PBIC Webinar

Improving Multimodal Outcomes through Performance Measurement and Design Flexibility

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November 14, 2016

Today's Presentation

- Introduction and housekeeping
- Presentations
- Questions at the end

Webinar Issues

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CM Credits and Email

⇨**Certificate of Attendance**

You will receive a certificate of attendance by email from the UNC Highway Safety Research Center

Pedestrian and Bicycle Information Center

Dear James,

Thank you for registering for "A Resident's Guide for Creating Safer Communities for Walking and Biking".

The Federal Highway Administration just released "A Resident's Guide for Creating Safer Communities for Walking and Bicycling," a free guide offering step-by-step instructions for residents and community groups looking to improve pedestrian and bicyclist safety, access, and comfort. This webinar offers an overview of the guide and will review how two communities used the principles outlined within it to make their communities more walkable and bikeable.

Tamara Redmon, with FHWA's Office of Safety, will introduce the guide and discuss how it fits within the US Department of Transportation's Safer People, Safer Streets Initiative.

Laura Sandt, with the Pedestrian and Bicycle Information Center, will discuss the content of the new guide and how residents can use it.

PBIC Webinars and News

- **Find PBIC webinars and webinar archives**
  pedbikeinfo.org/webinars
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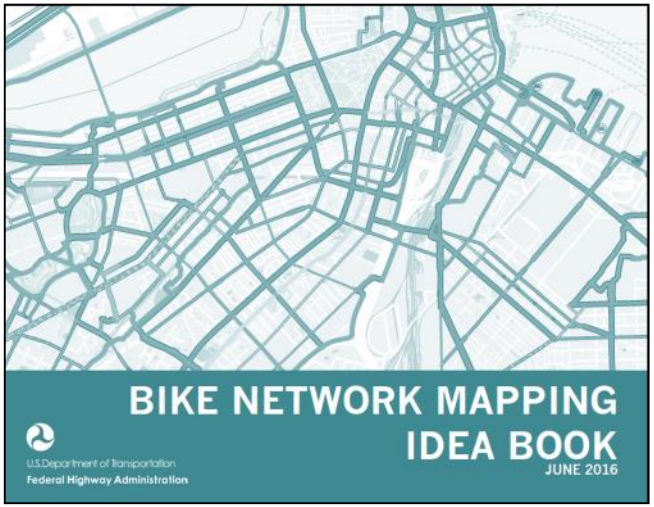
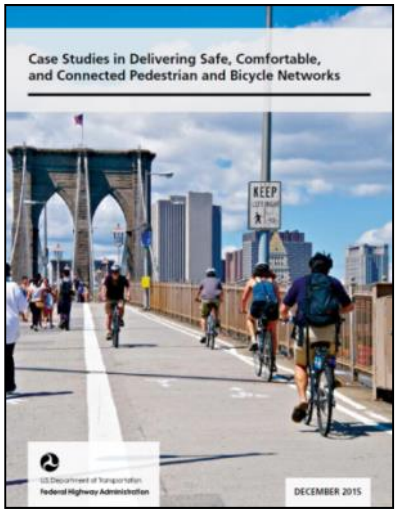
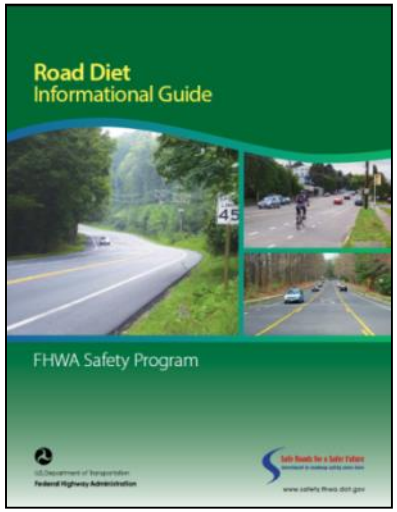
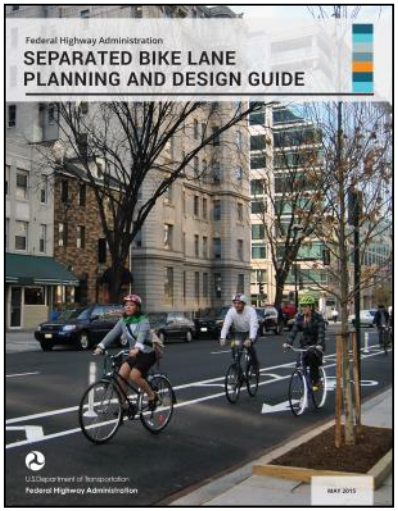
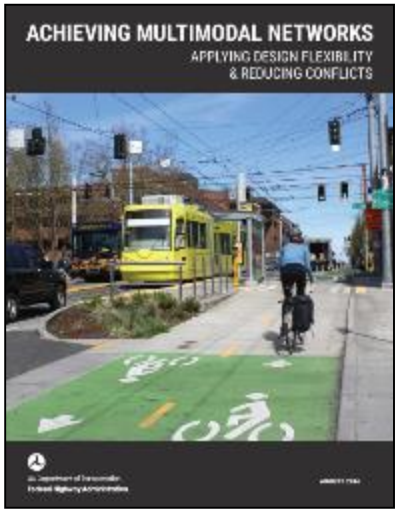
Recent FHWA Pedestrian and Bicycle Resources

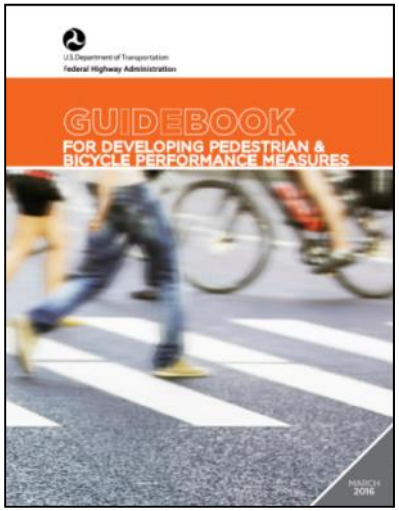








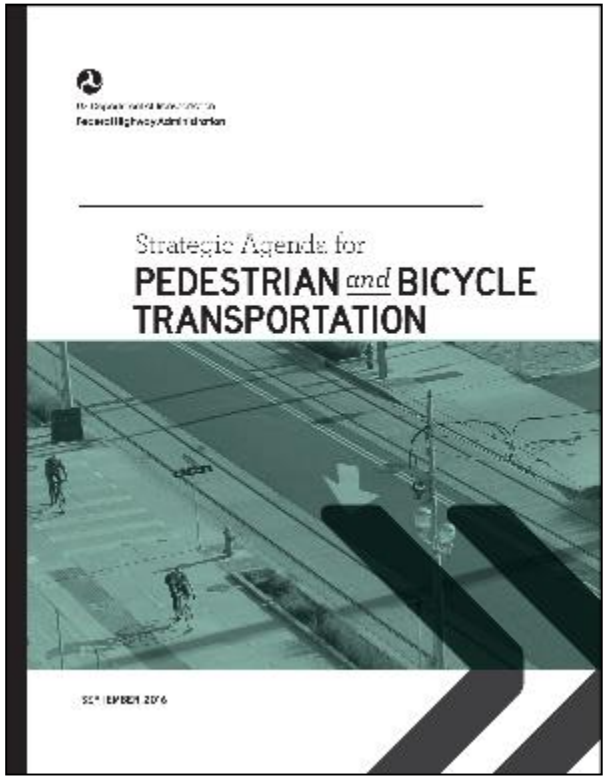




Available at www.fhwa.dot.gov/environment/bicycle_pedestrian

Strategic Agenda for Pedestrian and Bicycle Transportation

- Provides a framework for organizing existing and planned pedestrian and bicycle activities
- Emphasizes collaboration and partnerships
- Assumes a 3-5 year time horizon
- Builds on the policy statement on bicycle and pedestrian accommodations
- Demonstrates FHWA's ongoing national leadership on multimodal transportation and represents the agency's commitment to institutionalize and mainstream these issues moving forward



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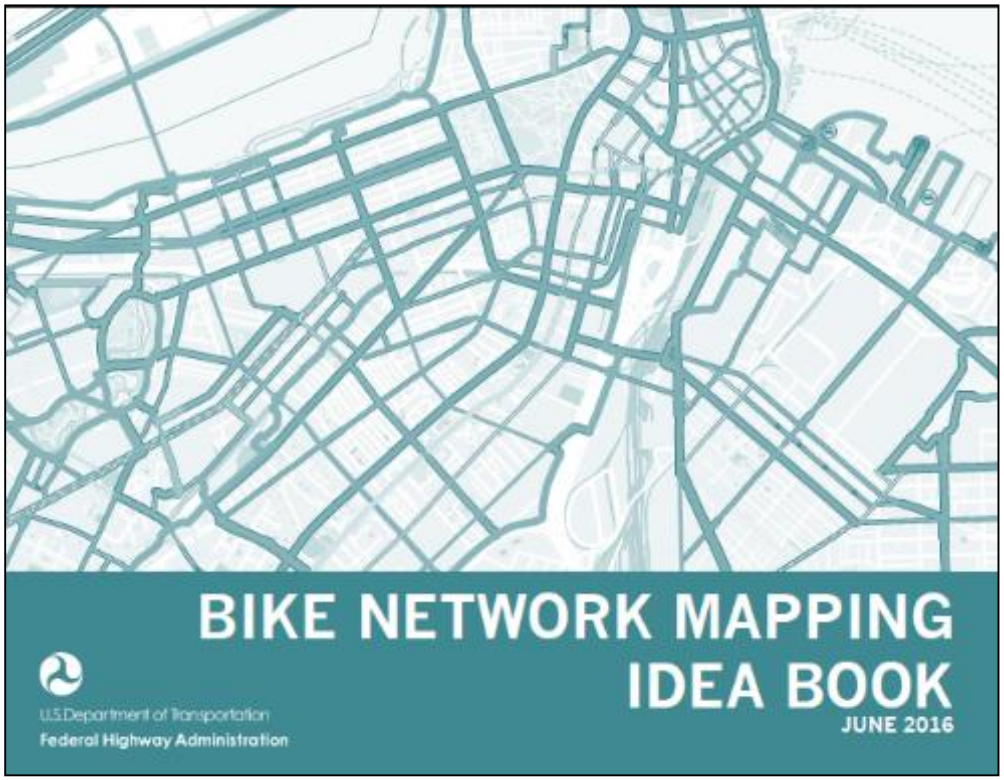
Linkages Between Resources



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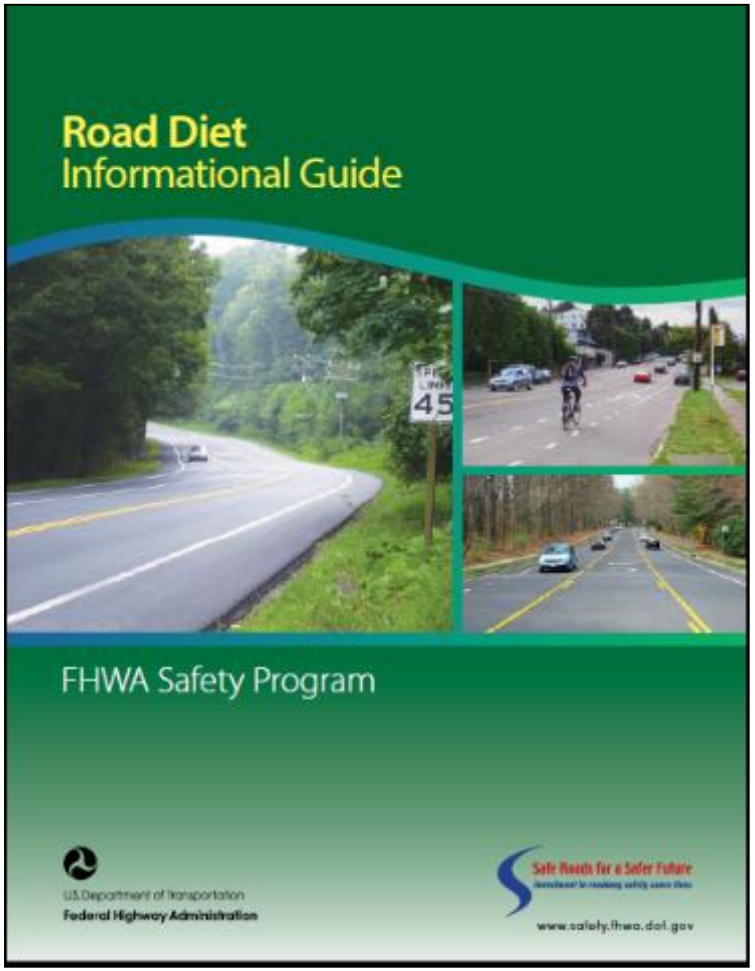
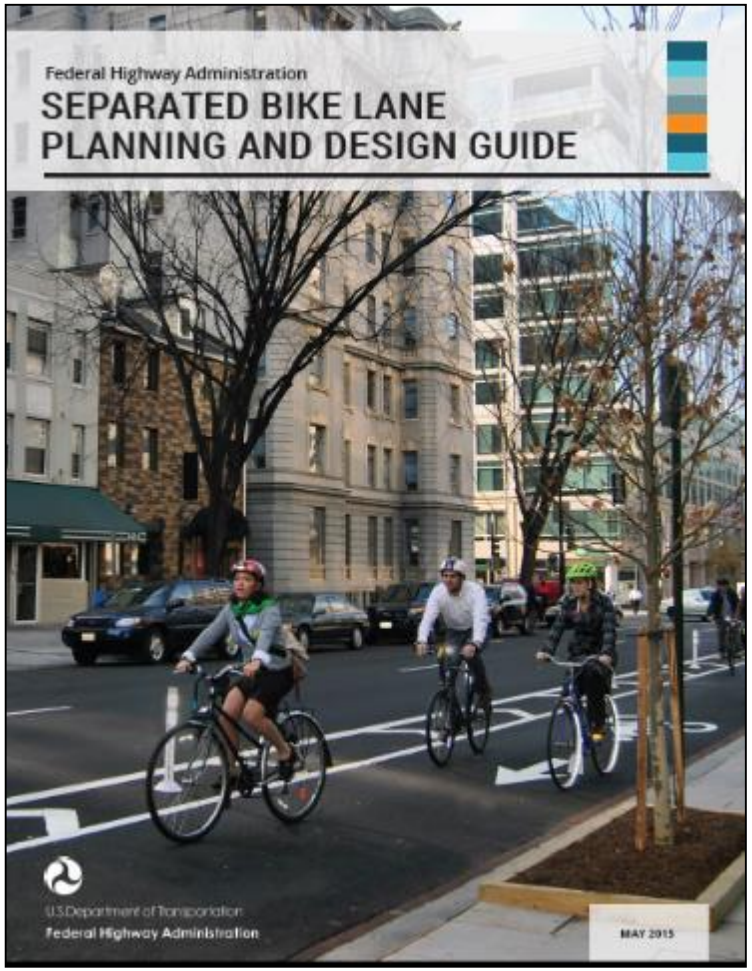




Available at www.fhwa.dot.gov/environment/bicycle_pedestrian

Design Resource Index

Design Resource Index

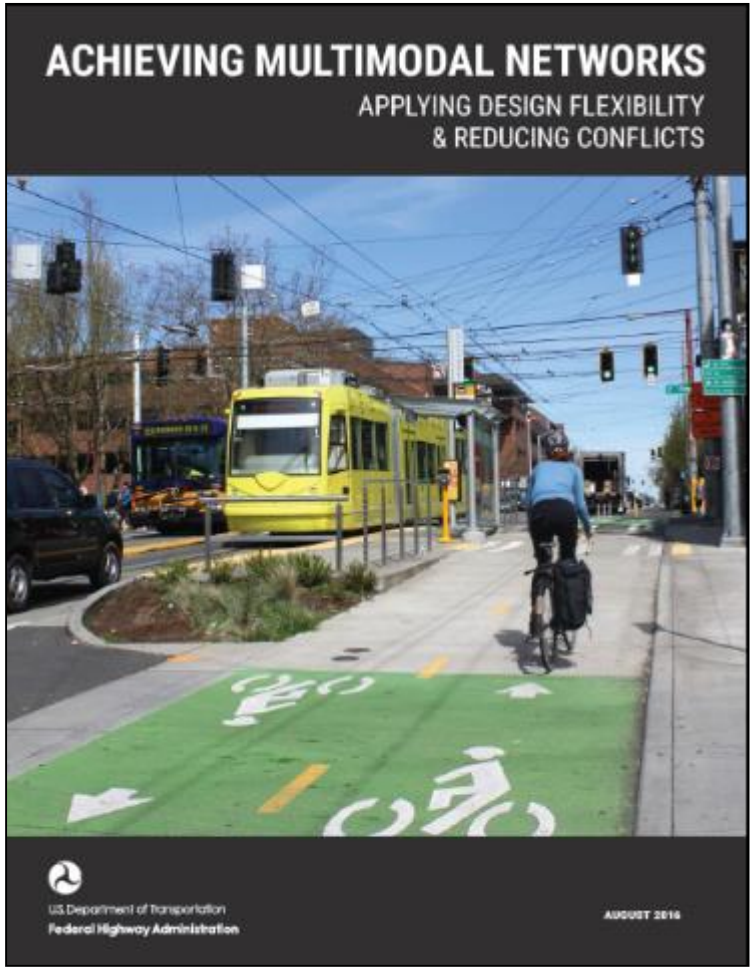
On-Street Bicycle Facility Design Treatments

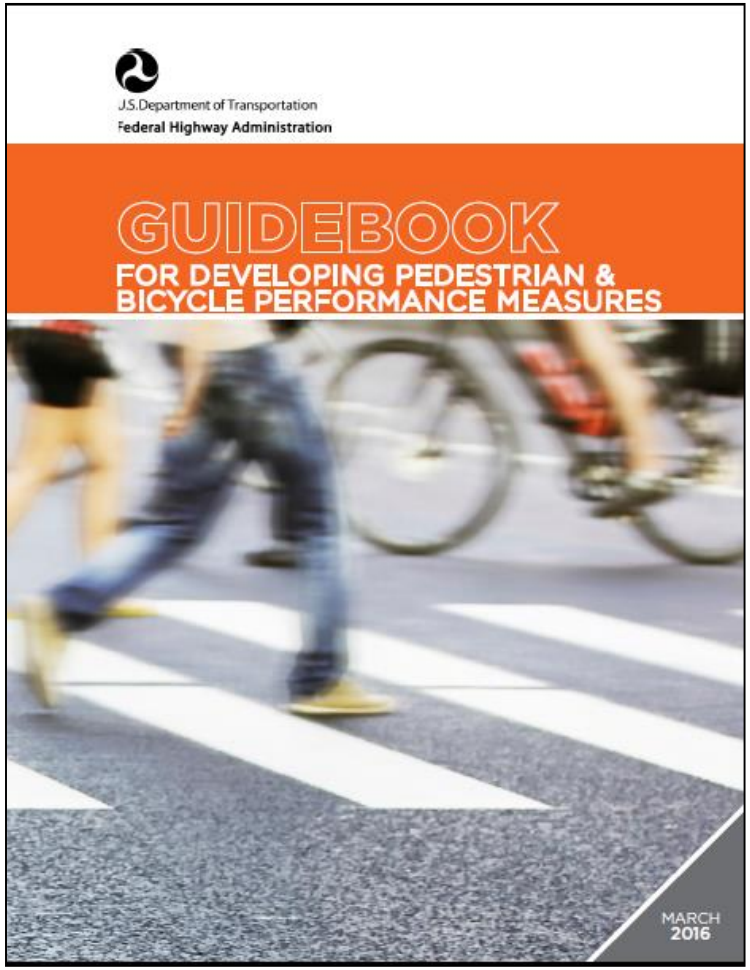
5/14/15

Key	Color
Design Treatment Addressed	
Interim Approval	
Experimental Status	

		Roadside Design Guide (2011) AASHTO	A Policy on Geometric Design of Highways and Streets (2011) AASHTO	Guide for the Development of Bicycle Facilities (2012) AASHTO
A.	**Bicycle Facility Selection**			
A1	Guidance of appropriate use/ typical application of bicycle facilities			Section 2.5.2
B.	**General Roadway Design**			
B1	Paved shoulders		Sections 2.7, 4.4	Section 4.5
B2	Bicycle route signs			Section 2.5.3
B3	Shared lane markings			Section 4.4
B4	Shared lane signage			Section 4.3
B5	Bicycle boulevards/neighborhood greenways			Section 4.10
B6	Bicycle accommodations related to traffic calming			Sections 4.12.6, 4.12.7
B7	Bicycle accommodations on bridges/tunnels		Sections 4.10.3, 4.16.4	Section 4.12.3
B8	Bicycle treatments at railroad crossings			Section 4.12.1
B9	Bicycle-safe drainage grate design		Section 2.7, 4.7.2	Section 4.12.8
B10	Rumble strips (bicycle guidance)		Section 4.5	Section 4.5.2
B11	Colored bicycle facilities			Section 4.7.2
C.	**Bicycle Lanes**			

Linkages Between Resources





Available at www.fhwa.dot.gov/environment/bicycle_pedestrian

Achieving Multimodal Networks:
Introduction

Interconnected pedestrian and bicycle infrastructure makes ***walking and bicycling a viable transportation choice*** for everyone and this contributes to the health, equity, and quality of life of our communities.

Achieving Multimodal Networks:
Objectives

Equip planners, designers, and policy makers with information, so that:

1. walking is a viable transportation choice for everyone, and

2. bicycling is a viable transportation choice for all ages and abilities.

Address *common concerns and perceived barriers*

Direct planners and designers to *existing national guidelines*

Olive Avenue, Complete Street, West Palm Beach, FL

Achieving Multimodal Networks:
Applying Design Flexibility

These documents state the need for flexibility and encourage engineering judgement:

- MUTCD
- AASHTO Green Book
- Highway Capacity Manual

"The intent of this policy is to provide guidance to the designer by referencing a recommended range of values for critical dimensions. ***Good highway design involves balancing safety, mobility, and preservation of scenic, aesthetic, historic, cultural, and environmental resources.*** This policy is therefore not intended to be a detailed design manual that could supersede the need for the application of sound principles by the knowledgeable design professional. ***Sufficient flexibility is permitted*** to encourage independent designs tailored to particular situations."

– AASHTO Green Book

Achieving Multimodal Networks:
Applying Design Flexibility

- Engineering Judgement

  "This Manual should not be considered a substitute for engineering judgment."

  – *MUTCD*

- Documentation

  "With reliance on complete and sound documentation, tort liability concerns need not be an impediment to achieving good road design."

  - *The Maine Department of Transportation's Highway Design Guide, Chapter 15: Flexible Design Practices*

- Experimentation

  Liability concerns should not limit innovations, experimentation and versatile applications of existing design treatments

Achieving Multimodal Networks:
Reducing Conflicts

Guiding Principles

1. Safety
2. Accommodation and Comfort
3. Coherence and Predictability
4. Context-Sensitivity
5. Experimentation

Capital City Trail, Madison, WI

Achieving Multimodal Networks:
Design Topics

PART 1: APPLYING DESIGN FLEXIBILITY

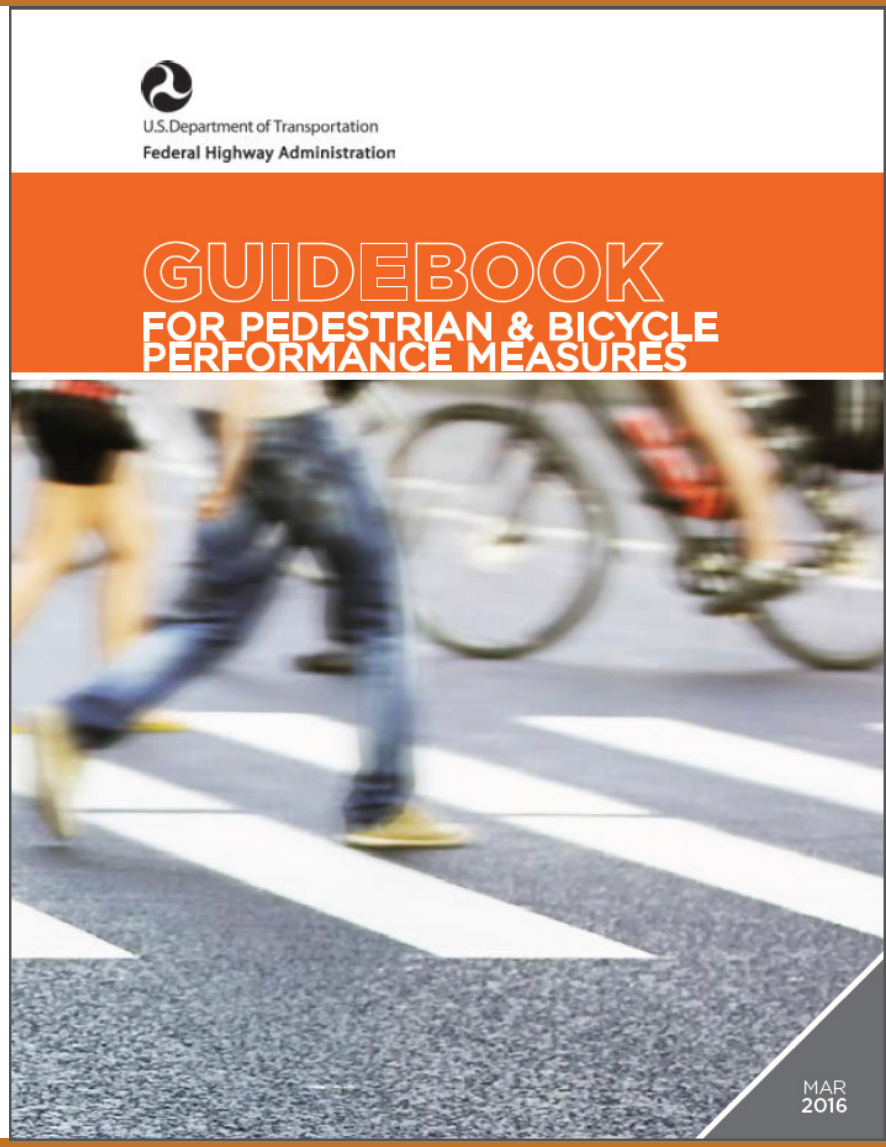
- DESIGN CRITERIA AND LANE WIDTH
- INTERSECTION GEOMETRY
- TRAFFIC CALMING AND DESIGN SPEED
- TRANSITIONS TO MAIN STREETS
- ROAD DIETS AND TRAFFIC ANALYSIS
- ENHANCED CROSSING TREATMENTS
- SIGNALIZED INTERSECTIONS
- PAVED SHOULDERS
- SEPARATED BIKE LANES
- BUS STOPS
- BRIDGE DESIGN
- SLOW STREETS

PART 2: REDUCING CONFLICTS

- NETWORK CONNECTIVITY
- SCHOOL ACCESS
- MULTIMODAL ACCESS TO EXISTING TRANSIT STATIONS
- MULTIMODAL ACCESS TO NEW TRANSIT STATIONS
- TRANSIT CONFLICTS
- FREIGHT INTERACTION
- ACCESSIBILITY
- TURNING VEHICLES
- SEPARATED BIKE LANES AT INTERSECTIONS
- SHARED USE PATHS
- MIDBLOCK PATH INTERSECTIONS
- SHARED STREETS

Performance Measures:
Introduction

Transportation investment decisions are based on measurement and analysis. ***Improving outcomes for walking and bicycling*** requires measuring performance comprehensively.



Performance Measures: Core Challenges

- Measuring performance with data available
- How to balance competing needs and impacts?
- Which measures "matter" in determining investment outcomes?
- How to differentiate "community goals" and "transportation measures?"

Performance Measures:
Goals and Transportation Measures

COMMUNITY GOALS CATEGORIES	TRANSPORTATION MEASURES CATEGORIES					
	ACCESSIBILITY	COMPLIANCE	DEMAND	INFRASTRUCTURE	MOBILITY	RELIABILITY
CONNECTIVITY	High			High	High	Low
ECONOMY	High			Low	High	High
ENVIRONMENT	High		High		Low	Low
EQUITY	High	Low	Low	High	High	Low
HEALTH	High	Low	High	High	Low	Low
LIVABILITY	High	Low	Low	High	Low	High
SAFETY	Low	High		High	Low	Low

Performance Measures:
Applications

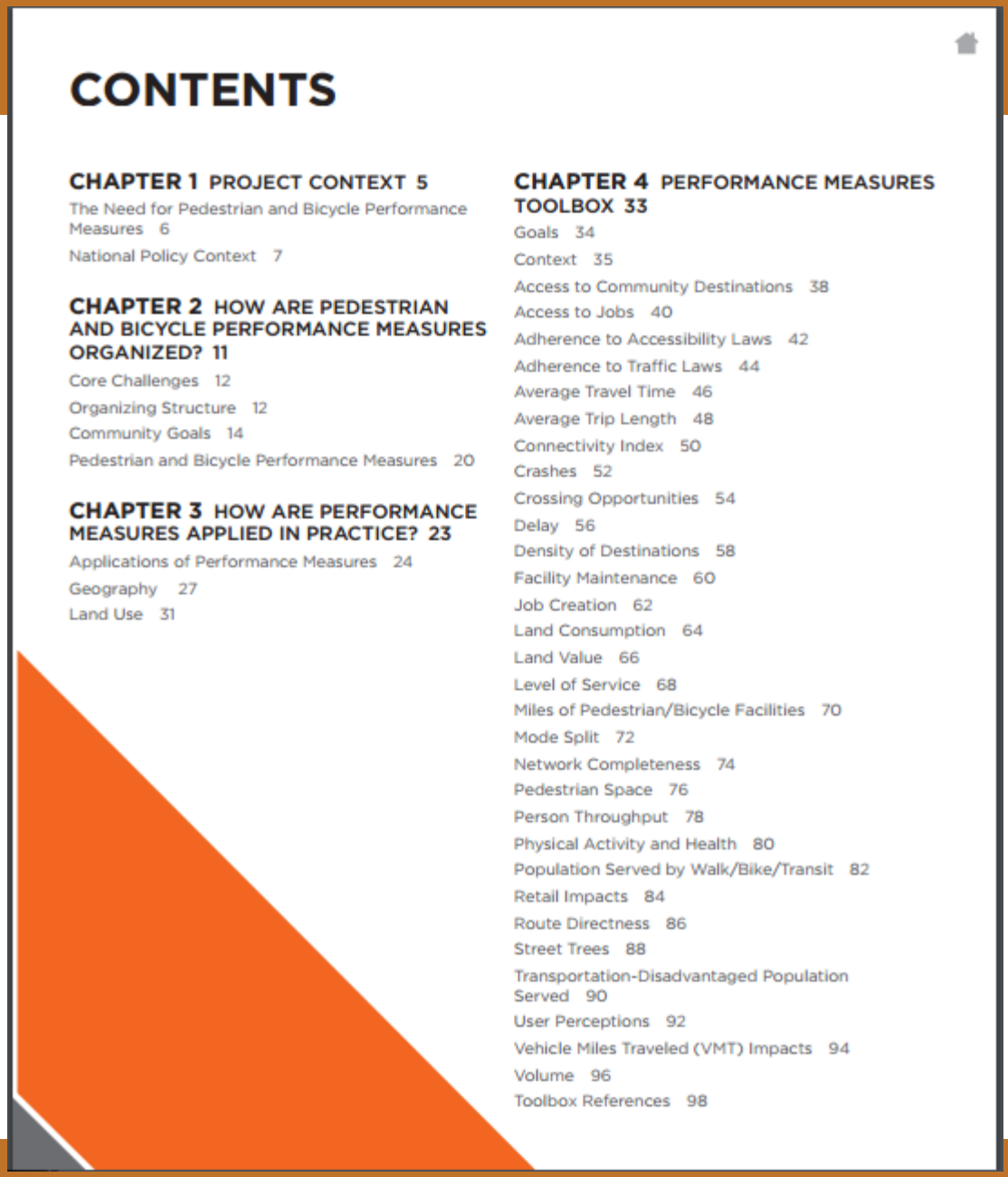
How will performance measures be used?

- Evaluate planning scenarios
- Long-term benchmarking
- Comparing alternatives
- Project prioritization
- Near-term standard

AGENCY/APPLICATION	COMMON PERFORMANCE MEASURE APPLICATIONS				
	PLANNING SCENARIO EVALUATION	LONG-TERM BENCHMARK	ALTERNATIVES COMPARISON	PROJECT NEED/ PRIORITIZATION	NEAR-TERM STANDARD
LOCAL JURISDICTION (COUNTY, CITY)					
SYSTEM/NETWORK PLANNING	X	X		X	
CORRIDOR OR PROJECT PLANNING	X		X	X	X
DEVELOPMENT REVIEW/ CODE COMPLIANCE	X		X		X
REGIONAL PLANNING AGENCY (MPO)					
SYSTEM/NETWORK PLANNING	X	X		X	
REGIONAL POLICY DEVELOPMENT		X			X
FUNDING ALLOCATION				X	
STATE AGENCY (DOT)					
STATEWIDE SYSTEM/ NETWORK PLANNING	X		X	X	
STATEWIDE POLICY DEVELOPMENT		X			X
FUNDING ALLOCATION				X	
CODE COMPLIANCE					X

Performance Measures: Guidebook

- Establish performance measurement program
- Desktop reference tool



CONTENTS

NETWORK COMPLETENESS

The portion of the transportation network that is usable for people walking or bicycling, and represents the minimum accommodations needed for a facility to be considered part of the walking or bicycling network.

GOALS

- CONNECTIVITY (X)
- ECONOMIC (X)
- ENVIRONMENT (X)
- EQUITY (X)
- HEALTH (X)
- LIVABILITY (X)
- SAFETY (X)

RELATED MEASURES

"Connectivity Index"

"Miles of Pedestrian/ Bicycle Facilities"

"Pedestrian Space"

"Route Directness"

CONTEXT

PERFORMANCE MEASURE APPLICATION

PROJECT PRIORITIZATION
A measure of network completeness can be used to prioritize projects that fill crucial gaps or meet unaddressed needs for walkers and bicyclists.

ALTERNATIVES COMPARISON
When comparing design options, an agency may consider how two or more possible configurations contribute to a more complete transportation network for those walking or biking.

SCENARIO EVALUATION (POSSIBLE)
Network Completeness can be applied in evaluating future scenarios of potential transportation investments and land use changes.

BENCHMARKING
An agency can report change over time through regular updates to inventories of intersection treatments, bicycle facilities, and sidewalks.

STANDARD
A performance baseline related to network completeness may call for a given percentage of the network to be completed each year or for a given percentage of sidewalks to meet ADA standards by a given year.

GEOGRAPHY	PREFERRED	POSSIBLE
STATE	X	
REGION	X	
LOCAL	X	

LAND USE CONTEXT	PREFERRED	POSSIBLE
URBAN	X	
SUBURBAN	X	
RURAL		X

DATA NEEDS & SOURCES

Inventory data for:

- Roadways.
- Sidewalks.
- Bike facilities.
- Pavement markings.
- Signs.
- Signals.

HOW TO TRACK

In some cases, agencies set a threshold for what qualifies as complete based on the context of the street (e.g., wider sidewalks in commercial areas or separated bike lanes in higher traffic conditions).

System completeness can be defined and measured in a variety of ways:

- Percent of roadway miles with complete sidewalks or bicycle facilities on both sides.
- Percent of planned pedestrian or bicycle network that is constructed.
- Percent of pedestrian or bicycle or roadway system that serves pedestrian and bicycle users ages 8 to 80.
- Percent of signalized intersections that have complete pedestrian and bicycle facilities, such as detection, push buttons or pedestrian-recall, striped crossings.
- Percent of sidewalk facilities accessible to users of all abilities.
- Percent of arterial and collector roadways with crossing opportunities every XX miles.

System completeness and inventory information can be reported as an aggregate measure (e.g., total miles of bike lanes) or stored in a GIS database.

PEERS TRACKING THE MEASURE

- Most agencies maintain an inventory of sidewalk, crosswalk, and/or bicycle lane infrastructure.
- A number of agencies, including the City of Oakland (California), the City of Boulder (Colorado), Montgomery County (Maryland), and Delaware DOT measure network connectivity using the Level of Traffic Stress method.[48] LTS is an effective measure for assessing the completeness of a network, particularly because it highlights all streets that are appropriate for the "interested but concerned" bicycling demographic. LTS also highlights areas of concern where the network is not complete and uncomfortable for less experienced bicyclists.

NOTES

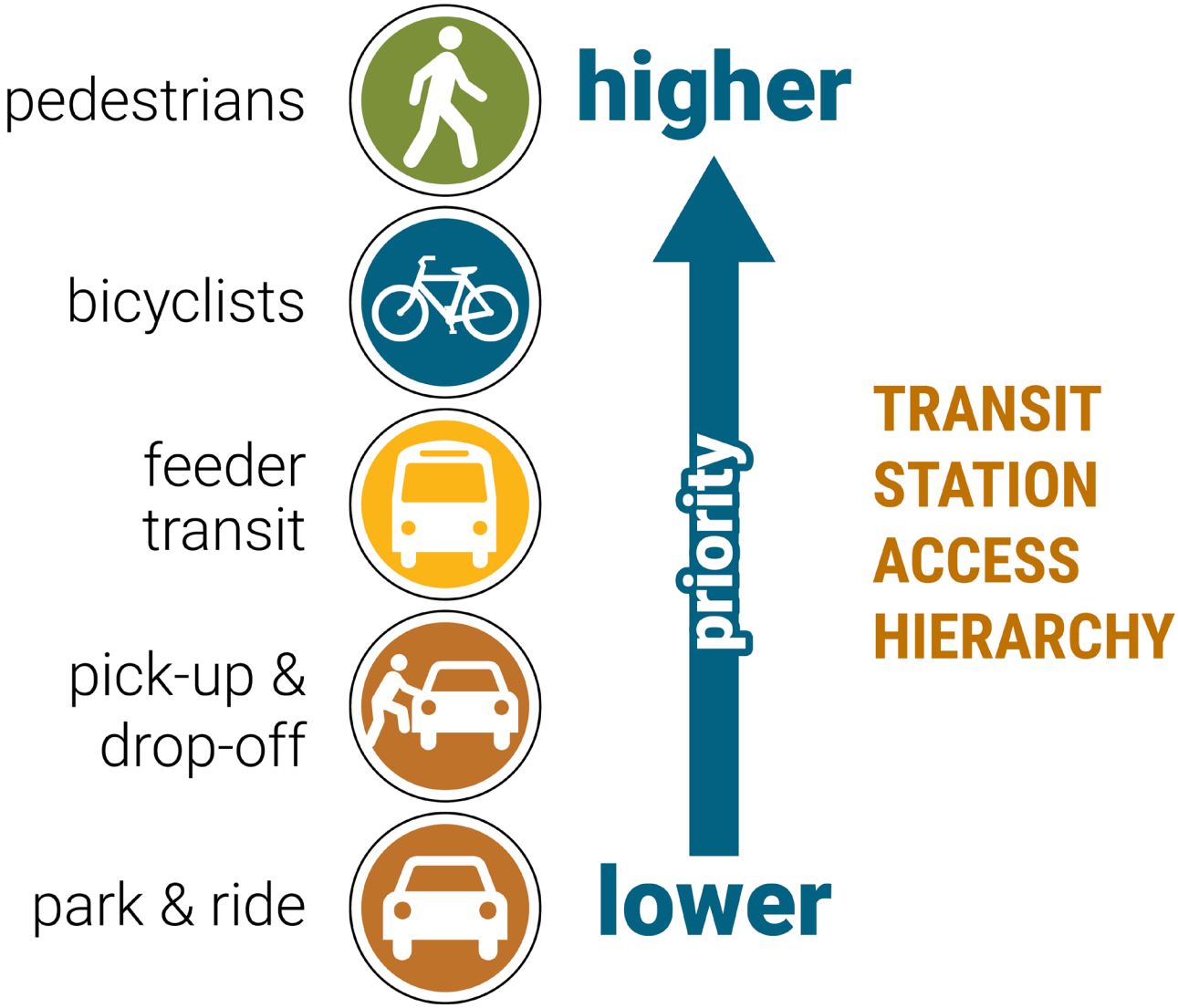
Completeness can be a subjective term and should be explicitly defined. For example, a minimum width of a sidewalk should be identified to qualify as part of a complete system.

Collecting inventory data can be time consuming and expensive, and some agencies lack documentation on pedestrian and bicycle infrastructure. With ever improving photographic inventories such as third party aerial photography and street-level photo inventories, agencies may be able to collect bulk information much more easily.

Network Completeness can be tied in with agencies' ADA Transition Plans, which require DOTs and other agencies to identify barriers to access for persons with disabilities.

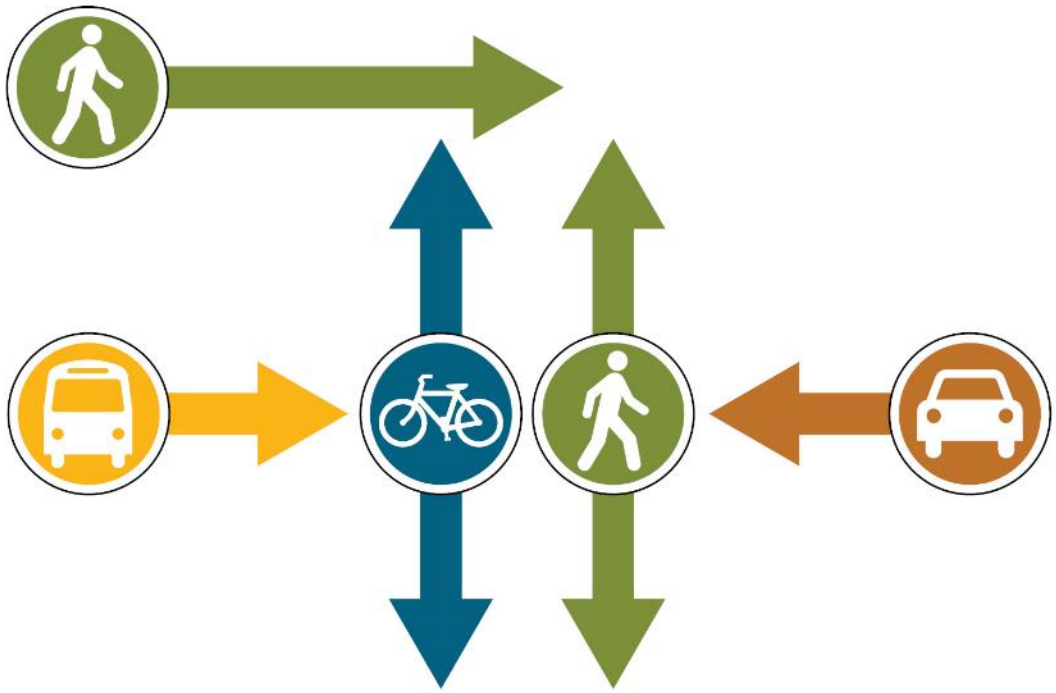
Access and Equity

Achieving Multimodal Networks:
Multimodal Access to Transit Stations



Achieving Multimodal Networks:
Multimodal Access to Transit Stations

Poor site planning at transit stations can contribute to crashes between various modes accessing the station.



Achieving Multimodal Networks:
Multimodal Access to Transit Stations

Design strategies:

- Street crossings
- Reduce crossing distances & curb radii
- Desire lines
  - Walk & bike shed analysis
  - Assessments

Achieving Multimodal Networks:
Case Study: MBTA Bicycle Parking, Boston, MA

- High-quality bicycle parking facilities at stations
- Station inventory
- Site-specific design treatments
  - Access
  - Circulation
  - Safety
  - Visibility
  - Number of spaces
- Pedal & Park facilities

Achieving Multimodal Networks:
Transit Conflicts

Bus Stop Placement

Considerations:

- Bus stop spacing
- Pedestrian & bike connectivity
- Placement at intersections

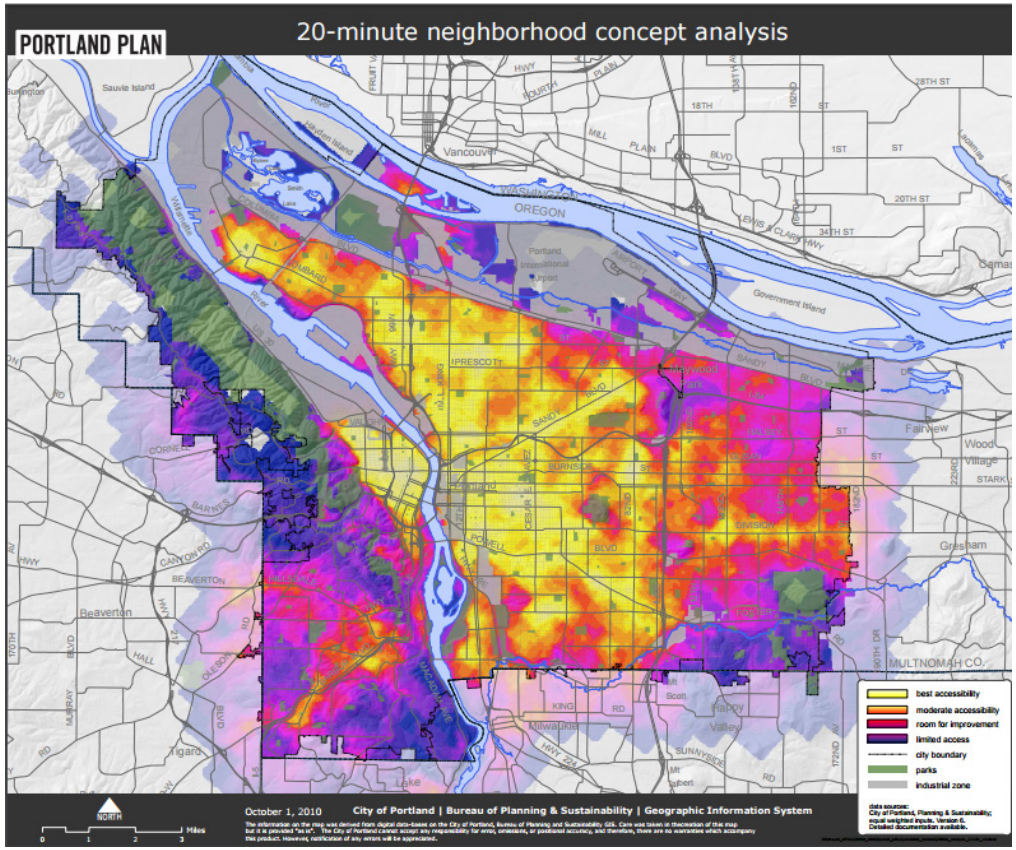
Performance Measure:
Access to Community Destinations

Definition

Measure of the proximity of pedestrian, bicycle, and transit infrastructure and services to origins and destinations (e.g., shopping, recreation, entertainment)

Application

- *Project Prioritization*
- *Alternatives Comparison*
- *Scenario Evaluation*
- *Benchmarking*



Performance Measure:
Access to Community Destinations

How to Track

Common access to destinations measures include:

- Proportion of destinations within walk/bike distance
- Proportion of comfortable infrastructure within walk/bike distance
- Percent of network complete within walk/bike distance
- Number of destinations accessible within walk/bike distance

DATA NEEDS & SOURCES

- Local parcel data.
- GIS data on schools, parks, healthcare centers, and other daily destinations.
- NAICS coded employment data, available from the U.S. Bureau of Labor Statistics.
- GIS data on transportation network for all modes.
- Optional: Demographic data from the U.S. Census Bureau.

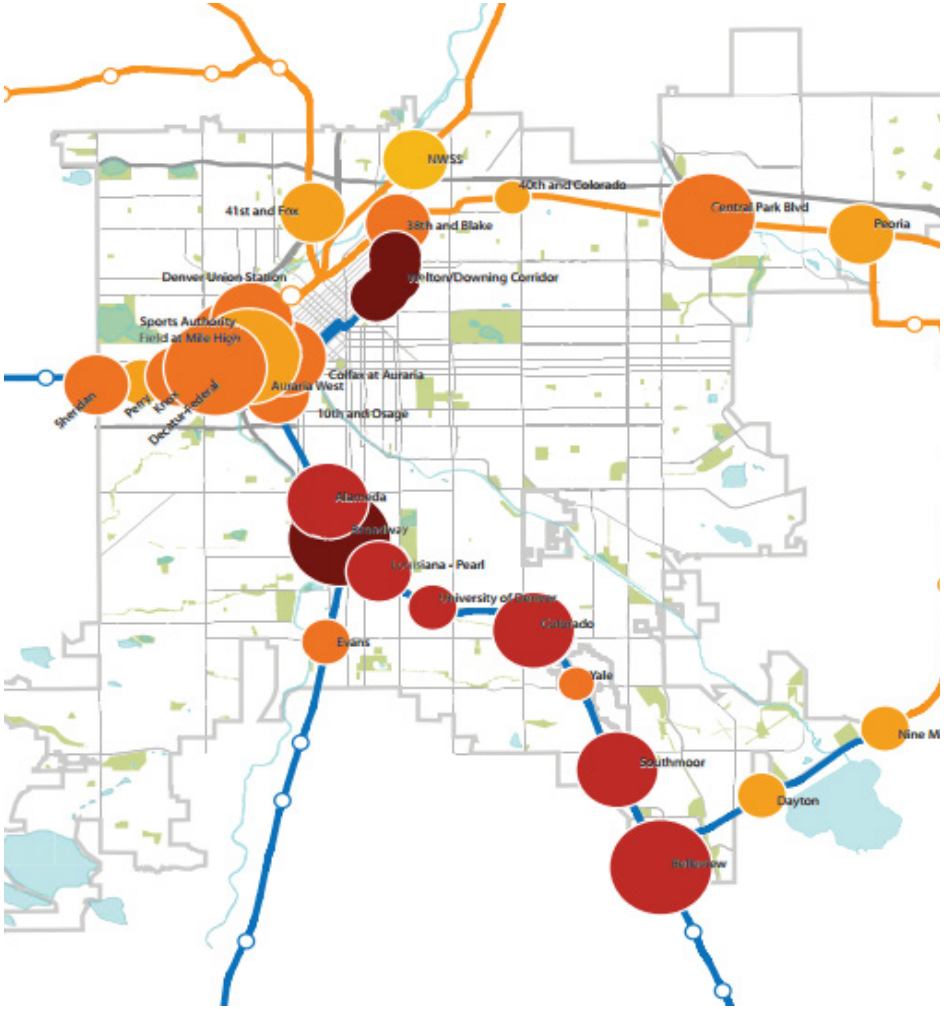
Performance Measure:
Population Served by Walk/Bike/Transit

Definition

The proximity of pedestrian, bicycle, and transit infrastructure and services (e.g., travel time, distance) to residential populations.

Application

- *Project Prioritization*
- *Alternatives Comparison*
- *Scenario Evaluation*
- *Benchmarking*
- *Standard*



Performance Measure:
Population Served by Walk/Bike/Transit

How to Track

Common methods to evaluate access to walk/bike/transit facilities include:

- Percent of population within ½-mile walk or 2-mile bike to transit station
- Percent of population within ¼-mile distance to sidewalk, trail, or bike facility
- Percent of transit stops that are accessible

DATA NEEDS & SOURCES

- U.S. Census demographic data.
- GIS transportation network for all modes.

Performance Measure:
Transportation-Disadvantaged Population Served

Definition

The proportion of low income, minority, senior, and disabled populations with access to pedestrian, bicycle, and transit infrastructure and services.

Application

- *Project Prioritization*
- *Alternatives Comparison*
- *Scenario Evaluation*
- *Benchmarking*
- *Standard*

THE FIVE E'S FRAMEWORK

Improving bicycle and pedestrian connectivity and safety is a significant component of the Plan, but creating a Bike and Walk Friendly Community takes more than just new trails, bike lanes and sidewalks. In order to create significant and lasting change, the Plan utilizes the Five E's framework to establish bicycling and walking as comfortable, safe and convenient transportation choices for people of all ages and abilities. Initially developed by the League of American Bicyclists, the Five E's framework consists of education, encouragement, enforcement, engineering and evaluation tactics to support active transportation. This unique, holistic approach to community transformation addresses the physical, social, and policy environments that influence transportation decisions and behaviors, creating meaningful opportunities to build a culture that values and supports walking and bicycling.

An additional E - equity - is often grouped with the Five E's to address access and opportunity for disadvantaged and low income populations within the community. There is, however, an important distinction between equity and the Five E's: equity is a guiding principle and desired outcome, whereas the Five E's are tools used to achieve the vision and goals of the Plan. The graphic below shows how equity is incorporated into the planning framework as an overarching principle that guides planning process and is integrated into all plan recommendations.

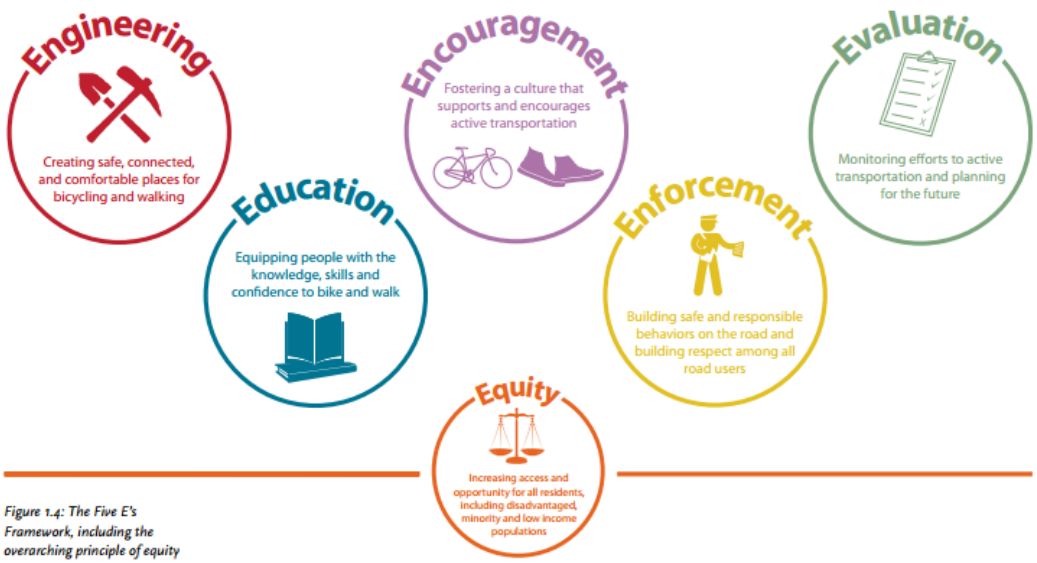


Figure 1.4: The Five E's Framework, including the overarching principle of equity

Performance Measure:
Transportation-Disadvantaged Population Served

How to Track

Evaluate the transportation system effectiveness in providing access to sidewalks, bicycle facilities, and transit stops for transportation-disadvantaged populations.

- Proportion of destinations within walk/bike distance
- Proportion of comfortable infrastructure within walk/bike distance
- Percent of network complete within walk/bike distance
- Number of destinations accessible within walk/bike distance

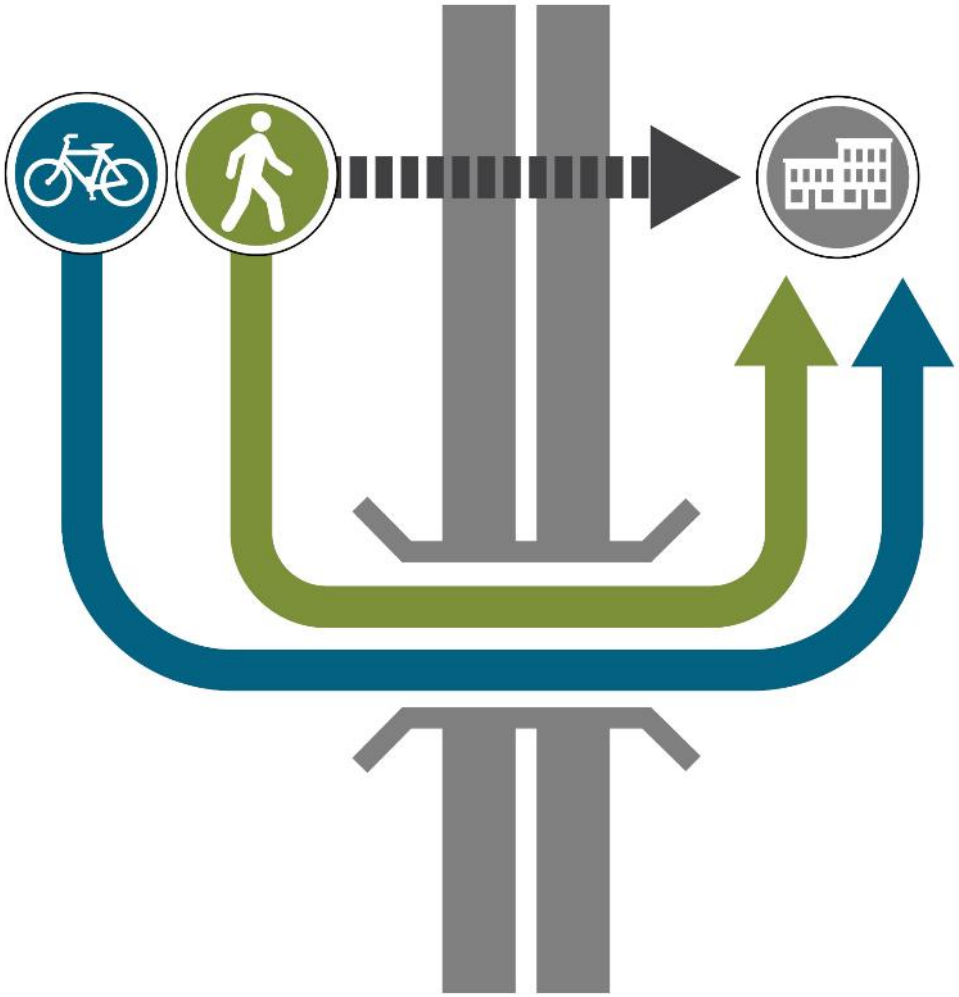
DATA NEEDS & SOURCES

- U.S. Census demographic data, including income, levels of poverty, zero-car households, seniors, children.
- GIS transportation network for all modes, including existing and proposed pedestrian and bicycle infrastructure. This data is usually found in local GIS Clearinghouses and/or from relevant local, regional, and State agencies.

Physical Characteristics

Achieving Multimodal Networks:
Network Connectivity

A well-connected network of pedestrian and bicycle facilities reduces conflicts by providing access where desired.



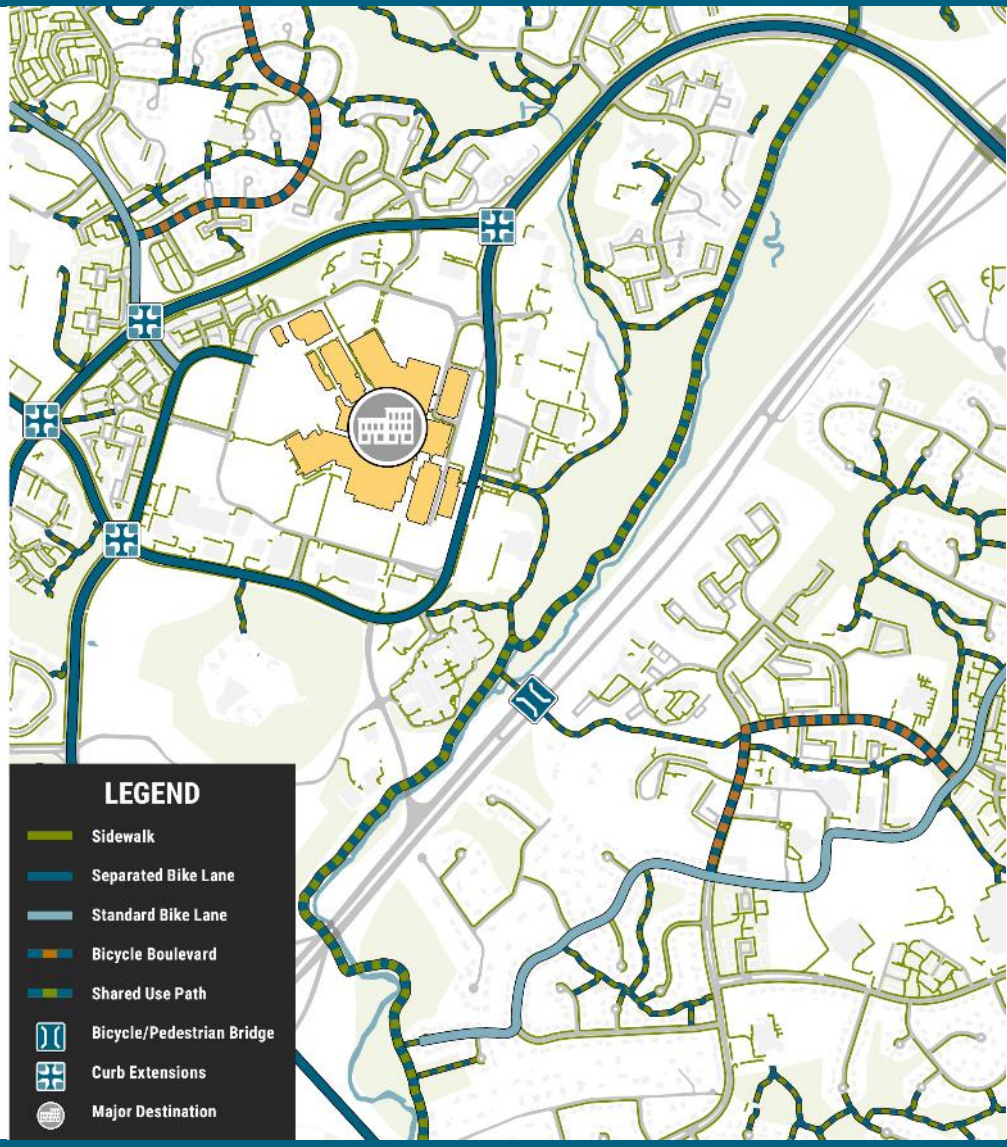
Achieving Multimodal Networks:
Network Connectivity

Network challenges:

- Disconnected street networks
- Barriers

Considerations:

- Pedestrian facilities
- Bicycles facilities
- Shared use paths



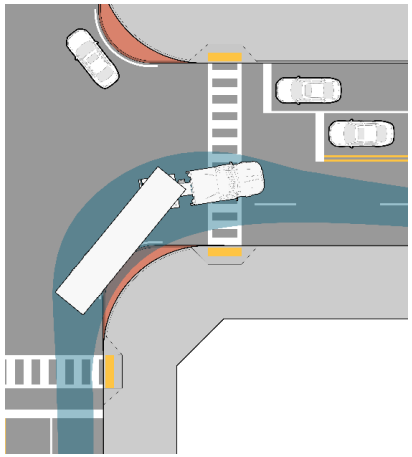
Achieving Multimodal Networks:
Intersection Geometry

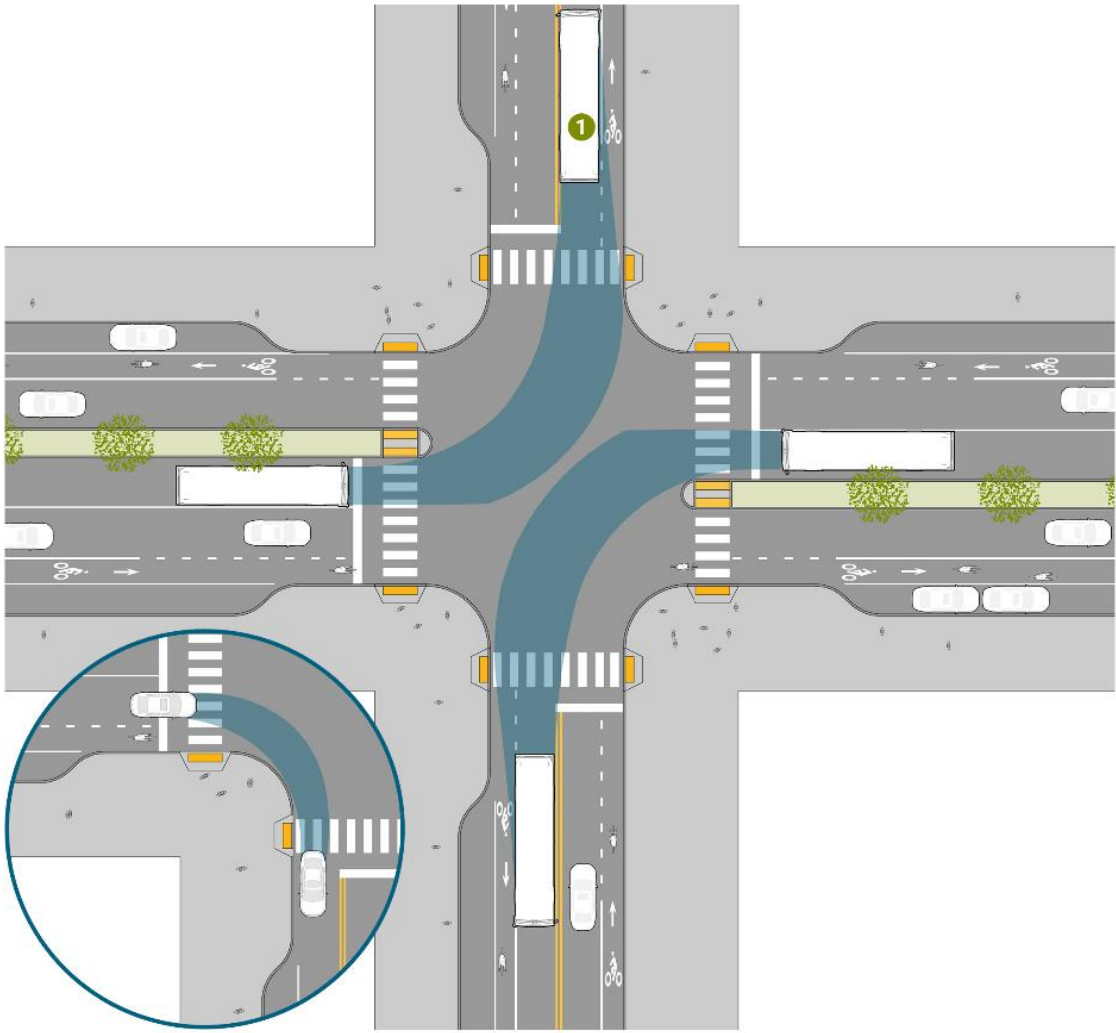
"If turning traffic is nearly all passenger vehicles, it may not be cost-effective or pedestrian friendly to design for large trucks. However, the design should allow for an occasional large truck to turn by swinging wide and encroaching on other traffic lanes without disrupting traffic significantly."

AASHTO Green Book 2011, p. 9-80

Achieving Multimodal Networks:
Intersection Geometry

- Layout
- Curb radii
- Curb extension
- Design vehicle
- Truck aprons





Achieving Multimodal Networks:
Bridge Design

"Integrating bicycle and pedestrian accommodation on new, rehabilitated, and limited-access bridges: DOT encourages bicycle and pedestrian accommodation on bridge projects including facilities on limited-access bridges with connections to streets or paths."

U.S. DOT Policy Statement on Bicycle and Pedestrian Accommodation Regulations and Recommendations 2010

Achieving Multimodal Networks:
Case Study: Truck Aprons, Burlington County, NJ

- Two-way stop control replaced with modern roundabout
- Maintains desired entering car speed
- Accommodates tractor trailers (WB-67)
- Mountable curb with minimum 3" reveal
- Stamped red concrete

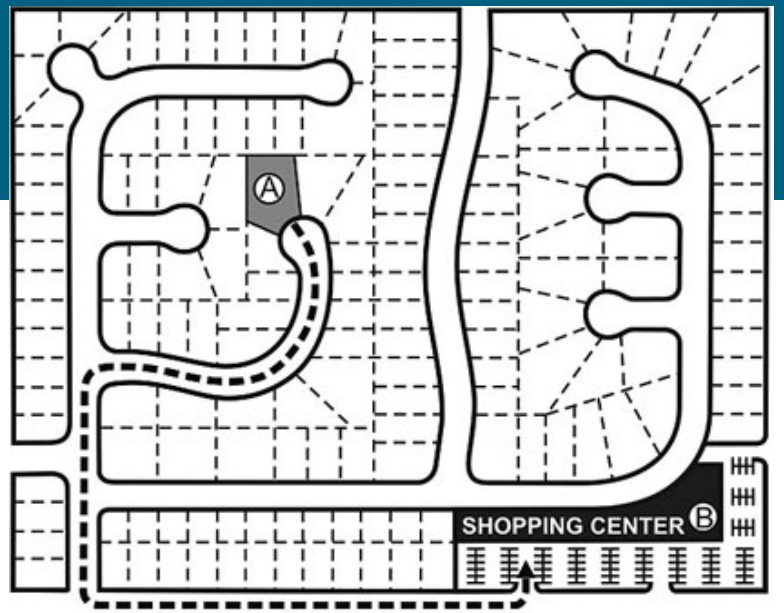
Performance Measure:
Connectivity Index

Definition

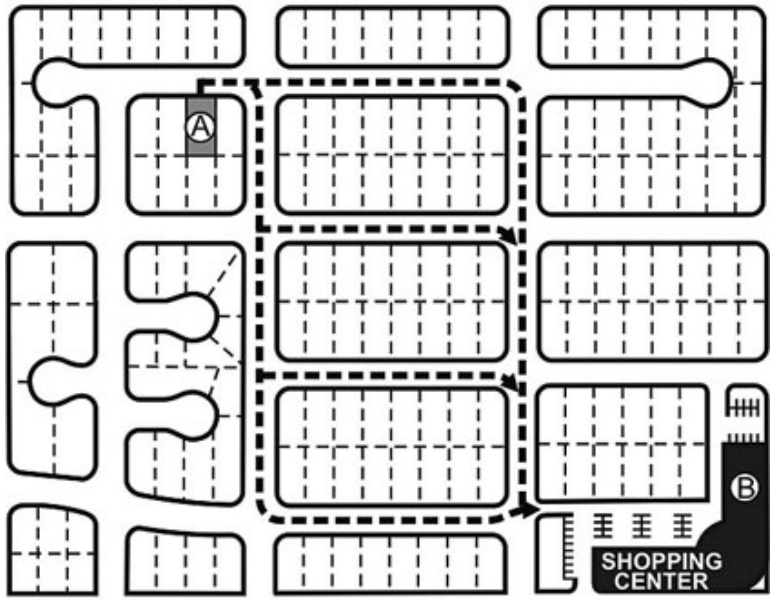
Connectivity is a representation of the number and directness of travel routes and options available to a user, while a connectivity index represents a number of specific measures used to assess walking and biking connectivity in a specific area

Application

- *Project Prioritization*
- *Alternatives Comparison*
- *Scenario Evaluation*
- *Benchmarking*
- *Standard*



(A) Conventional suburban hierarchical network.



Source: ITE

(B) Traditional urban connected network.

Performance Measure:
Connectivity Index

How to Track

A variety of metrics can be used as connectivity indices:

- Intersection Density
- Intersections per Linear Mile
- Network Density
- Connected Node Ratio
- Link-to-Node Ratio
- Polygon Density

DATA NEEDS & SOURCES

- GIS transportation networks for each mode to be evaluated are needed to apply a connectivity index measure to an area larger than a few blocks.
- Aerial imagery or static maps can be used to manually calculate connectivity for small areas.
- Long range plans.
- STIP/TIPs.

Performance Measure: Network Completeness

Definition

The portion of the transportation network that is usable for people walking or bicycling, and represents the minimum accommodations needed for a facility to be considered part of the walking or bicycling network

Application

- *Project Prioritization*
- *Scenario Evaluation*
- *Benchmarking*
- *Standard*

Performance Measure: Network Completeness

How to Track

Some of the common measures are % of:

- Roadway miles with complete facilities
- Planned network that is constructed
- Signalized intersections that have complete facilities
- Sidewalk facilities accessible to users of all abilities
- Bus stops with accessible boarding and alighting areas

DATA NEEDS & SOURCES

Inventory data for:

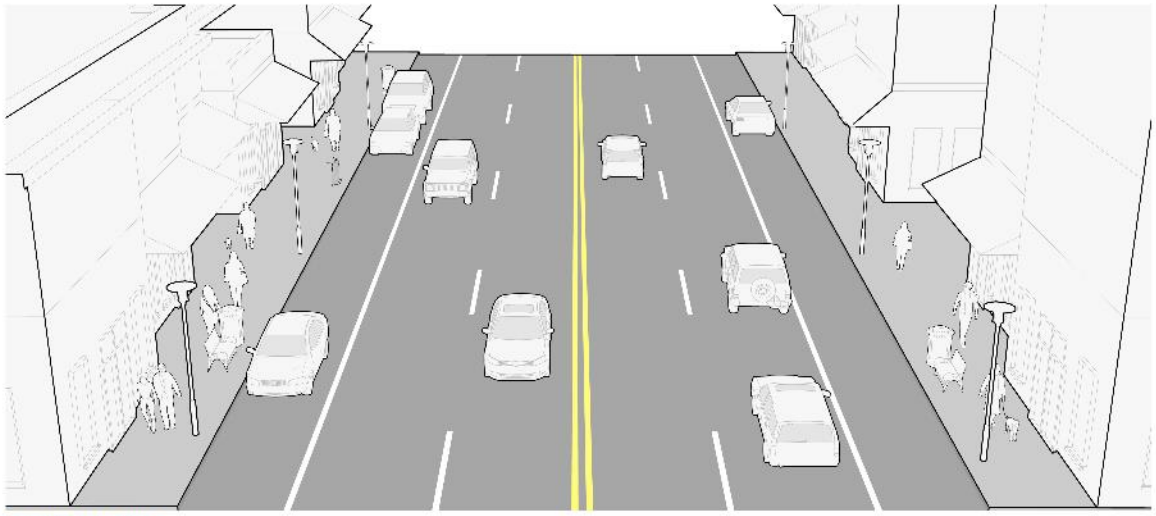
- Roadways.
- Sidewalks.
- Bike facilities.
- Pavement markings.
- Signs.
- Signals.

Safety and Behavior

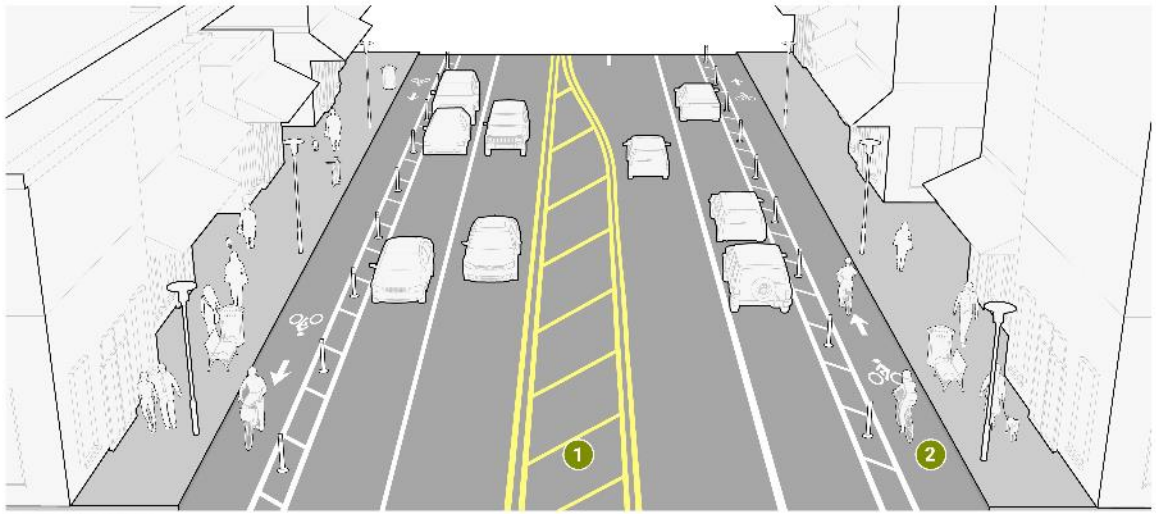
Achieving Multimodal Networks:
Road Diets and Traffic Analysis

Safety benefits

- Crash reduction
- Reduced pedestrian crossing distance
- Space for standard or separated bike lanes



BEFORE ROAD DIET



AFTER ROAD DIET

Achieving Multimodal Networks:
Road Diets and Traffic Analysis

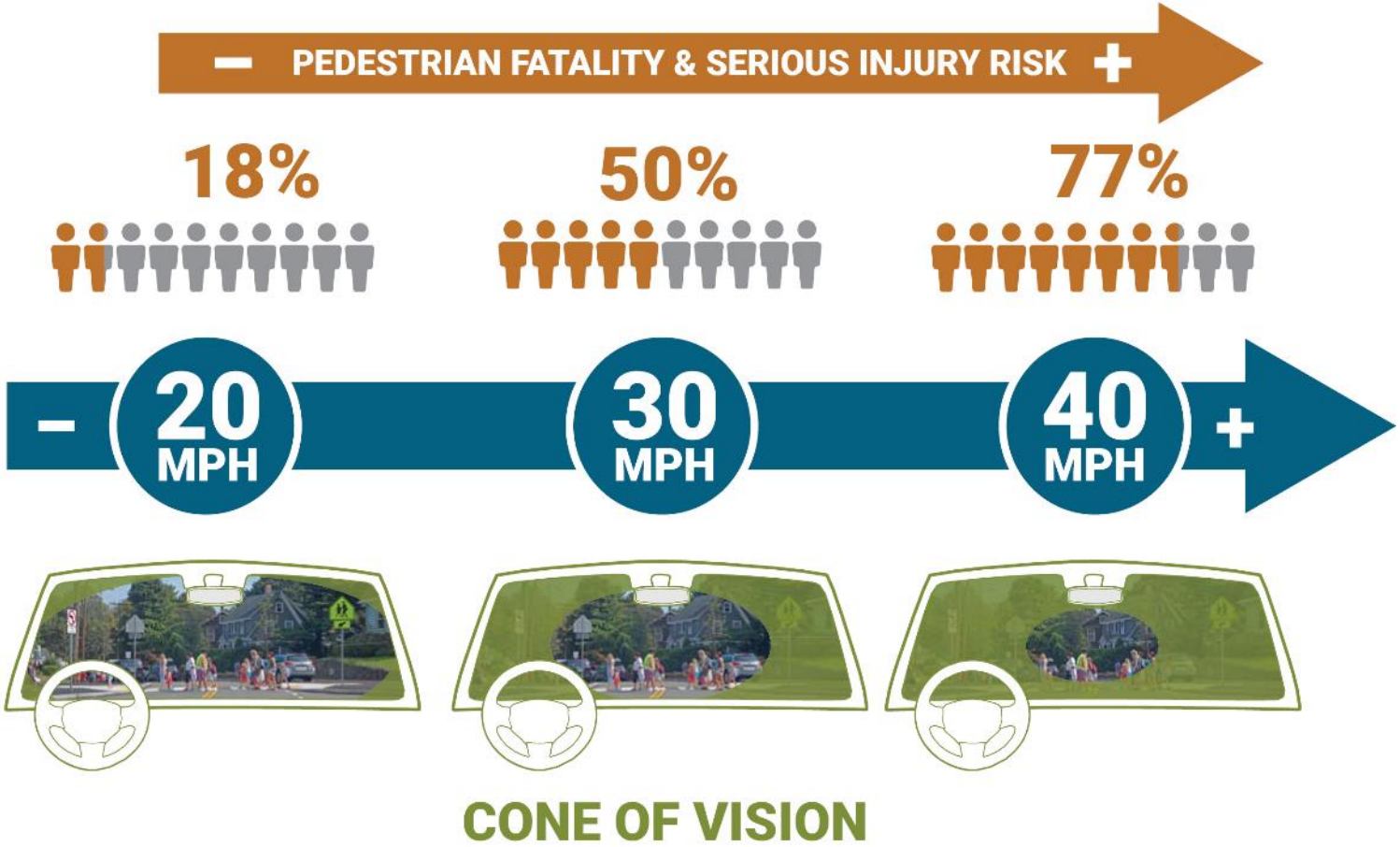
"Analysts and decision-makers should always be mindful that neither LOS [Level of Service] or any other single performance measure tells the full story of roadway performance."

TRB Highway Capacity Manual 2010, p. 8-11

"As always, engineering judgment should be applied to any recommendations resulting from HCM (or alternative tool) analyses."

TRB Highway Capacity Manual 2010, p. 8-20

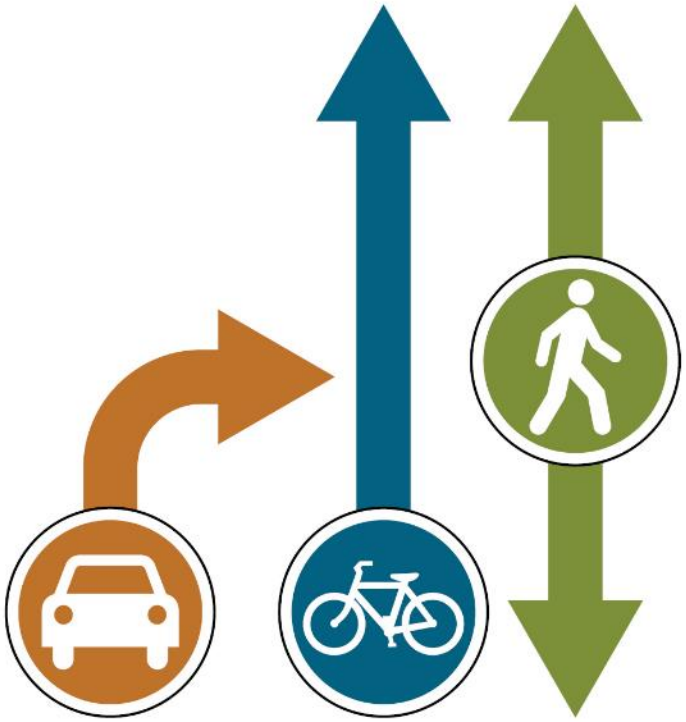
Achieving Multimodal Networks:
Design Speed



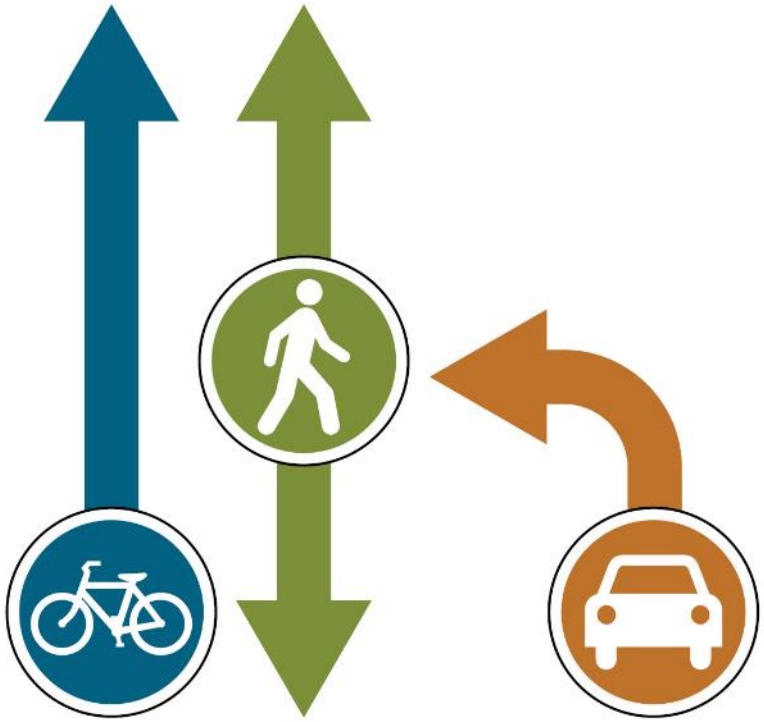
"The severity of pedestrian crashes, a significant concern in urban areas, is greatly increased as speeds increase."

AASHTO Flexibility Guide 2004, p. 19

Achieving Multimodal Networks:
Turning Vehicles



Right-turning vehicles crossing through bicyclists or pedestrians is known as a "right hook" crash

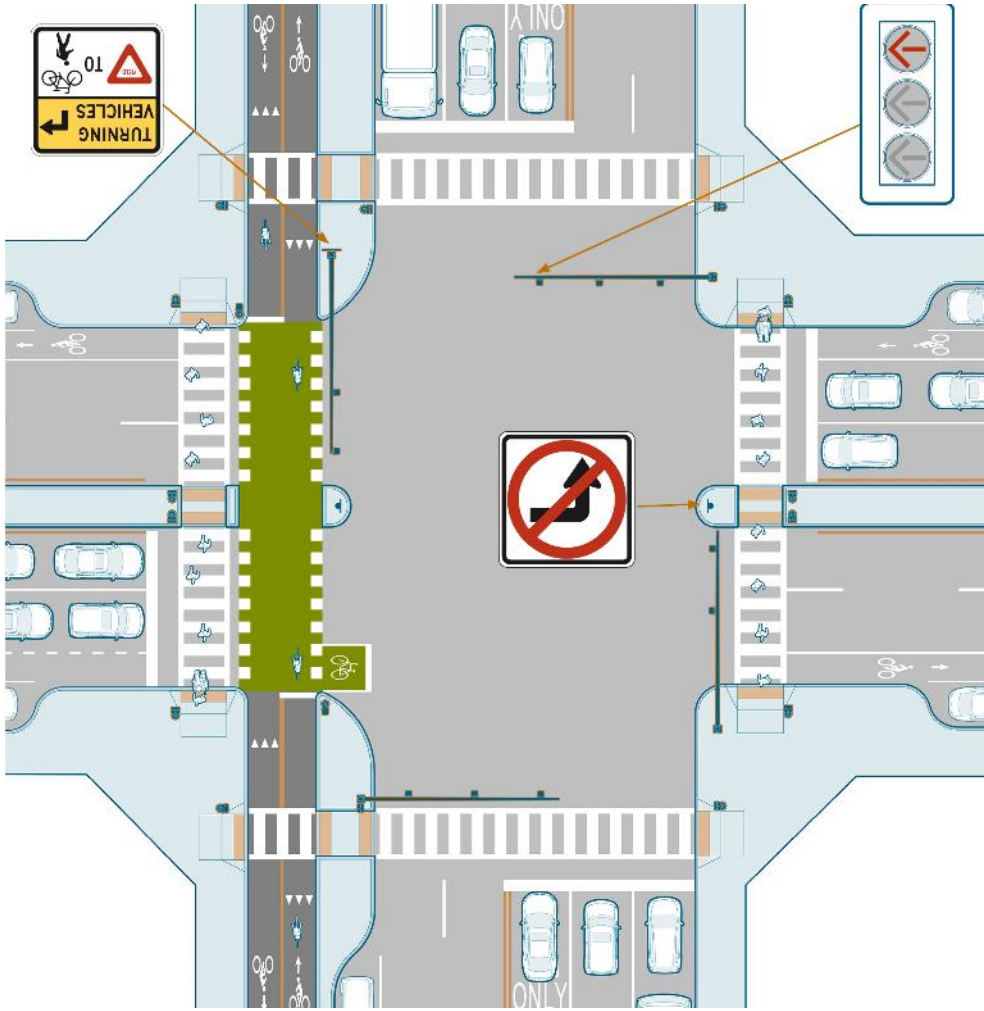


"Left hooks" are similar, where left-turning vehicles come into conflict with opposing traffic traveling straight

Achieving Multimodal Networks:
Turning Vehicles

Design strategies:

- Signalized intersections
- Crossings
- Pavement markings
- Separated bike lanes
- Signs
- Intersection geometry



Achieving Multimodal Networks:
Case Study: Lawyers Road, Reston, VA

- Two mile Road Diet
- 4-lane roadway reduced to one travel lane each direction, continuous center turn lane
- Added 5 ft bike lanes in each direction
- Travel speeds over 50 mi/h fell from 13 to 1 percent of daily traffic

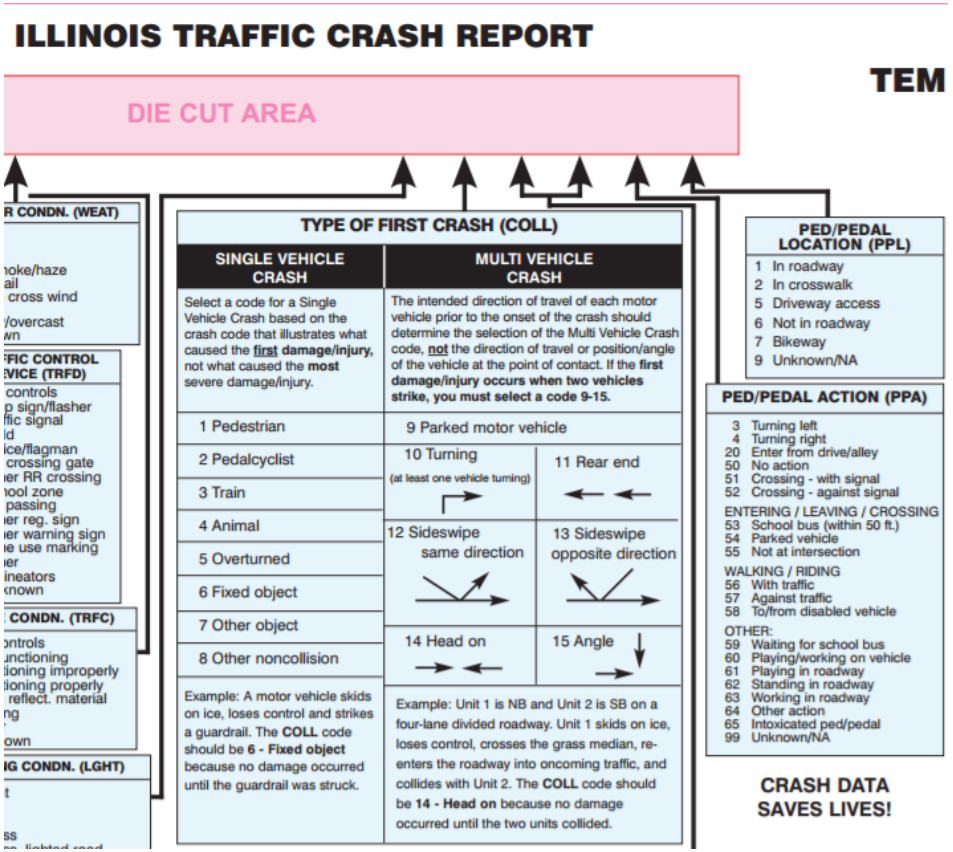
Performance Measure:
Crashes

Definition

The measured number of crashes or rate of crashes over a period of time, typically separated into modes and severity

Application

- *Project Prioritization*
- *Alternatives Comparison*
- *Benchmarking*



Performance Measure:
Crashes

How to Track

Some of the common measures are:

- Number of bicycle-involved and/or pedestrian-involved crashes over 5 years.
- Number of fatal or serious injuries of bicyclists and/or pedestrians over 5 years.
- Crashes per volume of bicyclists and/or pedestrians over 5 years (crash rates).

DATA NEEDS & SOURCES

- Local or State crash report database.
- State reported data.
- Fatality Analysis Reporting System (*FARS*).
- Potentially: emergency room visit data.
- Pedestrian and bicycle counts (volumes).
- Demographic information.
- Facility inventories.
- *Highway Safety Improvement Program Online Reporting Tool.*
- Highway Performance Monitoring System (HPMS).
- State Highway Safety Plan (HSP) and the State Strategic Highway Safety Plan (SHSP).

Questions?

- **Archive at www.pedbikeinfo.org/webinars**
  Download a video recording and presentation slides
- **Questions?**
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Coming Soon!

- Provides a bridge between existing guidance on bicycle and pedestrian design and rural practice.
- Encourages innovation in development of safe and appealing networks for bicycling and walking in small towns and rural areas.
- Provide examples of peer communities and project implementation that is appropriate for rural communities.