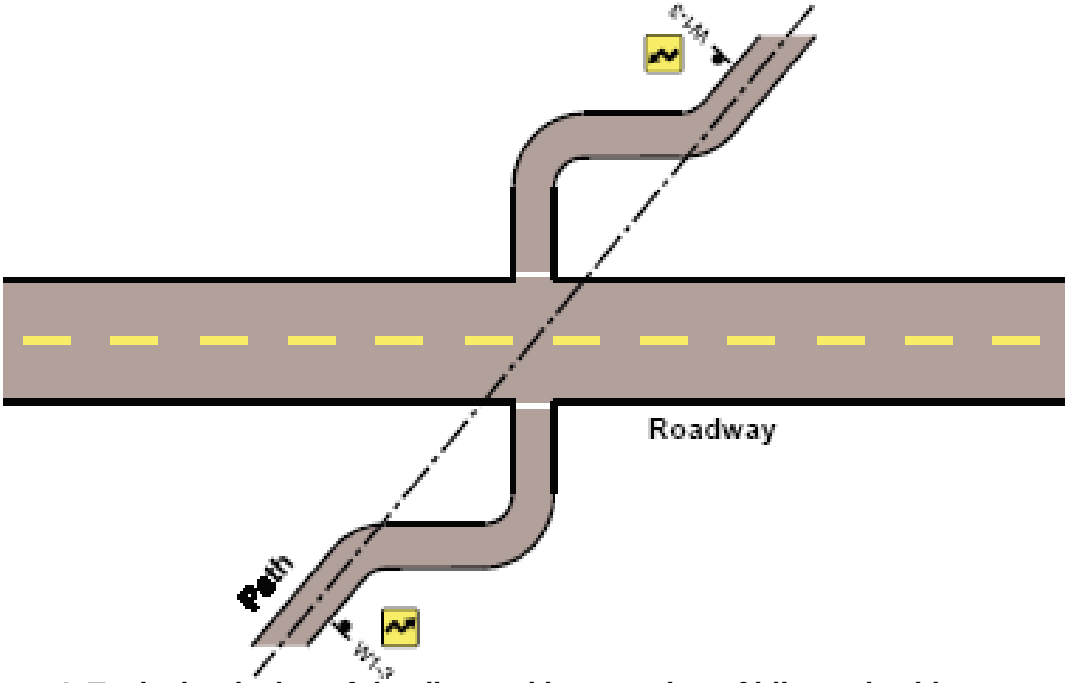

Figure 4. Typical redesign of the diagonal intersection of bike path with a street.[2]

- Careful design or physical barriers may be desirable to prevent motor vehicle access to bike paths. Path/street crossings must be carefully designed to minimize opportunities for motor vehicle access to bike paths, while at the same time permitting access for maintenance and emergency vehicles. The preferred design option, if sufficient right-of-way is available, is to split a trail approaching an intersection into two one-way segments. If the right-of-way is not available, use of bollards per the CA MUTCD is an appropriate design approach for the facility.

[2] *AASHTO Guide to the Development of Bicycle Facilities*, 1999.

- Consideration should be given to providing two-way stop controls with the stop signs facing the bicycle traffic on the path. Traffic analysis and review of impacts on all transportation modes must be conducted to determine if this is appropriate. Four-way stops at path/street intersections are not recommended because of frequent confusion about or disregard for right of way rules.

Bike Path Crossings at Street Intersections

Bike paths located adjacent to streets create challenges at intersections, which is why paths adjacent to streets are recommended where there are few or no street crossings. Where such intersections of paths and streets exist, there are design treatments that may be employed to facilitate crossings by both bicyclists and motorists. The following section describes some typical issues and design principles that should be used in developing facility designs. Final design decisions will also require review for consistency with transportation mode preferences for the particular street.

- The principles of intersection layout and geometry regarding pedestrians are transferable to pathway intersection design. Where a bike path parallel to a street intersects with another street, it is recommended that the path crossing be carefully integrated with the street intersection to help motorists and path users to recognize one another as intersecting traffic. To account for the unique characteristics of each intersection, guidelines and standards must be applied in conjunction with engineering judgment and analysis to select design treatments that best meet the needs of all transportation modes.
- Special consideration should be given to turning movements of both drivers and bicyclists. Drivers of left-turning vehicles crossing a bike path may not anticipate street crossings by bicyclists in a crosswalk, who travel at significantly higher speeds than pedestrians. If an intersection is signalized, the use of protected left turns will minimize conflicts. If a permissive left turn is in place for vehicle traffic crossing a path, the crossing should be set back from the intersection to allow for vehicle stacking space; in addition, signage may be used to make trail users and motorists aware of one another.
- Path crossing design should account for the differences in operational characteristics of pedestrians and bicyclists. Drivers slowing down to turn right across a path may not anticipate bicyclists on the path overtaking them as they travel straight across the street through the intersection. One possible treatment is to reduce the turn radius to slow down turning vehicles. Similarly, a prohibition against right turns on red at signalized intersections could reduce the potential for collisions between right-turning vehicles and bicyclists traveling straight on a bike path as the cross the street.

- Intersection design should help ensure that a path crossing is not blocked by typical traffic operations. Drivers on the street being crossed can potentially block the path crossing if they do not stop in the appropriate location. Options for reducing this concern include installing an advance stop bar or other pavement markings to maintain a clear area at the crossing.
- Refuge islands may be used to assist bicyclists at wide or complex path crossings. As described above, refuge areas are often used at mid-block crossing locations, but they may also be effective where a path crosses at an intersection of two streets. The same design considerations should be addressed as for the mid-block locations, however, designs will also need to accommodate turning movements of motor vehicles moving through the intersection.
- When bicycle paths cross streets at intersections, the path should generally be assigned the same traffic control as the parallel street. For example, if the adjacent street has a green signal, the path should also have a green/walk signal. Similarly, if a street is assigned the right-of-way at an intersection with a stop or yield sign for the intersecting street, the path should also be given the same control.
- The walk signal for any path shall not conflict with a protected left- or right-turn interval. This is consistent with the CA MUTCD.
- For intersections controlled by actuated traffic signals, the path crossing will also need to be actuated. Pushbuttons should be located within easy reach of both pedestrians and bicyclists. Bicyclists should not have to dismount to reach the pushbutton.
- Consideration should be given to providing a leading pedestrian interval at path crossings. The leading pedestrian interval provides a few seconds of green/walk signal time to path users before any potentially-conflicting motor vehicle movements are given a green signal. This allows pedestrians and bicyclists to have a head start into the street to become more visible to turning traffic.
- For stop-controlled intersections, consideration should be given to providing two-way stop controls with the stop signs facing the traffic crossing the path. As described above regarding mid-block crossings, this application may be appropriate for crossings at street intersections, and traffic analysis should be conducted to determine if this is appropriate.

Alternative Treatment to Class I Bike Paths – Cycle Tracks

While Class I paths are typically used by bicyclists, pedestrians, in-line skaters and other nonmotorized users, the term "cycle track" has been used in the U.S. to describe separated paths designed for exclusive use by bicyclists. Since cycle tracks are designed for the exclusive use of bicyclists, they are typically designed with an adjacent sidewalk to provide for pedestrian access. Such facilities are widespread in several European countries – notably the Netherlands and Denmark – but have only recently been designed for locations in the U.S. The primary advantage of cycle tracks over Class I paths is that by segregating bicyclists and pedestrians they reduce the potential for conflicts between these users. While heavy bicyclist and pedestrian volumes are typically accommodated by constructing a wider path or by constructing bicycle lanes in addition to a sidewalk, cycle tracks may be a preferred treatment at locations where pedestrians tend to walk side by side, where bicyclists tend to travel at relatively high speeds, or where bicycle lanes are not recommended because the corridor is otherwise served by a Class I facility. Cycle tracks may also be desirable in corridors which serve major generators of bicycle trips and which feature shoreline vistas.

Cycle tracks have been defined as follows:

> A cycle track is an exclusive bicycle facility that combines the user experience of a separated path with the on-street infrastructure of a conventional bike lane. Cycle tracks have different forms, but all share common elements. Cycle tracks provide space that is intended to be exclusively or primarily for bicycles, and are separated from vehicle travel lanes, parking lanes and sidewalks. Cycle tracks can be either one-way or two-way, on one or both sides of a street, and are separated from vehicles and pedestrians by pavement markings or coloring, bollards, curbs/medians or a combination of these elements.[3]

Since the U.S. experience with cycle tracks been limited to date, broadly accepted design guidelines have yet to be developed. However, cycle tracks have some operational similarities to bike paths, so some bike path design principles can be used in cycle track design. In particular, a primary concern regarding cycle track design is intersection treatments. It is therefore recommended that cycle tracks be limited to corridors with few intersections or driveways. Where traffic does cross a cycle track, City staff should carefully analyze each location to determine what concerns may exist – relevant factors include traffic volumes, accessibility, and visibility. One corridor where a cycle track is being considered is Shore Line Drive and Westline Drive.

[3] *Cycle Tracks: Lessons Learned*, Alta Planning and Design, February 2009.

Key issues that must be addressed in designing a cycle track include:

- A separate adjacent pedestrian pathway should be provided.
- Sufficient physical separation should be provided between the cycle track, the street, and pedestrian walkway. Similar to a bike path, a barrier may be provided between a cycle track and adjacent vehicle traffic.
- If the facility should be constructed within or outside of the existing street. The preferred design is to place the track outside the existing street, since drivers do not generally expect bicyclists approaching from the opposite direction. However, location of a cycle track could be considered within the existing street based on an analysis of the street's existing and future level of service, and impacts of the cycle track on operational issues such as turning traffic and visibility.
- Careful site review must be conducted to determine features to include in the intersection design to provide bicyclists and motorists with sufficient visibility. It is recommended that locations with street intersections be avoided.
- Potential operational concerns must be identified and addressed, such as interactions between bicyclists and people entering or exiting vehicles parked along the street.
- Cycle tracks should be carefully integrated into the City's bicycle facilities network. In particular, while bicyclists should generally not experience difficulties navigating from a Class I path to an adjacent cycle track, transitions between bike lanes and cycle tracks may be problematic.

Shoreline Access

As an island city, Alameda's existing and proposed trails are located largely along the shoreline. These shoreline trails are currently, or will likely be, designated as part of the San Francisco Bay Trail, a 500-mile trail linking together communities along the bay. To help provide consistency within Alameda and across the region, these standards recommend adherence to the Association of Bay Area Governments' Bay Trail design guidelines.

The Bay Conservation Development Commission (BCDC) typically requires new development or redevelopment within 100 feet of the shoreline to include a 10-foot wide trail for public access as part of its shoreline access requirements, where feasible. There are numerous segments of shoreline bike paths recommended in the Bicycle Master Plan that are anticipated to be completed in conjunction with new development or redevelopment. Other segments have existing shoreline access, but could be upgraded to conform to the City's standards, especially through the redevelopment process.

The City shall employ the following principles regarding shoreline access design:

- Coordinate with property owners and stakeholder agencies to develop trails that meet City of Alameda standards for Class I bike paths.
- Minimize impacts to the environment during construction and the regular maintenance and operation of the path.
- For facilities that permit bicycle access, select an appropriate path width, depending on the anticipated level and type of use, consistent with the City of Alameda's standards regarding bike path design and consideration of site constraints.
- Design trails to enhance the experience and quality of movement along the shoreline.
- Use appropriate paving surface materials for the level of use at the site and to maintain some level of consistency with the facilities provided for adjacent trail segments.
- Provide signage and/or pavement markings to direct pedestrian and bicycle traffic.
- Use durable materials to minimize maintenance requirements.

TABLE 1
Summary of Bike Path (Class I Bikeway) Design Standards,
Caltrans Minimums vs. City of Alameda Standards*

Element	Caltrans Minimum	City of Alameda Standards
Path paved width – typical	8’	10’,
Path paved width – Cross Alameda Trail, Bay Trail, or other waterfront trails	8’	12’-14’
Horizontal Clearance from obstructions	2’ each side	3’ each side
Graded area	2’ each side, less if paved path wider than 8’	3’; 4’ on one side for Cross Alameda Trail, Bay Trail, or other waterfront trails for jogging path
Vertical Clearance	8’	10’
Separation from adjacent street	5’ (use barrier if less)	5’; 3’ with physical barrier
Lighting (if path open for nighttime use)**	Not specified	Avg. 5 lux-22 lux, depending on location
Barrier height if adjacent to street and if needed	42” in most situations; 48” minimum in certain circumstances	minimum 4” for curb or wheel stop; 42” for fence as required by local conditions

* The City will need to evaluate proposed facilities on a case-by-case basis to determine if the City standards are feasible given the constraints of the project site. Where constraints do not permit the design per standards, the Planning Board will have the authority to authorize exceptions to these standards for land development projects, and the Transportation Commission will have the authority to authorize exceptions for capital improvement projects, as indicated on page 3 of this document.

** It may be desirable for a path to remain open at night based on the adjacent land uses, such as transit facilities.

Class II Bike Lanes

Bike lanes (Class II bikeways) allocate space in a street for bicyclists and are generally implemented to enhance bicyclists' comfort, encourage bicyclists to ride in the correct direction, and to avoid bicyclists riding on the sidewalk. Locations for bike lanes are determined based on the modal preferences identified for the street as well as the physical and operational characteristics. This section includes standards for the design of bike lanes along street segments and at intersections.

Design Characteristics

In designing new bike lanes, the City will follow the standards described below where feasible, but may revert to Caltrans standards as a result of physical constraints, as described previously. The required minimum and City standards for different conditions are indicated in Table 2. Generally, the City standards provide for additional bike lane width where one or more of the following conditions are present: adequate right-of-way exists to accommodate other transportation modes in conjunction with bicycles; relatively high traffic volumes or vehicle speeds; or commercial areas where there is relatively high turnover of on-street parking. The most typical locations for bike lanes in Alameda are for the following conditions:

- Adjacent to on-street parking: The City's minimum bike lane width when adjacent to on-street parking is 6 feet, although for streets with high parking volume or turnover, the standard is a 7-foot bike lane, if sufficient right-of-way exists. The City has identified a 13-foot minimum combined parking lane/bike lane area. City parking lanes are typically 8 feet wide, and this standard allows for 7-foot parking lanes in instances where the right of way is limited.
- On-street parking is prohibited: City standards call for a minimum bike lane width of 5 feet at locations where there is no on-street parking and a gutter present. For streets with a gutter, the seam of the gutter pan can be problematic for bicyclists; therefore, the City has established that there should be a minimum of 3 feet between the gutter and the bike lane stripe.

Figures 5 and 6 illustrate the preferred widths for bike lanes on streets with and without parking.

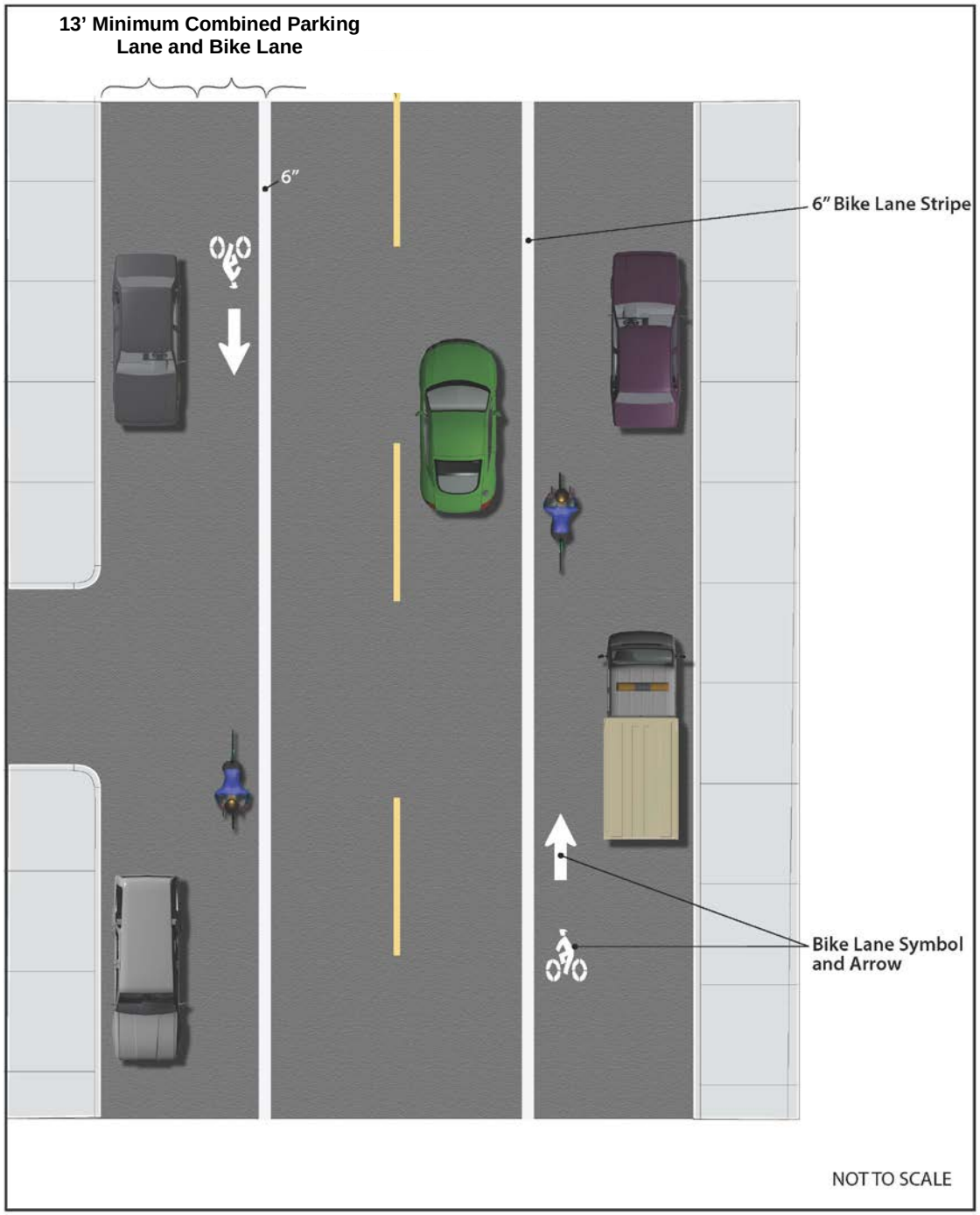

Figure 5. Typical design of bike lane where on-street parking is permitted.
(*source: Fehr and Peers*)

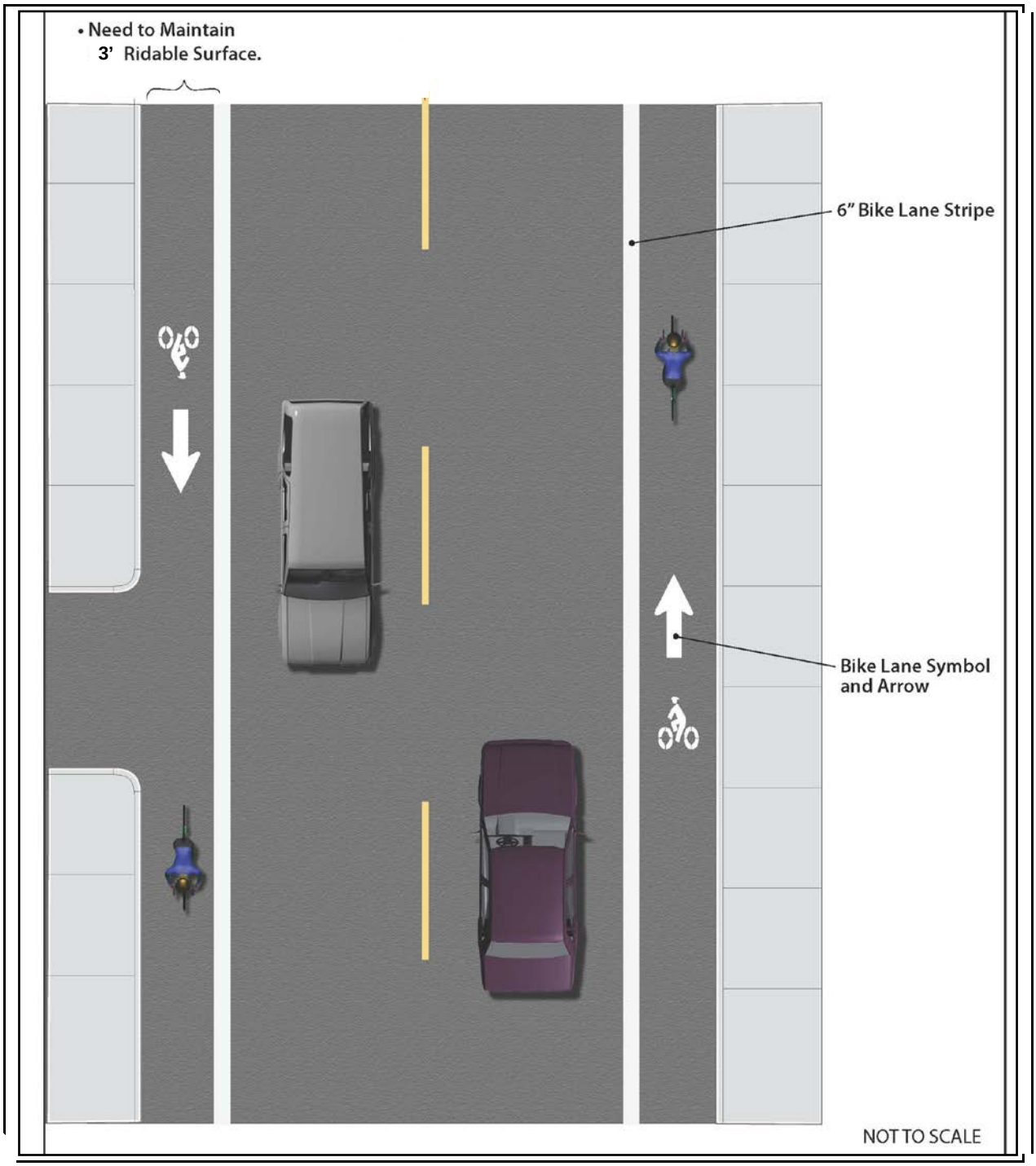

Figure 6. Typical design of bike lane where on-street parking is <u>not</u> permitted. (source: Fehr and *Peers*)

Treatments to Facilitate Left-Turning Movements by Bicyclists

Where bike lanes are located on streets with heavy vehicle traffic volumes, especially multi-lane streets, maneuvering into a position to make a left turn may be challenging. A treatment that can be used to facilitate the left turning movement for bicyclists is a "bike box". (Figure 7) The bike box is used to

delineate an area at a signalized intersection between the stop line for motor vehicles and the crosswalk. Bicyclists seeking to make a left turn can position themselves in the bike box in front of the stopped vehicle traffic during the red phase of the signal. Bike boxes may be designed using pavement markings and in some cases colored pavement. In terms of potential application of bike boxes in Alameda, they could be considered at signalized intersections on streets with bike lanes, if one or more of the following are present: 1) high volumes of left-turning bicycle traffic; 2) adequate present and future capacity in left turn lane that allows for a bike box without significantly impacting the multimodal traffic operations; 3) high volume of right turning traffic; 4) sufficient intersection visibility.

Figure 7. Bike box in Brooklyn, NY (*source: www.pedbikeimages.org/Steven Faust*)

Colored Bike Lanes

Another bike lane treatment used for very specialized circumstances is the use of colored pavement. (Figures 8 and 9) The primary application of colored bike lanes is to highlight the presence of a bike lane at a location where there is a significant volume of turning vehicle traffic crossing the facility. While the use of colored pavement is typically limited to the specific location of the cross traffic, in some instances, the entire length of the bike lane segment may include the colored pavement. It is recommended that the application of colored pavement in Alameda be considered only in a limited number of locations, due to the cost associated with maintenance. Project designers should also be careful to select materials that will not create a slick surface when wet. Potential project locations should be identified based on the volumes of motor vehicle turning traffic, and an evaluation of motorist yielding behavior.

Figure 8. Colored bike lane in Portland, OR (*source: www.pedbikeimages.org/Shawn Turner*)

Figure 9. Colored bike lane and bike box used together in Portland, OR

Providing Additional Space between Bicyclists on Designated Bikeways and Motor Vehicles in the Adjacent Travel Lane

Under certain conditions, additional measures may be taken to provide bicyclists with additional space in an on-street environment. One such treatment is the installation of pavement markings to provide additional space between a designated bikeway and the adjacent motor vehicle traffic (see Figure 10) if sufficient right-of-way is available, and if the bike lane would exceed eight feet in width. This would provide bicyclists with a greater comfort level by creating additional separation from motor vehicle traffic. Where such a treatment is employed, the solid lines parallel to traffic would need to be replaced by a dashed line at least 100 feet in advance of any intersection or driveway. This would enable bicyclists to turn left as needed without crossing the solid lines. The use of such pavement markings may be especially beneficial for streets with speed limits of at least 35 mph or with truck/bus traffic volumes greater than five percent of the total volumes, as these factors have been demonstrated to impact bicyclist comfort levels. Given the maintenance required for such treatments, maintenance costs should be considered when determining whether to use such treatment.

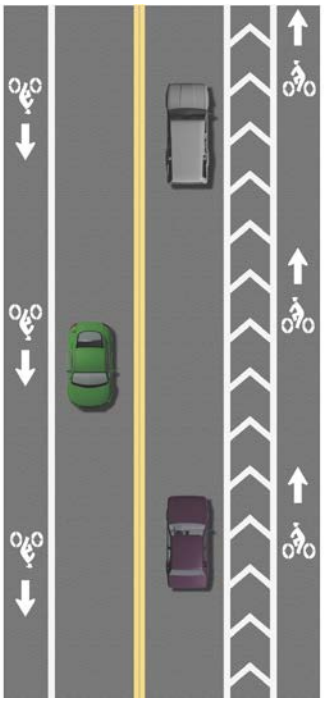

Figure 10. Conceptual design for designation of additional space between bicyclists and motorists in the adjacent travel lane. (*source: Fehr and Peers*)

Signage and Pavement Markings

Per the CA MUTCD, the R81(CA) regulatory sign will be used on all bike lanes. (Figure 11) Where these signs are used, pavement markings are also required on the far side of each intersection and at other locations as desired. In addition to intersections, bicycle lane markings should generally be provided at transition points, particularly where a bicycle lane transitions from the curb side to the left side of a right-turn lane. Otherwise, they should be placed at intersections with arterial streets and at least every ½ mile.

The CA MUTCD (Section 9C-04) allows the use of either a pavement legend or symbol for bike lane markings, and to date the City of Alameda has used the pavement legend. However, as part of a broader shift toward the use of symbols rather than legends, the City will transition over to the symbol bike lane markings accompanied by the bike lane arrow (see Figure 12) by implementing the new pavement markings for all new construction and updating the existing pavement markings in conjunction with street resurfacing projects. As discussed later in this document, guide signs may be used to supplement the R81 (CA) bike lane sign as part of the City's enhanced directional signage system.

Figure 11. R81(CA) bike lane sign
(source: CA MUTCD)

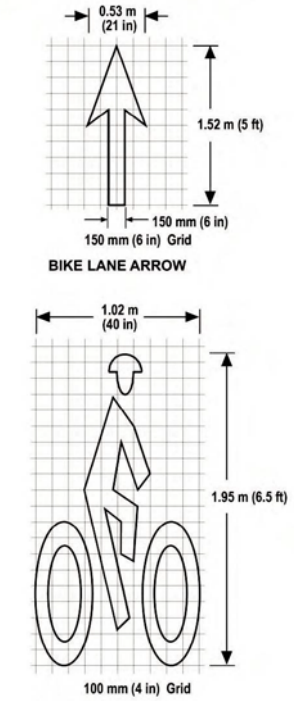

Figure 12. Recommended bike lane pavement parking

Caltrans requires that the left side of a bike lane be delineated with the use of a six-inch stripe. A four-inch stripe may be used to mark the right side of the bike lane. City staff will determine where this optional stripe should be used based on the operational

characteristics of the street in question. As noted on page 31, pavement markings such as parking T's may also be used to help define the bike lane area.

Bike Lanes at Intersections

Nationally, the majority of collisions between motorists and bicyclists occur at intersections. Bike lane treatments at intersections are, therefore, an important tool to guide motorists and bicyclists, and to help them operate or maneuver in a predictable manner in accordance with the rules of the road. The HDM provides several engineering treatments designed to reduce conflicts at intersections where there are bike lanes, including designs to stripe bike lanes where motor vehicle turn lanes are present and detection of bicyclists at actuated traffic signals. Examples can be seen in Figures 13 and 14.

Recommended designs for bicycle lanes passing through intersections are based on the following concepts:

- Motorists making right turns should make their turn from as close to the right-hand curb as practicable.
- Bicyclists going straight ahead should position themselves to the left of right turning traffic. This prevents right-turning drivers from crossing in front of through bicyclists.
- Bicyclists turning left should turn from a left turn lane or as close to the centerline or the left side lane as practicable. This requires bicyclists to merge left prior to reaching the intersection.

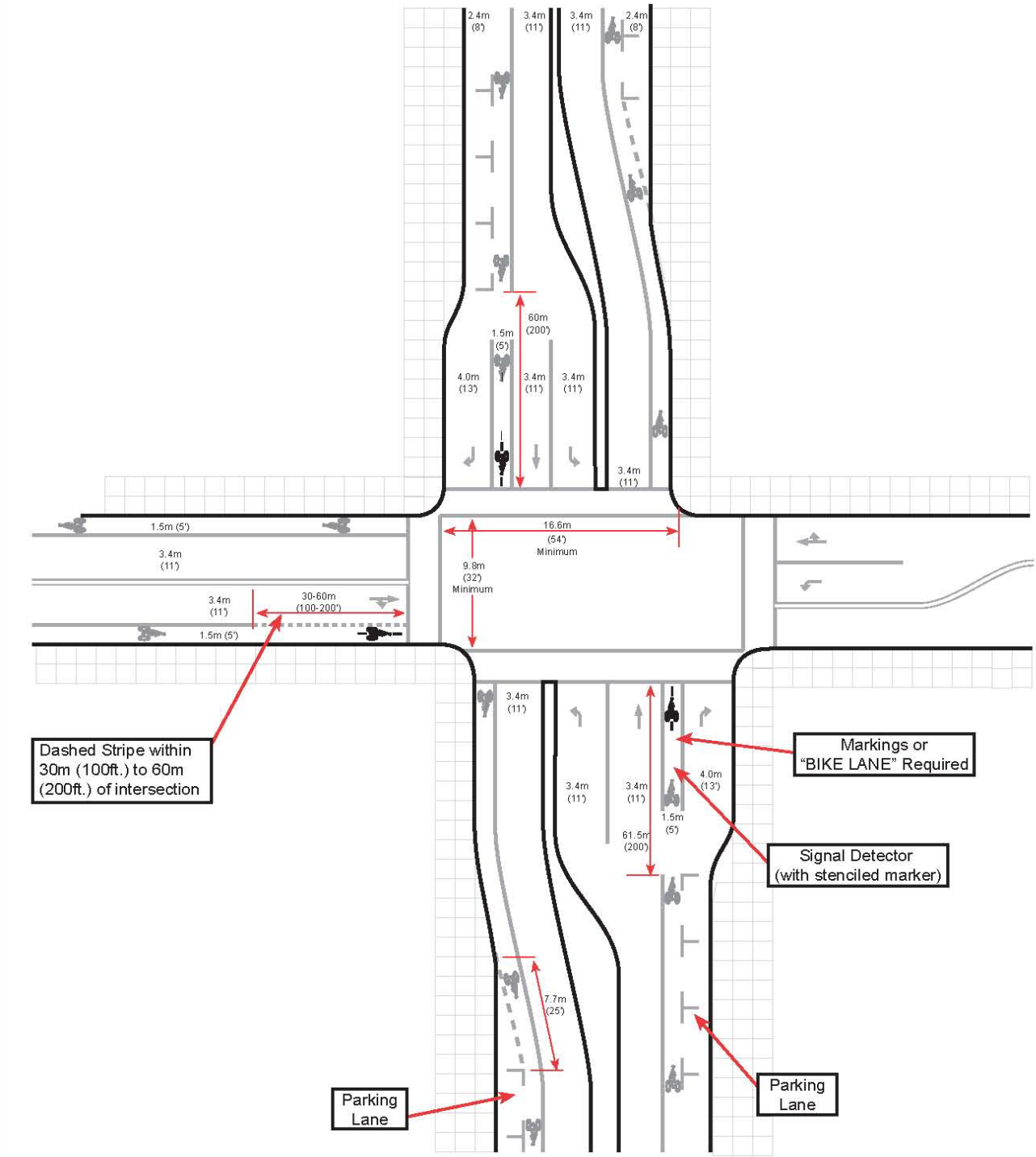

Figure 13. Typical bike lane pavement markings at intersections with right turn lanes.

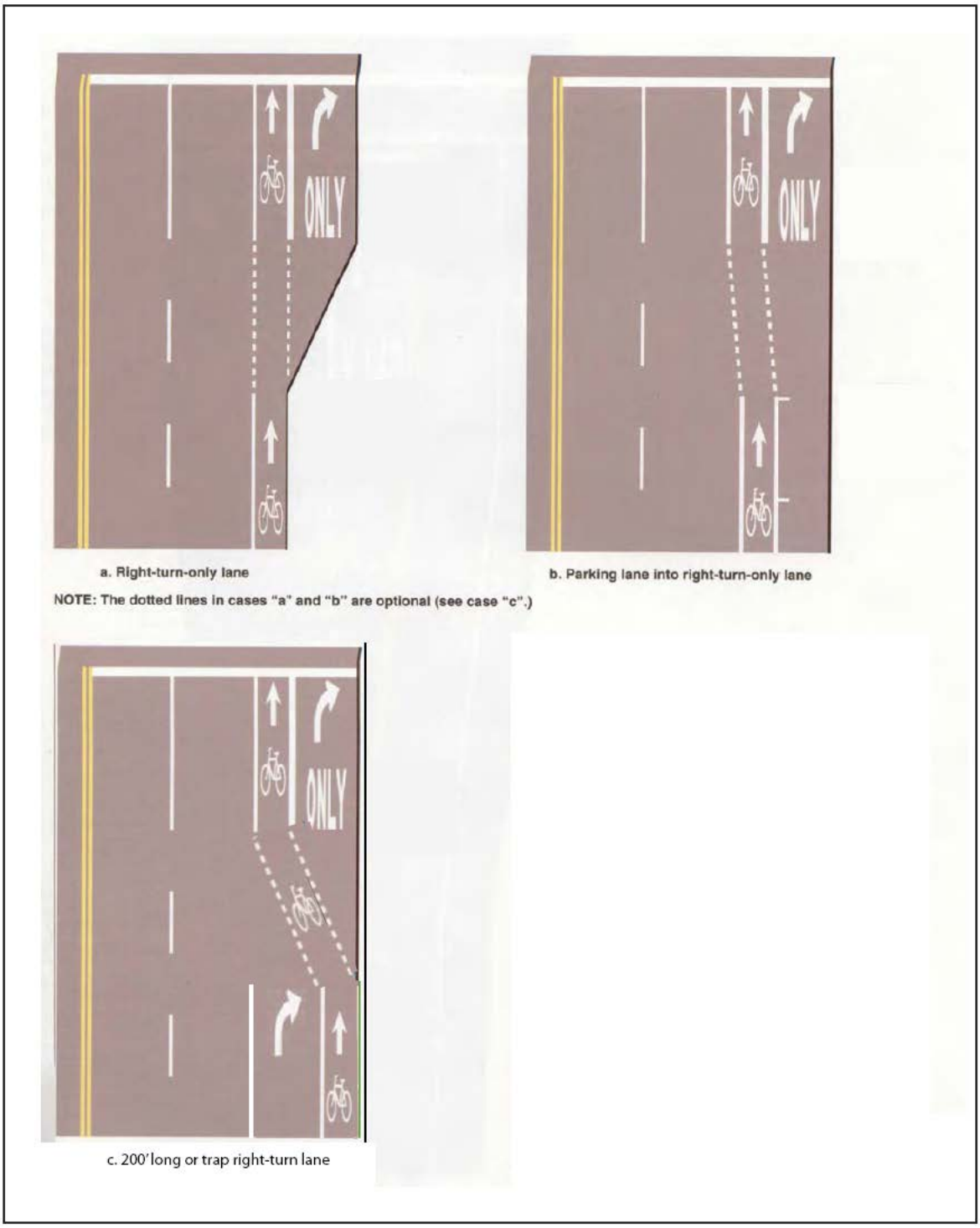

Figure 14. Sample designs of bike lane pavement markings at intersections with right turn lanes.(*source: AASHTO, 1999*)

Bus Stops

Bike lanes located on bus routes should be designed to help bicyclists and bus drivers anticipate one another's movements. Figure 15 provides examples of typical bike lane striping for intersections with near side and far side bus stops. For near side stops, the replacement of the bike lane's solid line with a dashed line indicates where vehicles will shift lanes to turn at the intersection, and also where a bus will pull into the curb lane at the bus stop. The broken line may also be used at locations with bus stops on the far side of an intersection to indicate where a bus may be crossing the bike lane; where used, the dashed line should continue at least 100 feet from the crosswalk.

Santa Clara Avenue at 8th Street

Santa Clara Avenue at Bay Street

Figure 15. Typical striping of bike lanes at bus stops located at the near and far side of intersections.

Addressing "Door Zone" Concerns

A significant concern for many bicyclists riding adjacent to parked vehicles is the potential for being injured by a vehicle door opening into their path of travel. One factor in reducing this risk is for bicyclists to correctly position themselves in the street so that they are clear of this "door zone". In terms of street and bicycle facility design, one technique that can help guide bicyclists is to utilize a modified design of the pavement markings for on-street parking spaces along some streets. As can be seen in Figure 16 below, this extended parking "T" visually guides bicyclists further away from the parked cars. The extension of the parking T has an added benefit of helping drivers to position themselves when parallel parking. This design should be used on all streets with marked parking Ts, including Class II and Class III bikeways as well as streets not designated as bikeways ("shared roadways").

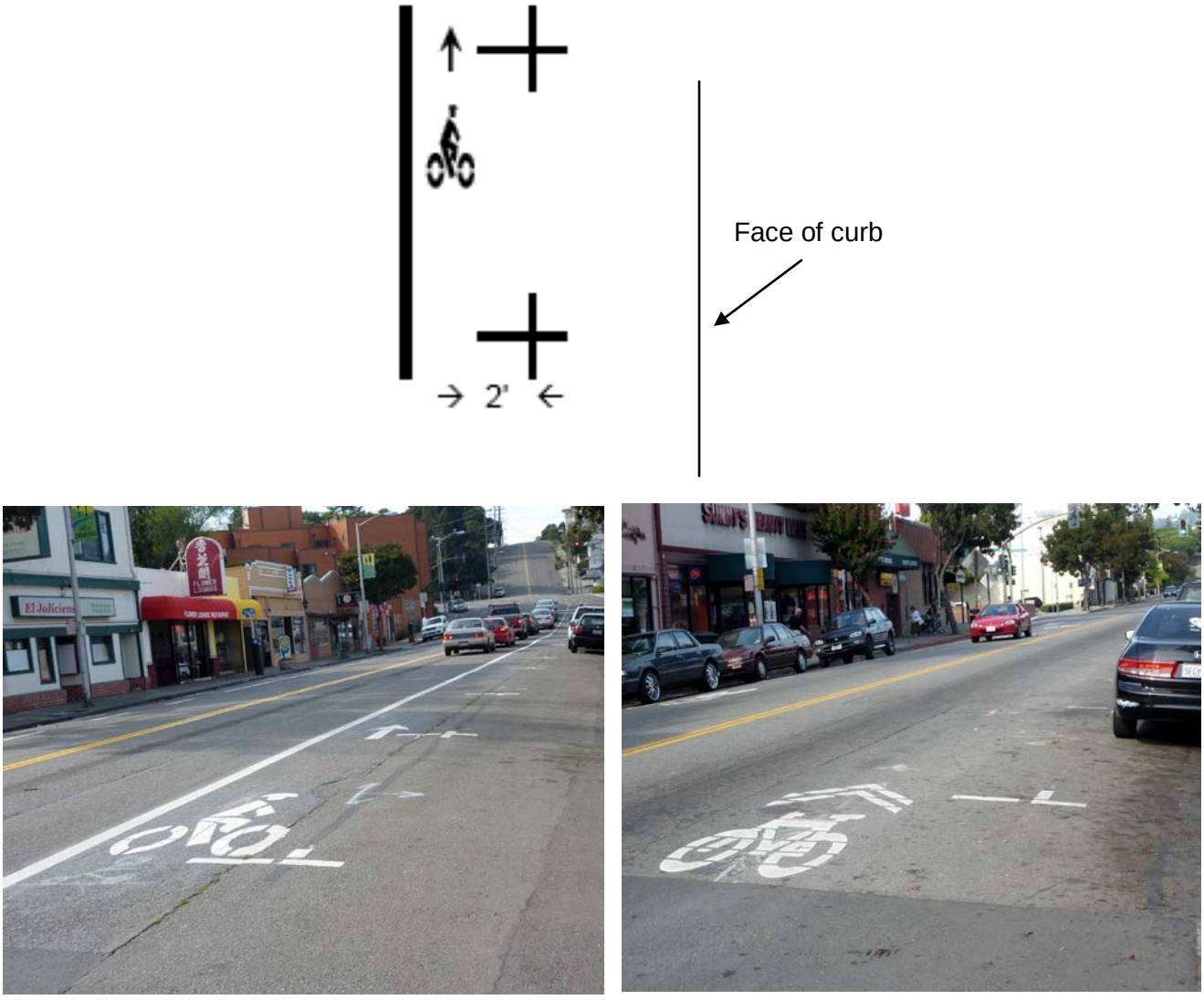

Figure 16. Use of parking T's along Class II and Class III bikeways to help bicyclists identify and steer clear of the "door zone" of parked vehicles. (source for diagram: City of Oakland)

Treatments at Bridges and Tubes

The streets at and near the estuary bridges and tubes are identified as regional or island arterials in the Transportation Element of the City's General Plan, with priority given to vehicular traffic and transit. If feasible, bicycle facilities on or near the approaches to bridges and tubes should consider special treatment to accommodate all road users, especially at transitions between the street and the structure. Appropriate measures to improve bicycle access at bridge and tunnel approaches include:

- If sufficient vehicular capacity can be maintained, provide additional riding area to create more space between bicyclists and automobiles.
- Provide additional signage informing bicyclists of existing riding conditions.
- Use dashed lines to delineate bicycle path of travel through conflict zones.
- The City will need to coordinate the implementation of enhancements for bicyclists with Caltrans and/or Alameda County, which own and operate the bridges and the tubes leading in and out of Alameda, as well as the City of Oakland.

Traffic Signals

Establishing appropriate signal timing and detection of bicyclists at traffic signals are important considerations in establishing bicyclists as recognized users of the street system. Signals with fixed timing provide sufficient green time for pedestrians to allow bicyclists to cross an intersection, but for actuated signals during off-peak hours, the timing may need to be adjusted to allow bicyclists additional time to clear the intersection. The City of Alameda standard is to use the equations recommended by AASHTO[4] to calculate the minimum green time (time required for bicyclists to react, accelerate, and cross the intersection), as follows:

Method for calculating appropriate clearance interval:

$$y + r_{clear} \geq t_r \left(\frac{v}{2b}\right)\left(\frac{w+l}{v}\right)$$

y = yellow interval(s)
r_{clear} = red clearance interval(s)
t_r = reaction time
v = bicyclist speed (mph)
b = bicyclist braking deceleration (4 to 8 ft/sec)
w = width of crossing (ft)
l = bicycle length (6 ft)

[4] *Guide for the Development of Bicycle Facilities*, AASHTO, 1999, p. 65.

Method for calculating minimum green time:

$$g+y+r_{clear} \geq t_{cross} = t_r + \frac{v}{2a} + \frac{w+l}{v}$$

g = minimum green

y, r_{clear} = yellow and red clearance interval(s) actually used

t_{cross} = time to cross the intersection

t_r = reaction time (2.5 sec)

v = bicyclist speed (ft/sec)

a = bicyclist acceleration (1.5 to 3 ft/sec)

w = width of crossing (ft)

l = bicycle length (6 ft)

The CA MUTCD requires that as new actuated traffic signals are installed or modified on public or private streets or driveways, 1) detection of bicycles shall be provided through loop detectors, video, or other method, 2) a push button be provided, or 3) the signal be operated with fixed timing.

At new actuated traffic signals where loop detectors are used for vehicle detection, the City of Alameda standard is to install Type D loop detectors, also known as diagonal quadrupoles. On streets where bike lanes are striped approaching the intersection where there is an actuated signal, a separate detector should be installed in the bike lane. On streets without designated bicycle facilities, the loop detectors should be set to detect bicycles as well as motorized vehicles. Detection of bicycle traffic should be addressed for all movements controlled by the signal at an intersection, including turn pockets. Ultimately, bicycle detection should be provided at all actuated signals in Alameda, but in the short term, priority should be given to locations where there are designated bicycle facilities and/or high volumes of bicyclists. Stencils indicating the loop detector should be marked on the street at the intersection to guide bicyclists regarding the optimal positioning of their bicycles over a loop detector, as indicated in Figure 17.

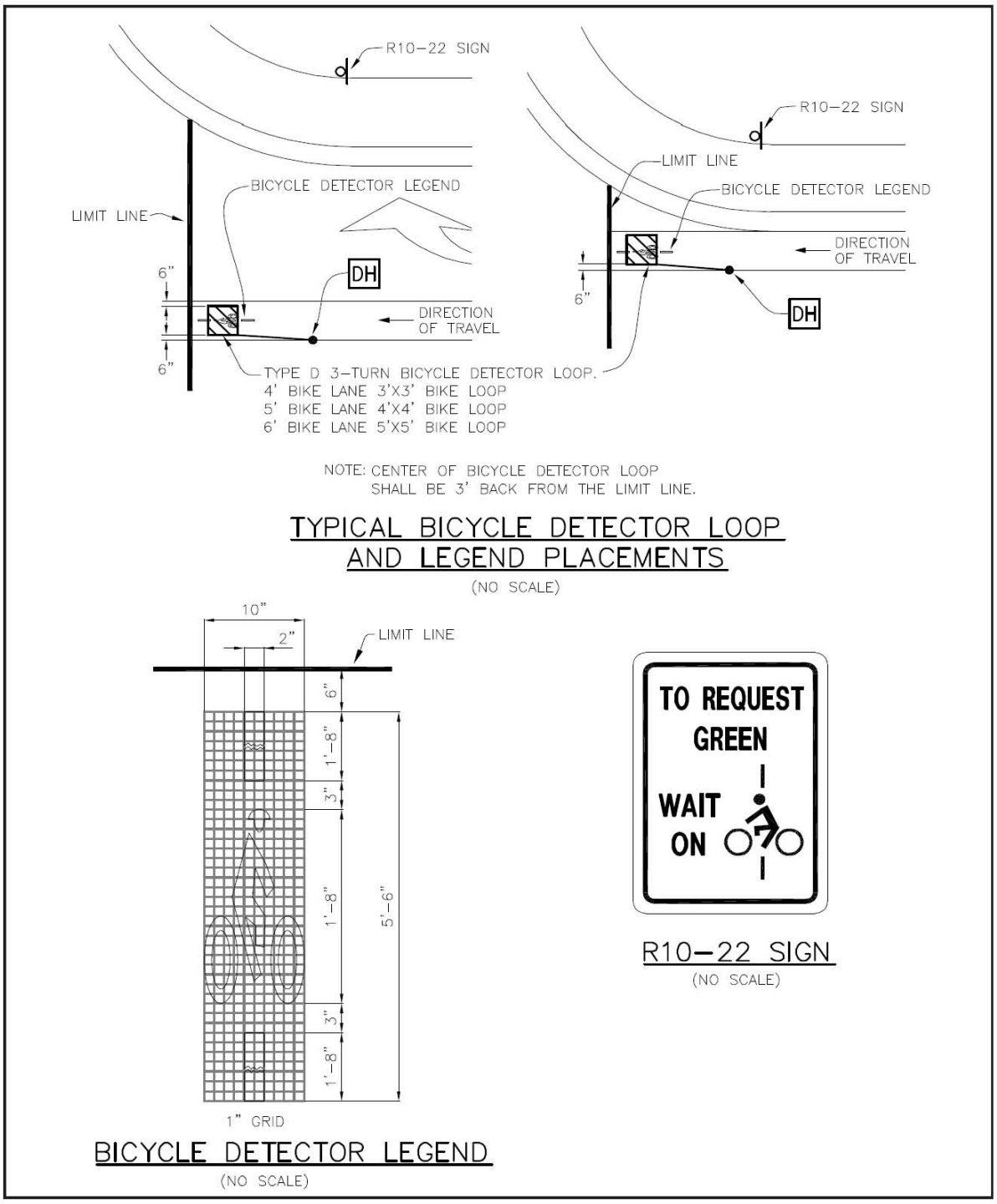

Figure 17. Bicycle Loop Detector Placement, Pavement Marking, and Sign. (*source: California Manual on Uniform Traffic Control Devices*, Caltrans, 2010.)

TABLE 2
Summary of Bike Lane (Class II Bikeway) Design Standards,
Caltrans Minimum vs. City of Alameda Standards*

Element	Caltrans Minimum	City of Alameda Standards
Width (with on-street parking)	5’	6’ minimum, expand to 7’ with high parking volume or turnover and if sufficient right of way exists**
Width (with gutter, no on-street parking)	5’	5’

* The City will need to evaluate proposed facilities on a case-by-case basis to determine if the City standards are feasible given the constraints of the project site. Where constraints do not permit the design per the standards, the Planning Board will have the authority to authorize exceptions to these standards for land development projects, and the Transportation Commission will have the authority to authorize exceptions for capital improvement projects, as indicated on page 3 of this document.

****** The City will maintain a minimum of a 13’ combined width for a bike lane and adjacent parking lane.

Class III Bike Route

Bike routes (Class III bikeways) are defined by the Caltrans *Highway Design Manual* (HDM) as bikeways that provide for "shared use with pedestrian or motor vehicle traffic." While this definition allows for the designation of sidewalks as bikeways, this is only recommended for specific instances on a case-by-case basis. Bike routes are intended to provide continuity throughout a bikeway network, including providing low traffic volume alternatives to arterial streets, closing gaps between discontinuous segments of bike lanes, and enhancing the overall coverage of the bikeway network throughout Alameda.

Design Characteristics

Minimum widths for bike routes are not presented in the HDM, as the acceptable width is dependent on many factors. Bike routes are typically designated with the D11-1 sign from the CA MUTCD, but may also include "Shared Roadway Bicycle Markings," also known as "sharrows." Sharrows are on-street stencils intended to provide a visible message to bicyclists and drivers to anticipate bicyclists in a particular corridor. Sharrows are especially helpful on bike routes that are used to bridge gaps between segments of a designated bike lane where there is insufficient right-of-way for a continuous bike lane. Another potential application for sharrows is in high-conflict zones. (Figure 18) Sharrows are suitable for streets with posted speeds below 35 mph, and it is recommended that sharrows be included on all Class III facilities in Alameda, consistent with CA MUTCD guidance. To date, the City has implemented sharrows on portions of Oak Street and on Fernside Boulevard.

The placement of the sharrow stencils as indicated in the CA MUTCD directs bicyclists to position themselves in the street at a location where they should be clear of the "door zone," i.e. the portion of the street impacted by opening or closing the doors of parked automobiles. The CA MUTCD minimum has the total distance of the sharrow's center from the curb at 11 feet. The City of Alameda standard is 12 feet, which is consistent with the best practice of the Santa Clara Valley Transportation Authority. The cities of Oakland and San Francisco have a sharrow standard of 11.5 feet. The additional 0.5 to 1 foot space, compared to Oakland, San Francisco and CA MUTCD, allows for a potentially wider door zone or greater distance of parked vehicles from the curb. (Table 3)

TABLE 3
Sharrow Placement

Variable	CA MUTCD Minimum	City of Alameda Standard
Distance of parked vehicle from curb	7'	7' 6"
Width of door zone	2' 6"	3'
Center of sharrow	1' 6" from edge of door zone	1' 6" from edge of door zone
Total distance of center of sharrow from curb	11'	12'

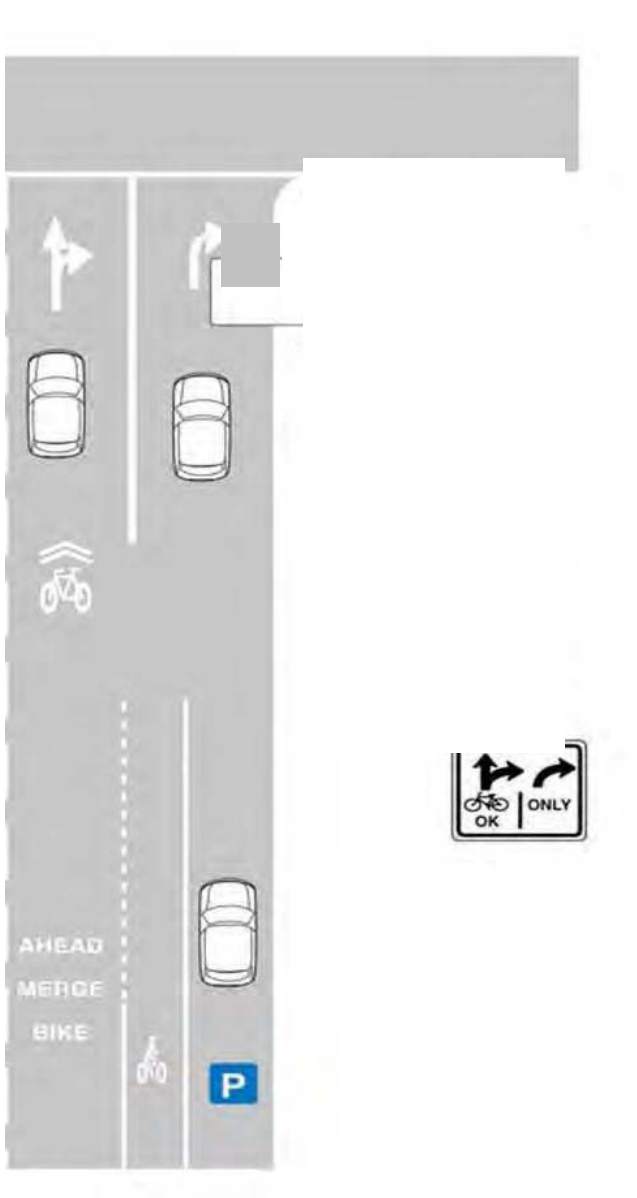

Figure 18. Use of sharrows to provide connectivity for bicyclists at a location where it is proposed to prioritize right-turning automobiles over bike lanes.(*source: Fehr and Peers*)

Bicycle Boulevards

An increasingly used type of Class III facility in the Bay Area and across the country is the "bicycle boulevard." Typically, bicycle boulevards are located on low-volume streets adjacent to higher volume arterials and are designed to provide bicyclists with a relatively direct and low conflict route to their destinations. Traffic calming treatments are often used in a series to reduce motor vehicle speeds along an entire corridor. Potential traffic calming devices that may be used in Alameda are described in the City's traffic calming toolbox. Approval of the use of traffic calming at a specific location would require an evaluation of traffic conditions, traffic warrants, and physical and operational constraints by Public Works staff as well as approval from the Police and Fire departments to address any potential concerns about impacts to emergency response routes and response times.

Caltrans and AASHTO have not developed guidelines regarding the designation and design of bicycle boulevards. However, the characteristics of facilities that have been implemented in other jurisdictions tend to be similar to one another. There are two levels of treatments that are typically employed in bicycle boulevard design: 1) basic features, which provide the minimum treatments to include on the facility, and 2) site-specific features, the use of which would be determined based on the needs of a specific corridor, the results of a detailed engineering analysis, and input from affected stakeholders.

From among the Class III bicycle routes adopted through the 2010 update of the City's Bicycle Master Plan, the following corridors have been identified as potential bicycle boulevards:

- San Jose Avenue from Morton Street to Fernside Boulevard
- Pacific Avenue from Marshall Way to Park Street
- Santa Clara Avenue from Third Street to Webster Street

Key Bicycle Boulevard Design Issues

There are several primary issues that should be addressed in the design of all bicycle boulevards:

- Provide an enhanced through-traffic environment for bicyclists without attracting cut-through motor vehicle traffic.
- Maintain or reduce motor vehicle speeds to 25 mph (85^{th} percentile speed).
- Ensure that the bicycle boulevards provide direct and convenient access to major destinations or other major bicycle facilities leading to these destinations.
- Provide comfortable intersection crossings for bicyclists.
- "Brand" the facility so that bicyclists and drivers will anticipate conditions typical of a bicycle boulevard.

Basic Bicycle Boulevard Elements

While the design of each bicycle boulevard may be somewhat unique, they should share some key features. As noted above, bicycle boulevards are a type of Class III bicycle route, so the establishment of basic characteristics is essential for establishing a bicycle boulevard "brand" to distinguish it from other Class III facilities. This branding will help bicyclists to readily identify bicycle boulevards and quickly understand the types of conditions they can expect.

The City of Berkeley developed a unique system of signage and pavement markings for its bicycle boulevard network. (Figure 19) To facilitate understanding and recognition of bicycle boulevards in Alameda, it is recommended that the City adopt similar designs. These designs could be customized for Alameda – i.e. including a unique logo – but should retain a certain level of consistency with the Berkeley designs.

Given funding constraints, it is recommended that these elements be installed as the initial phase in designating a bicycle boulevard. As additional funding is secured, additional treatments could be installed to supplement these treatments, pending a corridor-specific review, as described in the next section.

Figure 19. Bicycle boulevard pavement markings and signs used by the City of Berkeley. (*source: Fehr and Peers*)

III. BICYCLE PARKING

The availability of secure and convenient parking is as critical to bicyclists as it is to motorists, making bicycle parking a critical element of Alameda's bicycle facilities network. Bikeways providing access to key destinations, such as parks, schools, community facilities, transit stations, and shopping areas will be utilized to their potential only if these locations are equipped with the appropriate types and amounts of bicycle parking. This section establishes standards regarding the provision and placement of bicycle parking facilities; these standards are primarily based on the bicycle parking guidelines developed by the Association of Pedestrian and Bicycle Professionals (APBP).

The appropriate quantity and type of bicycle parking depends on the type of trips it is designed to serve. The primary distinction is between short-term and long-term bicycle parking. Short-term parking, designed to be used for approximately 2-3 hours, such as in a retail-oriented business district, is typically provided as racks. By comparison, long-term bicycle parking, which generally serves all-day parkers such as employees at a particular site, permits only limited access to the bicycle parking area and offers greater security. The City has also developed requirements for the sponsors of large public events to provide monitored bicycle parking, and these requirements are included as Appendix A.

In terms of meeting the need for bicycle parking, the Alameda Municipal Code (AMC) currently requires development and redevelopment projects to provide bicycle parking based on the number of automobile parking spaces required. It is recommended that the City modify its requirements by specifying the number of short- and long-term spaces to be provided in accordance with the project's land use, which is the approach used by APBP. This would tailor the facilities more to the needs of each site. In addition, it would not result in a reduction of the number of bicycle parking spaces in cases where the number of vehicle parking spaces is reduced. The need for bicycle parking at existing development should be provided in accordance with the priorities identified in the Bicycle Master Plan Update.

There are numerous potential funding sources for construction and maintenance of bicycle parking. These include the City, developers, local businesses, and transit providers, all of whom share in the benefits of these facilities. The funding arrangements need to be determined on a case-by-case basis.

The facility types described below are considered to meet the City's design requirements; these design options provide developers with the flexibility to provide bicycle parking that best meets the needs for their particular site.

Short-Term Bicycle Parking – Bicycle Racks

Rack Design

The design of a bicycle rack can significantly affect its ability to provide a convenient way to lock up a bicycle, to protect bicycles from theft or damage, and to maximize the number of bicycles that can be parked in a given area. These standards recommend bicycle racks that:

- Support a bicycle in at least two places to prevent it from falling over.
- Allow the locking of the frame and at least one wheel with a U-lock.
- Are securely anchored to the ground.
- Resist cutting, rusting, bending, or deformation.
- Do not include any protrusions that would prevent a bicycle from fitting snugly against the rack.

There are several rack designs that meet the above criteria that have been installed in Alameda and other jurisdictions. Figure 20 illustrates the use of "inverted U" style racks individually and in a series. The "post and ring" style racks shown in Figure 21 also conform to the City's standards. These designs are presented as examples of recommended racks, as there may be other commercially available or custom designs that meet these criteria as well.

Figure 20. Inverted U racks installed individually and in a series in Alameda.

Figure 21. Post and ring style bicycle rack.

Bicycle Rack Placement in Public Right-of-Way

Bicycle racks should be in a highly visible location, and not interfere with the main entrance to a building or facility. (Figure 22) Whenever possible, the racks should be visible from the doorways and/or windows of buildings, and not in an out of the way location, such as an alley. This will provide convenience to users, and the visibility will help deter theft or vandalism.

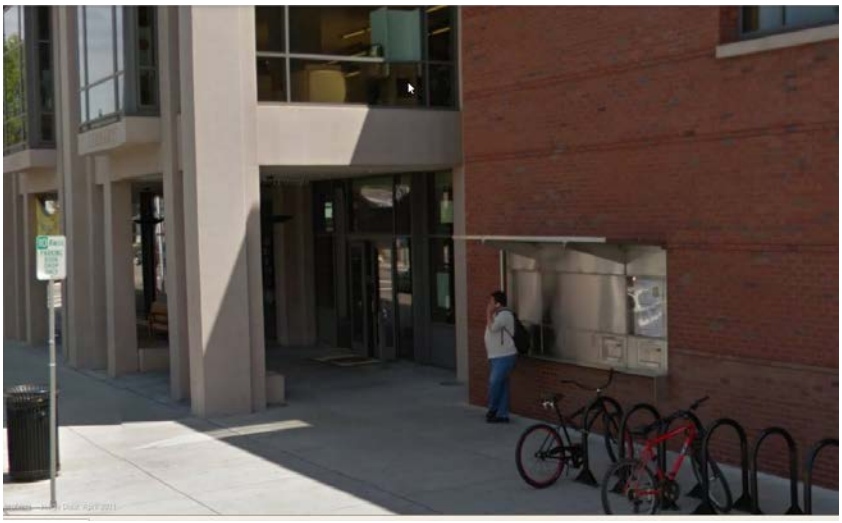

Figure 22. Bike racks in front of the Alameda Free Library are located in a highly visible location near the building's main entrance.

There are numerous considerations that must be addressed in determining the appropriate placement of bike racks, including access by pedestrians to area businesses and transit stops, access by utilities to their facilities, and emergency vehicle access to fire hydrants. These issues are especially relevant for racks installed in the sidewalk area. Individual racks are typically placed near the curb, although depending on the sidewalk dimensions and presence of obstacles, racks may be installed at the rear of the sidewalk area. Racks on the curb side of the sidewalk should be installed to minimize conflicts between parked bicycles and passengers entering or exiting the doors of parked vehicles.

It is recommended that bicycle racks be located with minimum clearances as indicated below. (Table 4) Where sufficient space is available, additional clearance may be provided based on a site evaluation by City staff.

TABLE 4

MINIMUM CLEARANCES FOR BICYCLE RACK PLACEMENT IN THE PUBLIC-RIGHT-OF-WAY*

Item	Minimum Clearance
Face of curb	2.5’ minimum, recommended 3’ if space available
Crosswalk	5’
Red/blue/white/yellow curb	Based on site-specific evaluation of operational issues
Fire hydrant	6’
Bus stop	Minimum 8’ setback from curb face
Utility vault	3’
Parked vehicles	3’ from the arc of the approximate location of the passenger side door.
Newsrack	3’
U.S. Mail box	3’
Traffic signal controller box	6’ from the door opening side of the box
Utility pole	3’
Tree well	3’
Trash can	3’
Storm drain inlet	To be determined based on staff field review
Building wall	Rack parallel to wall: 3’ Rack perpendicular to wall: 2’
Light pole	3’
Signal pole	3’ (while maintaining pedestrian push button access)
Sign pole	3’
Driveway aprons	10’
ADA ramp	4’

* Note: Recommended clearances must be implemented so that they are consistent with ADA access needs.

Site Layout

Racks should be installed to provide sufficient space for each bicycle, to allow bicyclists to access their bicycles, and to enable people to walk through the bicycle parking area. The standard bicycle footprint is six feet long and two feet wide. Racks installed parallel to one another should have at least 36 inches between them to facilitate access to the racks. If racks are installed as a series in two or more rows, aisles between the rows are recommended to be six feet wide to allow for passage between parked bicycles. Figure 23 shows typical dimensions and placement requirements for bicycle racks. Note that some racks intended to accommodate multiple bicycles do not provide enough space between bicycles to allow for handlebar widths, reducing the effective capacity of the rack. These rack designs should be avoided.

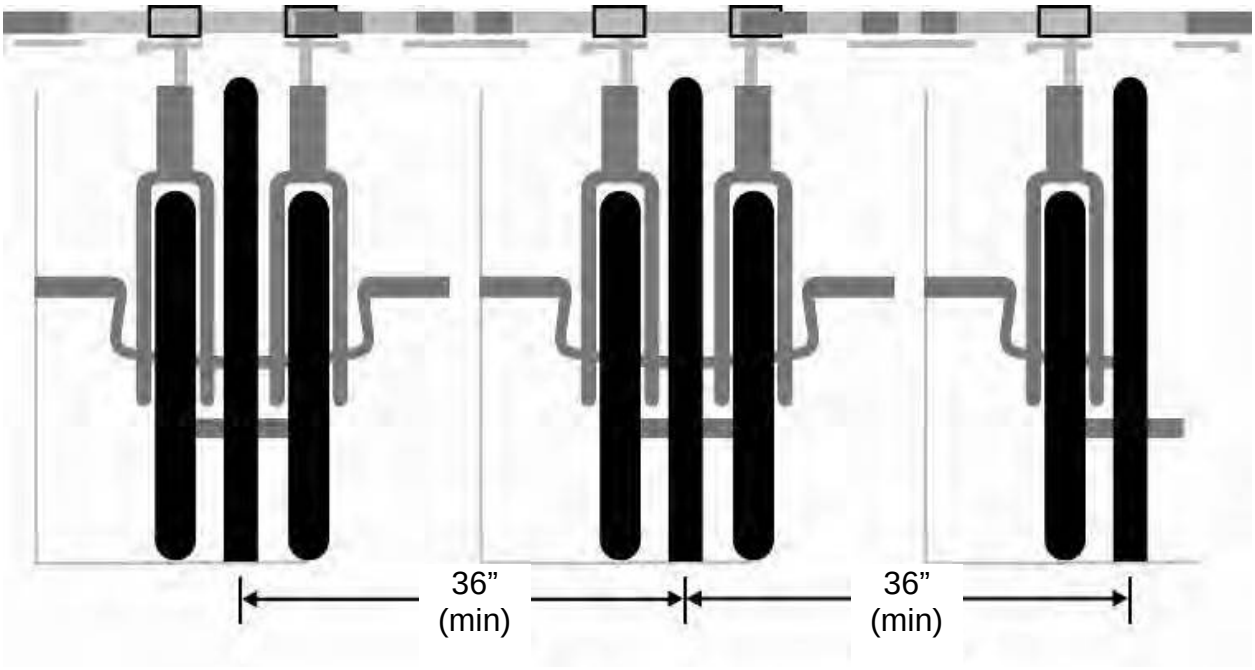

Figure 23. Typical dimensions and placement requirements for bicycle racks. (*source: Association of Pedestrian and Bicycle Professionals*)

In-Street Bicycle Corral – Bike corrals, which provide inverted U racks in a section of a street in place of an in-street parking space, have been used in a growing number of jurisdictions, including Portland, San Francisco and Berkeley. While a preferred design is to install the bicycle parking on top of a curb extension, which would provide protection for parked bicycles and avoid concerns about debris accumulating in the bicycle parking area, in-street corrals are a viable low-cost alternative. Two vehicle parking spaces can accommodate a corral with 10-12 racks for 20-24 bikes.

Bicycle corrals are ideal for locations with a high bicycle parking demand and insufficient sidewalk space. Corrals also reduce sidewalk clutter and do not obstruct pedestrian access in the public right-of-way. Due to the impact of such facilities on

adjacent land uses and on street sweeping operations, the City will only identify a proposed location and install a corral after consideration of the following:

- Businesses fronting the proposed location and appropriate business associations must be consulted regarding the location of the facility.
- Provision for on-going maintenance of the facility to keep the bike corral clean and free of debris since street sweeping by the City will not be possible.
- City staff must ensure that parking removal caused by the bicycle corral will not significantly impact the street or area.
- City staff must determine that a bike corral will provide the highest utility and benefit for bicyclists when compared to adding bicycle parking in the immediate vicinity, or that the corral is needed to create a wider clear sidewalk area for pedestrians.
- Bike corrals should be located as close as possible to high demand locations. Preferred locations are on main streets. However, City staff must evaluate the impact of the proposed corral on the traffic circulation issues, including the on-street parking supply, loading zones, and transit service.
- City staff must review the proposed location and design for impacts on visibility of pedestrians crossing the street, protection of bicycles and bicyclists from adjacent traffic, and potential conflicts with bus stops, access to fire hydrants, or manholes.
- Avoid locations that tend to have flooding concerns.
- Bicycle racks are typically installed perpendicular to the flow of traffic. Based on site-specific operational needs, racks may be installed at an angle to provide additional clearance from the travel lane, although this will decrease capacity of the corral. Considerations for this type of placement include the width of the travel lane, traffic volumes, and the demand for bicycle parking at the proposed location.
- Barriers such as bollards – using a breakaway design – or curbs are recommended to protect bicycles and bicyclists from adjacent traffic.
- It is recommended that there be a five-foot clear area on both ends of the corral to allow bicyclists to enter and exit more easily.
- The width of a corral should be consistent with the dimensions of the parking lane on the street where it is proposed to be installed. This prevents the bicycle parking from interfering with traffic flow, and enables bicycles – which are generally six feet in length – to be parked perpendicular to the curb, to allow for maximum capacity. For locations where additional space is desired between the bicycle parking area and the travel way or sidewalk, the racks may be installed diagonally, as indicated in Figure 24.

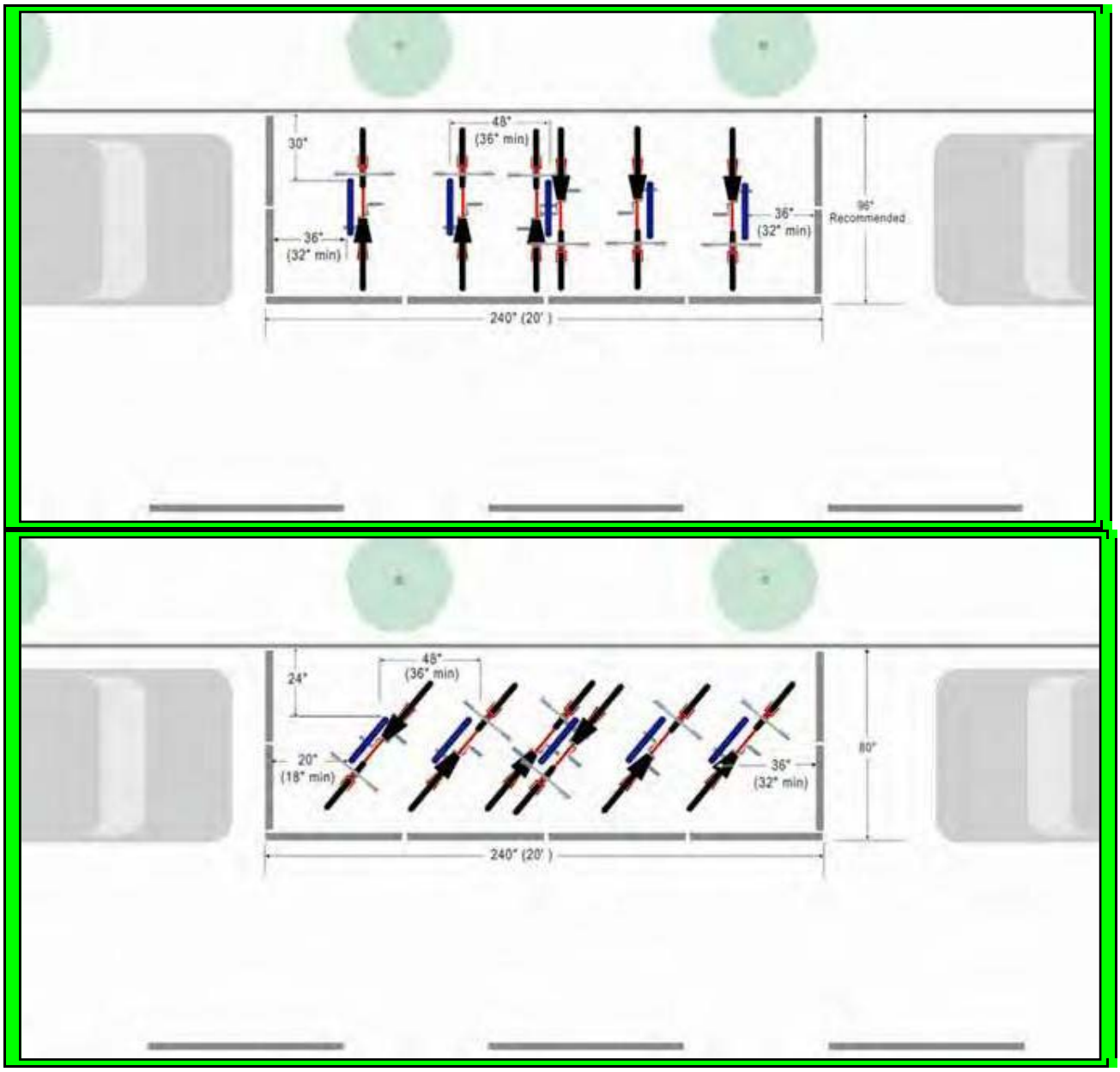

Figure 24. Sample Layout for In-Street Bicycle Corral, Perpendicular and Diagonal Options (*source: Association of Pedestrian and Bicycle Professionals*)

Surface Parking Lot Conversion – Surface parking lots may provide a convenient location for bicycle parking, by installing bicycle racks in a space formerly used for motor vehicle parking, or by using a portion of the lot that could not be configured for motor vehicle use. Using a rack layout similar to that of a bicycle corral, six bicycle racks (accommodating up to 12 bicycles) can fit in a single motor vehicle parking space. Bollards or other protection should be included to protect parked bicycles from potential collisions with motor vehicles.

A surface lot conversion may be appropriate under the following circumstances:

- City staff has determined that there is insufficient short-term bicycle parking in the vicinity, based on observation and an assessment of the needs of land uses in the immediate neighborhood.
- The rack location would be sufficiently convenient to the sites it is intended to serve, and there is adequate visibility to bicyclists and to support security at the location.
- Any adverse impacts to the supply of automobile parking must be determined and considered. Area businesses should be consulted in this process.

Covered Bicycle Parking Facilities – Covered bicycle racks, also referred to as a "bicycle oasis," provide shelter from weather conditions, and are recommended for racks where high use is anticipated, such as major transit stops. Rain may cause rusting to metal bicycle parts, while the ultraviolet rays from sunlight may degrade bicycle seats and tires. The covering must provide at least seven feet of vertical clearance; excessive height of the covering will reduce its ability to protect bicycles. Such a facility may be desirable at a location where multiple bicycle racks are to be installed, such as at a major transit stop. New York City and Portland have implemented such facilities, which can also be used to provide maps or other information (see Figure 25). The materials and design of covered bicycle facilities should be consistent with the City's bus shelter standard.

Mounting Types

There are two primary types of rack installation: surface mount and cast-in place. (Figure 26) Surface mount is preferred, however, racks are designed for only one or the other installation type. Racks should generally be installed in concrete. There are issues to consider with each type of installation, detailed below:

Figure 25. Example of covered bicycle parking in New York City. (*source: Fehr and Peers*)

Surface mount – This method should be used for installation on concrete surfaces; for many rack types, this is the only option. Anti-tampering bolts and other hardware should be used to prevent theft and removal of the rack. Surface mounted bicycle racks should only be mounted in concrete. If only asphalt or unpaved surfaces are available, concrete footings should be poured to anchor the hardware for individual racks. Multiple loop racks on flanges may be installed in asphalt, which can be useful for in-street bike corrals.

Embedded or cast-in-place – This option is viable where a concrete surface has not been established or is being repaired or retrofitted. While embedded racks are more secure than surface mounted ones, it should be noted that they cannot be relocated in the future if needed.

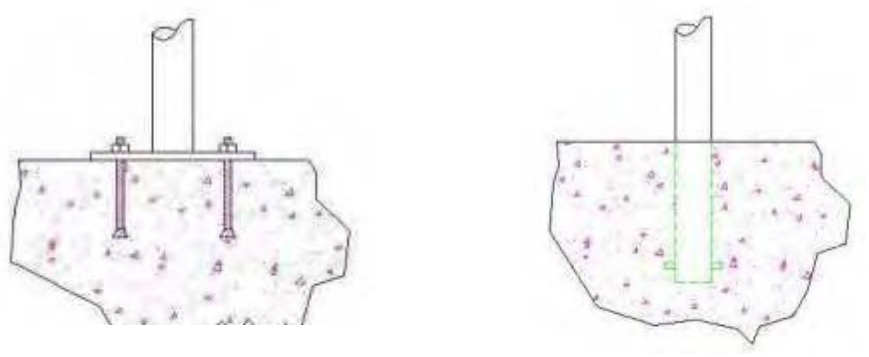

Figure 26. Surface and cast-in-place mounting of bicycle racks.

Long-Term Bicycle Parking

Bicycle racks provide adequate security for many types of bicycle trips. However, many bicyclists, such as those who commute to work or to a transit facility, need to lock their bicycles for long time periods each day.

To provide these bicyclists with a higher level of protection, there are numerous options available, as described below.

Bicycle Lockers – Bicycle lockers are covered storage units that can be locked individually, providing secure parking for one bicycle, as well as helmets or other riding gear. The City of Alameda currently has two types of bicycle lockers: 1) those which are assigned to a single user and can be accessed with a key, and 2) electronic lockers (located at the Civic Center Parking Structure and the Harbor Bay Ferry Terminal), for which cardholders use a "smart card" to access any vacant locker.

While the electronic lockers are more expensive per unit than single use lockers, each locker can serve a far greater number of bicyclists, which also reduces the total amount of space needed to accommodate bicycle parking. A further benefit of the electronic lockers is that the smart cards for the City's electronic lockers can be used with lockers at many other Bay Area locations, including BART stations. However, for locations where lockers are intended to serve private businesses, single-user lockers may be a more cost-effective option to serve regular bicycle commuters.

Bicycle lockers come in a variety of shapes and sizes depending on the need and the amount of space available, and should complement the aesthetic character of the site. A pair of lockers is typically about 29" wide by 51" high by 80" deep. The lockers have a diagonal divider inside the locker, dividing it into two bicycle parking spaces, which open from doors on opposite sides. Bicycle lockers can also be configured as wedge-shaped units, each accommodating one bicycle. This design is often useful for corner areas and for placement installed against walls where there is a constrained public right-of-way. Two typical layouts for the lockers are indicated in Figure 27.

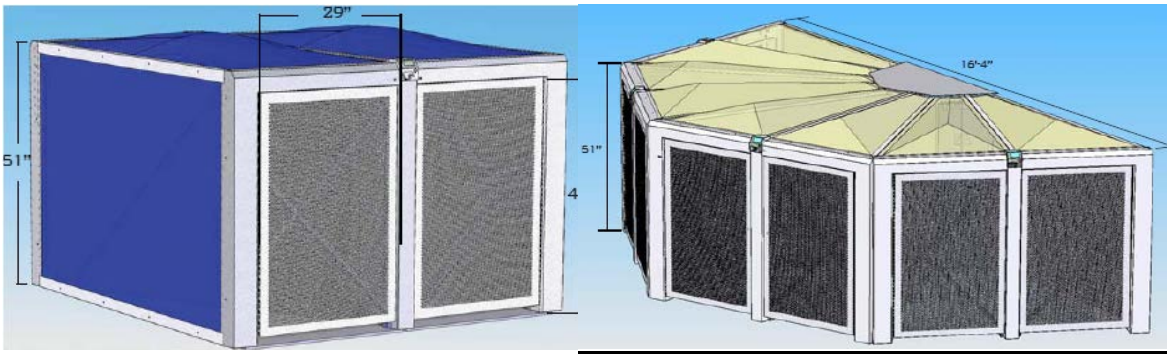

Figure 27. Alternative layouts for bicycle lockers (note that locker dimensions may vary by model and manufacturer).

Bicycle Cage – Bike cages are shared access storage areas in which cyclists lock their own bikes to bike racks installed within the cage, and are often located in a transit station or parking structure. Bike cages are a viable choice for transit centers and large employers or universities to provide an extra layer of security for long-term bike parking. While there is not a standard size for cages, a single cage of 18' by 20' occupies the same footprint as two standard parking stalls (or 9' by 20' each.)

Cyclists gain access to the bike cage by signing up in advance for a key or a key code, and registered users may enter at any time. Historically, bike cages have used conventional lock-and-key systems, but these have proved cumbersome from an administrative standpoint. Smart cards provide more convenient access and allow parking managers to monitor who goes in and out of the bike cages.

While cages provide additional security over U-racks or other on-street parking facilities, there is somewhat less protection than individual lockers, as multiple users may have access to the facility. To help mitigate this concern, small cages are preferred to limit the number of people with access to any single cage. Security may be bolstered by surveillance cameras and monitoring.

Bicycle Room – Bicycle rooms are similar in concept to a bicycle cage, but provide an enclosed and sheltered parking area, offering additional security. A bicycle room is an excellent option for a transit terminal, but any available building floor space can be converted into a bicycle room. Bike rooms may have wall racks or floor racks, and should allow easy access by elevator or ramp to the ground level. They may also feature amenities for bicyclists such as bike pumps, bike stands and basic tools. They also require little maintenance and an attendant is not needed because access to the facility is limited by requiring a key, access code, or other comparable security measure. Bicycle rooms are ideal in business parks or apartment or condominium complexes, and may be an ideal bicycle parking solution when addressed in the design phase of a new building.

Showers and Locker Room Facilities

Providing access to a shower and locker room is important for bicycle commuters with a rigorous commute and/or who are required to wear formal office attire. Such facilities can most easily be provided by large employers or in buildings where multiple companies house their operations. An alternative is for local health clubs to offer a limited membership to bicycle commuters, allowing them to use the club's shower and locker facilities. It is recommended that new development and redevelopment projects be encouraged during the development review process to provide shower and locker room facilities to complement the bicycle parking facilities as shown in Appendix C.

Requirements for Provision of Bicycle Parking Facilities for New Development and Redevelopment Projects

The quantity and type of bicycle parking can vary considerably depending on the land use associated with a project. For example, a retail store may need to accommodate customers that will only need to park their bicycles for an hour at a time, while an office building may primarily cater to employees, who may be bicycle commuters and may need to lock their bicycles for the entire workday. To ensure that new development and redevelopment projects provide the appropriate quantity and type of bicycle parking, Appendix B includes new requirements for both short- and long-term bicycle parking facilities to be provided as part of new development and modifications of existing development.

IV. SIGNAGE

The CA MUTCD defines three primary types of signs that are typically used on bicycle facilities (Section 2A.05), as well as the uses of colors for each sign type. These three primary sign types are as follows:

1) regulatory – give notice of traffic laws or regulations. Regulatory signs have a white, black or red background with a black, red, or white legend.
2) warning – give notice of a situation that might not be readily apparent. Warning signs have a yellow background with a black legend.
3) guide – show route designations, destinations, directions, distances, services, points of interest, and other geographical, recreational, or cultural information. Guide signs have a green background with a white legend.

The City will generally rely on the CA MUTCD regarding the application of all three sign types, which are illustrated in Figure 28. This section deals with the application of guide signs.

Regulatory Sign **Warning Sign** **Guide Sign**

Figure 28. Examples of regulatory, warning, and guide signs. (*source: CA MUTCD*)

There are three key issues addressed in these standards regarding the use of guide signs:

1) types of signs to use
2) guidance regarding sign placement
3) destinations to identify in the signage system

Current Signage Practices

Alameda currently employs R81 (CA) regulatory signs on bike lanes and D11-1 guide signs on bike routes. These standards recommend the use of additional guide signs on bikeways to provide directional and distance information as a relatively low-cost means to enhance the usability of the City's bicycle facilities network. The recommended route to drive to a destination may not be the same as the recommended route by bicycle, so

such signs can provide valuable assistance, especially for occasional riders and visitors. The signs recommended below are based on those in the CA MUTCD, with some minor modifications customized for use in Alameda.

Recommended Use of Guide Signs

The CA MUTCD guide signs are recommended as a way to support the existing bicycle network signage. (Figure 29) These signs may be installed on sign poles beneath the existing R81 (CA) and D11-1 signs. However, since the existing signs typically provide the minimum amount of required vertical clearance, the addition of the guide signs may require adding extensions to existing poles or replacing them to continue to provide sufficient vertical clearance. To provide a sense of identity for the Alameda bicycle facilities network, the City may choose to customize the destination arrow and supplemental plaque signs – D1-1b(R), D1-1b(L), and D1-1c below – with a logo that would be used throughout the system. CA MUTCD Chapters 2 and 9 include guidelines regarding the placement and clearances for guide signs,

For segments of the Bay Trail, the City should install the standard Bay Trail signs (at right), to provide regional connectivity to Bay Trail segments in other jurisdictions. Similarly, on other local bike path corridors, the City may choose to develop and implement a unique signage system as "branding" for the facility.

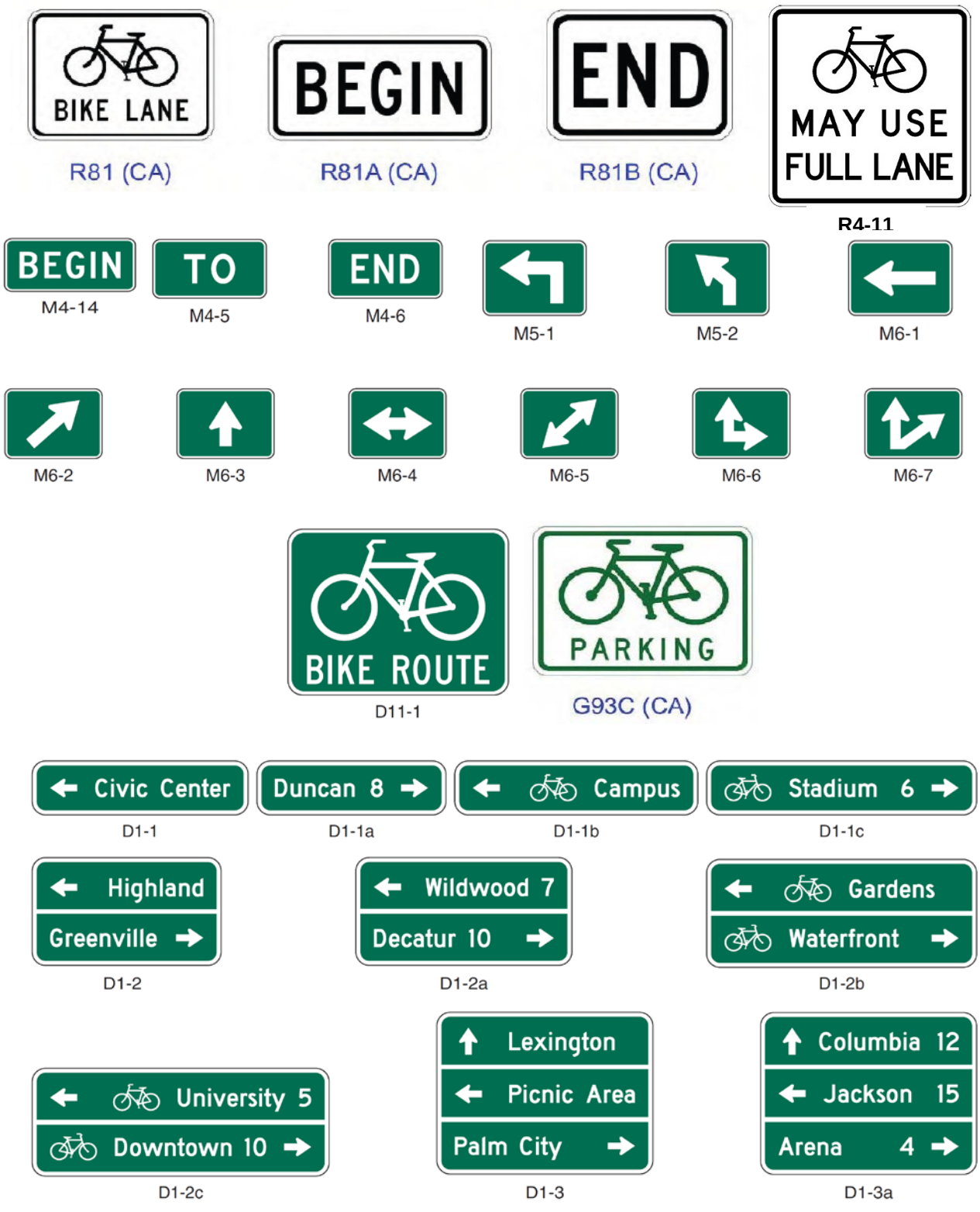

Figure 29. Selected CA MUTCD guide signs for bicycle facilities.

Recommended Destinations to be Served by Signage System

Given Alameda's size, it is recommended that a limited number of key destinations and landmarks be identified through the bicycle network signage system. The destination signs should include the name and distance (in miles) of each location from the sign, as indicated in sign D1-1a in Figure 29. Such a signage system could easily be expanded in the future should the City choose to do so. Examples of locations that could be included in the City's initial destination signage system are:

- Harbor Bay and Main Street ferry terminals
- College of Alameda
- Business districts
- Shopping centers
- Robert Crown Memorial State Beach
- Bridges and tubes (including BART stations in Oakland)

The specific location of signs will need to be determined through a field review. Signs should be installed based on the following principles:

- Along designated bicycle facilities.
- At key street intersections and intersections with designated bikeways. Signs should be installed at least every 1,200 feet (approximately every three blocks) along designated bikeways.
- At locations where a change in direction is required to access key destinations.

The implementation of a signage system will require significant outreach to a wide range of stakeholders in the City. At the time the City is prepared to move forward on the implementation of such a system, it is recommended that a committee be formed to facilitate the participation of these groups and individuals. The committee should be charged with working with appointed City boards and commissions and City staff to identify specific locations and routes to be served with the system, and to potentially develop a customized, Alameda-specific sign design.

V. CONCLUSION

The *City of Alameda Bicycle Facility Design Standards* were developed as a supplement to the 2010 *Bicycle Master Plan Update*. The Update was undertaken to support the policies of the revised Transportation Element of Alameda's General Plan, which demonstrates the City's commitment to developing a viable multimodal transportation system to support Alameda's future. These design standards are an important step in realizing these policies, as they illustrate the situations in which the City will, where feasible, exceed the Caltrans minimum requirements for bicycle facility design. It is anticipated that as Caltrans requirements are revised and a consensus develops around new "best practices," these standards will continue to evolve.

VI. REFERENCES AND RELATED RESOURCES

California Manual on Uniform Traffic Control Devices, Sacramento, CA: California Department of Transportation (Caltrans), 2010.

"Chapter 1000: Bikeway Planning and Design," *Highway Design Manual,* Sacramento, CA: California Department of Transportation (Caltrans), 2006.

Guide for the Development of Bicycle Facilities, American Association of State Highway Transportation Officials (AASHTO), Washington, DC, 1999.

Bicycle Parking Guidelines, 2nd Edition, Association of Pedestrian and Bicycle Professionals (APBP), Cedarburg, WI: 2010.

City of Alameda 1999 Bicycle Master Plan, 2010 Update.

City of Alameda General Plan, Transportation Element.

City of Alameda Pedestrian Plan, 2009.

City of Alameda Pedestrian Design Guidelines, 2010.

APPENDIX A

Monitored Bicycle Parking Requirements for Event Permit Application Conditions (Events Greater Than 1,000 Participants)

1) Organizers should reserve space for bike parking commensurate with at least 5% of the total expected crowd. Expect a greater need for bicycle parking (10%) at any event located on Recreation and Park property.
2) In parking bicycles, an average length of 6 feet and width of 2 feet should be reserved for a single bike.
3) Bicycle parking should be within sight of a regular entrance to the event (maximum of a one block radius). This can include car garages, schoolyards, parking lots, or on-street parking.
4) Valet parkers must handle the parking and return of bicycles. Bicycles should be returned upon receiving a claim check to ensure the same bicycles are returned that were left. Valet parkers should record the number of bicycles parked at the event and provide that number to the event sponsor in order to estimate the amount of space needed for the following year's event.
5) Bicycle parking should be monitored at all times by someone approved by the event sponsor.
6) Hours of operation of the secured attended bicycle parking must be at least the same hours as the event.
7) The sponsor shall be financially responsible for the secured attended bicycle parking in the event that bicycles are damaged or stolen.
8) Bicycle parking information must be provided whenever any kind of transportation or directional information is advertised for the event, in the same format and with equal amount of space. All events must indicate the location of the secured attended parking facilities and all event personnel must be aware of this location.

Should any unique circumstances arise in relation to the bicycle parking for a particular event, the applicant should contact the City of Alameda Public Works Department at (510) 747-7930.

Appendix B: Standards for Bicycle Parking Spaces – Development and Redevelopment Projects

Land Use Category	Specific Use	Long Term	Short Term
Residential	Multi-unit with private garage	None	0.05 per bedroom (2 minimum)
	Multi-unit without private garage	0.5 per bedroom (1 per unit minimum)	0.05 per bedroom; 0.1 per bedroom if above 30 units (2 minimum if less than 4 units; 6 minimum if 4 or greater units)
	Hotel/motel	1 per 25 rooms (2 minimum)	2% of max. daily attendance (2 min.)
	Residential care facility	1 per 20 employees or 70,000 square feet (sf) floor area, whichever is greater (2 minimum)	1 per 25 rooms (2 minimum)
Institutions or places of assembly	Libraries, museums, art galleries	1 per 10 employees (2 minimum)	1 per 4,000 sf floor area (2 minimum)
	Churches, theaters, auditoriums, lodges and mortuaries	1 space per 40 fixed seats or 1 per 4,000 sf floor area, whichever is greater (2 min.)	1 space per 40 fixed seats or 1 per 2,000 sf floor area, whichever is greater (2 min.)
	Bowling alley	1 per 10 alleys (2 minimum)	1 per 2 alleys (2 minimum)
	Night clubs, dance halls	1 per 5,000 sf floor area (2 minimum)	1 per 5,000 sf floor area (2 minimum)
	Public buildings, municipal and education	1 per 10 employees and 1 per 5 students of planned capacity (2 minimum)	1 per 3,000 sf floor area or 1 per 20 students of planned capacity, whichever is greater (2 minimum)
	Child care facilities, including family day care	1 per 20 employees (2 minimum)	1 per 20 students of planned capacity (2 minimum)
	Skating rinks and swimming pools	1 per 5,000 sf water or skating area (2 minimum)	1 per 1,000 sf water or skating area (2 minimum)
Commercial or office uses	Marinas	1 per 5,000 sf (2 minimum)	2 spaces at each public entrance (2 min.)
	Retail, banks, minor repair services	1 per 10,000 sf floor area (2 minimum)	1 per 2,000 sf floor area (2 minimum)
	Restaurants	1 per 5,000 sf floor area (2 minimum)	1 per 1,500 sf floor area (2 minimum)
	Office	1 per 10,000 sf floor area (2 minimum)	1 per 2,500 sf floor area (2 minimum)
	Medical service	1 per 12,000 sf floor area (2 minimum)	1 per 2,500 sf floor area (2 minimum)
	Work/live studios	1 per 4 units (2 minimum)	1 per 20 units (6 minimum)
Manufacturing and industrial uses	Warehouse, storage	1 per 8,000 sf floor area (2 minimum)	2 spaces at each public entrance (2 min.)
	Manufacturing, major	1 per 8,000 sf floor area (2 minimum)	2 spaces at each public entrance (2 min.)
Off-street parking lots and garages open to general public		1 per 20 motor vehicle parking spaces (2 minimum)	Minimum 6 spaces or 1 per 20 motor vehicle parking spaces
Parks and recreation sites		To be determined on the basis of similar use for park type (2 minimum)	1 per 4,000 sf land area (2 minimum)
Park and Ride Lots		Minimum of 4 spaces or 1 space per 10 automobile spaces	Minimum of 6 spaces or 1 per 10 auto spaces.

APPENDIX C

Alameda Standards for Provisions of Showers and Lockers for Development and Redevelopment Projects (Optional)

Use	Square Footage	Number of Showers	Number of Lockers
Office, industrial, manufacturing	0-4,999	0	0
	5,000-19,999	1	2
	20,000-49,999	2	4
	50,000 and up	4	8
Retail, eating and drinking, personal service	0-24,999	0	0
	25,000-49,999	1	2
	50,000-99,999	2	4
	100,000 and up	4	8

Showers should be provided for men and women. If only 1 shower is provided, it should be designed as a unisex facility that is accessible to people with disabilities.

As an alternative to including shower facilities within a building, a new business may submit a written agreement for employees to utilize existing shower facilities of a business within 300' of the project's line. The agreement must be signed by both parties involved, allow use of the facilities in perpetuity, establish allowable hours of use, include provisions for maintenance, and involve shared liability agreements.