FHWA Bikeway Selection Guide

Trung Vo P.E., AICP
Lyuba Zuyeva, AICP
Introductions & Welcome
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?

<table>
<thead>
<tr>
<th>Option</th>
<th>Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>I'm going as a camp fire this year.</td>
<td>David Hasselhoff</td>
</tr>
<tr>
<td>Oompa loompa</td>
<td>a lamp</td>
</tr>
<tr>
<td>Steve Irwin</td>
<td>J.P. Sears</td>
</tr>
<tr>
<td>Sexy police officer</td>
<td>Garbage truck</td>
</tr>
<tr>
<td>Winnie the Pooh</td>
<td></td>
</tr>
</tbody>
</table>
What was your best Halloween costume? OR what is your costume for this Halloween?

<table>
<thead>
<tr>
<th>Option</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Eleven from Stranger Things</td>
<td>A bee (Save the bee!)</td>
</tr>
<tr>
<td>A squirrel</td>
<td>Daria</td>
</tr>
<tr>
<td>Tweety</td>
<td>ZZ Top (billy gibbons)</td>
</tr>
</tbody>
</table>
What was your best Halloween costume? OR what is your costume for this Halloween?

- Camp fire
- Ratatouille
- Pirate

- More reasons for Separated bike lanes
- Understand FHWA's perspective on bicycle facility selection recommendations
Why are you here today?

- Interested in bike planning and learning more.
- Keeping myself up to date on any new facility types and implementation.
- Gather new information/perspective related to bike facility selection.
- Learn new strategies.
- To Learn.
- To make biking safer in my city.

Find out why FHWA produced this guide.
Get clarity on what’s the "official" guidance.
Learn about best practice for Bikeway selection.
Why are you here today?

- 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.
Why are you here today?

- Learning. And get out of office.
- Expand knowledge of Bikeway selection
- To improve my understanding of the bikeway options.
- Learn more about the best bicycle facilities for my projects.
- I want to provide better assistance to local governments who traditionally don’t invest in bike/ped infrastructure.
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

- **12%** Somewhat Confident
- **4%** Highly Confident
- **59%** Interested but Concerned
- **25%** Non-bicyclist

- **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?

- **28%** Highly confident
- **60%** Somewhat confident
- **8%** Interested but concerned
- **4%** Not a bicyclist
What Type of Bikeway Would You Choose?

Posted Speed = 25 mph
Vehicle Volume = 4,000 AADT
What type of bikeway would you choose? (2-lane, 25 mph, 4,000 ADT)
What Type of Bikeway Would You Choose?

Posted Speed = 25 mph
Vehicle Volume = 14,000 AADT
What type of bikeway would you choose? (2-lane, 25 mph, 14,000 ADT)
What Type of Bikeway Would You Choose?

Posted Speed = 30mph
Vehicle Volume = 40,000 AADT
What type of bikeway would you choose? (6-lane, 30 mph, 40,000 ADT)
How We Got Here
We are a car dependent culture
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
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!
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
“…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

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
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**

<table>
<thead>
<tr>
<th>Country</th>
<th>Injuries/100 million km cycled</th>
<th>Fatalities/10 million km cycled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Netherlands</td>
<td>1.1</td>
<td>5.5</td>
</tr>
<tr>
<td>United States</td>
<td>33.5</td>
<td>1.6</td>
</tr>
</tbody>
</table>

**National mode share:**
- **Netherlands:** 27%
- **United States:** 1%
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?
Policy and Planning

Vision

Goals
Chapter 2: Bikeway Selection Process

- Policy
- Planning
- Selection
- Design
Figure 1: FHWA Bikeway Selection Process and Guide Outline
2. Bikeway Selection Policy

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

3. Provide a transparent framework for prioritizing and programming transportation projects including specific bikeway types. Policies should promote a transparent decision making process for prioritizing and funding transportation projects at the system and bikeway level.

4. Define different planning contexts and decision considerations used to select desired bikeway strategies. Roadways pass through a broad range of land use development contexts, such as rural areas and urban centers. An agency’s policies for bikeway selection must clearly describe planning context and highlight relevant factors such as topography, curbside uses, geography distribution of destinations, local plans, and traffic characteristics. Policies can also address accessibility requirements and guidelines. For example, agencies can demonstrate how people with disabilities will be able to 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

- HOW DENVER COMMUTES:
  - 79%**
  - 15% (15%)
  - 5% (5%)
  - 7% (7%)
  - 5% (5%)

- TRAFFIC DEATHS:
  - 38%
  - 42%**

* 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 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

Sustainable Safety Principles:

- Functionality
- Homogeneity
- Predictability
- Forgiveness
- State Awareness

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>United States</td>
<td>54,589</td>
<td>40,100 (26.6%)</td>
</tr>
<tr>
<td></td>
<td>32,367 (40.7%)</td>
<td></td>
</tr>
<tr>
<td>Netherlands</td>
<td>3,506</td>
<td>613 (82.5%)</td>
</tr>
<tr>
<td></td>
<td>661 (81.1%)</td>
<td></td>
</tr>
</tbody>
</table>
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
3. Bikeway Selection Planning

Bikeway type selection should not be done in isolation. The decision is part of a broader planning process that considers and traffic characteristics of all modes, including freight, transit, personal vehicles, emergency access, bicyclists, and pedestrians. Community goals and priorities as well as public involvement and feedback from all parts of the community are important factors in the planning process. Networks should be thoughtfully and sustainably designed and developed. Most successful bicycle networks enable key linkages to and from the public realm.

The bicycle network informs bikeway type selection. High-quality facilities are needed to ensure that bikeway projects are planned and designed on a scale that meets the needs of the local community. Planning processes should also address the way that bicycle trips are supported in the community. The bicycle network is an essential element of the broader transportation network. Planning processes support the needs of the public realm and provide a means to determine the extent to which a bikeway or project exists.

At the core of the planning process is the vision for a future bicycle network. The vision describes desired future characteristics of the bicycle transportation system. The vision includes the target user type, the target design user type (as described on page 13), and the target bicyclist design user type.

The vision for the bike network can inform planning-related activities, such as decisions regarding where an agency chooses to pave shoulders and transportation corridors, as well as the planning and transportation needs of bicyclists. The vision can 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 thoughtfully and sustainably designed and developed. Most successful bicycle networks enable key linkages to and from the public realm. Networks should be thoughtfully and sustainably designed and developed. Most successful bicycle networks enable key linkages to and from the public realm.
Chapter 3: Bikeway Selection Planning

Vision
The Bicycle Network
Target Design User
Bikeway Types
Road Context
Project Type and Purpose

Bicycles 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 inequity.
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

<table>
<thead>
<tr>
<th>Facility Type</th>
<th>In Plan</th>
<th>Not in Plan, but Need Identified</th>
<th>Betterment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pedestrian Facility</td>
<td>NCDOT pays full</td>
<td>Cost Share</td>
<td>Local</td>
</tr>
<tr>
<td>Bicycle Facility</td>
<td>NCDOT pays full</td>
<td>NCDOT pays full</td>
<td>Local</td>
</tr>
<tr>
<td>Side Path</td>
<td>NCDOT pays full</td>
<td>Cost Share</td>
<td>Local</td>
</tr>
<tr>
<td>Greenway Crossing</td>
<td>NCDOT pays full</td>
<td>Cost Share</td>
<td>Local</td>
</tr>
<tr>
<td>Bus Pull Out</td>
<td>NCDOT pays full</td>
<td>Cost Share</td>
<td>Local</td>
</tr>
<tr>
<td>Bus Stop (pad only)</td>
<td>NCDOT pays full</td>
<td>Cost Share</td>
<td>Local</td>
</tr>
</tbody>
</table>
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
Planning Inputs

- Network
- Users
- Bikeway Types
- Context
Planning Inputs: Network
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
Planning Inputs: Users
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
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
BICYCLIST DESIGN USER PROFILES

Interested but Concerned

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

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

Highly Confident

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

**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.

---

Chapter 3: Bicycle Network – Design User

High Traffic Stress

Low Traffic Stress
Lunch
What about Scooters and E-Bikes?
Planning Inputs: Bikeway Types
Chapter 3:
The Bicycle Network - Form

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
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.
SEPARATION FROM TRAFFIC

- Shared-Use Path
- Side Path
- Separated Bike Lane
- Buffered Bike Lane
- Bike Lane
- Shoulder
- Shared Lane
Conventional Bike Lanes (High Speed and Volume Environments)
Conventional Bike Lanes (Low Speed Environments)
Buffered Bike Lanes (High Speed and Volume Environments)
Separated Bike Lane - Reconstruction
Neighborhood Greenways (aka Bike Boulevards)
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
Bikeway Selection Process

1. Plan
2. Identify Desired Bikeway Type
3. Assess and Refine
4. Evaluate Feasibility
5. Select Preferred Bikeway Type
Facility Selection Tools
City, Small Town, and Suburban Roadways

Identifies the preferred bikeway type.

Design User Assumption: Interested but concerned cyclist

Analysis: Bicycle Level of Traffic Stress
Separated Bike Lane or Shared Use Path

Bike Lane (Buffer Pref.)
Rural Roadways

- Identifies the preferred shoulder width.

**Design User Assumption:**
Confident bicyclist

**Analysis:**
Bicycle Level of Service
Rural Roadways

[Image of a rural road with trees on both sides and a graph showing traffic volume and shoulder width.]
Rural Roadways
Rural Roadways
Assess and Refine
Bikeway Selection Process

1. Plan
2. Identify Desired Bikeway Type
3. Assess and Refine
4. Evaluate Feasibility
5. Select Preferred Bikeway Type
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)
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?

- Bend in (toward travel lanes) 10
- Bend out (away from travel lanes) 8
- Maintain alignment 2
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?

- Left side: 11 votes
- Right side: 8 votes
- I'd never install a 2-way SBL on a 1-way street: 0 votes
Assessing and Refining
Assessing and Refining
Feasibility
Bikeway Selection Process

1. Plan
2. Identify Desired Bikeway Type
3. Assess and Refine
4. Evaluate Feasibility
5. Select Preferred Bikeway Type
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
Evaluating Feasibility
Evaluating Feasibility
Evaluating Feasibility
Assess Desirable Bikeway Design Values

Example for standard bicycle lanes from NACTO Urban Bikeway Guide:

Against Curb:
Desirable = 6’
Minimum = 4’

Against Parking:
Desirable = 7.5’
Minimum = 5’

Source: NACTO Bikeway Design Guide
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?

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
Evaluating Feasibility
Door Zone Bike Lane or No Bike Lane?

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
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
Door Zone Bike Lane or No Bike Lane?
Case Study: 15th Street, NW. Washington DC
Data Sources: District Department of Transportation

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
Shared Lanes
Crash Risk ~
20 crashes/million cyclists

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

Bikeway Selection Process

Illustrative examples
Bikeway Selection Process

Plan

Identify Desired Bikeway Type

Assess and Refine

Evaluate Feasibility

Select Preferred Bikeway Type
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
- pedestrian volumes are expected to be low

Confident Bicyclists Chosen for this Example
Preferred Bikeway Type

Rural Context

- 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
Participant Polling

Go to menti.com and
Use the code 74 78 56
Now What Type of Bikeway Would You Choose?

Posted Speed = 25 mph
Vehicle Volume = 4,000 AADT
Now, what type of bikeway would you choose? (2-lane, 25 mph, 4,000 ADT)

- Sidepath: 0
- Separated bike lane: 0
- Buffered bike lane: 9
- Conventional bike lane: 8
- Shared lane markings: 0
Now What Type of Bikeway Would You Choose?

Posted Speed = 25 mph
Vehicle Volume = 14,000 AADT
Now, what type of bikeway would you choose? (2-lane, 25 mph, 14,000 ADT)
Posted Speed = 30mph  
Vehicle Volume = 40,000 AADT

Now What Type of Bikeway Would You Choose?
Bikeway Selection Small Group Exercise

Local Case Study #2: Aurora
Bikeway Selection for Networks: Exercise #2

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

- policies
- plans
- project purpose
- project selection
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
Corridor Photos
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

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<th>Count</th>
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<tr>
<td>NO INJURY</td>
<td>46</td>
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<tr>
<td>Total Crashes</td>
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Year 3 (5/21/17 – 5/20/18)
Exercise #2 – Team Discussion

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
Participant Polling

Go to menti.com and
Use the code 74 78 56
<table>
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<th>Facility selection toolkit</th>
<th>Network planning considerations</th>
<th>7’ parking is viable with local examples.</th>
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<td>are appropriate</td>
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<tr>
<td>Rural bicycle selection guide</td>
<td>Graphs on type of facility</td>
<td>FHWA guidebooks on many more bike way</td>
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<tr>
<td>information was new to me</td>
<td>related to volume/speed</td>
<td>design &amp; implementation strategies</td>
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</table>
What is your most valuable takeaway from today?

- 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.
What is your most valuable takeaway from today?

It's ok to have less than minimum recommended width bike lanes if it will enhance connectivity.
FHWA Bikeway Selection Guide

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