Creating Walkable & Bikeable Communities

U.S. Department of Housing and Urban Development

U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT

PD&R

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1.1 PROJECT INTRODUCTION: STUDY OVERVIEW

Guidance for creating walkable and bikeable communities has increased dramatically over the past several years. A growing list of resources identify the current best practices for increasing walking, cycling, universal access, complete streets, "first mile, last mile" solutions, and sustainable urban design. This document builds on these previous efforts but with a focus on the critical need for integrated planning. The document aims to—

- Emphasize the importance of integrating land use, street design, and transportation strategies.
- Focus on small to mid-size communities with low to moderate income (LMI).
- Suggest innovative and exploratory ideas rather than restate regulatory statutes.
- Increase the accessibility of these concepts to a wider range of potential users.
- Provide the language needed to engage in dialogue and effect change to improve walkability and bikeability.

HUD recognizes the synergy and the link between land uses and transportation systems. This document tries to strengthen the link between land use planning, street design, and active transportation (cycling and walking). The feasibility of walking and cycling is as much determined by the presence of bike and pedestrian facilities as it is about the proximity of critical destinations to where people live.

The goal of this document is to explore walkable, bikeable options and to provide technical assistance, especially for rural, suburban, and smaller urban cities and communities. Many of these smaller communities cannot afford to keep planning staff up to date with recent innovations in active transportation. In small communities, elected officials have often not been exposed to innovative and evolving planning choices that may now be possible and desirable to implement. This document is designed to provide the tools, techniques, and samples for community leaders, elected officials, and interested persons to learn more how bike and pedestrian facilities might be considered in their communities.

This document is intended to serve as a source of discussion for comprehensive land use, pedestrian, and bicycle planning. It is not intended as a guideline or regulatory source on how to build streets and support transportation options. Many other documents and guidelines are available for those purposes. The Department of Transportation, through various administrative branches such as the Federal Highway Administration (FHWA) and the Federal Transit Administration (FTA), is responsible for providing guidance on how to build transportation networks.

The users of this document are reminded to seek and utilize current standards and regulations that exist at federal, state, regional, and local levels on how to implement these changes. The "how" should be the ending point of the conversation, however. It needs to start with the "what, where, and why" first. This document provides the "why" we should build communities in an integrated and sustainable way. Integrated transportation results from understanding land use relationships, scales of urban form, and the interface between the street and the living environment. This document also helps explain "what" changes are possible and "where" they should be considered.

1.1.1 Community Form and Transportation Function

The evolution of community form has been tied to transportation for many centuries. Human activity requires movement. The extent of movement is determined by the transportation choice. Walking is perhaps the most basic of transportation modes. Travel by walking has been the primary mode for most of humanity. Our villages and towns evolved out of the unique human scale related to walking distance. Horses, wagons, trains, bikes, motorcycles, buses, trolleys, streetcars, subways, and airplanes each have changed the scale and the resulting form of our communities. The scale of walking has been replaced by the scale of each successive mode of transportation.

At first, our increased mobility extended the functional aspects of our communities and allowed for wider travel and expanded opportunities. When we started building our communities around the scale of the personal automobile, our ability to walk or to take short trips or to travel by way of public transit was decreased. The way we built communities changed dramatically as well. Trails, walks, and roads that were once scaled to neighborhoods and communities soon became scaled to freeways, major arterials, and hierarchical collector streets. The pattern of streets tended to focus on connecting remote bedroom communities, regional retail malls, and metropolitan job centers. Today we find that walking, cycling, and taking transit have been made more difficult due to the changed scales of our communities.

Although increased mobility has enriched life experiences and made travel choice a personal freedom, it has come with some expense. Trips became longer, congestion higher, and the percentage of our income and time dedicated to mobility steadily increased. Transportation based mostly on private automobile travel is considered by many to be unsustainable in terms of air quality, energy resources, safety, and human health. Although our mobility has set us free, it has also shackled us to a way of life that not all enjoy. This document is not demanding that all persons change from their auto-centric lifestyles, however. It just notes that most all of us will benefit from some changes in our mobility options, and for those that wish to become less dependent upon all trips being by automobile, our own personal health, safety, and welfare will be greatly improved as well.

It does not require large investments to make communities more walkable as long as they are scaled to human walking distances and take into account safety and pedestrian comforts. Photo Source: Mike Singleton

1.1.2 The Scale of Needed Changes

Realistically, we should not expect nor suggest large changes in our transportation systems. Our transportation economy and personal behaviors will not support wholesale changes. Our land use patterns and auto-centric roadway systems cannot be changed in short periods of time. Small, incremental changes that help "evolve" communities back to human-scaled neighborhoods are possible, however. Large changes do not need to occur everywhere, but they should change in areas that we consider "smart growth"—town centers, main streets, and urban infill locations. They should change in our local neighborhoods to support healthier lifestyles. They should change where we have invested in public transportation, and they should change in areas where economic conditions have been harsh for many and where affordable housing should be coupled with affordable transportation.

When changes occur, they get noticed by people who are interested in connected and compact communities and "car-light" lifestyles. Projects that get noticed are essential for creating momentum and acceptance in other areas. The amount of change needed to start momentum is not that great. Certain parts of our communities need to be changed or enhanced to provide options for short-distance trip and use of transit systems. Where connected communities exist in the United States, they have attracted people interested in a transportation system that is not so reliant on regional movement and automobile travel. These options are already causing a shift in attitude and have helped to institutionalize the tools of change. This document discusses these tools in greater detail and suggests how they may make our communities more walkable and bikeable.

1.1.3 Affordable Transportation Focus

For residents with limited means, too often savings gained from achieving affordable housing are then spent on auto-based transportation. For many, job opportunities and affordable housing have often been located on opposite ends of a community. This is why, for instance, up to 30 percent of Community Development Block Grant (CDBG) funds and 50 percent of Entitlement CDBG funds are used for transportation infrastructure. Because communities are currently using a large proportion of their CDBG funds on infrastructure investments, HUD wants to make sure to provide resources for community leaders to better understand aspects of infrastructure—including the investments required to create more walkable and bikeable communities. Compact, efficient infill development, mixed land uses, and an emphasis on walking or cycling for transportation can contribute to major savings in infrastructure costs as well as personal transportation costs.

There is increasing evidence that providing places to walk and bicycle are successful strategies for improving the economic vitality and public health of a community. Walking is the number one physical activity of choice for most people,[1] and cycling represents an increasingly important mobility option as well as an effective form of exercise.[2] Sprawling development patterns with segregated land uses and a lack of safe, accessible pedestrian and bicycle networks act as barriers to achieving the benefits from these transportation options. The lack of transportation options often is felt more keenly in smaller and medium size cities, in communities with limited financial resources, and among low- and moderate-income households. The costs for individuals to drive are somewhat constant, no matter what the economic level of the driver. When fixed transportation costs are compared proportionally to the income of the drivers, the percentage of one's income being used for transportation becomes much higher to those with limited means. As often is the case, persons of limited means have less choice of where they live and work, which creates an additional burden on their personal budgets.

In the words of the Surface Transportation Policy Partnership, "This frustrates the very purpose of housing assistance programs, which is to lower the overall cost of living to low-income families."[3] An individual may realize savings on a month-to-month basis resulting from affordable housing; however, the monthly savings can be wiped out very quickly if transportation distances and modes are the only choices. To make matters worse, what could have resulted in local reinvestment of personal transportation savings now becomes exported out of the community, the region, and potentially the country. Small or medium-size communities (with fewer than 200,000 residents) often lack guidance or resources that can help them plan for, design, or implement more walkable or bikeable communities. HUD has created this document to help smaller communities create walkable and bicycle-friendly environments.

Many communities developed around the scale of the pedestrian. Photo source: Mike Singleton

1.2 DOCUMENT FOCUS:
TARGET USERS

The study is focused primarily on information for persons who are not expert in the fields of land use and town planning. This document has identified 10 different groups that may be interested in incorporating pedestrian- and bicycle-friendly elements into their communities. These start with grassroots-level organizations, such as—

1-Housing advocates.

2-Health and safety advocates.

3-Smart-growth advocates.

4-Advocates for mobility choices.

The mid-level users of this study are the entities that provide or build facilities, including—

5-Developers and financial institutions.

6-Housing providers or institutions.

7-Consultants such as architects, planners, landscape architects, and engineers.

The high-level users of the document are considered to be the decision makers, including—

8-Agency staff supporting local officials.

9-Local elected officials.

10-Federal, state, and regional regulators.

Finally, this document is intended to provide tools to allow advocates and professionals to better understand the mixture of tools needed to create a functioning community that incorporates elements that support increased use of walking and cycling. To ensure public safety and consistency in the environments we travel through, changes must follow rules. Innovative approaches may help to evolve rules, however, so that improvements in public health, safety, and welfare can be the top priority. Regulations need to evolve, and momentum from innovation helps this evolution.

1.3 USER DIRECTIONS:
HOW TO USE THIS DOCUMENT

This document can be used for many different purposes. Tools for finding specific items of interest include five quick reference methods.

Use the key at the beginning of each chapter as a guide based on the user type that matches your interests.

Use the tables in chapters 4, 5, 6, and 7 to find the best tools for your community. These tables point out the best practices for different community typologies and locations.

Look at the effectiveness points in these overview tables to determine what tool will return the best results for your situation.

At the end of each chapter is section titled "Ideas: Project Scaled Tips" to help provide quick methods for getting something done in your community.

Utilize the assessment tools in appendix A to evaluate your community's current walkable and bikeable ranking, and then utilize the tools in the appendixes to help increase the walkability and bikeability of your town.

1.4 KEY REFERENCES: FOUNDATIONAL DOCUMENTS

This publication should be used in conjunction with other resources for promoting more walkable and bikeable communities. This publication is a summary of existing tools, techniques, and standards that are used by state and local transportation officials, engineers, and planners. The foundational documents listed in the following sections should be used to supplement this publication, and all plans should be compared against these references for compliance to national standards.

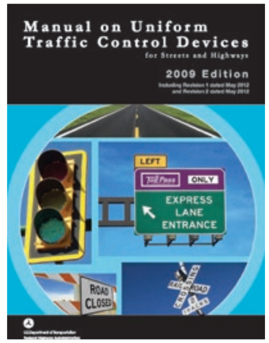
1.4.1 U.S. Dept. of Transportation (DOT)

The U.S. Department of Transportation (DOT) has made significant progress in updating guidelines for both bike and pedestrian facilities. These standards have also been integrated into other roadway and highway design standards. The official DOT policy is "to incorporate safe and convenient walking and cycling facilities into transportation projects. Every transportation agency, including DOT, has the responsibility to improve conditions and opportunities for walking and cycling and to integrate walking and cycling into their transportation systems. Because of the numerous individual and community benefits that walking and cycling provide—including health, safety, environmental, transportation, and quality of life—transportation agencies are encouraged to go beyond minimum standards to provide safe and convenient facilities for these modes."[4]

Since launching the Safer People, Safer Streets Initiative in 2014, DOT has engaged safety experts, stakeholders, local officials, and the public on a range of strategies to encourage safety for bicyclists and pedestrians on and around our streets, including transit stops.

Manual on Uniform Traffic Control Devices (2012)

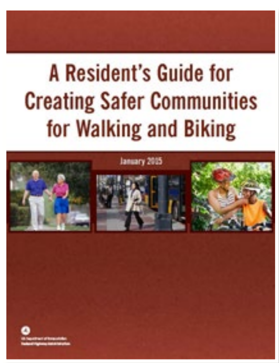
The MUTCD defines the standards used by road managers nationwide to install and maintain traffic control devices on all public streets, highways, bikeways, and private roads open to public travel. The MUTCD is published by the FHWA under 23 Code of Federal Regulations (CFR), Part 655, Subpart F. The most recent version is the 2009 Edition with Revisions 1 and 2, completed in 2012.



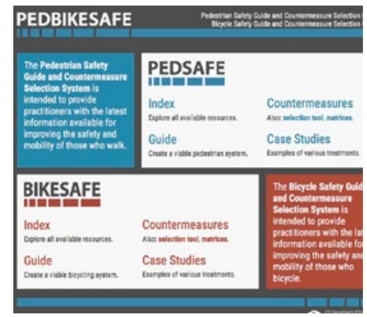
The MUTCD, which has been administered by the FHWA since 1971, is a compilation of national standards for all traffic control devices, including road markings, highway signs, and traffic signals. It is updated periodically to accommodate the nation's changing transportation needs and to address new safety technologies, traffic control tools, and traffic management techniques.

A Resident's Guide for Creating Safer Communities for Walking and Biking (2015)

This guide is intended to assist residents, parents, community association members, and others in getting involved in making communities safer for pedestrians and bicyclists. The guide includes facts, ideas, and resources to help residents learn about traffic problems that affect pedestrians and bicyclists and to find ways to help address these problems and promote safety among all road users. The guide includes information on identifying problems, taking action to address pedestrian and bicycle concerns, finding solutions to improve safety, and accessing resources to get additional information.



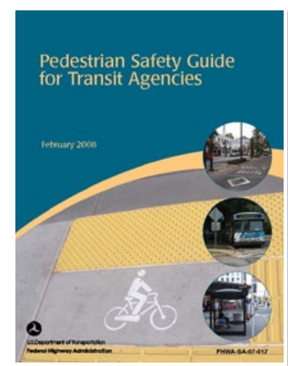
Bike/Pedestrian Safety Guide & Countermeasure Selection System *(http://www.pedbikesafe.org/)*



The Pedestrian Safety Guide and Countermeasure Selection System is intended to provide practitioners with the latest information available for improving the safety and mobility of those who walk. The on-line tools provide the user with a list of possible engineering, education, or enforcement treatments to improve pedestrian safety, and/or mobility based on user input about a specific location.

Pedestrian Safety Guide for Transit Agencies (2008)

The guide is intended to provide transit agency staff with an easy-to-use resource for improving pedestrian safety. The guide includes a variety of approaches to address common pedestrian safety issues that are likely to arise near transit stations and bus stops. It provides references to publications, guides, and other tools to identify pedestrian safety problems.



Separated Bike Lane Planning and Design Guide (2015)

The guide outlines planning considerations for separated bike lanes (often called cycle-tracks or protected bike lanes). It highlights different options for providing separation, including intersection design. It captures the current state of practice learned from examples across the United States.

Pedestrian and Bicycle Information Center *(http://www.pedbikeinfo.org)*

Since its inception in 1999, the Pedestrian and Bicycle Information Center's mission has been to improve the quality of life in communities through the increase of safe walking and cycling as a viable means of transportation and physical activity. The PBIC is operated for FHWA and is based on FHWA funds. To support this mission, the PBIC—

- Develops, synthesizes, promotes, and distributes accurate and current cycling and walking information.
- Provides expert technical assistance to various audiences to ensure that citizens and professionals have access to the best available information.
- Generates a network of informed individuals and organizations that can increase the exposure of pedestrian and bike issues to the general public.

FHWA Research List of On-line Reports and Technical Publications *(http://www.fhwa.dot.gov/research/publications/technical/#p)*

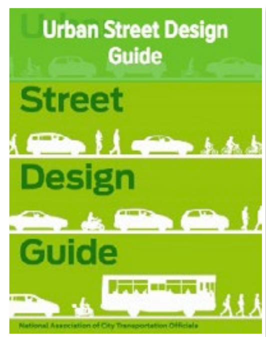
This extensive listing of research and publications includes many references to bike- and pedestrian-friendly improvements.

1.4.2 National Association of City Transportation Officials

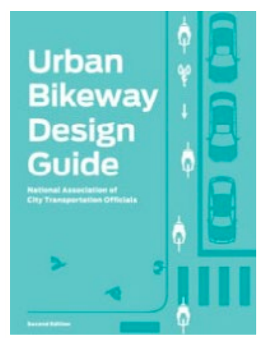
The National Association of City Transportation Officials (NACTO) is a 501(c)(3) nonprofit association that represents large cities on transportation issues of local, regional, and national significance. NACTO views the transportation departments of major cities as effective and necessary partners in regional and national transportation efforts and promotes their interests in federal decision making.

NACTO Publications

These NACTO guides represent innovative bicycle and streetscape facilities and treatments. It is important to note that some of its design treatments may not be permitted under the MUTCD. It is the responsibility of the reader to verify the latest levels of approval from FHWA. The NACTO Urban Street Design Guide (2013) is the more generalized of the three guides.



The NACTO Urban Bikeway Design Guide (2014) is organized into six sections, but its information is bicycle specific. For each section, it offers three levels of guidance: Required Features, Recommended Features, and Optional Features.



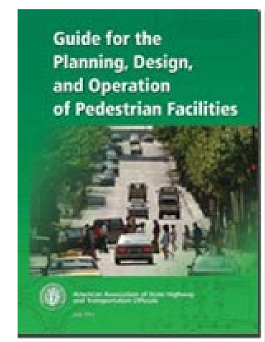
The latest in the NACTO series is Transit Street Design Guides (2016). This document can be used to integrate walking, cycling, and transit systems. The document shows how to accommodate transit access by foot or bike.

1.4.3 The American Association of State Highway and Transportation Officials

AASHTO consists of 52 state transportation departments. The AASHTO bicycle and pedestrian design guides are important national resources for planning and designing bicycle and pedestrian facilities and for identifying appropriate measures to improve safety and access.

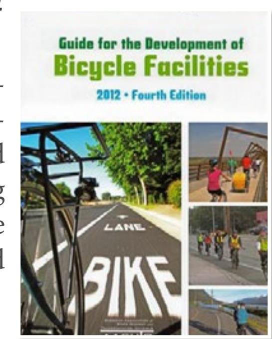
Guide for the Planning, Design & Operation of Pedestrian Facilities (2004)

The purpose of this guide is to provide guidance on the planning, design, and operation of pedestrian facilities along streets and highways.



Guide for the Development of Bicycle Facilities (2012)

This guide provides information on how to accommodate bicycle travel and operations in most riding environments to meet the needs of bicyclists and other highway users.

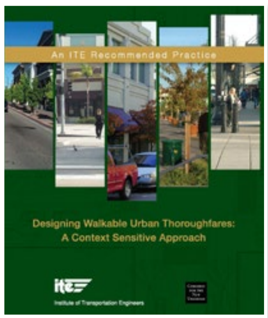


1.4.4 Institute of Transportation Engineers

The Institute of Transportation Engineers is an international educational and scientific association of transportation professionals who are responsible for meeting mobility and safety needs.

Designing Walkable Urban Thoroughfares: A Context Sensitive Approach (2010)

This report was developed in response to widespread interest in improving mobility choices and community character through a commitment to creating and enhancing walkable communities. This study highlights not only facility guidelines but also community building.



1.4.5 Other Foundational References

Model Design Manual for Living Streets—County of Los Angeles (2011)

This manual was produced for the County of Los Angeles as an open-source document available for others to use and adapt for their local conditions. The manual focuses on all users and modes of public streets. The document seeks to achieve a balanced street design that accommodates vehicles while ensuring that pedestrians, cyclists, and transit users can travel safely and comfortably on streets that are lively, beautiful, and sustainable.

LEED for Neighborhood Development (2014)

Developed by the U.S. Green Building Council, Leadership in Energy and Environmental Design (LEED) for Neighborhood Development (ND) is a framework for identifying, implementing, and measuring green building and neighborhood design, construction, operations, and maintenance. LEED-ND is a voluntary, market-driven, consensus-based tool that serves as a guideline and assessment mechanism. LEED-ND takes into account many land use, transportation design, street design, and bike/pedestrian facilities.

The Complete Streets: Best Policies and Implementation Practices (Annual)

The annual Complete Streets: Best Policies and Implementation Practices publication should be consulted. This document is produced by the American Planning Association and the National Complete Streets Coalition.

Other organizations that promote innovation may be able to help in providing ideas for innovation. Sample organizations include—

- Transportation for America.
- Smart Growth America.
- Congress for New Urbanism.
- Assoc. of Pedestrian and Bicycle Professionals.
- Alliance for Biking and Walking.

1.5 INNOVATION: CONSISTENCY VERSUS NEW IDEAS

There are a variety of tools and resources that can assist the transportation community in exploring and implementing innovative and experimental strategies for pedestrian and bicycle programs, devices, and projects. Although public safety, risk, and liability must always be considered, some level of flexibility is needed for the planning, design, and engineering of our roadway systems. Room must be provided to allow for innovation, local context, and testing of solutions to long-standing problems created by the sharing of the roadway among several different modes of travel.

Before a new traffic control device is used on a street or highway open to the public, the agency having jurisdiction over the roadway must ensure the device conforms to the provisions of the MUTCD. New designs, devices, or applications not covered in or not in compliance with the MUTCD can be used on roads open to the public only if FHWA experimentation approval is received. Inventors or manufacturers of new devices should work with state or local highway agencies that are interested in using the device to

Note: A variety of samples have been used in this document to demonstrate typical bike and pedestrian improvements found in the United States that are good examples of some aspect suggested in this study. Not all elements shown in the photos may be up to the latest standards or regulatory codes, however. Many of the project samples were completed prior to the latest standards. The reader is cautioned not to use the samples to create new projects. The latest ADA, FHWA, ITE, AASHTO, NACTO, and local standards and guidelines must be used in order to be fully compliant.

address known problems that they feel existing standard MUTCD devices are insufficiently effective in solving. Experimentation approval must be requested from FHWA by the highway agency having jurisdiction over the road. See Section 1A.10 of the MUTCD. A successful experiment is one in which the research results show that the public understands the new program, device, or application. The device or application generally needs to perform as intended, and the device must not cause adverse conditions. The experimenter must evaluate conditions both before and after installation of the experimental device and describe the measurements of effectiveness (MOEs) of the safety and operational benefits (e.g., better visibility, reduced congestion, improved safety). The MUTCD process also allows for the use of interim approvals. Interim approvals are considered by the Office of Transportation Operations based on the results of successful experimentation, studies, or research and an intention to place the new or revised device into a future rulemaking process for MUTCD revisions.

1.6 UNIVERSAL ACCESS:
FEDERAL ACCESS REQUIREMENTS

Universal access is the principle that all facilities should be made more accessible for all portions of the public, including those with physical challenges and mobility limitations. Though not as broadly applied to the full public, similar requirements have been mandated under federal laws and through state implementation of these laws. Recipients of federal financial assistance from the U.S. Department of Housing and Urban Development (HUD) and the DOT or its sub-agencies, such as the Federal Transit Administration and the Federal Highway Administration, must comply with Section 504 of the Rehabilitation Act of 1973, which prohibits discrimination against persons with disabilities under programs that receive federal financial assistance. The DOT adopted regulations implementing this requirement in 49 Code of Federal Regulations (CFR) Part 27. Congress expanded protections for persons with disabilities by passing the Americans with Disabilities Act of 1990 (ADA). Title II of the ADA prohibits public entities, such as states, local governments, and public transit providers, from discriminating against persons with disabilities regardless of whether such entities receive federal financial assistance. Specifically, no qualified individual with a disability shall, on the basis of disability, be excluded from participation in or be denied the benefits of the services, programs, or activities of a public entity.[5]

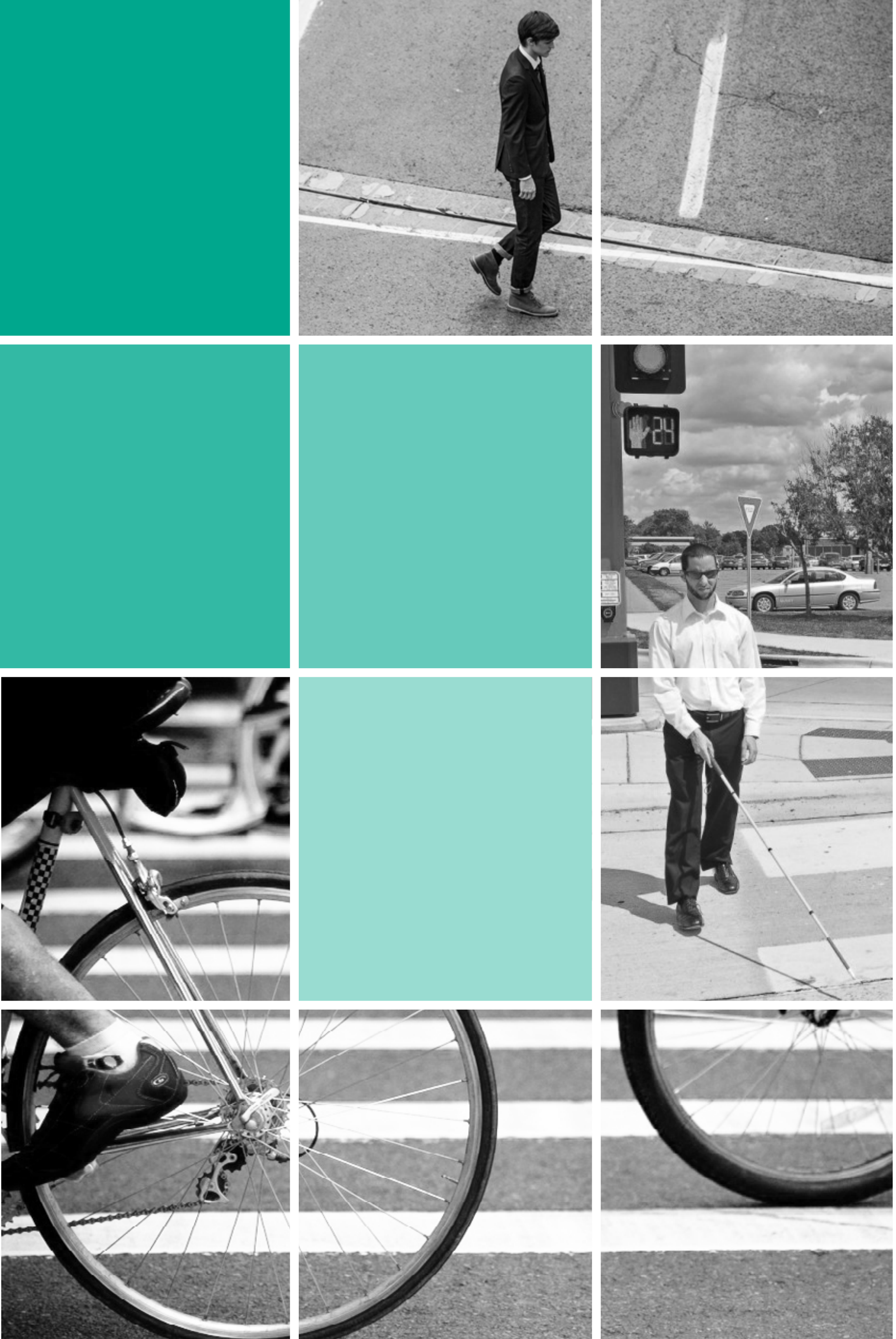
The U.S. Department of Justice (DOJ) adopted regulations in 1991 (28 CFR Part 35) setting forth more specific requirements public entities must follow to carry out the terms of Title II of the ADA. The DOJ regulations included the ADA Accessibility Guidelines (1991 ADAAG), developed by the U.S. Access Board, which sets forth specific standards for the design and construction of buildings and facilities to ensure accessibility, such as standards for accessible routes, curb ramps, ramps, and bus stops, among other things. The DOT also adopted the 1991 ADAAG into its Section 504 regulations in 1991.

The U.S. Access Board issued revisions to the ADAAG in 2004. The DOT adopted the revised ADAAG (with some modifications) into its Section 504 regulations in 2006. The DOJ adopted the revised ADAAG into its ADA regulations in 2010 (2010 Standards). The DOT applies the revised ADAAG to facilities in the public right-of-way, such as sidewalks, bus stops, curb ramps, and crosswalks, among other elements. The DOT has also adopted ADA regulations that apply specifically to public transportation in 49 CFR Part 37.

In addition, the U.S. Access Board published a Notice of Proposed Rule-making in 2011, supplemented in 2013, setting forth draft accessibility guidelines for the design, construction, and alteration of pedestrian facilities in the public right-of-way. These are commonly referred to as the 2011 Public Rights-Of-Way Accessibility Guidelines (PROWAG). Unlike the revised ADAAG, the draft PROWAG does not set forth enforceable standards. The PROWAG will obtain the force of law only after the U.S. Access Board issues a final set of guidelines and those guidelines are formally adopted into regulation by the DOT and/or the DOJ.

NOTES:

1. http://www.cdc.gov/vitalsigns/walking/
2. http://www.citylab.com/commute/2014/05/rise-bicycling-smaller-and-midsize-us-cities/9059/
3. http://transact.org/wp-content/uploads/2014/04/Transportation_and_Housing.pdf
4. http://www.fhwa.dot.gov/environment/bicycle_pedestrian/guidance/policy_accom.cfm
5. https://www.dol.gov/oasam/regs/cfr/28cfr/part35/35130.htm



CHAPTER 2: BENEFITS OF ACTIVE TRANSPORTATION

USER LEGEND

Advocate Organizations
- Housing Advocates
- Health and Safety Advocates
- Smart Growth Advocates
- Mobility Choice Advocates

Providing Entities
- Developers, Financial Institutions
- Housing Providers and Institutions
- Planning, Design or Engineering Consultants

Decision Makers
- Local Agency Planners and Engineers
- Local Elected Officials and Review Staff
- Federal, State and Regional Regulators

Active Transportation and Health: 3 hours of biking per week can reduce your risk of heart disease by 50%.

Transportation Activity for Weight Loss: For even a slow bike rider weighing 180 lbs, 245 calories can be burned in less than 30 minutes of travel.

Effects of the Built Environment: People who live in walkable neighborhoods are twice as likely to get the recommended daily amount of physical activity.

Active transportation (bicycling and walking) can bring many benefits to individuals, communities, and society at large. The following sections describe the noted benefits found in each of the primary benefit categories. Studies have found that only 20 percent of American adults regularly engage in recommended amount of physical activity.[1] Creating safe, convenient options for walking and bicycling allows more people to incorporate active transportation into their daily routine without having to set aside a special time for exercise.

2.1 HEALTH: HOW WALKING AND BIKING CAN IMPROVE HEALTH

2.1.1 Active Lifestyles

Building active transportation facilities provides opportunities for people to get outside, walk, bike, jog, skate, and rollerblade or partake in other physical activities. These aerobic activities all burn calories, enabling people to maintain a healthy weight and improve mental health. For example, a 160-pound adult walking at 3.5 miles per hour for 1 hour burns 314 calories, and running at 8 miles per hour for 1 hour burns 861 calories.[2] A 130-pound person bicycling at 14–16 miles per hour for 1 hour burns about 590 calories.[3] Burning 500 calories per day will translate into 1 pound lost per week.[4]

The U.S. Surgeon General, Dr. Vivek Murthy, recognized these health benefits in his "Step It Up!" campaign, a "Call to Action to Promote Walking and Walkable Communities."

Children who walk or bicycle to school are often healthier than their peers who are driven. Because of this, they also miss fewer days of school, are more alert in class, and perform better academically. Similarly, healthy employees miss fewer days of work,[5] focus better, and perform better at work than do those who are less healthy.

According to the President's Council on Fitness,[6] regular physical activity—

- Reduces the risk of heart disease, cancer, and stroke.
- Strengthens muscles, bones, and joints.
- Improves heart and lung condition.
- Decreases depression.
- Increases energy and self-esteem.
- Lengthens life expectancy.
- Relieves stress.

By contrast, people who live sedentary lifestyles have a greater risk of developing Type 2 diabetes, high blood pressure, high cholesterol, stroke, heart disease, and cancer. One study found that the risk for obesity increases 6 percent for every hour spent in a car, whereas the risk decreases 4.8 percent for every kilometer walked.[7]

2.1.2 Stress Relief

Exercise can act as a stress reliever. Being active can boost your feel-good endorphins and distract you from daily worries.[8] Mednet.com lists more than 100 illnesses, medical conditions, and mental problems as either caused by or intensified by stress. These conditions range from heart attacks and cancer to depression, insomnia, chronic fatigue, a variety of mental illnesses, and alcoholism. Having attractive bikeways, trails and pedestrian facilities can entice more people to get outside and become more active, relieving their stress and improving their health.

2.2 SAFETY: FIRST PRIORITY FOR PLANNING AND DESIGN

If provided low-stress bikeways, improved pedestrian crossings, and trails, people will be able to cycle, walk, and ride in a safer environment. Creating safe walking and biking facilities is imperative not just for providing transportation choices but also for providing safe travel for the many people who have no choice. Roughly 1 in 10 American households is carless,[9] which makes the issue not one of choice but of social equity and justice.

2.2.1 Safe Facilities

Bicycling on streets with low vehicular volumes and speeds or on a dedicated bikeway on a high-volume street with higher speeds provides a low-stress bicycling experience.[10] Shared streets (those with no separated bicycle lane) are often inherently uncomfortable bicycling environments, but they may be further enhanced with traffic-calming elements.[11] Dedicated bikeways make bicyclists more comfortable by increasing visibility and legitimacy. Bike lanes provide a place to ride where motorists generally do not intrude, and cyclists feel more comfortable. Separated bikeways go a long way in increasing cyclists' safety and comfort, even when traveling alongside fast-moving cars.[12]

Improved pedestrian-friendly safety features reduce the number of pedestrians hit by cars. For example, adding a sidewalk has a crash reduction factor of 88 percent.[13] Crossing islands reduce pedestrian-involved crashes by 46 percent at marked, uncontrolled crossings (no signals or stop signs.)[14]

Bike lanes, sidewalks, and parkways—when accommodated through narrowing motor vehicle travel lanes—also have the potential to reduce the speed of cars and improve safety. Speed is a key factor in crash reduction for three reasons. First, motorists' peripheral vision declines with speed. Second, stopping distance increases with speed. For example, the average stopping distance at 40 miles per hour is 170 feet, whereas at 25 miles per hour it is only 60 feet. Third, crash severity increases with speed. If hit by a car moving 20 miles per hour, a pedestrian has a 95-percent chance of survival but at 40 miles per hour, only a 15-percent chance (figure 2-1).[15]

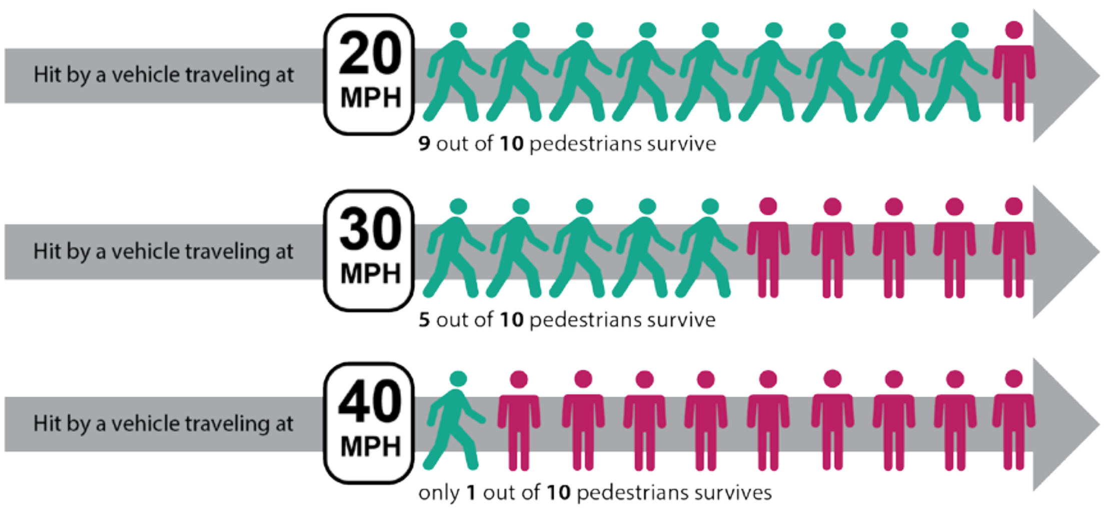
2.2.2 Safety in Numbers

The more cyclists, pedestrians, and joggers who use local streets and trails, the more people will be aware of and will look for them.[16] Also, because a greater percentage of motorists will use the streets and trails as cyclists, pedestrians, and joggers, more motorists will be aware of their presence.

2.2.3 Personal Safety

Personal safety benefits can result from having people out walking, cycling, or skating because they put "eyes on the street."[17] If more people are out and casually surveying the street, criminals are less likely to engage in antisocial activity. More people on the streets provides an increased sense of safety and may encourage yet more walking and biking.

Figure 2-1: Speed and Pedestrian Safety, where magenta icons represent fatalities



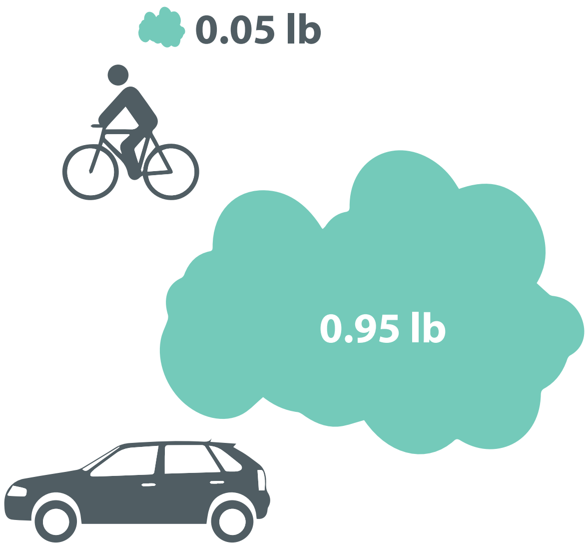


Figure 2-1: Air Quality and Transportation Options

Vehicles produce approximately 0.95 lbs of CO2/passenger/mile traveled of carbon emissions. Bicycling only produces 0.05 lbs of CO2/passenger/mile traveled.

Note: This study took into account not just the emissions from the vehicles themselves, but from the entire life cycle of the mode including production, maintenance and fuel — which in the case of bicycling includes caloric intake.

Source: European Cycling Federation's publication, "Cycle more Often 2 cool down the planet ! Quantifying CO2 savings of cycling"

2.3 **ENVIRONMENT:** ACTIVE TRANSPORTATION'S ROLE

There is a broad spectrum of benefits by providing active transportation networks, and along with individual benefits, there are also environmental benefits. Providing an increased use of facilities improves local air and water quality for the entire community (figure 2-2). These benefits are described in the following sections.

2.3.1 Improved Air Quality

As local residents decide to walk or bicycle instead of drive to work, to school, to shop, or for other purposes, greenhouse gas emissions will decrease and air quality will improve. Significant benefits can be gained even for very short trips. For instance, if residents of a small city (population: 50,000) were to convert 1 mile of motorized trips to non-motorized trips every day, it would result in 12,501,250 fewer miles driven per year (table 2-1). This represents the equivalent of 1,042 fewer cars on the road and the following air pollutant reductions: 10.14 pounds less carbon dioxide (CO2), 19,082 pounds less nitrogen oxides (NOX), and 28,472 pounds less volatile organic compounds (VOCs).[18] *(Note: These calculations relate to passenger cars only; they do not include light trucks and SUVs, which comprise a large share of vehicles driven and generate higher levels of emissions.)*

Table 2-1: Motorized Trips to Non-Motorized Trips Conversion Example (Passenger Cars)

City Population	Drivers (68.5% of total population)	Miles driven per year by residents	Reduction in miles driven, given 1 mile reduction per person per day	Equivalent of "cars on the road" reduced	CO2 reduced (lbs)	NO_x reduced (lbs)	VOC reduced (lbs)
50,000	34,250	411,000,000	398,498,750	1,042	10.14 million	19,082	28,472

It is important to note that when substituting a driving trip with a walking or bicycling trip, it also eliminates "cold starts," the most polluting portion of the car trip. Because the preceding calculations used trip averages, the actual reductions would likely be significantly higher.

Improved air quality has a positive impact not only on the environment but also on the people that live in it. According to the Centers for Disease Control (CDC), motor vehicles contribute to more than 50 percent of asthma-triggering air pollution in urban areas. According to the same CDC source, "Several years ago, researchers took advantage of a natural experiment to learn about the impact on pediatric asthma of decreased traffic levels and improved air quality." [19]

During the 1996 Summer Olympics Games in Atlanta, when peak morning traffic decreased 23 percent and peak ozone levels decreased 28 percent, emergency visits for asthma events in children decreased 42 percent. At the same time, children's emergency room visits for causes other than asthma did not change. These results suggest that efforts to reduce traffic congestion and improve air quality can also help improve the respiratory health of a community.

The calculations in table 2-1 were based on the following—

- The average fuel economy for a light vehicle sold today is approximately 25 miles per gallon. (Sean Gagnier, "Average Fuel Economy of New US Vehicles Rises to 25.4 mpg," Automotive News, April 3, 2014.)
- There are 685 drivers per 1,000 U.S. residents. (Federal Highway Administration, Office of Highway Policy Information, Highway Finance Data Collection, 2001.)
- 142,590,985 people live in U.S. cities with populations between 5,000 and 200,000. (U.S. Census Bureau, American Community Survey 5-year Estimates, 2009–2013.)
- The average U.S. driver drives 13,476 miles per year. (Federal Highway Administration, Office of Highway Policy Information, 2014.)

2.3.2 Improved Water Supply and Quality

Streets designed primarily for vehicle traffic are likely to be wide, with little landscaping and constructed of impervious materials. This is due to practical considerations for vehicles and normative decisions in which a premium is placed on speed and efficiency. These qualities combined offer little opportunity for sustainable water treatment. In contrast, streets designed for bicycle and pedestrian use, such as neighborhood greenways, are likely to be narrow, with enhanced landscaping and may be constructed of permeable materials. For example, the use of curb extensions and crossing islands to shorten crossing distances makes pedestrians more visible and reduces exposure while providing opportunities for enhanced landscaping and sustainable water treatment (e.g. bioswales and rain gardens). Similarly, the use of chicanes to calm traffic and provide a low-stress cycling experience provides opportunities for increased landscaping and water treatment.

2.4 ECONOMY: SAVING TRANSPORTATION COSTS

Active transportation networks can provide not only a cost savings to the users but immediate and long-term benefits to the local economy as well. These benefits are described in the following sections.

2.4.1 Cost Savings

Local residents that walk or bicycle for daily trips to the store, work, school, or other destinations can realize substantial costs savings by not using their cars (figure 2-3). The estimated annual cost of owning and operating a car is about 35 times more expensive than that of walking. (Note: Costs associated with walking include sturdy walking shoes, rain and snow gear, as well as occasional taxi or transit trips.)[20]

Cost savings for individuals and society also result from better health. For example, the yearly cost of being overweight is $524 for women and $432 for men. The annual cost of obesity is $4,879 for women and $2,646 for men.[21] Nationally, obesity-related ailments, such as chronic disease, disability, and death, are estimated to cost $190.2 billion annually.[22]

By 2018, obesity is estimated to cost the United States $344 billion per year, consuming 21 percent of our healthcare budget.[23] This would likely cause insurance rates to go up for those that purchase private insurance and consume significant resources from our public health insurance programs, such as Medicare and state health programs. Fortunately, walking and cycling are two forms of moderate exercise that are effective and convenient means of maintaining healthy weight and general fitness.[24]

Figure 2-3: Annual Cost of Transportation

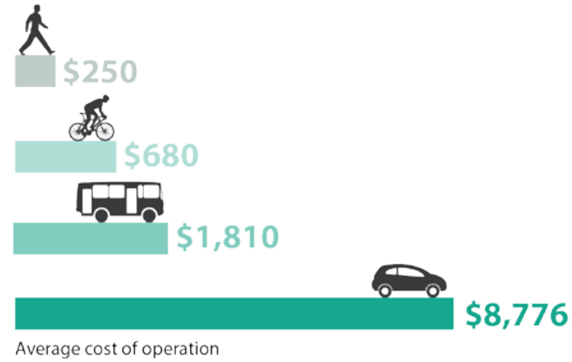


Figure source: Transit for Livable Communities, Minnesota

This trail made of decomposed granite allows rainwater to flow through, preventing flooding, while providing a solid surface for walking and biking. Photo source: Mike Singleton

Figure 2-4: What Most People Want

Nearly 8 out of 10 Americans believe it is important to live "within an easy walk" of shops, cafes, schools and other community places.[24]

Figure 2-5: Walkability and Property Value

Houses with above average levels of walkability sell for $4,000 to $34,000 more than houses with average levels of walkability.[25]

2.4.2 Economic Development

Research shows that trails have the potential to create jobs, expand local businesses, and enhance property values (figure 2-4). Shortly after its completion in 2012, the $62.5 million Indianapolis Cultural Trail, a multipurpose trail in urban Indianapolis, generated 11,000 jobs, as well as $863 million through construction, private-sector investment, and increased tourism. The project also increased property values by $45 million.[25] The 150,000 annual visitors to the Little Miami Scenic Trail in Ohio spend an average of $13.54 per visit on food, beverages, and transportation to the trail. They also spend an estimated $277 each year on clothing, equipment, and accessories during these trips.[26] In Apex, North Carolina, developers added a $5,000 premium to homes adjacent to a regional greenway, and those homes were still the first to sell.[27] These are just a few of many examples that document the economic benefit of active transportation facilities (figure 2-5).

All of these factors can help the tourism industry, restaurants, and other retail outlets, bringing in more tax revenue to the jurisdiction. In addition to attracting visitors, walkable, bikeable communities may motivate local residents to do more of their shopping and entertainment locally, rather than traveling to another city or town. Moreover, if they save money by driving less, they will have more disposable income that could be used locally.

2.4.3 Economically Viable Futures

Smaller U.S. cities and towns are having difficulty keeping and attracting vibrant industries and a millennial workforce. This "brain drain" is negatively impacting smaller cities. Many millennials want a more "urban" lifestyle where they can live in compact, walkable, bikeable communities.[28] Growing evidence exists that the baby boomer generation shares a similar desire for more compact, walkable communities.[29] If smaller cities expect to attract or retain both millennials and boomers, planning for denser, walkable and bikeable communities would be an effective formula. Otherwise, economies may stagnate or decline.

2.5 **QUALITY OF LIFE:** HOW ACTIVE TRANSPORTATION CAN HELP IMPROVE

Active transportation provides the opportunity for an increase in the quality of life for individual residents as well as the community as a whole. Active transportation networks create complete streets that make walking or biking more enjoyable and increase social interactions. These benefits are described in the following sections.

2.5.1 Reduced Driving for Short Trips

Many trips are short and can be done on foot or bicycle if safe and attractive facilities are available. Because 48 percent of all trips are 3 miles or less, 21 percent of all trips are less than 1 mile, and 60 percent of all trips less than 1 mile are done by driving, there is significant potential to convert these trips to active transportation trips.[30]

2.5.2 Social Interaction

Walking, cycling, skating, rollerblading, and other non-motorized transportation modes put people in the streets in situations that offer much more opportunity for social interaction compared to driving. This can make communities more vibrant and can help to develop stronger social capital.

Active transportation brings about a "people-oriented" feel to streets. People can be seen out where they interact with others that are out as well. Research conducted on three streets in San Francisco found that residents living on streets with light traffic had three times as many friends and twice as many acquaintances as those living on streets with heavy traffic.[31] Residents living on a bike boulevard (Clinton Street) in Portland, Oregon have put out artistic benches facing the street as a show of neighborhood interaction. This contrasts with the walls that line high-speed arterials in suburban subdivisions.

2.5.3 Enjoyment

People who use bike and pedestrian networks gain a significant opportunity to enjoy outdoor recreation. They are able to go out to enjoy those networks on their own and may find that the trails offer a terrific chance to spend time together with family. Polls show that residents greatly value trails and bikeways in their communities.[32] Best of all, trail activities can be enjoyed by people of nearly all ages.

2.5.4 Improvements to the Public Realm

By making walking and biking true transportation alternatives, cities may reduce the amount of public space dedicated to the movement and storage of private vehicles and repurpose it for "higher uses" (i.e. a "road diet," also referred to as street "right-sizing").[33] In addition to creating more space for walking and biking, road diets can create more public space. Medians, street furniture, landscaping, public art, historical plaques, wayfinding signs, improved bus stops, and community gardens exemplify the types of uses that could become the "higher and better" use of the public space.

2.6 INVESTMENTS: MAXIMIZING TRANSPORTATION AND LAND USE INVESTMENTS

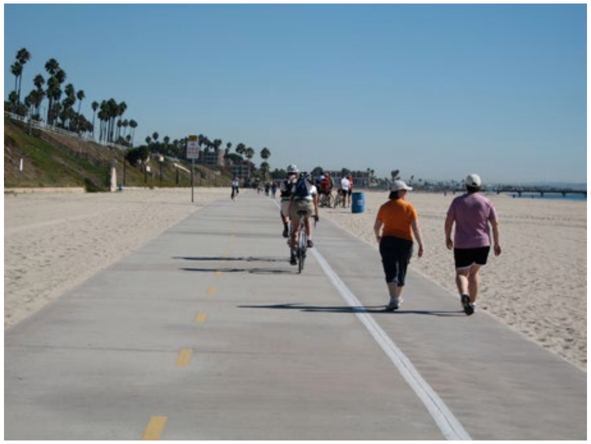
It is important to maximize the active transportation network and the process it takes to get there. The following are strategies to ensure this happens and the barriers that need to be addressed throughout the process.

2.6.1 Improving Access to Other Transportation Modes

Active transportation supports public transit, carpooling, vanpooling, and car-sharing programs. The "first-mile, last-mile" problem presents challenges in attracting people to use public transit and rideshare programs. The actual ride on transit or rideshare may be convenient, but getting to the origin and destination of a trip may discourage use. Active transportation allows for a broader use of transit and ridesharing by filling the first-and last-mile gaps.

2.6.2 Synergy with Transit-Oriented Development

Active transportation should be an integral part of planning transit-oriented development (TOD) projects (further explanation of TOD can be found in the glossary). The combination of highly accessible transit and attractive options for walking and cycling provides opportunities for people to go about their daily activities with minimal need for driving. In TOD areas, driving and parking can be time consuming and expensive, so active transportation and transit can compete well for patronage. One study of 26 TODs showed that people living within 0.5 mile of a transit station used transit four times as often as those living between 0.5 mile and 3 miles, and six times more likely than those living beyond 3 miles.[34] For smaller communities, where a large transit station is not feasible, this could be centered around a single-track train station or a regional transit center with TOD development surrounding the station.



Shoreline bike path with parallel walking areas - Long Beach, CA. Photo source: Mike Singleton

2.6.3 Connecting People to Land Uses

Many neighborhood destinations are within a reasonable walking or biking distance but are driven to because of poor bicycle and pedestrian routes connecting people's homes to other destinations and because of the ease of driving. People driving through their own neighborhood often overlook as destinations the assets their own community offers. Once people feel that it is safe and comfortable to walk, bicycle, or skate around their community, they will likely use local amenities and services more often.[35]

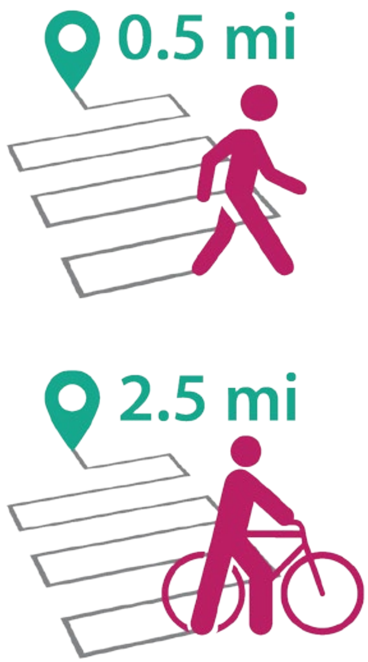


Figure 2-6: Walkable and Bikeable Distances

Most people are willing to walk 0.5 mile and bike 2.5 miles for transportation.

2.6.4 Tactical Urbanism

Tactical urbanism is another means of fast-tracking a project that can be held up for political reasons. Tactical urbanism is "an umbrella term used to describe a collection of low-cost, temporary changes to the built environment, usually—but not always—in cities, intended to improve local neighborhoods and city gathering places."[36] Tactical urbanism is also commonly referred to as guerrilla urbanism, pop-up urbanism, city repair, or DIY (do-it-yourself) urbanism.[37] Successful interventions can run the gamut of lawful or sanctioned to illegal or unsanctioned. There is no reason to suggest illegal actions because so many legal yet aggressive actions are possible.

2.7 BARRIERS: MEANS TO OVERCOME THEM

The barriers to expanding opportunities for active transportation in communities of fewer than 200,000 people are distance, infrastructure, economic, environmental, and political. These barriers are examined in the following sections, along with suggestions on how to overcome them individually.

2.7.1 Distance Barriers

Long distances between origins and destinations present a significant barrier for both walking and biking. There is a range—of course—of how far people are willing to walk and bicycle for transportation, but the planning research standards range from 0.25 mile—0.5 mile for walking[38] and around 2.5 miles for bicycling[39] (figure 2-6). Distance barriers exist because of land use planning decisions, wherein noncom-pact and segregated uses were permitted or encouraged.

Three primary strategies may be employed to overcome distance barriers: (1) develop bike- and pedestrian-friendly land use patterns that improve and add to the connectivity of the street network (new and old); (2) build pedestrian shortcuts in new and old development; and (3) develop transit networks that complement the pedestrian and bicycle networks by covering longer-distance trips. Changing land use patterns is fundamental to removing distance barriers, but it is typically a very slow and incremental process. In the interim, a robust transit network can help overcome these barriers while supporting walking and biking.

2.7.2 Infrastructure Barriers

Physical constraints present challenges for retrofitting existing communities for active transportation. On streets where the community wishes to widen sidewalks, improve pedestrian crossings, add bike lanes, or add separated bike lanes, there may not be enough space. In built environments, the existing curb-to-curb width may not be sufficient to make these improvements without making changes that would reduce the space required for vehicle travel or parking.

Although constructing trails may be quite desirable, some communities have no available corridors in which to construct them. Alternatively, right-of-way may exist but suffer from insufficient width or encroachment by adjacent property owners. The following improvements offer possible means to overcome physical barriers.

1) *Restriped Streets.* Often, streets are striped with travel and turn lanes wider than they need to be. By restriping travel lanes, turn lanes, and parking lanes to narrower dimensions, space can be reclaimed for active transportation. In most situations, 10-foot-wide travel lanes are adequate. Where high numbers of buses or trucks run, 11 feet may be needed. Parking lanes are commonly striped at 8 feet; they can be narrowed to 7 feet. Extending the pavement over the gutter pan, which is next to the curb, can effectively provide more pavement space.

2) *Road Diets.* A road diet is generally described as removing travel lanes from a roadway and utilizing the space for other uses and travel modes. This informational guide will focus on the most common road diet reconfiguration, which is the conversion of an undivided four-lane roadway to a three-lane undivided roadway made up of two through lanes and a center two-way left-turn lane (TWLTL). (For federal guidance on road diets, see FHWA's Road Diet Informational Guide at http://safety.fhwa.dot.gov/road_diets/info_guide/.)

3) *Innovative Drainage Treatments.* Islands and curb extensions can be used to improve pedestrian crossings and provide physical barriers for separated bike lanes, but they also alter drainage. Using runoff infiltration techniques that allow water to be absorbed and cleansed by the soil can reduce the need to apply expensive measures, such as moving catch basins. Other drainage strategies may redirect water around changed curbs.

4) *Conditioned New Development and Redevelopment.* New development and redevelopment offer opportunities to include walking and biking facilities as part of the initial design. By incorporating pedestrian and bicycle accommodation into long-term plans, local governments can condition new development to construct facilities when the property is developed or redeveloped. By utilizing updated street design manuals, new streets and sidewalks should be built with adequately wide sidewalks, low-speed streets, safe street crossings, bike lanes, and bike paths as part of the development.

2.7.3 Economic Barriers

Retrofitting existing communities with active transportation projects can result in expenditures for new facilities and programs. The facilities include a wide range of devices and measures, as shown in subsequent chapters of this report, such as sidewalk widening, improved pedestrian crossings, new signals and signal modifications, bike lanes and paths, separated bike lanes, and traffic calming. Wherever possible, active transportation projects should be bundled with other transportation projects. Creating an environment that embraces active transportation requires education, encouragement, enforcement, and evaluation programs. These additional efforts have ongoing operational costs.

New development and redevelopment bring opportunities to incorporate active transportation design features as integral parts of the development and do not present great additional capital costs. Moreover, as shown in the Economic Development section, there is often a significant return on these investments. Well-established practices often require developers to widen streets, flare intersections, and add traffic signals to accommodate new traffic resulting from development.

Pharr Road after Road Diet and Restriping - Atlanta, GA. Photo source: Ryan Snyder

Fifth Avenue After Road Diet and Restriping- San Diego, CA. Photo source: Mike Singleton

Communities and planning agencies are just starting to mitigate traffic and instead focus on reducing vehicle miles traveled (VMT) by requiring developers to pay for nearby bikeways, improved sidewalks, or enhanced pedestrian crossings. Legally, such mandates will require a demonstration of nexus between the development's impact and the required improvement, as well as a proportional nexus. Because accurate forecasting methodologies are needed to determine the offsetting benefits of the active transportation projects, establishing nexus presents challenges.

The following options help overcome the costs of retrofitting existing communities, streets, and neighborhoods with active transportation.

1) *Reprioritize existing transportation budget.* Every gallon of gasoline purchased pays a federal gasoline tax, and many states have their own gasoline taxes that provide the primary source of funding for transportation projects. Some locales have sales taxes and other regular sources of revenue for ongoing transportation needs. Although there is currently legitimate discussion over the adequacy of these revenue sources (especially because the federal gas tax has not been raised since 1993 and cars are more fuel efficient), these taxes still provide a regular funding stream. Many communities have historically used their transportation budgets for automobile-oriented projects. Projects such as street widenings, intersection flarings, and interchange reconstruction can deplete available funding quickly. Active transportation projects, by comparison, are relatively inexpensive. Simply looking to fund active transportation projects as a higher priority with existing funding streams can often provide sufficient design and construction budgets.
2) *Piggyback onto other projects.* The most cost-effective time to make many street improvements is at the time other improvements are being made. For example, the cost of applying paint or thermoplastic for bike lanes, crosswalks, and advance yield lines is very small relative to the cost of resurfacing. Similarly, when the street is dug up for major drainage or utility projects, new sidewalks with curb and gutter can be constructed less expensively than as separate projects.
3) *Institute special assessments.* Special assessments levy additional taxes on properties that benefit from the project being funded. These assessments can be structured to be paid for once up front or incrementally over time. Neighbors—as in Maintenance Assessment Districts (MADs)—can agree to tax themselves for a new sidewalk and pay for it over 20 years, for example. Alternatively, the property owners along a new trail may agree to pay for the trail, understanding that their property values will increase as a result of the trail. Tax increment financing (TIF) and Business Improvement Districts (BID) are other means of financing improvements through self-assessment (a portion of tax revenue, in the former case, and businesses in the latter).
4) *Seek inexpensive treatments.* Many active transportation projects can be relatively inexpensive. In many cases, paint (or thermoplastic, slurry, and so forth) can be applied to create bike lanes, high-visibility crosswalks, bike boxes, or other street markings without great cost. Similarly, low curbs are less expensive than high curbs and are often adequate for islands and curb extensions. Many other innovative ways exist to cut costs on projects.
5) *Update design manuals.* The greatest cost of active transportation projects comes in retrofitting streets that were not designed for walking or cycling; they were built following design manuals that did not consider active transportation. In communities where new design manuals have been adopted based on active transportation and living streets principles, changes to streets are made and new streets are constructed with walking and bicycling in mind. Adopt a Complete Streets or Living Streets Policy, which ensures that every department and street project is designed, built, maintained, and repaired for all users. Include all subdivisions and new development in policy language.
6) *Train local talent.* Funding capital projects is often easier than funding operational costs for ongoing programs. Many cities lack adequate funding for ongoing education, encouragement, enforcement, and evaluation programs. By having someone in the community—or in schools—trained to provide and organize these programs, a greater degree of sustainability can be reached. For example, if police departments are trained to give bicycle and pedestrian education and are keenly aware of bicycle and pedestrian needs in enforcement, they can incorporate these as part of their ongoing activities.
7) *Establish legally accepted nexus metrics.* In order to overcome the legal issues with establishing nexus between the impact of new development and required active transportation expenditures, accepted methodologies can be developed. Possible metrics may include vehicle miles traveled (VMT; i.e. a maintenance or reduction in miles traveled) and/or bicycle and pedestrian mode share (i.e. increase biking by a specified percent.

2.7.4 Environmental Barriers

The primary environmental barrier to active transportation facilities relates to the effects of pavement on waterways. Pavement reduces infiltration and can cause chemicals from streets to enter adjacent waterways. Common remedies include—

- Using pervious pavement.
- Using materials such as Grasscrete that allow water to soak into the ground.
- Using alternatives surfaces to paving, such as decomposed granite or porous pavement.

Further, many active transportation projects can be constructed with zero increase, or even a decrease, in paved area. Many active transportation projects are installed within the current right-of-way, requiring no new pavement and no new impacts to soil and water quality. Where active transportation projects lead to a lasting, reduced demand for driving, it may be possible to remove pavement (formerly dedicated to vehicle travel), actually improving soil, water, and air quality. Still other active transportation facilities may improve water and soil quality through increased landscaping (bioremediation), while causing no impact to vehicular circulation. Reclaiming excess paved surfaces for landscaping is common in urban trail, bike boulevard, and landscaped cycle tracks projects.

2.7.5 Political Barriers

Building new trails and incorporating well-designed sidewalks and attractive bike lanes into new development is unlikely to create political resistance from the community. In new greenfield development, a community doesn't exist. Developers sometimes oppose requirements to incorporate these features into their projects because they perceive them to add to costs without offering a similar return in value. As noted previously, however, active transportation features likely increase the value of their developments.

Political opposition more often stems from retrofitting existing roadways (i.e. reallocating space or eliminating on-street parking). Local residents sometimes express concerns that bicycle or pedestrian route improvements may exacerbate congestion. Fire departments often oppose street modifications that they perceive will impair their ability to respond quickly to emergencies.

Vehicle parking lost to bicycle projects is a continual concern, particularly among business owners. It is interesting to note that loss of parking often generates the most opposition to an active transportation project even where parking removal is minimal.[40]

Some communities have experienced crime along trails and are reluctant to expand them. The level of crime, although very low and not likely, can be perceived negatively. In other cases, residents oppose new trails along waterways or rights-of-way behind their homes because they perceive a loss of privacy. The following strategies offer some means to avoid or ameliorate these political issues.

1) *Involve the community and key stakeholders in early stages of the design process.* Too often, local planning or transportation departments bring plans to show the community after they are in a final form. Including a broad cross-section of stakeholders in workshops early in the planning process can avoid much community discontent. If stakeholders are included in the design process, they take ownership of the plan and want to see their ideas implemented. It is also critical to mix stakeholders at workshop tables so they understand the needs of different people. For instance, by putting school administrators, homeowners, business owners, and fire departments together with people with disabilities, older adults, and bicycle advocates, each group learns to understand and appreciate the other's needs.

Early input avoids late controversy. Community Workshop - Desert Hot Springs, CA. Photo source: Mike Singleton

Emergency access friendly street treatments - Redmond, WA. Photo source: Ryan Snyder

Retrofitted streetscape, including several vegetated planters and permeable paving. Photo source: Mike Singleton

Traffic circle with mountable curb to allow access for large vehicles. Photo source: Mike Singleton

2) *Use emergency access-friendly street treatments.* Emergency responders may oppose features that increase their response time. Some measures to reduce speeding to make communities more walkable and bikeable raise concerns from emergency responders. By planning improvements with this in mind, design for emergency access can be successful. Techniques such as mountable curbs on islands and curb extensions allow emergency vehicles to pass. Traffic calming facilities can be limited to streets that carry little traffic and are local and residential in nature so that the majority of the emergency access trip takes place on other streets. First responders like well-connected grids of streets with small blocks, as opposed to cul-de-sacs. These grids are much more conducive to walking and bicycling, so there is agreement here. Again, it is important to include emergency responders in planning and designing streets. More information on this topic can be found in Best Practices: Emergency Access in Healthy Streets, produced for the Los Angeles County Department of Public Health.[41] Also to note, emergency responses may be as a result of a collision between bikes, pedestrians, and vehicles. Anything that can be done to improve the safety of these users lowers the need for emergency access in the first place.

3) *Implement design solutions.* Design solutions can often reduce or eliminate political concerns. For example, there may be design solutions to reduce the impact of new trails located behind backyards. Moving alignments farther from homes and constructing fences or other features may alleviate some of these concerns. Where trails have a history of crime, adding lighting, call boxes, and wayfinding systems and trimming adjacent vegetation for greater visibility may reduce the likelihood of crime. As more people use trails, the crime element likely decreases because of greater exposure (more "eyes on the street").[42]

4) *Pick the low-hanging fruit.* Bringing active transportation projects to streets that create little disruption will likely result in minimal opposition. For example, restriping wide, low-traffic streets to create space for bike lanes is likely to create less opposition than road diets. Road diets are more politically feasible where traffic is light rather than where it is heavier. Introducing active transportation projects with little impact creates a growing constituency that will likely support more ambitious measures in the future. The improvements for cyclists and pedestrians can also often reduce traffic congestion and speeds. These side benefits should always be stressed to people and businesses along these streets to win their support for the project.

5) *Introduce new concepts with visual representations and local examples.* In communities that are just beginning to include active transportation facilities, many people are likely to be unfamiliar with the designs and vocabulary. Using visuals, such as pictures and renderings, helps people understand the concepts. Often, people think of compact communities as crowded, congested, and undesirable cities. Some people raise concerns about congestion resulting from changes proposed in the street, but showing contrasting photos of walkable communities and suburban arterial strips illustrates a different type of community. Most people respond positively to photographs of walkable communities. By using renderings to show how improvements could change the appearance of local streets, people can better envision what is planned and will often become more supportive. If people focus more on how nice their neighborhood could become, they will be less likely to focus on perceived negatives, such as congestion. Field visits, especially with elected officials and other policymakers, are another powerful way of conveying active transportation-related issues and opportunities.

6) *Propose interim solutions.* The field of active transportation is rife with examples of interim or temporary projects used to demonstrate the function of, and win community support for, a controversial new facility.[43] Temporary projects may include anything from a cycle track to a street closure (and public space creation). Best practices indicate that installations should appear convincingly temporary yet attractive and functional (and potentially compelling).

2.7.6 Jurisdictional Barriers

Some small cities may face jurisdictional barriers, such as a lack of authority to make transportation and land use decisions. The authority may instead reside in a county, state, or regional governmental entity (such as a metropolitan planning organization, or MPO). This is often the case with main streets that double as state highways. Best practices include collaboration with the superseding agency to identify planning and design solutions to meet the needs of both parties. More concretely, this collaboration could result in coordinated regional plans and projects that reflect best practices in bicycle and pedestrian accommodation. If a partnership cannot be formed, cities should provide documentation of their support for given recommendations or consider requesting a jurisdictional transfer. This way, there is a precedent of support if and when the superseding agency adjusts its position.

2.8 **RESOURCES:** IMPORTANT RESOURCES TO CONSIDER

For more information on land use planning, please consult the following foundational documents.

FHWA:

- Creating Safer Communities for Walking/Biking (2015)
- Pedestrian and Bicycle Information Center
- Pedestrian Safety Guide for Transit Agencies (2008)

AASHTO:

- Guide for the Planning, Design and Operation of Pedestrian Facilities (2004)

When the right tools have been placed in the right places with the right public and political support, a walkable and bikeable community can become a reality. Photo source: Mike Singleton

NACTO:

- Transit Street Design Guides (2016)
- Urban Bikeway Design Guide (2014)
- Urban Street Design Guide (2013)

OTHERS:

- Complete Streets: Best Policies and Implementation Practices (Annual)
- LEED for Neighborhood Development (2014)
- Model Design Manual for Living Streets (2011)

NOTES:

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CHAPTER 3:
THE PLANNING PROCESS

USER LEGEND

Advocate Organizations

- Housing Advocates
- Health and Safety Advocates
- Smart Growth Advocates
- Mobility Choice Advocates

Providing Entities

- Developers, Financial Institutions
- Housing Providers and Institutions
- Planning, Design or Engineering Consultants

Decision Makers

- Local Agency Planners and Engineers
- Local Elected Officials and Review Staff
- Federal, State and Regional Regulators

The first step in making a community more bike- and pedestrian-friendly is to plan for it. Planning at a high level is essential in getting treads and soles on the ground. The modern regulatory environment is very complex and can cause significant delays in constructing the infrastructure that a community wants and needs. If the foundation has not been set from the high level of policies and plans, then getting something built that will improve the physical circulation environment may be delayed or prevented because consistent planning has not been accomplished.

Community involvement is critical in the planning process. Photo source: Mike Singleton

3.1 PLANNING: OVERVIEW

A plan provides guidance on a community's long-term vision and goals. The planning process offers many opportunities to integrate pedestrian and bicycle improvements into a community's policies, plans, and projects. Pedestrian and bicycle planning may be included in a variety of plans.

- **General or comprehensive plans:** These broad plans are intended to provide a vision, goals, and policies for the long-range development of a city and include a variety of elements pertinent to bicycle and pedestrian planning: circulation, land use, parks and recreation, open space, or air quality and environmental issues.
- **Mobility master plans:** The circulation element of a comprehensive plan is an important means of integrating bicycle and pedestrian planning into broader transportation planning. This integrated approach may be bolstered by the preparation of dedicated bike and pedestrian master plans.
- **Community plans and specific plans:** These types of plans are location-specific, more detailed versions of comprehensive plans. Whereas a comprehensive plan is concerned with an entire city, a community or specific plan is looking at just a portion of that city. This level of detail typically allows for more detailed mapping and recommended improvements: bike and pedestrian facilities as they relate to land uses and roadway configurations.
- **Regional transportation plans:** These plans (e.g., county and MPO plans) present opportunities to improve regional multi-modal mobility and—increasingly—local networks of regional significance.

3.2 PLANNING PRINCIPLES: PROCESSES TO HELP BUILD WALKABLE AND BIKEABLE COMMUNITIES

Communities that are highly walkable and bikeable do not happen on their own. Some areas were developed through historical periods when vehicle travel did not dictate the design of communities. Some have evolved from policies or programs put in place. Most communities need to take an active planning and integration role to make real progress in building transportation networks that support active transportation, however. Ways to integrate this process include—

- Try to conceive of single projects that solve many problems. Consider addressing parking problems with solutions that address additional problems (e.g. conversion of parallel parking to back-in, angle parking in addition to increasing parking may contribute to traffic calming, an improved pedestrian realm, and placemaking).
- Incentivize projects that focus on enhancing the public realm. All properties impact, and are impacted by, decisions concerning public rights-of-way. Therefore, cities may incentivize project property owners to positively impact the transportation network in their immediate area (e.g. through traffic calming, public realm development, safety improvements, and active transportation enhancements).

- Integrate policies and priorities across several planning tools. These tools include the general plan; the circulation or mobility element; the land use element; conservation, climate action, or sustainability plans; park and recreation programs; and public safety and community health and well-being programs.
- Adopt multi-modal standards for level of service or quality of service as well as other complete streets or livable streets policies.
- Avoid mitigations based on levels-of-service analysis that actually hinder other modes of use, such as cycling. For example, to increase traffic throughput, additional turning lanes or general lanes are added, sometimes taking away on-street bike lanes or reducing walkway widths. One or more modes suffer so that vehicular input can be increased. This is counter to complete street goals.
- For transportation sustainability and equity in modes, consider switching to comparisons of vehicle miles traveled (VMT) or reduction in greenhouse gas (GHG) emissions.
- Ensure that development policies and review processes will help capture opportunities for active transportation improvements at the private project level or through public capital improvement plans.
- Highlight the links between land use planning, transportation planning, and public health.
- Recognize the important links between transit station area or bus stop access requirements and the role that active transportation plays in the first- and last-mile opportunities to utilize the transit facilities.

3.3 PROCESS: A SAMPLE APPROACH

The planning processes in small cities (those with populations under 200,000) may differ from one another depending on the city's neighbors and its regulatory foundation, as well as the size of the city. Planning in cities that are a part of larger metropolitan areas will likely require more coordination with neighboring jurisdictions and governing bodies than planning in cities that are surrounded by unincorporated, undeveloped lands. A metropolitan focus with regional perspective may offer cities increased support by way of funding sources and broader support, but this may also deprive the community of its independence. Standalone cities often have the opportunity to be more innovative and quicker in implementation than are those held back by multi-agency coordination and regional policies and practices. Regardless of context, all planning efforts rely on the support of planning agencies, the need for local political support, and a driving momentum created by grassroots organizations.

The following section discusses a typical planning process and a typical design process that can be applied to most active transportation improvements (figure 3-1). Some active transportation projects will be handled more at the general plan, master plan, or specific plan level and are considered planning efforts. Other plans will be for specific projects in which a much greater level of design and engineering is possible and that are therefore considered design projects. Design is an inclusive term that includes the design and engineering of a project with an emphasis on detailed plans that can be implemented.

3.3.1 Typical Planning-Level Process

The typical planning process involves a range of participants and leaders. Most often, plans originate from city planning or public works departments. As such, leaders are typically city planning or public works staff and, in many cases, hired consultants. Depending on the plan, residents and other stakeholders may also assume strong leadership roles.

Discuss Priorities

An initial discussion of priorities should involve identified stakeholders, city staff, and consultants (if hired). Priorities should relate to other planning efforts, and they should be transparent and well documented. These priorities and goals should be used throughout the planning process as guiding principles and a framework for the plan.

Document Existing Conditions

Relevant existing conditions data for bicycle and pedestrian planning typically include existing and planned transportation facilities (pedestrian, bicycle, transit, and vehicular), existing and planned land use, and demographic information (for example, bike/walk mode share, transit ridership, car ownership). This information is ideally collected as Geographic Information Systems (GIS) data. Other important information regarding existing conditions is gathered through a review of existing and ongoing plans, such as the agency's Americans with Disabilities Act (ADA) Transition Plan, standards, discussions with city staff and other stakeholders, and fieldwork verification and observation.

Identify Opportunities

Ideally, opportunities are developed through the analysis of the information gleaned from data, discussions, and fieldwork. Using the latest in GIS capabilities, spatial analysis, and modeling provides data-driven methods for identification of opportunities. GIS-based analysis topics can include attractors, walk times, level of traffic stress, bicycle/pedestrian priority, population and employment density, walk/bike-to-work mode share, income, and car ownership. Without GIS capabilities, planners will need to rely on field observation and public input to identify opportunities.

Develop an Outreach Plan

A strong outreach plan is informed by an analysis of existing conditions—with particular attention paid to community demographics—and the identification of opportunities. The traditional town hall weeknight meeting is increasingly seen as an ineffective means of soliciting community input that is representative of the community as a whole. Alternative strategies include piggybacking on existing, popular community events and using technology to create virtual town hall meetings and to reach community members on their schedules. This can be done through on-line surveys, social media outreach, e-mail surveys, and interactive websites for citizens to go to on their own time to provide feedback. A comprehensive outreach process will include gathering input from the community at large, as well as developing a smaller stakeholder steering committee composed of representatives from public agencies, advocate organizations, and community groups.

Gather Preliminary Community Ideas

This input opportunity is typically at an introductory meeting, where the project team presents the plan and receives initial input. Participants at this meeting typically share their perception of walking and cycling in the community, mark up maps showing barriers to active transportation, and suggest other ideas on how to improve walking and cycling conditions.

Develop Initial Recommendations

Preliminary recommendations should be developed through an analysis of existing conditions, the identification of opportunities, a discussion of priorities, and initial community input.

Obtain Initial Community Review of Recommendations

This opportunity represents a chance to share preliminary recommendations with the community and solicit their feedback. This is an opportunity to get directed feedback from advocacy or professional groups.

Provide More Detailed Recommendations

Recommendations should be refined, where appropriate, according to input received during the initial community review of the recommendations.

Revise Recommendations and Develop Implementation Plans

Given initial review comments from the community, revise any of the recommendations that need to be adjusted. Then an implementation plan should be developed that includes project ranking, phasing, rough cost estimates, and information regarding funding opportunities.

Obtain Final Consensus or Public Alignment on the Recommendations

This opportunity represents a chance to share the refined recommendations and implementation plan with the community and solicit their feedback.

Produce a Final Plan for Review and Adoption

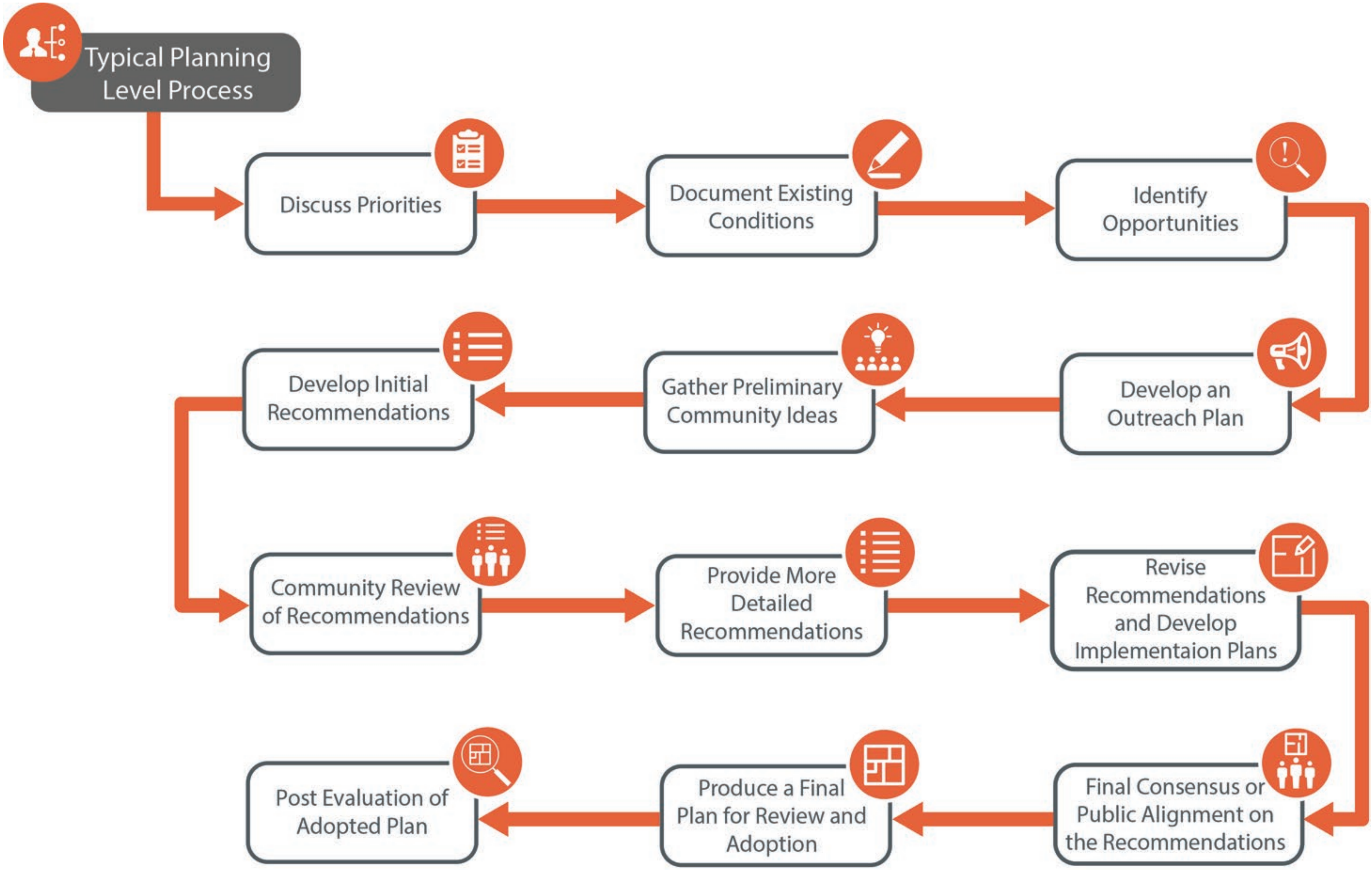
This represents the final round of production and review. Typically, approval for the plan is sought at departmental head, planning director, special boards, planning commission, and council levels.

Perform Post-Implementation Evaluation of Adopted Plan

An effective way to ensure that the plan is actually implemented—rather than "sitting on a shelf"—and that the plan successfully achieves stated goals is to develop a group of stakeholders who will monitor and assist with implementing the plan and assign staff to work toward implementation. The plan should also be shared on-line and with other public agencies that may be affected by some of the projects in the plan.

For more information on the transportation planning process, see the Federal Highway Administration's website at http://www.fhwa.dot.gov/planning/processes.

Figure 3-1: Typical Land Use and Transportation Planning Process



3.3.2 Typical Design-Level Process

The process is slightly different for a project that has had some previous level of idea creation and approval process. The design-level process focuses on specific decisions and designs that should result in something eventually getting constructed (figure 3-2).

Document Existing Conditions

The documentation of existing conditions for projects is generally the same as for plans, but because this process type is one step closer to implementation, it requires a more thorough analysis effort and can be done prior to public outreach.

Identify Opportunities

Opportunities may be different at the project level than the plan level. Project opportunities become more specific when taken from a design versus a planning perspective. The type of bike or pedestrian facility and location should be determined by previous planning efforts. Often, the original planning assumptions may not have been correct or the physical limitations of a site become a known reality, causing some of the assumptions or program elements to be modified. This may require a loop back to the original goals or policies identified at the plan level.

Develop an Outreach Plan

An outreach plan at the project level will resemble that of the planning level but may include an opportunity to capitalize on previous outreach efforts conducted at the planning stage.

Confirm Project Direction and Discuss Priorities

The initial outreach effort should be used to confirm that the project's focus and program are still supported by the community. If not, then a discussion is needed to determine the range of alternatives that should be considered. At this time, a process on how to select a preferred alternative should also be discussed. An initial discussion of priorities should involve identified stakeholders, city staff, and consultants (if hired). Priorities should relate to other planning efforts, and they should be transparent and well documented.

Identify Budgetary Constraints

Rough order cost estimates should be produced early to provide parameters for the scope of the project.

Explore Alternatives

Based on initial public input, preliminary alternatives should be developed through an analysis of existing conditions, the identification of opportunities, a discussion of priorities, and the identification of budgetary constraints. Each alternative should be measured against a ranking metric or a decision making process agreed to or informed by the initial public planning effort.

Present Project Programming and Initial Concept for Public Review

This second public input opportunity is where the project team presents the project through schematic or broad alternatives and receives detailed input on concerns or priorities. Depending on how much previous planning work was done, this step could be combined with the initial public review meeting.

Ideas should come from or at least be agreed to by the public that is affected by the decisions. Photo source: Mike Singleton

Develop Alternatives

Alternatives should be developed through an analysis of alternatives and initial community input. At least three alternative approaches, route locations, or solution types should be developed to get a true broad range of choices and costs.

Present Alternatives for Public Review

This step represents a chance to share additional or refined alternatives with the community and solicit their input. An initial ranking of the pros and cons of each alternative may be done prior to the presentation. Input should still be solicited to confirm conclusions or to air disagreements on the rankings or priorities, however. Alternatives should be ranked according to defined criteria and public input from previous meetings.

Refine the Selected Alternative

Based on rankings, a top alternative should be further refined. At this point, it is acceptable to take the project to a 30-percent design and engineering level to work out the details or to determine constraints and costs with a high level of certainty.

Final Public Outreach

This is an opportunity for the community to respond to the final conceptual design of the selected alternative. It should be made clear that additional public input will not be sought after the 30-percent design phase has been completed, so it is important to express all concerns and comments at this final outreach meeting.

Modify the Alternative

If there are still concerns over the project that indicate a lack of support of the project as proposed, some of the previous steps may need to be repeated. Having a minority opinion should not stop the project if everything has been done to address the concern or if the tradeoffs are so great that they will lessen the benefits of the alternative. If many public members have these same concerns and the concerns are based on logical discussions and not unsupportable fears, then it may be time to ask agency staff or elected officials for help to determine the future of the project.

Develop Final Recommendations

This is a final round of design refinement that comes from community input, agency review, or staff direction. This should finalize the design at the 30-percent level and allow the project to move forward. Depending on local policies and directives, this may need to be approved at higher levels through planning commission or city council actions. Those authorities may require that the environmental review process be completed at this stage as well, or, depending on the project, it may then be available for moving into final design and engineering.

Develop Final Design and Engineering Plans

The next step often includes the detailed design and engineering aspects of final construction documents, including a 60- or 65-percent construction drawing package. The package should include final drawings, phasing, detailed cost estimates, specifications, and other information needed to solicit bids, select a contractor, and construct the project.

Produce a Plan for Review and Adoption

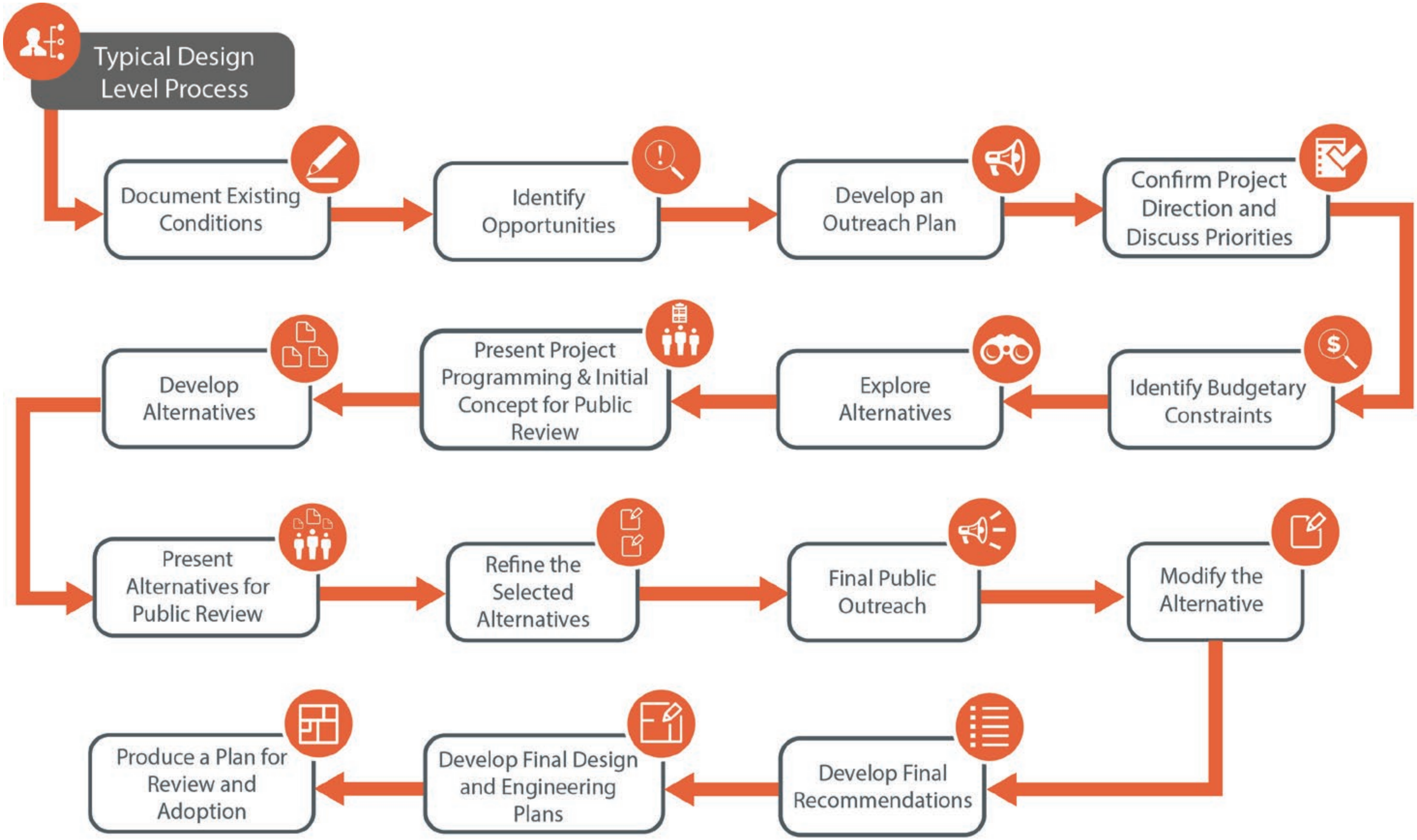
This represents the final round of production and review unless the project was approved at an earlier stage in this process. If not previously approved or if conditionally approved, this final step will act as the authoritative approval to commence the construction phase.

If you do not bring the public along on the process, they are likely to show up at the approval process and are not so likely to support the project. Photo source: Joe Punsalan

3.4 TOOLS: ENSURING INTEGRATED PLANNING

Integrated planning refers to the incorporation of bicycle and pedestrian accommodation planning into overall planning processes. Making bicycle and pedestrian accommodation an integral part of the planning process, rather than a "tacked on" element or afterthought, is necessary to create truly walkable and bikeable communities. Integration is required to achieve the health, safety, and welfare benefits discussed in chapter 2. Specific means of making bicycle and pedestrian accommodation planning integral with other efforts are described in table 3-1.

Figure 3-2: Typical Land Use and Transportation Design Process



3.4.1 Develop Multi-Modal Transportation Plans (MM)

MM-1: Develop transportation plans that focus on the improved mobility of people and goods rather than automobiles.

MM-2: Develop plans that include goals of lowering overall vehicle miles traveled and greenhouse gas emissions.

MM-3: Recognize the relationship between transportation modes, and plan accordingly (i.e. transit enables longer cycling and walking trips; cycling or walking enables "first- and last-mile" connections to transit).

MM-4: Utilize transportation demand management measures to maximize existing facilities.

MM-5: Match transportation investments with planning goals.

MM-6: Consider how transportation is connected with land uses and destinations that represent the daily needs and trips of residents.

3.4.2 Develop Land Use and Transportation Plans Concurrently (LT)

LT-1: Highlight the synergy between land development and transportation projects.

LT-2: Reinforce land use and transportation goals and policies with mobility options.

LT-3: Demonstrate why cycling and walking are key to the development of compact communities.

LT-4: Ensure that "10-minute neighborhoods" are built on a strong foundation of mobility options so that most daily needs can be met with a 10-minute walk, ride, or use of transit.

LT-5: Add mobility options to the concept of housing options.

LT-6: Provide a balance of jobs and housing to lower long-distance commute requirements.

LT-7: Develop parking and site-planning goals that support walking, transit use, and cycling.

LT-8: Use building design standards, including building scale and orientation, that are inviting and accessible to people arriving on foot, bike, and transit.

3.4.3 Suggest Other Means of Interjecting Bicycle and Pedestrian Planning (OM)

OM-1: Develop policies of routine accommodations that require appropriate bicycle and pedestrian accommodation in all new and major redevelopment projects (for an example, see the San Diego Association of Governments' Board Policy 031, Rule 211).[1]

OM-2: Develop policies of adding or improving bicycle facilities during routine street resurfacing (slurry sealing) and striping projects by way of lane diets or road diets.

OM-3: Develop a policy of street reclamation, wherein underused street space is reclaimed for cycling, walking, plazas, or other "higher" public uses.

Table 3-1: Summary of Planning Process Guidelines and Possible Points

PLANNING PROCESS RELATED TREATMENTS

Best Planning Process for Creating Walkable / Bikeable Communities	Develop Multi-Modal Transportation Plans (MM)					
	MM-1 - Focus on mobility of people & goods rather than vehicles	**MM-2** - Focus goals on lowering miles traveled & greenhouse gas emissions	**MM-3** - Recognize the relationship between transportation modes in plans	**MM-4** - Use TDM measures to maximize use of existing infrastructure	**MM-5** - Match transportation investments with planning goals	**MM-6** - Consider how the transportation network is connected
Effectiveness Rankings***	2	2	1	1	2	1

Best Planning Process for Creating Walkable / Bikeable Communities	Develop Land Use & Transportation Plans Concurrently (LT)							
	LT-1 - Highlight synergy between land development & transportation projects	**LT-2** - Reinforce land use & transportation with mobility options	**LT-3** - Show why biking & walking are key to compact communities	**LT-4** - Assure that "10 minute neighborhoods" include mobility options	**LT-5** - Add mobility options to the concept of housing options	**LVT-6** - Provide a balance of jobs & housing to lower long distance commutes	**LT-7** - Develop parking/site plan goals that support walking, transit & biking.	**LT-8** - Use standards that support people arriving on foot, bike & transit.
Effectiveness Rankings***	1	2	1	2	1	2	1	1

Best Planning Process for Creating Walkable / Bikeable Communities	Suggest Means of Interjecting Bike & Ped. Planning (OM)							
	OM-1 - Develop policies that require bike & ped. integration	**OM-2** - Develop policies of adding bike facilities with street resurfacing	**OM-3** - Develop a policy of reclamation where space is used for other modes	**OM-4** - Develop policies of multi-modal mitigation to offset traffic impacts	**OM-5** - Develop policies for parking reductions if modal options are added	**OM-6** - Adopt a complete streets policy pledging to accommodate all modes	**OM-7** - Prioritize bicycle & pedestrian capital improvement projects	**OM-8** - Create an ADA transition plan
Effectiveness Rankings***	1	1	1	1	1	2	2	2

Number of Planning Process Objectives: 22

Number of Planning Process Points: 31

*** Use as general guidance. Costs and benefits are localized and benefits will depend on the exact conditions within each community.

OM-4: Develop policies of multi-modal mitigation, wherein developers mitigate their transportation impacts by providing multi-modal—rather than automobile-only—improvements, such as allowing bike parking to substitute for car parking spaces.

OM-5: Develop policies for parking exemptions in which developers are exempt from providing vehicle parking in certain districts and instead contribute to multi-modal improvements, including bicycle parking (see land use case study on Gainesville, Florida, in chapter 4).

OM-6: Adopt a complete streets policy pledging to accommodate all modes of transportation in future roadway design, such as Smart Growth America's list of the "Best Complete Streets Policies."[2]

OM-7: Prioritize bicycle and pedestrian capital improvement projects (CIPs), and establish goals for their implementation.

OM-8: Create an ADA transition plan that identifies necessary accessibility improvements and establishes goals and prioritization of implementation.

3.5 IDEAS: PROJECT-SCALED STEPS

- No matter how small the project, there are opportunities at all scales to provide for active transportation improvements.
- As a landowner, with or without a project, understand the importance of proper planning and design and how it may affect your property or proposed project in the future. Become engaged in the process well before it is time to submit applications to the local agency for approvals and permits.
- Build alliances between public agencies and private interests so that when the time comes to obtain funding or to get approvals, the process will move more quickly and with less resistance.
- Support a positive outreach process that is transparent yet still protective of private property rights and the needs of the broader public.
- Engage local advocate groups in projects as supporters of good planning, safety, and well-designed communities.
- Offer to be a partner in funding adjacent active transportation elements that may extend a bit beyond the project's immediate impact areas. The project and the community will see a return on this investment.
- When possible, engage professionals that balance creativity and solutions with budgets and engineering constraints. This often means that planners, architects, landscape architects, and engineers will need to be part of the development team.

3.6 RESOURCES: IMPORTANT RESOURCES TO CONSIDER

FHWA:

- Creating Safer Communities for Walking/Biking (2015)
- List of On-line Reports and Technical Publications
- Pedestrian and Bicycle Information Center

NACTO:

- Transit Street Design Guides (2016)
- Urban Bikeway Design Guide (2014)
- Urban Street Design Guide (2013)

ITE:

- Designing Walkable Urban Thoroughfares (2010)

OTHERS:

- Complete Streets Best Policies and Implementation Practices (2010/Annual)
- LEED for Neighborhood Development (2014)
- Model Design Manual for Living Streets (2011)

For 10-minute neighborhoods to work, local businesses need to provide needed services or national chain stores need to downsize. Photo source: Plannersweb.com

Most members of the public can benefit from bike and pedestrian improvements. Photo source: Mike Singleton

NOTES:

1 http://www.sandag.org/organization/about/pubs/policy_031.pdf.

2 http://www.smartgrowthamerica.org/complete-streets-2014-analysis

CHAPTER 4:
LAND USE & MOBILITY INTEGRATION

USER LEGEND

Advocate Organizations
- Housing Advocates
- Health and Safety Advocates
- Smart Growth Advocates
- Mobility Choice Advocates

Providing Entities
- Developers, Financial Institutions
- Housing Providers and Institutions
- Planning, Design or Engineering Consultants

Decision Makers
- Local Agency Planners and Engineers
- Local Elected Officials and Review Staff
- Federal, State and Regional Regulators

All successful and sustainable communities include a range of distinct and different types of places—from quiet, shady residential streets to busy corridors, and from noisier, mixed-use downtowns to single-purpose industrial and employment districts. Considering how these land uses are arranged is perhaps the most important way to create communities that can easily be walked and biked. Within these various land use patterns, site and building design are also critically important in ensuring that coherent, safe, functional, and valuable places result.

The street layout and design of the public realm should be supportive of adjacent land uses. Likewise, encouraging land uses that provide an interface with the street and eyes on the street will be supportive of the street classification and its success. Photo source: Dan Burden

4.1 PRINCIPLES: BASICS OF A WALK- AND BIKE-FRIENDLY COMMUNITY

Good land use planning and urban design are best measured by how they complete the community's vision for a specific place and how they enhance the daily lives of their residents and users.

Consider the following qualitative and quantitative principles of effective land use planning—

- Effectively integrate transit, land use, and design.
- Encourage employment related businesses to be located within a 15-minute commute by public transportation, cycling, or walking.
- Create a shopping experience that is convenient and within a comfortable walking or biking distance.
- Site schools and parks within walking distance of a large number of homes.
- Provide useful transit options accessible by a 10-minute walk from a large number of homes and/or workplaces.
- Establish zoning standards or guidelines that protect or create the vision of the community.

Building setbacks need to match the needs of the public walk, but no more than necessary. Photo source: Ryan Snyder

4.1.1 Actions To Include

The following are overarching or underlying land use planning and design principles or actions that are the foundation of the recommendations made in this chapter.

- Allow for integration of land uses, bringing everyday destinations (schools, parks, and retail) and residential areas closer together, thereby decreasing distance barriers for walking.
- Strive for a housing and jobs balance in local communities. If not possible, provide walking and transit routes or bike facilities between these separated areas.
- Permit a mixture and intensity of land use to support an efficient transit system.
- Provide the ability to develop a compact urban framework through block length maximums and mixed-use zoning that ensures a high intersection density, thereby providing greater connectivity for active transportation.
- Provide incentives, bonus densities, or return of savings associated with balanced neighborhoods that have lower roadway infrastructure capital and maintenance costs.
- Prioritize continuously connected walkways along development that include buffering from the street.
- Require street connectivity within housing developments to improve the directness of routes and to decrease the distance barriers for walking and bicycling.
- Require a maximum setback distance for building entrances (as compared with the more standard setback minimums), which can enhance the pedestrian experience by siting buildings closer to the street and ensuring shorter trips through parking lots.
- Provide flexibility on the required number of car parking spaces to limit or reduce the size of parking lots or to encourage shared parking strategies and the unbundling of free parking that is hidden in rents and leases.

- Allow for the sharing of off-street parking among adjacent uses, and require new development to use shared parking; where shared parking is not possible, place parking lots to the rear of the lot or underground.
- Create bicycle parking minimum standards at commercial and workplace destinations, and promote showers and lockers to encourage bicycle-friendly businesses.
- Limit the interruption of the pedestrian experience by driveways by encouraging vehicular access from alleys or shared driveways when possible, as well as establishing driveway maximums in urban areas.
- Prohibit leapfrogging or noncontiguous development, and require consistent and connected patterns of development to reduce sprawl and distances between land uses.

4.1.2 Actions To Avoid

Proper land use planning can be quickly undone by mistakes made by planners or, more likely, benign neglect when planning principles are ignored. The following land use actions can cause a community to become isolated and bike and pedestrian unfriendly.

- Allow vehicular speed, movement, and flow to be the focus of how a street is engineered.
- Isolate land uses in uniquely different areas of the community.
- Concentrate retail in "big box" stores and in one area of a city, away from its customers.
- Allow a community's jobs to move to adjacent communities, and focus on providing major auto-centric corridors to get automobiles there.
- Concentrate local schools into larger regional schools that are isolated from neighborhoods.
- Focus on regionally scaled park facilities.
- Focus on large, simplified polygons of land uses instead of fine-grained neighborhoods and pedestrian-scaled mobility options.

4.2 TOOLS: BIKE- AND PEDESTRIAN-FRIENDLY LAND USE PRACTICES

This part of the chapter discusses a classification of the many tools that can be used to improve the walkability and bikeability of a community. Every city, town, and village is unique. This uniqueness creates a sense of place. There are a few general types of places that repeat from community to community where the relationship of street to adjacent land uses can be best expressed, however. The following place types are typical throughout built communities, although the type of community (urban, suburban, and rural) and local conditions create unique place types very specific to the community's setting. Using the tables on the following pages, look for ideas for your community by first picking the place type and then the community type to see what may apply best in your local area.

4.2.1 Neighborhoods (N)

Neighborhoods are the main component of cities, towns, and villages. These are the places where almost everyone lives. Neighborhoods may be composed primarily of single-family homes or may include a range of multifamily housing types.

A well scaled neighborhood street with a parkway buffer, walkways and buildings in close proximity to the walkway system. Photo source: Ryan Snyder

4.2.2 Corridors (C)

Corridors traverse developed areas and can have many different characteristics. They can occur at all scales—from a rural stop along a highway, to a main avenue within a town, to a high-intensity urban corridor in a large city. Many major street corridors began as rural roads, evolved into automobile thoroughfares lined with a range of commercial uses, and have lost much of their commercial value as retail and office uses have migrated to larger-format retail centers and business parks. Many of these corridors present a significant opportunity for communities to provide infill housing mixed with modest amounts of commercial uses within walking distance of adjoining neighborhoods. The repositioning of these often blighted "commercial strips" as more valuable mixed-use places requires a coordinated redesign of the streets and careful planning of the infill development along the corridor.

A well scaled infill project can help to bring life back to streets by way of the design of the interface, the ground floor uses and by adding more residents and potential customers to the local area. Photo source: Google Earth

4.2.3 Districts (D)

Special-use districts are areas dominated by a single type of land use, such as industrial districts where manufacturing, production, and distribution of goods are the primary activities. Other examples are employment centers that primarily provide high concentrations of commercial offices, medical centers, and large education campuses. Such districts benefit from a location that provides easy access to regional roads and highways. The sizes of buildings, truck traffic volumes, and hours of operation make them generally unsuitable for residential uses, however. Even within special-use districts, there are many opportunities to integrate useful amenities and strong reasons to ensure that all the streets are walkable, bikeable, and served by transit. In industrial, office-dominated, educational, or medical campus districts, this enables restaurants and other support businesses to succeed while reducing workers' need to drive out of the district for basic services, thereby reducing local traffic congestion as well.

Bicycle and pedestrian facilities can be incorporated into office parks . Photo source: http://www.schlitzpark.com/

4.2.4 Centers (VC/TC/UC)

Centers are typically the economic and social hearts of villages, towns, and cities. They can be village-scale centers or low- to high-rise downtowns, where unique regional destinations are often located. Village centers are generally related to rural areas, whereas town centers are related to suburban areas. Urban centers are restricted to urban communities by definition. The treatments and level of intensity of the three center types warrant guidelines specifically designed for each.

Village Centers (VC)

Village centers take many forms and occur at all scales, from a country store at a key intersection in a rural neighborhood to a busy "main street" in a larger but mostly rural community. Most village centers are generally more historic areas because many were built during a time when walking to stores was important and parking was generally scarce. They generally occurred prior to World War II, some dating back to the founding of original towns.

Special districts with a campus style layout can be very walkable and bikeable. Photo source: Ryan Snyder

Town Centers (TC)

Town centers in suburban areas generally came about after World War II, tied closely to suburban sprawl. Town centers are often less distinct in suburban areas than they are in rural centers or urban centers. Often it is difficult to find a public center of a suburban community. The centers often tend to be shopping districts or other institutional areas that are concentrated in a core area. For clarity of wayfinding and a sense of community and destination, a suburban area needs to have a center. People who tend to gravitate to suburban areas do so because of the lifestyle associated with single-family neighborhoods and school facilities and generally are not as concerned about the convenience of nearby shops, jobs, and schools.

Urban Centers (UC)

The primary difference between a town center and an urban center is that the latter environment is a compact mix of a wide range of land uses that typically creates a high land value as well as a high potential for roadway congestion. Accordingly, it is important that in addition to having a balanced street network for pedestrians, bikes, and motor vehicles, such places be provided with high levels of transit service.

Shopping districts should be designed with wide walkways that activate the public space. Photo source: Lisa Padilla

4.2.5 Housing Choices (H)

Where people live often determines how they move about the community on a daily basis. Often, where a person decides to live is determined by the availability of housing types and price points. Therefore, if a community is to be walkable and bikeable, it has to start with the mixture, size, and distribution of housing.

Select Sites To Develop That Are Already Walkable and Bikeable (HL)

To ensure that future owners, tenants, and renters can walk or bike to various destinations, housing planners, during the first step of site selection, should take into account the context of where the proposed project can be considered and whether the project can be centered in more intensive, diverse, and transit-supported areas.

Concentrate Housing Near Transit (HT)

Walking and biking are natural extensions of trips taken by transit. Many transit agencies do a good job of accommodating bikes on transit, and some make improvements for pedestrian access to stations. Transit, in turn, leverages partial trips taken by biking and walking. A well-served area persuades residents to be at least "car light," meaning that multi-driver households may be able to get by on one vehicle. With one vehicle, they are also much more apt to take transit and walk or bike to the station or to their final destinations. Ideally, development should be within 0.25 mile of transit for walking and 1 mile for biking. Some people will walk up to a mile and ride more than 3 miles to take transit, but their numbers drop off quickly, to a lesser degree.

Housing near transit. Photo source: Mike Singleton

Provide a Variety of Unit Sizes and Price Points (HS)

The nation's demographics are very diverse, and the occupant mix of this demographic requires a variety of resources. Various economic limitations and quality-of-life preferences have shifted housing needs to a broad range of housing types. To support a local jobs housing balance and encourage people to live in areas that are transit supportive as well as walkable and bikeable, a range of price points are needed, especially for households earning at or below the Area Median Income. Generally, the primary determinants of the price of units are first, location, and then, size. Most projects build excessively large units. Studio units, one-bedroom units, and flexible space design all allow for a person to afford to live near where they work, learn, play, and shop. Three-bedroom units are also important; they allow families to live in urban areas and not be forced into suburbia to find enough rooms.

Housing should be diverse for diverse residential needs. Photo source: Mike Singleton

Provide a Mixture of Rentals (HM)

To support a jobs housing balance in an area, workforce housing should be provided. The housing options should focus on rentals because ownership of housing can often anchor the buyer into one location for many years, during which the person may have multiple job locations and be forced into long commutes to get to work. If people are renting, they are more apt to find a location to rent near their employment than if they owned the unit. To increase diversity, include Additional Dwelling Units (ADUs), cottage-style housing, and workforce townhomes. Provide inclusionary housing that integrates affordable units for those living below the local median income found in the community.

Rentals and market rate sale housing. Photo source: Mike Singleton

Create Compact Units To Lower Costs (HC)

The amount of space needed for developments directly affects how spread out our residential origins and destinations become. The more spread out, the more citizens have to rely on longer-distance driving. The more land used up, the greater the costs of housing and leasable spaces. All of these factors affect the ability of an area to provide people and services that can be connected with walking and biking.

Develop Flexible Units That Can Grow With Family Size (HF)

Design flexible space into developments, in which walls can be moved to combine smaller blocks of space to create spaces that match the buyer's or renter's needs. Design flexible space into developments where connections can be made between units if the occupant size increases or decreases.

Compact infill and flexible units make housing more affordable. Photo source: Steven Vance

4.2.6 Land Use Mixtures (L)

Social trends created the current problem of isolated land uses, and many people in the planning professions were unable to see the disadvantages with this type of land use pattern. What was a positive attempt at separating incompatible land uses through Euclidean zoning and land use enforcement led the way to planning that over simplified land use patterns. It resulted in many general plans having large, colored land use polygons in widely separated quadrants of a community. Although this approach made mapping and planning easier, it resulted in replacing walkability as the appropriate scale to design our cities with the planning scale of the automobile and the freeway system. A return to human-scaled, walkable communities requires a reversal of planning trends from the past 50 years. The following are some ideas on how to avoid making auto-centric communities.

Encourage Housing and Jobs Near Each Other (LJ)

The most prevalent trip is one related to going to work each day, yet we separate our workplaces from our living places—often at great distances. Build housing near employment centers or at least near transit centers that can connect with employment centers. Traditionally, the types of employment that are more likely to have employees who live and work in the same general area are blue collar jobs because they were more widely distributed than were white collar jobs that tended to be concentrated in business parks, financial market areas, and government centers. Those who cannot afford higher transportation costs are more likely to live and work closer together. Current trends are indicating that those in higher-paid jobs are increasingly willing to pay more to live and work in more urban areas that have a concentration of social, economic, and entertainment options, however. Small business owners also often look close by for living opportunities. If jobs are centered in more remote areas, try to connect these areas with bike and pedestrian facilities or improved access to transit that would then connect to these job centers.

Encourage Community Centers Near Housing (LC)

For areas with families, young single adults, and seniors, a community center can be a very important part of daily life. Select a development area that is close to existing community centers. If the project is large enough, consider building a community center as part of the overall project.

Encourage Neighborhood Schools (LS)

Second to employment centers, the next most prevalent daily destination is schools. The travel may be from school buses, drop-offs, or, for older high school and college-aged students, by way of a vehicle. A well-distributed network of schools will result in more walking, biking, transit use, and carpool use. A centralized school system will require longer-distance commutes.

Provide Smaller and Well Distributed Parks (LP)

Access to parks is a regular weekly activity for families and younger active adults. The recreation experience should start at the front door, not at the car door. Walking or biking to the park is a health benefit associated with active transportation. A 10- to 15-minute walk time distance is reasonable for those wanting to get exercise. This translates into a 0.5-mile distance for walking and a 2-mile distance for biking. Tot lots should be within less than 0.25 mile of families. Smaller parks allow for distributed investments in broader areas compared to all investments going into community wide park facilities.

Encourage Small or Distributed Grocery Stores and Pharmacies (LG)

Local stores should be aimed at providing the daily needs of customers at a neighborhood level. When stores are centralized into large retail centers that are far away from residents and only accessible by vehicle, less frequent but larger purchases become more common, which in turn requires a vehicle just to transport the purchases.

Focus on Vertically or Horizontally Mixed Uses (LV)

The more land uses that can be found within a 10-minute or 0.5 mile walk of each other, the more walkable and bikeable the community will be. For the most efficient use of land, utilize ground floor spaces for retail, community functions, and services, with employment and residential uses on the upper floors. This vertical mix is the most efficient use of land area as long as privacy and noise issues are addressed. Horizontally distributed land uses may also be supportive of walking and biking, however, if proper site planning has been accomplished.

Neighborhood grocery stores can reduce auto trips and distances. Photo source: Dan Burden

Encourage High-Density Housing in Blocks Surrounding Walkable Main Streets (LM)

Given a 10-minute walk time, linear corridors of commercial businesses and older main streets are often surrounded by customers. Often, these districts turn their backs on neighborhoods. Land use planning and street layouts that encourage alleyways or short blocks provide better walking routes into these main street areas. Make sure that major roadways are able to be crossed safely and conveniently so that they do not split a main street area in half for those traveling by foot or bike. Consider transitional zoning for mid-density residential between single-family neighborhoods and main streets. This allows the single-family homes to be buffered from noise and traffic and builds in additional patrons for nearby businesses who do not require parking when visiting the businesses.

Add Eating/Entertainment/Social Centers Near Housing (LE)

People like to watch people and other activities occurring in a neighborhood. This makes people feel connected with others socially and provides great opportunities for the start of conversations that can lead to friendships. People like to eat outdoors when the weather is suitable. They like to walk to local entertainment and social centers. Provide these types of facilities near neighborhoods and encourage higher densities of residential populations to support these types of businesses.

4.2.7 Human-Scaled Elements (T)

The historical development of cities and towns throughout the world was designed with the human scale in mind until the last half of the twentieth century. The best cities throughout the world have always combined urban forms, street design, and land use mixtures that allow a person to work, play, learn, shop, and meet others, all within walking distance. Even building design that emphasized the human scale was important in our early communities but lost during the modernization of our cities. Horses, wagons, and buggies began to stretch this distance further. Bikes also extended the distance a few miles more down the road. Early transit buses and trains stretched our communities out more. None of these changes extended our range of communities faster and further than the advent of wide ownership of private automobiles, however. The scale of human travel based on walking needs to be revisited if we want our communities to become more walkable and bikeable. Destinations need to be planned to be closer together if we want people to walk and bike to them.

Reserve Avenues/Boulevards for Main Street-Type Retail (TA)

An avenue or a boulevard (see chapter 5 on street design) is the best location to have main street types of businesses. Although a main street is a type of street by itself, main street here refers to a scale of business and orientation of the business to the street. The street arrangement, pedestrian walkways, and bike facility elements can all add to the commercial viability of a street of commerce. Reserve these special streets for commercial activities that can build synergy between one parcel and the next. This can occur along corridors or main streets.

Discourage Big-Box Retail From Neighborhoods/ Centers (TB)

Large, regionally sized commercial buildings can dominate and dehumanize the scale of businesses. It can pull away a customer base from an area that was previously successful. The lure of free and ample parking can draw away a customer base to those businesses that offer only a product to be purchased at discount, volume prices. Businesses that are part of a user experience, including going to a nice place and interacting with others, are one of a few ways to counter the pull of big-box retail. Such businesses are designed for user experience and social interaction. Big-box retail is not defined by the franchise type or prices and marketing demographics but on the form of the building and the presence of large parking lots, which encourage longer-distance driving to meet basic neighborhood retail needs. Some of the large retail corporations have adapted their buildings and locations to be more contextual with urban areas or infill locations. If these types of developments do occur, make sure that through-the-site access for pedestrians is provided so that they are not forced around super blocks. Also build to ensure that people who have driven are not forced to move their vehicles to multiple locations in the same parking lot because the distance is too great and unfriendly to walk to other stores in the complex.

Keep Single Land Use Areas to Less Than Six Contiguous Blocks (TI)

A fine grain of land use mixture is needed to create walkable and bikeable communities by providing a mixture of origins and destinations in a walkable matrix. Block after block of single land uses do not promote walking or biking from origin to destination if the distance is too far. Avoid having more than six blocks in a row of the same land use. For measurement purposes, assume that one block is an average of 200 feet on its long axis. Some length of employment, institution, recreation, retail, or public services should interrupt the sameness of land uses that often prevails in many areas nities. It is also important to limit phys between different land use types. Pro destrian cut-throughs between housing office or retail developments. Anoth acceptable measurement is a 10-minute walk, or 0.5 mile, where land uses need to be mixed to support origins and destinations at a walking scale.

Orient Public Spaces at Centers of Intense Use (TS)

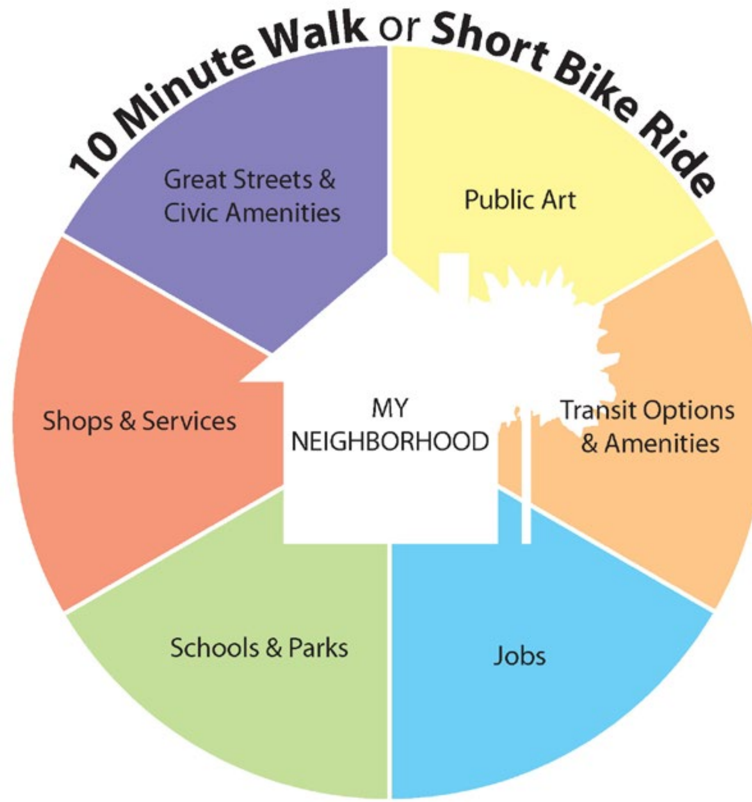
Human nature is to want to be part of activities with other humans. Urban forms and use levels that are too intensive can result in stress, however. Public spaces where a person can be slightly removed from the high intensity of uses should be added in centers to provide outlets for this stress. These areas als provide reasons for walking and help to tivate the street, making it better for oth may also be enticed to walk or ride th well as to—these areas.

Provide Local Uses in 10-Minute Walk Neighborhoods (TT)

Historically, 10-minute neighborhoods are how our towns originally grew. The centers of towns were a mixture of land uses that supported a lifestyle in which the majority of what people needed was within a 10-minute walk. In today's terms, a 10-minute neighborhood is where residents can access shops, services, recreation, and transit within a 10-minute walk. This concept needs to be included in urban planning and new development (see figure 4-1).

Figure 4-1: Ten minute neighborhoods

Typical services needed within walking distances.



4.2.8 Urban Design Treatments (U)

Urban design is the creation of urban environments, whether in small villages, neighborhoods, corridors, town centers, or major urban districts. Although sometimes used to describe only the selection of sidewalk patterns, benches, and streetlights, the term urban design is used here in its broadest and simplest sense: the design of environments in which people live, work, shop, and play.

The design and use of private development—collectively, the "private realm" of the city—must work in tandem with and shape the public realm of the city, defining the overall character of the place. When the design of the private and public realm work well together, the places they make are often experienced as "great streets" or "great places" and desirable destinations.

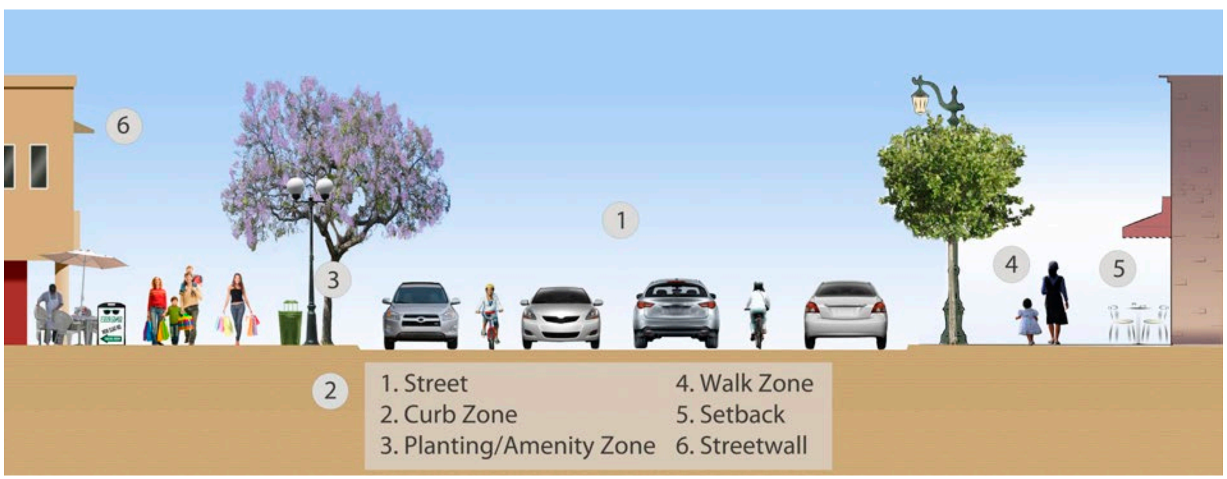
Creating great streets with good private realm design starts at the initial phase of laying out a project on a site, including the location and design of the building or buildings and the design of the access, parking, and landscape. Urban greening is one way of softening the harsh urban environment by providing human scale, visual interest, and comfort from extreme changes in weather. It also makes our built environments more sustainable. The following principles are general and are based on practices that support livable and healthy communities through (1) thoughtful site design, (2) appropriate building forms, and (3) good relationships between the building and the sidewalk and street that it fronts.

Positive Site Design and Orientation (UD)

The orientation of every building affects the building's relationship to people on the street. Each building component demands careful site design. Orientation of the active aspects of the building to public realm aspects of the street is imperative to activating the street and celebrating the pedestrian. Public spaces, parks, plazas, and tot lots help to tie the street to the land use and provide for socialization and spaces to eat, talk, and watch. These spaces can also provide for special events, farmers markets, and other social events. Parking lots and service entrances should be located toward the rear of the lot, accommodating automobiles but making it comfortable for people to access the buildings on foot. In order to encourage safe crossing at intersections, building entrances are best placed near these corners.

The public edge of a site should include landscape treatments and greening for aesthetics and sustainability as well as for adding human scale and protection from climate extremes.

Figure 4-2: Active ground floor spaces are essential in creating a street life that in turn, supports retail areas



Active ground floor spaces are essential in creating a street life that in turn, supports commercial retail areas. Photo source: Ryan Snyder

Appropriate Building Forms (UB)

Every building interacts with the street, so the details of key aspects of its form need careful consideration (see figure 4-2). The fenestration, window transparency, proximity to the walking portions of the street, height, and human scale of the building all determine the walkability of the street and how it interacts with the adjacent land uses.

Buildings' Relationship to Walkways (UW)

Each building needs to interact directly with the adjacent sidewalk on a micro level. Physical and visual access is critical for street activation and personal safety because it helps to provide more eyes on the street and more nearby social activity, which, in turn, supports many types of businesses.

4.3 BENEFITS: THE RIGHT TOOLS

Land uses set the foundation for a walkable and bikeable community. Although transit may bridge the distance gap for more remote employment areas, destination distance is the most important land use factor to consider. Choosing the right improvements for an area requires attention to the issues that are in need of change, the context of the project site, the available budget, and the benefits desired from the investment. This section ranks the characteristics and benefits achieved from each listed element. Table 4-1 shows the benefits achieved by the implementation of each element.

Supports affordable lifestyles and transportation choices: Helps people become more financially independent through savings in housing costs resulting from lower construction costs.

Saves commuting time and personal transportation costs: Can reclaim a person's time and money by providing links to less-expensive commute patterns and modes or by walking or biking.

Enables walking and biking due to decreased distances afforded by land use proximity: Allows for more direct walking and biking trips resulting from close proximity to local services, retail, schools, recreation, and employment.

Provides for a jobs/housing balance: If a variety of housing types and costs are provided, this housing could support local workers or may encourage employers to locate in the area.

Supports 10-minute neighborhoods with services: Supports the concept of a 10-minute neighborhood, where most trips can occur within a 10-minute walk, ride, or drive for a resident.

Provides for trip chaining within local drive time: Because a variety of services are provided in a well-mixed neighborhood, many trips can be chained together to and from work or school.

Builds more sociable and connected communities: Walking, local shopping, and the activation of the street can contribute to improved social interaction and an improved sense of community.

Can be integrated into smaller-scale projects and/or initiatives: The scale of this improvement makes it likely to be implementable as part of smaller infill projects or other neighborhood-level improvements.

Provides multiple benefits for many individuals: Because of the protection or convenience of travel, this element should entice new users to biking and walking for transportation or recreation.

4.3.1 Intensity Factors To Consider

Decisions that need to be made in terms of selecting the right tool for the right situation are partly based on the street intensity of vehicular movement (number of vehicle trips and speed), land use intensity (dwelling units per acre, mixture of land uses, and amount of activity), and the type of community (rural, suburban, or urban). Figure 4-3 displays the dimensionality of this decision process. A simple, two-dimensional approach of only two of these factors is not possible. All three dimensions must be considered when trying to find the best match of solutions to the location of the planned facility or where the countermeasure is needed. Although land and construction costs may be higher in more-intensive areas, compact development and existing infrastructure lower costs. These areas also enable increased physical activity, as walking and biking become a greater option through land use proximity. These transportation options also provide economic savings for the people living in these locations, which can offset the increases in housing costs.

Figure 4-3: The "Intensity" Cube

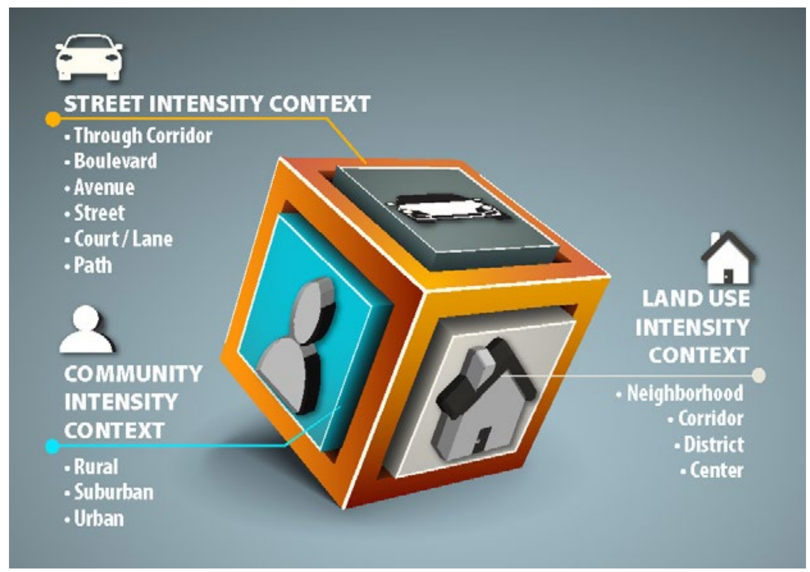


Table 4-1: Best Land Use Practices for Creating Walkable/Bikeable Communities

Best Land Use Practices for Creating Bikeable Communities*	HOUSING CHOICES						LAND USE MIXTURES								HUMAN SCALED ELEMENTS					URBAN DESIGN **		
	HL - Select sites that are already walkable / bikeable	**HT** - Concentrate housing near transit	**HS** - Provide a variety of housing sizes	**HM** - Provide a mixture of rentals and for sale units	**HC** - Create compact units to lower costs	**HF** - Develop flexible units that grow with family size	**LJ** - Encourage housing and jobs near each other	**LC**- Encourage community centers near housing	**LS** - Encourage distributed neighborhood schools	**LP** - Provide smaller and well distributed parks	**LG** - Encourage distributed grocery stores / pharmacies	**LV** - Focus on vertically or horizontally mixed uses	**LM** - Backup Main Streets with high density housing	**LE** - Add eating / entertainment near housing	**TA** - Reserve Avenues / Blvds. for Main Street retail	**TC** - Restrict big retail from Neighborhoods /Centers	**TI** - Keep single land uses to less than 6 blocks	**TS** - Orient public spaces at centers of intense use	**TT** - Provide local uses in 10-minute neighborhoods	**UD** - Thoughtful Site Design	**UB** - Appropriate Building Forms	**UW** - Buildings' Relationship to Walkways
Effectiveness Rankings* **	4	4	2	2	2	1	4	3	3	2	2	1	1	1	3	3	3	2	2	3	1	1
Supports affordable lifestyles and transportation choices	●	●	●	●	●		●	●	●	●	●	●						●	●			
Saves commuting time and personal transportation costs		●					●		●								●		●			
Enables walking and biking through land use proximity		●							●	●	●		●	●					●			
Provides for a jobs / housing balance	●	●	●				●												●			
Supports 10 minute neighborhoods with services	●	●	●				●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Provides for trip chaining within local drive time		●					●					●	●	●	●		●		●			●
Builds more sociable and connected communities	●	●	●	●		●		●	●	●	●		●	●				●	●	●	●	●
Can be integrated into smaller projects / initiatives	●		●	●	●	●				●		●						●		●	●	●
Provides multiple benefits for many individuals	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●

*** Use as general guidance. Costs and benefits are localized and benefits will depend on the exact conditions within each community.

Number of Land Use Guidelines: 22

Maximum Points Possible: 50

4.3.2 Place-Types To Consider

The remainder of the document utilizes community types (rural, suburban, and urban) along with place types (neighborhoods, corridors, districts, and centers) to describe the conditions that must be taken into account when trying to find the right solution for the right location. Rural areas usually have less complexity and less intensity than many other community types. They have their unique issues that must be addressed, however. For a map showing a typical rural area, please refer to figure 4-4. For a depiction of a suburban area, please refer to figure 4-5." Urban areas generally require more complex and costly improvements because of the intensity of land uses, people, and vehicular movement. For a typical urban area, please refer to figure 4-6.

This small street in Philadelphia requires no special walking or biking solutions since the intensity of vehicular, people use and lands uses are so low. Photo source: Mike Singleton

Little Italy in San Diego has a large number of persons with high levels of vehicular traffic which requires special solutions to create public spaces. Photo source: Mike Singleton

Seattle has a robust street, transit, and bikeway system. Solutions need to keep the local conditions in mind. Note treatments are not fully compliant with MUTCD. Photo source: Mike Singleton

Figure 4-4: Typical Rural Community under 50,000 population

This model will be used as the background for bike and pedestrian treatments in other sections of this chapter.

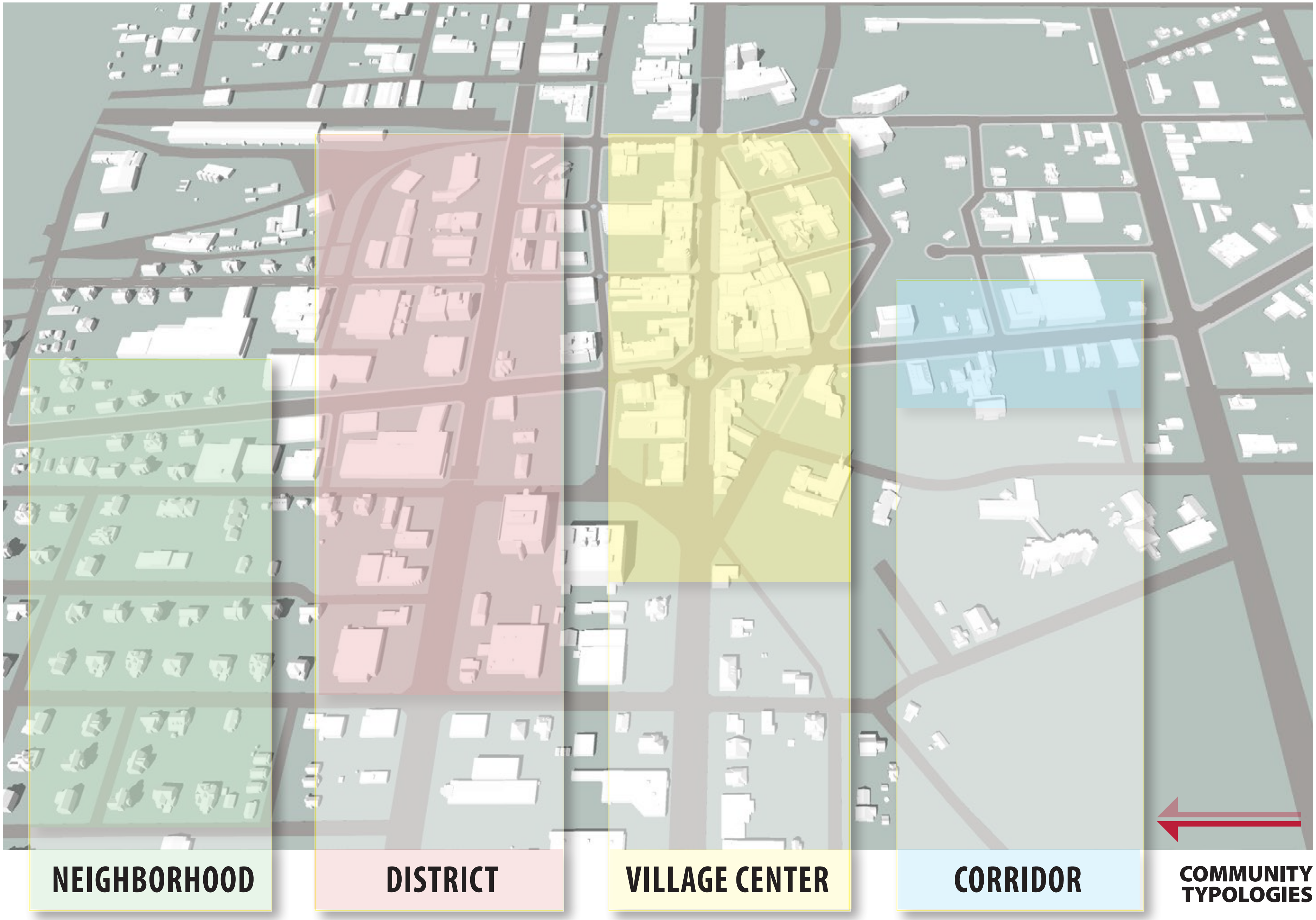


Figure 4-5: Typical Suburban Community under 100,000 population

This model will be used as the background for bike and pedestrian treatments in other sections of this chapter.

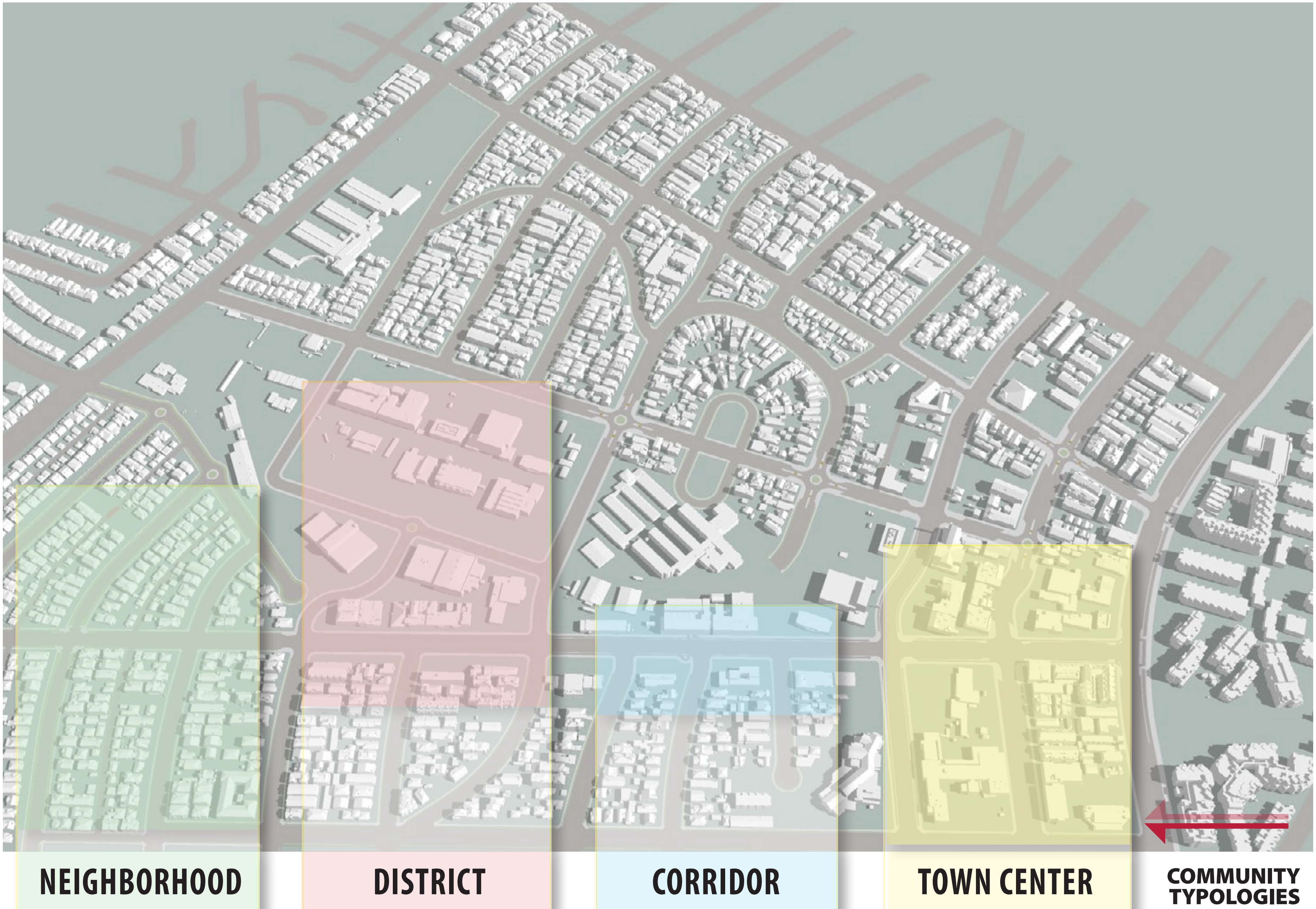
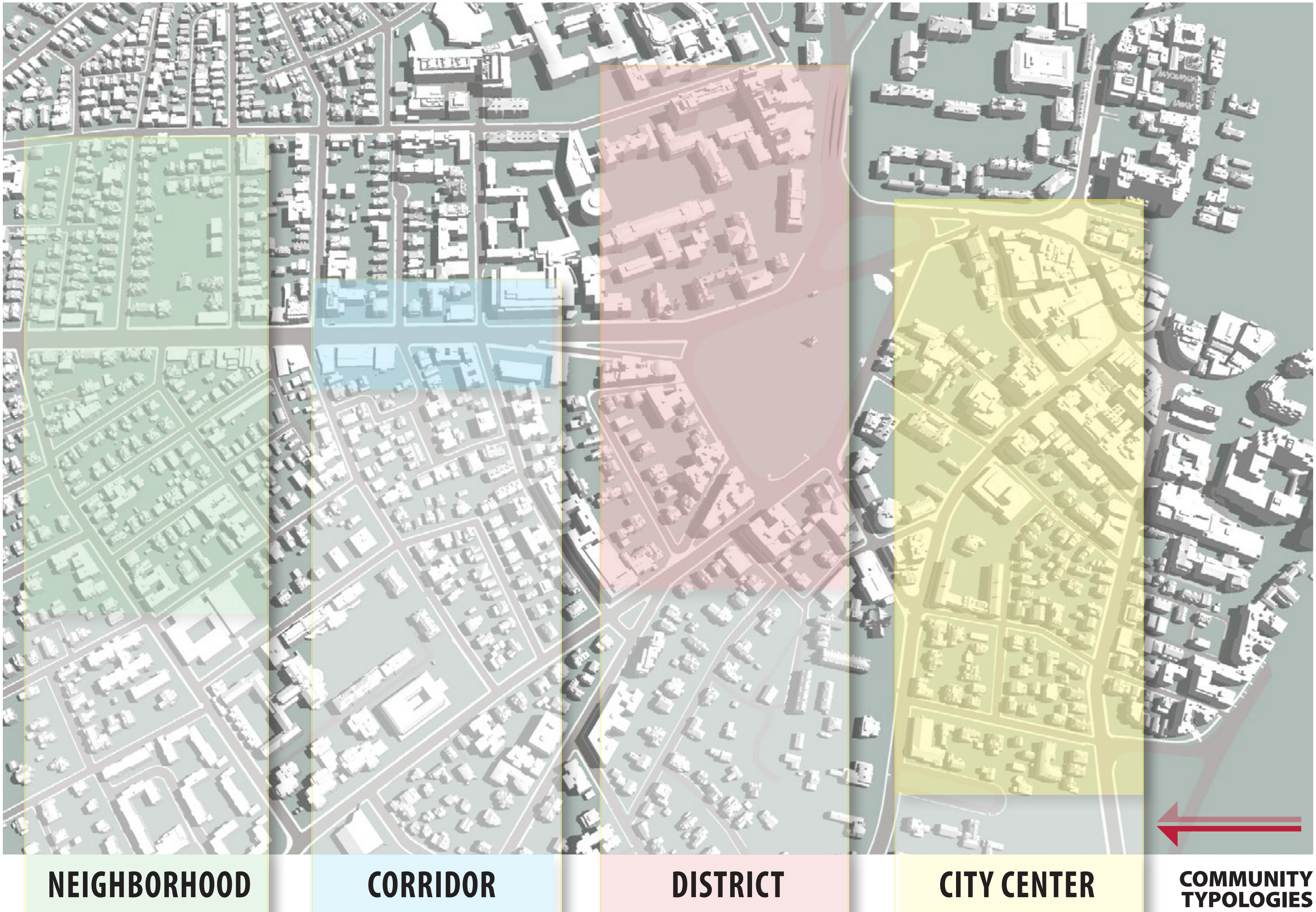


Figure 4-6: Typical Urban Community under 200,000 population

This model will be used as the background for bike and pedestrian treatments in other sections of this chapter.



4.4 CONTEXT: USING THE RIGHT TOOLS IN THE RIGHT LOCATIONS

The primary purpose of a street is to connect people to the land uses where they live, learn, work, shop, and play. As local land uses have moved farther away from where people live, the roadway network has become a facility to transport people over increasingly greater distances. Distances that used to be short and walkable now require either automobile or transit systems to get to services and destinations on a day-to-day basis. This never-ending cycle of centralizing land uses into separate and regionally based parts of a community forces everyone to travel much greater distances and has resulted in the restructuring of neighborhoods and communities as well as streets. This trend can only be reversed if the decentralization of land use is considered when revitalizing inner cities or in new greenfield developments. Human scale of travel needs to be considered and a focus placed back on 10-minute neighborhoods, where most of what people need is within walking and biking distance.

Traditional urban areas have maintained a mixture of land uses that supports the scales and distances of destinations that are feasible to reach by foot or bike. A fine-grain mixture of land uses are found within a 0.25-to-0.5-mile walking distance from most of the residential areas. More distant areas can be reached through transit systems, but the first 0.25- to 1-mile distance getting to and from the transit stop must also be pedestrian or biking friendly.

This portion of the chapter shows three examples of the community place types (neighborhood, corridor, district, and centers) in each of the three different types of community typologies (rural, suburban, and urban). Each of these areas is discussed on the following pages by use of a representative urban form and street network generated from actual locations in the United States.

The diagrams should be used to determine where a particular type of land use treatment should be considered and the extent that the network of streets and land uses must work together to achieve a walkable and bikeable community. The diagrams should be used only as a guide because they need to be adjusted based on local conditions, priorities, and policies. They provide insight, however, into how local context must be considered and how the interaction of land use, street configurations, and spatial arrangements can be integrated.

The matrices represent general guidance on the types of treatments and elements that are available to consider and where they may be most appropriate. None of this should take the place of a community master plan, circulation element, bike master plan, or pedestrian master plan but should serve as a foundation for these efforts. An extensive public review process that allows local conditions and priorities to be factored into the recommendations must take place when making plans for extensive changes in a community. The matrices provide insight as to the full range of items that should be considered.

4.4.1 Land Use Planning for Rural Areas

Rural Neighborhood Context

Rural areas are typically single-story, single-family detached homes. Some of these homes are on ranches, some on farms, but most are found in low-density neighborhoods, where the buildings are located at the center of larger lots where a farmhouse may have originally been centered in agricultural fields. These neighborhoods are typically serviced by a grid of streets, with large block spacing and large parcel sizes. A significant amount of open space exists, with a lower amount of improved recreation-based parks. The same type of land use may exist for a very large area of the community; although the number of units may not be high, the land area they take up typically is high. Refer to figure 4-7 for the most appropriate land use principles applicable to these areas.

Rural Corridor Context

Rural corridors are often made up of through-town highways and major avenues (arterials). The typical land uses adjacent to these through corridors are neighborhood- and community-serving commercial retail and service facilities, most with available parking in front of the business. The distance between land use types presents difficult challenges for walking and biking. Many rural corridors are the result of suburban style development, based on vehicular distances and inexpensive land. They are often made up of chain or corporate franchise business types that follow a model of extensive parking surrounding the business.

Figure 4-7: Best Land Use Practices for Creating Walkable/Bikeable Communities in Rural Areas

Best Land Use Practices for Creating Bikeable Communities*	HOUSING CHOICES						LAND USE MIXTURES								HUMAN SCALED ELEMENTS					URBAN DESIGN **		
	HL - Select sites that are already walkable / bikeable	**HT** - Concentrate housing near transit	**HS** - Provide a variety of housing sizes	**HM** - Provide a mixture of rentals and for sale units	**HC** - Create compact units to lower costs	**HF** - Develop flexible units that grow with family size	**LJ** - Encourage housing and jobs near each other	**LC**- Encourage community centers near housing	**LS** - Encourage distributed neighborhood schools	**LP** - Provide smaller and well distributed parks	**LG** - Encourage distributed grocery stores / pharmacies	**LV** - Focus on vertically or horizontally mixed uses	**LM** - Backup Main Streets with high density housing	**LE** - Add eating / entertainment near housing	**TA** - Reserve Avenues / Blvds. for Main Street retail	**TB** - Restrict big retail from Neighborhoods /Centers	**TI** - Keep single land uses to less than 6 blocks	**TS** - Orient public spaces at centers of intense use	**TT** - Provide local uses in 10-minute neighborhoods	**UD** - Thoughtful Site Design	**UB** - Appropriate Building Forms	**UW** - Buildings' Relationship to Walkways
Treatment Recommendations*																						
RN -Rural Neighborhood	✓		✓	✓					✓		✓					✓						
RC -Rural Corridor									✓		✓											
RD -Rural District	✓																				✓	✓
VC -Village Center	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

* Though all areas can benefit from these principles, they are more effective in specific community types and areas.

** Some design guidance elements are not shown on the associated mapping diagram since they apply community wide.

Rural District Context

A rural district is mostly made up of concentrated non-main-street-style shopping centers versus the strip commercial centers discussed in the preceding corridor section. These districts can also include industrial parks, major recreation centers, and rural-based community college areas or other educational campuses. Rural districts are often disconnected and separated from neighborhoods and corridors and may need connection improvements to make them bikeable and walkable.

Rural Village Center Context

A village center will typically have the main roads of the rural town coming through the commerce and government center. Mostly known as main streets, the collection of businesses and services is generally large enough to support many of the daily needs of these communities. The buildings are typically at the front of the parcels, with on street parking in front of the businesses. The scale is typically tall, single story or two to three story, with residential or office uses on the upper floors. Fortunately, these centers were developed historically with a human scale in mind and are not based purely on parking convenience. These areas are walkability and bikeability assets that need to be expanded or enhanced because they represent the type of land use and building form that typically interfaces well with the street.

4.4.2 Land Use Planning for Suburbs

Suburban Neighborhood Context

Suburban neighborhoods typically are made up of single-story, single-family detached homes. A certain mixture of apartments and condominiums can be found along the larger streets in the area. These are typically attached, three-story buildings. Some locally serving land uses will often include schools, libraries, parks, and community centers. In older communities, locally serving grocery stores can be found. The street network often is responsible for lowering bikeability due to its arrangement, hierarchy, and street widths. Extremely large portions of a community can consist of block after block and mile after mile of the single residential land use. Refer to figure 4-8 for the most appropriate land use principles applicable to these areas.

Traditional main streets are some of the most walkable and human scaled urban forms from a planning standpoint. Photo source: Mike Singleton

Suburban Corridor Context

Suburban corridors areas are the very typical development pattern associated with suburbs. The arrangement of one-lot-deep commercial properties that are strung along great distances of avenues and boulevards (major arterial, minor arterial, and major collectors) is typical of these areas. As a result of retail trends over the past 30 years, big-box retail businesses have often taken up the larger parcels, mostly surrounded by parking. Office buildings and medical facilities are also scattered in a linear fashion along these suburban corridors. The commercial areas typically developed with the idea that land uses that support a neighborhood should be concentrated in arterial intersections and along corridors that are within a few miles of housing. Though this centralization had some economic benefits for the businesses, it meant that most customers would come by way of car. Therefore, site planning focused on maximizing highly visible parking. Despite these typical problems with walkability, suburban districts can be retrofitted with improvements and land uses that can support higher levels of walking and biking.

Suburban District Context

Suburban districts are often made up of shopping districts (not counting commercial strips), large schools and community college campuses, business districts, major single corporate employers, public works yards and institutional facilities. Similar to rural areas, these districts are often not connected to the corridors and neighborhoods of these communities. They do represent an opportunity for positive infill if residential development can be provided through infill revitalization projects.

Figure 4-8: Best Land Use Practices for Creating Walkable/Bikeable Communities in Suburban Areas

Best Land Use Practices for Creating Bikeable Communities*	HOUSING CHOICES						LAND USE MIXTURES								HUMAN SCALED ELEMENTS					URBAN DESIGN **		
	HL - Select sites that are already walkable / bikeable	**HT** - Concentrate housing near transit	**HS** - Provide a variety of housing sizes	**HM** - Provide a mixture of rentals and for sale units	**HC** - Create compact units to lower costs	**HF** - Develop flexible units that grow with family size	**LJ** - Encourage housing and jobs near each other	**LC** - Encourage community centers near housing	**LS** - Encourage distributed neighborhood schools	**LP** - Provide smaller and well distributed parks	**LG** - Encourage distributed grocery stores / pharmacies	**LV** - Focus on vertically or horizontally mixed uses	**LM** - Backup Main Streets with high density housing	**LE** - Add eating / entertainment near housing	**TA** - Reserve Avenues / Blvds. for Main Street retail	**TB** - Restrict big retail from Neighborhoods /Centers	**TI** - Keep single land uses to less than 6 blocks	**TS** - Orient public spaces at centers of intense use	**TT** - Provide local uses in 10-minute neighborhoods	**UD** - Thoughtful Site Design	**UB** - Appropriate Building Forms	**UW** - Buildings' Relationship to Walkways
Treatment Recommendations*																						
SN -Suburban Neighborhood	✓	✓	✓	✓			✓	✓	✓		✓											
SC -Suburban Corridor									✓		✓						✓					
SD -Suburban District													✓	✓	✓		✓	✓	✓	✓	✓	✓
TC -Town Center	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

* Though all areas can benefit from these principles, they are more effective in specific community types and areas.

** Some design guidance elements are not shown on the associated mapping diagram since they apply community wide.

Suburban Town Center Context

Unlike rural and urban areas, it is often difficult to find the centers of many suburbs. There is not always a natural progression of density or an increased mixture and intensity of land uses. Often, suburban town centers are defined by the concentration of public civic facilities in close proximity to each other. They will often have a variety of office buildings and government office centers at their core. Even with these facilities located in the town centers, it is often difficult to find a concentration of destinations that are within walking or riding distances of each other. The potential for increasing walking and biking opportunities is high if a comprehensive approach is provided that creates residential infill and increased land use mixtures.

Suburban areas sometimes have more intensive town centers where people gather. Photo source: Mike Singleton

4.4.3 Land Use Planning for Urban Areas

Urban Neighborhood Context

Urban neighborhoods most commonly have a mixture of locally supporting businesses as well as a broad range of housing types (owned and rented), housing forms (attached and detached), housing intensity (two- to four-story housing above parking or taller towers of housing). Urban neighborhoods are typically more bikeable and walkable because of the closer distances for riding, the gridded nature of the roadway network, and the presence of biking facilities, high-quality walking facilities, and a mixture of land uses that can provide most of the daily needs of local residents. These neighborhoods are generally better supported by transit, thereby extending the distance of non-vehicular travel patterns. Refer to figure 4-6 for the most appropriate land use principles applicable to these areas.

Urban Corridor Context

Urban corridors generally comprise a large mixture of commercial and neighborhood areas bounding major boulevards and avenues. They do contain some amount of commercial businesses with parking located in front but are generally deeper than a single parcel and are typically multiple blocks in area. Unlike the single-sided focus of suburban corridors, all sides of an urban corridor block contain destinations. This difference improves the overall walkability of the area by providing multiple destinations in a short walking or cycling distance. These areas are generally surrounded on some of their sides with neighborhoods, making them good candidates for increasing connectivity and bikeability to the corridors.

Urban District Context

Urban districts generally include major campuses, cultural centers, entertainment districts, historic districts, and financial centers, with major employment in business parks and towers. Districts are typically surrounded by or interspersed with mixed neighborhoods. Generally, the block sizes are reasonable and biking and walking distances are acceptable.

City Center Context

Urban areas have clearly defined downtowns that spread over many blocks and contain a broad variety of residential, employment, entertainment, transportation, and cultural facilities. By the very nature of mixed uses, small blocks, gridded streets, and density, these areas are often very bikeable and walkable and have the added bonus of generally being serviced well by transit.

Downtowns often incorporate historic districts converted to urban main streets with retail and large amounts of street activity. Photo source: Mike Singleton

Figure 4-9: Best Land Use Practices for Creating Walkable/Bikeable Communities in Urban Areas

Best Land Use Practices for Creating Bikeable Communities*	HOUSING CHOICES						LAND USE MIXTURES								HUMAN SCALED ELEMENTS					URBAN DESIGN **		
	HL - Select sites that are already walkable / bikeable	**HT** - Concentrate housing near transit	**HS** - Provide a variety of housing sizes	**HM** - Provide a mixture of rentals and for sale units	**HC** - Create compact units to lower costs	**HF** - Develop flexible units that grow with family size	**LJ** - Encourage housing and jobs near each other	**LC**- Encourage community centers near housing	**LS** - Encourage distributed neighborhood schools	**LP** - Provide smaller and well distributed parks	**LG** - Encourage distributed grocery stores / pharmacies	**LV** - Focus on vertically or horizontally mixed uses	**LM** - Backup Main Streets with high density housing	**LE** - Add eating / entertainment near housing	**TA** - Reserve Avenues / Blvds. for Main Street retail	**TB** - Restrict big retail from Neighborhoods /Centers	**TI** - Keep single land uses to less than 6 blocks	**TS** - Orient public spaces at centers of intense use	**TT** - Provide local uses in 10-minute neighborhoods	**UD** - Thoughtful Site Design	**UB** - Appropriate Building Forms	**UW** - Buildings' Relationship to Walkways
Treatment Recommendations*																						
UN -Urban Neighborhood	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓		✓	✓
UC -Urban Corridor	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓			✓	✓	✓			✓
UD -Urban District	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓
CC -City Center	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓

* Though all areas can benefit from these principles, they are more effective in specific community types and areas.

** Some design guidance elements are not shown on the associated mapping diagram since they apply community wide.

4.5 IDEAS: PROJECT-SCALED STEPS

In order to achieve the recommendations of this chapter, land use practices must support the creation of good streets and great places to walk and bike. Project-scaled tools include—

- Draft community-based vision plans, which are critical agreements or road maps that articulate how communities see their streets, neighborhoods, districts, and future growth.
- Create zoning standards that allow, encourage, and require a diverse mix of land uses that support the creation of walkable, bikeable, and sustainable places.
- Integrate planning efforts that take into account comprehensive planning and the inclusion of transportation when land use and design decisions are being made.
- Adopt a complete streets ordinance or policy that requires all departments to analyze and attempt to integrate as many roadway users into the development of the roadway itself.
- Utilize policies that put a premium on integrated land use and compact infill development that is located nearest transit and in areas that are walkable and bikeable.
- Strike a balance between parking standards that protect areas from excessive use of on street parking and neighborhood parking impacts and from providing too much parking where parking adds to the cost of housing and leasing, expands the distances between origins and destinations, dominates a site, and discourages walking.
- Select your development site in an area that is already bikeable or walkable based on a good mixture of land uses as well as transit support.
- Select the specific site to make sure it can be connected to the rest of the area, and commit to improving the connections to the adjacent area so that the project can be both an origin and a destination for trips.
- Assume the costs necessary to connect the site with the community should be considered as part of site preparation. At the same time, work with the local community to extend these improved connections beyond the immediate adjacency of the project limits. Provide a project match of funds that will leverage other general fund, property bonding, or grant-based funding sources.
- If the project is a larger site, provide access through the site for walking and biking.
- If the project is large enough, provide on site recreation, neighborhood-serving functions, community facilities, a daycare facility, and other uses that allow a person to walk to the site, without having to drive.
- Ensure that the immediate site edges all have walkable environments that are safe, comfortable, and attractive.
- Contribute to crossing improvements that connect with important destinations within a few blocks of the development.
- Ensure that off-street and on street bike parking is made available.
- For the nonresidential portions of the project, ensure that employment centers contain changing rooms, showers, or locker rooms. This is valuable not only for people that may ride a bike or run or walk to work but also for the healthy midday breaks that employees can take for walking, running, or cycling.
- Avoid having the site dominated by parking in front of buildings. Consider maximizing on street parking through a cooperative agreement with the approving agency.
- Unbundle the cost of parking, especially structured parking, so that a future tenant, buyer, or renter can opt for less parking and be rewarded for not taking a parking space. This works best where one space is provided for a residential unit, with a second parking space requiring payment for use.
- Consider all parking on the proposed site a shared resource. Avoid reserved parking spaces where possible, and pool the parking resources through shared parking strategies and other uses of technology that stretch parking as far as possible without dominating the site or the expenses of the development that result in increased housing and business costs.
- Provide vertically mixed land uses that balance residential, retail, and employment in one location.
- For larger sites, provide horizontally mixed land uses that supplement the primary land use (residential, shopping, or employment) with supporting uses.
- Consider artist lofts and working studios that allow a person to live and work in the same facility.
- Create public spaces or edges that encourage a person to enter the site, interact with community members, and activate retail edges.

4.6 RESOURCES: IMPORTANT RESOURCES TO CONSIDER

For more information on land use planning, please consult the following foundational documents.

FHWA:

- Creating Safer Communities for Walking/Biking (2015)
- List of Online Reports and Technical Publications
- Pedestrian and Bicycle Information Center

NACTO:

- Transit Street Design Guides (2016)
- Urban Bikeway Design Guide (2014)
- Urban Street Design Guide (2013)

OTHERS:

- Complete Streets Best Policies and Implementation Practices (2010/Annual)
- LEED for Neighborhood Development (2014)
- Model Design Manual for Living Streets (2011)

4.7 **CASE STUDY:** GAINESVILLE, FLORIDA

City Background

The city of Gainesville, Florida, has a history of land use planning and zoning efforts in support of creating more walkable and bikeable communities. Gainesville is located in north-central Florida. It is the county seat and largest city in terms of size and population in Alachua County. The city measures 62.4 square miles. At the time of the 2013 American Community Survey, the population of Gainesville was 127,488. As of the 2010 census, the racial composition of Gainesville was 64.9 percent White, 23.0 percent African-American 6.9 percent Asian, 0.3 percent American Indians and Alaska Natives, 0.1 percent Native Hawaiians and Other Pacific Islanders, 1.9 percent some other race, and 2.9 percent reporting two or more races.

Gainesville is home to the University of Florida (UF), the nation's eighth largest university campus by enrollment. According to the HUD exchange FY 2014, 61.6 percent of people in Gainesville are low and moderate income. The city earned the "Silver Level" Bicycle Friendly Community designation from the League of American Bicyclists and has a bicycle mode share of 6.27 percent. According to the on-line Walk Score application, Gainesville is a "Car Dependent City," with most errands requiring a car (Walk Score: 33), though the urban core of the city, which includes the College Park/University Heights community (the specific focus of this case study, explained in the following section), is considered "very walkable," with Walk Scores ranging from 71 to 89.

The College Park/University Heights Community Redevelopment Area

This case study specifically focuses on the College Park/University Heights Community Redevelopment Area. The CP/UH Community Redevelopment Area is located in the center of the city of Gainesville and comprises three subareas: College Park, University Heights, and the Expansion Area. Collectively, the CP/UH area can be characterized as part residential, part mixed use, and part light industrial, with portions that have been in decline for several years.

The CP/UH area is interesting because it has been the subject of multiple rounds of land use and zoning strategies aimed at the same thing: creating a more urban, vibrant, walkable, and bikeable place. To date, the 2005 College Park/University Heights Community Redevelopment Plan Update has had the strongest impact on active transportation-supportive land use and is the focus of this case study. (The city is currently developing a form-based district plan, a plan that uses form-based code to support more streamlined and predictable development, as well as increased walk- and bikeability.)

The 2005 College Park/University Heights (CP/UH) Community Redevelopment Plan Update

In 2004, the city decided to update the CP/UH Redevelopment Plan, last updated in 1995, and include the Expansion Area. The 2005 plan included a refinement of the 1995 Land Use Characteristics and the formulation of objectives, initiatives, and cornerstone projects, intended to implement the 1995 plan. The following sections summarize elements of the 2005 plan and discuss how it supported a more walkable and bikeable community.

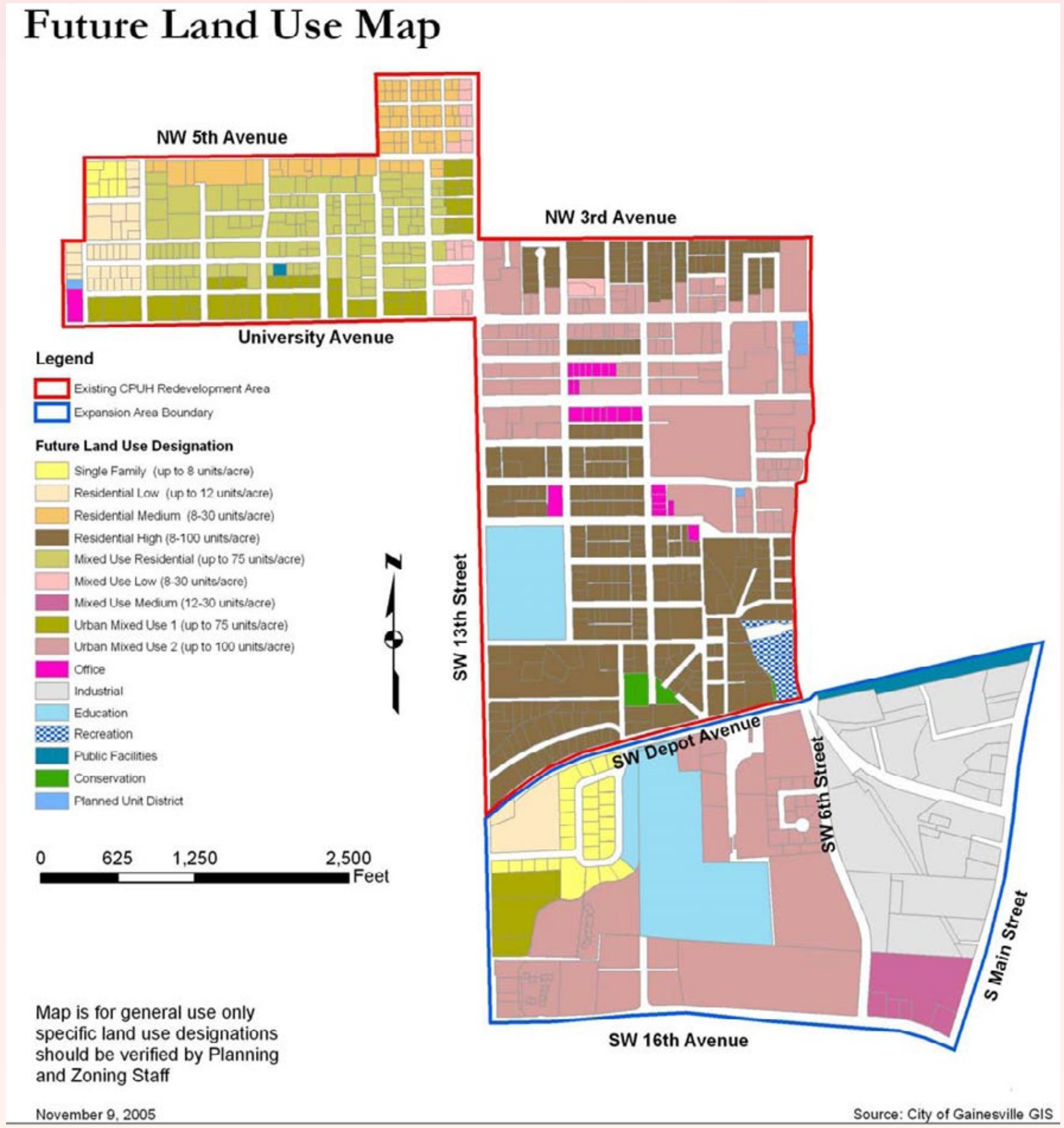
Sample corridor conditions in the CP/UH area (addressed by the 2005 Plan). Photo source: City of Gainesville, FL

Sample land use conditions in the CP/UH area (addressed by the 2005 Plan). Photo source: City of Gainesville, FL

<u>Land Use Characteristics, Transportation Mitigation, and Parking Exemption</u>

The College Park/University Heights area was mostly built out at the time of the 2005 plan. As such, future land use designations reflected a necessary balance between existing conditions and desired character. The two greatest contributions of the land use designations to walking and biking in the CP/UH area were the high overall mix of uses called for and densities permitted. The land use designations also specified other design elements supportive of walking and biking. For example, descriptions of several land uses stipulated that buildings be oriented to the street (i.e. front the street, with modest setbacks and build-to lines) and contribute to the pedestrian character of the area. The plan update also included a planned use district designation, an overlay land use district that allowed for increased land use flexibility.

Complementing land use plans were the Multi-modal Transportation Mitigation ordinance and Parking Exemption policy. The purpose of the Multi-modal Transportation Mitigation ordinance is to establish a method whereby the impacts of development on transportation facilities in the Urban Cluster can be mitigated through a Multi-modal Transportation Mitigation Program. The ordinance is intended to demonstrate a strong commitment to comprehensive transportation mobility planning, thereby reducing the potential for moratorium or unacceptable levels of traffic congestion without viable multi-modal alternatives. The Parking Exemption policy exempts developers from providing parking in the Central City District and requires bicycle parking and other multi-modal improvements as mitigation for transportation impacts.



Planned land use for the CP/UH area (per the 2005 Plan). Photo source: City of Gainesville, FL

Objectives and Initiatives

The 2005 plan included concrete objectives and initiatives to help achieve broader land use goals. The objectives and initiatives most relevant to creating walkable and bikeable communities are in the following list. Those that best demonstrate the plan's impact on walking and bicycling in the CP/UH area are further described with text and images.

- Infrastructure.
- Parking.
- Urban form.
- Traffic circulation.
- Land acquisition and redevelopment.
- Creation of mixed-use technology hubs.
- Public spaces.
- Cornerstone projects.
- SW 2nd Avenue.
- University Avenue as a Signature Street.
- Depot Rail Trail Gateway.

Creation of Mixed-Use Technology Hubs

The hub was seen as an opportunity to infuse the Redevelopment Area with new businesses and professors, researchers, and students. The increased foot traffic generated by the hub would provide necessary support for the mix of retail, residential, and other commercial uses envisioned for the area. Development of the mixed-use technology hub, coined "Innovation Square," is now well under way. Innovation Hub, the first building in Innovation Square, was completed in 2012 and is currently occupied by more than 20 startup companies.

SW 2nd Avenue

This project was identified as a "Great Street," a largely mixed-use activity center and corridor, tying residential neighborhoods to the university and downtown at either end (to use the terms employed in this document, part urban district and part urban corridor). The plan called for transportation options to be stressed along this corridor, including transit, cycling, and driving. The corridor was identified as an ideal location for the technology incubator and an ideal route for the UF circulator. Since the plan's completion, multi-modal improvements such as bike lanes, improved sidewalks, enhanced crosswalks, and landscaping have been implemented. Development of Innovation Square, described in the previous section, has also begun.

"After" conditions on SW 2nd Avenue (called for by the 2005 Plan). Photo source: Gainesville Landscape Contractors

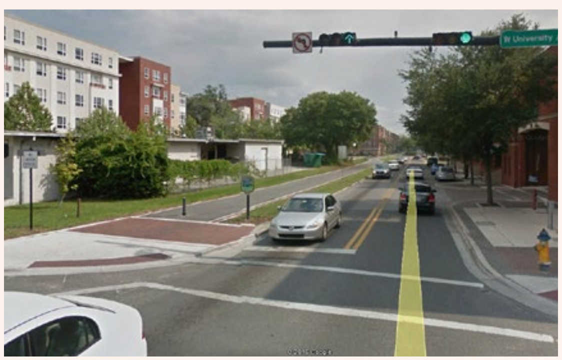
Above: "After" conditions of the Innovation Square site; Below: "Before, During and After" conditions of the Innovation Square Site (called for by the 2005 Plan). Photo source: Community Redevelopment Agency, City of Gainesville, FL

University Avenue as a Signature Street

This project called for the elevation of University Avenue as a "destination place" through aesthetic and parking improvements as well as planned upscale housing. Two of the housing developments, Jackson Square and West University Avenue Lofts, have been built. These developments contribute to the intended community character, including the pedestrian-friendly orientation of the buildings, enhanced sidewalks, landscaping, and quality bike parking. The creation of a destination place will require comparable transformations of adjacent properties.

Depot Rail Trail Gateway

The former Depot Rail Trail Bridge over SW 13th Street was identified as a source of blight. Due to its highly visible location, at the edge of the Community Redevelopment Area, the bridge was identified as a Gateway opportunity. In 2009, the CRA commissioned design for the redevelopment of the bridge. The bridge is now complete and won the Florida APWA's "Project of the Year" award in 2014.



"University Avenue as a Signature Street:" New mixed-use development and adjacent multi-use path (called for the 2005 Plan). Photo source: Google Earth

4.7.1 Conclusion

The city of Gainesville has been largely successful at supporting traditionally urban infill development and has increased walking, biking, and transit use within its urban core. To date, the city has made significant strides through redevelopment planning (which establishes a clear vision and goals), zoning overlays and a land development code (which support more compact, mixed-use development), and policies of multi-modal transportation mitigation and parking exemption (which capitalize on the interrelationship between active transportation-supportive land use and transportation). If approved, the creation of form-based districts within the University Heights/College Park area will likely perpetuate, and possibly accelerate, the walking and biking transformations already in motion.

"Before:" Depot Avenue Rail Trail Bridge. Photo source: Community Redevelopment Agency, Gainesville, FL

"After:" Helyx Bridge/ Depot Avenue Rail Trail Improvements (called for the 2005 Plan). Photo source: Community Redevelopment Agency, Gainesville, FL

CHAPTER 5: STREET DESIGN PRINCIPLES

USER LEGEND

Advocate Organizations
- Housing Advocates
- Health and Safety Advocates
- Smart Growth Advocates
- Mobility Choice Advocates

Providing Entities
- Developers, Financial Institutions
- Housing Providers and Institutions
- Planning, Design or Engineering Consultants

Decision Makers
- Local Agency Planners and Engineers
- Local Elected Officials and Review Staff
- Federal, State and Regional Regulators

The United States has a long and distinguished history of creating memorable and enduring cities, including Savannah, Georgia; Charleston, South Carolina; Madison, Wisconsin; Santa Barbara, California; and Port Townsend, Washington. These cities are memorable and enduring partly because of their streets. Well-planned streets help to create sustainable cities that support the environmental, social, and economic needs of their residents. This chapter provides insight and guidance on what makes streets work and how they can be planned, designed, and engineered to support walking and biking.

Streets can be examined at several levels: as independent travel ways, at the intersection of two or more travel ways, and as a network of travel ways and intersections. The design and function of each level and their relationship to one another is essential to creating walkable and bikeable communities. This chapter is organized by the three primary components of a street: networks, travel ways, and intersections. It begins with a summary of key principles for all street design and is followed by more detailed sections and design guidelines.

Fisherman's Wharf Redesign: San Francisco's newest shared street. Photo source: Aaron Bialick

5.1 PRINCIPLES: BASICS OF A WALK- AND BIKE-FRIENDLY STREET

Good land use planning and urban design can help create healthy neighborhoods with great streets and innovative and sustainable buildings. This section serves to highlight the essential principles governing street network, travel way, and intersection design. It also offers suggestions on what to do and what not to do in designing street networks, travel ways, and intersections. Note that the Federal Highway Administration (FHWA) recently demonstrated strong support for connected pedestrian and bicycle networks (see "Case Studies in Delivering Safe, Comfortable, and Connected Pedestrian and Bicycle Networks" from FHWA one of several examples).

5.1.1 Networks Principles

Street networks come in many forms, but those that support walking and bicycling have certain characteristics that need to be included, primarily for safety reasons. More than 32,000 people are killed each year in the United States in traffic crashes (National Highway Traffic Safety Administration, Traffic Safety Facts, 2003–2013 data). A well-designed street network is a powerful tool for reducing traffic crashes and fatalities while providing unique and beautiful places for our cities.

Some of the basic justifications for safety improvements include—

- Sustainable and resilient street networks foster economic and social activity. They constrain traffic growth by limiting the number of lanes on each street while providing maximum travel options by collectively providing more lanes on more streets. By providing opportunities for all modes of travel, an ideal street network enhances social equity and provides an ideal setting for high-quality design at all scales, including buildings, neighborhoods, and the region. The resulting communities can be some of the most beautiful places, with high property values and outstanding quality of life.
- Sustainable street networks improve traffic safety. Hierarchical street patterns (arterial-collector-local) with cul-de-sac subdivisions that depend on arterials have less capacity and contribute to crashes more than do gridded and distributed street networks. Hierarchical street networks divert traffic to high-speed arterials that have large intersections.
- According to the Federal Highway Administration,[1] 40 percent of crashes occur at intersections. The speed at which motor vehicles move on these arterial streets increases the likelihood and severity of crashes.
- Poorly connected street networks can be more dangerous than well-connected networks. A 2011 study of 24 California cities found a 30-percent higher rate of severe injury and a 50-percent higher chance of dying from traffic-related causes in cities dominated by sparsely connected cul-de-sacs compared with cities with dense, connected street networks.[2] A 2009 study from Texas found that each mile of arterial is associated with a 10-percent increase in multiple-vehicle crashes, a 9.2-percent increase in pedestrian crashes, and a 6.6-percent increase in bicycle crashes.[3]
- The rate of road fatalities per 100,000 people was 3.2 per year in cities with high intersection density versus 10.5 per year in cities with low intersection density.
- Sustainable street networks increase the number of people walking and bicycling and reduce vehicle miles traveled. Connectivity enables people to take shorter routes. It also enables them to travel on quieter streets. These shorter routes on quieter streets are more conducive to bicycling and walking. The California study

cited previously found that locations with a dense, connected street network had three to four times more people walking, bicycling, or using transit to get to work. This in turn led to a 50-percent reduction in vehicle miles traveled per capita in these cities.

- Sustainable street networks allow more effective emergency response. Studies in Charlotte, North Carolina found that when one connection was added between cul-de-sac subdivisions, the local fire station increased the number of addresses served by 17- percent and increased the number of households served by 12-percent. Moreover, the connection helped avoid future costs by slowing the growth of operating and capital costs; most of the cost to run a fire station is in salaries. Furthermore, Congress for the New Urbanism's report on emergency response and street design found that emergency responders favor well-connected networks with a redundancy of routes to maximize access to emergencies. Emergency responders can get stuck in a cul-de-sac and need options when streets back up.[4]

A common pedestrian problem in suburban roadways are wide high speed streets. Photo source: Joe Punsalan

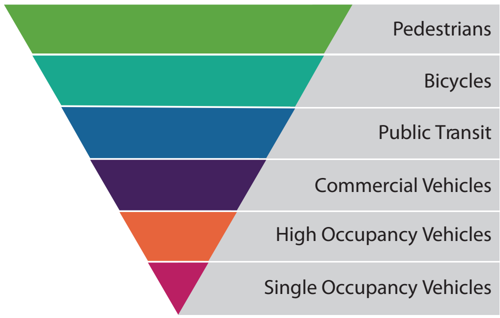
- These studies and others provide strong evidence that the benefits of a well-designed street network go beyond safety; they include environmental, social, and economic gains. Sustainable street networks shape land use markets and support compact development, in turn decreasing the costs of travel and providing utilities. Street networks like these have been resilient over hundreds of years and accommodate changing technology, lifestyles, and travel patterns. Interconnected street networks can also preserve habitat and important ecological areas by condensing development, reducing city edges, and reducing sprawl.
- Streets conducive to active transportation both shape and respond to the natural and built environment.
- Streets conducive to active transportation provide advantages to trips by foot, bike, and transit because these are the most sustainable types of trips.
- Streets conducive to active transportation are built to human-scaled walking dimensions.
- Street networks conducive to active transportation work in harmony with all transportation modes. Large parts of all of these networks are coincidental with the street network, but if any parts are separate from the street network, they must connect and interact with the network.
- Street systems conducive to active transportation protect, respect, and enhance a city's natural features and ecological systems.
- Streets conducive to active transportation maximize social and economic activity.

5.1.2 Travel Way Principles

The following key principles should be kept in mind for a well-designed travel way—

- Design to accommodate all users. Street design should appropriately accommodate all users of the street, including pedestrians, bicyclists, transit users, automobile drivers, and commercial vehicle drivers. Although not all streets can equally accommodate all users, a well-designed travel way considers context and purpose to provide appropriate accommodation for all street users. The upside down transportation hierarchy is shown in figure 5-1.
- Design according to the desired target speed for the surrounding context. Target speeds should reflect the role and responsibility of the street, including the type and intensity of land use; urban form; the desired activities on the sidewalk, such as outdoor dining; and the overall safety and comfort of pedestrians and bicyclists. The speed of vehicles impacts all users of the street and the livability of the surrounding area. Lower speeds reduce crashes and injuries.
- Design for safety. The safety of all street users, especially the most vulnerable users (children, older adults, and people with disabilities) and modes (pedestrians and bicyclists) should be paramount in any design of the travel way. The safety of streets can be dramatically improved through appropriate geometric design and operations.

Figure 5-1: Upside Down Transportation Hierarchy



5.1.3 Intersection Principles

The following principles apply to all users of intersections—

- Good intersection designs are compact.
- Unusual conflicts should be avoided.
- Simple, right-angle intersections are preferred since many intersection problems are worsened at skewed and multi-legged intersections.
- High-speed, free-flowing movement should be avoided.
- Access management practices should be used to remove additional vehicular conflict points near the intersection.
- Signal timing should consider the safety and convenience of all users and should not hinder bicycle or foot traffic with overly long waits or insufficient crossing time.

5.1.4 Actions To Include

Active transportation functions best in well-connected street networks with small blocks, narrow streets, and integration of designs that encourage walking and bicycling. In order to support walking and biking, as well as safer access to transit, utilize the following active street guidelines.

Networks

- Develop highly connected street networks with small block sizes.
- Design streets with as few travel lanes as necessary. If a highly connected network exists, most of these streets should have only two lanes.
- Incorporate well-designed sidewalks and pedestrian crossings into all streets and intersections.
- Lay out tight networks (200–300'-foot grids) so that streets offer cyclists and walkers many options for changing direction at each intersection, thereby reducing the overall length of the walk or ride.
- Where new development occurs outside existing developed areas, extend new streets from existing streets with similar characteristics and functional classifications.
- Reconnect broken street networks by adding new infill development that will also add connections for streets that are missing or that do not go through.
- Where residents desire disconnected grid (to limit vehicle traffic), recommend partially permeable street networks.

Travel Ways

- Build streets to the narrowest width necessary.
- Build or stripe travel lanes, turn lanes, and parking lanes to the narrowest width necessary.
- Design streets to the desired target speed.
- Incorporate dedicated bike facilities into all new boulevards and avenues.

Intersections

- Design intersections that are compact.
- Design simple, right-angle intersections because many intersection problems are worsened at skewed and multi-legged intersections.
- Avoid free-flowing movements designed for high vehicle speeds.
- Use access management practices to remove additional vehicular conflict points near the intersection.
- When establishing signal timing, consider the safety and convenience of all users and do not hinder bicycle or foot traffic with overly long waits or insufficient crossing times.
- Design tight curb radii and use curb extensions to reduce pedestrian crossing distances.
- Use roundabouts, to lower speeds and eliminate turn lanes, and neighborhood traffic circles, to calm traffic.

5.1.5 Actions To Avoid

The following list includes common design characteristics that discourage walking and bicycling.

Networks

- Do not encourage cul-de-sac networks that concentrate trips onto major streets, necessitating multi-lane streets to handle the traffic and reducing the number of options people have to travel to most destinations. Multi-lane streets have little “friction” to slow traffic because the lack of connectivity results in long blocks. With a lack of friction, these streets run fast and create speed differentials that are not compatible with bicycling or walking. The lack of connected blocks also requires people to walk long distances to cross the street.
- Do not encourage new development to occur in locations not already adjacent to existing development (leapfrog development). In order for new land uses to connect with existing land uses, new streets need to directly link to existing street networks.
- Do not construct streets without consideration of the needs of people walking or bicycling. Streets built without sidewalks, or without well-designed sidewalks, and street crossings present barriers to walking. Bicyclists need tight networks of bicycle-supportive streets so they do not have to travel too far out of their way to ride along attractive streets or bikeways.
- Do not construct more travel lanes than necessary. Multi-lane streets are more difficult for pedestrians to cross. They also introduce rear-end, sideswipe, and left-turn broadside crashes that do not occur on two-lane streets.5 (Multi-lane streets have capacity for 40,000 vehicles per day. Cities with populations of 200,000 people or less should not need multi-lane streets if they have well-connected street networks except where they are contiguous with other cities in major metropolitan areas.)

- Do not encourage gated communities. By definition, these are exclusive areas that break up the street network and require people on foot or bicycle to travel long distances to go around. Where residents desire disconnected grid (to limit vehicle traffic), recommend partially permeable street networks.

Travel Ways

- Do not build streets wider than necessary. Wide streets create more exposure for pedestrians when crossing the street. Wide streets have less friction that slows motor vehicle traffic, so they induce speeding, which degrades the street for bicyclists, as well as pedestrians. Wide streets also make land uses farther apart than necessary. Keeping land uses close to one another is central to designing for pedestrian and bicycle scale.
- Do not build new streets wider than needed for the desired target speed. The extra width, often given as an attempt to increase safety, likely contributes to higher actual speeds and the increased likelihood for pedestrian and bicycle fatalities.6
- Do not assume that future growth will necessitate more travel lanes. Additional capacity induces travel. Miles traveled have been essentially flat since 2007 (Historical Vehicle Miles Traveled Report, Federal Highway Administration, 1970 through December 2014). Furthermore, excess width can lead to burdensome maintenance costs, especially as municipal budgets get tighter.
- Do not build boulevards and avenues (major arterials) without dedicated bike facilities or pedestrian accommodation.
- Do not build boulevards without medians or crossing islands for pedestrians.

Intersections

- Do not stripe more than one left-turn lane.
- Do not stripe or construct right-turn-only lanes unless turning volumes are very high.
- Do not use signals where roundabouts are more appropriate.
- Do not use stop signs where mini-roundabouts or mini-circles are appropriate.
- Do not construct or stripe right-turn slip lanes except where large numbers of trucks or buses turn.

5.2 USERS: DESIGNING FOR ALL

The presence of several users and other factors are known to play central roles in the design and resulting walkability and bikeability of streets. The following paragraphs offer brief discussions of the roles played by each user or factor.

5.2.1 Pedestrians

The goal of roadway and intersection design should be to create an environment that is conducive to walking, where people can walk along and across the road and the roadside becomes a place where people want to be. The three most effective methods to achieve these goals are to minimize the footprint dedicated to motor vehicle traffic, to slow down the speed of moving traffic, and to provide sufficient buffers between fast-moving traffic and pedestrians.

5.2.2 Bicyclists

All streets should be designed with the expectation that bicyclists will use them. This does not mean every street needs a dedicated bicycle facility. For example, streets with low speeds and low volumes may be comfortably shared with vehicles. Streets need only to accommodate cyclists in an inviting and safe environment.

5.2.3 Target Speed

Frequently, the approach for setting design speeds is to use as high a design speed as possible to maximize throughput and lower travel time. This approach has many negative effects. Speed can kill the sense of place just as it can kill people. Because high speeds degrade the social and retail life of a street, they can devalue the adjacent land. In contrast to this approach, the goal for living streets is to support a design speed that creates a safer and more comfortable environment for motorists, pedestrians, and bicyclists. This approach also increases access to adjacent land, thereby increasing its value. For living streets, target speeds of 20 to 35 miles per hour are desirable.

5.2.4 Design Vehicles

A design vehicle is a generic vehicle type that designers and engineers design for based on expected use of a given street (e.g. a "truck route" will be designed to accommodate a high number of trucks). Designing for a larger vehicle than necessary is undesirable due to the potential negative impacts larger dimensions may have on pedestrian crossing distances and the speed of turning vehicles. On the other hand, designing for a vehicle that is too small can result in operational problems if larger vehicles frequently use the facility. It is important to design the street for the most common vehicles.

5.2.5 Transportation Performance Metrics and Active Transportation

Traffic volume data collection is an integral part of transportation planning and decision making, including forecasting. Traffic volumes determine such factors as the number lanes needed, the need for turn lanes, intersection treatments, appropriate pedestrian crossing treatments, appropriate treatment for bicycles, and the need for bus lanes.

<u>Multi-Modal Level of Service</u>

The quality of service of streets has conventionally been obtained using level of service (LOS) measurements. LOS assesses delay for motorists along a roadway section or at a signalized intersection. Where delay is greatest, LOS is lowest. Using this metric results in solutions that allow more traffic to flow and move faster. This degrades the street for pedestrians, people on bicycles, and people using transit. In response to this situation, a Multi-Modal Level of Service (MMLOS) has been developed that assesses the quality of the street for all modes. Using this metric can result in improvements for bicyclists, pedestrians, and people using transit.

<u>Alternatives to Level of Service: Vehicle Miles Traveled (VMT) and Automobile Trips Generated (ATG)</u>

In addition to MMLOS, we now have other metrics, such as reducing vehicle miles traveled (VMT) and automobile trips generated (ATG), to measure performance in a way that encourages less driving and promotes alternative modes (walking, bicycling, and transit use). These metrics help break the cycle of induced demand: a phenomenon in which increases in roadway capacity—intended to relieve congestion—induce more drivers and more driving.

5.2.6 Access Management

A major challenge in street design is balancing the number of access points to a street. Many conflicts between users occur at intersections and driveways. The presence of many driveways in addition to the necessary intersections creates many conflicts between vehicles entering or leaving a street and bicyclists or pedestrians riding or walking along the street. When possible, new driveways should be minimized and old driveways should be eliminated or consolidated, and raised medians should be placed to limit left turns into and out of driveways.

5.3 NETWORKS: STREET CLASSIFICATION SYSTEMS

The Federal Highway Function and Classification system is the conventional classification system that is commonly used to define the function and operational requirements for streets. Historically, this system has also been used as the primary basis for design criteria. This traditional classification system has focused mostly on the needs of automobiles and other motorized vehicles, however. It has not adequately taken into account the interaction of adjacent land uses or the urban form and function of streets to other uses and users. It has been used far too long to create streets that move vehicles in the most efficient and quickest way but has failed to integrate other users of streets. Table 5-1 compares the traditional classification system with an alternative classification system.

Traffic volume, trip characteristics, speed, level of service, and other factors in the functional classification system relate to the mobility of motor vehicles and do not consider the context or land use of the surrounding environment. This approach, while appropriate for high-speed rural and some suburban roadways, does not provide planners or engineers with guidance on how to design for living streets in a context-sensitive manner.

Table 5-1: Relationship between Functional Classification and Thoroughfares

	Thoroughfare Types						
Functional Classification	**FREEWAY/ EXPRESSWAY/PARKWAY**	**RURAL HIGHWAY**	**BOULEVARD**	**AVENUE**	**STREET**	**RURAL ROAD**	**ALLEY/REAR LANE**
Principal Arterial	■	■	■	■	■		
Minor Arterial		■	■	■	■		
Collector				■	■	■	
Local					■	■	■

Street types described here provide mobility for all modes of transportation, with a greater focus on the pedestrian. Designers should recognize the need for greater flexibility in applying design criteria, based more on context and the need to create a safe environment for pedestrians rather than strictly following the conventional functional classification system in determining geometric criteria.

The terms for an alternative typology for living streets are described in the following sections. Many municipalities use the terms avenue and street in combination with the street name as a way to differentiate streets running north and south from those running east and west (e.g., 1st Street, 1st Avenue); these uses differ from the definitions used in this manual. Table 5-1 provides the Federal Highway Function and Classification system names next to the living streets typologies. Table 5-2 provides a list of common street types.

Table 5-2: Form Based Street Design Classification System

STREET TYPE	DESCRIPTION	COMMON STREET CLASSIFICATIONS
THROUGH CORRIDOR	• Connections between urban, suburban and rural village centers generally with higher speeds • Driver focus on point "A" to point "B" connections • Higher volumes of traffic	• Freeways or limited access highways, • Highways • Frontage roadways • Major or principal arterials
BOULEVARD	• Connections between major centers or village centers within urban or suburban area • Often has a planted median.	• Major or principal arterials • Arterials or minor arterials
AVENUE	• Traverses and connects districts, links streets with boulevards. For all vehicles including transit. May or may not have a median.	• Urban minor arterials • Urban collectors
STREET*	• Serves neighborhood, connects to adjoining neighborhoods • Serves local function for vehicles and transit	• Local collector • Local street
ALLEY/LANE	• Link between streets • Allows access to garages	• Narrow and without sidewalks

*May have segments with specialized functions and features such as a Main Street segment.

Typical rural context through corridor: Chapel Hill, NC.
Photo source: Laura Sandt- www.pedbikeimages.org

Suburban context through corridor: Charlottesville, VA.
Photo source: Dan Burden- www.pedbikeimages.org

Urban context through corridor: Syracuse, NY.
Photo source: Onondaga Citizens League

5.3.1 Through Corridor

A street that travels through a major portion of a village, town, or city is considered to be a through corridor. The majority of users on these streets are not on local trips. The origins and the destinations generally are likely to be outside the community. This street typology is often associated with freeways, limited-access highways, primary urban arterial streets, and business district loops associated with the interstate or state highway systems.

Typical (although may not be ideal) rural context boulevard: Florida. Photo source: Neil Spiller FHWA

The restricted-access highways and freeways are always designed for high-speed travel. These higher-speed streets usually restrict bike or pedestrian access except in the western United States, where bicycle travel is often permitted. Through corridors are not a focus of this study except for the barriers that they represent to walking and biking. The through-corridor streets that have moderate- to high-speed and high-volume goals are the streets with the greatest safety concern and that represent the greatest barriers to our neighborhoods, districts, and centers. Additionally, because these roadways tend to be lined with destinations—this type of "strip commercial" development is the primary type of commercial development in many small to mid-size, low- and moderate-income (LMI) communities—it is important to incorporate a level of bike and pedestrian access into their design.

Typical (although may not be ideal) suburban boulevard: Orange, CA. Photos source: Nicole Schneider

5.3.2 Boulevard

A boulevard is a street designed for high vehicular capacity and moderate speed, traversing an urbanized area. Boulevards serve as primary transit routes. Boulevards should have dedicated bike facilities and fully accessible, wide walkway systems integrated with them. They may be equipped with bus lanes or side access lanes buffering sidewalks and buildings. Many boulevards also have raised medians that restrict left-turn movements. Often, these medians are landscaped as well. Because of the nature of these boulevards for through traffic, they are likely to be two to three lanes in each direction and also not have signal-controlled intersections at each block.

Typical (although may not be ideal) urban context boulevard: Missoula, MT. Photo source: Dan Burden

5.3.3 Avenue

An avenue is a street of moderate vehicular capacity and low to moderate speed, acting as a short-distance connector between urban centers and districts. An avenue will likely have more than one lane in each direction and may or may not have raised medians. A striped combination center turn lane may exist, and it is likely that not every intersection will be a controlled intersection.

Typical (although may not be ideal) rural context avenue: Seattle, WA. Photo source: Dan Burden

Typical (although may not be ideal) suburban context avenue: Cornelius NC. Photo source: Dan Burden

5.3.4 Street

A street is a local, multi-movement facility suitable for all community typologies and all frontages and uses. It is the most common type of roadway facility. It is rarely more than one lane in each direction, although it may contain a left turn pocket or combination turn lane. A street is generally controlled at intersections by stop signs or yield and through combinations. A street is typically urban or suburban in character, with raised curbs, gutter and drainage inlets, sidewalks, parallel parking, and trees in individual or continuous planters. The character may vary in response to the commercial or residential uses lining the street.

5.3.5 Lanes/Courts/Alleys

A court or a lane is a narrow street, often without sidewalks. Courts and lanes often do not allow two vehicles to pass each other between parked vehicles and generally do not contain centerline stripes. Alleys are narrow bypass streets, generally at the back of properties and typically used for utilities, trash pickup, and very local connections to garages and off-street parking areas.

Typical (although may not be ideal) urban context avenue: Ft. Lauderdale, FL. Photo source: Dan Burden

Typical (although may not be ideal) rural street. Photo source: Pedestrians.org

Typical (although may not be ideal) suburban street: Charlotte, NC. Photos source: Laura Sandt

Typical (although may not be ideal) urban street: Kalamazoo, MI. Photos source: Dan Burden

5.3.6 Paths/Trails/Special-Use Lanes

In new development, integrating a network of shared-use paths and earthen trails into the street network should be considered. Under this concept, every fourth or fifth "street" should provide comfortable access with low stress for bicyclists, pedestrians, joggers, skaters, and others along a linear parkway without motor vehicles. Where these paths and trails intersect streets, they should be treated as intersections with appropriate treatments. This type of network allows people to circulate to schools, parks, stores, and offices while staying primarily on dedicated paths and trails. These networks can also link to other paths and trails along waterways, utility corridors, rail rights-of-way, and other, more common active transportation corridors.

5.3.7 Sample Cross-Sections

Municipalities that are developing new subdivisions or modified streets through second-generation development should create new street standards based on the preceding street and functional classifications. Sample obliques for the basic street typologies are shown in figure 5-2." When adopting standards for new streets, local jurisdictions should also include the sidewalks as an integral part of the overall right-of-way and use the guidance provided in this chapter that recognizes all of the functional aspects of streets, including multiple modes of transportation and interaction with adjacent land uses.

In situations in which a community has a well-distributed network of gridded streets, most streets should have just two lanes (one in each direction). Four-lane streets or avenues (arterials and collectors) should be used to carry higher capacity along streets with more intensive adjacent land. In all but a few rare situations, six-lane boulevards (primary arterials) should not be needed. If a street has a very high traffic flow requirement, it can handle this flow as well as other street functions without being a divider street. A divider street splits the two sides of the street by making the roadway a barrier to cross-travel. The wider the street, the greater the number of lanes, and the higher the speed, the more the street would be considered a divider street. A seam street is one that pulls the two sides of the street together as a combined urban form. The street functions as a comprehensive space that includes circulation, but the ability to cross the street is not a problem and the flow of the street is slow enough to contribute to the retail or other function of the street. A street that is designed as a boulevard would be considered a through corridor if the majority of the trips begin or end outside the community.

Figure 5-2 shows the differences between a street, an avenue, and a boulevard. This figure demonstrates the subtle differences between the three that are emphasized when the context of land use, urban form, and street setting are all the same. In general, a street would only have two lanes, with on street parking. An avenue may have one or multiple lanes in each direction but is generally devoid of left turn controls and medians. A boulevard contains a median or some other form of left turn control as a method to keep opposing-direction vehicles apart. The overall width and right-

Sample of an urban lane or court: Philadelphia, PA.
Photo source: Dan Burden

Sample of path: Seattle, WA.
Photo source: Dan Burden

Specialty street- Festival Street: Asheville, NC.
Photo source: Dan Burden

of-way, as well as the likely vehicular volume of throughput, all increase from street, to avenue, and to boulevard—the highest.

In built-out communities, rigid street standards are often impractical. Curb-to-curb widths are expensive to change, buildings, exist and rights-of-way do not allow meeting full cross-section standards. Municipalities may want to reconfigure streets by reassigning space to make streets more closely meet the principles of living streets. This is most commonly done by "lane diets" and road diets, which redistribute space between the existing curb and gutter limits of the street but may also include new sidewalk construction.

Figure 5-3 provides examples of how some of the primary principles can be applied. This figure illustrates how poorly designed streets (at left) can be transformed into redesigned, living streets (at right). Road diets for four-lane streets (reducing the number of travel lanes) should be considered where daily traffic volumes are fewer than 20,000 (and sometimes 25,000) trips per day. Road diets for six-lane streets should be considered where daily traffic volumes are 40,000 or fewer.

Lane diets (reducing the width of lanes) can commonly be instituted for most streets except those with heavy truck traffic. Inside lanes should never be wider than 12 feet and can be as narrow as 9 to 10 feet. Outside lanes—depending on parking, bike facilities, and shoulders—should typically be no wider than 13 feet and as narrow as 10 feet if done in conjunction with shoulders, bike lanes, or shared outer lanes.

5.4 **TOOLS:** BIKE- AND PEDESTRIAN-FRIENDLY STREET DESIGN

Streets have an important bearing on the safety and general quality of life for all who use them. This section includes a discussion of the role of street networks in safety and livability, as well as characteristics of active, transportation-friendly street networks and design guidelines to create them.

5.4.1 Street Network Guidelines

Street networks compatible with active transportation provide a pattern of multi-modal streets that serve all community land uses and facilitate easy access to local, city, and regional destinations. The pattern, which mostly affects non-motorized modes, can result in the distribution of traffic that is consistent with the desired function of the street. One characteristic of a well-distributed grid network is that it offers many route choices that connect multiple origins with multiple destinations. (See figures 5-4 and 5-5. Source: Michele Weisbart.)

The street network functions best when it provides a variety of street types. The variety is enforced by the pattern of the street network itself but also by the design of individual street segments. Natural and built features, including topography and important community destinations, should be taken into account to create unique designs.

Figure 5-2: Comparison of a Street to an Avenue and to a Boulevard

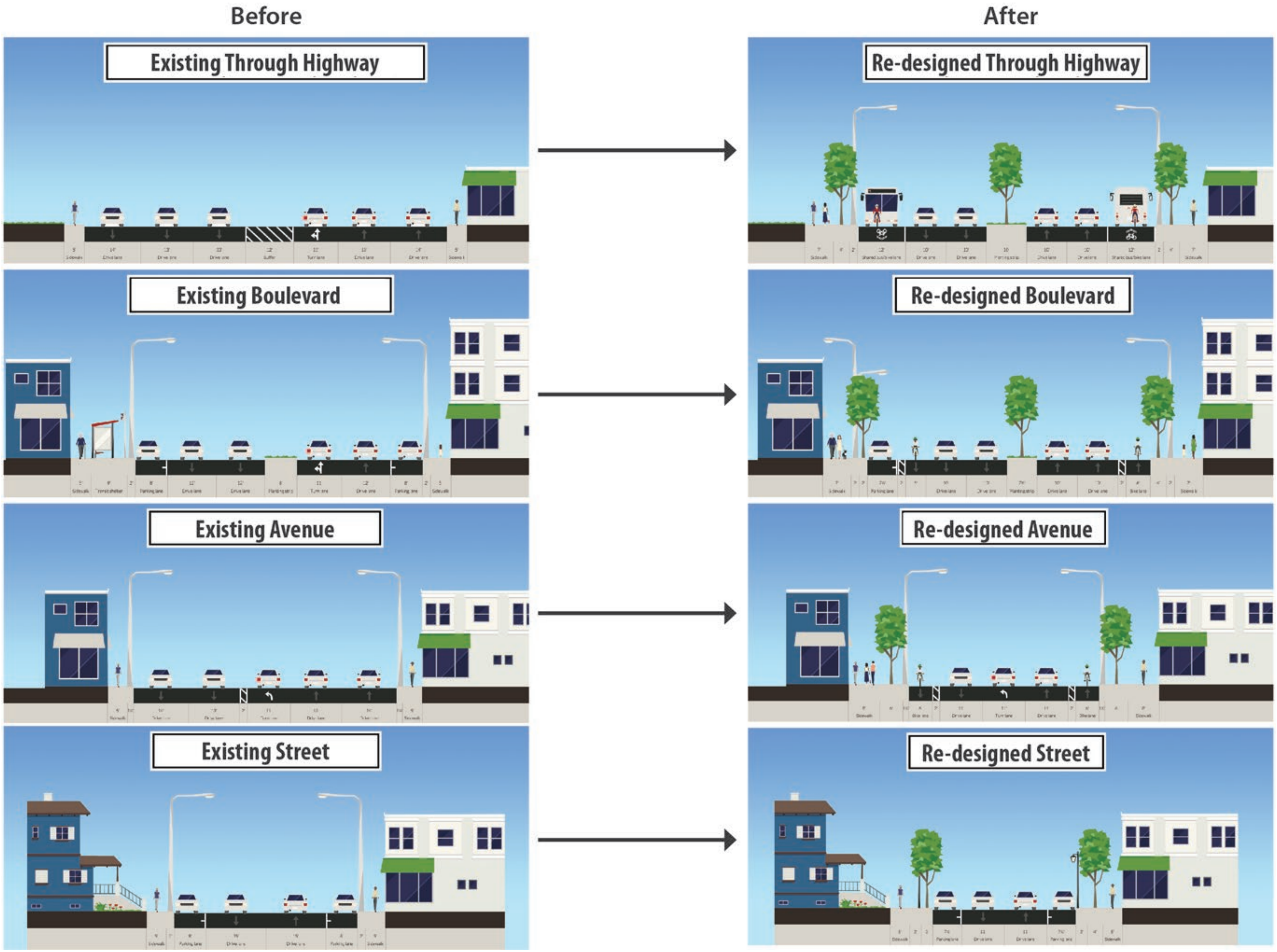
(Same land use context, different street types & configurations. Source: Claire Vlach, Bottomley Design & Planning)

Street

Avenue

Boulevard

Figure 5-3: Reclaiming Street Widths for Other Uses*



**For Federal guidance on road diets, see FHWA's Road Diet Informational Guide: http://safety.fhwa.dot.gov/road_diets/info_guide/*

Note: While actual widths permitted or required may vary from city to city, travel lanes of 11' or less are recommended for traffic calming, safety and pedestrian/bicyclist stress reduction.

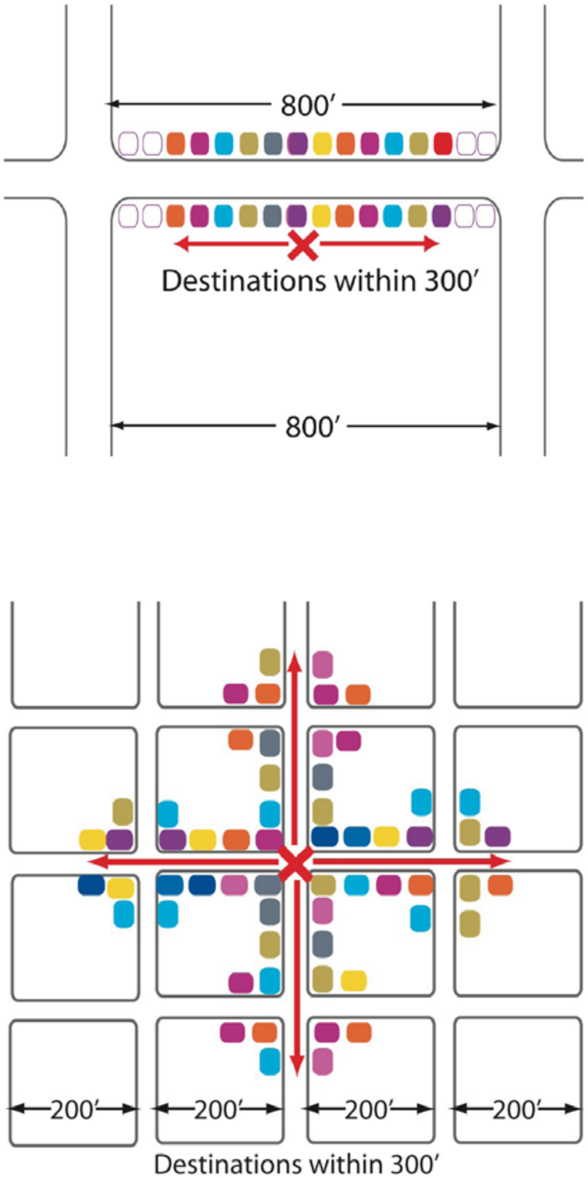


Figure 5-4: Long blocks limit destinations within walking distances. Short blocks offer more direct routes to more destinations

Source: Marty Bruinsma

The types of streets used in the network are described in the design standards provided in the following sections. The types differ in terms of their network continuity, cross-section design, and adjoining land use. The individual streets will change in character depending on their immediate land use context.

Lay Out Small Block Sizes To Shorten Walk/Ride Distances (NF)

Smaller block sizes shorten distances for both pedestrians and bicyclists. As a result, they ensure greater accessibility within the block through alleys, service courts, and other access ways. Larger blocks can be retrofitted with new streets, alleys, and other pedestrian or bicycle connections.

Provide a Grid or Straight Roadway Segments To Lower Out-of-Direction Travel (NG)

Boulevards and avenues that extend beyond the local area allow multiple street connections between neighborhoods and districts in a region. Additionally, local streets without closures can provide connections with adjacent neighborhoods and keep shorter blocks.

Provide a Distributed Network That Avoids Concentration of Traffic (ND)

A distributed network maximizes route options and the distribution of a fixed number of trips across a broader range of streets. It provides various low-stress routes for active transportation, including multiple routes for emergency vehicles.

Avoid Dead Ends/Gated Communities/Cul-de-Sacs (NC)

Dead ends and gated communities can create major out-of-direction travel for bikes, vehicles, and pedestrians. These network obstructions may cause conflicts in mixed-use neighborhoods, where there are many local destinations and origins. In order to avoid dead ends, pedestrians and bicyclists should be fully accommodated before a street is closed to prevent through traffic.

Avoid Wide/Fast Streets That Divide Communities (NW)

Maintain network quality by accepting growth and the resulting expansion of the street network (including development, revitalization, intensification, or redevelopment, particularly of active transportation facilities) while avoiding increases in street width or number of lanes because wider streets can create faster traffic that divides a community.

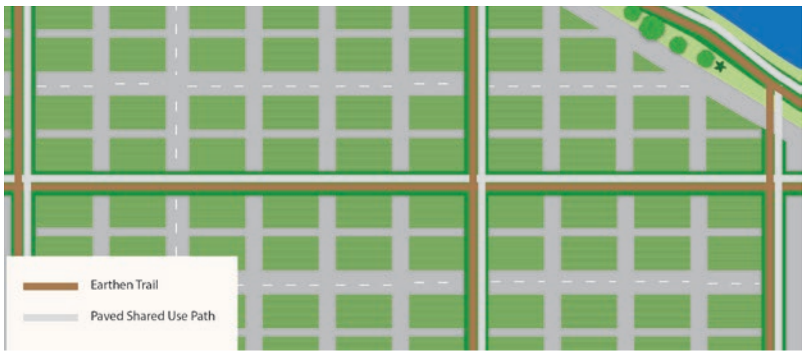


Figure 5-5: Integrated bike/walking trails within a grid of streets. *Source: Michele Weisbart*

Create Streets That Provide a Seam Between Sides of the Street (NS)

A pedestrian-friendly street needs safe and conveniently located crossing points that are universally accessible and well lighted. Streets should be created or revitalized to be seam streets, which may be achieved by road diets, lane diets, traffic calming, streetscape development, improved pedestrian crossing, and other types of improvements.

Include Bike- and Pedestrian-Friendly Diverters That Prevent Vehicular Through Traffic (NP)

In some instances, a street my need to be dead ended to prevent undesired through traffic. Traffic diverters can be used to provide pedestrian and bicycle connections through the end of the street. These types of diverters are also useful for bike boulevards and other streets where lower traffic volumes are a goal.

Avoid Leapfrog Development Into Areas With Few Mobility Options/Streets (NL)

Encouraging development for infill development where transit, bike, and pedestrian options exist can protect investments in these systems and avoid major infrastructure expansions.

Span Barriers With Bike or Pedestrian Bridges (NB)

Pedestrians and cyclists generally do not divert very far from horizontal or vertical directions for detours from their route. Bridges do not work well if they require long ramps, stairs, and elevators if a local street level option is available. Use landforms to obtain a gradual slope up to a bridge, and avoid out-of-direction ramp systems that emphasize the longer distance for pedestrians and bikes.

5.4.2 Roadway Guidelines

Roadway design is defined as design of the part of the street right-of-way between the two faces of curbs. It includes parking lanes, bicycle lanes, transit lanes, general-use travel lanes and medians. The design of the roadway is critical to the design of the entire street right-of-way because it affects not just the users in the roadway but those using the entire right-of-way, including the areas adjacent to the street.

Devices that prevent vehicles from through movements but allow bikes and pedestrians to enter a street are called diverters such as this on Morro Street in San Luis Obispo. Photo source: Drew Reed

Design To Accommodate All Modes (TM)

Do not force one mode of use to make changes to increase capacity at the expense of the other modes. Utilizing quantitative metrics to measure success may not always be the best way to accommodate all modes. Qualitative metrics are more appropriate.

Avoid streets so wide they divide the community. If exist, include ped. crossings at all intersections.
Photos source: Utah Department of Transportation

A street should bring together both sides like this example from Denver. Photo source: Ryan Snyder

Sometimes, only a bridge can make the needed connections. Photo source: George Ammerman

Ensure the Right Design Speed/Avoid Over-Designing the Street (TO)

Maximum throughput (based on congestion related to reaction time and the "Slinky®" delay effect associated with starts and stops and based on vehicular energy efficiencies) is best when kept at 35 miles per hour. For streets with high-volume demands, focus signal synchronization and design speeds on this ideal travel speed.

Design for Safety First, Multi-Modes Second, and Traffic Flow Third (TD)

"Safety first" should not be only a slogan but a foundation for street and community design. Safety of trips, regardless of mode, should always be the focus. Calmed traffic that is free flowing works best for all roadway users and reduces the severity of collisions if they do occur.

Protect Walkers by Using Parkways, Parking, and Street Trees (TP)

Pedestrians can be protected using parkways, parking, and street trees. On street parking can be important in the urban environment for the success of retail businesses that line the street and can provide a buffer for pedestrians and help calm traffic speeds. Additionally, pedestrian-scale lighting along sidewalks provides greater security, especially for people walking alone at night. Street trees that are large enough and spaced close enough can also be used as barriers to protect pedestrians because they can slow or stop a vehicle that comes onto the sidewalk.

Reduce Overall Roadway Widths as Much as Is Practical (TN)

Curb-to-curb widths that take more than 75 percent of the overall roadway right-of-way should be avoided if possible. Bike, parking, and walking facilities can be built by reclaiming width from excessively wide lanes of travel or an overbuilt number of lanes. Curb extensions or bulb-outs can be used to reclaim parts of the travel lanes that are not parkable and reduce overall crossing distances for pedestrians.

Minimizing the number of travel lanes is another important means of reducing overall width. Streets that average fewer than 20,000 average daily trips (ADTs) generally do not need more than one lane in each direction. Streets with fewer than 40,000 ADTs generally remain operational with two lanes in each direction.

Reduce Lane Widths To Allow for Other Users and for Traffic Calming (TR)

Wide lanes encourage speeding and meandering between striped lines. In order to increase driver attention and to limit weaving and drifting into adjacent lanes and bike facilities, lane widths can be narrowed. In most cases, a 10- or 11-foot lane is adequate for all vehicles, including larger buses or fire emergency vehicles. Only roadways with large trucks need to be wider. Permissive center left turn lanes should be no more than 12 feet in width and can be as small as 10 feet in width. All other roadway assets can be made available for medians, bike lanes, parkway strips, and other pedestrian facilities.

Protect and entice pedestrians by providing street trees and furnishings between vehicles and public spaces. Photo source: Mike Singleton

Manage Access by Limiting Curb Cuts/Driveways (TY)

Right turn conflicts between vehicles and bikes or pedestrians are increased along streets that have a large number of driveways accessed through curb cuts. It may be possible to lower these collisions by having joint-use access aprons between properties, as shown in figure 5-6. Additionally, regulatory signage and other raised median construction can help reduce problematic vehicle turns for cyclists and pedestrians.

Main Street (Route 62) is a major NY State truck route. The Village of Hamburg worked with NY State DOT to "right-size the street," narrowing travel lanes to 10 feet, inventing a 3 ft "park assist" lane. Photo source: Dan Burden

Manage Left Turn Movements Along Roadway Segments (TL)

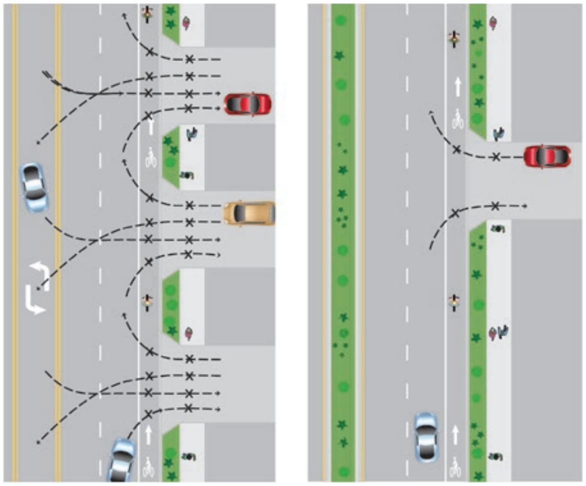
Medians used on urban streets provide access management by limiting left turn movements into and out of abutting development to select locations where a separate left turn lane or pocket can be provided. The reduced number of conflicts and conflict points decreases vehicle crashes, provides pedestrians with a refuge as they cross the road, and provides space for landscaping, lighting, and utilities. These medians are usually raised and curbed. Landscaped medians enhance the street or help to create a gateway entrance into a community.

5.4.3 Intersection Overview

Most conflicts between roadway users occur at intersections, where travelers cross each other's path. Good intersection design indicates to those approaching the intersection what they must do and who has to yield. Exceptions to this include places where speeds are low (typically less than 18 miles per hour) or where a shared space design (naked streets) causes users to approach intersections with caution. Conflicts for pedestrians and bicyclists are exacerbated due to their greater vulnerability, lesser size, and reduced visibility to other users.

Limit free left turns between intersections through the use of medians. Photo source: Melissa Saks- The Brooklyn Paper

Figure 5-6: Managed Driveway Access



Manage in and out privileges for driveway to avoid in-lane conflicts and collisions with bikes and pedestrians. Source: Michele Weisbart

This section describes design considerations in intersection geometry and intersection signalization, as well as roundabouts and other features to improve safety, accessibility, and mobility for all users. The benefits and constraints of each feature are examined, and the appropriate use and design of each feature are described.

Intersection geometry is a critical element of intersection design, regardless of the type of traffic control used. Geometry sets the basis for how all users traverse intersections and interact with each other. The principles of intersection geometry apply to both street intersections and freeway on- and off-ramps.

Yield Controlled

Yield-controlled intersections include both those that are explicitly yield controlled and those that are "uncontrolled." Uncontrolled intersections, those without any accompanying regulatory signage or pavement markings, are yield controlled by default. Intersections that are explicitly yield controlled can be identified by both signage and pavement markings. Yield control can be superior to stop control because it results in less air pollution, wasted fuel, and neighborhood traffic noise. In many contexts, particularly at the intersection of residential and local streets, yield control also provides an equal or even greater degree of safety (i.e. safety may be increased where yield control results in less certainty and more cautious driving).

Stop Controlled

Stop control utilizes regulatory signage and pavement markings. Two-way stop control is the most common form of intersection control, followed by all-way stops. The use of all-way stops should be consistent with the Manual on Uniform Traffic Control Devices (MUTCD). Stop control is sometimes (over)used to calm traffic but has the unintended effect of increasing air pollution, fuel consumption, and neighborhood traffic noise. As previously mentioned, in many contexts, a neighborhood traffic calming circle is a preferable and more effective option.

Signalized Intersections

Signalized intersections provide unique challenges and opportunities for livable communities and complete streets. On one hand, signals provide control of pedestrians and motor vehicles—with numerous benefits. Where signalized intersections are closely spaced, signals can be used to control vehicle speeds by providing appropriate signal progression on a corridor. Signalized intersections should be consistent with the MUTCD. Traffic signals allow pedestrians and bicyclists to cross major streets with minimal conflict with motor vehicle traffic. On the other hand, traffic signals create challenges for non-motorized users. Signalized intersections often have significant turning volumes, which conflict with concurrent pedestrian and bicycle movements. In some cases, roundabouts offer safer, more convenient intersection treatment than do signals.

5.4.4 Intersection Guidelines

Make All Legs of an Intersection Available for Pedestrian Crossings (IP)

The practice of restricting only one or two legs of an intersection from pedestrian crossing does not create a pedestrian-friendly street. Signalization and out-of-direction crossing distances disproportionately inconvenience pedestrians. Also, excessive crossing distances may result in unsafe crossings. Pedestrian crossing restrictions are often implemented in the name of safety; however, they often are equally guided by goals or standards of high vehicular throughput. Another problem with pedestrian crossing restrictions is that the restriction is difficult to communicate to those with vision disabilities.

Minimize Free Left Turn Only and Free Right Turn Only Lanes (IL)

Medians used on urban streets provide access management by limiting left turn movements into and out of abutting development to select locations where a separate left turn lane or pocket can be provided. The reduced number of conflicts and conflict points decreases vehicle crashes, provides pedestrians with a refuge as they cross the road, and provides space for landscaping, lighting, and utilities. These medians are usually raised and curbed. Landscaped medians enhance the street or help to create a gateway entrance into a community.

The most commonly used left turn phases at an intersection with a left turn lane are permissive, permissive-protected, and protected phasing. Protected phasing provides a separate signal time when pedestrians can cross the street without conflicts with turning vehicles; this is the preferred option. Permissive-protected phasing provides a shorter time of non-conflicts with pedestrians, and permissive phasing allows motorists to turn simultaneously with pedestrians crossing the street.

Limit free left turns lanes through new medians, road diets, and protected signalized intersections.
Photo source: Kentucky Transportation Cabinet

Provide Signals or Stops on Roads (IS)

If the hierarchy of traffic flow and street classification is very clear, pedestrian crossing signals, all-way stops, or pedestrian-actuated yield crossing points can be used. Stop signs or yield sign-controlled intersections can provide safe crossings for pedestrians at all intersections involving more than two lanes and that are posted above 25 miles per hour. It should be noted that stop signs can have the effect of increasing mid-block travel speeds and should not be used for traffic calming. The use of stop signs and signals should be determined by local standards and engineering review (MUTCD warrants for signals and stop signs may still be required).

Provide Minimal Radius on Corners or Utilize Rolled Curb Bulb-Outs (IM)

Intersection geometry based on the turning radius can have a significant impact on the comfort and safety of non-motorized users as well as the ability of the vehicle to make the turning movement. Although the goal should be to use standard curbs and ramps for bulb-outs, in some cases, street geometry and local radius standards may require the use of rolled curbs. Small corner radii provide the

Pedestrians benefit greatly on streets with two or four way stop signs. Photo source: Polish Hill Civic Association following benefits: smaller, more pedestrian-scale intersections resulting in shorter crossing distances; slower vehicular turning speeds; reduced pedestrian crossing distance and crossing time; better geometry for installing perpendicular ramps for both crosswalks at each corner; and simpler, more appropriate crosswalk placement in line with the approaching sidewalks.

Bulb-outs provide additional benefits for pedestrians: they occupy space at intersections unavailable to car parking (for visibility reasons), effectively adding it to the sidewalk to reduce crossing distance, slow vehicle speeds, and provide more space for street furniture.

Make Intersections Compact and Well Defined (IC)

Decisions at intersections often require split-second choices, precisely at the point of the greatest number of potential conflict points. As such, the clarity of movements and the understanding of yielding expectations must be very simple and well defined.

Avoid Irregular Intersections Unless Striping/ Medians Can Make Them Safer (II)

Multi-leg intersections (more than two approaching roadways) are generally undesirable and introduce complications for all users. Multiple conflict points are added because users arrive from several directions. Users may have difficulty assessing all approaches to identify all possible conflicts and yield requirements. These intersection types require users to cross more lanes of traffic, thereby making the travel distance across the intersection wider. Skewed intersections also require users to crane their necks to see other approaching users, making it less likely that some users will be seen.

Use Roundabouts and Mini-Circles To Eliminate Left Turn Conflicts and Control Speeds (IR)

Modern roundabouts are potentially the least expensive, safest, and most aesthetic form of traffic control for many intersections. This section of the chapter briefly describes roundabout application and design information. For more detailed information, refer to the NCHRP Report 672, *Roundabouts: An Informational Guide, Second Edition.*

Well-designed roundabouts have central islands for users of the street to go around the intersection, splitter islands that force users of the street to travel around the central island, truck aprons that larger vehicles can mount where needed, pedestrian crossings, and signs and markings. Roundabouts operate on the principle that drivers approach a roundabout and look left for any approaching vehicles that could conflict with their travel path. If there is no possible conflict, the approaching driver can enter the roundabout without delay. If there is a vehicle, or many conflicting vehicles, the approaching drivers yield to the conflicting vehicle on their left and wait for a safe gap to enter the roundabout. Though most roundabouts in the United States are single lane roundabouts, there are several multi-lane roundabouts found in heavily traveled urban areas.

Mini-roundabouts are a new form of roundabout that includes a traversable central island and traversable splitter islands to accommodate large vehicles. Mini-roundabouts are used in low-speed environments where operating speeds are 30 miles per hour or less and right-of-way constraints preclude the use of a standard roundabout.

Traffic circle used to slow traffic and avoid stop sign requirements. Photo source: Ryan Snyder

Modern roundabout used to increase throughput (compared to signals) and lowers speeds overall. Photo source: Andrew Bossi

Neighborhood traffic circles (or mini-circles) are very small circles that are retrofitted into local street intersections to control vehicle speeds within a neighborhood. Typically, a tree and/or landscaping is located within the central island to provide increased visibility of the roundabout and to enhance the intersection. The design of neighborhood traffic circles is primarily confined to selecting a central island size to achieve the appropriate design speed of around 15 to 18 miles per hour.

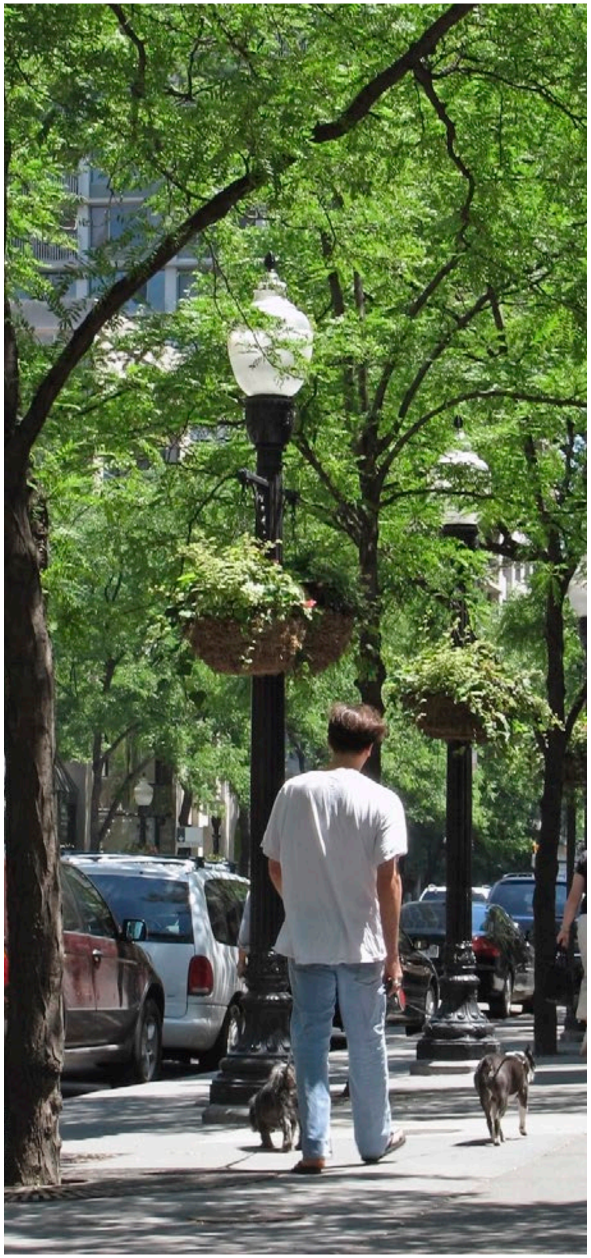
Due to their free-flowing nature, both roundabouts and neighborhood traffic circles require special design treatments for accessibility. These may include, but are not limited to, ADA standards, positive traffic control (through Rectangular Rapid Flashing Beacons [RRFBs], audible devices and truncated domes.

Use Bulb-Outs or Curb Extensions To Calm Traffic (IB)

The straight line and continuous and consistent edge of roadway principles in the past have actually resulted in increased speeds and increased severity of collisions. The lack of edge friction and the excessive consistency allow drivers to feel complacent and inattentive and are more likely to increase speed. An abruptly changing roadway edge, on the other hand, may require evasive action if the change is too dramatic. A variety of improvements can be made that provide horizontal deflection of motor vehicle movements, with the benefit of reduced speeds and protection of adjacent users. Curb extensions offer many benefits, including reduced pedestrian crossing distance, resulting in less exposure to vehicles and shorter pedestrian clearance intervals at signals; improved visibility between pedestrians and motorists; a narrowed roadway, which has a potential traffic calming effect; additional room for street furniture, landscaping, and curb ramps; reduced rear ending of parked cars due to inattentive drivers; additional on street parking potential due to improved sight lines at intersections; and management of street water runoff with infiltration techniques.

Curb extension at a pedestrian crossing.
Photo source: National Association of City Transportation Officials

Curb extension or bulb-outs used in Florida.
Photo source: Dan Burden



Streets are public spaces all onto themselves, but when connected with the right balance of land uses, they become a communities focal point. Photo source: iStock-Getty Images

5.5 BENEFITS: PICKING THE RIGHT TOOLS

Street networks and conditions can either enhance or destroy the ability of a community to be walkable and bikeable. Choosing the right improvements for an area requires attention to the issues that are in need of change, the context of the project site, the available budget, and the benefits desired from the investment This section ranks the characteristics and benefits achieved from each listed element. Figure 5-7 shows the benefits achieved by the implementation of each of the following elements.

Increases safety for bicyclists and pedestrians: Safety for cyclists and walkers can increase if streets are designed appropriately, with legible intersections, proper widths to match or calm speeds, and dedication of appropriate space for different users.

Decreases travel distance and travel time commitments: Connected and distributed streets ensure the shortest distance between likely destinations. Directness of route can be assisted through the use of smaller blocks, simple grids, smaller street crossing distances, as well as intra-property connections or mid-block crossings.

Allows for multiple choice of direction of travel: The more choices pedestrians or cyclists have for turning on a block generally means a quicker route to destinations on that block.

Supports access to adjacent land uses: These changes will result in better support of adjacent land uses, especially from a cyclist and pedestrian perspective.

Can result in lower infrastructure costs: Overall costs of development or redevelopment are lower because the cost of construction or maintenance of roadways will go down.

Helps in traffic calming: The proposed street elements will contribute to calmed traffic and will create a better environment for main street shopping and business uses.

Supports increased socialization: Walking, local shopping, and the activation of the street can contribute to improved social interaction and an improved sense of community.

Can be integrated into smaller-scale projects and/or initiatives: The scale of this improvement makes it likely to be implementable as part of smaller infill projects or other neighborhood-level improvements.

Provides multiple benefits for many individuals: Because of the protection or convenience of travel, this element should entice new users to engage in biking and walking for transportation or recreation.

Figure 5-7: Best Practices Implementation Benefits

Best Street Planning and Design Practices for Creating Bikeable Communities*

STREET NETWORK LAYOUT PLANNING ("N")

Best Street Planning and Design Practices for Creating Bikeable Communities*	NF - Layout small block size to shorten walk / ride distances	NG - Provide a grid to lower out of direction travel	ND - Provide distributed network to avoid bottlenecks	NC - Avoid dead ends / gated communities / cul-de-sacs	NW - Avoid wide / fast streets that divide communities	NS - Create streets that provide a seam between street edges	NP - Include diverters that prevent vehicle thru traffic	NL - Avoid leapfrog development into low mobility	NB - Span barriers with bike or pedestrian bridge
Effectiveness Rankings ***	4	4	3	2	3	2	2	1	1
Street layout increases safety for bikes and pedestrians					●		●		●
Decreases travel distance and travel time commitments	●	●		●	●			●	●
Allows for multiple choice of direction of travel	●	●		●				●	●
Street design supports access to adjacent land uses					●	●			
Street design can result in lower infrastructure costs					●			●	
Improvement helps in traffic calming	●				●		●		
Street design supports increased socialization			●			●			
Can be integrated into smaller scale projects / initiatives	●	●		●		●	●		
Provides multiple benefits for many individuals	●	●			●	●	●	●	

STREET TRAVELWAY DESIGN ("T")**

Best Street Planning and Design Practices for Creating Bikeable Communities*	TM - Design to accommodate all modes	TO - Assure the right design speed / avoid overdesigning	TD - Design for safety 1st, multi-modes 2nd & traffic flow 3rd	TP - Protect walkers by using parkways, parking & street trees	TN - Reduce overall roadway widths as much as practical	TR - Reduce lane widths to allow for other users & for traffic	TY - Manage access by limiting curb cuts / driveways	TF - Manage non-intersection free left turns with medians
Effectiveness Rankings ***	3	2	3	2	2	1	2	2
Street layout increases safety for bikes and pedestrians	●	●	●	●	●	●	●	●
Decreases travel distance and travel time commitments	●		●		●			
Allows for multiple choice of direction of travel	●							
Street design supports access to adjacent land uses	●		●					
Street design can result in lower infrastructure costs		●			●	●		
Improvement helps in traffic calming	●	●	●	●	●	●		
Street design supports increased socialization	●							
Can be integrated into smaller scale projects / initiatives	●	●	●		●	●	●	●
Provides multiple benefits for many individuals	●	●	●	●	●			

STREET INTERSECTION DESIGN ("I")

Best Street Planning and Design Practices for Creating Bikeable Communities*	IP - Make all legs of an intersection available for ped	IL - Minimize free left turn only and free right turn only lanes**	IS - Provide signals or stops except 2 lane streets below 25	IM - Provide small radius on corners or utilize rolled curb bulb-outs	IC - Make intersections compact and well defined**	II - Avoid irregular intersections or use measures to lessen	IR - Use roundabouts / circles to slow speeds & eliminate left	IB - Use bulbouts to define parking & calm traffic**	IF - Avoid free right turn channelization designs**
Effectiveness Rankings ***	1	1	3	2	1	1	2	3	1
Street layout increases safety for bikes and pedestrians		●	●	●		●	●	●	●
Decreases travel distance and travel time commitments	●			●	●	●		●	
Allows for multiple choice of direction of travel	●								
Street design supports access to adjacent land uses									
Street design can result in lower infrastructure costs					●				
Improvement helps in traffic calming		●	●	●	●		●	●	
Street design supports increased socialization									
Can be integrated into smaller scale projects / initiatives	●	●	●	●	●			●	●
Provides multiple benefits for many individuals			●		●		●	●	

*** Use as general guidance. Costs and benefits are localized and benefits will depend on the exact conditions within each community.

Number of Street Guidelines: 24

Maximum Points Possible: 53

When features of walkways bike facilities, transit services, activated edges, parking and calmed vehicular traffic all come together, it becomes a complete street. Photo source: Mike Singleton

5.6 CONTEXT: USING THE RIGHT TOOLS IN THE RIGHT LOCATIONS

The primary purpose of a street is to connect people to the land uses where they live, learn, work, shop, and play. Streets, however, have been slowly converted to only move vehicular traffic, often through an area or neighborhood instead of within the local community.

This portion of the chapter shows four examples of the community place types (neighborhood, corridor, district, and center) in each of the three different types of community typologies (rural, suburban, and urban). Each of these areas is discussed on the following pages by use of a representative street network that comes from various locations in the United States. The diagrams should be used to determine where a particular street should be considered and the extent to which the network of streets and land uses must work together to achieve a walkable and bikeable community. The diagrams should be used only as a guide because they need to be adjusted based on local conditions, priorities, and policies. They provide insight, however, into how local context must be considered and how the interaction of land use, street configurations, and spatial arrangements can be integrated. The Best Street Planning and Design Practices for Creating Bikeable Communities figures represent general guidance on the types of treatments and elements that are available to consider and where they may be most appropriate. None of this should take the place of a community master plan, circulation element, or bike or pedestrian master plan but should serve as a foundation for these efforts. The matrices provide insight as to the full range of items that should be considered.

5.6.1 Street Design for Rural Areas

Rural Neighborhood Context

Rural neighborhoods are typically serviced by a grid of streets, with large block spacing and large parcel sizes. The network is often not complete, with large parcels of land without roadways, making walking and biking more challenging. Blocks are long and crossing opportunities are limited. Roadways typically are narrower, with limited shoulders and walkway systems. Standard streets and courts or lanes are also somewhat common. Figure 5-8 identifies the most appropriate street network and roadway design principles applicable for these areas.

Rural Corridor Context

Rural corridors are often made up of through-town highways and major avenues (arterials). In this context, through corridors are more prevalent than avenues and boulevards. Many rural corridors are the result of suburban-style development, based on vehicular distances and inexpensive, land putting destinations at great distances from each other.

Rural District Context

A rural district is mostly made up of concentrated non-main-street-style shopping centers versus strip commercial establishments discussed previously in the corridor context. Rural districts are often disconnected and separated from neighborhoods and corridors and may need connection improvements to make them bikeable and walkable.

Rural Village Center Context

A village center will typically have the main roads of the rural town running through the commerce and government center. Fortunately, these centers were developed historically with a human scale in mind and not based purely on parking convenience. These areas are walkability and bikeability assets.

A common pedestrian problem in rural roadway are the lack of walking facilities. Photo source: Joe Punsalan

Figure 5-8: Street Design Best Practices for Rural Areas

Best Street Planning and Design Practices for Creating Bikeable Communities*	STREET NETWORK LAYOUT PLANNING ("N")									STREET TRAVELWAY DESIGN ("T")**								STREET INTERSECTION DESIGN ("I")								
	NF - Layout small block size to shorten walk / ride distances	**NG** - Provide a grid to lower out of direction travel	**ND** - Provide distributed network to avoid bottlenecks	**NC** - Avoid dead ends / gated communities / cul-de-sacs	**NW** - Avoid wide / fast streets that divide communities	**NS** - Create streets that provide a seam between street edges	**NP** - Include diverters that prevent vehicle thru traffic	**NL** - Avoid leapfrog development into low mobility	**NB** - Span barriers with bike or pedestrian bridge	**TM** - Design to accommodate all modes	**TO** - Assure the right design speed / avoid overdesigning	**TD** - Design for safety 1st, multi-modes 2nd & traffic flow 3rd	**TP** - Protect walkers by using parkways, parking & street trees	**TN** - Reduce overall roadway widths as much as practical	**TR** - Reduce lane widths to allow for other users & for traffic	**TY** - Manage access by limiting curb cuts / driveways	**TF** - Manage non-intersection free left turns with medians	**IP** - Make all legs of an intersection available for ped	**IL** - Minimize free left turn only and free right turn only lanes**	**IS** - Provide signals or stops except 2 lane streets below 25	**IM** - Provide small radius on corners or utilize rolled curb bulb-outs	**IC** - Make intersections compact and well defined**	**II** - Avoid irregular intersections or use measures to lessen	**IR** - Use roundabouts / circles to slow speeds & eliminate left	**IB** - Use bulbouts to define parking & calm traffic**	**IF** - Avoid free right turn channelization designs**
Treatment Recommendations*																									
RN -Rural Neighborhood	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓
RC -Rural Corridor	✓	✓		✓		✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓			✓
RD -Rural District	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓
VC -Village Center	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

* Though all areas can benefit from these principles, they are more effective in specific community types and areas.

** Some design guidance elements are not shown on the associated mapping diagram since they apply community wide.

5.6.2 Street Design for Suburban Areas

Suburban Neighborhood Context

Street patterns are mostly curvilinear and arranged in a collector-style hierarchy, in which the neighborhood streets are regularly intersected with collectors, arterials, and major arterials collecting and distributing vehicular volumes. Often the streets are made up of cul-de-sac streets that do not connect with other streets. Some bikeway facilities are present, mostly as bike lanes on wider streets. The most prevalent cycling and walking problem in these areas relates to a lack of short connections between areas due to cul-de-sacs, large distances needed to travel to other land uses or destinations, and higher-speed and higher-volume streets. The street network often is responsible for lowering bikeability due to its arrangement, hierarchy, and street width. Figure 5-9 identifies the most appropriate street network and roadway design principles applicable for these areas.

Suburban Corridor Context

These areas are the typical development type associated with suburbs. The arrangement of one-lot-deep commercial properties that extend along great distances of avenues and boulevards (major arterials, minor arterials, and major collectors) is typical of these areas. The greatest walking and biking challenge relates to the large distances between land use destinations and neighborhood origins. Roadway design is usually focused on getting the largest volume of traffic through these areas, so the distances and the movement through intersections are significant challenges. In addition, free-turning left turns and right turns into and out of driveways are particularly troublesome for many cyclists and pedestrians due to misjudgment by drivers.

Suburban District Context

Similar to rural areas, these districts are often not connected to the corridors and neighborhoods of suburban communities.

Suburban Town Center Context

Usually, street speeds are reduced in town centers compared to districts and corridors, which is better for cyclists and pedestrians. Extensive amounts of on street parking does represent a challenge for cyclists due to pullouts, backups and door openings. Typically, street block widths are reasonable, and most intersections have positive control with signals or stop signs.

5.6.3 Street Design for Urban Areas

The street systems in urban areas are typically gridded, although some boulevards and avenues can split the grid or be angular or curvilinear. Urban neighborhoods are typically more bikeable because of the closer distances between destinations, the gridded nature of the roadway network, the presence of biking facilities, and the presence of 10-minute neighborhoods, with a mixture of land uses that can provide for most of the daily needs of local residents. Walking is also benefited by the street network and intersection designs of urban areas. Figure 5-10 identifies the most appropriate street network and roadway design principles applicable for these areas.

Urban Neighborhood Context

Street networks in urban neighborhoods are typified by highly connected grid patterns, with a fine-grained mesh of residential streets comprising the majority of the streets. These streets are typically bounded by collector streets and avenues that carry more traffic (of all modes) and may include some neighborhood-serving destinations. Strong network connectivity tends to support walking and bicycling because it provides short travel distances and multiple route options.

Neighborhood streets in urban areas tend to be rather narrow and configured as follows: two narrow travel lanes; two vehicle-parking lanes; generous, tree-lined parkway strips; connected sidewalks; and few driveways. The basic design of urban neighborhood streets provides inherent support for walking and bicycling (i.e. narrow streets, parked cars and street trees, calm traffic). In terms of special facilities, pedestrians have sidewalks and crosswalks, whereas bicyclists tend to comfortably share narrow streets with motorists. In some cases, traffic calming, signage, and other enhancements may be required.

Urban Corridor Context

Urban corridors generally consist of a large mixture of commercial and neighborhood areas bounded by major boulevards and avenues. These areas are generally surrounded on some of their sides with neighborhoods, making them good candidates for increasing connectivity and bikeability to the corridors.

Urban District Context

Generally, block sizes are reasonable and biking and walking distances are acceptable in urban districts. Walkway widths and amenities are present, increasing walkability in these districts.

City Center Context

City centers generally consist of human-scaled block sizes and controlled intersections, making walking easy and direct. Congestion levels in downtown areas, along with parking deficiencies, can make walking and biking more competitive with drive times.

Figure 5-9: Street Design Best Practices for Suburban Areas

Best Street Planning and Design Practices for Creating Bikeable Communities*

STREET NETWORK LAYOUT PLANNING ("N")

Treatment Recommendations*	**NF** - Layout small block size to shorten walk / ride distances	**NG** - Provide a grid to lower out of direction travel	**ND** - Provide distributed network to avoid bottlenecks	**NC**- Avoid dead ends / gated communities / cul-de-sacs	**NW** - Avoid wide / fast streets that divide communities	**NS** - Create streets that provide a seam between street edges	**NP** - Include diverters that prevent vehicle thru traffic	**NL** - Avoid leapfrog development into low mobility	**NB** - Span barriers with bike or pedestrian bridge
SN -Suburban Neighborhood	✓	✓	✓	✓	✓	✓	✓	✓	✓
SC -Suburban Corridor	✓	✓		✓	✓	✓		✓	✓
SD -Suburban District	✓	✓	✓	✓	✓	✓			✓
TC -Town Center	✓	✓	✓	✓	✓	✓			✓

STREET TRAVELWAY DESIGN ("T")**

Treatment Recommendations*	**TM** - Design to accommodate all modes	**TO** - Assure the right design speed / avoid overdesigning	**TD** - Design for safety 1st, multi-modes 2nd & traffic flow 3rd	**TP** - Protect walkers by using parkways, parking & street trees	**TN** - Reduce overall roadway widths as much as practical	**TR** - Reduce lane widths to allow for other users & for traffic	**TY** - Manage access by limiting curb cuts / driveways	**TF** - Manage non-intersection free left turns with medians
SN -Suburban Neighborhood	✓	✓	✓	✓	✓	✓	✓	✓
SC -Suburban Corridor	✓	✓	✓	✓	✓	✓	✓	✓
SD -Suburban District	✓	✓	✓	✓	✓	✓	✓	✓
TC -Town Center	✓	✓	✓	✓	✓	✓	✓	✓

STREET INTERSECTION DESIGN ("I")

Treatment Recommendations*	**IP** - Make all legs of an intersection available for ped	**IL** - Minimize free left turn only and free right turn only lanes**	**IS** - Provide signals or stops except 2 lane streets below 25	**IM** - Provide small radius on corners or utilize rolled curb bulb-	**IC** - Make intersections compact and well defined**	**II** - Avoid irregular intersections or use measures to lessen	**IR** - Use roundabouts / circles to slow speeds & eliminate left	**IB** - Use bulbouts to define parking & calm traffic**	**IF** - Avoid free right turn channelization designs**
SN -Suburban Neighborhood	✓	✓	✓	✓	✓	✓	✓	✓	✓
SC -Suburban Corridor	✓	✓		✓		✓	✓	✓	✓
SD -Suburban District	✓	✓		✓	✓	✓	✓	✓	✓
TC -Town Center	✓	✓	✓	✓	✓	✓	✓	✓	✓

* Though all areas can benefit from these principles, they are more effective in specific community types and areas.

** Some design guidance elements are not shown on the associated mapping diagram since they apply community wide.

5.7 IDEAS: PROJECT-SCALED STEPS

In order to achieve the recommendations of this chapter, implement street layout and design practices that support the creation of good streets and great places to walk and bike. Tools for the agency representative or elected official include—

5.7.1 Tools To Be Used by Approving Agencies With Land Use and Street Jurisdiction

- Consider the guidelines in this document when completing general plan, circulation element, and community plan updates.
- Review project-level and specific plan-level proposals, utilizing these guidelines.
- Consider adjusting design manuals or street standards to reflect these guidelines.
- Adopt complete street, multi-modal street, or livable street policy and associated design manuals.
- Use the guidelines as a different perspective for projects that are being required to modify lane geometry or for new roadway construction in order to handle greater levels of traffic. Context is important, as is the overall network and the role of the street in providing for many uses.
- Consider a street under review as a part of a network. If the street forces other uses to be compromised and the integration of the design principles of this document do not resolve the issue, then consider making adjacent streets more useful, accessible, and safe.
- Through the environmental review process, require projects to consider all users of a street when determining levels of service and possible mitigations.

5.7.2 Tools To Be Used by Project Proponents or Developers

- Select a development site in an area that is already bikeable or walkable, based on a good street network, with ample bike and pedestrian facilities already available.
- Assume the costs necessary to connect the site with the local street, bicycle, and pedestrian network as part of site preparation costs. At the same time, work with the local community to extend and improve the street network beyond the immediate adjacency of the project limits. Provide a project match of funds that will leverage other general fund, property bonding, or grant-based funding sources.

A common problem in urban areas are over-capacity walkways with infrequent crossing opportunities. Many urban type solutions have been provided including this pedestrian scramble that allows for all directions of street crossings during a controlled phase of the signals. Photo source: streets.mn

Figure 5-10: Street Planning and Design Best Practices for Urban Areas

Best Street Planning and Design Practices for Creating Bikeable Communities*	STREET NETWORK LAYOUT PLANNING ("N")									STREET TRAVELWAY DESIGN ("T")**								STREET INTERSECTION DESIGN ("I")								
	NF - Layout small block size to shorten walk / ride distances	**NG** - Provide a grid to lower out of direction travel	**ND** - Provide distributed network to avoid bottlenecks	**NC**- Avoid dead ends / gated communities / cul-de-sacs	**NW** - Avoid wide / fast streets that divide communities	**NS** - Create streets that provide a seam between street edges	**NP** - Include diverters that prevent vehicle thru traffic	**NL** - Avoid leapfrog development into low mobility	**NB** - Span barriers with bike or pedestrian bridge	**TM** - Design to accommodate all modes	**TO** - Assure the right design speed / avoid overdesigning	**TD** - Design for safety 1st, multi-modes 2nd & traffic flow 3rd	**TP** - Protect walkers by using parkways, parking & street trees	**TN** - Reduce overall roadway widths as much as practical	**TR** - Reduce lane widths to allow for other users & for traffic	**TY** - Manage access by limiting curb cuts / driveways	**TF** - Manage non-intersection free left turns with medians	**IP** - Make all legs of an intersection available for ped	**IL** - Minimize free left turn only and free right turn only lanes**	**IS** - Provide signals or stops except 2 lane streets below 25	**IM** - Provide small radius on corners or utilize rolled curb bulb-	**IC** - Make intersections compact and well defined**	**II** - Avoid irregular intersections or use measures to lessen	**IR** - Use roundabouts / circles to slow speeds & eliminate left	**IB** - Use bulbouts to define parking & calm traffic**	**IF** - Avoid free right turn channelization designs**
Treatment Recommendations*																										
UN -Urban Neighborhood	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
UC -Urban Corridor	✓	✓		✓		✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓
UD -Urban District	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
CC -City Center	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

* Though all areas can benefit from these principles, they are more effective in specific community types and areas.

** Some design guidance elements are not shown on the associated mapping diagram since they apply community wide.

- If the project site is large, provide the proper layout and mix of streets to accommodate the project and the wider communities needs.
- Ensure that the immediate site edges all have walkable environments that are safe, comfortable, and attractive.
- Contribute to crossing improvements that connect with important destinations within a few blocks of the development.
- Push to make improvements for mitigating traffic congestion issues by way of increased support for transit, biking, and walking.
- Resist project requirements that cause the project to decrease the safety, access, and comfort of cyclists or pedestrians near your project site.

5.8 RESOURCES: IMPORTANT RESOURCES TO CONSIDER

For more information on land use planning, please consult the following foundational documents.

FHWA:

- List of Online Reports and Technical Publications

NACTO:

- Transit Street Design Guides (2016)
- Urban Bikeway Design Guide (2014)
- Urban Street Design Guide (2013)

ITE:

- Designing Walkable Urban Thoroughfares (2010)

OTHERS:

- LEED Neighborhood Design (2014)
- Model Design Manual for Living Streets (2011)
- Complete Streets Best Policies and Implementation Practices (2010/Annual)

NOTES:

1 *The National Intersection Safety Problem* 2009. FHWA-SA-10-005. November.

2 Marshall, W., and N. Garrick. "Does the Street Network Design Affect Traffic Safety?" *Accident Analysis and Prevention* 43(3): 769–781

3 Dumbaugh, E.R. Rae. "Safe Urban Form: Revisiting the Relationship between Community Design and Traffic Safety." *Journal of the American Planning Association 7* (53): 309–329)

4 *Effect on Connectivity on Fire Station Service Area and Capital Facilities.* 2009 presentation by the Charlotte, North Carolina Department of Transportation." http://www.midwesternite.org/2009meeting/presentations/2A/2009%20ITE%20MW%20Conference%20-%20Magnasco.pdf.

5 http://www.smartgrowthamerica.org/complete-streets-2014-analysis.

6 *Designing Walkable Urban Thoroughfares: A Context Sensitive Approach.* 2010. Institute of Transportation Engineers.

CHAPTER 6: BIKEWAY PLANNING AND DESIGN

USER LEGEND

Advocate Organizations

- Housing Advocates
- Health and Safety Advocates
- Smart Growth Advocates
- Mobility Choice Advocates

Providing Entities

- Developers, Financial Institutions
- Housing Providers and Institutions
- Planning, Design or Engineering Consultants

Decision Makers

- Local Agency Planners and Engineers
- Local Elected Officials and Review Staff
- Federal, State and Regional Regulators

There are many cyclists with highly variable levels of skill, speed and comfort levels. All need to be accommodated.

Many early bikeway plans assumed that bicyclists more resemble pedestrians than vehicles in their behavior. This approach led to undesirable situations in which bicyclists were being under served by inadequate facilities, pedestrians resented bicyclists being in their space, and motorists became confused by bicyclists entering and leaving the traffic stream in unpredictable ways. Only under special circumstances (e.g., on multi-use paths) should bicyclists and pedestrians share the same space.

People on bicycles are legal users of the street, although they are slower and less visible than motor vehicles. Bicyclists are also more vulnerable to injury in a collision compared to motorists. They need accommodation on busy, high-speed roads and at complex intersections. In congested urban areas, bicyclists provided with well-designed facilities can often proceed faster than motorists.

Well-designed bicycle facilities guide cyclists to ride in a manner that conforms to the vehicle code: in the same direction as traffic and usually in a position 3 to 4 feet from the right edge of the traveled way. This distance may need to be increased to avoid parked cars, debris, drainage grates, and other potential hazards.

6.1 USERS: UNDERSTANDING USER PRIORITIES AND CAPABILITIES

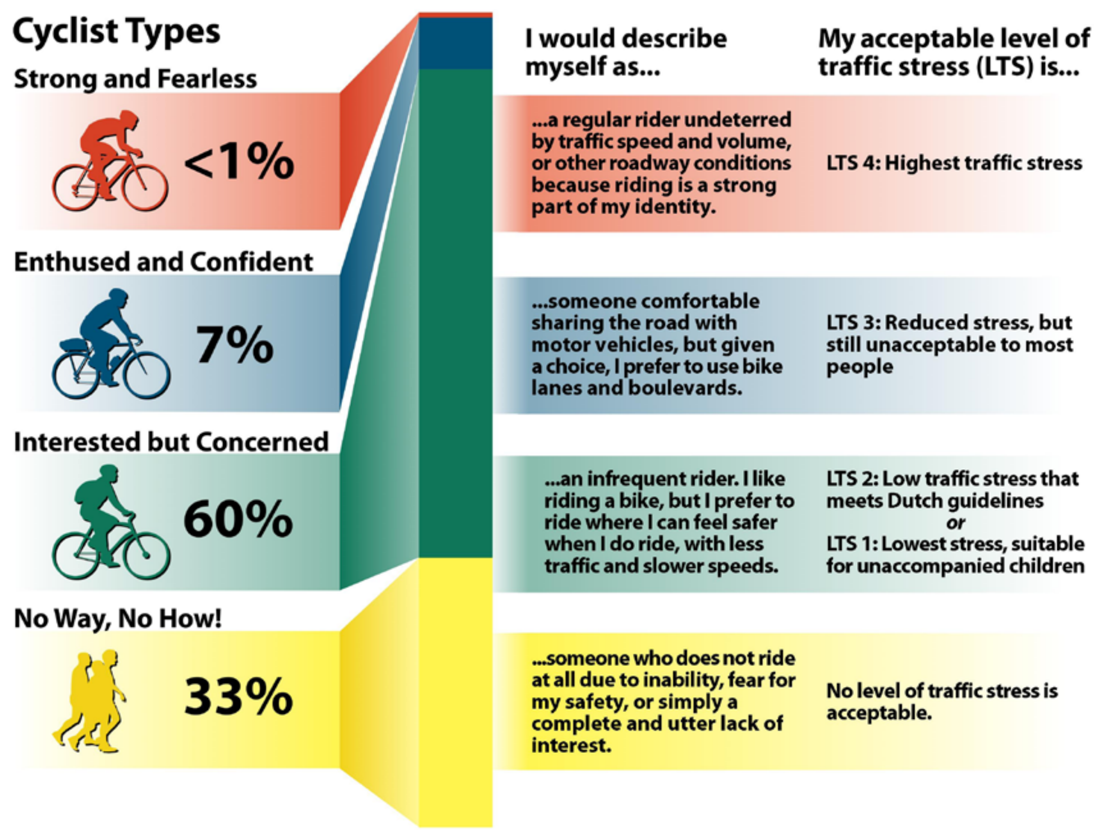
Bicycling is different from other transportation modes in several important respects, and it also contains several different classes of users. Bicycling relies heavily on momentum. Because bicyclists use their own power and must constantly maintain their balance, they generally try to avoid interruptions. Typical bicyclist speeds range from 10 to 15 miles per hour, enabling them to make trips of up to 5 miles in urban areas in about 25 minutes, the equivalent of a typical suburban commuter trip time. Varying cyclist skill levels result in a wide variety of speeds and expected behaviors.

Several systems of bicyclist classification are used within the bicycle planning professions. These classifications can be helpful in understanding the characteristics and infrastructure preferences of different cyclists. Bicycle planning should use a wide variety of options, from shared roadways to separated facilities, to accommodate as many user types as possible and to provide a comfortable and safe experience for the greatest number of cyclists.

A classification system developed by the City of Portland, Oregon (figure 6-1), lists the following bicycle user types—

- **Strong and Fearless:** Bicyclists who will ride anywhere regardless of roadway conditions. These bicyclists can ride faster than other user types, prefer direct routes, and will typically choose roadways, even if shared with vehicles, over separate bicycle facilities, such as paths. These constitute a very low percentage of the population.
- **Enthused and Confident:** This group encompasses intermediate cyclists who are mostly comfortable riding on all types of bicycle facilities but usually prefer low-traffic streets, bike lanes, or separate paths when available. They may deviate from a more direct route in favor of a preferred facility type. This group includes commuters, utilitarian cyclists, and recreational riders and probably represents less than 10 percent of the population.
- **Interested but Concerned:** This user type makes up the bulk (likely between one-half and two-thirds) of the cycling or potential cycling population. They are cyclists who typically ride only on low-traffic streets or paths under favorable conditions and weather. They perceive traffic and safety as significant barriers toward increased use of cycling. These cyclists may become "Enthused and Confident" with facilities, education, and encouragement.
- **No Way, No How:** People in this category are not cyclists; they perceive severe safety issues with riding in traffic and do not ride a bicycle under any circumstances. Some among this group may eventually give cycling a second look and may progress to one of the preceding user types. This group likely accounts for between one-fourth and one-third of the population.

Figure 6-1: Bike User Classification System



6.2 PRINCIPLES: BASICS OF A BIKE-FRIENDLY COMMUNITY

The following principles are needed for setting the foundation for a bikeable community and should be considered when planning a new community, for in-fill projects, or for neighborhood revitalization.

- Bicyclists should have safe, convenient, and comfortable access to all destinations.
- Every street could possibly be used by cyclists, regardless of designation or improvements.
- Not every street need to accommodate cyclists; however, parallel streets and corridor networks need to provide appropriate facilities for all abilities. Bike, pedestrian, and transit facilities should be integrated to provide a network of travel solutions.
- Bicyclists should generally be separated from pedestrians except while on multi-use paths.
- Shared use of the roadway with vehicles is acceptable along low-volume, low-speed streets.
- Conventional or buffered bike lanes should be used on medium-volume, medium-speed streets.
- High-volume, high-speed streets need to have horizontal separation (as provided by a multi-use path) or vertical separation (as provided by roadway barriers) commonly provided by cycle tracks.
- Bikeway treatments should provide clear guidance for how a cyclist is expected to utilize the facility and how vehicles and cyclists should interact in a predictable manner.
- Because most bicycle trips are short, a complete network of designated bikeways should have a grid of roughly 0.5 mile or less.
- Attention should always be focused on intersections or segments where safety risks are high or where a segment condition changes dramatically, to the detriment of riding space.

6.2.1 Actions To Include

- Design streets with the assumption that people on bicycles have to travel to the same destinations as do people in motor vehicles.
- Design streets to encourage cyclists to act in a manner that is consistent with vehicular travel.
- Design streets to make it clear where cyclists should be and how they should move through the space.
- Design streets with the assumption that nearly every street may be used by a bicyclist.
- Design bikeways to the highest level that is needed and feasible in its context.
- Ensure that well-designed bicycle parking is available wherever it might be needed.

6.2.2 Actions To Avoid

- Do not construct new boulevards (arterial streets) without low-stress bicycle facilities, such as buffered or separated bike lanes.
- Do not construct new avenues (collector streets) without bike lanes or some bikeway designation.
- Do not remove bike lanes to make space for more vehicular travel lanes or turn lanes.
- Do not stripe the minimum width of a bike lane where space is available for a wider one.
- Do not assume that people will ride only in certain parts of town or on certain streets.
- Do not assume that drivers understand the rules of the road or their responsibility in sharing the roadway with other users.
- Do not assume that enforcement or self-motivated actions on the drivers' part will cause them to react or behave in a safe and accommodating fashion.

6.3 TOOLS: FACILITIES THAT CAN HELP MAKE A BIKE-FRIENDLY COMMUNITY

This part of the chapter discusses a series of tools that can be used to improve the bikeability of a community. The tools are broadly grouped into five categories—

- Bike and vehicle sharing travel lanes.
- Bike-only travel lanes.
- Protected bike facilities, separated from travel lanes.
- Bike facilities at intersections.
- Bike amenities.

Within each of the five categories, the tools are ordered from most to least effective. Each category is identified by a unique letter label, and each tool, a unique two-letter label (e.g. Tools for Bike and Vehicle Sharing Travel Lanes: S; Bike Boulevards: SB). These two-letter labels are also used in the contextual matrices and maps.

For each tool, a high-level discussion regarding where, why, and how to use the tools is provided. Each description is also accompanied by one or more photos from real projects in real communities. The photos represent typical applications of the tools. Photos are not meant to provide regulatory guidance and may or may not meet all of the current regulatory requirements or best management practices. The reader should consult applicable guidelines specific to the community as well as national level guidelines found in the foundation reference documents in chapter 1. More specific information describing the broad range of available tools and sample 3D models can be found in appendix B.

6.3.1 Bike and Vehicle Sharing Travel Lanes (S)

<u>Bike Boulevards/Greenways (SB)</u>

A bicycle boulevard is an enhanced shared roadway, where a local street has been modified to function as a prioritized through street for bicyclists while maintaining local access for automobiles. This is done by adding traffic-calming devices to reduce motor vehicle speeds and installing traffic diverters or controls that limit through movements by vehicles. A bike boulevard gives priority to through bicyclist movement and generally removes stops signs in the primary direction of the street.

Generally, bicycle travel on local streets is compatible with residential neighborhoods. Often, measures that support bicycle boulevards are done in conjunction with neighborhoods that would benefit from restricting through traffic of motorists. By reducing traffic and improving crossings, bicycle boulevards also improve conditions for pedestrians.

A greenway is a version of a bike boulevard that typically includes urban forestry, placemaking features, and stormwater runoff or rain gardens. Successful bicycle boulevard implementation requires careful planning with residents and businesses to ensure acceptance.

Neighborhood Greenway for "All Ages and Abilities." Photo Source: Clintonville Greenways

Neighborhood Traffic Circle often used as a diverter to slow vehicular traffic. Photo Source: Bike Long Beach

Vehicle diverter. Photo source: www.pedbikeimages.org/ Adam Fukushima

Sharrow road marking. Photo source: John Holloway

Bike route sign. Photo source: Mike Singleton

<u>Sharrows With Standard or Greenback Boxes (SH)</u>

Shared-lane marking stencils (commonly called "sharrows"—derived from the words shared and arrows) may be used as an additional treatment for shared roadways. The stencils can serve a number of purposes: they remind bicyclists to ride farther from parked cars to prevent "dooring" collisions, they make motorists aware of bicycles potentially in the travel lane, and they show bicyclists the correct direction of travel and lane position.

<u>Bike Routes With No Improvements Other Than Signage (SR)</u>

Posted bike route signs can be used on roadways with low traffic volume. These routes may parallel busier streets and provide low-stress alternatives, as in Bike Boulevards. Bike route signage can provide direction to other bike facilities or destinations. Although less desirable than other bike facilities, routes are typically implemented for the sake of network connectivity. They may be ineffective at closing gaps due to the high-stress experiences they create. In light of this, many communities offer widened sidewalks ("urban trails") in addition to bike route signage in such locations.

6.3.2 Bike-Only Travel Lanes (B)

A bike lane is a portion of the travel way designated for use by bicyclists, with restricted movement by motor vehicles across the solid white line. They are most suitable on avenues and boulevards or any street that has the width to accommodate at least a 5-foot-wide marked lane. Bike lanes may also be provided on rural roads where there is anticipation of high bicycle use. Bike lanes are generally not recommended on local streets that have relatively low traffic volumes and speeds because a shared roadway would be the more appropriate facility. There are no hard and fast mandates for providing bike lanes, but as a general rule, most jurisdictions consider bike lanes on roads with traffic volumes in excess of 3,000–5,000 ADT or traffic speeds of 30 miles per hour or greater.

Bike lanes have the following advantages—

- They enable cyclists to ride at a constant speed, especially when traffic in the adjacent travel lanes tends to speed up or slow down (stop-and-go).
- They enable cyclists to position themselves where they will be visible to motorists.
- They encourage cyclists to ride in the designated lane rather than on the sidewalk.
- As long as roads are wide enough, these treatments are inexpensive to implement.
- They are a visual reminder for vehicles turning onto the roadway that the lane may be occupied by bikes.

<u>Buffered Bike Lanes (BB)</u>

Buffered bike lanes have many of the benefits of protected bike facilities, with a much lower cost and the added benefit of maneuverability. They provide a painted divider between the bike lane and the vehicular travel lanes and/or parked vehicles on the street.

Buffered Bike Lanes. Photo source: Mike Singleton

This additional space can improve the comfort of cyclists because they do not have to ride as close to passing motor vehicles. A buffer may also be used between parked cars and bike lanes to direct cyclists to ride outside the door zone of the parked vehicles. Additionally, buffered bike lanes can also be used to slow traffic because they narrow the travel lanes.

Buffered bike lanes are most appropriate on wide, busy streets. They can be used on streets where physically separating the bike lanes with vertical protection is undesirable for cost, operational, or maintenance reasons.

<u>Conventional Bike Lanes (BL)</u>

Conventional bike lanes are one-way facilities that carry bicycle traffic in the same direction as adjacent motor vehicle traffic. Ideally, bike lanes should be provided on both sides of a two-way street. These bike lanes are created with a solid stripe and stencils.

Movements across the bike lane are allowed for driveways and at intersections. Commonly, the bike lane will be dashed where heavier vehicular turning movements are needed across the bike lane direction. Motorists are prohibited from using bike lanes for driving and parking but may use them for emergency avoidance maneuvers or breakdowns.

6.3.3 Separated (Protected) Bike Facilities From Travel Ways (P)

This category of bike travel way includes pathway systems that are completely removed from roadways or those that have separations from motor vehicles using vertical and horizontal barriers. Separated bike lanes, sometimes known as cycle tracks, are bikeways located on or adjacent to streets where bicycle traffic is separated from motor vehicle traffic by physical barriers, such as on street parking, posts or bollards, and landscaped islands.

Streets selected for separated bike lanes should have minimal pedestrian and driveway crossings. They should also have minimal loading and unloading activity associated with delivery vehicles and other street activity that may conflict with the free and open movement of the cycle track.

The design of separated bike lanes at intersections requires particular care. At intersections, the facility may be terminated, forcing cyclists to momentarily reenter the street while crossing, or the facility may continue via a protected intersection, where protection is provided by physical barriers and a dedicated signal phase.

The area to be used by bicycles should be designed with adequate width for street sweeping to ensure that debris will not accumulate (generally 8 feet clear of obstructions). If less than 8 feet is provided, then a smaller-than-standard street sweeper will need to be purchased by the local road authority.

Separated bike lanes may be designed as one-way or two-way facilities. In most circumstances, one-way separated bike lanes work best because they are much simpler to design at intersections and because drivers are less likely to expect cyclists traveling against the flow of vehicular traffic (i.e. drivers will not likely look both ways).

<u>Bike/Multi-Use Paths (PM)</u>

A multi-use path, also known as shared-use path, is a bike facility where other non-motorized uses are allowed. Multi-use paths are designed primarily for use by bicyclists and pedestrians, including pedestrians with disabilities, for transportation and recreation purposes, as mentioned in the Access Board's 2013 Supplemental Notice of Proposed Rule-making on shared-use paths. These facilities are separated from the roadway and are paved with a firm surface. Historically, multi-use paths have generally been associated with river corridors, rail corridors, open space, and recreational use areas. Often, they are direct routes with only a few cross-streets, making them quick ways to get from point A to point B. In this way, they also make for great transportation corridors.

Bike Path or Multi-Use Paths. Photo source: Joe Punsalan

<u>Separated Bike Lanes—One-Way Cycle Track (PO)</u>

The purpose behind separated bike lanes is to offer a protected area for bicycle travel in areas with high-speed and high-volume vehicular traffic. In general, vehicle speed and volume are positively correlated with the degree of vertical and horizontal separation, as well as strength of buffering material, provided. Typically, separated bike lanes are located on existing streets but may intermittently depart from streets, functioning more like a bike path. Additional guidance can be found in the FHWA Separated Bike Lane Planning and Design Guide.

One-Way protected Cycle Track. Photo source: San Francisco Bicycle Coalition

One-way separated bike lanes may exist on the same street (on two-way streets) or on parallel streets as "couplets" (on one-ways streets). Characteristic conflicts related to separated bike lanes and interruptions (mid-block driveways, alleyways, and other curb cuts) may be mitigated through proper geometric design, pavement markings, signage, education, and enforcement.

<u>Separated Bike Lanes—Two-Way Cycle Track (PT)</u>

Two-way separated bike lanes are similar to one-way separated bike lanes in that they are against the curb and protected from the adjacent travel lane with a raised curb and a parking lane. They provide two-way travel space and require only one protective barrier, taking up less space on the street than two one-way separated bike lanes. At the same time, however, they are wide enough for most conventional street sweepers. Two-way separated bike lanes present more potential conflict points at intersections than do one-way separated bike lanes. Therefore, these facilities must be designed with more care, such as requiring separate signal phases at intersections.

Two-way buffered Cycle Track protected by offset buffers from the roadway. Photo source: Mike Singleton

Bike Lane or Path Utilizing a Bridge (PB)

In some cases, the only way to safely travel across a major roadway, through corridor, limited-access highway, or freeway is to cross the roadway with a bridge. In additional cases, such as over rail lines or through major land features, bridges may be required to make bike network connections.

Bike bridges can be combined with pedestrian bridges. Given the expensive nature of the bridge, they should be constructed only if they are serving both bike and pedestrian uses. Bridges generally work best when the ramps are as short and direct as possible while still meeting ADA requirements for grade.

A Dual Path Bicycle/Pedestrian Bridge over I-80, Berkeley, CA. Photo source: http://journeyleaf.typepad.com/

6.3.4 Bike Facilities at Intersections (I)

All too often, improvements in bikeability along roadway segments are overshadowed by difficult and uncomfortable intersection crossings. Although high-speed street segments can be protected by certain types of facilities listed in the previous section, a "concerned, but interested" person willing to ride along these improved streets will be deterred by poorly designed and potentially unsafe intersections.

A well-designed intersection facilitates the through movements of bicyclists, pedestrians, motorists, and transit, so traffic flows in a safe and efficient manner. Designs for intersections with bicycle facilities should reduce conflicts between bicyclists and vehicles by heightening visibility, clearly denoting right-of-way, and ensuring that the various users are aware of each other. Intersection treatments can resolve both queuing and merging maneuvers for bicyclists and are often coordinated with timed or specialized signals.

Chapter 5 provided general principles of street geometric design. If these principles are applied, they will not only help calm traffic but also benefit cyclists and pedestrians. The configuration of a safe intersection for bicyclists may include additional elements, such as color, signs, medians, signal detection, and pavement markings.

Intersection design should take into consideration existing and anticipated bicyclist, pedestrian, and motorist movements. In all cases, the degree of mixing or separation between bicyclists and other modes is intended to reduce the risk of crashes and increase bicyclist comfort. The level of treatment required for intersections will depend on the bicycle facility type used, the adjacent street function, and the adjacent land use.

Protected Bike Intersections (IG)

Communities across the United States are implementing protective treatments for intersections—a technique developed in the Netherlands—similar to that for separated bike lanes. Protected intersections are important because they maintain the integrity (low-stress experience) of their adjoining separated bike lanes by fully separating cyclists from motor vehicles. Hallmark features of these protected intersections include a two-stage crossing supported by an advance queuing space, protective concrete islands, special bike-cross markings (alongside crosswalks), and special signal phasing.

Although mostly experimental in the United States, protected intersections are appropriate to pair with separated bike lanes/cycle tracks. Separated bike lanes at intersections require deliberate design solutions. Protected intersections offer the highest level of clarity and ease of use through design.

Protected bike intersection, Chicago, IL. Photo source: John Greenfield

Two-Stage Turn Queue Boxes (IQ)

Two-stage turn queue boxes can provide a more comfortable crossing for many cyclists because they entail two simple crossings rather than one complex crossing. They also provide a degree of separation from vehicular traffic because they do not require cyclists to merge with traffic to make left turns. They require experimental approval, however.

On right-sided, one-way separated bike lanes, bicyclists are often unable to merge into traffic to turn left due to the physical separation that is part of this facility. This makes the provision of two-stage left turns critical in ensuring these facilities are functional. The same principles for two-stage turns apply to both bike lanes and separated bike lanes.

Although two-stage turns may increase bicyclist comfort in many locations, this configuration will typically result in higher-than-average signal delay for bicyclists due to the need to receive two separate green signal indications—one for the through street followed by one for the cross-street.

Two stage turn queue boxes. Photo source: National Association of City Transportation Officials

Jug Handles for Left Turn With Bike Crosswalk (IJ)

A jug handle is a change in the outer curb lane or striping that allows cyclists to reposition their direction to take advantage of bike traffic signals, bike crosswalks, and actuators that allow for a left-turn movement from the right side of the street. Because this treatment allows cyclists to make a protected left turn rather than simply merge with vehicular traffic, it will appeal to a broader range of cyclists (those who identify as "interested, but concerned").

Jug Handle. Photo source: Mike Singleton

Mixing Zone With Solid and Dashed Markings (IZ)

Pavement coloring is useful in conjunction with several bicycle facilities. The primary goal of colored pavements is to differentiate specific portions of the travel way with colored pavements that can clarify where vehicles and bikes are supposed to mix and yield to each other. Colored pavements should be used to highlight conflict areas between bicycle lanes and turn lanes, especially where bicycle lanes merge across motor vehicle turn lanes or where exiting lanes for motor vehicles cross bike through-movements. Colored pavements can be used in conjunction with shared-lane markings (greenback sharrows) in heavily used commercial corridors where no other provisions for bicycle facilities are evident.

Although a variety of colored treatments have been used, the Federal Highway Administration has approved a bright green for interim use. Maintenance of color and surface condition are issues to consider. Traditional traffic paints and coatings can become slippery when wet and may present safety issues for cyclists. Long-life surfaces, which use a mixture of bonding agents and sand or bead particles, provide good wet-skid resistance and enhance safety.

Mixing zone markings. Photo source: Joe Punsalan

Mid-Block Bike Crossings/Signals (IH)

In many instances, off-street bike paths and cycle tracks meet existing roadways mid-block. This is especially true of multi-use paths. If the intersection of the path and the roadway is close to a standard signalized or controlled intersection, then it is reasonable to require the path user to travel to the nearest intersection. If this distance is excessive, however (several hundred feet away), many path users will not use intersection crossings, crossing instead along the most direct route and endangering themselves. In these cases, a mid-block crossing may be warranted to enhance safety and comfort.

Bike cross walk. Photo source: Calm Street Boston

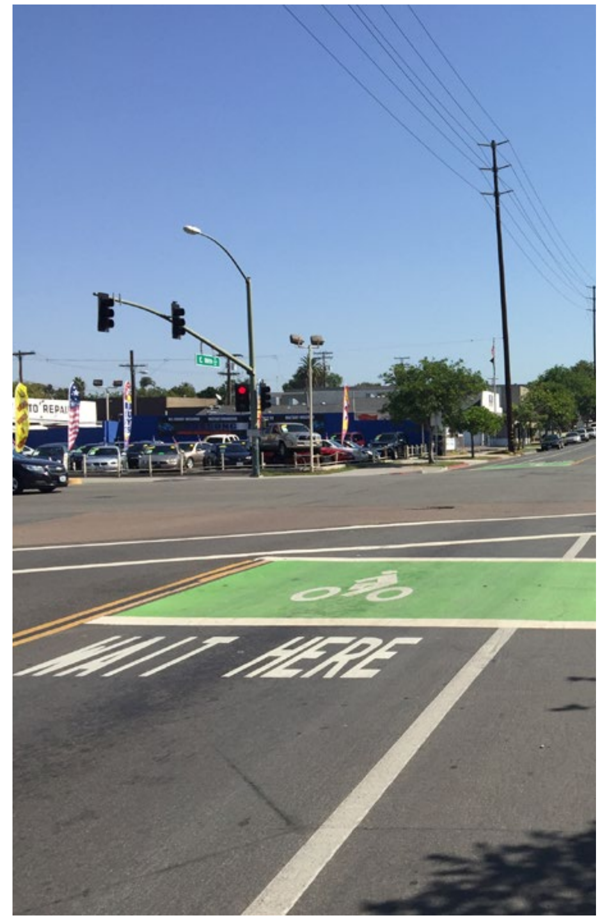
Through-Intersection Painted Markings (IT)

Continuing marked bicycle facilities at intersections ensures that separation, guidance on proper positioning, and awareness by motorists are maintained through these potential conflict areas. These markings remind the vehicle driver that a route through the intersection is related to the possible presence of cyclists in the marked space.

Painted markings through intersection. Photo source: Mike Singleton

Bike Boxes (IK)

A bike box is a designated area at the head of a traffic lane at a signalized intersection that provides bicyclists with a safe and visible way to get ahead of queuing traffic during the red signal phase. These boxes keep vehicles back far enough that bikes can position themselves to make a left turn or be safely removed from a free right turn lane.



Bike Box, National City, CA. Photo source: Mike Singleton

Dedicated or Shared Right Turn Lanes (IR)

The appropriate treatment for right-turn-only lanes is to place a bike lane pocket between the right turn lane and the rightmost through-lane. If a full bike lane pocket cannot be accommodated, a shared bicycle/right turn lane can be installed that places a standard-width bike lane on the left side of a dedicated right turn lane.

Shared right turn lane, Portland, OR. Photo source: [BikePortland.org]

Diverter of Traffic/Bike and Pedestrians Allowed (ID)

Diverters may be required in some locations to maintain a low-stress cycling experience by preventing direct and convenient vehicular access. In the case of bike boulevards, the priority of movement for bikes through an area—accomplished by "flipping" stop signs away from the direction of bicycle travel—may entice more vehicle use.

To reverse this unintended negative consequence, a semipermeable diverter may be used, permitting bike and pedestrian access while prohibiting vehicle access. In other cases, diverters or barriers may be used to reconfigure suboptimal intersections (e.g. skewed, multi-leg). In these cases, reclaimed space may be used for bicycle and pedestrian travel and queuing.

Traffic diverter, San Luis Obispo, CA. Photo source: Mike Singleton

6.3.5 Bike Amenities (A)

This section describes miscellaneous bike treatments that are not specifically part of bike travel ways or intersection treatments. In most cases, these elements are bike amenities that make the cycling experience more useful, convenient, and prioritized.

Bike Stations With Public Lockers/Showers (AD)

Certain types of mobility hubs, transit centers, or major destination points have such a high density of possible bike users that a bike station may be warranted. A bike station is a center for bike storage, repair, and general information. In some cases, bike stations have lockers, changing facilities, and showers, which may further incentivize bicycle commuting.

Private Lockers/Showers (AP)

Besides improving safety for cyclists, perhaps the next most important aspect of determining if an individual can commute to work on a regular basis is the availability of a place to change and shower. Related to this is the ability for safe and secure storage that is located in a convenient and well-monitored location in the building. These facilities may be required under development standards. The availability of these amenities can also encourage other healthy lifestyles, such as exercising at work during lunch breaks or before or after work hours.

Bike Traffic Signal Heads (AH)

This category includes all types of traffic signals that are directed at cyclists. These can include traffic light-style green, yellow, and red lightings, with signage indicating who the light signal is for, or special bikeway icons displayed in the signage light itself. Nearside bicycle signals may incorporate a countdown-to-green display as well as a countdown-to-red display.

Bike signal. Photo source: Mike Singleton

Bike station, Washington, DC. Photo source: John Holloway

Bike Signal Detection/Sensors/Actuators (AF)

Bicycle detection is used at intersections with traffic signals to alert the signal controller that a bicycle crossing has been requested. Bicycle detection occurs either through the use of push buttons or by automated means (e.g., in-pavement loops, video, and microwave). Inductive loop vehicle detection at many signalized intersections is calibrated to the size or metallic mass of a vehicle, meaning that bicycles may often go undetected. The result is that bicyclists must either wait for a vehicle to arrive, dismount and push the pedestrian button (if available), or cross illegally. Loop sensitivity can be increased to detect bicycles.

Bike actuators for signals. Photo source: Joe Punsalan

Bicycle-Share Stations/Programs (AB)

The inclusion of a bike-share station may be economically feasible if the demand is high enough, such as in urban or tourist areas, large institutions, and educational districts. A bike-share program has the potential to encourage non-cyclists to choose this form of transportation, with minimal upfront investment from the user. For a system to be useful and reliable as a transportation option, the distribution of bike-share stations must be frequent and widespread.

Capital Bikeshare, Washington, DC. Photo source: John Holloway

Bicycle Storage and Parking (AS)

To support bicycling, all businesses, institutions, and employment centers should provide bike parking and storage systems for its employees, students, and customers. Refer to the Association of Pedestrian and Bicycle Professionals (APBP) Bike Parking Guidelines for additional information.

Bikeway Wayfinding Systems (AW)

A bikeway wayfinding system is typically composed of signs indicating direction of travel, location of destinations, and travel time/distance to those destinations; pavement markings indicating to bicyclists that they are on a designated route or bike boulevard and reminding motorists to drive courteously; and maps providing users with information regarding destinations, bicycle facilities, and route options.

Bike Repair/Tool Stations (AT)

The inclusion of a bike repair facility or a smaller self-contained tool station may be warranted and useful to many users at mobility hubs located near major transit or at institutions that have a high number of bike users.

Bike Repair Station . Photo source: Urban Racks

6.1 BENEFITS: PICKING THE RIGHT TOOLS

Choosing the right improvements for an area requires attention to the issues that are in need of change, the context of the project site, the available budget, and the benefits desired from the investment. This section ranks the characteristics and benefits achieved from each listed element. Table 6-1 identifies the benefits achieved by the implementation of each of the described elements.

Provides a cost-effective element: This element is considered to be cost effective, with reasonable costs when compared to the overall benefits of implementation.

Quick to do and easy to implement: Implementation should be relatively simple in terms of processing, design, and construction. The overall implementation schedule is short.

Attracts new users: Because of the protection or convenience of travel, this element should entice new users to bike for transportation or recreation.

Balanced (cost effective, quick, and adds users): Given the previous benefits, this ranking indicates that the element provides a balance of all three rankings of cost, time, and attraction of new users.

Allows for innovative approach: This treatment is considered to be new or experimental. Many agencies and developers may wish to try new, innovative techniques.

Increases biking efficiency and reduces trip length: Speed and directness of route affect the ability of riders to get to their destination. This ranking indicates that the improvement will cut down on travel time.

Provides for traffic calming: Safety and comfort can be improved for cyclists if car travel is calmed to slower speeds and motor vehicle movements are more subtle and predictable.

Adds protection from traffic: A level of security and safety improvements can be expected from this element. It may also result in real or perceived safety.

Can be integrated into smaller-scale projects/initiatives: The scale of this improvement makes it likely to be implementable as part of smaller infill projects or other neighborhood-level improvements.

Provides multiple benefits for multiple modes: Improvements may directly affect cycling activities but also benefit transit users, pedestrians, and businesses located along the proposed area of improvement.

The greatest benefits from bike facilities comes from when it touches the greatest number of users.

Table 6-1: Benefits and effectiveness rankings of each bike improvement element

Best Bike Facility Design Practices for Creating Bikeable Communities*	SHARED LANES ("S")			BIKE LANES ("B")		SEPARATED LANES ("P")				INTERSECTION TREATMENTS ("I")									AMENITIES FOR BIKES ("A")							
	SB - Bike Boulevards / Greenways	**SH** - Sharrows (standard or greenback boxes)	**SR** - Bike Route (signage only)	**BB** - Buffered Bike Lanes	**BL** - Conventional Bike Lanes	**PM** - Bike /Multi-Use Paths	**PO** - Separated Bike Lanes One Way Cycle Track	**PT** - Separated Bike Lanes-Two Way Cycle Track	**PB** - Multi-use Path using a Bridge	**IG** - Protected Bike Intersections	**IQ** - Two Stage Queue Boxes	**IJ** - Jug Handles for Left Turn with Bike Crosswalk	**IZ** - Mixing Zones (Dash or Green Paint)	**IH** - Mid-block Bike Crossings / Signals	**IT** - Through Intersection Painted Markings	**IK** - Bike Boxes	**IR** - Dedicated / Shared Right Turn Lanes	**ID**- Diverters of Traffic / Bikes & Peds Thru	**AD** - Bike Stations with Public Lockers / Showers	**AP** - Private Lockers / Showers**	**AH** - Bike Traffic Signal Heads**	**AF** - Bike Signal Loops / Sensors / Actuators**	**AB** -Bike Sharing Stations / Programs	**AS** - Bike Storage and Parking**	**AW** - Bike Wayfinding Systems**	**AT** - Bike Repair / Tool Stations
Effectiveness Rankings ***	3	1	1	3	1	4	4	3	2	4	2	2	2	2	1	1	1	1	4	3	2	1	1	1	1	1
Provides a cost effective element	●	●	●	●	●						●		●		●	●	●							●	●	
Quick to do / easy to implement		●	●	●									●		●	●	●									
Attracts new users	●			●		●	●	●	●	●		●		●					●	●			●	●	●	
Balanced (cost effective, quick & adds users)	●			●		●							●									●		●		
Allows for innovative approach				●			●	●		●	●	●	●	●	●						●	●				●
Increases biking efficiency and reduces trip length	●					●			●					●				●			●	●			●	
Provides for traffic calming	●	●	●	●	●	●				●			●		●	●										
Adds protection from traffic				●		●	●	●	●	●	●		●	●								●				●
Can be integrated into smaller scale projects / initiatives										●	●	●	●	●	●	●				●	●	●		●	●	●
Provides multiple benefits for multiple modes	●			●	●	●				●			●	●				●	●	●			●		●	

*** Use as general guidance. Costs and benefits are localized and benefits will depend on the exact conditions within each community.

Number of Bike Guidelines: **26**

Maximum Points Possible: **52**

The greatest benefits from bike facilities comes from when it touches the greatest number of users.

6.5 CONTEXT: USING THE RIGHT TOOLS IN THE RIGHT LOCATIONS

The second half of the chapter will focus on the ways in which these tools may be combined in specific place types to provide a viable bicycle network.

There are many options for a wide range of traditional and innovative bike facilities that can be added to most streets. The first half of the chapter was dedicated to the tools available. The second part of the chapter is dedicated to understanding the local context of community typologies and place types. Matching the right type of facility to the right type of user to the right location is very important and potentially complex, requiring attention to detail. Utilize the following guidance for an overview of where certain facilities should be considered—

- Use shared roadways where a bike route is needed as part of a complete bikeway network and where space does not exist for bike lanes along streets with traffic volumes under 3,000 to 5,000 vehicles per day and where speeds are typically under 35 miles per hour.
- Use bike boulevards where a continuous route can limit traffic volumes to under 3,000 per day, preferably where alternative parallel streets exist that have capacity to absorb any traffic that may be diverted.
- Use shoulder bike lanes (if roads are greater than 5 feet) or shoulder stripes (if roads are less than 5 feet) on rural highways.
- Use bike lanes along routes where adequate space exists and traffic volumes are greater than 3,000 to 5,000 vehicles per day.
- Use wider or buffered bike lanes and colored bike lanes where traffic volumes are high (over 10,000 vehicles per day) and/or where prevailing travel speeds are over 30 miles per hour.
- Use bikes in bus lanes where bus lanes exist, especially where the bus lane is over 12 feet wide.
- Use buffered bike lanes where adequate space exists (where there is room for only one buffer, it should go between the travel lane and bike lane, except where on street parking turnover is frequent).
- Use raised bike lanes where extra protection for bicyclists is desired and where a high expectation of mounting and unmounting the curb is expected.
- Use separated bike lanes in downtown areas or along busy or high-speed streets.
- Use one-way separated bike lanes (cycle tracks) when possible instead of two-way separated bike lanes because drivers often do not expect cyclists coming in a contraflow direction.
- Use multi-use paths along continuous rights-of-way, such as waterways, railways, utility corridors, and recreation areas.

Various matrices, diagrams, and maps have been created to show the context of different community typologies and different place types. The maps should be used to see where a particular type of facility should be considered and the extent to which the network needs to be developed. These diagrams should be used only as guidance and need to be adjusted based on local conditions, priorities, and policies. They provide insight, however into how local context must be considered and how the interaction of land use, street configurations, and spatial arrangements must be integrated. The matrices represent general guidance on the types of facilities that are available to consider and where they may be most appropriate. None of this should take the place of a bike master plan and a public review process that allows local conditions and local priorities to be factored into the recommendations. These matrices provide the full range of items to be considered, however. Subsequently in the chapter, the benefits of each type of bikeway element and amenity have been summarized and ranked on matrices. A review of these benefits should be part of the overall planning process.

6.5.1 Integrating Bike Facilities With the Street System

Most bikeways are physically part of the street; therefore, well-connected street systems are very conducive to bicycling, especially those with a fine-grained network of low-volume, low-speed streets suitable for shared roadways. In less-well-connected street systems, where wide streets carry the bulk of traffic, bicyclists need supplementary facilities, such as short sections of paths and bridges, to connect otherwise unconnected streets.

There are no hard and fast rules for when a specific type of bikeway should be used, but some general principles may help to guide the selection. As a general rule, when traffic volumes and speeds increase, greater separation from motor vehicle traffic is needed. Other factors to consider include users (more children or recreational cyclists may warrant greater separation), adjacent land uses (multiple driveways may cause conflicts with shared-use paths), available right-of-way (separated facilities require greater width), and costs.

As a general rule, designated bicycle facilities (e.g., bike lanes and separated bike lanes) should be provided on all major streets (avenues and boulevards) because these roads generally offer the greatest level of directness and connectivity in the network and are typically where destinations are located. There are occasions when it is infeasible or impractical to provide bikeways on a busy street or the street does not serve the mobility and access needs of bicyclists.

The following guidelines should be used to determine whether it is more appropriate to provide facilities on a parallel local street—

- It is not economically or environmentally feasible to provide adequate bicycle facilities on the street.
- The street does not provide adequate access to destination points within reasonable walking distances, or separated bikeways on the street would not be considered safe.
- The parallel route provides continuity and convenient access to destinations served by the street.
- Costs to improve the parallel route are no greater than costs to improve the primary street.
- If any of these factors are met, cyclists may actually prefer the parallel local street facility in that it may offer a higher level of comfort (bicycle boulevards are based on this approach).

Because of the vast difference in speed and skill of cyclists, assume that the slower and less skilled cyclists are provided with facilities that they feel comfortable and safe with. Photo source: Dan Burden

Off-street paths can also be used to provide transportation in corridors otherwise not served by the street system, such as along rivers and canals, through parks, along utility corridors, on abandoned railroad tracks, or along active railroad rights-of-way. Although paths offer the safety and scenic advantages of separation from traffic, they must also offer frequent connections to the street system and to destinations, such as residential areas, employment sites, shopping, and schools. Street crossings must be well designed, with measures such as signals or median refuge islands. Additional guidance includes—

- Use buffered bike lanes where adequate space exists (where there is room for only one buffer, it should go between the travel lane and bike lane except where on street parking turnover is frequent).
- Use raised bike lanes where extra protection for bicyclists is desired.
- Use separated bike lanes in downtown areas or along busy or high-speed streets.
- Use one-way separated bike lanes where there is space for one buffer or to minimize conflict from cyclists coming in a contraflow direction.
- Use two-way separated bike lanes on streets with high activity levels or where it connects to a path on one end.
- Use multi-use paths along continuous rights-of-way, such as waterways, railways, utility corridors, and recreation areas.

6.5.2 Planning for Different Places and Different Communities

The following text and supporting graphics describe how bike guidelines should be considered in each of the four community place types. The intensity, typical streets, and land uses have been grouped into the three development types: —rural, suburban, and urban. Because funding of biking facilities is generally very limited, selecting the right solution for the right location is very important. Land use type and the intensity and conditions of the roadway are the primary determinants in setting priorities and matching improvements to local conditions. The overall goal of all guidelines discussed in this chapter is to match the improvement type with the area so that the largest cross-section of the community will benefit from the improvement and so that safety will also be increased by recognizing the context of the area's land uses, street patterns, and use levels.

This listing does not exclude other treatments from being considered. It identifies those treatments that are the most important to be considered. Each community may wish to customize these guidelines based on their own specific combination of intensity of development and vehicular travel volumes, as well as their specific mixture of land uses.

6.5.3 Planning and Designing Bikeway Facilities for Rural Areas

Rural Neighborhood Context

Rural areas are typically single-story, single-family detached homes. Some of these homes are on ranches, some are on farms, but most are found in low-density neighborhoods. These neighborhoods are typically serviced by a grid of streets, with large block spacing and large parcel sizes. A significant amount of open space exists, with a lower amount of improved recreational-based parks. Many streets do not contain bikeway or walkway systems, and roads are relatively narrow, providing challenges for cyclists in these areas. Figures 6-2 and 6-3 identify the most appropriate bikeway facility treatment for these areas.

Rural Corridor Context

Rural corridors are often made up of through highways and major avenues (arterials) (figure 6-4). The typical land uses are neighborhood- and community-serving commercial retail and service facilities, mostly with available parking in front of the businesses. Larger distances separate these land use types, mostly without the connectivity of bikeway systems. Although traffic volumes may be reasonable, vehicle speeds are typically higher and on typically smaller streets with limited biking facilities, which is why a wide shoulder is desirable.

Rural District Context

A rural district is mostly composed of concentrated and non-main-street shopping centers (versus strip commercial), industrial parks, major recreation centers, and rural-based community college areas (figure 6-5). These districts may or may not have a good internal network of bikeway facilities. They are often disconnected from neighborhoods and corridors and may need connection improvements to make them bikeable.

Rural Village Center Context

A village center will typically have main roads of the rural town, extending through the commerce and government center (figure 6-6). Mostly known as main streets, the collection of businesses and services is generally large enough to support many of the daily needs of these communities. The buildings are typically at the front of the parcels, with on street parking in front of the businesses. The scale is typically tall, single story or two to three story, with residential or office uses on the upper floors. For the most part, these centers are bikeable based on their scale but may have challenges due to extensive on street parking. Also, traffic volumes and turning motions are typically a challenge if this street is carrying a large capacity of through traffic.

Rural bike facilities tend to be focused on recreational activities and avoiding main through corridors. Photo source: iStock

Figure 6-2: Overview of a Typical Rural Area with Recommended Treatments

Best Bike Facility Design Practices for Creating Bikeable Communities*	SHARED LANES ("S")			BIKE LANES ("B")		SEPARATED LANES ("P")				INTERSECTION TREATMENTS ("I")									AMENITIES FOR BIKES ("A")							
	SB - Bike Boulevards / Greenways	**SH** - Sharrows (standard or greenback boxes)	**SR** - Bike Route (signage only)	**BB** - Buffered Bike Lanes	**BL** - Conventional Bike Lanes	**PM** - Bike /Multi-Use Paths	**PO** - Separated Bike Lanes One Way Cycle Track	**PT** - Separated Bike Lanes-Two Way Cycle Track	**PB** - Multi-use Path using a Bridge	**IG** - Protected Bike Intersections	**IQ** - Two Stage Queue Boxes	**IJ** - Jug Handles for Left Turn with Bike Crosswalk	**IZ** - Mixing Zones (Dash or Green Paint)	**IH** - Mid-block Bike Crossings / Signals	**IT** - Through Intersection Painted Markings	**IK** - Bike Boxes	**IR** - Dedicated / Shared Right Turn Lanes	**ID**- Diverters of Traffic / Bikes & Peds Thru	**AD** - Bike Stations with Public Lockers / Showers	**AP** - Private Lockers / Showers**	**AH** - Bike Traffic Signal Heads**	**AF** - Bike Signal Loops / Sensors / Actuators**	**AB** -Bike Sharing Stations / Programs	**AS** - Bike Storage and Parking**	**AW** - Bike Wayfinding Systems**	**AT** - Bike Repair / Tool Stations
Treatment Recommendations*																										
RN -Rural Neighborhood	✓	✓	✓			✓											✓	✓								
RC -Rural Corridor			✓	✓	✓	✓			✓					✓							✓	✓		✓	✓	
RD -Rural District		✓	✓		✓	✓			✓													✓		✓		
VC -Village Center	✓	✓			✓	✓		✓	✓					✓				✓	✓	✓	✓	✓		✓	✓	✓

* Though all areas can benefit from the implementation of these principles, they are more effective in specific community types and areas.

** Some design guidance elements are not shown on the associated mapping diagram since they apply community wide.

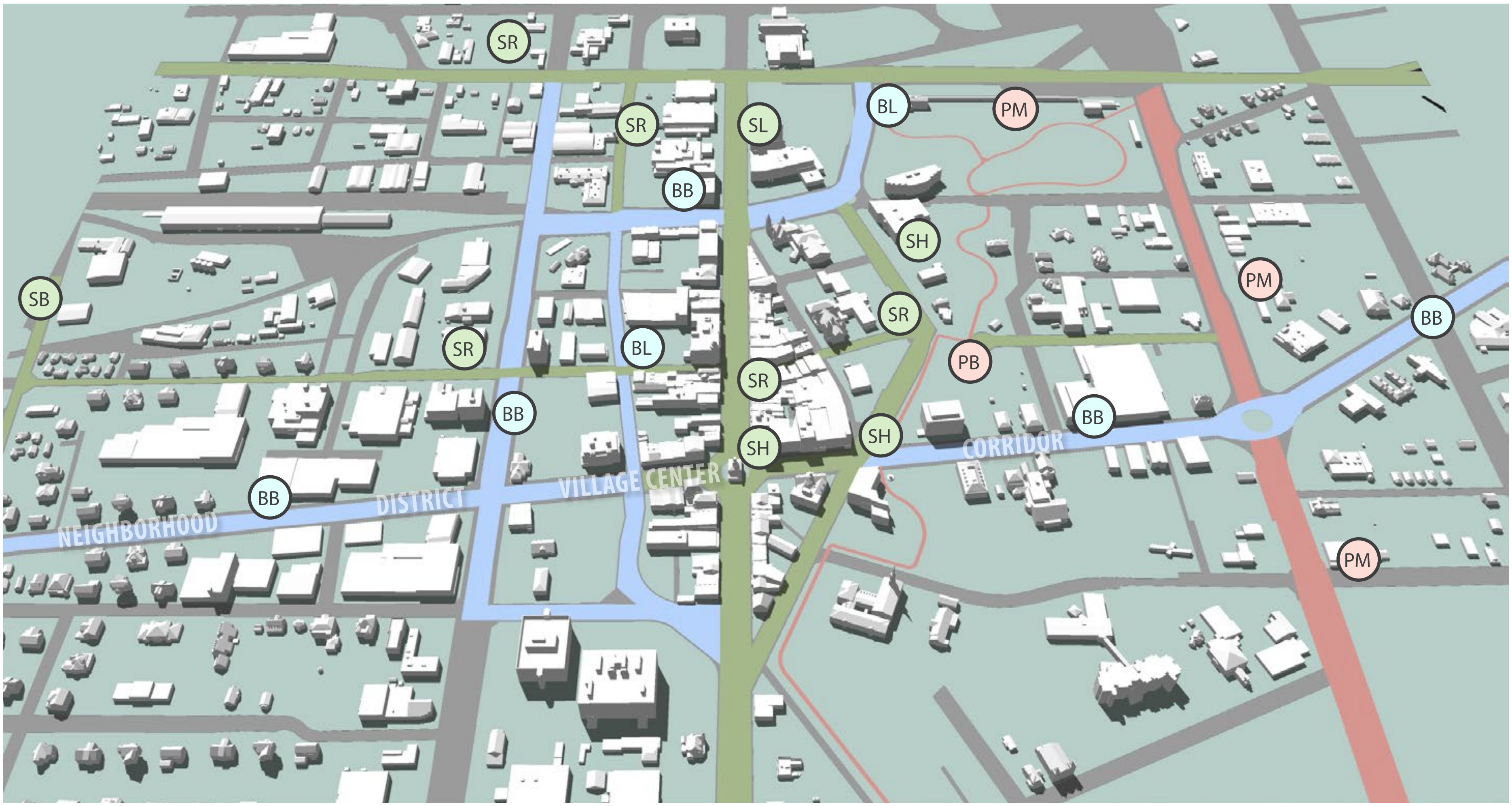


Figure 6-3: Rural Neighborhood

Figure 6-4: Rural Corridor

Figure 6-5: Rural District

Figure 6-6: Village Center

Planning and Designing Bikeway Facilities in Suburban Areas

Suburban Neighborhood Context

Suburban neighborhoods are typically single-story, single-family detached homes. A certain mixture of apartments and condominiums can be found along the larger streets in the area. These are typically attached three-story buildings. Street patterns are mostly curvilinear and arranged in a collector-style hierarchy, where the neighborhood streets are regularly intersected with collectors, arterials, and major arterials collecting and distributing vehicular volumes. Often, the streets include cul-de-sac streets that do not connect with other streets. Locally serving land uses will often include schools, libraries, parks, and community centers. In older communities, locally serving grocery stores can be found. Some bikeway facilities are present, mostly bike lanes on wider streets.

The most prevalent cycling problem in these areas relates to the lack of short connections between areas due to cul-de-sacs, large distances needed to travel to other land uses or destinations, and higher-speed and higher-volume streets. The street network is often responsible for lowering bikeability due to its arrangement, hierarchy, and street widths. Figures 6-7 and 6-8 identify the most appropriate bikeway facility treatment for these areas.

Suburban Corridor Context

These areas are the typical development type associated with suburbs (figure 6-9). The arrangement of one-lot-deep commercial properties extending along great distances of avenues and boulevards (major arterial, minor arterial, and major collector) is typical of these areas. As a result of retail trends over the past 30 years, big-box retail businesses have often taken up the larger parcels, mostly surrounded by parking. Office buildings and medical facilities are also scattered in a linear fashion along these suburban corridors.

The greatest cycling challenge relates to the large distances between land use destinations and neighborhood origins. The attention is usually focused on getting the largest volume of traffic through these areas, so intersection movements and the distances are significant challenges. In addition, free-turning left turns and right turns into and out of driveways are particularly troublesome for many cyclists due to misjudgments by drivers.

Suburban bike facilities need to buffer against higher speed streets and direct or parallel routing. Photo Source: Streetsblog Los Angeles

Suburban District Context

Suburban districts are often made up of shopping districts (not counting commercial strips), large schools and community college campuses, business districts, major single corporation employers, and public works yards and institutional facilities (figure 6-10). Similar to rural areas, these districts are often not connected to the corridors and neighborhoods of these communities.

Suburban Town Center Context

Unlike rural and urban areas, it is often difficult to find the centers of many suburbs (figure 6-11). There is not always a natural progression of density or of an increased mixture and intensity of land uses. Often, suburban town centers are defined by the concentration of public civic facilities in near approximation to each other. They will often have a variety of office buildings and government office centers at their core. Even with these facilities located in the town centers, it is often difficult to find a concentration of destinations that are within biking distances of each other. Usually, the street speeds come down in these areas compared to districts and corridors, which makes it better for the cyclists. Extensive amounts of on street parking does represent a challenge for cyclists due to pullouts, backups, and door openings. The potential for infill and increasing land use mixtures and bikeable destinations is high if handled comprehensively.

Figure 6-7: Overview of a Typical Suburban Area with Recommended Treatments

Best Bike Facility Design Practices for Creating Bikeable Communities*	SHARED LANES ("S")			BIKE LANES ("B")		SEPARATED LANES ("P")				INTERSECTION TREATMENTS ("I")									AMENITIES FOR BIKES ("A")							
	SB - Bike Boulevards / Greenways	**SH** - Sharrows (standard or greenback boxes)	**SR** - Bike Route (signage only)	**BB** - Buffered Bike Lanes	**BL** - Conventional Bike Lanes	**PM** - Bike /Multi-Use Paths	**PO** - Separated Bike Lanes One Way Cycle Track	**PT** - Separated Bike Lanes-Two Way Cycle Track	**PB** - Multi-use Path using a Bridge	**IG** - Protected Bike Intersections	**IQ** - Two Stage Queue Boxes	**IJ** - Jug Handles for Left Turn with Bike Crosswalk	**IZ** - Mixing Zones (Dash or Green Paint)	**IH** - Mid-block Bike Crossings / Signals	**IT** - Through Intersection Painted Markings	**IK** - Bike Boxes	**IR** - Dedicated / Shared Right Turn Lanes	**ID**- Diverters of Traffic / Bikes & Peds Thru	**AD** - Bike Stations with Public Lockers / Showers	**AP** - Private Lockers / Showers**	**AH** - Bike Traffic Signal Heads**	**AF** - Bike Signal Loops / Sensors / Actuators**	**AB** -Bike Sharing Stations / Programs	**AS** - Bike Storage and Parking**	**AW** - Bike Wayfinding Systems**	**AT** - Bike Repair / Tool Stations
Treatment Recommendations*																										
SN -Suburban Neighborhood	✓	✓	✓		✓	✓											✓	✓						✓	✓	
SC -Suburban Corridor	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	
SD -Suburban District	✓	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	
TC -Town Center	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓

* Though all areas can benefit from the implementation of these principles, they are more effective in specific community types and areas.

** Some design guidance elements are not shown on the associated mapping diagram since they apply community wide.

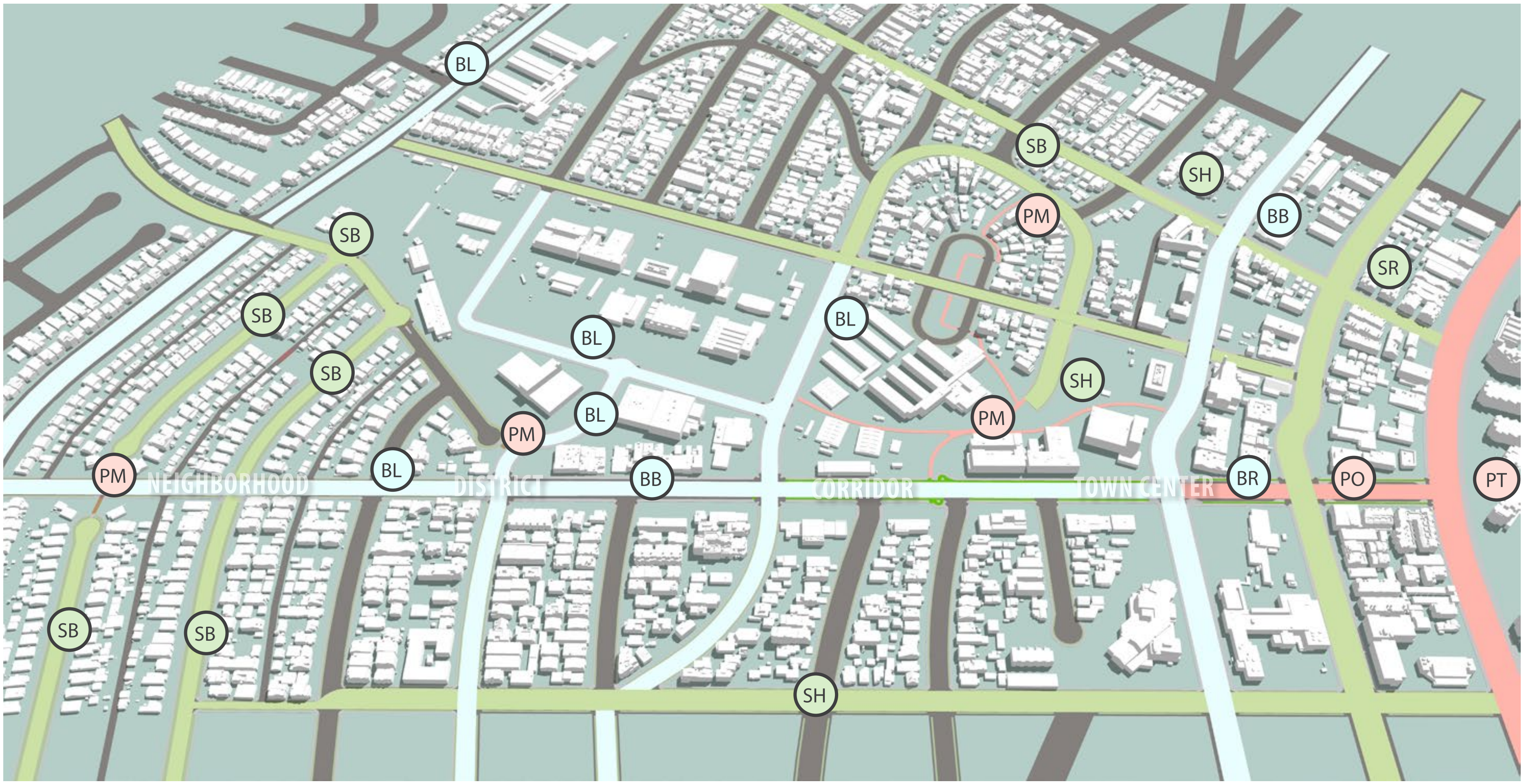


Figure 6-8: Suburban Neighborhood

Figure 6-9: Suburban Corridor

Figure 6-10: Suburban District

Figure 6-11: Town Center

6.5.4 Planning and Designing Bikeway Facilities in Urban Areas

Urban Neighborhood Context

Urban neighborhoods most commonly have a mixture of locally supporting businesses, as well as a broad range of housing types (owned and rented), housing forms (attached and detached), housing intensity (two- to four-story housing above parking; taller towers of housing). The street systems are typically gridded, although some boulevards and avenues can split the grid or be angular or curvilinear. Urban neighborhoods are typically more bikeable because of the closer distances for cycling, the gridded nature of the roadway network, the presence of biking facilities, and the mixture of land uses that can provide for most of the daily needs of local residents. These neighborhoods are generally well supported by transit, thereby extending the distance of non-vehicular travel patterns. Figures 6-12 and 6-13 identify the most appropriate bikeway treatment for these areas.

Urban Corridor Context

Urban corridors are generally made up of a large mixture of commercial and neighborhood areas bounding major boulevards and avenues (figure 6-14). They contain some commercial businesses with parking found in front but are generally more than one parcel deep along a corridor. These areas are generally surrounded on some of their sides with neighborhoods, making them good candidates for increasing connectivity and bikeability to the corridors.

Urban District Context

Urban districts generally include major campuses, cultural centers, entertainment districts, historic districts, and financial centers, with major employment in business parks and towers (figure 6-15). Districts are generally surrounded or interspersed with mixed neighborhoods. Generally, the block sizes are reasonable and biking distances are acceptable.

City Center Context

Urban areas have clearly defined downtowns that spread over many blocks and contain a broad variety of residential, employment, entertainment, transportation, and cultural facilities (figure 6-16). By their very nature of mixed uses and density, these areas are often very bikeable and are serviced well by transit.

City riding is often more constrained with more activity that requires bike facilities in more locations. Photo Source: iStock

Figure 6-12: Overview of a Typical Urban Area with Recommended Treatments

Best Bike Facility Design Practices for Creating Bikeable Communities*	SHARED LANES ("S")			BIKE LANES ("B")		SEPARATED LANES ("P")				INTERSECTION TREATMENTS ("I")									AMENITIES FOR BIKES ("A")							
	SB - Bike Boulevards / Greenways	**SH** - Sharrows (standard or greenback boxes)	**SR** - Bike Route (signage only)	**BB** - Buffered Bike Lanes	**BL** - Conventional Bike Lanes	**PM** - Bike /Multi-Use Paths	**PO** - Separated Bike Lanes One Way Cycle Track	**PT** - Separated Bike Lanes- Two Way Cycle Track	**PB** - Multi-use Path using a Bridge	**IG** - Protected Bike Intersections	**IQ** - Two Stage Queue Boxes	**IJ** - Jug Handles for Left Turn with Bike Crosswalk	**IZ** - Mixing Zones (Dash or Green Paint)	**IH** - Mid-block Bike Crossings / Signals	**IT** - Through Intersection Painted Markings	**IK** - Bike Boxes	**IR** - Dedicated / Shared Right Turn Lanes	**ID**- Diverters of Traffic / Bikes & Peds Thru	**AD** - Bike Stations with Public Lockers / Showers	**AP** - Private Lockers / Showers**	**AH** - Bike Traffic Signal Heads**	**AF** - Bike Signal Loops / Sensors / Actuators**	**AB** -Bike Sharing Stations / Programs	**AS** - Bike Storage and Parking**	**AW** - Bike Wayfinding Systems**	**AT** - Bike Repair / Tool Stations
Treatment Recommendations*																										
UN -Urban Neighborhood	✓	✓	✓		✓	✓											✓	✓						✓	✓	
UC -Urban Corridor	✓			✓	✓		✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	
UD -Urban District	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CC -City Center	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

* Though all areas can benefit from the implementation of these principles, they are more effective in specific community types and areas.

** Some design guidance elements are not shown on the associated mapping diagram since they apply community wide.

Figure 6-13: Urban Neighborhood

Figure 6-14: Urban Corridor

Figure 6-15: Urban District

Figure 6-16: City Center

6.6 IMPLEMENTATION: PROJECT-SCALED STEPS

The bikeway network can sometimes be improved with low-cost solutions that can easily and quickly be implemented. Some may result in lasting changes, whereas others may serve as an interim step to experiment with design concepts until more permanent solutions can be constructed. Lighter, quicker, cheaper (LQC) features can also involve people in the community to help with installation. Implementation ideas that do not require a high degree of traffic engineering analysis, environmental review, political approvals, public vetting, or cost are included in this category. The assumption for implementation ideas is that the applicant has proposed a construction project that may be residential, mixed use, institutional, retail, or employment based and that this project will attract a fair number of residents, students, customers, or employees. The following suggestions exemplify LQC opportunities that make the project site and the neighborhood more bikeable—

- Work with the approval agency to fund and construct a bike route or route adjacent to the project.
- If room exists and the idea is consistent with existing plans—or at least not contrary to plans—integrate a bike lane or buffered bike lane and fund its construction as part of the project approval process.
- For any intersection adjacent to the project site, work with the approval agency on making changes that improve safety and clarity of that intersection. Integrate these changes into the project, and fund the improvement.
- If on street parking exists or is planned next to the project, ensure that the appropriate off-set from this parking is accommodated in the street, with wider curb lanes or buffered bike lanes.
- If the project includes open space and park areas, integrate and fund a multi-use path through the project site or to the center of the recreation space.
- If the local agency has an adopted a master plan or a capital improvements plan for bike facilities adjacent to the project site, not only integrate these plans but also fund their construction as part of the project.
- Provide bike racks, bike lockers, or bike cages in a secure and monitored location as a basic part of the overall project.
- If a bike-share program is proposed in the area, accommodate the program by offering a portion of the site or right-of-way for bike-share use.
- Program and construct a shared changing room and/or shower facility as part of the site amenities for all employees or visitors to the project. This is not required for purely residential projects.

6.7 RESOURCES: IMPORTANT RESOURCES TO CONSIDER

For more information on land use planning, please consult the following foundational documents.

FHWA:

- Bike/Pedestrian Safety Guide and Countermeasure
- Creating Safer Communities for Walking/Biking (2015)
- List of Online Reports and Technical Publications
- Manual on Uniform Traffic Control Devices (2012)
- Pedestrian and Bicycle Information Center
- Separated Bike Lane Planning and Design Guide (2015)

NACTO:

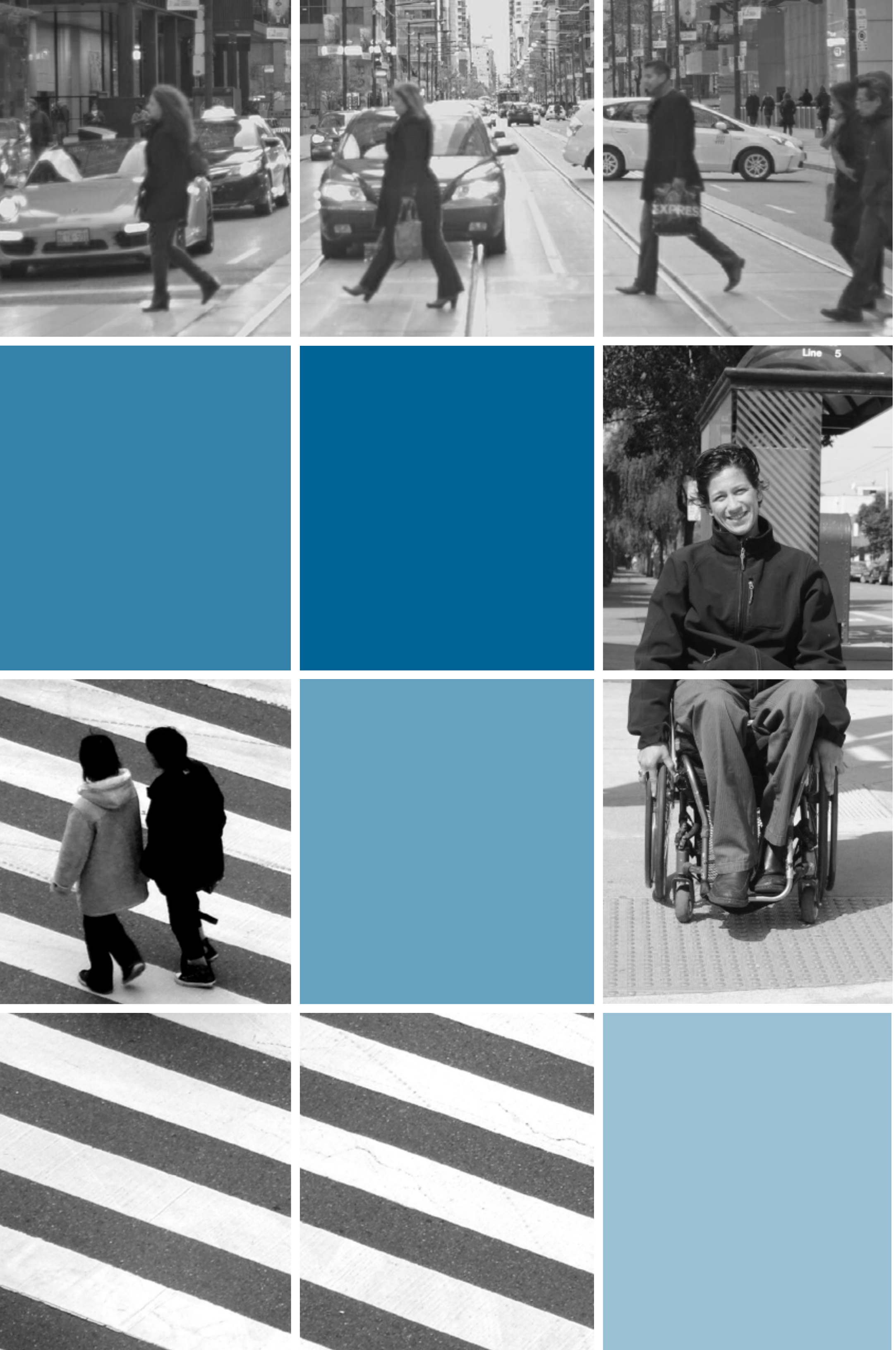
- Transit Street Design Guides (2016)
- Urban Bikeway Design Guide (2014)
- Urban Street Design Guide (2013)

ITE:

- Guide for the Development of Bike Facilities (2012)

OTHERS:

- Complete Streets Best Policies and Implementation Practices (2010/Annual)
- LEED for Neighborhood Development (2014)
- Model Design Manual for Living Streets (2011)



CHAPTER 7: PEDESTRIAN DESIGN PRINCIPLES

USER LEGEND

Advocate Organizations
- Housing Advocates
- Health and Safety Advocates
- Smart Growth Advocates
- Mobility Choice Advocates

Providing Entities
- Developers, Financial Institutions
- Housing Providers and Institutions
- Planning, Design or Engineering Consultants

Decision Makers
- Local Agency Planners and Engineers
- Local Elected Officials and Review Staff
- Federal, State and Regional Regulators

Designing for pedestrians equates to designing for people. Pedestrians are simply people walking or wheeling for health, transportation, exploration, and socializing. Sometimes, the walking environment can be harsh and unsafe. For these reasons, it is critical to ensure that people have a safe and comfortable place to walk. People of all ages and physical abilities should be able to walk along and cross streets in a safe manner. Crossing the street should not be a nerve-racking experience. It should feel safe and comfortable for everyone.

Nowhere is the concept of universal access more important than in the design of the pedestrian environment. Although perhaps not obvious at first glance, streets are the focus of public life and the most openly accessible part of our built environment. Users of streets consist of the greatest variation in travel modes and capabilities and are thus the realm where attention to design detail is essential to effectively balance user needs. The public walkway is also the location where signs and street furniture are located and is where transitions are made between modes (e.g., driver or passenger to pedestrian via parking, bus stop, train station, or bike rack). The pedestrian environment consists of (1) walkways that are along streets and through other public spaces; (2) street crossings; (3) the transitions from walks to streets, generally referred to as ramps or curb ramps; (4) control devices; and (5) the operations of these devices.

When basic principles or guidelines are not followed, walkways can often be too narrow and full of obstructions, such as utility poles, steep driveway ramps, and bus stops surrounded by obstructions that block the path of travel. Many walking environments appear disorderly, with random placement of shelters, poles, trash receptacles, and bike racks. When basic principles and guidelines are followed, walkways can be built to accommodate pedestrians of all ages and physical abilities. They become inviting pedestrian environments that accommodate walking for transportation and health, as well as for social interaction and interfacing with businesses.

Designing the pedestrian realm for universal access enables persons with disabilities, from minor physical challenges typical of the elderly or the very young to more dramatic challenges related to disease, accidents, and disabilities from birth. Those with challenges can be helped, through changes in the built environment, to live independently and to lead full, enriched lives. With fully accessible facilities, they should be able to go to work, school, shop, and otherwise engage in normal activities on their own. Moreover, walking environments that accommodate people with disabilities improve walking conditions for everyone. People with strollers and rolling suitcases can make their way with ease. Children can mature by learning to navigate through their neighborhoods with independence. Inaccessible pedestrian networks, on the other hand, can lead to people becoming housebound and socially isolated, which in turn can lead to a decline in well-being and a host of associated negative mental health outcomes, such as depression.

These pedestrian design guidelines integrate design and land use to provide safe and convenient passage for pedestrians. Walking facilities should have adequate walking areas and provide comfortable buffers between pedestrians and traffic. These guidelines will ensure that walkways, in all development and redevelopment areas, provide access for people of all ages and physical abilities.

7.1 USERS: UNDERSTANDING USER PRIORITIES AND CAPABILITIES

Pedestrians are even more diverse, in terms of their capabilities and requirements, than cyclists. Almost everyone is a pedestrian at one time or another. No matter the travel mode (bicycle, transit, automobile), travelers begin and end their trips as pedestrians. As such, planning for pedestrians requires a comprehensive and accessibility-focused approach.

Pedestrians are diverse in their levels of comfort, safety priorities and capabilities. Photo source: BlueZones

When planning for the creation of walkable and bikeable communities, it is extremely important to understand the scale of walking as shown in table 7-1. What may seem to be a close trip in a vehicle or a moderate distance by bike is often prohibitively long by walking. Although humans evolved over hundreds of thousands of years as wanderers traveling 6–12 miles a day, in the United States, the average walking distance is typically less than 1 mile per day, with many being much more sedentary than this. For planning standards, however, 0.5 mile walking trips are reasonable to assume.

For general guidance, taking into account roadway crossings that may include signals, assume that most pedestrians can cover 0.5 mile within a 15-minute period. Most people are willing to walk this distance for transportation, health, and social interaction reasons. If done for transportation, assume two trips per day. The recommendation for a healthy activity level—counting all steps taken—is 10,000 steps per day. Given this recommendation, 0.5-mile trips are safe to assume, with an outer range of 1 mile.

According to the 2010 U.S. census, nearly 20 percent of the population identify as having a disability. The majority of these disabilities affect the individual's ability to walk or maneuver across streets. This large percentage of the American population emphasizes the need for universal access and the enforcement of the Americans with Disabilities Act (ADA) and other accessibility requirements in all public rights-of-way and places, as well as facilities accessed by other members of the community.

Table 7-1: Scale of Walking

	PEDESTRIAN 1 (VERY FAST)	PEDESTRIAN 2 (FAST)	PEDESTRIAN 3 (MODERATE)	PEDESTRIAN 4 (SLOW)
Minutes per Mile	15	17.5	20	22.5
Miles per Hour	4	3.43	3	2.67
Roadway/Slope Impedance	3.5	3	2.75	2.4
Feet per Second	5.1	4.4	4	3.5
20 Minute Time Commitment	1.16	1.00	0.91	0.08
15 Minute Time Commitment	0.87	0.75	0.68	0.60
10 Minute Time Commitment	0.58	0.50	0.45	0.40
5 Minute Time Commitment	0.29	0.25	0.23	0.20

**Use engineering judgment when considering whether to provide extra time for pedestrians crossing streets beyond the MUTCD-required interval where appropriate conditions exist.*

7.2 PRINCIPLES: BASICS OF A WALK-FRIENDLY COMMUNITY

The following principles should be incorporated into every pedestrian facility—

- The walking environment should be easy to use and understand.
- The walking environment should seamlessly connect people to places. It should be continuous, with complete sidewalks, well-designed curb ramps, and well-designed street crossings.
- Pedestrian and driver sight distances should be maintained near driveways and intersections.
- Pedestrians must be able to cross roads safely. Municipalities have an obligation to provide safe and convenient crossing opportunities.
- The safety of all street users, particularly more vulnerable groups (e.g. children, older adults, and people with disabilities) must be considered when designing streets.
- Allow uncontrolled crossings on narrow streets with low volumes and speeds. In these locations, provide marked crosswalks, pedestrian crossing signs, and regulatory signs indicating a yield requirement to pedestrians on the part of drivers and pedestrians.
- Provide active control crossings for all wide streets with high volumes and speeds, particularly where distance between crossings is great. Controls can be signals, pedestrian-actuated flashers, or other hybrid signalization.

7.2.1 Actions To Include

- Construct sidewalks and/or walkways convenient to where people need to go.
- Adopt and follow four-zone walkway design guidelines (see descriptions that follow).
- Follow all accessibility standards and Public Rights-of-Way Accessibility Guidelines (PROWAG) recommendations.
- Design tight curb returns (15 to 20 feet preferred) except where buses or trucks frequently turn and the travel lane is adjacent to the curb.
- Break up large or complex intersections with islands.
- Design pedestrian crossings for both safety and accessibility; assume that crossings are needed where significant numbers of people are crossing or will likely cross once built.
- Design for safe pedestrian crossings, especially near transit stops and near schools where children may cross.
- Design crossings for pedestrians of all ages and abilities, especially around senior centers, medical centers, and service centers, where people with physical challenges may congregate.
- Add more safety design features to pedestrian crossings as traffic volume, the number of lanes, the street width, and speed increases.

7.2.2 Actions To Avoid

- Do not construct a sidewalk on only one side of the street where development is on both sides.
- Do not construct sidewalks with poles, posts, utility boxes, and so forth in the pedestrian zone of the sidewalk.
- Do not construct more than one left or right turn that is not controlled by a signal or that is considered to be permissible (yield) with pedestrian crossings at signalized intersections.
- Do not make pedestrians wait more than 90 seconds to cross at signalized intersections.
- Do not install pedestrian push buttons in locations that are not easily accessed by people in wheelchairs.
- Do not use warning lights that flash all the time at pedestrian crossings; they are ignored.
- Do not construct streets wider than necessary, thereby increasing pedestrian crossing distances.
- Do not space pedestrian crossings too far apart (within communities, they should be spaced no more than 200 to 300 feet apart).
- Do not design curb returns to accommodate the largest vehicles on the road unless large vehicles are the dominant vehicles planned for in the design of the road. On multi-lane roads with more than one lane in each direction, larger vehicles can utilize the two lanes for turning motions.
- Do not attempt to divert pedestrians to cross at locations away from where they are crossing, unless those locations are very close by. Do not expect pedestrians to walk more than 150 feet in any direction to find a safe crossing point.
- Do not construct textured crosswalks that are rough on wheelchairs. Such crosswalks will create maintenance problems, and they are not very visible to approaching drivers.
- Do not remove crosswalks unless they are poorly located and unsafe.
- Do not compromise pedestrian safety or convenience to improve motor vehicle traffic flow.
- Do not divert pedestrians to overpasses or underpasses unless those alternatives are designed to be nearly as convenient as directly crossing at street level.

7.3 TOOLS: FACILITIES THAT CAN MAKE A WALK-FRIENDLY COMMUNITY

This part of the chapter discusses a series of descriptions of the many tools that can be used to improve the walkability of a community. The descriptions provide explanations on what the element can be used for, individual recommendations or guidelines on how to use the facility, and what components are needed to make the tool work. The ways the tool can be used for various situations and conditions, as well as how the tool can be combined with other tools are the focus of the second half of the chapter.

These guidelines are arranged by the three primary locations of pedestrian facilities: walkway segments along streets or in open space or recreation areas; street crossings mid-block or at intersections; and the transition between walkway and intersection interface, commonly referred to as ramps, driveways, and curb cuts. This chapter then discusses some additional input on crossing-control devices and signal timing.

Because the roadway system of the United States is so heavily influenced by vehicular use, the categories primarily deal with the relationship of where the pedestrian is in relation to the motor vehicle. The guidelines have been arranged with the more effective and innovative facilities first and then the more traditional and simpler elements. All categories have been noted by a single letter for the one of five broader categories. Each element has a two-letter abbreviation, and individual components and guidelines include a number. This three-digit coding is used throughout the rest of the document and is included on the matrices, as well as the maps at the end of the chapter.

7.3.1 Walkway Treatments (W)

By definition, sidewalks are walkways provided within a roadway corridor. Under PROWAG, they are allowed to follow the vertical grade of the street. Walkways can either be sidewalks or pedestrian facilities that are separated from the street. Sidewalks should provide a comfortable space for pedestrians between the roadway and adjacent land uses. Sidewalks along streets are the most important component of pedestrian mobility. They provide access to destinations and critical connections between modes of travel, including automobiles, transit, and bicycles. General provisions for sidewalks include pathway width, slope, space for street furniture, utilities, trees and landscaping, and building ingress and egress requirements.

Walkway Presence and Continuity (WC)

Perhaps the most important attribute for pedestrian facilities is continuity. The United States evolved from a rural setting and smaller towns, primarily without the dominance of the automobile. When the automobile grew in popularity, it was at a time of tremendous growth. Many developments ignored the needs of the pedestrian, assuming that all would drive to all destinations. For those who could not afford a vehicle, it was assumed that they could take public transportation. Based on these historical development patterns, we now face the need to fill gaps to provide pedestrian continuity. Note that many cities rely on developers to build their sidewalks—segment by segment—as "conditions of approval." Although this policy saves cities money, it makes the construction of usable, continuous sidewalks contingent on development.

A well defined and barrier free walking environment must be the focus of walkway systems. Photo source: Bruce Damonte

Primary Universal Walkway Access Guidelines (WU)

Under the Rehabilitation Act of 1973 and the Americans with Disabilities Act (ADA) of 1990, state and local governments and transit agencies must ensure access to people with disabilities. Under ADA, the U.S. Access Board develops guidelines and standards to ensure this access; these are found in the proposed rule form in the PROWAG. The United States Access Board's ADA and ABA Accessibility Guidelines focus mainly on facilities on sites. Although the guidelines address certain features common to public sidewalks, such as curb ramps, further guidance is necessary to address conditions and constraints unique to public rights-of-way. The Board is developing new guidelines for public rights-of-way that will address various issues, including access for blind pedestrians at street crossings, wheelchair access to on street parking, and solutions to various constraints posed by space limitations, roadway design practices, slope, and terrain. The new guidelines will cover pedestrian access to sidewalks and streets, including crosswalks, curb ramps, street furnishings, pedestrian signals, parking, and other components of public rights-of-way. The Board's aim in developing these guidelines is to ensure that access for persons with disabilities is provided wherever a pedestrian way is newly built or altered and that the same degree of convenience, connection, and safety afforded the public generally is available to pedestrians with disabilities.

Once these guidelines are adopted by the Department of Justice and the Department of Transportation, they will become enforceable standards under title II of the ADA. Until they are enforceable, title II entities must still provide access to pedestrian facilities in accordance with ADA regulations.

This document will not attempt to list ADA requirements or to propose guidelines for these statutes and standards. The standards may change and are open to some level of interpretation. The adoption of other state and local standards, which can exceed the federal standards, also makes it difficult to include requirements on a national-level publication.

All pedestrian projects as well as street projects must abide by the latest standards of both federal and local requirements and must not discriminate against persons with disabilities, even if there is no standard for a particular type of facility. This applies to new construction and also to any project that changes an area, thereby requiring facilities be brought up to the latest standard.

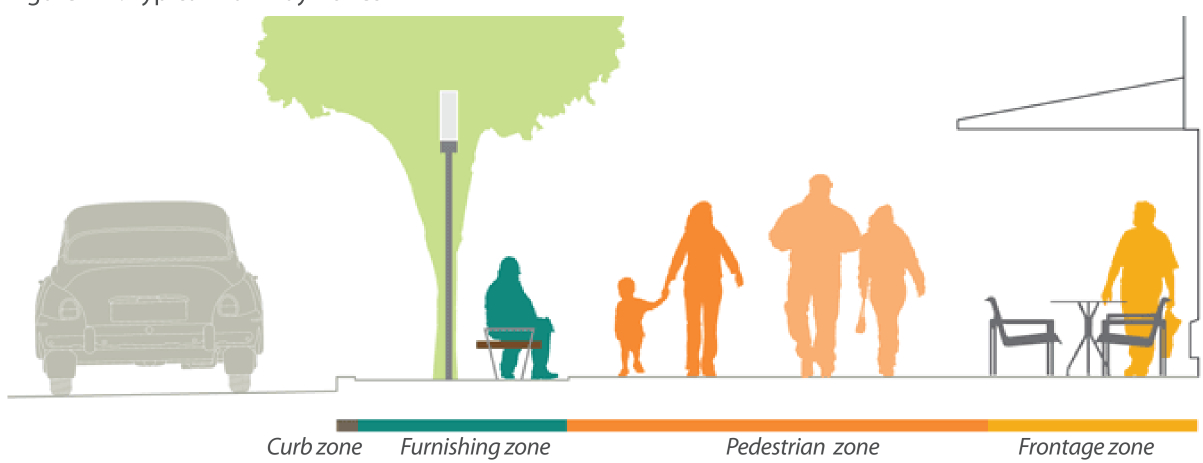
In addition, even without a project identified, the responsibility for the removal of barriers to access remains enforceable and must be worked into ADA transition plans, with some community funding identified to remove the barriers.

A broader approach that takes the basic philosophies of universal access into account should be incorporated into all planning, design, engineering, and public facility programming projects as a basic foundation to these efforts.

Segments of Walkway Systems

Sidewalks associated with walkways next to roadways are made up of four distinct zones: the curb zone, the furnishing zone, the pedestrian zone, and the building frontage zone (figure 7-1). The minimum widths of each of these zones vary based on street classifications as well as land uses. The Street Classifications section in this chapter describes these recommendations in more detail as applied to individual cities. "Walkway Width Capacity Metrics" recommends minimum widths for each zone for different street types and land uses. Some judgment may be needed on a case-by-case basis to establish actual widths of each of the four zones.

Figure 7-1: Typical Walkway Zones



Curb Zones—Curb, Gutter, Parking, and Bulb-Outs (W1)

The curb zone serves primarily to prevent water and cars from encroaching on the sidewalk. It defines where the area for pedestrians begins and the area for vehicles ends. It is the area that people using assistive devices must traverse to get from the street to the sidewalk, so its design is critical to accessibility.

Furnishing Zone—Trees, Signage, Utilities, and Furniture (W2)

The furnishing zone is located between the curb line and the pedestrian zone. The furnishing zone should contain all fixtures, such as street trees, bus stops and shelters, parking meters, utility poles and boxes, lamp posts, signs, bike racks, news racks, benches, waste receptacles, drinking fountains, and other street furniture to keep the pedestrian zone free of obstructions. In residential neighborhoods, the furnishing zone is often landscaped. Resting areas with benches and space for wheelchairs should be provided in high-volume pedestrian districts and along blocks with a steep grade to provide a place to rest for older adults, wheelchair users, and others. The furnishing zone is essential to ensure that driveway ramps are kept out of the pedestrian use areas.

Pedestrian Zone—Surface Materials, Continuity, Slopes (W3)

The pedestrian zone, situated between the building frontage zone and the furnishing zone, is the area dedicated to walking and should be kept clear of all fixtures and obstructions. The pedestrian access route (PAR) is a major component of the pedestrian zone: clear space that connects the public right-of-way to building and property entry points, parking areas, and public transportation.

Building Frontage Zone—Furniture/Utilities (W4)

The building frontage zone is the portion of the sidewalk located immediately adjacent to buildings, and provides shy distance or buffer from buildings, walls, fences, or property lines. It includes space for building-related features, such as entryways and accessible ramps. It can include landscaping, as well as awnings, signs, news racks, benches, and outdoor café seating. In single-family residential neighborhoods, landscaping typically occupies the building frontage zone.

Walkway Width Capacity Metrics (WW)

Sidewalks vary according to the type of street they serve. A local street with residences requires different sidewalk dimensions than a boulevard with commercial establishments (table 7-2). The descriptions indicate the recommended width of the various walkway zones.

The furnishing zone does not have to have actual street furniture, but should include trees, lighting and other utilities as a minimum. Photo source: Unknown

Walkers do not take up much space, but care must still be taken to meet ADA requirements and comfort of all walkway users. Photo source: Mike Singleton

Table 7-2: Walkway Width Capacity Metrics

	BOULEVARD	AVENUE	STREET
WW-1: VILLAGE/TOWN/CITY CENTERS	Frontage: 4′6″ (8′ with café seating) Pedestrian: 8′ Furniture: 7′ (6′-8′ at bus stops and where large trees are desired) Curb: 6″ Minimum Width: 20′	Frontage: 3′6″ (8′ with café seating) Pedestrian: 7′ Furniture: 5′ (6′-8′ at bus stops, and where large trees are desired) Curb: 6″ Minimum Width: 16′	Frontage: 2′6″ (8′ with café seating) Pedestrian: 6′ Furniture: 4′ Curb: 6″ Minimum Width: 14′
WW-2: DISTRICTS	Frontage: 1′6″ Pedestrian: 6′ Furniture: 6′ Curb: 1′6″ Minimum Width: 15′	Frontage: 1′6″ Pedestrian: 5′ Furniture: 5′ Curb: 1′6″ Minimum Width: 13′	Frontage: 1′6″ Pedestrian: 4′ Furniture: 4′ Curb: 1′6″ Minimum Width: 11′
WW-3: CORRIDORS	Frontage: 4′6″ Pedestrian: 6′ Furniture: 5′ (6′-8′ at bus stops and where large trees are desired) Curb: 6″ Minimum Width: 16′	Frontage: 2′6″ Pedestrian: 6′ Furniture: 5′ (6′-8′ at bus stops, and where large trees are desired) Curb: 6″ Minimum Width: 14′	Frontage: 1′6″ Pedestrian: 6′ Furniture: 4′ Curb: 6″ Minimum Width: 12′
WW-4: NEIGHBORHOODS	Pedestrian: 6′ Furniture: 7′6″ Curb: 6″ Minimum Width: 14′	Pedestrian: 5′ Furniture: 6′6‴ Curb: 6″ Minimum Width: 12′	Pedestrian: 4′ Furniture: 5′6″ Curb: 6″ Minimum Width: 10′

Note 1: Where 4′ width is permitted for pedestrian zones, passing areas must be provided at maximum 200′ intervals.
Note: 2 Federal, local and state standards need to be verified. Use of the foundational documents listed in this publication is recommended.

Inadequate width walkway. Photo source: Mike Singleton

Adequate width walkway. Photo source: Mike Singleton

Ideal width walkway. Photo source: Mike Singleton

7.3.2 Street Crossings (C)

Walking requires two important features in the built environment: people must walk along streets and they must get across streets. Crossing a street should be easy, safe, convenient, and comfortable. Although pedestrian behavior and intersection or crossing design affect the street-crossing experience, motorist behavior is the most significant factor in pedestrian safety. About 40 percent of pedestrian crashes occur at intersections. Additional pedestrian crashes occur when a person crosses the road away from intersections,[1] especially with turning vehicles.

A number of tools exist to improve pedestrian safety and make crossing streets easier. Effective traffic management can address concerns about traffic speed and volume. A motorist driving more slowly has more time to see, react, and stop for a pedestrian. The number of pedestrians also influences motorists. In general, motorists are more aware of pedestrians when more people walk. Most tools to address crossing challenges are engineering treatments, but tools from enforcement, education, and planning toolboxes are also important. Providing marked crosswalks is only one of the many possible engineering measures.

When considering how to provide safer crossings for pedestrians, the question should not be, "Should I provide a marked crosswalk?" Instead, the question should be, "What are the most effective measures that can be used to help pedestrians safely cross the street?" Deciding whether to mark or not mark crosswalks is only one consideration in creating safe and convenient pedestrian crossings. Because safety should be the greatest concern, however, crosswalk identification should be increased in general. Many drivers believe that they do not need to yield to pedestrians unless they are in a marked crosswalk. This popular but inaccurate belief can be countered with more crosswalk markings.

- Crossing treatments that have the highest crash reduction factors (CRFs) should be used when designing crossings.
- The best pedestrian crossings begin with controlling local speed. In general, urban arterials should be designed to a maximum of 30 or 35 miles per hour (note: 30 miles per hour is the optimal speed for moving motor vehicle traffic efficiently.)
- Every crossing is different and should be selected and designed to fit the local environment.
- Crosswalks at uncontrolled intersections (including mid-block crosswalks) require special treatment because these are locations where motorists do not automatically stop.

<u>Pedestrian Bridge or Underpass (CB)</u>

Certain crossings of high-speed roadways, freeways, limited-access highways, and rail lines are difficult or impossible to make work at grade crossings. Although every effort should first be made to resolve the at-grade conflicts, the priority of the facility or other safety standards may prevent at-grade crossings.

Because most of these barriers are very long with few above-grade or at-grade crossing points available, sometimes a grade-separated option must be pursued to provide the needed connectivity for cyclists and pedestrians. Although grade separation, obtained through a bridge or tunnel, is a superior way of deconflicting mobility uses, it often is very expensive and, if not handled properly, can be ignored by individuals who are used to crossing at illegal locations.

High visibility cross walk with static ped. warning signs.
Photo source: Mike Singleton

Contrasting cross walk with rubberized warning sign.
Photo source: Mike Singleton

Raised median refuge with marked crosswalk.
Photo source: Dan Burden

Raised speed table, high visibility markings and warning signs.
Photo source: Dan Burden

Median refuge with a 'z' crossing, improving sight lines and providing more storage space. Photo source: Mike Singleton

Flashing diodes in pavement and warning sign.*
Photo source: Dan Burden

Rectangular Rapid Flashing Beacon with median refuge.
Photo source: Mike Singleton

Standard light signal at pedestrian only mid-block crossing.
Photo source: Mike Singleton

Pedestrian hybrid beacons (HAWK) and median refuge.
Photo source: Mike Cynecki

**Note: In-pavement flashers tend to be less visible, and require more maintenance, than overhead illumination.*

Raised Crosswalk/Speed Table (CT)

Raised crosswalks slow traffic and put pedestrians in a more visible position. They are trapezoidal in shape on both sides and have a flat top where the pedestrians cross. They are most appropriate in areas with significant pedestrian traffic and where motor vehicle traffic should move slowly, such as near schools, on college campuses, in main street retail environments, and in other similar places. They are especially effective near elementary schools, where they raise small children by a few inches and make them more visible.

Crossings at Signals (CS)

Pedestrian crossing treatments at signalized intersections are less complicated than uncontrolled crossings because motorists have to come to a full stop. The following provides guidance for crossing tools at signalized intersections.

Crossings at Stop/Yield Signs (CY)

Pedestrian crossing treatments at stop-controlled intersections are less complicated than uncontrolled crossings because motorists have to come to a full stop. They are also usually less complicated than signalized intersections. They are likely to occur at intersections with less traffic than would be at signalized intersections. The following provides guidance for crossing tools at stop-controlled intersections.

Crossings at Mid-blocks—Markings, Median Refuges, Crossing Islands, and Signs (CM)

A mid-block crossing is a nonstandard location for crossing, so drivers may not be aware of the crossing movements or will be less likely to yield to the pedestrian if the crossing area does not include some of the other tools that are recommended to be part of the mid-block crossing.

Bridges that force a great deal of out of direction travel are not likely to be used. Photo source: Vicki Scuri

Direct bridges are recommended. Photo source: Mike Singleton

Drummond Bike Tunnel, Davis , CA; Photo source: The Davis Enterprise

Crossings at Uncontrolled Intersections (CN)

Intersections without traffic signals or stop signs are considered uncontrolled intersections. The decision to mark a crosswalk at an uncontrolled location should be guided by an engineering study. Factors considered in the study should include vehicular volume and speed, roadway width and number of lanes, stopping sight distance and triangles, distance to the next controlled crossing, nighttime visibility, grade, origin and destination of trips, left turning conflicts, and pedestrian volume. The engineering study should be based on the FHWA study, Safety Effects of Marked Versus Unmarked Crosswalks at Uncontrolled Locations.

Crosswalk Markings and Requirements (CX)

Crosswalks are present, by law, at all intersections, whether marked or unmarked, unless the pedestrian crossing is specifically prohibited. At mid-block locations, crosswalks exist only where marked. At these non-intersection locations, the crosswalk markings legally establish the crosswalk. Crosswalks should be considered at mid-block locations where there is strong evidence that pedestrians want to cross there because origins and destinations are across from each other and there is an overly long walking distance to the nearest controlled crossing. Marked crosswalks alert drivers to expect crossing pedestrians and direct pedestrians to desirable crossing locations. Although many motorists are unaware of their precise legal obligations at crosswalks, drivers must yield to pedestrians in any intersection, whether marked or unmarked.

Because of the low approach angle at which pavement markings are viewed by drivers, the use of longitudinal stripes in addition to or in place of transverse markings can significantly increase the visibility of a crosswalk to oncoming traffic (figure 7-2). Although research has not shown a direct link between increased crosswalk visibility and increased pedestrian safety, high-visibility crosswalks have been shown to increase motorist yielding and channelization of pedestrians, leading the Federal Highway Administration to conclude that high-visibility pedestrian crosswalks have a positive effect on pedestrian and driver behavior.

Decorative crosswalk pavement materials should be chosen with care to ensure that smooth surface conditions and high contrast with surrounding pavements are provided. Textured materials within the crosswalk are not recommended. Without reflective materials, these treatments are not visible to drivers at night. Decorative pavement materials often deteriorate over time and become a maintenance problem while creating uneven pavement. Recommended crosswalk striping sample options are shown in figure 7-3.

Primary Universal Access Guidelines (CU)

Under ADA, the Access Board has developed and continues to maintain design guidelines for accessible buildings and facilities (including access through public rights-of-way and access to publicly owned land) known as the ADA Accessibility Guidelines (ADAAG). ADAAG covers a wide variety of facilities and establishes minimum requirements for new construction and alterations.

The Board maintains a similar responsibility for accessibility guidelines under the Architectural Barriers Act (ABA). The ABA requires access to certain facilities designed, built, altered, or leased with federal funds. Like ADAAG, the Board's ABA accessibility guidelines apply to new construction and alterations.

The agencies responsible for standards under the ADA are the Department of Justice (DOJ) and the Department of Transportation (DOT). The agencies responsible for standards under the ABA are the General Services Administration (GSA), the Department of Defense (DOD), the Department of Housing and Urban Development (HUD), and the United States Postal Service (USPS).

Figure 7-2: Crosswalk Visibility

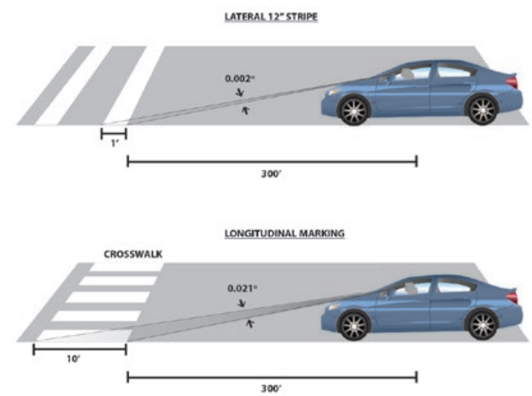


Figure 7-3: Recommended Crosswalk Markings

7.3.3 Access From Walk to Street (A)

Curb Extensions/Bulb-Outs (AC)

Curb extensions extend the sidewalk or curb line out into the parking lane or travel lanes, which reduces the effective street width. Curb extensions significantly improve pedestrian crossings by reducing the pedestrian crossing distance, visually and physically narrowing the roadway, improving the ability of pedestrians and motorists to see each other, and reducing the time that pedestrians are in the street.

Motorists typically travel more slowly at intersections or mid-block locations with curb extensions because the restricted street width sends a visual cue to slow down. Turning speeds are lower at intersections with curb extensions (curb radii should be as tight as is practicable.) Curb extensions also prevent motorists from parking too close to the intersection.

Curb extensions also provide space for two curb ramps and level sidewalks where existing space is limited, increase the pedestrian waiting space, and provide additional space for pedestrian push button poles, street furnishings, plantings, bike parking, and other amenities. A benefit for drivers is that extensions allow for better placement of signs (e.g., stop signs and signals).

Apex ramps can force a person in a wheelchair too far out into the active lanes of the street. Photo Source: Mike Singleton

Curb extensions are generally only appropriate where there is an on street-parking lane. Where street width permits, a gently tapered curb extension can reduce crossing distance—without creating a hazard—at an intersection along streets that do not have on street parking. Curb extensions must not extend into travel lanes or bicycle lanes.

Primary Universal Access on Ramps—Perpendicular/Apex/Parallel (AA)

Proper curb ramp design is essential to enable pedestrians using assistive mobility devices (e.g., scooters, walkers, and crutches) to transition between the street and the sidewalk. These design guidelines provide a basic overview of curb ramp design. ADA requires installation of curb ramps in new sidewalks and whenever an alteration is made to an existing sidewalk or street. Roadway resurfacing is considered an alteration and triggers the requirement for curb ramp installations or retrofits to current standards. Curb ramps are typically installed at intersections, mid-block crossings (including trail connections), accessible on street parking, and passenger loading zones. Curb ramps should have a proper landing, approach, flare, ramp, and gutter and a detectable warning. Each of these is critical in providing safe access for people in wheelchairs. In order to be functional, they must be designed and constructed with the correct dimensions. Please refer to figures 7-4 and 7-5 for more information on ramp placements. It is important to note that directional ramps are always safer and more accessible. Apex ramps are shown in this document for comparison purposes only because they are a very common type of ramp.

Level Walk to Street With Blended Transition (AL)

Blended transitions are areas where either the entire sidewalk has been brought down to the street or crosswalk level or the street has been brought up to the sidewalk level. They work well on large radius corners where it is difficult to line up the crosswalks with the curb ramps; but they have drawbacks.

Children, persons with cognitive impairments, and guide dogs may not distinguish the street edge. For these reasons, detectable warnings must also be placed at the edge of the sidewalk anywhere the curb is missing (i.e., if possible, wrapped around the entire corner) to alert pedestrians with visual impairments of the transition to the street.

Turning vehicles may also encroach onto the sidewalk. Bollards may be used to prevent encroachment of vehicles onto the sidewalk but are not a substitute for detectable warnings.

Ramps have many components that need to be ADA compliant. Photo source: www. http://ada.ashdownarch.com/

Figure 7-4: Apex ramp

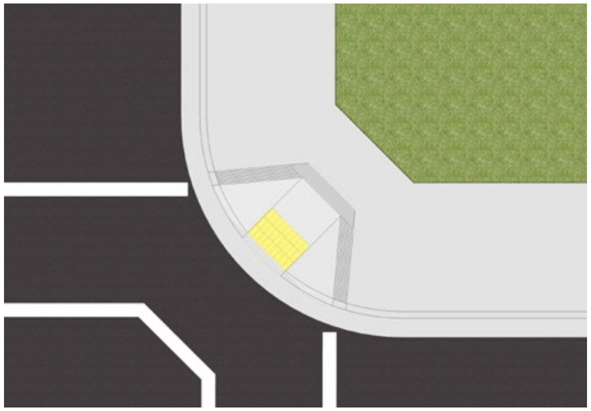


Figure 7-5: Directional ramp

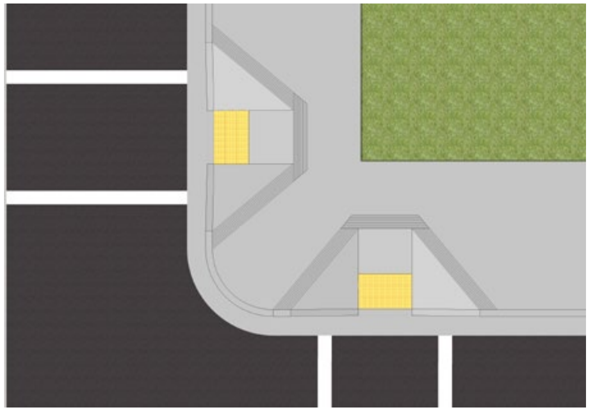
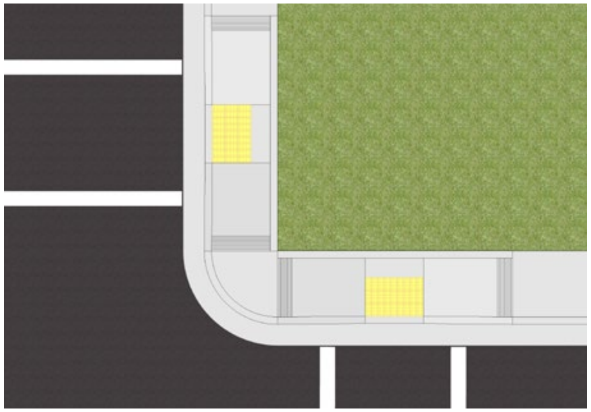


Figure 7-6: Parallel ramp



Reduced Radius Corners (AR)

Corner radii determine vehicle turning speeds and pedestrian crossing distances. Minimizing the size of a corner radius lowers turning speeds and decreases crossing distance by several feet.

7.3.4 Crossing Control Devices (D)

Pedestrian Hybrid Beacon (DH)

A pedestrian hybrid beacon is used to warn and control traffic at non-signalized locations to help pedestrians cross a street or highway at a marked crosswalk. A pedestrian hybrid beacon can be used at a location that does not meet traffic signal warrants or at a location that meets traffic signal warrants but a decision has been made to not install a traffic control signal. This category can include a High-intensity Activated crossWalK (HAWK) with special signal sequencing (table 7-3).

Pedestrian Crossing Using Standard Signal (DP)

Partial intersections that do not allow for left turning movements or mid-block locations where a pedestrian facility is needed can utilize standard traffic signals for controlling these types of crossings. Drivers are most familiar with standard green/yellow/red signals, making this type of treatment likely to result in the greatest level of compliance.

Rectangular Rapid Flashing Beacon Crossing (DR)

The RRFB offers significant potential safety and cost benefits because it achieves very high rates of compliance at a very low cost compared to other, more restrictive devices, such as full mid-block signalization. The components of the RRFB are not proprietary and can be assembled by any jurisdiction with off-the-shelf hardware. The FHWA believes that the RRFB has a low risk of safety or operational concerns; however, a proliferation of RRFBs in the roadway environment to the point that they become ubiquitous could decrease their effectiveness. Use of RRFBs should be limited to locations with critical safety concerns, such as pedestrian and school crosswalks at uncontrolled locations. The RRFB uses rectangular, high-intensity LED-based indications, flashes rapidly in a wig-wag "flickering" flash pattern, and is mounted immediately between the crossing sign and the sign's supplemental arrow plaque. Installation of RRFBs requires FHWA approval under the existing Interim Approval.

Pedestrian-Actuated Flashing Signage and In-Road Flashers (DW)

Early versions of mid-block crossings included roadway flashers located at the edge of crosswalk markings matched with pedestrian yield signs that included in-sign flashers as well. The flashers are activated by the pedestrian. The driver is expected to yield to the pedestrian but can pass after the pedestrian has cleared the lane in the crosswalk. Note that in-pavement flashers tend to be less visible—and require more maintenance—than overhead illumination.

DS-Pedestrian Scramble Signals/Markings (DS)

A pedestrian scramble combines all of the pedestrian movements with one signal phase and then works two phases of vehicular movement. In areas of high pedestrian traffic or with wide streets, the total crossing time of pedestrians can be reduced because diagonal movements are allowed. Often, left and right turning movements have to wait for pedestrians to clear the crosswalk. A scramble can result in a more efficient traffic flow because direct conflicts are separated into different signal phases.

"No Turn on Red" Warnings (DN)

Pedestrian scrambles and other bike-related improvements associated with two-way cycle tracks and bike crosswalks require restrictions on turning to lower pedestrian, bike, and vehicle conflicts. Because these restrictions are not that common in the United States, extra signage and signalization are required to communicate this restriction to the driver.

Pedestrian Signals for Universal Access, With Audible and Visual Countdowns (DD)

Pedestrian-activated traffic controls require pedestrians to push a button to activate a walk signal and so are discouraged in urban areas, where multiple pedestrians are present most of the time. Each standard phase should work into the signal phasing, a standard pedestrian green light phase without an activation. In more suburban or rural areas, however, interjecting a standard pedestrian phase with or without a pedestrian present is not efficient for traffic flow and is overkill for the lower number of pedestrians anticipated.

Section 35.160 of the ADA requires communication with persons with disabilities that is as effective as communication with others. The reader should refer to the Accessible Pedestrian Signal (APS) provisions (audible and tactile in addition to visual communication) in the PROWAG and the technical language in the MUTCD.

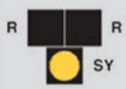
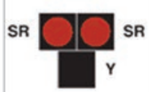
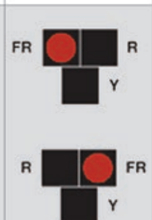
Where pedestrian-activated traffic controls exist, they should be located as close as possible to curb ramps without reducing the width of the path. The buttons should be at a level that is easily reached by people in wheelchairs near the top of the ramp. The U.S. Access Board guidelines recommend buttons raised above or flush with their housing and large enough for people with visual impairments to see them.

Pedestrian scramble signage. Photo source: Juan Alberto Bonilla

Pedestrian activated flashing. Photo source: iStock

Pedestrian scramble markings. Photo source: Juan Alberto Bonilla

Table 7-3: Sequence for a Pedestrian Hybrid Beacon. Source: MUTCD

	DRIVERS		PEDESTRIANS	
	Will see...	**Will do...**	**Will see...**	**Will do...**
1		Proceed with caution.		Push the button to activate the system.
2	 FLASHING	Slow down. A pedestrian has activated the system.		Wait.
3		Prepare to stop.		Continue to wait.
4		STOP. A pedestrian is in the crosswalk.		Start crossing when all vehicles are stopped.
5		STOP. Proceed with caution if sidewalk is clear.		Continue crossing; the signal will count down.
6		Proceed if the crosswalk is clear		Push the button to activate system

Legend
SY Steady yellow **SR** Steady red
FY Flashing yellow **FR** Flashing red

7.3.5 Signal Timing (T)

Leading Pedestrian Interval (TG)

This method of signal phasing allows for the release of the pedestrian signal 5 to 10 seconds prior to the release of the vehicular signal. This allows pedestrians to be well along the way of the crossing when vehicles are making left or right turns—potentially across the path of the pedestrians in crosswalks.

Concurrent Pedestrian/Vehicle Signals (TH)

If a signal automatically includes a green cycle for vehicular movement along with a pedestrian green cycle phase at the same time, then it is considered to be concurrent. In urban areas, where pedestrians are waiting to cross the street most of the time, it is not necessary to require them to actuate a pedestrian crossing request. This type of integrated signal system allows for synchronization of several traffic signals because the pedestrian phase is integral and always activated.

Pedestrian Phase Intervention in Cycle (TJ)

Depending on the technology of the controller, an ongoing green phase can be interrupted and extended when a pedestrian pushes an actuator. This avoids the need for the pedestrian to have to wait through several cycles of signal phasing before the next pedestrian phase comes up. Also, when pedestrians realizes they are going to have to wait for the next cycle, they will often either cross anyway or will push the button for crossing the other direction, leaving behind the request for a crossing that may never be used.

Signals Synchronized to Bikes/Pedestrian Pace (TK)

Synchronizing a series of signals to turn green for pedestrians can be accomplished if these signals are interconnected.

Available Crossing Timing for Pedestrian Signals (TX)

People with disabilities often need more time to cross the street. Signals can be set to add more time to cross where there are more older adults or people with disabilities. Some modern technology can also detect slower pedestrians to add more crossing time.

7.4 BENEFITS: PICKING THE RIGHT TOOLS

Choosing the right improvements for an area requires attention to the issues that are in need of change, the context of the project site, the available budget, and the benefits desired from the investment. This section ranks the characteristics and benefits achieved from each listed element. Table 7-4 shows the benefits achieved by the implementation of each of the described element.

Provides a cost-effective element: This element is considered to be cost effective, with reasonable costs when compared to the overall benefits of implementation.

Quick to do and easy to implement: Implementation should be relatively simple in terms of processing, design, and construction. The overall implementation schedule is short.

Attracts new users: Because of the protection or convenience of travel, this element should entice new users to walk for transportation or for recreation.

Balanced (cost effective, quick, and adds users): Given the previous benefits, this ranking indicates that the element provides a balance of all three rankings of cost, time, and attraction of new users.

Allows for innovative approach: This treatment is considered to be new or experimental. Many agencies and developers may wish to try new, innovative techniques.

Increases walking efficiency and reduces trip length: Speed and directness of route affect the ability of walkers to get to their destination. This ranking indicates that the improvement will cut down on travel time.

Provides for traffic calming: Safety and comfort can be improved for pedestrians if car travel is calmed to slower speeds and motor vehicle movements are more subtle and predictable.

Adds protection from traffic: A level of security and safety improvements can be expected from this element. It may also result in real or perceived safety.

Can be integrated into smaller-scale projects/initiatives: The scale of this improvement makes it likely to be implementable as part of smaller infill projects or other neighborhood-level improvements.

Provides multiple benefits for multiple modes: Improvements may directly affect pedestrian activities but also benefit transit users, cyclists, and businesses located along the proposed area of improvement.

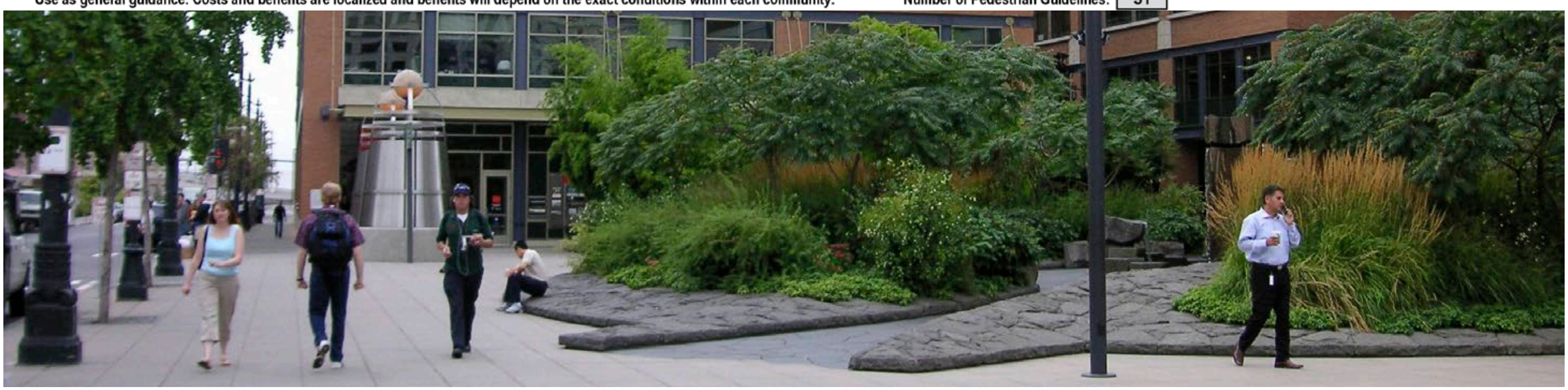
Pedestrian facilities need to take into consideration the users, the setting and the issues before determining a solution. Photo source: Joe Raedle / Getty Images

Table 7-4: Benefits of the pedestrian implementation methods

Best Pedestrian Design Practices for Creating Walkable Communities	WALKWAY TREATMENTS ("W")							STREET CROSSINGS ("C")								INTERSECTIONS ("A")				CROSSING CONTROL DEVICES ("D")						
	WC - Walkway Presence and Continuity**	**WU** - Primary Universal Walkway Access	**W1** - Curb Zone (parking / bulb-outs)**	**W2** - Furnishing Zone (trees / signage / utilities /	**W3** - Walking Zone (surface materials /	**W4** - Building Frontage Zone (furniture/ business/	**WW** - Walkway Width Capacity Metrics**	**CB** - Pedestrian Bridge or Underpass	**CT** - Raised Crosswalk / Speed Table	**CS** - Crossings at Signals**	**CY** - Crossings at Stop / Yield Signs**	**CM** - Mid-block crossing (markings / medians	**CN** - Crossings with No Controls	**CX** - Crosswalk Markings and other Requirements**	**CU** - Primary Universal Crossing Access	**AC** - Curb Extensions / Bulb-outs	**AA** - Universal Access on Ramps (perp./ apex /	**AL** - Level Walk to Street with Blended Transition	**AR** - Reduced Radius Corners	**DH** - HAWK Signals	**DP** - Pedestrian Only Crossing using Standard	**DR** - RRFB Signals	**DW** - Ped. Actuated Flashing Signage & In	**DS** - Pedestrian Scramble Signals /	**DN** - No Turn on Red Warnings	**DD** - Signals for Universal Access (audible
Effectiveness Rankings ***	2	2	1	1	1	1	2	3	3	2	1	3	0	2	2	2	2	2	1	4	3	3	3	2	2	1
Provides a Cost Effective Element	$									$	$			$				$	$		$	$	$	$	$	$
Quick to Do / Easy to Implement										●	●			●							●	●	●	●		●
Attracts New Users	●	●		●				●		●	●	●		●	●	●	●			●			●			
Balances Features (Cost Effective, Quick & Builds Users)	●			●						●	●	●		●	●		●		●		●	●	●	●	●	●
Allows for Innovative Approach												●						●		●		●	●	●	●	
Increases Walking Efficiency and Reduces Trip Length	●						●	●		●		●				●			●	●	●	●	●	●	●	
Provides for Traffic Calming			●	●					●	●	●	●		●		●			●	●	●	●	●		●	●
Adds Protection from Traffic	●		●	●				●	●	●	●	●		●		●			●	●	●	●	●	●	●	
Can be integrated into smaller scale projects	●	●	●	●	●	●	●		●	●	●	●		●	●	●	●	●	●			●	●	●		●
Provides Multiple Benefits for Multiple Modes	●	●	●	●				●		●	●	●		●	●	●	●		●					●		

*** Use as general guidance. Costs and benefits are localized and benefits will depend on the exact conditions within each community.

Number of Pedestrian Guidelines: 31



The benefits from well designed public spaces and walkways include street activation, encouragement of healthy activity, mobility options and improved safety. Photo source: Mike Singleton

7.5 CONTEXT: USING THE RIGHT TOOLS IN THE RIGHT LOCATIONS

The following text and supporting graphics describe how pedestrian guidelines should be considered in each of the four community place types. The intensity, typical streets, and land uses have been grouped into the three development types: rural, suburban, and urban. Because funding of pedestrian facilities is generally very limited, selecting the right solution for the right location is very important. Land use type and the intensity and conditions of the roadway are the primary determinants in setting priorities and matching improvements to local conditions. The overall goal of all guidelines discussed in this chapter is to match the improvement type with the area so that the largest cross-section of the community will benefit from the improvement. Safety will also be increased by recognizing the context of the area's land uses, street patterns, and use levels.

There are many options for a wide range of traditional and innovative pedestrian facilities that can be added to most streets. The first half of the chapter was dedicated to the tools available. The second portion of the chapter is dedicated to understanding local context of community typologies and place types. Matching the right type of facility to the right type of user to the right location is very important and potentially complex, requiring attention to detail. Utilize the following guidance for an overview of where certain facilities should be considered:

- Prioritize pedestrian improvements based on safety first, connectivity second, access third, and qualitative walkability fourth. All of these aspects are important to include.
- Removal of ADA-based barriers and lack of connectivity between origins and destinations should also be high priorities. All new projects or major retrofits will have to consider accessibility.
- Walkability and safety are most important around schools, business/commercial districts, major employment centers, and transit stops. These areas should be given priority in planning, engineering, and implementation.
- Filling in walkway gaps is more important than retrofitting missing walkway systems found in many older and more rural neighborhoods.
- Four-way stop sign-controlled intersections are best for pedestrians as long as there is only one lane in each direction. Roundabouts can also be safe treatments but may require special design considerations for the visually impaired.
- Fully signalized intersections are the next safest form of street crossing and should be the first choice when trying to find an improved way to cross a busy street.
- Mid-block crossings are essential only in areas where great distances exist between controlled intersections or where trails, open spaces, transit bus stops, and other major destinations are located mid-block. These crossings are especially important for safety where long distances between formal crossings encourage de facto mid-block crossing.
- To fix pedestrian crossing problems, remember context, and provide the best overall pedestrian experience. As a general rule, first consider less-intensive solutions (high-visibility crosswalks, yield signs, and so forth) and move to more-intensive solutions (RRBF, PHB, or full signals), if warranted.
- Crosswalk markings should be used more extensively in urban, suburban, and rural village centers.
- For streets that have or are likely to have high levels of walking, identify pedestrian signal phasing that offers the walker priority across intersections and the ability to interject a pedestrian crossing request into the current phase and/or the ability to add to the time allowed for crossing for those that may need more time.

Various matrices, diagrams, and maps have been created to show the context of different community typologies and different place types. The maps should be used to see where a particular type of facility should be considered and the extent to which the network needs to be developed. These diagrams should be used only as guidance and need to be adjusted based on local conditions, priorities, and policies. They provide insight, however, into how local context must be considered and how the interaction of land use, street configurations, and spatial arrangements must be integrated. The matrices represent general guidance on the types of facilities that are available to consider and where they may be most appropriate. None of this should take the place of a pedestrian master plan and a public review process that allows local conditions and local priorities to be factored into the recommendations. These matrices provide the full range of items to be considered, however. Subsequently in the chapter, the benefits of each type of pedestrian element and amenity have been summarized and ranked on matrices. A review of these benefits should be part of the overall planning process.

7.5.1 Planning and Designing Walking Treatments for Rural Areas

Rural Neighborhood Context

A significant amount of open space exists, with a lower amount of improved roadway and walking facilities. Many streets do not contain walkway systems, and roads are relatively narrow, providing two immediate challenges for pedestrians in these areas.

Rural Corridor Context

Larger distances separate these land use types, mostly without the connectivity of walkway systems. Although traffic volumes may be reasonable, vehicle speeds are typically higher and on typically smaller streets with limited walking facilities.

Rural District Context

These districts may or may not have a good internal network of pedestrian facilities. They are often disconnected from neighborhoods and corridors and may need connection improvements to make them walkable.

Rural Village Center Context

For the most part, these centers are walkable based on their scale but may have challenges due to the lack of safe crossings over the "main street" of downtown if this street is carrying a large capacity of through-traffic.

For an overview of the four community types found in rural areas, refer to—

- "Figure 7-7: Overview of a Typical Rural Area with Recommended Treatments"
- "Figure 7-8: Rural Neighborhood Example Showing Typical Pedestrian Improvements"
- "Figure 7-9: Rural District Example Showing Typical Pedestrian Improvements"
- "Figure 7-10: Rural Village Center Example Showing Typical Pedestrian Improvements"
- "Figure 7-11: Rural Corridor Example Showing Typical Pedestrian Improvements"

Typical rural walking environment, Photo source: Dan Burden

Main streets provide some of the most human scaled and walkable communities in the United States. Photo source: iStock

Figure 7-7: Overview of a Typical Rural Area with Recommended Treatments

Best Pedestrian Design Practices for Creating Walkable Communities	**WALKWAY TREATMENTS ("W")**							**STREET CROSSINGS ("C")**								**INTERSECTIONS ("A")**				**CROSSING CONTROL DEVICES ("D")**							**SIGNAL TIMING ("T")**				
	WC - Walkway Presence and Continuity**	**WU** - Primary Universal Walkway Access	**W1** - Curb Zone (parking / bulb-outs)**	**W2** - Furnishing Zone (trees / signage / utilities /	**W3** - Walking Zone (surface materials /	**W4** - Building Frontage Zone (furniture/ business/	**WW** - Walkway Width Capacity Metrics**	**CB** - Pedestrian Bridge or Underpass	**CT** - Raised Crosswalk / Speed Table	**CS** - Crossings at Signals**	**CY** - Crossings at Stop / Yield Signs**	**CM** - Mid-block crossing (markings / medians	**CN** - Crossings with No Controls	**CX** - Crosswalk Markings and other Requirements**	**CU** - Primary Universal Crossing Access	**AC** - Curb Extensions / Bulb-outs	**AA** - Universal Access on Ramps (perp / apex /	**AL** - Level Walk to Street with Blended Transition	**AR** - Reduced Radius Corners	**DH** - HAWK Signals	**DP** - Pedestrian Only Crossing using Standard	**DR** - RRFB Signals	**DW** - Ped. Actuated Flashing Signage & In	**DS** - Pedestrian Scramble Signals /	**DN** - No Turn on Red Warnings	**DD** - Signals for Universal Access (audible	**TG** - Pedestrian Advance Walk Notice	**TH** - Concurrent Pedestrian / Vehicle	**TJ** - Pedestrian Phase Intervention in Cycle**	**TK** - Signals Synchronized to Bikes /	**TX** - Available Crossing Timing for Pedestrian
Treatment Recommendations																															
RN -Rural Neighborhood	✓	✓			✓		✓						✓	✓	✓		✓		✓												✓
RC -Rural Corridor	✓	✓			✓		✓			✓	✓			✓	✓		✓			✓	✓	✓	✓			✓			✓		✓
RD -Rural District	✓	✓			✓		✓			✓	✓			✓	✓		✓		✓		✓					✓					✓
VC -Village Center	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓	✓	✓		✓

* Though all areas can benefit from the implementation of these principles, they are more effective in specific community types and areas.

** Some design guidance elements are not shown on the associated mapping diagram since they apply community wide.

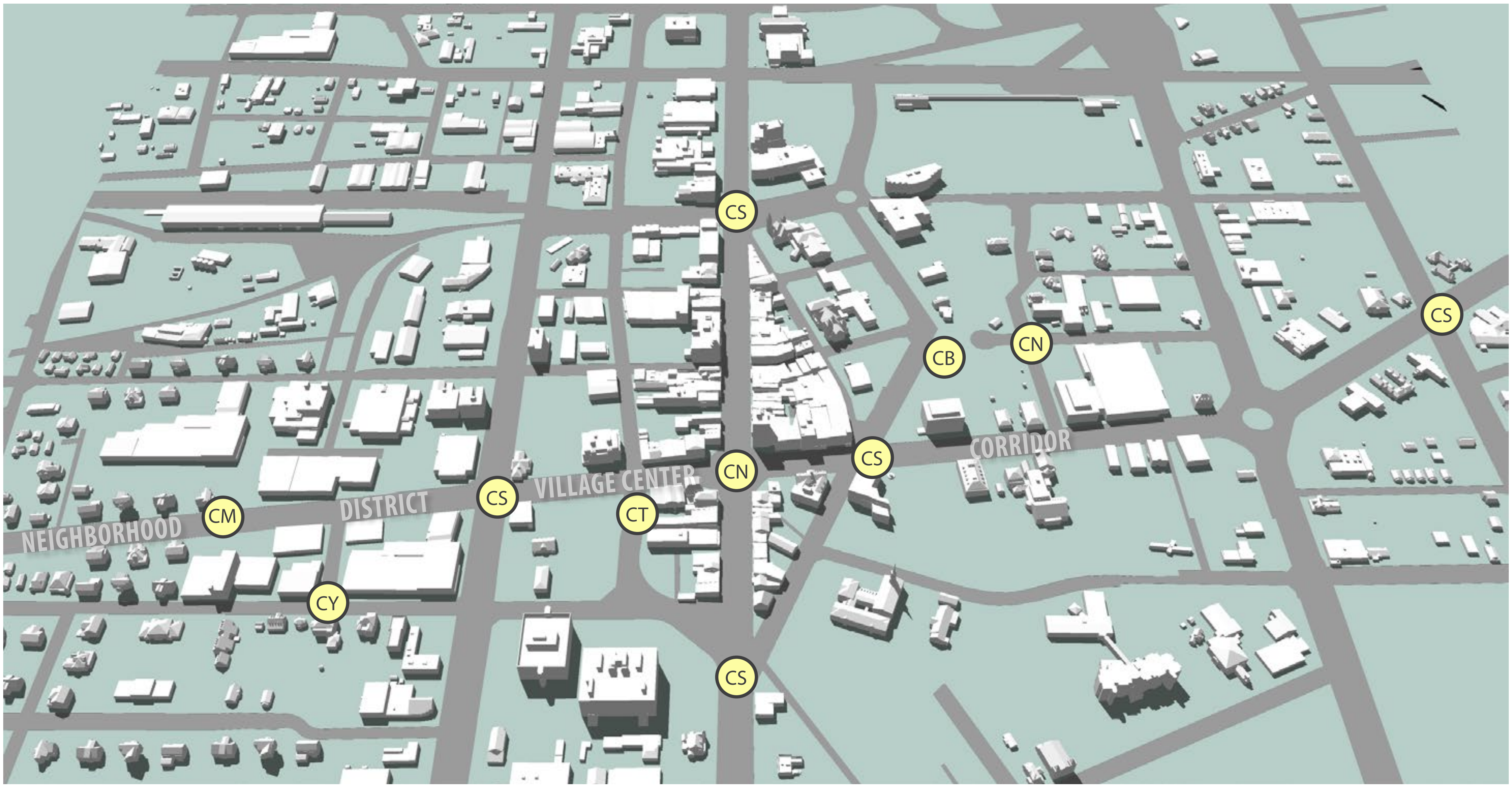


Figure 7-8: Rural "Neighborhood" Example Showing Typical Pedestrian Improvements

Figure 7-9: Rural "District" Example Showing Typical Pedestrian Improvements

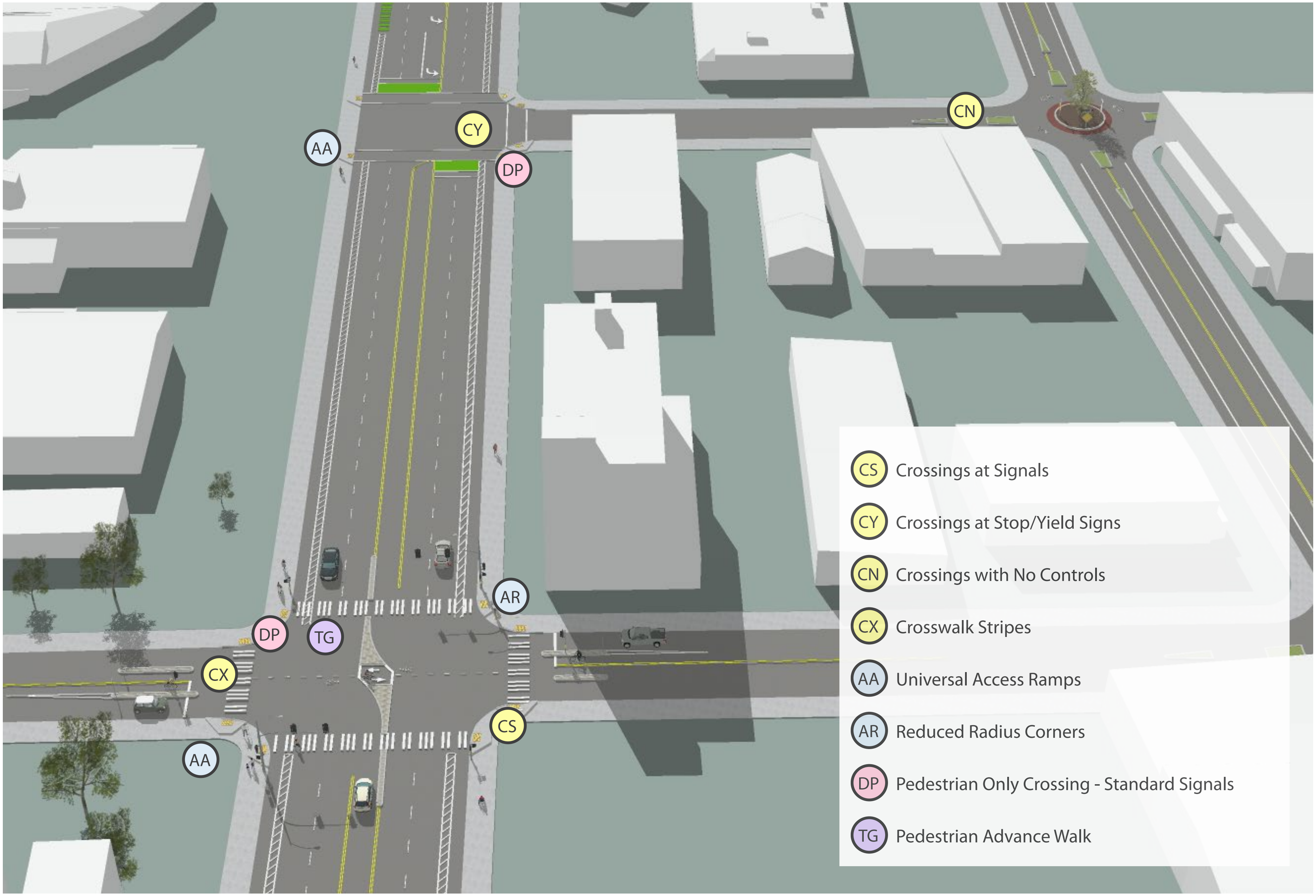


Figure 7-10: Rural "Village Center" Example Showing Typical Pedestrian Improvements

Figure 7-11: Rural "Corridor" Example Showing Typical Pedestrian Improvements

7.5.2 Planning and Designing Walking for Suburban Areas

Suburban Neighborhood Context

Street patterns are often curvilinear and arranged in a collector-style hierarchy, where the neighborhood streets are regularly intersected with collectors, arterials, and major arterials collecting and distributing vehicular volumes. The streets often include cul-de-sac streets that do not connect with other streets. Walkways are common, mostly sidewalks without parkway strips unless the development was built in the past 25 years.

The most prevalent pedestrian problem in these areas relates to a lack of short connections between areas due to cul-de-sacs, large distances needed to travel by foot to other land uses or destinations, and higher-speed and higher-volume streets that need to be crossed. The street network is often responsible for lowering walkability due to its arrangement, hierarchy, and street widths.

Suburban Corridor Context

The greatest pedestrian challenge relates to the large distances between land use destinations and neighborhood origins. The attention is usually focused on getting the largest volume of traffic through these areas, so street crossings and the distances between crossing points are significant challenges.

Suburban District Context

Similar to rural areas, these districts are often not connected to the corridors and neighborhoods of these communities. They may have internal pedestrian circulation systems that support intra-district movement but are generally not connected well to other districts, corridors, or centers.

Suburban Town Center Context

Unlike rural and urban areas, it is often difficult to find the centers of many suburbs. There is not always a natural progression of density or of an increased mixture and intensity of land uses. Even if more-intense facilities are located in the town center, it is often difficult to find a concentration of destinations that are within walking distance of each other. Usually, the street speeds are reduced in these areas compared to districts and corridors. The potential for infill and increasing land use mixtures and walkable destinations is high if handled comprehensively.

For an overview of the four community types found in suburban areas, please refer to—

- Figure 7-12: Overview of a Typical Suburban Area with Recommended Treatments
- Figure 7-13: Suburban "Neighborhood" Example Showing Typical Pedestrian Improvements
- Figure 7-14: Suburban "District" Example Showing Typical Pedestrian Improvements
- Figure 7-15: Suburban "Corridor" Example Showing Typical Pedestrian Improvements
- Figure 7-16: Suburban "Center" Example Showing Typical Pedestrian Improvements

Suburbs typically have single land use types over broad areas, connected collectors and arterials. Photo source: unknown

Suburban streets are often wider than necessary. Photo source: Dan Burden

Figure 7-12: Overview of a Typical Suburban Area with Recommended Treatments

Best Pedestrian Design Practices for Creating Walkable Communities

Treatment Recommendations	WALKWAY TREATMENTS ("W")							STREET CROSSINGS ("C")							
	WC - Walkway Presence and Continuity**	**WU** - Primary Universal Walkway Access	**W1** - Curb Zone (parking / bulb-outs)**	**W2** - Furnishing Zone (trees / signage / utilities /	**W3** - Walking Zone (surface materials /	**W4** - Building Frontage Zone (furniture/ business/	**WW** - Walkway Width Capacity Metrics**	**CB** - Pedestrian Bridge or Underpass	**CT** - Raised Crosswalk / Speed Table	**CS** - Crossings at Signals**	**CY** - Crossings at Stop / Yield Signs**	**CM** - Mid-block crossing (markings / medians	**CN** - Crossings with No Controls	**CX** - Crosswalk Markings and other Requirements**	**CU** - Primary Universal Crossing Access
SN -Suburban Neighborhood	✓	✓	✓	✓	✓		✓						✓	✓	✓
SC -Suburban Corridor	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓
SD -Suburban District	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓
TC -Town Center	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓

Treatment Recommendations	INTERSECTIONS ("A")				CROSSING CONTROL DEVICES ("D")						
	AC - Curb Extensions / Bulb-outs	**AA** - Universal Access on Ramps (perp./ apex /	**AL** - Level Walk to Street with Blended Transition	**AR** - Reduced Radius Corners	**DH** - HAWK Signals	**DP** - Pedestrian Only Crossing using Standard	**DR** - RRFB Signals	**DW** - Ped. Actuated Flashing Signage & In	**DS** - Pedestrian Scramble Signals /	**DN** - No Turn on Red Warnings	**DD** - Signals for Universal Access (audible
SN -Suburban Neighborhood		✓		✓		✓					
SC -Suburban Corridor	✓	✓			✓	✓	✓				✓
SD -Suburban District		✓	✓	✓	✓	✓	✓				✓
TC -Town Center	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Treatment Recommendations	SIGNAL TIMING ("T")				
	TG - Pedestrian Advance Walk Notice	**TH** - Concurrent Pedestrian / Vehicle	**TJ** - Pedestrian Phase Intervention in Cycle**	**TK** - Signals Synchronized to Bikes /	**TX** - Available Crossing Timing for Pedestrian
SN -Suburban Neighborhood					✓
SC -Suburban Corridor			✓		✓
SD -Suburban District	✓				✓
TC -Town Center	✓	✓	✓	✓	✓

* Though all areas can benefit from the implementation of these principles, they are more effective in specific community types and areas.

** Some design guidance elements are not shown on the associated mapping diagram since they apply community wide.

Figure 7-13: Suburban "Neighborhood" Example Showing Typical Pedestrian Improvements

Figure 7-14: Suburban "District" Example Showing Typical Pedestrian Improvements

Figure 7-15: Suburban "Corridor" Example Showing Typical Pedestrian Improvements

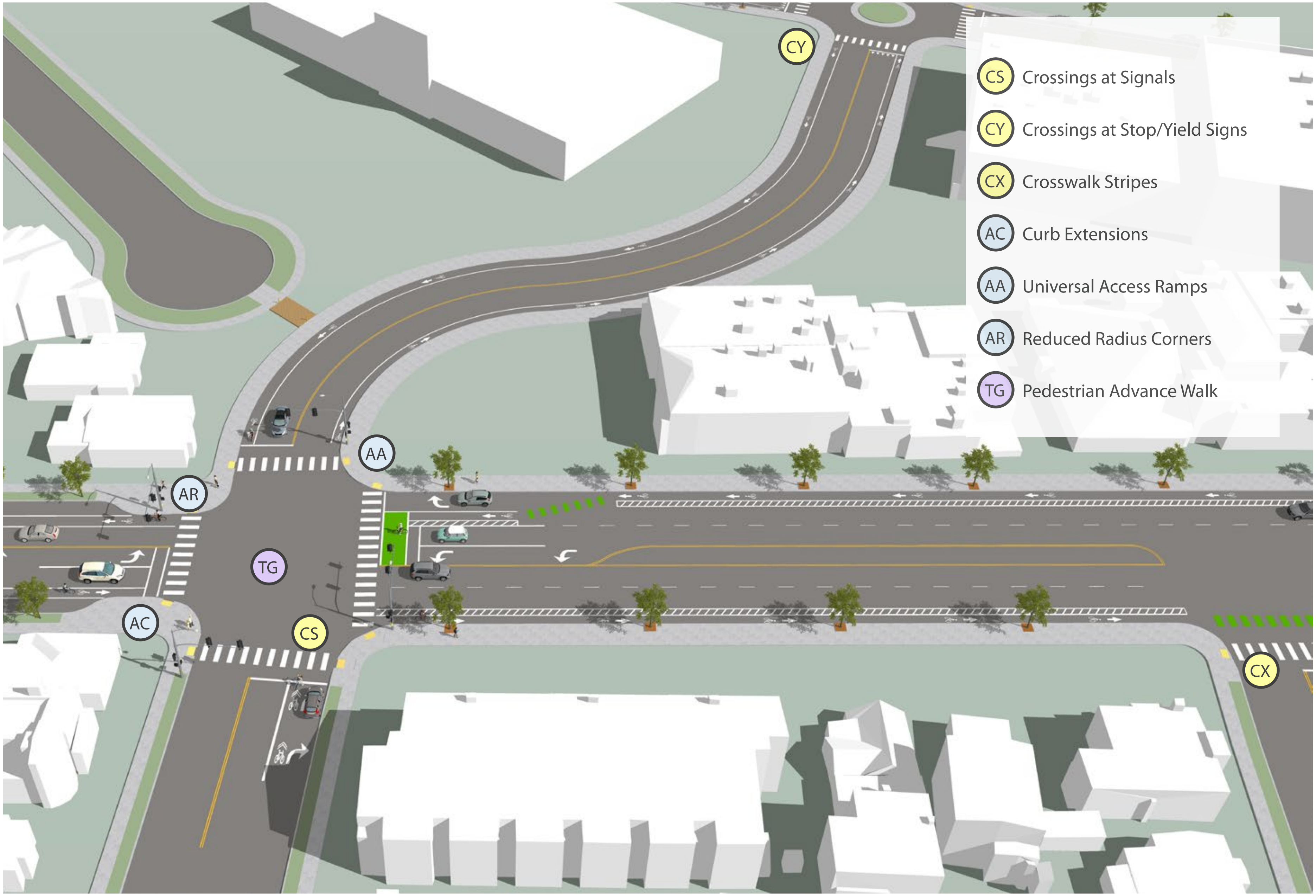


Figure 7-16: Suburban "Center" Example Showing Typical Pedestrian Improvements

7.5.3 Planning and Designing Walking for Urban Areas

Urban Neighborhood Context

Urban neighborhoods are typically more walkable because of the closer distances for walking, the gridded nature of the roadway network, the presence of walking facilities, and the mixture of land uses that can provide for most of the daily needs of local residents. These neighborhoods are generally better supported by transit, thereby extending the distance of non-vehicular travel patterns.

Urban Corridor Context

These areas are generally surrounded on some of their sides with neighborhoods, making them good candidates for increasing connectivity and walkability to the corridors.

Urban District Context

Urban districts are generally major campuses, cultural centers, entertainment districts, historic districts and financial centers with major employment in business parks and towers that all benefit by walking. Districts are generally surrounded or interspersed with mixed neighborhoods. Generally, the block sizes are reasonable and walking distances acceptable to make access to a district by foot a possibility.

City Center Context

By their very nature of mixed uses and density, these areas are often very walkable and serviced well by transit. Land uses are generally mixed both vertically and horizontally, helping to created origins and destinations closer to each other.

For an overview of the four community types found in urban areas, please refer to—

- Figure 7-17: Overview of a Typical Urban Area with Recommended Treatments
- Figure 7-18: Urban "Neighborhood" Example Showing Typical Pedestrian Improvements
- Figure 7-19: Urban "Corridor" Example Showing Typical Pedestrian Improvements
- Figure 7-20: Urban "District" Example Showing Typical Pedestrian Improvements
- Figure 7-21: Urban "City Center" Example Showing Typical Pedestrian Improvements

Major roadway barriers can sometimes make urban areas difficult to walk across, Photo source: Minesweeper

Many of the nation's mid sized cities are walkable, although the edges of these towns often are not. Photo source: APBP

Figure 7-17: Overview of a Typical Urban Area with Recommended Treatments

Best Pedestrian Design Practices for Creating Walkable Communities	WALKWAY TREATMENTS ("W")							STREET CROSSINGS ("C")								INTERSECTIONS ("A")				CROSSING CONTROL DEVICES ("D")							SIGNAL TIMING ("T")				
	WC - Walkway Presence and Continuity**	**WU** - Primary Universal Walkway Access	**W1** - Curb Zone (parking / bulb-outs)**	**W2** - Furnishing Zone (trees / signage / utilities /	**W3** - Walking Zone (surface materials /	**W4** - Building Frontage Zone (furniture/ business/	**WW** - Walkway Width Capacity Metrics**	**CB** - Pedestrian Bridge or Underpass	**CT**- Raised Crosswalk / Speed Table	**CS** - Crossings at Signals**	**CY** - Crossings at Stop / Yield Signs**	**CM** - Mid-block crossing (markings / medians	**CN** - Crossings with No Controls	**CX** - Crosswalk Markings and other Requirements**	**CU** - Primary Universal Crossing Access	**AC** - Curb Extensions / Bulb-outs	**AA** - Universal Access on Ramps (perp./ apex /	**AL** - Level Walk to Street with Blended Transition	**AR** - Reduced Radius Corners	**DH** - HAWK Signals	**DP** - Pedestrian Only Crossing using Standard	**DR** - RRFB Signals	**DW** - Ped. Actuated Flashing Signage & In	**DS** - Pedestrian Scramble Signals /	**DN** - No Turn on Red Warnings	**DD** - Signals for Universal Access (audible	**TG** - Pedestrian Advance Walk Notice	**TH** - Concurrent Pedestrian / Vehicle	**TJ** - Pedestrian Phase Intervention in Cycle**	**TK** - Signals Synchronized to Bikes /	**TX** - Available Crossing Timing for Pedestrian
Treatment Recommendations																															
UN -Urban Neighborhood	✓	✓	✓	✓	✓		✓						✓	✓	✓	✓	✓		✓		✓	✓	✓								✓
UC -Urban Corridor	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓			✓			✓			✓		✓	✓		✓
UD -Urban District	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓	✓	✓	✓	✓		✓	✓			✓		✓	✓		✓
CC -City Center	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓	✓	✓

* Though all areas can benefit from the implementation of these principles, they are more effective in specific community types and areas.

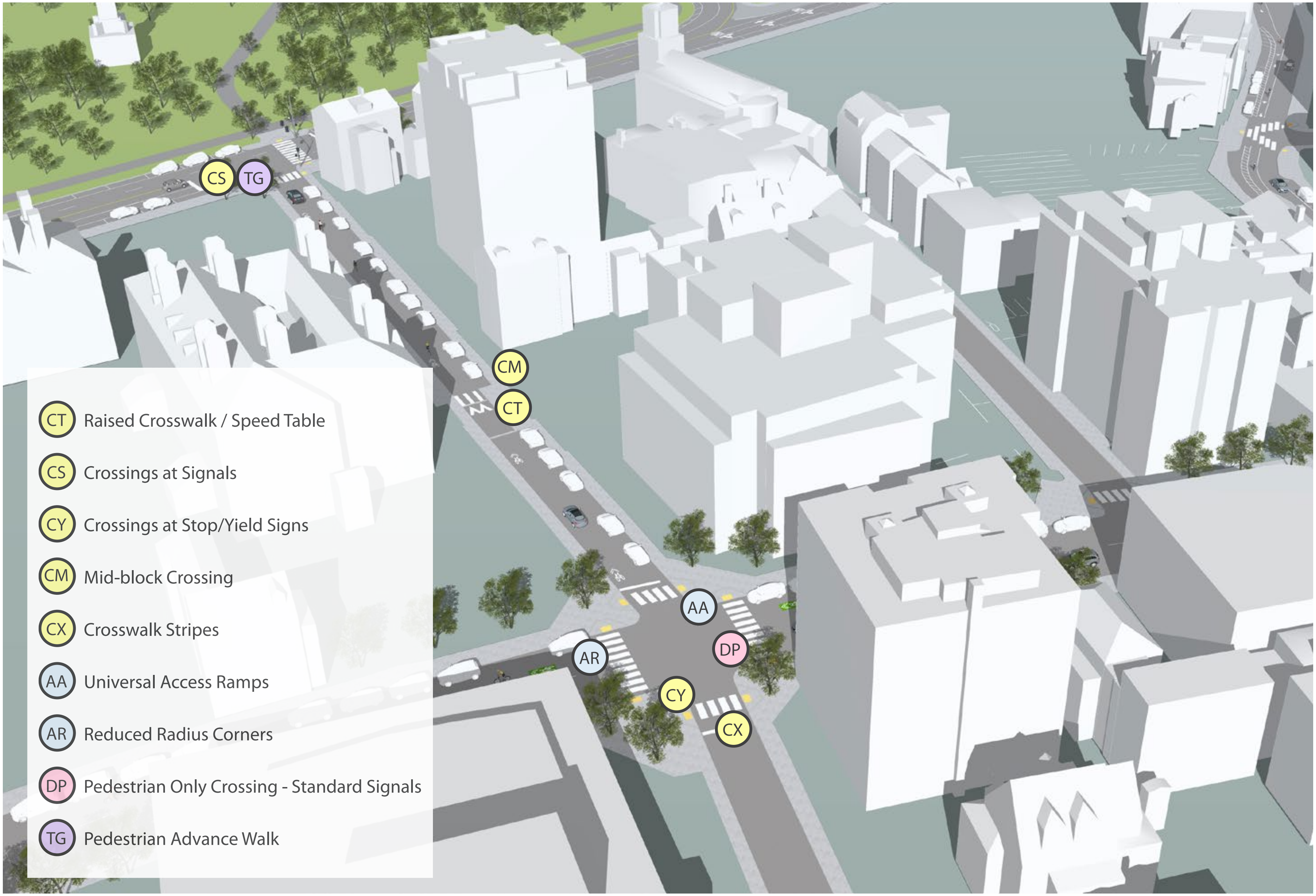
** Some design guidance elements are not shown on the associated mapping diagram since they apply community wide.

Figure 7-18: Urban "Neighborhood" Example Showing Typical Pedestrian Improvements

Figure 7-19: Urban "Corridor" Example Showing Typical Pedestrian Improvements

Figure 7-20: Urban "District" Example Showing Typical Pedestrian Improvements

Figure 7-21: Urban "City Center" Example Showing Typical Pedestrian Improvements



7.6 IMPLEMENTATION: PROJECT-SCALED STEPS

The pedestrian network can sometimes be improved with low-cost solutions that can easily and quickly be implemented. Some may result in lasting changes, whereas others may serve as an interim step to experiment with design concepts until more permanent solutions can be constructed. Lighter, quicker, cheaper (LQC) features can also involve people in the community to help with installation. Implementation ideas that do not require a high degree of traffic engineering analysis, environmental review, political approvals, public vetting, or cost are included in this category. The assumption for these implementation ideas is that a project-level improvement for a residential, institutional, mixed-use, retail, or employment facility is proposed by a developer, public or private. The construction of the project is likely to attract a fair number of residents, students, customers, or employees. Therefore, the applicant should consider what can be done specifically by the project, assuming that items that are too far away from the project site will be difficult to show a nexus that requires contribution by the applicant.

The following exemplifies LQC enhancements—

- Make the project itself as walkable as possible, including making the connections and offering the site as part of the pedestrian network.
- Solve the existing pedestrian problems immediately surrounding the site. These may include difficult crossings, incomplete connections, excessive distances between controlled intersections, ADA compliance issues, and maintenance problems with walking surfaces.
- Look at making better connections in the general neighborhood or district, especially related to safe routes to school and to transit.
- If the project site is larger, provide mid-block or midproject walkway improvements that provide shortcuts to project tenants, employees, visitors, and the general public.
- Provide a great walking environment next to the project. This would include full development and proper design of the four areas of the walking environment (curb line, furnishing zone, pedestrian zone, and building frontage zone). Street trees, lighting, public art, and street furniture are all contributors to improving the walking environment.
- Provide adequate lighting to make the immediate project site area is walkable at night as well as during the day.
- Work cooperatively with the approving agency for the interconnection of on site, near-site, and off site improvements that other grants, projects, or agencies can extend toward the project site, while the project tries to improve what is in their control toward these connections.
- Upgrade the intersections around the project site, not only for increased traffic flow and on street parking but for pedestrian crossings.

It does not take a lot to make a walkable location, just attention to detail and safety. Photo source: Dan Burden

7.7 RESOURCES: IMPORTANT RESOURCES TO CONSIDER

For more information on land use planning, please consult the following foundational documents.

FHWA:

- Bike/Pedestrian Safety Guide and Countermeasure
- Creating Safer Communities for Walking/Biking (2015)
- List of Online Reports and Technical Publications
- Manual on Uniform Traffic Control Devices (2012)
- Pedestrian and Bicycle Information Center
- Pedestrian Safety Guide for Transit Agencies (2008)

AASHTO:

- Guide for the Planning, Design, and Operation of Pedestrian Facilities (2004)

ITE:

- Designing Walkable Urban Thoroughfares (2010)

OTHERS:

- Complete Streets Best Policies and Implementation Practices (2010/Annual)
- LEED for Neighborhood Development (2014)
- Model Design Manual for Living Streets (2011)
- NCHRP Project 20-7 (232): ADA Transition Plans: Guide to Best Practices
- NCHRP Project 3-62: Guidelines for Accessible Pedestrian Signals
- 2010 ADA Standards: 28 CFR Part 35; 49 CFR Parts 27 and 37
- 2011 PROWAG
- 2013 SNPRM

7.8 **CASE STUDY:** JACKSON, MICHIGAN

In 2003, Jackson, Michigan started active-living interventions to help solve the low physical activity levels of residents. The small midwestern city employed a three-prong community intervention, utilizing the "5P" model to increase safe physical activity opportunities and encourage walking and biking for short trips. The interventions were targeted at three levels: (1) elementary schools; (2) worksites; and (3) citywide networks. In 2009, an academic study, including pre-intervention and post-intervention research, was conducted.[2] The 2009 study provides compelling evidence for the success of Jackson's strategies and is the basis of this case study.

7.8.1 City and Demographic Background[4]

The City of Jackson is located in the south central area of Michigan and is the county seat of Jackson County. It is roughly 40 miles west of Ann Arbor and 35 miles south of Lansing. The city measures roughly 11 square miles and has a population density of roughly 3,085 persons per square mile. As of the 2010 census, it had a population of 33,534. As of the 2010 census, the racial makeup of the city was 71.4 percent White, 20.4 percent African-American, 0.4 percent Native American, 0.7 percent Asian, 1.6 percent from other races, and 5.5 percent from two or more races. A relatively large share of Jackson's population (59.5 percent) is considered to be low to moderate income (LMI). Cited barriers to active transportation in Jackson include Michigan's four-season climate and the area's strong auto-oriented history and culture. The three major private employers in the City of Jackson are a hospital, a gas and electric company and a power management company. The 2009 publication notes the lack of a centrally located university or other conventionally bike/walk-friendly industry as a barrier to active transportation.

Importantly, the City of Jackson, MI has an exceptional record of overweight and obesity. At the time of the 2009 paper's publication, the state of Michigan had been among the top 10 heaviest states for the past 14 years. In 2009, overweight and obesity statistics for Jackson residents mirrored that of the state (62 percent of adults were overweight and obese, 11 percent of high school students were overweight, and 13 percent were at-risk for being overweight).[4] In 2009, Jackson's rates of heart disease were on par with the State of Michigan at 252.5 cases per 100,000, and Jackson County's rate of diabetes-related deaths, 118.7/100,000, were far worse than the state's average of 88/100,000.[5] Contributing to all of the health problems, the 2009 report stated, was a low rate of physical activity. Indeed, a 2006 survey completed by the United Way of Jackson County found that 30 percent of Jackson County respondents indicated that they had not exercised at all during the past month.[6]

It is interesting to note that Michigan is currently ranked the 15th heaviest state. This mild improvement may be, in part, due to interventions similar to those employed in Jackson. (Unfortunately, the comprehensive 2010 Report of the Office of Michigan Surgeon General has not since been updated.)

7.8.2 General Approach

The city of Jackson is unique because of its background and its approach. Unlike communities well known for their walkability (e.g. Berkeley, California; Madison, Wisconsin; and Ann Arbor, Michigan), Jackson, according to the 2009 report, was "a blue-collar, industry-based city without a history of advocacy in active transportation." Despite its "late start," Jackson made significant strides in 2003 by employing a multipronged approach. Jackson's approach to increasing physical activity was unique for focusing on infrastructure in addition to the typical encouragement programs. Although the health benefits of walking and biking are well documented,[7] research and understanding of the role of the built environment in promoting biking and walking has been historically lacking in the United States.[8] Several studies have revealed that a significant share of the population feels unsafe because of traffic conditions. The Jackson approach is an acknowledgment that encouragement alone is insufficient to change behavior and positively impact health outcomes.

Safe routes to school identifies walking routes to school and makes safety improvements to them. Photo source: City of Jackson, Michigan

There was general agreement in Jackson that although encouragement programs were successful for the limited number of individuals enrolled in the programs, the community was ready to try a more widespread intervention with the potential to affect a greater number of community members. A partnership (the Walkable Communities Task Force)—comprising 20 members from the city engineering department, road commission, public health department, local hospital, public school administration, local bicycle club, and a variety of other service organizations—was formed to generate ideas for interventions and to seek funding opportunities. In 2003, Jackson was selected as 1 of 25 communities in the nation to receive the Robert Wood Johnson Foundation's "Active Living by Design" grant. Soon after, the partnership developed its strategy.

7.8.3 Methods

The partnership decided that it would employ a combination of programs and projects and that it would target interventions to two different audiences. The Jackson project utilized Active Living by Design 5P model, which includes the following focus areas: preparation, promotion, programs, physical projects, and policy. The 5P model calls on multidisciplinary expertise from the fields of public health, planning, engineering, and education. The two target audiences for the 5P interventions included elementary school children (grades K–6), and working-age adults. Elementary school children were chosen as a target group because of the strong availability of state and national Safe Routes to School support, and because of the ability of such interventions to reach both students and parents.[9] The intervention goal for this population was to increase walking and biking trips among elementary school children by at least 30 percent in 5 years. Working-age adults were selected because of the availability of national resources for programs such as Bike-to-Work day and other employment-sponsored health programs. The intervention goal for this population was to increase the number of working-age adults walking or biking for their short trips (less than 5 miles) by 50 percent in 5 years.

Table 7-5 summarizes the 5Ps, or intervention types; the purpose of each intervention type; and the exact intervention used for each target audience.

Table 7-3: 5P Intervention Types

		TARGET AUDIENCE		
INTERVENTION TYPE	**PURPOSE OF INTERVENTION**	**ELEMENTARY SCHOOL CHILDREN**	**WORKING-AGE ADULTS**	**OVERALL COMMUNITY LEVEL**
PREPARATION	Develop a multidisciplinary partnership to oversee the project	Develop grassroots 'Safe Routes to School' teams at each school	Form leadership teams at worksites	Form 'Walkable Communities' Task Force
PROMOTIONAL	Generate interest in walkability Earn media attention Introduce individuals to "Try-it-Out" events	Walk to School Day	Smart Commute Day	Create project specific website and published newsletter
PROGRAMS	Go beyond short term promotion Encourage long-term increases in physical activity	Safe Routes to School	Foot Energy[11] Michigan Prisoner Re-entry Initiative bikes program	Produced first Jackson area bike map in 20 years
PHYSICAL PROJECTS	Improve the safety and convenience of walking and biking in the City of Jackson	Variety of improvements to make walking to school safer	Bike lanes, Bike route signage, Bus bike carriers	None listed
POLICY	Create policies that could lead to long-term, sustainable, change	School District Wellness Policy	Media campaign to raise support for bike lanes	Complete Streets Policy

7.8.4 Results

The results of Jackson's 5P Model approach show positive changes in attitudes toward active transportation, intentions to try active transportation, and, most importantly, actual physical activity. The impacts of preparation and policy interventions are anecdotal and not directly tied to active transportation outcomes, so they have been excluded from this discussion.[10] Promotional, program, and physical project interventions were found to have direct and measurable impacts on walking and biking. Highlights of these impacts follow.

Promotion

1) Walk to School Day: Participation increased from 650 student participants in 2004 to 1,254 participants in 2007.
2) Smart Commute Day: Smart Commute Day participation increased 102 percent in 3 years, and more than 80 percent of people said the event "would" or "might" increase the probability of them smart commuting in the future.
3) Variety of improvements to make walking to school safer: Website hits increased 300 percent. Publication of quarterly newsletter since 2005.

Programs

1) Safe Routes to School:
   - Established Safe Routes to School programs grew from one school in 2004 to seven in 2007.
   - The percentage of the student body walking to school doubled at three of the four participating schools.
2) Foot Energy and Michigan Prisoner Reentry Initiative bikes program:[11]
   - This organization established a worksite pilot "company bikes program."
3) The prisoner reentry program had 16 participants in the first 3 months.
   - Jackson produced its first area bike map in 20 years; nearly 9,000 maps were distributed in 2006–07.

Physical Projects

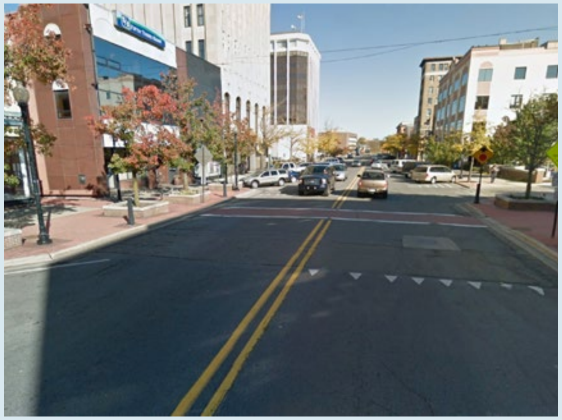
1) A variety of improvements were made to make walking to school safer: sidewalks, crosswalks, and signage was installed around four elementary schools.
2) Bike lanes, bike route signage, and bus bike carriers were added: 6.5 miles of new bike lanes were constructed, 12 bus bike carriers were installed (for the entire fleet), and signs were posted on all bike routes.

7.8.5 Conclusions From Case Study

The 2009 study was merely observational. Data limitations and the inclusion of possibly confounding variables prevent the formulation of causal relationships. Nonetheless, the Jackson experience indicates the effectiveness of local community-driven projects, which utilize a variety of interventions, to increase walking and biking. The unusually high degree of success across the various target audiences in Jackson seems to point to the particular effectiveness of including infrastructure improvements in promoting physical activity. The Jackson experience also indicates the importance of identifying a clear lead organization or partnership to help initiate and manage such a project.

To date, the City of Jackson is continuing efforts to promote walking, biking, and community health. The Walkable Communities Task Force currently functions as an advisory board to the City Council. The city also has a list of ongoing pedestrian and bicycle improvements, many of which were presumably generated by the Walkable Communities Task Force, the 2003 grant-funded 5P project and related projects.

Jackson can serve as a source of inspiration for many reading this design manual. In the words of the 2009 report, "If a small city with winter weather, in the heart of automotive country can rally support and enthusiasm for this important mission, many other communities nationwide should join in the call to create active, healthy places for their citizens to live as well."



Pedestrian improvements in Downtown Jackson, Michigan. Photo source: Google Earth

NOTES:

1 Federal Highway Administration. 2003. A Review of Pedestrian Safety Research in the United States and Abroad.

2 http://www.humankinetics.com/acucustom/sitename/Documents/DocumentItem/17541.pdf.

3 Some city and demographic information has changed since the 2009 study. This summary will report current information and reference 2009 figures only where relevant and interesting to this case study.

4 Office of Michigan Surgeon General. 2004. Michigan Surgeon General's Health Status Report: Healthy Michigan 2010. Lansing, MI: Michigan Department of Community Health.

5 Jackson County Health Department. 2006. 2006 Annual Report. Jackson, MI.

6 Jackson County United Way. 2006. 2006 Jackson Community Report Card. Jackson, MI.

7 http://www.cdc.gov/nccdphp/dch/pdf/HealthEquityGuide.pdf.

8 http://www.ncbi.nlm.nih.gov/pubmed/12948971.

9 Staunton C.E., D. Hubsmith, and W. . 2003. "Promoting Safe Walking and Biking to School: The Marin County Success Story." *American Journal of Public Health*, 93 (9): 1431–34.

10 Full results can be viewed in the full paper, on which this case study is based.

11 The Foot Energy Program consisted of individualized maps and active transportation plans for workers; workplace active transportation improvements (e.g. lockers, bike racks); and a "Company Bikes" program.

CHAPTER 8: IMPLEMENTATION FRAMEWORK

USER LEGEND

Advocate Organizations
- Housing Advocates
- Health and Safety Advocates
- Smart Growth Advocates
- Mobility Choice Advocates

Providing Entities
- Developers, Financial Institutions
- Housing Providers and Institutions
- Planning, Design or Engineering Consultants

Decision Makers
- Local Agency Planners and Engineers
- Local Elected Officials and Review Staff
- Federal, State and Regional Regulators

The intent of this chapter is to discuss various ways in which an organization can implement projects, policies, or programs that will result in a larger quantity and higher quality of walking and biking facilities. It also discusses methods in which HUD can take a supporting role or, in some cases, a leadership role that may encourage the implementation of these guidelines.

8.1 LOCAL AGENCY: ADOPTION OF PRINCIPLES

Cities and communities may wish to incorporate these principles when wishing to create walkable and bikeable communities. This may be best accomplished by integrating these principles with other policies, plans, and regulatory frameworks.

8.1.1 Use This Guide on a Project Basis

A city wishing to use this guide, but unwilling or unable to incorporate it in a systemic manner, may be able to use it for a specific project. This approach has the benefit of easy implementation. Much of the information provided in this guide can be applied to a given project without requiring general plan amendments or other significant undertakings. This approach has the drawback of being only a one-time benefit. Projects designed and implemented using this guide may reflect best practices in bicycle and pedestrian planning but do little to influence the overall transportation system over a long period of time. Notably, however, efforts to implement projects using this guide may highlight systemic, citywide walkability/bikeability issues (i.e. general plan guidance that dictates greater-than-12-foot travel lanes on all city streets, thereby inducing vehicle speeding and inhibiting the creation of bicycle lanes). Identification of these issues may catalyze more fundamental changes.

8.1.2 Use This Guide for "Complete Streets" and "Routine Accommodation" Ordinances

The adoption of a complete streets or routine accommodation ordinance represents a more aggressive integration of walking and biking into a city's overall transportation system. A complete streets ordinance ensures that transportation systems are planned and designed for all users, regardless of travel mode, age, or physical ability. A routine accommodation ordinance typically ensures that pedestrian and bicycle accommodation for all new streets and all major street reconstruction is provided routinely. This guide may be used to provide increased definition to these relatively high-level ordinances. They can describe what is specifically meant by appropriate bicycle and pedestrian accommodation and what is required to build a complete street. Major strengths of these approaches are that they address the creation of networks and the importance of routinely accommodating pedestrians and cyclists. Drawbacks to these approaches include their slower timetable (i.e. ordinances must be fully vetted and adopted before generating projects) and their potential lack of influence on the city as a whole (i.e. complete streets ordinances may identify only certain streets, and routine accommodation ordinances apply only to new and reconstructed streets).

8.1.3 Use This Guide for General Plan Amendments and Development Regulations

This guide may be used to inform general plan amendments and developer regulations. Doing so represents the most aggressive—but also the most effective—means of fostering a pedestrian- and bicycle-friendly community. Pursuing a general plan amendment or overhauling developer regulations is the most aggressive approach because it considers bicycle and pedestrian accommodation not just as an added benefit but as integral to the transportation system. By and large, most general plan transportation or circulation elements in American cities are automobile oriented and treat bicycle and pedestrian accommodation as afterthoughts. Amending a general plan or updating developer regulations presents an opportunity to look at city streets as public spaces, places to accommodate all modes of transportation, and even places to be re-purposed for "higher" uses (e.g. pedestrian malls, "woonerven," etc.). The primary drawback to these approaches is the amount of time required to make these changes. This is due to not only the generally slow planning and regulatory processes but also the inevitable political opposition involved in fundamentally changing transportation planning and practice.

Streets are for people and for the daily activities that are the heart and soul of our communities. Photo source: BlueZone

8.2 IMPLEMENTATION: BIKEWAY NETWORKS

Implementation of a bikeway network often requires an implementation plan. Some bikeways—such as paths, bicycle boulevards, and other innovative techniques described in this guide—will require a capital improvement project process, including identifying funding, a public and environmental review process, and plan preparation. Other bikeway improvements piggyback onto planned construction, such as resurfacing, reconstruction, or utility work.

The majority of bikeway facilities are provided on streets in the form of shared roadways or bicycle lanes. Shared roadways usually require virtually no change to existing roadways except for some directional signs, occasional markings, and minor changes in traffic control devices; removing unnecessary centerline stripes is a strategy that can be implemented after resurfacing projects. Striped bike lanes are implemented on existing roads through use of the following strategies.

For further information on the following topics, see relevant FHWA documents—

- *Road Diet Informational Guide.*
- *Workbook for Building On-Road Bicycle Networks through Resurfacing Projects.*

8.2.1 Bike Facilities Added as Part of Resurfacing

The cost of striping bicycle lanes is negligible when incorporated with resurfacing, as this avoids the high cost of stripe removal; the fresh pavement provides a blank slate. Jurisdictions will need to anticipate opportunities and synchronize restriping plans with repaving and reconstruction plans. If new pavement is not anticipated in the near future, grinding out the old lane lines can still provide bike lanes.

There are three ways of finding room for bike lanes.

Lane Diets

Where all existing or planned travel lanes must be retained, travel lanes can be narrowed to provide space for bike lanes. Recent studies have indicated that the use of 10-foot travel lanes does not result in decreased safety in comparison with wider lanes for vehicle speeds up to 35 miles per hour.[1] Especially on streets where trucks and buses frequently run, 11-foot lanes can be used satisfactorily at higher speeds. Where a choice between a 6-foot bike lane and an 11-foot travel lane must be made, however, it is usually preferable to have the 6-foot bike lane. Parking lanes can also be narrowed to 7 feet to create space for bike lanes.

Road Diets

Reducing the number of travel lanes provides space for bicycle lanes. Many streets have more space for vehicular traffic than is necessary. Some streets may require a traffic and/or environmental analysis to determine whether additional needs or impacts may be anticipated. The traditional road diet changes a four-lane undivided street to two travel lanes, a continuous left-turn lane (or median), and bike lanes. In other cases, a four-lane street can be reduced to a two-lane street without a center turn lane if there are few left turn movements. One-way couplets are good lane-reduction candidates if they have more travel lanes in one direction than are necessary for the traffic volumes. Because only one bike lane is needed on a one-way street, removing a travel lane can free enough room for other features, such as on street parking or wider sidewalks. Both legs of a couplet must be treated equally so there is a bike lane in each direction.

Parking Removal

On street parking is vital on certain streets (such as in residential or traditional central business districts with little or no off-street parking), but other streets have allowable parking without a significant visible demand. In these cases, parking prohibition can be used to provide bike lanes, with minimal public inconvenience.

8.2.2 Bike Facilities Added as Part of Utility Work

Utility work often requires reconstructing the street surface to complete restoration work. This provides opportunities to implement bike lanes and more complex bikeways, such as bike boulevards, separated bike lanes, or paths. It is necessary to provide plans for proper implementation and design of bikeway facilities prior to the utility work. It is equally necessary to ensure that existing bikeways are replaced where they exist prior to utility construction.

8.2.3 Bike Facilities Added as Part of Development Projects

When streets are slated for reconstruction in conjunction with redevelopment, opportunities exist to integrate bicycle lanes or other facilities into the redevelopment plans.

8.2.4 Bike Facilities Added as Paved Shoulders

Adding paved shoulders to existing roads can be expensive if done as standalone, capital improvement projects, especially if ditch lines have to be moved or if open drains are changed to enclosed drains. Paved shoulders can be added at little cost, however, if they are incorporated into projects that already disturb the ground beyond the pavement, such as laying utility lines or drainage work.

8.2.5 Bike Facilities Implemented Using Lighter, Quicker, and Cheaper Methods

Many treatments for adding bikeways to streets simply involve paint (or thermoplastic) and signs, which are not expensive compared to structural changes. The least expensive way to make these changes is to install them with resurfacing of streets. Separated bike lanes can involve more expense, but this can also be minimized through use of planters, pylons, rubber parking stops, and similar other devices to provide the physical protection. For additional examples of lighter, quicker, and cheaper methods, see chapters 6 and 7 (Bikeway Planning and Design, and Pedestrian Design Principles, respectively).

Many roadways are wider than needed for vehicular travel and can be reclaimed for other uses. Photo source: BlueZone

8.3 IMPLEMENTATION PROGRAMS: CYCLING AND WALKING

This section comprises a diverse menu of programs intended to support increased bicycling and walking. Due to a long history of routine accommodation for pedestrians (i.e. sidewalks, crosswalks, dedicated signals), programs targeting walking are relatively uncommon. Conversely, the historic lack of routine accommodation for cyclists has fostered confusion about the role of bicycles in the overall transportation system and has necessitated an impressive diversity and breadth of bicycle-related programs. Despite a likely emphasis on programming and less on projects, bicycle programs remain an important element of successful bicycle planning. The following sections offer some background on the changing "state of practice" in bicycle programming—namely, the increased integration of programs and projects—culminating in a comprehensive menu of bicycle and pedestrian programs.

8.3.1 Evolving the State of Practice in Bicycle Programs

There has been a shift away from the traditional, compartmentalized "Five E's" approach developed by the League of American Bicyclists (engineering, education, encouragement, enforcement, and evaluation and planning) and toward a fully integrated, complementary menu of initiatives. By offering a menu of initiatives, rather than a prescriptive list, active transportation programming can more accurately address the existing conditions and desired outcomes of a given context.

In addition to changes in the content and organization of active transportation programs, there has also been a shift in implementation strategies. Programs are increasingly targeted at specific project areas, in conjunction with the construction of bicycle and pedestrian facility projects. The implementation of a capital project presents a unique opportunity to promote a city's active transportation system and cycling and walking as attractive transportation options. Projects, or engineering, represent the most visible and perhaps most tangible evidence of a great place for bicycling. The same can be said for walking. A new bicycle facility attracts attention of cyclists and non-cyclists alike. As such, it represents a great opportunity to reach out to the "interested, but concerned" within the neighborhood. The effect on this target group will be strongest by directly linking facility improvements and supportive programs. In this way, bundling bicycle programs with projects represents a much higher return on investment for both.

Recommended programs are organized as a menu of initiatives, each listed under a broad category—

1. Education/encouragement/marketing.
2. Education/enforcement.
3. Monitoring and evaluation.

8.3.2 Education/Encouragement/Marketing

Smart Trips Program Bundle

Smart Trips is a generic name for community-based transportation demand management (TDM) programs that provide tools and incentives to make cycling (and often, walking, ridesharing, and transit) the preferred mode for particular trips. Traditionally, TDM programs are implemented as employer-based programs targeting the commute trip. Smart Trips are intended to complement efforts aimed at commuting behavior by targeting other household trips. Implementation of a variety of initiatives, leveraged as part of a Smart Trips program and delivered as a "bundle," has been important to the success of Smart Trips programs in other cities. The bundled delivery of Smart Trips initiatives (initiatives a through e, described in the following sections) allows for the saturation of a target audience within a target neighborhood and has been instrumental in maximizing limited outreach dollars.

Street Smarts Classes and Bicycle Ambassador Programs

This initiative promotes safe bicycling through community-based outreach, which helps bridge the gap between people who want to start riding and the availability of opportunities to help people learn to bike safely. Ideally, safety would be taught through bike safety courses delivered at a cycling education center (described subsequently) and on city streets, as appropriate.

Bicycle Friendly Businesses and Districts

Cities can promote the League of American Bicyclists' (LAB) Bicycle Friendly Business program among local businesses to encourage cycling by their employees and customers. Businesses then use their bike friendliness as part of marketing. Bicycle Friendly Business Districts combine the efforts of individual businesses to offer a more supportive and coherent cycling environment.

Community Bike Programs

Community bike programs, also known as bike kitchens, are commonly formed as grassroots initiatives by community members within low-income and underserved communities to provide bicycles, helmets, maintenance, and safety instruction to people as a means of expanding their transportation options and providing people better access to work and services.

Events—Bike Month

Proclaim May as Bike Month, and participate in Bike to Work Week events. Host pit stops during Bike to Work Weeks and Days. To increase encouragement, host Bike to Work days more often, such as monthly. Promote Bike Month or monthly Bike to Work days heavily within Smart Trips target areas and among target populations.

Safety should be in front of other efforts when making our communities bikeable and walkable. Photo source: BlueZone

Safe Routes to School Program

Successful Safe Routes to School (SRTS) programs not only provide encouragement and support for walking and cycling but address legitimate safety concerns of many parents. SRTS programs tackle safety issues through education and infrastructure improvements. Wherever possible, SRTS efforts should be integrated into the larger processes of planning and project implementation. Best practices in SRTS education programs combine more traditional print media and classroom tactics with experiential courses and clinics.[2] Ideally, SRTS programs could partner with a traffic garden (discussed subsequently) to offer more comprehensive traffic safety education, teaching children the fundamental rules and responsibilities of all modes.

SRTS efforts for infrastructure improvement are unique in their incorporation of youth perspectives. Youth are encouraged to participate at all phases and even to serve as a Safe Routes to School liaisons. Funding may be available through additional Safe Routes to School grants, available at both the federal and state level. This funding can be used for a variety of activities, including site-specific evaluation and planning, infrastructure costs, and education programs. Assistance with funding applications and program facilitation is available from local nonprofits. More information can be found at http://www.saferoutesinfo.org.

Promote the Walking School Bus[3] and Bicycle Train

These are volunteer-based programs in which children are chaperoned by adults as they walk or bike to school. Parents often cite safety issues as one of the primary reasons they are reluctant to allow their children to walk or ride a bike to school. Providing adult supervision may help reduce those worries for families who live within walking or bicycling distance to school. These programs and volunteer efforts require coordination and potential attention to other issues, such as safety training and liability.

Participate in Walk and Bike to School Day

This one-day event in October is an international effort in more than 40 countries to celebrate the many benefits of safely walking and bicycling to school. Walking and rolling to school embodies the two main goals of First Lady Michelle Obama's Let's Move! campaign: to increase the physical activity of kids and to empower parents to make these kinds of healthy choices. The National Center for Safe Routes to School, which serves as the clearinghouse for the federal Safe Routes to School (SRTS) program, coordinates on-line registration efforts and provides technical support and resources for Walk to School Day. For more information, go to www.walktoschool.org.

Cycling/Pedestrian Education Center

A cycling/pedestrian education center would serve as a clearinghouse for cyclist and pedestrian educational materials—electronic and printed—and host a variety of courses. Course material would be bike and pedestrian specific and, in the case of the traffic garden (described in the next section), cover general mobility.

Build and Operate a Traffic Garden

Traffic gardens are mini-streetscapes where elementary-age children operate pedal-powered vehicles. The goal is to teach them how to be responsible roadway users. They have been a fixture in European cities for decades and, by some accounts, exist in several U.S. cities as "Safety Towns." Traffic gardens are likely the most powerful educational tool because they are experiential and they require participants to experience the roadway through all modes. Education efforts aimed at understanding the "other" modes would be far less necessary if everyone used each mode from time to time. Barring this reality, traffic gardens offer a great simulation. The 2009 International Scan Team, a federally sponsored delegation of pedestrian and bicycle professionals, was so impressed with traffic gardens that they included traffic gardens in their official policy recommendations.

Walk and Bike to school days can teach mobility options and safety at a young age. Photo source: BlueZone

Building Awareness of Cycling as a Safe and Common Mobility Option Through Marketing Campaigns

Marketing is about more than advertising; communication and promotion play important roles. For people to see bicycling as a desirable mode choice and pay attention to safety, they need to be engaged through effective marketing. More-engaged people will have a twofold effect—

- It will lead to more people riding bikes.
- It will lead to more-aware bicyclists, drivers, and pedestrians and to more people who care about bike safety.[4]

Typical marketing campaigns, especially those initiated by government agencies, tend to be information laden and uninspiring. Lessons from the field of marketing point to the proven effectiveness of positive messages.[5] Positive messages will inspire people and get more of them to ride. The objective is not to get everybody to ride bicycles all of the time but rather to target those who are most ready to change. Messages should inspire people to move from "might" to "sometimes" and from "sometimes" to "often."

Host an Open Streets Event

Open Streets events are celebrations of livable streets and communities, encouraging citizens and businesses to get out in the street and enjoy their city through active participation. In Open Streets events, the street is closed to automobiles for use by people and non-motorized transportation. Bogotá, Colombia, often is credited with starting Open Streets events (called Ciclovías there), but they have gained considerable popularity in the United States in the past 5 years. For more information on Open Streets events, visit http://openstreetsproject.org/.

8.3.3 Education and Enforcement

Designate a Police Department Liaison Responsible for Cycling and Pedestrian Issues

This liaison would perform the important function of communication between the law enforcement agency and the community. The liaison would be in charge of the supplemental education of fellow officers regarding pedestrian and bicycling rules, etiquette, and behavior. The liaison could be the same person as the referee for the traffic garden.

Targeted Enforcement

Targeted enforcement at locations of demonstrated bicycle and pedestrian issues is an effective way to expand motorist, cyclist, and pedestrian education. Targeted enforcement may be expanded to warn and educate those stopped about laws, rules of the road, and safety procedures. This could be in the form of a brochure or tip card explaining each user's rights and responsibilities.

8.3.4 Monitoring and Evaluation

Create a City Staff Bicycle/Pedestrian Coordinator Position

The creation of a bicycle/pedestrian coordinator position[6] would demonstrate commitment to walking, cycling, and creating more complete streets. The position of a coordinator or program manager can help coordinate between different city departments to ensure consistency and cooperation in planning projects. A coordinator would manage programs and implement projects listed in city plans.

Support a Bicycle/Pedestrian Advisory Committee

A bicycle/pedestrian advisory committee (BPAC) assists cities with the implementation of plans, projects, policies, and programs. A BPAC allows city staff, volunteers, and bicycle advocates to continue efforts to improve cycling throughout their city. This group acts as a community liaison and addresses issues concerning local cycling. The BPAC can review the implementation and regularly evaluate the progress of adopted master plans. City support for creating the committee and for budgeting time and resources for city staff and elected officials to attend and support these meetings is recommended.

Conduct Cyclist and Pedestrian Counts and Review Collision Data

Conduct regular cyclist and pedestrian counts to determine baseline mode share and subsequent changes. This assists in prioritizing and justifying projects when funding is solicited and received. Counts can also be used to study cycling and walking trends. Counts should be conducted at the same locations and at the same times every year. Conducting counts during different seasons within the year may be beneficial to understanding the differences in bike and pedestrian traffic volume based on weather. Results of the number of cyclists should be regularly recorded for inclusion in the bicycle report card.

Establish a Process for Referrals to Law Enforcement

Design a communication process that encourages students and parents to notify schools and police of the occurrence of a crash or near miss during school commute trips involving auto, bus, pedestrian, or bicycle transportation. Include in this reporting system not only the police department but also the traffic safety commission, the planning department, and SRTS stakeholders to help better use the data generated.

Develop a Bicycle/Pedestrian Report Card

Develop a bicycle/pedestrian report card, a checklist used to measure the success of plan implementation as well as any effort made. The report card could be used to identify the magnitude of accomplishments in the previous year and general trends. The bicycle/pedestrian report card could include, but not be limited to, the following categories—

- System completion.
- Travel by bicycle or on foot (counts).
- Safety.

The report card could be developed to utilize information collected as part of annual and ongoing evaluations, as discussed in the previous sections. The report card is not intended to be an additional task for city staff but rather a means of documenting and publicizing[7] efforts related to bicycle and pedestrian planning. If a bicycle/pedestrian advisory committee is appointed, it can be a task of the committee to review the report cards and adjust future plans and goals accordingly.

Traffic garden. Photo source: Alison Moss

8.4 HUD SUPPORT: COMMUNITY DEVELOPMENT BLOCK GRANT PROGRAM (CDBG)

One way in which communities may implement the tools presented in this guide is to take advantage of HUD's existing support for creating walkable and bikeable communities through its Community Development Block Grant (CDBG) program. Although decisions on how to spend CDBG resources are entirely local, this program is often used to fund infrastructure: typically, state recipients spend upwards of 50 percent of their CDBG allocation, and local entitlement jurisdictions spend around 10 percent, on infrastructure. HUD would like to actively support infrastructure expenditures with this guide, which can a serve as a resource for community leaders—and other document users—to better understand not only best practices in bicycle and pedestrian infrastructure but also the street network and land use contexts needed to support them.

State and local governments can further support walkable and bikeable communities by adjusting their funding award process or infrastructure budgeting process funds to include any or all of the guidelines found within this document. For example, a state or local government that uses a competitive process could incorporate bonus points based on the design guideline numbering system found in this document, which would reward an applicant for incorporating such design features into its proposed project.

8.5 RESOURCES: IMPORTANT RESOURCES TO CONSIDER

There are significant resources available through Internet research that will provide more current discussions on policies, standards, and best practices. These resources should be reviewed prior to making any decisions on planning, design, or engineering. The foundational documents listed in chapter 1 should always be referenced first. Then, the references and research in appendix B should be consulted early. Finally, local documents and policies will always take precedence over the suggestions made in this document and should be thoroughly reviewed and integrated into any efforts toward making local communities more bikeable and walkable.

Apply for Bicycle Friendly Community/ Neighborhood Designation

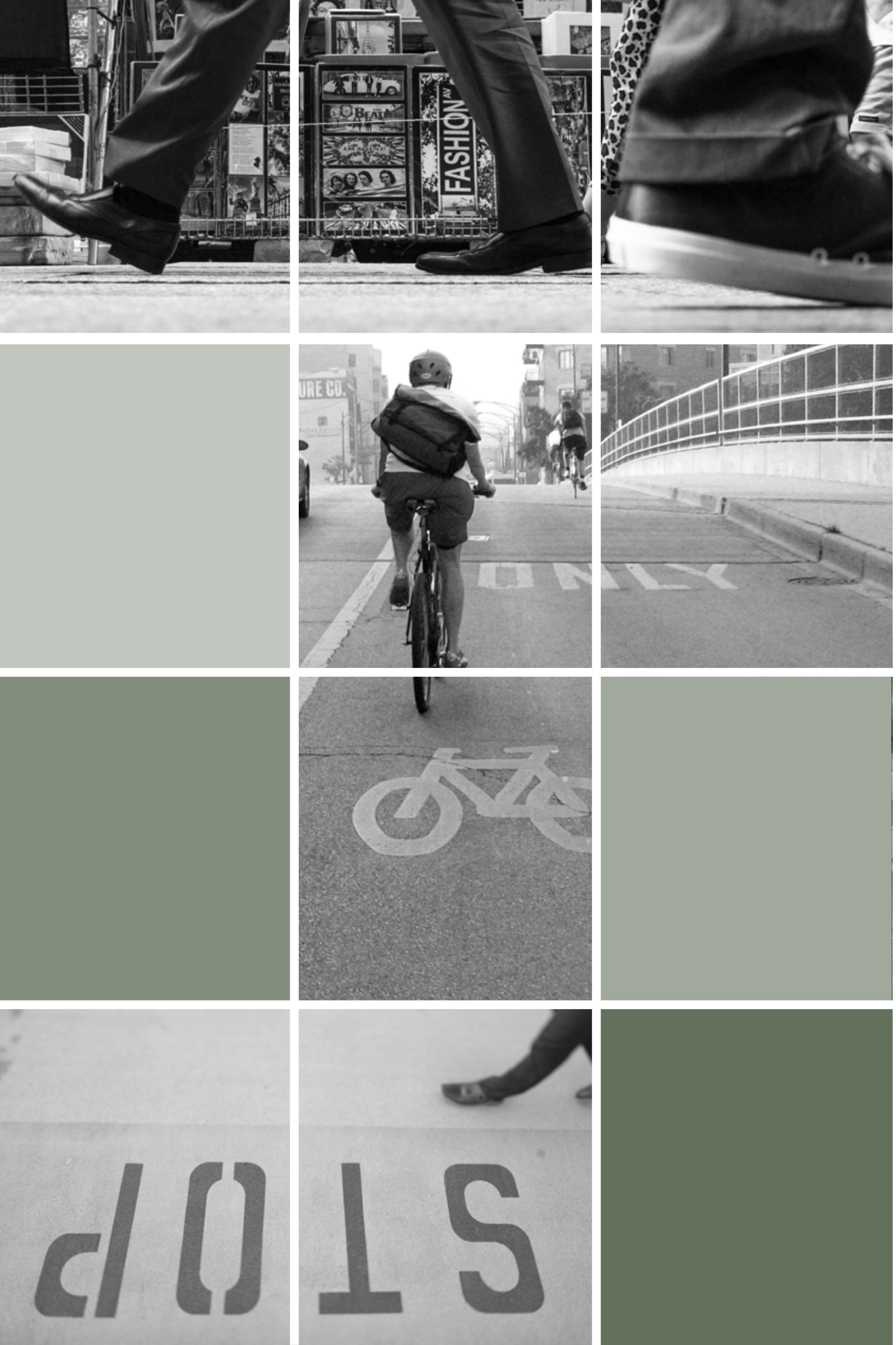
Bicycle Friendly Community/Neighborhood designation is part of an official program offered by the League of American Bicyclists (LAB) intended to provide communities with guidance on becoming more bicycle friendly and offer recognition for their achievements. Like the report card described previously, applying for Bicycle Friendly Community/ Neighborhood designation provides a standard by which cities may measure their progress.

From the LAB website—

"The Bicycle Friendly Community (BFC) program provides a roadmap to improve conditions for bicycling and the guidance to make your distinct vision for a better, bikeable community a reality. A community recognized by the League as Bicycle Friendly welcomes bicyclists by providing safe accommodation."

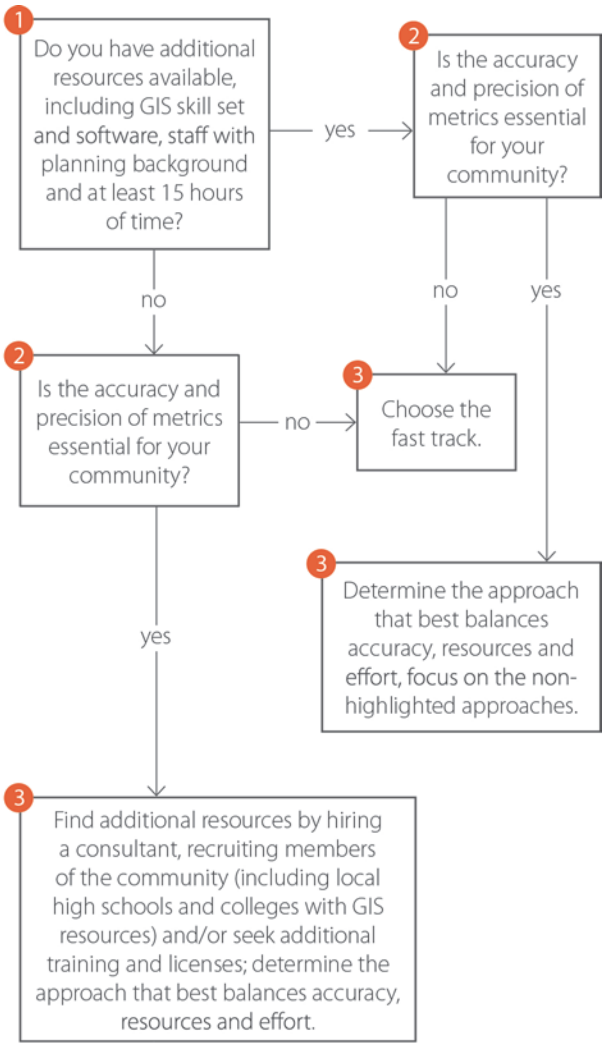
NOTES:

1. Potts, Ingrid, Douglas Harwood, and Karen Richard. 2007. "Relationship of Lane Width to Safety for Urban and Suburban Arterials."
2. The Alameda County SRTS program offers the following array of education and safety programs: Educator Guides, Skills Drills Bicycle Safety Course, Bicycle Clinics, Bicycle Safety Certification Program, and Bikemobile, a mobile repair clinic.
3. www.walkingschoolbus.org.
4. http://bikepgh.org/care/.
5. Bikes Belong Foundation Safety Campaign Best Practices Report: www.bikesbelong.org
6. http://www.bikeleague.org/resources/reports.
7. The City of San Francisco publishes its bicycle report cards on-line: http://www.sfbike.org/?report card.



CHAPTER 9: COMMUNITY SELF-ASSESSMENT TOOL

Figure 9-1: Flow Chart - Which Approach Works Best?



This chapter presents a Community Self-Assessment Tool that allows communities with varying levels of resources and expertise to assess their bikeability and walkability. A thorough assessment of walking and biking conditions provides an understanding of what is and is not working well to support a walkable and bikeable community. Aspects that are working well can be monitored to ensure that they continue to support walking and biking, and aspects that are lacking can be targeted for investment and improvement. A detailed example of the Self-Assessment Tool can be found in Appendix A.

The chapter begins with an overview of how to use the Self-Assessment Tool, including pre- and post-evaluation considerations, guidance on selecting analysis zones, and a brief listing of the self-assessment metrics and additional indicators for measuring and tracking walkability and bikeability. The next sections, Assessment Metrics: Measuring Your Current or Future Successes and Approach: Description of Metrics To Use, provide more detailed descriptions of the metrics and the approach options for measuring them, each followed by the approach methodologies. Finally, the Other Indicator: Supplements to the Self-Assessment Metrics section describes more walkability and bikeability measures that communities can track over time.

Because walkability and bikeability evaluation is important for communities of all sizes and with all levels of resources, this chapter provides multiple approaches to each metric. All approaches address the same underlying concept, but each requires a different level of resources and effort and results in a different level of measurement accuracy (table 9-1).

The lowest-effort approach for each metric, called the fast-track approach, is highlighted throughout this document and described in detail, with a workbook to guide completion. The workbook provides detailed instructions on how to complete the fast-track approach for each metric.

This fast-track approach is intended for communities with limited resources, including software, staff time, and planning-related skills. This approach is denoted throughout the document. The tradeoff of this approach, however, is a lower level of accuracy.

If your community has the resources, time, and skill available, the alternative approaches will provide a greater level of accuracy. Detailed instructions for the more resource-intensive approaches can be found in appendix A. Use the flowchart to help guide the decision of what approach to use for each metric.

9.1 ASSESSMENT TOOLS: HOW TO USE THEM FOR YOUR COMMUNITY

This tool allows communities to evaluate their own walkability and bikeability by dividing their community into appropriate subareas, or analysis zones, calculating individual scores for various metrics, and then weighting and summing all metrics to determine an overall Community Self-Assessment Score. The tool also includes “Additional Indicators” that do not directly factor into the Community Self-Assessment Score but can be tracked over time to indicate progress toward a more walkable and bikeable community.

9.1.1 Preparation

To fill out this self-assessment, it is important to have an adequate understanding of the time and resources that will be required (table 9-2). The fast-track approach is expected to take about 8 hours. It is possible for one individual to complete the fast-track approach; however, collaborating and crowdsourcing responses are encouraged. This collaboration helps create a dialogue on important community wide issues. Completing the assessment as a group also increases accuracy by bringing together various people's experiences and skills. Metrics that are suitable for crowdsourcing are identified throughout this chapter.

The self-assessment should be led by an individual who is invested in the bicycle or pedestrian quality of the community, such as a planner, intern, other city staff member, political leader, or active transportation advocate. Although one individual can feasibly complete the approach alone, it is recommended that the lead for the self-assessment seek the input of additional members of the community. This additional input can come from individuals currently involved in the field, but it may also come from those familiar with the community, including religious groups, neighborhood associations, and large employers. The remainder of this chapter will refer to this individual or group as the "self-assessment team."

The only resources required for completing the designated fast-track approaches are a computer with Internet and Google Earth. Google Earth can be downloaded for free at earth.google.com/download-earth.html.

9.1.2 Accompanying Documents

In addition to this chapter, the following two components will help your community complete this self-assessment—

Appendix A contains detailed instructions for all of the approaches for each metric.

The Excel Worksheet allows you to enter the chosen weights, approaches, and scores for each analysis zone. The instruction tab will guide the self-assessment team in how to use this worksheet. The summary tab will autofill, based on your input scores, for each zone and summarize the results. This file is available as a separate downloadable Excel worksheet.

9.1.3 Walk- and Bicycle-Friendly Community Designations

This self-assessment is a complement of two national designation programs: the League of American Bicyclists' Bicycle Friendly Community (BFC) and the Pedestrian and Bicycle Information Center's Walk Friendly Community (WFC). Both of these programs have an extensive application that is reviewed by a panel of experts who designate communities as honorable mention, bronze, silver, gold, or platinum (and diamond for BFC) ranking based on their level of walk- or bike-friendliness. Awards are also accompanied by feedback to help guide communities to reach the next ranking. Communities with a desire to seek national recognition for their accomplishments in creating a more walk- and bike-friendly community may choose to apply for these designations.

Figure 9-2: Metric Designations

This speech self-assessment can help communities with their application to these two programs. Metrics that directly correspond to each of these designations are identified throughout the document. The work done for these metrics can be used for your BFC or WFC application as well.

The BFC and WFC programs cover all five Es of biking and walking—engineering, education, encouragement, enforcement, and evaluation. This assessment is based solely on the engineering component of your community. This focus helps communities evaluate and improve the design of facilities and land uses.

9.1.4 Establish Analysis Zones

Communities applying the tool should consider their neighborhood's size and characteristics to decide whether it is appropriate to divide the community into small analysis zones. The tool will then be applied to each analysis zone separately. Analysis zones will be determined by areas of the community that have similar characteristics based on local knowledge of factors such as street grid, land use, and urban form. Street typologies and vehicular speeds and volumes can also be used to draw boundaries between subareas, distinguishing between residential, commercial, and other land uses.

There is no predefined size for an analysis zone. It will vary greatly depending on the street grid, distribution of land uses, and size of the community. In the example of analysis zones for the Town of Carrboro, North Carolina, the street grid and land uses help guide the creation of analysis zones. Analysis zones can vary in shape, and their size can range from a couple of blocks to 1 mile wide (figure 9-1).

Figure 9-3: Analysis Zone Example: Carrboro, NC

9.1.5 Pre- and Post-Evaluation

Conducting an assessment before implementing any of the guidance described in this document provides a baseline for comparison. This comparison allows community members, staff, and political leaders to track the progress of their community and help guide it to be more walk- and bike-friendly. Once steps have been taken to improve the walking and biking environment, a post-evaluation should be conducted to measure the effect of the effort. For factors that may vary under different conditions, the post-evaluation should be conducted under conditions as comparable as possible to those during the pre-evaluation. Bicycle and pedestrian counts are the metric under Additional Indicators that will be most affected by the variation in factors. The following factors can be used to minimize variation:

- **Duration**—Determine the length of time that the metric or indicator is measured.
- **Day of week**—Tuesdays, Wednesdays, and Thursdays are most representative of typical weekday conditions.
- **Season**—Measure during the school year, avoiding school holidays. If possible, coordinate with the National Bicycle and Pedestrian Documentation Project count dates in May and September each year.[1]
- **Weather**—Avoid unusual weather conditions, like rain, snow, and heat waves.
- **Special events**—Avoid parades, holidays, and other special circumstances.

The same approach should be used for both pre- and post-evaluation, even if resources become available for a more "accurate" approach during post-evaluation than during pre-evaluation. This will help to ensure comparable results.

9.2 ASSESSMENT METRICS: MEASURING YOUR CURRENT OR FUTURE SUCCESSES

The following list, along with table 9-3, provides nine metrics that can be used to measure walkability and bikeability—

1) Diversity of land uses within a 5-minute walk (0.25 mile).
2) Number of jobs within 15 minutes (0.75-mile walk/3-mile bike).
3) Percentage of arterial and commercial collector roadways with a low level of traffic stress.
4) Percentage of residents and workers within 0.25 mile of a high-quality[2] bike facility.
5) Street network.
6) Site access and parking typology.
7) Percent of streets with sidewalks.
8) Percent of corners with curb ramps.
9) Distance between marked crossings.

9.2.1 Approaches to Measuring the Metrics

Data and analysis for each metric can be collected and assessed in a number of ways. The various approaches for each metric are organized in table 9-3 from lowest to highest complexity based on effort and resources. Although these are qualitative variables, a scale of 1 to 3 was applied to each to denote the relative effort, resources, or importance. Effort is a qualitative measure of the amount of staff time required to collect any necessary data and execute the analysis in order to measure the metric. Resources describe a qualitative measure of any special skills, tools, or software licenses required to complete the analysis. The score corresponding to accuracy represents how well that approach captures the appropriate value of the metric for the community.

The final weight column indicates the importance of each metric by assigning a weight that will be used to compute an aggregate self-assessment score as part of the tool. Although suggested weighting values are provided in the table, each community should consider the relative importance of the metrics listed in achieving its own goals and weight them accordingly. Based on the community's assessment of its own resources and values, it will select an appropriate level of effort and other resources to apply to computing each metric value.

9.2.2 Application

The self-assessment tool is applied by calculating the value of each metric and multiplying the result by its respective weight to account for the importance of that metric. The weighted scores from each metric are then summed to derive an overall score for the community. This score is then interpreted based on the provided legend. The tool presents results in a graphic format that conveys to the community the relative importance of each factor, suggesting opportunities for the most improvement with the least effort. The level of accuracy of the data collection and analysis approach chosen for each metric should also be considered when interpreting the results.

9.2.3 Additional Indicators

This chapter also offers optional, supplemental metrics to these nine metrics. These additional metrics are not essential and are less-directly correlated to walkability and bikeability. They are often easier to measure or collect, however, and provide even more metrics to track the walkability and bikeability of your community. Additional metrics are divided into two categories: (1) outcome metrics that can be quantitatively tracked over time; and (2) actions and initiatives that are more qualitative. See the following section for descriptions of both outcome- and action/initiative-oriented metrics.

9.3 APPROACH: DESCRIPTION OF METRICS TO USE

This section provides information about each metric, along with descriptions of the alternative approaches to applying each metric. Communities interested in conducting a walkability and bikeability self-assessment should—

1) Review the range of metrics and approaches described.
2) Select the weight to be applied to each metric based on these guidelines and the community's goals and values. A metric can be assigned a weight of "0" if it does not reflect community goals and values.
3) Select an approach for each metric that is appropriate to the effort and resources the community can invest in evaluation. Consider the fast-track approach, highlighted in yellow, if resources are limited and you are aware of the limitations of accuracy. A metric can be assigned a weight of "0" if an appropriate approach cannot be identified.
4) Apply the selected evaluation approaches, and enter results in the worksheet in appendix A to compute an overall Community Self-Assessment Score.
5) Supplement the Community Self-Assessment Score with Additional Indicators as interest and resources allow.

Less-complex approaches are described in detail within this chapter, whereas more complex approaches with established documentation reference other publicly available resources.

Table 9-1: Self-Assessment Metrics and Approaches

METRICS	APPROACHES	DESIGNATION	EFFORT REQUIRED	RESOURCES REQUIRED	LEVEL OF ACCURACY	WEIGHT
1) LAND USE DIVERSITY	Images of Typical Street		1	1	1	1.2
	Images of Land Use Map		1	1	2	
	Fieldwork		3	2	2	
	Walk Score®		1	1	2	
	Entropy Score		3	2	2	
	GIS Analysis		2	3	3	
2) NUMBER OF JOBS WITHIN 15 MINUTES (WALK/BIKE)	LEHD OnTheMap		2	2	2	0.8
	GIS analysis		2	3	2	
3) LOW-STRESS ROADWAYS	Images of Typical Street		1	1	1	1.2
	Simplified LTS Table		2	2	2	
	LTS Tables		2	1	3	
4) PERCENTAGE OF RESIDENTS AND WORKERS NEAR HIGH-QUALITY BIKE FACILITY	Miles of Bike Facilities per Capita		2	1	1	1.0
	LEHD OnTheMap		2	1	2	
	GIS Analysis		2	3	3	

METRICS	APPROACHES	DESIGNATION	EFFORT REQUIRED	RESOURCES REQUIRED	LEVEL OF ACCURACY	WEIGHT
5) STREET NETWORK	Images of Street Network Grids		1	1	1	1.2
	Manual Count from Google Earth		2	1	3	
	GIS Analysis		2	3	3	
6) SITE ACCESS AND PARKING TYPOLOGY	Images of Typical Shopping Area		1	1	1	0.8
7) PERCENT OF STREETS WITH SIDEWALKS	Local Knowledge Estimate		1	1	1	1.0
	Google Earth Aerial Imagery Review		2	1	2	
	Google Earth Street View Review		2	1	2	
	Field Inventory		2	2	3	
8) PERCENT OF CORNERS WITH CURB RAMPS	Local Knowledge Estimate		1	1	1	0.8
	Google Earth Desktop Inventory		2	1	2	
	Field Inventory		2	2	3	
9) DISTANCE BETWEEN MARKED CROSSINGS	Google Earth Measurement		2	1	3	1.0
	Field Measurement		2	1	3	

9.3.1 Metric 1: Land Use Diversity

Land use diversity measures the variety of destinations within a particular area (i.e. analysis zone). With an increase in the variety of land use options within a short walk, residents are more likely to make shorter, more frequent trips for goods and services, and these trips are less likely to be made by car. Mixed-use areas have been shown to have a statistically significant correlation with higher levels of walking.[3] A 5-minute walk equates to about a 0.25-mile buffer, a distance that someone is likely to walk instead of drive.

The fast-track approach for this metric is to use Walk Score®. If Walk Score® does not exist for your community, however, Approach 1 is recommended as a fast-track approach.

Approach 1: Images of a Typical Street

Using local knowledge, the self-assessment team reviews a spectrum of five street images and selects the image that most accurately depicts a representative street for their community's analysis zones.

Approach 2: Images of a Land Use Map

Using locally available land use or zoning maps and local knowledge, the self-assessment team reviews a spectrum of five land use maps and selects the one that most appropriately matches the land use mix in their community.

Approach 3: Fieldwork

The self-assessment team uses guidelines to select multiple locations for analysis and then conducts a field survey, counting the number of different services within a 5-minute walk of each location to develop a representative value for the analysis area.

Approach 4: Walk Score®

This approach uses Walk Score® values to assess the land use diversity of each analysis zone. The Walk Score® analysis uses land use categories and applies a detailed algorithm to assign different scores to destinations based on how far they are from the analyzed address. The resulting score ranges from 0 ("Car-Dependent") to 100 ("Walker's Paradise").

The self-assessment team uses guidelines to select multiple locations for analysis and then uses www.walkscore.com to look up each location's Walk Score® value.

Approach 5: Entropy Score

This is a formula used to measure land use diversity that ranges from 0 to 1, calculated from employment-related land use data. The score will equal 1 when land use is most heterogeneous and 0 when most homogeneous.

Approach 6: GIS Analysis

A Geographic Information System (GIS) spatial analysis will allow the self-assessment team in the community to use the land use shape file within a certain buffer area to calculate the variation of land use types based on the entropy formula.

HOW TO IMPROVE LAND USE DIVERSITY

See chapter 4 to learn more about how to incorporate a mixture of land uses within your community. Section 5.4 on Health, Land Use, and Mobility and section 5.5 on Implementation provide more specific guidance on creating a land use that encourages biking and walking. This includes recommendations to provide access to grocery stores, opportunities for open streets events, land uses that attract a mix of generations, and effective use of public space. Implementation strategies for these recommendations include improving zoning standards, creating community-based vision plans, integrating land use and transportation in the planning process, and promoting infill development.

9.3.2 Metric 2: Number of Jobs Within 15 Minutes

A higher density of jobs increases the likelihood that residents will be able to have a job within a walkable/bikeable distance from their home. This metric equates to a radius of 0.8 mile or 2.5 miles for walking and biking, respectively. A 15-minute buffer was chosen based on an average of the walking and biking journey-to-work times, as reported by American Community Survey 2009–2012 Summary Reports—11.5 minutes and 19.3 minutes for walk and bike trips, respectively.[4]

Approach 1: LEHD OnTheMap

The Longitudinal Employer-Household Dynamics (LEHD) data source, available from the U.S. Census Bureau, provides estimates of employers and employees coded at the census block level. By applying the 0.8-mile and 2.5-mile buffers for walking and biking using the freely available web-based tool called On The Map, determine the number of jobs within those buffers.

Approach 2: GIS Analysis

Use the network buffer tool to determine the census blocks that are within the determined 0.8- and 2.5-mile buffers of the subarea. Import LEHD data, and join these data with the predetermined census blocks. Use the statistics tool to view the total number of jobs within these census blocks.

HOW TO IMPROVE NUMBER OF JOBS WITHIN 15 MINUTES

The approach to improving job density is similar to those recommended under Metric 1: Land Use Diversity which references chapter 5. In addition, there should be a specific focus on the location of large employers and on distributing jobs throughout the community, mixed with other land uses.

9.3.3 Metric 3: Percentage of Low-Stress Roadways

For bicycling to attract a high percentage of the population, with a focus on the "interested but concerned" bicyclists, it is important to create a low-stress, comfortable bicycling environment.[5] The Mineta Transportation Institute developed a mechanism to quantify the Level of Traffic Stress (LTS) of roadways that corresponds to the type of users willing to use them.[6] LTS 1 describes a roadway that most children can tolerate. LTS 2 will be tolerated by the mainstream adult population. LTS 3 is tolerated by the "enthused but confident" cyclists who have a higher threshold but still prefer a dedicated facility. LTS 4 is tolerated only by the "strong and fearless" cyclists. Because local residential streets tend to have low levels of traffic stress, the greater the percentage of arterial and commercial collector streets that have a low LTS, the more connected a network is and the greater the number of destinations comfortably accessible for the majority of the population to reach by bike. The approaches described in the following sections all approximate LTS for arterial and commercial collector streets within the analysis zone and score based on the percent of those roadways that achieve LTS 1 or 2. Although neighborhood streets tend to be lower stress, crossings of larger collector and arterial streets can still present significant barriers for some bicyclists. For additional reading on Level of Traffic Stress, see http://www.northeastern.edu/peter.furth/criteria-for-level-of-traffic-stress/.

Approach 1: Images of Typical Street

The self-assessment team reviews images of four streets that represent each LTS. The self-assessment team will then determine which image best represents the character of the arterial and commercial collector streets in the subarea.

Approach 2: Simplified LTS Table

Use a simplified decision table to approximate the LTS for arterial and commercial collector streets in the analysis zone. Answer questions about the type of bike infrastructure available, the speed of the roadway, and the number of lanes per direction to determine an approximate LTS score.

Approach 3: LTS Tables

Use the six tables provided in an LTS summary document to determine the LTS for each arterial and commercial collector roadway in the analysis zone. Consider the LTS for each segment, as well as each intersection crossing.

HOW TO IMPROVE THE PERCENTAGE OF LOW-STRESS ROADWAYS

Refer to chapter 6 on Bikeway Planning and Design for recommendations for improving the comfort of your community's streets for bicyclists. Section 6.3 comprehensively discusses each type of bike facility, when it is best applied, and how to effectively design it. By appropriately implementing a bicycle facility type that is appropriate for the number of lanes, speed, and volume of a roadway, all levels of bicycle users can feel safe.

9.3.4 Metric 4: Percentage of Residents and Workers Near Bicycle Facilities

It is important for a complete community to have high-quality biking facilities within close proximity (defined for this analysis as 0.25 miles or less) to all residents. Residents are more likely to choose to bike if they are able to access a designated, high-quality facility within a 3-minute bike ride from their home. For this analysis, a high-quality bike facility is defined as one with an LTS of 2 or better.

Approach 1: Miles of Bike Facilities per Capita Calculation

Determining the number of miles of high-quality bike facilities per square mile does not directly address the percentage of residents and workers near high-quality facilities, but it is an acceptable proxy for this metric. Divide the miles of on- and off-street facilities (LTS 2 or better) in the analysis area by the area of the analysis zone in square miles. If the number of trails and bike lanes is not already known, use Google Earth or conduct field measurements to determine the mileage.

Approach 2: LEHD OnTheMap

The LEHD data source, available from the U.S. Census Bureau, provides estimates of employers and employees coded at the census block level. By applying the 1- and 3-mile buffers for walking and biking using the freely available web-based tool OnTheMap, determine the number of jobs within those buffers.

Approach 3: GIS Analysis

In GIS, map the high-quality bicycle facilities in the community. Use the buffer tool to create a layer of 0.25 mile buffer around each of these facilities. Bring in census data for population density at the census block level. Determine the number of residents in the buffer previously created by selecting tracts within the buffer and using the statistics tool.

HOW TO IMPROVE THE PERCENTAGE OF RESIDENTS AND WORKERS NEAR BICYCLE FACILITIES

The first three sections of chapter 6 identify strategies to determine how to create an effective bicycle network that is well connected and comprehensive. Ensuring that a low-stress bicycle facility is provided within close proximity of all residences and employers requires an extensive network that takes advantage of opportunities for implementation. A priority focus should be on implementing a low-stress bicycle facility within close proximity to high-density residences and employers.

9.3.5 Metric 5: Street Network

This metric is positively correlated to smaller block sizes and greater connectivity, which are indicators of walkability and bikeability. A greater density of intersections decreases walking distance between destinations and allows for a greater number of route options for pedestrians and bicyclists. It also translates to opportunities for pedestrians or bicyclists to choose a route on a lower-volume or lower-speed road. A study by Robert Cervero and Reid Ewing found that intersection density has a larger effect on walking than land use density or diversity.[7]

Approach 1: Images of Street Network Grids

Using local knowledge, the self-assessment team reviews five images that represent a spectrum of street grid networks and selects the image that most accurately depicts the street grid for their community's analysis zone.

Approach 2: Manual Count Through Google Earth

Use Google Earth aerial imagery to count the number of intersections within the study area. Measure the area of the study area. Divide the number of intersections in the study area by the area of the study area in square miles to find the average number of intersections per square mile in the analysis zone.

Approach 3: GIS Analysis

Use GIS analysis tools to determine the number of intersections within the analysis zone by creating an intersection shape file from the streets shape file, and divide by the square mileage of the analysis area.

HOW TO IMPROVE THE NUMBER OF INTERSECTIONS PER SQUARE MILE

Section 6.2, Essential Principles of Active Transportation Street Networks, and section 6.3, Street Network Characteristics describe ways to increase the number of intersections per square mile. Establishing a block size maximum of 1,600 feet means more intersections that allow for more route choices and increased connectivity. Larger blocks can also be retrofitted with alleys and bicycle and pedestrian connections, such as paseos and promenades. Discouraging one-way streets, gated streets, cul-de-sacs, widening of streets, and limited-access streets also helps create a dense street grid accessible to all users. Block length requirements, zoning, and connectivity within housing developments are also all within the control of the jurisdiction and can improve intersection density.

9.3.6 Metric 6: Site Access and Parking Typology

Commercial, retail, and office site plan design, particularly regarding how parking is incorporated, is an important indicator of walkability and bikeability. Locating building entrances close to the street network and its bicycle/pedestrian facilities provides more convenient and safer access for pedestrians. On the other hand, frontage parking lots provide an additional distance and barrier, and are high-conflict areas for bicyclists and pedestrians. A large amount of vehicle parking that is readily accessible, visible, and not priced can artificially alter mode splits by discouraging biking and walking and encouraging driving. In addition to the design of parking, parking policy can influence the supply and use of parking. Parking policies include shared parking, parking pricing, parking maximums instead of minimums, allowance to replace car parking requirements with bike parking, and altering parking requirements by overlay districts.

Refer to chapter 4, Land Use & Mobility Integration, for further guidance on parking design, placement, and policy.

Approach 1: Images of Typical Shopping Area

Review a spectrum of five site and parking typology images, and select the image that most accurately depicts a representative commercial, retail, or office center for the community's analysis zone. Then assign the analysis zone a score from 0, meaning vast areas of parking all located between the street's pedestrian facilities and shopping entrance, to 100, meaning that there is no parking located on site.

HOW TO IMPROVE SITE ACCESS AND PARKING

There are numerous policy and urban design techniques that can help make site access and parking more walk and bike friendly. These include—

1. Ensuring that building setback makes sites accessible from pedestrian facilities.
2. Creating parking maximums rather than minimums that consider context, land use, and transit proximity.
3. Proposing shared parking for land uses with offset peak uses.
4. Utilizing on street parking rather than off-street parking to serve as a buffer from moving vehicles for pedestrians.
5. Integrating parking into site design rather than simply placing frontage parking lots between the street and building.
6. Promoting district parking strategies; promoting parking in the rear of buildings or underground.
7. Providing ground floor retail for above-grade parking to activate the pedestrian space.

Section 5.2.6, Access Management and section 5.2, Street and Paired Land Use Environment Types, further describe how to create parking lot designs and layouts that are conducive to biking and walking.

9.3.7 Metric 7: Percent of Streets With Sidewalks

The presence of sidewalks increases both levels of walking and the safety of pedestrians. Sidewalks reduce crashes caused by walking along the roadway by 86 percent.[8] It is preferable to have a sidewalk on both sides of the street to allow pedestrians to safely and conveniently reach destinations on either side of the street. Only sidewalks that are at least 4 feet wide should be considered within this metric. Based on commonly adopted ADA standards, 4 feet allows a sidewalk to be navigated by a wheelchair, with limited passing capability of others on the walkway. This metric will determine the percent of each side of the street that has a universally accessible sidewalk. Even small gaps in the sidewalk should not be counted, regardless of whether the majority of the block has a sidewalk.

Approach 1: Local Knowledge Estimate

Using local knowledge, the self-assessment team estimates the percentage of miles of street in the subarea that have no sidewalk, sidewalk on one side, and sidewalk on both sides. These estimates should be reviewed by additional staff or community members who are familiar with the pedestrian network.

Approach 2: Google Earth Aerial Imagery Review

The self-assessment team uses Google Earth to measure the sidewalk inventory from an aerial view.

Approach 3: Google Earth Street View Review

The self-assessment team uses Google Earth to measure the sidewalk inventory from street view. This will provide a more accurate inventory than the aerial view.

Approach 4: Field Inventory

The self-assessment team goes into the field and measures the presence of sidewalks on all streets within the subarea using a measuring wheel.

HOW TO IMPROVE THE PERCENTAGE OF STREETS WITH SIDEWALKS

Completing the sidewalk network requires strategic prioritization before spending money on design and implementation. Prioritization will include land use and population/employment density to best meet the needs of the community. It is also important to design sidewalks to meet standards and effectively and safely serve the needs of pedestrians. See chapter 7, Pedestrian Design Principles, to learn more about effectively incorporating sidewalks into the street network. Section 8.6.8 also has recommendations for sidewalk implementation given limited resources and time.

9.3.8 Metric 8: Percentage of Corners With Curb Ramps

Curb ramps are an important component of the street network that makes a community accessible to pedestrians of all abilities. Curb ramps must be designed to allow the safe and accessible use by wheelchairs. Each corner of an intersection must have a curb ramp that provides direct access for each street. A traditional four-way intersection will have two ramps at each corner, as shown in the middle image. An exception can be made when there is at least 48 inches of depth between the sidewalk ramp and crosswalk markings.

Approach 1: Local Knowledge Estimate

Using local knowledge, the self-assessment team estimates the percent of street corners in the subarea that have the appropriate number of curb ramps. This estimate should be reviewed by additional staff or community members who are familiar with the pedestrian network. ADA-compliant standards should be determined to the best ability possible.

Approach 2: Google Earth Desktop Inventory

The self-assessment team uses Google Earth to count the number of curb ramps from street view. ADA-compliant standards should be determined to the best ability possible.

Approach 3: Field Inventory

The self-assessment team goes into the field and counts all curb ramps and measures them to determine whether they are ADA compliant by using a measuring tape.

HOW TO IMPROVE THE PERCENTAGE OF CORNERS WITH CURB RAMPS

Proper curb ramp design and installation is defined by ADA requirements to provide access for all users. Roadway resurfacing or alterations provide a good opportunity to update curb ramps. Similar to the process for sidewalks, a prioritization of locations will provide the information to most effectively install and update curb ramps to satisfy codes. Section 8.5 of the guidelines comprehensively covers the proper elements to address pedestrian needs at intersections, including the variations of options and geometry for curb ramps.

9.3.9 Metric 9: Distance Between Marked Crosswalks

The proximity of marked pedestrian crossings is important in promoting safe and accessible walking. The more destinations on a corridor, the more important it is to have frequent marked crossings at signalized intersections and mid-block crossings if intersections are far apart. Infrequent marked crossings are more likely to force pedestrians to take an indirect route (to detour to the crosswalk) to reach their destination. Determine the densest destination corridor within the study area. This can be done through Google Earth aerial views or local knowledge. More pedestrian-friendly study areas have a smaller average distance between marked crossings (at signalized intersections, stop-controlled intersections, and mid-block. Mid-block crossings on corridors with more than two lanes and speeds greater than 30 mph should have a pedestrian refuge island and a beacon or signal. Refer to the MUTCD, Chapter 4, Part E for additional guidance on mid-block crossing enhancements (http//mutcd.fhwa.dot.gov/htm/2009/part4/part4e.htm).

Approach 1: Google Earth Measurement

The self-assessment team uses Google Earth to measure the distance between marked crosswalks on the densest destination corridor in the subarea.

Approach 2: Field Measurement

The self-assessment team goes into the field and uses a measuring wheel to measure the distance between marked crosswalks on the densest destination corridor in the subarea.

HOW TO IMPROVE DISTANCE BETWEEN MARKED CROSSWALKS

Inventorying spacing of pedestrian crossings is an important first step in identifying the need for additional crossings. Studying key origins and destinations in combination with areas with gaps in marked crossings will help identify locations to implement additional crossings. These locations should be prioritized based on factors including pedestrian counts; key land uses, such as schools and parks; and crash history. Design and implementation team members should select appropriate treatments as discussed in previous chapters identifies pedestrian crossing treatments and appropriate facilities to use based on speed, volume, and lanes.

9.4 OTHER INDICATORS: SUPPLEMENTS TO THE SELF-ASSESSMENT METRICS

This list of additional metrics includes low-effort options that can provide additional insight into the bikeability and walkability of a community. Although they are not a part of the tool, they provide an easy way to track the improvements in mobility of a community over time. They complement the tool by providing additional information that directly addresses the travel behavior of community members. These metrics are separated into two categories: outcome measures and actions/initiatives. Within each category, metrics are listed generally in order of their priority.

9.4.1 Outcome Measures

Bike Score/ Walk Score

Walkscore.com allows users to put in an address, city, or neighborhood and produces a 0–100 score for walking and biking in that area. This methodology determines the walkability and bikeability of an area through an algorithm that analyzes distances to hundreds of destinations, weighted based on category of relevance. Amenities within a 5-minute walk are given the most points, with fewer points awarded as distance increases. It is important to note that this value does not consider the bicycle or pedestrian facilities used to reach these destinations. Walk and Bike Score tells a community the density, type, and distribution of destinations in an area or near an address.

Although Walk and/or Bike Score are primarily used for specific addresses, they often are available on a neighborhood or citywide scale. When a score is not available at this scale, enter an address close to the center of the analysis zone to determine an average scale.

Currently, Walk Score and Bike Score values for individual locations are available free of charge from walkscore.com. Bulk data requests can be purchased for approximately $1 dollar per point location.

Screenline Bicycle and Pedestrian Counts

Screenline bicycle or pedestrian counts determine the number of cyclists/pedestrians entering and leaving a certain area. It also indicates the number of cyclists/pedestrians using a particular facility. Identify the main bicycle/pedestrian routes for cyclists/pedestrians entering and exiting the analysis zone, and count the number of bicyclists/pedestrians entering and exiting during a peak hour.

Manual bicycle counts can also capture the ratio of female to male bicyclists. Female bicyclists are said to be an “indicator species” for safe bicycling conditions.[9] This is due to supporting research showing that some women are more risk averse than men, meaning they are more likely to bike when bike-friendly conditions are present.

Screenline counts do not indicate how comfortable a bicyclist or pedestrian is using that facility or the distance of their trip.

Bicycle and Pedestrian Commute Mode Share

The American Community Survey publishes estimates for resident’s primary mode of transportation to work. Refer to the American Community Survey’s most recent 3- or 5-year estimates for the bicycle and pedestrian mode share for your city. This value represents the number of residents that identify bicycling or walking as their primary mode to get to work. This value does not indicate the number of people who bike or walk for recreation or as part of their commute, such as to a transit station. The data are also skewed against accurate bike/walk mode share because the survey is collected throughout the year, including during harsh winter months, so the data may under-represent biking and walking activity. The survey taker is asked for the primary mode used in the previous week, so even a commuter making multiple bike commute trips would not be counted unless the primary mode of transportation was a bike. The numbers do not take into account the variability of modes for one user; only the primary mode is counted. This information will not be available at a neighborhood level. Data that change annually are not reliable given the small sample size. Therefore, this metric is best looked at over an extended period of time.

Bicycle or Pedestrian-Related Crash Rate per Capita(PDO, Injury, and Fatality)

Work with the local police department, sheriff, highway patrol, or state Department of Transportation to retrieve the past year of crash data. Crash data should be organized by crash type that allows the filtering by bicycle- or pedestrian-related crashes. Separate crashes into those involving bikes and those involving pedestrians. Divide each category by 10,000 to get crashes per 10,000 population. Crashes that occurred in the analysis zone can only be separated out if the resources are available. Crash data serve as a proxy for how dangerous an area is for bicyclists and pedestrians. Crash data are often incomplete due to unreported crashes and inconsistency in the method that police use to report a crash. These data also do not reveal near misses.

Bicycle- or Pedestrian-Related Fatalities per Capita

Crash data should also include severity—property damage only, injury, and fatality. Use the same methodology as in the previous metric, except only consider crashes resulting in a fatality. Fatalities that occurred in the analysis zone can be separated out only if the resources are available. Fatalities serve as a proxy for how dangerous an area is for bicyclists and pedestrians. Because the sample size for fatalities is so small, however, this may not be an accurate representation of safety.

Percent of Intersections With Bicycle Intersection Treatments

Count the total number of intersections in the analysis zone. Count the number of intersections in the analysis zone that have a treatment or treatments specifically for bicyclists. This can include a bicycle signal, loop detector, striping, green paint, a bike box, or a continued bike lane. Intersections are often seen as the weakest link for bicyclists, serving as the location that is the least comfortable for bicyclists. Therefore the percentage of intersections with bicycle treatments is a representation of the level of safety and comfort provided to bicyclists through the infrastructure present. Refer to NACTO for guidance on bicycle intersection treatments: http://nacto.org/cities-for-cycling/design-guide/intersection-treatments/.

Number of government employees, in full-time equivalents (FTE), that work on bicycle and/or pedestrian-related issues

Having dedicated staff to work on bicycle and pedestrian issues allows these issues to receive the appropriate level of attention. Note all city staff that work on these issues and the time dedicated. For example, an employee who works 20 hours a week on these issues would count as 0.5. This value is an indicator of the resources delegated to biking and walking but does not represent what is on the ground for biking and walking.

Percent of Sidewalks With at Least Two Urban Design Features

Sidewalks that have urban design features make walking a safer and more comfortable experience. Urban design features can include, but are not limited to, pedestrian-scale lighting, trees, and plantings; street furniture; or community identifiers (gateways, public art, and so forth). Estimate or measure the percentage of sidewalks in the analysis zone that have at least two urban design features that enhance the pedestrian experience. This metric reflects more on the comfort of a pedestrian facility than on the safety, convenience, or accessibility of a facility. This metric does not consider bikeability.

9.4.2 Actions and Initiatives

An adopted Bicycle and/or Pedestrian Master Plan

Does your community have a bicycle and/or pedestrian master plan in place?

Having an adopted bicycle and/or pedestrian master plan lets a community focus on implementation. A plan helps lay out a schedule, funding opportunities, and responsibility and accountability to various agencies. The process itself brings key stakeholders together to prioritize and discuss issues. The existence of a plan, however, does not necessarily equate to implementation.

Existence of a Bicycle and/or Pedestrian Advocacy Group

Does your community have a bicycle and/or pedestrian advocacy group?

An advocacy groups helps unite the efforts of community members who are passionate about improving biking and walking in the community. This energy can be effectively harnessed to plan education and encouragement events, as well as to speak in favor of engineering projects that improve biking and walking. The existence of an advocacy group, however, does not necessarily equate to implementation.

Adopted ADA Transition Plan

Does your community have an ADA Transition Plan in place?

Every agency is required to have an ADA Transition Plan. This plan ensures that all facilities in a community are universally accessible and identifies the methods, schedule, and responsible parties.

Existence of a Bike-Share Program

Does your community have a bike-share program or bike library?

Bike-share programs come in varying forms: bikes that are scattered around a community without locks and can be used by anyone and picked up and deposited anywhere; a bike library has all bikes located in one place and is usually man powered; and automated stations that are scattered throughout a community. A bike-share program provides residents and visitors easy and accessible ways to make short trips by bike and helps complete the first or last mile of a transit trip. The existence of a bike-share program, however, does not address land use or infrastructure issues.

Existence of Bike Parking Ordinances

Does your community have any ordinances in place for bike parking? If so, how aggressive are those ordinances?

Evaluate the types of ordinances in place, as well as the specific requirements identified in those ordinances (such as the number of bike parking spaces per apartment unit). Ordinances can include bike parking required with existing development, bike parking required with new development, and bike parking that substitutes for car parking. Bike parking is an important end-of-trip facility but does not reflect on the facilities present as part of the street network.

Total Number of Public and Private Bike Parking Spaces in Your Community

Count or estimate the number of bike parking spaces in your community, including those at apartment buildings, shopping centers, transit stops and stations, offices, and so forth. Note the type of bike rack provided and how it fits into the following bike parking guidelines: www.apbp.org/resource/resmgr/publications/bicycle_parking_guidelines.pdf.

Regular Maintenance of Bicycle and Pedestrian Facilities (Sweeping and Plowing)

How often does the municipality sweep or plow the bike lanes and sidewalks? How frequent are complaints from residents regarding debris or snow removal?

Existence of Safe Routes to School (SRTS) Programming (Walk to School Day, Walking School Bus, Student Safety Patrol, Tracking System)

Does your community have a Safe Routes to School program? Have you received grant funding toward these efforts? How many engineering projects have been implemented through SRTS efforts? How many educational and encouragement programs have been implemented through SRTS efforts?

Existence of Walking, Biking, or Trails Map

Do you have a walking, biking, or trail map created? How are these distributed to the community—at major events, at trailheads, located in City Hall? How frequently is this map updated?

Perform Bicycle and/or Pedestrian Intercept Surveys

Do you survey bicyclists and pedestrians in your community? Do you collect survey data after the implementation of a major bicycle or pedestrian project? What do you do with the survey data collected?

Number of Traffic Calming Practices Implemented

Do you have traffic-calming elements present on your streets? What is the process for determining where and which traffic-calming elements to implement?

Traffic-calming elements can include roundabouts, curb extensions, partially closed streets, pedestrian refuge islands, narrower travel lanes, and speed tables. Having traffic-calming facilities is important, but they must be implemented appropriately in order to be effective. Further explore various traffic-calming approaches here: http://trafficcalming.org/.

9.5 FINAL SCORES: INTERPRETATION OF RESULTS

The summary tab of the self-assessment worksheet provides the subscore for each metric, each analysis zone, and the total weighted score for all analysis zones for the nine metrics summed. Based on a community's total score, the level of walkability and bikeability can be identified based on the following ranges. Also look at how each analysis zone scored and each metric. Aim to reach the next score level during your community's post-evaluation. Analyze each analysis zone and metric in order to determine what it will take to move to the next designation.

Score 0–20: Bronze

Score 21–40: Silver

Score 41–60: Gold

Score 61–80: Platinum

Score 81–100: Diamond

9.6 CASE STUDY: COLUMBIA, MISSOURI

Columbia, Missouri is 63.5 square miles and is located in north-central- Missouri, a little more than 100 miles from Missouri's two largest cities—Kansas City and St. Louis. Columbia's population increased by about 30 percent from 2000 to 2013. The estimated area median income in 2012 was $40,118, compared to $45,321 for all of Missouri. The population is made up of 76.0 percent White, 10.8 percent African-American, 5 percent Asian, 3.5 percent Hispanic and 5 percent other.

This case study focuses on the various approaches implemented by Columbia to evaluate engineering, education, and encouragement programs and projects. Columbia, Missouri was one of four participating pilot communities in the Federal Highway Administration's (FHWA) Non-motorized Transportation Pilot Program (NMTPP), receiving $25 million of funding for bicycle and pedestrian infrastructure projects and programs. Following the pilot program, each community saw a significant shift to active mode and the resulting benefits in energy savings, environmental quality, safety, and public health. Quantified benefits of the program from the four communities cumulatively include the following—

- A reduction of 85.1 million miles from vehicular trips between 2009 and 2013.
- A 15.8-percent increase in walk mode share from 2007 to 2013.
- A 44-percent increase in bike mode share from 2007 to 2013.
- Increased walk and bike trip count at project sites of 56 and 115 percent, respectively.
- A 20-percent decline in the number of pedestrian fatalities and a 28.6-percent decline in the number of bicycle fatalities from 2002 to 2012.
- A cumulative reduction of 25 pounds of carbon dioxide (CO2) pollution per capita in 2013, or a total of 9,065 tons.

Columbia specifically saw significant improvements in bicycling over the course of the program. This progress was tracked through a number of different evaluation tools that the city applied. By performing bicycle and pedestrian counts, the city noted increases in biking and walking during peak commute hours over specific periods of time. From 2007 to 2008, biking and walking during peak commute times increased 71 and 33 percent, respectively. Between 2007 and 2013, annual counts in Columbia revealed that walking increased an estimated 22 percent and bicycling increased an estimated 44 percent. In addition to the increases in biking and walking seen over the course of the program, transit ridership tripled and bikes placed on bus racks increased by 83 percent. The city tracked the number of existing and newly implemented facilities, as well. Infrastructure projects during the NMTPP included intersection improvements, 30 miles of bike lanes, 14 miles of marked bike routes, sidewalk projects, trail connections, and additional bike parking.

Although educational and promotion efforts housed under the "GetAbout Columbia" marketing campaign represent only a small portion of the budget of this program, they were indicated as an essential complement to infrastructure improvements that were partially responsible for the achievement of the mode shift. Surveys are distributed to those who participate in GetAbout Columbia's classes, and feedback is evaluated. As a part of the NMTPP, the city completed a "Consumer Awareness and Attitudes" annual survey to capture more nuanced trends in travel behavior. Columbia also applied to the League of American Bicyclists' Bicycle Friendly Community, a mechanism to receive feedback on the five Es (engineering, education, encouragement, enforcement, and evaluation) and a method to track progress.

New pedway on the north side of Stadium Boulevard in Columbia, MO. Photo source: GetAbout Columbia

Cyclist on the Windsor/Ash Bicycle Boulevard in Columbia, MO. Photo source: GetAbout Columbia

NOTES:

1 http://bikepeddocumentation.org/participate/

2 Level of Traffic Stress 2 or better

3 Cervero R, Kockelman K. Travel demand and the 3Ds: Density, diversity, and design. Transportation Research Part D-Transport and Environment. 1997;2(3):199–219.

4 http://www.census.gov/hhes/commuting/files/2014/acs-25.pdf

5 Roger Geller, Four Types of Cyclists, (Portland, OR: City of Portland, Office of Transportation, n.d., circa 2007), https://www.portlandoregon.gov/transportation/article/264746

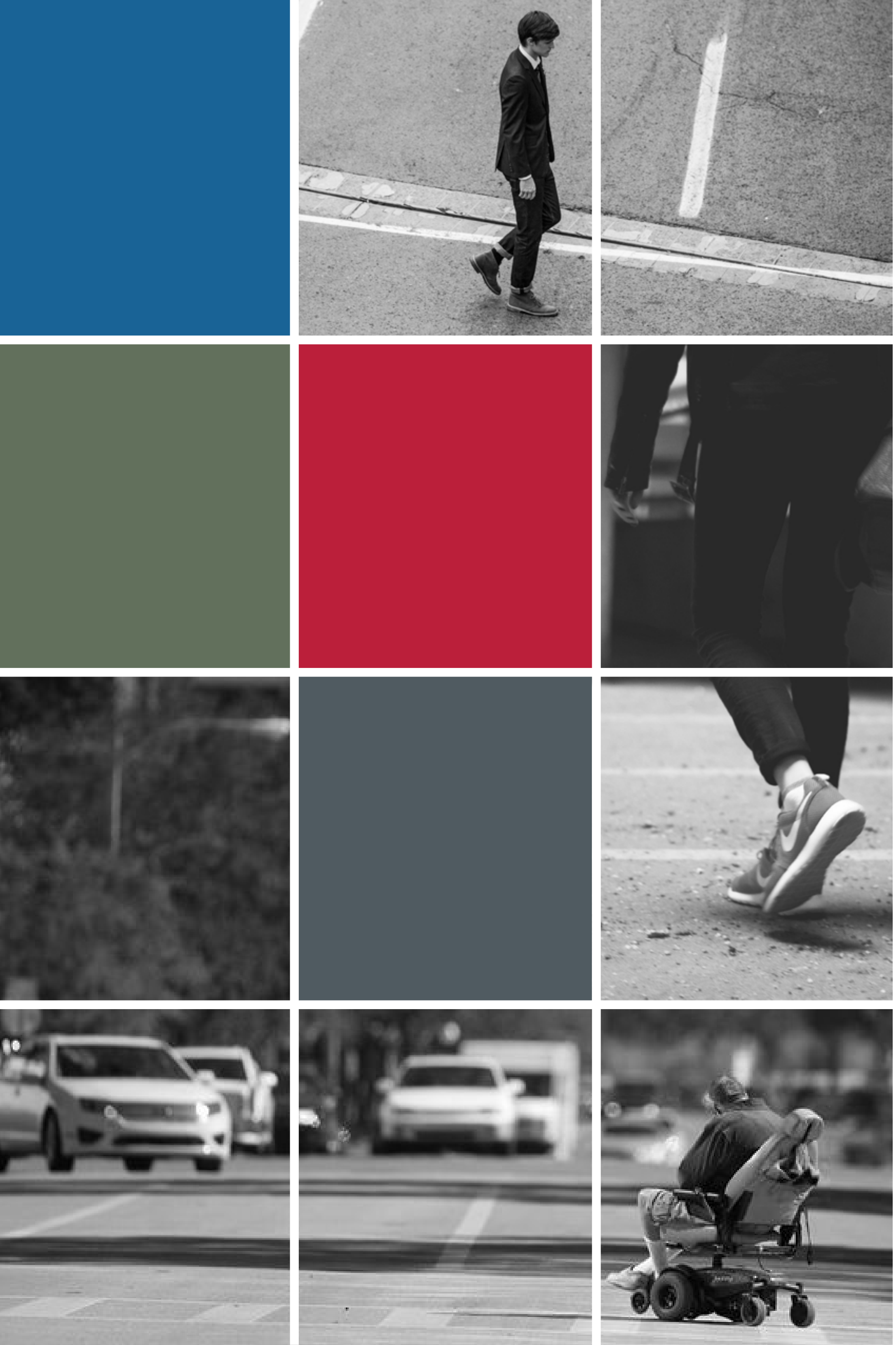
6 Mekuria, Maaza, Peter Furth and Hilary Nixon. Low-Stress Bicycling and Netrok Connectivity. Mineta Transportation Institute. May 2012. http://transweb.sjsu.edu/PDFs/research/1005-low-stress-bicycling-network-connectivity.pdf.

7 Cervero, R and Reid Ewing. Travel and the Built Environment: A Meta-Analysis. Journal of American Planning Association. 2010; 76 (3); 265-294.

8 McMahon, P., Zegeer, C., Duncan, C., Knoblauch, R., Stewart, R., & Khattak, A. (2002). An analysis of factors contributing to 'walking along roadway' crashes: Research study and guidelines for sidewalks and walkways. (FHWA-RD-01-101). Washington, DC: Federal Highway Administration.

9 Baker, Linda. "How to Get More Bicyclists on the Road." 21 September 2009.

10 https://www.scientificamerican.com/article/getting-more-bicyclists-on-the-road/



APPENDIX A:

COMMUNITY SELF-ASSESSMENT TOOL METHODOLOGY

METRIC 1: LAND USE DIVERSITY

Approach 1: Images of a Typical Street

1. Consider the land uses and distribution of those land uses within the analysis zone. Consider the land uses that people within the zone—including residents, workers, students, and visitors—would encounter within a 5-minute walk of their home, school, or place of employment. Could the typical person accomplish all of his or her daily needs within a 5-minute walk (about 0.25 mile)? Are there any potential destinations within walking distance? Consider commercial destinations, such as restaurants, coffee shops, grocery stores, bars, and shopping, as well as community destinations, like parks, schools, health services, and cultural and religious resources.
2. Review the following descriptions and accompanying images (figure A-1). Select the one that most accurately represents the analysis zone.
   - **a) Score 0–20:** There is no variation in the types of destinations available within a 5-minute walk.
   - **b) Score 21–40:** Very few needs can be met within a 5-minute walk for most people. Residents in adjacent neighborhoods could conceivably walk to the commercial corridor for a specific purpose, but most would not choose to do so. Retail employees have limited options for restaurants within walking distance and would have challenges crossing to the other side of the roadway.
   - **c) Score 41–60:** Some needs can be met within a 5-minute walk. Residents in adjacent neighborhoods could walk to the commercial center for some local-serving destinations, like restaurants, coffee shops, and personal services. Sidewalk connectivity allows workers to walk to restaurants and coffee shops in the area.
   - **d) Score 61–80:** Many needs can be met within a 5-minute walk. Residents in adjacent neighborhoods could walk to a variety of local-serving destinations, like cafes, restaurants, personal services, shopping, and perhaps grocery stores, small offices, and entertainment venues. Some residents could live above other land uses, placing walkable destinations at their doorstep. Some residents may even work within walking distance of their homes.
   - **e) Score 81–100:** A wide variety of destinations are available within a 5-minute walk. Multiple options for restaurants, cafes, bars, shopping, grocery stores, entertainment venues, and personal services are accessible on foot. Public open space, education and cultural centers, and multiple employment options are also available. Determine a score within the 20-point range of the chosen image. Select the middle of the range (e.g., 10 for 0–20) if your average street looks most closely like the image provided. If your typical street looks less mixed than the image, then pick a number at the lower end of the range. If your typical street looks more mixed than the image, then pick a number at the upper end of the range.
3. Place this score as the community's 0–100 Score for Metric 1: Land Use Diversity in the self-assessment worksheet. Repeat this approach for each analysis zone, as necessary.

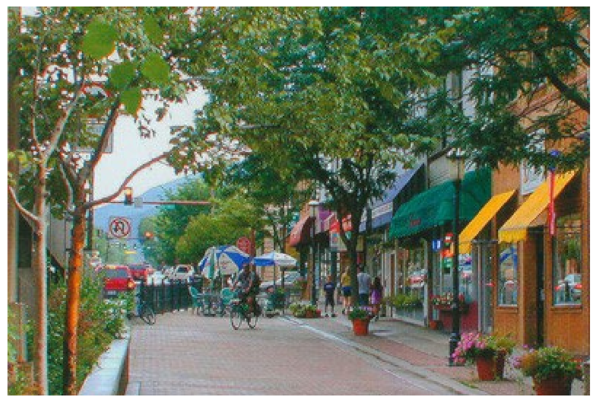
Figure A-1: Approach 1 Images of Typical Streets

a) Score 0–20
Image source: imgarcade.com

b) Score 21–40
Image source: dkolb.com

c) Score 41–60
Image source: Bradenton.com

d) Score 61–80
Image source: growinwatsonville.com



e) Score 81–100
Image source: Glenwood Springs

Approach 2: Images of a Land Use Map

1. After establishing an analysis zone or zones, reflect on the streets and the mix of land uses within them, using a local land use map as a guide. Consider the land uses that people within the zone—including residents, workers, students, and visitors—would encounter within a 5-minute walk of their home, school, or place of employment. Could the typical person accomplish all of their daily needs within a 5-minute walk (about 0.25 mile)? Are there any potential destinations within walking distance? Consider commercial destinations such as restaurants, coffee shops, grocery stores, bars, and shopping, as well as community destinations like parks, schools, health services, and cultural and religious resources.

2. Review the following descriptions and accompanying images (figure A-2). Select the one that most accurately represents the analysis zone.

3. Assign the analysis zone a score from 0, meaning no destinations within walking distance, to 100, meaning daily needs can be met within walking distance. The following land use map images provide illustrative examples for comparison.

   a) **Score: 0–20:** There is no variation in the types of destinations available within a 5-minute walk.

   b) **Score: 21–40:** Very few needs can be met within a 5-minute walk for most people. A church and a school provide some neighborhood destinations, but the commercial uses along the major arterial are primarily automobile-oriented (a car dealer and gas station). A liquor store, a convenience store, and a fast-food restaurant provide the only local-serving options. A railroad right-of-way prevents walking to the southeast.

   c) **Score: 41–60:** Some needs can be met within a 5-minute walk. Residents in adjacent neighborhoods could walk to the commercial strip for some local-serving destinations, such as restaurants, coffee shops, home goods stores, and personal services. Sidewalk connectivity allows workers to walk to restaurants and coffee shops in the area.

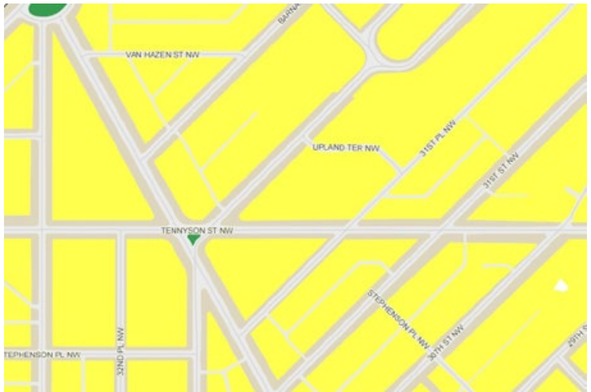
   d) **Score: 61–80:** Many needs can be met within a 5-minute walk. Although the dominant land use is residential, residents could walk to a variety of local-serving destinations, such as cafes, restaurants, personal services, shopping, grocery stores, small offices, and entertainment venues. Some residents may even work within walking distance of their homes.

   e) **Score 81–100:** A wide variety of destinations are available within a 5-minute walk. Multiple options for restaurants, cafes, bars, shopping, groceries, entertainment and personal services are accessible on foot. Public open space, education and cultural centers, and multiple employment options are also available.

4. Determine a score within the 20-point range of the chosen image. Select the middle of the range (e.g., 10 for 0–20) if your average street looks most like the image provided. If your typical street looks less mixed than the image, then pick a number at the lower end of the range. If your typical street looks more mixed than the image, then pick a number at the upper end of the range.

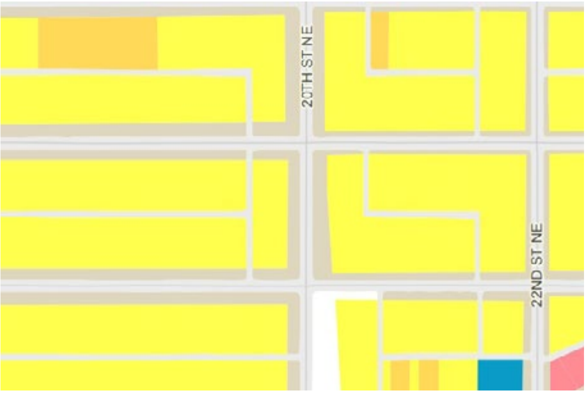
5. Place this score as the community's 0–100 Score for Metric 1: Land Use Diversity in the self-assessment worksheet. Repeat this approach for each analysis zone, as necessary.

Figure A-1: Approach 2 Images of Land Use Types



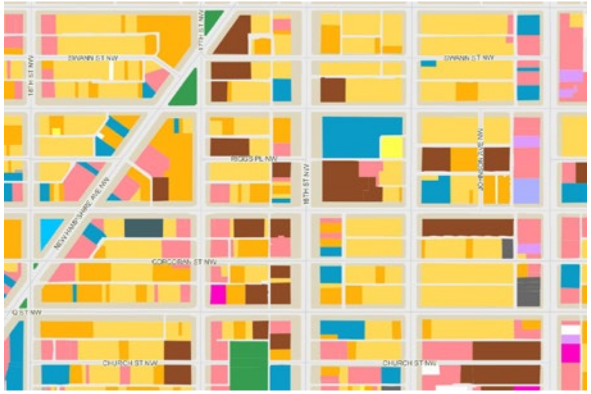
a) Score 0-20

b) Score 20-40



c) Score 40-60

d) Score 60-80



e) Score 80-100

Approach 3: Fieldwork

1. After establishing an analysis zone or zones, reflect on the streets and the mix of users within the zones to select a handful of addresses to serve as starting points for analysis. Consider locations that reflect the experience of residents, workers, students, and visitors. Select at least three starting points that will reflect representative conditions throughout the analysis zone.

2. Review the 10 categories of land uses in the following list—

   - **Grocery stores:** including full-service grocery stores and local-serving food markets
   - **Restaurants:** with dine-in or takeout service
   - **Cafes:** such as coffee, tea, or donut shops
   - **Bars:** bars and nightlife destinations
   - **Parks:** parks and outdoor green spaces
   - **Schools:** elementary, middle, and high schools
   - **Shopping:** such as retailers for clothing, gifts, and home goods
   - **Entertainment:** such as cinemas, theaters, and other arts venues
   - **Services:** such as dry cleaners and hair and nail salons
   - **Community:** such as libraries, churches, and recreation centers

3. Walk through the community, starting from each identified address, to see how many of these destination categories can be reached within a 5-minute walk. For each starting point, assign 10 points for each destination category that can be reached within a 5-minute walk. Do not score additional points for multiple destinations within the same category. For example, if there are three restaurants within a 5-minute walk but no other destination categories are accessible, score 10 points only. If few or no destination categories are accessible within a 5-minute walk, consider scoring 5 points (half score) for destination categories that can be reached within a 10-minute walk (about 0.5 mile). Document this approach, if taken, so that post-evaluation is based on a comparable approach. The final score for each starting point is the sum of points for all accessible land use categories. The overall score for each analysis zone is the average of the scores for each starting point within that analysis zone.

4. Place this score as the community's 0–100 Score for Metric 1: Land Use Diversity in the self-assessment worksheet. Repeat this approach for each analysis zone, as necessary.

Approach 4: Walk Score®

This approach uses Walk Score® values to assess the land use diversity of each analysis zone. The Walk Score® analysis uses land use categories, including grocery stores, schools, parks, and retail, and applies a detailed algorithm to assign different scores to destinations based on how far they are from the analyzed address. Additional detail on the Walk Score® approach is available at https://www.walkscore.com/methodology.shtml. The resulting score ranges from 0 ("Car-Dependent") to 100 ("Walker's Paradise").

1. Go to www.walkscore.com.

2. Select three to five addresses within the analysis zone that accurately represent the area with regard to land use mix. Consider locations that reflect the experience of residents, workers, students, and visitors.

3. Enter each address individually into the Walk Score® website, and record the Walk Score® for each address.

4. Total the three to five Walk Scores® recorded in step 3.

5. Calculate the average Walk Score®: divide the total Walk Score® (step 4) by the number of addresses used to collect Walk Score® (step 2).

6. Place this averaged score as the community's 0–100 Score for Metric 1: Land Use Diversity in the self-assessment worksheet. Repeat this approach for each analysis zone, as necessary.

Approach 5: Entropy Score

The entropy score is a formula used to measure land use diversity that ranges from 0 to 1, calculated from household- and employment-related land use data. The score will equal one when land use is most heterogeneous (most diverse) and zero when most homogeneous (least diverse). There are many possible specifications of the entropy formula, but a useful version employed by the Environmental Protection Agency (EPA) Smart Location Database (SLD) assigns employment types to five broad categories and includes a sixth category for households: (1) Office, (2) Retail, (3) Industrial, (4) Services, (5) Entertainment/Accommodation/Food Services, and (6) Households.

To calculate the entropy score—

1. Sum employment and households by the six categories listed previously for each analysis zone or subarea.

2. Calculate the entropy score according to the following formula (additional information provided in the Smart Location Database User Guide):

   D2a_EpHHm (Entropy Score) = -A/(ln(N))

   Where:

   A = (HH/TotAct)*ln(HH/TotAct) + (E5_Ret10/TotAct)*ln(E5_Ret10/TotAct) + (E5_Off10/TotAct)*ln(E5_Off10/TotAct) + (E5_Ind10/TotAct)*ln(E5_Ind10/TotAct) + (E5_Svc10/TotAct)*ln(E5_Svc10/TotAct) + (E5_Ent10/TotAct)*ln(E5_Ent10/TotAct)

   TotEmp = total employment

   HH = number of households

   E5_Ret10 = retail employment

   TotAct = TotEmp + HH

   E5_Off10 = office employment

   E5_Ind10 = industrial employment

   E5_Svc10 = service employment

   E5_Ent10 = entertainment/accommodations/food services employment

   N = number of activity categories (employment or households) with count > 0.

3. Aggregate the entropy scores from each subarea to get an entropy score for the analysis zone. Because the entropy score varies between 0 and 1, multiply by 100 and round to the ones' place to score this metric in the self-assessment worksheet (e.g., an entropy score of 0.557 should be recorded as 56).

4. Place this score as the community's 0–100 Score for Metric 1: Land Use Diversity in the self-assessment worksheet. Repeat this approach for each analysis zone, as necessary.

Approach 6: GIS Analysis

A GIS-based approach makes it possible to calculate the entropy score, described previously, more accurately and more quickly, provided that GIS software and a skilled analyst are available. The calculation is the same as the previous calculation, but GIS analysis allows the employment data to be aggregated more precisely to the identified analysis zone or zones and the calculation can be automated, rather than manual. This approach will provide more directly comparable values of the entropy score.

If GIS resources are available—

1. Consider an approach that systematically divides analysis zones into regular subareas of roughly even size and shape.

2. Aggregate the entropy scores from each subarea to get an entropy score for the analysis zone. Because the entropy score varies between 0 and 1, multiply by 100 and round to the ones' place to score this metric in the self-assessment worksheet (e.g., an entropy score of 0.557 should be recorded as 56).

3. Place this score as the community's 0–100 Score for Metric 1: Land Use Diversity in the self-assessment worksheet. Repeat this approach for each analysis zone, as necessary.

METRIC 2: NUMBER OF JOBS WITHIN 15 MINUTES

Approach 1: LEHD OnTheMap

The Longitudinal Employer-Household Dynamics (LEHD) data source, available from the U.S. Census Bureau through a simple, web-based tool at http://onthemap.ces.census.gov/, provides estimates of employers and employees coded at the census block level. The tool is free to use. Circular 0.8-mile and 2.5-mile buffers will overestimate the number of jobs accessible within a 15-minute walk and bike ride, respectively, but are a consistent and relatively accurate approximation of a walkable and bikeable distance. The following steps describe in detail how to use LEHD OnTheMap to calculate employment within a 15-minute walk or bike ride. Additional documentation for OnTheMap is available at http://lehd.ces.census.gov/applications/help/onthemap.html#!what_is_onthemap.

1. Select two to four addresses to serve as points for analysis. Consider locations that reflect the experience of residents, workers, students, and visitors. Select a number of starting points that will reflect representative conditions throughout the analysis zone. These can be the same as or different from other points chosen for this analysis zone.
2. Enter the first address in the search bar in the left-hand pane of http://onthemap.ces.census.gov/.
3. Select the "Geocoder Results" item that corresponds to the address searched (figure A-3).
4. Select "Change Selection Area" from the resulting text bubble on the map (figure A-4).
5. Change the value in the "Simple/Ring" Radius field to 0.8 mile.
6. Press "Confirm Selection."
7. Select "Perform Analysis on Selection Area" in the text bubble on the map.
8. Select the following settings from the menu—
   - **a) Home/Work Area:** Work
   - **b) Analysis Type:** Area Profile—All Workers
   - **c) Year:** 2012 (or most recent)
   - **d) Job Type:** All Jobs
9. Record the number of Total All Jobs, as it appears on the right side panel.
10. Repeat steps 2 through 7 for each selected address in step 1, and record the Total All Jobs for each.
11. Repeat steps 2 through 7 for a 2.5-mile radius (changing the value in step 5) for each of the addresses identified in step 1, and record the Total All Jobs for each.
12. Average the jobs calculated for the Total All Jobs in the 0.8-mile radius.
13. Average the jobs calculated for the Total All Jobs in the 2.5-mile radius.
14. Find where the number calculated in step 12 falls in column A of table A-1. Find where the number calculated in step 13 falls in column B of the same table. Use the higher score in the event that a 2.5-mile buffer extends substantially beyond the edges of your community or developed area. Record the number of points associated with the total jobs calculated in the preceding steps.
15. Place this averaged score as the community's 0–100 Score for Metric 2: Number of Jobs within 15 Minutes in the self-assessment worksheet. Repeat this approach for each analysis zone, as necessary.

Table A-1: Total Employment Points

TOTAL EMPLOYMENT 0.8-MILE RADIUS (COLUMN A)	TOTAL EMPLOYMENT 2.5-MILE RADIUS (COLUMN B)	POINTS
< 80	< 750	0
81–400	751–3,800	10
401–800	3,801–7,500	20
801–1,600	7,501–15,000	30
1,601–3,200	15,001–30,000	40
3,201–4,800	30,001–45,000	50
4,801–8,000	45,001–75,000	60
8,001–16,000	75,001–150,000	70
16,001–24,000	150,001–225,000	80
24,001–32,000	225,001–300,000	90
> 32,000	> 300,000	100

Figure A-3: Approach 1, Step 3

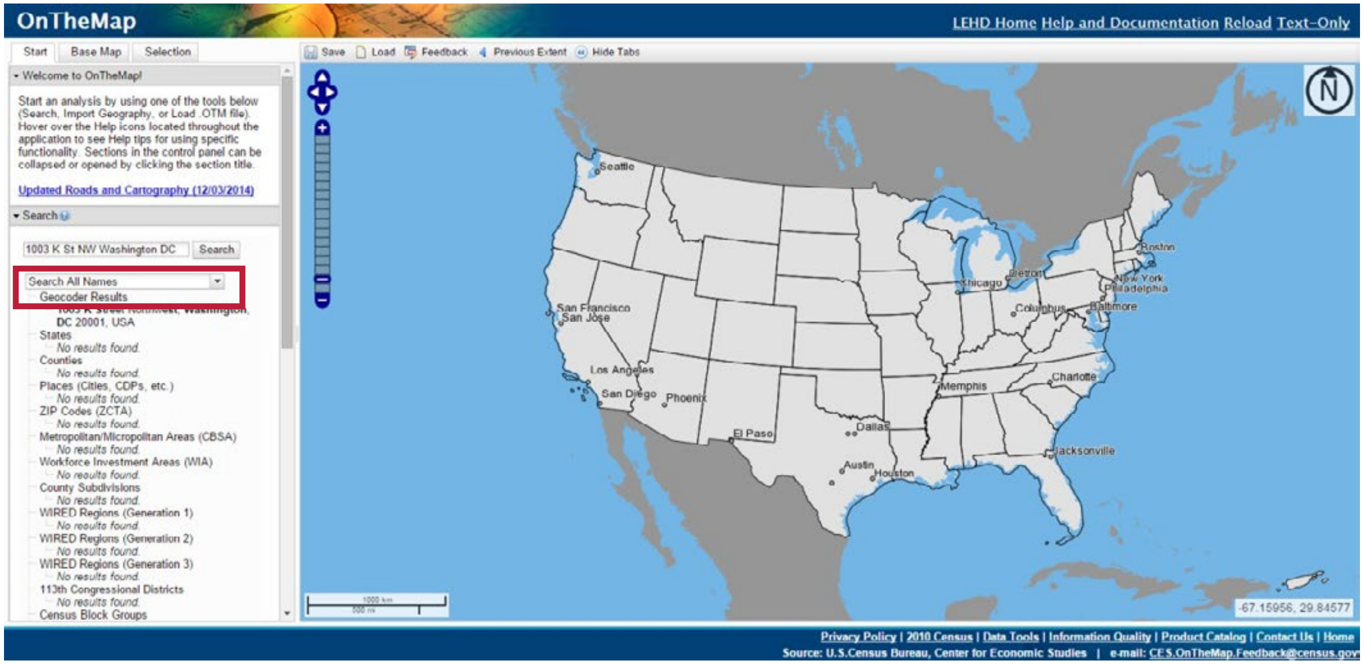
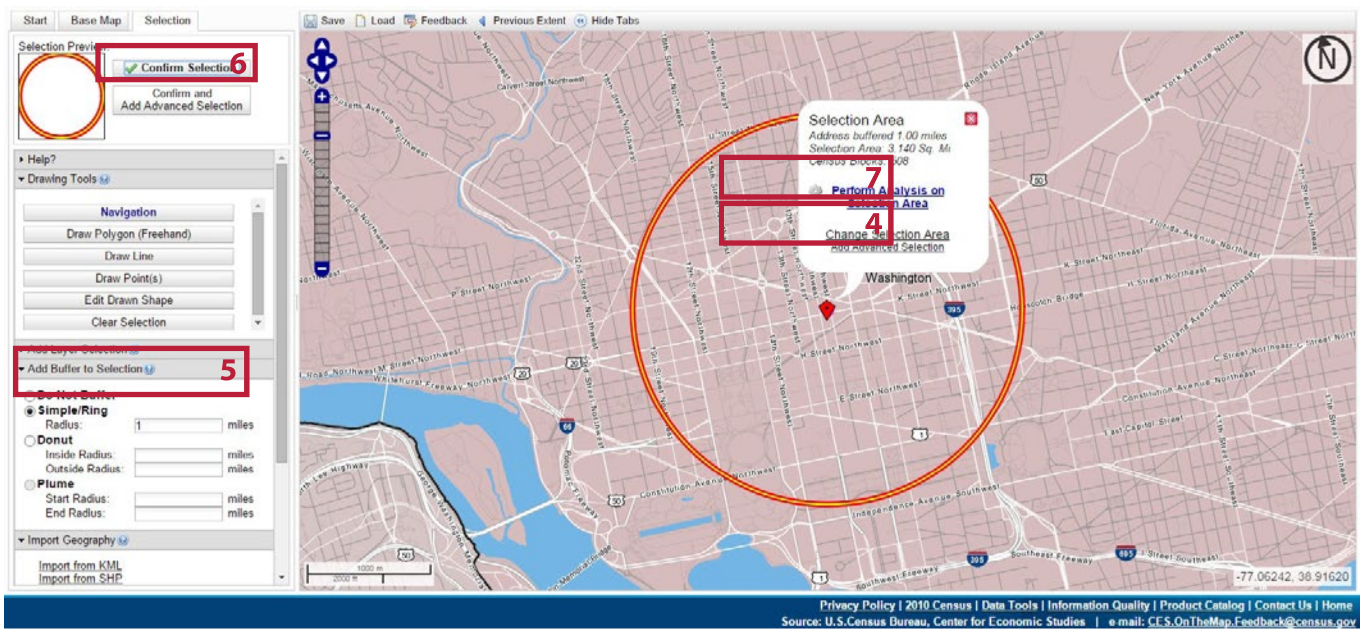


Figure A-4: Approach 1, Step 4-7



Approach 2: GIS Analysis

1. Start by selecting two to four addresses to serve as points for analysis. Consider locations that reflect the experience of residents, workers, students, and visitors. Select a number of starting points that will reflect representative conditions throughout the analysis zone.

2. Use the network buffer tool in a GIS software program like ArcGIS, to determine which census blocks are accessible within a 0.8-mile walk and 2.5-mile bike ride of each analysis point. The network analysis buffer will be smaller than a simple circular buffer because it reflects the available paths within the determined 0.8- and 2.5-mile buffers of the subarea. This approach more accurately represents the destinations to which a commuter could actually walk or bike.

3. Import LEHD data (http://lehd.ces.census.gov/) comparable to the data described in Approach 1, and join these data with the selected census blocks. Use the statistics tool to view the total number of jobs within these census blocks.

4. Score the analysis zone based on walkable and bikeable employment using table A-1 in Approach 1. This will result in lower scores than the simple circular buffer approach, but they will be more accurate.

5. Place this averaged score as the community's 0–100 Score for Metric 2: Number of Jobs within 15 Minutes in the self-assessment worksheet. Repeat this approach for each analysis zone, as necessary.

METRIC 3: PERCENTAGE OF LOW-STRESS ROADWAYS

Approach 1: Images of a Typical Street

1. Make a list of all of the arterial and collector streets in the analysis zone. Arterial roadways are typically multi-lane thoroughfares that carry longer-distance through traffic. Commercial collector roads carry moderate volumes of traffic and are typically abutted by commercial uses, like shops, restaurants, and other businesses.

2. Review the images corresponding to Levels of Traffic Stress 1 through 4 (figure A-5).

   a) Level of Traffic Stress #1: A separated bike lane separates bicyclists from moving vehicular traffic.

   b) Level of Traffic Stress #2: A bike lane on a 30-mph street, with room to avoid the door zone.

   c) Level of Traffic Stress #3: Bike lane next to parking on multi-lane, 30-mph street in a commercial area, without space to ride outside the door zone.

   d) Level of Traffic Stress #4: Mixed traffic on a 30-mph, multi-lane road.

3. For each arterial and commercial collector street in the analysis zone, use local knowledge and/or aerial images and fieldwork to select the level of traffic stress that best represents the character of the street.

4. Determine the percent of streets that had an image with LTS 1 or 2. Streets achieving only LTS 3 or 4 should not count. This percent is the analysis zone's score for metric 3. For example, if roughly 10 percent of arterials and commercial collectors in the analysis zone achieve LTS 1 and 20 percent of arterials and commercial collectors in the analysis zone achieve LTS 2, the score for the analysis zone would be 30.

5. Place this score as the community's 0–100 Score for Metric 3: Percentage of Low-Stress Roadways in the self-assessment worksheet. Repeat this approach for each analysis zone, as necessary.

Figure A-2: Approach 1 Images: Level of Traffic Stress (Low to High) Stress (Low to High)

a) Level of Traffic Stress #1

Source: www.northeastern.edu/peter.furth/criteria-for-level-of-traffic-stress/

b) Level of Traffic Stress #2

Source: www.northeastern.edu/peter.furth/criteria-for-level-of-traffic-stress/

c) Level of Traffic Stress #3

Source: www.northeastern.edu/peter.furth/criteria-for-level-of-traffic-stress/

d) Level of Traffic Stress #4

Source: www.northeastern.edu/peter.furth/criteria-for-level-of-traffic-stress/

Table A-2: Simplified LTS Decision Table

PHYSICALLY SEPARATED BIKEWAY?	BIKE LANE	SPEED	LANES PER DIRECTION	LEVEL OF TRAFFIC STRESS (LTS)
Yes	(any)			1
No	Yes	25mph or less	1	1
			2+	3
		30mph	1	2
			2+	3
		35mph	(any)	3
		40mph	(any)	4
	No	25mph or less	1	2
			2	3
			3+	4
		30mph	1	3
			2+	4
		35mph+	(any)	4

Source: Fehr & Peers, adapted from Mekuria, Maaza, Peter Furth and Hilary Nixon. Low-Stress Bicycling and Netrok Connectivity. Mineta Transportation Institute. May 2012. http://transweb.sjsu.edu/PDFs/research/1005-low-stress-bicycling-network-connectivity.pdf. Accessed 5 February 2015.

Approach 2: Simplified LTS Table

Use table A-2 to assign roadways to Levels of Traffic Stress 1 through 4. Note that the simplified table is only an approximation and does not consider the full set of factors included in a Level of Traffic Stress assessment (Mekuria 2012).

1. For each arterial and commercial collector street in the analysis zone, collect information on bike facilities, vehicular speeds, and number of lanes; then reference table A-2 to identify the corresponding Level of Traffic Stress. Arterial roadways are typical multi-lane thoroughfares that carry longer-distance through traffic. Commercial collector roads carry moderate volumes of traffic and are typically abutted by commercial uses, like shops, restaurants, and other businesses.

2. Assign the analysis area a score based on the percent of arterial and commercial collector streets that achieve LTS 1 or 2; streets achieving only LTS 3 or 4 should not count. For example, if roughly 10 percent of arterials and commercial collectors in the analysis zone achieve LTS 1 and 20 percent of arterials and commercial collectors in the analysis zone achieve LTS 2, the score for the analysis zone would be 30.

3. Place this score as the community's 0–100 Score for Metric 3: Percentage of Low-Stress Roadways in the self-assessment worksheet. Repeat this approach for each analysis zone, as necessary.

Approach 3: LTS Tables

1. Use the six tables provided in an LTS summary document by Peter Furth, available here: http://www.northeastern.edu/peter.furth/wp-content/uploads/2014/05/LTS-Tables1.pdf.
   - Table 1: Helps narrow LTS by bicycle facility type.
   - Tables 2 and 3: Show LTS for a bike lane alongside and not alongside a parking lane, respectively.
   - Table 4: Shows LTS for streets with bikes in mixed traffic based on number of lanes and prevailing speed.
   - Table 5: Shows LTS based on treatments and geometry of a bike approaching an intersection at a right turn lane.
   - Table 6: Shows LTS at unsignalized crossings based on number of lanes and speed.
2. Use the tables to determine the LTS for each roadway in the subarea. The tables should be combined using a "weakest link" approach, meaning that a given roadway should receive the worst score merited by consideration of all criteria. If conditions of the roadway change, identify the appropriate LTS for each similar segment. Determine the percentage of streets that have an LTS 1 or LTS 2 similar to Approach 2.

3. Place this score as the community's 0–100 Score for Metric 3: Percentage of Low Stress Roadways in the self-assessment worksheet. Repeat this approach for each analysis zone, as necessary.

METRIC 4: PERCENTAGE OF RESIDENTS NEAR BICYCLE FACILITIES

Approach 1: Miles of Bike Facilities per Capita Calculation (proxy)

This approach does not directly determine the percentage of residents and workers near high-quality facilities, but it is an acceptable proxy for this metric.

1. Open or download Google Earth Pro: http://www.google.com/earth/.
2. Identify the analysis zone in Google Earth Pro. You may want to draw a boundary around this area using the "Add Polygon" tool. Adjust the "Style, Color" setting for "Area" to "Outlined" so the area within the boundary is not covered.
3. Using the measuring tool in Google Earth Pro (the ruler on the top of the screen), measure all of the bike lanes within the analysis zone. Record the miles of bike lanes.
4. Using the measuring tool in Google Earth Pro, measure all of the paths and trails within the analysis zone. It may be easiest to use the "path" feature within the rule tool if trails and paths are not straight. Record the miles of paths and trails.
5. Add the miles of lanes (step 3) and trails (step 4), and record the total miles.
6. Open the ruler tool in Google Earth Pro and select "polygon."
7. Trace the boundary of the analysis zone, and record the area in square miles, as reported by the ruler tool.
8. Divide the miles of off-street trail and on street bike facility (step 5) in the analysis zone by the area of the analysis zone (step 6), and record the miles of bike facilities per square mile.
9. Using the value from step 8, determine how many points to attribute this analysis zone using table A-3.
10. Place this averaged score as the community's 0–100 Score for Metric 4: Percentage of Residents and Workers near Bike Facilities in the self-assessment worksheet. Repeat this approach for each analysis zone, as necessary.

Table A-2: Bike Facility Points

MILES OF BIKE FACILITY PER SQUARE MILE	POINTS
< 1	20
1–2	40
2–4	60
4–8	80
> 8	100

Figure A-6: Approach 2: Step 2

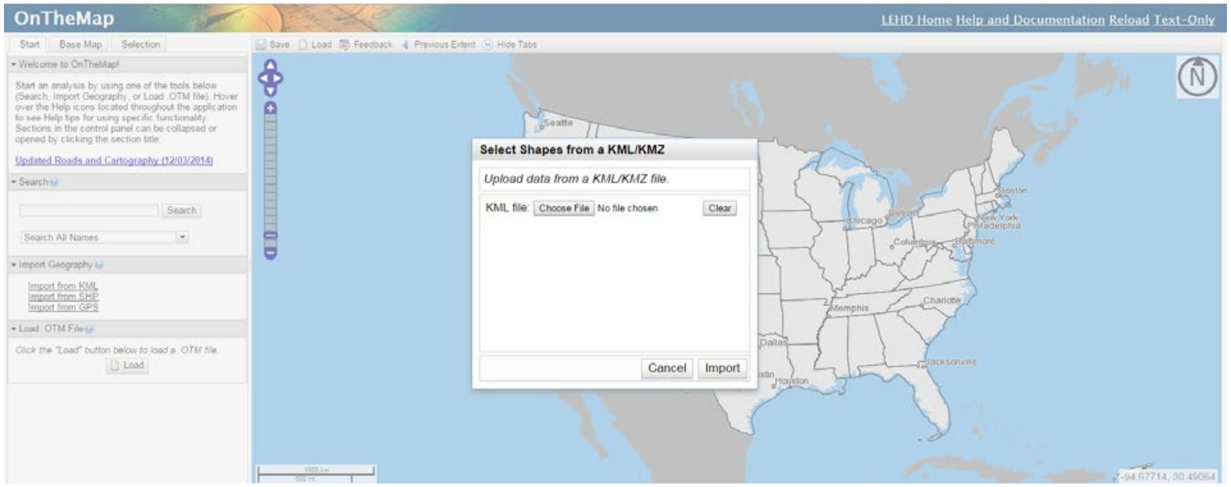
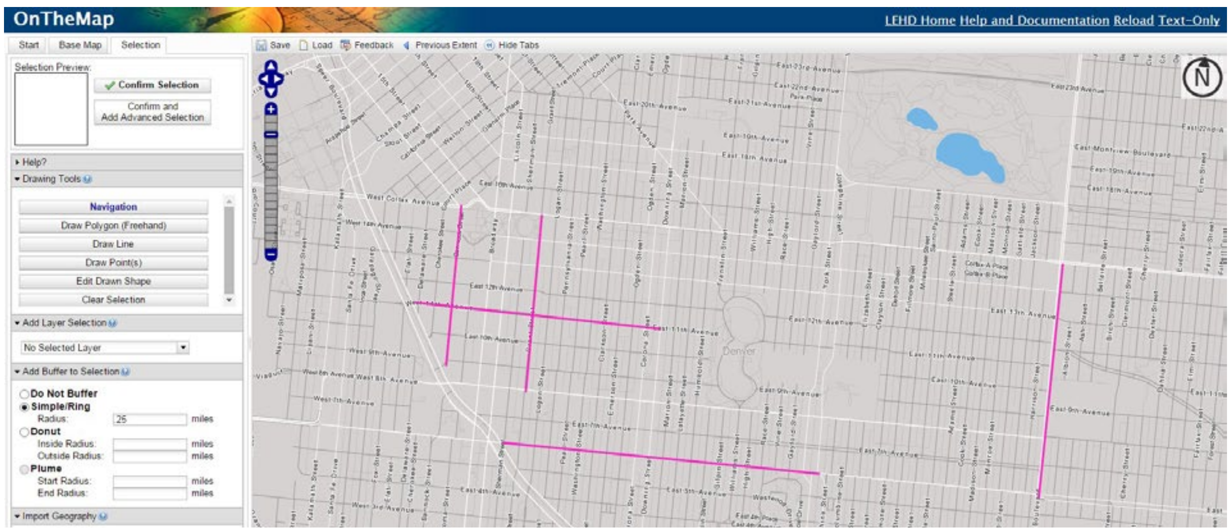


Figure A-7: Approach 2: Step 3



Approach 2: LEHD OnTheMap

The Longitudinal Employer-Household Dynamics (LEHD) data source, available from the U.S. Census Bureau through a simple, web-based tool at http://onthemap.ces.census.gov/, provides estimates of employers and employees coded at the census block level. The tool is free to use. LEHD OnTheMap can be used to calculate the number of residents and workers living and working within 0.25 mile of a high-quality bicycle facility. Additional documentation for OnTheMap is available here: http://lehd.ces.census.gov/applications/help/onthemap.html#!what_is_onthemap.

1. Start by creating a kml (Google Earth) or shapefile (GIS) of all bike facilities considered LTS 1 or LTS 2. This will include off-street paths that can accommodate bikes, as well as bike lanes on streets with speed limits of 30 mph or less and 2–3 lanes.

2. Select "Import [KML, SHP, or GPS]" in the search bar in the left-hand pane of http://onthemap.ces.census.gov/. Import the high-quality bike facility file in its appropriate form (figure A-6).

3. Select "Zoom to Imported Shapes." If shape is correct, click on "Select all lines," and then select "Continue with Selected Feature" (figure A-7).

4. From the "Add Buffer to Selection" window, select "Simple/Ring," and enter .25, to represent the 0.25-mile buffer, and then press "Confirm Selection" (figure A-8).

5. Select “Perform Analysis on Selection Area,” and then do two runs to get first data on employees and then data on residents. Select the following settings from the menu—

    a) **Home/Work Area:** First Work, then Home

    b) **Analysis Type:** Area Profile—All Workers

    c) **Year:** 2012 (or most recent)

    d) **Job Type:** All Jobs

6. Note the number of “Total Jobs” for both the home and the work analysis.

7. Repeat steps 2 through 5 for a polygon of the entire analysis zone, but do not buffer (figure A-9).

8. Note the number of home and work jobs for the entire analysis zone.

9. Divide the total number of home (or origin) and work (or destination) jobs in the bike facilities buffer by the total number of home (or origin) and work (or destination) jobs in the entire analysis zone.

10. The score assigned for this metric will be equal to the percentage of total residents and workers who live and work within 0.25 mile of a high-quality bicycle facility.

11. Place this averaged score as the community’s 0–100 Score for Metric 4: Percentage of Residents and Workers near Bike Facilities in the self-assessment worksheet. Repeat this approach for each analysis zone, as necessary.

Figure A-8: Approach 2: Step 4

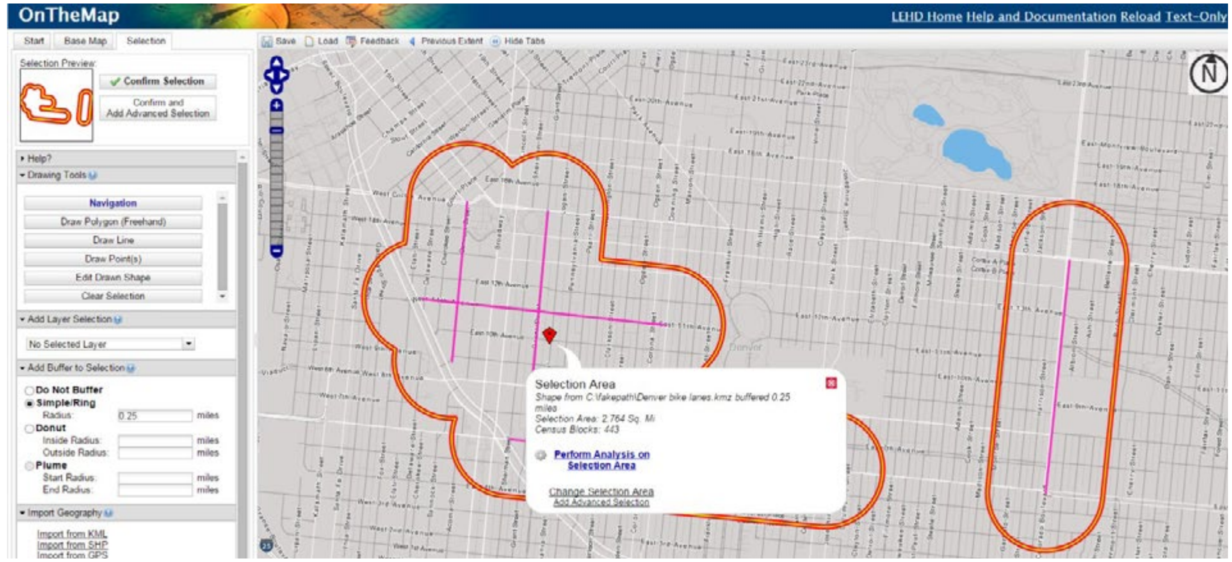
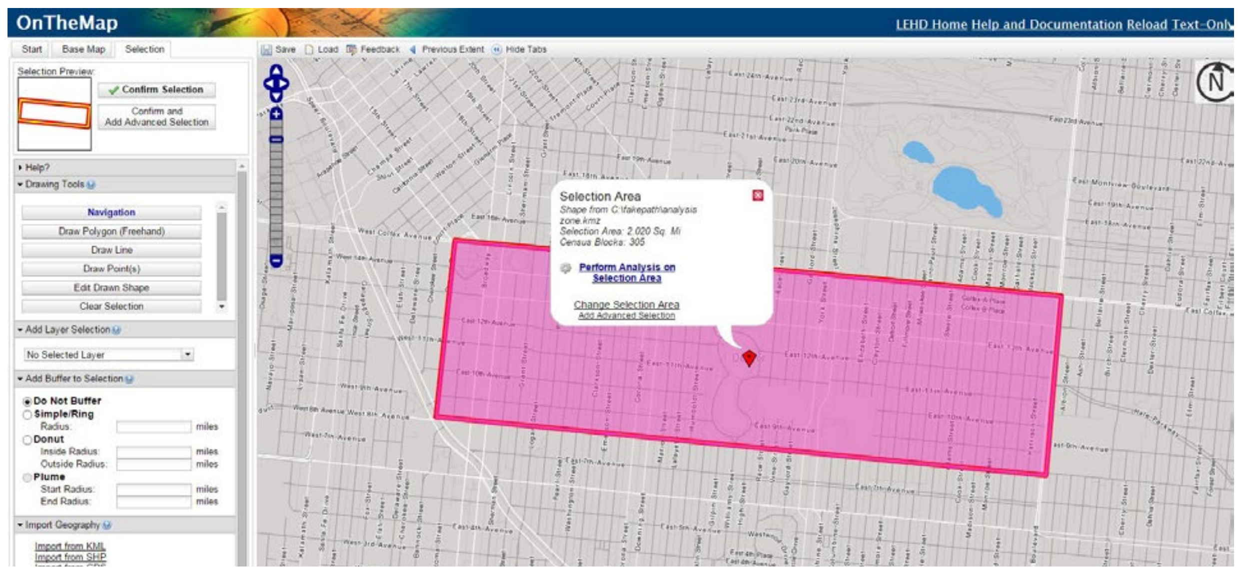


Figure A-9: Approach 2: Step 7



Approach 3: GIS Analysis

1. Create a polygon shape file of the analysis zone in GIS. Import U.S. census population data at the census block level into GIS. Import LEHD data (http://lehd.ces.census.gov/) for the census blocks contained with the analysis zone. Use the clipping tool to cut the residential and employment data to match the analysis zone. Note the number of people who live and work in the analysis zone, using the statistics tool. Because population and employment distribution is not consistent for a census block, take a percentage proportional to the area clipped.

2. Create or import an existing shape file of off-street paths and on street bike lanes. Use the network buffer tool to create a polygon shape file that is a 0.25-mile buffer of these bicycle facilities. Use the clipping tool to create a new polygon of U.S. census data and LEHD OnTheMap data that are within the 0.25-mile buffer polygon. Use the statistics tool to determine the number of residents and employees who live and work within this 0.25-mile-buffer polygon. Divide this number by the total number of people who live and work in the analysis zone, as determined previously. This will provide the percent of people that live and/or work within 0.25 mile of a high-quality bicycle facility out of the total number that live and/or work in the analysis zone.

3. The score assigned for this metric will be equal to the percent of total residents and workers who live and work within 0.25 mile of a high-quality bicycle facility.

4. Place this averaged score as the community's 0–100 Score for Metric 4: Percentage of Residents and Workers near Bike Facilities in the self-assessment worksheet. Repeat this approach for each analysis zone, as necessary.

METRIC 5: STREET NETWORK

Approach 1: Images of Street Network Grids

1. After establishing analysis zones, determine the streets and grid within the zones. Are streets curvilinear or parallel/perpendicular? Are blocks less than 700 feet long, providing a number of pedestrian options? Are there frequent cul-de-sacs and/or loops, or do local streets connect through? Assign the analysis zone a score from 0—meaning that streets are curvilinear, full of cul-de-sacs, and do not connect—to 100—meaning that all streets are parallel or perpendicular with short blocks, forming a dense grid. The following images provide illustrative examples for comparison. Determine a score between the stated ranges based on where the grid and street configuration within your analysis zone falls.

2. Review the following descriptions and accompanying images (figure A-10). Select the one that most accurately represents the analysis zone.

   a) **Score 0–20:** The street grid consists of large, curvilinear arterials that branch out into local streets that primarily end in cul-de-sacs. Almost none of the local streets connect. Arterials draw large amounts of vehicular through traffic, creating large intersections with many conflicts. This is often referred to as "lollipops on a stick."

   b) **Score 21–40:** Local streets branch off of arterials. Arterials are primarily curvilinear. Many local streets end in cul-de-sacs, but not all of them. Other local streets loop around and connect back to the same arterial they started from. Rarely do local streets connect through to a parallel arterial. This is often referred to as "loops and lollipops."

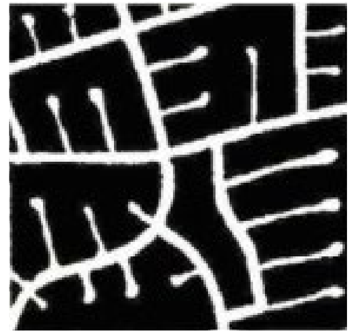
c) **Score 41–60:** There is an occasional cul-de-sac, but most streets connect. Streets are primarily curvilinear rather than parallel, disorienting the pedestrian. Most blocks are long—greater than 1,000 feet—creating fewer choices for pedestrians. There is no pattern or consistency to this distorted grid system. There are still some cul-de-sacs, but only a few.

d) **Score 61–80:** Streets are parallel and connect to each other to form a grid, but blocks are inconsistent in length, with most blocks greater than 700 feet, twice the length of a typical city block. Not all streets connect through to a perpendicular street but create an "L" shape instead, causing pedestrians to potentially detour to reach their destination.

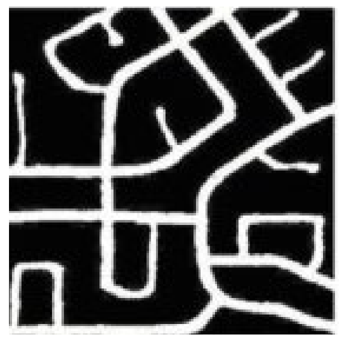
e) **Score 81–100:** All streets are parallel or perpendicular and connect to form a dense grid. Blocks are short—300 to 400 feet—providing lots of options for pedestrians and bicyclists and diffusing vehicular traffic, making for fewer conflicts at intersections.

3. Place this averaged score as the community's 0–100 Score for Metric 4: Percentage of Residents and Workers near Bike Facilities in the self-assessment worksheet. Repeat this approach for each analysis zone, as necessary.

Figure A-10: Street Network Grids

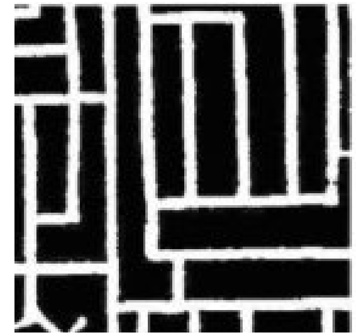


a) Score 0-20

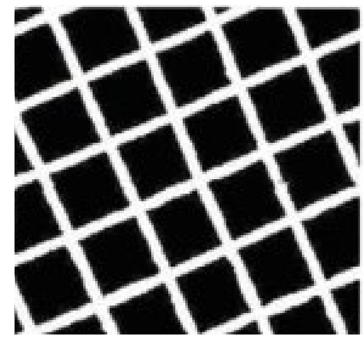


b) Score 20-40

c) Score 40-60



d) Score 60-80



e) Score 80-100

(Images Source: Southworth, M. and E. Ben-Joseph (1997). Street and the Shaping of Towns and Cities. New York, McGraw-Hill.)

Table A-3: Intersections per Square Mile

MILES OF BIKE FACILITY PER SQUARE MILE	POINTS
< 10	10
11–30	20
31–50	30
51–100	40
101–150	50
151–200	60
201–250	70
251–300	80
301–400	90
> 400	100

Approach 2: Manual Count From Google Earth

1. Open or download Google Earth Pro: www.google.com/earth/download/gep/agree.html.

2. Identify the analysis zone in Google Earth Pro. Draw a boundary around this area.

3. From Google Earth's aerial view, count the number of intersections in the zone. An intersection is defined as the junction of two or more roads meeting or crossing. The following variations would be considered one intersection: a three-way (or T) intersection, a four-way intersection, and a junction with five or more legs. Roads include alleyways and pedestrian-only streets but not sidewalks, private roads, or cul-de-sacs. All roads should be publicly accessible.

4. Open the ruler tool in Google Earth Pro, and select "Polygon." Trace the boundary of the analysis zone, and record the area in square miles, as reported by the ruler tool.

5. Divide the number of intersections counted in the analysis zone (step 3) by the size of the zone (step 5), to determine the number of intersections per square mile.

6. Using the number of intersections per square mile (step 6), determine how many points to attribute to this analysis zone using table A-4.

7. Place this averaged score as the community's 0–100 Score for Metric 5: Street Network in the self-assessment worksheet. Repeat this approach for each analysis zone, as necessary.

Approach 3: GIS Analysis

GIS allows for a more automated approach to determining the number of intersections in the study area. It is important to have an accurate shape file of the intersections within the study area. If you have a road shape file but not an intersection shape file, you can use the Intersect tool (Analysis Tools<Overlay<Intersect) to create a point shape file of intersections based on all instances where roads intersect. It is important to clean this layer, making sure that cul-de-sacs do not appear as intersections and that private roads are not counted. Be sure that you have an accurate polygon shape file of the analysis zone. Determine the number of intersections within the analysis zone by following these steps:

1. Selection<Select by Location<Select Features from "Analysis Zone Intersections," Source Layer: Analysis Zone<Spatial Selection: Are Within the Source Layer Feature. This will select all of the intersections within the analysis zone. Open the attribute table of the intersections, and note the number of points selected. Divide this by the area (in square miles) of the analysis zone. This can be determined by using the statistics tool under the polygon analysis zone shape file.

2. Award the analysis zone the number of points denoted in table A-4 based on the number of intersections per square mile calculated through this approach.

3. Place this averaged score as the community's 0–100 Score for Metric 5: Street Network in the self-assessment worksheet. Repeat this approach for each analysis zone, as necessary.

METRIC 6: SITE ACCESS AND PARKING TYPOLOGY

Approach 1: Images of a Typical Shopping Area

Using local knowledge, the self-assessment team from the community reviews a spectrum of five site and parking typology images and selects the image that most accurately depicts a representative commercial, retail, or office center for their community's analysis zone.

After establishing analysis zones, determine shopping areas and their parking configuration within the zones. Then, assign the analysis zone a score from 0—meaning vast areas of parking all located between the street's pedestrian facilities and the shopping entrance—to 100—meaning that there is no parking located on site. Look at an aerial photograph of the analysis zone.

1. Think about the quantity of vehicular parking provided and the location and distribution of that parking within the site. Is there an excess supply of parking? How much of the street or sidewalk is fronted by off-street parking? Are there pedestrian facilities and amenities throughout the parking lot?

2. Review the following images and accompanying descriptions. Select which one (a through e) most accurately represents the analysis zone.

   a) **Score 0–20:** There are very large surface parking lots primarily located between the street and the building. Each retailer generally has its own parking. It takes a long time and is dangerous to walk or bike from the street to the building entrance. (Image Source: coastalpaving.com)
   b) **Score 21–40:** There is a large amount of vehicular parking. Not all parking is between the street and the building—parking is distributed throughout the site. Buildings are slightly more pedestrian accessible from the street than in the previous image. (Image Source: cvilleshop.com)
   c) **Score 41–60:** There is only a small amount of parking between the street and the building entry. Some parking may be behind the building. There are pedestrian facilities throughout the parking area. Parking is shared among retailers. (Image Source: localsugar.co)
   d) **Score 61–80:** Parking is available close to the building entrance, but pedestrian facilities are prioritized. Parking is shared among retailers. (Image Source: visitjacksonville.com)
   e) **Score 81–100:** There is no parking between the primary pedestrian space and the building frontage. There are a large number of pedestrian facilities and amenities that provide direct access to building entrances. Customers can stroll down the pedestrian facility without a particular destination and window shop. (Image Source: philipsmarchall.net)

3. Determine a score within the 20-point range of the chosen image. Select the middle of the range (for example, 10 for 0–20) if your average street looks most like the image provided. If your typical street looks less pedestrian accessible than the image, then pick a number at the lower end of the range. If your typical street looks more pedestrian accessible than the image, then pick a number at the upper end of the range.

4. Place this averaged score as the community's 0–100 Score for Metric 6: Site Access and Parking Typology in the self-assessment worksheet. Repeat this approach for each analysis zone, as necessary.

Table A-4: Percent of Streets with Sidewalks

MILES OF BIKE FACILITY PER SQUARE MILE	POINTS
0–20%	10
21–40%	30
41–60%	50
61–80%	70
81–100%	90

METRIC 7: PERCENT OF STREETS WITH SIDEWALKS

Approach 1: Local Knowledge Estimate

1. Based on local knowledge, consider the presence and condition of sidewalks throughout the analysis zone. Think of each side of the street separately. For example, if sidewalks are complete on one side of every street but there are no sidewalks on the other side of the street, count as 50 percent of streets with sidewalks. There must be a complete sidewalk on both sides of every street to receive 100 percent. Also, only consider sidewalks that can be navigated by a wheelchair. In order for a wheelchair to navigate a sidewalk, the sidewalk should be at least 4 feet wide and the pavement or concrete should be in at least fair condition.

2. Estimate the percentage of each side of the street that has a sidewalk.

3. Using the value from step 2, determine how many points to attribute this analysis zone, using table A-5.

4. Place this averaged score as the community's 0–100 Score for Metric 7: Percent of Streets with Sidewalks in the self-assessment worksheet. Repeat this approach for each analysis zone, as necessary.

Approach 2: Google Earth Aerial Imagery Review

1. Identify the analysis zone in Google Earth.

2. In aerial view, look at each side of the street separately, measuring the miles of sidewalk with the ruler tool that appears to be wheelchair accessible—estimated to be at least 4 feet wide with pavement that appears to be in at least fair condition. For example, if sidewalks are complete on one side of every street but there are no sidewalks on the other side of the street, this would be considered 50 percent of streets with sidewalks. There must be a complete sidewalk on both sides of every street to receive 100 percent. Divide the length of wheelchair-accessible sidewalk summed from each side by the total length of both sides of the street combined, whether or not a sidewalk is present (also equal to double the centerline mileage). The resulting decimal will be the percent of streets with sidewalk.

3. Place this score as the community's 0–100 Score for Metric 7: Percent of Streets with Sidewalks in the self-assessment worksheet. Repeat this approach for each analysis zone, as necessary.

Approach 3: Google Earth Street View Review

1. Identify the analysis zone in Google Earth.
2. Looking at each side of the street separately, use the ruler tool to measure the miles of sidewalk that appears to be wheelchair accessible. Wheelchair accessibility can be determined by sidewalks that measure at least 4 feet wide with the ruler tool in aerial view and appear to have at least fair pavement condition in street view. Consider each side of the street separately. For example, if sidewalks are complete on one side of every street but there are no sidewalks on the other side of the street, this would be considered 50 percent of streets with sidewalks. There must be a complete sidewalk on both sides of every street to receive 100 percent. Divide the length of wheelchair-accessible sidewalk on both sides of the street combined by the total length of both sides of the street combined, whether or not a sidewalk is present (also equal to double the centerline mileage). The resulting decimal will be the percent of streets with sidewalk.
3. Place this score as the community's 0–100 Score for Metric 7: Percent of Streets with Sidewalks in the self-assessment worksheet.

Approach 4: Field Inventory

1. Print a map of the analysis zone or zones, and take it into the field, along with a measuring wheel or tape, level, and clipboard. Evaluate and measure the sidewalk of each side of the street separately. All existing sidewalks must meet ADA accessibility standards, which can be located in Section 4.3 Access Characteristics in the following document: http://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/sidewalks/chap4a.cfm. A summary of these guidelines is in the following list. Refer to the document and any state or local ADA policies for more detailed guidance.
   - Sidewalks must have 4 feet of clear space, not including curb width.
   - The grade of the sidewalk is not to exceed 5 percent.
   - Cross-slopes should not exceed 2 percent.
   - There must be 80 inches of unobstructed vertical passage space.
   - Changes in level of sidewalk are not to exceed 0.25 inch.
   - Grates located in walking surfaces should have spaces no greater than 0.5-inch wide in one direction.
   - Objects projecting from walls that have leading edges of 27–80 inches should not protrude more than 4 inches into walks and passageways.
   - Sidewalk surfaces should be firm, stable, and slip resistant.
2. Consider each side of the street separately. For example, if sidewalks are complete on one side of every street but there are no sidewalks on the other side of the street, this would be considered 50 percent of streets with sidewalks. There must be a complete sidewalk on both sides of every street to receive 100 percent. Divide the length of wheelchair-accessible sidewalk on both sides of the street combined by the total length of both sides of the street combined, whether or not a sidewalk is present (also equal to double the centerline mileage). The resulting decimal will be the percent of streets with sidewalk.
3. Place this score as the community's 0–100 Score for Metric 7: Percent of Streets with Sidewalks in the self-assessment worksheet. Repeat this approach for each analysis zone, as necessary.

Table A-5: Percent of Corners with Curb Ramps

MILES OF BIKE FACILITY PER SQUARE MILE	POINTS
0–20%	10
21–40%	30
41–60%	50
61–80%	70
81–100%	90

METRIC 8: PERCENT OF CORNERS WITH CURB RAMPS

Approach 1: Local Knowledge Estimate

1. Think about the intersections in the analysis zone, both signalized and unsignalized.

2. Think about the curb ramps of each intersection and whether they are ADA compliant. Refer to ADA Accessibility Survey Instructions for curb ramps to more specifically explore the geometrics that determine whether a curb ramp is ADA compliant: http://www.ada.gov/pcatoolkit/app1curbramps.pdf. In order for a curb ramp to be ADA compliant, use your best judgment to determine if each corner and ramp satisfies the following criteria—

    - Has a separate, directional curb ramp for each crossing leg. For corners with one diagonal crosswalk, there should be 4 feet between the ramp and crosswalk striping to allow wheelchairs to turn into the crosswalk before the start of vehicle traffic.
    - Ramp slope and width that can be maneuvered by a wheelchair.
    - Three feet of clear sidewalk space before the start of the ramp.
    - Detectable warning material along the width and length of the ramp.

3. Estimate the percentage of corners that have ADA-compliant curb ramps.

4. Using the value from step 3, determine how many points to attribute this analysis zone, using table A-6.

5. Place this averaged score as the community's 0–100 Score for Metric 8: Percent of Corners with Curbs Ramps in the self-assessment worksheet. Repeat this approach for each analysis zone, as necessary.

Approach 2: Google Earth Desktop Inventory

1. Draw or note the analysis zone limits in Google Earth.

2. Go to each intersection (signalized and unsignalized) in the analysis zone in street view, and take an inventory of the curb ramps on every corner. Refer to ADA Accessibility Survey Instructions for curb ramps to more specifically explore the geometrics that determine whether a curb ramp is ADA compliant: http://www.ada.gov/pcatoolkit/app1curbramps.pdf. In order for a curb ramp to be ADA compliant, use your best judgment to determine if each corner and ramp satisfies the following criteria—

    - Has a separate, directional curb ramp for each crossing leg. For corners with one diagonal crosswalk, there should be 4 feet between the ramp and crosswalk striping to allow wheelchairs to turn into the crosswalk before the start of vehicle traffic.
    - Ramp slope and width that can be maneuvered by a wheelchair.
    - Three feet of clear sidewalk space before the start of the ramp.
    - Detectable warning material along the width and length of the ramp.

3. Estimate the percent of corners that have ADA-compliant curb ramps.

4. Using the value from step 3, determine how many points to attribute this analysis zone, using table A-6.

5. Place this score as the community's 0–100 Score for Metric 8: Percent of Corners with Curbs Ramps in the self-assessment worksheet. Repeat this approach for each analysis zone, as necessary.

Approach 3: Field Inventory

1. Print a map of the analysis zone, and take it into the field, along with a measuring wheel or tape, level, and clipboard. Go to each intersection (signalized and unsignalized) in the analysis zone, and take an inventory of the curb ramps on every corner. Refer to ADA Accessibility Survey Instructions for curb ramps to more specifically explore the geometrics that determine whether a curb ramp is ADA compliant: http://www.ada.gov/pcatoolkit/app1curbramps.pdf. A summary of ADA-accessible criteria for curb ramps includes—

    - There should be a separate curb ramp in the direction of each approach leg. If there is only one diagonal curb ramp, use the measuring wheel to determine if there is 48 inches between the curb ramp and the painted crosswalk, providing enough room for a wheelchair to turn before entering the space designated for vehicle traffic. If a diagonal curb ramp does not have 48 inches, it will be counted as not having an adequate curb ramp.
    - The width of the ramp, not including flared sides, should be 36 inches.
    - The slope should not exceed 10 percent for a 6-inch rise or 12.5 percent for a 3-inch rise.
    - The slope across the ramp should not exceed 2 percent.
    - The slope of the gutter should not exceed 5 percent.
    - The ramp should be flush where it meets the gutter and where it meets the sidewalk.
    - Detectable warning material should be present along the width and length of the ramp.
    - Vehicles should be prohibited from parking in front of the curb ramp.
    - The curb ramp should have 36 inches of clear space at its preceded sidewalk.
    - The slope of the curb ramp's flared sides may not exceed 8.33 percent when there is less than 48 inches between the top of the curb ramp and the edge of the sidewalk.
    - The entire curb ramp, not including the flared sides, should be within the marked crosswalk.

2. Divide the total number of corners with wheelchair-accessible curb ramps by the total number of corners in the study area. The score received for this metric will be equal to the percent of corners with wheelchair-accessible curb ramps.

3. Place this score as the community's 0–100 Score for Metric 8: Percent of Corners with Curbs Ramps in the self-assessment worksheet. Repeat this approach for each analysis zone, as necessary.

Table A-6: Distance Between Marked Crosswalks

MILES OF BIKE FACILITY PER SQUARE MILE	POINTS
> 2,500	0
1,001–2,500	20
701–1,000	40
401–700	60
200–400	80
< 200	100

METRIC 9: DISTANCE BETWEEN MARKED CROSSINGS

Approach 1: Google Earth Measurement

1. Determine the densest destination corridor within the analysis zone. This will be the street through the area that has the most commercial and retail destinations. It can be determined through local knowledge, observing the density from a Google Earth aerial, or referring to a zoning map for a commercial corridor overlay district.

2. Determine the points between which the corridor has commercial or retail land uses. If the whole analysis zone is residential, pick the corridor with the most residences (identifying apartments or multifamily homes is a good start).

3. In Google Earth, use the ruler tool to measure the distance between marked crosswalks, either at intersections or mid-block, along this corridor between the predetermined extents. A marked crosswalk can be as simple as two parallel painted lines or it may be something of higher visibility. In order for a mid-block crossing at a four-lane road to qualify, it should have a median refuge island and a beacon or signal.

4. Average the distances measured in step 3.

5. Use table A-7 to assign a point value to the value from step 4.

6. Place this score as the community's 0–100 Score for Metric 9: Distance Between marked Crosswalks in the self-assessment worksheet. Repeat this approach for each Analysis Zone, as necessary.

Approach 2: Field Measurement

1. Follow the same steps 1 and 2 listed in Approach 1: Google Earth Measurement.

2. In the field, use a measuring wheel to measure the distance between marked crosswalks, either at intersections or mid-block, along this corridor between the predetermined points. A marked crosswalk can be as simple as two parallel painted lines, or it may be something of higher visibility. In order for a mid-block crossing at a four-lane road to qualify, it should have a median refuge island and a beacon or signal.

3. Average the distances measured between each of the marked crosswalks. Use table A-7 to assign a point value to the average distance between marked crosswalks.

4. Place this score as the community's 0–100 Score for Metric 9: Distance Between marked Crosswalks in the self-assessment worksheet. Repeat this approach for each analysis zone, as necessary.

SELF-ASSESSMENT TOOL

Instructions for Self-Assessment worksheet

Note: Delete and replace the sample text in the light green cells. This sample text serves as an example, and should be filled in by the evaluation B2:D3

1. Identify all of the analysis zones within the community.
2. Place the name of each analysis zone in cell C3 in each of the tabs in this worksheet. Leave unused tabs with blank entries.
3. Estimate the percent of the community that is comprised of each analysis zone (based on your judgment or data about the zone's area, population, or relative importance in the community). Input these values in the "Zone Weighting" column of the summary tab.
4. For each zone, use the table and text in the self-assessment to determine the most appropriate approach for each metric from the drop down in cells C6 through C14. Within the same metric the approach will likely be the same for all zones, unless a certain zone has more or fewer resources than other zones.
5. You can use the recommended weights (cells D6 through D14, based on best practices and professional judgment) or identify community and zone-specific weights based on your community's priorities.

Figure A-11: Self-Assessment Tool Summary

Zone	Zone Description	Zone Weighting	Land Use Diversity	Number of Jobs within 15 minutes (Walk/Bike)	Low-Stress Roadways	Percentage of Residents and Workers Near High-Quality Bike Facilities	Street Network	Site Access and Parking Typology	Percent of Streets with Sidewalks	Percent of Corners with Curb Ramps	Distance Between Marked Crossings	Overall Community Self-Assessment Score
	Pre-Evaluation Scores											
	Average Score:		**10.0**	**35.0**	**42.0**	**68.0**	**80.0**	**90.0**	**100.0**	**40.0**	**50.0**	**56.0**
1	Downtown	100%	10	35	42	68	80	90	100	40	50	56.0
2	Oak Park	0%	0	0	0	0	0	0	0	0	0	0.0
3	Rolling Hills	0%	0	0	0	0	0	0	0	0	0	0.0
4	Happy Valley	0%	0	0	0	0	0	0	0	0	0	0.0
5	Kensington	0%	0	0	0	0	0	0	0	0	0	0.0
6	Villa Pancho	0%	0	0	0	0	0	0	0	0	0	0.0
7	Shawnee Heights	0%	0	0	0	0	0	0	0	0	0	0.0
8	Bon Air	0%	0	0	0	0	0	0	0	0	0	0.0
	Post-Evaluation Scores											
	Average Score:		**10.0**	**40.0**	**50.0**	**70.0**	**80.0**	**90.0**	**100.0**	**65.0**	**75.0**	**62.7**
1	Downtown		10	40	50	70	80	90	100	65	75	62.7
2	Oak Park		0	0	0	0	0	0	0	0	0	0.0
3	Rolling Hills		0	0	0	0	0	0	0	0	0	0.0
4	Happy Valley		0	0	0	0	0	0	0	0	0	0.0
5	Kensington		0	0	0	0	0	0	0	0	0	0.0
6	Villa Pancho		0	0	0	0	0	0	0	0	0	0.0
7	Shawnee Heights		0	0	0	0	0	0	0	0	0	0.0
8	Bon Air		0	0	0	0	0	0	0	0	0	0.0
	Change											
	Average Score:		**0.0**	**5.0**	**8.0**	**2.0**	**0.0**	**0.0**	**0.0**	**25.0**	**25.0**	**6.7**
1	Downtown		0	5	8	2	0	0	0	25	25	6.7
2	Oak Park		0	0	0	0	0	0	0	0	0	0.0
3	Rolling Hills		0	0	0	0	0	0	0	0	0	0.0
4	Happy Valley		0	0	0	0	0	0	0	0	0	0.0
5	Kensington		0	0	0	0	0	0	0	0	0	0.0
6	Villa Pancho		0	0	0	0	0	0	0	0	0	0.0
7	Shawnee Heights		0	0	0	0	0	0	0	0	0	0.0
8	Bon Air		0	0	0	0	0	0	0	0	0	0.0

Figure A-12: Zone 1 Example: Steps 1-5

Analysis Zone 1	1 **Analysis Zone Description**		***Pre-Evaluation***	***Post-Evaluation***	***Change***	***Accuracy, Resources, and Effort***		
	Downtown		Date:	Date:				
Metric	2 **Selected Approach**	3 **Weight** (0.8, 1.0, 1.2; low to high)	**Score** (0-100, low to high)	**Score** (0-100, low to high)	**Score** (0-100, low to high)	**Accuracy** (1-3, low to high)	**Resources** (1-3, low to high)	**Effort** (1-3, low to high)
Land Use Diversity	Images of a Land Use Map	1.2	10	10	0	1	1	2
Number of Jobs within 15 minutes (Walk/Bike)	LEHD OnTheMap	1	35	40	5	2	2	2
Percentage of Low-Stress Roadways	Simplified LTS Table	1.2	42	50	8	2	2	2
Percentage of Residents and Workers Near High-Quality Bike Facilities	Miles of Bike Facilities per Capita Calculation (proxy)	1	68	70	2	2	1	1
Street Network	Images of Street Network Grids	1.2	80	80	0	1	1	1
Site Access and Parking Typology	Images of Typical Shopping Area	0.8	90	90	0	1	1	1
Percent of Streets with Sidewalks	Google Earth Aerial Imagery Review	1	100	100	0	2	1	2
Percent of Corners with Curb Ramps	Local Knowledge Estimate	0.8	40	65	25	1	1	1
Distance Between Marked Crosswalks	Google Earth Measurement	1	50	75	25	2	1	3
Overall Community Self-Assessment Weighted Average Score:			**56.0**	**62.7**	**6.7**			

6. After completing the pre-evaluation for each metric based on the instructions provided in the guide, fill out cells E6 through E14 with the resulting score. Fill in the date or date range of the pre-evaluation in cell E3.

7. The final, weighted score from the pre-evaluation will auto-fill in Cell E15.

8. Once you have completed a post-evaluation, fill in cells G6 through G14 with those results. Fill in the date or date range of the post-evaluation in cell G3.

9. The final, weighted score from the post-evaluation will auto-fill in Cell G15.

10. Fill in additional indicators (columns O and P, cells 5-18, 20-35) as described in the guide.

11. The summary tab will auto-fill completely, except for the Zone Weighting selected in step 3. This provides a summary of the key information from each analysis zone as well as an overall weighted Community Self-Assessment Score.

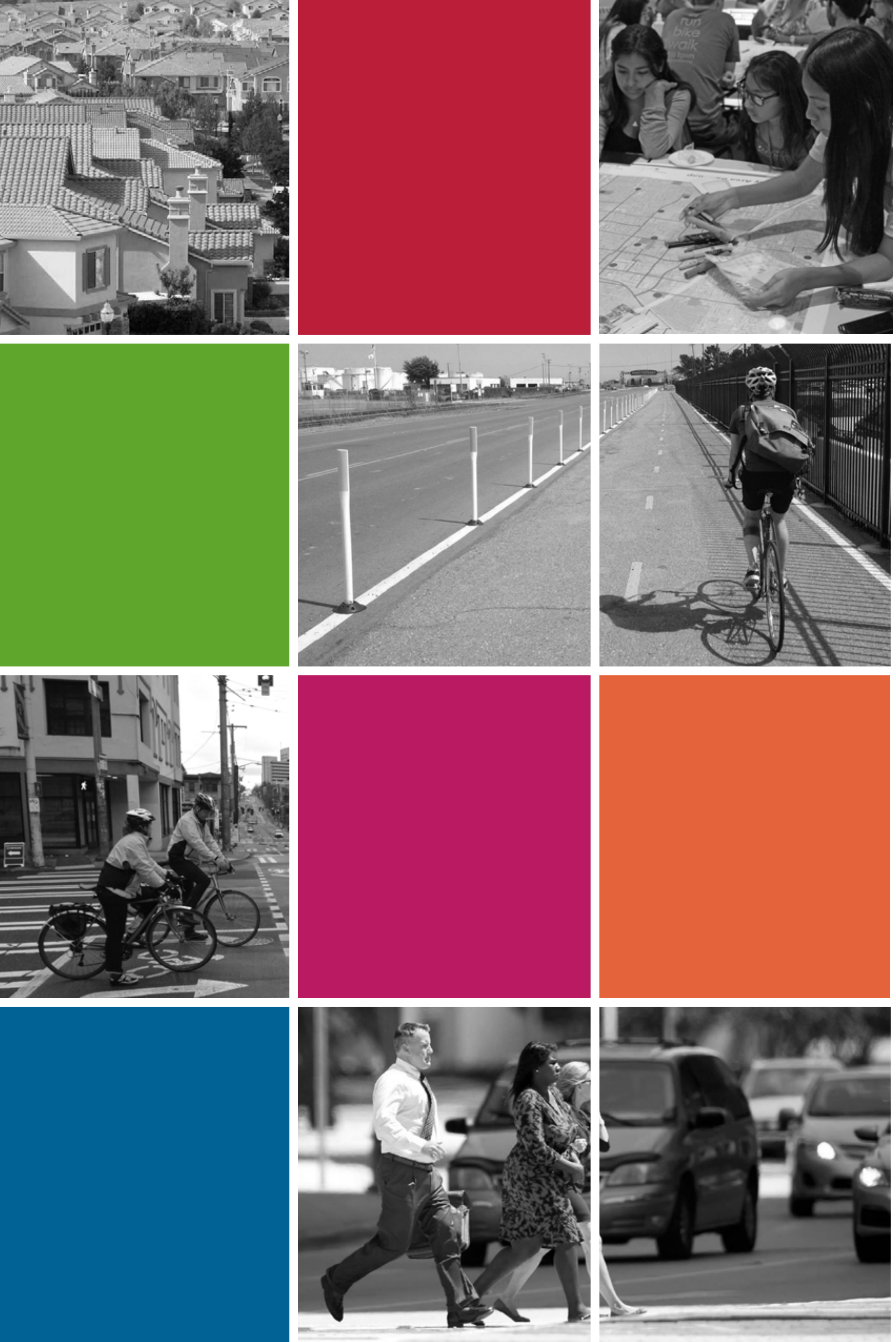
Figure A-13: Zone 1 Example: Steps 6-11

Analysis Zone 1	**Analysis Zone Description** Downtown		*Pre-Evaluation* Date:	*Post-Evaluation* Date:	*Change*	*Accuracy, Resources, and Effort*		
Metric	**Selected Approach**	**Weight** (0.8, 1.0, 1.2; low to high)	**Score** (0-100, low to high)	**Score** (0-100, low to high)	**Score** (0-100, low to high)	**Accuracy** (1-3, low to high)	**Resources** (1-3, low to high)	**Effort** (1-3, low to high)
Land Use Diversity	Images of a Land Use Map	1.2	10	10	0	1	1	2
Number of Jobs within 15 minutes (Walk/Bike)	LEHD OnTheMap	1	35	40	5	2	2	2
Percentage of Low-Stress Roadways	Simplified LTS Table	1.2	42	50	8	2	2	2
Percentage of Residents and Workers Near High-Quality Bike Facilities	Miles of Bike Facilities per Capita Calculation (proxy)	1	68	70	2	2	1	1
Street Network	Images of Street Network Grids	1.2	80	80	0	1	1	1
Site Access and Parking Typology	Images of Typical Shopping Area	0.8	90	90	0	1	1	1
Percent of Streets with Sidewalks	Google Earth Aerial Imagery Review	1	100	100	0	2	1	2
Percent of Corners with Curb Ramps	Local Knowledge Estimate	0.8	40	65	25	1	1	1
Distance Between Marked Crosswalks	Google Earth Measurement	1	50	75	25	2	1	3
Overall Community Self-Assessment Weighted Average Score:			**56.0**	**62.7**	**6.7**			

Additional Indicators	**Pre-Evaluation Value**	**Post-Evaluation Value**	**Change**
Outcome Measures			
Walk Score	56	58	2
Bike Score	42	52	10
Bicycle Count	4,852	5,266	414
Pedestrian Count	10,947	12,055	1,108
Bicycle Commute Mode Share	1.2%	1.9%	0.7%
Pedestrian Commute Mode Share	8.5%	9.6%	1.1%
Pedestrian PDO crash rate per 100,000 population	4.55	4.21	-0.34
Pedestrian injury crash rate per 100,000 population	2.12	1.50	-0.62
Pedestrian fatality crash rate per 100,000 population	0.09	0.07	-0.02
Bicycle PDO crash rate per 100,000 population	3.10	2.22	-0.88
Bicycle injury crash rate per 100,000 population	2.10	1.84	-0.26
Bicycle fatality crash rate per 100,000 population	0.30	0.22	-0.08
Government employees working on bicycle- and pedestrian-related issues (FTEs)	0.0	0.5	0.5
Percent of sidewalks with at least two urban design features	28%	45%	17%

Actions and Initiatives			
Adopted bicycle plan (0/1)	0	0	0
Adopted pedestrian plan (0/1)	0	0	0
Bicycle advocacy group (0/1)	0	1	1
Pedestrian advocacy group (0/1)	0	0	0
Adopted ADA transition plan (0/1)	0	1	1
Bikeshare program (0/1)	0	0	0
Bike parking ordinance (0/1)	0	0	0
Number of bike parking spaces	470	550	80
Regular maintenance of pedestrian facilities (0/1)	1	1	0
Regular maintenance of bicycle facilities (0/1)	1	1	0
Safe Routes to School programming (0/1)	0	1	1
Walking map (0/1)	0	0	0
Bicycling map (0/1)	0	0	0
Pedestrian intercept survey (0/1)	0	0	0
Bicyclist intercept survey (0/1)	0	0	0
Number of traffic calming practices implemented	0	2	2

Note: Pre-filled values are fictitious examples only.



APPENDIX B:
DESIGN TOOLS

Develop Multi-Modal Transportation Plans (MM)

For multi-modal plans, communities should consider—

MM-1: Developing transportation plans that focus on the improved mobility and accessibility of people and goods rather than of automobiles.

MM-2: Developing plans that include goals of lowering overall vehicle miles traveled and greenhouse gas emissions.

MM-3: Recognizing the interrelationship between different transportation modes, and planning accordingly (i.e. transit enables longer biking and walking trips; biking and walking enable "first/last mile" connections to transit).

MM-4: Utilizing Transportation Demand Management measures to maximize the use of existing facilities (e.g. active transportation, transit, ridesharing, telecommuting, ITS)

MM-5: Matching transportation investments with planning goals.

MM-6: Considering how the transportation network is connected. (e.g. whether people living in residential areas can walk or bike to employment centers, shopping, schools, parks, and transit hubs).

Develop Land Use and Transportation Plans Concurrently (LT)

For the concurrent development of land use and transportation plans, communities should consider—

LT-1: Highlighting the synergy between land development and transportation projects.

LT-2: Reinforcing land use and transportation goals and policies with transportation options.

LT-3: Demonstrating why biking and walking are key to the development of compact communities.

LT-4: Building "10-minute neighborhoods" on a strong foundation of active transportation options and street connectivity so that most daily needs can be met with a 10-minute walk, bike ride, or transit trip.

LT-5: Providing a balanced mix of housing, working, shopping, recreation, and civic uses to lower long-distance commute requirements.

LT-6: Developing parking and site-planning goals that support walking, transit use, and biking.

LT-7: Using building design standards, including building scale and orientation, that are inviting and accessible to people arriving on foot, bike, and transit.

LT-8: Adopting a standard of short block lengths (200–400 feet), street connectivity, and/or intersection density. (These principles are crucial to providing more options—routes—to people who walk and bike.)

Suggest Other Means of Interjecting Bicycle and Pedestrian Planning (OM)

For other means of interjecting bicycle and pedestrian planning, communities should consider—

OM-1: Developing policies of routine accommodations that require appropriate bicycle and pedestrian accommodation in all new and major redevelopment projects.

OM-2: Developing policies of adding or improving bicycle facilities during routine street resurfacing (slurry sealing) and striping projects by way of lane diets or road diets.

OM-3: Developing a policy of street reclamation, wherein underused street space is reclaimed for biking, walking, plazas, or other "higher" public uses.

OM-4: Developing policies of multi-modal mitigation, wherein developers mitigate their transportation impacts by providing multi-modal, rather than automobile-only, improvements (e.g. allowing bike parking to substitute for car parking spaces).

OM-5: Developing policies for parking exemptions, in which developers are exempt from providing vehicle parking in certain districts and instead contribute to multi-modal improvements, including bicycle parking (see land use case study on Gainesville, Florida in chapter 4).

OM-6: Adopting a complete streets policy, pledging to accommodate all modes of transportation in future roadway design.

OM-7: Prioritizing bicycle and pedestrian capital improvement projects (CIPs), and establishing goals for their implementation.

OM-8: Creating an ADA transition plan that identifies necessary accessibility improvements and establishes goals and prioritization of implementation.

B-2: Land Use Tools

Neighborhoods (N)

For neighborhoods, communities should consider—

N-1: Providing users from "8 to 80 years old" access and use of streets. This helps create successful cities for everyone. Streets are the living rooms and playrooms of the neighborhood and may be designed mainly for the safety and enjoyment of pedestrians while still accommodating vehicular use. Streets in nonresidential areas can be focused on movement, but neighborhood streets should be focused on living.

N-2: Designing streets with sidewalks, flanked by street trees and landscaped parkway strips on the public side and landscaped front yards on the private side.

N-3: Encouraging on-street parking in neighborhoods where right-of-way widths permit. On-street parking serves visitors and residents and provides a valuable buffer between pedestrians, children at play, and passing traffic.

N-4: Placing residences to front the street with gracious front doors and overlook the street with windows to provide a sense of security through eyes on the street.

N-5: Designing front doors of houses to be closer to the street than the garage to emphasize the home over automobile storage and to bring eyes closer to the street.

N-6: Providing access to parking and garages via alleys and driveways from side streets so that automobiles cause minimal disruption to the pedestrian environment (sidewalks). When necessary, a driveway from the front of a lot to access a garage located behind or beside the residence can be as narrow as possible, and the walkway and driveway design should clearly indicate that the driver is crossing a pedestrian area instead of the pedestrian crossing a driving area.

Corridors (C)

For corridors, communities should consider—

C-1: For short- to mid-length corridors that are no longer being used effectively as commercial corridors, lining the majority of the corridor with uses, including neighborhood centers at appropriate nodes and densities; multifamily housing of various types; and single-family housing appropriately buffered with landscaped setbacks.

C-2: Avoiding forms of "pure buffers," such as sound walls and berms, because they can disconnect the city and should be employed only as a last resort.

C-3: Integrating the community visioning process with transit-planning processes and retail capacity studies to determine the ideal location and size of neighborhood centers.

C-4: Conducting analyses to define existing or emerging character by segment, potential nodes and centers, or destinations that are focused on pedestrian activity.

C-5: Including a mix of land uses at specific nodes that encourage people to make trips by walking and bicycling.

C-6: Creating design standards for development within the segments that will remain automobile oriented and allow the segments to be made as pedestrian- and bicycle-friendly as possible by minimizing the number of curb cut locations and widths that interrupt the sidewalk; using buffering from on-street parking so that the walk environment is made safer and more comfortable; and providing setbacks for landscaping and transit amenities, where possible, to encourage transit use.

C-7: Encouraging appropriately scaled buildings on either side of the corridor to create, but not overshadow, the pedestrian environment. Consult closely with the residents of adjoining neighborhoods to ensure that building size matches community expectations.

Districts (D)

For districts, communities should consider—

D-1: Organizing special-use districts around a balanced street network, with development standards to ensure that the urban design does not exclude pedestrians and bicyclists.

D-2: Allowing other uses (e.g., restaurants, cafes, and small convenience stores) within the area to provide a pedestrian-friendly street frontage that encourages employees or visitors to travel from nearby businesses on foot.

D-3: Establishing safety measures for bicycles and pedestrians, understanding that major corridors entering special-use districts typically carry heavier traffic and trucks.

D-4: Ensuring that street networks have clear paths of travel for truck traffic that do not encroach on sidewalks. Instead of widening roadways or travel lanes to provide this buffer, provide parkways, street furnishing zones, widened sidewalks, and so forth, that both enhance the pedestrian realm and further separate pedestrians from roadway traffic.

D-5: Designing buildings to create a good public face along streets, with unattractive uses behind buildings or screened by fences and landscaping.

D-6: In uses such as medical centers, designing the building frontage and entrances onto the campus and its individual buildings from the sidewalk to be pedestrian friendly and to accommodate people with mobility impairments. Services open to the public, such as cafés and gift shops, may face the street.

D-7: Designing educational campuses, which generally are composed of larger areas without public streets, to have a clear network of pedestrian paths and streets that encourage walking and biking, not driving, and allow neighboring pedestrians and bicyclists to pass through the campus.

D-8: Providing setbacks that vary based on the street and sidewalk character of the buildings. Landscaping along public sidewalks and shade trees should be provided to reduce the effects of urban heat islands, which are common in highly paved industrial districts.

D-9: Using on-street parking to buffer pedestrians from faster-moving traffic, and, where provided, on-site parking that is connected to clear, safe pedestrian pathways.

D-10: Designing loading docks and service functions to avoid conflicts with pedestrian entrances from sidewalks into the facility.

Centers

Village Centers (VC)

For village centers, communities should consider—

VC-1: Including a high level of mixed use, providing an array of goods, services, employment, and residential options that can function both as an extension of the adjoining neighborhoods and as a convenient destination for people passing through.

VC-2: Designing buildings to face the primary street to engage pedestrians and create a livelier street environment.

VC-3: Where vertical mixed use is feasible, locating commercial uses that provide convenient goods and services to customers on the ground floor, with upper floors as residential or office space.

VC-4: Using street trees, landscaped areas/planters, street furniture, decorative lampposts, and public art to create a sense of place and a safe and enjoyable pedestrian environment.

VC-5: Within setback areas, locating forecourts with sidewalk dining, narrow landscape zones that soften the streetscape while allowing views of the shops, and simple shop fronts built right to the sidewalk

VC-6: When designing purely residential buildings in village centers, ensuring the ground-floor street interface provides a degree of privacy for the residents, either by setting the building back behind a landscaped yard or raising the ground floor above the sidewalk level, or both.

VC-7: Where off-street parking is required, locating it behind the building or underground whenever possible rather than between the sidewalk and the buildings.

VC-8: Reducing the number of required large off-street parking structures or lots through shared use, by which people whose peak parking demand in the daytime (for offices) share the parking space with those whose peak use is at night (e.g., dinner restaurants and residences). This saves cost, improves environmental effects, and improves the urban environment for people.

VC-9: Utilizing plazas in village centers, which can create opportunities for resident interaction.

Town Centers (TC)

For town centers, communities should consider—

TC-1: Combining government agencies, major employers, cultural facilities, and commercial retail centers into a more concentrated core of the community that will result in a destination and a level of street activity that occurs when an individual parks his or her vehicle and does a number of chained activities during that visit.

TC-2: Encouraging a central parking lot, concentrated areas of on-street parking, or a parking structure that is centrally located, and arranging a number of land uses around that site that are synergistic in providing a sense of place and a variety of purposes that will result in people walking throughout the center.

TC-3: Using wayfinding, public art, and urban form to emphasize the center of the community.

TC-4: Investing in an extensive street revitalization program that has wider walkways, great interconnection of many facilities with walkways, a strong streetscape program with large trees, and street furnishings.

TC-5: Emphasizing the center of town by creating a visible presence in the roadway environment, with major pedestrian crossing facilities such as high-visibility marked crosswalks, pedestrian crossing warning signs, mid-block crossings, bulb-outs, and protected parking lanes with angled parking.

Urban Centers (UC)

For urban centers, communities should consider—

UC-1: Ensuring that transit services and amenities connect to and complement pedestrian and bicycle networks. Urban centers require a suite of mobility options to serve large populations and prevent auto congestion.

UC-2: Promoting a mix of uses to provide an array of goods, services, employment, and housing along with important public and cultural institutions.

UC-3: Designing buildings to face the primary street (which often can be more than one side of a block) and support an active pedestrian environment.

UC-4: Designing buildings in large urban centers to form a consistent street wall (following a consistent pattern of setback and height); the street wall typically is at the back of a wide sidewalk.

UC-5: Designing the ground floor-street interface to provide a degree of privacy for the residents of purely residential buildings, with residences normally set back from and raised above the sidewalk.

UC-6: Ensuring that windows from offices and other interior spaces overlook the street to support an environment that feels safe. Commercial uses generally front the sidewalk with large, transparent shop fronts, but some institutional and office uses commonly connect to the sidewalk environment with lobbies and foyers instead.

UC-7: Designing porte-cochère or drop-off areas, for hotels and office buildings that require them, to occur at the street edge along the curb zone to avoid interrupting the sidewalk. When such off-street vehicular access must be provided, it may be integrated into a forecourt or entry plaza that is designed first as a public space for people and incidentally allows vehicular access. The width of the pedestrian zone can be maintained throughout; the furniture and/or frontage zones can be reduced.

UC-8: Including on-street parking to buffer pedestrians from faster-moving traffic

UC-9: Requiring above-grade structured parking to be lined with ground-floor active uses that front the street rather than either exposed or hidden with blank walls. Upper floors can be screened, at a minimum, or preferably located behind inhabited portions of the building, which may continue to face the street.

UC-10: Placing surface parking lots behind a building that fronts the sidewalk and public street, or, at a minimum, screened with attractive landscaping or public art to provide a comfortable street edge for passing pedestrians. Vendor kiosks or "slim stores" can also be used for this purpose.

UC-11: Establishing a district parking strategy that creates a supply of available parking that is shared by many uses, whose peak parking demands will be at different times of the day and the week. This, together with a strong transit component and an attractive walking and biking environment, will reduce the required amounts of parking.

Housing Choices

Select Sites To Develop That Are Already Walkable and Bikeable (HL)

To select sites that are already walkable and bikeable, communities should consider—

HL-1: Checking walk and bike scores, which will indicate the general walkability and bikeability of an area.

HL-2: Understanding the demographics of the potential users of a future project, which is important in determining the types of destinations and job locations that these future users may have as a priority. Siting near employment centers is important, as would be siting near educational centers. Providing nearby destinations of interest to future residents is one way of ensuring that some people in the proposed project will decide to walk or bike to their destinations.

HL-3: Looking for major destinations up to 0.5 mile from the proposed project site to gauge walkability.

HL-4: Utilizing 3 miles for biking to gauge bikeability, depending on street network barriers and stress levels of adjacent streets.

HL-5: Assuming 5 miles for transit distance, which includes a 0.5-mile walk time zone for the first and last segments of the trip and 4 miles of transit travel time. Of course, some will travel much greater distances on transit and by car for what they consider local destinations. In order to lower overall vehicle miles traveled, even a 5-mile drive to major destinations can save significant energy, improve air quality, and lower congestion.

Concentrate Housing Near Transit (HT)

To concentrate housing near transit, communities should consider—

HT-1: Locating the housing project within 3 miles of a major transit hub. An express or rapid bus-based transit system would need to be within 1 to 2 miles. Standard bus services with longer wait times may be able to only attract riders from less than 1 mile.

HT-2: Planning the new project so its future users can easily get to and from transit stations or, better yet, accommodate them on site.

HT-3: Providing on-site connections and improvements to near-site transit services.

HT-4: Supporting an on-site or near-site bike-share or carshare program.

HT-5: Providing a drop-off zone for rideshare (Uber, Lyft, carpool, and vanpool) options to accommodate newer rideshare trends.

Provide a Variety of Housing Sizes (HS)

To concentrate housing near transit, communities should consider—

HS-1: Providing a mixture of sizes from studios to three-bedroom units that are efficient with the size of the spaces to keep the units affordable.

HS-2: Recognizing the trends that have many single-occupant households as well as combined friends, nontraditional family types, and extended-family living situations.

Provide a Mixture of Rentals and For-Sale Units (HM)

To concentrate housing near transit, communities should consider—

HM-1: Focusing on integrating affordable units with the market-rate units.

HM-2: Allowing for an intra-building mix of for-sale units and rental units, or allow for subleasing on a more liberal basis.

HM-3: Providing affordable units and supporting first-time buyers, while encouraging those who wish to invest more in walkable and bikeable neighborhoods that are affordable. Individuals that self select these locations also appreciate a lifestyle that has greater financial returning terms of transportation savings. to activate the community and provide for a broad range of customer types and employer types as well.

Create Compact Units To Lower Costs (HC)

To create compact units to lower costs, communities should consider—

HC-1: Being efficient with the horizontal arrangement of site features to keep unit prices low and minimize spread of the built environment.

HC-2: Rightsizing units so that they are not excessive in space. The right-sized units may also help to control excessive gentrification of certain urban areas where younger and wealthier people may wish to live and invest, sometimes at the expense of those less fortunate.

HC-3: Preparing site plans that do not overly dedicate space to parking by way of efficient parking lot design, structured parking, parking lifts and technologies for compact parking, tandem parking, and other on-site carshare opportunities that may lower on-site parking requirements.

HC-4: Allowing certain types of guest parking or overflow parking to double as public realm space or recreational space that can be temporarily used for parking peaks.

Develop flexible units that can grow with family size (HF)

To develop flexible units, communities should consider—

HF-1: Designing flexible space into developments, in which walls can be moved to combine smaller blocks of space to create spaces that match the buyer or renter needs.

HF-2: Designing flexible space into developments, in which connections can be made between units if the household size increases or decreases.

HF-3: Creating first-floor land uses that are commercial in nature but that allow the space to be designed so that it can provide an occupant use benefit, such as community rooms and sales offices, but later may evolve into commercial retail that can help to activate the street.

Land Use Mixtures

Encourage Housing and Jobs Near Each Other (LJ)

To encourage housing and jobs near each other, communities should consider—

LJ-1: Building housing near employment centers or at least near transit centers that can connect with employment centers. The most prevalent trip is one related to going to work each day, yet we separate our workplaces from our living places.

LJ-2: Looking for job areas and a general density of employment, especially small businesses associated with town centers or main streets, corridors, and business districts. The types of employment that are more likely to have a person live and work in the same general area are blue-collar jobs and low- to moderate-paying jobs. Small business owners also often look close by for living opportunities.

Encourage Community Centers Near Housing (LC)

To encourage community centers near housing, communities should consider—

LC-1: Selecting a development area that is close to existing community centers. For areas with families, young single adults, and seniors, a community center can be a very important part of daily life.

LC-2: Building a community center as part of the overall project if the project is large enough.

Encourage Well-Distributed/Smaller Neighborhood Schools (LS)

To encourage well-distributed and smaller neighborhood schools, communities should consider—

LS-1: Establishing a well-distributed network of schools that will result in more walking, biking, transit use- and carpool use. Second to employment centers, the most prevalent daily destination is that of schools. The travel may be on school buses, as drop-offs or, for older high school and college-age students, by way of a vehicle. A centralized school system will require longer-distance commutes.

LS-2: Building housing and other support facilities near community colleges to allow for some students to live nearby and be able to walk or bike to these campuses.

Provide Smaller and Well-Distributed Parks (LP)

To provide smaller and well-distributed parks, communities should consider—

LP-1: Providing access to parks. Going to the park is a regular weekly activity for many families and younger active adults. The recreation experience should start at the front door, not at the car door. Walking or biking to the park is a health benefit associated with active transportation. A 10- to 20-minute walk time distance is reasonable for those wanting to get exercise. This translates into almost a 1-mile distance for walking and a 3-mile distance for biking.

LP-2: Ensuring that parks have walking access points and bike facilities nearby.

LP-3: Ensuring that bike parking facilities are provided at all parks.

Encourage Small/Distributed Grocery Stores/Pharmacies (LG)

To encourage small and distributed grocery stores and pharmacies, communities should consider—

LG-1: Ensuring that local groceries stores can provide the daily needs of customers at a neighborhood level. Centralized into very large shopping centers that are only accessible by vehicles and encouraging large quantities of groceries to be bought requires customers to have a vehicle for getting the groceries home and for getting to these regional shopping centers.

LG-2: Locating pharmacies within walking distances of neighborhoods in areas where a high percentage of the population is seniors. The small size of products purchased makes it realistic for seniors to be able to walk to these centers for their prescriptions and other daily needs.

Focus on Vertically or Horizontally Mixed Uses (LV)

For vertically or horizontally mixed uses, communities should consider—

LV-1: Utilizing ground-floor spaces for retail and community functions and services, with employment and residential uses on the upper floors, for the most efficient use of land. This vertical mix is the most efficient use of land area as long as privacy and noise issues are addressed. The more land uses that can be found within a 10-minute or 0.5-mile walk of each other, the more walkable and bikeable the community will be.

LV-2: Using a horizontal mix of land uses if height restrictions prevail in certain areas. Horizontally mixed uses are effective as long as the internal circulation does not force the entrances of all establishments to the outside of the block, without any interior routes provided.

Back Up Walkable Main Streets With High-Density Housing (LM)

To back up walkable main streets with high-density housing, communities should consider—

LM-1: Encouraging alleyways and short blocks that provide better walking routes into main street areas through land use planning and street layouts. Given a 10-minute walk time, linear corridors of commercial businesses and older main streets are generally surrounded by customers. Often, these districts turn their back on neighborhoods.

LM-2: Reaching into the neighborhoods with street improvements, urban design treatments, and angle parking with bulb-outs and crosswalks.

LM-3: Avoiding main streets that have a through-corridor that is not sensitively designed for safe and convenient crossings. Such areas can be restricting their walk-in customers to one-half their potential if the main streets do not attract people from neighborhoods located on the other side of these through-corridors.

Add Eating/Entertainment/Social Centers Near Housing (LE)

For eating, entertainment, and social centers near housing, communities should consider—

LE-1: Providing facilities near neighborhoods that allow people to engage in social activities. People like to watch other people and other activities in a neighborhood. It makes them feel connected and provides great opportunities for the start of conversations that can lead into friendships. People like to eat outdoors when the weather is suitable. People like to walk to local entertainment and social centers.

LE-2: Being cautious of establishments that produce loud noises and other levels of activities that may create tension with adjacent residents. Provide an alleyway or street between these uses if possible. If not, make sure that interior sound attenuation will address the nuisance levels that can occur with certain types of establishments.

Human-Scaled Elements

Reserve Avenues/Boulevards for Main Street Type Retail (TA)

To reserve avenues and boulevards for main street type retail, communities should consider—

TA-1: Reserving avenues or boulevards for commercial activities that can build synergy between one parcel and the next. These special streets are the best locations to have main street types of businesses. The street arrangement, pedestrian treatments, and bike facility elements can all add to the commercial viability of a street of commerce. This can occur along corridors or main streets.

TA-2: Providing lighting and landscaped street treatments consisting mostly of street trees and street furnishings because the walking environment must be safe and well lighted to build synergy. There has to be a buffer distance between moving vehicles and the storefront/pedestrian interface. A parkway may be used to set the active roadway farther back from the public realm spaces.

TA-3: Planning land uses to concentrate activity into nodes instead of long corridors or edges. This will make the distance between possible destinations shorter and more walkable.

TA-4: Avoiding gaps in business districts. A few parcels that have switched from streetwall urban forms to pulled-back buildings with off-street parking can break the continuity of a walking street and cause customers to stop and turn around at the area where the main street seems as though it stops, which harms the rest of the businesses that are farther away.

Restrict Big-Box Retail From Neighborhoods/Centers (TB)

To restrict big-box retail from neighborhoods and centers, communities should consider—

TB-1: Avoiding large, regionally sized commercial buildings that can not only dominate and de-humanize the scale of business districts but also pull away a customer base from an area that was previously successful.

TB-2: Designing for user experience and social interaction. The lure of free and ample parking can draw away a customer base for those businesses that just offer a product to be purchased. Businesses that are part of a user experience, including going to a nice place and interacting with others, offer one of a few ways to counter the pull of big-box retail.

TB-3: Avoiding big-box retail in areas with pedestrian-scale and main street environment or in other centers of villages, towns, or cities that may result in damage to these commercial place types. Certain corridors may be an appropriate location for some types of larger national chain stores, however.

Keep Single Land Use Areas to Less Than Six Contiguous Blocks (TI)

To keep single land use areas to less than six contiguous blocks, communities should consider—

TI-1: Avoiding more than six blocks in a row of the same land use. A fine grain of land use mixture is needed to create walkable and bikeable communities. Block after block of single-use land does not promote the movement from origin to destination if the distance is too far. Some level of employment, institution, recreation, retail, or public services should interrupt the sameness of land uses that often prevails in many areas of communities.

TI-2: Changing the intensity of similar land uses, which may be helpful. High- to low-density housing should transition from one area to another. Variations in retail types and institutions may also help to provide variation in urban forms. It is not as successful as actual differences in land uses, however.

Orient Public Spaces Toward Intense-Use Centers (TS)

To orient public realm spaces at centers of intense use, communities should consider—

TS-1: Adding public spaces, where a person can be slightly removed from the bustle and traffic of an area, in centers that have an intensity of uses. Human nature is to interact or be part of activities in our built environment. Too much intensity of urban forms and use levels can result in stress, however.

TS-2: Consulting design professionals to ensure the three levels of experience: social interaction, areas of observation, and areas of respite and passive internal thought.

TS-3: Including public spaces to help activate semi-private spaces. A well-designed public space can draw people to commercial nodes or institutional plazas. The facility can help to support commercial success and improve public safety.

Create 10-Minute Walk Neighborhoods With Local Services (TT)

To create a 10-minute-walk neighborhood, communities should consider—

TT-1: Including the concept of a 10-minute walk neighborhood in urban planning and new development. This concept relates back historically to how our towns grew. The centers of towns were a mixture of land uses that supported a lifestyle in which the majority of what people needed was within a 10-minute walkable distance.

TT-2: Designing the center of neighborhoods and districts to include a mixture of institutions and retail businesses. Higher-density housing should surround these centers to provide the greatest benefit to the greatest number of residents.

TT-3: Designing the zone around the center to include not only the more intense residential land uses but also recreation, public service, education, and employment areas.

TT-4: Including lower levels of residential density in the outer zone, along with park and recreation facilities and some commercial shopping districts and corridors.

TT-5: Ensuring that transit services come through all of these zones, especially the center of the zones.

TT-6: Installing bike facilities, which can extend the 10-minute walking distance of 0.5 to 0.67 mile up to 2 miles, within a short 10-minute ride.

Urban Design Treatments (U)

Thoughtful Site Design (UD)

For thoughtful site design, communities should consider—

UD-1: Designing new projects or buildings developed on large parcels to form new blocks and interior streets that create a comfortable and walkable block size to help create or complete a network of streets.

UD-2: Designing buildings to be oriented to the street to promote sidewalk activity and provide eyes on the street for the safety and comfort of pedestrians.

UD-3: Designing the site to minimize disruptions to pedestrian areas, whether sidewalks or mid-block passageways (typically by limiting the number and width of driveways).

UD-4: Designing all buildings to be sited with their primary entries and fronts easily accessed from the nearest sidewalk to encourage access from the sidewalk and on-street parking.

UD-5: Limiting and consolidating the number of driveways. They may be no wider than necessary and designed to allow motorists to see pedestrians on the sidewalk.

UD-6: Locating parking lots and service entrances toward the rear of the lot, accommodating automobiles but making it comfortable for people to access the buildings on foot.

UD-7: Extending a coherent network of pedestrian routes into the property wherever buildings are not built immediately adjacent to the public sidewalk so that pedestrians approaching from the street can access each building without walking through vehicular drives and parking lots.

UD-8: Designing the building pattern within a block to form comfortable, habitable outdoor spaces that promote a “sense of place” and a unique local character.

Appropriate Building Forms (UB)

For appropriate building forms, communities should consider—

UB-1: Planning and designing building height, density, and setbacks to create a type of place that has an appropriate scale and character closely coordinated with the street typology.

UB-2: Developing building design standards to support a healthy street environment for pedestrians. For example, design buildings to take into account how they interact with strong winds to avoid wind tunnels or restrict flows of natural light and air.

UB-3: Designing one- to three-story buildings entirely at a pedestrian-oriented neighborhood scale, with features that can be appreciated by people walking or bicycling.

UB-4: Designing mid-height buildings of four to six stories at a pedestrian-oriented scale for the lower two to three floors and integrating windows, balconies, and other features that provide opportunities for occupants to overlook the street from upper floors. Taller buildings (more than six stories) can have a base of lower floors designed similarly to those of mid-height buildings and may benefit by stepping back from the frontage above this level to provide a street character that is not overwhelming to the pedestrian.

UB-5: Knowing that in most mixed-use districts and neighborhood centers, it is more important to provide a relatively steady streetwall to define a simple "street as an outdoor room" than to provide varied setbacks and step-backs to break up the mass (see preceding section on streetscape environment types). In suburban environments with freestanding buildings, the desire to articulate the building form is understandable. In urban districts and centers, however, the primary placemaking role of buildings is to calmly define the space of the place rather than to "express themselves" as unique objects.

UB-6: Designing towers in very dense areas (such as an urban center) to be slender and mostly transparent, with a low to mid-rise base that provides pedestrian-oriented features. Towers can be designed to look attractive and approachable from the street and sidewalk, not to be simply an icon in the skyline.

UB-7: Integrating parking into the site and building design; ideally, parking would be (a) underground, (b) tucked behind the building fronting the sidewalk and accessible from an alley or side street, or (c) sited internally to the project or block so that the buildings "wrap it" to the greatest degree possible.

UB-8: Designing buildings by applying universal access principles (like locating stairs in prominent locations to encourage people to use them), making naturally clear paths through good design and an integrated site and building design approach.

Buildings' Relationship to Walkways (UW)

For buildings' relationship to walkways, communities should consider—

UW-1: Providing well-designed frontages and clear entry points from the sidewalk to buildings, which contributes to the overall character of the community.

UW-2: Designing building frontages to be mostly transparent, with "active storefronts" that allow pedestrians to see into shops, restaurants, and public spaces for active mixed-use and commercial streets.

UW-3: Designing building frontages to include windows overlooking the street, with a layering of landscape, porch, patio, or semipublic space that buffers appropriately (setbacks will vary based on street typology and the scale of the buildings) along residential streets.

UW-4: Designing the primary building face to be located on the most active street frontage, with an attractive and welcoming facade that includes entry doors, windows, signs, and other character-defining elements.

UW-5: Designing the secondary building face that exists along a mid-block passage or side street to also include openings overlooking the public space.

UW-6: Locating the tertiary (back) side of the building along a back alley or service drive, where pedestrian movement is secondary to service, with loading docks, service entries, trash storage, and other unattractive functions accommodated there.

UW-7: Limiting blank walls to the rear and very limited along the secondary face.

UW-8: Integrating lighting into the building design to indirectly illuminate the sidewalk at night by light filtering through storefront windows and installing architectural lighting that features the building and enriches the street environment at night.

B-3: Street Tools

Street Network Guidelines

Lay Out Small Block Sizes To Shorten Walk/Ride Distances (NF)

For small block sizes that shorten walk or ride distances, communities should consider—

NF-1: Establishing a block size maximum of 1,600 linear feet (additive perimeter of all sides; equates to 400 linear feet on a side if a square).

NF-2: Where block size is exceeded, retrofitting large blocks with new streets, "paseos" (or pedestrian plazas), "woonerven" (or shared streets), promenades, alleys, and pedestrian and/or bicycle connections.

NF-3: Ensuring greater accessibility within the block through alleys, service courts, and other access ways.

Provide a Grid or Straight Roadway Segments To Reduce Out-of-Direction Travel (NG)

For grid or straight roadway segments to reduce out-of-direction travel, communities should consider—

NG-1: Not allowing street closures that would result in longer blocks for existing networks.

NG-2: Requiring multiple street connections between neighborhoods and districts across the whole region. This is achieved by designing boulevards and avenues that extend beyond the local area. Multiple local streets must also connect with adjacent neighborhoods.

NG-3: Maintaining network function by discouraging one-way streets unless the advantages from multi-modal accommodation outweigh the out-of-direction disadvantages.

Provide a Distributed Network That Avoids Concentration of Traffic (ND)

For a distributed network that avoids concentration of traffic, communities should consider—

ND-1: Providing a redundancy of routes to maximize route options and the distribution of a fixed number of trips across a broader range of streets.

ND-2: Distributing networks that provide various low -tress routes for active transportation as well as multiple routes for emergency vehicles.

ND-3: Providing a diverse street network comprising a variety of street types.

Avoid Dead Ends/Gated Communities/Cul-de-Sacs (NC)

In order to avoid dead ends or cul-de-sacs, communities should consider—

NC-1: Not allowing full or partial street closures except on bike boulevards or in other areas where pedestrian have been fully accommodated.

NC-2: Providing connection for pedestrians and cyclists through the street to an adjacent unrestricted street where a street closure has been used to prevent through traffic on local streets.

NC-3: Not allowing gated communities in mixed-use neighborhoods with many local destinations and origins that can create major out-of-direction travel for bikes, vehicles, and pedestrians.

NC-4: Not allowing a network obstruction for cyclists and pedestrians if it causes more than a 2-minute out-of-direction delay.

Avoid Wide/Fast Streets That Divide Communities (NW)

In order to avoid wide and fast divisive streets, communities should consider—

NW-1: Maintaining network quality by accepting growth and the resulting expansion of the street network (including development, revitalization, intensification, or redevelopment, particularly of active transportation facilities) while avoiding increases in street width or in number of lanes.

NW-2: Concentrating additional vehicular throughput along the corridor on the intersections and not the roadway segments. If the majority of the road can be made to accommodate multiple uses, then do not extend multiple lanes down segments only because special turning lanes are needed at the intersections.

NW-3: Providing mitigations—including special signals, roadway markings, lane diets, signage, and/or walkway extensions—if a left or right turn lane is needed and bike or pedestrian facilities are negatively affected.

NW-4: If possible, not allowing major streets to traverse neighborhoods, districts, or centers. If a street is beyond human scale (more than 80 feet in width), has multiple lanes for crossing (more than three), has high speeds (greater than 25 mph), and has a moderate to high level of vehicular movement (more than 3,000 vehicles per day), it is potentially a "divider" street and must include potential improvements to offset these dividing characteristics.

NW-5: Offsetting a wide divider street by adding median refuges, mid-block crossings, landscaped medians, wide sidewalks, walkway extensions, parking, street trees, lighting, and bike lanes to help counter the negative affects of such streets.

NW-6: NW-6: Avoiding widening existing streets for capacity increase, or reclassifying a street with limited access for cyclists and walkers. Look first to improved signal technology and then to a distribution of traffic to adjacent streets that will not increase the effects to these areas. If these options do not work, either consider accepting higher levels of congestion or ensure that other improvements are made to this street or adjacent couplets that will adequately support the adjacent land use and multiple modes of travel.

Create Streets That Provide a Seam Between Sides of the Street (NS)

For streets that provide a seam between sides of the streets, communities should consider—

NS-1: Using road diets, lane diets, traffic calming, streetscape development, walkway buffers, lighting, consistent design features, on-street parking, and improved pedestrian crossings to create or revitalize existing streets to be "seam" streets.

NS-2: Providing pedestrian crossings at least every 300 feet where pedestrian activity is common or where land uses should be generating pedestrian activities. If intersections are farther apart than 300 feet, then consider mid-block crossings—if they can be made safe and will not significantly affect the vehicular flow of traffic.

Include Bike- and Pedestrian-Friendly Diverters That Prevent Vehicular Through-Traffic (NP)

For bike- and pedestrian-friendly diverters, communities should consider—

NP-1: Providing for pedestrian connections through the street end if a street does have to be dead ended. For streets where through traffic is not desired, provide for bike traffic to continue through the intersection by way of a traffic diverter that is sensitive to bike and pedestrian users.

Avoid Leapfrog Development Into Areas With Few Mobility Options/Streets (NL)

In order to avoid leapfrog development into areas with few mobility options, communities should consider—

NL-1: Encouraging development as infill development in areas where transit, bike, and pedestrian options already exist.

NL-2: Encouraging new development as close as possible to existing development, where capacity in transit, walking, and biking can be absorbed.

NL-3: If new development does occur in a leapfrog pattern, connect pedestrian and bicycle facilities to the new site from existing areas of connectivity.

Span Barriers With Bike or Pedestrian Bridges (NB)

For span barriers with bike or pedestrian bridges, communities should consider—

NB-1: Avoiding the expense of bike or pedestrian bridges where at-grade crossings are more appropriate.

NB-2: Avoiding a bridge that requires substantial vertical or horizontal out-of-distance travel. These types of facilities are not likely to be used if they require a great deal of extra travel.

NB-3: Connecting streets by way of a bridge across urban freeways so that pedestrians and bicyclists have links to neighborhoods without having to use streets with freeway on and off ramps.

NB-4: Where possible, utilizing existing landforms to support sides of bridges and to minimize the vertical access requirements.

NB-5: Where possible, having ramp systems moving in the direction of travel, without a lot of back-and-forth direction on ramps that take the user out of direction.

NB-6: Designing all pedestrian bridges (minimum of 5 feet wide) to accommodate bikes (minimum of 10 feet wide), and, when possible, designing bridges to provide emergency vehicular and maintenance access as well (minimum of 15 feet wide).

Travel Way Guidelines

Design To Accommodate All Modes (TM)

In order to accommodate all modes, communities should consider—

TM-1: Designing streets to deliver a high multi-modal level of service (MMLOS). Level of service assesses traffic flow and assigns a higher level to streets that flow freely. MMLOS measures the quality of service provided to transit users, pedestrians, and people on bicycles.

TM-2: Ensuring that most streets integrate bike facilities within the travel way by including bicycle lanes, separated bike lanes, bicycle boulevards, and other types of shared roadways (with or without shared lane markings).

TM-3: Ensuring that major transit streets give priority to transit systems, including dedicated transit lanes, bus bulbs, bus pullouts, and shared bike/bus transit lanes.

TM-4: Ensuring that safe pedestrian crossings and protected walking areas are present on all streets, regardless of the classification. Pay special attention to any street where the traffic is faster than 35 mph because survivability of a collision goes down dramatically above this speed.

TM-5: Providing on-street curbside parking on most streets. Exceptions can be made for very narrow streets or streets with bus lanes.

Ensure the Right Design Speed/Avoid Overdesigning the Street (TO)

In order to ensure the right design speed, communities should consider—

TO-1: Keeping maximum throughput (based on congestion related to reaction time and the "Slinky®" delay effect associated with starts and stops, and based on vehicular energy efficiency) at 35 mph. For streets with high-volume demands, focus signal synchronization and design speeds on this ideal travel speed.

TO-2: Installing additional protection for pedestrians through the use of buffers, barriers, and offsets for streets where posted speeds exceed 35 mph. Consider additional buffers or protection for cyclists as well.

TO-3: Providing alternative routes for walkers and cyclists on nearby, slower-speed streets for through-corridors and limited-access roadways with posted speeds that exceed 45 mph.

TO-4: Having a 25-mph speed limit for maximum safety of various user types on all other streets.

TO-5: Using design features that support lower-speed environments, such as narrower streets, narrower lanes, and small corner radii.

TO-6: Providing signal progression at speeds that support the target speed of a corridor whenever feasible.

Design for Safety First, Multi-Modes Second, and Traffic Flow Third (TD)

In order to design for safety first, communities should consider—

TD-1: Ensure that "Safety first" is not simply a slogan but a foundation for street and community design. Pay special attention to the crossing of multi-lane wide roadways with high volume and high speeds.

TD-2: Focusing on the throughput of trips, regardless of mode. Bike and walking trips take up a much lower percentage of the street infrastructure, as do transit trips, so they should receive higher priority for accommodation and congestion relief.

TD-3: Protecting walkers by using parkways, on-street parking and street trees, because calmed traffic that is free flowing works best for all roadway users.

TD-4: Providing on-street parking, which is important in urban environments for supporting adjacent retail, calming traffic, and providing a buffer for pedestrians. On-street parking occupies about one-half the surface area per car compared with off-street parking, which requires driveways and aisles for access and maneuvering. (Where parking is provided, a portion of spaces must be ADA accessible.; see PROWAG for guidance.)

TD-5: Pedestrians are hit disproportionately when visibility is poor: at dusk, night, and dawn. Providing illumination or improving existing lighting increases nighttime safety at intersections and mid-block crossings, as motorists can better see pedestrians. Pedestrian-scale lighting along sidewalks provides greater security, especially for people walking alone at night. Transit stops require illumination of the travel way for safer street crossing and pedestrian-scale illumination at the stop or shelter for security.

TD-6: Managing demand for on-street parking by charging market-rate prices. Free or under priced parking encourages people to drive instead of biking, walking, or taking transit. Parking expert Donald Shoup recommends setting variable parking prices to target a 15-percent vacancy rate for curb parking. In addition to encouraging people to curtail driving, it also creates turnover that benefits retailers by making convenient parking available for short shopping trips.

TD-7: Using back-in (or head-out) angled parking in lieu of head-in angled parking where angle parking is proposed for on-street parking. Motorists pulling out of back-in angled parking can better see the active street they are entering. This is especially important to bicyclists. Moreover, people exiting cars do so on the curbside and are unlikely to step into an active travel lane.

Protect Walkers by Using Parkways, Parking, and Street Trees (TP)

For parkways, parking, and street trees, communities should consider—

TP-1: Adding on-street parking to provide protection for pedestrian walkways. If the street has highly variable levels of daytime and nighttime parking, however, the lack of vehicles in parking spaces may make the driver feel it is okay to drive faster.

TP-2: Including street trees in a 5- to 10-foot-wide parkway strip to form a protective barrier. These trees must be no more than 30 feet apart to be effective, and they must be of sufficient size.

TP-3: Including a buffer distance from the edge of the curb to the walking environment to help protect pedestrians. Contiguous sidewalks at the curb line should be avoided unless an on-street parking lane or bike lane exists.

Reduce Overall Roadway Widths as Much as Practical (TN)

In order to reduce overall roadway widths, communities should consider—

TN-1: Avoiding curb-to-curb widths that take more than 75 percent of the overall roadway right-of-way. The parking lane and curb extensions (if any) would count toward the non-travel way portion of this cross-section.

TN-2: Reclaiming width from excessive lanes of travel or overbuilt number of lanes and return it to bike, parking, or walking facilities. Do not reconfigure curbs and gutters for less than a 3-foot gain on either side of the roadway. If marginal width increases do not allow for 3 feet, consider widening walkways on only one side of the street.

TN-3: Utilizing curb extensions or bulb-outs to reclaim parts of the travel lanes that are not parkable. This will reduce the overall crossing distance substantially.

TN-4: Ensuring that the bulb-out still leaves at least 4 feet of lane width for bikes to go through the intersection corners on roadways that have a through bike lane and a travel lane less than 13 feet wide.

TN-5: Sizing the on-street parking lanes based on the adjacent street speeds (table B-1).

Table B-1: Parking Lane Widths

MOVEMENT TYPE	DESIGN SPEED	PARKING LANE WIDTH
Slow	20–25 mph	Angle: 16.5′(60°); 15′(45°)
Slow	20–25 mph	Parallel: 7 feet
Low	30–35 mph	Parallel: 7–8 feet

Reduce Lane Widths To Allow for Other Users and for Traffic Calming (TR)

In order to reduce lane widths, consider—

TR-1: Providing a certain amount of shy (or clear) space for lane widths, assuming most vehicles are only 6 feet wide and larger commercial vehicles are 8.5 feet. It is possible, where traffic is slower, to consider a 9-foot lane. In fact, consider making 10-foot travel lanes the default, with permission to go to 11 when a major bus or truck route is present. In nearly all cases, a 10- or 11-foot lane is adequate for all vehicles, including larger buses or fire emergency vehicles. Do not build lanes wider than 12 feet unless intended for shared vehicle/bicycle use. Wide lanes encourage speeding and meandering between the striped lines. Driver attention is more constant on narrower lanes, limiting weave and drifting into adjacent lanes and bike facilities.

TR-2: Designing turn lanes to be made at 9 or 10 feet, because of slower speeds, with a maximum of 11 feet for roads that serve trucks.

TR-3: Designing permissive center left turn lanes to be no more than 12 feet in width.

TR-4: Dedicating all other roadway width to medians, bike lanes, parking lanes, bulb-outs, chevron "no drive" stripes, and other pedestrian facilities beyond the curb, including parkway strips for plantings and walking surfaces.

Manage Access by Limiting Curb Cuts/Driveways (TY)

In order to manage access, communities should consider—

TY-1: Requiring joint-use access aprons between properties, limiting the width of the driveways to 24 feet, and preventing left turns as much as possible to reduce collisions with bikes. Right turn conflicts between vehicles and bikes or pedestrians are increased along streets that have a large number of driveways accessed through curb cuts.

TY-2: Limiting left turns by regulatory signage and/or raised median construction. Exiting vehicles making left or right turns out of driveways and local access road aprons are also problematic for cyclists and walkers.

TY-3: Reclaiming space for on-street parking where an adjacent land use and building typology has changed and access from the street through a curb cut is no longer needed.

Manage Left Turning Movements Along Roadway Segments (TL)

In order to manage left turning movements, communities should consider—

TL-1: Avoiding permissive (yield only) left turn lanes along roadway segments where possible. This free turning movement is very problematic for cyclists because most drivers poorly judge the speed of fast-moving cyclists. Separated left turns at intersections are much safer.

TL-2: Installing a left turn lane, which can be beneficial when used to perform a road diet, such as reducing a four-lane section to three lanes, with the center lane provided for turning movements.

TL-3: Using medians to create tree canopies over travel lanes, contributing to a sense of enclosure, which equates to edge friction that slows vehicles. As shown in table B-2, medians can vary in width. Recommended widths depend on available right-of-way and function. Because medians require a wider right-of-way, the designer must weigh the benefits of a median with the issues of pedestrian crossing: distance, speed, context, and available roadside width.

Table B-2: Median Types and Widths

MEDIAN TYPE	MINIMUM WIDTH	RECOMMENDED WIDTH
Median for access control	4 feet	6 feet
Median for pedestrian refuge	6 feet	8 feet
Median for trees and lighting	6 feet[1]	10 feet[2]
Median for single left turn lane	10 feet[3]	10 feet[2]
Median for single left turn lane and pedestrian refuge	16 feet[4]	16 feet

Table Notes:

An area measured 6 feet from curb face to cut-out walkway edge generally is considered the minimum width for proper growth of small trees. If trees are in a planter with a tree grate, a 4-foot width by 10-foot length should be considered as the minimum planting area.

Wider medians provide room for larger trees and more extensive landscaping.

A 10-foot lane provides for a turn lane without a concrete traffic separator.

This measurement includes a 10-foot turn lane and a 6-foot pedestrian refuge.

Intersection Guidelines

Make All Legs of an Intersection Available for Pedestrian Crossings (IP)

In order to make all legs of an intersection available for pedestrian crossings, communities should consider—

IP-1: Avoiding the use of pedestrian restrictions at any intersection except those that require multiple left turn movements and where other solutions that follow will not allow for safe pedestrian crossings.

IP-2: Using a pedestrian scramble, in which all pedestrian movements are separate from vehicular movements.

IP-3: Using special signage and warning signals about the need for vehicles making left turns to yield to pedestrians.

IP-4: Providing a leading pedestrian interval (LPI): a pedestrian crossing signal that holds the first few seconds of the phase for pedestrian crossings.

IP-5: Providing a pedestrian median refuge where people can safely stand until they are sure that the vehicle will yield to their crossing movement.

Minimize Free Left-Turn-Only and Right-Turn-Only Lanes (IL)

To minimize free turn only lanes, communities should consider—

IL-1: Balancing the need for turn lanes for vehicle movements with other needs because turn lanes increase vehicle speeds on the street and the chance of left turn head-on collisions. Turn lanes also increase the crossing distance for pedestrians.

IL-2: Placing left turn lanes in an urban environment where they are considered acceptable because there are negative effects to roadway capacity when left turns block the through-movement of vehicles.

IL-3: Restricting free left turn movements altogether at minor intersections on streets with a moderate to high number of pedestrians and cyclists. Medians can be used to block small-street intersection movements and prevent free left turns from the travel lane segments.

IL-4: Avoiding more than one left turn lane at an intersection in urban places. The more lanes there are, the wider the street is for pedestrians to cross. Although right turns from through-lanes may delay vehicle through-movements, they also reduce vehicle speeds due to slowing associated with turning, which increases pedestrian safety and comfort.

IL-5: Avoiding the installation of right turn lanes because they increase the crossing distance for pedestrians and the speed of vehicles; therefore, exclusive right turn lanes should rarely be used except at limited-access highway intersections. If required, they should be mitigated with raised channelization islands. Double right turn lanes create difficult choices for bicyclists, who need to ride on the left side of the turn lanes.

Provide Signals or Stops on All Roads Except Two-Lane, Low-Speed Streets (IS)

In order to provide signals or stops, communities should consider—

IS-1: Providing at least a stop-sign- or yield-sign-controlled intersection at all intersections with more than two lanes and a posted speed exceeds 25 mph or where the 85th percentile of drivers are exceeding 25 mph.

IS-2: Installing a two-way stop-sign-controlled intersection if the hierarchy of traffic flow and street classification is very clear. In these cases, if the free-movement direction is high speed and high volume and the context indicates the need for pedestrian crossings, consider the use of signals, four-way stops, or pedestrian-actuated yield crossing points.

IS-3: Providing safe, controlled crossing points no more than 300 feet apart in urban and suburban areas where pedestrians are likely.

IS-4: Providing short signal cycle lengths to allow frequent opportunities for pedestrians to cross major roadways.

Provide Minimal Radius on Corners (IM)

In order to provide minimal radius on corners or rolled curb bulb-outs, communities should consider—

IM-1: Using a passenger vehicle as the default design vehicle when designing corner radii. The default corner radius for a passenger vehicle is 15 feet.

IM-2: Using larger-design vehicles as the default design vehicle only where they are known to regularly make turns at the intersection. Corner radii should be designed based on the larger-design vehicle traveling at very slow speeds.

IM-3: Adjusting the radius to assume that if there are two lanes of travel in each direction, then the larger turning vehicle can utilize the number one lane for the movement, bypassing the number two lane, which typically would require a broader radius depending on the receiving lane on the perpendicular street. Encroachment onto multiple receiving lanes by large vehicles is acceptable.

IM-4: Taking into account the effect that bicycle lanes and on-street parking may have on the effective radius. The bike and parking lane can help with the ease of turning for larger vehicles.

Make Intersections Compact and Well Defined (IC)

In order to make intersections compact and well defined, communities should consider—

IC-1: Positioning on-street parking far enough away from intersections to allow for good visibility of pedestrians preparing to cross the street.

IC-2: Following all local- and national-level standards for placement, size, and content of signage and signalization needs.

IC-3: Placing the highest level of visibility on the movement or yielding action that will result in the greatest improvement in safety for those users that are most vulnerable to injury.

IC-4: Designing compact intersections that result in a lower number of overall moving lanes and signals, as well as slower speeds and lower risks of death or injury.

IC-5: Designing right-angle intersections (intersections where streets meet at perpendicular angles) whenever possible to decrease crossing distances and increase visibility.

Avoid Irregular Intersections Unless Striping/ Medians Can Make Them Safer (II)

In order to avoid irregular intersections, communities should consider—

II-1: Designing the intersection so that there are no more than four legs. This is accomplished by removing one or more legs from the major intersection and creating a minor intersection further up- or downstream of the intersection.

II-2: Designing or redesigning the intersection closer to a right angle. Some right-of-ways may have to be purchased, but this can be offset by the larger area no longer needed for the intersection, which can be sold back to adjoining property owners or re-purposed for a pocket park, rain garden, greenery, and so forth.

II-3: As an alternative, closing one or more of the approach roads to motor vehicle traffic, while still allowing most segments and directions through the intersection.

II-4: Providing pedestrian refuges if the crossing distance exceeds approximately 40 feet.

II-5: Striping general-use travel lanes and bike lanes with dashes to guide bicyclists and motorists through a long undefined area.

Use Roundabouts and Mini-Circles To Eliminate Left Turn Conflicts and Control Speeds (IR)

For roundabouts and mini-circles, communities should consider—

IR-1: Using roundabouts for streets below 20,000 to 25,000 average daily traffic volumes. A roundabout keeps traffic moving at a speed that is overall more efficient than traffic signal-controlled intersections while allowing multiple users to move through this intersection in a safe manner.

IR-2: Avoiding the creation of roundabout without taking into account movements by bikes and pedestrians. Signage, lane striping, and deflection angles that decrease speed in the mixing circle are all required to accommodate bike use. Median splitters, refuges, high visibility striping, and signage are also essential for pedestrian safety.

IR-3: Installing roundabouts where angled parking or other on-street parking is required. It reduces the overall speed in the area to less than 25 mph, which allows for collision avoidance between vehicles backing out and those seeking to move through the area.

IR-4: Taking into account emergency vehicle and truck traffic turning radii by providing a portion of the roundabout as a mountable curb.

IR-5: Allowing vertical elements to be in the roundabout circle and raised median splitter islands so that they create highly visible spatial definers of where vehicles should and should not be. Driver eye-level views should be kept as open as possible so that drivers are aware of other movements in the roundabout.

IR-6: Utilizing traffic circles on smaller or lower-volume streets to obtain some level of traffic calming and pedestrian crossing priority.

Use Bulb-Outs or Curb Extensions To Calm Traffic (IB)

For bulb-outs, communities should consider—

IB-1: Using curb extensions to replace the parking lane at crosswalks where on-street parking is allowed. Curb extensions should be the same width as, or slightly narrower than, the parking lane. The appropriate corner radius should be applied based on local conditions and standards. Due to reduced road width, the corner radius on a curb extension may have to be larger than if curb extensions were not installed.

IB-2: Reducing the crossing distance by adding a curb extension where excessively wide streets occur.

IB-3: Using rolled curbs to allow emergency vehicles and trucks to partially utilize a portion of the bulb-out for making tight turns if the receiving lanes of the perpendicular street are limited and the turning radius is kept small. Markings on the ground should be used to indicate a "stay back" distance if large vehicles are approaching.

IB-4: Combining bulb extensions with highly visible pedestrian crosswalks, improved lighting, and other public realm improvements that help to justify the costs associated with these changes. All ADA and universal access requirements must be met.

Avoid Free Right Turn Channelization Designs (IF)

In order to avoid free right turn channelization designs, communities should consider—

IF-1: Avoiding right turn lanes because they increase the size of the intersection, the pedestrian crossing distance, and the likelihood of right turns on red by inattentive motorists who do not notice pedestrians on their right.

IF-2: Adding a right turn lane where there are heavy volumes of right turns (approximately 200 vehicles per hour or more) to provide additional vehicle capacity without adding additional lanes elsewhere in the intersection.

IF-3: Installing a raised channelization island between the through-lanes and the right turn lane at intersections of multi-lane roadways where trucks make frequent right turns to enhance pedestrian safety and access.

IF-4: Installing a raised island to allow pedestrians to cross fewer lanes at a time with an overall reduction in the total vehicle conflict exposed travel distance. The design should allow motorists and pedestrians to judge the right turn movement separately from the pedestrian conflict crossing point.

IF-5: Providing a yield sign for the slip lane, with at least a 60-degree angle between vehicle flows, which reduces turning speeds and improves the visibility of pedestrians and vehicles to the yielding driver.

IF-6: Placing the crosswalk across the right turn lane about one car length back from where drivers yield to traffic on the other street, allowing the yielding driver to respond to a potential pedestrian conflict first, independently of the vehicle conflict, and then move forward, with no more pedestrian conflict.

B-4: Bike Tools

Descriptions and Tools for Bike and Vehicle Sharing Travel Lanes (S)

Bike Boulevards/Greenways (SB)

For bike boulevards/greenways, communities should consider—

SB-1: Selecting a direct and continuous street rather than a circuitous route that winds through neighborhoods.

SB-2: Placing motor vehicle traffic diverters or barriers at key intersections to reduce through-motor vehicle traffic (diverters are designed to allow through-bicyclist and -pedestrian movements).

SB-3: Turning stop signs toward intersecting streets so bicyclists can ride with few delays in forward movement.

SB-4: Replacing stop-controlled intersections with mini-circles and mini-roundabouts to reduce the number of stops cyclists have to make and to calm traffic.

SB-5: Placing traffic-calming devices, such as speed tables, chicanes, and other horizontal or vertical deflections to reduce motor vehicle traffic speeds.

SB-6: Placing wayfinding and other signs or markings to direct cyclists to key destinations and to alert motorists of the presence of bicyclists.

SB-7: Utilizing signals where appropriate, including loop detection to ensure that bicyclists can activate the signal.

SB-8: Utilizing a wide enough median refuge at street crossings to provide a safe holding location for bicyclists and pedestrians.

SB-9: Providing a median refuge without positive signal control only on two-lane (total) streets.

SB-10: SB-10: Using signalized median crossings on higher-peed /multi-lane streets.

Figure B-1: Bike Boulevard

Figure B-2: Bike Boulevard Traffic Calming Options

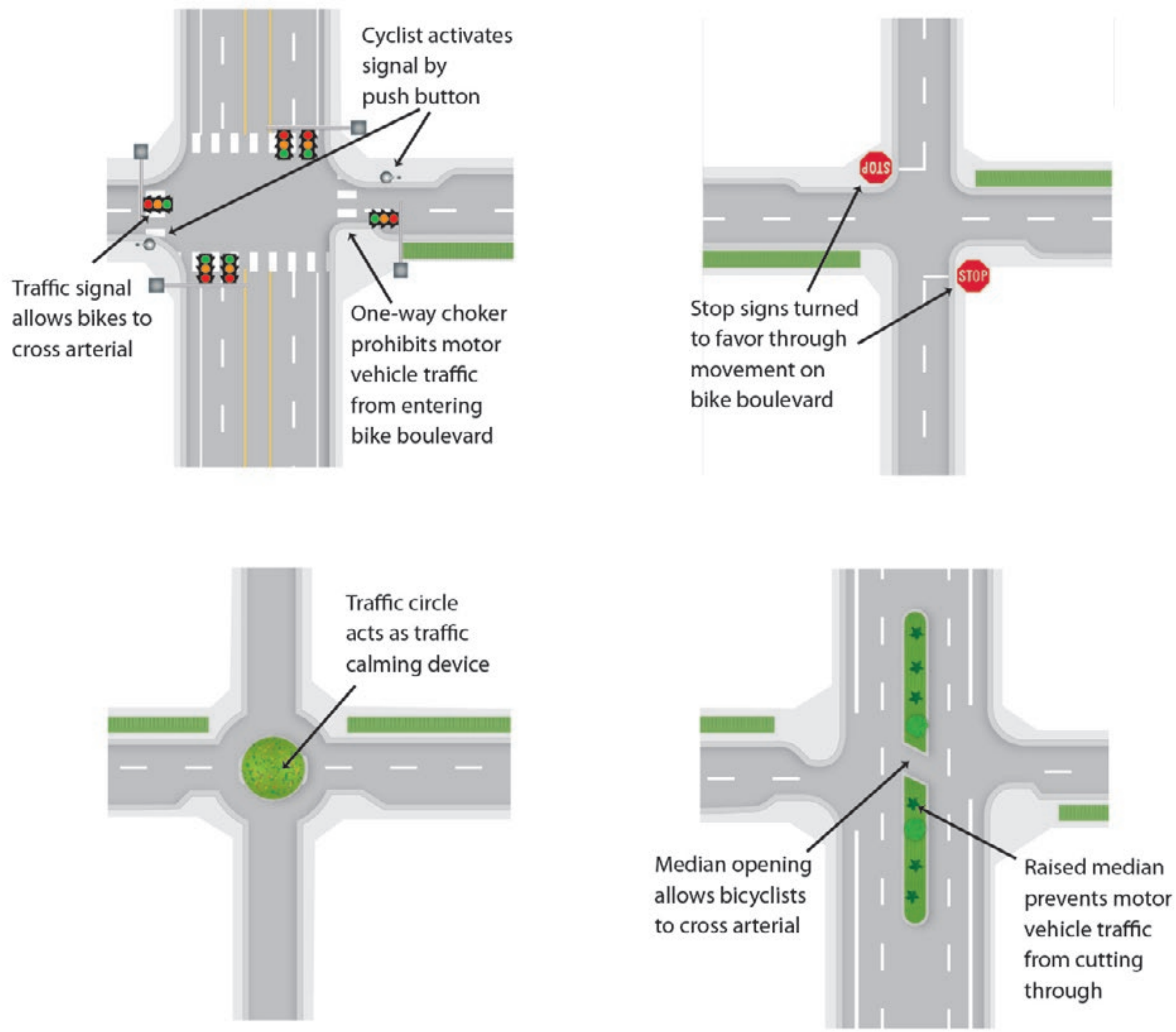
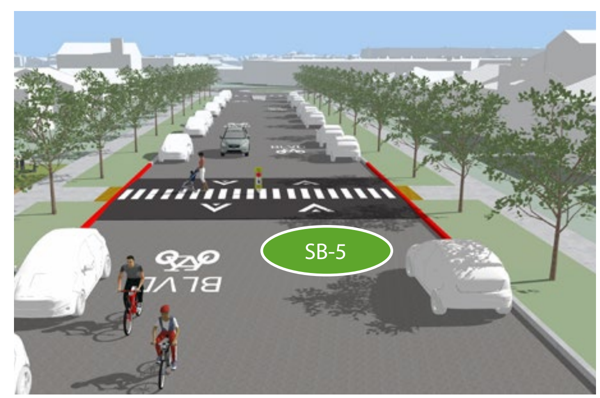


Figure B-3: Bike Boulevard Pedestrian Crossing



Shared-Lane Markings With Standard or Greenback Boxes (SH)

For shared-lane markings with standard or greenback boxes, communities should consider—

SH-1: Using shared-lane markings only when roadway widths do not allow for a higher separated facility but continuity of travel through these restricted areas is needed.

SH-2: Not allowing shared-lane markings to be used when the roadway is wide enough to accommodate the minimum standards of a bike lane.

SH-3: Using shared-lane markings only on streets with traffic speeds of 25 mph or less. Although many states and cities allow the use of shared-lane markings on streets up to 35 mph, it is not consistent with "best practices."

SH-4: Placing shared-lane markings on streets that have two lanes in each direction or at least a center turn buffer lane.

SH-5: Using raised Botts' dots or markers to provide an audible clue to what the passing driver is intending to do, allowing riders to know when they are being passed.

SH-6: Placing shared-lane markings that are next to parallel parking at an appropriate distance from the curb or from the typical edge of parked vehicles.

SH-7: Placing shared-lane markings in the center of the shared travel lane to promote cyclists taking the lane in areas with wider parking lanes.

SH-8: Placing the shared-lane marking between vehicle tire tracks to increase the life of the markings and decrease long-term maintenance costs.

SH-9: Using a greenback color behind the shared-lane marking symbol to increase visibility.

SH-10: Using a black or dark grey background or a greenback color when placing white stencil on concrete surfaces.

SH-11: Installing signage that indicates the right of the cyclist to take the lane and to help warn drivers of cyclists' presence.

SH-12: Installing shared-lane markings where they will direct cyclists away from hazards (e.g. the gutter pan, the door zone).

Figure B-4: Shared Lane Markings

Bike Routes With No Improvements Other Than Signage (SR)

For bike routes with no improvements other than signage on streets with low traffic volume, communities should consider—

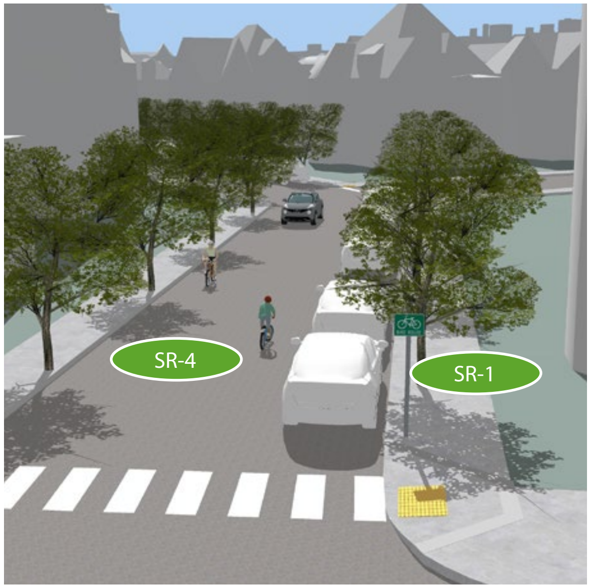
SR-1: Providing a bike route sign, located along the route, at least every 1,000 feet.

SR-2: Providing a sign with an arrow, at an appropriate distance in advance of the turn, when the route changes direction or streets.

SR-3: Providing major destination directions and general distances, with directional arrows if located near intersections, where the rider may depart from the route to join another bike facility or standard road.

SR-4: Removing centerlines on streets with low volumes to enable cyclists and vehicles to share the road more effectively.

Figure B-5: No Improvements other than Signage



Descriptions and Tools for Bike-Only Travel Lanes (B)

Buffered Bike Lanes (BB)

For buffered bike lanes, communities should consider—

BB-1: Providing a buffer to increase cyclist comfort and safety and to calm traffic.

BB-2: Buffering to remove excess space from travel lanes and provide edge friction and enclosure on the perception of width in the roadway surface.

BB-3: Delineating buffer with white chevron-style diagonal lines between two solid white lines.

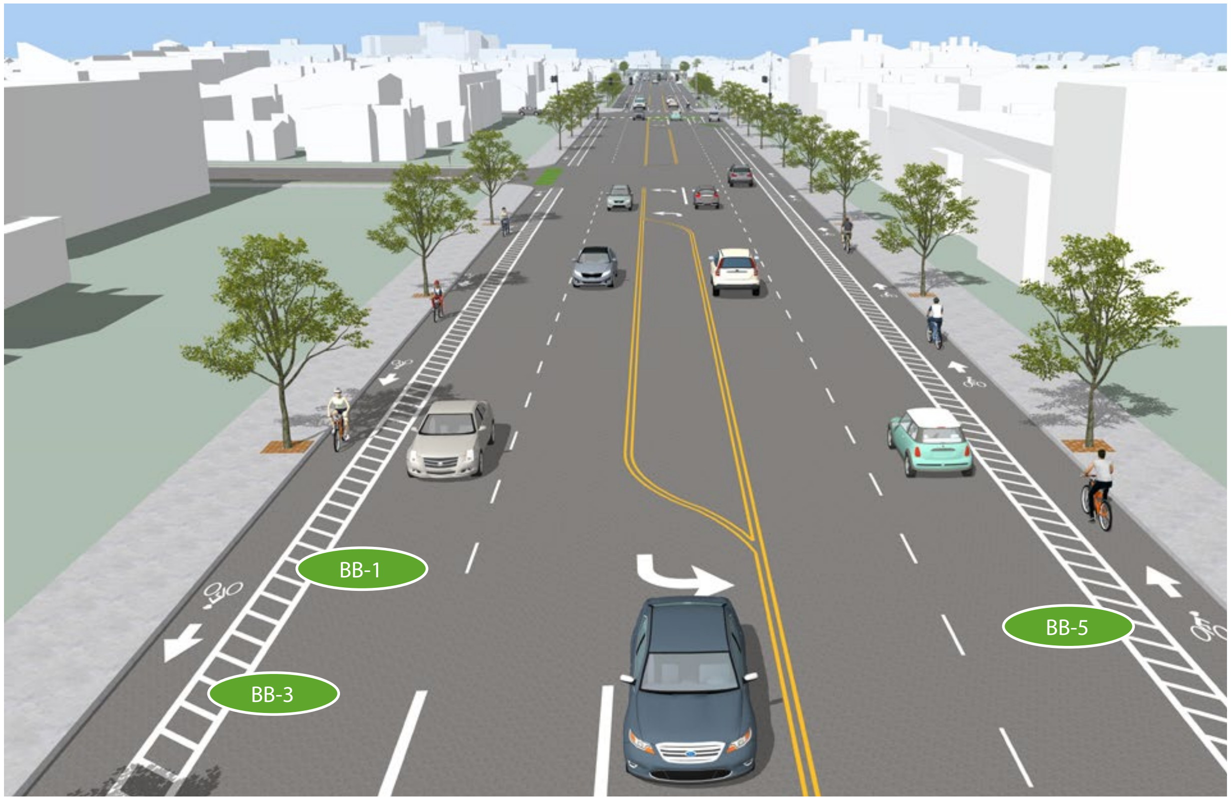
BB-4: Delineating buffer when the bike lane is proposed to be more than 6 feet wide to clarify that the lane is not for motor vehicles.

BB-5: Designing buffer to start 5 feet from the curb face and be at least 2 feet wide.

BB-6: Allowing buffers on either side of the bike travel way to go from several feet wide down to no buffering. This way, the bike facility can adapt to changing roadway conditions and geometry.

BB-7: Adjusting buffering and solid lines to accommodate right turns (or left turns if on the left-hand side of one-way streets) to clarify where drivers are expected to make lane turns.

Figure B-6: Buffered Bike Lanes



Conventional Bike Lanes (BL)

For conventional bike lanes, communities should consider—

BL-1: Designing bike lanes to be a minimum of 5 feet wide from the face of a curb; 6 feet is preferred, and 4 feet is acceptable in constrained scenarios.

BL-2: Ensuring that bike lanes are a minimum of 4 feet wide on open shoulders.

BL-3: Placing bike lanes far enough from the curb to avoid debris and drainage grates and far enough from other vehicles to avoid conflicts.

BL-4: Designing bike lanes to direct cyclists to ride far enough from the curb to be visible to motorists.

Descriptions and Tools for Separated Bike Facilities Away (Protected) From Travel Ways (P)

Bike/Multi-Use Paths (PM)

For multi-use paths, communities should consider—

PM-1: Designing shared-use paths to be a minimum of 8 feet wide with 2 feet of graded shoulder on each side. This width is suitable in open space, rural, small-town, or suburban settings.

PM-2: Generally, a 12-foot-wide paved path is preferred for more urban areas. Wider pavements may be needed in high-use areas, regardless of the rural, suburban, or urban nature of the area.

PM-3: Widening pavement or separating walkways with significant numbers of pedestrians, bicyclists, or skaters to eliminate conflicts.

PM-4: Providing firm to hard surface paths—made of concrete, asphalt, or (compacted and emulsified) decomposed granite—to accommodate wheeled transportation modes and to meet ADA requirements.

PM-5: Providing firm-surface side trails or graded shoulders for the safety and comfort of wheeled transportation users.

PM-6: Using color, stains, or paint to enhance safety, operational efficiency, and a sense of place.

PM-7: Designing street crossings to be direct, safe, and comfortable (see section 6.3.4, Descriptions and Guidelines for Bike Facilities at Intersections [I]).

PM-8: Including amenities, such as signage, pathway entry control, lighting (in some limited cases), trash facilities, drinking fountains, interpretive points of interest, seating areas, and public art.

Figure B-7: Conventional Bike Lane

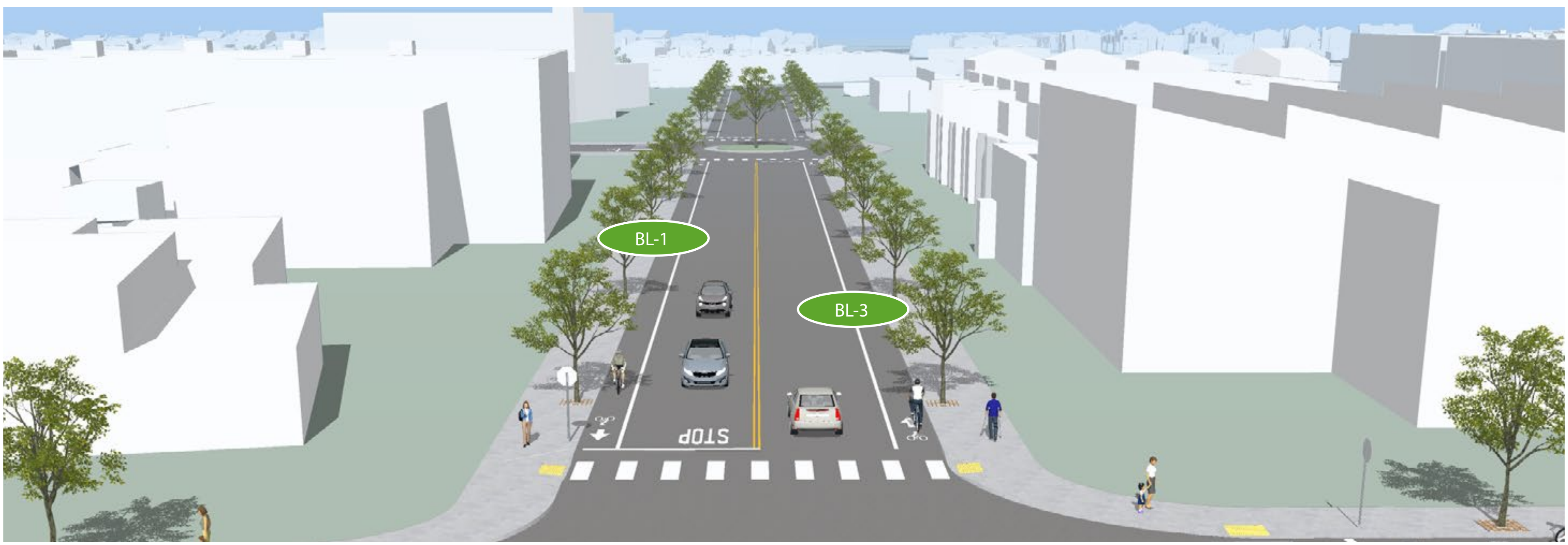
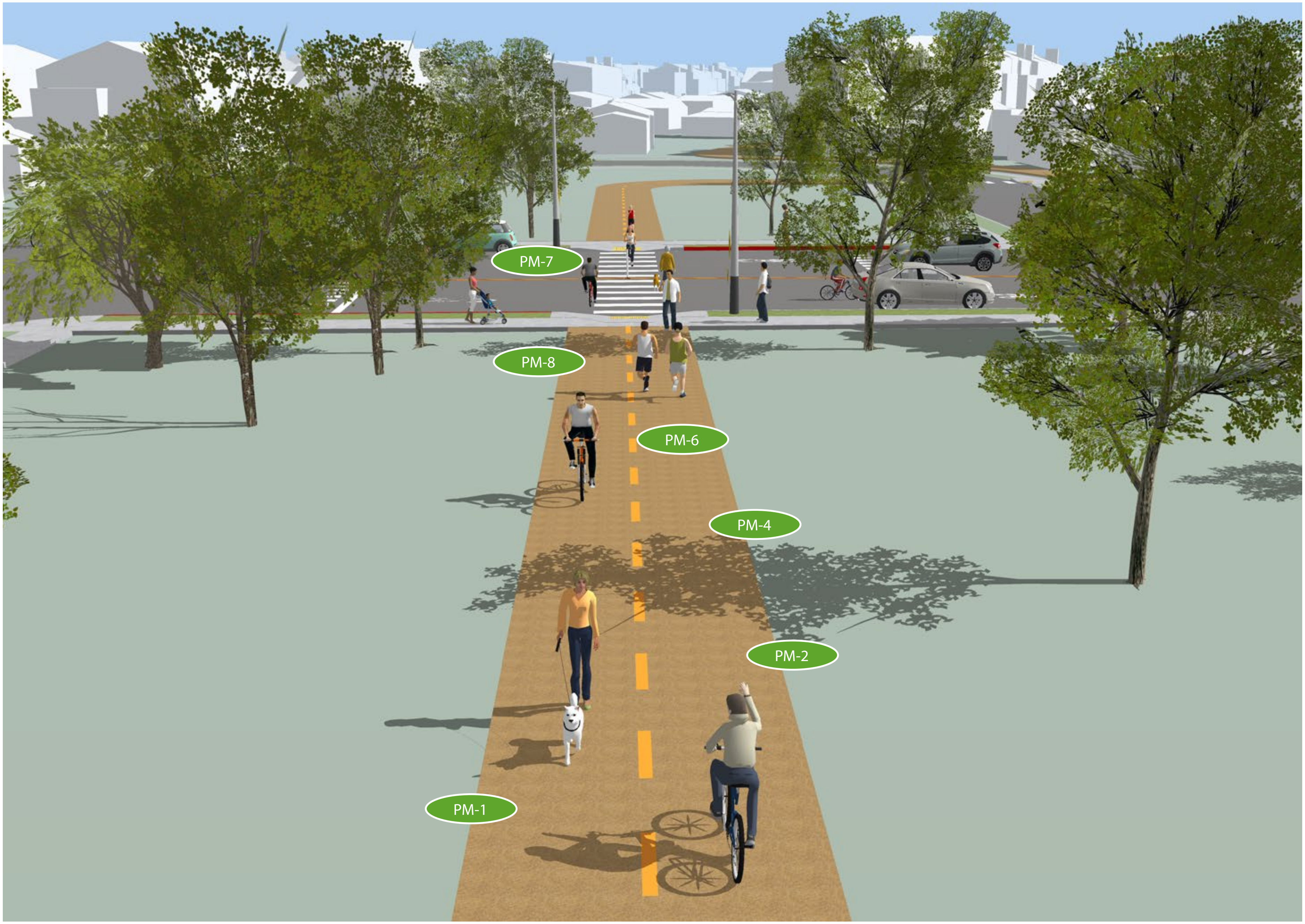


Figure B-8: Multi-Use Path



Separated Bike Lanes—One-Way Cycle Track (PO)

For separated bike lanes and one-way cycle tracks, communities should consider—

PO-1: Designing the bicycle travel lane to be at least as wide as a standard bike lane.

PO-2: Providing sufficient bicycle travel lane width to accommodate street sweeping and snow removal equipment service.

PO-3: Providing a buffer between the bike lane and the adjacent parking or travel lane that is wide enough to mitigate conflicts (e.g. a 3-foot buffer may prevent door conflicts).

PO-4: Using any of the following protective barriers within the buffered area: posts/bollards, pylons, curbing, and landscaped islands.

PO-5: Prohibiting parking near driveways and intersections to allow for good visibility.

PO-6: Constraining driveway openings along separated bike lanes to slow vehicles and improve mutual visibility.

PO-7: Using coloring, yield markings, and/or signage in areas where motorists cross separated bike lanes.

PO-8: Constructing separated bike lanes above the grade of the streets and driveways, requiring vehicles to mount cycle tracks and giving priority to cyclists.

PO-9: Installing gaps in protective barriers to allow wheelchair users to cross them, ensuring that all gaps meet accessibility standards.

PO-10: Identifying and remediating any obstructions (e.g. cracks, utility covers) when installing separated bike lanes on existing streets.

PO-11: Carefully integrating separated bike lanes and transit, ensuring that accessibility standards are met and pedestrian and bike conflicts are minimized.

Figure B-9: Separated Bike Lane - One Way

Please note FHWA Separated Bike Lane Planning and Design Guide, as well as emerging best practices for maintaining accessibility

Separated Bike Lanes—Two-Way Cycle Track (PT)

Although guidelines for the one-way cycle track also apply to the two-way facility, communities should also consider—

PT-1: Designing the bike lanes to be 12 feet wide for two-way cycle tracks (with a 3-foot buffer), 8 feet wide in constrained scenarios.

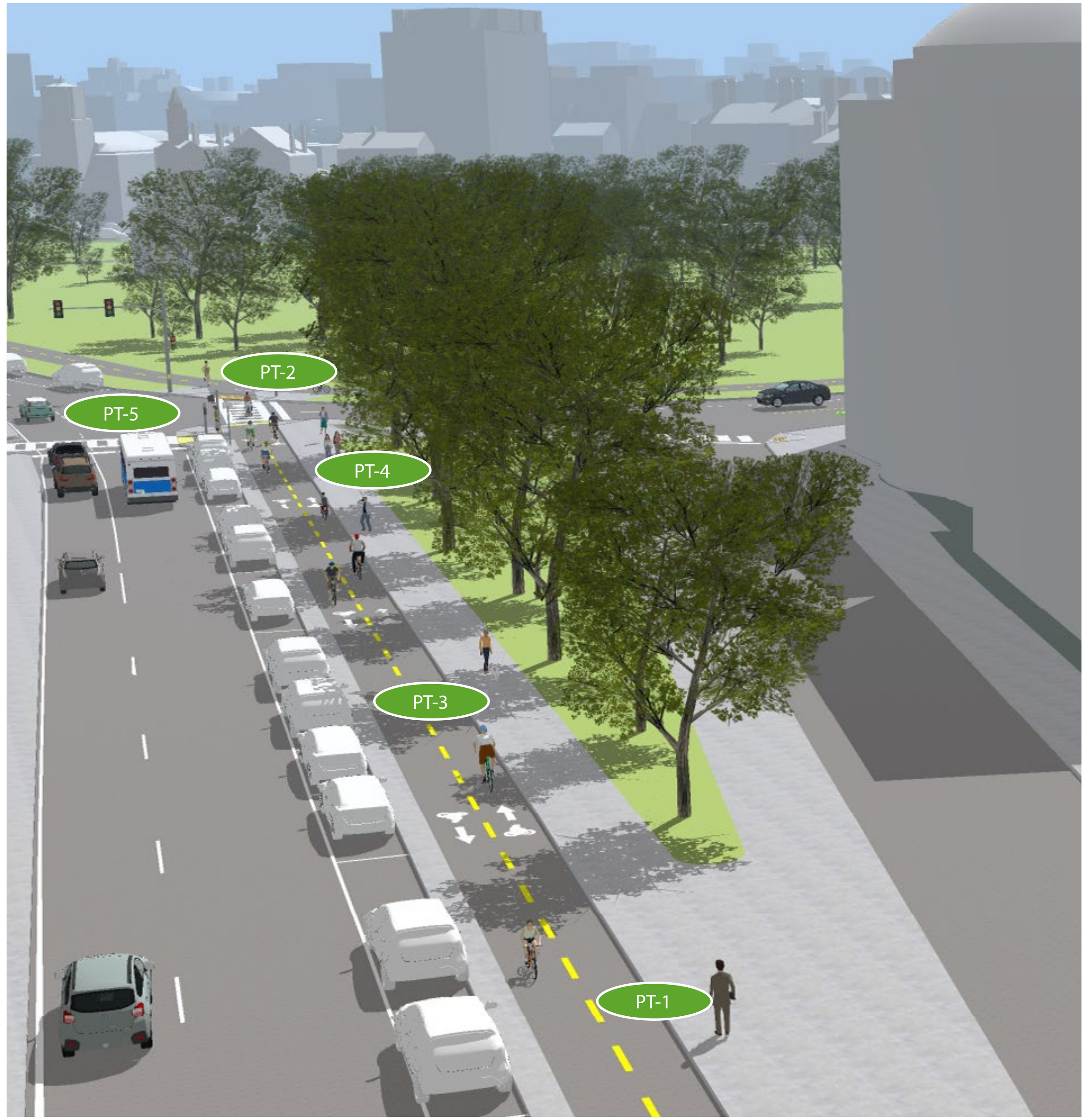
PT-2: Designing terminations of the two-way facility with care, directing cyclists to safe crossings or adjacent facilities.

PT-3: Requiring a dashed centerline.

PT-4: Installing additional vertical signage warning of two-way bike traffic, as well as colored lane markings, to improve safety.

PT-5: Adding markings through the intersection, as well as restrictions on right turns on red, and special bike signals and sensors.

Figure B-10: Separated Bike Lane - Two Way



Bike Lane or Path Utilizing a Bridge (PB)

For bike lanes or paths utilizing a bridge, communities should consider—

PB-1: Ensuring that the bridge meets ADA ramp limitations: no more than 5-percent continuous grade or 8.33 percent with landings and handrails.

PB-2: Ensuring that the bridge meets safety standards of railing height (with railing/fence at least 4 feet high).

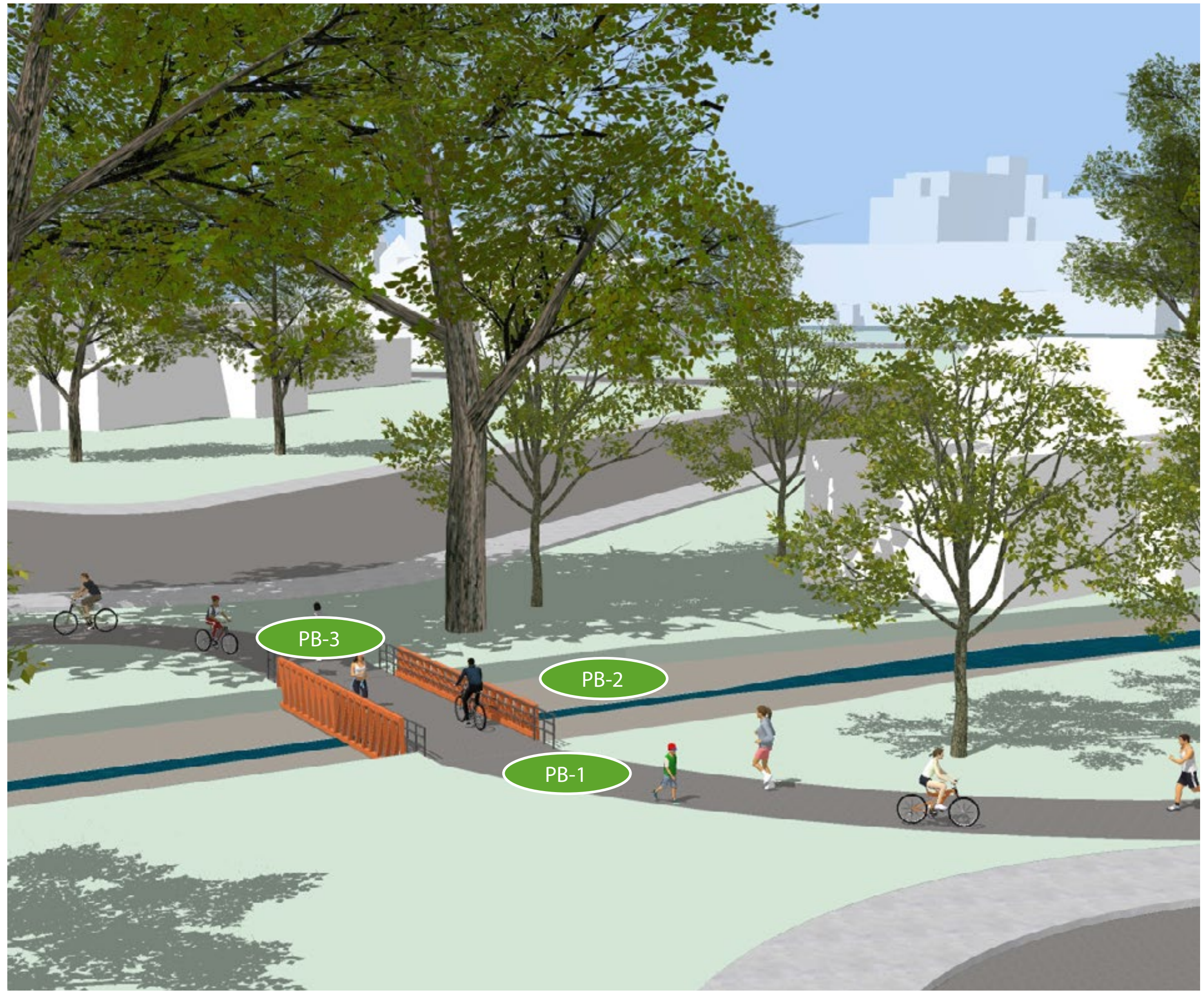
PB-3: Providing minimum widths for emergency, maintenance or security vehicles to be allowed on the bridge.

PB-4: If needed, installing bridge lighting for any protrusions that may be placed in the more limited travel way.

PB-5: Installing barriers or a perceived non-entry device to keep motor vehicles off the bridge, especially if it was not designed for vehicular use.

PB-6: Elevating the climb to the bridge from as great a distance as possible to lessen the braided ramp system that may be required for ADA.

Figure B-11: Bike Bridge



Descriptions and Tools for Bike Facilities at Intersections (I)

Separated Bike Intersections (IG)

For separated bike intersections, communities should consider—

IG-1: Providing physical protection in the form of small, paved and raised barriers that separate vehicles from bikes.

IG-2: Providing a special signal phase that corresponds with motor vehicles traveling the same direction to give cyclists a head start and allow right turn restrictions to be released when the through movement turns green.

IG-3: Having a red phase in separated bike lanes when conflicting turning movements of vehicles in the travel lanes have a green phase, and vice versa.

IG-4: Adding colored and stencil-separated bikeways through intersections to notify motorists that they are crossing a bikeway.

IG-5: Designing in conjunction with pedestrian crosswalks to avoid bike and pedestrian conflicts.

Protected bike lane with roundabout.
Photo source: Blue Zones, LLC and TDC Design Studio

Figure B-12: Separated Bike Intersection

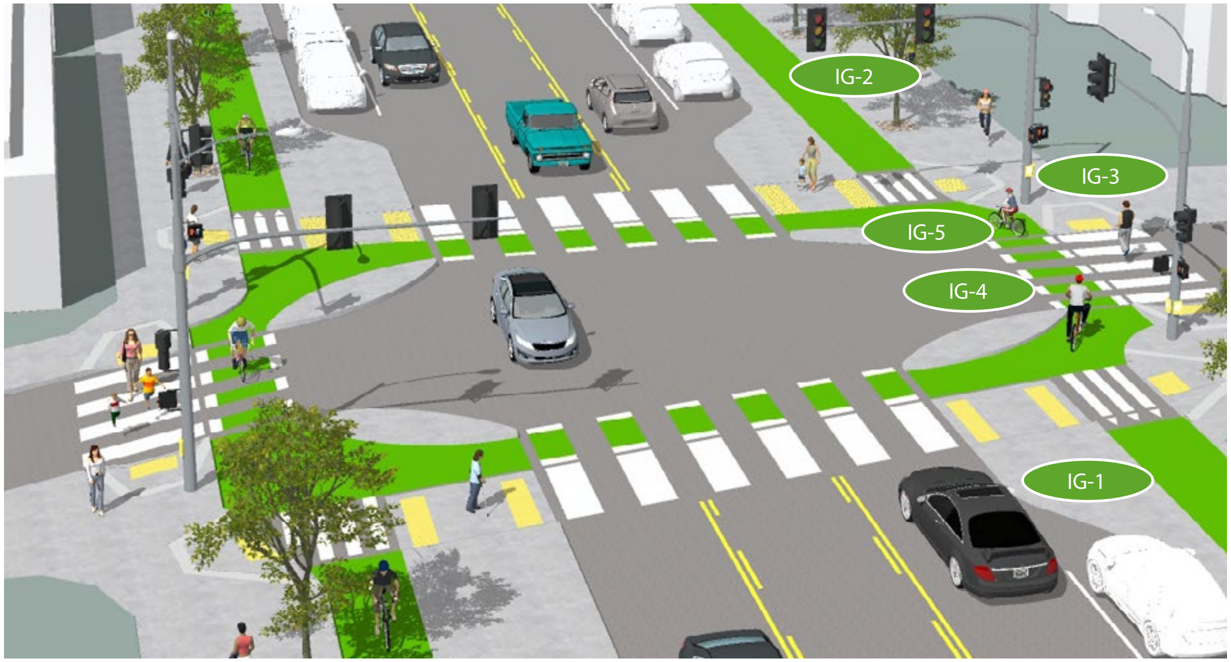
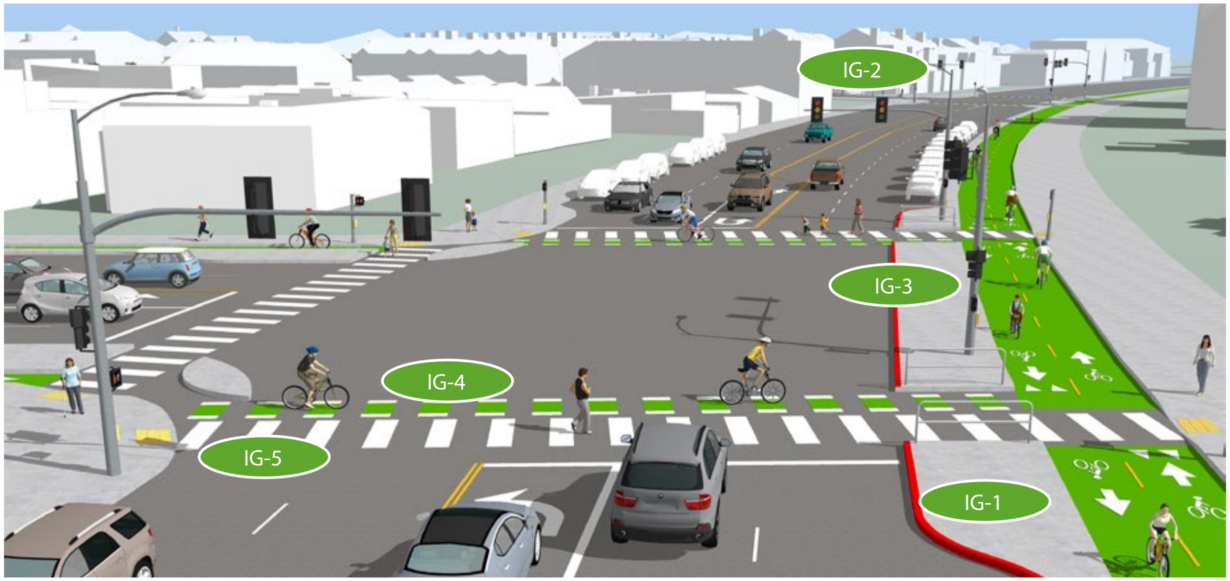


Figure B-13: Partial separated intersection combined with a two-way cycle track and a bike/pedestrian crosswalk. Please note FHWA Separated Bike Lane Planning and Design Guide, as well as emerging best practices for accessibility.



Two-Stage Turn Queue Boxes (IQ)

For two-stags turn queue boxes, communities should consider—

IQ-1: Providing two-stage turn queuing boxes to assist cyclists making a two-stage turn in a complex (multi-lane and/or multi-leg) or separated intersection.

IQ-2: Providing two-stage turn queuing boxes where the width of the lanes of both streets is wide enough to accommodate the painted bike boxes and where they can be separated from pedestrian crosswalks.

IQ-3: Avoiding locations where right-turn-only pocket lanes cannot be separated from the bike box.

Figure B-14: Two-Stage Turn Queue Boxes

Jug Handles for Left Turn With Bike Crosswalk (IJ)

For jug handles, communities should consider—

IJ-1: Installing jug handles in areas where through traffic is at a speed or volume that it is difficult for all but the most skilled cyclists to make left turns when they are traveling on the right side of the road.

IJ-2: Designing jug handles to start a left-hand split from the bike lane early enough to allow slowing and a hard left turn for the cyclist to reposition themselves at a right angle to their previous direction.

IJ-3: Placing a raised median diverter to separate the through-movements by other bikes and vehicles, providing a safe haven for cyclists who are waiting for signals to change.

IJ-4: Using stripes, chevrons, lane markings, and green paint with stencil arrow directions to clarify the movement if a raised median is not possible.

IJ-5: Providing a special bike crosswalk that is separated from pedestrian crosswalks.

IJ-6: Installing special bike signals, instructions, and actuators that can sense the cyclist or be activated to complete the movement.

Figure B-15: Jug Handles

Mixing Zone With Solid and Dashed Markings (IZ)

For mixing zones with solid and dashed markings, communities should consider—

IZ-1: Using colorful pavement to highlight conflict areas between vehicles and bikes.

IZ-2: Using colorful pavement to visibly reduce the perceived width of the street for traffic calming and clarity purposes.

IZ-3: Applying to the FHWA for a non-MUTCD experimental use permit to use color pavement.

IZ-4: Dashing the colored sections of lanes where crossing occurs with white line dashing to indicate that a vehicle is crossing over a bike facility. This puts the yield burden on the faster-moving vehicle.

Figure B-16: Mixing Zone

Mid-block Bike Crossings/Signals (IH)

For mid-block bike crossings, communities should consider—

IH-1: Keeping crossings simple on low-volume, low-speed roadways, such as short collectors through neighborhoods (e.g. using yield control, painted crosswalk and yield bars, and simple regulatory/warning signage).

IH-2: More-intensive design on high-volume and high-speed roadways such as multi-lane minor and major arterials (e.g. using pedestrian hybrid beacon (PHB) control or full signalization, refuge islands or raised medians, lighting, and high-visibility regulatory/warning signage).

IH-3: Considering an offset of movements across the median, if large enough, to allow cyclists to watch for vehicular compliance to the yielding.

IH-4: Combining mid-block bike crossings with pedestrian crossings whenever possible.

Through-Intersection Painted Markings (IT)

For through-intersection painted markings, communities should consider—

IT-1: Markings through the intersection: dashed lines, green boxes, or shared-lane marking icons.

IT-2: Adding standard bike lane symbols and arrows or other icon markings that face both directions through the intersection on cycle tracks, especially two-way cycle tracks on one side of a street.

IT-3: Carrying shared lane marking lanes through an intersection, with care given to dash, to indicate that vehicles can cross through this line.

IT-4: Having simple turning arrows, straight-ahead arrows, stop-here markings, and other treatments at intersections.

Figure B-17: Mid-block Bike Crossing

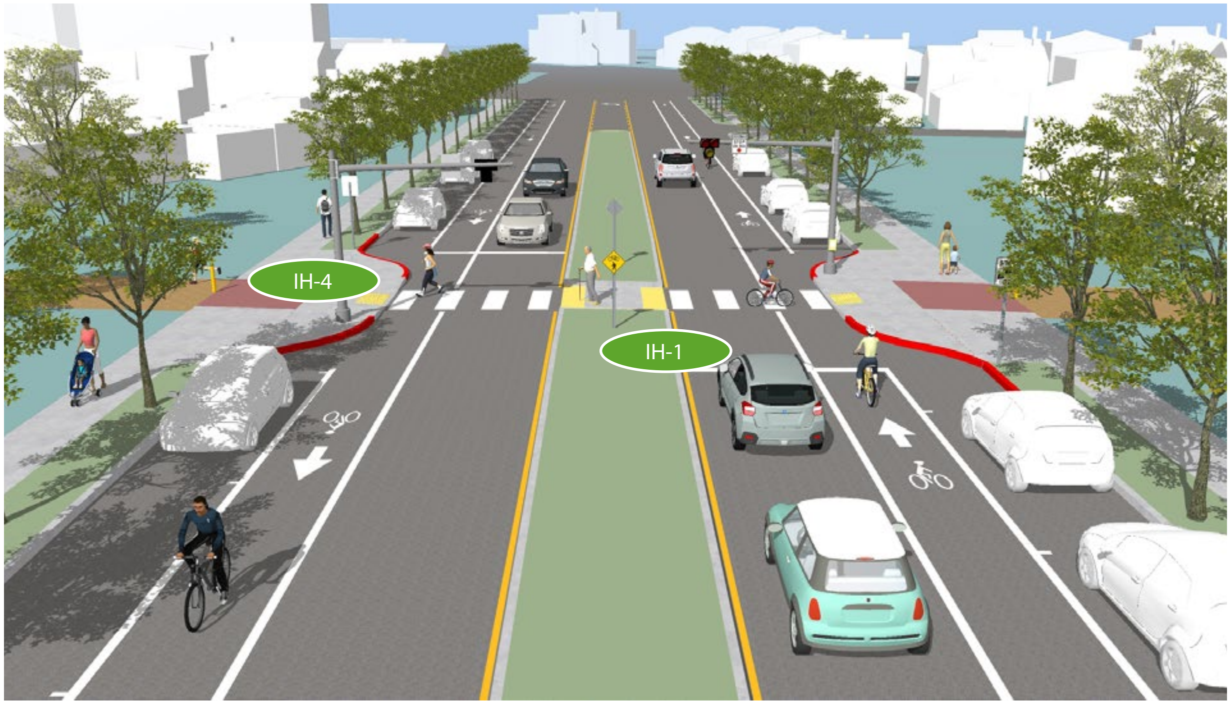


Figure B-18: Through Intersection Painted Markings

Bike Boxes (IK)

For bike boxes, communities should consider—

IK-1: Providing bike boxes at signalized intersections with high volumes of bicycles and/or motor vehicles, especially those with frequent bicyclist left turns and/or motorist right turns.

IK-2: Providing bike boxes where there may be right- or left-turning conflicts between bicyclists and motorists.

IK-3: Providing bike boxes where there is a desire to better accommodate left-turning bicycle traffic.

IK-4: Providing bike boxes where a left turn is required to follow a designated bike route or boulevard or access a shared-use path, or when the bicycle lane moves to the left side of the street.

IK-5: Providing bike boxes when the dominant motor vehicle traffic flows right and bicycle traffic continues through (such as at a Y intersection or access ramp).

IK-6: Providing bike boxes to give bicyclists a safe and visible way to get ahead of queuing traffic during the red signal phase.

Dedicated or Shared Right Turn Lanes (IR)

For dedicated or shared right turn lanes, communities should consider—

IR-1: Including solid lane boxes, crossover markings with breaks in solid lines indicating allowed crossing points, and a sharks-tooth yield line to best create spaces for bikes to hold at an intersection.

IR-2: Placing a dashed strip on the right edge of the box and a solid lane marking on the left-hand side for a shared right turn lane. The markings must make clear the expected behavior and yielding requirements for these types of intersections.

IR-3: Including signs advising motorists and bicyclists of proper positioning within the shared right lane and that a vehicle must hold behind a bike until the green phase of the light.

Diverter of Traffic/Bike and Pedestrian Allowed (ID)

For traffic diverters, communities should consider—

ID-1: Making barriers to access clear to drivers from some distance away.

ID-2: Installing visible signage warning of road closures to clearly indicate the movements allowed.

ID-3: Installing clear markings and signage on diverters so that bikes move toward the middle of the street and vehicles turn to the right.

ID-4: Coordinating pedestrian crosswalks, median refuges, signals, lane markings, and other features so that both bikes and pedestrians can maneuver safely through these intersections.

Figure B-19: Bike Boxes

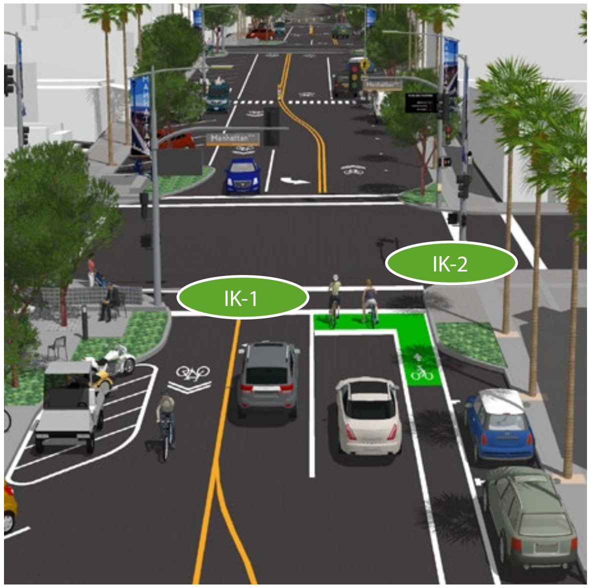
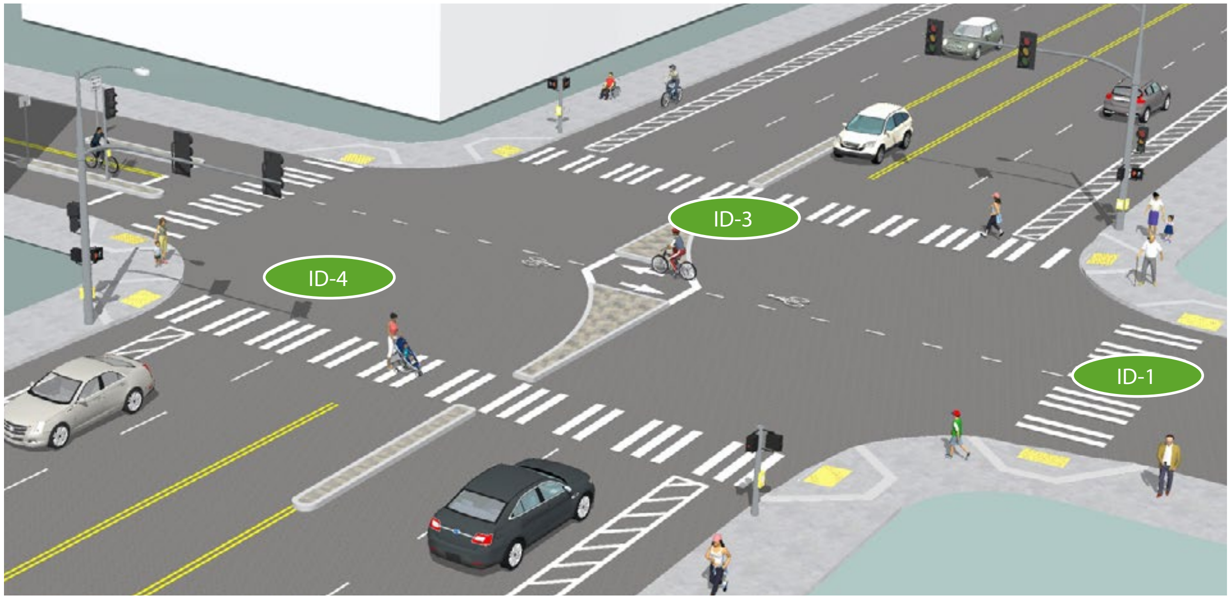


Figure B-20: Traffic Diverter



Descriptions and Tools for Bike Amenities (A)

Bike Stations With Public Lockers/Showers (AD)

For bike stations with public lockers and showers, communities should consider—

AD-1: Installing enclosed and monitored well-placed series of bike racks at major transit hubs, where cyclists will feel comfortable leaving their bike for an extended period.

AD-2: Installing bike stations at campuses or major employment corporate centers.

AD-3: Requiring all employment centers and businesses larger than a certain size to provide bike parking and changing facilities. If this is not possible, they can be provided through a cooperative or subsidized facility.

AD-4: Having individual unisex stalls used privately by one individual at a time to alleviate risk concerns over shower facilities.

Private Lockers/Showers (AP)

For private lockers and showers, communities should consider—

AP-1: Requiring employers with more than 25 employees to provide one private locker and shower facility somewhere within the primary building or adjacent building complex.

AP-2: Requiring employers to provide one private locker and shower facility per every 25 employees, up to 10 facilities.

AP-3: Allowing site operators of health facilities or other community- or business park-related organizations to meet this performance requirement through shared facility agreements or memberships.

Bike Traffic Signal Heads (AH)

For bike traffic signal heads, communities should consider—

AH-1: Providing bicycle countdowns that communicate how much time is left until the green bicycle indication is shown.

AH-2: Implementing a leading bicycle interval (LBI), in conjunction with a bicycle signal head, to give bicyclists a green signal while the vehicular traffic is held at all red for several seconds. This treatment can be used to enhance a bicycle box.

Bike Signal Detection/Sensors/Actuators (AF)

For bike signal detection, communities should consider—

AF-1: Including bicycle detection at all intersections where cyclists are permitted to ride, as a matter of routine accommodation.

AF-2: Ensuring that bicycle detection provides adequate time for cyclists to cross the full intersection.

AF-3: Ensuring that all traffic signals are sensitive to bike presence to be able to trip the signal on the next cycle because all streets can be used by cyclists.

AF-4: Ensuring that cyclists are accurately detected (are sensitive to the mass and volume of a bicycle and its rider) and providing clear guidance to bicyclists on how to actuate detection (e.g., which button to push or where to stand).

Bicycle-Sharing Stations/Programs (AB)

For bicycle-sharing stations and programs, communities should consider—

AB-1: Working out public and private partnerships to initiate a local bike-share program.

AB-2: Providing a critical mass of facilities in areas that are considered to be bikeable communities.

Bicycle Storage and Parking (AS)

For bicycle storage and parking, communities should consider—

AS-1: Providing secure bicycle parking at likely destinations as an integral part of a bikeway network.

AS-2: Locating bicycle parking in well-lit, secure locations close to the main entrance of a building, without interfering with pedestrian movement.

AS-3: Installing bike racks that support the bicycle well and make it easy to lock a U-shaped lock to the frame of the bike and the rack.

Refer to the APBP Bike Parking Guidelines for additional information.

Bike Wayfinding Systems (AW)

For bike wayfinding systems, communities should consider—

AW-1: Implementing a comprehensive wayfinding system that supports and describes the local bicycle network.

AW-2: Using wayfinding to provide branding and placemaking and to encourage access to business, cultural, and tourist destinations.

AW-3: Using wayfinding to provide confirmation of route and available choices of routes.

AW-4: Using wayfinding for information related to local destinations.

AW-5: Using wayfinding to provide information related to distances and directions.

Bike Repair/Tool Stations (AT)

AT-1: Locating manned repair facilities in high-use areas that would typically be part of a bike station or major bike storage facility.

AT-2: Locating standalone unattended tool stations at major confluences of bike facilities and near transit centers and major destinations. Vendors can provide a turnkey solution that requires little more than the initial capital investment.

Walkway Treatments (W)

Walkway Presence and Continuity (WC)

For walkways, communities should consider—

WC-1: Providing the shortest connections between origins and destinations as possible.

WC-2: Minimizing steep grades between surfaces. Walkways away from the street are required to maintain a 5-percent or 8-percent (with railing) ramp system.

WC-3: Providing grade separation from adjacent streets.

WC-4: Ensuring that walkways attached to the street comply with all other ADA requirements. All intersections must be regraded to meet percent slope maximums, however.

WC-5: Providing mid-block crossings along long blocks or areas with a wide distribution of streets to minimize total walk times.

WC-6: Closing gaps in dead end or cul-de-sac streets with pedestrian accessible paths or cut-throughs.

WC-7: Closing gaps along roadways (e.g. between developments) to promote accessibility and conform with federal ADA regulations.

WC-8: Prioritizing sidewalk gap closure along through-corridors, boulevards, and avenues—if not properly handled—presents a gap in continuity and therefore must be a priority.

Primary Universal Walkway Access Guidelines (WU)

The following list of principles is paraphrased from the Project Universal Access website (http://www.humantransport.org/universalaccess/page2.html).

WU-1: **Universal Access to Destinations** indicates that all destinations served by the public road system shall be accessible by pedestrians and by drivers of all vehicles (including bicycles), except that vehicle operation may be restricted for reasons of excessive weight, noise or size, or extraordinary potential for damage to the property or person of others.

WU-2: **Equal Rights of Use** describes the people's right to use that portion of a street designed for travel that is not diminished by less weight, less size, or less average speed associated with their travel mode. The adequate accommodation of heavier, larger, faster travel modes by a road's design must not imply its inadequacy for or unintended use by smaller, lighter, or slower modes. Demand-actuated traffic signals must detect and serve a diversity of users, including bicycle operators in the roadway and pedestrians using crosswalks.

WU-3: **Integration of Modes** is a principle stating that travel by different modes shall not be segregated by law or facility design without compelling, objective, scientifically valid evidence of operational advantages of segregation that outweigh the disadvantages. Segregation of pedestrian from vehicle traffic may be warranted on busy roads due to the different maneuverability and nighttime visibility characteristics of pedestrians and vehicles. Segregation of different vehicle types is undesirable, as this segregation almost always creates increased conflicts at junctions, forces users of some vehicle types to use inferior facilities, or stigmatizes users who violate the segregation policy for safety reasons.

WU-4: **Uniformity and Simplicity** is a principle that states transportation systems should be simple and intuitive. Designs and regulations should be uniform across facilities. Similar traffic situations should be treated in a similar manner, enabling more rapid and reliable user behavior. Vehicle-type-specific exceptions to the rules of the road are undesirable because such exceptions make traffic movements less predictable and traffic negotiation less reliable.

WU-5: **Accessible Surfaces** states that, to the extent practicable, travel surfaces should accommodate travel on foot with minimal trip hazards and via common assistive devices, such as wheelchairs. Roadway surfaces should be as clear as possible of hazards for narrow tires such as bicycle tires.

WU-6: **Crossable Roadways** describes the importance of crossing distances at non-signalized access locations that must not exceed the distance that can be covered at walking speed before traffic may arrive from beyond sight distance, or during reasonable gaps in roadway traffic. Refuges provided to reduce crossing distances should be large enough to store assistive devices, such as wheelchairs and strollers. Traffic signal timing should provide adequate clearance intervals for safe crossing by pedestrians and slow vehicles.

WU-7: **Appropriate Space for Use** needed for maneuvering and recovery should be incorporated for all vehicle operators and for pedestrians, including wheelchair users. If it is desirable to accommodate faster speeds for some modes while slower modes are present on the same road, the road may be designed to facilitate easier overtaking between modes. Overtaking activities should take place at distances appropriate for the difference in speed, maneuverability of modes, and vulnerability of users.

Curb Zones—Curb, Gutter, Parking, and Bulb-Outs (W1)

For curb zones, communities should consider—

W1-1: Providing a minimum curb zone width of 6 inches, or 18 inches where pedestrian or freight loading is expected and may conflict with obstacles in the furniture zone.

W1-2: Providing low curbs (3 to 4 inches high) to reduce the division between the travel way and the sidewalk, particularly in areas with significant pedestrian traffic. Low curbs also improve the geometry and feasibility of providing two perpendicular curb ramps per corner.

W1-3: Including on-street parking in the curb zone—as appropriate—to calm traffic, thereby enhancing pedestrian safety and comfort.

W1-4: Installing curb extensions, bulb-outs, or bus bulb-outs to extend the sidewalk and reap the following benefits: decreased crossing distances for pedestrians, increased visibility between pedestrians and drivers, traffic calming by "pinching in" on the intersection, increased landscaped space, and increased definition of the pedestrian realm.

Furnishing Zone—Trees, Signage, Utilities, and Furniture (W2)

For furnishing zones, communities should consider—

W2-1: Providing a minimum furniture zone width of 4 feet.

W2-2: Providing a parkway width of 6 to 8 feet, where bus stops exist, to accommodate multiple users.

W2-3: Providing a minimum planting area of 40 square feet, where street trees are included.

W2-4: Providing an open planter, where the planting area is narrow, to ensure the health of trees.

W2-5: Including parkways strips to achieve mobility, environmental, and public safety goals: traffic calming, stormwater runoff, and pedestrian protection.

W2-6: Providing tree spacing that is appropriate to the tree type and parkway context: small trees associated with parkway strips of 4 to 6 feet wide should be spaced 20 feet apart; larger trees associated with parkway strips wider than 6 feet should be spaced 30 feet apart.

W2-7: Installing furnishing elements in the furnishing zones to reduce barriers in the walkway zone. All vertical elements and furnishings should be kept 2 feet from the face of the curb, including signs, meters, light poles, and the backs or fronts of street furniture.

W2-8: Installing trash receptacles in the parkway strip in business districts or town centers, pending the availability of routine collection and maintenance.

W2-9: Ensuring the accessibility of all elements in the furnishing zone intended for pedestrian use—benches, water fountains, and so forth.

W2-10: Installing signage to provide important information for all roadway users. Sign use and placement should be done judiciously, as overuse tends to create noncompliance and disrespect. Too many signs can also create visual clutter.

W2-11: Installing regulatory signage such as STOP, YIELD, or turning restriction signs.

W2-12: Installing warning and wayfinding signage to provide information, especially to motorists and pedestrians unfamiliar with an area. Care must be given to the proper placement of these signs to ensure high visibility and continuity in placement.

W2-13: Installing advance pedestrian warning signs where motorists may not expect pedestrian crossings.

W2-14: Using MUTCD-prescribed fluorescent yellow/green pedestrian, bicycle, and school warning signs (Section 2A.10 of the 2009 MUTCD) for all new and replacement installations.

W2-15: Using the sign referred to as a "R1-5" in conjunction with advance yield lines.

W2-16: Using the sign referred to as "R1-6" on median islands, especially where there is on-street parking, to alert motorists to the crossing.

W2-17: Minimizing signage through good street design. For instance, instead of installing signage with messages like "SLOW" and "CAUTION," allow streets to convey these messages themselves through narrow travel lanes, parkway landscaping, and on-street parking.

W2-18: Providing lighting in the furnishing zone and at all pedestrian crossing locations. Adequately bright illumination should be present at all marked crossings.

W2-19: Utilizing the FHWA HT-08-053, Information Report on Lighting Design for Mid-block Crosswalks.

W2-20: Providing crosswalk lighting of a color that contrasts with standard roadway lighting (see "Recommended Illumination by Street Type").

Note: Guidance on crosswalk lighting levels comes from the Illuminating Engineering Society of North America (IESNA) intersection guidance to illuminate pedestrians in the crosswalk to vehicles.

Walking Zone—Surface Materials, Continuity, Slopes (W3)

For walking zones, communities should consider—

W3-1: Complying with the following ADA-required guidelines, including that the route be firm, stable, slip-resistant, and have a maximum cross-slope of 2 percent.

W3-2: Maintaining a walkway grade that does not exceed the general grade of the adjacent street.

W3-3: Providing a pedestrian access route (PAR) of 5 or 6 feet to allow two wheelchair users to comfortably pass one another. If, instead, a minimum PAR (4 feet) is provided, passing areas are required at a maximum of 200-foot intervals.

W3-4: Designing pedestrian zones to be at least 4 feet wide where there is a parkway strip or furnishing zone of 4 feet and a building frontage zone of 2 feet.

W3-5: Using a 5-foot-wide standard if the walkway is not against a building and has no parkway strip. If the walkway is adjacent to zero lot line storefronts and the curb without a defined building edge zone or furnishings zone, the walkway should be at least 6 feet wide.

W3-6: Designing driveways for accessibility, including a cross-slope of no more than 2 percent. To provide a continuous PAR across driveways, aprons should be confined to the furniture and curb zones.

W3-7: Prohibiting the encroachment of utility poles or utility transformers and equipment in minimum (4-foot) walking zones. Underground vaults would be an exception if they are flush to the walking surface.

Building Frontage Zone—Furniture/Utilities (W4)

For building frontage zones, communities should consider—

W4-1: Providing a minimum building frontage zone width of 18 inches if adjacent to a wall, fence, or building to accommodate door openings, window openings, and other protrusions.

W4-2: Providing a building frontage zone of 4 feet in locations where outside seating is desired to accommodate a small dining area.

W4-3: Providing a building frontage zone of 8 feet in locations where larger-scale dining is proposed.

W4-4: Placing sitting benches at least 3 feet from building walls to avoid an encroachment on passing pedestrians.

W4-5: Prohibiting any encroachments that cause the usable walkway width to fall below 4- to 6-foot standards.

W4-6: Using a special material or treatment to call out intrusions in the building frontage zone (utility connections, meters, and backflow preventers) to prevent injuries.

Table B-3: Recommended Illumination by Street Type

FUNCTIONAL CLASSIFICATION	AVERAGE MAINTAINED ILLUMINATION AT PAVEMENT BY PEDESTRIAN AREA CLASSIFICATION		
	High	Medium	Low
Through Corridor (Major Arterial)	3.4 fc	2.6 fc	1.8 fc
Boulevard (Major Urban Arterial/Collector)	2.9 fc	2.2 fc	1.5 fc
Avenue (Major Arterial/Collector)	2.6 fc	2.0 fc	1.3 fc
Major Street (Local Road or Collector)	2.1 fc	1.6 fc	1.0 fc
Minor Street (Local or Lane)	1.8 fc	1.4 fc	0.8 fc

Note: FC stands for "foot candle" and is defined as the amount of luminance on a 1 square foot surface of which there is uniformly distributed flux of one lumen. ANSI-IESNA RP-8-00, "Roadway Lighting," P. 15

Street Crossings (C)

Pedestrian Bridge or Underpass (CB)

For building frontage zones, communities should consider—

CB-1: Recommending overcrossings over under-crossings for personal safety.

CB-2: Designing bridges to be at least 6 feet wide if only used by pedestrians and 12 feet wide if shared with bikes.

CB-3: (Required) Following ADA access standards and regulations for slopes and cross-slopes.

CB-4: Providing railing and fencing of adequate height for the safety of bridge and roadway users.

CB-5: Providing adequate lighting for most bridge crossings and all underpasses; providing natural light through skylights, if possible.

CB-6: Employing open architecture, if a tunnel or passageway is provided, for personal safety.

CB-7: Elevating the climb to the bridge from as great a distance as possible to lessen the braided ramp system that may be required for ADA.

Figure B-21: Pedestrian bridges can be great assets, offering direct pedestrian and bicycle connections, and scenic views.

Raised Crosswalk/Speed Table (CT)

For raised crosswalks/speed tables, communities should consider—

CT-1: Installing raised crosswalks to make pedestrians more visible. Raised crosswalks should include a flat, smooth surface for walking and two beveled slopes for mounting/driving over the crosswalk.

CT-2: Paving the level crosswalk area with smooth materials. Special texture or pavements used for aesthetics should be placed on beveled slopes to alert approaching motorists.

Crossings at Signals (CS)

For crossings at signals, communities should consider—

CS-1: Permitting crossing on all intersection legs.

CS-2: Providing a separated left turn signal to reduce conflict from permissive left turns.

CS-3: Extending the overall phase of the traffic signal to allow all legs of the pedestrian crossing to work.

CS-4: Providing a leading pedestrian interval to give pedestrians a head start and increase their visibility to motorists.

CS-5: Providing a pedestrian exclusive phase known as a pedestrian scramble, to clear a larger amount of the pedestrian traffic across all legs at one time.

CS-6: Providing a sensor-based pedestrian crossing system to allow for the earlier release of the left turn hold that conflicts with the pedestrian movement.

CS-7: Allowing shorter, more "efficient" phases only if coupled with special actuators that permit extended phases for slower pedestrians.

CS-8: Installing median refuges on very wide streets to provide a resting place for especially slow pedestrians should they not clear the intersection within a single signal phase.

CS-9: Providing additional actuators in median refuges.

Crossings at Stop/Yield Signs (CY)

For crossing at signals, communities should consider—

CY-1: Providing marked crossings at yield-controlled intersections where supported by need and engineering judgment.

CY-2: Providing marked crossings at stop-controlled intersections near schools or areas of high levels of pedestrian activity with higher traffic volumes and greater crossing distances.

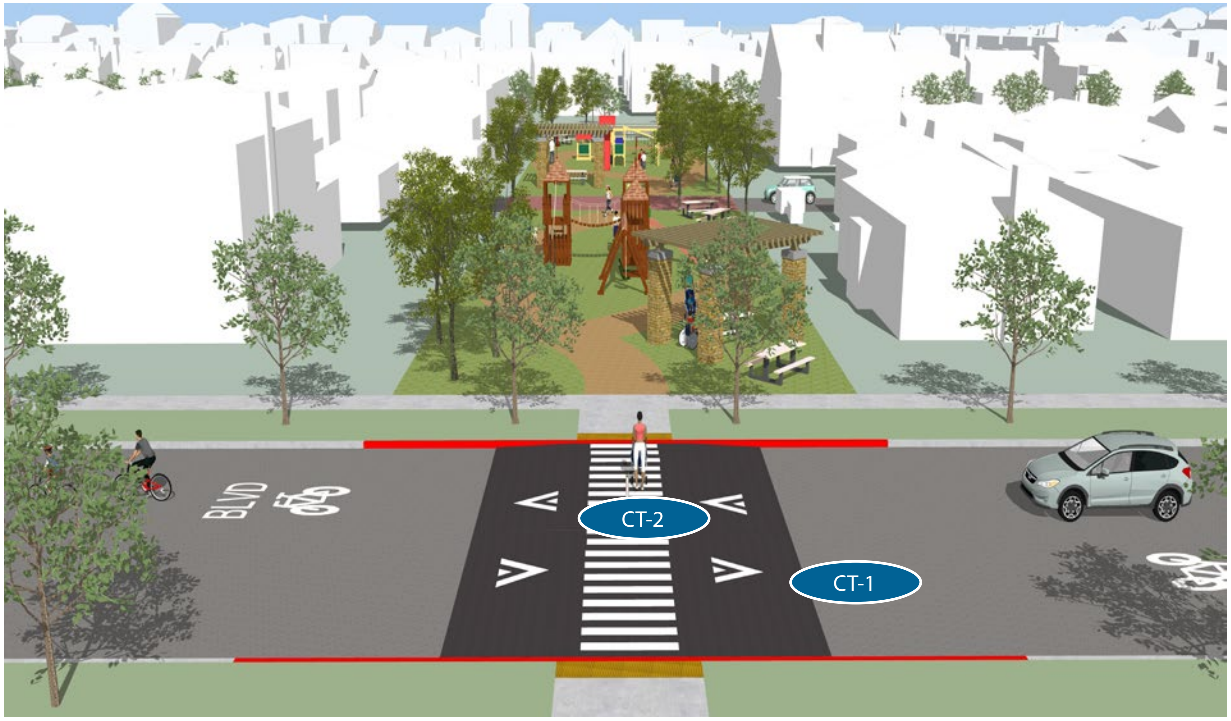
CY-3: Providing marked crosswalks using standard double line or ladder or continental-style markings.

CY-4: Installing advance stop lines (12 to 24 inches wide) at an appropriate distance (4 to 6 feet) from the crosswalk to motorists to stop traffic well in advance of crosswalks.

CY-5: Tightening curb radii, in conjunction with pavement markings, in order to slow turning speeds and increase safety for crossing pedestrians.

CY-6: Providing crossing islands and raised pedestrian crossings where circumstances merit (for example, long crossing distances, proximity to schools).

Figure B-22: A raised speed table works well in neighborhood settings where speeds and traffic volumes are low.



Crossings at Mid-blocks—Markings, Median Refuges, Crossing Islands, and Signs (CM)

For crossings at mid-blocks, communities should consider—

CM-1: Providing mid-block crossings with median refuges to simplify pedestrian crossings of a complex street (so that crossings may be made in two stages and in much less time).

CM-2: Implementing mid-block crossings to slow or calm traffic.

CM-3: Including raised islands in mid-block crossings—where traffic speeds and volumes are high and sight distances are poor—to further calm traffic and increase pedestrian visibility.

CM-4: Installing crossing islands, instead of signal-controlled crossings—on two-lane, slower, and lower-volume streets—to lower installation and maintenance costs, reduce waiting times, and increase safety benefits.

CM-5: Adding crossing islands in conjunction with road diets (e.g. where a four-lane undivided road is reduced to a two-lane roadway with center turn lane/refuge).

CM-6: Planting tall trees and low ground cover on crossing islands to increase visibility, reduce surprise, and minimize signage.

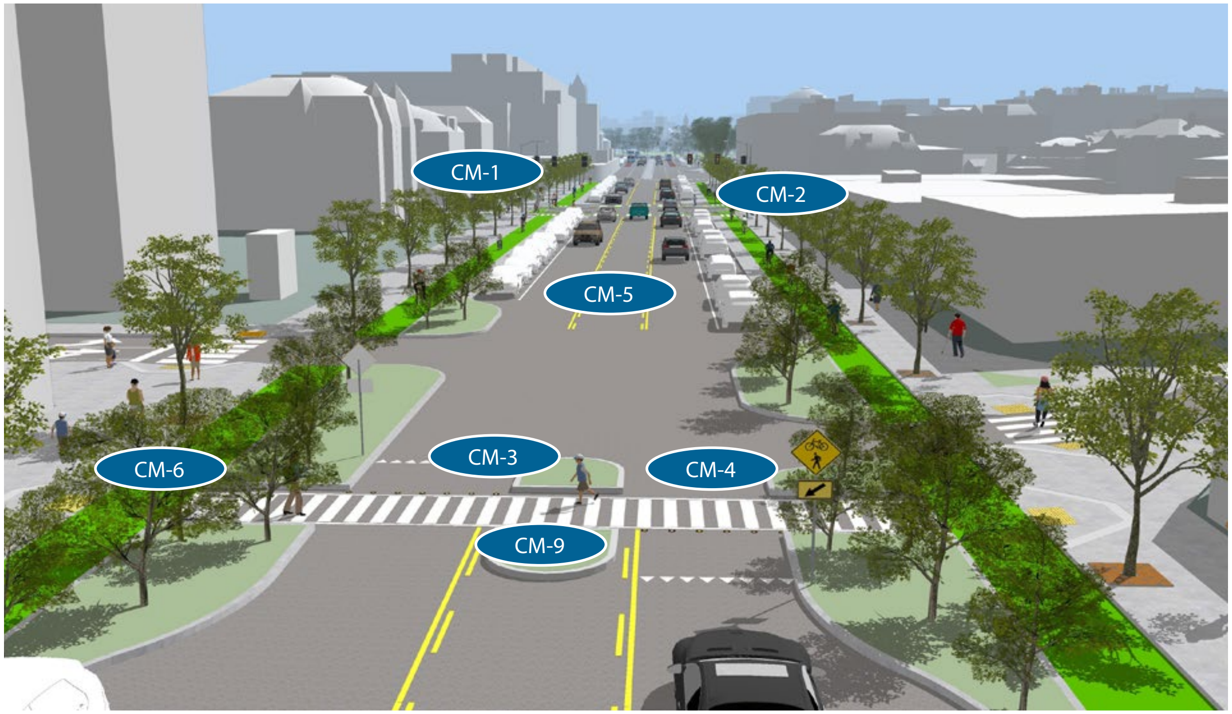
CM-7: Extending median islands where curves of hill crests complicate crossings to improve visibility.

CM-8: Providing adequate lighting for islands and crosswalks to enhance visibility and safety.

CM-9: Designing crossing islands to be a minimum 6 feet wide (islands may be as narrow as 4 feet where roadway width is very constrained).

CM-10: Inserting a 90-degree bend to the crosswalk—when used on higher-speed roads and where space is available—to help orient pedestrians to oncoming traffic as they cross.

Figure B-23: Mid-block crossing with median refuge, shark-tooth yield markings, warning signs and flashers.



Crossings at Uncontrolled Intersections (CN)

For crossing at uncontrolled intersections, communities should consider—

CN-1: Implementing advance yield lines at uncontrolled crossings of multi-lane roads to prevent multiple-threat vehicle and pedestrian collisions.

CN-2: Per Section 3B.16 of the MUTCD, placing advanced yield markings 20 to 50 feet in advance of crosswalks, depending upon local requirements and location-specific variables: vehicle speeds, traffic control, street width, on-street parking, potential for visual confusion, nearby land uses with vulnerable populations, and demand for queuing space.

CN-3: Placing advanced yield markings 30 feet in advance of crosswalks in the majority of locations. This setback allows a pedestrian to see if a vehicle in the second (or third) lane is stopping after a driver in the first lane has stopped.

CN-4: Installing advanced yield or stop lines (depending on whether the state requires a yield or stop) to indicate where vehicles must yield or stop to reduce vehicle encroachment into the crosswalk and improve a driver's view of pedestrians.

CN-5: Providing special treatments for pedestrians at uncontrolled crossings and mid-block crosswalks. These are locations where motorists do not automatically stop.

Table B-4: Appropriate Treatment for Pedestrians at Uncontrolled Crossings with Prevailing Speeds Less Than 30 mph

DEVICE OR TREATMENT	NUMBER OF LANES AND TRAFFIC VOLUME									
	2 Lanes	2 Lanes + 1 Turning Lane	4 Lanes ADT = 10,000-15,000	4 Lanes ADT = 15,001-20,000	4 Lanes ADT = 20,001-25,000	4 Lanes ADT = 25,001-30,000	4 Lanes ADT = 30,001-40,000	4 Lanes ADT > 40,000	6 Lanes ADT = 25,000-40,000	6 Lanes ADT > 40,000
Marked Crosswalks										
Advance Stop Lines										
Curb Extensions										
Lighting*										
Signs**										
Raised Crossing Islands/ Medians										
Raised Crosswalks***										
Rectangular Rapid Flash Beacon										
Pedestrian Hybrid Beacon										
Signalize with Devices for Signalized Intersections										
Road Diet										

* refers to overhead lighting of crosswalks ** only appropriate at non-signalized crossings ***along school routes, main streets, at transit stations, or where significant numbers of disables people or older adults cross

Table B-5: Appropriate Treatment for Pedestrians at Uncontrolled Crossings with Prevailing Speeds Greater Than 30 mph

DEVICE OR TREATMENT	NUMBER OF LANES AND TRAFFIC VOLUME									
	2 Lanes	2 Lanes + 1 Turning Lane	4 Lanes ADT = 10,000-15,000	4 Lanes ADT = 15,001-20,000	4 Lanes ADT = 20,001-25,000	4 Lanes ADT = 25,001-30,000	4 Lanes ADT = 30,001-40,000	4 Lanes ADT > 40,000	6 Lanes ADT = 25,000-40,000	6 Lanes ADT > 40,000
Marked Crosswalks										
Advance Stop Lines										
Curb Extensions										
Lighting*										
Signs**										
Raised Crossing Islands/ Medians										
Raised Crosswalks***										
Rectangular Rapid Flash Beacon										
Pedestrian Hybrid Beacon										
Signalize with Devices for Signalized Intersections										
Road Diet										

* refers to overhead lighting of crosswalks ** only appropriate at non-signalized crossings *** along school routes, main streets, at transit stations, or where significant numbers of disabled people or older adults cross

Crosswalk Markings and Requirements (CX)

For crosswalk markings and requirements, communities should consider—

CX-1: Marking all signalized intersections with a stop bar and double bar crosswalk, at a minimum, unless the pedestrian crossing is specifically prohibited.

CX-2: Including stop bars on local streets with four-way stops, and also including high visibility, marked crosswalks, as appropriate (e.g. near schools or other areas of high foot traffic).

CX-3: Using continental crosswalks, a high-visibility crosswalk pattern, around schools at stop-controlled locations; at some locations, well-marked crosswalks are needed.

CX-4: Including crosswalks across the permissive direction at certain two-way stop-controlled intersections (e.g. near schools or other areas of high foot traffic).

CX-5: Providing marked crosswalks with—only—yield control on streets with one lane in each direction, and considering additional safety features to minimize conflicts on streets with multiple lanes.

CX-6: Providing pedestrian crossing signs, as well stop or signal controls if more than one lane is provided in each direction.

CX-7: Marking a high-visibility crosswalk, sharks-tooth yield line, and signage indicating the responsibility to yield to pedestrians at all uncontrolled intersections (except as noted previously) with only one lane in each direction, fewer than 3,000 vehicles per day, and posted speeds less than 25 mph.

CX-8: Not including any crosswalk markings for uncontrolled intersections that do not meet the preceding requirements (3,000 ADT; 25 mph) and are not candidates for stop signs or traffic signals.

CX-9: Directing transit users to marked crosswalks.

CX-10: Marking trail or multiuse path crossings. If both bike and pedestrian uses exist, a dual crosswalk with a set of bike markings should be included.

CX-11: Including a marked crosswalk with positive intersection control at any signalized or stop-controlled intersection that has high pedestrian-generator land use types.

CX-12: Spacing crosswalk markings to provide comfortable and convenient crossings (at least every 300 feet apart in urban or suburban areas).

CX-13: Providing double-outline crosswalks only at four-way stops and certain signalized intersections.

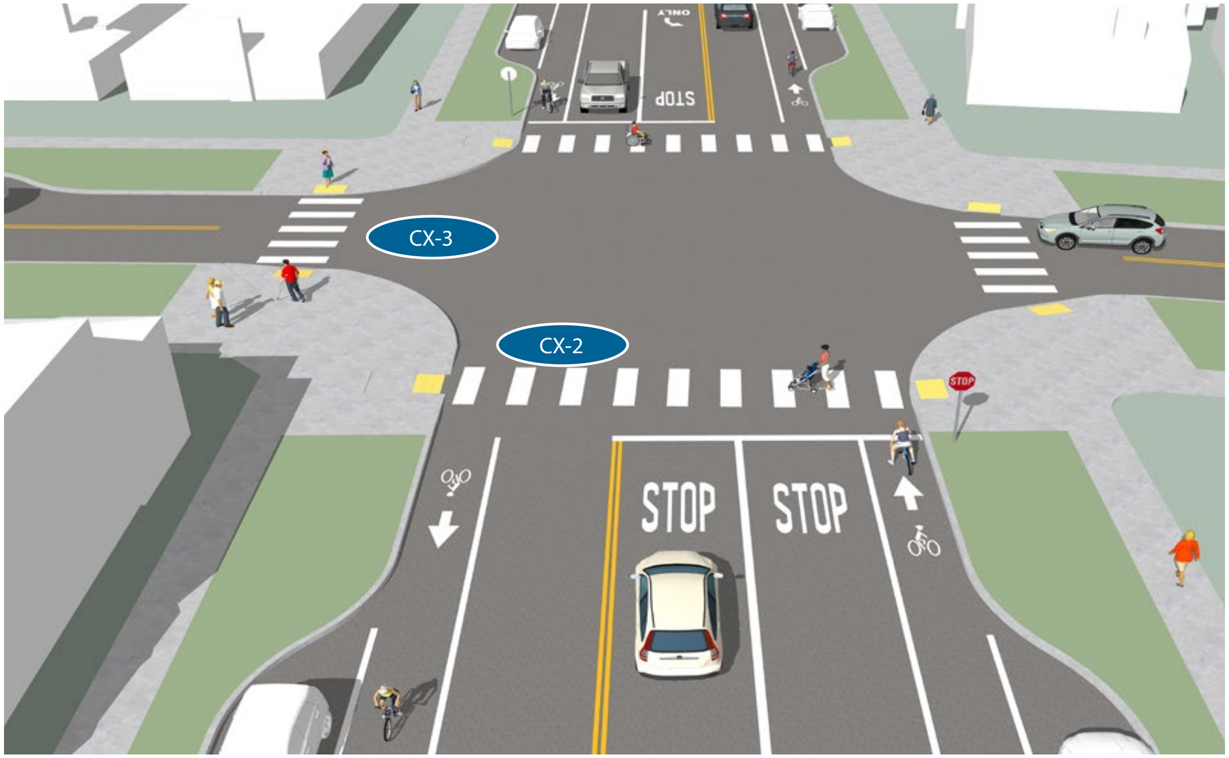
CX-14: Providing high-visibility (ladder- or continental-style) crosswalk markings at all intersections where driver judgment occurs and crosswalk prominence is needed.

CX-15: Installing zebra-style stripings or other high-visibility treatments near schools.

CX-16: Providing solid marked crosswalks or enhanced paving only if the contrasting color or pavement provides sufficient visual contrast.

CX-17: Implementing "staggered" continental crosswalks, with the longitudinal stripes positioned to avoid vehicle wheel paths as much as possible, reducing wear (of the painted or thermoplastic applied markings).

Figure B-24: Pedestrian bulb-outs with high visibility crosswalk markings at a two-way partially controlled intersection.



Primary Universal Access Guidelines (CU)

The Department of Justice and the Department of Transportation, through their adoption of the Americans with Disabilities Act Accessibility Guidelines (ADAAG) and accompanying regulations, set the standard for accessibility in the United States. The Americans with Disabilities Act (ADA) requires nondiscrimination, even if there is no standard.

In an effort to provide increased specificity and standards, the Proposed Guidelines for Pedestrian Facilities in the Public Right-of-Way (Published in the Federal Register on July 26, 2011), or PROWAG, was developed. Guidelines from PROWAG, some of which may be inconsistent with adopted DOT/DOJ standards, are provided in the following list. Further research is advised before community implementation of these guidelines.

CU-1: Pedestrian crossings shall comply with R305 in chapter 3 (CU-1: R305.1 General)

CU-2: Crosswalks shall comply with R305.2 and shall contain a pedestrian access route that connects to departure and arrival walkways through any median or pedestrian refuge island (R305.2 Crosswalks).

CU-3: Marked crosswalks shall be 6 feet wide minimum (R305.2.1 Width).

CU-4: Where pedestrian access routes are contained within pedestrian street crossings, the grade of the pedestrian access route shall be 5-percent maximum (R302.5.1 Pedestrian Street Crossings).

CU-5: Except as provided in R302.6.1 and R302.6.2, the cross-slope of pedestrian access routes shall be 2 percent maximum (R302.6 Cross Slope).

CU-6: Where pedestrian access routes are contained within pedestrian street crossings without yield or stop control, the cross-slope of the pedestrian access route shall be 5 percent maximum (R302.6.1 Pedestrian Street Crossings Without Yield or Stop Control).

Access From Walk to Street (A)

Curb Extensions/Bulb-Outs (AC)

For curb extensions/bulb-outs, communities should consider—

AC-1: Installing curb extensions (on streets with on-street parking) to reduce the pedestrian crossing distance, visually and physically narrow the roadway, and improve the ability of pedestrians and motorists to see each other.

AC-2: Designing the curb extension to properly handle street drainage, which may require that the catch basin be relocated.

AC-3: Providing extensions on access manholes, valve access panels, and various junction boxes, if affected by curb extensions.

AC-4: Mitigating any parking loss that may result from the addition of curb extensions by, for example, relocating curbside fire hydrants to areas where no parking is allowed, such as at the curb extension.

AC-5: Providing “mountable” curb extensions where tighter turning radii affect the turning movements of larger vehicles, such as school buses and large fire trucks.

AC-6: Gently tapering curb extensions, where on-street parking does not exist, to minimize hazards and improve maintenance and street sweeping.

Primary Universal Access On-Ramps—Perpendicular/Apex/Parallel (AA)

For sidewalk ramps, communities should consider the following primary universal access principles—

AA-1: **Curb Ramp Components**—The following text defines the curb ramp components, along with minimum dimensions.

- **Landing**—the level area at the top of a curb ramp facing the ramp path. Landings allow wheelchairs to enter and exit a curb ramp, as well as travel along the sidewalk without tipping or tilting. This landing must be the width of the ramp and measure at least 4 feet by 4 feet.
- **Approach**—the portion of the sidewalk on either side of the landing. Approaches provide space for wheelchairs to prepare to enter landings.
- **Flare**—the transition between the curb and sidewalk. Flares provide a sloped transition (10-percent maximum slope) between the sidewalk and curb ramp to help prevent pedestrians from tripping over an abrupt change in level. Flares can be replaced with curb where the furniture zone is landscaped.
- **Ramp**—the sloped transition between the sidewalk and street where the grade is constant and cross-slope at a minimum. Curb ramps are the main pathway between the sidewalk and the street.
- Gutter—the trough that runs between the curb or curb ramp and the street. The slope parallel to the curb should not exceed 2 percent at the curb ramp.
- **Detectable Warning**—truncated dome surface and visual contrast to alert pedestrians with visual impairments of the sidewalk-to-street transition.

AA-2: **Curb Ramp Types**—There are several types of curb ramps that meet minimum requirements for accessibility. Perpendicular curb ramps are placed two per corner and provide the shortest and most convenient crossing. Diagonal ramps are single ramps at the apex of the corner and meet basic requirements but necessitate longer crossings. Parallel curb ramps are oriented parallel to the street and ramp the sidewalk down. These are used where there is no space for perpendicular ramps.

- **Perpendicular Curb Ramps**—Perpendicular curb ramps are placed at a 90-degree angle to the curb or the gutter grade break. They must include a level landing at the top to allow wheelchair users to turn 90 degrees to access the ramp or to bypass the ramp if they are proceeding straight. Perpendicular ramps work best where there is a wide sidewalk, curb extension, or planter strip. Perpendicular curb ramps provide a direct, short trip across the intersection.
- **Parallel Curb Ramps**—Parallel curb ramps are oriented parallel to the street; the sidewalk itself ramps down. They are used on narrow sidewalks where there is not enough room to install perpendicular ramps. Parallel curb ramps require pedestrians who are continuing along the sidewalk to ramp down and up. Where space exists in a planting strip, parallel curb ramps can be designed in combination with perpendicular ramps to reduce the ramping for through-pedestrians. Careful attention must be paid to the construction of the bottom landing to limit the accumulation of water and/or debris.
- **Diagonal Curb Ramps**—Diagonal curb ramps are single curb ramps at the apex of the corner. These have been commonly installed by many jurisdictions to address the requirements of the ADA but have since been identified as a non-preferred design type because they introduce dangers to wheelchair users. Diagonal curb ramps direct wheelchair users and people with strollers or carts toward the middle of the intersection, near active portions of the roadway. Being in the intersection longer exposes the user to greater risk of being hit by vehicles. A single ramp at the apex should be avoided in new construction.

AA-3: One ramp should be provided for each crosswalk, which usually translates to two per corner. This maximizes access by placing ramps in line with the sidewalk and crosswalk and by reducing the distance required to cross the street, compared with a single ramp on the apex.

AA-4: Install curb ramps at all intersections, mid-block crossings, accessible on-street parking spaces, and passenger loading zones.

AA-5: Include detectable warning treatments in all curb ramps, employing texture and color, to alert the visually impaired that they are about to enter the street. PROWAG suggests the width of the detectable strip to be as wide as the ramp and 24 inches deep.

Table B-6: Curb Ramp Design Standards

RAMP TYPE	CHARACTERISTIC	ADA STANDARDS	PROWAG
PERPENDICULAR (UNLESS NOTED AS APEX)	Maximum slope of ramps	8.33%	8.3%
	Maximum cross-slope of ramps	2%	2%
	Maximum slope of flared sides	10%	10%
	Minimum ramp width	36”	48”
	Minimum landing length	36”	48”
	Minimum landing width	Not Specified	48”
	Maximum gutter slope	5%	5%
	Changes in level	Flush	Flush
	Truncated domes	Full depth & width or 24” deep	24” deep

Level Walk to Street With Blended Transition (AL)

For blended transitions, communities should consider—

AL-1: Using blended transitions in lieu of curb ramps on corners with large radii where it is difficult to line up the crosswalks with the curb ramps.

AL-2: Including detectable warning treatments in all blended transitions, employing texture and color to alert the visually impaired that they are about to enter the street.

AL-3: Augmenting blended transitions with bollards, planting boxes, or other intermittent barriers to prevent cars from traveling on the sidewalk.

Reduced Radius Corners (AR)

For reduced radius corners, communities should consider—

AR-1: Providing the smallest practicable curb radii to increase pedestrian comfort and calm traffic. (A 10- to 15-foot radius allows for the slower turning and shorter crossing distances consistent with an urban environment.)

AR-2: Taking advantage of multiple lanes, where they exist, to accommodate wider turns while still providing reduced curb radii.

AR-3: Reducing turning speeds to 15 mph or less. (Minimizing turning speeds is crucial to pedestrian safety, as corners are where drivers are most likely to encounter pedestrians crossing in the crosswalk, and this can result in injuries and fatalities if vehicle speed is too high.)

Crossing Control Devices (D)

Pedestrian Hybrid Beacon (DH)

For pedestrian hybrid beacons, communities should consider—

DH-1: Placing beacons in conjunction with signage, crosswalks, and advanced yield lines to warn and control traffic at locations where pedestrians enter or cross a street or highway.

DH-2: Only installing pedestrian hybrid beacons at marked crosswalks.

DH-3: Using accessible pedestrian signal (APS) technology, in conjunction with pedestrian hybrid beacons (PHBs), to communicate the signal mode to people with vision disabilities.

Pedestrian Crossing Using Standard Signals (DP)

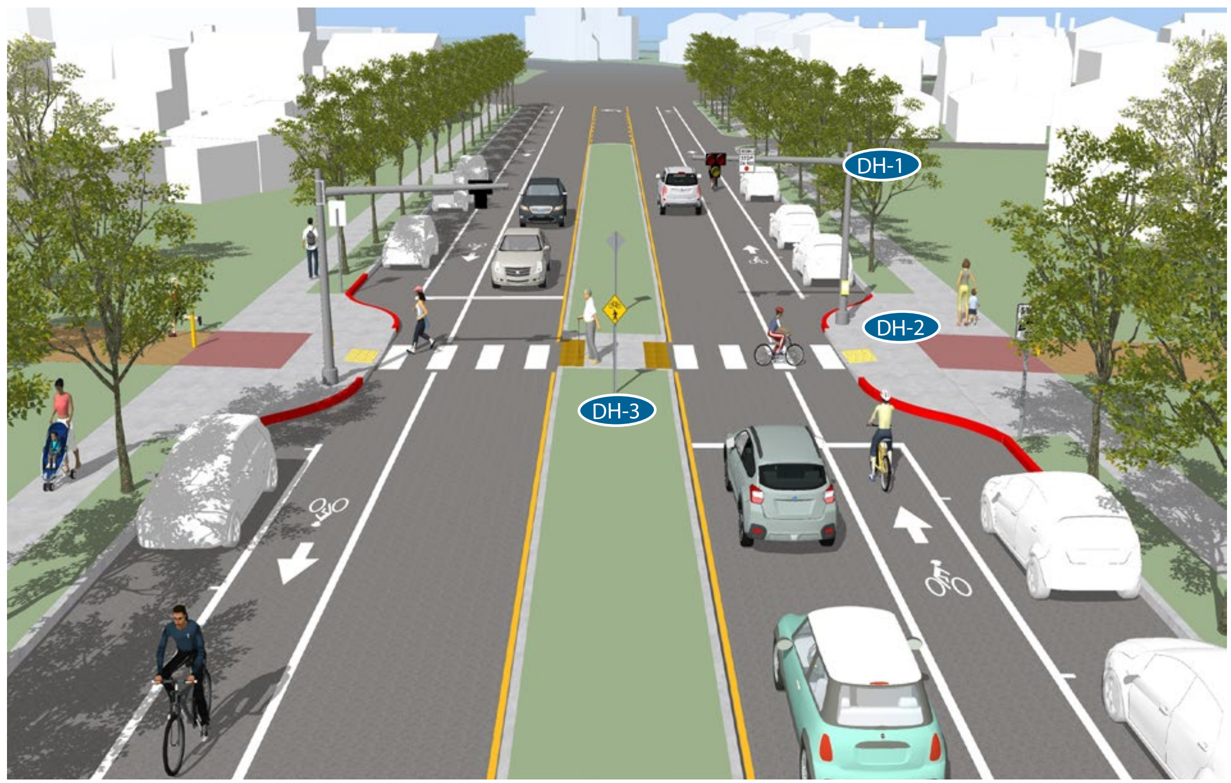
For pedestrian crossings using standard signals, communities should consider—

DP-1: Providing a full median that blocks left turn movements to prevent driver confusion about the permissive green light.

DP-2: Installing a full stop bar and marked crosswalk in conjunction with standard signal crossings.

DP-3: Providing enhanced street lighting at the crossing to ensure safety for dark nighttime conditions.

Figure B-25: Mid-block crossing with Pedestrian Hybrid Beacon.



Rectangular Rapid Flashing Beacon Crossing (DR)

For pedestrian crossings using Rectangular Rapid Flashing Beacon Crossings, communities should consider—

(Installation of RRFBs requires FHWA approval under the existing Interim Approval.)

DR-1: Utilizing RRFBs in locations where traffic is likely to yield to pedestrians (this facility is supported by yield control only).

DR-2: Installing RRFB treatments where approaches are relatively flat and straight (to support motorist and pedestrian visibility).

DR-3: Generally restricting RRFB treatments to two lane streets where only two travel lanes must be crossed. (Multi-lane crossings require co-ordinated yielding and generally are less effective and safe.)

DR-4: (Ideally) Installing RRFB crossings in conjunction with the following treatments: median refuges, high-visibility crosswalks, sharks-tooth yield bar set back 30 feet, signs indicating stopping location, and yield requirements.

DR-5: Using APS technology in conjunction with RRFBs to communicate the signal mode to people with vision disabilities.

Pedestrian-Actuated Flashing Signage and In-Road Flashers (DW)

For pedestrian-actuated flashing signage and in-ground flashers, communities should consider—

DW-1: Including a yield bar, using a sharks-tooth design, positioned at least 20 feet from the crosswalk.

DW-2: Ensuring that flashing diodes in the crosswalk face drivers as well as pedestrians so that both parties know when it is safe to cross the street.

DW-3: Designing a median refuge that allows pedestrians to temporarily hold position at the middle of the crossing to ensure that they have the eye of the driver and that the driver is going to yield.

Figure B-26: Mid-block crossing with Rectangular Rapid Flashing Beacon Crossing.

Pedestrian Scramble Signals/Markings (DS)

For pedestrian scrambles, communities should consider—

DS-1: Educating both pedestrians and motorists so that they may safely and effectively use the facility.

DS-2: Providing adequate signage and APS technology to support safe and effective use. Pedestrians sometimes jump the gun on the phase and walk against the pedestrian signal head, thinking that it did not change appropriately. Also, many pedestrians approaching a pedestrian scramble are unsure about the diagonal crossing, so signage should also communicate this opportunity.

DS-3: Ensuring that communication with persons with disabilities is as effective as communication with others (required by 28 CFR 35.160). Communication goes way beyond signage.

DS-4: Including "no right turn on red" signage to limit the conflict points with pedestrians.

"No Turn on Red" Warnings (DN)

For "no turn on red" warnings, communities should consider—

DN-1: Mounting the "no turn on red" sign in a highly visible location and including bright lights and iconic turn diagrams that make it very clear to the driver they must not turn while the light is activated.

DN-2: Enabling a blackout phase for "no turn on red" signage to bring attention back to standard signals when the prohibition is lifted.

Figure B-27: In the appropriate location, a pedestrian scramble can save time for drivers and improve safety.

Figure B-28: Intersection with no turn on red light to protect pedestrians and cyclists from right turn conflicts.

Pedestrian Signals for Universal Access With Audible and Visual Countdowns (DD)

For pedestrian signals for universal access (including audible and visual countdowns), communities should consider—

DD-1: Providing universal access through APS (e.g. audible tones, verbal messages, and/or vibrating surfaces) to inform people with visual impairments of the correct time to cross the street and the correct direction to move. (APSs are the most commonly requested accommodation under Section 504 of the Rehabilitation Act of 1973. For more information on effective communication requirements, see 28 CFR 35.160.)

DD-1: Providing verbal messages, over other APS amenities, as they provide the most informative guidance.

DD-1: Installing APS actuators close to the departure location and on the side away from the center of the intersection because they are typically only audible 6 to 12 feet from the push button.

DD-1: Installing APS actuators at least 10 feet apart to prevent competing or conflicting messages.

DD-1: Where two accessible pedestrian push buttons are placed less than 10 feet apart, providing accessible push buttons with push-button locator tones, tactile arrows, audible walk messages, and other relevant tools.

DD-1: Installing APS systems with adaptive (walk indication and push-button locator) volume levels; volume should automatically adjust in response to ambient sound.

Signal Timing (T)

Leading Pedestrian Interval (TG)

For a leading pedestrian interval, communities should consider—

TG-1: Installing this type of signal timing in areas with high intersection visibility and where turning radii are tight, keeping turning speeds as low as possible.

TG-2: Ensuring that APS technology is included in implementation of a leading pedestrian interval for the safety of visually impaired pedestrians.

Concurrent Pedestrian/Vehicle Signals (TH)

For concurrent pedestrian/vehicle signals, communities should consider—

TH-1: Utilizing a concurrent pedestrian phase in urban areas or other districts with high pedestrian volumes present throughout the day.

TH-2: Utilizing a concurrent pedestrian phase where synchronized signals have been implemented and where older signal-phasing technologies cannot accommodate the variability of pedestrian phases that are actuated by pedestrians.

Pedestrian Phase Intervention in Cycle (TJ)

For pedestrian phase intervention in cycle, communities should consider—

TJ-1: Modifying software or hardware at signals that currently do not allow for an immediate intervention of the phasing cycle with a new pedestrian crossing request. (These are most important on streets that are wide or for signal cycles that are very long.)

Signals Synchronized to Bikes/Pedestrian Pace (TK)

For signals synchronized to bike/pedestrian pace, communities should consider—

TK-1: First, determining an appropriate multiplier of time that recognizes multiples of various modes of travel. (Assuming a 3-mph walking speed, along with a 15-mph bike speed and a 30-mph vehicle speed, a mathematical calculation can be made that synchronizes all three modes to hit the intersection at similar times, all at the time the light changes to green.)

Available Crossing Timing for Pedestrian Signals (TX)

For crossing timing for pedestrian signals, communities should consider—

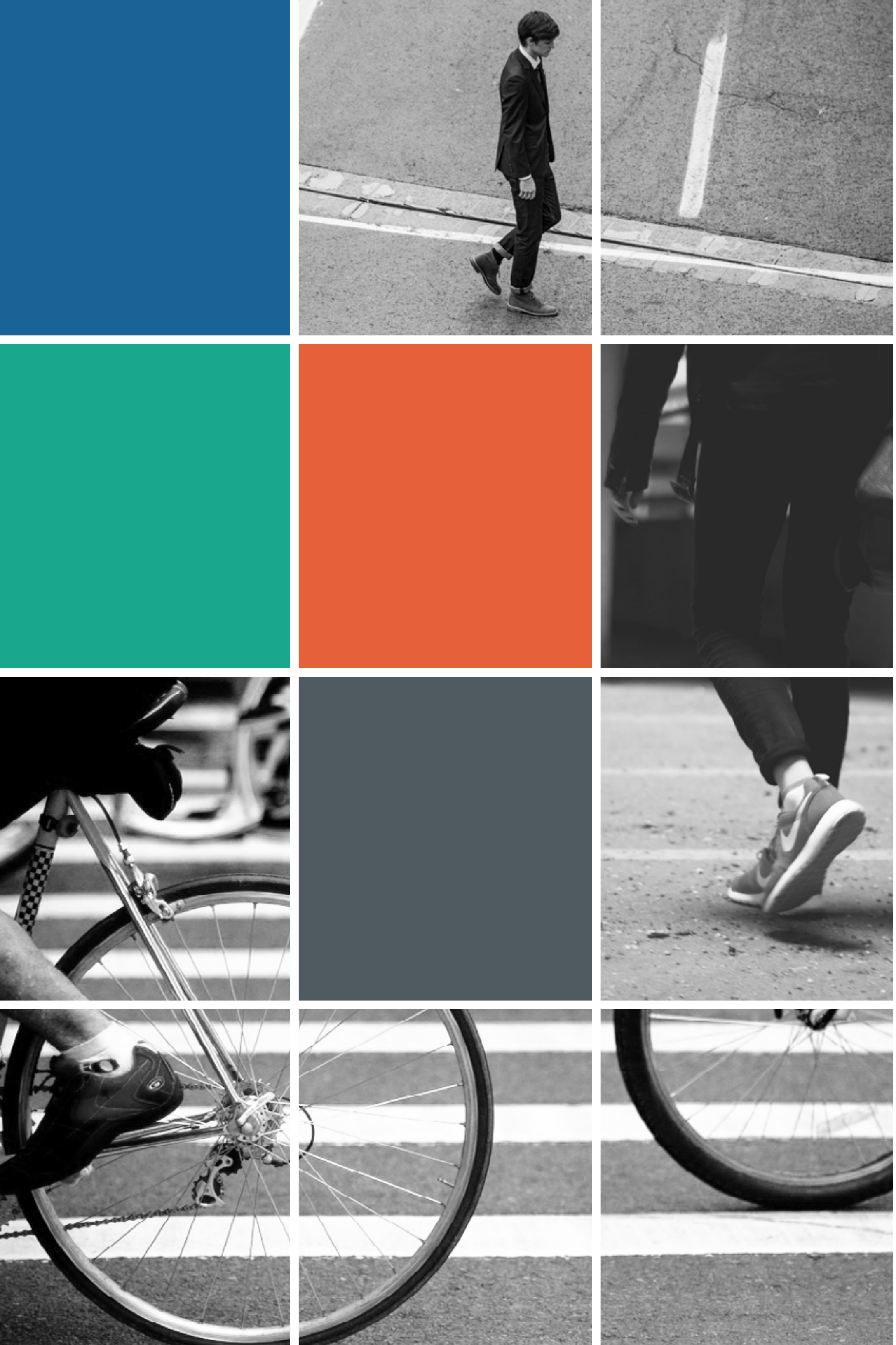
TX-1: Lengthening crossing times for people with disabilities and elderly people. (The Manual on Uniform Traffic Control Devices (MUTCD) requires that transportation agencies use an assumed walking speed of 3.5 feet per second for signal timing and a second check at 3 feet per second.)

TX-2: Using an assumed walking speed of 2.8 feet per second where a large number of older adults or persons with disabilities cross.

TX-3: Installing modern signals, which, upon detecting slower pedestrians, can add more crossing time.

TX-4: Using PUFFIN (Pedestrian-User-Friendly-Intelligent) traffic signals, which use infrared devices to detect the presence of pedestrians in the crosswalk, to extend the signal as needed. (PUFFIN signals are more efficient because they allow for a faster standard crossing and are extended only when needed.)

TX-5: Providing for personalized signal timing for slower pedestrians, as is done in Singapore, through the use of a card at the push button that adds time to the walk cycle.



APPENDIX C:
ADDITIONAL RESOURCES

Table C-1: Additional Resources

Reference	Chapter 1	Chapter 2	Chapter 3	Chapter 4	Chapter 5	Chapter 6	Chapter 7	Chapter 8	Chapter 9	Author	Agency	Web Link
2009 bicycle friendly America yearbook						✓				Bill Nesper	League of American Bicyclists	N/A
Walking the Walk		✓			✓		✓			Joe Cortright	CEOs for Cities	http://blog.walkscore.com/wp-content/up-loads/2009/08/WalkingTheWalk_CEOsforCities.pdf
Living a Car-Free Life		✓			✓	✓	✓			Jay Walljasper	AARP	http://www.aarp.org/livable-communities/get-ting-around/info-2015/living-without-a-car.html
Obesity Relationships with Community Design, Physical Activity, and Time Spent in Cars		✓				✓	✓			L. Frank et. al.	N/A	N/A
One in five adults meet overall physical activity guidelines		✓								N/A	Center for Disease Control and Prevention	http://www.cdc.gov/media/releases/2013/p0502-physical-activity.html
A Practitioner's Guide Advancing Health Equity: Community Strategies for Preventing Chronic Disease				✓	✓	✓	✓			Dee Merriam	Center for Disease Control and Prevention: Division of Community Health	http://www.cdc.gov/nccdphp/dch/pdf/HealthEqui-tyGuide.pdf
A Walkable Places Survey: Approach and Results							✓		✓	Katherine Shriver	TRB; Baltimore Metropolitan Council	http://www.ltrc.lsu.edu/TRB_82/TRB2003-002081.pdf
Accessibility and Protected Lanes						✓	✓			Craig Williams, Nathan Wilkes	APBP	http://www.apbp.org/?page=PBL_webinars&hh-SearchTerms=%22Craig+and+Williams%22, http://youtu.be/Lv1VFxl-Zys
Active Community Environment Toolkit: Creating environments that encourage walking, biking, and public transit in Washington State						✓	✓	✓		N/A	Washington State Depts of Health, Commerce and Transportation	http://depts.washington.edu/waaction/tools/docs/15_ACEtoolkt_E12L.pdf
Active Living and Social Justice: Planning for physical activity in low-income, black, and Latino communities		✓	✓			✓	✓			Kristen Day	N/A	http://trid.trb.org/view.aspx?id=778318
Active Transportation Action Plan			✓					✓		N/A	Strategic Growth Council/California Health in All Policies Taskforce	http://sgc.ca.gov/docs/Active_Transportation_Ac-tion_Plan_9-26-14.pdf
Aging in Place, Stuck without Options: Fixing the Mobility Crisis Threatening the Baby Boom Generation		✓								Jana Lynott	AARP	http://t4america.org/docs/SeniorsMobilityCrisis.pdf
Americans Prefer to Live in Mixed-Use, Walkable Communities		✓								Joe Molinaro and Hugh Morris	National Association of Realtors	http://www.realtor.org/reports/nar-2013-communi-ty-preference-survey
Americans' Views on their Communities, Housing, and Transportation		✓								Beldon Russonello Strategists	Urban Land Institute	http://uli.org/wp-content/uploads/ULI-Documents/America-in-2013-Final-Report.pdf
Battling America's Epidemic of Physical Inactivity: Building More Walkable, Livable Communities		✓								Mark Fenton	Journal of Nutrition Education and Behavior	http://www.ncbi.nlm.nih.gov/pubmed/16246279
Bicycle Friendly America Blueprint						✓					League of American Bicyclists	http://bikeleague.org/sites/default/files/american_bicyclist_janfeb11.pdf
Bicycle Friendly America Guide 2012						✓					League of American Bicyclists	http://bikeleague.org/sites/default/files/AB-mar-apr2012-forweb_1.pdf
Bicycling and Walking in the United States - 2014 Benchmarking Report						✓	✓			N/A	Alliance for Walking and Biking, with support from the CDC	http://www.bikewalkalliance.org/resources/bench-marking#previousreports
Bicycling Means Business: The Economic Benefits of Bicycle Infrastructure		✓				✓				Darren Flusche, Pilicy Director	League of American Bicyclists	http://bikeleague.org/sites/default/files/Bicycling_and_the_Economy-Econ_Impact_Studies_web.pdf
Bike Walk Twin Cities 2013 Report						✓	✓			N/A	FHWA	http://www.bikewalktwincities.org/sites/default/files/bwtc-2013-count-report-final-lowres.pdf
Building Livable Communities: A Policymaker's Guide to Transit-Oriented Development			✓							Paul Zykofsky	Local Government Commission	http://lgc.org/wordpress/docs/freepub/communi-ty_design/guides/blc_tod_dev_guidebook_1999.pdf

Table C-1: Additional Resources (cont.)

Reference	Chapter 1	Chapter 2	Chapter 3	Chapter 4	Chapter 5	Chapter 6	Chapter 7	Chapter 8	Chapter 9	Author	Agency	Web Link
Building Walkable, Bikeable Communities						✓	✓	✓		N/A	Massachusetts Department of Public Health	http://www.mass.gov/eohhs/docs/dph/mass-in-motion/community-walk-bike.pdf
California Targets Better Air With Smarter Land Use		✓								Stuart Cohen and Seth Schneider	Community Transportation	http://web1.ctaa.org/webmodules/webarticles/articlefiles/California_Targets_Better_Air.pdf
City Cycling						✓				John Pucher and Ralph Buehler	N/A	http://mitpress.mit.edu/books/city-cycling-0
Complete Streets Local Policy Workbook			✓							Stefanie Seskin	National Complete Streets Coalition	http://www.smartgrowthamerica.org/documents/cs/resources/cs-policyworkbook.pdf
Complete Streets Policy Analysis 2011			✓							Stefanie Seskin	National Complete Streets Coalition	http://www.smartgrowthamerica.org/documents/cs/resources/cs-policyanalysis.pdf
Connecting Parks, Community and Public Health		✓		✓	✓		✓			Dee Merriam	Center for Disease Control and Prevention: Division of Community Health	http://www.parkpride.org/media-room/faqs/con-tent/2013parkpridedeemerriam.pdf
Creating Great Places: The Role of Citizen Participation			✓							Lynn Richards	Congress for the New Urbanism	http://www.centerforurbanstudies.com/docu-ments/silverman_patterson/jcds_participation_special_issue.pdf#page=24
Creating Walkable and Bikeable Communities: A User Guide to Developing Pedestrian and Bicycle Master Plans			✓			✓	✓			N/A	The Center for Transportation Studies at Portland State University	http://www.pdx.edu/ibpi/sites/www.pdx.edu.ibpi/files/IBPI%20Master%20Plan%20Handbook%20FINAL%20%287.27.12%29.pdf
Cycling and the City: A case study of how gendered, ethnic and class identities can shape healthy transport choices		✓	✓			✓				R. Steinbach, J. Green, J. Datta and P. Edwards	N/A	http://www.ncbi.nlm.nih.gov/pubmed/21396761
Cycling in Small Cities						✓				Susan Handy, Eva Heinen and Kevin Krizek	N/A	http://www.its.ucdavis.edu/research/publications/publication-detail/?pub_id=1789
Dangerous By Design					✓		✓			Lily Shoup	USDOT	http://letsgokc.com/docs/DangerousbyDesign.pdf
Design Manual for Small Towns: Transportation and Land Use Strategies for Preserving Small Town Character				✓	✓	✓	✓			N/A	Virginia DOT	http://www.tjpdc.org/pdf/rep_comm_designMan-ual.pdf
Economic Impact of Bicycling and Walking in Vermont		✓				✓	✓			Resource Systems Inc., Economic and Policy Resources, Inc., and Local Motion	Vermont Agency of Transportation	http://vtransengineering.vermont.gov/sites/aot_program_development/files/documents/ltf/BikePedFinal%20Report%20Econ%20Impact%20Walking%20and%20Biking2012.pdf
Economic Value of Walkability		✓					✓			Todd Alexander Litman	Victoria Transport Policy Institute	http://www.vtpi.org/walkability.pdf
Emergency Access in Healthy Streets:Best Practices					✓					Ryan Snyder, Patrick Siegman, Herbie Huff, Cullen McCormick	Los Angeles County Department of Public Health	
Engaging More Women in Bicycling		✓				✓				Liz Cornish Jones, Women Bike Program Manager	League of American Bicyclists	http://www.bikeleague.org/sites/default/files/Womens_Outreach_Report_WABA_web.pdf
Equity Asset Map		✓								N/A	Safe Routes to School National Partnership	http://saferoutespartnership.org/sites/default/files/pdf/FINAL_EQUITY%20ASSET_map.pdf
Essential Smart Growth Fixes for Urban and Suburban Zoning codes				✓						Kevin Nelson et al (Incl Lynn Richards)	EPA	http://www.epa.gov/smartgrowth/essential_fixes.htm
Estimating Bicycling and Walking for Planning and Project Development: A Guidebook (NCHRP Report 770)									✓	J. Richard Kuzmyak et al	Transportation Research Board (TRB)	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_770.pdf

Table C-1: Additional Resources (cont.)

Reference	Chapter 1	Chapter 2	Chapter 3	Chapter 4	Chapter 5	Chapter 6	Chapter 7	Chapter 8	Chapter 9	Author	Agency	Web Link
Evaluating Active Transport Benefits and Costs: Guide to Valuing Walking and Cycling Improvements and Encouragement Programs		✓				✓	✓			Todd Alexander Litman	Victoria Transport Policy Institute	http://www.vtpi.org/nmt-tdm.pdf
Evaluating Smart Growth - Implications for Small Communities		✓								Mary Edwards and Anna Haines		http://jpe.sagepub.com/content/27/1/49.abstract
Evidence on Why Bike-Friendly Cities Are Safer for All Road Users		✓				✓				Wesley E. Marshall and Norman W. Garrick	Journal of Environmental Practice	http://www.cycle-helmets.com/bikes-safer-all-road-users.pdf
Examining Consumer Behavior and Travel Choices									✓	Kelly Clifton	Portland State University	http://trec.pdx.edu/research/project/411/Examining_Consumer_Behavior_and_Travel_Choices
First Mile, Last Mile:How Federal Transit funds can Improve Access to For People who Walk and Bike			✓					✓		Ken McLeod, Legal Specialist	League of American Bicyclists, Alliance for Biking and Walking	http://www.advocacyadvance.org/docs/FirstMile-LastMile_August2014_web.pdf
Four Model Ordinances to Help Create Physically Active Communities			✓							N/A	APA	http://www.atpolicy.org/node/124
Fundamentals of Bicycle Boulevard Planning and Design						✓	✓				IBPI	http://www.pdx.edu/ibpi/sites/www.pdx.edu.ibpi/files/BicycleBoulevardGuidebook%28optimized%29.pdf
General "Benefits of Biking" Research		✓								N/A	FHWA	http://www.fhwa.dot.gov/environment/bicycle_pedestrian/resources/data/benefits_research.cfm
Get Active Orlando: Changing the Built Environment to Increase Physical Activity		✓								McCreedy M and Leslie JG	American Journal of Preventive Medicine	http://www.ncbi.nlm.nih.gov/pubmed/19944940
Getting Out and About: The Relationship Between Urban Form and Senior Travel Patterns		✓								Jana Lynott et al	AARP	http://www.tandfonline.com/doi/abs/10.1080/02763890903327366#.VMFOMSvF-ip
Getting the Wheels Rolling: A Guide to Using Policy to Build Bicycle Friendly Communities			✓								Changelab	http://changelabsolutions.org/sites/default/files/Getting_the_Wheels_Rolling_Toolkit-FINAL_20130823_0.pdf
Growing Cooler: The Evidence on Urban Development and Climate Change		✓								Reid Ewing, Keith Bartholomew, Steve Winkelman, Jerry Walters and Don Chen	Urban Land Institute	http://www.smartgrowthamerica.org/growing-cooler
Guide for the Geometric Design of Driveways					✓					Jerome S. Gluck, Janet M. Barlow, Ronald W. Eck, William F. Hecker and Herbert S. Levinson	NCHRP	https://books.google.com/books?hl=en&lr=&id=Jf8QpknYV_0C&oi=fnd&pg=PP1&dq=%22Scott+Windley%22+accessibility&ots=di9p_mm9sQ&sig=If6ayBRtuT0dBa69KC57x11sQno#v=onepage&q=%22Scott%20Windley%22%20accessibility&f=false
Guidelines for Analysis of Investment in Bicycle Facilities						✓		✓	✓	Kevin Krizek et al	NCHRP/TRB	http://atfiles.org/files/pdf/bicycle-facility-investment-nchrp-552.pdf
How to Develop a Pedestrian Safety Action Plan							✓	✓		Michael Ronkin	Designing Streets for People	http://safety.fhwa.dot.gov/ped_bike/ped_focus/docs/fhwasa0512.pdf
Impacts of Land Use Strategies on Travel Behavior in Small Communities and Rural Areas				✓						Brian Morton	TRB	http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=2987
Infrastructure, Programs and Policies to Increase Bicycling: An international review			✓			✓		✓		John Pucher, Jennifer Dill and Susan Handy	Journal of Preventive Medicine	http://www.sciencedirect.com/science/article/pii/S0091743509004344
Land Use and Zoning Regulations for Healthier Communities				✓						N/A	Active Transportation Alliance	http://www.atpolicy.org/node/82

Table C-1: Additional Resources (cont.)

Reference	Chapter 1	Chapter 2	Chapter 3	Chapter 4	Chapter 5	Chapter 6	Chapter 7	Chapter 8	Chapter 9	Author	Agency	Web Link
Land Use Impacts on Transport- How Land Use Factors Affect Travel Behavior				✓						Tod Litman and Rowan Steele	Victoria Transport Policy Institute	http://www.vtpi.org/landtravel.pdf
Low Stress Bicycling and Network Connectivity						✓				Maaza C. Mekuria, Ph.D., P.E., PTOE	Mineta Transportation Institute	http://transweb.sjsu.edu/project/1005.html
Main Street, When a Highway Runs Through It: A Guide for Oregon Communities					✓					Michael Ronkin	Designing Streets for People	http://www.oregon.gov/ODOT/HWY/BIKEPED/docs/mainstreethandbook.pdf
Making Streets for Walking: Dan Burden on Reforming Design Standards							✓			Dan Burden	Blue Zones	http://www.streetsblog.org/2010/04/08/making-streets-for-walking-dan-burden-on-reforming-de-sign-standards/
Mapping the Intersection of Physical Activity & the Built Environment: A Baseline Profile of Indianapolis				✓	✓	✓	✓			Tess Weathers	Indiana University School of Medicine - Department of Public Health	http://www.inhealthyweight.org/files/built_envi-ronment.pdf
Marin County, CA: Pilot funds energize existing community efforts to increase bicycling and walking						✓	✓	✓		N/A	Nonmotorized Transportation Pilot Program	http://www.walkbikemarin.org/documents/Pilot%20Projects_Marin_Final_ltr_lr.pdf
Measuring the Benefits of Compact Development on Vehicle Miles and Climate Change		✓								Jerry Walters and Reid Ewing	Environmental Practice	http://journals.cambridge.org/action/displayAb-stract?fromPage=online&aid=6383424
MO Climate Action Plan, Transportation Chapter of Brentwood		✓								Matthew DeAngelo	US Green Building Council – Missouri Gateway Chapter	https://www.brentwoodmo.org/DocumentCenter/View/9009
Model Design Manual for Living Streets		✓	✓	✓	✓	✓	✓	✓		Ryan Snyder et. Al.	Los Angeles County Department of Public Health/UCLA	http://modelstreetdesignmanual.com
Move This Way			✓								Changelab	http://changelabsolutions.org/sites/default/files/MoveThisWay_FINAL-20130905.pdf
NACTO Urban Bikeway Design Guide						✓					NACTO	http://nacto.org/cities-for-cycling/design-guide/
NACTO Urban Street Design Guide					✓	✓	✓				NACTO	http://nacto.org/usdg/
National Physical Activity Plan: Four transportation, land use and community design strategies				✓	✓	✓	✓			N/A	National Physical Activity Plan Alliance	http://www.physicalactivityplan.org/transportation.php
New Walking and Cycling Routes and Increased Physical Activity		✓								Anna Goodman, PhD, Shannon Sahlqvist, PhD, and David Ogilvie, PhD	American Journal of Public Health	http://ajph.aphapublications.org/doi/abs/10.2105/AJPH.2014.302059
Nonmotorized Transportation Pilot Program: continued progress in developing walking and bicycling networks						✓	✓	✓		N/A	FHWA	http://www.fhwa.dot.gov/environment/bicycle_pe-destrian/ntpp/2014_report/hep14035.pdf
Not a "paper": Community-based tools to increase active travel on foot or by bike						✓	✓	✓		Kit Keller	APBP	https://apha.confex.com/apha/136am/webpro-gram/Paper182488.html
Not an article; see link for organization or topic information			✓				✓			N/A	Washington State DOT	http://www.wsdot.wa.gov/LocalPrograms/Plan-ning/Walkable.htm
Not an article; see link for organization or topic information			✓			✓				Not an article; see link for organization or topic information	Not an article; see link for organization or topic information	Not an article; see link for organization or topic information
Not an article; see link for organization or topic information						✓	✓			Not an article; see link for organization or topic information	Not an article; see link for organization or topic information	Not an article; see link for organization or topic information
Not an article; see link for organization or topic information						✓	✓			Not an article; see link for organization or topic information	Not an article; see link for organization or topic information	Not an article; see link for organization or topic information
Not an article; see link for organization or topic information		✓								Not an article; see link for organization or topic information	Not an article; see link for organization or topic information	Not an article; see link for organization or topic information
Not an article; see link for organization or topic information		✓								Not an article; see link for organization or topic information	Not an article; see link for organization or topic information	Not an article; see link for organization or topic information

Table C-1: Additional Resources (cont.)

Reference	Chapter 1	Chapter 2	Chapter 3	Chapter 4	Chapter 5	Chapter 6	Chapter 7	Chapter 8	Chapter 9	Author	Agency	Web Link
Not an article; see link for organization or topic information		✓								Not an article; see link for organization or topic information	Not an article; see link for organization or topic information	Not an article; see link for organization or topic information
Not ONE article; whole library of papers on benefits of trails		✓				✓	✓			N/A	American Trails and National Trails Training Partnership (NTTP)	http://www.americantrails.org/resources/economics/
Not ONE article; whole library of papers on equity in AT		✓				✓	✓			N/A	Robert Wood Johnson Foundation - Center to Prevent Childhood Obesity	http://www.rwjf.org/content/dam/farm/toolkits/toolkits/2012/rwjf72846
Oregon Greenhouse Gas Reduction Toolkit: City of Corvallis- Creating a Top Bicycling City in America		✓				✓				N/A	Oregon DOT - Oregon Sustainable Transportation Initiative	http://www.oregon.gov/ODOT/TD/TP/docs/Toolkit/Case%20Studies/Corvallis%20Case%20Study_Final_071713.pdf
Partnership Moves Community Toward Complete Streets		✓								Geraghty AB, Seifert W, Preston T, Holm CV, Duarte TH and Farrar SM	American Journal of Preventive Medicine	http://www.ncbi.nlm.nih.gov/pubmed/19944943
Pedestrian and Bicycle Information Center- Fact Sheets		✓								N/A	Pedestrian and Bicycle Information Center	http://www.pedbikeinfo.org/data/factsheet.cfm
Pedestrian and Bicycle Safety Guide and Countermeasure Selection System						✓	✓	✓	✓		PBIC	http://pedbikesafe.org/
Planning Complete Streets for Aging America		✓								Jana Lynott et al	AARP	http://assets.aarp.org/rgcenter/il/2009_02_streets.pdf
Principles for Improving Transportation Options in Rural and Small Town Communities					✓	✓	✓			Lilly Shoup and Becca Homa	Transportation for America	http://t4america.org/wp-content/uploads/2010/03/T4-Whitepaper-Rural-and-Small-Town-Communities.pdf
Promoting Safe Walking and Cycling to Improve Public Health: Lessons From The Netherlands and Germany		✓				✓	✓			John Pucher, PhD, and Lewis Dijkstra, PhD	American Journal of Public Health	http://policy.rutgers.edu/faculty/pucher/AJPHfrom-Jacobsen.pdf
Protected Bike Lanes Mean Business		✓				✓				N/A	People for Bikes and Alliance for Walking and Biking	https://www.sfbike.org/wp-content/uploads/2014/04/Protected_Bike_Lanes_Mean_Business.pdf
Public Policies for Pedestrian and Bicyclist Safety and Mobility			✓							N/A	USDOT, in collaboration with AASHTO and NCHRP	http://katana.hsrc.unc.edu/cms/downloads/PBSPolicyReview.pdf
Rails to Trails- Quantifying the Benefits of Active Transportation		✓								N/A	Rails to Trails Conservancy	http://www.railstotrails.org/policy/active-transportation-for-america/quantifying-benefits/
Recommended Community Strategies and Measurements to Prevent Obesity in the United States			✓	✓	✓	✓	✓			Laura Kettel Khan et al	CDC	http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5807a1.htm
Resources for Physical Activity Participation: does availability and accessibility differ by neighborhood socioeconomic status		✓	✓							PE Estabrooks, RE Lee and NC Gyurcsik	N/A	http://www.ncbi.nlm.nih.gov/pubmed/12704011
Risk of injury for bicycling on cycle tracks versus in the street						✓				Anne C Lusk, Peter G Furth, Patrick Morency and Luis F Miranda-Moreno		http://injuryprevention.bmj.com/content/early/2011/02/02/ip.2010.028696.full.pdf?sid=a2e-d422a-9dbe-409a-b762-40e0ffbcedc6
Speed management : A road safety manual for decision-makers and practitioners					✓						WHO	http://www.who.int/roadsafety/projects/manuals/speed_manual/en/
Statistics regarding bicycling and the environment		✓				✓				N/A	People for Bikes	http://www.peopleforbikes.org/statistics/category/environmental-statistics
Street Design Guidelines for Healthy Neighborhoods					✓	✓	✓			Dan Burden	Blue Zones	http://onlinepubs.trb.org/Onlinepubs/circulars/ec019/Ec019_b1.pdf

Table C-1: Additional Resources (cont.)

Reference	Chapter 1	Chapter 2	Chapter 3	Chapter 4	Chapter 5	Chapter 6	Chapter 7	Chapter 8	Chapter 9	Author	Agency	Web Link
Streets and Sidewalks, People and Cars: The Citizen's Guide to Traffic Calming					✓					Dan Burden	Blue Zones	http://www.lgc.org/streets_and_sidewalks
Sustainable Urbanism: Urban Design with Nature		✓		✓	✓	✓	✓			Lynn Richards	Congress for the New Urbanism	https://books.google.com/books?hl=en&l-r=&id=6he0qcS3ZaUC&oi=fnd&pg=PT17&d-q=Lynn+Richards+Congress+for+the+New+Ur-banism&ots=7iyqd6GOmy&sig=tubeYZN9v-JuYUk0iTRU4KMx8Bo0#v=onepage&q&f=false
Synergies between Low-carbon and Healthy Transport Policies		✓								Jennifer S. Mindell 1 ; Judith M. Cohen 2 ; Stephen Watkins 3 ; Nicholas Tyler 4	ICE Publishing	http://www.icevirtuallibrary.com/content/arti-cle/10.1680/tran.2011.164.3.127
Synthesis of Successful Bicycle Planning in Mid-Size Cities						✓				Hongchao Liu, Wesley Kumfer, Bhargavi Chintaluri	Texas Tech University	http://ntl.bts.gov/lib/43000/43500/43520/0-6582-1_revised.pdf
The Alliance Benchmarking Report						✓				N/A	Alliance for Biking & Walking	http://www.bikewalkalliance.org/resources/bench-marking
The Built Environment, Climate Change, and Health: Opportunities for Co-Benefits		✓								Younger M, Morrow-Almeida HR, Vindigni SM and Dannenberg AL	American Journal of Preventive Medicine	http://www.ncbi.nlm.nih.gov/pubmed/18929978
The Effective of Urban Design and Land Use and Transport Policies and Practices to Increase Physical Activity: A systematic review		✓								Gregory W. Heath, Ross C. Brownson, Judy Kruger, Rebecca Miles, Kenneth E. Powell, Leigh T. Ramsey, and the Task Force on Community Preventive Services		http://activelivingresearch.org/sites/default/files/JPAH_5_Heath_0.pdf
The Effectiveness of Urban Design and Land Use and Transport Policies and Practices to Increase Physical Activity: A Systematic Review				✓	✓	✓	✓			Gregory W. Heath et al	N/A	http://activelivingresearch.org/sites/default/files/JPAH_5_Heath_0.pdf
The New Majority: Pedaling Toward Equity		✓				✓				Carolyn Szczepanski	League of American Bicyclists	http://bikeleague.org/sites/default/files/equity_re-port.pdf
The Path to Active Living: Physical Activity Through Community Design in Somerville, Massachusetts		✓								Burke NM, Chomitz VR, Rioles NA, Winslow SP, Brukilacchio LB and Baker JC	American Journal of Preventive Medicine	http://www.ncbi.nlm.nih.gov/pubmed/19944939
Urban Structure Matters, Even in a Small Town				✓						Petter Næss and Ole B. Jensen	Journal of Environmental Planning and Management, in collaboration with the NAACP	http://vbn.aau.dk/en/publications/urban-structure-matters-even-in-a-small-town%28c46c9e70-3373-11db-8b1e-000ea68e967b%29.html
Washington County Bicycle Facility Design Kit						✓					Washington County Oregon	http://www.co.washington.or.us/LUT/Divisions/CPM/bike-facility-design-toolkit.cfm
Why Walking and Walkability? The Latest Info to Make the Case-- Statistics and Data		✓								Paul Heberling	US DOT	http://www.slideshare.net/PWPB_Slides/pwpb-he-berling-rm30610am
Youth Travel to School: Community Design Relationships with Mode Choice, Vehicle Emissions, and Healthy Body Weight		✓								Lawrence Frank and Company, Inc.	EPA	http://www.epa.gov/dced/youth_travel.htm

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