# 6th and Wisconsin Intersection Improvement Project

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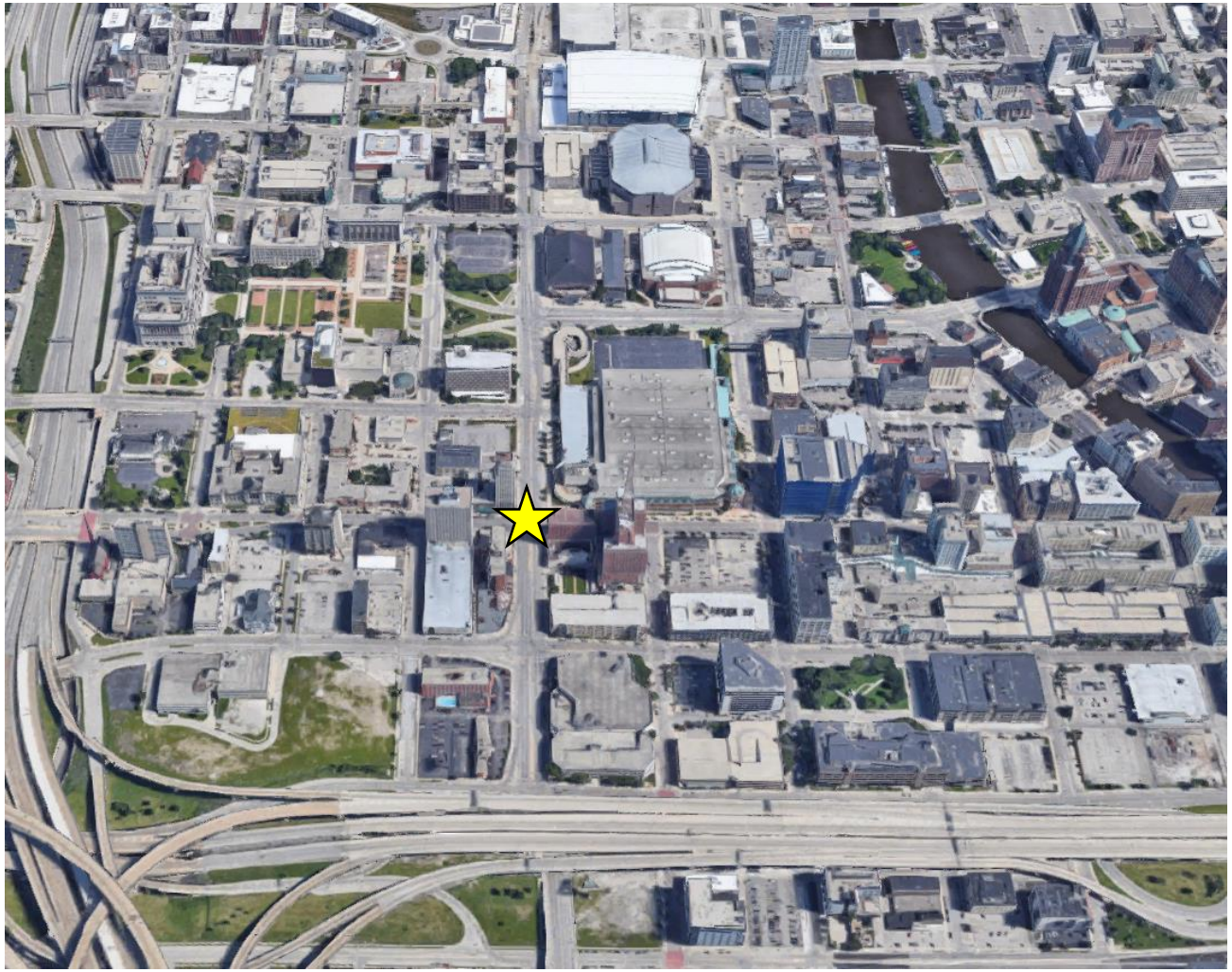
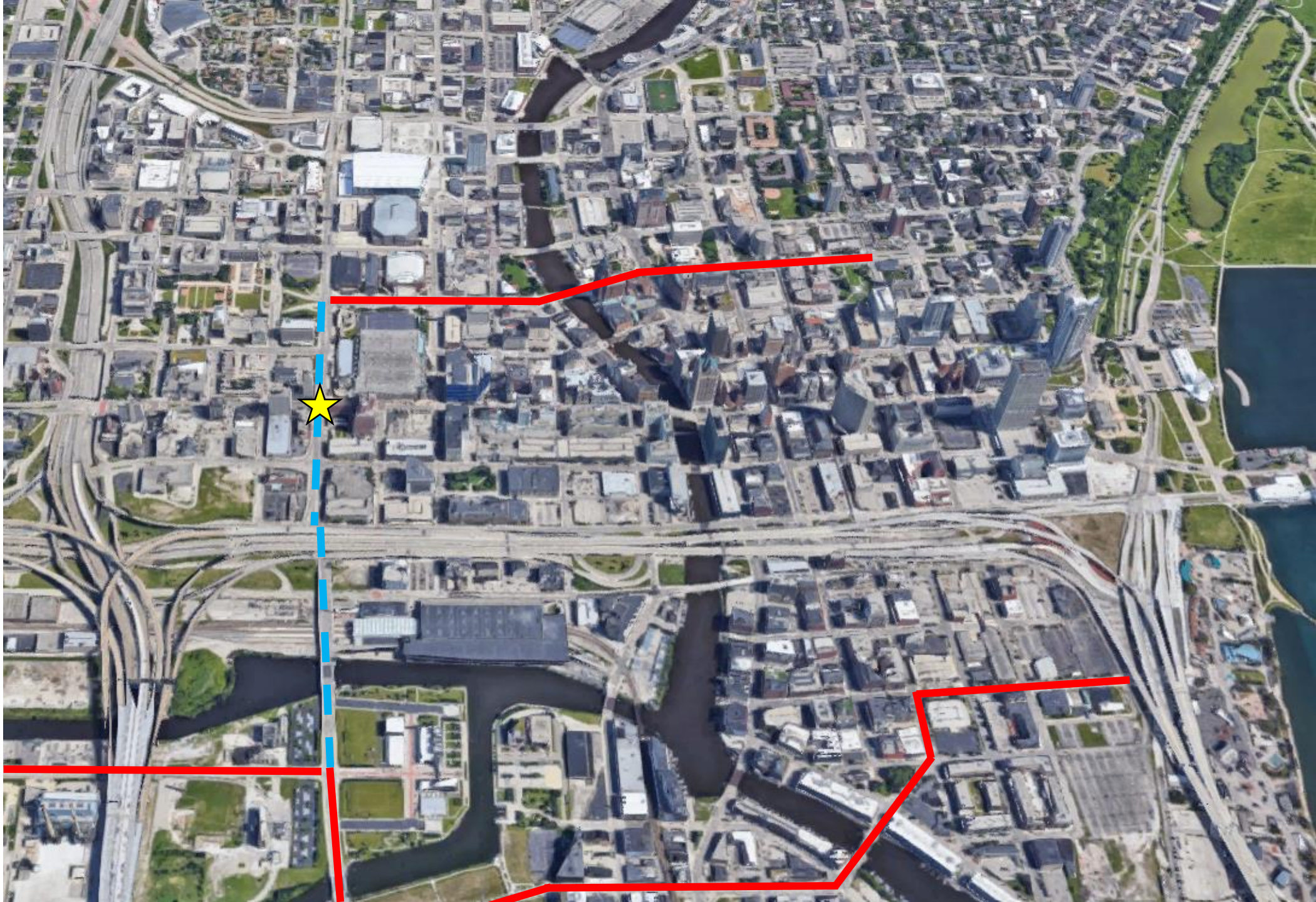
# Neighborhood Characteristics

- Westown neighborhood
  - Wisconsin Center
  - Hotels
  - Parking
- Transporation
  - Transit hub
  - Future BRT site
  - Pedestrian activity



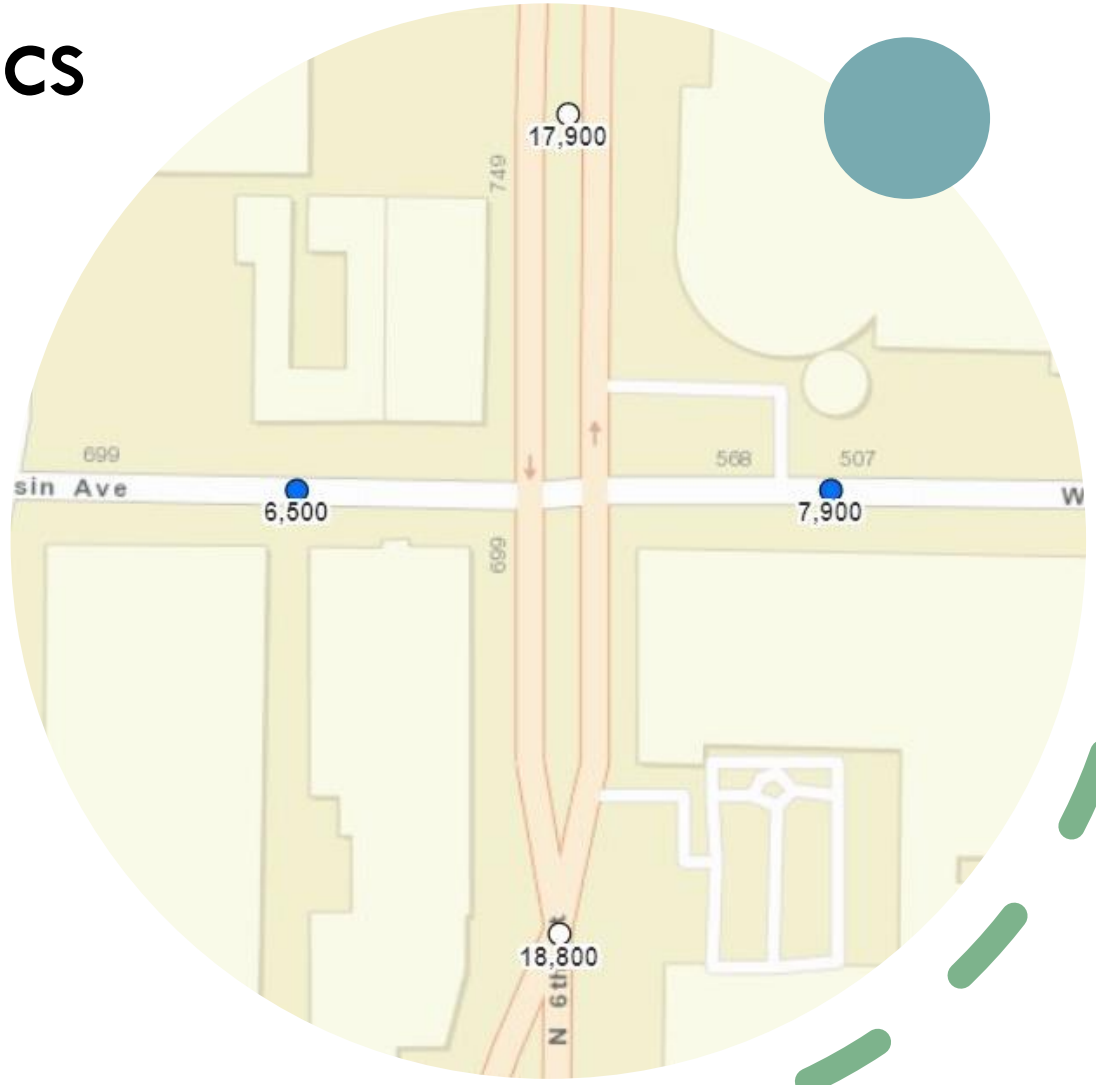
Google Maps

# Bicycle Network



# Intersection Characteristics

- Traffic volumes
  - But use of intersection isn't limited to cars alone!
- Estimated 58,000 pedestrian crossings annually




WisDOT

# Levels of Service & Stress

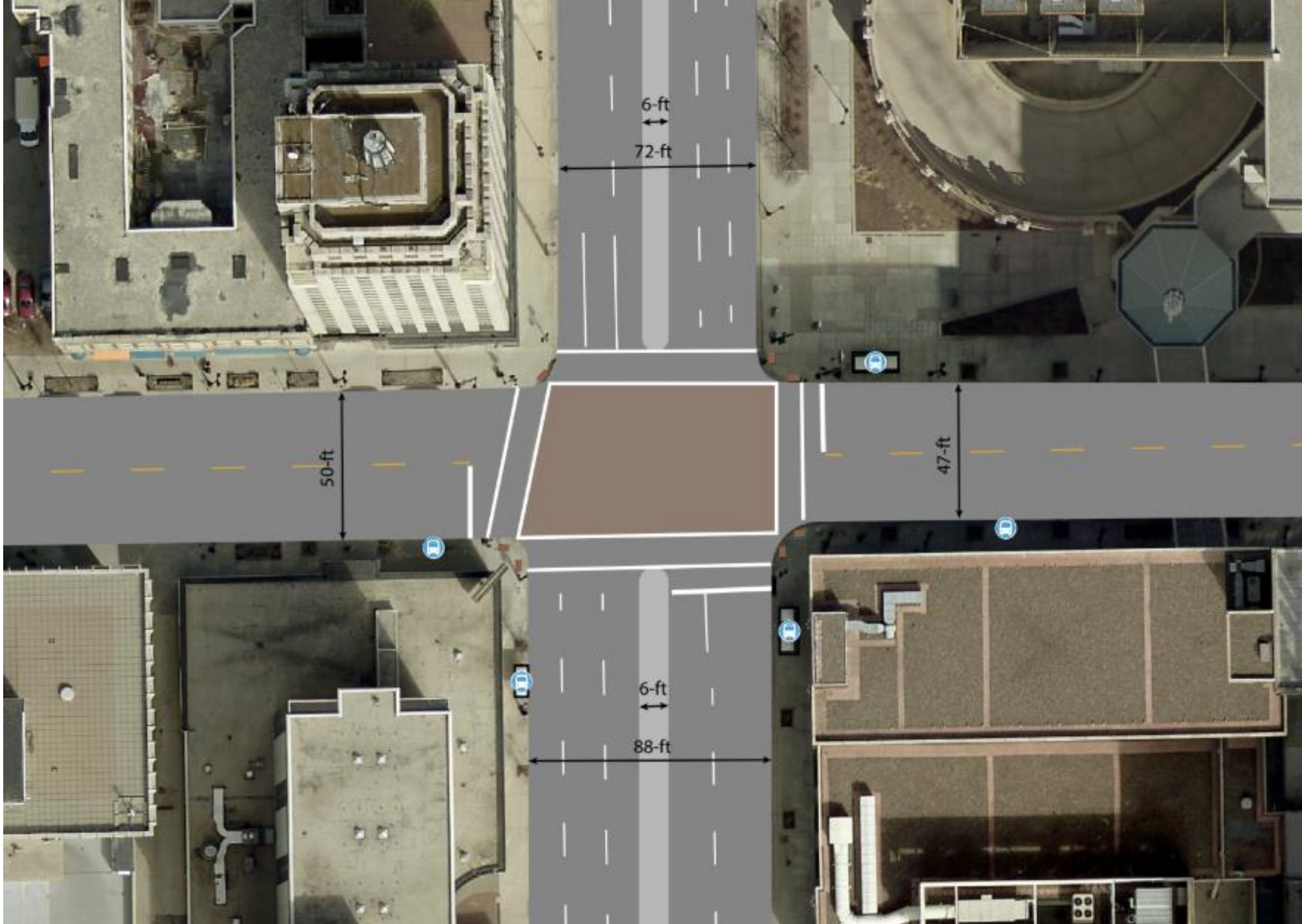
## 6th Street before improvement

- Pedestrian Grade: A (largely impacted by sidewalk size)
- Bicycle Grade: D
- Bicycle Level of Traffic Stress: 4

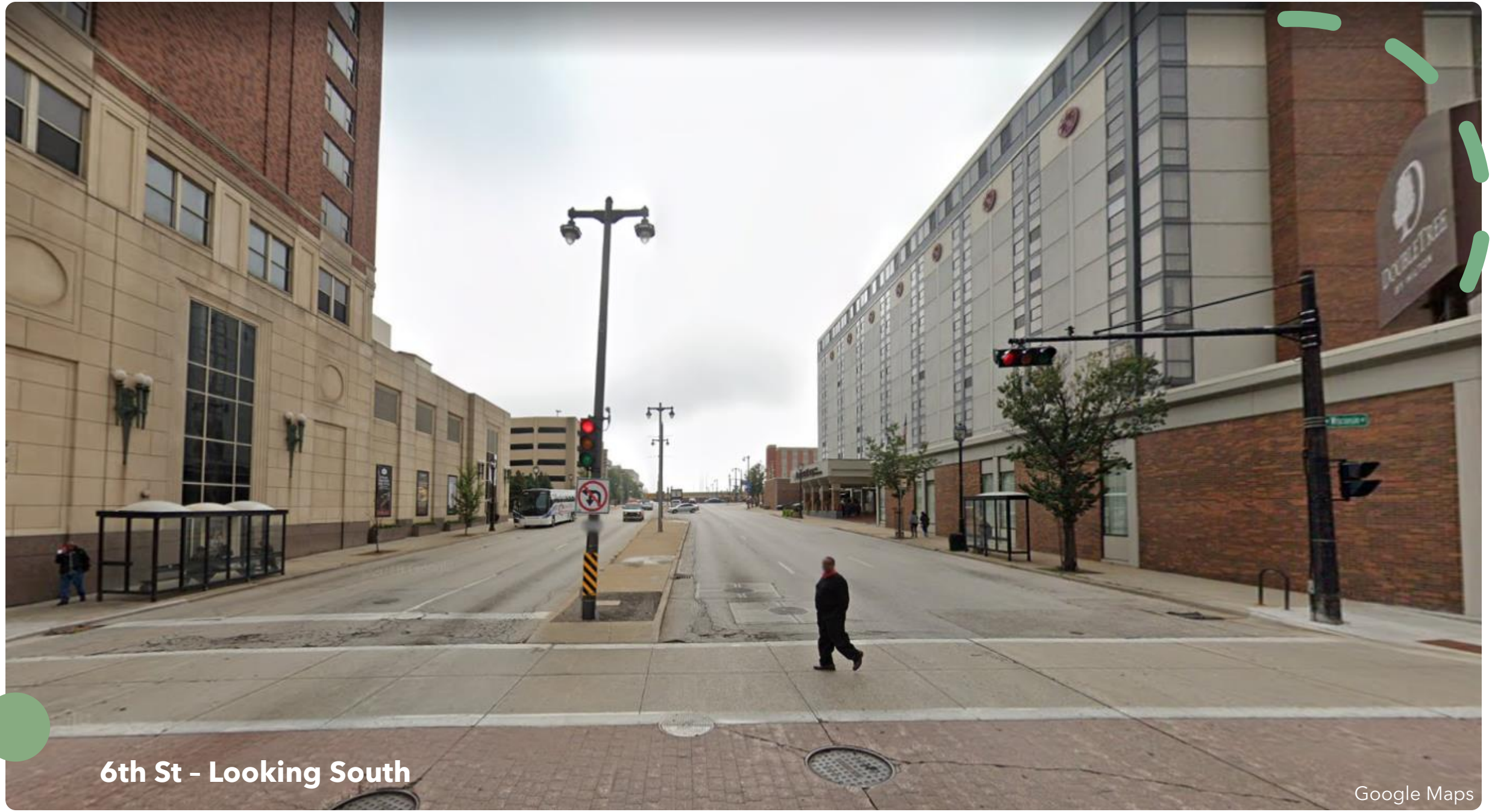
## Wisconsin Avenue before improvement

- Pedestrian Grade: A (impacted by street planters & size of sidewalk)
- Bicycle Grade: D
- Bicycle Level of Traffic Stress: 3

# Existing Intersection Design

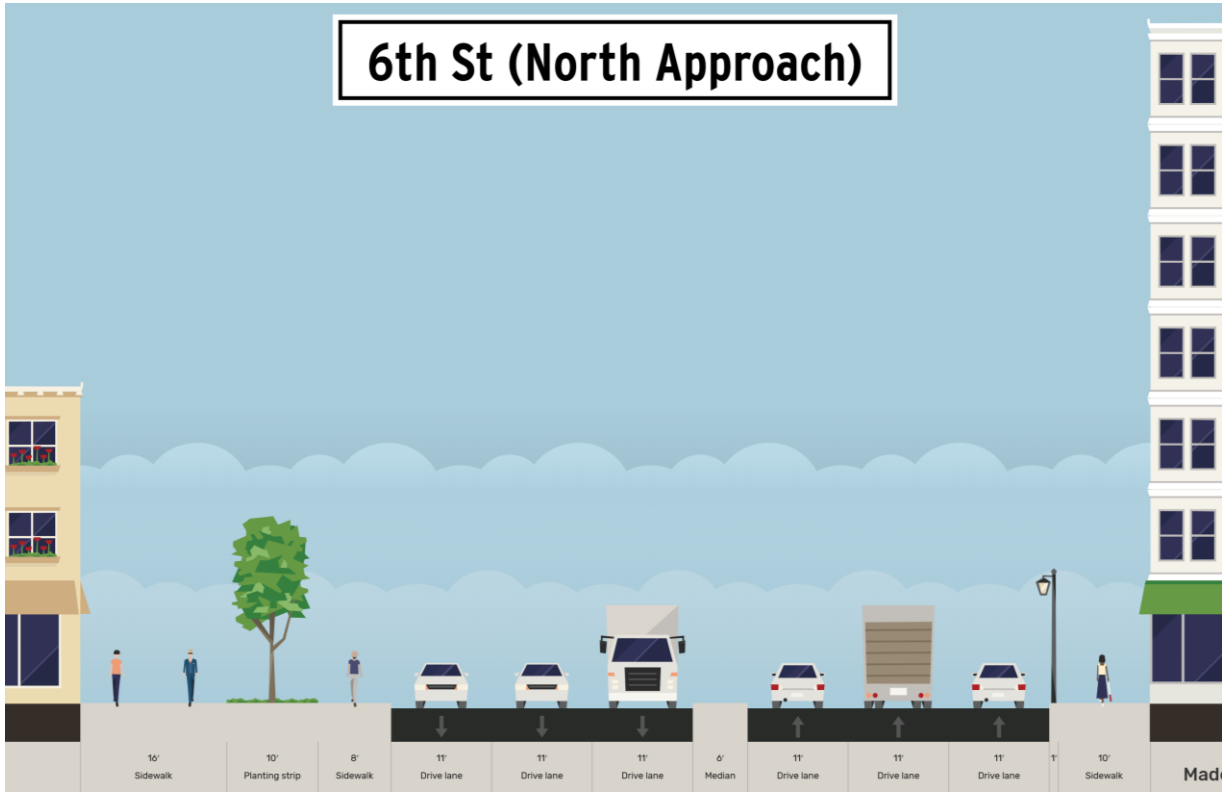


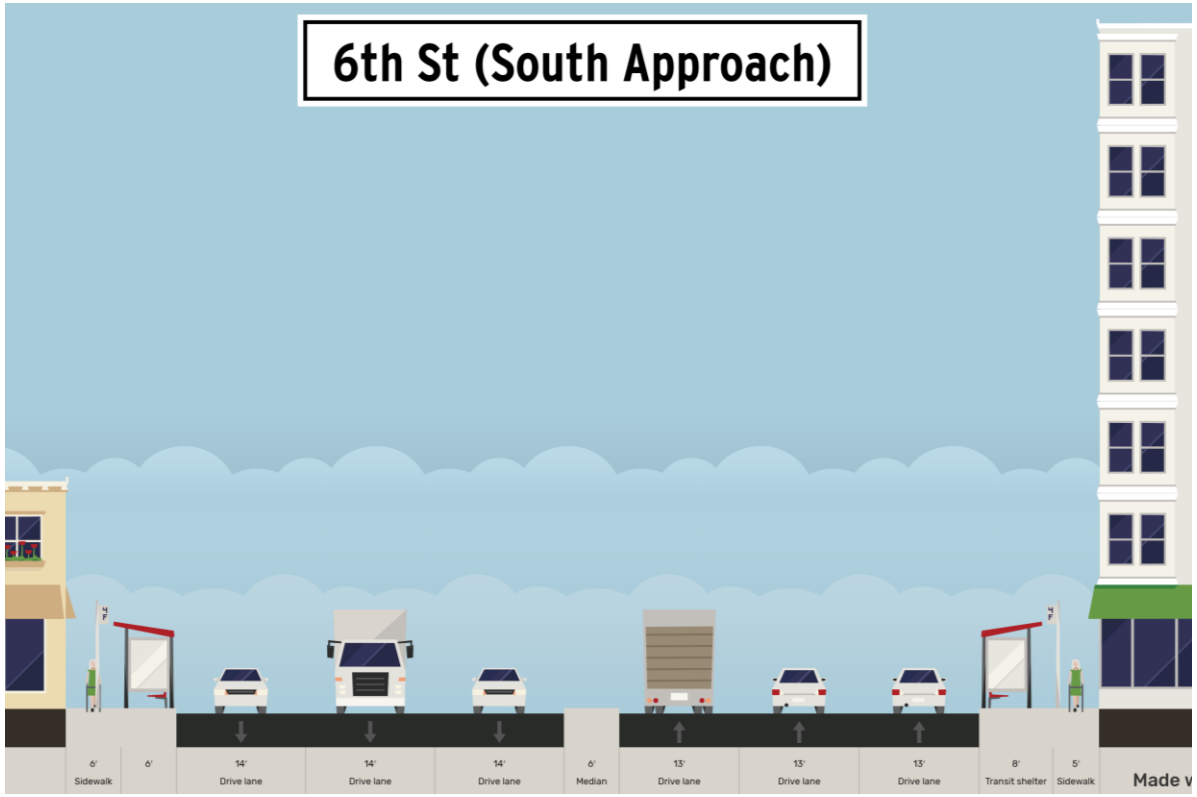

6th St – Looking North




**6th St – Looking South**

# 6th St Cross-Sections

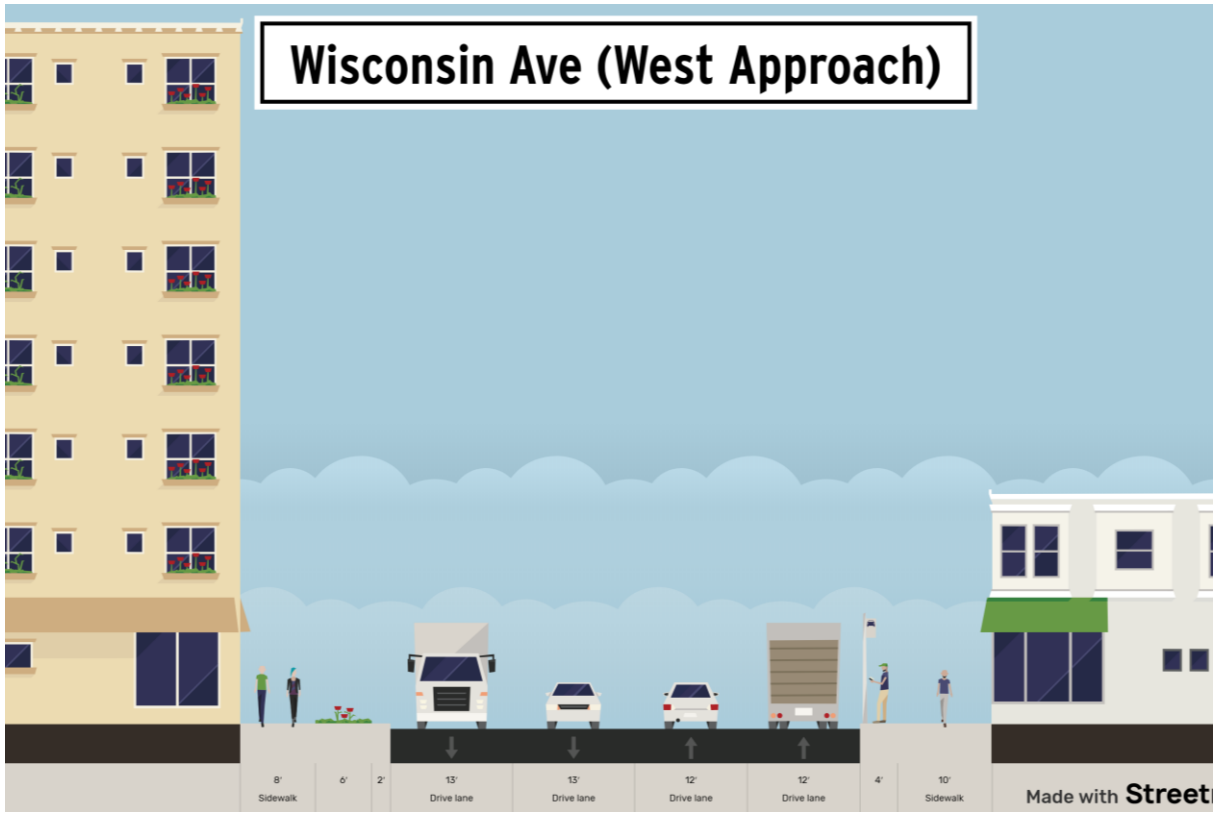


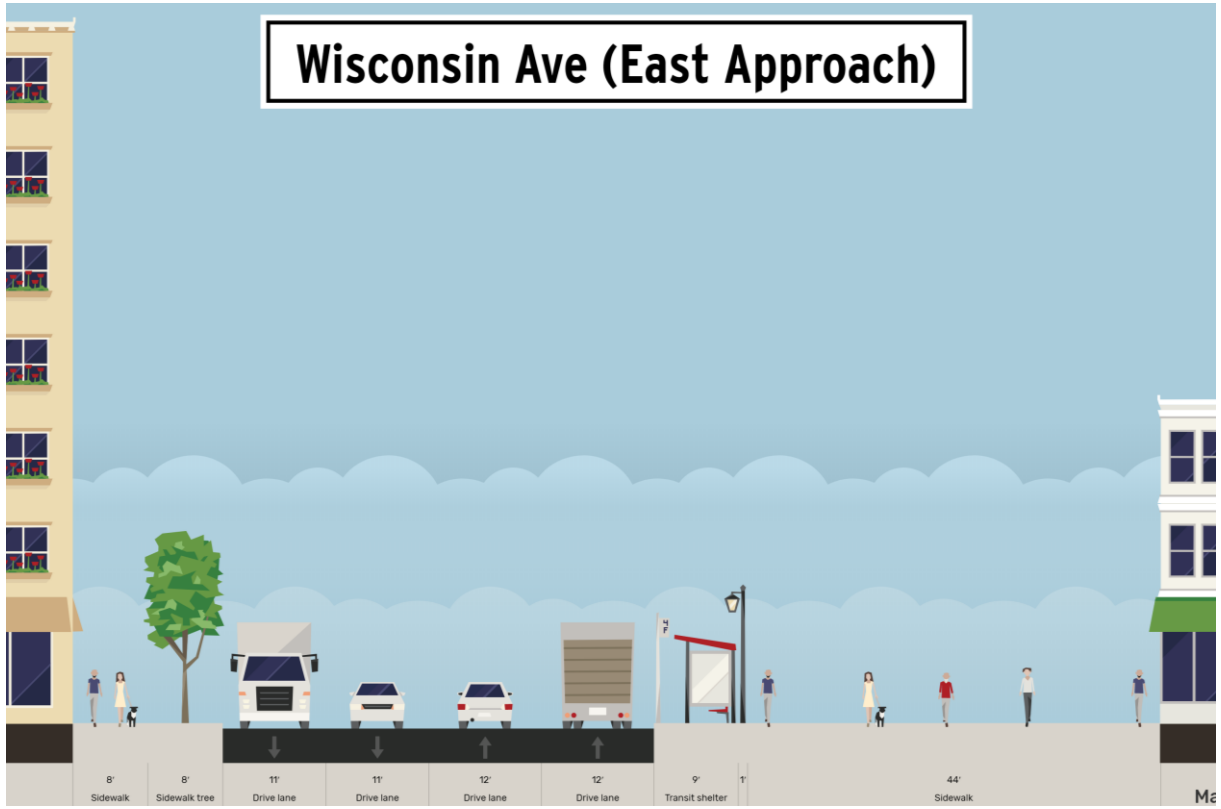




**Wisconsin Ave – Looking West**


Wisconsin Ave – Looking East
Google Maps

# Wisconsin Ave Cross-Sections



# Problems with Intersection

- Wide roads and lanes
  - Long crossing distance
  - Encourages speeding
  - Excessive space designated for cars
- No designated space for bicyclists
- Poorly marked crosswalks
- Transit mixed with car traffic
- Stop bars too close to the crosswalks (less than 6 feet)

# Project Goals

1

**Improve** safety of vulnerable road **users**

2

Increase number of people walking, biking and taking transit

3

Create economic benefits by increasing accessibility of neighborhood

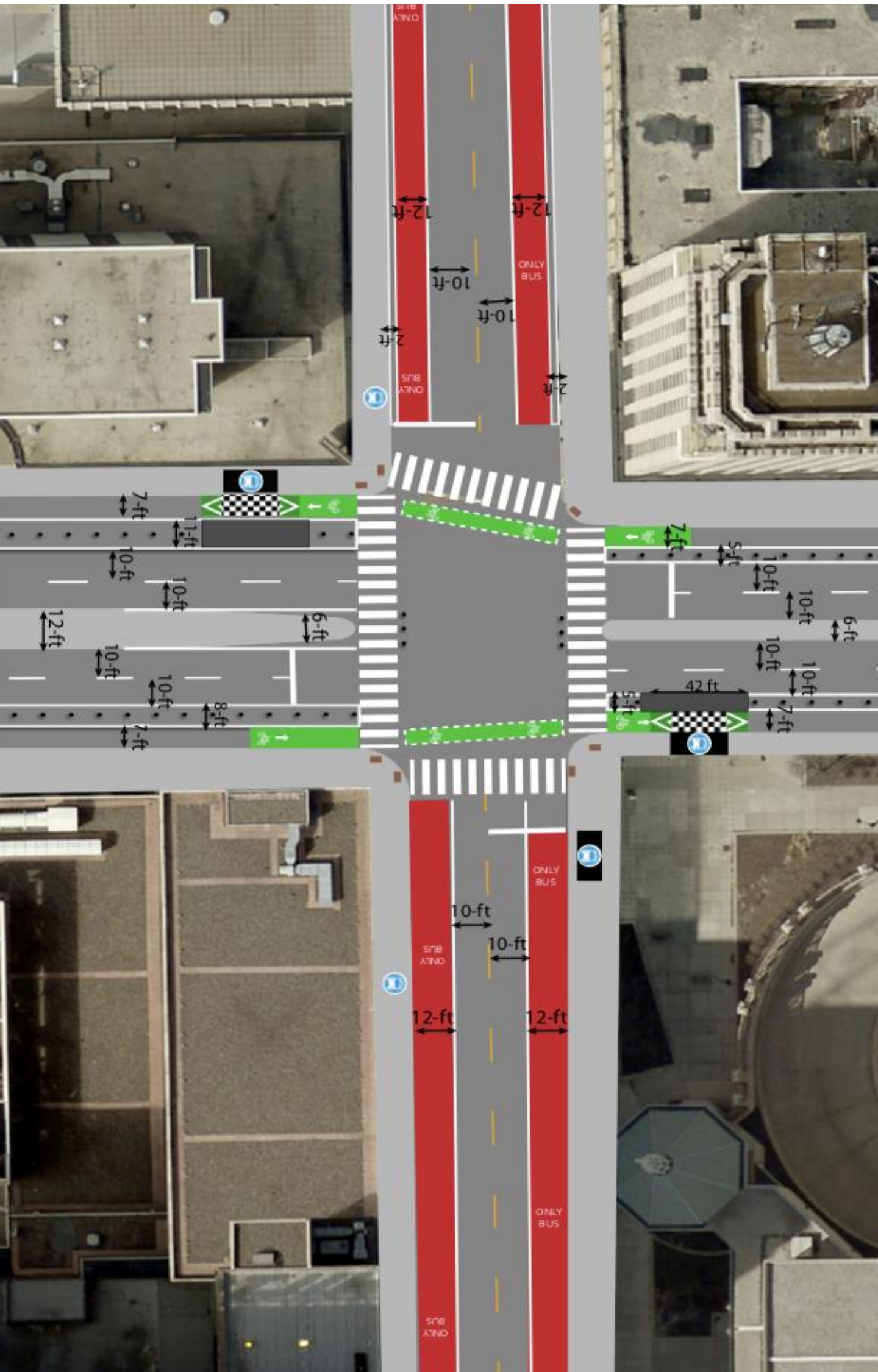
# Design Alternatives

IMMEDIATE REDESIGN

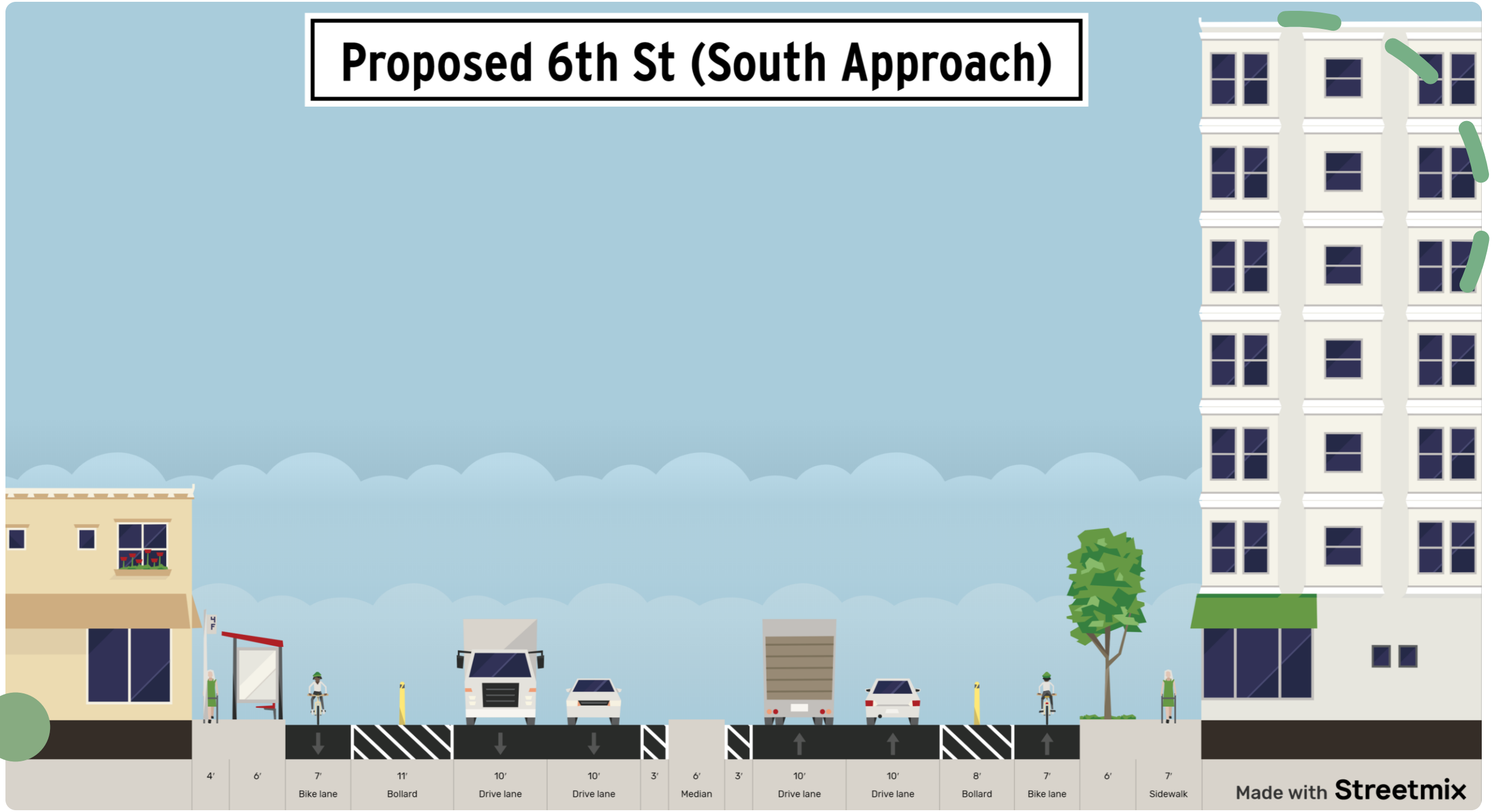
FUTURE – TRANSIT OPTION

FUTURE – BICYCLE OPTION

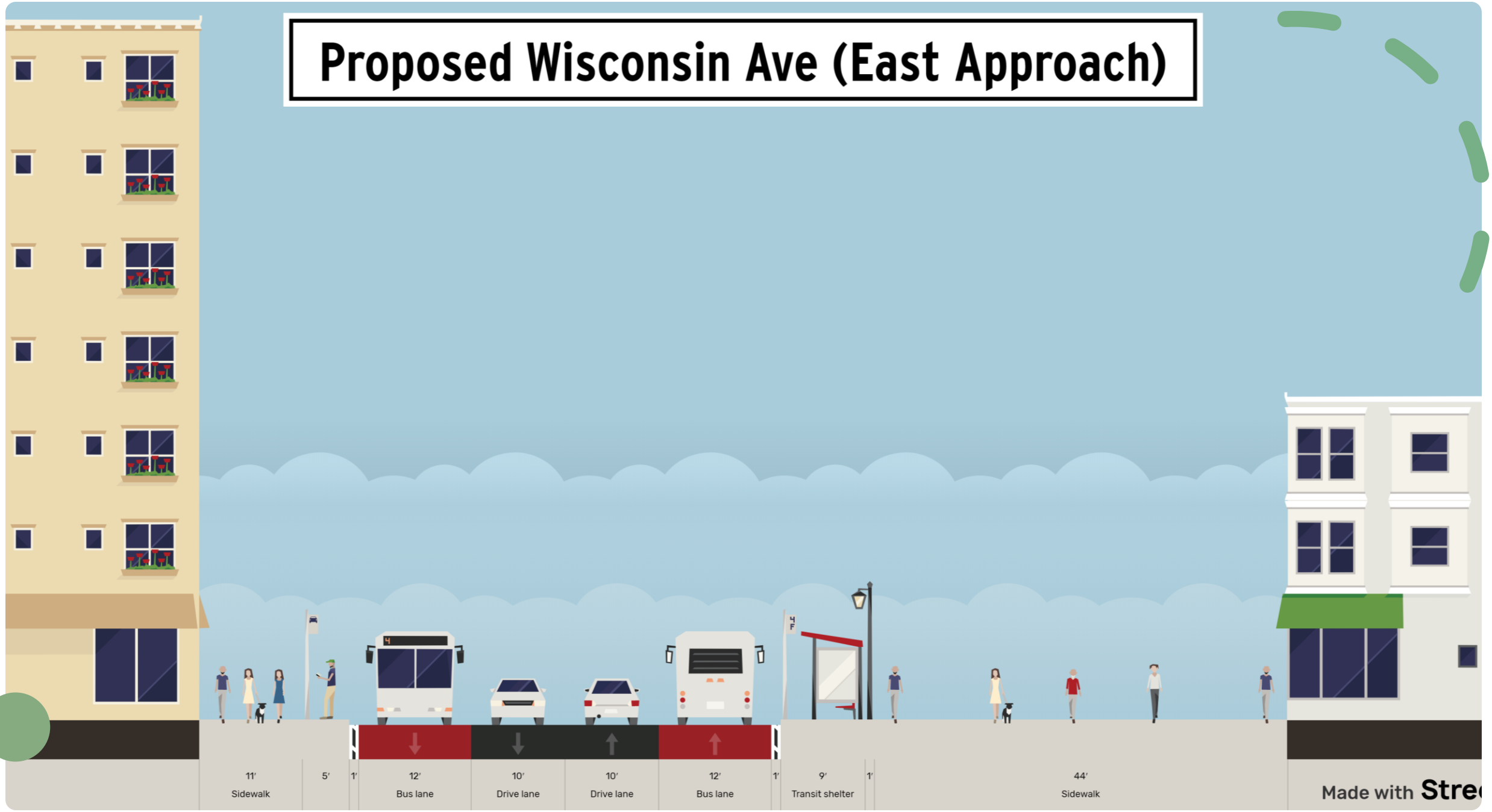
# Immediate Redesign



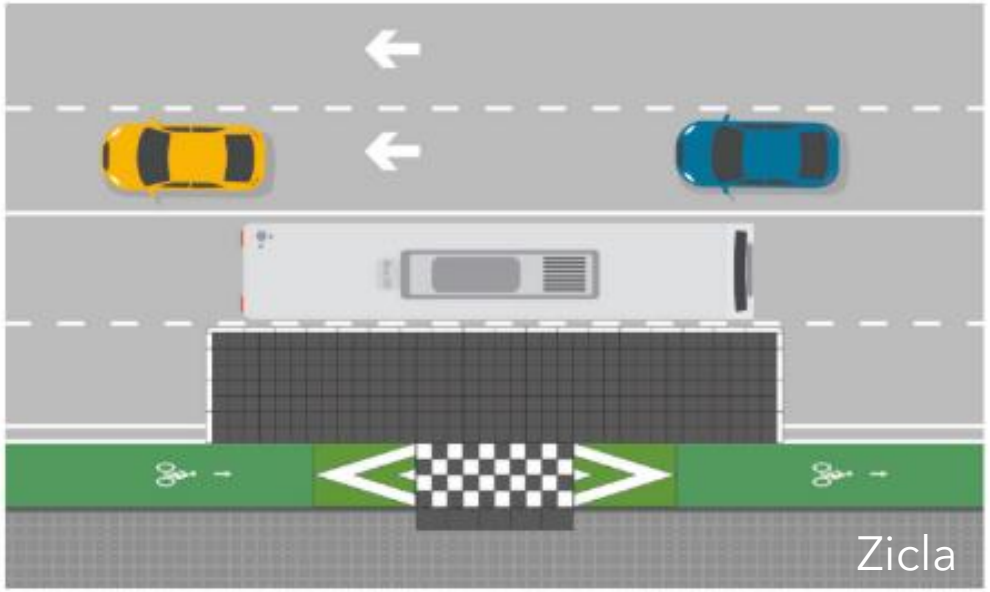
# Proposed 6th St (South Approach)



# Proposed Wisconsin Ave (East Approach)



# Key Elements

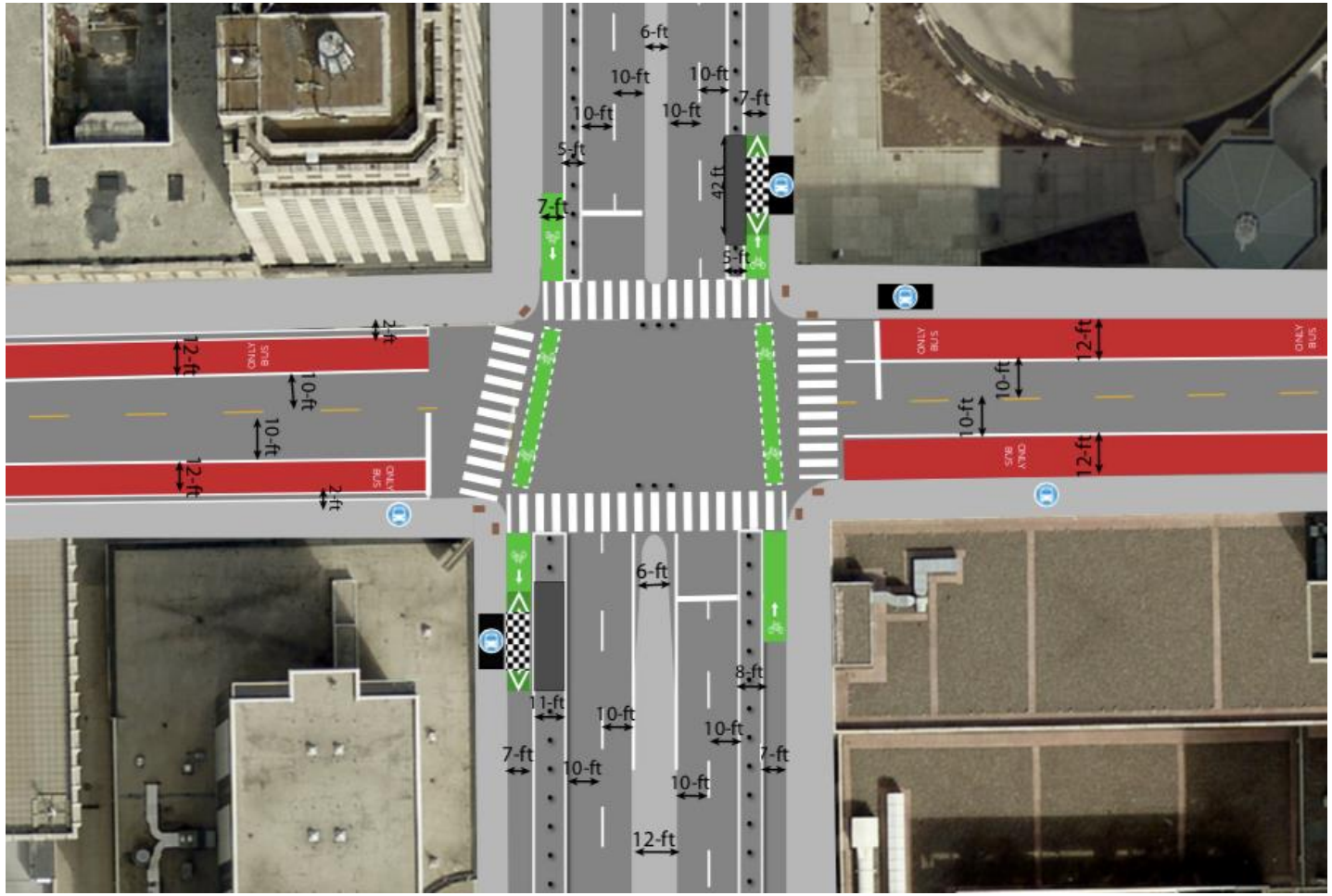



**BIKE LANE BOARDER WITH ACCESS BRIDGE**
**40ft BUS** *(42 ft 2 7/8 in x 14 ft 5 3/8 in).*

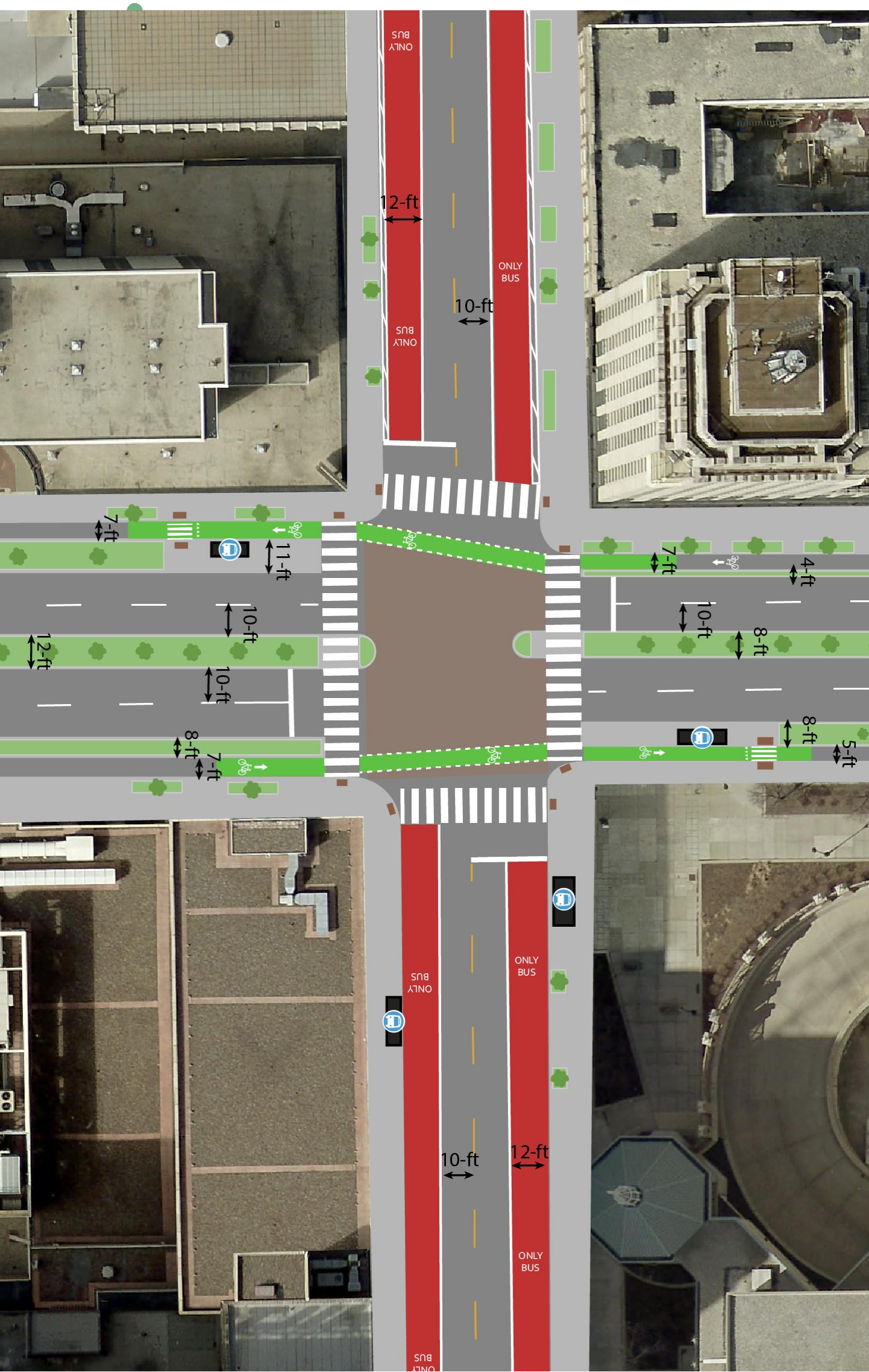
- Bus only lanes on Wisconsin
- Separated bike lanes on 6th
- Bus pads

# Immediate Redesign

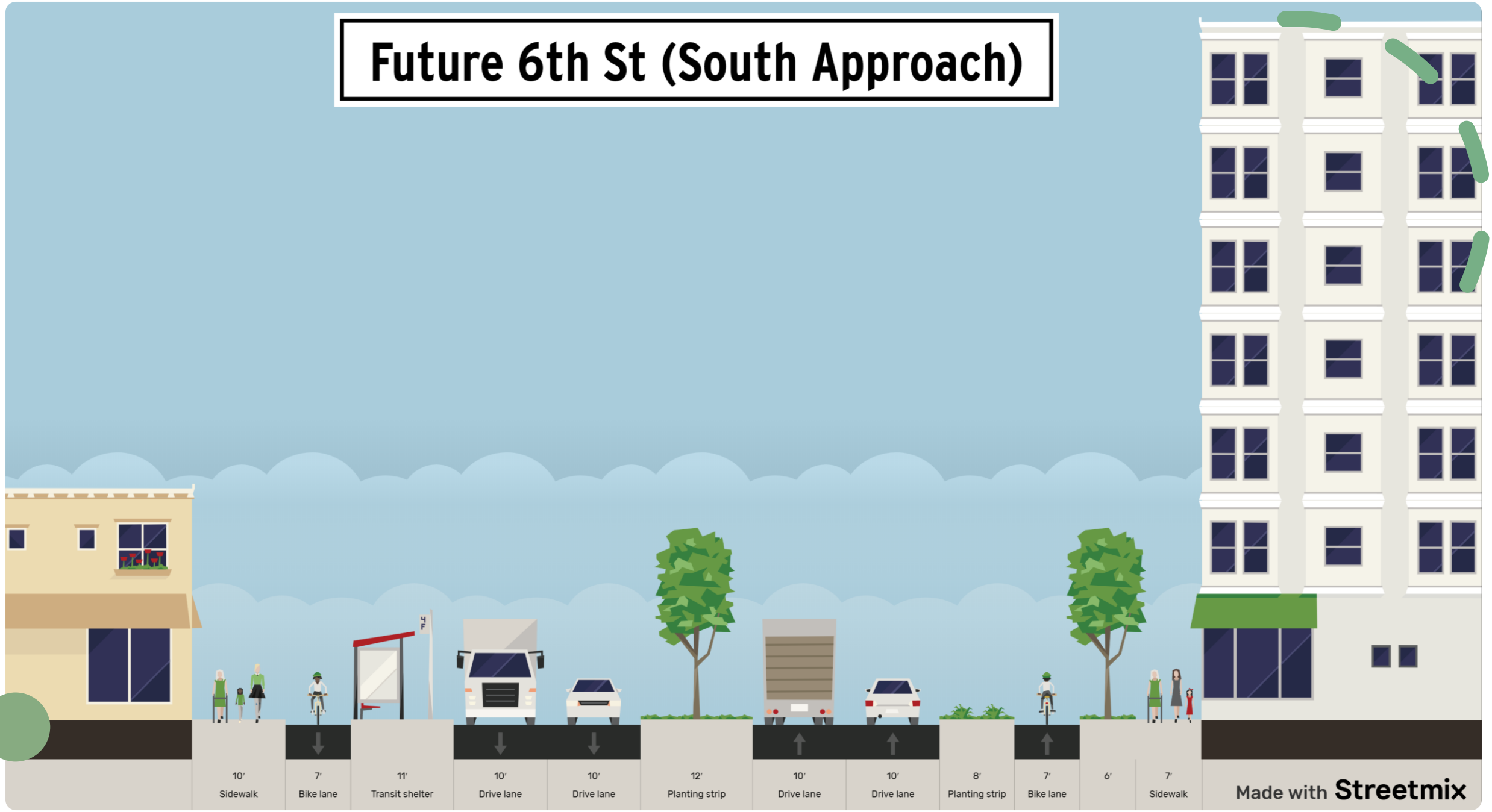
- Estimated Cost: $180,000
- Level of service
  - Wisconsin Ave
    - Pedestrian Grade: A
    - Bicycle Grade: NA
  - 6th Street
    - Pedestrian Grade: A
    - Bicycle Grade: A*
    - LOS is unable to account for separated bike lanes
- Bicycle Level of Traffic Stress
  - Wisconsin Ave: 3
  - 6th Street: 1



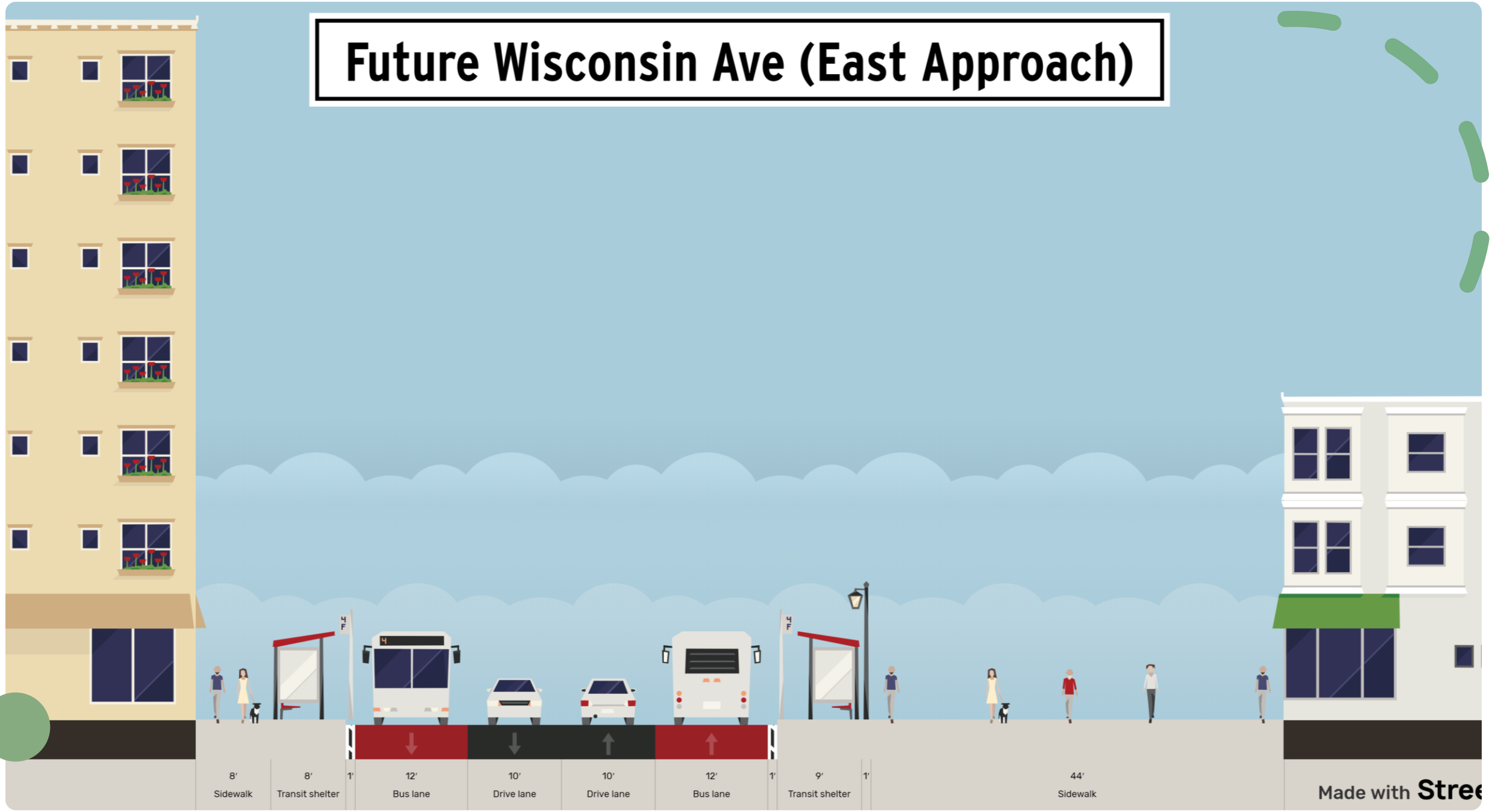
# Future – Transit Option



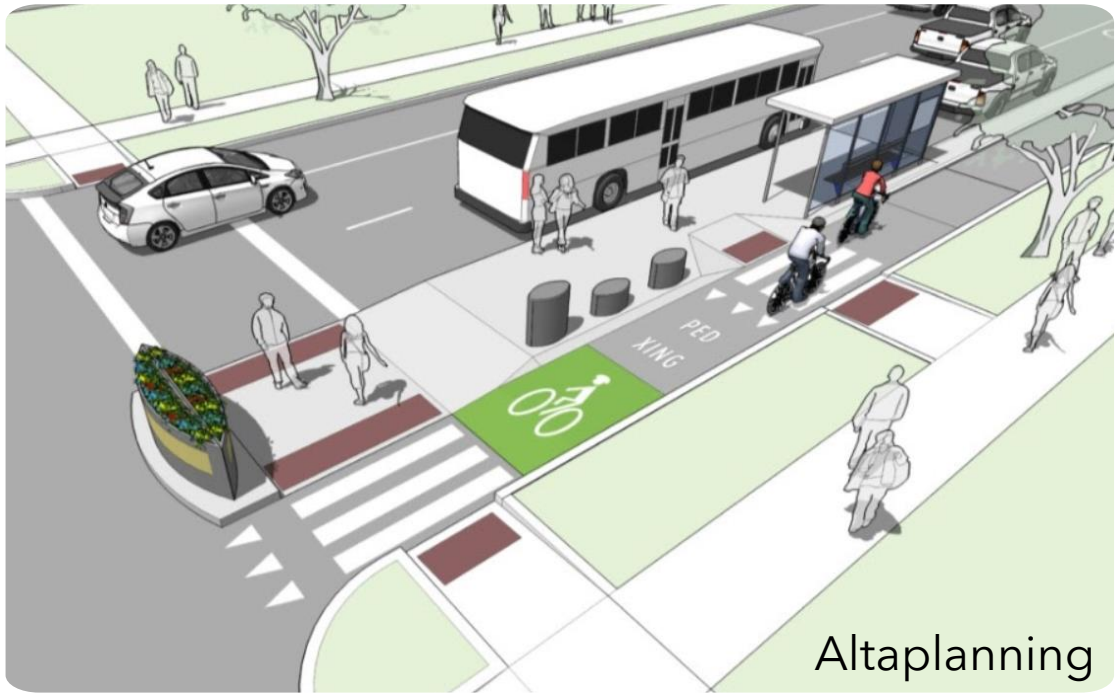
# Future 6th St (South Approach)



# Future Wisconsin Ave (East Approach)



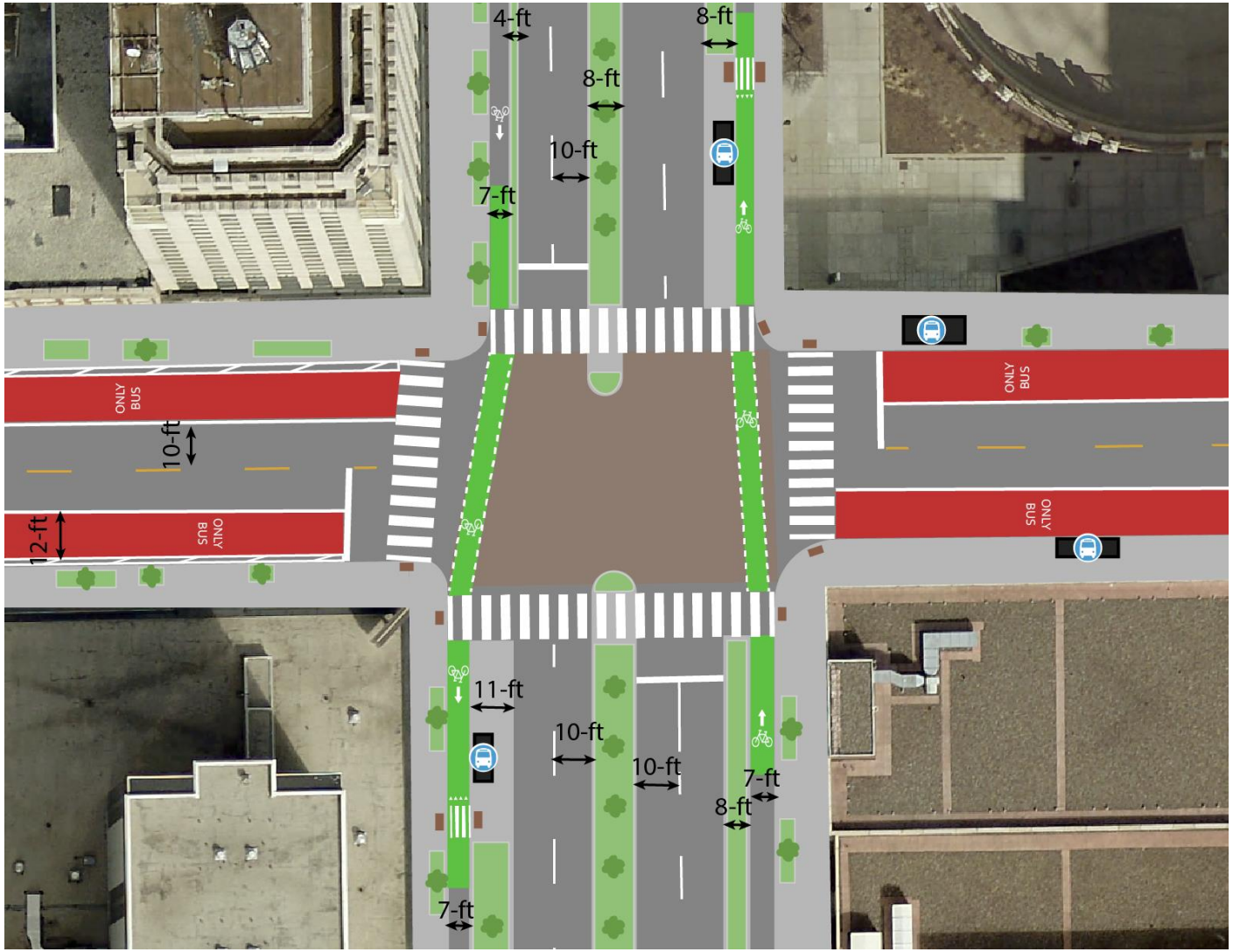
# Key Elements



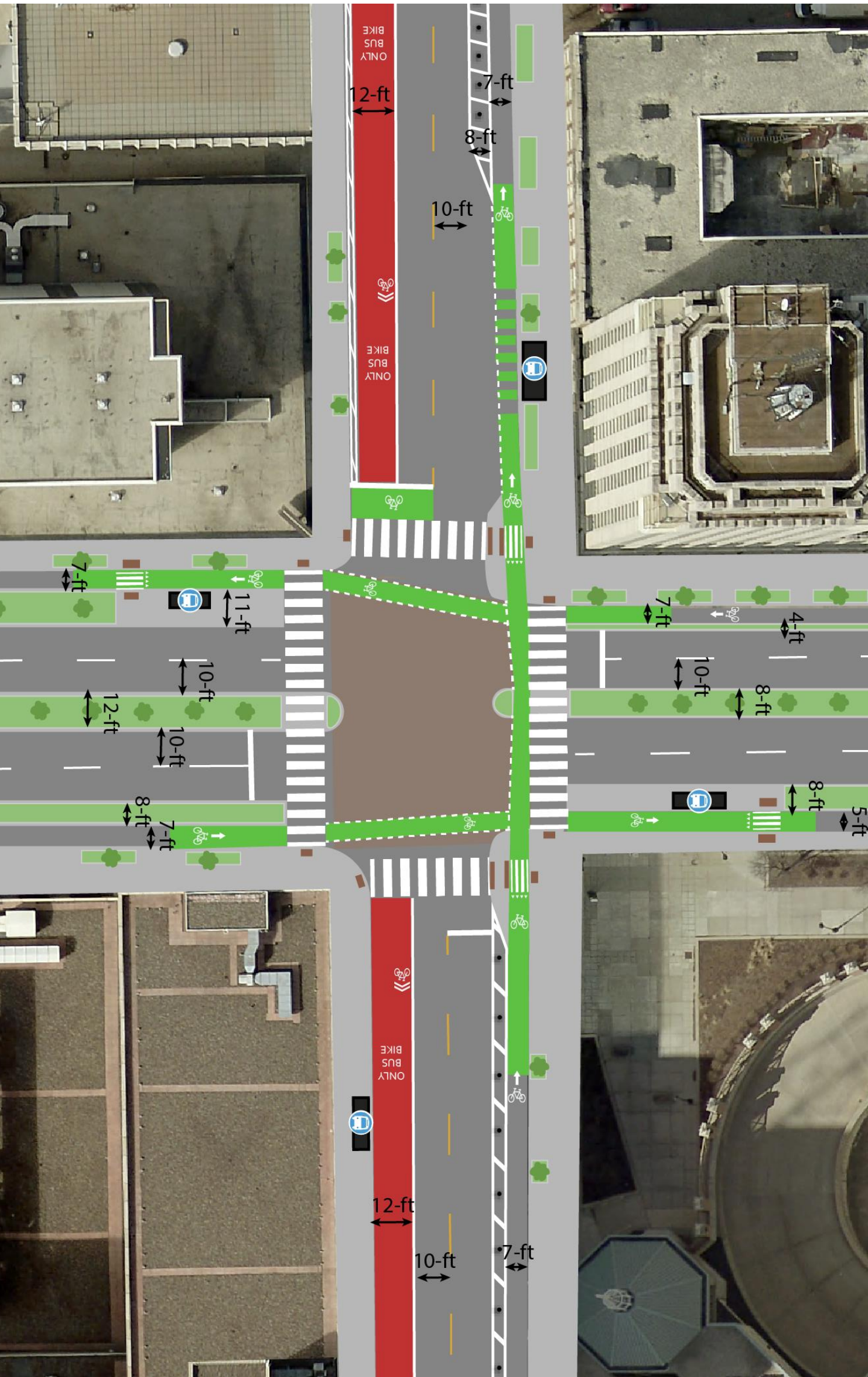

- Permanent bus stops on 6th
- Reconstructed medians with plantings
- Bike lanes separated by bioswales on 6th
- Bus only lanes on Wisconsin
- Plan for future bike lanes on W Michigan St

# Future – Transit Option

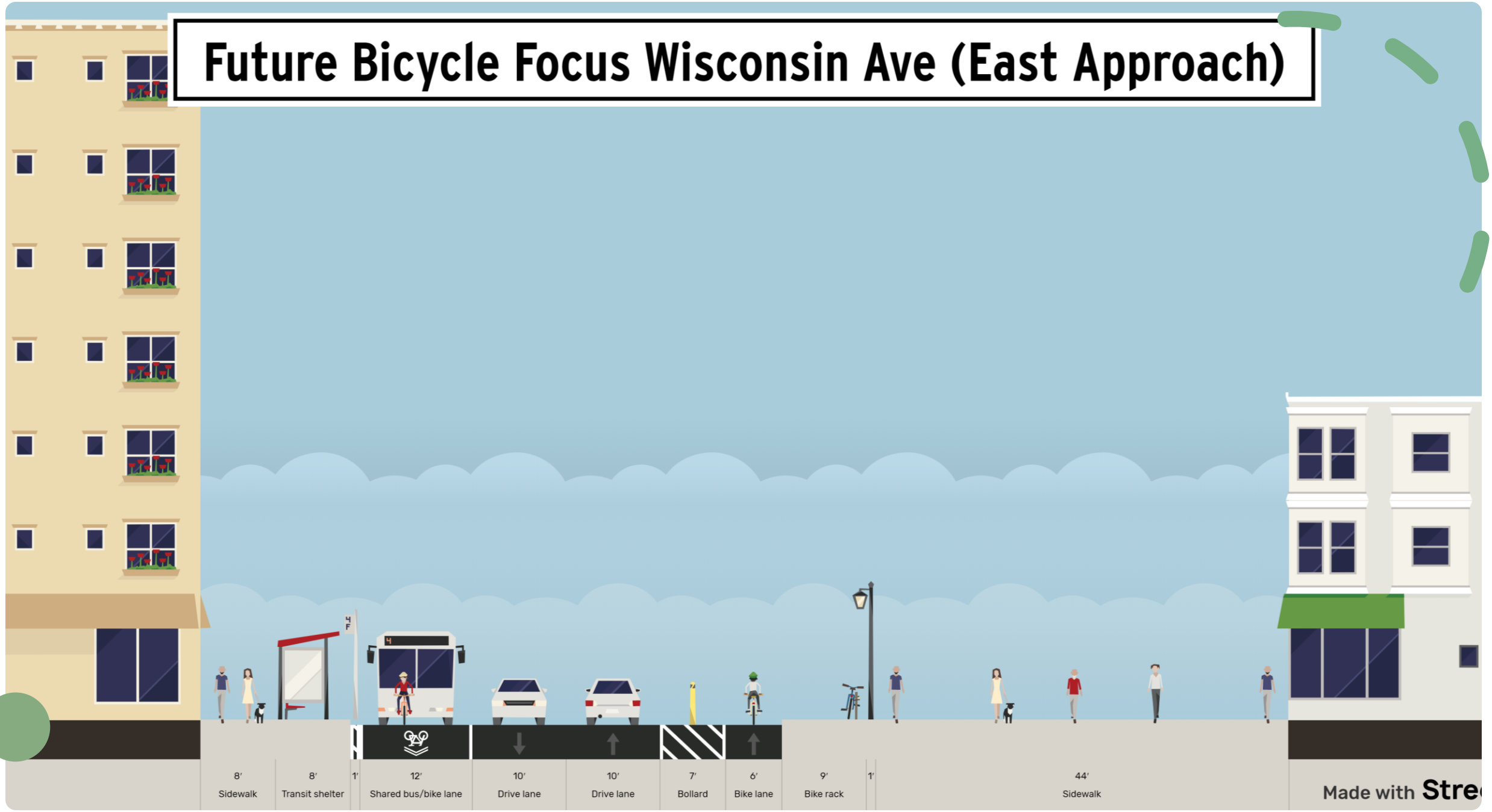
- Estimated Cost: $490,000
- Level of service
  - Wisconsin Ave
    - Pedestrian Grade: A
    - Bicycle Grade: NA
  - 6th Street
    - Pedestrian Grade: A
    - Bicycle Grade: A*
- Level of Traffic Stress
  - Wisconsin Ave: 3
  - 6th Street: 1



# Future - Bicycle Option



# Future Bicycle Focus Wisconsin Ave (East Approach)



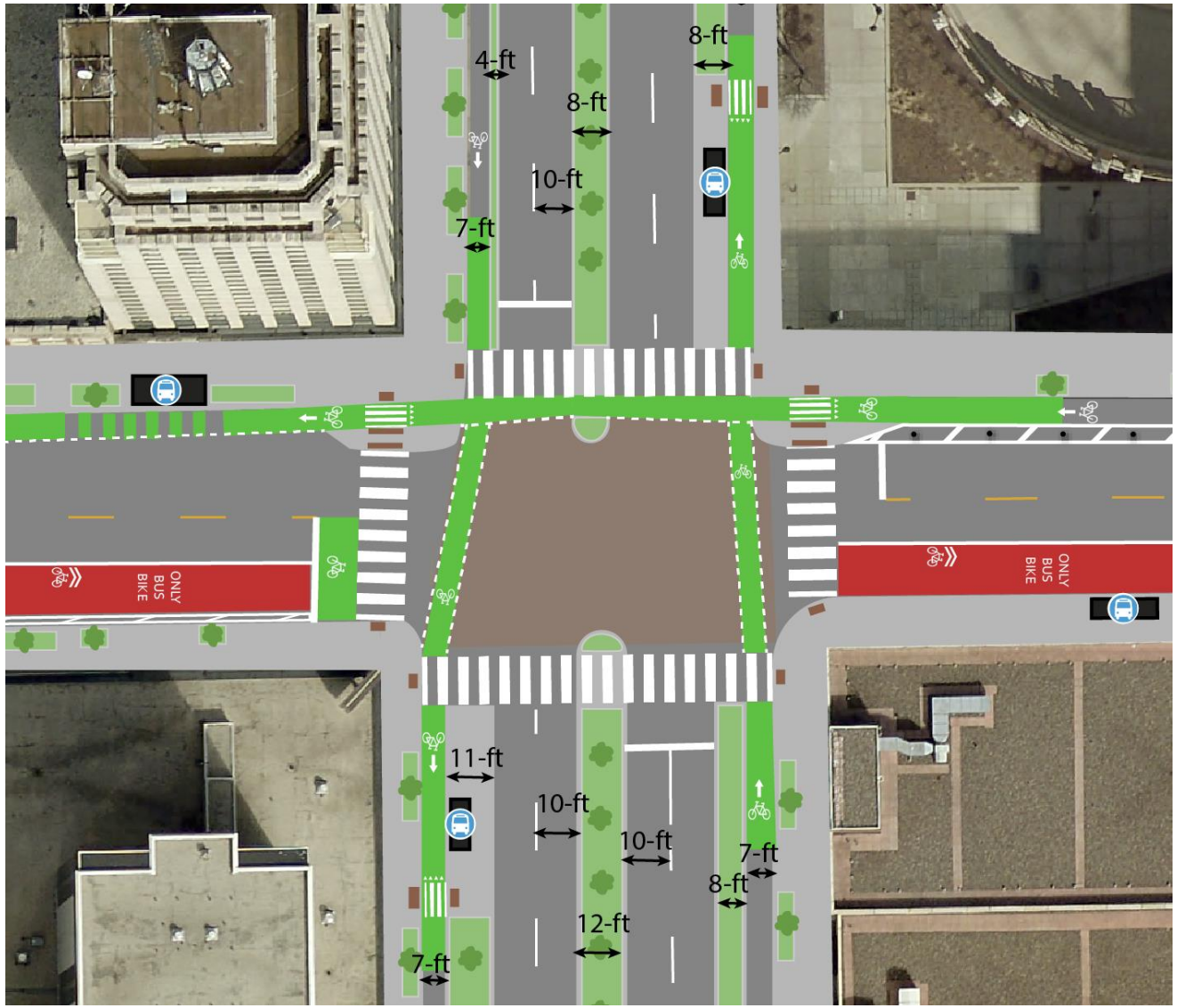
# Key Elements


Bike Box – Portland, OR

- Separated bike lane WB on Wisconsin
- Shared Bus and Bike lane EB on Wisconsin
- Curb Extensions
- Bike Box for turning from Wisconsin

# Future – Bicycle Option

- Estimated Cost: $500,000
- Level of service
  - Wisconsin Ave
    - Pedestrian Grade: A
    - Bicycle Grade: A
  - 6th Street
    - Pedestrian Grade: A
    - Bicycle Grade: A*
- Level of Traffic Stress
  - Wisconsin Ave: 2 WB, 3 EB
  - 6th Street: 1



# Recommended Plan

Phase 1: Immediate Redesign

Phase 2: Future – Transit Option

# Design Challenges

- Cost – project implementation and maintenance
- Opposition from road users / resistance to change
- Confusion by road users
- Need for education
- Need for enforcement

Questions?

# Image Sources

- Bus Pad Rendering - https://www.zicla.com/
- Bus Stop Island Rendering -https://altaplanning.com/separated-bike-lanes/
- Bike Box Photo - https://nacto.org/publication/urban-bikeway-design-guide/intersection-treatments/bike-boxes/
- Google Maps (October 2019)
- Approach Cross Sections made with Streetmix
- Cost Estimates – Dr Schneider's excel document

# Appendix

## Level of Service Calculations

**Intersection Before Improvements**

**Wisconsin Ave**

| Link-Based Pedestrian Level of Service Evaluation | | | | Link-Based Bicycle Level of Service Evaluation | | |
|---|---|---|---|---|---|---|
| | | *(Measure to the closest 0.5 feet)* | | | | *e to the closest* |
| **Input Variable Description** | **Variable** | **Measurement** | *(Typical range)* | **Input Variable Description** | **Variable** | **surement** |
| Number of through lanes in the study direction of travel | $N_{th}$ | 1.0 | *(1-4)* | Number of through lanes in the study direction of travel | $N_{th}$ | 1.0 |
| Character of cross-section (1= divided by median; 0 = undivided) | D | 0.0 | *(0-1)* | Character of cross-section (1 = divided by median; 0 = undivided) | D | 0.0 |
| Motorized vehicle running speed (miles/hour) | $S_r$ | 30.0 | *(5-55)* | Pavement condition rating (5 = excellent to 1 = poor) | $P_c$ | 3.0 |
| Midsegment automobile flow rate (vehicles/hour) | $v_m$ | 329.2 | *(100-3000)* | Motorized vehicle running speed (miles/hour) | $S_r$ | 30.0 |
| Width of the outside through lane (feet) | $W_{ol}$ | 13.0 | *(9-16)* | Adjusted motorized vehicle running speed (miles/hour) | $S_{ra}$ | 30.0 |
| Width of the bicycle lane (feet) (use 0 if doesn't exist) | $W_{bl}$ | 0.0 | *(0-7)* | Midsegment automobile flow rate (vehicles/hour) | $v_m$ | 329.2 |
| Width of the paved outside shoulder or parking area (feet) | $W_{os}$ | 12.0 | *(0-10)* | Adjusted midsegment demand flow rate (vehicles/hour) | $v_{ma}$ | 329.2 |
| Curb is present (1 = yes; 0 = no) | C | 1.0 | *(0-1)* | Percent heavy vehicle volume (percentage) | $P_{HV}$ | 4.0 |
| Adjusted Width of the paved outside shoulder (feet) | $W_{os}$* | 10.5 | | Adjusted percent heavy vehicle volume (percentage) | $P_{HVa}$ | 4.0 |
| Proportion of on-street parking occupied (decimal) | $p_{pk}$ | 0.50 | *(0-0.9)* | Width of the outside through lane (feet) | $W_{ol}$ | 12.0 |
| Effective width of combined bicycle lane and shoulder or parking area (feet) | $W_1$ | 10.0 | | Width of the bicycle lane (feet) (use 0 if doesn't exist) | $W_{bl}$ | 0.0 |
| Total width of outside through lane, bicycle lane, & paved shoulder (feet) | $W_t$ | 13.0 | | Width of the paved outside shoulder or parking area (feet) | $W_{os}$ | 13.0 |
| Effective width of outside through lane, BL & shoulder as function of traffic volume (feet) | $W_v$ | 13.0 | | Curb is present (1 = yes; 0 = no) | C | 1.0 |
| Buffer width between roadway and sidewalk (ft) (use 0 if no SW) | $W_{buf}$ | 5.0 | *(0-12)* | Adjusted Width of the paved outside shoulder or parking area (feet) | $W_{os}$* | 11.5 |
| Continuous barrier (1 = Y; 0 = N) | B | 0.0 | *(0-1)* | Proportion of on-street parking occupied (decimal) | $p_{pk}$ | 0.50 |
| Buffer area coefficient | $f_b$ | 1.0 | | Total width of outside through lane, bicycle lane, & paved shoulder (feet) | $W_t$ | 12.0 |
| Sidewalk width *(not including buffer)* (feet) (use 0 if doesn't exist) | $W_{sw}$ | 6.0 | *(0-16)* | Effective width of outside through lane, BL & shoulder as function of traffic volume (feet) | $W_v$ | 12.0 |
| Adjusted available sidewalk width | $W_{as}$ | 6.0 | | Effective width of outside through lane (feet) | $W_o$ | 15.0 |
| Sidewalk width coefficient | $f_{sw}$ | 4.2 | | Cross-section adjustment factor | $F_w$ | -1.13 |
| **Pedestrian LOS score for the roadway link** | $I_{p,link}$ | **1.89** | | **Bicycle LOS score for the roadway link** | $I_{b,link}$ | **4.01** |
| **Pedestrian LOS grade for the roadway link** | **Grade** | **A** | | **Bicycle LOS grade for the roadway link** | **Grade** | **D** |

**6th Street**

| Link-Based Pedestrian Level of Service Evaluation | | | | Link-Based Bicycle Level of Service Evaluation | | |
|---|---|---|---|---|---|---|
| | | *(Measure to the closest 0.5 feet)* | | | | *(Measur e to the closest 0.5 feet)* |
| **Input Variable Description** | **Variable** | **Measurement** | *(Typical range)* | **Input Variable Description** | **Variable** | **surement** |
| Number of through lanes in the study direction of travel | $N_{th}$ | 3.0 | *(1-4)* | Number of through lanes in the study direction of travel | $N_{th}$ | 3.0 |
| Character of cross-section (1= divided by median; 0 = undivided) | D | 1.0 | *(0-1)* | Character of cross-section (1 = divided by median; 0 = undivided) | D | 1.0 |
| Motorized vehicle running speed (miles/hour) | $S_r$ | 30.0 | *(5-55)* | Pavement condition rating (5 = excellent to 1 = poor) | $P_c$ | 3.0 |
| Midsegment automobile flow rate (vehicles/hour) | $v_m$ | 745.8 | *(100-3000)* | Motorized vehicle running speed (miles/hour) | $S_r$ | 30.0 |
| Width of the outside through lane (feet) | $W_{ol}$ | 11.0 | *(9-16)* | Adjusted motorized vehicle running speed (miles/hour) | $S_{ra}$ | 30.0 |
| Width of the bicycle lane (feet) (use 0 if doesn't exist) | $W_{bl}$ | 0.0 | *(0-7)* | Midsegment automobile flow rate (vehicles/hour) | $v_m$ | 745.8 |
| Width of the paved outside shoulder or parking area (feet) | $W_{os}$ | 11.0 | *(0-10)* | Adjusted midsegment demand flow rate (vehicles/hour) | $v_{ma}$ | 745.8 |
| Curb is present (1 = yes; 0 = no) | C | 1.0 | *(0-1)* | Percent heavy vehicle volume (percentage) | $P_{HV}$ | 4.0 |
| Adjusted Width of the paved outside shoulder (feet) | $W_{os}$* | 9.5 | | Adjusted percent heavy vehicle volume (percentage) | $P_{HVa}$ | 4.0 |
| Proportion of on-street parking occupied (decimal) | $p_{pk}$ | 0.50 | *(0-0.9)* | Width of the outside through lane (feet) | $W_{ol}$ | 11.0 |
| Effective width of combined bicycle lane and shoulder or parking area (feet) | $W_1$ | 10.0 | | Width of the bicycle lane (feet) (use 0 if doesn't exist) | $W_{bl}$ | 0.0 |
| Total width of outside through lane, bicycle lane, & paved shoulder (feet) | $W_t$ | 11.0 | | Width of the paved outside shoulder or parking area (feet) | $W_{os}$ | 12.0 |
| Effective width of outside through lane, BL & shoulder as function of traffic volume (feet) | $W_v$ | 11.0 | | Curb is present (1 = yes; 0 = no) | C | 1.0 |
| Buffer width between roadway and sidewalk (ft) (use 0 if no SW) | $W_{buf}$ | 0.0 | *(0-12)* | Adjusted Width of the paved outside shoulder or parking area (feet) | $W_{os}$* | 10.5 |
| Continuous barrier (1 = Y; 0 = N) | B | 0.0 | *(0-1)* | Proportion of on-street parking occupied (decimal) | $p_{pk}$ | 0.50 |
| Buffer area coefficient | $f_b$ | 1.0 | | Total width of outside through lane, bicycle lane, & paved shoulder (feet) | $W_t$ | 11.0 |
| Sidewalk width *(not including buffer)* (feet) (use 0 if doesn't exist) | $W_{sw}$ | 12.0 | *(0-16)* | Effective width of outside through lane, BL & shoulder as function of traffic volume (feet) | $W_v$ | 11.0 |
| Adjusted available sidewalk width | $W_{as}$ | 10.0 | | Effective width of outside through lane (feet) | $W_o$ | 13.0 |
| Sidewalk width coefficient | $f_{sw}$ | 3.0 | | Cross-section adjustment factor | $F_w$ | -0.85 |
| Cross-section adjustment factor | $F_w$ | -5.23 | | Motorized vehicle volume adjustment factor | $F_v$ | 2.09 |
| Motorized vehicle volume adjustment factor | $F_v$ | 0.57 | | Motorized vehicle speed adjustment factor | $F_s$ | 1.35 |
| Motorized vehicle speed adjustment factor | $F_s$ | 0.36 | | Motorized vehicle speed adjustment factor | $F_p$ | 0.79 |
| **Pedestrian LOS score for the roadway link** | $I_{p,link}$ | **1.74** | | **Bicycle LOS score for the roadway link** | $I_{b,link}$ | **4.14** |
| **Pedestrian LOS grade for the roadway link** | **Grade** | **A** | | **Bicycle LOS grade for the roadway link** | **Grade** | **D** |

# Appendix

## Level of Service Calculations

**Immediate Redesign**

Wisconsin Ave

| Link-Based Pedestrian Level of Service Evaluation | | | | Link-Based Bicycle Level of Service Evaluation | | |
|---|---|---|---|---|---|---|
| | | *(Measure to the closest 0.5 feet)* | | | | *(Measure to the closest* |
| **Input Variable Description** | **Variable** | **Measurement** | *(Typical range)* | **Input Variable Description** | **Variable** | **asurement** |
| Number of through lanes in the study direction of travel | $N_{th}$ | 1.0 | *(1-4)* | Number of through lanes in the study direction of travel | $N_{th}$ | |
| Character of cross-section (1= divided by median; 0 = undivided) | D | 0.0 | *(0-1)* | Character of cross-section (1 = divided by median; 0 = undivided) | D | |
| Motorized vehicle running speed (miles/hour) | $S_r$ | 30.0 | *(5-55)* | Pavement condition rating (5 = excellent to 1 = poor) | $P_c$ | |
| Midsegment automobile flow rate (vehicles/hour) | $v_m$ | 329.2 | *(100-3000)* | Motorized vehicle running speed (miles/hour) | $S_r$ | |
| Width of the outside through lane (feet) | $W_{ol}$ | 10.0 | *(9-16)* | Adjusted motorized vehicle running speed (miles/hour) | $S_{ra}$ | |
| Width of the bicycle lane (feet) (use 0 if doesn't exist) | $W_{bl}$ | 0.0 | *(0-7)* | Midsegment automobile flow rate (vehicles/hour) | $v_m$ | |
| Width of the paved outside shoulder or parking area (feet) | $W_{os}$ | 12.0 | *(0-10)* | Adjusted midsegment demand flow rate (vehicles/hour) | $v_{ma}$ | |
| Curb is present (1 = yes; 0 = no) | C | 1.0 | *(0-1)* | Percent heavy vehicle volume (percentage) | $P_{HV}$ | |
| Adjusted Width of the paved outside shoulder (feet) | $W_{os}$* | 10.5 | | Adjusted percent heavy vehicle volume (percentage) | $P_{HVa}$ | |
| Proportion of on-street parking occupied (decimal) | $p_{pk}$ | 0.50 | *(0-0.9)* | Width of the outside through lane (feet) | $W_{ol}$ | |
| Effective width of combined bicycle lane and shoulder or parking area (feet) | $W_1$ | 10.0 | | Width of the bicycle lane (feet) (use 0 if doesn't exist) | $W_{bl}$ | |
| Total width of outside through lane, bicycle lane, & paved shoulder (feet) | $W_t$ | 10.0 | | Width of the paved outside shoulder or parking area (feet) | $W_{os}$ | |
| Effective width of outside through lane, BL & shoulder as function of traffic volume (feet) | $W_v$ | 10.0 | | Curb is present (1 = yes; 0 = no) | C | |
| Buffer width between roadway and sidewalk (ft) (use 0 if no SW) | $W_{buf}$ | 5.0 | *(0-12)* | Adjusted Width of the paved outside shoulder or parking area (feet) | $W_{os}$* | |
| Continuous barrier (1 = Y; 0 = N) | B | 0.0 | *(0-1)* | Proportion of on-street parking occupied (decimal) | $p_{pk}$ | |
| Buffer area coefficient | $f_b$ | 1.0 | | Total width of outside through lane, bicycle lane, & paved shoulder (feet) | $W_t$ | |
| Sidewalk width *(not including buffer)* (feet) (use 0 if doesn't exist) | $W_{sw}$ | 7.0 | *(0-16)* | Effective width of outside through lane, BL & shoulder as function of traffic volume (feet) | $W_v$ | |
| Adjusted available sidewalk width | $W_{as}$ | 7.0 | | Effective width of outside through lane (feet) | $W_e$ | |
| **Pedestrian LOS score for the roadway link** | $I_{p,link}$ | **1.90** | | **Bicycle LOS score for the roadway link** | $I_{b,link}$ | |
| **Pedestrian LOS grade for the roadway link** | **Grade** | **A** | | **Bicycle LOS grade for the roadway link** | **Grade** | **NA** |

6th Street

| Link-Based Pedestrian Level of Service Evaluation | | | | Link-Based Bicycle Level of Service Evaluation | | |
|---|---|---|---|---|---|---|
| | | *(Measure to the closest 0.5 feet)* | | | | *(Measure to the closest 0.5 feet)* |
| **Input Variable Description** | **Variable** | **Measurement** | *(Typical range)* | **Input Variable Description** | **Variable** | **asurement** |
| Number of through lanes in the study direction of travel | $N_{th}$ | 2.0 | *(1-4)* | Number of through lanes in the study direction of travel | $N_{th}$ | 2.0 |
| Character of cross-section (1= divided by median; 0 = undivided) | D | 1.0 | *(0-1)* | Character of cross-section (1 = divided by median; 0 = undivided) | D | 1.0 |
| Motorized vehicle running speed (miles/hour) | $S_r$ | 30.0 | *(5-55)* | Pavement condition rating (5 = excellent to 1 = poor) | $P_c$ | 5.0 |
| Midsegment automobile flow rate (vehicles/hour) | $v_m$ | 745.8 | *(100-3000)* | Motorized vehicle running speed (miles/hour) | $S_r$ | 30.0 |
| Width of the outside through lane (feet) | $W_{ol}$ | 10.0 | *(9-16)* | Adjusted motorized vehicle running speed (miles/hour) | $S_{ra}$ | 30.0 |
| Width of the bicycle lane (feet) (use 0 if doesn't exist) | $W_{bl}$ | 7.0 | *(0-7)* | Midsegment automobile flow rate (vehicles/hour) | $v_m$ | 745.8 |
| Width of the paved outside shoulder or parking area (feet) | $W_{os}$ | 11.0 | *(0-10)* | Adjusted midsegment demand flow rate (vehicles/hour) | $v_{ma}$ | 745.8 |
| Curb is present (1 = yes; 0 = no) | C | 1.0 | *(0-1)* | Percent heavy vehicle volume (percentage) | $P_{HV}$ | 4.0 |
| Adjusted Width of the paved outside shoulder (feet) | $W_{os}$* | 9.5 | | Adjusted percent heavy vehicle volume (percentage) | $P_{HVa}$ | 4.0 |
| Proportion of on-street parking occupied (decimal) | $p_{pk}$ | 0.50 | *(0-0.9)* | Width of the outside through lane (feet) | $W_{ol}$ | 10.0 |
| Effective width of combined bicycle lane and shoulder or parking area (feet) | $W_1$ | 10.0 | | Width of the bicycle lane (feet) (use 0 if doesn't exist) | $W_{bl}$ | 7.0 |
| Total width of outside through lane, bicycle lane, & paved shoulder (feet) | $W_t$ | 17.0 | | Width of the paved outside shoulder or parking area (feet) | $W_{os}$ | 11.0 |
| Effective width of outside through lane, BL & shoulder as function of traffic volume (feet) | $W_v$ | 17.0 | | Curb is present (1 = yes; 0 = no) | C | 1.0 |
| Buffer width between roadway and sidewalk (ft) (use 0 if no SW) | $W_{buf}$ | 5.0 | *(0-12)* | Adjusted Width of the paved outside shoulder or parking area (feet) | $W_{os}$* | 9.5 |
| Continuous barrier (1 = Y; 0 = N) | B | 0.0 | *(0-1)* | Proportion of on-street parking occupied (decimal) | $p_{pk}$ | 0.50 |
| Buffer area coefficient | $f_b$ | 1.0 | | Total width of outside through lane, bicycle lane, & paved shoulder (feet) | $W_t$ | 17.0 |
| Sidewalk width *(not including buffer)* (feet) (use 0 if doesn't exist) | $W_{sw}$ | 6.0 | *(0-16)* | Effective width of outside through lane, BL & shoulder as function of traffic volume (feet) | $W_v$ | 17.0 |
| Adjusted available sidewalk width | $W_{as}$ | 6.0 | | Effective width of outside through lane (feet) | $W_e$ | 25.0 |
| Sidewalk width coefficient | $f_{sw}$ | 4.2 | | Cross-section adjustment factor | $F_w$ | -3.13 |
| Cross-section adjustment factor | $F_w$ | -5.34 | | Motorized vehicle volume adjustment factor | $F_v$ | 2.30 |
| Motorized vehicle volume adjustment factor | $F_v$ | 0.85 | | Motorized vehicle speed adjustment factor | $F_s$ | 1.35 |
| Motorized vehicle speed adjustment factor | $F_s$ | 0.36 | | Motorized vehicle speed adjustment factor | $F_p$ | 0.28 |
| **Pedestrian LOS score for the roadway link** | $I_{p,link}$ | **1.92** | | **Bicycle LOS score for the roadway link** | $I_{b,link}$ | **1.57** |
| **Pedestrian LOS grade for the roadway link** | **Grade** | **A** | | **Bicycle LOS grade for the roadway link** | **Grade** | **A** |

# Appendix

## Level of Service Calculations

**Transit Design**

**Wisconsin Ave**

| Link-Based Pedestrian Level of Service Evaluation | | | | Link-Based Bicycle Level of Service Evaluation | | |
|---|---|---|---|---|---|---|
| | | *(Measure to the closest 0.5 feet)* | | | | *(Measure to the closest* |
| **Input Variable Description** | **Variable** | **Measurement** | *(Typical range)* | **Input Variable Description** | **Variable** | **asurement** |
| Number of through lanes in the study direction of travel | $N_{th}$ | 1.0 | *(1-4)* | Number of through lanes in the study direction of travel | $N_{th}$ | |
| Character of cross-section (1= divided by median; 0 = undivided) | D | 0.0 | *(0-1)* | Character of cross-section (1 = divided by median; 0 = undivided) | D | |
| Motorized vehicle running speed (miles/hour) | $S_r$ | 30.0 | *(5-55)* | Pavement condition rating (5 = excellent to 1 = poor) | $P_c$ | |
| Midsegment automobile flow rate (vehicles/hour) | $v_m$ | 329.2 | *(100-3000)* | Motorized vehicle running speed (miles/hour) | $S_r$ | |
| Width of the outside through lane (feet) | $W_{ol}$ | 10.0 | *(9-16)* | Adjusted motorized vehicle running speed (miles/hour) | $S_{ra}$ | |
| Width of the bicycle lane (feet) (use 0 if doesn't exist) | $W_{bl}$ | 0.0 | *(0-7)* | Midsegment automobile flow rate (vehicles/hour) | $v_m$ | |
| Width of the paved outside shoulder or parking area (feet) | $W_{os}$ | 12.0 | *(0-10)* | Adjusted midsegment demand flow rate (vehicles/hour) | $v_{ms}$ | |
| Curb is present (1 = yes; 0 = no) | C | 1.0 | *(0-1)* | Percent heavy vehicle volume (percentage) | $P_{HV}$ | |
| Adjusted Width of the paved outside shoulder (feet) | $W_{os}$* | 10.5 | | Adjusted percent heavy vehicle volume (percentage) | $P_{HVa}$ | |
| Proportion of on-street parking occupied (decimal) | $p_{pk}$ | 0.50 | *(0-0.9)* | Width of the outside through lane (feet) | $W_{ol}$ | |
| Effective width of combined bicycle lane and shoulder or parking area (feet) | $W_1$ | 10.0 | | Width of the bicycle lane (feet) (use 0 if doesn't exist) | $W_{bl}$ | |
| Total width of outside through lane, bicycle lane, & paved shoulder (feet) | $W_t$ | 10.0 | | Width of the paved outside shoulder or parking area (feet) | $W_{os}$ | |
| Effective width of outside through lane, BL & shoulder as function of traffic volume (feet) | $W_v$ | 10.0 | | Curb is present (1 = yes; 0 = no) | C | |
| Buffer width between roadway and sidewalk (ft) (use 0 if no SW) | $W_{buf}$ | 5.0 | *(0-12)* | Adjusted Width of the paved outside shoulder or parking area (feet) | $W_{os}$* | |
| Continuous barrier (1 = Y; 0 = N) | B | 0.0 | *(0-1)* | Proportion of on-street parking occupied (decimal) | $p_{pk}$ | |
| Buffer area coefficient | $f_b$ | 1.0 | | Total width of outside through lane, bicycle lane, & paved shoulder (feet) | $W_t$ | |
| Sidewalk width *(not including buffer)* (feet) (use 0 if doesn't exist) | $W_{sw}$ | 6.0 | *(0-16)* | Effective width of outside through lane, BL & shoulder as function of traffic volume (feet) | $W_v$ | |
| Adjusted available sidewalk width | $W_{as}$ | 6.0 | | Effective width of outside through lane (feet) | $W_o$ | |
| **Pedestrian LOS score for the roadway link** | $I_{p,link}$ | **1.94** | | **Bicycle LOS score for the roadway link** | $I_{b,link}$ | |
| **Pedestrian LOS grade for the roadway link** | **Grade** | **A** | | **Bicycle LOS grade for the roadway link** | **Grade** | **NA** |

**6th Street**

| Link-Based Pedestrian Level of Service Evaluation | | | | Link-Based Bicycle Level of Service Evaluation | | |
|---|---|---|---|---|---|---|
| | | *(Measure to the closest 0.5 feet)* | | | | *(Measure to the closest 0.5 feet)* |
| **Input Variable Description** | **Variable** | **Measurement** | *(Typical range)* | **Input Variable Description** | **Variable** | **asurement** |
| Number of through lanes in the study direction of travel | $N_{th}$ | 2.0 | *(1-4)* | Number of through lanes in the study direction of travel | $N_{th}$ | 2.0 |
| Character of cross-section (1= divided by median; 0 = undivided) | D | 1.0 | *(0-1)* | Character of cross-section (1 = divided by median; 0 = undivided) | D | 1.0 |
| Motorized vehicle running speed (miles/hour) | $S_r$ | 30.0 | *(5-55)* | Pavement condition rating (5 = excellent to 1 = poor) | $P_c$ | 5.0 |
| Midsegment automobile flow rate (vehicles/hour) | $v_m$ | 745.8 | *(100-3000)* | Motorized vehicle running speed (miles/hour) | $S_r$ | 30.0 |
| Width of the outside through lane (feet) | $W_{ol}$ | 10.0 | *(9-16)* | Adjusted motorized vehicle running speed (miles/hour) | $S_{ra}$ | 30.0 |
| Width of the bicycle lane (feet) (use 0 if doesn't exist) | $W_{bl}$ | 7.0 | *(0-7)* | Midsegment automobile flow rate (vehicles/hour) | $v_m$ | 745.8 |
| Width of the paved outside shoulder or parking area (feet) | $W_{os}$ | 11.0 | *(0-10)* | Adjusted midsegment demand flow rate (vehicles/hour) | $v_{ms}$ | 745.8 |
| Curb is present (1 = yes; 0 = no) | C | 1.0 | *(0-1)* | Percent heavy vehicle volume (percentage) | $P_{HV}$ | 4.0 |
| Adjusted Width of the paved outside shoulder (feet) | $W_{os}$* | 9.5 | | Adjusted percent heavy vehicle volume (percentage) | $P_{HVa}$ | 4.0 |
| Proportion of on-street parking occupied (decimal) | $p_{pk}$ | 0.50 | *(0-0.9)* | Width of the outside through lane (feet) | $W_{ol}$ | 10.0 |
| Effective width of combined bicycle lane and shoulder or parking area (feet) | $W_1$ | 10.0 | | Width of the bicycle lane (feet) (use 0 if doesn't exist) | $W_{bl}$ | 7.0 |
| Total width of outside through lane, bicycle lane, & paved shoulder (feet) | $W_t$ | 17.0 | | Width of the paved outside shoulder or parking area (feet) | $W_{os}$ | 11.0 |
| Effective width of outside through lane, BL & shoulder as function of traffic volume (feet) | $W_v$ | 17.0 | | Curb is present (1 = yes; 0 = no) | C | 1.0 |
| Buffer width between roadway and sidewalk (ft) (use 0 if no SW) | $W_{buf}$ | 5.0 | *(0-12)* | Adjusted Width of the paved outside shoulder or parking area (feet) | $W_{os}$* | 9.5 |
| Continuous barrier (1 = Y; 0 = N) | B | 0.0 | *(0-1)* | Proportion of on-street parking occupied (decimal) | $p_{pk}$ | 0.50 |
| Buffer area coefficient | $f_b$ | 1.0 | | Total width of outside through lane, bicycle lane, & paved shoulder (feet) | $W_t$ | 17.0 |
| Sidewalk width *(not including buffer)* (feet) (use 0 if doesn't exist) | $W_{sw}$ | 8.0 | *(0-16)* | Effective width of outside through lane, BL & shoulder as function of traffic volume (feet) | $W_v$ | 17.0 |
| Adjusted available sidewalk width | $W_{as}$ | 8.0 | | Effective width of outside through lane (feet) | $W_o$ | 25.0 |
| Sidewalk width coefficient | $f_{sw}$ | 3.6 | | Cross-section adjustment factor | $F_w$ | -3.13 |
| Cross-section adjustment factor | $F_w$ | -5.39 | | Motorized vehicle volume adjustment factor | $F_v$ | 2.30 |
| Motorized vehicle volume adjustment factor | $F_v$ | 0.85 | | Motorized vehicle speed adjustment factor | $F_s$ | 1.35 |
| Motorized vehicle speed adjustment factor | $F_s$ | 0.36 | | Motorized vehicle speed adjustment factor | $F_p$ | 0.28 |
| **Pedestrian LOS score for the roadway link** | $I_{p,link}$ | **1.86** | | **Bicycle LOS score for the roadway link** | $I_{b,link}$ | **1.57** |
| **Pedestrian LOS grade for the roadway link** | **Grade** | **A** | | **Bicycle LOS grade for the roadway link** | **Grade** | **A** |

# Appendix

## Level of Service Calculations

**Bicycle Design**

**Wisconsin Ave**

| Link-Based Pedestrian Level of Service Evaluation | | | | | Link-Based Bicycle Level of Service Evaluation | | |
|---|---|---|---|---|---|---|---|
| | | *(Measure to the closest 0.5 feet)* | | | | | *(Measure to the closest 0.5 feet)* |
| **Input Variable Description** | **Variable** | **Measurement** | *(Typical range)* | | **Input Variable Description** | **Variable** | **asurement** |
| Number of through lanes in the study direction of travel | $N_{th}$ | 1.0 | *(1-4)* | | Number of through lanes in the study direction of travel | $N_{th}$ | 1.0 |
| Character of cross-section (1= divided by median; 0 = undivided) | D | 0.0 | *(0-1)* | | Character of cross-section (1 = divided by median; 0 = undivided) | D | 0.0 |
| Motorized vehicle running speed (miles/hour) | $S_r$ | 25.0 | *(5-55)* | | Pavement condition rating (5 = excellent to 1 = poor) | $P_c$ | 5.0 |
| Midsegment automobile flow rate (vehicles/hour) | $v_m$ | 329.2 | *(100-3000)* | | Motorized vehicle running speed (miles/hour) | $S_r$ | 25.0 |
| Width of the outside through lane (feet) | $W_{ol}$ | 11.0 | *(9-16)* | | Adjusted motorized vehicle running speed (miles/hour) | $S_{ra}$ | 25.0 |
| Width of the bicycle lane (feet) (use 0 if doesn't exist) | $W_{bl}$ | 7.0 | *(0-7)* | | Midsegment automobile flow rate (vehicles/hour) | $v_m$ | 745.8 |
| Width of the paved outside shoulder or parking area (feet) | $W_{os}$ | 12.0 | *(0-10)* | | Adjusted midsegment demand flow rate (vehicles/hour) | $v_{ma}$ | 745.8 |
| Curb is present (1 = yes; 0 = no) | C | 1.0 | *(0-1)* | | Percent heavy vehicle volume (percentage) | $P_{HV}$ | 4.0 |
| Adjusted Width of the paved outside shoulder (feet) | $W_{os}$* | 10.5 | | | Adjusted percent heavy vehicle volume (percentage) | $P_{HVa}$ | 4.0 |
| Proportion of on-street parking occupied (decimal) | $p_{pk}$ | 0.50 | *(0-0.9)* | | Width of the outside through lane (feet) | $W_{ol}$ | 10.0 |
| Effective width of combined bicycle lane and shoulder or parking area (feet) | $W_1$ | 10.0 | | | Width of the bicycle lane (feet) (use 0 if doesn't exist) | $W_{bl}$ | 7.0 |
| Total width of outside through lane, bicycle lane, & paved shoulder (feet) | $W_t$ | 18.0 | | | Width of the paved outside shoulder or parking area (feet) | $W_{os}$ | 12.0 |
| Effective width of outside through lane, BL &shoulder as function of traffic volume (feet) | $W_v$ | 18.0 | | | Curb is present (1 = yes; 0 = no) | C | 1.0 |
| Buffer width between roadway and sidewalk (ft) (use 0 if no SW) | $W_{buf}$ | 5.0 | *(0-12)* | | Adjusted Width of the paved outside shoulder or parking area (feet) | $W_{os}$* | 10.5 |
| Continuous barrier (1 = Y; 0 = N) | B | 0.0 | *(0-1)* | | Proportion of on-street parking occupied (decimal) | $p_{pk}$ | 0.50 |
| Buffer area coefficient | $f_b$ | 1.0 | | | Total width of outside through lane, bicycle lane, & paved shoulder (feet) | $W_t$ | 17.0 |
| Sidewalk width *(not including buffer)* (feet) (use 0 if doesn't exist) | $W_{sw}$ | 8.0 | *(0-16)* | | Effective width of outside through lane, BL & shoulder as function of traffic volume (feet) | $W_v$ | 17.0 |
| Motorized vehicle speed adjustment factor | $F_s$ | 0.25 | | | Motorized vehicle speed adjustment factor | $F_p$ | 0.28 |
| **Pedestrian LOS score for the roadway link** | $I_{p,link}$ | **1.64** | | | **Bicycle LOS score for the roadway link** | $I_{b,link}$ | **1.35** |
| **Pedestrian LOS grade for the roadway link** | **Grade** | **A** | | | **Bicycle LOS grade for the roadway link** | **Grade** | **A** |

**6th Street**

| Link-Based Pedestrian Level of Service Evaluation | | | | | Link-Based Bicycle Level of Service Evaluation | | |
|---|---|---|---|---|---|---|---|
| | | *(Measure to the closest 0.5 feet)* | | | | | *(Measure to the closest 0.5 feet)* |
| **Input Variable Description** | **Variable** | **Measurement** | *(Typical range)* | | **Input Variable Description** | **Variable** | **asurement** |
| Number of through lanes in the study direction of travel | $N_{th}$ | 2.0 | *(1-4)* | | Number of through lanes in the study direction of travel | $N_{th}$ | 2.0 |
| Character of cross-section (1= divided by median; 0 = undivided) | D | 1.0 | *(0-1)* | | Character of cross-section (1 = divided by median; 0 = undivided) | D | 1.0 |
| Motorized vehicle running speed (miles/hour) | $S_r$ | 30.0 | *(5-55)* | | Pavement condition rating (5 = excellent to 1 = poor) | $P_c$ | 5.0 |
| Midsegment automobile flow rate (vehicles/hour) | $v_m$ | 745.8 | *(100-3000)* | | Motorized vehicle running speed (miles/hour) | $S_r$ | 30.0 |
| Width of the outside through lane (feet) | $W_{ol}$ | 10.0 | *(9-16)* | | Adjusted motorized vehicle running speed (miles/hour) | $S_{ra}$ | 30.0 |
| Width of the bicycle lane (feet) (use 0 if doesn't exist) | $W_{bl}$ | 7.0 | *(0-7)* | | Midsegment automobile flow rate (vehicles/hour) | $v_m$ | 745.8 |
| Width of the paved outside shoulder or parking area (feet) | $W_{os}$ | 11.0 | *(0-10)* | | Adjusted midsegment demand flow rate (vehicles/hour) | $v_{ma}$ | 745.8 |
| Curb is present (1 = yes; 0 = no) | C | 1.0 | *(0-1)* | | Percent heavy vehicle volume (percentage) | $P_{HV}$ | 4.0 |
| Adjusted Width of the paved outside shoulder (feet) | $W_{os}$* | 9.5 | | | Adjusted percent heavy vehicle volume (percentage) | $P_{HVa}$ | 4.0 |
| Proportion of on-street parking occupied (decimal) | $p_{pk}$ | 0.50 | *(0-0.9)* | | Width of the outside through lane (feet) | $W_{ol}$ | 10.0 |
| Effective width of combined bicycle lane and shoulder or parking area (feet) | $W_1$ | 10.0 | | | Width of the bicycle lane (feet) (use 0 if doesn't exist) | $W_{bl}$ | 7.0 |
| Total width of outside through lane, bicycle lane, & paved shoulder (feet) | $W_t$ | 17.0 | | | Width of the paved outside shoulder or parking area (feet) | $W_{os}$ | 11.0 |
| Effective width of outside through lane, BL &shoulder as function of traffic volume (feet) | $W_v$ | 17.0 | | | Curb is present (1 = yes; 0 = no) | C | 1.0 |
| Buffer width between roadway and sidewalk (ft) (use 0 if no SW) | $W_{buf}$ | 5.0 | *(0-12)* | | Adjusted Width of the paved outside shoulder or parking area (feet) | $W_{os}$* | 9.5 |
| Continuous barrier (1 = Y; 0 = N) | B | 0.0 | *(0-1)* | | Proportion of on-street parking occupied (decimal) | $p_{pk}$ | 0.50 |
| Buffer area coefficient | $f_b$ | 1.0 | | | Total width of outside through lane, bicycle lane, & paved shoulder (feet) | $W_t$ | 17.0 |
| Sidewalk width *(not including buffer)* (feet) (use 0 if doesn't exist) | $W_{sw}$ | 8.0 | *(0-16)* | | Effective width of outside through lane, BL & shoulder as function of traffic volume (feet) | $W_v$ | 17.0 |
| Adjusted available sidewalk width | $W_{as}$ | 8.0 | | | Effective width of outside through lane (feet) | $W_o$ | 25.0 |
| Sidewalk width coefficient | $f_{sw}$ | 3.6 | | | Cross-section adjustment factor | $F_w$ | -3.13 |
| Cross-section adjustment factor | $F_w$ | -5.39 | | | Motorized vehicle volume adjustment factor | $F_v$ | 2.30 |
| Motorized vehicle volume adjustment factor | $F_v$ | 0.85 | | | Motorized vehicle speed adjustment factor | $F_s$ | 1.35 |
| Motorized vehicle speed adjustment factor | $F_s$ | 0.36 | | | Motorized vehicle speed adjustment factor | $F_p$ | 0.28 |
| **Pedestrian LOS score for the roadway link** | $I_{p,link}$ | **1.86** | | | **Bicycle LOS score for the roadway link** | $I_{b,link}$ | **1.57** |
| **Pedestrian LOS grade for the roadway link** | **Grade** | **A** | | | **Bicycle LOS grade for the roadway link** | **Grade** | **A** |

# Appendix

## Cost Calculations

### Immediate Redesign

| Type | Units | Cost/unit | Total Cost |
|---|---|---|---|
| Restripe Road | 0.263 | $50000/Mile | $ 13,150 |
| High visibility crosswalk | 830 | $6/LF | $ 4,980 |
| Stop Bar | 84 | $13/LF | $ 1,092 |
| Stop Bar Removals | 84 | $2.50/LF | $ 210 |
| Edge Line | 835 | $0.65/LF | $ 543 |
| Bicycle Lane | 0.158 | $22500/Mile | $ 3,555 |
| Green Bike Lane Paint | 1288 | $6.50/sqft | $ 8,372 |
| Bicycle marking | 8 | $125/unit | $ 1,000 |
| Red Bus Lane Paint | 5550 | $6.50/sqft | $ 36,075 |
| Words | 16 | $125/word | $ 2,000 |
| Plastic delineators | 60 | $90/unit | $ 5,040 |
| Bicycle lane buffer | 835 | $0.65/LF | $ 543 |
| Bus Shelter | 1 | $7500/shelter | $ 7,500 |
| Bus Pad | 2 | $50,000/pad | $ 100,000 |
| Total | | | $ 184,060 |

### Future - Transit Option

| Type | Units | Cost/unit | Total Cost |
|---|---|---|---|
| Restripe Road | 0.263 | $50000/Mile | 13150 |
| High visibility crosswalk | 830 | $6/LF | 4,980 |
| Stop Bar | 84 | $13/LF | 1092 |
| Stop Bar Removals | 84 | $2.50/LF | 210 |
| Edge Line | 500 | $0.65/LF | 325 |
| Bicycle Lane | 0.158 | $22500/Mile | 3555 |
| Green Bike Lane Paint | 1288 | $6.50/sqft | 8372 |
| Bicycle marking | 8 | $125/unit | 1000 |
| Red Bus Lane Paint | 5550 | $6.50/sqft | 36075 |
| Words | 16 | $125/word | 2000 |
| Bus Shelter | 2 | $7500/shelter | 15000 |
| Street tree | 20 | $350/tree | 7000 |
| Continuous raised median | 0.447 | $792000/mile | 354024 |
| New curb and gutter | 0.447 | $90,000/mile | 40230 |
| New ADA curb ramp | 2 | 1500/ramp | 3000 |
| Total | | | 490013 |

### Future - Bicycle Option

| Type | Units | Cost/unit | Total Cost |
|---|---|---|---|
| Restripe Road | 0.263 | $50000/Mile | 13150 |
| High visibility crosswalk | 830 | $6/LF | 4,980 |
| Stop Bar | 84 | $13/LF | 1092 |
| Stop Bar Removals | 84 | $2.50/LF | 210 |
| Edge Line | 500 | $0.65/LF | 325 |
| Bicycle Lane | 0.158 | $22500/Mile | 3555 |
| Green Bike Lane Paint | 2128 | $6.50/sqft | 13832 |
| Bicycle marking | 13 | $125/unit | 1625 |
| Red Bus Lane Paint | 2775 | $6.50/sqft | 18037.5 |
| Words | 12 | $125/word | 1500 |
| Plastic delineators | 17 | $90/unit | 952 |
| Bicycle lane buffer paint | 500 | $0.65/LF | 325 |
| Bus Shelter | 3 | $7500/shelter | 22500 |
| Street tree | 20 | $350/tree | 7000 |
| Continuous raised median | 0.447 | $792000/mile | 354024 |
| New curb and gutter | 0.447 | $90,000/mile | 40230 |
| New ADA curb ramp | 2 | 1500/ramp | 3000 |
| Curb extension (no drainage | 2 | $7500/unit | 15000 |
| Bike box | 1 | $3750/unit | 3750 |
| Total | | | 505087.5 |