FTA RESEARCH

FEDERAL TRANSIT ADMINISTRATION

Manual on Pedestrian and Bicycle Connections to Transit

AUGUST 2017

FTA Report No. 0111
Federal Transit Administration

PREPARED BY
Transportation Research & Education Center (TREC)
at Portland State University

U.S. Department of Transportation
Federal Transit Administration

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U.S. Department of Transportation
1200 New Jersey Avenue, SE
Washington, DC 20590

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Metric Conversion Table

SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
LENGTH				
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
VOLUME				
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
NOTE: volumes greater than 1000 L shall be shown in m^3				
MASS				
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
TEMPERATURE (exact degrees)				
^oF	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	^oC

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This manual provides a compendium of best practices to help transportation professionals improve pedestrian and bicycle safety and access to transit, including information on evaluating, planning for, and implementing improvements to pedestrian and bicycle access to transit. In addition to covering key concepts such as access sheds, connected networks, and station area comfort, safety, and legibility, the manual covers needs specific to pedestrians, such as complete sidewalks and safe, convenient crossings, and to bicyclists, such as bicycle parking and on-transit accommodations. Topics covered include integrating bike share with transit and making bike share and transit more accessible to people who are unable to ride standard bicycles. The manual also features a detailed section on implementation that covers funding, marketing, interagency coordination, and data collection. Also included are references to existing guidance documents and information collected through a literature review, interviews with professionals, and three case studies of regions that are taking innovative approaches to integrating pedestrians and bicycles with transit—Atlanta, Los Angeles, and Minneapolis-St. Paul.

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ABSTRACT

This manual provides a compendium of best practices to help transit and other transportation professionals improve pedestrian and bicycle safety and access to transit, including information on evaluating, planning for, and implementing improvements to pedestrian and bicycle access to transit. In addition to covering key concepts such as access sheds, connected multimodal networks, and station area comfort, safety, and legibility, the manual covers needs specific to pedestrians, such as complete sidewalks and safe, convenient crossings, and to bicyclists, such as bicycle parking and on-transit accommodations. Topics covered include integrating bike share with transit and making bike share and transit more accessible to people who are unable to ride standard bicycles. The manual also features a detailed section on implementation that covers funding, marketing, interagency coordination, and data collection. Also included are references to existing guidance documents and information collected through a literature review, interviews with professionals, and three case studies of regions that are taking innovative approaches to integrating pedestrians and bicycles with transit—Atlanta, Los Angeles, and Minneapolis-St. Paul.

ACRONYMS

AASHTO	American Association of State Highway and Transportation Officials
ADA	Americans with Disabilities Act
APTA	American Public Transportation Association
BRT	Bus Rapid Transit
CDC	Centers for Disease Control and Prevention
EPA	Environmental Protection Agency
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
GIS	Geographic Information System
ITE	Institute of Transportation Engineers
LRT	Light Rail Transit
MARTA	Metropolitan Atlanta Rapid Transit Authority
MPO	Metropolitan Planning Organization
MUTCD	Manual on Uniform Traffic Control Devices
NACTO	National Association of City Transportation Officials
NHTS	National Household Travel Survey
PROWAG	Draft Proposed Right-of-Way Accessibility Guidelines
RPA	Regional Planning Agency
SCAG	Southern California Association of Governments
TCRP	Transit Cooperative Research Program
TOD	Transit-Oriented Development
USDOT	United States Department of Transportation

EXECUTIVE SUMMARY

Overview

Why? By approaching transit service as door-to-door, not just stop-to-stop, transit agencies and their jurisdictions can improve safety and increase public transportation use. Walking is a foundational element of a balanced transportation network and provides a key connection to public transportation. Most people are pedestrians (on foot or using a wheelchair or other assistive device) at one end or the other of a transit trip. Although smaller shares of transit users ride a bicycle (vs. walk) to access stops, bicycling offers the opportunity to further expand the reach of transit.

Walking and bicycling are important tools for making it easier and more convenient for riders to use public transportation. They also give riders more options and support multimodal trips as well as help alleviate overcrowding and serve as backstops in cases of transit outages. Finally, these active transportation modes promote rider health, alleviate congestion, and reduce motor vehicle pollutants.

Crosswalk at a rail station in Atlanta, Georgia

Accessible bicycle parking in Portland, Oregon

What? This manual provides noteworthy practices to help transit and other transportation professionals improve pedestrian and bicycle safety and access to transit. It provides information on evaluating, planning for, and implementing improvements to pedestrian and bicycle access to transit. In addition to covering key concepts such as access sheds, connected networks, and station area comfort, safety, and legibility, the manual covers needs specific to pedestrians, such as complete sidewalks and safe, convenient crossings, and to bicyclists, such as bicycle parking and on-transit accommodations. Topics covered include integrating bike share with transit and making bike share and transit more accessible to people who are unable to ride standard bicycles. The manual also features a detailed section on implementation that covers funding, marketing, interagency coordination, and data collection.

How? The manual includes references to existing guidance documents and information collected through a literature review, interviews with professionals, and three case studies of regions that are taking innovative approaches to integrating pedestrians and bicycles with transit—Atlanta, Los Angeles, and Minneapolis-St. Paul. The case studies help to frame several key lessons, including the need for transit agencies to prioritize walking and bicycling for transit access, the value of strong plans and policies as pillars of future prioritization and investment in walking and bicycling connections, and the importance of transit agencies and Regional Planning Agencies (RPAs) in helping local jurisdictions to enhance their capacity to plan for, fund, and implement improvements.

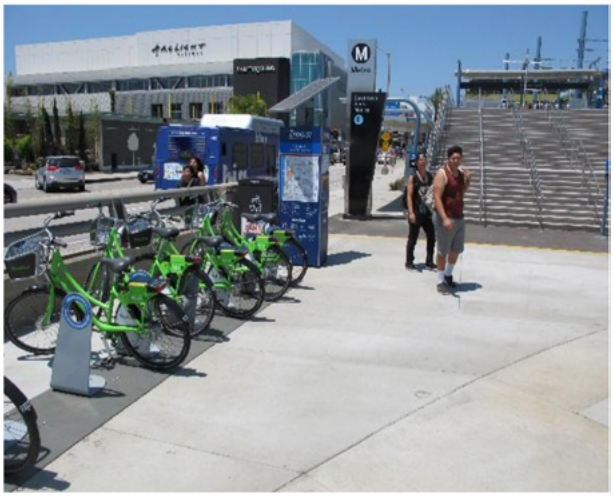
Manual Organization

This manual is divided into the following areas:

- **Section 1** discusses the benefits of improving pedestrian and bicyclist access to transit.
- **Sections 2 and 3** discuss the overarching concepts regarding pedestrian and bicycle access to transit such as access sheds and important planning and design concepts integral to creating high-quality station areas.
- **Sections 4 through 9** examine specific considerations and techniques for riders accessing public transportation by foot or bicycle, such as bus stop location and bicycle-bus conflicts. They also discuss access considerations for both pedestrians and bicyclists by examining elements such as street crossings, wayfinding, and other first/last mile solutions.
- **Sections 10 and 11** highlight planning and implementation for pedestrians and bicyclists. The implementation section addresses subjects such as agency priorities and ideas about collaboration, cooperation, and coordination.
- **Section 12** presents three case studies—Atlanta, Los Angeles, and Minneapolis-St. Paul.
- **Section 13** lists key resources by subject area and section. Peer reviewed literature is listed alphabetically at the end.

Case Study Communities

The **Los Angeles** region typically has been viewed as the epitome of car culture and sprawl. However, more transit trips are made there than any region in the US outside of the New York City region (APTA, 2017). Within the region, Long Beach and Santa Monica have been leaders in promoting active transportation, and now, cities such as Los Angeles and Pasadena and regional agencies (e.g., the Los Angeles County Metropolitan Transportation Authority [LACMTA] and the Southern California Association of Governments [SCAG]) are also refocusing efforts around active transportation. As the region builds out a transit network and rolls out bike share, it has a unique opportunity to reinvent itself. Public support of funding referenda, strong active transportation policies, government leaders who are promoting walking and bicycling, and demonstration projects position the region to be a future leader in pedestrian and bicycle access to transit.



Integrating transit with walking and bicycling is vital to ensure that people can easily and safely connect to transit. Having bicycle and pedestrian infrastructure at and around the immediate station area can encourage walking and bicycling. (Photo: Outside the Downtown Santa Monica Expo Line station)

Providing options for bicycle storage and boarding will encourage more people to ride bicycles to transit. If transit is equipped to accommodate bicycles, then people can choose to bring bicycles with them. Alternatively, a range of bicycle storage options allows people to park their bicycles at the transit station instead. (Photo: Outside the North Hollywood Red Line station)

Over the last 25 years, **Atlanta** has become one of the fastest-growing regions in the US. This rapid growth has contributed to urban sprawl, long commutes, and increased congestion. The region has now begun to focus more on walking, bicycling, and connections to transit. In 2016, the City of Atlanta voted on measures that will bring increased funding to transit operations and capital investments, along with a measure that includes $190 million to directly expand bike and pedestrian access to transit. An important catalyst for regional interest in walking, bicycling, and transit connections has been the BeltLine, which consists of multiuse paths, transit, and public parks being developed in stages along a 22-mile former freight rail corridor ringing downtown Atlanta. In addition, the City of Atlanta, the Atlanta Regional Commission, and the Metropolitan Atlanta Rapid Transit Authority (MARTA) are working to develop more connected active transportation networks with links to transit.

High-quality pedestrian infrastructure is vital for accessing transit routes on major arterials and highways. The provision of well-marked, signalized crossings with pedestrian crossing islands goes a long way to improve safety along busy corridors. (Photo: Buford Highway in DeKalb County)

Investments in walking, bicycling, and connections to transit can catalyze economic development. Although only a few miles of the BeltLine trail have been finished, this initial investment has spurred more than $1 billion in private development. (Photo: Ponce City Market along the BeltLine)

The **Minneapolis-Saint Paul** region is known for a world-class trail system that serves as the backbone of its bicycle network. Current challenges include creating safe and comfortable connections between the popular trail system and transit, filling in gaps and continuing to build out the bike share system to ensure that the growing light rail transit (LRT) and bus rapid transit (BRT) systems are well-connected to safe, comfortable, and convenient walking and bicycling routes, and extending trail successes and culture to streets and areas outside Minneapolis.

Improving both old and new bus stop designs is important. Stops should be highly visible, and lines and directions should be clearly marked. Comfort, safety, and accessibility can be provided through seating, shelter, cameras, and wide access routes. (Photo: Snelling and University A-Line bus stop)

Integrating multimodal networks requires coordination among agencies overseeing transit, trails, streets and services such as bike share. The region has been working to integrate its expanding light rail and bike share systems while connecting them with the extensive trail system. (Photo: 50th Street–Minnehaha Metro Transit light rail station and NiceRide bike share, viewed from Minnesota Valley State Trail)

Key Takeaways

Throughout site visits and conversations with people working to make walking and bicycling to and from transit safer and more appealing transportation options, several themes emerged. Although each city or region will have its own systems and challenges, following are some key findings that can help guide the transformation to a more connected transit system.

Collaboration is key. If the goal is to improve safety and maximize the use of walking and bicycling to transit, no single agency or organization can accomplish this on its own. Transit agencies do not control the street network around stations and stops; cities and counties usually do not make transit routing and facility choices; and RPAs may be the only organizations in a region with the capacity and mandate to be considering long-range planning opportunities and needs for walking and bicycling at a system-wide scale. Funding for larger projects is likely to come from multiple sources. State DOTs often maintain safety data that can be key to walking and bicycling projects. Moreover, a city, county, or region may face many other competing transportation needs, so connecting walking and bicycling to transit requires collaboration among a variety of agencies.

Culture change is needed both organizationally and socially. Change at the organizational level can happen at all levels. Champions leading the charge are needed among both agency staff and leadership. Adopting clear plans and policies to support active transportation connections to transit is a driver of organizational culture change and gives employees working on these topics the authority to advance them. In addition, the metrics that agencies are pursuing should be in line with desired goals. Culture change within an organization can be furthered by getting all players (planners, engineers, elected officials, police, etc.) to experience what it is like to get around without a car.

Broader cultural messaging is also important to encourage more people within the potential reach of transit to actually embrace walking and bicycling to get to transit. People will be more likely to walk and bike to transit if they hear about these modes, know people who are trying them, and have positive experiences. Agencies and organizations involved in transportation play a role in shaping culture change and adapting their message and programs to it. Some of the best projects come about when cities are able to anticipate future needs and demands and find creative ways to show people how transit, walking, and bicycling can make their lives better.

Safety, comfort, and convenience are pillars of inspiring people to want to walk and bicycle to transit. Feeling safe is a foundational element of a system in which people are comfortable walking or bicycling to access transit. If people feel that walking or bicycling is unsafe, either because of traffic or crime, other efforts will be severely constrained. Improving access to the system by making it safe

and convenient to all users, regardless of ability, can expand ridership (Ryan and Frank, 2009). Wayfinding around and at stations is important to making it easy and convenient for pedestrians and bicyclists to connect to transit. Frequent and reliable transit service also makes walking and bicycling more appealing ways to access transit.

Technology offers a great opportunity to help people understand and actualize the potential benefits from walking and bicycling—in terms of understanding how active they are being (e.g., wearable activity tracking technology) and what options are available to them (e.g., maps and apps that include walking, bicycling, and transit, and how to make the connections) and making it easy to connect (e.g., working to integrate payment systems).

Planning is a key element in knowing where change and improvements are needed and being prepared to take advantage of opportunities to implement change. Transit agencies should seek to incorporate walking and bicycling into their capital projects; implement retrofits to stations, station areas, and on-board facilities; and work with local municipalities and other entities to identify opportunities for access and network improvements. When planning the placement of stations and stops, transit agencies also should consider pedestrian and bicycle access and safety.

Street owners such as state, city, and county governments can identify bicycle and pedestrian access to transit improvements and document them in a plan or other official document. This allows the agencies to act quickly when funding opportunities arise, provide documented support for improvements, and include these improvements when larger projects are implemented.

RPAs are important planning partners for helping local agencies. As the coordinator of regional transportation priorities, they play a critical role in mediating discussions across local jurisdictions about how transportation dollars are planned and programmed. RPAs also may provide guidance on how to conduct planning activities and assessments, where there are opportunities to work together and how to fund projects, quantify benefits, and implement improvements.

SECTION 1

Overview

According to the most recent National Household Travel Survey (NHTS) data from 2009, about 10% of daily trips are made by walking and 1% are made on a bicycle. Walking and bicycling are integral to public transit ridership. According to the American Public Transportation Association (APTA), a total of 10.3 billion transit rides were made in 2016 (APTA, 2017). For 85% of the transit trips recorded in the 2009 NHTS, the first mode of access to get to transit was walking. At the other end of the transit trip, 83% of riders walked as their last mode to get to their final destination. Nearly one in six walking trips in the US is made to access transit (*TCRP Report 95).* Although less than 1% of transit trips involve using a bicycle to get to or from the stop or station, rates of bicycling are increasing in many cities. In addition, bike share systems are being introduced in many cities, often as a complement to traditional public transit systems.

Safety concerns around walking and bicycling can be a barrier for many people and are not unfounded (Schneider, 2011). In 2015, more than 5,300 pedestrians and 800 bicyclists were killed in crashes with motor vehicles. Pedestrians represented about 15% and bicyclists about 2% of traffic fatalities in motor vehicle crashes; compared to their share of trips, these modes are over-represented in traffic fatalities. Moreover, while the US highway fatality rate has declined nearly 20% since 2006, it has increased by about 12% for pedestrians and 6% for bicyclists. Improving safe access to transit for pedestrians and bicyclists can increase transit ridership, increase individuals' health and wellness related to physical activity, and provide access to a greater number of opportunities for jobs, education and other essential services. Increasing the connectivity of multimodal networks by improving infrastructure and filling gaps can create both safer and more accessible transportation systems for all users. Finally, long trip distances are another major barrier to increasing walking and bicycling; locating key destinations closer together and integrating walking and bicycling with transit are strategies to address this barrier.

About This Manual

This manual aims to provide best practices to support the work of public transportation and other transportation professionals in improving pedestrian and bicycle safety and access to transit. It includes references to many existing guidance documents as well as information collected through a literature review, interviews with professionals, and three case studies of regions that are taking innovative approaches to integrating pedestrian and bicycle routes with transit—Atlanta, Los Angeles, and Minneapolis-St. Paul. Lessons and images from the case studies are featured throughout the manual.

The manual is divided into the following sections: Section 1 discusses the benefits of improving pedestrian and bicyclist access to transit. Sections 2 and 3 discuss the overarching concepts regarding non-motorized access to transit such as access sheds and important planning and design concepts integral to creating quality station areas. Sections 4 through 9 examine specific considerations and techniques for non-motorized users accessing transit such as bus stop location and bicycle-bus conflict solutions. These sections also discuss access concerns for both pedestrians and bicyclists by examining elements such as street crossings, wayfinding, and other first/last mile solutions. Sections 10 and 11 delve into planning for pedestrians and bicyclists and implementing those plans. The implementation section delves into subjects such as agency priorities as well as ideas about collaboration, cooperation, and coordination. Section 12 discusses the three case study cities in depth. Section 13 lists the key resources by subject area and section. Peer reviewed literature is listed alphabetically at the end.

Benefits of Improving Walking and Bicycling Access to Transit

Transit relies on people being able to get to and from stops and stations safely and easily. Improving walking and bicycling access to transit are key parts of a successful transit system.

Transit depends on safe pedestrian access. In most cases, transit users are pedestrians, either on foot or via wheelchair or other assistive device, on at least one end of their journey (Cervero, 2001). Having safe and convenient ways to walk to and from transit should be a primary objective.

Help improve equity. People with lower incomes are less likely to have access to a car and more likely to walk and use a bicycle for transportation. Improving the ways that people can safely and conveniently get to and from transit without a car can improve the experience and save money for these individuals (Taylor and Garrett, 1999; Kaplan et al., 2015).

Extend the reach of transit. The farther people can safely and comfortably walk or ride a bicycle to or from transit, the more useful the transit system is to more people. This serves to extend the reach of the transit system and expand the potential rider base (Cervero et al., 2013; Loutzenheiser, 1997; Ryan and Frank, 2009). Extending the access to transit service through high-quality pedestrian connections to transit may also help to reduce demand on costly paratransit service.

Make the transit system work better for riders. Safe and convenient walking and bicycling routes can make it easier for transit riders to get to the stop or station of their choice. Some people may choose to walk or bicycle a bit

further to a transit stop that provides more direct or convenient service (such as an express route) rather than going to a closer stop with less convenient service (such as a local route). The ability to walk or bike to a station with service that better suits individual needs can make the system work better for riders (Schumann, 1997; Brons, Givoni and Rietveld, 2009).

Support more multimodal trips and more options. Some people may want to walk or bicycle one way or for a specific portion of their trip (e.g., via a bike boulevard or on a downhill segment) and take transit for another portion of the trip. They may want to have the option to take transit when the weather gets too hot, too cold, or too rainy. Giving people more options to complete their travel can help to make transit, as well as walking and bicycling, a more appealing choice (Saneinejad et al., 2012; Schumann, 1997).

Alleviate overcrowding on transit. Having a transit system that connects smoothly to walking and bicycling routes can help to alleviate overcrowding, as some riders may choose to walk or bicycle for a portion of their trips (Pucher and Buehler, 2009).

Serve as a redundancy in cases of transit outages. In extreme cases of transit service outage, well-connected pedestrian and bicycle routes can serve as a backup for some riders, allowing them to make their entire trip using active transportation if necessary or connecting through to a stop or station where transit is running (Piatkowski, Krizek and Handy, 2015; Zimmerman et al., 2015).

Improve health and well-being. Walking and bicycling to transit make the entire transportation system healthier, providing physical activity for riders and resulting in less pollution than if they had taken a motor vehicle to access transit. The Centers for Disease Control and Prevention (CDC) recommends that adults engage in at least 150 minutes of moderate-intensity physical activity per week, which translates into 30 minutes per day 5 days per week. Active transportation to and from transit can help meet some or all of this goal (Morency et al., 2011; Besser and Dannenberg, 2005; Frank et al., 2006). Walking and bicycling to transit takes cars off the road, which can reduce auto emissions and improve air quality (Frank et al., 2006). Recent research has even shown that people who walk or ride a bicycle for their commute trips are happiest with their commute (Smith, 2017).

Access for All Users

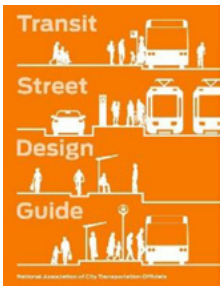
It is important that efforts to improve walking and bicycling connections to transit consider the access needs of all users, including youth, aging adults, and people with disabilities. In accordance with the Americans with Disabilities Act of 1990 (ADA) and Section 504 of the Rehabilitation Act, a number of resources provide guidance that should be considered when planning for access to transit.

In 2015, the Federal Transit Administration (FTA) released a circular, *Americans with Disabilities (ADA): Guidance*, which provides guidance to recipients and sub-recipients of FTA funding on how to carry out projects and operations in accordance with the ADA. The United States Access Board has developed sets of guidelines for *Transportation Facilities* and for *Transportation Vehicles*. Section 810 of the US Department of Justice's *2010 ADA Standards for Accessible Design* describes requirements for the accessible design of transportation facilities. When considering how riders get to and from the stations, the Access Board's *Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way* (PROWAG) should also be considered.

There are no similar guidelines for making bicycling and bicycling access to transit accessible for users of all abilities. Variations of bicycles, including tricycles, side-by-side tandems, hand cycles, and recumbent bicycles, may be options for people who cannot ride a standard two-wheeled bicycle. The adaptive cycling movement also works to identify specific adaptations that can make a bicycle suitable for a specific individual's needs. Two international organizations that focus on making cycling available for anyone who wants to partake are Inclusive Cycling International (http://www.inclusivecyclinginternational.org/) and Cycling for All (http://cyclingforall.org/). This manual discusses some efforts to provide bike parking for non-standard bicycles, along with policies for bringing such bicycles on board transit vehicles; however, many transit services do not currently accommodate non-standard bicycles.

Key Resources

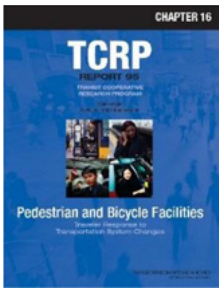
Along with plans discussed in the Planning section, a number of key design and guidance documents for making walking and bicycling connections to transit are discussed here.



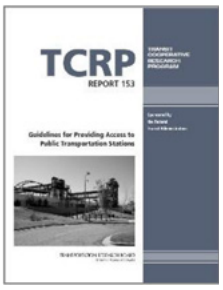
- The National Association of City Transportation Officials (NACTO)'s *Transit Street Design Guide* (2016) provides detailed design guidance in a number of areas, including designing streets and lanes, stops, stations, and intersections to accommodate transit vehicles and users. The publication breaks guidance into elements that are critical to the design, those that are recommended, and those that are optional, along with recommended engineering dimensions. Design suggestions throughout the manual focus on the needs of pedestrians and bicyclists to access and share space with transit.

- The Federal Highway Administration's *Achieving Multimodal Networks: Applying Design Flexibility and Reducing Conflicts* (2016) provides guidance for how planners and designers can apply design flexibility found in national design guidance to address common challenges and barriers to building a multimodal transportation network. The publication focuses on "reducing multimodal conflicts and achieving connected networks so that walking and bicycling are safe, comfortable, and attractive options for people of all ages and abilities."

- The American Public Transportation Association's (APTA) recommended practice document *Design of On-street Transit Stops and Access from Surrounding Areas* (2012) "is intended to support transit agencies to actively pursue access improvements by describing the on-street stop design features and characteristics that improve or support access to transit." The document provides standards and guidelines on key passenger access needs, including street connectivity, street design, surrounding land uses, location of stops, and design of stops.

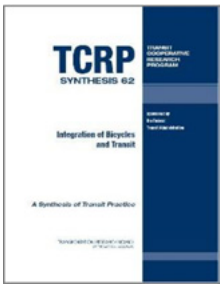


- *Transit Cooperative Research Program (TCRP) Report 95, Chapter 16, Pedestrian and Bicycle Facilities* (2012) provides new and synthesized research on factors influencing walking and bicycling behavior and demand, as well as looking at connections to transit.

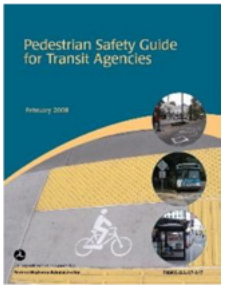


- *TCRP Report 153, Guidelines for Providing Access to Public Transportation* (2012) discusses pedestrian and bicycle access to stations. Chapter 7 provides four key design principles for pedestrian access to transit, including designing pedestrian routes within the station to be direct and to minimize conflicts, creating a strong sense of security for customers, enabling passengers to orient themselves quickly and easily, and creating a network of safe, direct, and appealing walking routes to the station. Chapter 8 discusses areas where improvements are needed, including bicycle access routes, bike parking, and on-board accommodation. An accompanying CD includes a station access planning spreadsheet tool that allows trade-off analyses among the various access modes (automobile, transit, bicycle, pedestrian, and transit-oriented development) for different station types.

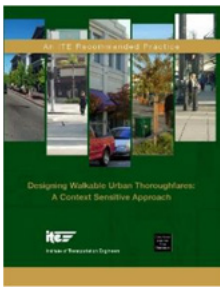
- *TCRP Synthesis 62, Integration of Bicycles and Transit* (2005) discusses integrating bicycles with bus and rail transit, including on-board accommodations, bicycle parking and related costs, safety implications, and more. The report also includes an overview of bicycle and transit integration programs.



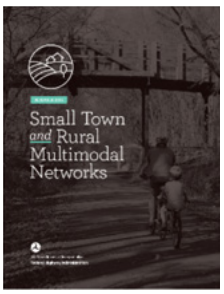
- The Federal Highway Administration's (FHWA) *Pedestrian Safety Guide for Transit Agencies* (2008) "is intended to provide transit agency staff with an easy-to-use resource for improving pedestrian safety" and focuses on tools and strategies transit agencies can take to identify safety and access issues, develop partnerships and plans to address them, and implement fixes.



- The Institute of Transportation Engineers' (ITE) *Designing Walkable Urban Thoroughfares: A Context-Sensitive Approach* (2010) is a detailed resource that promotes context-sensitive solutions and applies them to "the concepts and principles in the planning and design of urban thoroughfares." This resource provides detailed engineering standards for pedestrian and bicycle safety on streets with bus transit. These specific standards are necessary to understand when taking an active transportation vision and applying it in real life.



- FHWA's *Small Town and Rural Multimodal Networks* guide (2016) provides resources and ideas for small towns and rural areas to create "safe, accessible, and comfortable multimodal networks."



SECTION
2

Access Sheds and Networks

Approaching transit service as "door-to-door and not stop-to-stop" can improve safety and increase transit use, which better serves the needs of riders (APTA, 2012). When considering transit from this perspective, the importance of planning for the area around stops and stations becomes apparent. Planning for safe and convenient access starts with considering the area around the stop or station to or from which people might be walking or riding. This section covers key analysis concepts of access sheds and networks.

Access Sheds

An access shed is defined as the area around a focal point to which a person would reasonably travel. Planners also talk about pedestrian sheds, walk sheds, walkable catchment (the distance a person will walk), and bike sheds (the distance a person will bicycle).

Access sheds are critical when considering transit because they are integral to understanding the number of people that could access a transit line (how many people live or work within walking or bicycling distance of a stop or station?) and whether people can reach their desired destination once they exit the transit system (can they reasonably walk or bicycle from the station to their destination?). An access shed is most simply calculated as a certain distance radius from a station "as the crow flies" (Figure 2-1).

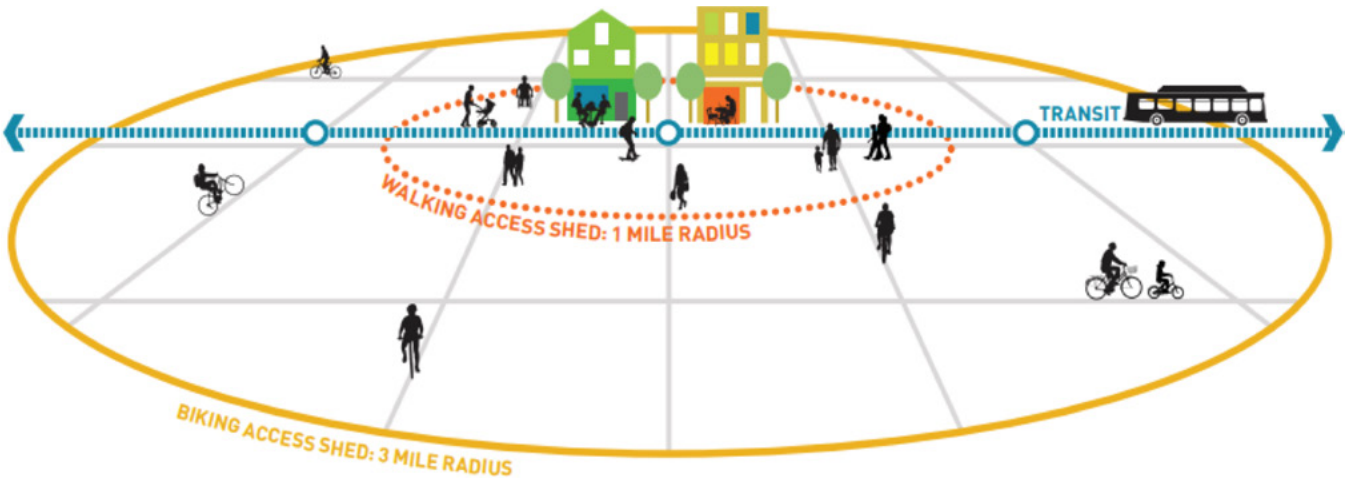
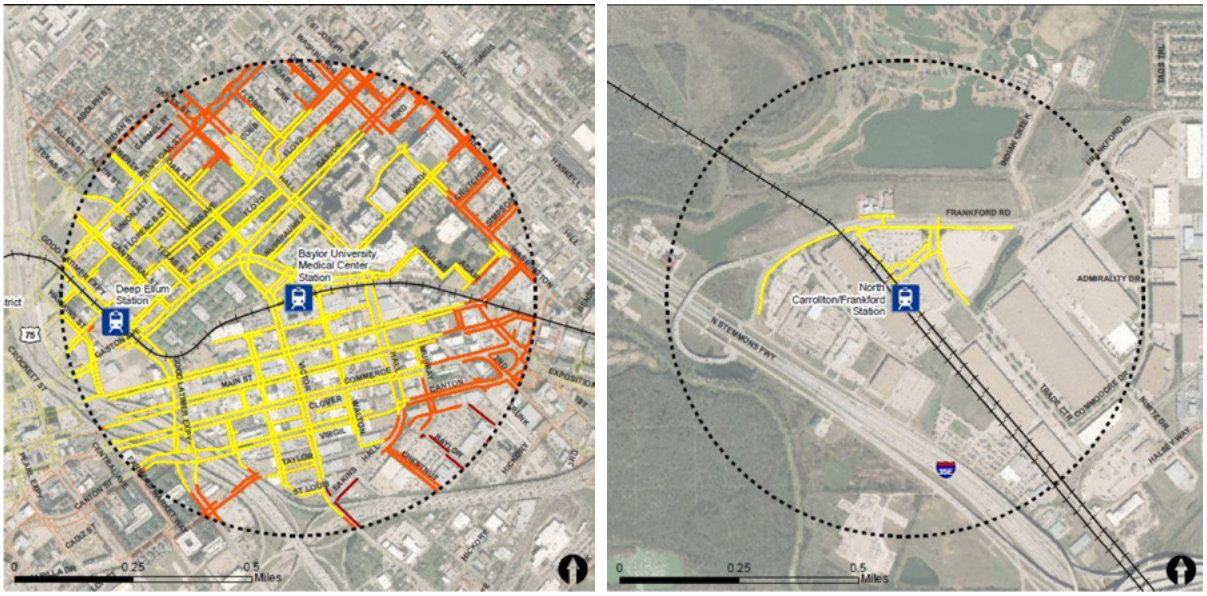


Figure 2-1 *"As-the-crow-flies" access sheds from theAtlanta Regional Commission's* ***Walk. Bike. Thrive!*** *plan*

However, in reality, pedestrians and bicyclists are constrained to the existing network of available sidewalks, bicycle routes, streets, or other available facilities. Agencies are increasingly looking to network analyses to calculate the actual distances for both pedestrians and bicyclists using the available facilities (e.g., Figure 2-2). These true travel distances more accurately illustrate how far someone would need to walk and take into account street grids, the existence of poorly-connected networks, and barriers to travel such as railways, freeways, and waterway crossing points.



Source: NCTCOG Active Transportation Routes to Rail study, 2014

Figure 2-2 *Examples of network walk sheds of a half-mile (yellow) and walking routes beyond a half-mile network walk shed (red) around two Dallas Area Rapid Transit rail stations*

Of course, walking a half-mile on a high-speed arterial without a sidewalk and no crosswalks with pedestrian signals is very different from walking the same distance on a low-traffic residential street with sidewalks and crossing facilities. Therefore, some network analyses consider additional factors that reduce the likelihood that people want to walk or bike, thus shrinking the effective access shed. Such factors include topography, lack of crossing opportunities, low-quality infrastructure, and high-speed corridors with little space for cyclists or pedestrians. A related type of network analysis rates streets and crossings by "level of traffic stress," with the assumption that bicyclists would be more willing to ride or to go farther distances to ride on low-stress routes such as those separated from motor vehicle traffic. Routes with more interactions with motorists, greater speeds, and more challenging intersections are rated as more stressful (for an explanation of level of traffic stress, see Mekuria et al., 2012). More complex analyses calculate factors such as energy expenditures required to

walk or bicycle to calculate impedance costs. Impedance is defined as the amount of resistance encountered. Routes that are high-stress, such as those on a busy road without any bicycle facilities or routes that require a high level of effort such as bicycling uphill, expend a greater amount of a person's willingness to ride than low-stress or low-energy routes (with the end result being a smaller bike shed). Impedance analyses generally identify the extent of the walk or bike shed based on an impedance budget or the most energy or stress the average person would be willing to expend (see Table 2-1 for variables used by Hennepin County, Minnesota, that focus on energy expenditure).

Table 2-1

Values of Variables and Coefficients used in Hennepin County Bike Shed Analysis

Variables and Coefficients	Description	Assumed Value
W_{rider}	Energy consumed in watts per person bicycling	To be calculated
K_A	Drag factor	0.245
V	Velocity	4 m/s (8.9 mph)
V_W	Wind velocity	0
m	Mass of the rider	80 kg (176 lbs)
g	Acceleration of gravity	9.807 m/s^2
S	Slope	Calculated in GIS
C_R	Tire rolling resistance coefficient	0.004

Source: Hennepin County Bottineau LRT Bicycle Study, 2016

Network analyses can help identify locations for targeted, strategic improvements to expand the bike or walk shed by connecting disconnected street grids, bridging barriers, adding crossings, or improving sidewalks or bicycle routes. Improvements to fill in network gaps and address barriers can decrease the actual distance someone would have to walk or bicycle to get to a station. Improvements that address the quality of the walk or bicycle trip can promote an environment where people are actually willing to walk or bicycle farther. In either scenario, the effective walk or bike shed is increased, which makes it easier for people to get to transit and easier to get from transit to their final destination.

The San Bernardino Associated Governments (SANBAG) explored the concept of pedestrian and bicycle access sheds for multiple stations in San Bernardino, California, using GIS and fieldwork in the *Improvement to Transit Access for Cyclists and Pedestrians Final Report* (2012). To understand the existing conditions around each of the selected stations, the researchers conducted a series of walking and bicycling audits, intercept surveys at each of the stations, four public workshops, and an online comment period.

The SANBAG study found that the conditions that influence a walk shed include sidewalk width, condition and location, crosswalks, curb ramps, street tree locations, raised medians, utility poles, lighting, street furniture, and wayfinding

signs. More walkable environments, specifically those with improved sidewalk amenities and more pedestrian-friendly traffic conditions, street scale, and landscaping, were predictive of people choosing to walk rather than drive to transit, according to research conducted in Mountain View, California (Park et al., 2014). The SANBAG study determined that the conditions that influence a station's bike shed include speed and condition of vehicular traffic, pavement condition, "door zone" and driveway conflicts, transit service and waiting environment within the corridor, amount of trip generators and attractors, and the amount of bicycle striping or signage. Figure 2-3 illustrates an example of how SANBAG expanded the bike shed around a station.

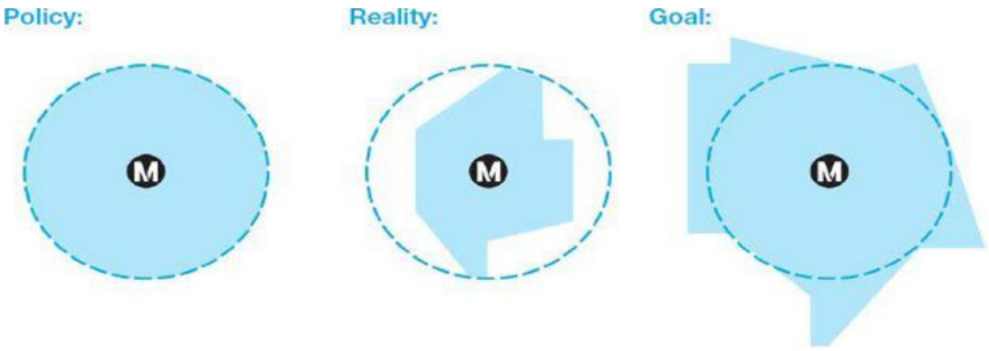
Figure 2-3 *Example of building bicycle lanes and expanding access shed around stations in San Bernardino Valley, CA (Graphic: SANBAG)*

Recognizing the gaps and inefficiencies in their system, the Los Angeles County Metropolitan Transportation Authority (Metro), in its *First Last Mile Strategic Plan* (2013), developed a program called The Pathway. The goal of The Pathway is to improve and expand the access shed for users traveling to and from stations (Figure 2-4). Metro is doing this by pursuing improvements that expand access sheds by:

- Increasing the average speed of active transportation users through measures that decrease crossing wait times with signal prioritization and improved walking and bicycling speed and capacity through route improvements.
- Decreasing the distance needed to access stations by fixing gaps in the network, adding crossing opportunities, and creating shortcuts.
- Improving intermodal connectivity by improving wayfinding and multimodal links and enhancing communication by refining signs.

Figure 2-4

Metro's First Last Mile Strategic Plan *(2014) outlines ways to increase access sheds around stops and stations*



FTA Recognition of Walk and Bike Sheds

FTA's 2011 Final Policy Statement on Eligibility of Pedestrian and Bicycle Improvements under Federal Public Transportation Law (76 FR 52046) acknowledges that poor "first and last mile" connections can be a barrier to accessing transit. The policy statement encourages agencies and municipalities to improve walking and bicycling connections. The purpose is "to simplify the process for determining whether a pedestrian or bicycle improvement qualifies for FTA funding by defining a radius around a public transportation stop or station within which FTA will consider pedestrian and bicycle improvements to have a de facto functional relationship to public transportation." It establishes a formal policy for the eligible radius around transit stops for both pedestrian and bicycling improvements:

> All pedestrian improvements located within one-half mile and all bicycle improvements located within three miles of a public transportation stop or station shall have a *de facto* physical and functional relationship to public transportation. Pedestrian and bicycle improvements beyond these distances may be eligible for FTA funding by demonstrating that the improvement is within the distance that people will travel by foot or by bicycle to use a particular stop or station.

In response to comments received pertaining to the policy, FTA pointed to some of the benefits of including these improvements in transit projects, stating that:

> … by considering pedestrian improvements located within one-half mile and bicycle improvements located within three miles of a public transportation stop or station to have a de facto physical and functional relationship to public transportation, individuals will benefit from improved traffic flow, shorter trip lengths, safer streets for pedestrians and cyclists, … and independence for individuals who prefer not to or are unable to drive.

Connected Networks

Multimodal transportation systems require connected walking, bicycling, and transit networks that serve users with a variety of preferences and needs. To have robust access sheds to transit, these networks need to be interconnected, complementary, and purposefully redundant. Pedestrians and bicyclists are best served by safe and comfortable routes that tie as directly as possible into transit stop and station locations.

USDOT officially noted its support of fully-integrated pedestrian and bicycle networks in its *Policy Statement on Bicycle and Pedestrian Accommodation Regulations and Recommendations* (2010), noting that "every transportation agency, including DOT, has the responsibility to improve conditions and opportunities for walking and bicycling and to integrate walking and bicycling into their transportation systems."

FHWA has published a number of reports detailing best practices and guidance for developing effective multimodal networks. These include:

- *Case Studies in Delivering Safe Comfortable and Connected Pedestrian and Bicycle Networks (2016)*
- *Achieving Multimodal Networks (2016)*
- *Delivering Safe, Comfortable, and Connected Pedestrian and Bicycle Networks: A Review of International Practices (2015)*
- *Small Town and Rural Multimodal Networks (2017)*

Case Studies in Delivering Safe Comfortable and Connected Pedestrian and Bicycle Networks details a set of principles of connected networks adapted from the Dutch CROW (Centre for Research and Contract Standardization in Civil and Traffic Engineering) manual and outlines a number of strategies to advance those networks. The stated principles of connected networks are:

- Cohesion – How connected is the network in terms of its concentration of destinations and routes?
- Directness – Does the network provide direct and convenient access to destinations?
- Accessibility – How well does the network accommodate travel for all users, regardless of age or ability?
- Alternatives – Are there a number of different route choices available within the network?
- Safety and Security – Does the network provide routes that minimize risk of injury, danger, and crime?
- Comfort – Does the network appeal to a broad range of age and ability levels and is consideration given to user amenities?

The report highlights examples of projects that contribute to connected networks, which are organized in the following categories:

- Planning and Prioritization – How agencies are planning their transportation systems and prioritizing improvements so that projects result in a connected network.
- Shared Use Paths – Using shared use paths and the off-roadway network to link the transportation system together and allow for more direct pedestrian and bicycle travel.
- Corridor Improvements – Changes to high speed, high volume corridors to improve safety, accessibility, and comfort for non-motorized users.
- Bridges – Addressing pinch points and bottlenecks in the network to ensure safe and comfortable accommodation for pedestrians and bicyclists to and across bridges and underpasses.
- On-Road Facilities – Improvements that can be made within the existing street right-of-way to create space for more bicycle and pedestrian travel.
- Intersections and Crossing Improvements – Addressing the safety of intersections and other crossings that may serve as barriers to the pedestrian and bicycle network.

Achieving Multimodal Networks uses a series of design topics to highlight ways that planners and designers can apply the design flexibility found in current national design guidance to address common roadway design challenges and barriers. It focuses on reducing multimodal conflicts and achieving connected networks so that walking and bicycling are safe, comfortable, and attractive options for people of all ages and abilities. For example, Figure 2-5 explores the option of placing floating bus stops to address bus and bicyclist leapfrogging or when these road users are in situations where they must frequently pass one another, potentially leading to conflicts.

Delivering Safe, Comfortable, and Connected Pedestrian and Bicycle Networks: A Review of International Practices is a report with the purpose of identifying "noteworthy and innovative international designs, treatments, and other practices that have potential to improve bicycle and pedestrian safety and access and increase walking and bicycling in the United States" and highlights a number of treatments and strategies that can help to close network gaps, minimize delay for active transportation users, and allow for longer trips while improving safety. A key finding was that prioritizing walking and bicycling networks in agency plans and goals was a common characteristic among jurisdictions that succeeded in achieving high walking and bicycling rates.

Small Town and Rural Multimodal Networks addresses how existing national guidelines apply to small towns and rural communities to make walking and bicycling safe, accessible, and comfortable for users of all ages and abilities. The report details how explores innovative potential approaches to making rural areas more appealing for pedestrian and bicyclists.

DESIGN STRATEGIES

BUS AND BIKE CONFLICTS

A common conflict between buses and bicyclists is referred to as bus-bike leapfrogging. Bus-bike leapfrogging occurs when a bus and bike are traveling on a roadway in the same direction and pass each other at multiple places. The bicyclist is traveling at a constant speed with the bus passing, pulling into a stop, departing the stop, passing the bicyclist, and traveling to the next stop. This crossing of users can create multiple instances where conflicts can occur.

Bus-bike leap-frogging is uncomfortable for bicyclists as well as for bus drivers and passengers as it can impact bus schedules. On one-way streets it may be feasible to avoid transit conflicts entirely by locating bicycle facilities on the other side of the street. Otherwise, implementation of a floating bus stop can eliminate leap-frogging, improving bicyclist's comfort and bus operation.

CONSIDERATIONS

- Provide clear indication of the purpose and operations of the floating bus stop for pedestrians and bicyclists.
- Provide adequate tapers for bicyclists to transition from bicycle lane to behind the bus stop. 1
- Provide bus stop passengers amenities such as shelters, benches, and trash barrels outside of bicycle travel. 2
- Maintain accessible pedestrian access to stop amenities, sidewalk, and boarding areas.
- Provide continuous separated bicycle facility behind the boarding area. For more information, refer to the design topic on **Separated Bike Lanes** 3 **(FHWA Separated Bike Lane Guide 2015, pp. 92–96)**.
- Provide clearly marked crosswalks from the island to the adjacent sidewalk 4 **(FHWA Separated Bike Lane Guide 2015, pp. 92–96)**.
- Consider a raised crosswalk across the bicycle facility 5 **(FHWA Separated Bike Lane Guide 2015, pp. 92–96)**.
- Consider yield or stop lines and YIELD [or STOP] HERE FOR PEDESTRIANS (R1-5) signs to alert bicyclists of the passenger crosswalks **(MUTCD 2009, Sec. 2B.11)**.

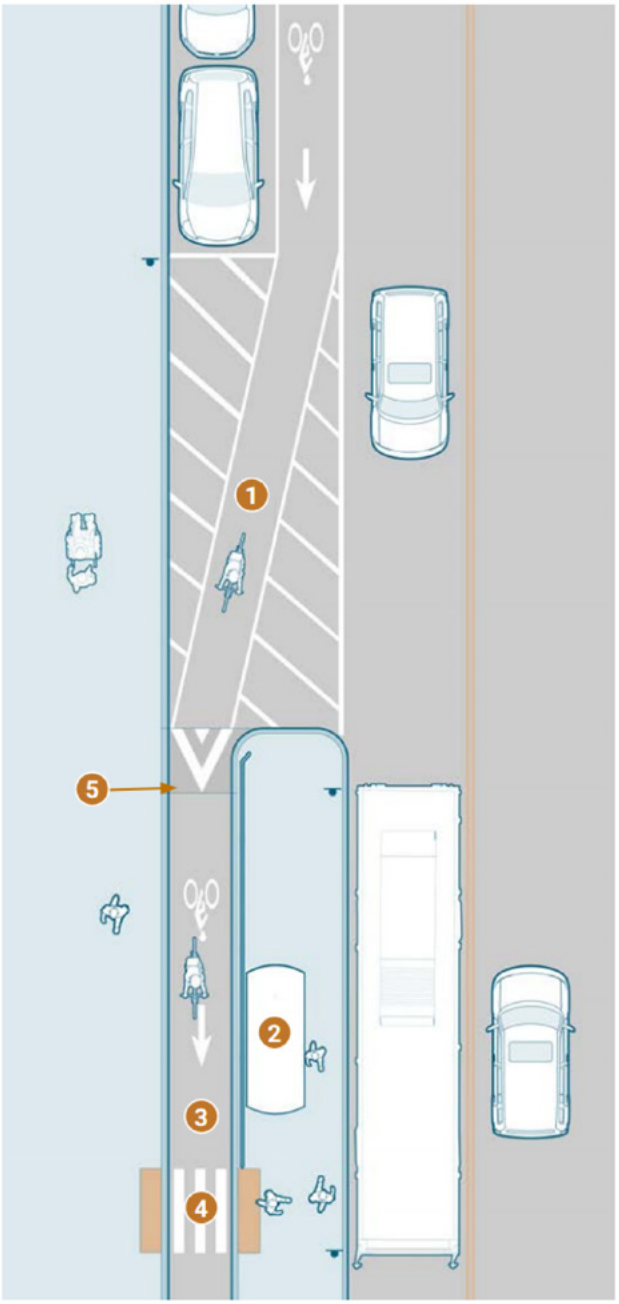


Figure 2-5 *Bus and Bike Conflicts diagram from* FHWA Achieving Multimodal Networks *document*

The resources listed above, along with pedestrian and bicycle specific guidance resources discussed in Sections 5 and 6, discuss strategies and approaches to improving walking and bicycling networks. Table 2-2 provides a quick review of some strategies and approaches that can improve the walking and/or bicycling environment and contribute to complete networks.

Table 2-2

Examples of Implementation Strategies/Facilities to Improve Walking and Bicycling Networks

Strategy / Approach	Primary Benefits	
Sidewalks – adding, repairing, widening		
Lighting, shade, trees/landscaping, seating		
Bike lanes, buffered bike lanes		
Bicycle boulevards		
Separated bike lanes		
Trails and paths		
Traffic calming – speed humps, traffic circles, road narrowing, diverters		
Wayfinding		
Crossings – grade-separated, marked crossings, raised crossings, in-street crossing signage, high-visibility crossing signage, staggered crossings		
Signalization – Signalized crossing, high-intensity activated crosswalk (HAWK) signal, bike signal, scramble signal, leading pedestrian interval		
Intersection treatments – areas for turning and/or queueing, advance stop lines, reduce curb radii		
Reduced crossing distances – pedestrian crossing island, curb extension		
Accessibility features – audible cues, detectable warning surfaces, curb ramps		

SECTION 3

Key Concepts for Stops and Stations

All transit stations and stops are unique due to each site's characteristics, surrounding land uses, and relevant regulations. But each stop and station is a gateway for passengers who are using the transit system, so great care should go into designing a stop or station that is informative and comfortable (NACTO, 2016). When designing a stop, the agency should consider the range of potential passengers and their needs. "The fundamental goal in the design of a transit stop must be a good passenger experience" (APTA 2012, 2).

This section covers key concepts necessary for creating quality station areas for walking and bicycling, including factors around the station area (i.e., within the walk shed or bike shed or at the station itself). Within that area, some key planning and design concepts to consider are safety and security, comfort and a sense of place, legibility, universal design, and managing modal interactions. Considering these concepts when planning and designing around stations and stops can help make users get to and from transit safely and comfortably.

Personal Safety and Security

Safety and security includes the personal safety of passengers getting to, waiting at, or leaving a station as well as the security of their belongings against theft. Concerns over personal safety are significant and can serve as a barrier for passengers accessing the transit system. Women, in particular, are more likely to feel vulnerable to victimization and harassment near or at transit stations (Loukaitou-Sideris, 2014). When possible, transit agencies should keep staff and station agents visible and locate their posts so they can see all entrances and circulation zones. Additional measures such as providing adequate lighting and placing transit waiting areas in high-visibility and well-frequented locations, providing emergency buttons or phones (Figure 3-1), ensuring multiple exit opportunities, and providing security cameras are important steps to alleviate safety concerns. Station design should also avoid blind corners and secluded locations. Real-time arrival information can also alleviate concerns about waiting.

Crime Prevention Through Environmental Design (CPTED) techniques, which focus on how design choices can create environment conducive to safety (and not conducive to crime), can be used when making decisions about access to transit stops, stations, including surrounding areas (Cozens and Lowe, 2015; Cozens and van der Linde, 2015).

Figure 3-1

Emergency call box, Expo Line Trail, Santa Monica, CA

Transit stop lighting should be placed near passenger waiting areas and along walkways and ticket-buying locations. Streetlights will not provide an adequate amount of light in all instances; lighting at a pedestrian scale is necessary in station areas and along sidewalks. Pedestrian-scale lighting should be no taller than 12 feet (APTA, 2012). At major points of conflict between pedestrians and automobiles or transit vehicles, illumination is necessary to avoid nighttime collisions.

Bicycle theft is a concern at transit stops; therefore, bicycle parking should be in a convenient location to boarding areas and within sight of station staff for improved security. See Section 7 for more information about bicycle parking at stops and stations.

Comfort and Sense of Place

Beyond safety and security, rider comfort is an important consideration for all transit riders. Shelter and seating are key elements of comfort and may be more important to riders who have walked or bicycled to the station, particularly riders with mobility limitations, and people with disabilities. Other details such as art and trash/recycling receptacles can improve aesthetics and, in turn, improve user comfort levels.

Seating and Shelter

Passenger comfort can be improved by having places to sit that are protected from elements while waiting for a bus or train. The seating should be a short walk from the boarding point but out of the pedestrian "through zone" (where they need to walk). Seating with backrests and arm supports can be more comfortable for older adults and passengers with disabilities and can make it easier for them to sit down and stand up. Wheelchair space should be provided under a shelter next to any seating provided. Figure 3-2 is an example of well-

placed, covered seating at a BRT stop in California. Bicycle riders also appreciate a secure, covered place to lock their bicycles and protect them from the elements. Seating and shelter structures also provide a good opportunity for an agency or municipality to emphasize placemaking or incorporate branding (see APTA, 2012 for more details.) For example, Metro Transit in King County, Washington, has a Bus Shelter Mural Program that engages community members, including youth, in painting murals in bus shelters; more than 900 murals have been installed since the program began in 1989 (http://metro.kingcounty.gov/prog/sheltermural/).

Figure 3-2

BRT bus stop with shelter, seating, and art, in North Hollywood, CA

Trees and Landscaping Features

The inclusion of landscaping and site furnishings can help humanize a site and make it more comfortable. Station areas usually have a lot of hardscape, and trees and vegetation provide shade and help cool the spaces. Landscaping can also provide a form of separation between motor vehicles and waiting passengers. In urban, suburban, and small-town rural settings where pedestrian and bicycle activity is expected and the traffic speed is lower, and depending on the context, roadway design may incorporate street trees, furnishings, and plantings to create a sense of enclosure. This provides a traffic calming effect, which may increase comfort and safety for vulnerable road users (FHWA, *Achieving Multimodal Networks).* Agencies may have various requirements related to visibility (also referred to as sight visibility triangles), but it is essential that landscape plantings and site furnishings not interfere with the visibility of drivers leaving and entering the station area. It is also important to note that if there is an inadequate number of bicycle storage options, some cyclists will lock bicycles to trees, lampposts, or handrails.

Trash/Recycling Receptacles

It is important that passengers find the station areas of good quality and well-maintained. Trash receptacles placed at regular intervals and located in logical locations help with goal, and provide an opportunity for branding and placemaking.

Design Features and Placemaking

Placemaking is more than good urban design; it takes the physical, cultural, and social identities of a community from its location, history, and values to build a sense of place. Placemaking's goal is to create places that reflect the character of the local community, which people care about and want to spend time in. For instance, Atlanta's BeltLine Plan includes the development of pedestrian- and bicycle-friendly streetscapes and also incorporates public art of native tree leaf sculptures (Figure 3-3). This leaf artwork ties the path to its local surroundings and helps create a sense of place. These human-scaled streetscapes become more inviting to users and integrate local and regional elements.

Figure 3-3

Public art on BeltLine Trail in Atlanta

In San Francisco's Mission District, Bay Area Rapid Transit (BART) worked with the Metropolitan Transportation Commission, the San Francisco County Transportation Authority, Mission Housing Development Corporation, and other partner agencies to transform the 16th Street BART station in the Mission District from an uninviting and unsafe environment to a vibrant public plaza and community meeting space (Figure 3-4). A community-driven planning process created a vibrant design that features mosaics, sitting steps, artistic benches, and an outdoor gallery that displays work by local artists. The project used two Transportation Enhancements grants totaling $2,996,000 and leveraged $428,000 in local support (Transportation Alternatives Data Exchange, Rails-to-Trails Conservancy).

Figure 3-4

Improved 16th Street BART Station Plaza in San Francisco, CA (Photo: Transportation Alternatives Data Exchange)

Art

Art can help with both placemaking and humanizing a transit stop area. For instance, TriMet in Portland has a Public Art Program that promotes transit use and community pride by installing public art, both permanent and temporary, at stations across the region (http://trimet.org/publicart/busshelters.htm). Even the agency's transit stop signs and poles were designed by a local artist. (See Figure 3-5 for an example of locally-produced public art at a Portland transit station.)

Figure 3-5

Public art at SE Park Ave MAX station along MAX Orange Line in Clackamas County, OR

Effective Wayfinding

Transit can be overwhelming and intimidating for users; it also can be confusing. If transit users cannot understand how to use a system, let alone get to or from a transit stop from their origin or destination, they will not use transit. Routes to the stop should be as direct as possible and include wayfinding and other markings. The NACTO *Transit Street Design Guide* notes that "predictable, incremental wayfinding and brand identification guides riders through the entire trip" (p188). Signs and clearly-branded stop features can help riders navigate to the station, and more specifically, to the correct waiting location for their desired transit route and destination. The Guide recommends placing wayfinding elements at regular intervals and at decision point locations.

Wayfinding Advice from TCRP Report 153

Wayfinding should be placed along desire lines and in direct line-of-sight (Figure 3-7); when line-of-sight is not possible, clearly place signs directing to parking areas, key transfer points, entrances, and local amenities. Wayfinding needs to be consistent and legible throughout the transit system. Maps should be clearly posted, indicating both nearby destinations as well as station plans.

A network that is clearly and logically marked and branded is a significant component in a successful first/last mile plan. Legibility and wayfinding also includes posting clear signs and markers along routes to transit stations and posting maps with bicycle and walking routes clearly marked (Figure 3-6). A cohesive system helps a transit network operate as a unit instead of a series of disconnected stops. In some cities, the streets already have so much visual clutter that it is important that the transit signs are clear and easily-identifiable.

Figure 3-6

MARTA wayfinding signs to stations for pedestrians and bicyclists

Figure 3-7

MARTA's consistent wayfinding signs help direct riders to stations from surrounding streets

The need for clear wayfinding does not end once passengers arrive at a station; they need both guidance to direct them to bike parking and other station amenities, as well as trip information. Well-placed signs help passengers locate transit station elements such as boarding areas, bicycle lockers, and nearby popular attractions or destinations. Passengers also need trip information. At a bus stop, the minimum information required is a sign indicating the stop's station identification number and the routes that service the stop. Legibility provisions related to visual characters on signs in PROWAG are a recommended practice. More detailed information could include maps and detailed timetables, and, when possible, real-time arrival information. This information can help to remove barriers for transit riders in terms of accessing transit.

Maps help both pedestrians and cyclists. Posting bicycle route and walking maps in station areas (Figure 3-8) can show transit riders the many options around them as well as promote special areas of interest to locals and tourists.

Figure 3-8

Vicinity map posted outside New York City Transit subway station

Agencies need to consult early with the state and local DOTs regarding signage issues along roadways, to ensure that proposed signs are consistent with State or local requirements, or the *Manual on Uniform Traffic Control Devices* (MUTCD).

Some options are available to provide wayfinding for blind and visually-impaired pedestrians accessing transit, with new technologies being developed and introduced (Easter Seals Project Action, 2011). Tactile maps, if well-designed, can be useful for some visually-impaired pedestrians. New technologies, however, are more promising. Infrared "talking signs" use transmitters and handheld receivers to provide verbal messages to users. GPS systems with personal digital assistants (PDAs) or smartphone applications can also help riders to find stops and stations.

Universal Design

The FHWA/FTA Memorandum "Announcement of USDOT Accessibility Regulations" regarding accessibility states: "We urge you to include universal design, which addresses the needs of people with disabilities and enhances the pedestrian experience of all transportation network users, as an integral part of the planning process from its inception" (USDOT, 2000). Universal design goes beyond designing for users with disabilities; it is a broader way of thinking about and designing for a diverse group of people. The goal of universal design is to design for as wide a range of users so that as many people as possible, regardless of age or ability can access spaces and products. This design approach makes areas more welcoming, usable, and accessible for all users. The Victoria Transport Policy Institute (VTPI) provides an overview of key universal design considerations for transportation systems. According to VTPI, when designing a station using universal design, agencies "should consider all possible obstacles that may exist in buildings, transportation terminals, sidewalks, paths, roads, and vehicles" (VTPI, 2014). Station components that should reflect universal design include, for example, wider walkways to accommodate a wide range of users with mobility devices and passengers with luggage or families with strollers. Universal design components such as wider walkways and curb cuts benefit everyone at the station.

SECTION
4

Stop and Station Considerations

This section covers specific considerations at stops and stations related to accommodating pedestrians and bicyclists. In general, high-quality stops and stations incorporate the concepts of safety and security, comfort, directness, legibility, wayfinding, and universal design, as discussed in the previous section.

Transit service, including stop and station areas, brings together people traveling by (and transferring between) different modes. With this interaction comes opportunity to make the connection seamless, but also the challenge to have the modes operate safely in the same environment. Transit stops can be places at which multiple modes interact in limited space. Conflict zones at station areas can be highlighted to increase awareness and improve safety. Methods to do this include colored pavement, thermoplastic bicycle and pedestrian markings, textured paving, and raised walkways/crossing zones. Landscaping and site furnishings also can be strategically placed to help designate gathering spaces and user zones. The City of Austin is very intentional when designing around different modes. According to a City staff person, "We pay attention to minimizing conflict points between different modes and where they do conflict make them as direct and visible as possible. We have used different pavers, and we design our parking areas with short driving aisles that reduce automobile speeds and channel pedestrians for the parking areas to trails/sidewalks that lead to station/stops" (Center of Innovation & Excellence, 2015, 13).

Bus Stops

At a basic level, bus stops should be connected to the sidewalk network, highly-visible, and not impede sidewalk movement. Often, durable concrete bus pads are included to handle the wear of frequent heavy vehicle use. FHWA's *Pedestrian Safety Guide for Transit Agencies* discusses several checklists, prompt lists, and audit tools that can be used to assess the pedestrian safety and access for bus stops (see Chapter 1 of FHWA guide). The guide also notes factors to consider in determining bus stop locations, such as sight lines between passengers and drivers, stopping at areas commonly used by pedestrians, proximity to key destinations, ease of transfers and crossings, and other factors (Chapter 3).

Bus Stop Design

Designing Walkable Urban Thoroughfares: A Context Sensitive Approach discusses design recommendations for bus stop passenger boarding areas. It recommends

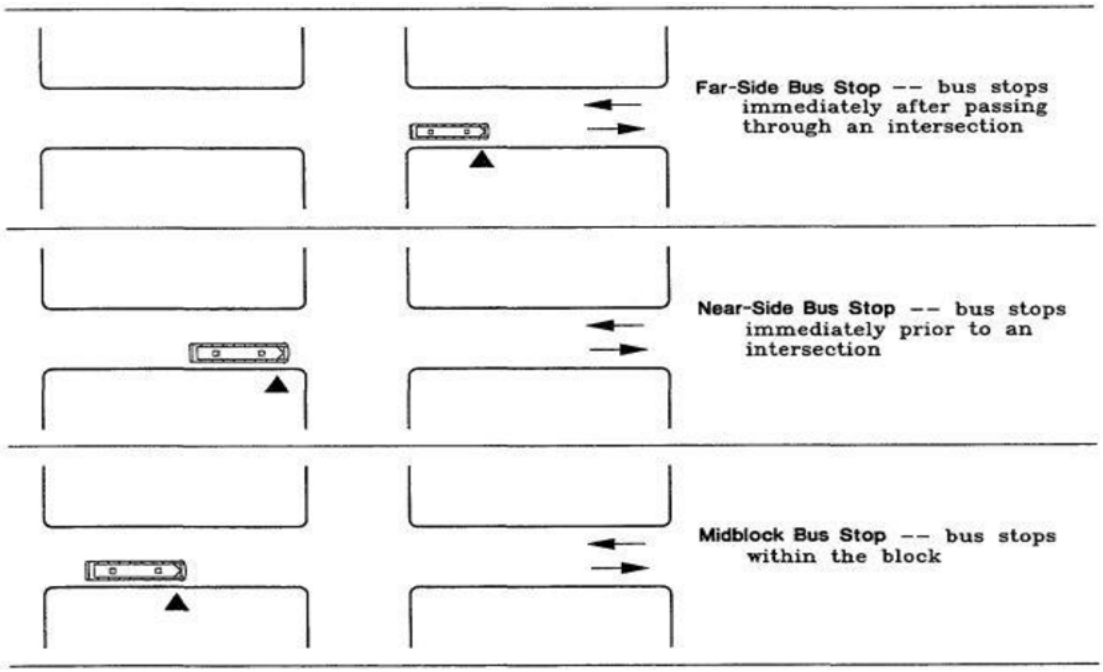
that bus stops include a landing area adjacent to the curb of 34 feet in length and 8 feet in depth, provide convenient pedestrian access from adjacent buildings, ensure good visibility for bus drivers, and keep driveways far enough away from the bus stop area (ITE, 2010). Landscaping is encouraged to promote comfort but should be placed far enough back to not impede visibility. Street furniture should have at least 4 feet of horizontal clearance to allow for access and maintenance.

Additional key bus stop design resources include the following:

- *TCRP Report 19, Guidelines for the Location and Design of Bus Stops* (1996) provides details and drawings of sample bus stop locations, accessibility requirements, pads, shelters, and amenities.
- *TRCP Synthesis 117, Better On-Street Bus Stops* (2015) uses a survey and case studies to highlight efforts by transit agencies to better serve riders at bus stops better.
- Easter Seals Project ACTION's *Toolkit for the Assessment of Bus Stop Accessibility and Safety* (2014) focuses on measures transit agencies and jurisdictions can take to remove physical, cognitive, and psychological barriers to accessing transit for people with disabilities.
- *NACTO's Transit Street Design Guide* (2016) includes chapters dedicated to the design and implementation of quality stops and stations (Chapter 3) and stop and station elements (Chapter 4).
- AASHTO's *Guide for Geometric Design of Transit Facilities on Highways and Streets* (2014) provides geometric details on stop and station design and placement on streets and highways and includes a chapter on guidelines for bicycle and pedestrian access to transit (Chapter 7).

Bus Stop Locations

In deciding where to locate a bus stop, factors affecting access and safety often can conflict. A stop at a specific location may be the easiest and most accessible for pedestrians, but that may not mean it is the safest for pedestrians getting on or off a bus. Many factors go into choosing a bus stop location, and cities and transit agencies are taking a variety of approaches to solve this problem. A synthesis of six transit agencies from around the US found that far-side bus stops were mentioned three times more often than near side as the preferred choice (*TCRP Synthesis 117*). However, decisions over where to place a bus stop are complex, and a range of factors can influence where to place a bus stop. ITE's Designing Walkable Urban Thoroughfares goes into great detail about the benefits and drawbacks of each type of bus stop location, and NACTO's Transit Street Design Guide discusses far side, near side, and mid-block stops for both in-lane and pull-out stops. Figure 4-1 illustrates these three options for bus stop locations.



Source: TCRP Report 19, p. 20

Figure 4-1 *Common bus stop locations*

Far-Side

Stops at the far side of an intersection are generally preferred to stops on the near side because pedestrians can cross in a crosswalk behind the bus where they are more visible to oncoming traffic. Far-side stops are especially important when a bus is turning left at an intersection or there is a heavy amount of right-turning traffic at an intersection. A roadway with multiple lanes may cause automobiles to pull around buses; placing a stop beyond an intersection instead of before it will minimize conflicts. In addition, far-side bus stops provide an opportunity to install signal prioritization infrastructure to aid bus movement through the intersection and to the stop (NACTO*, Transit Street Design Guide,* 60).

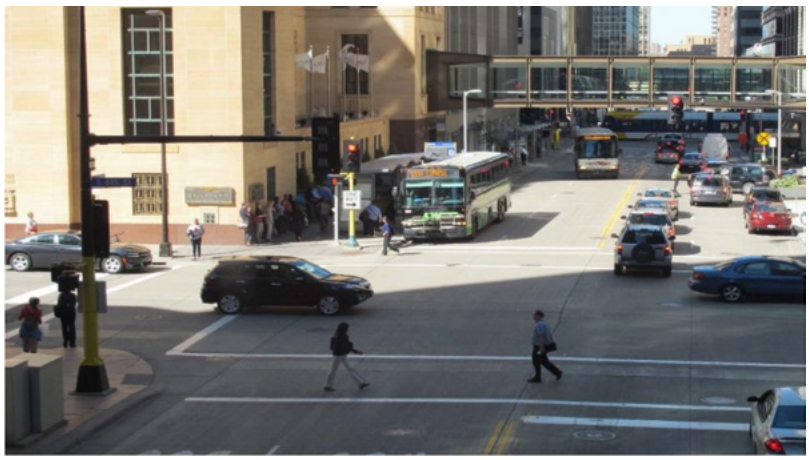
Far-side bus stops have some drawbacks, depending on the context. They can slow down bus travel times if a bus needs to stop at an intersection before stopping a second time at a far-side stop. However, some research has shown that far-side stops reduce overall bus delay compared to near-side stops (Gu et al, 2014). If a far-side stop is located within a travel lane, automobiles may back up into the intersection. Also, a far-side stop may impede right-turn movements from a cross street, and a lack of visibility around the corner could cause safety issues for people accessing the bus stop.

Near-Side

Near-side stops often are more accessible for pedestrians since the front of the bus is closer to a crosswalk at an intersection (Figure 4-2). Near-side stops are also easier for bus drivers to navigate—they can see all traffic in front of them at the intersection and can use the entire length of the intersection to re-enter a travel lane if needed. In addition, if a bus is stopped at a red light, it can allow passengers to board the bus.

Figure 4-2

Bus pulling up to near-side bus stop in downtown Minneapolis



Near-side bus stops have drawbacks as well. If a near-side bus stop is located in a travel lane, it prohibits automobiles behind the bus from crossing the intersection or turning right. Near-side bus stops also limit the effectiveness of traffic signal prioritization.

Mid-block

Mid-block bus stops may be necessary in some instances, but also present challenges. They are most appealing on a long block on which pedestrians cannot be expected to walk a long way to reach a bus stop or in places where a mid-block destination will attract foot traffic. Mid-block bus stops and crossings minimize the number of conflict points for pedestrians—generally, traffic will be coming from only one direction—but vehicle speeds are often much higher and drivers are not expecting the crossing to occur. According to recent data from the National Highway Traffic Safety Administration (NHTSA), 72% of pedestrian fatalities in 2015 occurred at non-intersection locations (NHTSA, 2017).

Any mid-block bus stop should also include a safe way for pedestrians to cross the street to access the bus stop, as close to the bus stop as possible (Figure 4-3). ITE recommends using a signalized crossing on streets where pedestrians may need to wait more than 60 seconds to find a gap in traffic for a crossing and installing median refuges for people crossing the street (ITE, 2010). Landscaping features, street furniture, and fencing also can be used to channelize pedestrians into crossing at specific points (*TCRP Report 117*).

Figure 4-3

MARTA bus stopped at mid-block crossing along Buford Highway with pedestrian hybrid beacon crossing behind bus stop

Other Important Location Factors

Ultimately, bus stops need to be in places where people want to go—near businesses, shopping, amenities, and housing. Care should be taken to 1) minimize walking distances for pedestrians who are accessing a bus stop and 2) provide safe access for pedestrians. There is no single best practice for siting a bus stop that will minimize issues around safety and access for pedestrians, but a number of considerations can help to ensure that bus stops are pedestrian-friendly and located in a place that people will use.

In-Lane Bus Stops

Far-side, near-side, and mid-block bus stops can be designed either as pull-out stops removed from traffic or as in-lane stops where the bus remains in the through-traffic lane. The primary benefit of in-lane stops for buses is that they save time and prioritize transit use along the corridor. In-lane stops also improve pedestrian and bicycle connections to transit because sidewalk space is not taken away for a bus stop. Bus bulbs, which extend the curb out to the edge of the travel lane, will provide space for a bus stop waiting area (NACTO, *Transit Street Design Guide,* 70). Boarding islands separate bus and rail traffic from other motorized traffic and allow the free movement of other transport modes, either automobiles or bicycles. See NACTO's *Transit Street Design Guide* for more information on how in-lane bus stops are used.

GRCTA Bus Stop Guidelines

The Greater Cleveland Regional Transit Authority (GCRTA) has two guidelines—Bus Stop Design Guidelines and Transit Waiting Environments—that the agency uses to create a better bus stop. The first document sets out the agency's criteria in siting, establishing, and building a new bus stop and includes all factors that the agency feels need to be taken into account. The second document recognizes that the customer experience is important in getting people to take the bus, especially when a rider could choose to use a motor vehicle instead. Amenities, from shelters to protect from weather to bicycle racks to facilitate bicycle connections to transit, are important in getting more people to ride transit.

Pedestrian-Bus Conflicts

The topic of reducing pedestrian-bus conflicts extends beyond the specific purview of this manual, but it is an essential endeavor for any transit agency. A resource that can provide key information on the topic is *TCRP Report 125, Guidebook for Mitigating Fixed-Route Bus-and-Pedestrian Collisions* (2008), which discusses ways to mitigate potential conflicts between buses and pedestrians. The guidebook defines four main types of collisions, two of which pertain to bus stop locations—bus pulling into a stop and bus pulling away from a stop. For each collision type, contributing factors and strategies for mitigating that type of collision are detailed. Strategies for mitigating common collision types range from bus operator training to public education to bus modification. The guidebook also details applications of each of the suggested strategies and their reported effectiveness.

The guidebook notes that "bus pulling into a stop" collisions with pedestrians account for 15% of pedestrian-bus collisions. Key contributors to this type of collision are given as:

- Crowded bus stop locations, which can be due to high passenger demand, limited space to wait, and obstacles.
- Lack of visibility of pedestrians at stops due to obstructions or lack of lighting.
- Bus stop locations that are either too near the roadway, causing pedestrians to wait too near passing traffic, or too far from the roadway, resulting in pedestrians moving into the roadway to be more visible.

Collisions with pedestrians when a bus is pulling away from a stop account for 10% of bus-pedestrian collisions, according to the guidebook, with the most common instance pertaining to pedestrians running to catch a bus as it pulls away. Other contributing factors to this type of collision discussed include lack of information about subsequent bus arrivals, lack of visibility of pedestrians at a stop, instances of bus drivers focused on vehicular traffic as they leave a stop, and sidewalk obstacles resulting in pedestrians tripping or falling into the path of a bus.

Bicycle-Bus Conflicts

When bicycles and buses share a street, they are often in conflict on the right side of the road. Buses may need to pull across or into a bike lane to access a stop and, in many instances, buses stop for passengers while in bike lanes. When this happens, bicyclists may pass either to the left or right of the stopped bus. "Leapfrogging" occurs when a bus passes a bicycle before pulling over to the right for a stop and the bicycle then passes the stopped bus, a process that can repeat itself a number of times on a single stretch of road.

There are several ways to address this problem that involve funneling bicycle traffic and transit service into separate streams. One such approach is to build an island bus stop and place the bike lane between the sidewalk and the island bus stop. Bicycles will permanently stay to the right of a bus and will have their own dedicated space to the right of a bus when it approaches a stop (see Figure 4-4). Pedestrian crossings in the bike lane should always be prioritized over bicycle movement. A second approach is to build a bicycle lane on the left side of the road. In addition to reducing the likelihood of a bicycle and bus conflict, this approach lessens the risk of "dooring," since bicycles will be riding next to the passenger side door of a car if a lane is placed next to parked automobiles. In some cases, bike traffic and transit service can be funneled to parallel corridors, contributing to an overall multimodal network.

Figure 4-4

Bike lane in Los Angeles running behind floating bus stop, which eliminates conflict between bicycles and buses

When bicycle and bus traffic cannot be separated into separate streams, bus stop locations that provide ample room for bicyclists to safely pass on the left are preferred. Pavement markings and signs can be used to encourage safe passing, which may include highly-visible routing bicycle lanes (such as with the use of colored pavement). Wide shared bus and bike lanes at stop locations are another approach that can provide passing opportunities for bicyclists. In some cases, agencies remove the bike lane altogether and require bikes to merge in with buses and other traffic.

Training and education on scanning for and yielding to bicyclists, along with observing rights-of-way, are essential elements of minimizing bus and bicycle conflicts at bus stops.

Bus Rapid Transit Stops

Several characteristics about bus rapid transit (BRT) service affect on-street stops and how they best serve pedestrians and bicyclists. BRT buses often are

articulated, and stops usually are spaced farther apart than those for traditional bus service. BRT service generally incorporates payment prior to boarding and seeks to get riders loaded and unloaded as quickly as possible.

Although they may be able to stop at standard bus stops, bus stops or stations with features that specifically accommodate BRT are preferred. Platforms may be higher (9–15") to accommodate level boarding and ease accessible boarding, which will require a ramp up to the platform. Platforms should also have detectable warning surfaces (see PROWAG R308.1). Boarding may occur through the front or rear door, necessitating more boarding zones. BRT stops can stand out from other service through distinct branding.

Median Bus Stop

BRT stops may be designed at median locations to avoid the need to pull to the side of a busy road (or pull off a separated highway). Median stops work best with transit service that requires a dedicated travel lane. All pedestrians must cross traffic to reach the bus stop, but they will need to cross only one direction of traffic. Intersections should be designed to prioritize safe pedestrian crossings. A median bus stop also will provide a refuge area for pedestrians looking to cross the entire street. NACTO's *Transit Street Design Guide* and APTA's Bus Rapid Transit Stations and Stops include more information on how to construct median boarding areas that are safe and well-connected to the pedestrian and bicycle network.

The EmX BRT system in Eugene, Oregon, runs primarily in the middle of its streets (Figure 4-5) with median bus stops (with some isolated curbside stations). Having a common boarding area for both directions of service helps people find the station for the return trip. Running buses in the median also creates more space for prominent stops that help identify the station and bus service branding.

Figure 4-5

Median boarding station for EmX in Eugene, OR (Photo: Oregon Department of Transportation)

APTA's *Bus Rapid Transit Stations and Stops* provides recommended practices for BRT stations and stops, and covers stop and station types, location, spacing, dimensions, branding, and amenities.

Streetcar Stops

Streetcars and streetcar stops share many characteristics with bus stops because they generally operate in mixed traffic. However, the presence of tracks and their limiting influence on the ability of a vehicle to transition in or between lanes requires stations to be curbside or for curbs to be extended to meet the vehicle path (exceptions are median stops and plaza type stops). Chapter 4 of the *DC Streetcar Design Criteria Manual* covers the topic of streetcar stop design, including siting criteria, platform design, station amenities, and the integration of public art.

Transit operators often will seek to make streetcar stops stand out from bus stops for the purpose of branding the service; this may include specific shelter or other amenities. Streetcar stops also may need specific ticket vending and informational displays.

The NACTO *Transit Street Design Guide* notes that platform height can be an issue with streetcar systems. In general, boarding as close to level as possible is desired, which requires a raised platform. Newer streetcars also have low boarding areas; however, older streetcars may require a "mini-high" platform, a retrofit for transit vehicles with high boarding consisting of "a small platform and ramp to permit accessible boarding to select vehicle doors".

Because streetcar lines tend to operate in mixed traffic, there is the possibility of marked bike lanes or routes on the same streets as a streetcar. Although this generally is not advised, placing a bicycle route behind a streetcar stop can minimize interactions between bicyclists and streetcars or tracks. Locations for pedestrians to cross a bicycle route to access a station should be clearly marked, and railings can be used to limit pedestrian crossings to these marked locations. Figure 4-6 demonstrates how Portland separates walking and bicycling traffic from a streetcar stop and indicates where pedestrians may cross.

Where streetcar tracks share right-of-way with mixed traffic, bicyclists can be at significant risk of crashes involving the tracks. A study found that, in Toronto, a city with an extensive streetcar system, 32% of injury crashes to bicyclists involved streetcar tracks, with most of those involving a tire getting caught in a rail flangeway, whereas other crashes involved slipping on tracks or hitting a component of the track (Teschke et al., 2016).

Figure 4-6

Separated walking and bicycling routes from streetcar route and station in Portland

All rail crossings for bicyclists (and pedestrians) should be at 90 degrees to minimize the crossing distance and lower the probability that a wheel will get stuck in the gap. Roadway markings and bike lane placement can be designed to make road users aware of the presence of the tracks and how to safely maneuver across them. Some cities are also using signs to indicate the risk posed to bicyclists by streetcar tracks. Word message signs can be used, but custom symbol signs are not compliant with the MUTCD.

For passengers using any type of wheeled device to access rail transit, the flangeway gap in the pavement for train wheels can cause wheels to get stuck, leading to crashes or people becoming caught in the path of an oncoming train. Flangeway filler products can be used that collapse when a train rolls over the track, but then refill the gap, making it much safer for wheeled users to cross (*AASHTO Bicycle Facilities*). Where 90-degree crossings are not possible, flangeway fillers are much more important to include (*TCRP Report 175*). However, flangeway fillers can add significant maintenance costs; each time a train rolls over the track, the filler is compressed and, over time, that constantly-repeated action will cause the flangeway filler to wear down.

Alta Planning + Design's *Lessons Learned and Recommendations for Managing Bicycle Interactions and Streetcars* (2008) discusses how streets can accommodate bicyclists and streetcars together.

Light and Heavy Rail Stops

Light rail stops generally have dedicated right-of-way, but stops can be on-street and share many characteristics with streetcar stops. Heavy rail operates on exclusive right-of-way and is often grade-separated from other traffic. Rail stations with multiple levels should have elevators and other accommodations, such as bicycle rails on stairways or bike ramps where feasible, for transporting bicycles between levels.

Plan for More Users

Rail transit stops usually have higher numbers of riders than bus, BRT, or streetcar systems. Therefore, the station areas are considerably larger. These stations, whether elevated, at street level, or underground, should have multiple entrances and exits. Although this is primarily the case due to safety concerns, it is important to remember that patrons will access a station from all directions if the surrounding walking and bicycling network is connected. Each entrance should be easy for high volumes of pedestrians and bicyclists to navigate. Elevators are not necessary at every entrance for an elevated or underground station, but signs pointing people to the elevator are necessary.

Some transit systems do not have fare gates, instead relying on an honor system or random ticket checks to ensure that people are paying fares. Gated systems, however, need to ensure that wheelchairs, strollers, and bicycles can comfortably fit through at least one of the fare gates to reach the station (Figure 4-7).

Figure 4-7

Wide fare gate in Los Angeles

Station Area Amenities

Stations that are elevated or at street level need to provide adequate amounts of shelter and seating, depending on the number of people who use the station and how much space is provided. Each station is unique, and the amount of space at a station likely will be as much a determinant for seating as expected usage. Stations with underused space could consider installing bicycle racks; in gated stations, this can provide an additional level of security for bicycle parking in a highly-visible place.

Wayfinding is important to provide for arriving passengers at rail stops to help them acclimate to the surrounding streets and other pedestrian and bicycle facilities. Many stations in more suburban settings have park-and-ride lots nearby. Wayfinding is especially important for pedestrians and bicyclists who must navigate through these parking lots. Park-and-rides lots often have space for bicycle parking—either racks or lockers—and getting bicyclists in and out next to cars requires signs that are clear along with adequate space for both modes.

Transit-Oriented Development (TOD)

Rail stops are more likely to be places where further real estate development is expected. In these cases, additional space to accommodate future pedestrian and bicyclist needs, such as space for bicycle parking or bike share stations, can be incorporated (Figure 4-8).

Figure 4-8 *Pedestrian crossing (left) and additional space adjacent to rail station (right) at Lindbergh Center Transit Station, Atlanta*

Accessing Rail Stations

Rail stations face a unique challenge in getting pedestrians and bicyclists to safely access a station. In many cases, these users need to cross both streets and railroad tracks to reach a rail station. Transit riders should be able to do this safely and comfortably. Bridges and underpasses can get transit riders across tracks or busy roads in situations where at-grade crossings are not feasible, but these solutions often are expensive to build. When grade separation is not feasible, there are several at-grade crossing treatments.

Useful resources for considering at-grade pedestrian-rail crossings include *TCRP Report 175, Guidebook on Pedestrian Crossings of Public Transit Rail Services* (2015), which outlines 34 separate pedestrian treatments, with tactics ranging from

barriers to infrastructure to design; the Metrolink (Southern California) *Highway-Rail Grade Crossings Recommended Design Practices and Standards Manual* (2009); and *TCRP Report 137, Improving Pedestrian and Motorist Safety Along Light Rail Alignments (2009).* Section R305.2.5 of PROWAG outlines accessibility requirements for such crossings, including the need for detectable warning surfaces.

Channelization

One type of at-grade crossing involves channelizing. Barriers can achieve this goal in a number of ways. First, they can funnel pedestrians into crossing railroad tracks at specified points where safety treatments have been put in place. Channelization can also be used to create a "Z-crossing," which turns the pedestrian pathway so it faces an oncoming train before the crossing (*TCRP Report 175*). Gates also impede pedestrians from crossing in front of a train. Pedestrian gates that are separate from automobile gates also can be employed, often with a hanging horizontal bar known as a gate skirt to discourage pedestrians from ducking underneath.

Rail stations often involve the independent movement of different types of transportation: bicycles and pedestrians, trains, and automobiles. Unique solutions will need to be found based on the circumstances in and around each station area.

Signals and Lights

Signals and flashing lights can be used to warn pedestrians about upcoming railroad crossings (Figure 4-9). Signals that activate when a train is approaching inform pedestrians and motorists that it is no longer safe to cross the railroad tracks (*TCRP Report 175*). Flashing red lights or blankout signals stay turned off when no trains are nearby. In Houston, flashing lights are embedded into the pavement beside the light rail track to inform both motorists and pedestrians as they look at the roadway that a train is on its way (*TCRP Report 137*). A more complete list of safety treatments centered around signals, flashing lights, and audible cues can be found in Appendix A of *TCRP Report 137.*

Figure 4-9

Metro Transit rail crossing in Minneapolis with flashing light signals and blankout signals that activate only when train approaching

Passive Signs

In many places, no active crossing treatments exist; instead, static signs and pavement markings indicate to pedestrians that they are approaching railroad tracks. Passive signs provides a clear, constant message to pedestrians about possible oncoming trains. Because of their unchanging nature, however, these signs may go unnoticed.

TriMet Passive Signs

TriMet in Portland has many locations at which passive signs serve as the only warning device for pedestrians of an upcoming railroad crossing. These are often located at the edges of stations where pedestrian traffic is heaviest. However, these crossings are usually directly in front of or behind the stopped train. Any trains moving through these spaces are moving at slow speeds, and a crossing in front of a stopped train allows pedestrians to make eye contact with the train conductor before crossing the tracks. TriMet also uses gates and barriers to channel pedestrians into specified crossing points where conductors will expect them to cross, along with pavement markings and detectable warnings.

TCRP Report 137 explores whether active or passive treatments are more effective for safe pedestrian crossings. A well-designed active treatment is more effective than a passive treatment in generating attention from all pedestrians, bicyclists, and motorists.

Passive warnings, though less effective, can still be beneficial. A simple warning, when used in a place where pedestrians can see the warning well in advance, can be all that is needed. Barriers are a highly-effective passive tool to ensure that pedestrians use marked crosswalks across a street or railroad track (*TCRP Report 137*). A swing gate forces pedestrians to take action by moving the gate out of the way before crossing the railroad tracks (Metrolink 2009). Pavement markings also help capture a pedestrian's attention to an upcoming railroad crossing. Detectable pavement warnings can also be used to signal to a pedestrian that they are entering an area where they are about to cross railroad tracks (*TCRP Report 175*). Figure 4-10 shows a rail crossing treatment that uses both pavement markings as well as swing gates.

Figure 4-10

Swing gates with signs telling pedestrians to look both ways and pavement markings at crossing in Los Angeles

Audible Cues

There are two kinds of audible warnings—train horns and audible signals that are fixed at each railroad crossing. When trains are moving at higher speeds (usually above 35 miles per hour), a train horn should always be sounded at a crossing (*TCRP Digest 84*). At crossings where it is difficult for the train conductor to see the crossing well in advance, a train horn should be sounded. The point at which a pedestrian can see a train coming is equal to the time that a train horn should be sounded, generally between 500 and 1,000 feet in advance of the crossing (*TCRP Digest 84*). The loudest setting should be used in a safety emergency.

Warning bells at crossings for pedestrians are important. If at all possible, providing pedestrian-specific barriers and gates (Figure 4-11) will provide an added layer of safety (*TCRP Digest 84*). FHWA recommends that pedestrians have a minimum of 20 seconds' warning before a train arrives, with all safety treatments fully-deployed 5 seconds before the train arrives (*FHWA Pedestrian Safety Guide for Transit Agencies*). However, active safety treatments that last much longer than necessary are often ignored by pedestrians, which creates a different set of safety problems (*TCRP Report 137*). If more than one train is arriving, then additional treatments are needed to convey this information.

Audible cues are a challenge because surrounding communities often complain about the noise. As a result, transit agencies look to either install noise mitigation technology or reduce bell and horn usage in residential areas, to the detriment of pedestrian safety. Consult *TCRP Digest 84* for ways to address any concern with audible cues around railroad tracks.

Figure 4-11

Flashing lights, audible cues, and pedestrian crossing gate at Westwood/Rancho Park station along Metro's Expo Line in Los Angeles

SECTION 5

Pedestrian Access

The NACTO *Transit Street Design Guide* notes that pedestrian-friendly urban streets and connected comfortable pedestrian networks allow transit to reach its greatest potential because a "wide range of potential riders will walk farther" to access transit in those situations (p188). Pedestrian network factors that can make the transit connection more amenable include direct connections, short blocks, short crossing distances, and many crossing opportunities, specifically at transit stop locations.

A 2015 study of the factors that affect the likelihood that people will walk and take transit found that the amount of time it takes to walk to transit, perceptions of crime safety, and sidewalk availability were the most important factors (Tilahun and Li, 2015). Another study found that the type of transit service being offered has an effect on walking distances to use public transit, with subway riders walking a bit farther than bus users and commuter rail users walking significantly farther, on average (El-Geneidy et al., 2010). Overall, statistical models show that walking distances to transit stations vary based on household, personal and trip characteristics (especially headway), type of transit (metro, commuter rail, and buses), and route characteristics.

Sidewalks

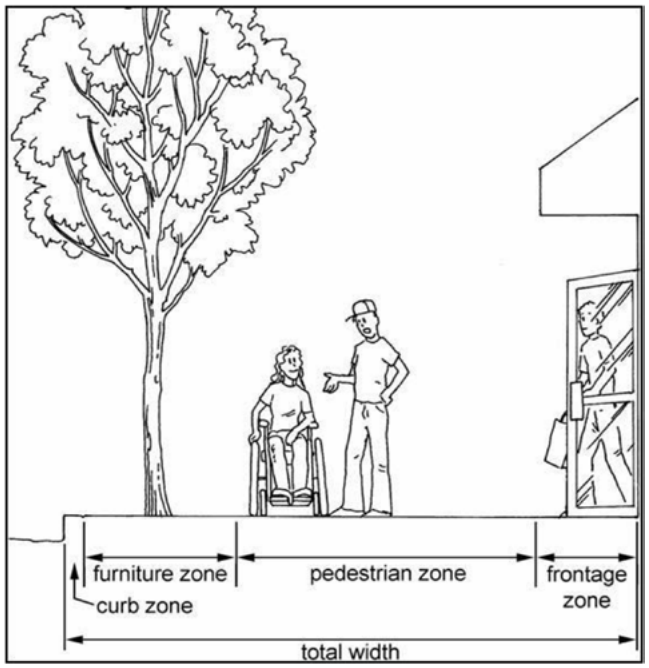
High-quality and accessible sidewalks are needed for pedestrians to safely reach a transit stop. Numerous resources outline specific engineering standards for sidewalks across a variety of situations (see *AASHTO Pedestrian Facilities* or ITE's *Designing Walkable Urban Thoroughfares*), but some general standards apply. A resource that can serve as a starting point for pursuing quality sidewalks is FHWA's *Guide for Maintaining Pedestrian Facilities for Enhanced Safety* (2013).

Sidewalk Sections

As AASHTO details, there are three sections to a sidewalk: 1) a buffer zone, which is the space between the street and where pedestrians are walking, 2) a pedestrian zone, where pedestrian movement occurs, and 3) a frontage zone, which businesses occupy with advertisements, seating, or retail (*AASHTO Pedestrian Facilities*). There should be adequate space for all three zones (Figure 5-1).

Figure 5-1

FHWA sidewalk diagram of furniture zone, pedestrian zone, and frontage zone (Graphic: FHWA Vegetation Control for Safety, 2007)



The buffer zone is important because it provides pedestrians with a bit of distance from moving traffic, which can improve comfort and minimize the likelihood that people walking will be splashed by passing vehicles in wet conditions. Parked cars can serve this purpose (*FHWA Pedestrian Safety Guide for Transit Agencies*). The buffer zone should minimize obstructions that will prevent drivers from seeing pedestrians. The sidewalk zone must be accessible to and usable by persons with disabilities and wide enough to accommodate two pedestrians walking side-by-side (Figure 5-2). AASHTO recommends a minimum clear width of four feet at low volume locations, but up to 6-8 feet on arterials and 8-10 feet in city center areas (AASHTO *Pedestrian Facilities).* Any objects such as telephone poles or street trees must not encroach upon this space.

Within the station area in the buffer zone, it is important to understand how many people are expected to use the station during peak periods. There should be sufficient sidewalk space for people to unload and board, wait to board, and transfer to another service if nearby.

Figure 5-2

Trees and bike racks in furniture zone along NE Orenco Station Pkwy in Hillsboro, OR, providing buffer for pedestrian zone

Charlotte Road Diets

*The City of Charlotte (NC) is actively pursuing road diets, which generally convert 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, along corridors with heavy automobile traffic (see Figures 5-3 and 5-4). Road diets can make streets safer for all users and can create space for wider sidewalks (and bicycle bike lanes). In Charlotte, road diets are used primarily to make streets safer and to create space for bicycle bike lanes, but FHWA recommends using a road diet to improve sidewalks as well (*FHWA Road Diet Informational Guide*).*

The Charlotte DOT used $300,000 in Transportation Enhancements funding to implement a road diet on Clanton Road, converting a 0.7-mile segment of a four-lane undivided highway into a two-lane divided highway. The road diet between Sergeant Drive and West Boulevard incorporated planted medians, new crosswalks, and bike lanes.

Figure 5-3 *Four-lane road in Charlotte, NC, changed to three-lane road with median turn lane to create space for bicycle lanes (Photos: Ken Tippette)*

Figure 5-4 *Road diet on Clanton Road in Charlotte, NC (Photo: Rails-to-Trails Conservancy / trade.railstotrails.org)*

When Metro was drafting the *First Last Mile Strategic Plan* for Los Angeles County, the agency identified broken and damaged sidewalks as one of the major barriers that prevented more people from getting to transit stations. The majority of people accessing these stations must navigate difficult streets and sidewalks. The agency also noted that the county had one of the highest pedestrian fatality rates in the nation. The plan identifies numerous ways to provide additional pedestrian paths and fixes to the existing sidewalk infrastructure.

Crossings

Pedestrian crossings are necessary to reach a transit stop, and they are the most likely places where safety conflicts will arise. A 2014 study looked at transit-bound and non-transit bound pedestrians crossing Huntington Avenue in Boston and found that when a transit vehicle was waiting or approaching, pedestrians crossed at greater speeds and were willing to accept smaller gaps to cross (Meng and Dulaski, 2014). Other research has shown that transit corridors, with higher levels of pedestrian activity, often are high-risk locations and that transit riders represent a high percentage of crashes involving pedestrians (Pulugurtha and Penkey, 2010). Findings such as these amplify the need to provide safe crossings near transit stops.

Intersections with a complete set of crosswalks allow pedestrians to cross directly and safely (Figure 5-5). A safe and accessible crossing option should be provided at regular intervals—around every 300–400 feet in an urban environment, according to ITE (*Designing Walkable Urban Thoroughfares*)—to make walking convenient and appealing, as well as to discourage unsafe crossing.

Figure 5-5

Crossing at light rail station in Minneapolis

Appendix A of *TCRP Report 112 / NCHRP Report 562, Improving Pedestrian Safety at Unsignalized Crossings* details 17 different crossing treatments and documents when each treatment should be used. Treatments involving a flashing beacon should flash only when a pedestrian is present in the intersection. Studies have shown that motorists are more likely to stop when the beacons only flash when a pedestrian is present, as opposed to flashing all the time (*TCRP Report 112*).

Leading pedestrian intervals (LPIs), which give pedestrians a walk signal before the light turns green, thus making them more visible to drivers, can be effective at crosswalks at stoplights. LPIs reduce collisions between pedestrians and automobiles by as much as 60%; the interval is recommended to be 3–7 seconds (NACTO *Urban Street Design Guide*). Providing an LPI is especially important at intersections where left- and right-turning movements are common.

Safety and Security

Pedestrians and bicyclists accounted for nearly 90% of collisions with fatalities involving light rail vehicles in the mid-2000s (*TCRP Report 137*), so the safety of these two travel modes should be prioritized. One part of addressing safety for light rail is to ensure that transit operators and other road users have a clear view of the station area so that they can see people on foot or on bicycles. Providing clear sightlines in a station area is also important for police and security cameras (*ITE Designing walkable Urban Thoroughfares*).

PEDSAFE

The Pedestrian Safety Guide and Countermeasure Selection System (PEDSAFE) catalogs 67 treatments to improve the pedestrian environment in a variety of circumstances. PEDSAFE has put together two matrices to showcase that treatments are best used in specific situations: "Crash Type Matrix" identifies crash type by location within the streetscape and provides solutions to reduce the number of future crashes, and "Performance Objective Matrix" pairs a specific goal within a streetscape and provides solutions to meet that goal.

On-street parking can provide a buffer between the pedestrian sphere and fast-moving automobile traffic. Parking, however, must never be allowed where a bus or train will enter a station area. As APTA notes, "Never assume that a driver knows where not to park" (APTA 2012). On-street parking can also impede motorists from seeing pedestrians, so keeping parking areas away from transit service makes pedestrians visible and safe.

Additional design features can make pedestrian spaces around transit safer. Curb bulb outs at a transit station can shorten crossing distances for pedestrians and make them more visible to oncoming traffic. Median islands provide refuge for pedestrians as they cross a street to reach a transit station. Perceived safety is also important - fewer pedestrians will use the station if it is not perceived to be safe. Shelters may be necessary to protect waiting pedestrians from the weather, but shelter interiors should be visible from the outside (*AASHTO Pedestrian Facilities*).

Lighting

Lighting is important, both to provide clear visual sightlines at night and for added security. Lighting is necessary for pedestrians to see the path they need to take to reach their destination, and for transit service to see pedestrians who are waiting at a stop, crossing the street or railroad tracks, or walking along a sidewalk. All crossings where pedestrian activity is expected at night should be illuminated, especially near transit stations. Transit operators need to be able to see pedestrians crossing the street or waiting at a station (*TCRP Report 175*).

SECTION 6

Bicycle Access

Like pedestrians, bicyclists need a safe and accessible route to or from the transit stop or station. However, bicyclists are able to travel further in a short amount of time, and, thus, have a considerably larger area from which they can access a stop—FTA policy recognizes a distance of three miles around a stop or station as being relevant to the station (FTA, 2011).

To get to the station, bicyclists have needs similar to pedestrians, such as safe crossings; however, bicyclist needs in getting to a station include safe bicycle routes. Measures that encourage more people to ride bicycles to transit have the potential to increase the number of potential transit riders.

Networks to Get to a Stop or Station

There need to be safe, comfortable, and connected bicycle routes to help a bicyclist get to and from a station. These may include paths, bike lanes, separated bike lanes, or low-stress local streets. A case study of the San Francisco Bay area found that in areas with a denser network of bus and rail transit routes, bicycle routes were often naturally connected to transit stop locations; however, in areas outside urban centers with more sparse transit networks, cities and other jurisdictions had to be more intentional in connecting bicycle routes to transit stop locations. Similarly, a case study in the Portland area found that in more outlying areas, carefully planning out connections was necessary (in part, because transit is spread more thinly and, in part, because trip distances become too great for many people to cover using only bicycling or transit). In Vancouver, British Columbia, new SkyTrain lines were constructed in tandem with parallel protected bicycle routes. This approach of providing parallel or redundant bicycle and transit routes has been seen as particularly helpful as a means of addressing overload and crowding on transit (Pucher and Buehler, 2009).

FHWA's *Case Studies in Delivering Safe, Comfortable, and Connected Pedestrian and Bicycle Networks* (2015) provides key principles of exemplary pedestrian and bicycle networks; the principles are cohesion, directness, accessibility, alternatives, safety and security, and comfort. Adhering to these principles can help to increase the effectiveness of the bicycle network in getting people to and from transit to their origins or destinations, effectively increasing the size of the bike shed around a stop or station.

BIKESAFE

The Bicycle Safety Guide and Countermeasure Selection System (BIKESAFE) catalogs 46 treatments to improve the safety and mobility of bicyclists. BIKESAFE has put together two matrices to showcase which treatments are best used in specific situations: "Crash Type Matrix" identifies crash type by location within the streetscape and provides solution to reduce the number of future crashes, and "Performance Objective Matrix" pairs a specific goal within a streetscape and provides solutions to meet that goal.

There are a number of guidance and resource documents for planning bicycle routes and networks, including NACTO's *Urban Bikeway Design Guide (2013),* FHWA's *Separated Bike Lane Planning and Design Guide* (2015), and AASHTO's *Guide for the Development of Bicycle Facilities* (2012).

Wayfinding

Wayfinding signs and street markings that direct bicyclists to transit are a useful way of connecting bicyclists with transit. Incorporating transit stops and stations into standard bicycle wayfinding signs should be regular practice.

Signs at and around stations can point bicyclists and pedestrians toward transit stations (Figure 6-1). Signs also can point bicyclists toward parking facilities in a station area if they are not within clear sight of a station area (Figure 6-2). Santa Monica has a wayfinding project underway to implement wayfinding signs at a half-mile radius around each Expo Line station to help people get to and from the stations. Metro also posts county bicycle maps at many stations, helping bicyclists continue their trip or make a last mile connection from transit (Figure 6-2).

Agencies need to consult early with the state and local DOTs regarding signage issues along roadways, to ensure proposed signage is consistent with State or local requirements, or the MUTCD.

Figure 6-1

Bicycle wayfinding sign pointing riders to transit

Figure 6-2

Wayfinding signs at Metro stations in Los Angeles, including bicycle parking and bicycle maps

In the Station

Stairways, Elevators, Escalators: Access to rail stations often involves staircases, elevators, or escalators. In many cases, the fastest option for bicyclists is to carry their bicycle up and down the stairs, although this can be very challenging or impossible for some people, especially in very crowded or confined conditions (Figure 6-3). Bicyclists are generally discouraged from using escalators, although some transit agencies are considering permitting their use. Rails, grooves, or concrete ramps can be added to staircases for bicyclists to push their bicycle up the staircases. When doing so, designers should consider how the installation may affect blind and visually-impaired pedestrians. Bicycles are generally permitted on elevators and, in some cases, bicyclists are explicitly directed to use the elevators.

Figure 6-3

Los Angeles Metro rider carrying bike down staircase (left), bike ramp adjacent to Minneapolis Metro Transit station (center), and elevator at Atlanta MARTA station (right)

Fare gates: Getting through a fare gate can be a challenge for a person with a bicycle. Wider gates (Figure 6-4) can provide access for a variety of users who may be challenged to get through a standard gate, including bicyclists, wheelchair users, riders with strollers, and those with packages or luggage.

Figure 6-4

Los Angeles Metro fare gates wide enough for passengers with bicycles, strollers, and suitcases

Bicycle repair areas: Some transit operators are installing bicycle repair or "fixit" stations, either in areas adjacent to stations or near bicycle parking areas (Figure 6-5). These typically offer a set of tools to carry out basic bicycle repairs or adjustments, such as a hanging stand, air pump, and screwdrivers or Allen wrenches. Some agencies are partnering with private bike shops or other companies to provide vending machines with essential bicycle-related items such as bike tubes, parts, and other accessories.

Figure 6-5

Fixit stations in Atlanta and Portland

Bus-Bicycle Boardings in Cleveland

Conditions that are beyond the control of a transit agency often have a significant impact on people using bicycles to access transit. The Greater Cleveland Regional Transit Authority (GCRTA) saw a steady increase in usage on bus bicycle racks between 2008 and 2011. However, adverse weather conditions led to many fewer people taking a bicycle to reach transit. Providing shelters that can protect bus patrons from the rain while waiting for the bus may encourage more bicyclists, even in wet conditions. The study also found that higher-quality transit service levels were positively associated with increased bicycle boardings (Flamm, 2013).

SECTION
7

Bicycle Parking at Transit

Although most people who access transit by bicycle prefer to take their own bicycles on board a transit vehicle, the secondary preference is to have bicycle parking facilities at transit stations (Krizek et al., 2011). Bicycling serves as an important first/last-mile connection to transit stations, and catchment areas for bicyclists accessing transit may be upwards of three miles. As a result, transit stations should provide ample bicycle parking to accommodate a variety of needs.

It is most important to incorporate bicycle parking around rail stations and bus transit hubs, particularly those that offer express bus service. Bicycle parking is especially important for rail systems that have restrictions on bicycles on board or that lack space for accommodating bicycles on vehicles. Bicycle parking facilities generally can be categorized into two groups: standard bicycle racks and more-secure bicycle parking options such as bicycle lockers and bicycle stations. Figure 7-1 shows bicycle racks and lockers located adjacent to each other.

Figure 7-1

Bicycle racks and lockers at North Hollywood Station, Los Angeles

Transit agencies should consider developing agency guidelines for bicycle parking, including what types and designs to use, where to place parking, how much parking is necessary, and how to plan and design stations so that bicyclists approaching the station can access the parking. In general, a mix of bicycle parking options is preferred, as some riders will want secure options (particularly those leaving their bicycles for an entire day or overnight) and others will want the ease of a standard bike rack. Placement as close to the transit stop or

station as possible is generally preferred, while ensuring that bike parking, when occupied, does not protrude into pedestrian space. Signs pointing bicyclists to existing bicycle parking should also be used. APTA is currently developing a guidance document on best practices and standards for bicycle parking to be available in Fall 2017.

Types of Bicycle Parking

Less-Secure Parking

Standard bicycle racks are the most common form of bicycle parking in the US. These facilities are geared toward short-term usage and typically are found in the public right-of-way. For these facilities, the Association for Pedestrian and Bicycle Professionals (APBP) encourages the use of inverted U-locks, circular racks, and post and loop rings (Figure 7-2). Schoolyard and coat hanger racks are among rack types not recommended by the APBP.

Figure 7-2

Recommended rack types include inverted U-rack (above left) and post and loop ring (above right). Schoolyard (below left) and coat hanger (below right) not recommended.

Photos: Initiative for Bicycle and Pedestrian Innovation

Standard bicycle racks provide an inexpensive and effective way to provide parking accommodations, although they are not the first preference of most bicyclists commuting to transit stations. Most often, these facilities can be found in the open air or sheltered within or adjacent to a station area (Figure 7-3).

Having racks in readily-observable locations can permit passive security from transit users and passers-by. However, one of the biggest concerns found among those bicycling to transit was leaving their bicycle unattended at a transit station for the majority of the day. In general, racks should be placed in highly-visible locations, preferably with cover and lighting. When possible, security cameras can provide extra security. A solution employed by some transit agencies, such as BART and MARTA, is to locate bicycle racks within the fare zones of station areas (Figure 7-4). Such a strategy is a cost-effective way to provide greater security and help prevent bicycle theft.

Figure 7-3

Sheltered bicycle racks along MAX Orange Line in Milwaukie, OR

Figure 7-4

Bicycle racks inside fare gates at MARTA rail station

Secure Bicycle Parking

Secure, long-term bicycle parking provides more protection from theft and an added measure of shelter. Such facilities can help alleviate the concerns of bicyclists who are wary of leaving bicycles unattended at a transit station and can encourage more bicycle connections to transit. These facilities also raise the

visibility of cycling to public transportation and can encourage new users to give it a try.

Bicycle Lockers

One of the most prevalent types of secure bicycle parking facilities are individual bicycle lockers that securely protect a bicycle and its components and often provide storage room for other gear as well, such as a helmet, bags, lights, and clothing (Figure 7-5). Bicycle lockers have increasingly been employed by a wide variety of transit agencies across the US. The Washington Metropolitan Area Transit Authority (WMATA) has 2,400 bicycle lockers within the rail system and 2,400 unsecured bicycle parking spaces. The most common type of bicycle lockers are accessible by key access and rentable by a single user and are typically leased out by the transit agency for six months to a year at a cost of up to $120 per year.

Figure 7-5

Bicycle lockers at light rail stop in Minneapolis and bus stop in Los Angeles

However, a long-term lease structure with a significant upfront fee may discourage some bicyclists from using these facilities. One alternative used by King County Metro, BART, Caltrain, TriMet, and other agencies is on-demand eLockers, which are made available on a short-term, first-come, first-served basis. Although eLockers require a small upfront fee for a keycard, users are charged on an hourly basis thereafter, making it a more flexible option for bicyclists.

One aspect to keep in mind is that the installation of both bicycle lockers and eLockers necessitates periodic checks to ensure that the lockers are being used properly and not as storage for miscellaneous items.

Bike Cages and Rooms

Another type of secure bicycle parking facility is the bicycle cage and room, which restricts access exclusively to people parking bicycles inside a secure designated area. Typically, bicycle cages and rooms are accessed with a key, keypad, or cardkey. To make efficient use of the space, secure bike cages often feature two-tiered racks, with the top rack having a mechanism to allow for easy loading. If theft occurs in bicycle cages, video monitoring can allow for identification of the perpetrator. Bicycle garages may be located as a separate facility contained within a station area or located within a parking structure. Bicycle parking rooms are best suited for stations with park-and-ride-type facilities and others outside a city center that have a larger footprint. As a part of the Orange Line, TriMet incorporated secure bicycle parking into two station areas, one enclosed within a parking structure and the other as a separate, controlled-access garage (Figure 7-6).

Figure 7-6 *TriMet bike-and-ride facilities with secure bicycle parking for nominal fee*

In Boston, the biggest crime on transit is bicycle theft. Using a Federal grant, Boston installed Pedal and Park secure bicycle parking cages at 14 Massachusetts Bay Transportation Authority (MBTA) transit stations, card-access facilities that have room for 50–150 bicycles, 6 security cameras, security lighting, and an intercom system connected to the police. The upcoming Green Line extension has Pedal and Park cages already included in the plan. (For more information, see http://www.bostonmagazine.com/news/blog/2013/04/12/mbta-pedal-and-park-cages/ and http://www.mbta.com/riding_the_t/bikes/Default.asp#bike_parking).

Bike Stations

The BART system has introduced six full-service bike stations that offer a variety of services, including valet parking, controlled-access parking, bicycle rentals, bicycle repairs, and classes and events. Valet parking is free during the day, and the cost of controlled-access parking is based on hourly usage, which is three cents per hour from 9:00 AM–6:00 PM AND ONE CENT PER HOUR AT OTHER TIMES.

Similarly, LA Metro has introduced a Bike Hub at El Monte Station at the end of the Silver Line (Figure 7-7). This facility offers secure bicycle parking 24/7, along with a variety of other services such as bicycle repair, rentals, and classes and events. Membership passes are available for 7 days, 30 days, or a full year. They plan to open additional Bike Hubs.

Figure 7-7
LA Metro El Monte Bike Hub

Non-Standard Bicycle Parking

Not all bicycles will fit on standard racks, including tandem bicycles, tricycles, recumbent bicycles, cargo bicycles, and bicycles with trailers. A few agencies have implemented more versatile racks that can accommodate these types of bicycles. Racks that are longer, lower to the ground, and provide more adjacent space can be more accommodating (Figure 7-8). The racks may be marked with a wheelchair marking to signify that they are for people with disabilities in some cases; however, no specific policies or regulations were identified related to who would be eligible to use such spaces or what type of device may be parked there. It would likely not make sense to require an official DMV disability permit, as doing so could dissuade users and enforcement would be difficult. Agencies may wish to provide some written and/or graphical explanation as to the intended or acceptable use of the spaces.

Figure 7-8

Non-standard bicycle parking at TriMet's SE Park Avenue light rail station

Determining Bicycle Parking Needs

Bicycle parking requirement assessments should consider current and induced demand (i.e., those who would use bicycle parking if it better met their needs), as well as future demand based on the current and planned bicycle network, bike sheds, and land use.

TCRP Report 153, Guidelines for Providing Access to Public Transportation Stations used recent data from transit agencies around the US to develop a Station Access Planning Tool. The spreadsheet model provides a research-based methodology for determining parking demand, including bicycle parking, at transit stations. Model inputs include type of transit, land use characteristics, station-area demographics, local bicycle commute mode share, and daily transit ridership. This tool was used by Lane Transit District for its *2013 Regional Bike Parking Study*.

The Puget Sound Regional Council (PSRC), the MPO for the Seattle region, created a methodology to estimate demand for bicycle use to transit and bicycle parking at stations (Krizek and Stonebraker, 2010). By looking at factors such as employment, number of transit trips, and localized bicycle commuting mode share, PSRC aimed to determine how many people bicycled to reach a transit station and how many parked their bicycles there or took their bicycles with them on transit. Such models are instructive in thinking about how to better plan for bicycle storage facilities, both now and in the future.

It is also critical to assess if existing bicycle parking options appropriately match the needs of transit riders. For example, the BART Bicycle Plan reported that a lack of sufficient bicycle parking was a primary obstacle to bicycling to BART, yet overall bicycle parking occupancy did not suggest a deficiency; however, an examination of bicycle parking by type revealed a mismatch—racks far from station gates were occupied at only 22%, whereas bicycle parking inside fare gates, in bike lockers, and in bike stations were occupied at much higher rates of 94%, 56%, and 31%, respectively. Overall, BART found that about 25% of cyclists who brought their bicycles onboard did so because of a lack of secure parking at their originating station.

Bicycle Parking Demand

BART's 2015 Bike Parking Capital Program recommended specific bicycle parking improvements at its 18 busiest stations in terms of bicycle access. Each station has a specific recommendation for the addition of secure bicycle parking facilities based on factors such as passenger demand and existing usage of secure facilities at each station. The four types of secure bicycle parking facilities recommended are 1) bicycle racks contained in station paid areas, 2) eLockers, 3) arc lockers, and 4) bike stations. The report also contains recommendations for removal of unsecure bicycle parking facilities or outdated facilities at some stations. In addition, the report contains individual station profiles that highlight detailed site plans for the incorporation of new bicycle parking facilities at each station. Ultimately, additional bicycle infrastructure will lead to more people bicycling. This induced demand was found at several BART stations where the addition of bike stations, bike lockers, and bicycle racks led to increases in bicycling to these stations (Cervero et al., 2013). Well-coordinated policies, pricing, infrastructure, and incentives can proactively encourage behavior change that increases bike/walk access to transit.

Other End-of-Trip Facilities

In some situations, end-of-trip facilities are provided at transit stations to improve the overall experience for bicyclists. These may include personal lockers (as opposed to bike lockers) and access to shower facilities. Typically, these facilities are accessed by subscribing to a service and may be contingent upon having a subscription to another service such as a bike locker, secure bicycle parking, or a bike station. For example, the Minnesota DOT's ABC Ramps facilities in Minneapolis (which combine automobile parking and transit hubs along with bicycle facilities) offer access to day lockers and showers for customers who already rent a bike locker. Access to these facilities is an additional $50 for customers who already have a 6- or 12-month bike locker contract (Figure 7-9) and covers the duration of their locker contract.

Figure 7-9

Locker and shower facilities at ABC Ramps, Minneapolis

SECTION

8

Bicycles on Transit Vehicles

Many people who use a bicycle to access transit prefer to keep their bicycle (Figure 8-1) with them for two reasons: first, it allows transit users to use their bicycle to complete a last mile connection to their destination, and second, bicyclists generally have security concerns about leaving their bicycle parked at a transit stop for several hours a day. Transit agencies are looking at creative ways to accommodate more bicycles on transit.

Figure 8-1

Bicyclists boarding Metro Expo Line train in Los Angeles

Criteria

Transit agencies should consider first whether it is feasible to allow bicycles on transit vehicles and, if so, how best to accommodate them. The Mineta Transportation Institute (MTI) report *Bicycling Access and Egress to Transit: Informing the Possibilities* examined whether transit users want to bring their bicycles aboard vehicles. From focus groups in five cities, MTI found that the majority of respondents preferred bringing their bicycle with them on a transit vehicle, with parking their bicycle at a transit station the second preferred option. Areas with more widely available secure parking were more likely to prefer parking their bicycle at the station. Other research that has incorporated bike share as a solution found similar results: respondents greatly preferred to bring their bicycles with them on transit, and parking a bicycle at the station and bike sharing were the next two preferred options (Krizek and Stonebraker, 2011).

Those who preferred bringing their bicycle on board a transit vehicle did so because they were most comfortable on their own bicycles, were concerned about leaving their bicycle at a transit station for a lengthy period of time, or enjoyed having the flexibility to change travel plans. There were several concerns with bringing bicycles on transit, however. A lack of space and needing to wait for longer periods of time and not knowing or having difficulty loading a bicycle onto a bus rack were the most common concerns.

Those who preferred bicycling to a transit station and leaving their bicycle there often did so due to the inconvenience of bringing bicycles on board transit vehicles, though they still expressed concerns was about leaving a bicycle unattended at a transit station for the majority of the day (see Section 7 for more on secure bike parking).

Determining the number of bicyclists that may access a stop or station is part of the challenge. One important factor for transit agencies to explore is to understand the surrounding land use and population profile around transit service areas. Within two miles of a stop or station, lower median household incomes, a younger population, and higher residential density more likely will lead to people bicycling to transit. Having bicycling facilities around transit is also a strong determinant for people to use a bicycle (Krizek and Stonebraker, 2010). Station areas with these characteristics should focus efforts on providing sufficient bicycle boarding and storage capacity.

Adding Bicycle Capacity in a Built-Out Rail System: BART, San Francisco

The Bay Area Rapid Transit (BART) system in the San Francisco region recently adopted a number of policies related to bicycles. BART led several bicycle inventories at stations across the system to see how many bicycles were being parked at stations during peak times by counting bicycles at stations during the spring on Tuesdays through Thursdays between 10:00 am and 2:00 pm. These inventories are not complicated; BART was simply getting a sense of where it was hitting or nearing peak capacities. Through survey data, BART also learned that about 25% of people who bicycle to stations park their bicycles at the station. A survey from 2008 found that 72% of bicyclists using transit took their bicycles with them, even though BART had more than 4,300 bicycle parking spots, of which more than 1,000 were secure bicycle lockers (Pucher and Buehler, 2009). With these data, the agency was able to produce an estimate of the number of bicycles coming to stations and being taken onto trains. It installed two horizontal bars along the inside wall of each train car where three bicycles can be stored at any given time (Figure 8-3). However, the agency acknowledges that its trains are crowded, and their preference is to get more people to park their bicycles at stations. BART is working to make bicycle parking more secure and attractive and also to help cyclists find room on train cars via a website that predicts which cars on specific trains will be less crowded for bicyclists to use and store their bicycles for the ride. Through observation and survey data, BART has been able to better understand how bicyclists are using their system, which will inform future policies.

Figure 8-2

BART's new train cars with three built-in bicycle racks
(Source: BART)

Adding Bicycle Capacity to a New Rail System: HART, Hawaii

Hawaii Area Rapid Transit (HART) is building an elevated rail system from downtown toward the airport and the community of Kapolei on the Hawaiian island of Oahu. HART is taking a multi-pronged approach of providing for secure parking at stations along with on-board bicycle accommodation, coordinating with bike share, and improving bicycle access to the stations.

HART is providing plaza space around each station to facilitate pedestrian and bicycle movement and bicycle storage that can meet future growth. Each station will have a minimum of 10 bicycle racks, but many will have more upon opening. HART is also pursuing secure bicycle parking facilities. There is a historic building in Honolulu's Chinatown district that the agency plans to refurbish into a bicycle locker and valet service. Bike valet service allows riders to leave their bicycle with someone at a staffed parking facility, sometimes combined with bike servicing opportunities (e.g., get a tune-up while your bike is parked). Because it can plan for bicycles now, this infrastructure can be ready ahead of demand.

The train design also will encourage bicycles aboard trains. Each train will have four cars, and each car will have four vertical bicycle hooks and roughly a dozen areas with seats that flip up to accommodate bicycles. The four-car trains will have open gangways; if a bicyclist boards a train and cannot find a place to store his/her bicycle in that train car, he/she can walk into a different train car.

In addition, Bikeshare Hawaii launched in Honolulu in 2016. HART has incorporated space for bike share racks near stations or inside the station or along the train platform to facilitate a seamless connection between bicycles and transit. Figure 8-4 shows the plans for incorporating bicycle parking into the construction of the new station.

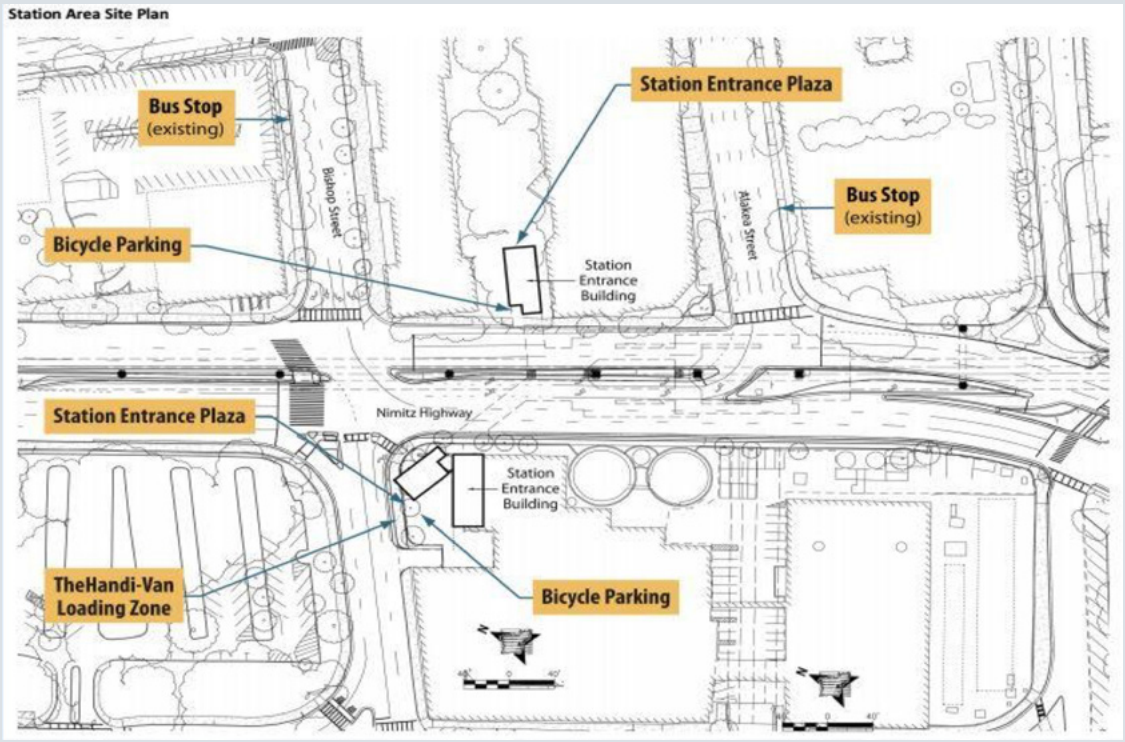


Figure 8-3 *HART's Honolulu high-capacity transit corridor project two bicycle parking locations for its Downtown station (Source: HART)*

HART in Honolulu mapped existing bicycle lanes, paths, and routes, along with sidewalk conditions within quarter and/or half mile buffers of each station. To improve access, proposed improvements to the network around the station were mapped (see Figure 8-4).

Figure 8-4 *Existing and proposed bike facilities around HART's Downtown station (Source: HART)*

Exterior Racks on Buses

A total of 60% of all transit trips taken in the US are by bus, and between 2000 and 2008, the percentage of buses equipped with bicycle racks rose from 27% to 71% (Pucher and Buehler, 2009). If a system is using bike racks, it is important that bike racks are consistently presented to create reliability for the traveler.

A standard practice is to put an exterior bicycle rack on the front of a bus instead of in the rear. Problems with rear-mounted bicycle racks include difficulty in servicing bus engines, inability to see the bike rack, and dirty bicycles from bus exhaust fumes (*TCRP Synthesis 62*). Exterior bicycle racks on the front of a bus avoid all these problems. Generally, bicycle racks on the front of a bus can store two or three bicycles. When the racks are empty, however, it can be difficult for a bus driver to judge whether the rack is up or down. Some transit agencies have added an indicator light to show when the bicycle rack is deployed.

To best accommodate bicycles, all buses in a transit agency's fleet should be equipped with exterior bicycle racks on the front of the bus that can hold a minimum of two bicycles (Figure 8-5). However, with only two spots on many buses, and up to three on others (Figure 8-6), these often fill up. Metro Transit in Minneapolis-St. Paul has approved a pilot program to put sensors on the bike racks at the front of buses along the A Line. If the pilot works, Metro Transit hopes to put these data online so bicyclists can see if racks on buses are available before the bus arrives.

Bicycles Inside Buses

BRT systems, oten identified through off-board fare payment systems, level boarding, and longer buses, have the ability for people to bring bicycles aboard. Lane Transit District (LTD) in Eugene, Oregon, allows bicycles to be brought on board its buses, which increases capacity for bicycles. Since Eugene is home to the University of Oregon, it is likely that the system would see higher rates of bicycle connections to transit than in other communities. It is easy to bring a bicycle directly onto the bus, and up to three bicycles can be stored onboard a bus at any given time. These buses do not have exterior bicycle racks.

Figure 8-5 *TriMet bus in Portland with front-loading bicycle rack for two bicycles*

Figure 8-6 *Metro Orange Line BRT bus in Los Angeles with front-loading bicycle rack for three bicycles*

Types of Interior Racks on Trains

In general, rail transit cars do not need complex design changes to accommodate bicycles on board (*TCRP Synthesis 62*). There are several different ways to accommodate bicycles, ranging from simple retrofits to specific bicycle infrastructure aboard the train. Common racks include horizontal bars and seats that flip up for storing a bicycle with both wheels on the ground and bicycle hooks for vertical storage (Figure 8-7). Many trains do not have any designated space for bicycles, leaving cyclists to stand with their bicycle.

Examples of Interior Racks

All BART trains have been retrofitted to accommodate bicycles. BART designates two spaces per train for bicycle storage with signage and a horizontal bar where 2–3 bicycles can be tied up during a trip. New train cars on order will have three compression mechanisms per train car that will hold a bicycle wheel in place while a train is moving. TriMet's newer train cars have four bicycle hooks—two at each end of a train car next to entrance areas. Bicycle hooks can be difficult to use, so TriMet recommends that cyclists bring their bicycle on board in an upright position to make the storage process easier. Below each hook is a small gauge that catches the bottom wheel of the bicycle and prevents the bicycle from swinging while the train moves.

Figure 8-7 *Bicycle storage on light rail in Minneapolis and Portland, consisting of upright hanging cleats adjacent to door*

If an agency is concerned about users being able to load a bicycle onto a hook, alternative measures such as horizontal bars or compression mechanisms are promising options to explore. A bicycle hook must be high enough that it can support bicycles of all lengths, but not so high that a typical user will struggle to secure his/her bicycle wheel onto a hook.

Commuter rail cars have a lot of potential for bicycle storage spaces. In the summer, some Massachusetts Bay Transportation Authority (MBTA) commuter trains run a special car with bicycle racks along one half of the train car (Figure 8-8).

Figure 8-8

MBTA commuter rail car with seating removed to create room for bicycles (Photo: MBTA)

The literature highlights an urgent need for transit agencies to do all they can to accommodate bicycles aboard transit vehicles. Nearly two-thirds of bicycle-transit users in Philadelphia and more than four-fifths of bicycle transit users in San Francisco wanted to have their bicycle to help reach their final destination (Flamm and Rivasplata, 2014). Agencies should better understand why people want to bring their bicycles with them and help accommodate them.

Streetcars

Streetcars often do not come with any sort of interior bicycle storage area, as the vehicles are much shorter in length than light or heavy rail vehicles. American streetcar systems typically cover distances that are easily accessible by bicycle.

Bicycle Boarding Policies

Agency rules determine when and where bicycles can go aboard transit vehicles. Although the majority of boarding rules relate to rail transit, there are some general rules that apply to bus transit vehicles as well. In general, transit agencies make bicycle boarding information publicly available online, at stations through written or audible messages, and aboard the vehicles themselves. Twitter, Facebook, and other social media platforms can be used to communicate bicycle policies.

Rail Transit

Although transit agencies often provide spaces for bicycles, many agencies will limit the number of bicycles that can be brought on board or where they can be stored once on board. Light rail vehicles generally are more accommodating for bicycles with designated storage spaces, and heavy rail service often will require bicyclists to stand with their bicycles (*TCRP Synthesis 62*). Figure 8-9 demonstrates one way that a Los Angeles Metro train accommodates bicycles on board.

Two transit agencies in the Bay Area have no bicycle boarding restrictions. BART is working on technology that will predict which train cars are less crowded, which will help bicyclists find a car in which to store their bicycle. Caltrain, a commuter train service in the Bay Area, often has lead cars that accommodate between 16 and 32 bicycles (Pucher and Buehler, 2009).

WMATA has restrictions that prohibit bicyclists from boarding with their bicycles during rush hour. All WMATA heavy rail vehicles have three boarding doors per car, and bicycles are prohibited from entering through the middle door of a train car during all hours of operation. Additionally, the MBTA does not allow bicycles aboard trains during rush hour.

Figure 8-9

Bicycle storage area on Metro subway car in Los Angeles

Bus Transit

Although most transit agencies do not allow bicycles on board buses, there are exceptions. These rules are often in place to prevent crowding, but some local bus services, for example Lane Transit District (LTD) in Eugene, Oregon, do allow bicycles on board (*TCRP Synthesis 62).*

On-Board Policies for Non-Traditional Bicycles

Some transit agencies have standards for non-traditional bicycles, such as cargo bicycles, adult tricycles, and tandem bicycles, among many other types. The project team reviewed 32 agency policies, of which 17 addressed non-traditional bicycles. Four agencies allow electric bicycles (E-bikes) as long as the battery compartment is sealed. Several agencies restrict motor-powered bicycles, which is different from an E-bike. Fewer still restricted users from bringing tandem bicycles, tricycles, recumbent bicycles, and cargo bicycles from being brought aboard transit.

Folding bicycles allow users to easily bring their bicycles aboard a bus or train and store the bicycle under their seat, as long as the transit agency allows folding bicycles. A total of 18 transit agencies were found to allow folding bicycles inside vehicles, generally as long as they were fully collapsed and stored under the seat of the transit passenger. Folding bicycles should not block aisles or take away seating from other transit users.

Figure 8-10

Passenger on LA Metro Gold Line with folding bicycle from CALSTART

Source: CALSTART

CALSTART Folding Bikes Program

In Los Angeles, the non-profit CALSTART partnered with FTA to promote a folding bicycle pilot program with the City of Pasadena (See Figure 8-10). When folded, these bicycles fit under a bus seat and are not intrusive into the space of other bus riders. Since Pasadena was just one of 88 jurisdictions within the Los Angeles County Metro service area, there were challenges in getting bus operators to accept these bicycles. However, more widespread use of folding bicycles could lead to broader acceptance for transit agencies and solve a major capacity issue. When CALSTART launched its folding bicycle program, the goal was to sell 500 subsidized folding bicycles to the community; within a year, they nearly met their target. CALSTART relied on newspaper advertising and word-of-mouth to reach their target audience, which were successful in spreading the word.

SECTION
9

Bike Share and Transit

Bike share can act as a means of extending the transit system out from the transit stop or station. To make it effective, bike share stations should be sited at key transit stops, with station networks that extend out to serve jobs, residences, and key neighborhood destinations (Figure 9-1). A recent study of the relationship between bike share and transit found that in areas of lower density, often outside city cores, bike share users are inclined to use the service to access transit, and in high-density cores, bike share may serve as an alternative to transit (Martin and Shaheen, 2014). In either situation, the two services play important roles vis-à-vis one another—the ability to access transit by using bike share can expand the reach of transit, and the ability to substitute transit trips with bike share (and vice versa) gives users options and redundancy that can be particularly useful in times of service outages, between scheduled service, and in varying weather conditions.

Figure 9-1

Santa Monica Breeze bike share and LRT station

Bike share has the potential to support increased transit ridership. A study of bike share trip origins and destinations in Washington, DC found several important connections between bike share and public transit use. First, the study found that the highest bike share ridership occurred at locations close to Metro stations. Second, the study estimated that a 10% increase in bike share trips would have a direct impact on transit ridership (leading to an increase of 2.8%) (Ma et al., 2015). Another case study details a Dutch rail system bicycle rental program designed to connect rail transit with bicycle trips to attract more train users by better serving their entire door-to-door trip. Surveys have found

that upwards of 10% of program participants shifted vehicle trips to train-bicycle combined trips; meanwhile, transit-bicycle users increased from 30% of riders to 50% of riders (Villwock-Witte and van Grol, 2015).

Guidance on coordinating bike share systems and stations with transit is currently limited. The Pedestrian and Bicyclist Information Center prepared *Bike Sharing in the United States: State of the Practice and Guide to Implementation* for FHWA. The guide covers basic considerations for planning and operating a bike share system. Although not focused on the connection to transit, the guide does discuss the role of bike share in enhancing the transit service area. NACTO's *Bike Share Station Siting Guide* touches on some consideration on siting bike share stations near transit, including the need to ensure that pedestrian access to and from transit stops and stations is not impeded.

Coordinating Bike Share and Transit

Bike share and transit should be coordinated, offering benefits to both the transit agency and the rider. For riders, bike share offers the opportunity to get to their end destination faster and to access more destinations. For transit agencies, bike share can help reduce the strain on their on-board capacity—if transit riders can use a bike share bicycle at their destination, they may be less likely to want to bring a bicycle on-board a bus or train, reducing the likelihood of exceeding the capacity of the system to handle on-board bicycles and opening up slots for other riders.

Placing bike share at stations can help signal to transit riders that a bicycle trip could be an effective means of completing their journey. In Charlotte, many transit stations now have B-Cycle bike share. As the system has proven to be successful, developments being constructed along the light rail lines have been purchasing bike share stations and including them in the new residential developments. In the Twin Cities, the Green Line LRT between Minneapolis and St. Paul opened in 2014 with Nice Ride bike share stations placed at each LRT stop (Figure 9-2), which helped convey the message that they were part of a unified transportation system.

Space often is limited, so there may not be enough space on station property to place all of the elements an agency would like. Many stations have not been designed to accommodate bike share; however, with some planning, these elements can remain accessible to passengers. In Fargo, all GreatRides bike share stations are within sight of a bus stop, if not on the same corner as the bus stop. Visibility is essential, and bike share riders need to know to what location they are riding.

Figure 9-2

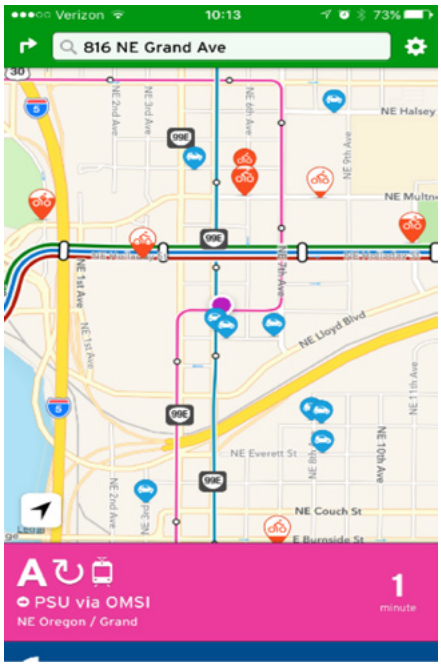
Bike share station sited across from LRT station in Minneapolis

Public Information

Public information coordination, including making sure that transit and bicycle maps, websites, and apps provide users with information about where connections can be made; agency messaging and these services should highlight the complementary nature of the services. Figure 9-3 is a screen shot of an app that integrates bike share and transit.

Figure 9-3

Transit App incorporates information on bike share availability and public transit arrivals



Recognizing the mutually-beneficial relationship between transit and bicycle in providing transportation options, Denver's transit agency (RTD) and Denver Bicycle arranged an advertising trade wherein RTD would advertise bike share

on buses and light rail and Denver B-cycle would place RTD ads on their bicycles (van Meter, 2012).

Fare Systems

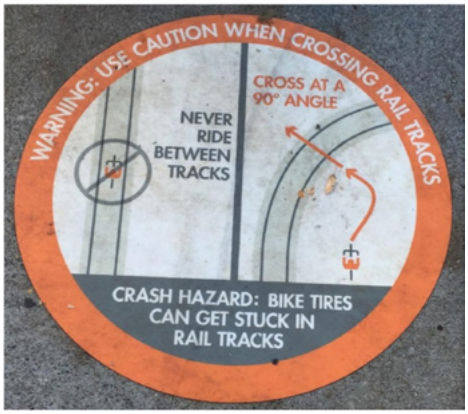
Fare system coordination can help people embrace the idea of making a transfer between transit and bike share and make the actual transfer smoother. This can include having a consistent fare system between two systems, having compatible payment technology, and integrating payments. There are various ways to work toward integrated and coordinated fares. Systems that use TAP (transit access pass) or related cards may be able to allow users to use their TAP cards for both transit and bike share. In Los Angeles, although the back-end payment systems of Metro Transit and Metro Bike Share are still managed separately (users must have separate accounts, and actual payments are separately processed), the TAP card can be used for either system. For systems that have app-enabled access or payment, an integrated app interface may be able to present a coordinated system.

Safety

Safety coordination is important for the interoperation of bike share and transit systems. Some bike share users may not be very experienced bicyclists. Efforts to educate both bike share users and transit operators should be considered. Bus drivers, in particular, may benefit from extra training on safely interacting with bike share riders (and other bicyclists). For more information on safety trainings, see Section 11, Implementation. Some bike share operators will include instructions, rules of the road, and special considerations for bicyclists on bike share kiosks or on stickers on the bicycles. Inexperienced bicyclists may be particularly prone to crashes related to streetcar tracks; a study found that non-regular bicyclists were over-represented among people who had crashed on streetcar tracks (Teschke et al., 2016). The City of Portland placed sidewalk decals (Figure 9-4) explaining how to interact with streetcar tracks at some bike share stops adjacent to streetcar lines; the decals explain that bicyclists should cross tracks at 90-degree angles and not ride inside the rails.

Figure 9-4

Sidewalk decal placed at selected bike share stations in Portland, OR



Data

Data coordination can be an important tool for understanding both transit riders and bike share users. Bike share data have the potential to provide useful information on what station pairings are being used to access transit adjacent bike share stations. Some systems that have incorporated on-bicycle GPS have the potential to provide more in-depth information on what routes they are bicycling on. This information has the potential to inform transit agencies and bike share operators on where riders are coming from and what the bike shed looks like for a given station and may provide insight into how to better serve riders through the placement of bike share stations or other means.

Accessible Bike Share

Many people cannot safely or comfortably ride a standard bicycle, and standard bike share bicycles may limit users in terms of their carrying capacity. Some bike share systems are exploring options to provide alternative cycling opportunities, including tricycles, hand cycles, side-by-side bicycles, cargo bicycles, and heavy-duty bicycles. Because these bicycles are non-standard, they may not fit into standard bike share docks. Some systems require users to reserve a bicycle and pick it up and drop it off at a specified central location, thus reducing its utility as a point-to-point service. For example, B-cycle offers a tricycle that is compatible with its docking stations and can be specified when looking for available bicycles on their website. Tricycles provide an option for people who may not be able to balance a standard bicycle and provide greater storage capacity. Madison B-cycle has added tricycles to its system, although the limited number of tricycles may reduce its utility. Portland's Biketown bike share system is launching an Adaptive Bicycle Pilot Project in Spring 2017; the service will provide adaptive bicycles (likely tricycles and hand cycles) to existing bicycle rental businesses locating near non-motorized trails. The decision to focus on trails and paths without automobiles was due to feedback received during outreach at several adaptive bicycling clinics or events. Zagster provides bike-sharing platforms to a number of universities and smaller cities and offers up to six different accessible bicycles, including a hand cycle, side-by-side tandem, heavy-duty cruiser, standard tricycle, recumbent tricycle, and cargo tricycle. Offerings vary by system. The College Park, Maryland system offers side-by-side bicycles, tricycles, and hand cycles. The Carmel, Indiana, system offers tricycles. The Ohio State University system offers five of the six available types.

SECTION
10

Planning for Pedestrian and Bicycle Access to Transit

Planning for safe, convenient, and appealing pedestrian and bicycle connections to transit is both essential and challenging. Often, multiple agencies and jurisdictions are involved that must work together to create a seamless connected experience for the end-user. A pedestrian might begin a trip on a local road with a privately-maintained sidewalk and cross a county road before arriving at a bus stop maintained by a transit agency. A bicyclist may ride on a local street to a trail maintained by a city parks department before arriving at a rail station owned by a transit agency. Planning efforts need to take all these players into account to be successful. A key element of most planning processes is that they start with engaging the public and stakeholders to help identify vision and priorities for the transportation network.

FHWA's *Transportation Planning Process Briefing Book* (2015) provides an overview of the transportation planning process, including required planning at the state and regional level. The needs of pedestrians and bicyclists, including access to transit, should be considered in these planning processes. In some cases, agencies may also wish to undertake a separate, but complementary, planning effort focused on pedestrian and/or bicycle access to transit. The following section details general considerations for these planning efforts.

Why Plan?

Identify roles and goals: The planning process can help agencies articulate and share their vision for what roles various entities play in the connections between walking, bicycling, and transit and what the goals for the agency and overall system should be. This process is useful for the agency engaged in the planning effort to identify its understanding and objectives both internally (making sure that leadership and staff are working toward a common goal) and externally (to communicate with other agencies and with the public).

Identify needs and prioritize projects: Plans can help agencies identify unsafe and uncomfortable gaps in the pedestrian and bicycle network that prevent people from getting to transit or from getting where they need to go from transit. Other types of needs may include station-area improvements, bicycle parking, boarding and alighting needs, and on-board facilities. Plans may also explore the need for transit routing, scheduling improvements, or

information-sharing to better serve pedestrians and cyclists. Improvements to address the needs should be identified.

Establish policy: Planning processes can help agencies articulate and establish policies around pedestrian and bicycle access to transit. Agency staff can look to existing and adopted plans for guidance on expressed agency policies when carrying out their jobs. This might include requirements to provide a certain level of access or consider pedestrians and cyclists when planning new infrastructure, updates, or programs.

Support funding efforts: An existing plan is an indication that an issue or problem has been considered and that the agency has thoughtfully established a desired path forward. Having an existing list of desired improvements or projects articulated in a plan prepares agencies to quickly move to pursue funding opportunities when they arise.

Develop partnerships: Planning processes allow staff to develop relationships across agencies. Whether through formalized processes such as steering or advisory committees or through informal communication around planning goals, the planning process offers an opportunity for staff to develop relationships and understanding of other agencies challenges and needs. These partnerships may help uncover specific plan goal or projects and can serve to be invaluable once the plan is complete and implementation efforts are underway.

Who Plans?

Different entities can be involved in planning for pedestrian and bicycle connections to transit. Transit agencies are the most obvious since they operate transit lines and systems. However, their jurisdiction usually ends outside the transit vehicle or station. Thus, states, cities, counties and other municipalities with jurisdiction over the streets, sidewalks, and trails to which pedestrians and bicyclists might want to connect should also be considering connections between walking and bicycling routes and transit. As the arbiters of the long-range regional transportation planning and project selection processes, Regional Planning Agencies (RPAs) are well-positioned to take a more detailed look at planning needs pertaining to bicycle networks and overall systemic approaches. Since RPA (and statewide) transportation plans must be multimodal, these agencies will already be engaged in pedestrian and bicycle planning at that level; local agencies may do their own planning, but they should be integrating with the regional and state planning efforts. Furthermore, RPA boundaries are often more reflective of multi-jurisdictional transit service areas.

Common Plan Elements

Different plans relating to improving the connection between walking, bicycling, and transit tend to share some comment elements. Common plan elements across the various types of plans include:

- Identifying existing conditions, including current transit stops and stations, current and potential ridership, pedestrian and bicycle amenities at the stop location, walking and bicycling desire lines, and access to the station such as existence of safe, convenient, and comfortable crossings, sidewalks, and bicycle routes. Often, existing conditions reports will use walk and bike shed concepts to define the study area. Presenting opportunities and constraints can also be an effective means of conveying existing conditions.
- Providing a toolkit of treatments or approaches can be an effective way of educating agency staff, leadership, and the public on the tools available to improve walking and bicycling connections to transit and establish best practices. Toolkits may be grouped by user groups (pedestrians, bicycles, aging and disability communities), by location (immediate stop or station location, adjacent crossings and sidewalks, or access routes and connections within the walk or bike shed), or by a combination of these groupings.
- Recommended improvements, often drawn from the plan's toolkit of best practices, establish a goal and plan for how to make getting to transit safer, more convenient, and more comfortable.

Other plan elements may be recommended or possibly required for certain federally-regulated plans. These include:

- Addressing how the plan will promote transit accessibility for youth and members of the aging and/or disability community who wish to walk or bicycle to stops or stations.
- Articulating an ongoing plan to achieve community engagement around improving walking and bicycling connections to transit. This can include both receiving input and working with the community to identify solutions, and making sure that communication remains open with the community throughout plan implementation.
- "Big picture" funding options and opportunities, such ballot initiatives or other regional funding, along with specific project or corridor funding opportunities.

A key element in the utility of plans pertaining to walking and bicycling connections to transit (and other plans) is whether they are implemented. For this reason, plans should specify how improvements will be implemented, including how projects will be prioritized, what are available and proposed

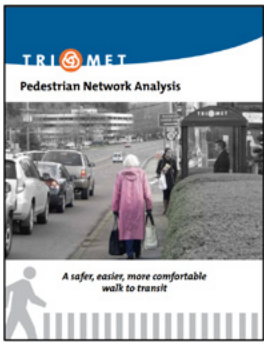
funding mechanisms, who will carry out the projects, and how implementation will be tracked and monitored.

Types of Plans

This section details a number of different types of plans pertaining to pedestrian and bicycle connections to transit. Although these different types are broken out, plans may be cross-cutting or include various aspects of these types. For each type of plan, one or two example plans to which agencies can look are provided.

Pedestrian access plans focus on improving pedestrian access to transit stops through a process of identifying specific or general areas of need, identifying a toolkit of best practices and solutions, and proposing improvements to address the needs. They often focus on sidewalks, crossings, and transit stop factors that are likely to affect pedestrians, such as access points/locations, seating, shelter, and lighting.

The Santa Clara Valley Transportation Authority's *Pedestrian Access to Transit Plan* (2016/2017) is under development and will "focus on walking access to bus stops and train stations in Santa Clara County." The *Existing Conditions Report* (2014) discusses concepts of walkability and applies them to Santa Clara County, summarizes known information about the local rates and the safety of walking and existing transit services, and establishes evaluation methods for assessing walking to transit needs. In doing this, the "VTA seeks to identify planned projects that are a high priority for transit access, and conduct focused field work at locations that are important to study, but have not yet been addressed in prior planning efforts. The outcomes will include a list of pedestrian projects for which VTA, the Cities, and the County can seek funding" (p43). The *Draft Project List* (2016) details the known toolkit of pedestrian improvement measures and then details known issues and opportunities for improvement in eleven different geographic focus areas, typically specific neighborhoods or corridors.



TriMet conducted a *Pedestrian Network Analysis* to develop "an objective, data-driven system for prioritizing places around the region where pedestrian infrastructure investments will provide safer and more comfortable access to transit." The project's report (2011) includes sections on why transit stops should be walkable and accessible (Chapter 1), developing a methodology for identifying priority areas based on community environment, stop locations and nearby attractors, deficiencies, and opportunities (Chapter 2), and conducting detailed analyses of ten areas identified as focus areas (Chapter 3). The report concludes with a toolkit of strategies and treatments (Chapter 4) and policies (Chapter 5) to improve make walking to transit safer, easier and more comfortable.

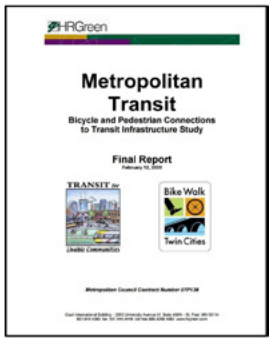
Bicycle access plans focus on improving access to transit stops for bicyclists. Major areas of focus include bicycle parking at stops locations, onboard accommodations for bicycles, and having first/last mile bicycle network connections that allow people to ride to and from transit safely and comfortably.

BART's *Bicycle Plan: Modeling Access to Transit* (2012) is an example of a bicycle access plan focused on access to rail stations. The plan sought to plan out a means to "retool its stations and approach to access planning to attract thousands more bicycles than cars to the system each day," which benefits the system by reducing the need to build costly auto parking, bolsters ridership, and encourages public and environmental health. The plan presents available quantitative and qualitative data on existing conditions for people using bicycles to access BART, looking at bicycle parking, onboard access, getting bicycles through stations (including through fare gates and up/down stairs), communication around bicycle-related information, automobile parking and its influence on bicycle access to stations, and improving first/last mile connections by addressing gaps in bicycle paths and lanes (Chapter 2). Chapter 3 outlines goals and strategies to improve the connection to transit for cyclists, with a primary focus on the goal of doubling the share of BART passengers who access stations by bicycle by 2022. The 20 strategies deemed to be most effective in encouraging more bicycling to BART stations are discussed in Chapter 5. Of note is a *Bicycle Investment Tool* outlined in Chapter 4 of the Bicycle Plan that is designed to help commuter rail operators to identify the expected effect of bicycle related investments.

TriMet released the *TriMet Bike Plan* (2016) that covers access to both rail and bus transit. The plan outlines goals of identifying priority areas for access improvements, increasing desirable bicycle parking at stops and stations, supporting onboard access and communication of policies, and encouraging safe interactions between bicyclists and buses. The plan identifies 17 bicycle access priority focus areas, including proposed projects and other actions to support improved bicycle access, and 11 bicycle parking priority areas and projects. The plan also outlines a set of recommended program and policy action in each of six topical focus areas: Transit/Bike Interaction, Bike Parking, Bike Share Integration, Bikeway Access, Onboard Storage, and Monitoring Progress.

Also see SEPTA *Cycle-Transit Plan* (2015); Miami-Dade MPO *Transit System Bicycle Master Plan for Miami-Dade County* (2014).

Pedestrian and bicycle access plans incorporate both pedestrian and bicycle access to transit. They cover areas of importance to both pedestrians and bicyclists.



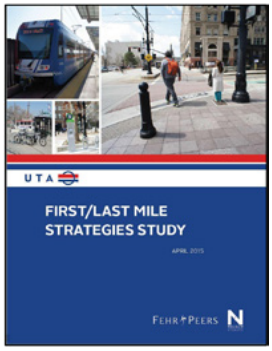
The Minneapolis-St Paul Area Metro Council *Bicycle and Pedestrian Connections to Transit Infrastructure Study* (2009) was tasked with identifying infrastructure improvements for connections for walking and bicycling to transit. The report states that a primary purpose is for communities to use the list of improvements to apply for funding to complete the projects. The study starts with a toolkit of improvements in three categories, including legal access (ADA curb access for transit and pedestrian curb cuts and ramps), safety (bike lanes, crossing treatments such as crosswalks, pedestrian hybrid beacons, and median/refuge islands, sidewalks, lighting, etc.), and facilities (benches, bike lockers, shelters, etc.). The project identification section of the study then suggests a set of options from the menu of improvements that would be appropriate improvements for each of a number of corridors or other locations.

The SANBAG plan *Improvement to Transit Access for Cyclists and Pedestrians* (2012) focuses on walking and bicycling access to transit for six Metrolink commuter rail stations and four BRT stations. The plan provides detailed existing conditions and recommended improvement for each station area. The plan also includes a toolkit of best practices relating to sidewalks, intersections, traffic calming, bicycle facilities, and transit stops and station design (Chapter 2), and detailed review of federal, state, and local funding and implementation options. Also see King County *Non-Motorized Connectivity Study* (2014).

The City of Richmond's *Bicycle and Pedestrian Network Improvement Study* (2017) was an FHWA-funded planning process that sought to recommend pedestrian and bicycle access improvements associated the planned construction of 7.6-mile, $24.9-million BRT project call The Pulse.

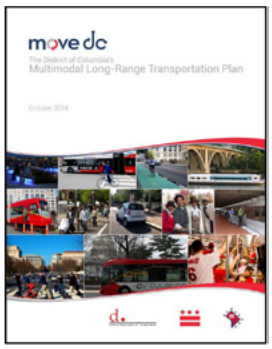
First/last mile plans focus on completing transit trips for passengers by examining how they get from their origin to the stop or station where they board transit and how they get from the final stop to their final destination. These plans would include pedestrian and bicycle access, along with other modes, such as park-and-ride, ride-hailing, etc. First/last mile plans generally start with a recognition that transit ridership depends on people being able to access it; improving conditions for pedestrians and cyclists in the areas around the origin and destination stops can extend the effective reach of the transit system and thereby increase the potential ridership base.

Metro and the Southern California Association of Governments (SCAG) *First Last Mile Strategic Plan* (2014) establishes an approach to guide LA Metro, LA County, cities, and other groups to improve first/last mile connections to transit. A core element of the plan is the concept of the "Pathway," which is defined as "a proposed county-wide, transit access network designed to reduce the distance and time it takes people to travel from their origins to stations and from stations to destinations, while simultaneously improving the user experience" (p13). The concept is a way of articulating a bundle of transportation options and improvements, with a focus on extending transit reach and reducing travel times by incorporating walking and bicycling improvements. Guiding principles of the pathway are that it is safe, intuitive, universally accessible, efficient, and fun. Chapter 5 of the plan provides a toolbox of Pathway concepts designed to extend the reach of transit, while Chapter 6 applies the toolbox concepts to a set of case studies.



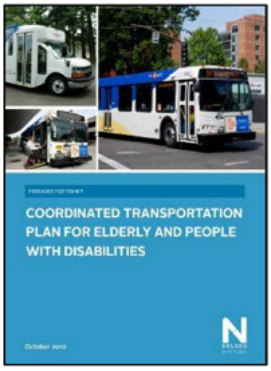
The Utah Transportation Authority (UTA) *First/Last Mile Strategies Study* (2015) notes that "a first or last mile gap is a barrier that discourages potential riders from using transit because a station cannot be easily accessed from home, work, or other destinations," and that "improving access starts with creating urban environments with cohesive pedestrian and bicycle networks that are inviting and safe, with multiple transportation options available including shared transport systems, and with a comprehensive transit system" (p1-1). The study includes an assessment of existing station area connectivity, details separate toolboxes of improvement approaches for different category types including pedestrians, bicycles, and demand management, and outlines strategies by peer agencies. The report also details first/last mile approaches by a set of station typologies, which consist of urban, multi-modal, institutional, suburban non-residential, suburban, and auto-dependent.

Safe Routes to Transit (SR2T) plans are similar to pedestrian and bicycle access plans; however, they have a particular focus on safety. SR2T plans and programs are also branded to elicit the relatively successful marketing of Safe Routes to School (SRTS) programs. The Solano Transportation Authority (STA) *Safe Routes to Transit Plan* (2011) states that is purpose is to generate increased transit ridership by identifying specific strategies that improve transit center access and pedestrian and bicyclist safety," with an ultimate goal of providing adequate detail and justification for STA and its member agencies to pursue funding that can be used to implement projects and programs." The plan includes an analysis of pedestrian and bicycle collisions, crimes, walking audits, and site reviews of walk shed areas of 0.5 and 1 miles around five priority Transit Facilities of Regional Significance. Improvement strategies were ranked according to their effectiveness in closing gaps, improving access for pedestrians, bicycles and people with disabilities, improving safety and improving convenience.



Multi-modal plans focus on the interdependence of a variety of modes in creating an effective and accessible transportation system. Although not specifically focused on the connections between walking, bicycling, and transit, they acknowledge the importance of the connection. The District Department of Transportation (DDOT) *move dc* Plan (2014) lays out an overall vision for Washington, DC that "is intended to be a starting point for coordinated transportation investments for the District in the next 25 years" (p99). The plan contains separate modal elements for pedestrians, bicycles, and transit. The pedestrian and bicycle elements recommend prioritizing walking and bicycling improvements that improve access to transit, and the bicycle element points out that "Safe and convenient bicycle routes can relieve overcrowding on peak transit lines in peak hours in addition to extending the reach and efficiencies of those systems" (pB-1).

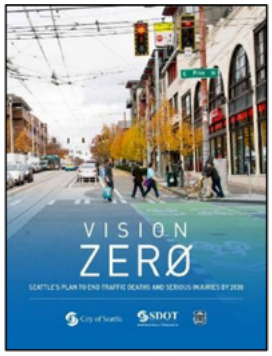
Bicycle and pedestrian access to transit in a rural setting – the Cape Cod Commission (CCC) is the "regional land use planning and regulatory agency created in 1990 to serve the citizens and 15 towns that comprise Barnstable County, Massachusetts." In 2013, the CCC released *Closing the Gaps: Connecting Cape Cod's Bicycle and Pedestrian Network to Transit Routes*, which assesses the connectivity of existing walking, bicycling and transit networks on Cape Cod, identifies gaps and potential connector project, and provides a simple priority analysis of projects.



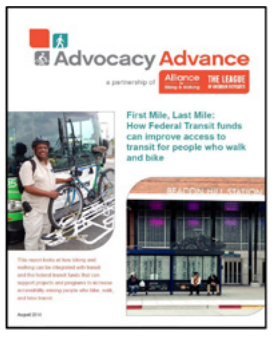
Accessibility planning. Although few plans specific to improving accessibility to transit for people with disabilities were identified, nearly all transit agencies have accessibility info pertaining to their systems posted on their website. The US. Access Board's *Proposed Guidelines for Pedestrian Facilities in the Public Right-of-Way* (PROWAG, 2011) is an important set of guidelines for designing streets and sidewalks in accordance with the ADA. TriMet released a *Coordinated Transportation Plan for Elderly and People with Disabilities* (2012). A key strategic initiative of the plan is to encourage the use of fixed-route transit, an important element of which are bus stop improvements to ensure they are accessible to older adults and people with disabilities; suggested steps include "adding benches or seats, providing real-time scheduling information, ensuring that the path of travel to the bus stop can be navigated by persons with disabilities, ensuring the bus stop platform can accommodate persons in wheelchairs, and making sure shelters are transparent to promote personal security" (p5-2). Another key strategic initiative is to enhance pedestrian access by encouraging jurisdictions to make their communities more pedestrian friendly. The World Bank's *Bus Rapid Transit Accessibility Guidelines* (2007) focus on considerations and improvements to make the BRT environment accessible for all users. AARP's *Achieving Transit Access: An Action Plan* (2011) "presents a step by step process that any group can use to negotiate with transit agencies to achieve ADA compliance."

Station area plans may arise when an infrastructure project is planned, such as a new rail line or station update. Station area plans may offer the opportunity to consider how to best allocate infrastructure investments, and how to align station access with existing and planned bicycle and pedestrian networks. Hennepin County's Southwest Light Rail Transit Bicycle Facility Assessment *Technical Memorandum #1, Existing Conditions, and Technical Memorandum #2, Recommendations*, assessed existing bike sheds around proposed LRT stations, and provide recommendations for bicycle parking around stations, for network improvements, and for addressing potential bicycle and pedestrian conflicts in the stations areas.

Transit-oriented development (TOD) plans can explore ways to harness the power of TOD and dense land use around transit stations to create a larger number of origins and destinations within walking and bicycling distance of transit, and to explore design approaches to facilitate walking and bicycling to transit. The City of Denver's *Transit Oriented Denver* (2014) presents a typology of TOD station area characteristics, including those for downtown, urban center, general urban, urban, and suburban station types. Street and block patterns, along with mobility options and appropriate/necessary bicycle and pedestrian infrastructure to access stations for each type, are presented. The document also uses walk sheds around rail stations to identify TOD market readiness. Also see GCRTA's webpage on *TOD Best Practices* and the Center for Transit-Oriented Development's *Oriented Toward Equity: A Rating System for Equitable Transit-Oriented Development* (2015).



Vision Zero goals and plans are focused on the goal of eliminating traffic deaths. Although they are not directly focused on improving connections between transit and walking or bicycling, they are connected because bicyclists and pedestrians, many of whom may be seeking to access transit, are overrepresented in traffic fatalities. The plans are premised on the notion that traffic deaths and injuries are preventable with better design and user behavior. Seattle's *Vision Zero Plan* (2015) has sections focused on transit safety improvements and improving crosswalk policies to better serve transit access locations.



Funding – The Advocacy Advance *First Mile, Last Mile* Report (2014) is focused on how federal transit funds can improve access to transit for pedestrians and bicyclists. The report is broken down into two primary sections, the first focusing on improvements that can improve the integration of walking and bicycling with transit and the second on funding programs and policies that can be used to implement these improvements.

General Planning Guidance – FHWA maintains a web page (*www.fhwa.dot.gov/planning/processes/pedestrian_bicycle/publications/*) that contains a number of helpful resources for planning related to pedestrian and bicycle programs.

The following FHWA resources provide some general guidance on bicycle and pedestrian transportation planning, or transportation planning more broadly:

- *Bicycle and Pedestrian Transportation Planning Guidance* (2003)
- *Statewide Pedestrian and Bicycle Planning Handbook* (2014)
- *Metropolitan Pedestrian and Bicycle Planning Handbook* (2017)
- *Transportation Planning Process Briefing Book* (2015)

SECTION
11

Implementation

There are many challenges to implementing a complete system of pedestrian and bicycle connections to transit. Different agencies and jurisdictions have to collaborate to ensure that the experience of making the connection is a smooth one for the transit user, funding often must be put together from a variety of sources, and information conveyed to the user has to be timely—only a few of the factors that need to be considered. This section outlines some key considerations for implementing connected walking, bicycling, and transit systems at every step of the process, from framing city or agency policies at the beginning to data collection after the project has been completed. Throughout the steps of the implementation process discussed in this section, ongoing public involvement and engagement remains vital, particularly at planning and decision-making junctures.

Setting Agency Priorities and Culture

Success in promoting walking and bicycling connections to transit starts with the culture within the transit agency itself, including the goals and values it develops, the investments it makes, and the priorities it sets.

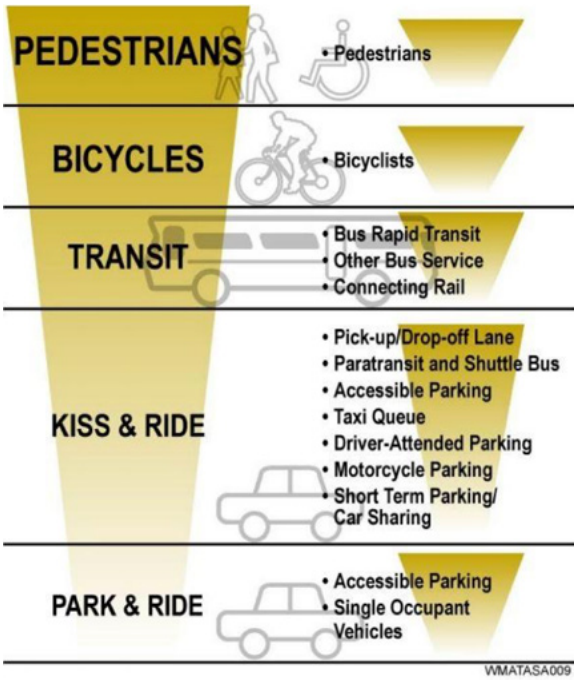


Figure 11-1

WMATA Transit Access Mode Hierarchy

Prioritize Walking and Bicycling for Transit Access

Walking is the foundational element of all transit systems and the dominant way in which users access transit. Bicycling is a companion mode that shares the environmental and health benefits of walking and offers an opportunity to expand the reach of transit systems in a low-impact and minimally resource-intensive way. These and other active transportation modes, along with ensuring accessibility for older adults and persons with disabilities, should be prioritized in considering access modes to transit. WMATA's Transit Access Mode Hierarchy (Figure 11-1) demonstrates this prioritization.

Clarify Agency Policies and Staff Responsibility for Walking and Bicycling

Agencies should make sure walking and bicycling priorities included in agency policy and that staff have capacity to address these issues. When possible,

agencies should look to dedicate staff to these issues, including making sure that there is someone responsible for overseeing implementation of pedestrian- and bicycle-specific action items. Further, the agency should ensure that other staff consider pedestrian and bicycling needs in other aspects of agency operations and planning as a standard practice.

Walk- and Bicycle-Friendly Training

Agencies should consider training staff, including transit operators, station planners and managers, and those working in real estate and in other areas, on ways that recognize and respect walking and bicycling as complementary modes to transit. Training should include content that promote awareness of and the ability to communicate agency policy on these topics. Transit operator training should help drivers be proactive in supporting walking and bicycling safety and comfort. For example, Metro Transit in the Minneapolis-St. Paul area ran a "Look and See" campaign geared at helping bus operators to always be aware of their blind spots, alert for pedestrians and bicyclists, and cognizant of the vulnerability of these road users in any potential interaction with a bus. The San Francisco Municipal Transportation Agency (SFMTA) and the San Francisco Bicycle Coalition put together a training video for bus operators on how to safely interact with people on bikes. The video is regularly shown to SFMTA Muni drivers (available at *https://www.youtube.com/watch?v=fv-6DmdYLfY*).

In addition to education and training campaigns specifically targeted to walking and bicycling safety, these topics should be integrated into existing defensive driving training for bus operators.

Related to training, agencies should explore programming to provide personal exposure for all employees to walking and bicycling to increase awareness of things that effect and matter to pedestrians and bicyclists.

Leading by Example

Agencies should consider ways to support staff who want to including walking and bicycling in their commute to work or for conducting work-related travel, such as providing quality bicycle parking and shower facilities, offering healthcare cost incentives for active transportation, helping with trip planning, and more.

Celebrate Accomplishments

Agencies can hold grand openings for walk and bicycle improvements to transit and use them to highlight existing elements in the system that can serve pedestrians and bicyclists.

Making the Connection between Walking and Bicycling Access and Transit Service

The neighborhood around a transit station might be conducive to walking and bicycling, and the station facilities might be optimal, but if transit users have to wait exceedingly long for a bus or train, they likely will not bother to make the connection.

Service Frequency and Reliability

A key factor in connecting walking and bicycling to transit is that transit service needs to be reliable and frequent enough that users are willing to use the service. In spite of good connections to a transit stop or station and high-quality amenities, lack of frequent service will deter many people from using the service despite the quality infrastructure.

Public Information

Closely related to reliable service is the need to communicate to users when the next bus or train will arrive. Frequent service is important, but if users are able to know when the next bus will be arriving and plan their trip around making that connection, they often can make the connection work. Real-time information about delays and outages also needs to be conveyed. If construction will affect the ability to walk or bicycle to or from a station, that information should be posted at the station and on routes approaching to the station.

Agencies should also consider user experience on the way to the stop or station. If service is out at a station, it is important to inform pedestrians and bicyclists at strategic points on their route to the station, particularly if the information might help them to reroute to an alternative stop or station.

Wayfinding to a station and useful bicycle and pedestrian maps at the station are helpful. Vicinity maps should show nearby pedestrian and bicycling routes, crossings, and destinations.

The needs of pedestrians and bicyclists also need to be considered as a transit agency develops public materials such as including schedules and system maps and on technology platforms such as apps and websites.

Make Active Transportation Visible

Bicycle facilities located in high-visibility areas near transit can inform people that bicycling is a way to connect to transit. Bicycle racks and lockers located near station entrances or inside stations will be seen by many transit users. In

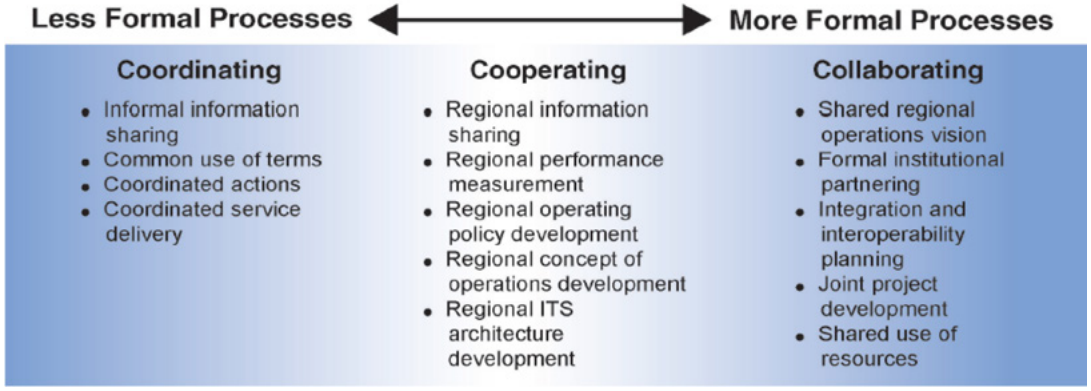
Los Angeles, Metro operates the El Monte Bike Hub, a bicycle storage and full-service facility located adjacent to the large El Monte bus station.

Collaboration, Cooperation, Coordination

Community groups, cities, transit agencies, counties, and RPAs need to work together to develop a connected network of walking, bicycling, and transit modes. Transit services, connecting streets, sidewalks, trails, and other walking or bicycling facilities are almost always dispersed across a number of different agencies and municipalities. No one agency has control of all aspects of the walking, bicycling, and transit connection. Identifying network gaps, planning for new facilities, connecting routes to transit, applying for funding, and implementing projects are steps that need to be coordinated. Thus, there need to be avenues of communication among agencies as well as models of collaboration, cooperation, and coordination upon which to draw. There is no specific blueprint to be followed, and different approaches may work better in different places. However, there are some models that represent ways that collaboration can occur successfully (Figure 11-2).

Figure 11-2

Coordination, cooperation, and collaboration



Source: FHWA, Regional Transportation Operations Collaboration and Coordination

Formal Collaboration

Formal collaboration models take a variety of forms. Every metropolitan region, transit agency, and city is organized differently, and conversations with city, county, transit, and RPA officials from across the US showed that each agency approaches collaboration differently. However, there are some common themes.

RPAs and Transit Agencies

RPAs and transit agencies are often tasked with bringing many different parties together and kicking off the collaboration among groups. Transit infrastructure crosses jurisdictional lines, which provides RPAs and transit agencies with an

opportunity to convene all parties for collaboration. Bicycle and pedestrian infrastructure also is increasingly seen through a regional network lens, so these regional government bodies can be leaders in fostering safe and accessible bicycle and pedestrian connections to existing and future transit service.

The MPOs in Atlanta and Los Angeles work to educate cities on the importance of quality and pedestrian infrastructure and inspire cities to pursue new policies. The Atlanta Regional Commission (ARC) collaborates by providing technical assistance to cities and participates on a regional transit committee. The Southern California Association of Governments (SCAG) helps train city leaders, legislators, and businesses on ways to improve bicycle and pedestrian access and offers toolkits to other groups that reach this same goal.

Metro in Los Angeles has grant-making authority and works with cities to help finance shovel-ready projects. With 88 jurisdictions inside Los Angeles County, Metro's service area, relationships around bicycle and pedestrian infrastructure vary from strong to minimal involvement. As a result, Metro's collaboration work spans from funding projects to providing education and expertise. Many cities do not have the staff or time to conduct bicycle and pedestrian planning work, so Metro provides that help in some instances. The MBTA in Boston has many cities in its service area, and the amount of regular contact it has with each varies, which is generally related to the amount of rail and bus service that the MBTA provides. The MBTA is always looking to build and improve relationships as resources and time allows and has a strong relationship with MassDOT to coordinate work at the state-level.

Cities

There are many different kinds of structures at the city level and outside of it. Atlanta's transportation department is a government entity, but all other transportation players are not tied directly to city government. The Atlanta BeltLine is a ring trail network currently under construction that is managed by Atlanta Beltline, Inc., an independent agency outside of government. Atlanta BeltLine, Inc. is also constructing a streetcar line running parallel to the entire trail, which it will turn it over to Atlanta Streetcar upon completion to operate. Similar to Atlanta, Honolulu created a semi-autonomous agency to manage the construction and operation of rail service. The Honolulu Authority for Rapid Transportation (HART) has spent time building relationships with groups, from grassroots citizens to the RPA, and works closely with all groups at its monthly partners meeting. When Denver was rebuilding its central Union Station, all partners, including the City, took time to sort out individual roles for each agency before moving forward with planning, design, and execution.

Cities and transit agencies often need to collaborate in and around station areas. Although transit agencies have jurisdiction over a station area, the

surrounding street and sidewalk network is managed by other jurisdictions such as cities, counties, or states. Bus and rail routes will often cross several jurisdictions (*FHWA Pedestrian Safety Guide for Transit Agencies*). Any pedestrian and bicycle improvements that a transit agency may seek should be made with these partners (*TCRP Report 153*). Other factors, such as road speed limits and infrastructure maintenance, also fall outside a transit agency's control (*FHWA Pedestrian Safety Guide for Transit Agencies*). However, station area access improvements, such as bicycle parking, are often a transit agency's responsibility, depending on how close it is to a station. Cities and transit agencies can work to incorporate TOD planning and bicycle and pedestrian access planning into the beginning of any expansion project, so these improvements can be set when all partners are at the table (*TCRP Report 153*).

Collaboration Logistics

For these collaboration models to effectively address pedestrian and bicycle connections to transit, cities and transit agencies should meet on a regular basis, and regional, state, and neighborhood groups should also be brought into these meetings. Transit agencies can establish pedestrian and bicycle task forces that discuss access and safety issues with connections to transit. It is especially important to ensure that local residents are involved, as they are the ones that will use these facilities every day, and their input on how to make safer and more convenient connections is invaluable.

Discussions and plans for bicycle and pedestrian infrastructure around transit are best addressed together because these modes have traditionally been ignored in the planning process. Promoting these two modes together ensures that neither mode is left out in the future. However, it is important to recognize that different strategies need to be used when planning for bicycle and pedestrian connections. The access sheds for the two modes—traditionally considered to be one-half mile for pedestrians and three miles for bicyclists—necessitate different planning approaches.

Informal Coordination

Formal collaboration models can lead to informal coordination outside of projects. Discussions about projects and issues outside of these normal channels can build stronger relationships on future work. In Los Angeles, Metro recognizes that roles among similar parties will often change when a new project comes up, so having a strong relationship with all parties, even outside of formal channels, is beneficial.

Sometimes informal work can lead to more formal relationships. Persistence can be one method to becoming part of a more formal collaboration process. In Minneapolis, Hennepin County wanted to have a voice on bicycle and pedestrian issues with Metro Transit. The County attended meetings without being a part

of the committee and, over time, it became a familiar and reliable face to Metro Transit. In turn, Metro Transit relied on Hennepin County to help advance transit projects.

Road safety assessments are one example of an informal activity that can bring together various agencies (and the public) around pedestrian and bicycle safety, while building relationships.

Role of Advocates and Community Groups

Community behavior can lead to unanticipated coordination as well. In Fargo, Great Rides Bike Share operates only in North Dakota, but anecdotal observations noted that people are riding the bicycles to Moorhead, Minnesota. As a result, Great Rides has opened a dialogue with its neighbors across the border. When users are able to articulate needs and point to trends, governments are better able to collaborate to meet these needs.

Similarly, advocates can often prompt agencies to explore innovative ways of meeting community needs. In Los Angeles, Metro notes a strong relationship with the walking and bicycling advocacy community; through this partnership, it has started new projects partnerships.

Partnerships and Cooperation

Agencies working on connecting walking and bicycling to transit also have many opportunities to partner on programs or other initiatives outside of the planning process. These projects often fall outside of both formal models of collaboration and informal models of coordination.

Education is an area in which these partnerships can be fruitful. The more knowledgeable agency staff are about the best practices in making walking and bicycling connections, the better able the agency will be to implement improvements. The same can be said of partners from around the city. A workshop may require minimum attendance, which can be met by working with local professionals. Such workshops will increase everyone's knowledge and awareness in implementing innovative approaches to walking and bicycling connections. The City of Atlanta received a grant to provide training on innovative bicycle facilities and invited partners from agencies and non-profits from around the city to look into improving connections to transit. SCAG's Go Human campaign is helping to train City staff and elected officials on the benefits of active transportation, and their regional influence can help reach communities that go beyond Metro's service area in Los Angeles County.

Transit agencies or city transportation departments might partner with advocacy or community groups (such as a local bicycle coalition or a branch of a national organization such as AARP) on walking and bicycling safety initiatives, bicycle

classes, organized rides, or other programs. Safe routes to schools and safe routes to transit initiatives can be valuable ways to encourage more people to try walking and bicycling to transit.

Partnerships can also be used to help launch a new service. In Fargo, Great Ride Bike Share worked exclusively with a for-profit bicycle shop in town for service and maintenance, which the bike share program was not able to provide initially. Without such a partnership, it likely would have been much more difficult for Great Ride to get started in Fargo, and it has helped the bike share organization focus more on launching the program.

Internal Collaboration

Internal collaboration often does not garner as much attention as the partnerships fostered among cities and agencies, but internal organization is necessary before any outside partnerships are successfully built. In general, cities and agencies recognize that there was and still is, in many cases, a disconnect between planning staff and engineers and construction teams for transit projects. Better communication between these two parties within a city government or agency from the beginning will help foster a stronger and more cohesive understanding of what needs to be done before construction begins.

Charlotte has taken an uncommon approach relative to other cities in focusing on internal coordination. Both the Charlotte DOT and the Charlotte Area Transit System (CATS) are City agencies. CATS was expected to separate itself from City government, but that never materialized. The two agencies have a very close relationship, which has helped with larger road and transit projects. Their partnership, along with the City police department, has formed a bus stop committee to consider concerns about bus stop safety and locations.

With so many jurisdictions in the Los Angeles region, cities and agencies cannot neglect to address internal coordination. Metro's *First Last Mile Strategic Plan was approved by the Board of Directors and is being adopted across all sectors of the agency, ensuring that first/last mile connections are worked into the agency's culture and station planning methodology. The various City departments in Long Beach work closely to achieve citywide goals. For the site planning review process, projects above a certain size are reviewed by all City departments. Long Beach's Mobility Element, a plan to prioritize walking, bicycling, and transit modes over the private automobile, is an adopted policy that influences how the City looks at bicycle and pedestrian connections.*

Pilot and Demonstration Projects

Pilot or demonstration projects can be an invaluable tool for testing new programs and facilities to see if they work in the local context, to show a community how a project might look, to test new technology, or for a variety of other reasons.

The Los Angeles region has had demonstration projects and open streets events on a large scale. Most prominently, CicLAvia events in Los Angeles and around Los Angeles County are open streets events at which people walk, bicycle, roller blade, skateboard, and use other forms of active transportation along streets that are closed to cars. Such events are now common throughout the US. Metro, a CicLAvia partner, encourages participants to get to and from the event via transit. SCAG is also a proponent of demonstration projects and open streets events throughout the six-county Los Angeles region. Cities that wish to put on a demonstration project or open streets event often turn to SCAG because of its knowledge about these projects. The City of Los Angeles is also promoting its People Street initiative, which transforms underused streets and repurposes them for walkable uses for the community (Figure 11-3).

Figure 11-3

Planters in Los Angeles blocking drop-off area from cars with Metro bike share station

Advocates can take a role in designing demonstration projects. Cities and agencies should look to harness this power to improve bicycle and pedestrian connections to transit. Better Block PDX, a Portland-based group, has worked with the City of Portland to temporarily convert multi-lane roads in downtown Portland into community spaces that are pedestrian- and bicyclist-friendly (see Figure 11-4). In Atlanta, the MARTA Army, a local community group, is working to improve MARTA bus stops through the addition of maps and timetables, or even by adding trash cans paid for through crowd-sourced funding. Events and community driven amenities such as these can help people and agencies imagine new ways to think about existing spaces. Cities, transit agencies, and outside organizations all share a common goal, and together, spaces and stations can be made friendlier for pedestrians and bicyclists.

Figure 11-4

Better Block PDX pedestrian plaza with ping pong tables in Portland, OR (Photo: Greg Raisman, Flickr)

Funding

FHWA maintains a Departmental resource that lists *Pedestrian and Bicycle Funding Opportunities* and potential eligibility of a variety of projects across 15 USDOT and related funding streams. Among the funds that can be used for transit-related pedestrian and bicycle projects include:

- *Transportation Investment Generating Economic Recovery Discretionary Grant Program (TIGER)*
- *Transportation Infrastructure Finance and Innovation Act (loans) (TIFIA)*
- *Congestion Mitigation and Air Quality Improvement Program (CMAQ)*
- *Surface Transportation Block Grant Program (STBGP)*
- *Transportation Alternatives Set-Aside (TA)*
- *Federal Lands and Tribal Transportation Programs (FLTTP)*

Among the FTA-specific programs that can be used to fund pedestrian and bicycle project and programs include:

- *Metropolitan & Statewide and Nonmetropolitan Transportation Planning (5303, 5304, 5305)*
- *Urbanized Area Formula Grants (5307)*
- *Fixed Guideway Capital Investment Grants ("New Starts") (5309)*
- *Enhanced Mobility of Seniors and Individuals with Disabilities (5310)*
- *Bus and Bus Facilities Formula Grants (5339)*
- *Formula Grants for Rural Areas (5311)*

A 2014 report from Advocacy Advance on funding first/last mile connections (*First Mile, Last Mile: How Federal Transit Funds Can Improve Access to Transit for People Who Walk and Bike*) details eligible FTA programs for funding different

infrastructure improvements, including FTA programs eligible for bicycle lanes and related bicycle network improvements, bicycle parking, and end-of-facility-type improvements for on-board accommodations, bike racks on buses, bike share, pedestrian facilities and ADA accessibility, sidewalks, signs, and trail. Under each type of improvement, several of the FTA programs listed above are eligible as funding sources.

Overall, FTA-funded projects are required to use a 1% set aside for Associated Transit Improvements, "projects that are designed to enhance public transportation service or use and that are physically or functionally related to transit facilities." Eligible projects include:

- Historic preservation, rehabilitation, and operation of historic public transportation buildings, structures, and facilities
- Bus shelters
- Landscaping and streetscaping, including benches, trash receptacles, and street lights
- Pedestrian access and walkways
- Bicycle access, including bicycle storage facilities and installing equipment for transporting bicycles on public transportation vehicles
- Signage
- Enhanced access for persons with disabilities to public transportation

Note that, as discussed in the Access Sheds section, pedestrian improvements within half a mile and bicycle improvements within three miles of a transit stop or station may be eligible for FTA funding (FTA, 2011). Those distances may be increased if it can be shown that people will walk or bicycle the longer distances.

Flexibility of Funding

USDOT offers several flexible funding programs to fund transit-related activities. Flexible funds are legislatively-specified funds that may be used for a variety of purposes. The idea of flexible funds is that a local area can choose to use certain Federal surface transportation funds based on local planning priorities, not on a restrictive definition of program eligibility. Flexible funds include FHWA Surface Transportation Block Grant Program (STBGP) funds, CMAQ, and FTA Urban Formula Funds. Flexible funding allows for the innovative use of FTA and FHWA funds to improve quality of life in communities. Typically, these funds are distributed to transit agencies and municipalities through programs administered by State DOTs and RPAs. FHWA funds may be transferred to FTA, where they can be used with the eligibility and requirements of the FTA program to which they are transferred, generally including for the design, construction and maintenance of pedestrian and bicycle projects related to transit facilities.

The 2014 Advocacy Advance report highlights ARC, Atlanta's RPA, which has been able to use this flexibility for several bicycle and pedestrian projects. According to ARC, three advantages to flexing funds are a faster, more streamlined approval process under FTA requirements, the potential for a lower match for bicycle and pedestrian projects through incorporating "soft" matching such as donated right-of-way or in-kind services, and the authorization of funds for all phases (preliminary engineering, right-of-way, construction) at the same time.

A November 2012 report from the Government Accountability Office (GAO), *Flexible Funding Continues to Play a Role in Supporting State and Local Transportation Priorities*, cited examples of flexible funding being used to support bicycling and walking projects, including Pittsburgh, in which flexible funding has been used to, among other things, install bike racks on buses, and Portland, in which flexible funding was used for bicycle and pedestrian improvements along an interstate.

Surface Transportation Block Grant Program

The Surface Transportation Block Grant Program (STBGP) (formerly the Surface Transportation Program under MAP-21 and SAFETEA-LU) is the largest potential source of flexible funds among all federal-aid highway programs. It can be used for a broad array of highway purposes and for major transit purposes as well. STBGP promotes flexibility in State and local transportation decisions and provides flexible funding to best address state and local transportation needs.

The STBGP program provides set-aside funding for Transportation Alternatives (formerly Transportation Enhancements under SAFETEA-LU) that encompass a variety of smaller-scale transportation projects such as pedestrian and bicycle facilities, recreational trails, and safe routes to school projects. Each State receives a share of the national total of Transportation Alternatives funding. These funds are administered through State DOTs, and RPAs coordinate project selection. For most projects funded with TA set-aside funds, there is generally an 80% federal share and 20% state or local match.

Transportation Enhancements/ Transportation Alternatives Examples

The M-Path Extension provides a critical link between two popular Metrorail stations in Miami—Dadeland South and Dadeland North. The project included the construction of a multiuse trail, a bicycle and pedestrian bridge over the entrance ramp to SR 878, and lighting, signs, and fencing at the two metro stations (Figure 11-5). In addition, new traffic signals were installed at the intersections with pedestrian ramps, intersections were repaved and restriped, and additional landscaping and paving work was completed. Miami-Dade County worked with Metrorail to leverage funding through the Transportation Enhancements program.

Figure 11-5

M-Path bicycle and pedestrian bridge over SR 878 in Miami (Photo: Transportation Alternatives Data Exchange)

Congestion Mitigation and Air Quality Improvement (CMAQ) Program

The CMAQ Program is another source of funding for both FTA and FHWA projects and supports two important objectives of the US Department of Transportation: improving air quality and managing traffic congestion. CMAQ projects and initiatives are often innovative solutions to common mobility problems and are intended to benefit areas in either nonattainment or maintenance for the National Ambient Air Quality Standards (NAAQS) for ozone, carbon monoxide, or particulate matter. Eligible activities funded through the CMAQ Program include transit system capital expansion and improvements, travel demand management strategies and shared ride services, and pedestrian and bicycle facilities and promotional activities that encourage bicycle transportation. Additional information on the CMAQ program is available at https://www.fhwa.dot.gov/environment/air_quality/.

CMAQ funds accounted for 80% of the $1.35 million cost of the McDonald's Cycle Center in Chicago's Millennium Park (Advocacy Advance, 2009). The facility is adjacent to Millennium Station (Metra commuter rail) and Chicago Transit Authority bus and rail service and includes secure bicycle parking, lockers, showers, bicycle rentals, and a bicycle repair shop (Figure 11-6).

Figure 11-6

McDonald's Cycle Center in Chicago (Photo: Chicago Department of Transportation)

Dedicated State and Local Funding Sources

State, local, and regional funding sources may provide more flexibility in terms of funding safe and comfortable connections between transit, walking, and bicycling. They are also essential to satisfy the requirement to match federal funds with local funds.

State Sources

In addition to federal funding, states use additional public revenue sources to fund bicycling and walking projects and connections to transit. A 2014 report from Advocacy Advance, *State Revenue Sources that Fund Bicycling and Walking Projects*, details a wide variety of funding sources states have used to support the planning and implementation of bicycle and pedestrian facilities, including:

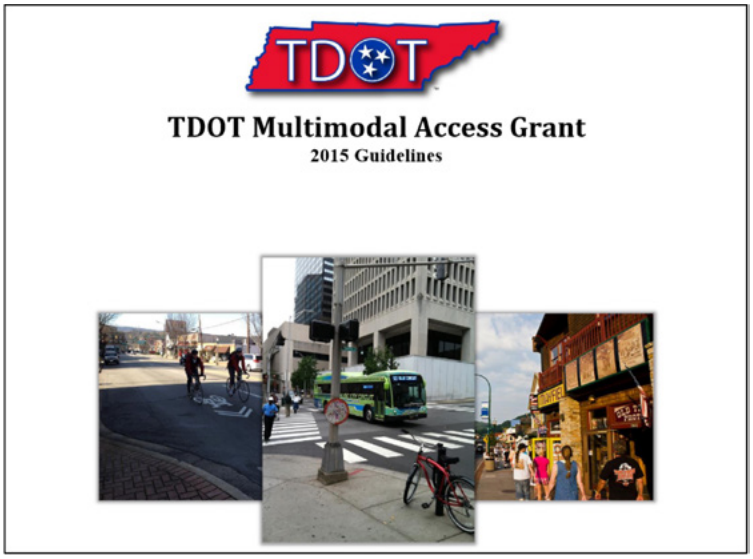
- State fuel tax
- Vehicle license and registration fees
- General fund
- Bond proceeds
- Lottery revenue
- School zone speeding fines
- Toll roads
- Vehicle transfer fees

For example, Tennessee DOT created the Multimodal Access Fund, a grant program that uses State gas tax revenue to fund infrastructure projects for bicyclists, pedestrians, and transit users. Multimodal projects that are not in

the agency's rights-of-way may still eligible to receive funding, including projects that "provide direct access to a transit hub." A total of $30 million in State gas tax revenue was set aside for FY 2014–2016 to implement the grant program. Tennessee provides 95% of project funding, requiring only a 5% local match (https://www.tn.gov/tdot/topic/multimodal-multimodal-access-grant#sthash.bUUXTHfQ.dpuf).

Figure 11-7

Tennessee DOT Multimodal Access Grant application



Every state has a statewide bicycle and pedestrian coordinator who typically is employed by a State DOT. These coordinators are a great resource for learning more about the statewide funding opportunities that may be available to support bicycling, walking, and connections to transit.

Local Sources

Bicycle and pedestrian connections to transit can also be funded through a variety of local funding sources. Often these sources can be used as match for federal funds. Examples of dedicated funding sources include:

- Sales tax
- Wage tax
- Development impact fees
- Property tax
- School zone speeding fines
- Fuel tax
- Transportation fee

Public/Private Partnerships

Public/private partnerships can be used to fund multimodal projects that connect people to transit. In such partnerships, a contractual agreement between a public agency and private partner is used to deliver a service or facility for the use of the general. Common examples of public/private partnerships that play a role in providing connections to transit include business improvement districts and private bike share operations.

Larger multimodal projects can also successfully leverage public/private partnerships. One example is the Downtown Greenway, a planned four-mile multiuse greenway that will loop around downtown Greensboro, North Carolina, and create better multimodal connections. The estimated cost for completion of the Downtown Greenway is $26 million, which is being funded through a public/private partnership. Contributions from private businesses and foundations in the Greensboro area are supplementing federal, state, and local public funding sources. Planning and community engagement efforts for the Downtown Greenway have been led by Action Greensboro, a local non-profit organization that supports initiatives to enhance Greensboro's quality of life and is underwritten by six local foundations.

Public/private partnerships are also an important element of some bike share systems, often with a private system operator, a public agency that oversees aspects of the system including planning, and a sponsor that pays some amount in exchange for certain promotional rights, such as naming rights or having a logo displayed on bikes or stations.

Marketing and Promotion

A big challenge in getting people to walk and bike to transit is communicating to transit users that these options exist. Marketing and advertising play a big role, as do wayfinding signs around stations. Simply seeing quality bicycle and pedestrian infrastructure around stations is beneficial in getting more people to walk and bicycle to transit.

Open Streets Events

Many cities host open streets events for which entire neighborhoods are closed to automobile traffic and bicyclists and pedestrians are encouraged to use all of the streets in the neighborhood. These events are an opportunity to reach this target audience. In Los Angeles County, Metro reported that there were high rates of bicycle-to-transit use on weekend days with CicLAvia events. Metro also encourages participants to take transit to reach CicLAvia.

Promotional Campaigns

For RPAs, the marketing audience often includes local public officials in addition to the general public. SCAG's Go Human campaign promotes active transportation modes and improved public health. Its approach to marketing the program has three elements—getting cities to donate advertising space through various media, hosting open streets events to showcase possible safety improvements for bicyclists and pedestrians, and offering training events and toolkits to community members and targeted groups to further spread the message and get people to buy in. These resources can help members of the community as well, but it is not the primary audience.

Data Collection and Evaluation

Data collection is important for understanding how people use a transportation system and how integrated bicycling and pedestrian modes are part of the system. Cities and agencies across the US take different approaches to collecting usage data, reflecting a lack of general standards or best practices. However, there are several methods and strategies that are common.

Collecting Usage Data

Methods for collecting data related to walking, bicycling, and their connection to transit use include, but are certainly not limited to, counts, surveys, and anecdotal evidence.

Counts can take a variety of forms. Automatic counters, such as trail counters on the Atlanta BeltLine or bicycle counters on the Hawthorne Bridge or Tilikum Crossing in Portland, automatically count pedestrians and bicyclists (Figure 11-8). In Portland, sensors under the concrete sense when a bicycle crosses and register a count and can distinguish bicyclists from pedestrians. Yearly hand counts are also conducted. In Charlotte, CATS bus drivers count when bicycles are added onto the bicycle rack at the front of the bus. Generally, buses are equipped with a button used for registering a bicycle boarding. Minneapolis is working to develop technology that will automate bicycle boarding counts so people will know if there is space on an upcoming bus to add their bicycle (see the Minneapolis case study for more information). In Los Angeles, SCAG counts people who attend open street events.

The website for FHWA's Bicycle-Pedestrian Count Technology Pilot Project (https://www.fhwa.dot.gov/environment/bicycle_pedestrian/countpilot/) includes a report on a project to supplement counting programs in 10 locations around the country, including case studies and training materials, as well as a list of other resources on counting pedestrians and bicycles. The FHWA report *Coding Non-motorized Station Location Information in the 2016 Traffic Monitoring Guide Format* (2016) can assist agencies in standardizing count formatting.

Figure 11-8

Counter tallying bicyclists crossing Tilikum Crossing in Portland, OR

Surveys and inventories are also used to gauge people's travel patterns. BART uses surveys to determine if people are bringing their bicycles with them on trains or parking them at stations. BART also conducts an annual bicycle parking inventory for which staff count the number of bicycles parked at stations. Santa Monica recently completed an online survey that will look at mode share for different modes of transportation. Online, mail, and in-person or intercept surveys all have their strengths and weaknesses and cost different amounts of money to administer. However, understanding system use is necessary as a means to better understand how cities and transit agencies can improve bicycle and pedestrian connections to transit (Salant and Dillman, 1994).

Finally, anecdotal evidence and observation can help gauge usage if counts, surveys, or analyses are not possible due to time, budget, or staff constraints. Simply keeping an eye out for people using the service and whether or not walking and bicycling are involved can provide a good baseline for exploring more specific issues in greater depth.

Cities and agencies should be flexible in how data is collected, and they should consider making changes if those changes will improve service.

FHWA's *Guidebook for Developing Pedestrian & Bicycle Performance Measures* (2016) details a wide range of performance measures based on city or agency priorities related to bicyclists and pedestrians. It also provides information on how to capture data with these methods and how they are organized. This guidebook is a good reference for cities or agencies looking to start or expand their data capabilities.

FHWA's *Incorporating Qualitative Data in the Planning Process: Improving Project Delivery and Outcomes* (2017) provides information on qualitative data collection methods and tools to inform planning processes and improving outcomes.

Evaluating Station Access and Prioritizing Investments

Determining accessibility to a stop or station is important, and many factors should be considered. Bicycle lockers or racks, shelters and benches, lighting, sidewalk access, etc., are important, and it is difficult to determine which stations and stops need to be serviced first. In the Twin Cities, Metro has developed a points system for identifying bus stops that need immediate work (Figure 11-9). Stops that are not ADA-compliant and stations that have a history of crashes involving bicycles and pedestrians are assigned a higher number a points. Lack of facilities, while inconvenient, does not warrant as much attention as safety issues. In cataloging each bus stop, the stops with the highest number of points (deficiencies) are serviced first.

TABLE 1

BUS STOP RANKING SYSTEM

Variable	Type	Max. Score
ADA Accessible	Legal Access†	3 points
ADA Pad for Wheelchair	Legal Access†	4 points
Crash History - Bicycle	Safety	3 points
Crash History - Pedestrian	Safety	3 points
Safety Crosswalk Access†	Safety	3 points
Lighting††	Safety	3 points
Level of Service	Safety	2 points
Sidewalk Access	Safety	2 points
Bike Lane Access	Safety	2 points
Right-of-Way Buffer	Safety	2 points
Shelter	Facilities	1 point
Bench	Facilities	1 point
Bus Schedule	Facilities	1 point
Trash	Facilities	1 point
Bike Locker	Facilities	1 point

† The ADA Legal Access variables do not pertain to access issues for the hearing and visually impaired.
‡ Intersection timing issues - both crossing time and waiting time - were not incorporated into this analysis.
†† Lighting is assumed to be at street level as opposed to pedestrian level.

Metro, Bicycle and Pedestrian Connections to Transit Infrastructure Study, 2009

Figure 11-9

Factors for determining bus stop priority for needed walking and bicycling improvements in Twin Cities

Metro has a similar system for evaluating station access around its light rail stations. Using a 0–10 scale on a variety of issues; through a series of weights associated with each question, each station receives a total score, which determines how resources should be allocated (Table 11-1).

Montgomery County, Maryland, conducted an extensive inventory cataloging 150 features at the 5,400 bus stops throughout the county and put this information into a GIS layer, which was able to track improvements to the bus stops across the county as they took place over several years.

A walk shed or bike shed analysis can determine how people will access a stop or station by foot or by bicycle. In Denver, RTD is working to better understand how people can reach their station areas and how the agency can work to improve connections. RTD has performed extensive walk shed analyses around its stations and has also conducted mode of access and egress analyses for a couple of stations. HART in Hawaii conducted walk audits around its rail station areas with other local agencies, cataloguing a wide range of information and strategically choosing a few projects for implementation to improve pedestrian and bicycle access. It is important for officials from cities and transit agencies to get out and see the network; simply relying on maps will not tell the whole story.

Table 11-1 *Bicycle Improvement Prioritization Factors for New LRT Station*

Criteria	Notes	Value	Weighting
Is project located close to LRT station?	Proximity to LRT station point in GIS	Projects ranked in comparison to each other on scale of 0–10	30%
Does project create direct connection to LRT station?	Connection to LRT station	Yes = 15; No = 0	15%
Does project address known safety concern?	Bicycle crashes per mile	Projects ranked in comparison to each other on scale of 0–10	15%
How many zero-car households does project serve?	Assigned zero-car households to each project based on adjacent blocks	Projects ranked in comparison to each other on scale of 0–10	15%
How many employees and residents does project serve?	Assigned zero-car households to each project based on LEHD data points; assigned population to each project based on adjacent blocks	Projects ranked on scale of 0–10 based on employment and residential density (jobs + population per mile	15%
Does project directly serve schools and libraries?	Known schools and libraries per mile	Projects ranked in comparison to each other on scale of 0–10	5%
Does project improve connections to regional trail network and Metropolitan Council's regional bike transportation network?	Proximity to trail or bicycle network segment in GIS	Projects ranked in comparison to each other on scale of 0–10	5%

Source: Twin Cities, Hennepin County Bottineau LRT Bicycle Study, 2016

The ActiveTrans Priority Tool is a 10-step process that ranks which bicycle and pedestrian projects should be improved first and looks at bicycle and pedestrian modes separately. An outline of the tool is discussed in *NCHRP Report 803*.

Incorporating Vision Zero guidelines, if a city or transit agency has adopted such policies, is important. As Metro Council showed in the Twin Cities, station access issues are often defined first by safety issues, with amenities and services coming later. It is important to collect safety data at and immediately near stop and station areas. This will help identify places at which access is not safe and where improvements can be made.

All stops and stations, no matter the number of amenities, will need to be serviced on occasion. It is important to establish a system that periodically evaluates a stop or station both for the amenities it offers (ensuring that they still function properly and have not fallen to an inadequate standard) and for access to the station. Outside of this schedule, users should be able to provide feedback to the City or transit agency on issues, such as pedestrian and bicycle issues, a vandalized bus schedule, or other problems.

SECTION
12

Case Studies

The research team selected three metropolitan areas for comparing and contrasting the benefits of and obstacles to implementing best practices. These case studies provide examples of best practices in larger metropolitan areas with a range of transit types, densities, and land uses, including urban and more suburban settings. Based on extensive outreach to more than 15 agencies and communities, Minneapolis, the Los Angeles region (including Santa Monica and Long Beach), and Atlanta were selected for the studies. Although there are some common threads from each, agencies and communities with different models of structure and interagency collaboration were deliberately selected to illustrate several options for best practices.

Interviews were conducted with relevant agency staff from transit agencies, City or County planning and engineering departments, and bike share and advocacy groups in each of the three locations, and relevant documents were gathered. Conversations with key agency officials centered on jurisdictional issues; how the agencies and staff work together on planning, design, implementation, and funding; and key successes, challenges, and barriers. In addition, extensive site visits were conducted on transit and by foot and bicycle to observe and experience the access to transit for station design, bicycle parking at stations, pedestrian access and crossings, and other relevant features.

Following are summaries from the three case study site visits and key lessons that are transferable to other agencies.

Atlanta Case Study

Background and Setting

Atlanta is the ninth largest metropolitan area in the county, with more than 5 million residents within the 29-county Metropolitan Statistical Area. The Atlanta metro area has been one of the fastest growing regions in the US for the last 25 years, adding more than 2 million people since 1990. Such growth has made Atlanta prone to some of worst traffic and longest commute times in the country.

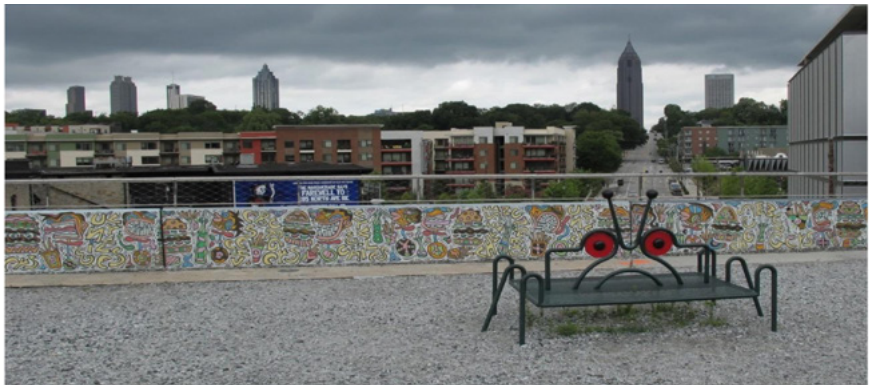
The Metropolitan Atlanta Rapid Transit Authority (or MARTA), the primary transit provider for the region, is the eighth largest transit agency by ridership in the US. It developed the first heavy rail system in the Southeast, which began operating in 1979; since then, the rail system has expanded to four lines, the last of which was extended in 2000. The agency also operates an extensive bus service that serves Fulton, DeKalb, and Clayton counties.

In the lead up to 1996 Summer Olympic Games hosted in Atlanta, the federal government invested more than $400 million in infrastructure improvements. Of these expenditures, $114 million went toward key transit projects such as the Atlanta University Center Pedestrian Walkway, which improved access to the MARTA system in downtown Atlanta (http://www.gao.gov/archive/2000/gg00183.pdf). If not for the special circumstances surrounding the Summer Olympics, however, these investments would not have materialized.

In the last decade, a greater focus on multimodal connections has emerged in Atlanta. The city is seeking to undergo a transformation from an automobile-oriented region to one that integrates transit, walking, and bicycling options as important, everyday modes of transportation. A web of existing transit options will be augmented by a comprehensive streetcar network, multi-use paths, and improved bicycle routes, sidewalks, and crossings (Figure 12-1). A focal point of this renaissance is the Atlanta BeltLine, the largest comprehensive revitalization effort ever undertaken in Atlanta. The City of Atlanta, the Atlanta Regional Commission (ARC), and MARTA are also actively working to expand investments in walking, bicycling, and facilitating connections to transit. The dedication of staff and resources to bicycle and pedestrian planning has been critical to these efforts.

Figure 12-1

Scenes from Atlanta BeltLine trail



Major Initiatives and Key Agency Initiatives

Metropolitan Atlanta Rapid Transit Authority (MARTA)

MARTA is the major transit provider in the Atlanta metro area, operating four heavy rail lines and extensive bus service within a three-county area. Average weekday ridership is more than 430,000 for bus and rail service combined. To accommodate bicyclists, all MARTA buses are equipped with bike racks, and there are no restrictions on bicycles on-board rail cars.

Although MARTA does not have direct control over areas outside stations, the agency has worked extensively with partners to develop better bicycle and pedestrian connections to transit. One of the most significant efforts was a $32-million project that developed a pedestrian bridge that connects two disconnected quadrants in the Buckhead neighborhood and created a new entrance to MARTA's Buckhead Station across Georgia Highway 400 (Figure 12-2).

Figure 12-2

Pedestrian bridge at MARTA Buckhead station over Georgia Hwy 400

MARTA has also worked closely with the City of Atlanta on the siting of bike share stations around rail station, providing a first/last mile connection. In recent years, the agency has been very proactive in providing bicycle parking at rail stations. As a means of security, open racks have been moved within stations, beyond fare gates. Although MARTA has control over only its own property, it has worked to improve bicycle and pedestrian connections to transit. Key partnership comes in working with the Georgia DOT (GDOT) along arterial bus corridors owned by the State. MARTA has also worked with community improvement districts, such as the Buckhead Community Improvement District (CID).

MARTA has worked with GDOT on $11.5 million in investments in sidewalks, raised medians, and crossing signals along a dangerous 2.3-mile stretch of Buford Highway. A distillation of the traffic problems in the Atlanta region, the Buford Highway is six-lane arterial that originates in Midtown Atlanta and serves as a vital connection to northeast suburbs in DeKalb County. In the last 15 years, a heavily transit-dependent Hispanic population sprouted up along the highway, increasing the number of people that need to access transit along the busy arterial. The automobile-oriented route had limited marked crossings, sidewalks, and other pedestrian infrastructure, creating conditions that led to 30 pedestrian deaths and 250 injuries along a stretch of Buford Highway. However, in recent years, MARTA has worked with GDOT and the City of Brookhaven to add signalized crossings and sidewalk improvements along the highway (Figure 12-3). This has created a much safer pedestrian environment, especially for those accessing transit along the corridor.

Figure 12-3

Pedestrian hybrid beacon and median refuge islands, part of improved Buford Highway in DeKalb County, GA

Key Resources:

- *Five-Year Transit Oriented Development Strategic Plan (2013)*

Atlanta Beltline, Inc.

In 2005, under the leadership of then mayor Shirley Franklin, the City of Atlanta created an independent non-profit agency, Atlanta BeltLine, Inc. (ABI), to oversee the planning and execution of the Atlanta BeltLine, the largest revitalization effort in the city's history. The BeltLine (Figure 12-4) uses an existing 22-mile historic rail corridor that encircles Atlanta to develop approximately 22 miles of light rail or streetcar transit and 33 miles of multi-use trails linking together with 45 Atlanta neighborhoods.

In 2015, the City of Atlanta adopted the Atlanta Streetcar System Plan, which expanded the BeltLine transit to include additional street running routes to create an integrated 50+ mile streetcar rail system, providing key connections from the BeltLine to major destinations in the city. As a whole, the project is

poised to significantly expand the regional transit and transportation system in a way that prioritizes multimodal networks, and creates pedestrian and bicycle connections to transit from trails and local streets.

Figure 12-4

Bicyclist and pedestrians using Eastside Trail, part of Atlanta BeltLine

The BeltLine 2030 Strategic Implementation Plan also emphasizes TOD, an expansion of park land and public spaces, the creation of affordable housing, brownfield remediation, and economic revitalization of city neighborhoods. To realize these goals, ABI has formed extensive partnerships with the City of Atlanta, MARTA, ARC, Invest Atlanta, GDOT), the US Environmental Protection Agency (EPA), FTA, and other agencies. Although the BeltLine as a whole will not be completed until 2030, the sections that have been completed have been a success—the Eastside Trail, which opened in 2014, receives 1.3 million annual visitors and has helped spur more than $3 billion of private residential, commercial, and mixed-use investment along the entire corridor.

The entirety of the BeltLine falls within the city of Atlanta, and ABI is working closely with the City as it continues developing the BeltLine, including coordinating streetscape improvements to access routes and reviewing planned developments within the BeltLine Planning Area, encompassing areas up to a half mile from the corridor.

Funding for the project comes from a variety of sources, but the major funding source is the Tax Allocation District (TAD), a total of 6,500 acres established around the 22-mile route. The TAD employs tax-increment financing accruing from non-single family properties. A sister nonprofit organization, the Atlanta Beltline Partnership (ABP), harnesses private, corporate, and philanthropic support for the BeltLine, including more than $54 million in funds to date.

The transformative nature of the BeltLine has been recognized with a number of awards, including a National Phoenix Award for Excellence in Brownfield Redevelopment and the EPA National Award for Smart Growth Achievement.

Key Resources:

- *Atlanta BeltLine 2030 Strategic Implementation Plan (2013)*
- *Atlanta Streetcar System Plan (2014)*
- *Atlanta BeltLine Integrated Action Plan for Economic Development, Housing & Real Estate (2015)*

City of Atlanta

In 2008, Atlanta developed Connect Atlanta, its first comprehensive transportation plan, to ensure efficient, effective, affordable transportation that enhances mobility and quality of life. Through Connect Atlanta, the City of Atlanta has embraced a broader focus on a multimodal transportation network, realizing the importance of walking, bicycling, and transit as a means of creating more complete, connected communities. Atlanta Mayor Kasim Reed stated that he aims to make Atlanta the most bikeable, walkable, livable city in the Southeast.

Central to the City of Atlanta's goal to creating a more livable environment and connecting bicycling, walking, and transit are three key supplements to the Connect Atlanta plan. Move Atlanta: A Design Manual for Active, Balanced & Complete Streets, was developed to serve as a comprehensive guide to designing streets in Atlanta for health, safety, livability, and sustainability. This guide has played an important role in the restriping and repaving of city streets to ensure safer, more comfortable facilities for walking and bicycling.

Similarly, the City's Cycle Atlanta Phase 1.0 study has emphasized active transportation connections along key mobility corridors. Specifically, the City identified priority corridors within the BeltLine that will connect to existing or future transit options. Cycle Atlanta Phase 2.0 will focus on designing conceptual high quality connected bicycle infrastructure along 1–3 corridors on 6–8 MARTA train stations and was set to kick off the first quarter of 2017. The plan will document opportunities and constraints related bicycle access at each selected MARTA station. Also, in conjunction with MARTA, the City has also developed Transit Oriented Development: A Strategy for Advancing Transit-Oriented Development, which provides a comprehensive TOD policy and strategy that advances pedestrian-oriented design mixed-use residential development at and around MARTA station areas.

The City of Atlanta recently demonstrated its commitment to bicycling by hiring its first-ever Chief Bicycle Officer in 2015. This role has been critical

to coordinating the City's efforts around bicycling, from the engineering and design of bicycle facilities to oversight of the City's new and growing bike share program. Despite this significant hire, the Department of Planning and Development has only a few staff members devoted to planning for walking and bicycling and connecting these modes to transit. In addition, the Department of Public Works, which has control over city streets, largely relies on contractors to plan, design, and implement infrastructure in the public right-of-ways.

Accordingly, the City of Atlanta relies on partners to contribute to planning and implementing projects that make walking and bicycling to transit safe and more convenient. ABI is a prime example of a non-government organization carrying out vital planning and implementation in this area. Similarly, the PATH Foundation and Community Improvement Districts (which operate similar to Business Improvement Districts) also engage in planning and constructing trails, bicycle routes, and pedestrian facilities in the city. The City and MARTA have also worked with advocacy groups such as PEDS, which developed a Safe Routes to Transit Toolkit. Coordination between these groups is necessary to create a complete network that serves the needs of pedestrians and bicyclists.

Key Resources:

- *Connect Atlanta (2008)*
- *Cycle Atlanta Phase 1.0 (2013)*
- *Move Atlanta: A Design Manual for Active, Balanced, & Complete Streets (2015)*
- *Transit Oriented Development: A Strategy for Advancing Transit-Oriented Development (2015)*

Atlanta Regional Commission (ARC)

ARC is the metropolitan planning organization for Atlanta, overseeing a 10-county area that is home to more than 4 million people. This diverse geographic area covers more urban environments in Fulton and DeKalb counties, along with more suburban, exurban, and rural areas in the metro area. ARC's recent work in the area of walking and bicycling has been aimed at promoting a shift in the region toward thinking about walk and bike travel sheds, prioritizing investments based on increasing mode shifts away from cars, and recognizing the interconnectivity of transit and active transportation in a region as large as Atlanta. To accomplish these goals, ARC works to provide information and tools to cities and other organizations in the region that are implementing projects. They have also worked with agencies around the region to more effectively deploy flexible funding opportunities.

ARC's Walk. Bike. Thrive! plan expands upon past regional bicycle and pedestrian planning efforts, introducing a new framework for prioritizing regional investments in walking and bicycling (Figure 12-5). The plan emphasizes targeted

investments that can make it easier for people to walk or bicycle instead of driving. *Walk. Bike. Thrive!* also focuses on the larger picture of a multimodal transportation network and the importance of bicycling and walking connections to transit.

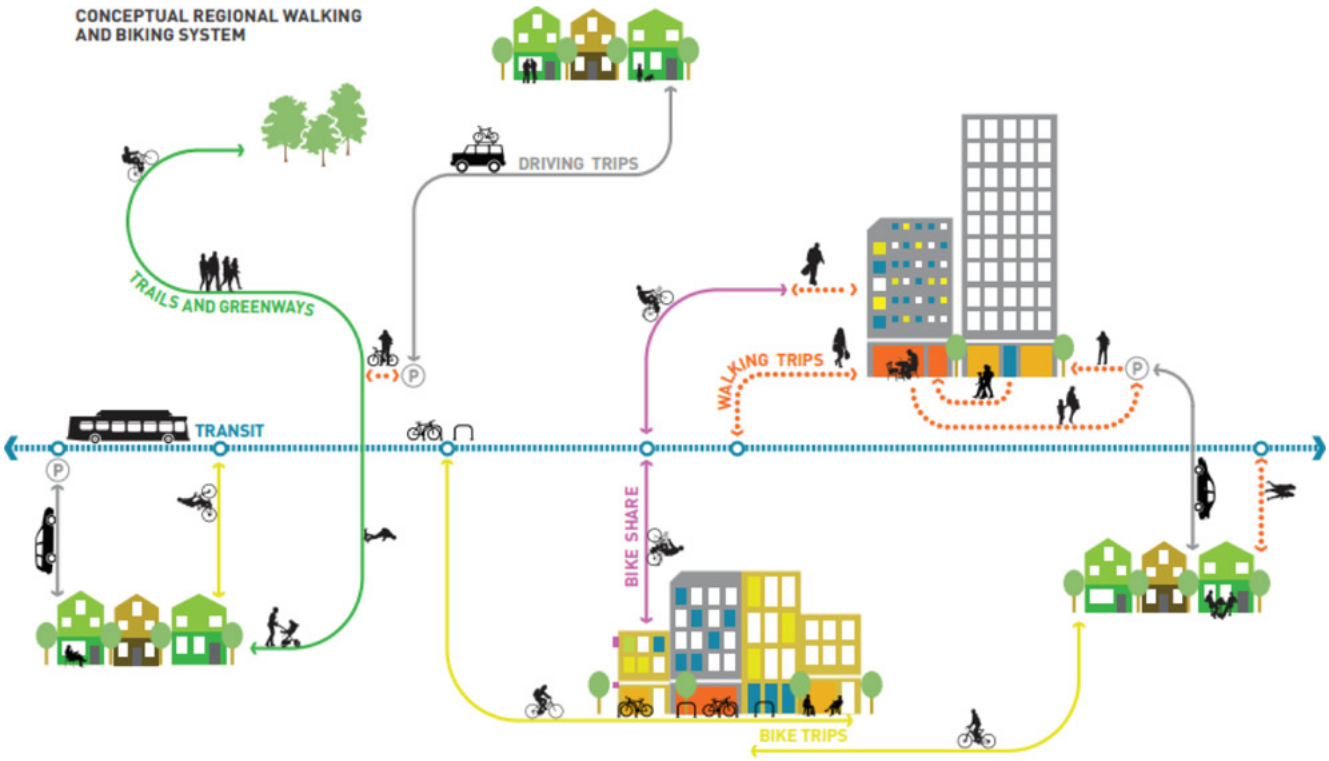


Figure 12-5 *Conceptual regional walking and bicycling system from ARC's Walk. Bike. Thrive! plan*

The plan also provides guidance to help local jurisdictions offer residents safer, more comfortable places to walk and bicycle. As a part of this planning effort, ARC is hosting workshops for local officials to educate and encourage investments in walking and bicycling, and developing toolkits that can be used by local governments to plan for new and improved facilities. In addition, ARC is implementing a Regional Bike-to-Ride Infrastructure project to improve active transportation connections to transit across the metro Atlanta region.

Key Resources:

- *Walk. Bike. Thrive!* (2016)

Key Lessons

Target Investments that Have the Most Impact

A common theme shared by agencies in Atlanta is the importance of targeting investments that have the most impact in connecting people to transit. With finite resources devoted to bicycle and pedestrian infrastructure, connections to transit have served as focal points for investments. This approach has been central to the City of Atlanta's efforts around bicycle investments. Cycle Atlanta Study 1.0 prioritized corridors that linked to multimodal transit hubs within the BeltLine, and Cycle Atlanta 2.0 will focus on connectivity to MARTA stations outside of the BeltLine. On a regional level, ARC used several layers of analysis in Walk. Bike. Thrive! to identify key regional focus areas to target key investments in bicycle and pedestrian infrastructure (see Figure 12-6).

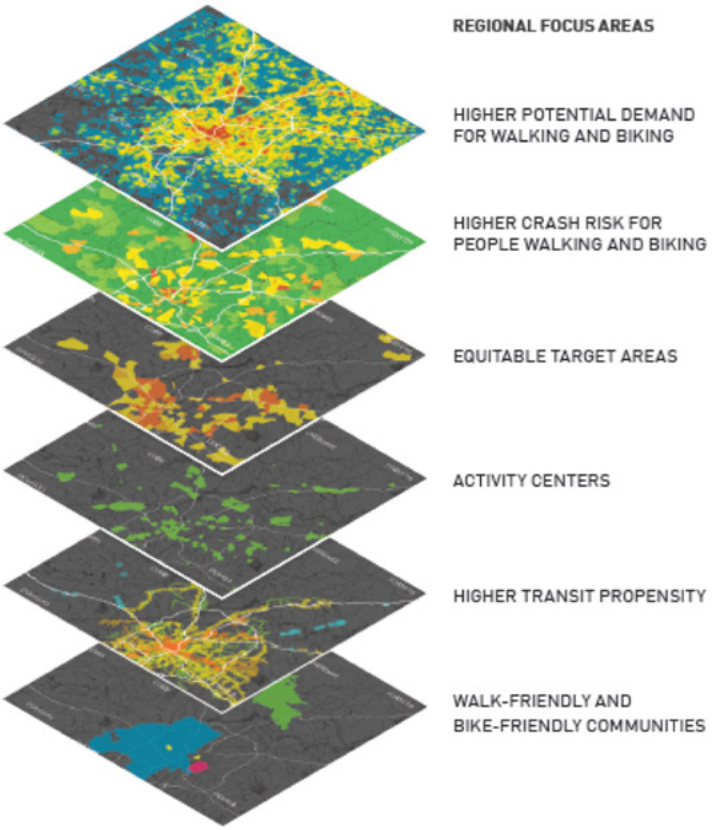


Figure 12-6

Factors considered in ARC's Walk. Bike. Thrive!

Funding Comes in a Variety of Forms

MARTA is currently funded by a one-cent sales tax collected in the City of Atlanta and Fulton and DeKalb counties. A region-wide transportation special-purpose local-option sales tax (TSPLOST), which would have provided money to a variety of transportation projects, failed in 2012. However, in 2016 the City of Atlanta voted to devote a one-half cent sales tax increase towards MARTA transit operations and capital investments and a 0.4-cent TSPLOST toward general transportation investments, which includes $190 million that will directly expand bike and pedestrian access to transit. Similarly, Renew Atlanta, a $250-million infrastructure bond passed by voters in 2015, is funding several bicycling and walking projects in the city, including 14 complete streets projects. For the BeltLine, the City of Atlanta created special tax allocation districts along the 22-mile corridor that serve as a key revenue source for the multiuse corridor. This revenue source is being supplemented by foundation grants and federal funding. Through federal sources such as CMAQ and STBGP, ARC has facilitated bicycle and pedestrian projects in the metro Atlanta area.

Education and Encouragement are Critical

Atlanta faces the challenge of making a cultural shift toward more multimodal transportation. Education and encouragement strategies have been critical to familiarizing people with new infrastructure and building a culture around walking, bicycling, and transit. For the last seven years, ABI has hosted Art on the BeltLine, the largest temporary public art installation in the Southeast. This four-month long event also features a variety of programming from tai chi and yoga to tours with Trees Atlanta. This activation of public space has played a significant role in encouraging people to explore walking and bicycling on the BeltLine.

On a regional level, ARC has recognized the importance of providing tools and resources to educate local officials and staff about planning. ARC is encouraging more walk-friendly and bike-friendly designated communities, which can provide specific guidance to communities to improve walking and bicycling networks. ARC is also offering workshops for local officials that are interested in bicycle and pedestrian improvements in their communities, but would like more guidance on how to plan and implement better facilities.

Investments Can Catalyze Economic Development

Sometimes, improvements to walking, bicycling, and connections to transit are seen as standalone investments that simply provide greater access to jobs, education, healthcare, and other services. However, investments in key mobility corridors have the ability to catalyze significant development and encourage the revitalization of neighborhoods, attracting new jobs, opportunities, and housing and paving the way for small and disadvantaged business enterprises.

Although far from finished, the BeltLine has already generated more than $3 billion in investment along the 22-mile corridor. One of the biggest success stories to date is the Eastside Trail, a completed two-mile segment of the BeltLine, which has transformed Atlanta's Historic Fourth Ward neighborhood. A prominent example is the redevelopment of a historic Sears, Roebuck & Co. building into the Ponce City Market. The area's largest adaptive reuse project, Ponce City Market has helped the 2.1-million square foot building be remade into a mixed-use development that features a large food hall, restaurants, retail, office space, and residential units.

Key Resources:

- *BeltLine Overview (http://beltline.org/about/the-atlanta-beltline-project/atlanta-beltline-overview/)*
- *City of Atlanta Ballot Measures (http://www.atlantaga.gov/index.aspx?page=1300)*
- *Relay Bike Share (http://relaybikeshare.com/)*

- *PEDS Safe Routes to Transit (http://peds.org/campaigns/safer-streets/safe-routes-to-transit/)*
- *Atlanta Streets Alive (http://www.atlantastreetsalive.com/)*

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- Atlanta Regional Commission: Byron Rushing, Aaron Fowler
- Alta Planning + Design: Collin Chesston
- Nelson\Nygaard: Joel Mann

Los Angeles Case Study

Background and Setting

Los Angeles is the second largest city in the US, with more than 18 million residents within the 6-county area under the jurisdiction of SCAG, the region's metropolitan planning organization. The Los Angeles metropolitan area has typically been viewed as the "car capital of the nation," an example of endless sprawl and highway expansion.

The Blue Line, a light-rail train service running from downtown Los Angeles to Long Beach, opened in 1990, which signaled a turn away from auto-oriented transport toward a broader future in public transportation. In 2008, voters in Los Angeles County approved Measure R, a half-cent sales tax increase to fund transit service expansions and improvements for Metro. By 2016, Metro operated two subway lines and four light rail lines, with two light rail extensions opening that year as well. As the Los Angeles region is home to the largest current expansion of rail transit in the US, there are many efforts underway to ensure that walking and bicycling are integral parts of the system. Shared mobility programs and initiatives centered around rail stations, such as bike share, EV carshare, and mobility hubs, are increasingly expanding the reach of public transit networks beyond the first/last mile to build regional multimodal networks. At the same time, efforts are underway to bring the expansive Los Angeles urban landscape down to a manageable scale for pedestrians and bicyclists by encouraging active transportation-friendly infrastructure and programs.

Santa Monica and Long Beach have been leaders in promoting active transportation modes, in part due to their smaller sizes, coastal climates, and embrace of active lifestyles. Now, the City of Los Angeles, Metro, and SCAG,

among other jurisdictions, are working hard to refocus transportation planning efforts around active transportation modes. As bicycling becomes more prominent across the Los Angeles metropolitan area, and as bus and rail transit continues to expand, Los Angeles has positioned itself well to improve bicycle and pedestrian access and connections to transit.

Major Initiatives and Key Agency Initiatives

Los Angeles County Metropolitan Transportation Authority (Metro)

LA's Metro runs two heavy rail lines, four light rail lines, extensive bus service across the county, and a bike share system that opened in July 2016 in partnership with the City of Los Angeles. According to 2014 American Community Survey data, Los Angeles County is home to 9.97 million people. That same year, Metro estimates that weekday bus and rail ridership reached nearly 1.5 million per day (http://isotp.metro.net/MetroRidership/Index.aspx).

By focusing on better bicycle and pedestrian access to its stations, Metro can promote active transportation and higher ridership. Metro and the Southern California Association of Government (SCAG)'s *First Last Mile Strategic Plan* (2014) laid important groundwork on which Metro can begin to promote more active transportation modes as a complement to their transit service. This plan introduced the Pathway, a concept that outlines a toolbox of strategies to improve bicycle and pedestrian access to stations. The Active Transportation Strategic Plan (ATSP, 2016) took elements from the First Last Mile Strategic Plan and began to apply these principles to all 661 Metro bus and rail stations in the county. The ATSP also examined what local jurisdictions were already doing and worked to bolster local efforts to build first/last mile improvements throughout the region, including providing training for City staff, and helping them access funding.

Figure 12-7

Bicycles aboard Metro Orange Line BRT bus in Los Angeles

Metro also launched bike share with the aim of building out the system across the entire county. The launch started in downtown Los Angeles, and the first expansion is planned for Pasadena, with a number of other jurisdictions interested. Metro's entire service area is much too large for a comprehensive bike share system, so Metro is planning to build out the network around transit corridors, providing a critical first/last mile connection for people who do not have or do not want to use a car. Metro is also working to integrate the regional TAP card, which works with all Metro bus, rail, and most other public bus services in the region, with bike share, which will provide a seamless connection between bicycles and transit. The TAP card currently can be connected to bike share memberships for renting bike share bicycles, but payment accounts are independently maintained. Although free transfers currently are not possible between bike share and transit, the bike share fare system was designed to be familiar to transit riders, at $1.75 per single ride for a limited period (same cost as a transit ride) before raising to the permanent rate of $3.50 per ride.

Metro has also convened a wide array of partners—planners, municipalities, and advocacy groups—to work on a bike/bus interface study, which will examine bicycle and bus interactions on 15 corridors throughout the county and examine bicyclist safety and transit operations before and after a specific bicycle treatment was implemented. The goal of the study is to create a set of guidelines that cities can use that will keep bicyclists safe and keep transit services moving. The study also uses extensive survey outreach and focus groups to reach people who are impacted.

Key Resources:

- *First Last Mile Strategic Plan (2014)*
- *Regional Bike Share Implementation Plan (2015)*
- *Active Transportation Strategic Plan (2016)*

City of Los Angeles

The City of Los Angeles adopted its Mobility Plan 2035 in 2016, which places an emphasis on safety, complete streets (Figure 12-8), and first/last mile connections. Following major investments in transit through Measure R, the Mobility Plan serves as a restructuring of Los Angeles' approach to transportation, with an emphasis on safety and accessibility over mobility. Los Angeles' efforts to improve the quality of pedestrian, bicycle, and transit infrastructure are aimed at increasing the use of active modes of transportation and shared modes, primarily public transit, while maintaining goods movement circulation. By adopting a complete streets approach, Los Angeles will implement measures to expand walk and bike sheds around transit stops, goals identified in Metro's complementary First Last Mile Strategic Plan. Making sure that streets are safe for all transportation users, specifically those who "walk, bike, or roll," is of the utmost importance for Los Angeles.

Figure 12-8

Complete street with protected bicycle lane, mid-block pedestrian crossing, and median refuge island in Downtown Los Angeles

For the Mobility Plan 2035 to succeed, Los Angeles is also undergoing a cultural shift in terms of linking transportation and land use. For the City, creating bicycle and pedestrian spaces means enhancing quality of life in communities. The City's People Streets Program, a placemaking program featuring plazas, parklets (shown in Figure 12-9), and bicycle corrals, intends to engage residents citywide. One of the benefits of the program is that it helps to show local businesses and residents that neighborhoods can be improved by making streets more dynamic and multipurpose places. To help people walk to these spaces and throughout the city, leading pedestrian intervals have been implemented throughout Downtown Los Angeles, Boyle Heights, and many centrally-located neighborhoods with high volumes of pedestrian activity.

The efforts towards livability are coupled with efforts to repurpose traditional car traffic lanes into multimodal lanes in projects such as on Los Angeles Street and Figueroa, Spring and Main streets in Downtown Los Angeles. Additionally, regional and local dollars have propelled key low-stress bike routes including the Los Angeles River and Expo Line Bike Path projects. These low-stress complete streets infrastructure projects are companion projects to the bike share program launched in partnership with Metro.

Key Resources:

- *Complete Streets Manual and Design Guide (2014)*
- *Mobility Plan 2035 (2016)*

Figure 12-9

Parklet created by City of Los Angeles People St program (Photo: LADOT People St Flickr)

City of Long Beach

In adopting the Mobility Element, a City plan to reprioritize transportation modes away from the personal automobile, Long Beach has created a strong vision for a future where walking, bicycling, and transit modes receive highest priority. Long Beach is already well-suited to meet these goals: Metro's Blue Line runs through the heart of the city, the Transit Gallery provides a hub for transit service, and the Long Beach Bikestation along the Transit Gallery was the first such facility in the US. The goals for the plan, which include reduced greenhouse gas emissions, more compact development, and walkable neighborhoods, fit well with what the City has already created. Pedestrian-friendly streets and more bicycle infrastructure, such as the protected bike lane shown in Figure 12-10, are at the heart of the City's future planning.

The City has used the Mobility Element as a foundation for future planning work. Its Downtown and TOD Pedestrian Master Plan specifically looks at walkability in the downtown core around the Blue Line, and outlines a shared street, "streetlets," green alleys, and bicycle boulevards. For site planning projects that reach a specific threshold, all City departments must review the plan before being approved, allowing planners to ensure that all future projects are friendly for pedestrians and bicyclists.

Figure 12-10

Protected bicycle lane in Long Beach, CA

Key Resources:

- *Mobility Element (2013)*
- *Downtown and TOD Pedestrian Master Plan (2016)*

City of Pasadena

In 2003, Metro's Gold Line opened, which connected Pasadena with Downtown Los Angeles by light rail. These stations were not particularly friendly for bicycle or pedestrian use. In 2006, Pasadena completed a pedestrian plan, much earlier than many other cities in the Los Angeles region had created any sort of active transportation plan. More recent efforts have centered on creating its own version of a Mobility Element and a Bicycle Transportation Action Plan, rounding out Pasadena's own suite of plans in active transportation.

With Metro's bike share launch in Downtown Los Angeles now complete, Pasadena is next in line to join Metro's bike share program. Between bike share and the City's completed Bicycle Transportation Action Plan, Pasadena is working internally and with Metro to expand its bicycle infrastructure, making a conscious effort to improve bicycle infrastructure around existing Gold Line stations, with much of its funding is coming in grants from Metro and Caltrans' Active Transportation Program.

Key Resources:

- *Pasadena Pedestrian Plan Volume 1 and Volume 2 (2006)*
- *Mobility Element (2015)*
- *Bicycle Transportation Action Plan (2015)*

City of Santa Monica

Like Long Beach, Santa Monica is a beach town where people are more inclined to travel by foot or bicycle. Santa Monica has embraced this culture and is actively promoting these transportation modes. The Bicycle Action Plan recognizes that bicycle transportation is critical to reaching a complete streets goal, toward greater economic health for the city, managing air pollution, and reducing congestion. The City's Pedestrian Action Plan, which complements the City's Vision Zero plan, recognizes walking as a fundamental way to get around the compact and dense city. The plan works to remove pedestrian obstacles and provide ways for people to more easily access the Expo Line expansion into the city.

Santa Monica has also launched GoSaMo, a campaign to encourage residents to get around without using a car. The city launched Breeze, its own bike share system, in November 2015. The Expo light rail line extension came to downtown Santa Monica in May 2016. Big Blue Bus is a bus service based in Santa Monica that runs to various points in Los Angeles County. The City is adding bicycle infrastructure and pedestrian scrambles. The City has pulled all these transport modes together under the GoSaMo umbrella to make is easy to get around Santa Monica without a car (Figure 12-11).

Figure 12-11

Santa Monica's Breeze bike share station and regular bicycle racks outside Metro's Expo Line Downtown Santa Monica station

Key Resources:

- *Bicycle Action Plan (2011)*
- *Pedestrian Action Plan (2015)*

Southern California Association of Governments (SCAG)

SCAG is the metropolitan planning organization for Los Angeles, overseeing a 6-county area that is home to 18 million people in 191 different cities. SCAG has no funding authority, so it cannot build any infrastructure. Instead, it works

closely with cities, jurisdictions, and agencies to implement policies related to bicycle and pedestrian access. The Go Human campaign shows how SCAG works with the jurisdictions inside its six-county service area. The campaign, which is centered on promoting safe environments for pedestrians and bicyclists, involves advertising, demonstration projects, and trainings for cities and elected officials. Although SCAG wants to reach members of the community—drivers, most notably—SCAG is more interested in educating its member jurisdictions in how to further promote active transportation.

SCAG has also engaged in research around bicycling and pedestrian transportation. Research topics included an examination of greenhouse gas emissions for various modes of first/last mile transportation when connected to transit, how active transportation impacts health and the local economy, and a database for counters that includes both pedestrian and bicycle counts.

Key Resources:

- *Go Human (2015)*
- *2016–2040 Regional Transportation Plan/Sustainable Communities Strategy (2016)*

Key Lessons

A strong policy foundation is vital. Outside of Long Beach and Santa Monica, there is little bicycle infrastructure in the Los Angeles region, and pedestrians often find challenges in getting around. However, the Los Angeles region as a whole has laid a strong policy foundation upon which future infrastructure can be built. Metro's Board of Directors has adopted both the First Last Mile Strategic Plan and the ATSP, which gives Metro staff the authority to promote active transportation modes when they collaborate with other jurisdictions. The City of Pasadena is adding improvements at intersections to make pedestrians visible and safe when crossing the street, including leading pedestrian intervals, which give pedestrians a head start when crossing, and pedestrian scrambles, which devote a portion of the signal cycle exclusively to pedestrians who can then cross in any direction. Similarly, other jurisdictions have adopted Vision Zero and complete streets policies, which further drive the need for good pedestrian and bicycle infrastructure. The Los Angeles region has spent a lot of time planning, and that will aid the region as a regional bicycle network and stronger pedestrian network are created.

Leadership from the top is important, and strong advocates are needed in planning roles. A culture shift at a City or agency was often the biggest factor in pushing bicycle and pedestrian infrastructure improvements. This often manifested in two ways. First, there was a slow but steady change in the hiring of new staff members, who were much more receptive to bicycle and pedestrian as a legitimate transportation mode and were enthusiastic in planning

for these modes. Second, there was a strong shift at the top of government, usually a City manager or agency board, which signaled a new direction for the government body. This new leadership from the top gave staffers the authority to carry out plans and policies that promoted active transportation. As a result, new transit projects now have a stronger bicycle and pedestrian focus, and existing transit infrastructure is being retrofitted to better accommodate bicyclists and pedestrians.

Demonstration projects—show, don't tell. Demonstration projects have been used at every level of government to show residents, elected officials, and governments the power of active transportation infrastructure. SCAG's *Go Human* campaign has consisted of several demonstration projects of interest to a city to show residents what a more bicycle and pedestrian friendly space could look like. Several of these projects are located along transit routes or take place during CicLAvia open streets events. These CicLAvia events, for which Metro and the City of Los Angeles are partners, encourage people to take transit to attend these car-free open streets events. Los Angeles, through its People Street initiative, works to reallocate street space for pedestrians and bicyclists. As more people see the power of these demonstration projects, more will support future bicycle and pedestrian strategies, especially around transit.

Collaboration may look messy, but roles are still defined. For regional projects, there are generally no formal collaboration models that are set up for one project and then can be used as a model for future projects. Each project is unique, and the collaboration structure should adapt to meet these specific needs. However, the best way to collaborate with other government bodies and jurisdictions is to constantly communicate. For example, the general managers of all transit operators in Los Angeles County meet on a regular basis to discuss policies and issues, and the TAP card system is often on the agenda. This kind of collaboration helps make transit transfers seamless. Funding authority often determines whether a regional body has the ability to implement plans, but even a regional transit agency like Metro does not own city streets, so the agency has to work with jurisdictions to reach a common goal of improving active transportation infrastructure.

Even when funding authority is not in play, collaboration is necessary to achieve regional goals. Metro's Gold Line stretches north and east out of Los Angeles through South Pasadena, Pasadena, Arcadia, Monrovia, Duarte, Irwindale, and Azusa. Planned eastward expansion of the Gold Line will reach Montclair, which is outside Los Angeles County, Metro's service area. All communities along the Gold Line have a strong working relationship with each other, and all understand the importance of bicycle access to the Gold Line and how bicycles need to cross jurisdictional lines to get to where they are going. Such collaboration efforts are vital if walking and bicycle networks centered on transit are to grow across an entire region.

California State law greatly aids active transportation investments. Certain legislation, such as the *California Environmental Quality Act* (CEQA) and the State's Complete Streets Act, has made it easier to pursue active transportation projects. CEQA set disclosure rules for legislation, making it easier to challenge government projects on environmental grounds, and the Complete Streets Act required cities to adopt complete streets plans. For Los Angeles, long known for its air quality problems, such legislation provided State-level support to pursue active transportation projects, both to reduce greenhouse gas emissions and other types of pollutants and to make streets a safer place for all users.

Funding comes in a variety of forms. Metro funds many of its current work through sales tax ballot initiatives, the last one being Measure R, a one-half cent sales tax increase in 2008. Los Angeles voters approved an additional one-half cent sales tax increase in 2016 for expansion of existing Metro transportation projects. Metro also has grant-making authority, and many cities, including Long Beach and Pasadena, take advantage of this money to propose new bicycle and pedestrian projects, especially around Metro transit properties. In Santa Monica, general fund dollars are used to promote GoSaMo, the City's pedestrian-, bicycle-, and transit-oriented mobility program, and a strong policy base with bicycle and pedestrian action plans have helped make this possible. Caltrans, the State transportation agency, also has an Active Transportation Program that provides grants to cities across the state.

Key Resources:

- *Rail to Rail/River Active Transportation Corridor (https://www.metro.net/projects/r2r/)*
- *Metro Bike Hub: El Monte (http://bikehub.com/metro/)*
- *Metro's Sales Tax Measure Expansion Plan (http://theplan.metro.net/)*
- *List of all Metro Projects (https://www.metro.net/projects/)*
- *Metro Bike Share (https://bikeshare.metro.net/)*
- *Long Beach Bikestation (http://home.bikestation.com/bikestation-long-beach)*
  Long Beach Bike Share (http://www.longbeachbikeshare.com/)
- *Breeze: Santa Monica Bike Share (http://santamonicabikeshare.com/)*
- *CicLAvia (http://www.ciclavia.org/)*
- *California Environmental Quality Act (CEQA) (http://resources.ca.gov/ceqa/)*
- *AB 1358: California's Complete Streets Act (http://www.leginfo.ca.gov/pub/07-08/bill/asm/ab_1351-1400/ab_1358_bill_20080930_chaptered.pdf)*

Acknowledgments:

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Minneapolis-St. Paul Case Study

Background and Setting

Minneapolis is known for its world-class trail system that serves as the backbone of its bicycle network. The region boasts a growing light rail and BRT system, and Minneapolis' downtown bus mall deposits thousands of pedestrians in the city center each morning. The city, which is also known for its cold winters, has developed a secondary pedestrian network in the form of a skyway that permits indoor travel through most of the downtown area. Current challenges include creating safe and comfortable connections between the popular trail system and transit, filling in gaps and densifying the bike share system, ensuring that the growing LRT and BRT systems are well connected to safe, comfortable and convenient walking and bicycling routes, and extending trail successes and culture to streets and areas outside of the city of Minneapolis.

Figure 12-12

Part of Minneapolis extensive trail system

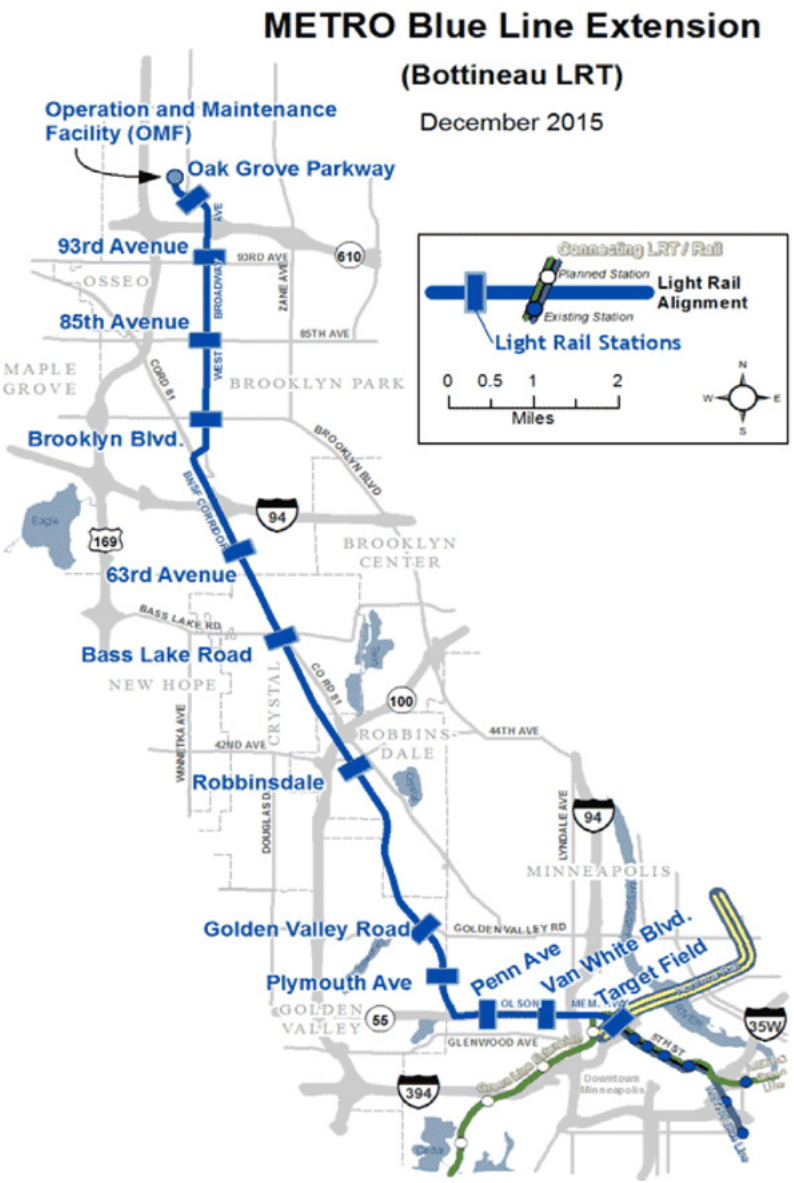
Major Initiatives and Key Agency Initiatives

Metro Transit

Metro Transit operates transit services in the Minneapolis-St. Paul region, including light rail service, bus and BRT, and commuter rail. Metro's LRT system added the Green Line connecting downtown Minneapolis to downtown St. Paul in June 2014 and is currently planning for a Green Line extension to suburbs to the southwest (the Southwest Corridor Project) and a Blue Line extension to suburbs in the northwest (Figure 12-13). Both are aiming to begin service in 2021. Metro is also moving ahead with BRT service, with the Red Line operating south from the Mall of America and a rapid bus line (A Line) providing a connection for a number of neighborhoods in St. Paul to the Blue line in Minneapolis and on to the Green line in St. Paul.

Figure 12-13

Map of planned Metro Transit Blue Line light rail extension



Metro Transit is looking to increase on-board bicycle capacity on its transit fleet after adding two-bicycle racks to its entire bus fleet; it is looking at three-bicycle racks, which are already in use in some cities. Three-bicycle racks extend further in front of the bus and operators are concerned about how they would affect their turning radius, particularly on downtown streets. In the interim, Metro Transit is looking at ways to provide real-time data so cyclists can know in advance if an expected bus has room for their bicycle and reduce frustration for riders.

Hennepin County

Hennepin County is the largest county in Minnesota, with 45 cities including Minneapolis. As part of the Southwest light rail extension (Green Line) and Bottineau Blue Line extension, Hennepin County conducted bicycle studies for both projects, as well as Station Area plans that included a pedestrian access element. For these studies, it looked at walk sheds and bike sheds around planned stations, including looking for gaps in the network and potential improvements. It assists cities and other local jurisdictions by conducting feasibility studies for network improvements, and help cities identify and apply for funding.

Key Resources:

- *Southwest Light Rail Transit Bicycle Facility Assessment, Technical Memorandum #1, Existing Conditions, and Technical Memorandum #2, Recommendations (2015)*
- *Bottineau LRT / Metro Blue Line Extension Bicycle Study (2016)*

NiceRide Minnesota

NiceRide Minnesota is private non-profit bike share operator that introduced bike share to the region in 2010 and has expanded to 190 stations and more than 1700 bicycles. As rail stations have come online, NiceRide's goal has been to place bike share stations at every rail stop so people instinctively think of the bike share and transit/rail connection. It received funding to place stations at all Green Line stations when the line opened in 2014 and is now working to fill in the network to the density they would like. To achieve this, it has developed a Five-Year Assessment and Strategic Plan to densify its system by adding 6–10 stations per year, focusing on specific target areas each year. As part of the densification project, it has an interactive online map through which community members can choose stations. NiceRide is also involved in other bicycle programs that aim to get bicycles to people not being served by bike share, including providing bicycle access to long-term residents at the Mayo Clinic and offering bicycles for the season to low-income individuals in selected neighborhoods through the NiceRide Neighborhood Program.

Key Resources:

- *Five-Year Assessment and Strategic Plan (2015)*

Metropolitan Council

The Metropolitan Council serves as the designated MPO for the Twin Cities metropolitan region and carries out long-range planning activities. In addition to and in support of long-range planning, Metro maintains regionals data on bicycling networks and is working to develop a regional pedestrian network database.

The Metropolitan Council developed the 2040 Transportation Policy Plan (TPP), which was adopted by the Metropolitan Council on January 14, 2015. Chapter 7 of the TPP covers bicycle/pedestrian investments and is based on the Council's 2014 Regional Bicycle System Study, which looks at on how on-street bikeways and trails serve regional transportation trips. The TPP states that the "high level of importance of both walking and bicycling in connecting to the regional transit system should be noted; there are many more residents who live within three miles of transit service (compared to proximity to work) who could take advantage of improved opportunities to combine transit with walking or biking" and that improvements should facilitate and encourage those connections. Among the key factors guiding the prioritization of walking and bicycling investments are connecting with transit and regional destinations.

Key Resources:

- *Bicycle and Pedestrian Connections to Transit Infrastructure Study (2009)*
- *Transportation Policy Plan element of the Thrive 2040 (2014)*
- *Regional Bicycle System Study (2014)*

Key Lessons

Ensure that bicycle and pedestrian connections are included in early planning phases. Expanding transit into suburbs presents challenges and opportunities. Pedestrian access in suburbs can be poor because many do not have sidewalks, there are many cul-de-sacs and few gridded streets, and most people accessing transit in those locations are using park-and-rides. However, thorough consideration of bicycle and pedestrian access issues during planning phases offers some opportunities. For the Blue Line extension, a bicycle study was conducted very early, and bicycle parking, access points, and crossings were able to be incorporated into the design at the 30% stage. Early is a great time to engage the community and identify potential space for bicycle parking and crossing locations that can be integrated into the station area design. Early planning also provides opportunities to consider how the LRT line will interact and connect with regional trails. Although the plans can change after this point, having these considerations already included provides them with inertia and momentum up to keep the bicycle facilities in the plan. Meanwhile, on the Green Line extension, planning for the project, including a bicycle study, were occurring at the same time that the city of Hopkins, through which the LRT will pass with a stop blocks from its downtown, was working on a mainstreet improvement plan. Metro Transit and the City of Hopkins were able to coordinate on their planning efforts and make for a better connection between the station and the main street. Planning for the original Blue and Green lines in Minneapolis and St. Paul did not include considerations for walking and bicycling connections; as a result, Hennepin County and the two cities are still working to implement some connections on those lines long after they opened.

Transit agencies should acknowledge the importance of embracing walking and bicycling. For Metro Transit, pushing a culture that embraces walking and bicycling as important complements to the transit system has been essential. It is important for a transit agency to serve as a model of the pedestrian- and bicycle-friendly environment that it wishes to provide for customers. Having people on staff who are passionate about bicycling and walking, often young and enthusiastic employees, has been necessary because many of the projects in this area have required staff to add these duties to their existing workloads, but have embraced the opportunity. Efforts to promote a culture friendly to walking and bicycling have included organizing an annual unofficial company bicycle and ride trip, usually taking an outbound weekend commuter train to the end of the line and riding back. In addition to providing an opportunity to engage with fellow employees in a fun group experience, the ride also provides an opportunity to experience getting to and from stations on a bicycle and what the bicycle experience is like in different parts of the region. Staff working on bicycle and pedestrian connections have identified an ally in the Metro Transit police force with bicycle police officers and arranged a tour for Metro Transit employees to go out with bicycle police officers and experience their perspective. The tour was featured in the company newsletter and promoted both the police force and the importance of bicycling.

Figure 12-14

Metro Transit bicycle racks that recall Metro buses, light rail, and commuter rail trains

Getting people to city centers without cars is important. Nearly all transit riders are pedestrians at one end of their trip or the other, an important fact for cities and regions to keep in mind. In Minneapolis, the Marq2 bus mall corridor has been extremely successful in making bus trips into and out of the center city quick and efficient, making transit an easier choice for many Twin Cities area residents (Figure 12-15). The couplet of Marquette and 2nd avenues

were redesigned in 2009 to provide express bus service that could pick up passengers and get out of downtown much faster than traditional bus service. This has the effect of creating a group of pedestrians downtown. In fact, even the Ramps, a set of large parking garages with transit on the edge of downtown set the stage for people to be walking, using bicycles (bike share or their own bicycles) or taking transit around downtown during the day. Making it easy for people to leave their cars behind, even for the first or last mile, can be important.

Figure 12-15

Marq2 transit corridor in Minneapolis (Photo: Metro Transit)

Making bus stops effective is about getting the details right. Metro Transit has several current or recent projects aimed at improving the quality of bus stops by making them more consistent, visible, comfortable, safe, accessible, and helpful. On the more enhanced end of the bus stop spectrum, the recently-implemented A Line rapid arterial bus line included specially-branded and outfitted stops (Figure 12-16). In total, 38 platforms throughout the A Line bus route, which connects the Blue line LRT in Minneapolis (and the airport) to the Green line LRT and areas to the east in St. Paul, were implemented with a consistent design. The design includes branded 10-foot pylons that can be seen from a block or more away and flash when a bus is within a minute away, comfortable shelters with lighting and heat, ample width to accommodate wheelchairs around the shelter, audible arrival cues, and vicinity maps. The A Line platforms were built out into the parking strip to accommodate easier loading and unloading and are nine inches high rather than the standard six inches to allow bus boarding ramps to sit flat when extended. Another effort, the Better Bus Stops program, is aimed at improving bus stops throughout the Metro service areas by adding shelters, improving signs to include at a minimum to route numbers and directions served, and adding vicinity maps to the more frequented stops.

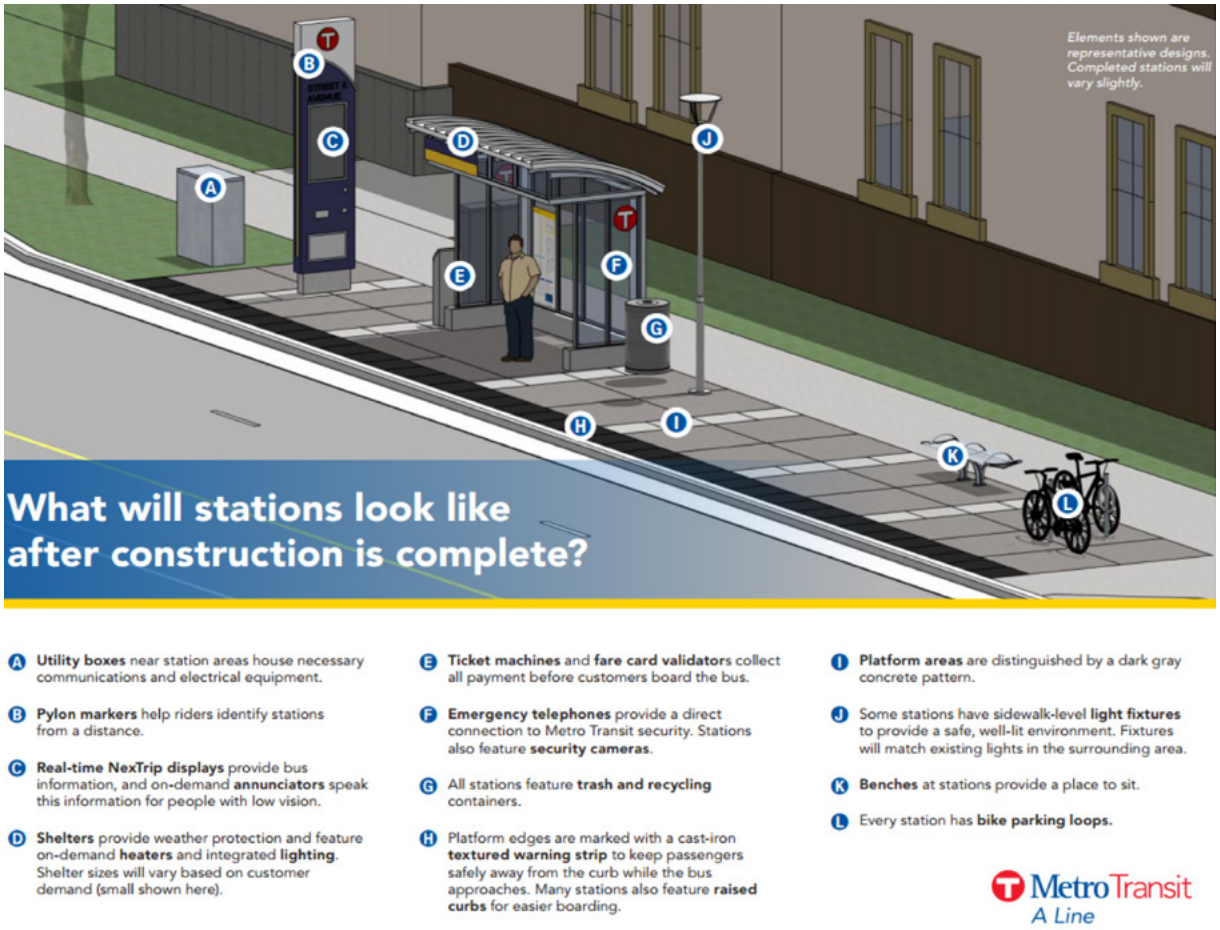


Figure 12-16 *Metro Transit A Line bus stop elements*

Key Resources:

- *Metro Transit A Line (http://www.metrotransit.org/a-line-now-open)*
- *Metro Transit Marq 2 Bus Lanes (http://www.tlcminnesota.org/a-transit-improvement-marq2-bus-lanes/)*

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SECTION 13

References and Citations

Resources

Key resources are denoted with an asterisk (*). Brief annotations for key resources are also provided the first time they appear.

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Section 2, Access Sheds and Network

*American Public Transportation Association. (2012). *Design of On-street Transit Stops and Access from Surrounding Areas* (Recommended Practice APTA SUDS-RP-UD-005-12). Washington, DC. http://www.apta.com/resources/hottopics/sustainability/Documents/APTA%20SUDS-RP-UD-005-12%20On%20Street%20Transit%20Stops.pdf.

Discusses ways to provide or improve connections to, from and at on street transit stops. Provides guidelines for street connectivity, street design, and surrounding land uses and information on how to assess existing or new on-street transit stops and provide input to local jurisdictions to invest in pedestrian improvements.

Federal Highway Administration. (2016). *Achieving Multimodal Networks*. http://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/multimodal_networks/fhwahep16055.pdf.

Federal Highway Administration. (2015). *Case Studies in Delivering Safe, Comfortable, and Connected Pedestrian and Bicycle Networks*. https://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/network_report/.

Federal Highway Administration. (2015). *Delivering Safe, Comfortable, and Connected Pedestrian and Bicycle Networks: A Review of International Practices*. http://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/global_benchmarking/page00.cfm.

*Federal Transit Administration. (2011). *Final Policy Statement on Eligibility of Pedestrian and Bicycle Improvements under Federal Transit Law*. https://www.federalregister.gov/documents/2011/08/19/2011-21273/final-policy-statement-on-the-eligibility-of-pedestrian-and-bicycle-improvements-under-federal.

FTA policy statement that "all pedestrian improvements located within one-half mile and all bicycle improvements located within three miles of a public transportation stop or station shall have a de facto physical and functional relationship to public transportation" and are thereby eligible for FTA funding.

Federal Highway Administration (2016). *Small Town and Rural Multimodal Networks*. Washington, DC. https://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/small_towns/.

*Los Angeles County Metropolitan Transportation Authority. (2014). *First Last Mile Strategic Plan*. https://media.metro.net/docs/First_Last_Mile_Strategic_Plan.pdf.

Establishes a strategic approach for LA Metro, LA County, cities, and other groups to improve first/last mile connections to transit. A core element of the plan is the concept of the Pathway, which is defined as "a proposed county-wide, transit access network designed to reduce the distance and time it takes people to travel from their origins to stations and from stations to destinations, while simultaneously improving the user experience."

San Bernardino Associated Governments. (2012). *Improvement to Transit Access for Cyclists and Pedestrians: Final Report*. San Bernardino, CA. http://www.sanbag.ca.gov/planning2/study_bike-improvmnts.html.

United States Department of Transportation. (2010). *United States Department of Transportation Policy Statement on Bicycle and Pedestrian Accommodation Regulations and Recommendations*. https://www.fhwa.dot.gov/environment/bicycle_pedestrian/guidance/policy_accom.cfm.

Section 3, Key Concepts for Stops and Stations

*American Public Transportation Association. (2012). *Design of On-street Transit Stops and Access from Surrounding Areas* (Recommended Practice APTA SUDS-RP-UD-005-12). Washington, DC. http://www.apta.com/resources/hottopics/sustainability/Documents/APTA%20SUDS-RP-UD-005-12%20On%20Street%20Transit%20Stops.pdf.

Discusses ways to provide or improve connections to, from, and at on-street transit stops. Provides guidelines for street connectivity, street design, and surrounding land uses and information on how to assess existing or new on-street transit stops and provide input to local jurisdictions to invest in pedestrian improvements.

Center of Innovation & Excellence (CIE). (2015). A Literature Review of Best Practices in the Planning And Implementation of Bike Facilities in Suburban LRT Expansion Projects. Prepared for Hennepin County Public Works, Housing, Community Works and Transit. http://www.hennepin.us/-/media/hennepinus/residents/transportation/bottineau/bottineau-bike-study-appendix-D.pdf?la=en.

*National Association of City Transportation Officials. (2016). *Transit Street Design Guide*. Island Press. Washington, DC. http://nacto.org/publication/transit-street-design-guide/.

Provides detailed design guidance in a number of areas including designing transit streets and lanes, stops, stations, and intersections. The guide breaks guidance into elements that are critical to the design, those that are recommended, and those that are optional, along recommended dimensions. The needs of pedestrians and bicyclists to access and coexist with transit plays a key role in design suggestions throughout the guidebook.

*Transit Cooperative Research Program (TCRP). (2012). *TCRP Report 153: Guidelines for Providing Access to Public Transportation*. Washington, DC. http://www.trb.org/Main/Blurbs/166516.aspx.

Addresses planning and design for providing access to high-capacity transit stations, including guidelines for arranging and integrating various station design elements. Presents guidelines for bicycle and pedestrian access to and from station areas. Provides elements of successful station access planning and specific lessons learned from case studies across the US.

United States Department of Transportation. (2000). FHWA/FTA Memorandum: Announcement of USDOT Accessibility Regulations. Washington, DC. https://www.fhwa.dot.gov/environment/bicycle_pedestrian/resources/atl.cfm.

Victoria Transport Policy Institute. (2014). Universal Design. Transportation Systems that Accommodate All Users, including People with Disabilities and Other Special Needs. Victoria, BC. http://www.vtpi.org/tdm/tdm69.htm.

Section 4, Stop and Station Considerations

Alta Planning + Design. (2008). Bicycle Interactions and Streetcars: Lessons Learned and Recommendations. Prepared for Lloyd District Transportation Management Association. http://www.altaplanning.com/wp-content/uploads/Bicycle_Streetcar_Memo_ALTA.pdf.

*American Association of State Highway and Transportation Officials (AASHTO). (2014). *Guide for Geometric Design of Transit Facilities on Highways and Streets.* https://bookstore.transportation.org/item_details.aspx?id=2215.

Provides geometric details on stop and station design and placement on streets and highways, and includes a chapter on guidelines for bicycle and pedestrian access to transit (Chapter 7).

American Association of State Highway and Transportation Officials Executive Committee. (2012). *Guide for the Development of Bicycle Facilities.* https://bookstore.transportation.org/collection_detail.aspx?ID=116.

American Public Transportation Association. (2010). *Bus Rapid Transit Stations and Stops* (Recommended Practice APTA BTS-BRT-RP-002-10). Washington DC. http://www.apta.com/resources/standards/Documents/APTA-BTS-BRT-RP-002-10.pdf.

*District Department of Transportation. (2012). *DC Streetcar Design Criteria Manual.* Washington, DC. http://ddot.dc.gov/sites/default/files/dc/sites/ddot/publication/attachments/ddot_dc_streetcar_design_criteria_January_2012.pdf.

Chapter 4 provides in depth guidance streetcar stop design, including siting criteria, platform design, station amenities, and the integration of public art.

*Easter Seals Project ACTION. (2014). *Toolkit for the Assessment of Bus Stop Accessibility and Safety.* http://www.nadtc.org/resources-publications/toolkit-for-the-assessment-of-bus-stop-accessibility-and-safety/.

Focuses on measures transit agencies and jurisdictions can take to remove physical, cognitive, and psychological barriers to accessing transit for people with disabilities. Provides a toolkit for conducting a bus stop inventory and guidance on best practices for universal design.

Easter Seals Project ACTION. (2011). *Improving Transit Facility Accessibility by Employing Wayfinding Technology.* Information Brief, November 2011.

http://www.nadtc.org/resources-publications/improving-transit-facility-accessibility-by-employing-wayfinding-technology/.

*Federal Highway Administration. (2008). *Pedestrian Safety Guide for Transit Agencies*. Washington, DC. http://safety.fhwa.dot.gov/ped_bike/ped_transit/ped_transguide/.

Provides transit agencies with a resource for improving pedestrian safety, incorporating information about common pedestrian safety issues, descriptions of engineering, education, and enforcement programs that have been effective, and references to other tools that can be used to identify pedestrian safety problems. Serves as a resource for transit agency staff and other partners who work to develop safe access and egress for transit passengers.

Greater Cleveland Regional Transit Authority (GCRTA). (2004). *Transit Waiting Environments: An Ideabook for Making Better Bus Stops*. Cleveland, OH. http://www.gcbl.org/files/resources/tweprint.pdf.

Greater Cleveland Regional Transit Authority. (2015), *Bus Stop Design Guidelines*. http://www.riderta.com/sites/default/files/serviceplanning/BusStopDesignGuidelines201510.pdf.

*Institute of Transportation Engineers. (2010). *Designing Walkable Urban Thoroughfares: A Context Sensitive Approach*. http://library.ite.org/pub/e1cff43c-2354-d714-51d9-d82b39d4dbad.

Provides engineering standards for pedestrian and bicycle safety on streets and bus transit, placing an emphasis on context-sensitive solutions and shies away from solutions that can apply in all situations. The guide provides design guidelines for lane widths, medians and refuge islands, bicycle lanes, on-street parking, mid-block crossings, bus stops, and storm water management.

Metrolink. (2009). *SCRRA Highway-Rail Grade Crossings: Recommended Design Practices and Standards Manual*. http://www.metrolinktrains.com/pdfs/EngineeringConstruction/Grade_Cross_Stand_Guidelines_Manual_Jun29_09.pdf.

*National Association of City Transportation Officials. (2016). *Transit Street Design Guide*. Island Press. Washington, DC. http://nacto.org/publication/transit-street-design-guide/.

National Highway Traffic Safety Administration. (2017). *Traffic Safety Facts: 2015 Data, Pedestrians*. Publication DOT-HS-812-375. Washington, DC. https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812375.

*Transit Cooperative Research Program. (1996). *TCRP Report 19: Guidelines for the Location and Design of Bus Stops*. Washington, DC. http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rpt_19-a.pdf.

Provides guidelines to transit agencies and local governments for locating and designing bus stops that consider convenience, safety, and access to sites. Discusses the need for cooperation and coordination between stakeholders, engineering consideration such as curb radii and stop configurations, and community integration, including pedestrian access and station amenities.

Transit Cooperative Research Program. (2008). *TCRP Report 125: Guidebook for Mitigating Fixed-Route Bus-and-Pedestrian Collisions*. Washington, DC. http://www.tcrponline.org/PDFDocuments/TCRP_RPT_125.pdf.

Transit Cooperative Research Program. (2009). *TCRP Report 137: Improving Pedestrian and Motorist Safety Along Light Rail Alignments*. Washington, DC. http://www.trb.org/Publications/Blurbs/162666.aspx.

*Transit Cooperative Research Program. (2015). *TCRP Report 175: Guidebook on Pedestrian Crossings of Public Transit Rail Services*. Washington, DC. http://www.tcrponline.org/PDFDocuments/tcrp_rpt_175.pdf.

Details 34 treatments that involve barriers, design, signs and signals, pavement markings, infrastructure, and operations changes for improving pedestrian safety around light rail and streetcar crossings. The guide also provides case studies that examine how different transit agencies addressed their unique pedestrian safety concerns.

Transit Cooperative Research Program. (2007). *TCRP Research Results Digest 84: Audible Signals for Pedestrian Safety in LRT Environments*. Washington, DC. http://www.trb.org/Main/Blurbs/158958.aspx.

*Transit Cooperative Research Program. (2015). *TRCP Synthesis 117: Better On-Street Bus Stops*. Washington, DC. http://www.tcrponline.org/PDFDocuments/tcrp_syn_117.pdf.

Catalogs survey responses from 48 transit agencies in the US and Canada on their guidelines for building bus stops and provides several case studies from across the country where better bus stops have been built. Does not provide many details on how to accommodate bicycles and pedestrians coming to the stop, but it is a great resource for the immediate stop area.

Transit Cooperative Research Program. (2015). *TCRP Report 175: Guidebook on Pedestrian Crossings of Public Transit Rail Services*. Washington, DC. http://www.tcrponline.org/PDFDocuments/tcrp_rpt_175.pdf.

Section 5, Pedestrian Access

*American Association of State Highway and Transportation Officials. (2004). *Guide for the Planning, Design, and Operation of Pedestrian Facilities*. https://bookstore.transportation.org/item_details.aspx?id=119.

Provides thorough guidance on the planning, design, and operation of pedestrian facilities, focusing on effective measures for accommodating pedestrians on public rights-of-way. Describes appropriate methods for accommodating pedestrians on different roadway and facility types. Primary audience is planners, roadway designers, and transportation engineers working at the local, state, and regional level.

*American Public Transportation Association. (2012). *Design of On-street Transit Stops and Access from Surrounding Areas* (Recommended Practice APTA SUDS-RP-UD-005-12). Washington, DC. http://www.apta.com/resources/hottopics/sustainability/Documents/APTA%20SUDS-RP-UD-005-12%20On%20Street%20Transit%20Stops.pdf.

Federal Highway Administration. (2013). *Guide for Maintaining Pedestrian Facilities for Enhanced Safety*. Report FHWA-SA-13-037. Washington, DC. https://safety.fhwa.dot.gov/ped_bike/tools_solve/fhwasa13037/.

Federal Highway Administration. (2014). *Road Diet Informational Guide*. FHWA Safety Program, Report FHWA-SA-14-028. Washington, DC. https://safety.fhwa.dot.gov/road_diets/info_guide/.

*Institute of Transportation Engineers. (2010). *Designing Walkable Urban Thoroughfares: A Context Sensitive Approach*. http://library.ite.org/pub/e1cff43c-2354-d714-51d9-d82b39d4dbad.

National Association of City Transportation Officials. (2016). *Transit Street Design Guide*. Island Press. Washington, DC. http://nacto.org/publication/transit-street-design-guide/.

PEDSAFE. (2013). *Pedestrian Safety Guide and Countermeasure Selection System*. http://www.pedbikesafe.org/PEDSAFE/.

Transit Cooperative Research Program. (2006). *TCRP Report 112/NCHRP Report 562: Improving Pedestrian Safety at Unsignalized Crossings*. Washington, DC. http://www.trb.org/Publications/Blurbs/162666.aspx.

Transit Cooperative Research Program. (2009). *TCRP Report 137: Improving Pedestrian and Motorist Safety Along Light Rail Alignments*. Washington, DC. http://www.trb.org/Publications/Blurbs/162666.aspx.

*Transit Cooperative Research Program. (2015). *TCRP Report 175: Guidebook on Pedestrian Crossings of Public Transit Rail Services*. Washington, DC. http://www.tcrponline.org/PDFDocuments/tcrp_rpt_175.pdf.

Section 6, Bicycle Access

*American Association of State Highway and Transportation Officials Executive Committee. (2012). *Guide for the Development of Bicycle Facilities*. https://bookstore.transportation.org/collection_detail.aspx?ID=116.

Provides thorough guidance on how to accommodate bicycle travel and operations, resulting in facilities that meet the needs of bicyclist and other road users. The guide provides flexibility to encourage designs that are adaptable to specific local context and incorporate the needs of bicyclists, pedestrians, and motorists.

BIKESAFE. (2014). *Bicycle Safety Guide and Countermeasure Selection System*. http://www.pedbikesafe.org/bikesafe/.

Federal Highway Administration. (2015). *Case Studies in Delivering Safe, Comfortable, and Connected Pedestrian and Bicycle Networks*. https://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/network_report/.

*Federal Highway Administration. (2015). *Separated Bike Lane Planning and Design Guide*. https://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/separated_bikelane_pdg/page00.cfm.

Provides a broad review of separated bike lane planning considerations; and flexible menu of design recommendations for the implementation of separated bike lanes. Features specific recommendations for separated bike lanes at transit stops and the mitigation of conflicts between bicyclists and transit vehicles.

*Federal Transit Administration. (2011). *Final Policy Statement on Eligibility of Pedestrian and Bicycle Improvements under Federal Transit Law*. https://www.federalregister.gov/documents/2011/08/19/2011-21273/final-policy-statement-on-the-eligibility-of-pedestrian-and-bicycle-improvements-under-federal.

*National Association of City Transportation Officials. (2013). *Urban Bikeway Guide*. Island Press. Washington, DC. http://nacto.org/publication/urban-bikeway-design-guide/.

Provides detailed design guidance for bicycle facilities in a number of areas, including bike lanes, cycle tracks, bike boulevards, intersection treatments, bikeway signing and marking, and bicycle signals. Includes three levels of guidance for required, recommended, and optional elements of specific facilities.

Section 7, Bicycle Parking at Transit

*Association of Pedestrian and Bicycle Professionals. (2010). *Bicycle Parking Guidelines (2nd Edition)*. http://www.apbp.org/?page=publications.

Provides comprehensive guidance on the implementation of bicycle parking, covering topics such as short- and long-term bicycle parking, elements of good rack designs, maintenance best practices, placement and site plans, and a variety of images and charts to illustrate key concepts.

*Association of Pedestrian and Bicycle Professionals. (2015). *Essentials of Bike Parking: Selecting and Installing Bike Parking that Works*. http://c.ymcdn.com/sites/www.apbp.org/resource/resmgr/Bicycle_Parking/EssentialsofBikeParking_FINA.pdf.

Provides a brief overview of APBP's Essentials of Bike Parking, covering site planning for short and long-term bike parking facilities, recommended bicycle rack selection, and guidance on placement and installation.

Bay Area Rapid Transit. (2015). BART Bike Parking Capital Program: Increasing Bike Access While Reducing Bikes Onboard. Prepared by Eisen Letunic. https://www.bart.gov/sites/default/files/docs/BART%20bike%20pkg%20update_2015-04-20_0.pdf.

Federal Highway Administration. (2006). *Federal Highway Administration University Course on Bicycle and Pedestrian Transportation: Lesson 17 Bicycle Parking and Storage*. https://www.fhwa.dot.gov/publications/research/safety/pedbike/05085/pdf/lesson17lo.pdf.

Bay Area Rapid Transit. (2012). *BART Bicycle Plan: Modeling Access to Transit*. Oakland, CA. http://www.bart.gov/sites/default/files/docs/BART_Bike_Plan_Final_083012.pdf.

*San Francisco Municipal Transportation Agency (2015). *Bicycle Parking: Standards, Guidelines, Recommendations*. https://www.sfmta.com/sites/default/files/pdfs/2015/SFMTA_bicycle_parking_guidelines.pdf.

Provides detailed guidance on how public agencies can install bike parking, covering the spacing, materials, specifications, and overall best practices for building short- and long-term bicycle parking. Provides a variety of images and charts to illustrate key concepts.

Transit Cooperative Research Program (TCRP). (2012). *TCRP Report 153: Guidelines for Providing Access to Public Transportation*. Washington, DC. http://www.trb.org/Main/Blurbs/166516.aspx.

Section 8, Bicycles on Transit Vehicles

City of Honolulu. (2011). Station Access and Modal Interface Report: Honolulu High-Capacity Transit Corridor Project. Honolulu, HI. http://hartdocs.honolulu.gov/docushare/dsweb/View/Collection-669.

*Mineta Transportation Institute. (2011). Bicycling Access and Egress to Transit: Informing the Possibilities (MTI Report 10-07). http://transweb.sjsu.edu/PDFs/research/2825_bicycling_access.pdf.

Case studies from five different American cities, towns, and counties provide information on best practices for integrating bicycles with transit. Focus group data shows that bicyclists like to bring their bicycles with them onto transit vehicles instead of leaving their bicycles at a transit stop or station.

*Transit Cooperative Research Program. (2005). *TCRP Synthesis 62: Integration of Bicycles and Transit*. Washington, DC. http://www.trb.org/Main/Blurbs/156477.aspx.

Discusses integrating bicycles with bus and rail transit services, including on-board accommodations, bicycle parking, and related costs, safety implications, and more. Also documents many existing bicycle and transit integration programs across the US and Canada.

Section 9, Bike Share and Transit

National Association of City Transportation Officials (NACTO). (2016). *Bike Share Station Siting Guide*. http://nacto.org/wp-content/uploads/2016/04/NACTO-Bike-Share-Siting-Guide_FINAL.pdf.

Toole Design Group and the Pedestrian and Bicycle Information Center. (2012). Bike Sharing in the United States: State of the Practice and Guide to Implementation. Prepared for FHWA. http://www.pedbikeinfo.org/pdf/Programs_Promote_bikeshareintheus.pdf.

Section 10, Planning for Pedestrian and Bicycle Access to Transit

AARP. (2011). Achieving Transit Access: An Action Plan. Washington, DC. http://www.aarp.org/content/dam/aarp/livable-communities/learn/transportation/transit-access-project-aarp.pdf.

Advocacy Advance. (2014). First Mile, Last Mile Report. Washington, DC. http://www.advocacyadvance.org/docs/FirstMileLastMile_August2014_web.pdf.

Cape Cod Commission (CCC). (2013). Closing the Gaps: Connecting Cape Cod's Bicycle and Pedestrian Network to Transit Routes. Barnstable, MA. http://www.capecodcommission.org/resources/initiatives/TRIPfinalrpt.pdf.

Center for Transit-Oriented Development. (2015). Oriented Toward Equity: A Rating System for Equitable Transit-Oriented Development. Boston, MA. http://www.northeastern.edu/dukakiscenter/wp-content/uploads/2013/10/NEU_eTOD_rprt_web.pdf.

City of Denver. (2014). Transit Oriented Denver. Denver, CO. https://www.denvergov.org/content/dam/denvergov/Portals/193/documents/TOD_Plan/TOD_Strategic_Plan_FINAL.pdf.

District Department of Transportation (DDOT). (2014). *move dc* (2014). Washington, DC. http://www.wemovedc.org/.

Federal Highway Administration (FHWA). (2015). Bicycle and Pedestrian Provisions of Federal Transportation Legislation. Washington, DC. https://www.fhwa.dot.gov/environment/bicycle_pedestrian/guidance/guidance_2015.cfm.

Federal Highway Administration (FHWA). (2017). City of Richmond Bicycle and Pedestrian Network Improvement Study. Washington, DC. https://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/richmond_nis/.

Federal Highway Administration (FHWA). (2014). *Statewide Pedestrian and Bicycle Planning Handbook*. Washington, DC. http://www.planning.dot.gov/documents/Ped-Bike_State_Planning_Handbook.pdf.

Federal Highway Administration (FHWA). (2014). *Statewide Transportation Planning for Healthy Communities*. Washington, DC. http://www.planning.dot.gov/documents/VolpeFHWA_DOT_Health.pdf.

Greater Cleveland Regional Transit Authority. TOD—Best Practices. Cleveland, OH. http://www.riderta.com/tod/bestpractices.

Hennepin County. Southwest Light Rail Transit Bicycle Facility Assessment. Minneapolis, MN. http://www.hennepin.us/~/media/hennepinus/residents/transportation/documents/Tech%20Memo%201%20-%20Existing%20Conditions.pdf (Technical Memorandum #1 Existing Conditions) and http://www.hennepin.us/~/media/hennepinus/residents/transportation/documents/Tech%20Memo%202%20-%20Recommendations.pdf (Technical Memorandum #2 Recommendations).

King County. (2014). Non-Motorized Connectivity Study. Seattle, WA. http://metro.kingcounty.gov/programs-projects/nmcs/#report.

*Los Angeles County Metropolitan Transportation Authority (Metro) and Southern California Association of Governments (SCAG). (2014). First Last Mile Strategic Plan. Los Angeles, CA. https://media.metro.net/docs/First_Last_Mile_Strategic_Plan.pdf.

Miami-Dade Metropolitan Planning Organization. (2014). Transit System Bicycle Master Plan for Miami-Dade County. Miami, FL. http://www.miamidade.gov/transit/library/reports/transit-system-bicycle-master-plan.pdf.

Minneapolis St Paul Area Metro Council. (2009). Bicycle and Pedestrian Connections to Transit Infrastructure Study. St. Paul, MN. http://www.metrocouncil.org/Transportation/Publications-And-Resources/Bicycle-and-Pedestrian-Connections-to-Transit-Infr.aspx.

San Bernardino Associated Governments (SANBAG). (2012). Improvement to Transit Access for Cyclists and Pedestrians. San Bernardino, CA. http://www.sanbag.ca.gov/planning2/study_bike-improvmnts.html.

*San Francisco Bay Area Rapid Transit (BART). (2012). *First Last Mile: Modeling Access to Transit*. Oakland, CA. http://www.bart.gov/sites/default/files/docs/BART_Bike_Plan_Final_083012.pdf.

Presents available quantitative and qualitative data on existing conditions for people using bicycles to access BART. Outlines 20 key strategies to improve the connection to transit for cyclists and provides a Bicycle Investment Toolkit to assess the expected effect of bicycle related improvements on bicycle access rates to stations.

Santa Clara Valley Transportation Authority. (2016). Pedestrian Access to Transit Plan. San Jose, CA. http://www.vta.org/getting-around/bike-and-pedestrian/pedestrian-program.

Seattle. (2015). Vision Zero Plan. Seattle, WA. http://www.seattle.gov/visionzero/the-plan.

Solano Transportation Authority (STA). (2011). Safe Routes to Transit Plan. Suisun City, CA. http://www.sta.ca.gov/Content/10044/SafeRoutestoTransit.html.

Southeastern Pennsylvania Transportation Authority (SEPTA). (2015). SEPTA Cycle-Transit Plan: A Strategic Approach. Philadelphia, PA. http://www.septa.org/sustain/pdf/cycletransitplan15.pdf.

*TriMet. (2011). Pedestrian Network Analysis. Portland, Oregon. http://trimet.org/projects/pedestrian-network.htm.

Details a methodology for identifying priority areas based on community environment, stop locations and nearby attractors, deficiencies, and opportunities and conducts detailed analyses of ten areas identified as focus areas. Provides a toolkit of strategies, treatments, and policies to improve make walking to transit safer, easier and more comfortable.

TriMet. (2012). Coordinated Transportation Plan for Elderly and People with Disabilities. Portland, Oregon. https://trimet.org/pdfs/publications/elderly-and-disabled-plan.pdf.

TriMet. (2016). TriMet Bike Plan. Portland, Oregon. http://trimet.org/bikeplan/.

Utah Transportation Authority (UTA). (2015). First/Last Mile Strategies Study. Salt Lake City, UT. https://www.rideuta.com/UTAProjects/UTA-First-Last-Mile-Strategies-Study.

World Bank. (2007). *Bus Rapid Transit Accessibility Guidelines*. Washington, DC. http://siteresources.worldbank.org/DISABILITY/Resources/280658-1172672474385/BusRapidEngRickert.pdf.

Section 11, Implementation

*Advocacy Advance. (2014). *First Mile, Last Mile: How Federal Transit funds can improve access to transit for people who walk and bike*. Washington, DC. http://www.advocacyadvance.org/docs/FirstMileLastMile_August2014_web.pdf.

> *Details eligible FTA programs for funding different infrastructure improvements - including listing eligible FTA programs for bike lanes and related bicycle network improvements, bike parking and end of facility type improvements, on-board accommodations, bike racks on buses, bike share, pedestrian facilities and ADA accessibility, sidewalks, signage and trail.*

Advocacy Advance. (2014). *State Revenue Sources that Fund Bicycling and Walking Projects*. Washington, DC. http://www.advocacyadvance.org/docs/StateRevenueSources_June2014.pdf

Advocacy Advance. (2009). *Congestion Mitigation and Air Quality (CMAQ) Improvement Program.* Washington, DC.

Federal Highway Administration. (2016). *Coding Non-motorized Station Location Information in the 2016 Traffic Monitoring Guide Format*. Report FHWA-HEP-17-011. Washington, DC. https://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/tmg_coding/

Federal Highway Administration. (2008). *Pedestrian Safety Guide for Transit Agencies* (FHWA-SA-07-017). Washington, DC. http://safety.fhwa.dot.gov/ped_bike/ped_transit/ped_transguide/transit_guide.pdf

Federal Highway Administration. (2015). *Fixing America's Surface Transportation (FAST) Act*. Washington, DC. http://www.fhwa.dot.gov/fastact/legislation.cfm.

Federal Highway Administration. (2016). *Guidebook for Developing Pedestrian & Bicycle Performance Measures*. Washington, DC. https://www.fhwa.dot.gov/

environment/bicycle_pedestrian/publications/performance_measures_guidebook/pm_guidebook.pdf.

Federal Highway Administration. (2017). *Incorporating Qualitative Data in the Planning Process: Improving Project Delivery and Outcomes* (FHWA-HEP-17-075). Washington, DC. https://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/qualitative_data/

*Federal Highway Administration. (2016). *Pedestrian and Bicycle Funding Opportunities*. Washington, DC. http://www.fhwa.dot.gov/environment/bicycle_pedestrian/funding/funding_opportunities.cfm.

Table highlights the potential eligibility of more than 40 specific pedestrian and bicycle activities and project types under a variety of USDOT surface transportation funding program through the FAST Act, including FTA, Transportation Alternatives, Congestion Mitigation and Air Quality, and the Surface Transportation Block Grant Program.

Federal Highway Administration (FHWA). (2002). *Regional Transportation Operations Collaboration and Coordination: A Primer for Working Together to improve Transportation Safety, Reliability and Security*. Washington, DC. http://ntl.bts.gov/lib/jpodocs/repts_te/13686/13686.pdf.

*Federal Transit Administration. (2011). *Final Policy Statement on Eligibility of Pedestrian and Bicycle Improvements under Federal Transit Law*. Washington, DC. https://www.federalregister.gov/documents/2011/08/19/2011-21273/final-policy-statement-on-the-eligibility-of-pedestrian-and-bicycle-improvements-under-federal.

Federal Transit Administration. (2016). *FHWA Flex Funding*. Washington, DC. https://www.transit.dot.gov/regulations-and-guidance/environmental-programs/livable-sustainable-communities/fhwa-flex-funding.

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