

NACTO DESIGNING CITIES
DENVER 2023

#NACTO2023

Let it Snow, Rain and Drain

A Conversation on Street Drainage and Usability

Houston, Miami, Minneapolis



Donald Buaku, AICP, aAIA

Planner Manager /
Urban Design Studio Lead

Houston Public Works



Josiel Ferrer-Diaz, P.E.

Deputy Director / Chief Operations
& Maintenance Officer

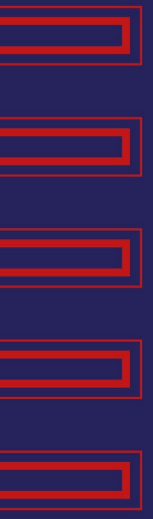
Miami-Dade County



Bryan Dodds

Deputy Director /
City Engineer

Minneapolis





Houston



Miami-Dade



Minneapolis

#NACTO2023

NACTO DESIGNING CITIES
DENVER 2023

Houston

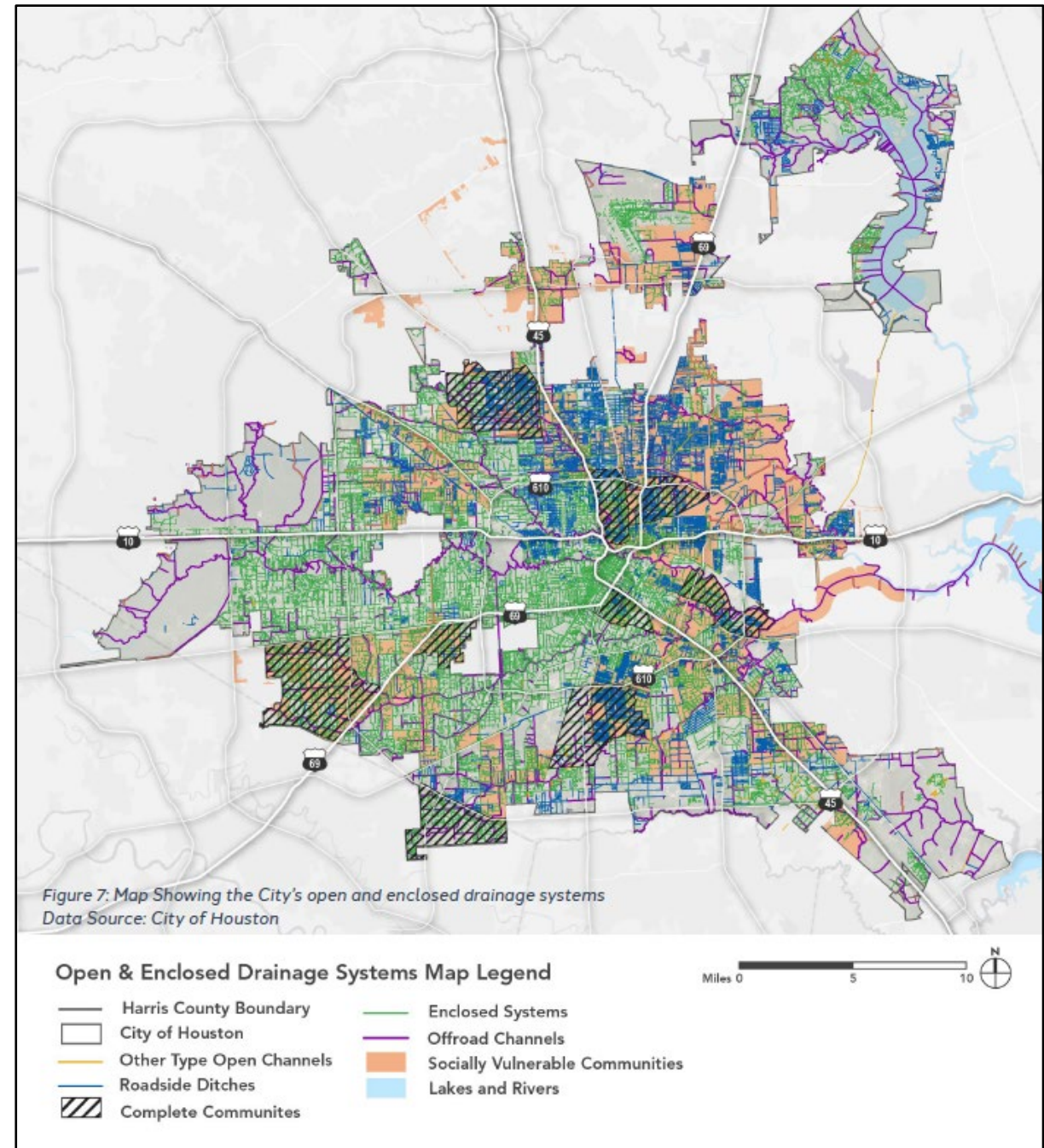
Houston Resilient Sidewalks Plan

Donald Buaku, AICP, assoc. AIA | City of Houston



By the Numbers

- 4th Largest city in the country
- Most diverse city in the country
- **671 square miles** across Houston
- 16,000 lane miles of streets (the distance between Houston and Tokyo and back)
- Over 1 million traffic signs
- 2,500 traffic signals
- 1,371 bridges
- **4,500 miles of sidewalks**
- 3,900 miles of stormwater lines
- 2,800 miles of roadside ditches



Not that Word Again?!



What is Urban

RESILIENCE?

The capacity of individuals, communities, institutions, businesses, and systems within an urban area to survive, adapt and thrive no matter what kinds of chronic stresses and acute shocks they experience.

– *Resilient Houston*



Quick Background



- **August 2017:** Hurricane Harvey devastates Houston
- **CDBG DR 17** (Disaster Recovery) funding received by COH for planning activities.
 - 6 Resilience Planning Studies,
 - 1 modeling effort,
 - 1 Hazard Mitigation Plan, and
 - 3 Housing planning support initiatives

Quick Background



February 2018

\$835 M available for Hurricane Harvey Recovery (CDBG-DR 17 program) through the Texas GLO, from HUD.

Local Action Plan released allocating \$23 M for planning efforts

Procurement Processes

- **Project Awarded to Consulting Team**
- **Council Approval**
- **Project Underway**

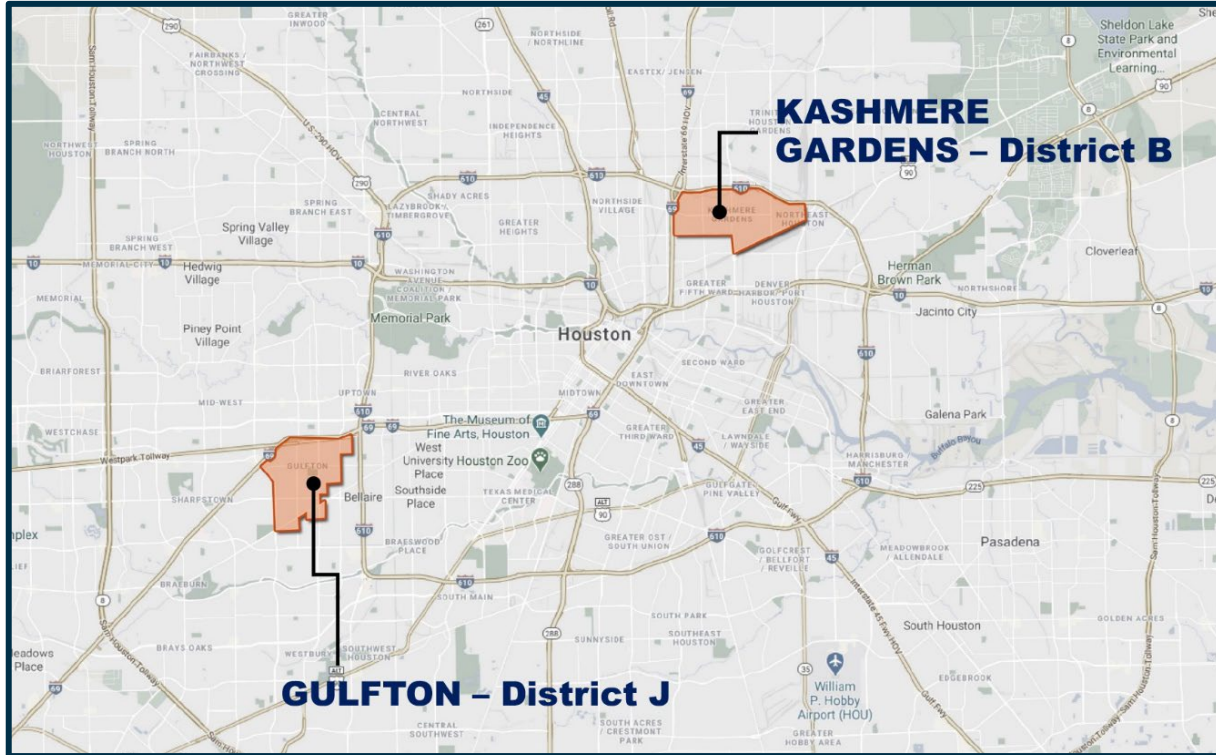
Project Completion



We are here!



Project Charge

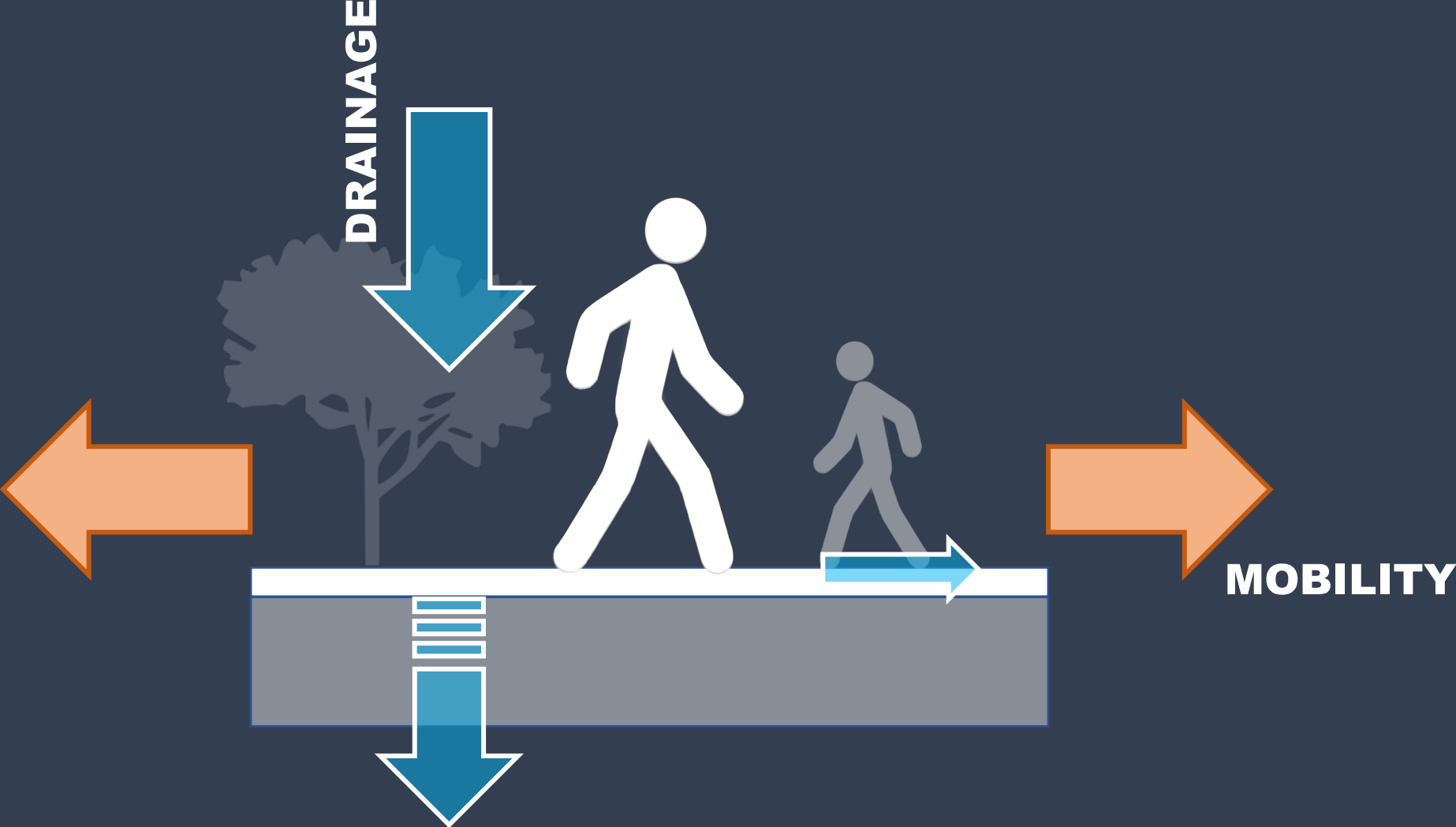


- Two (2) Neighborhood Sidewalk Plans
 - Kashmere Gardens
 - Gulfton
- A City-wide toolkit.
- Address safety, drainage, accessibility, alternative materials, innovative design, **funding**, maintenance requirements, etc.

Principles - considerations



Principles – sidewalk performance



Literature Review & Mapping

Houston Public Works Sidewalk Program constructs new sidewalks and ramps along streets leading to schools, major thoroughfares and improves accessibility for people with disabilities*.

*The Pedestrian Accessibility Review process is managed through the Mayor's Office for People with Disabilities

CODE

The Sidewalk Program is governed by [Code of Ordinances Article III, Sections 40-83 & 84](#)

PROGRAMS

The Sidewalk Program has three types of requests.

| PROGRAM REQUEST | SIDEWALK UP TO | ELIGIBILITY |
|---------------------------------|----------------|---|
| Pedestrian Accessibility Review | 1,500 feet | Person with disability has no safe path to travel to: <ul style="list-style-type: none"> - bank - bus stop - educational facility - employment - grocery store - place of worship - home - medical facility - METROLift - pharmacy - vehicle |
| School Sidewalk | 4 blocks | Used by students to walk to school Not around school perimeter Not on dead-end street |
| Major Thoroughfare | 4 blocks | Along designated thoroughfare No existing sidewalk Evidence of pedestrian traffic no future reconstruction or improvements planned within the next 5 years |

Pedestrian Accessibility Review

The highest priority projects come from the Mayor's Office for People with Disabilities Pedestrian Accessibility Review process. The request provides up to 1,500 feet of improved sidewalk accessibility for people with disabilities to safely travel to the bank, bus stop, educational facility, employment, grocery store, home, medical facility, METROLift, pharmacy, vehicle or place of

LIVABLE CENTERS STUDY
PREPARED BY ASAKURA ROBINSON
WITH: GOLDEN & ASSOCIATES

RESILIENT HOUSTON

City of Houston, Texas, Ordinance No. 2020 - 684

AN ORDINANCE AMENDING CHAPTER 1, CHAPTER 10, CHAPTER 26, CHAPTER 33, CHAPTER 40, AND CHAPTER 42 OF THE CODE OF ORDINANCES, HOUSTON, TEXAS, RELATING TO ESTABLISHING STANDARDS FOR WALKABLE PLACES IN THE CITY AND AMENDING RELATED PROVISIONS FOR TRANSIT ORIENTED DEVELOPMENT, ESTABLISHING FEES; PROVIDING FOR SEVERABILITY; ESTABLISHING AN EFFECTIVE DATE; CONTAINING FINDINGS AND OTHER PROVISIONS RELATED TO THE FOREGOING SUBJECT; AND DECLARING AN EMERGENCY.

WHEREAS, the City of Houston, Texas, (the "City") in the exercise of its lawful authority may enact police power ordinances to promote and protect the health, safety, and welfare of the public; and

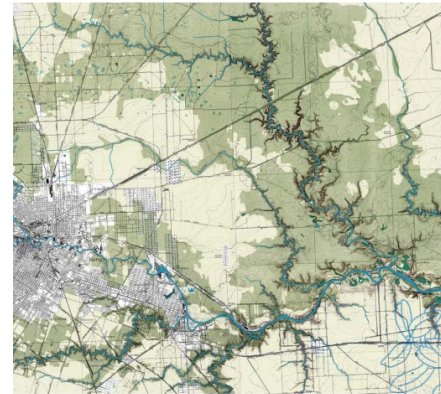
WHEREAS, the City is a municipal corporation and home rule city organized under the Constitution and the general and special laws of the State of Texas, and thereby

Walkable Places Rules

Learn how you can create a Walkable Place



Living With Water™ Houston



January 2020



KASHMERE GARDENS COMPLETE COMMUNITIES

ACTION PLAN

Mayor Sylvester Turner
City of Houston
Planning and Development Department
December 2020

HOUSTON VISION ZERO
OUR STREETS • OUR LIVES • OUR COMMITMENT

HEALTHY LIVING MATTERS
BUILT ENVIRONMENT & FOOD
Connecting Policy to the Future
Houston Public Works, Planning & Development Department

CITY OF HOUSTON HOUSTON PUBLIC WORKS

INFRASTRUCTURE DESIGN MANUAL

CAROL ELLINGER HADDOCK, P.E., DIRECTOR

HOJIN LIM, P.E., CFM CITY ENGINEER

JULY 2020

Project Scope

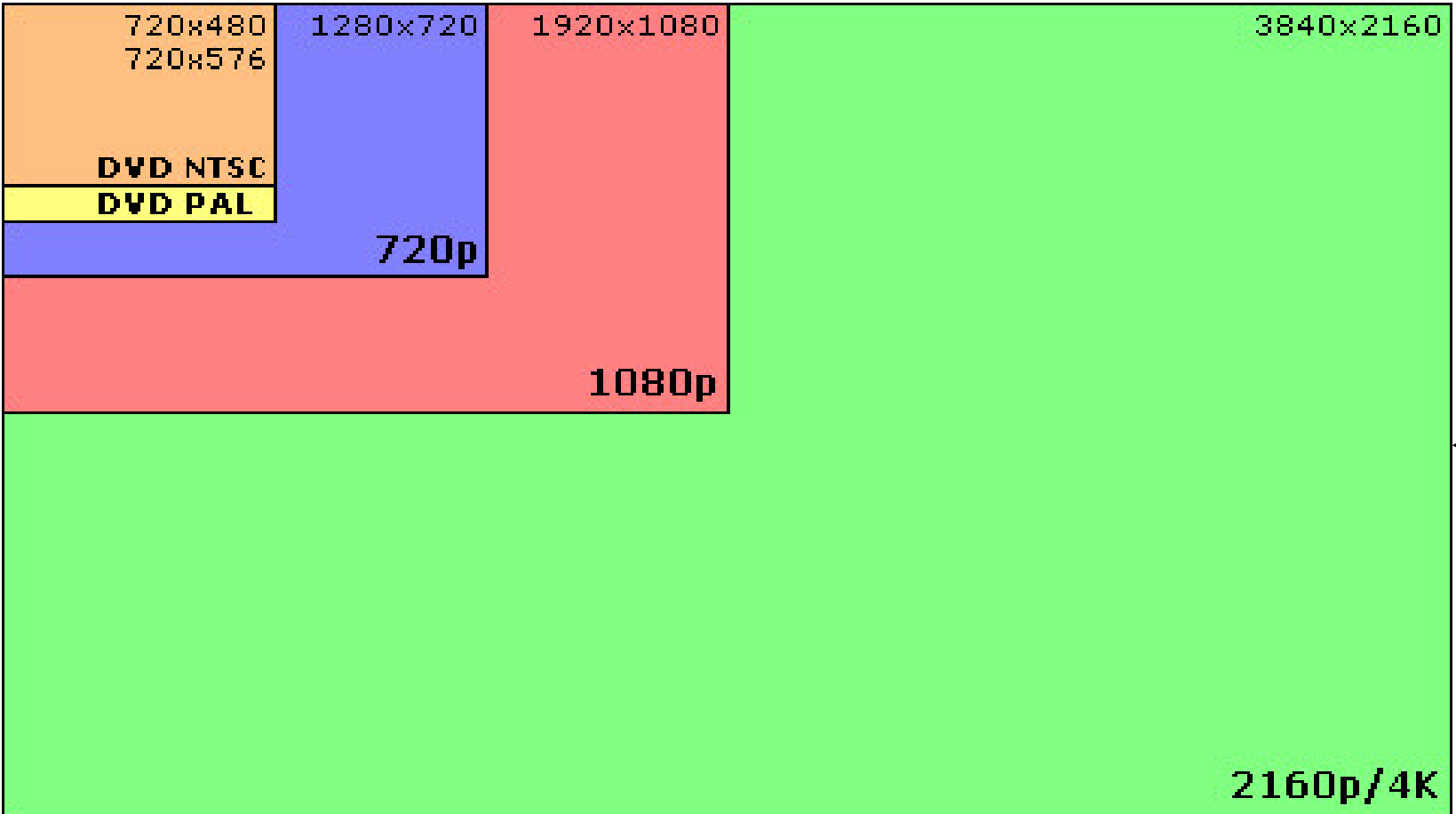
Previous Plans & Status Quo

This Plan!

Future Offshoots

Further Studies

Specific Plans

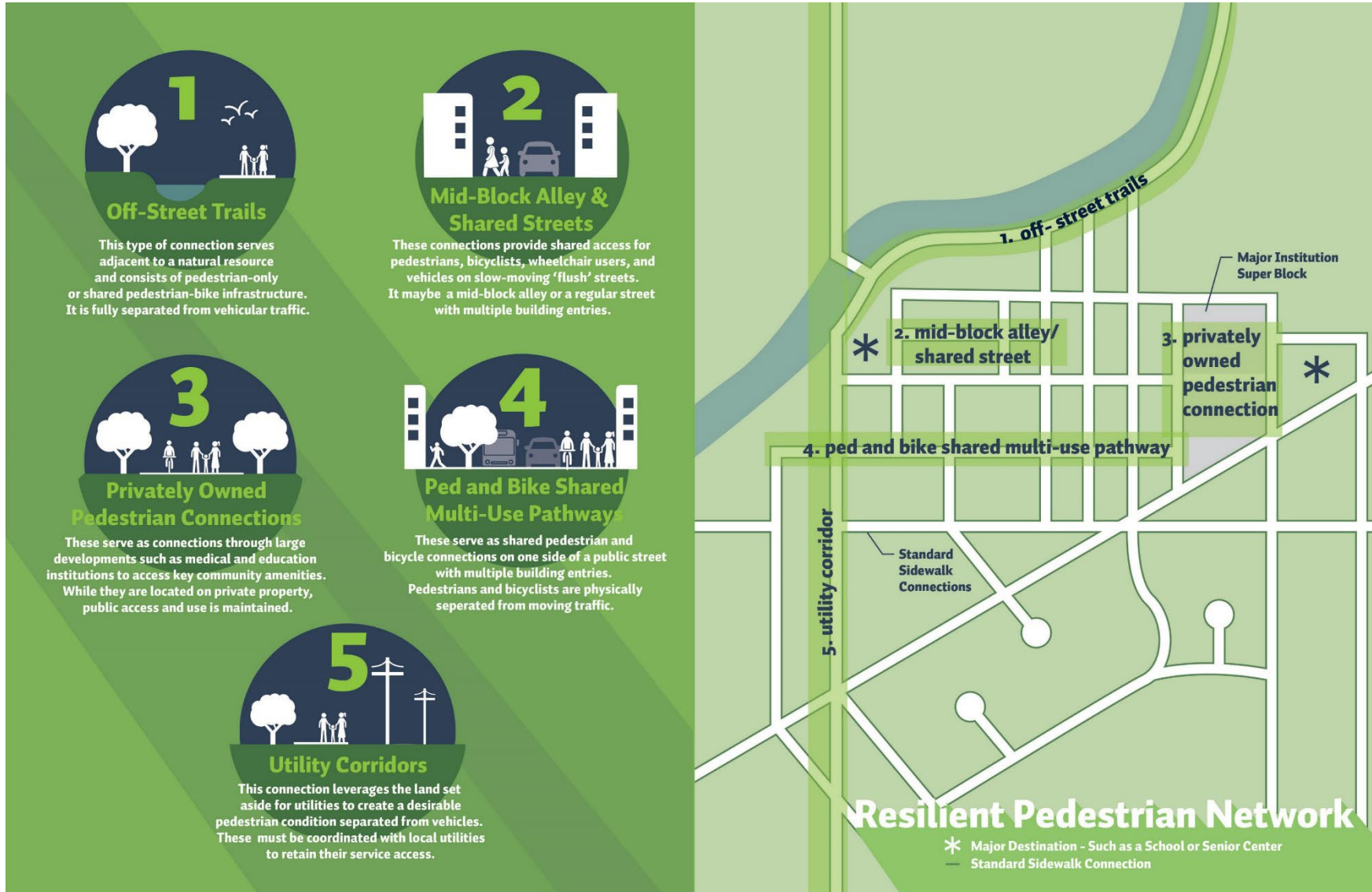


Project Scope



- Planning level
- Examine sidewalks for mobility and drainage
- Create a menu of options
- Contribute to a **Resilient Pedestrian Network**

Resilient Pedestrian Network – beyond the sidewalk



Wins Here & There



Space City Sweeper - 2022



Bagby Street Improvements - 2021

Wins Here & There



Protected Intersections
Gray & Austin Streets
2020



Lawndale St Improvements
2022



11th Street Improvements
March 2023

Existing Conditions



Existing Conditions

Open Ditch



Open ditch next to roadway with no sidewalks



Open ditch next to property line with no sidewalks



Open ditch next to roadway with sidewalk on one side



Open ditch next to property line with sidewalk on one side



Open ditch next to roadway with sidewalk on both sides



Open ditch next to property line with sidewalk on both sides



Open ditch between narrow roadway or property line

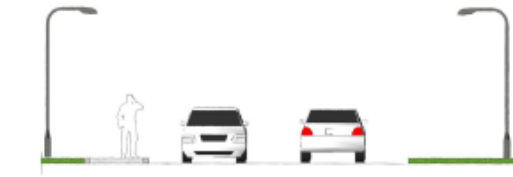
Curb & Gutter



Curb and gutter in a local street with no sidewalks



Curb and gutter in a major thoroughfare with no sidewalks



Curb and gutter in a local street with buffered sidewalk on one side



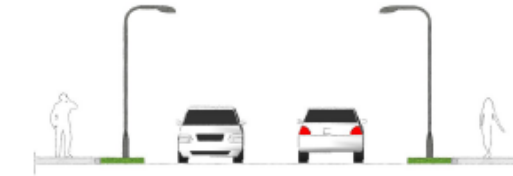
Curb and gutter in a major thoroughfare with buffered sidewalks on both sides



Curb and gutter in a local street with unbuffered sidewalks on both sides



Curb and gutter in a major thoroughfare with unbuffered sidewalks on both sides



Curb and gutter in a local street with buffered sidewalks on both sides



Curb and gutter in a major thoroughfare with buffered sidewalk on one side

Community Involvement

Walking Improvements

- 85% Wider and Unobstructed Sidewalks
- 79% Improved Existing Crosswalks
- 57% More and More Frequent Opportunities to Cross the Street
- 72% Street Trees for Shade and to Help Calm Down Traffic
- 74% Street and Sidewalks that are Safe and Clear for the community
- 70% Improved Bus Stops with Shelter and Lighting



**Over
1000
Respondents!**

City-wide Toolkit

Scenario OD-1: Existing

Open Ditch Next to Roadway

Existing Context

Primarily observed in local residential streets, this existing condition involves an open ditch on at least one side, directly adjacent to the roadway. The space between the open ditch and property line may include a sidewalk or completely lack pedestrian infrastructure. The roadway may contain parking on one or both sides of the street. Overhead and at-grade utilities are generally located at the edge of the ROW.



Typical existing conditions on local residential streets

Scenario Applicability Criteria

| | |
|---------------------------|--|
| Right-of-Way (ROW) | 40' – 80' |
| Travel Lanes | Two minimum |
| Drainage | Open Ditch |
| Pedestrian Infrastructure | No sidewalks; sidewalk on one side; sidewalk on both sides in poor condition |



Scenario OD-1: Proposed

Open Ditch Next to Roadway

Preferred Solution OD-1.0

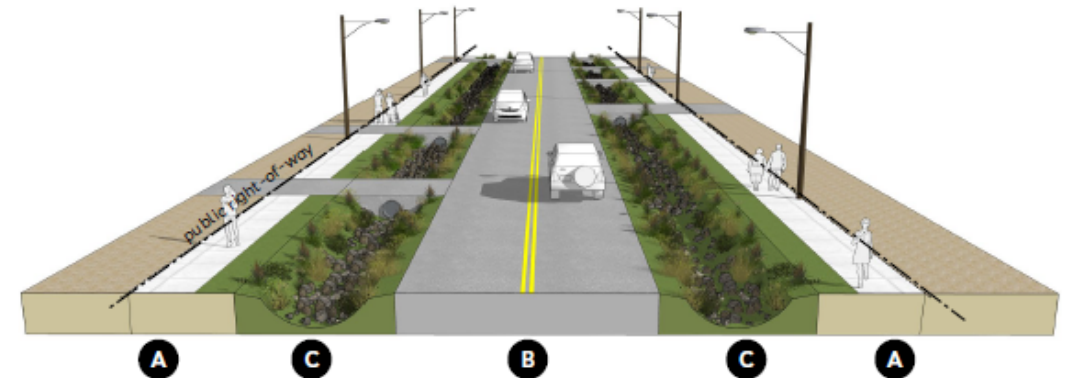
The proposed improvements include adding a sidewalk on at least one side of the ROW. Additional improvements include converting the open ditch into a bioswale to mitigate potential flooding created by adding additional impervious pavement. No change is proposed to the existing roadway.

Scenario Improvement Criteria

| | | |
|----------------------------|---|----------|
| Sidewalk/ Pedestrian Zone* | 5' minimum (6' preferred) standard concrete sidewalk | A |
| Vehicular and Bike Access* | 18' minimum with two bi-directional lanes (20' preferred) Refer to the City of Houston Bike Plan | B |
| Drainage/ Amenity Zone | 8' minimum open ditch repurposed as bioswale | C |

Alternative Solutions

| | |
|-------|--|
| OD-11 | Provide permeable sidewalk on at least side of the street. Maintain existing open ditches and roadway. |
| OD-12 | Provide standard concrete sidewalk on at least one side of the street. Convert part or all of the roadway to porous asphalt to mitigate drainage issues. Maintain existing open ditches. |
| OD-13 | Regrade entire street and provide one consolidated bioswale in middle of ROW. Provide standard concrete sidewalks (raised or with slotted curbs) on both sides of the street. |



* Will require modification approval if located on a TOD Street, Major Thoroughfare, or within the Central Business District. May require modification approval if identified in the Walkable Places Plan.

Scenario OD-1: Proposed

Open Ditch Next to Roadway

Proposed Conditions: Renderings and Built Examples



OD-1.0 Rendering of proposed improvement on one side of street



OD-1.0 Rendering: of proposed improvement on both sides of the street



OD-1.0 Built example in Seattle, WA
Photo courtesy of Mark Holema



OD-1.0 Built example in Eagle Creek
Photo courtesy of Ecologic

Scenario OD-1: Proposed

Open Ditch Next to Roadway

Proposed Conditions: Renderings and Built Examples



OD-1.1 Rendering of permeable sidewalk on one side of the street next to open ditch



OD-1.1 Built example of permeable sidewalk in Seattle, WA



OD-1.2 Built example of porous asphalt in Seattle,
Photo courtesy of Mithun



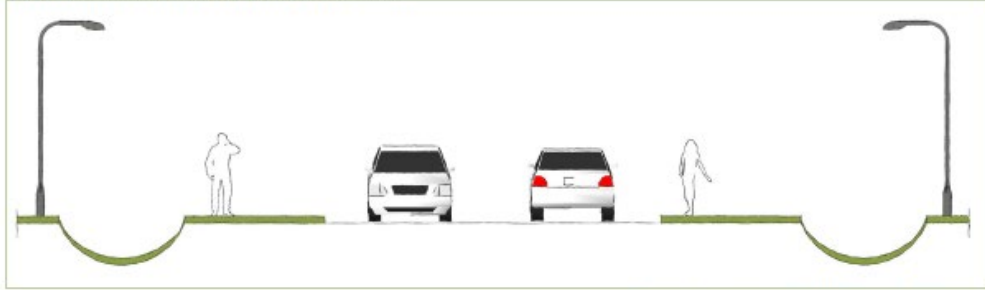
OD-1.2 Built example of porous asphalt in Pringle Creek; Photo courtesy Greenworks

Scenario OD-2: Existing

Open Ditch Next to Property Line

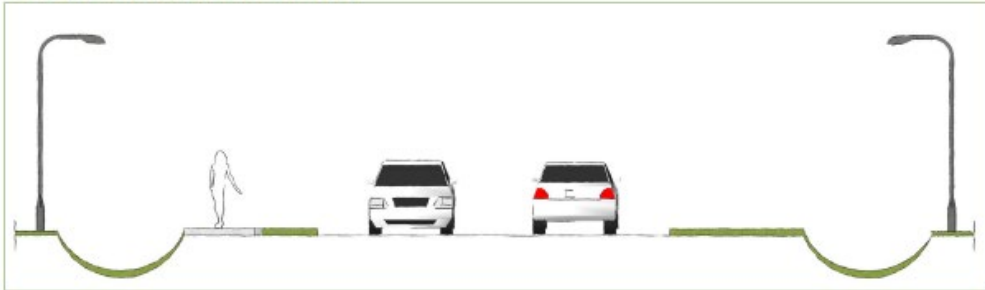
Prototypical Existing Conditions Section

Section 1: No Sidewalks on Both Sides of the Street



Sketch courtesy of the City of Houston

Section 2: Sidewalk on One Side of the Street



Sketch courtesy of the City of Houston



Rendering of an existing condition with no sidewalks on both sides of the street

Scenario OD-2: Proposed

Open Ditch Next to Property Line

Preferred Scenario Solution OD-2.0

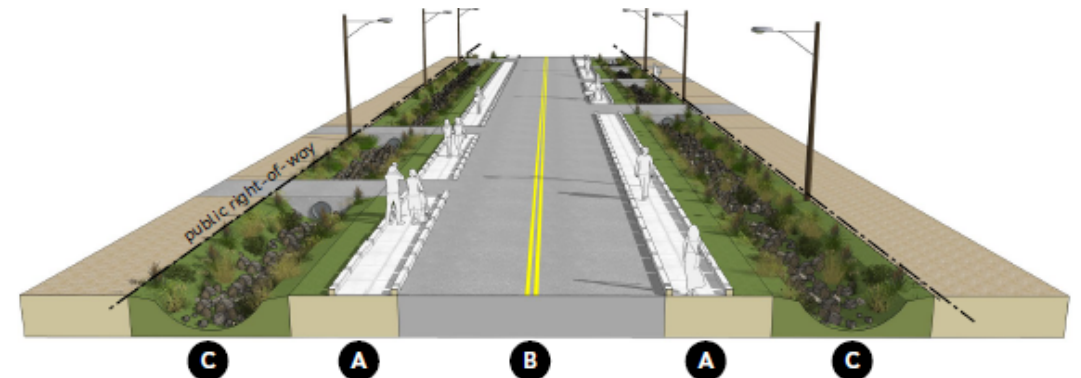
Proposed improvements include adding a sidewalk on at least one side of the roadway with a six-inch vertical concrete slotted curb for protection allowing water to drain to the bioswale. This curb satisfies the safety buffer requirement of the IDM. Additional improvements include converting the open ditch into a bioswale or bioretention planter to mitigate potential flooding created by the addition of impervious pavement.

Scenario Improvement Criteria

| | | |
|----------------------------------|--|----------|
| Sidewalk/ Pedestrian Zone* | 6' minimum (7' preferred) standard concrete sidewalk | A |
| Vehicular and Bike Access | 18' minimum (20' preferred) with two bi-directional lanes Refer to the City of Houston Bike Plan | B |
| Drainage/ Amenity Zone | 8' minimum open ditch repurposed as bioswale | C |

Alternative Solutions

| | |
|--------|---|
| OD-2.1 | Provide permeable sidewalk with slotted curbs on at least side of the street. Maintain existing open ditches. |
| OD-2.2 | Provide standard concrete sidewalk with slotted curbs on at least one side of the street. Convert part or whole of roadway to porous asphalt. Maintain existing open ditches. |
| OD-2.3 | Regrade entire street and provide one consolidated open ditch bioswale on one side of the ROW. Provide standard concrete sidewalk that is raised or with slotted curbs. |



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Scenario OD-2: Proposed

Open Ditch Next to Property Line

Proposed Conditions: Renderings and Built Examples



OD-2.0 Rendering of proposed improvement on both sides of street



OD-2.1 Rendering of permeable paving sidewalk on one side of the street



OD-2.0 Built example in Houston



OD-2.3 Built example of reggraded street with concrete sidewalk and a consolidated bioswale on one side of the street



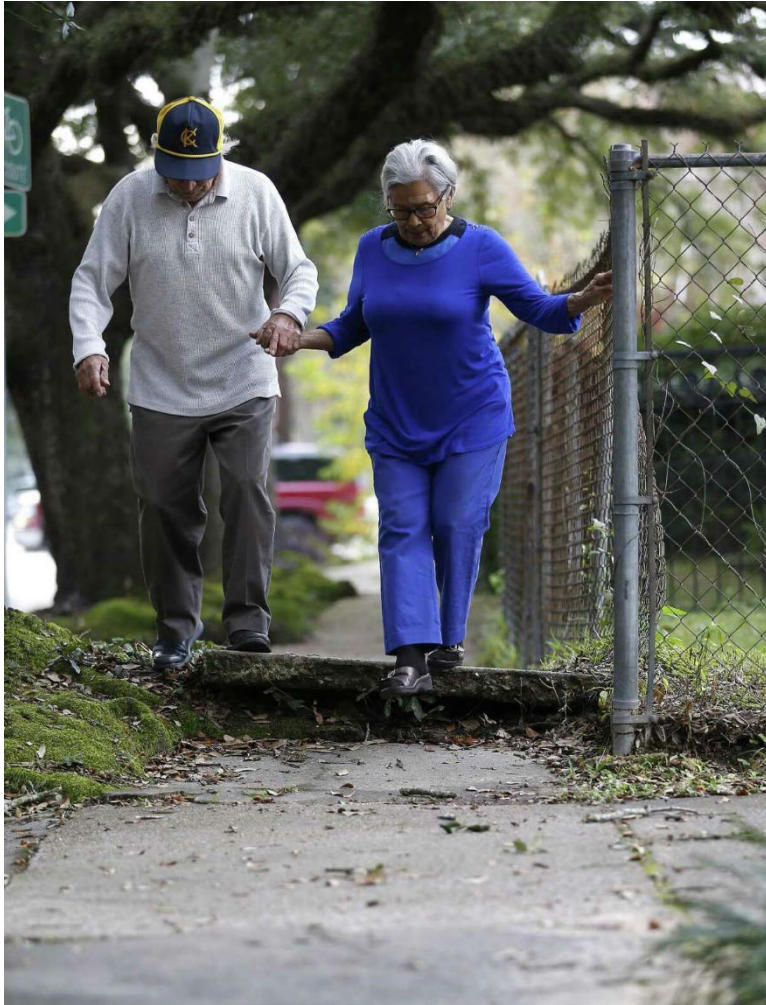
Resiliency is Funding Too!



While our toolkit will produce an actionable plan, without funding, ... implementation is not likely.

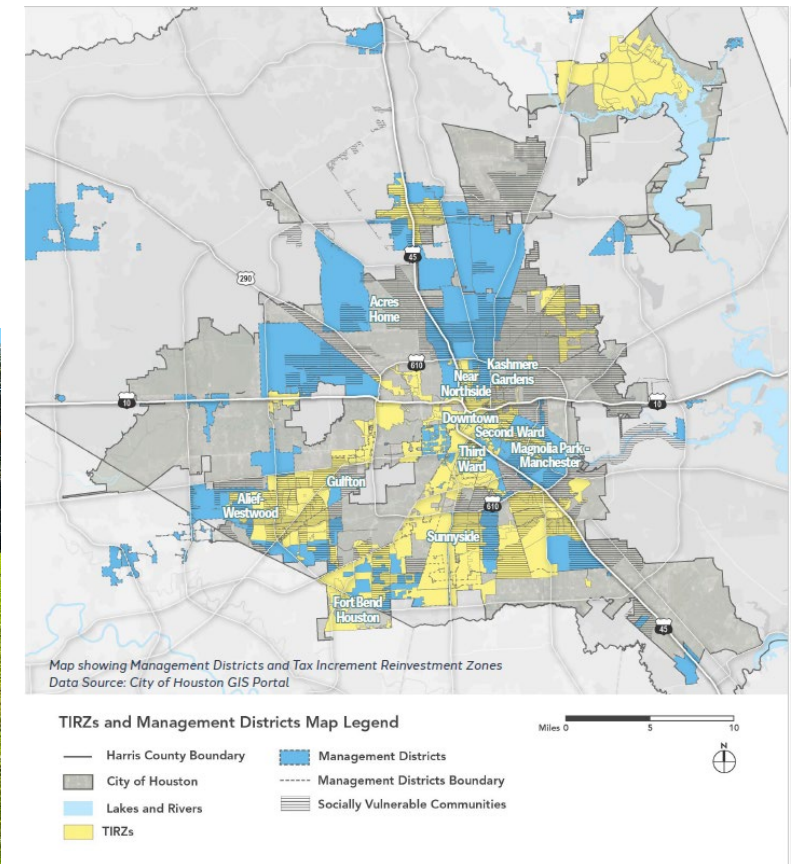
We have to elevate the many barriers observed, including but not limited to, lack of neighborhood-scale funding mechanisms, for further action.

Resiliency is Funding Too!



The case of “Funding Deserts”

- Lack of awareness and/or coverage of existing funding



Future Funding Strategies



- **Sidewalk Fee-in-Lieu (COH)**

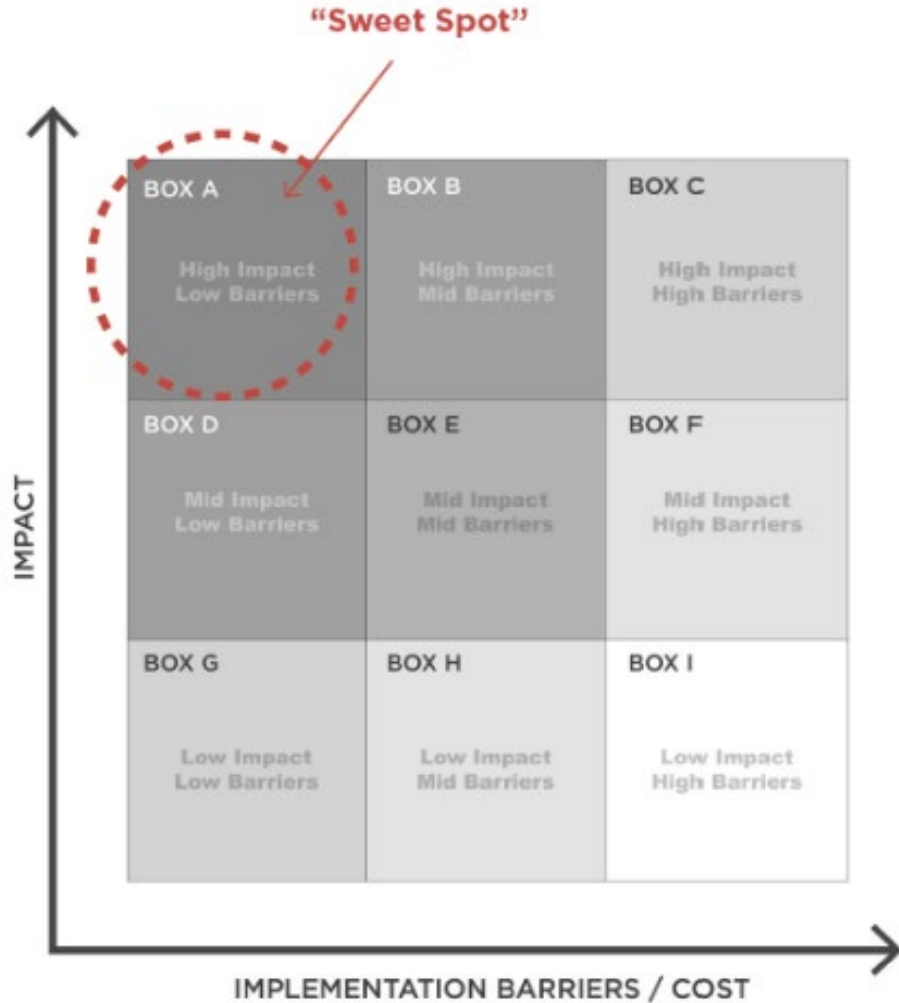
- City Council approved January 2023
- Developers of new construction to pay a fee instead of providing sidewalks (\$12 per sq. foot) where applicable
- Projected revenue of \$1.7m annually
- City divided into sidewalk service areas – 70% spent in generating area, rest city-wide

- Target Infrastructure Grants (IRA, IIJA)

- Other Potential Strategies:

- Neighborhood Partnering Program
- Transportation Benefit Districts
- Community Facility Districts

Prioritization & Phasing



- Develop a prioritization matrix to identify sidewalk scenarios/corridors that can be implemented first
- Identify ways to phase sidewalk projects to offer immediate mobility
 - **Near Term** – safe & accessible tactical solutions
 - **Long Term** – permanent capital projects as more funding becomes available

Prioritization & Phasing

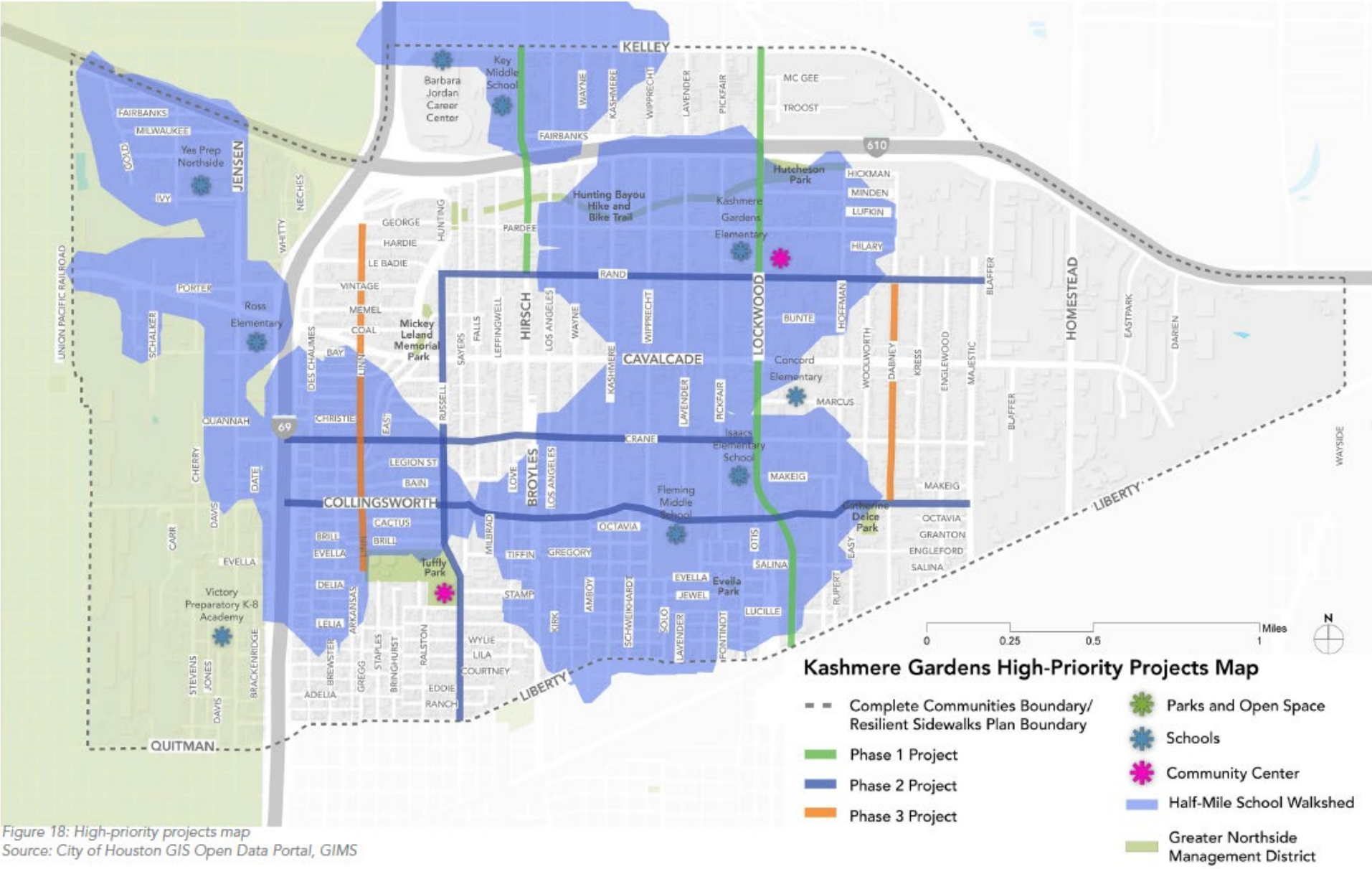


Figure 18: High-priority projects map
 Source: City of Houston GIS Open Data Portal, GIMS

Actionable Next Steps



- Produce an actionable toolkit
 - Plug into city docs like the IDM
 - Create a working document
 - Menu of options for all to work with
 - Inform & coordinate with city pilot projects
- Create a robust sidewalk inventory and a priority list
- Identify offshoot projects to be tackled
- Identify grant funding and partnerships

COH Pilot Projects – Malone Park, Winter St., Winzer Park



Contact – Resilient Sidewalks Plan on *Engage Houston*



[Home](#) / [Resilient Sidewalks Plan](#)

Resilient Sidewalks Plan



LOCATION Kashmere Gardens, Gulfton, and City-wide

COUNCIL DISTRICT [B](#), [J](#)

TYPE Plan

START [Fall 2021](#)

COMPLETION [Winter 2023](#)

MIAMI-DADE



Problem

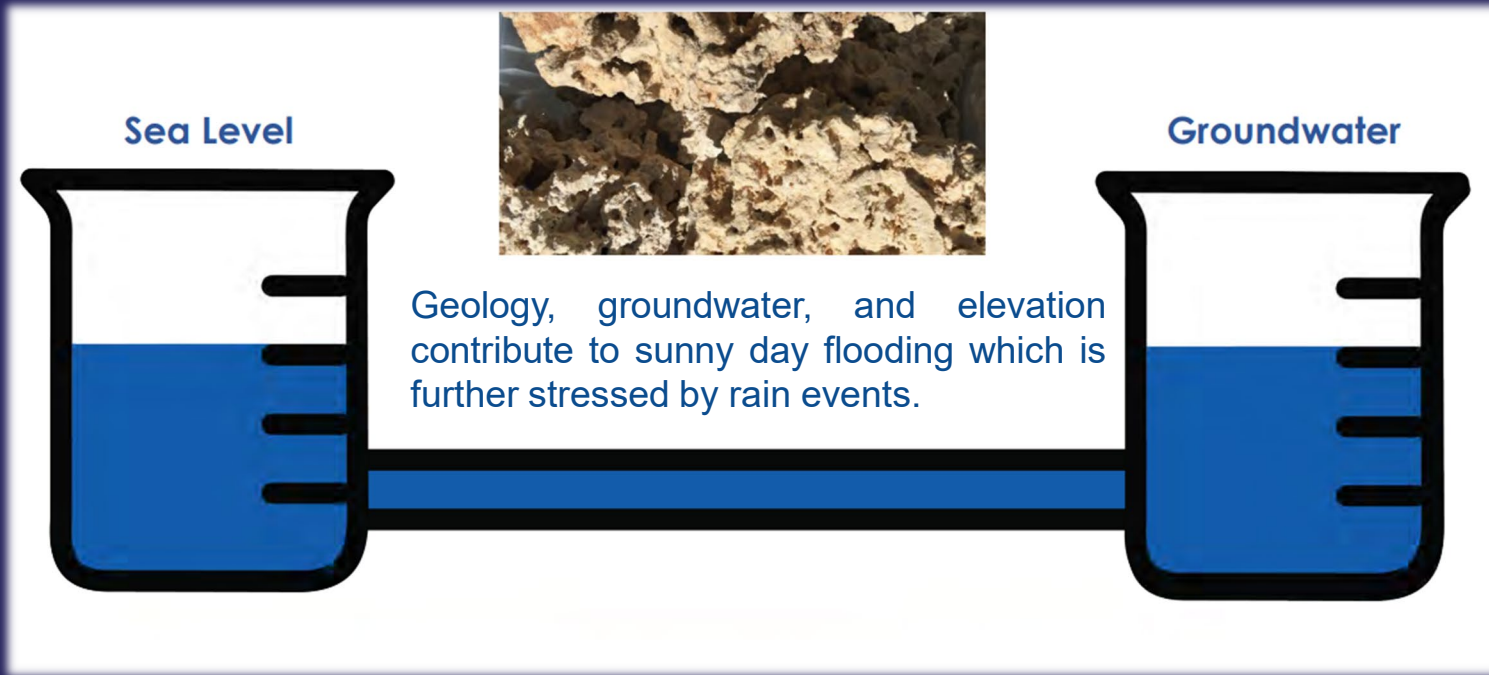
- The most vulnerable are the most affected
- The environment is vulnerable to flooding but the community is prepared for alternative modes of transportation

Question

- Strategically plan bicycle corridors and transit corridors but not sacrifice connectivity
- Planning maintenance based on the user and not the condition



The Environment



Planning and Design Principles for Complete Streets

- Planning for complete streets without considering groundwater and stormwater management is not a complete story
- Develop policy in minimum elevations, aesthetics, and harmonization but be flexible to local conditions and do not sacrifice connectivity
- Design roads based on established hierarchy including all road users



Stormwater Infrastructure Maintenance for All

- Stormwater maintenance plan must prioritize emergency routes, bicycle corridors, and transit corridors.
- Stormwater maintenance plan must work hand-in-hand with transportation master planning
- Establish road hierarchy for all users to inform drain cleaning cycles.
- Prioritize tree canopy and other alternative stormwater management practices that serve multiple purposes



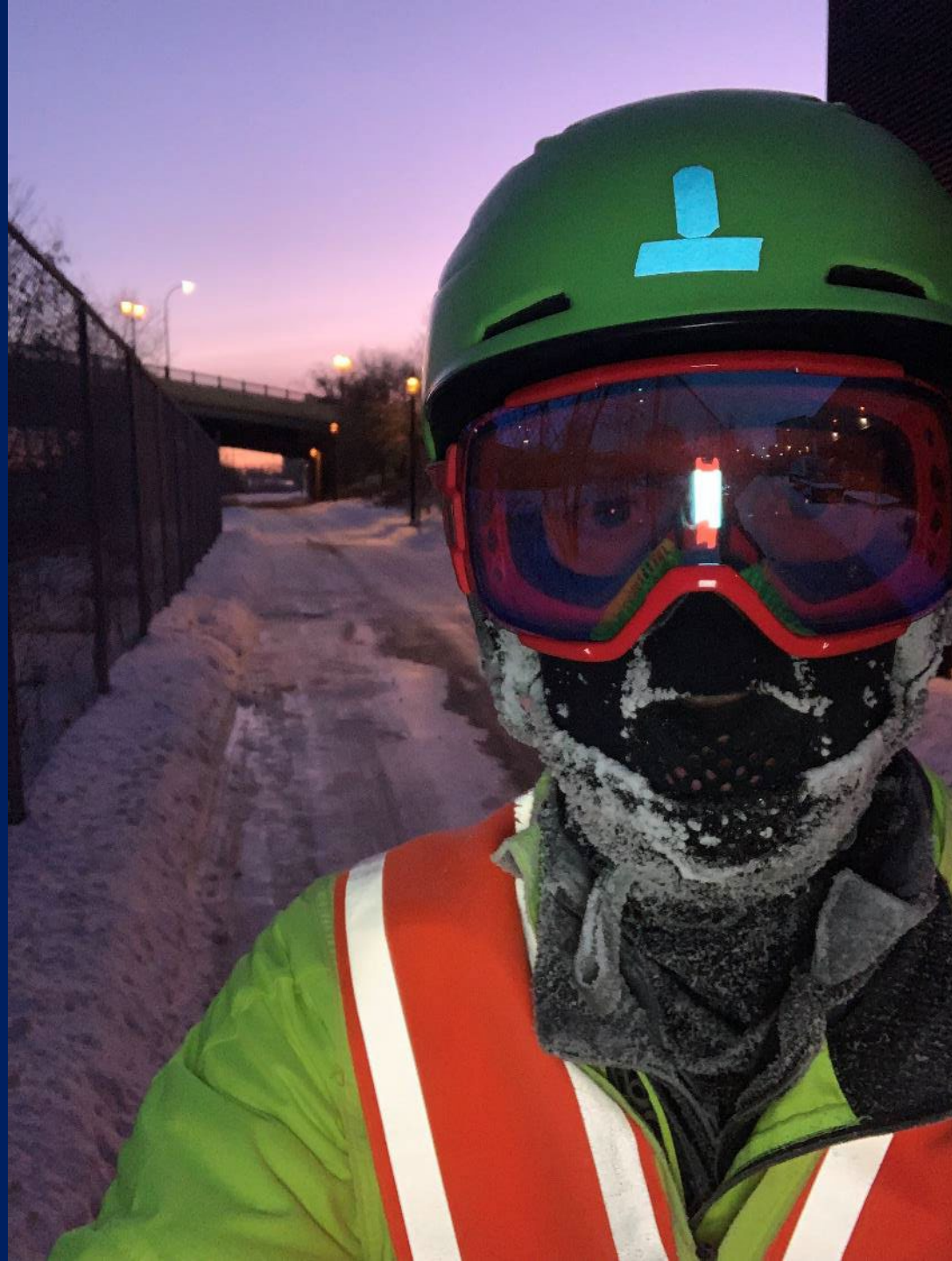
Let it snow!

The Minneapolis
Perspective

#NACTO2023









LEFT TURN
YIELD
ON GREEN

County B

LIBRARY

No Parking

AMERICA
EST. 1776



RPM
x1000

0 1 2 3 4 5 6

INST ECON V8 SW
0 MPG -25°F









Minneapolis
VISION ZERO
ACTION PLAN 2020-2022



2022 Update
Americans with Disabilities
(ADA) Transition Plan for P
Works
Minneapolis



CITY OF MINNEAPOLIS

Street Design Guide

February 2021



City of Lakes

CITY OF MINNEAPOLIS

Transportation Action Plan

December 4, 2020

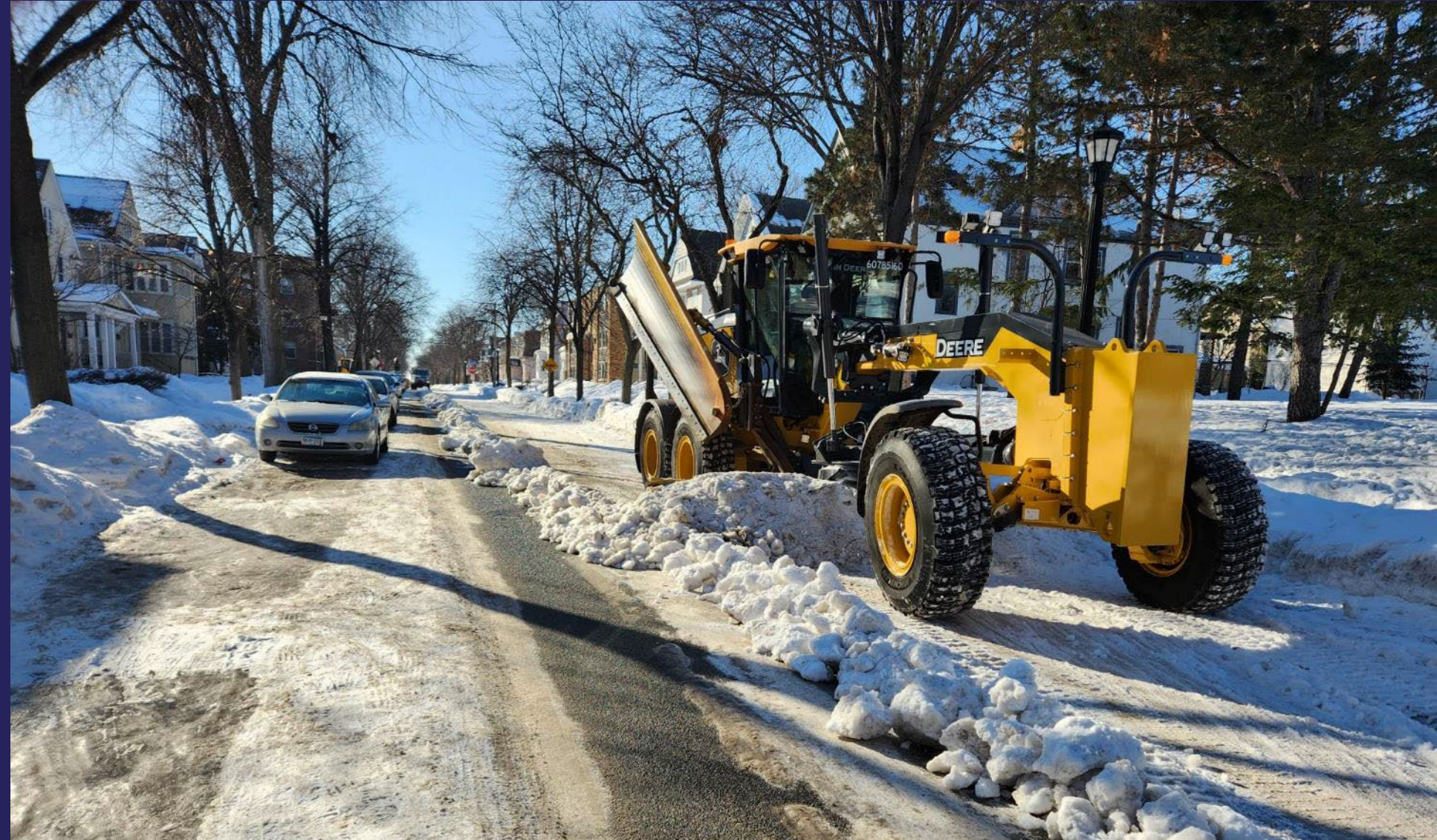


Policy Guidance

Front and Underbody Plow Truck



Grader



Front End Loader



Front End Loader w/ Blower



Skid-Steer Loader



Skid-Steer - Blower



Pickup with Plow



Pickup with Plow/Spreader

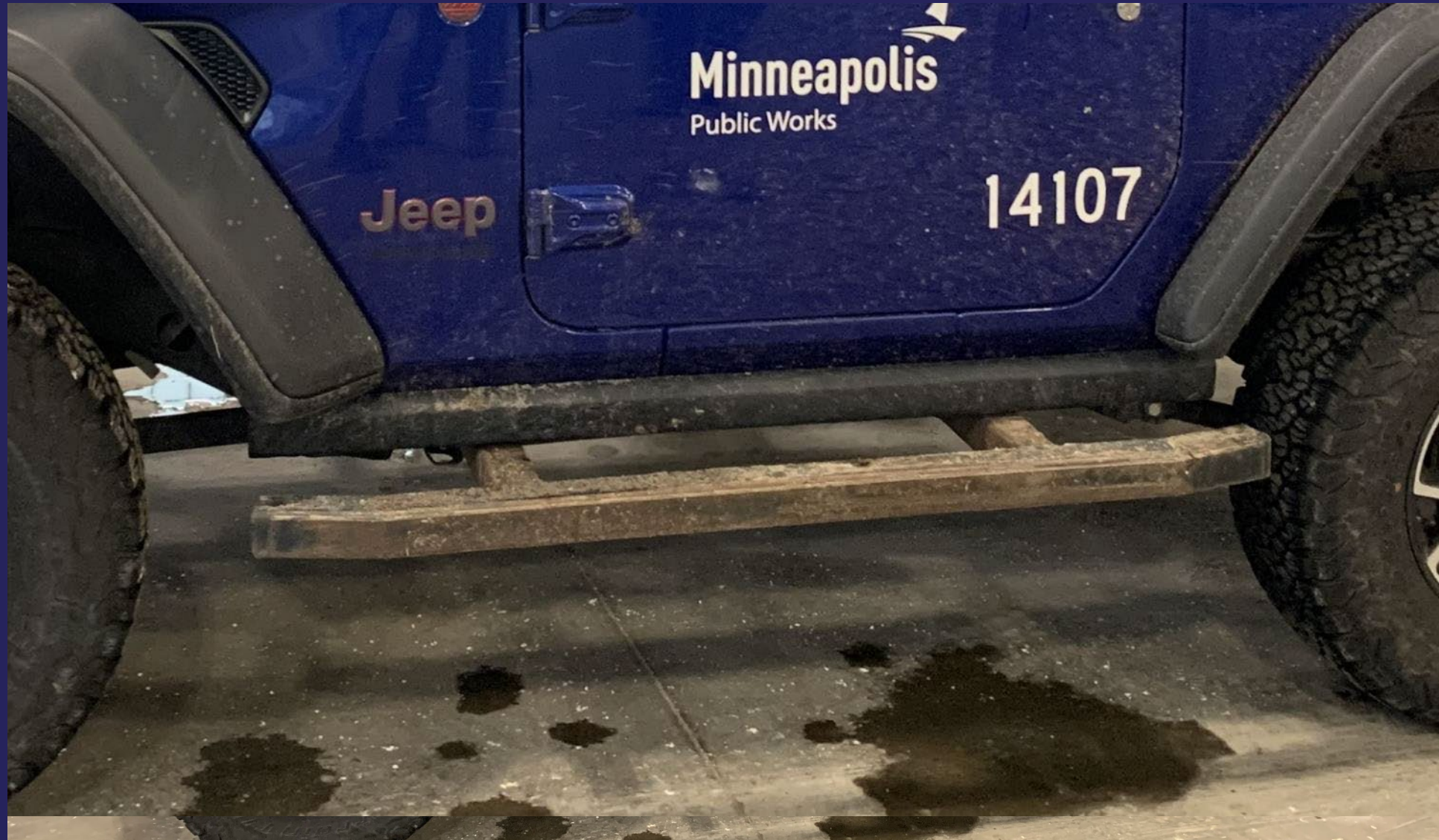


Jeep with Plow





Jeep with Plow



Toolcat 5600 – Plow/Spreader



Toolcat 5600 – Brush/Spreader



Multihog CV



Multihog CV



Multihog CV



Ravo 5 iSeries



Sidewalks and Bikeways



Snowplow Operator Training

#NACTO2023



Snowplow Operator Training

#NACTO2023




Snowplow Operator Training

#NACTO2023



Johnson St Before

← 1934 Johnson St NE
Minneapolis, Minnesota


 Google Street View

Aug 2018 [See latest date](#)



Johnson St After

← 1943 Johnson St NE
Minneapolis, Minnesota

 Google Street View

Aug 2022 See more dates

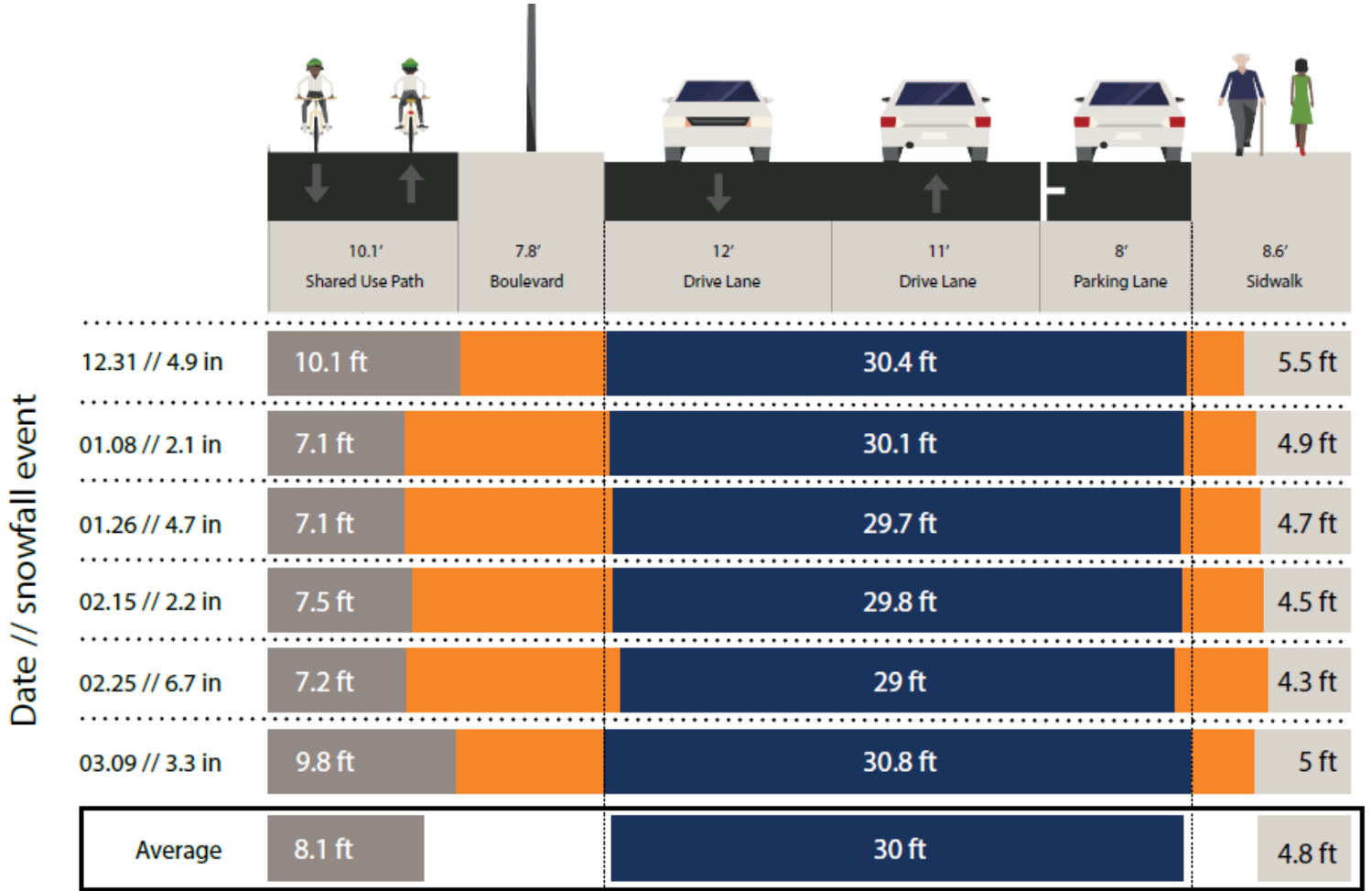


22nd Ave NE
WINDOM PARK

19th Ave NE

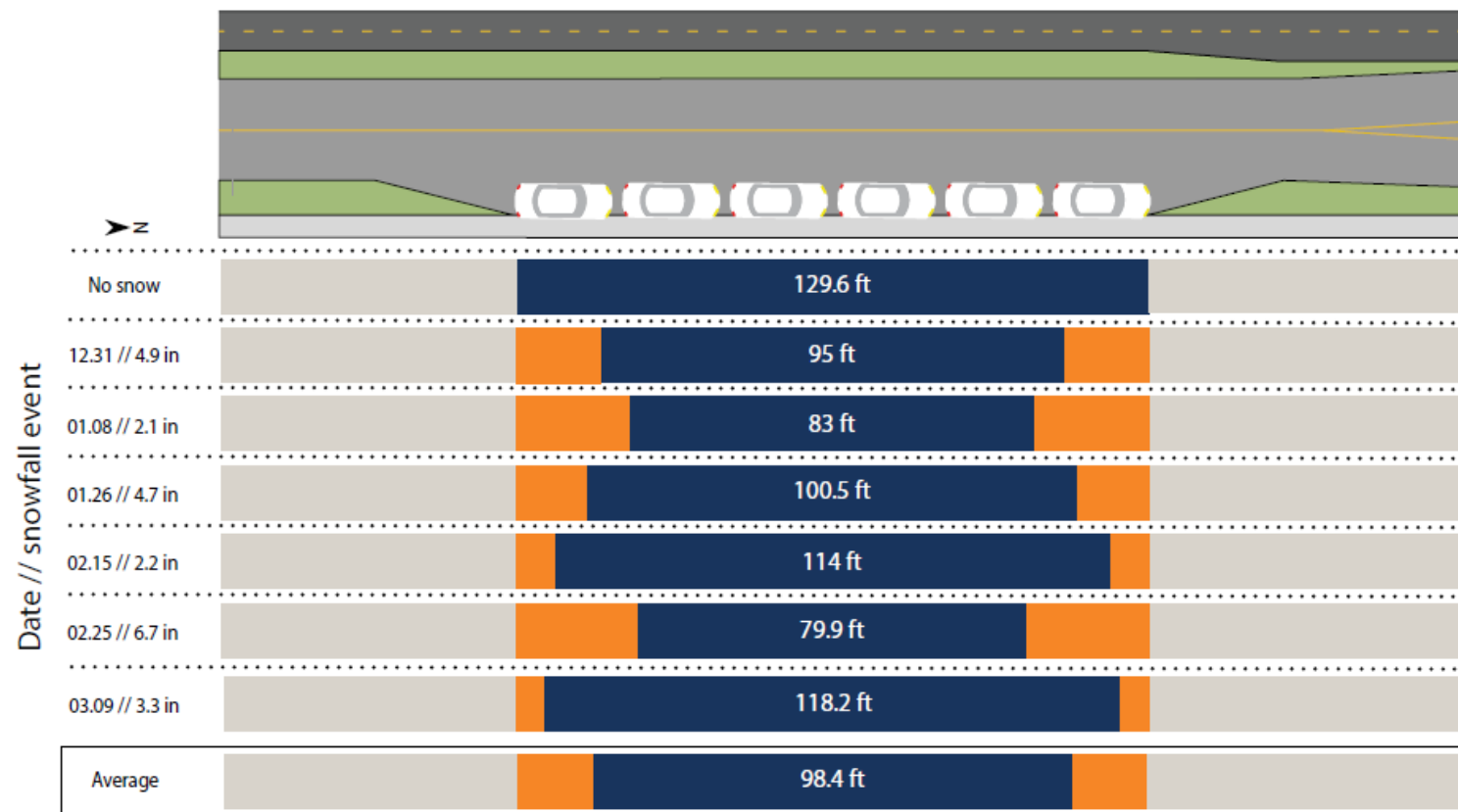
Google

Johnson St Cross Section





Johnson St Parking Bay



Plymouth
Ave
Before

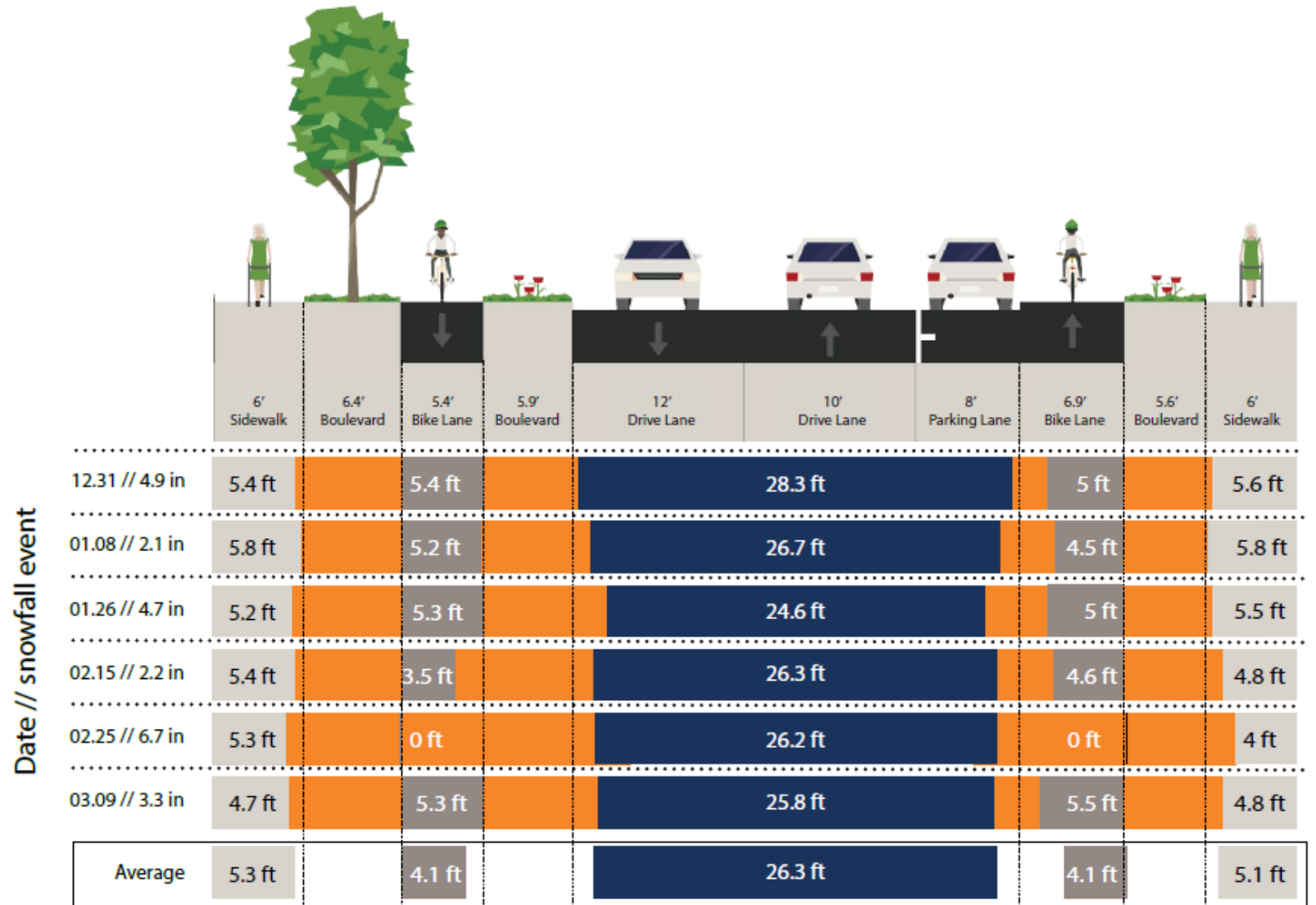


Plymouth Ave After

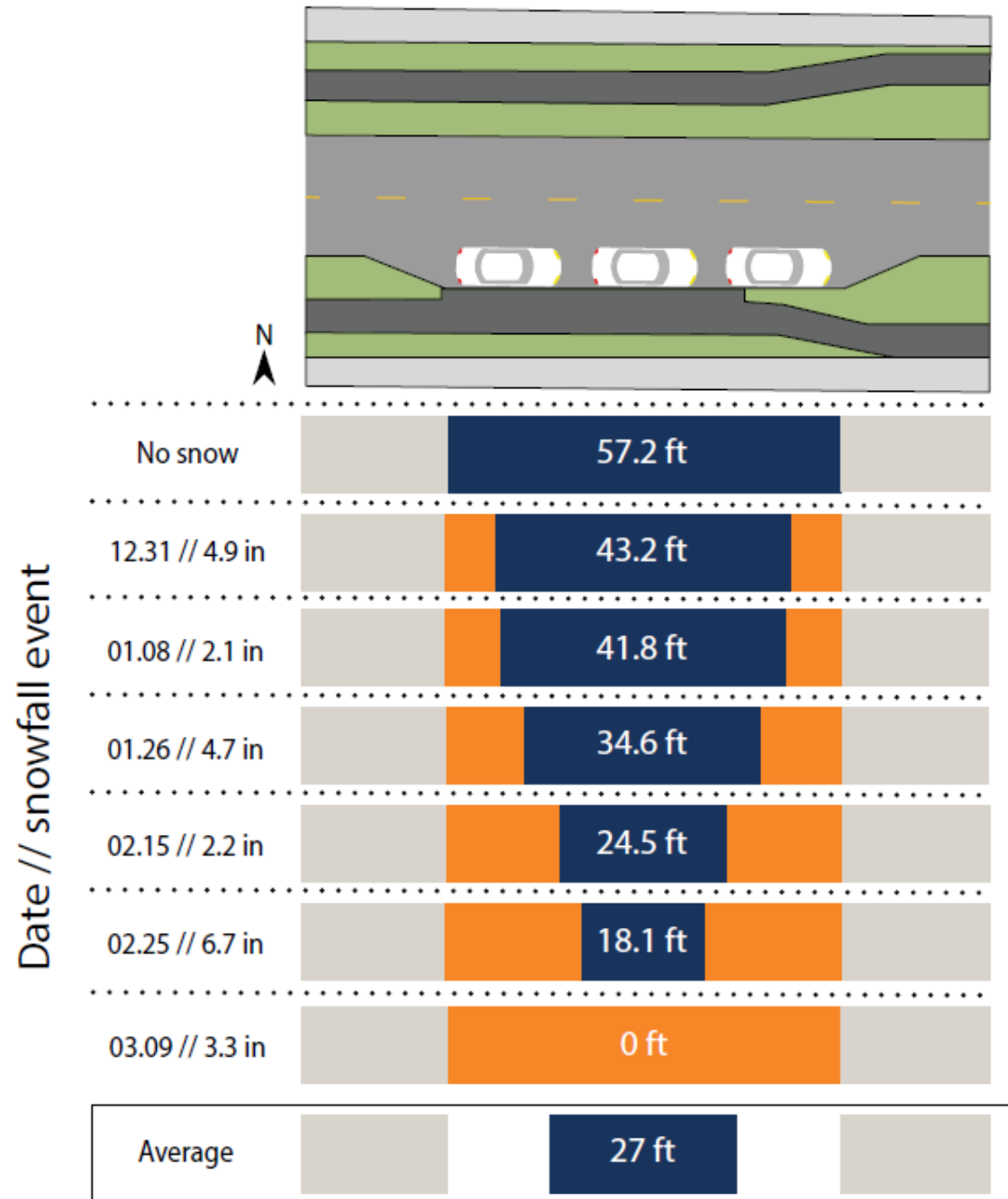




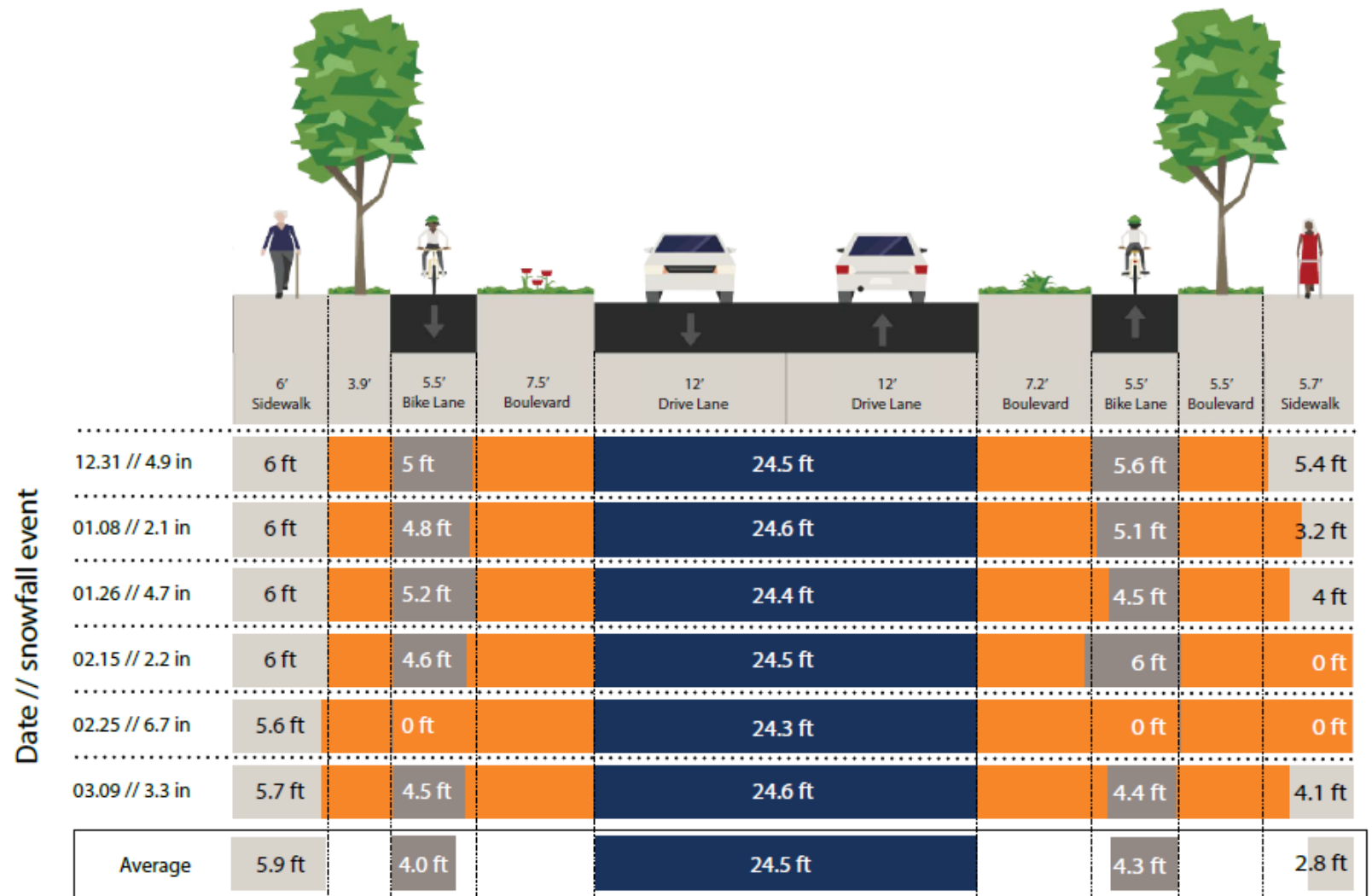
Plymouth Ave



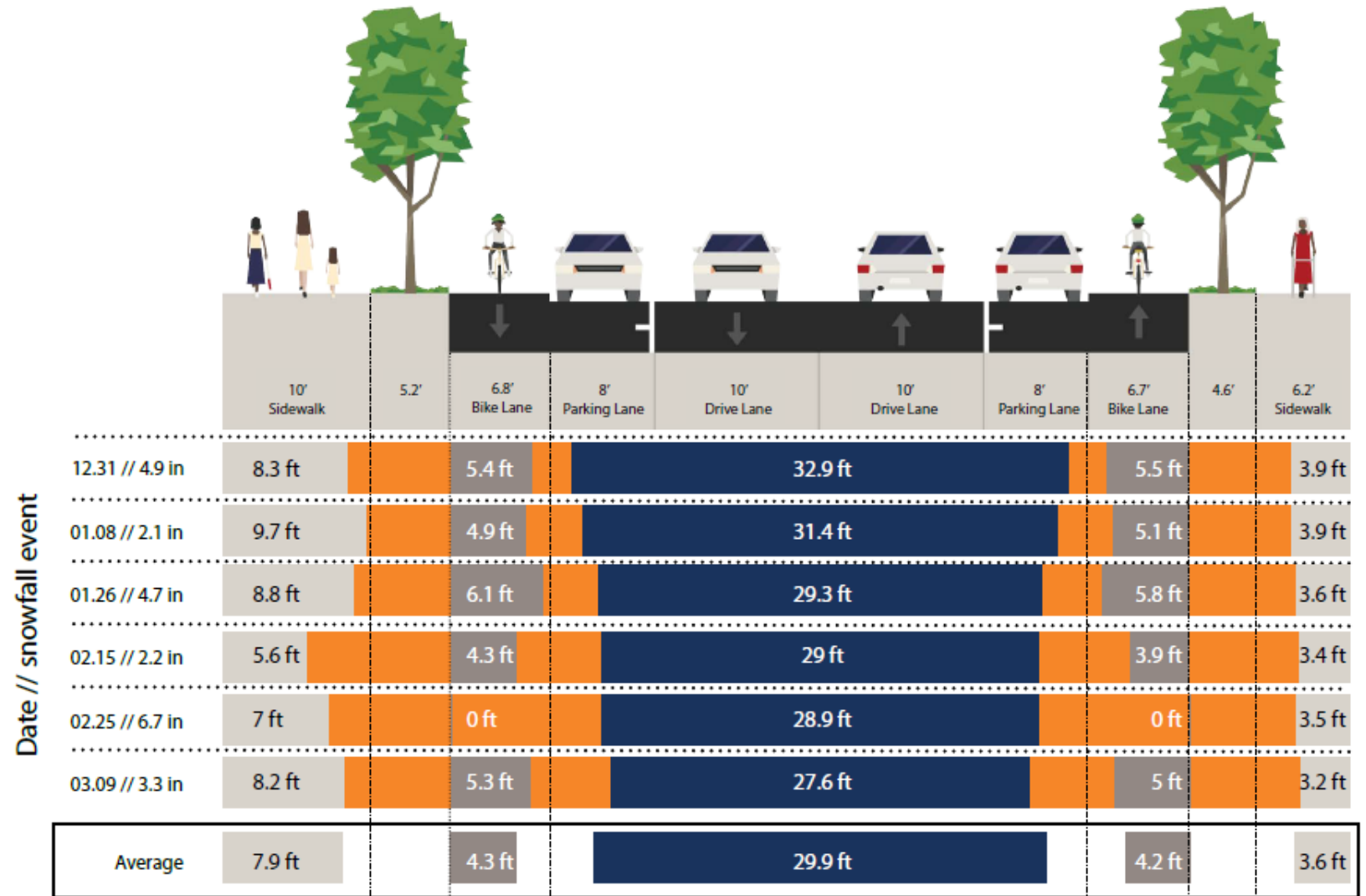
Plymouth Ave Parking Bay



Plymouth Ave



Plymouth Ave



Plymouth Ave



← 1922 1st Ave S
Minneapolis, Minnesota
Google Street View
Jun 2019 See latest date



1st Ave - Before



#NA

1st Ave - After



1st Ave



1st Ave



1st Ave



1st Ave



1st Ave



1st Ave



1st Ave



1st Ave



1st Ave

Bryant Ave - Before

← 900 W 46th St
Minneapolis, Minnesota

 Google Street View


May 2019 [See latest date](#)



Bryant Ave - After

← 901 W 46th St

Minneapolis, Minnesota

 Google Street View

Oct 2022


[See latest date](#)



Bryant Ave - Before



← 898 W 46th St
Minneapolis, Minnesota

 Google Street View

May 2019 See latest date

Bryant Ave - After

← 899 W 46th St
Minneapolis, Minnesota

 Google Street View

Oct 2022 See latest date



Bryant Ave - Before

← 818 W 46th St
Minneapolis, Minnesota


 Google Street View

May 2019 [See latest date](#)

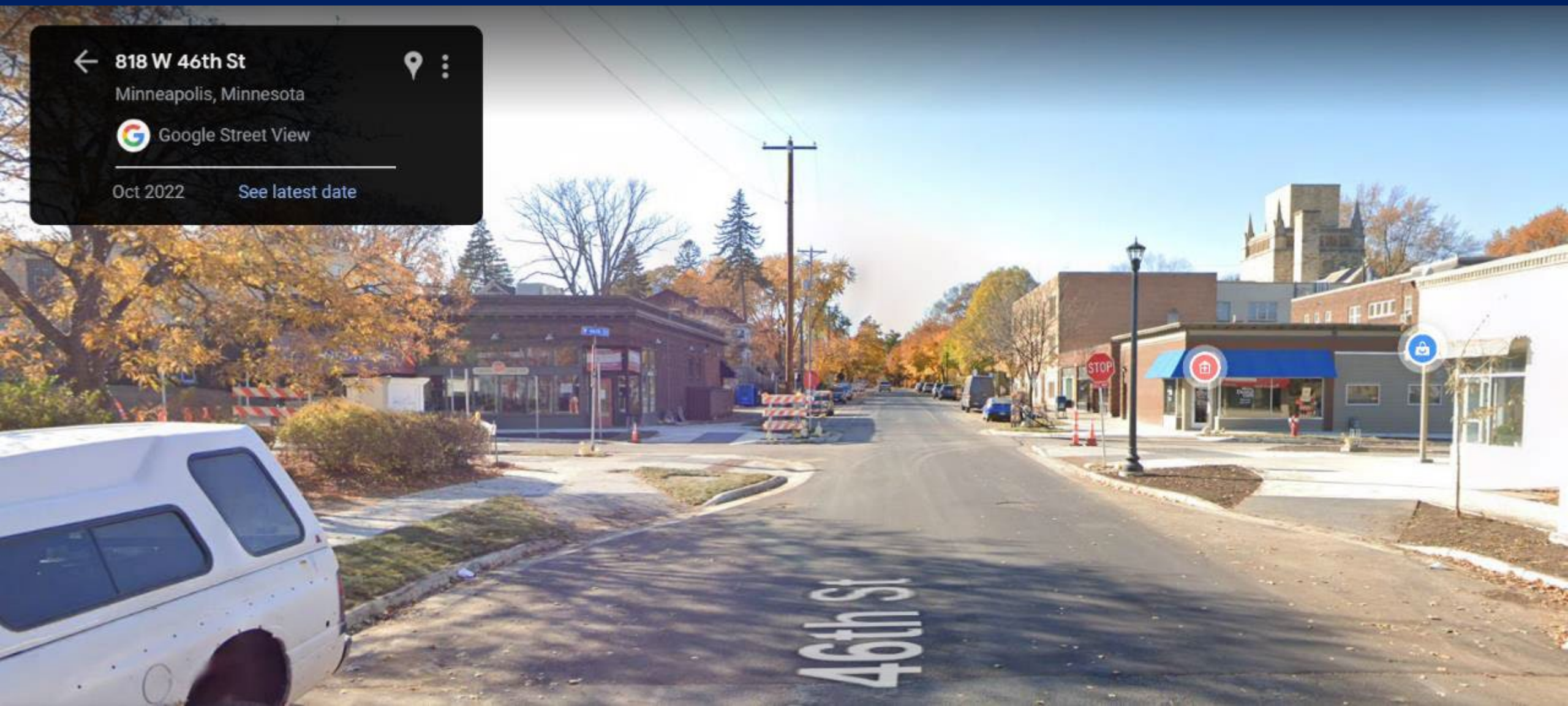


Bryant Ave - After

← 818 W 46th St
Minneapolis, Minnesota

 Google Street View

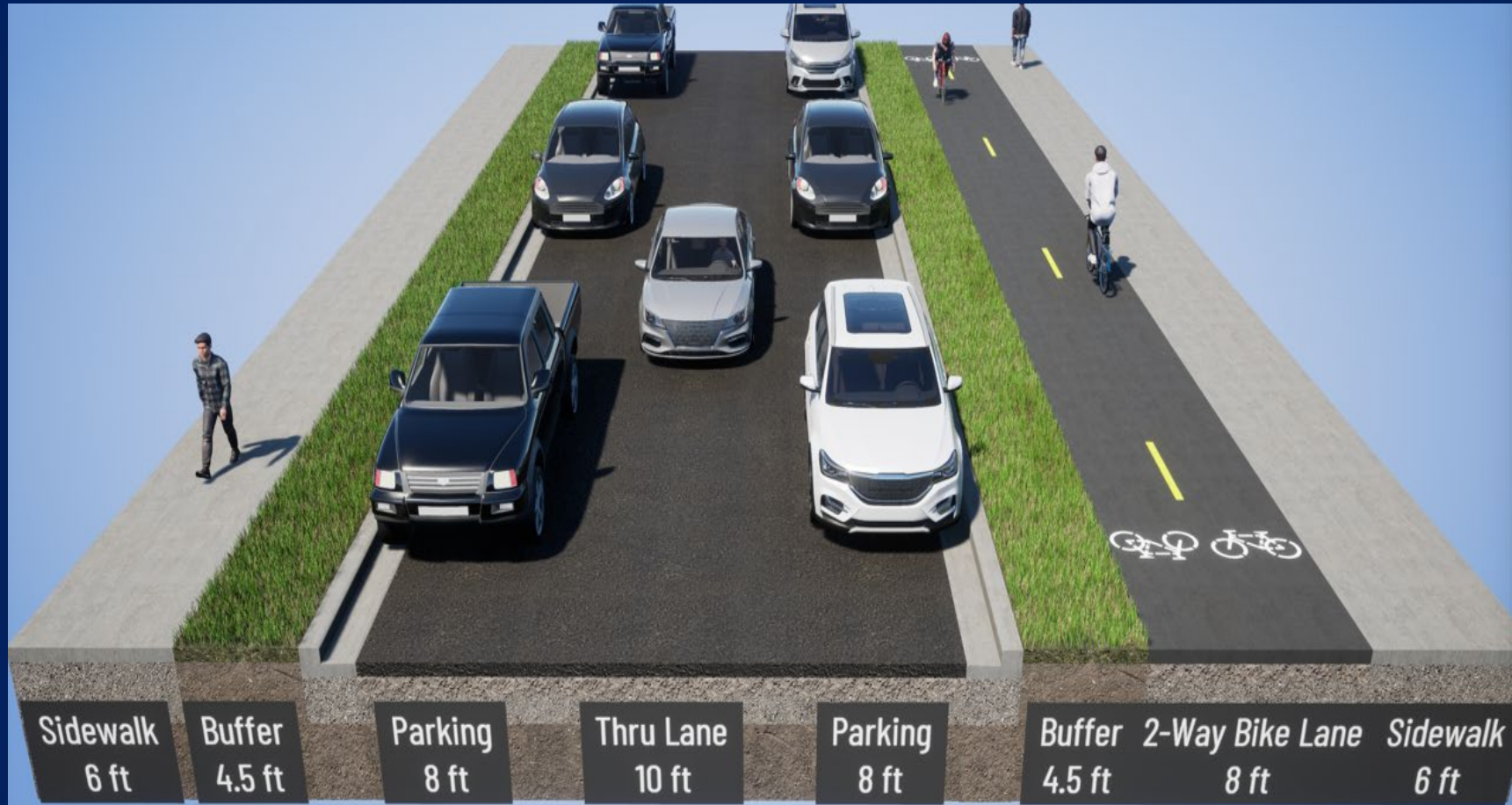
Oct 2022 See latest date



Bryant Ave - After



Bryant Ave

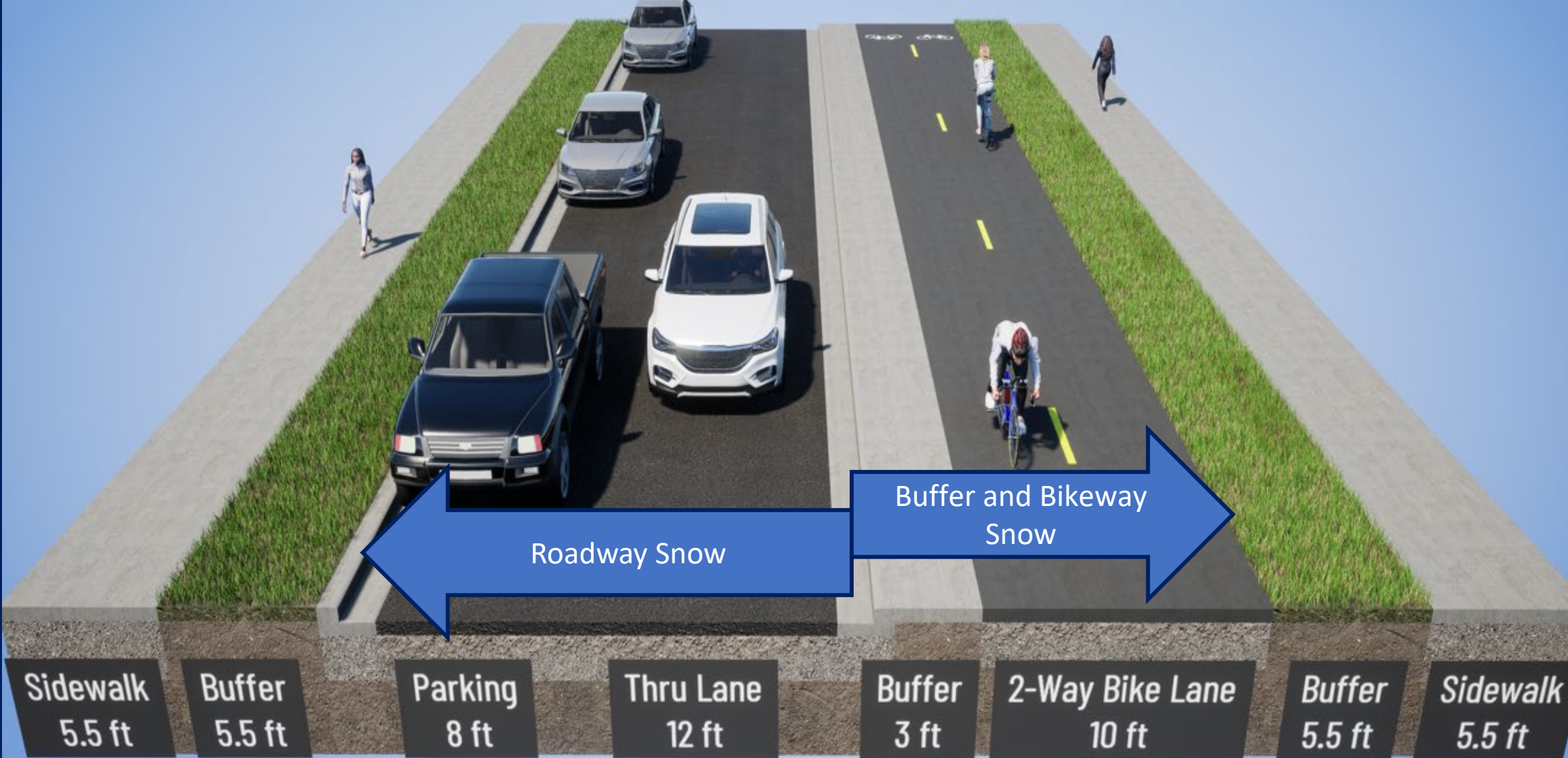




Bryant Ave



Bryant Ave



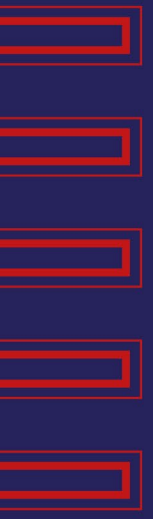


DESIGNING CITIES
NACTO **DENVER** 2023

Thank you!

#NACTO2023





NACTO DESIGNING CITIES
DENVER 2023

#NACTO2023

Panel Discussion, Q&A

TALKING POINTS

- **Industry Trends (and Best Practices) vs. Operations & Maintenance Realities**
- **Equity in Infrastructure Provision and Operations**
- **Funding and Prioritization**



NACTO DESIGNING CITIES
DENVER 2023

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