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Metropolitan Planning Organization

Innovative Bikeway Design Hands-on Workshop

August 8, 2018

Brad Davis, Paul Wojciechowski & Collin Chesston – Alta Planning + Design

Agenda

- Welcome and Introductions
- Bikeway Design 101

BREAK

- Network Design Exercise

BREAK

- Intersection Design Exercise

CLOSING REMARKS

Thank you for snack and refreshments!

via planning, inc.

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Presenters

Collin Chesston

Brad Davis, AICP

Paul Wojciechowski, PE, AICP

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Alta Planning + Design has a mission to create active, healthy communities.

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BROWARD COMPLETE STREETS MASTER PLAN

Better Streets • Better Communities• Better Broward

Identify Projects

Program Projects

Implement Projects

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FDOT Complete Streets

FDOT Complete Streets

Table 201.4.1 Design Speed

Limited Access Facilities (Interstates, Freeways, and Expressways)		
Area	**Allowable Range (mph)**	**SIS Minimum (mph)**
Rural and Urban	70	70
Urbanized	50-70	60
Arterials and Collectors		
Context Classification	**Allowable Range (mph)**	**SIS Minimum (mph)**
C1 Natural	55-70	65
C2 Rural	55-70	65
C2T Rural Town	25-45	40
C3 Suburban	35-55	50
C4 Urban General	30-45	45
C5 Urban Center	25-35	35
C6 Urban Core	25-30	30

Topic #625-000-002
FDOT Design Manual
January 1, 2018

Table 210.2.1 – Minimum Travel and Auxiliary Lane Widths

Context Classification		Travel (feet)			Auxiliary (feet)			Two-Way Left Turn (feet)	
		Design Speed (mph)			Design Speed (mph)			Design Speed (mph)	
		25-35	40-45	≥ 50	25-35	40-45	≥ 50	25-35	40
C1	Natural	11	11	12	11	11	12	N/A	
C2	Rural	11	11	12	11	11	12		
C2T	Rural Town	11	11	12	11	11	12	12	12
C3	Suburban	10	11	12	10	11	12	11	12
C4	Urban General	10	11	12	10	11	12	11	12
C5	Urban Center	10	11	12	10	11	12	11	12
C6	Urban Core	10	11	12	10	11	12	11	12

Travel Lanes:

(1) Minimum 11-foot travel lanes on designated freight corridors, SIS facilities, or when truck volume exceeds 10% with design speed 25-35 mph (regardless of context).

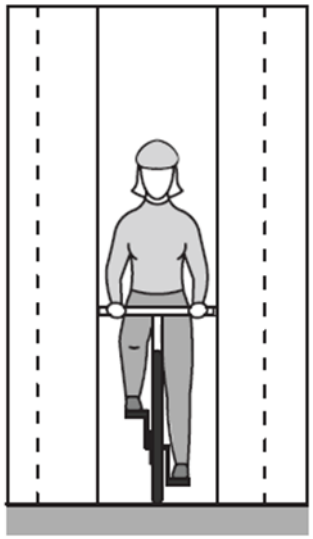
(2) Minimum 12-foot travel lanes on all undivided 2-lane, 2-way roadways (for all context classifications and design speeds). However, 11-foot lanes may be used on 2-lane, 2-way curbed roadways that have adjacent buffered bicycle lanes.

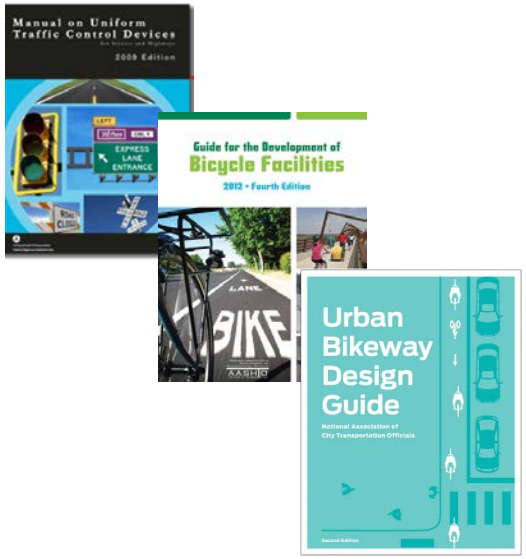
(3) 10-foot travel lanes are typically provided on very low speed roadways, but should consider wider lanes when transit is present or truck volume exceeds 10%.

(4) Travel lanes should not exceed 14 feet in width.

Introduction to Bikeway Design

- Design User
- Regulatory Framework
- Bikeway Facilities Overview





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Design Vehicle & User

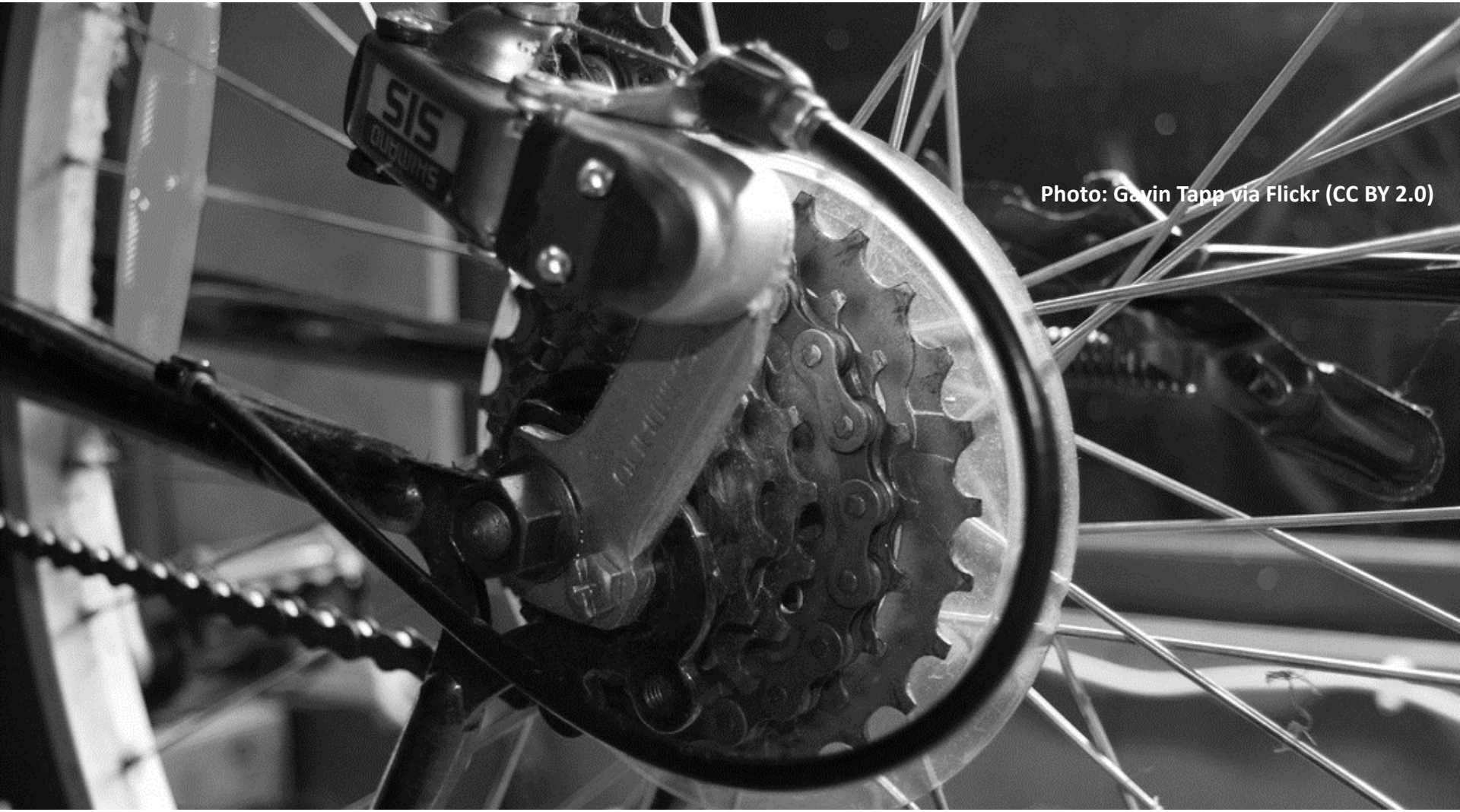


Photo: Gavin Tapp via Flickr (CC BY 2.0)

Design Vehicle

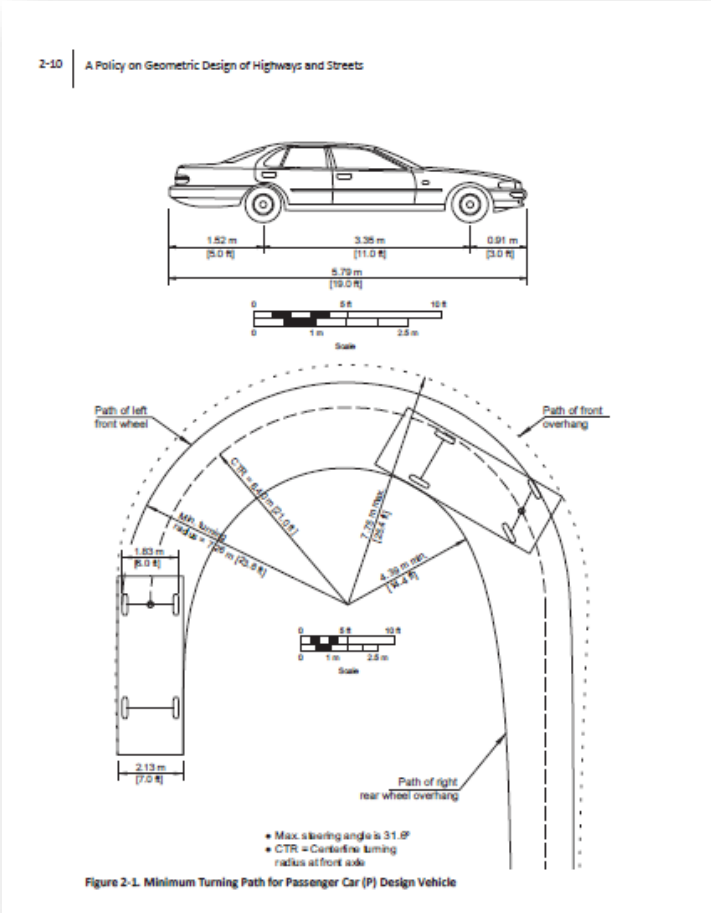


Figure 2-1. Minimum Turning Path for Passenger Car (P) Design Vehicle

AASHTO.
Geometric Design of Highways and Streets. 2011.

Bicycle Design Vehicle

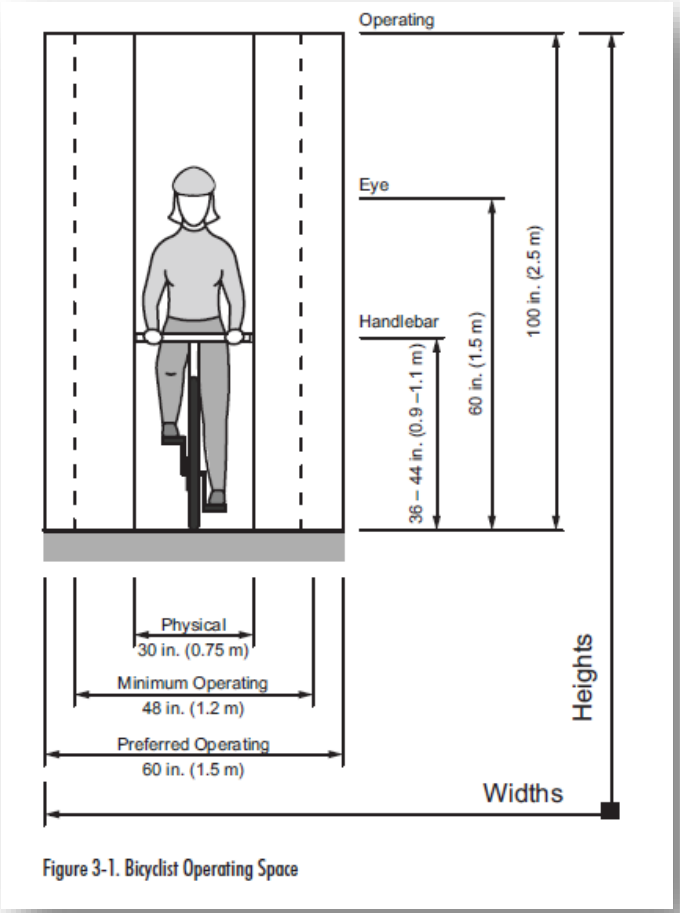
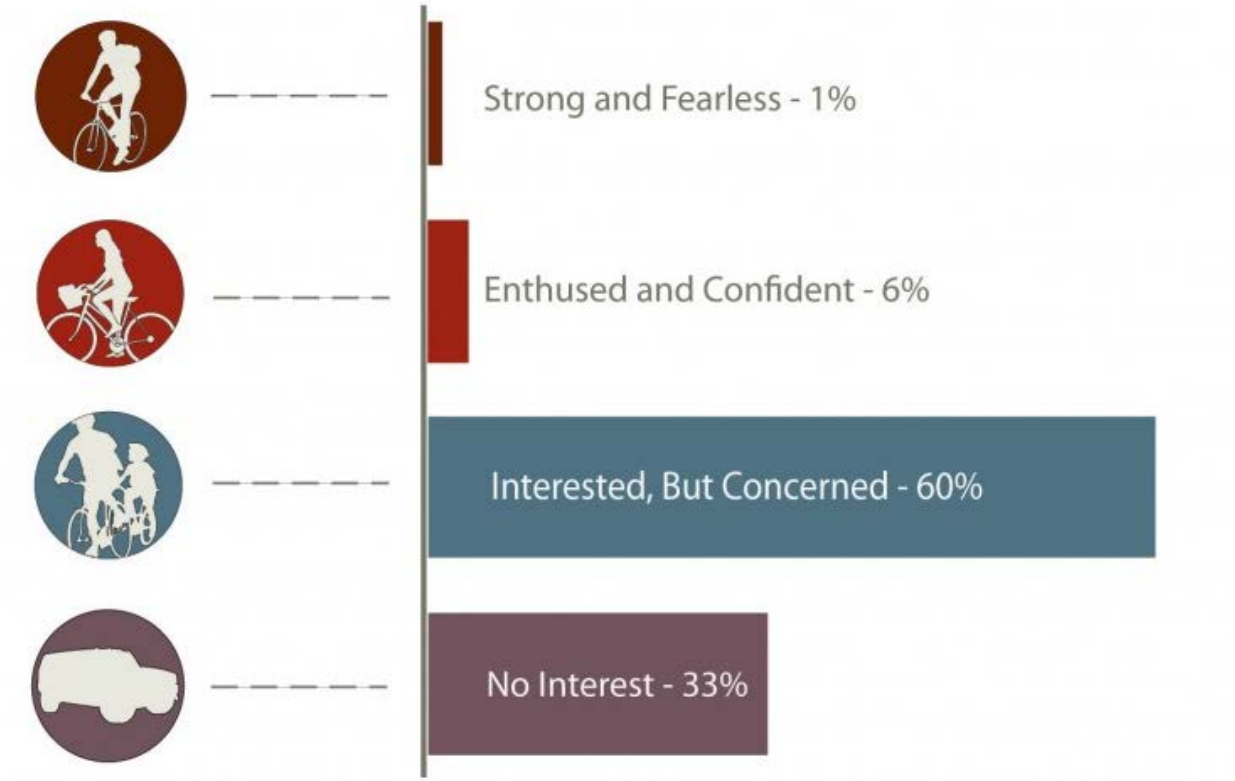


Figure 3-1. Bicyclist Operating Space

AASHTO.
Guide for the Development of Bicycle Facilities. 2012.

Design User

Four Types of Bicyclists



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BUILD IT FOR ISABELLA

ISABELLA: 12 YEARS OLD AND READY TO RIDE

Meet Isabella. Like most girls her age, she is exploring her independence. She just started 7th grade and loves doing cartwheels in the grass with her friends and sharing her life through Instagram. She is ready to travel her world by bike, but is the network ready for her? Isabella wants to bike to school, the library and the ice cream shop, but her mom worries about her getting across or along busy streets. Isabella likes to ride, but she's still small and her skills aren't fully developed. She's sometimes a little wobbly and it's hard for her to see over parked cars near intersections.

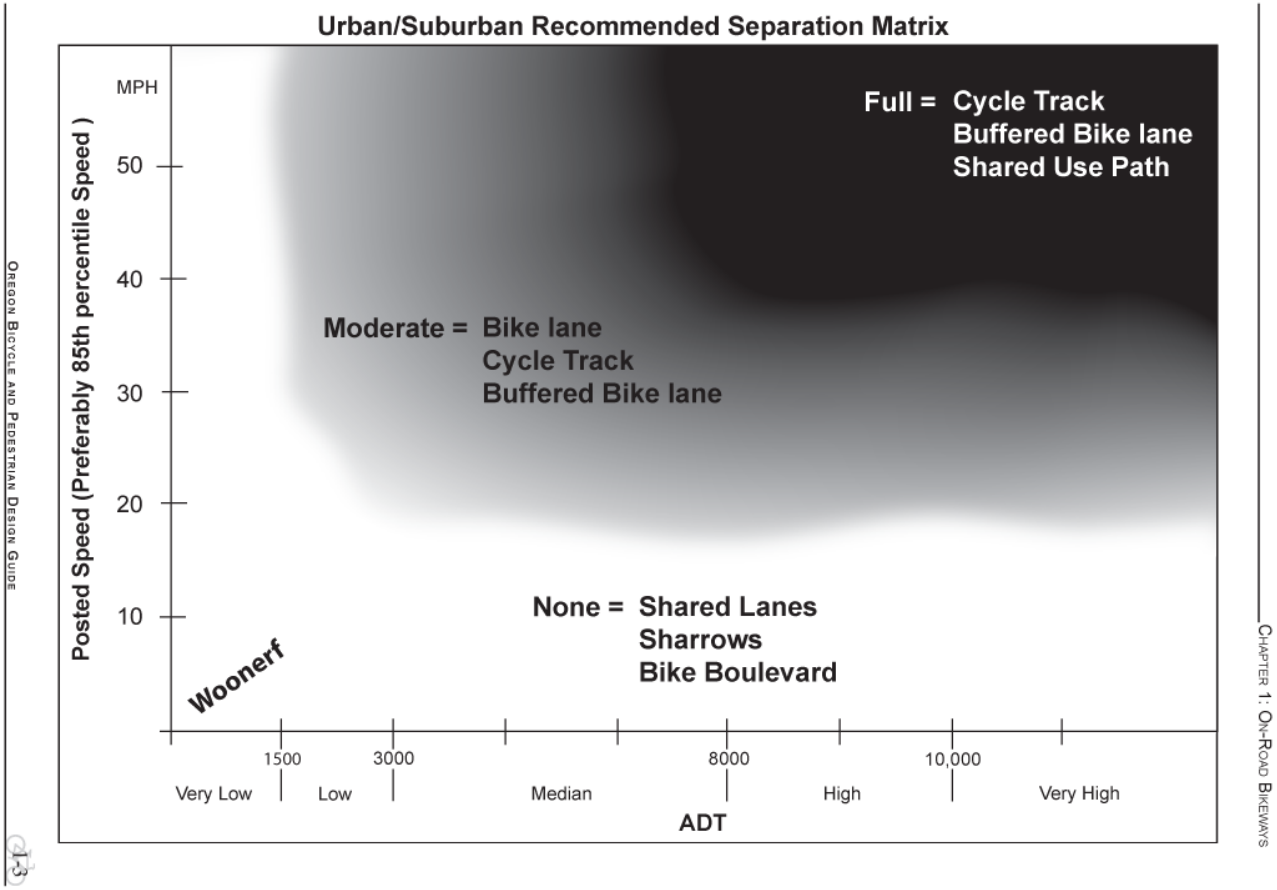
What does Isabella need to ride safely around her world?

- Are we planning low-stress, connected networks that work for Isabella?
- What if every project was designed with Isabella in mind?

If we build it for Isabella, wouldn't it work beautifully for the rest of us too?

Facility Selection

Bicycle Facility Selection



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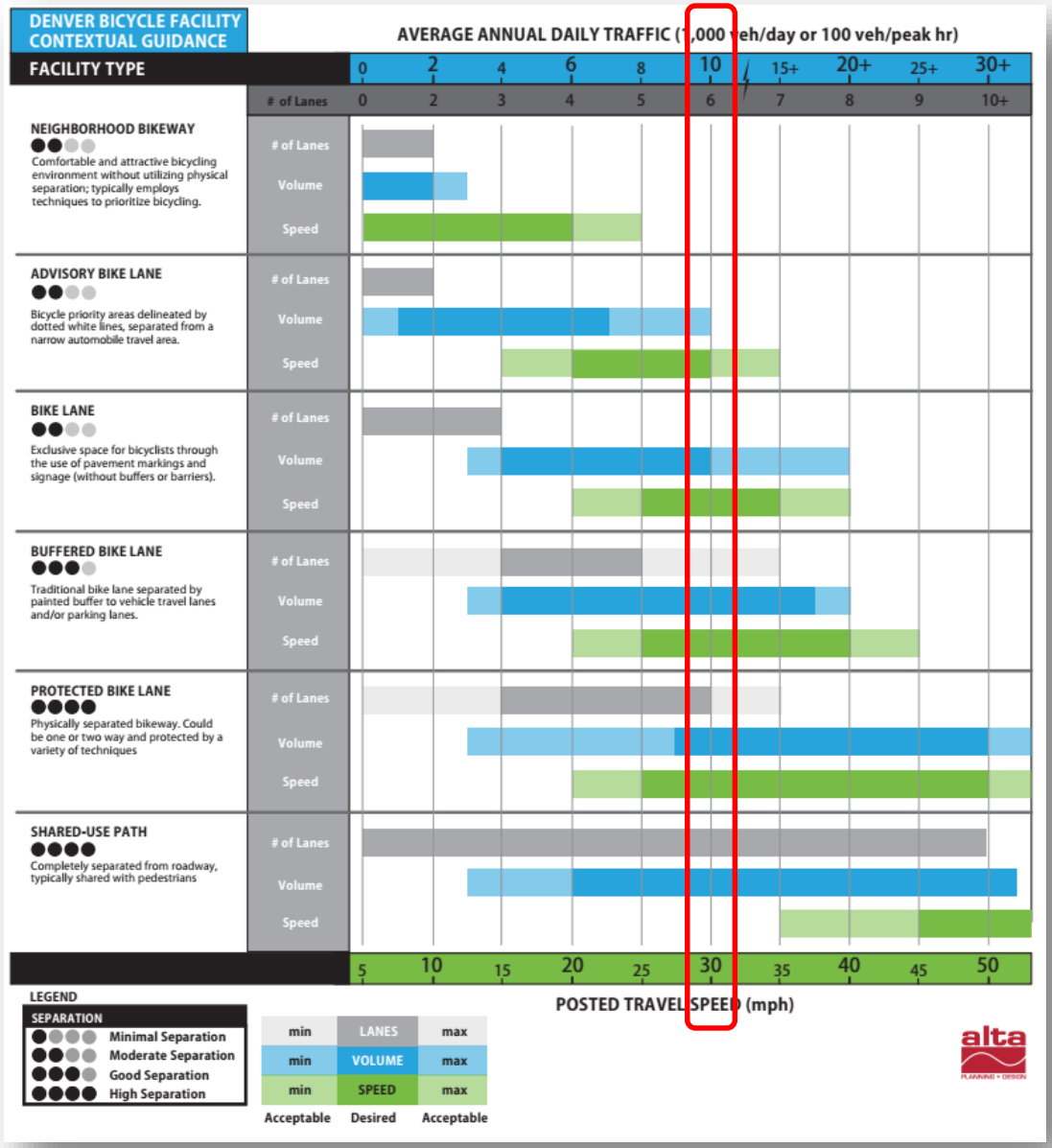

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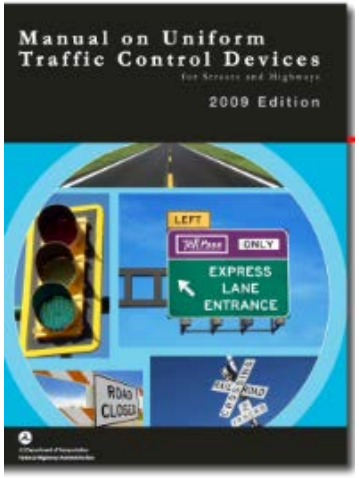
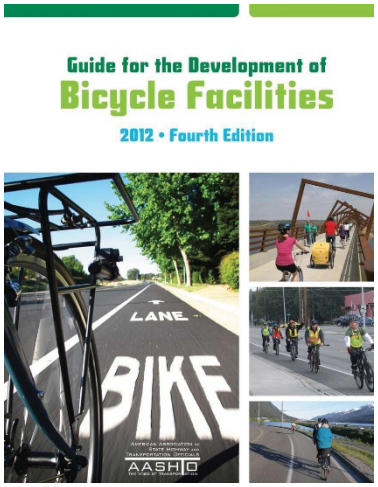
Bicycle Facility Selection

Other Factors:

- Number of lanes
- Driveway spacing
- Heavy vehicles
- On-street parking
- Center median
- Transit frequency
- Network considerations

Regulatory Framework





NACTO

apbp
ASSOCIATION OF PEDESTRIAN & BICYCLE PROFESSIONALS
Expertise for Active Transportation

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GUIDANCE

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Guidance Spectrum

Federal		State	Local
MUTCD	*Green Book AASHTO*	*MUTCD Supplement State Road Design Manual*	City Street Design Manual

MUTCD

Color

Stencil

Buffer

Signage

Signals

State/Local Guidance

Cycle Track Width

Buffer Width

Orientation

Parking

Context/ Application

Interpreting Guidance

MUTCD	NACTO
Shall	Required
Should	Recommended
May	Optional

FHWA MUTCD Status

- Experimental

Dashed Bicycle Lanes

- Interim Approval

Green-Colored Pavement

Alternate Design for the U.S. Bicycle Route (M1-9) Sign

Bicycle Signal Faces

Two-Stage Turn Box

Bicycle Box

- Interpretations

Use of R4-11 Sign on Roads with Speed Limits Above 35mph

Modified Bicycle Destination Sign

Installation of Advance Turn and Directional Assemblies for Bike Route Signs

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https://mutcd.fhwa.dot.gov/res-resources.htm

2010 Design

United States Department of Transportation Policy Statement on Bicycle and Pedestrian Accommodation Regulations and Recommendations

Signed on March 11, 2010 and announced March 15, 2010

Purpose

The United States Department of Transportation (DOT) is providing this Policy Statement to reflect the Department's support for the development of fully integrated active transportation networks. The establishment of well-connected walking and bicycling networks is an important component for livable communities, and their design should be a part of Federal-aid project developments. Walking and bicycling foster safer, more livable, family-friendly communities; promote physical activity and health; and reduce vehicle emissions and fuel use. Legislation and regulations exist that require inclusion of bicycle and pedestrian policies and projects into transportation plans and project development. Accordingly, transportation agencies should plan, fund, and implement improvements to their walking and bicycling networks, including linkages to transit. In addition, DOT encourages transportation agencies to go beyond the minimum requirements, and proactively provide convenient, safe, and context-sensitive facilities that foster increased use by bicyclists and pedestrians of all ages and abilities, and utilize universal design characteristics when appropriate. Transportation programs and facilities should accommodate people of all ages and abilities, including people too young to drive, people who cannot drive, and people who choose not to drive.

Policy Statement

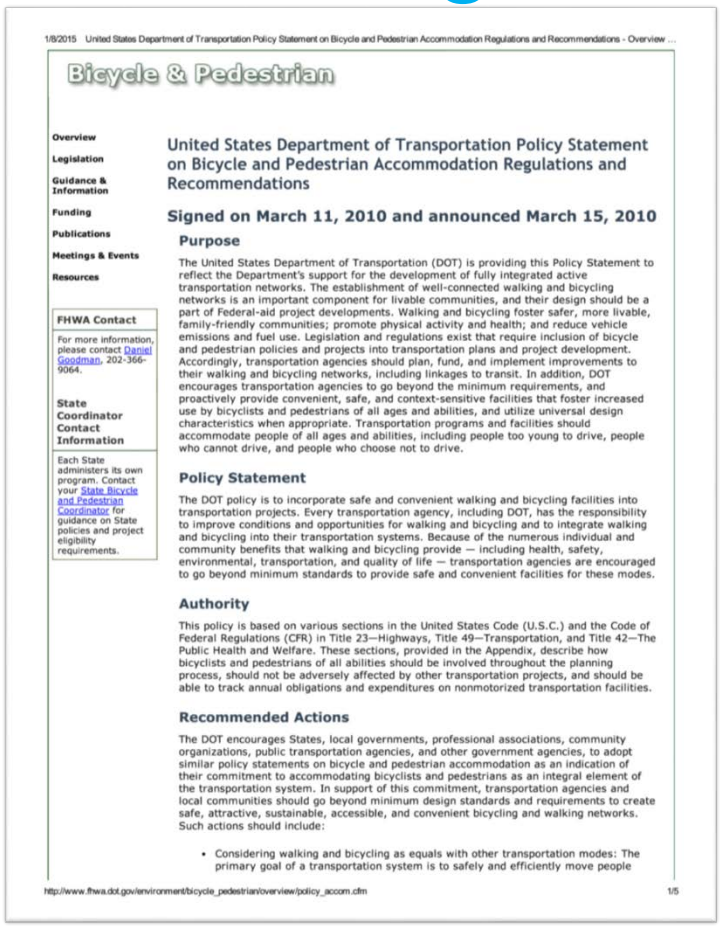
The DOT policy is to incorporate safe and convenient walking and bicycling facilities into transportation projects. Every transportation agency, including DOT, has the responsibility to improve conditions and opportunities for walking and bicycling and to integrate walking and bicycling into their transportation systems. Because of the numerous individual and community benefits that walking and bicycling provide — including health, safety, environmental, transportation, and quality of life — transportation agencies are encouraged to go beyond minimum standards to provide safe and convenient facilities for these modes.

Authority

This policy is based on various sections in the United States Code (U.S.C.) and the Code of Federal Regulations (CFR) in Title 23—Highways, Title 49—Transportation, and Title 42—The Public Health and Welfare. These sections, provided in the Appendix, describe how bicyclists and pedestrians of all abilities should be involved throughout the planning process, should not be adversely affected by other transportation projects, and should be able to track annual obligations and expenditures on nonmotorized transportation facilities.

fhwa.dot.gov/environment/bicycle_pedestrian/overview/policy_accom.cfm

2010 Design Accommodation Memo



1/8/2015 United States Department of Transportation Policy Statement on Bicycle and Pedestrian Accommodation Regulations and Recommendations - Overview ...

Bicycle & Pedestrian

Overview
Legislation
Guidance & Information
Funding
Publications
Meetings & Events
Resources

FHWA Contact

For more information, please contact Daniel Goodman, 202-366-9064.

State Coordinator Contact Information

Each State administers its own program. Contact your State Bicycle and Pedestrian Coordinator for guidance on State policies and project eligibility requirements.

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Recommended Actions

The DOT encourages States, local governments, professional associations, community organizations, public transportation agencies, and other government agencies, to adopt similar policy statements on bicycle and pedestrian accommodation as an indication of their commitment to accommodating bicyclists and pedestrians as an integral element of the transportation system. In support of this commitment, transportation agencies and local communities should go beyond minimum design standards and requirements to create safe, attractive, sustainable, accessible, and convenient bicycling and walking networks. Such actions should include:

- Considering walking and bicycling as equals with other transportation modes: The primary goal of a transportation system is to safely and efficiently move people

http://www.fhwa.dot.gov/environment/bicycle_pedestrian/overview/policy_accom.cfm 1/5

"...DOT encourages transportation agencies to go **beyond the minimum** requirements, and proactively provide convenient, safe, and context-sensitive facilities that foster increased use by bicyclists and pedestrians of **all ages and abilities**, and utilize universal design characteristics when appropriate."

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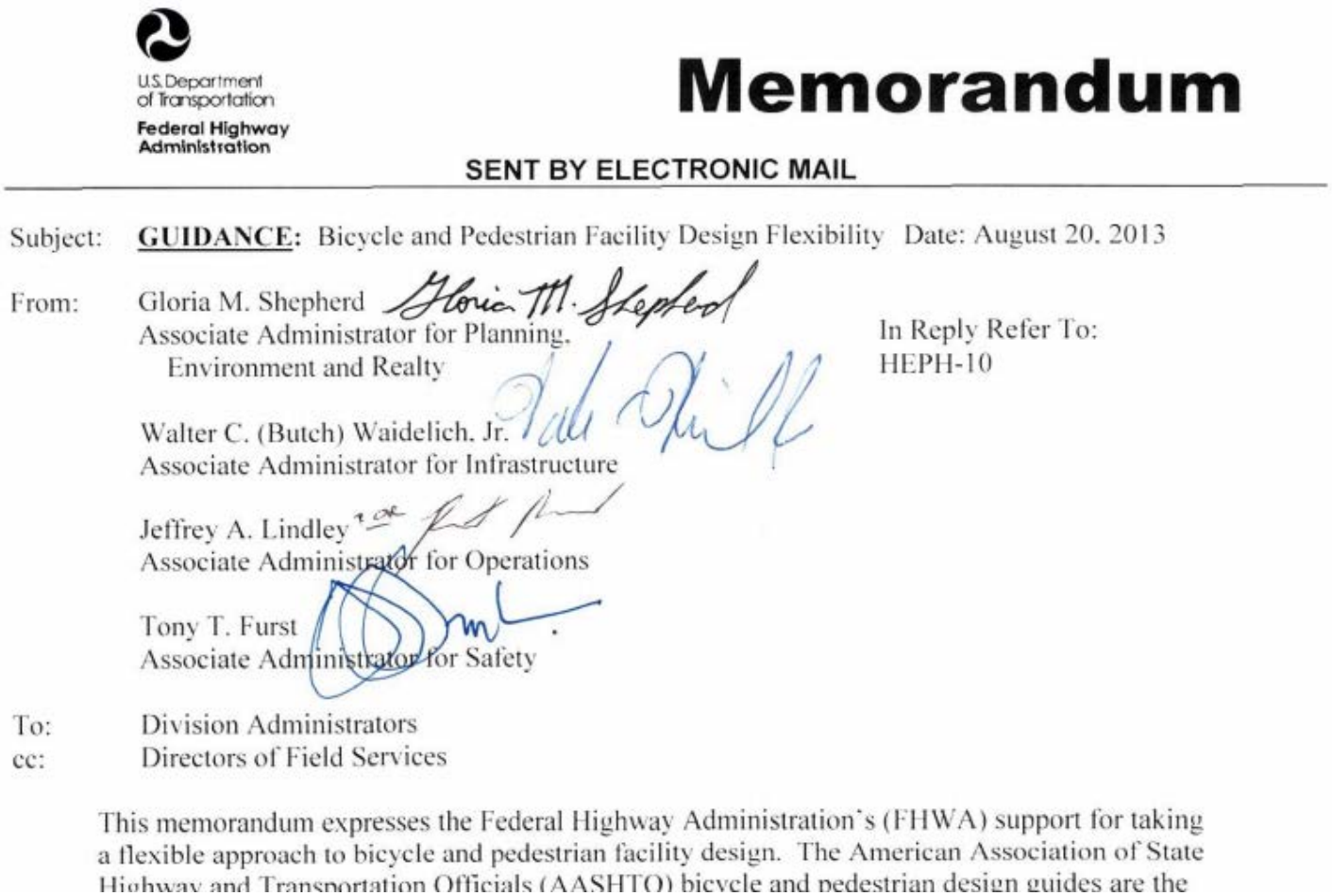
2013 Design Flexibility Memo



U.S. Department of Transportation
Federal Highway Administration

Memorandum

SENT BY ELECTRONIC MAIL

Subject: **GUIDANCE:** Bicycle and Pedestrian Facility Design Flexibility Date: August 20, 2013

From: Gloria M. Shepherd
Associate Administrator for Planning, Environment and Realty

In Reply Refer To:
HEPH-10

Walter C. (Butch) Waidelich, Jr.
Associate Administrator for Infrastructure

Jeffrey A. Lindley
Associate Administrator for Operations

Tony T. Furst
Associate Administrator for Safety

To: Division Administrators
cc: Directors of Field Services

This memorandum expresses the Federal Highway Administration's (FHWA) support for taking a flexible approach to bicycle and pedestrian facility design. The American Association of State Highway and Transportation Officials (AASHTO) bicycle and pedestrian design guides are the

Federal Highway Administration's (FHWA) support for taking a **flexible approach** to bicycle and pedestrian facility design.

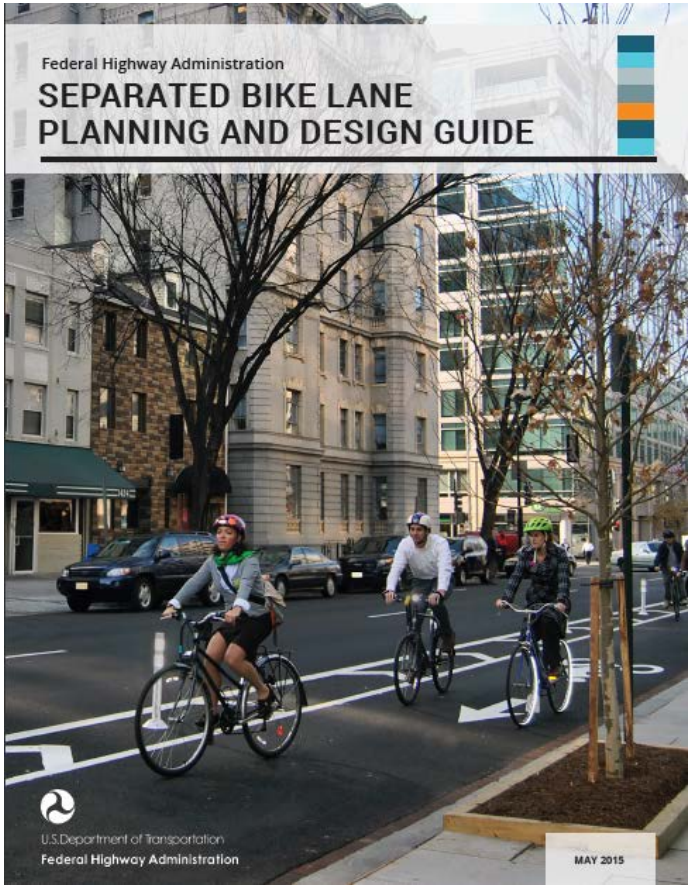
https://www.fhwa.dot.gov/environment/bicycle_pedestrian/guidance/design_flexibility.cfm

2013 Design Flexibility Memo

"…support for taking a **flexible approach** to bicycle and pedestrian facility design. FHWA **supports the use of [NACTO, ITE and other] resources** to further develop nonmotorized transportation networks, particularly in urban areas."

https://www.fhwa.dot.gov/environment/bicycle_pedestrian/guidance/design_flexibility.cfm

FHWA Separated Bike Lane Planning and Design Guide



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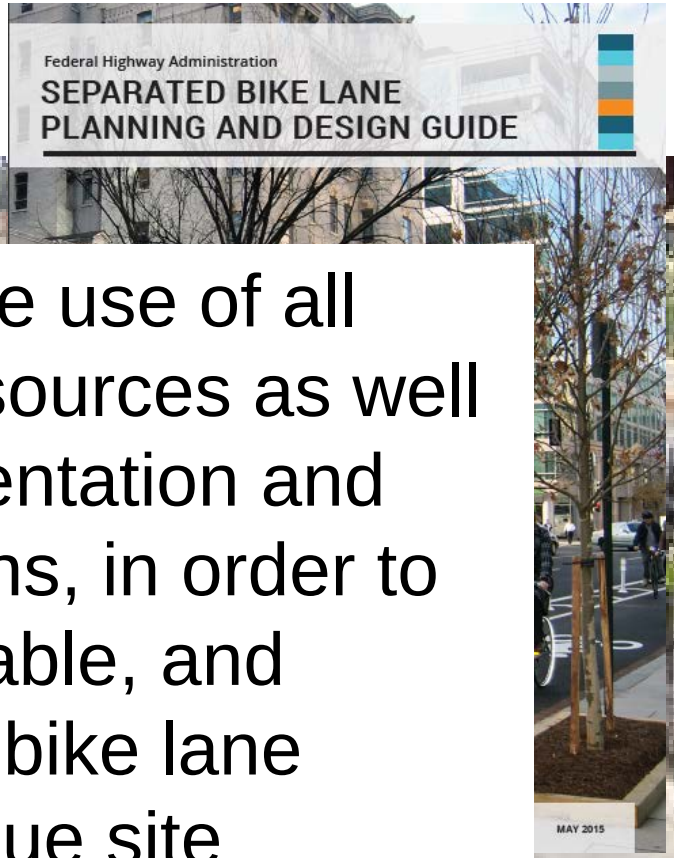
Design Guidance



"FHWA encourages the use of all appropriate design resources as well as continued experimentation and modifications of designs, in order to develop safe, comfortable, and predictable separated bike lane treatments that fit unique site conditions and needs for each project."

Design Guidance

"Project sponsors should fully integrate nonmotorized accommodation into surface transportation projects. Section 1404 of the Fixing America's Surface Transportation (FAST) Act modified 23 U.S.C. 109 to require federally-funded projects on the National Highway System to consider access for other modes of transportation, and provides greater design flexibility to do so.."

More information is available at the following web address:

http://www.fhwa.dot.gov/environment/bicycle_pedestrian/funding/funding_opportunities.cfm

2015 “Clarifying Document”

1. Federal Funds **CAN** be used to build protected bike lanes
2. Federal Funds **CAN** be used for road diets
3. Engineers are **ALLOWED** to use design guides other than the AASHTO Green Book for projects that receive federal funds
    1. FLEXIBILITY in Design
4. “Highway” funding **CAN** be used for bike and pedestrian infrastructure

https://www.transportation.gov/fastlane/separating-fact-fiction-bike-ped-project-funding-design-and-environmental-review

2015 “Clarifying Document”

5. Vehicle lanes **DON’T** have to be a certain width to receive federal funds
6. Curb extensions, roundabouts and trees **CAN** be used on streets in the NHS
7. Speed limits **DO NOT** need to be set using average (85%) vehicle speeds.

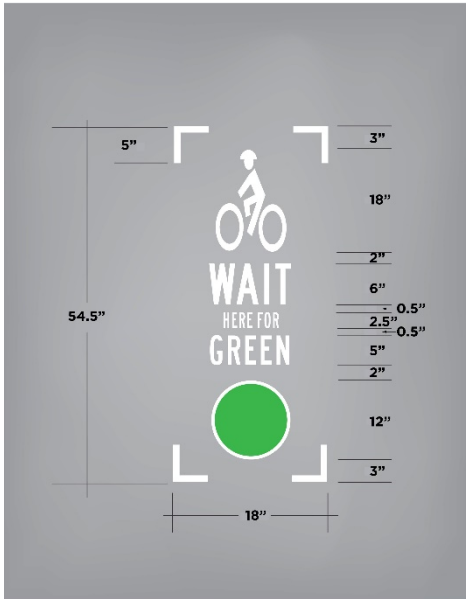
https://www.transportation.gov/fastlane/separating-fact-fiction-bike-ped-project-funding-design-and-environmental-review

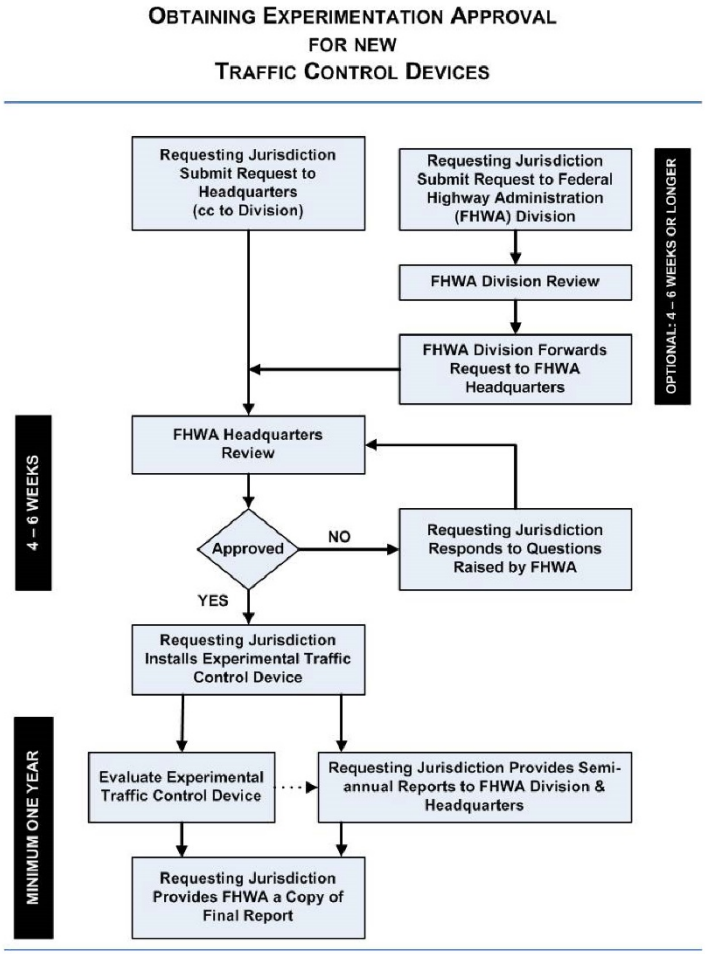
FHWA – Request to Experiment

- Statement about the nature of the problem
- Information about the proposed solution
- Research/evaluation plan
- Agree to restore the site if findings are bad
- Agree to provide semi annual progress reports during experimentation

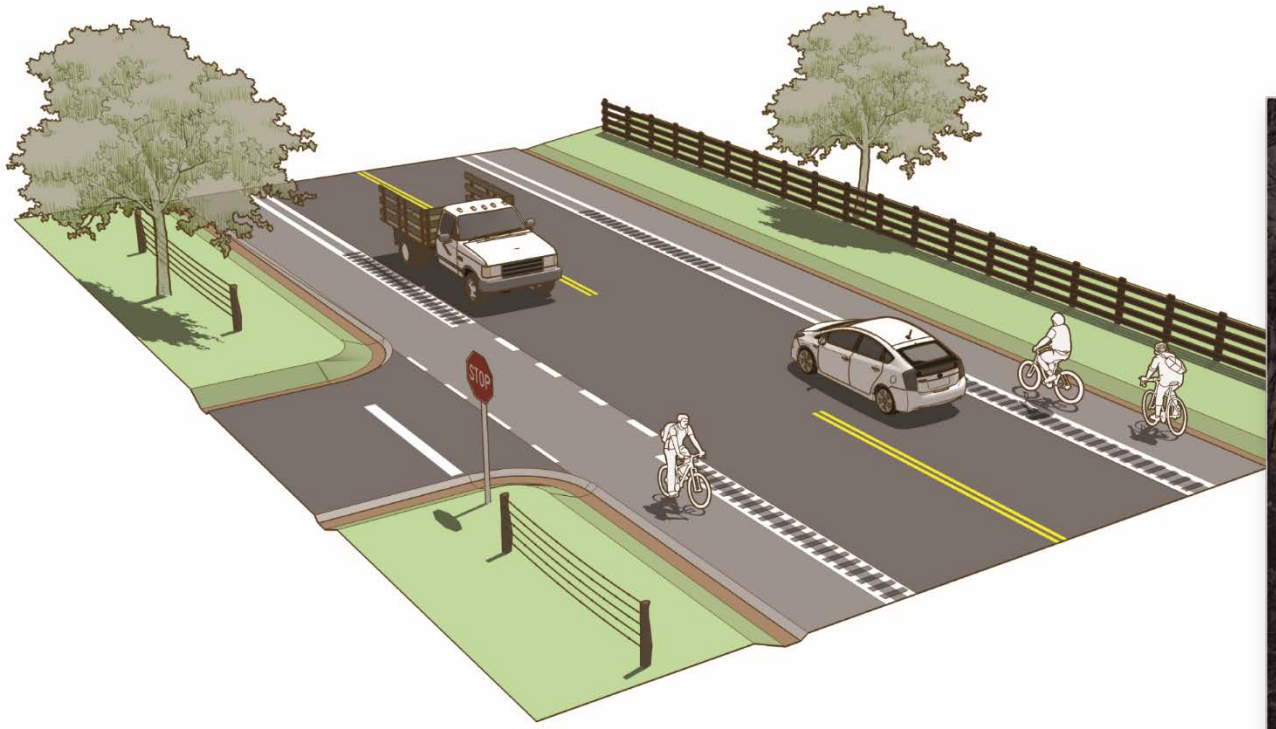
Detailed in MUTCD 1A.10

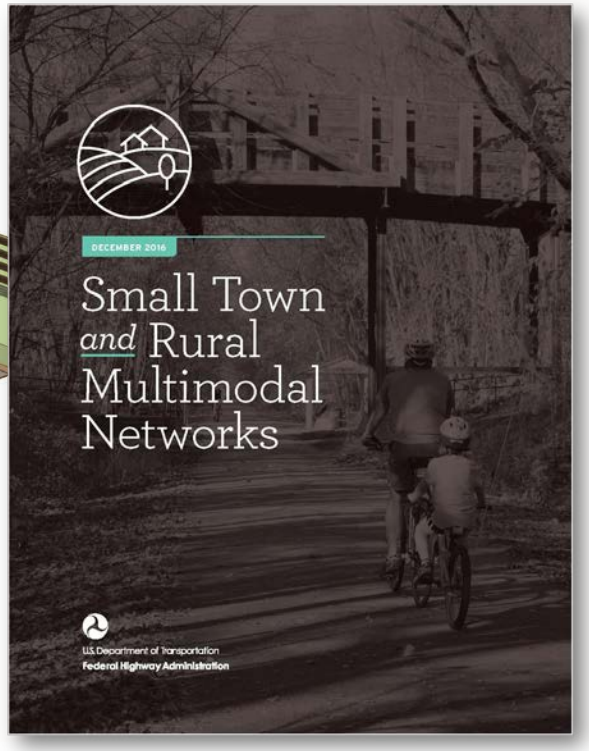
FHWA – Request to Experiment





Small Town ***and*** Rural Multimodal Networks





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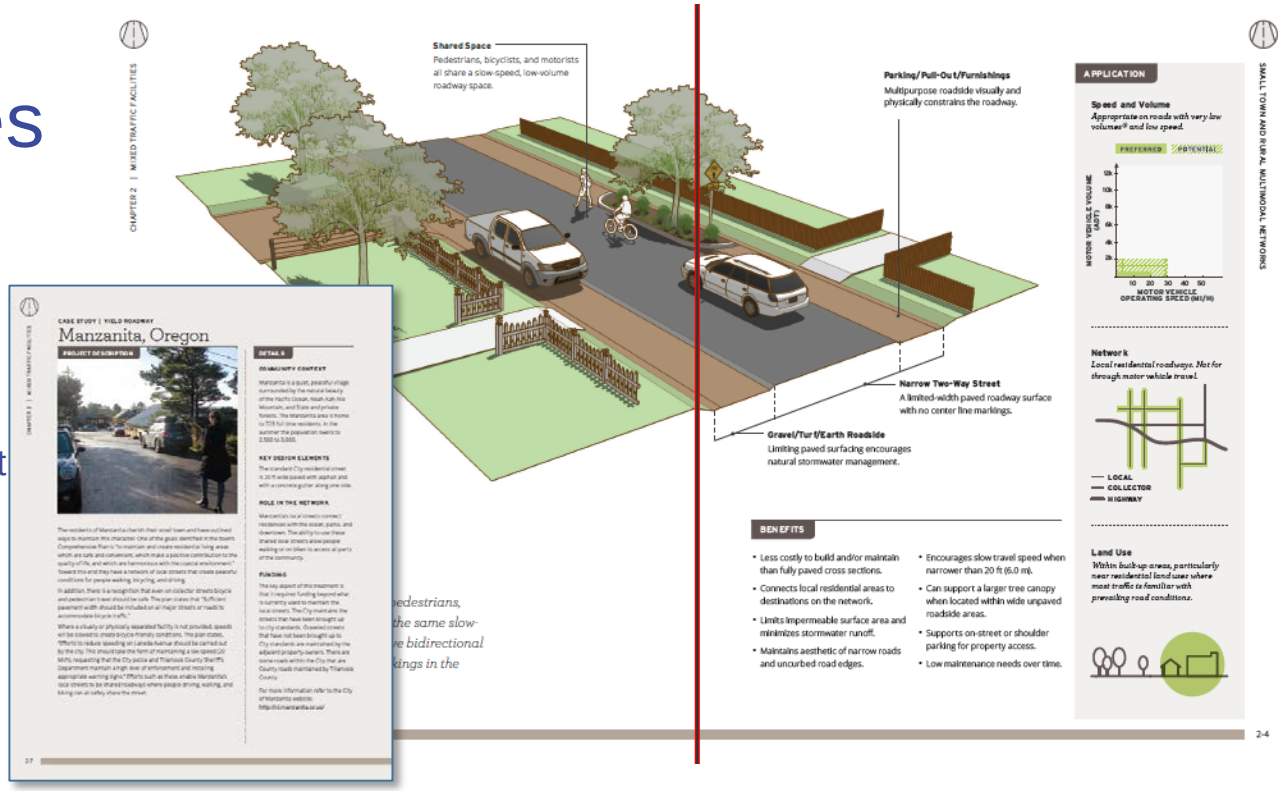
Content Areas

- Application
- Benefits
- Case Studies
- Guidance
  - Geometric Design
  - Markings
  - Signs
  - Intersection treatment
  - Implementation
  - Accessibility



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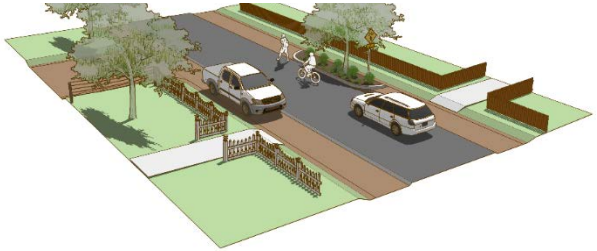
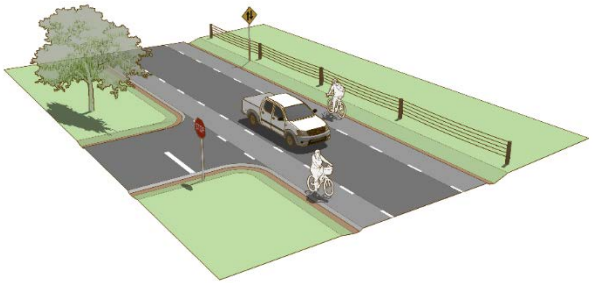
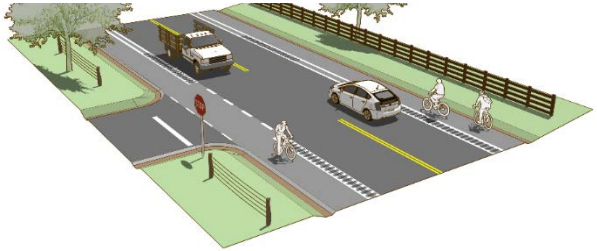
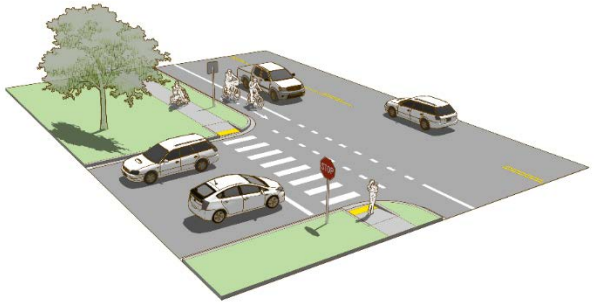
Mixed Traffic



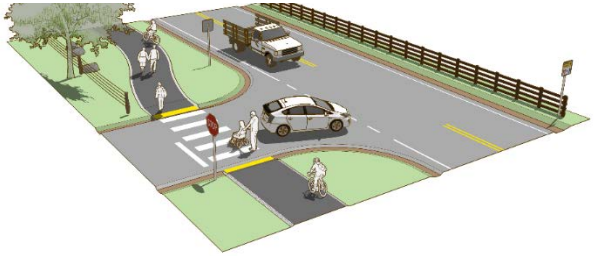


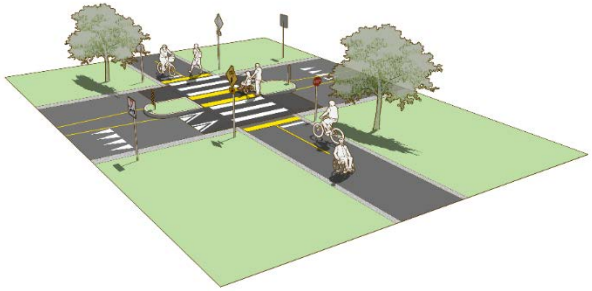
Visually Separated

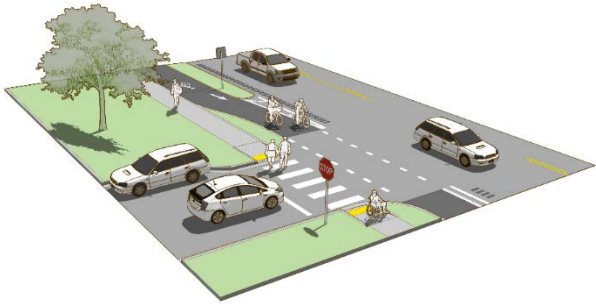




Physically Separated







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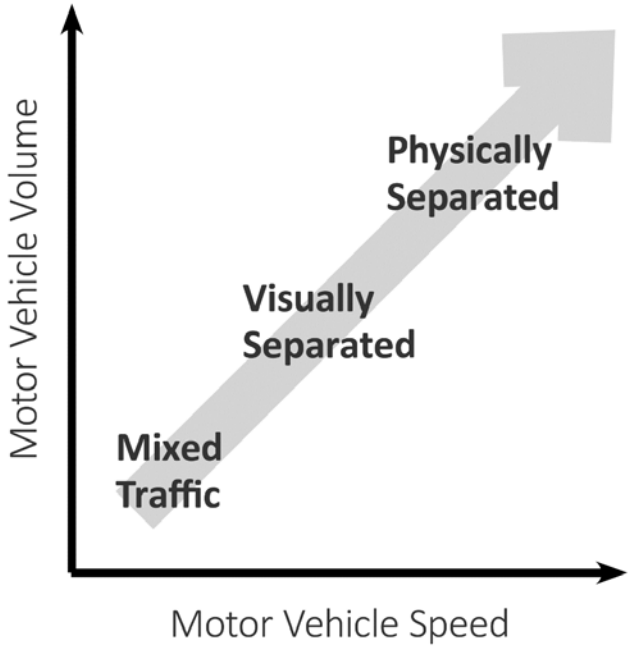
Focus on Complete Networks of Facilities

Networks are interconnected pedestrian and/or bicycle transportation facilities that allow people of all ages a and conveniently get whe

Facility Categories:

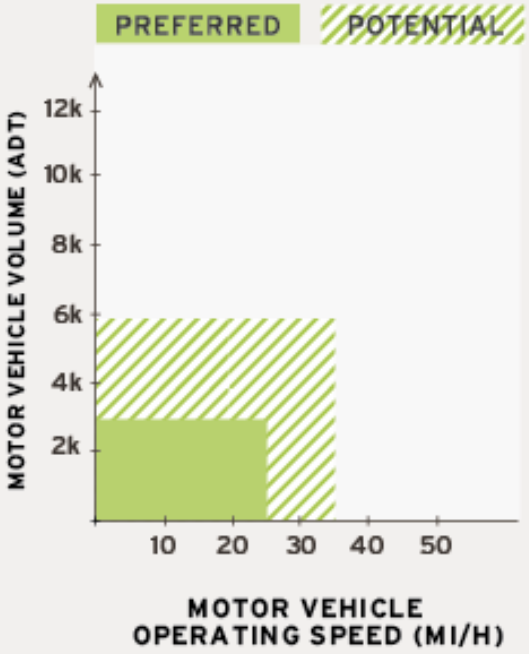
- Mixed Traffic
- Visually Separated
- Physically Separated



EXAMPLE APPLICATION

Speed and Volume

Most appropriate on streets with low to moderate volumes and moderate speed motor vehicles.



Network

Applies to constrained connections between built-up areas.

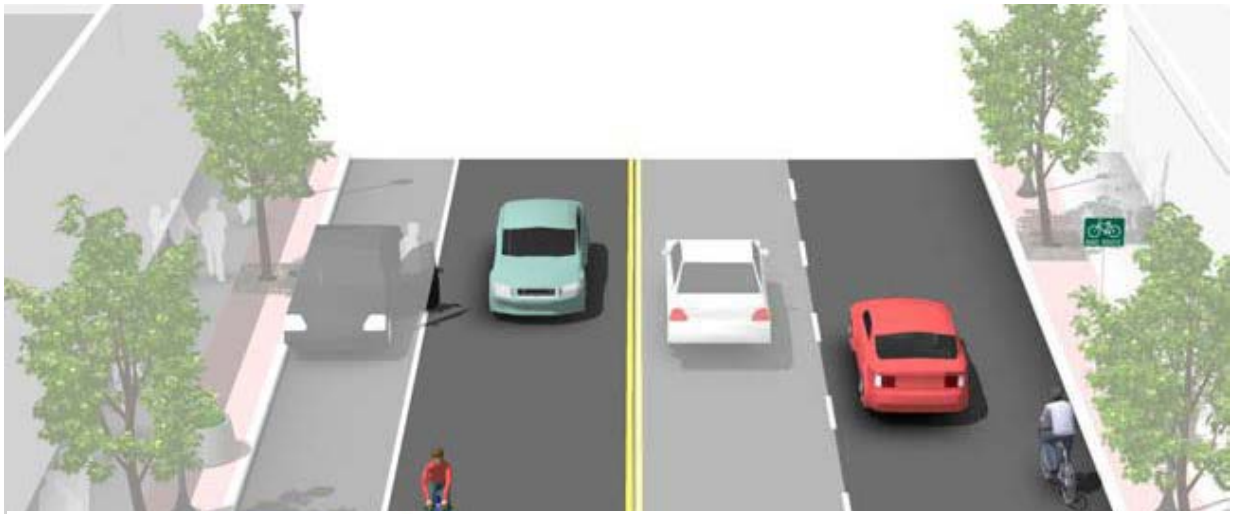
Land Use

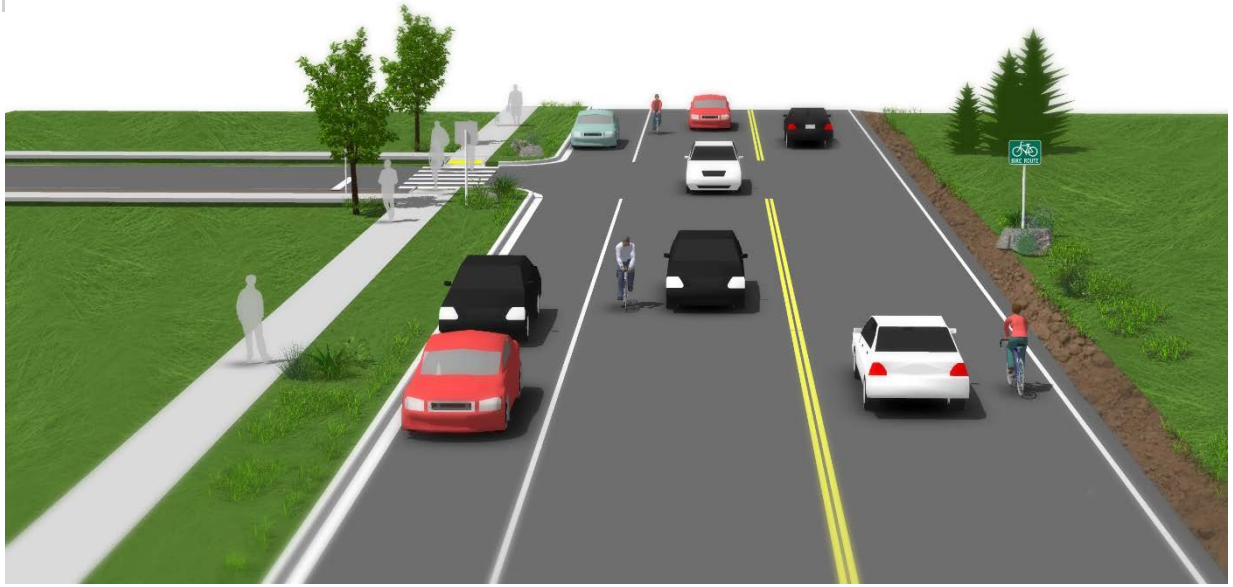
For use outside, between and within built-up areas with bicycle and pedestrian demand and limited available paved roadway surface.

Bikeway Types

- Signed Shared Roadway
- Marked Shared Roadway (Shared Lane Markings)
- Bicycle Boulevard/Calm Street/Quiet Street
- Shoulder Bikeway
- Conventional Bike Lane
- Buffered Bike Lane
- Protected Bike Lane / Cycle Track
- Two-Way Cycle Track
- Off-Street Shared Use Path / Sidepath

Signed Shared Roadway





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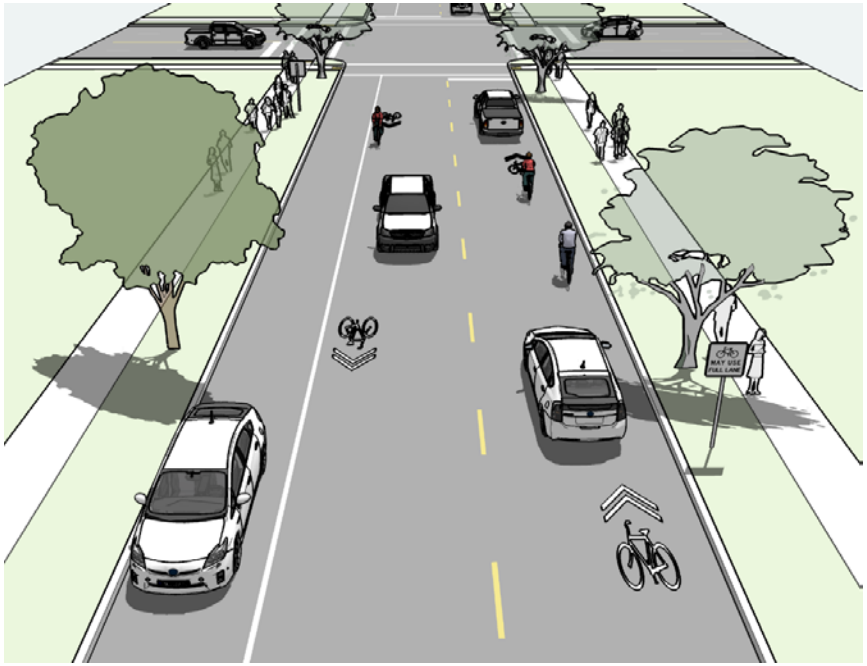
Marked Shared Roadway



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Bicycle Blvd./ Calm Street/ Quiet Street

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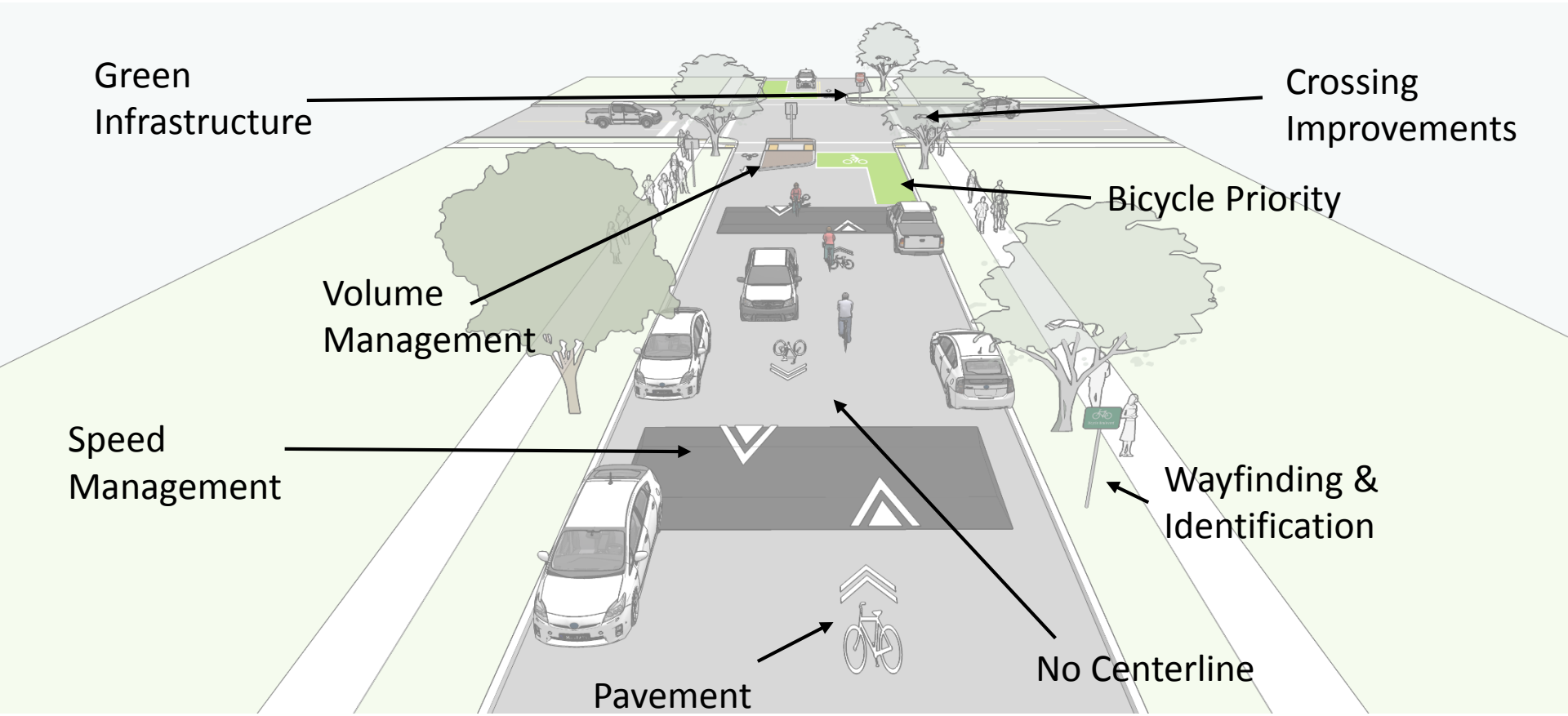
Bicycle Blvd./ Calm Street/ Quiet Street



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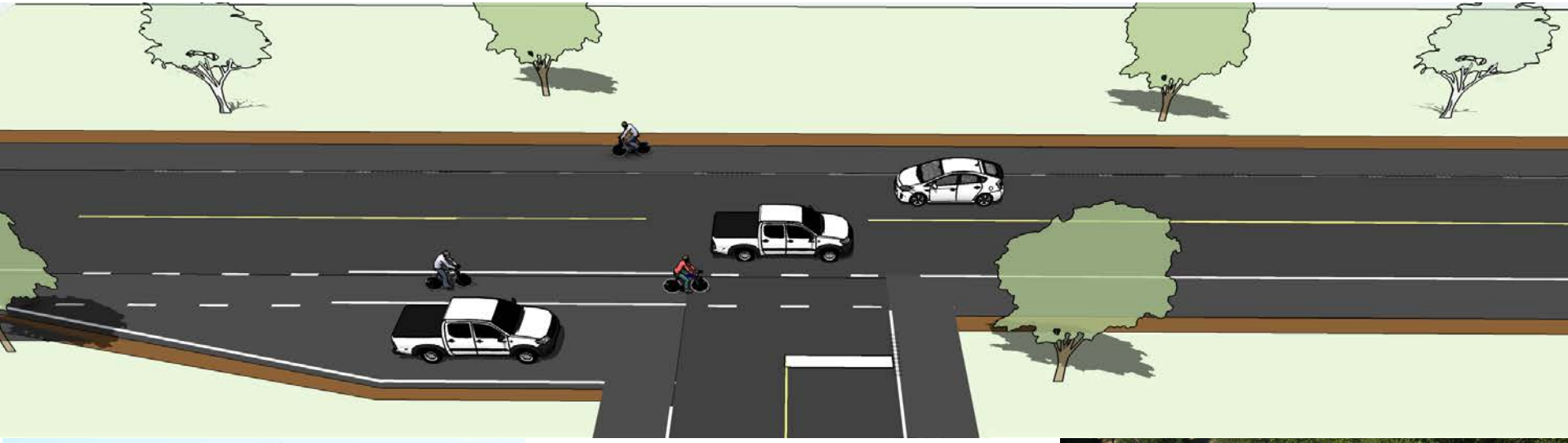
Shoulder Bikeway



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Conventional Bike Lane

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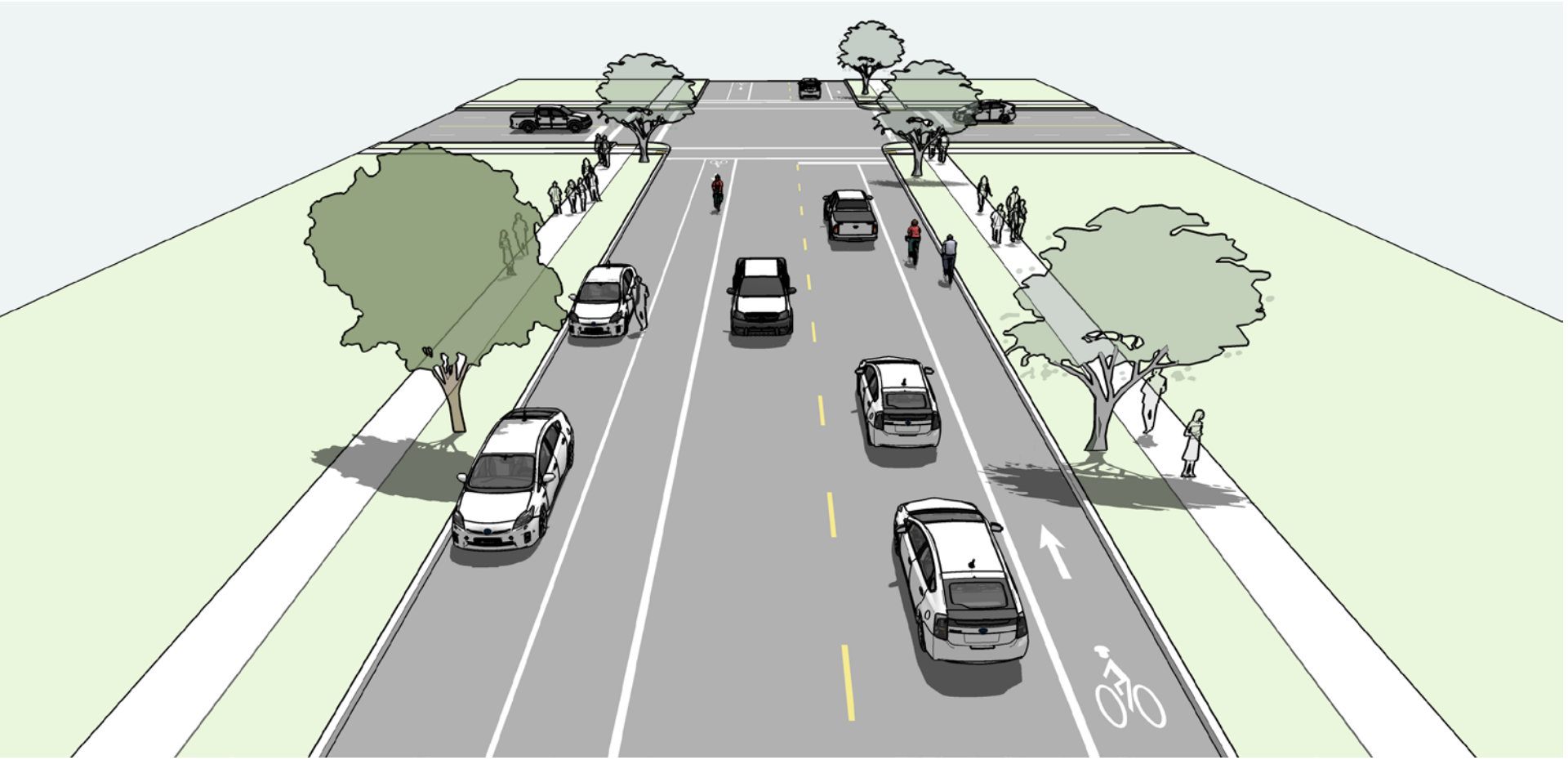
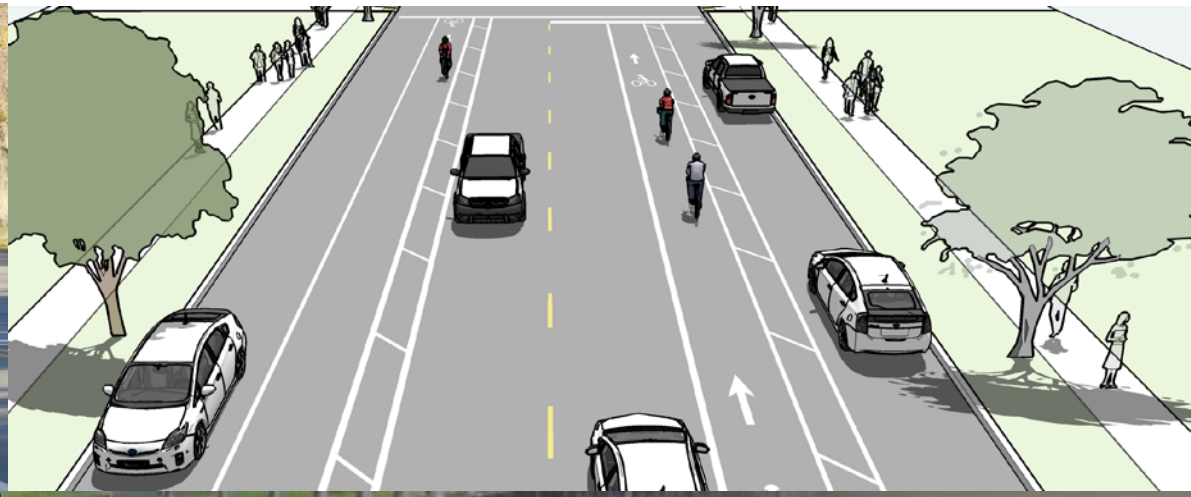
Typical



Guidance

- 6 ft wide preferred
- 5 ft minimum adjacent to parking
- 5 ft minimum adjacent to curb (gutter pan width needs consideration)
- 4 ft minimum with no curb (rare in urban areas)
- 4 ft minimum adjacent to islands at intersections or for bike slots.
- Wider than minimum dimensions preferred whenever possible.
- **7 ft. maximum**

Buffered Bike Lane



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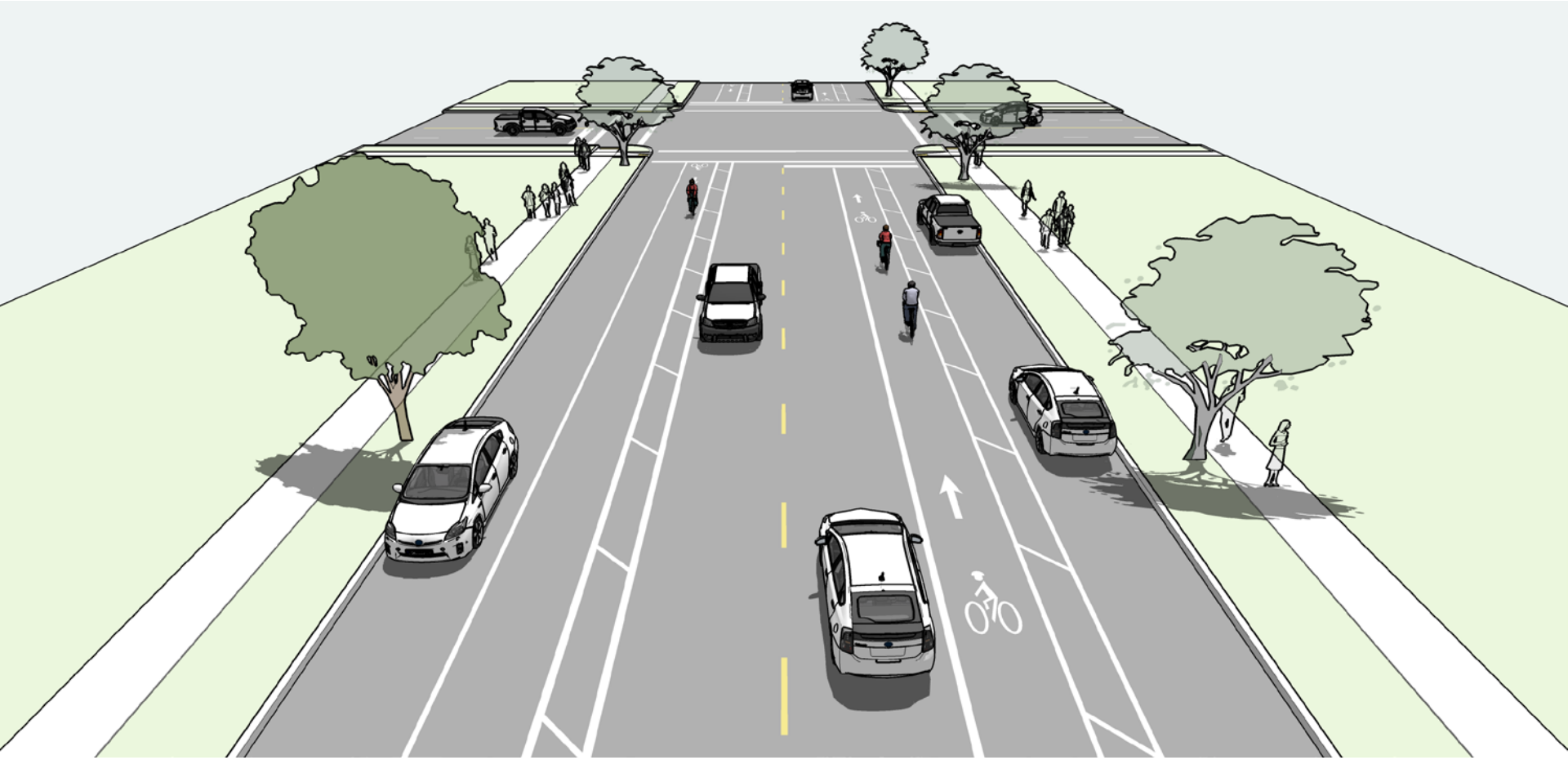
Buffered Bike Lanes

Application

- Anywhere a standard bike lane is being considered.
- High travel speeds, high travel volumes, and/or large amounts of truck traffic.
- Streets with with door zone risk(particularly in high turnover or occupancy)
- Streets with extra lanes or extra lane width.

Buffered Bike Lanes



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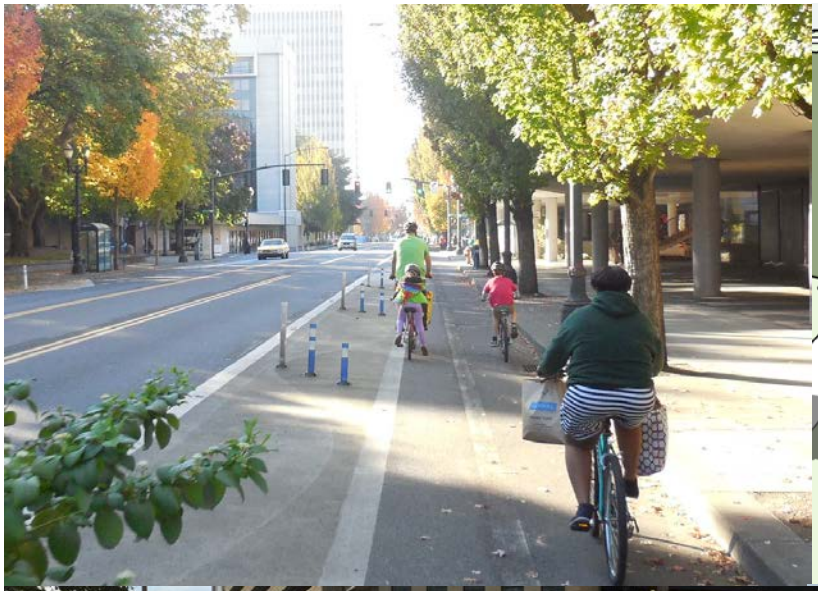
Buffered Bike Lanes

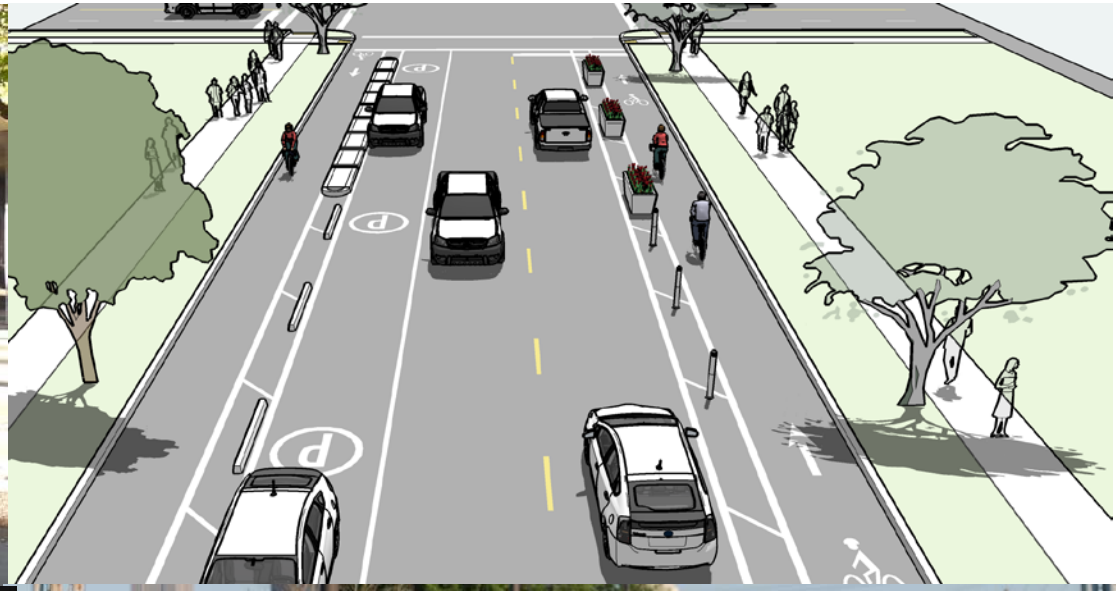
Guidance

- Buffer 1.5 ft or larger
- Stripe interior of buffer if 2.5 ft or larger*
- Chevrons or 4 in lines angled at 30 to 45 degrees and striped at intervals of 10 to 40 (speed limit rule of thumb)

*Striping on narrower buffers is possible, but potentially impractical.

Protected Bike Lane / Cycle Track





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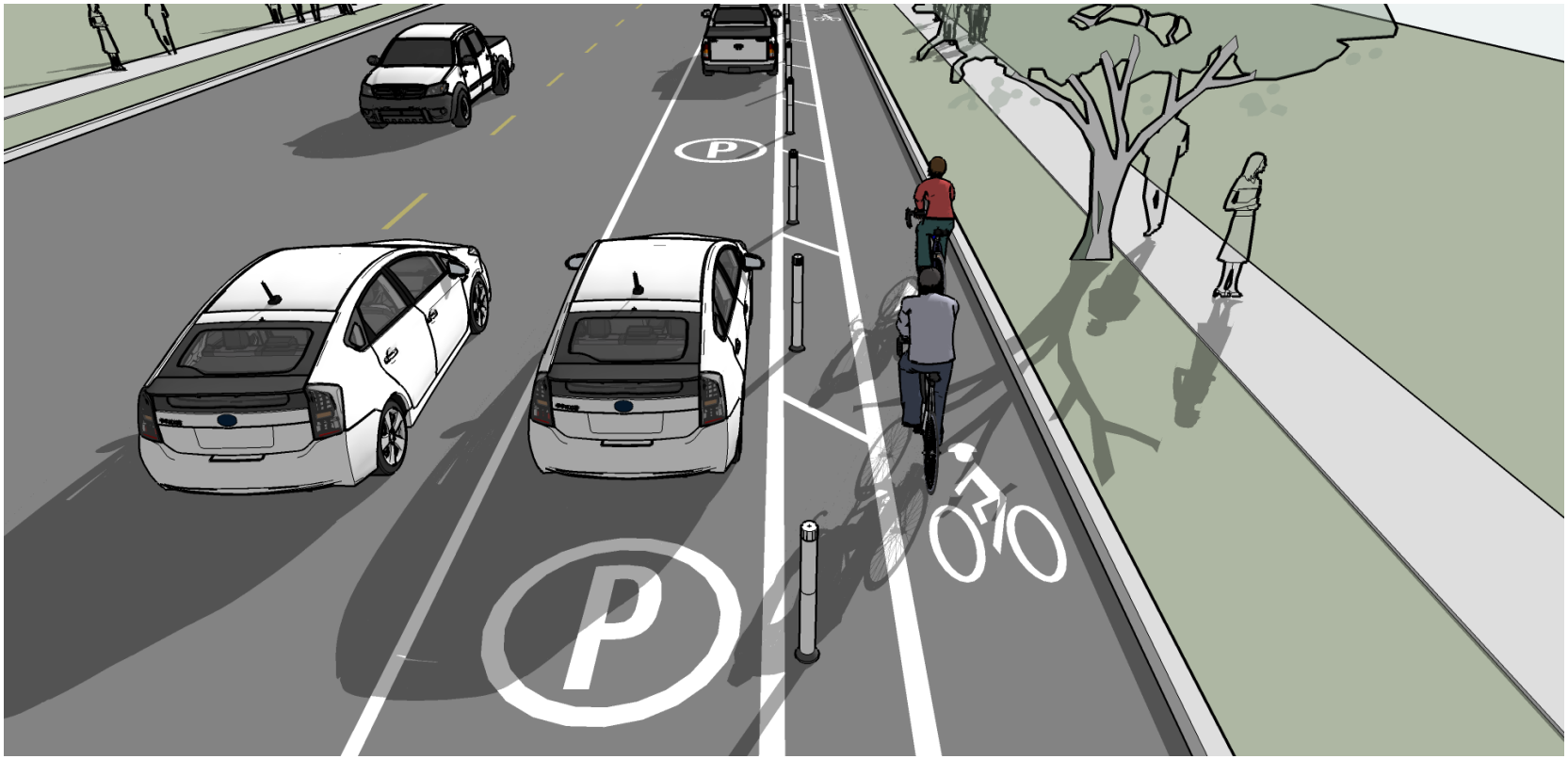
Protected Bike Lanes



8 ft

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alta
PLANNING + DESIGN

Cycle Tracks / Protected Bike Lanes

AKA Cycle Tracks, Protected Bike Lanes

Defined:

A separated bike lane is an exclusive facility for bicyclists that is located within or directly adjacent to the roadway and that is physically separated from motor vehicle traffic with a vertical element.

AASHTO

"In some situations, it may be better to place one-way sidepaths on both sides of the street or highway, directing wheeled users to travel in the same direction as adjacent motor vehicle traffic."

AASHTO Guide for the Development of Bicycle Facilities

The MUTCD

Established as Preferential Lanes (3D.01) with Channelizing Devices (3H.01)

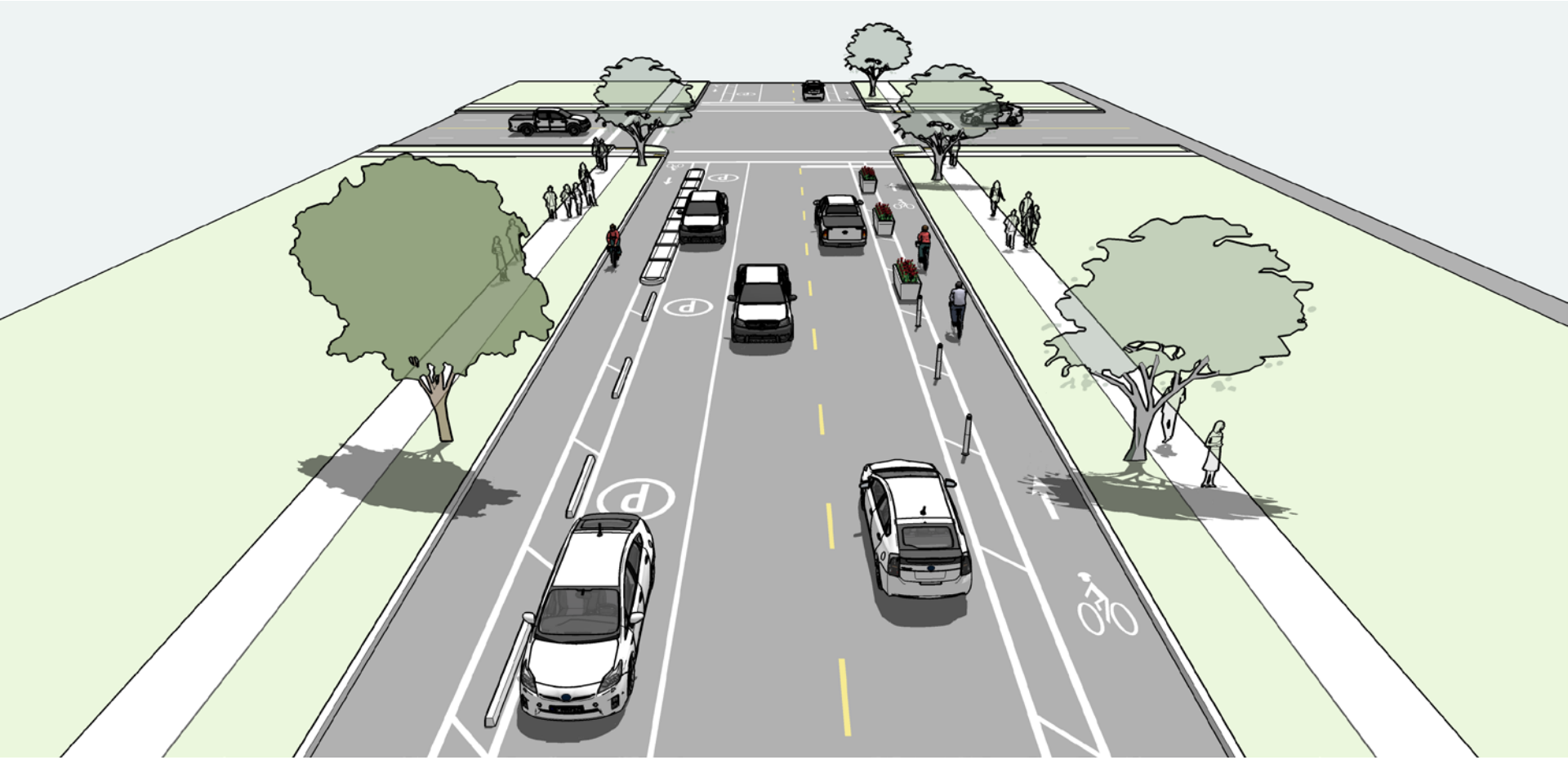
FHWA. Manual on Uniform Traffic Control Devices

Separated Bike Lanes

Application

- Places with many bicyclists or where you want to attract bicyclists to
- Anywhere you want to **REDUCE** the stress level of bicycling
- Downtowns
- Streets with high speed
- Multi-lane streets
- Streets with double parking or loading
- Streets with high parking turnover

One-Way



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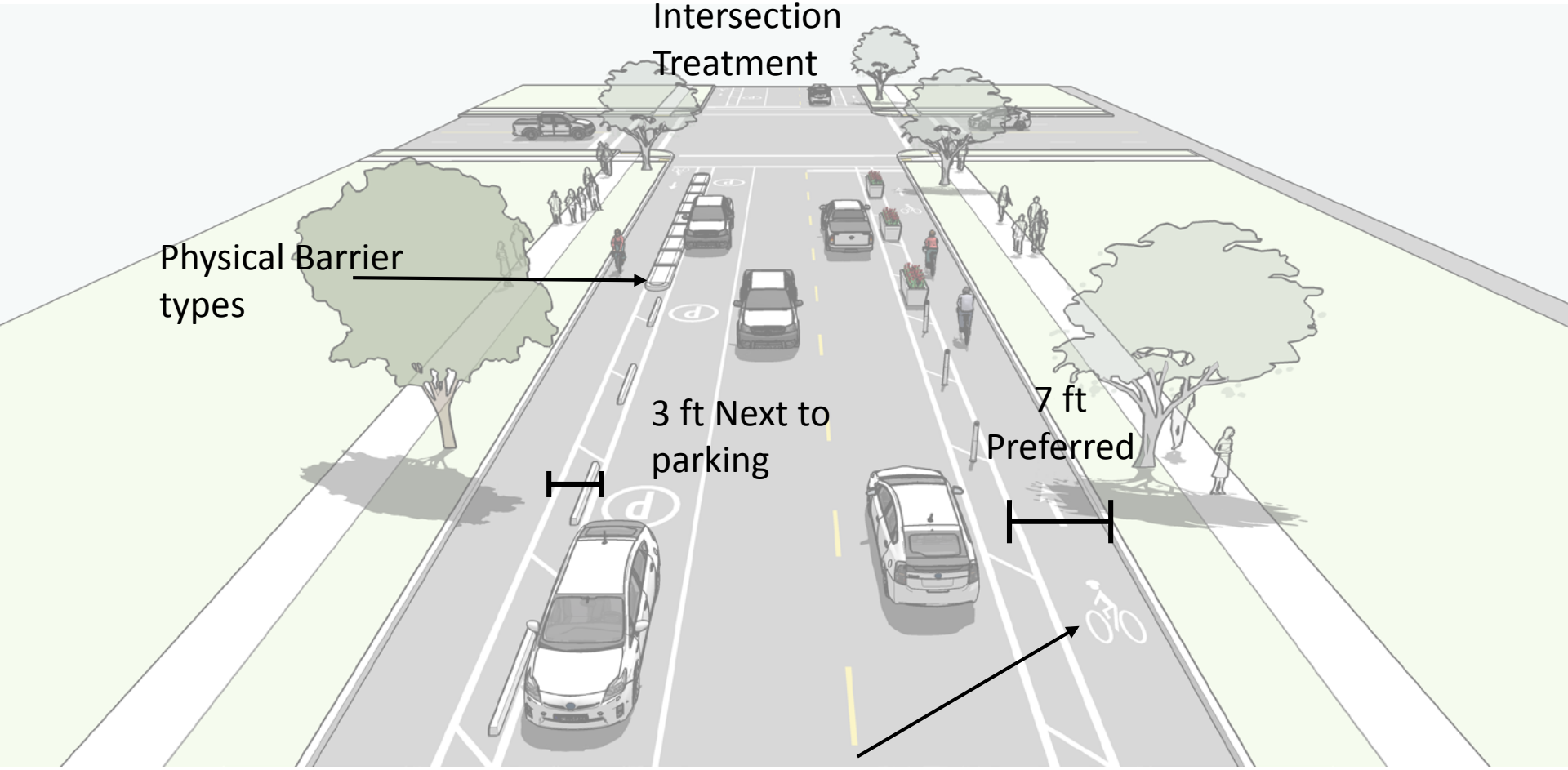
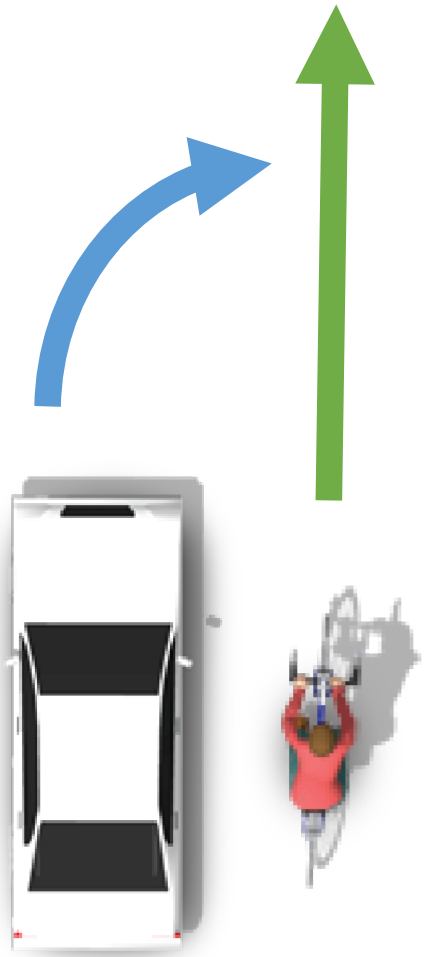
One-Way


Intersection Treatment
Physical Barrier types
3 ft Next to parking
7 ft Preferred
Bike Lane Marking

Bike Lanes at Intersections



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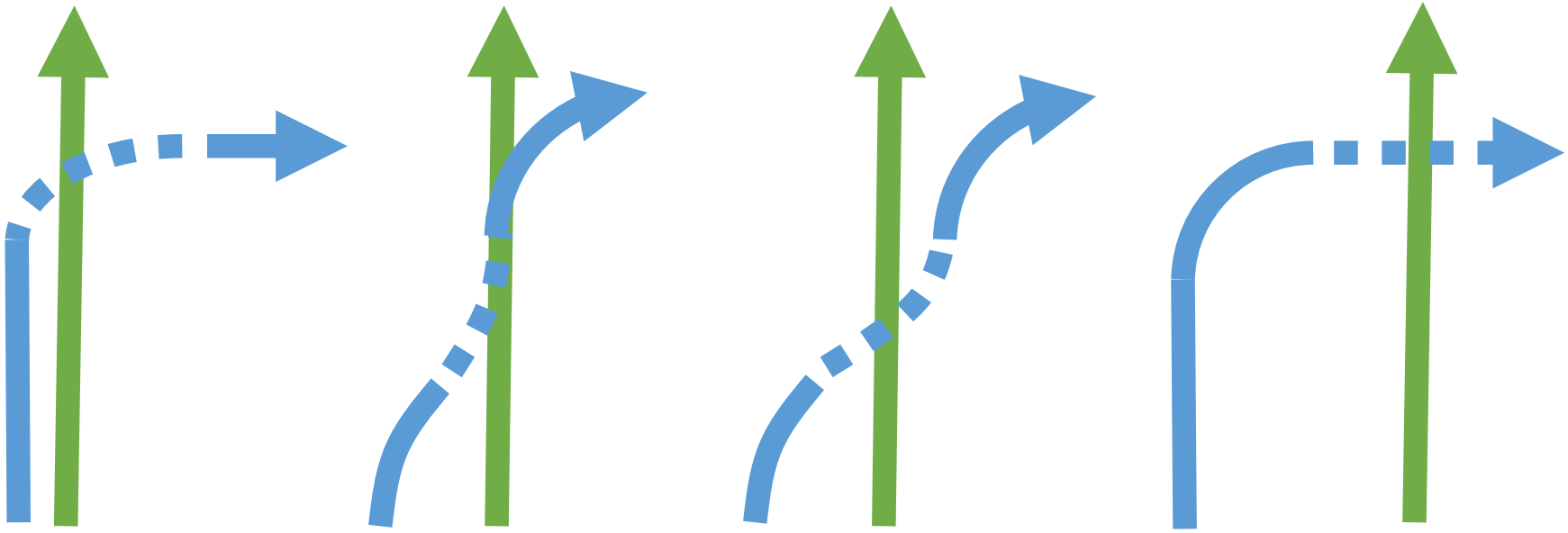
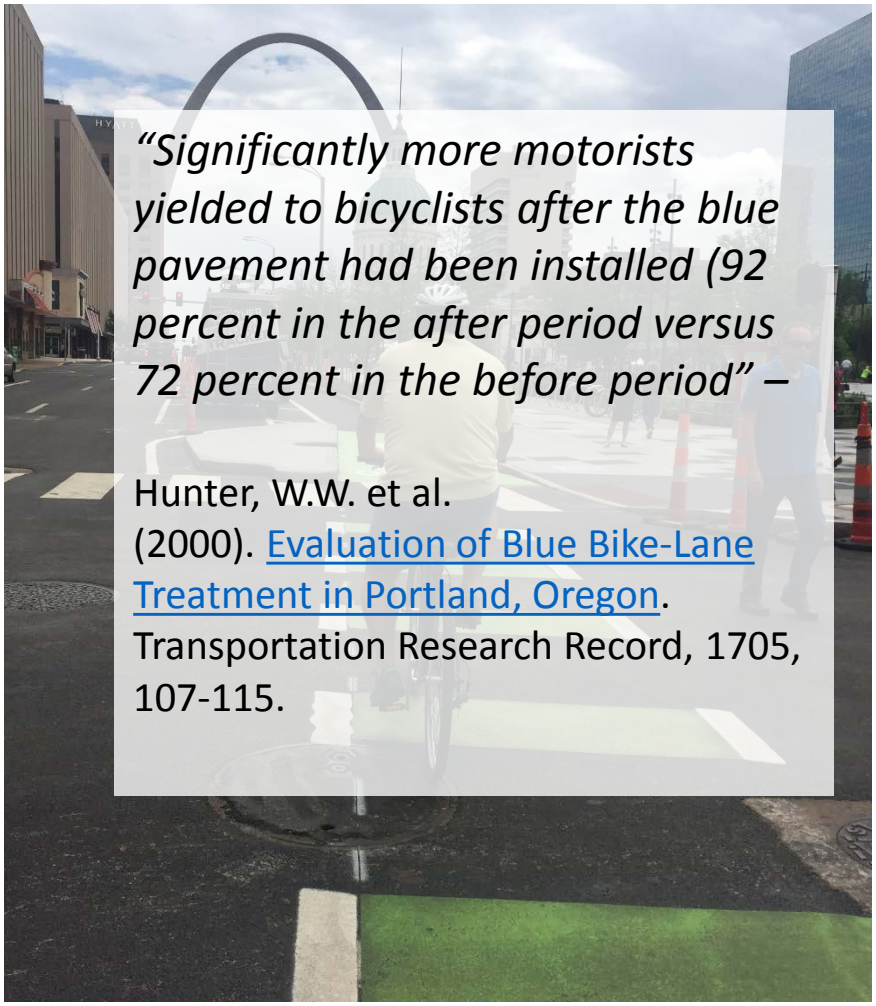
Intersection Design Principles

- Increasing Awareness
- Increasing Conspicuity/Visibility
- Isolating Conflicts
- Clearly Assigning Priority



Intersection Crossing Markings



"Significantly more motorists yielded to bicyclists after the blue pavement had been installed (92 percent in the after period versus 72 percent in the before period" –

Hunter, W.W. et al. (2000). Evaluation of Blue Bike-Lane Treatment in Portland, Oregon. Transportation Research Record, 1705, 107-115.

Applications

- Across signalized intersections
- **Along bike lanes and buffered bike lanes** (also a must for cycle tracks)
- At minor street intersections that are stop or yield controlled
- Where vehicle movements encroach into bicycle space

Benefits

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Benefits

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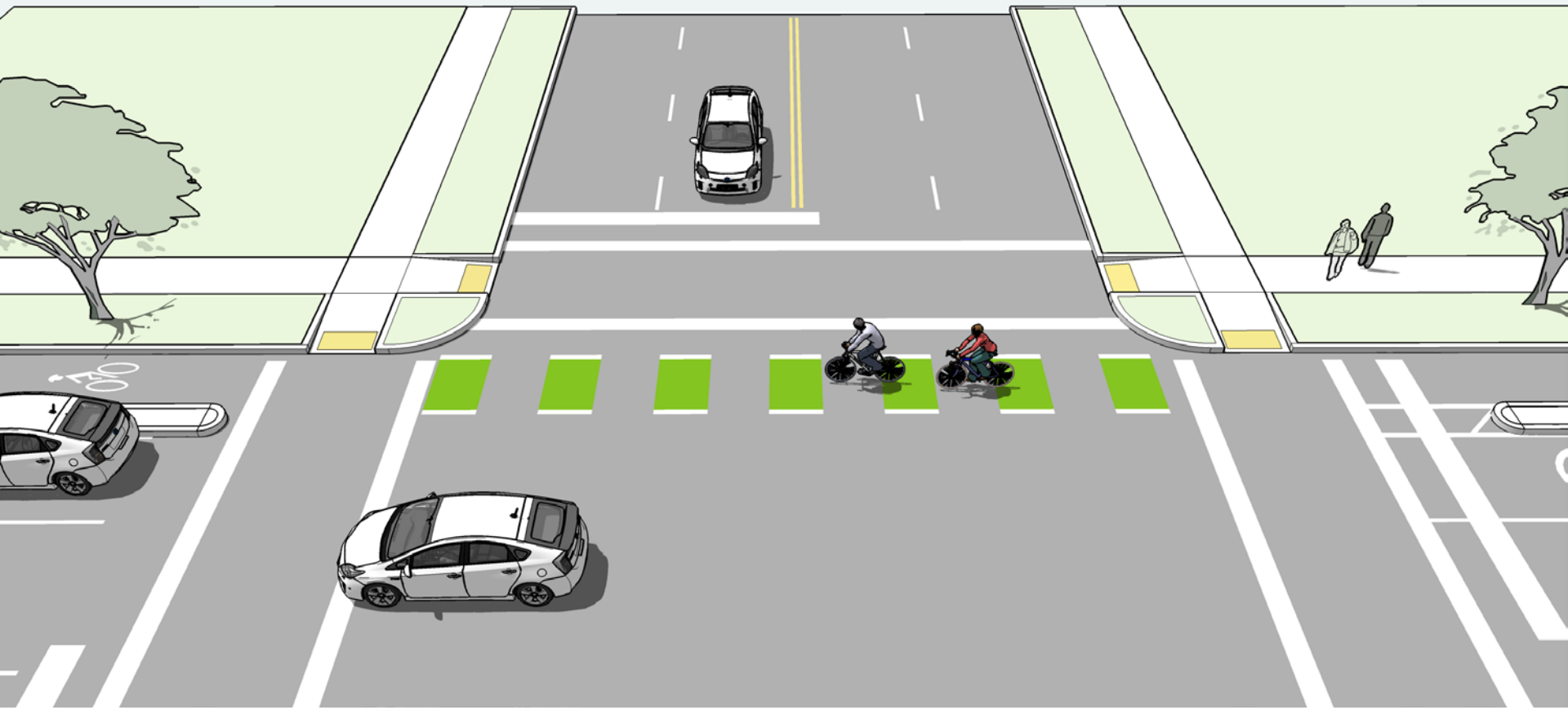
Intersection Crossing Markings



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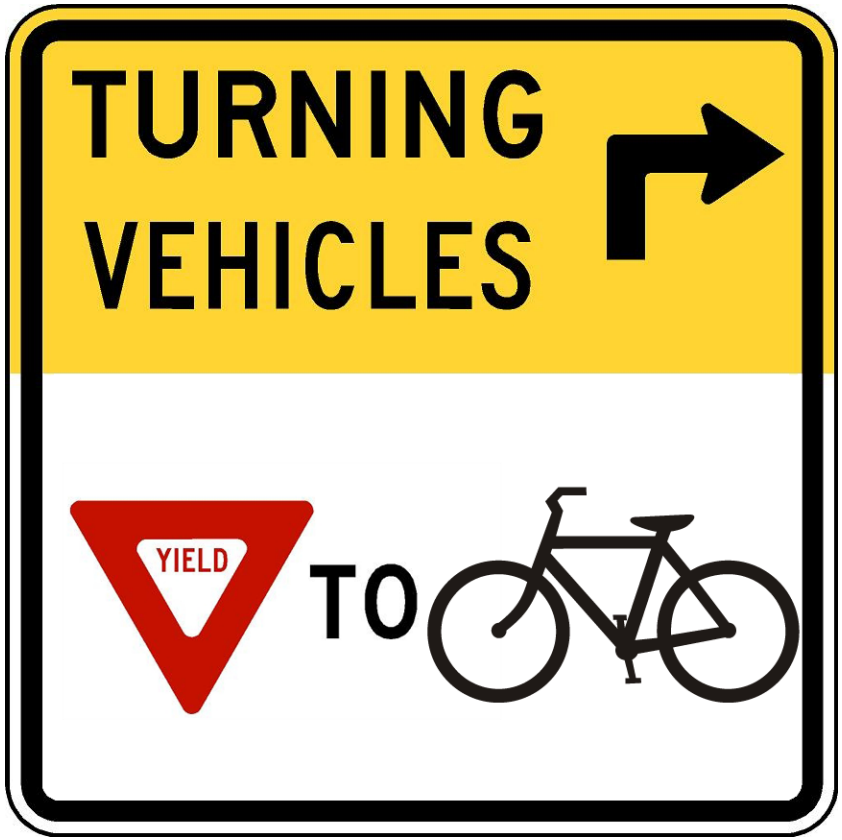
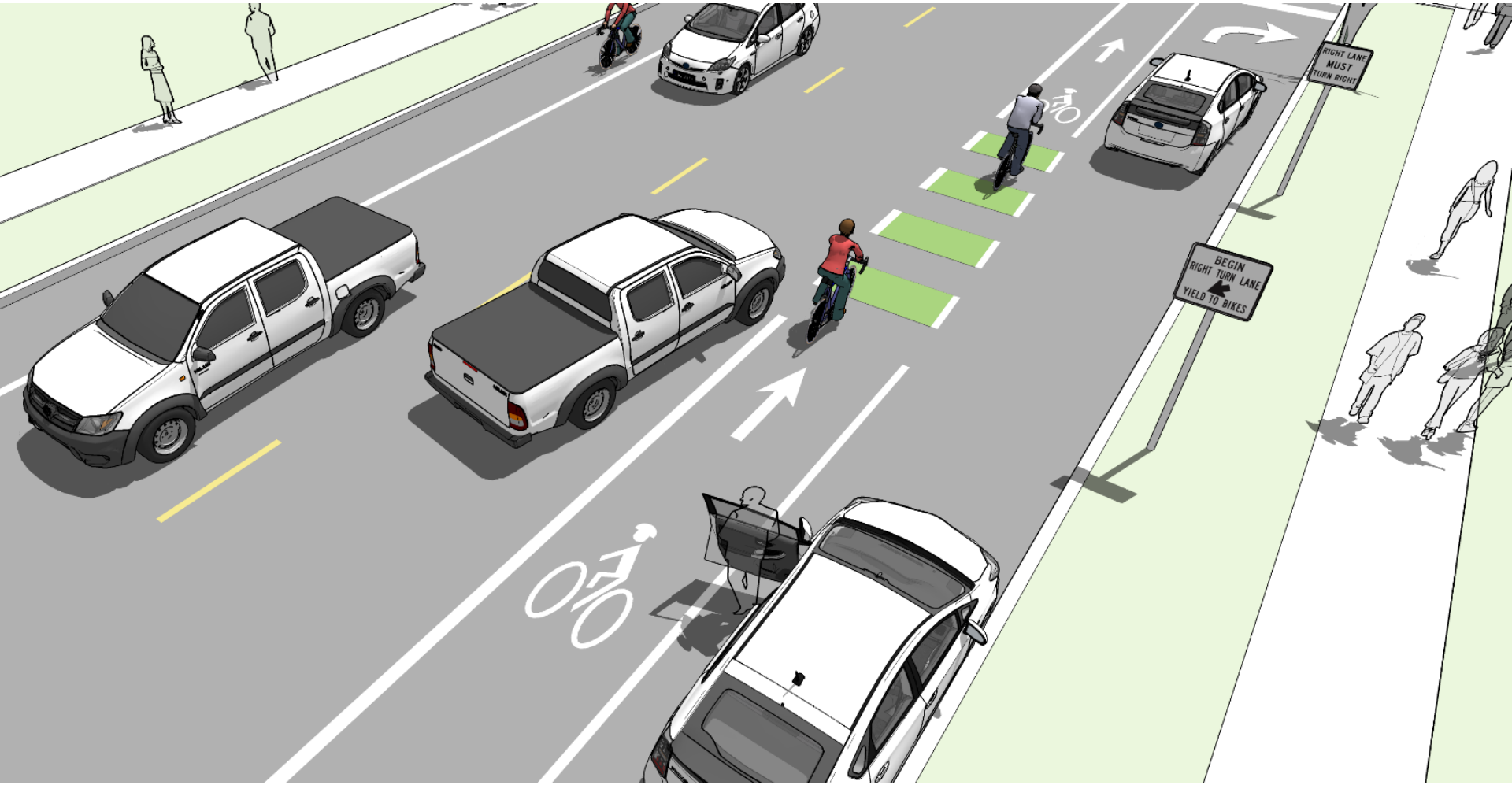
Yield Signs

R4-4



R10-15 (Modified)

Through Bike Lanes



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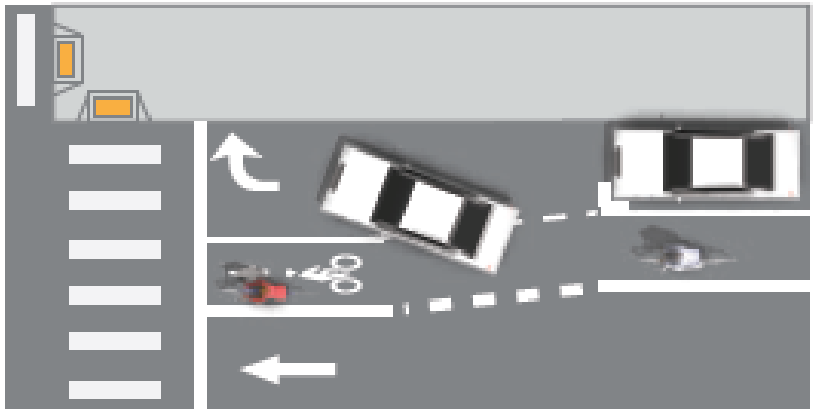
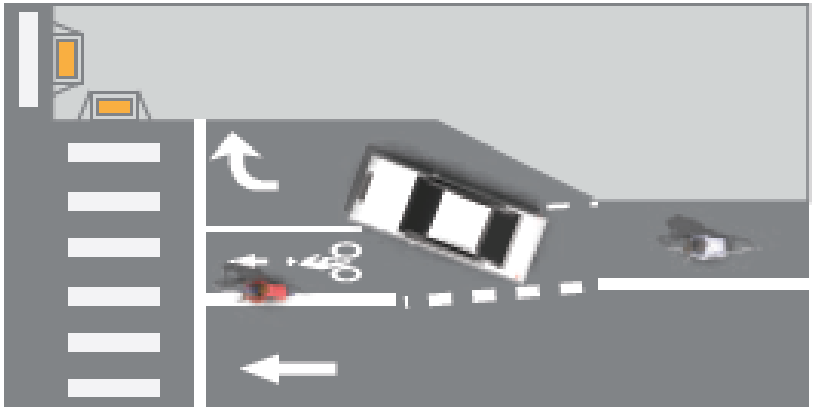
Through Bike Lanes

Auxiliary Right-Turn-Only Lane Added

These are appropriate conditions for use of through bike lanes.



Parking lane into right-turn-only lane. Through bike lanes provide bicycle priority within weaving area



Right-turn-only lane added at intersection with throat widening. Through bike lanes provide bicycle priority within weaving area.

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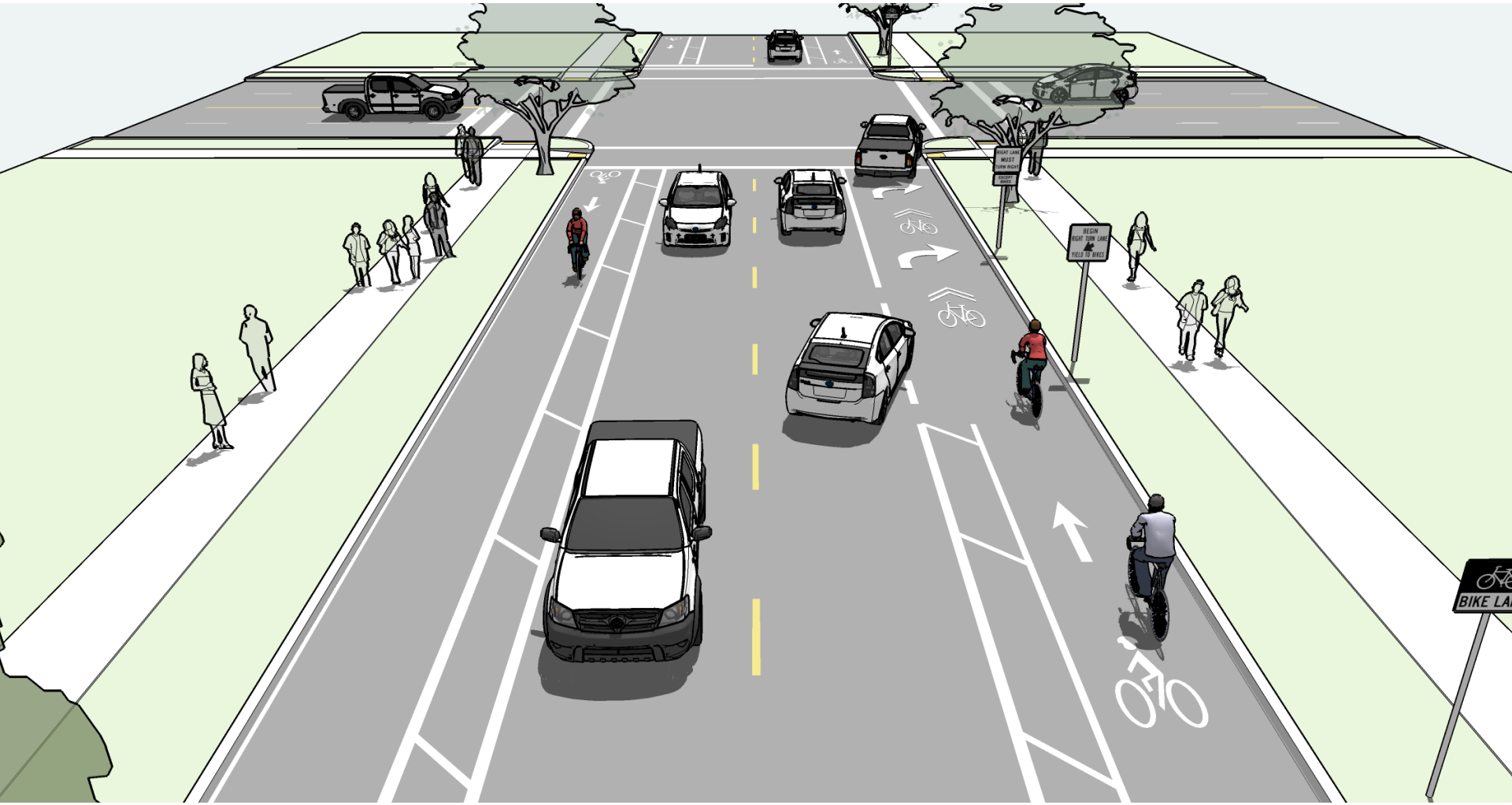
Shared Turn / Bike Lane



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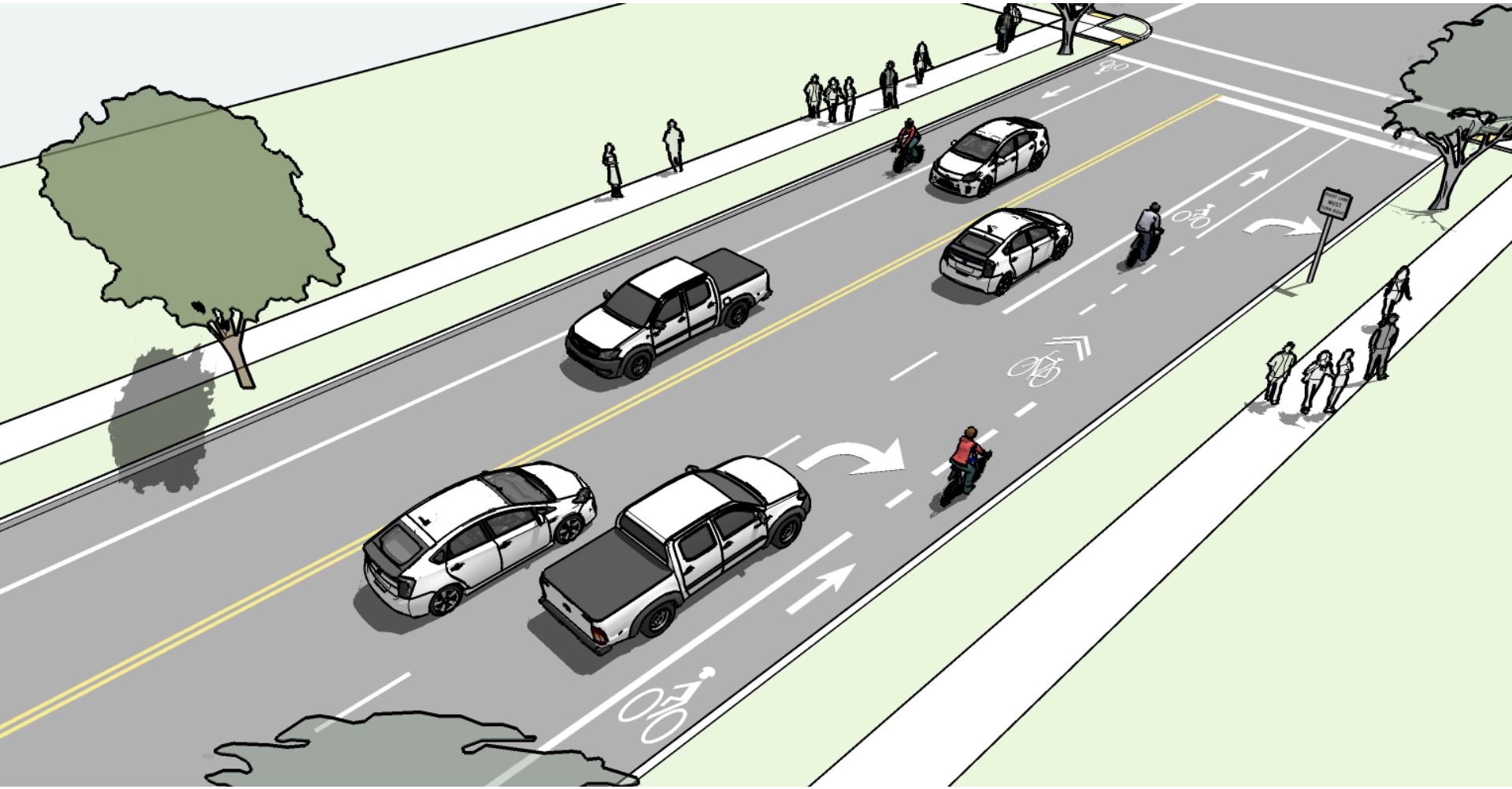
Drop Lane Transition



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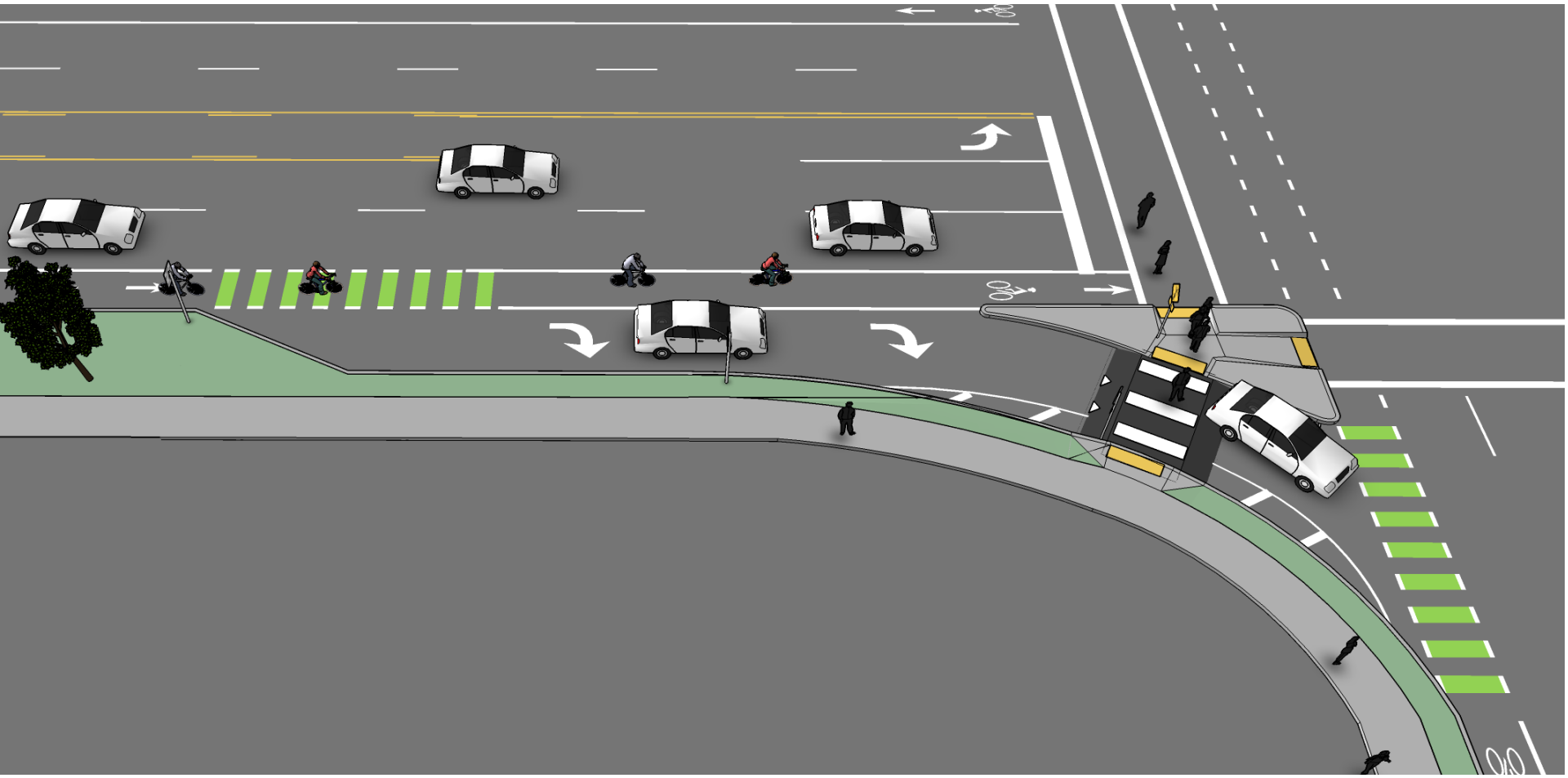
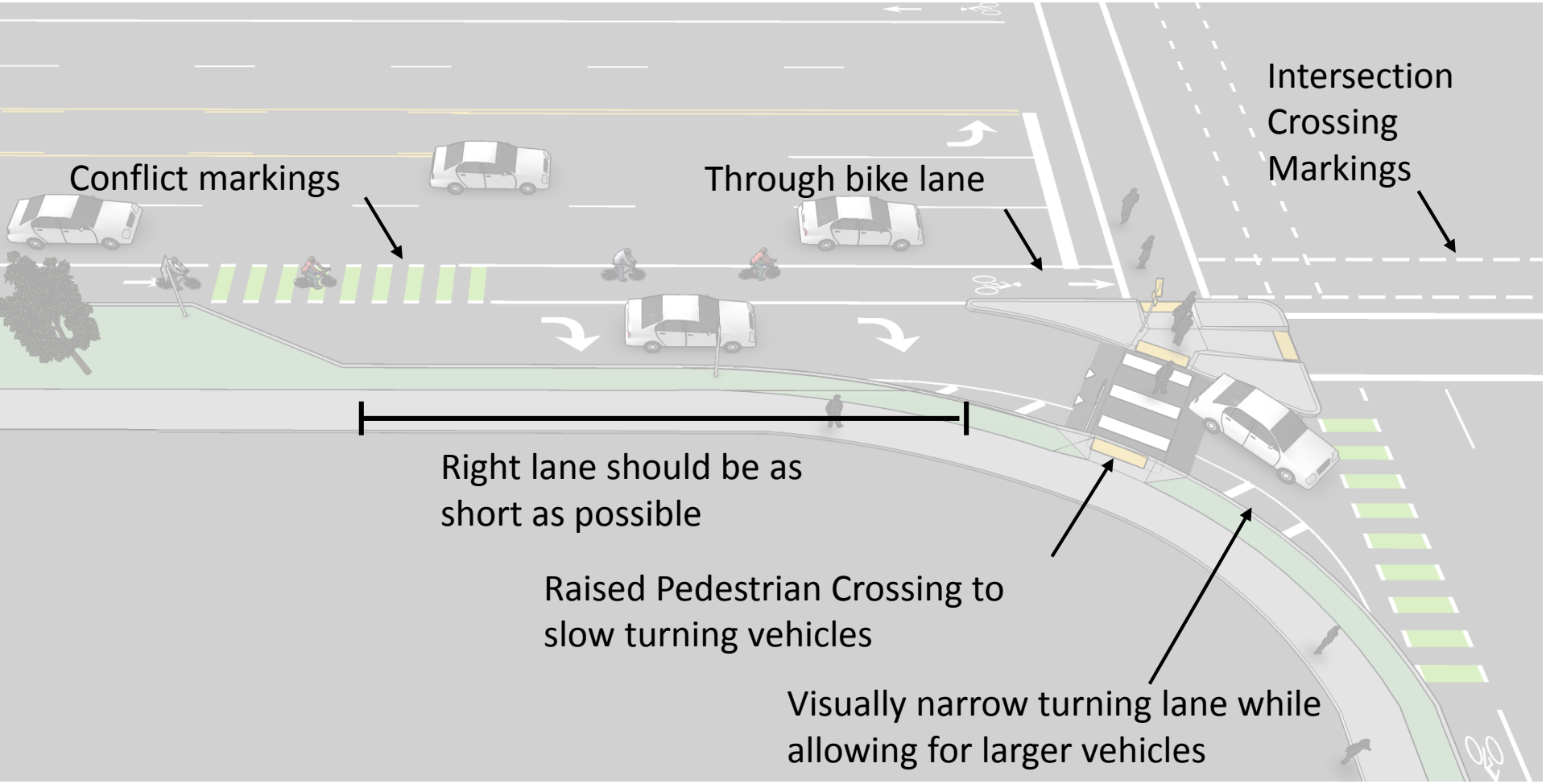
Drop Lane Transition

Channelized Turn Lane



Channelized Turn Lane

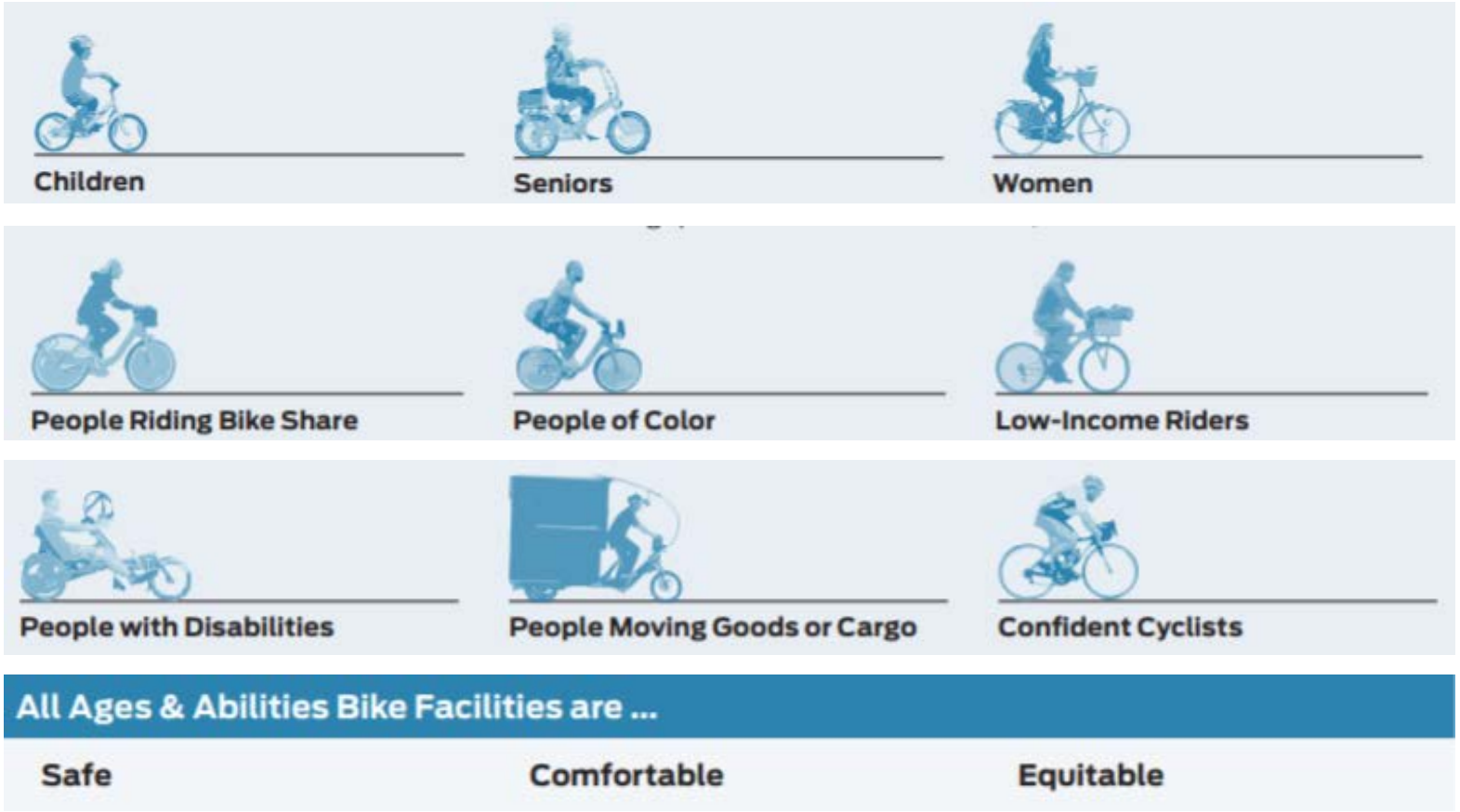


Break

Network Design Exercise

Photo: Adam Coppola

Designing an "All Ages and Abilities Network"



Source: NACTO *Designing for All Ages and Abilities*


Start
Park
Jobs
Services
School
Food
0
.25
.5
1.0
Miles

Hybrid Beacon
for Crossing Major Traffic Streets

$250/each

A hybrid beacon is a type of signal used to improve non-motorized crossings of major streets in locations where side-street volumes do not support installation of a conventional traffic signal. The use of a red signal indication improves yield compliance when compared to a rapid flash beacon.

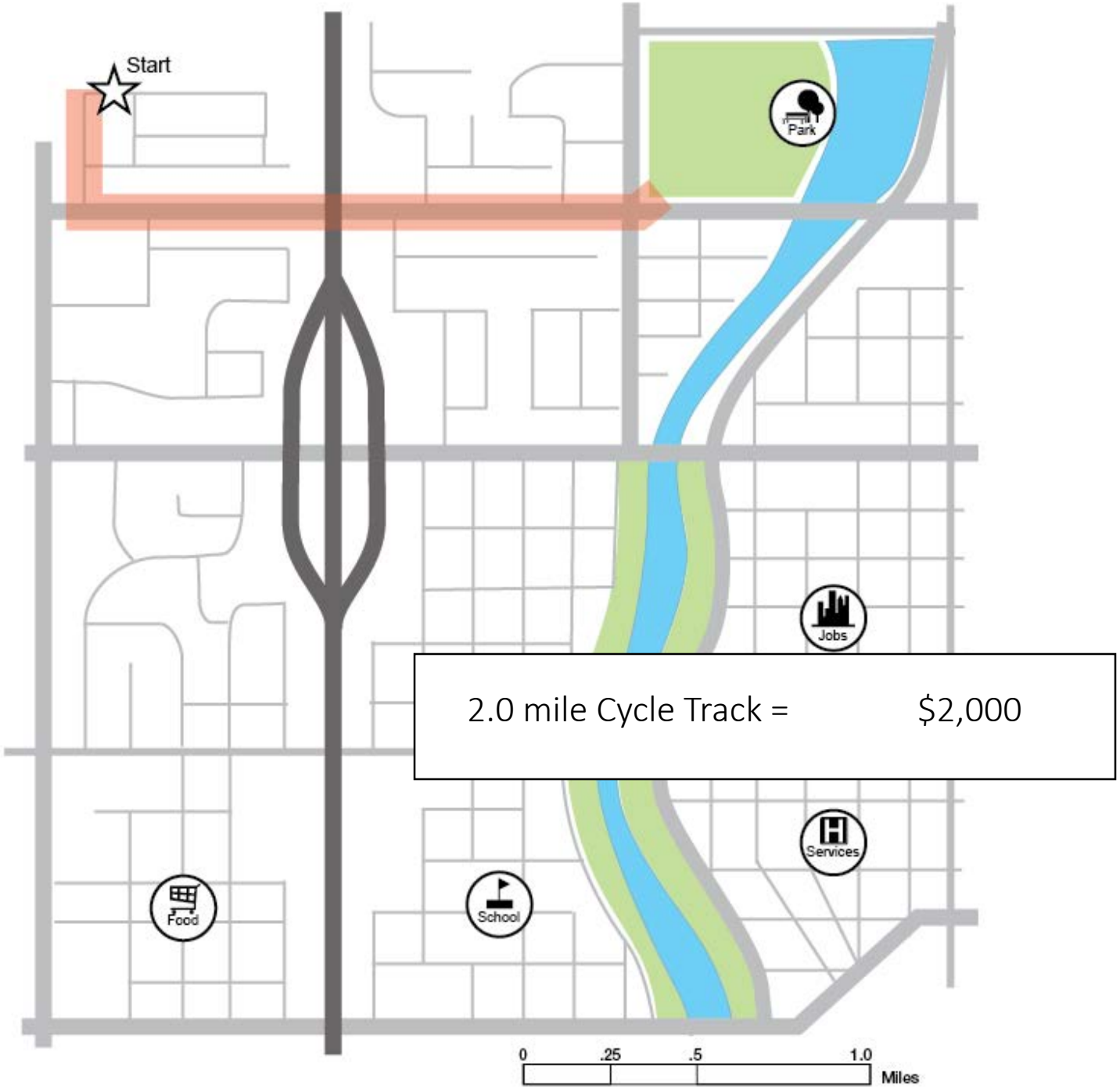
Hybrid Beacons perform like a full traffic signal indication, and is LTS 1.

Cycle Tracks
for Major Traffic Streets

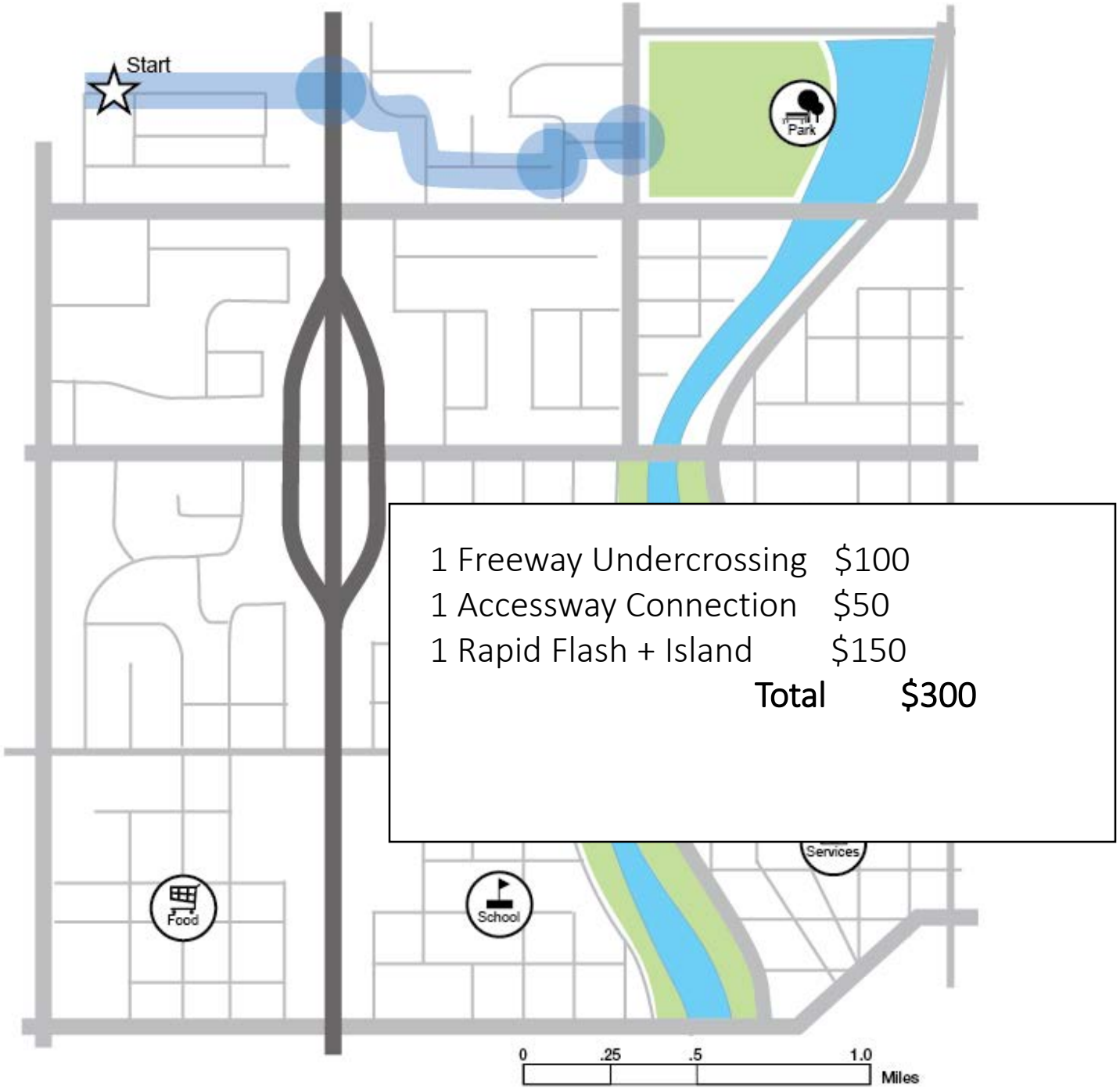
$1,000/mile

Cycle tracks are physically separated from motor traffic and distinct from the sidewalk. Cycle tracks are either raised or at street level and use a variety of elements for physical protection from passing traffic.

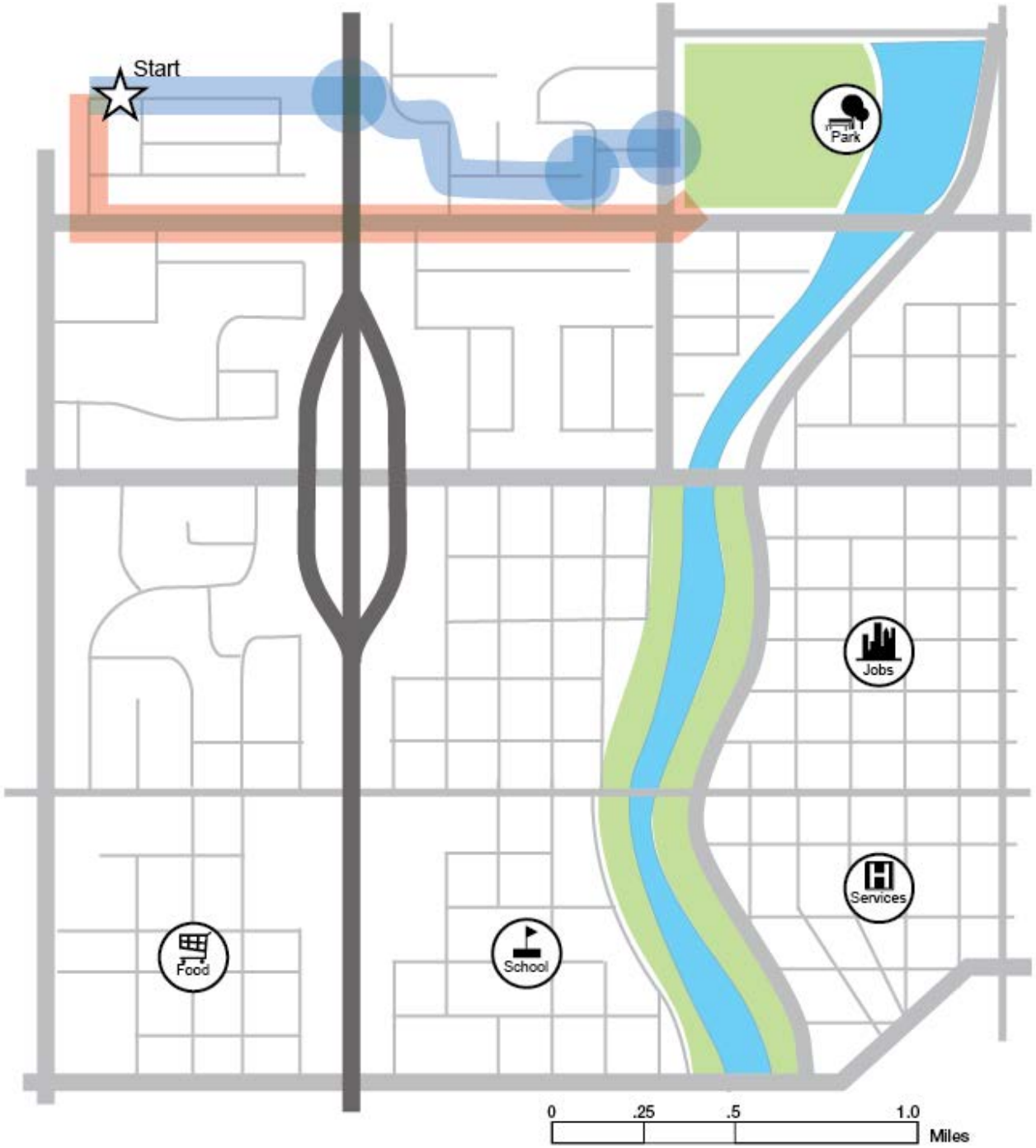
Cycle tracks are LTS 1 facilities, and should be used to create low-stress conditions on major traffic streets.



2.0 mile Cycle Track = $2,000



1 Freeway Undercrossing	$100
1 Accessway Connection	$50
1 Rapid Flash + Island	$150
Total	**$300**


Start
Park
Jobs
Services
School
Food
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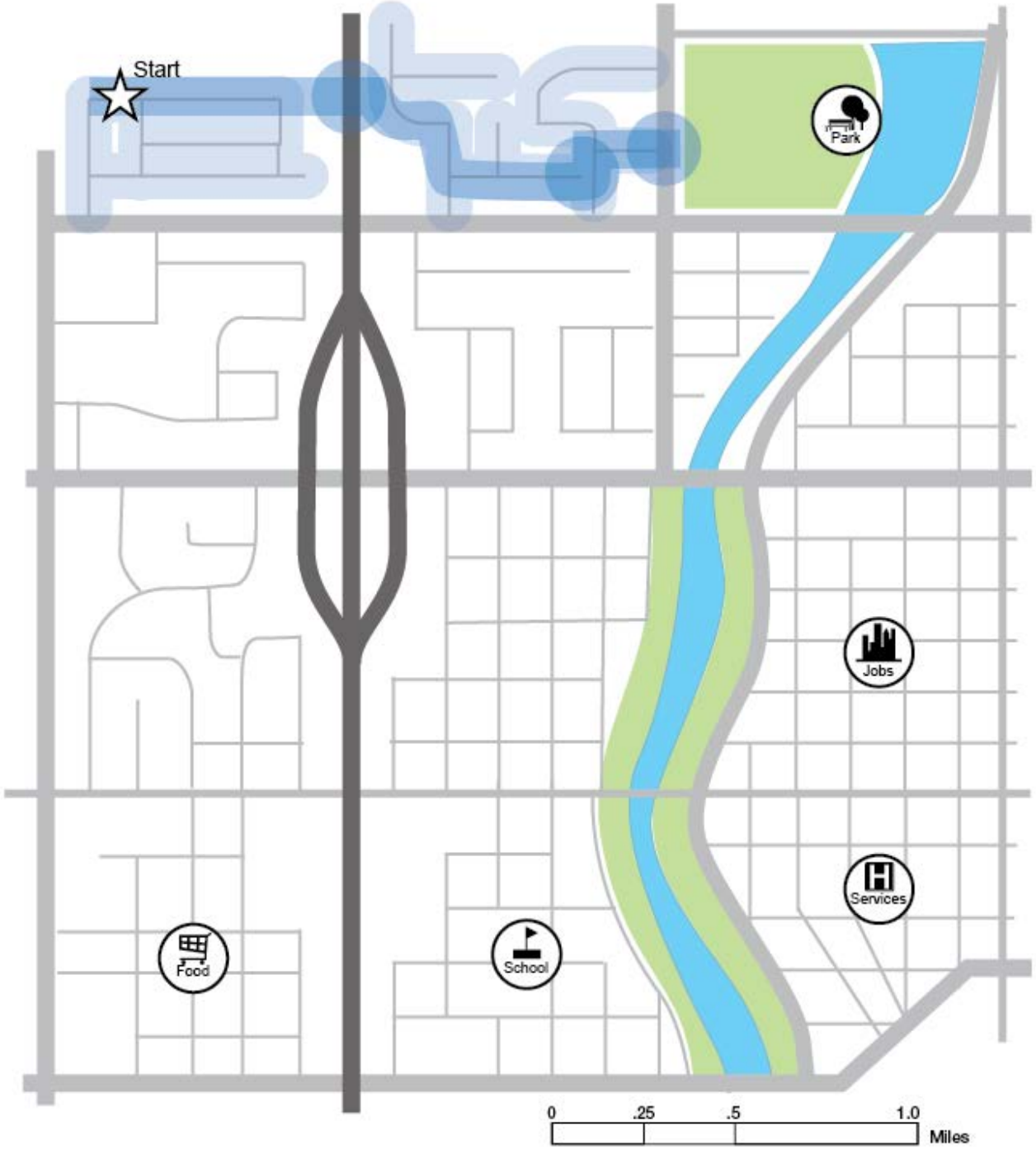
1.0
Miles


Start
Park
Jobs
Services
School
Food
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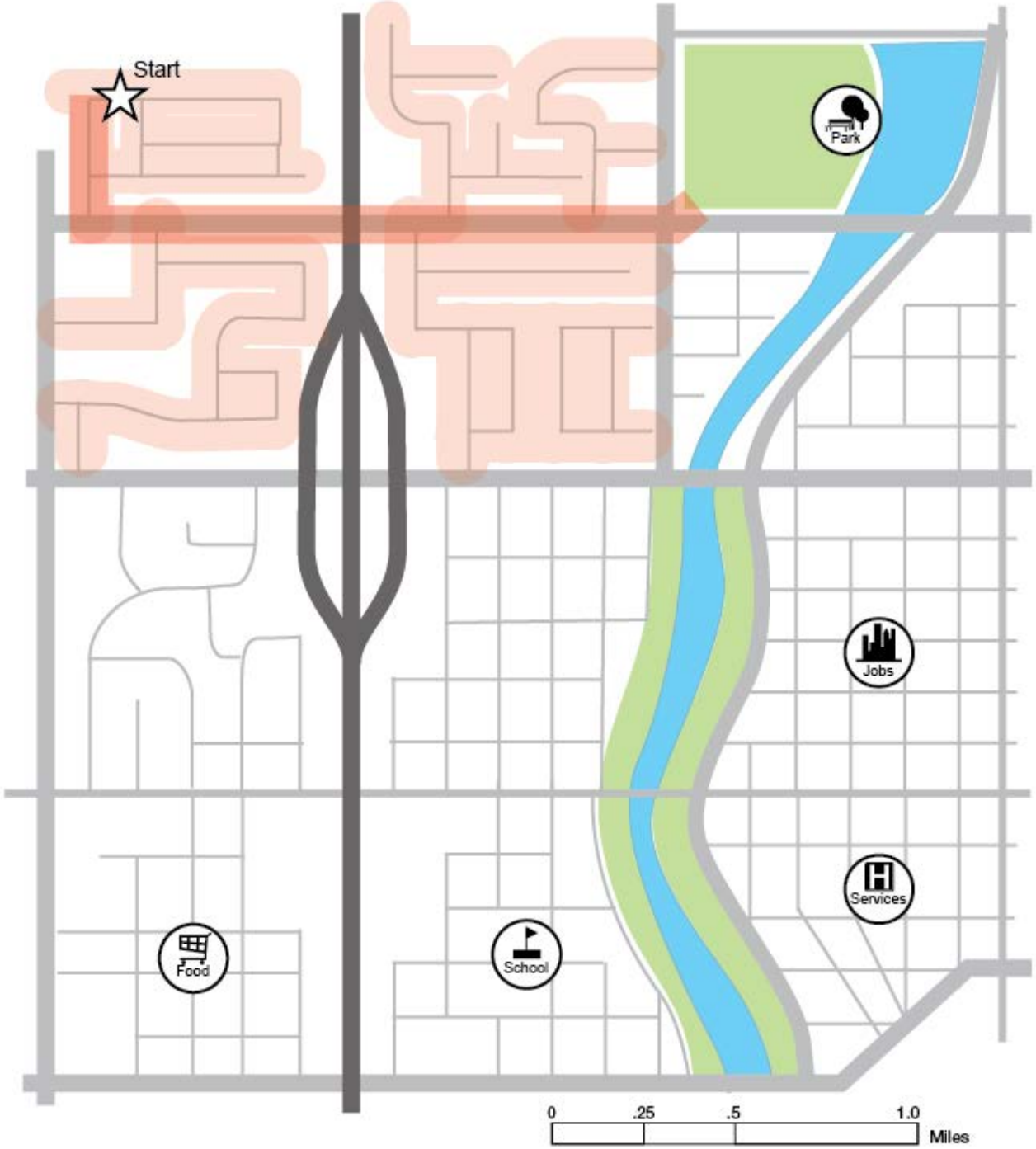
Miles


Start
Park
Jobs
Services
School
Food
0
.25
.5
1.0
Miles

Break

Intersection Design Exercise

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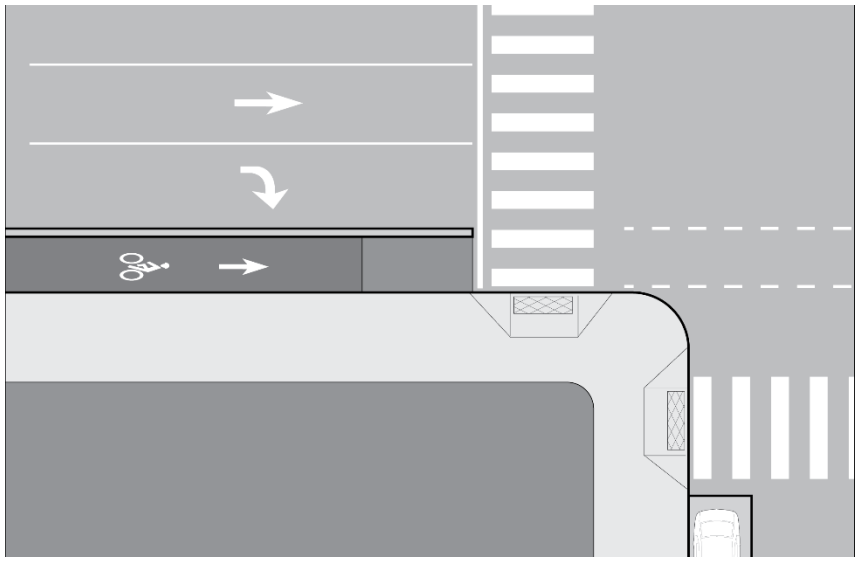
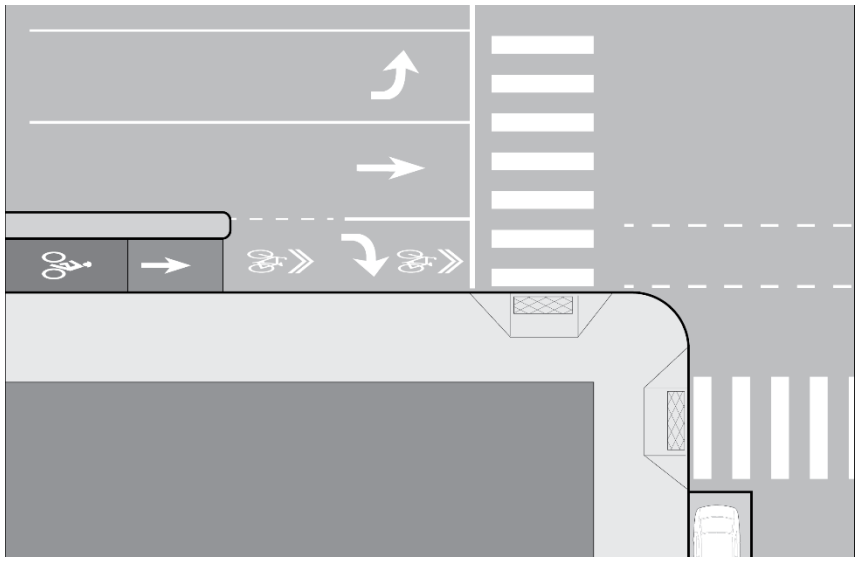
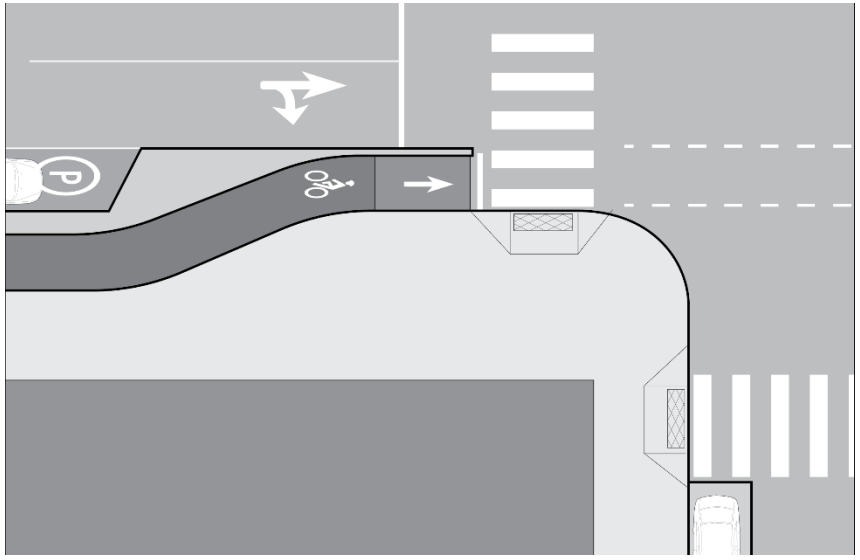


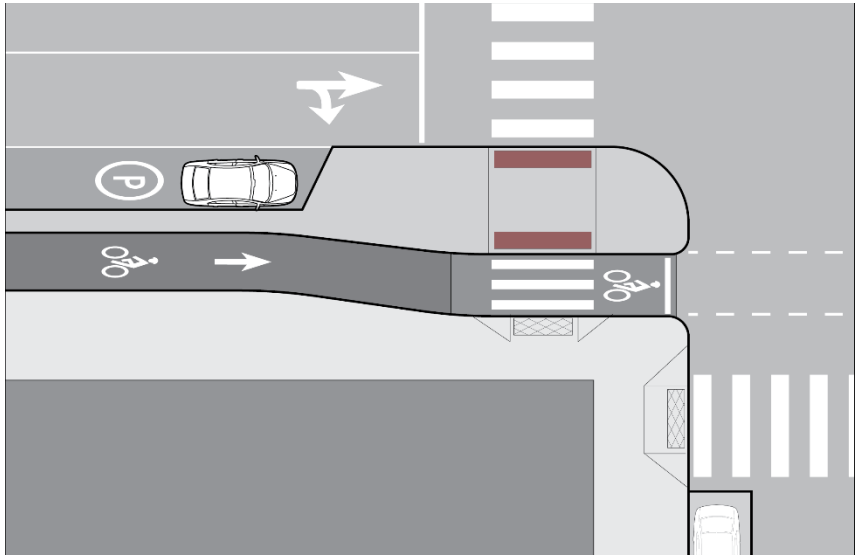
Protected Signal Phase



Mixing Zone

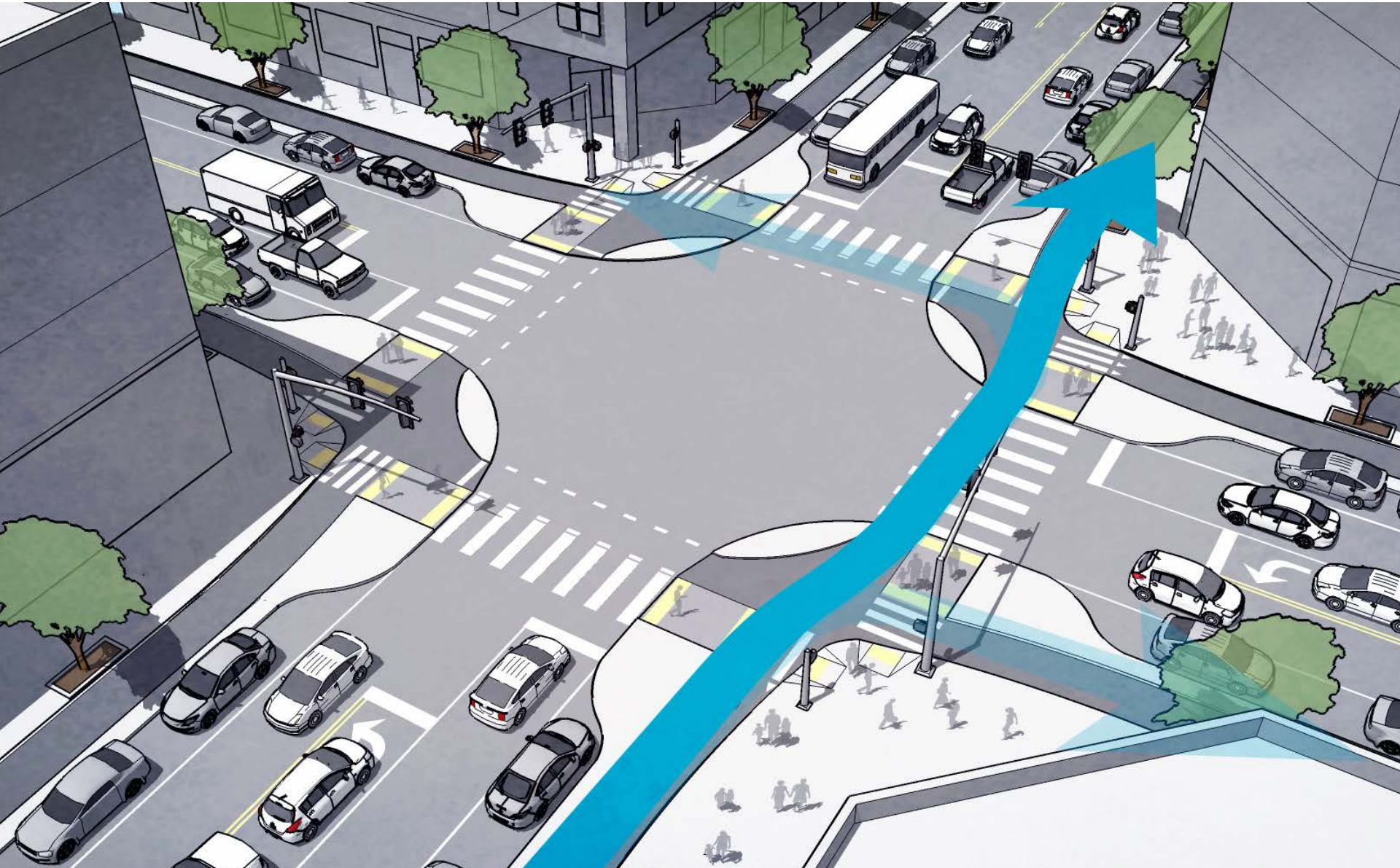


Adjacent Crossing



Separated Crossing

Dutch Design in an American Context



Requested by
ASSEMBLY CONCURRENT RESOLUTION NO. 26
1971 REGULAR SESSION

STATE OF CALIFORNIA
BUSINESS AND TRANSPORTATION AGENCY
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

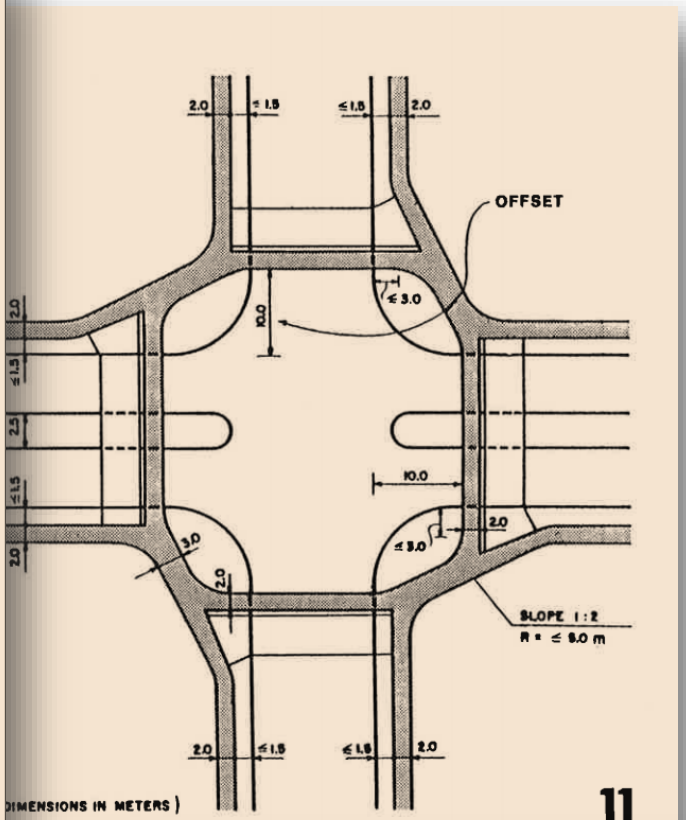
BIKEWAY PLANNING CRITERIA AND GUIDELINES

April 1972

Prepared by
INSTITUTE OF TRANSPORTATION
AND
TRAFFIC ENGINEERING

SCHOOL OF ENGINEERING AND APPLIED SCIENCE
UNIVERSITY OF CALIFORNIA, LOS ANGELES
UCLA-ENG-7224

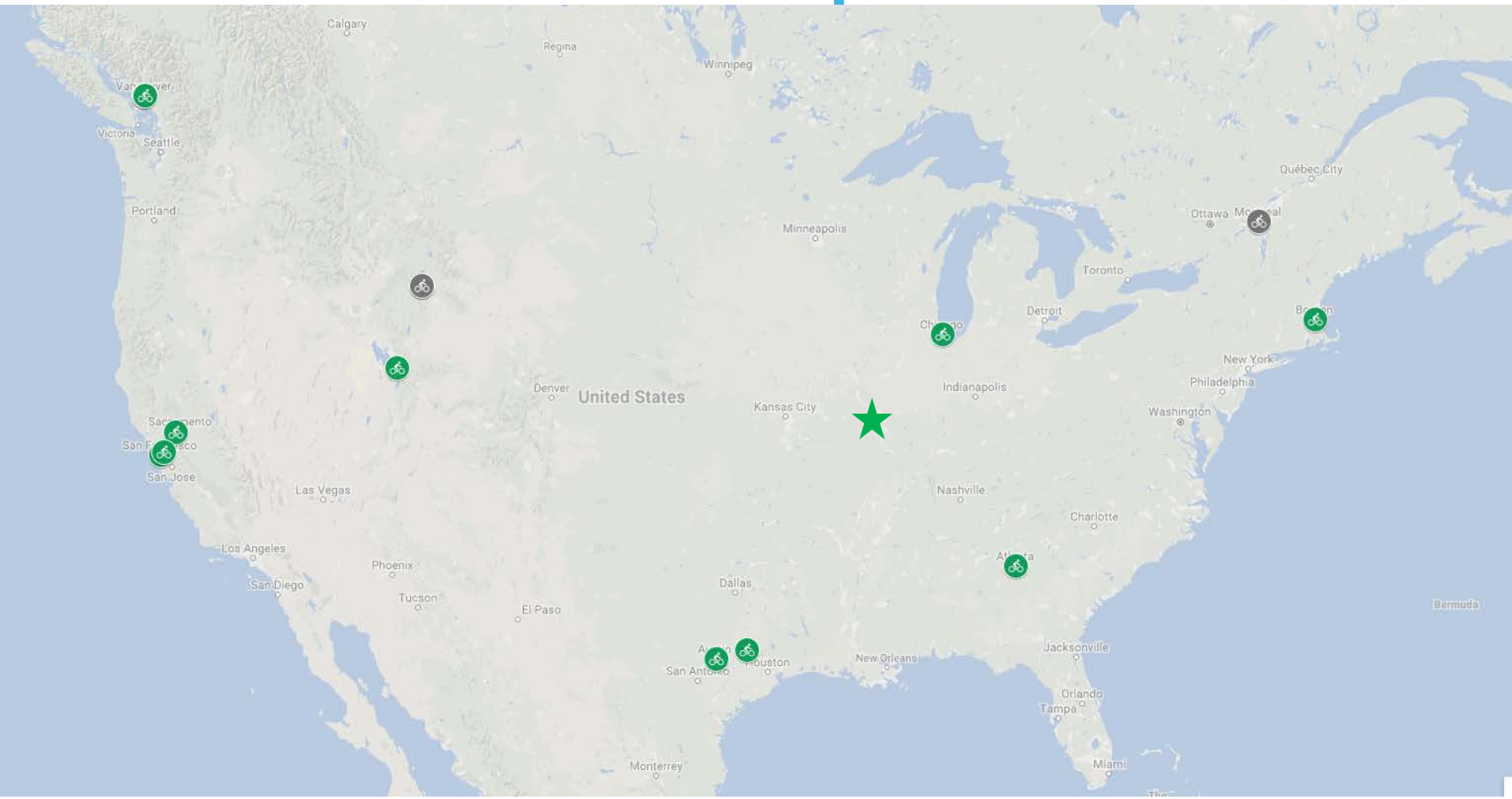
Reprinted November 1972 by the Federal Highway Administration, U. S. Department of Transportation, Washington, D. C.



BIKEWAY PLANNING CRITERIA AND GUIDELINES

April 1972

North American Adoption



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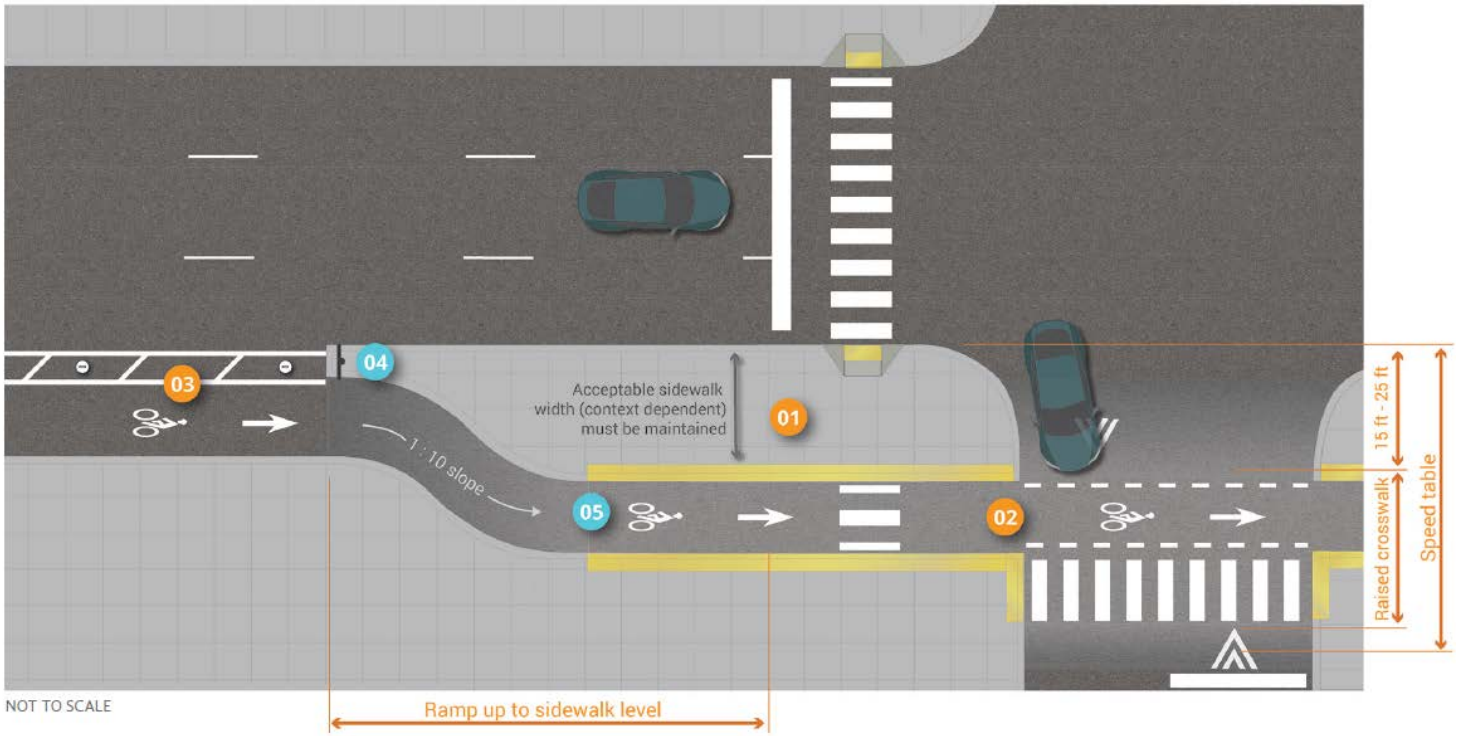
Protected Intersection: Guidance Basis

- Can be built using the **FHWA Separated Bike Lane Planning & Design Guide 2015**.



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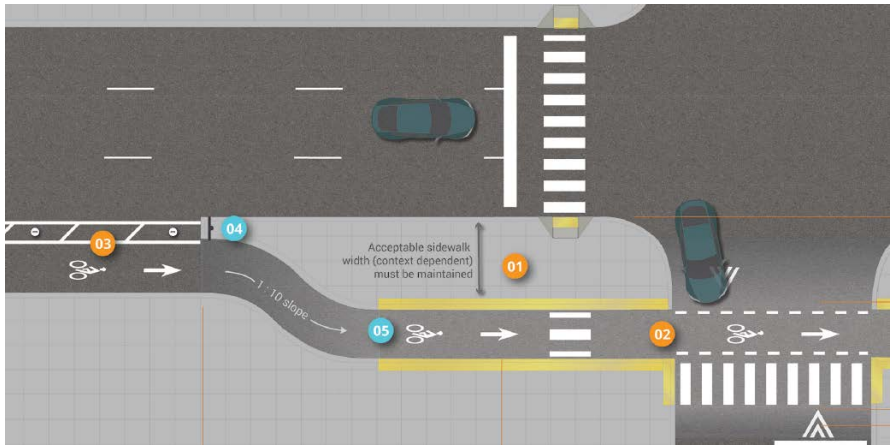
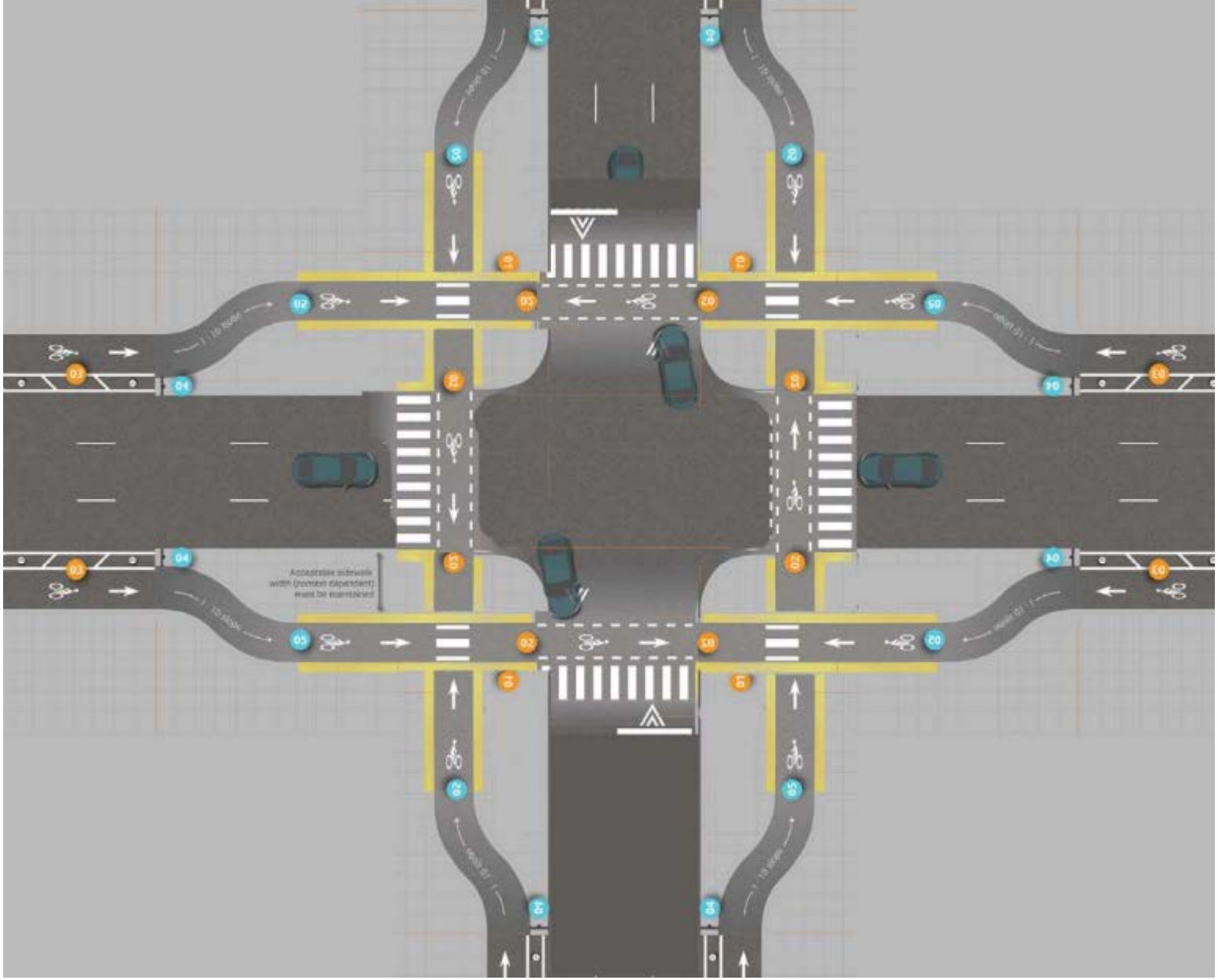
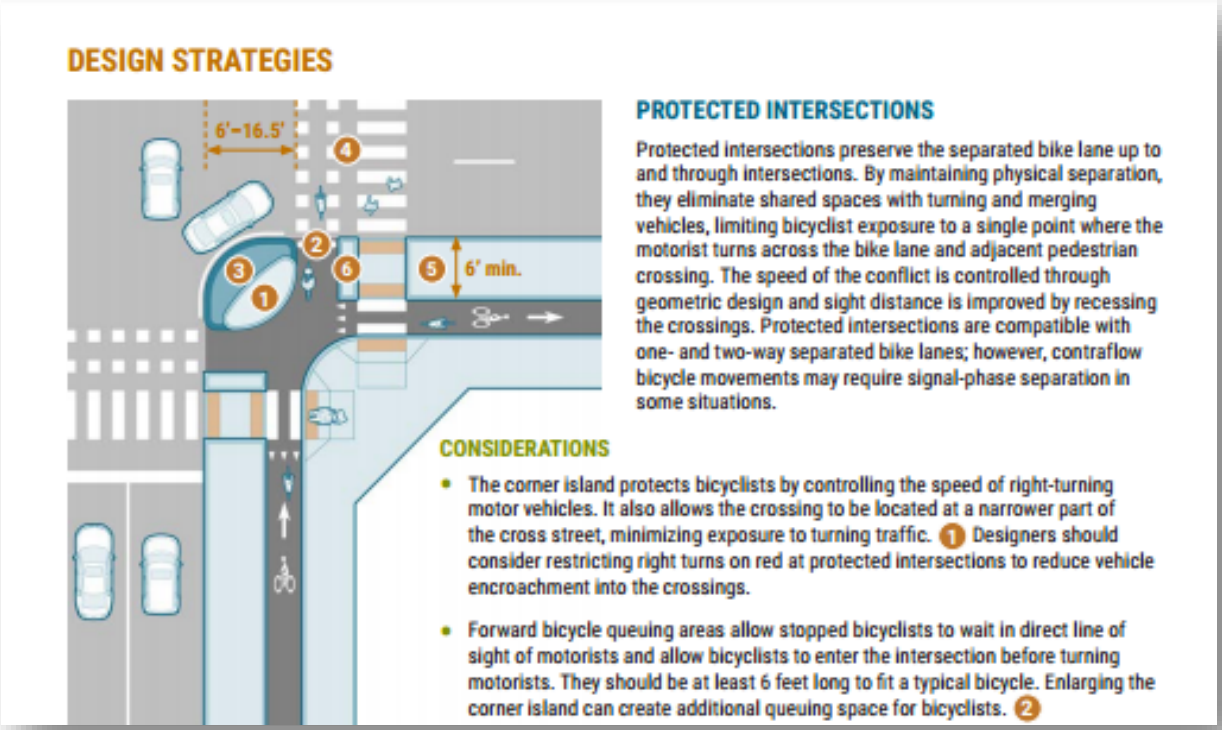

03
04
Acceptable sidewalk
width (context dependent)
must be maintained
01
1 : 10 slope
05
02


Acceptable sidewalk width (context dependent) must be maintained

Protected Intersection: Guidance Basis

- Formally supported by **FHWA Achieving Multimodal Networks 2016**.



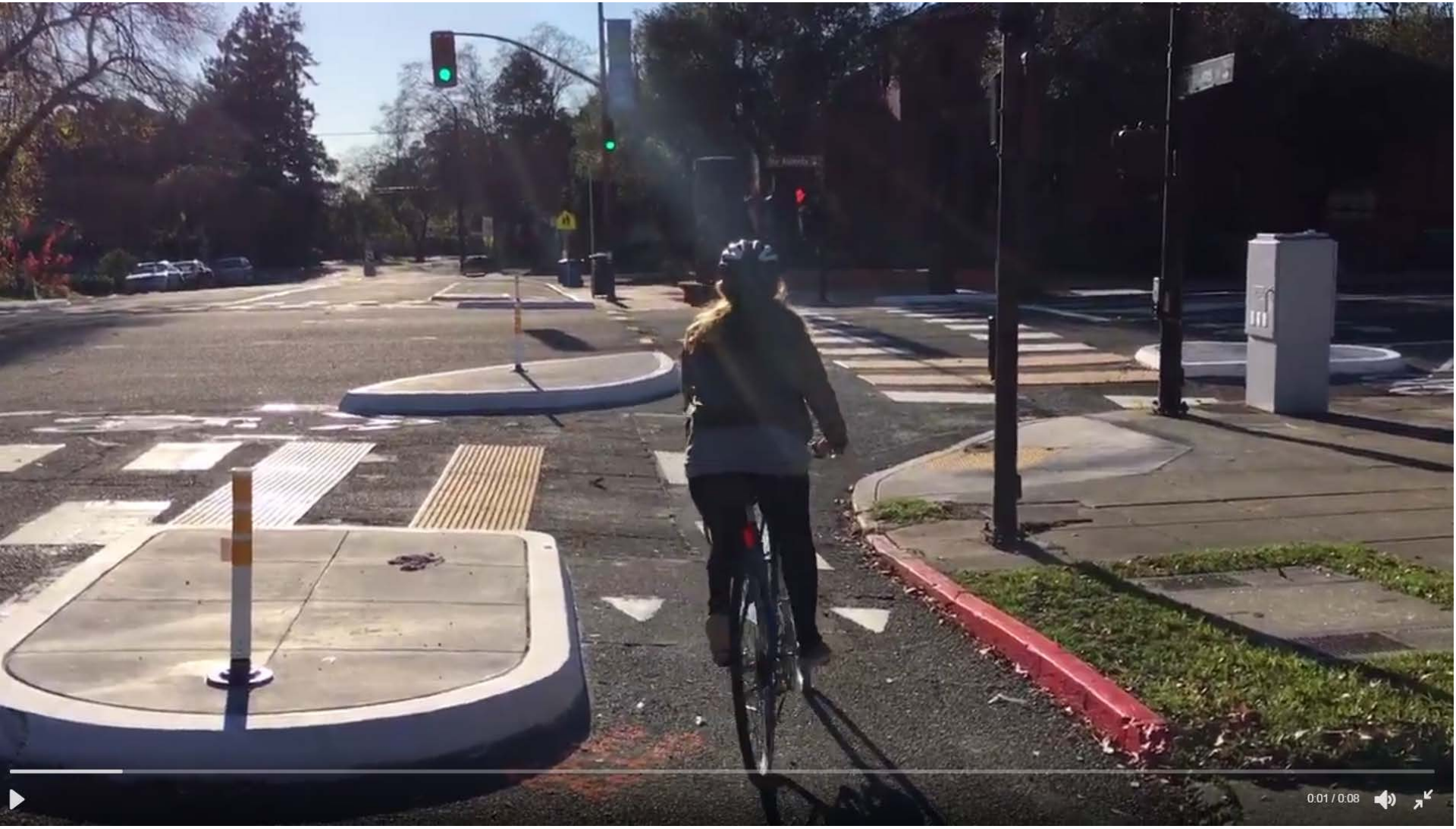
DESIGN STRATEGIES

PROTECTED INTERSECTIONS

Protected intersections preserve the separated bike lane up to and through intersections. By maintaining physical separation, they eliminate shared spaces with turning and merging vehicles, limiting bicyclist exposure to a single point where the motorist turns across the bike lane and adjacent pedestrian crossing. The speed of the conflict is controlled through geometric design and sight distance is improved by recessing the crossings. Protected intersections are compatible with one- and two-way separated bike lanes; however, contraflow bicycle movements may require signal-phase separation in some situations.

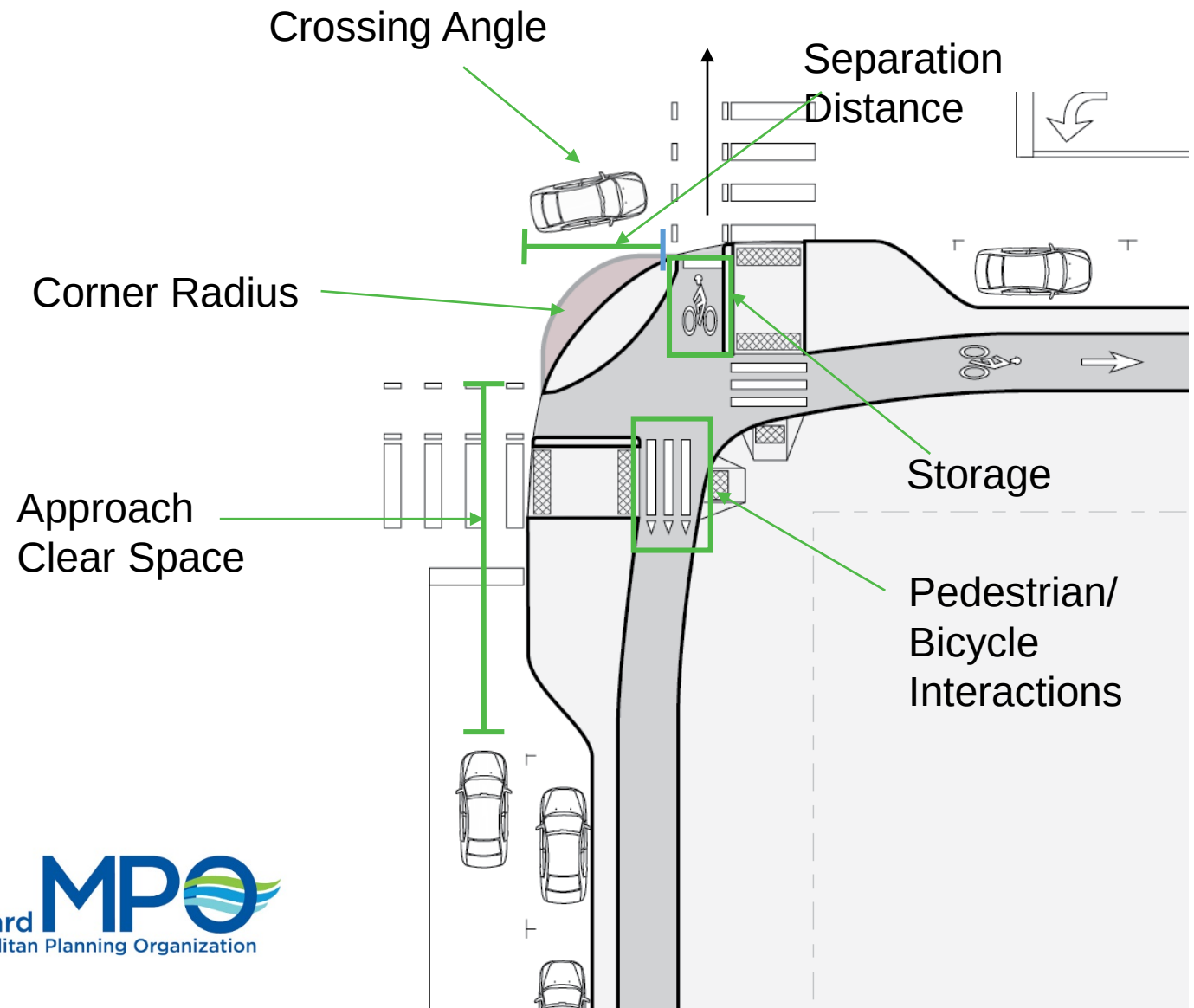
CONSIDERATIONS

- The corner island protects bicyclists by controlling the speed of right-turning motor vehicles. It also allows the crossing to be located at a narrower part of the cross street, minimizing exposure to turning traffic. (1) Designers should consider restricting right turns on red at protected intersections to reduce vehicle encroachment into the crossings.
- Forward bicycle queuing areas allow stopped bicyclists to wait in direct line of sight of motorists and allow bicyclists to enter the intersection before turning motorists. They should be at least 6 feet long to fit a typical bicycle. Enlarging the corner island can create additional queuing space for bicyclists. (2)



Berkeley, CA

Parts of a Protected Intersection



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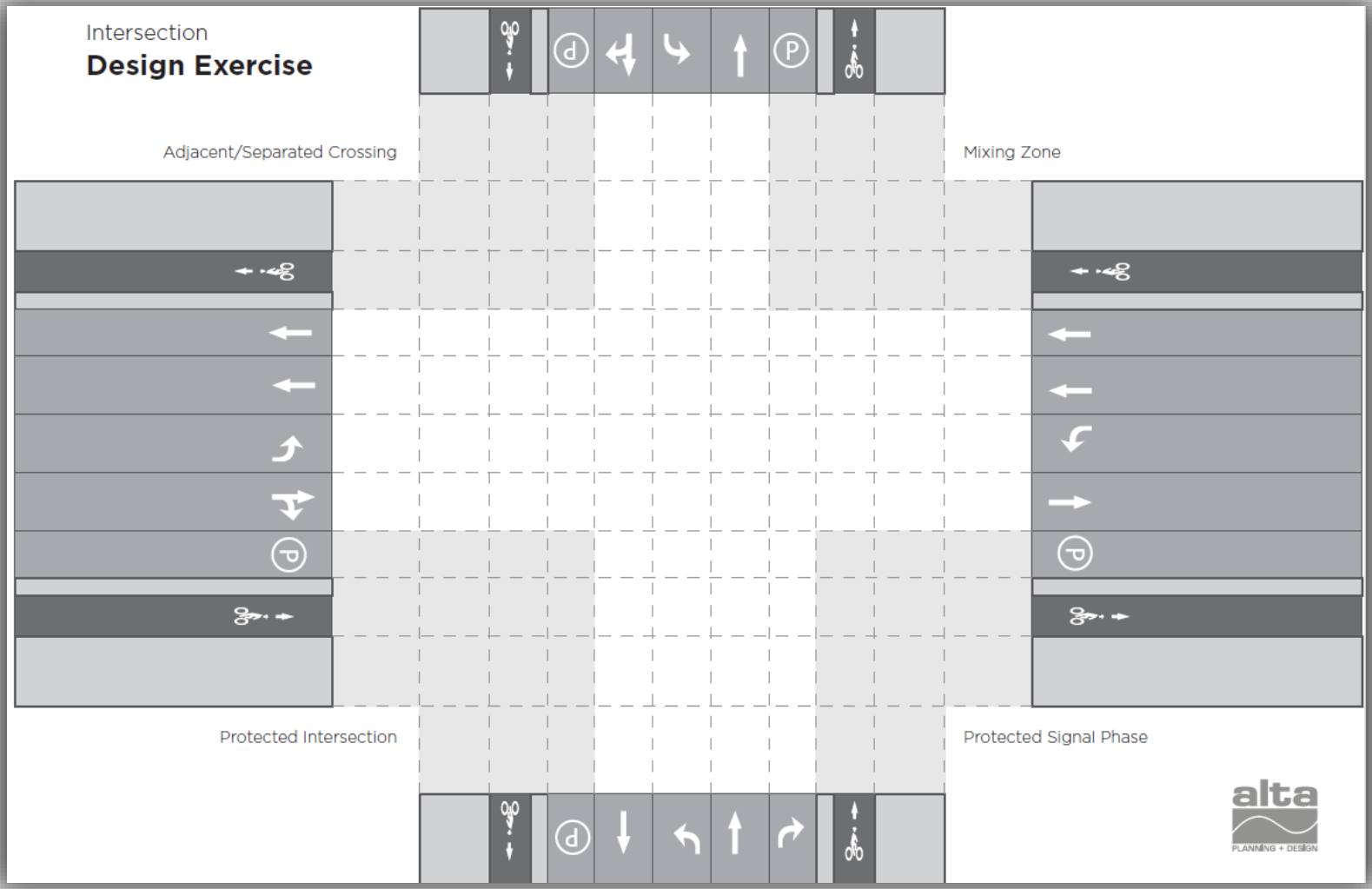
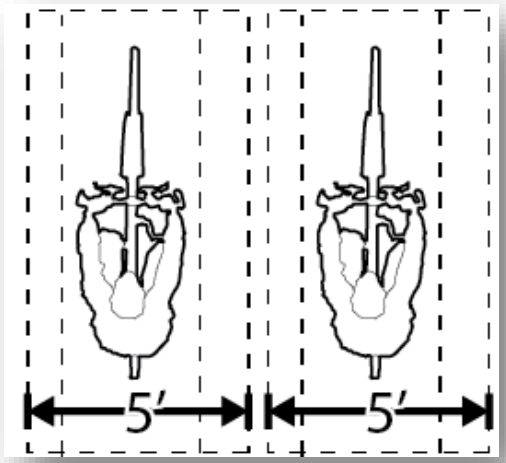
Intersection

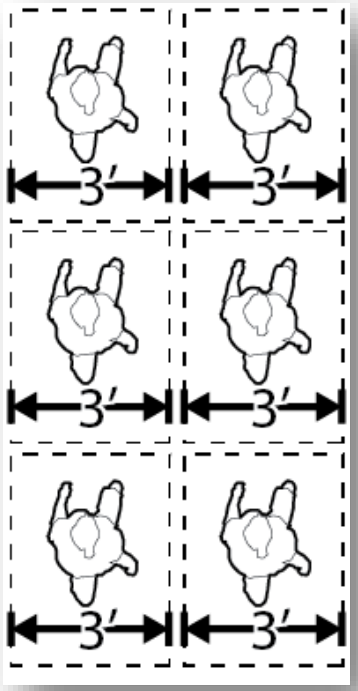
Design Exercise



Bicyclists



Pedestrians



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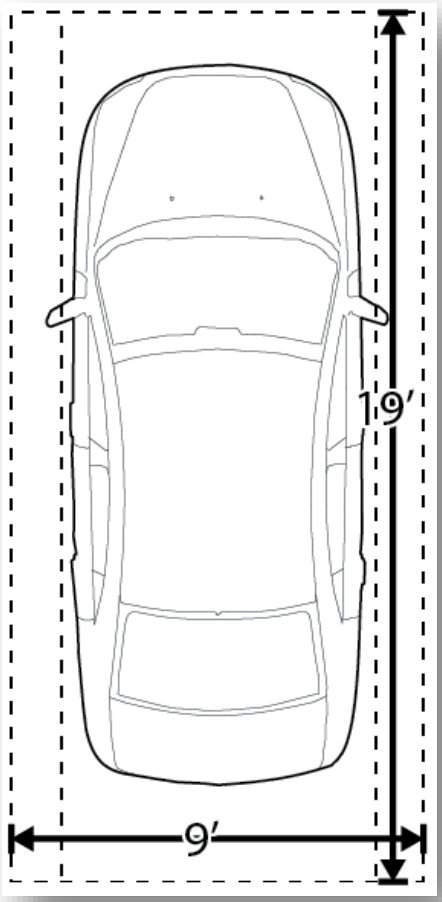
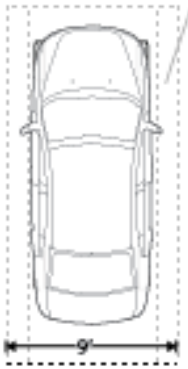


PASSENGER CAR

AASHTO turning template



BUS

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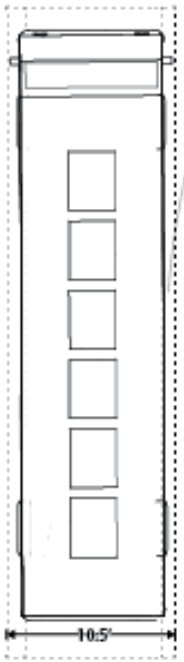

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PARKING
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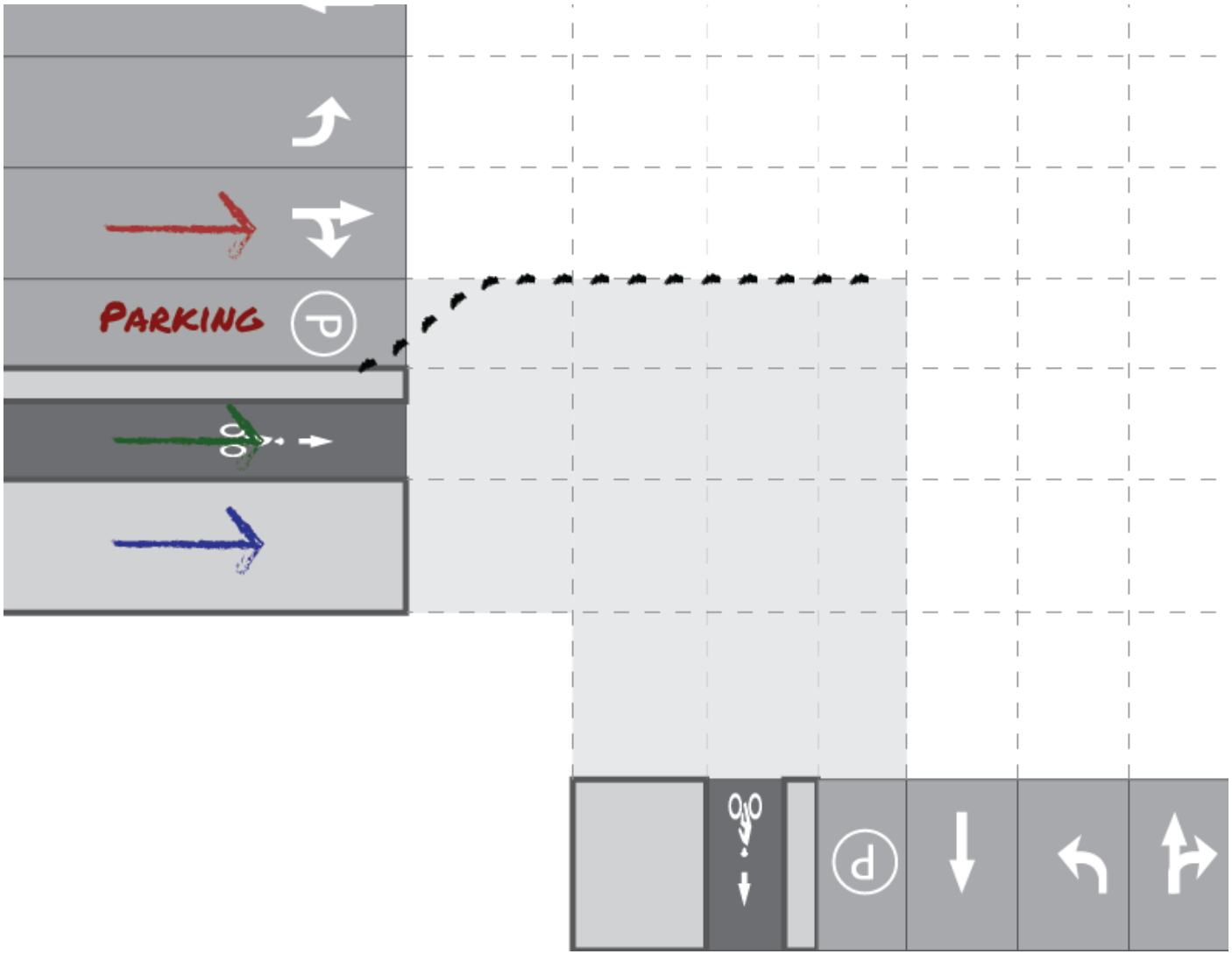
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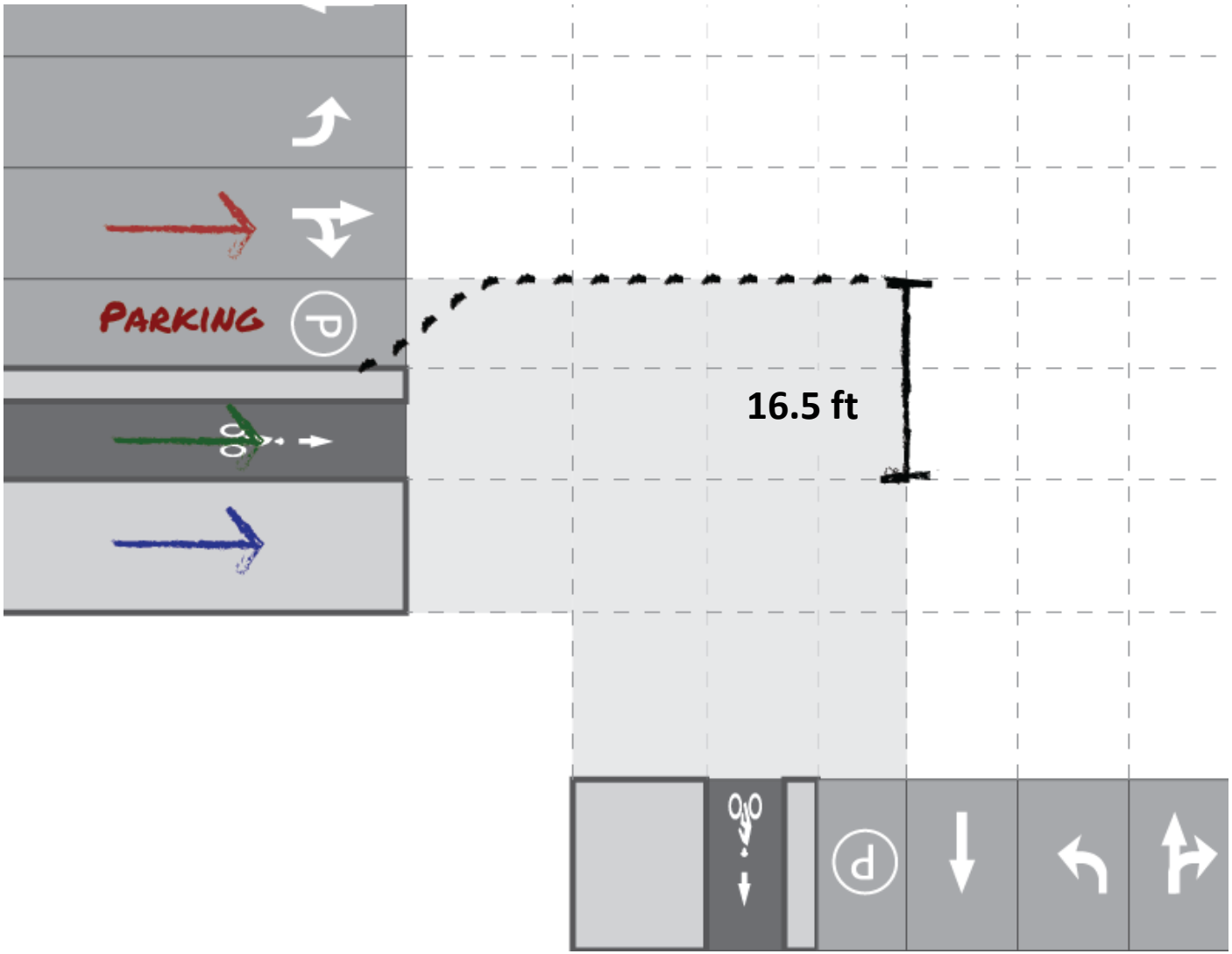
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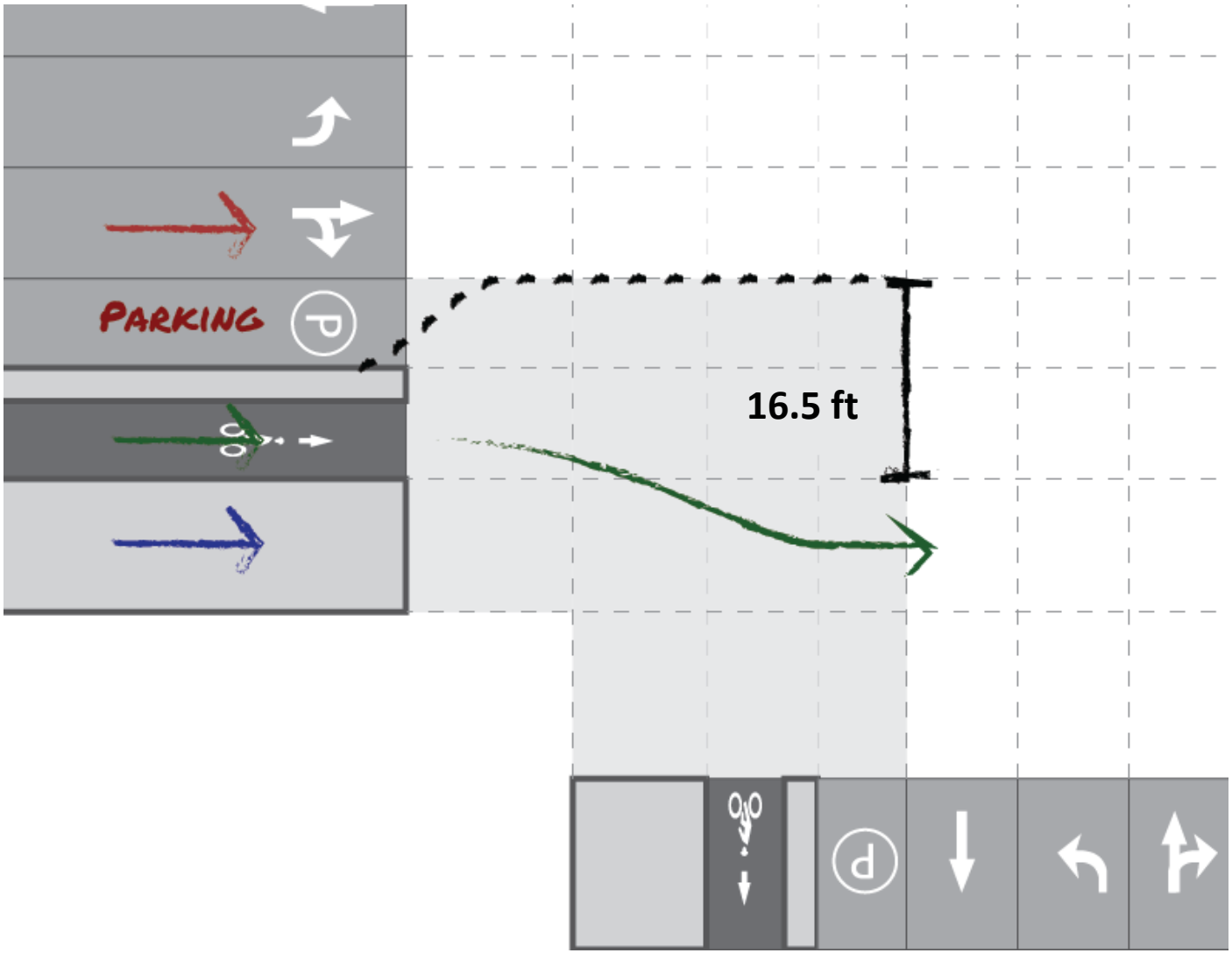
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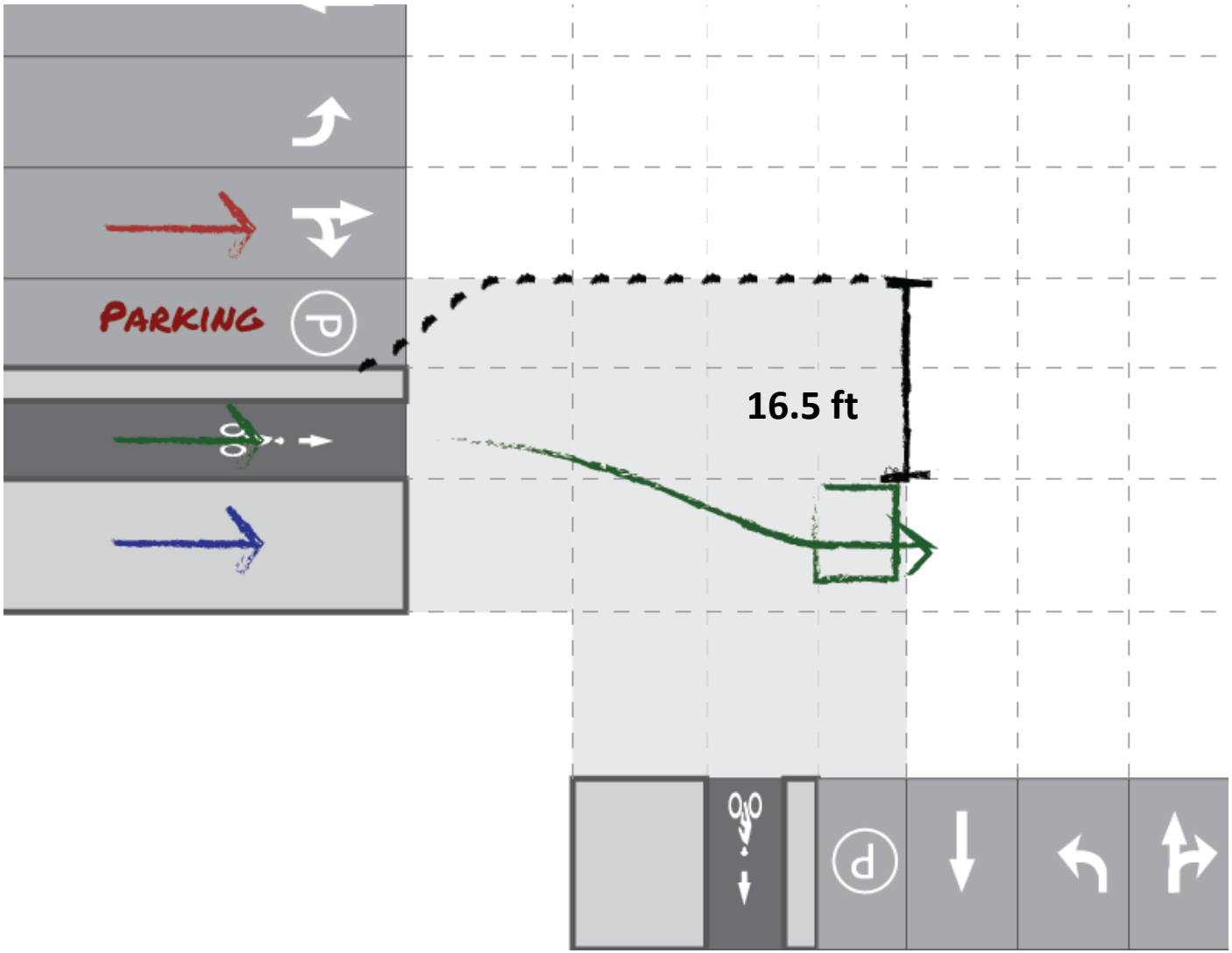
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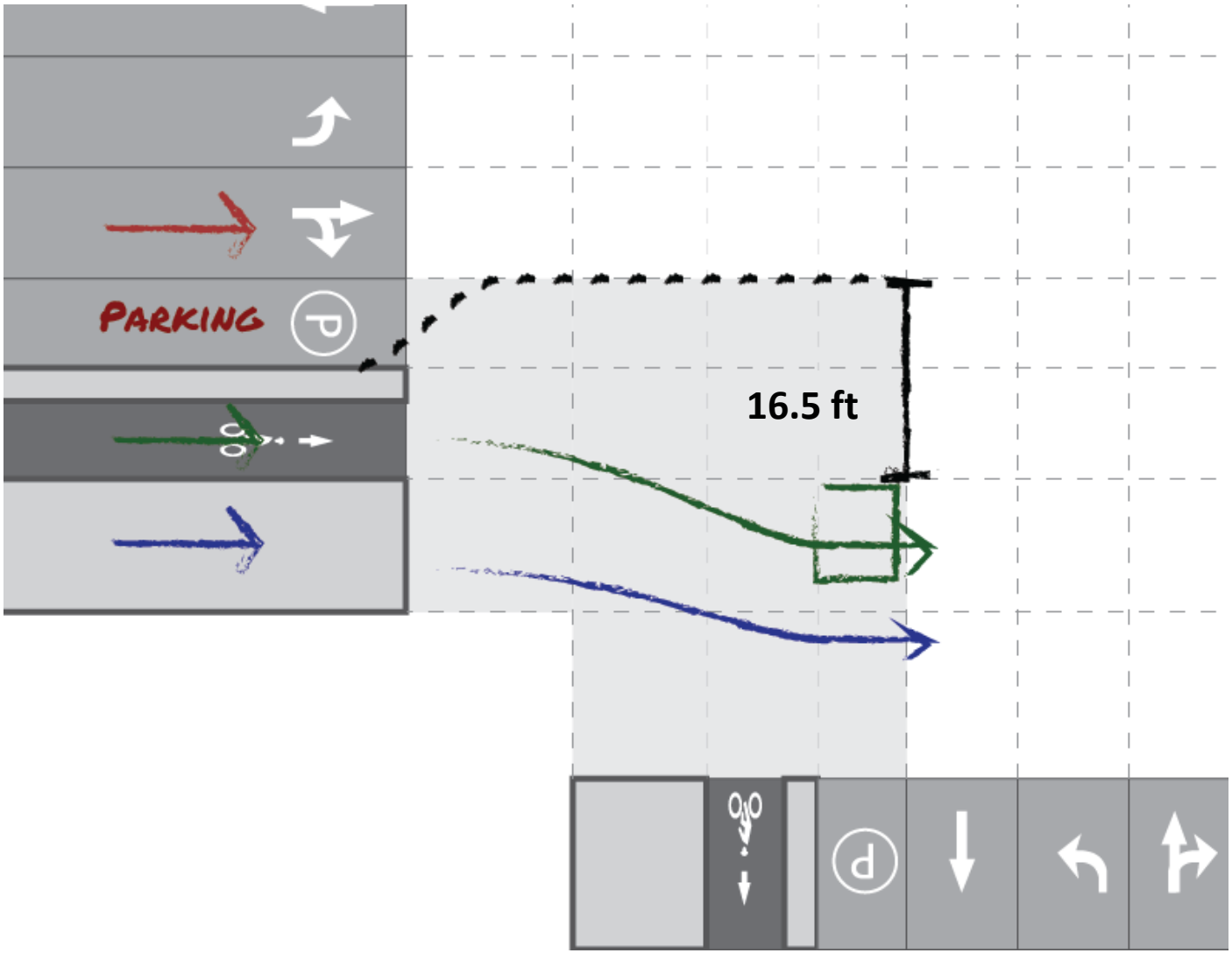
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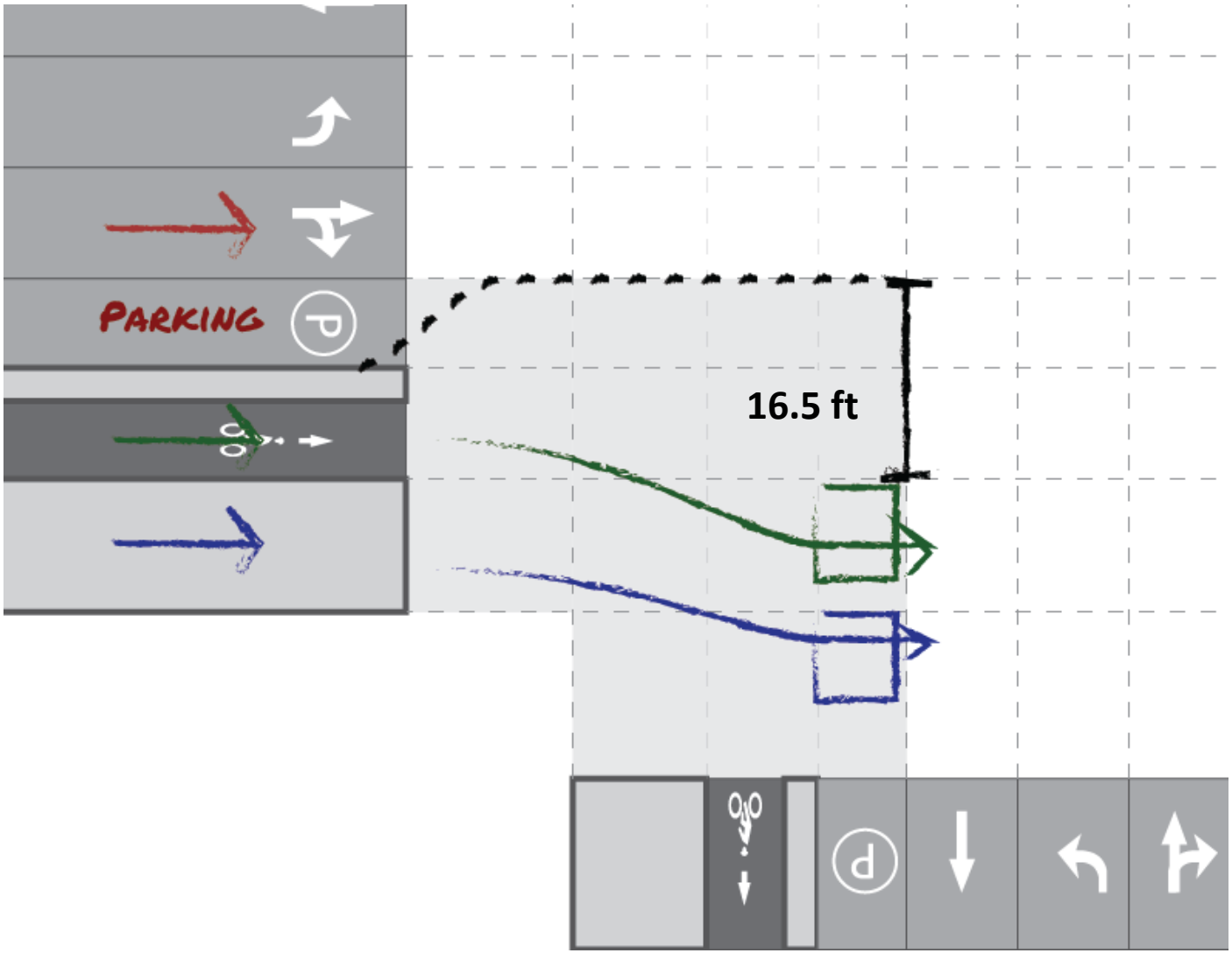
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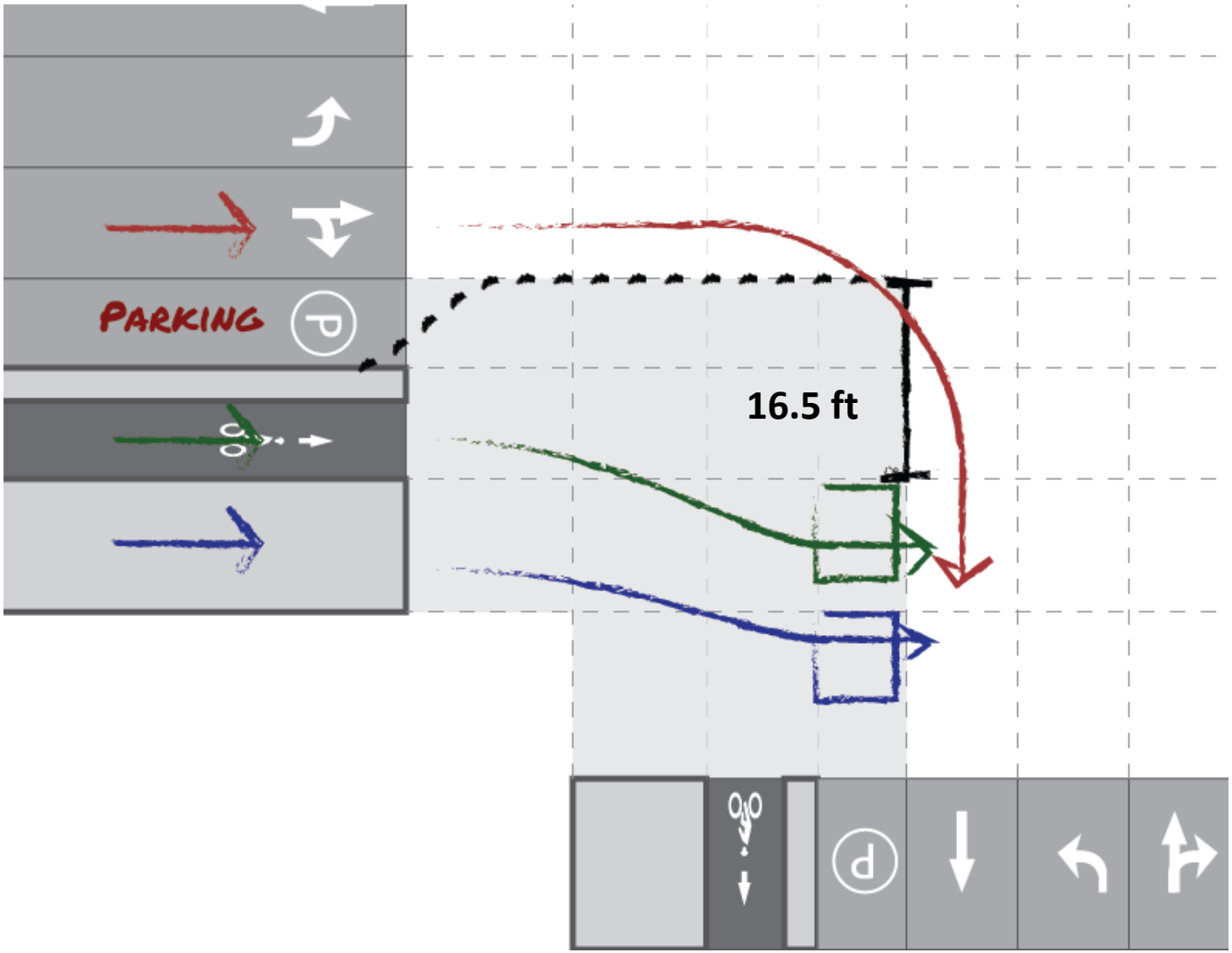
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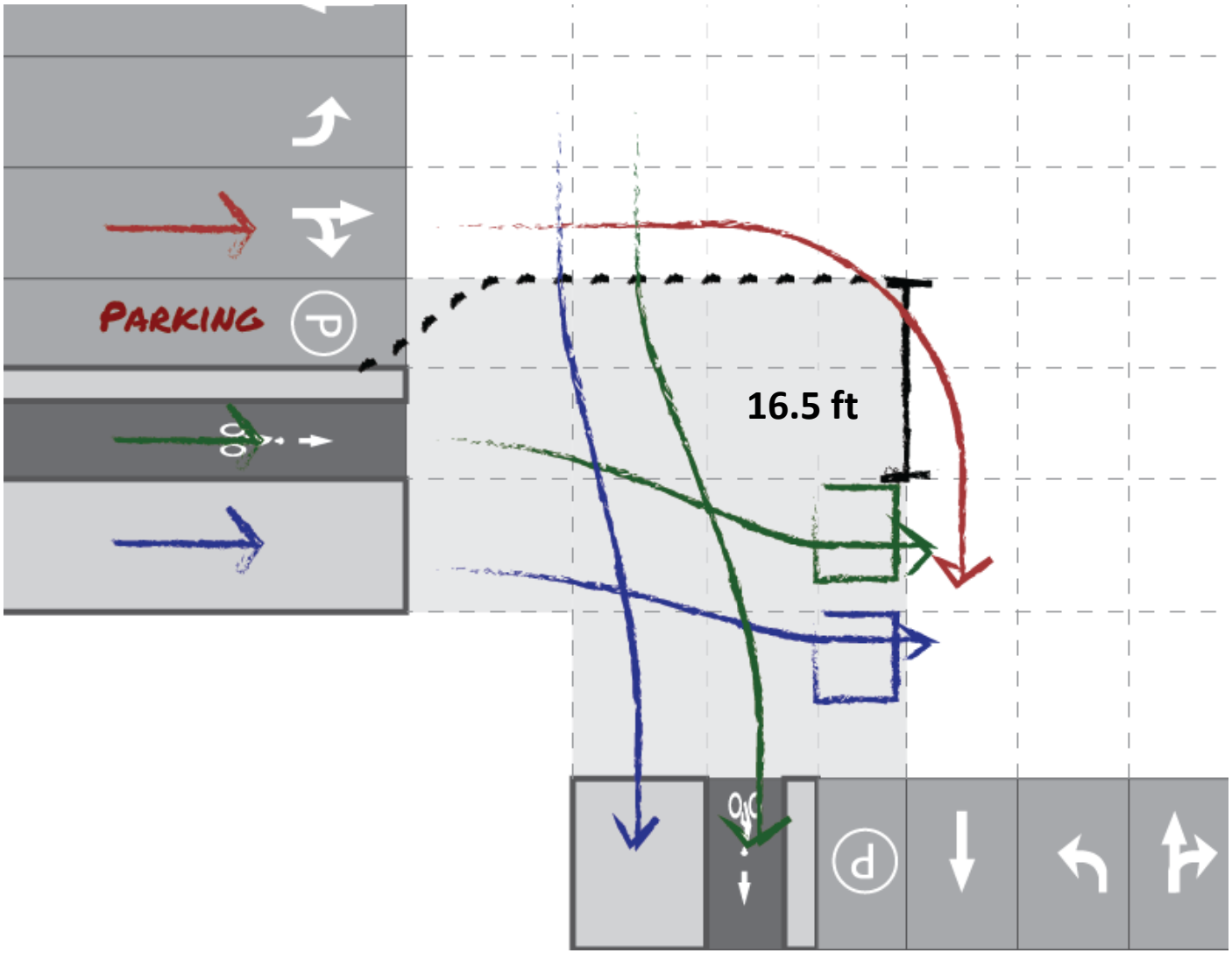
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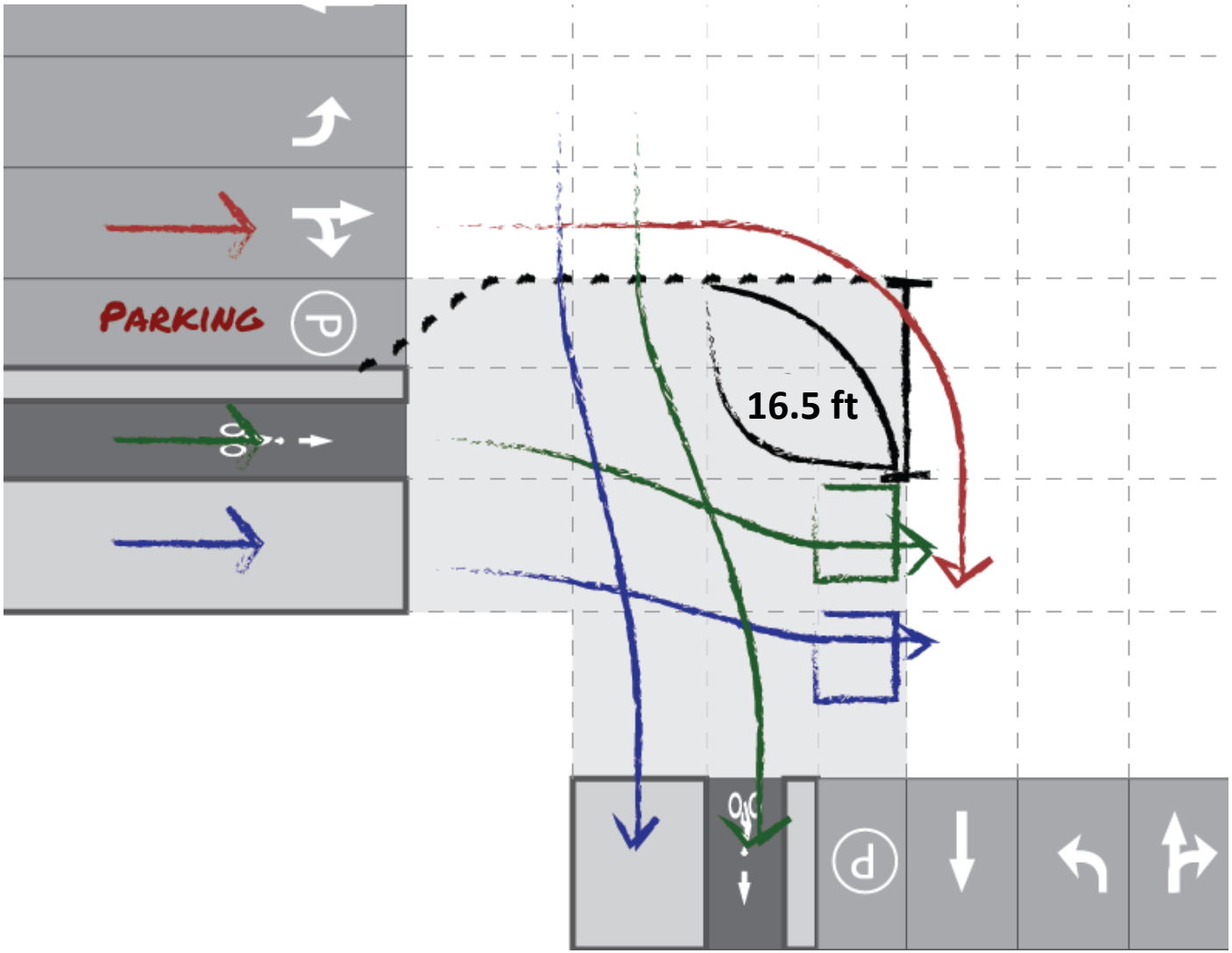
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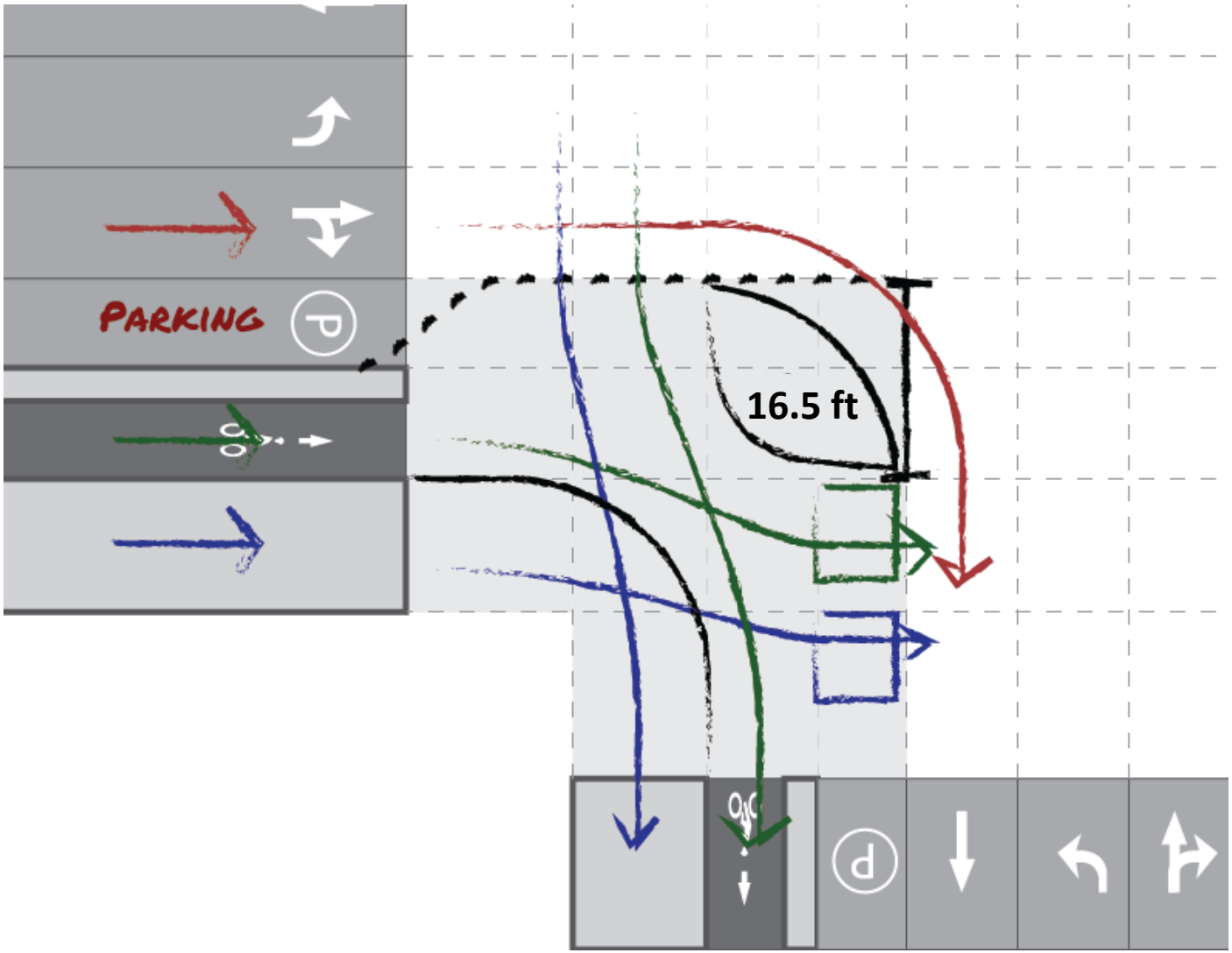
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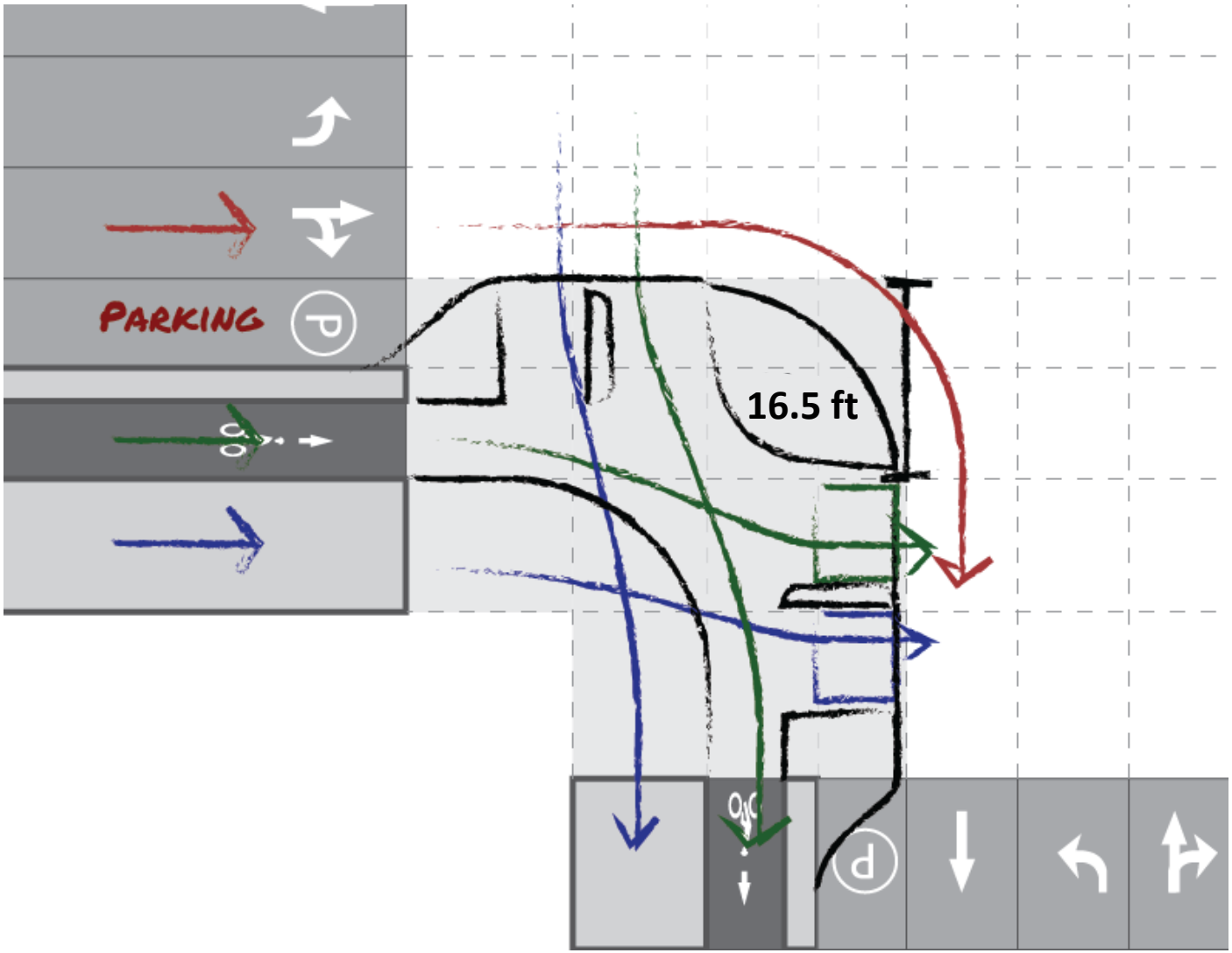
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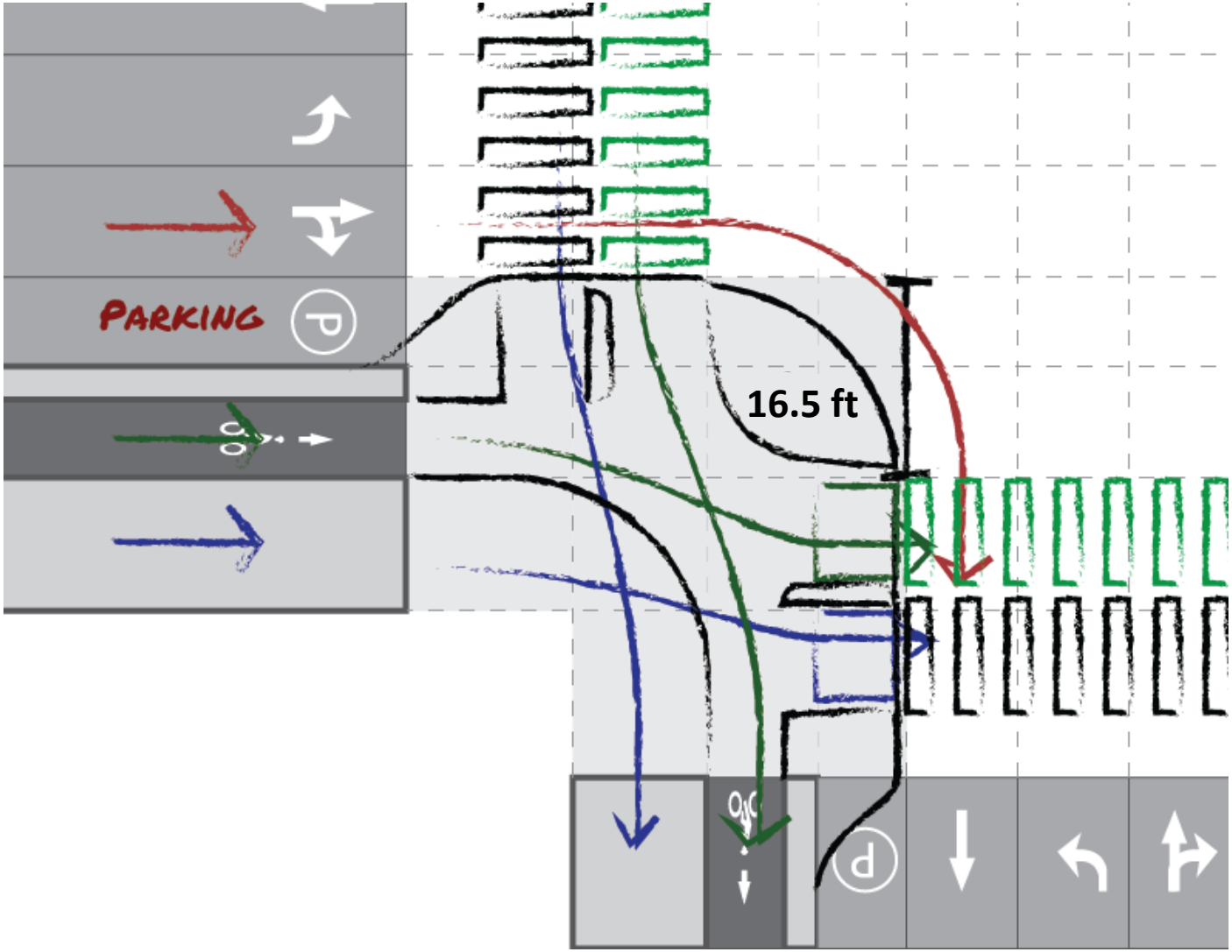
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