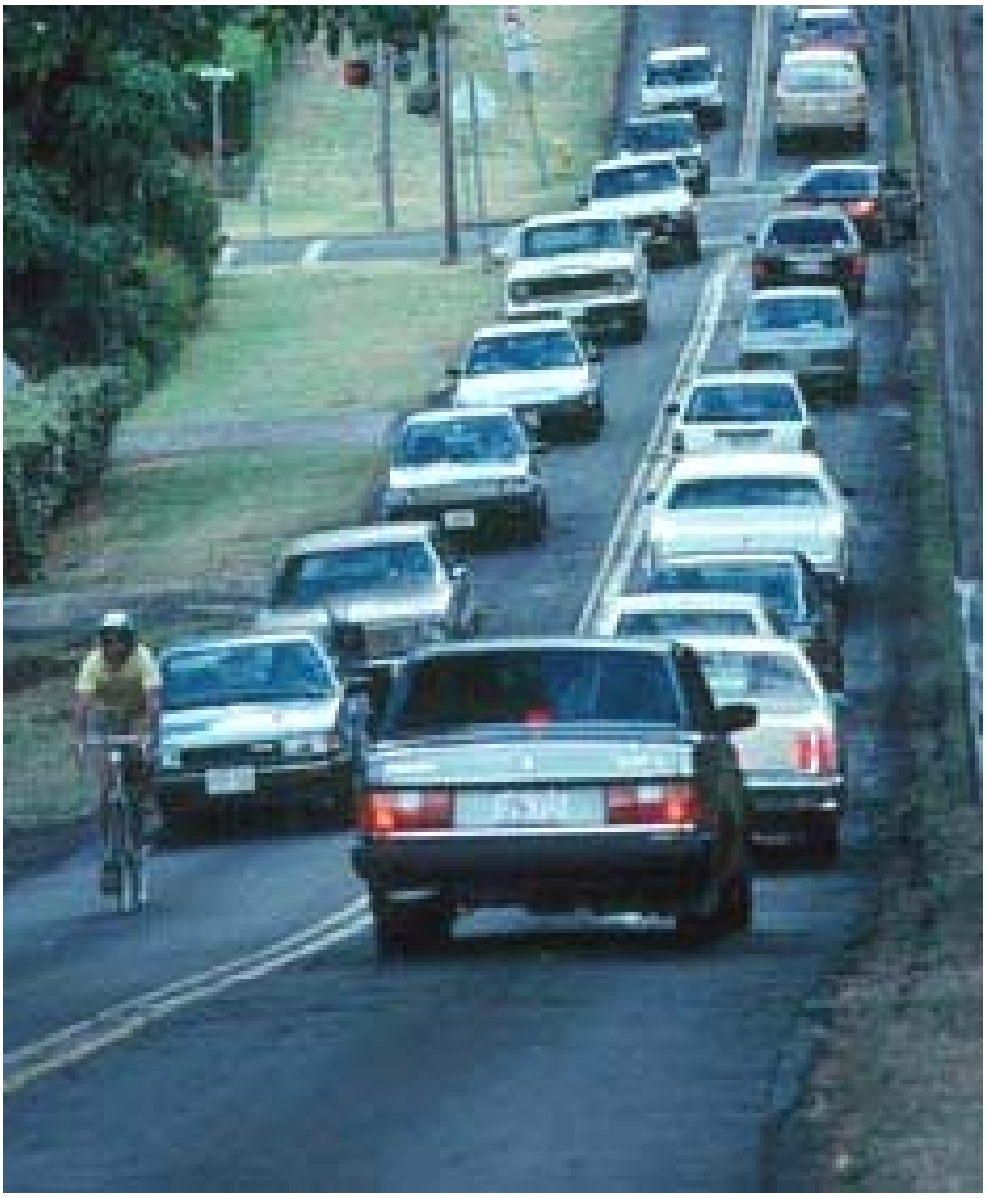
Breaking Barriers to Bicycling: Bicycle Lanes Best Practices and Pilot Treatments



MORPC
Mid-Ohio Regional Planning Commission

Breaking Barriers to Bicycling: Bicycle Lanes Best Practices and Pilot Treatments

Prepared by:
Mid-Ohio Regional Planning Commission
285 East Main Street
Columbus, OH 43215
(614) 228-2663/www.morpc.org

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"Information and statistics referenced herein were obtained from the identified sources. The best practices presented herein are not express or implied opinions, suggestions or statements that any current condition or practice violates an applicable safety regulation or standards.

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FOREWARD

Breaking Barriers to Bicycling: Bicycle Lanes Best Practices and Pilot Treatments is a **compilation** of best practices, research and test projects that communities across the nation can review to improve the bicycling environment. This document focuses primarily on bike lanes and the challenges associated with intersection and interchange safety. Intersections and interchanges are barriers to all but the most experienced traffic bicyclists. In encouraging bicycling, it is important that we address those challenges that create a barrier to the use of this alternative mode of transportation.

Most bicycle/auto crashes occur at intersections including driveways, parking lots, and alleys. Appropriate design and signage will place motorists and bicyclists at ease as they learn to share the road and safely maneuver challenging intersections.

The information presented in this document has been gathered from various sources including A Policy on Geometric Design of Highways and Streets by the American Association of State Highway and Transportation Officials (AASHTO) Green Book, AASHTO Guide for the Development of Bicycle Facilities, the Federal Highway Administration (FHWA), Departments of Transportation, Manual of Uniform Traffic Control Devices and various local communities.

We hope that by seeing what others have done, local communities in central Ohio will be inspired to create programs that will encourage, build and promote a safer bicycling environment.

BACKGROUND

While Federal regulation encourages and supports the construction of bicycle facilities, the overwhelming cry from the public for more facilities has created a more intense review of local, regional and state policies. Even though ISTEA and TEA-21 called for the consideration of bicycle facilities when improving road facilities, bicycle enthusiasts and advocates interpreted consideration as actively pursuing.

In the quest to build more bikeways in central Ohio, policies are being challenged to ensure bicycles are considered in the planning process. In 2004, the Central Ohio Bicycle Advocacy Coalition challenged the policies of the MPO, the Mid-Ohio Regional Planning Commission (MORPC), to include language in its policy to routinely accommodate bicycle and pedestrians when local communities apply for MORPC-attributable federal funds.

MORPC, as the MPO, is required by legislation to plan for the "development and integrated management and operation of transportation systems and facilities (including pedestrian walkways and bicycle transportation facilities) that will function as an intermodal transportation system." However, to require the routine inclusion of bicycle and pedestrian facilities was a first for central Ohio.

As a steward of public funds, MORPC embraces the regional responsibility of providing a transportation system that is seamless and that provides for the needs of all modes of transportation. However, the maintenance and construction of the various elements of the transportation system are the responsibility of state and local jurisdictions.

Local communities now faced with a regional policy that requires routine accommodation of bicycle and pedestrian facilities are challenged to find ways to adhere to the policy. Inclusion in new roadway construction isn't as much of a challenge as retrofitting existing infrastructure. The first of several, this document is designed to provide some assistance to local communities in constructing bicycle facilities for new and existing roadways.

Recently, the public has requested MORPC to intervene on transportation improvement projects that are occurring in the region but are not utilizing MORPC-attributable federal funds. While MORPC cannot guarantee or ensure the inclusion of bicycle and pedestrian facilities in these projects, MORPC has drafted internal guidelines, which will suggest consistent recommendations to the sponsors of such projects. These internal guidelines appear in this report in Appendix A.

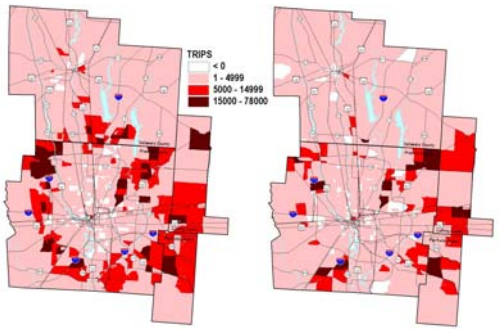
EXISTING CONDITIONS

Local land use policies and the strong home-rule status of central Ohio's municipalities continue to foster, encourage and support an automobile-oriented society. Intermodal transportation to and from new developments will be more important than ever as users of the system seek alternative and more efficient ways to reach destinations. The bikeway transportation system provides just one of many alternatives to those who choose not to or who are unable to drive.

Figure 1

Land Use as Traffic

1995 - 2010 2010 - 2025



5000 trips = 500 houses or
150,000 square feet retail or
350,000 square feet office or
900,000 square feet industrial

- Every new house and every square foot of new commercial or industrial development translates into new trips.
- Residential development accounts for over 1/2 of the trips in the region.
- Over 1/2 the expected development by 2025 will be in place by 2010.

Bicyclists have the same mobility needs as every other user of the transportation system. They use the highway system as their primary access to goods, services, and recreational activities. Existing highways and streets, often with relatively inexpensive improvements, must serve as the base system to provide for the travel needs of bicyclists. Multi-use trails and trail connectors can augment this existing system in scenic corridors, greenways or places where access is limited. Transit is an important link and partner to a comprehensive bikeway system. Bicycle transportation planning is an effort that should consider many alternatives to provide for safe and efficient bicycle travel.

In central Ohio, however, the bicycle transportation system that exists is primarily multi-use trails. Trails appear to be safer because they are separated from motor vehicle traffic. Local communities are apprehensive about constructing bike lanes, wide curb lanes or paved shoulders because facilities they construct are viewed safe for all users.

There are basically three types of riders. The more traffic-experienced rider is confident riding anywhere he or she is legally allowed to operate and can negotiate busy and high-speed roads that have few, if any, special accommodations for bicyclists. The less experienced adult/teen riders are less confident and prefer to use roadways with a more comfortable amount of operating space, perhaps with designated space for bicyclists, or shared-use paths that are away from motor vehicle traffic. Children/Teen riders may be confident riders and have excellent bike handling skills, but have yet to develop the traffic sense and experience of an everyday adult rider.

Bike lanes, wide curb lanes or paved shoulders would appeal to the more traffic-experienced rider. Having no way to control which users will use bike lanes, local communities are reluctant to build these facilities in fear of tort liability claims.

The AASHTO Green Book, other state-adopted highway standards, federal and state regulations and guidelines, and research publications issued by the Transportation Research Board are often used in tort cases to educate the jury about the standard level of practice for design. Expert witnesses are used, who in turn rely on written text to explain the accepted standard practices for design to the jury.

As a result of concerns about litigation, communities avoid designing bike lanes, wide curb lanes and paved shoulders. Communities need to remember that the skills, experience and judgment of their design engineers are still valuable tools that should be applied to solving design problems and that, with reliance on complete and solid documentation, tort liability concerns need not be an impediment to achieving good design.

Model Planning Guidelines

The process of planning bicycle facilities must be fully integrated into the other ongoing planning activities, comprehensive planning, sub-area planning, site plan review and highway design. Key elements that appeared to be consistently present in jurisdictions adequately treating bicycle accommodations include:

- Policy statements in the comprehensive plan that relate to bicycle needs and objectives
- Inclusion of bicycle facility elements in the comprehensive plan
- Preparation of sub-area or sector plans for areas needing special coordination
- Designation of a knowledgeable person or persons on the planning and/or engineering staff to serve as the in-house bicycle advocate

Effective bicycle- and pedestrian-oriented land use planning will have the most significant impact on bicycle travel of any bicycle strategy. Model planning guidelines can encourage the use of bicycles and walking by locating and forming mixed land uses that reflect the average trip length associated with bikes (approximately 2 miles) and walking (about 0.5 miles). Connectivity of adjacent residential and mixed uses will also foster increased bicycling and walking.

Another important element of local planning must involve problem identification. An ongoing process that should take place at all levels is the identification of the major deficiencies that have become pervasive over the years as well as the day-to-day isolated problems that occur. Both public agencies and private citizens are an integral part of the problem identification process.

Planning and Engineering

Bicycle transportation planning is commonly construed as the effort undertaken to develop complete/comprehensive bicycle facilities for transportation and recreational activities. The resulting system is composed of multi-use trails, improved roadways, bicycle lanes, bicycle parking, bicycle mapping and transit links. All facilities are interconnected and spaced closely enough to satisfy the travel needs of bicyclists.

Education

Bicycle education on how to maneuver through turning movements at intersections, interchanges, and driveways in either the midblock or intersection area is crucial in reducing bicycle/motor vehicle conflicts. Driveways or alleys in commercial areas are the highest risk for conflicts because more motor vehicle traffic is present. Bicyclist education about the danger of driveways is warranted, with the message focusing not only on motorist drive-out but also on motorist overtaking situations. Motorist education relating to the overtaking situation above is also needed. Bicyclist education about correct position when riding on streets with on-street parking is also highly recommended. Law enforcement agencies also need training on the proper enforcement of bicyclists' rights and duties.

Encouragement

According to FHWA and many state and local jurisdictions, bicycle lanes are the preferred bicycle facility in urban environments. Paved shoulders are appropriate in rural areas and wide curb lanes are appropriate in areas where there is not enough room to accommodate bicycle lanes or where traffic conditions call for the experienced traffic bicyclist.

In areas that are transitioning from rural to urban, the needs of bicyclists can be accommodated by retrofitting bike lanes onto many existing roadways using the following methods:

1. marking and signing existing shoulders as bike lanes
2. physically widening the roadway to add bike lanes
3. restriping the existing roadway to add bike lanes

On projects where it is not physically possible to provide bike lanes due to constraints such as existing buildings or environmentally sensitive areas, a wide outside lane may be substituted. A wide outside lane should only be considered after other options have been pursued, such as narrowing or removing travel lanes or parking. Wide lanes allow motor vehicles to pass a bicyclist in the lane, but provide few of the benefits of bike lanes. Bike lanes should resume where the constraint ends.

Effectively reducing running (actual) speeds to less than 25 MPH creates a more comfortable environment for bicycling where there is insufficient width for bike lanes.

Bicycle lanes, paved shoulders and wide curb lanes are most challenging to design and maneuver at intersections and interchanges. Bicyclists' ability to maneuver through intersections and interchanges requires knowing traffic law. Bicycles are considered slow-moving vehicles and must obey the same laws as motorists.

According to the Transportation Research Board's Committee on Bicycling and Bicycle Facilities, a recommendation was presented to FHWA that states children bicyclists and their parents prefer a network of designated bicycle facilities (e.g., bike lanes, separate bike paths, or side street bicycle routes) through the key travel corridors typically served by arterial and collector streets or provide usable roadway shoulders on rural highways.

However, apprehension exists particularly with the use of bike lanes in conditions with high traffic volume and speed. This is certainly the condition that communities fear most. Children/teens aged 10 through 15 leave their "safe" neighborhoods and the "safe" bike path to venture out and explore other destinations. Bike lanes would be beneficial in these quests. However, this would be the user group most at risk when using bike lanes.

In order for these children/teens to learn to maneuver in bike lanes through the intersections and interchanges, they need to be educated on how to ride in traffic. Education plays a paramount role to this age group when installing bike lanes. Currently in central Ohio bike education is offered sparsely, if at all. More

education coupled with emulating experienced traffic riders would assist in training this age group to bike in traffic.

Are there streets that should not be fitted for bike lanes?
According to the Chicago Bike Lane Design Guide, bicycle lanes have been successfully implemented on streets with upwards of 30,000 vehicles per day. Bike lanes work best when cars are traveling between 25 and 35 miles per hour, the posted speed for most urbanized areas.

The challenge for local communities is to provide a design that will safely maneuver bicyclists through intersections and interchanges. Best practices for these specific challenges continue to evolve as municipalities across the country strive to make their communities more bicycle friendly.

The remainder of this guide focuses primarily on the innovative design of bicycle lanes at intersections and interchanges that have achieved some modicum of success or that are being tested. Many of the treatments can be altered to fit individual locations and situations. However, each situation must be evaluated to determine the possibilities that are appropriate for that particular project. This guide assumes that the bicyclist that will use bicycle lanes will be the experienced traffic bicyclist and the casual or new adult/teenage rider.

BEST PRACTICES

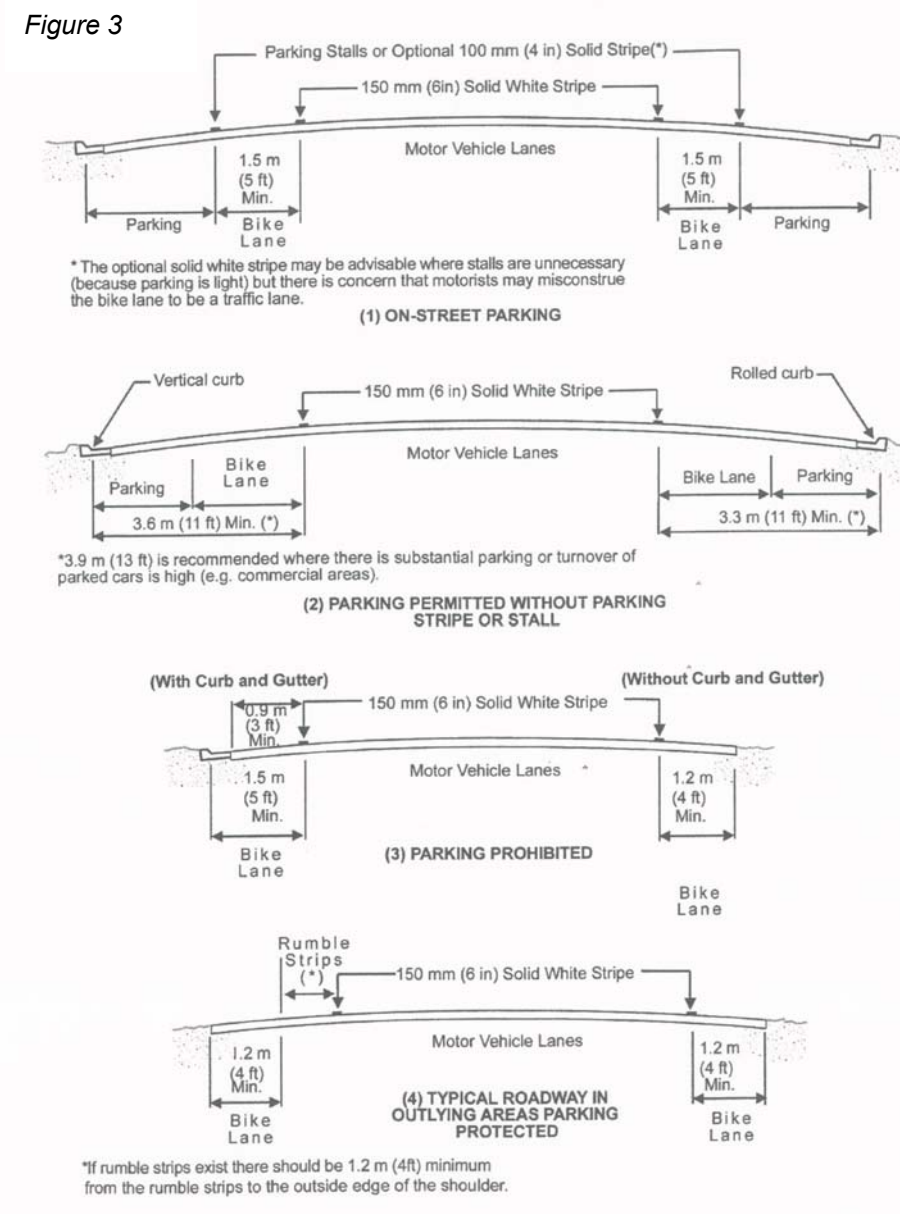
Design Standards and Approaches

Bicycle Lane - also known as a Class II Bikeway, is a portion of the roadway designated by striping, signing, and/or pavement markings for preferential or exclusive use of bicycles.

Figure 2

As a relatively new feature in the roadway cross-section, bike lane design has been the topic of much study in recent years. Bike lane design can be quite challenging in situations where the existing urban traffic patterns are complex and cross-sections are already constrained by heavy traffic volumes. Designers throughout the country develop new and better solutions each year.

Figure 3



Typical Bike Lane Cross-Sections
AASHTO Guide for the Development of Bicycle Facilities

(1) On-street Parking
If parking is permitted, the bike lane should be placed between the parking area and the travel lane and have a minimum width of 5 feet.

(2) Parking Permitted without Parking Stripe or Stall
Where parking is permitted but a parking stripe or stalls are not utilized, the shared area should be a minimum of 11 feet without a curb face and 12 feet adjacent to a curb face. If the parking volume is substantial or turnover is high, an additional 1 to 2 feet of width is desirable.

(3) Parking Prohibited
Figure 3 depicts a bike lane along the outer portion of an urban curbed and uncurbed street where parking is prohibited.

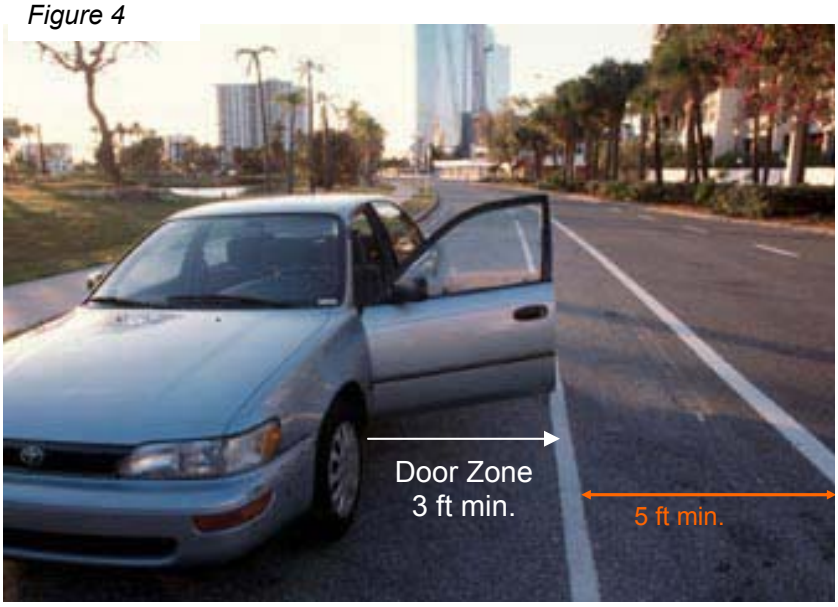
The recommended width of a bike lane is 5 feet from the face of a curb or guardrail to the bike lane stripe. This 5-foot width should be sufficient in cases where a 1 – 2-foot wide concrete gutter pan exists, given that a minimum of 3 feet of rideable surface is provided, and the longitudinal joint between the gutter pan and pavement surface is smooth. The width of the gutter pan should not be included in the measurement of the rideable or usable surface, with the exception of those communities that use an extra wide, smoothly paved gutter pan that is 4 feet wide, as is a bike lane. If the joint is not smooth, 4 feet of rideable surface should be provided.

Since bicyclists usually tend to ride a distance of 32 - 40 inches from a curb face, it is very important that the pavement surface in this zone be smooth and free of structures. Drain inlets and utility covers that extend into this area may cause bicyclists to swerve and have the effect of reducing the usable width of the lane. Where these structures exist, the bike lane width may need to be adjusted accordingly.

(4) Typical Roadway in Outlying Areas Parking Protected
Figure 4 depicts a bike lane on a roadway in an outlying area without curbs and gutters. This location is in an undeveloped area where infrequent parking is handled off the pavement. Bike lanes should be located within the limits of the paved shoulder at the outside edge. Bike lanes may have a minimum width of 4 feet, where the area beyond the paved shoulder can provide additional maneuvering width. A width of 5 feet or greater is preferable and additional widths are desirable where substantial truck traffic is present, or where motor vehicle speeds exceed 50 mph.

Bicycle lanes serve the needs of all types of bicyclists in urban and suburban areas, providing them with their own travel lane on the street surface. The minimum width of a bike lane should be 5 feet against a curb or adjacent to a parking lane. The 5 feet should be located outside the door zone. The door zone (also known as the danger zone) is the area that is the width of the car door when the door is open. Allow a minimum of 3 feet for the door zone.

Figure 4

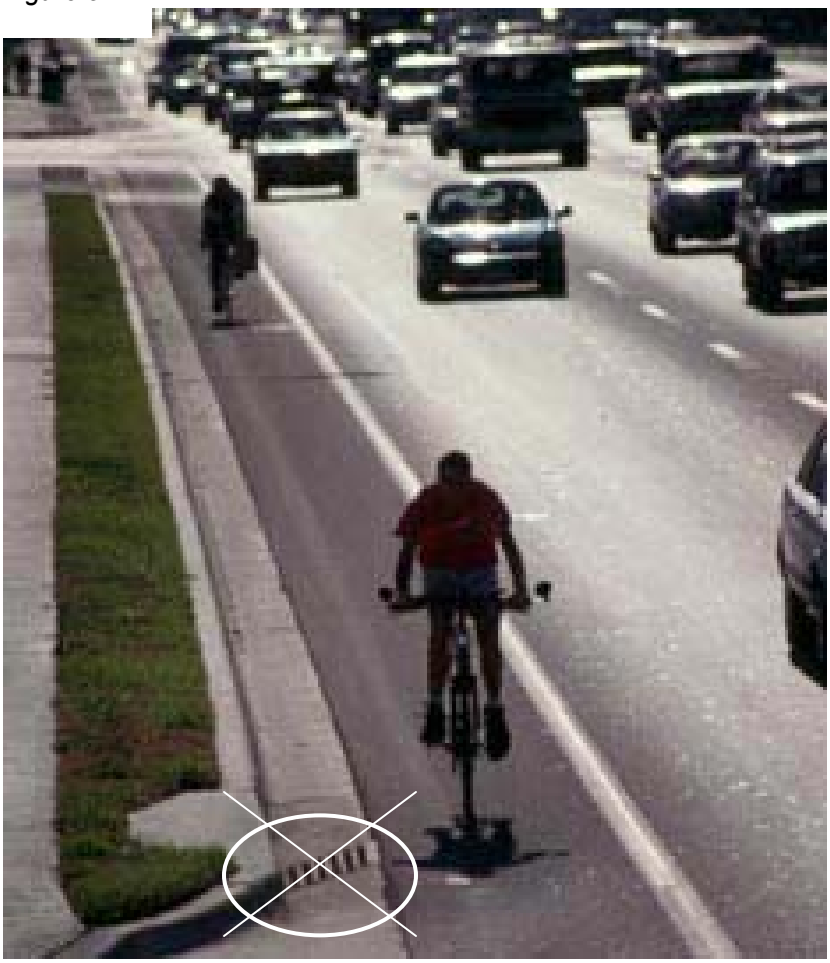


Wider bike lanes are recommended on streets with higher motor vehicle speeds and traffic volumes, or where pedestrian traffic in the bike lane is anticipated. Width measurements are taken from the curb face to the bicycle lane stripe. Regular maintenance is critical for bike lanes.

Bike lanes should always be one-way facilities, carrying traffic in the same direction as adjacent motor vehicle traffic, and they should not be placed between parking spaces and the curb. Since bicyclists must periodically merge with motor vehicle traffic, bike lanes should not be separated from other motor vehicle lanes by curbs, parking lanes, or other obstructions. Two-way bike lanes on one side of two-way streets create hazardous conditions for the bicyclist and are not recommended.

On one-way streets, bicycle lanes should be installed on the right-hand side, unless conflicts can be greatly reduced by installing the lane on the left-hand side. Left-side bicycle lanes on one-way streets may also be considered where there are frequent bus or trolley stops, unusually high numbers of right-turning motor vehicles, or if there is a significant number of left-turning bicyclists.

Figure 5



However, experienced riders who depend upon mirrors for traffic awareness use them on the left side of the bike, helmet or glasses. Left-turn situations have shown that they lose sight of a great deal of roadway when they ride to the left of traffic. In a turn situation, this poses no major issue because of the short distance of the event; however, for longer distances; many would feel seriously uncomfortable using such lanes.

Bicycle lanes should be provided with adequate drainage to prevent potentially hazardous conditions. The drainage grates should be bicycle-safe. When an immediate replacement is not possible, a temporary correction of welding thin metal straps across the grates perpendicular to the drainage slots at 4 inches with center-to-center spacing should be considered.

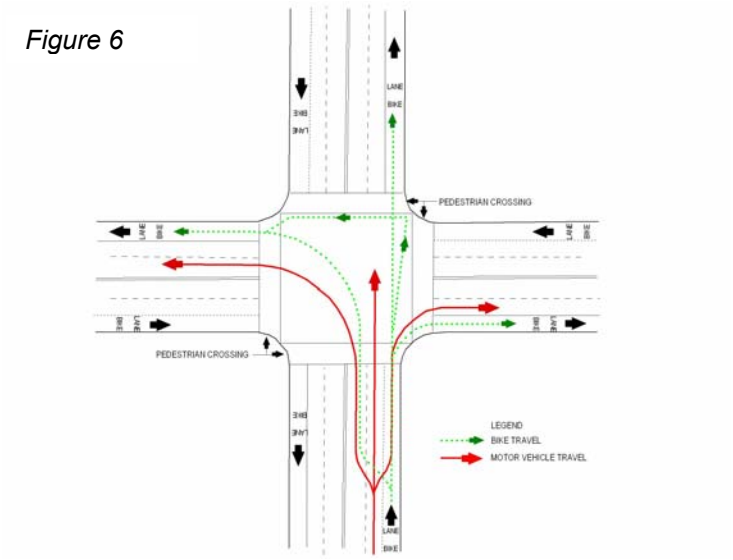
Bicycle lanes can complicate turning movements at intersections. This is where knowing traffic law becomes important. In order for bicyclists to maneuver through intersections, it is important that the bicyclist know what is expected of the motorist. This section will show best practices for turning movements.

Intersections and Interchanges

Most auto/bicycle crashes occur at intersections. For this reason, bikeway design at intersections is to be accomplished in a manner that will minimize confusion by motorists and bicyclists and will permit both to operate in accordance with the normal rules of the road.

Figure 6 illustrates a typical intersection of multilane streets, with bike lanes on all approaches. Some common movements of motor vehicles and bicycles are shown. At intersections where

Figure 6

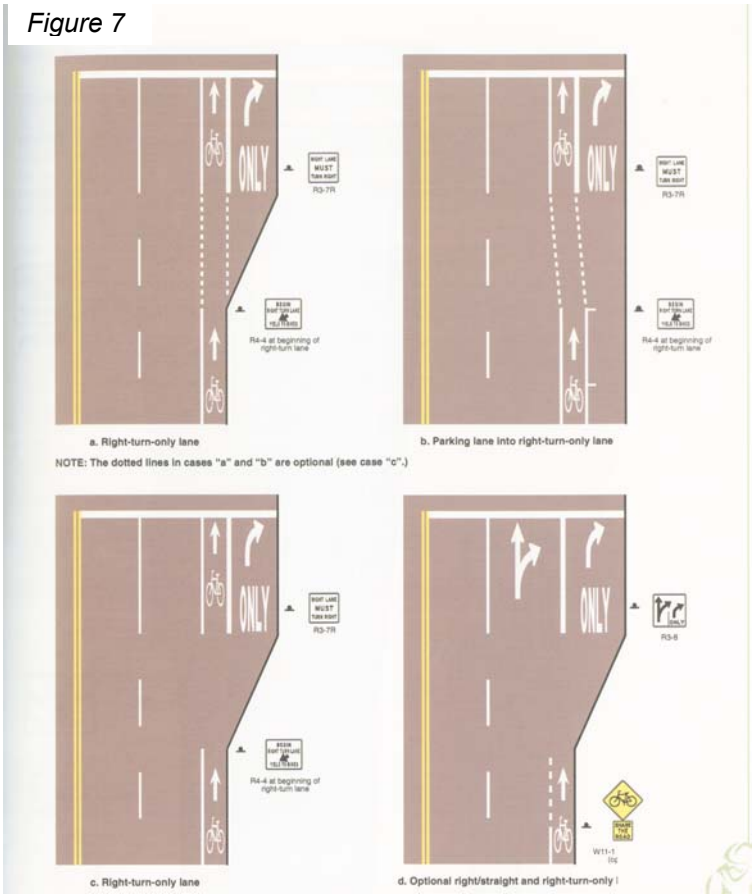


Typical Bicycle and Auto Movements at Major Intersections
AASHTO

there are bike lanes and traffic signals, installation of bicycle-sensitive loop detectors within the bike lane (well in advance of intersections) is desirable. It is also important that loop detectors in left-turn lanes be sensitive enough to detect bicycles. The use of push-button actuators at bikeway intersections is not preferred by bicyclists as they must stop to actuate the signal.

Figures 7 and 8 illustrate recommended striping patterns for bike lanes crossing a motorist right-turn-only lane, or freeway off- and on-ramps. When confronted with such intersections, bicyclists will have to merge with right-turning motorists. Since bicyclists are typically traveling at speeds less than motorists, they could signal and merge where there is a sufficient gap in right-turn traffic, rather than at any predetermined location.

Figure 7



Bike Lanes Approaching Right-Turn-Only Lanes AASHTO

For this reason, it is recommended that either all delineations are dropped at the approach of the right-turn lane (or off ramp), or that a single, dashed bike lane line be extended across the right-turn lane. A pair of parallel lines (delineating a bike lane crossing) to channel the bike merge is not recommended, as bicyclists will be encouraged to cross at a predetermined location, rather than when there is a safe gap in right-turning traffic. Also, some bicyclists are apt to assume they have the right-of-way and neglect to check for right-turning traffic.

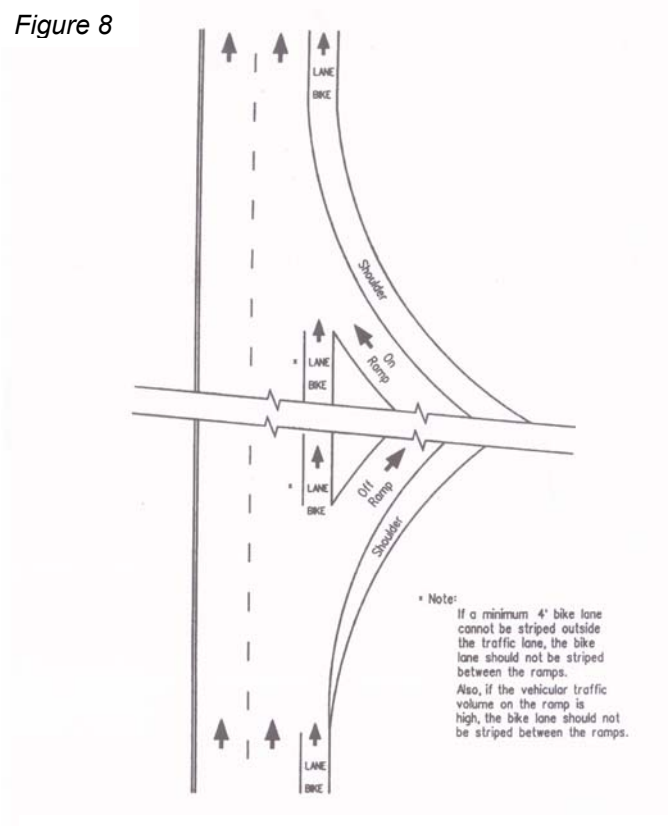
The City of Columbus, Ohio, recommends for right-turn lanes greater than 200 feet in length, a marked island (2-3 feet wide) be installed between the bike lane and right-turn lane where space

permits. This reduces the time a bicyclist is exposed directly to traffic on both sides.

A dashed line across the right-turn-only lane (or off ramp) is not recommended on extremely long lanes, or where there are double right-turn-only lanes. For these types of intersections, all striping is dropped to permit judgment by the bicyclists to prevail. Bike lanes crossing on ramps do not present the same problems, as bicyclists normally have a good view of traffic entering the roadway, and will adjust their path to cross ramp traffic.

A single dash line may be useful in special cases, such as freeway ramps, where there is a greater distance between the beginning and end of the ramp. A bike crossing sign is intended for use on highways to warn motorists of the potential for bicyclists crossing the roadway.

Figure 8



WSDOT Design Manual, Facilities for Nonmotorized Transportation

City of Davis, California

Davis, California, has established itself as “America’s Best Cycling City.” With an area just over ten square miles, Davis has 48.8 miles of bike lanes and 49 miles of bike paths. More than 80 percent of all collector and arterial streets within the city have bike lanes and/or bike paths. This is the highest such ratio of any city in the country!

For decades, the City of Davis has led the nation in the design and construction of innovative bicycle facilities. This is how the City of Davis addresses bicycle lanes.

Bike Lanes

Bike lanes provide a significant benefit to safe and efficient bicycle circulation. Conflicts between bikes and autos are dramatically reduced when on-street lanes are installed. Having separate identifiable areas on the street for bikes and autos places the travelers in predictable locations.

Generally, bicycle lanes are provided or planned for all collector and arterial streets. The city’s guideline width for on-street bike lanes is eight feet when adjacent to the curb and fifteen feet (8 feet parking + 7 feet for bikes) where parking is allowed. There is a consensus among bicycle planning and safety experts that bike lanes constructed to the Davis guidelines are safe and adequate.

Bike lanes become unsuitable for bicycle riders that lack the necessary skill to safely use them when traffic volumes are heavy and/or vehicle speeds are high. These individuals should use alternate routes. There are bicyclists who have the desire and skill to use on-street lanes, such as bike commuters, so these facilities are still very much needed.

Width criteria for bike lanes takes into account occasional obstructions, such as leaf piles and yard debris, that may exist in the bike lanes that would require bicyclists to steer around them. While automobiles do sometimes stray into the bike lane and bicyclists sometimes stray into the vehicle lane, these incursions seldom result in crashes. Mid-block crashes between bikes and motor vehicles are rare. More common are bike/bike accidents and bikes running into fixed objects such as parked cars. The majority of bike/car crashes occur at intersections.

Intersection Considerations

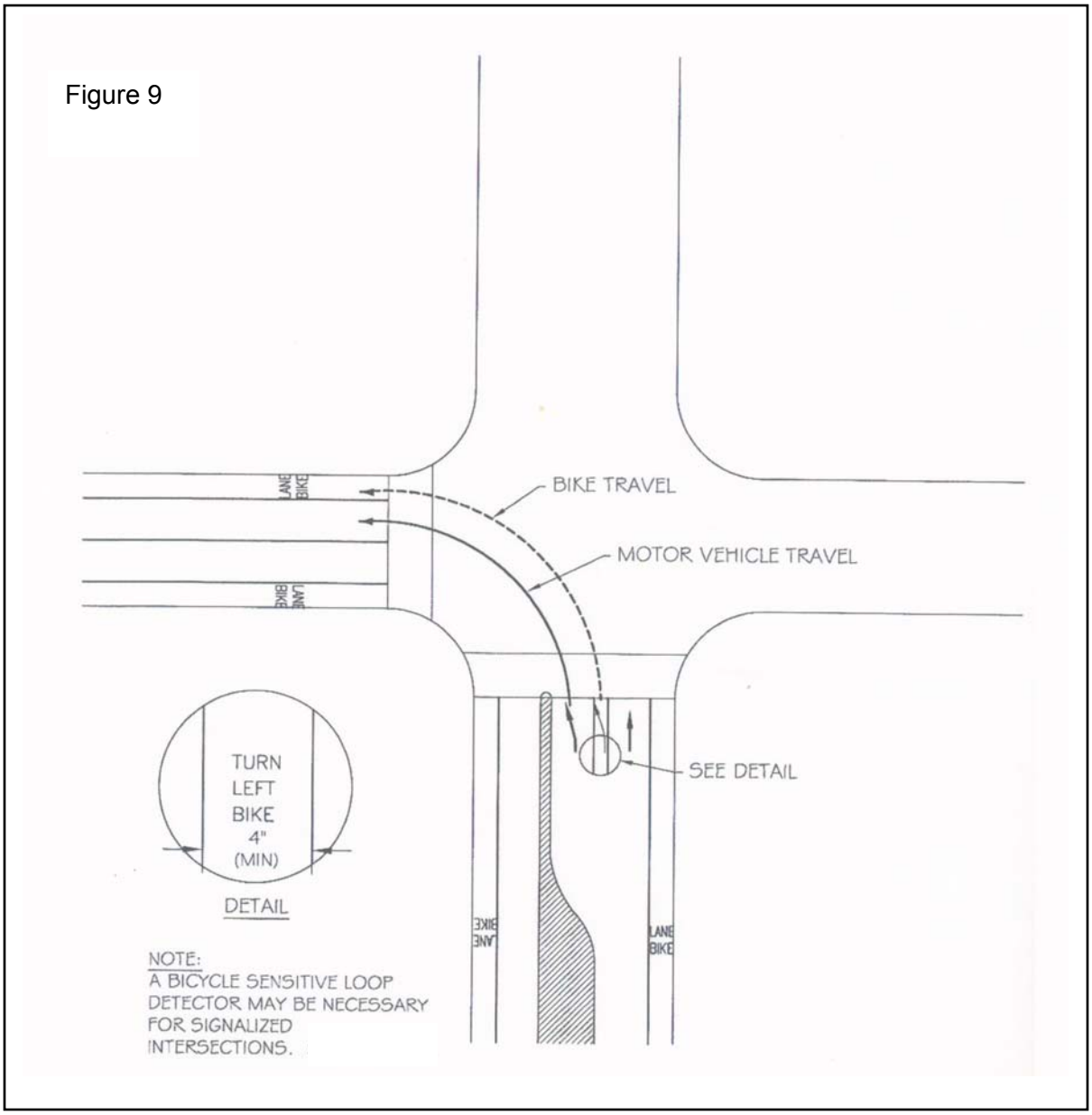
Intersections are the locations where many bicycle/auto conflicts occur. Skilled bicyclists usually have little problem making the appropriate transitions when using on-street lanes. Lesser skilled bike drivers may have difficulty safely performing weaving maneuvers near intersections. These bicycle drivers need alternate, less demanding routes as alternatives to using the on-street bike lanes.

When using such alternate routes, the bicyclist will still need to cross busy arterial streets, usually at signalized intersections. Special loop detectors (which can detect bicycles) as well as bicycle-oriented signal call buttons can facilitate the crossing. Bicycle routes typically used by younger children need to provide protected signalizations for crossing arterial streets, both at intersections and at other locations where crossings are needed. Grade-separated crossings are an alternative to protected at-grade crossings. Such crossings tend to be very expensive, which limits where they can be considered to only a few high priority locations.

Neither bike overpasses nor underpasses work well near intersections. The crossing length is longer and there is not the opportunity to adjust the road grade to shorten the slopes of the crossing. Also, the transitions between on-street lanes and the separate crossing path increase the possibility of unsafe movements. Underpasses can prompt personal safety concerns if their required length is too great and/or visibility through the underpass is limited.

Research has shown that the majority of bicycle/motor vehicle crashes occur at intersections. Therefore, special consideration must be given to bicycle and vehicle movements at intersections. Bicycle lanes enhance visibility between bicycles and motor vehicles, and provide the best opportunity for a safe interaction between vehicles. Typical treatment of these lanes is shown in Figures 7, 9 and 10. Note that a weaving section of sufficient length, considering prevailing vehicle speeds, is essential for the left-turn and through bicycle lanes to be effective.

Figure 9



Bike Left-Turn Lane
WSDOT, Design Manual, Facilities for Non-motorized Transportation

Figure 10

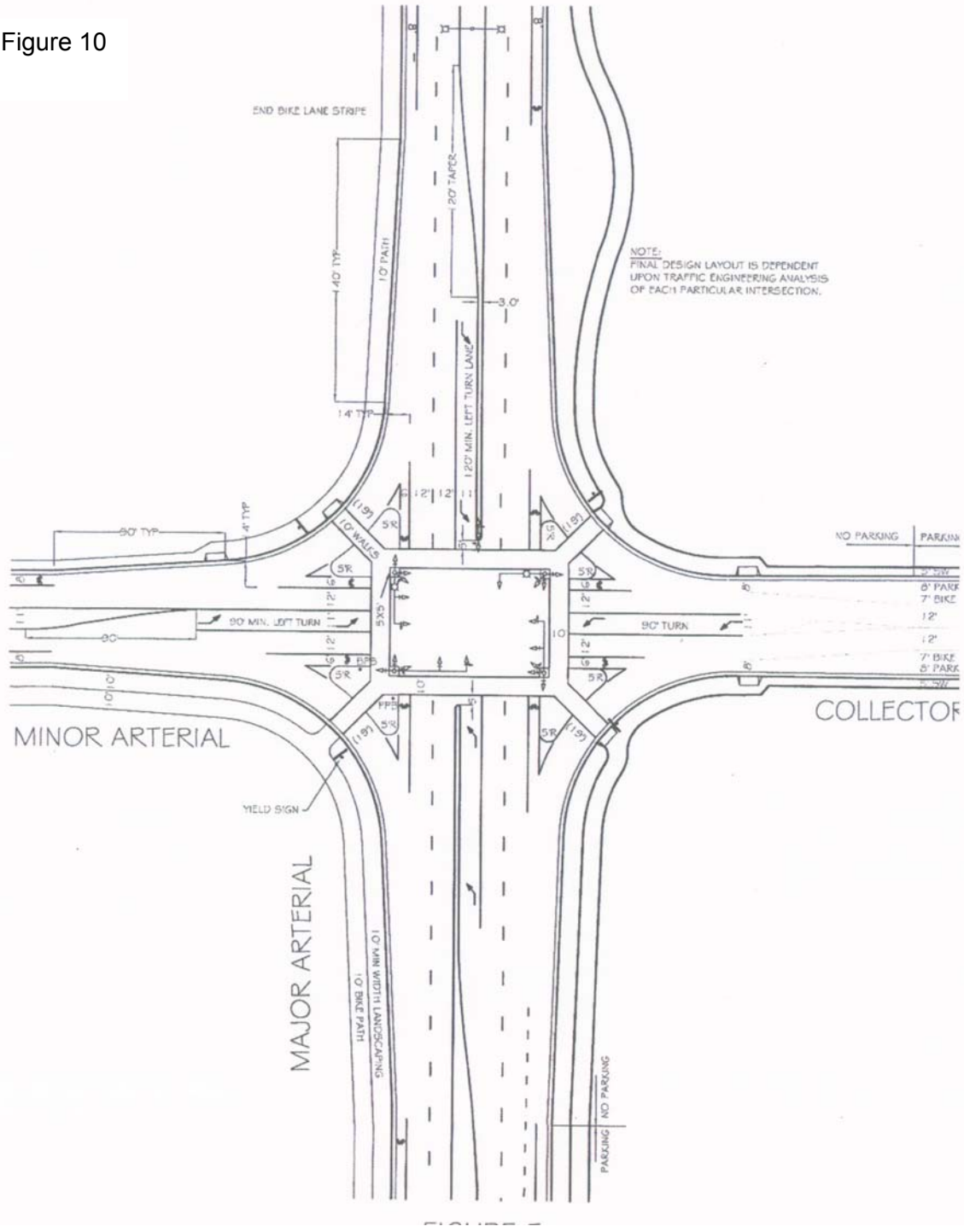
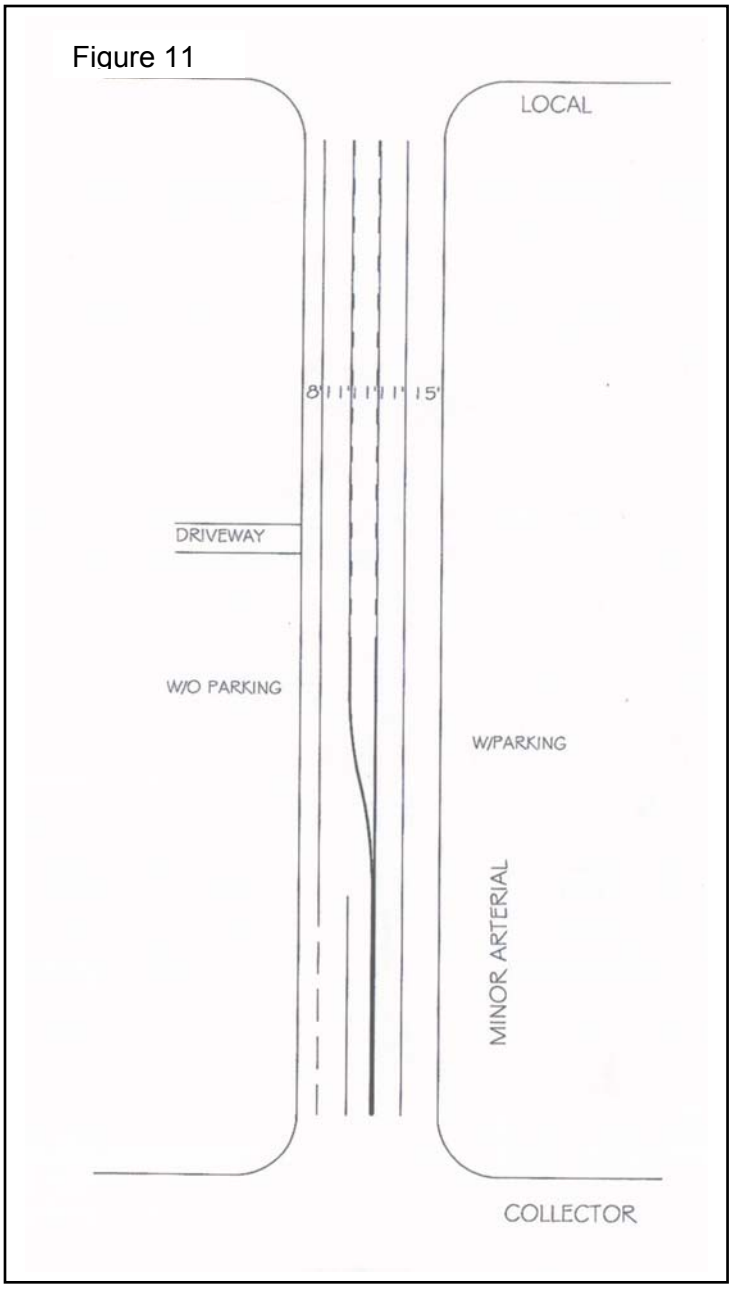


Figure 10 shows typical intersection treatment where a Class I (bike path) facility interacts with an intersection. The bike path may or may not continue beyond the intersection. The advantage of this intersection design is that it places the bicyclist in a predictable location and minimizes the distance to cross opposing vehicle lanes during the prescribed signal phase.

Figure 11 displays a plan view of a street segment constructed with a continuous center left-turn lane. This lane, combined with on-street bike lanes creates a bicycle-friendly route by making it easier and safer to cross the street compared to a four-lane road.



Minor Arterial Bike Lanes and Two-Way Left-Turn Lane

Figure 12 provides some additional information about the traffic islands for bicycles at arterial intersections. These islands make it easier for bicyclists to approach the intersection, making it a convenient and safe crossing.

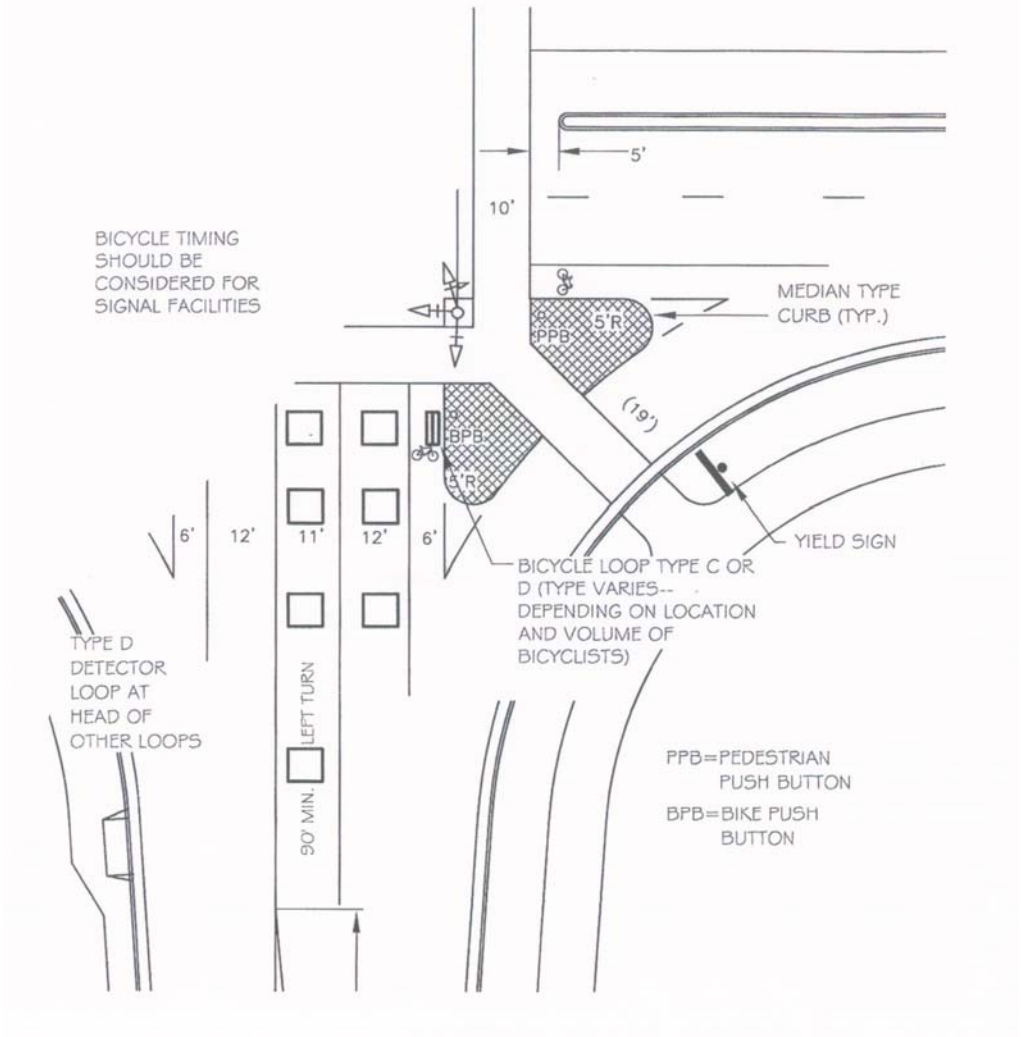


Figure 12

Traffic Islands for Bicycles at Major Intersections

Chicago, Illinois

The Pedestrian and Bicycle Information Center partnered with the City of Chicago and Chicagoland Bicycle Federation to develop a Bike Lane Design Guide. The Chicago Bike Lane Design Guide shows what works in the City of Chicago and is an excellent example of how facilities for bicyclists can be integrated into the layout of busy urban streets. The guide essentially shows how bicycles can be retrofitted into an existing street system. If your community is just embarking on a program of marking bike lanes for the first time, effort should be taken to educate drivers, local politicians and even the bicycling community as to how the lanes will operate, where they will be installed, and how people should behave when encountering them. Bicycle lanes have been successfully implemented on streets with upwards of 30,000 vehicles per day. Bike lanes work best when cars are traveling between 25 and 35 miles per hour. Review how Chicago addresses the challenge of intersections.

Intersections

Intersections present one of the most significant design challenges on streets with bike lanes. If space allows, the outer bike lane stripe is dotted all the way to the stop bar at controlled intersections, and to the extension of the property line at uncontrolled intersections. This alerts bicyclists to the potential for motorists to be crossing their path and encourages safe merging in advance of the intersection (see Figure 13 bike lane with parking; intersection with 2-way arterial street).

When a bike lane intersects with a one-way street, or where right turns are prohibited, the bike lane is solid all the way to the intersection (see Figure 14 bike lane with parking; intersection with 1-way arterial street).

Historically, Chicago has widened major intersections to improve capacity by allowing for opposing left-turn lanes and two through lanes in each direction. This often leaves no room for a bike lane at the intersection so the outer bike lane stripe is dropped at the beginning of the taper for the turn bay. The parking lane line is continued toward the intersection to encourage drivers to park closer to the curb and provide more room for the bicyclist (see Figure 15 bike lane at 50’ wide intersection).

When bike lanes are considered for streets with channelized intersections, the curb lane is designated with markings and signs indicating “Right Turn Only Except for Bikes.” This improves safety for bicyclists by preventing through motorists from passing on the right while still allowing through bicyclists to use the lane. Signage also indicates that motorists should yield the shared lane to the bicyclist (see Figure 16, typical bike lane signage).

When the width allows, the bike lane is dotted to encourage right-turning vehicles to merge right. The bike lane then continues for a minimum of 30 feet until the stop bar (see Figure 17 bike lane at 60' wide intersection).

Parking Setbacks.

On-street parking is available throughout Chicago. Sight distance requirements restrict vehicle parking within 20 feet of all intersections. On streets with bus routes, parking is prohibited for 80 feet to allow space for buses to pull to the curb. The 4-inch bike lane stripe is dropped to allow for turning movements and the lane line is dotted to indicate where merging should occur.

Defining the parking lane. Some agencies choose not to paint a stripe between the bicycle lane and the parking lane, preferring to leave a 12 - 13 foot combined parking and bike lane. The advantages of striping the line to define the parking lane include:

- The striping encourages motorists to park closer to the curb and thus provide more space for bicyclists in the bike lane, especially when they need to avoid an opening car door.
- The striping discourages motorists from thinking that the shared bike/parking lane is in fact a travel lane for motor vehicles, particularly when parking is relatively light and turn over is high.

If parking is typically long-term and consistently utilized, or if the individual parking stalls are marked with a cross or T, a full stripe between the bike lane and parking lane may not be necessary.

Figure 13

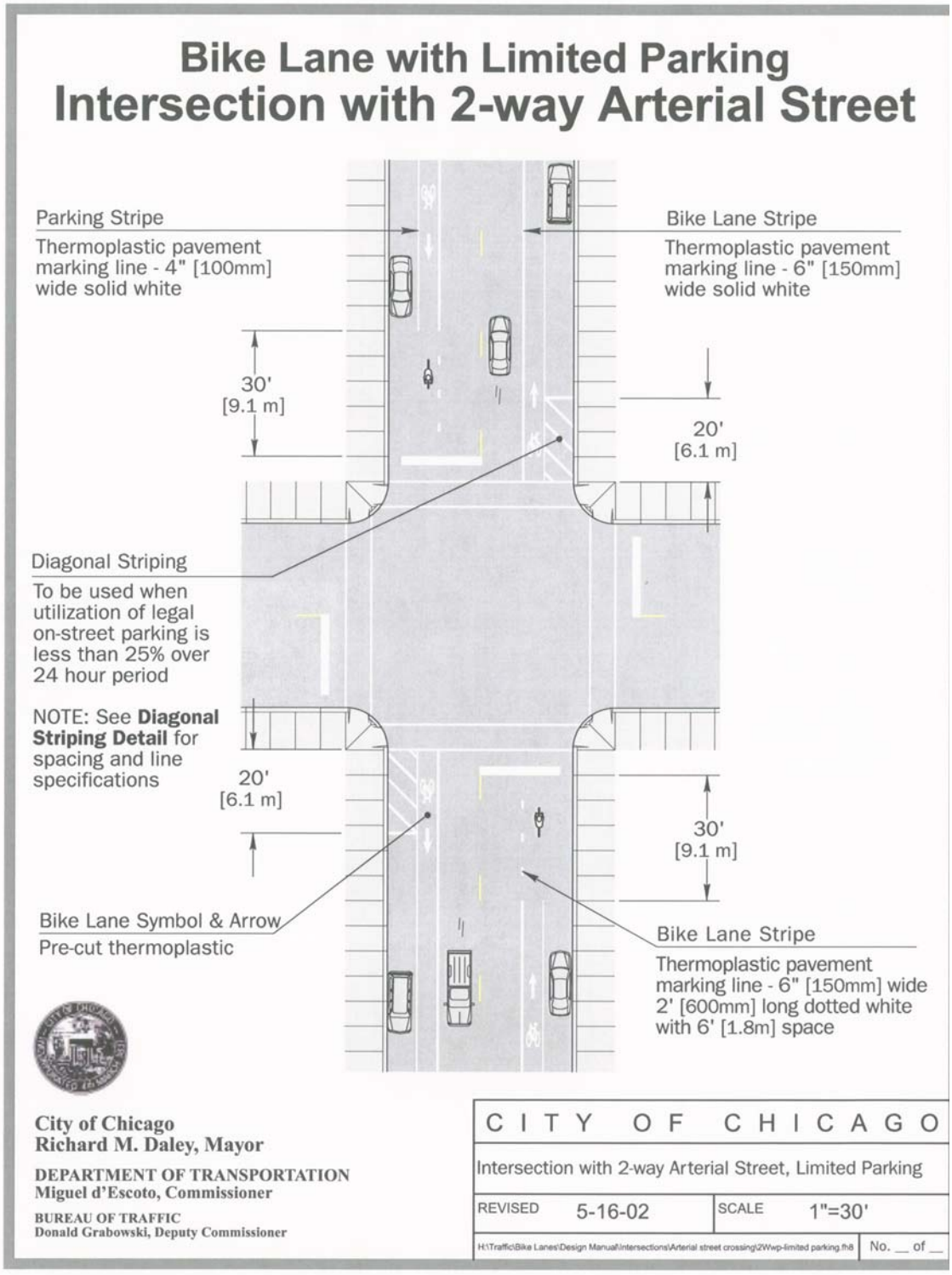
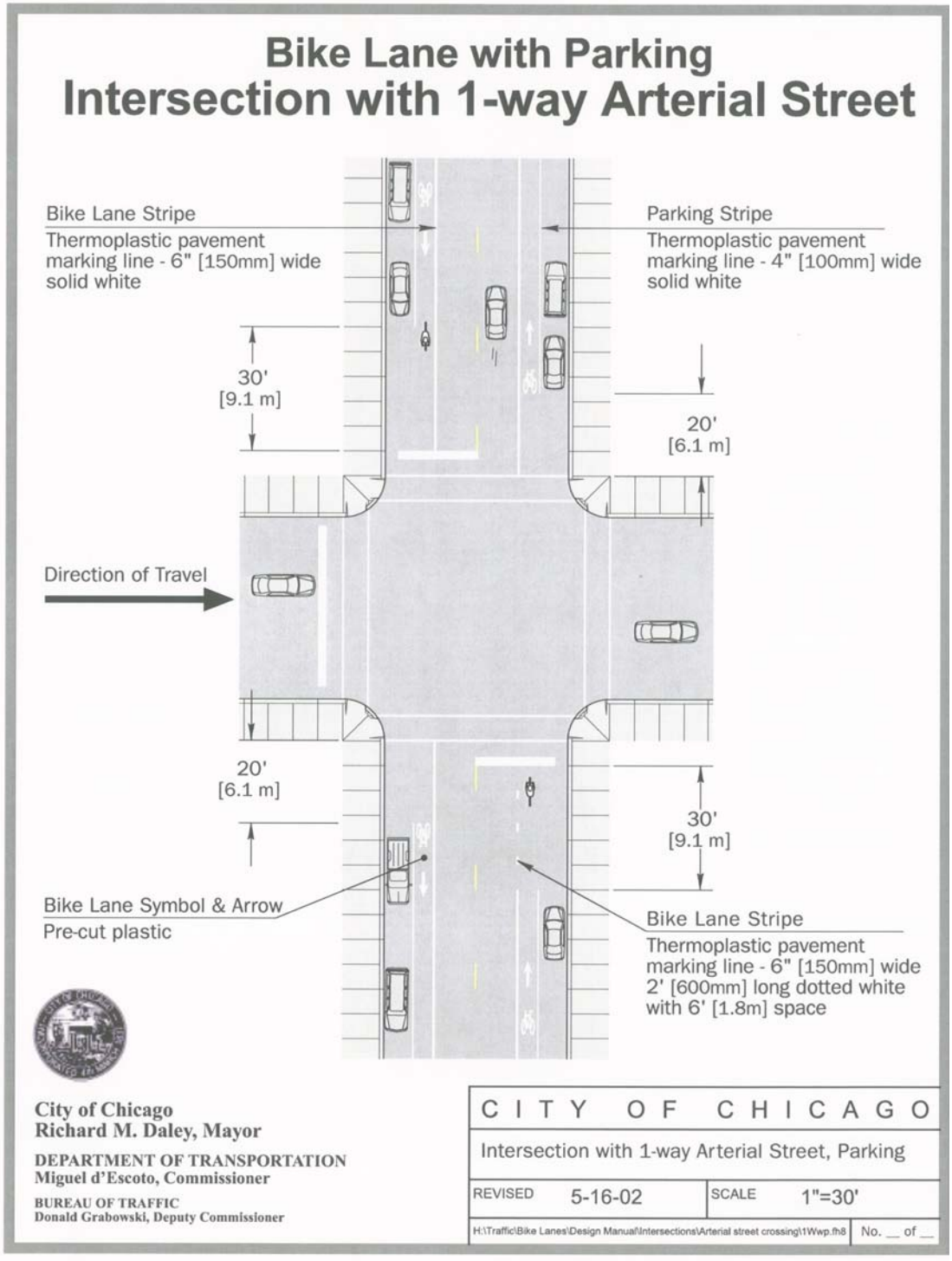

Bike Lane with Limited Parking
Intersection with 2-way Arterial Street
Parking Stripe
Thermoplastic pavement marking line - 4" [100mm] wide solid white
Bike Lane Stripe
Thermoplastic pavement marking line - 6" [150mm] wide solid white
30' [9.1 m]
20' [6.1 m]
Diagonal Striping
To be used when utilization of legal on-street parking is less than 25% over 24 hour period
NOTE: See Diagonal Striping Detail for spacing and line specifications
20' [6.1 m]
30' [9.1 m]
Bike Lane Symbol & Arrow
Pre-cut thermoplastic
Bike Lane Stripe
Thermoplastic pavement marking line - 6" [150mm] wide 2' [600mm] long dotted white with 6' [1.8m] space
City of Chicago
Richard M. Daley, Mayor
DEPARTMENT OF TRANSPORTATION
Miguel d'Escoto, Commissioner
BUREAU OF TRAFFIC
Donald Grabowski, Deputy Commissioner
CITY OF CHICAGO
Intersection with 2-way Arterial Street, Limited Parking
REVISED 5-16-02
SCALE 1"=30'
H:\Traffic\Bike Lanes\Design Manual\Intersections\Arterial street crossing\2Wwp-limited parking.fh8
No. __ of __

Figure 14


Bike Lane with Parking
Intersection with 1-way Arterial Street
Bike Lane Stripe
Thermoplastic pavement marking line - 6" [150mm] wide solid white
Parking Stripe
Thermoplastic pavement marking line - 4" [100mm] wide solid white
30' [9.1 m]
20' [6.1 m]
Direction of Travel
20' [6.1 m]
30' [9.1 m]
Bike Lane Symbol & Arrow
Pre-cut plastic
Bike Lane Stripe
Thermoplastic pavement marking line - 6" [150mm] wide 2' [600mm] long dotted white with 6' [1.8m] space
City of Chicago
Richard M. Daley, Mayor
DEPARTMENT OF TRANSPORTATION
Miguel d'Escoto, Commissioner
BUREAU OF TRAFFIC
Donald Grabowski, Deputy Commissioner
CITY OF CHICAGO
Intersection with 1-way Arterial Street, Parking
REVISED 5-16-02
SCALE 1"=30'
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No. __ of __

Figure 15

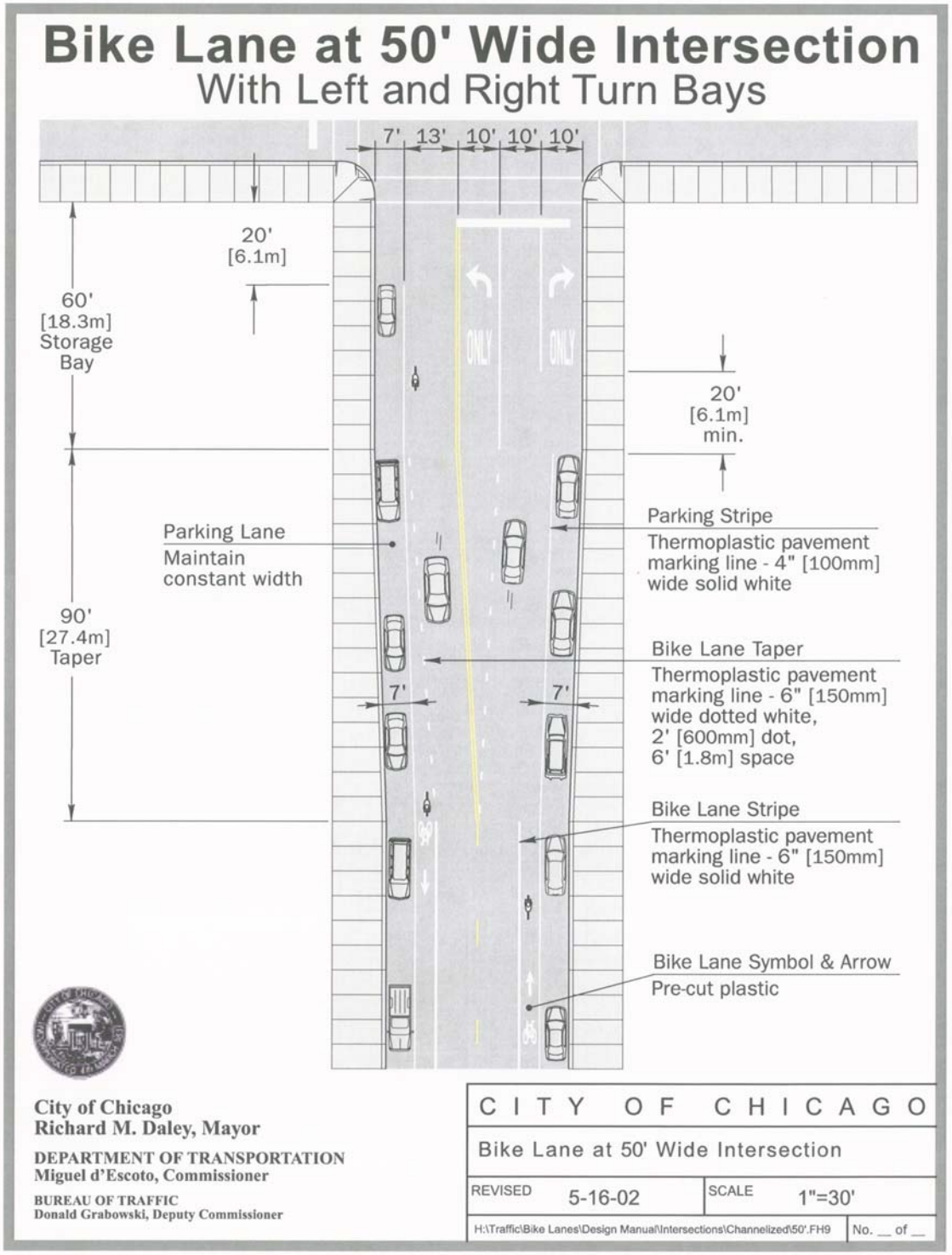

Bike Lane at 50' Wide Intersection
With Left and Right Turn Bays
7' 13' 10' 10' 10'
20'
[6.1m]
60'
[18.3m]
Storage
Bay
ONLY
ONLY
20'
[6.1m]
min.
Parking Lane
Maintain
constant width
Parking Stripe
Thermoplastic pavement
marking line - 4" [100mm]
wide solid white
90'
[27.4m]
Taper
Bike Lane Taper
Thermoplastic pavement
marking line - 6" [150mm]
wide dotted white,
2' [600mm] dot,
6' [1.8m] space
7'
7'
Bike Lane Stripe
Thermoplastic pavement
marking line - 6" [150mm]
wide solid white
Bike Lane Symbol & Arrow
Pre-cut plastic
City of Chicago
Richard M. Daley, Mayor
DEPARTMENT OF TRANSPORTATION
Miguel d'Escoto, Commissioner
BUREAU OF TRAFFIC
Donald Grabowski, Deputy Commissioner
CITY OF CHICAGO
Bike Lane at 50' Wide Intersection
REVISED 5-16-02
SCALE 1"=30'
H:\Traffic\Bike Lanes\Design Manual\Intersections\Channelized\50'.FH9
No. __ of __

Figure 16

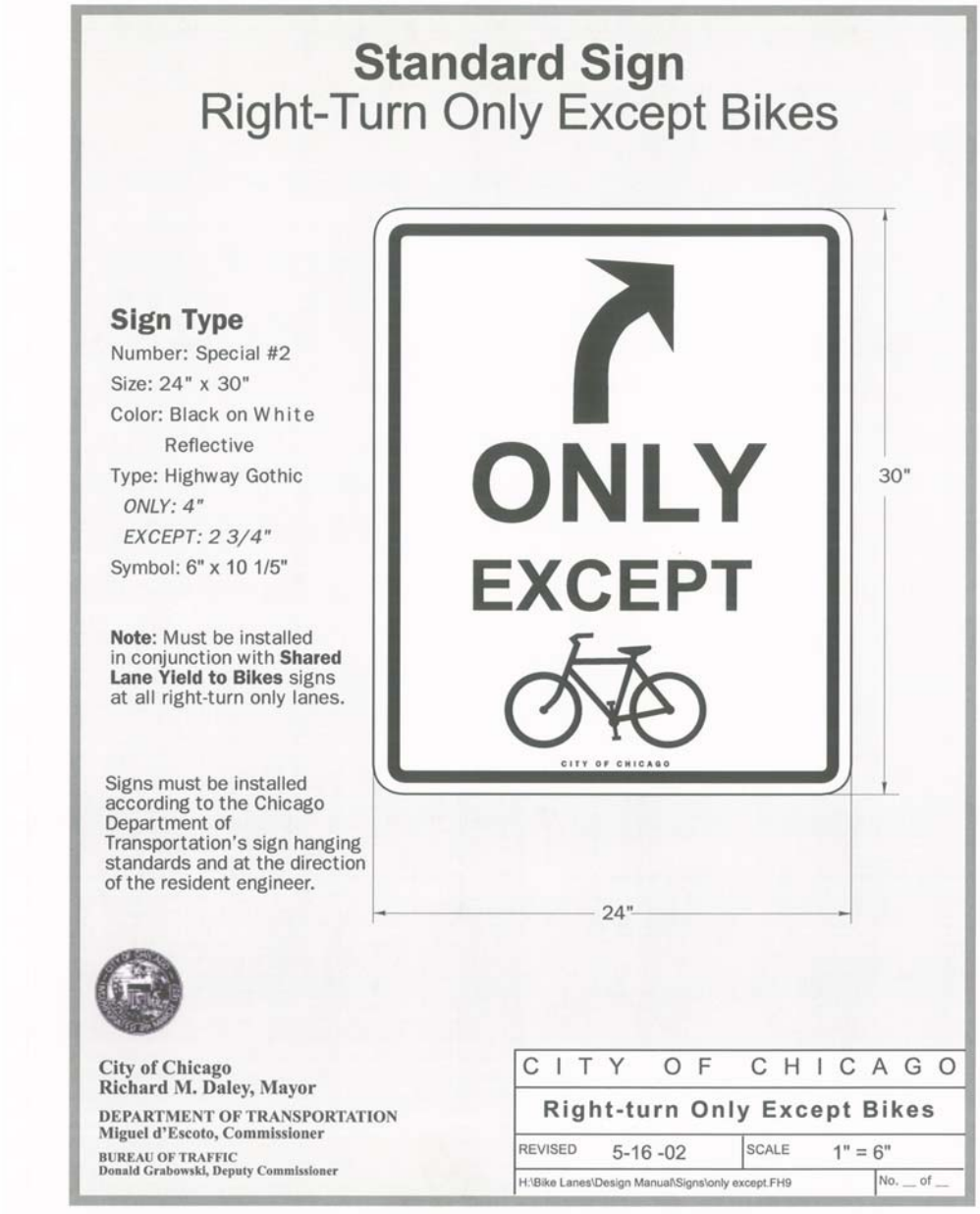
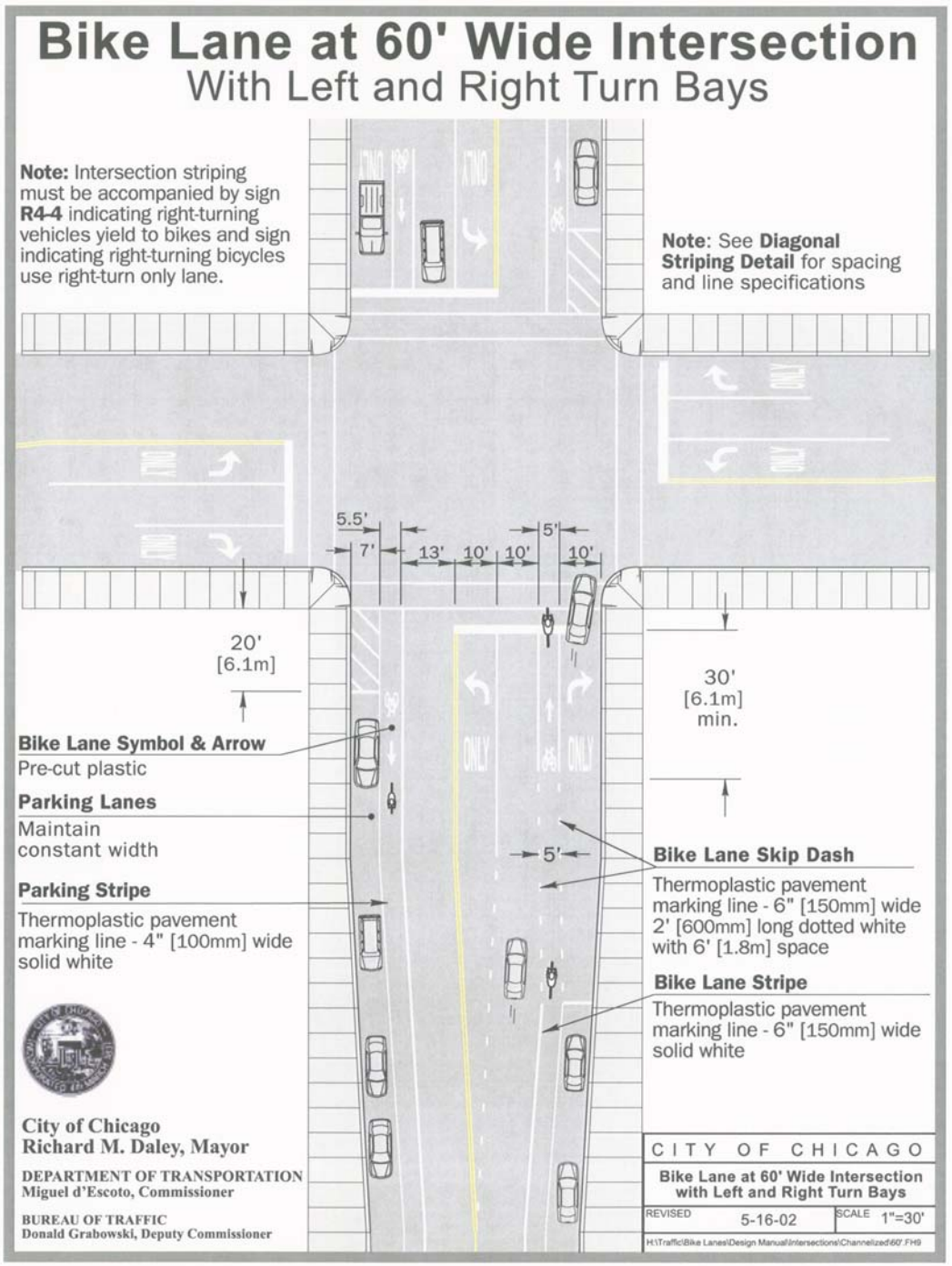

Standard Sign
Right-Turn Only Except Bikes
Sign Type
Number: Special #2
Size: 24" x 30"
Color: Black on White
Reflective
Type: Highway Gothic
ONLY: 4"
EXCEPT: 2 3/4"
Symbol: 6" x 10 1/5"
Note: Must be installed in conjunction with Shared Lane Yield to Bikes signs at all right-turn only lanes.
Signs must be installed according to the Chicago Department of Transportation's sign hanging standards and at the direction of the resident engineer.
ONLY
EXCEPT
CITY OF CHICAGO
30"
24"
City of Chicago
Richard M. Daley, Mayor
DEPARTMENT OF TRANSPORTATION
Miguel d'Escoto, Commissioner
BUREAU OF TRAFFIC
Donald Grabowski, Deputy Commissioner
CITY OF CHICAGO
Right-turn Only Except Bikes
REVISED 5-16 -02
SCALE 1" = 6"
H:\Bike Lanes\Design Manual\Signs\only except.FH9
No. __ of __

Figure 17


Bike Lane at 60' Wide Intersection
With Left and Right Turn Bays
Note: Intersection striping must be accompanied by sign R4-4 indicating right-turning vehicles yield to bikes and sign indicating right-turning bicycles use right-turn only lane.
Note: See Diagonal Striping Detail for spacing and line specifications
5.5'
7'
13'
10'
10'
5'
10'
20'
[6.1m]
30'
[6.1m]
min.
Bike Lane Symbol & Arrow
Pre-cut plastic
Parking Lanes
Maintain constant width
Parking Stripe
Thermoplastic pavement marking line - 4" [100mm] wide solid white
5'
Bike Lane Skip Dash
Thermoplastic pavement marking line - 6" [150mm] wide 2' [600mm] long dotted white with 6' [1.8m] space
Bike Lane Stripe
Thermoplastic pavement marking line - 6" [150mm] wide solid white
City of Chicago
Richard M. Daley, Mayor
DEPARTMENT OF TRANSPORTATION
Miguel d'Escoto, Commissioner
BUREAU OF TRAFFIC
Donald Grabowski, Deputy Commissioner
CITY OF CHICAGO
Bike Lane at 60' Wide Intersection with Left and Right Turn Bays
REVISED 5-16-02
SCALE 1"=30'
H:\Traffic\Bike Lanes\Design Manual\Intersections\Channelized\60' FH9

Special Design Treatments

AASHTO acknowledges that bicycle lanes tend to complicate both bicycle and motor vehicle turning movements at intersections. This problem is further complicated at major interchanges where the bicyclist is proceeding straight and the motorist is turning right. In order to make the bicyclist safer while maneuvering intersections, various designs have been and are being tested.

In any situation where it is difficult for bicyclists to traverse the undefined area created by right-lane merge movements, the following is offered as guidance. Professional judgment and sound engineering practices must be used on the site-specific application of any design treatment.

Blue Bicycle Lanes

The City of Portland, Oregon, is testing the impact of painting bike lanes blue as they pass through intersections. Cities in Denmark, the Netherlands, and other European countries have done this for many years (although some choose red or green paint).

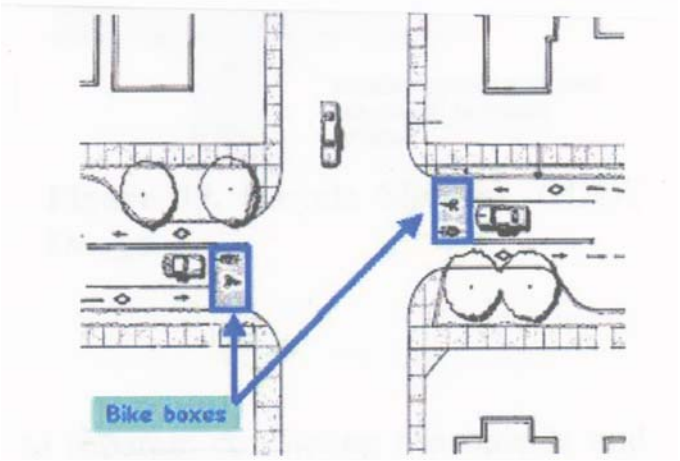
Figure 18

Advanced Stop Line (Bike Box)

The City of Cambridge, Massachusetts, has recently re-striped a complex signalized intersection with a design that allows bicyclists using bicycle lanes to wait at a red light several meters ahead of other travel lanes. When the light changes, bicyclists can get away quicker and make a left turn without conflicting with other traffic.

The objective of the advance bicycle box is to improve the visibility of bicyclists at intersections and to enable them to correctly position themselves for turning movements during the red signal phase by allowing them to proceed to the front of the queue.

Figure 19



Kansas, Design Criteria, Section 5302 Local Bicycle Facility Design Guidance for the Metropolitan Kansas City Region

A bicycle lane leading up to a bicycle “reservoir” is located between the motor vehicle stop line and the crosswalk. The bicycle box should be 12 to 14 feet deep. If it is shallower, bicyclists tend to feel intimidated by the motor vehicles, and if it is deeper, motorists tend to encroach. To increase its effectiveness, a bicycle stencil should be placed in the bicycle box and a contrasting surface color is strongly recommended for the reservoir and the approach bicycle lane. Instructional signs and separate bicyclist signal heads can be installed in conjunction with the bicycle box.

This treatment may be used at intersections with high motor vehicle and bicycle ADT, frequent turning conflicts, and intersections with a high percentage of turning movements by both bicyclists and motorists. According to the Department of Environment, Transport, and Regions of Great Britain (DETR) advance stop lines have been used successfully at sites with motor vehicle flows up to 1000 vehicles per hour and with two-lane approaches.

Contra-flow Bicycle Lanes

The objective of contra-flow bicycle lanes is to increase efficiency and safety by shortening trip distances. Contra-flow bicycle lanes have been used in some locations where there is a strong demand for bicyclists to travel against the normal flow of traffic or

to travel in both directions on a one-way street. Contra-flow bicycle lanes are especially applicable for use on one-way streets, in hilly areas or where the alternate route is circuitous or hazardous.

Figure 20

The City of Cambridge, Massachusetts, asks the following questions to evaluate potential contra-flow lane locations:

- Is safety improved because of reduced conflicts?
- Can bicyclists safely and conveniently re-enter the traffic stream at either end of the contra-flow section?
- Is the contra-flow bicycle lane short and does it provide direct access to a high-use destination point?
- Are there no or very few intersecting driveways, alleys, or streets on the side of the proposed contra-flow lane?
- Are there a substantial number of bicyclists already using the street?
- Is there sufficient street width to accommodate a full-dimension bicycle lane?
- Will the contra-flow bicycle lane provide substantial savings in travel distance compared to the route motor vehicles must follow?
- Are traffic volumes acceptable?

There are multiple examples of contra-flow bicycle lanes that exist around the country; however, the contra-flow lane should be considered in only certain circumstances.

Shared Bicycle/Bus Lanes

Shared bicycle/bus lanes provide dedicated lanes for bikes and buses in areas where it is not feasible to have separate lanes for both modes. The lane is painted or paved with colored asphalt to emphasize the lane designation. The lane should be wide enough to allow bicyclists to pass a stopped bus. The right lane is stenciled as a diamond lane, with supporting signage and

pavement legends that designate the lane for buses and bicycles only.

Shared bicycle/bus lanes are commonly used in downtowns where it is difficult to find room for dedicated bicycle lanes. Considerations of shared bicycle/bus lanes include:

- Bicyclists must pass stopped buses on the left whether there is a bicycle lane or not
- A dedicated bicycle lane is often unnecessary
- Provides separation of faster and slower moving traffic

Bikes and buses travel at approximately the same average speed. Travel time for buses and bikes is improved as they are not hindered by congested auto traffic.

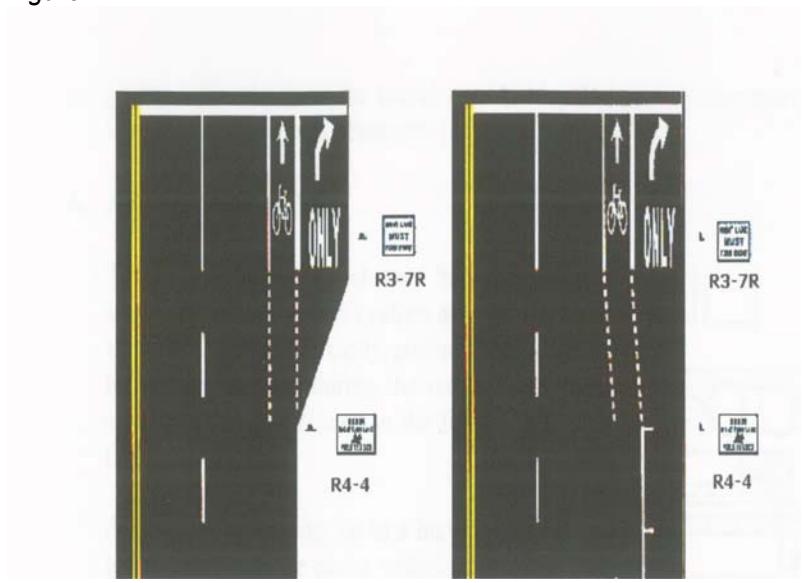
Disadvantages of shared bicycle/bus lane include: there is a leap-frog effect of buses and bikes; if not designed well, or if turning traffic is allowed use of the lane, benefits of the lane will be reduced.

Examples currently include Tucson, AZ; Madison, WI; Toronto, Ontario; Vancouver, BC; and Philadelphia, PA. Philadelphia colors its shared lane red to add emphasis.

Bike Slots

The Missouri Department of Transportation, District IV, is currently using an intersection treatment it calls a bike slot. The bike slot is an intersection treatment that was developed from the AASHTO Guide for the Development of Bicycle Facilities. AASHTO presents optional treatments for pavement parking where a bike

Figure 21



lane approaches a major intersection. However, the bike slot is an option even though bike lanes may not be present.

The absence of a bike lane does not preclude the need to accommodate the bicyclists especially at intersections. The bike slot intersection treatment is beneficial where there are conflicts between through bicyclists and right turning vehicles. Bicyclists who stay to the far right following the curb along a right-turn lane and then either continuing across the intersection or swerving to the left across the right-turn lane at the intersection put them in danger.

Left-Turn Only Bicycle Lane

Left-hand turns are often a difficult maneuver for the bicyclists. Some cities have developed left-turn bicycle lanes to increase safety and make the left-hand turn easier. This treatment is especially useful where a signed bicycle route may jog a short distance to another through street.

Figure 22

As with all guidance, professional judgment and sound engineering practices must be used on any site-specific application of any design treatment.

Bikeway Signing and Marking

The use of appropriate signs and pavement markings will improve the safety and general public acceptance of bicycles on public roadways. Regulatory and warning signs will alert bicyclists to potential conflicts and convey regulatory messages to both bicyclists and motorists at highway intersections. Consult the Manual of Uniform Traffic Control Devices (MUTCD) for the latest and most complete set of specifications for bicycle-related signs and markings. According to the MUTCD, bicyclist traffic control devices must adhere to the following five basic requirements to perform their intended function:

1. Fulfill a need.
2. Command attention.
3. Convey a clear, simple meaning.
4. Command respect of road users.
5. Give adequate time for proper response.

The local design, placement, operation, maintenance and uniformity of bicycle traffic control devices must be consistent with MUTCD recommended standards. Uniformity of design includes shape, color, symbols, wording, lettering, reflectorization and sizes.

Regulatory signs give notice of traffic laws or regulations that bicyclists and motorists must follow. Examples include signs for bicycle lane designation, no parking signs, stop signs and yield signs.

In Ohio, the Ohio Manual of Uniform Traffic Control Devices currently offers the following bicycle signage:

Figure 23

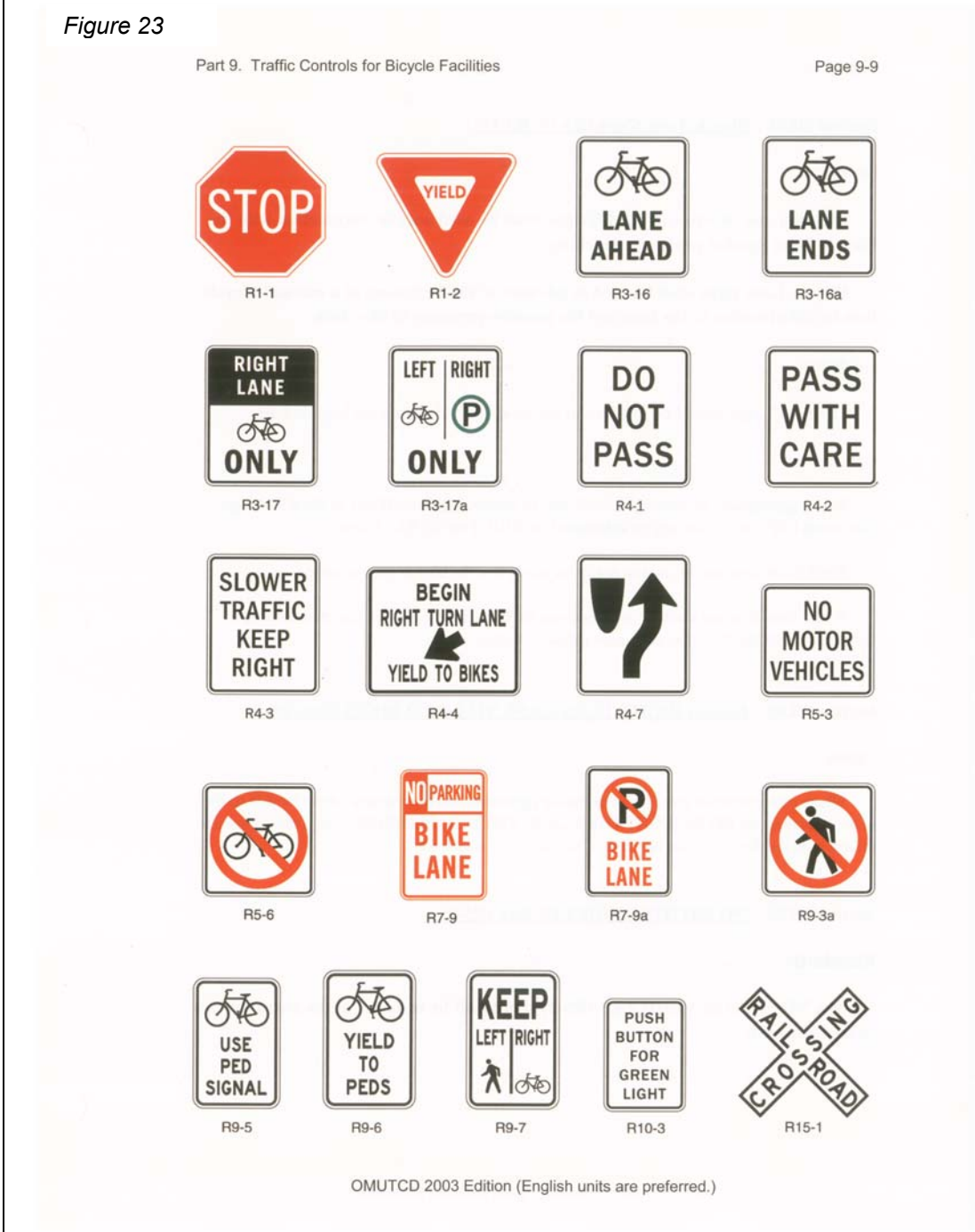

Part 9. Traffic Controls for Bicycle Facilities
Page 9-9
STOP
R1-1
YIELD
R1-2
LANE AHEAD
R3-16
LANE ENDS
R3-16a
RIGHT LANE
ONLY
R3-17
LEFT | RIGHT
P
ONLY
R3-17a
DO NOT PASS
R4-1
PASS WITH CARE
R4-2
SLOWER TRAFFIC KEEP RIGHT
R4-3
BEGIN RIGHT TURN LANE
YIELD TO BIKES
R4-4
R4-7
NO MOTOR VEHICLES
R5-3
R5-6
NO PARKING
BIKE LANE
R7-9
P
BIKE LANE
R7-9a
R9-3a
USE PED SIGNAL
R9-5
YIELD TO PEDS
R9-6
KEEP
LEFT | RIGHT
R9-7
PUSH BUTTON FOR GREEN LIGHT
R10-3
RAILROAD CROSSING
R15-1
OMUTCD 2003 Edition (English units are preferred.)

Figure 24

W8-1

W8-2

W10-1

W12-2

W8-10

W8-10p

W11-1

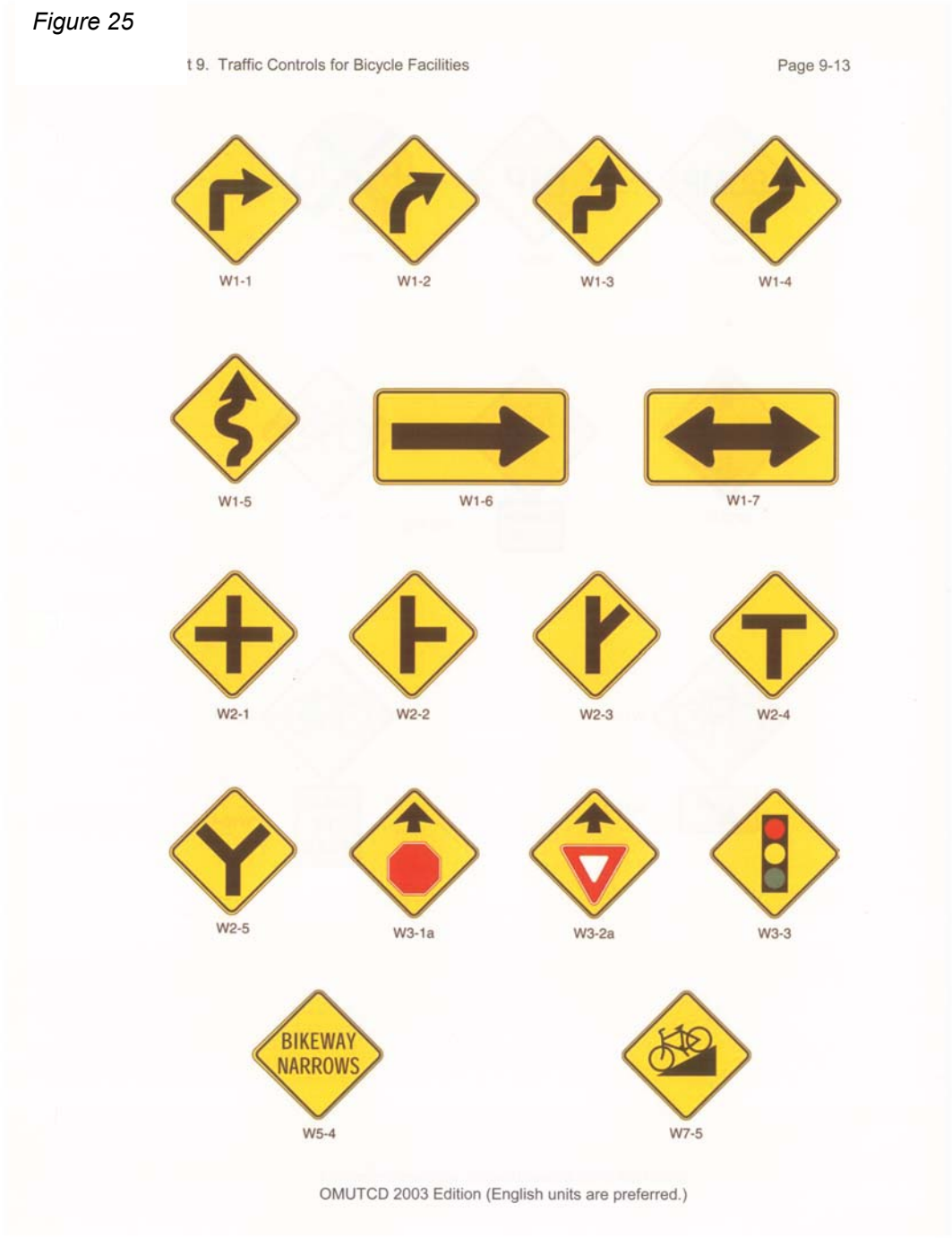
W11-1

W16-7

W11-1

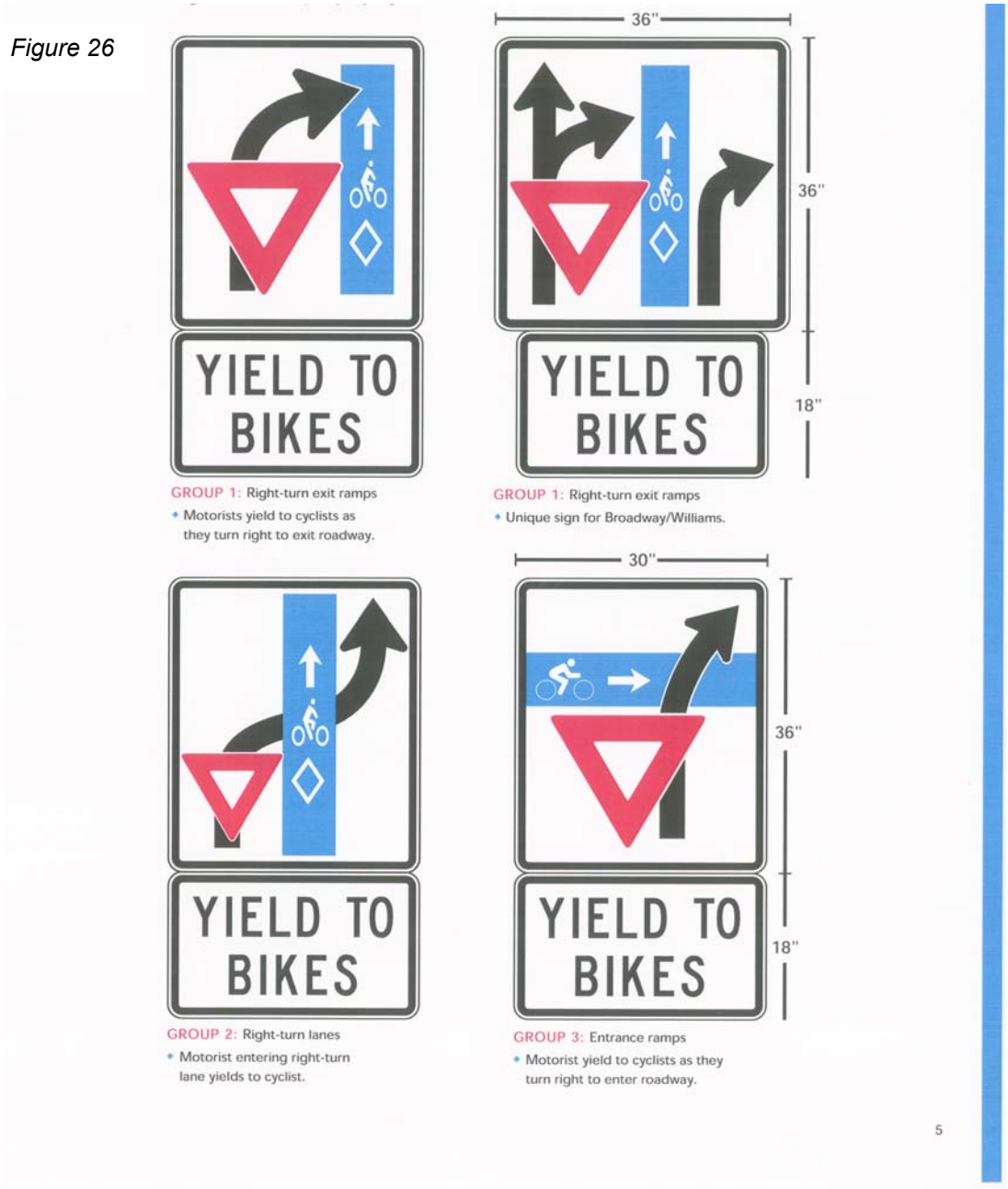
W16-1

Figure 25


t 9. Traffic Controls for Bicycle Facilities
Page 9-13
W1-1
W1-2
W1-3
W1-4
W1-5
W1-6
W1-7
W2-1
W2-2
W2-3
W2-4
W2-5
W3-1a
W3-2a
W3-3
BIKEWAY
NARROWS
W5-4
W7-5
OMUTCD 2003 Edition (English units are preferred.)

Figures 26 and 27 are bicycle signs other cities have tested to aid motorists and bicyclists in maneuvering through intersections.

Figure 26




Standard Sign
Bike Lane at Intersection
Sign Type
Number: Special
Size: 30"x30"
Color: Black on White
Reflective
Type: 5" Highway Gothic
Symbol: 10" x 6 1/2"
Note: Must be installed at intersections where bike lane continues to stop bar to the left of the right-turn only lane.
ONLY
30"
30"
Signs must be installed according to the Chicago Department of Transportation's sign hanging standards and at the direction of the resident engineer.
City of Chicago
Richard M. Daley, Mayor
DEPARTMENT OF TRANSPORTATION
Miguel d'Escoto, Commissioner
BUREAU OF TRAFFIC
Donald Grubowski, Deputy Commissioner
CITY OF CHICAGO
Bike Lane at Intersection
REVISED 3-28-02
SCALE 1" = 6"
www.bicyclinginfo.org | Bike Lane Design Guide 41


Standard Sign
Right-Turn Only
Except Bikes and Buses
Sign Type
Number: Special #3
Size: 24" x 30"
Color: Black on White
Reflective
Type: Highway Gothic
ONLY: 4"
EXCEPT: 2 3/4"
Symbol: 6" x 10 1/5"
Note: Must be installed in conjunction with Shared Lane Yield to Bikes signs at all right-turn only lanes with bus stops.
ONLY
EXCEPT
30"
24"
Signs must be installed according to the Chicago Department of Transportation's sign hanging standards and at the direction of the resident engineer.
City of Chicago
Richard M. Daley, Mayor
CITY OF CHICAGO


Standard Sign
Right-Turn Only Except Bikes
Sign Type
Number: Special #2
Size: 24" x 30"
Color: Black on White
Reflective
Type: Highway Gothic
ONLY: 4"
EXCEPT: 2 3/4"
Symbol: 6" x 10 1/5"
Note: Must be installed in conjunction with Shared Lane Yield to Bikes signs at all right-turn only lanes.
ONLY
EXCEPT
30"
24"
Signs must be installed according to the Chicago Department of Transportation's sign hanging standards and at the direction of the resident engineer.
City of Chicago
Richard M. Daley, Mayor
DEPARTMENT OF TRANSPORTATION
Miguel d'Escoto, Commissioner
BUREAU OF TRAFFIC
Donald Grubowski, Deputy Commissioner
CITY OF CHICAGO
Right-turn Only Except Bikes
REVISED 5-16-02
SCALE 1" = 6"
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Standard Sign
Shared Lane Yield to Bikes
Sign Type
Number: Special #1
Size: 24" x 24"
Color: Black on Yellow Reflective
Font: 2 3/4" Highway Gothic
Symbol: 13" x 7 1/2"
Note: Must be installed at the beginning of shared lane at point where bike lane striping ends.
SHARED LANE
YIELD TO
BIKES
24"
24"
Signs must be installed according to the Chicago Department of Transportation's sign hanging standards and at the direction of the resident engineer.
City of Chicago
Richard M. Daley, Mayor
DEPARTMENT OF TRANSPORTATION
Miguel d'Escoto, Commissioner
BUREAU OF TRAFFIC
Donald Grubowski, Deputy Commissioner
CITY OF CHICAGO
Shared Lane Yield to Bikes
REVISED 5-16-02
SCALE 1" = 6"

Figure 27

Innovative Bicycle Treatments

The ITE Pedestrian and Bicycle Council developed a report on a large variety of innovative treatments that accommodate bicycles. The report, *Innovative Bicycle Treatments,* provides basic information on a large variety of innovative treatments to accommodate bicycles. The report is intended as an introduction to the treatments and, where available, includes publications and contact information on agencies that have further information and often first-hand experience with particular facilities. While this guide is geared toward the safe maneuvering through intersections and interchanges, *Innovative Bicycle Treatments* is a catalog of solutions to various traffic problems involving bicycles. Many of the treatments can be altered to better fit individual locations.

CONCLUSION

This guide is offered to aid local communities in designing bike lanes that will assist bicyclists in maneuvering through complex intersections and interchanges. As more and more bicycle lanes are constructed, central Ohio will need to implement better design and signage to help reduce conflicts.

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