



Designing for Bicyclist Safety

Module C

# INTERSECTION DESIGN TREATMENTS

# LEARNING OUTCOMES

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- ✘ Understand intersection design options and features
- ✘ Select appropriate design feature for a bikeway in a given context

# KEY SAFETY FACTORS

- ✘ Speed
- ✘ Number of lanes
- ✘ Visibility
- ✘ Traffic volume & composition
- ✘ Conflict points
- ✘ Proximity
- ✘ Bike control
- ✘ Connectivity







Designing for Bicyclist Safety

# SHARED-USE PATH CROSSINGS

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# SIDE-STREET CROSSINGS



Adjacent Road Speed Limit (Mi/h)	Recommended Sidepath Separation Distance at Crossings
< 25 mi/h	6.5 ft (2.0 m)
35–45 mi/h	6.5–16.5 ft (2.0–5.0 m)
≥ 55 mi/h	16.5–24 ft (5.0–7.0 m)

*\*Separation distance may vary in response to available right of way, visibility constraints and the provision of a right turn deceleration lane.*

# MID-BLOCK CROSSING DESIGN PROCESS

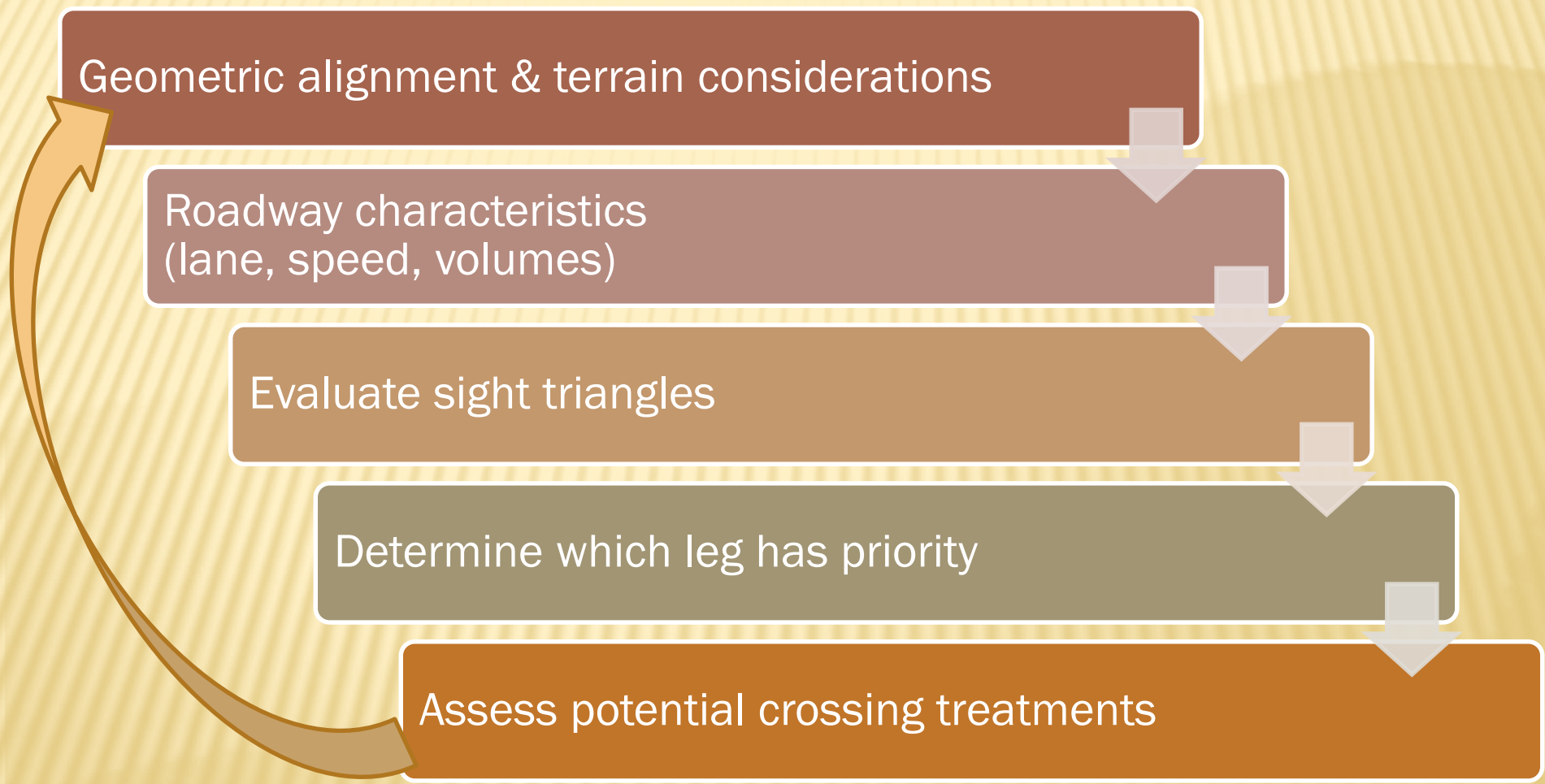
Geometric alignment & terrain considerations

Roadway characteristics  
(lane, speed, volumes)

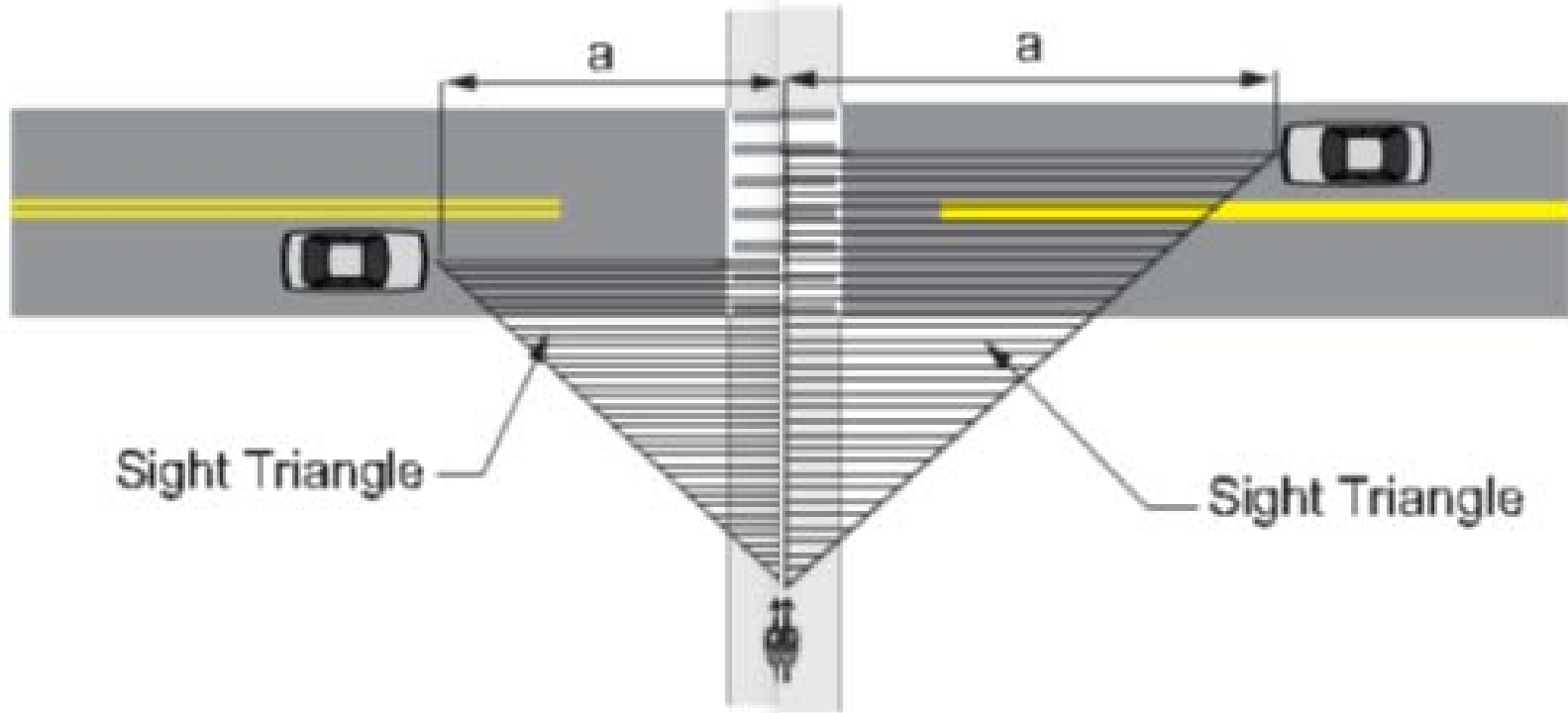
Evaluate sight triangles

Determine which leg has priority

Assess potential crossing treatments

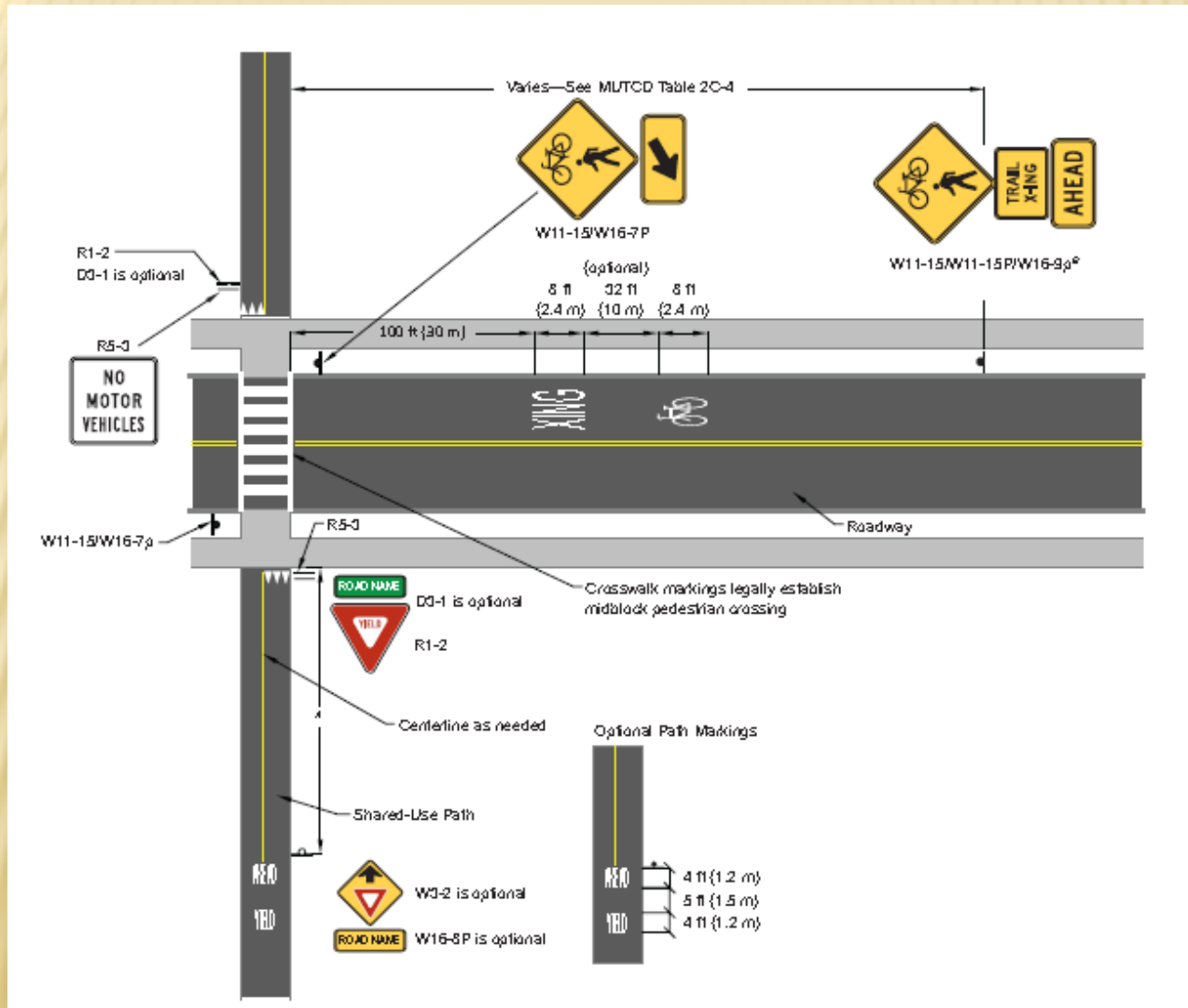


# SIGHT TRIANGLES



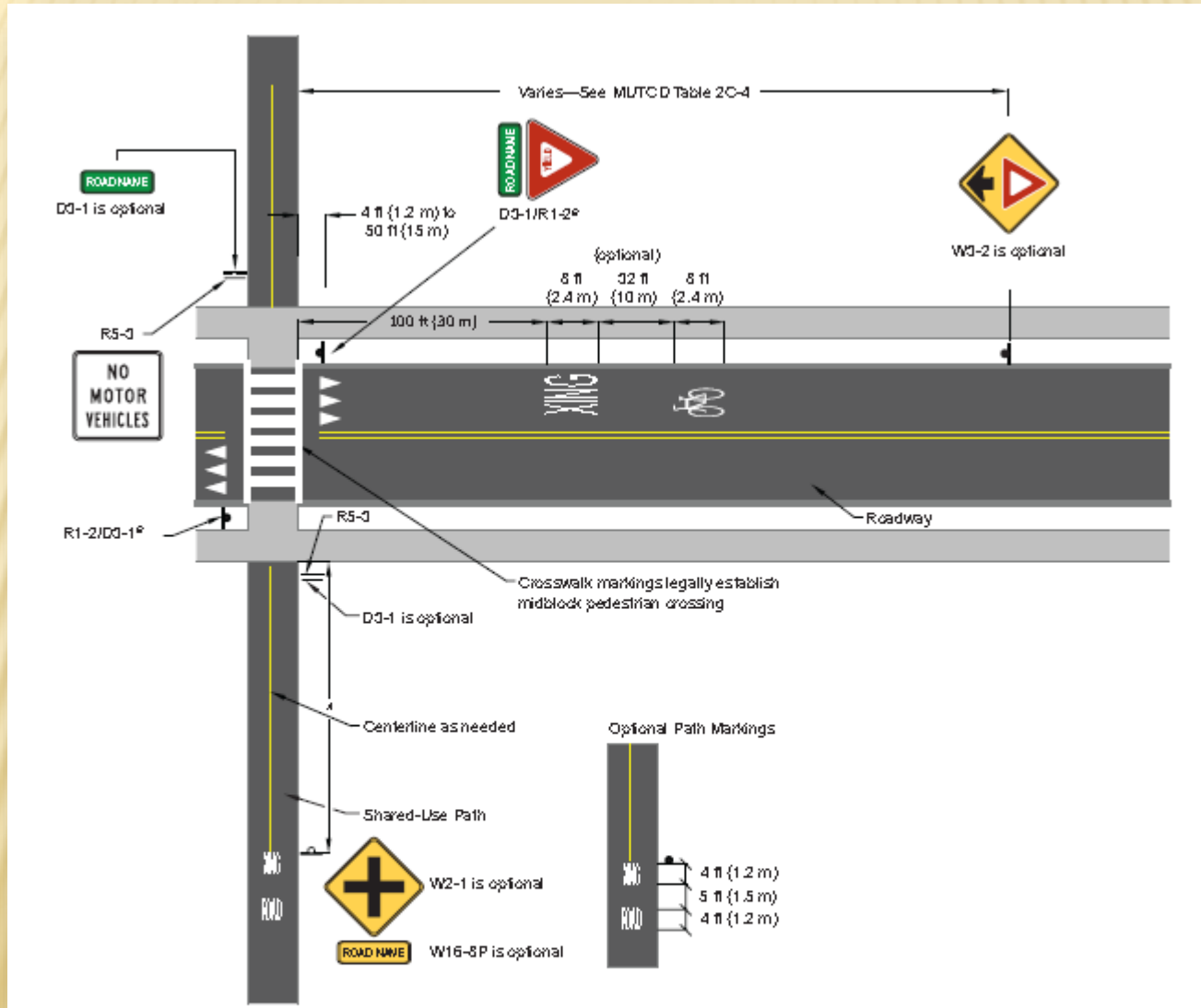


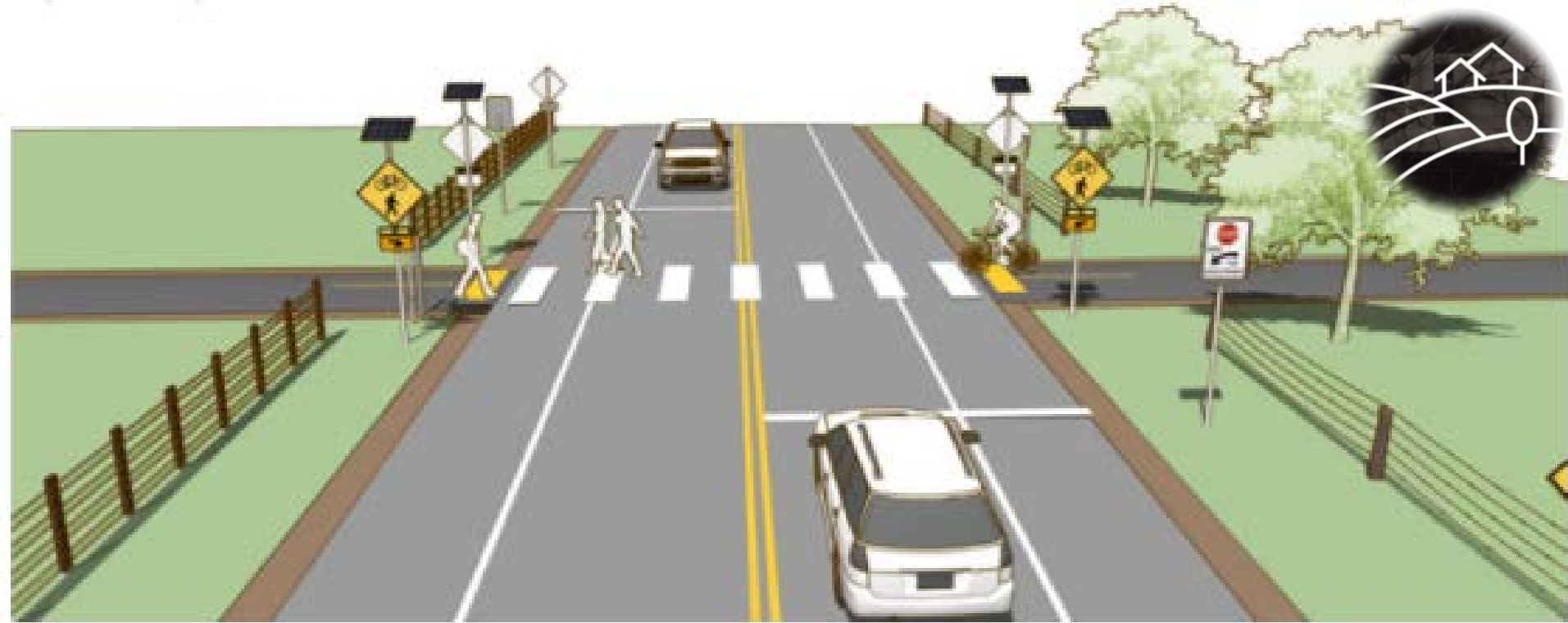
# PATH YIELDS TO ROADWAY





# ROAD YIELDS TO PATHWAY





## Crossing Countermeasures

- ✘ Advance warning signs
- ✘ Advance yield/stop line
- ✘ Raised island/crossing
- ✘ RRFB/PHB

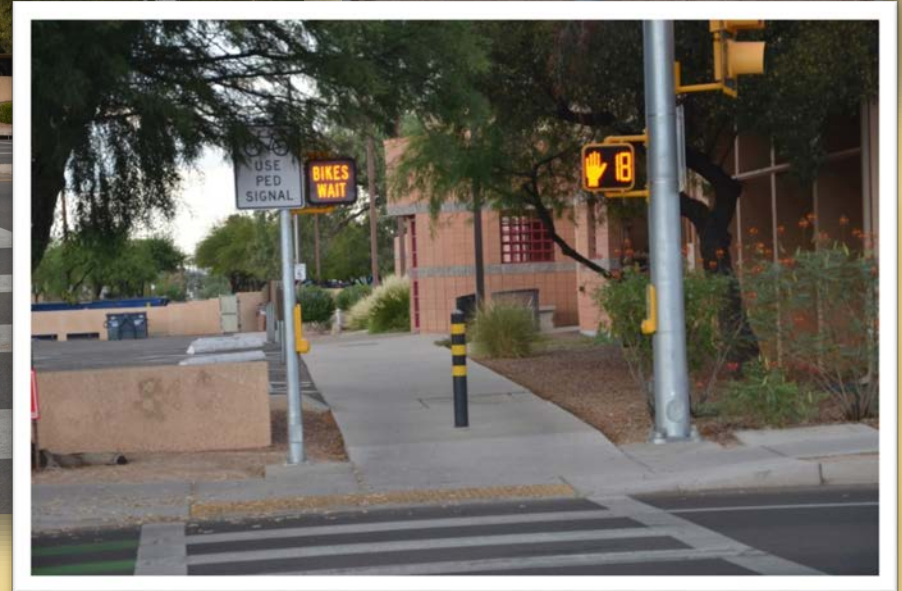






# BIKE “HAWK” PHB

- ✘ First installation Tucson, AZ
- ✘ “BIKES WAIT”/”BIKES OK”





Designing for Bicyclist Safety

# INTERSECTION DESIGN

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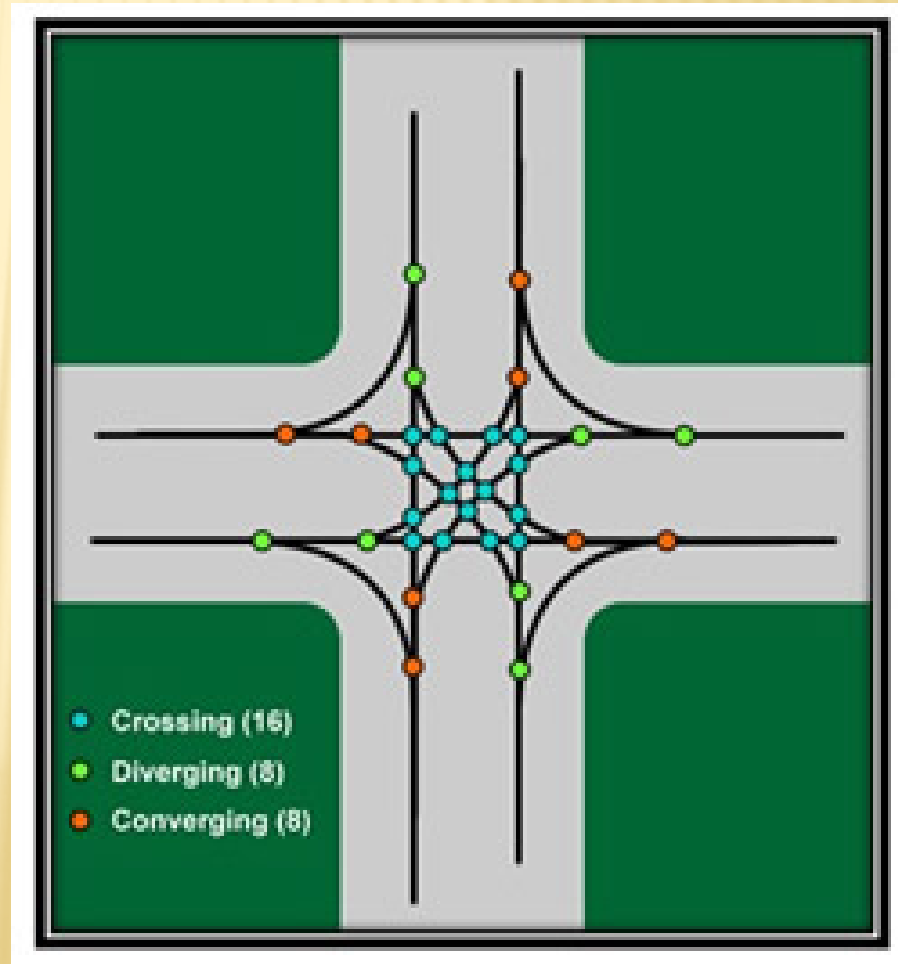
# INTERSECTION DESIGN PRINCIPLES

- ✘ Reduce speed
- ✘ Minimize exposure to conflicts
- ✘ Communicate right-of-way priority
- ✘ Provide adequate sight distance

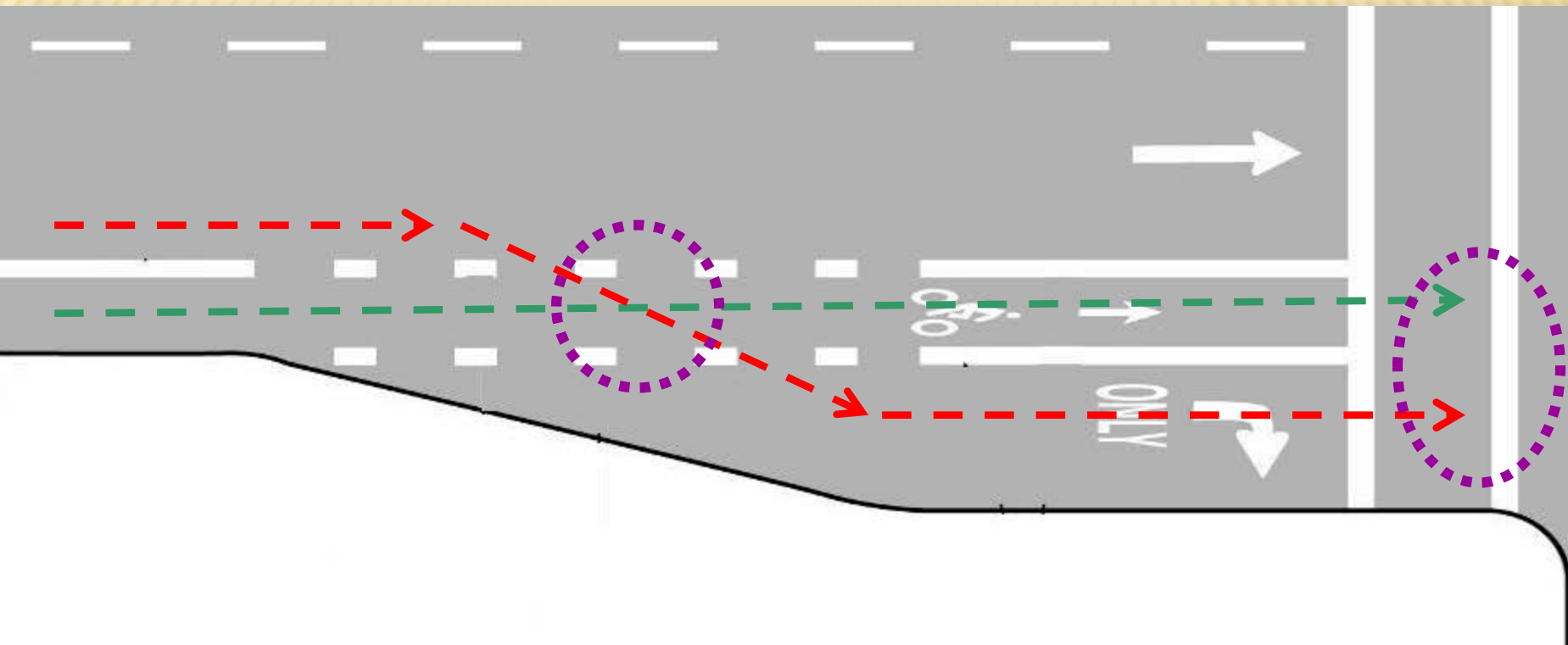


# INTERSECTION CONFLICTS

- ✘ Typical conflicts for both pedestrians and motorists, plus:
  - + Right-turn/thru movement
  - + Weaving to left turn



# RIGHT-TURN/THRU CONFLICT



# LEFT-TURN CONFLICT







# INTERSECTION COUNTERMEASURES

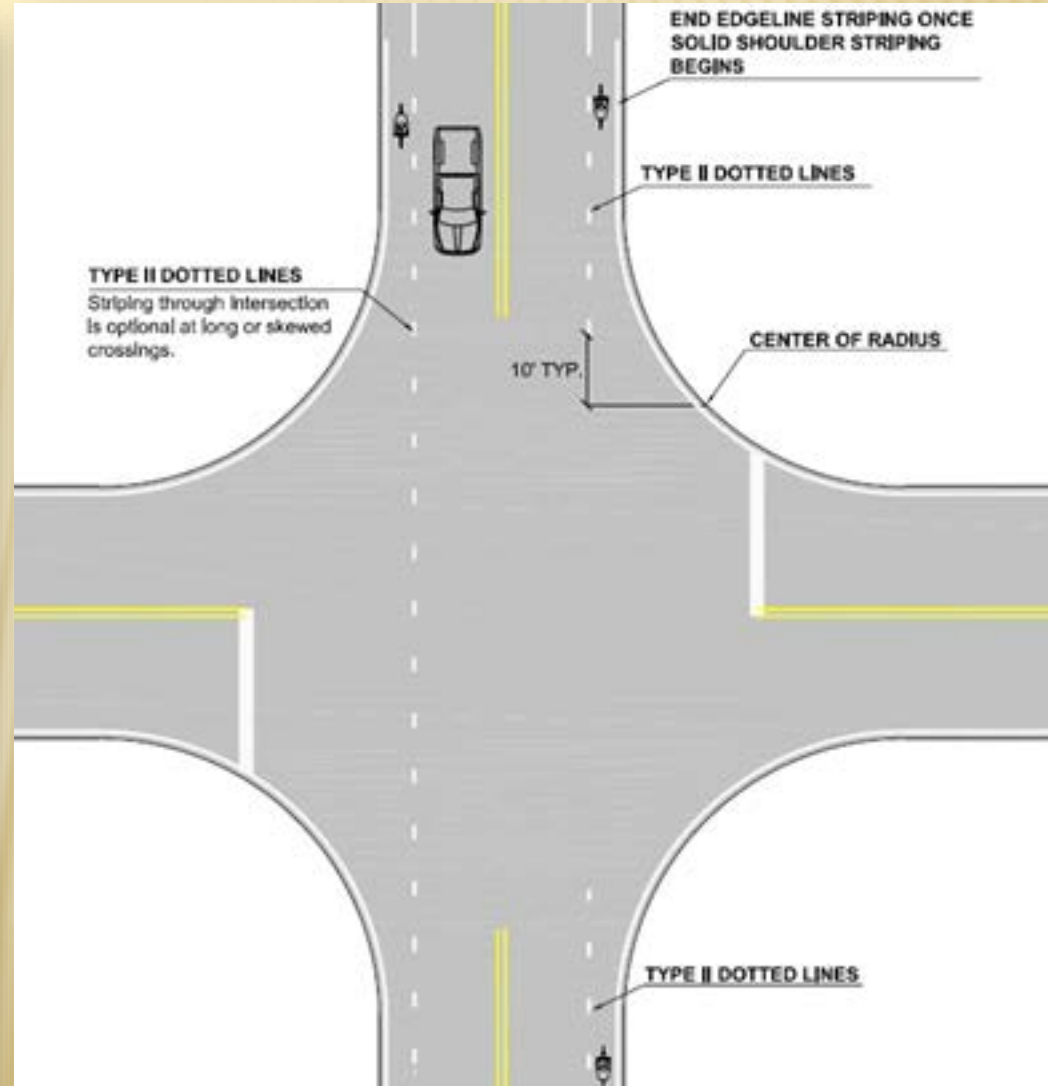
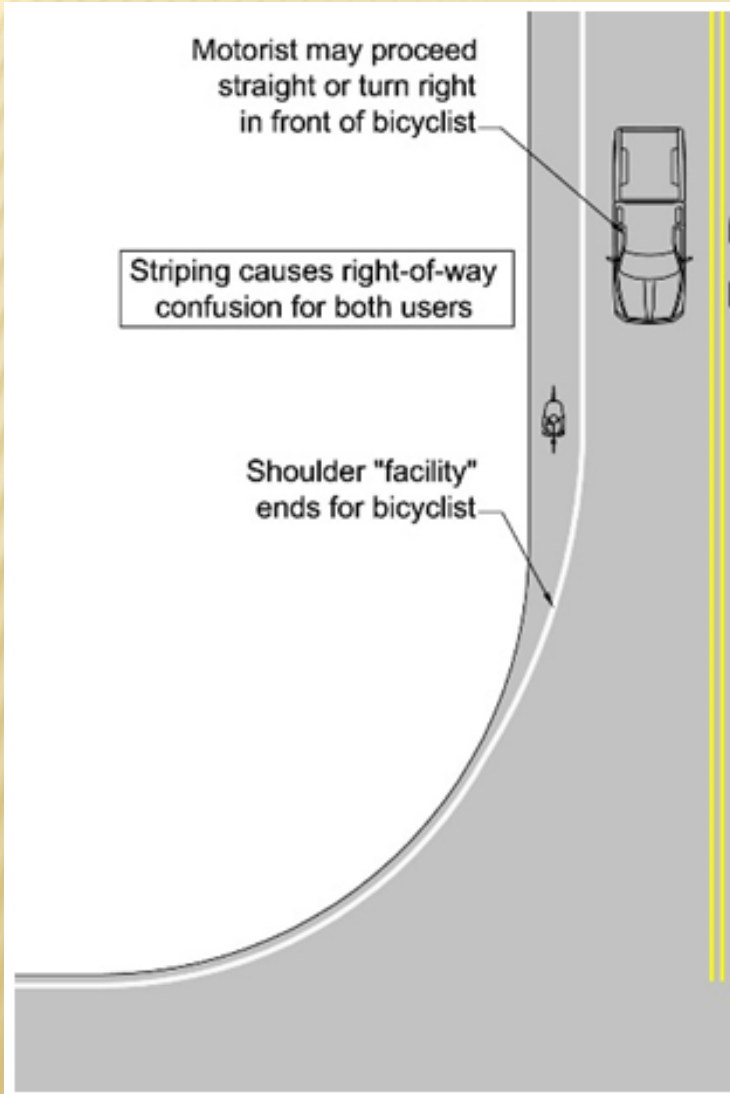
# SHOULDER RIDING AT INTERSECTION

- ✘ Shoulder not a travel lane
- ✘ Modify shoulder striping
- ✘ Opportunity to switch to shared lanes **OR**
- ✘ Add bike lane thru intersection





# SHOULDER STRIPING





# INTERSECTION WITH SHARED LANES

- ✘ Additional/all lanes are shared at intersection



# BIKE LANE THRU INTERSECTION







# BIKE LANE THRU INTERSECTION





# HIGHLIGHT CONFLICT ZONE



**Dotted Line Extensions**



**Shared Lane Markings**

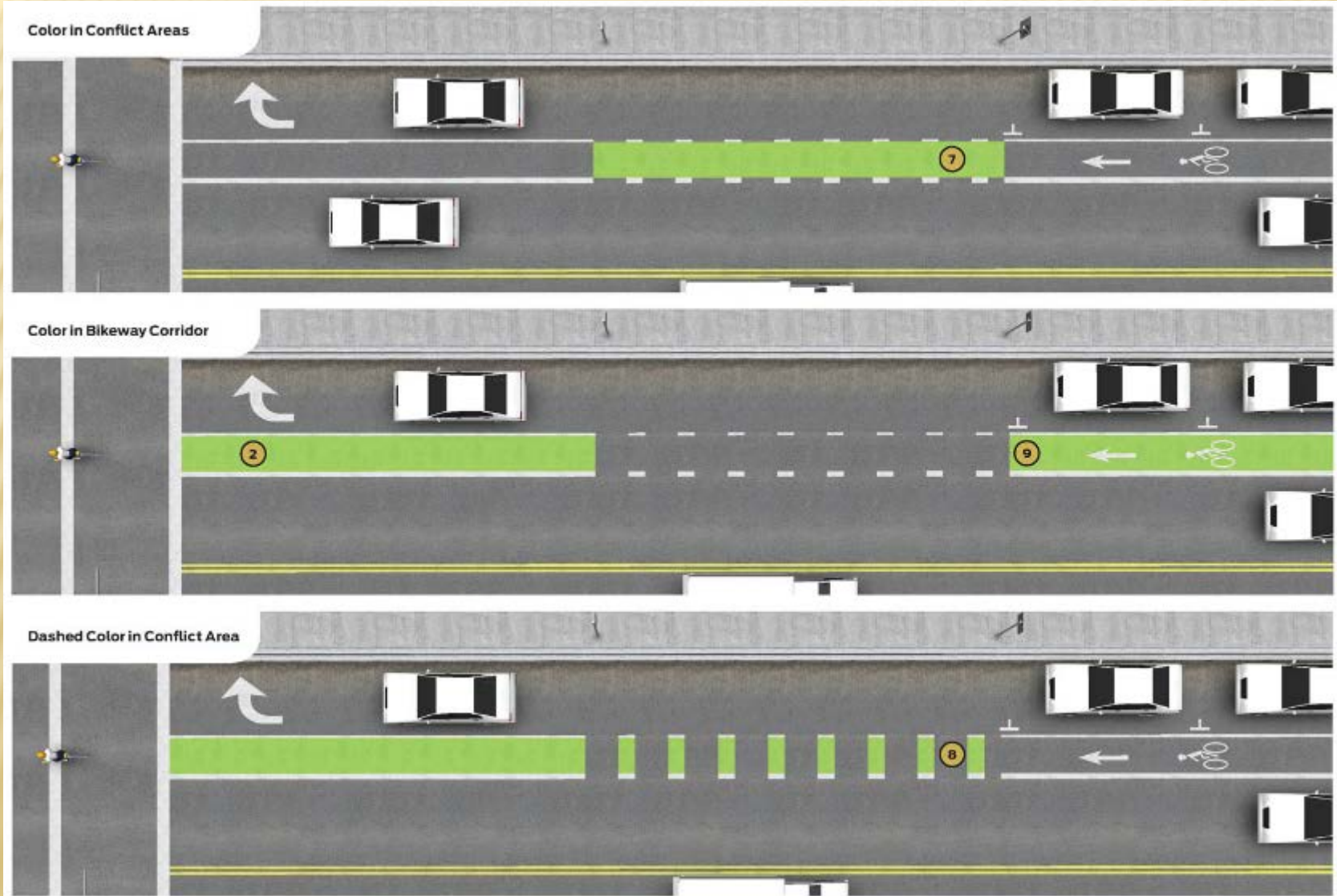


**Colored Conflict Area**



**Elephant's Feet**

# HIGHLIGHT CONFLICT ZONE





# BIKE LANE THRU INTERSECTION





# SHARROW W/ GREEN BACKGROUND







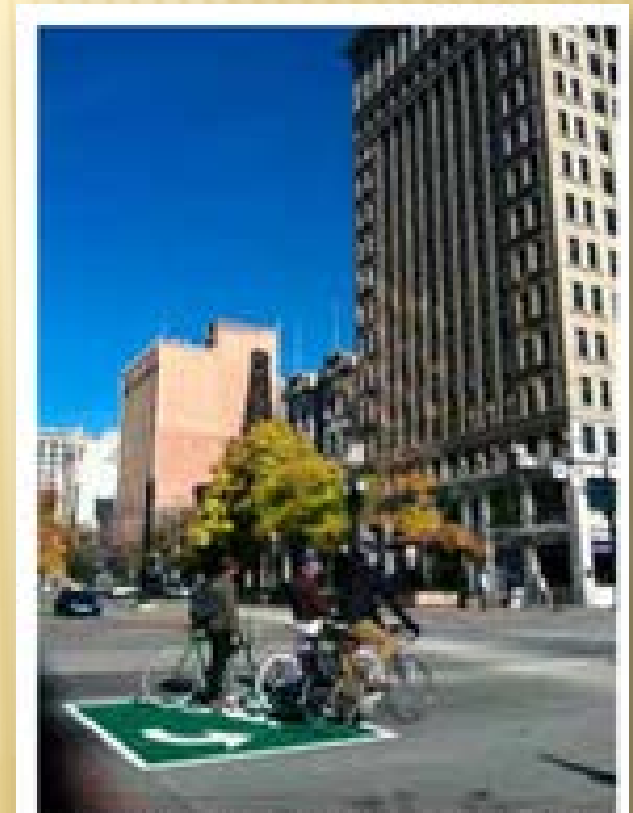
# TWO-STAGE LEFT TURN BOX





# TWO-STAGE LEFT-TURN QUEUE BOX

- ✘ Required design elements include:
  - + Bicycle symbol
  - + Turn or through arrow
  - + Turn on red prohibition
  - + Passive detection of bicycles
- ✘ Size to prevent conflicts



SALT LAKE CITY, UT (PHOTO: SALT LAKE CITY PUBLIC WORKS)

# BIKE BOX





# BIKE BOX

- ✘ Increase visibility
- ✘ Reduce signal delay for bikes
- ✘ Positioning for left-turn
- ✘ Prevent “right-hook” (except at onset of green)
- ✘ Groups bikes





# BIKE BOX

## ✘ Required elements:

- + Advance stop bar
- + Bike symbol
- + RTOR prohibited
- + Setback from crosswalk
- + Countdown ped signal
- + Yellow change & red clearance



# SAFER SIGNALS FOR BICYCLISTS

- ✘ Bikes start-up and travel slower than cars
  - + Differentiating bike detection to optimize signals
  - + Set initial and gap times to accommodate bikes
- ✘ Leading Bike Interval
- ✘ Segregate Conflicting Movements





# BICYCLE SIGNAL FACE

## Application for:

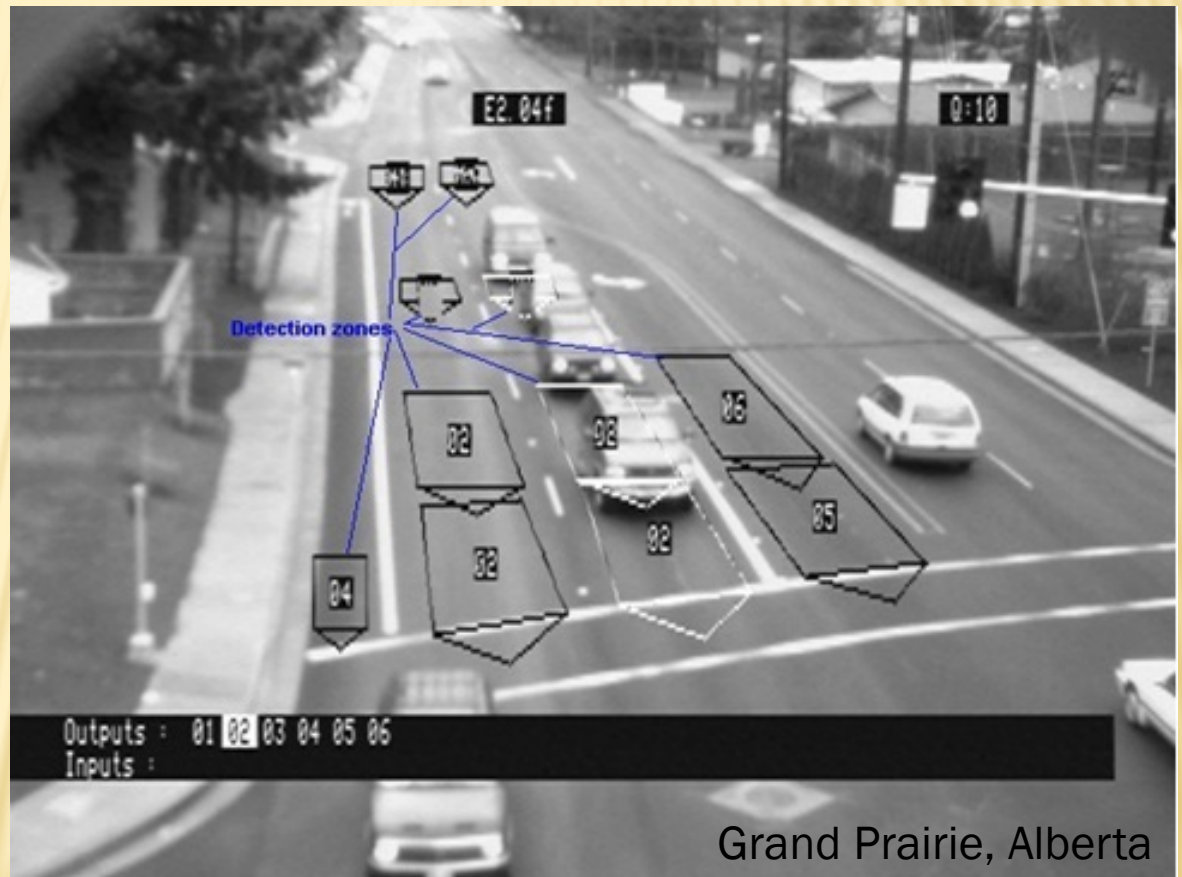
- ✘ Bicyclist non-compliance
- ✘ Provide a leading or lagging bicycle interval
- ✘ Continue the bicycle lane on the right-hand side of an exclusive turn lane
- ✘ Augment the design of a segregated counter-flow
- ✘ Unusual or unexpected arrangements of the bicycle movement through complex intersections, conflict areas, or signal control.





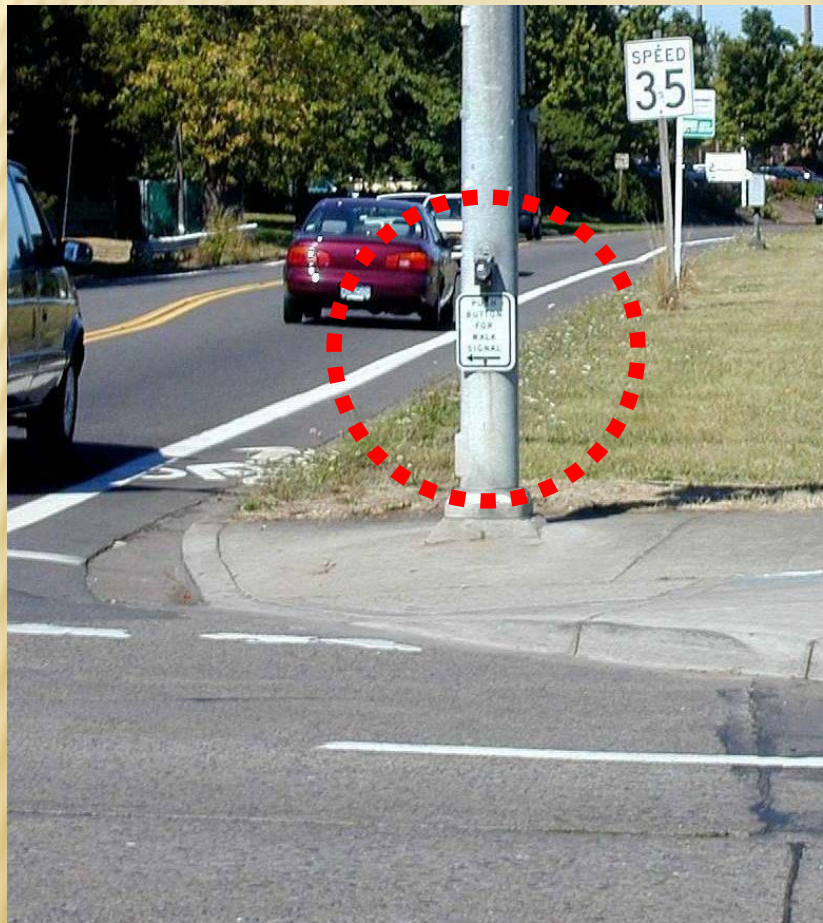
# BICYCLE DETECTION

- ✘ Buttons
- ✘ Loops
- ✘ Video
- ✘ Microwave
- ✘ Radar
- ✘ Infrared





# PUSH BUTTONS





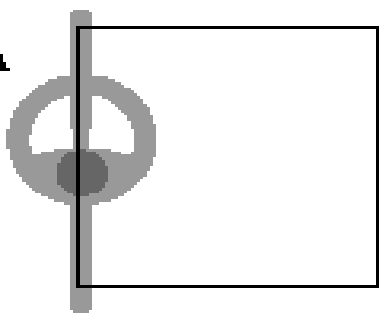
# LOOP DETECTION



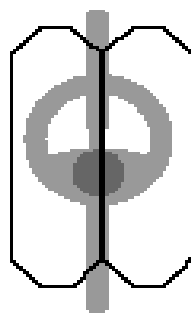
Portland, OR



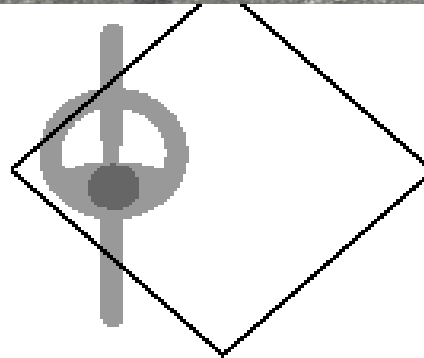
FACTO



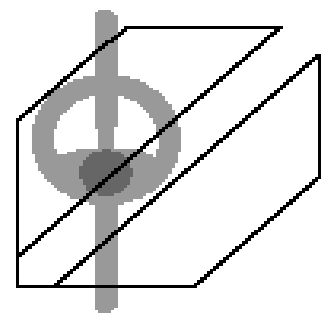
Square



Quadrupole



Diamond

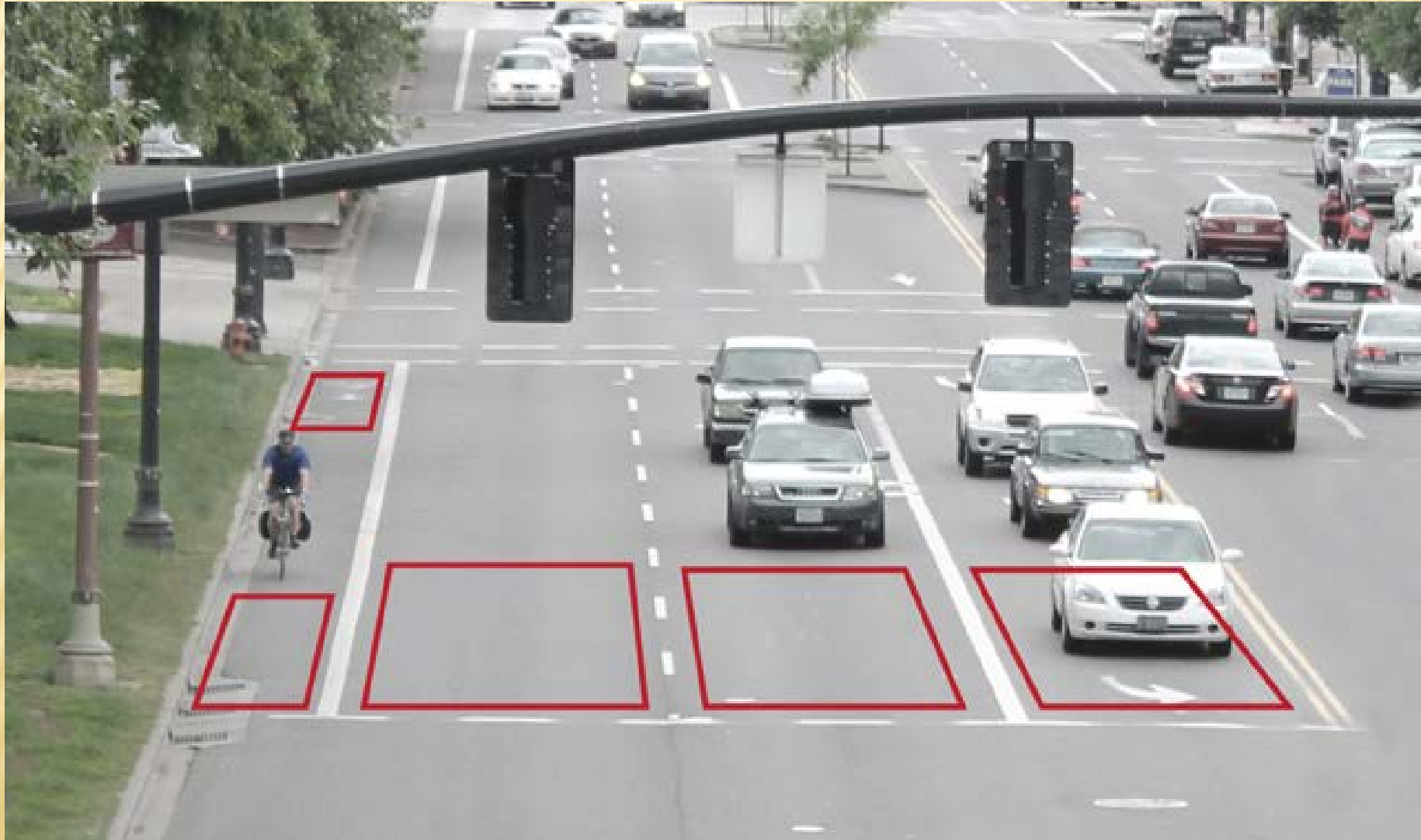


Diag. Quadrupole

*Direction of Travel*



# PASSIVE DETECTION





# BICYCLISTS AT ROUNDABOUTS

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# MAKING ROUNDABOUTS WORK

- ✘ Slow speeds
  - + Deflection
  - + Truck apron
  - + NO BIKE LANES
- ✘ Simple
  - + Single lane
  - + NO BIKE LANES
- ✘ Splitter islands
- ✘ Escape ramps







Bend, Oregon

Bike lane ends at splitter island





Bend, Oregon

Slower speeds and fewer conflict points





Bend, Oregon

Slower speeds and fewer conflict points





Bike lane begins

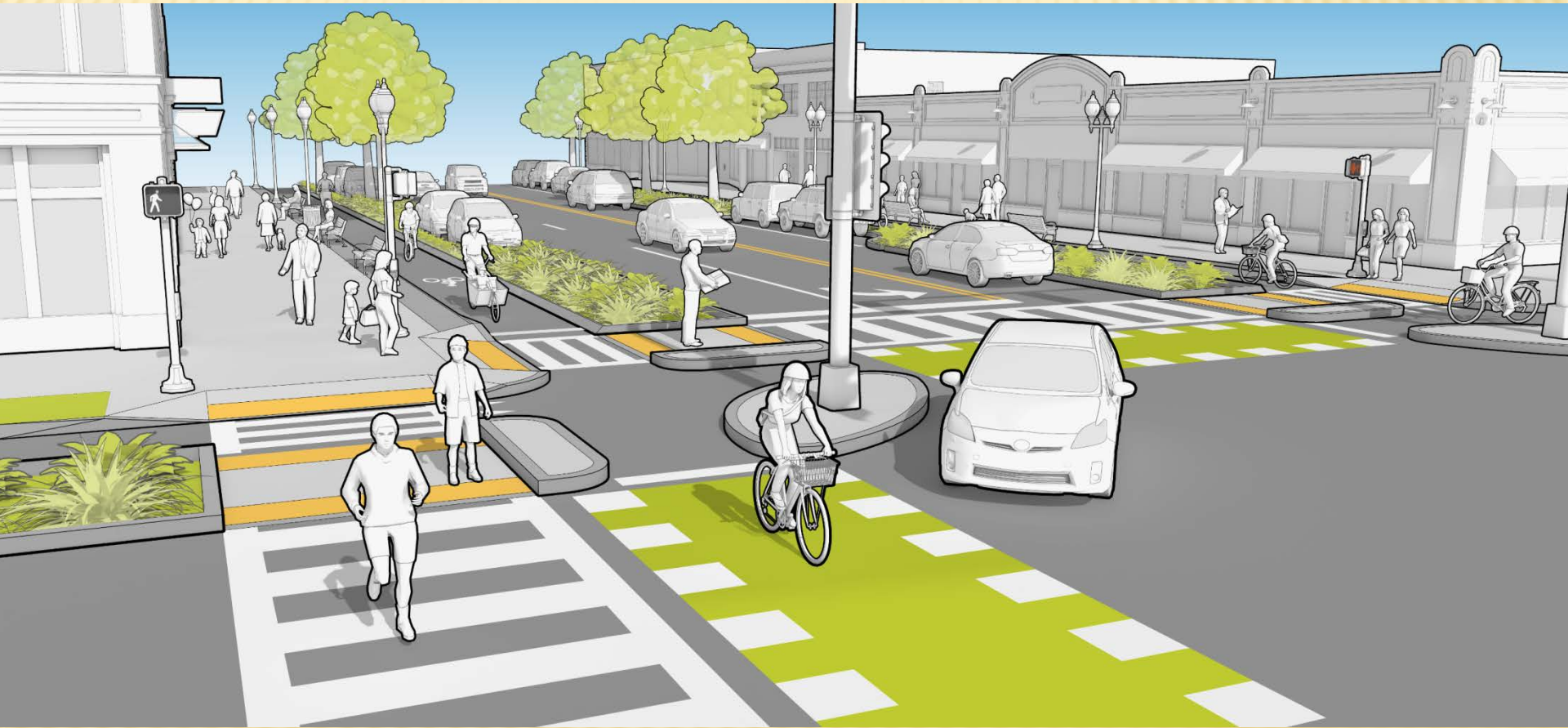




Bend, Oregon

Escape ramp

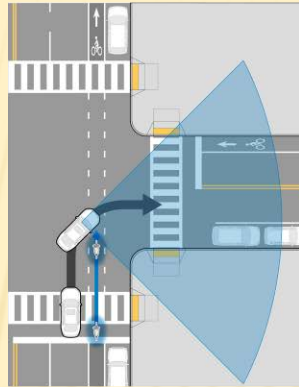
# “PROTECTED” INTERSECTIONS



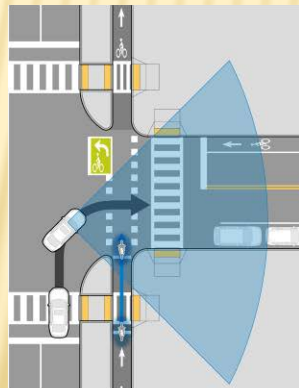


# VISIBILITY AT CONFLICT POINTS

motorist's view at  
conventional bike lane



motorist's view at  
**separated bike lane**



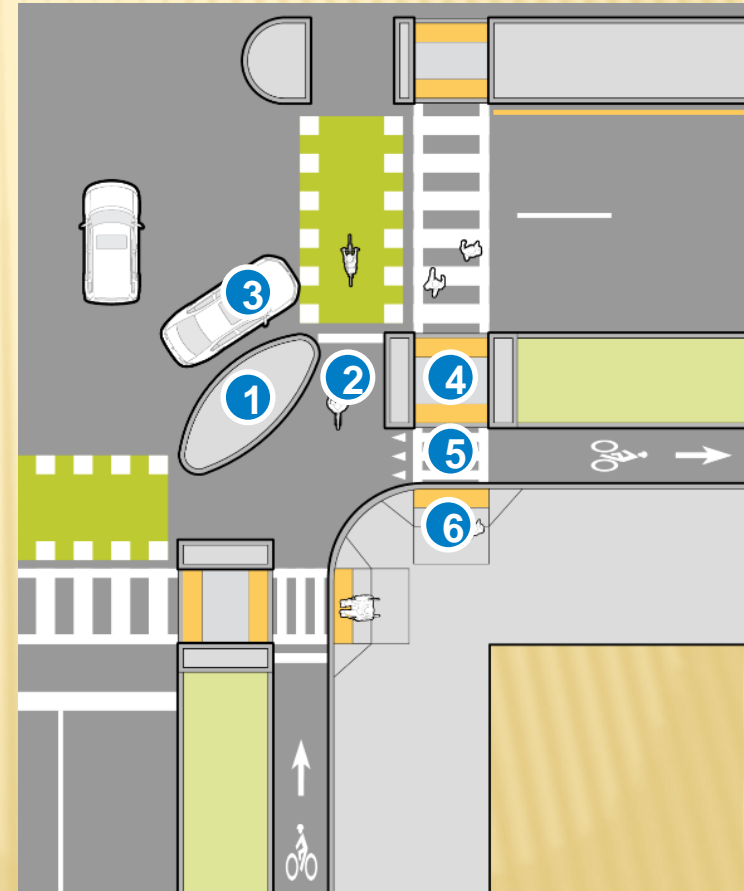
# VISIBILITY AT CONFLICT POINTS





# PROTECTED INTERSECTIONS

- 1 Corner refuge island
- 2 Forward bicycle queuing area
- 3 Motorist yield zone
- 4 Pedestrian crossing island
- 5 Pedestrian crossing of separated bike lane
- 6 Pedestrian curb ramp

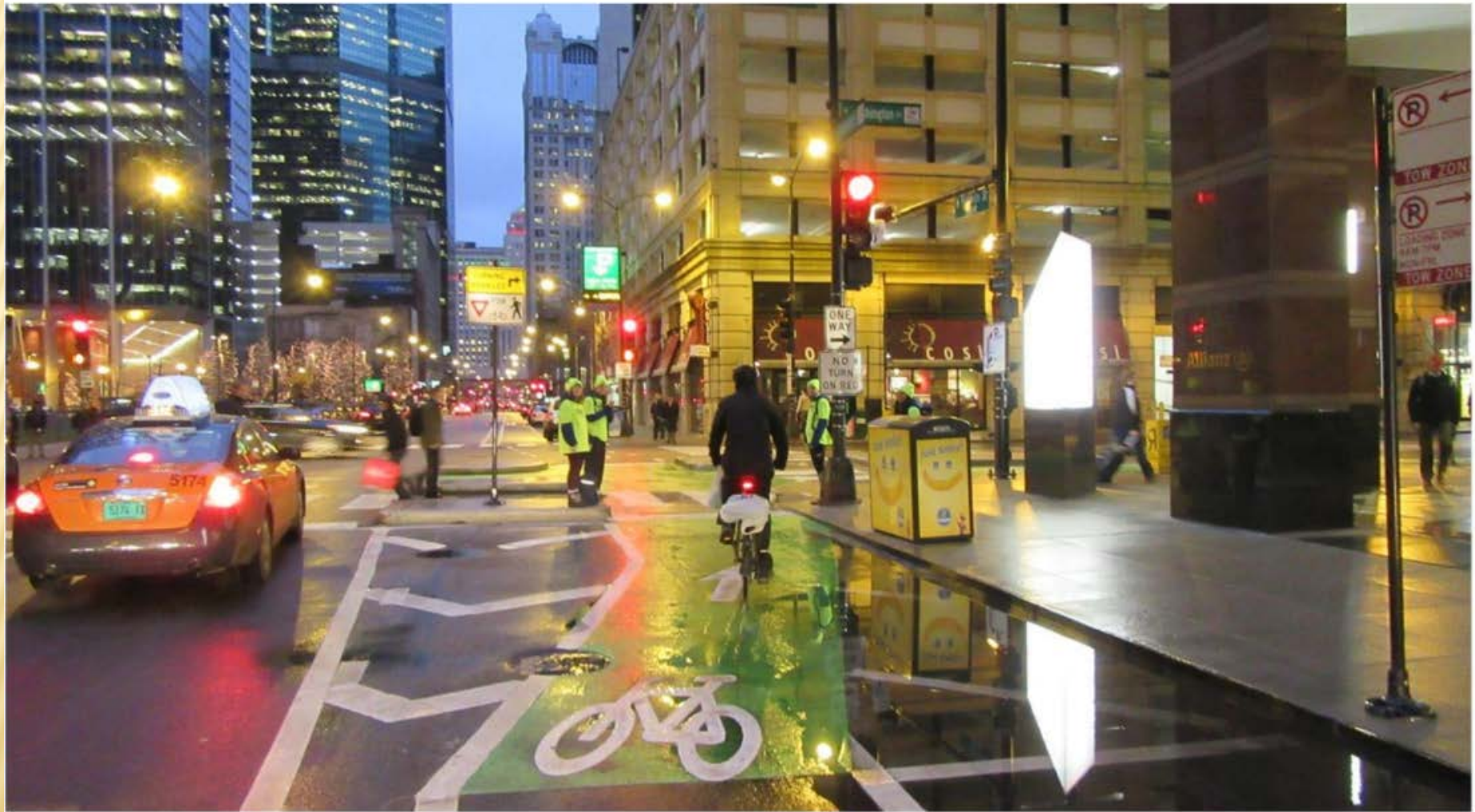


# CHICAGO, IL





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# CHICAGO, IL





# LEARNING OUTCOMES

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- ✘ Understand intersection design options and features
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# SUMMARY THOUGHTS

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