FHWA Bikeway Selection Guide

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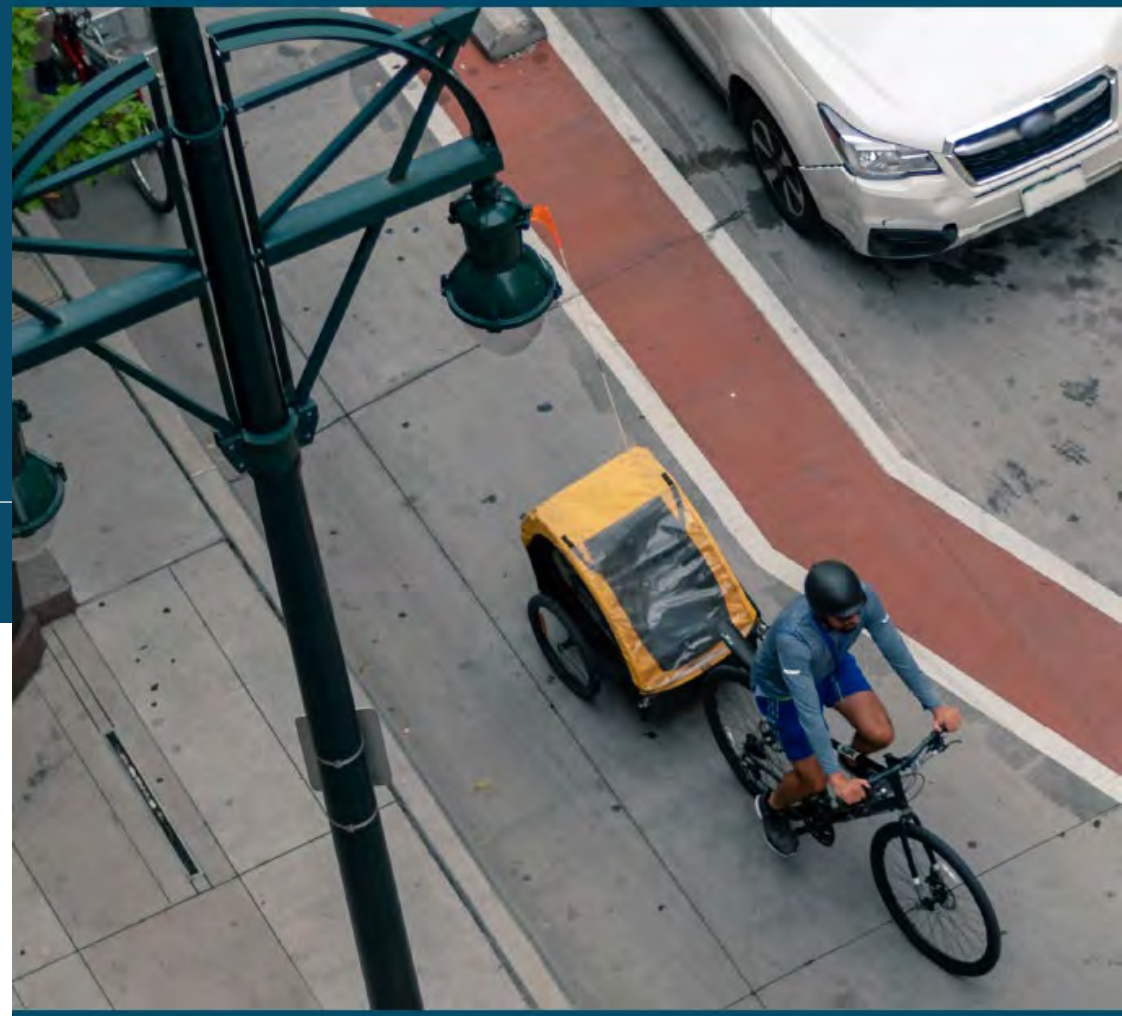
U.S. Department of Transportation
Federal Highway Administration



Introductions & Welcome

U.S. Department of Transportation
Federal Highway Administration


THULE


STRIDER

Participant Polling

Go to **menti.com** and

Use the code **74 78 56**

What was your best Halloween costume? OR what is your costume for this Halloween?

Mentimeter

I'm going as a camp fire this year.

Sexy police officer

David Hasselhoff

Oompa loompa

Garbage truck

a lamp

Steve Irwin

Winnie the Pooh

J.P. Sears

23

What was your best Halloween costume? OR what is your costume for this Halloween?

Mentimeter

- Eleven from Stranger Things
- A bee (Save the bee!)
- Power rangers family costumes
- A squirrel
- Daria
- The grim reaper
- Tweety
- ZZ Top (billy gibbons)
- Steve Jobs

23

What was your best Halloween costume? OR what is your costume for this Halloween?

Mentimeter

Camp fire

Ratatouille

Pirate

More reasons for Separated bike lanes

Understand FHWA's perspective on bicycle facility selection recommendations

23

Why are you here today?

Mentimeter

Interested in bike planning and learning more.

Learn new strategies

Find out why fhwa produced this guide

Keeping myself up to date on any new facility types and implementation

To Learn

Get clarity on what's the "official" guidance.

Gather new information/perspective related to bike facility selection

To make biking safer in my city

Learn about best practice for Bikeway selection

23

Why are you here today?

Mentimeter

My organization needs to advance our bikeways and get on the same page with one another.

Because of the title of the agenda. I need to learn about the bikeway selection guide

I wanted to learn more about bikeways and selection because it will be an integral part of my position moving forward.

Expand my knowledge of bikeway placement

Learn more about multimodal options and about the selection guide

I want to make bicycling in Colorado a better and safer mode choice for residents and visitors.

Best solutions for getting out of a car

how can we work together to make consistent design decision/improvements to bikeways in the region

How to build more Separated bike lanes

23

Why are you here today?

Mentimeter

Learning. And get out of office.

To improve my understanding of the bikeway options.

I want to provide better assistance to local governments who traditionally don't invest in bike/ped infrastructure

Expand knowledge of Bikeway selection

Learn more about the best bicycle facilities for my projects

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Chapter 1: Purpose of the Guide

> The Federal Highway Administration's Bikeway Selection Guide is a resource to help transportation practitioners consider and make informed trade-off decisions relating to the selection of bikeway types.

It is intended to supplement planning and engineering judgment.

> It incorporates and builds upon FHWA's support for design flexibility to assist transportation agencies in the development of connected, safe, and comfortable bicycle networks that meet the needs of people of all ages and abilities.

Chapter 1: Introduction
Purpose of the Guide

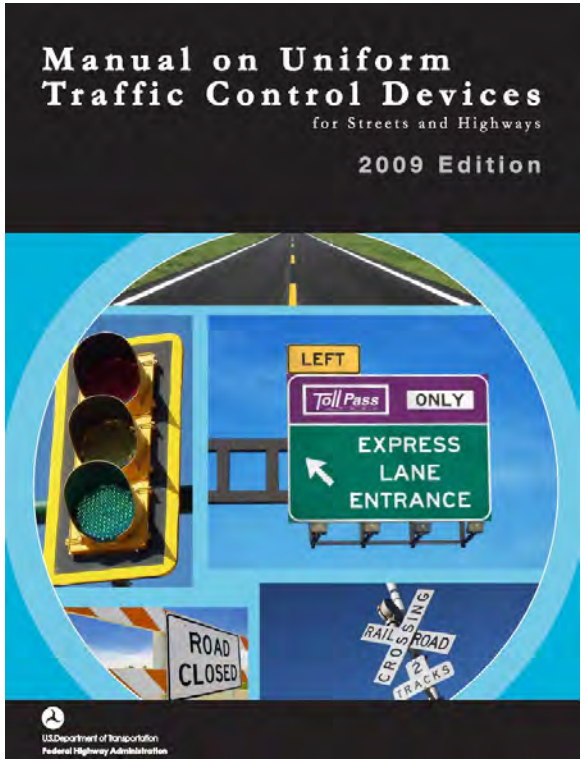
FHWA goals

- Increase the number of short trips made by bicycling and walking to 30% by 2025
- Reduce pedestrian and bicyclist fatalities
  - by 80% in 15 years
  - to zero in 20 – 30 years

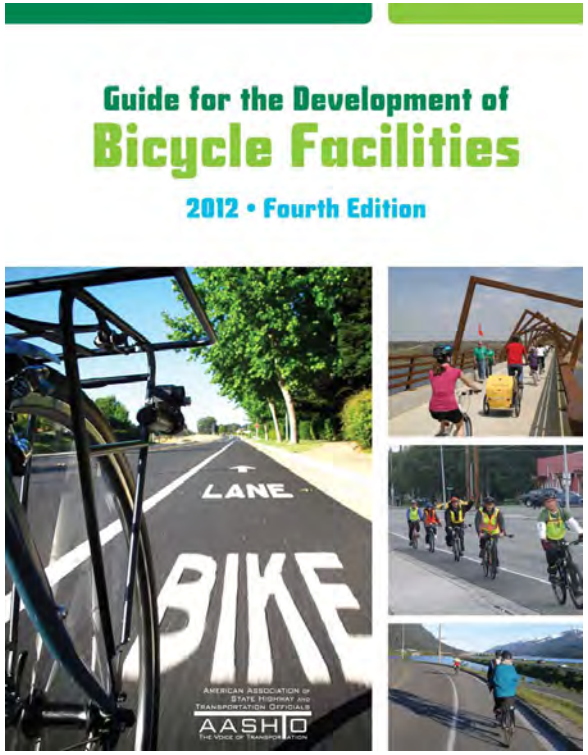
Disclaimer

This guide IS NOT a design guide. Its sole purpose is to help practitioners make informed decisions for selecting bikeway types.

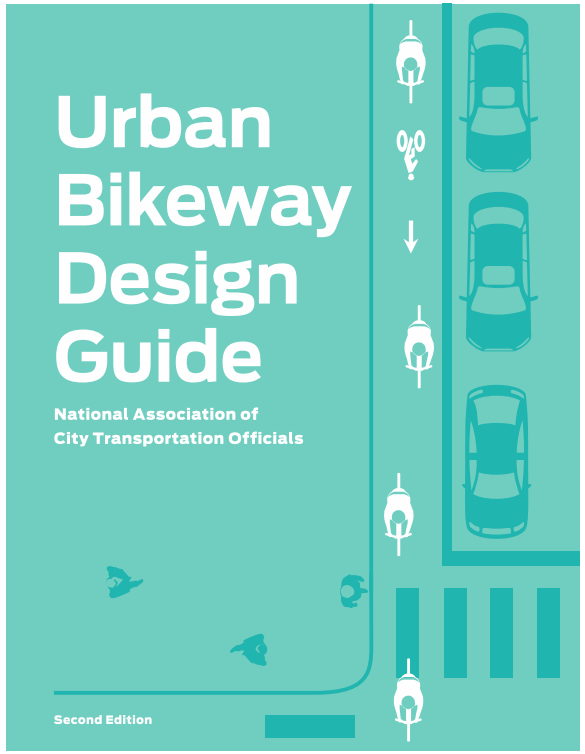
Chapter 1: Introduction
Bikeway Selection Guide Supports



FHWA

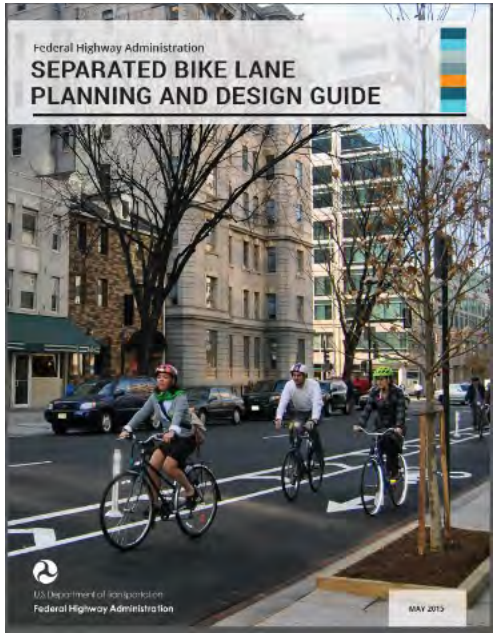


AASHTO



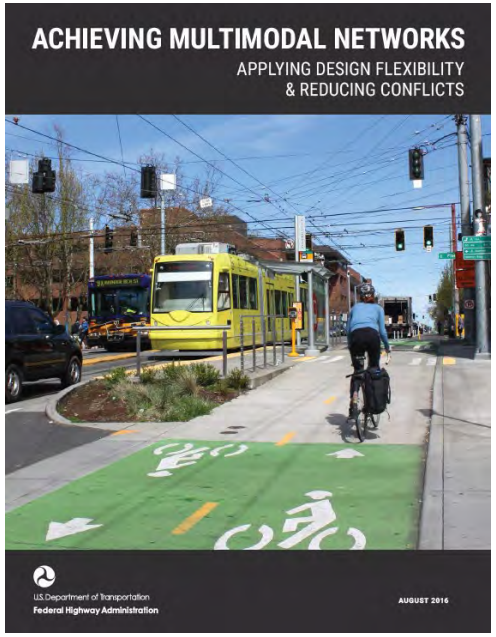
NACTO & ITE

Chapter 1: Introduction
Bikeway Selection Guide Complements



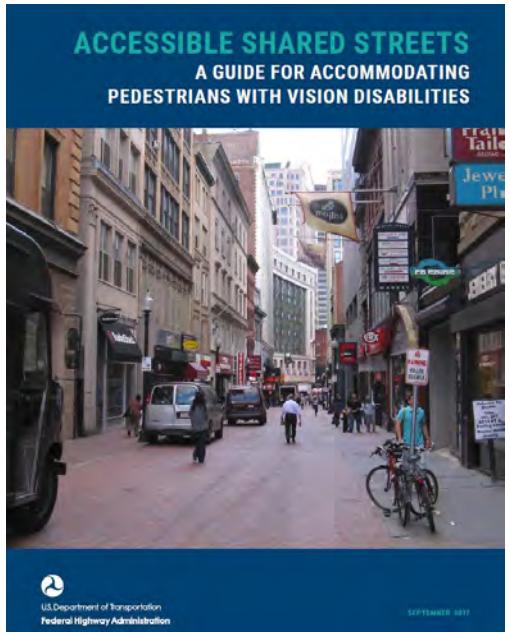
FHWA Separated Bike Lane Planning and Design Guide

May 2013



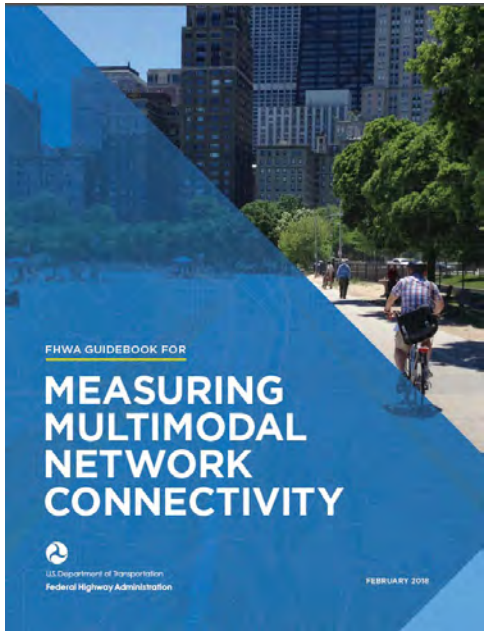
FHWA Achieving Multimodal Networks

August 2016



FHWA Accessible Shared Streets

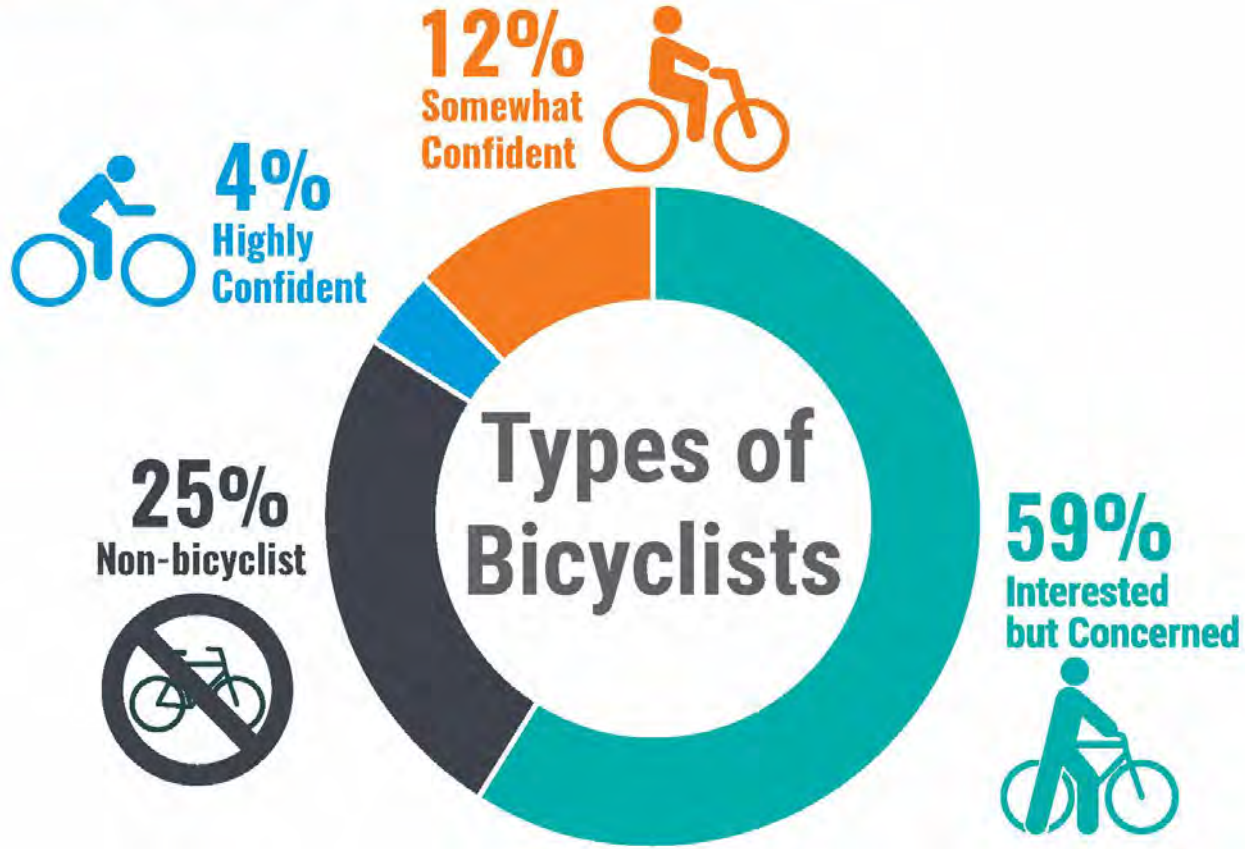
September 2017



FHWA Measuring Multimodal Network Connectivity

February 2018

Types of Bicyclists in the Denver Region



Highly Confident bicyclists are willing to ride on almost any type of street.

Somewhat Confident bicyclists will ride on most streets, but prefer trails or streets with bicycle infrastructure.

Interested but Concerned bicyclists would like to ride but are concerned about safety.

Non-bicyclists do not currently ride bicycles and are not interested.

Participant Polling

Go to **menti.com** and

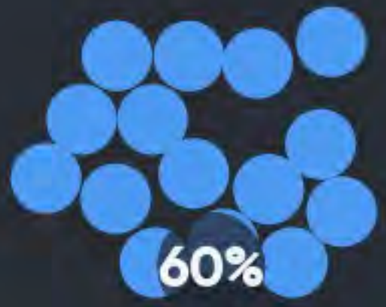
Use the code **74 78 56**

What type of bicyclist are you?

Mentimeter

28%

Highly confident



60%

Somewhat confident

8%

Interested but concerned

4%

Not a bicyclist

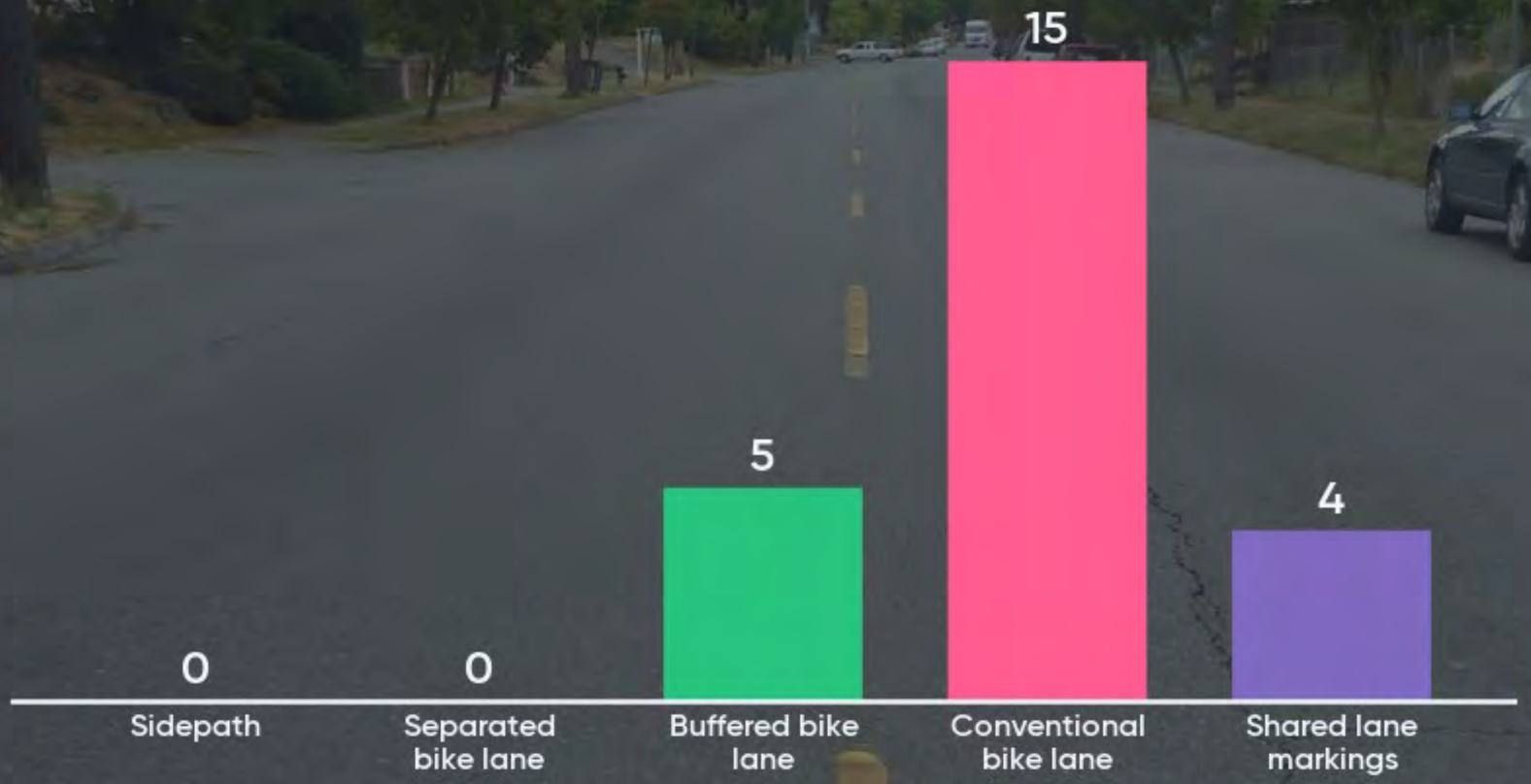
25

What Type of Bikeway Would You Choose?

U.S. Department of Transportation
Federal Highway Administration

What type of bikeway would you choose? (2-lane, 25 mph, 4,000 ADT)

Mentimeter



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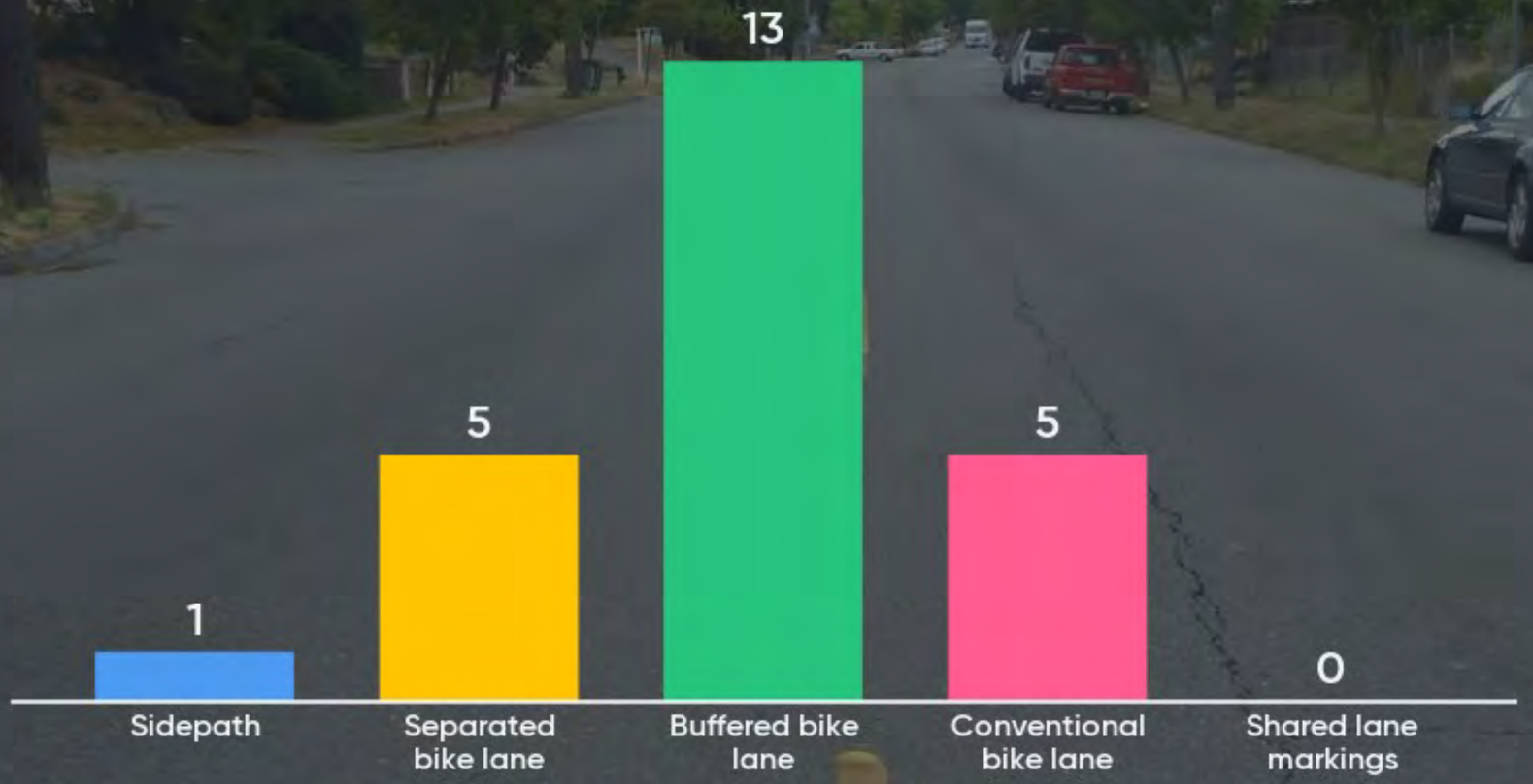
What Type of Bikeway Would You Choose?

U.S. Department of Transportation
Federal Highway Administration

What type of bikeway would you choose? (2-lane, 25 mph, 14,000 ADT)

Mentimeter



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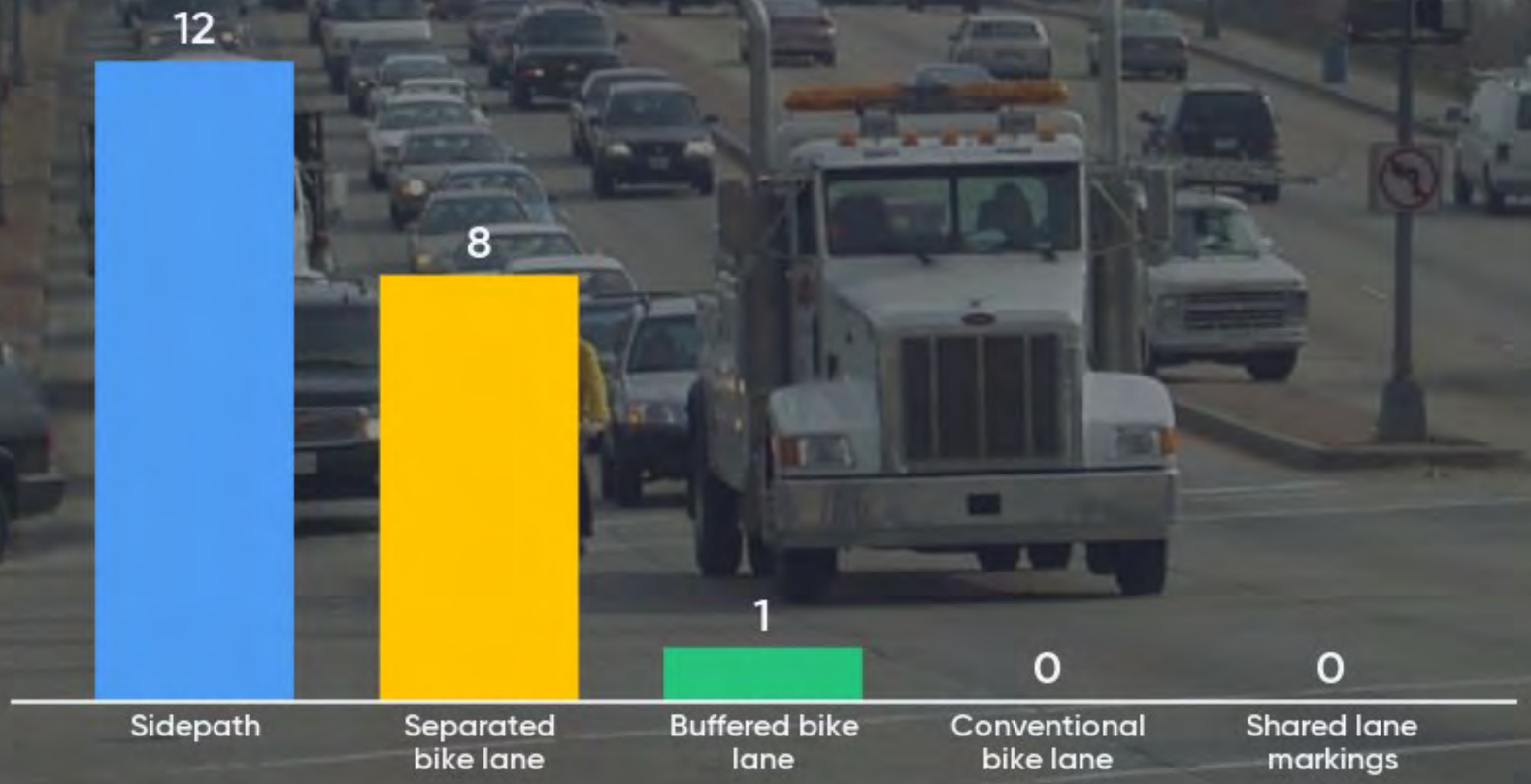
What Type of Bikeway Would You Choose?

U.S. Department of Transportation
Federal Highway Administration

What type of bikeway would you choose? (6-lane, 30 mph, 40,000 ADT)

Mentimeter



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How We Got Here

We are a car dependent culture

GOVERNING

THE STATES AND LOCALITIES

FINANCE | HEALTH | INFRASTRUCTURE | MANAGEMENT | ELECTIONS | POLITICS | PUBLIC SAFETY | URBAN | EDU

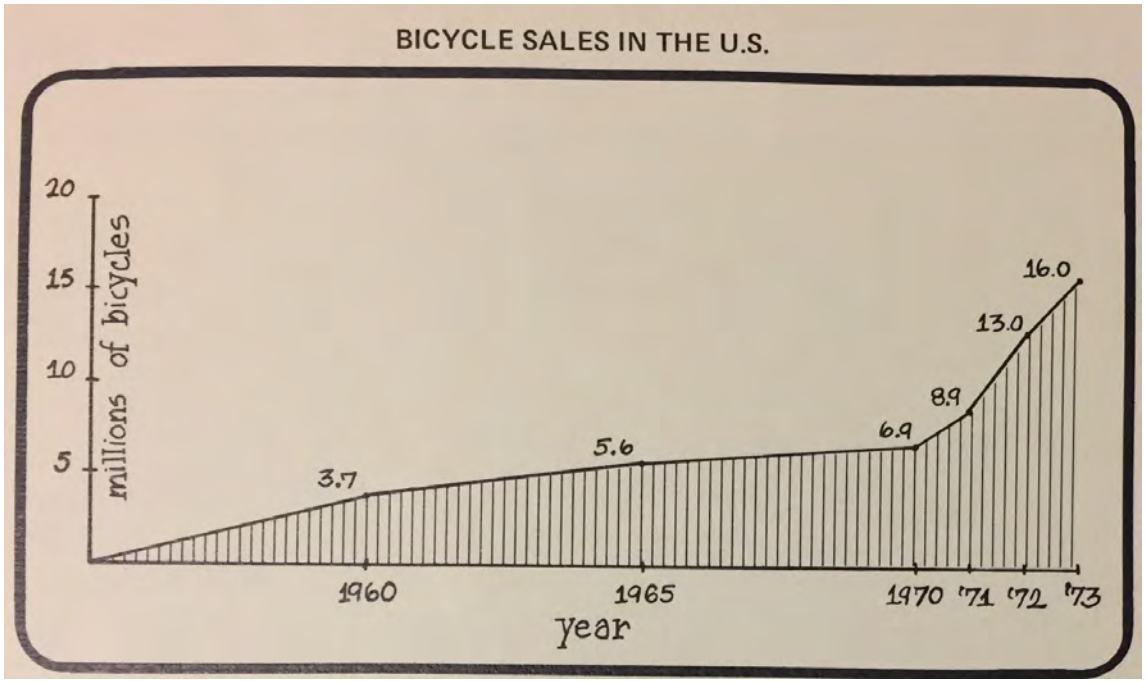
PUBLIC SAFETY & JUSTICE

"Poor communities have double the fatality rates of wealthier communities."

BY MIKE MACIAG | AUGUST 2014

Background

San Francisco bicyclists seeking a dedicated bike lane on Market Street protest in front of City Hall in 1972.
Source: Joe Rosenthal, The Chronicle

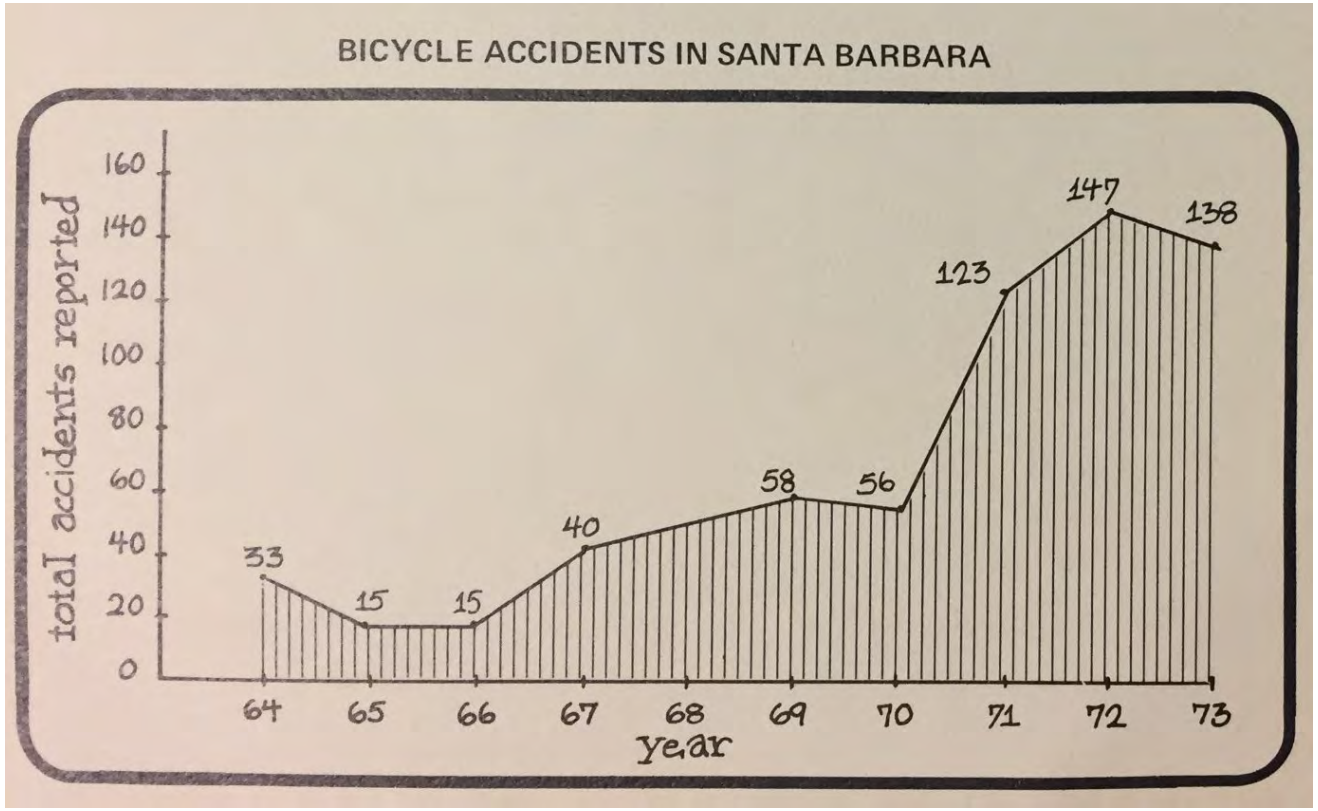


Background

Bicycle crash increases 1970 - 1971:

- Miami up 50%
- Colorado up 50%
- California up 35%
- Massachusetts 45%

Source: NYTimes, 9/24/1972



America’s First Bikeway Network – Davis, CA, 1967-1972

200
500
1000
2000
BICYCLES

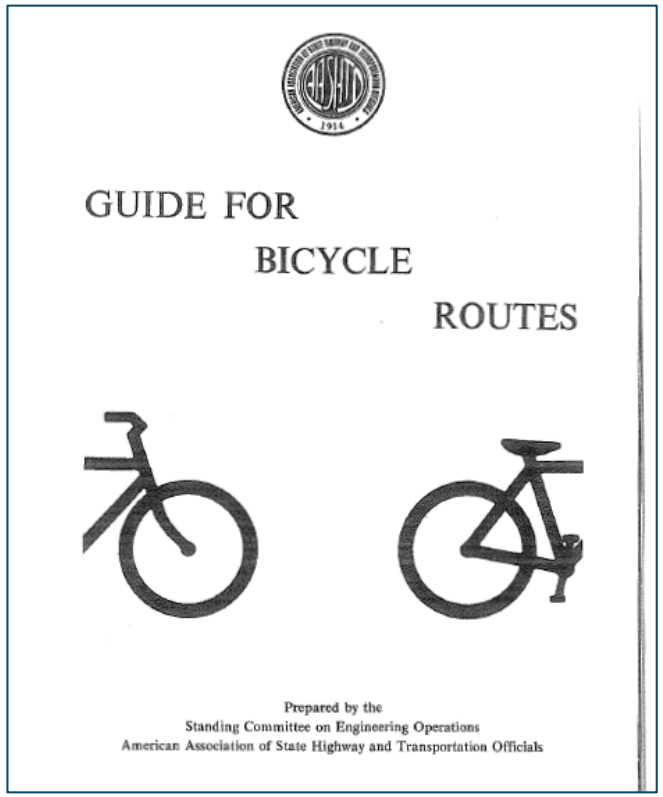
1971 BICYCLE VOLUMES
AM AND PM PEAK PERIODS

U.S. Department of Transportation
Federal Highway Administration

Need for Guidance

As bicycling increased, the US DOT recognized a need for design guidance.

In 1974, the AASHTO Guide for Bicycle Routes was born!



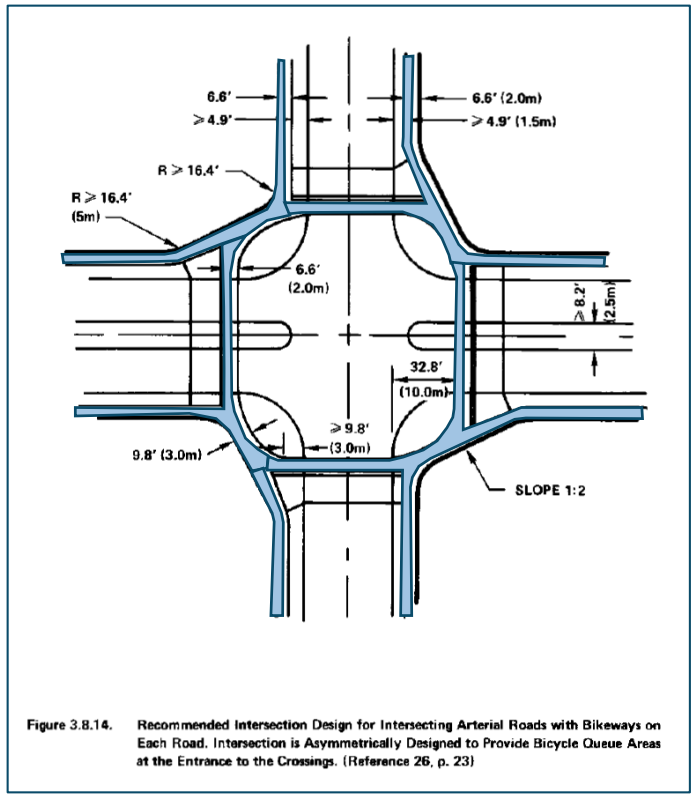


Figure 3.8.14. Recommended Intersection Design for Intersecting Arterial Roads with Bikeways on Each Road. Intersection is Asymmetrically Designed to Provide Bicycle Queue Areas at the Entrance to the Crossings. (Reference 26, p. 23)

1974 AASHTO Bike Guide

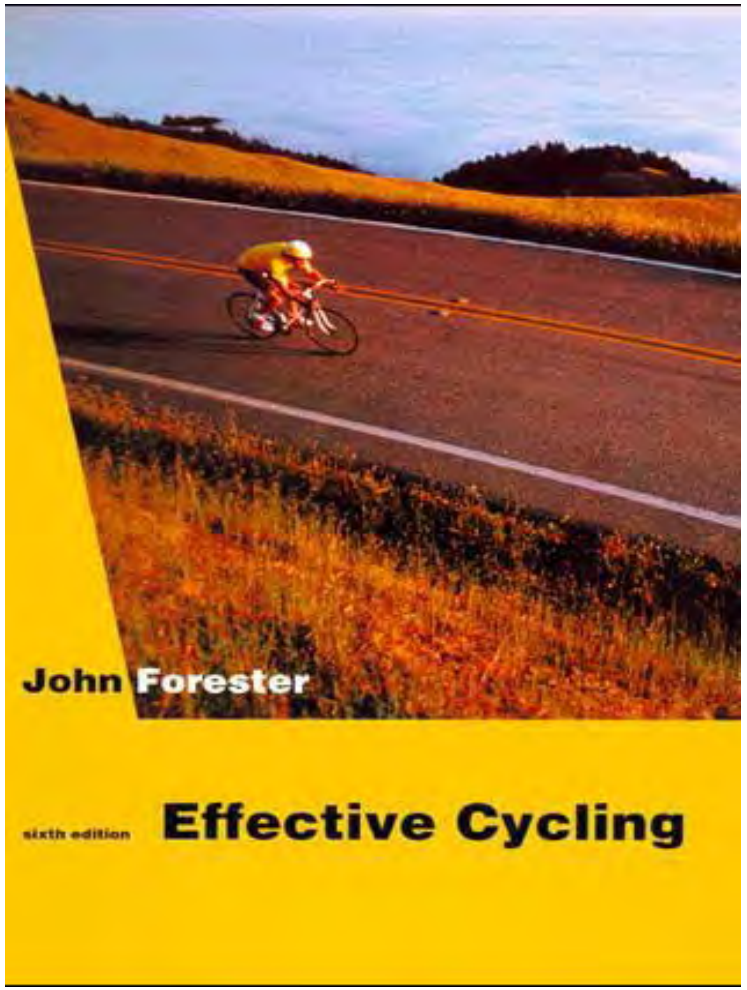
Minimum design speed:	**10 mph**
Desirable design speed:	**15 mph**
Bicycle lane criteria:	**specific volumes included**
Wide curb lanes:	**not included**
Separated bike lanes:	**recommended**
Sidepath intersection:	**use protected intersection**

Some Bicyclists Grow Concerned

- Mandatory use laws inconvenient, restrictive, potentially unsafe
- Facilities not well maintained
- “Right to road” endangered

John Forester

"…the California government decided to "make cycling safe" by establishing a system of laws and facilities that would **impose the childish cyclist-inferiority system of operation upon all cyclists**."



“Vehicular cycling…is faster and more enjoyable, so that the plain joy of cycling overrides the annoyance of even heavy traffic.”

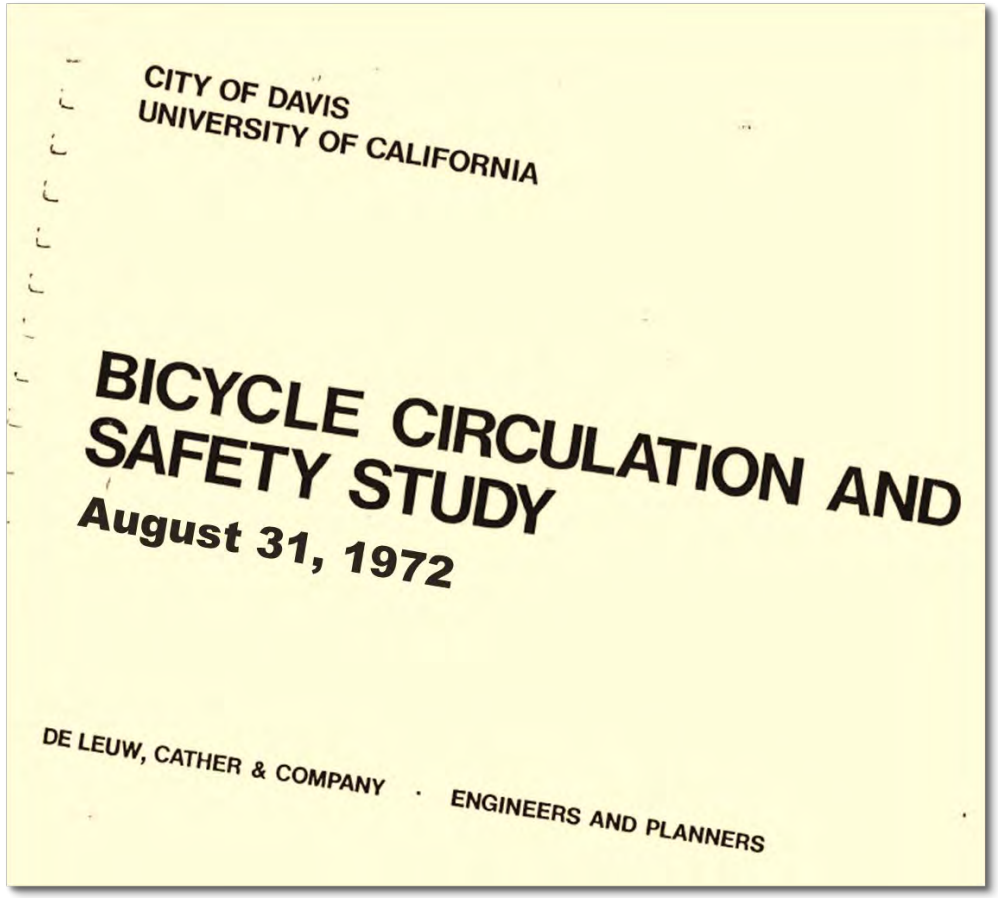
- John Forester

Early Research

1975 report on Safety and Locational Criteria for Bicycle Facilities findings consistent with modern-day research on bicyclists' preferences and safety:

- Bicyclists prefer separation
- Bike lanes safer than shared lanes
- Contra-flow bicycling increased crashes
- Sidewalk cycling less safe

De Leuw (1974), Cross (1974), and Kaplan (1976)



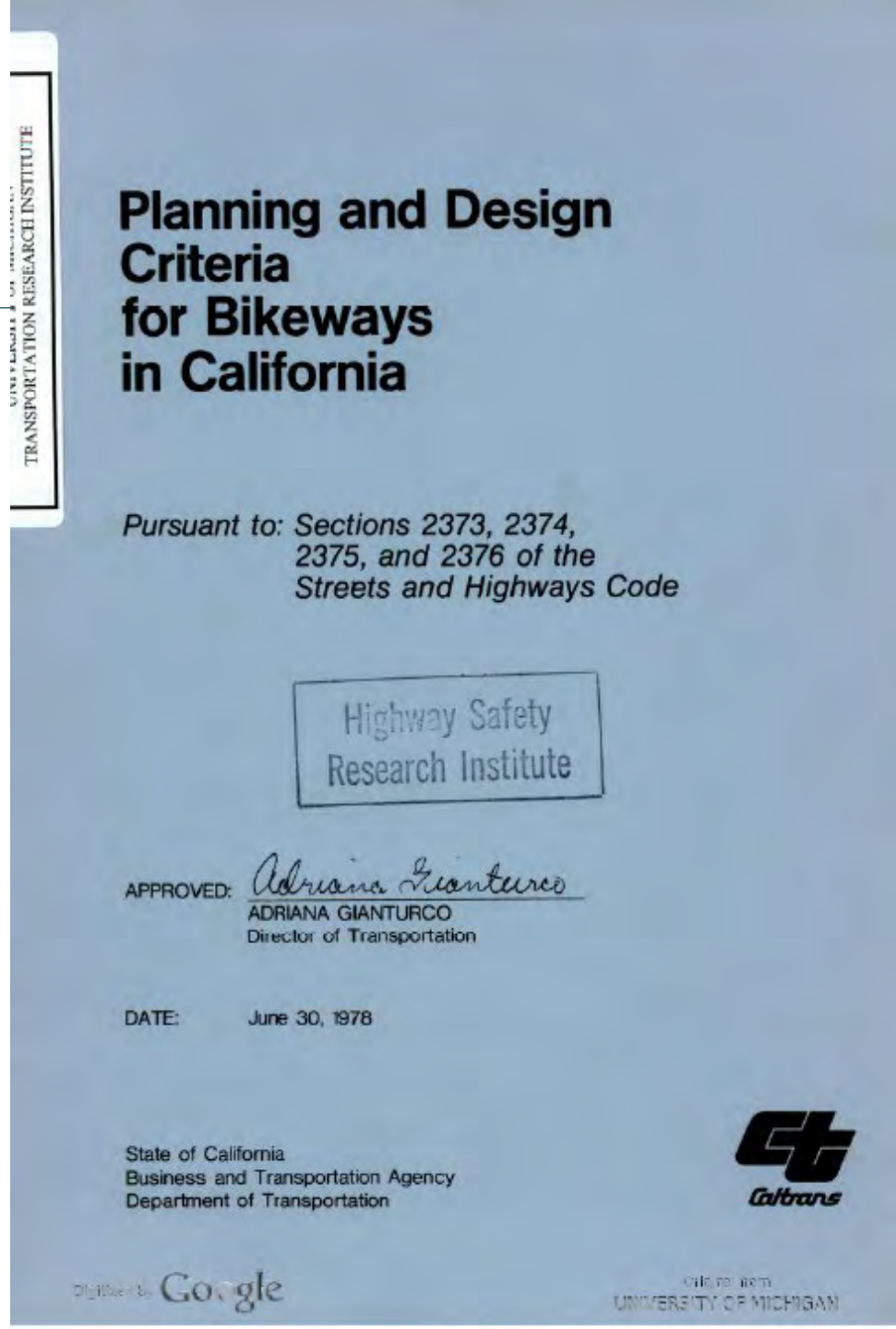
California as a Bellwether

"The fear of liability on the part of the organizations whom the members represented was the only argument that swayed them."

- J. Forester

Efforts to separate bicycles from the normal flow of vehicular traffic are not practical in the 20th century – the priority is to accommodate motorized vehicular traffic.

- CalTrans engineer Harold Munn



> The LAW supports bike paths as separate facilities where no public road exists, on bridges, to bypass or parallel limited access highways, or in special recreation and park areas.

- League of American Wheelman, 1973

1981 AASHTO Bike Guide

Minimum design speed:	**20 mph**
Desirable design speed:	**30 mph**
Bicycle lane criteria:	**loose**
Wide curb lanes:	**preferred if no bike lane**
Separated bike lanes:	**prohibited**
Sidepath intersection:	**avoid designing sidepaths**

Many of the common problems are related to improper behavior and can only be corrected through effective education and enforcement programs.

- AASHTO Introduction

Wide Lanes Win the Day in 1980s


SOUTHEASTERN
Quality Without Question
FedEx MultiModal
FXFZ
974147
JKK-1891
TEXAS
40

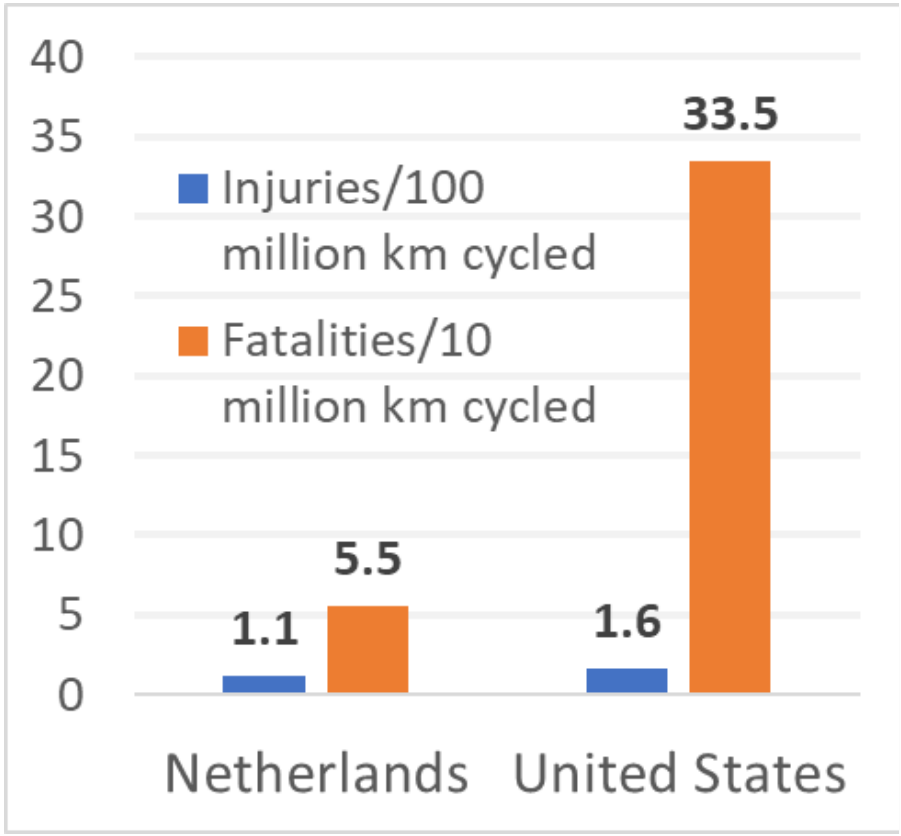
1991 AASHTO Bike Guide

Minimum design speed:	**20 mph**
Desirable design speed:	**30 mph**
Bicycle lane criteria:	**loose**
Wide curb lanes:	**preferred if no bike lane**
Separated bike lanes:	**prohibited**
Sidepath intersection:	**avoid designing sidepaths**

1999 AASHTO Bike Guide

Minimum design speed:	**20 mph**
Desirable design speed:	**30 mph**
Bicycle lane criteria:	**loose**
Wide curb lanes:	**preferred if no bike lane, wider**
Separated bike lanes:	**prohibited**
Sidepath intersection:	**integrate with intersection**

2000s
European Evidence Increasingly Important



National mode share: 27% 1%

2012 AASHTO Bike Guide

Minimum design speed:	**18 mph**
Desirable design speed:	**30 mph**
Bicycle lane criteria:	**may serve potential cyclists**
Wide curb lanes:	**last resort if no bike lane**
Separated bike lanes:	**introduced as one-way sidepath**
Sidepath intersection:	**integrate with intersection**

Today: Bicycling for Everyone!

2020 AASHTO Bike Guide

- Minimum design speed: **15 mph**
- Desirable design speed: **18-30 mph**
- Bicycle lane criteria: **may serve potential cyclists**
- Wide curb lanes: **last resort if no bike lane**
- Separated bike lanes: **definitively supports**
- Sidepath intersection: **protected intersection option**

Big issue with every guide: what facility type to choose…

…and what if you can’t get your first choice?

U.S. Department of Transportation
Federal Highway Administration

Policy and Planning

Vision

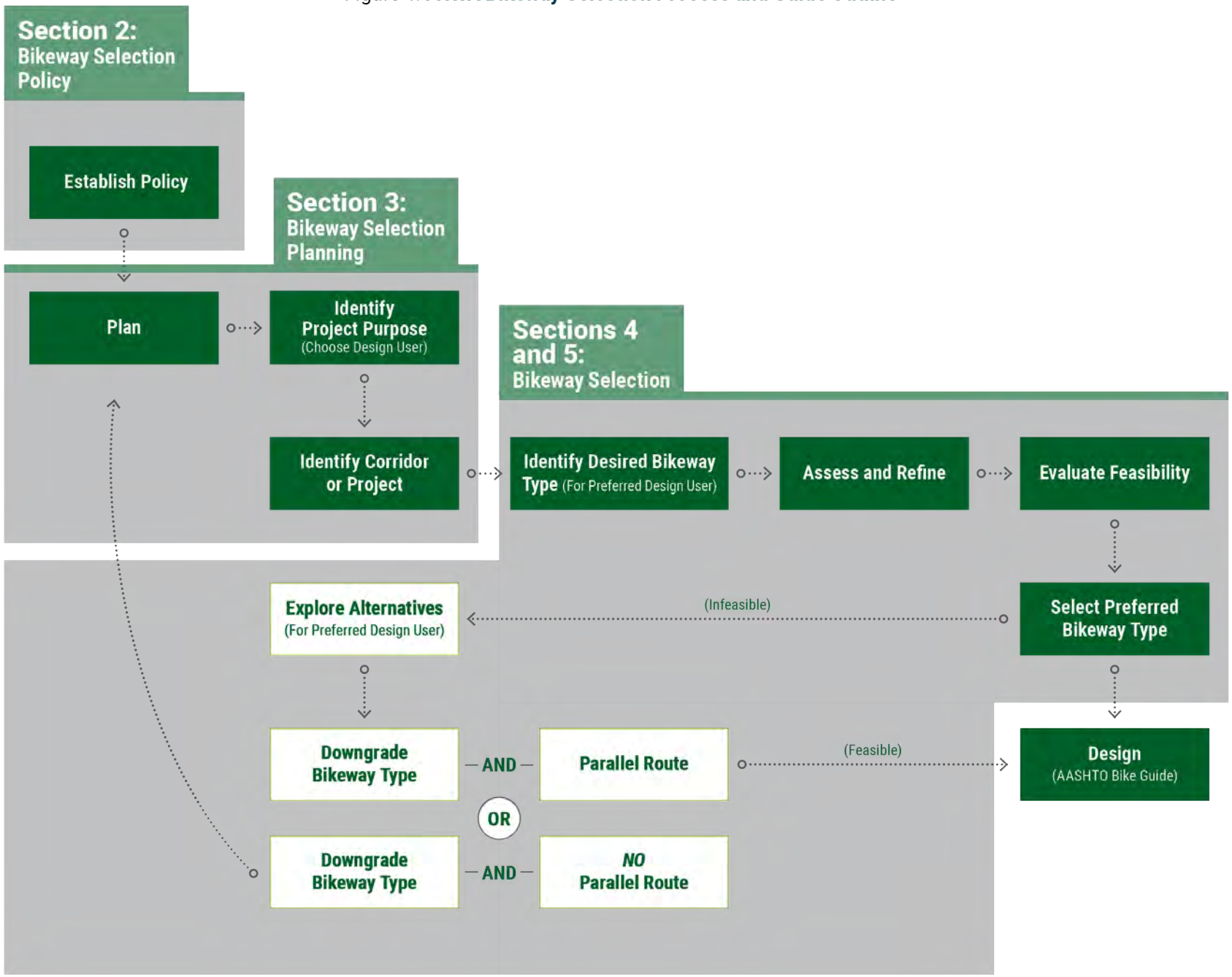
Goals

U.S. Department of Transportation
Federal Highway Administration

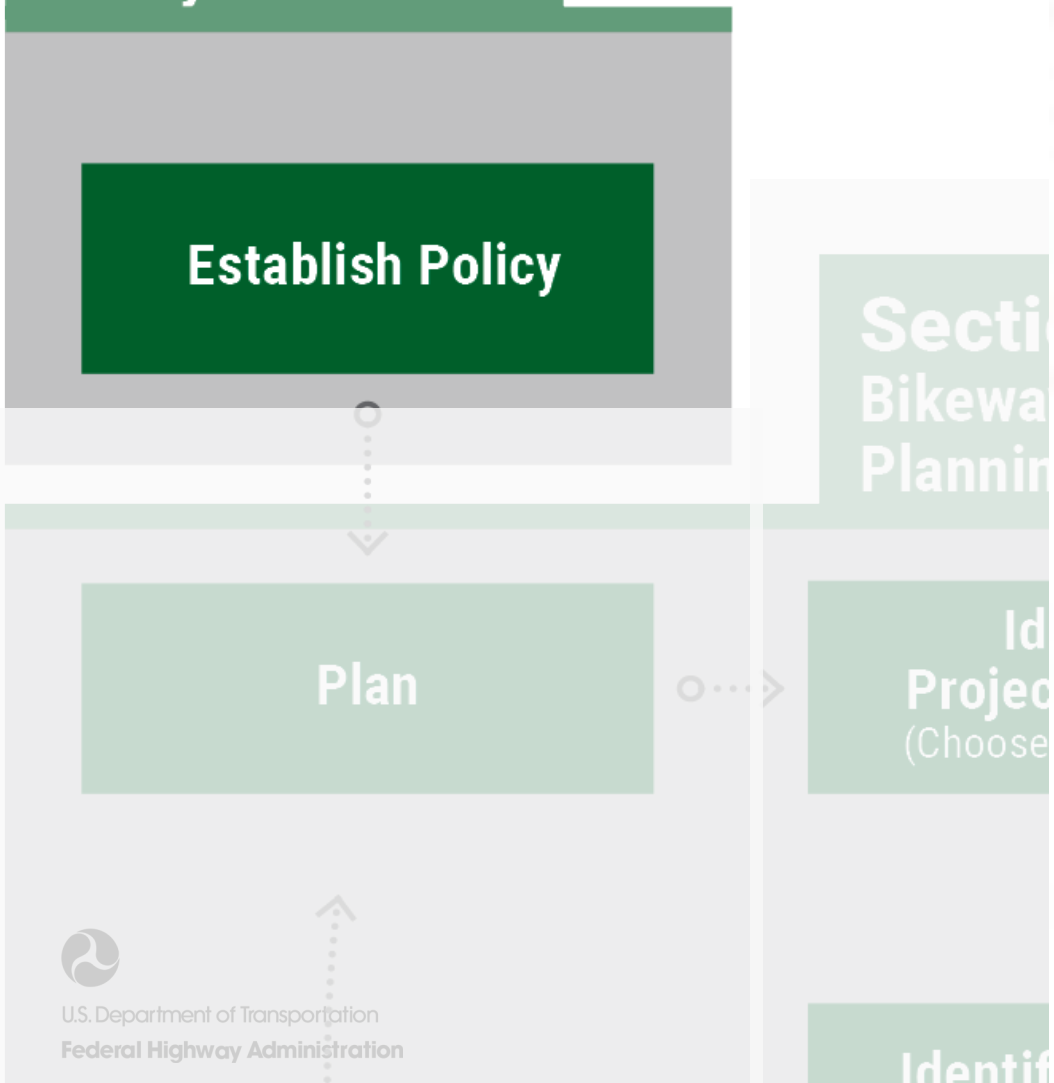
Chapter 2:
Bikeway Selection Process

- Policy
- Planning
- Selection
- Design

Figure 1: **FHWA Bikeway Selection Process and Guide Outline**



Section 2: Bikeway Selection Policy



2. Bikeway Selection Policy

A transportation agency's policies can help to define a vision for the transportation network. They can also support consiste implementation of projects that meet the needs of all users. Policies can address a broad range of topics, such as bikeway s funding, project development, planning, design, accessibility, and maintenance. Policies are also useful to guide and prioriti acceptable trade-offs. The following section highlights examples of how policies can provide context and serve as a framew the bikeway planning and selection process.

Policies relating to bikeway selection can:

1. **Define specific goals and expectations for the bicycle network.** For example, an agency may establish a policy stating that the primary bicycle network should serve the "interested but concerned" user type and/or be designed to support a target bicycle mode share (see page 13).

2. **Make the linkage between bikeway selection and broader goals for multimodal access and safety.** Vision Zero policies and related "Road to Zero" or "Toward Zero Deaths" initiatives can specifically reference bikeway selection as a strategy for reducing fatalities and serious injuries. Policies can explain how bikeway selection occurs as part of all transportation activities and funding programs. They can also explain the relationship between broader goals for level of service (LOS) and the project's defined purpose. For example, as part of the long-range planning process, an agency can establish a desired LOS for bicyclists and identify the bikeway types that will

4. **Provide a transparent framework for prio and programming transportation project including specific bikeway types.** Policies promote a transparent decision making process fo prioritizing and funding transportation projects an bikeways.

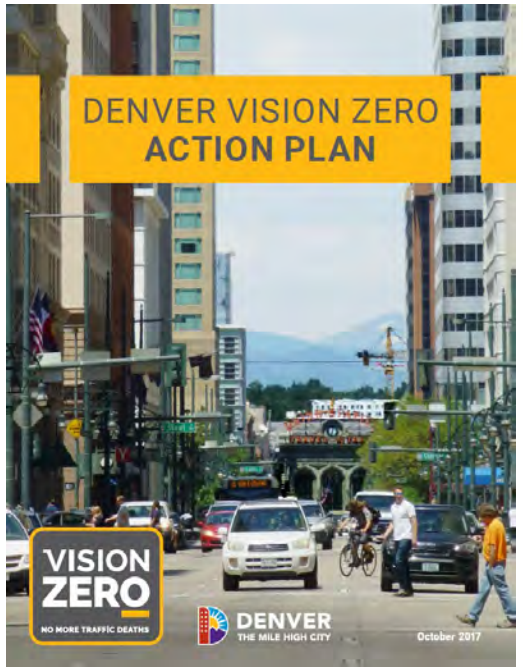
5. **Define different planning contexts and d considerations used to select desired bik** Roadways pass through a broad range of land use development contexts, such as rural areas and urb centers. An agency's policies for bikeway selectio clearly describe planning context and highlight rel factors such as topography, curbside uses, geogra distribution of destinations, local plans, and traffic characteristics. Policies can also address accessi requirements and guidelines. For example, agency can demonstrate how people with disabilities will cross a separated bike lane.

Chapter 2:
Establish Bikeway Selection Policy

Example:

Define specific goals and expectations for the bicycle network.

- Increase bicycling?
- Improve safety?

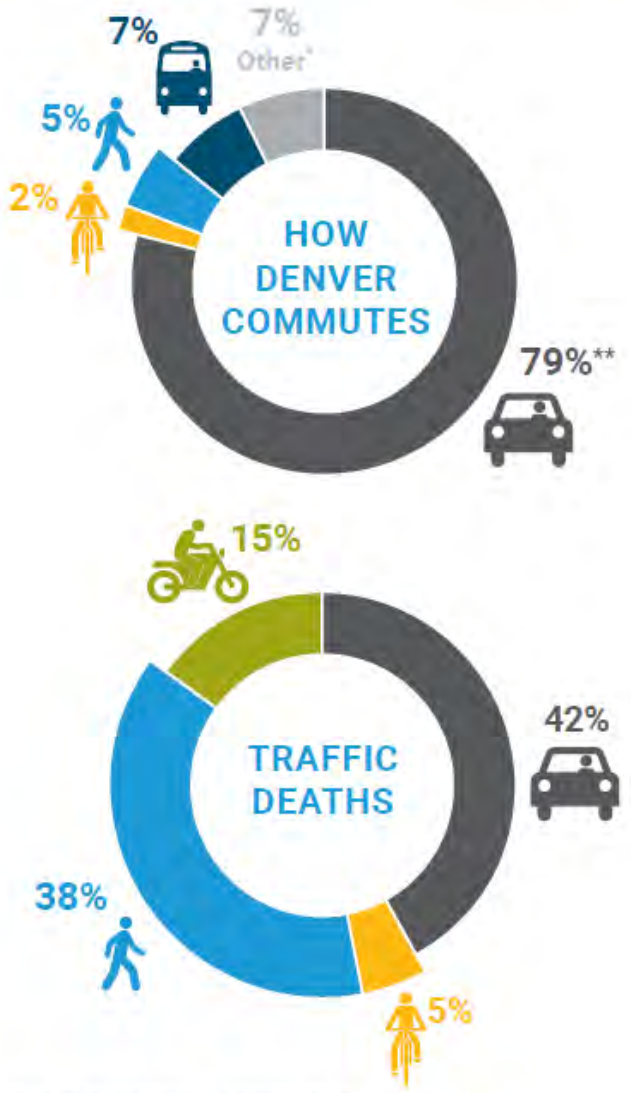


Reconfigure streets and intersections to improve safety and operations

Continue building the enhanced bikeway network and the amenities that support it (bicycle detection, parking), and phase implementation to ensure connectivity.

20 miles of bikeways/year

Figure 2: How Denver commutes versus Denver traffic deaths



* Includes motorcycle commuting
** Includes driving alone and carpooling

Source: U.S. Census Bureau (2011-2015); DPD (2011-2016)

Chapter 2:
Establish Bikeway Selection Policy

The Dutch Approach to Safety and Bikeway Selection

Between the 1950s and 1970s, the Netherlands and the United States began an intense period of auto-centric planning. The resulting increases in motor vehicle travel led to a steady increase in transportation related fatalities. In 1972 transportation-related fatalities peaked in both countries. Improvements in roadway design, vehicle design, and medical care since the early 1970s have led to decreases in fatalities between 1972 and 2011, and between 1972 and 2017, as shown in Table 1 below.

The Most Effective Features of Sustainable Safety

The Dutch Sustainable Safety program includes

The Dutch Sustainable Safety program includes traditional reactive strategies to address crashes that have occurred as well as efforts to improve vehicle design. The improved safety outcomes, however, are largely obtained by the preventative approach to roadway design which strives to prevent serious crashes, and where crashes do occur, to minimize the risk of severe

		Fatalities (2011)	Fatalities (2017)
United States	54,589	32,367 (- 40.7%)	40,100 (- 26.6%)
Netherlands	3,506	661 (- 81.1%)	613 (- 82.5%)

Sustainable Safety Principles:

- Functionality
- Homogeneity
- Predictability
- Forgiveness
- State Awareness

Chapter 2:
Establish Bikeway Selection Policy

Define goals, expectations, and metrics for success

Tie to multimodal network standards

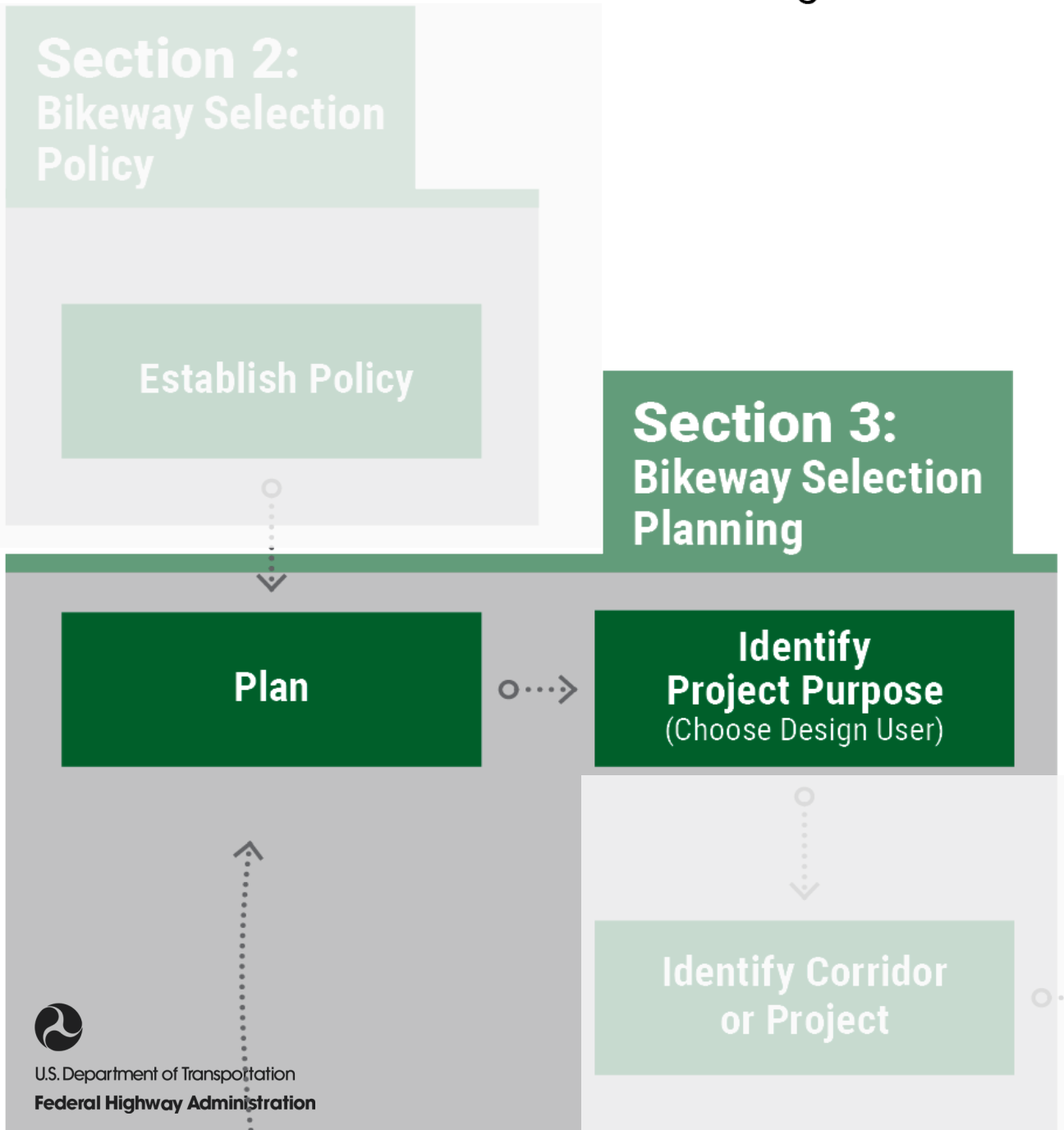
- e.g., Complete Streets, Sustainable Safety, Vision Zero

Make project prioritization transparent

Assess project-level feasibility

Proactively address maintenance

Figure 1: **FHWA**



3. Bikeway Selection Planning

Bikeway type selection should not be done in isolation. The decision is part of a broader planning process that accou
and traffic characteristics of all modes, including freight, transit, personal vehicles, emergency access, bicyclists, an
includes community goals and priorities as well as public involvement and feedback from all parts of the community

Vision

At the core of the planning process is a vision for a future bicycle network. The vision is developed through a planning process and is typically documented in a local, regional, or state plan. The vision describes desired future characteristics of and outcomes for bicycle transportation and typically defines, explicitly or implicitly, the target bicyclist design user type (as described on page 13).

The vision for the bike network can inform planning-related activities, such as decisions regarding where an agency chooses to pave shoulders and transportation recommendations in a small area plan. It should also be integrated into planning discussions about large scale transportation initiatives and plans for other types of networks, such as transit and freight.

To strengthen the vision, an agency may set it into policy. Agencies may consider adoption of the Safe Systems or Sustainable Safety policy, as described in the previous pages, which applies to all transportation decisions. In this case, the agency might prioritize the most vulnerable road users above other transportation objectives. These priorities inform the planned network and specific objectives for each transportation improvement project.

The Bicycle Network

A bicycle network is a seamless interconnected system of bikeways. The purpose and quality of the network depends on the assumptions, goals, and decisions made during the planning process. Networks should be thought
provide necessary and desired connections an
most successful bicycle networks enable peop
abilities to safely and conveniently get where th

The bicycle network informs bikeway type sele
where higher quality facilities are needed the m
project is planned on a roadway that is a critica
network, including the appropriate bike infrastr
prioritized as a part of that project. A lower qua
as a regular bike lane on a busy suburban arteri
speed traffic is a missed opportunity to build o
high comfort bike network that serves a greate
population. The opportunity to make a high-qua
may not occur again for decades. While this bik
improvement over no bikeway facility, it will not
most people given the context.

Similarly, if a project is planned on a road that i
bike network, a trade-off on the quality of the bi
be more acceptable (keeping in mind that bicyc
to travel on all public roads, unless prohibited, v
bicycle facility is present).

By influencing bikeway selection in this way, the
network helps communities be strategic about
and implementation, while also helping to balan
network needs, such as for transit and freight.
staff and advocates set priorities by recognizin
individual street or road does not serve the sam
network and that some are more important tha
network also helps to determine the extent to w
route (described on page 34) is a feasible alter

Chapter 3: Bikeway Selection Planning

Vision

The Bicycle Network

Target Design User

Bikeway Types

Road Context

Project Type and Purpose

Bicycle Network Vision Statements

Massachusetts Department of Transportation Statewide Bike Plan Vision

Massachusetts' integrated and multimodal transportation system will provide a safe and well-connected bicycle network that will increase access for both transportation and recreational purposes. The Plan will advance bicycling statewide as a viable travel option - particularly for short trips of three miles or less - to the broadest base of users and free of geographic ineq

Policy Example: Boulder Complete Streets

Complete Streets and Vision Zero integrated as part of Boulder Transportation Master Plan

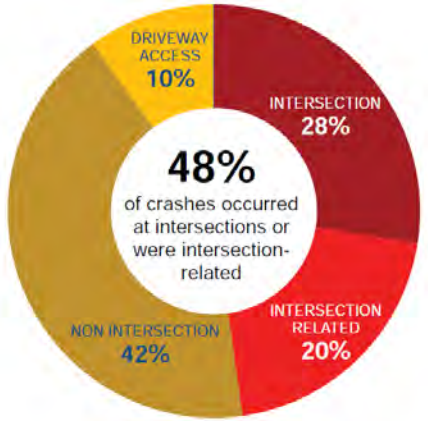
Policy Example: NCDOT Complete Streets

- Adopted in 2009
- Updated in 2019
- Specifies exceptions
- Exception review by Committee members
- No local cost if in a local plan

Complete Street Cost Share			
Facility Type	**In Plan**	**Not in Plan, but Need Identified**	**Betterment**
Pedestrian Facility	NCDOT pays full	Cost Share	Local
Bicycle Facility	NCDOT pays full	NCDOT pays full	Local
Side Path	NCDOT pays full	Cost Share	Local
Greenway Crossing	NCDOT pays full	Cost Share	Local
Bus Pull Out	NCDOT pays full	Cost Share	Local
Bus Stop (pad only)	NCDOT pays full	Cost Share	Local

Policy Example: Austin Vision Zero

- Adopted in 2016
- Annual Vision Zero Report Card for the purpose of “tracking the City’s progress towards the goal of zero deaths and serious injuries by 2025
- Integrated within Austin Strategic Mobility Plan
- Mapped out high-injury network
- Prioritized improvement needs



CRASHES BY LOCATION

Planning Inputs

- **Network**
- **Users**
- **Bikeway Types**
- **Context**

Planning Inputs: Network

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Federal Highway Administration

Chapter 3:
The Bicycle Network

Seven Principles of Bicycle Network Design

Safety
The frequency and severity of crashes are minimized and conflicts with motor vehicles are limited

Comfort
Conditions do not deter bicycling due to stress, anxiety, or concerns over safety

Connectivity
All destinations can be accessed using the bicycling network and there are no gaps or missing links

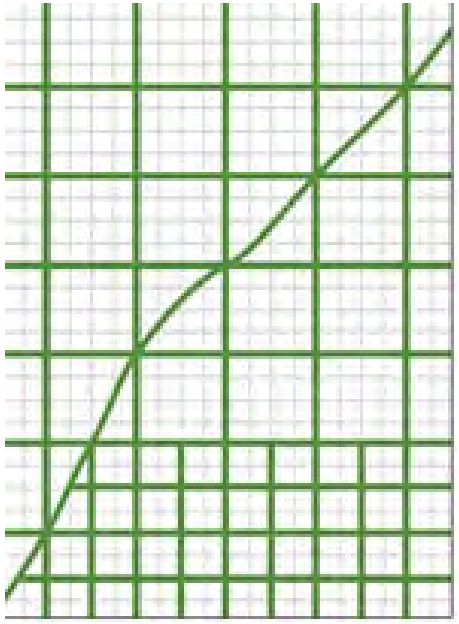
Directness
Bicycling distances and trip times are minimized

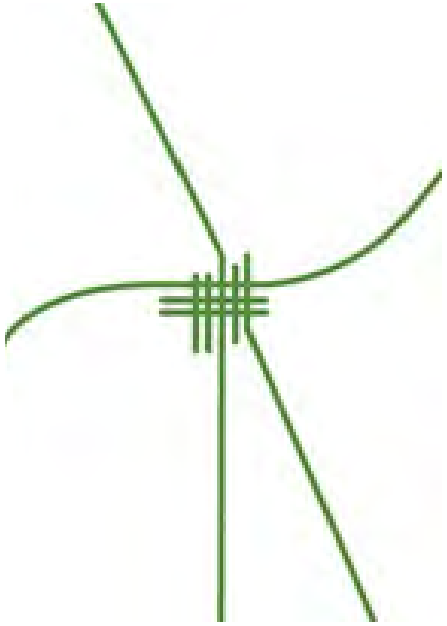
Cohesion
Distances between parallel and intersecting bike routes are minimized

Attractiveness
Routes direct bicyclists through lively areas and personal safety is prioritized

Unbroken Flow
Stops, such as long waits at traffic lights, are limited and street lighting is consistent

Network Context





The level to which the preferred bikeway type should be compromised, if compromise is necessary, should be informed by the relative importance of the segment within the larger network and the availability of alternative routes. For example, if the form of the bike network is a grid, a compromise on one segment may be acceptable given that a high-quality parallel route may be available.

In contrast, if there is only one roadway that provides access for bicyclists, for example to a downtown center, compromising on the bikeway type is less desirable.

Key Components of Pedestrian and Bicycle Network Connectivity

- Network Completeness
- Network Density
- Route Directness
- Access to Destinations
- Network Quality

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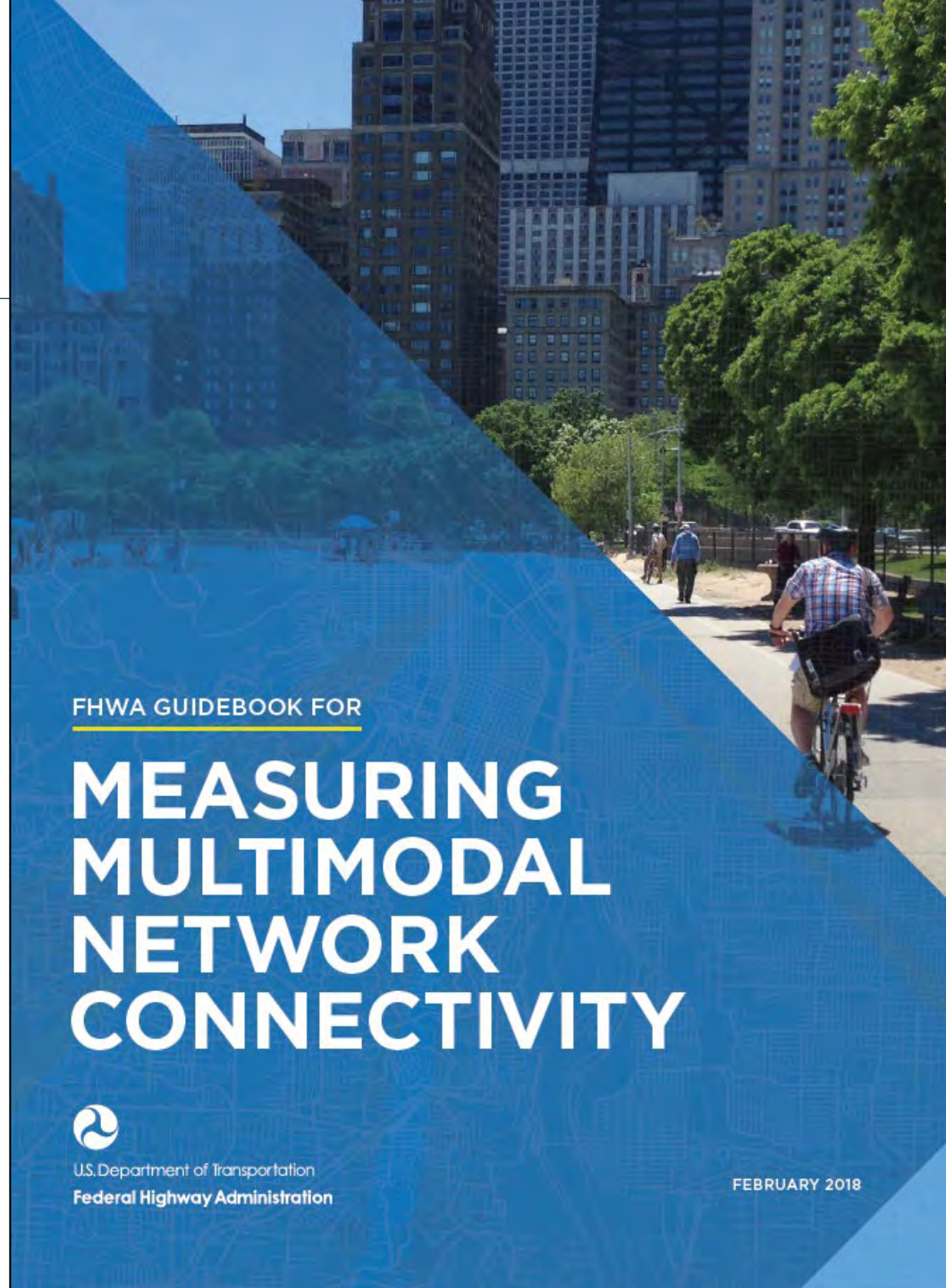

Planning Inputs: Users

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Chapter 3:
The Bicycle Network - Design User

Key Principles

Safety
The frequency and severity of crashes are minimized and conflicts with motor vehicles are limited

Comfort
Conditions do not deter bicycling due to stress, anxiety, or concerns over safety

Connectivity
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Unbroken Flow
Stops, such as long waits at traffic lights, are limited and street lighting is consistent

BICYCLIST DESIGN USER PROFILES

Interested but Concerned	Somewhat Confident	Highly Confident
Often not comfortable with bike lanes, may bike on sidewalks even if bike lanes are provided; prefer off-street or separated bicycle facilities or quiet or traffic-calmed residential roads. May not bike at all if bicycle facilities do not meet needs for perceived comfort.	Generally prefer more separated facilities, but are comfortable riding in bicycle lanes or on paved shoulders if need be.	Comfortable riding with traffic; will use roads without bike lanes.

LOW STRESS TOLERANCE

HIGH STRESS TOLERANCE

Source: Dill, J., McNeil, N. (2012). Four Types of Cyclists? Examining a Typology to Better Understand Bicycling Behavior and Potential.

BICYCLIST DESIGN USER PROFILES

Interested but Concerned

51%-56% of the total population

Often not comfortable with bike lanes, may bike on sidewalks even if bike lanes are provided; prefer off-street or separated bicycle facilities or quiet or traffic-calmed residential roads. May not bike at all if bicycle facilities do not meet needs for perceived comfort.

Somewhat Confident

5-9% of the total population

Generally prefer more separated facilities, but are comfortable riding in bicycle lanes or on paved shoulders if need be.

Highly Confident

4-7% of the total population

Comfortable riding with traffic; will use roads without bike lanes.

LOW STRESS TOLERANCE

HIGH STRESS TOLERANCE

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Source: Dill, J., McNeil, N. (2012). Four Types of Cyclists? Examining a Typology to Better Understand Bicycling Behavior and Potential.

Chapter 3:
Bicycle Network – Design User

High Traffic Stress

Low Traffic Stress

Lunch

What about Scooters and E-Bikes?

Planning Inputs: Bikeway Types

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Chapter 3:
The Bicycle Network - Form

Safety
The frequency and severity of crashes are minimized and conflicts with motor vehicles are limited

Comfort
Conditions do not deter bicycling due to stress, anxiety, or concerns over safety

Connectivity
All destinations can be accessed using the bicycling network and there are no gaps or missing links

Key Principles

Directness
Bicycling distances and trip times are minimized

Cohesion
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Attractiveness
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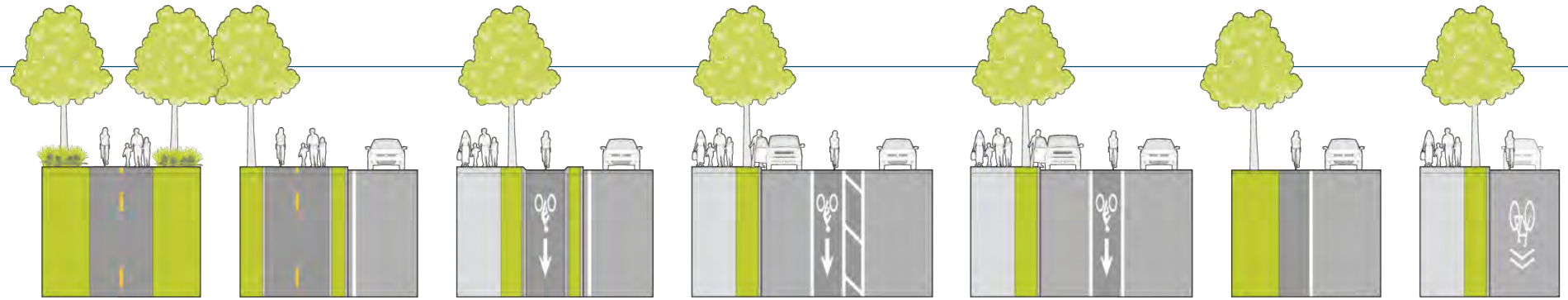

Shared-Use Path | Side Path | Separated Bike Lane | Buffered Bike Lane | Bike Lane | Shoulder | Shared Lane

+ SEPARATION FROM TRAFFIC −

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Conventional Bike Lanes (High Speed and Volume Environments)

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Conventional Bike Lanes (Low Speed Environments)

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Buffered Bike Lanes (High Speed and Volume Environments)

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Separated Bike Lane - Retrofit

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Separated Bike Lane - Reconstruction

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Shared Use Paths

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Neighborhood Greenways (aka Bike Boulevards)

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Low-Stress Bicycle Network

- Referred to often as an “all ages and abilities” network or a high-comfort network.
- Designed to be safe and comfortable for all users.
- Created with an emphasis on quality.

Low-Stress Bicycle Network

- Separated bike lanes and shared use paths
- Low-speed and low-volume streets with characteristics of bicycle boulevards
- By serving a broad audience, low-stress networks maximize system use. They have resulted in bicycling rates of 5 to 15 percent in the United States.

Planning Inputs: Context

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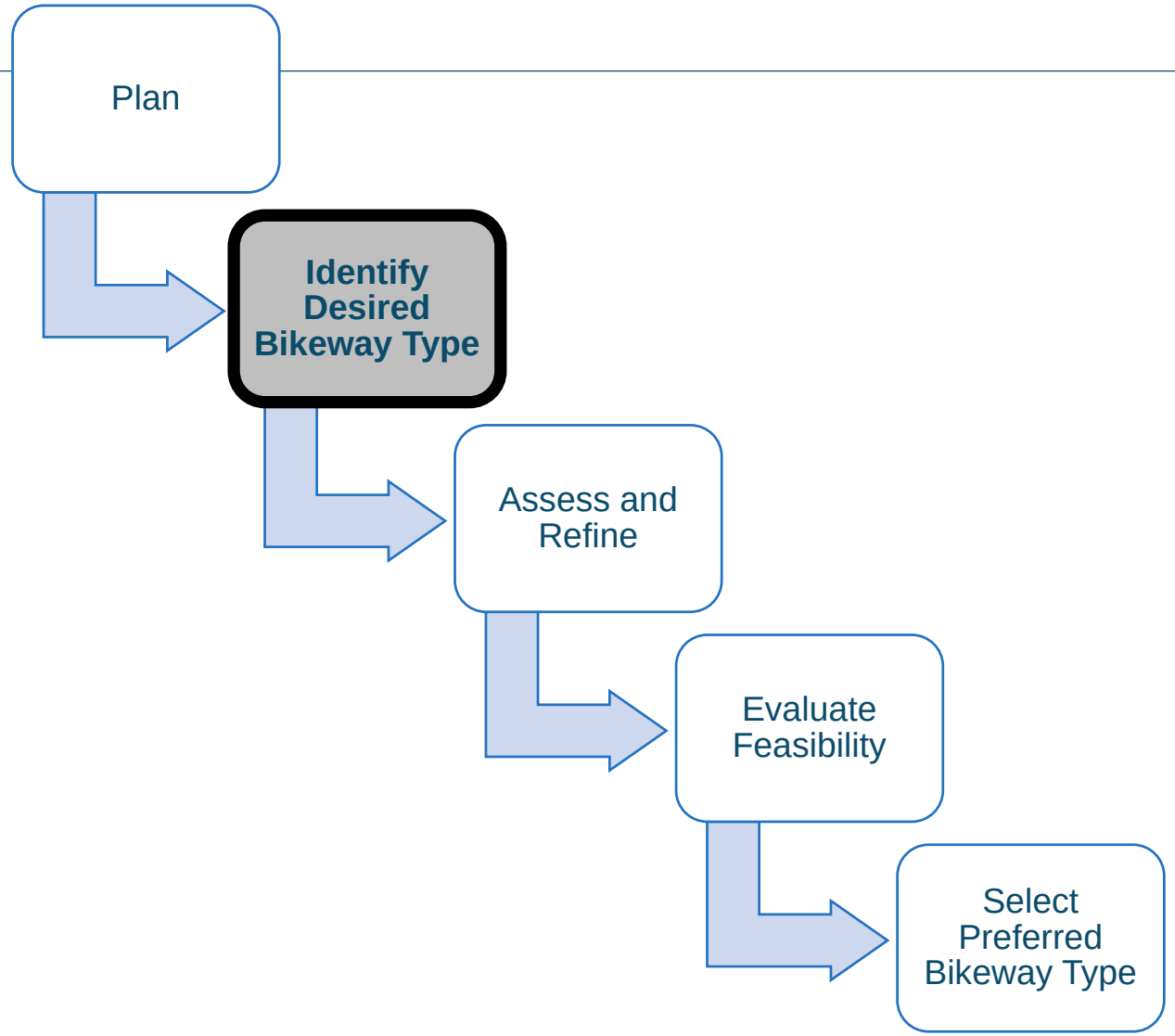
Bikeway Selection Process



Facility Selection Tools

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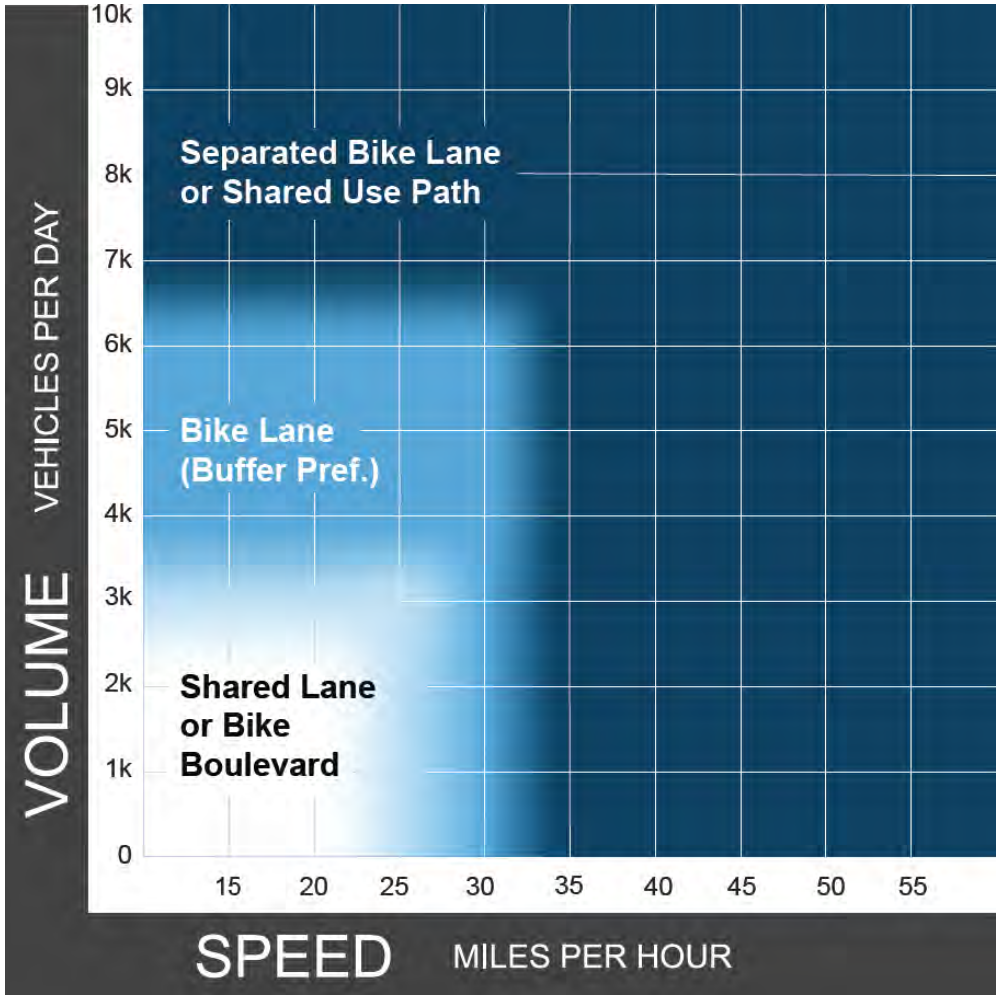
City, Small Town, and Suburban Roadways

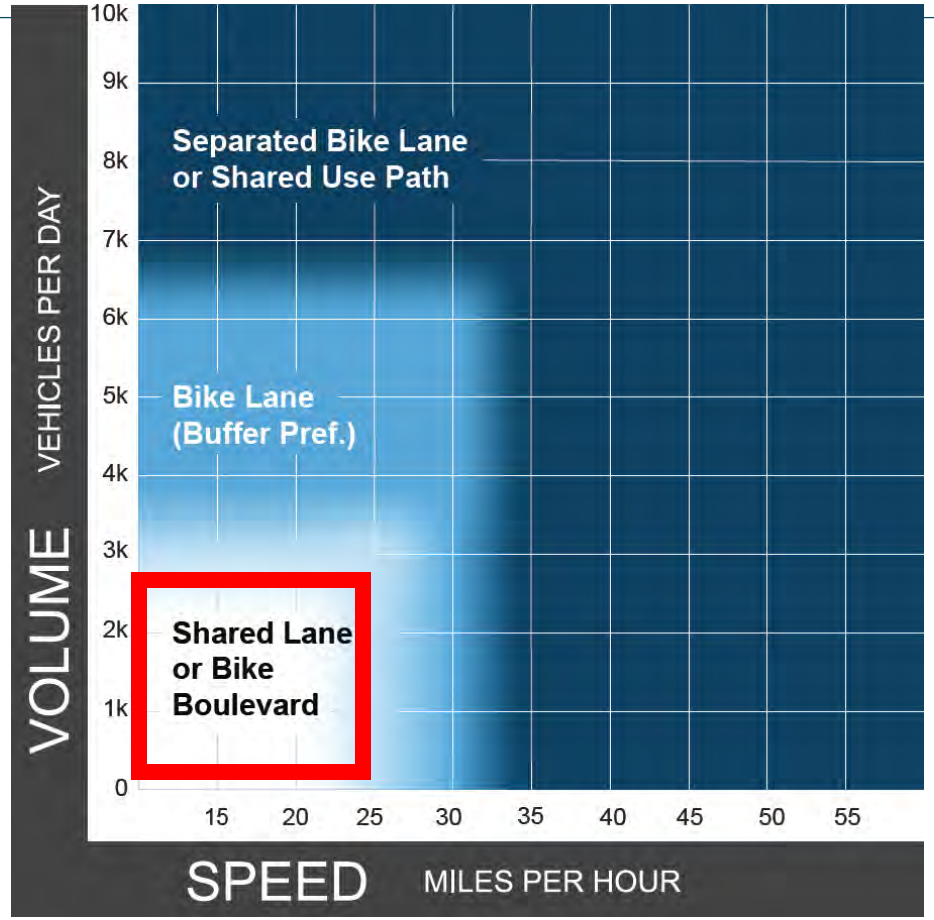


Identifies the **preferred** bikeway type.

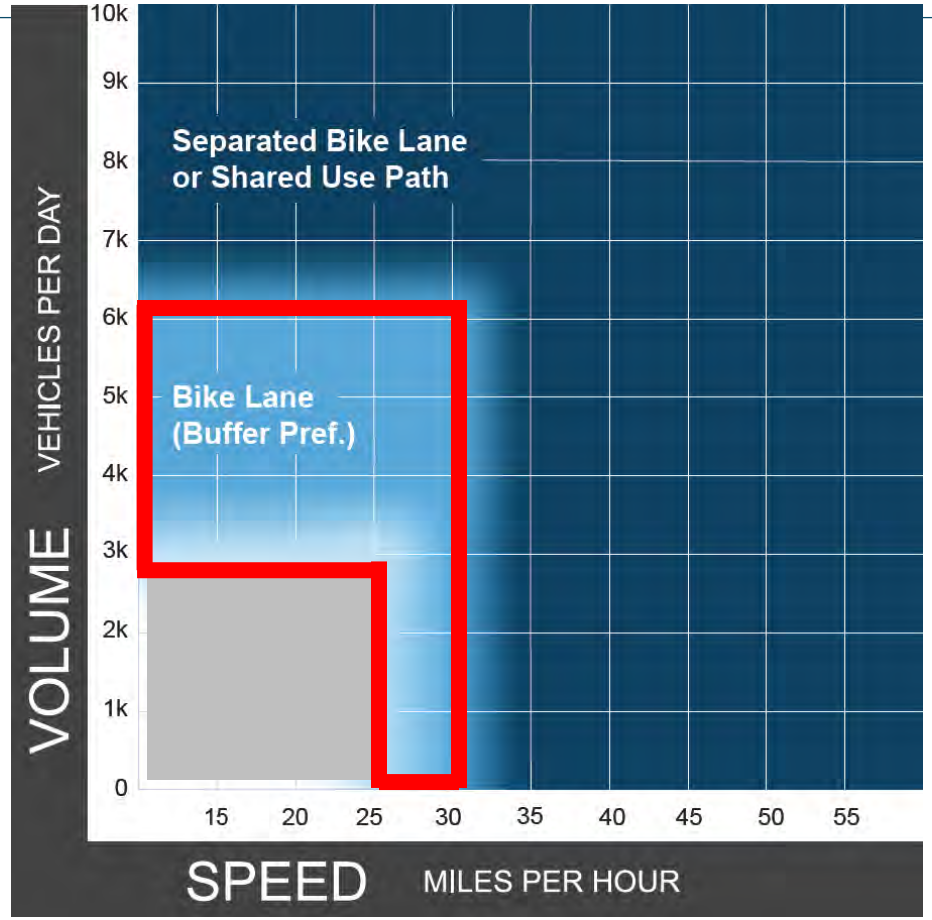
Design User Assumption:
Interested but concerned cyclist

Analysis:

Bicycle Level of Traffic Stress


VOLUME VEHICLES PER DAY
10k
9k
8k
7k
6k
5k
4k
3k
2k
1k
0
Separated Bike Lane
or Shared Use Path
Bike Lane
(Buffer Pref.)
Shared Lane
or Bike
Boulevard
15
20
25
30
35
40
45
50
55
SPEED MILES PER HOUR


STOP HERE
ON RED
EXCEPT BICYCLES
WAIT HERE


VOLUME VEHICLES PER DAY
10k
9k
8k
7k
6k
5k
4k
3k
2k
1k
0
Separated Bike Lane
or Shared Use Path
Bike Lane
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15
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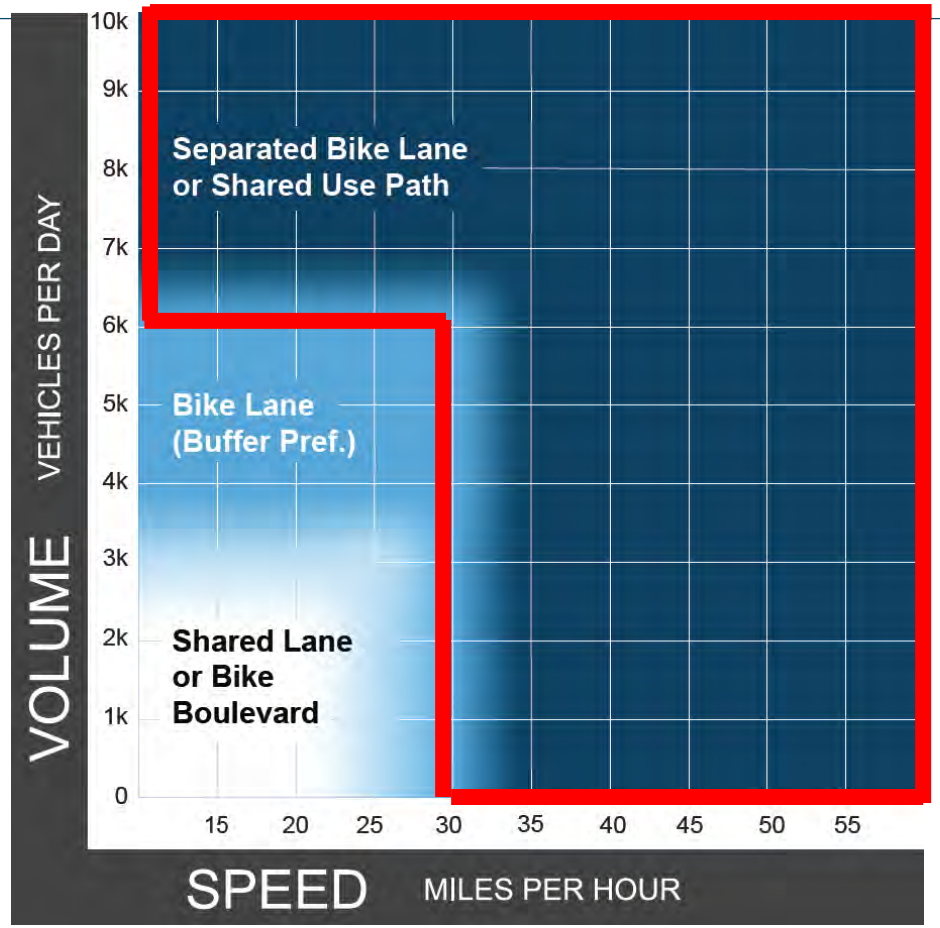
SPEED MILES PER HOUR


VOLUME VEHICLES PER DAY
10k
9k
8k
7k
6k
5k
4k
3k
2k
1k
0
Separated Bike Lane
or Shared Use Path
Bike Lane
(Buffer Pref.)
Shared Lane
or Bike
Boulevard
15
20
25
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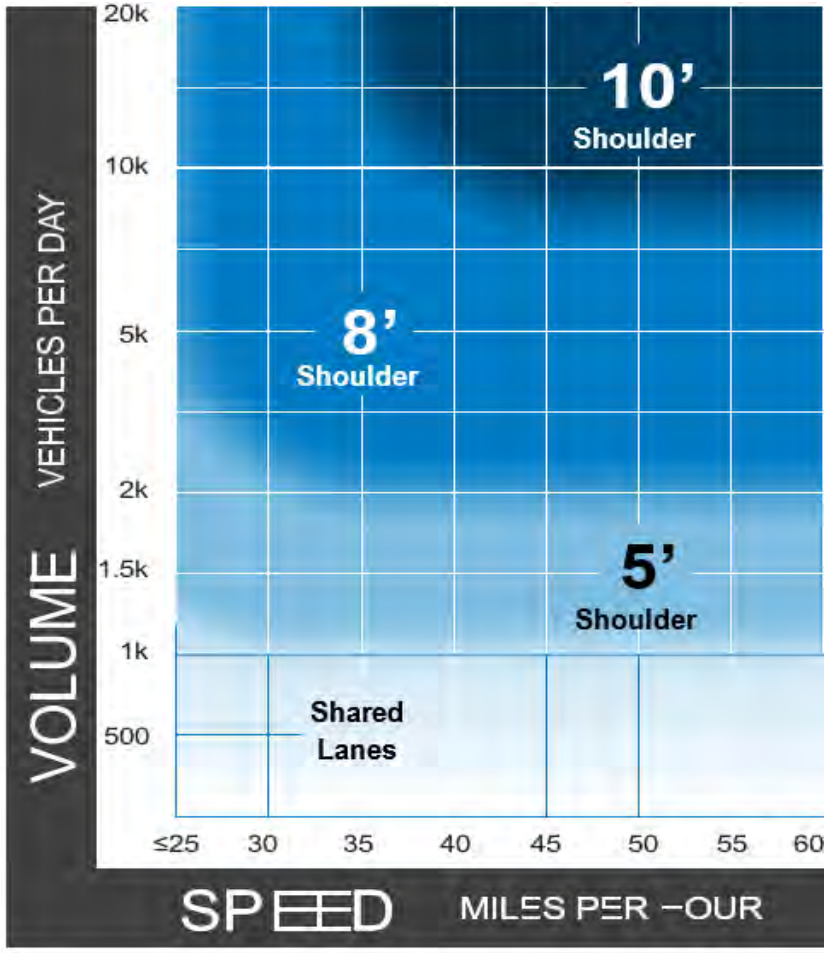
50
55
SPEED MILES PER HOUR

Rural Roadways



Identifies the **preferred** shoulder width.

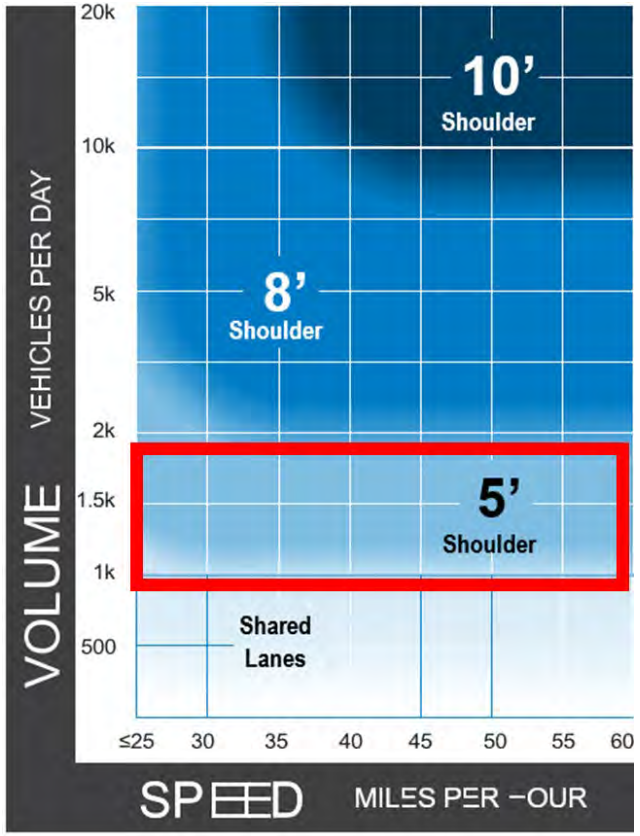
Design User Assumption:

Confident bicyclist

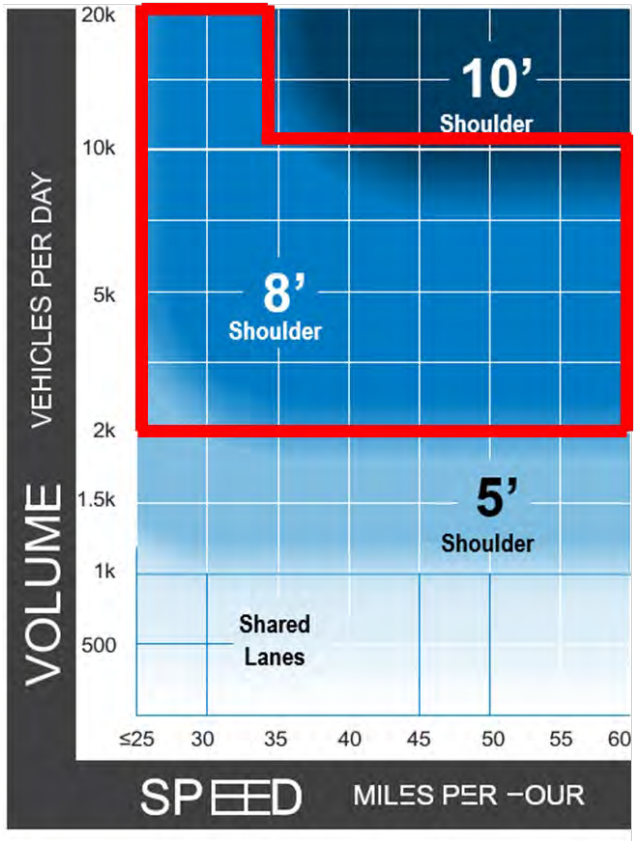
Analysis:

Bicycle Level of Service

Rural Roadways



Rural Roadways



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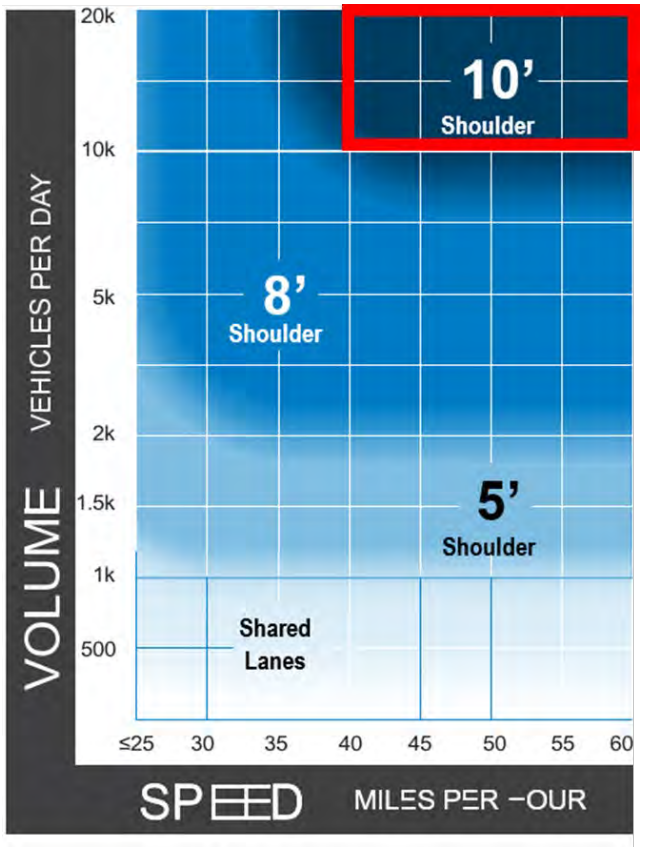
Rural Roadways



Assess and Refine

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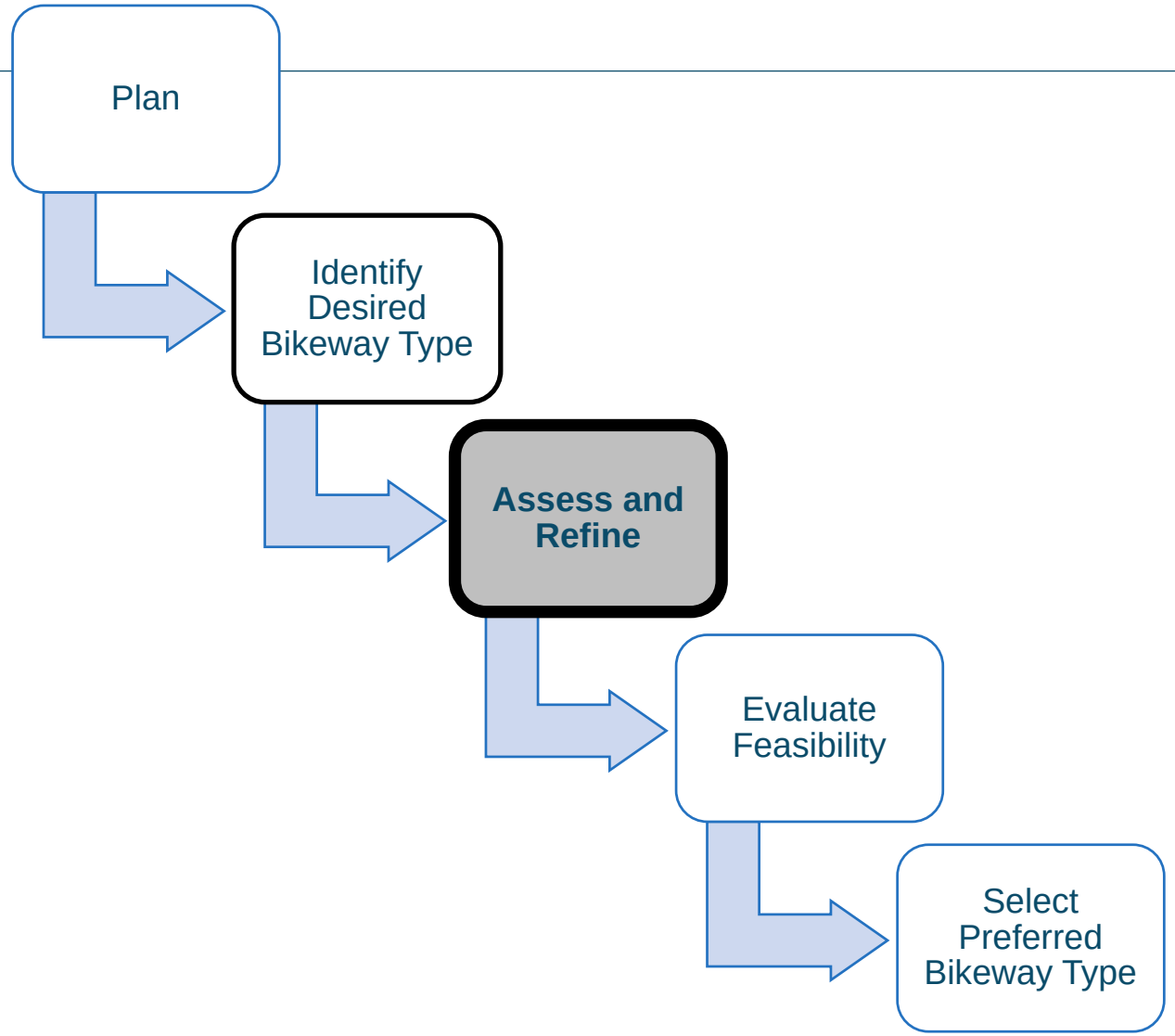
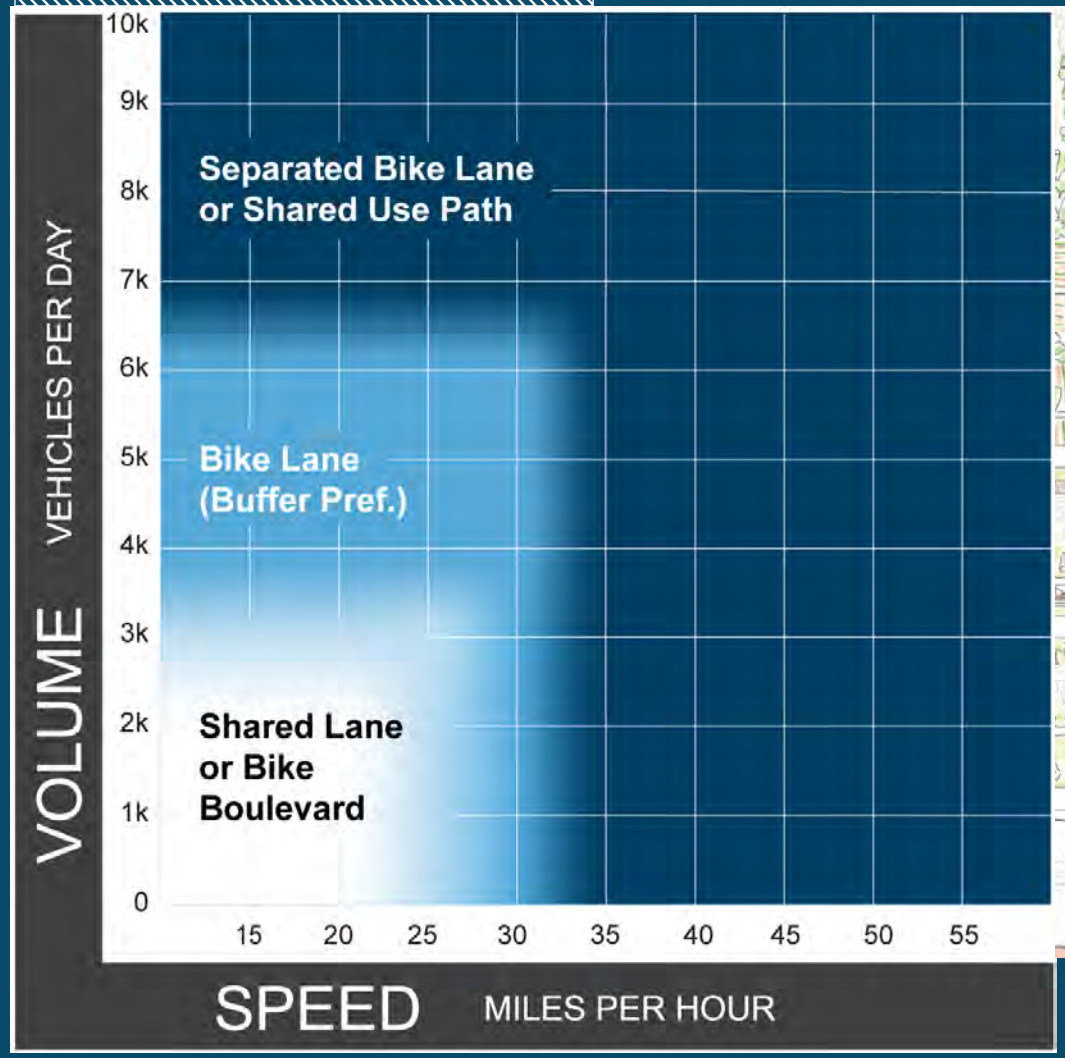
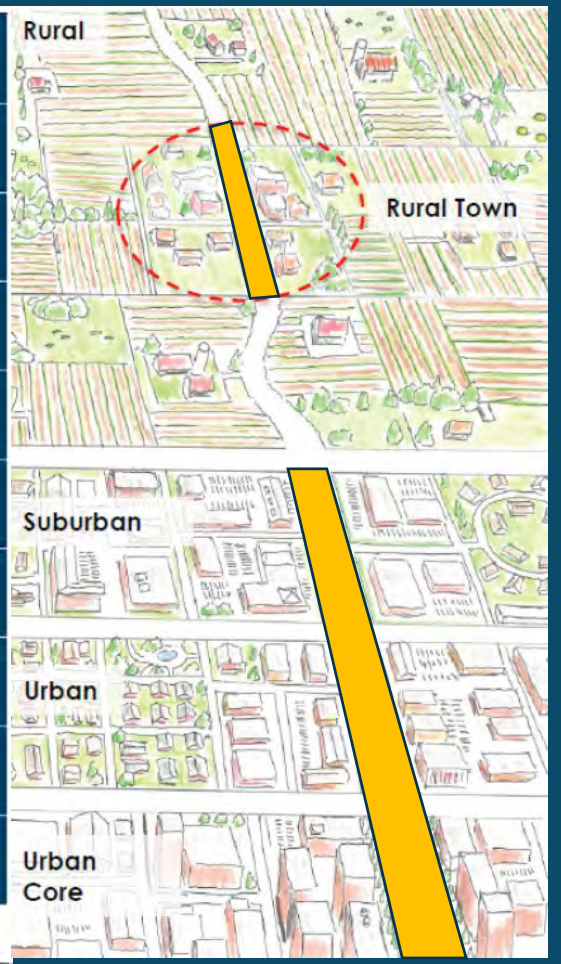
Bikeway Selection Process



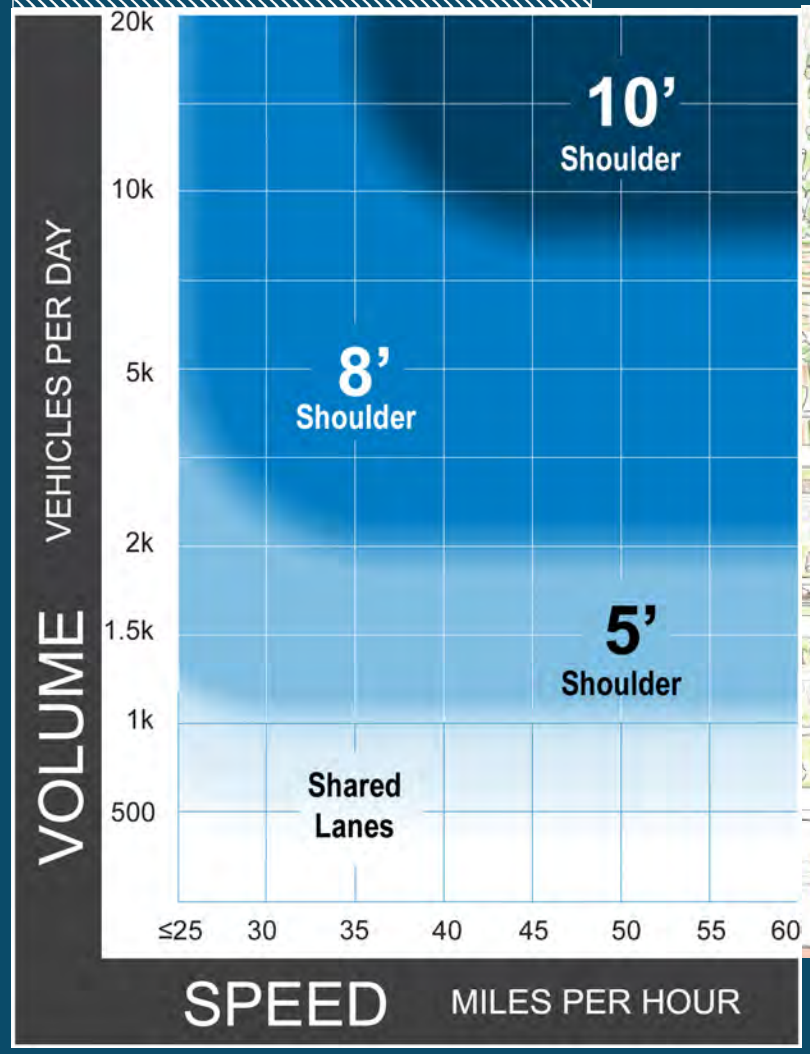
Preferred Bikeway Type

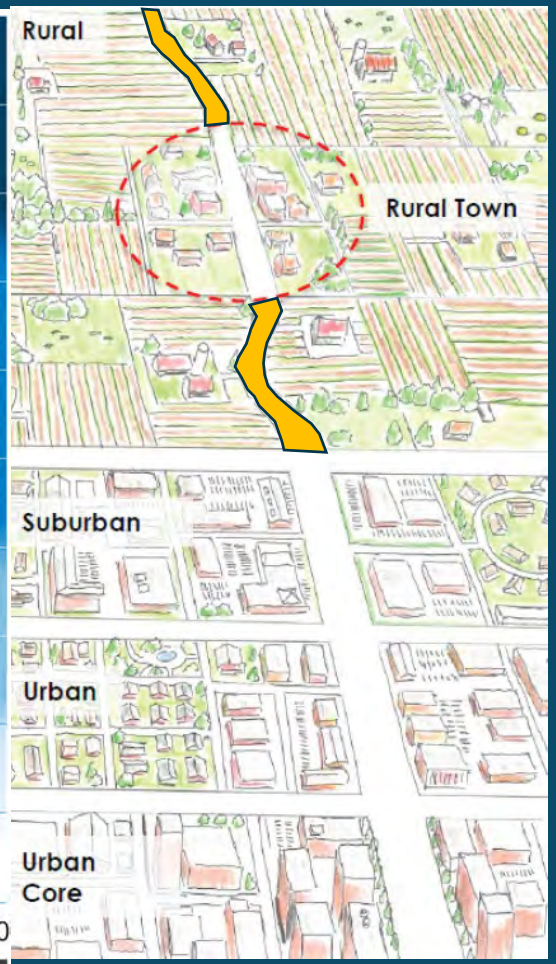
Urban, Urban Core, Suburban, and Rural Town Contexts



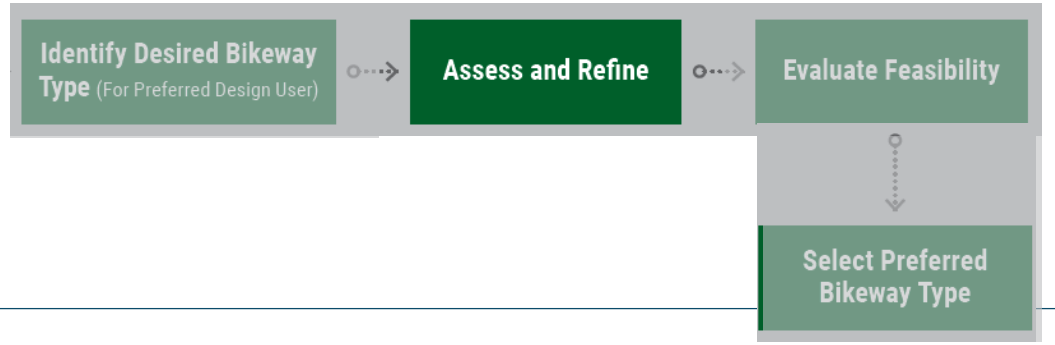


Preferred Bikeway Type
Rural Context





Assessing and Refining the Desired Bikeway Type



- Motor vehicle peak hour volumes
- Traffic vehicle mix
- Curbside activity (e.g., deliveries, parking turnover, transit)
- Driveway and intersection frequency
- Direction of operation
- Vulnerable populations and equity Considerations
- Network connectivity gaps
- Transit considerations (first- and last-mile connections)

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Participant Polling

Go to **menti.com** and

Use the code **74 78 56**

When designing a separated bike lane approach at an intersection, what treatment would you consider first?

Mentimeter

Bend in (toward travel lanes)

Bend out (away from travel lanes)

Maintain alignment

20

When designing a 2-way separated bike lane on a 1-way street, which side of the street would you place the 2-way bike lane?

Mentimeter

Left side

Right side

0

I'd never install a 2-way SBL on a 1-way street

19

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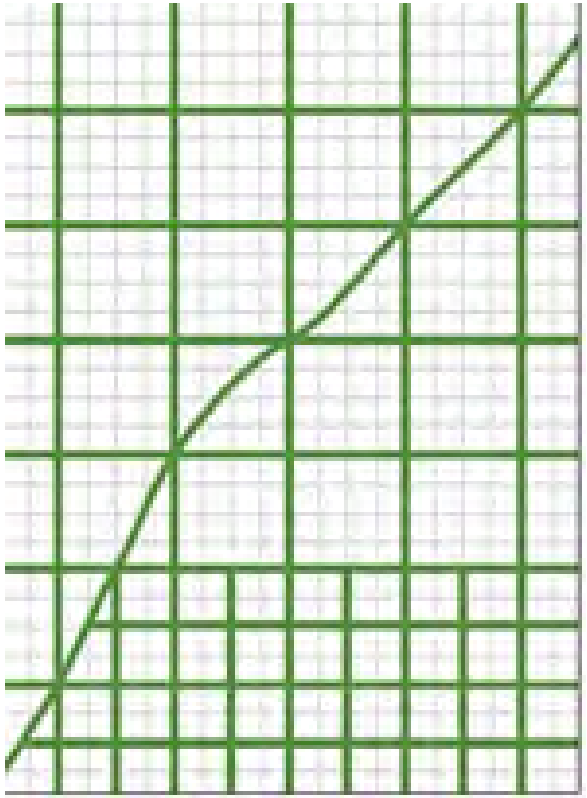
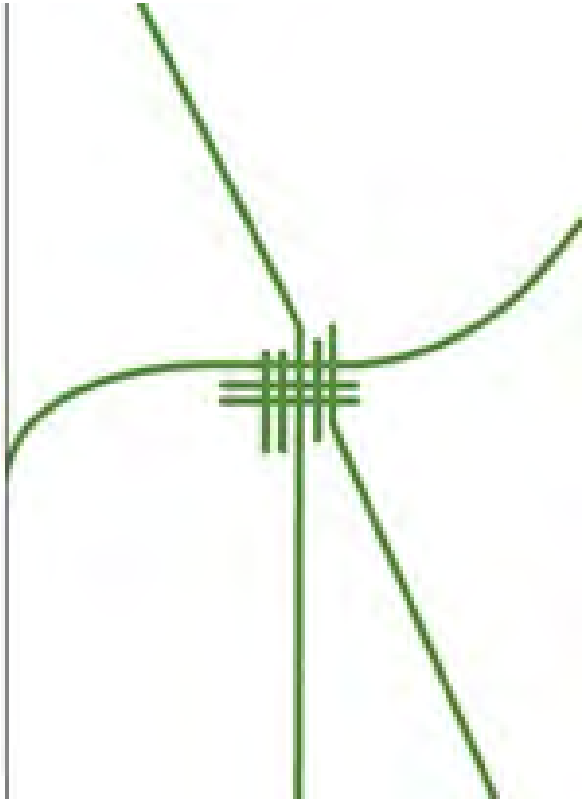
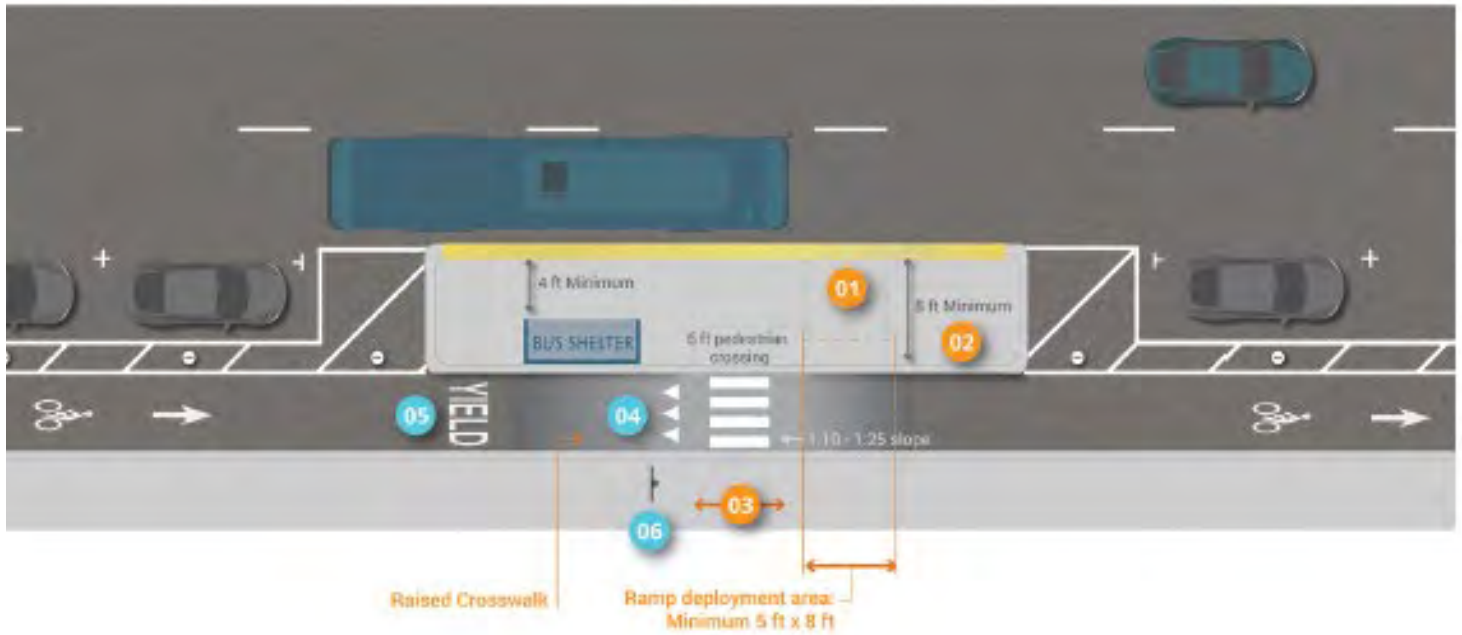
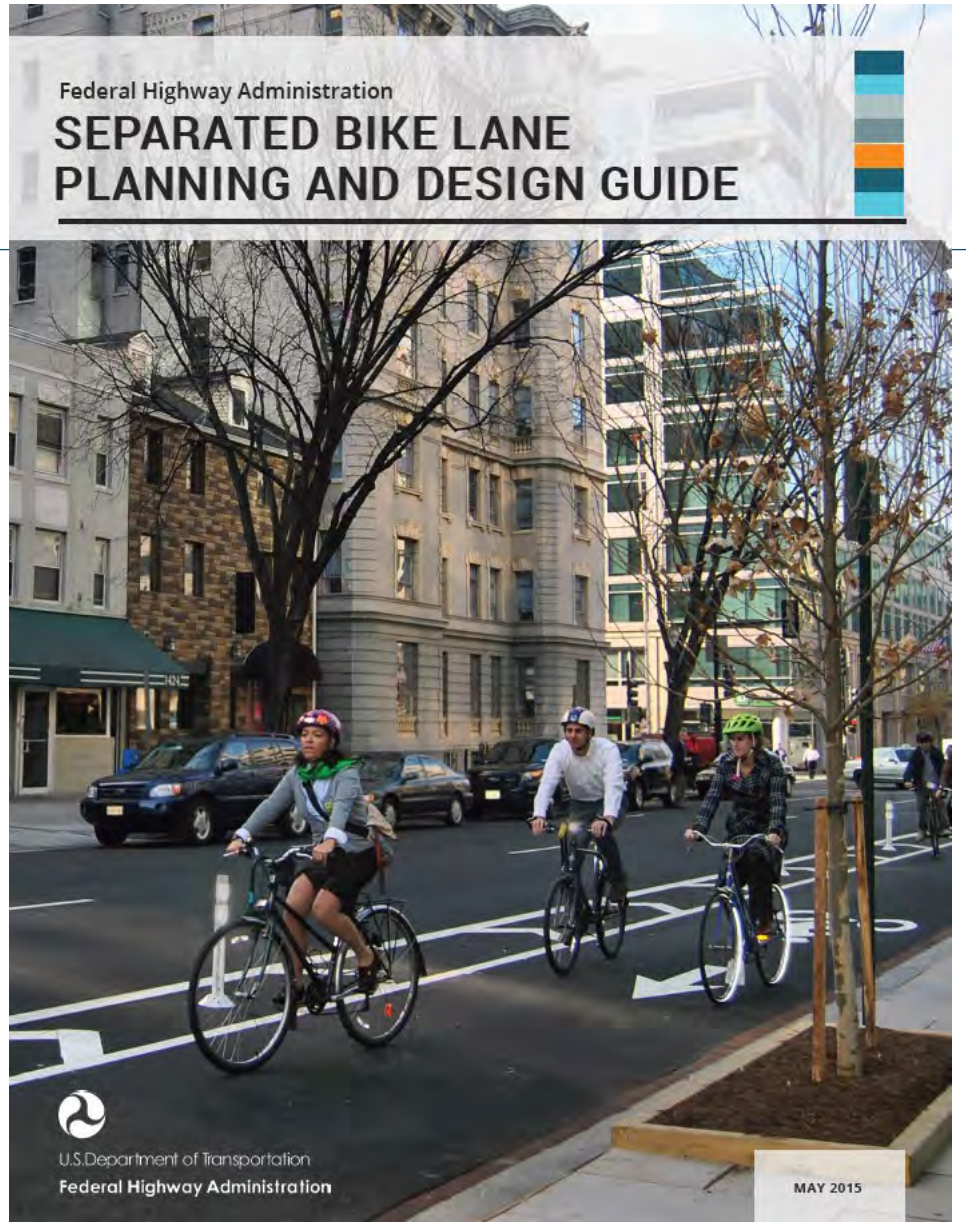
Assessing and Refining





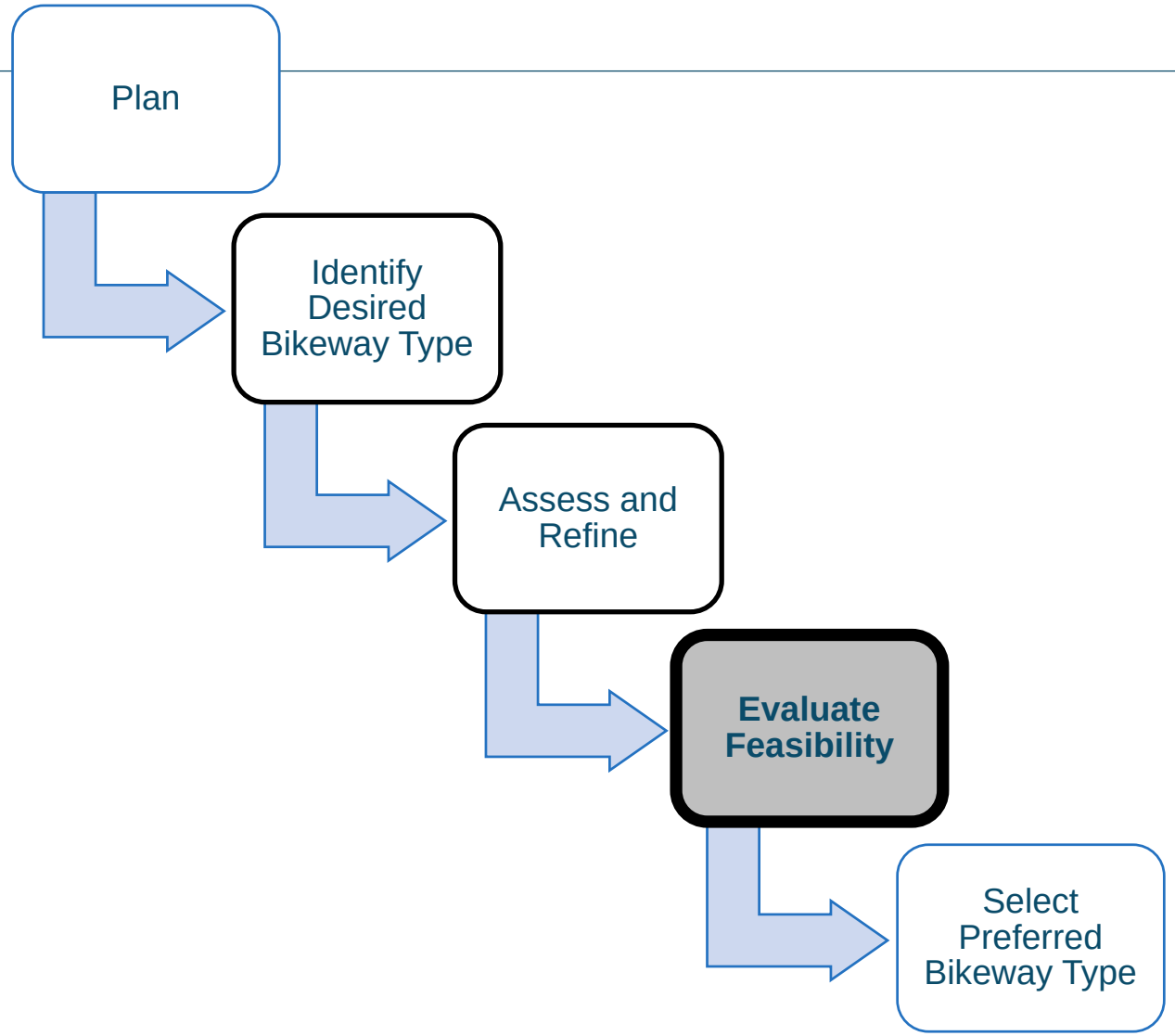
Assessing and Refining



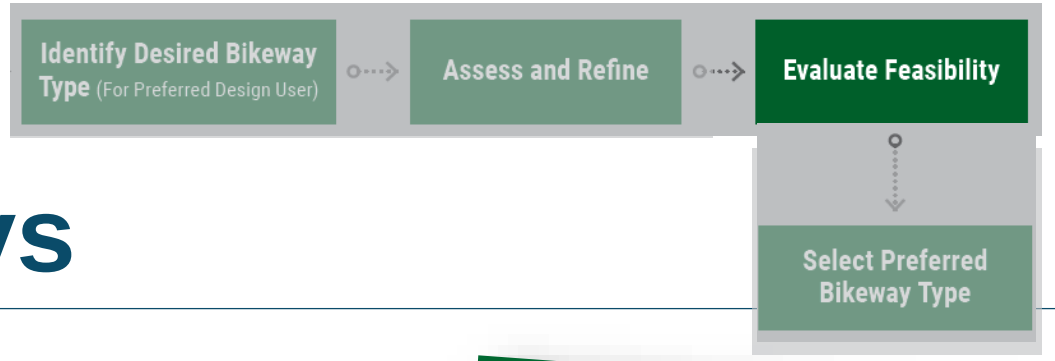


Feasibility

Bikeway Selection Process



Evaluating Feasibility Finding Space for Bikeways

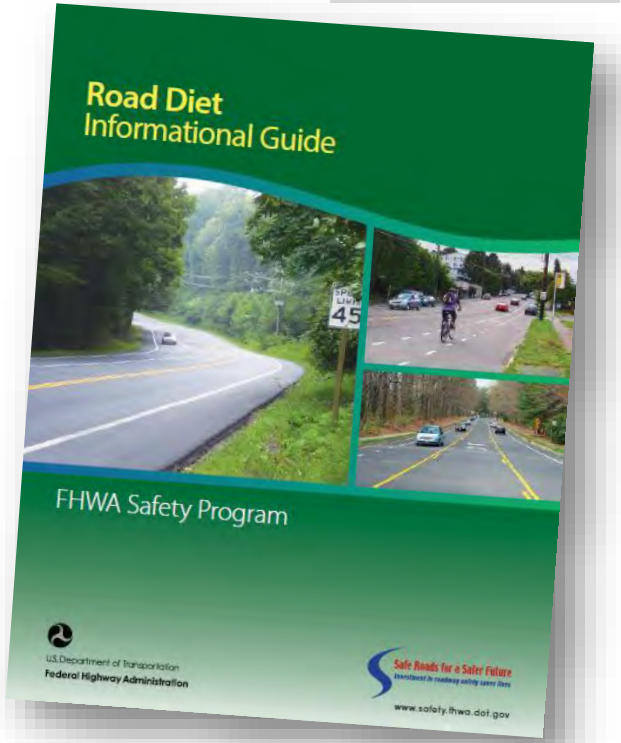


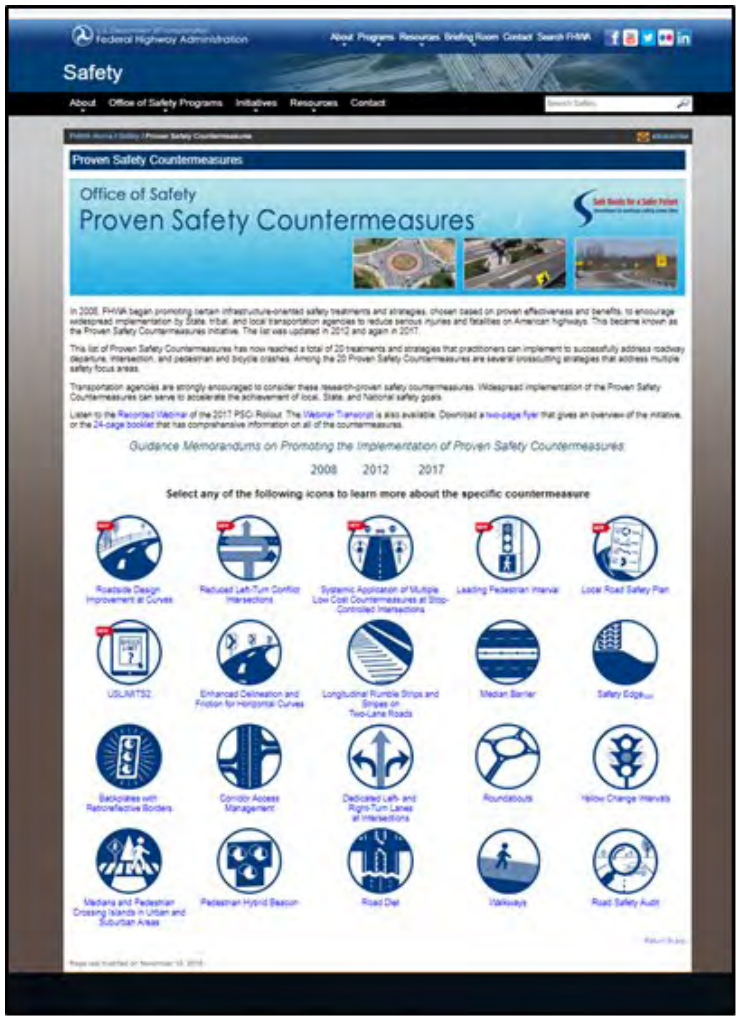
Project Type

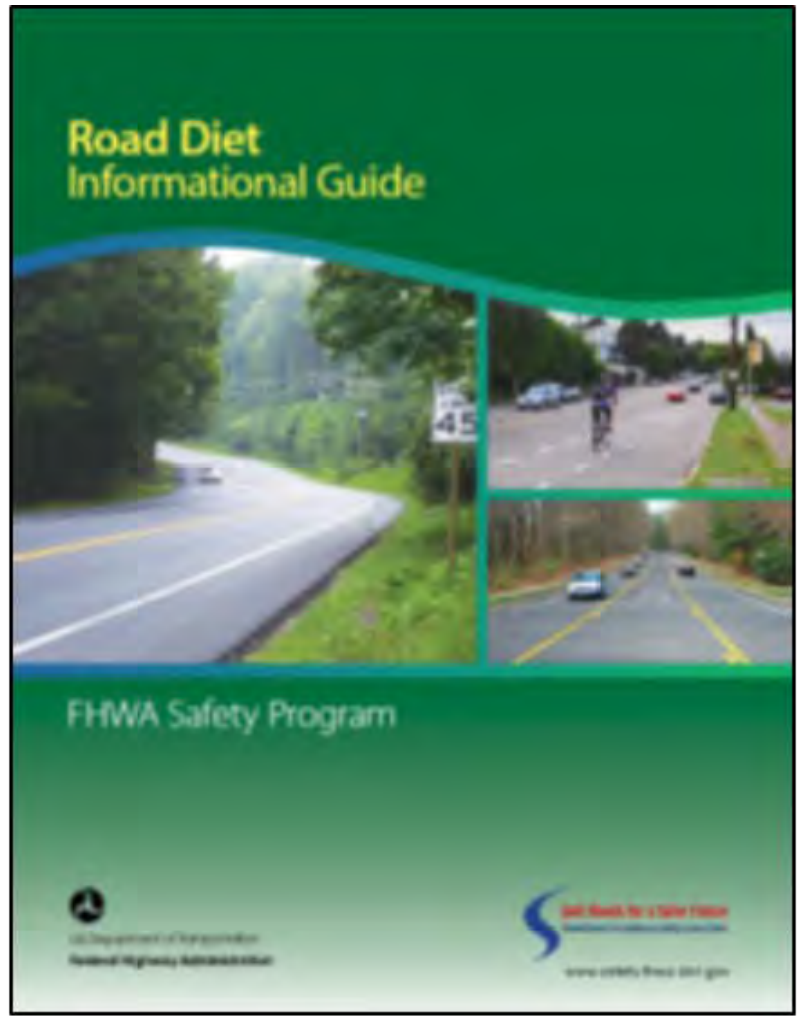
- New construction
- **Reconstruction (curb changes)**
- **Resurfacing or striping (no curb changes)**

Options for reallocating roadway space

- Narrowing travel lanes
- Removing travel lanes
- One-way streets
- Reorganizing street space
- Changing street parking







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Evaluating Feasibility

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Evaluating Feasibility

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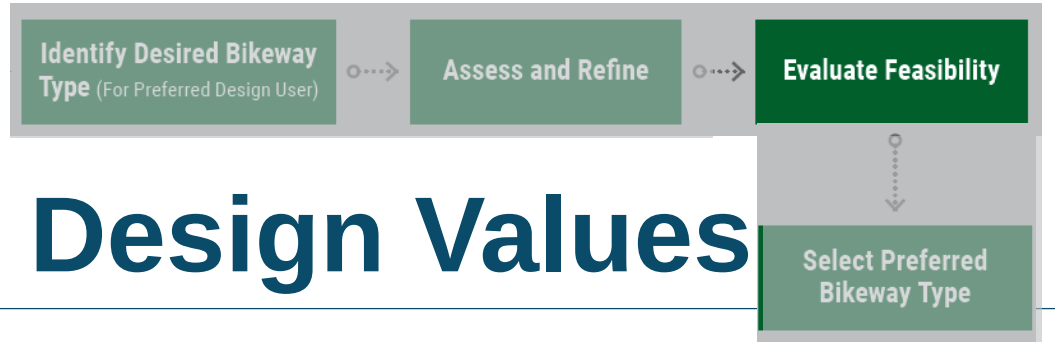
Evaluating Feasibility
Assess Desirable Bikeway Design Values



Example for standard bicycle lanes from NACTO Urban Bikeway Guide:

The desirable bike lane width adjacent to a curbface is 6 feet. The desirable ridable surface adjacent to a street edge or longitudinal joint is 4 feet, with a minimum width of 3 feet. In cities where illegal parking in bike lanes is an concern, 5 foot wide bike lanes may be preferred. Read More+

Against Curb:

Desirable = 6’

Minimum = 4’

When placed adjacent to a parking lane, the desirable reach from the curb face to the edge of the bike lane (including the parking lane, bike lane, and optional buffer between them) is 14.5 feet; the absolute minimum reach is 12 feet. A bike lane next to a parking lane shall be at least 5 feet wide, unless there is a marked buffer between them. Wherever possible, minimize parking lane width in favor of increased bike lane width. Read More+

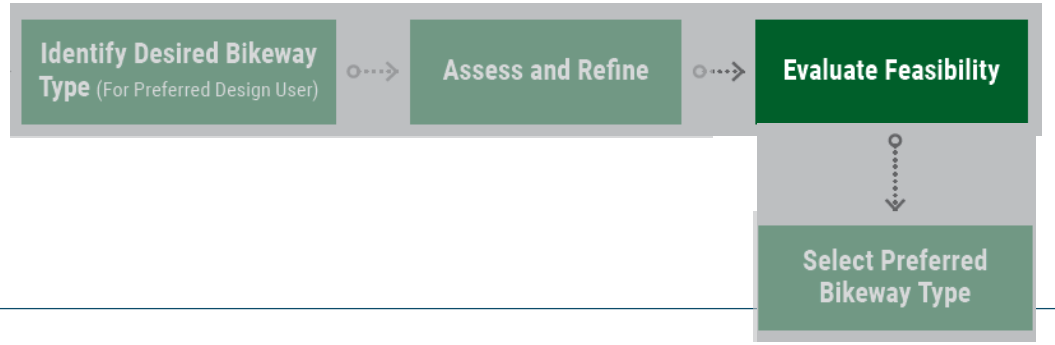
Source: NACTO Bikeway Design Guide

Against Parking:

Desirable = 7.5’

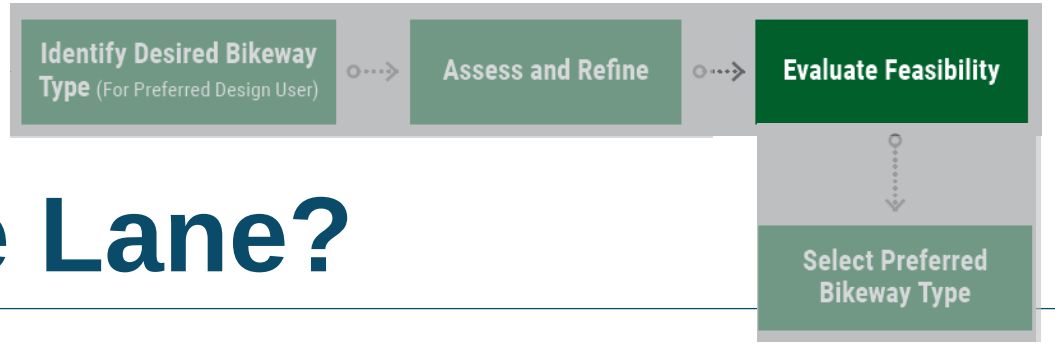
Minimum = 5’

Evaluating Feasibility Constrained Bikeways



"The use of minimum width bikeways should be **limited to constrained roadways where** desirable or preferred bikeway widths cannot be achieved after **all other travel lanes have been narrowed to minimum widths** appropriate for the context of the roadway."

Evaluating Feasibility
Wide Outside Lane or Bike Lane?



15 – 16’ Wide Outside Lane

10’ – 11’ Lane with 5’-6’ bike lane

Source: Longview, TX Bicycle and Pedestrian Plan

Wide lanes:

- Do not improve bicycling comfort
- Encourage faster traffic
- Shared lanes have higher bike crash risk

Narrow lanes with bike lanes:

- Improve bicycling comfort
- Encourage slower traffic
- Have lower bike crash risk
- Generally do not increase motorists crash rates if on 45 mph or less roadways

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Evaluating Feasibility
Door Zone Bike Lane or No Bike Lane?

15 – 16’ Wide Outside Lane adjacent to parking

10’ – 11’ Lane with 5’-6’ bike lane adjacent to parking

Wide lanes:

- Do not improve bicycling comfort
- Encourage faster traffic
- Shared lanes have higher bike crash risk
- Parking increases bike crash risk

Narrow lanes with bike lanes:

- Improve bicycling comfort
- Encourage slower traffic
- May lower bike crash risks compared to wide lanes

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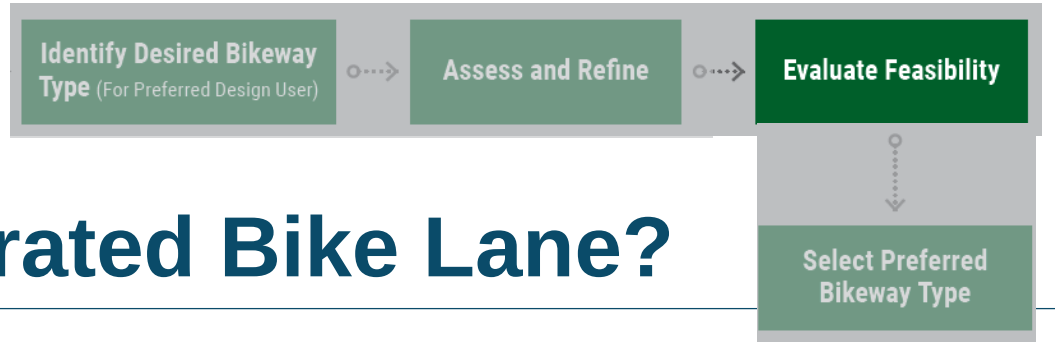
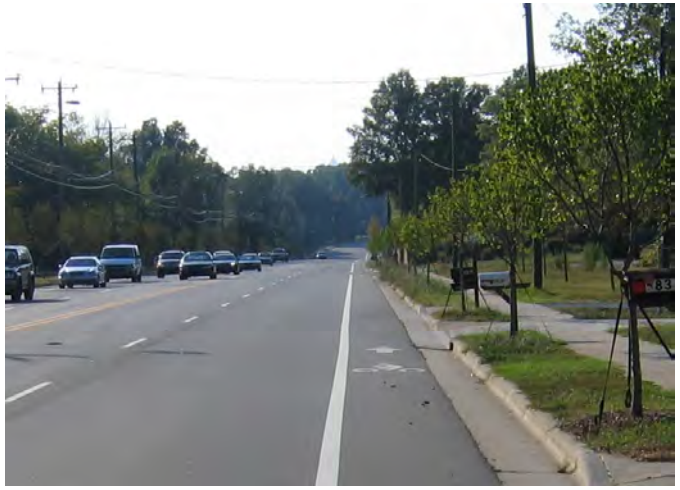


Evaluating Feasibility
Narrow Bike Lane or 2-Way Separated Bike Lane?



Narrow Bike Lanes:

- Improve bicycling comfort for Confident bicyclists
- Do not accommodate Interested but Concerned bicyclists

2-Way Separated Bike Lanes:

- Improve bicycling comfort for all bicyclists increasing use
- Has higher rate of bicycle crashes compared to 1-way separated bike lanes due to contra-flow movement

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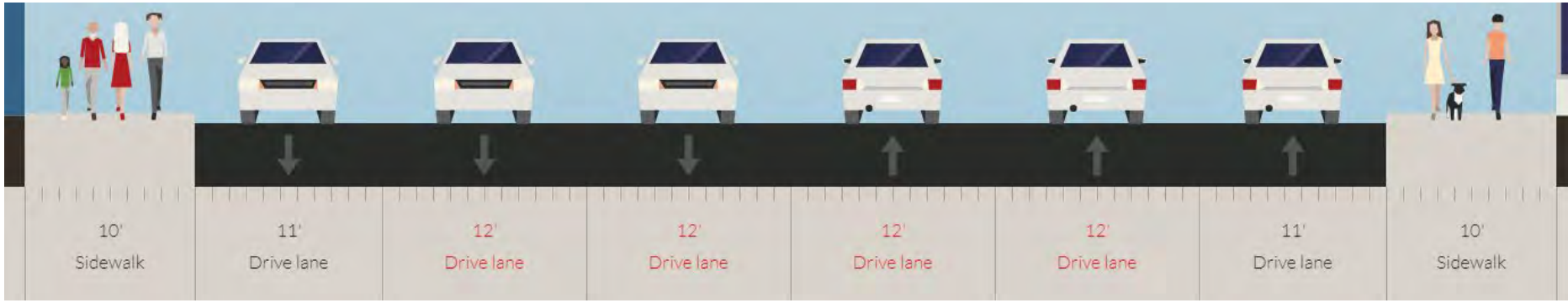
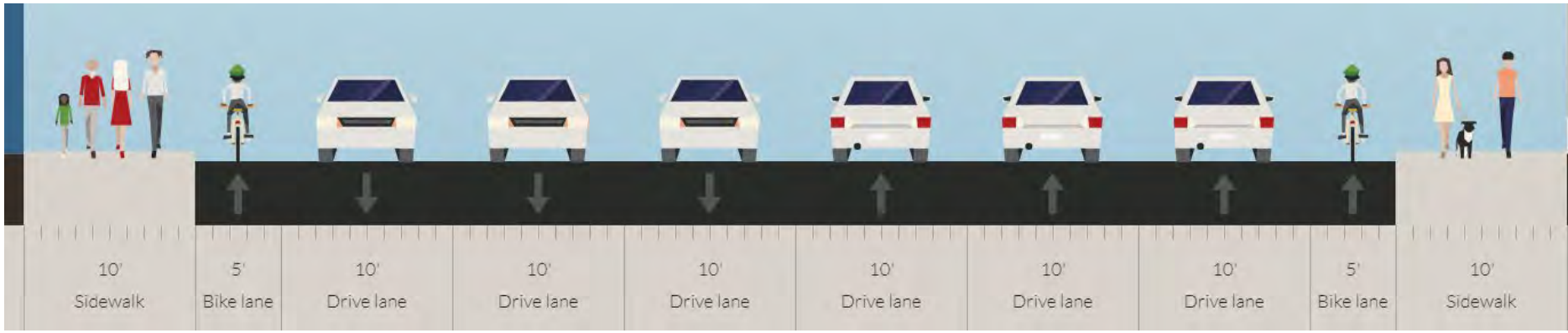
Existing Shared Lanes
2005 - 2009:

- 30 – 60 bicyclists/hour
- averaged 5 crashes/year
- Crash Risk ~
  20 crashes/million cyclists



Option 1
Bike Lane

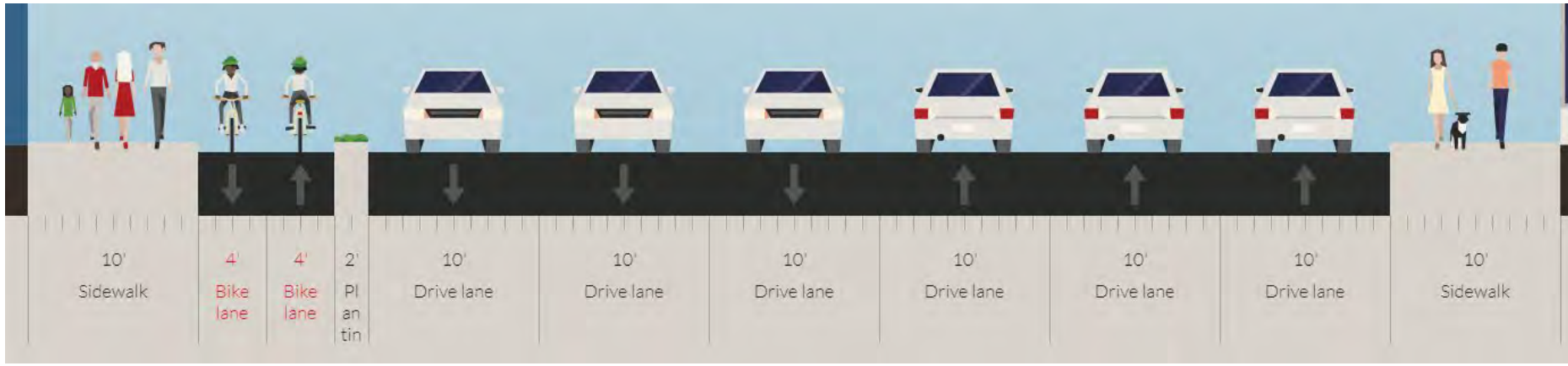
Not Chosen



Option 2 built in 2010
Separated Bike Lane
2016:

- 350 – 400 bicyclists/hour
- averaged 10 crashes/year
- Crash Risk ~
  7 crashes/million cyclists

65% reduction in crash risk



Case Study: 15th Street, NW. Washington DC

Data Sources: District Department of Transportation

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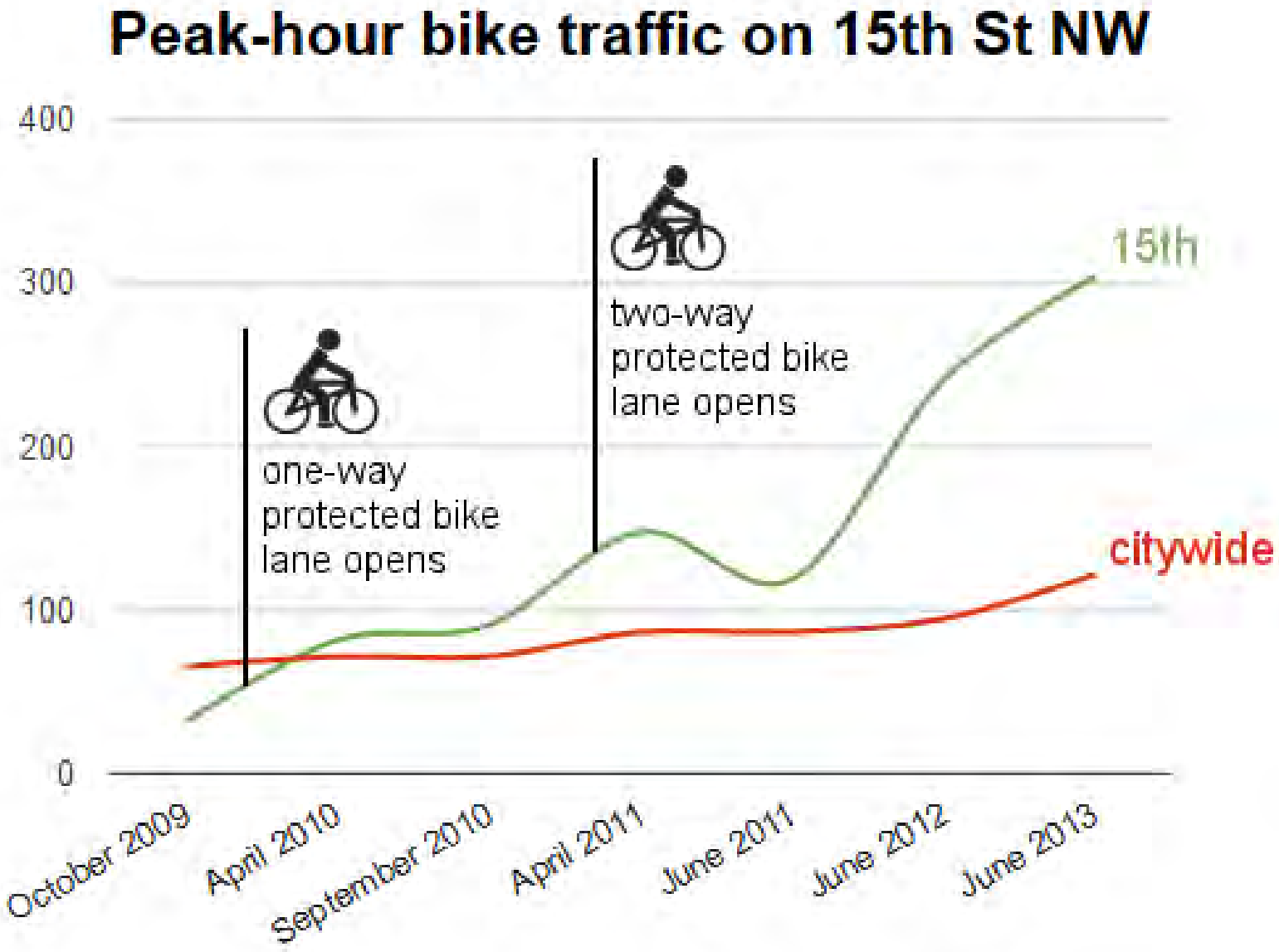
Shared Lanes
Crash Risk ~
20 crashes/million
cyclists



2-Way PBL
Crash Risk ~
7 crashes/million
cyclists

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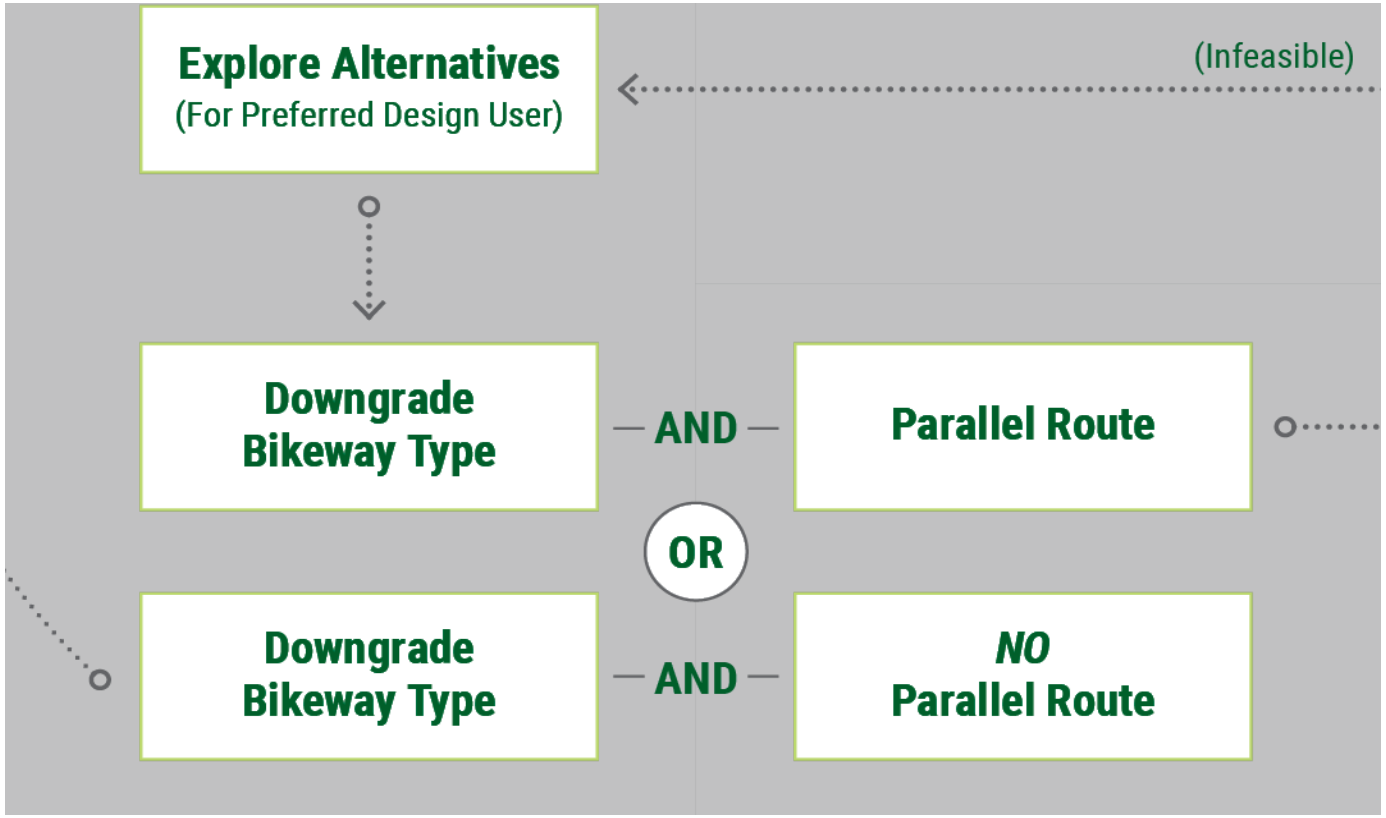
Chapter 4: Bikeway Selection
preferred bikeway is “infeasible”



Downgrading the bikeway type has potential impacts:

- Suppressed bicycling
- Reduced safety from:
  - Sidewalk bicycling
  - Shared lane or constrained bikeway dimensions

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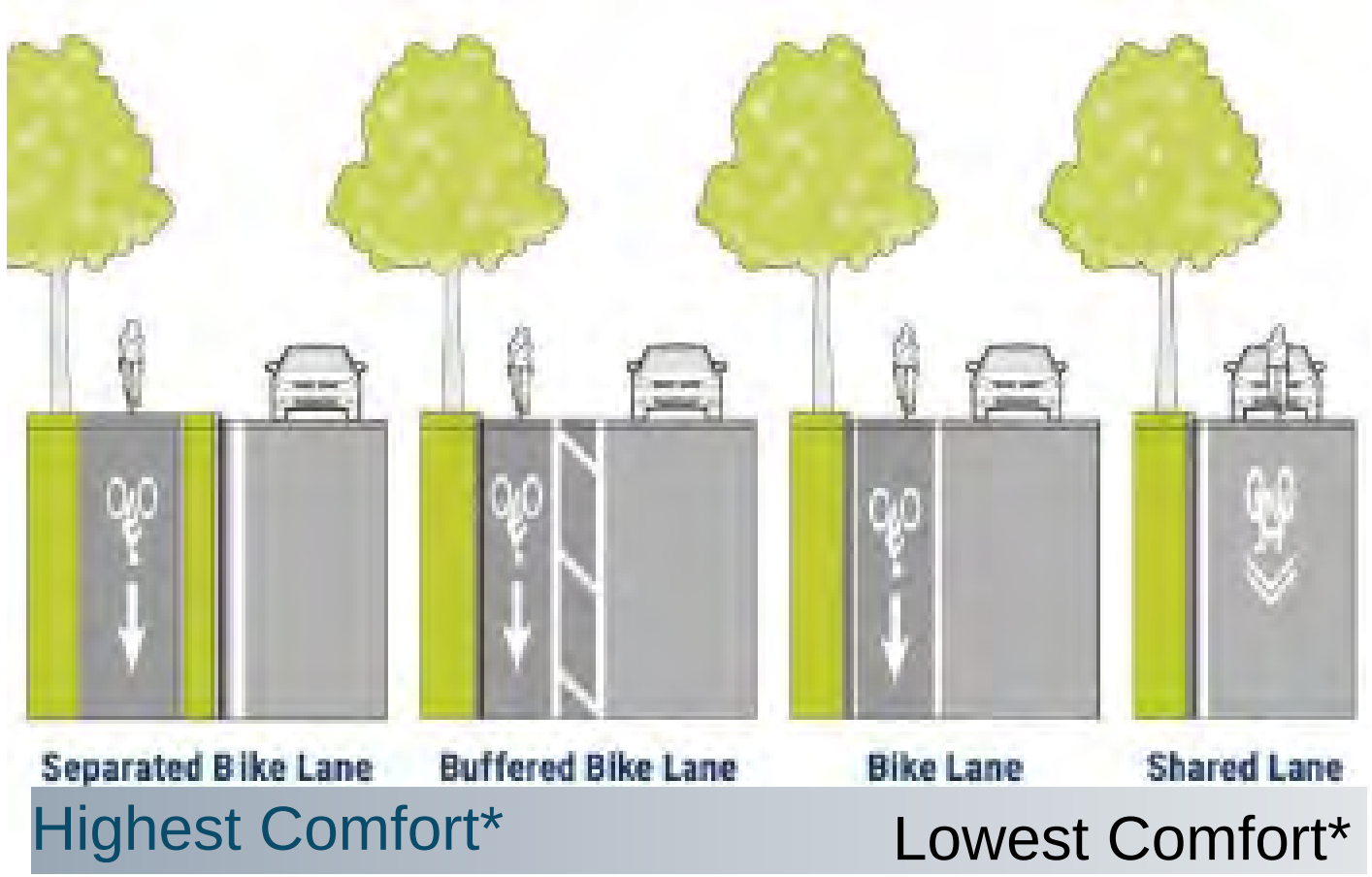
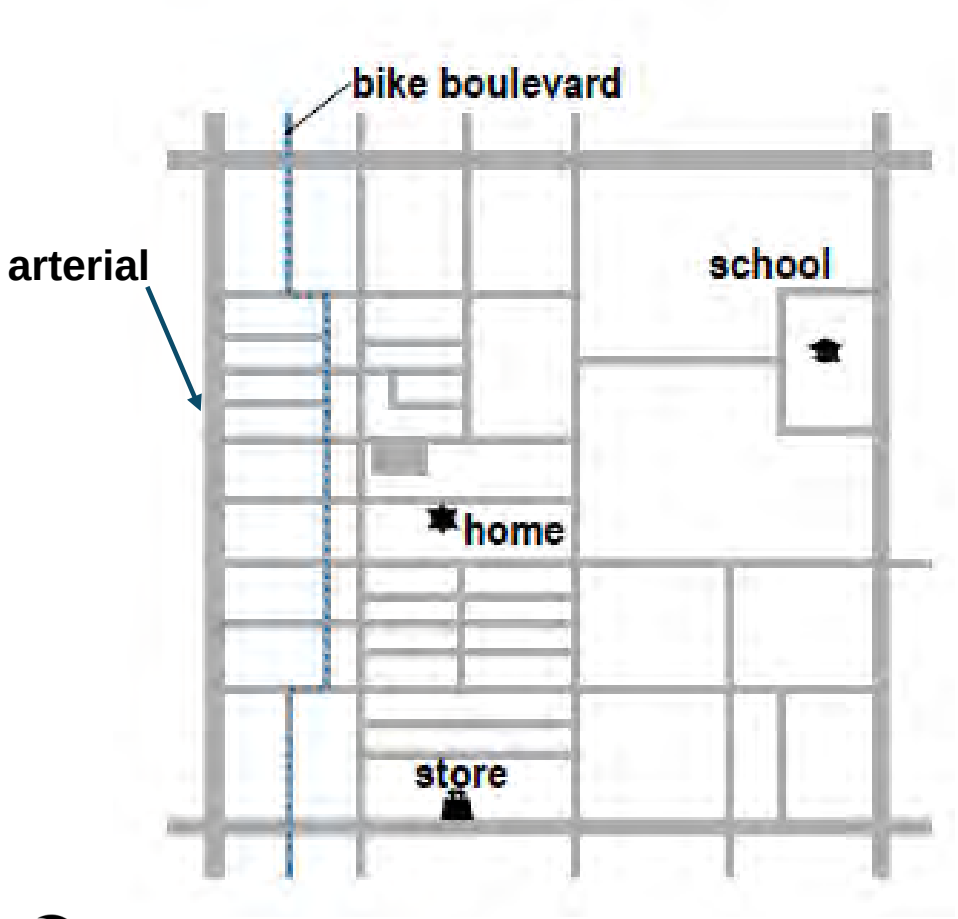
Chapter 4: Bikeway Selection

If the preferred bikeway is infeasible on the main route, select “the next best facility” for it as a short term measure.



*Assumption is high volume roadway with speeds > 30mph with sidepath bicyclists comfort contingent upon pedestrian volume

Chapter 4: Bikeway Selection



Parallel routes can accommodate the Interested but Concerned if:

- It is designed for their comfort
- Detour is less than 30% in length*
- Neighborhood bikeways may require assessments of major street crossings

*Broach, J., Dill, J., and J., Gliebe. Where Do Cyclists Ride? A Route Choice Model Developed with Revealed Preference GPS Data. *Transportation Research Part A: Policy and Practice*, Vol. 46, No. 10, 2012, pp. 1730-1740.

Bikeway Selection Process

Illustrative examples

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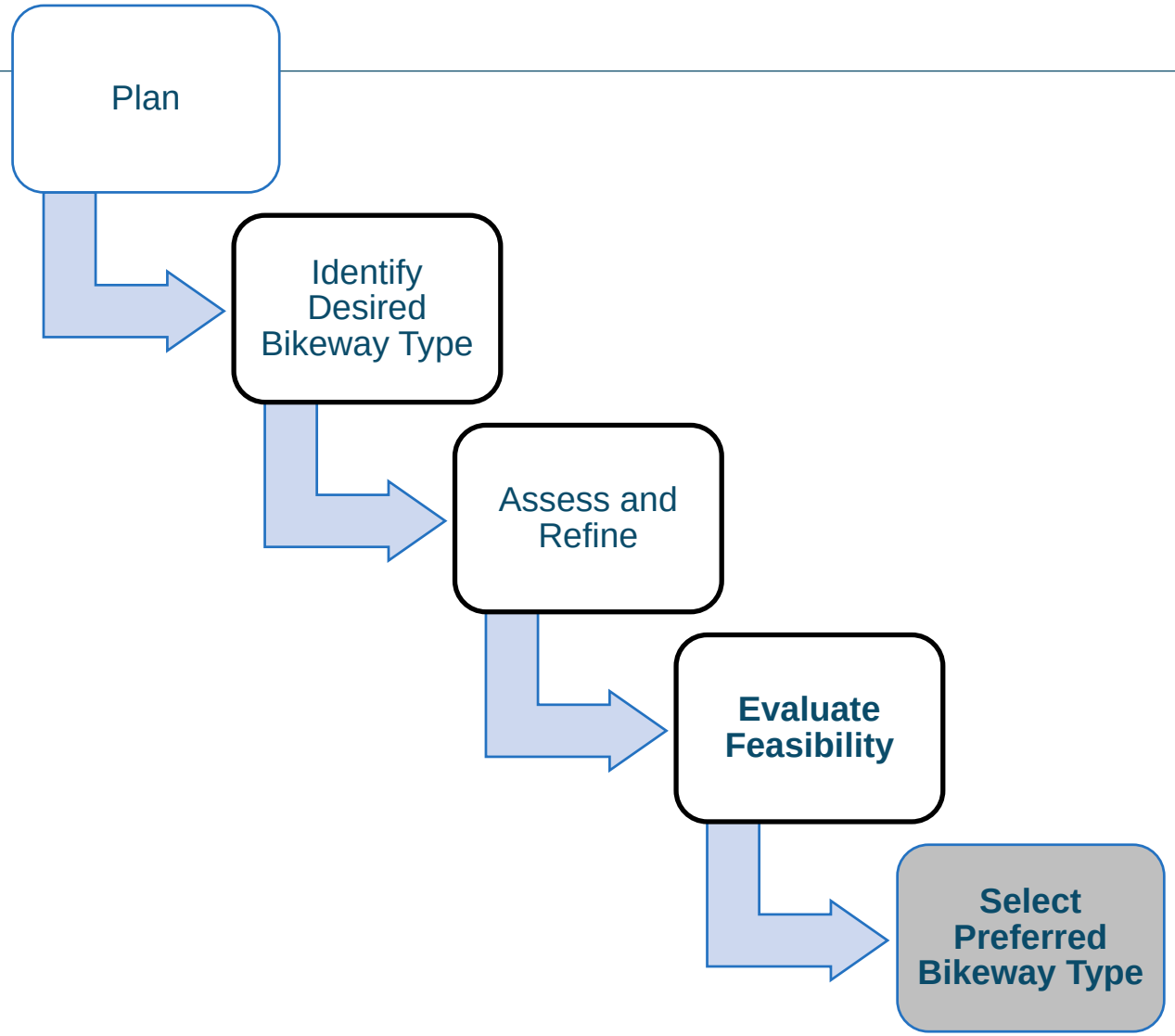
Bikeway Selection Process



Chapter 5.
Bikeway Selection in Practice

Example Case Studies to Apply the Guide Include:

- **Rural Context, 2-Lane Roadway**
- Small Town Context, 2-Lane Roadway
- **Suburban, 4-Lane Roadway**
- Suburban, 6-Lane Roadway

High-Speed 2-Lane Roadway (Base Condition)

- rural, two-way, 22-foot-wide undivided road
- popular state bicycle route connecting two small towns
- Average Daily Traffic (ADT) is 1,500 (4% trucks)
- operating speed is 45 mph
- public right-of-way extends to 10 feet on either side of the roadway
- motorists can easily change lanes to pass; however, there are locations with limited sight lines
- pedestrian volumes are expected to be low

Who is Our Design User?

- popular state bicycle route connecting two small towns
  - Confident Bicyclists?
  - Interested But Concerned?
  - Both are uncomfortable due to 45+ mph speeds
- pedestrian volumes are expected to be low

Who is Our Design User?

- popular state bicycle route connecting two small towns
  - Confident Bicyclists?
  - Interested But Concerned?
  - Both are uncomfortable due to 45+ mph speeds
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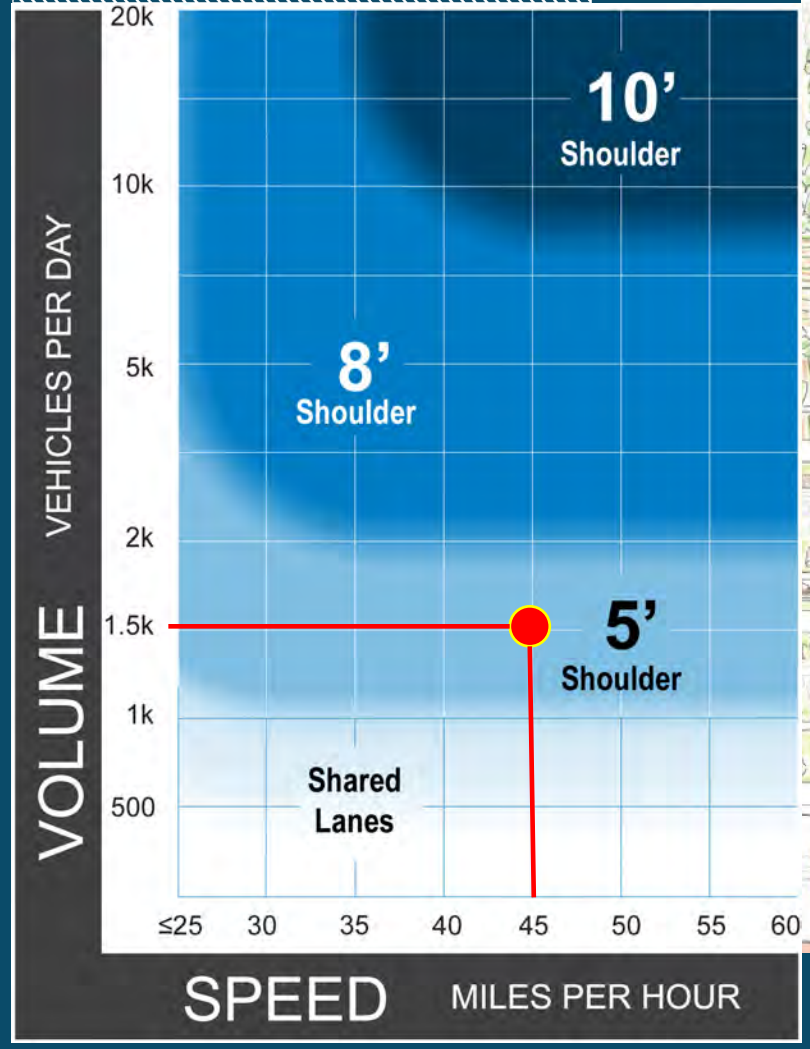
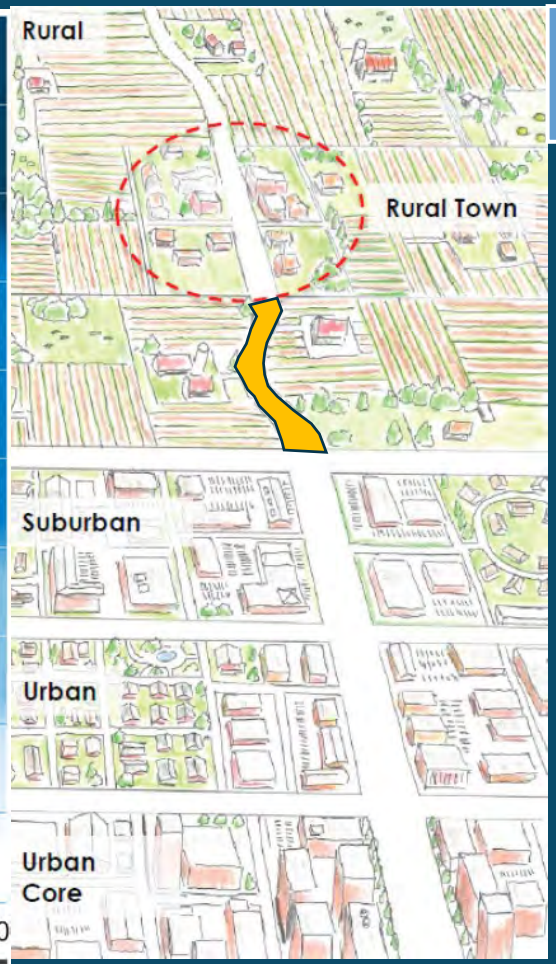
Confident Bicyclists Chosen for this Example

Identify Project Purpose (Choose Design User) → **Identify Desired Bikeway Type** (For Preferred Design User) → Assess and Refine → Evaluate Feasibility → Select Preferred Bikeway Type

Preferred Bikeway Type
Rural Context





Design User Assumption = Confident Bicyclists

- Average Daily Traffic (ADT) is 1,500 (4% trucks)
- operating speed is 45 mph.

5’ Shoulder Option

- Confident cyclists are comfortable (BLOS = ‘”B”)
- Relatively inexpensive option
- No room for rumble strips
- Interested but Concerned cyclists are uncomfortable due to 45 mph and no protection (potential suppressed bike volume)
- Pedestrians may walk in shoulder, but will not feel safe

Wide Shoulder Option

- Confident cyclists are very comfortable (BLOS = ‘”A”)
- Relatively more expensive option
- Room for rumble strips
- Interested but Concerned cyclists are uncomfortable due to 45 mph and no protection (potential suppressed bike volume)
- Pedestrians may walk in shoulder, but will not feel safe

Shared Use Path Option

- Confident cyclists are very comfortable (BLOS = ‘”A”)
- Most expensive option
- Room for rumble strips
- Interested but Concerned cyclists are comfortable due with protection
- Pedestrians are comfortable and will feel safe, while low volume will not result in conflicts with bikes

4-Lane Suburban Roadway (Base Condition)

- 4-lane, 50-foot-wide street
- various large business and retail parcels with busy driveways
- Average Daily Traffic (ADT) is 9,000 (2% trucks/buses)
- operating speed is 35 mph
- public right-of-way extends to 10 feet on either side of the roadway with continuous sidewalks that have trees and utility poles located within them.
- Expected peak hour volumes:
  - 25-50 pedestrians
  - 200-250 bicyclists
- Built environment is a challenge

Who is Our Design User?

- Important retail corridor for the area with lots of destinations for work and shopping
  - Confident Bicyclists?
  - Interested But Concerned?
  - Both are uncomfortable due to 35+ mph speeds and 9,000 ADT
- pedestrian volumes are moderate due to businesses

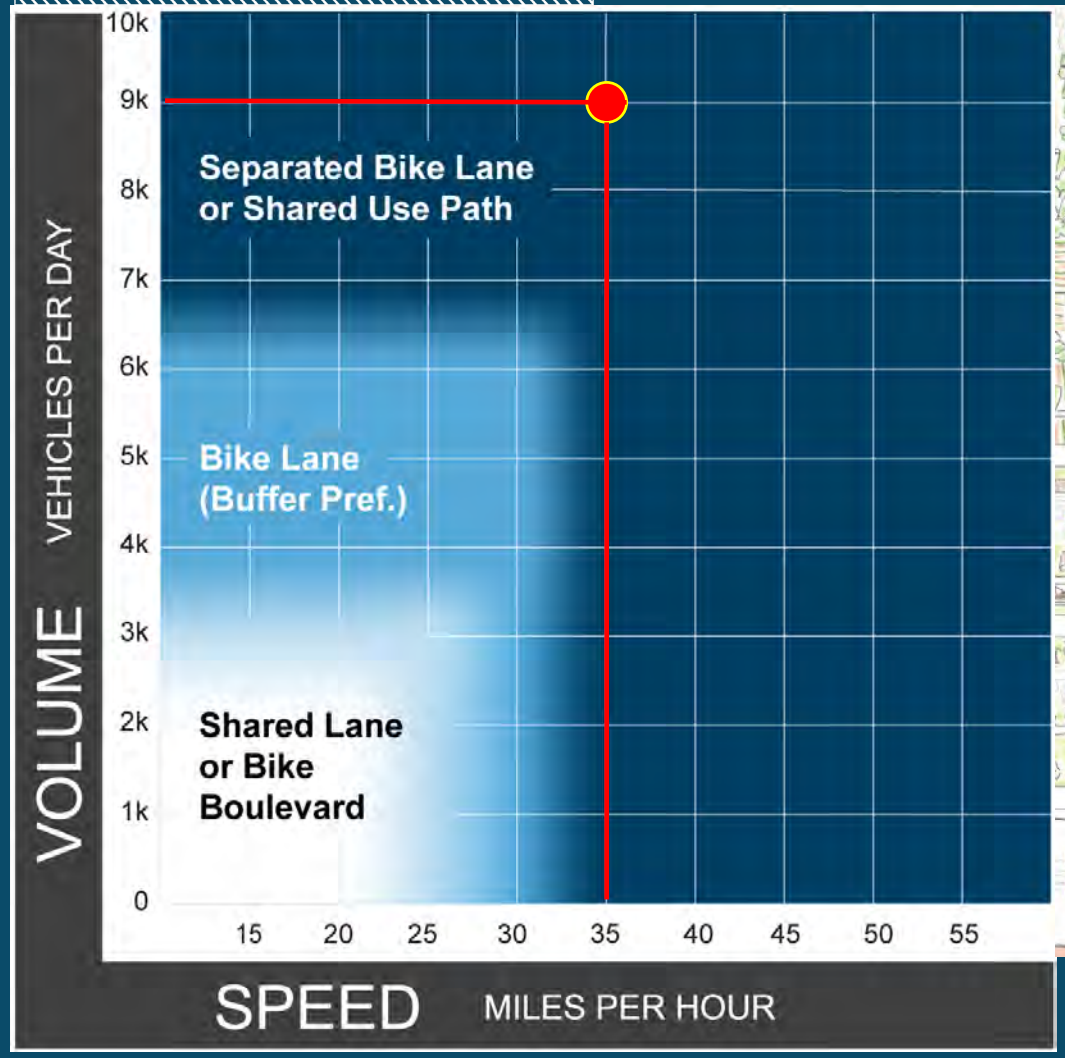
Who is Our Design User?

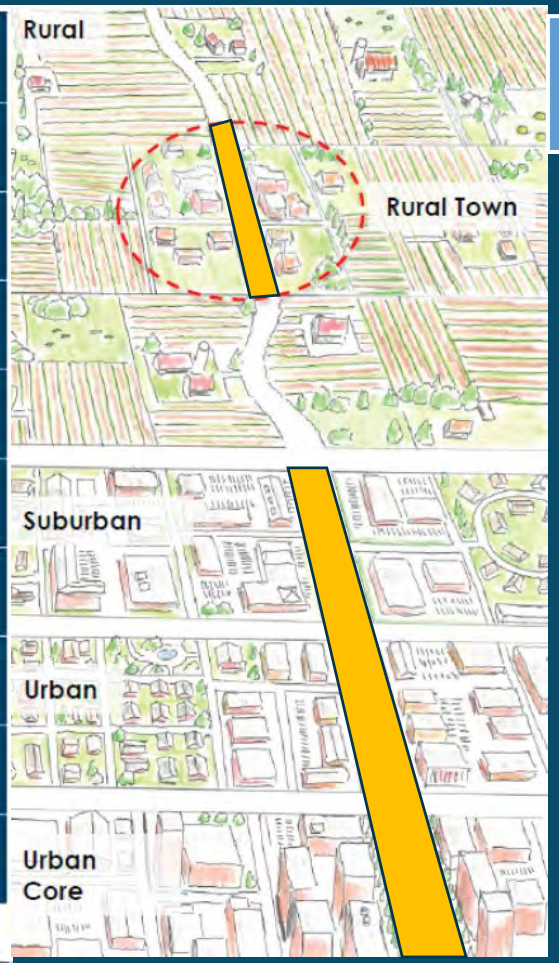
- Important retail corridor for the area with lots of destinations for work and shopping
  - Confident Bicyclists?
  - Interested But Concerned?
  - Both are uncomfortable due to 35+ mph speeds and 9,000 ADT
- pedestrian volumes are moderate due to businesses

Interested But Concerned Bicyclists Chosen for this Example

Preferred Bikeway Type

Urban, Urban Core, Suburban, and Rural Town Contexts





Design User Assumption = Interested But Concerned Bicyclist

- Average Daily Traffic (ADT) is 9,000
- 2% trucks/buses
- operating speed is 35 mph

Bike Lane Option

- Road Diet gains 12’ of space for 6’ bike lane
- Confident cyclists are comfortable (BLOS = ‘”B”)
- Relatively inexpensive option
- Motorist passing, turning easier
- Pedestrians enjoy buffer

Separated Bike Lane Option

- Road Diet gains 12’ of space for 4’ bike lane with 2’ buffer
- Relatively inexpensive option
- Interested but Concerned cyclists are comfortable (LTS 1) due to separation
- Confident cyclists are comfortable (BLOS = “A”)
- Pedestrians enjoy additional buffer

Shared Use Path Option

- Road Diet gains 12’ of space from road to create 6’- 12’ buffer
- Most expensive option
- Utilities relocate to buffer and sidewalk widened to 12’ - 14’
- Interested but Concerned cyclists are comfortable (LTS 1) due to separation
- Confident cyclists may prefer the road due to pedestrians on the path
- If bicycle volumes increase beyond 200/hour, or pedestrians exceed 30% of users, the path can begin to conflicts between pedestrians and bicyclists may result

Putting It Into Practice

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Federal Highway Administration

Participant Polling

Go to **menti.com** and

Use the code **74 78 56**

Now What Type of Bikeway Would You Choose?

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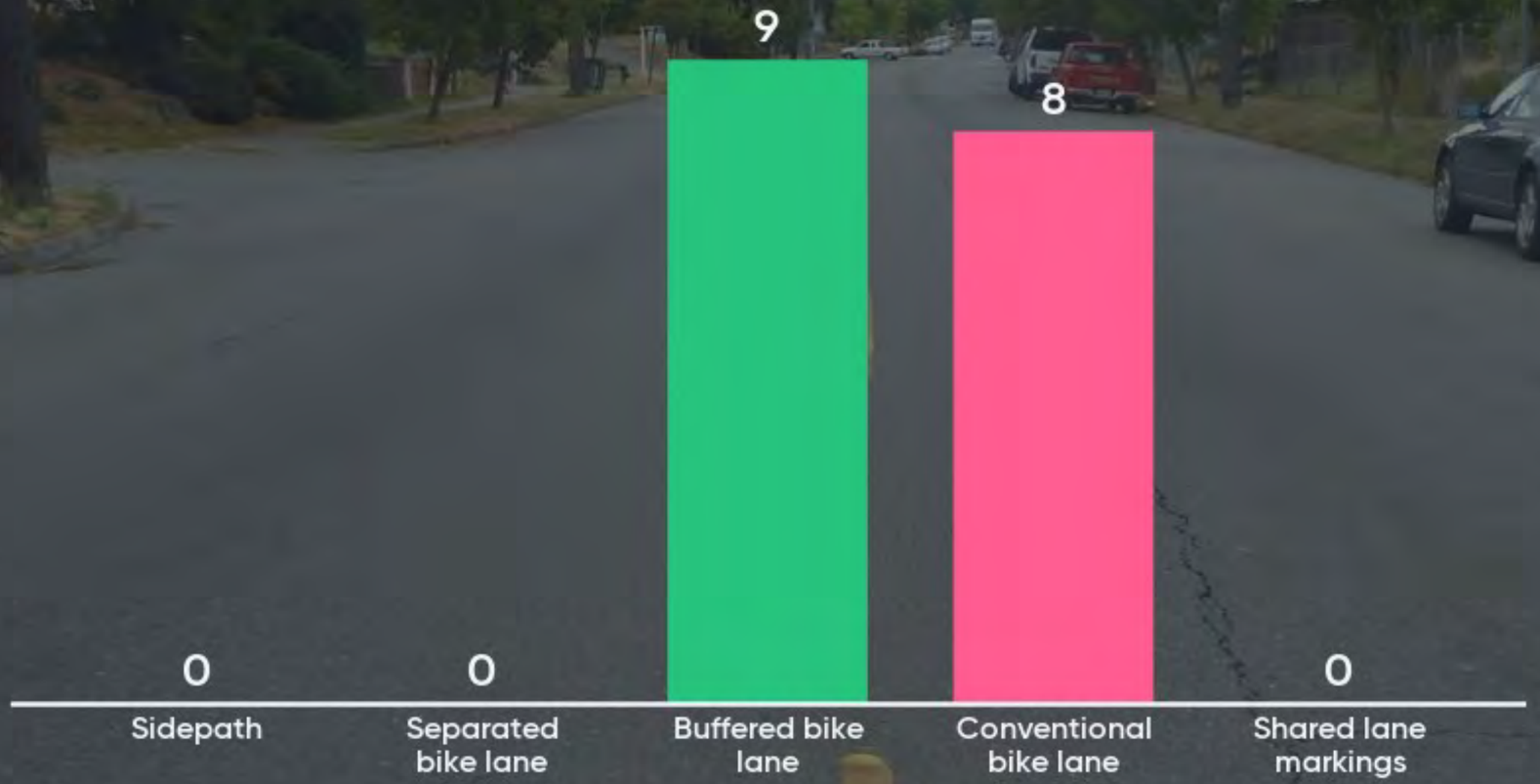
Now, what type of bikeway would you choose? (2-lane, 25 mph, 4,000 ADT)

Mentimeter



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Now What Type of Bikeway Would You Choose?

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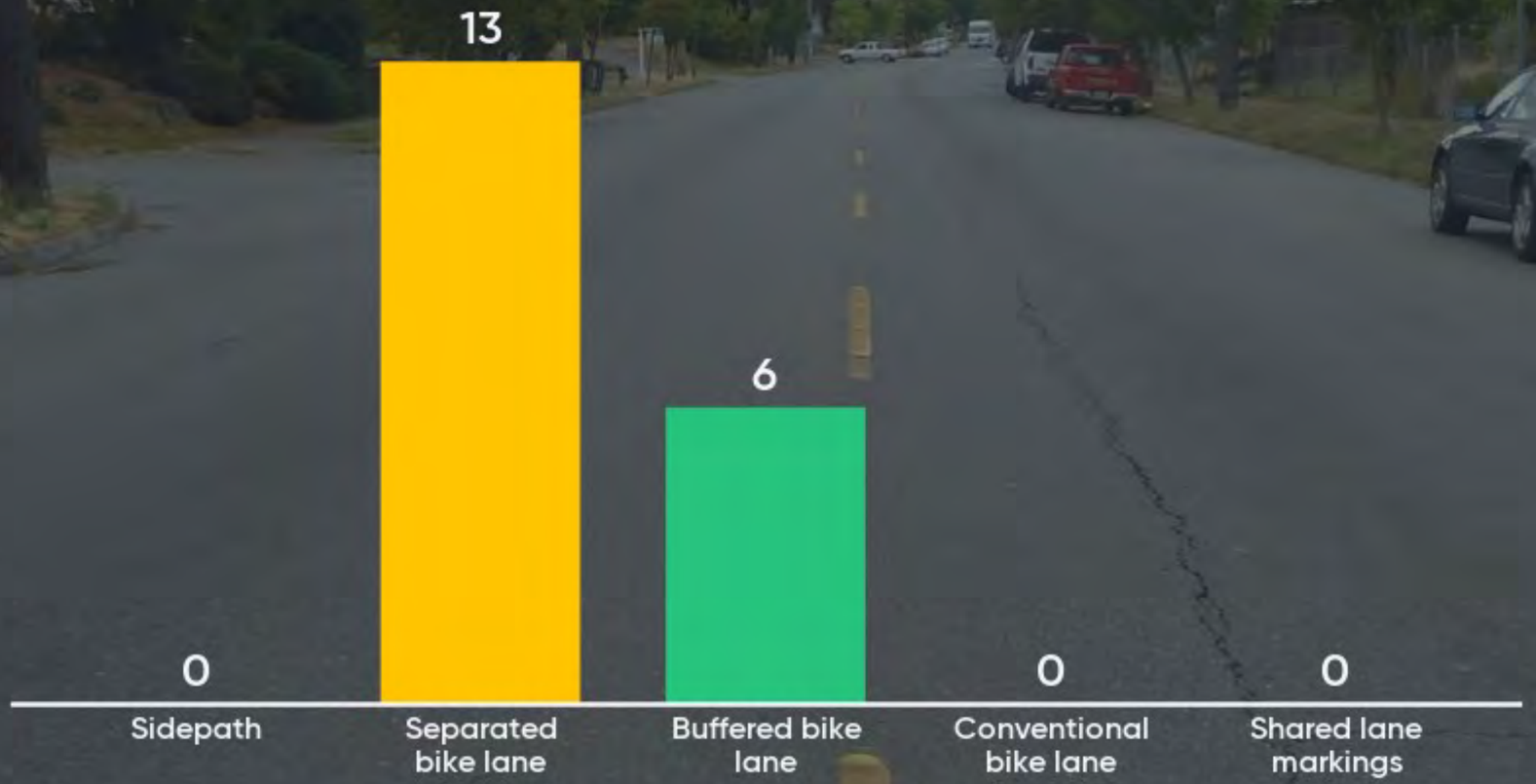
Now, what type of bikeway would you choose? (2-lane, 25 mph, 14,000 ADT)

Mentimeter



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Now What Type of Bikeway Would You Choose?

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Break

Bikeway Selection Small Group Exercise

Local Case Study #2: Aurora

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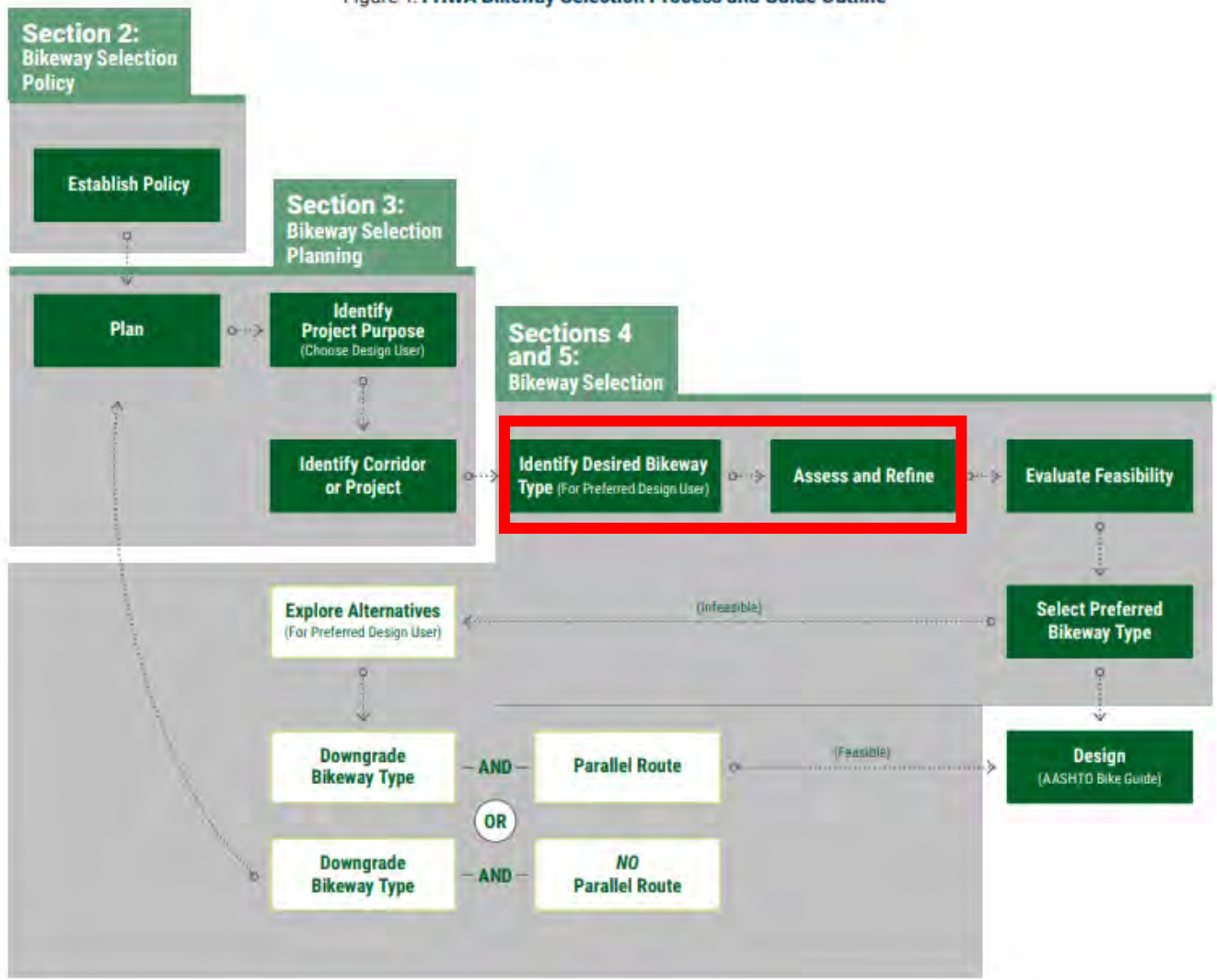
Bikeway Selection for Networks: Exercise #2

Review Questions for Exercise 2

Apply Bikeway Selection Guide to the early stages of bikeway selection:

- policies
- plans
- project purpose
- project selection

Figure 1: **FHWA Bikeway Selection Process and Guide Outline**



Example: Aurora, Colorado

Objectives:

Move people east-west on a parallel corridor to Colfax Ave.

East 13th Street Serves as a more comfortable alternative between Denver/Aurora

Planning Factors and Constraints:

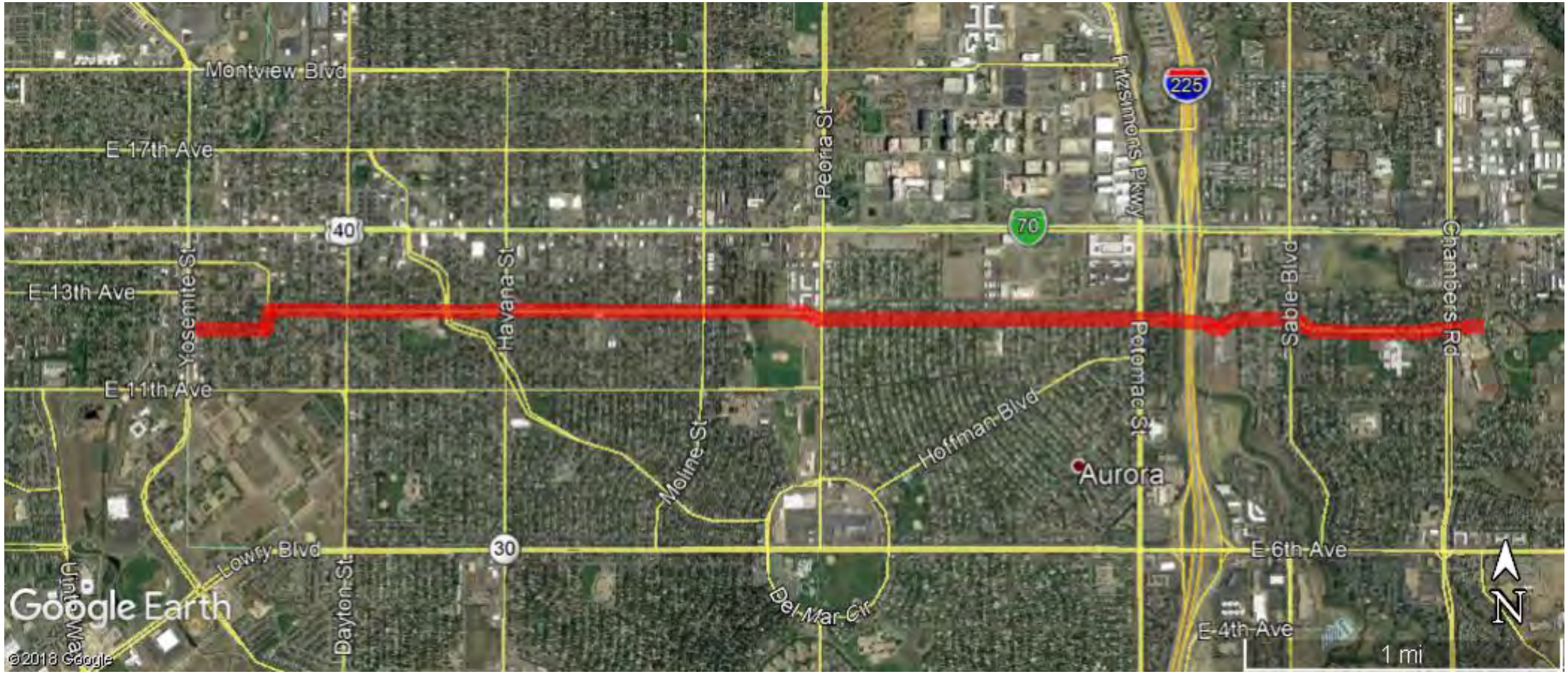
Limited ROW

On-Street Parking

Narrow sidewalks

Primarily residential interspersed with schools and churches

Corridor Map



U.S. Department of Transportation
Federal Highway Administration

Public Works Department
15151 E. Alameda Pkwy
Aurora CO 80012 USA
www.auroragov.org
303-739-7000
GIS@auroragov.org

City of Aurora, Colorado

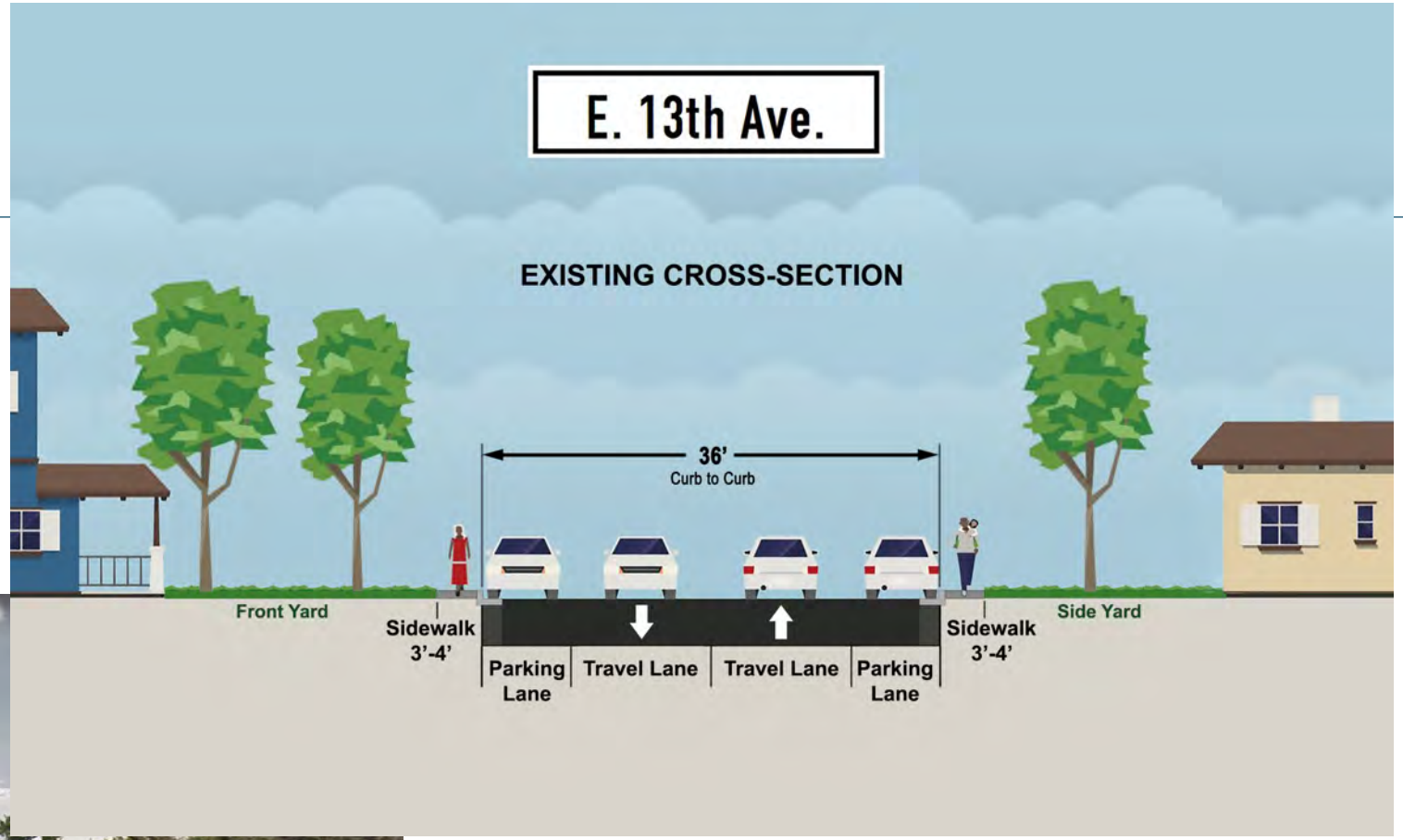
2018 East 13th Avenue Development

May 30, 2018

Aurora
Worth Discovering!

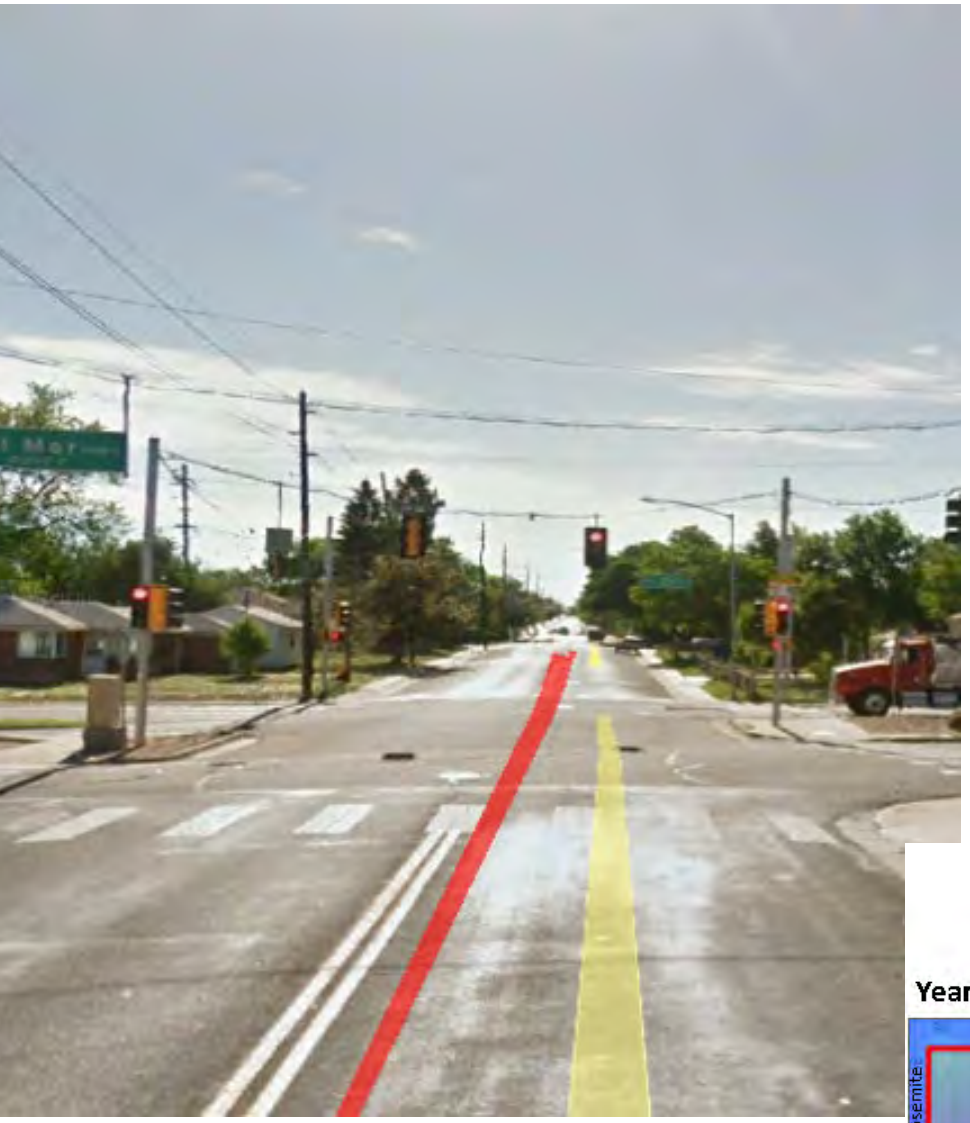
Corridor Photos

U.S. Department of Transportation
Federal Highway Administration


E. 13th Ave.
EXISTING CROSS-SECTION
36'
Curb to Curb
Front Yard
Sidewalk
3'-4'
Parking
Lane
Travel Lane
Travel Lane
Parking
Lane
Sidewalk
3'-4'
Side Yard


E 13th Ave
Google

Corridor Information



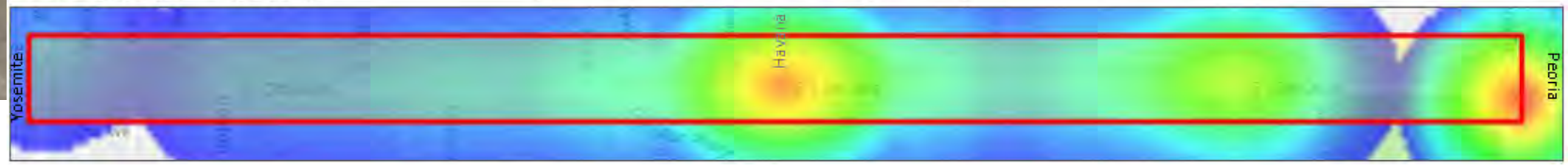
East of Ursula, May 2018

- ADT: 2,424
- Posted Speed Limit: 25 MPH
- 85 Percentile Speed: EB - 31 MPH; WB – 32 MPH
- Average Daily Bike Users: 16
- High Number of Crashes at Arterial Crossings

Roadway Configuration = two-way travel, on-street parking

Accident Severity	Count
INJURY	8
NO INJURY	46
Total Crashes (5/21/17 - 5/20/18)	**54**

Year 3 (5/21/17 – 5/20/18)



Exercise #2 – Team Discussion

Review Questions for Exercise 2

1. What is the project purpose?

2. Who is the target design user?

3. What is the selected corridor(s) or project?

4. What is an option(s) for the desired bikeway type for the select corridor(s)?

5. What are the potential trade-offs, barriers, or constraints to implementing the desired bikeway type?

6. What data or information do you want or need to further assess initial bikeway selection?

Action Plan for Moving Forward

Please refer to Action Plan Handout

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Participant Polling

Go to **menti.com** and

Use the code **74 78 56**

What is your most valuable takeaway from today?

Mentimeter

- Facility selection toolkit
- Network planning considerations
- 7’ parking is viable with local examples.
- Learning the pros and cons on various bikeways and when they are appropriate
- I was able to learn more about bike planning and the different options available.
- Feasibility Evaluation
- Rural bicycle selection guide information was new to me
- Graphs on type of facility related to volume/speed
- FHWA guidebooks on many more bike way design & implementation strategies

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What is your most valuable takeaway from today?

Mentimeter

Analyzing our network for “best fit” facilities based on speed and volume to identify largest gaps

Separated bike lanes are always better if you have space

Options and how to downgrade types .

The discussion on feasibility was interesting and helpful In thinking About how to apply bike way measures to existing roads.

Hearing ideas from participants

Designing for all comfort levels and the trade offs associated with reducing/enhancing bikeway facilities.

Thinking through an organized process

An understanding of all the info guides and tools for design decisions.

Start thinking about how to design bikeway based on factors. .adt, speed, context etc

19

What is your most valuable takeaway from today?

Mentimeter

Its ok to have less than minimum recommended width bike lanes if it will enhance connectivity

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FHWA Bikeway Selection Guide

Trung Vo P.E., AICP
Lyuba Zuyeva, AICP

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